**Proposed Studentship – ARIES NERC DTP**

ROYAL HOLLOWAY UNIVERSITY OF LONDON

# Vicarious Calibration of Earth Observing satellites using salt pans and Desert regions

*Supervisor(s): Prof Martin D, King*

**Project Description:**

Earth Observation allows regular and synoptic observation of large areas and is critical for monitoring planetary change or providing data products such as soil moisture. Accurate calibration of space-borne Earth-observing satellites is needed for data products and inter-calibration is needed for time series data important to climate change.

Research methodology
Calibration of a flying satellite is by “vicarious calibration”[1], i.e. the observation of Earth surface targets which are reflective, spatially uniform over large areas and constant e.g. deserts[1] and sand dunes[2]. The directional reflectivity (BRDF) of natural surfaces is not isotropic and a function of the viewing and illumination angles. The BRDF of these surfaces must be characterised for the correction of Earth observed images. The reflectivity of sand and salt pans depends on the scattering and absorption of light in the surface layer and the surface roughness[4]. The minerals in the sand are small particles. Thus, the top few mm of a sand is a highly scattering domain with the absorption of photons by a few light absorbing particles (humic and coloured minerals). The aim is to measure and model the bidirectional reflectance, BRDF, of proxy sand and salt pan surfaces for the inter-calibration of optical space sensors on satellites used for long-term remote sensing data. The output will be a BRDF(bidirectional reflectance distribution function) of sand and salt pan at the bottom and top of atmosphere as a function of changing conditions for calibration and validation of EO satellites.[3]

Objectives
1) Measure the BRDF of artificially created sand and salt pans using the RHUL goniometer as function composition, light absorbing components and surface roughness.
3) Reproduce laboratory and field BRDF with modelled BRDF from radiative transfer codes: PanarRad, and LayerTran, written by the project partner, and fully explore parameter space not possible in experiment.
4) With reflectivity of real sand and salt pans[1] invert the absorption spectrum of the impurities by radiative transfer modelling.
5) Use radiative transfer models with sand and salt pan BRDF to produce top of atmosphere BRDF for satellite calibration, with libRadtran or LayerTran.

Training
You will be trained and gain skills in Earth observation, spectrometry, field optics, radiative-transfer and its inversion, metrology, computer control of laboratory rigs, laboratory rig construction and experimentation, programming, field based measurement science and chemical analysis of minerals. As well as producing academic papers and knowledge you will be trained in reporting to metrology standards for the space agencies and providing publically accessible standards.

Person specification
You will be a numerate person willing to conduct field, laboratory and modelling experiments with a numerate physical science or engineering degree.

**References:**

Amelia Marks, Corrado Fragiacomo, Alasdair MacArthur, Giuseppe Zibordi, Nigel Fox, Martin King. “Characterisation of the BRDF (HDRF) of snow surfaces at Dome C, Antarctica, for the inter-calibration and validation of satellite remote sensing products” Remote sensing of Environment. 2015, 407-416, doi: 10.1016/j.rse.2014.11.013

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Lamare, M. L., Lee-Taylor, J., and King, M. D.: The impact of atmospheric mineral aerosol deposition on the albedo of snow & sea ice: are snow and sea ice optical properties more important than mineral aerosol optical properties?, Atmospheric Chemistry and Physics., 16, 843-860, doi:10.5194/acp-16-843-2016, 2016.

Nigel Fox, Andrea Kaisser-Weiss, Werner Schmutz, Kurtis Thome, Dave Young, Bruce Wielicki, Rainer Winkler, Emma Woolliams, “Accurate radiometry from space: an essential tool for climate studies” Phil. Trans. R. Soc. A 369, p4028-4063 (2011)

N.P.Fox, M.C. Greening, “Quality Assurance Framework for Earth Observation (QA4EO): The guide” CEOS portal and Http:www.QA4EO.org (2009)

*This project has been shortlisted for funding by the ARIES NERC Doctoral Training Partnership. Undertaking a PhD with ARIES will involve attendance at training events.*

*ARIES is committed to equality & diversity, and inclusion of students of any and all backgrounds. All ARIES Universities have Athena Swan Bronze status as a minimum.*

*Applicants from quantitative disciplines who may have limited environmental science experience may be considered for an additional 3-month stipend to take appropriate advanced-level courses.*

*Usually only UK and EU nationals who have been resident in the UK for 3 years are eligible for a stipend. Shortlisted applicants will be interviewed on 26th/27th February 2019.*

*For further information please see www.aries-dtp.ac.uk or contact us at aries.dtp@uea.ac.uk*

*Details on how to apply can be found here* ***www.rhul.ac.uk/studyhere/postgraduate/applying***
*Please contact the Postgraduate Programmes Co-ordinator, if you have additional questions about the department or application procedures (email:* ***pgadmin@es.rhul.ac.uk*** *; tel: 01784-443581).*
*Applicants are requested to send an additional copy of their CV directly to the lead supervisor of the project in which they are interested. Please also contact the supervisor if you have any questions about the project itself*