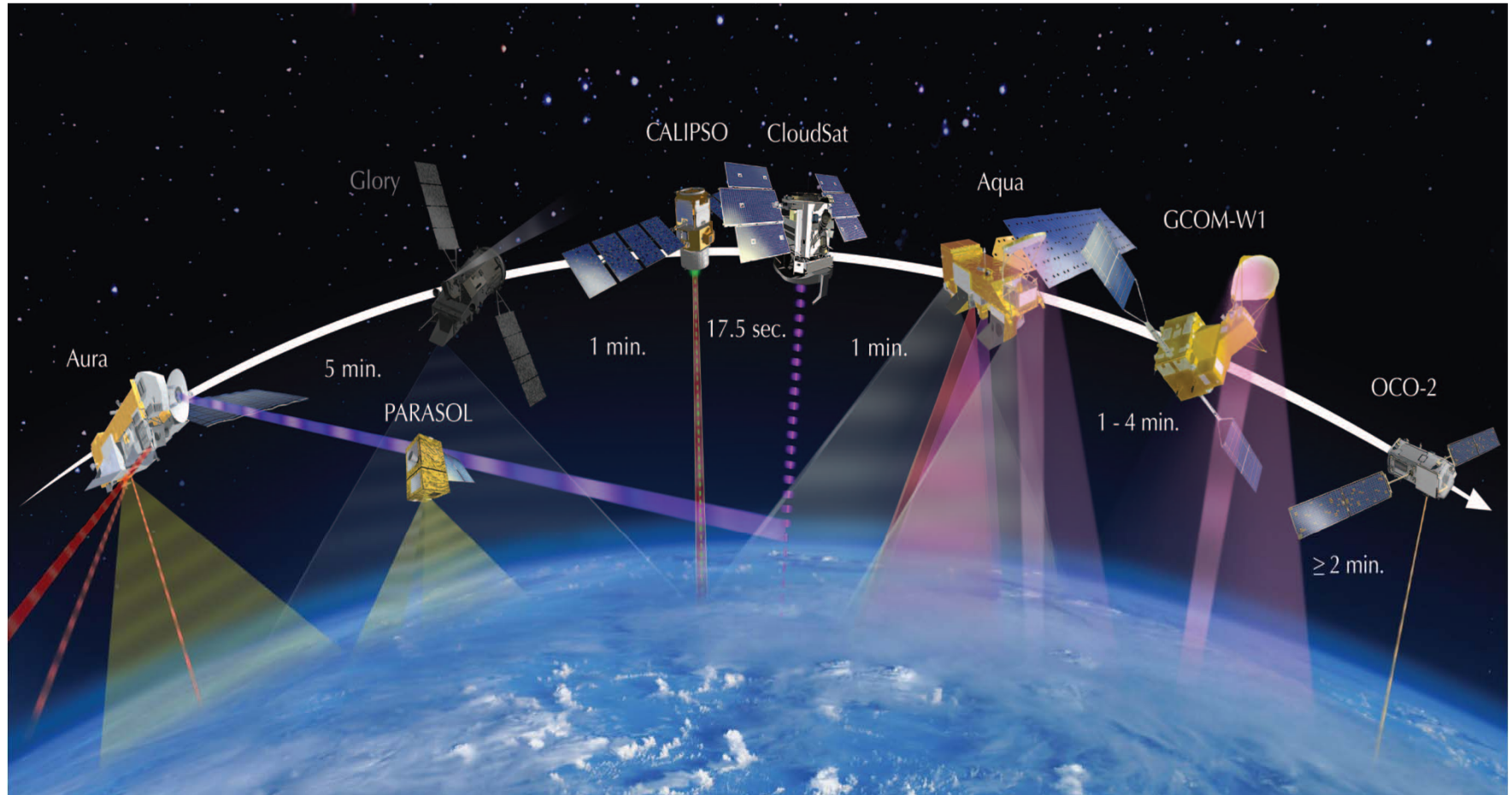




- ✧ NASA is the leading federal agency for climate science
- ✧ Monitors atmosphere, sun activity, sea level, pollution, ice changes, and more



<http://climate.nasa.gov>



A-TRAIN
formation flying

CloudSat - A View Into the Clouds

- CloudSat is a Spaceborne cloud profiling radar tuned so that clouds reflect energy based on the amount of condensed/frozen water in the cloud
- Gives us the first global look at the structure and life cycle of clouds of all types

What is remote sensing?

The acquisition of data or information about a location or object without direct, physical contact with the item of interest.

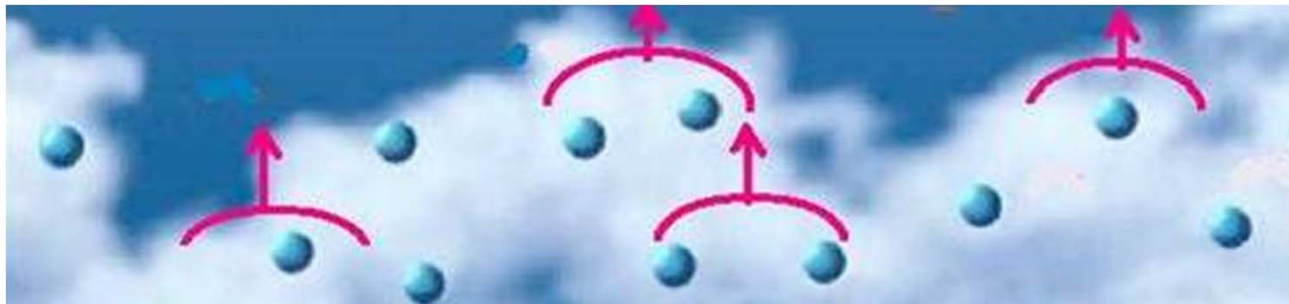
This is different than an in-situ measurement, which is one where the instrument is in physical contact with the object(s) being monitored

Examples

As CloudSat orbits Earth, it transmits short pulses of microwave energy down into the Earth's atmosphere.



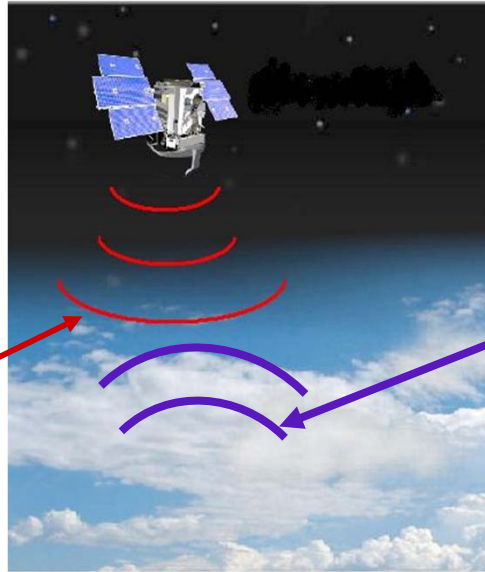
As CloudSat orbits Earth, it transmits short pulses of microwave energy down into the Earth's atmosphere.



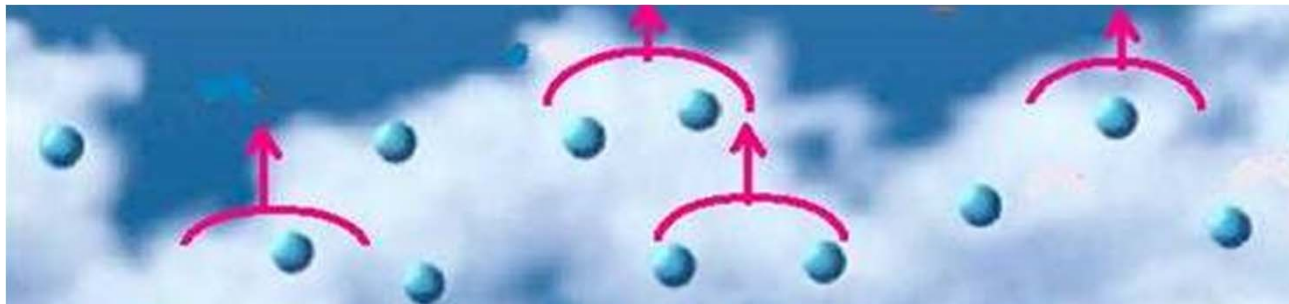
*A fraction of these pulses reflect off of cloud particles and bounce back to the satellite.
Other pulses continue downward*



As CloudSat orbits Earth, it transmits short pulses of microwave energy down into the Earth's atmosphere.

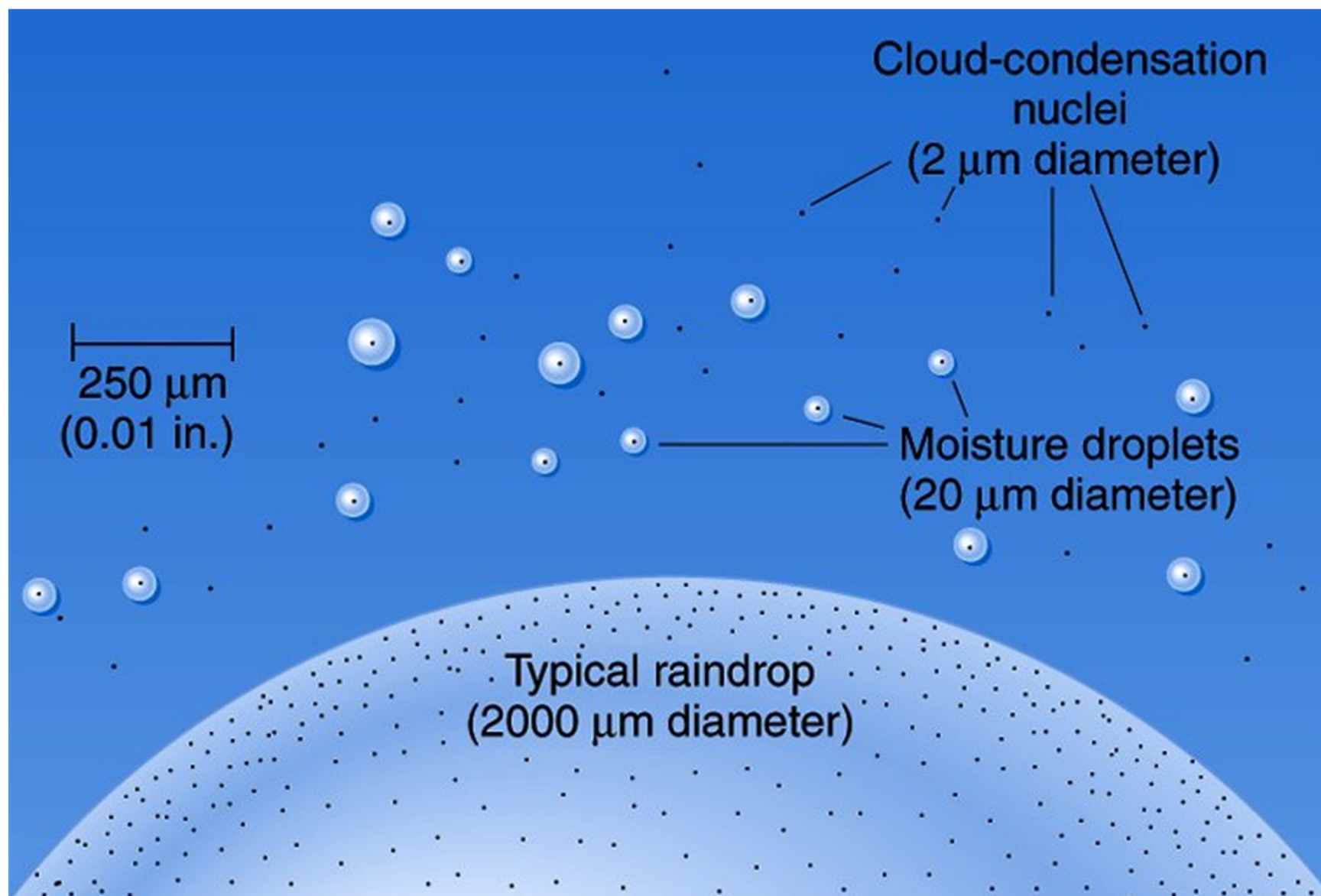


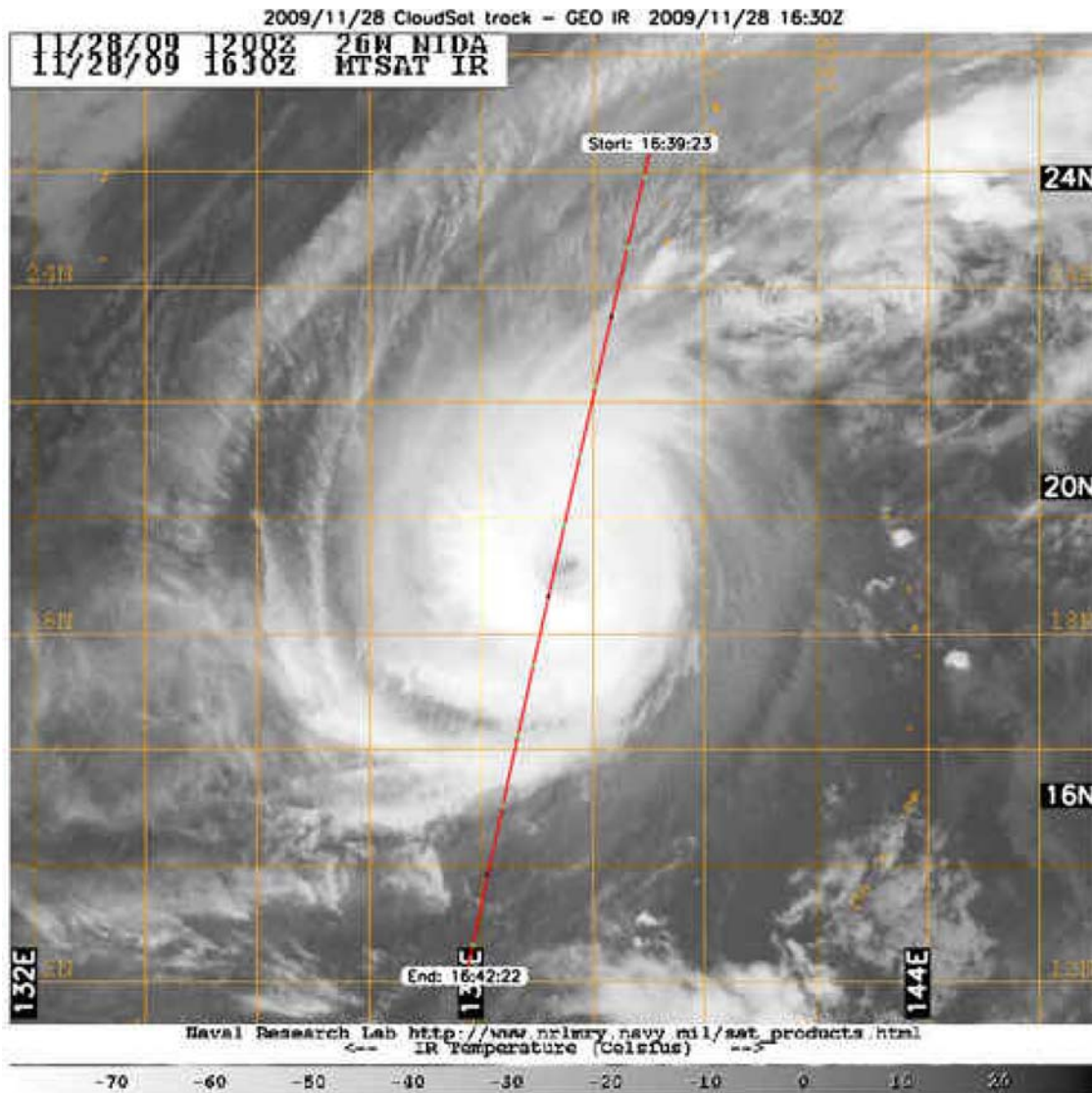
The CloudSat radar measures the time delay and magnitude of the reflected signal



*A fraction of these pulses reflect off of cloud particles and bounce back to the satellite.
Other pulses continue downward*

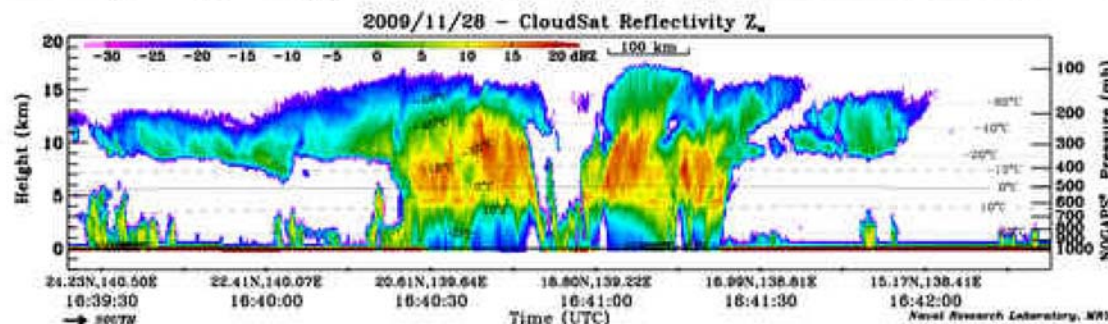






There are many hurricane overpasses on the CloudSat website, in addition you'll find:

- educational resources about clouds
- connections between clouds and art
- ways to access looks at the clouds over your school from CloudSat.

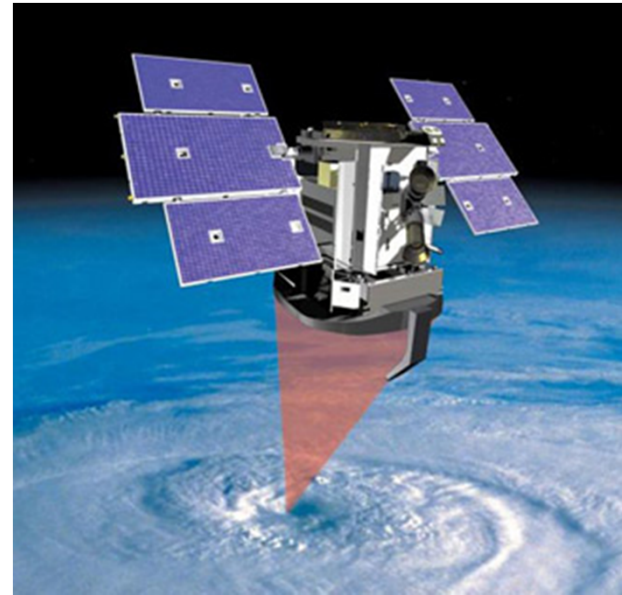


The CloudSat Education Network



The CloudSat Education Network (CEN) is the outreach program of the mission that utilizes surface observations *collected by students* to compare with CloudSat radar data.

Student observations are based on the GLOBE Atmosphere Protocol, and data is sent to both GLOBE and the CEN server through the CEN Webpage



Observations are timed to coincide with overpasses of CloudSat - happens every 10-16 days for any single school

Observations include measurement of temperature, cloud type and cover, contrail information, and precipitation, *along with* photographs of clouds





GLOBE & CLOUDSAT

student work & projects



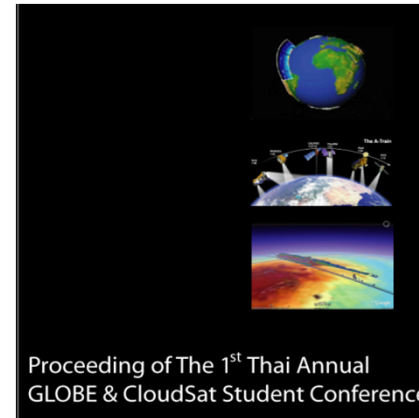
Cameroon



Collecting Weather data

- Cameroon students work in schools with limited access to technology. Their teachers bike to a local internet café to enter data. Current initiative to help improve technology & access underway.

Thailand



Year-long projects culminate in one week conference

- 10 schools from all over Thailand work with Thai university graduate students on inquiry, school-based projects using GLOBE/CloudSat data and gather to present their work.



GLOBE & CLOUDSAT

student work & projects

INDIA



Winners of the art contest!

- One of CloudSat's highest performing countries.
- Science is favorite subject among secondary students.

GERMANY

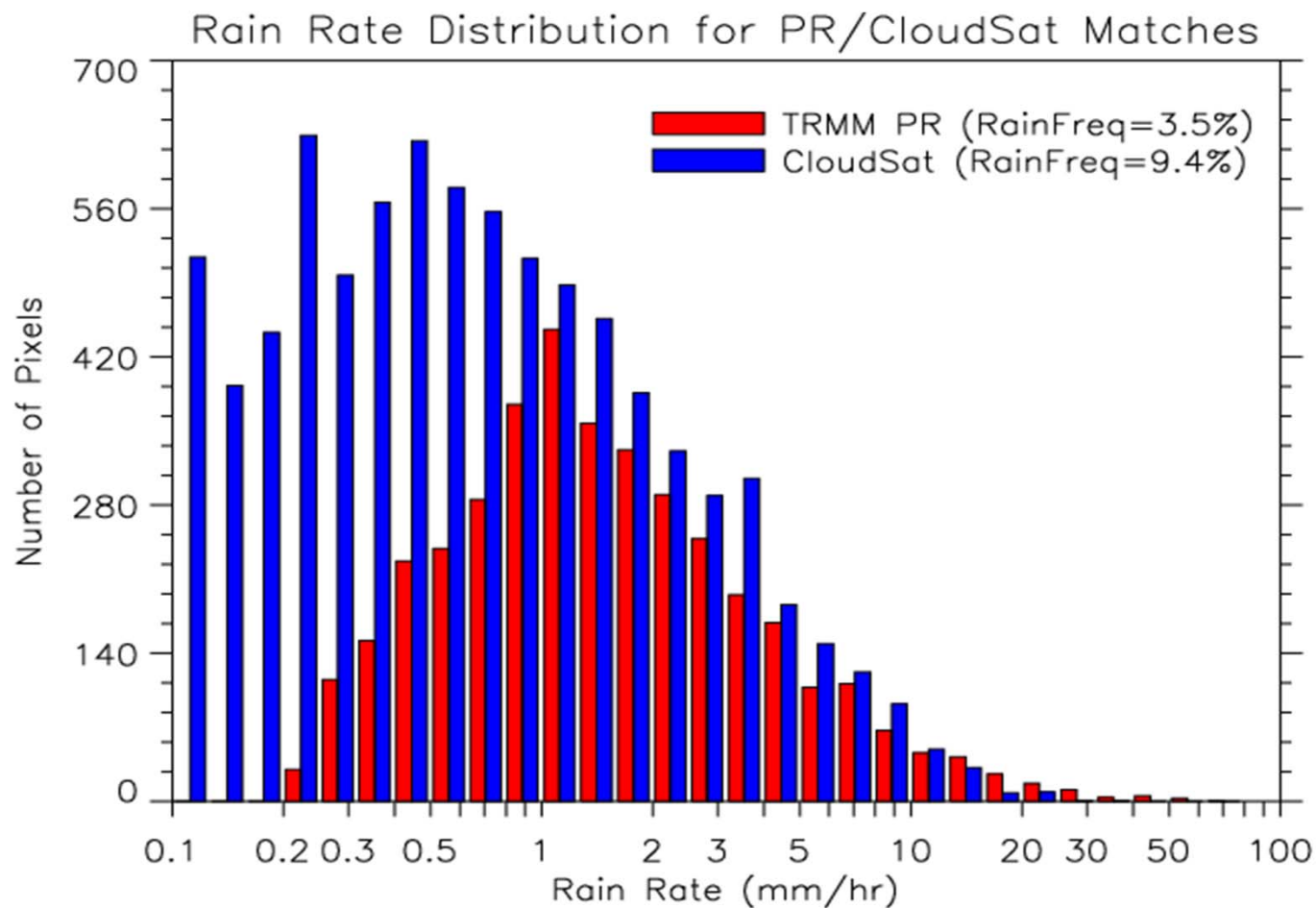


Students enter weather data

- Gymnasium Schlob Neuhaus awarded GLOBE Germany school of the year for their work with CloudSat data on weather project.

CloudSat measures rainfall previously missed by satellites

Before CloudSat, satellite observations of rainfall were unable to detect light rainfall (drizzle). Because CloudSat can observe a large range of rainfall rates from drizzle to heavy rainfall, CloudSat data have shown that it rains more than 3 times more often (blue bars below) than previously observed (red bars below), primarily because CloudSat detects the light precipitation previously missed (the lack of red bars at the left).



Source: Berg
and L'Ecuyer
(GRL, 2009)

CloudSat “FIRSTS”

- **FIRST global vertical cloud structure statistics, including the occurrence of multiple (overlapping) clouds.**
- **FIRST ability to monitor, from space, polar storms in the polar night.**
- **FIRST snowfall detection and quantification.**
- **FIRST global water and ice content of clouds and the total mass of condensate.**
- **FIRST estimate of how efficiently clouds convert condensed water into rain.**
- **FIRST estimate of the fraction of clouds on Earth that are precipitating.**
- **FIRST observation from space that sees both the clouds and the precipitation that falls from clouds at the same time.**
- **FIRST (indirect) estimate of the atmospheric radiative heating by clouds.**