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Modelling the impact of the solar UV flux on Ganymede's atmosphere for constraining planetary missions: application to aeronomic emissions

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In the framework of future space missions to Ganymede, a pre-study of this satellite is a necessary step to constrain instrument performances according to the mission objectives. This work aims at characterizing the impact of the solar UV flux on Ganymede's atmosphere and especially at deriving some key physical parameters that are measurable by an orbiter. Another objective is to test several models for reconstructing the solar flux in the Extreme-UV (EUV) in order to give recommendations for future space missions.

We first compute the primary production of excited and ionized states due to photoabsorption, neglecting the secondary production that is due to photoelectron impacts as well as to precipitated suprathermal electrons. Computations are performed at the equator and close to the pole, in the same conditions as during the Galileo flyby. From the excitations, we then compute the radiative relaxation leading to the atmospheric emissions. We also propose a simple chemical model to retrieve the stationary electron density. There are two main results:
(i) the modelled electron density and the one measured by Galileo are in good agreement. The main atmospheric visible emission is the atomic oxygen red line at 630 nm, both in equatorial and in polar conditions. This emission is measurable from space, especially for limb viewing conditions.
(ii) The input EUV solar flux may be directly measured or reconstructed from only two passbands solar observing diodes with no degradation of the modelled response of the Ganymede's atmosphere. This result strongly supports the idea that future planetary mission should include a radiometer to measure the local solar EUV flux.