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Sand Dune Ridge Alignment Effects On Surface BRF Over Libya-4 Calibration Site

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The verification of satellite data calibration consistency is a critical prerequisite to the generation of Essential Climate Variables from space observations. In that context, Pseudo Invariant Calibration Sites (PICS) play a critical role because there are suitable for sensor stability monitoring. The Committee on Earth Observation Satellites (CEOS) has identified 6 sites for their good spatial and temporal stability. Among the 6 desert CEOS PICS, Libya-4 has proven to be the most stable though it has the most complicated topography. This site presents other decisive advantages: its large spatial extension covering an area of about 1x1 degree, the absence of vegetation and the existence of numerous data sets collected over Libya-4 as it has already been intensively used as PICS.

Libya-4 site is composed of long sand dune ridges that might impact surface Bidirectional Reflectance Factor (BRF) as a function of the sun azimuth angle. So far, only 1D Radiative Transfer Models (RTMs) have been used to simulate satellite signals over Libya-4. In order to further reduces modelling uncertainties, all possible source of errors needs to be analysed in details, especially concerning surface reflectance as it plays a dominant role above 600nm on the top-of-atmosphere BRF. This study addresses the impact on surface BRF of (i) the size of the selected region over Libya-4 and (ii) the effects of sand dune ridge alignment. Specifically, this work analyses surface BRF azimuthal dependencies due to sand dune organization for different Region-of-Interests size using a 3D Monte Carlo ray-tracing RTM. Such analysis is relevant when observations acquired by mid-morning and mid-afternoon sun-synchronous polar orbiting satellites are compared.

The topography is characterized with the 30m resolution ASTER Digital Elevation Model. Four different region-of-interest size, ranging from 10km up to 100km, are studied. Results show that sand dunes generate more backscattering than forward scattering at the surface. The mean surface reflectance averaged over different viewing and illumination angles is pretty much independent from the size of the selected area thought the standard deviation differs. Sun azimuth position has an effect on surface reflectance field that is more pronounced for high sun zenith angles. Such 3D azimuthal effects should be taken into account to decrease the simulated radiance uncertainty over Libya-4 below 3% for wavelengths larger than 600nm.