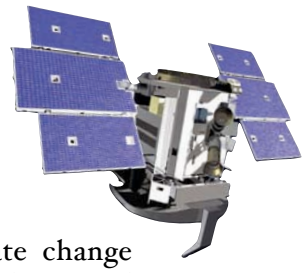
The CloudSat Downlink

The "Other" Kind of Climate Change – Extremes in Climate



What is the difference between weather and climate, and how are they related?

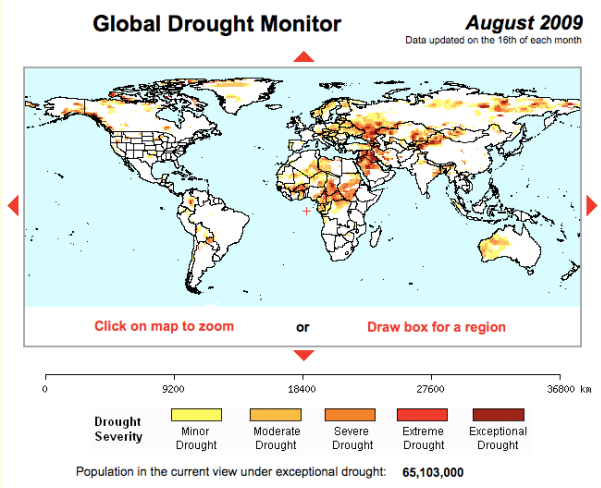
In central New York state, and all through the Northeastern United States, it's been an unusual year for weather. Lots of clouds, lots of rain, and the temperature has yet to get above 32°C (90°F). Along the front range of Colorado's Rocky Mountains, there's been enough rain and snow to allow a full current of water to flow in the Cache La Poudre River in Fort Collins for the first time in 10 years. These are examples of unusual weather patterns that can happen unpredictably anywhere in the world.

Unfortunately, many people confuse these unusual weather patterns with climate change. It's not uncommon to hear people say that, given cooler than normal temperatures, that there is no global warming! And yet, despite these patterns, the global average temperature in 2009 is the fifth warmest ever! (See the data for yourself at the National Climatic Data Center at http://www.ncdc.noaa.gov/oa/climate/research/2009/jun/global.html).

So that brings us to the real question – what is the difference between weather and climate and how do they influence each other? Think about rolling dice. Every time you roll a typical 6-sided die, you have the same chance of rolling a "1" as you might have of rolling a "6". So how is this like weather and climate? If a "1" means sun, and a "6" means rain, then what ever is "rolled" by the atmosphere is your weather that day. It's not even uncommon that you might roll three "6"s in a row – a rainy spell, maybe like the one in New York – but if you keep rolling the dice enough times over many years, it will all equal out to a typical pattern – which is like the climate!

So how might climate change affect our dice? If you take your dice and put pieces of tape on one side to make that side heavier, the heavy side will end up on the bottom more often. This will change how often you get different kinds of weather. Maybe now you'll roll more "1's" and have more hot, sunny days than before. The climate has changed, not just by making it warmer, but also changing how often we can "roll" very hot days!

Scientists working with the Intergovernmental Panel on Climate Change (http://www.ipcc.ch) have been looking at changes in these climate extremes. One thing we've seen is that we're having more droughts globally than we've had in a long time (see the image below from University College in London)

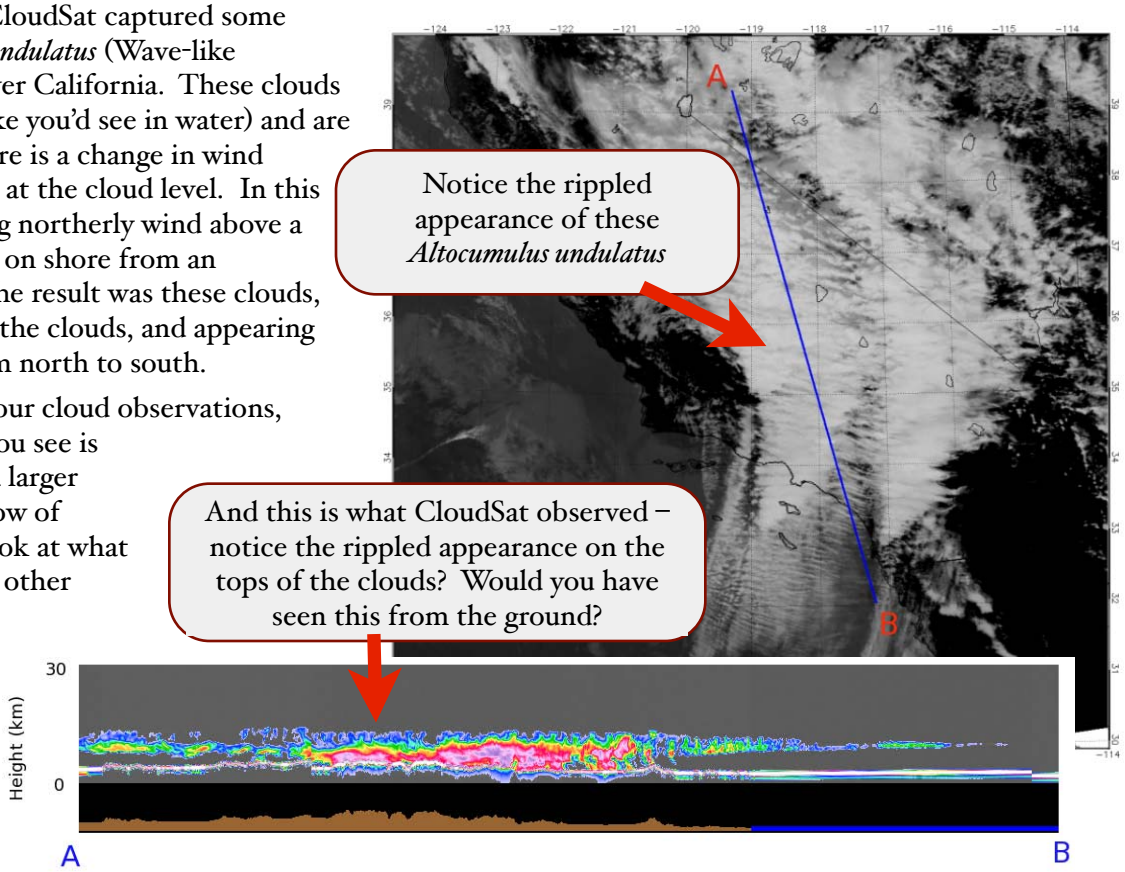


So has it seemed hotter or colder than usual this year? Have you had more rain? Remember, you're seeing changing weather patterns, not necessarily climate change. But, if it lasts for a long time, it might be a sign that the dice have changed!

CLOUDSAT CAPTURES "WAVES" IN CLOUDS OVER CALIFORNIA

On June 3, 2009, CloudSat captured some excellent *Altocumulus undulatus* (Wave-like altocumulus clouds) over California. These clouds look like waves (just like you'd see in water) and are often caused when there is a change in wind direction and/or speed at the cloud level. In this case, there was a strong northerly wind above a layer of clouds coming on shore from an approaching storm. The result was these clouds, forming at the tops of the clouds, and appearing like waves moving from north to south.

When you make your cloud observations, remember that what you see is almost always part of a larger pattern. If you see a row of clouds in the sky, go look at what CloudSat saw, or some other visible satellite image. Sometimes clouds will look completely different from space!



WHY ARE CLOUDS SOMETIMES WHITE AND SOMETIMES DARK?

Here's a simple demonstration you can do to show students why thick clouds appear white from the sides and top, but dark when you're underneath them.

What you need

- 2 Petri dishes (clear glass works best)
- 50 mL **Whole** Milk
- India ink (or inkpad refill ink)
- A dropper
- Enough water to fill petri dishes
- Overhead projector

What do to

Place your water-filled petri dishes on the overhead and turn it on. You should be projecting images of the light passing through the water up onto your screen. To one of the dishes, add a enough drops of ink so that the light no longer passes through. **Ask your students where the light went**. It's being absorbed by the ink, which is why the water appears black and no light passes through.

Now, **ask them what will happen when you add whole milk to the other petri dish**. Now add some drops of whole milk to the water. You should see that the image on the screen turns black, but the dish itself looks white. **Ask students what is happening to the light now.** The light is being scattered off of the fat globules in the whole milk and out the sides of the dish. No light passes through to the screen. It's similar to the ink in that no light goes through, but different in that the light isn't being absorbed, but rather redirected.

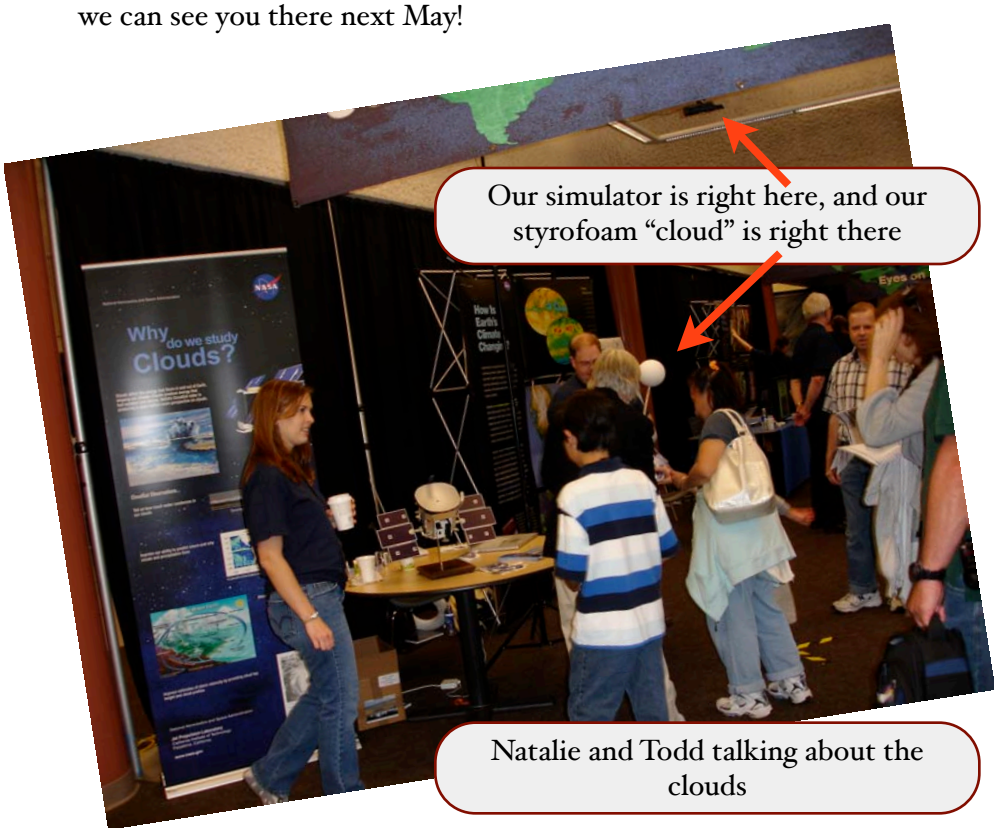
This is like what happens in some clouds. Light from above can't pass through, so it appears dark when looking up at them. But the light is scattered out the sides, making the cloud appear bright white from a distance.

CEN AT THE JPL OPEN HOUSE

During the first weekend in May, the CloudSat Education Network was on the road at the NASA Jet Propulsion Laboratory (JPL) Open House in Pasadena, California. On May 2 and 3, several of the CEN scientists and educators manned an exhibit in the Earth exhibit hall along with several other Earth-monitoring NASA missions. And we debuted a new fun educational toy - our CloudSat simulator - which was a huge hit as you can see from the pictures below.

The CloudSat simulator is meant to demonstrate the concept of active remote sensing - where a satellite transmits energy that is reflected off of objects and received by the satellite. The time it takes for a signal to go out and come back tells us where the object is. Our simulator uses an ultrasonic transducer - the same kind as those often used to measure distances and speeds in classroom physics experiments. But we mounted ours over people's heads and we let people jump up and down underneath it. It was great fun (and good exercise too...).

We participate in the JPL Open House every year, and hope that we can see you there next May!



Our simulator is right here, and our styrofoam "cloud" is right there

Natalie and Todd talking about the clouds

Don't forget to send your cloud and CloudSat related questions to askascientist@atmos.colostate.edu

Newsletter Contributors

DR. TODD ELLIS

Assistant Professor of Meteorology at the State University of New York College at Oneonta and member of the CEN Outreach Team. He can be reached at ellistd@oneonta.edu

MS. DEANNA TEBOCKHORST

Director of Education Outreach for the CEN, based in Fort Collins, Colorado at Colorado State University. She can be reached at deanna@atmos.colostate.edu

MS. NATALIE TOURVILLE

Colorado State University graduate student and resident computer genius who regularly finds cool CloudSat images and puts them on the website. She can be reached at natalie@atmos.colostate.edu.

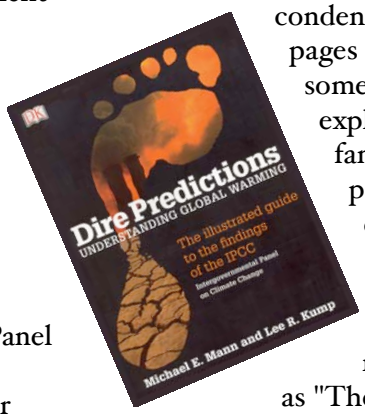
MORE PICTURES FROM THE JPL OPEN HOUSE

Greetings from the JPL Open House

BOOK REVIEW: DIRE PREDICTIONS: UNDERSTANDING GLOBAL WARMING

By Todd Ellis

Since we've been talking about climate change in this edition of the *Downlink*, it seemed good to review another excellent resource for climate change: *Dire Predictions: Understanding Global Warming* by Michael Mann and Lee Kump.



In 2007, the Intergovernmental Panel on Climate Change (IPCC) released their massive 2100 page, 3 volume report on the scientific assessments of climate change, their human impacts, and the possibilities for mitigation. However, this massive collection is not easy to read for students of any age. *Dire Predictions* condenses them into 200 pages of easily understood, sometimes amusing explanations and fantastic full-color, full-page illustrations, laid out by DK Publishing, which specializes in popular illustrated reference books such as "The Way the Universe Works."

Sections treat "Climate Change Basics," "Climate Change Projections," "The Impacts of Climate Change," "Vulnerability and Adaptation to Climate Change," and "Solving Global Warming." They also strive to debunk commonly held myths about climate change. The authors consider each myth or misunderstanding and explain any kernel of truth within it before providing its refutation.

While the book is perfect for people already interested in global climate change, it would also make a good beginning for an introductory course in the subject for students not majoring in science, including middle school students.

The ISBN is 978-0136044352.