AGU journal highlights -- April 27, 2011

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The following highlights summarize research papers that have been recently published in *Geophysical Research Letters* (GRL), the *Journal of Geophysical Research-Space Physics* (JGR-A), the *Journal of Geophysical Research-Oceans* (JGR-C), and the *Journal of Geophysical Research-Biogeosciences* (JGR-G).

In this release:

Anyone may read the scientific abstract for any already-published paper by clicking on the link provided at the end of each Highlight. You can also read the abstract by going to http://www.agu.org/pubs/search_options.shtml [1] and inserting into the search engine the full doi (digital object identifier), e.g. 10.1029/2011GL046786, 2011. The doi is found at the end of each Highlight below.

Journalists and public information officers (PIOs) at educational or scientific institutions who are registered with AGU also may download papers cited in this release by clicking on the links below. Instructions for members of the news media, PIOs, and the public for downloading or ordering the full text of any research paper summarized below are available at http://www.agu.org/news/press/papers.shtml [2].

1. Could the cold winter of 2009-2010 have been predicted?
In parts of North America and Europe, the winter of 2009-2010 was one of the coldest and snowiest in recent history. These extreme weather patterns were likely the result of the strongly negative phase of the North Atlantic Oscillation (NAO). Researchers wondered whether this negative NAO could have been predicted.

Jung et al. explore the origin and predictability of the unusually cold winter using numerical simulations and the European Centre for Medium-Range Weather Forecasts monthly forecasting system. They analyze the possible role of various forcing mechanisms, including anomalies in sea surface temperature and sea ice, tropical atmospheric circulation, incoming solar radiation, and near-surface temperatures. The researchers find that none of these factors could account for the observed NAO anomaly. This could explain why most operational forecasting systems had trouble predicting the strongly negative NAO winter. They suggest that

internal atmospheric variability was primarily responsible for the negative NAO during the 2009-2010 winter.

Source: *Geophysical Research Letters*, doi:10.1029/2011GL046786, 2011 http://dx.doi.org/10.1029/2011GL046786 [3]

Title: Origin and predictability of the extreme negative NAO winter of 2009/10

Authors: T. Jung: European Centre for Medium-Range Weather Forecasts, Reading, UK; Alfred-Wegener-Institute for Polar and Marine Research, Bremerhaven, Germany;

F. Vitart, L. Ferranti, and J.-J. Morcrette: European Centre for Medium-Range Weather Forecasts, Reading, UK.

2. Coastal cooling and marine productivity increasing off Peru
The upwelling system off Peru is of environmental and economic importance due to the region's high fish productivity. It has been suggested that global warming may be leading to increasing temperature differences between the coast and the ocean, causing increases in alongshore wind stress and coastal upwelling in this zone. Upwelling brings nutrients from deep waters toward the surface, increasing biological productivity.

To confirm reported trends of increasing coastal cooling and rising biological productivity, Gutiérrez et al. analyze sediment records spanning the past 150 years as well as instrumental records from the main upwelling zone off Peru. They find that sea surface temperatures have been declining since the 1950s in the main upwelling zone. The cooling trend is likely linked to increased upwelling in spring, during which there is enhanced biological productivity.

Source: *Geophysical Research Letters*, doi:10.1029/2010GL046324, 2011 http://dx.doi.org/10.1029/2010GL046324 [4]

Title: Coastal cooling and increased productivity in the main upwelling zone off Peru since the mid-twentieth century

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3. Lightning radio-wave pattern tied to gamma ray flashes

Terrestrial gamma ray flashes (TGFs) are bursts of high-energy radiation released in Earth's atmosphere during thunderstorms and are believed to be associated with lightning. Much remains to be learned about the properties of these events and related lightning activity. To characterize the lightning processes that produce TGFs, Lu et al. analyze 56 TGFs detected by the Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI) satellite from 2004 to 2009. They look at the timing and characteristics of the very low frequency (VLF) and ultralow-frequency (ULF) radio emissions that occur in conjunction with TGFs. The researchers determine that the large majority of TGF-associated lightning signals contain at least one VLF impulse superimposed on a slow ULF pulse indicative of significant upward negative charge transfer within 2□□ milliseconds. Gamma rays are emitted in the course of this slow process, the authors report, suggesting that this process plays a key role in gamma ray production.

Source: *Journal of Geophysical Research-Space Physics*, doi:10.1029/2010JA016141, 2011
http://dx.doi.org/10.1029/2010JA016141 [5]

Title: Characteristics of broadband lightning emissions associated with terrestrial gamma ray flashes

Authors: Gaopeng Lu, Steven A. Cummer, Jingbo Li, and Feng Han: Electrical and

Computer Engineering Department, Duke University, Durham, North Carolina, USA;

David M. Smith: Department of Physics, Santa Cruz Institute for Particle Physics, University of California, Santa Cruz, California, USA;

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4. Analyzing peat's ability to trap methane bubbles

Peatlands, thick deposits of partially decayed plant matter, are a globally important carbon store. Peat soils make up one third of the global soil carbon pool, and provide one of the largest natural sources of atmospheric methane. Bubbles of methane, an important greenhouse gas, are produced by the decomposition of peat underwater. The bubbles increase in size until their buoyancy exceeds the forces keeping them in place, at which point the methane bubbles move upward through the soil and are released at the surface in what is known as an ebullition event. Ebullition events may account for a large proportion of methane lost from peatlands.

To learn more about the factors contributing to the ability of peat to trap gas bubbles, Kettridge and Binley use X-ray computed tomography to produce detailed high resolution three-dimensional images of a wide range of peat samples composed of different plant species at varying levels of decomposition. They use simulations to predict the pathways that different bubbles could take through the imaged samples and identify the potential of the peat to trap bubbles. The research shows that the ability of peat to trap gas depends on both the constituents of the peat and how these constituents are spatially arranged. The authors find that peat samples with longer structural components trapped gas more readily than those with shorter components, demonstrating the need to incorporate some representation of peat structure into models of gas bubble transport.

Source: *Journal of Geophysical Research-Biogeosciences*, doi:10.1029/2010JG001478, 2011
http://dx.doi.org/10.1029/2010JG001478 [6]

Title: Characterization of peat structure using X-ray computed tomography and its control on the ebullition of biogenic gas bubbles

Authors: Nicholas Kettridge: Department of Geography and Earth Sciences, McMaster University, Hamilton, Ontario, Canada;

Andrew Binley: Lancaster Environment Centre, Lancaster University, Lancaster, UK.

5. Probe of influential Greenland current finds no trend

The East Greenland–Irminger Current (EGIC), which flows southwestward along the eastern coast of Greenland, is important because variability in the EGIC likely influences convection in the Labrador and Irminger Seas, and could affect the global meridional overturning circulation. Daniault et al. present new measurements of the EGIC transport variability from 1992 to 2009 based on satellite altimetry data and 2

years of data from a moored array. They find that the EGIC transport was close to average from 1992 to 1996, decreased between 1997 and 2005, and has increased since 2006. Beyond this decadal variability, the researchers find no significant trend in the 1992-2009 EGIC transport time series, confirming that EGIC transport variability has not changed significantly over the past two decades.

Source: *Geophysical Research Letters*, doi:10.1029/2011GL046863, 2011 http://dx.doi.org/10.1029/2011GL046863 [7]

Title: The 1992-2009 transport variability of the East Greenland-Irminger Current at 60°N

Authors: N. Daniault: Laboratoire de Physique des Océans, Université de Bretagne Occidentale, Brest, France;

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6. Radar maps ocean motion off U.S. West Coast

A network of high-frequency radar systems designed for mapping ocean surface currents now provides unprecedented detail of coastal ocean dynamics along the United States' west coast. The network has grown over the past decade from a few radars to what is now considered the largest network of its kind in the world, providing nearly complete coverage of currents along approximately 2,500 km (1,553 miles) of shoreline. With an ability to resolve kilometer-scale currents out to approximately 150 km (93 miles) offshore, the technology has been used for local oceanographic studies in addition to applications for supporting oil spill response, search and rescue, fisheries, and coastal discharge assessment.

Using observations collected by a centralized data assembly center, Kim et al. present a multiyear synthesis of the dynamics of the surface currents off the U.S. West Coast. The surface circulation is governed by a complex combination of factors including tides, winds, Earth's rotation, synoptic ocean signals, and interactions of theseforces. The researchers report on the geographic differences of these dynamics and illustrate how the high-frequency radar system is able to characterize phenomena such as the seasonal transition of alongshore surface circulation, submesoscale eddies, and coastally-trapped waves. The researchers envision that the network will continue to provide valuable real-time monitoring of the U.S. West Coast as well as long-term, science-quality records of ocean climate signals.

Source: *Journal of Geophysical Research-Oceans*, doi:10.1029/2010JC006669, 2011 http://dx.doi.org/10.1029/2010JC006669 [8]

Title: Mapping the U.S. West Coast surface circulation: A multiyear analysis of high-frequency radar observations

Authors: Sung Yong Kim, Eric J. Terrill, and Bruce D. Cornuelle: Scripps Institution of Oceanography, University of California, San Diego, La Jolla, California, USA;

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7. Aircraft used to measure oil evaporation in Gulf

Following the Gulf of Mexico oil spill in April 2010, some hydrocarbons dissolved in the ocean, while others evaporated into the atmosphere. Ryerson et al. describe airborne in situ measurements of the hydrocarbons in the atmosphere during initial cleanup operations. By comparing the amounts of chemicals in the atmosphere with those in crude oil, they determined which compounds dissolved in the ocean and which evaporated. Also, by measuring the rate at which the compounds reached the atmosphere, they could estimate that oil and gas were leaking into the Gulf at a rate of at least 32,600-47,700 barrels of fluid per day. They found that massive amounts of hydrocarbons from the spill, about 258,000 kg/day (568,793 pounds/day), evaporated into the atmosphere within hours of surfacing; an additional 200,000 kg (440,925 pounds) were found to evaporate over the following one to two days. The airborne measurement method could be applied to future oil spills to help researchers understand the fate of spilled oil and gas and help resource managers in mitigation efforts.

See related press release:
http://www.agu.org/news/press/pr_archives/2011/2011-11.shtml [9]

Source: *Geophysical Research Letters*, doi:10.1029/2011GL046726, 2011
http://dx.doi.org/10.1029/2011GL046726 [10]

Title: Atmospheric emissions from the Deepwater Horizon spill constrain air-water

partitioning, hydrocarbon fate, and leak rate

Authors: T. B. Ryerson, C. A. Brock, D. W. Fahey, R.-S. Gao, A. M. Middlebrook, D. M. Murphy, D. D. Parrish, A. R. Ravishankara, J. M. Roberts: Chemical Sciences Division, Earth System Research Laboratory, NOAA, Boulder, Colorado, USA;

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8. Amazon region became less green due to 2010 drought

The Amazon region became significantly less green due to a severe 2010 drought. Xu et al. analyze satellite-based measurements to compare the greenness of Amazon vegetation due to the 2010 drought to that due to a severe drought in 2005. They find that the decline in greenness due to the 2010 drought affected an area four times greater than the area affected in 2005. More than half of all drought-stricken forest showed greenness declines in 2010, compared to only 14 percent in 2005. Furthermore, the declines in greenness in 2010 persisted past the time when rainfall returned to normal levels. Vegetation that is not as green absorbs less carbon dioxide, leaving more of the gas in the atmosphere, possibly accelerating global warming.

See related press release:
http://www.agu.org/news/press/pr_archives/2011/2011-14.shtml [11]

Source: *Geophysical Research Letters*, doi:10.1029/2011GL046824, 2011
http://dx.doi.org/10.1029/2011GL046824 [12]

Title: Widespread decline in greenness of Amazonian vegetation due to the 2010

drought

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SOURCE [13]

Links:
[1] http://www.agu.org/pubs/search_options.shtml
[2] http://www.agu.org/news/press/papers.shtml
[3] http://dx.doi.org/10.1029/2011GL046786
[4] http://dx.doi.org/10.1029/2010GL046324
[5] http://dx.doi.org/10.1029/2010JA016141
[6] http://dx.doi.org/10.1029/2010JG001478
[7] http://dx.doi.org/10.1029/2011GL046863
[8] http://dx.doi.org/10.1029/2010JC006669
[9] http://www.agu.org/news/press/pr_archives/2011/2011-11.shtml
[10] http://dx.doi.org/10.1029/2011GL046726
[11] http://www.agu.org/news/press/pr_archives/2011/2011-14.shtml
[12] http://dx.doi.org/10.1029/2011GL046824
[13] http://www.eurekalert.org/pub_releases/2011-04/agu-ajh042711.php