P1.11 NORTH AMERICA CLIMATE EXTREMES MONITORING SYSTEM

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1. INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report (TAR) concluded that most of the observed warming of the last 50 years is likely to have been due to an increase in greenhouse gas concentrations (IPCC, 2001). This report also concluded that other aspects of climate such as precipitation, Artic sea ice extent, sea level, and snow cover were also influenced by changing climate conditions.

However, findings with regard to changes in extreme events such as heat waves, drought, and heavy precipitation events were far less conclusive than those for changes in mean conditions. In an effort to improve the scientific understanding of observed changes in extreme climate conditions, NOAA's National Climatic Data Center is developing an interactive web site which will provide users with easy-to-use tools for analyzing trends and variability in climate extremes across the North American continent.

2. DATA AND INDICES

The analysis of climate extremes is made possible through the calculation of a set of extremes indices which was developed by the World Meteorological Organization (WMO) Commission for Climatology/CLIVAR Expert Team on Climate Change Detection Monitoring and Indices (ETCCDMI). The indices, which have also been used in global analyses by Alexander et al. (2005), are based on daily temperature values or daily precipitation amount. Some are based on fixed thresholds that are of relevance to particular applications. In these cases, thresholds are the same for all stations. Other indices are based on thresholds that vary from location to location. In these cases, thresholds are typically defined as a percentile of the relevant data series.

From a set of 27 core indices defined by the ETCCDMI, a subset of 12 of the most important indices to climate change study was initially selected (Table 1).

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The software for calculating these indices was provided on behalf of the ETCCDMI by Xuebin Zhang of Environment Canada (http://cccma.seos.uvic.ca/ETCCDMI/) and has been used to calculate the indices for a set of stations in the US, Canada and Mexico.

Number of Frost Days	Annual count of days with daily minimum temperature < 0º C
Number of Summer Days	Annual count of days with daily maximum temperature > 25º C
Number of Icing Days	Annual count of days with daily maximum temperature < 0º C
Number of Tropical Nights	Annual count of days with daily minimum temperature > 20º C
Growing Season Length	Annual count of days between first span of at least 6 days with daily mean temperature > 5º C and first span after having 6 days with mean temperature < 5º C.
Much below average minimums	Percentage of days when daily minimum temperature was < 10th percentile
Much below average maximums	Percentage of days when daily maximum temperature was < 10th percentile
Much above average minimums	Percentage of days when daily minimum temperature was > 90th percentile
Much above average maximums	Percentage of days when daily maximum temperature was > 90th percentile
Greatest 5-day Total Rainfall	Maximum amount of rainfall falling within any consecutive 5-day period
Simple Precipitation Intensity Index	Amount of precipitation that fell on days with any amount of precipitation
Maximum Length of Dry Spell	Maximum number of consecutive days without precipitation

Table 1. Suite of 12 of 27 indices developed by the WMO ETCCDMI. To be included in the NCDC North America Climate Extremes Monitoring website.

The indices were calculated from a variety of data sources. When possible, only data that had been adjusted to remove the effects of non-climatic influences were used. A set of 210 stations with homogeneity adjusted daily temperature data were provided for Canada (Vincent et al. 2002) as well as a set of 494 adjusted precipitation stations for Canada (Mekis and Hogg, 1999).

Adjustments have not been applied to U.S. daily data. Stations used for the Continental U.S. were those stations that passed the Menne and Williams (2005) statistical homogeneity tests. Stations for Alaska, Hawaii, Puerto Rico and the US Virgin Islands are a subset of the most homogenous stations for temperature and precipitation as identified using a 4-phased process that involved 1) visual inspections of various graphs of the station data, 2) examination of the metadata, both digital and scanned in paper archive metadata, 3) the homogeneity test described by Wang (2003), and 4) consultation with State Climatologists for the respective states and regions.

From this analysis, a set of approximately 750 stations with the fewest moves and instrument changes were identified. No adjustments or estimates of the most homogenous daily temperature and precipitation records have been applied to Mexican stations, so station selection was based on length of record and reporting frequency. The inventory for Mexico consists of approximately 300 temperature and precipitation stations.

3. ANALYSIS FEATURES

Website features will include options for producing trend maps and anomaly maps for North America as a whole, Canada, Mexico, or the Unites States. Station trends can be calculated and displayed for subsets of stations based on station elevation, significance level of the resulting trends, and percent of available data. Any set of years and seasons from 1955 to present can be selected for analysis and mapping. Each station's trend is displayed as a colored dot with the legend corresponding to appropriate bins.

An example for trends in Number of Frost Days (Figure 1) and Greatest 5-Day Total Rainfall (Figure 3) are shown. The underlying values for the trend analysis period can be viewed in time series format by clicking on the dot for any station on the map. Using this click and point action enables the user to view a time series graph of the station of interest as shown in the examples in Figures 2 and 4.

4. SUMMARY

This paper briefly summarizes efforts at NOAA's National Climatic Data Center to develop an interactive website for display and analysis of climate extremes in North America. A set of monthly and seasonal extremes indices calculated from daily data are provided to support the study of variability and trends in temperature and precipitation extremes.

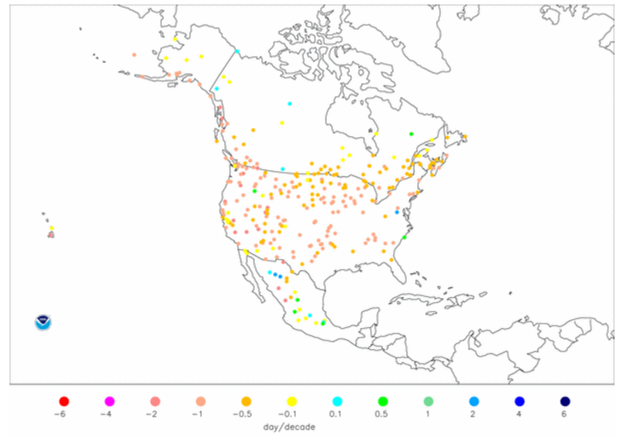

Figure 1. Decadal trend in Number of Frost Days for the month of March (1955-2002). Only those stations with 80% non-missing data during the period and trends significant at the 90% Confidence Level are plotted.

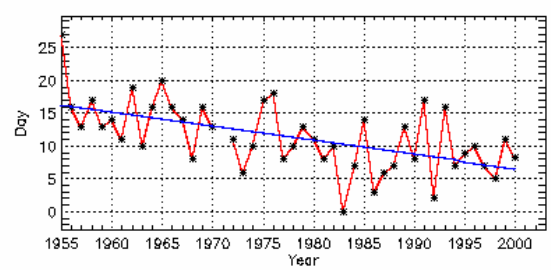

Figure 2. Number of Frost Days in March (black stars) and linear trend line (blue line) for a single station (Wenatchee) in the U.S. state of Washington. The linear trend is -2.1 days/decade.

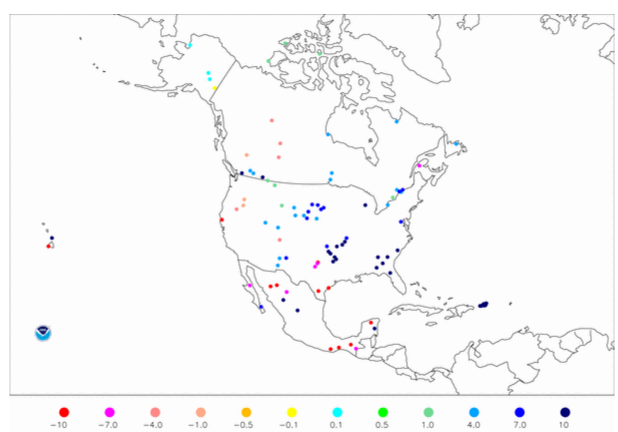

Figure 3. Decadal trend in Greatest 5-day Total Rainfall for the Sep-Nov season (1955-2002). Only those stations with 80% non-missing data during the period and trends significant at the 90% Confidence Level are plotted.

The website provides options for producing trend maps of 12 indices on a station-level scale plotted by country or for the continent as a whole. Users are provided with the capability to inspect the underlying year-to-year variability for any station trend on the map. Graphing of individual station index values can also be accomplished through a secondary station selection feature involving access to the full station inventory. This website will be available in 2006 via NCDC's Climate Monitoring homepage at www.ncdc.noaa.gov/oa/climate/research/monitoring.html.

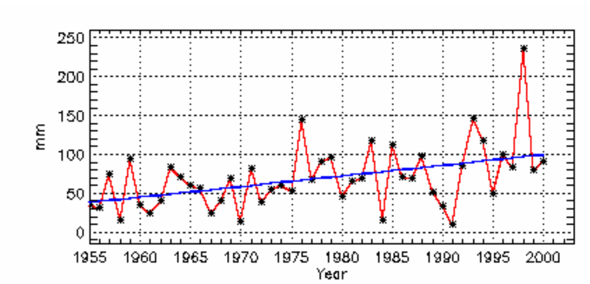

Figure 4. Greatest 5-day Total Rainfall during the Sep-Nov season (black stars) and linear trend line (blue line) for a single station (Cordele) in the U.S. state of Georgia. The linear trend is +13.6 mm/decade.

5. REFERENCES

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