Future of cal/val

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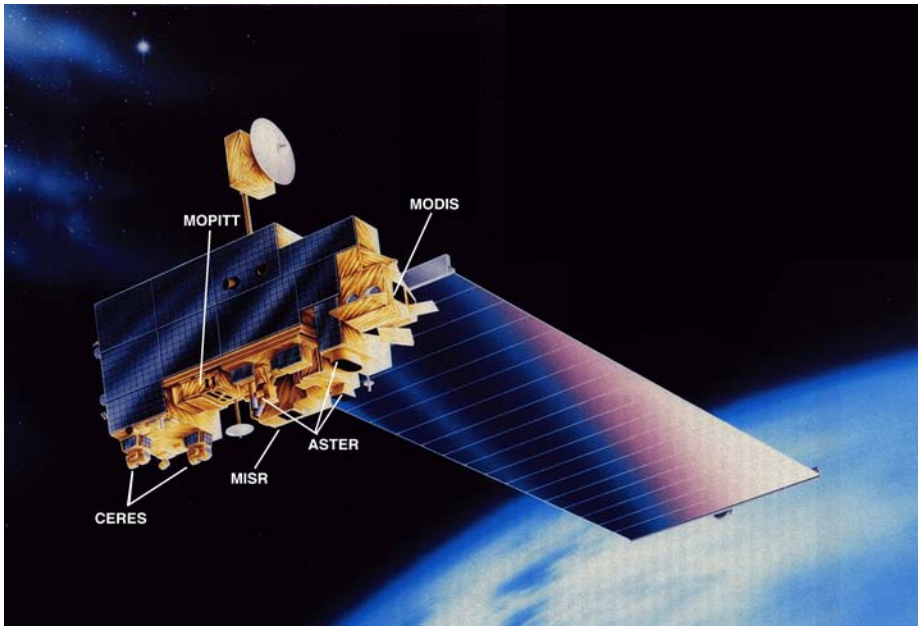
Key issues for cal/val

Importance of cal/val continues to increase as models improve and budget pressures go up

- Better cal/val approaches and instrumentation needed in response to
  - Improved on-orbit and airborne sensors
  - Constellations and distributed measurements
  - New processing methods and models
- Uncertainties are decreasing making SI-traceability and co-dependent errors more important
- Budget limitations
  - Increase need for cal/val
  - Mean less funds for cal/val
- Must maintain a results-based philosophy
- Critical to train the next group of cal/val scientists

Improved techniques

Climate-quality data have changed the way cal/val views its mission



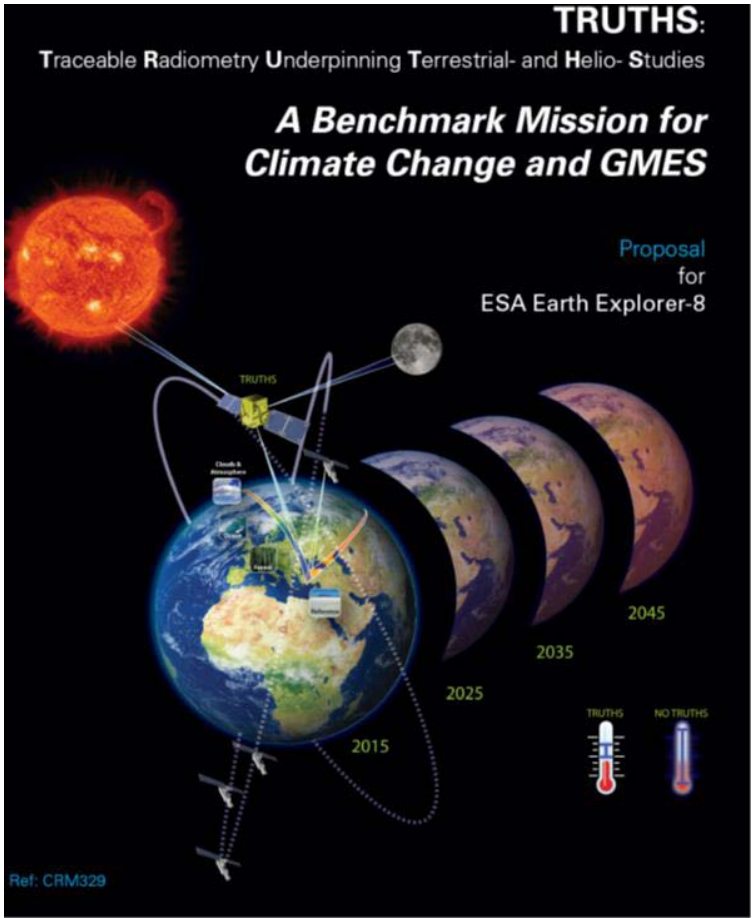
Terra's platform synergy of multiple sensors has been key to the mission's success

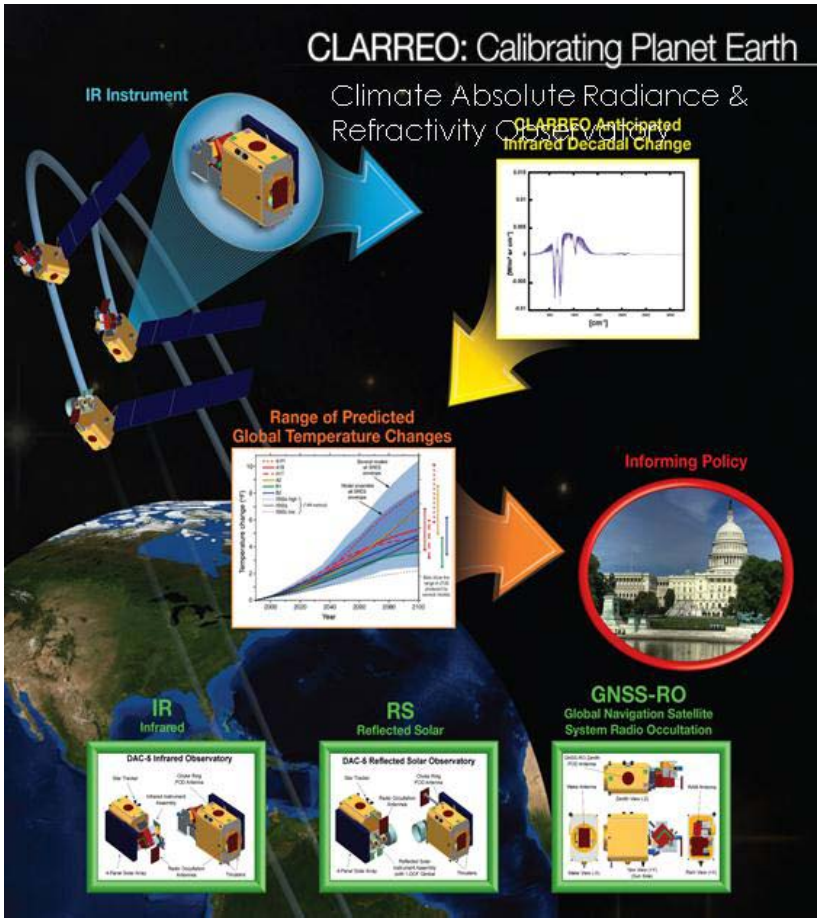
- Synergy between research-quality systems (OLI and MSI) and operational weather systems (VIIRS and OLCI)
- Requires consistently calibrated and validated data sets
  - Intercalibration to a few high-quality sensors
  - Valid across time and multiple countries

Climate-quality data

"Absolute" uncertainties < 0.3% in band-integrated albedo force new approaches

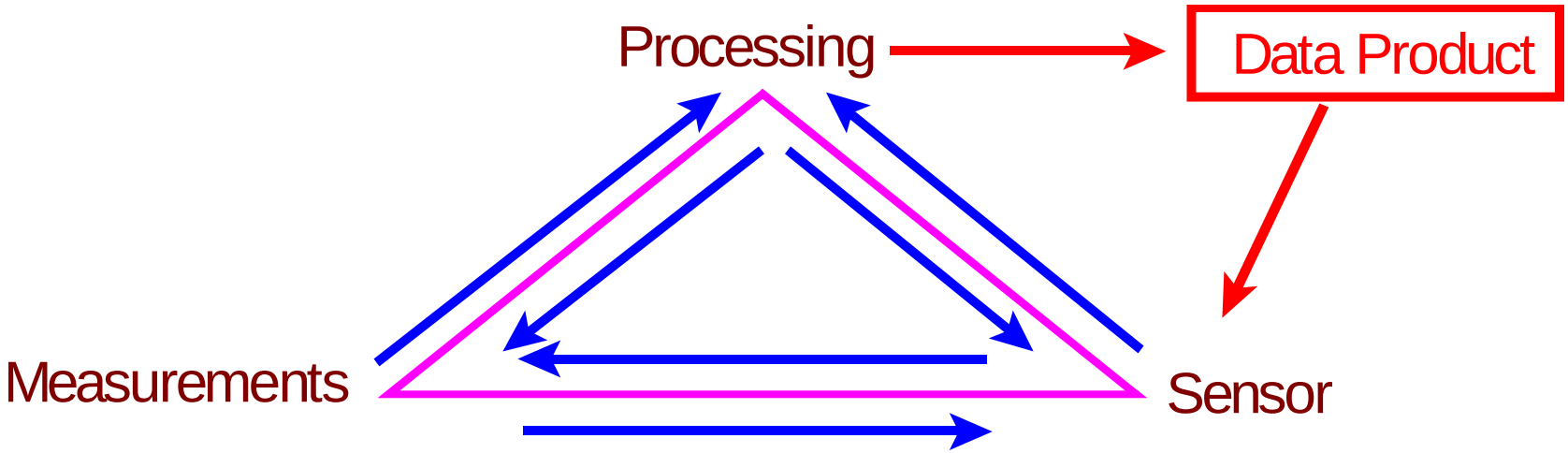
- TRUTHS (Traceable Radiometry Underpinning Terrestrial- and Helio-Studies)
- CLARREO (Climate Absolute Radiance and Refractivity Observatory)





Calibration and validation

Developing climate-quality data products forces improvements to all facets of retrieval



- SI-traceability and data quality assurance
- Inclusion of new instrument approaches and characterization techniques
- Reduced uncertainties increase importance of of co-dependent error sources

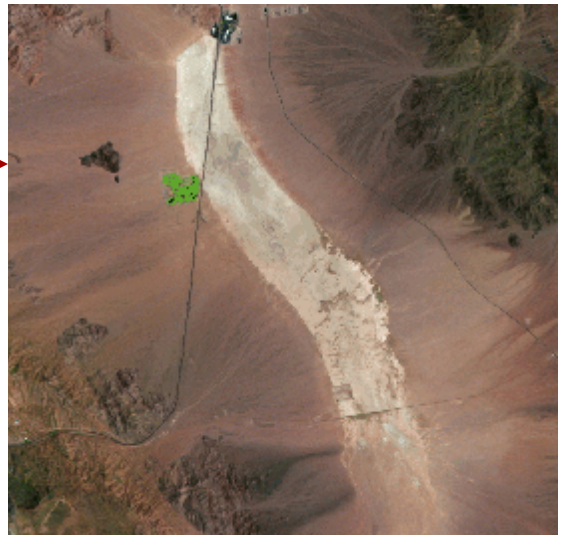
In-situ approaches provides good example

Includes surface, atmospheric, instrumental, and model uncertainties

Instrument and measurement approaches of surface and BRDF model

RTC Code

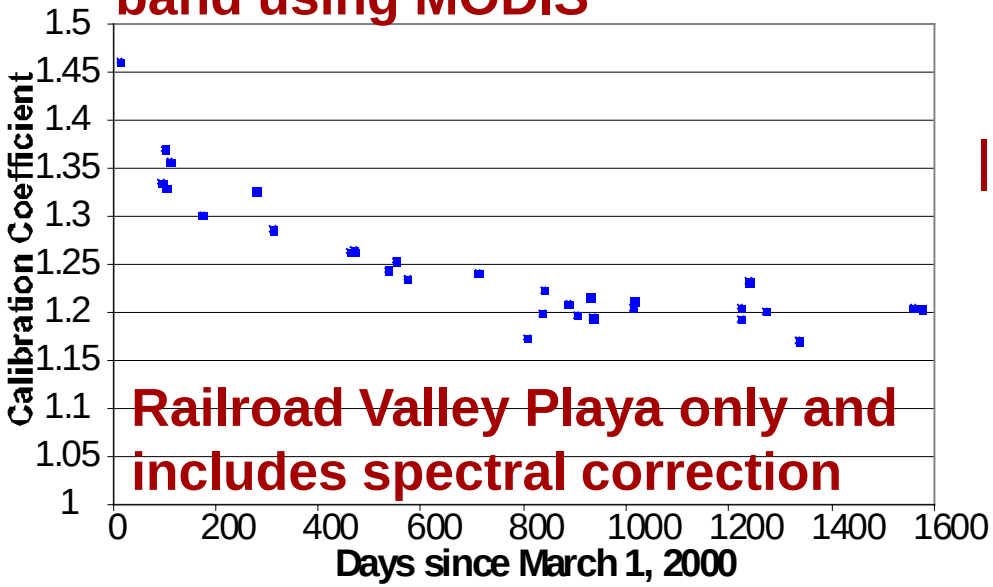
Predict at-sensor radiance for a selected area of the site and compare to imagery



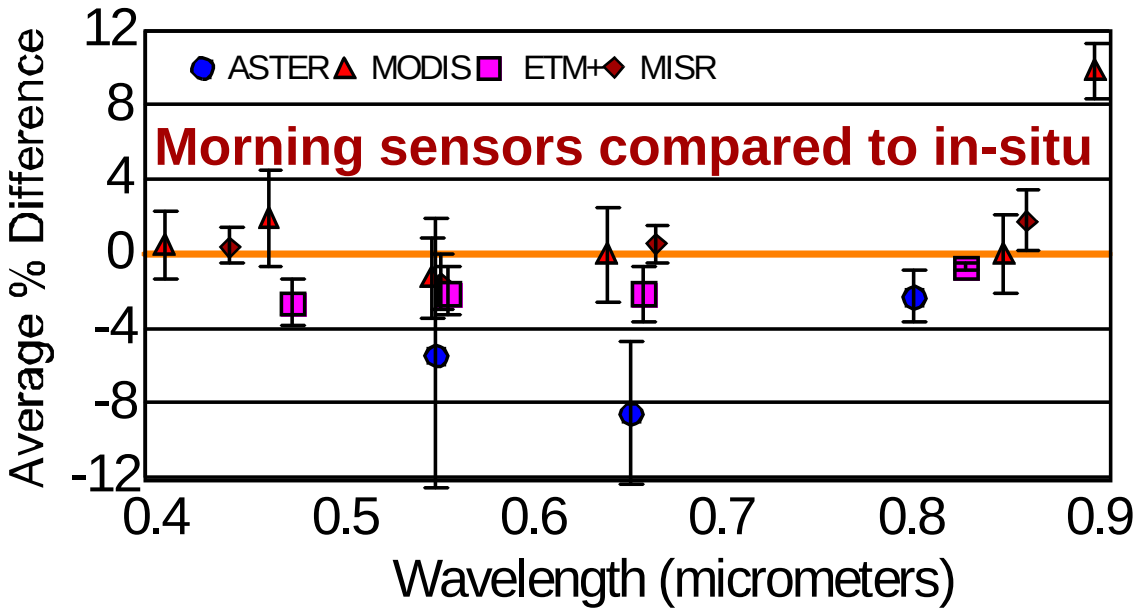
Instrument and measurements approaches of atmospheric conditions

Sensors, models, and methods

Calibration for ASTER green band using MODIS



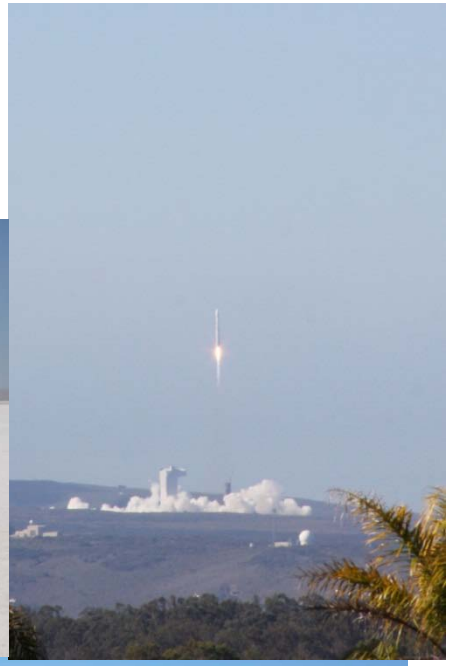
Improved approaches are needed to decouple sensor and model effects

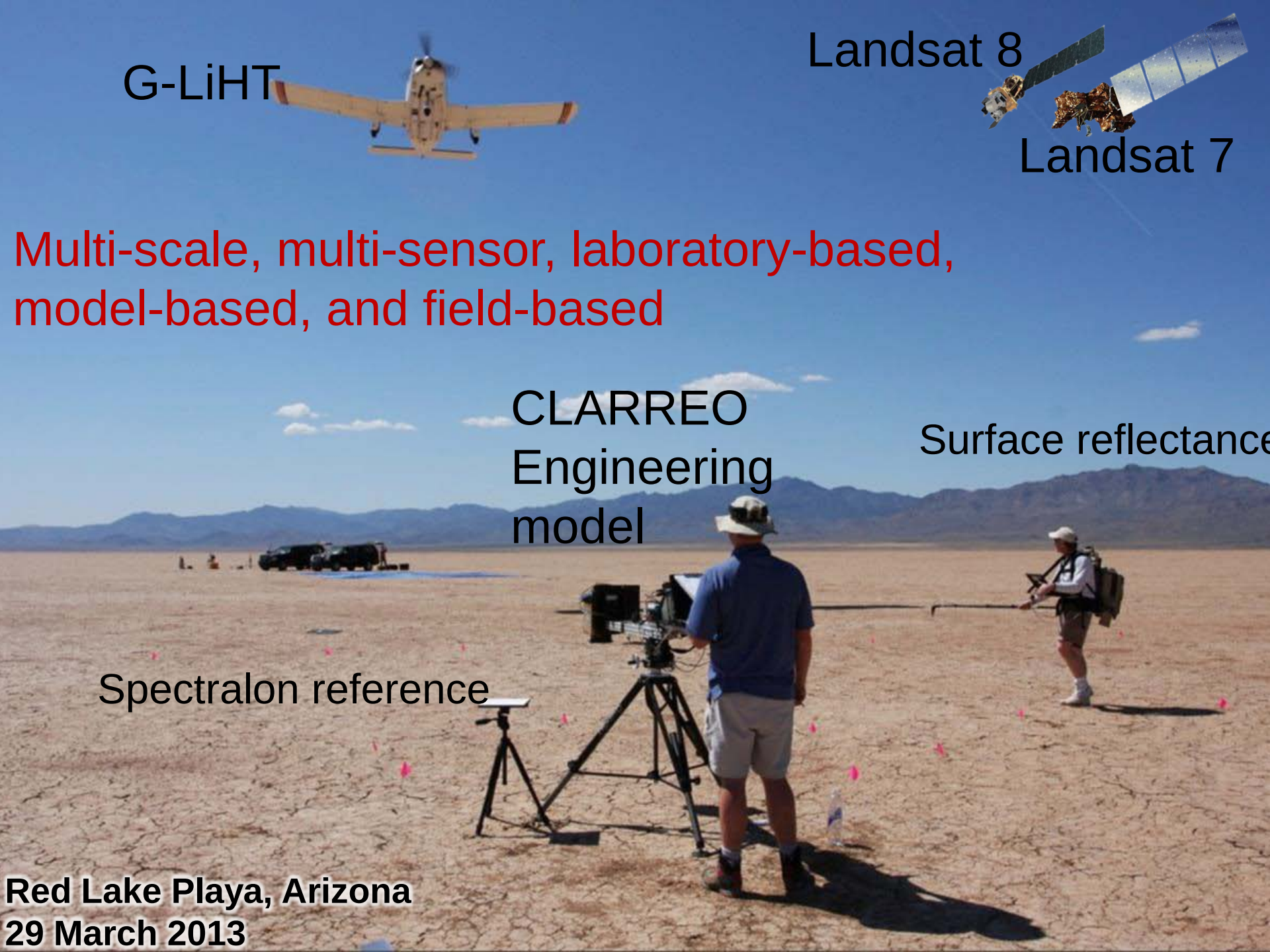


Future cal/val scientists

Involving younger, data-oriented researchers into instrument-related cal/val has to be a priority



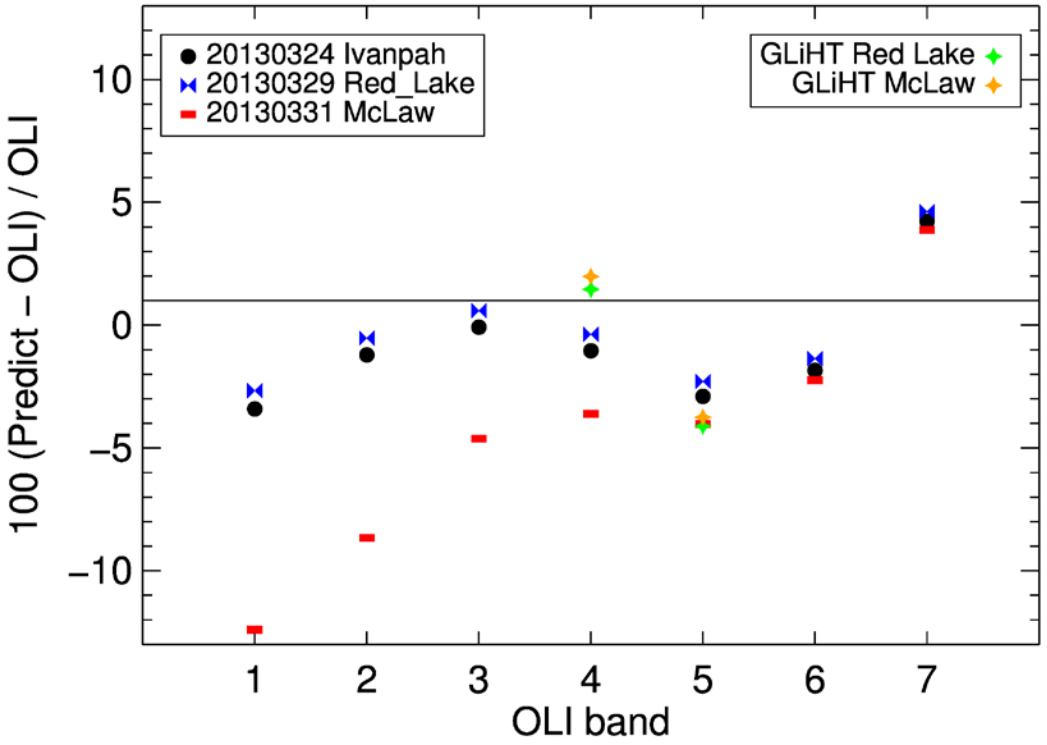





G-LiHT
Landsat 8
Landsat 7
Multi-scale, multi-sensor, laboratory-based, model-based, and field-based
CLARREO Engineering model
Surface reflectance
Spectralon reference
Red Lake Playa, Arizona
29 March 2013

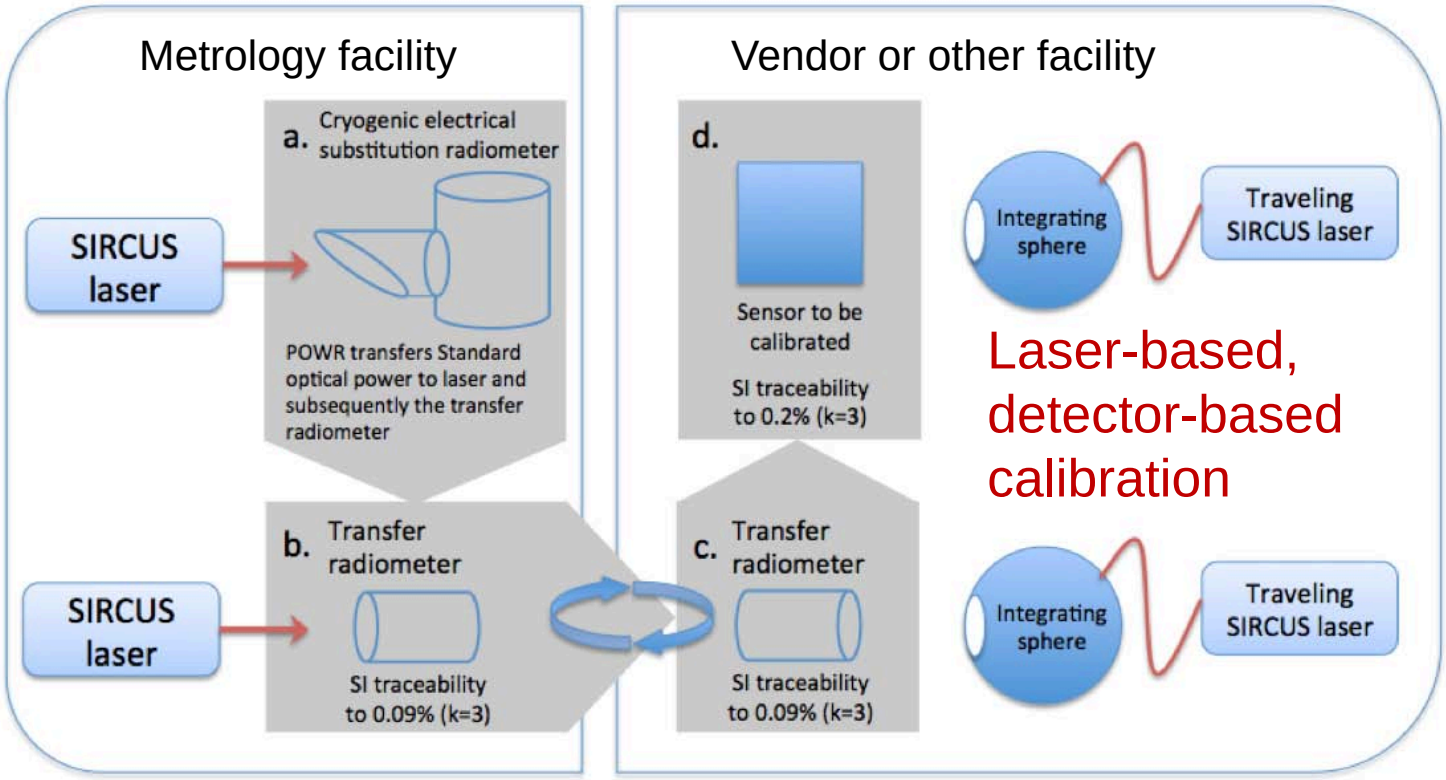
Need a change in scale of uncertainties

Vicarious calibration results from Landsat-8 OLI from GSFC ground and airborne collections

- Are differences real or because of unknown uncertainties?
- Solar models
- Radiance or Reflectance
- Scaling
- Radiative transfer
- Pre-launch biases



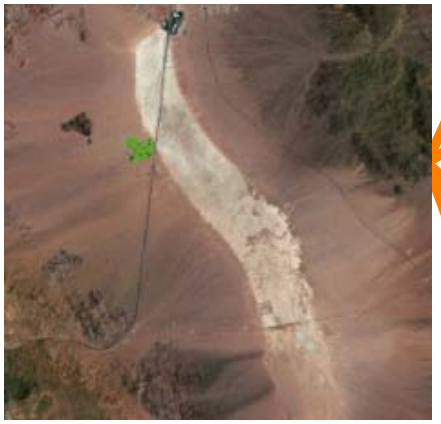
Incorporating new sensor characterizations



- Detector-based standards
- Stray light and size of source effects
- Polarization sensitivity

Model-based future of cal/val

Selected Test Site



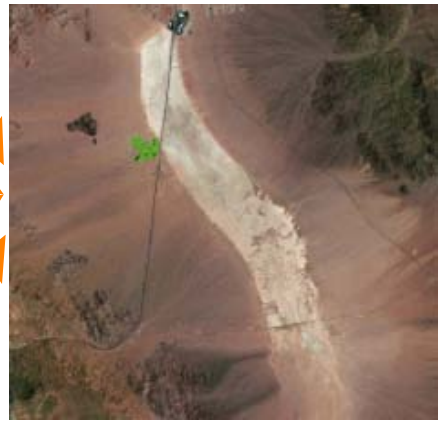
Ground-based Measurements

Satellite-based Measurements

Airborne-based Measurements

Model-based "Measurements"

Predicted At-sensor radiance



Emphasizes the source radiance

Moves away from one-to-one cross calibrations and empirical only

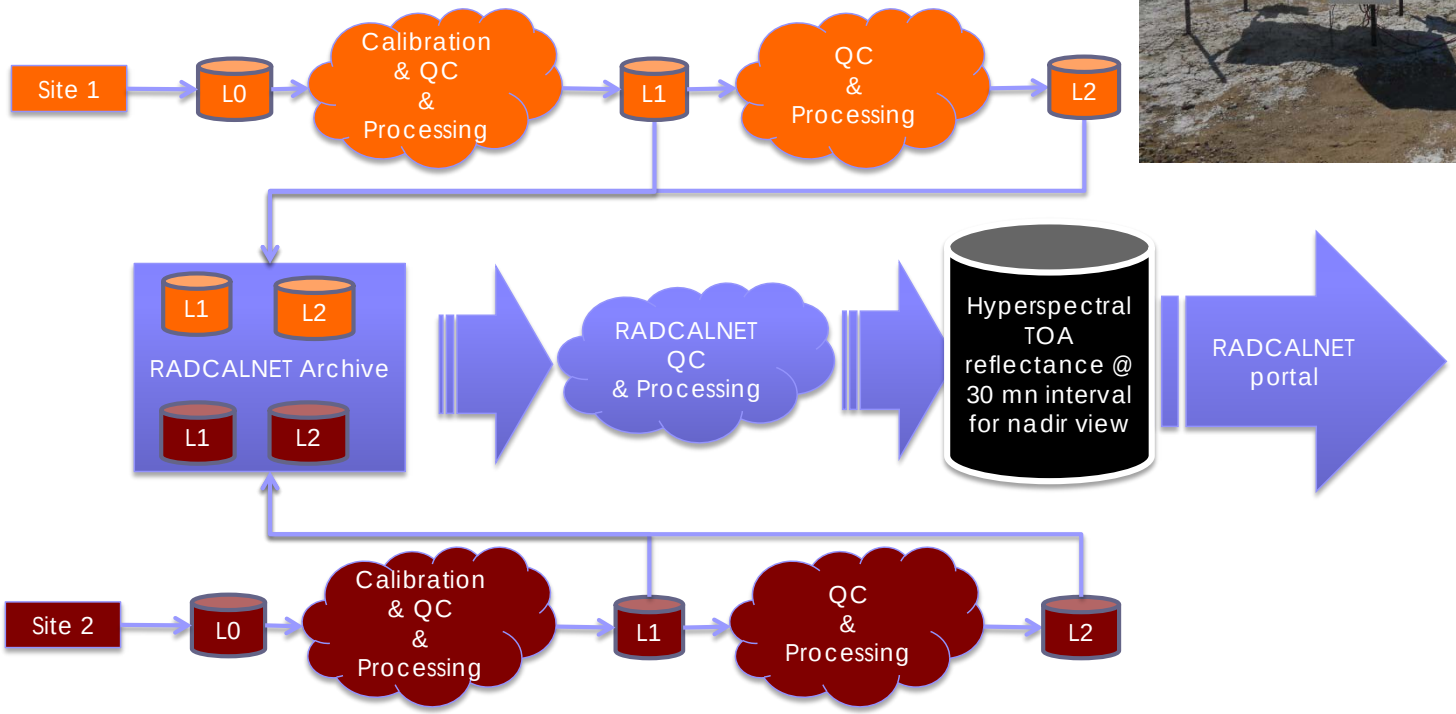
Radiance is for arbitrary
1) Time
2) View angle
3) Sun angle

SI-Traceable with documented error budget and uncertainty

Automated approaches

Automated cal/val methods increase the available data with lower long-term costs

- Landnet and RadCalNet are good examples of this
- RadCalNet will be demonstrated with OLI and MSI intercomparison



Results-based approaches

How many cal/val scientists does it take to change a light bulb?

- **None**
  - **We are perfectly happy to discuss in the dark which light bulb would be the best replacement**
- Reprocessing should not be a bad thing
  - MODIS is nearing completion of its Collection 6
  - Entire MODIS archive (two instruments, 14 years) takes only a few months to reprocess all products
- Balance between getting things right and getting them fast
- Tip the balance towards getting information to the user communities not the science teams

Summary – state the obvious

Improving cal/val results will be difficult as budgets force hard decisions on priorities

- Techniques that optimize cost while improving accuracy and traceability are needed
- New ideas will come from the newest generation of researchers
- Experienced researchers will guide the cross-cutting issues needed to improve cal/val models and instruments
- Goal should be climate-quality data capabilities