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Energy transfer processes over the Antarctic Plateau

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At the surface of the Antarctic Plateau, transfer of energy between the snow surface and the atmosphere, in the forms of shortwave radiation, longwave radiation, sensible heat, latent heat, and subsurface heat fluxes, is often dominated by processes in the stable boundary layer (SBL) and the near-surface snow. This extreme environment is readily studied at South Pole Station, which represents a large area of the plateau. Routine observations of global radiation, temperature, humidity, and wind speed at the South Pole are used to determine the surface energy balance (SEB). Historical estimates of the surface energy balance at the South Pole are reviewed and compared with current estimates. Differences of up to 50 W m-2 are found in the net radiation estimates. Sensible and latent heat fluxes are calculated using Monin-Obukhov theory. The magnitude of sensible heat fluxes seem to be underestimated throughout the year. Latent heat fluxes are negligible throughout the year, implying no significant frost deposition or sublimation during the year. A one-dimensional finite-volume model, forced by the surface skin temperature, is used to calculate the subsurface heat flux. These fluxes are found to be much greater on short time scales than in the monthly mean. Instantaneous heating rates of up to 3 K per day are found in the near-surface snow despite small heating rates in the monthly mean. Large post-depositional vapor pressures are found in summer due to the combination of large heating rates and relatively high temperatures.