GEOQ EXTERNAL NEWS

ESA declares end of mission for Envisat

Paris, 9 May 2012 – Just weeks after celebrating its tenth year in orbit, communication with the Envisat satellite was suddenly lost on 8 April. Following rigorous attempts to re-establish contact and the investigation of failure scenarios, the end of the mission is being declared.

The Envisat satellite. (Credit: ESA)

A team of engineers has spent the last month attempting to regain control of Envisat, investigating possible reasons for the problem.

Despite continuous commands sent from a widespread network of ground stations, there has been no reaction yet from the satellite.

As there were no signs of degradation before the loss of contact, the team has been collecting other information to help understand the satellite's condition. These include images from ground radar and the French Pleiades satellite.

With this information, the team has gradually elaborated possible failure scenarios. One is the loss of the power regulator, blocking telemetry and telecommands.

Another scenario is a short circuit, triggering a 'safe mode' – a special mode ensuring Envisat's survival. A second anomaly may have occurred during the transition to safe mode, leaving the satellite in an intermediate and unknown condition.

Although chances of recovering Envisat are extremely low, the investigation team will continue attempts to re-establish contact while considering failure scenarios for the next two months.

The outstanding performance of Envisat over the last decade led many to believe that it would be active for years to come, at least until the launch of the follow-on Sentinel missions.

However, Envisat had already operated for double its planned lifetime, making it well overdue for retirement.

With ten sophisticated sensors, Envisat has observed and monitored Earth's land, atmosphere, oceans and ice caps during its ten-year lifetime, delivering over a thousand terabytes of data.

An estimated 2500 scientific publications so far have been based on this information, furthering our knowledge of the planet.

During those ten years, Envisat witnessed the gradual shrinking of Arctic sea ice and the regular opening of the polar shipping routes during summer months.

Together with other satellites, it monitored the global sea-level height and regional variations, as well as global sea-surface temperatures with a precision of a few tenths of a degree.

Years of Envisat data have led to a better understanding of ocean currents and chlorophyll concentrations.

In the atmosphere, the satellite observed air pollution increase in Asia and its stability in Europe and North America, and measured carbon dioxide and methane concentrations. Envisat also monitored the Antarctica ozone hole variations.

Over land, it mapped the speed of ice streams in Antarctica and Greenland. Its images were used regularly to update the global maps of land use, including the effects of deforestation.

Using its imaging radar, Envisat mapped ground displacements triggered by earthquakes and volcanic eruptions, improving understanding of tectonics and volcanic mechanisms.

Envisat provided crucial Earth observation data not only to scientists, but also to many operational services, such as monitoring floods and oil spills. Its data were used for supporting civil protection authorities in managing natural and man-made disasters.

Envisat has also contributed valuable information to the services within Europe's Global Monitoring for Environmental Security (GMES) programme, paving the way for the next generation of satellites.

Now with the end of the mission, the launch of the upcoming GMES Sentinel satellites has become even more urgent to ensure the continuity of data to users, improve the management of the environment, understand and mitigate the effects of climate change and ensure civil security.

Release published by the European Space Agency (ESA)

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Study of Patagonian glacier's rise and fall adds to understanding of global climate change

Woods Hole, Mass., 16 March 2012 – Glaciers play a vital role in Earth's climate system, and it's critical to understand what contributes to their fluctuation.

Increased global temperatures are frequently viewed as the cause of glacial melt, but a new study of Patagonia's Gualas Glacier highlights the role of precipitation in the glacier's fluctuation. The study, conducted by Sébastien Bertrand of the Woods Hole Oceanographic Institution (WHOI) and his colleagues, reconstructs a 5,400 year-record of the region's glacial environment and climate, comparing past temperature and rainfall data with sediment records of glacier fluctuations and the historical observations of early Spanish explorers.

The study, 'Precipitation as the main driver of Neoglacial fluctuations of Gualas Glacier, Northern Patagonian Icefield,' was published March 15 in the Open Access journal *Climate of the Past*.

As glaciers fluctuate, retreating or adding mass, they dramatically affect the water cycle – locking up fresh water as they amass, causing the sea level to rise as they thaw and retreat.

"Improving our understanding of the impact of climate changes on glacier variability is one of the most pressing aspects of present-day climate research," says Bertrand, a postdoctoral fellow in WHOI's Marine Chemistry and Geochemistry department and the Renard Centre of Marine Geology, University of Ghent.

The focus of the work is Gualas Glacier, a 32-kilometre long shifting mountain of ice with an area of 119.2 square kilometres that sits above Golfo Elefantes. It is part of the Northern Patagonian Icefield (NPI), a series of 70 glaciers fed by precipitation that originates in the Pacific Ocean and falls in the rain belt west of the Andes, reaching levels of up to ten metres a year. The majority of the western NPI glaciers have retreated over the last 150 years.

"These glaciers are retreating as a response to global climate change, but not only because of increasing temperature, which is generally cited as the cause of worldwide glacier retreat," said Bertrand. "The fast retreat of Gualas, and other western NPI glaciers,

WHOI postdoctoral fellow Sébastien Bertrand calibrates an instrument along the Rio Aysen, South America. (Photo courtesy of Zakaria Ghazoui, Renard Centre of Marine Geology, University of Ghent, Belgium.)

A team of researchers led by Sébastien Bertrand, of the WHOI Marine Chemistry and Geochemistry department, took sediment samples during five weeks of field work in the fjords of Chilean Patagonia. (Photo courtesy of Dr. Claudia Silva.)

during the last century, seems to be driven by a decrease in winter precipitation – snow – rather than by an increase in temperature."

The study constituted the first effort to use glaciomarine sediments–sediments transported by glaciers or their meltwater to the marine environment – from the fjords of Northern Chilean Patagonia to reconstruct Holocene glacier fluctuations, reaching back 5,400 years. After analyzing a sediment core gathered in the central basin of Golfo Elefantes during a 2005 cruise aboard the icebreaker *Nathaniel B. Palmer,* the scientists reckoned that over five millennia the glacier had seen three major periods of advance. Once this picture was assembled, it was compared with data on regional temperature and precipitation to determine which factor most impacted Gualas Glacier.

Two high resolution sea-surface temperature records were used as temperature indicators, and pollen records demonstrated precipitation levels. Examining these, the scientists discovered trends in the pollen/precipitation levels that corresponded to the fluctuations seen in the glacier, while the temperature levels were less influential, suggesting the glacier was mostly affected by precipitation.

In addition to the geological record, the study incorporates the observations of early Spanish explorers, beginning with Antonio de Vea in 1675. Spanish explorers documented their voyages to Patagonia, noting what they saw, and omitting what they didn't – or couldn't – see. Using the explorers' maps and descriptions of Patagonia's fjords, Bertrand and his colleagues pieced together the life-story of Gualas Glacier. Through studying these historical documents, the scientists determined that Gualas Glacier has retreated nine kilometres over the last 110 years, including 2.5km during the last 25 years.

Although this study reveals the glaciers west of the Andes are controlled by precipitation, Bertrand says that glaciers on the eastern – leeward – flank of the icefield may be controlled by temperature.

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"It needs to be tested if we are to understand and better predict the impact of global climate change on Patagonian glaciers," he said. He added that glaciers located in other maritime environments might also be driven by changes in precipitation rather than temperature.

The idea to use historical documents came from team member Fernando Torrejón, an historian with the University of Concepción (Chile) who specializes in extracting climate and environmental information from written and iconographic documents. Bertrand recalls, "I knew his work on some Chilean glaciers, such as San Rafael, so I asked him to participate in this study to complement the results from the sediment cores."

Torrejón plumbed the records of the 17th-century Spanish explorers archived at the library at the University of Concepción and the National Library of Chile, in Santiago. His contribution added an interesting historical component to the study and confirmed the interpretation of the geological/sediment record.

Reference

Bertrand, S. et al. (2012): Precipitation as the main driver of Neoglacial fluctuations of Gualas glacier, Northern Patagonian Icefield, *Clim. Past*, 8, 519–534.

Release published by the Woods Hole Oceanographic Institution

Taming uncertainty in climate prediction

Using the uncertainty quantification method in precipitation modeling

March 2012 – Uncertainty just became more certain. Atmospheric and computational researchers at Pacific Northwest National Laboratory used a new scientific approach called 'uncertainty quantification,' or UQ, that allowed them to better simulate precipitation. Their study is the first to apply a stochastic sampling method to select model inputs for precipitation representations and improve atmospheric simulations within a regional weather research and forecasting model. Their approach marks a significant advancement in representing precipitation, one of the most difficult climate components to simulate.

The word 'uncertain' always seems to appear when describing Earth and atmospheric systems in numerical models. Trying to represent complexity through computer simulations has limitations, not the least of which is a lack of sufficient computing power. Consider trying to model human body systems with numbers. Humans come in all shapes, sizes, ages, locations, and temperaments. It's the same with atmospheric systems. Getting a handle on the systems' uncertainties, to effectively and efficiently represent current weather and climate systems in a computer model, paves the way for scientists to apply those same techniques to predict the future climate changes. Sound predictions will give planners the tools to forecast the probability of extreme weather and climate events.

A PNNL team of atmospheric scientists and computational modelers used the Weather Research Forecasting (WRF) model to validate a new approach to improving parameters used to estimate precipitation. Using observational data from the Southern Great Plains (SGP), gathered by a US Department of Energy Atmospheric Radiation Measurement (ARM) Climate Research Facility, they reduced the uncertainty for several parameters in the convective cloud scheme in WRF to improve the precipitation calculations.

"We used an interdisciplinary team and the powerful computing resources at multiple locations to tackle this challenge," said Dr. Yun Qian, a climate scientist at PNNL. "Precipitation is much more challenging to represent in climate simulations than, for example, temperature. And it's harder to predict. The UQ methodology provides a way to assess key parameters that are critical for precipitation calculation in regional and global climate models."

Using the vast amount of data collected at SGP, the team used a numerical technique to identify and improve the precipitation calculations in WRF. The team was the first to use a stochastic algorithm, an important sampling method to study parameterizations in regional climate simulations. The method, called Multiple Very Fast Simulated Annealing (MVFSA), randomly chooses numbers within distributions to minimize model errors. MVFSA is computationally more efficient, requiring a lower number of simulations to better match the observational data.

MVFSA identified five optimal parameters to reduce the model precipitation bias at a 25-kilometre climate grid. The team then improved precipitation simulations on a 12-kilometre grid, as well as temperature and wind results. Testing the model on another climate region showed that the MVFSA process produces improved results across spatial scales, processes, and other climatic regions.

The results of the UQ process show an improved model with better predictability making it more reliable in projecting future climate change.

Working within the Community Atmospheric Model (CAM5), a global climate model, the team will test the optimized representations in convective precipitation scenarios. Finding that some representations were more important than others, the UQ approach will focus on how improving representations of convection in climate model helps to improve simulations of the global circulation and climate.

Reference

Yang, B. et al. (2012): Some issues in uncertainty quantification and parameter tuning: a case study of convective parameterization scheme in the WRF regional climate model, *Atmos. Chem. Phys.*, 12, 2409–2427.

Research highlight published by the Pacific Northwest National Laboratory

‘Warming hole’ delayed climate change over eastern United States

50-year model suggests regional pollution obscured a global trend

Cambridge, Mass., 26 April 2012 – Climate scientists at the Harvard School of Engineering and Applied Sciences (SEAS) have discovered that particulate pollution in the late 20th century created a ‘warming hole’ over the eastern United States – that is, a cold patch where the effects of global warming were temporarily obscured.

While greenhouse gases like carbon dioxide and methane warm the Earth’s surface, tiny particles in the air can have the reverse effect on regional scales.

“What we’ve shown is that particulate pollution over the eastern United States has delayed the warming that we would expect to see from increasing greenhouse gases,” says lead author Eric Leibensperger (Ph.D. ‘11), who completed the work as a graduate student in applied physics at SEAS.

“For the sake of protecting human health and reducing acid rain, we’ve now cut the emissions that lead to particulate pollution,” he adds, “but these cuts have caused the greenhouse warming in this region to ramp up to match the global trend.”

At this point, most of the ‘catch-up’ warming has already occurred.

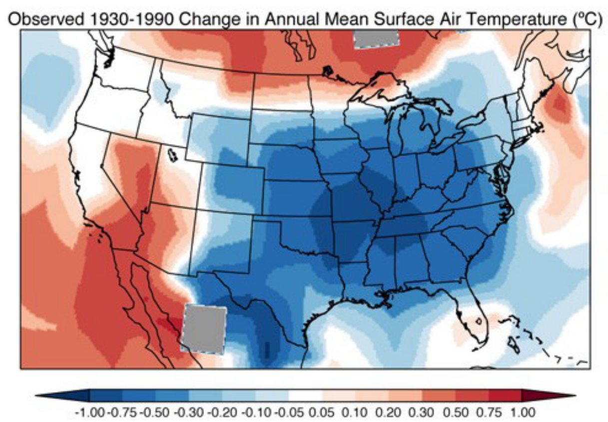
The findings, published in the journal *Atmospheric Chemistry and Physics*, present a more complete picture of the processes that affect regional climate change. The work also carries significant implications for the future climate of industrial nations, like China, that have not yet implemented air quality regulations to the same extent as the United States.

Until the United States passed the Clean Air Act in 1970 and strengthened it in 1990, particulate pollution hung thick over the central and eastern states. Most of these particles in the atmosphere were made of sulfate, originating as sulfur emissions from coal-fired power plants. Compared to greenhouse gases, particulate pollution has a very short lifetime (about one week), so its distribution over the Earth is uneven.

“The primary driver of the warming hole is the aerosol pollution – these small particles,” says Leibensperger. “What they do is reflect incoming sunlight, so we see a cooling effect at the surface.”

This effect has been known for some time, but the new analysis demonstrates the strong impact that decreases in particulate pollution can have on regional climate.

The researchers found that interactions between clouds and particles amplified the cooling. Particles of pollution can act as nucleation sites for cloud droplets, which can in turn reflect even more sunlight than the particles would individually, leading to greater cooling at the surface.



Observed change in surface air temperature between 1930 and 1990. Observations are from the NASA GISS Surface Temperature Analysis. (Image courtesy of Eric Leibensperger.)

The researchers’ analysis is based on a combination of two complex models of Earth systems. The pollution data comes from the GEOS-Chem model, which was first developed at Harvard and, through a series of many updates, has since become an international standard for modeling pollution over time. The climate data comes from the general circulation model developed by NASA’s Goddard Institute for Space Studies. Both models are rooted in decades’ worth of observational data.

Since the early 20th century, global mean temperatures have risen – by approximately 0.8 degrees Celsius from 1906 to 2005 – but in the US ‘warming hole,’ temperatures decreased by as much as one degree Celsius during the period 1930–1990. US particulate pollution peaked in 1980 and has since been reduced by about half. By 2010 the average cooling effect over the East had fallen to just 0.3 degrees Celsius.

“Such a large fraction of the sulfate has already been removed that we don’t have much more warming coming along due to further controls on sulfur emissions in the future,” says principal investigator Daniel Jacob, the Vasco McCoy Family Professor of Atmospheric Chemistry and Environmental Engineering at SEAS.

Jacob is also a Professor of Earth and Planetary Sciences at Harvard and a faculty associate of the Harvard University Center for the Environment.

Besides confirming that particulate pollution plays a large role in affecting US regional climate, the research emphasizes the importance of accounting for the climate impacts of particulates in future air quality policies.

“Something similar could happen in China, which is just beginning to tighten up its pollution standards,” says co-author Loretta

J. Mickley, a Senior Research Fellow in atmospheric chemistry at SEAS. "China could see significant climate change due to declining levels of particulate pollutants."

Sulfates are harmful to human health and can also cause acid rain, which damages ecosystems and erodes buildings.

"No one is suggesting that we should stop improving air quality, but it's important to understand the consequences. Clearing the air could lead to regional warming," Mickley says.

Reference

Leibensperger, E. M. et al. (2012): Climatic effects of 1950–2050 changes in US anthropogenic aerosols – Part 2: Climate response, *Atmos. Chem. Phys.*, 12, 3349–3362.

Release published by the Harvard's School of Engineering and Applied Sciences

Cassini sees objects blazing trails in Saturn ring

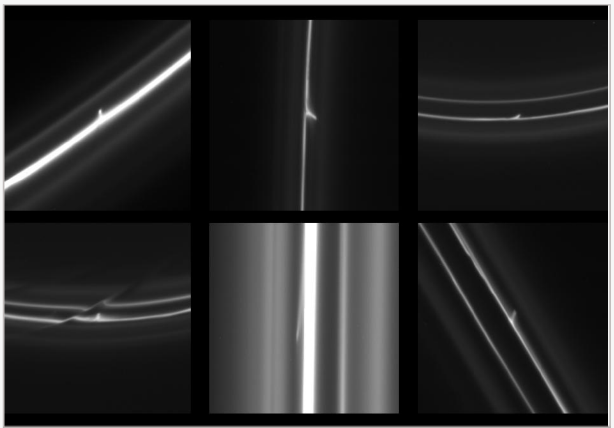
Pasadena, Calif., 23 April 2012 – Scientists working with images from NASA's Cassini spacecraft have discovered strange half-mile-sized (kilometre-sized) objects punching through parts of Saturn's F ring, leaving glittering trails behind them. These trails in the rings, which scientists are calling 'mini-jets,' fill in a missing link in our story of the curious behavior of the F ring. The results will be presented tomorrow at the European Geosciences Union meeting in Vienna, Austria.

"I think the F ring is Saturn's weirdest ring, and these latest Cassini results go to show how the F ring is even more dynamic than we ever thought," said Carl Murray, a Cassini imaging team member based at Queen Mary University of London, England. "These findings show us that the F ring region is like a bustling zoo of objects from a half mile [kilometre] to moons like Prometheus a hundred miles [kilometres] in size, creating a spectacular show."

Scientists have known that relatively large objects like Prometheus (as long as 92 miles, or 148 kilometres, across) can create channels, ripples and snowballs in the F ring. But scientists didn't know what happened to these snowballs after they were created, Murray said. Some were surely broken up by collisions or tidal forces in their orbit around Saturn, but now scientists have evidence that some of the smaller ones survive, and their differing orbits mean they go on to strike through the F ring on their own.

These small objects appear to collide with the F ring at gentle speeds – something on the order of about four miles per hour (two metres per second). The collisions drag glittering ice particles out of the F ring with them, leaving a trail typically 20 to 110 miles (40 to 180 kilometres) long. Murray's group happened to see a tiny trail in an image from Jan. 30, 2009 and tracked it over eight hours. The long footage confirmed the small object originated in the F ring, so they went back through the Cassini image catalog to see if the phenomenon was frequent.

"The F ring has a circumference of 550,000 miles [881,000 kilometres], and these mini-jets are so tiny they took quite a bit of time and serendipity to find," said Nick Attree, a Cassini imaging associate at Queen Mary. "We combed through 20,000 images and were delighted to find 500 examples of these rogues during just the seven years Cassini has been at Saturn."



This set of six images obtained by NASA's Cassini spacecraft shows trails that were dragged out from Saturn's F ring by objects about a half mile (1 kilometre) in diameter. NASA/JPL-Caltech/SSI/QMUL.

In some cases, the objects traveled in packs, creating mini-jets that looked quite exotic, like the barb of a harpoon. Other new images show grand views of the entire F ring, showing the swirls and eddies that ripple around the ring from all the different kinds of objects moving through and around it.

"Beyond just showing us the strange beauty of the F ring, Cassini's studies of this ring help us understand the activity that occurs when solar systems evolve out of dusty disks that are similar to, but obviously much grander than, the disk we see around Saturn," said Linda Spilker, Cassini project scientist based at NASA's Jet Propulsion Laboratory, Pasadena, Calif. "We can't wait to see what else Cassini will show us in Saturn's rings."

Release published by NASA's Cassini-Huygens mission team