FALL MEETING PREVIEW

Professional Development Workshops for Scientists and Educators

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Attendees at the 2002 AGU Fall Meeting are eligible to participate in several special workshops related to education, teaching, and research in the Earth and space sciences that are being held in conjunction with the San Francisco meeting.

Using Global Data Sets in Teaching Earth Processes

Thursday, 5 December; 8:30 AM–5:00 PM; Marriott Hotel, Pacific C

This one-day workshop is designed for faculty who are interested in increasing their use of inquiry-based approaches employing online global data sets to teach Earth processes. The workshop will feature leaders who work extensively with online global data, either in their research, or their courses. Topics covered by the workshop will include: 1) strategies for engaging introductory students with data sets; 2) using inquiry to develop conceptual understanding; 3) managing data, computers, students, and products; 4) techniques for evaluating student learning in this setting. Examples will be drawn from across the Earth system. Participation is limited to 20.

Conveners: Cathryn Manduca (Carleton College) and David Mogk (Montana State University).

For more information, contact Cathryn A. Manduca; Tel: +1-507-646-7096; E-mail: cmanduca@carleton.edu.

How to Get a Research Program Started at a PUI (Primarily Undergraduate Institution)

Thursday, 5 December; 1:00–5:00 PM; Marriott Hotel, Pacific A

This workshop, sponsored by the Council on Undergraduate Research (CUR) Geosciences Division, will present strategies and approaches for developing and sustaining research programs at the undergraduate level. It is designed for new geoscience faculty, including graduate students preparing to enter academic positions, who are interested in developing an undergraduate research program; as well as faculty interested in expanding their research programs to include undergraduates. The workshop will cover—and participants will receive materials on—funding opportunities (including NSF), project selection and mentoring of undergraduates, and institutional support for undergraduate research. Facilitators will work with the participants to develop their own strategy for developing a research program involving undergraduates.

Presenters/facilitators in this workshop include: Linda Reinen (Pomona College); Patricia Manley (Middlebury College); Lydia Fox (University of the Pacific); Karen Grove (San Francisco State University); and Jill Singer (NSF-DUE).

Participation is limited to 25; cost is $20. To register, contact: Don Woodrow, woodrow@hws.edu.

Additional information can be obtained from Karen Grove; Tel: +1-415-338-2617; Fax: +1-415-338-7705; E-mail: kgrove@sfsu.edu.

Improving Introductory Science Teaching for Non-science Majors

Saturday, 7 December; 6:00–9:00 PM; Marriott Hotel, Pacific I

The introductory survey course for non-science majors presents a unique challenge for many college and university faculty. Sponsored by the NSF-funded National Institute for Science Education, this three-hour teaching excellence workshop provides participants with successful teaching strategies and effective assessment procedures. Participants will review recent results of educational research on teaching and learning, and explore how course goals can be used to significantly improve the introductory course. With a focus on active learning strategies, participants will receive a materials package of classroom-tested, collaborative group learning activities that engage students in their own learning. Participants will also investigate how contemporary assessment procedures, including portfolio assessment, performance assessment, and concept mapping, are successfully implemented in courses for non-science majors in concert with conventional testing and grading approaches. New and senior faculty, as well as graduate students and post-docs, are encouraged to attend.

No pre-registration is necessary, but workshop is limited to 60 participants.

Conveners: Ed Prather and Tim Slater (University of Arizona); Mike Zeilik (University of New Mexico).

For more information, contact Tim Slater; Tel: +1-520-621-7096; Fax: +1-520-621-1532; E-mail: tslater@as.arizona.edu.

Evaluating Geoscience Education Projects with the DLESE Evaluation Toolkit

Monday, 9 December; 6:00–9:00 PM; Moscone Center, Room 270

This workshop is being sponsored by NSF as part of the Digital Library for Earth System Education (DLESE) Evaluation Toolkit program. It is designed to help geoscience educators and project evaluators find good evaluation resources, get feedback and help with geoscience education evaluation, and share results with one another.

Registration for this workshop can be done online at: http://cires.colorado.edu/~k12.

For more information, contact Susan Buhr, Cooperative Institute for Research in Environmental Sciences (CIRES); Tel: +1-303-492-5657; E-mail: Susan.Buhr@colorado.edu.

SECTION NEWS

ATMOSPHERIC SCIENCES

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Trends and Variations in Arctic Climate System

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Prominent changes of the Arctic atmosphere-ice-ocean system observed in recent years have sparked intense discussions as to whether these changes represent episodic events or long-term shifts in the Arctic environment. In the past, the lack of long-term observations in the Arctic made it difficult to explore this issue. Although the length of available instrumental records is often too short to give a quantitative, statistical description of processes at multi-decadal time scales, these Arctic records, which are similar in length to the global records, provide insight into long-term variations of the Arctic climate system and suggest that high-latitude climate feedbacks merit further study.

Air Temperature: Variability and Trends

An analysis of instrumental records shows that global surface air temperature has increased by 0.6°C since 1861, with a slightly greater rate of warming in the 20th century [*Jones et al.*, 1999]. In the Northern Hemisphere, the 1990s were the warmest decade of that period. A composite Arctic temperature record also shows warming (Figure 1), which may be associated with increased precipitation over land, decreased snow cover, contracted extent of sea ice, sea level rise, and changes in atmospheric and oceanic circulation patterns [*IPCC*, 2001].

Caution is important when identifying these observations, as manifestations of enhanced high-latitude warming, because the temperature variations are complicated by strong natural variability. In the Arctic, this variability is dominated by multi-decadal fluctuations with a time scale of 50–80 years. In particular, this low-frequency variability found in numerous climatically important parameters, dubbed "low-frequency oscillation" (LFO) [*Polyakov and Johnson*, 2000], is evident in many instrumental and proxy records from the Northern Hemisphere [*Delworth and Mann*, 2000] and the Arctic [*Polyakov et al.*, 2002b]. Long-term records have now become available following the release of Russian meteorological observations poleward of 62°N and sea ice extent and fast-ice thickness measurements from the Kara, Laptev, East Siberian, and Chukchi Seas. We chose 75 land meteorological stations, maintaining approximately homogeneous spatial coverage, and omitting records with gaps [*Polyakov et al.*, 2002b]. Twenty-four records are longer than 100 years, and 31 others are longer than 65 years. Observations from 20 stations cover less than 65 years. The shortest record used is 43 years. To eliminate site density bias, we omitted data before 1875, because only a few time records—mostly from Scandinavian stations—extend to earlier years.

Fortunately, the remaining geographical bias in the early part of the composite time series is relatively small [*Polyakov et al.*, 2002a]. All of the land station data have been assessed for homogeneity using an interstation comparison. Monthly data have also been assessed for errors by identifying peaks exceeding three standard deviations and then checking them with nearby station records.

Figure 1 shows the composite Arctic surface air temperature and its long-term trend; detailed data description may be found in *Polyakov et al.* [2002b], and also on the Web (http://www.frontier.iarc.uaf.edu/~igor/data/airtemppres.php). Two distinct warming periods from 1920 to 1945, and from 1975 to the present, are clearly evident. In analyzing hemispheric and global temperatures, *Jones et al.* [1999] documented the same periods of warming. Compared with global and hemispheric temperature rise, the high-latitude temperature increase was stronger in the late 1930s to early 1940s than in recent decades. For example, the magnitude of these maxima was almost indistinguishable within the 55–85°N zonal band [*Serreze et al.*, 2000], while north of 62°N, the 1938 maximum of annual Arctic air temperature anomaly reached 1.69°C compared with the 2000 maximum of 1.49°C.

As can easily be seen, the large-amplitude Arctic multi-decadal variability influences the sign of the air temperature trends [*Polyakov et al.*, 2002a]. For example, air temperature trends calculated from 1940 to the present are positive. However, since Arctic temperatures in the 1930s and 1940s were exceptionally high, trends calculated from the 1920s to the present show a small but statistically significant cooling tendency. Extending the time series further back into the 19th century, the temperature trend again changes sign, signifying a general warming tendency over the entire record. In addition, over the 125-year record, we can identify periods when Arctic trends were actually smaller or of different sign than Northern Hemispheric trends calculated using *Jones et al.* [1999] air temperature data. This analysis underscores the inherent difficulty in differentiating between trends and long-term fluctuations. Computed Arctic air temperature trends depend on the phases and intensity of the LFO in addition to any underlying trend, while Northern Hemisphere trends are not as dependent on multi-decadal variability. Trends in Arctic air temperature for recent decades have been discussed in several studies and vary from -0.37 to +0.19°C/decade. The Arctic air temperatures for 1960–1990 show warming trends, but extending the records back in time by only 10 years produces strong cooling trends.

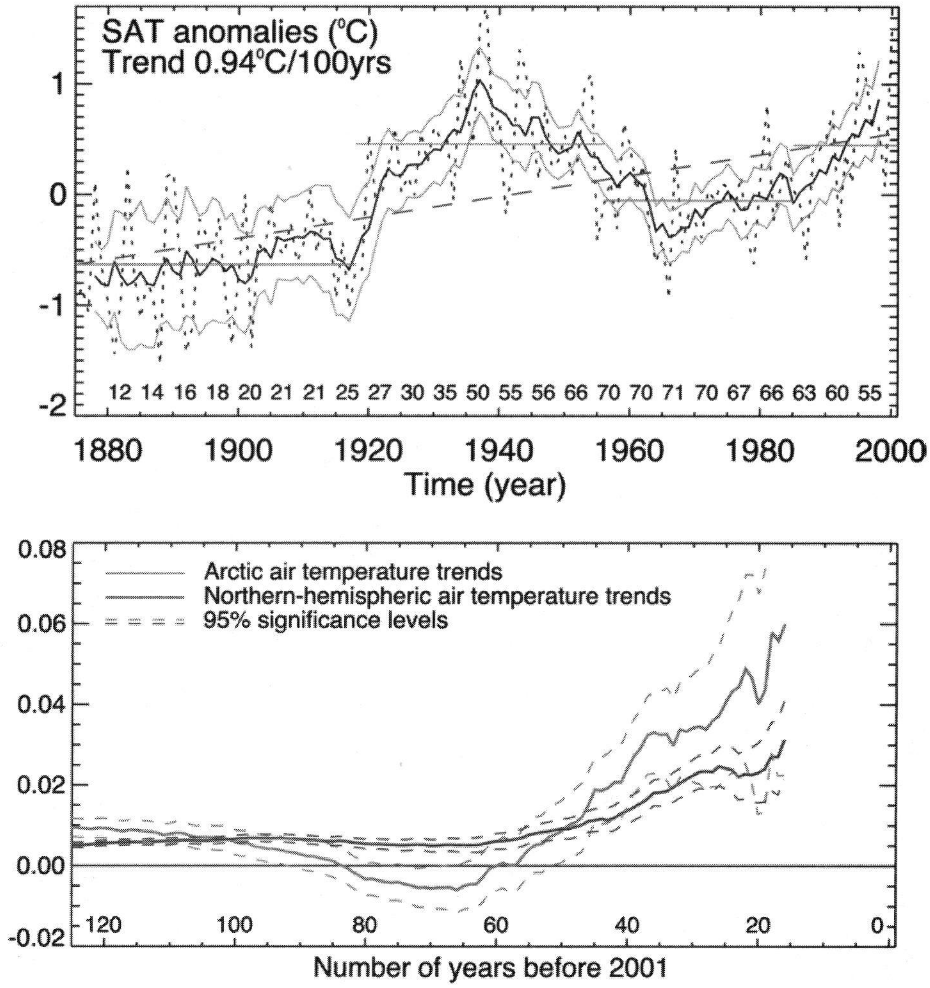

Fig. 1. (Top) Annual anomalies of Arctic surface air temperature (SAT) are shown. Blue dashed lines show annual means, blue solid lines show 6-year running means, yellow lines depict 95% significance levels, red dashed lines show trends, and green horizontal lines show means for positive and negative phases of multi-decadal variations. Numbers in the bottom parts of the panels indicate the number of stations used for averaging. (Bottom) Surface air temperature trends (°C/year) are shown, ranging from a 17-year period (1985–2001) to the full record length (1875–2001), at 1-year increments. Original color image appears at the back of this volume.

Polar Amplification

Comparing air temperature trends for 1901 to 1997—potentially years with the most pronounced human impact—the difference between the *Jones et al.* [1999] Northern Hemisphere data and the Arctic data is only 0.01°C/decade, a statistically indistinguishable 20% difference. The similarity of Arctic and Northern Hemispheric air temperature trends for this period may result from a near-cancellation of positive/negative LFO phases, and therefore, does not support amplified warming in polar regions predicted by models (*IPCC Report* [2001]; see also Figure 2, top). Extending our air temperature time series by 25 years back to 1875—a year associated with an extended and cold negative LFO phase—leads to the two-fold increase of the Arctic trend compared with the Northern Hemispheric trend. While this appears consistent with polar amplification, we believe it is more appropriately described as a statistical artifact resulting from a biased sampling of the LFO. In an analysis of long-term air temperature changes, *Vinnikov et al.* [1980] used gridded Northern Hemispheric air temperature for 1891 to 1978, the first half of which was dominated by the negative, cold LFO phase prior to the 1920s, and the second by the positive, warm LFO phase of the 1930s to 1940s. By averaging these data within zonal bands, they also found a two-fold polar amplification of air temperature trends.

The apparent lack of amplification in the century-long maritime Arctic air temperature time series may be due to the moderating role of sea ice. We examined long-term observational records of fast-ice thickness and ice extent from four Arctic marginal seas, Kara, Laptev, East Siberian, and Chukchi. The analysis indicates that long-term trends are small and generally statistically insignificant, while trends for shorter records are not indicative of the long-term tendencies, in agreement with the trends of air temperature. Strong low-frequency variability in these time series places a constraint on our ability to resolve long-term trends.

If long-term trends are accepted as a valid measure of climate change, then the air temperature and ice data do not support the proposed polar amplification of global warming. The potential importance of large-amplitude variability and numerous feedbacks involved in Arctic atmosphere-ice-ocean interactions implies that the Arctic poses severe challenges to generating the credible model-based projections of climate change. Figure 2 shows a multi-model ensemble of surface air temperature changes in the latter part of the next century predicted by coupled models used by the Intergovernmental Panel on Climate Change (IPCC). The maximum simulated warming is in the central Arctic, while the observations do not provide evidence of amplified high-latitude warming. Figure 2 also shows multi-model standard deviation of mean winter temperatures from control simulations (1961–1990). The standard deviations reach up to 14°C among five coupled models used by the IPCC, which introduces large uncertainties into the projected changes. Natural Arctic variability further obscures long-term changes, limiting our ability to resolve trends and identify complex positive and negative feedbacks in the Arctic climate system. There are some indications that the importance of the ice- and snow-albedo feedbacks may be exaggerated [*Robock*, 1983], which may explain why the amplification of global warming is not found in the Arctic.

Authors

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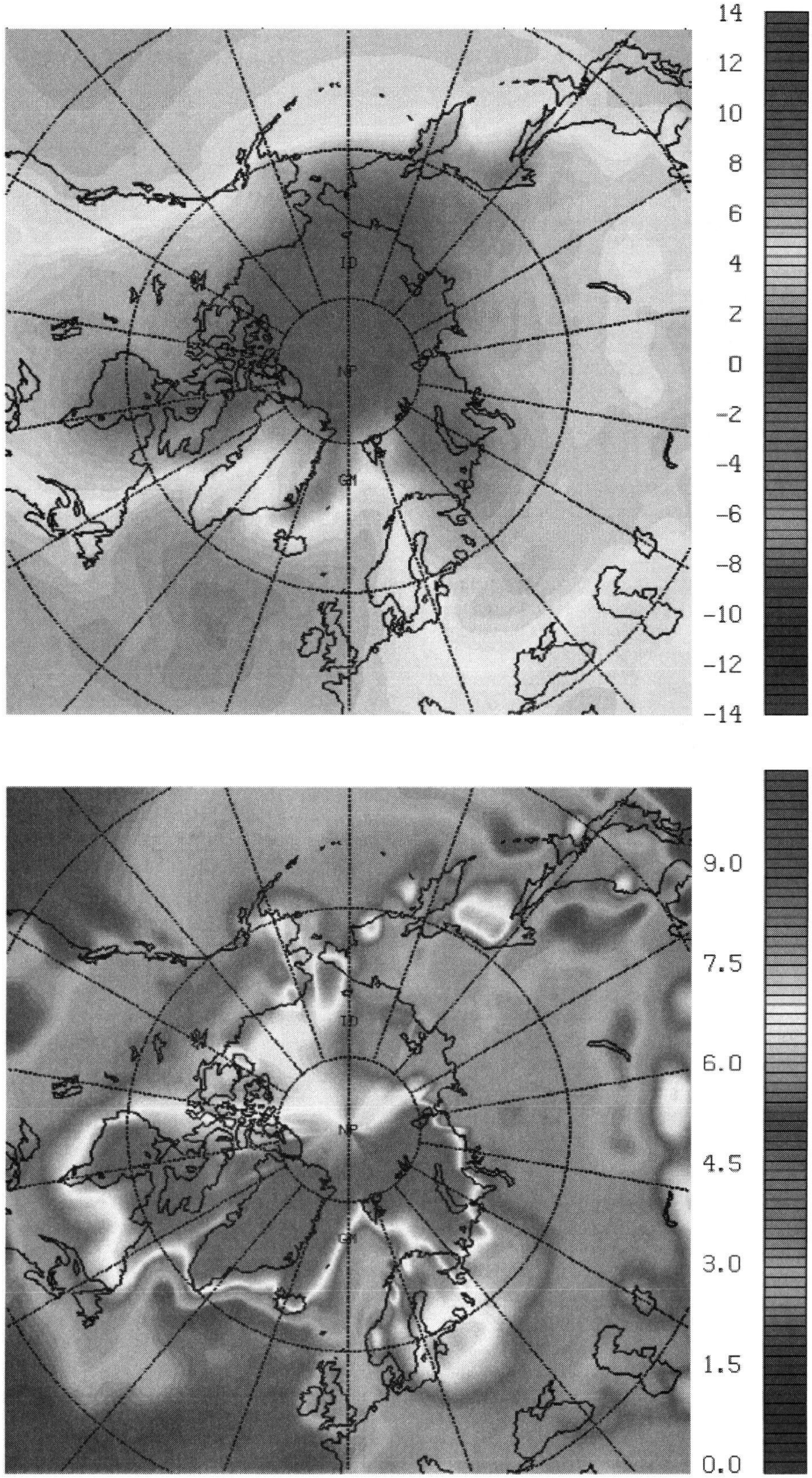
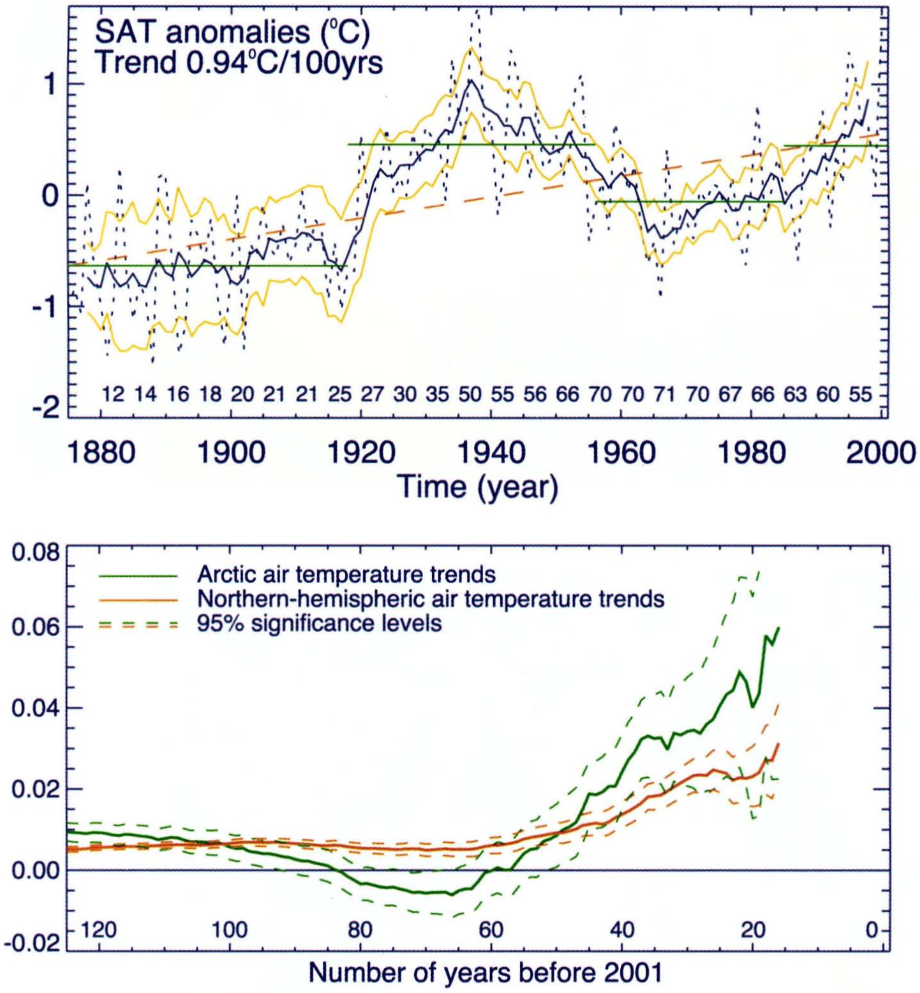


Fig. 2. Upper panel: Multi-model composite of surface air temperature changes in the latter part of the 21st century were predicted by coupled models used in the Intergovernmental Panel on Climate Change's 2001 assessment. Lower panel: Across model standard deviation of mean winter temperature in present-day (control) climates simulated by these models are shown. Original color image appears at the back of this volume.



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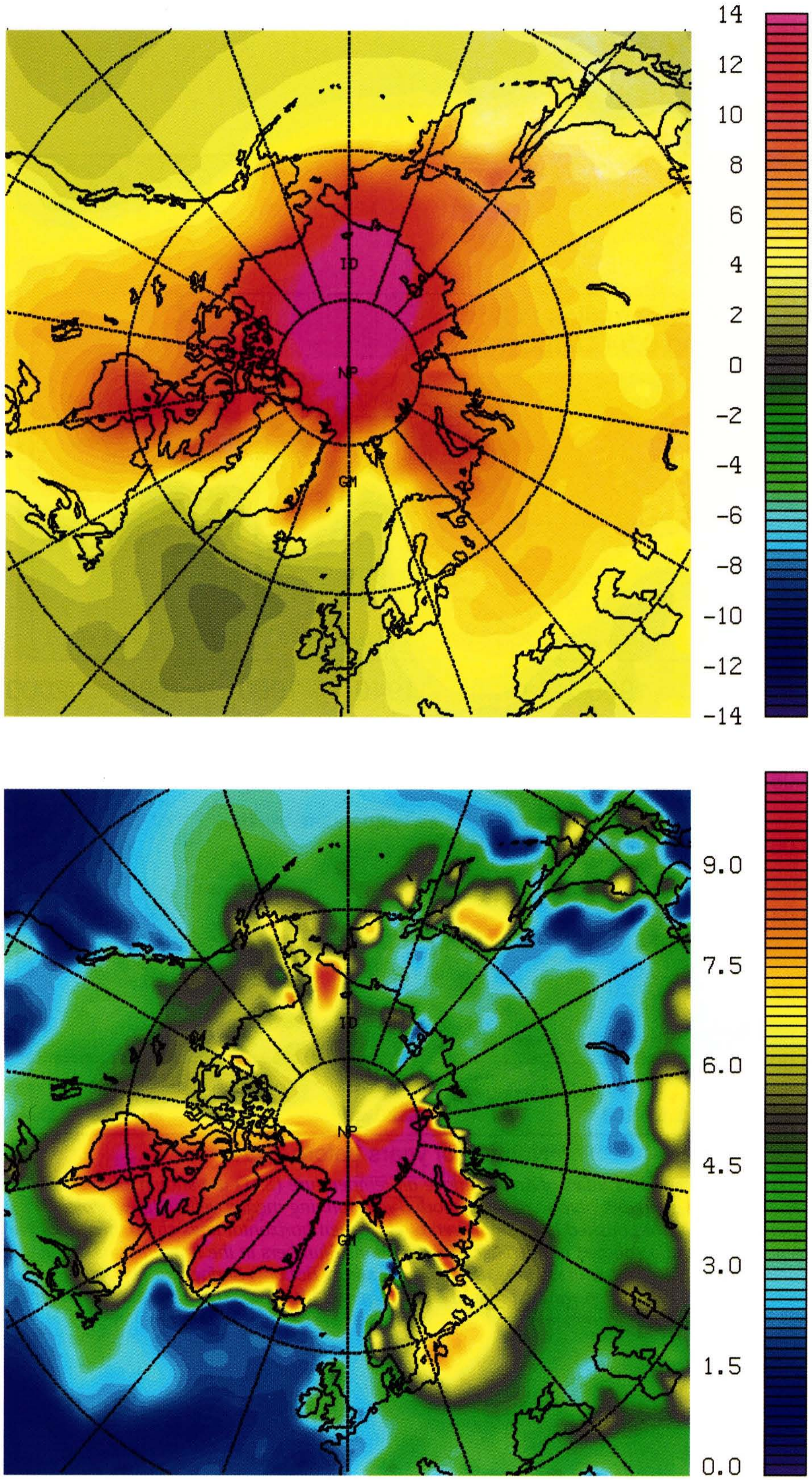

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