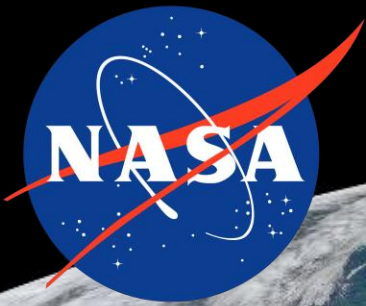




HYPERSENSPECTRAL *IN SITU* SUPPORT FOR PACE (HYPERINSPACE)

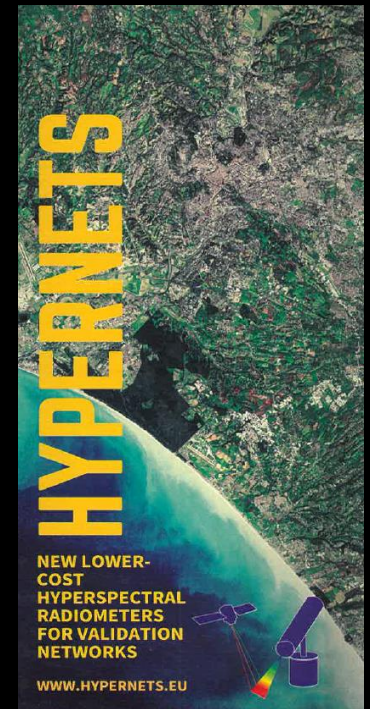
Autonomous above-water radiometry

Dirk Aurin, PhD., USRA @ NASA
Goddard Space Flight Center
dirk.a.aurin@nasa.gov
Ocean Sciences February 28, 2019

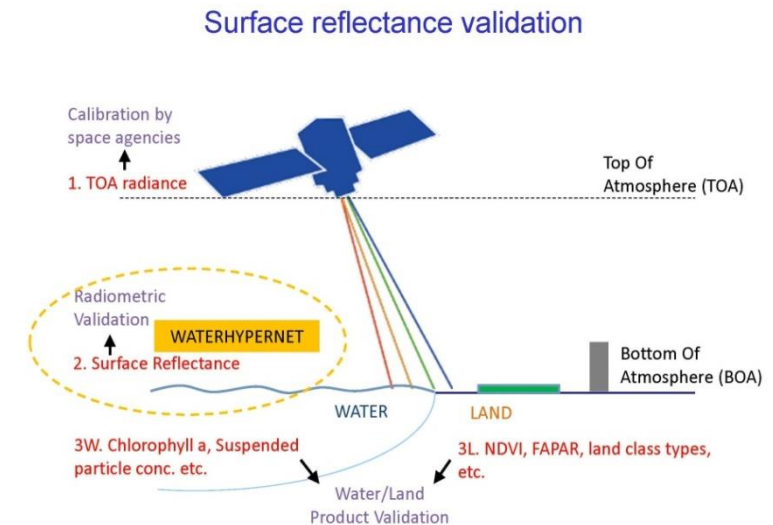


Quality Data for Cal/Val and Algorithm Development

- Satellite OC imagery, without *in situ* validation = fridge magnets and mouse pads
- AeronetOC-like hyperspectral towers may help
 - Finite & fixed (none planned for US yet)
 - Not yet built
- Autonomous Above-Water Data
 - Ferries, RVs since ~2003
 - Often matched to in-water AOPs/IOPs
 - All conditions and water-types
 - Is it “quality” data?
 - How was it processed?



WATERHYPERNET: A Hyperspectral network for water colour validation. Credit: RBINS.



Challenges



Recent NASA Affiliated Cruises with HyperSAS:

- NOAA NESDIS STAR/JPSS/VIIRS - CZCS to present
 - Nov 2014; MAB (Hyperpro, HTSRB, HyperSAS, etc.)
- ECOA
 - June-July 2015; US E. Coast
 - RV Gordon Gunter
- NOAA VIIRS JPSS 2015
 - Dec 2015; MAB, Bahamas
- KORUS
 - May 2016; Korea, East Sea
 - RV Onnuri
- Cyanate
 - Aug 2016; MAB
 - RV Sharp
- Sea-to-Space
 - Jan Feb 2017; E. Pacific
 - RV Falkor
- Po6S
 - July-Sept 2017; Trans-Pacific
 - RV Nathaniel Palmer
- EXPORTS
 - Sept 2018; N.E. Pacific
 - RV Sally Ride
- EXPORTS
 - May 2019; N.E. Atlantic
 - RV Discovery



Thousands of hours/miles of automated collections & counting

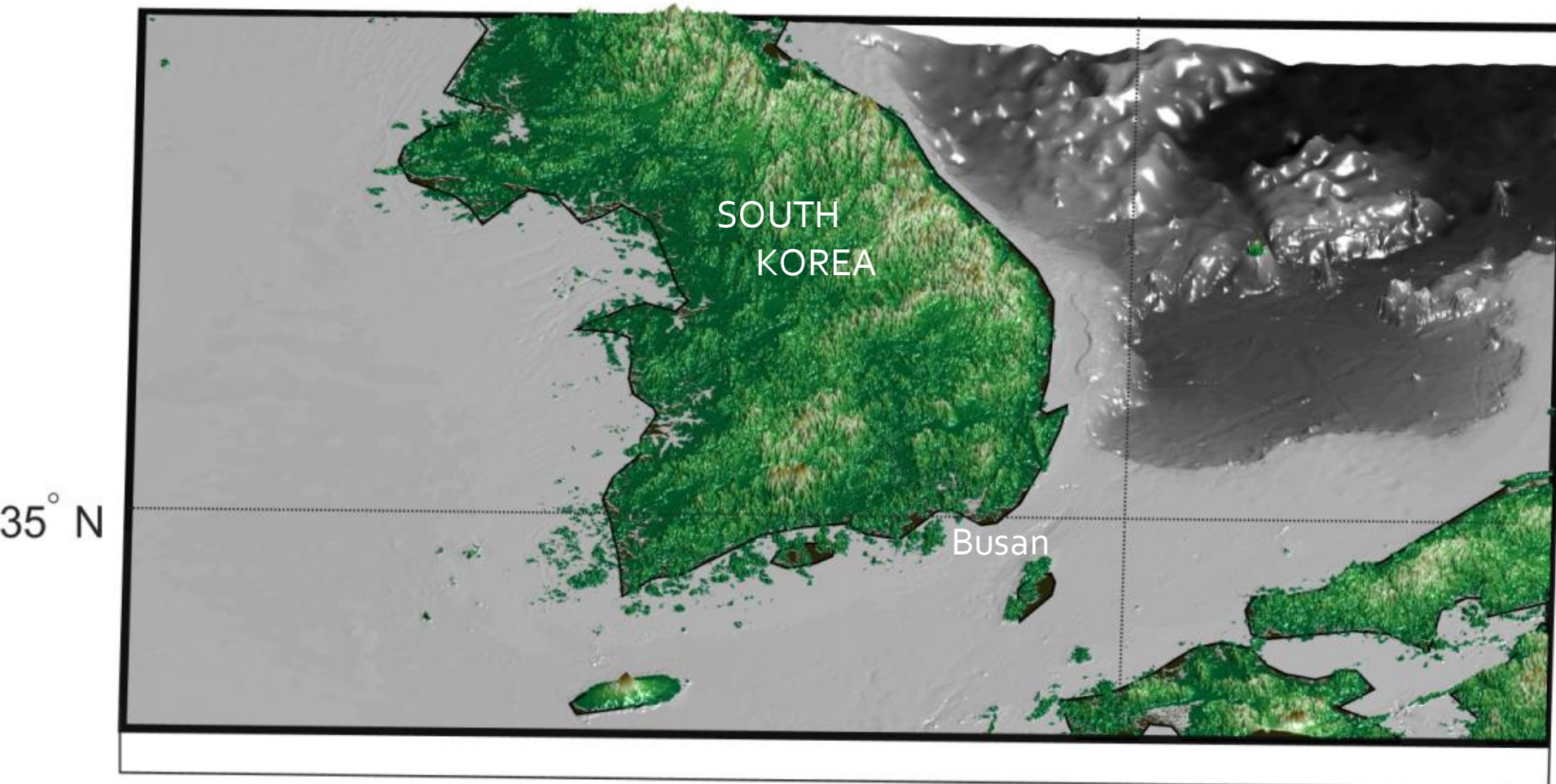
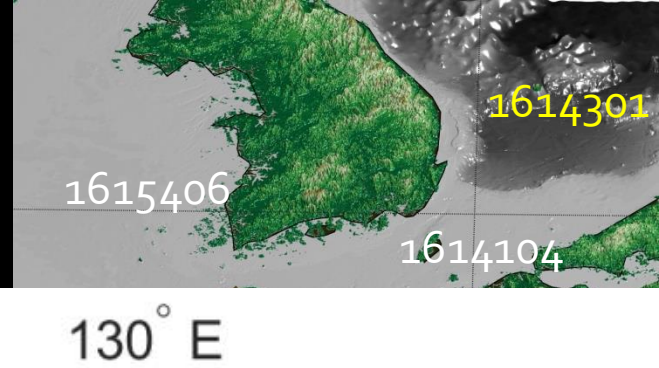


Dirk Aurin; OS2020 San Diego

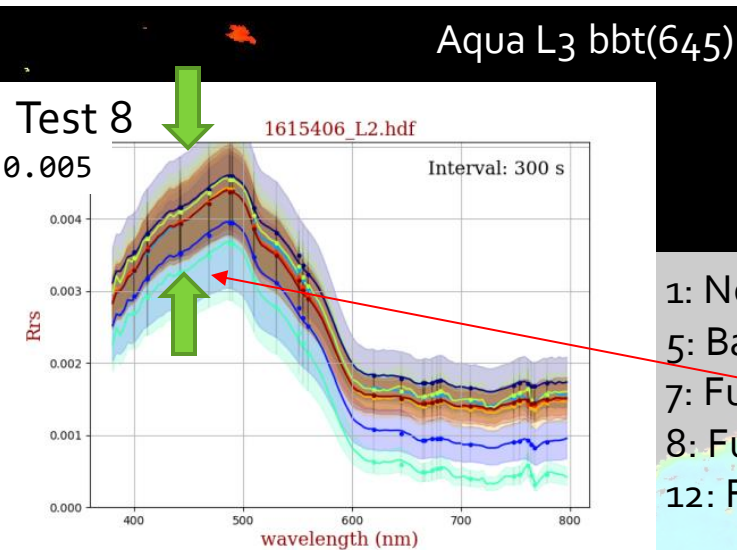
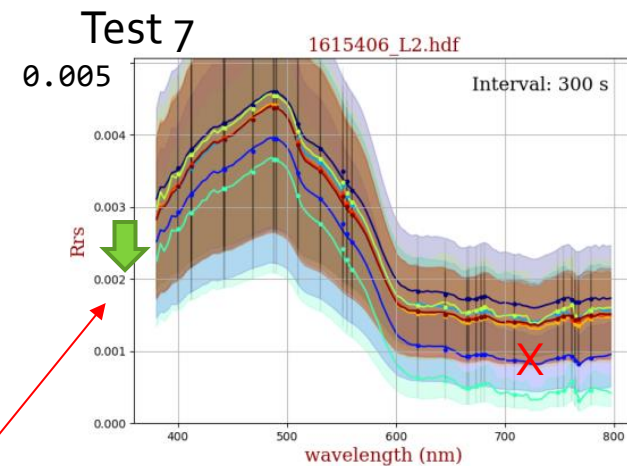
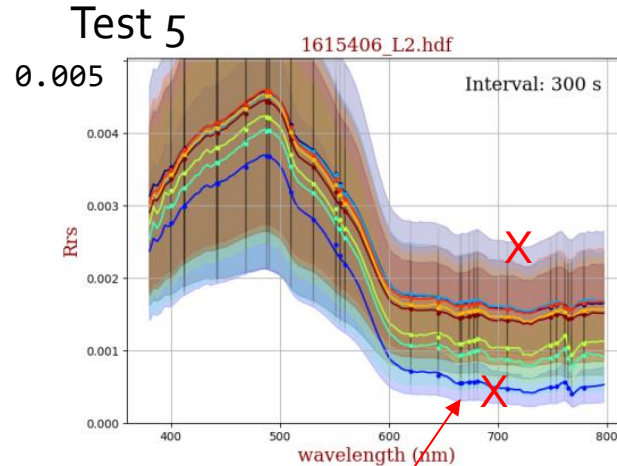
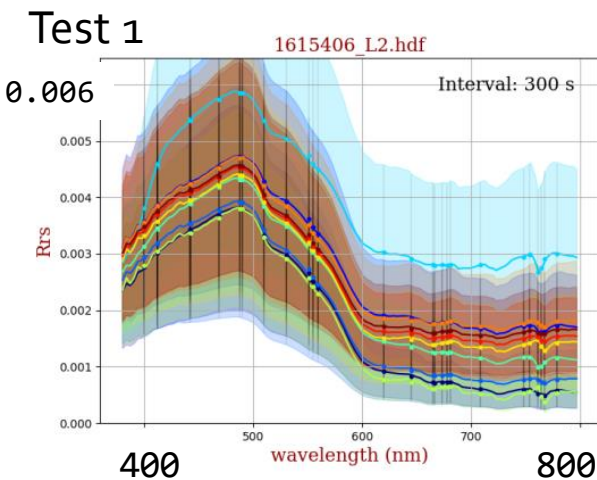
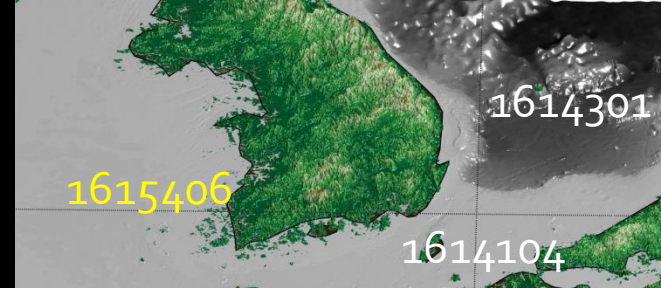


Preliminary Findings

KORUS 2016 $R_{rs}(\lambda, t)$

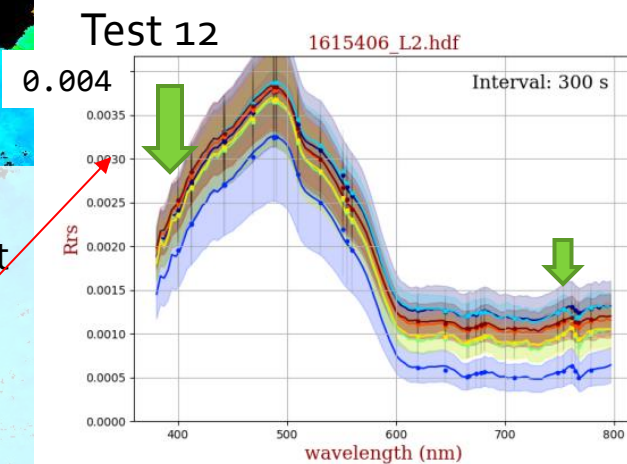


Underway Data 5 Minute Ensembles

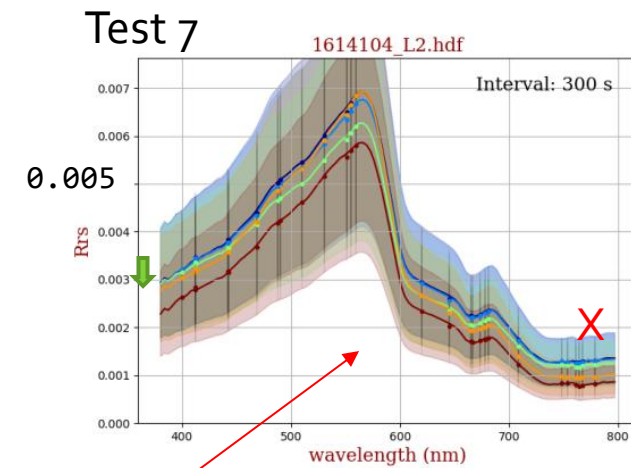
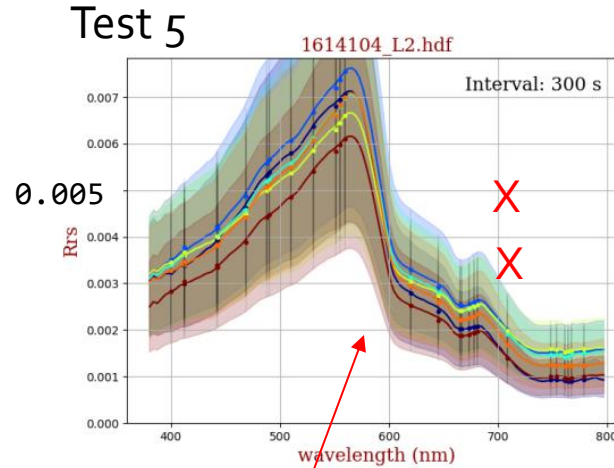
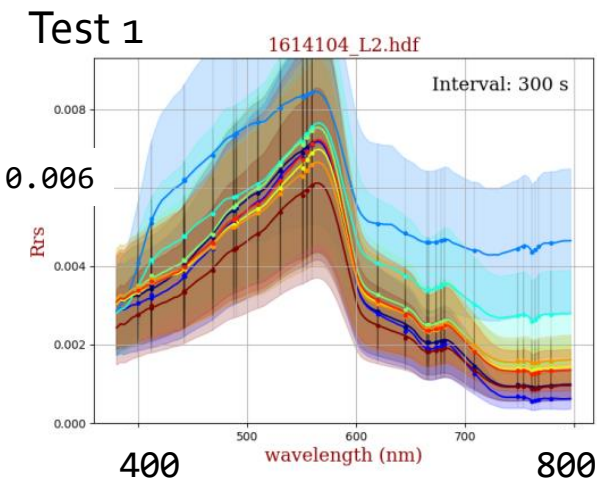
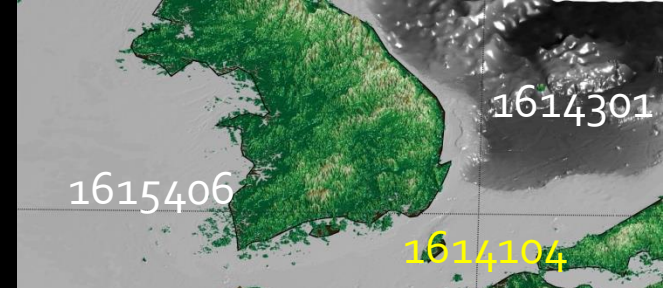


Aqua L3 bbt(645)

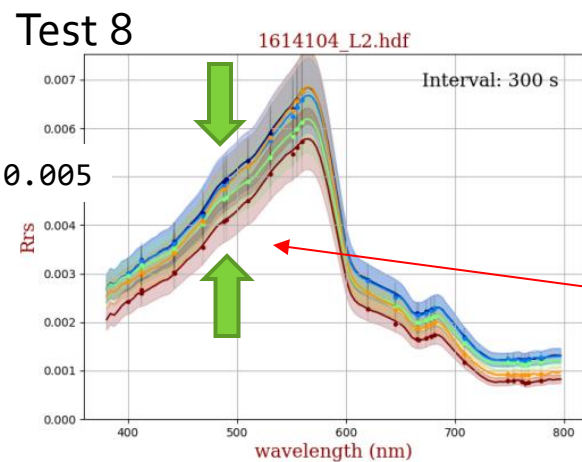
1: No QC + 50% Lt + Mobley Glint
5: Basic QC + 50% Lt + Mobley Glint
7: Full QC + 10% Lt + Mobley Glint
8: Full QC + 10% Lt + Ruddick Glint
12: Full QC + 10% Lt + Zhang Glint
+ SimSpec NIR



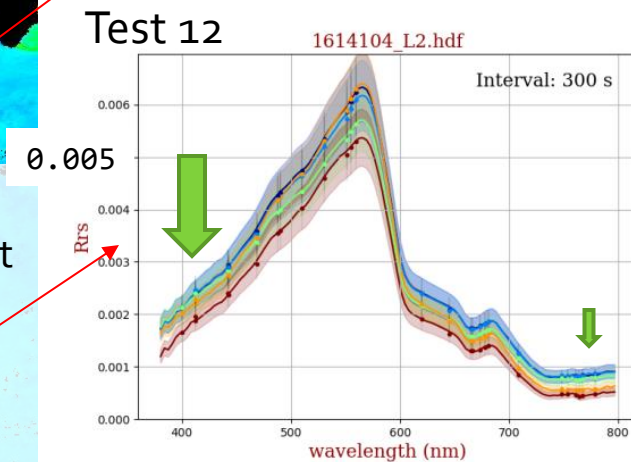
Processing Improvements



Aqua L3 bbt(645)

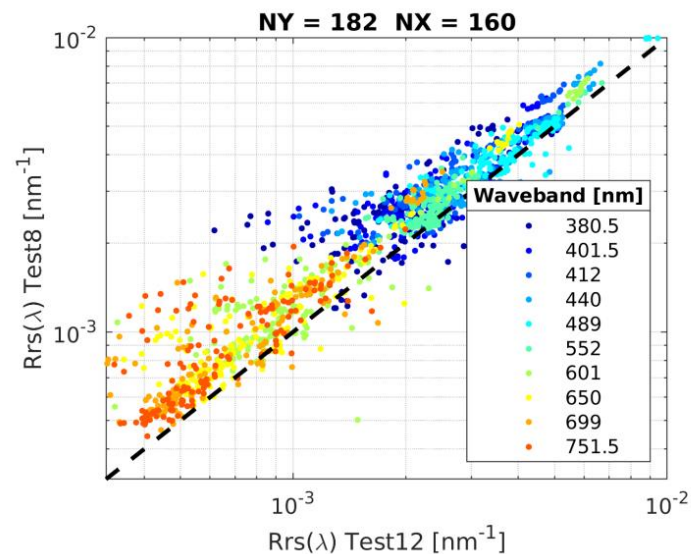
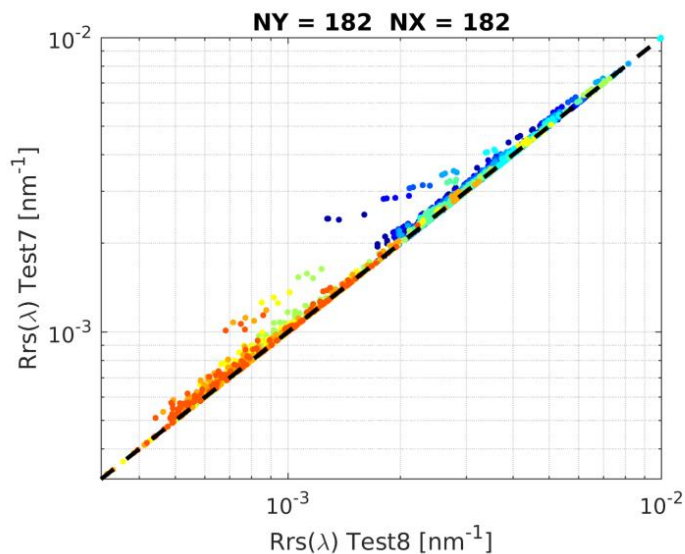
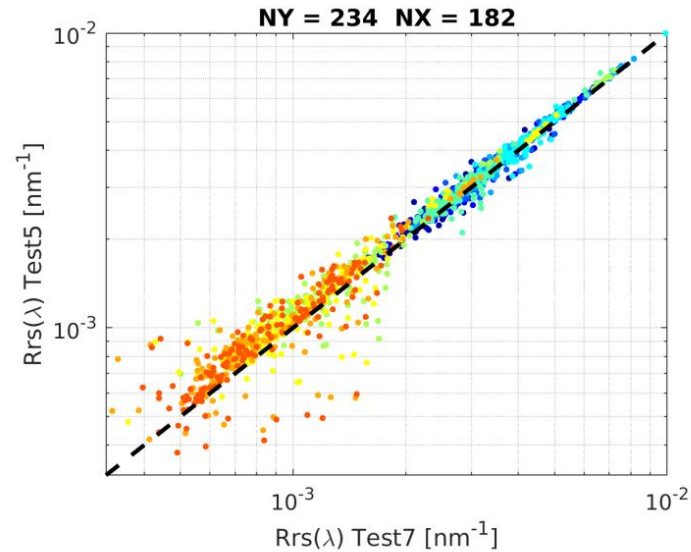
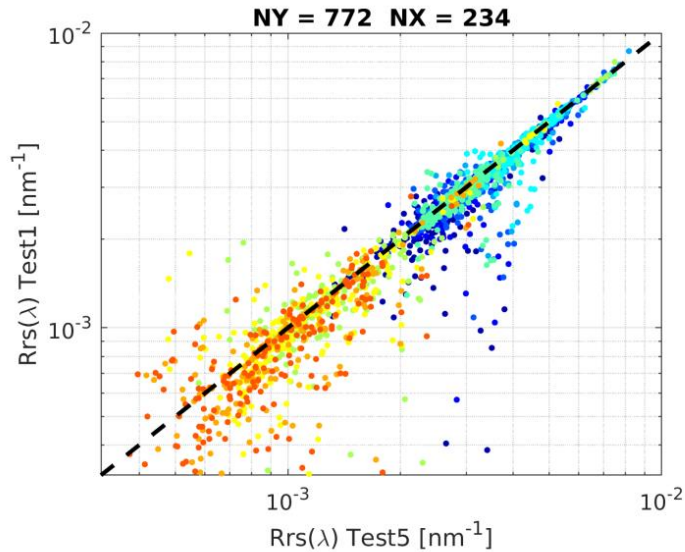


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7: Full QC + 10% Lt + Mobley Glint
8: Full QC + 10% Lt + Ruddick Glint
12: Full QC + 10% Lt + Zhang Glint
+ SimSpec NIR



Entire Cruise

- 1: No QC + 50% Lt + Mobley Glint
- 5: Basic QC + 50% Lt + Mobley Glint
- 7: Full QC + 10% Lt + Mobley Glint
- 8: Full QC + 10% Lt + Ruddick Glint
- 12: Full QC + 10% Lt + Zhang Glint + SimSpec NIR



Summary

- Many challenges - Is underway data “quality”?
 - Collected under non-ideal conditions
 - HyperInSPACE adapts to conditions & filters using field info
 - Transparent, shareable, and traceable
 - Still need to validate; match to station in-water data
- Is HyperInSPACE ready?
 - We need beta testers. Contact me.
- What's next?
 - BRDF correction and uncertainty budgets need improvement (not just in HyperInSPACE)
 - Add in OC product retrievals (Kd, Chl, GIOPs, QAA, etc.)
 - Should grow to accommodate more instrument suites (DALEK, WISP, Trios, Hypernets, ...?)

Configuration: KORUS.cfg

☐ Enabled

Frame Type:

ShutterLight

Level 1A Processing

Raw binary to HDF5

Solar Zenith Angle Filter

☒ SZA Max 65.0

Level 1B Processing

Apply factory calibrations

Level 1C Processing

Filter on pitch, roll, yaw, and azimuth

Rotator Home Angle Offset 0.0

Rotator Delay (Seconds) 60.0

Pitch & Roll Filter ☒

Absolute Rotator Angle Filter ☒

Relative Solar Azimuth Filter ☒

Level 1D Processing

Data deglitching and shutter dark corrections

☒ Deglitch Data

Window for Darks (odd) 9

Window for Lights (odd) 11

Launch Anom. Anal. to test params on L1C. Save config after updating params. Results saved to /Plot/L1C_Anoms.

Waveband interval to plot (integer): 3

Anomaly Analysis

Level 1E Processing

Interpolation to common times and wavebands.

Interpolation Interval (nm) 3.5

Generate Plots (slow; saved in ./Plots/L1E/) ☐

Save SeaBASS text file ☒

SeaBASS Header File KORUS.hdr

Level 2 Preliminary

GMAO MERRA2 ancillary data are required for Zhang glint Zhang correction and can fill in wind for Ruddick glint. WILL PROMPT FOR EARTHDATA USERNAME/PASSWORD [Register here.](#)

Download Ancillary Models ☒

Level 2 Processing

Quality control filters, glint correction, temporal binning, reflectance calculation.

Eliminate where Lt(NIR)>Lt(UV) ☒

☒ Enable Spectral Outlier Filter

☒ Enable Meteorological Filters

☒ Dawn/Dusk Es(470/680)< 1.5

☒ Enable Percent Lt Calculation

Skyglint/Sunglint Correction (Rho)

☒ Ruddick 2006 Rho
 ☐ Zhang 2017 Rho
 ☐ Mobley 1999 Rho

NIR Residual Correction ☒

☐ Simple resid. Hooker 2003 (blue water)
 ☒ Simil. Spec. Ruddick 2006 (turbid)

Remove Negative Spectra ☐

Add Weighted Satellite Bands:

☒ AQUA
 ☒ Sen-3A
 ☐ V-NPP
 ☒ TERRA
 ☐ Sen-3B
 ☒ V-JPSS

Generate Spectral Plots

☒ Rrs
 ☒ nLw
 ☒ Es
 ☒ Li
 ☒ Lt

Save SeaBASS text file ☒