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OH temperatures and intensities from astronomical spectra taken at Cerro Paranal in Chile

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OH airglow is an important indicator for the properties and variability of the mesopause at about 87 km. OH bands cover a wide range of wavelengths from the optical to the near-infrared. The lines can be used to study intensities, vibrational temperatures, and rotational temperatures. The latter are expected to be close to the climate-related thermal temperatures of the band-specific emission layers. Most spectroscopic OH measurements focus on the determination of the rotational temperature for a single band by using a few lines with a low rotational upper level in a narrow wavelength range. Therefore, the specialised instruments that are typically used for airglow spectroscopy observe only a small fraction of the OH spectrum with limited information on the state of the upper atmosphere.

In contrast, echelle spectrographs used at large astronomical observatories have the wavelength coverage, resolution, and sensitivity to study many OH bands and other airglow lines simultaneously. Since each ground-based observation from an astronomical telescope includes an observation of the night-sky emission, these data are also very valuable for upper atmosphere research, even though the timing and direction of the observations are not optimised and the targeted astronomical objects have to be removed from the spectra.

In order to investigate the potential of astronomical data, we have selected archival data from the X-Shooter echelle spectrograph at the Very Large Telescope (VLT) of the European Southern Observatory located at Cerro Paranal in the Chilean Atacama desert. X-Shooter is well suited, since it covers a wide wavelength range from 300 to 2500 nm comprising most OH bands. With spectral resolutions between 3300 and 18200, the majority of the strong lines are separated. Data are available since 2009, which results in a data set in the order of 10000 spectra with sufficient signal-to-noise ratio. The time coverage could be extended to 1998 if data from other VLT spectrographs were used as well.

We present first results on OH line measurements covering a wide range of wavelengths. The measured temperatures and intensities are compared with each other and are related to observing parameters, like the time of the night, date of the year, and solar activity. Short-term variations are best seen in data for single nights with more than 100 spectra. Finally, the results are discussed in terms of the geographic location and OH measurements from the literature.