S'COOL BREEZE

Student's Cloud Observations On-Line

Volume 3 , Issue 7 March 2004

The Sky is the Limit

By MARS Exploration Rover Mission Team, NASA Jet Propulsion Laboratory

Believe it or not, some of the scientists on the Mars Exploration Rover Science team don't really care too much about rocks - or for that matter anything on the surface of Mars. They have "higher" ambitions. Their passion lies in the skies – the Martian skies – and, from the hazy glow of the atmosphere, they pull precious pieces of information.

Two of these sky gazers are Mike Wolff and Mike Smith. They are looking forward to Opportunity's landing and the chance to do more atmospheric studies than they've been able to do so far. "It's a bit of a running joke that the atmospheric team gets left out," laughs the jovial pair. "Let's be honest, this is predominantly a geology mission – water and rocks." The atmospheric team is also a little outnumbered, "There are very few of us atmospheric scientists who want to spend Spirit's or Opportunity's time looking at the sky. The vast majority of the team wants to look at the ground."

This Mars Global Surveyor image shows bluish white water-ice clouds in the Martian atmosphere.

All the joking aside, Mike and Mike know the importance of good atmospheric data, explaining that it is crucial for "ground-lookers" to know what they are seeing. For instance, scientists study the light that is reflected from each surface to determine what minerals are in the rocks on Mars. In order to make accurate calculations, they must understand the atmosphere through which the light traveled before reaching the rocks and reflecting back.

"They DO need us," smiles Wolff. "Our team provides information about the amount of dust and water vapor in the atmosphere, allowing other teams to make sense of what they're seeing."

Beyond a supportive role, the atmospheric team is trying to answer big questions about the climate on Mars that will help all future Mars exploration.

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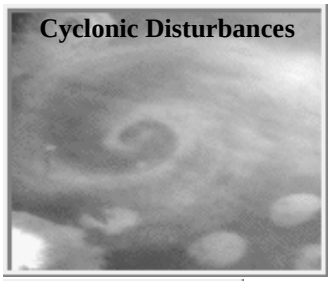
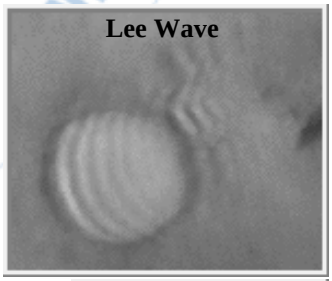
Inside this issue:

A Pictorial of Martian Clouds

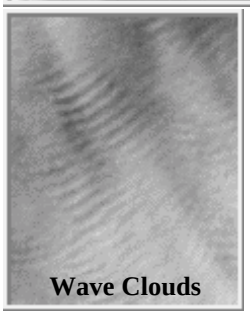
By Roberto Sepulveda
Courtesy of Michael J. Hamilton, *Views of the Solar System*



Cyclonic Disturbances



Lee Wave



Wave Clouds

Cloud Streets

Have you ever wondered if clouds are a part of only Earth's splendid skies? Ever thought of clouds on a more celestial plane? Well, thanks to many international space missions, scientists have observed clouds in the atmospheres of most planets belonging to our solar system. In fact, clouds are common features on Mars. The Martian atmosphere has only a trace of water vapor; however, the temperature and pressure is such that the atmosphere is usually close to saturation and produces clouds. Numerous cloud images, like the magnificent display seen in the Cyclonic photo on the left, have also been obtained from the Mariner and Viking spacecrafts. Cyclonic disturbances like this are

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Late morning Martian hours, looking toward the Sun.

Early afternoon, when the Sun was higher and the skies appeared darker.

This image mosaic taken by Spirit's panoramic camera shows the hills southeast of Spirit's landing site. Like a smoggy day in Los Angeles, dusty Martian skies limit how much detail can be seen.

"We need a complete understanding of the environment we're working with - what conditions do we need to prep for? How much dust is there, and will it interfere with machinery? What are the temperature extremes that can interfere with the successful operation of instruments? The more we understand the weather on Mars, the more likely it is that a Mars mission will have success," explains Smith in a serious moment.

The term "weather on Mars" can mean a lot of different things, but the atmospheric team is harvesting hypotheses from four main elements using Rover's instruments:

Air Temperature - the atmospheric team can determine the temperature of the Martian atmosphere at various heights from the surface to about two kilometers (about 1.2 miles) above the surface. Orbiters and previous landed missions could not provide this near-surface information

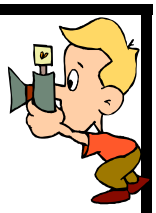
Water-Ice Clouds - Like the high, wispy, cirrus clouds we see here on earth, water vapor in Mars' atmosphere freezes and forms into cirrus-like clouds on Mars. By studying the quantity, location, and longevity of these clouds, scientists can better understand how water is exchanged between the Martian surface and atmosphere. "With Spirit and Opportunity we can watch the clouds throughout the day and monitor how they change," explains Wolff.

Water Vapor - "Water-vapor is a fancy atmospheric term for humidity," jokes Wolff. Mars does have some water vapor, but not much. The amount of water vapor in the atmosphere is important to scientists because it is a key part of the current climate and potentially gives clues about the distribution of water under the surface.

Dust - Scientists operating a rover on the surface of Mars have one major concern when it comes to dust: accumulation. The planet is covered in the fine, powder-like material and daily winds blow it across the planet forming dunes and ripples. Too much of this dust on the solar panels could cause them to work less efficiently.

During the mission, the rovers will point their Panoramic camera's and Mini-TES instruments towards the sky, giving the atmospheric team another chance to shine. Most of the atmospheric sequences only take under 20 minutes, and are easy to fit into all the rover's other daily activities. "We'll hopefully have lots of these 'fill-in' sequences throughout the mission," explains a smiling Smith. "We don't ask for much, but we promise to deliver a lot!"

The Winners of S'COOL's 4th Cloud Photo Contest



S'COOL received several photos for our fourth photo contest. We continue to enjoy the competitions and our next cloud contest will be announced during the next school year. We will continue to accept great photos to include in S'COOL's On-Line Cloud Chart at: http://asd-www.larc.nasa.gov/SCOOL/cldchart.html You may send us your photos as digital files or prints. Be sure to include your school, teacher name and photographer's first name (if a student) on photos submitted.

FIRST PLACE WINNERS of S'COOL's 4th Photo Contest are:
Sundog: Saint James School; Falls Church, VA, USA
Halo: Taipei Municipal Girls HS; Taipei, Taiwan
Rays: Sant Antoni Abat ; Valencia, Spain
For a list of all winners and their winning photos please visit our website at: http://asd-www.larc.nasa.gov/SCOOL/cloud_contest/

NASA STEMS

NASA Science **T**rivia
to **E**xcite & **M**otivate **S**tudents

Well, we're pretty sure that you know what the first successful Mars mission was. If you thought Mariner 4, in 1964, you are correct! But did you know that NASA is attempting to place a lighthouse in outer space? Not the typical lighthouse seen along marine areas but a high-precision interplanetary lighthouse that will guide incoming spacecraft as they near Mars. This 'lighthouse' will be aboard the Mars Reconnaissance Orbiter scheduled to be launched August 2005. This will be an experimental opportunity to test the use of the newest optical navigation camera. For more Mars facts and history visit: http://marsprogram.jpl.nasa.gov/missions/

Quarter's Worth of Websites

NASA's Mars Exploration Program: http://marsprogram.jpl.nasa.gov/
This site offers students and teachers a wealth of knowledge about the past, present and future missions related to Mars. It is loaded with multimedia images and videos that can be shared with students in the classroom.

The Gateway to Astronaut Photography of the Earth: http://eol.jsc.nasa.gov/
The Gateway to Astronaut Photography of Earth hosts the best on-line collection of astronaut photographs of the Earth.

Space Station Science Picture of the Day: http://science.nasa.gov/ppod/
Science officers aboard the ISS present pictures taken from the station's windows and sometimes highlight ongoing scientific research in physics and biology.

NASA's Earth Observatory: http://eol.jsc.nasa.gov/EarthObservatory/PostedSort.htm
Site for photographs submitted by our Earth Sciences and Image Analysis group.

Going Through the LooPlans Lesson

Create a Cloud in a Bottle

Objective: Students will use critical thinking skills of analysis and evaluation to determine conditions necessary for the formation of clouds.

Type of Activity: Application/Extension **Suggested Grade Level:** 8-12 (adaptable to other grade levels as teacher demonstration)

Vocabulary: Water Vapor, Condensation, Evaporation, Condensation Nuclei (Aerosol), Fog

Materials: warm water, aluminum tray, ice, see-through jar, match (aerosol source)

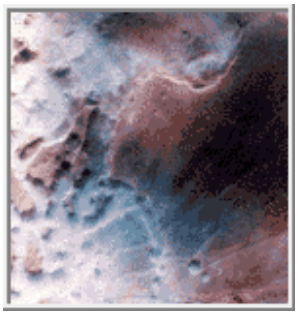
Background: Clouds consist of millions of tiny droplets of water. The droplets form by the condensation of water vapor. Air is cooled as it moves higher in the atmosphere. The cooling of the air prompts the condensation of the water droplets on dust particles. Condensation may also occur near the Earth's surface, resulting in fog. Fog forms when warm air passes over a cooler area, such as a body of water.

Lesson Activity: Here's how to make your own cloud.

1. Fill a jar with 2 inches (5cm) of warm water and stir.
2. Ask an adult to light a match, blow it out and drop it into the jar.
3. When the smoke clears, place an ice-filled aluminum tray on top of the jar.
4. Watch carefully and a cloud will form near the top of the jar just beneath the tray.

Teacher Notes: Warm tap water typically works well but do not use boiling water.

Complete Lesson Plan available at:
http://asd-www.larc.nasa.gov/SCOOL/lesson_plans/Create_Cloud_lab.html
Student "Cloud Cookery" available at:
http://asd-www.larc.nasa.gov/SCOOL/PDF/Cloud_ID_rev.pdf



A Pictorial of ... (Continued from page 1)

common during the late summer and fall along the edge of the polar cap. In the foreground, frost can be seen as bright areas. Martian cloud patterns have been classified into the following categories:

Lee waves: These clouds form in the lee of large obstacles such as mountains, ridges, craters and volcanoes.

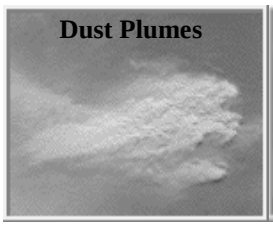
Wave clouds: These clouds appear as rows of linear clouds. They are common at the edge of the polar caps.

Cloud streets: They appear as linear rows of cumulus-like, bubble-shaped clouds.

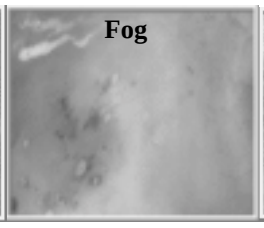
Streaky clouds: These clouds have a direction but do not observe any repetitive pattern.

Fog: Usually occurs in low areas such as valleys, canyons and craters. It forms during the coolest times of the day such as dawn and dusk. .

Plumes: These are elongated clouds. They appear to have a source of rising material and in many cases are composed of dust particles.



Dust Plumes



Fog

Streaky Clouds

Teacher Corner

Over 1650 participants are now registered.
Keep spreading the word!

Have you changed your school information? Please remember to notify us of any changes in your school information, e-mail address or anything you feel is important for our database.

New Student Resource - Cloud Tutorial!!!

The S'COOL team is proud to present our newest tutorial Check out the *Cloud Tutorial* at the following website:
http://asd-www.larc.nasa.gov/SCOOL/tutorial/

S'COOL Teachers Share Lessons

Check out the great lesson ideas at:
http://asd-www.larc.nasa.gov/SCOOL/lesson_plans/index.cfm
Join us by sending us your lesson ideas!

Remember, **Daylight Saving Time** begins **Soon!!!**
Request your updated satellite overpass schedule by selecting 'daylight saving time' on S'COOL's Overpass Calculator. Your school's schedule will be automatically adjusted to include the new time change.

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Upcoming Events

CERES Science Team Conference
March 26-31, 2004
Boulder, CO USA

NSTA Convention
April 1-4, 2004
Atlanta, Georgia USA

IOP–Intensive Observation Period
April 19-23 2004
World-wide

http://asd-www.larc.nasa.gov/SCOOL/visits.html

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Roberto Sepulveda, editor
Dr. Lin Chambers, French translator
Roberto Sepulveda, Spanish translator

"An Italian S'COOL Connection"

"My students are enthusiastic about working on the S'COOL project because: 1. they work for NASA
2. what before were referred to as simply 'clouds' have now taken on a more concrete meaning. They've learned to name and distinguish the clouds (they always have their heads in the clouds!)."

Maria Alfano, docente Scienze matematiche, Scuola Media Statale; Cave de Tirren, Italy

Check out our News and Reviews pages at:
http://asd-www.larc.nasa.gov/SCOOL/newsrev.html