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Improved Intercalibration of Earth Observation Data

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The last 20 years has witnessed a tremendous expansion in the Earth observation ecosystem. There are many new space-borne imaging systems being deployed to serve the ever-evolving needs of the remote sensing community. These new systems are being developed to address a wide range of environmental problems, often with a dedicated application for each sensor. The ability to combine data from several different sensing systems is essential to ensuring that all users of remotely sensed data have reliable, calibrated and intercalibrated images to suit their needs (past, present, and future).

As the number of space-borne sensors has grown, the nature of these sensing systems and their needs for calibration have changed in the past decade. The majority of sensors (regardless of wavelength or type) have relied on on-board sensor calibration methods. These methods, while understood, were often complicated, expensive, and took up valuable space on the satellite. Many systems are now being launched without any on-board calibration and rely on other methods (either modeling or ground-based features with known properties).

The research presented in this special issue represents some of the recent advancements towards the goal of achieving a stable calibration environment for our Earth observation ecosystem. From methods to assess atmospheric gas concentrations to novel approaches to sensor correction when instruments have unforeseen difficulties in establishing a true measurement when on-orbit, various methods must be experimented with and then implemented to ensure a consistent and stable reference.

Vicarious calibration using Pseudo-Invariant Calibration Sites (PICS) provides an independent and traceable link between pre-flight and post-launch calibration efforts. The objective of this technique is to provide a series of well-characterized ground-based measurements in conjunction with atmospheric measurements and image data to allow image comparison on a common radiometric scale. These procedures have been in use for almost 30 years and have been successful at calibrating airborne and space-borne systems. The models used to compute the top of atmosphere spectral radiance or reflectance require a measure of surface material properties (e.g., BRDF), atmospheric conditions and sensor properties. Detailed estimates of these parameters are limited by the lack of field instruments for many Earth targets but are essential to develop a very high quality radiometric correction.

Half of the papers in this special section present the results of a field campaign conducted in 2015 to the Algodones Dunes in California, USA. The Algodones Dunes site was selected as a potential candidate site for vicarious calibration of various NASA satellite systems. The site displays similar potential with respect to temporal stability but offers enhanced access not found at many other well-known PICS sites (Libya-4, for example). The scientific team was charged with developing a host of spectral measurements, geophysical data, and a complete set of hyperspectral and elevation data from which models could be developed to test if the site was suitable for an absolute calibration reference.

Intercalibration between thermal instruments requires a workflow that differs from the reflective. An article is presented in this special section that investigates the parameters impacting intercalibration in the thermal regime. It is a common practice for researchers to use calibrated instruments (e.g., MODIS) as reference data for another when the data are collected near-contemporaneously. This article investigates this assumption and the impact of temporal collections offsets, differences in sensor response, and differences in sensor view angle on the intercalibration process.

We appreciate the contributions from all of the authors who submitted their research for inclusion in this issue. We would also like to applaud the efforts of the many reviewers for their efforts in ensuring the highest quality in the research presented in this special section.