Assessing the potential of the AIRS surface temperature and specific humidity in turbulent heat flux estimates in the Southern Ocean

Doug Shenfu

Surface air temperature (T_A), sea surface temperature (T_O), and surface specific humidity (q_a) satellite retrievals from the Atmospheric Infrared Sounder (AIRS) are compared with shipboard measurements across Drake Passage for the period from September 2002 to June 2007. The objective is to evaluate whether AIRS retrievals, in conjunction with microwave sea surface temperatures from the Advanced Microwave Scanning Radiometer (AMSRE), can provide sufficiently accurate parameters to estimate sensible and latent heat fluxes in the data-limited Southern Ocean. The collocated data show that both AIRS T_A and T_O are colder than those from shipboard measurements, with a time-mean bias of –2.03°C for T_A and –0.22°C for T_O. Results show that air-sea temperature difference (T_A–T_O), q_a, and relative humidity (RH) are the major factors contributing to the differences between satellite and shipboard temperature measurements. Differences in AIRS and shipboard T_A (ΔT_A) decrease with increasing T_A–T_O, and ΔT_A increases with increasing RH. Whereas differences in AIRS and shipboard T_O (ΔT_O) increase with both increasing T_A–T_O and increasing q_a. The time-mean q_a from AIRS is lower than the shipboard q_a by 0.69 g/kg. Statistical analyses suggest that T_A–T_O, cloud, and q_a are the major contributors to the q_a difference (Δq_a). Δq_a becomes more negative with both increasing T_A–T_O and increasing cloud fraction. Δq_a also becomes more negative as q_a itself increases. Compared with T_A, T_O, and T_A-T_O, from the National Centers for Environmental Prediction/National Center for Atmospheric Research Reanalysis (NCEP/NCAR) reanalysis, AIRS-derived and AMSRE-derived variables show more small-scale spatial structure, as is also typical of the ship observations. Although AIRS q_a gives a better representation of the full range of values of shipboard q_a, its deviation from shipboard q_a is relatively large compared to NCEP q_a. Compared with several existing gridded flux products, turbulent fluxes estimated from AIRS and AMSRE data using bulk algorithms are better able to represent the full range of flux values estimated from shipboard parameters.