An Overview of the UW Hyperspectral Retrieval System for AIRS, IASI and CrIS

Nadia Smith[a], Elisabeth Weisz[b] and William L. Smith

Cooperative Institute for Meteorological Satellite Studies (CIMSS)
Space Science and Engineering Center (SSEC)
University of Wisconsin-Madison

[a]nadia.smith@ssec.wisc.edu
[b]elisabeth.weisz@ssec.wisc.edu

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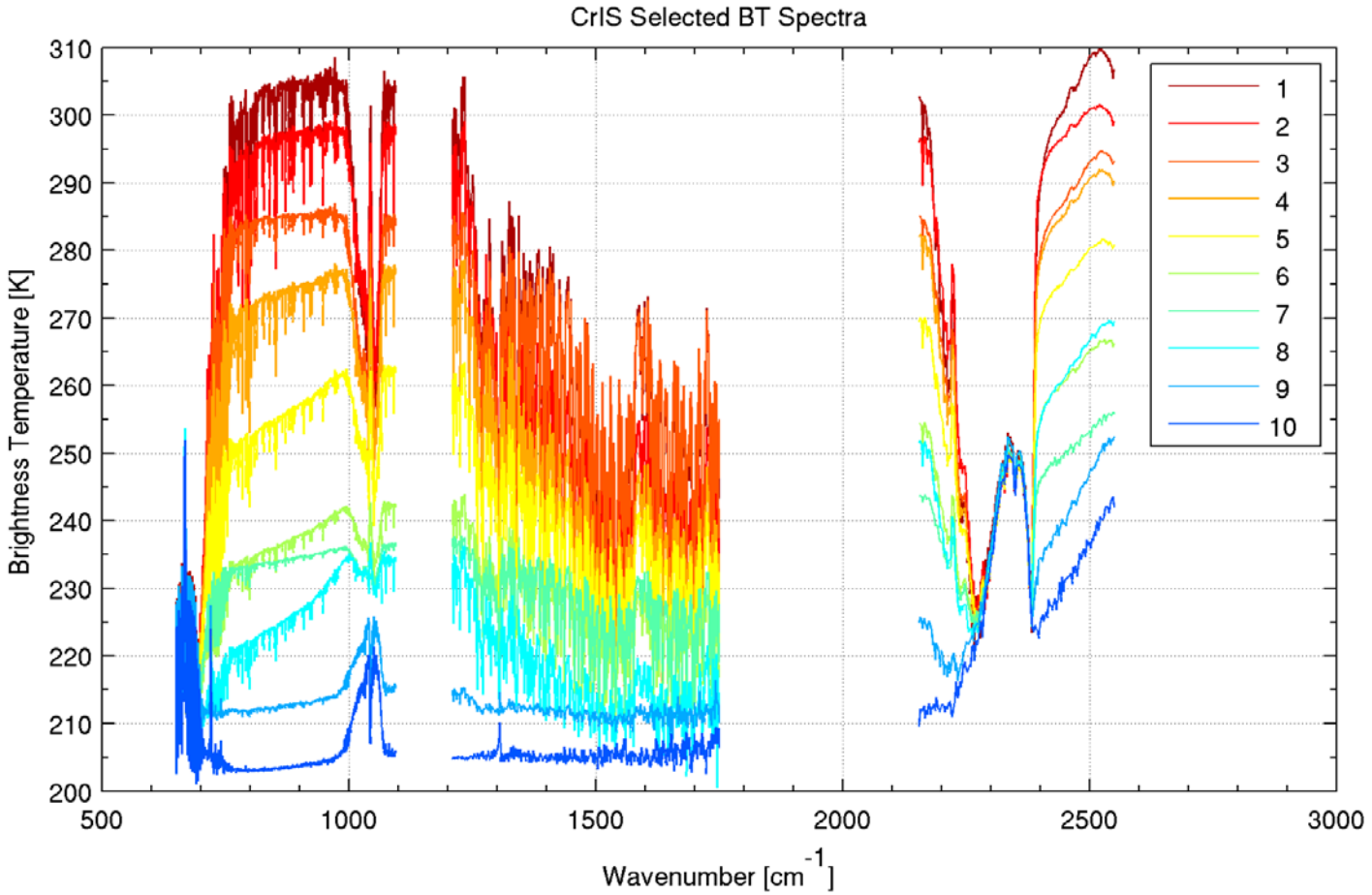
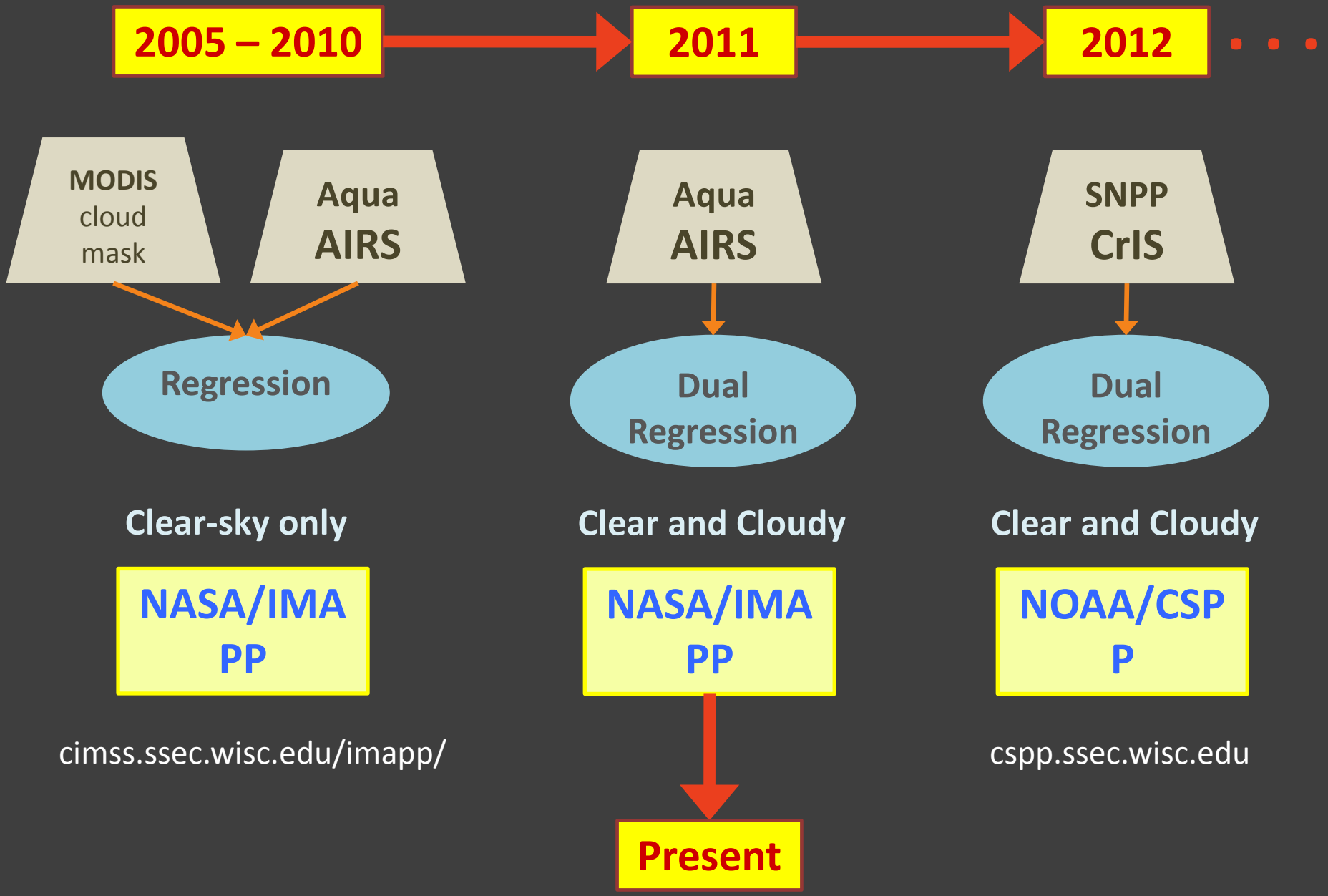
Hyperspectral Infrared Brightness Temperature Spectrum (CrIS)



High-spectral resolution infrared (IR) spectra contain information on:

- Surface properties (type, temperature, emissivity, inversion…)
- Temperature and humidity profiles (high vertical resolution)
- Cloud properties (altitude, temperature, optical thickness, ice/liquid content)
- Trace gases (O_3, CO, N_2O, CH_4 …)
- Dust and volcanic ash


2005 – 2010
2011
2012
MODIS cloud mask
Aqua AIRS
Aqua AIRS
SNPP CrIS
Regression
Dual Regression
Dual Regression
Clear-sky only
Clear and Cloudy
Clear and Cloudy
NASA/IMAPP
NASA/IMAPP
NOAA/CSPP
Present
cimss.ssec.wisc.edu/imapp/
cspp.ssec.wisc.edu

Level 1

Geo-referenced
Calibrated Radiances
Multi-instrument capability

Level 2

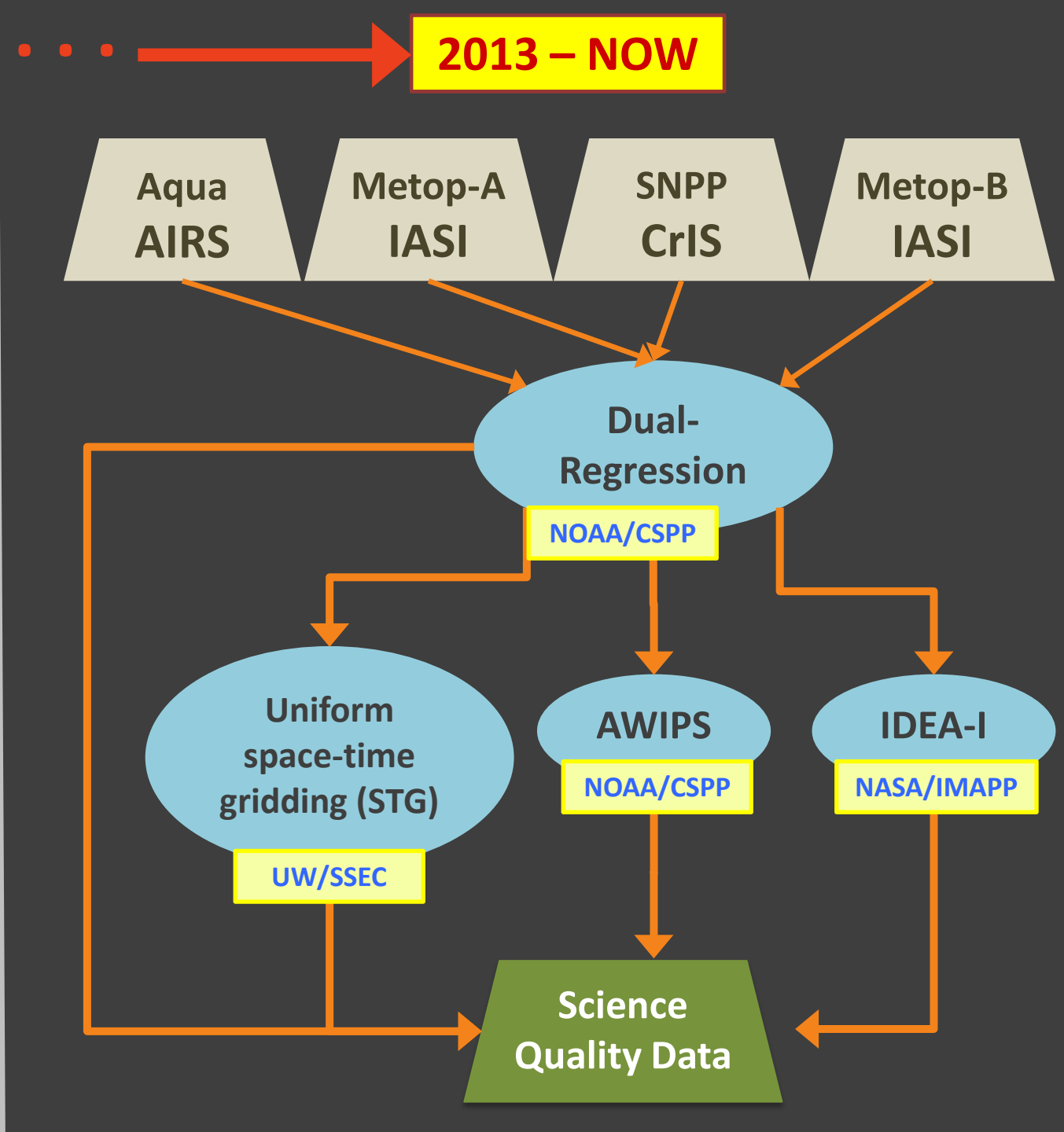
Retrieves quantitative info of Earth surface, clouds, trace gases and thermodynamic profiles for clear and cloudy skies

Level 3 + 4

Space-Time consistent data aggregation and colocation. Dynamic approach (application specific). Instrument independent, multi-parameter, robust descriptive statistics

The User

Can generate consistent, traceable data with good uncertainty estimates



Strengths of Dual-Regression Retrieval Algorithm

Off-line radiative transfer calculation
Least squares regression coupled with geophysical classification of brightness temperature makes radiance inversion problem near-linear
Optimized for direct broadcast environment, with low latency, high data volume, consistency and precision
Distributed as open-source stand-alone software package
Product-centric; can be applied to any hyperspectral sounder
Fast reprocessing of entire record for up-to-date data records
Retrieve atmospheric information for all FOVs from TOA to surface/cloud top
Consistency in space and time allows development of multi-instrument multi-parameter applications

DR processes 25-75 FOVs per second

Full package for all three instruments ~2GB: lightweight, easy to install and run on local system. No sophisticated resources required.

Severe Weather Analysis

Utilize multi–instrument capability to improve temporal resolution of soundings

Many case studies demonstrate the value of this multi-instrument approach to derive time-tendency information.

- Metop-A and Metop-B overpasses occur prior to convective cloud development
- At ~19:00 UTC (NPP overpass) convective cells are present, intensifying rapidly until ~19:35 UTC (Aqua overpass)
- AIRS cold cloud top temperatures (<-60°C) indicate strong updrafts (~30 minutes prior tornado)
- An EF-5 tornado struck Moore, OK, just after 20:00 UTC (3 PM local time)

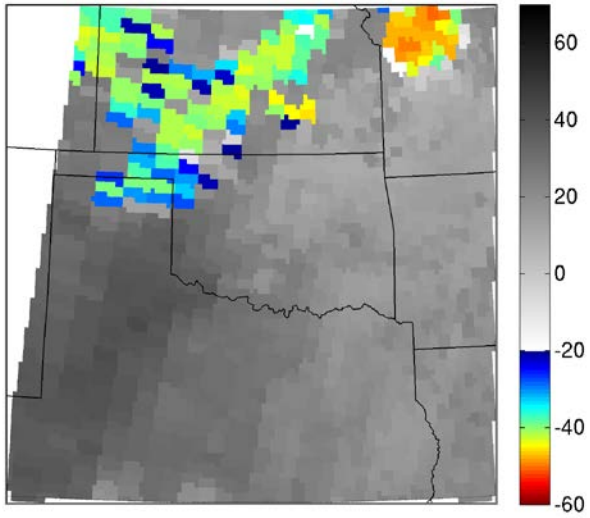
– Alaskan forecast community: high latitude regions have 20+ instrument overpasses
– Convection Working Group: study pre-convective environment
– Support efforts to prepare community for MTG-IRS

Publication: Weisz et al. in preparation

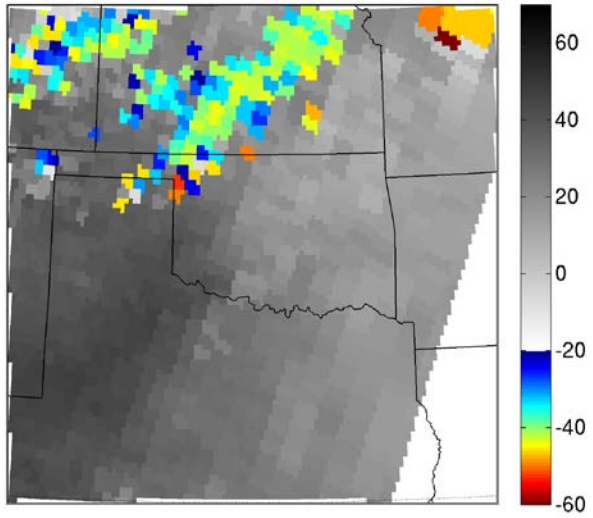
Moore, OK Tornado (20 May 2013)

Cloud Top Temperature [°C]

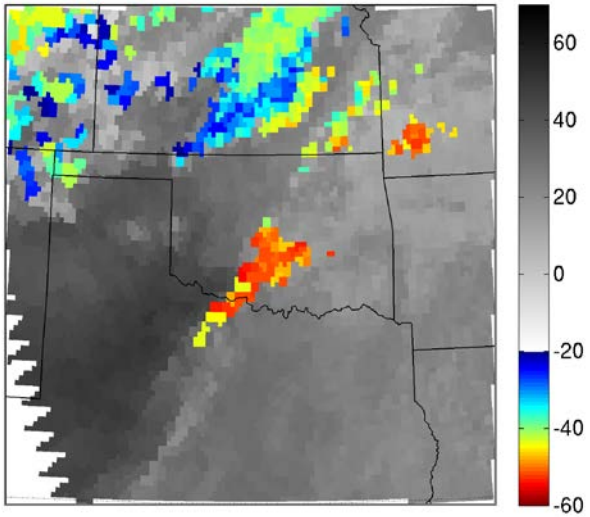
Metop-A **IASI** @ **15h56 UTC**



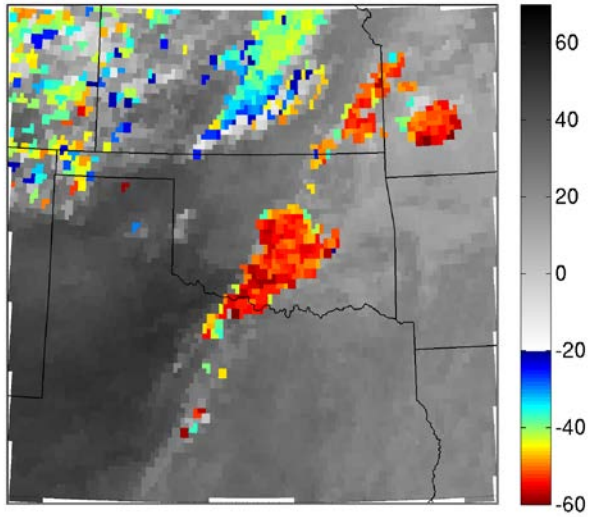
Metop-B **IASI** @ **16h53 UTC**



SNPP **CrIS** @ **19h00 UTC**



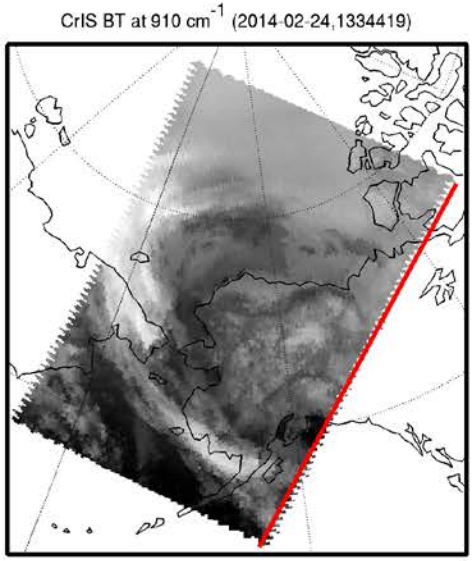
Aqua **AIRS** @ **19h35 UTC**

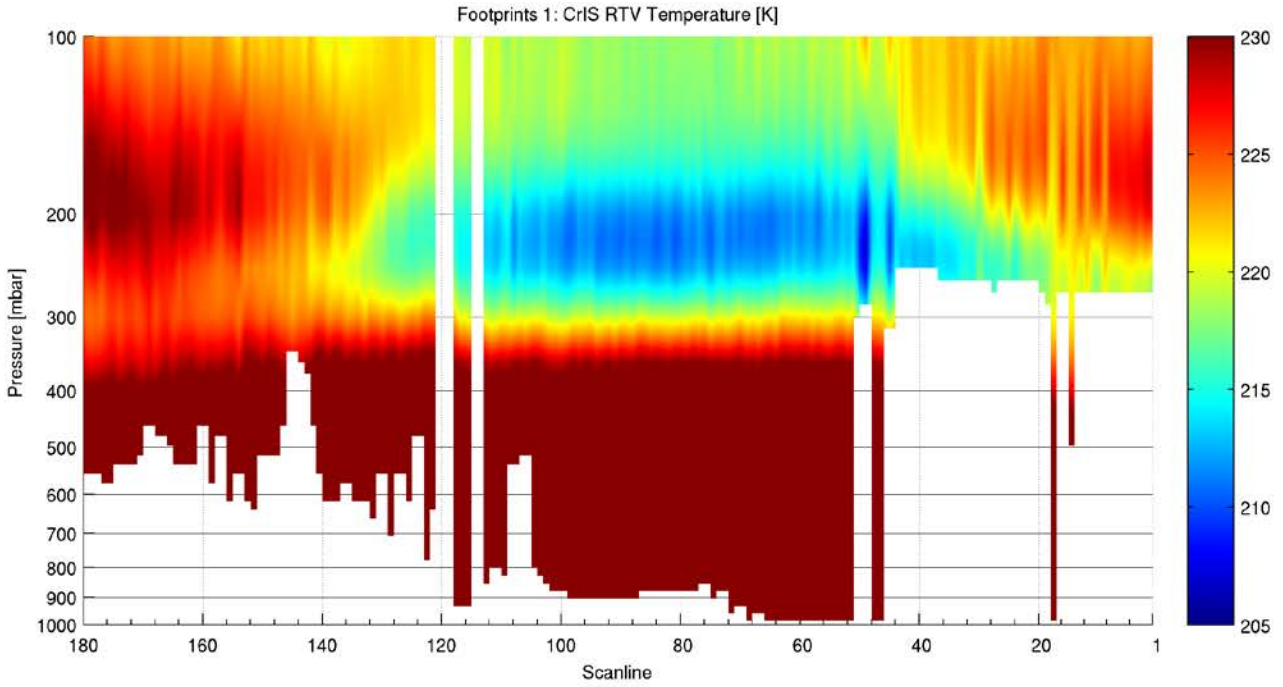


Working with Alaskan forecasting community to serve the Aviation industry

Detecting cold air aloft over polar regions

CrIS Temperature Cross-Sections (24 February 2014, 13:30 UTC)





Initial results demonstrate proof of concept

We aim to work with Alaska forecasters on developing innovative ways to add vertical information to their viewing capabilities so that they may improve forecasting of these events to commercial aviation over polar regions.

Efforts to add skill to meso-scale environmental monitoring systems

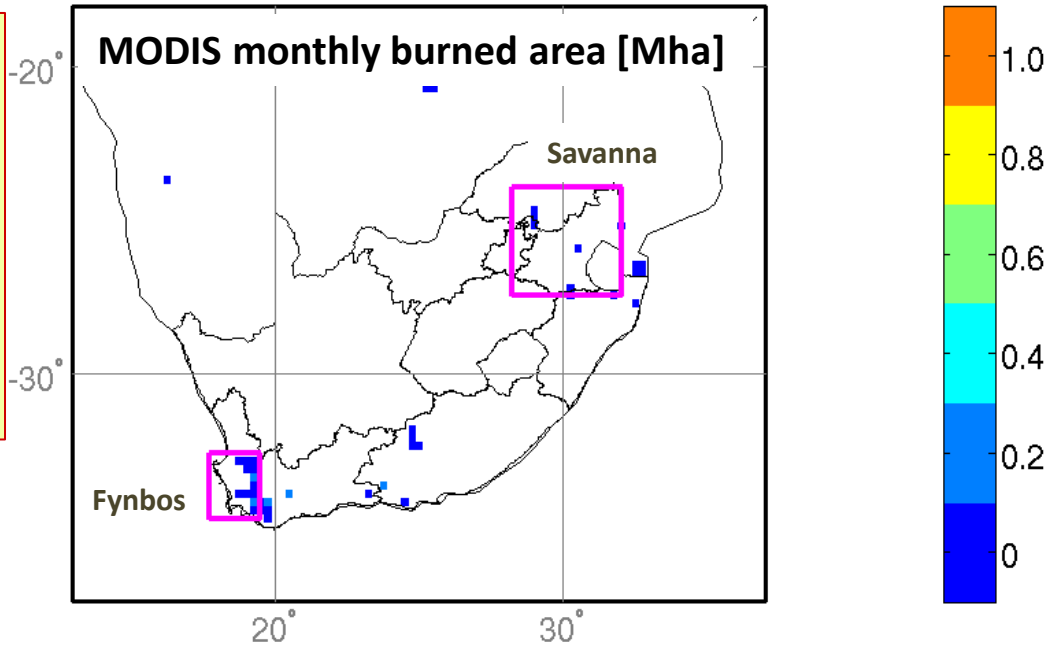
Working with South African fire monitoring and forecasting community: WWW.AFIS.CO.ZA

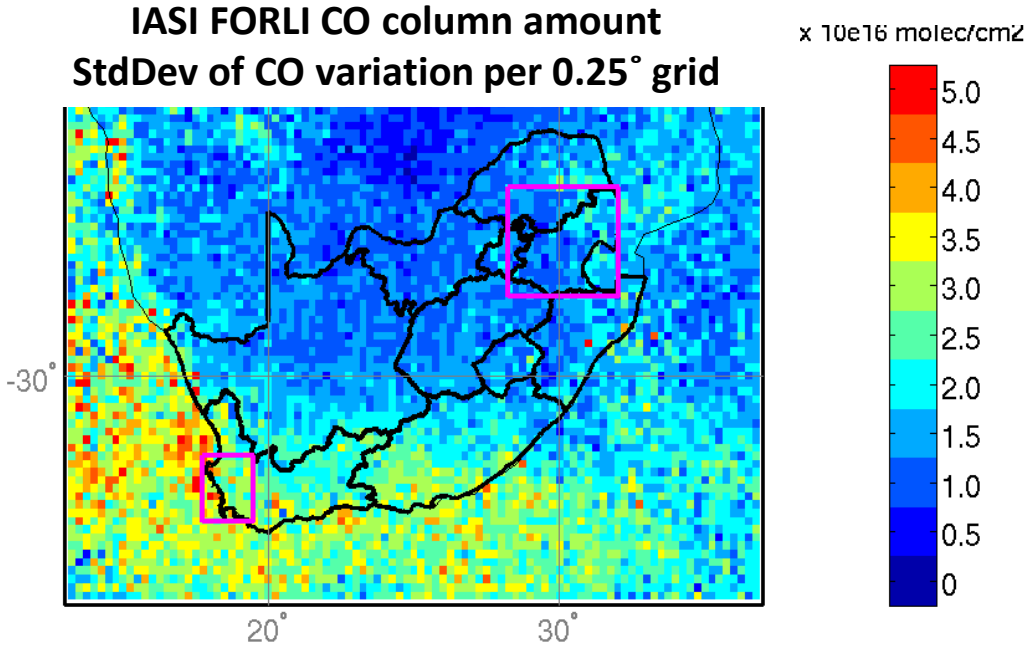
Objective: Add information about emissions to active fire and fire scar monitoring

Pilot study: test correlation between IASI CO and MODIS Burned Area products.

Collaboration with Dr. Helen de Klerk from Stellenbosch University

Based on lessons learned here we will add capability to the UW hyperspectral system

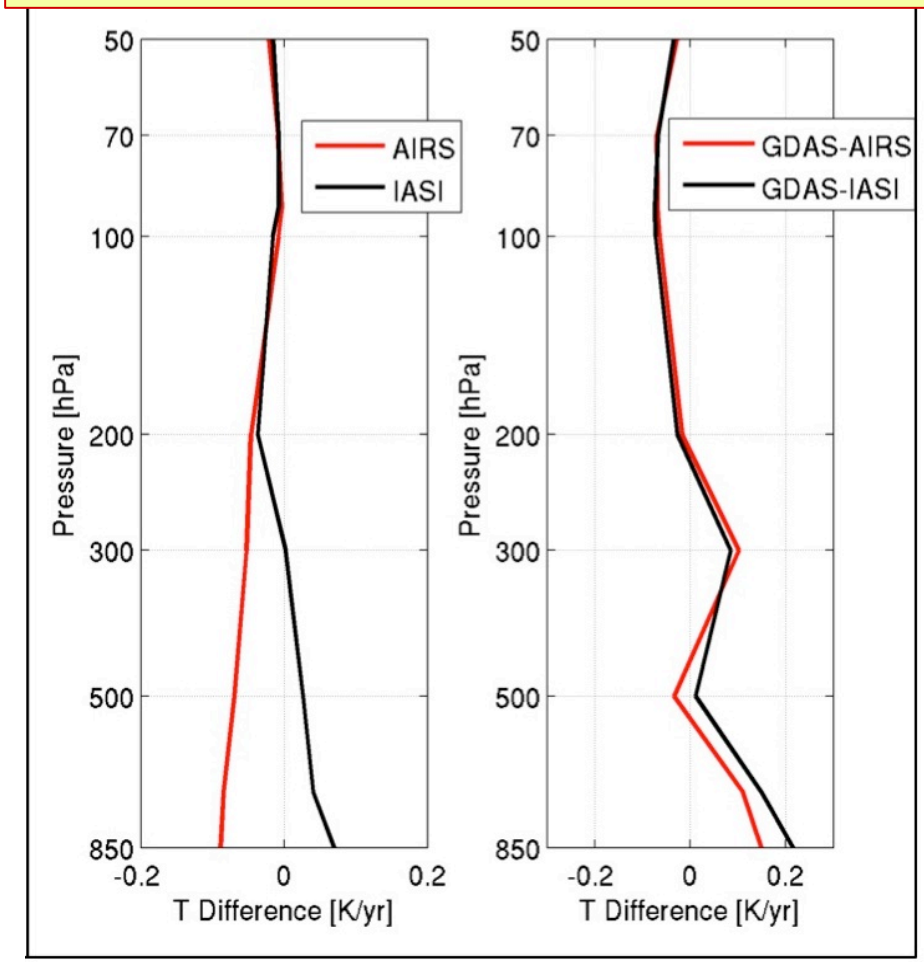




Smith, N, de Klerk H.M. et al (2013) Towards a multi-instrument analysis of atmospheric composition in fire driven ecosystems. *Proceedings of the 2013 Joint EUMETSAT/AMS Conference,* 16–20 Sep, Vienna, Austria

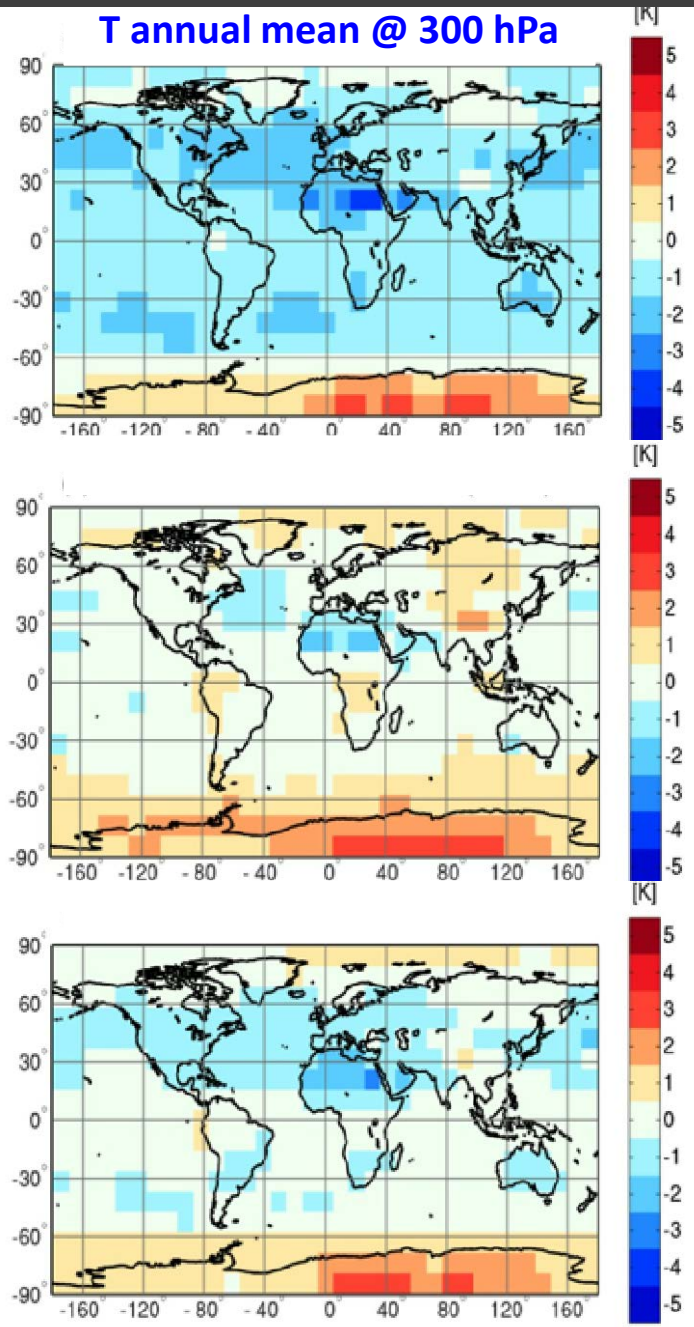
Supporting efforts to build long term records of essential climate variables

Characterizing sources of systematic differences among instrument data records:
(1) diurnal sampling and (2) instrument effects

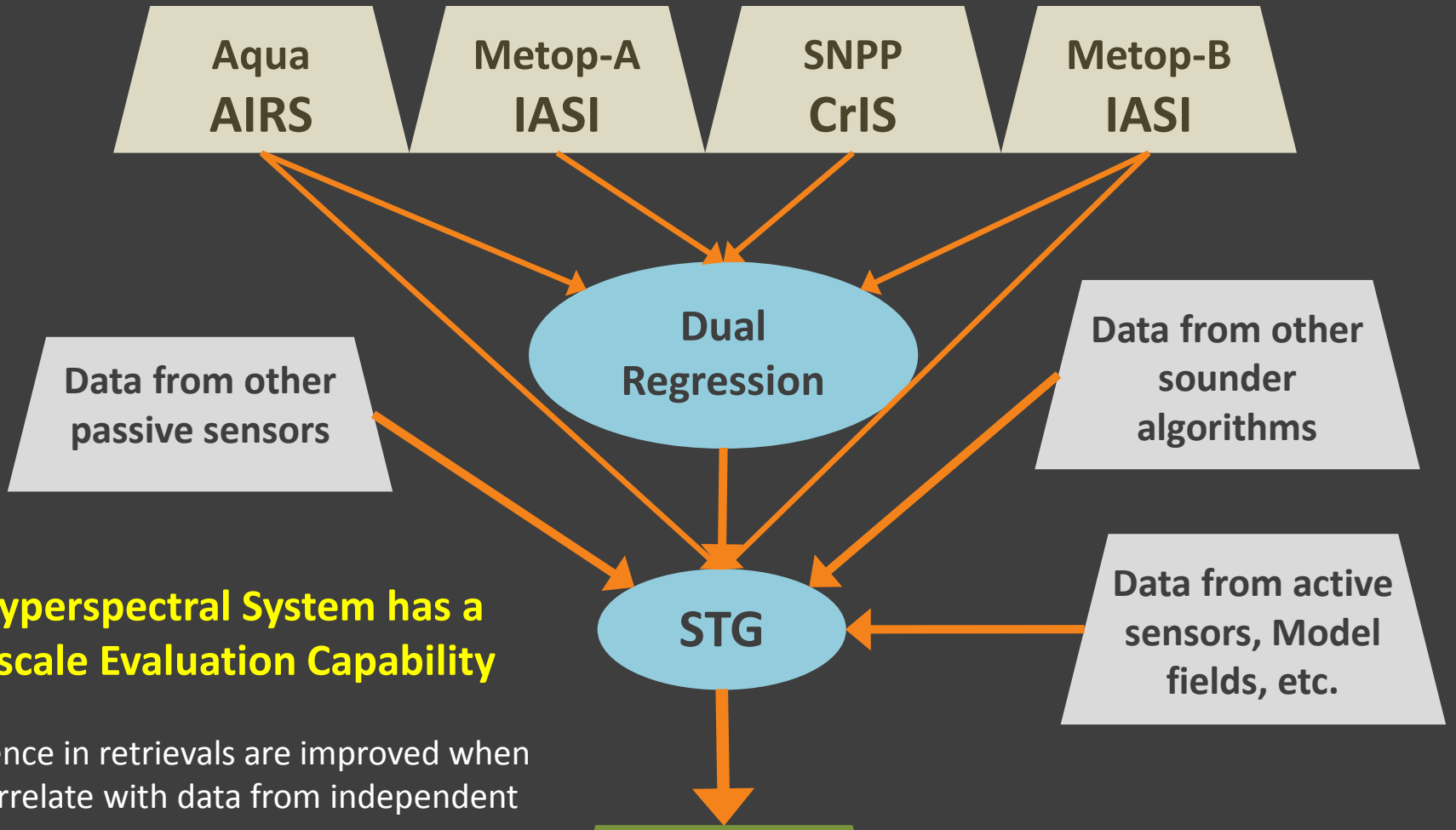


Smith, N., Smith, W.L., Weisz, E., and Revercomb, H. (in preparation). Climate monitoring with satellite data records – investigating the continuity among AIRS, IASI and CrIS soundings. J. Climate.

T annual mean @ 300 hPa



PRESENT



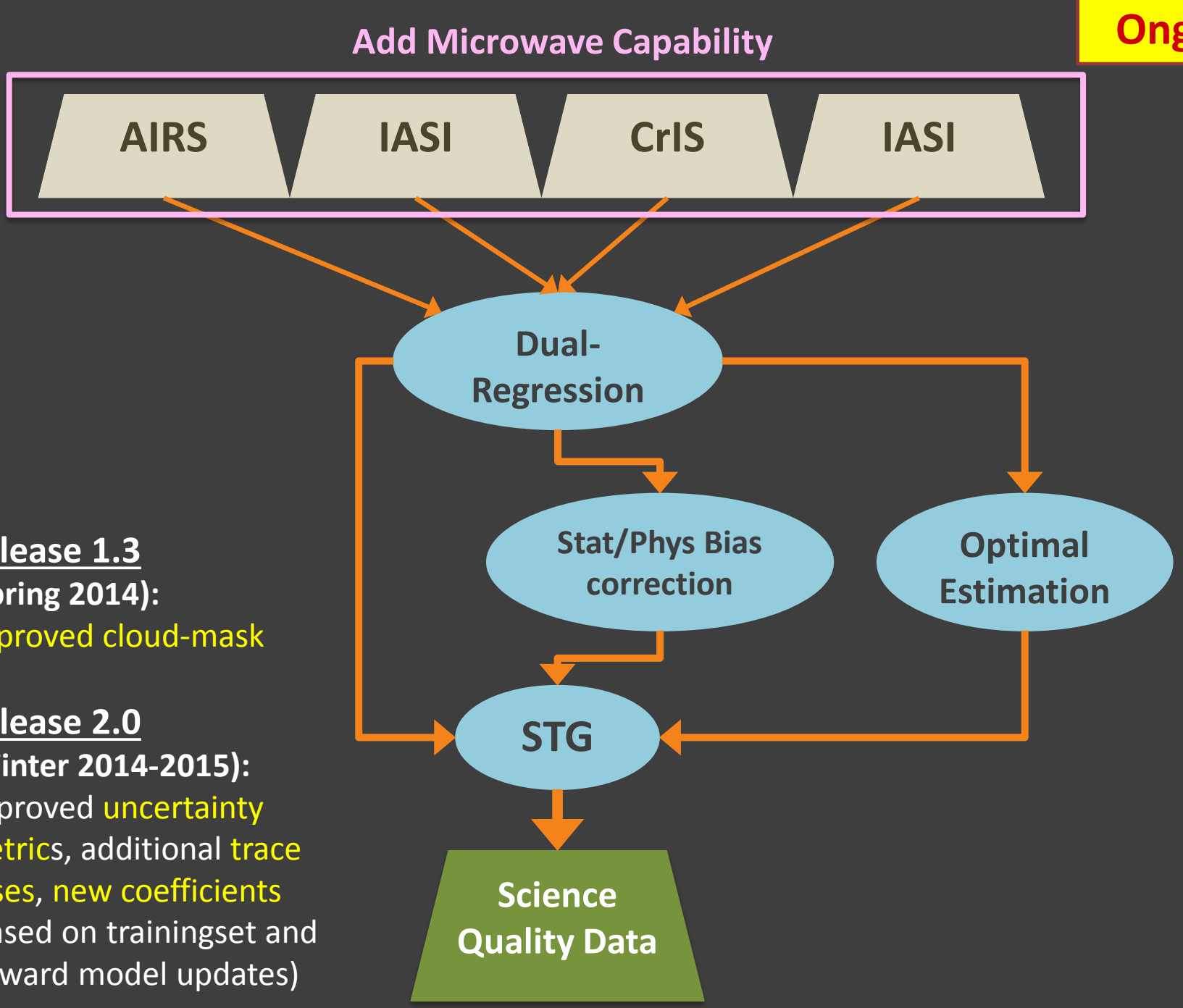
UW Hyperspectral System has a large-scale Evaluation Capability

Confidence in retrievals are improved when they correlate with data from independent sources.

We gain insight into observed short and long-term patterns through multi-source comparisons.

Study differences in data as a result of sources of systematic uncertainty Characterize DR bias

Ongoing



Release 1.3
(Spring 2014):
Improved cloud-mask

Release 2.0
(Winter 2014-2015):
Improved uncertainty metrics, additional trace gases, new coefficients (based on trainingset and forward model updates)

- We continue to work closely with users
- Maintain product **relevance**
- Develop **requirements** for new methods and products
- Promote **transparency** and **traceability**
- Retain **flexibility** to best serve user community