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Simulating ion charge states in the solar wind using a multi-species coronal model

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The physical mechanisms at play during the formation of the solar wind are still debated however they have a great impact on large scale flows. We propose a new model to study the origin of the solar wind extending from the chromosphere through the transition region into the corona. The model solves a set of 1-D conservation equations for coupled neutral and charged particles by assuming gyrotropy and a bi-Maxwellian velocity distribution functions for all species. The effect of collisions are solved self-consistently and the heat flux is computed along and perpendicular to the magnetic field. The magnetic field properties are taken from different magnetostatic models of the corona. We study the effect of heating protons or electrons on the formation of the transition region and on the formation of temperature anisotropies in the corona. We study different ways in which the heating can be constrained by observations. In particular we compute the freeze-in temperature of heavy ions, in a first approach by simply using the electron densities and temperatures computed in our model and in a second approach by coupling the transport of heavy ions directly to the major constituents. Throughout the study we evaluate under which coronal conditions good predictions of the in-situ solar wind properties are obtained by comparing the output of our model with the bulk properties and composition of the solar wind measured by Ulysses and ACE and in a near future Parker Solar Probe and Solar Orbiter. Time permitting we will also present preliminary work that compares fluid, kinetic-fluid and kinetic approaches at modelling the solar wind.