

## Gravity Wave Effects on Circulation

**AGU Chapman Conference on Atmospheric Gravity Waves and Their Effects on General Circulation and Climate; Honolulu, Hawaii, 28 February to 4 March 2011**

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Atmospheric gravity waves account for a significant fraction of the observed variability in the atmosphere with periods from tens of minutes to tens of hours. The wind and temperature variances associated with high-frequency gravity waves are generally observed to increase with height from near the ground up to the lower thermosphere, and studies of gravity waves in the upper atmosphere have been a staple of middle and upper atmospheric dynamics for many years. Gravity waves act to exchange mean horizontal momentum between the Earth's surface and the atmosphere and among different layers of the atmosphere, and so they play a role in forcing global-scale atmospheric circulation. Recent work on dynamical coupling of the troposphere with the middle atmosphere has made it clear that gravity waves have a significant influence on the general circulation even in the lower atmosphere, and so global climate simulation models need to adequately treat the effects of atmospheric gravity waves that are not explicitly resolved.

The AGU Chapman Conference on Atmospheric Gravity Waves and Their Effects on General Circulation and Climate reviewed

recent developments in this rapidly evolving field. Important advances in observations, theory, and numerical modeling were presented. Particularly exciting were new results from observational techniques that will allow characterization of the spatial dependence of the statistics of the gravity wave field and help determine connections with geographically dependent wave sources. Such results were reported from various satellite remote sensing instruments as well as from long-lived constant altitude balloons that perform in situ sampling in the lowermost stratosphere as they travel around the globe.

Other observational and modeling studies presented at the meeting concentrated on understanding the interaction between mean flows and waves in situations with large and systematic mean flow variations. On a short time scale this approach was seen in several studies of gravity waves during the stratospheric midwinter sudden warming phenomenon. At longer time scales the systematic mean zonal wind reversals in the tropical quasi-biennial oscillation (QBO) provide a beautiful test bed for observing and modeling the effects on filtering vertically propagating gravity waves generated in the tropical troposphere. In turn, the momentum transports

associated with gravity waves account for a significant fraction of the mean flow driving the QBO.

It was clear from many presentations at the conference that gravity wave studies have benefited enormously from the increased activity in recent years in developing and applying global atmospheric models that include serious representations of the middle atmosphere. With successful simulations of the mean wind and temperature structure throughout the atmosphere, such models can be analyzed to understand the role of gravity waves in maintaining such key global circulation features as the QBO and Brewer-Dobson circulation. The papers at the conference highlighted the range of exciting investigations that can now be executed, from studying the role of gravity wave forcing of the mean flow in operational short-term weather forecasts to self-consistent simulations of the expected response of the QBO to increased greenhouse gas concentrations.

A photo of participants, the conference program, abstracts, and presentations can be found at [http://iprc.soest.hawaii.edu/meetings/workshops/11\\_02\\_Chapman\\_Conference/](http://iprc.soest.hawaii.edu/meetings/workshops/11_02_Chapman_Conference/).

—KEVIN P. HAMILTON, International Pacific Research Center, School of Ocean and Earth Science and Technology, University of Hawai'i at Manoa, Honolulu; M. JOAN ALEXANDER, Colorado Research Associates Division, NorthWest Research Associates, Inc., Boulder, Colo.; E-mail: alexand@cora.nwra.com; and KAORU SATO, Department of Earth and Planetary Science, University of Tokyo, Tokyo, Japan

## ABOUT AGU

### Want Change? Call Your Representative

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During my tenure as an AGU Congressional Science Fellow, which began in September 2010 and continues until November 2011, my time has been shared between working with the U.S. House of Representatives Natural Resource Committee Democratic staff and in the office of Rep. Ed Markey (D-Mass., ranking Democrat on the committee). I appreciate getting to work with staff, fellows, and interns who inspire me, make me laugh, and know their issues cold.

Much of my work on the committee is related to fish, wildlife, oceans, lands, and water issues and is directly related to my background in ecology and evolutionary biology (I studied zebra ecology and behavior in Kenya). My assignments have included asking the Environmental Protection Agency (EPA) about why it has not changed the allowed usage of certain

pesticides that the National Marine Fisheries Service has found to jeopardize the recovery of endangered Pacific salmon; helping to identify research needs and management options to combat the swiftly spreading and catastrophic white nose syndrome in North American bats; and inquiring as to whether a captive-ape welfare bill, if passed without amendment, could thwart development of a vaccine to stop the Ebola virus from continuing to cause mass mortality in endangered wild apes.

My portfolio in Rep. Markey's office includes science, nuclear safety and nonproliferation, homeland security, defense, foreign affairs, human rights, and trade. Markey and his staff have been leaders on nuclear safety for decades. During the current Japanese nuclear crisis resulting from the earthquake and tsunami that struck that country in March, I have helped draft a number of oversight letters to the Obama administration urging it to close

gaps in U.S. nuclear safety regulations. I also helped write a staff report, "Fukushima fallout: Regulatory loopholes at U.S. nuclear power plants."

During my fellowship I have learned some tips about how constituents can best engage with their representatives, which may be useful to pass along to those who communicate with, or are considering getting in touch with, members of Congress. Bear in mind that the House and Senate have different rules and cultures, which may make my advice less relevant for the Senate. Also, as a fellow I still have plenty to learn, and I am sure that some AGU members have their own successful strategies for working with Congress.

My overall message is that you can't beat the power of directly telling your representative what you want him or her to do. Do you want your representative to write legislation that would change existing laws or to propose an amendment to a bill that has been introduced but not yet voted on? Let elected officials know clearly what actions you want them to take. When feasible, it is best to visit your representative or your representative's staff in person. If that is not possible, pick up the phone or write a personal letter or e-mail. Establish relationships with staff members in the

representative's Washington, D. C., and home district offices who handle issues you care about. Members of Congress do pay attention to constituents.

Also, find common ground with a group so that together you represent more than just one person. Enlist other people to join a meeting and call a House member's office. It makes a big impression when 20 constituents, for instance, appear for a meeting or when a congressional office is "phone-banked" (which occurs when an office receives so many constituent phone calls on an issue that the House member may have to take a position on that issue to allow staff to stop answering calls and resume their other work).

Make an explicit "ask." Congressional meetings with constituents are brief, often less than a half hour. When I am meeting with a constituent, I want to know at the conclusion of the meeting what the constituent wants from Rep. Markey. For instance, should the representative cosponsor a bill, vote yes or no on a piece of legislation, ask a question of the administration by letter or at a hearing, or request a particular funding level for a federal program from the Appropriations Committee? Ask for only one or a few things, and make at least one of the requests plausible.

In addition, provide answers to the questions your requests may raise with House members and staff:

Is your request consistent with your representative's past actions, including the level of interest he or she has shown on your issue? Thomas, the Library of Congress's online database (<http://thomas.loc.gov>), is a great resource for researching bills and the history of actions by members of Congress.

Is there anything potentially controversial about your request? If you advocate for support of science funding or for agencies to be enabled and required to make regulatory decisions using the best science, that may be considered controversial. Some House members reject or poorly understand consensus science on climate change, evolution, and other issues. Consider, for instance, House Speaker John Boehner's comments about climate change in a 19 April 2009 interview with George Stephanopoulos of ABC News: "The idea that carbon dioxide is a carcinogen that is harmful to our environment is almost comical. Every time we exhale, we exhale carbon dioxide. Every cow in the world,

you know, when they do what they do, you've got more carbon dioxide," Boehner said. Use the opportunity of your meeting to correct misperceptions about science or to thank representatives for supporting lawmaking grounded in science. Also, explain what you are learning as a scientist and how it is relevant to the day-to-day workings of your congressional district and the country.

What is the administration's position on your issue? If you are asking for support on a scientific grants program, for example, you could find out in advance of your meeting what the funding level is for the program in the president's budget request to Congress.

What does your request mean for a representative's home district, state, and the nation? If you are advocating for science funding, identify the economic benefits in addition to noting the wonder of discovery or the need for support of graduate education. What do scientific grants mean for job creation, national security, or the crisis of the day?

How can your representative influence things through committee membership? The committee to which a bill is "referred" depends on which part of the executive branch would implement the change to laws that might be required by the bill if it eventually became law. Legislation is "marked up" (amended) in a hearing within a committee and brought to the House floor only if it passes out of committee. Committees also hold oversight hearings, where House members on the committee have additional opportunities to ask questions of witnesses, including questions you might want them to ask. Visit the committees online to view their membership, jurisdiction, and the schedule and webcasts of hearings.

Another tip to remember is to time your request to action in Congress. If you are advocating for a particular science program, tell your representative what you want at key stages in the annual cycle of the federal budget: as budget hearings approach, when funding requests are due from House members to the relevant appropriations subcommittees, when appropriations bills are being debated and amended, and so forth. If your issue is in the news, that may be a good time to call House members and offer your thoughts and expertise. To find out which bills will soon come to the House floor and what amendments have been proposed for them, visit the Committee on

Rules Web site (<http://rules.house.gov/>). To see which bills are currently being debated and voted upon by the House, visit the House Office of the Clerk's Web site (<http://clerk.house.gov/>).

In addition, it is helpful to find supporters for your position on both sides of the aisle. As the current majority party in the House, Republicans set the rules of parliamentary procedure. If you want a bill to receive a hearing, be brought to a vote, and potentially be approved by the House, then persuade Republicans to cosponsor the legislation. Also, a letter from Congress to the administration carries far more weight if it has bipartisan cosigners.

For useful background, examine your representative's campaign contributors and the campaigns of other House members to which your representative contributes. Two Web sites to look at are those of the Federal Election Commission (<http://www.fec.gov>) and Open Secrets (<http://www.opensecrets.org>). The issue of campaign contributions will not come up during your meeting with a House member because campaign fund-raising is illegal in congressional offices.

Finally, consider expanding your policy advocacy beyond Congress. Federal agencies also have the power to take action on some issues. This can be important when some members of Congress may favor measures such as voting species off the endangered species list rather than allowing the Fish and Wildlife Service and National Marine Fisheries Service to make listing decisions based on the best available science; trying to prevent EPA from regulating greenhouse gases; and cutting the Land and Water Conservation Fund monies that states use to acquire land for conservation, among other measures. Get to know individual agency staff members because they can help your cause. Also, bear in mind that state, local, and tribal governments; intergovernmental organizations; companies; and nongovernmental organizations are decision makers with real power. Consider contacting these groups, as well as your representative, for assistance.

I hope that sharing my experience will be useful to readers who want to communicate more effectively with elected officials and other decision makers. Of course, don't forget that you too are a decision maker!

—ILYA R. FISCHHOFF, AGU/AAAS Congressional Science Fellow, Washington, D. C.