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Surface energy budget of the Larsen C Ice Shelf, and its relation to atmospheric circulation

P. Kuipers Munneke (1), J. C. King (2), T. Gray (2), M. R. van den Broeke (1), and C. H. Reijmer (1)

(1) Utrecht University, Institute for Marine and Atmospheric Research Utrecht, Utrecht, Netherlands (p.kuipersmunneke@uu.nl), (2) British Antarctic Survey, National Environmental Research Council, Cambridge, UK

Ponding of melt water has played a pivotal role in the breakup of ice shelves in the past decades. In-situ observations are important to determine the relation between meltwater production and the atmospheric circulation over the ice shelves. Data collected by two automatic weather stations (AWS) on the Larsen C ice shelf, Antarctica, between 22 January 2009 and 1 February 2011 are analyzed and used as input for a model that computes the surface energy budget (SEB), including melt energy. The two AWSs are separated by about 70 km in the north-south direction, and both the near-surface meteorology and the SEB show similarities, although small differences in all components (most notably the melt flux) can be seen. In winter, longwave cooling of the surface is entirely compensated by a downward turbulent transport of sensible heat. In summer, the positive net radiative flux is compensated by melt, and quite frequently by upward turbulent diffusion of heat and moisture, leading to sublimation and weak convection over the ice shelf. The month of November 2010 is highlighted, when strong westerly flow over the Antarctic Peninsula led to a dry and warm föhn wind over the ice shelf, resulting in warm and sunny conditions. Under these conditions the increase in shortwave and sensible heat fluxes is larger than the reduction of net longwave and latent heat fluxes, providing energy for significant melt.