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Providing assessments of the origin of climate states, and the role of specific forcings, is not only of great importance for understanding the role of natural and anthropogenic influences on climate, but is also expected to advance efforts on multiannual climate prediction. While having only explored the role of ocean surface conditions for terrestrial climate herein, the fact that such a large influence was isolated serves to further confirm the leading role of oceans in climate variability and change.

To the extent that natural origins for the SST states of 2004 were important, the simulations indicate that appreciable global mean land temperature variations can occur that may temporarily either enhance or mask anthropogenic signals of land temperature change. To the extent that greenhouse gas origins for the SST states of 2004 were important, the simulations indicate that much of the global mean land warmth is (at least currently) arising from a feedback processes involving air-sea interactions. In either situation, anticipating the future trajectory of the oceans is argued to be of great significance for multiannual climate projections as a whole.

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Author Information

Martin P. Hoerling, TaiYi Xu, and Gary Bates, NOAA Climate Diagnostic Center, Boulder, Colo.; Arun Kumar and Bhaskar Jha, NOAA Climate Prediction Center, Washington, D.C.

NEWS

3-D Visualization of Tonga Earthquake

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Scientists at the Scripps Institution of Oceanography (SIO; La Jolla, Calif.) have created interactive three-dimensional (3-D) visualizations of the 3 May magnitude 8.0 earthquake that occurred near Neiafu, Tonga. The earthquake occurred at 1526 UTC at a depth of 16 kilometers (as recorded by the USArray seismic network operated at SIO, http://anf.ucsd.edu). A tsunami warning was initially issued, but it was subsequently canceled, and to date, no fatalities have been reported.

These 3-D visualizations are available for free download at the Scripps Visualization Center Web site (http://www.siovizcenter.ucsd.edu). The first visualization shows the hypocenter of the 3 May Tonga main shock and locations of historical earthquakes. Global topography and bathymetry data are also included for reference. The second visualization shows a more localized view of the Tonga region, along with vertical cross sections of the velocity structure in the region. An obvious correlation can be seen between changes in the velocity structure and the historical earthquake locations, which map out the geometry of the Tonga subduction zone.

These visualizations were created with using the Fledermaus software developed by Interactive Visualization Systems and stored as a 'scene' file. To view these visualizations, viewers need to download and install the free viewer program iView3D (http://www.ivs3d.com/products/iview3d). Viewers can then explore the scene file by rotating, zooming in and out, or panning over the data. They can use the left mouse button to spin the data; click and drag the middle mouse button to zoom in and out of the center of the screen; and click and drag the right mouse button to zoom in on a specific point of interest. For detailed instructions, viewers can refer to the Help menu after launching iView3D.

This visualization work was made possible by U.S. National Science Foundation award EAR-0545250 to SIO, University of California, San Diego for "Community Access to Visualizations of EarthScope Focus Sites: Collaborative Construction of Virtual 3-D Models."

—Debi Kilb, Allison Jacobs, Atul Nayak, and Graham Kent, SIO, University of California, San Diego; E-mail: anayak@ucsd.edu

Source of Climate Change Becomes Focus of Senate Hearing

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A 26 April Senate subcommittee hearing on the possible effects of climate change developed into a discussion about the extent to which the climate warming can be explained by natural or anthropogenic causes.

The hearing before the Senate Commerce, Science, and Transportation Subcommittee on Global Climate Change and Impacts began with subcommittee chair Sen. David Vitter (R-La.) acknowledging that the planet is experiencing a warming trend and that understanding the potential changes that may accompany the warming is an important task. "For once, we are not here to argue about the causes of observed warming trends," he said.

Steve Murawski, director of Scientific Programs and chief science advisor for the National Marine Fisheries Service, spoke about several possible effects of climate change, including a long-term rise in sea levels, increasing acidification of the oceans, loss of sea ice, and rising water temperatures.

Thomas Armstrong, director of the Earth Surface Dynamics Program at the U.S. Geological Survey, brought up the question of what is the cause of climate change. Armstrong noted that the scientific community is largely in agreement that human activity in the twentieth and twenty-first centuries has enhanced greenhouse gas concentrations in the atmosphere and affected global temperature and climate.

"But climate change is also a natural, continuous, inevitable Earth process that has occurred throughout Earth's history," Armstrong said. Understanding the processes and distinguishing natural change from change imposed on the natural system by human activities "is just the first step towards success in the field of climate change," he told the subcommittee.

These statements prompted questions from Sen. Vitter on how twentieth-century trends in temperature compare to previous natural cycles, the impact of greenhouse gases on temperature, and the validity of current climate models.

Syun-Ichi Akasofu, director of the International Arctic Research Center in Fairbanks, Alaska, said that because current climate models cannot reproduce the warming over the past 50 years that has occurred in the continental Arctic, it would be incorrect to conclude that this climate change is due entirely to anthropogenic causes.

Robert Corell, senior policy fellow at the American Meteorological Society and an affiliate of the Washington Advisory Group, noted that the Intergovernmental Panel on Climate Change and much of the scientific literature indicate that human-induced carbon dioxide (CO_2) contributions to the atmosphere are the predominant factor behind the warming of the planet.

Subcommittee ranking member Sen. Frank Lautenberg (D-N.J.) asked at what point do "the alarms sound loudly enough" for the government to intervene to reduce the human contributions of CO_2 into the atmosphere.

Corell noted that even if humans took action to reduce CO_2 emissions, it would take the planet about 200 years for the CO_2 to stabilize at some higher level in the atmosphere, and that temperatures would increase for roughly another 200 years. Sea level would continue to rise for probably another thousand or more years. "It seems logical that you ought to move that action time shorter to lower those temperature rates and to reduce the time for stabilization to occur," Corell said. "I think the conventional wisdom within the scientific community is that we know enough now to take appropriate action."

—Sarah Zielinski, Staff Writer

In Brief

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Myers nominated to head USGS U.S. President George W. Bush will nominate Mark Myers to be director of the U.S. Geological Survey (USGS), the White House announced on 3 May.

Myers most recently held the position of Alaska State Geologist and director of the State of Alaska Division of Geological and Geophysical Survey. Prior to that position, Myers headed the State of Alaska Division of Oil and Gas, the agency that oversees leases of state lands for oil and gas exploration.

An expert on Alaskan North Slope sedimentary and petroleum geology, Myers is a certified professional geologist with the American Institute of Professional Geologists and a certified petroleum geologist with the American Association of Petroleum Geologists.

The current USGS acting director, Patrick Leahy, will continue to lead the agency until Myers is confirmed by the U.S. Senate.

—Sarah Zielinski, Staff Writer

NASA satellites will study clouds and aerosols Two NASA satellites, with missions to study the vertical distributions of clouds and aerosols within the atmosphere, were launched on 28 April from Vandenberg Air Force Base, Calif.

The satellites, CloudSat and CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations), eventually will circle approximately 705 kilometers above Earth for three years in a sun-synchronous polar orbit.

"Between CloudSat and CALIPSO, we will be able to make an entire map from the top of any cloud structure, clear down to the Earth's surface," said Tom Livermore, CloudSat project manager at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif. By contrast, most other satellite images do not have this vertical dimension.

On CALIPSO, a lidar instrument will pulse low-power light through the atmosphere, with a portion of the energy traveling back to the satellite. From this, layers in the atmosphere can be deduced. CALIPSO also will house visible and infrared cameras to image the size of aerosols.

CloudSat will use a Cloud-Profiling Radar, 1000 times more sensitive than a typical weather radar, to map the inside of clouds.

"By the end of the three years, we will have a very comprehensive data set, not just of the instantaneous location of clouds and aerosols around the planet, but also of the seasonal variations and long term trends over the three years," explained Kevin Brown, CALIPSO project manager at NASA's Langley Research Center in Hampton, Va. This data will help with predictions of climate properties and the Earth's energy budget.

CloudSat was developed by JPL in collaboration with the Canadian Space Agency. CALIPSO is a collaboration between NASA and France's Centre National d'Etudes Spatiales.

—Mohi Kumar, Staff Writer

MEETINGS

International Symposium on Airborne Geophysics

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Airborne geophysics can be defined as the measurement of Earth properties from sensors in the sky. The airborne measurement platform is usually a traditional fixed-wing airplane or helicopter, but could also include lighter-than-air craft, unmanned drones, or other specialty craft.

The earliest history of airborne geophysics includes kite and hot-air balloon experiments. However, modern airborne geophysics dates from the mid-1940s when military submarine-hunting magnetometers were first used to map variations in the Earth's magnetic field. The current gamut of airborne geophysical techniques spans a broad range, including potential fields (both gravity and magnetics), electromagnetics (EM), radiometrics, spectral imaging, and thermal imaging.

For the most part, the geophysical sensors used in airborne applications may also be deployed in ground-based modes. For example, subtle variations in the Earth's gravity field have traditionally been measured at discrete surface points that can then be compiled into a map. However, ground-based measurements can be logistically intensive and expensive, particularly in remote regions. If a geophysical sensor can be made to operate at the necessary frequency and accuracy, it is much more efficient to survey from the air. Indeed, in many situations ground access may be undesirable, difficult, and/or dangerous.

Some airborne geophysical techniques, such as magnetic field mapping, are in routine use worldwide; other techniques, such as airborne electromagnetics, are still undergoing significant development. Depending on the physics involved, different airborne techniques may require very different survey design. Parameters such as flight height, flight-line spacing, and flight speed may differ significantly depending on the geophysical sensor being used. If multiple sensors are deployed simultaneously, it can be tricky to optimize these survey design parameters.

The traditional application of airborne geophysics has been in mineral and energy exploration. Aeromagnetic surveys have been flown, at least at coarse resolution, over much of the world. Numerous contractors routinely conduct airborne exploration surveys worldwide.

The application of airborne geophysics to geohazard mapping and mitigation is a topic of current research interest. Many of the