Geophysical Research Abstracts
Vol. 17, EGU2015-7687-1, 2015
EGU General Assembly 2015

Using pan-Arctic, springtime, surface radiation observations to quantify atmospheric preconditioning processes that impact the sea ice melt season

Christopher Cox (1,2), Taneil Uttal (2), Sandy Starkweather (1,2), Janet Intrieri (2), Marion Maturilli (3), Vasily Kustov (4), Elena Konopleva (5), Sara Crepinsek (1,2), Chuck Long (1,2)

(1) Cooperative Institute for Research in Environmental Sciences (CIRES), Boulder, CO, (2) NOAA Earth System Research Laboratory (ESRL) Boulder, CO, (3) Alfred Wegener Institute, Potsdam, Germany, (4) Arctic and Antarctic Research Institute, St Petersburg, Russia, (5) Science and Technology Corporation, Boulder, CO

Accurate, seasonal-scale forecasts of sea ice extent and distribution are critical for weather forecasting, transportation, the energy industry and local Arctic communities. Current forecasting methods capture an overall trend of decreasing sea ice on decadal scales, but do not reliably predict inter-annual variability. Recent work using satellite observations identified a relationship between spring-time, cloud modulated, shortwave radiation, and late season sea-ice extent; this relationship suggested an atmospheric preconditioning process that modulates the ice-albedo feedback and sets the stage for the melt season. Due to a general lack of emphasis on the role of the atmosphere on the evolution of the summer sea-ice, compounded by biases in cloud properties within models, this preconditioning process is poorly represented in current forecasting methods.

Longwave and shortwave radiation data collected at the surface from stations surrounding the Arctic Basin as part of the Baseline Surface Radiation Network (BSRN) provide high-quality, continuous observations of the surface radiation budget. This includes downwelling fluxes and surface-cloud radiative interactions which cannot be directly acquired by satellites. These BSRN data are used to investigate the role of the atmosphere and clouds in seasonal scale variability of sea ice conditions, and the potential for improving predictability by incorporating these atmospheric observations into prediction strategies. We find that the downwelling fluxes measured at the land stations in spring are well correlated with sea ice conditions in September, especially in regions of the Arctic Ocean where late summer sea ice concentration has large inter-annual variability. Using observations of the total radiative flux (longwave + shortwave) at the surface, it is possible to make a seasonal sea-ice extent forecast that is within the range of uncertainty of forecasts currently incorporated into the Sea Ice Prediction Network (SIPN). Cloud variability and associated shortwave modulation of the ice-albedo feedback are found to be important, but the shortwave anomaly alone is insufficient unless combined with the longwave anomaly, which dominates and is opposite in sign in the presence of clouds. The amount of open water in the Western Arctic in September and October then controls cloud cover during the autumn freeze-up, potentially revealing a preconditioning mechanism that persists into the following melt season.