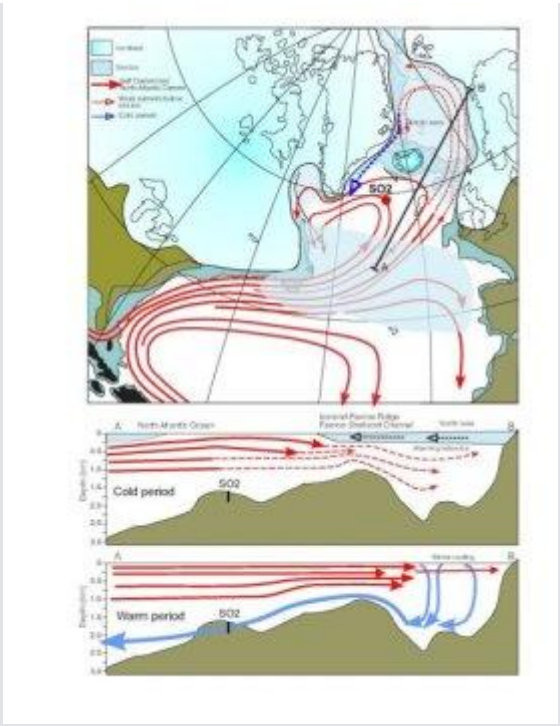
GK BULLETIN (FEB)

Article 1

'Ice age blob' of warm ocean water discovered south of Greenland

*Date:*February 19, 2016
Source: CAGE - Center for Arctic Gas Hydrate, Climate and Environment
Summary: Greenland experienced several abrupt and brutal climate changes during the last ice age. But even during the coldest periods a blob of warm surface water existed nearby.



These are North Atlantic current and ice sheets during the last ice age. SO2 is the site where the sediment core is retrieved from, indicating existence of a warm blob.

Credit: Illustration: T. Rasmussen/CAGE and E. Thomsen/Aarhus University

New research published in *Scientific Reports* in February **indicates that a warm ocean surface water prevailed during the last ice age, sandwiched between two major ice sheets just south of Greenland.**

Extreme climate changes in the past Ice core records show that Greenland went through 25 extreme and abrupt climate changes during the last ice age some 20,000 to 70,000 years ago. In less than 50 years the air temperatures over Greenland could increase by 10 to 15 °C. However the warm periods were short; within a few centuries the frigid temperatures of the ice age returned. That kind of climate change would have been catastrophic for us today.

Ice core records from Antarctica also show climate changes in the same period, but they are more gradual, with less severe temperature swings.

The Nature Scientific Report study shows that an area of the Nordic Seas, just south of Iceland, followed the Antarctic pattern of warming and cooling. Which is strange since it is so close to Greenland.

"We had expected to see sudden climate changes. But sediment core records from the area show that the climate changes here were actually gradual, and quite identical to Antarctic climate changes." says CAGE professor Tine Rasmussen, the principal author of the paper.

Gulf Stream holds the answers

Then, as now, **the circulation of Atlantic Ocean, with currents such as the Gulf Stream, regulated transportation of heat to this area. Simply put, the surface currents transport heat from the southern and tropical Atlantic toward the North Atlantic.**

" The Nordic seas between Norway and Greenland play a crucial role for the current patterns of the Atlantic Ocean. They act as a pump. Here the warm and salty surface water cools down during winter. It becomes heavy and is pumped down to the bottom before returning to the Atlantic, where it continues as a deep current all the way to the Antarctic region. " co-author Erik Thomsen from Aarhus University (link) points out.

Without this pump, the north-south current system would slow down considerably. Changes in this circulation can have a profound impact on the global climate system.

During the ice ages this circulation was assumed to work as a seesaw in the playground -- going up and down in opposite directions with an axis somewhere around the equator. The idea is that when it warmed in the north, it cooled in the south and vice versa. But Rasmussen and colleagues indicate another scenario.

Rewriting the seesaw hypothesis

During the coldest periods of the last ice age the Nordic seas were covered with a permanent layer of sea ice. The pump stopped transporting the heat northward. The heat accumulated in the southern oceans. However, the warming was not restricted to the south.

" Our results show that it continued all the way to Iceland. The warming was slow and gradual, and happened simultaneously in both hemispheres. Little by little the warm Atlantic water penetrated into the Nordic sea underneath the ice cover. It melted the ice from below. Once the ice was gone, the pump started up again, bringing additional warm water into the Nordic seas. And we got a warmer period for 50 years. " says Rasmussen.

Large ice sheets continued however, to cover the continents around the Nordic seas. In contact with the warm ocean water they started calving. This delivered icebergs and fresh water into the sea and caused a cooling down of the surface water. The seas were again frozen. And the pump slowed down.

The warm ocean blob of the ice ages rewrites the understanding of the ocean circulation systems, and how they affected the extreme climate changes of the past. The seesaw was actually more of a 'push and pull' system.

"There are no symmetrical processes in the north and the south -- the climate changes were principally governed by simultaneous warming and the constant closing and re-opening of the sink pump in the Nordic seas" says Tine Rasmussen

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Story Source:

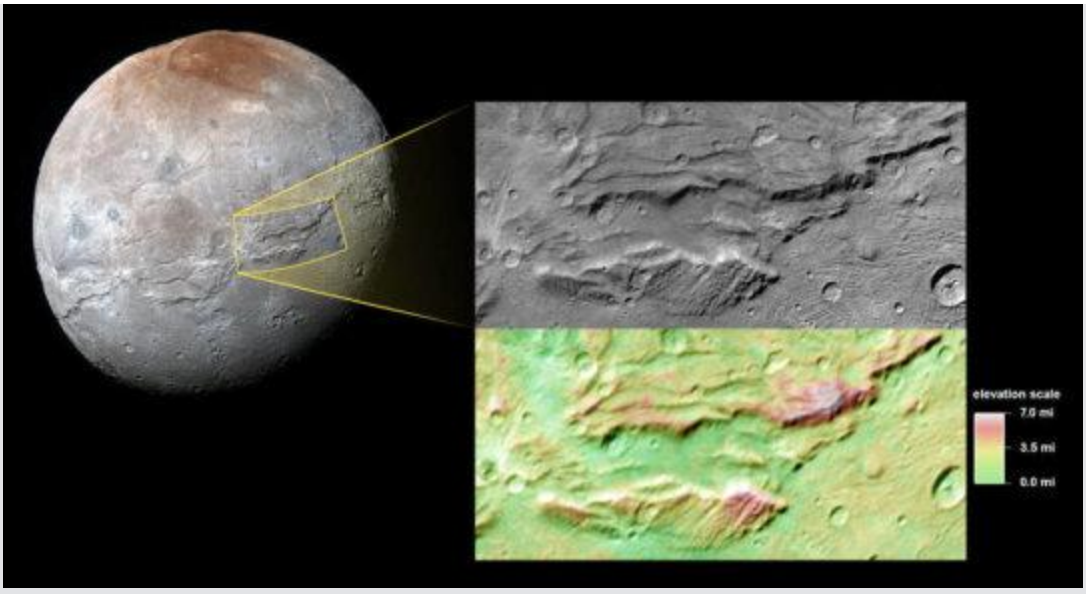
The above post is reprinted from materials provided by **CAGE - Center for Arctic Gas Hydrate, Climate and Environment**. *Note: Materials may be edited for content and length.*

Article 2

Pluto's 'Hulk-like' moon Charon: A possible ancient ocean?

*Date:*February 19, 2016
*Source:*NASA
Summary:

Pluto's largest moon may have gotten too big for its own skin. **Images from NASA's New Horizons mission suggest that Pluto's moon Charon once had a subsurface ocean that has long since frozen and expanded, pushing outward and causing the moon's surface to stretch and fracture on a massive scale**.



Pluto's Moon Charon A close-up of the canyons on Charon, Pluto's big moon, taken by New Horizons during its close approach to the Pluto system last July. Multiple views taken by New Horizons as it passed by Charon allow stereo measurements of topography, shown in the color-coded version of the image. The scale bar indicates relative elevation.

Pluto's largest moon may have gotten too big for its own skin.

Images from NASA's New Horizons mission suggest that Pluto's moon Charon once had a subsurface ocean that has long since frozen and expanded, pushing outward and causing the moon's surface to stretch and fracture on a massive scale.

The side of Pluto's largest moon viewed by NASA's passing New Horizons spacecraft in July 2015 is characterized by a system of "pull apart" tectonic faults, which are expressed as ridges, scarps and valleys -- the latter sometimes reaching more than 4 miles (6.5 kilometers) deep. Charon's tectonic landscape shows that, somehow, the moon expanded in its past, and -- like Bruce Banner tearing his shirt as he becomes the Incredible Hulk -- Charon's surface fractured as it stretched.

The outer layer of Charon is primarily water ice. This layer was kept warm when Charon was young by heat provided by the decay of radioactive elements, as well as Charon's own internal heat of formation. Scientists say Charon could have been warm enough to cause the water ice to melt deep down, creating a subsurface ocean. But as Charon cooled over time, this ocean would have frozen and expanded (as happens when water freezes), lifting the outermost layers of the moon and producing the massive chasms we see today.

The top portion of this image shows part of the feature informally named Serenity Chasma, part of a vast equatorial belt of chasms on Charon. In fact, this system of chasms is one of the longest seen anywhere in the solar system, running at least 1,100 miles (about 1,800 kilometers) long and reaching 4.5 miles (7.5 kilometers) deep. By comparison, the Grand Canyon is 277 miles (446 kilometers) long and just over a mile (1.6 kilometers) deep.

The lower portion of the image shows color-coded topography of the same scene. Measurements of the shape of this feature tell scientists that Charon's water ice layer may have been at least partially liquid in its early history, and has since refrozen.

This image was obtained by the Long-Range Reconnaissance Imager (LORRI) on New Horizons. North is up; illumination is from the top-left of the image. The image resolution is about 1,290 feet (394 meters) per pixel. The image measures 240 miles (386 kilometers) long and 110 miles (175 kilometers) wide. It was obtained at a range of approximately 48,900 miles (78,700 kilometers) from Charon, about an hour and 40 minutes before New Horizons' closest approach to Charon on July 14, 2015.

Story Source:

The above post is reprinted from materials provided by **NASA**. *Note: Materials may be edited for content and length.*

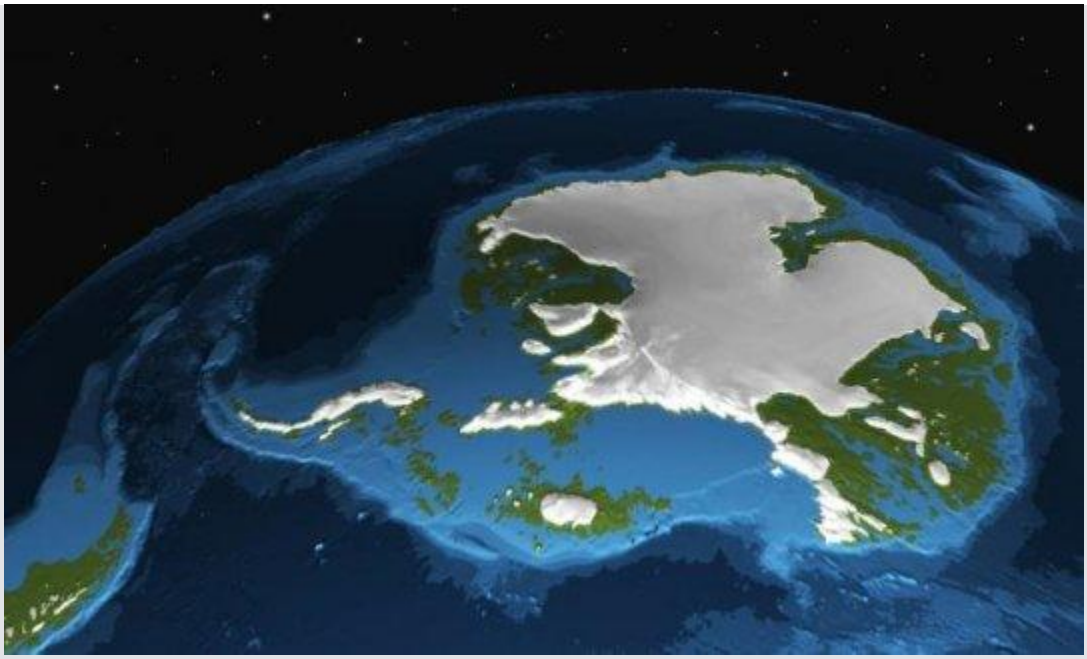
Article 3

The Army has taken control of Haryana's Munak canal that supplies water to Delhi. In tweets early in the morning, Delhi chief minister Arvind Kejriwal said, "we have completely run out of water" and added that it will take time to assess damage to canal, if any. Jat protesters fighting for jobs and educational quotas under OBC category had taken over the canal and cut water supply.

Article 4
Antarctic ice sheet is more vulnerable to carbon dioxide than expected

***Date:*February 22, 2016**
*Source:*University of Massachusetts at Amherst

Summary: Results from a new climate reconstruction of how Antarctica's ice sheets responded during the last period when atmospheric carbon dioxide reached levels like those expected to occur in about 30 years, plus sediment core findings reported in a companion paper, suggest that the ice sheets are more vulnerable to rising atmospheric carbon dioxide than previously thought.



The authors state that taken together, findings from companion papers in PNAS highlight that large changes in the Antarctic ice sheets may be possible at lower levels of atmospheric carbon dioxide than previous studies have shown.

Credit: UMass Amherst

Results from a new climate reconstruction of how Antarctica's ice sheets responded during the last period when atmospheric carbon dioxide (CO_2) reached levels like those expected to occur in about 30 years, plus sediment core findings reported in a

companion paper, suggest that the ice sheets are more vulnerable to rising atmospheric CO_2 than previously thought.

Details appear in two papers in the current *Proceedings of the National Academy of Sciences*.

Researchers led by Edward Gasson and Robert DeConto at the University of Massachusetts Amherst, with colleagues at Pennsylvania State University and GNS Science, New Zealand, report results of a climate and ice sheet modeling study, while Richard Levy of New Zealand and colleagues with the National Science Foundation's Antarctic drilling program (ANDRILL), report their analyses of a 3,735-foot sediment core from McMurdo Sound to reconstruct the Antarctic ice sheets' history.

The authors state that taken together, the findings highlight that large changes in the Antarctic ice sheets may be possible at lower levels of atmospheric carbon dioxide than previous studies have shown.

Gasson explains that climate researchers have long sought to create a model that simulates conditions similar to those experienced during the early to mid-Miocene, as established by sediment core data. This was likely the last time atmospheric CO_2 levels were slightly higher, at 500 parts per million (ppm), than the 400 ppm level reached just last year, and global average temperatures were about 3 to 4 degrees Celsius higher than today.

But this does not mean that melting Antarctic ice sheets will raise global sea levels immediately, the researchers say. "The ice sheets will take hundreds of years to respond, so although CO_2 may be at the same level as during the Miocene in the next 30 years, it doesn't mean that they will melt in 30 years," Gasson adds.

Understanding how the huge Antarctic ice sheets will respond to such warming is a major goal for climate scientists. Gasson says, "We know that the Antarctic ice sheet will eventually melt if we burn all known fossil fuel reserves, raising sea levels by over 100 feet. What these two studies show is that the Antarctic ice sheet is also vulnerable to much lower levels of carbon dioxide than we thought possible before."

Previous attempts to simulate Antarctic ice sheet retreat have been inadequate because despite direct geological evidence that large swings in the extent of ice sheets driven by small changes in atmospheric CO_2occurred, it was difficult for computer simulations to model them.

Gasson and colleagues' model includes three key new strategies that improve the simulation. In particular, Gasson and colleagues use a component that captures feedbacks between the ice sheet and climate better than before. The UMass Amherst-led modeling team authors point out that their work "largely resolves the discrepancy between geological records and ice sheet models that had previously existed."

Article 5

Antarctica could be headed for major meltdown

Date: February 23, 2016
Source: University of California Los Angeles UCLA
Summary:

In the early Miocene Epoch, temperatures were 10 degrees warmer and ocean levels were 50 feet higher -- well above the ground level of modern-day New York, Tokyo and Berlin. Now a geochemist reports finding striking similarities between climate change patterns today and millions of years ago.

Antarctica's glaciers are the size of the United States and Mexico combined, and they contain enough water to raise the world's sea level by 180 feet. (Stock image)

Credit: © pranodhm / Fotolia

In the early Miocene Epoch, temperatures were 10 degrees warmer and ocean levels were 50 feet higher -- well above the ground level of modern-day New York, Tokyo and Berlin.

It was more than 16 million years ago, so times were different. But there was one important similarity with the world we live in today: The air contained about the same amount of carbon dioxide. That parallel raises serious concerns about the stability of ice sheets in Antarctica, according to a study published in the *Proceedings of the National Academy of Sciences*.

All told, Antarctica's glaciers are the size of the United States and Mexico combined, and they contain enough water to raise the world's sea level by 180 feet. And although no humans live permanently in Antarctica, what happens there impacts everyone, said Aradhna Tripati, a geochemist at UCLA's Institute of the Environment and Sustainability who collaborated on the research.

"The ice sheets serve as huge stores of water," Tripati said. "As the ice melts, it gets dumped in the ocean and the sea level rises."

The study is the latest revelation of ANDRILL, a $20 million research project focused on the South Pole. The effort, now 12 years old, has involved 100 researchers from seven countries. ANDRILL researchers were the first to bore holes through Antarctic ice shelves and sea ice to sample the ocean floor below.

Previous research showed that ice shelves -- the parts of the ice sheets that extend over water -- are vulnerable to even small increases in greenhouse gases. But the new study, which was written by Richard Levy of GNS Science, a New Zealand research organization, was the first to demonstrate that the huge, land-based glaciers are also vulnerable.

David Harwood, a University of Nebraska paleontologist who led the study, said the project's goal was to see what prehistoric environments could tell us about the modern era of climate change.

"We're drilling back into the past to understand the future and how dynamic our planet can be," he said.

To do that, researchers set 90 tons worth of drilling equipment on a floating sea ice in McMurdo Sound, where conditions can be particularly harsh: The average August temperature is minus 23 degrees Fahrenheit, and savage windstorms can occur at a moment's notice. Using a diamond-tipped tubular drill, researchers bored through 24 feet of ice, 1,200 feet of water and 3,300 feet of ocean floor. The rock samples they collected preserve a chronological record of environmental conditions dating back 20 million years.

The samples were sent to Tripati for analysis. As she looked at the sedimentary layers, a story began to emerge. Samples that were formed during warmer times, when the ice shelf was gone or unstable, were tan-colored and rich with fossils. But samples drawn from years when the sea was covered with ice, were mostly rock with fossils from only a few deep sea organisms.

Looking even closer, Tripati examined individual molecules from the samples to determine air and water temperatures at different times in history. Warmer times correlated with higher levels of carbon dioxide in the atmosphere, melting ice shelves and the loss of parts of the East Antarctic ice sheet.

According to Tripati, scientists are seeing early signs of the same conditions today.

"If carbon dioxide is sustained at current levels, we run the risk of Antarctic ice shelf disappearance," she said.

The ice shelves are critical because they act like a cork in a Champagne bottle, holding back the huge, land-based flows of glacial ice on the Antarctic continent, Tripati said. But they are particularly sensitive to temperature changes. Just a few degrees of increased warmth can make them disappear because they are warmed by both the air and the sea.

And disappearing ice shelves lead to even more warming because of something called the albedo effect: Light-colored ice reflects the sun's radiation away from Earth. After it melts, the darker-colored seas absorb more radiation and more heat.

That process could take hundreds of years, but signs of rapid change are already here. In 2002, the Larsen B ice shelf -- which was made up of more than 1,250 square miles of 720-foot-thick ice -- disintegrated into the ocean over the course of a month, shocking scientists and observers. Over the past several decades, seven out of 12 ice shelves on the Antarctic Peninsula have collapsed.

"They've just been going like dominoes," Tripati said.

Still, researchers say the PNAS findings offer a glimmer of hope. Policymakers rely on computer models to predict future climate change, and the models now can be refined based on the new information about changes that occurred millions of years ago, Tripati said.

The big question that remains is how fast melting will occur. Harwood said the ANDRILL findings emphasize the fragility of ice shelves and the urgency of taking action on a global scale.

"The models simulate thresholds, points of no return," he said. "It's good for policymakers to know how fast we have to get off this train or turn it in a new direction."

Article 6

A large-ish meteor, occurred on Feb. 6

This pretty much summarizes a large-ish meteor impact over the South Atlantic Ocean, which occurred on Feb. 6, and was recorded by the **Fireball and Bolide Reports page of NASA's Near Earth Object Program**.

The event itself is notable because it is the largest atmospheric impact recorded since the **famous Chelyabinsk bolide** that exploded over Russia in 2013, causing widespread structural damage and injuries to the city with a population of 1 million.

This recent Feb. 6 event unleashed an energy equivalent of 13,000 tons of TNT exploding instantaneously (a.k.a. a "13 kiloton" explosion); the Chelyabinsk impact ripped through the Ural Mountain skies with a whopping energy of *440 kilotons*.

Initially noticed by NASA's Ron Baalke and **then investigated by Bad Astronomer Phil Plait**, it quickly became clear that the high-altitude impact was likely caused by a chunk of space rock approximately 5-7 meters (16-23 ft) wide. The Chelyabinsk impact was caused by a rock nearly 20 meters (65 ft) wide.

The Feb. 6 meteor most likely burned up the majority of its mass during atmospheric entry, any pieces falling as small meteorites safely into the ocean.

ANALYSIS: How Many Tiny Asteroids Buzz Earth?

This didn't happen over a populated region and, as far as I can tell, there have been no eyewitness reports from mariners or pilots who happened to be in the area at the time. Though this is certainly an important and scientifically interesting event, the impact on the lifeforms of Earth (barring a few unlucky fish 600 miles off the coast of Brazil) was minimal. But the fact that NASA "failed" to tell the world about the impact has gotten some news outlets excited.

"Space agency fails to warn the world about massive blast, even though it's the largest atmospheric explosion since the Chelyabinsk meteor," writes **Mirror.co.uk**.

But possibly the best headline comes from another UK news outlet, **The Express**: "FRONT-room-sized meteor came out of nowhere and exploded with force of Hiroshima bomb." Because your front room (*British to US translation: living room*) is now a universal standard of meteoroid measurement. Noted.

NEWS: Russian Meteor: Chelyabinsk Asteroid Had Violent Past

The Mirror also wandered down the conspiracy path, questioning how NASA even recorded the Feb. 6 impact, highlighting Plait's analysis that the atmospheric impact was likely detected by classified military technology.

Normally, atmospheric explosions are recorded by seismic monitors, microphones and/or satellite observations. As Plait pointed out, as the impact was in open ocean, it's not likely that seismic monitors would have been used to record the impact energy. As the military has pretty obvious reasons for monitoring atmospheric explosions, it seems likely the data came from a classified source, probably satellites.

Though an interesting energetic event, Feb. 6 isn't the only time the Earth has been hit by space rocks since Chelyabinsk. Every single day Earth is peppered with around 100 tons of space debris. The vast majority of this mass is no bigger than a grain of sand, and on a clear night you might be lucky to see these tiny specks burn up in the high atmosphere as meteors.

As they slam into the upper atmosphere, these tiny pieces of space rock create a shock wave which, through rapid heating of atmospheric gases, incinerates the debris, erupting in a fast blaze of light. These are called meteors (or "shooting stars). Larger (and rarer) pieces of space rock will hit the atmosphere as a meteor and may explode as a bolide (as the Chelyabinsk event dramatically showcased), some pieces hitting the ground as meteorites.

ANALYSIS: Why I'm Sad Asteroid 2011 MD Missed Earth

Monitoring the regularity of these larger impacts is key for scientists to better understand our Earth's interplanetary environment and although the Feb. 6 event is now grabbing the headlines, remember that most large impacts will happen over

water (as the Earth is 70 percent ocean) and impacts of space rocks of around Chelyabinsk meteoroid dimensions are (statistically-speaking) a once in a century thing. Oh, and as for NASA not reporting a bolide impact that no one saw, well, it looks like the tabloid press has that covered.

Article 7

Carbon tax needed to cut fossil fuel consumption

Will we ever stop using fossil fuels? Not without a carbon tax, suggests a study
Date: February 24, 2016

*Source:*Massachusetts Institute of Technology

*Summary:*Technology-driven cost reductions in fossil fuels will lead us to continue using all the oil, gas, and coal we can, unless governments pass new taxes on carbon emissions, says one expert.

In recent years, proponents of clean energy have taken heart in the falling prices of solar and wind power, hoping they will drive an energy revolution. But a new study co-authored by an MIT professor suggests otherwise: Technology-driven cost reductions in fossil fuels will lead us to continue using all the oil, gas, and coal we can, unless governments pass new taxes on carbon emissions.

"If we don't adopt new policies, we're not going to be leaving fossil fuels in the ground," says Christopher Knittel, an energy economist at the MIT Sloan School of Management. "We need both a policy like a carbon tax and to put more R&D money into renewables."

While renewable energy has made promising gains in just the last few years -- the cost of solar dropped by about two-thirds from 2009 to 2014 -- new drilling and extraction techniques have made fossil fuels cheaper and markedly increased the amount of oil and gas we can tap into. In the U.S. alone, oil reserves have expanded 59 percent between 2000 and 2014, and natural gas reserves have expanded 94 percent in the same time.

"You often hear, when fossil fuel prices are going up, that if we just leave the market alone we'll wean ourselves off fossil fuels," adds Knittel. "But the message from the data is clear: That's not going to happen any time soon."

This trend -- in which cheaper renewables are outpaced by even cheaper fossil fuels -- portends drastic climate problems, since fossil fuel use has helped produce record warm temperatures worldwide.

The study concludes that burning all available fossil fuels would raise global average temperatures 10 to 15 degrees Fahrenheit by the year 2100; burning oil shale and methane hydrates, two more potential sources of copious fossil fuels, would add another 1.5 to 6.2 degrees Fahrenheit to that.

"Such scenarios imply difficult-to-imagine change in the planet and dramatic threats to human well-being in many parts of the world," the paper states. The authors add that "the world is likely to be awash in fossil fuels for decades and perhaps even centuries to come."

The paper, "Will We Ever Stop Using Fossil Fuels?," is published in the*Journal of Economic Perspectives*. The authors are Knittel, who is MIT's William Barton Rogers Professor in Energy; Michael Greenstone, the Milton Friedman Professor in Economics and the College at the University of Chicago; and Thomas Covert, an assistant professor at the Booth School of Business at the University of Chicago. The scholars examine costs over a time frame of five to 10 years, stating that further forecasts would be quite speculative, although the trend of cheaper fossil fuels could continue longer.

More efficient extraction

At least two technological advances have helped lower fossil fuel prices and expanded reserves: hydraulic fracturing, or fracking, which has unlocked abundant natural gas supplies, and the production of oil from tar sands. Canada, where this type of oil production began in 1967, did not recognize tar sands as reserves until 1999 -- an energy-accounting decision that increased world oil reserves by about 10 percent.

"There are hydrocarbons that we can now take out of the ground that 10 or 20 years ago we couldn't," Knittel observes.

So whereas some energy analysts once thought the apparently limited amount of oil reserves would make the price of oil unfeasibly high at some point, that dynamic seems less likely now.

To see how much better firms are at extracting fossil fuels from Earth, consider this: The probability of an exploratory oil well being successful was 20 percent in 1949 and just 16 percent in the late 1960s, but by 2007 that figure had risen to 69 percent, and today it's around 50 percent, according to the U.S. Energy Information Administration.

As a result of these improved oil and gas extraction techniques, we have consistently had about 50 years' worth of accessible oil and natural gas reserves in the ground over the last 30 years, the scholars note.

All told, global consumption of fossil fuels rose significantly from 2005 through 2014: about 7.5 percent for oil, 24 percent for coal, and 20 percent for natural gas. About 65 percent of global greenhouse gas emissions are derived from fossil fuels, according to the U.S. Environmental Protection Agency. Of those emissions, coal generates about 45 percent, oil around 35 percent, and natural gas about 20 percent.

Renewable hope

To be sure, renewable energy has seen an impressive decline in its prices within the last decade. But looking at the "levelized" cost of energy (which accounts for its long-term production and costs), solar is still about twice as expensive as natural gas. The need to handle sharp evening increases in power consumption -- what energy analysts call the "duck curve" of demand -- also means power suppliers, already wary of solar power's potential to reduce their revenues, may continue to invest in fossil fuel-based power plants.

The development of better battery technology, for storing electricity, is vital for increased use of renewables in both electricity and transportation, where electric vehicles can be plugged into the grid for charging. But the example of electric vehicles also shows how far battery technology must progress to make a large environmental impact. Currently only 12 percent of fossil fuel-based power plants are sufficiently green that electric vehicles powered by them are responsible for fewer emissions than a Toyota Prius.

Alternately, look at it this way: Currently battery costs for an electric vehicle are about $325 per kilowatt-hour (KwH). At that cost, Knittel, Greenstone, and Covert calculate, the price of oil would need to exceed $350 per barrel to make an electric vehicle cheaper to operate. But in 2015, the average price of oil was about $49 per barrel.

"It's certainly the case that solar and wind prices have fallen dramatically and battery costs have fallen," Knittel says. "But the price of gas is a third almost of what it used to be. It's tough to compete against $1.50 gasoline. On the electricity side ... the cheap natural gas still swamps, in a negative way, the cost of solar and even wind."

Emphasizing the case for a carbon tax

That may change, of course. As Knittel observes, new solar techniques -- such as thin-film layers that integrate solar arrays into windows -- may lead to even steeper reductions in the price of renewables, especially as they could help reduce installation costs, a significant part of the solar price tag.

Still, the immediate problem of accumulating carbon emissions means some form of carbon tax is necessary, Knittel says -- especially given what we now know about declining fossil fuel costs.

"Clearly we need to get out in front of climate change, and the longer we wait, the tougher it's going to be," Knittel emphasizes.

Knittel supports the much-discussed policy lever of a carbon tax to make up for the disparity in energy costs. That concept could take several specific forms. One compelling reason for it, from an economists' viewpoint, is that fossil fuels impose costs on society -- "externalities" -- that users do not share. These include the increased health care costs that result from fossil fuel pollution, or the infrastructure costs that are likely to result from rising sea levels.

"Taxes on externalities are not inconsistent with the free-market system," Knittel says. "In fact, they're required to make the free-market system achieve the efficient outcome. This idea that a pure free-market economy never has taxes is wrong."

Knittel adds: "The point of the paper is that if we don't adopt policies, we're not leaving fossils fuels in the ground."

Article 8

Predicting human evolution: Teeth tell the story

Date: February 24, 2016
Source: Monash University
Summary:

The evolution of human teeth is much simpler than previously thought, research shows, suggesting that we can predict the sizes of teeth missing from human and hominin fossils. The findings will be useful in interpreting new hominin fossil finds, and looking at the drivers of human evolution. As well as shedding new light on our evolutionary past, the findings will provide clues about how we may evolve into the future.

Cast of the skull of Lucy, the australopith Australopithecus afarensis from Ethiopia, included in the study.

Credit: David Hocking

Monash University-led research has shown that the evolution of human teeth is much simpler than previously thought, and that we can predict the sizes of teeth missing from human fossils and those of our extinct close relatives (hominins).

A new study published in the journal *Nature*, led by evolutionary biologist Dr Alistair Evans from Monash University, took a fresh look at the teeth of humans and fossil hominins. The research confirms that molars, including wisdom teeth, do follow the sizes predicted by what is called 'the inhibitory cascade' -- a rule that shows how the size of one tooth affects the size of the tooth next to it. This is important because it indicates that human evolution was a lot simpler than scientists had previously thought.

Dr Alistair Evans explains how our fascination with where we come from, and what our fossil ancestors were like, has fuelled our search for new fossils and how we can interpret them.

"Teeth can tell us a lot about the lives of our ancestors, and how they evolved over the last seven million years. What makes modern humans different from our fossil relatives? Palaeontologists have worked for decades to interpret these fossils, and looked for new ways to extract more information from teeth," Dr Evans said.

Dr Evans, a research associate at Museum Victoria, discussed how this new research has challenged the accepted view that there was a lot of variation in how teeth evolved in our closest relatives.

"Our new study shows that the pattern is a lot simpler than we first thought -- human evolution was much more limited," Dr Evans said.

Dr Evans led an international team of anthropologists and developmental biologists from Finland, USA, UK and Germany, using a new extensive database on fossil hominins and modern humans collected over several decades, as well as high resolution 3D imaging to see inside the fossil teeth.

The team then took the research a step further by applying the findings to two main groups of hominins: the species in the genus *Homo* (like us and Neanderthals), and australopiths, including specimens like Lucy, the famous fossil hominin from Africa.

Dr Evans explained that while it was discovered that both groups follow the inhibitory cascade, they do so slightly differently.

"There seems to be a key difference between the two groups of hominins -- perhaps one of the things that defines our genus, *Homo*," Dr Evans said.

"What's really exciting is that we can then use this inhibitory cascade rule to help us predict the size of missing fossil teeth. Sometimes we find only a few teeth in a fossil. With our new insight, we can reliably estimate how big the missing teeth were. The early hominin Ardipithecus is a good example -- the second milk molar has never been found, but we can now predict how big it was."

Another author on the *Nature* paper was Professor Grant Townsend from the University of Adelaide's School of Dentistry. The study examined teeth of modern humans, including those in one of the world's largest collections of dental casts housed at the Adelaide Dental Hospital.

"These collections of dental casts are critical to finding our place in the hominin evolutionary tree, and advancing knowledge in the oral health of Australians," said Professor Townsend.

The findings of the study will be very useful in interpreting new hominin fossil finds, and looking at what the real drivers of human evolution were. As well as shedding new light on our evolutionary past, this simple rule provides clues about how we may evolve into the future.

Article 9

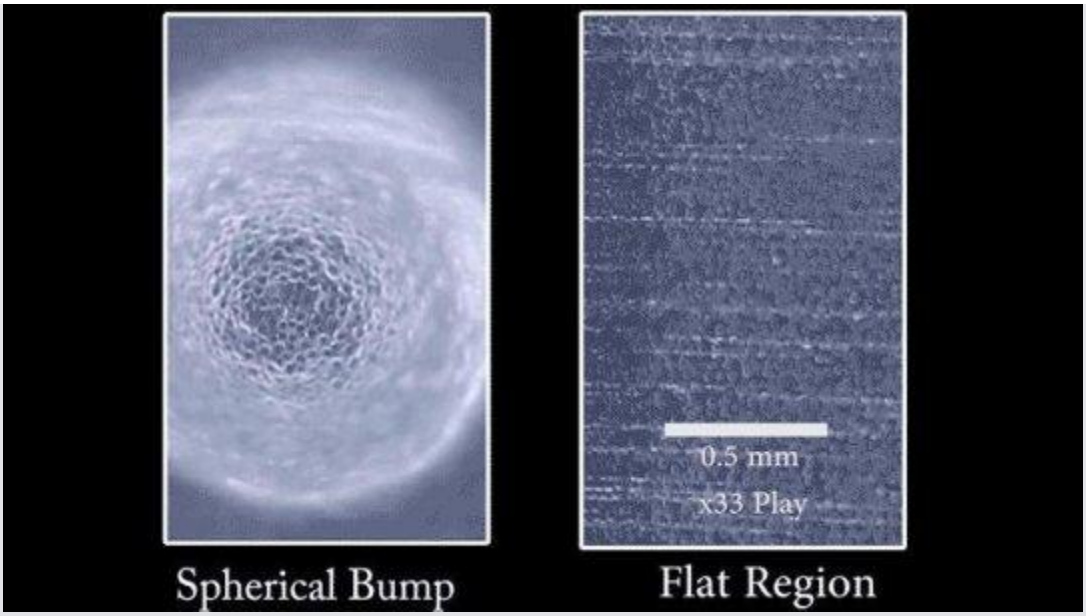
Pulling water from thin air

Inspired by a desert beetle, cactus and pitcher plant, researchers design a new material to collect water droplets

*Date:*February 24, 2016

*Source:*Harvard John A. Paulson School of Engineering and Applied Sciences

Summary: As the planet grows drier, researchers are looking to nature for more effective ways to pull water from air. Now, scientists have drawn inspiration from three organisms to develop a better way to promote and transport condensed water droplets.



Droplets grow faster on the apex of the bumps compared to a flat region with the same height.

Credit: Courtesy of the Aizenberg Lab/Harvard SEAS

Organisms such as cacti and desert beetles can survive in arid environments because they've evolved mechanisms to collect water from thin air. The Namib desert beetle, for example, collects water droplets on the bumps of its shell while V-shaped cactus spines guide droplets to the plant's body.

As the planet grows drier, researchers are looking to nature for more effective ways to pull water from air. Now, a team of researchers from the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) and the Wyss Institute for Biologically Inspired Engineering at Harvard University have drawn inspiration from

these organisms to develop a better way to promote and transport condensed water droplets.

"Everybody is excited about bioinspired materials research," said Joanna Aizenberg, the Amy Smith Berylson Professor of Materials Science at SEAS and core faculty member of the Wyss Institute. "However, so far, we tend to mimic one inspirational natural system at a time. Our research shows that a complex bio-inspired approach, in which we marry multiple biological species to come up with non-trivial designs for highly efficient materials with unprecedented properties, is a new, promising direction in biomimetics."

The new system, described in *Nature*, is inspired by the bumpy shell of desert beetles, the asymmetric structure of cactus spines and slippery surfaces of pitcher plants. The material harnesses the power of these natural systems, plus Slippery Liquid-Infused Porous Surfaces technology (SLIPS) developed in Aizenberg's lab, to collect and direct the flow of condensed water droplets.

This approach is promising not only for harvesting water but also for industrial heat exchangers.

"Thermal power plants, for example, rely on condensers to quickly convert steam to liquid water," said Philseok Kim, co-author of the paper and co-founder and vice president of technology at SEAS spin-off SLIPS Technologies, Inc. "This design could help speed up that process and even allow for operation at a higher temperature, significantly improving the overall energy efficiency."

The major challenges in harvesting atmospheric water are controlling the size of the droplets, speed in which they form and the direction in which they flow.

For years, researchers focused on the hybrid chemistry of the beetle's bumps -- a hydrophilic top with hydrophobic surroundings -- to explain how the beetle attracted water. However, Aizenberg and her team took inspiration from a different possibility -- that convex bumps themselves also might be able to harvest water.

"We experimentally found that the geometry of bumps alone could facilitate condensation," said Kyoo-Chul Park, a postdoctoral researcher and the first author of the paper. "By optimizing that bump shape through detailed theoretical modeling and combining it with the asymmetry of cactus spines and the nearly friction-free coatings of pitcher plants, we were able to design a material that can collect and transport a greater volume of water in a short time compared to other surfaces."

"Without one of those parameters, the whole system would not work synergistically to promote both the growth and accelerated directional transport of even small, fast condensing droplets," said Park.

"This research is an exciting first step towards developing a passive system that can efficiently collect water and guide it to a reservoir," said Kim.

This research was supported by the Department of Energy.

Article10

Nitrogen a neglected threat to biodiversity

Pollutant imperils vulnerable species through numerous complex mechanisms

Date: February 24, 2016

Source: American Institute of Biological Sciences

*Summary:*Nitrogen pollution is a recognized threat to sensitive species and ecosystems. However, the means and severity of the damage are elusive, hampering efforts to manage this

Habitat destruction and the direct exploitation of species often occupy center stage in discussions of biodiversity perils. However, indirect harms, such as that posed by nitrogen pollution, remain underappreciated and poorly understood despite playing a key role in species declines. In an article for the journal *BioScience*, a team of environmental researchers led by Daniel Hernández of Carleton College, in Minnesota, outline the challenges associated with nitrogen.

To better understand nitrogen-induced biodiversity imperilment, the authors surveyed 1400 species listed under the Endangered Species Act, finding a total of 78 that face known hazards from excess nitrogen. The mechanisms of nitrogen's impacts are diverse, encompassing direct toxicity, depleted oxygen resulting from excess fertilization, and incursions by invasive species that outcompete local populations or exclude their food sources. In many instances, direct attribution of declines to nitrogen pollution was hampered by "sometimes long and difficult-to-trace chains of causation from climate and atmospheric stressors to impacts," say the authors.

In recent years, the amount of nitrogen pollution has grown steadily. Fertilizer use, leguminous crop agriculture, and fossil fuel burning have more than doubled the amount of global reactive nitrogen, and in the United States, human-derived nitrogen additions are thought to be fourfold greater than natural sources. Despite this trend, say the authors, "existing laws and policies to protect biodiversity were largely developed before these threats were fully recognized."

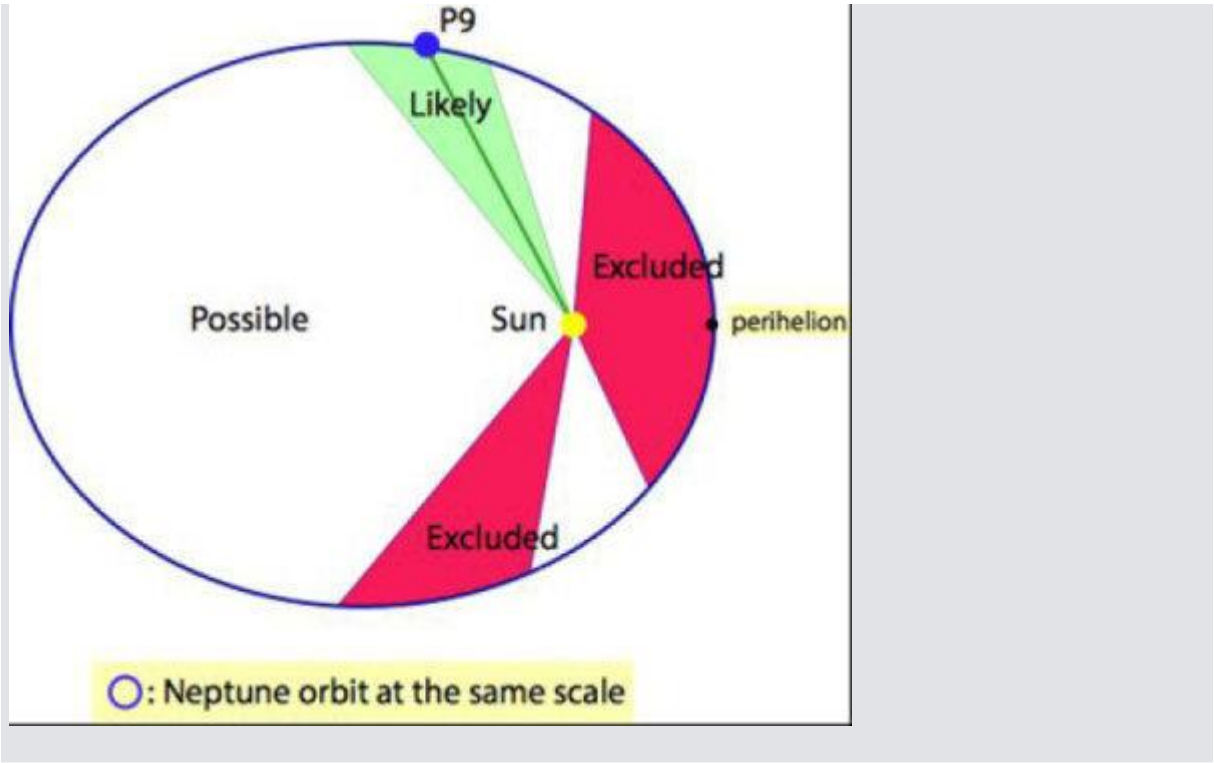
Even with the dearth of regulatory approaches for managing nitrogen pollution, the authors point to a case study of grasslands in California indicating that nitrogen's impacts on imperiled species can be substantiated "through a range of investigations at the atmosphere-ecosystem interface and the intersections of ecosystem, community, and population ecology, involving both historical and comparative approaches," which could aid future management efforts.

If regulatory structures can be appropriately modernized to encompass such approaches, efforts to mitigate nitrogen's species imperilment may be fruitful, say the authors, because unlike global threats that resist local solutions, nitrogen pollution "can be more readily addressed within the boundaries of a single nation, region, or watershed."

Article 11

Searching for planet 9

*Date:*February 25, 2016
*Source:*CNRS
*Summary:*Using observations from the Cassini spacecraft, a team of astronomers has been able to specify the possible positions of a ninth planet in the Solar System.



Location of a possible ninth planet. Analysis of radio data from the Cassini spacecraft defines forbidden areas (in red) where the perturbations created by the planet are inconsistent with observations, and a likely area (green) where the addition of the planet improves the model prediction, reducing the differences between the calculations and Cassini data. The position of minimum residues is the most likely location for a planet at P9. Scales are in astronomical units (AU).

Credit: Image courtesy of CNRS

Using observations from the Cassini spacecraft, a team of French astronomers from the Institut de mécanique céleste et de calcul des éphémérides (Observatoire de Paris / CNRS / UPMC / université Lille 1), and the laboratory GeoAzur (Observatoire de la Côte d'Azur / CNRS / Université de Nice-Sophia Antipolis / IRD) have been able to specify the possible positions of a ninth planet in the Solar System. This research is published on 22nd February 2016 in *Astronomy & Astrophysics letters*.

The Kuiper Belt Objects, small bodies similar to Pluto beyond Neptune, have a particular distribution that is difficult to explain by pure chance. This is what led Konstantin Batygin and Mike Brown at Caltech (US) to propose, in a paper published January 20, in *The Astronomical Journal*, the existence of a ninth planet of 10 Earth

masses, whose perturbations on Kuiper Objects could have led to their current distribution. Using numerical simulations, the two scientists determined the possible orbit of this planet. To be able to reproduce the observed distribution of Kuiper Belt Objects, this orbit, with a semi-major axis of 700 AU, must be very eccentric (e = 0.6) and inclined (i = 30°), but no constraint on the current position of the planet is proposed in the study of Batygin and Brown. This does not facilitate the task of observers who need to search in all possible directions in longitude to try and discover this planet.

Since 2003, Agnès Fienga (astronomer at the Observatoire de la Côte d'Azur), Jacques Laskar (CNRS senior researcher) and their team have been developing the INPOP planetary ephemerides, which calculate the motion of planets in the Solar System with the highest accuracy. In particular, using data from the Cassini spacecraft (NASA / ESA / ASI), the distance between The Earth and Saturn is known with an uncertainty of about 100m. The researchers had the idea to use the INPOP model to test the possibility of adding a ninth planet in the Solar System, as proposed by Batygin and Brown.

In the study published this week, the French team shows that depending on the position of the planet from its perihelion (denoted "true anomaly"), the ninth planet induces perturbations in the orbit of Saturn that can be detected by analyzing the radio data from the Cassini spacecraft, orbiting Saturn since 2004. The researchers were able to compute the effect induced by the ninth planet and to compare the perturbed orbit to the Cassini data. For an angle from perihelion of less than 85 ° or greater than -65 °, the perturbations induced by the ninth planet are inconsistent with the observed Cassini distances. The result is the same for the sector from -130 ° to -100 °. This result allows to exclude half of the directions in longitude, in which the planet cannot be found. On the other hand, it appears that for some directions, the addition of the ninth planet reduces the discrepancies between the model calculated by the astronomers and the observed data, by comparison to a model that does not include this ninth planet. This makes plausible the presence thereof of the ninth planet for an angle from perihelion between 104 ° and 134 °, with a maximum probability for 117 °.

The existence of a ninth planet can only be confirmed by direct observation, but by restricting the possible directions of research, the French research team makes an important contribution to this quest.

Article12

NASA sees a different kind of El Nino

Date: February 25, 2016
Source: NASA/Goddard Space Flight Center
*Summary:*A new NASA visualization shows the 2015 El Nino unfolding in the Pacific Ocean, as sea surface temperatures create different patterns than seen in the 1997-1998 El Nino. Computer models are just one tool that NASA scientists are using to study this large El Nino event, and compare it to other events in the past.

A new NASA visualization shows the 2015 El Niño unfolding in the Pacific Ocean, as sea surface temperatures create different patterns than seen in the 1997-1998 El Niño. Computer models are just one tool that NASA scientists are using to study this large El Nino event, and compare it to other events in the past.

"The start of an El Niño is important," said Robin Kovach, a research scientist with the Global Modeling and Assimilation Office (GMAO) at NASA's Goddard Space Flight Center in Greenbelt, Maryland. The visualization shows how the 1997 event started from colder-than-average sea surface temperatures -- but the 2015 event started with warmer-than-average temperatures not only in the Pacific but also in in the Atlantic and Indian Oceans.

"The '97 El Niño was much stronger in the Eastern Pacific, with much warmer water up to the coast of South America," Kovach said. In 2015, the warmest waters are instead in the Central Pacific and extend west of the International Date Line.

The water temperature variations typical of El Niño are not only at the surface of the equatorial Pacific, but below the surface as well. And these variations were also different in 2015, compared to 1997. At the height of the El Niño in November, colder-than-average temperatures in the Western Pacific and warmer-than-average temperatures in the Eastern Pacific were stronger and extended deeper in 1997 than in 2015.

Goddard's computer models, with input from ocean buoys, atmospheric models, satellite data and other sources, can also simulate what ocean water temperatures could do in the coming months. The GMAO seasonal forecast, which takes 18 hours to complete, and creates more than 9 Terabytes of data, shows that this 2015 El Niño could be different until the end.

"In the past, very strong El Niño events typically transition to neutral conditions and then a La Niña event," said Kovach. February computer model runs forecast a return to normal sea surface temperatures by June. The latest Feb 5, 2016 forecast does not yet predict below normal sea surface temperatures that would result in a large La Niña. As of Feb. 14, 2016, the latest ocean computer model shows colder-than-average water temperatures off the South American coast from Ecuador to Panama. "This current El Niño has been different so it will be interesting to see what happens in the next forecast and the coming months."

Article 13

A day before budget, PM Narendra Modi says 125 crore people will test him. Asking students appearing for exams to remain positive in his monthly radio programme, 'Mann ki Baat', PM Modi said, "I have an exam tomorrow. 125 crore citizens are going to test me as the budget will be presented in Parliament. But I'm confident and wish success to you too."

Article 14

Nasa has said India and the US could jointly explore Mars and even invited India to send astronauts to the Red Planet. India's maiden mission to the Red Planet, Mangalyaan,

has opened the eyes of the world on Isro's capabilities at undertaking low cost, high value inter-planetary mission. (TOI 29 TH FEB)