



Publication Year	2016
Acceptance in OA	2020-11-24T14:02:04Z
Title	The H ₂ O and O ₂ exospheres of Jupiter's moon Ganymede
Authors	Plainaki, C., MILILLO, Anna, MASSETTI, Stefano, MURA, Alessandro, Jia, X., Orsini, S., MANGANO, VALERIA, DE ANGELIS, Elisabetta, LAZZAROTTO, FRANCESCO, RISPOLI, ROSANNA
Handle	http://hdl.handle.net/20.500.12386/28505
Journal	MEMORIE DELLA SOCIETA ASTRONOMICA ITALIANA
Volume	87



The H₂O and O₂ exospheres of Jupiter's moon Ganymede

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Abstract.

A simulation of the H₂O and O₂ exospheres of Jupiter's moon Ganymede, through the application of a 3D Monte Carlo modeling technique, is presented. Our model takes into consideration the combined effect on the exosphere generation of the main surface release processes (i.e. sputtering, sublimation and radiolysis) and the surface precipitation of the energetic ions of Jupiter's magnetosphere constrained strongly by Ganymede's intrinsic magnetic field. In order to model the magnetospheric ion precipitation to Ganymede's surface, we used as an input the electric and magnetic fields from the global MHD model of Ganymede's magnetosphere (Jia et al., 2009). The exospheric model described in this paper is based on EGEON, a single-particle Monte Carlo model already applied for a Galilean satellite (Plainaki et al. 2010, 2012, 2013). We find that at small altitudes above the moon's subsolar point the main contribution to the neutral environment comes from sublimated H₂O whereas the spatial distribution of the directly sputtered-H₂O molecules exhibits a close correspondence with the plasma precipitation region and extends at high altitudes, being, therefore, well differentiated from the sublimated water. Moreover, we find that the O₂ exosphere comprises two different regions: the first one is an homogeneous, relatively dense, thermal-O₂ region extending to some 100s of km above the surface, whereas the second one is less homogeneous and consists of more energetic O₂ molecules sputtered directly from the surface after water-dissociation by ions has taken place; the spatial distribution of the energetic surface-released O₂ molecules depends both on the impacting plasma properties and the moon's surface temperature distribution.

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