CLOUDSAT EDUCATION NETWORK

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1. INTRODUCTION

The CloudSat Education Network aims to be a network of approximately 100 schools around the world recruited to provide additional data to CloudSat scientists related to the mission scientific goals, along with data from the GLOBE Program. In return for providing scientist-requested data, students benefit from interaction with mission scientists, special web and hard copy activities, web chats and other benefits. Students and teachers design the ground-based experiments after receiving requests for certain types of data from CloudSat scientists. The best benefit of all is the interaction with other students and teachers from other cultures who share common interests in the environment and Earth's atmosphere. While supporting actual NASA mission scientists is exciting for the students, the CloudSat Education Network seeks to go far beyond this goal by providing a rewarding educational experience for the students that provides them with scientific content, experience with inquiry and international contacts. Currently schools in Africa, Europe, Southeast Asia, Oceania and the United States are participating. While targeted areas for additional schools will be based partially on geographic need of data as indicated by the scientists, the network will recruit and welcome schools across the world committed to the goals of the network.

2. NETWORK MISSION

The mission of the CloudSat Education Network is to build a partnership between scientists, teachers, students and the communities where they live. As a partnership there must be obvious and evident benefits to each member. The scientists will receive valid and useful data for their research, teachers will be offered the tools to help them become confident and competent science teachers, students will receive quality hands-on inquiry instruction and through all three of these, the community will see the benefits of the science and education taking place in their community (Figure 1).

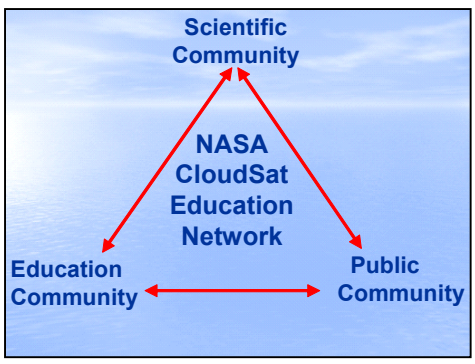

Figure 1. The CloudSat Education Network.

3. NASA CLOUDSAT MISSION

The CloudSat mission will collect data on clouds with an instrument known as a Cloud Profiling Radar (CPR) (NASA Facts, 2003). Clouds are one of the least understood elements of climate and the hydrological cycle. Yet without an understanding of clouds, weather forecasting and climate modeling become nearly impossible. For millennia, humans have studied clouds from the ground. Over the last century, it has become possible to study clouds from above. Until now, though, there was no good way to study the insides of clouds. CloudSat radar is a special type of active microwave radar (94 GHz) to provide a global survey of cloud properties to aid in improving cloud models and the accuracy of weather forecasts, with the long-term goal of improving global climate models (Figure 2). This cloud-profiling radar will provide vertical distribution of cloud physical properties including liquid water content, ice content, and cloud optical depth (Stephens et al., 2002). The CloudSat mission is a cooperative effort that includes its international partner, Canada, and its industry partner, Ball Aerospace and Technologies Corporation. Among CloudSat's other partners are Colorado State University, Jet Propulsion Laboratory, Canadian Space Agency, the U.S. Air Force, U.S. Department of Energy, Goddard Space Flight Center and scientists from France, United Kingdom, Germany, Japan and Canada. The CloudSat website is: http://cloudsat.atmos.colostate.edu/.

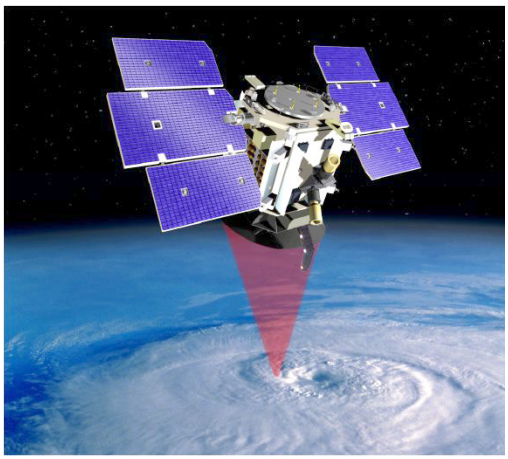

Figure 2. NASA ESSP satellite CloudSat (courtesy of Ball Aerospace).

4. CLOUDSAT EDUCATION NETWORK

The CloudSat Education Network is a pivotal part of the NASA CloudSat satellite mission's education and public outreach program. The goal of the Network is to provide the opportunity for schools around the world to partner with CloudSat scientists and engineers. The Network uses proven science and education programs such as the GLOBE Program to partner scientists,

teachers, students and the communities where they live to give students meaningful, authentic and contemporary educational experiences. Student activities and learning outcomes are designed to meet both general education outcomes and specific standards or objectives from school curricula. The main focus of the knowledge development component of the project is to help students better understand long-term climate change and the climatic processes that maintain the Earth's energy balance.

Satellites cannot provide all the answers and ground referenced data are also needed. Though satellites can cover large areas daily, there are gaps in coverage. The atmosphere varies significantly within these gaps and student measurements can improve coverage for many types of observations.

With the launch of the CloudSat satellite anticipated for 2005, the CloudSat Education Network began supporting the Science mission midyear 2004 and will continue through early 2007. Participation in the Network throughout the duration of the project will be monitored and schools will need to maintain levels of participation in order to maintain 'Membership' in the network. The base level of participation is the reporting of cloud cover, cloud type, temperature and precipitation data every 16 days, coinciding with the satellite overpass. The CloudSat Website will have the day and time of fly-over. After the data are collected, students enter the results into the CloudSat website on-line data entry pages. While most of the protocols are GLOBE Program Atmosphere Protocols, some measurements will be unique to CloudSat to tailor to the special needs of the CloudSat scientists (http://www.globe.gov).

Participation in the CloudSat Education Network can give teachers the tools to provide students the opportunity to:

- Develop basic numeracy skills by gathering and processing environmental information that can be used by scientists to compliment the measurements taken by the CloudSat satellite. (Scientists will benefit from this ground-based reference data.)
- Develop practical science skills by measuring, recording and analyzing local environmental measurements.
- Communicate and learn with other students from around the world using appropriate information and communications technologies.
- Interface with the CloudSat Education Network Website which will offer student friendly materials and ideas to support the educational goals of member schools.
- Liaise with, ask questions, and offer ideas to the CloudSat Science Team.

The network will be international in nature targeting up to 100 schools. Currently we have schools from Australia, New Zealand, Ghana, Cameroon, Croatia, Germany, Thailand and the United States prepared to participate. Existing and new contacts are being pursued in Malaysia, Taiwan, South Africa, the United Kingdom and Pakistan. Schools through existing networks such as the GLOBE Program have been targeted and contacts are being made in Russia, Iceland, Sweden, Finland, Estonia, Canada and China.

5. CLOUDSAT CLOUD COVER PROTOCOL PILOT

Among the many ways that schools can participate in the CloudSat Education Network, is participation in pilot studies. Teachers and students conduct research on the best design for ground-based data-collecting methods and experiments. The results are shared with the rest of the Network. The first pilot study has been completed. At the request of CloudSat scientists for more detailed Cloud Cover data, a protocol was developed to take measurements in four quadrants of the sky. The pilot for the protocol tested whether an average of these quadrants would produce an accurate full sky measurement or if an additional full sky measurement would be necessary (Figure 3). The protocol was developed by Paula McKean's class in Auckland, New Zealand.

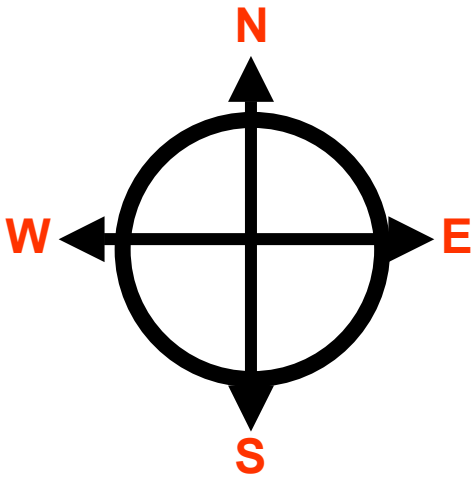

Figure 3. The first CEN Pilot Study involved the quadrants of the sky and cloud cover.

The Trial Plan was to have two groups per school commit to two consecutive school weeks (10 days) and to record data simultaneously, then report the results. One group would take measurements of each quadrant and average the results producing a single full sky measurement. The second group would take a single full sky measurement. The groups were then given the opportunity to participate in a one-week on-line forum to discuss results and make recommendations. The Forum was designed and supported by John Lockley, Senior Lecturer and New Zealand GLOBE Country Coordinator, University of Waikato, Hamilton New Zealand, and Jennifer Lockett, CloudSat Education Network Coordinator.

An estimated 175 students from ages 8-22 participated in this first pilot activity representing the countries of Australia, New Zealand, Croatia, Cameroon and the United States. Each school was provided written protocol and field guide materials, excel spreadsheets for data reporting, registration, instructions and the opportunity to participate in the follow-up online forum. These were supported by hard copy mailings, email, class visits and phone calls. In addition to the data schools provided detailed School Profiles to be posted on the Education Network Website when school registration begins.

By analyzing over 1000 data points collected during the pilot, the average of the quad measurements were the same as the single full sky measurement only 72% of the time. In order for the average measurements to replace the single full sky measurement it was discussed and decided the readings should be the same 80% of the time or better. Using these results then, the

Cloud Cover Protocol for CloudSat will include the quadrant measurements as well as a separate full sky measurement.

Through these activities the teachers involved have offered their students the opportunity to use the processes that help them to become scientifically literate. This literacy strengthens many of the skills needed in daily life such as critical thinking, working cooperatively in teams, problem solving and using technology effectively. As students become scientifically literate they will be better prepared to participate in cultural, civic and economic decisions and as well as become life-long learners.

The next pilot study is in the planning stages. CloudSat scientists have asked for more detailed precipitation data and a plan to solicit ideas from the teachers and students is being developed.

6. REFERENCES

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