Creating a Haines Index Climatology for the United States, Alaska, Hawaii, and Puerto Rico

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1. INTRODUCTION

Since the Haines Index (HI) was introduced (Haines 1988), it has been used as a tool by fire managers to assess fire risk. The HI is an index for wildland fire severity (growth potential) based upon environmental lapse rates and moisture. Each of the two factors, stability and moisture, could influence the fire growth. The HI does not take into account fuel moisture and is not a component of the National Fire Rating System or the Fire Behavior Prediction System.

The index values range from 2 to 6 depending on weather conditions. The higher value represents conditions more conducive to plume dominated fire growth. Atmospheric instability and lack of moisture can promote the spread and intensity of fires by increasing the height and strength of smoke columns, chance of causing spotting, fire whirls, and other convective, or uplifting winds at the surface that affect fire behavior (Werth and Ochoa 1993).

Several studies have explored the properties of the Haines Index. Brotak (1993) considered the use of upper air data from 1200 UTC for computing the Index. Werth and Werth (1998) expanded the original climatolology of the Haines Index (1988) for the western United States.

In the present study, a 30 year Haines Index Climatology for the United States, including Alaska, Hawaii, and Puerto Rico is being prepared for low, mid, and high elevations. Alaska, Hawaii, and Puerto Rico are being examined because these states have not been included in previous studies. Preliminary HI parameters, averages, and relevant statistics were obtained using C++ and spreadsheet analysis histograms, and bar graphs.

The climatology will determine the frequency of occurrence of HI values (2 to 6) and examine the spatial and temporal patterns displayed by the relative frequencies of the HI values. The frequency analysis will also help determine whether the 1200 UTC values can provide more advance notice or better prediction and discrimination of pending fire risk than the 0000 UTC values.

2. METHODS

Meteorological upper air data from the period 1961 to 1990 was obtained from NCDC's CD-Rom (NCDC 1993). The data were downloaded from the CD-Rom (WMO Station Identifier format) placed in individual files according to each station name, and placed in sub-file by year. Data from one to three radiosonde sites are analyzed for each station.

The Skew-T/Hodograph Analysis and Research Program (SHARP) was used to view upper air soundings. The program allowed view/retrieve of meteorological data one sounding per analysis. Therefore data was downloaded in ASCII text FSL format and placed in files by each station name and in sub-files by year, which ensured QC-data entry and meteorological validity. Station Identifiers were obtained from NOAA (http://www-frd.fsl.noaa.gov/mab/raob).

The Haines Index was calculated based on the rate for 950 to 850 mb temperature differences and a temperature dewpoint spread at 850 mb (Haines 1988). The initial temperature and dewpoint at each layer mentioned above were verified by hand calculations in select cases to verify the C++ program.

The Haines Index values for 0000 UTC and 1200 UTC were then placed into a spreadsheet and analyzed to obtain relative frequencies of occurrence. The relative frequency was calculated by dividing the number of occurrences for a particular Haines Index value by the total number of days for which data were available. Preliminary seasonal charts from 1961 to 1967 for 0000 UTC and 1200 UTC were then prepared (using normal meteorological definition, spring (MAM), summer (JJA), fall (SON), winter (DJF)) to illustrate the frequency of occurrence spatially and for temporal evaluation.

The charts were analyzed to determine if the frequency of occurrence changes or varies dramatically throughout the seasons. The charts will also indicate which HI value dominates the region and describes which season is more prone to have moderate to high fire growth potential.

Brotak (1993) showed a shift in the Index values of 6 (high fire risk) to 5 (moderate fire risk) in all locations, with a more noticeable shift for low elevations. We will look at the 1200 UTC and 0000 UTC results and determine if the shift is also noticeable for our data set, and if our results will aid fire managers in their decision-making in accessing the growth of wildland fires.

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3. RESULT

HI values have been calculated for the Eastern US, Alaska, Hawaii, and Puerto Rico. The western US will be calculated in the near future. Jackson, MS was chosen because of warm and humid climate seen over the region due to the influence of Maritime Tropical Air. This region is generally considered to have low resulting fire danger due to the pronounced effects of Gulf Moisture. The results for Jackson, MS are examined and presented below.

Histograms for the spring (MAM), summer (JJA), fall (SON), and winter (DJF) seasons of the relative frequency distribution of HI values were prepared for 0000 UTC and 1200 UTC. The 0000 UTC data for Jackson, MS (KJAN) showed a uniform pattern of moderate growth potential through out March – May. The relative frequency increased across months. Frequencies for 1963 were not calculated because data was not available. Spring 1965, shows an increase of 19% from April to May from moderate to high fire growth potential. 1966 and 1967 displayed a greater increase during moderate potential growth rate than was seen for high potential growth rate.

1200 UTC shows a slight variation between low and moderate fire growth potential during the season for 1961. A steady increase is shown from March-May at HI=5 moderate fire growth potential from 1962-1967. Absence of any HI=6 values times during the season shows the possibility of having little or no high potential growth rate during the season. The shift from HI=6 to HI=5 at 1200 UTC corresponds to Brotak (1993).

The summer pattern is distinctively different from the spring. Values for the HI=5 were seen predominately through out the entire period for 1961 to 1967. 1200 UTC shows higher percentages than 0000 UTC but both times reflect moderate growth potential. Maximum temperatures occur around 4pm, which could be one reason for the high frequencies of moderate growth during 1200 UTC.

The 0000 UTC data for the fall season shows a decreasing pattern in relative frequencies for HI=5 from September-November. A definite increase from low to moderate potential fire growth and decreasing again during high potential fire growth is seen through out 1961 to 1967. 1200 UTC displays the same pattern as 0000 UTC with higher relative frequency values being displayed for 1200 UTC. The winter season pattern shows mainly a uniform pattern of low fire potential growth through out the years.

The resulting climatology of Haines Index will provide aid to fire managers in their decision-making in assessing the growth of wildland fires by providing a benchmark of the HI's behavior in their region. It will also provide a better definition & separation of risk categories and help determine if the 1200Z value can provide greater advance notice of pending fire-risk than the 0000Z values, e.g., Haines (1988).

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