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Estimating the Influence of the Stratospheric Processes on the Antarctic Atmospheric Energy Budget

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We discuss ongoing work to construct an atmospheric energy budget for the Southern Hemisphere polar region based on observations from the post-1979 period. Satellite measurements and atmospheric reanalyses are synthesized in order to describe the long-term means and variability of radiative, latent and sensible heating, as well as the atmospheric transport of moist static energy into the polar region. We compare estimates of the atmospheric transport of energy determined by direct calculation and as a budget residual. The largest difference occurs in the summer season, when the estimates can vary by over 30%. Decadal trends in energy budget components linked to stratospheric ozone depletion and increases in well-mixed greenhouse gases (GHG) are identified. Trends occur primarily in the summer season when changes in the Southern Hemisphere atmospheric circulation associated with ozone depletion are most pronounced. Comparisons are made between observed trends and general circulation model simulations with individually prescribed transient ozone and GHG forcings. Shorter term interannual variations in the energy budget associated with the El Niño-Southern Oscillation and Southern Annular Mode (SAM) are also examined. We find that large magnitude SAM events such as the sudden stratospheric warming (SSW) of 2002 can have a significant effect on the polar atmospheric energy budget. Similarly, robust differences in the Northern Hemisphere polar energy budget are found when winters with and without SSWs are compared.