



## **Characterization of Earth as an exoplanet on the basis of VIRTIS-Venus Express data analysis.**

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The Visible and InfraRed Thermal Imaging Spectrometer (VIRTIS, Piccioni et al., 2007) on board the Venus Express spacecraft observed the planet Earth several times in the course of the mission. In particular, a subset of 48 observations has been taken from a distance at which our planet is imaged at sub-pixel size, as exoplanets are observed using current technologies. We studied this full subset to understand which spectral signatures, related to different surface and cloud types, can be identified from the integrated planet spectrum. As expected, we found that the cloud coverage has a key role in the identification of surface features and that vegetation is very difficult to be detected. To validate our results we built a simple tool capable to simulate observations of an Earth-like planet as seen from a VIRTIS-like spectrometer in the 0.3 - 5.0  $\mu\text{m}$  range. The illumination and viewing geometries, along with the spectrometer instantaneous field of view and spectral grid and sampling, can be defined by the user. The spectral endmembers used to generate the planet have been selected from an observation of Earth registered from the instrument VIRTIS on board the ESA mission Rosetta, with similar characteristics, during the third flyby of the spacecraft around our planet, occurred in November 2009. Hence, we simulated planets made of: vegetation, desert, ocean, water ice clouds and liquid water clouds. Using different amounts for each spectral class we inferred the percentages that are required to identify each class when all the spectral information is integrated into a single pixel. The outcome of this analysis confirms that clouds are not a negligible issue in the research for spectral signatures, in particular those related to the habitability of a planet and its climate conditions, even when the cloud coverage is not so high.

Acknowledgements:

This study has been performed within the WOW project financed by INAF and thanks to the support from the Italian Space Agency to VIRTIS Venus Express and Rosetta.

### References

Piccioni, G., et al., 2007. VIRTIS: The Visible and Infrared Thermal Imaging Spectrometer. ESA Special Publication, SP-1295, 1-27.