Estimation of all-sky instantaneous surface incident shortwave radiation from Moderate Resolution Imaging Spectroradiometer data using optimization method

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Overview

- Surface incident solar radiation (ISR) is a crucial parameter in the land surface radiation budget (SRB)
- Existing products and algorithms have insufficient spatial resolution and accuracy

Background

- Existing methods have some limitations
- Parameterization methods have uncertainties from input parameters
- Look up table (LUT) based methods uses linear interpolation. It also have relatively low efficiency or limited dimensions.
- Machine learning (ML) based methods are based on statistic relationship and are lack of physical basis
- Existing products have insufficient accuracy and resolution for land surface models and other applications.

Optimization based algorithm

A new optimization based algorithm for estimation ISR and DSR was developed:
- 1. Retrieve surface BRDF, AOD and COD
- 2. Calculate surface ISR and PAR

Cloud Screening

- The 3-D structure of clouds may cause different views from the sensor and the site tower.
- We calculated the “cloud mask” for each SURFRAD observation based on site-observed direct/total ISR ratio and radiative simulation.
- If the MODIS cloud mask data product differed from the cloud mask of the corresponding SURFRAD observation, the observation was not included in the validation.

Validation Results

- Existing products have insufficient accuracy and resolution for land surface models and other applications.

Algorithm validation

- 1. MODIS data in the year 2013
- 2. Seven Surface Radiation Budget Network (SURFRAD) sites
- Eight Greenland Climate Network (GC-Net) sites

Summary

- Algorithm can simultaneously estimating cloud mask, AOD, COD and surface reflectance/albedo
- Inclusion of high level products and cloud-screening process will increase the accuracy

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