

Long-term observations of polar middle atmosphere temperatures

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Since 1997 the Bonn University lidar has been operated at Esrange (68 N, 21 E) in northern Sweden during winter as well as during summer. 110 daily mean temperature profiles were obtained from this data set for July and August. The ALOMAR RMR-lidar is located on the Norwegian Island Andøya (69 N, 16 E) and has been operated since 1994. Temperature measurements are available from 1997 and 240 daily mean temperature profiles were determined for July and August. We have compared both data sets to a climatology obtained from about 100 temperature measurements by rocket-borne falling spheres. 48 of these measurements were in July and August, mainly from the years 1989 – 1993. A direct comparison shows the climatological temperatures to be up to 10 K warmer than the temperatures measured by lidar, depending on altitude. Gravity wave modulation of the temperature profiles is not likely to cause these systematic differences, since all data sets use average temperatures which are smoothed either vertically (falling sphere data) or temporally (lidar data). However, gravity waves can modify the atmospheric dynamics and thus influence the atmospheric temperature structure indirectly. Further, tidal variations may account for the observed differences at least in part, since most falling spheres have been launched around local midnight, while lidar measurements have been performed throughout all the day. We have used the data from the lidar at Esrange to determine the diurnal and semidiurnal tidal variation of the temperature at different altitudes. The combination of diurnal and semidiurnal tides account for about 3 – 5 K of the difference among lidar and falling sphere temperatures on average. Larger tidal contributions of 15 – 20 K have been observed at certain altitudes and years. We have removed the maximum contribution of the overall tidal variation from the temperature difference between lidar and FS-data. The remaining temperature difference is on average between –3 and +6 K, depending on altitude.