



## Multi-sensor data processing method for improved satellite retrievals

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Satellite remote sensing has provided massive data that improve the overall accuracy and extend the time series of environmental studies. In reflective solar bands, satellite data are related to land surface properties via radiative transfer (RT) equations. These equations generally include sensor-related (calibration coefficients), atmosphere-related (aerosol optical thickness) and surface-related (surface reflectance) parameters. It is an ill-posed problem to solve three parameters with only one RT equation. Even if there are two RT equations (dual-sensor data), the problem is still unsolvable. However, a robust solution can be obtained when any two parameters are known.

If surface and atmosphere are known, sensor intercalibration can be performed. For example, the Advanced Very High Resolution Radiometer (AVHRR) was calibrated to the MODerate-resolution Imaging Spectroradiometer (MODIS) in Fan and Liu (2014) [Fan, X., and Liu, Y. (2014). Quantifying the relationship between intersensor images in solar reflective bands: Implications for intercalibration. *IEEE Transactions on Geoscience and Remote Sensing*, 52(12), 7727-7737.]. If sensor and surface are known, atmospheric data can be retrieved. For example, aerosol data were retrieved using tandem TERRA and AQUA MODIS images in Fan and Liu (2016a) [Fan, X., and Liu, Y. (2016a). Exploiting TERRA-AQUA MODIS relationship in the reflective solar bands for aerosol retrieval. *Remote Sensing*, 8(12), 996.]. If sensor and atmosphere are known, data consistency can be obtained. For example, Normalized Difference Vegetation Index (NDVI) data were intercalibrated among coarse-resolution sensors in Fan and Liu (2016b) [Fan, X., and Liu, Y. (2016b). A global study of NDVI difference among moderate-resolution satellite sensors. *ISPRS Journal of Photogrammetry and Remote Sensing*, 121, 177-191.], and among fine-resolution sensors in Fan and Liu (2017) [Fan, X., and Liu, Y. (2017). A generalized model for intersensor NDVI calibration and its comparison with regression approaches. *IEEE Transactions on Geoscience and Remote Sensing*, 55(3), doi: 10.1109/TGRS.2016.2635802.].

These studies demonstrate the success of multi-sensor data and novel methods in the research domain of geoscience. These data will benefit remote sensing of terrestrial parameters in decadal timescales, such as soil salinity content in Fan et al. (2016) [Fan, X., Weng, Y., and Tao, J. (2016). Towards decadal soil salinity mapping using Landsat time series data. *International Journal of Applied Earth Observation and Geoinformation*, 52, 32-41.].