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Surface radiative fluxes over the pan-Arctic land region: Variability and trends

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Surface radiative fluxes are a key driver of the land surface hydrological cycle, but because in situ measurements are sparse, relatively little attention has been focused on their space-time variations. Recent satellite data and atmospheric model reanalysis products have resulted in data sets that predict most or all terms in the surface energy budget and offer the opportunity to investigate variations in surface radiative fluxes. This study contributes the NASA Energy and Water Cycle Study (NEWS), which is intended to improve estimates of the terrestrial energy budget components for the hydrologic and ecological communities. We analyzed surface downward shortwave (DSW) and longwave radiation (DLW) and albedo over the pan-Arctic domain from (1) the European Centre for Medium-Range Weather Forecast (ECMWF) 40-Year Reanalysis (ERA-40), (2) the ECMWF Interim Reanalysis (ERA-Interim), (3) the International Satellite Cloud Climatology Project-Flux Data (ISCCP-FD), and (4) a Temperature Index (TIND) scheme for the period from 1984 to 2006. As compared with in situ measurements, the reanalysis products provide better estimates of the DSW diurnal cycle than do the satellite product and temperature index scheme simulation. At the regional scale, all data sets have similar temporal patterns except for DLW in ISCCP and snow season albedo. In terms of dominant spatial variability, all data sets show large variability in the pan-Arctic. In addition, DSW and DLW show a similar latitudinal gradient. However, the difference in albedo suggests a need of improvement for the reanalysis products. For a small number of stations with relatively long records, we analyzed long-term trends in DSW and found a turning point between 1985 and 1990. Before that, a dimming period exists, whereas brightening occurred thereafter.