Climate Woes Real, Say Most in U.S., Canada, but Differ on Cause

Eighty-two percent of Canadians and 70% of Americans say there is solid evidence of global warming, according to two recent surveys. However, those numbers do not constitute a consensus on the human influence on climate. Just 49% of Canadians and 27% of Americans believe both that there is solid evidence of global warming and that humans are its primary cause, say researchers who conducted the paired surveys.

The National Survey of Canadian Public Opinion on Climate Change and the National Survey on Energy and the Environment posed similar questions to Canadians and Americans in September 2015. The surveys were released on 13 October as part of a report, "Mind the Gap: Climate Change Opinions in Canada and the United States" (see http://bit.ly/climate_change_opinions), during a presentation at the Woodrow Wilson International Center for Scholars in Washington, D. C.

Policy Implications

Although many people think climate change is happening, the fact that not as many think it is caused primarily by humans "has enormous implications" for policy support to take action about global warming, said Christopher Borick with the Institute of Public Opinion at Muhlenberg College in Pennsylvania, who was involved with the U.S. survey.

The U.S. survey found that 56% of Republicans now believe there is evidence of global warming compared with 47% in fall 2014, whereas Republican climate skeptics fell to 26% from 41%. Among Democrats, 79% say there is evidence of global warming, compared with 71% in 2014; among Independents, the number increased to 69% from 57%, according the survey.

The surveys also found that less than 30% of Canadian and American respondents claim to have much knowledge about global warming.

"Nothing in our data to this day suggests that public opinion actually constitutes a pressure for government to act," said Erick Lachapelle, a professor at the University of Montreal involved with the Canadian survey and earlier similar polls. "When you look beyond the 80% perception that there is solid evidence of global warming, you find actually quite a lot of skepticism even in Canada."

Levels of Skepticism

Lachapelle said the skepticism falls into four categories: pure denial; "causal skepticism," where people question the cause of global warming; "consequential skepticism," where people don't see a direct threat from global warming and thus are not motivated to take action; and "response skepticism," where people doubt that anything can be done about global warming.

People who acknowledge global warming but attribute it to natural causes align more with climate-change skeptics than with individuals who consider it anthropogenically driven, Lachapelle added. "To lump them together, I think, is a major problem for those that want to claim consensus. They are different creatures."

By **Randy Showstack,** Staff Writer

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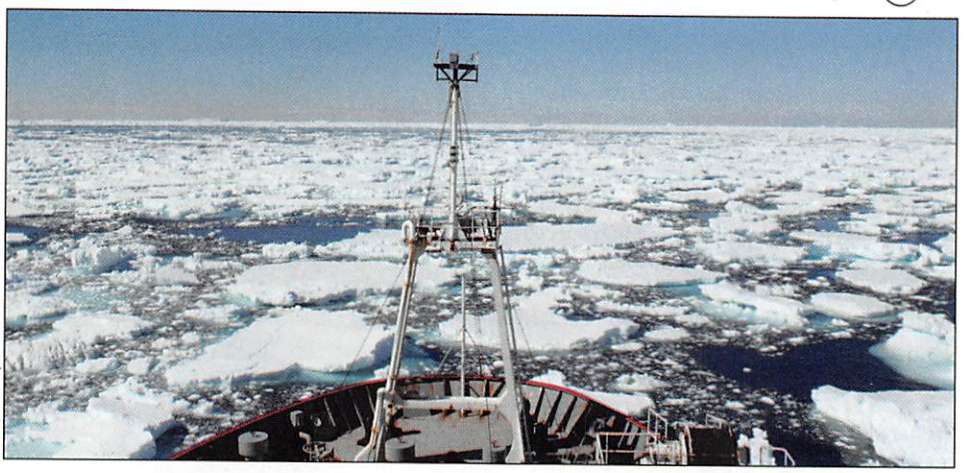
Physical-Biogeochemical Coupling in the Southern Ocean

Southern Ocean Dynamics and Biogeochemistry Workshop
Pasadena, California, 2–5 February 2015



Andrew Thompson

A view from the RRS James Clark Ross *in the northern Weddell Sea. Surface buoyancy fluxes and gas exchange in the lead-filled, marginal ice zone around Antarctica remain poorly constrained because of a lack of observations.*

Over the past 15 years, physical and biogeochemical studies have established that the Southern Ocean, the region surrounding Antarctica, plays a disproportionately large role in modulating Earth's climate. Dense water masses that reside near the ocean bottom throughout mid- and low-latitude basins reach the surface in the Southern Ocean through a combination of wind- and eddy-induced transport. These waters are exposed to heat, freshwater fluxes, and atmospheric gases, which ventilate the deep-ocean reservoirs of heat and carbon.

This region is also critical for the biogeochemical conditioning of nutrients that will be available for primary production (synthesis of organic compounds from carbon dioxide) at lower latitudes. These processes are typically linked to the large-scale depth-latitude structure of the Southern Ocean's density and other property fields, such as temperature, dissolved oxygen, and nutrients.

Research during the past 5 years has increasingly shown that a two-dimensional (2-D), cross-sectional view of the Southern Ocean is too simplistic. Energy content peaks at mesoscales, 10–20 kilometers in the Southern Ocean, but the amplitude and organization of these mesoscale features are not uniform. Distributions of temperature, salinity, nutrients, and dissolved gases typically exhibit even greater structure and patchiness.

The functioning and evolution of Southern Ocean ecosystems and the ventilation of the ocean's deep carbon reservoir depend on the transport of these tracers, which involves an interplay between the underlying circulation and the temporally and spatially varying tracers. The coupled variability of these fields is only beginning to be explored.

To identify gaps in our understanding of Southern Ocean circulation, air-sea fluxes, and tracer fluxes, a workshop on Southern Ocean dynamics and biogeochemistry was held at the California Institute of Technology in Pasadena this past February.

The meeting opened with overview lectures by Michael Meredith, Andy Hogg, Ric Williams, and Danny Sigman on sustained observations, the meridional overturning circulation, air-sea partitioning of carbon, and nutrient fluxes, respectively. The meeting continued over a 3-day period with shorter presentations and significant time for group discussions. Planning future observational strategies that integrate the physical and biogeochemical oceanographic communities was a key goal.

Three major research themes emerged from the meeting discussions:

- 3-D pathways influencing heat uptake, carbon sequestration, and preformed nutrients in the upper ocean. Zonal variations in mass and tracer fluxes extend throughout the water column and localize transport across the Antarctic Circumpolar Current (ACC). It remains unclear how this localization and the 3-D structure of ACC transport properties will respond to a changing climate. Meeting participants also emphasized the need to explore the coupling between physics and biogeochemistry at submesoscales (10 kilometers and smaller) and its impact on setting preformed nutrient values.
- Buoyancy forcing and gas exchange in the marginal sea ice zone. Observations needed to resolve surface processes in the region spanning the winter sea ice extent to coastal polynyas (open water surrounded by sea ice) remain sparse. Specifically, measurements are needed to determine the strength of surface buoyancy forcing and the efficiency of gas equilibration in a divergent, spatially nonuniform (e.g., lead- or gap-filled) sea ice field. These processes significantly influence the lowermost overturning cell dynamics, as well as water mass properties and carbon dioxide concentrations.
- Shelf and slope controls on mass and tracer fluxes. Discussion focused on the need for high-resolution process modeling and better parameterizations of eddy processes over the continental shelf and slope, including localization of transport due to topographic features and the injection of nutrients, such as iron, into the water column due to flow-topography interactions.

Participants discussed observational strategies needed to provide insight into these research priorities. The group highlighted the use of heterogeneous autonomous platforms to acquire persistent (continuous) measurements that resolve seasonal variability in the dynamical processes highlighted above. As sensor development for these platforms continues, an intelligent blend of autonomous and ship-based measurements is needed to advance the science.

Sustained observations, both oceanic and atmospheric, that lead to continuous time series will remain critical for detecting changes in the Southern Ocean. Achievement of these goals in such a challenging environment requires a coordinated, international effort.

Meeting participants and their presentations can be found at http://workshop.caltech.edu/socean/. The workshop was supported by the Linde Center for Global Environmental Science.

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