Alice Bradley
MIT Women in Aerospace Symposium

Bio:

I am a Ph.D. student at the University of Colorado Boulder with the Aerospace Engineering department and the Remote Sensing, Earth and Space Sciences focus area. My research focuses in sea ice - ocean - atmosphere interactions in environments with partial sea ice cover using unmanned aircraft as a sensing platform. My thesis is on processes surrounding freeze-up in the Arctic, including both cooling processes in the upper ocean prior to ice growth and the effect of delayed ice growth on the first-year ice cover. I also work with unmanned aircraft and airborne sensor systems for surface observation of sea ice, and microbuoys for low-cost in situ measurement of the upper ocean. I grew up in Alaska and attended Dartmouth College in New Hampshire before moving to the University of Colorado for graduate school. I received my M.S. in aerospace engineering in spring 2014, with a focus in remote sensing technology.

Abstract:

As anthropogenic climate change warms the planet, the Arctic, and particularly Arctic sea ice, is feeling the effects first. What was once a stable, multiple-year-old ice pack with narrow bands of seasonal ice growth around the coasts and edges has given way to large expanses of younger ice. Expansive areas of ice-free Arctic Ocean are a new phenomenon, and climate models predict that these areas will continue to grow over the coming decades until the entire Arctic Ocean is a seasonal ice environment sometime in the middle of this century. First-year ice (sea ice that forms out of open water in the winter), is thinner than multi-year ice, which matters both for its resilience to summer melt and to operational and indigenous users in the Arctic who may be trying to either break through the ice or travel across it. Whether the current trend in thinning Arctic sea ice will continue as first-year ice comes to dominate the basin is unknown, and depends on how first-year ice growth over the winters will respond to changes in the seasonal cycle of melt and freezing.

The challenge to understanding the dynamics of a first-year ice dominated environment lies in the difficulty of making observations. When the pack ice persists year to year, scientists can deploy instruments on the ice in the the fall and monitor growth throughout the winter and decay the subsequent summer. Without a stable platform to hold instruments, first-year ice demands increased use of satellite-based remote sensing techniques and airborne measurements.

My thesis work seeks to address this question in part using observations of sea ice thickness from a laser altimeter flown on NASA's airborne IceBridge campaign. The ice thickness measurements are filtered for areas of first-year ice using an ice age product developed from feature tracking in satellite-based passive microwave observations of ice cover. With this combined data set, the influence of summertime conditions on the next winter's first-year ice pack becomes clear. The summer with the record minimum sea ice extent (2012), is followed by an anomalously thin winter ice pack. Trends in first-year ice thickness with latitude show a small correlation with freeze-up date but a stronger correlation to summertime upper ocean temperatures, suggesting that oceanic heat fluxes associated with trapped summer warmth

are slowing ice growth.

The method for finding the first year ice thickness distributions through a combined remote sensing approach, along with some results of the study of first-year ice thicknesses will be presented in my talk. The mechanisms behind the connection between summertime near-surface ocean heat and the growth of sea ice in the winter are described on my poster, along with a novel unmanned-aircraft based method for observing these processes.