Science Mission Directorate

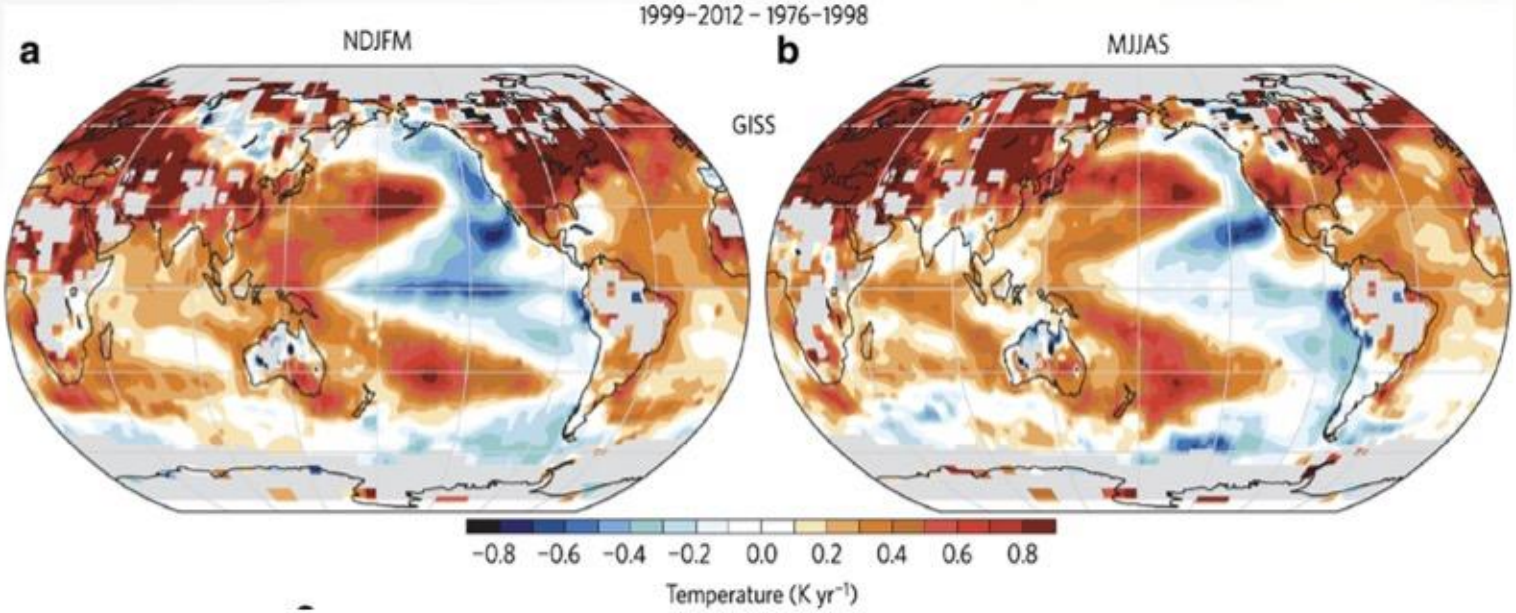
Weekly Highlights

December 9, 2016

The Global Warming Hiatus: Slowdown or Redistribution?

Yan, X.-H., Boyer, T., Trenberth, K., Karl, T. R., Xie, S.-P., Nieves, V., Tung, K.-K. and Roemmich, D | Earth's Future | November 2016 | doi:10.1002/2016EF000417

A NASA co-funded study offered a comprehensive analysis of the "global warming hiatus", the observed decrease in global mean surface temperature (GMST) warming trend during 1998–2013, compared to the warming in the latter half of the 20th Century, as termed by the Intergovernmental Panel on Climate Change (IPCC) (2013). The researchers reviewed the uncertainties and knowledge gaps regarding this "hiatus" and posited insights from a collective diverse set of information. One salient insight is that the GMST phenomenon is a surface characteristic that does not represent a slowdown in warming of the climate system but rather an energy redistribution within the oceans. A review of recent scientific publications helped demonstrate the difficulty and complexities in pinpointing the oceanic sink of the "missing heat" from the atmosphere and the upper layer of the oceans, which defines the "hiatus." Variability and heat sequestration over specific regions (i.e. Pacific, Atlantic, Indian, Southern Oceans, etc.) were also discussed, along with the varying, coastal response to the hiatus.

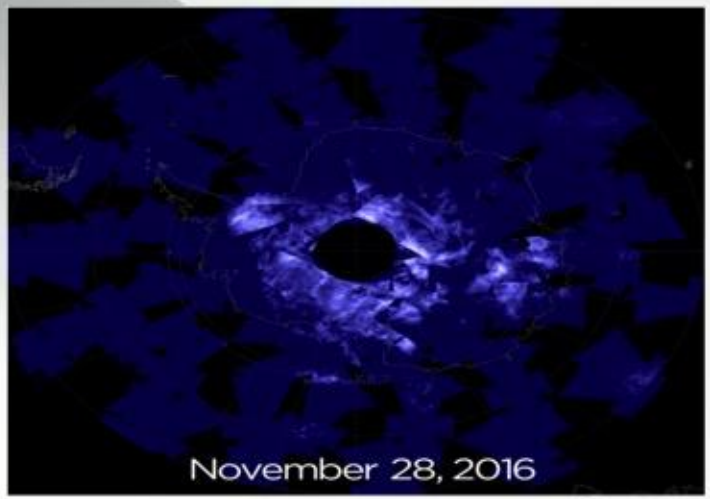


Above: Regime differences between 1999–2012 and 1976–1998. Mean surface temperature differences between 1999–2012 and 1979–1998 for November–March (NDJFM) (a) and for May – September (MJJAS) (b) for surface temperature from the Goddard Institute for Space Studies.

Global mean surface temperatures (GMST) exhibited a smaller rate of warming during 1998–2013, compared to the warming in the latter half of the 20th Century. Although, not a "true" hiatus in the strict definition of the word, this has been termed the "global warming hiatus" by IPCC (2013).

NASA's Heliophysics AIM Mission Observes Early Noctilucent Clouds (NLCs) Over Antarctica

Noctilucent clouds (NLCs) observed by the Heliophysics AIM mission aren't usually visible at this time, but this year they are early. Data from the AIM spacecraft shows the sky over Antarctica glowing electric blue in the Southern Hemisphere as early as 17 November, the earliest observation of these clouds AIM has seen yet.



AIM mission data recorded the appearance of NLCs beginning on 17 November. Over the next 11 days the presence of NLCs in the Southern skies continued to grow. This image shows the accumulation of NLCs at their peak on 28 November 2016. Credit: NASA AIM

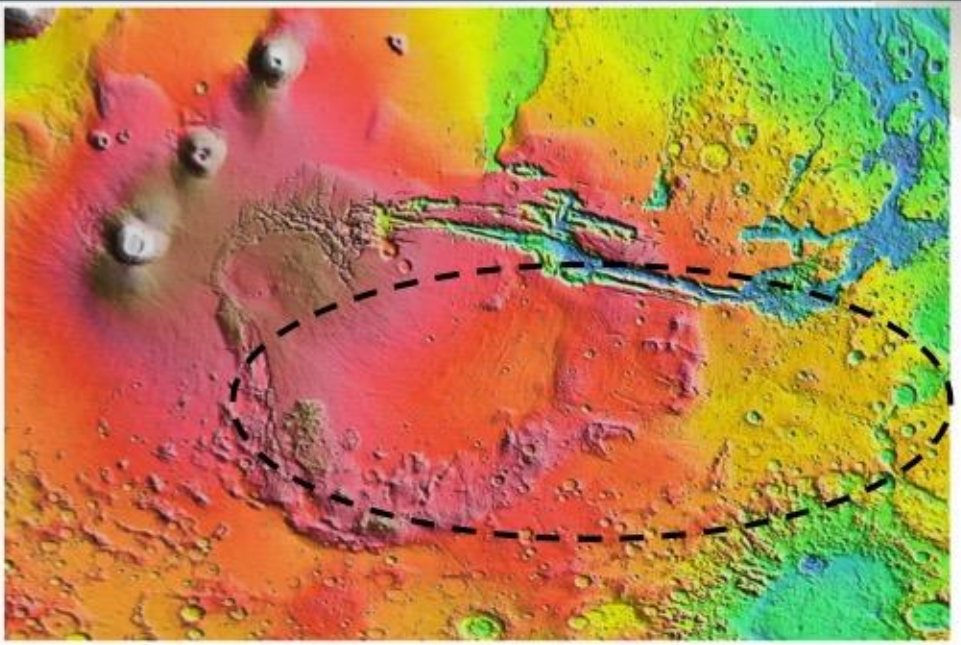
Noctilucent clouds are Earth's highest clouds, sandwiched between Earth and space 50 miles above the ground in a layer of the atmosphere called the mesosphere.

AIM studies NLCs in order to better understand the mesosphere, and its connections to other parts of the atmosphere, weather and climate. We observe them seasonally, during summer in both the Northern and Southern hemispheres. This is when the mesosphere is most humid, with water vapor wafting up from lower altitudes.

Additionally, this is also when the mesosphere is the coldest place on Earth – dropping as low as minus 210 degrees Fahrenheit – due to seasonal air flow patterns.

Scientists say the early start to NLCs this year corresponds to an earlier seasonal change at lower altitudes. Since its 2007 launch, AIM data has shown us that changes in one region of the atmosphere can effect responses in another distinct, and sometimes distant, region. Scientists call these relationships atmospheric teleconnections. Now, due to natural precession, the spacecraft's orbit is evolving, allowing the measurement of atmospheric gravity waves - phenomena that could be contributing to the teleconnections.

Thaumasia Planum Provides Clues to Mars' Past



An alternative explanation for the formation of a region with high elevation suggests that the Thaumasia Planum was created by a chain of volcanoes, not a megalandslide as previously suggested.

- Chemical signatures from the Mars Odyssey Gamma Ray Spectrometer show variations of different minerals across this region that is roughly the size of North America (dashed, at left).

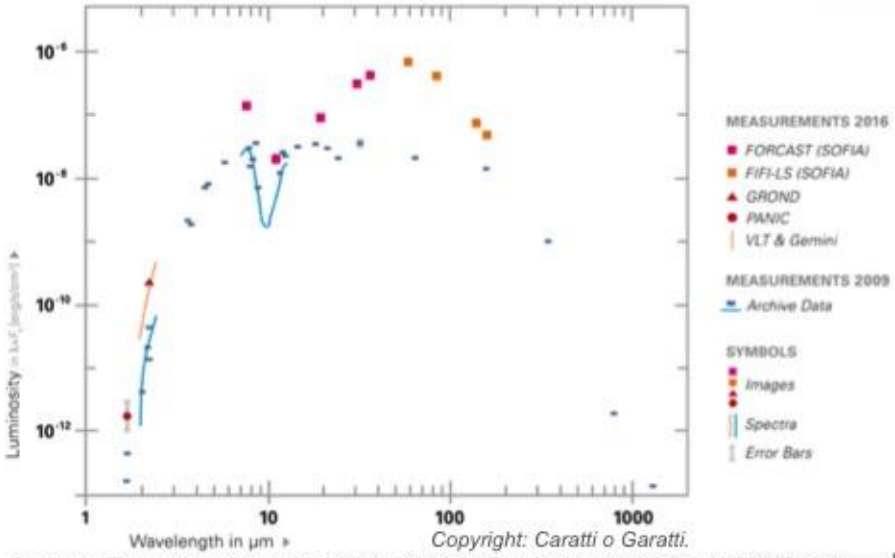
- Previous research had suggested that this unusually elevated region had its origins from a salt-lubricated landslide. This research however showed that there were no signals of near-surface salt deposits that would be necessary for this scenario.
- The researchers instead suggest that the range of chemical signatures are best explained by constant volcanic eruptions as the mantle beneath evolved over geologic time.
- This evolution could have caused a change in the type of volcanism from shield volcanoes, like in Hawaii, to more explosive volcanism, which would have released significantly more volatiles into the air and affected the climate.

Hood et al. 2016. *JGR: Planets*

Fireworks for Birth of Massive Stars

Published in the November 14, 2016 issue of the Nature Physics Journal.

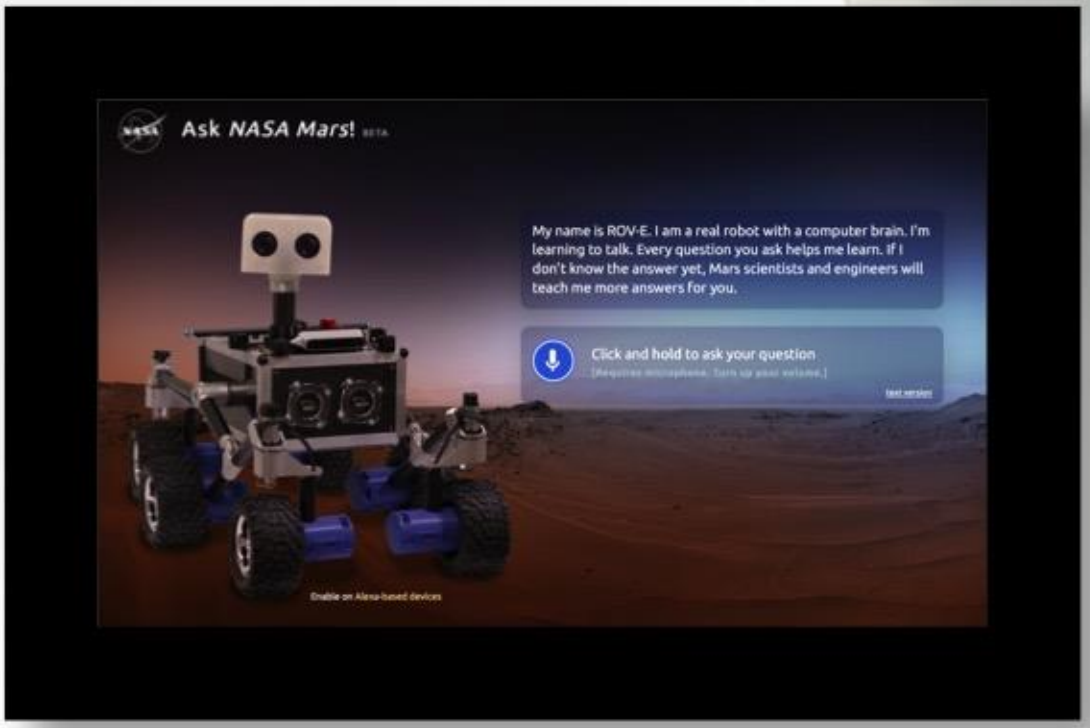
- For the first time an international scientific team observed and analyzed an outburst from a high-mass young stellar object that was caused by material accreting onto a star. The team combined mid-infrared and far-infrared images from the Stratospheric Observatory for Infrared Astronomy (SOFIA) with near-infrared images and spectra from other ground observatories (Gemini Observatory, ESO/VLT, Calar Alto Observatory, and ESO/MPG) of a star named S255IR NIRS 3 (or NIRS 3 for short).
- With these data the researchers confirmed that high mass stars may form like their less massive siblings, namely from collapsing interstellar gas and dust clouds, gathering the in-falling material through a so-called "accretion disk" of gas and dust surrounding the young star.
- The new data provide proof of episodic accretion in young massive stars, previously observed during the formation of low mass stars: as the matter distribution in the accretion disk is not continuous but lumpy, disk fragments are occasionally ingested onto the growing star causing an eruption known as an accretion burst. The new observations of NIRS 3 confirm that the formation of high mass stars can be considered as a scaled up version of the process by which low mass stars like our Sun are born. The main differences are that massive stars would form through larger accretion disks with much higher accretion rates and on much shorter time-scales (around 100,000 years instead of several million years).



Caption: The spectral energy distributions before the outburst (blue; 2009) and during the outburst in (red & yellow; 2016).

- NIRS 3 is 6,000 light years away and 20 times more massive than our Sun. Previous observational data available from archives indicate that NIRS 3 is surrounded by a disk-like structure, probably an accretion disk, and is the source of a strong bipolar jet that is ejecting materially at hundreds of kilometers per second. Two lobes (cavities either side of the source carved by the jets) are visible in as two infrared-bright nebulae.
- The new observations of NIRS 3 obtained from November 2015 to April 2016 showed a sudden increase in brightness of the central object and, subsequently, of the two nebulae. The brightening of the nebulae is due to tiny dust grains, which act as a mirror and reflect the light of the sudden-flare from the central protostar (causing the so-called light-echo). Images taken a few months apart reveal the motion of the light-echo, and from the distance travelled by the light (moving at about 300,000 km/s), scientists could infer that the burst began in June 2015. The researchers found that in nine months the burst has produced the same amount of energy as the Sun has produced in almost 100,000 years. The astronomers could also work out how much matter must have fallen onto the young star to produce the outburst: roughly the equivalent of two giant planets like Jupiter.

Rov-E Can Now Talk and Answer Mars Questions!



- Mars Outreach rover “ROV-E” can now talk and follow simple commands for outreach at public venues (leverages Amazon’s AWS cloud, Alexa, Greengrass etc)
- ROV-E demonstrated Alexa Amazon “talking” skills at a recent Re-Invent technical conference reaching approximately 35,000 attendees

- Voice-enabled Q&A system is available at home as an “Ask NASA Mars” Skill for Alexa-enabled devices, as well as online for anyone (links to text only version for those not able to use microphones and/or speakers
- Soft launch of Beta online version: mars.nasa.gov/ask-nasa-mars