

Ferry Ocean Colour Observation Systems (FOCOS)

- Deployment
- Data quality
- Download
- Data reduction
- Data analysis

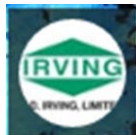
Maycira Costa

Satellite Validation International Workshop, Plymouth
June, 2017



<http://uvicspectral.com/>

maycira@uvic.ca



West Coast of Canada



Salish Sea

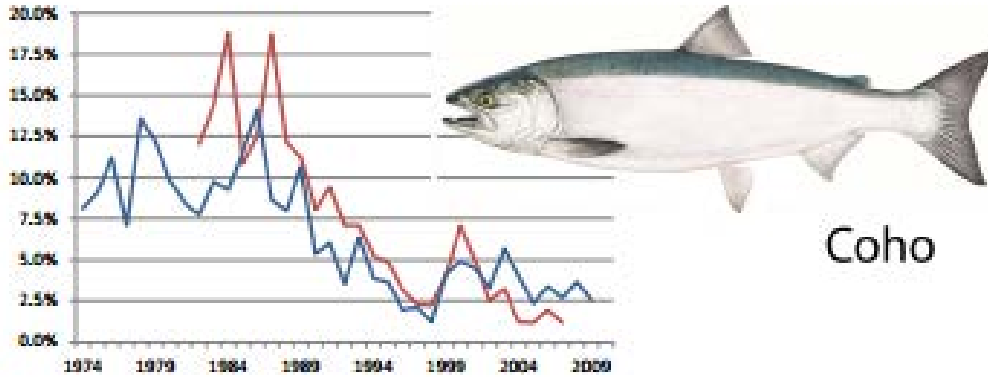


~17,000 km²

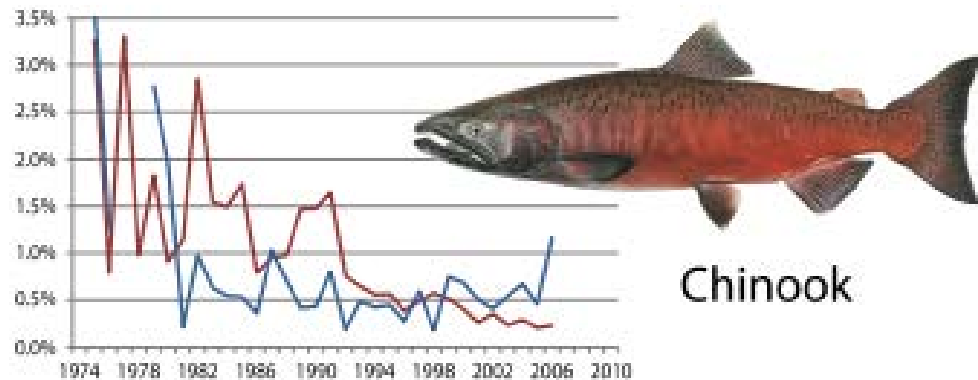
~7,500 km coastline

~ 8 million population

Why do we care?

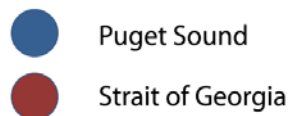


? Synchrony between primary/secondary phenology and salmon productivity.

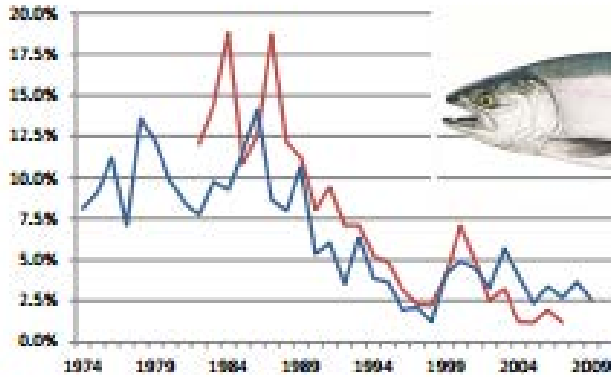


Spatial-temporal time series

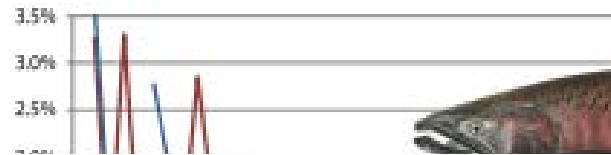
Marine survival rates



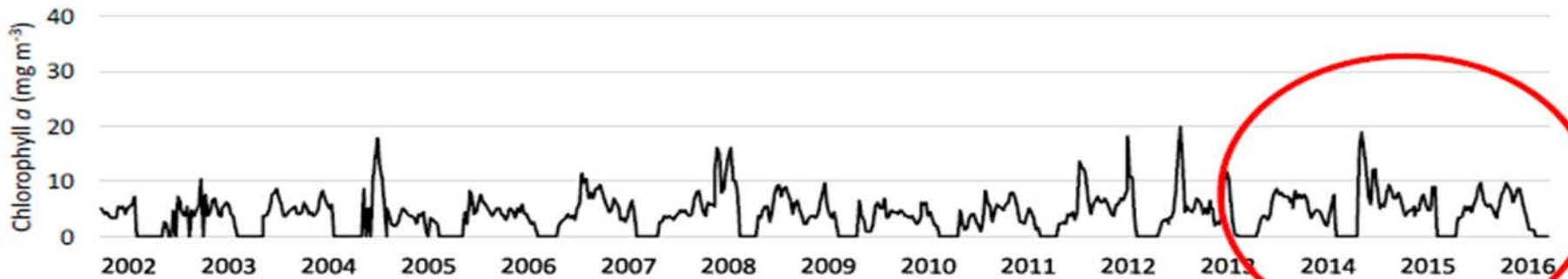
Why do we care?



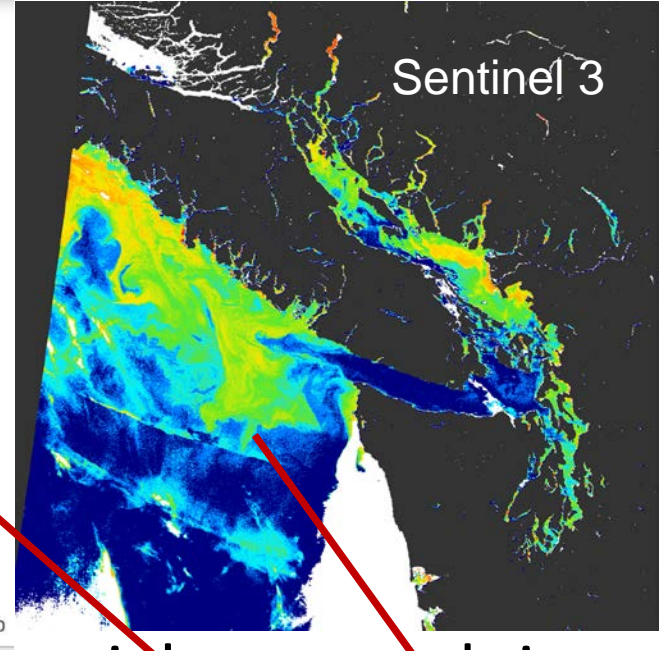
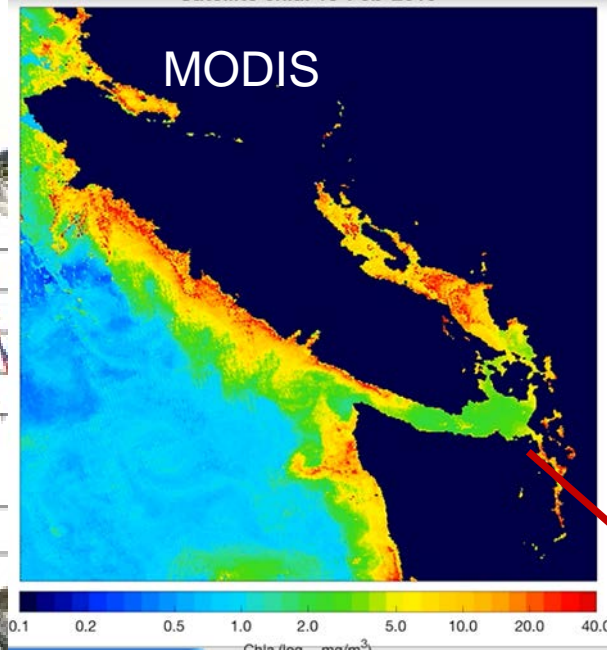
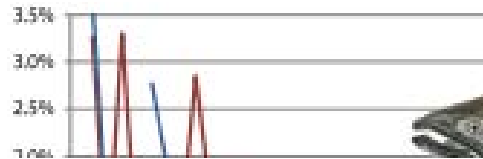
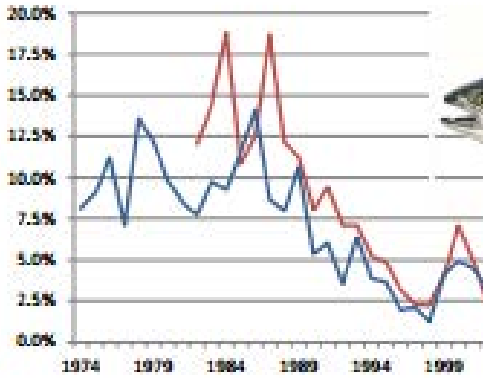
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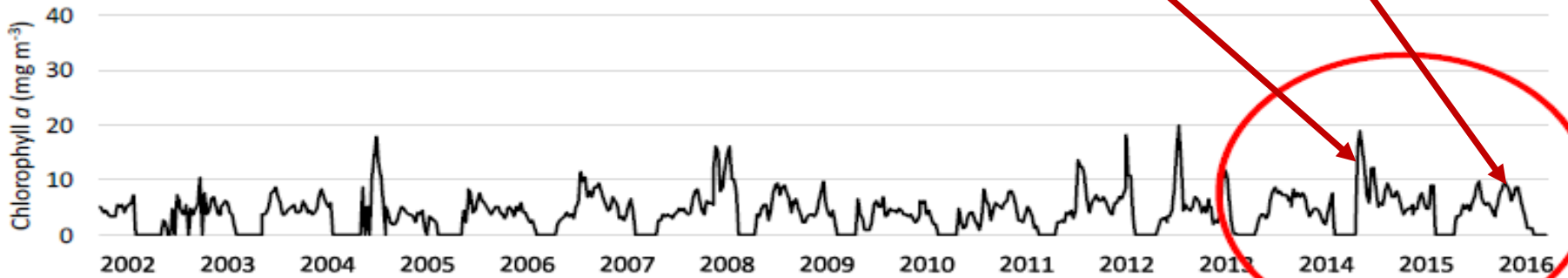
Weekly median chlorophyll levels for the Central Strait of Georgia (2002-2016)



Why do we care?



Weekly median chlorophyll levels for the Central Strait of Georgia (2002-2016)



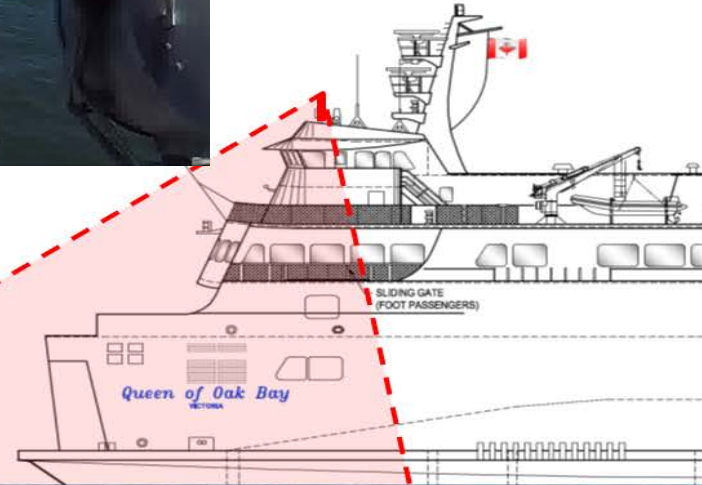
1. Deployment requirements

Instrument – HyperSAS Solar Tracker



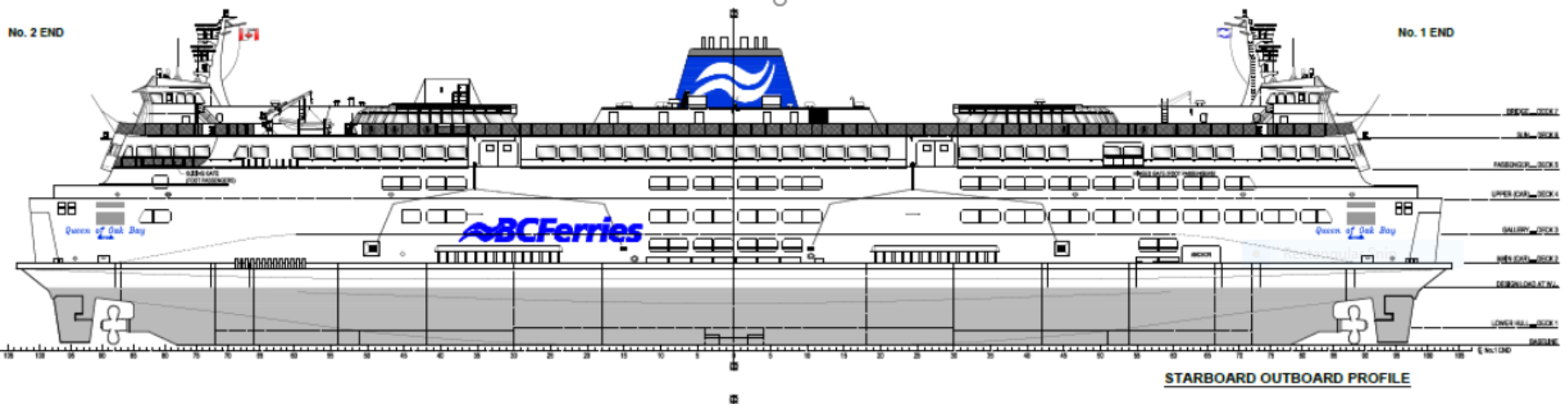
FOCOS

(Ferry Ocean Colour Observation System)

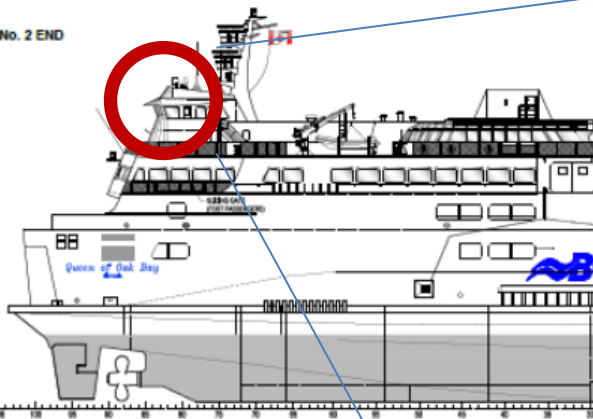


Queen of Oak Bay

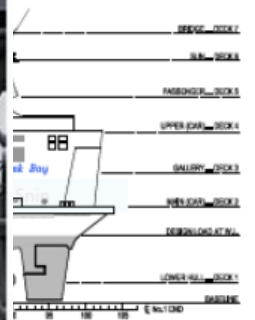
Length ~ 140 m



No. 2 END

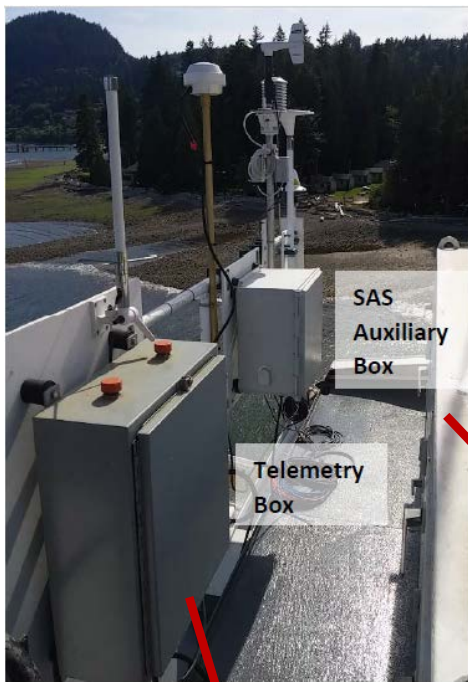


No. 1 END



PROFILE

BERTH # 2



SAS ST mounted on a pedestal

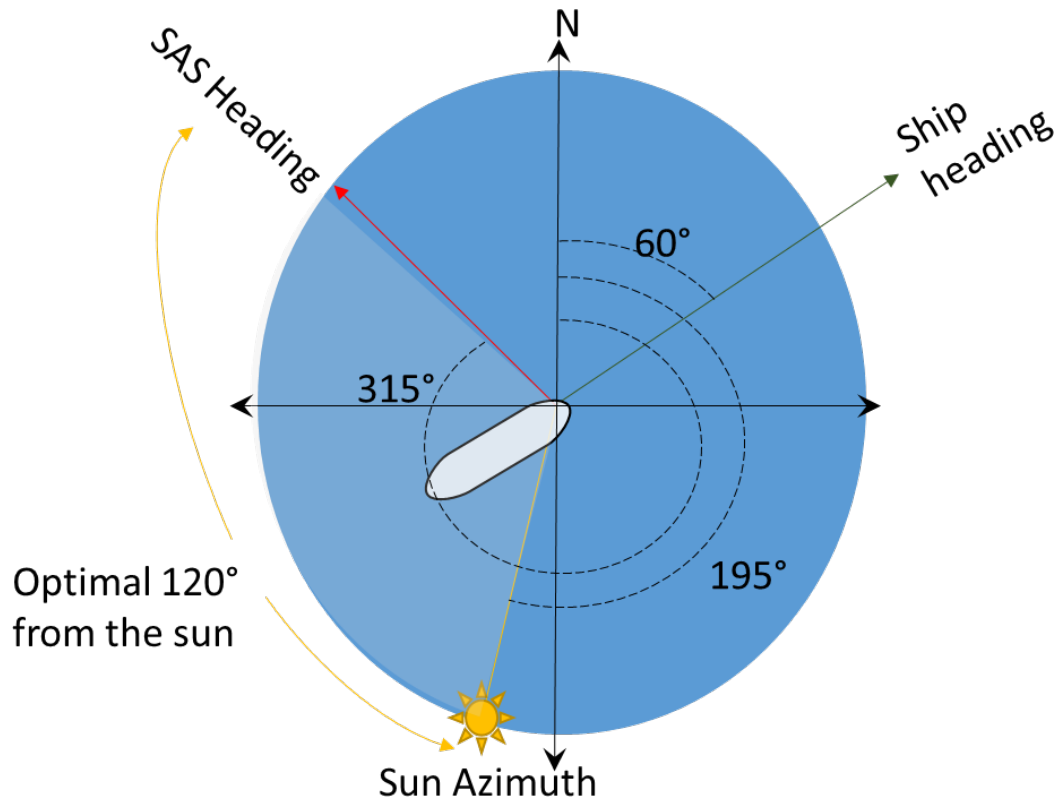


Driver computer: Linux and has Ethernet connectivity



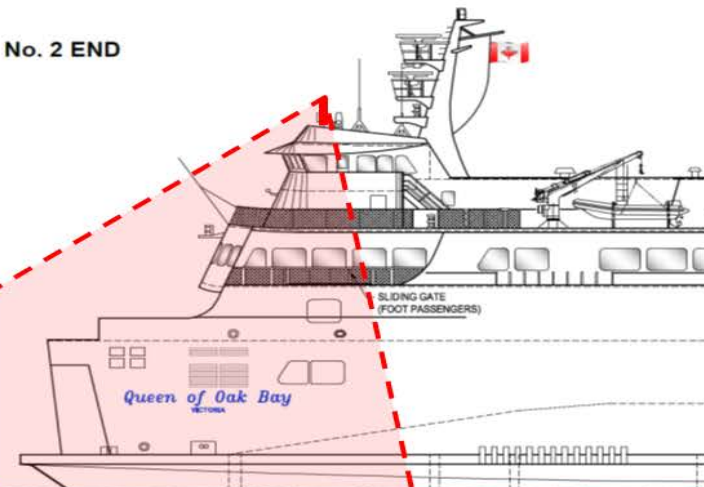
Power supply and SAS deck unit

FOCOS



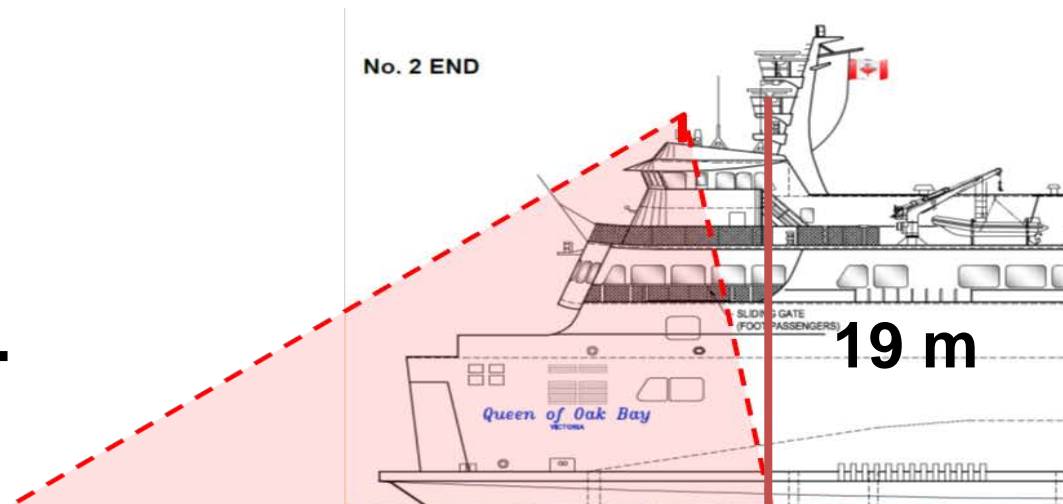
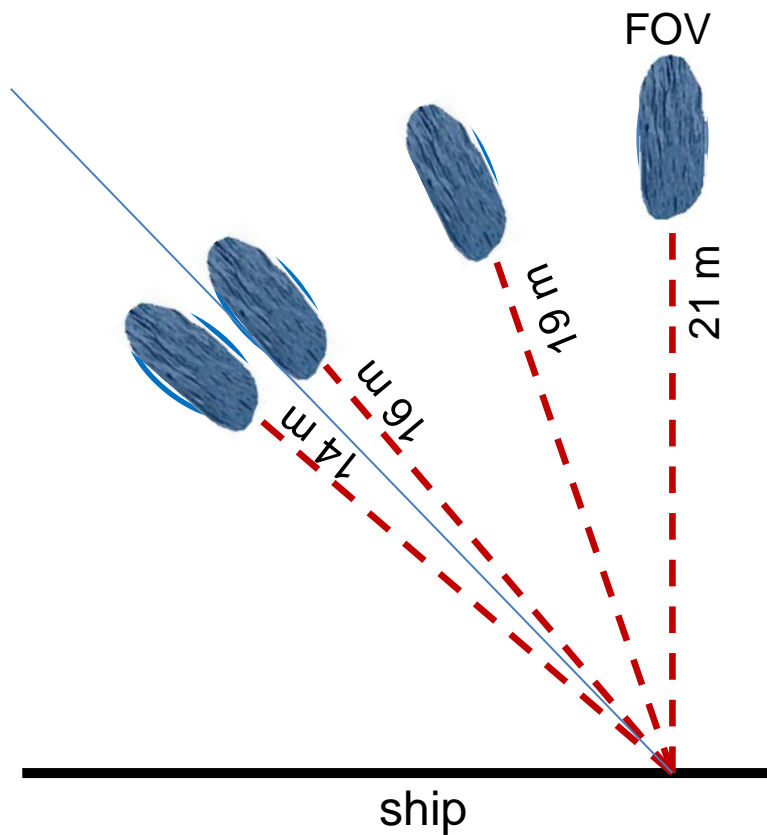
- Avoid ship structure, shadow, wake
- Sun-sensor azimuth
- Distance from ship

No. 2 END

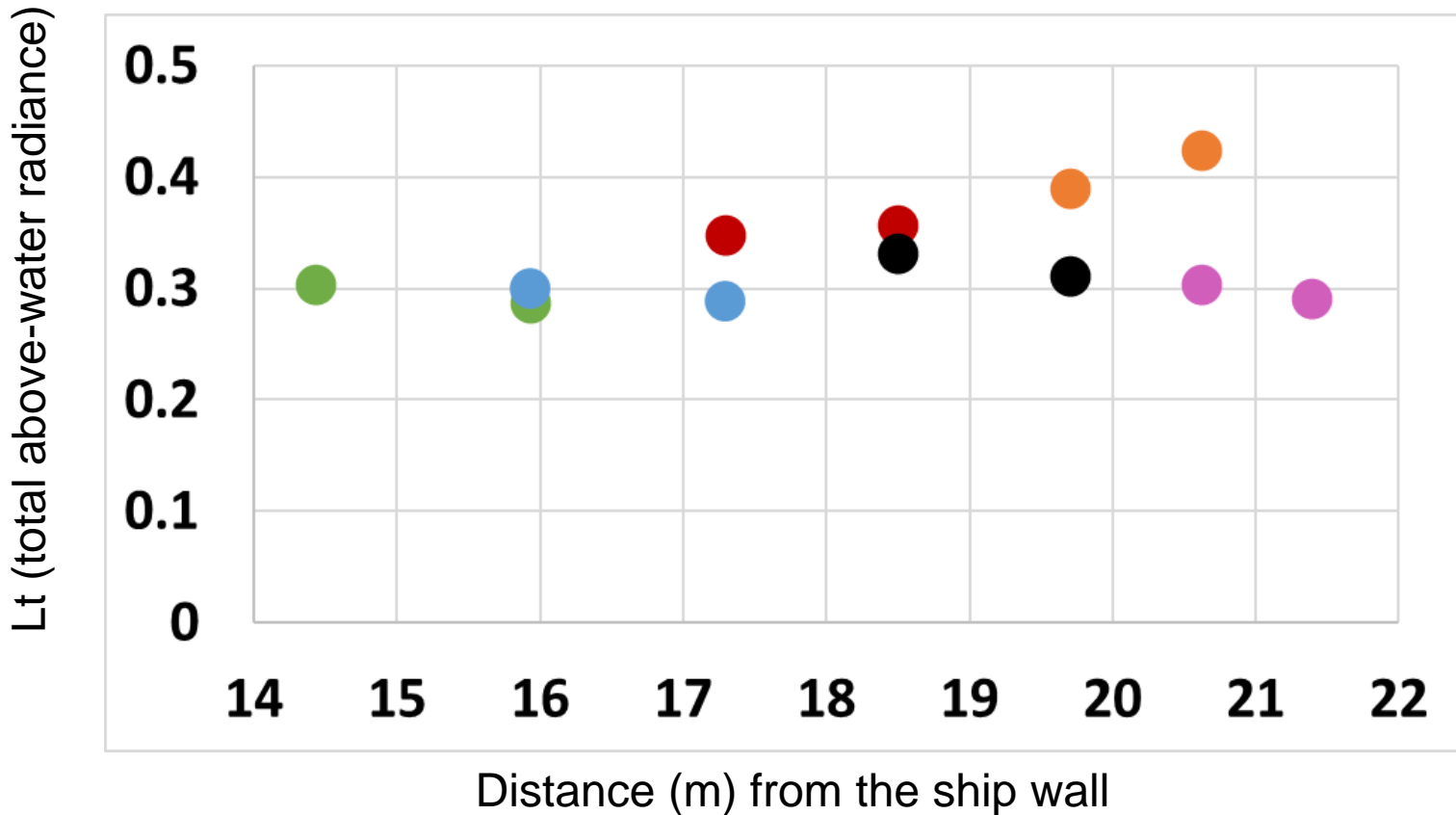


Sensor rotates to optimize sun-sensor azimuth angle

Field of view footprint and distance from the ship:
16-21 m is acceptable



Effect of distance from the ship wall on Lt (412nm)



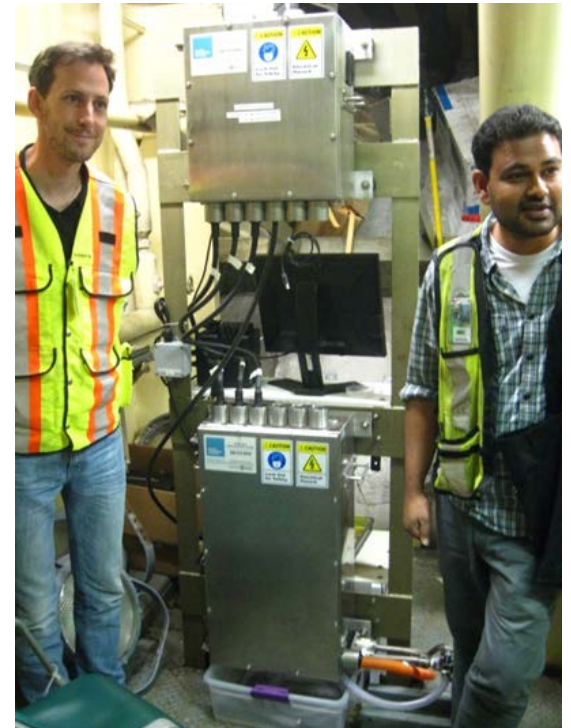
Same colour represents measurements made less than 1 minute apart, but the rotator changed azimuth angle. Note Lt is very similar for consecutive distances from the ship wall.

2. Data quality:

bi-weekly cleaning of instrument lens;
8 months deployment and re-calibration



SAS Solar Tracker - cleaning



Ferrybox, cleaning

FOCOS

3. Download: near-real time – Ocean 2.0





4. Data Reduction: PySciDON (based on Python)

The PySciDON main interface is a light-colored window with a dark title bar. It contains several sections: 'Config File' with a dropdown menu showing 'TestFerries.cfg' and 'New', 'Edit', and 'Delete' buttons; 'Wind Speed File' with an empty text box and 'Add' and 'Remove' buttons; 'Single-Level Processing' with buttons for 'Preprocess Raw', 'Level 1 --> 1a', 'Level 1a --> 1b', 'Level 1b --> 2', 'Level 2 --> 2s', 'Level 2s --> 3a', and 'Level 3a --> 4'; and 'Multi-Level Processing' with buttons for 'Level 1 --> 2', 'Level 1 --> 2s', 'Level 1 --> 3a', and 'Level 1 --> 4'.

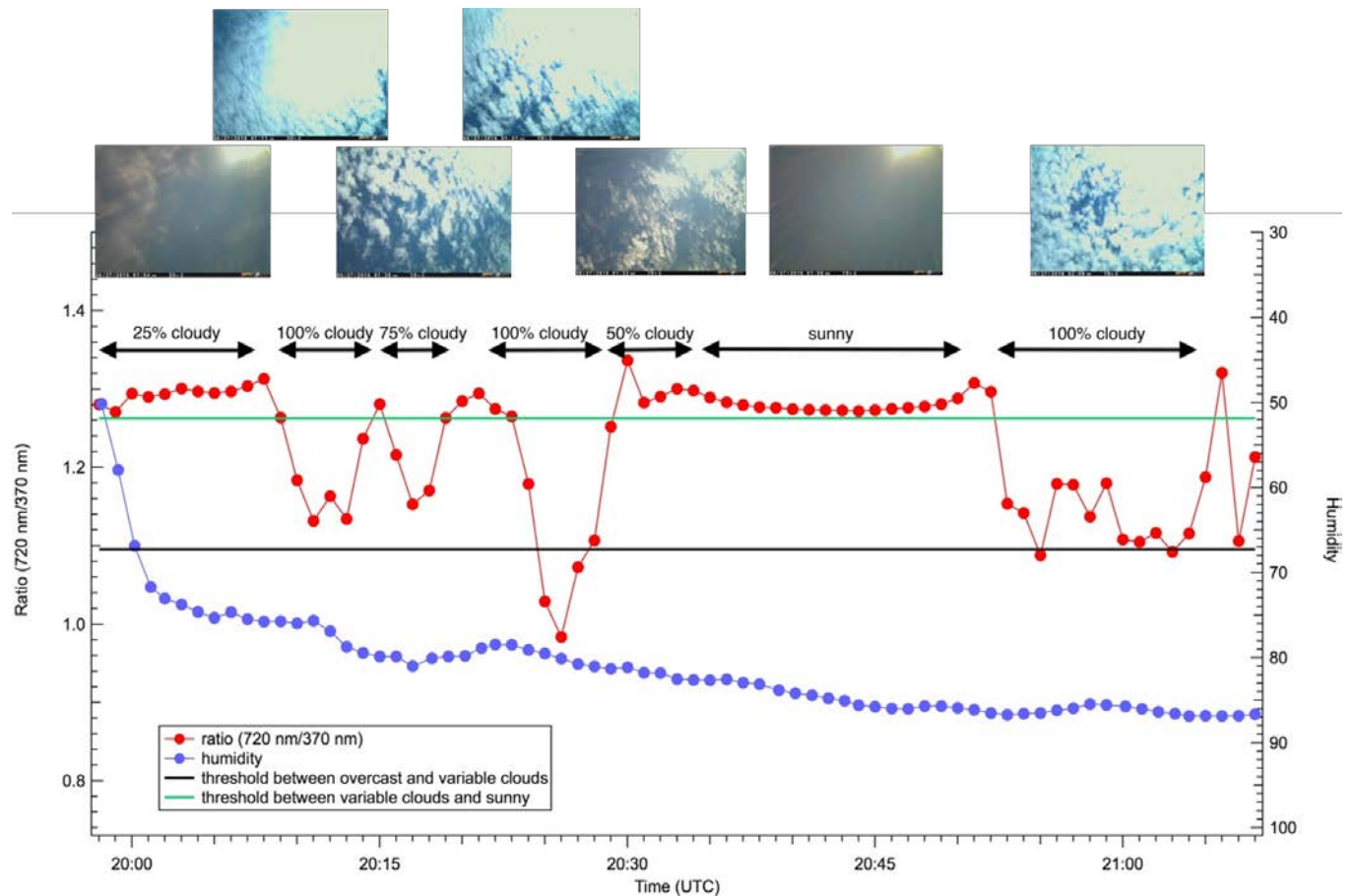
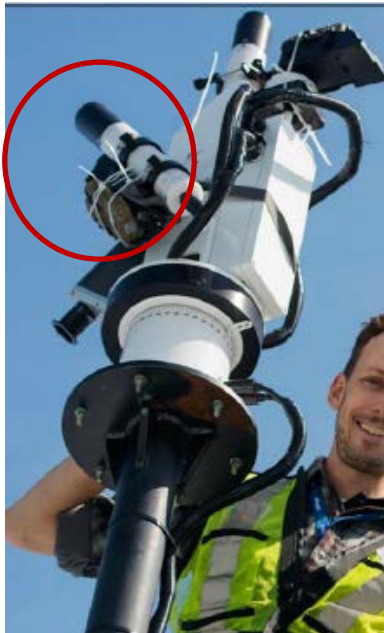
The 'Edit Config' dialog box is titled 'Edit Config' and shows 'Editing: TestFerries.cfg'. It has an 'Add Calibration Files' button and a file browser dropdown showing '/'. Below are several settings: 'Enabled' (checkbox), 'Frame Type:' dropdown set to 'ShutterLight', 'Enable Longitude/Direction Checking' (checkbox checked), 'Longitude Min' (-123.943), 'Longitude Max' (-123.288), 'Ferry Direction' dropdown set to 'E', 'SAS Solar Tracker - Angle Detection/Cleaning' (checkbox checked), 'Angle Min' (90.0), 'Angle Max' (135.0), 'Level 3 - Interpolation Interval (nm)' (1.0), 'Level 4 - Enable Meteorological Flags' (checkbox checked), 'Es Flag' (2.0), 'Dawn/Dusk Flag' (1.0), 'Rainfall/Humidity Flag' (1.095), 'Level 4 - Rrs Time Interval (seconds)' (60), and 'Level 4 - Default Wind Speed (km/h)' (10). 'Save' and 'Cancel' buttons are at the bottom.

- Sensors calibration
- Time interpolation
- Wavelength interpolation
- Filters:
 - Direction checking
 - Lat/long threshold
 - Angle threshold
 - Pitch/roll
 - Remove data with artifacts (ship)
- Meteorological flags
 - Es magnitude
 - Dawn/dusk
 - Rain/high humidity/cloud
- Wind Speed – Rrs
- Time binning
- Satellite Response Function
 - Sentinel-3, MODIS, VIIRS

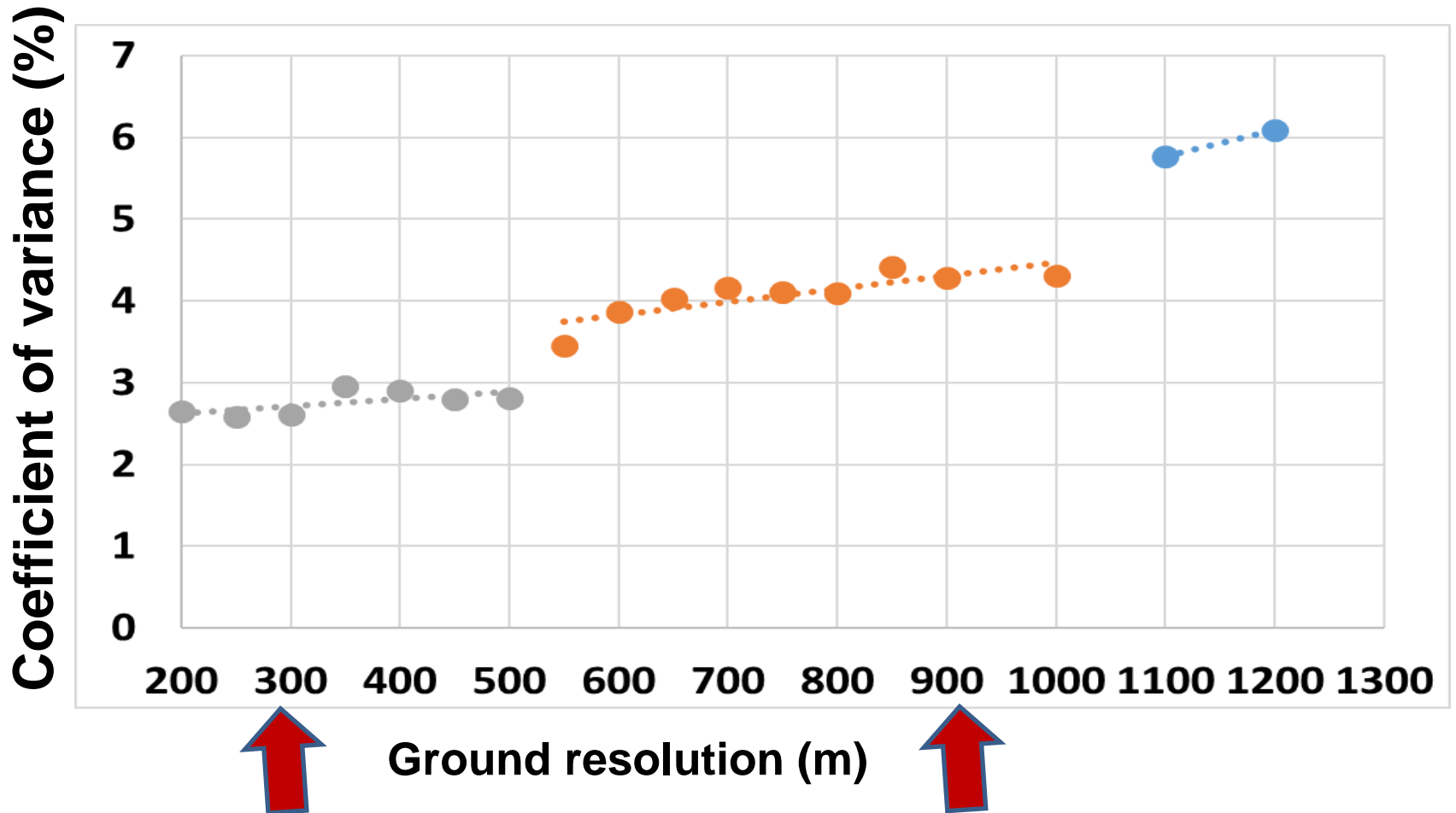
FOCOS

Meteorological Flags

N=35,000 in situ spectra



Time binning: Effect of ground resolution on Lt variability (560 nm)

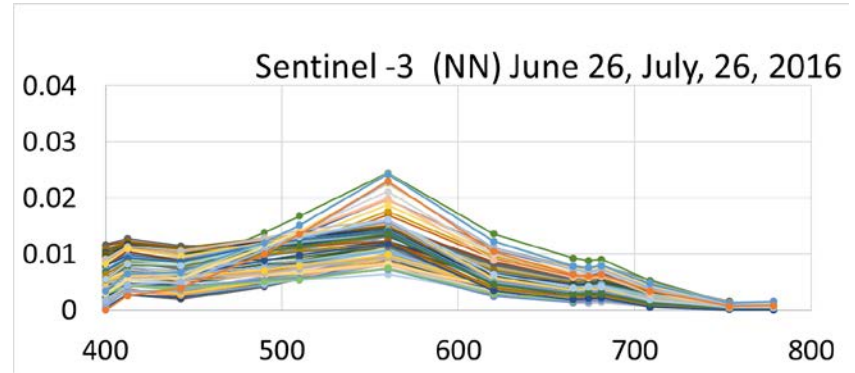
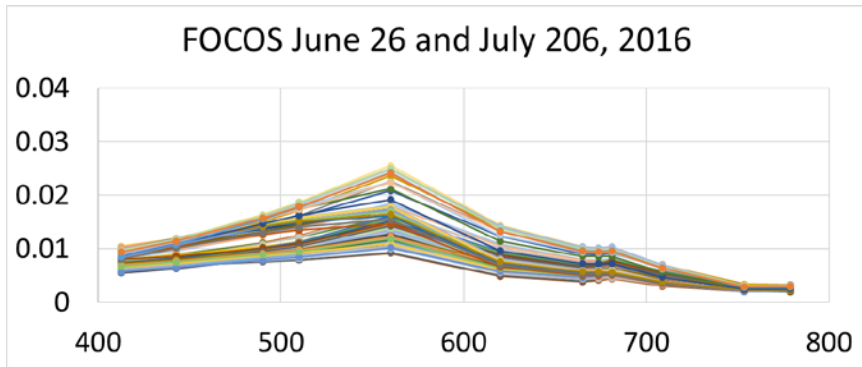


5. Data Analysis: Sentinel 3 validation (June, July, Aug N~220)

(Mobley, 1999 – rho)
(Lowest 5%)

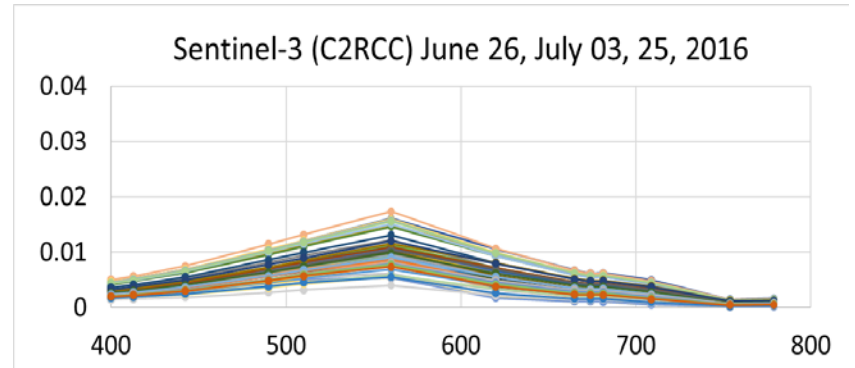
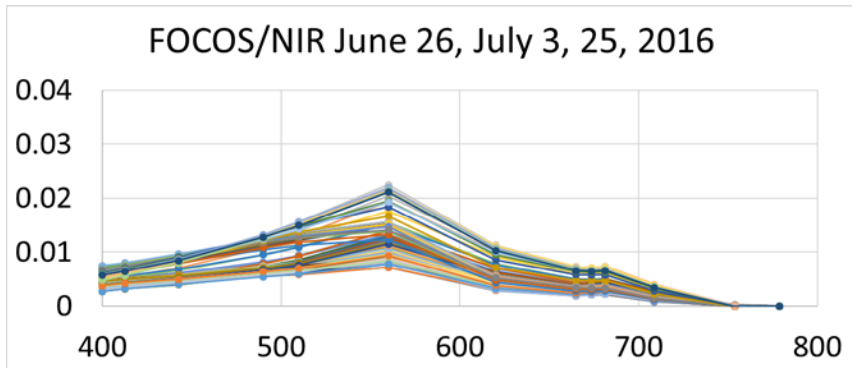
In situ

Sentinel 3 (Level 2)

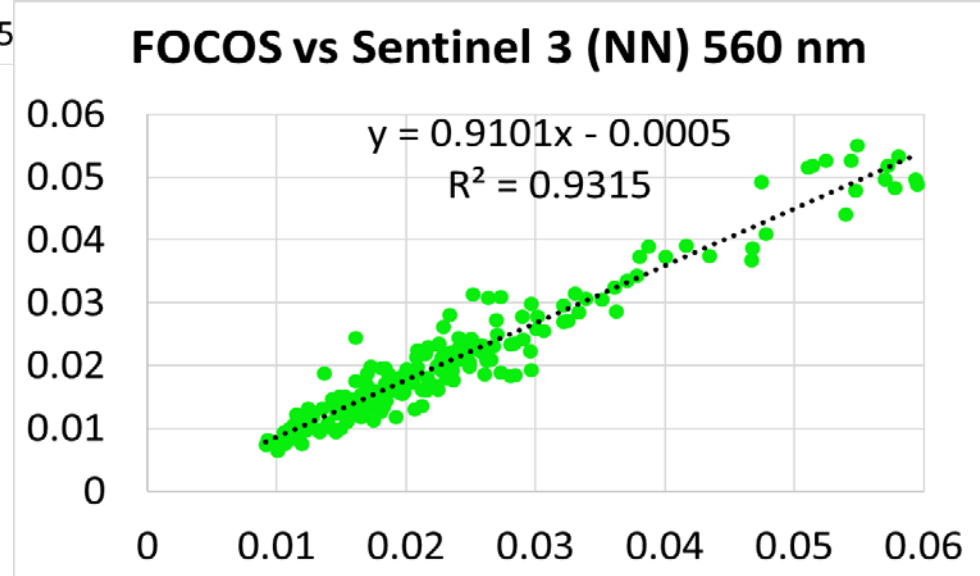
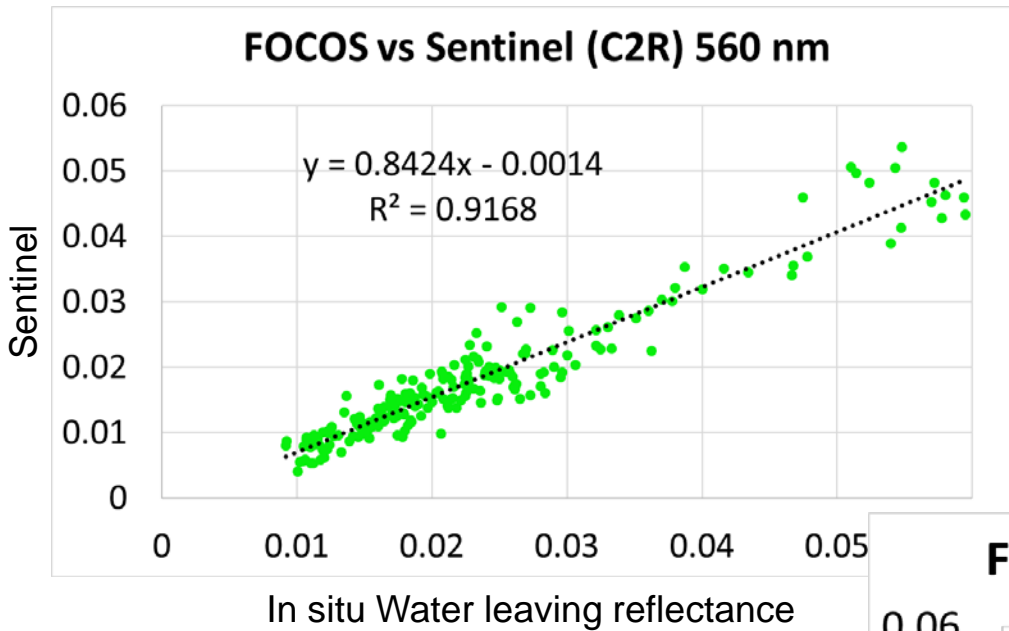


In situ corrected to 780nm

Sentinel 3 (C2RCC)



5. Data Analysis: Sentinel 3 validation



5. Data Analysis: Sentinel 3 validation

Sentinel (Level 2) vs
in situ

N=220	PD%	R ²
400	-27	0.5
412	-11	0.56
442	-21	0.75
490	-16	0.9
510	-13	0.92
560	-9	0.94
620	-23	0.84
665	-33	0.78
681	-29	0.7
709	-44	0.6

Sentinel (C2R) vs
in situ

N=220	PD%	R ²
400	-45	0.8
412	-42	0.8
442	-32	0.9
490	-18	0.9
510	-16	0.9
560	-20	0.9
620	-23	0.9
665	-35	0.9
681	-43	0.8
709	-42	0.8

5. Data Analysis: Sentinel 3 validation

Sentinel (Level 2) vs
in situ (NIR corr)

N=220	PD%	R ²
400	1.2	0.52
412	21.2	0.62
442	0.7	0.77
490	2.2	0.94
510	2.9	0.93
560	2.8	0.93
620	1.8	0.86
665	2.9	0.77
681	3.4	0.76
708	5.1	0.67
709	10.8	0.33

Sentinel (C2R) vs
in situ (NIR corr)

N=220	PD%	R ²
400	-24.5	0.81
412	-21.8	0.85
442	-12.6	0.91
490	1.6	0.94
510	1.3	0.93
560	-8	0.93
620	5.1	0.89
665	1.65	0.86
681	-13.1	0.84
709	19.2	0.8

summary

- It is a lot of work! I will try my best to calculate uncertainties
- It is important to understand your instrument, specially if it is autonomous – filter data with artifacts!
- Geometry is key
- Large data sets requirements: filter, flags, processing!
- Sentinel-3looking forward the new calibrated data

Thank you
maycira@uvic.ca

