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INTEGRATING GLOBE STUDENT DATA OBSERVATIONS AT NCDC IN CLIMATE MONITORING ACTIVITIES

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1. Globe Background

Global Learning and Observations to Benefit the Environment (GLOBE) is a worldwide network of students, teachers, and scientists working together to study and understand the global environment. Students and teachers from over 9,500 schools in more than 90 countries are working with research scientists to learn more about our planet. GLOBE students make environmental observations at or near their schools and report their data through the Internet. Scientists use GLOBE data in their research and provide feedback to the students to enrich their science education. Images and database files are available on the World Wide Web, enabling students and other visitors to visualize and analyze environmental observations around the world. The GLOBE web page (Fig 1.) is at the following address: http:///www.globe.gov

Fig 1. GLOBE Web Home Page.

GLOBE science and education activities help students reach higher levels of achievement in science and math, while also helping increase the environmental awareness of all individuals and increasing our scientific understanding of the earth. Internationally, GLOBE is being implemented through bilateral agreements between the U.S. government and governments of over 90 partner nations.

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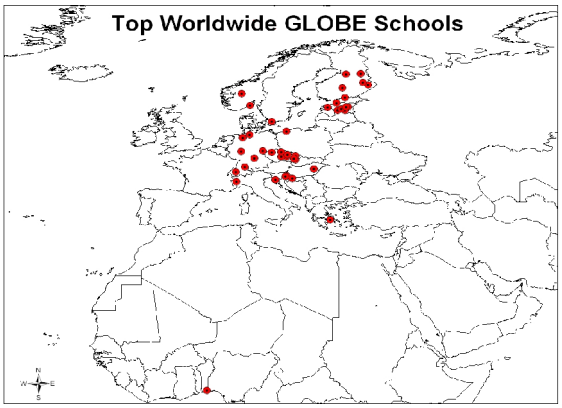

Fig 2. Top Worldwide GLOBE Schools.

Globally, there are about 3,700 GLOBE stations taking temperature and or precipitation observations daily. NCDC analyzed over 5,400 stations that recorded temperature measurements. The “top schools” or stations with the least errors and most complete data are shown in Figure 2. and Figure 3. There were a total of 41 foreign GLOBE schools selected for additional analysis.

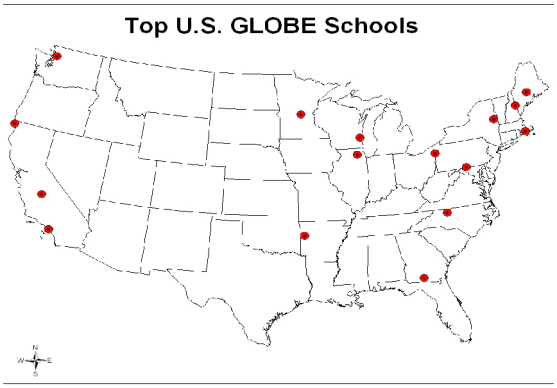

Fig 3. Top U.S. Globe Schools.

In the United States, temperature and or precipitation measurements are taken from more than 2,400 stations on a routine basis. There were a total of 16 U.S. schools selected for additional analysis. This paper looks at the completeness and accuracy of the student observations taken by schools in the GLOBE network.

Fig 4. NCDC WWW Home Page.

2. NCDC Background

NCDC's mission is to "manage America's resource of global climatological in-situ and remotely sensed data and information to promote global environmental stewardship; to describe, monitor and assess the climate; and to support efforts to predict changes in the Earth's environment." The center's web page (Fig 4.) is at the following address: http://www.ncdc.noaa.gov. The WWW site handles approximately 3.0 - 5.0 million users per year.

NCDC produces operational as well as special-event reports on climate and weather around the globe. These NCDC reports place today's climate in historical perspective and are available via the NCDC web site. For many years NCDC has produced summaries to "describe the climate" and was recently tasked with the responsibility of "monitoring and assessing the climate," as well.

This paper summarizes various quality control procedures developed at NCDC to evaluate GLOBE student data and highlights GLOBE student data used in NCDC monitoring activities. Summary statistics and an executive report was sent to the GLOBE program office.

3. Project Overview and Details

NCDC developed procedures for incorporating student data into climate monitoring activities. All 5,400 + GLOBE schools were then analyzed using an NCDC Quality Control (QC) program to check for internal temperature consistency or content errors. Three types of errors comprised about 94% of the total number of inconsistencies. The most frequent occurring error (60%) was when today's maximum temperature was less than yesterday's observation temperature. The second most common error (26%) occurred when today's minimum temperature was greater than yesterday's observation temperature. These errors may show a misunderstanding of the 24-hr station period and could be the result of many noontime or mid-afternoon measurements. Another common error (8%) was yesterday's minimum temperature was greater than today's maximum temperature. The next procedure was identifying GLOBE schools that take observations consistently and have a relatively long period of record. Those schools that fit these criteria were further analyzed using additional NCDC (QC) procedures. The first criteria was that schools had to have at least three years of data, be a current station as of the end of 2001, and have no more than 20% of missing data during their period of record. This provided a subset of 59 top GLOBE schools. Daily temperature data for *ALL* GLOBE schools was then analyzed for their period of record of taking observations through the end of 2001 in order to see which schools were updated and consistent in recording data.

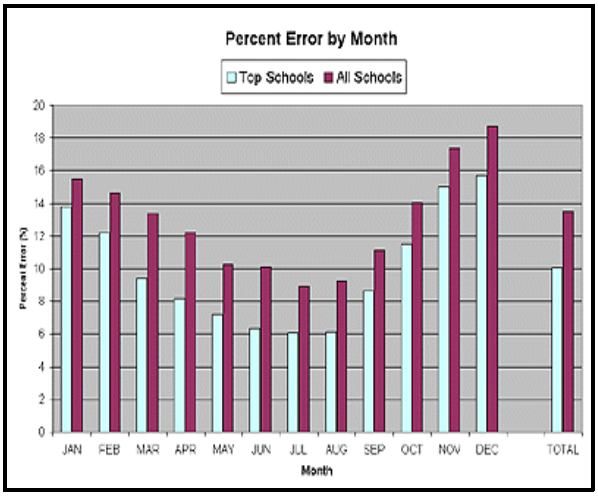

Fig 5. Error Station Plot for all GLOBE stations.

Figure 5 shows the overall percent of errors for all schools and the top schools selected by the quality control program. In all cases, the error rate was 2-4 % lower for the outstanding schools .

Overall, there were 57 schools in 14 different countries which met final NCDC quality control standards. The countries along with the number of schools in parenthesis are as follows : Benin (1), Croatia (5), Czech Republic (8), Estonia (7), Finland (6), Germany (5), Greece (1), Hungary (1), Italy (1), Norway (2), Poland (1), Sweden (1), Switzerland (2), and the United States (16). For the 57 schools that were used in the analysis, the average reporting length was 5.1 years and nearly one-third have reported for 6 years or longer. There was a lower error percentage for all schools in this analysis for observations taken over the summer and on weekends. This could be due to teachers taking observations.

Additional Awards by Category

The following schools were noted for their standard of excellence in the listed categories.

Percentage Reporting

U.S.	Tabor Academy - MA	100.0%
Other	Voore Comp. School - Estonia	99.9 %

Lowest Error Rate

U.S.	Rossmoor Elementary - CA	1.98%
Other	3rd Lyceum of Algaleo - Greece	0.87%

Most Days Reported

U.S.	Rossmoor Elementary - CA	2374
Other	Gymnasium Ohmoor - Germany	2436

Longest Period of Record

U.S.	Kent Prairie Elementary- WA	2447 (6.7 yrs)
Other	Gym. Ohmoor - Germany	2449 (6.7 yrs)

4. Extreme Event Analysis

Fig 6. Hurricane Agnes Collage

Climate Watch

As part of the climate monitoring efforts, the center produces a timely report called, **"Climate Watch"**. Figure 6 is a collage of images dealing with Hurricane Agnes. July 2002 was the 30th anniversary of the storm. Although Agnes wasn't a strong hurricane, she brought massive flooding to parts of the eastern United States. Agnes caused $ 3.5 billion in damages back in 1972 and a death toll of 122 lives. Agnes was the nation's costliest hurricane (after adjusting for inflation) until Hurricane Andrew in 1992. If the losses from Agnes were adjusted to 1997 dollars, damages would eclipse $10 billion. The report is issued within the first ten days of the month and updated several times as warranted. The report contains climatological information, data, satellite images, and analyses of current events for the month. The report also highlights new National Weather Service (NWS) station records of interest and global extreme events. As part of the monitoring of extreme events, NCDC uses every reliable source of climate data and information. In several of the "Climate Watch" reports GLOBE data were extremely valuable in the analysis of extreme events (Fig.7).

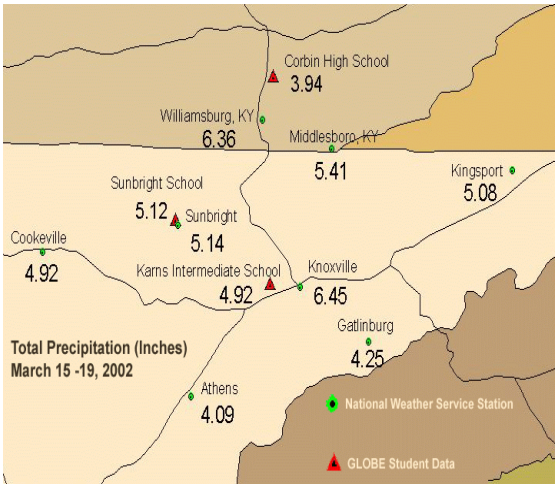

Fig 7. Heavy Rainfall Event- March 2002

A series of low pressure systems bringing heavy rainfall affected parts of Kentucky, Tennessee and Virginia during the March 15-19, 2002 period. Radar estimates indicated that east central Tennessee picked up over 7.00 inches of rain. An analysis of the event was done using National Weather Service, cooperative station data and GLOBE schools in and near the region that received flooding rains. In this analysis, note how the GLOBE student data compare favorably with the rest of the analysis. Also, note the axis of the precipitation was across eastern Tennessee into southern Kentucky. According to media reports, the National Guard was called in to help evacuate residents affected by a storm that damaged or destroyed at least 250 homes in the worst flooding to hit eastern Kentucky in 25 years. Figure. 7 shows the precipitation analysis of the event during March 15-19, 2002.

5. Conclusion

NCDC has found that many GLOBE schools, not just the "outstanding" ones make consistent and reliable observations and are utilized in our Climate Monitoring operations as shown in the example in Figure 7. NCDC uses these data for identifying and validating extreme weather events. NCDC appreciates the students and teachers at these schools for taking high quality atmospheric measurements that can be incorporated into climate monitoring activities.