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What Do We Know About Air-Sea Exchanges In The Southern Ocean?

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Our understanding of the air-sea exchanges of heat, freshwater and momentum (wind stress) in the Southern Ocean will be reviewed. The Southern Ocean experiences the strongest wind forcing of any of the world's ocean basins with the potential for significant wind driven latent and sensible heat losses. However, severe undersampling has limited our observation based knowledge of the heat exchange to the extent that its is not clear whether the ocean gains or loses heat to the atmosphere over much of this region. At 60 oS the zonal annual mean net air-sea heat flux for the ECMWF reanalysis is a gain of about 15 Wm-2 , the NCEP/NCAR reanalysis has close to zero heat exchange while constrained ship based flux fields and residual analyses (top of the atmosphere satellite measurements + atmospheric divergence) both show a heat loss of 10-20 Wm-2. Differences between the various available air-sea exchange datasets will be discussed and an attempt made to determine which is likely to provide the most reliable picture of ocean-atmosphere interaction in this region. The study will be guided by analysis of output for the Southern Ocean from various models including the coupled model HadCM3 and the NEMO ¼ degree ocean model which has been run for the last 50 years. A similar analysis will be carried out for the freshwater flux (evaporation – precipitation, E-P) with a focus on an evaluation of the precipitation field from the various products against the GPCP remote sensing dataset. Finally, the results will be put in the context of water mass transformation studies and the requirement for net ocean heat gain to transform high southern latitude surface waters to lighter densities.