

GEOTRACES

International effort to conduct multidisciplinary studies of processes affecting global marine biogeochemical cycling; Emphasis on key trace elements and isotopes (TEIs), and their *sensitivity to changing environmental conditions.*

- **Extremely relevant to the Arctic, where *rapid climate change* and *accompanying biogeochemical responses* are occurring.**
- **Understanding current biogeochemical processes & establishing baselines will provide insights into the Arctic's future.**



Avenues of Study

GEOTRACES:

- Fluxes and Processes at Ocean Interfaces
- Internal Cycling
- Development of proxies for past change
- **Micronutrient and trace metal cycling**
Fe, Al, Mn, other TM, REE
- **Tracers of freshwater sources**
 $\delta^{18}\text{O}$, Ba, nutrients
- **Tracers of particle flux**
 ^{234}Th , ^{230}Th , ^{231}Pa , ^{210}Po , ^{210}Pb , ^7Be
- **Tracers for exchange of shelf with open ocean**
Fe, Al, Mn, REE, ^{228}Ra , Nd, Hf, Be, DOC (lignin)
- **Tracers of water mass circulation and mixing**
Pu, ^{137}Cs , ^{129}I , ^{99}Tc , ^{227}Ac



The Arctic is Unique

- **Extremely vulnerable to climate change**
 - **climate feedbacks**
 - **ice-albedo**
 - **stratification change/ heat flux**
 - **riverine inputs (C, nutrients)**

- **Important Global role in climate**
 - **Thermohaline circulation**
 - **Heat budget (albedo)**
 - **carbon input (e.g. C in permafrost)**

- **Coupling with human activity**
 - **affected by, and impact on**
(e.g. subsistence communities)



What is/has been the most successful initiative of your organization/program/project and what role did international partnerships play in that success?

International Planning

- Three international workshops in 1997 identified ~35 sections in the Atlantic, Pacific and Indian Oceans. Fifteen nations plan to stage expeditions
- Arctic Planning underway – will require extraordinary international collaboration (**High Costs!!**)
 - repeat hydrography?

Interactions with other international programs

- IMBER-mutual interest in micronutrients
- SOLAS-impacts of atmospheric inputs on ocean chemistry
- IPY- The first GEOTRACES sections were operated in the Southern and Arctic Oceans

Arctic Sea Ice Extent Plummets in 2007

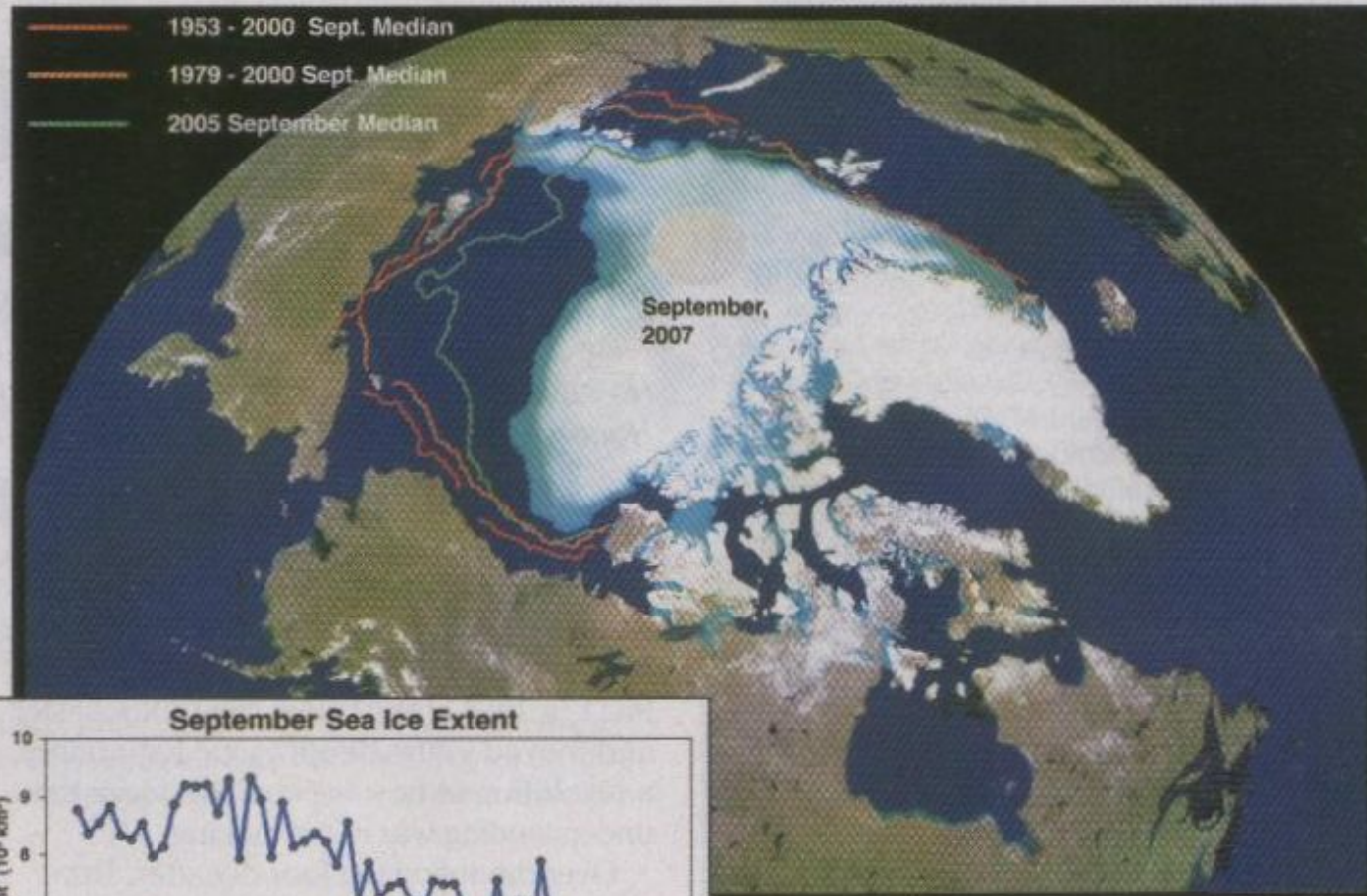
EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

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Arctic sea ice declined rapidly to unprecedented low extents in the summer of 2007, raising concern that the Arctic may be on the verge of a fundamental transition toward a seasonal ice cover.

Arctic sea ice extent typically attains a seasonal maximum in March and minimum in September. Over the course of the modern satellite record (1979 to present), sea ice extent has declined significantly in all months, with the decline being most pronounced in September. By mid-July 2007, it was clear that a new record low would be set during the summer of 2007.

perhaps a
real-time experiment!!



Is it getting worse fast?

What are/were the impediments to successful international partnership and coordination and how were these overcome?

International cooperation relatively successful !

- Nations have come together to identify sections (international workshops)
 - Adopted individual GEOTRACES sections in global ocean (not Arctic).
 - Data Management
 - Compilation of data into secure and readily searchable databases open to international investigators.
 - GEOTRACES International Data Management - hosted at the British Oceanographic Data Centre funded by NERC (UK) and NSF (USA)
- Arctic Planning underway – will require *extraordinary international collaboration !!*



What does the future, (next 10 years), of coordinated, international arctic science look like from the perspective of your organization/program/project?

GEOTRACES Arctic Cruise Planning Meeting June 2009, Delmenhorst, Germany

- **Formulated Scientific Issues**
- **Constructed a map of proposed GEOTRACES Arctic Ocean sections.**

“We did not identify countries or persons to take the lead in expeditions to any of these favored tracks and regions as we did not want to make claims at this stage. We wanted to encourage initiatives to propose and organize expeditions along the lines of our recommendations and with regard to the high costs did not expect that competition for cruise tracks in the Arctic would be an issue.”



US Arctic GEOTRACES Workshop!
Washington D.C, Sept 29-Oct 1, 2010

Goals:

- **To set US priorities**
- **To establish collaborative US- International Arctic studies**



