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Decadal Arctic surface atmosphere/ocean heat budgets and mass transport estimates from several atmospheric and oceanic reanalyses

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The Arctic is undergoing dramatic changes associated with the loss of seasonal and permanent ice pack. By exposing the surface ocean to the atmosphere these changes dramatically increase surface exchange processes. In contrast, increases in freshwater and heat input decreases turbulent exchanges within the ocean. In this study we present results from an examination of changing ocean heat flux, storage, and transport during the 36 year period 1980-2015. To identify changes in the surface atmosphere we examine three atmospheric reanalyses: MERRA2, ERA-I, and JRA55. Significant differences in fluxes from these reanalyses arise due to the representation of clouds and water vapor. These differences provide an indication of the uncertainties in the historical record. Next we turn to the Simple Ocean Data Assimilation version 3 (SODA3) global ocean/sea ice reanalysis system to allow us to infer the full ocean circulation from the limited set of historical record of ocean observations. SODA3 has 10 km horizontal resolution in the Arctic and assimilates the full suite of historical marine temperature and salinity observations. To account for the uncertainties in atmospheric forcing, we repeat our analysis with each of the three atmospheric reanalyses.

In the first part of the talk we review the climatological seasonal surface fluxes resulting from our reanalysis system, modified for consistency with the ocean observations, and the limits of what we can learn from the historical record. Next we compare the seasonal hydrography, heat, and mass transports with direct estimates from moorings. Finally we examine the impact on the Arctic climate of the changes in sea ice cover and variability and trends of ocean/sea ice heat storage and transport and their contributions to changes in the seasonal stratification of the Arctic Ocean.