Multi-Sensor Intercalibration Monitoring at the Atmosphere SIPS

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Atmosphere Discipline Meeting

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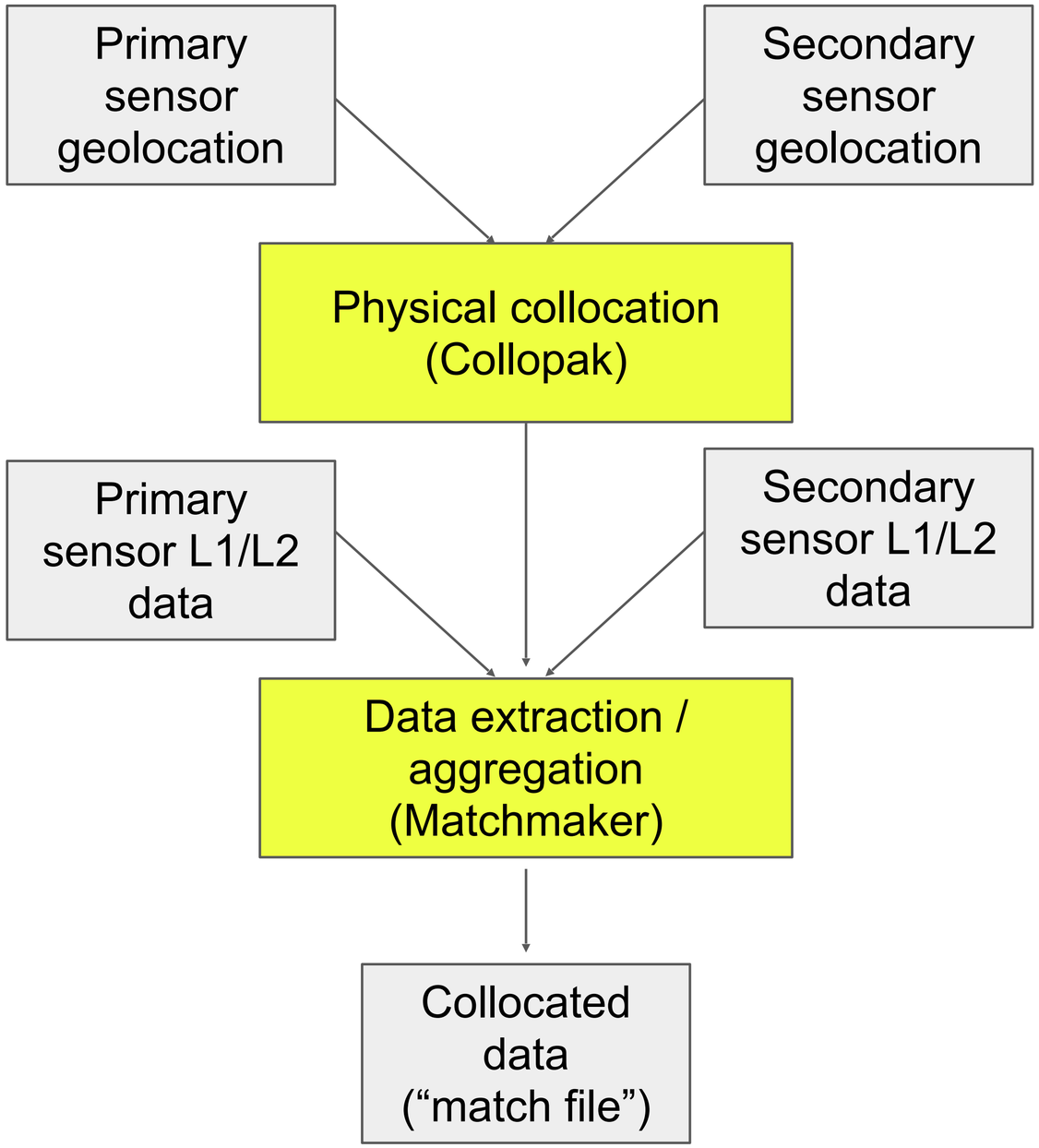
Collocation and Multi-Sensor Match File Capabilities

- SIPS multi-sensor collocation tools support:
  - Calibration assessment of L1 data (e.g., MODIS-VIIRS reflectance biases)
  - Validation of L2 products (e.g., CALIPSO for analysis of cloud & aerosol retrievals)
  - Algorithm development using multiple instruments (e.g., Fusion, CrIS IMG)
- “Collopak” software performs geometric calculations to identify collocated observations
- “Matchmaker” software aligns L1/L2 sensor data into a joint file for easy comparison or combined use
- Sensors supported include:
  - MODIS
  - VIIRS
  - CALIPSO
  - GEO (AHI, ABI)



Slide Credit: Greg Quin

VIIRS/MODIS Reflectance Band Bias Analyses

- SIPS Aqua-MODIS/VIIRS matchfiles have been used for long-term radiometric bias analyses:
  - liquid water phase clouds over oceans (Meyer et al.)
  - “Dark water” (clear, deep inland or ocean) scenes (Sayer et al.)

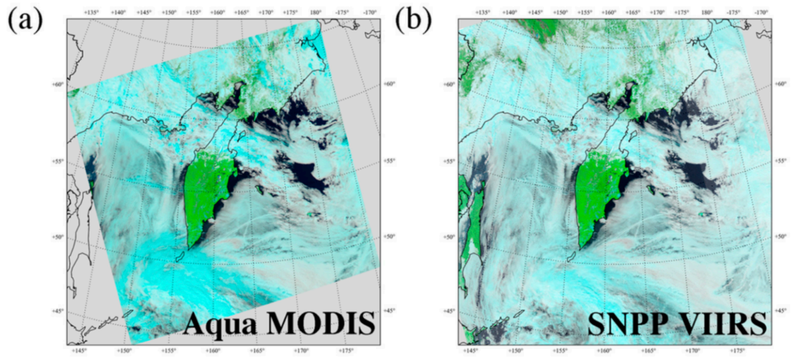
- Initial monitoring effort uses liquid water phase cloud product
  - Automated testing for trending and outliers
  - Automatically updated interactive web application for viewing results

- Can easily (and want to!) add more products to established pipeline

remote sensing

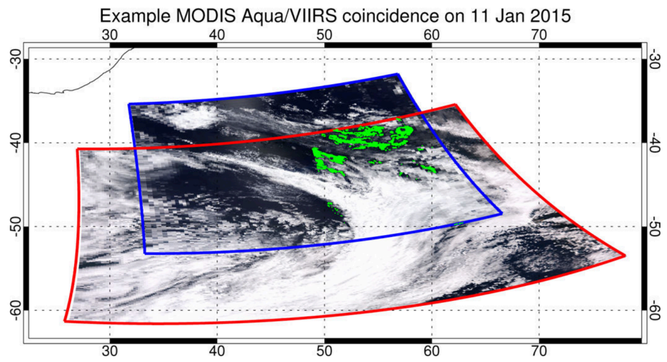
Derivation of Shortwave Radiometric Adjustments for SNPP and NOAA-20 VIIRS for the NASA MODIS-VIIRS Continuity Cloud Products

Kerry Meyer [1,*], Steven Platnick [1], Robert Holz [2], Steve Dutcher [2], Greg Quinn [2] and Fred Nagle [2]



Cross-calibration of S-NPP VIIRS moderate resolution reflective solar bands against MODIS Aqua over dark water scenes

A. M. Sayer[1,2], N. C. Hsu[2], C. Bettenhausen[2,3], R. E. Holz[4], J. Lee[2,5], G. Quinn[4], and P. Veglio[4]



Web App Demo

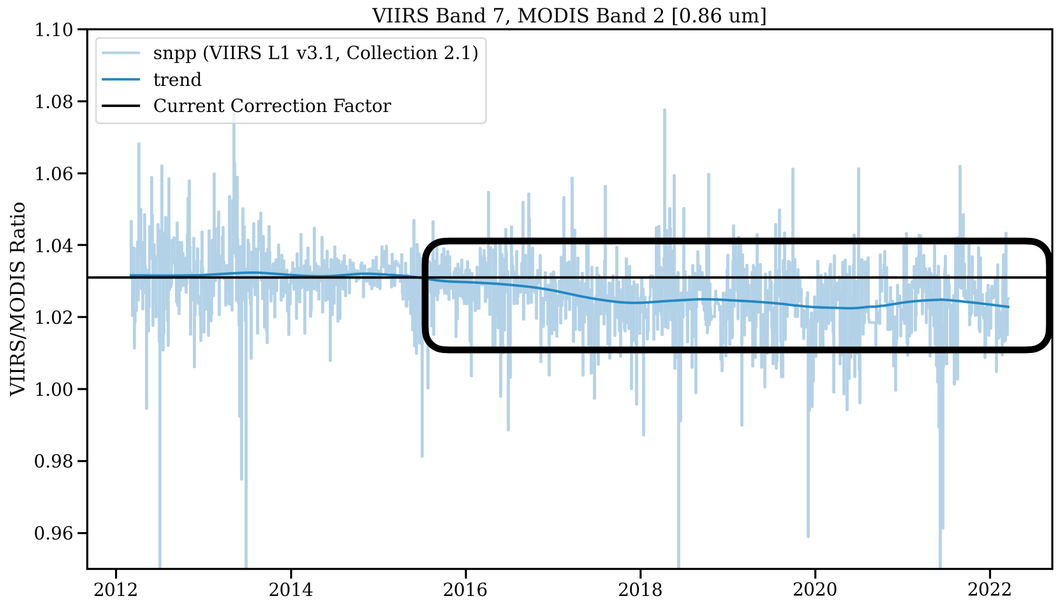
SNPP M7 Alert

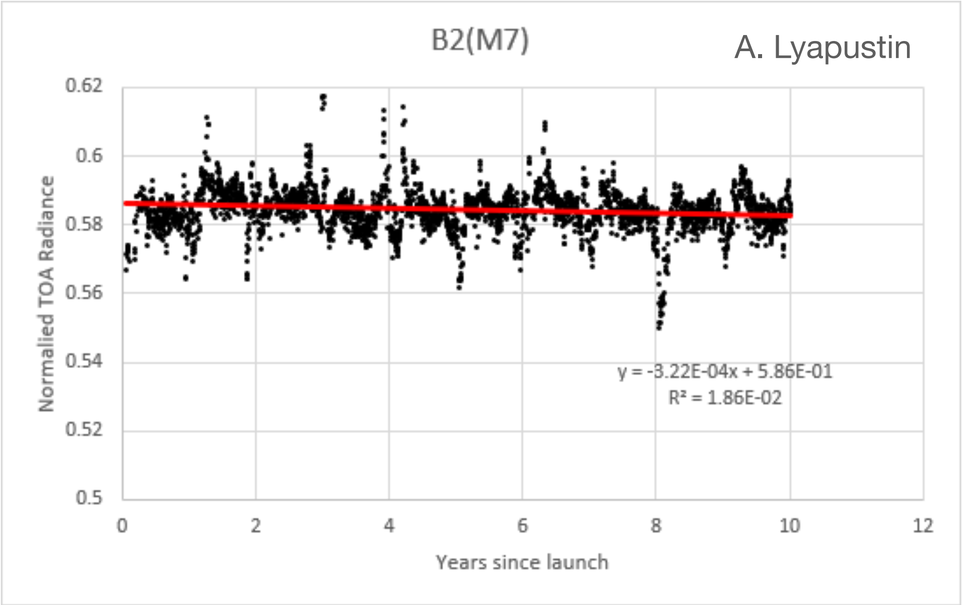
- Significant trending identified since ~2018
- Monitoring has shown consistency of discrepancy over time
- Similar results identified by other calibration methods (DCC, desert sites, and MAIAC)
- Currently investigating magnitude of impact on CLDPROP products

```
Aqua-Modis/SNPP-VIIRS Intercalibration Ratio Check

CRITICAL VIIRS Bands: [7]
OK VIIRS Bands: [5, 8, 10, 11]

VIIRS Band 5 (0.672 micron):
    Max outlier in last week: 0.00992 (Threshold: 0.05)
    Latest Trend: 0.955 (Production scale factor: 0.95, Difference: -0.005)
VIIRS Band 7 (0.865 micron):
    Max outlier in last week: 0.00498 (Threshold: 0.05)
    Latest Trend: 0.9778 (Production scale factor: 0.97, Difference: -0.00781)
        Difference exceeding threshold of 0.0075!
VIIRS Band 8 (1.24 micron):
    Max outlier in last week: 0.00303 (Threshold: 0.1)
    Latest Trend: 0.9955 (Production scale factor: 0.99, Difference: -0.00545)
VIIRS Band 10 (1.61 micron):
    Max outlier in last week: 0.00469 (Threshold: 0.1)
    Latest Trend: 0.9869 (Production scale factor: 0.98, Difference: -0.0069)
VIIRS Band 11 (2.25 micron):
    Max outlier in last week: 0.00695 (Threshold: 0.1)
    Latest Trend: 0.9717 (Production scale factor: 0.97, Difference: -0.00167)
```





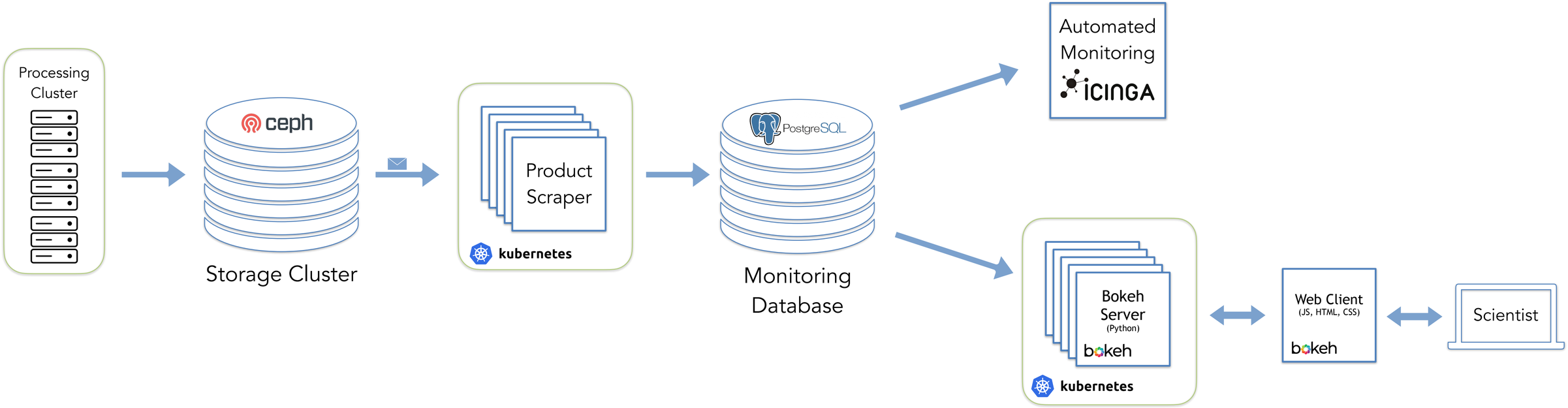
Libya 4 Desert Calibration Site

Outlook

- ASIPS provide automated alerts and data visualization capabilities allowing for proactive product monitoring
- The web applications is available to science team members at: https://sips.ssec.wisc.edu/intercalibration/
- Similar pipelines developed/under consideration:
  - TEB (M13, M15, M16) via CRIS/VIIRS comparisons
  - Deep Convective Clouds
  - GEO-LEO Matchups
  - L2 products comparing recent data to climatological records
- The ASIPS can support new monitoring capabilities as requested by the Atmosphere science team

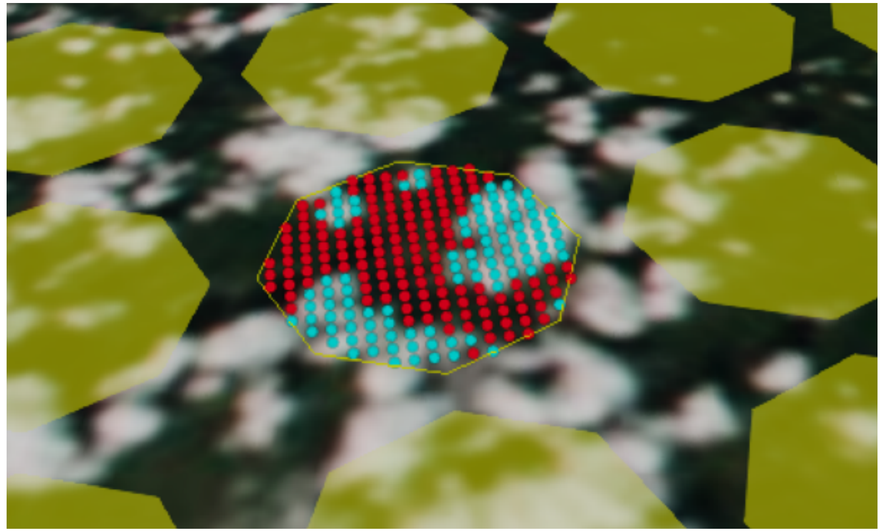
Backup Slides

Monitoring Pipeline



Collocation tools: Collopak

- Physical collocation utilities for various sensor combinations
  - Each collocation program use geolocation data from the “primary” (larger-footprint) and “secondary” sensors to compute coincident observations
  - Output is a NetCDF file containing array indexes that identify observations that overlap spatially
- Collopak also includes TLE-based orbital navigation tools (the programs that power the SIPS “OrbNav” API)
- Available on sipssci2, or for download
  - `/mnt/software/support/collopak`
  - https://www.ssec.wisc.edu/~gregq/collopak/



Primary / Master \ Secondary / Follower	AVHRR	CALIOP	CLOUDSAT	Fixed Grid GEO	MODIS	POLDER	VIIRS
AIRS		✸	✸	✸	✸		
AMSR-E			✸	✸	✸		
CLOUDSAT		✸			✸		✸
CrIS		✸		✸			✸
Fixed Grid GEO		✸	✸		✸		✸
HIRS	✸	✸					
IASI	✸			✸	✸		
MODIS		✸				✸	✸
VIIRS		✸					

Slide Credit: Greg Quin

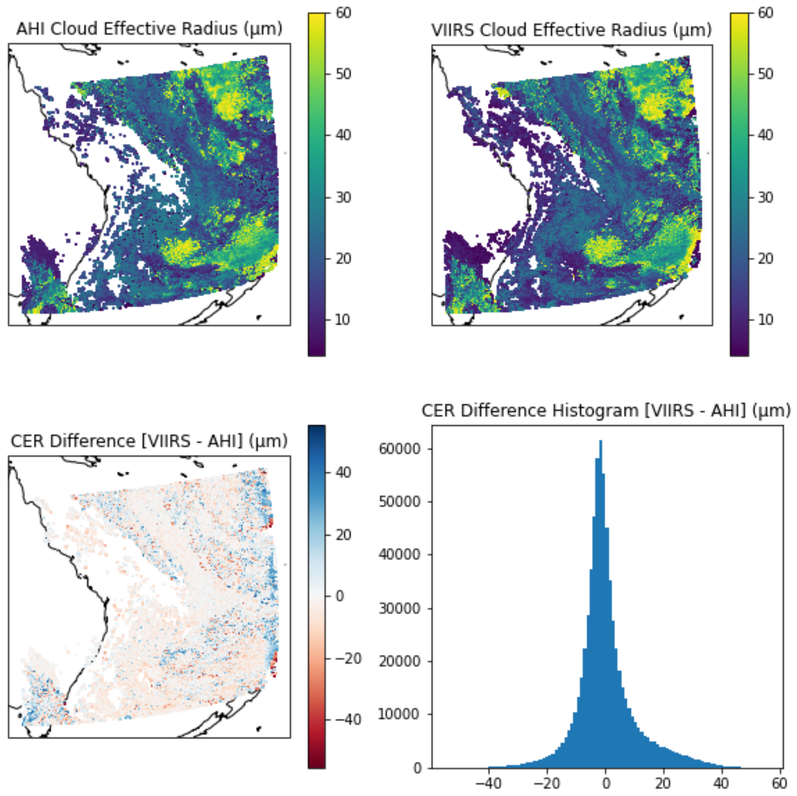
Collocation tools: Matchmaker

- New project in development to simplify creation of multi-sensor “match files” that contain side-by-side data from multiple sensors
- Goals
  - Better science team control over match file contents
  - Unified code base for correct & efficient application of collocation array indexes
  - Accumulation of reusable configuration and code for common matchup needs (e.g. CALIOP)
- Similar approach to Yori: a configuration file drives the construction of the match file
- Many simple use cases can be handled just by setting desired output variables in configuration
- More complex uses possible by either pre-processing sensor data (like the “pre-yori” step for L3) or via a Python plug-in system for custom processing

```
[outputs.ahi_Cloud_Effective_Radius]
source = "ahi_l2_cldprop/geophysical_data/Cloud_Effective_Radius"

[outputs.viirs_Cloud_Effective_Radius]
source = "viirs_l2_cldprop/geophysical_data/Cloud_Effective_Radius"
aggregation = "mean"

[outputs.viirs_Cloud_Effective_Radius_sdev]
source = "viirs_l2_cldprop/geophysical_data/Cloud_Effective_Radius"
aggregation = "std"
```



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