2017_66: Investigating dust-climate interactions over India

Supervisors: Dr Helen Brindley (h.brindley@imperial.ac.uk) and Dr S. K. Satheesh (Divecha Centre for Climate Change)

Department: Physics

Mineral dust is a key component of the Earth system; the major tropospheric aerosol by mass, it exerts strong direct and indirect effects on the Earth’s Radiation Budget (ERB), scattering and absorbing incoming solar and emitted longwave radiation and modifying the properties of, in particular, ice clouds. Dust deposited to the ocean is a key source of iron, stimulating the biological pump and influencing air-sea carbon exchange. Similarly, deposited dust constitutes a major source of nutrients for the world’s rainforests, providing a further link to the carbon cycle.

Despite this, our ability to predict dust emission, amount and impact in a changing world is poor. A recent study comparing the output of climate models used in the IPCC 5th Assessment Report concludes that ‘there is no reason to assume that the projections of dust emission and concentration for the 21st century have any validity.’

Given the multi-faceted role that dust plays within the Earth System there is an urgent need to improve this situation.

Research within the Space and Atmospheric Physics (SPAT) group over the last few years has contributed to the limited progress which has been made in this area by developing a variety of approaches to detect and quantify dust presence using observations from the Spinning Enhanced Visible and InfraRed Imager (SEVIRI). This instrument, on the Meteosat series of geostationary satellites, allows dust to be identified at source and tracked with 15 minute resolution. Moreover, the Geostationary Earth Radiation Budget radiometer, also flying on the Meteosat series, can be used to isolate and assess the dust impact on the ERB.

So far this work has been focused on northern Africa and Arabia. However, with the recent move of Meteosat-8 over the India Ocean the opportunity exists to significantly extend the scope of the research to cover the Indian sub-continent. Predicted dust amounts from the UK HadGEM climate model are known to show a systematic low bias in this region yet the reasons for this are unclear: are local sources too weak, is too little dust transported over the region, or are removal processes (e.g. dry and wet deposition) too strong?

For more information on how to apply visit us at www.imperial.ac.uk/changingplanet
In this project you will build on this previous work within SPAT to develop a method to identify and quantify dust presence over India from SEVIRI. Working in partnership with the Divecha Centre in Bangalore you will use an extensive network of surface based measurement sites to assess and potentially improve your approach. Once a thoroughly validated record has been derived, you will exploit the temporal resolution of the data to provide an improved understanding of the links between dust emission and relevant meteorological and surface drivers, particularly focusing on precipitation, soil moisture and vegetation. Via existing links with the UK Meteorological Office it is envisaged that the metrics you develop will be used to evaluate the strength of these relationships as simulated by their next generation Earth System model, UKESM1, which will contribute to the next IPCC Assessment Report.