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GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITES (GOES) IN SUPPORT OF NOAA'S CLIMATE REFERENCE NETWORK (CRN)

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ABSTRACT

Cost-effective, reliable, near real-time transmission and data distribution are key technologies in successfully observing climate change. The GOES primarily support National Weather Service requirements. However, for more than thirty years the satellites have also provided communication support to an extended interagency user community conducting scientific research and protecting lives and property in the Western Hemisphere. NOAA's Climate Reference Network uses NOAA's GOES infrastructure to collect and distribute observations from stations located in the United States and Canada.

This poster illustrates several factors key to the success or failure of data communications for in-situ climate observations, why the GOES Data Collection System (DCS) continue to be a very favorable communications alternative, the role of near real-time communications in transitioning instrument and algorithm changes from research to operations and the role planned for GOES in the Global Climate Observing System and a modernized regional climate network. Additionally, consideration is given to the impact to GOES-R capability and ground systems of a climate network consisting of hundreds of stations with the need for near real-time high data rate communications and large message windows.

1. INTRODUCTION

The impact of climate on energy needs, transportation, housing, water quality, air quality, human health, business, agriculture, forestry, animal husbandry and aquaculture has been acknowledged for centuries. Recent policy debate has included questions of whether or not the climate is changing, how it might be changing, impacts of any change, whether or not mitigation is needed, and whether or not mitigation is feasible. Answering any one of these questions involves the analysis of weather observations made over long periods of time, and most historical data have sufficient noise and bias to preclude any hope of unambiguous answers. Collecting data suitable to climate study has proven to be complicated and data communication technologies have proven key to addressing some of those complexities.

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NOAA's endeavor to adequately observe climate can be traced to the Reference Climate Station (RCS) Network which was attempted during the 1970's and 1980's (1)(2). One of the impediments to the RCS network's success was the lack of timely data receipt from the observing platforms. NOAA implemented the Climate Reference Network (CRN) twenty years later and equipped its sites with a GOES satellite communication capability.

2. KEY FACTORS FOR SUCCESSFUL DATA COMMUNICATION FOR IN-SITU CLIMATE OBSERVATION

Characteristics of successful climate observing networks were outlined in the 1990's (1)(2). They include managed network change, comprehensive metadata, timely assessment of data quality, data completeness and low cost solutions for accessing the data and metadata. Satellite communication technology provides geographically broad, reliable, comprehensive, real-time reports from observing platforms, but can be costly. The cost is even higher if there is a need to communicate with the observing platform. CRN uses NOAA's GOES and the GOES DCS capabilities because they meet the majority of the national network's needs at a remarkably low cost. A recent communications study by the NOAA Center for Operation and Oceanographic Products and Services described the continued cost-effectiveness of the GOES solution (3). Long-term observing networks like CRN face special budget challenges and low cost stable solutions contribute to a lower budget profile and help reduce risk.

3. THE ROLE OF NEAR REAL-TIME DATA RECEIPT IN RESEARCH TO OPERATIONS

CRN's near real-time access to its data allows the network's scientists and engineers to monitor each station's performance. This close daily monitoring is necessary to meet the network's data completeness goal of 98% data availability within thirty days of the close of the observing month. Near real-time access also allows CRN partners to see how the instrument configuration performs in operations. Some changes to network instrumentation, algorithms, and equipment have been designed, tested, deployed and monitored in months instead of years because impacts can be seen quickly and reliably.

4. CONSTRAINTS

Limits of the GOES solution include the current lack of a way to send commands to a station (two-way communication), limitations on the number and size of communication windows, and very limited redundant ground control and data distribution systems.

The long-term CRN budget after full network deployment in 2008 will be heavily weighted toward maintenance and CRN regularly evaluates the network configuration for cost effectiveness and current technology. A two-way communication capability could reduce the expense of distributing programming changes to the platforms and expedite program updates. It could also reduce the expense of retrieving missed observations and allow ad hoc diagnostic commands to be issued directly to the station minimizing the need for site host visits. A two-way GOES capability Small Business Innovation Research (SBIR) Phase 1 topic was announced in November 2005, a feasibility study was completed and a SBIR Phase 2 topic to develop a prototype capability was awarded in July, 2007. The GOES DCS user community supports this effort for the management capability it gives to NOAA/NESDIS and for its potential benefit to GOES DCS users.

CRN currently consists of the original USCRN stations deployed to explain climate variability in the 48 conterminous states, and Global Climate Observing System stations in Alaska and Hawaii. CRN has also cooperated with the Alabama State Climatologist in deploying and maintaining more than a dozen stations modeled after CRN. The upgraded Alabama climate stations (4) are under consideration as pilots for modernizing the National Weather Service Cooperative Observer Program (COOP) (5) stations designated as the Historical Climate Network (HCN) (6). The use of GOES communications for the modernized HCN would result in more than a thousand transmitting platforms and would challenge current GOES capabilities. NOAA/NESDIS and the GOES DCS user community continue migrating observing platforms from 100 baud to 300 baud transmitters and consolidating channel assignments. In addition NOAA/NESDIS has developed new transmitter standards that will allow manufacturers to halve transmission bandwidth with the goal of achieving 400 channels for DCS assignments on the current spacecraft. The next generation of NOAA satellite, GOES-R, is in development. Plans for expanding the DCS capability on this satellite have not been announced.

There are more than 25,000 GOES DCS platforms in the field and most are used for protecting life and property. This highly visible critical user base continues to provide advocacy for NOAA's effort to ensure the GOES DCS reliability. NOAA/NESDIS has begun strengthening backup procedures for the DCS but has had limited success in implementing full redundancy for that system. NOAA/NESDIS has Continuity of Operations procedures for spacecraft command and control at two locations on the East Coast. The GOES DCS user community has conveyed its concern that the command and control locations are too close together. NOAA/NESDIS and the GOES DCS user community have a continuing dialogue on this topic.

5. REFERENCES

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