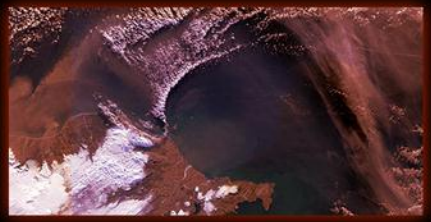
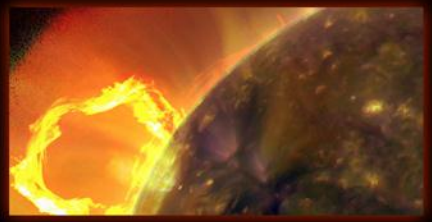
National Aeronautics and Space Administration

NASA Science

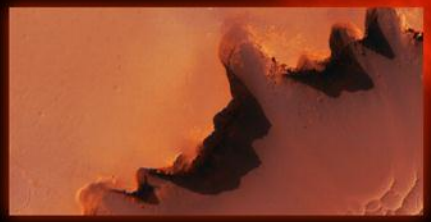
Weekly Highlights
August 30, 2013



EARTH SCIENCE



HELIOPHYSICS

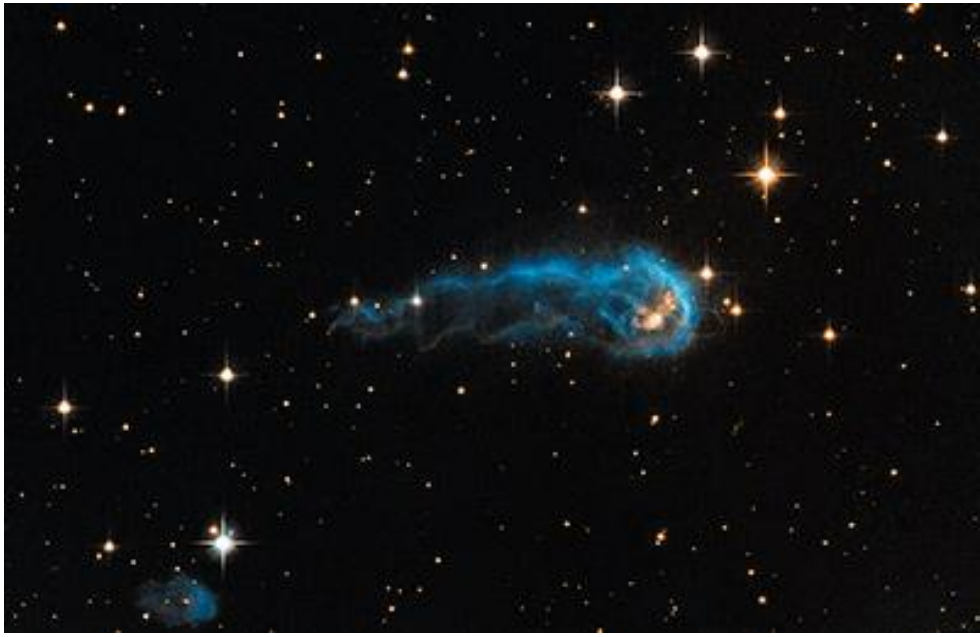


PLANETARY SCIENCE

ASTROPHYSICS

Hubble Sees a Cosmic Caterpillar

- This light-year-long knot of interstellar gas and dust resembles a caterpillar on its way to a feast. But the meat of the story is not only what this cosmic caterpillar eats for lunch, but also what's eating it. Harsh winds from extremely bright stars are blasting ultraviolet radiation at this "wanna-be" star and sculpting the gas and dust into its long shape.
- The culprits are 65 of the hottest, brightest known stars, classified as O-type stars, located 15 light-years away from the knot, towards the right edge of the image. These stars, along with 500 less bright, but still highly luminous B-type stars make up what is called the Cygnus OB2 association. Collectively, the association is thought to have a mass more than 30,000 times that of our Sun.
- The caterpillar-shaped knot, called IRAS 20324+4057, is a protostar in a very early evolutionary stage. It is still in the process of collecting material from an envelope of gas surrounding it. However, that envelope is being eroded by the radiation from Cygnus OB2. Protostars in this region should eventually become young stars with final masses about one to ten times that of our Sun, but if the eroding radiation from the nearby bright stars destroys the gas envelope before the protostars finish collecting mass, their final masses may be reduced.
- Spectroscopic observations of the central star within IRAS 20324+4057 show that it is still collecting material quite heavily from its outer envelope. Only time will tell if the formed star will be a "heavy-weight" or a "light-weight" with respect to its mass.



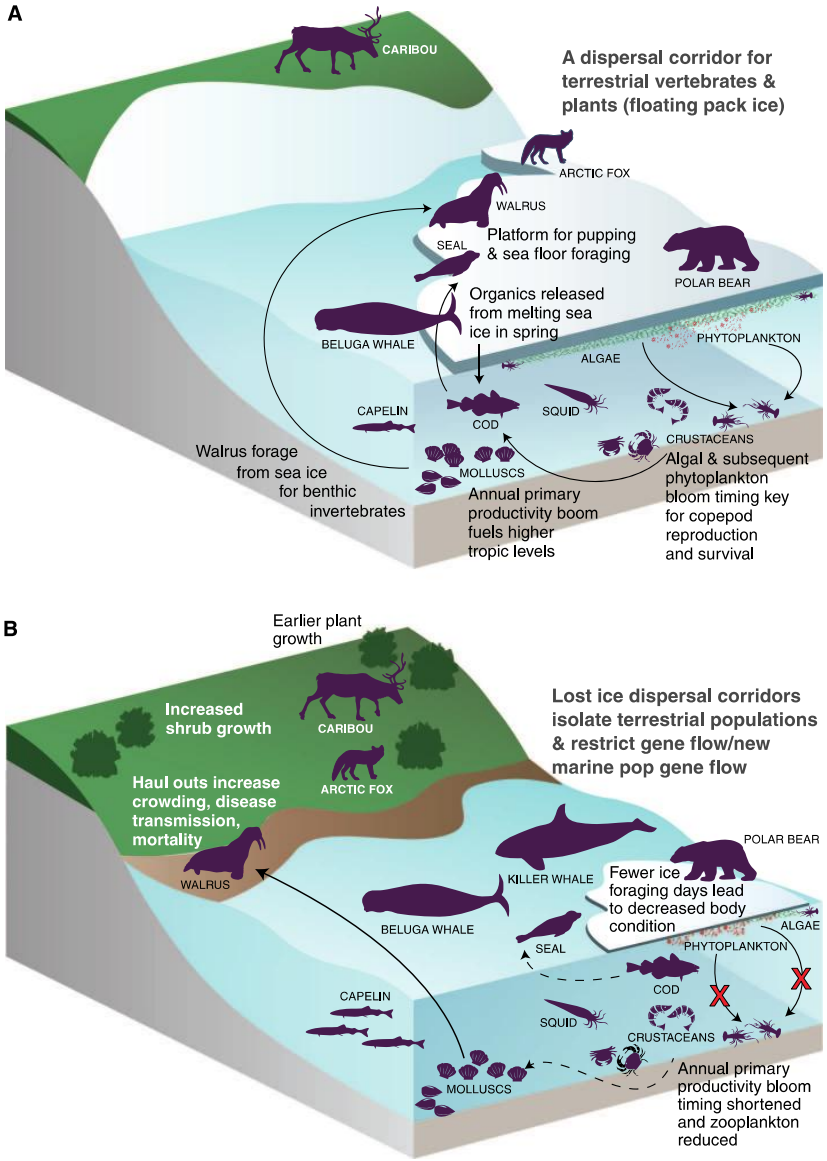
Credit: NASA, ESA, and the Hubble Heritage Team (STScI/AURA)

This image of IRAS 20324+4057 is a composite of Hubble Advanced Camera for Surveys data taken in green and infrared light, and ground-based hydrogen data from the Isaac Newton Telescope. The object lies 4,500 light-years away in the constellation Cygnus.

Ecological Consequences of Sea-Ice Decline

Eric Post, Uma S. Bhatt, Cecilia M. Bitz, Jedediah F. Brodie, Tara L. Fulton, Mark Hebblewhite, Jeffrey Kerby, Susan J. Kutz, Ian Stirling and Donald A. Walker, www.sciencemag.org SCIENCE VOL 341 2 AUGUST 2013

NASA funded scientists synthesized recent developments in the study of ecological responses to sea-ice decline, after a decade with nine of the lowest arctic sea-ice minima on record, including the historically low minimum in 2012. Sea-ice loss emerges as an important driver of marine and terrestrial ecological dynamics, influencing productivity, species interactions, population mixing, gene flow, and pathogen and disease transmission. Primary producers dependent upon sea ice as their habitat underpin the entire marine food web of the Arctic (Fig. A). The loss of over 2 million km^2 of arctic sea ice since the end of the last century represents a stunning loss of habitat for sea-ice algae and sub-ice phytoplankton, which together account for 57% of the total annual primary production in the Arctic Ocean. Sea-ice loss may also influence ecological dynamics indirectly through effects on movement, population mixing, and pathogen transmission. For populations and species currently isolated only during the summer ice-free season in the Arctic, declining annual presence of sea ice will reduce trans-ice and interisland migrations outside of the summer season. Sea-ice loss and a lengthening of the ice-free season will thus in- crease genetic isolation among populations of such species. Viewing sea ice as an important indicator of climatic warming and as an integrator and driver of ecological dynamics in the Arctic will improve our understanding of the systems-level functioning of this region and our basis for anticipating and responding to further change.



***Right**: Ecological interactions influenced by sea ice. The sea-ice biome influences the abundance, distribution, seasonality, and interactions of marine and terrestrial species by its presence (A). It is unique for its complete seasonal disappearance in portions of its distribution. Lengthening of this annual period of absence and an overall decline in ice extent, thickness, and stability will have considerable consequences for these species and interactions (B).*

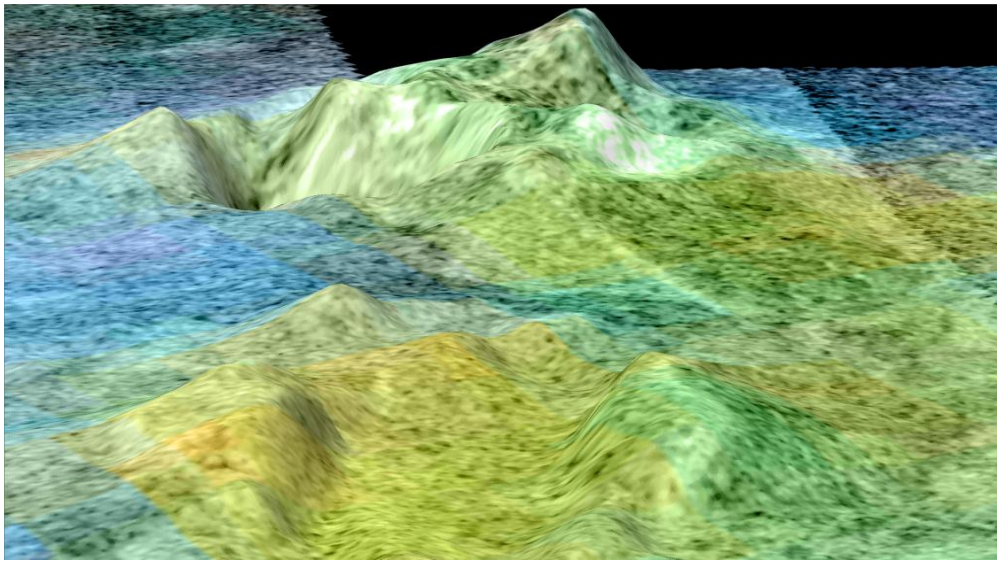
Titan's "Mount Doom"

Do ice volcanoes release slushy flows on the surface of Saturn's moon Titan? New evidence* from NASA's Cassini spacecraft points to that possibility more strongly than ever.

•Scientists have debated the existence of ice volcanoes, or *cryovolcanoes*, on Titan, and NASA's Cassini spacecraft has found strong evidence that a mountain named Mount Doom and its nearby terrain are cryovolcanic in origin.

•The nearly mile-high mountain was renamed in honor of Mount Doom in J.R.R. Tolkien's fantasy fiction "The Lord of the Rings." It appears to be part of a series of cryovolcanic cones, craters, flows, and pits.

•Cryovolcanoes are thought to erupt a slushy combination of water ice and liquid water rather than molten rock as volcanoes on Earth and Io do. Evidence for these unusual features is present on several extremely cold moons in the solar system, including Titan and Neptune's moon Triton. Enceladus, another moon of Saturn, is the only place where we have definitively seen a cryovolcanic eruption.

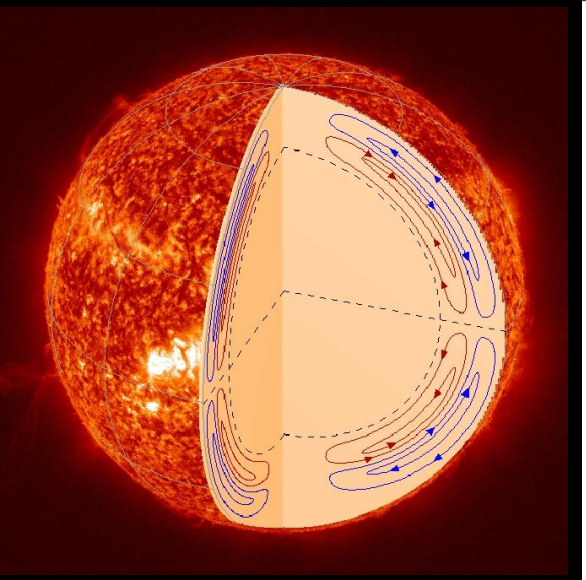


Cassini radar data and visible and infrared spectrometry were combined in this view of Mt. Doom with colors showing compositional differences. Mt. Doom is adjacent to the deepest depression so far found on Titan, Sotra Patera, an elongated, mile-deep pit. Green and yellow colors show areas that appear cryovolcanic in origin.

- A topographic model produced from Cassini data by the U.S. Geological Survey shows flow-like features characteristic of volcanic activity.
- Scientists have long argued about cryovolcanoes on Titan because of what their existence would imply about larger questions about Titan's internal structure and potential habitability.

*Cryovolcanism on Titan: New results from Cassini RADAR and VIMS
R. M. C. Lopes, et al., JOURNAL OF GEOPHYSICAL RESEARCH: PLANETS, VOL. 118, 416–435, doi:10.1002/jgre.20062, 2013

Solar Dynamics Observatory Untangles Motion Inside the Sun



Observations by the HMI instrument on NASA's SDO spacecraft show a two-level system of circulation inside the sun. This circulation is connected to the flip of the sun's north and south magnetic poles that occurs approximately every 11 years. Image: NASA/SDO/Stanford

- Using an instrument on NASA's Solar Dynamics Observatory, called the Helioseismic and Magnetic Imager, or HMI, scientists have overturned previous notions of how the sun's internal flows move from equator to pole and back again, a key part of understanding how the solar dynamo works. Modeling this system also lies at the heart of improving predictions of the intensity of the next solar cycle.

- Solar activity is powered by a complex, ever-changing magnetic current inside the sun known as the dynamo. This magnetic system flips approximately every 11 years, with magnetic north and magnetic south switching poles. The process is an integral part of the sun's progression toward solar maximum.

- Recent science results show that, instead of a cycle of flow moving toward the poles near the sun's surface and then back to the equator, the material inside the sun shows a double layer of circulation, with two cycles on top of each other. Since the mid-1990s researchers have been observing movement inside the sun using a technique called helioseismology. The technique makes use of the fact that waves course across the sun, back and forth, oscillating with an approximately five minute period. By monitoring the oscillations seen at the surface of the sun, scientists have learned about the material through which the waves travel, including what the material is made of and how fast and in what direction it is moving.

- SDO observations showed scientists how material inside the sun rotates from east to west: material moves more slowly at the poles than it does at the equator. The observations also soon showed that material moved from the equators toward the poles within the top 20,000 miles of the sun's surface – but the flow back toward the equator from the poles was not detected.

- Scientists used two years of HMI data and compared the results measured at four different heights within the sun's surface, and found the results were not consistent with the normal convention. A new method was used to make these four sets of data agree with each other and it also helped find the long-sought equatorward flow inside the sun. They found that the flow toward the poles does occur in a layer near the sun's surface – but the equatorward flow isn't at the bottom. Instead, the material seeps back toward the equator through the middle of the convection layer. Moreover, deep down inside the layer is a second stream of material moving toward the poles, making the double-cell system in which oblong flow systems are stacked on top of each other. The new observations have important consequences for modeling the solar dynamo which will improve our understanding of magnetism on the sun.

"Extreme Evaluation" Workshop Co-Facilitated by NICE Program Evaluator

July 24, 2013

"Extreme Evaluation" participants working in small groups.

The Minority University Research and Education Program's (MUREP) **NASA Innovations in Climate Education (NICE)** project contributed to a workshop during the recent Astronomical Society of the Pacific "Ensuring STEM Literacy" meeting. NICE's program evaluator co-designed and facilitated the **"Extreme Evaluation"** workshop along with partners from the climate change evaluation community.

The two-part, interactive workshop used case studies and real data from NASA-funded evaluations to engage 24 participants in innovative evaluation practices. Participants worked with concept map rubrics for formative and summative assessment, and tried their hands at qualitative coding of open-response data. Discussions focused on the application of these practices to participants' own projects and evaluation goals.

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