



An atmospheric radiation model for the Very Large Telescope at Cerro Paranal in Chile

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The quality of ground-based astronomical observations is strongly affected by scattering, absorption, and radiation processes in the Earth's atmosphere. For effective telescope time management, it is important to accurately estimate the wavelength-dependent contribution of the Earth's atmosphere to the observed flux. For this reason we developed an atmospheric radiation model for the Very Large Telescope of the European Southern Observatory at Cerro Paranal in the Atacama desert. It is comprised of all relevant components, i.e. scattered moonlight, scattered starlight, zodiacal light, molecular radiation and absorption in the lower atmosphere, and airglow line and continuum emission in the upper atmosphere. The model covers the entire wavelength range from the near-UV to the mid-IR. Thermal radiation and absorption in the lower atmosphere are computed applying the LBLRTM radiative transfer code and suitable time-averaged atmospheric profiles for the telescope site. Scattered light from extended sources, such as zodiacal light and airglow, is estimated by 3D single scattering calculations and a multiple scattering correction. The intensity and variability of airglow emission lines and continuum is derived by a semi-empirical model based on more than 1000 high signal-to-noise spectra of the FORS1 instrument taken over six years. A comparison of the resulting combined model with observed data yields an accuracy of about 20 per cent, which is a significant improvement over previous models.