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Stratosphere/mesosphere coupling during the winter/summer transition at Davis, Antarctica

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The mobile scanning iron lidar of the Leibniz Institute of Atmospheric Physics in Kühlungsborn (IAP) was in operation at Davis, Antarctica, from December 15, 2010, until December 31, 2012. It measured iron densities, vertical winds, and temperatures in the iron layer, i. e. from approximately 80 to 100 km. The measurement principle is based on probing the Doppler broadened resonance line of iron atoms at 386 nm. The lidar can operate under daylight conditions. Typical values for temperature uncertainty, altitude and time resolution are 3-5 K, 1 km, and 1 hour, respectively. At Davis, the lidar has achieved at total of 2900 hours of temperature measurements which is presumably the largest nearly continuous data set in Antarctica. In this presentation we concentrate on the winter/summer transition in three consecutive years and compare with circulation changes in the stratosphere derived from MERRA (NASA's Modern-Era Retrospective analysis for Research and Applications). We also compare with the northern hemisphere (NH). We find that the thermal structure around the mesopause at Davis is closely coupled to the general circulation in the stratosphere, more precisely to the transition from winter to summer conditions. In contrast to theoretical expectations we occasionally find the mesopause significantly higher and colder(!) compared to the NH. The mesopause altitude changes by several kilometers throughout the summer season, which is significantly different from the summer in the northern hemispheric. Depending on altitude, temperatures can be warmer or colder compared to the NH summer. The Australian Antarctic Division has been operating a 55 MHz VHF radar at Davis since February 2003. We have studied the seasonal variation of polar mesosphere summer echoes (PMSE). PMSE are strong radar echoes related to ice particles and therefore require atmospheric temperatures lower than the frost point temperature. We note that (apart from low temperatures) more ingredients are required for PMSE, for example, background electrons and neutral air turbulence. The VHF radar at Davis (69°S) frequently detected PMSE. We compare the seasonal variation of PMSE with stratospheric circulation, both at Davis and at ALOMAR (69°N). We present model calculations applying the Kühlungsborn Mechanistic Circulation Model (KMCM) to facilitate the interpretation of the stratosphere/mesosphere coupling during the winter/summer transition, and the difference between the southern and the northern hemisphere.