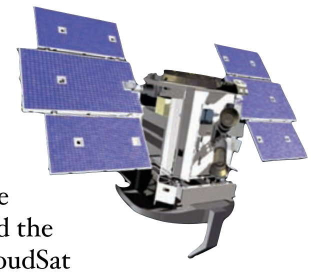
The CloudSat Downlink

Cloud Classification from Space

You've identified clouds from the ground, but how does a satellite like CloudSat identify them from above? – by Matt Rogers



By now, almost every CEN student and teacher is familiar with identifying clouds from the ground - estimating cloud cover using tips and techniques taught at teacher trainings, putting four students in a 90-degree box to scan quadrants of the sky, comparing observed clouds to the GLOBE cloud chart, and having long discussions over just what is the difference between an altocumulus and a cumulus cloud. But when you do those observations, you're making a measurement with your eyes and brains that is very difficult to do with other scientific instruments!

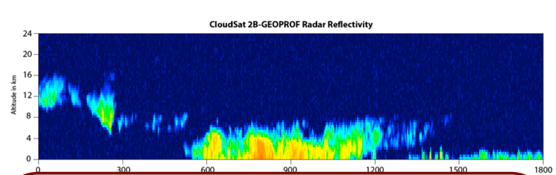
Nothing in the world compares to the sophistication of the human brain, especially with regard to pattern-matching skills like we use when we identify clouds. Even the youngest of our CEN students has far, far more 'processing power' than the most powerful of computers, to say nothing of our favorite orbiting cloud radar. Have you ever stopped for a second and wondered 'how exactly does CloudSat identify clouds?' After all, it's not like CloudSat can check a cloud chart, or ask a friend if it's uncertain about a particular cloud.

Since we are all familiar with how a human would identify a cloud, it might be a good idea to explain how a robotic brain, attached to a one-of-a-kind radar circling the earth, might find a way to identify cloud types from space. Although CloudSat cannot experience any of the five senses so familiar to us, it does have one, very powerful sense - it can measure how much water there is in the atmosphere and how far away that water is by 'listening' to its reflected radar signal. This signal, called 'radar reflectivity factor', tells us a lot about the properties of water in the atmosphere and helps CloudSat identify cloud types from space.

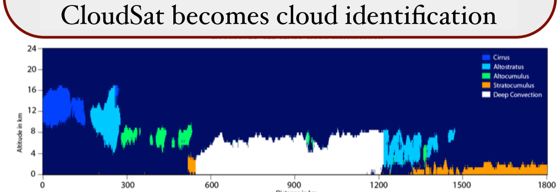
Two scientists, Prof. Ken Sassen of the University of Alaska-Fairbanks, and Prof. Zhien Wang of the University of Wyoming, lead the work necessary that lets CloudSat determine different types of clouds. They discovered that different types of clouds had different properties, and that if you knew just a little bit of extra information (like the temperature of the atmosphere at different levels and how big a cloud is in kilometers and whether or not the cloud is producing rain or snow) then you could identify eight different types of clouds: cirrus, altostratus, altocumulus, stratus/stratocumulus, cumulus, deep cumulonimbus, and nimbostratus.

The two scientists spent years working on their cloud rules, and figuring out how to get the extra information they needed from satellites already in space. They used maps of the ground, data from other A-Train satellites, computer models, and advanced computer techniques to figure out the most likely kinds of clouds that fit all the data. With all this information, they built a kind of electronic cloud chart used to perform cloud identification from space – the CloudSat 2B-CLDCLASS product, one of the most useful and unique properties of our Earth ever measured from space.

Of course, once you've created something as wonderful as Profs. Sassen and Wang did, you want to keep double-checking your work to make sure you're getting the very best answer you can. And that's where all of us in the CEN come into the picture - as sophisticated and elegant as their tables are, they can always be refined and improved on by using the power of a single human brain that can 'know', in a way that no algorithm or satellite or computer can, what a cloud is. By sending in your observations of cloud type, you are helping all of us who work on CloudSat to make our electronic cloud charts better and better!

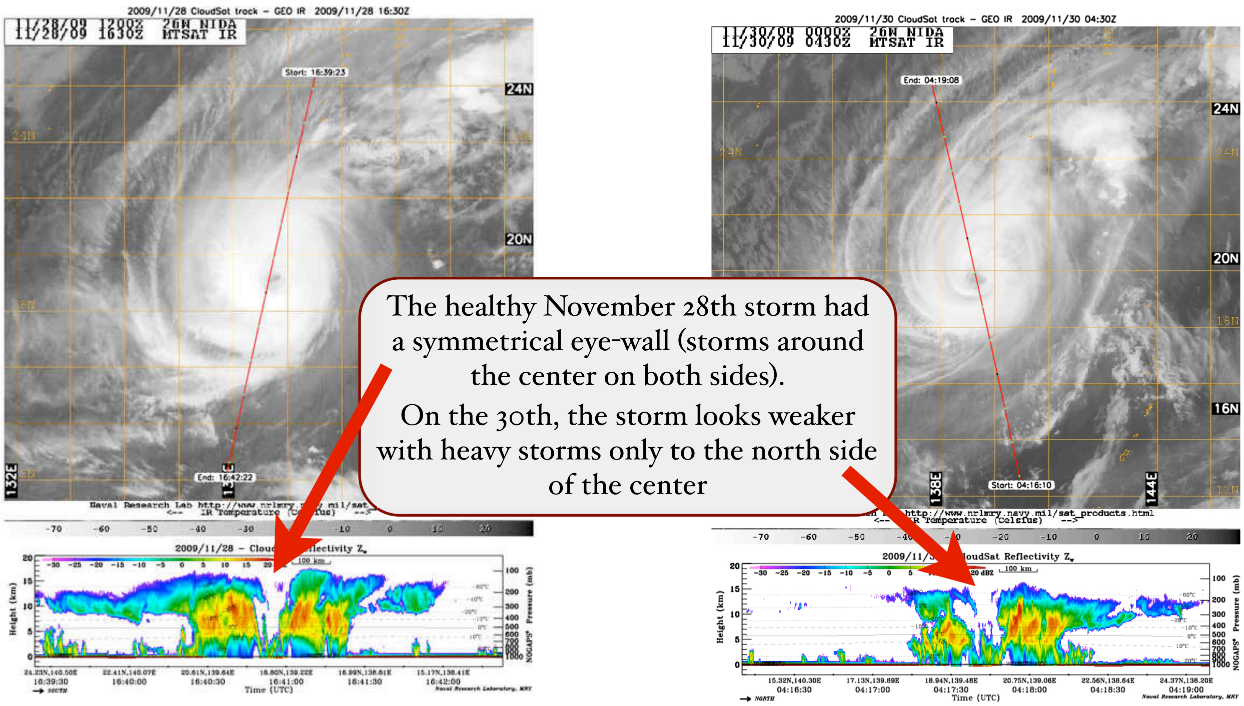


An example of how radar reflectivity from CloudSat becomes cloud identification



CLOUDSAT PASSES THROUGH THE EYE OF TYPHOON NIDA!

On November 28 and November 30, 2009, CloudSat did something amazing. It passed right over the eye of Typhoon Nida not once, but twice! And in between the passes, you can see that the storm was weakening as it passed over cooler ocean waters and moved into dry air that started to use up some of the energy from the storm! So not only can learn about the eye of this impressive storm, but we got to watch as it weakened over three days!



SCATTERING SKY LIGHT - OR - WHY IT'S HARD TO SEE IN THE HAZE

Depending on where you live, you may not see haze much. Haze is a word meteorologists use to describe the particles in the air that grow big in hot, humid days that makes it hard to see very far. But why is that? It's hard to do this as a classroom demo, so instead, today lets use our imaginations with the following question:

If I'm standing on the roof of a tall building, I can see farther to the west in the morning than I can in the afternoon. Why?

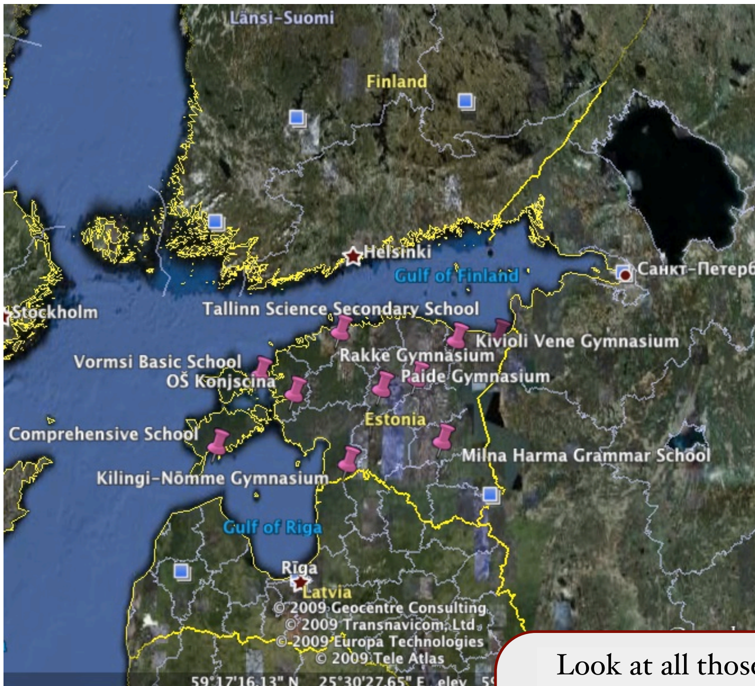
Let's start by thinking about haze particles themselves. These are certain tiny specks in the air that grow bigger when they are in humid conditions. The bigger they get, the more likely it is that when light hits them from behind, most of the light gets sent straight ahead (almost like it gets focused by the particles). So imagine you are standing in the morning, looking west. The sun would be at your back. This means that any sunlight hitting our haze is more likely to travel forward (away from you). Your eyes don't get flooded with extra light bounding off the haze into your eyes, and you can see farther!

Later in the day, the sun would be in front of you. The light scatters forward into your eyes, making it much harder to see. (Actually, if you've ever been in a car with a dirty windshield the same thing happens. Looking into the sun, the windshield is much harder to see through that if the sun is behind you.)

But there's one more thing. Later in the day, it also tends to get more humid as the air tends to have more moisture in the afternoon. This makes the haze bigger, and makes the light hitting your eyes from the sky that much brighter!

So for those of you that play games outside where you have to catch a ball in the air, the next time you drop the ball, tell them that the haze made you do it!

USING GOOGLE EARTH TO FIND OUR CEN SCHOOLS



By Todd Ellis and Joshua Torres

Have you ever wondered where on Earth those other CEN schools are? Wonder no more - you can now use the free Google Earth to locate and contact all the other active schools in the CloudSat Education Network.

The special file containing all the CEN schools is available on the CEN webpage, you can freely download it and see where all the other schools are. There are links to some of the schools webpages too.

And keep paying attention to this newsletter for future announcements as scientists are working to find other ways to use Google Earth to see data about clouds in our atmosphere!

Look at all those schools in Estonia! Now you can find out exactly where they are with Google Earth!

BOOK REVIEW: THE CLOUDSPOTTER'S GUIDE: THE SCIENCE, HISTORY, AND CULTURE OF CLOUDS, BY GAVIN PRETOR-PINNEY

By Todd Ellis

This edition's book is about something that, by now, I think we're all familiar with - looking up at clouds. Gavin Pretor-Pinney takes this to a whole new level with a bit of the science of what's in a cloud and why they have those shapes all the way through to references to clouds is poetry, physics, and pop culture.

The best part of this book, besides all the funny stories and amazing pictures, is that the science is not only accurate but fun to read. He really captures the spirit of what all of us at CEN think about the clouds - that there's a story in every one. Now in paperback, the stories the author tells in *The Cloudspotter's Guide* are definitely worth the read.

This book is available in paperback from Perigee Trade. The ISBN is 978-0399533457.

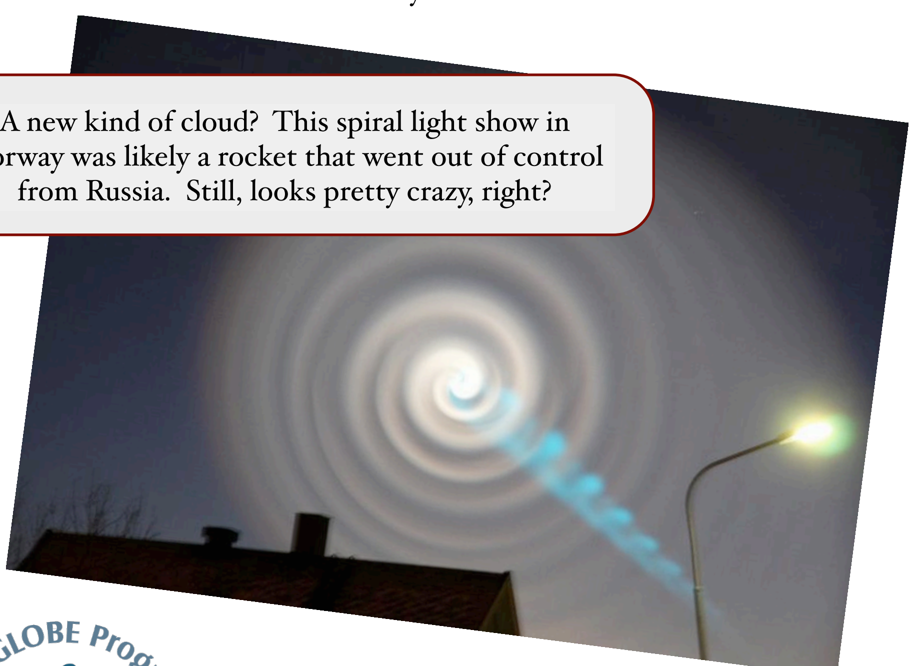
NEW YEARS WISHES FROM ALL OF US AT THE CEN

As 2009 comes to a close the CloudSat outreach team would like to express our appreciation to all of our CEN schools. Thank you for your participation and the efforts that each of you make, we truly appreciate it! Through 2009 schools have reported an amazing 2228 times and have made significant contributions to our understanding of clouds, climate, and weather.

During 2009 we have added this newsletter, updated our database, and refreshed our website. We hope that some of these changes will help us provide you with tools for bringing CloudSat and atmospheric sciences into your schools & classrooms. Severe weather events are featured on the website and we are in the process of posting a Google map of CEN schools. We encourage you to connect with others in the CloudSat network, find out where they are on the Google Earth map, to share stories, collaborate on projects, and build connections. We would be delighted to feature any of your stories, photos, or projects in our newsletter!

All of us wish all of you the very best in the coming New Year!

And here's an end of year science question: December is the last month of the year and the month when a solstice occurs. A solstice is an astronomical event that happens twice each year, when the tilt of the Earth's axis is most inclined toward or away from the Sun, causing the Sun's apparent position in the sky to reach its northernmost or southernmost extreme. When do you think the other solstice is?



A new kind of cloud? This spiral light show in Norway was likely a rocket that went out of control from Russia. Still, looks pretty crazy, right?

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

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