

Evaluation of MODIS/VIIRS/Landsat-8 Albedo Products over BSRN Sites

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Abstract

The satellite albedo products from the Moderate Resolution Imaging Spectroradiometer (MODIS), the Visible Infrared Imaging Radiometer Suite (VIIRS), and the Landsat-8 Operational Land Imager (OLI) are evaluated using ground measured albedo over six BSRN sites in the United States supported by the SURFace RADiation Network (SURFAD) throughout the year 2014. All the three satellite products agree well with the ground measurements from spatially representative towers (Desert Rock, Fort Peck, and Table Mountain), with RMSEs of 0.028 for MODIS, 0.031 for VIIRS, and 0.045 for OLI. The daily retrievals from MODIS and VIIRS capture the seasonal variation, ephemeral snow, and snow melt effects on surface albedo, as measured by the tower measurements. However, over less spatially representative tower locations (e.g. Goodwin Creek, Penn State, and Sioux Falls), the difference can be significant during the dormant season.

As a key land surface radiative parameter, land surface albedo quantities are required by climate, biogeochemical, hydrological and weather forecast models across different temporal and spatial scales. Therefore highly accurate albedo products at both high temporal resolution from MODIS and VIIRS and high spatial resolution from Landsat-8 OLI are critical for future projections of climate and land surface changes.

Data processing

• MODIS, VIIRS daily blue-sky albedo (gridded sinusoidal 1km resolution)

The daily blue-sky albedo from MODIS and VIIRS are calculated using the 1km MODIS and the VIIRS Bidirectional Reflectance Distribution Function (BRDF) parameters and the MODIS daily aerosol product.

The BRDF parameters are derived by fitting multiday, multispectral, cloud-cleared, atmospherically-corrected surface reflectances to the Ross-Thick/Li-Sparse-Reciprocal (RTLSR) semi-empirical BRDF model (Schaaf et al., 2002; Schaaf et al., 2011). This daily retrieval algorithm further emphasizes the single day of interest (Wang et al., 2014).

The daily 1km MODIS BRDF parameter product, MCD43T1, is a temporary product based on 500m MODIS surface reflectance, and is used to produce MODIS 30 arcsec CMG BRDF parameter product, MCD43D. The daily gridded sinusoidal 1km VIIRS BRDF parameter product, VNP43M1, is generated using the gridded 1km VIIRS surface reflectance.

• Landsat 30 m blue-sky albedo

The Landsat-8 OLI blue-sky albedo is generated by coupling 30-m Landsat surface reflectances with concurrent MODIS Bidirectional Reflectance Distribution Functions (BRDF) Products (Shuai et al., 2011). The Landsat pixels within the field of view (FOV) of the tower albedometers are averaged for this evaluation.

• Ground-measured albedo

The ground-measured albedo is calculated as the ratio of upward and downward radiation measured at the towers. Mean albedo values within 2-hour temporal windows centered at the Landsat overpass time have been used for this evaluation. Days with anomalously large variance in the ground measurements within the 2-hour window were excluded.

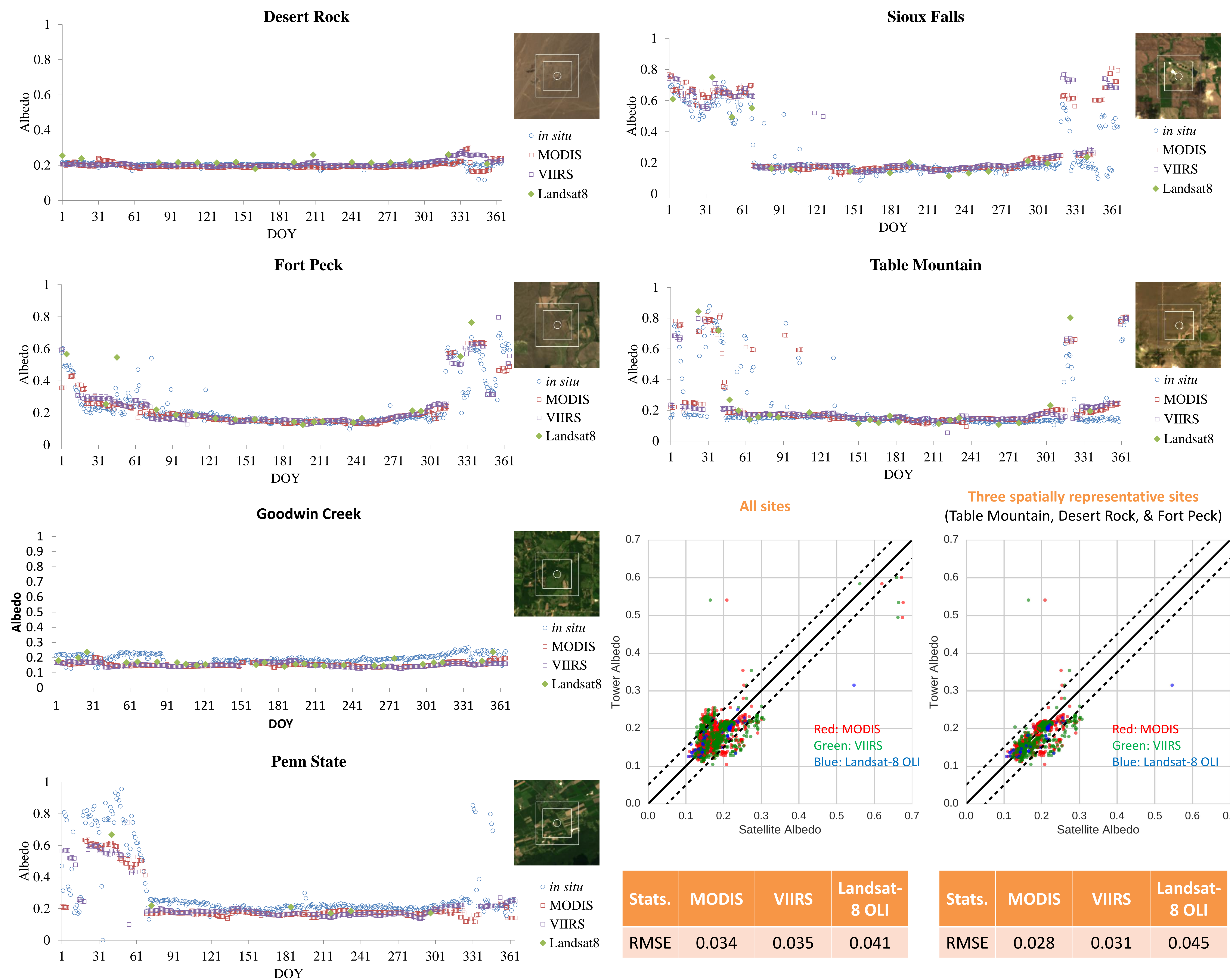
All blue-sky albedo values have been computed for the Landsat overpass time at each location.

Site list

Site name	Latitude	Longitude	Land cover
Desert Rock	36.62320° N	116.01962° W	Desert, Sparse grass
Fort peck	48.30798° N	105.10177° W	Grassland
Goodwin Creek	34.2547° N	89.8729° W	Grassland
Penn State	40.72033° N	77.93100° W	Agriculture
Sioux falls	43.73431° N	96.62334° W	Grassland
Table Mountain	40.12557° N	105.23775° W	Grassland

All towers are 10m high, and the effective FOVs of all the albedometers are 126.28m

Results



- The outliers of Landsat 8 and VIIRS albedo are caused by residual clouds in the current processing chains
- Only high quality MODIS and VIIRS retrievals are compared with *in situ* albedo

Reference

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<http://www.esrl.noaa.gov/gmd/grad/surfgrad/> (SURFRAD)

<http://www.ndsc.ncep.noaa.gov/coop/bsrn/> (BSRN)

<http://www.umb.edu/spectralmass> (Schaaf Lab and MODIS albedo Users Guide)