Comparing spectral characteristics of Landsat-8 and Sentinel-2 data for Arctic permafrost regions

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Optical remote sensing in the Arctic is highly restricted by frequent cloud cover and low illumination angles, which decreases the amount of useable images during the short vegetation period considerably. As a result, even the more than 30-year long and continuous Landsat mission archive only contains few suitable images for a summer season per year. With the start of the ESA Copernicus Sentinel-2 mission in 2015 and enhanced data availability from its two satellites (S-2A, S-2B) the revisit time, combining data of the two Sentinel-2 and the Landsat-8 satellites, is shortened to less than five days in high latitude regions. The dramatic increase in the number of images per summer season enhances the opportunity for cloud-free image acquisitions considerably. Hence, assessing the spectral compatibility of multispectral Landsat-8 and Sentinel-2 images for a combined application in time-series analysis of multispectral properties to monitor vegetation and landscape dynamics in the Arctic is particularly important. This increase in image availability of the Arctic facilitates the possibility of creating dense time series, which improves mapping vegetation and biomass and monitoring their changes in a rapidly warming Arctic. An advantage is to be able to detect landscape dynamics and to differentiate between rapid and gradual changes, and therefore describing permafrost region disturbances better [Stow et al., 2004]. In general, the multispectral Landsat-8 Operational Land Imager (OLI) and the Sentinel-2 Multispectral Imager (MSI) sensors are comparable: they feature several roughly corresponding bands and similar spatial resolutions. While both global and regional assessments of Landsat-8 and Sentinel-2 datasets already describe the combined usability of the two, they also underline the necessity of regional studies to capture the landscape specific responses of both sensors before any combined application. Therefore, before a linked use in time series analysis of high latitude tundra regions the comparability of sensor-signal responses for both systems needs to be tested and analysed in detail for specific target surfaces. The aim of this study in progress is to assess spectral characteristics of Landsat-8 and Sentinel-2 same-day acquisition images from the Arctic Lena Delta in North Siberia in summer 2016. We assess image pairs corrected to surface reflectance and cloud masked based on single band comparisons, multispectral indices (e.g. normalized difference vegetation index (NDVI)) and the sensor responses over a summer period by land cover type. Our focus areas are especially areas with wet sedge- and moss-dominated tundra, moist grass- and moss-dominated tundra, moist to dry dwarf shrub-dominated tundra as well as dry moss-, sedge- and dwarf shrub-dominated tundra areas in the central Lena Delta [Schneider et al., 2009]. While we hypothesize that both sensors show the same spectral properties, we expect that the specific signal responses may systematically differ. Therefore, in certain analysis contexts, the joint use of Landsat-8 and Sentinel-2 imagery requires the application of spectral adjustment. The land cover specific analysis will likely indicate the range of differing signal responses of Landsat-8 and Sentinel-2 images.

References

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