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Ionising sources in the coma of 67P probed by Rosetta

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An ionospheric model has been developed in order to quantify the ion number density in the coma of 67P/Churyumov-Gerasimenko. The model is driven by Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA)/Cometary Pressure Sensor (COPS) neutral density and assumes isentropic expansion for the neutral density profile. The two ionisation sources considered are photo-ionisation by solar extreme ultraviolet (EUV) radiation and electron-impact ionisation. The EUV radiation is estimated from fluxes measured by the Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED)/ Solar EUV Experiment (SEE), taking into account the phase shift and the heliocentric distance ratio; between Earth and comet 67P. The electron-impact ionisation production rates are derived from Rosetta Plasma Consortium (RPC)-Ion and Electron Sensor (IES) integrated electron fluxes and corrected for the S/C potential from RPC/LAngmuir Probe (LAP) measurements. Our results are compared with in situ measurements of the plasma density from RPC-Mutual Impedance Probe (MIP) and RPC-LAP.

There is a good agreement between the modelled and RPC observed electron densities. The ionospheric model enables to distinguish the relative contributions of the different sources to the total cometary plasma. At high heliocentric distances, electron-impact ionisation becomes the dominant ionisation source and is enhanced over the winter hemisphere. As the solar activity has decreased since the beginning of the mission in 2014, the relative importance of photo-ionisation has decreased as well. However, at low heliocentric distances, photo-ionisation seems to be the most dominant ionising source, in particular through the perihelion period in summer 2015.