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Cloud radiative forcing sensitivity to Arctic synoptic regimes, surface type, cloud phase and cloud properties during the Fall 2014 Arctic Radiation, IceBridge and Sea-Ice Experiment (ARISE)

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Surface cloud radiative forcing (CRF) estimates in the Arctic cover a wide range of values when comparing various datasets (e.g. MERRA, CERES), and show high bias when compared to in-situ ground-based flux measurement stations (e.g. in Greenland) [Wenshan and Zender, 2014]. These high variations and biases result from an intricate relationship between the prevailing synoptic regimes, surface types (open ocean versus sea-ice), and cloud properties [e.g. Barton et al., 2012; Bennartz et al., 2013].
To date, analyses are focused on large-scale or inter-annual comparisons [e.g. Barton et al., 2012; Taylor et al., 2014], or on several specific ground-based sites [Shupe et al., 2004; Sedlar et al., 2012]. Nevertheless, smaller scale CRF variations related to the sharp changes in sea-ice cover, cloud type and synoptic regimes in autumn are still not well understood. Here, we are focusing on assessing the CRF sensitivity to a composite variable matrix of atmospheric stability regimes, cloud profiles and properties and surface type changes during the NASA ARISE campaign conducted in the Fall of 2014 during the Arctic sea-ice minimum in the Beaufort Sea.
We are interested in answering the following questions: (1) what are the combinations of distinct synoptic regimes, surface types, and cloud properties that result in the lowest or highest simulated CRF values over the Arctic Beaufort Sea during the autumn 2014 sea-ice growth period?, and (2) can we relate these simulated extremes to the observations made during the ARISE campaign?
We are using the libRadtran radiative transfer modeling package to calculate the CRF sensitivity matrix, with daily gridded atmospheric profiles input from MERRA re-analysis, cloud fields and properties from CALIPSO, MODIS, AVHRR, daily variations in sea-ice margins from AMSR-2, and complementary airborne measurements collected on the C-130 during the campaign. In performing sensitivity analysis, we examine CRF extremes sorted by atmospheric stability regimes and cloud property range combinations. We also evaluate sensitivity of CRF to our clear sky estimations based on the prevailing atmospheric condition and ice cover.
Finally, we compare synoptic regimes and cloud cover amount for September 2014 with previous years (2010-2013) to put our interpretations in a broader context.

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