

## Johnson received the 2013 Georg Wüst Prize

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Prof. Dr. Georg Wüst



Dr. Gregory C. Johnson

Dr. Gregory C. Johnson received the Georg Wüst Prize 2013 at the European Geophysical Union (EGU) General Assembly in Vienna, Austria, April 2013. This biannual prize is awarded for outstanding contributions to the general field of oceanography and is sponsored by the German Society for Marine Research and *Ocean Dynamics*. The following is a transcript of the citation by Prof. Wolff and the response by Dr. Johnson.

### Citation by Prof. Wolff:

The German Society for Marine Research (Deutsche Gesellschaft für Meeresforschung, DGM) awards this biennial prize with the generous sponsorship of the international Springer journal *Ocean Dynamics*. Specifically, it is meant to honor excellent mid-career scientists, thus targeting a

group missed by the “outstanding life-time achievements” awards or those directed explicitly at bright “young scientists.” It is the intent that this honor will further inspire the recipient to address the demanding tasks that are imposed in understanding and predicting the oceans' response and contribution to climate change.

The inaugural presentation of the Georg Wüst Prize was firstly presented at the 2005 EGU General Assembly in Vienna by Prof. Arnold L. Gordon, Lamont-Doherty Earth Observatory of Columbia University, and me to Dr. Stephen Rintoul, CSIRO, Hobart, Australia. Since then, the Georg Wüst Prize has been awarded to Dr. Eberhard Fahrback in 2007, to Prof. Karen Heywood in 2009, and to Prof. Andreas Oschlies in 2011.

This year, in 2013, the Georg Wüst Prize is presented to Dr. Gregory C. Johnson of the Ocean Climate Research Division at the Pacific Marine Environmental Laboratory of the National Oceanic and Atmospheric Administration, Seattle, USA. Unfortunately, the President of the DGM, Prof. Oliver Zielinski, could not make it to Vienna on time, so as his predecessor and also as Chief Editor of *Ocean*

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*Dynamics*, it is my honor and distinct pleasure to present the Georg Wüst Prize 2013 to Dr. Johnson.

Before discussing the achievements of Gregory Johnson, I first quote from Arnold Gordon's statement at the 2005 presentation concerning Georg Wüst's achievements.

“Georg Wüst, born 15 June 1890, brought descriptive oceanography into the modern era. Through a careful analysis of each hard-won observational data point that passed his meticulous quality control procedures, he probed into the secrets of the ocean, contributing to several research areas. He is best known for his Atlantic Ocean studies, where with great insight and skill he combined water mass analysis by means of the temperature–salinity relationship and the core method, with the dynamic approach of geostrophic balance, to reveal the nature of the deep Atlantic's stratification and circulation”.

Coming now to Gregory Johnson, I quote from the nomination letter:

“Dr. Johnson is an observational physical oceanographer who works much in the spirit of Georg Wüst. He is global in his research, having collected and analyzed data in all major ocean basins. He publishes valuable, insightful basin and global scale analyses of oceanographic currents, water properties, transport, and their variability from the surface to the abyss, from the equator to the Antarctic and the Bering Sea. He uses a wide variety of observations in those analyses including in situ temperature, salinity, oxygen, nutrient, and velocity measurements, as well as remotely sensed satellite sea-surface height (altimetry) and sea-surface temperature data. While he is at heart a sea-going observationalist, Dr. Johnson is also a talented and creative theoretician. Finally, he has the temperament to take the extraordinary care needed to ensure ocean measurements are of the highest quality and to rigorously quantify uncertainty. This rare and powerful combination of skills – a deep understanding of ocean dynamical theory; a talent for innovative analysis of oceanographic data; and a rigorous approach to the collection and interpretation of ocean observations – has underpinned his substantial contributions to the field.

Dr. Johnson began working on the abyssal currents as a graduate student in the Woods Hole Oceanographic Institution/Massachusetts Institute of Technology Joint Program, describing their cross-equatorial flow in the Pacific and Indian Oceans. As a postdoctoral researcher at the University of Washington's applied physics laboratory he worked on outflow dynamics through observational analysis and laboratory studies,

providing new insights into the role of interfacial friction and bottom stress in strong outflows and their cross-channel secondary circulation. While often returning to studies of the abyssal water properties and circulation from Antarctica through the equator to the northern North Atlantic and Pacific, he has worked with an astonishing number of oceanographers on topics including tropical ocean circulation and its variability both seasonal and interannual, the subtropical cells, equatorial currents and waves from the surface to the abyss (including an observational analysis that produced a climatology of tropical Pacific upper ocean currents that is widely used as a benchmark for ocean model validation), subtropical and subpolar mode waters and their variability, Bering Sea currents and water property variations, mid-depth circulations associated with hydrothermal plumes, intermediate water variability, the role of double-diffusion in water-mass variations, mesoscale eddies, as well as data quality control and synthesis. Recently his work has expanded to the roles of the oceans in climate change, including quantifying changes in the tropical oxygen minimum zones, long-term warming of Antarctic Intermediate Water, and the ocean's uptake of heat (and its role in sea level rise) in the upper and abyssal oceans. Recent studies with his student Sarah Purkey have shown that the Antarctic Bottom Water is warming, freshening and contracting over much of the global ocean. The changes are sufficiently large to make an important contribution to the global energy budget and sea level. In addition to these analyses, he has been serving as a lead author of Chapter 3: Observations: Oceans for the Intergovernmental Panel on Climate Change Fifth Assessment Report. He also has been first author of annual updates on ocean heat content since 2005 and sea surface salinity since 2006 for the Annual State of the Climate reports published as supplements to the Bulletin of the American Meteorological Society. In addition to his outstanding research achievements, Dr. Johnson has provided leadership at the international level. Examples include his service to IPCC, his efforts to ensure data from Argo and repeat hydrographic sections are of the highest possible quality and easily accessible, and his membership of numerous WOCE, CLIVAR and Argo committees. He leads an Argo group that deploys a substantial fraction of the Argo array (well over 450 active floats as of August 2012). He has led efforts within Argo on the development of scientific quality control (including published papers on sensor response corrections and salinity adjustment algorithms) that have been adopted internationally as the Argo standards for scientific quality

control of CTD data from Argo floats. The methods he has developed for quality control of CTD data have become the international standard.

He is a generous and dedicated supervisor and mentor to younger scientists. His postdocs and students are themselves having a substantial impact on the field.

His work continues to have a profound impact on the field and will leave a lasting legacy”.

As a member of the prize committee, Arnold Gordon adds the following sentences:

“Georg Wüst (1964) stated that oceanographic progress depends directly on the observations from the great ocean expeditions, with advances hinged on technology, improvement of instrumentation, and data analysis closely linked to the development of new theoretical concepts. With few observational data points, Georg Wüst, and his colleagues, had to take on the convenient assumption of steady-state, in describing the ocean condition. We now have far many more data points, thanks to an abundance of regional surveys, with the global WOCE and CLIVAR efforts, and with a virtual explosion of observations during the first decade of the 21<sup>st</sup> century, provided by the Argo profilers. Greg Johnson makes full use of the greater observational base that he has played a central role in the building. He has taken on the temporal dimension, describing in quantitative manner ocean variability, including deep ocean warming over recent decades. Greg is a global oceanographer, whose observational approach, following in the spirit of Georg Wüst, has taken us to the next level of appreciation of the ocean state”.

The prize consists of a 3-D laser-engraved picture of the old meteor in a glass block, a prize certificate, an honorary lifetime membership of the German Society of Marine Research, and a prize money of 1,500 €.

Congratulations Greg!

Prof. Dr. Jörg-Olaf Wolff, Chief Editor, *Ocean Dynamics*

#### **Response by Dr. Johnson:**

I am honored and delighted to accept the 2013 Georg Wüst Prize here in Vienna at the General Assembly of the European Geosciences Union. I would like to thank the German Society for Marine Research for awarding me this prize and Springer Verlag's *Ocean Dynamics* for sponsoring it. I would also like to thank Prof. Dr. Jörg-Olaf Wolff and colleagues for their extremely generous citation and nomination.

It is humbling to receive a prize awarded previously to Stephen Rintoul, Eberhard Fahrback, Karen Heywood, and Andreas Oschlies. I could not possibly improve on their words regarding Prof. Dr. Wüst, so I will focus on acknowledging those with whom I have had the pleasure to work over the years, as one of the best things about oceanography is the people.

Of course, one's doctoral advisor can be very influential on one's career path. I was fortunate enough to study with one of Wüstian bent, the late Dr. Bruce Warren, at the Woods Hole Oceanographic Institution. Bruce showed me the importance of collecting high-quality data and analyzing them with care. As his student, while studying the spreading of bottom waters across the equators of the Indian and Pacific oceans, I hand-contoured oceanographic sections, the better to understand the data (and, no, I am not so old that computer contouring was not a possibility). Bruce was a good friend. He is still an inspiration to me, and I think of him often.

My tutoring on Wüstian attention to data and experimental design continued with my postdoctoral advisor, Prof. Tom Sanford of the University of Washington's Applied Physics Lab. I was privileged to study deep overflow and outflow dynamics as a part of his group for two very stimulating years. I am also happy to thank Dr. Bruce Taft, who hired me as an oceanographer at NOAA's Pacific Marine Environmental Laboratory 20 years ago, and all the wonderful scientists, staff, postdocs, and students at PMEL and the University of Washington with whom I am privileged to collaborate on a daily basis, as well as, of course, my national and international colleagues who are so generous with their ideas, data, and time. It is this great community that makes oceanography so engrossing and rewarding.

When I was first introduced to physical oceanography as a somewhat bewildered undergraduate summer student fellow at Woods Hole, trying to absorb the wisdom of Prof. Peter Rhines, I found it quite interesting, but somewhat academic. Since then, we have become increasingly aware of the large roles the ocean plays in Earth's changing energy, carbon, and hydrological cycles. Hence, oceanography is entwined with issues like a warming atmosphere, changing rainfall patterns, melting ice, rising sea levels, changing ecosystems, and increasing ocean acidity, making it very relevant to society at large. That relevance is rewarding, if overwhelming at times. Wüst's legacies are many, but with societal relevance in mind, I would like to focus for a minute on the important responsibility of collecting high-quality oceanographic data.

Oceanographic data collected by so many through international programs like the World Ocean Circulation Experiment, the Climate Variability and Predictability Research Program, and the Argo Program are vital to

studying a changing planet, and high-quality historical data including those from the Meteor Expedition that Wüst led are very precious. Those who collect such data are not sufficiently celebrated. I am very fortunate to work with two outstanding people who lead data collection efforts by my group at PMEL: Ms. Kristene McTaggart has worked with me over the past two decades with a very high degree of professionalism and patience – going to sea, collecting, calibrating, processing, and quality controlling excellent oceanographic data on many cruises during WOCE and CLIVAR, also assessing and quality controlling endless Argo float oceanographic data. Dr. Elizabeth Steffen has worked with me unrelentingly and painstakingly over the past decade on almost all aspects of Argo float logistics – testing, refitting, repairing, shipping, deploying, and monitoring over 600 PMEL Argo floats. Thank you both; the science we do would not happen without your dedication.

Finally, I would like to thank my wife and colleague, Prof. LuAnne Thompson, for her unstinting generosity and love as well as my daughter Lucy, who has stoically endured

too many discussions of Antarctic Bottom Water, Rossby waves, and climate change at the dinner table.

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