Langley Automated Sensor Inter-calibration System (LASICS): Open Access Tools for Satellite Imager Inter-Calibration

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1. Abstract

- Satellite imager calibration teams are tasked with maintaining stable measurement records to facilitate reliable monitoring of geophysical parameters and ensure dependable input for forecast models. Satellite imagers are neither uniformly calibrated nor radiometrically scaled to a common reference standard. Consistent inter-calibration between various earth-orbiting satellite imager pairs is a critical step in the creation of seamless earth-scene reflectance data records over time for input to higher level algorithms that retrieve earth system climate-sensitive properties.
- Each imager inherently by virtue of its optics (and associated properties like spectral response etc.) and orbit will have a unique measurement of the same earth-scene reflected signal. A key part of this is the computationally efficient and optimal identification and prediction of science opportunities where the imager pairs from their respective earth-orbits near-simultaneously view the same stable terrestrial targets with nearly identical viewing and solar geometry.

2. Introduction

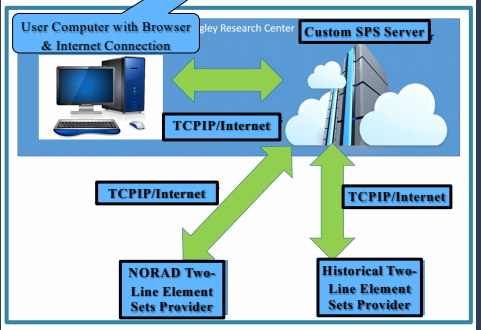
Langley Automated Sensor Inter-calibration System (LASICS) will provide the Earth remote sensing community with a foundation for the harmonization of remote sensing climate data records by the development of an intuitive, user-friendly, interactive web-browser enabled open access client. This client works with a back-end server-side customized software package that was originally developed for the CLARRREO Pathfinder (CPF) Science Planning System (SPS).

- First it will provide ray-matched prediction of events where the imager pairs from their respective earth-orbits near-simultaneously view the same stable terrestrial targets with nearly identical viewing and solar geometry. These prediction events can be modified by the User via constraints to optimize their inter-calibration or retrieval comparison requirements.
- Second it will leverage, an existing extensive and ever-growing database of earth-imager channel spectral response functions, on-demand capabilities for computation and visualization of spectral band adjustment factors (SBAF) using a variety of external hyper-spectral earth observation sources (e.g. SCIAMACHY, GOME-2 for VIS and IASI, AIRS for IR) and a variety of Solar Irradiance Spectra.

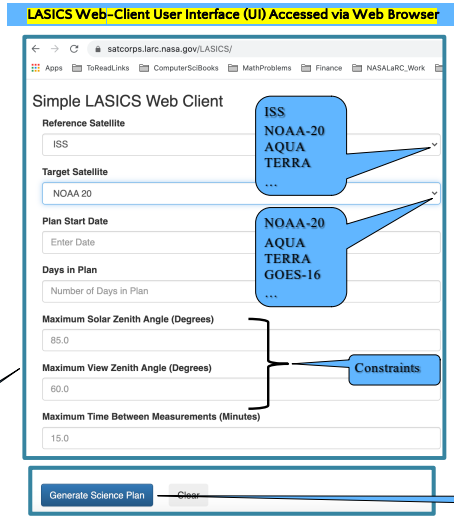
LASICS is a joint effort by the CLARREO and CERES project to provide the remote sensing community an open-source web-based client that incorporates best practices when comparing sensor channel radiances/reflectances or environmental data retrievals by providing spatio-temporally coincidental science opportunities.

3. LASICS Server-side Architecture

- LASICS will leverage a modified version of a custom Science Planning System (SPS) software package that has been developed at NASA/LaRC for use in planning inter-calibration operations to be performed by the CLARREO Pathfinder instrument after it is installed on the International Space Station (ISS).
- The core of the SPS contains a MATLAB package with routines that can be used to predict opportunities to perform inter-calibration between sensors on Low Earth Orbit (LEO) spacecraft, sensors on Geosynchronous Earth Orbit (GEO) spacecraft, and invariant sites on Earth's surface, and to obtain lunar spectral irradiance measurements.
- Spacecraft orbits are propagated with the SGP4 (Simplified General Perturbations 4) software and Two-Line Element sets provided by the U.S. Strategic Command. The position and orientation of the Moon are obtained from the SPICE (Spacecraft, Planet, Instrument, direction Cosine, Event) Toolkit for MATLAB (MICE) provided by NASA's Navigation and Ancillary Information Facility at JPL.

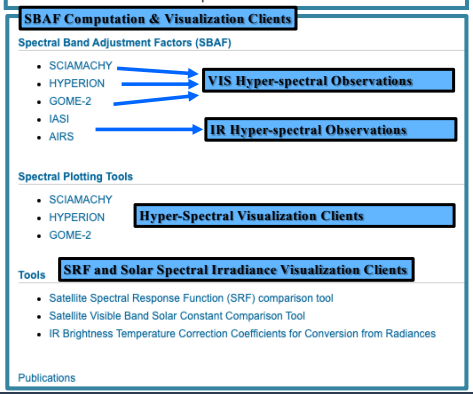


4. LASICS Web-Client UI Architecture



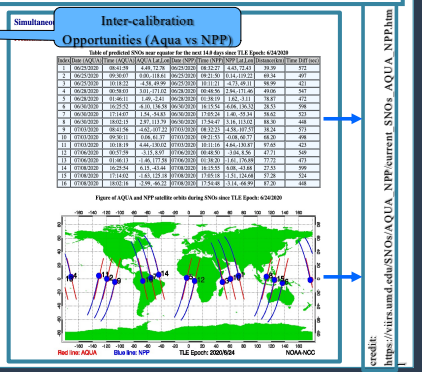
5. NASA/LaRC Inter-Calibration Web-Clients

The NASA LaRC Calibration Website:
https://satcorps.larc.nasa.gov/cgi-bin/site/showdoc?docid=9
Provides access to other intuitive, user-friendly, open access web clients to the Science Inter-Calibration Community for:
Spectral Band Adjustment Factor Computation (via Hyperspectral Data Sources), Spectral Response Function (SRF) comparisons and Band Solar Constant Computation/Visualization using a variety of sources of Solar Irradiance Spectra.



5. Conclusion

- Current approaches to identifying sensor inter-calibration opportunities involve the transfer of tremendous amounts of science data over limited bandwidth networks and brute-force comparisons of geolocation and timing information in the datasets for two sensors in order to create a near-simultaneous sensor earth-scene datasets suitable for statistical regressions and other science applications.
- CLARREO Pathfinder SPS has been suitably modified and will be made publicly available to the satellite sensor inter-calibration community via the LASICS web-client that will work with any web-browser on any machine connected to the internet. The use of event prediction algorithms based on orbital mechanics (SGP4), that serves as the core of the SPS, has been found to be substantially more efficient than current approaches.
- LASICS will use orbit propagators and relative geometries to determine various inter-calibration opportunities and will produce inter-calibration opportunities when the constraints of time, position, and line-of-sight between the reference sensor and the target inter-calibration sensor are satisfied.



6. References

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2. Carlos M. Roithmayr, C. Lukashin, P. W. Speth, G. Kopp, K. Thome, B. A. Wielicki, and D. F. Young, "CLARREO Approach for Reference Intercalibration of Reflected Solar Sensors: On-Orbit Data Matching and Sampling", IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING, VOL. 52, NO. 10, OCTOBER 2014

7. Acknowledgements

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