

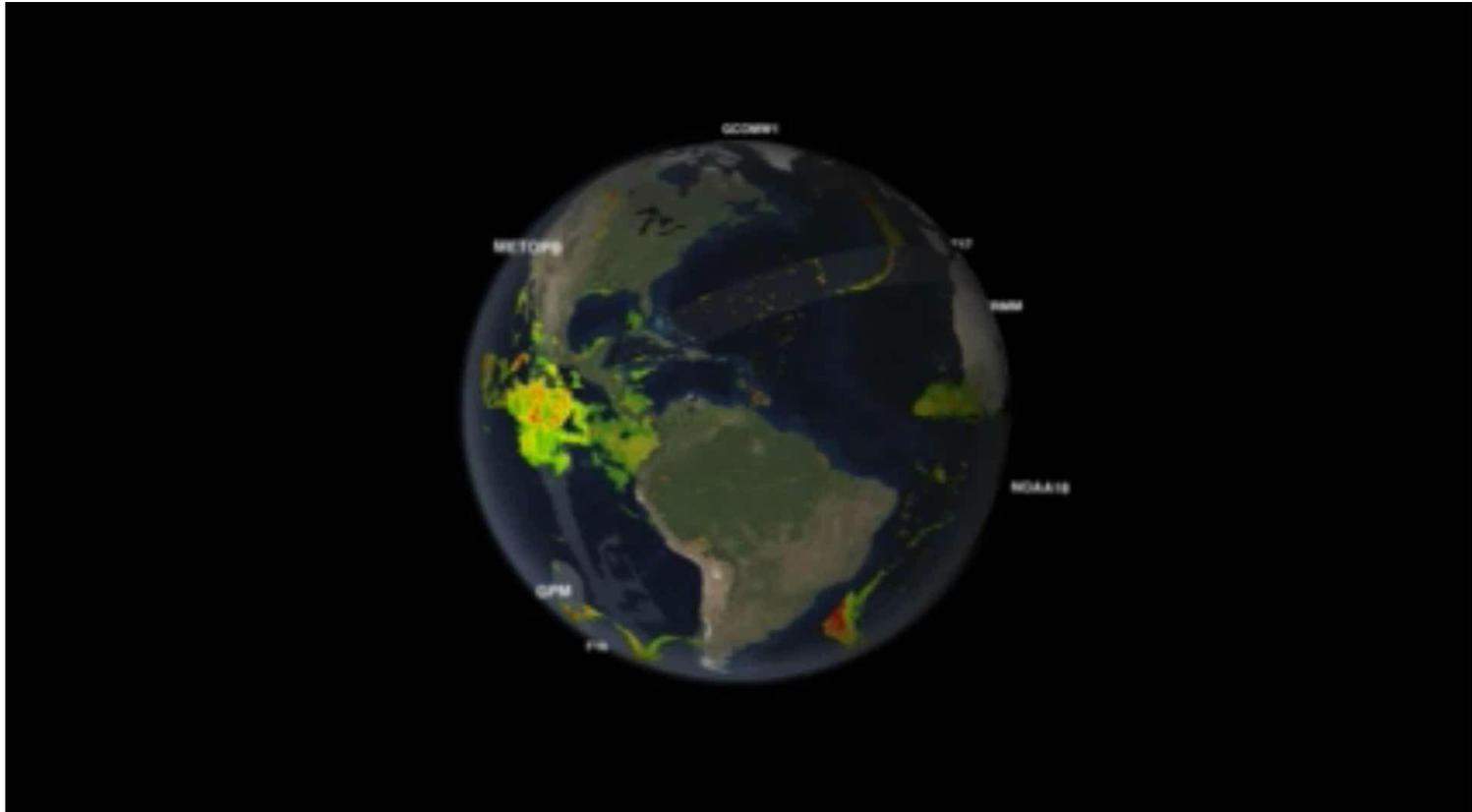


Use Of Automated In-situ Measurements for Sensor Harmonization

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What is the challenge?

Developing calibration approaches that allow users to fuse data from a range of sensors



GPM example where GPM is the reference used to allow data fusion from 12 total sensors

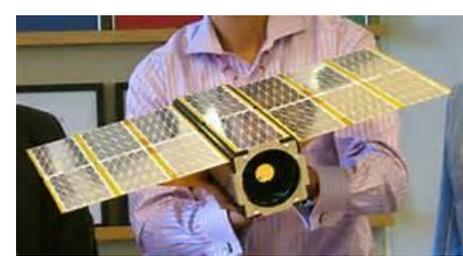
Things will get more interesting

Video courtesy NASA's
Scientific Visualization Studio

Already 50 countries
working with 100s of
systems



NASA's Earth
remote sensing
fleet as of early
2015



Planned expansion of smallsat
usage and constellations
means more systems to
calibrate



Detecting change is a key science driver

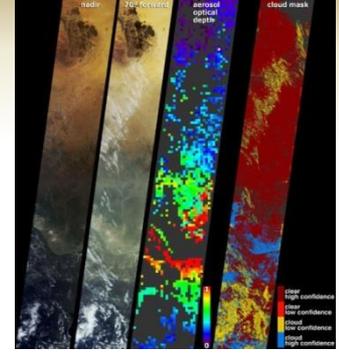
Some is easy to see as with this ASTER imagery



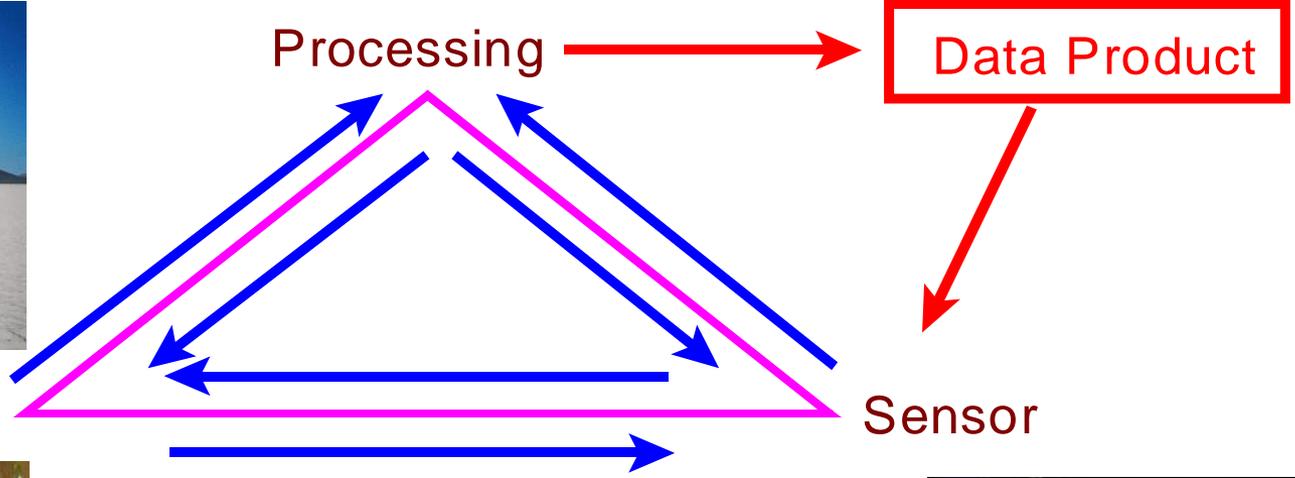
- Other effects are more subtle
- Some applications require fusion of data sets as in the GPM example
- All require calibration fit for purpose

Pretty pictures may not be good enough

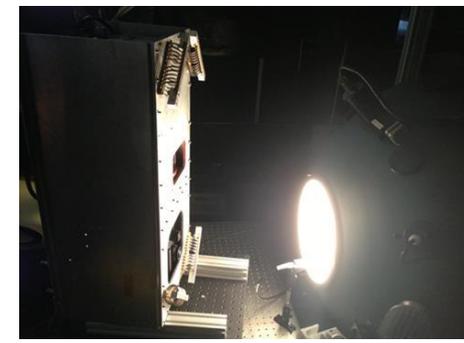
Sensors, measurement approaches and processing methods are all improving



Measurements



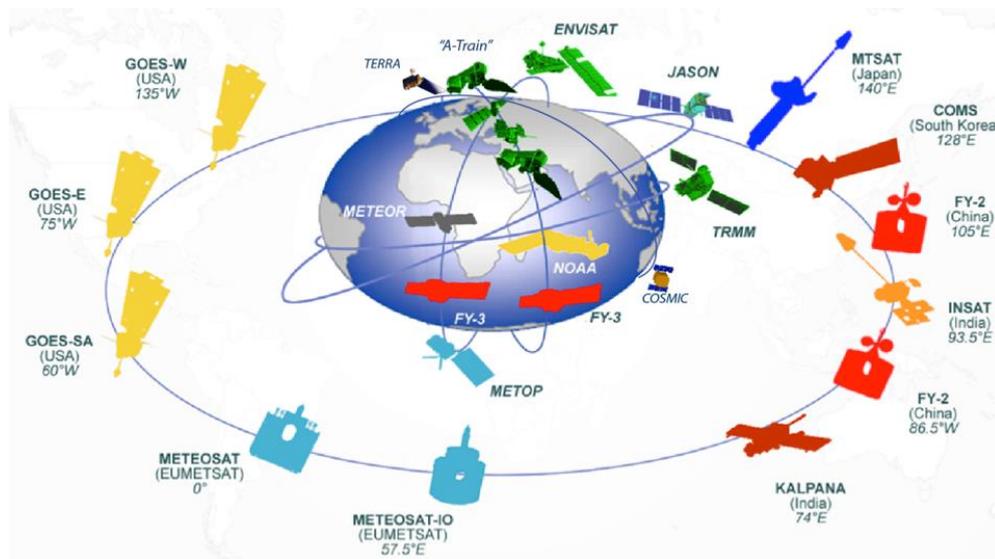
- Users are pushing sensors and vice versa
- Requiring better accuracy
- SI traceability is more important



Harmonization has to change as well

Have to move away from one by one comparisons

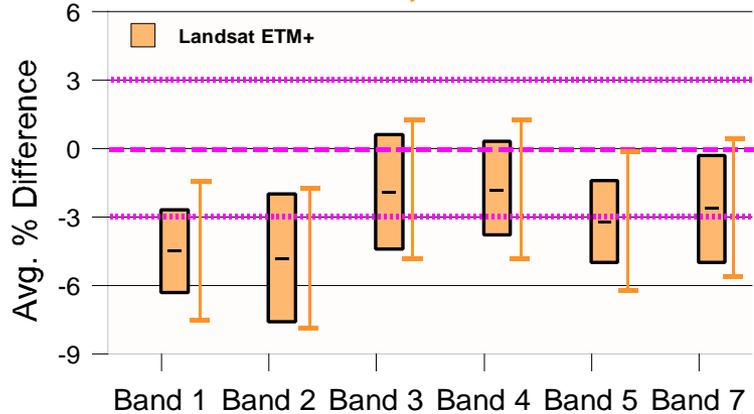
- Already too many systems to do in pair-wise fashion of intercomparisons
- No way to cover all sensors with coincident views
- Far too many to attempt to accomplish with on-site personnel making in situ measurements



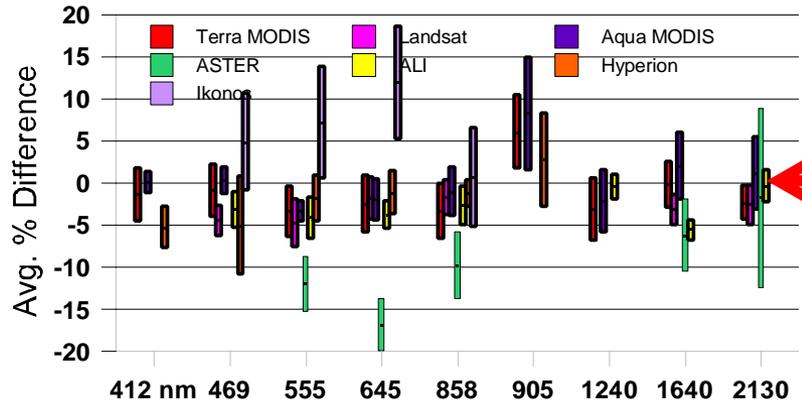
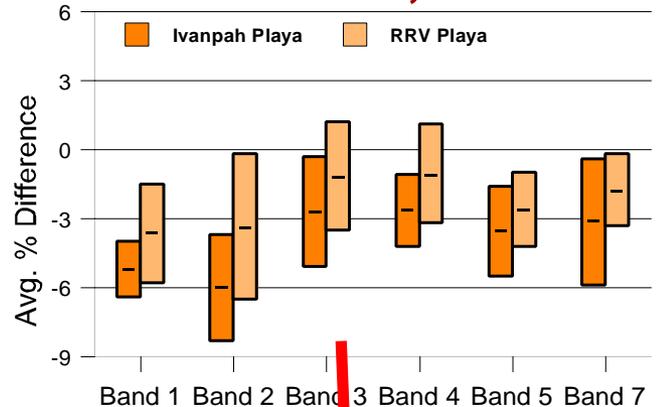
Reflectance-based results showed a solution

In situ approach that evolved since the 1980s to develop an SI-traceable harmonization

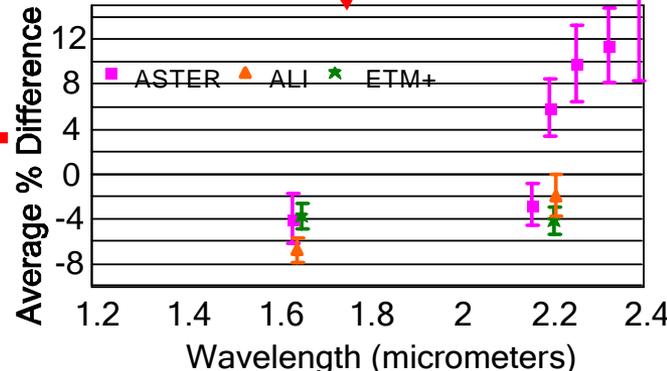
One sensor, one site



One sensor, two sites



Many sensors many sites

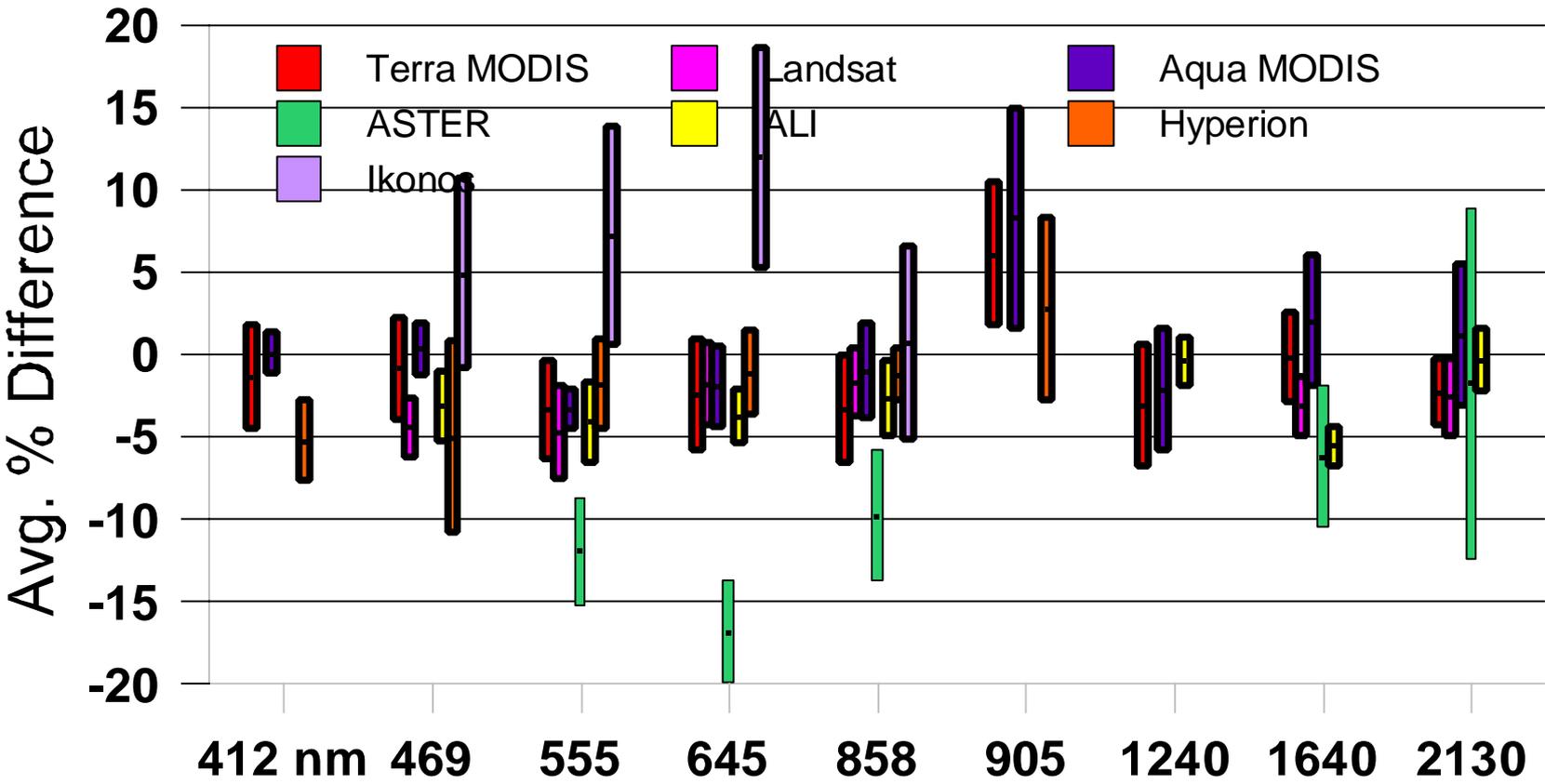


3 similar sensors multiple sites



Many sensors, sites, non-coincident views

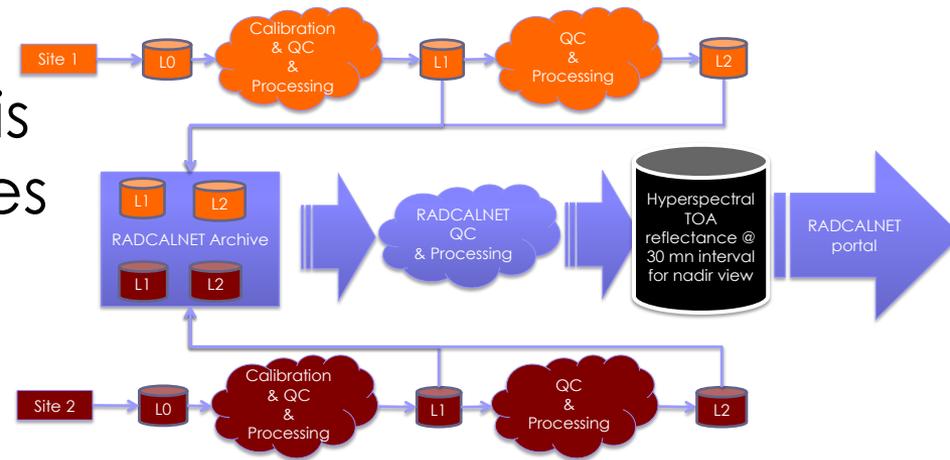
Terra, Aqua, EO-1 offered an excellent test bed for comparing across platforms



Next step is in situ without people

Multiple sites would offer a range of opportunities for absolute calibration

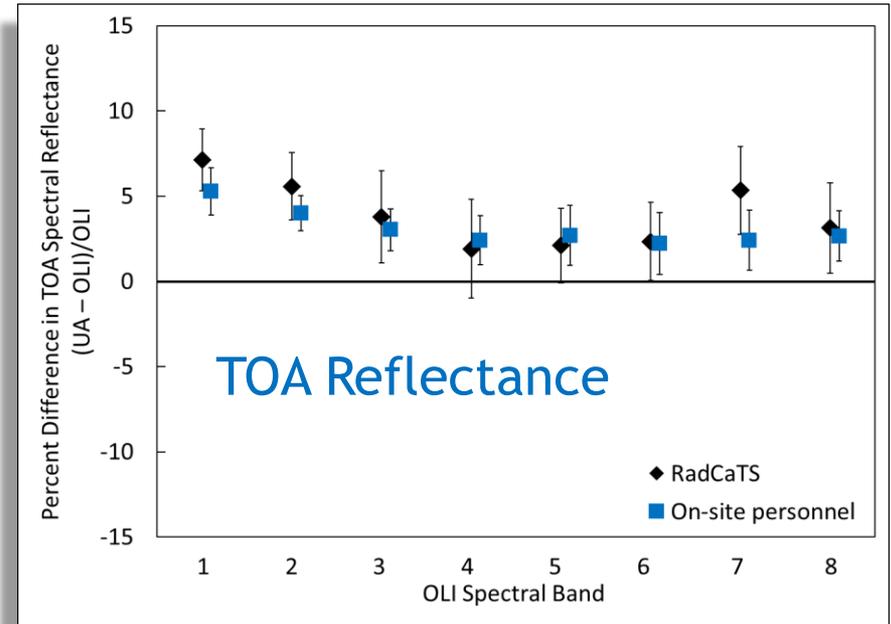
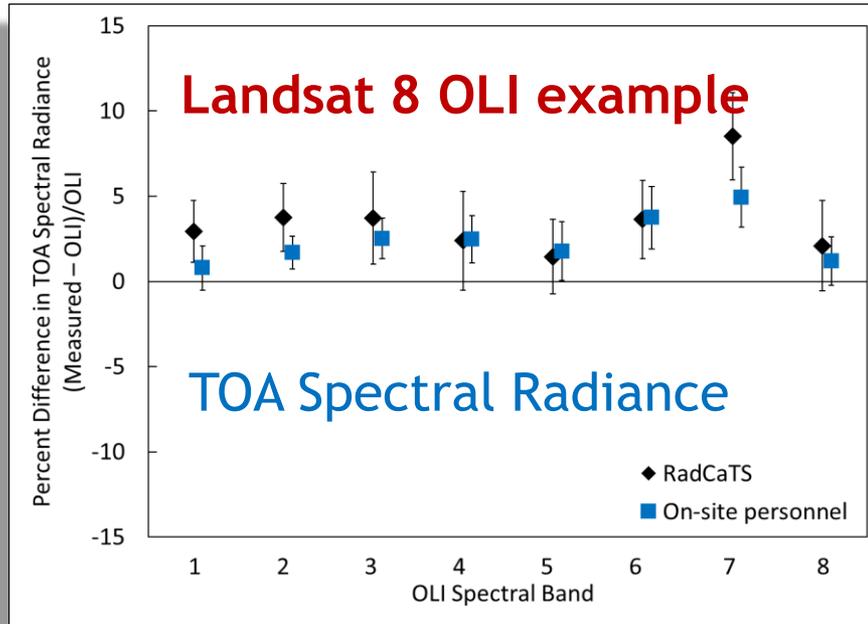
- CEOS Working Group on Calibration and Validation is working to network such sites
- Provide predicted top-of-atmosphere reflectance to user community
- Goal for distribution of data is late 2016



Railroad Valley, NV example

Automated approach is the University of Arizona's RadCaTS site

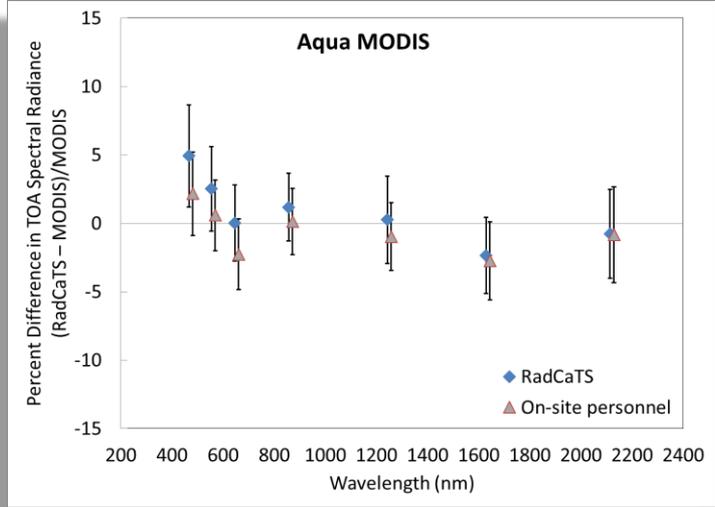
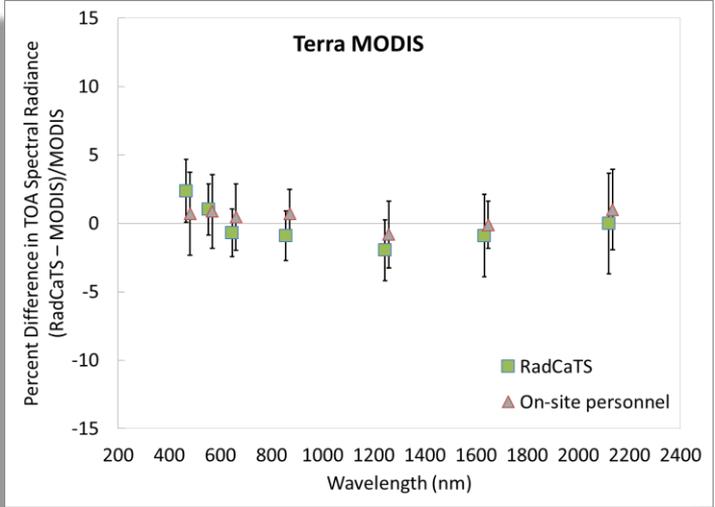
- Agreement between people on site and no personnel present is very good



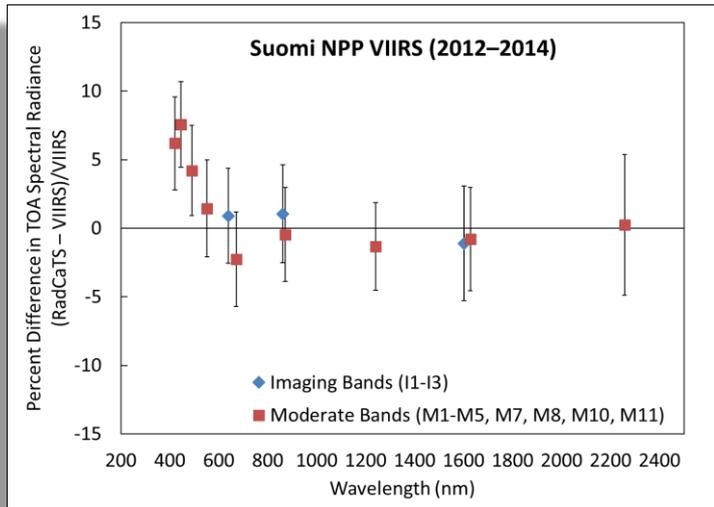
- Development of SI-traceable error budget is underway

Method has been applied to multiple sensors

Terra and Aqua MODIS as well as S-NPP VIIRS are shown here



MODIS land bands (1-7)



S-NPP VIIRS



Networked results will subset full data

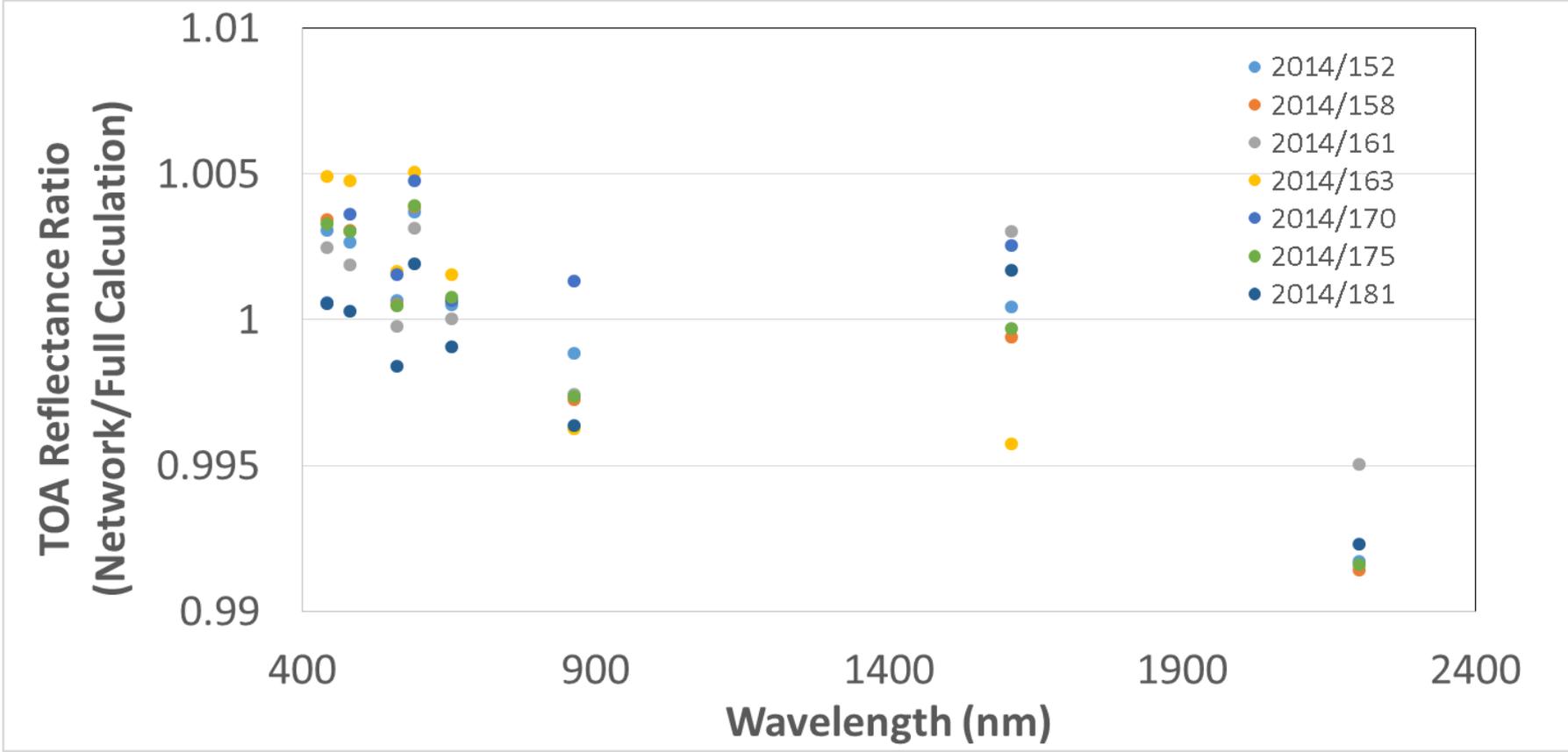
Absolute, SI-traceable uncertainties will be documented

- Top-of-atmosphere reflectance for a nadir view at 30-min intervals will be available
 - 10-nm spectral sampling
 - Currently being tested for 50-m spatial areas
- Satellite sensors need only collect imagery of a site
 - Lowest uncertainties for nadir or near-nadir views
 - Corrections for off-nadir cases could be developed
- Expect <3% uncertainty for nadir view, low aerosol, high to moderate resolution sensors



Networked results match exact calculations

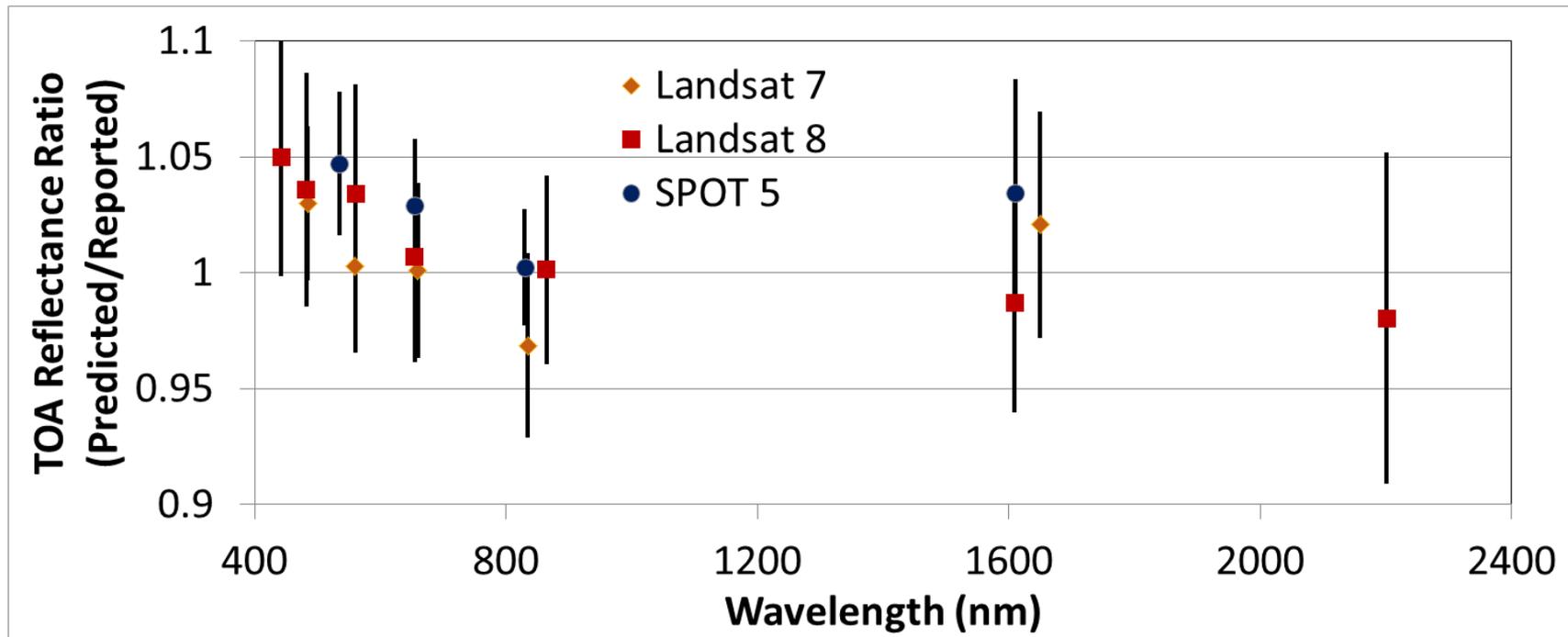
Sites are selected to minimize uncertainties from the network's spectral and temporal sampling



Network results for RRV Playa site

Non-coincident data with >4 collections for each sensor

- Three separate sensors have been used with network results to date
- Also useful for individual calibration of a given sensor



Summary

Need to switch from sensor-centric to SI-traceable source-centric

- A calibration network provides an additional tool
- In situ methods provide an SI-traceable, absolute calibration
- Automated collections ensure data are available when sensor views site
 - No need to coordinate with ground groups
 - No need for site managers to see the imagery
- Expected expansion will give more global coverage
- Well suited for expected rise in large number of imagers expected over next decade
- Plans are to have the network available this time next year

