GPC Newsletter

February 2014

IN THIS ISSUE

APS TOPICAL GROUP ON THE PHYSICS OF CLIMATE

Message from the Editor

This is the second GPC Newsletter, timed like the first one with the APS March Meeting. We hope you agree that the formatting has become more professional with iteration.

We would like to increase the frequency of the Newsletter to at least twice per year, and this is where you, the GPC membership, can be of enormous value. We invite comments, event notices, letters, and especially specific suggestions for content. Any of the above, addressed to GPCnews@aps.org, will be gratefully acknowledged in a timely fashion.

Welcome from the GPC Chair, *Bob Behringer, Duke University*

I have the privilege of welcoming everyone to the second year of existence and the second Newsletter of the Topical Group on the Physics of Climate (GPC). Last year saw our first steps as a topical group, following an extended period of planning and discussion of how the GPC should be structured. We had a presence at the APS 2013 March Meeting in Baltimore, with an invited session, a focus session, and also a presence at the Kavli Plenary Session. The GPC also sponsored a mini-symposium, joint with the DFD, at the November, 2013, Division of Fluid Dynamics meeting in Pittsburgh.

We are now looking forward to the March 2014 Meeting of the APS, which will take place over March 3-7, 2014, in Denver, CO. For this meeting, we will have an invited session (Session G 40, Tuesday, 11:15—2:15, Mile High Ballroom 2B-3B) and a focus session (Session Q30, starts at 2:30,

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An Overview of the IPCC Fifth Assessment Report (AR5), *Ken Minschwaner, New Mexico Tech*

The Intergovernmental Panel on Climate Change (IPCC) is in the process of finalizing its Fifth Assessment Report (AR5) for 2013-14. The AR5 is the latest in a series of climate change assessments that have been released roughly every six years, since the publication of the first IPCC report in 1990. The IPCC was established in 1988 by the United Nations Environment Programme and the World Meteorological Organization with the goal of providing the international community with a scientific view of the current state of knowledge on climate change. Even though the Panel is composed largely of scientists currently engaged in climate research, it does not conduct research or carry out any climate monitoring activities on its own.

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Atmospheric Physics at New Mexico Tech, *Sharon Sessions, New Mexico Tech*

Understanding the science of climate change is a monumental task, the importance of which cannot be understated. Many young physicists recognize this, and many aspire to combine their love of physics with an opportunity to make a significant impact to climate science by pursuing research in atmospheric or climate physics. Consequently, there is a growing demand for programs which integrate atmospheric science and traditional physics. The purpose of this article is to highlight one institute which has been doing this since the mid-1940s.

The connection between atmospheric science and physics is a natural one, yet convention has separated these fields in formal undergraduate and graduate programs. Both atmospheric science and traditional physics programs are abundant across the United States, but there is a

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Welcome from the GPC Chair – *continued from p. 1*

Room 605). Following Q30, we will have an official GPC Business Meeting (Session R40, Wednesday, 5:45—6:45 in the Mile High Ballroom, 2B-3B). I encourage your participation. In particular, if you are curious about the GPC, these sessions and the Business Meeting would be excellent opportunities to learn about the group. There will also be an opportunity to sign up to become a member of the GPC at these events.

I would like to offer my thanks to all the contributors to the process that has led to the creation and evolution of the GPC, and in particular to the members of Executive Committee whose terms ended in December, 2013. The past GPC chair, Jim Brasseur provided a detailed account of the process leading to the group in the 2013 Newsletter. As he noted, the GPC was created in the context of an official "Statement on Climate Change" by the American Physical Society, and a "Commentary" in April 2010 (http://www.aps.org/policy/statements/07_1.cfm). One of the issues surrounding the evolution of the GPC was the fact that "Climate" is at the same time a scientific, an economic, and a political issue. The point of the GPC is that it focuses only on the physics of processes involved in climate dynamics and characterization, independent of social influences.

All of us associated with the GPC look forward to your participation in the March Meeting and in particular in the events sponsored by the Topical Group on the Physics of Climate at the 2014 APS March Meeting. Please also join the GPC leadership at the GPC Business Meeting on Tuesday 5:45 – 6:45 pm in room 301 of the Convention Center.

In closing it may be worth reiterating the a key aspect of the GPC: "The objective of the GPC shall be to promote the advancement and diffusion of knowledge concerning the physics, measurement, and modeling of climate processes, within the domain of natural science and outside the domains of societal impact and policy, legislation and broader societal issues. The objective includes the integration of scientific knowledge and analysis methods across disciplines to address the dynamical complexities and uncertainties of climate physics."

Please refer to the GPC website for details such as bylaws, governance, etc: http://www.aps.org/units/gpc/index.cfm, and please see below for members of important GPC committees, including the executive committee.

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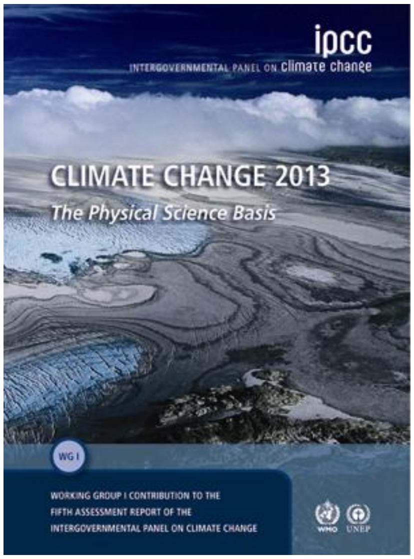
An Overview of the IPCC Fifth Assessment Report (AR5) – *continued from p. 1*



Rather, it is charged with reviewing, assessing, and summarizing the most recent scientific, technical and socio-economic information relevant to understanding climate change. The IPCC process attempts to assess the literature as it stands, and is aimed to reflect the level of reasonable scientific consensus as well as disagreement.

There are three working groups (WG) within IPCC: the first focuses on the physical science basis of climate change (WGI), while the second examines impacts, adaptation and vulnerability (WGII), and the third is concerned with mitigation (WGIII). WGI's report, "Climate Change 2013: The Physical Science Basis", and an associated "Summary for Policymakers" were both approved by the IPCC in September of 2013. Similar approvals of reports and summaries are planned from WGII and WGIII in March and April of 2014. A full synthesis report and summary is expected to be finalized in October 2014. Here, I briefly review some of the findings from the WG1 report that may be of interest to some members of the GPC.

The WG1 report contains 14 chapters that cover both direct and proxy observations of changes in all components of the climate system, including the surface, atmosphere, ocean, and cryosphere. It further quantifies the link between changes in atmospheric composition and the radiative forcing of the surface-troposphere system, and the consequent detection and attribution of observed changes in climate. There is one chapter devoted entirely to the evaluation of climate models, which are then used in subsequent chapters to make projections for both near-term and long-term climate changes.

One of the more important concepts found throughout the WG1 report is that of uncertainty. The AR5 applies a consistent treatment of characterizing uncertainties, using calibrated language scales to define the appropriate level of precision. A key revision from previous assessments is the added clarification between "confidence" and "likelihood" phrases. For the confidence in the validity of a finding, this is expressed qualitatively based on the type, amount and consistency of evidence, and on the level of agreement. There are five confidence levels (very low, low, medium, high, very high), based on the evidence (limited, medium, robust), and agreement (low, medium, high). For the likelihood of a particular finding or outcome, this is expressed quantitatively in terms of a probability based on a statistical analysis of observations or model results (or simply expert judgment if statistics are lacking). There are seven likelihood qualifiers used in the AR5, ranging from "exceptionally unlikely" (< 1% likelihood probability) to "virtually certain" (>99% likelihood probability). Many of the highlights noted below fall within the "likely" (>66%) and "very likely" (>90%) categories.

The WG1 report documents, with high confidence, that the atmospheric concentrations of greenhouse gases carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), have all increased since 1750 due to human activity. The 2011 concentrations of these gases exceeded pre-industrial levels by about 40%, 150%, and 20%, respectively, and now substantially exceed the highest concentrations recorded in ice cores during the past 800,000 years. Of the cumulative, anthropogenic CO_2 emissions, roughly 40% has remained in the atmosphere and 30% has been absorbed by the oceans, causing a decrease in mean surface ocean pH of 0.1 (i.e., ocean acidification). The remaining 30% has accumulated in natural land ecosystems, although a significant range of uncertainty remains for this quantity. It is very likely that more than 20% of emitted CO_2 will remain in the atmosphere longer than 1,000 years after emissions have stopped. The long time required by sinks to remove CO_2 emitted by human activity implies that any anthropogenic climate changes will be irreversible on human time scales.

The total anthropogenic radiative forcing (RF) for 2011 relative to 1750 is estimated to be +2.29 [1.13 to 3.33] W/m^2, which is 43% larger than the value from 2005 in the AR4. This increase results from continued growth in most greenhouse gas concentrations (CO_2, CH_4 and N_2O altogether account for more than 80% of the total greenhouse gas RF), combined with an estimated weaker net cooling effect from aerosols. The RF is defined as the change in net radiative flux at the top of the atmosphere due to a prescribed change in concentration of a radiatively active gas. A positive RF produces a warming of the atmosphere-ocean system, whereas a negative RF leads to cooling. In previous IPCC reports, all surface and tropospheric conditions were held fixed, leading to an instantaneous RF value. The AR5 report adopts the concept of an effective RF, where physical variables except for the ocean and sea ice are allowed to respond to perturbations with rapid adjustments, thus providing an improved indication of the eventual temperature response to radiative driving. As with the AR4, aerosols and their impact on cloud albedo continue to generate the largest uncertainties in the total RF estimate, providing a net negative radiative forcing of -0.9 [-1.9 to -0.1] W/m^2. The RF due to solar irradiance changes is estimated to be 0.05 [0.00 to 0.10] W/m^2, which contributes only a few percent to the estimated total, postindustrial RF.

Updated assessments of observed changes in the climate system play a critical role in the WG1 AR5. The longest observational datasets are for land surface air temperatures and sea surface temperatures, and here the report states that "It is certain that global mean surface temperature has increased since the late 19th century". Global-scale measurements of surface temperature are available from about 1850 onward, while routine soundings of atmospheric temperature extend back to the 1950's and data from about the last three decades include satellite measurements of surface and atmospheric properties. Constructing homogeneous, long-term datasets from these different sources is extremely challenging; however, the current set of records paints a consistent picture that the globally averaged, combined land and ocean surface temperature increase from 1880 to 2012 was 0.85 [0.65-1.06] $^{\circ}C$. In addition, the data show surface warming over nearly the entire globe for the time period when calculation of regional trends is robust (1901-2012). The report also notes substantial decadal and interannual variability in global mean surface temperature, so that trends based on shorter time series (10's of years) will be sensitive to the start and end dates and may not generally indicate long-term climate trends.

Above the surface, atmospheric temperatures are subject to higher uncertainty. The report notes that while it is virtually certain that the global troposphere has warmed since the mid-20th century and that the stratosphere has cooled (as expected from greenhouse gas radiative effects), there is only medium confidence in the rate of change and its vertical structure in the Northern Hemisphere extra-tropical troposphere, and there is low confidence elsewhere. For precipitation, there is high confidence that precipitation has increased over mid-latitude land areas of the Northern Hemisphere since 1951, but low confidence in any long-term positive or negative trends elsewhere. Estimated global changes in precipitation show mixed results and are inconclusive.

The AR5 contains an extensive analysis of extremes in climate and extreme weather events. These were also highlighted in AR4 because of their potentially high impact on society and ecosystems compared to changes in mean climate. The level of confidence remains high that changes in the frequency of cold and warm extremes is consistent with overall warming. It is very likely that the number of cold days and nights has decreased, while the number of warm days and nights has increased on a global scale. While there is less confidence in changes to precipitation, it is likely that there has been an increase in heavy precipitation events over many land areas. For tropical cyclone activity, concerns about data quality complicate the detection of long-term (~100 yr) trends in all ocean basins, although it is virtually certain that the frequency and intensity of the strongest tropical cyclones has increased in the North Atlantic since about 1970.

Significant improvements to the understanding of energy uptake and storage by the oceans have occurred since the AR4. There is high confidence that ocean warming accounted for more than 90% of the energy accumulated in the climate system since 1971, with about 60% stored in the upper ocean (0-700 m depth) and about 30% stored in the ocean below 700 m. There is high confidence that the total change in mean sea level since 1901 is 19 cm, and that the rate of sea level rise since 1950 has been larger than the mean rate during the previous two millennia. Over the past twenty years, global mean sea level rise is, with high confidence, consistent with the sum of contributions from ocean thermal expansion (40%), from changes in land water storage (about 10%), and from melting of glaciers, ice caps, and ice sheets (50%).

Observations and analyses of changes in the cryosphere have also expanded and improved since the AR4. There is very high confidence that the Northern Hemisphere Spring snow cover has decreased since about 1950, and that there has been a net loss of ice mass from the Greenland and Antarctic ice sheets. There is high confidence that the spatial extent of Arctic sea ice has decreased in every successive decade since 1979, with the most rapid loss during summer.

The AR5 includes an extensive evaluation of climate models and studies of climate system responses using combined observations and model simulations. The report concludes that the physics in climate models has improved since the AR4, and that long-term model simulations show trends in global-mean surface temperature that agree with the observed long-term trend. However, differences are noted between simulated and observed trends over periods as short as 10 to 15 years, and there is only medium confidence in the understanding of such differences (e.g. 1998-2012), which may include natural internal modes of variability such as a possible redistribution of heat within the ocean. These modes are not well understood, but there is evidence to suggest that warming of the deep ocean (> 700 m depth) accelerated over the past decade, with a corresponding "hiatus" in upper ocean warming as more heat was drawn down to the deep ocean. Changes in surface winds and atmospheric circulation patterns are implicated in these changes; such variations are observed, for example, with the El Nino – Southern Oscillation (ENSO), and with the Pacific Decadal Oscillation (PDO).

Finally, there is a substantial analysis of projected global and regional climate change. A new set of four emission scenarios, called the Representative Concentration Pathways (RCPs), was used for the model simulations of future climate. The RCPs are distinguished by their approximate total radiative forcing in 2100 relative to 1750, ranging from 2.6 W/m^2 for RCP2.6 (a mitigation scenario), to 8.5 W/m^2 for RCP8.5 (a high baseline emission scenario). The intermediate cases RCP4.5 and RCP6.0 are stabilization scenarios in which the RF plateaus around the year 2100. Not surprisingly, the magnitudes of projected changes are sensitive to the choice of RCP. Global mean warming of the surface from the 1986-2005 time period to the 2081-2100 time period is projected to lie between 0.3°C and 2.6°C for RCP2.6, and this warming increases to 2.6°C-4.8°C for RCP8.5.

For all of the scenarios, there is very high confidence that the Arctic region will warm more than the global mean and that warming over land will be larger than over the ocean. It is also very likely that Arctic sea ice cover will continue to diminish and that Northern Hemisphere spring snow cover will decrease. A nearly ice-free Arctic Ocean in September is likely before the mid-21st century for RCP8.5; for the other scenarios there is no confident projection of when the Arctic might become ice-free in September.

Predicted global mean sea level rise from the 1986-2005 to 2081-2100 time periods will likely be in the range 0.26-0.55 m for RCP2.6, increasing to 0.45-0.82 m for RCP8.5. There is high confidence that net ice loss from Greenland will make a positive contribution to sea level rise, while an increase in snowfall in the Antarctic is expected to lead to a net increase in ice mass and a negative contribution to future sea level increases (medium confidence). This apparent contradiction between what has been observed over the past twenty years (decreasing Antarctic ice mass) and what is predicted in the next eighty years (increasing Antarctic ice mass) is likely related to a shorter time scale for the response of atmosphere/ocean temperatures in the polar southern hemisphere versus a longer time scale for changes to the hydrologic cycle. The recent decline is the result of increased melting over accumulation, while the models simulate higher future accumulation which more than offsets predicted future melting.

In terms of key uncertainties (and here is an area where physicists can contribute their expertise), the AR5 highlights a few areas that are presently very difficult to quantify. One uncertainty concerns feedbacks, and in particular the radiative feedbacks by clouds remain poorly understood, both observationally and from a modeling standpoint. Improved understanding and modeling of the hydrologic cycle, including changes in cloud properties and precipitation patterns, are also needed to better simulate continental and regional-scale precipitation in climate models. Another key area which has been highlighted due to the recent "warming hiatus" is the uncertainty associated with global ocean heat fluxes and possible changes to ocean circulation patterns.

A few summarizing statements from the AR5 section on future climate change that are worth noting are "Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system.", and that "Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond. Most aspects of climate change will persist for many centuries even if emissions of CO_2 are stopped." There are many more interesting and thought-provoking findings presented in the IPCC AR5 WG1 report, and I hope that this short article has stimulated the reader's interest in digging a little deeper!

GPC Executive Committee Members-at-Large and Newsletter Editor:

Left to right: Brad Marston (12/2014), Warren Warren (12/2014), Judith Curry (12/2015), Dan Rothman (12/2015), Sharon Sessions (12/2016), Morgan O'Neill (Student Member, 12/2016), Peter Weichman (Newsletter Editor, 12/2015).

Atmospheric Physics at New Mexico Tech – *continued from p. 1*

relatively small number of programs which explicitly house atmospheric science within the physics department. Some examples of such programs can be found at University of Maryland, Baltimore County; the Desert Research Institute in Reno, Nevada; University of Toronto; and at my home institute, New Mexico Tech (NMT).

The NMT physics department consists of twelve faculty members, with half doing research in atmospheric physics and half in astrophysics. This complimentary combination of specialties provides unique synergy in research and resources. Overlap in the physics of planetary atmospheres, remote sensing, and atmospheric or stellar convection provides opportunities for collaboration and discussion amongst all members of the department, and helps form a strong cohesion between graduate students.

The graduate program requires a physics background based on core physics courses complimented by specialized courses in atmospheric physics which provide a solid foundation for research. In addition to MS and PhD degrees in physics with research emphasis in atmospheric physics, NMT also offers an atmospheric physics option for undergraduates pursuing a BS. This curriculum is a suitable model for physics departments that wish to adopt a program in atmospheric physics since it builds on an existing set of core courses. Incorporating upper level undergraduate atmospheric physics courses which also satisfy an introduction at the graduate level might constitute a first step in integrating an atmospheric physics program. The addition of faculty to support atmospheric physics research would provide the opportunity to develop more specialized courses.

Atmospheric research at NMT has a long history beginning in 1946 when physicist E. J. Workman became President of NMT (which was then named Mexico School of Mines). His primary interest was atmospheric electricity, and New Mexico thunderstorms provided a perfect opportunity to study precipitation development and thundercloud electrification. Later, cloud physics research at NMT attracted scientists from around the world, and by the late 1950s, it was clear there was demand for a permanent mountain top research facility. With support from the National Science Foundation and the Office of Naval Research, the main research building was completed by 1963. Located near the summit of South Baldy Peak in the nearby Magdalena

Mountains, the lab was named after Dr. Irving Langmuir, Nobel Laureate and collaborator of the NMT group. Research at Langmuir Lab—often involving instrumented weather balloons or rockets for triggering lightning—has resulted in major contributions to the understanding of thunderstorm electrification, lightning propagation, and charge structure. Many of these were the results of innovations in

instrumentation. One of the most notable is the design and construction of the lightning mapping array (LMA) which tracks the time and space coordinates of lightning propagation. LMA stations have been installed at sites worldwide and they have contributed to major discoveries, including the identification of conditions that determine whether an initial breakdown will result in a cloud-to-cloud or cloud-to-ground flash.

As the department grew, research specializations diversified. NMT now has a convection and dynamics group which studies the physics of planetary atmospheres and tropical dynamics with an emphasis on convection. Students in this group have participated in field programs either as remote data analysts aiding in flight plans, or as key personnel dropping instruments from research aircraft in locations ranging from Guam to Costa Rica. This group has also made major contributions to the physics of atmospheric convection. For example, the development of a quantitative model for the formation of detrainment layers in cumulus clouds was used to help explain the observed transition of a *cumulus congestus* cloud to a mature thunderstorm. Recently, the group proposed a mechanism—which has been observationally validated—to explain the formation of a surface vortex in the presence of a mid-tropospheric vortex during tropical cyclone formation.

Other atmospheric research at NMT specializes in remote sensing and radiative processes in the middle and upper atmosphere, with the goals of understanding climate feedbacks, effects of trace greenhouse gases, and stratospheric ozone. One recent contribution from this group was the characterization of unprecedented loss of ozone in the Northern Hemisphere in early 2011, which showed that chemical ozone destruction over the Arctic was comparable to that in the Antarctic ozone hole.

The demographics of our department are nearly as unique as our research specialties. Of our 12 faculty members, 25% are women (which is approximately double the national average for PhD granting physics programs), and more than 40% of our 30 graduate students are women. Furthermore, graduates of the NMT physics program have a high success rate in finding jobs after receiving their degree.

NMT is located in Socorro, NM, in the beautiful Rio Grande Valley. It is 75 miles south of Albuquerque, 18 miles north of the Bosque del Apache national wildlife refuge (where the birds fly to in the winter), and its proximity to the Magdalena mountains provides a plethora of outdoor recreational opportunities including hiking, rock climbing, and mountain biking.

Information about our program may be found at www.physics.nmt.edu, or by E-mailing sessions@kestrel.nmt.edu

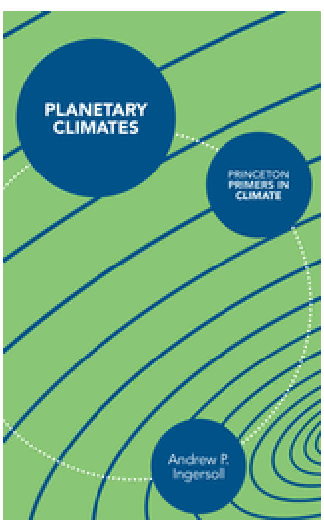
GPC Program Committee

Left to right: Robert Behringer (Chair), Robert Ecke, Daniel Rothman, Andrew Kaldor

The role of the Program Committee is to work with the Executive Officers in scheduling contributed papers within areas of interest to the GPC and in arranging symposia and sessions of invited papers sponsored by the GPC at Society meetings. From time to time the Program Committee may also organize special GPC meetings and workshops, some with and some without the participation of other organizations.

Planetary Climates by Andrew Ingersoll (Princeton University Press, 2013)

Capsule review by Brad Marston, Brown University



Planetary Climates, a volume in the "Princeton Primers in Climate" series, packs an amazing amount of climate science into a compact volume. Author Andy Ingersoll, a distinguished planetary scientist at Caltech, emphasizes the similarities and differences between atmospheres of the planets (and some moons and minor planets) of the solar system. "As on Venus, the emitted infrared radiation [from Jupiter] is large and independent of latitude. This contrasts with Earth, where the emitted radiation decreases significantly from the equator to the poles, in response to the extra sunlight absorbed at the equator. We explained the difference between Venus and Earth, first as due to the greater mass of the Venus atmosphere, and, second as due to the slower rotation of the Venus atmosphere. Jupiter is a rapidly rotating planet, so the second explanation doesn't apply…" Attention is paid to the many interesting unanswered questions (the chapter on Saturn is replete with such questions).

As observations of the climates of other planets increase in both quality and length, changes in those climates will likely become more apparent. Understanding so gained may provide lessons for a better understanding of Earth's climate. The study of the atmospheres of exoplanets (planets around other stars) may eventually reach the point where they too will contribute to a broader understanding of climate. The book closes with a brief survey of exoplanets. Ingersoll has a talent for explaining complicated ideas with more familiar analogs drawn from everyday life. Material in separate boxes provides details -- a mini course in atmospheric physics -- for more technically inclined readers. Readers at different levels will all learn from the book.

Another excellent volume in the "Princeton Primers in Climate" series is Atmosphere, Clouds, and Climate by David Randall. William H. Ingham has written a review for the APS Forum on Physics & Society.

GPC-Organized Mini-symposium: *"Global Climate Models: Dynamical Cores, Strengths and Weaknesses"*

The GPC sponsored an exciting "mini-symposium" at the 66th Annual Meeting of the APS Division of Fluid Dynamics (DFD) in Pittsburgh Pennsylvania, on November 25th, 2013. The 3-hour symposium was organized and chaired by Jim Brasseur (2013 GPC Chair), Brad Marston (GPC Executive Committee) and John Wettlaufer (current GPC Chair Elect), and all DFD members. The aim of the proposal to the DFD was to introduce global climate modeling to the greater fluid dynamics community and to draw upon the extensive expertise within the fluid dynamics community on computational fluid dynamics of complex dynamical systems with high fidelity modeling on high performance computing platforms. The focus of the symposium was the importance, in climate computational systems, of solutions of coupled, highly nonlinear, dynamical systems that describe the atmosphere, oceans, ice and land surfaces separately, and their couplings over huge ranges of length and time scales in the "dynamical cores" of global climate and general circulation models. The mini-symposium addressed modeling and numerical efficacy issues within dynamical cores. The specific aims included discussion, analysis, and debate over the strengths and weaknesses of dynamical cores used within existing GCMs, the development of new collaborations between fluid dynamicists and climate scientists, and the introduction of expertise from the Division of Fluid Dynamics into issues surrounding GCMs and prediction of climate. These aims were met through five excellent 25-minute presentations with vibrant discussion following each:

- **Mark Taylor**, Sandia National Labs: *"The Spectral Element Dynamical Core in the Community Atmosphere Model."*
- **Jin Lee**, National Oceanic and Atmospheric Administration: *"A 3-D Finite-Volume Non-hydrostatic Icosahedral Model (NIM)"*
- **Peter Lauritzen**, National Center for Atmospheric Research: *"Dynamical Cores and Climate Modeling"*
- **James Cho**, University of London: *"Intercomparison of General Circulation Models for Hot Extrapolar Atmospheres."*
- **Chris Forest**, Penn State University Department of Meteorology: *"Exploring effects of different dynamical cores in global climate models on regional predictions."*

GPC Nominating Committee

Left to right: James Brasseur (Chair), Brad Marston Margaret Murnane, Raymond Pierrehumbert, Raymond Shaw, Robert de Zafra.

The role of the Nominating Committee is to prepare a slate of candidates for the open elected positions each year. The Nominating Committee shall also respond with appropriate names to the Society's call for nomination for senior Society positions.

2014 APS March Meeting Sessions

Our invited and focus session at the March Meeting will provide excellent opportunities to hear from climate experts. Invited speakers will home in on key factors that are critical to climate, such as ocean properties, sea ice and cloud dynamics, and they will consider current models and their differences with recent observations, for instance, the hiatus in global warming.

A. GPC Invited Session: The Physics of Climate (Session G40, 11:15 am - 2:15 pm, Tuesday, March 5)

KENNETH GOLDEN
Professor, Department of Mathematics, Adjunct Professor of Bioengineering, University of Utah

Title: *Sea ice, climate, and multiscale composites*

Synopsis: While global climate models generally predict sea ice declines over the 21st century, the precipitous losses observed so far have significantly outpaced most projections. I will discuss how mathematical models of composite materials and statistical physics are being used to study key sea ice processes and advance how sea ice is represented in climate models.

PATRICK HEIMBACH
Senior Research Scientist, Department of Earth, Atmospheric and Planetary Sciences, MIT

Title: *Ice sheet-ocean interactions and sea level change*

Synopsis: In Greenland, a growing body of evidence points to the marine margins of its glaciers as the region most responsible for recent major ice loss. Similarly, ice streams in West Antarctica that feed vast floating ice shelves have exhibited large decadal changes. I review observational evidence and present physical mechanisms that might explain the observed changes, in particular in the context of ice sheet-ocean interactions

DANIEL CZICZO Associate Professor of Atmospheric Chemistry, Department of Earth, Atmospheric and Planetary Sciences, MIT

Title: *The Role of Clouds in Climate Change*

Synopsis: The role of greenhouse gases, predominantly CO_2, on climate has been understood since the work of Arrhenius in the late 1800's. The role of clouds on the Earth's radiative balance is far more uncertain. I will describe the current state of knowledge of cloud formation and what aspects remain uncertain. Information gained from laboratory and field studies will be compared to our understanding of Earth's current state and how climate is projected to change in the future.

KYLE ARMOUR
Postdoctoral Fellow, Department of Earth, Atmospheric and Planetary Sciences, MIT

Title: Causes and consequences of time-varying climate sensitivity

Synopsis: While constraining climate sensitivity has long been a focus of climate science, this global and equilibrium metric provides only limited understanding of transient and regional changes over the coming centuries. I show that climate sensitivity depends fundamentally on the respective geographic patterns of local radiative feedbacks and surface warming, and thus it naturally varies in time as the pattern of surface warming evolves, activating feedbacks of different strengths in different regions.

JUDITH CURRY
Chair, Professor, School of Earth and Atmospheric Sciences
Georgia Tech

Title: *Causes and implications of the growing divergence between climate model simulations and observations*

Synopsis: For the past 15+ years, there has been no increase in global average surface temperature, which has been referred to as a 'hiatus' in global warming. By contrast, estimates of expected warming in the first several decades of 21st century made by the IPCC AR4 were 0.2 C/decade. I summarize the recent CMIP5 climate model simulation results and comparisons with observational data. The stadium wave hypothesis provides a plausible explanation for the hiatus in warming and helps explain why climate models did not predict this hiatus.

B. GPC Focus Session: The Physics of Climate (Session Q30, 2:30 – 5:06 pm, Wednesday, March 5)

HEZI GILDOR
Professor, Institute of Earth Sciences, The Hebrew University

Title: *Uncertainties and complexities in small-scale ocean surface mixing processes*

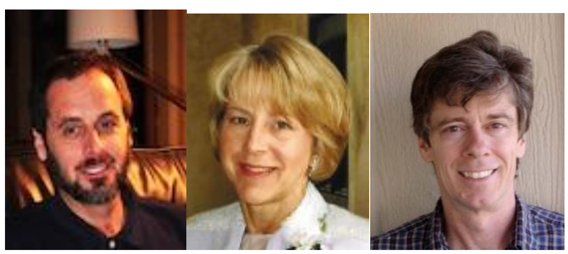
Synopsis: Ocean mixing and dispersion processes are intermittent in time, nonlinear, and inhomogeneous in space. Much is known about processes with a spatial scale of a few tens of km (that can be studied using satellite data) and about very fine-scale processes (turbulent motions of millimeters to meters that can be studied using microstructure turbulence profilers). However, there is a lack of both observations and understanding of the so-called "submesoscale" processes, composed of motions on a scale of a few kilometers. I will demonstrate, using surface current measurements by High Frequency radar, the existence of temporary submesoscale barriers to mixing. This has important implications for a wide range of predictions. We were also able to verify the existence of these barriers using aerial photographs. Using a non-stationary Lagrangian stochastic model, I will present a method for estimating the upper bound of the horizontal eddy diffusivity based on the existence of such barriers.

Contributed talks:

Dibyendu Mandal, Jeffrey B. Weiss, Baylor Fox-Kemper, Royce K.P. Zia	Stochastic Stommel box models for the thermohaline structure of the oceans
Jeffrey B. Weiss, Baylor Fox-Kemper, Dibyendu Mandal, Royce K.P. Zia	Nonequilibrium life-cycles in Ocean Heat Content
Sharon Sessions, David Raymond, Saska Gjorgjievska	Sensitivity of deep tropical convection to changes in the thermodynamic environment
Yingdi Liu, Hongli Dang, Pongtorn Charoensuppanimit, Sayeed Mohammad, Khaled Gasem, Sanwu Wang	Atomic-scale mechanism of incorporation of carbon dioxide in coal
Solomon Bililign, Sujeeta Singh, Damon Smith, Marc Fiddler	Calibration of cavity ring-down spectrometry, integrating nephelometery, and condensation particle counting for distinguishing aerosol scattering/absorption properties
Rudra Aryal, Seth Malhotra	Variability of Aerosol Optical Properties Based on Particle Size, Concentration and Origin
Brad Marston, Greg Chini	Multiscale Atmospheric Physics Modeled by Cumulant Expansions
R. Tao	Can We Eliminate the Major Tornado Threats in Tornado Alley?
Juan Restrepo, Shankar Venkataramani, Darin Comeau, Hermann Flaschka	How can you tell whether Earth is warming Up?
Lynn Kaluzienski, Justin Burton, Mac Cathles	Iceberg capsize hydrodynamics and the source of glacial earthquakes

GPC Communications Committee

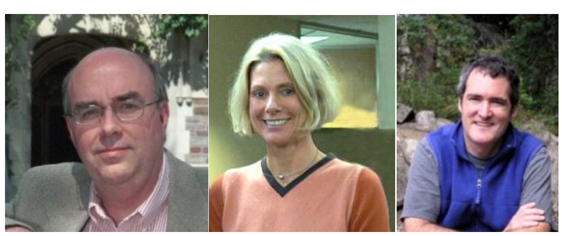
Left to right: Peter Weichman (Chair), Barbara Levi, Michael Ritzwoller



The role of the Communications Committee is to have oversight of the Newsletter and any other publications that may be established by the GPC. The Communications Committee shall also be responsible for keeping the physics community and other interested communities informed about climate physics issues, activities, and accomplishments through the Newsletter, GPC website and email messages.

GPC Ad-hoc Science Liaisons Committee (SLC)

Left to right: Warren Warren (Chair), Judith Lean, Brad Marston



The role of the SLC is to advise the various other GPC Committees with regard to potential useful relationships between the GPC and scientific organizations outside the APS. Specific objectives of the SLC include:
(a) Initiate contact and serve as liaison between the GPC and external scientific organization with related interests to enhance the objectives of the GPC.
(b) Identify high-quality research on climate physics traditionally presented in other societies and provide this information to the GPC Program Committee.
(c) Develop concepts that enhance the objectives of the GPC through activities with external scientific organizations for consideration by the GPC Executive Committee.

Upcoming Events and Other Links of Interest

APS Climate Change Statement Review, including January 8, 2014 workshop transcript. GPC members are playing a role in this process, and more details will be reported in the next newsletter.

Physics of Sustainable Energy III: Using Energy Efficiently and Producing It Renewably, U.C. Berkeley, March 8-9, 2014.

The American Geophysical Union (AGU) conference list, especially the Fall Meeting, San Francisco, CA, Dec. 15-19, 2014.

The American Meteorological Society (AMS) conference list.

Second Conference on Atmospheric Biogeosciences, Portland, OR, May 12-15, 2014.

21st Conference on Applied Climatology, Westminister, CO, June 9-13, 2014.

14th Conference on Atmospheric Radiation and Cloud Physics, Boston, MA, July 7-11 2014.

Anthony Slingo Symposium, Boston, MA, July 7-11 2014.

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