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European SpaceCraft for the study of Atmospheric Particle Escape (ESCAPE): a planetary mission to Earth, proposed in response to the ESA M5-call

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Abstract

ESCAPE is a mission proposed in response to the ESA-M5 call that will quantitatively estimate the amount of escaping particles of the major atmospheric components (nitrogen and oxygen), as neutral and ionised species, escaping from the Earth as a magnetised planet. The spatial distribution and temporal variability of the flux of these species and their isotopic composition will be for the first time systematically investigated in an extended altitude range, from the exobase/upper ionosphere (500 km altitude) up to the magnetosphere. The goal is to understand the importance of each escape mechanism (thermal or non-thermal), its dependence on solar and geomagnetic activity, in order to infer the history of the Earth's atmospheric composition over a long (geological scale) time period. Since the solar EUV and solar wind conditions during solar maximum at present are comparable to the solar minimum conditions 1–2 billion years ago, the escaping amount and the isotope and N/O ratios should be obtained as a function of external forcing (solar and geomagnetic conditions) to allow a scaling of the escape rates to the past. The result will be used as a reference to understand the atmospheric/ionospheric evolution of magnetised planets, which is essential for habitability. To achieve this goal, a slowly spinning spacecraft is proposed equipped with a suite of instruments developed and supplied by an international consortium. These instruments will detect escaping populations from the upper atmosphere and magnetosphere by a combination of in-situ measurements and of remote-sensing observations. The ESCAPE mission proposal successfully passed the first technical and programmatic screening by ESA and is now entering into the scientific assessment phase.