

Observations for Climate: Monitoring Changes in Arctic Sea Ice Thickness, Mass Balance and Marine Mammal Activity

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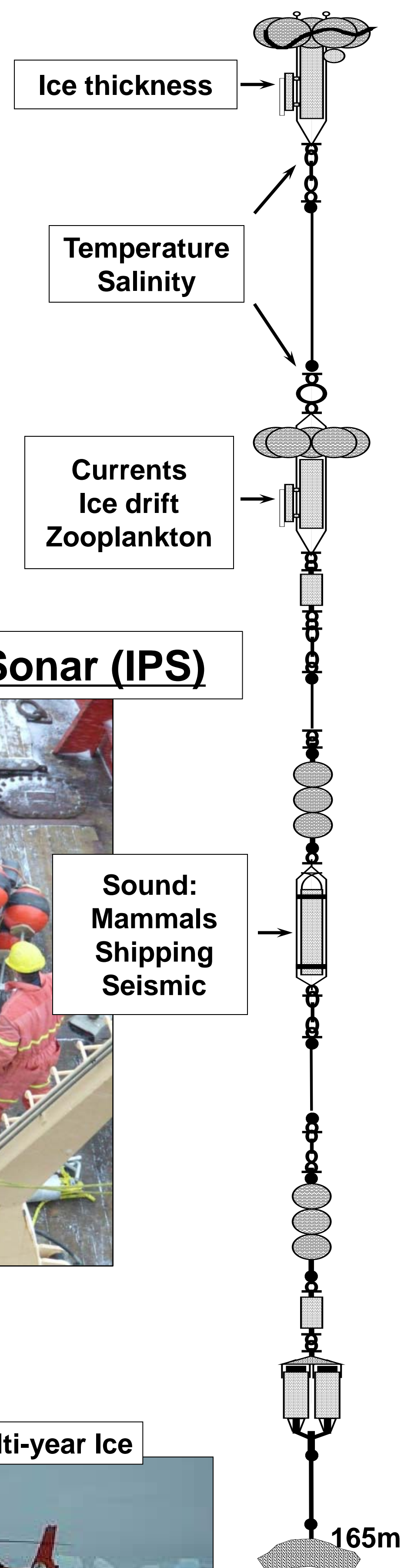
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OVERARCHING GOAL: Explore *what* Arctic sea ice thickness changes are taking place and *how* these changes occur, leading to improved forecasts of future conditions and a more timely and effective *response* to the impacts of environmental change.

OBJECTIVE: Continue and expand the critical network of observations aimed at monitoring and understanding changes in the thickness and mass balance of the Arctic sea ice cover

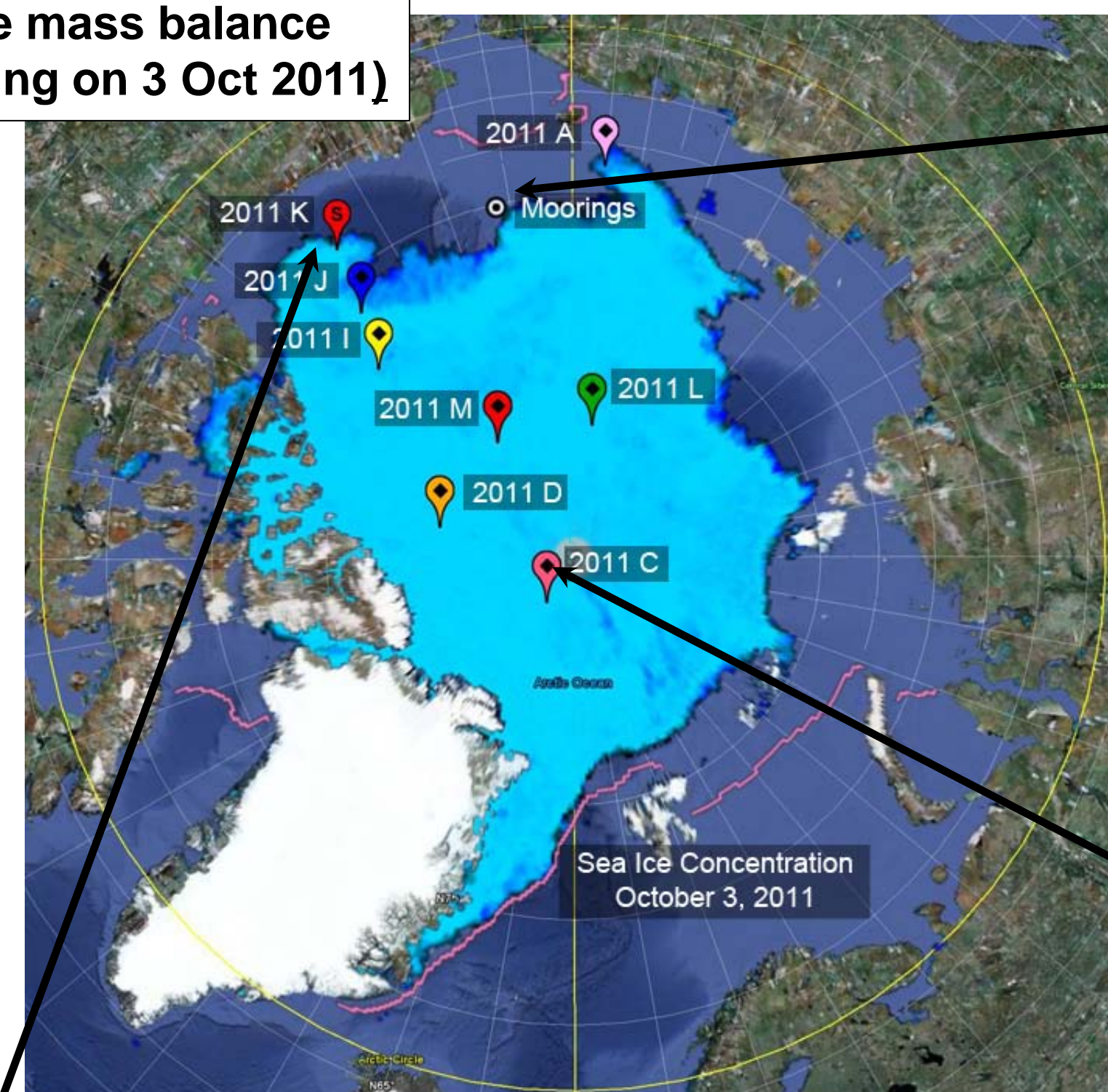
APPROACH: Deploy and maintain an array of drifting ice mass balance buoys (IMBs) and a sea floor mounted mooring on the Chukchi Plateau equipped with ice profiling sonar (IPS) and passive acoustic sound recorders.

PROGRESS: Since NOAA began its support of this project in 2003 and in collaboration with the NSF Arctic Observing Network Program, a total of 50 IMBs have been deployed in the Arctic Ocean and the IPS site has been visited 9 times to service the mooring, with 100% data recovery. Data collected from the IMBs, SIMBs and IPS are made widely available via the web site: <http://imb.crrel.usace.army.mil/>



- KEY RESULTS**
- Analyses of the IMB data have shown that solar heat input to the ocean is strongly correlated to the bottom melting of the sea ice cover in regions of low ice concentration (e.g. near the ice edge).
 - The IMB data have been used by the scientific community to develop instruments (e.g. satellite and airborne) that remotely observe changes in sea ice thickness. They have also been combined with other Ice-Based Observatory data to investigate freshening of the upper ocean.
 - Data from the IMBs are featured in a K-12 outreach effort, the Adopt-A-Buoy Program.
 - While still a relatively short record, monthly mean draft data from the IPS suggests little change in the thickness of the seasonal ice over the period of observation. The lack of trend in seasonal ice is a stark contrast to the dramatic decline of multi-year ice thickness in the western Arctic.
 - Early results from the AURAL recorder mounted on the IPS reveal regionally-dependent acoustic habitats, with the differences related to contrasts in sea ice cover, temperature and general patterns of ocean circulation.

Location of ice mass balance buoys and mooring on 3 Oct 2011

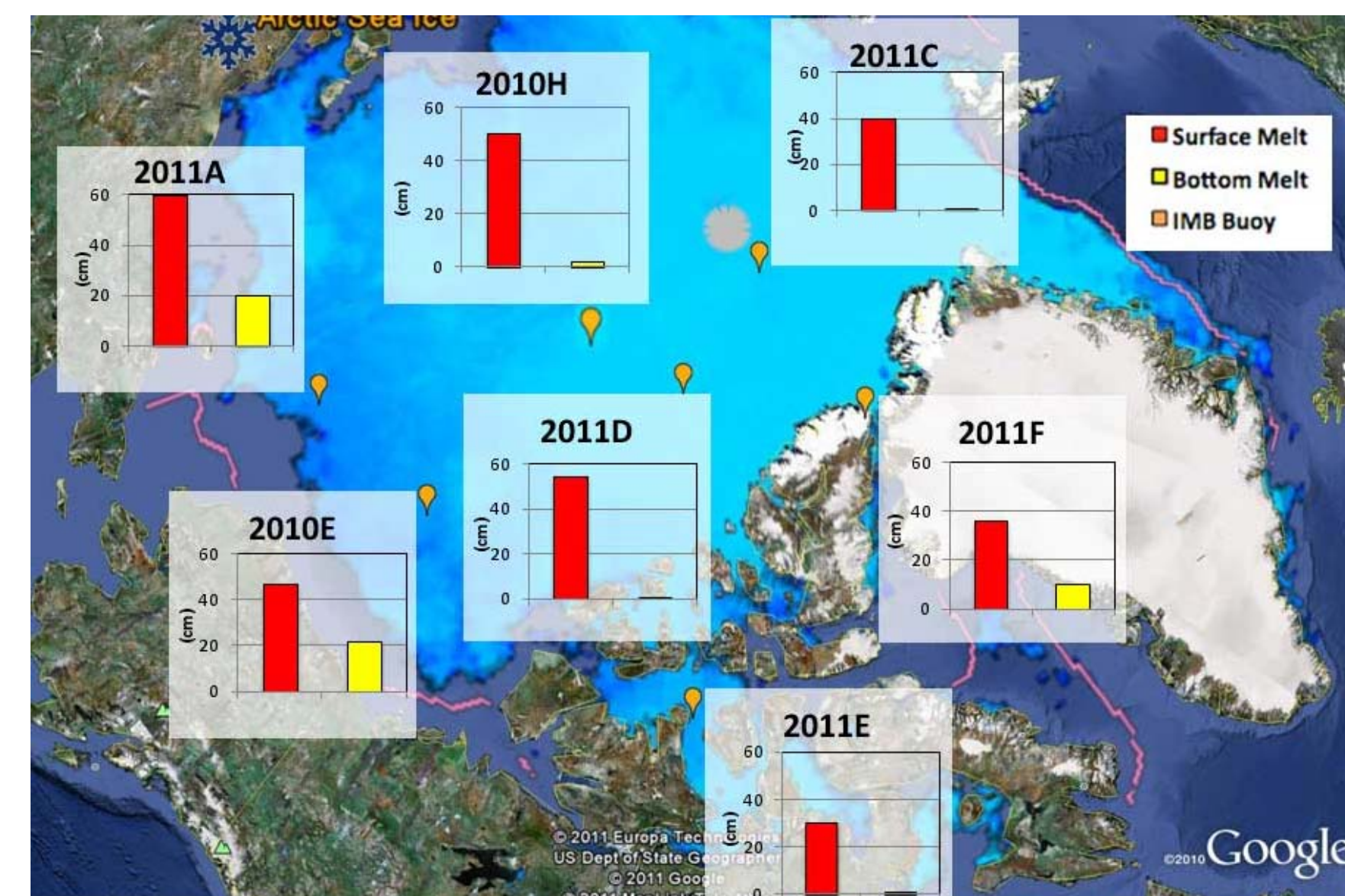


Moored Ice Profiling Sonar (IPS)



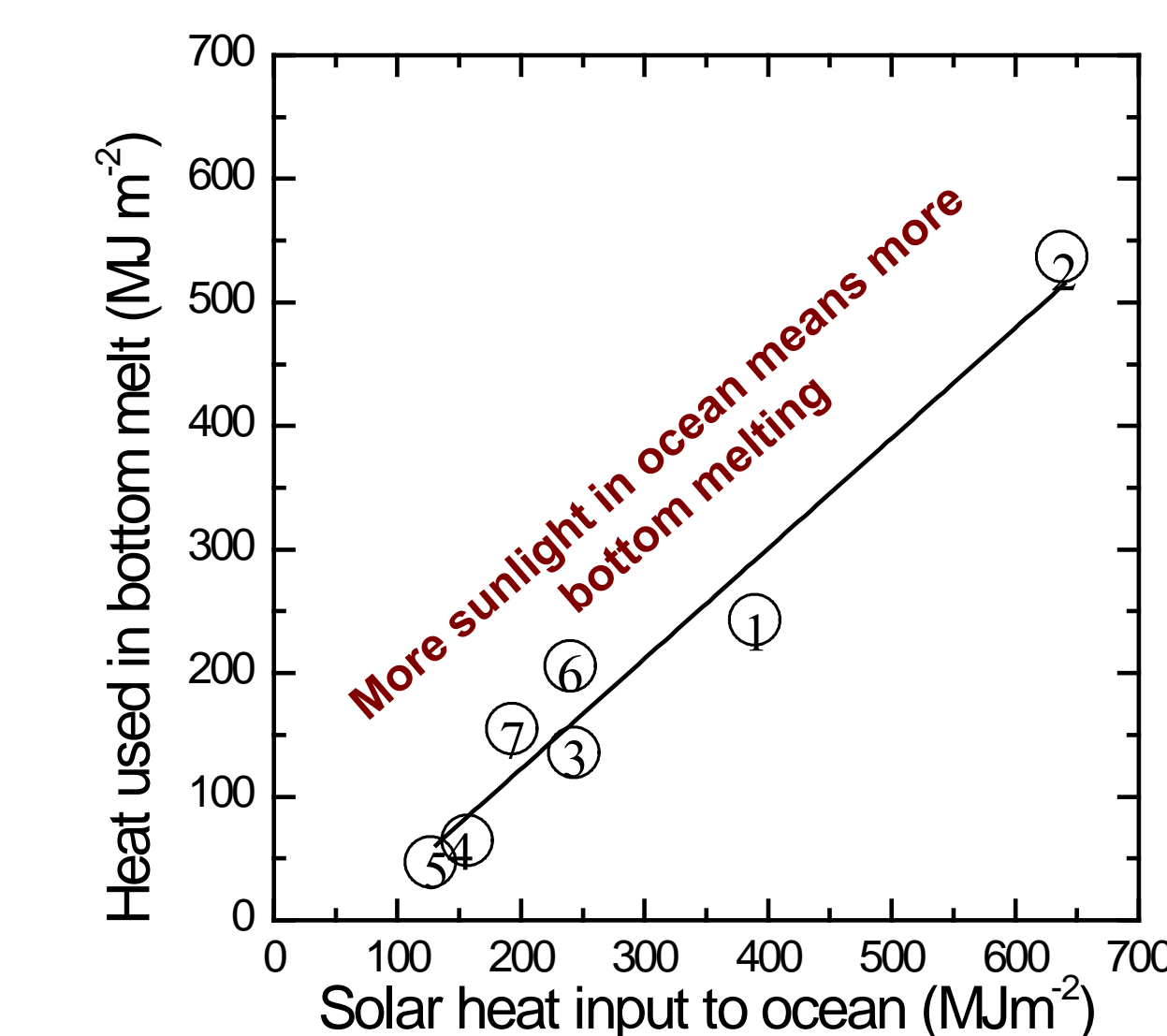
Sound: Mammals Shipping Seismic

Network of ice mass balance buoy showing surface and bottom melt across the Arctic Ocean through July 2011

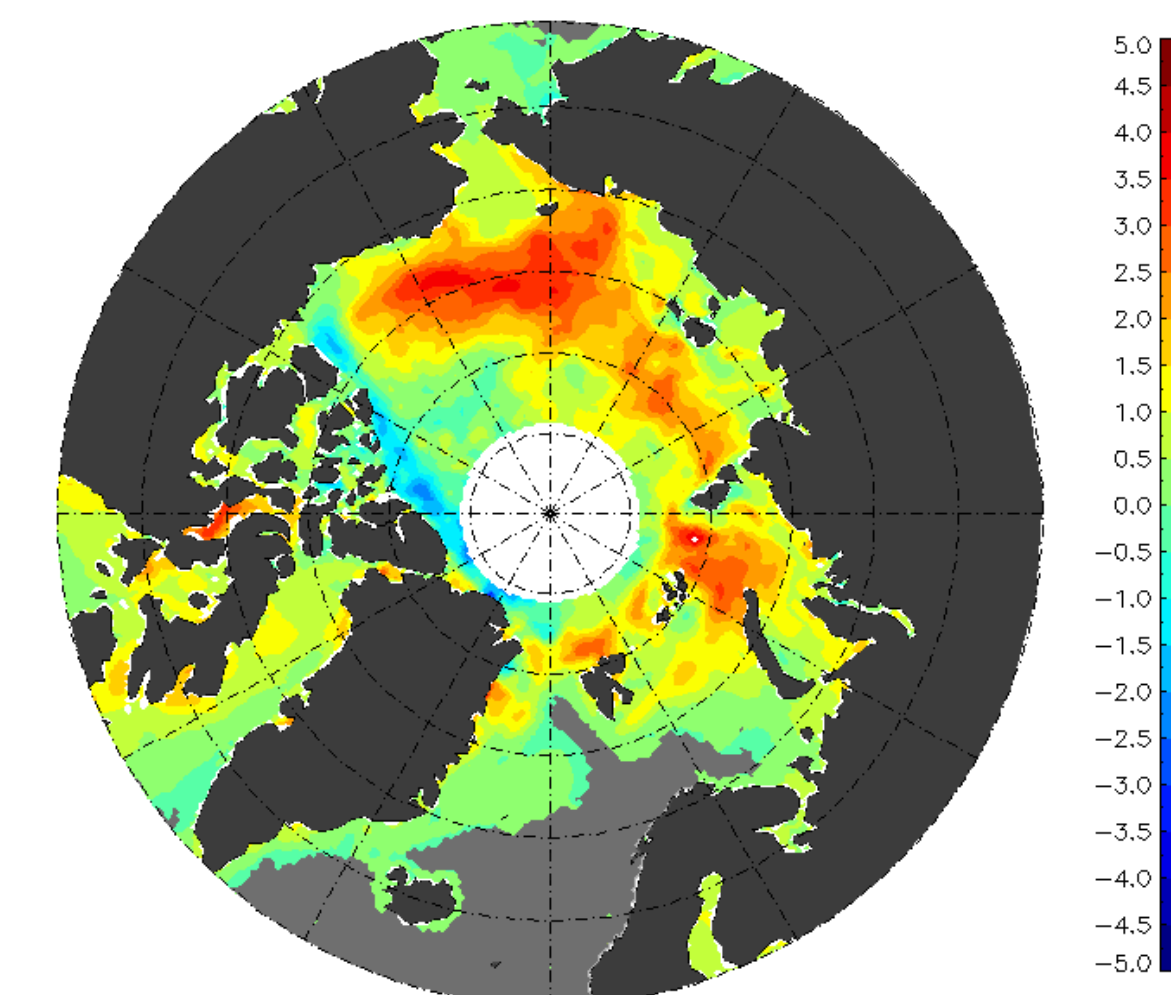


In summer 2011, surface melt at buoys located in the vicinity of the ice edge was consistent with previous years, while surface melt closer to the North Pole was relatively high.

Comparison of heat used in bottom melting to local solar heat input to leads

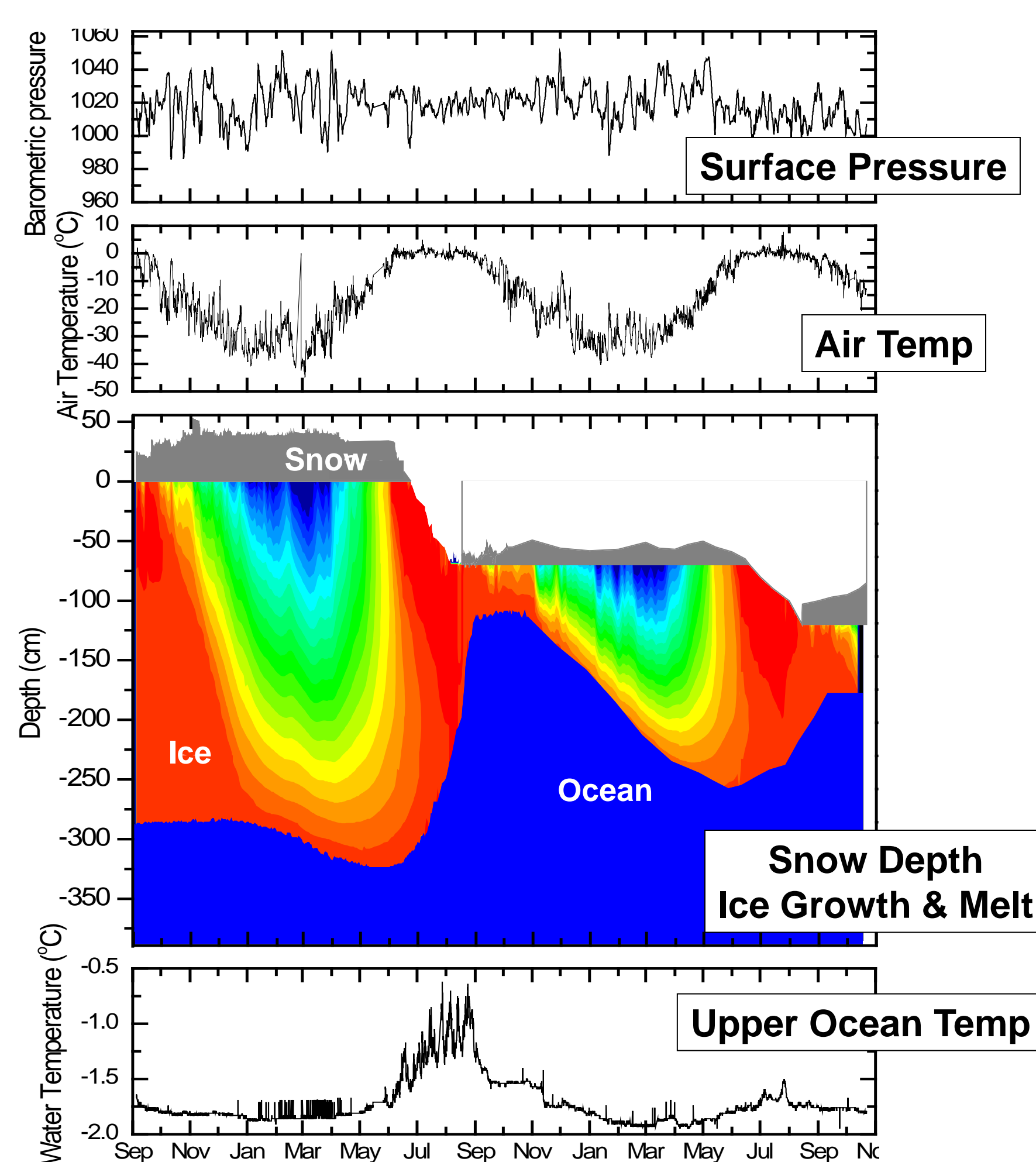


30 year trends in solar heat to upper ocean

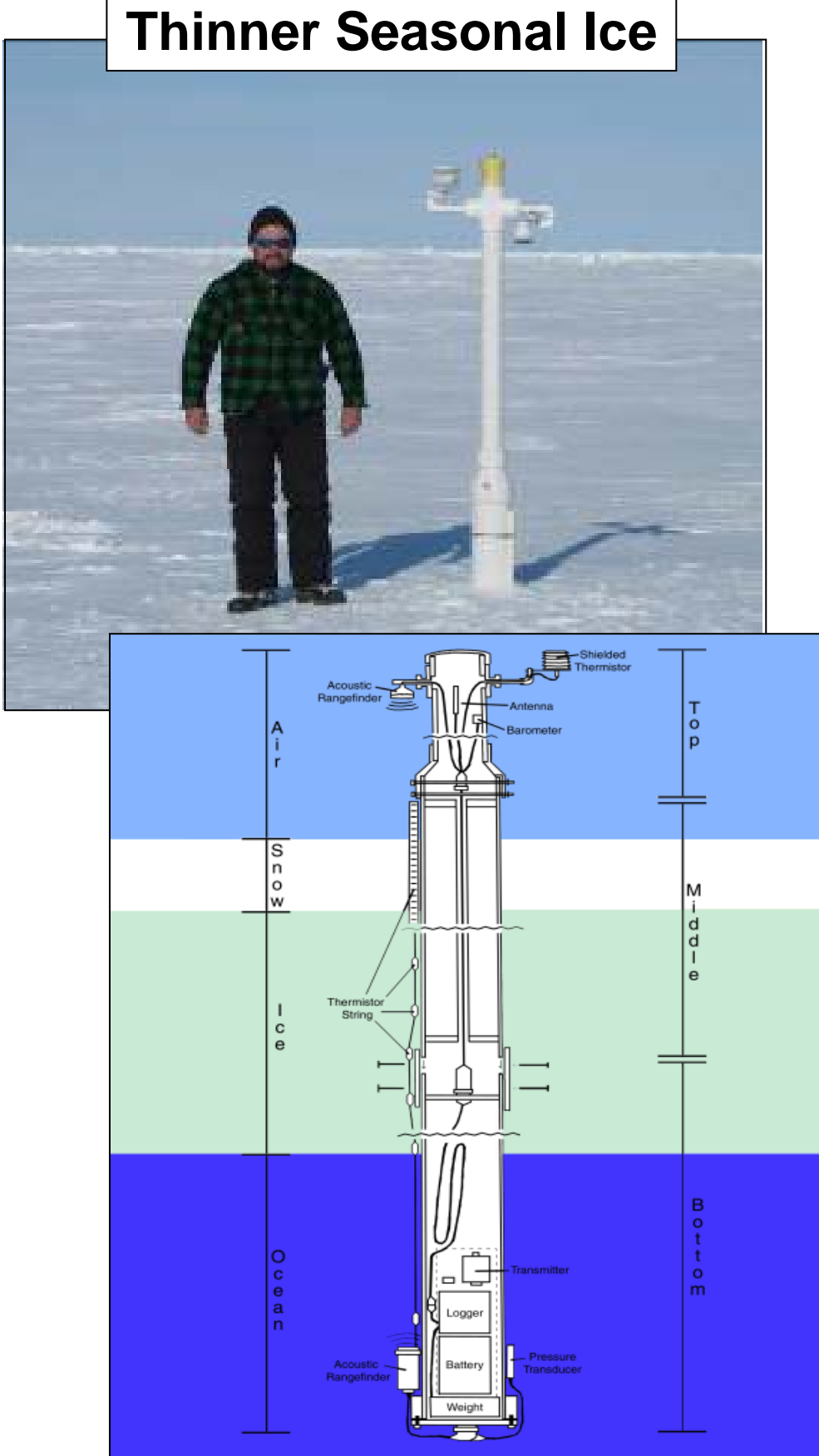


Bottom melting increases linearly with solar heat input to ocean. Solar heat input to ocean has been increasing over past three decades solar, and so has bottom melting.

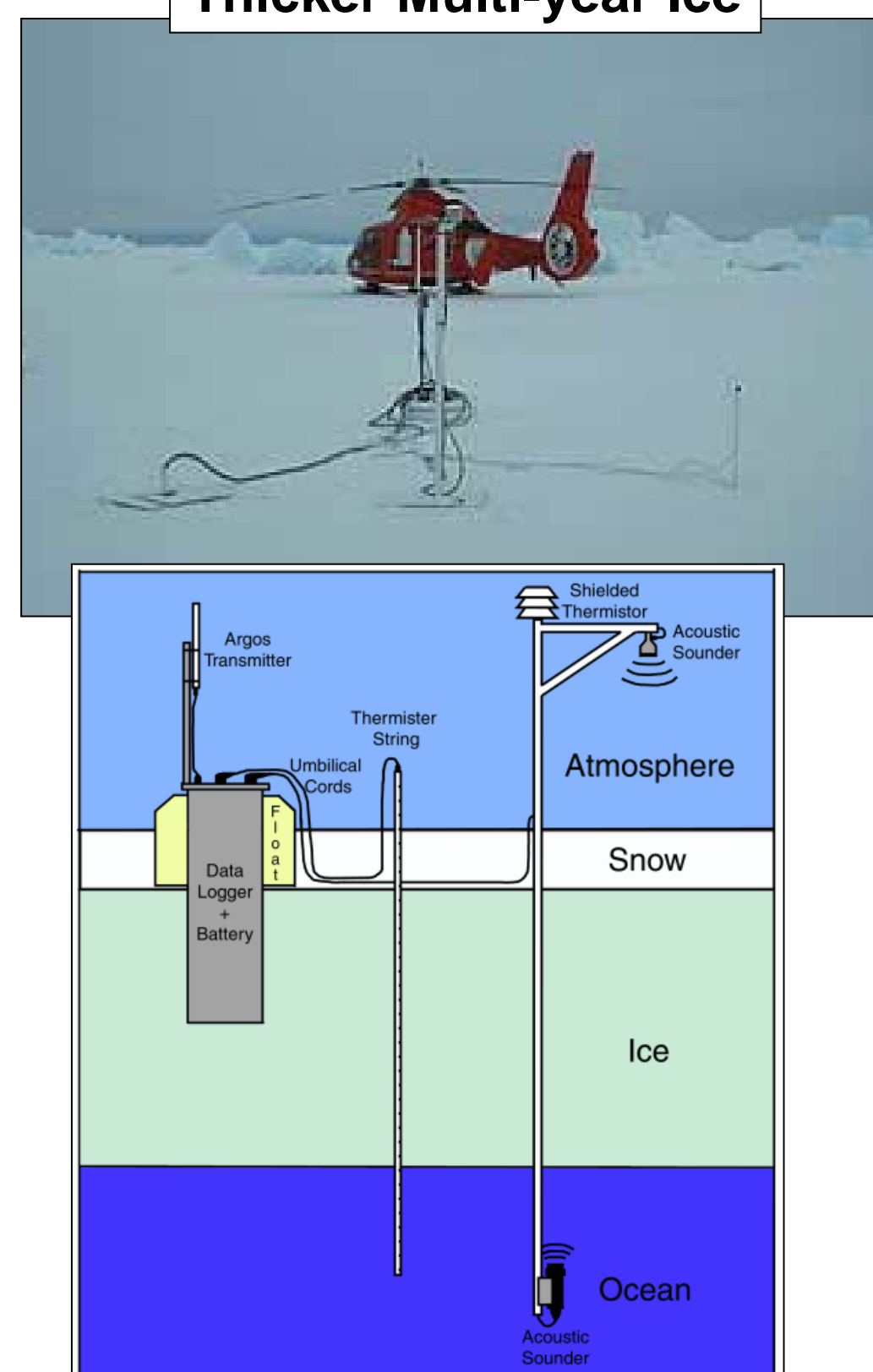
Ice Mass Balance Buoys (IMB)



Thinner Seasonal Ice



Thicker Multi-year Ice

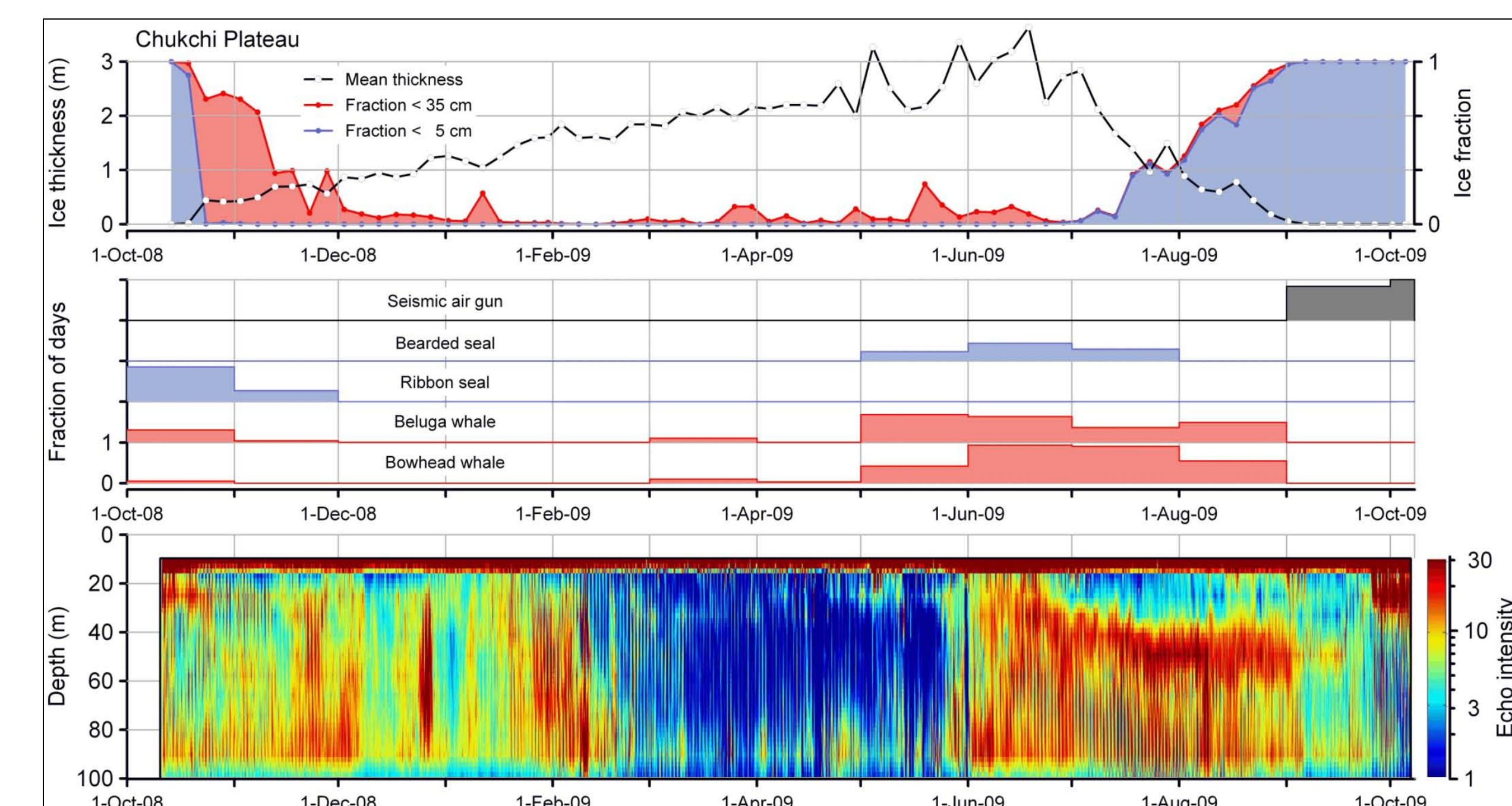


Opportunity for educational outreach: Adopt-A-Buoy Program



8th grade science students signing ice mass balance buoy bound for deployment in the Arctic Ocean sea ice cover.

Comparison of marine mammal call frequencies, sea ice conditions and planktonic backscatter at the mooring site on the Chukchi plateau



The presence of marine mammals at the Chukchi Plateau site varies with environmental conditions:

- Bearded seal: Thickest sea ice (2–3 m) in spring/early summer
- Ribbon seal: Significant fraction of thin ice (<35 cm) in autumn
- Beluga and Bowhead whale: Presence of ice and high abundance of zooplankton prey