U.S. CLIVAR
May 2008, Vol. 6, No. 1
VARIATIONS

Atlantic Meridional Overturning Circulation shows significant changes in early data from international monitoring systems at 26.5ºN

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Recent modeling and paleoceanographic studies have suggested strong links between variations in the Atlantic Meridional Overturning Circulation (AMOC) and changes in important climate signal variations such as precipitation and tropical storms over the neighboring continents (e.g. Zhang and Delworth, 2006). The broad spatial scale AMOC flows are a primary mechanism by which heat energy is transferred from the equator to the poles and these flows are closely linked with the regional climate variability around the Atlantic basin and the globe. Recognition of this key role for the AMOC led to the identification of *improvements in understanding of the AMOC* being designated as one of four key short-term priorities in the recent US interagency Ocean Research Priorities Plan. Historically observations of the AMOC have in general been somewhat sparse either/both in space and time. One of the longest-running programs to observe components of the AMOC is the NOAA Western Boundary Time Series (WBTS) program to monitor the Florida Current and the Deep Western Boundary Current near 27ºN, which has been making observations since 1982. In 2004 the WBTS program became the cornerstone of one of the most audacious field programs ever attempted: the time series observation of full-water-column circulation across an entire ocean basin. Called the Meridional Overturning Circulation Heat-flux Array (MOCHA) by the US participants and the Rapid Climate Change 26ºN Array (RAPID) by the UK and German participants, this line of moorings represents the first true effort to accurately capture the complete top-to-bottom AMOC using something other than infrequently repeated hydrographic sections (see Figure 1).

These joint programs bring together scientists from NOAA/AOML (Molly Baringer, Chris Meinen, and Silvia Garzoli), the University of Miami (Bill Johns and Lisa Beal), the Max Planck Institute for Meteorology (Jochem Marotzke) and the National Oceanography Centre, Southampton (Harry Bryden, Stuart Cunningham, Torsten Kanzow, Joel Hirschi, Darren Rayner, Hannah Longworth, and Elizabeth Grant). Several articles have recently been published in the journal Science and elsewhere discussing the early results from the overlapping arrays of instruments. Among the first results is the discovery that contrary to previous expectations, the AMOC shows a high degree of variability on time scales of days to months (Meinen et al., 2006; Cunningham et al., 2007; Kanzow et al., 2007, Johns et al., 2008). This variability exists at surprisingly short time

Successful Coordination - Key to Successful Science Research

by David M. Legler, Director

Over the past few months I was reminded again of the importance of fundamentals of coordinating research and programmatic activities. Successful coordination seems to be most effective if all involved are working under a shared vision, agree on roles and responsibilities, and then share (to some extent) the credit for the resulting product or finding. In climate research we often rely on groups like WCRP and CLIVAR to bring together scientists and supportive research funders to catalyze the scientific planning required for producing the vision and guidance for roles and responsibilities. As climate science evolves and matures, as funding resources becomes increasingly constrained, and as agency roles change, the need for this scientific planning becomes even stronger. Moreover, new opportunities are always opening. For example there are efforts underway to revise national climate research program plans in anticipation of a new administration in

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2009. U.S. CLIVAR has an opportunity to provide input to new plans and we hope to discuss how best to contribute to this process in the coming months.

U.S. CLIVAR Summit 2008

The U.S. CLIVAR Summit will be held 14-17 July 2008 in Irvine, California - minutes away from John Wayne International (Orange County) Airport. Meeting Reports and logistical details will be available soon. This will be an opportunity for the U.S. CLIVAR panels and committee to meet in plenary and separately. *Logistical information and a draft agenda are available online*. A science symposium will occur, Monday, July 14. The topic:

Climate Predictions for 2018: What can we say now and with what fidelity/uncertainty? What is our plan to better predict climate 10 years into the future?

scales (days to weeks) near the western boundary, where it is perhaps more expected as that is where the strongest meridional flows exist and where the baroclinic and barotropic components of the transport are often opposing one another although they are statistically uncorrelated (Figure 2; see also Meinen et al., 2006). However this strong high-frequency variability, and the 'compensation' between barotropic and baroclinic components of the transport, also exists when the transports are integrated across the entire basin (Kanzow et al., 2007).

An earlier analysis of snapshot hydrographic sections published in Nature (Bryden et al., 2005) suggested that there had been a 30% decrease in AMOC strength over the period from 1957 to 2004. While there has been no sign of such a precipitous decrease near the western boundary in the Atlantic over this same time period (Meinen et al., 2006; Schott et al., 2006), such a significant change in the basin-wide AMOC would likely result in significant changes in air temperatures, precipitation and other climactically important quantities throughout the Northern Hemisphere. However, the Bryden et al., (2005) analysis was based on only five snapshot data points over a 50-year period, and another of the key results of the recent RAPID/MOCHA array is that all five snapshot values of the AMOC discussed in the Bryden et al., (2005) paper are observed within the first year of the array data (Figure 3). The large high-frequency variability found in the first data from the basin-wide RAPID/MOCHA array illustrates the danger of analyzing small numbers of snapshot sections as provided by the decade-and-longer-apart repeat hydrographic sections. These results illustrate why more regular observations such as those being made by the RAPID/MOCHA array will be required to accurately determine any possible trend or shift in the AMOC. With these overlapping programs now funded through at least the year 2014 by a combination of funding from US-NOAA, US-NSF, and UK-NERC there is an assurance that at least a complete decade of data will be collected, and over the next few years further analysis with both observations and numerical models will be taking place to improve our understanding of AMOC variability and plan for the necessary observing systems moving forward into the future.

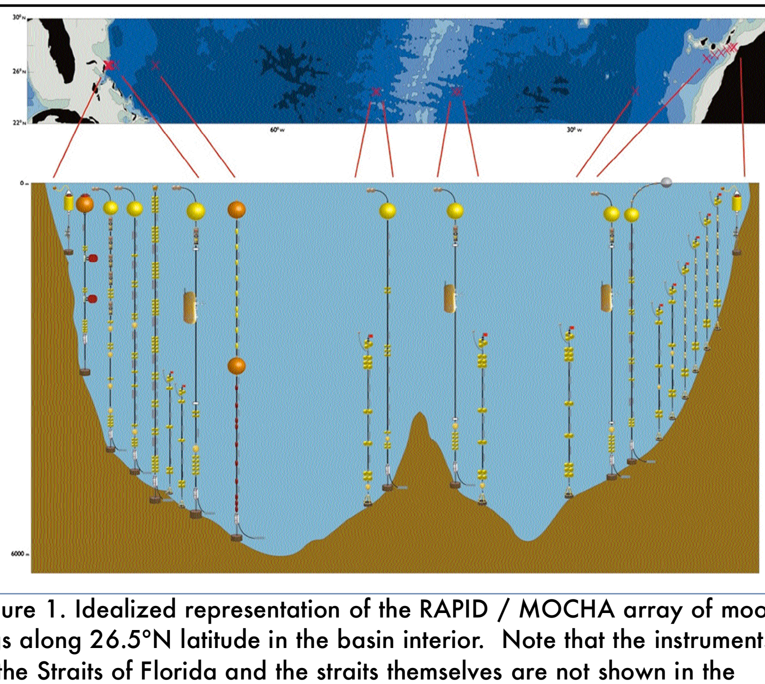

Figure 1. Idealized representation of the RAPID / MOCHA array of moorings along 26.5°N latitude in the basin interior. Note that the instruments in the Straits of Florida and the straits themselves are not shown in the lower illustration. Figure courtesy of Darren Rayner, National Oceanography Centre, Southampton, UK.

Variations

Published three times per year
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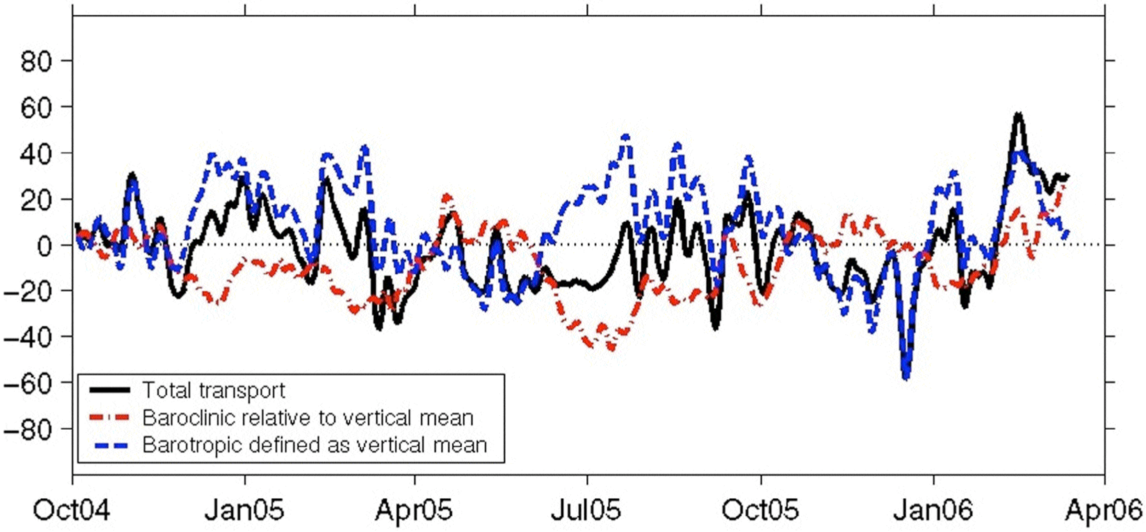
This newsletter is supported through contributions to the U.S. CLIVAR Office by NASA, NOAA—Climate Program Office, and NSF.

Figure 2. Transport (in Sverdrups) integrated between the Bahamas Bank and 72°W along 26.5°N and between 800 and 4800 dbar. Variations of the barotropic (blue), baroclinic (red), and total transport are shown. Figure modified from Meinen et al., (2006).



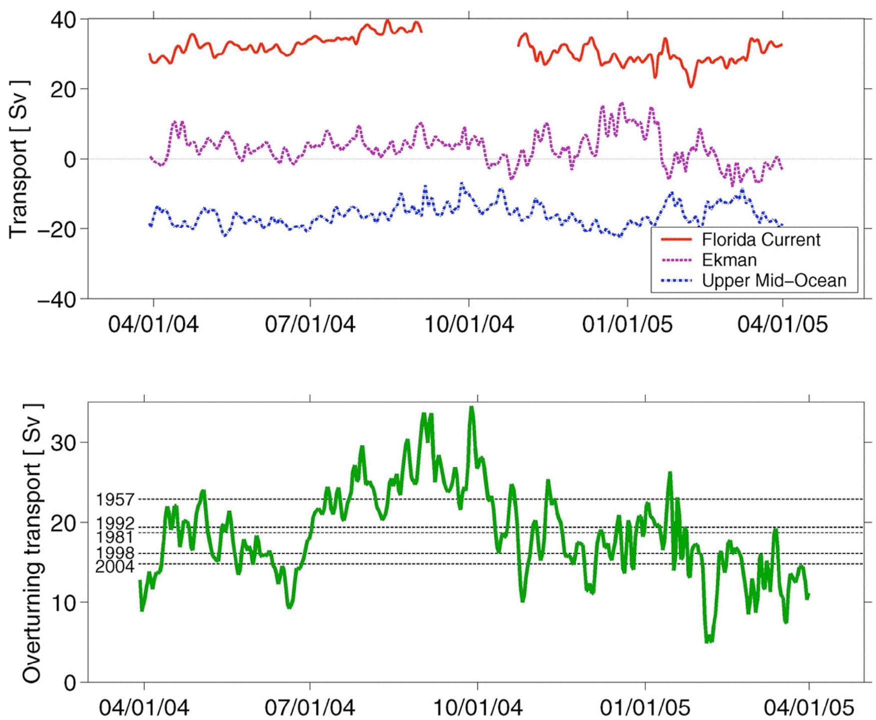


Figure 3. Upper panel – Measured constituents of the meridional transport above 1000 m integrated from Florida to Africa. Note that the gap in the Florida Current time series resulted from hurricane damage to the recording system; this gap was interpolated in the later analysis. Lower panel – The overturning transport, defined as the net meridional transport above 1000 m (green line), and the five snapshot estimates of overturning calculated from hydrographic sections by Bryden et al., (2005). Note that all time series have been smoothed with a three-day low pass filter. Lower panel modified from Baringer and Meinen (2008).

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Recent ENSO and SAM Teleconnections for Antarctica

By Ryan L. Fogt, National Research Council
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Dramatic climate change has been observed in polar regions of both hemispheres during recent decade. In contrast, however, to the well-recognized pattern of warming and melting observed in the Arctic), the climate change near Antarctica is much more nuanced (e.g, Turner et al. 2007). Rapid warming has occurred since 1950 in the western Antarctic Peninsula region, and part of the Larsen Ice Shelf on the eastern side of the peninsula recently collapsed (Shepherd et al. 2003). Yet, cooling is found over interior Antarctica (e.g., Monaghan et al. 2008), and in contrast to the statistically-significant decrease in Arctic sea ice since the early 1970s, no statistically-significant trend is found for Antarctic sea ice extent during the same time period (Vinnikov et al. 2006). The subtleties of Antarctic climate change require us to carefully consider the mechanisms that influence regional climate variability. In that regard, we consider the two most pronounced and well-known atmospheric climate phenomena that impact the Southern Ocean and Antarctica. The two are the El Niño-Southern Oscillation (ENSO) and the Southern Hemisphere Annular Mode (SAM) (e.g., Bromwich et al. 2000; Thompson and Wallace 2000; Fogt and Bromwich 2006; L'Heureux and Thompson 2006).

The ENSO is directly associated with cycles of warm and cold sea surface temperature anomalies in the central and eastern equatorial Pacific. It impacts global climate on interannual and interdecadal time scales. Beyond the local impacts on tropical pressure, temperature and precipitation, ENSO anomalies extend poleward in both hemispheres (e.g., Trenberth and Caron 2000). Regions where the ENSO teleconnection appear particularly strong in the high southern latitudes include the South Pacific Ocean, off the coast of West Antarctica and in the vicinity of the Drake Passage (Bromwich et al. 2004; Turner 2004; Fogt and Bromwich 2006). As an example, a large blocking high pressure forms over the southeast Pacific Ocean as a response to El Niño, that is, an ENSO warm event (Renwick and Revell 1999). Low-frequency variability is readily seen in the amplitude of this pressure center, which can occur with the Pacific-South American (PSA) pattern (e.g., Kiladis and Mo 1998). Similar to its counterpart in the Northern Hemisphere, the Pacific-North American (PNA) pattern, the PSA represents a series of alternating positive and negative geopotential height anomalies extending from the west-central equatorial Pacific through Australia-New Zealand, to the South Pacific near Antarctica-South America, and then bending northward toward Africa, following a great circle trajectory. Consequently, the climatic influence of ENSO in high southern latitudes can extend to the Atlantic Ocean sector.

On the other hand, the SAM is not an external forcing, rather it represents the dominant mode of the circulation variability in high southern latitudes. The SAM is also known as the high-latitude mode, and the Antarctic Oscillation (AAO, Thompson and Wallace 2000). It appears as the first empirical orthogonal function in the month-to month 500-hPa geopotential heights or sea level pressure (e.g., Kiladis and Mo 1998). The phenomenon is characterized by zonal pressure anomalies in the mid-latitudes having the opposite sign of the zonal pressure anomalies over Antarctica and the high southern latitudes. The positive (negative) phase of SAM corresponds to a stronger (weaker) circumpolar westerly atmospheric circulation over the

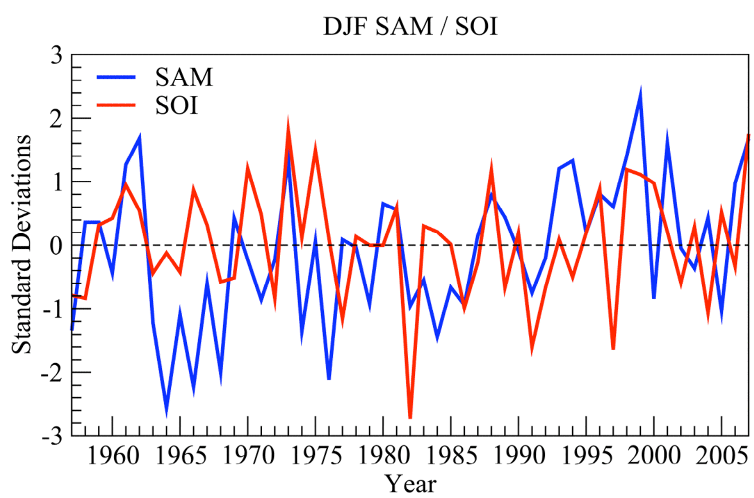


Figure 1. Time series of the normalized Tahiti – Darwin Southern Oscillation Index (SOI) and Southern Hemisphere Annular Model (SAM) index averaged over December, January and February (DJF) for 1957/8 to 2007/8. Values, normalized by 1 standard deviation of the variability, are plotted for the year of December. The most recent values for 2007/8 are striking as they represent both one of the strongest positive SAM events and the second strongest positive SOI event (La Niña) during the last 50 years.

Southern Ocean.

While there is a modest correlation between ENSO and SAM, the two phenomena have displayed considerable independence within the well-observed period that began around 1957. Several recent studies have considered how the two different phenomena may interact through interference and addition within the climate anomalies of high southern latitudes (L'Heureux and Thompson 2006; Fogt and Bromwich 2006; Fogt 2007; and Stammerjohn et al. 2008). For example, Fogt and Bromwich examined linked ENSO-SAM behavior within the framework of decadal variability. They found strong additive effects when La Niño (El Niño) events correspond to the positive (negative) phase of SAM. Under such conditions, the contributions to the induced pressure anomalies near the Amundsen Sea will tend to have similar sign, therefore reinforcing the response.

Stammerjohn et al. (2008) expanded the linkage studies between ENSO and SAM to demonstrate that the impact of SAM on seasonal sea ice retreat and advance was much stronger when a La Niña (El Niño) event corresponded to the positive (negative) phase of SAM. In particular, when 1990s La Niña events corresponded the positive phase of SAM, the March-April-May (austral autumn) sea ice advance was delayed by an average of 22 days for the western Antarctic Peninsula and southern Bellingshausen Sea. In contrast, the delay during the positive phase of SAM averaged 10 days when La Niña was not present. The sea ice advance in the western Ross Sea reacts in an opposite way, occurring earlier with the positive phase of SAM in the 1990s, however the magnitudes of the changes in the Ross Sea are half or less than that near the Antarctic Peninsula. These findings demonstrate that climate change in high southern latitudes needs to be interpreted with regard to ENSO and SAM linkages. Moreover, the increasing positive polarity of SAM during the well-observed modern satellite era (beginning around 1979) will strongly modulate the climate trends (Fogt and Bromwich 2006; Fogt 2007). The following paragraphs demonstrate the most recent example of SAM/ENSO synchrony, in this case occurring during austral summer.

The 2007/8 DJF case

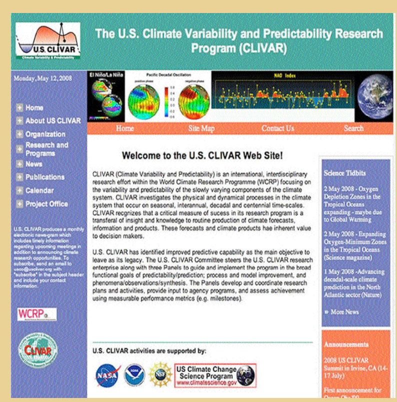
The magnitude and phase of the ENSO cycle are often measured via the normalized Tahiti – Darwin Southern Oscillation Index (SOI). Positive values correspond to La Niña with relative cold temperatures over the tropical eastern Pacific Ocean. For the SAM, Marshall (2003) developed a station-based index that was free of the spurious variations found in some reanalysis fields from southern high latitudes. A time series of austral summer-averaged SOI and the Marshall SAM index is shown in Figure 1. Values shown are seasonal averages for December, January and February (DJF) during 1957/8 to 2007/8. The recent values for 2007/8 are striking as they represent one of five largest positive SAM events and the second strongest positive SOI event (La Niña) during the last 50 years. Therefore, we expect strong interactions for a high southern latitude region near West Antarctica extending from the Ross Sea to the Weddell Sea in accordance with Fogt and Bromwich (2006) and Stammerjohn et al (2008).

Figure 2 displays the surface pressure anomalies during the recent austral summer (2007/8 DJF). The global projection in Figure 2a shows both the tropical and southern high latitude features, while the stereographic projection in Figure 2b depicts the high latitudes in detail. The anomaly field is in accordance with both a strong La Niña and a strong positive phase for the SAM. Consistent with the strong zonal circulation over the Southern Ocean, a negative pressure anomaly is shown over Antarctica. The observed negative anomaly over Antarctica in comparison to long-term stations records has maxima of 8.3 hPa at McMurdo and 8.0 hPa at nearby Scott Base, both at the southwest edge of the Ross Sea. The anticorrelation between high latitudes and mid-latitudes is especially robust at these Pacific longitudes. Correspondingly, Figure 2 shows a positive anomaly in the vicinity of New Zealand. The series of anomalies including the negative anomaly over the Southern Ocean near 50°S, 120°W and positive anomaly east of South America resemble a PSA pattern characteristic of La Niña.

The non-zonally-symmetric component of the pressure anomalies are also consistent with a positive SAM, which typically includes an enhanced low near the Amundsen and Bellingshausen Seas (Lefebvre et al. 2004; Kwok and Comiso 2002). To the east of the Antarctic Peninsula, the anomaly pattern suggests enhanced zonal flow over the northern Weddell Sea, and offshore flow near 0°longitude. The austral summer case of 2007/8 appears to be an ideal case to study the combined contributions of ENSO and SAM.

Sea ice

The sea ice pattern for DJF 2007/8 is now considered as both ENSO and SAM are important for modulating the sea ice cover of the Southern Ocean. Southern Hemisphere sea ice anomalies have an increased climatological significance during austral summer when solar insolation is large. Sea ice anomalies provided by the Arctic Climate Research group at the University of Illinois



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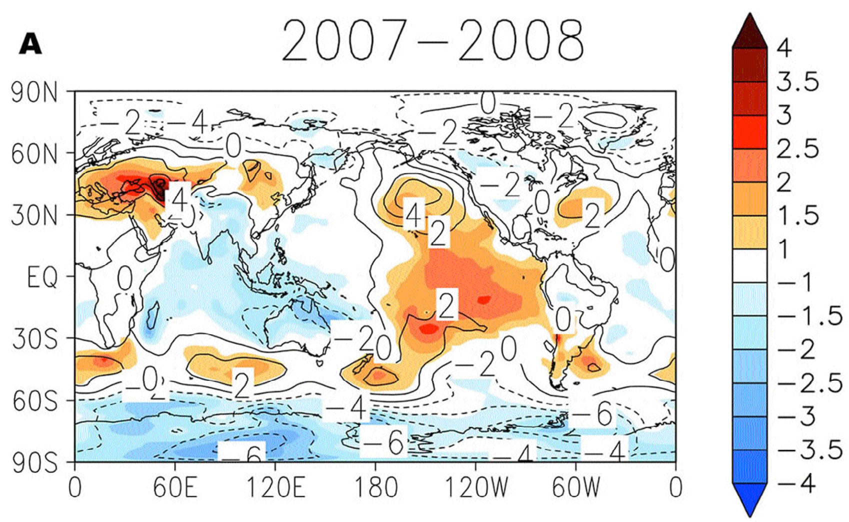

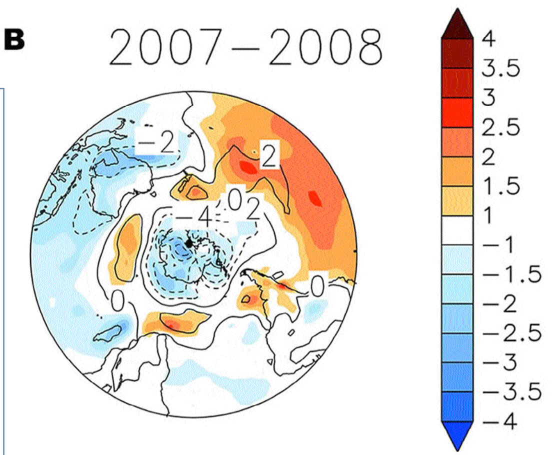

Figure 2. The 2007/8 surface pressure anomaly during DJF for (a) both hemispheres, and (b) southern high latitudes compared to the 1979-2007 mean. Values are from the NCEP/NCAR Reanalysis and normalized by 1 standard deviation (color scale in standard deviations). The pattern shows a combination of (1) an ENSO cold event (La Niña) over the Pacific and Southern Oceans, and (2) the positive phase of the SAM. Antarctic stations McMurdo and Scott Base are near the black circle in (b).

(http://arctic.atmos.uiuc.edu/cryosphere/IMAGES/current.365.south.jpg) reveal a huge positive anomaly that reaches values as large as 2.0?106 km2 during summer 2007/8 even while the climatological sea ice extent rapidly decreases at this time of year. The anomalous sea ice processes, however, have moderated the reduction this summer producing an anomaly that can reach 25% of the actual value. The Ekman drift due to surface wind stress is believed to be an important modulator for Southern Ocean sea ice. Hall and Visbeck (2002) demonstrate that the Ekman drift induced by the increased westerly drag during the positive SAM phase enhances the northward flow of sea ice and contributes to greater areal coverage. Thus the enhanced Ekman drift associated with the strong zonal circulation during 2007/8 is suggested as contributor to the positive sea ice anomaly for the Southern Hemisphere. Furthermore, the decadal trend towards positive polarity of the SAM can contribute to the different trend for Antarctic sea ice in contrast to the observed decrease in the Arctic.

Figure 3 shows the Southern Hemisphere sea ice extent anomaly for December 2007. A representation of the Antarctic Dipole can be seen with a negative anomaly in sea ice extent (blue area) near the peninsula, and a positive anomaly (red area) near the eastern Ross Sea. Yuan and Martinson (2001) demonstrated that the Antarctic Dipole is linked to ENSO forcing and appears as sea ice extent anomalies of contrasting signs that extend from the Ross Sea to the Weddell Sea. Additionally, Figure 3a shows an extended area with a positive sea ice anomaly that includes the northern Weddell Sea and the region near 0° longitude. The anomaly could be explained by enhanced Ekman drift over the Weddell Sea and northward wind stress near 0° longitude. The large area covered by this regional sea ice anomaly indicates that it is especially important for the net positive Antarctic anomaly. Figure 3b shows the net anomaly is extremely large by climatological standards. The extension of the teleconnection pattern deep into the Atlantic sector was hinted at by Fogt and Bromwich (2006) and Fogt (2007) when they found a coherent ENSO response extending much farther east during the 1990s when the SAM tended to the positive phase than during the 1980s when the SAM tended toward its negative phase. The strong synchronized contribution of both La Niña and SAM appears to enhancing this striking sea ice anomaly during the recent summer. The linkage between the ENSO and SAM phenomena, however, is nuanced and still poorly understood. New efforts are required to gain a robust understanding of this teleconnection.

Acknowledgements

Thanks to Gareth Marshall for the SAM Index. This work is supported by NSF grant ATM-0751291.

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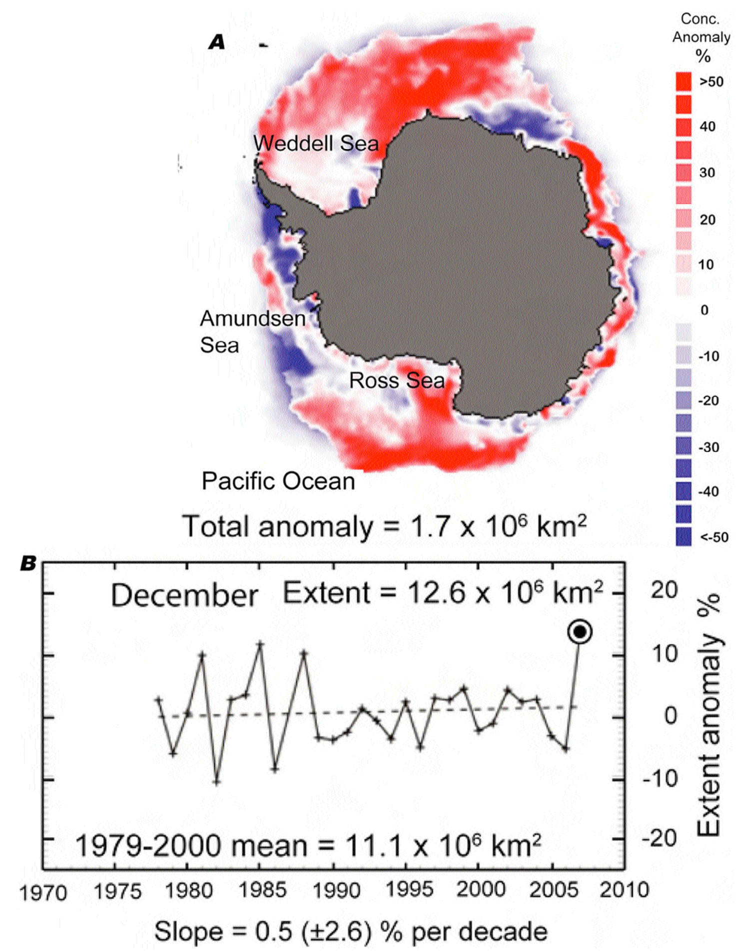

Figure 3. Antarctic sea ice anomalies for December extracted from Scambos et al. (2008) including (a) the horizontal distribution of sea ice concentration anomaly during December 2007 via a color scale. Positive (negative) anomalies are red (blue). The largest positive contribution is located near the Atlantic Sector east of the Antarctic Peninsula. A secondary positive contribution is found near the Ross Sea. The pattern reflects the combined contributions of La Nina and SAM. In (b) the time series is shown of the overall Antarctic sea ice extent anomaly from the late 1970s to 2007. December 2007 has one of the largest positive anomalies during this time span, corresponding to the very strong ENSO and SAM events.

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U.S. CLIVAR Working Group on High Latitude Surface Fluxes

Mark A. Bourassa, Florida State University and
Sarah Gille, Scripps Institute of Oceanography (co-chairs)

U.S. CLIVAR has established a Working Group on High Latitude Surface Fluxes this year, with the particular goal of addressing some of the myriad challenges associated with air-sea and air-ice-ocean exchanges in Arctic, Antarctic, and Southern Ocean regions. The working group activities are motivated by several identified deficiencies in estimates of high latitude surface fluxes (e.g., sensible and latent heat, radiative fluxes, stress, and gas fluxes).

First, in situ observations of fluxes are difficult to obtain because high latitude regions are remote and require instrumentation able to withstand high winds, extremely rough seas, and cold temperatures. Such observations are vital for satellite calibration, which is one approach to filling the void of traditional observations.

Second, the unique conditions in high latitude regions mean that lessons learned in equatorial and subtropical regions do not necessarily translate into improvements in high latitude fluxes. For example, winds over the Southern Ocean are among the strongest in the world, both in magnitude and frequency of occurrence, and can exceed the speeds for which scatterometer wind retrieval algorithms have been tested and the range of validity for standard drag coefficients. Northern Hemisphere, high-latitude, extreme marine storms occur less often, but tend to strengthen much more rapidly. Ocean and atmospheric stratification in high latitude regions can be extremely weak, resulting in deep mixed layers, and it can be extremely strong, pushing the limits of existing stability parameterizations. High latitude regions are also characterized by ice and ice/water mixes, which add additional complexity to calculating and applying fluxes.

Third, since high latitude regions are under-going rapid climate change, marked by rapidly diminishing ice cover, we expect that the character of high latitude fluxes is also changing. That is, flux climatologies are evolving in regions where the characteristics of either the overlying atmosphere or the upper ocean are changing. Fluxes through an ice-free Arctic Ocean, for example, are distinctly different from fluxes through a high-albedo, ice-covered Arctic Ocean. A substantial reduction in the extent of an ice sheet will modify the fluxes in a wider area than that of the changing ice sheet, due to modification of the overlying air mass. These fluxes are expected to have a large influence on both atmospheric and oceanographic circulation and meridional energy transfer, which will impact global climate in fundamental ways: as examples, high latitude surface fluxes control meridional overturning circulation in the ocean, ocean uptake of CO2, and meridional transport of heat in the atmosphere.

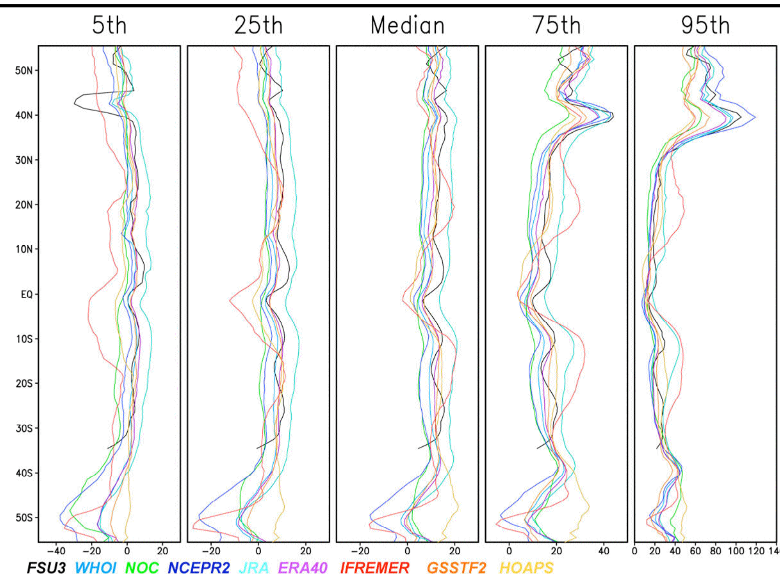

Figure 1. Distributions (5th, 25th, 50th, 75th, and 95th percentiles) of contributions to zonally averaged Atlantic sensible heat fluxes. Reanalysis products include NCEPR2 (Kanamitsu et al. 2002), JRA25 (Onogi et al. 2007), and ERA40 (Uppalla et al. 2005). Satellite derived products include IFREMER and HOAPS2 (based on method of Grassl et al. 2000). The HOAPS2 variables examined herein are identical in the HOAPS3 product. Products based on ship and buoy observations include FSU3 (adapted from the method of Bourassa et al. 2005) and NOC1.1 (formerly SOC; Josey et al. 1998). Hybrid NWP model and satellite products include WHOI (Yu and Weller 2007) and GSSTF2 (Chou et al. 2003). These products were chosen because they are freely available, reasonably easy to obtain, and reasonably homogeneous throughout a common comparison period. The common period of March 1993 through December 2000 is examined.

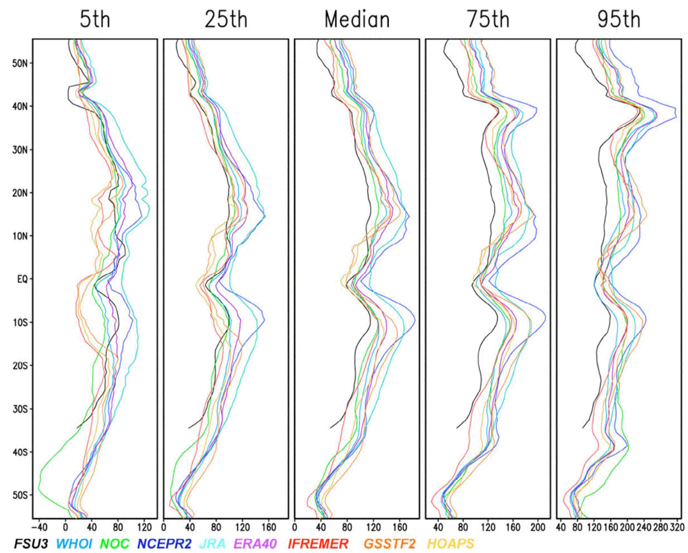

Figure 2. As for Fig. 1, except for the latent heat flux.

Flux products that include high latitudes can differ substantially, even in their climatological annual averages, and they do not resolve small-scale features that are present in sea surface temperature or wind fields. For example, monthly averaged sensible and latent heat fluxes were compared for nine research quality products, and found to differ by >40Wm-2 in both sensible (Fig. 1) and latent (Fig. 2) heat fluxes for the high latitude (ice free) southern and northern portions of the Atlantic basin. In particular, sensible heat fluxes in the Southern Ocean have a relatively large spread among products compared to the rest of the Atlantic basin (for at least the 5th through 75th percentiles of fluxes over what is considered to be year-around open water). Latent heat fluxes have a relatively small spread in the high southern latitudes due to the relatively small values of this flux; however, the spread in the high northern latitudes is rather wide for the stronger events. The wide range of values for these fluxes is a major issue for high latitude energy budgets. In contrast, monthly stress products are in relatively good agreement; however, synoptic scale (and finer) variability in reanalysis products is highly suspect in the Southern Ocean (Hilburn et al. 2003). This finding appears to be partially related to a very strong dependence on rawindsonde data in these products (Langland et al. 2008). The strengths and weaknesses of flux products differ from product to product, and are not sufficiently well described.

At this point, it is not clear to the developers of flux products what accuracies and resolutions are required to study key processes in high latitudes. While concerns about fluxes are common, there has not always been extensive communication between the users of flux products, who hope for accurate gridded fields, and the observers of fluxes, who concern themselves with the details of turbulent boundary layer physics. The physics considered in flux parameterizations also changes the distribution of extreme forcing events (Fig. 3), which have a disproportionately large impact on some atmosphere and ocean processes.

Furthermore, there is often a disconnect with the producers of gridded flux fields and large segments of the user community. Similarly, Arctic and Antarctic specialists rely on somewhat different funding streams and have tended not to interact; analogous issues apply for meteorologists and oceanographers. However, there appears to be much common ground.

The International Polar Year (IPY) intensive observing period (2007-09) is now underway, and several high latitude flux programs are just beginning. Spurred by IPY, planning is starting for Arctic and Southern Ocean observing systems. While IPY has drawn the attention of a large number of international committees, there has been comparatively little focused effort on high latitude fluxes. These fluxes are of interest for a wide range of oceanographic, atmospheric, and over-ice applications. This provides a particular impetus for the US CLIVAR working group.

Objectives

The High Latitude Surface Flux Working Group has a largely scientific focus, aimed at evaluating the current state of knowledge for high latitude fluxes, disseminating our evaluation to the broader scientific community, and laying groundwork for improved flux estimates. The working group will consider air-sea fluxes of momentum, heat, radiation, freshwater, and gas. It will also evaluate fluxes through open ocean, ice covered regimes as well as transition zones, and will consider both Arctic and Antarctic/Southern Ocean regions.

The group has two specific goals that it intends to address in its two year lifetime:

A. Assess status of flux products for momentum and heat in high-latitude regimes, providing an honest assessment of the state of flux products; evaluate commonalities between Arctic and Antarctic. These will be assessed on a variety of spatial/temporal scales that are important to the user community.

B. On the basis of the flux assessment, identify priorities for continued flux observations, parameterizations, and requirements for updated reanalyses and gridded flux products.

The working group is beginning to make plans for a workshop focused on high latitude surface fluxes. A key goal for this workshop is to engage a broader range of perspectives.

Participation

The co-chairs are Mark Bourassa (Florida State University, FSU) and Sarah Gille (Scripps Institution of Oceanography, SIO). The other members of the working group are Cecilia Bitz (University of Washington), Dave Carlson (IPY, British Antarctic Survey),

Calendar of CLIVAR and CLIVAR-related meetings

Further details are available on the U.S. CLIVAR and International CLIVAR web sites: www.usclivar.org and www.clivar.org

Workshop on Uncertainties in High-Resolution Climate Proxy Data
9-11 June 2008
Trieste, Italy
Attendance: Invited
Contact: http://www.clivar.org

2nd Joint Global Ocean Surface Underway Data (GOSUD)/Shipboard Automated Meteorological and Oceanographic System(SAMOS) Workshop
10-12 June 2008
Seattle, Washington
Attendance: Open
Contact: Shawn Smith (smith@coaps.fsu.edu)

Workshop on Uncertainties in High-Resolution Climate Proxy Data
9-11 June 2008
Trieste, Italy
Attendance: Invited
Contact: http://www.clivar.org

PAGES-CLIVAR Panel Meeting
12 June 2008
Trieste, Italy
Attendance: Invited
Contact: http://www.clivar.org

CCSM Annual Meeting
17-19 June 2008
Breckinridge, Colorado
Attendance: Invited
Contact: http://www.ccsm.ucar.edu

2008 IEEE International Geoscience & Remote Sensing Symposium
6-11 July 2008
Boston, MA
Attendance: Open
Contact: http://www.igarss08.org/

Summer School on ENSO: Dynamics and Predictability
14-23 June 2008
Puna, Hawaii
Attendance: Limited
Contact: http://www.clivar.org

Conference on Global Atmospheric Circulation during the Past 100 Years
15-20 June 2008
Monte Verita, Switzerland
Attendance: Open
Contact: http://www.clivar.org

International Workshop on Earth Observation and Remote Sensing Applications
30 June - 2 July 2008
Beijing, China
Attendance: Open
Contact: http://www.2008eorsa.org/

SCAR/IASC IPY Open Science Conference: "Polar Research - Arctic and Antarctic Perspectives in the International Polar Year"
8-11 July 2008
St. Petersburg, Russia
Attendance: Open
Contact:http://www.scar-iasc-ipy2008.org/

IGARSS 2008
7-11 July 2008
Boston, Massachusetts
Attendance: Open
Contact: http://www.igarss08.org

US CLIVAR Science Symposium on Climate in 2018
14 July 2008
Irvine, CA
Attendance: Limited
Contact: http://www.usclivar.org

US CLIVAR Summit
15-17 July 2008
Irvine, CA
Attendance: Invited
Contact: http://www.usclivar.org

Western Pacific Geophysics Meeting
29 July - 1 August 2008
Cairns, Australia
Attendance: Open
Contact: http://www.agu.org/meetings/wp08/

Course on Satellite Oceanography 2008
3-23 August 2008
Ensenada, Mexico
Contact: http://www.ioc.unesco.org

NOAA OCO Annual Meeting
3-5 September 2008
Silver Spring, MD
Attendance: Invited
Contact: http://www.oco.noaa.gov

NOAA CPPA PI Meeting
29 September - 1 October 2008
Silver Spring, MD
Attendance: Invited
Contact: http://www.climate.noaa.gov

Third CLIVAR/GODAE Meeting on Ocean Synthesis Evaluation
6-7 October 2008
Tokyo, Japan
Attendance: Invited
Contact: http://www.clivar.org

CLIVAR Drought Workshop and NOAA Climate Diagnostics and Prediction Workshop
20-24 October 2008
Lincoln, Nebraska
Attendance: Open
Contact: http://www.cpc.ncep.noaa.gov/products/outreach/CDPW33.shtml

WMO Commission for Atmospheric Sciences (CAS) - Fourth International Workshop on Monsoons (IWM-IV)
20-25 October 2008
Beijing, China
Attendance: Open
Contact: http://www.wmo.int

Will Drennan (University of Miami), Chris Fairall (NOAA, Boulder), Ross Hoffman (Atmospheric and Environmental Research, Inc.), Gudrun Magnusdottir (University of California, Irvine), Mark Serreze (University of Colorado), Kevin Speer (FSU), Lynne Talley (SIO), Gary Wick (NOAA, Boulder), .

The working group welcomes input from others and expects to coordinate with programmatic groups focused both on surface fluxes and on the Arctic and Antarctic regions, including IPY, the Study of Environmental Arctic Change (SEARCH), the Climate and Cryosphere Project (CliC), the CliC/International CLIVAR Arctic Climate Panel, the International CLIVAR Southern Ocean Panel, the Arctic Ocean Model Intercomparison Project (AOMIP), the Southern Ice-Ocean Model Intercomparison Project (SIOMIP), the Global Energy and Water Cycle Experiment (GEWEX), the Arctic Observing Network, the Southern Ocean Observing System, SEAFLUX, Shipboard Automated Meteorological and Oceanographic Systems (SAMOS), the World Climate Research Program Working Group on Surface Fluxes, the Surface Ocean—Lower Atmosphere Study (SOLAS), and the Southern Ocean Gas Exchange Experiment (GasEx).

Further information about the working group is available on the web:

http://www.usclivar.org/Organization/hlatwg.html

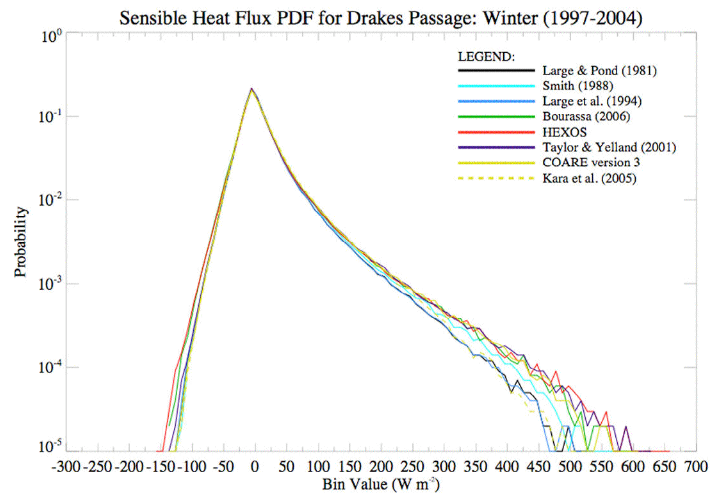

Figure 3. Latent heat flux probability distributions for various models. Six of the models (Large and Pone 1981; Smith 1988, Large et al. 1994; HEXOS: Smith et al. 1992; Taylor and Yelland 2001; and Bourassa 2006) have been coded to differ only in their stress related parameterization (drag coefficient or roughness length). Two models are used as coded: COAREv3 (Fairall et al. 2003) and Kara et al. (2005).

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U.S. CLIVAR Drought Working Group Workshop

In Conjunction with NOAA's 33rd Climate Diagnostics and Prediction workshop.
20-24 October 2008

The workshop will be hosted by the National Drought Mitigation Center, University of Nebraska, Lincoln; and co-sponsored by the Climate Prediction Center (CPC) of the National Centers for Environmental Prediction / NOAA and the U.S. Climate Variability and Predictability (U.S. CLIVAR) Program. The AMS is a cooperating sponsor.

The workshop will focus on the status and prospects for advancing climate monitoring, assessment and prediction, with major emphasis on drought. This includes three major themes: (i) improving climate predictions / predictability, (ii) understanding and attribution of drought and its impacts, and (iii) incorporating climate predictions / projections in the development and delivery of drought products. Note that in a departure from past years, the 2008 CDPW will address drought across multiple time scales (weekly through decadal to centennial and longer) and for multiple regions (North America, South America, Africa, Asia, etc.). Thus, papers that assess the role of ocean, land, and seasonal cycle in multi-year droughts as evidenced in coupled models (especially from IPCC CMEP-3 runs) to complement DRiCOMP and U.S. CLIVAR drought working group research results, and that link drought research and societal needs (e.g. the NIDIS program) are strongly encouraged. The results from DRiCOMP investigations and the U.S. CLIVAR Drought Working Group will also be presented and discussed. The Workshop will feature focused oral sessions with a mix of invited and submitted presentations, thematic poster sessions (including an evening reception), and a drought Town Hall discussion. The majority of contributed papers will be presented in poster sessions.

The outcome of this year's workshop will be an assessment of our current understanding and ability to predict drought, including identifying opportunities for advances, and exploring new products to support regional decision making.

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