Open Seminar Series
Geoscience & Remote Sensing

Multiscale Modeling of Atmospheric Refraction and Optical Turbulence

Dr. Sukanta Basu
TU Delft, CITG - GRS
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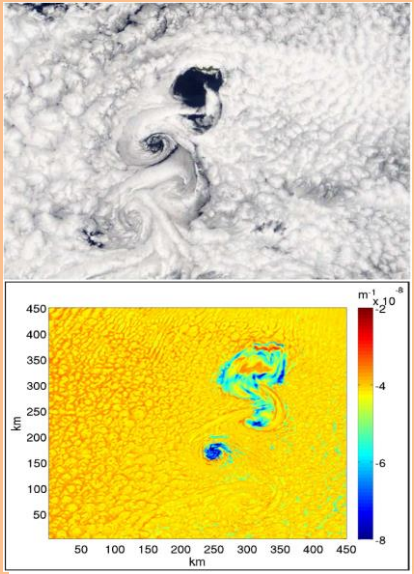
12:40-13:30
CiTG room F

Understanding optical wave propagation through our atmosphere is crucial in a variety of civilian and military applications (e.g., laser communications, remote sensing, observational astronomy, target detection). Atmosphere presents both small scale and large scale variations of refractive index which perturb optical wave propagation. For example, organized mesoscale wake vortices (shown in the left panel) are capable of distorting optical ray trajectories by tens of meters at a range of one hundred kilometer or so. In addition, they can induce vertical oscillations in the ray trajectories as a result of the quasi-periodic vortex shedding. During this seminar, we will present several other examples of (anomalous) atmospheric refraction and discuss their practical implications.

The second part of the presentation will be focused on optical turbulence (commonly quantified by the refractive index structure parameter, Cn2). In the recent years, we have been developing diverse methodologies of varying complexities for the reliable estimation of Cn2. Some of these approaches are physically-based and require high-performance computing; a few utilize the inherent vertical scaling of temperature fields; while the others simply make use of data-mining. We will elaborate on the prowess of each approach and also point out their weaknesses.

Throughout this seminar, we will identify several outstanding research problems and potential M.Sc. thesis topics.



Top panel: MODIS satellite imagery of von Kármán vortex streets (VKVSs) in the wake of Madeira island on July 5th, 2002. Bottom panel: vertical gradient of refractive index in a simulated VKVS. The cross-section is at approximately 650 m MSL.