Heat fluxes over sea ice in observations and models

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Little is known about errors in the atmospheric forcings of large-scale sea ice-ocean models around Antarctica. These forcings involve atmospheric reanalyses, typically those from the National Center for Environmental Prediction and National Center from Atmospheric Research (NCEP-NCAR), climatologies, and empirical parameterizations of atmosphere-ice heat and radiation fluxes. In the present paper, we evaluate the atmospheric forcing fields of sea ice models in the Southern Ocean using meteorological and radiation observa- tions from two drifting station experiments over Antarctic sea ice. The latter are Sea Ice Mass Balance in the Antarctic (SIMBA, Bellingshausen Sea, Oc- tober 2007) and ISPOL (Ice Station POLarstern, Weddell Sea, December 2004). Analysis suggests that the NCEP-NCAR reanalyses have relatively low biases for variables that are assimilated by the system (temperature, winds and humidity) and are less accurate for those which are not (cloud fraction and radiation fluxes). The main deficiencies are significant day-to-day errors in air temperature (root-mean square error 1.4–3.8◦C) and a 0.2–0.6 g/kg mean overestimation in NCEP-NCAR specific humidity. In addition, associated with an understimation of cloud fraction, NCEP-NCAR reanalyses shortwave radiation feature a large positive bias (43–109 W/m2) partly compensated by a 20–45 W/m2 negative bias in longwave radiation. Those biases can be drastically reduced by using empirical formulae of radiation fluxes and climatologies of relative humidity and cloud cover. However, this procedure obviously implies a loss of day-to-day and interannual variability in the radiation fields. We provide technical recommendations on how the radiation forcing should be handled to reduce sea ice model forcing errors. The various errors in forcing fields found here should not hide the great value of atmospheric reanalyses for the simulation of the ice-ocean system.