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An intercomparison and validation of satellite-based surface radiative flux estimates over the Arctic

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Accurate determination of radiative energy fluxes over the Arctic is of crucial importance for understanding atmosphere-surface interactions, melt and refreezing cycles of the snow and ice cover, and the role of the Arctic in the global energy budget. Satellite-based estimates can provide comprehensive spatiotemporal coverage, but the accuracy and comparability of the existing datasets must be ascertained to facilitate their use. Here we compare radiative flux estimates from CERES SYN/EBAF, GEWEX SRB and our own experimental Fluxnet-CLARA data against in situ observations over Arctic sea ice and the Greenland Ice Sheet during summer of 2007. In general, CERES SYN1deg flux estimates agree best with in situ measurements, although with two particular limitations. 1) Over sea ice the upwelling shortwave flux in CERES SYN1deg appears to be underestimated because of an underestimated surface albedo. And 2), the CERES SYN1deg upwelling longwave flux over sea ice saturates during midsummer. The AVHRR-based GEWEX and Fluxnet-CLARA flux estimates generally show a larger range in retrieval errors relative to CERES, with contrasting tendencies relative to each other. The largest source of retrieval error in the Fluxnet-CLARA downwelling shortwave flux is shown to be an overestimated cloud optical thickness. The results illustrate that satellite-based flux estimates over the Arctic are not yet homogeneous and further efforts are necessary to investigate the differences in the surface and cloud properties which lead to disagreements in flux retrievals.