Geophysical Research Abstracts
Vol. 14, EGU2012-4960, 2012
EGU General Assembly 2012

Simultaneous wind and temperature measurements with a twin Doppler lidar in Northern Norway

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Wind and temperature measurements are fundamental to understand atmospheric dynamics. However, a wide altitude range of the middle atmosphere from about 15 to 70 km is hard to access by remote sensing instruments: the absence of free electrons prevents radar measurements, and the optical depth prevents satellite remote sensing over the whole altitude range. In-situ measurements by rockets allow only sporadic snapshots, while balloons are not able to ascent high enough. Our Rayleigh/Mie/Raman lidar at the Arctic Lidar Observatory for Middle Atmosphere Research (ALOMAR) in Northern Norway (69° N, 16° E) allows to measure temperatures, aerosols, and wind speed simultaneously. By applying two independently steerable telescopes we are able to measure vertical profiles of two wind components at once. The wind retrieval currently allows wind measurements in aerosol free parts of the middle atmosphere up to 85 km altitude without external calibration. The temporal and spatial resolution is 1 h and 3 km, respectively. We present case studies from campaigns conducted in the last three years. For validation we use measurements of vertical wind speed, which is close to zero for long integration times, simultaneous measurements of the same horizontal wind component with both telescopes or other remote sensing techniques operating at the limits of the instruments altitude range. The case studies include data recorded during stratospheric warmings and during periods of enhanced wave activity. Wave signatures are clearly visible in time-height sections of temperature and horizontal wind.