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Airglow measurements with astronomical data

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The highly elusive airglow lines and continuum probe the atmosphere at a height of roughly 80 to several 100 km. Since the emission originates from different atoms (O, Na) as well as different molecules as line emission (OH,O_2) or in continuum emission (NO+O/O_3) one needs to span a broad wavelength range to cover them all (near-UV to near-IR). Most spectrographs used by the community cover only a very narrow wavelength range with medium to high resolution. The European Southern Observatory (ESO) has the necessary instruments to provide spectra from near-UV to near-IR with moderate to high spectral resolution. ESO's main site is the Very Large Telescope (VLT), which is located in the Atacama desert in Chile at an altitude of 2635 m. It consists of four 8 m class telescopes and several smaller ones.
The X-Shooter instrument is mounted on one of the 8 m class telescopes and covers a wavelength range of 300-2500 nm simultaneously. Thus, it is one of the most sensitive and versatile spectrographs at hand today and has a resolution of 3000-18000 depending on the observation mode. Observations started in October 2009 and continue until today. Our current dataset includes all observations taken between October 2009 and March 2013. The temporal coverage of this period is good since X-Shooter is frequently used. Due to its wide wavelength range, X-Shooter provides almost all OH bands, most of the O_2 bands, and the atomic lines NI[520.0 nm], OI[557.7 nm], NaID[589.0 nm], and OI[630.0,636.4 nm]. This gives us the opportunity to do a detailed study on airglow lines and continuum depending on different parameters such as solar activity, night time, and seasonal variation. In addition, we are able to derive mesopause temperatures depending on the same parameters. All the above mentioned studies are a valuable asset to the understanding of the dynamics and chemical processes in the upper atmosphere.
To illustrate the capabilities of astronomical data, we investigated intensity measurements of FeO*, which was recently discovered to contribute to the airglow continuum. Until now mainly its existence was proven but studies on its properties based on large datasets are missing. To obtain reasonable results on the FeO* emission between 500-720 nm, one has to disentangle several continuum contributions. Nevertheless, the two main peaks are clearly visible in our X-Shooter spectra. Furthermore, we will compare FeO* to NaID intensities since they are expected to be linked in two ways: they are both replenished by meteors and their intensities should vary in union as both of them have ozone as a common reactant. We present a longterm study on the intensity measurements for FeO* and NaID to probe their variations.