ABOUT PITHIA-NRF

PITHIA-NRF is a unique Research Infrastructure that brings together the best European facilities, databases, and models to study the Earth's IONOSPHERE, THERMOSPHERE, and PLASMASPHERE.

PITHIA-NRF aims to pave the way for considerable research advances and promote the development of novel business practices and innovative technologies in the upper atmosphere and near-Earth domains. In doing so, PITHIA-NRF will significantly contribute to predicting the upper atmospheric effects causing possible widespread economic repercussions and, thus, support the design of technologies mitigating these detrimental impacts.

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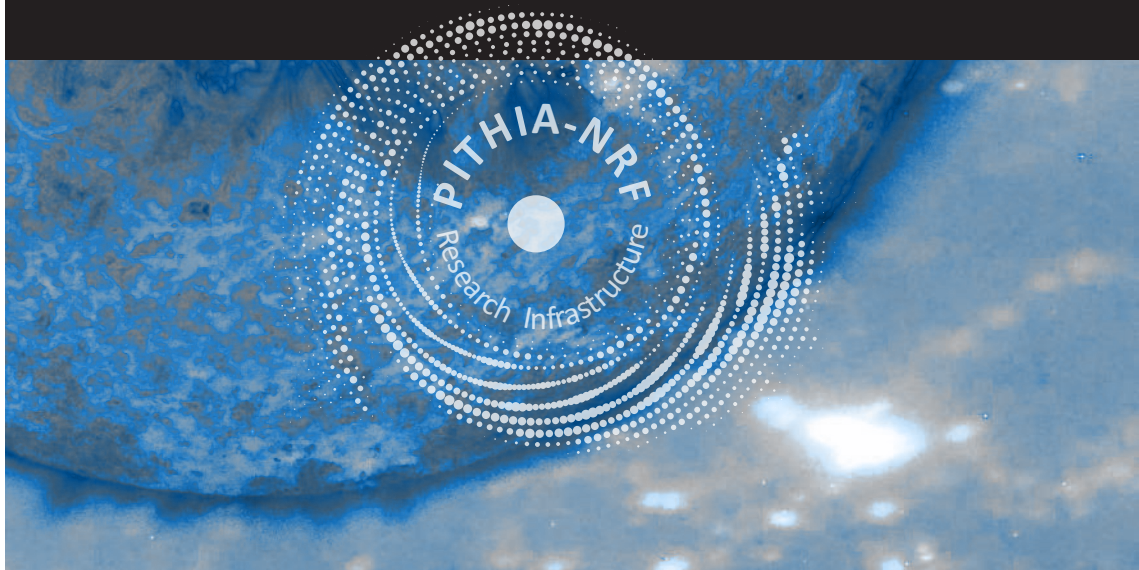
THE SOCIO-ECONOMIC COST OF UPPER ATMOSPHERIC SPACE WEATHER

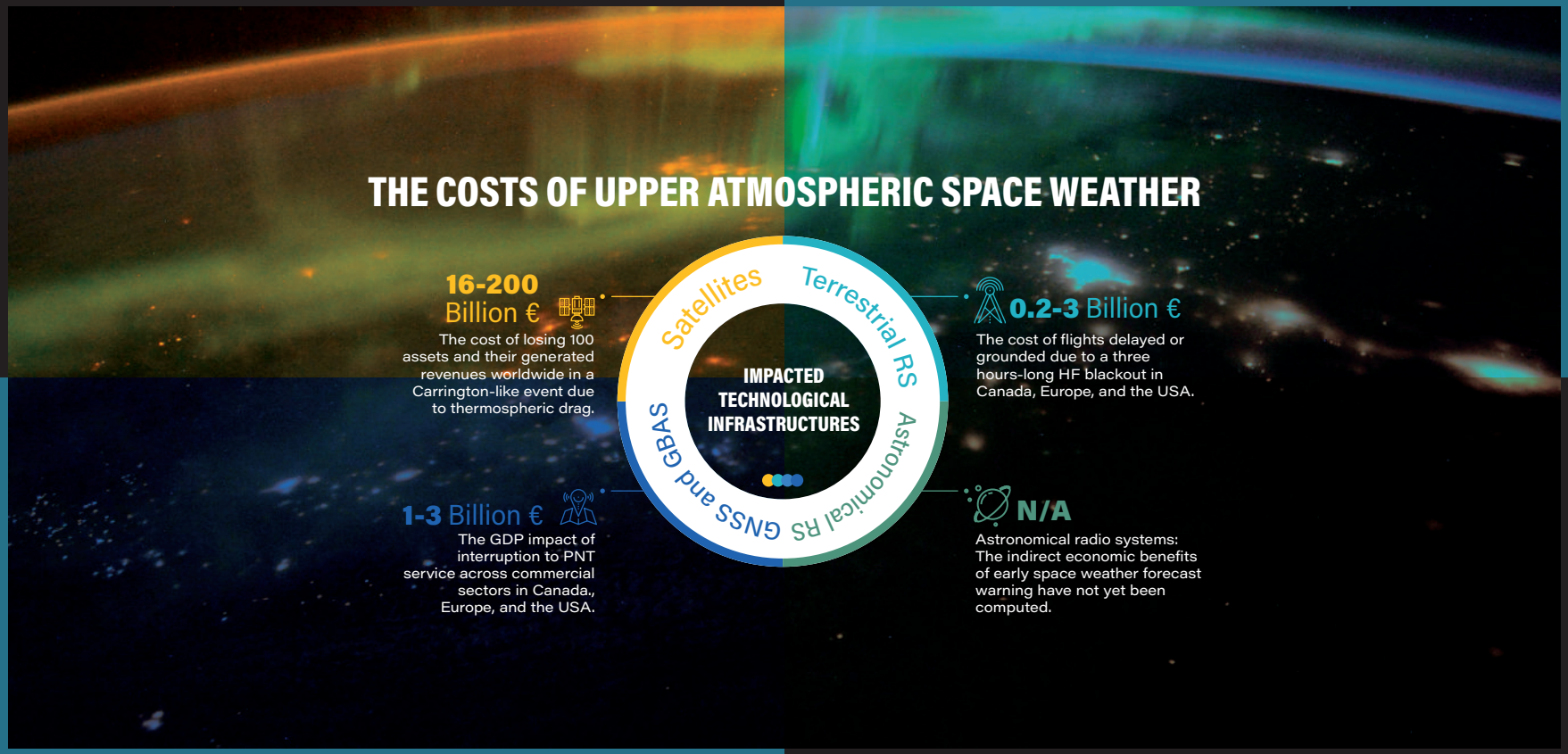


LEO **SATELLITES**

With the advent of mega-constellations, the LEO domain has become crowded. Eighty-five percent of all satellites now move in LEO orbit. However, these spacecraft are at risk from space weather events: Thermospheric drag can induce orbital track changes, exponentially increasing the risk of cascading collisions which could cause the loss of several commercial assets and the revenues they generate.

TERRESTRIAL RADIO SYSTEMS

Cost estimates for terrestrial radio systems focus on the impacts on aviation of HF radio waves absorption in the upper atmosphere. HF communications remain the primary means of communicating over the poles in aviation. Depending on the intensity, the HF blackout could last for three hours in all low- and mid-latitude regions on the dayside of the Earth or several days at high latitudes.



GNSS AND **GBAS**

In 2021, the global demand for GNSS equipment generated €200 billion between devices and services revenues, with Europe holding a 20% market share. We report the costs of a 14-day GNSS outage affecting the precision agriculture, road transport, logistics, and surveying sectors in Europe, the USA, and Canada.

ASTRONOMICAL RADIO SYSTEMS

LOFAR (Low-Frequency Array) is currently the largest radio telescope operating at the lowest frequencies detectable from Earth. LOFAR is a multipurpose sensor network infrastructure that can allow multiple lines of research at once; solar science and space weather are among them. However, the view of the radio universe at the VHF frequencies of LOFAR is strongly affected by the Earth's ionosphere.