HiTeSEM: A SATELLITE SENSOR CONCEPT FOR HYPERSPECTRAL THERMAL REMOTE SENSING

T. Udelhoven [a, *], T. Knigge [b], M. Schlerf, [c], C. Bossung [a], K. Segl [d] , A. Eisele [d], A. Müller [e] , T. Storch [e], R. Reulke [f], P. Fischer [e], G. Rock [a]

[a] Trier University, Environmental Remote Sensing & Geoinformatics Department, 54286 Trier, Germany - udelhoven@uni-trier.de
[b] Airbus Defense and Space, Space Systems, 88039 Friedrichshafen, Germany - thiemo.knigge@astrium.eads.net
[c] Centre de Recherche Public - Gabriel Lippmann, L-4422 Belvaux, Luxembourg - schlerf@lippmann.lu
[d] Helmholtz-Zentrum Potsdam, Deutsches GeoForschungsZentrum GFZ,14473 Potsdam – Karl.Segl@GFZ-potsdam.de
[e] German Aerospace Center, Earth Observation Center, 82234 Oberpfaffenhofen, Germany – peter.fischer@dlr.de
[f] German Aerospace Center, Institute of Optical Sensor Systems, 12489 Berlin-Adlershof – reulke@informatik.hu-berlin.de

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ABSTRACT:

HiTeSEM (High-resolution Temperature and Spectral Emissivity Mapping) is a preparatory study, funded by the German Aerospace Center (DLR) that aims preparing the floor for a future spaceborn hyperspectral thermal mission. Thermal remote sensing is poised to become a major source of information on land surface processes. HiTeSEM aims at closing the research gap still hampering utilization of the thermal infrared data at reasonable spectral and spatial resolution and focusses on surface-solid Earth interactions to assess natural and human-induced changes. Land surface temperature (LST) and spectral emissivity (LSE) of the Earth are the basis for the extraction of sensitive variables in geology, pedology, and vegetation monitoring. Towards this end, HiTeSEM will enable the research community to evaluate the potential of emissive spectroscopy methodologies in Earth observation to answer a series of key science questions related to global change, human health, and food security. Relevant target variables include soil mineral composition, soil organic matter (SOM), surface moisture availability, evapotranspiration and stomatal/surface conductance. These are key indicators for soil productivity and plant stress in sensitive regions and can be used to govern and adapt land use practices under challenging ecological and climatic conditions. In urban remote sensing HiTeSEM is expected to furnish important information to define thermal models, which implies knowledge of the surface material composition by means of spectral emissivity retrieval. The methodological challenge of HiTeSEM lies in the development of a robust high performance temperature emissivity separation (TES) technique to allow optimum pre-processing of the measured thermal radiance signal at the sensor level. From these scientific goals a series of mission and instrument requirements has been derived that can be summarized as follows:

Mission requirements

Orbit:	sun-synchronous (to be synchronised with Sentinel 2)
	SSO with 14:00 LTAN or LTDN
	Follow-up observations of selected targets (day – night): 1.5 - 5 days
Mission lifetime:	5 years
Target revisit time:	1 month (tilt < 5°) / 5 days (tilt < 30°)

Instrument requirements

Wavelength range:	TIR: 8 μm - 12.5 μm
No. of spectral bands:	~75
Ground IFOV:	hyperspectral: 60 x 60 m2
	broadband: 20 x 20 m2
NEDT:	0.05 K @ 300 K
Swath width:	50 km - 100 km

These and further more detailed requirements such as spectral and radiometric calibration accuracies or position knowledge are expected to be detailed in a dedicated Phase A study together with ESA and a wide research community.

* Corresponding author