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Validation of the summertime surface energy budget of Larsen Ice Shelf (Antarctica) as represented in two regional atmospheric models

J. King (1), A. Kirchgaessner (1), P. Kuipers-Munneke (2), and M. van den Broeke (2)

(1) British Antarctic Survey, Climate Programme, Cambridge, United Kingdom (Amelie.Kirchgaessner@bas.ac.uk), (2) Institute for Marine and Atmospheric research Utrecht, Utrecht University, Netherlands

Over the past two decades, ice shelves to the east of the Antarctic Peninsula have retreated rapidly and, in some cases, disappeared completely in response to rapid atmospheric warming during the summer melt season. In order to understand the drivers of ice shelf retreat, it is necessary to study how the surface energy balance (and hence surface melt rates) on the ice shelves respond to changing atmospheric conditions. As direct measurements of surface energy balance and melt rates in this region are only available for a few locations and over limited time periods, such studies are best carried out using high-resolution atmospheric models.

We have validated surface energy fluxes over Larsen C ice shelf simulated by two high-resolution regional atmospheric models – the WRF model, run at 5 km resolution as part of the Antarctic Mesoscale Prediction System (AMPS) and the UK Met Office Unified Model (UM) run at 4 km resolution as part of an experimental real-time forecast system for the Antarctic Peninsula region. Model energy fluxes were compared with those measured at an automatic weather station on Larsen C Ice Shelf during January and early February 2011.

Both models provide a realistic simulation of the components of the surface energy balance and their diurnal and day-to-day variation. Downwelling shortwave radiation in the AMPS model is biased high. This error is partially balanced by a low bias in downwelling longwave radiation, suggesting that the errors in both components result from AMPS forecasting insufficient cloud cover, or clouds that are optically too thin. Overall, the simulation of the surface energy balance in both models appears to be good enough to use the models as tools for studying spatial and temporal variation of melt rates in this region.