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The Sensor Independent Atmospheric Correction (SIAC) approach applied to Sentinel-2 and Landsat-8 data

Feng Yin (1), Jose Gomez-Dans (1), Philip Lewis (1), and Gerardo Lopez-Saldana (2)

(1) NCEO/University College London, NCEO, Dept of Geography, United Kingdom (j.gomez-dans@ucl.ac.uk), (2) Assimila Ltd, Reading, UK

Combining observations from different optical observations is often done at surface reflectance level. At this stage, the effect of the atmosphere has been mitigated by atmospheric correction approaches. A major hindrance in the combined use of data coming from different sensors arises from the different assumptions taken in the independent sensor atmospheric correction scheme. These assumptions can result in incompatibilities between data from different sensors, such as biases, which may be hard to detect and/or correct. Additionally, few methods provide credible uncertainty estimates, a requirement for using the data in complex inversion schemes.

In this contribution, we introduce the SIAC framework, which aims to provide a generic approach to atmospheric correction. The method is based on the contemporary existence of (i) estimates of the spectral surface directional reflectance ("BRDF descriptors") coming from e.g. the MCD43 MODIS product), (ii) the availability the fast emulators (surrogate approximations to complex radiative transfer models), and (iii) coarse resolution estimates of atmospheric composition through the Copernicus Atmosphere Monitoring Service (CAMS). The BRDF descriptors data set allows us to provide an expectation of surface reflectance at coarse resolution. To match this estimate to the top-of-atmosphere (TOA) measurements from e.g. Sentinel-2, we first estimate an effective point spread function (PSF), which results in a direct match of the coarse resolution expectation, propagated through the atmosphere by means of an emulated RT model, with the PSF-integrated TOA measurements. This results in a likelihood function, that can then be used to infer atmospheric composition parameters (e.g. aerosol opticla thickness, AOT and total column water vapour, TCWV) when the likelihood is extended by prior knowledge on atmospheric composition derived from CAMS, as well as expectation of spatial smoothness. The parameters are retrieved with full uncertainty, and are then use for correcting the TOA reflectance.

In this contribution, we demonstrate the SIAC approach with data from Sentinel-2 and Landsat-8. Results of atmospheric parameter inversions are presented over a large set of AERONET sites (globally distributed, >300). Results show that the proposed method is able to retrieve accurate estimates of AOT and TCWV for both sensors. Simultaneously acquired Landsat-8 and Sentinel-2 data show very small (<0.001) differences in surface reflectance, demonstrating the ability of SIAC to provide consistent estimates of surface reflectance. Comparisons with in situ radiometers on the RadCal Network show a very strong correlation of the retrieved reflectances with the in situ measurements. In some cases, differences can be traced back to the L1C product.