BIPOMAC (Bipolar Climate Machinery)

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To facilitate better understanding of the ocean-atmosphere-ice related processes that trigger, amplify and propagate climate change in polar regions, the international and multidisciplinary project "Bipolar Climate Machinery" (BIPOMAC), a study of the interplay of northern and southern polar processes in driving and amplifying global climate variability has been included as a core project in the International Polar Year 2007/08 (IPY; www.ipy.org, Project #130). BIPOMAC has now also been incorporated into PAGES new science program and represents one of the three themes in PAGES Focus 3 "Land/Ocean/Cryosphere/Biosphere Dynamics and Linkages".

Paleoclimatic research and climate models demonstrate that processes and varying conditions in polar regions play a key role in driving and amplifying global climate variability at centennial to millennial timescales. The significance of polar regions in the global climate system is evident from the distinct warming of the polar regions above that of the global average. Important polar processes include the biological cycling and physical circulation in the polar oceans, the formation and distribution of sea ice, the behavior of permafrost areas, atmospheric circulation and transport of water vapor, and the volume and stability of continental ice. Polar and subpolar oceans represent High-Nutrient-Low-Chlorophyll (HNLC) areas and also potentially major CO_2 sinks during glacial conditions, when increased input of micronutrients, like iron, stimulates primary production and enhances the biological pump. Meltwater pulses, which alter surface ocean density gradients, can also induce rapid climate change. The impact of such environmental events in the Arctic Ocean, North Atlantic, North Pacific and Southern Ocean may propagate globally via ocean circulation through the operation of the "bipolar seesaw".

New results from Greenland and Antarctic ice cores have provided details on the methane-linked age relationship of climate variability and its development, particularly over the past 55 kyr (EPICA, 2006). The BIPOMAC network will generate the knowledge necessary to clarify the intertwined roles of bipolar ice, ocean and atmospheric processes in climate evolution and sea level change at different operational modes of the bipolar climate machinery. This knowledge will come from the well-organized collaboration of paleoceanographers, paleolimnologists, geophysicists, glaciologists and modelers, who will study marine and terrestrial records covering the Pliocene to Holocene from both polar regions. This will also include records from areas that have been sparsely investigated to date, if at all (central Arctic Ocean, Arctic Pacific, NE Siberia, Antarctic Pacific, Antarctic ice shelves). Sampling of these areas will benefit from recently developed technologies and encourage further developments at a larger scale (e.g., deep drilling in sea ice covered areas and through ice shelves).

The goals of BIPOMAC

- Decipher the polar mechanisms (ice-permafrost-ocean-atmosphere) and thresholds in triggering rapid (10^2-10^3 yr) climatic changes during warm and cold conditions, and compare the spatial and temporal evolution of such changes in both polar regions and their link with low-latitude climate history.
- Reveal the mechanisms and timing of past bipolar and zonal climate teleconnections.
- Study Pleistocene linkage of climate and biogeochemical cycles on orbital timescales in the 100 kyr and 40 kyr world.
- Document the occurrence and timing of ice, ocean and land conditions of warm early Pliocene in both polar regions.
- Generate networks of polar climate records (ice, ocean, land) to enhance our knowledge of meridional and zonal climate variability during warm and cold climate conditions.

BIPOMAC also includes projects aiming to develop innovative methods for the enhancement of paleoenvironmental reconstructions and increase the accuracy in dating polar records.

Substantial BIPOMAC fieldwork is scheduled or is currently being accomplished for IPY2007/08. Further fieldwork, research and synthesis will extend beyond the IPY, as integration of laboratory results, modeling and datasets remains a key aim of PAGES Focus 3. This research will substantially increase our ability to forecast future climate and sea level change and focus our responses to the environmental challenges that we are, and will be, facing.

Reference

EPICA community members, 2006: One-to-one coupling of glacial climate variability, *Nature*, **444**: doi:10.1038/nature05301

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IGBP Congresses occur every four years and bring together the leadership of the IGBP community to discuss forward-looking scientific issues that cut across the program and aid integration and synthesis. The 4th Congress is designed to assist the development of the scientific agenda for the period 2008-2013. IGBP has chosen Cape Town, South Africa to improve the program's research and networking on development issues, such as risk and vulnerability, important to Africa and other developing countries.