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INSPIRE Sat 3 AtmoLITE - measuring gravity waves from a Microsat

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Atmospheric dynamics are composed largely of atmospheric circulations of different scales. One such circulation is the mesospheric pole-to-pole circulation, which gives rise to the intriguing phenomenon whereby the polar summer mesosphere, despite receiving 24 hours of sunlight, is the coldest region in the atmosphere. Circulations in general are governed by atmospheric waves, which again come in various shapes and sizes. The pole-to-pole circulation of the upper mesosphere in particular is driven by so-called gravity waves. Gravity waves are buoyancy waves where gravity serves as the restoring force. These waves carry energy and momentum from the lower atmosphere into the mesosphere and lower thermosphere. As gravity waves travel vertically with wavelengths on the scale of kilometers, they can be well measured by a satellite with a limb looking configuration. In recognition of the significance of accurately measuring these atmospheric dynamics, researchers have developed advanced instrumentation to capture the intricate details of these phenomena. This brings us to a significant joint initiative aimed at enhancing our understanding of the upper mesosphere. A collaborative effort between the Jülich Research Center and the University of Wuppertal
in Germany led to the development of such a limb sounding instrument. The instrument's primary objective is to provide vertical temperature profiles with a fine vertical sampling of 1.5 km. These precise measurements enable the effective capture and analysis of small to medium-scale gravity waves in heights of about 90-130km, which is crucial for understanding the energy and momentum transfer in the atmosphere. The measurement principle is based on spectral information which is captured by an imaging Spatial Heterodyne Interferometer. This is essentially a Michelson interferometer with the two mirrors exchanged with blazed gratings in Littrow configuration. The spectrum is extracted from the interferogram which is superimposing the image on the detector. To specifically observe the oxygen A-band emissions, a bandpass filter of \SI{6}{nm} centered around \SI{763}{nm} is used. The Oxygen A-band was chosen as it peaks around \SI{90}{km} and from its relative spectral band shape, the temperature can be directly derived. The instrument is scheduled to be launched on the International Satellite Program in Research and Education (INSPIRE) Sat-3 mission, led by the Indian Institute of Space Science and Technology. The objective of the mission is twofold: to acquire expertise for all participating scientists and to validate the onboard instruments in orbit. Furthermore, the mission aims to integrate into the INSPIRE constellation, providing a constellation of Earth and space weather-monitoring satellites. The expected outcomes include enhanced models of atmospheric dynamics and will facilitate more accurate space weather and climate predictions.

Primary author: GEMBA, Gregor (Forschungszentrum Jülich, ICE-4)

Co-authors: Mr FRÖHLICH, Denis (Forschungszentrum Jülich, ZEA-2); Dr OLSCHEWSKI, Friedhelm (Bergische Universität Wuppertal); Dr RONGEN, Heinz (Forschungszentrum Jülich, ZEA-2); UNGERMANN, Jörn (FZJ); Mr MIEBACH, Marco (Forschungszentrum Jülich, ICE-4); Mr GAUSS, Martin (Forschungszentrum Jülich, ICE-4); Dr KAUFMANN, Martin (Forschungszentrum Jülich, ICE-4); RIESE, Martin (FZJ); PREUSSE, Peter (FZJ); Mr AUGSPURGER, Tobias (Forschungszentrum Jülich, ICE-4); NEUBERT, Tom (FZJ)

Presenter: GEMBA, Gregor (Forschungszentrum Jülich, ICE-4)

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