

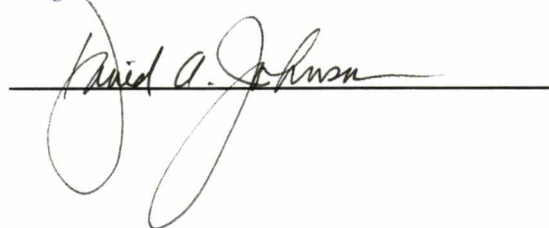
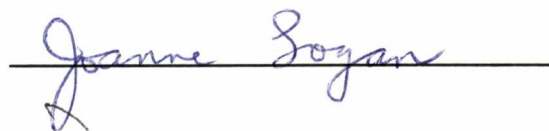
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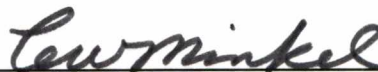


Joseph M. Prochaska, Major Professor

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Associate Vice Chancellor
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**A POLICY ANALYSIS FOR THE IMPLEMENTATION OF A NATIONAL
WEATHER SERVICE ULTRAVIOLET RADIATION FORECAST**

A Thesis

Presented for the

Master of Science in Planning

Degree

The University of Tennessee, Knoxville

James Lewis A. Free
August 1994

DEDICATION

I dedicated this thesis to my parents H.D. and Lynn Free. Through their love, encouragement, patience, and financial support, they have shown their dedication to my academic career and to this project in particular. Without their many contributions, this effort could not have been possible.

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ABSTRACT

Increased incidence of all types of skin cancer has become a major health issue and is receiving a growing amount of attention from physicians and scientists. Ongoing research is examining a probable link between ultraviolet radiation exposure and skin cancers; however, different hypotheses have been proposed about potential increased health impacts from ultraviolet radiation exposure.

It is recognized that the National Weather Service will someday have an ultraviolet radiation forecast to inform and educate the public on UV conditions and hazards of UV exposure. The purpose of this study is to evaluate alternative dissemination possibilities for the implementation of a UV forecast by the National Weather Service. Planning criteria for this study consist of policy analyses that are fundamental for implementation of NWS forecasts that could help ameliorate health and social impacts from sunlight exposure.

Primary information sources used for this research were one hundred forty NWS Field Offices located throughout the NWS service area. Methods of research for data collection involved the distribution of survey questionnaires to all NWS Field Offices identified by the NWS Office of Public Affairs. Most questions addressed the use of a UV forecast, the preferred format of a UV forecast, and the suggested dissemination frequency by NWS Field Offices and the National Meteorological Center. Analyzed responses from participants indicated a widespread Field Office interest in the implementation of a UV forecast.

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CHAPTER I

INTRODUCTION

Problem Definition

Recent surges in the reported cases of all types of skin cancers have caused atmospheric scientists and physicians to investigate the probable link between ultraviolet radiation exposure and skin cancers. The National Cancer Institute indicates that "skin cancer is the most commonly occurring cancer in the United States" (National Cancer Institute 1994b, 2). A report published in the May 1994 *Journal of the American Academy of Dermatology* revealed that the incidence of two types of skin cancer will be similar in magnitude to the total incidence of all cancers not related to the skin (Miller and Weinstock 1994, 776). Damaging effects of the sun and changes in outdoor leisure activities of Americans are commonly accepted as reasons for increased incidence of skin cancers and for the advancement, and possible initiation, of other health problems. A definitive conclusion has not yet been fully reached as to what exacerbates damaging effects of the sun.

Considering identified and unidentified potential harmful impacts from exposure to ultraviolet irradiance, health care professionals widely stress limiting exposure to the sun as an important skin cancer prevention strategy. However, there is often a lack of public awareness about risks associated with sun exposure

and time of day when the sun's rays are most damaging. To this end, benefit can be gained from the release of a daily forecast of ultraviolet radiation. Based on the premise that the National Weather Service (NWS) will someday have an ultraviolet (UV) radiation forecast to inform the public of current and future UV conditions at the ground throughout the country, a policy analysis must be conducted prior to the dissemination and implementation of an ultraviolet (UV) radiation forecast.

Purpose of the Study

The purpose of this study is to systematically evaluate alternative dissemination possibilities for the implementation of an ultraviolet radiation forecast by the National Weather Service. Evaluation research involved the distribution of self-administered survey questionnaires to NWS Field Offices. A copy of the survey is located in Appendix A. Obtrusive research conducted through this study's survey questionnaire produced responses pertaining to dissemination practices of a UV forecast that can be adopted by NWS Field Offices and by the NWS's National Meteorological Center (NMC). Most research questions address the use of UV forecast, the preferred UV forecast format, and the suggested dissemination frequency of a UV forecast by NWS Offices. A primary goal of this research is to present facts and findings using survey data collected from NWS Field Offices to help identify dissemination policies and procedures that can be implemented for a NWS ultraviolet radiation forecast.

Field Offices of the NWS depend on support and guidance from a national

forecast headquarters known as the National Meteorological Center. NMC serves as the operating nerve center for all NWS Field Offices (US DOC 1985, 4). Because most weather analyses and forecast guidance packages originate at NMC, it is likely that a UV forecast would be developed and distributed to Field Offices of the NWS by the NMC. In return, Field Offices would probably use a UV forecast in similar ways as they use other forecast information from NMC. Normally, Field Offices distribute slightly refined and modified weather information from the NMC to the public.

Field Offices are considered ideal sources for investigating dissemination possibilities of a UV forecast. One of the most important reasons for collecting data from the Field Offices is because of their close working relationship with users in their service areas. Many NWS Field Offices periodically conduct surveys of user needs within the area served by their own Office to help evaluate their Office's performance. Constant efforts are taken by Offices to help ensure that accurate weather warnings and comprehensive weather information will be disseminated rapidly and effectively among local user groups.

The units of analysis for this study consist of the surveys returned by NWS Field Offices. All Field Offices fall into one of two Office types. Out of the 217 NWS Field Offices, 44 are Weather Service Forecast Offices (WSFOs) and 173 are Weather Service Offices (WSOs). Responsibilities and operations of the Field Offices vary between WSFOs and WSOs.

Both NWS Field Office types offer an invaluable service to people in their

service area by alerting people of hazardous weather conditions and calling them into action to properly respond to an impending natural hazard. A NWS operations publication states that WSFOs are responsible for issuing daily weather forecast for states or for large areas (US DOC 1985, 4). WSOs are responsible for releasing WSFO weather forecast information that has been adapted to meet local area needs. Many of the smaller northeastern states are served by WSOs which operate with support given by a single WSFO. In Texas, there are three WSFOs which provide support to many WSOs.

Survey questionnaires for this study were requested to be completed by a senior official in each Field Office. Each NWS WSFO falls under the direction of an Area Manager who is also responsible for managing certain operations for all WSOs within the forecast area of the Area Manager's WSFO (Shumway). The Area Manager of each WSFO is sometimes referred to as the WSFOs Meteorologist In Charge. Depending on the particular Office, each WSO is supervised locally by a Meteorologist In Charge or by an Official In Charge.

Dissemination Considerations

Fourteen of the survey's nineteen questions addressed dissemination possibilities and have been divided into three types of basic dissemination survey questions. In the context of disseminating or transmitting a UV forecast by the NWS, basic survey questions examined the communication process from both a content perspective and as a process (Ross 7). The three types of basic

dissemination questions in the survey pertained to the use of a UV forecast, the preferred format of a UV forecast, and the suggested dissemination frequency of a UV forecast. Five survey questions specifically addressed applications of a UV forecast through the National Oceanic and Atmospheric Administration (NOAA) Weather Radio program. All other basic survey questions investigated dissemination possibilities of a UV forecast for uses classified as general Weather Service operations.

Four of fourteen basic dissemination survey questions pertained to the use of a UV forecast for general Weather Service operations. Out of the four basic 'use' questions, two questions were presented to help assess Office respondents' need or interest in simply having a UV forecast. The applications of a daily UV forecast by officials in Field Offices were investigated through a 'use' type question. Information was collected through a fourth 'use' question on communication technologies that should be used by the NWS to disseminate UV information. Discussions about dissemination possibilities in this chapter are included for orientation purposes by describing certain NWS operations and technologies.

Many possibilities exist for the applied use of daily UV forecast information by officials in Field Offices. The ten most possible uses of a UV forecast involve the dissemination of UV information along with forecast products that are released for the public and for special user groups. NWS operations are structured "to contribute to the safety, health, welfare, comfort, and convenience of the public," and involve the release of public forecast products, such as state forecast

products, short term forecast products, zone forecast products, public information statements, and hazardous weather forecast products (US DOC 1985, 6).

State forecast products are prepared twice daily by WSFOs and describe expected general weather conditions for about forty-eight hours and give extended forecasts for up to five days (US DOC 1985, 6). Short term forecasts are a recent addition to operations by many NWS Field Offices. NWS modernization, which calls for the implementation of new major technologies and new Weather Service procedures, has helped to bring about the distribution requirement of short term forecasts (US FCSET 1992, 52 and 81). Short term forecasts are issued on important or significant ongoing weather within service areas of Field Offices. They are designed to keep the general public up-to-date on current weather conditions and are issued a minimum of every six hours.

Zone forecast products issued by WSFOs four times per day indicate expected weather conditions over a zone of sufficient climatological homogeneity, usually five thousand to fifteen thousand square miles (US DOC 1985, 9). Public information statements are released for a variety of informational purposes. Observations have been made of public information statements that pertain to changes in NWS operations, climatological data, fire danger information, notification of NWS service enhancements, NWS public announcements, tropospheric ozone information, severe weather safety information, severe weather outlooks, and weather information for special audiences. Hazardous weather forecast products describe the likelihood of inclement weather in terms of low,

moderate, and high risks.

People who usually need special weather information and might be particularly interested in UV forecast information include travelers, campers, boaters, sportsmen, and farmers (US DOC 1985, 178). A NWS traveler's forecast can alert tourists to unanticipated weather threats and inform them of precautions that can be taken to prevent, avoid, or minimize risks. Recreational forecast products are designed for specific outdoor sporting activities and leisure interests. Recreational forecasts are released for areas such as lakes, beaches, mountain resorts, and National Parks where outside activities are commonplace. Because outdoor activities involve direct exposure to the elements of weather, benefit can be gained for those who employ greater cognizance to weather information presented in forecast products applicable to their interests.

NWS Field Office officials could use a UV forecast from the NMC to assist them with their normal forecasting duties. A low UV forecast could serve as an indication of increased chances for thick cloud cover or precipitation, which might yield lower surface temperatures. Finally, a UV forecast could be used by NWS Field Offices exclusively as a forecast product over NOAA Weather Radio. Dissemination possibilities for all three types of survey questions pertaining only to NOAA Weather Radio were investigated through five basic survey questions.

A final question on the 'use' of a UV forecast with general Weather Service operations pertained to communication technologies that should be used by the NWS to disseminate a daily UV forecast. Field Office officials were asked to

identify all applicable communication technologies that should be used for UV forecast dissemination. Responses were accepted for five primary NWS communication technologies: National Facsimile Network; Family of Services; NOAA Weather Wire Services; NOAA Weather Radio; and Multiple-Access Recorded Telephone Announcement Systems (US DOC 1985, 151).

NMC in Camp Springs, Maryland, uses the National Facsimile Network to transmit weather graphics to about 85 NWS Field Offices located throughout the U.S. (US DOC 1985, 162). Family of Services is an electronic environmental database used by the NWS to make a wide array of weather information available to users outside of the NWS (US DOC 1985, 160). NOAA Weather Wire Services are communication methods used to disseminate weather forecasts and weather warnings to radio and television stations (US DOC 1985, 158). A major relay process used by the NWS to reach the public during severe weather involves the use of NOAA Weather Wire Services and NOAA Weather Radio.

NOAA Weather Radio is a part of operations in most NWS Field Offices. Most NOAA Weather Radio stations operate twenty-four hours a day and provide the public with severe weather information, general weather information, and other detailed weather information. Many NOAA Weather Radio receivers are equipped with a warning tone device that can be activated by the NWS during hazardous weather conditions.

Multiple-Access Recorded Telephone Announcement Systems "provide the public with a means for direct access to current weather information, forecasts, and

warnings 'on demand' via telephone" (US DOC 1985, 162). A NWS operations manual describes three types of announcement systems according to the access permitted (US DOC 1985, 162). A Type I system allows up to one thousand calls simultaneously and gives the caller the latest local weather forecast and weather observation. Another system is described by the NWS as a large volume system, but is designed to provide an abbreviated forecast for the caller. A third type of system is a much smaller one and provides similar information as that of Type I, but accepts only five callers at any given time.

Research addressed a basic type of dissemination question related to the format of a UV forecast. Three basic survey questions investigated preferred format of a UV forecast for general Weather Service operations. One survey question investigated Field Office preferences for a UV forecast issued by the NMC. Possible preferences involved a 'text' and/or 'graphic' UV forecasts. The other two basic survey questions were linked to identifying the areas that should be given UV forecast information by NMC. Area possibilities consisted of specific sites, states, and/or regions. Along the lines of forecasting for areas, consideration was given to whether Field Offices should have UV forecasts from the NMC for areas that are locations of anticipated high UV exposure only.

A final type of basic dissemination question was related to the frequency of UV forecast issuance to NWS Field Offices by the NMC. Two survey questions addressed the preferred times for having a UV forecast in terms of 'days' and 'hours' of the day by Field Offices.

Substantive Assumptions

This research recognizes that the primary cause of skin cancer is exposure to ultraviolet radiation. It is assumed that a scientifically developed system used to forecast ultraviolet radiation would be "defined on a scale related to the total intensity of the portion of the UV spectrum that affects humans" (O'Toole 5). UV forecasts should account for UV-B rays and possibly UV-A rays of the ultraviolet radiation spectrum. At present, scientific findings have established a link between UV-B exposure and incidence of skin cancer. Some researchers propose the hypothesis that UV-A is a significant skin cancer promoter (Skolnich 1991b, 3219). Development of UV forecast systems can be modified as more findings become available on the effects associated with exposure to ultraviolet radiation.

Modernization of the NWS is assumed to not interfere with the dissemination possibilities investigated through this study's survey research. Future transitions of WSFOs and WSOs to Weather Forecast Offices (WFOs) will still necessitate policy analysis for the types of dissemination practices addressed in this study's basic survey questions.

Chapter two presents a review of literature related to the subject of ultraviolet radiation. A description of the procedures used to conduct the survey questionnaire is contained in chapter three. Data collected through the field research is described in the fourth chapter. A summary of results and their policy implications is given in the final chapter of this report.

CHAPTER II

REVIEW OF RELATED LITERATURE

Definition of UV Radiation

The Journal of the American Medical Association reported in June 1991 "that more than 95% of all skin cancers can be attributed to exposure to ultraviolet radiation" (Skolnick 1991a, 3217). Ongoing research is being conducted to determine the particular spectral composition of ultraviolet (UV) radiation that is a primary cause of skin damage. Research has produced convincing findings that indicate a variety of impacts associated with exposure to ultraviolet type B radiation. However, little evidence has been collected on the ability of ultraviolet type A radiation to cause serious damage to the skin. Because of the uncertainty of effects from exposure to the types of UV radiation, the Food and Drug Administration (FDA) has requested manufacturers of sunscreens to label their products according to the type of UV protection offered (Eller 76). In an effort to inform and educate citizens about adverse impacts from exposure to UV radiation, Environment Canada began releasing a daily UV forecast for its citizens beginning in 1992.

Radiation is defined as "the wavelike energy emitted by any substance that possesses heat and travels through space at 300,000 kilometers per second (the speed of light)" (Lutgens and Tarbuck 483). On the electromagnetic spectrum, UV

radiation falls between the shorter invisible X rays and the longer visible rays of the sun. UV rays comprise the portion of the electromagnetic energy having a wavelength from 0.20 to 0.40 micrometers (Oke 9). Wavelength for UV radiation is further subdivided into types A, B, and C. UV radiation type C has a wavelength less than 0.29 micrometers, UV type B radiation has a wavelength from 0.29 to 0.32 micrometers, and UV type A radiation has a wavelength from 0.32 to 0.40 micrometers (Marwick 3041).

Radiation emitted to and from the earth's surface is commonly referred to as short-wave and long-wave radiation. Scientists have designated the ranges 0.15 to 3.00 micrometers and 3.00 to 100.00 micrometers as short-wave radiation and long-wave radiation, respectively (Oke 11). Radiation emitted from the sun normally encompasses wavelengths from 0.15 to 3.00 micrometers, with a peak wavelength of about 0.48 micrometers (Oke 11). Radiant wavelengths emitted from the earth have a peak of about 10.00 micrometers and extend from 3.00 to 100.00 micrometers (Oke 11). Less than one percent of the sun's radiation is emitted as radio waves, X rays, and gamma rays (Lutgens and Tarbuck 40).

Factors Controlling UV Radiation

Incoming short-wave radiation and long-wave radiation at the earth's surface are affected by intervening material in the earth's atmosphere. Atmospheric constituents, such as gases and particles, absorb, scatter, and reflect radiation emitted from the sun. The amount of radiation received at the earth's surface

largely depends on the concentration of gases and particles in the air.

Ozone is the primary component of the atmosphere that absorbs a large quantity of UV radiation. At approximately nine to thirty-one miles above the earth's surface is a concentration of ozone less than 0.00005 percent by volume, with a peak concentration at about sixteen miles above ground level (Lutgens and Tarbuck 6). Ozone serves as the earth's shield against damaging short-wave radiation since it blocks UV type C radiation, partially blocks UV type B rays, and minimally blocks UV type A radiation (Marwick 3041).

Ozone is a molecule of oxygen that contains three oxygen atoms. An intricate series of natural processes that take place in the stratosphere help form most of the atmospheric gas. Short-wave ultraviolet rays are absorbed by oxygen molecules which dissociate into single atoms of oxygen (Lutgens and Tarbuck 6). Ozone forms when oxygen molecules combine with oxygen atoms in the presence of a third, neutral molecule that acts as a catalyst (Lutgens and Tarbuck 6). Ozone in the troposphere, which extends above the earth's surface to about six miles, forms differently than ozone in the stratosphere, which extends from about six to thirty-one miles above ground level (Neiburger et al. 38). Tropospheric ozone is formed when industrial and transportation pollutants absorb solar radiation and initiate and facilitate a chain of chemical reactions (Neiburger et al. 338). Ozone concentrations in the troposphere can cause health problems and can have a toxic effect on plants (Lutgens and Tarbuck 110).

Stratospheric ozone development and concentrations vary naturally and

because of anthropogenic sources. Because scientists have a limited set of reliable ozone measurement data, it is difficult to distinguish natural perturbations and periodic fluctuations from human-induced ozone depletion. Comprehensive ozone measurements in the U.S. date back to the late 1970's only. In 1978, less extensive ground-base systems used for ozone measurements were superseded by the use of a total ozone mapping spectrometer (TOMS) found on a satellite operated by the National Aeronautic and Space Administration (Stevens 1991, A:1). Use of TOMS allows for global measurements of total column ozone. Total column ozone is the amount of ozone over any given location of the earth.

Based on comprehensive satellite data collected through the use of TOMS, concentrations of stratospheric ozone appear to be decreasing in many areas. Net ozone decreases of about 4% from 1978 to 1990 were observed over the U.S. and for locations with similar latitudes (Stevens 1991, A:1). For latitudes near the equator, very little depletion was observed, but for latitudes near the poles ozone net decreases were greater than 8% (Stevens 1991, A:1).

For more than twenty years there has been concern with the need to protect the ozone layer because of its vital role of preventing the intrusion of damaging shorter UV rays. Scientists in the early 1970's first proposed the theory that human activities involving the production and emission of certain chemicals, chiefly chlorofluorocarbons (CFC's), could potentially have adverse impacts on the balance of life-supporting ozone in the stratosphere (Lutgens and Tarbuck 7). CFC's are a class of volatile organic compounds that are used for various industrial

processes and as the fluid that transfers heat in refrigerators and air conditioners (Stevens 1993b, A:1). Retention of CFC's in the atmosphere can last as long as 22 to 111 years (Miller 1990, 501). Therefore, a considerable time lag exists between CFC emissions and stratospheric ozone depletion.

CFC's were developed in 1930 and production during the late 1980's was greatest in the U.S. compared to CFC production exhibited by other industrialized countries (Miller 1990, 500). Scientific findings documenting reductions in ozone concentrations were released for the first time in the mid 1980's (Stevens 1991, 1). Following the observations of decreased ozone concentration, greater numbers of scientists began to predict a likely increase in UV radiation. The threats of stratospheric ozone depletion and increases in UV radiation prompted many manufacturers to search for CFC substitutes and to initiate plans for the phaseout of CFC's themselves.

In response to the environmental impacts associated with the production of CFC's, the United Nations (UN) initiated the development of an international strategy for protecting the ozone layer by calling for a significant reduction in the emission of CFC's by specific dates (Lutgens and Tarbuck 9). In September 1987, under the auspices of the UN, many countries endorsed an agreement known as the Montreal Protocol, which called for significant reductions in CFC's (Jacobson 56). The Montreal Protocol represented the first attempt by the UN to coordinate international controls on CFC emissions. Subsequent to the first signing of the Montreal Protocol, a series of amendments have been made to move up deadlines

for phasing out the production of CFC's and to include other ozone destroying elements for phaseout purposes. The last amendment involved the signing by eighty-seven countries in November 1992, which agreed to phaseout the manufacture of CFC's by the end of 1995 (Stevens 1993b, A:1). Empirically based environmental findings can contribute to having countries more willing to adopt production standards that are environmentally sound.

Scientific findings documenting an observed long-term increase in UV radiation in North America were not released until late 1993. Researchers with Environment Canada published results in the *Journal of Science* for a four and a half year study noting that UV wavelengths between 0.29 and 0.325 micrometers increased from 1989 to 1993 by 35% in the winter and 6.7% in the summer while total ozone losses were observed to have decreased by about 4% over Canada (Stevens 1993a, C:11). At present the Canadian observations are part of a very limited number of data sets on ultraviolet surface irradiance that can be used for providing a useful UV radiation climatology (Center for Global Environmental Studies 11).

The Environment Canada researchers cautioned against drawing conclusions about trends in ozone depletion beyond the period of the study because of effects of a volcanic eruption in the Philippines in 1991 (Stevens 1993b, 1). The significant volcanic eruption of Mt. Pinatubo and other natural climatic processes such as cyclic changes in solar output could have altered stratospheric ozone levels observed over Canada (Miller 1990, 501). Explosive

eruptions similar in magnitude to the eruption of Mt. Pinatubo are sufficiently powerful to initiate an intricate series of natural processes that deplete stratospheric ozone (Lutgens and Tarbuck 373).

Factors other than the amount of stratospheric ozone can have a great impact on how much UV radiation reaches the earth's surface. Solids, liquids, and gases in the atmosphere affect radiation by absorbing, reflecting, and scattering incoming short-wave radiation. Only about 25% of short-wave radiation penetrates directly to the earth's surface without some sort of interference on the part of the atmosphere (Lutgens and Tarbuck 43).

Water vapor has the ability to absorb, reflect and scatter incoming short-wave radiation. Above the stratospheric concentrations of ozone, oxygen absorbs many of the UV type C rays emitted by the sun (Neiburger et al. 79). Dust particles and aerosols dispensed from the explosion of a volcanic eruption can absorb and reflect incoming short-wave radiation producing a measurable reduction in UV rays reaching the earth (Lutgens and Tarbuck 6).

Numerous particles near the earth's surface such as salt from the ocean, soil blown in the air, smoke and soot from fires, and pollen and microorganisms lifted by the wind are retained in the atmosphere due to the earth's movements and help to filter UV rays by absorbing, reflecting, and scattering short-wave radiation (Lutgens and Tarbuck 6). Pollution from anthropogenic sources may reduce the amount of incoming short-wave radiation by more than 30% (Oke 280). Because pollutants effectively filter the ultraviolet portion of the electromagnetic

spectrum, it is common to lose 40% and on occasion as much as 90% due to absorption and scattering (Oke 280). Approximately 30% of short-wave radiation is reflected to space by the atmosphere and clouds (Neiburger et al. 81).

Reception of UV radiation varies according to geographical location, solar zenith angle, altitude, and atmospheric composition. Locations higher in altitude have less atmosphere for UV rays to penetrate to reach the surface, hence such locations have less absorption, reflection, and scattering of incoming short-wave radiation (McIntyre 53).

Types of Skin Cancer

Information from the American Cancer Society indicates the rate of melanoma, the deadliest form of skin cancer, has increased by 4% each year since 1973 (Stassel Metro:2). A report published in the May 1994 *Journal of the American Academy of Dermatology* noted a striking increase in the incidence of nonmelanoma skin cancers in North America during the past two decades (Miller and Weinstock 1994, 774). Increases in the incidence of skin cancers are largely attributed to lifestyle changes, increased outdoor activities, and possibly a better documentation of skin cancer cases. Ozone depletion and increases in ultraviolet radiation are discounted by most health professionals as causes of increases in skin cancer cases prior to the 1990's. Physicians are concerned about predicted increases in UV radiation, but because of recent small decreases in ozone concentrations and the lag of 20 to 30 years for UV exposure to lead to cancer,

increased incidence of melanoma skin cancers is yet to result from increased levels of UV radiation reaching the earth's surface (Harvard Medical School 1). In response to the known and potential adverse impacts of exposure to UV radiation, scientists and physicians are investigating the link between UV exposure and skin cancers.

Skin cancer can occur anywhere on anyone's body. Leading risk factors include a family history of melanoma followed by a skin type with a freckling complexion (Brody C:9). Skin cancer is more common in people with light colored skin who have spent a considerable amount of time outdoors (National Cancer Institute 1994c, 2). Areas of the body that are often exposed to sunlight are common places for skin cancers. Skin cancers are commonly diagnosed on one's neck, face, ears, shoulders, hands, arms, and legs. A report in *The Journal of the American Medical Association* states that most melanomas occur on the backs of men and the legs of women (Skolnick 1991b, 3220).

Skin cancer is defined by the National Cancer Institute (NCI) as a disease in which malignant cancer cells are found in the outer layers of the skin (NCI 1994c, 2). As explained by the NCI, there are two main layers of the skin and several kinds of cells. The outer layer is the epidermis and the inner layer is the dermis. The epidermis contains three kinds of cells including scaly cells on the surface termed squamous cells, basal cells, and cells called melanocytes which give skin its color (NCI 1994c, 2). Blood vessels, nerves, and sweat glands are found in the thicker inner layer, known as the dermis (NCI 1994c, 2).

Types of skin cancer are classified according to the cells of the skin affected by malignant cancer cells. Skin cancer that starts in the melanocytes is referred to as melanoma cancer. Basal cell cancers and squamous cell cancers develop in the epidermis and are the most common cancers in the U.S. (Marwick 3041). The less common, but rapidly increasing melanoma skin cancer is more serious and deadlier than nonmelanoma skin cancers (basal cell and squamous cell carcinomas).

Cancers can develop in other parts of the body and damage squamous cells, basal cells, and melanocytes. Kaposi's sarcoma and cutaneous T-cell lymphoma, a cancer of the lymph system, are examples of other kinds of cancer that may affect the skin (NCI 1994c, 2). Actinic keratosis is a skin condition that is not cancer, but can change into nonmelanoma skin cancer in some people (NCI 1994c, 2).

Cure rates for skin cancers are reported to be increasing through a combination of prompt diagnosis and treatment by physicians (Heller Metro:2). All skin cancers can be treated, but prognosis for recovery depends on the type of skin cancer and how far it has spread (NCI 1994c, 2). Most nonmelanoma skin cancers can be cured (NCI 1994c, 2). All skin cancers are best treated when detected early. The National Cancer Institute (NCI) warns that skin cancer can look many different ways and is most commonly indicated by a change on the skin, such as a growth or sore that will not heal (NCI 1994c, 2).

Manifestations of skin cancers can include multiple symptoms, some of

which are more common indicators of particular skin cancers. Squamous cell cancer often appears as a firm red bump and a squamous cell tumor may bleed, feel scaly, or develop a crust (NCI 1994c, 3). NCI indicates that squamous cell tumors may spread to the lymph nodes in the areas surrounding the squamous carcinoma. Basal cell cancer has two common appearances. Basal cell cancer often appears as a small raised bump that has a smooth, pearly appearance, or it may look like a scar which is firm to the touch (NCI 1994c, 3). NCI indicates basal cell carcinoma may spread to tissues around the cancer, but usually confines itself from other parts of the body. In 1992 researchers at Dartmouth Medical School released the first definitive results of a study on recurring nonmelanoma skin cancers indicating people with a history of squamous cell and basal cell carcinomas have a 35% risk of developing another tumor within three years and a 50% risk within five years (Facklemann 421).

Melanoma skin cancer, the deadliest form of skin cancer, must be detected early to allow for a better prognosis. It is very important to detect melanoma skin cancer early because it can spread quickly to other parts of the body through the lymph system or through the blood (NCI 1994a, 2). Signs of melanoma include the appearance of a new mole, change in the size, shape, or color of a mole, oozing or bleeding from a mole, or a mole that feels itchy, hard, lumpy, swollen, or tender to the touch (NCI 1994a, 2). People who have melanoma cancer successfully removed remain at risk of developing additional melanoma cancer (Greeley 1991, 17).

Consultation of professional care is recommended for people who have any of the previously stated warning signs of skin cancer. Physicians can perform a biopsy to determine if abnormal skin appearances or irregular skin textures contain cancer cells by excising a portion of suspect tissue and examining it under a microscope (NCI 1994a, 2). Once tissue has been found to contain cancer cells, additional tests will be performed to determine if cancer cells have spread to other parts of the body. Assessments of coverage and thickness of cancer cells are used to help determine treatment for skin cancers. Treatments used for all types of skin cancers include surgery, chemotherapy, radiation therapy, and biologic therapy (NCI 1994c, 3 and NCI 1994a, 3).

According to NCI, surgery is the most common treatment for all skin cancers. Chemotherapy involves the use of drugs such as creams, lotions, pills, or injections to kill cancer cells. Radiation therapy uses X-rays to kill cancer cells. Biological therapy uses materials made by one's own body or in a laboratory to boost, direct, or restore one's own immune system to fight cancer (NCI 1994c, 3).

Additional measures beside early detection and prompt diagnosis are being taken to help reduce health threats associated with UV exposure. Because of the uncertainty of effects from exposure to the types of UV radiation, researchers are attempting to better define biologic responses to short-wave radiation. Research for human health is concerned not only with the role of UV radiation in the development of skin cancer, but also with better understanding the extent and threshold for suppression of the immune-system responses to increased UV

exposure, the relationship of potential changes in the levels and diagnosis of human resistance to the spread of infectious diseases, and the possible role of UV exposure in leading to cataract formation and cataract-related blindness (Center for Global Environmental Studies 7 and 18).

Effects of UV Exposure

Greater exposure to the sun because of changes in occupational settings and increased outdoor leisure activities are associated with increased incidence and risks of skin cancers. Most researchers agree on the cause of nonmelanoma skin cancers, but considerable controversy exists over the causes of melanoma skin cancer. Scientific evidence reported in many health and science journals has linked UV radiation types A and B to nonmelanoma skin cancers, but with varying degrees of effectiveness. Some researchers claim efforts taken since the 1960's involving the use of sunscreens as a protector against UV exposure have had an unintended consequence of significantly promoting the incidence of melanoma skin cancer (Skolnick 1991b, 3218 and 3219).

Known hazards of exposure to UV type B radiation have been documented through scientific findings. Animal studies have connected UV type B radiation exposure to the incidence of squamous cell cancer, basal cell cancer, and melanoma cancer (Skolnick 1991b, 3218). Observations have been made indicating human skin is very sensitive to ultraviolet radiation, with a peak sensitivity in the UV type B range of the electromagnetic spectrum at about .295

micrometers (Oke 86). A report in The Journal of the American Medical Association estimates that UV type B radiation at .297 micrometers is at least 5000 times more effective as a complete carcinogen than UV type A radiation (Skolnick 1991b, 3218). Yet ultraviolet type A rays penetrate deeper into the skin beyond the epidermis into the dermis and are estimated to outnumber UV type B rays reaching the earth by about nine to one (Eller 74).

Animal studies on UV type A radiation exposure have established a link to nonmelanoma skin cancers, but not to melanoma skin cancers (Skolnick 1991b, 3218). An assistant professor of dermatology at Columbia University, Vincent DeLeo, M.D., is noted in Skolnick's report (1991b) indicating research has found UV type A radiation can increase production of reactive oxygen molecules that cause cell membrane damage and other health impacts. Meanwhile, some researchers and physicians suggest a greater magnitude of impact is a result of UV type A radiation exposure. Serious speculation on the role of UV type A radiation has emerged only in recent years.

Health impacts related to the significant promoting of melanoma cancer by exposure to UV type A radiation is a hypothesis proposed without any scientific evidence establishing a nexus between UV type A radiation exposure and melanoma skin cancer (Eller 76). Most researchers and physicians who claim UV radiation is a major promoter of melanoma cancer base their findings on two concepts related to measures taken by people who attempt to prevent sun damage. First, the use of sunscreen products beginning in the 1960's has allowed

individuals to increase the amount of time spent outside and to be exposed to more UV type A radiation for longer periods (Skolnick 1991b, 3219). UV type B radiation produces high levels of vitamin D within the human body, but because sunscreens block UV type B radiation, a possible consequence of the use of these products is a reduction of skin protecting vitamin D (Skolnick 1991b, 3218). The false sense of extra protection offered by sunscreens can allow people to feel safer in the sun, yet increase their chances for skin cancer according to those proposing UV type A radiation as a major promoter of skin cancer (Gutfeld et al. 14).

In December 1990 the American Academy of Dermatology and other renowned medical organizations around the world strongly criticized the hypothesis that UV type A radiation promotes skin cancer. Critics of the hypothesis based their position on the absence of scientific evidence linking increased incidence of melanoma cancer to the use of sunscreens and due to lack of documentation on the role of Vitamin D in fighting skin cancer (Eller 76). Warwick Morison, M.D., professor of dermatology at Johns Hopkins School of Medicine, has been quoted saying "There's no evidence at all, however, that sunscreens are associated with an increase in cancer" (Gutfeld et al. 14). Additional explanation has been given by Mudhukar A. Pathak, M.B., Ph.D, chairman of the Skin Cancer Foundation's Photobiology Committee, which included the following in *Prevention*:

The rising number of cancers we're now seeing resulted from 10 to 20 years ago, when sunscreens of SPF 15 or higher weren't manufactured. The sunscreens were used to minimize the discomforts of sunburn and to promote tanning. Real use of effective sunscreens didn't begin until 1978 or 1980 (Gutfeld et al. 14).

SPF refers to sun protection factor and can be used for determining how long one can stay in the sun without burning. Multiply the SPF by the time it normally takes skin to burn to estimate the effectiveness of a sunscreen's protection (Brody C:9). Additionally, critics of the theory linking UV type A radiation to damaging skin effects claim researchers need to pay greater attention to assessing whether people have been using sunscreen products correctly, or at all, as well as the duration and frequency of their sun exposure (Gutfeld et al. 15).

The American Academy of Dermatology claims the worldwide rate of melanoma increase is greater than the rate of melanoma increase in the U.S. and because use of sunscreens in the U.S. is among the highest of all places, it is expected that if sunscreens were promoters of cancer, manifestations of melanoma occurrences could be assumed to be greatest in the U.S. (Skolnick 1991b, 3219). Two leading proponents of the UV type A radiation theory, epidemiologists Frank and Cedric Garland of California, refute the previously stated claim made by the American Academy of Dermatology (Eller 75). Cedric Garland, M.D., Ph.D., has been quoted in The Journal of the American Medical Association as saying:

In general, the countries most affected by increased rates of melanoma are the most affluent where sunscreens are heavily used, such as Australia, New Zealand, the Scandinavian countries, Great Britain, and the United States. I can't think of any poor country that has the increase in melanoma seen here and in those more affluent countries (Skolnick 1991b, 3219).

The National Cancer Institute notes that it is not known if reduction of exposure to UV radiation through sunscreens can reduce the incidence of melanoma skin cancer in humans (NCI 1994b, 2). NCI reports information from

animal studies suggest sunscreens may not be protective for UV radiation-induced melanoma cancer (NCI 1994b, 3). Nonetheless, NCI states evidence that indicates regular use of sunscreens will reduce the incidence of squamous cell cancer and basal cell cancer. "Most evidence about UV radiation exposure and the prevention of skin cancer comes from observational and analytic epidemiologic studies, not from experimental studies in humans" (NCI 1994b, 2).

In response to increased speculation about impacts from various spectral compositions of UV radiation, manufacturers of sunscreens responded by having products designed to offer protection from UV types A and B radiation. Schering-Plough attempted to assign UV type A radiation protection percentages on their sunscreen products, but was asked to remove the percentages by the FDA because the concept had not been evaluated by the U.S. government (Eller 75). In the early 1990's, the FDA attempted to develop their own UV type A radiation claim system but advised people in the meantime to watch for the term broad spectrum on sunscreens which implies a sunscreen provides protection from UV type B and some UV type A radiation (Eller 77).

Almost all health experts recommend avoiding exposure to UV radiation as a basic step to help prevent all types of skin cancers. Another step that can be taken to help reduce risks of cancers involves changing outdoor activities to reduce time of exposure to high-intensity UV radiation (NCI 1994b, 1). To help prevent nonmelanoma skin cancers physicians recommend using sunscreens or wearing protective clothing.

Observations about the relationship between exposure and skin cancers can serve as a basis for some cancer intervention strategies. Paul Bergstresser, M.D., chairperson of the Department of Dermatology, University of Texas Southwestern Medical Center, has been quoted in the *FDA Consumer* saying, "Those people with the highest light exposure appear to have a lower frequency of melanomas than those who get sunlight more episodically" (Greeley 1991, 17). Information from the National Cancer Institute tends to support the claim made by Dr. Bergstresser. NCI reveals studies have consistently shown increased cumulative exposure to UV radiation is a risk factor for nonmelanoma skin cancer, whereas for melanoma skin cancer studies suggest intermittent acute sun exposure is more damaging (NCI 1994b, 2 and 3).

A contributing factor to incidence of melanoma skin cancer may pertain to acute sun exposure during childhood years. A report in the *FDA Consumer* notes as much as 80% of sun exposure can occur before the age of 18 and a history of painful or blistering sunburn during the first ten to twenty years of life will double the risk of cancer (Greeley 1991, 20). Dr. Darrell Rigel, a dermatologist at New York University Medical Center was quoted in a 1991 health letter saying:

It appears in certain new studies that the risk of melanoma is particularly related to the duration and intensity of sun exposure received during the teen years. If you had three or more blistering sunburns before the age of 20, the risk of developing melanoma is four to five times that of someone who had no blistering sunburns (Harvard Medical School 1).

The *Harvard Medical School Health Letter* also referred to other studies conducted at New York University, one of which showed that people who worked outdoors for

three or more years as teenagers have triple the average risk for melanoma.

Increased childhood exposure to UV radiation is of major concern to health officials. Health impacts from adolescent sun exposure could be significantly exacerbating losses from melanoma. Dr. Sydney Hurwitz, M.D., clinical professor of pediatrics and dermatology at Yale University School of Medicine, has been quoted in the *FDA Consumer* saying "There are no figures yet on skin cancers among teens" (Greeley 1993, 31). Through further investigation of consequences from youth sun exposure, explanation might be offered for the escalating number of melanoma skin cancer cases. Meanwhile, if the current rate of increase for melanoma skin cancer continues, the lifetime risk of an individual developing melanoma will narrow from 1 in 105 to 1 in 75 by the year 2000. (Skolnick 1991a, 3217).

An additional observation about UV radiation exposure and the incidence of skin cancer pertains to geography. Earlier in this chapter, altitude and solar zenith angle were referred to as factors affecting the amount of UV radiation reaching the earth's surface. Locations higher in altitude generally receive greater amounts of incoming solar radiation and, consequently, face a greater threat from UV exposure. Likewise, merely living closer to the equator, where solar zenith angles are greatest, increases exposure and risks from UV radiation (Harvard Medical School 1). In 1990 a Harvard Medical School health letter noted two striking cancer statistics from one of the most recent data sets collected by the American Cancer Society (1978-1981) indicating Tucson, Arizona, had the highest

reported melanoma rate in the U.S. with 27 cases per 100,000 residents compared to only 6 per 100,000 in Detroit, Michigan (Harvard Medical School 1).

Effects of UV exposure are not restricted to skin cancer. Of the human-health responses to UV type B radiation studied thus far, the strongest case for a casual link to increased UV exposure is nonmelanoma skin cancer; however, potentially important health effects include cataract formation, cataract-related blindness, and suppression of the immune system (Center for Global Environmental Studies 18). A report in the *FDA Consumer* gives reference to Vincent Giovinazzo, M.D., noting data collected on Chesapeake Bay watermen who spend a lot of time on the water show those who wore sun protection, such as sunglasses, developed fewer cataracts (Greeley 1991, 18). According to Margaret Kripke, M.D., Ph.D., chairperson of the Department of Immunology, University of Texas, research shows UV radiation not only suppresses the immune response of cells in the skin but may also induce generalized immune suppression and have a significant impact on how people fight off infectious diseases (Greeley 1991, 18). Precautions applicable for reducing potential UV impacts include preventing high-intensity UV exposure or at least limiting sun exposure during peak sun times.

Manufacturers of eye wear have responded to threats posed from UV exposure by designing sunglasses for different intensities of sunlight. In May 1991 it was reported the Food and Drug Administration and the Sunglass Association of America had agreed that manufacturers may voluntarily label sunglass products

according to the performance standards set by the American National Standards Institute in New York (Greeley 1991, 18). Quantitatively translating wavelength-specific impacts to ocular damage is difficult, but it is known UV exposure can affect the incidence of ocular damage and cataracts are estimated to be responsible for 17 million cases of blindness worldwide each year (Center for Global Environmental Studies 16 and 24). Miller et al. report cataract surgery was the most significant Medicare cost line item in the U.S. in 1993 with 1.2 million procedures done (Miller et al. 1994, 1).

Consequences of UV radiation exposure on other essential forms of life are not fully known. UV radiation can significantly affect plant and animal life throughout the earth's biosphere. For some animal responses, chronic exposure to UV radiation is more important, but for plants the peak event is probably more important (Center for Global Environmental Studies 16). "However, existing exposure systems do not accurately simulate the UV-radiation quality of sunlight and are therefore of limited use for predicting the magnitude of responses to increased UV-B exposure produced by stratospheric-ozone depletion" (Center for Global Environmental Studies 21).

Implications of Increased UV Radiation

Conclusions about future impacts from exposure to UV radiation are based on known health statistics and anticipated atmospheric conditions. Potential decreases in ozone, and therefore increases in UV radiation at the earth's surface,

can significantly contribute to the escalating number of skin cancer cases and other health impacts. Threats from possible increases in UV radiation reaching the earth's surface are of major concern of health officials. Published reports indicate similar estimates for impacts associated with increased UV radiation and serve as an alarming factor for many in the scientific community.

Each 1% decrease in ozone increases the amount of UV radiation reaching the earth's surface by about 2% (Lutgens and Tarbuck 9). The National Academy of Sciences has been quoted in The Atmosphere, an Introduction to Meteorology, responding to how ozone depletion could affect human health:

We estimate that there will be a 2 percent to 5 percent increase in basal cell cancer incidence per 1 percent decrease in stratospheric ozone. The increase in squamous cell skin cancer incidence will be double that (Lutgens and Tarbuck 1989, 9).

The Environmental Protection Agency predicts (1992) every 1% depletion of ozone will yield a 1% to 3% increase in basal cell carcinoma and 2% to 5% increase in squamous cell carcinoma (Marwick 3041).

A 1992 report in The Journal of the American Medical Association quotes Arthur J. Sober, M.D., Harvard Medical School, who cites a study based on effects of a 10% ozone depletion indicating "a 16% to 18% increase in basal cell carcinoma in both men and women and a 19% increase in incidence of melanoma in men and a 32% increase in melanoma among women" (Marwick 3041). A May 1994 report in the Journal of the American Academy of Dermatology estimates nonmelanoma skin cancers will develop in 900,000 to 1,200,000 people in the U.S. in 1994, thereby exceeding the incidence of all cancers not related to the skin and

becoming similar in magnitude to the incidence of all noncutaneous malignancies (Miller and Weinstock 776). Examples of noncutaneous cancers can include prostate, breast, lung, colon, rectum, uterine, oral, leukemia, and pancreatic cancer (Stassel Metro:2). Not considering cancer predictions, a 1% depletion of ozone is estimated to result in a .6% increase in cataract incidence or 100,000 new cases per year, worldwide (Center for Global Environmental Studies 24-25).

In response to known and unknown health risks associated with UV exposure, health officials widely favor programs designed to better educate citizens about hazards and uncertainties from sunlight. For example, each spring the American Academy of Dermatology sponsors public programs in communities nationwide for early detection and screening of skin cancers (Greeley 1991, 20). In May 1991 it was reported scientists and dermatologists with the Skin Phototrauma Foundation in Parsippany, New Jersey, were attempting to develop a universal sunburn index that could be included in some broadcast weather reports (Eller 75). As part of an education campaign about hazards of sun exposure, the U.S. National Weather Service began discussing the possibility of having a UV forecast in the early 1990's. At the start of this report Canada was the only country that had a forecast of UV radiation offered to its citizens by the government. Canada's UV forecast is the topic of the final section of this chapter.

Environment Canada's UV Index

In response to increased threats from exposure to UV radiation the Canadian government developed a weather forecast product pertaining exclusively to radiation reaching the earth's surface. Examples of Canadian weather forecasts with UV information are located in Appendix B. In the spring of 1992 Environment Canada's Weather Service began delivering a forecast of the expected intensity of UV radiation called the UV Index (O'Toole 2). A primary application of the UV Index is as a guide to help people make decisions on how and when to guard against excessive exposure to the burning rays of the sun (O'Toole 5). Ultimate goals of the UV Index are to reduce the incidence of skin cancers and other human effects from exposure to damaging sunlight. Original implementation of the Canadian UV Index was scheduled for spring 1993; however, great public concern in 1992 over potential increases in UV created a demand for the most scientific information available (O'Toole 2).

"The UV Index is defined on a scale related to the total intensity of the portion of the UV spectrum that affects humans," and index values generally run from 0 to 10 (O'Toole 5). In the 0 to 10 range of index values are four qualitative exposure categories described as low, moderate, high, and extreme exposure. UV Index values are a forecast of the intensity of UV radiation reaching the earth's surface under a clear sky at midday. Environment Canada's Atmospheric Environment Service weather offices distribute the UV Index to the public along with sun exposure safety information on a daily basis across the country.

When the UV Index was introduced in 1992, it did not account for cloud cover. Because a considerable amount of incoming radiation can be absorbed, reflected, or scattered by water vapor, scientists are attempting to incorporate cloud cover as a forecast variable. Scientists are using records of cloud cover and UV to help make improvements to the way effects of cloud cover are a determining factor of UV radiation (O'Toole 6). UV Index values released in 1992 were based on measurements of ozone collected from a ground-network of observation stations and were determined by using:

Weather prediction models and meteorological relationships to predict the depth of ozone; and sun angles and the stratospheric ozone depth predictions are used to calculate the UV Index. A relationship between ozone depth and UV was determined from physical principles and the algorithms were fitted to past data. The UV intensity is weighted with respect to the effects on human erythema (sun-burn) (O'Toole 6).

Canadian scientists point out that the UV Index can be calculated for any location on earth given stratospheric ozone measurements and numerical model output (O'Toole 7). A range of 0 to 10 for the Canadian UV Index values is open ended and "Practically speaking a value of 12 which is equivalent to 300 milliwatts/meter/meter/ is the highest likely value anywhere on the earth (O'Toole 7).

After the first year of having the UV Index, officials evaluated the product's usefulness and performance. Part of the evaluation involved survey research conducted among citizens throughout Canada. Decima Research analyzed answers given by 1200 respondents to a five question survey questionnaire on

attitudes related to Environment Canada's UV Index (Decima Research 1). Of the survey respondents, 73% were aware of the UV Index, while 59% indicated the UV Index influenced their sun exposure habits (Decima Research 2 and 3).

Because exposure to UV radiation is major cause of health problems in the U.S., considerable benefit could result from the NWS development and issuance of a UV forecast product. The NWS could use ozone measurements from aircraft, research balloons, sounding rockets, satellites, and space shuttle missions as a basis for determining how much radiation can reach the earth's surface (US NASA 1989a, 7). Exact monitoring and forecast principles can be developed according to available technology. Based on the premise that the NWS will someday have a UV radiation forecast, a policy analysis must be conducted prior to the dissemination and implementation of a UV forecast. The next chapter describes this study's research framework of how a UV forecast might be disseminated in the U.S. by the National Weather Service.

CHAPTER III

METHODOLOGY

Overview

The methodology for this study consists of survey research conducted among all National Weather Service (NWS) Field Offices responding to a survey questionnaire. A self-administered survey questionnaire was constructed to help determine what policies and procedures the NWS could possibly use to disseminate an ultraviolet type B radiation forecast. A two page survey questionnaire and a cover letter, which explained the purpose of the survey, were mailed out with a self addressed stamped envelope. A copy of the survey is located in Appendix A. To help ensure a high level of confidence with the data analysis for this research, survey questionnaires were mailed to each NWS Field Office. All NWS Field Office senior officials were asked to participate in the study by completing and returning the questionnaire.

Additional measures were taken for a high level of confidence with the validity of the survey's response rate. The survey's cover letter was written in such a manner that the participants were given specific information as to the origin of the survey, the purpose of the survey, the potential uses of survey responses, and the confidentiality of Office participation. To help identify that the project was academically oriented, University of Tennessee letterhead was used for the cover

letter. The letterhead listed a telephone number that Offices could call, if they desired, to clarify any questions about the survey.

Content of the cover letter incorporated an important premise upon which the entire research process was to be based. At the time of the survey mailing there had not been any formal decision by the NWS as to whether a UV forecast should be a part of daily Weather Service operations. Therefore, the author structured the survey process based on the hypothesis that eventually the NWS would have a public UV forecast which would require the implementation of efficient and effective dissemination policies and procedures specifically designed for the UV forecast. Considering that hypothesis, the purpose of the survey in the cover letter was identified as an attempt "to collectively evaluate how all NWS Offices in each Region *might use* a UV forecast *should one* be issued by the National Meteorological Center (emphasis added)." With respect to the use of survey responses, again, a conditional statement was given which noted that responses to survey questions by individual Offices "*could serve* to help establish dissemination policies and procedures that the NWS *might use* if it decides to implement an ultraviolet radiation forecast (emphasis added)."

Confidential participation was perceived as a very important means to help ensure a high response rate. In the cover letter it was stated that "all individual responses would be strictly confidential." Considering the nature of the questions, which tended to reveal how informed some Offices might be on the subject of UV radiation, it was very important that the provision of confidential Office participation

be adopted. Furthermore, the only identification of Office location requested was the state in which Office participants were located. Analysis of the survey responses reveals that all Office participants did voluntarily identify their state location and the majority of Offices chose not to include a return address on the postage paid envelope.

Selective steps were taken to help remove the influence of organizational pressures which some officials might have felt. Respondents were notified that only the author would see their individual survey answers. NWS Field Offices were told that individual responses would be not summarized by state, but by their official NWS Region. No attempt has been made to identify individual Office respondents or nonrespondents. However, comments or suggestions from individual survey participants may be referred to on an anonymous basis, restricted to the particular NWS Region or referred to as All NWS Regions only.

At the conclusion of the cover letter, a final attempt was made to help establish a high rate of participation with the survey questionnaire. NWS Offices were instructed that they could indicate whether they would like to receive a copy of the summarized survey results for their Region and for all of the other Regions upon completion of the data analysis. The author's process of soliciting important information from NWS Offices and later becoming an information dissemination source by sharing the useful research results was meant to assure Offices that, indeed, the research project was authentic and could serve as a learning process for all involved.

A copy of research results will be dispensed to requesting Offices upon completion of the data analysis. The necessary condition for satisfying the 'completion of the data analysis,' refers to the final submission and approval of the analyzed survey results, supplementing the entire thesis project, by The University of Tennessee, School of Planning. Subsequent to final thesis approval and the mailing of results to requesting Offices, including the distribution of a copy to the NWS's National Meteorological Center, the author will only address any questions pertaining to the research with continual adherence to the confidentiality issues previously discussed in this section.

Participants

Participants in the survey were meteorologists of National Weather Service (NWS) Forecast Offices (WSFOs) and Weather Service Offices (WSOs). The two types of Offices taken together are referred to as NWS Field Offices. All NWS Field Offices within the NWS organization, as identified by the NWS Office of Public Affairs, were mailed survey questionnaires. A Field Office's location was identified as being in one of six Regions as defined by the NWS. Figure 1 in Appendix C depicts the NWS Regions and the states which each Region encompasses. Regional Administrative Organizations of the NWS were made up of the following six Regions: NWS Eastern Region; NWS Southern Region; NWS Central Region; NWS Western Region; NWS Alaska Region; and the NWS Pacific Region. Table 1 in Appendix E identifies how many WSFOs and WSOs

are in each NWS Region.

All territories in the United States (U.S.) are served by the NWS and fall under the jurisdiction of one Regional Administrative Organization only. Some locations beyond the physical boundaries of the fifty states of the U.S. are served by the NWS. Many U.S. territories elsewhere in the world are routinely given NWS forecast information and weather services. These areas are, also, encompassed by NWS Regional boundaries. In particular, the NWS's Southern Region boundary was expanded to include some islands in the Caribbean Sea. Areas served by a WSFO in San Juan, Puerto Rico, are the only non-mainland U.S. territories found in the NWS Southern Region.

In the Pacific Region many WSOs are found outside the Hawaiian state boundary. Seven Pacific islands are hosts to NWS WSOs. The only Regions which have at least one NWS Field Office located outside of the continental U.S. are the Southern Region and Pacific Region. A complete list of all NWS Field Office locations classified by city and state for each NWS Region is located in Appendix D.

The distribution of NWS Field Offices varies among the six NWS Regions as indicated by the range of 68 (28%) in the NWS Central Region to 11 (5%) in the NWS Alaska Region. See Table 1 in Appendix E for a complete list of the total number of NWS Field Offices in each Region. Of the 217 total possible number of NWS Field Office survey participants, 44 (21% of all NWS Field Offices) are WSFOs. For the All Regions category analyzed as a whole, the mean number

of WSFOs per Region is 7.3 and the median per Region is 8. The NWS Pacific Region had the fewest number of Forecast Offices with only 1 (2% of all NWS WSFOs), while the NWS Southern Region had the greatest number with 13 (30% of all NWS WSFOs).

Data Collection

The data collected for this study consisted of completed and returned survey questionnaires from NWS Field Offices. A copy of the survey is located in Appendix A. Any NWS Office which answered three or more survey questions was included in the data collection. Survey responses from NWS Offices were accepted for forty days after they were mailed out to the Offices. New questionnaires were not mailed to NWS Offices that failed to respond to the initial appeal.

Two techniques were established for the management of information collected through the survey. Question responses were recorded according to the participant's Office location (NWS Region) and the participant's Office type (WSFO or WSO). All responses to each question from NWS Field Offices in the same NWS Regional Administrative Organization were scored together. For each NWS Region, responses were summarized for both Weather Service Forecast Offices (WSFOs) and for Weather Service Offices (WSOs). NWS Office locations were determined by the participant's answer to survey question eighteen about which state the participant's Office is located in.

There were two benefits inherent within the two methods of data management. Possible differences could be perceived in survey responses to certain questions by NWS Field Offices in one NWS Regional Administrative Organization versus the responses of Offices in another NWS Region. Relationships and tendencies of responses could be assessed between NWS WSFOs and WSOs. A primary purpose of using data sets organized by NWS Region was to monitor and assess total scored responses in each Region to individual survey questions. Greater detail on the methods used to analyze the collected data is given in the data analysis discussion in the last section of this chapter.

Limitations of the Study

No other study has been identified which examines how National Weather Service Field Office personnel perceive the possible use of an ultraviolet (UV) radiation forecast. In the United States prior to 1991, there had hardly been any discussion, whatsoever, of having a national public forecast of UV radiation. Because of the lack of awareness associated with the idea of having a NWS UV forecast, some Offices might have responded without realizing the potential benefits from having a NWS UV forecast. In the cover letter, it was stated that a UV forecast would inform the public of current and future ultraviolet conditions at the ground throughout the country, and a fundamental goal of a UV forecast would be to help reduce public health risks associated with exposure to UV radiation. If

NWS Offices did not satisfactorily understand the variability of exposure to UV radiation in terms of hours, days, or seasons, this lack of knowledge might be reflected in some of their survey responses.

This research was limited to identifying viable alternative dissemination policies for a NWS UV forecast prior to the official decision for implementation of a UV forecast. Research based on a need for specific findings with policy implications should incorporate multiple time-series designs (Babbie 44). In this manner, applied research should be extended to assess NWS Field Offices' potential uses of a UV radiation forecast during the implementation stage of a UV forecast and at some point after the UV forecast has been used regularly by the Offices. It is possible that the interactive nature of obtrusive research conducted through this study's survey questionnaire might have had an influence on the responses given by NWS Field Office officials as they participated in the study. Data collected for this study should serve as a benchmark for the first time-series analysis regarding potential uses of a UV forecast by NWS Field Offices. Future modification and refinement of dissemination policies could be based on the comparison of the first time-series analysis versus a second time-series analysis.

A portion of this study involved research aimed at helping to identify viable UV forecast dissemination practices for the NWS's National Oceanic and Atmospheric Administration (NOAA) Weather Radio Program. Five of the nineteen survey questions were devoted exclusively to NOAA Weather Radio programming issues. A NWS WSO Official In Charge has been quoted saying "NOAA Weather

Radio serves as a primary means of delivering warnings to the public and other user groups" (Mencan). NOAA Weather Radio programming by individual NWS Field Offices is one of the most direct forms of the organization's public interaction. Yet, if a survey of nearly 10,000 Canadian citizens on their knowledge and usage of 'Weatheradio Canada' can be at all indicative of American NOAA Weather Radio awareness, then most probably Weather Radio is unfamiliar to the majority of U.S. citizens.

Environment Canada's, Atmospheric Environment Service "operates a special national radio network called 'Weatheradio Canada'," which is very similar to the NWS's NOAA Weather Radio program in the U.S. (Environment Canada n.p.). A 1989 'Weatheradio Canada' survey commissioned by the Atmospheric Environment Service of Canada produced results which indicated a low national awareness of its country's Weatheradio service. Only 22% of the national population knew about the service. Other Canadian surveys conducted in 1987 and 1986 indicated that the national awareness of 'Weatheradio Canada' ranged from 10% to 38%, respectively (Environment Canada 1). Although no studies of the magnitude of the Canadian studies have been conducted about NOAA Weather Radio, an assessment of NOAA Weather Radio awareness in the U.S. would most likely produce similar results (Mencan).

The primary research questions for this study were intended to identify potentially successful and viable policies and procedures for disseminating a UV radiation forecast through the existing NOAA Weather Radio Program and its

population of users. While NOAA Weather Radio is a major interface between the NWS and the public, a lack of awareness of NOAA Weather Radio is a problem in itself.

Private and public partnerships involving the providing of weather information and the identification of weather sources have helped to increase the public's awareness of NOAA Weather Radio (Mencan). Since NWS promotional campaigns are continually expanded, more people will be educated about NWS operations. An anticipated result is an increase in the use of NOAA Weather Radio. A proper design of dissemination policies for a UV forecast prior to its inception will afford current and future NOAA Weather Radio users a greater quality of service delivery.

NWS Field Office survey participation may have been inadvertently suppressed by the distribution of a NWS Technical Information Message to NWS Field Offices. It is possible that a small percentage of NWS Field Offices may have interpreted a NWS Headquarter's electronic transmission as being applicable to the researcher's survey questionnaire. Two NWS Field Offices returned blank survey questionnaires with copies of National Technical Information Messages. Copies of the NWS Technical Information Messages dated May 17 and May 18, 1994, are located in Appendix F. Content of the two versions were similar, but the source of origination differed.

Four days after the researcher's survey questionnaire was mailed to NWS Field Offices, a number of national television stations televised a news story on the

potential threats associated with exposure to UV radiation. Columbia Broadcasting System (CBS) and Cable News Network (CNN) both aired reports on the subject of UV radiation on May 17, 1994. CBS news noted that the NWS was attempting to develop and issue a public UV forecast by the early part of summer 1994. Subsequent to May 17, 1994, many newspapers across the country disclosed information pertaining to the NWS's experimentation "with ways to add a solar-hazard rating to the daily forecast" (Schmid A:1). On May 18, 1994, one such article appeared on the front page of The State, a daily newspaper circulated statewide in South Carolina. Widespread national media attention to the subject of UV radiation and a possible NWS UV forecast very well could have been in response to the May 17, 1994, Technical Information Message released by the NWS.

There was a dual purpose for the NWS Headquarter's release of the National Technical Information Message. It was disseminated among most NWS Field Offices for the purpose of informing NWS Field Office personnel as to the status and announcement of the organization's proposal to have a UV forecast. For most NWS Field Offices, it was the first notification of any plans for a NWS UV forecast. Simultaneously, the National Technical Information Message was addressed to "all NWS product users" and could have referred to private citizens, media outlets, consulting firms, and others (Newton n.p.).

In the National Technical Information Message, it was disclosed that the NWS was working with various federal agencies, the American Meteorological

Society, and private industry to develop an experimental UV forecast. July 1994 was identified as a tentative date for a NWS demonstration and evaluation project involving experimental forecasting for a selected number of trial sites. It was stated that Offices chosen as test sites would be given "background material on the development and use of the index (the UV radiation forecast) substantially before that time" (Newton n.p.). In one version of the Message, a request located near the end noted that "NWS Offices should disregard any information they receive on this product that is not distributed by the NWS" (Newton n.p.). Content of that request might have been construed by some NWS officials, such as those who returned blank questionnaires with copies of the National Technical Information Message, as being applicable to this study's survey questionnaire.

Another transmission was sent to most NWS Field Offices six days later which helped clarify the work of this researcher. On May 23, 1994, a message in the form of a memorandum for all NWS employees stated that this researcher was a graduate student at The University of Tennessee and had developed a survey questionnaire as a personal research project. A copy of the Administrative Message is located in Appendix F. The major portion of this Administrative Message included the following:

This survey is not an official request by the NWS. You may respond if you wish. However, the results will not be used to help establish dissemination policies and procedures for the ultraviolet radiation index that the NWS plans to implement experimentally in the late June/early July 1994 timeframe (Uccellini n.p.).

Quite possibly, the NWS Headquarter's release of the May 23 Administrative

Message led to more NWS Field Office participation in the survey. Some Field Office officials who understood the National Technical Information Message to apply to the survey questionnaire may have changed their interpretations upon receiving the Administrative Message.

Data Analyses

Survey responses from NWS Field Offices were analyzed for the purpose of describing possible uses of a UV forecast by NWS Field Offices. Descriptive analyses were conducted for responses given to each survey question by NWS Offices. Answers given for each survey question have been summarized for NWS Field Offices in each Regional Administrative Organization. By aggregating the survey data collected from each NWS Region, descriptive studies were prepared for the entire NWS Field Office population. Survey answers given to questions one, ten, fifteen, and sixteen b were further analyzed for all NWS Regions' WSFOs and WSOs because those questions pertained to uses of a UV forecast and are fundamental for determining likely functions of a UV forecast between NWS Office types. Responses from the two types of NWS Field Offices were disclosed only for the entire Field Office population. Survey data analyzed by Region and for the All Regions category were used to help formulate recommendations for NWS policies and procedures for the dissemination of a UV forecast.

Data analyses were performed to address some fundamental dissemination issues for a NWS UV forecast. Most analyses pertain to the communication

process from both a content perspective and as a process (Ross 7). Analyses were conducted for fourteen basic survey questions pertaining to NWS's use of a UV forecast (six questions), the preferred format of a UV forecast (four questions), and the suggested dissemination frequency of a UV forecast (four questions). Analyses of five basic survey questions specifically addressed applications of a UV forecast through NOAA Weather Radio programming.

Analyses were also given for three other survey questions. To identify NWS Regional demand for UV radiation monitoring equipment, Field Offices' responses to survey question three were analyzed. Survey question eight responses were analyzed to evaluate NWS Field Offices' opinions as to the usefulness of a UV forecast among various organizations (in their local area). NWS Field Offices' familiarity with local weather user groups yielded a qualified response to UV applications in the area served by their Field Office. A final survey question that was analyzed investigated NWS Offices' awareness of the Canadian daily UV forecast.

Following this chapter, a description of survey results is presented in chapter four. Appendix E contains tabular data for the analyses of individual survey questions. A summary of results along with comments given by officials who answered the questions is given in chapter five.

CHAPTER IV

RESULTS

Empirical data collected through this study's obtrusive field research is disclosed in this chapter. Findings are reported in a format which explicitly links NWS Field Office survey answers to each research question. Description of survey responses are given for fourteen basic survey questions pertaining to the use of a UV forecast, the preferred UV forecast format, and the suggested dissemination frequency of a UV forecast by NWS Field Offices. Descriptions are also given for three other survey questions. Data analyses for this applied research were "predicated on a need for specific facts and findings with policy implications" (Babbie 44).

The number of survey responses from NWS Field Office participants reached a peak during the second week after the surveys were mailed out to Field Offices. The second week was also the week in which the Administrative Message was electronically transmitted to NWS Field Offices. There were eleven survey responses received within one week of the original mailing. In weeks two, three, four, and five, there were one hundred six, twenty three, three, and zero survey responses received, respectively. Fifteen Offices from various NWS Regions requested copies of the summarized research results. After the survey was mailed out, eight NWS Field Office officials called to clarify some survey issues.

Use of a NWS UV Forecast

This section describes possible uses of a UV forecast by NWS Field Offices. Responses to survey questions one, ten, fifteen, and sixteen B are described. Relationships and tendencies of survey responses are addressed for all NWS WSFOs and WSOs for four survey questions pertaining to UV forecast uses. Significant Regional disparities in survey responses are noted. References are given for survey answers that receive a majority or unanimous response by NWS Field Offices.

Survey question one was a closed ended question and asked whether NWS Field Offices had an interest in receiving a daily UV forecast from the National Meteorological Center (NMC) for the area served by their NWS Office. Table 2 in Appendix E contains summarized information for all NWS Regions. More than two thirds of all NWS Field Offices responded to survey question one, yielding a response rate with a level of confidence exceeding 96%. For the All NWS Regions category, there was a ratio greater than 3 to 1 for Offices with an interest in having a UV forecast.

There were two distinct Regional disparities with responses to survey question one among Field Offices in the NWS Central Region and Alaska Region. NWS Central Region Offices responded in excess of 6 to 1 for having an interest in a UV forecast. Field Offices in the Alaska Region, by a ratio of 2 to 1, did not have an interest in having a UV forecast.

A majority of both types of Field Offices had an interest in having a UV

forecast, but a greater percentage of WSFOs had an interest in a UV forecast. Table 2.1 in Appendix E contains tabular information for the two types of NWS Field Offices. For NWS WSFOs and WSOs there was a ratio of interest in excess of 6.5 to 1 and 2.5 to 1 for the two Office types, respectively.

Survey question sixteen B pertained to opinions of NWS Field Offices as to whether the NWS should have a UV forecast. A summary of NWS Field Office responses by Region to survey question sixteen B is located in Table 3 in Appendix E. Answers given by respondents were scored as 'yes,' 'no,' or 'other responses.' Other responses consisted of participants' own answers. Sixty-four percent of NWS Field Offices in the All NWS Regions category responded to the survey question, yielding a level of confidence greater than 95%. For 'yes' and 'no' Office responses there was a ratio greater than 4 to 1, respectively. Only 4% of the participating Offices responded with other responses.

A majority of Offices in the All NWS Regions category indicated that the NWS should have a UV forecast. But the degree of support varied among four NWS Regions. All responding NWS Pacific Region Offices answered 'yes', but the Office response rate for the Region was 36%. Offices in the Southern Region responded with a 'yes' to 'no' ratio of 3 to 1. Analyzed responses for the Central Region produced the greatest Regional disparity. Seventy percent of all possible NWS Central Region Office participants responded to survey question sixteen B. There was a 'yes' to 'no' margin of 19 to 1 with survey responses. In the Eastern Region, Offices responded affirmatively as to whether the NWS should have a UV

forecast by a ratio greater than 2.5 to 1.

There was a similar trend with responses given by NWS WSFOs and WSOs. Summarized data for the two Office types is in Table 2.1 in Appendix E. Responses from both types of NWS Field Offices in the All NWS Regions category produced a 'yes' to 'no' ratio of just over 4 to 1.

Survey question ten instructed respondents to allocate one hundred points among ten suggested alternative uses of a UV forecast by NWS Offices. A summary of total allocated points by Field Offices in each NWS Region is given in Table 4 in Appendix E. Each NWS Office was asked to have the column total for survey question ten equal to one hundred points. Responses were analyzed for the percent of the total number of allocated points to UV forecast uses for each of the individual uses. Participation by NWS Offices in the All NWS Regions category with survey question ten was 63%, which produced a level of confidence in excess of 94%.

On a percentage basis, a majority of the points allocated by Offices in the All NWS Regions category were for the use of a UV forecast as a forecast product by itself over NOAA Weather Radio (21%), as part of a public information statement (20%), to supplement a recreational forecast (18%), to supplement an agricultural forecast (9%), and each of the remaining forecast use alternatives received 3-6% of the total number of allocated points.

Regional disparities from the summary of points allocated by the All NWS Regions category existed between certain NWS Regions. The greatest deviation

from the overall tendency of point allocation occurred with the Alaska Region and Pacific Region. Pacific Region Offices allocated 58% of their total points to the use of a UV forecast as a product by itself over NOAA Weather Radio. A second majority of 25% was allocated for the variable 'supplement a zone forecast product.' NWS Alaska Region Offices allocated 21% and 18% of their points for applying a UV forecast to a recreational forecast and as part of public information statement, respectively.

Offices in both the NWS Eastern Region and Western Region had the majority of their points allocated towards use of a UV forecast over NOAA Weather Radio. A second majority was with the use of a UV forecast as a supplement to a recreational forecast.

Points allocated by NWS WSFOs and WSOs were very similar to one another for all but one of the ten alternative UV forecast uses. Table 4.1 in Appendix E contains a summary of points allocated to forecast uses by all NWS WSFOs and WSOs. Total percentage points allocated by WSFOs and WSOs differed from one another by no more than two percentage points for each forecast use, except for the use variable 'supplement a zone forecast product.' WSFOs allocated 9% of their total number of points to the zone forecast use, compared to only 5% by the WSOs.

Responses from all NWS Field Offices to survey question ten were further analyzed for the All NWS Regions category and for each NWS Region. Tables were constructed identifying frequencies in which ranges of scores were allocated

for possible uses of a daily UV forecast by NWS Field Offices. Table 4.2 in Appendix E contains summarized data on ranges of scores allocated for UV forecast uses by NWS Offices in the All NWS Regions category. Information for each of the individual NWS Regions is found in Tables 4.3, 4.4, 4.5, 4.6, 4.7, and 4.8 in Appendix E. Offices in the All NWS Regions category responded most frequently for allocating any points to the use of a UV forecast for the survey variable, part of a public information statement. Use of a UV forecast as a Weather Radio product by itself received the second most number of Office responses. The most common ranges of points allocated by Offices in the All NWS Regions category were zero to ten and eleven to twenty points.

Survey question fifteen asked Office participants to indicate communication technologies that the NWS should use to disseminate UV information. A complete listing of responses by NWS Region is given in Table 5 in Appendix E. Offices were instructed to indicate all communication technologies that should be used for forecast dissemination. Sixty-four percent of all NWS Offices responded to survey question fifteen, yielding a level of confidence greater than 94%. Of the 138 Office participants, 80% and 78% marked NOAA Weather Wire Services and NOAA Weather Radio, respectively. Approximately, 70% selected Family of Services. Nearly 24% of all Office participants selected both multiple-access recorded phone systems and the National Facsimile Network.

Responses by Offices in each Region were similar to overall response patterns of Offices in the All NWS Regions category. There were a few Regional

variations with responses to survey question fifteen. Most noticeable was a majority of Offices in the NWS Eastern Region which chose the Family of Services most frequently for UV forecast dissemination. NWS Alaska Region Office responses were most frequent with NOAA Weather Wire Services and Family of Services. In the NWS Pacific Region, a second majority of Office responses included the multiple-access recorded phone system.

Table 5.1 in Appendix E contains information on WSFO and WSO responses to survey question fifteen. Survey responses to question fifteen by NWS WSFOs and WSOs differed for the second and third most commonly selected UV forecast dissemination sources. In decreasing order, WSFOs most frequently selected the following as technologies that should be used by the NWS to deliver UV information: NOAA Weather Wire Services, Family of Services, and NOAA Weather Radio. WSOs for the All NWS Regions category equally chose NOAA Weather Wire Services and NOAA Weather Radio as the dissemination technology that the NWS should use for dissemination of a UV forecast. Family of Services was the next most commonly selected survey variable.

Preferred UV Forecast Format

Four research questions address likely format possibilities for a UV forecast. Responses from NWS Field Offices to survey question two, six, and seven are described in this section. Substantial similarities and differences in responses to each question from Offices in each NWS Region are presented.

Survey question two asked for the preferred format of a daily UV forecast released to Field Offices by the NMC. Table 6 in Appendix E contains summarized information for responses to survey question two by Offices in each NWS Region. Choices given to respondents were 'text,' 'graphic,' and 'both.' Sixty-four percent of all NWS Field Offices responded to survey question two, producing a level of confidence greater than 94%. Offices in the All NWS Regions category largely selected 'both' as their survey answer. There was a ratio of preference for 'both' types of UV forecast formats of nearly 2.5 to 1 as compared to the 'graphic' format. For 'both' format types compared to 'text' format preferences, there was a ratio greater than 3 to 1.

Differences from the All Regions summarized data were evident in responses from Offices in three NWS Regions. In the NWS Western Region the preferred format of a UV forecast by NWS Offices was 'graphic.' Out of the total number of actual Office participants in the Western Region, 6% more selected the 'graphic' format (44%) versus the survey variable 'both' (38%). With fewer than 50% of Alaska Region Offices responding to survey question two, there was slightly more than a 1.5 to 1 preference ratio for the 'text' only UV forecast format versus a 'graphic' or 'both' format types.

In the NWS Pacific Region there was a response rate of slightly 36% of all possible number of Office participants. Responses from Pacific Region Offices indicated an equal preference for having a 'text' UV forecast and 'both' UV forecast formats. No Offices indicated a preference for the 'graphic' forecast format.

Survey question seven addressed the general arrangement possibilities for a UV forecast. Table 7 in Appendix E contains a summary of responses received from Offices in each NWS Region. Field Offices were instructed to indicate all applicable UV forecast types that would be useful for the area served by their Office. Offices could select one or more of three given choices, including a site specific UV forecast, a state UV forecast, and a regional UV forecast.

Survey responses were received from 63% of Offices in the All NWS Regions category, which produced a confidence level greater than 94%. Out of all possible NWS Field Office respondents, 34% selected the site specific UV forecast. Thirty-three percent of all possible respondents were in favor of having a state UV forecast type. Only 18% of all possible Offices respondents chose the regional UV forecast.

A comparison of the trend of responses from the All Regions category versus individual NWS Regions revealed a few Regional differences. NWS Central Region Offices had a majority of their responses for a state UV forecast. In the NWS Central Region there was a 1.5 to 1 ratio for a state UV forecast versus a site specific UV forecast. In the NWS Alaska Region, Offices favored a site specific UV forecast (27% of all possible Field Office participants), but a second majority was for the regional UV forecast (20% of all possible participants). Pacific Region Field Offices equally favored a site specific UV forecast and a state UV forecast.

Survey question six pertained to a basic design concept of a UV forecast.

Summarized data for responses by Offices in each NWS Region is given in Table 8 in Appendix E. NWS Field Offices were given a 'yes' or 'no' question as to whether daily UV information should be given out by the NMC to Field Offices for high hazard areas only. Responses to survey question six were sufficient for a 95% confidence level. By a ratio of 1.6 to 1 Field Offices indicated that the NMC should not give them a daily UV forecast for high hazard areas only.

Regional disparities from the All Regions summarized data were found with responses summarized for the NWS Western Region, Alaska Region, and the Pacific Region. NWS Western Region Offices had a 'no' to 'yes' preference ratio of only 1.28 to 1. Office response rate in the Western Region was 58%. With a 53% response rate, Field Offices in the Alaska Region were equally divided among 'yes' and 'no' responses. In the NWS Pacific Region, there was a 36% participation rate with survey question six, yielding a 'no' to 'yes' ratio of 3 to 1.

Suggested Dissemination Frequency of a UV Forecast

NWS Field Offices were given two questions which asked how often they would like to have a UV forecast from the NMC. Question four pertained to 'days' that Offices would like to have UV forecast issued to them by the NMC, if one were released. Survey question five investigated the times of day in which NWS Field Offices would like to have a UV forecast. For survey question four, respondents selected only one dissemination frequency ('day'). With survey question five, respondents were instructed to select all preferred forecast

dissemination frequencies ('times of day').

Table 9 in Appendix E presents summarized information for responses given to survey question four by Offices in each NWS Region. Sixty-five percent of all NWS Field Offices responded to survey question four, yielding a confidence level greater than 95%. Choices of 'days' from which NWS Field Offices selected one response, included 'once a week in summer,' 'twice a week in summer,' 'daily in summer,' 'days with a high UV exposure,' 'daily year-round,' and 'other responses.' Eight NWS Offices gave their own answers and those responses qualified as 'other responses.'

A majority of Offices in All NWS Regions selected the variable 'daily in summer.' A second majority was for 'days with a high UV exposure.' Responses for 'daily in summer' outnumbered selections for 'days with a high UV exposure' by a ratio of 2.36 to 1. Each of the other selections received less than 6% of the possible number of responses from Offices in All NWS Regions.

Regional disparities from the summarized data for the All NWS Regions category were inherent in responses given by Offices in the NWS Alaska Region and Pacific Region. In the Alaska Region, an equal majority of selections was given for variables 'twice a week in summer' and 'daily year-round.' Each of those selections received responses from 20% of the possible number of NWS Field Office participants. Alaska Region Field Office participation with survey question four was 53%. Alaska Region Offices, again, had an equal second majority (7%) of selection for variables 'daily in summer' and 'days with a high UV exposure.'

Pacific Region Office selections were given for three 'day' frequencies. By a ratio of 2 to 1, Offices selected 'once a week in summer' over both 'twice a week in summer' and 'daily year-round.' Only 36% of the possible NWS Pacific Region Office participants responded to survey question four.

Survey question five listed five choices of daily 'time' in which NWS Offices selected one or more to indicate when they would like to have a UV forecast issued by the NMC. Table 10 in Appendix E contains summarized data for each NWS Region. Sixty-four percent of all NWS Field Offices responded with at least one selection, yielding a confidence level greater than 94%. Times of day selected by most Offices were '12:00 AM to 6:00 AM' and '6:00 AM to 12:00 PM.' Selections were greater for the '12:00 AM to 6:00 AM' period versus the '6:00 AM to 12:00 PM' time by a ratio of 2.8 to 1. Less than 10% of the possible number of NWS Office participants responded to each of the other selections.

Summarized responses to survey question five were representative of responses from Offices in all other NWS Regions, except, the NWS Alaska Region and Pacific Region. Alaska Region Offices had an equal majority of selection for '12:00 AM to 6:00 AM' and '6:00 AM to 12:00 PM' (50% of responses from actual Office participants). Nearly 38% of all actual Office participants selected '12:00 PM to 6:00 PM.' Fifty-three percent of all Alaska Region Offices responded to survey question five.

Pacific Region Offices selected only two times in which they would like to have a UV forecast. Four out of eleven Pacific Region Offices answered survey

question five. Two Offices responded for both '12:00 AM to 6:00 AM' and '6:00 AM to 12:00 PM.'

Applications to NOAA Weather Radio Program

Survey question nine was designed to find out if NWS Field Offices would disseminate a UV forecast over NOAA Weather Radio, should a UV forecast be made available by the NMC. Table 11 in Appendix E lists summarized data for responses to survey question nine by NWS Field Offices in each NWS Region. Offices responded 'yes,' 'no,' or as 'Office without NOAA Weather Radio.' Responses to question nine were received from 64% of the NWS Field Offices in All NWS Regions, yielding a confidence level in excess of 95%. For all Offices which responded as 'yes' or 'no,' there was a 7 to 1 ratio for Offices in favor of disseminating a UV forecast over NOAA Weather Radio.

Responses to survey question nine varied according to NWS Region. Except for the NWS Alaska Region, the majority of Offices in all other Regions responded 'yes.' Alaska Region Offices were equally split between 'yes' and 'no' as to whether a UV forecast should be disseminated over NOAA Weather Radio. 'Yes' to 'no' ratios were the greatest with the NWS Central Region (20 to 1) and Southern Region (9.6 to 1). A 'yes' to 'no' ratio of 2 to 1 for the Pacific Region was the least. NWS Eastern Region Offices and Western Region Offices had a 'yes' to 'no' ratio of 4.6 to 1 and 5.5 to 1, respectively.

Survey question eleven asked NWS Offices if they would be willing to run

a NOAA Weather Radio recording designed to inform the public about a UV forecast and what can be done to reduce adverse effects from UV radiation. Table 12 in Appendix E contains a summary of responses to survey question eleven by Offices in each NWS Region. Participants responded as 'yes,' 'no,' or as 'Office without NOAA Weather Radio.' Out of all possible NWS Field Office participants, 65% responded to question eleven, yielding a confidence level greater than 95%. Summarized responses for Offices in the All Regions category produced results similar to those for question nine.

Responses to survey question eleven by Offices in All NWS Regions had a 'yes' to 'no' ratio of 8.3 to 1. A majority of Offices in each of the NWS Regions responded 'yes' to survey question eleven. 'Yes' to 'no' ratios ranged from 13.6 to 1 in the NWS Central Region to 3.8 to 1 in the NWS Eastern Region. Two NWS Regions did not have any 'no' responses. Alaska Region Offices and Pacific Region Offices responded with a 'yes' to 'no' ratio of 5 to 0 and 3 to 0, respectively.

Survey question twelve investigated 'days' in which NWS Field Offices would release a UV forecast over NOAA Weather Radio, should a UV forecast be made available by the NMC. Table 13 in Appendix E presents summarized information for responses to survey question twelve by NWS Field Offices in each Region. Choices selected by participants consisted of each of the seven days of the week, 'everyday,' 'any day with high UV exposure,' and 'no day.' Fifty-nine percent of all NWS Field Offices responded to survey question twelve, yielding a confidence level greater than 92%.

Two selections were most commonly chosen by Offices in the All NWS Regions category. Out of the actual number of Offices responding to survey question twelve, 51% and 50% selected 'everyday' and 'any day with high UV exposure,' respectively. All other selections received three percent ($\pm 2\%$) of the total possible number of selections by all NWS Field Offices.

Responses to question twelve by Offices in each NWS Region compared to summarized data for Offices in All NWS Regions revealed a variation in responses given by Offices in three NWS Regions. Offices in each of the six NWS Regions had the majority of their selections for the same two variables. But the selection with the greatest frequency was contrary to that of the All Regions summarized data for the NWS Central Region, Alaska Region, and Pacific Region. Central Region Offices selected 'any day with high UV exposure' versus 'everyday' by a ratio of 1.1 to 1. Alaska Region and Pacific Region Offices responded in favor of 'any day with high UV exposure' compared to 'everyday' by a ratio of 2 to 1 and 3 to 1, respectively.

Survey question thirteen asked NWS Field Offices to indicate the times of day they would probably disseminate a UV forecast over the NOAA Weather Radio. Table 14 in Appendix E contains a summary of responses to survey question thirteen by Field Offices in each NWS Region. Selections consisted of eight sets of equally spaced three hour intervals for the twenty-four hour day, 'during actual time of high UV exposure,' and 'no time of day.' Responses for survey question thirteen were received from 59% of all NWS Field Offices, yielding

a level of confidence greater than 92%.

For Offices in the All NWS Regions category, the '6:00 AM to 9:00 AM' selection received the majority of responses. Out of the actual number of Office participants, 62% responded to the '6:00 AM to 9:00 AM' selection followed by 44% for the '9:00 AM to 12:00 PM' selection.

Summarized data for responses to question thirteen from Offices in each NWS Region indicated that every NWS Region had the majority of their selections with '6:00 AM to 9:00 AM.' Except for the Western and Pacific Regions, every Region shared the second most commonly selected time for disseminating a UV forecast over NOAA Weather Radio. Western Region Offices selected '3:00 AM to 6:00 AM' as their second most common time of dissemination. Pacific Region Offices had a second majority of equal selection with '3:00 AM to 6:00 AM' and '9:00 AM to 12:00 PM.'

A final question pertaining exclusively to NOAA Weather Radio was question fourteen. Table 15 in Appendix E lists summarized information for responses to survey question fourteen by Offices in All NWS Regions. NWS Field Offices were asked to identify the kind of UV information they would prefer to disseminate over NOAA Weather Radio. Responses consisted of one of the following: 'quantitative,' 'qualitative,' 'both,' and 'none.' Out of the total possible number of NWS Field Office participants, 59% responded to survey question fourteen, yielding a level of confidence greater than 92%.

NWS Offices in the All NWS Regions category most frequently selected

'both' for the kind of UV information preferred for dissemination through NOAA Weather Radio. 'Qualitative' information was the second most commonly selected variable. There was a preference for disseminating 'both' kinds of UV information versus 'qualitative' UV information by a ratio of 3.1 to 1. Only 7% of NWS Offices in the All NWS Regions category selected 'none' as an answer to question fourteen.

Summarized results for Offices in the All NWS Regions category were representative of results from Offices in all other Regions, except, the NWS Alaska Region. Offices in the Alaska Region equally selected 'both' and 'qualitative' as kinds of UV information preferred for dissemination over NOAA Weather Radio. In the NWS Pacific Region, there was a ratio of 3 to 0 for selection of 'both' and 'qualitative' UV information. Response rates to question fourteen by Offices in the NWS Alaska Region and Pacific Region were 33% and 27%, respectively.

Other Survey Questions

Survey question three asked NWS Field Offices if they would like to have UV radiation equipment. Table 16 in Appendix E contains summarized information for each of the six NWS Regions. Offices responded 'yes,' 'no,' or with 'other responses.' 'Other responses' consisted of answers from two Offices indicating they already had UV equipment. Responses were received from 61% of Offices in the All NWS Regions category, yielding a level of confidence in excess of 93%. Offices in the All NWS Regions category responded with a 'yes' to 'no' ratio of 2.5

to 1.

Summarized responses for Offices in most Regions were very similar to the overall trend of responses displayed by Offices in the All NWS Regions category. With a 53% response rate, Alaska Region Offices responded 'yes' to 'no' by a ratio of 4 to 0. 'Yes' to 'no' ratios of 1.7 to 1 and 1.3 to 1 were observed for the NWS Western Region and Alaska Region.

Survey question eight asked NWS Field Offices to identify organizations in their local area that might benefit from a NWS UV forecast. Table 17 in Appendix E contains summarized data for responses given to question eight by Field Offices in each NWS Region. Respondents selected one or more of eight possible answers. Choices consisted of seven specific organizations and 'other organizations.' Six NWS Field Offices gave their own answers and those Office responses qualified as 'other' answers. For all NWS Offices in All NWS Regions, there was a 64% participation rate with question eight, yielding a level of confidence greater than 95%.

A summary of responses to question eight by Offices in the All NWS Regions category revealed the 'general public' as the most common selection, followed by 'health organizations.' Of the actual number of NWS Offices responding to survey question eight, 89% and 76% of Offices selected 'general public' and 'health organizations,' respectively. Sixty-seven percent and 60% of all participating NWS Offices selected 'tourism industry' and 'mass news disseminators' as likely benefactors of a NWS UV forecast.

Summarized data for responses to question eight indicated that the majority of Offices in each NWS Region selected 'general public.' Regional disparities were inherent in responses from four NWS Regions when compared to summarized data for the All NWS Regions category. NWS Central Region Offices had the same top three most commonly selected organizations as that by the All NWS Regions category. But Central Region Offices had two organizations, 'mass news disseminators' and 'agriculture industry' equally selected as the fourth most common organization likely to benefit from a NWS UV forecast. In the NWS Western Region, the second most commonly selected organization was equally split between 'health organizations' and 'mass news disseminators.' Third and fourth most popular selections by Offices in the NWS Western Region were 'tourism industry' and 'sporting organizations.'

Pacific Region Offices equally selected 'general public' and 'tourism industry' most frequently. 'Health organizations' was the second most commonly selected variable. Three organizations equally received the fourth greatest number of responses ('agriculture industry,' 'mass news disseminators,' and 'local or state governments').

Survey question sixteen A asked NWS Field Office officials if they were aware of a UV forecast issued daily by Environment Canada's Atmospheric Environment Service. Table 18 in Appendix E presents a summary of responses to survey question sixteen A for Offices in each of the six NWS Regions. Respondents answered 'yes' or 'no.' Two thirds of all NWS Field Offices

responded, yielding a confidence level greater than 95%.

By a ratio of 2.7 to 1, respondents in the All NWS Regions category were not aware of Canada's daily UV forecast. Summarized results for each NWS Region were very similar to each other. Offices in the NWS Western Region had a slightly lower 'no' to 'yes' ratio of 1.6 to 1, possibly indicating that more of the respondents in this Region were aware of the Canadian UV forecast.

Chapter five presents some specific conclusions based on the findings described in this chapter. A summary of answers for each of the basic types of survey questions and some general survey comments from survey respondents are presented in chapter five. Emphasis is given for Offices in the All NWS Regions category.

CHAPTER V

CONCLUSION

Summary of Results

A questionnaire sent to NWS Field Offices in all NWS Regions produced a widespread response from NWS Field Offices located throughout the service area of the organization. Data were collected from NWS WSFOs and WSOs and can serve as a basis for defining NWS policies and procedures for the dissemination of a NWS UV forecast. This analysis gives an assessment of NWS Field Office assumptions and values through which an independent conclusion can be reached (Patton and Sawicki 13). Critical variables in deciding dissemination policies and procedures are examined through this report.

Responses to at least three survey questions were received from 67% of the total possible number of NWS Field Office participants. Descriptive statistics of the total possible number of NWS Offices responding to all survey questions include the following: mean, 63.7%; median, 64%; mode, 64%; and the range, 59% to 67%. Of response rates to all questions, a minimum level of confidence of over 92% was given for survey questions twelve, thirteen, and fourteen with only 59% of all possible Offices responding. Survey questions one, seventeen, and eighteen had a 67% Office response rate and the greatest level of confidence, which exceeded 96%.

Survey responses varied according to NWS Region. Office response rates for the NWS Eastern Region, Southern Region, and Central Region ranged from 59% to 73%. Western Region Offices had a participation rate with survey questions that ranged from 46% to 61% with a mean participation rate of 55%. Any conclusions drawn from responses submitted by Offices in the Alaska Region and Pacific Region are suspect since response rates to most questions were under 50% of the total possible number of responses. This chapter emphasizes a summary of responses given by Offices in the All NWS Regions category for the three types of basic dissemination survey questions. A summary of questions pertaining exclusively to NOAA Weather Radio is given by itself.

'Use' of a UV forecast is a critical variable that can be analyzed to help determine the practicality of a sunlight forecast. Survey questions that addressed the 'use' of a UV forecast indicated a widespread Office interest in having a UV forecast and that the NWS should issue a UV forecast. Observations of survey answers from NWS meteorologists indicate NWS Field Offices should use a UV forecast as a forecast product by itself over NOAA Weather Radio, as part of a public information statement, and to supplement a recreational forecast. Communication technologies the NWS should use to disseminate a UV forecast include NOAA Weather Wire Services, NOAA Weather Radio, and Family of Services.

NWS Field Offices are inclined to better use UV information presented in both a text format and a graphic format. Forecasters at the NMC should give

WSFOs and WSOs a UV forecast daily in summer for specific sites or for states. UV information from the NMC should be disseminated to Field Offices between 12:00 AM and 6:00 AM per Field Office local time.

For all questions pertaining only to NOAA Weather Radio, there was an average Office response rate of 61.2%, yielding a level of confidence greater than 93%. Based on results of this survey, Field Offices should be required to deliver both quantitative and qualitative UV information between 6:00 AM and 12:00 PM over NOAA Weather Radio, either every day or on days with a high UV exposure. Additionally, NOAA Weather Radio should be used to deliver an explanation of a UV forecast and to give sun exposure safety information to the public.

Survey responses revealed professional assumptions of organizations in local Field Office's service areas that are most likely to benefit from a UV forecast including the general public, health organizations, the tourism industry, and mass news disseminators. A request for comments revealed that although the tourism industry was identified as the third most common organization, several Offices indicated a UV forecast might not be welcomed and even resisted by tourism officials. A comment from a NWS Field Office official included the following:

In a tourist-oriented area such as here, the information would be important every day, all year long, IF it is shown that the health hazard is significant. Also, it should be noted that some resistance to such information could come from some media and industries which historically promote people's going out to purposely be exposed to sunlight (i.e. "tanning index" promoters and some segments of the tourism industry). They would have to be "re-educated." (NWS Field Office official).

Another Field Office official commented in his survey response that the "Tourism

industry would probably not be in favor of it." Seven Offices commented on likely resistance for acceptance and promotion by the tourism industry of a possible UV forecast.

Twelve Offices commented on how a UV forecast could be a valuable service for the tourism industry. Comments from two NWS Field Office officials included the following:

Most of our area is coastal with a large volume of tourists wanting to sit in the sun. Some will say they are here to be in the sun and don't care about UV. Others would heed any advice we would put out (NWS Field Office official).

We have actually had requests for UV forecasts because we live on the _____ border and in a major camping/fishing tourism area. Have also had concerned parents call wondering how to find out about the amount of U.V. radiation (NWS Field Office official).

Survey results indicated that a majority of NWS Offices were not aware of Environment Canada's daily UV forecast. Field Office officials could be given information on the success and importance of the Canadian Weather Service's UV Index for its citizens to help illustrate a potential for similar yields of a NWS UV forecast. UV radiation monitoring equipment, which is in wide demand in all NWS Regions, could be used as part of an awareness campaign on UV radiation hazards for selected NWS Offices and the general public by providing information on current UV conditions and local sunlight climatology.

Other comments from NWS Office officials addressed reasons why the NWS should or should not have a UV forecast. One official said, "Variations in UV radiation are significant in locations near the South Pole (e.g. Antarctica, Southern

Australia, and the southern tip of South America) but variations over the U.S. are generally insignificant" (NWS Field Office official). One official responded, "Have we become a nation of whimps that need to be told when to go outside and when not?" An explanation from another NWS meteorologist included the following:

After several years, we still can not get the American public to understand wind chill indices and heat indices, let alone this new subject. Hell!, we can not even get most of the U.S. public to heed severe weather warnings and then at the last moment, they call the office and request advice on what to do. It is one thing to educate the public and to try to protect them, it is another thing altogether to beat your head against the wall! I for one am against this sort of product until the public understands the basics of everyday weather that they live in; your fault my fault, no-body's fault, they just do not get it! (NWS Field Office official).

The reference in that comment about public comprehension of windchill indices and heat indices has been recently researched by Professor Dennis M. Driscoll, Ph.D, Meteorology Department, Texas A&M University.

Dr. Driscoll surveyed 500 television meteorologists about their use of thermal comfort indexes and indications about their reception by the public. Research results indicated many public misconceptions about windchill indices and heat indices, and what is understood is sometimes fallacious (Driscoll 37). Dr. Driscoll gave reasons for abandoning the current system of indexes and suggested a new system be developed. In the context of a UV forecast, if the public does not readily understand the intended meaning of the forecast, measures can be taken to modify the product or to better educate the public. A "trial and error" time of product testing can be used to help structure a UV forecast that is more likely to be understood and reacted to by the public.

The importance of having an informed public on hazards of weather were specifically revealed through comments given by twelve NWS Office officials. One official commented, "A UV forecast, assuming the users were properly educated, could be of real benefit. This Office would look forward to participating in such a project." Another Field Office official commented:

I heartily support both public education as to the hazards of UV exposure and daily advisories to the public of predicted UV and hazard levels. As one of the older weather safety and Skywarn training lecturers in the state, I have the impression that the bulk of the general public, especially teenagers, have little or no perception of the hazards or the end-results of the pursuit of the deepest, darkest tan possible (NWS Field Office official).

Several Offices stated that UV information had been requested in the past and UV forecast development should not be delayed. According to one NWS official, "A forecast of UV by the NWS is long overdue. Thanks for your efforts! This a worthwhile project". A final comment from a NWS Field Office official reflected on the primary purpose of the NWS and how it relates to a UV forecast: "The core mission of the NWS is to protect life and property."

A UV forecast could serve to help reduce increasing health impacts from the UV radiation on the public if an accurate forecast were properly disseminated by the NWS and understood by the public. If the NWS has accurate and reliable UV forecasting technology, a UV forecast should be released in an effort to help stem pronounced increases in skin cancer cases.

The primary reason for having a UV forecast is because lifestyle changes, not increases in UV radiation, are resulting in increased incidence of all types of

skin cancer. Changes in outdoor leisure activities, occupational settings, population migration, and population age structure can make society more vulnerable to the hazards of sunlight exposure. "Ever since fashion designer Coco Chanel sported her new tan after a yachting vacation in the 1920's, many Americans have equated tanned skin with good health, great wealth, leisure time, social status, beauty, and high fashion" (Greeley 1991, 16).

The center of population in the U.S. has shifted over the past one hundred and fifteen years from near Cincinnati, Ohio to near St. Louis, Missouri where the number of clear days are estimated at seventy-one and eighty-six, respectively (Hoffman 187 and 387). Also, with respect to population migration, thirty-six of the fifty fastest-growing metropolitan areas from 1980 to 1990 were located in California, Florida, or Texas where greater percentages of possible sunshine are found (Hoffman 390). Increased use of the automobile can result in greater exposure to UV radiation and allow for trips to areas where sunshine is more abundant. Moreover, the average life expectancy has increased by fifteen point seven years in the U.S. since 1920 (Hoffman 956). Because a significant time lag exists for UV exposure to lead to cancer, melanoma is expected to be more common among the elderly.

With extra resources, this study could be expanded to yield additional information that might help define or expand NWS dissemination policies and procedures for a UV radiation forecast. Survey research could be conducted among a broader range of potential users of a UV forecast. Although many NWS

Offices conduct periodic surveys of user needs within the area served by their own Office, generic survey questionnaires could be sent out to people living in several NWS Offices' service areas. Users could be surveyed from a sample of Offices located in various NWS Regions. Through additional survey research, more specific users of a UV forecast could be identified. By knowing likely users, plans can be made to have UV information incorporated or developed into special user weather forecasts. In addition, greater effort can be taken to reach people who might benefit from UV forecasts but are not aware of the implications of exposure to UV radiation.

Television forecasters are likely users of a UV forecast. Because UV ground observation stations are costly and the satellite UV monitoring systems are restricted to certain public uses, television meteorologists would likely adapt a NWS UV forecast to their programming. NWS Field Offices in a great majority of communities are the source of much weather information given out by television meteorologists, as evidenced by the fact that in most news broadcasts, the NWS is referred to as the official source of weather advisories, weather watches, weather warnings, and some climatological data.

To help further define and modify a UV forecast, a survey questionnaire could be "sent to telecasters who are holders of the Seal of Approval of a major professional meteorological society," such as the American Meteorological Society or the National Weather Association (Driscoll 37). Ideally, input from those professionals should be similar to input solicited from the NWS professionals

surveyed for this study. The applications of a UV forecast through other dissemination sources such as public television and radio are recommended for additional research.

The NWS should issue a public UV forecast to help reduce the escalating consequences from UV exposure and to make people more informed on actions they can take to reduce adverse effects from sunlight. Because of limited scientific evidence on the prevention of melanoma skin cancer, specific sun protection strategies should be given for nonmelanoma skin cancers. The NWS issuance of a UV forecast along with the most scientifically proven comprehensive sun protection strategies would have much potential for lowering incidence of skin cancer.

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APPENDICES

APPENDIX A

Thesis Survey Questionnaire

THE UNIVERSITY OF TENNESSEE
KNOXVILLE



School of Planning

College of Architecture and Planning
1618 Cumberland Ave.
Knoxville, Tennessee 37996-3300
(615) 974-5227

May 13, 1994

National Weather Service
National Oceanic and Atmospheric Administration
Department of Commerce

Dear National Weather Service Personnel,

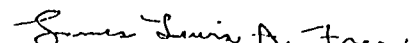
As a graduate student in The School of Planning at The University of Tennessee, I am conducting a survey among all Field Offices of the National Weather Service (NWS) for a thesis project. The purpose of the survey is to collectively evaluate how all NWS Offices in your Region might use an ultraviolet radiation (UV) forecast should one be issued by the National Meteorological Center. Your response will be aggregated with the responses of all other NWS Offices in your Region.

All individual responses will be strictly confidential and only I will see your answers. In addition to aggregating responses for each Region, all of the Regional responses will be summarized collectively. The questionnaire survey conducted for this research project could serve to help establish dissemination policies and procedures that the NWS might use if it decides to implement an ultraviolet radiation forecast.

The NWS's National Meteorological Center (NMC) in Camp Springs, Maryland, has been attempting to develop a product which would inform the public of the current and future ultraviolet conditions at the ground throughout the country. A fundamental goal of a UV forecast would be to help reduce public health risks associated with exposure to UV radiation. In order to prepare for this study, I worked with the NWS in Camp Springs during the summer of 1993.

It is requested that the Meteorologist in Charge, Official in Charge, or the Warning Preparedness Meteorologist complete the questionnaire. Please have the questionnaire completed as soon as possible, and send it to me in the enclosed postage paid envelope. At your request, you will receive a copy of the summarized results for your Region and for all other Regions when the data analysis is complete. Thank you for your time and assistance.

Sincerely,


James Lewis A. Free

NWS Survey Questionnaire

1. Do you have an interest in having a daily forecast of ultraviolet radiation (UV) from the National Meteorological Center (NMC) for the area served by your NWS Office?
☐ Yes ☐ No
2. If made available, what format would you prefer for a daily UV forecast released to your Office by the NMC?
 [CHECK ALL THAT APPLY]
☐ Text ☐ Graphic ☐ Both
3. If your NWS Office were not closing due to modernization or if you are a NEXRAD site, would you like to have UV radiation monitoring equipment?
☐ Yes ☐ No
4. Should a UV forecast be made available, how often would you like to have a UV forecast from the NMC?
☐ Once a week during summer. ☐ Everyday during summer. ☐ Other (please specify):
☐ Twice a week during summer. ☐ Only for days with high exposure to UV. _____
5. If a UV forecast were made available, what time of the day would you like to have a daily UV forecast issued by the NMC? [PLEASE CHECK ALL THAT APPLY]
☐ 12AM-6AM ☐ 12PM-6PM ☐ Other (please specify):
☐ 6AM-12PM ☐ 6PM-12AM _____
6. Should daily UV information be given out by the NMC to the NWS Field Offices for high hazard areas only (locations with high UV exposure)?
☐ Yes ☐ No
7. What type of NMC UV forecast information would be useful to your Office? [PLEASE CHECK ALL THAT APPLY]
☐ Site Specific UV Forecast ☐ State UV Forecast ☐ Regional UV Forecast
8. If a NWS forecast of UV were made available, it would be helpful for which of the following:
 [CHECK ALL THAT APPLY]
☐ Agriculture Industry ☐ Health Organizations
☐ Tourism Industry ☐ Sporting Organizations
☐ Mass News Disseminators ☐ General Public
☐ Local or State Governments ☐ Other (please specify): _____
9. Would your NWS Office disseminate the UV forecast over the NOAA Weather Radio?
☐ Yes ☐ No
10. Please rank how your Office might use a daily UV forecast by allocating 100 points among the suggested ten alternatives: [THE COLUMN TOTAL SHOULD EQUAL 100 POINTS]
☐ 1. Assist with normal forecasting duties.
☐ 2. Supplement a Recreational Forecast.
☐ 3. Supplement an Agricultural Forecast.
☐ 4. Supplement a Zone Forecast Product.
☐ 5. Part of a Traveler's Forecast Product.
☐ 6. Part of a Short Term Forecast Product.
☐ 7. Part of a State Forecast Product.
☐ 8. Part of a Hazardous Weather Forecast Product.
☐ 9. Part of a Public Information Statement.
☐ 10. A Forecast product by itself over NOAA Weather Radio.
☐ _____

100 POINTS

11. Would you be willing to run a NOAA Weather Radio recording designed to inform the public about the UV Forecast and what can be done to reduce the adverse effects from UV radiation?

☐ Yes ☐ No

12. What days would you probably disseminate a UV forecast over the NOAA Weather Radio?
[PLEASE CHECK ALL THAT APPLY]

☐ Monday ☐ Friday ☐ Any day with high a
☐ Tuesday ☐ Saturday ☐ UV exposure.
☐ Wednesday ☐ Sunday ☐ Other (please specify):
☐ Thursday ☐ Every day. _____

13. Approximately what time of day would your Office probably disseminate a UV forecast over the NOAA Weather Radio?
[PLEASE CHECK ALL THAT APPLY]

☐ 12AM-3AM ☐ 12PM-3PM ☐ During actual time of
☐ 3AM-6AM ☐ 3PM-6PM ☐ high exposure.
☐ 6AM-9AM ☐ 6PM-9PM ☐ Other (please specify):
☐ 9AM-12PM ☐ 9PM-12AM _____

14. What kind of UV information would you prefer to disseminate over NOAA Weather Radio?

☐ Quantitative ☐ Qualitative ☐ Both ☐ None

15. In your opinion, the NWS should deliver UV information using the following technologies:
[PLEASE CHECK ALL THAT APPLY]

☐ National Facsimile Network
☐ Family of Services
☐ NOAA Weather Wire Services
☐ NOAA Weather Radio
☐ Multiple-Access Recorded Telephone Announcement Systems

16. Environment Canada's Atmospheric Environment Service issues a daily UV forecast. a) Were you aware that they were issuing a UV product? b) The NWS should issue a UV forecast?

a) ☐ Yes ☐ No b) ☐ Yes ☐ No

17. This questionnaire was completed by:

☐ Meteorologist In Charge ☐ Official In Charge
☐ Warning Preparedness Meteorologist

18. Please indicate in which state your Office is located.

*If you have any comments, please, feel free to offer them here.

THANK YOU VERY MUCH FOR YOUR HELP

APPENDIX B

Examples of Canadian Weather Forecasts with UV Information

Example 1

Forecasts for coastal british columbia issued by the pacific weather Centre of environment Canada at 10 am pdt Monday 23 may 1994 for Today and Tuesday.

The next scheduled forecast will be issued at 3 pm.

Synopsis for coastal bc.

a ridge of high pressure produced clear skies over the lower Mainland and most of vancouver Island last night. Overnight lows Varied greatly..from near 4 in lower inland valleys to 12 near the Water. The north remained cloudy with rain and wind reported over The charlottes and overnight minima near 10.

the ridge of high pressure will continue to dominate the weather Over the extreme south through Tuesday. A frontal system producing Rain over the charlottes will slumps slowly southeastwards and Weaken spreading rain to northern vancouver Island tonight. Showers And much cooler conditions are slated for the south on Wednesday. In The wake of the front showery and cool conditions will prevail over The north.

Freezing level..3000 metres south to 1700 metres north.

U.v. Index for today..moderate ranging from 6.4 in the south to 5.4 in the north.

The index indicates the uv intensity in full sunlight at Midday. Ultraviolet intensities are lower under thick cloud cover. Variable cloudiness still allows full u.v. Exposure during the sunny Periods. U.v. Index values will be higher with increased elevation.

U.v categories	uv index range	average time to burn.
Extreme	9.0 or higher	less than 15 minutes
High	7.0 to 8.9	around 20 minutes
Moderate	4.0 to 6.9	around 30 minutes
Low	less than 4.0	one hour or more.

Example 2

Forecasts for the southwest interior of british columbia issued by
The mountain weather service office of environment Canada in kelowna
At 3 pm pdt Sunday may 22 1994 for tonight Monday and Tuesday.
The next scheduled forecast will be issued at 5 am Monday.

Uv levels: low moderate high extreme
 less than 4.0 4.0 to 6.9 7.0 to 8.9 9.0 +

Freezing level..near 2400 metres.

Okanagan valley district.

Tonight..a few clouds. Patchy ground frost in low lying areas.

Monday..sunny with afternoon cloudy periods.

Tuesday..a mix of sun and cloud. Isolated afternoon showers.

Location	tonight		Monday			Tuesday		
	low	pop	hi	pop	uv	low	hi	pop
Vernon	6	20	21	20	6.1	6	23	30
Kelowna	4	20	22	20	6.2	5	24	30
Summerland	5	20	21	20	6.2	6	23	20
Penticton	4	20	23	20	6.2	5	25	20
Osoyoos	6	20	24	20	6.2	7	26	20

Example 3

Forecasts for the northwest territories issued by the arctic weather
Centre of environment Canada at 3.45 pm mdt Sunday 22 may 1994 for
Tonight Monday and Tuesday.
The next scheduled forecast will be issued at 3.45 am mdt Monday.

Uv index under bright sunshine for Monday is 4 and corresponds to the
Moderate category.

Sun tip.. Eyes do not develop a tolerance to the sun.
Wear sunglasses that screen out uv rays.

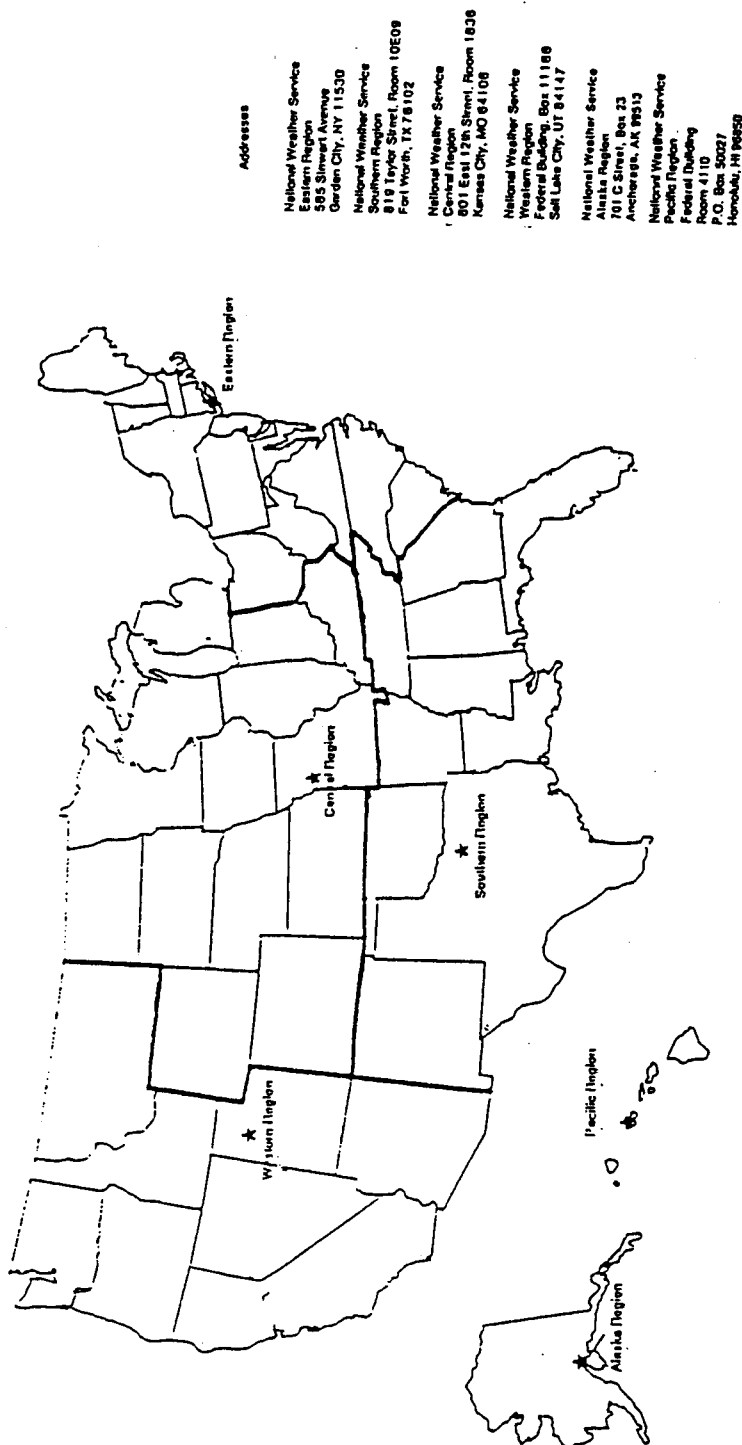
North great slave.

Tonight..clear. Lows near 5.

Monday and Tuesday..sunny. Winds southeast 20 km/h and gusty in the
afternoon. Highs both days near 16 except a little cooler near the
lake. Lows Monday night near 5.

APPENDIX C

Figure of NWS Regions



Source: Adapted from "United States. Department of Commerce. National Oceanic and Atmospheric Administration. *Operations of the National Weather Service*. Washington, D.C.: GPO, 1985.

APPENDIX D

City and State Locations of NWS Field Offices by Region as Identified by the National Weather Service Office of Public Affairs

NWS Eastern Region

Connecticut

Stratford ^
Windsor Locks

Delaware

New Castle

Maine

Caribou
Portland *

Maryland

Baltimore

Massachusetts

East Boston *
Taunton ^
Worcester

New Hampshire

Concord

New Jersey

Atlantic City
Mt. Holly *
Newark ^

New York

Albany
Buffalo *
Johnson City
New York City
North Syracuse
Rochester

North Carolina

Buxton
Charlotte
Fletcher
Greensboro
Raleigh *
Wilmington

Ohio

Cincinnati
Cleveland *
Columbus
North Canton
Swanton
Vandalia

Pennsylvania

Allentown
Avoca
Corapolis *
Erie
Harrisburg
Montoursville
State College

Rhode Island

Warwick

South Carolina

North Charleston
West Columbia *

Vermont

South Burlington

Virginia

Lynchburg
Norfolk
Roanoke
Sandston
Sterling *

West Virginia

Beaver
Charleston *
Elkins
Huntington

Notes: (1) ^ Denotes an Office without NOAA Weather Radio transmitting capabilities.
(2) * Denotes a NWS Forecast Office. An Office not starred is a NWS Office.

NWS Southern Region

Alabama

Birmingham *
Huntsville
Mobile
Montgomery

Arkansas

Fort Smith
North Little Rock *

Florida

Apalachicola ^
Coral Gables *
Dayton Beach
Jacksonville
Key West
Orlando ^
Pensacola
Ruskin
Tallahassee
West Palm Beach

Georgia

Atlanta *
Augusta
Columbus
Macon
Savannah

Louisiana

Baton Rouge
Lake Charles
Shreveport
Slidell *

Mississippi

Jackson *
Meridian
Tupelo

New Mexico

Albuquerque *
Roswell ^

Oklahoma

Norman *

Puerto Rico

San Juan *

Tennessee

Blountsville
Chattanooga
Louisville
Memphis *
Old Hickory

Texas

Amarillo
Austin
Beaumont
Brownsville
Corpus Christi
Dickinson
El Paso
Fort Worth *
Houston
Lubbock *
Midland
San Antonio *
Victoria
Waco
Wichita Falls

Notes: (1) ^ Denotes an Office without NOAA Weather Radio transmitting capabilities.
(2) * Denotes a NWS Forecast Office. An Office not starred is a NWS Office.

NWS Central Region

Colorado

Alamosa
Colorado Springs
Denver *
Grand Junction
Pueblo

Illinois

Milan
Peoria
Rockford
Rosemont
Springfield

Indiana

Evansville
South Bend

Iowa

Des Moines *
Dubuque
Sioux City
Waterloo

Kansas

Concordia
Dodge City
Goodland
Topeka *
Wichita

Kentucky

Jackson
Lexington
Louisville *
West Paducah

Michigan

Alpena
Detroit
Flint
Grand Rapids
Houghton Lake ^
Lansing
Negaunee
Muskegon
Sault Ste. Marie

Minnesota

Duluth
International Falls
Minneapolis *
Rochester
St. Cloud

Missouri

Kansas City
Springfield

Nebraska

Lincoln
Norfolk
North Platte
Omaha *

North Dakota

Bismarck *
Fargo
Williston

South Dakota

Aberdeen
Huron
Rapid City
Sioux Falls *

Wisconsin

Green Bay
La Crosse
Madison
Milwaukee

Wyoming

Casper
Cheyenne *
Lander
Sheridan

Notes: (1) ^ Denotes an Office without NOAA Weather Radio transmitting capabilities.
(2) * Denotes a NWS Forecast Office. An Office not starred is a NWS Office.

NWS Western Region

Arizona

Flagstaff
Yuma ^

Nevada

Las Vegas
Reno *

California

Bakersfield
Bishop ^
Clovis
Eureka
Los Angeles *
Redding ^
San Diego
Santa Maria ^
Stockton ^

Oregon

Klamath Falls ^
Medford
Pendleton
Portland *
Warrenton

Utah

Salt Lake City *

Idaho

Boise *
Pocatello

Washington

Olympia
Seattle *
Spokane
Wenatchee

Montana

Great Falls *
Helena
Missoula

NWS Alaska Region

Alaska

Anchorage *
Barrow ^
Cold Bay ^
Fairbanks *
Homer ^
Juneau *
King Salmon ^
Kodiak

Alaska (continued)

Kotzebue ^
McGrath ^
Nome
St. Paul Island ^
Unalakleet ^
Valdez
Yakutat

NWS Pacific Region

Pacific Islands

Chuuk ^
Koror ^
Majuro ^
Pago Pago ^
Pohnpei ^
Wake Island ^
Yap ^

Hawaii

Hilo
Honolulu *
Kahului ^
Lihue ^

Notes: (1) ^ Denotes an Office without NOAA Weather Radio transmitting capabilities.
(2) * Denotes a NWS Forecast Office. An Office not starred is a NWS Office.

APPENDIX E

Data Analysis Tables

Table E-1: Distribution of National Weather Service Field Offices among NWS Regions.

NWS Region	Weather Service Forecast Office	Weather Service Office	Total
Eastern Region			
possible number of Office participants	11	40	51
percent of All Regions total number	25%	23%	24%
Southern Region			
possible number of Office participants	13	39	52
percent of All Regions total number	30%	23%	24%
Central Region			
possible number of Office participants	9	51	60
percent of All Regions total number	20%	30%	28%
Western Region			
possible number of Office participants	7	21	28
percent of All Regions total number	16%	12%	13%
Alaska Region			
possible number of Office participants	3	12	15
percent of All Regions total number	7%	7%	7%
Pacific Region			
possible number of Office participants	1	10	11
percent of All Regions total number	2%	6%	5%
All Regions			
possible number of Office participants	44	173	217
percent of All Regions total number	100%	100%	100%

Note: The 'possible number of Office participants' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs.

Table E-2: NWS Field Offices Interested in Having a Daily UV Forecast from the National Meteorological Center (Survey Question 1).

NWS Region	Yes	No	Total
Eastern Region			
number of responses	25	11	36
possible number of responses	51	51	51
response rate	49%	22%	71%
Southern Region			
number of responses	28	7	35
possible number of responses	52	52	52
response rate	54%	13%	67%
Central Region			
number of responses	38	6	44
possible number of responses	60	60	60
response rate	63%	10%	73%
Western Region			
number of responses	13	4	17
possible number of responses	28	28	28
response rate	46%	14%	61%
Alaska Region			
number of responses	3	6	9
possible number of responses	15	15	15
response rate	20%	40%	60%
Pacific Region			
number of responses	3	1	4
possible number of responses	11	11	11
response rate	27%	9%	36%
All Regions			
number of responses	110	35	145
possible number of responses	217	217	217
response rate	51%	16%	67%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
(2) The level of confidence for the 'All Regions' 'response rate' exceeds 96%.

Table E-2.1: Comparisons of WSFOs' and WSOs' Responses to Selected Survey Questions
(Survey Questions 1 and 16B).

NWS Office Type	Yes	No	Total
Interested in Having a UV Forecast			
Weather Service Forecast Offices			
number of responses	32	5	37
possible number of responses	44	44	44
response rate	73%	11%	84%
Weather Service Offices			
number of responses	78	30	108
possible number of responses	173	173	173
response rate	45%	17%	62%
Total for All Office Types			
number of responses	110	35	145
possible number of responses	217	217	217
response rate	51%	16%	67%
NWS Should Have a UV Forecast			
Weather Service Forecast Offices			
number of responses	27	6	33
possible number of responses	44	44	44
response rate	61%	14%	75%
Weather Service Offices			
number of responses	83	19	102
possible number of responses	173	173	173
response rate	48%	11%	59%
Total for All Office Types			
number of responses	110	25	135
possible number of responses	217	217	217
response rate	51%	12%	62%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
(2) The level of confidence for the All Offices' 'response rate' exceeds 96% for the Survey Variable - 'Interest in a UV Forecast.' The level of confidence for the All Offices' response rate for the survey variable '[Whether the] NWS Should Have a UV Forecast' exceeds 94%.

Table E-3: Field Offices' Opinions as to Whether the NWS Should Issue a UV Forecast (Survey Question 16B).

NWS Region	Yes	No	Other Responses	Total
Eastern Region				
number of responses	26	10	-	36
possible number of responses	51	51		51
response rate	51%	20%		71%
Southern Region				
number of responses	24	9	1	34
possible number of responses	52	52	52	52
response rate	46%	17%	2%	65%
Central Region				
number of responses	38	2	2	42
possible number of responses	60	60	60	60
response rate	63%	3%	3%	70%
Western Region				
number of responses	12	3	1	16
possible number of responses	28	28	28	28
response rate	43%	11%	4%	57%
Alaska Region				
number of responses	6	1	-	7
possible number of responses	15	15		15
response rate	40%	7%		47%
Pacific Region				
number of responses	4	-	-	4
possible number of responses	11			11
response rate	36%			36%
All Regions				
number of responses	110	25	4	139
possible number of responses	217	217	217	217
response rate	51%	12%	2%	64%

- Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
- (2) 'Other Responses' include "possibly, but at the National level only," "need more information about product," "only if it were proven to be reliable," and "undecided."
- (3) The level of confidence for the 'All Regions' 'response rate' exceeds 95%.

Table E-4: Each NWS Field Office's Allocation of 100 Points among Possible Alternative Uses of a Daily UV Forecast (Raw Scores) (Survey Question 10).

NWS Region	Assist with Normal Forecasting Duties	Supplement a Recreational Fcst.	Supplement an Agricultural Fcst.	Supplement a Zone Fcst. Product	Part of a Traveler's Forecast Product	Part of a Short Term Fcst. Product
Eastern Region						
number of allocated points	64	746	313	153	98	240
percent of total allocated points	2%	23%	9%	5%	3%	7%
[Region's response rate 65%]						
Southern Region						
number of allocated points	127	449	360	180	145	300
percent of total allocated points	4%	14%	11%	5%	4%	9%
[Region's response rate 64%]						
Central Region						
number of allocated points	96	724	418	355	156	497
percent of total allocated points	2%	16%	10%	8%	4%	11%
[Region's response rate 73%]						
Western Region						
number of allocated points	143	350	65	50	57	40
percent of total allocated points	10%	23%	4%	3%	4%	3%
[Region's response rate 54%]						
Alaska Region						
number of allocated points	50	170	100	20	-	300
percent of total allocated points	6%	21%	12%	2%	-	38%
[Region's response rate 53%]						
Pacific Region						
number of allocated points	-	-	15	75	-	25
percent of total allocated points			5%	25%		8%
[Region's response rate 20%]						
All Regions						
number of allocated points	480	2439	1271	833	456	1402
percent of total allocated points	4%	18%	9%	6%	3%	10%
[Regions' response rate 63%]						

Notes: (1) The 'Region's response rate' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs divided into the total number of Offices which responded to survey question ten and multiplied by one hundred. Survey questionnaires were mailed to all NWS Field Offices.
(2) The level of confidence for the 'All Regions' 'response rate' exceeds 94%.

Table E-4: (cont.)

NWS Region	Part of a State Forecast Product	Part of a Hazardous Weather Fcst. Product	Part of a Public Information Statement	A Fcst. Product by Itself over NOAA Weather Radio	Total Number of Allocated Points
Eastern Region number of allocated points percent of total allocated points [Region's response rate 65%]	112 4%	256 7%	537 16%	781 24%	3300 100%
Southern Region number of allocated points percent of total allocated points [Region's response rate 64%]	152 5%	159 5%	822 25%	606 18%	3300 100%
Central Region number of allocated points percent of total allocated points [Region's response rate 73%]	203 5%	195 4%	909 21%	847 19%	4400 100%
Western Region number of allocated points percent of total allocated points [Region's response rate 54%]	20 1%	80 5%	260 17%	435 29%	1500 100%
Alaska Region number of allocated points percent of total allocated points [Region's response rate 53%]	-	20 3%	140 18%	-	800 100%
Pacific Region number of allocated points percent of total allocated points [Region's response rate 20%]	10 3%	-	-	175 58%	300 100%
All Regions number of allocated points percent of total allocated points [Regions' response rate 63%]	497 4%	710 5%	2668 20%	2844 21%	13600 100%

Notes: (1) The 'Region's response rate' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs divided into the total number of Offices which responded to survey question ten and multiplied by one hundred. Survey questionnaires were mailed to all NWS Field Offices.

(2) The level of confidence for the 'All Regions' 'response rate' exceeds 94%.

Table E-4.1: WSFOs' Versus WSOs' Allocation of 100 Points among Possible Alternative Uses of a Daily UV Forecast (Raw Scores for Offices in All Regions) (Survey Question 10).

NWS Office Type	Assist with Normal Forecasting Duties	Supplement a Recreational Fcst.	Supplement an Agricultural Fcst.	Supplement a Zone Fcst. Product	Part of a Traveler's Forecast Product	Part of a Short Term Fcst. Product
Weather Service Forecast Offices number of allocated points percent of total allocated points [WSFOs' response rate 80%]	72 2%	583 17%	278 8%	305 9%	85 2%	391 11%
Weather Service Offices number of allocated points percent of total allocated points [WSOs' response rate 58%]	408 4%	1856 18%	993 10%	528 5%	371 4%	1011 10%
Total for All Office Types number of allocated points percent of total allocated points [All Offices' response rate 63%]	480 4%	2439 18%	1271 9%	833 6%	456 3%	1402 10%

Notes: (1) The WSFOs' and WSOs' response rate equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs divided into the total number of Offices which responded to survey question ten and multiplied by one hundred. Survey questionnaires were mailed to all NWS Field Offices.
(2) The level of confidence for the All Offices' 'response rate' exceeds 94%.

Table E-4.1: (cont.)

NWS Office Type	Part of a State Forecast Product	Part of a Hazardous Weather Fcst. Product	Part of a Public Information Statement	A Fcst. Product by itself over NOAA Weather Radio	Total Number of Allocated Points
Weather Service Forecast Offices number of allocated points percent of total allocated points [WSFOs' response rate 80%]	128 4%	154 4%	738 21%	767 22%	3500 100%
Weather Service Offices number of allocated points percent of total allocated points [WSOs' response rate 58%]	369 4%	556 6%	1930 19%	2077 21%	10100 100%
Total for All Office Types number of allocated points percent of total allocated points [All Offices' response rate 63%]	497 4%	710 5%	2668 20%	2844 21%	13600 100%

Notes: (1) The 'Region's response rate' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs divided into the total number of Offices which responded to survey question ten and multiplied by one hundred. Survey questionnaires were mailed to all NWS Field Offices.

(2) The level of confidence for the 'All Offices' response rate exceeds 94%.

Table E-4.2: Frequency in Which Ranges of Scores Were Allocated for Possible Uses of a Daily UV Forecast by NWS Field Offices in All NWS Regions (Survey Question 10).

Possible Uses	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	Total Points Allocated for UV Fcst. Use	Total Number of Offices Allocating Any Points to Fcst. Use
Assist with Normal Forecasting Duties	26	7	-	-	2	-	-	-	-	1	480	36
Supplement a Recreational Fcst.	17	15	20	6	9	2	1	6	-	1	2439	77
Supplement an Agricultural Fcst.	24	12	10	1	2	-	-	1	1	2	1271	53
Supplement a Zone Forecast Product	24	10	8	-	3	-	-	-	1	-	833	46
Part of a Traveler's Forecast Product	21	7	5	-	1	-	-	-	-	-	456	34
Part of a Short Term Forecast Product	26	18	8	3	4	2	-	-	-	2	1402	63
Part of a State Forecast Product	25	6	2	2	2	-	-	-	-	-	497	37
Part of Hazardous Weather Forecast Product	21	10	3	1	3	-	-	1	-	-	710	39
Part of a Public Information Statement	26	23	17	3	8	2	1	1	2	5	2668	88
A Forecast Product by Itself over NOAA Weather Radio	21	20	11	5	10	2	-	3	4	6	2844	82
Total Number of Range Selections for All Forecast Uses	231	128	84	21	44	8	2	12	8	17	13600	555

Note: The response rate for 'NWS Field Offices in All NWS Regions' to question ten was 63%. Therefore, the level of confidence is in excess of 94%.

Table E-4.3: Frequency in Which Ranges of Scores Were Allocated for Possible Uses of a Daily UV Forecast by NWS Field Offices in the NWS Eastern Region (Survey Question 10).

Possible Uses	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	Total Points Allocated for UV Fcst. Use	Total Number of Offices Allocating Any Points to Fcst. Use
Assist with Normal Forecasting Duties	4	3	-	-	-	-	-	-	-	-	64	7
Supplement a Recreational Fcst.	4	3	6	2	4	1	-	2	-	-	746	22
Supplement an Agricultural Fcst.	8	4	3	1	1	-	-	-	-	-	313	17
Supplement a Zone Forecast Product	7	4	1	-	-	-	-	-	-	-	153	12
Part of a Traveler's Forecast Product	4	1	2	-	-	-	-	-	-	-	98	7
Part of a Short Term Forecast Product	12	5	-	1	-	-	-	-	-	-	240	18
Part of a State Forecast Product	5	2	-	1	-	-	-	-	-	-	112	8
Part of Hazardous Weather Forecast Product	8	4	1	-	2	-	-	-	-	-	256	15
Part of a Public Information Statement	6	8	5	-	-	-	-	-	-	2	537	21
A Forecast Product by Itself over NOAA Weather Radio	3	8	3	2	1	2	-	2	-	2	781	23
Total Number of Range Selections for All Forecast Uses	61	42	21	7	8	3	-	2	-	4	3300	150

Note: The response rate for 'NWS Field Offices in the NWS Eastern Region' to question ten was 65%.

Table E-4.4: Frequency in Which Ranges of Scores Were Allocated for Possible Uses of a Daily UV Forecast by NWS Field Offices in the NWS Southern Region (Survey Question 10).

Possible Uses	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	Total Points Allocated for UV Fcst. Use	Total Number of Offices Allocating Any Points to Fcst. Use
Assist with Normal Forecasting Duties	7	2	-	-	1	-	-	-	-	-	127	10
Supplement a Recreational Fcst.	6	3	3	3	-	-	1	1	-	-	449	17
Supplement an Agricultural Fcst.	6	-	3	-	1	-	-	1	-	1	360	12
Supplement a Zone Forecast Product	5	2	1	-	-	-	-	-	1	-	180	9
Part of a Traveler's Forecast Product	6	4	1	-	-	-	-	-	-	-	145	11
Part of a Short Term Forecast Product	6	2	2	-	-	1	2	-	-	-	300	13
Part of a State Forecast Product	6	2	-	1	1	-	-	-	-	-	152	10
Part of Hazardous Weather Forecast Product	4	3	1	1	-	-	-	-	-	-	159	9
Part of a Public Information Statement	9	4	3	3	3	1	-	1	-	2	822	26
A Forecast Product by Itself over NOAA Weather Radio	4	8	2	1	3	-	-	1	-	1	606	20
Total Number of Range Selections for All Forecast Uses	59	30	16	9	10	3	1	4	1	4	3300	137

Note: The response rate for 'NWS Field Offices in the NWS Southern Region' to question ten was 64%.

Table E-4.5: Frequency in Which Ranges of Scores Were Allocated for Possible Uses of a Daily UV Forecast by NWS Field Offices in the NWS Central Region (Survey Question 10).

Possible Uses	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	Total Points Allocated for UV Fcst. Use	Total Number of Offices Allocating Any Points to Fcst. Use
Assist with Normal Forecasting Duties	14	-	-	-	-	-	-	-	-	-	96	14
Supplement a Recreational Fcst.	5	8	9	-	3	1	-	1	-	-	724	27
Supplement an Agricultural Fcst.	9	6	4	-	1	-	-	-	1	-	418	21
Supplement a Zone Forecast Product	10	3	5	-	2	-	-	-	-	-	355	20
Part of a Traveler's Forecast Product	8	2	1	-	1	-	-	-	-	-	156	12
Part of a Short Term Forecast Product	6	9	4	2	2	-	-	-	-	-	497	23
Part of a State Forecast Product	11	2	2	-	1	-	-	-	-	-	203	16
Part of Hazardous Weather Forecast Product	9	2	-	-	2	-	-	-	-	-	195	13
Part of a Public Information Statement	10	7	7	-	4	1	1	-	1	1	909	32
A Forecast Product by Itself over NOAA Weather Radio	11	4	4	1	4	1	-	-	3	-	847	28
Total Number of Range Selections for All Forecast Uses	93	43	36	3	13	3	1	1	5	1	4400	206

Note: The response rate for 'NWS Field Offices in the NWS Central Region' to question ten was 73%.

Table E-4.6: Frequency in Which Ranges of Scores Were Allocated for Possible Uses of a Daily UV Forecast by NWS Field Offices in the NWS Western Region (Survey Question 10).

Possible Uses	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	Total Points Allocated for UV Fcst. Use	Total Number of Offices Allocating Any Points to Fcst. Use
Assist with Normal Forecasting Duties	1	2	-	-	-	-	-	-	-	1	143	4
Supplement a Recreational Fcst.	2	1	2	1	1	-	-	2	-	-	350	9
Supplement an Agricultural Fcst.	1	3	-	-	-	-	-	-	-	-	65	4
Supplement a Zone Forecast Product	3	1	-	-	-	-	-	-	-	-	50	4
Part of a Traveler's Forecast Product	3	-	1	-	-	-	-	-	-	-	57	4
Part of a Short Term Forecast Product	2	1	-	-	-	-	-	-	-	-	40	3
Part of a State Forecast Product	2	-	-	-	-	-	-	-	-	-	20	2
Part of Hazardous Weather Forecast Product	-	-	-	-	-	-	-	1	-	-	80	1
Part of a Public Information Statement	1	3	2	-	1	-	-	-	1	-	260	8
A Forecast Product by Itself over NOAA Weather Radio	3	-	1	1	1	-	-	-	1	2	435	9
Total Number of Range Selections for All Forecast Uses	18	11	6	2	3	-	-	3	2	3	1500	48

Note: The response rate for 'NWS Field Offices in the NWS Western Region' to question ten was 54%.

Table E-4.7: Frequency in Which Ranges of Scores Were Allocated for Possible Uses of a Daily UV Forecast by NWS Field Offices in the NWS Alaska Region (Survey Question 10).

Possible Uses	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	Total Points Allocated for UV Fcst. Use	Total Number of Offices Allocating Any Points to Fcst. Use
Assist with Normal Forecasting Duties	-	-	-	-	1	-	-	-	-	-	50	1
Supplement a Recreational Fcst.	-	1	-	-	1	-	-	-	-	1	170	3
Supplement an Agricultural Fcst.	-	-	-	-	-	-	-	-	-	1	100	1
Supplement a Zone Forecast Product	-	1	-	-	-	-	-	-	-	-	20	1
Part of a Traveler's Forecast Product	-	-	-	-	-	-	-	-	-	-	-	-
Part of a Short Term Forecast Product	-	1	1	-	1	-	-	-	-	2	300	5
Part of a State Forecast Product	-	-	-	-	-	-	-	-	-	-	-	-
Part of Hazardous Weather Forecast Product	-	1	-	-	-	-	-	-	-	-	20	1
Part of a Public Information Statement	-	2	-	-	-	-	-	-	-	1	140	3
A Forecast Product by itself over NOAA Weather Radio	-	-	-	-	-	-	-	-	-	-	-	-
Total Number of Range Selections for All Forecast Uses	-	6	1	-	3	-	-	-	-	5	800	15

Note: The response rate for 'NWS Field Offices in the NWS Alaska Region' to question ten was 53%.

Table E-4.8: Frequency in Which Ranges of Scores Were Allocated for Possible Uses of a Daily UV Forecast by NWS Field Offices in the NWS Pacific Region (Survey Question 10).

Possible Uses	0 - 10	11 - 20	21 - 30	31 - 40	41 - 50	51 - 60	61 - 70	71 - 80	81 - 90	91 - 100	Total Points Allocated for UV Fcst. Use	Total Number of Offices Allocating Any Points to Fcst. Use
Assist with Normal Forecasting Duties	-	-	-	-	-	-	-	-	-	-	-	-
Supplement a Recreational Fcst.	-	-	-	-	-	-	-	-	-	-	-	-
Supplement an Agricultural Fcst.	-	1	-	-	-	-	-	-	-	-	15	1
Supplement a Zone Forecast Product	-	-	1	-	1	-	-	-	-	-	75	2
Part of a Traveler's Forecast Product	-	-	-	-	-	-	-	-	-	-	-	-
Part of a Short Term Forecast Product	-	-	1	-	-	-	-	-	-	-	25	1
Part of a State Forecast Product	1	-	-	-	-	-	-	-	-	-	10	1
Part of Hazardous Weather Forecast Product	-	-	-	-	-	-	-	-	-	-	-	-
Part of a Public Information Statement	-	-	-	-	-	-	-	-	-	-	-	-
A Forecast Product by Itself over NOAA Weather Radio	-	-	1	-	1	-	-	-	-	1	175	3
Total Number of Range Selections for All Forecast Uses	1	1	3	-	2	-	-	-	-	1	300	8

Note: The response rate for 'NWS Field Offices in the NWS Pacific Region' to question ten was 28%.

Table E-5: Opinions of NWS Field Offices As to What Communication Technologies the NWS Should Use to Disseminate a UV Forecast (Survey Question 15).

NWS Region	National Facsimile Network	Family of Services	NOAA Weather Wire Services	NOAA Weather Radio	Multiple-Access Recorded Phone Systems	Total Number of Offices Responding To Survey Question
Eastern Region						
number of responses	9	26	21	24	6	33
possible number of responses	51	51	51	51	51	51
response rate	18%	51%	41%	47%	12%	65%
Southern Region						
number of responses	4	21	31	27	7	35
possible number of responses	52	52	52	52	52	52
response rate	8%	40%	60%	52%	13%	67%
Central Region						
number of responses	13	32	37	39	10	44
possible number of responses	60	60	60	60	60	60
response rate	22%	53%	62%	65%	17%	73%
Western Region						
number of responses	7	11	13	12	5	14
possible number of responses	28	28	28	28	28	28
response rate	25%	39%	46%	43%	18%	50%
Alaska Region						
number of responses	1	4	6	3	2	8
possible number of responses	15	15	15	15	15	15
response rate	7%	27%	40%	20%	13%	53%
Pacific Region						
number of responses	1	2	3	3	2	4
possible number of responses	11	11	11	11	11	11
response rate	9%	18%	27%	27%	18%	36%
All Regions						
number of responses	35	96	111	108	32	138
possible number of responses	217	217	217	217	217	217
response rate	16%	44%	51%	50%	15%	64%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices. (2) The level of confidence for the All Regions' 'response rate' exceeds 94%.
(3) Respondents were instructed to indicate all preferred communication technologies for forecast dissemination.

Table E-5.1: Opinions of NWS WSFOs' Versus WSO's As to What Communication Technologies the NWS Should Use to Disseminate a UV Forecast (Survey Question 15).

NWS Office Type	National Facsimile Network	Family of Services	NOAA Weather Wire Services	NOAA Weather Radio	Multiple-Access Recorded Phone Systems	Total Number of Offices Responding To Survey Question
Weather Service Forecast Offices						
number of responses	9	27	30	26	5	33
possible number of responses	44	44	44	44	44	44
response rate	20%	61%	68%	59%	11%	75%
Weather Service Offices						
number of responses	26	69	81	82	27	105
possible number of responses	173	173	173	173	173	173
response rate	15%	40%	47%	47%	16%	61%
Total for All Office Types						
number of responses	35	96	111	108	32	138
possible number of responses	217	217	217	217	217	217
response rate	16%	44%	51%	50%	15%	64%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices. (2) The level of confidence for the All Offices' 'response rate' exceeds 94%.
(3) Respondents were instructed to indicate all preferred communication technologies for forecast dissemination.

Table E-6: Preferred Format among NWS Field Offices for a Daily UV Forecast If One Were Released by the National Meteorological Center (Survey Question 2).

NWS Region	Text	Graphic	Both	Total
Eastern Region				
number of responses	3	8	23	34
possible number of responses	51	51	51	51
response rate	6%	16%	45%	67%
Southern Region				
number of responses	7	6	20	33
possible number of responses	52	52	52	52
response rate	13%	12%	38%	63%
Central Region				
number of responses	6	10	28	44
possible number of responses	60	60	60	60
response rate	10%	17%	47%	73%
Western Region				
number of responses	3	7	6	16
possible number of responses	28	28	28	28
response rate	11%	25%	21%	57%
Alaska Region				
number of responses	3	2	2	7
possible number of responses	15	15	15	15
response rate	20%	13%	13%	47%
Pacific Region				
number of responses	2	-	2	4
possible number of responses	11		11	11
response rate	18%		18%	36%
All Regions				
number of responses	24	33	81	138
possible number of responses	217	217	217	217
response rate	11%	15%	37%	64%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.

(2) The level of confidence for the 'All Regions' 'response rate' exceeds 94%.

Table E-7: NWS Field Offices Indicating the Types of NMC UV Forecast That Would Be Useful for the Area Served by Their Office, Should One Be Made Available (Survey Question 7).

NWS Region	Site Specific UV Forecast	State UV Forecast	Regional UV Forecast	Total Number of Offices Responding to Survey Question
Eastern Region				
number of responses	18	13	10	33
possible number of responses	51	51	51	51
response rate	35%	25%	20%	65%
Southern Region				
number of responses	17	14	13	33
possible number of responses	52	52	52	52
response rate	33%	27%	25%	63%
Central Region				
number of responses	21	31	11	44
possible number of responses	60	60	60	60
response rate	35%	52%	18%	73%
Western Region				
number of responses	12	9	2	14
possible number of responses	28	28	28	28
response rate	43%	32%	7%	50%
Alaska Region				
number of responses	4	2	3	8
possible number of responses	15	15	15	15
response rate	27%	13%	20%	53%
Pacific Region				
number of responses	2	2	-	4
possible number of responses	11	11	-	11
response rate	18%	18%	-	36%
All Regions				
number of responses	74	71	39	136
possible number of responses	217	217	217	217
response rate	34%	33%	18%	63%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.

(2) Respondents were instructed to indicate all preferred forecast types.

(3) The level of confidence for the 'All Regions' 'response rate' exceeds 94%.

Table E-8: NWS Field Offices Which Indicate That the National Meteorological Center Should Give Them Daily UV Forecasts for High Hazard Areas Only (Survey Question 6).

NWS Region	Yes	No	Total
Eastern Region			
number of responses	10	24	34
possible number of responses	51	51	51
response rate	20%	47%	67%
Southern Region			
number of responses	14	21	35
possible number of responses	52	52	52
response rate	27%	40%	67%
Central Region			
number of responses	15	28	43
possible number of responses	60	60	60
response rate	25%	47%	72%
Western Region			
number of responses			
possible number of responses	7	9	16
response rate	28	28	28
	25%	32%	57%
Alaska Region			
number of responses	4	4	8
possible number of responses	15	15	15
response rate	27%	27%	53%
Pacific Region			
number of responses	3	1	4
possible number of responses	11	11	11
response rate	27%	9%	36%
All Regions			
number of responses	53	87	140
possible number of responses	217	217	217
response rate	24%	40%	65%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
(2) The level of confidence for the 'All Regions' 'response rate' exceeds 95%.

Table E-9: Days in Which NWS Field Offices Would Like to Have a UV Forecast Issued to Them by the NMC, if One Were Released (Survey Question 4).

NWS Region	Once a Week in Summer	Twice a Week in Summer	Daily in the Summer	Days with a High UV Exposure	Daily Year-Round	Other Responses	Total
Eastern Region							
number of responses	2	3	19	6	1	2	33
possible number of responses	51	51	51	51	51	51	51
response rate	4%	6%	37%	12%	2%	4%	65%
Southern Region							
number of responses	1	3	21	8	2	1	36
possible number of responses	52	52	52	52	52	52	52
response rate	2%	6%	40%	15%	4%	2%	69%
Central Region							
number of responses	2	3	24	10	3	2	44
possible number of responses	60	60	60	60	60	60	60
response rate	3%	5%	40%	17%	5%	3%	73%
Western Region							
number of responses	-	-	7	5	1	3	16
possible number of responses	-	-	28	28	28	28	28
response rate	-	-	25%	18%	4%	11%	57%
Alaska Region							
number of responses	-	3	1	1	3	-	8
possible number of responses	-	15	15	15	15	-	15
response rate	-	20%	7%	7%	20%	-	53%
Pacific Region							
number of responses	2	1	-	-	1	-	4
possible number of responses	11	11	-	-	11	-	11
response rate	18%	9%	-	-	9%	-	36%
All Regions							
number of responses	7	13	72	30	11	8	141
possible number of responses	217	217	217	217	217	217	217
response rate	3%	6%	33%	14%	5%	4%	65%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices. (2) The level of confidence for the 'All Regions' response rate exceeds 95%.

(3) 'Other Responses' include "Monday-Wednesday-Friday," "twice a week yearly," "every week year-round," "weekly year-round," "everyday April through September," "everyday during tourist season," "not sure of a useful frequency," and "none."

Table E-10: The Times of Day in Which NWS Field Offices Would Like to Have a UV Forecast Issued by the NMC, if One Were Released (Survey Question 5).

NWS Region	12:00 AM to 6:00 AM		6:00 AM to 12:00 PM		12:00 PM to 6:00 PM		6:00 PM to 12:00 AM		No Time of Day	Total Number of Offices Responding to Survey Question
	number of responses	possible number of responses	number of responses	possible number of responses	number of responses	possible number of responses	number of responses	possible number of responses		
Eastern Region										
number of responses	25	51	7	51	5	51	3	51	-	33
possible number of responses	51	51	51	51	10%	10%	6%	6%		51
response rate	49%		14%							65%
Southern Region										
number of responses	21	52	10	52	4	52	3	52	-	34
possible number of responses	52	52	19%	8%	8%	6%	6%	6%		52
response rate	40%									65%
Central Region										
number of responses	34	60	10	60	4	60	2	60	-	44
possible number of responses	60	60	17%	7%	7%	3%	3%	3%		60
response rate	57%									73%
Western Region										
number of responses	12	28	1	28	1	28	1	28	1	15
possible number of responses	28	28	4%	4%	4%	4%	4%	4%	28	28
response rate	43%								4%	54%
Alaska Region										
number of responses	4	15	4	15	3	15	1	15	-	8
possible number of responses	15	15	27%	20%	20%	7%	7%	7%		15
response rate	27%									53%
Pacific Region										
number of responses	2	11	2	11	-	-	-	-	-	4
possible number of responses	11	11	18%	18%						11
response rate	18%									36%
All Regions										
number of responses	98	217	34	217	17	217	10	217	1	138
possible number of responses	217	217	16%	8%	8%	5%	5%	5%	217	217
response rate	45%								.5%	64%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices. (2) The level of confidence for the 'All Regions' 'response rate' exceeds 94%.
(3) Respondents were instructed to indicate all preferred forecast issuing times.

Table E-11: NWS Field Offices Which Would Disseminate a UV Forecast Over the NOAA Weather Radio, Should a UV Forecast Be Made Available by the National Meteorological Center (Survey Question 9).

NWS Region	Yes	No	Office without NOAA Radio	Total
Eastern Region				
number of responses	28	6	1	35
possible number of responses	48	48	3	51
response rate	58%	13%	33%	69%
Southern Region				
number of responses	29	3	3	35
possible number of responses	49	49	3	52
response rate	59%	6%	100%	67%
Central Region				
number of responses	40	2	1	43
possible number of responses	59	59	1	60
response rate	68%	3%	100%	72%
Western Region				
number of responses	11	2	2	15
possible number of responses	21	21	7	28
response rate	52%	10%	29%	54%
Alaska Region				
number of responses	2	2	3	7
possible number of responses	7	7	8	15
response rate	29%	29%	38%	47%
Pacific Region				
number of responses	2	1	1	4
possible number of responses	3	3	8	11
response rate	67%	33%	13%	36%
All Regions				
number of responses	112	16	11	139
possible number of responses	187	187	30	217
response rate	60%	9%	37%	64%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.

(2) The level of confidence for the 'All Regions' 'response rate' exceeds 95%.

Table E-12: NWS Offices That Would Broadcast a UV Forecast Explanation through a NOAA Weather Radio Recording (Survey Question 11).

NWS Region	Yes	No	Office without NOAA Radio	Total
Eastern Region				
number of responses	27	7	1	35
possible number of responses	48	48	3	51
response rate	56%	15%	33%	69%
Southern Region				
number of responses	29	3	3	35
possible number of responses	49	49	3	52
response rate	59%	6%	100%	67%
Central Region				
number of responses	40	3	1	44
possible number of responses	59	59	1	60
response rate	68%	5%	100%	73%
Western Region				
number of responses	12	1	2	15
possible number of responses	21	21	7	28
response rate	57%	5%	29%	54%
Alaska Region				
number of responses	5	-	2	7
possible number of responses	7	-	8	15
response rate	71%	-	25%	47%
Pacific Region				
number of responses	3	-	1	4
possible number of responses	3	-	8	11
response rate	100%	-	13%	36%
All Regions				
number of responses	116	14	10	140
possible number of responses	187	188	30	217
response rate	62%	7%	33%	65%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.

(2) The level of confidence for the 'All Regions' 'response rate' exceeds 95%.

Table E-13: Days in Which NWS Field Offices Would Release a UV Forecast over the NOAA Weather Radio, Should a UV Forecast Be Made Available by the NMC (Survey Question 12).

Region	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Everyday	Any Day with High UV Exposure	No Day	Total Number of Office Respondents
Eastern Region											
number of responses	1	-	1	-	3	2	2	17	13	1	30
possible number of responses	51		51		51	51	51	51	51	51	51
response rate	2%		2%		6%	4%	4%	33%	25%	2%	59%
Southern Region											
number of responses	2	1	1	2	2	1	1	17	15	2	32
possible number of responses	52	52	52	52	52	52	52	52	52	52	52
response rate	4%	2%	2%	4%	4%	2%	2%	33%	29%	4%	62%
Central Region											
number of responses	-	-	-	2	5	4	4	21	23	-	42
possible number of responses				60	60	60	60	60	60		60
response rate				3%	8%	7%	7%	35%	38%		70%
Western Region											
number of responses	1	1	1	1	1	1	1	8	6	-	14
possible number of responses	28	28	28	28	28	28	28	28	28		28
response rate	4%	4%	4%	4%	4%	4%	4%	29%	21%		50%
Alaska Region											
number of responses	-	-	-	1	-	-	1	2	4	-	7
possible number of responses				15			15	15	15		15
response rate				7%			7%	13%	27%		47%
Pacific Region											
number of responses	-	-	-	-	-	-	-	1	3	-	4
possible number of responses								11	11		11
response rate								9%	27%		36%
All Regions											
number of responses	4	2	3	6	11	8	9	66	64	3	129
possible number of responses	217	217	217	217	217	217	217	217	217	217	217
response rate	2%	1%	1%	3%	5%	4%	4%	30%	29%	1%	59%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices. (2) The level of confidence for the 'All Regions' 'rate of response' exceeds 92%.
(3) Respondents were instructed to indicate all preferred forecast release days.

Table E-14: Times of Day in Which NWS Field Offices Would Disseminate a UV Forecast over the NOAA Weather Radio, Should a UV Forecast Be Made Available by the NMC (Survey Question 13).

Region	12 AM to 3 AM	3 AM to 6 AM	6 AM to 9 AM	9 AM to 12 PM	12 PM to 3 PM	3 PM to 6 PM	6 PM to 9 PM	9 PM to 12 AM	During Actual Time of High UV Exposure	No Time of Day	Total Number of Office Respondents
Eastern Region											
number of responses	1	7	24	15	8	7	6	2	6	1	31
possible number of responses	51	51	51	51	51	51	51	51	51	51	51
response rate	2%	14%	47%	29%	16%	14%	12%	4%	12%	2%	61%
Southern Region											
number of responses	-	4	24	14	10	7	1	-	2	1	32
possible number of responses	-	52	52	52	52	52	52	-	52	52	52
response rate	-	8%	46%	27%	19%	13%	2%	-	4%	2%	62%
Central Region											
number of responses	-	6	33	19	15	7	3	-	11	-	43
possible number of responses	-	60	60	60	60	60	60	-	60	-	60
response rate	-	10%	55%	32%	25%	12%	5%	-	18%	-	72%
Western Region											
number of responses	1	6	9	4	2	1	1	-	4	-	13
possible number of responses	28	28	28	28	28	28	28	-	28	-	28
response rate	4%	21%	32%	14%	7%	4%	4%	-	14%	-	46%
Alaska Region											
number of responses	1	1	5	2	2	2	2	1	-	-	5
possible number of responses	15	15	15	15	15	15	15	15	-	-	15
response rate	7%	7%	33%	13%	13%	13%	13%	7%	-	-	33%
Pacific Region											
number of responses	-	2	4	2	1	-	-	-	1	-	4
possible number of responses	-	11	11	11	11	-	-	-	11	-	11
response rate	-	18%	36%	18%	9%	-	-	-	9%	-	36%
All Regions											
number of responses	3	26	79	56	38	11	13	3	24	2	128
possible number of responses	217	217	217	217	217	217	217	217	217	217	217
response rate	1%	12%	36%	26%	18%	5%	6%	1%	11%	1%	59%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
(2) Respondents were instructed to indicate all preferred forecast dissemination times.
(3) The level of confidence for the 'All Regions' 'response rate' exceeds 92%.

Table E-15: Kind of UV Information That NWS Field Offices Would Prefer to Disseminate over NOAA Weather Radio (Survey Question 14).

NWS Region	Quantitative	Qualitative	Both	None	Total
Eastern Region					
number of responses	3	7	20	3	33
possible number of responses	51	51	51	51	51
response rate	6%	14%	39%	6%	65%
Southern Region					
number of responses	4	5	19	4	32
possible number of responses	52	52	52	52	52
response rate	8%	10%	37%	8%	62%
Central Region					
number of responses	2	11	28	1	42
possible number of responses	60	60	60	60	60
response rate	3%	18%	47%	2%	70%
Western Region					
number of responses	1	2	11	-	14
possible number of responses	28	28	28	-	28
response rate	4%	7%	39%	-	50%
Alaska Region					
number of responses	-	2	2	1	5
possible number of responses	-	15	15	15	15
response rate	-	13%	13%	7%	33%
Pacific Region					
number of responses	-	-	3	-	3
possible number of responses	-	-	11	-	11
response rate	-	-	27%	-	27%
All Regions					
number of responses	10	27	83	9	129
possible number of responses	217	217	217	217	217
response rate	5%	12%	38%	4%	59%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.

(2) The level of confidence for the 'All Regions' 'response rate' exceeds 92%.

Table E-16: Number of NWS Field Offices That Would Like to Have UV Radiation Monitoring Equipment (Survey Question 3).

NWS Region	Yes	No	Other Responses	Total
Eastern Region				
number of responses	22	9	-	31
possible number of responses	51	51		51
response rate	43%	18%		61%
Southern Region				
number of responses	24	8	1	33
possible number of responses	52	52	52	52
response rate	46%	15%	2%	63%
Central Region				
number of responses	29	11	-	40
possible number of responses	60	60		60
response rate	48%	18%		67%
Western Region				
number of responses	10	6	-	16
possible number of responses	28	28		28
response rate	36%	21%		57%
Alaska Region				
number of responses	4	3	1	8
possible number of responses	15	15	15	15
response rate	27%	20%	7%	53%
Pacific Region				
number of responses	4	-	-	4
possible number of responses	11			11
response rate	36%			36%
All Regions				
number of responses	93	37	2	132
possible number of responses	217	217	217	217
response rate	43%	17%	.5%	61%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
(2) 'Other Responses' include "already have UV equipment (two Offices)."
(3) The level of confidence for the 'All Regions' 'response rate' exceeds 93%.

Table E-17: NWS Field Office Responses As to What Organizations in Their Local Area Might Benefit from a NWS UV Forecast, Should One Be Made Available (Survey Question 8).

NWS Region	Agriculture Industry	Tourism Industry	Mass News Disseminators	Local or State Governments	Health Organizations	Sporting Organizations	General Public	Other	Total Number of Office Respondents
Eastern Region									
number of responses	11	24	20	13	26	13	26	1	33
possible number of responses	51	51	51	51	51	51	51	51	51
response rate	22%	47%	39%	25%	51%	25%	51%	2%	65%
Southern Region									
number of responses	15	23	22	7	28	21	31	2	34
possible number of responses	52	52	52	52	52	52	52	52	52
response rate	29%	44%	42%	13%	54%	40%	60%	4%	65%
Central Region									
number of responses	25	28	25	12	33	21	41	2	44
possible number of responses	60	60	60	60	60	60	60	60	60
response rate	42%	47%	42%	20%	55%	35%	68%	3%	73%
Western Region									
number of responses	8	10	12	4	12	8	14	-	16
possible number of responses	28	28	28	28	28	28	28	-	28
response rate	29%	36%	43%	14%	43%	29%	50%	-	57%
Alaska Region									
number of responses	1	4	3	2	3	2	7	1	8
possible number of responses	15	15	15	15	15	15	15	15	15
response rate	7%	27%	20%	13%	20%	13%	47%	7%	53%
Pacific Region									
number of responses	2	4	2	2	3	1	4	-	4
possible number of responses	11	11	11	11	11	11	11	-	11
response rate	18%	36%	18%	18%	27%	9%	36%	-	36%
All Regions									
number of responses	62	93	84	40	105	66	123	6	139
possible number of responses	217	217	217	217	217	217	217	217	217
response rate	29%	43%	39%	18%	48%	30%	57%	3%	64%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
(2) 'Other' includes "research and development office purposes only," "universities," "fishing industry," and "recreational interests (identified by three Offices)."

Table E-18: NWS Field Offices That Were Aware of Environment Canada's Atmospheric Environment Service's Daily Issuance of a UV Forecast (Survey Question 16A).

NWS Region	Yes	No	Total
Eastern Region			
number of responses	9	27	36
possible number of responses	51	51	51
response rate	18%	53%	71%
Southern Region			
number of responses	10	25	35
possible number of responses	52	52	52
response rate	19%	48%	67%
Central Region			
number of responses	11	33	44
possible number of responses	60	60	60
response rate	18%	55%	73%
Western Region			
number of responses	6	10	16
possible number of responses	28	28	28
response rate	21%	36%	57%
Alaska Region			
number of responses	2	6	8
possible number of responses	15	15	15
response rate	13%	40%	53%
Pacific Region			
number of responses	1	3	4
possible number of responses	11	11	11
response rate	9%	27%	36%
All Regions			
number of responses	39	104	143
possible number of responses	217	217	217
response rate	18%	48%	66%

Notes: (1) The 'possible number of responses' equals the total number of NWS Field Offices identified by the NWS Office of Public Affairs. Survey questionnaires were mailed to all NWS Field Offices.
(2) The level of confidence for the 'All Regions' 'response rate' exceeds 95%.

APPENDIX F

National Technical Information Messages and Administrative Message

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NATIONAL TECHNICAL INFORMATION MESSAGE 94-14
NATIONAL WEATHER SERVICE HEADQUARTERS
350 PM EDT TUE MAY 17 1974

TO: ALL NWS PRODUCT USERS

FROM: MARY C. NEWTON
ACTING CHIEF, SERVICES DEVELOPMENT BRANCH

SUBJECT: ULTRAVIOLET POTENTIAL (UVP) INDEX

(THE FOLLOWING INFORMATION WAS PROVIDED BY RICHARD PRZYWARTY OF
THE OFFICE OF METEORODOGY.)

The National Weather Service (NWS) is working in coordination with the U.S. Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the American Meteorological Society (AMS) and private industry to develop an experimental Ultraviolet Potential (UVP) Index guidance forecast.

A strong driver for the development of the UVP index is the need to increase public awareness of the risks of over-exposure to the sun's harmful rays.

The NWS is currently evaluating the scientific merit of the UVP Index as well as providing input on outreach products to educate the public on how to interpret the UVP. UVP Index brochures will be provided jointly by the EPA, NWS and CDC.

The NWS hopes to begin a demonstration and evaluation project which would involve the experimental release of a UVP index forecast for a limited number of test sites for a designated period of time. Our target date for the start of this demonstration is July 1974. We plan to have background material on the development and use of the index to the involved forecast offices substantially before that time.

NWS OFFICES SHOULD DISREGARD ANY INFORMATION THEY RECEIVE ON THIS PRODUCT THAT IS NOT DISTRIBUTED BY THE NWS.

All questions concerning the UVP index may be directed to Jim Miller of the National Meteorological Center's Climate Analysis Center. Jim can be reached on (301) 763-8071.

END

[206] From: Mac McLaughlin at W-SR-SRH 5/18/94 2:05PM (2855 bytes: 1 in)
To: Bart Hagemeyer at W-SR-MLB, Bill Read at W-SR-HGX, Don Dettinger at
W-SR-HGX, Mike Young at SFOGATE, mflynn@swami.tamu.edu (Mickey Flynn) at
SMTPGATE, rgetz@awis.auburn.edu (Roger Getz) at SMTPGATE
To mailing list: #NWSOs at W-SR-HUB, #WSFOs at W-SR-HUB, #WSOs at W-SR-HUD,
#AWSCs at W-SR-HUB
Subject: Ultraviolet Potential

----- Message Contents -----

A number of offices are calling concerning a press release about the NWS beginning to issue an Ultraviolet Potential Index. NWSH released information concerning this project on AFOS yesterday (5/17/94) under the identifier WSHFNSNMC. I'm repeating the content of the message below in case any of you do not store that PIL.

SUBJECT: ULTRAVIOLET POTENTIAL (UVP) INDEX

The National Weather Service (NWS) is working in coordination with the U.S. Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), the American Meteorological Society (AMS), and private industry to develop an experimental Ultraviolet Potential (UVP) Index guidance forecast.

A strong driver for the development of the UVP Index is the need to increase public awareness of the risks of over-exposure to the sun's harmful rays.

The NWS is currently evaluating the scientific merit of the UVP Index as well as providing input on outreach products to educate the public on how to interpret the UVP. UVP Index brochures will be provided jointly by the EPA, NWS, and CDC.

The NWS hopes to begin a demonstration and evaluation project which would involve the experimental release of a UVP Index forecast for a limited number of test sites for a designated period of time. Our target date for the start of this demonstration is July 1994. We plan to have background material on the development and use of the index to the involved forecast offices substantially before that time.

All questions concerning the UVP Index may be directed to Jim Miller of the National Meteorological Center's Climate Analysis Center. Jim can be reached on 301 763 8071.

END OF MESSAGE

Now you know as much about this proposal as we know here at SRH. Suggest you refer inquiries to the reference at NMC.

Mac McLaughlin
Chief, MSD

NNNN>##KA
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ETTA000 KWSH 231839

ADMINISTRATIVE MESSAGE
NATIONAL WEATHER SERVICE HEADQUARTERS
235 PM EDT MON MAY 23 1994

ATTENTION ALL EMPLOYEES

MEMORANDUM FOR: All NWS Employees

FROM: Louis Uccellini,
Acting Chief, Office of Meteorology

SUBJECT: Questionnaire on Ultraviolet Radiation Index
Forecast

A questionnaire has been sent to a number of our field offices requesting input on the development and/or implementation of an ultraviolet radiation index forecast. James Lewis A. Free, a former NWS summer intern and now a graduate student at the University of Tennessee, developed the survey as a PERSONAL research project.

THIS SURVEY IS NOT AN OFFICIAL REQUEST BY THE NWS. YOU MAY RESPOND TO THE SURVEY IF YOU WISH. HOWEVER, THE RESULTS WILL NOT BE USED TO HELP ESTABLISH DISSEMINATION POLICIES AND PROCEDURES FOR THE ULTRAVIOLET RADIATION INDEX THAT THE NWS PLANS TO IMPLEMENT EXPERIMENTALLY IN THE LATE JUNE/EARLY JULY 1994 TIME-FRAME.

The NWS continues their development on the experimental ultraviolet radiation index forecast. More information will be distributed before the product's planned implementation date.

END

APPENDIX G

List of Abbreviations

chlorofluorocarbons.....	CFCs
Department of Commerce.....	DOC
Federal Coordinating Council for Science, Engineering, and Technology.....	FCCSET
Food and Drug Administration.....	FDA
National Aeronautic and Space Administration.....	NASA
National Cancer Institute.....	NCI
National Meteorological Center.....	NMC
National Oceanic and Atmospheric Administration.....	NOAA
National Weather Service.....	NWS
sun protection factor.....	SPF
total ozone mapping spectrometer.....	TOMS
United Nations.....	UN
United States.....	US
ultraviolet (radiation).....	UV
Weather Forecast Office.....	WFO
Weather Service Forecast Office.....	WSFO
Weather Service Office.....	WSO

VITA

James Lewis A. Free was born in Bamberg, South Carolina. He attended public schools in that city and was graduated from Bamberg-Ehrhardt High School. In August of 1989 he entered the University of South Carolina and was graduated in August 1992 receiving a Bachelor of Science degree in Geography with an emphasis in climatology. While an undergraduate, he was employed for two and half years as a climatologist for the South Carolina Water Resources Commission.

In August 1992, the author began his graduate work at The University of Tennessee Graduate School of Planning. During the summer of 1993 he completed a planning practicum as a physical scientist with the National Meteorological Center in Camp Springs, Maryland. Mr. Free had an emphasis in environmental planning and was awarded a Master of Science in Planning degree in August of 1994.

Mr. Free has a special interest in applied climatology, land use planning, and policy analysis, and hopes to pursue a career in a professional setting concerned with oceanic or terrestrial natural resource management.