Evaluation of VIIRS performance over coastal waters and its capacity to detect dark water and algal blooms

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Objectives

- Evaluate/Validate VIIRS ocean color data products
- Demonstrate VIIRS capacity in studying coastal oceans (water quality, algal blooms, oil spills)
- Share data and results with community to advance science and mission planning

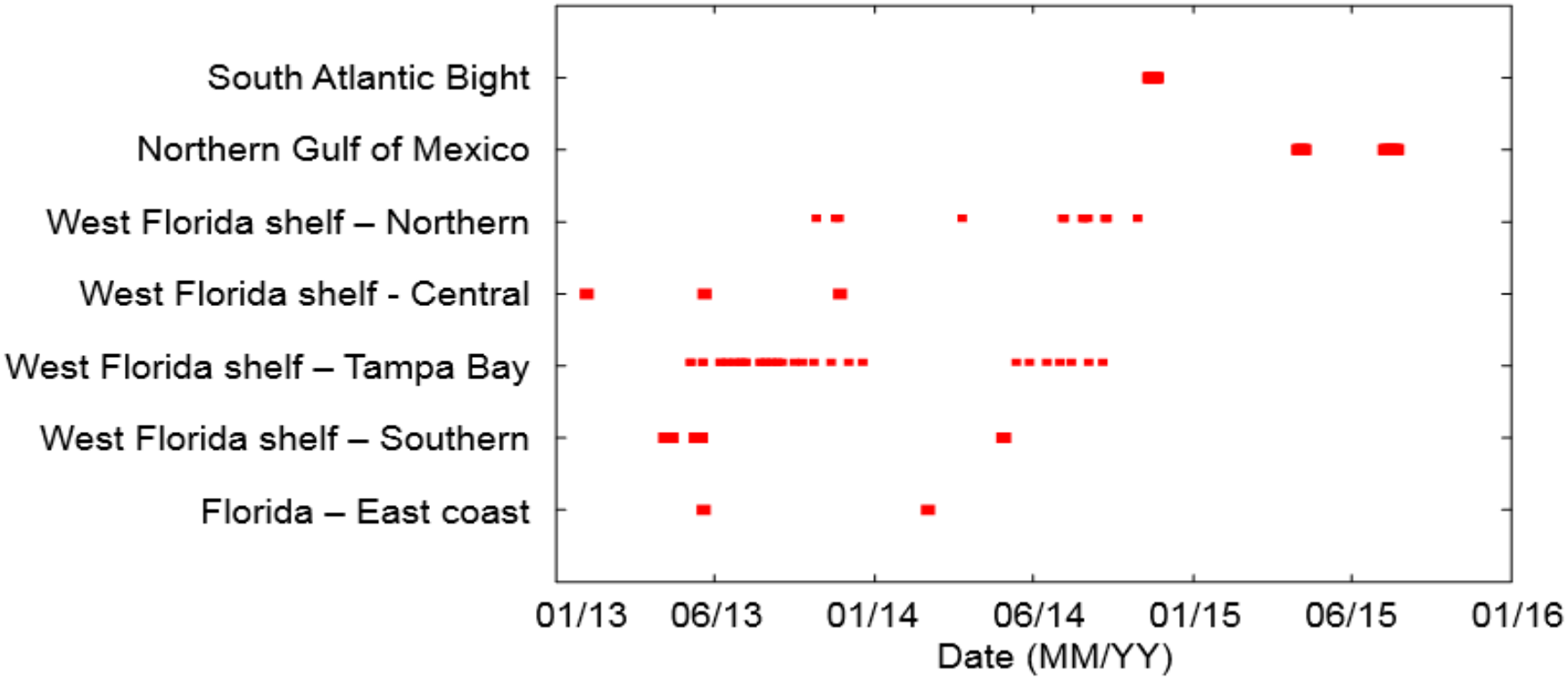
How?

- Field measurements following community-accepted protocols
- Satellite data analysis and comparison with field measurements
- Communication with science team and the community
- Technical reports and publications

Field Measurements

Conducted by USF Optical Oceanography Lab in collaboration with other groups.

All measurements have filter-pads absorptions and CDOM absorptions. Most measurements also have scattering and reflectance IOPs. Some have taxonomy and profiling data.

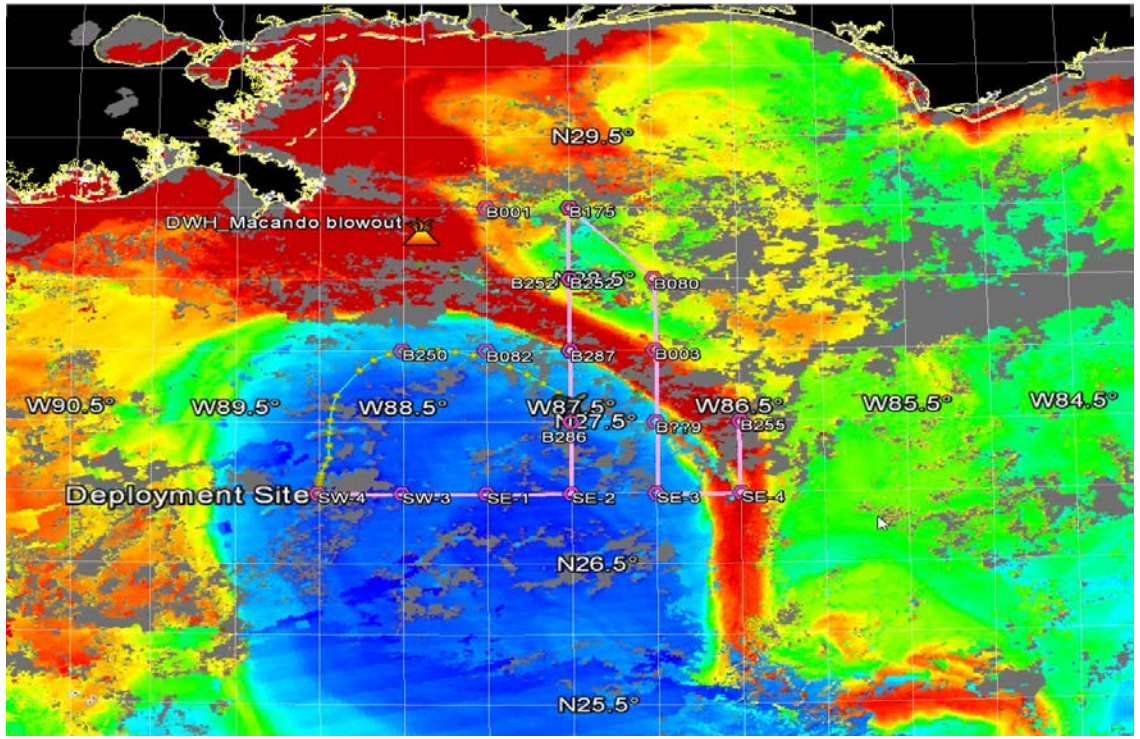


Note: NOAA VIIRS cruises not plotted here

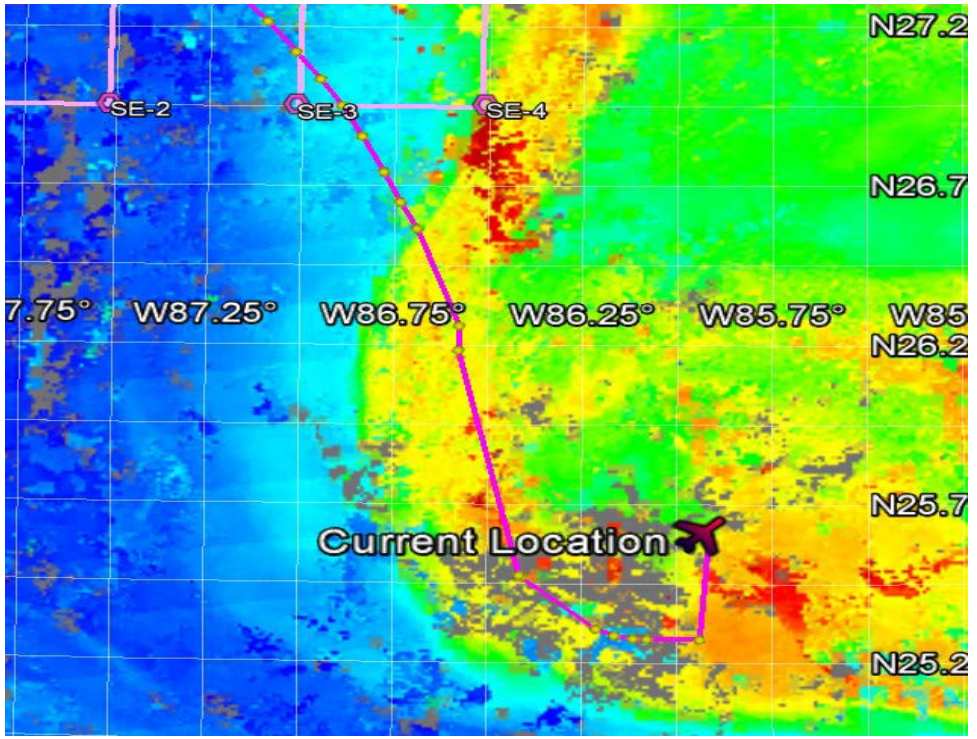
Field Measurements

An example from the DEEPEND02 cruise (Aug 8 – 22, 2015)

MODIS 5-day composite ending Aug 12, overlaid with cruise stations and glider track to Aug 12

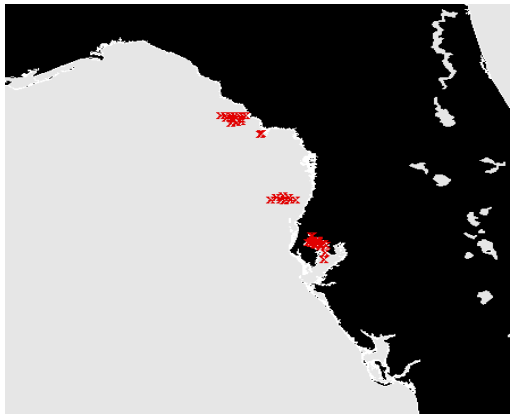


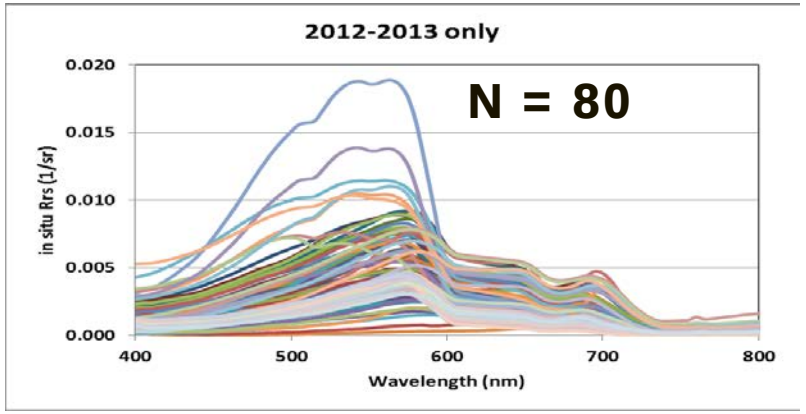
MODIS 3-day composite showing glider track up to Aug 18

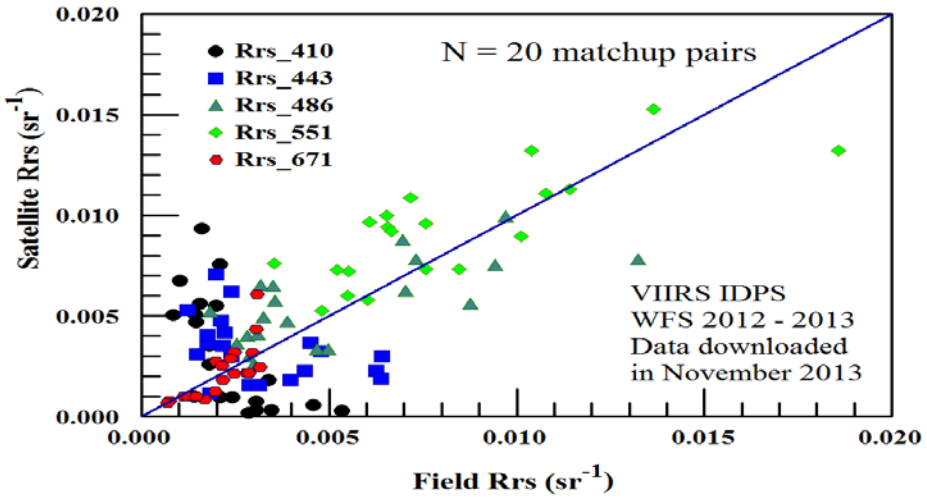


NOAA VIIRS Validation Results

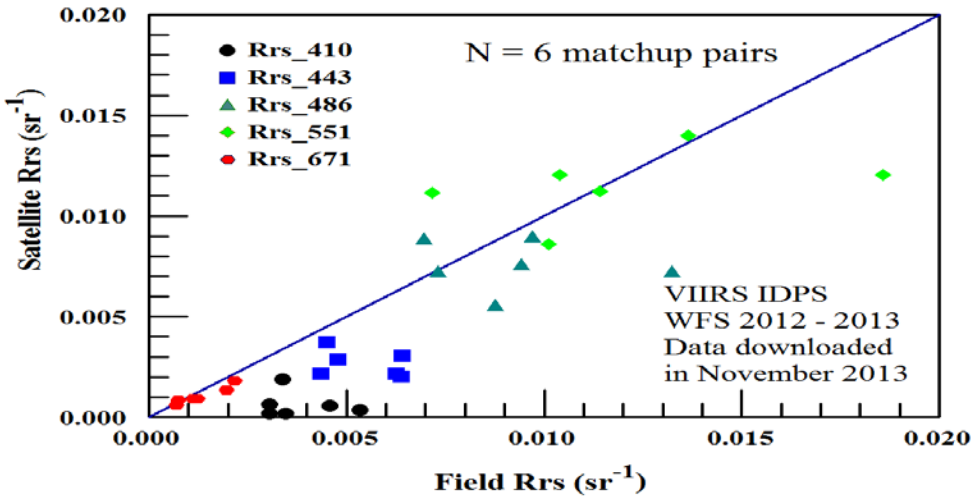
Initial Validation (IDPS processing) in 2014







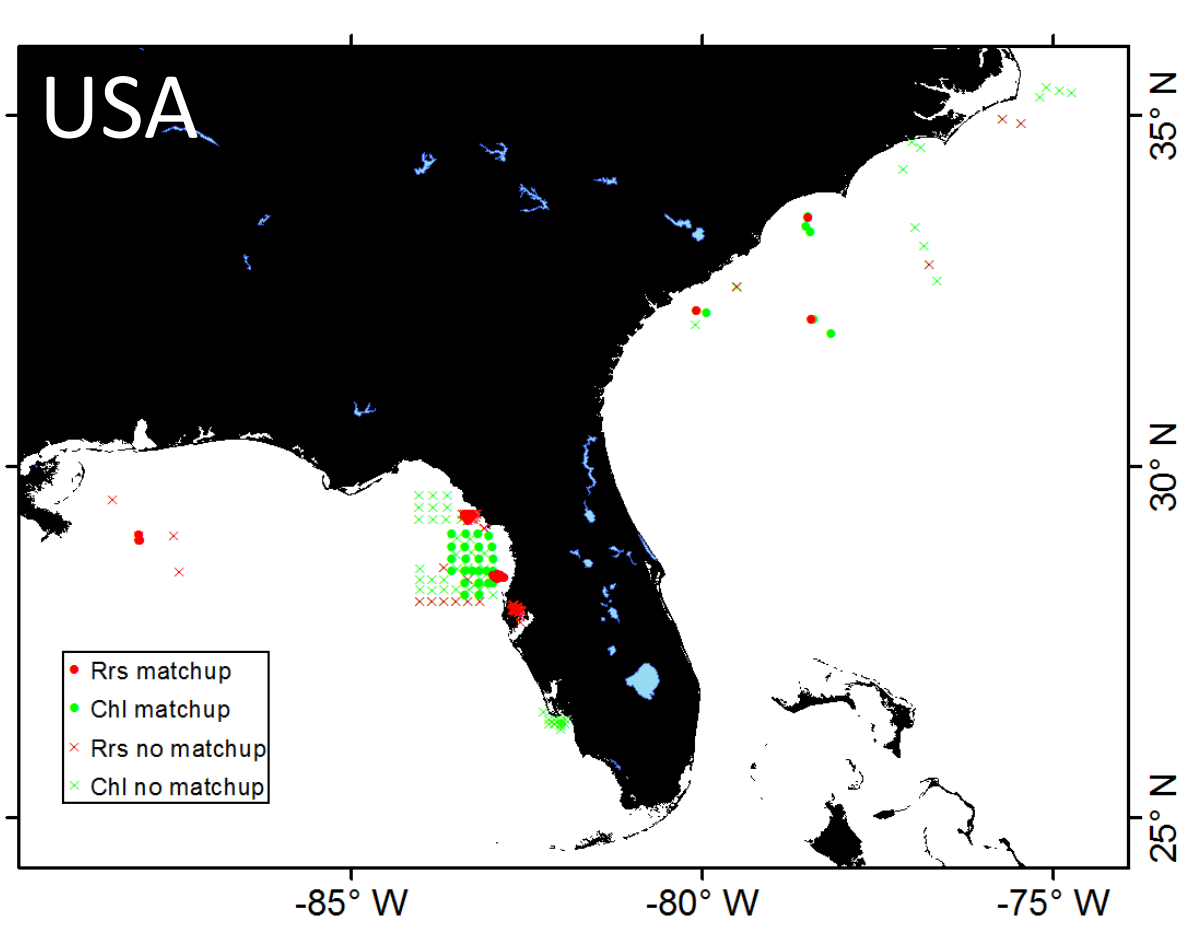
QF Flags not applied

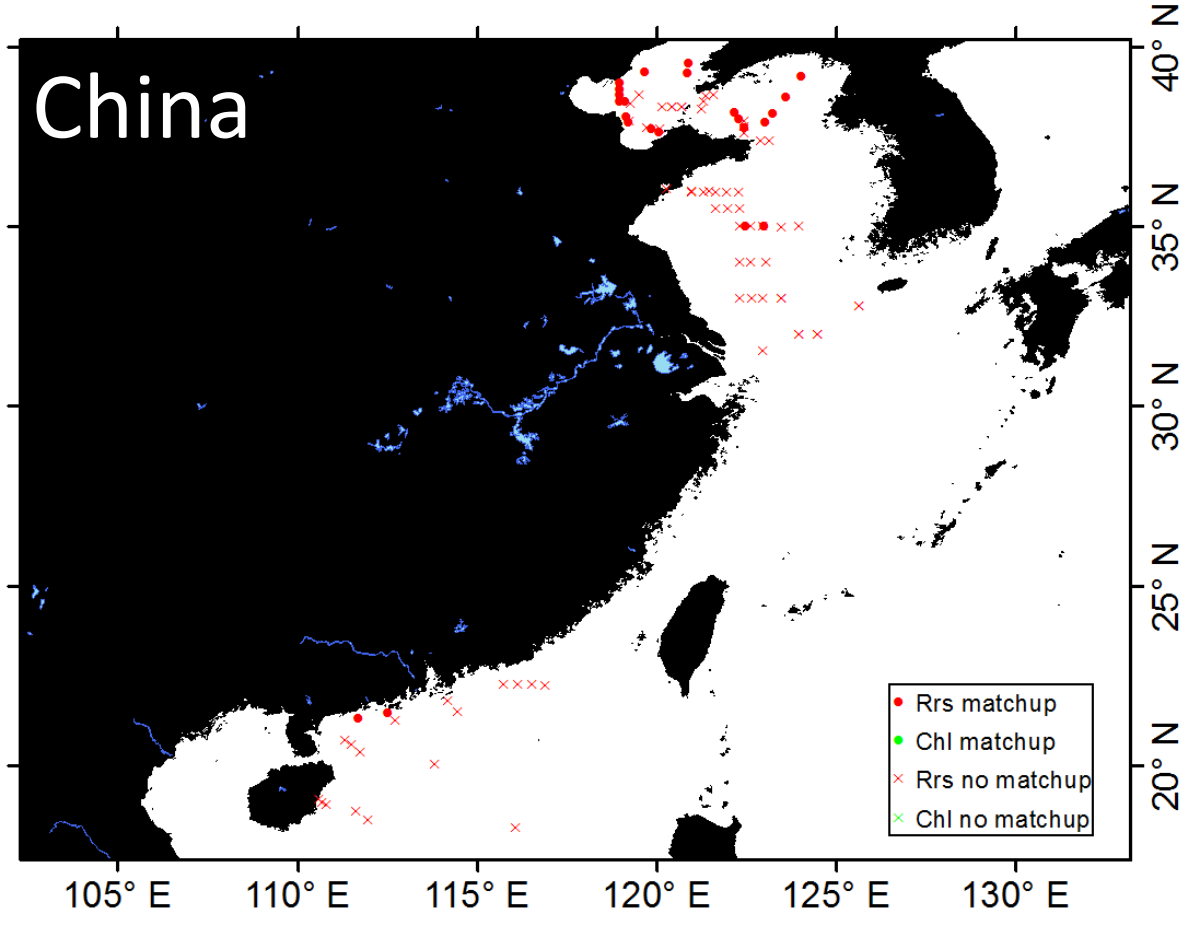


QF Flags applied

New Validation (MSL12 processing)

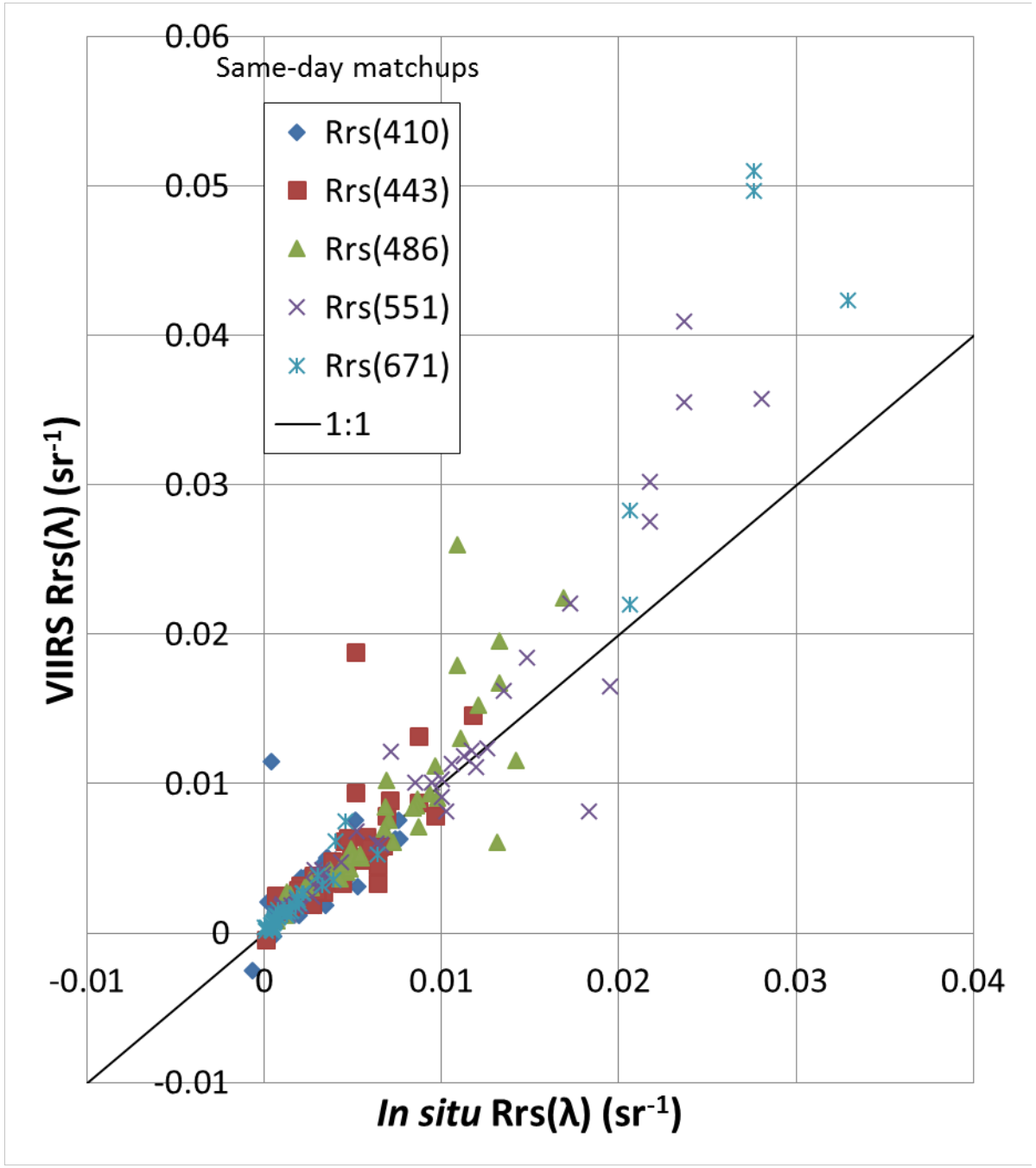
VIIRS data downloaded from NOAA/NESDIS ftp site in July 2016
Field data collected between 2012 and 2015 from different cruises





NOAA VIIRS

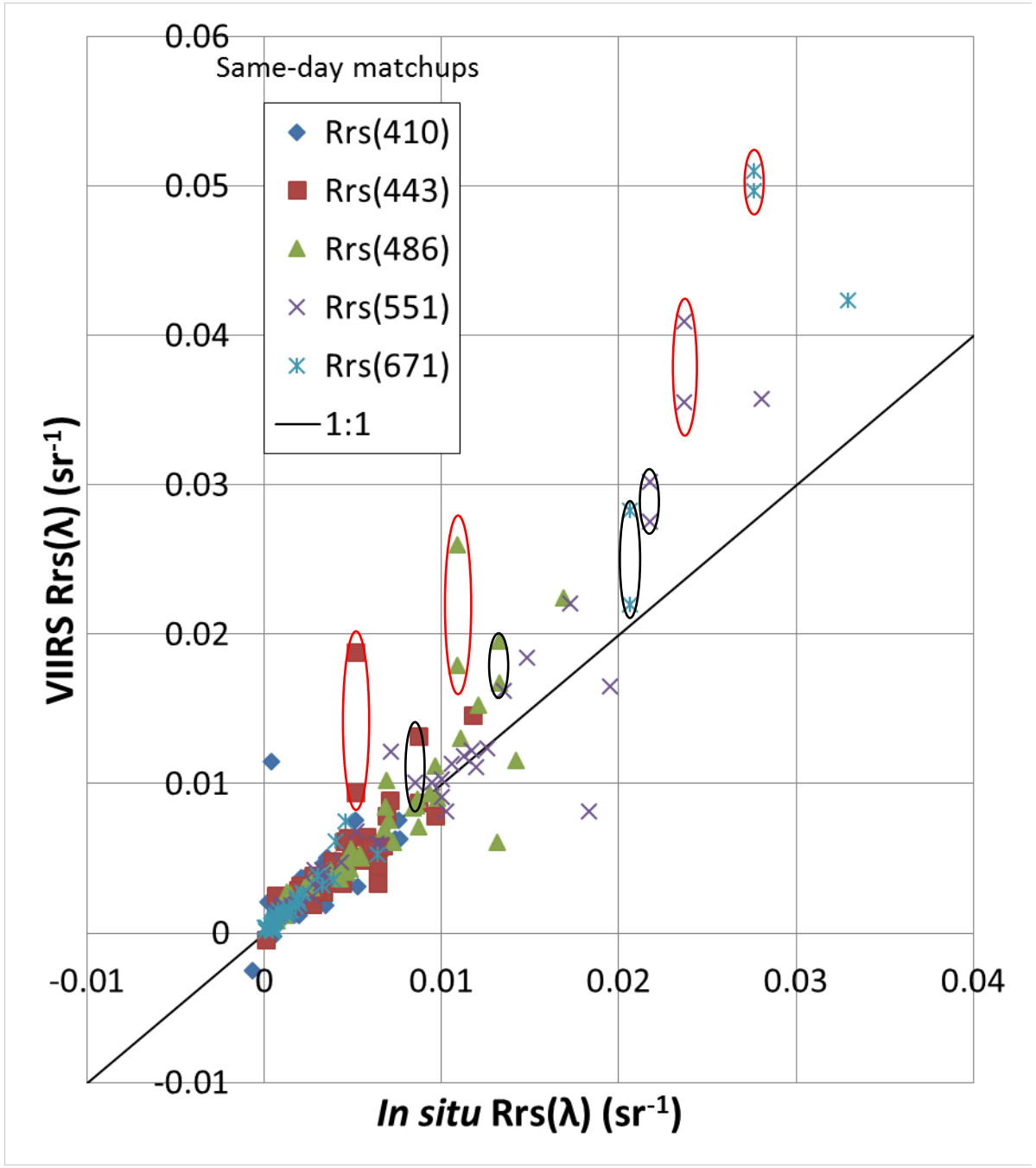
Linear-scale same-day matchups between *in situ* and VIIRS Rrs(λ).



	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	63.7	0.00118	38
Rrs(443)	18.5	0.00140	39
Rrs(486)	20.9	0.00185	40
Rrs(551)	21.4	0.00232	43
Rrs(671)	37.1	0.00184	43

NOAA VIIRS

Two *in situ* spectra had replicate same-day VIIRS matchups (i.e., 2 valid VIIRS measurements for that location and date). One outlined in red and the other outlined in black. Rrs values for both spectra are higher than in situ values, thus they're easily identified in this graph.



	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	63.7	0.00118	38
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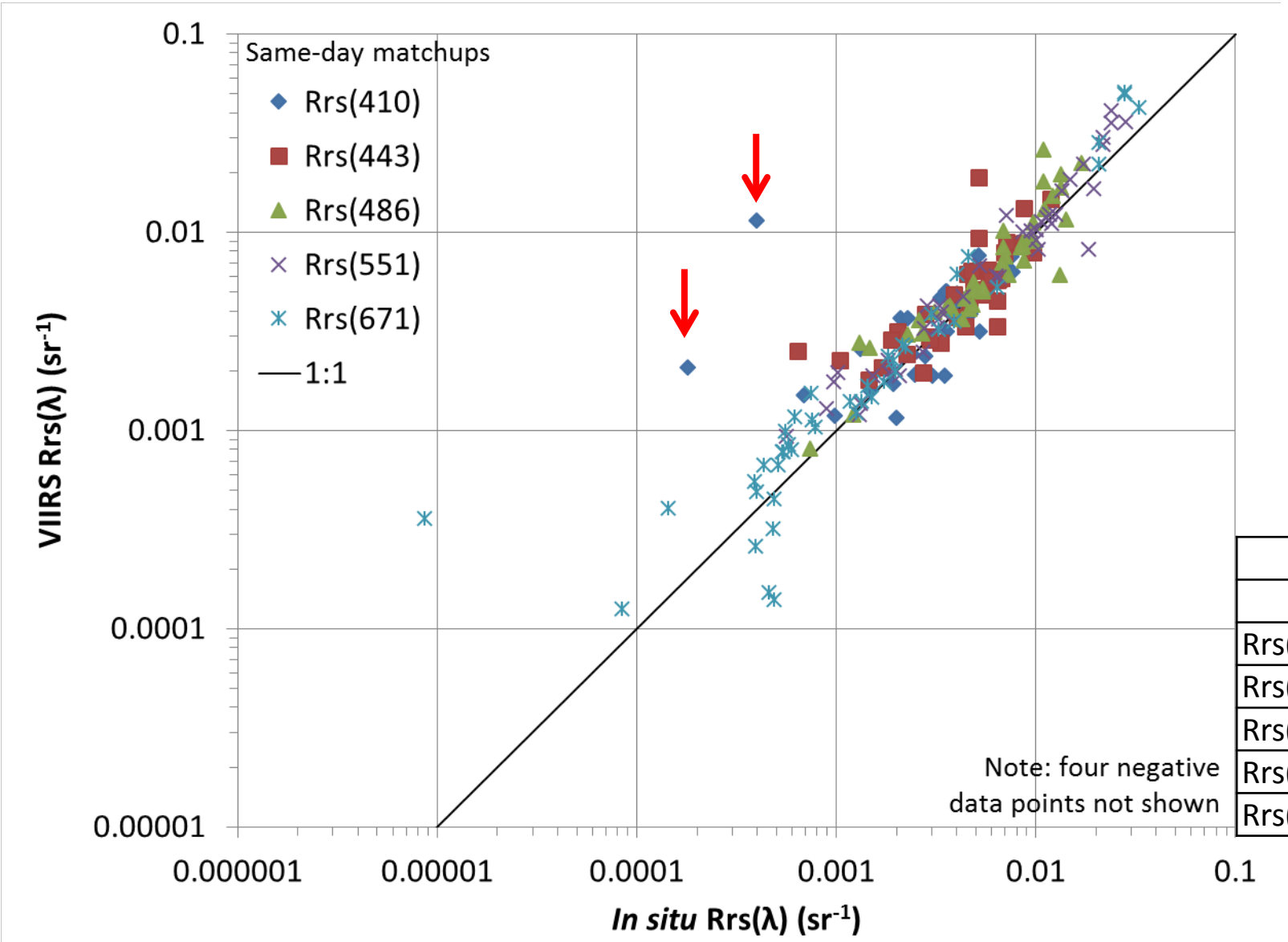
NOAA VIIRS

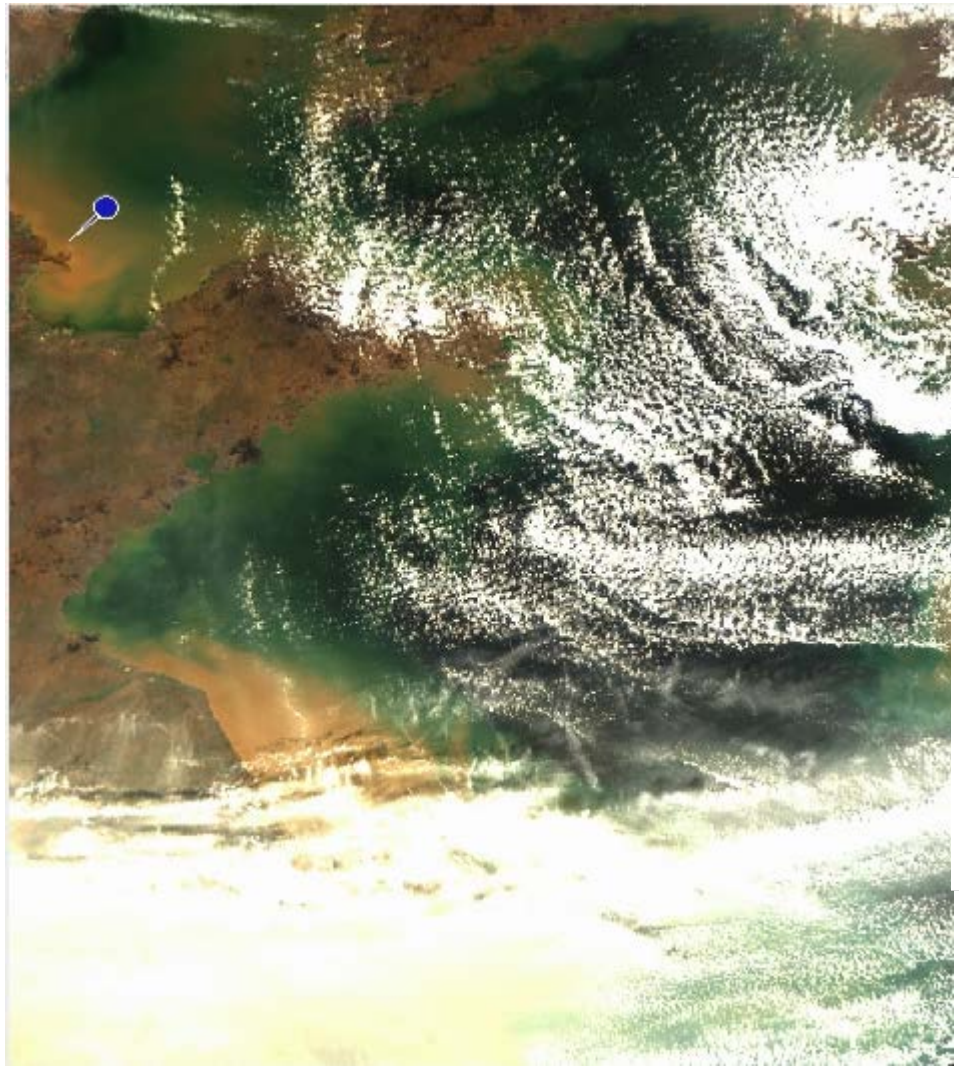
Log-scale same-day matchups between *in situ* and VIIRS Rrs(λ).

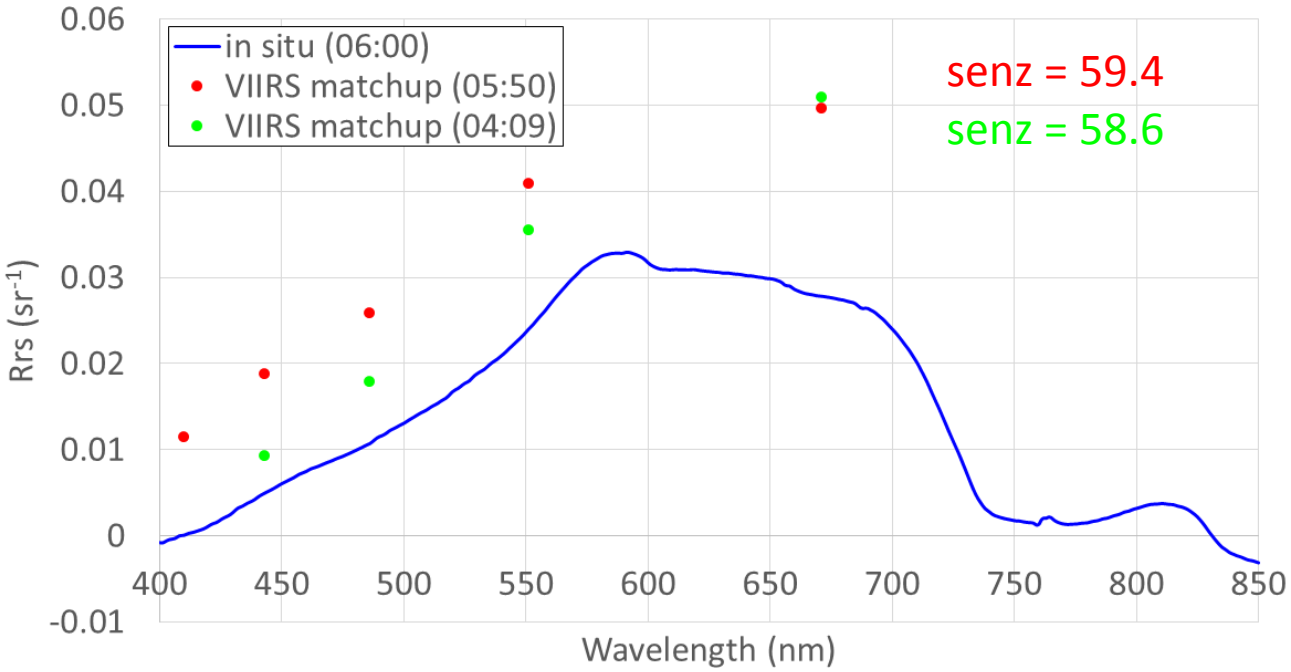


	All data			Without 2 outliers		
	UPD (%)	MAD (sr^{-1})	N	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	63.7	0.00118	38	57.4	0.00088	36
Rrs(443)	18.5	0.00140	39	13.2	0.00105	37
Rrs(486)	20.9	0.00185	40	18.0	0.00151	38
Rrs(551)	21.4	0.00232	43	19.6	0.00199	41
Rrs(671)	37.1	0.00184	43	35.2	0.00140	41

NOAA VIIRS

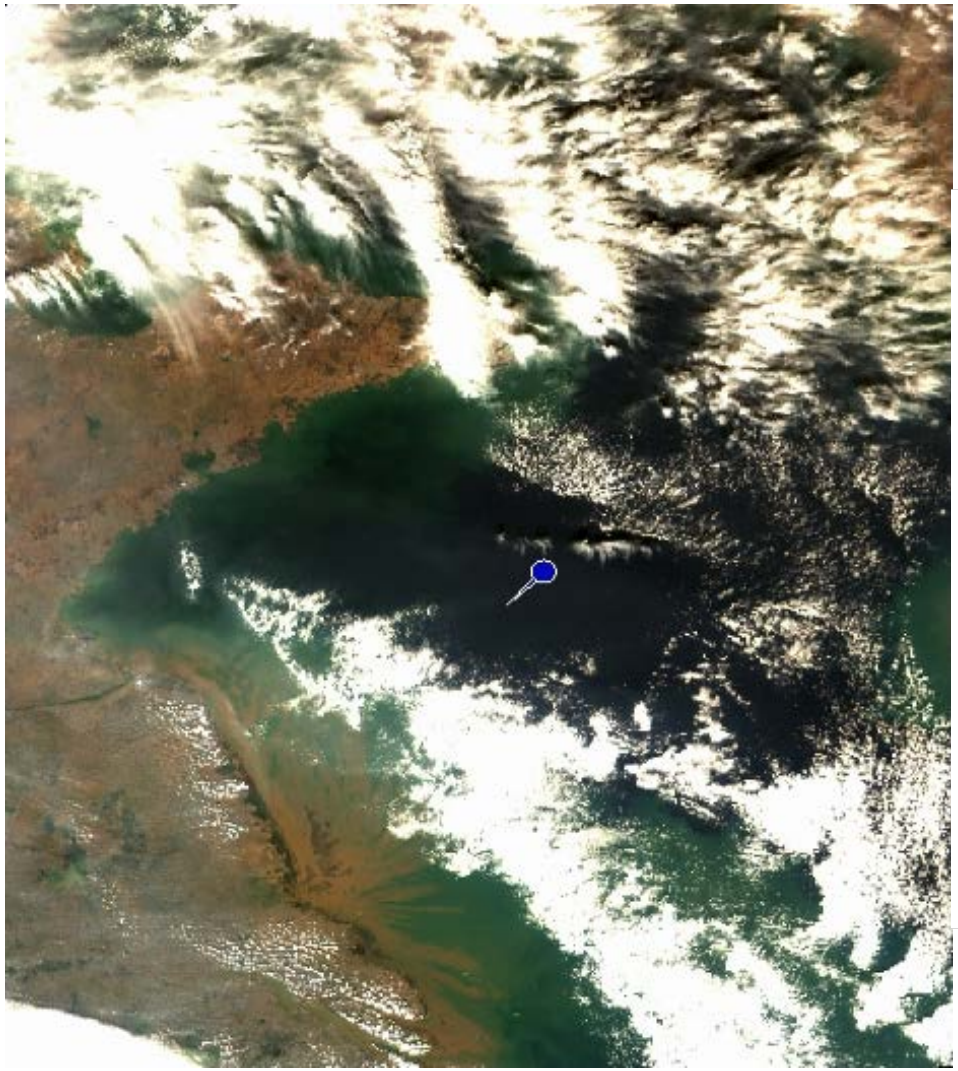
V20123240406

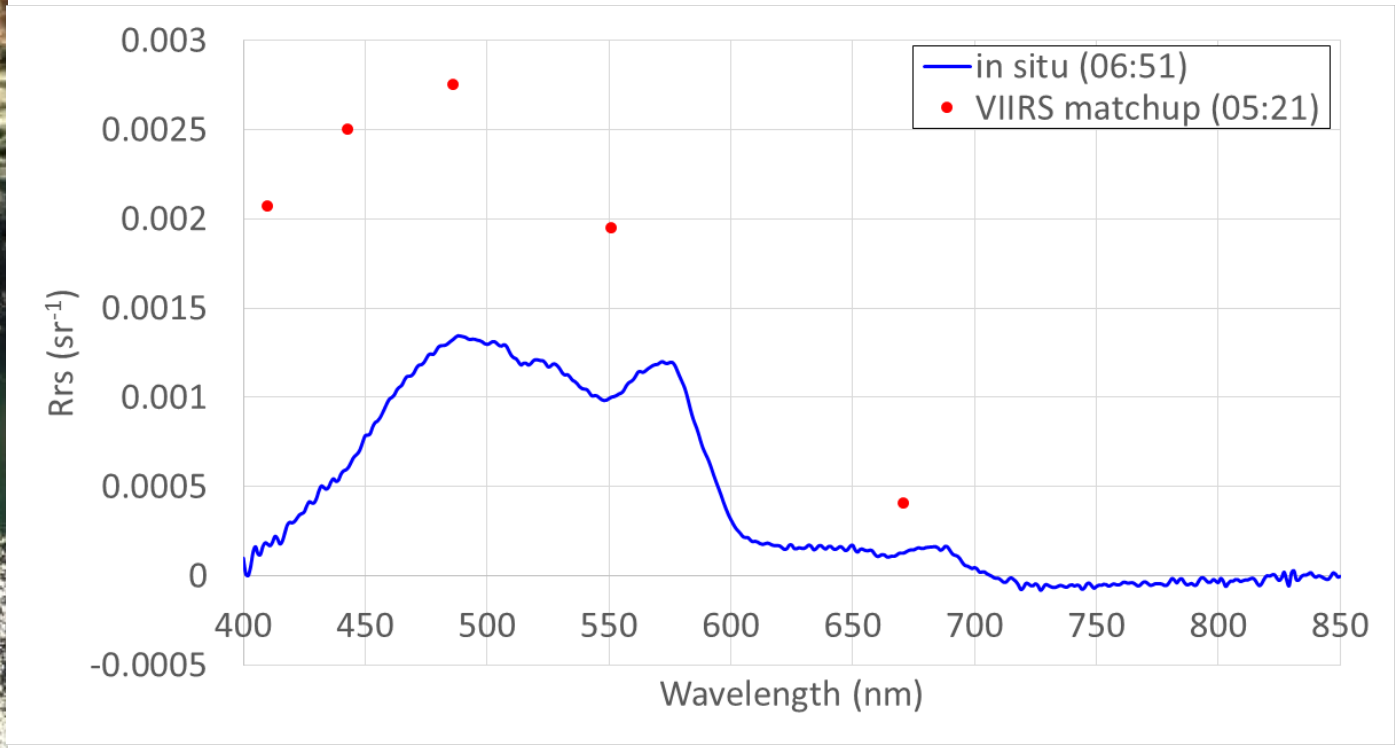




NOAA VIIRS

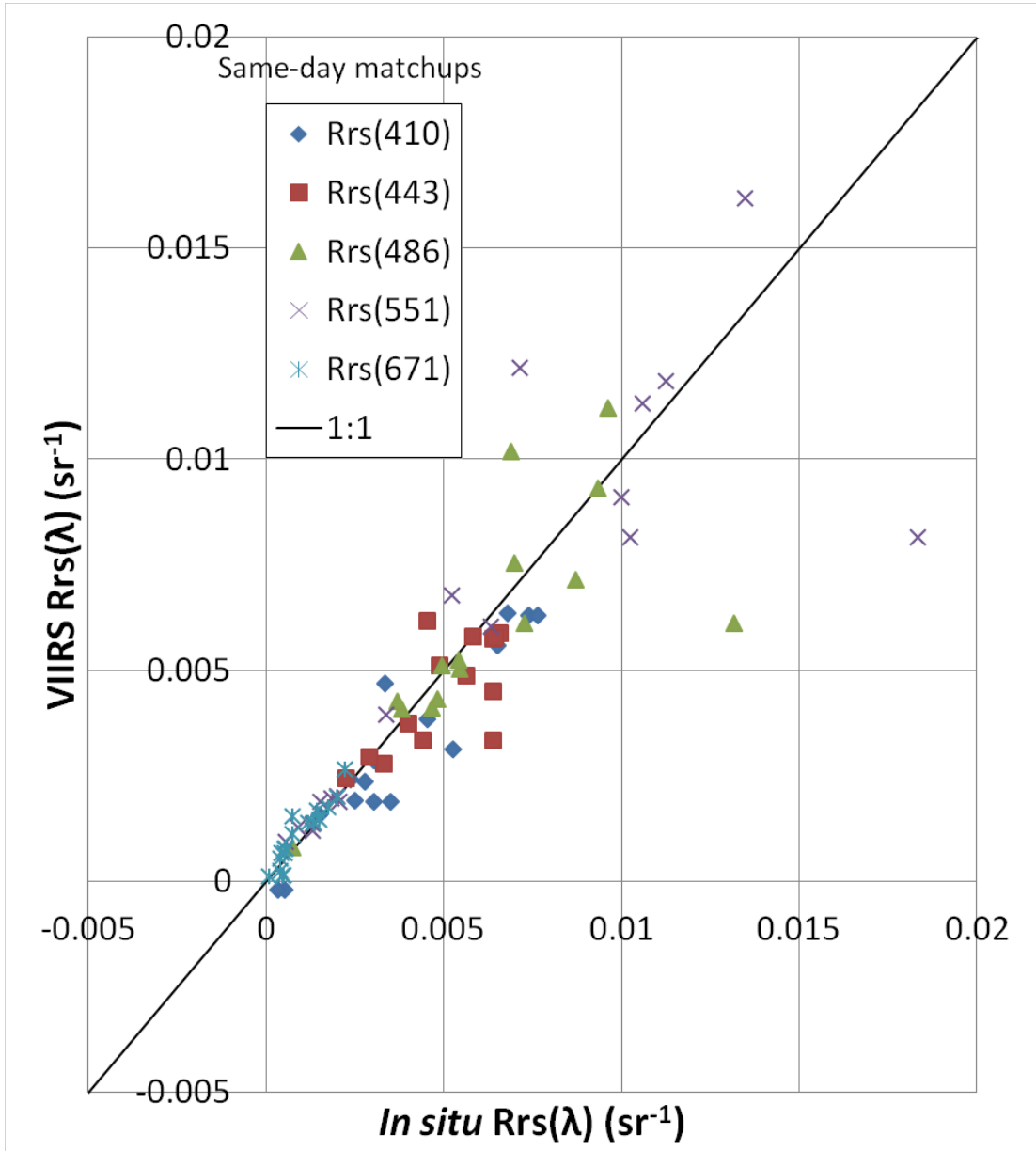
V20133170518

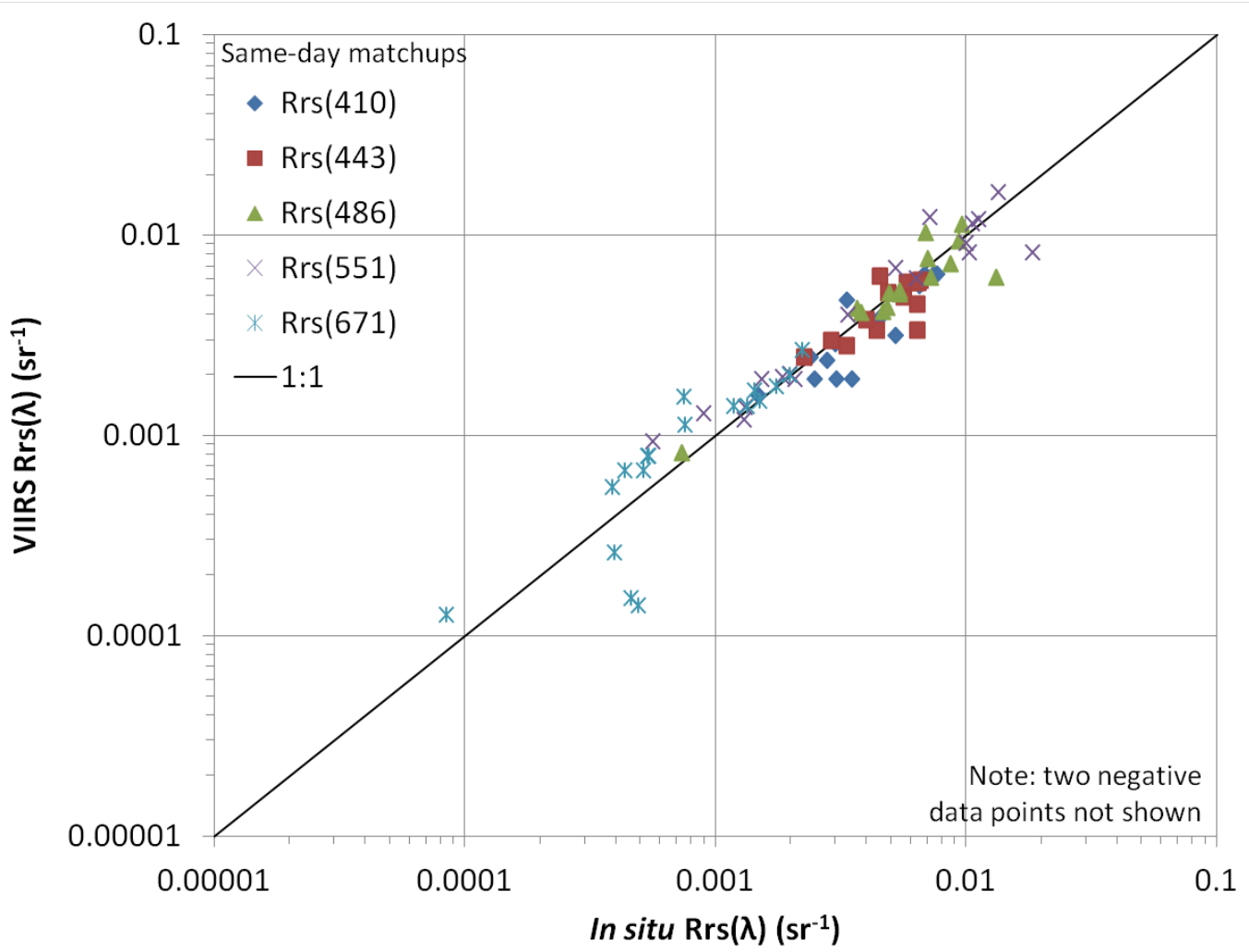




NOAA VIIRS

USA only

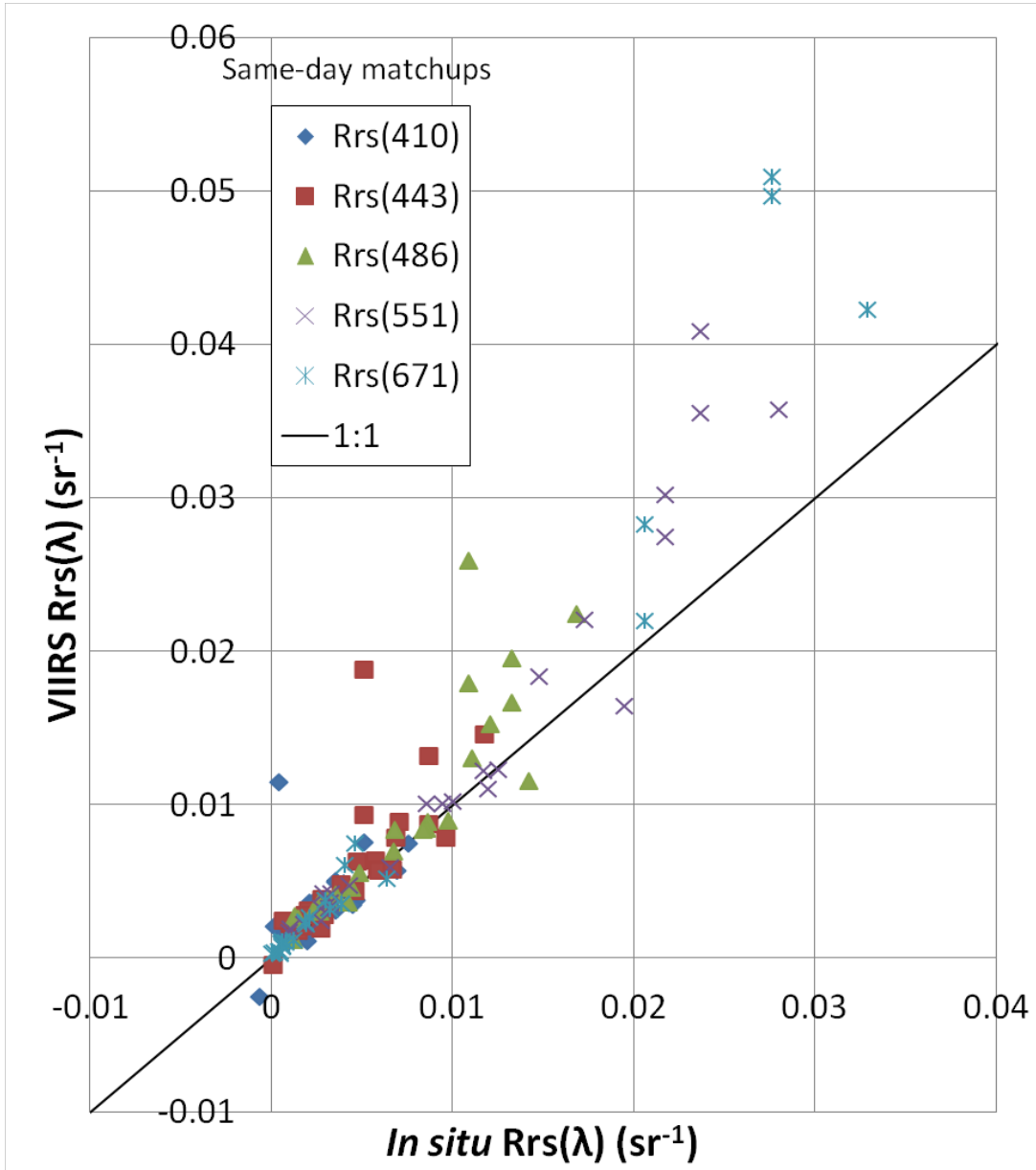


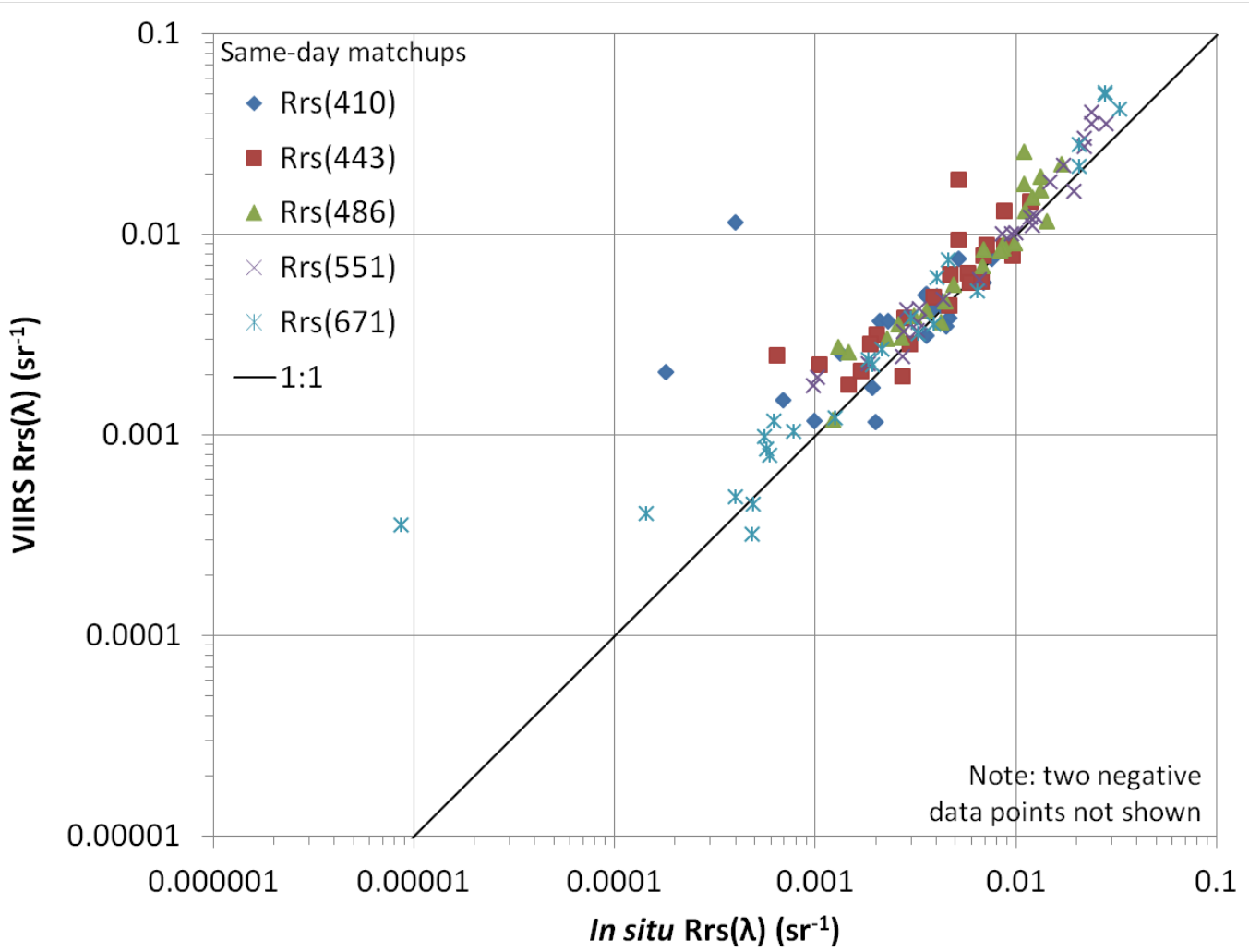


	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	102.4	0.00082	16
Rrs(443)	17.4	0.00084	14
Rrs(486)	16.1	0.00120	15
Rrs(551)	20.8	0.00146	18
Rrs(671)	35.3	0.00022	18

NOAA VIIRS

China only

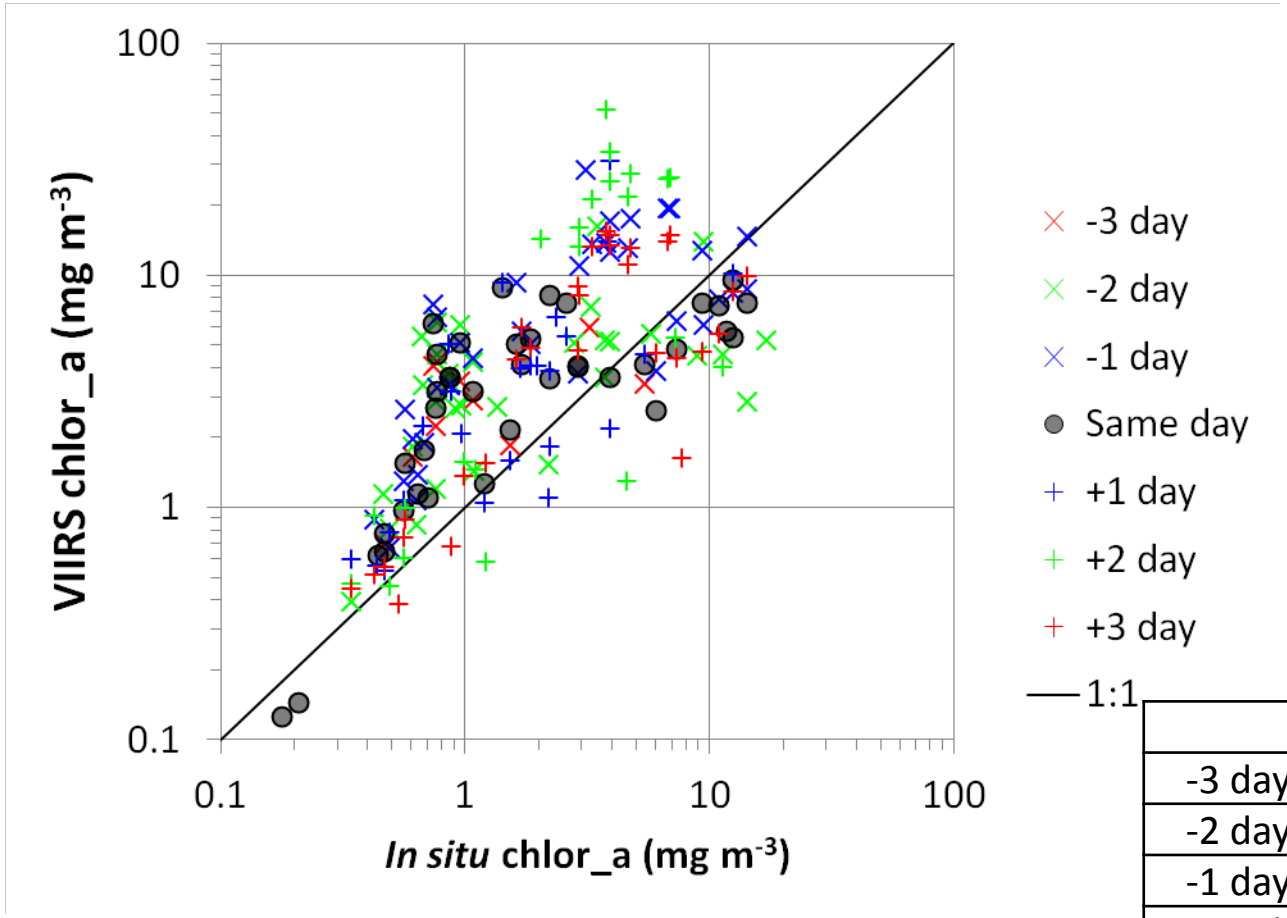




	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	35.6	0.00144	22
Rrs(443)	19.1	0.00171	25
Rrs(486)	23.8	0.00224	25
Rrs(551)	21.7	0.00293	25
Rrs(671)	38.5	0.00301	25

NOAA VIIRS

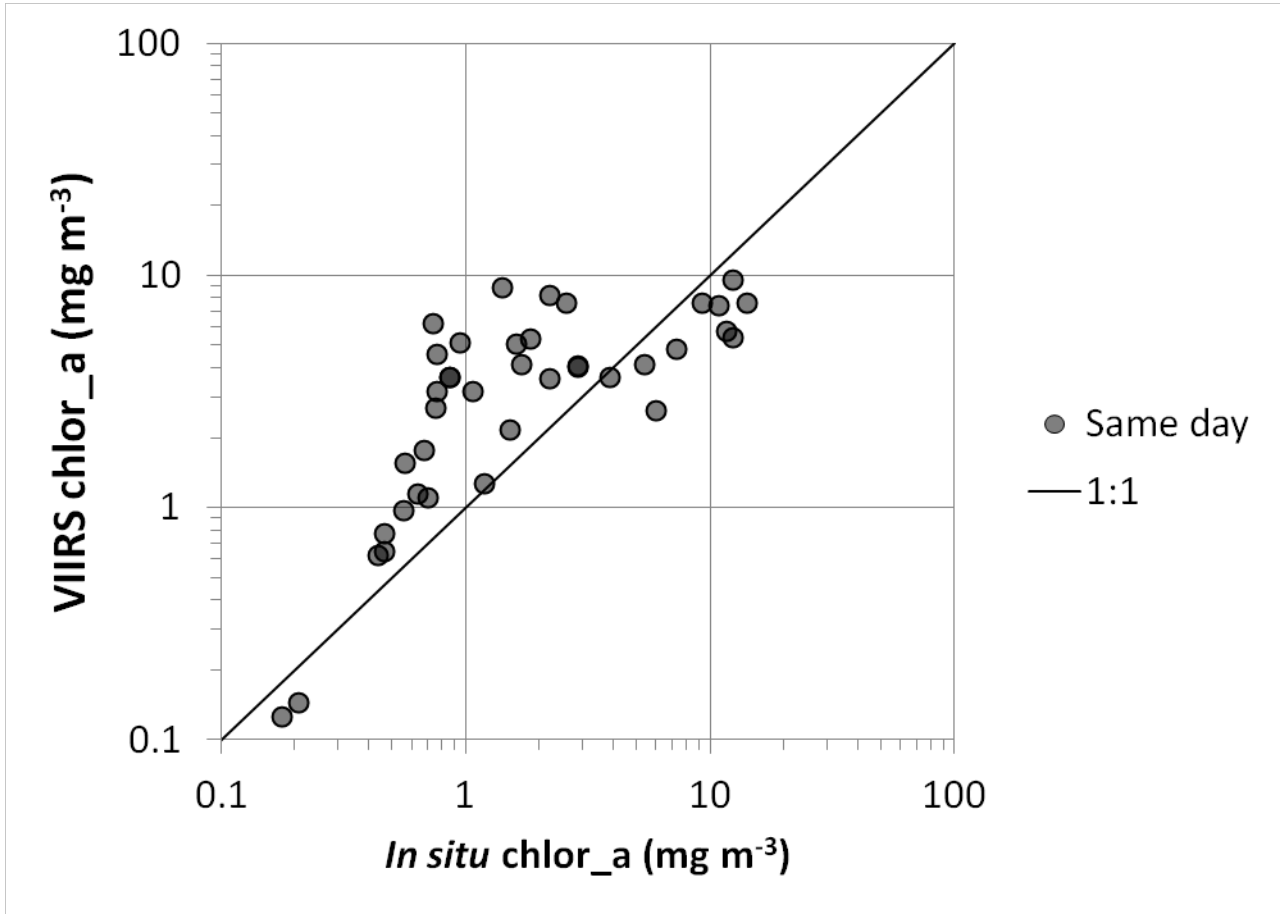
log-scale matchups between *in situ* and VIIRS chlor_a.



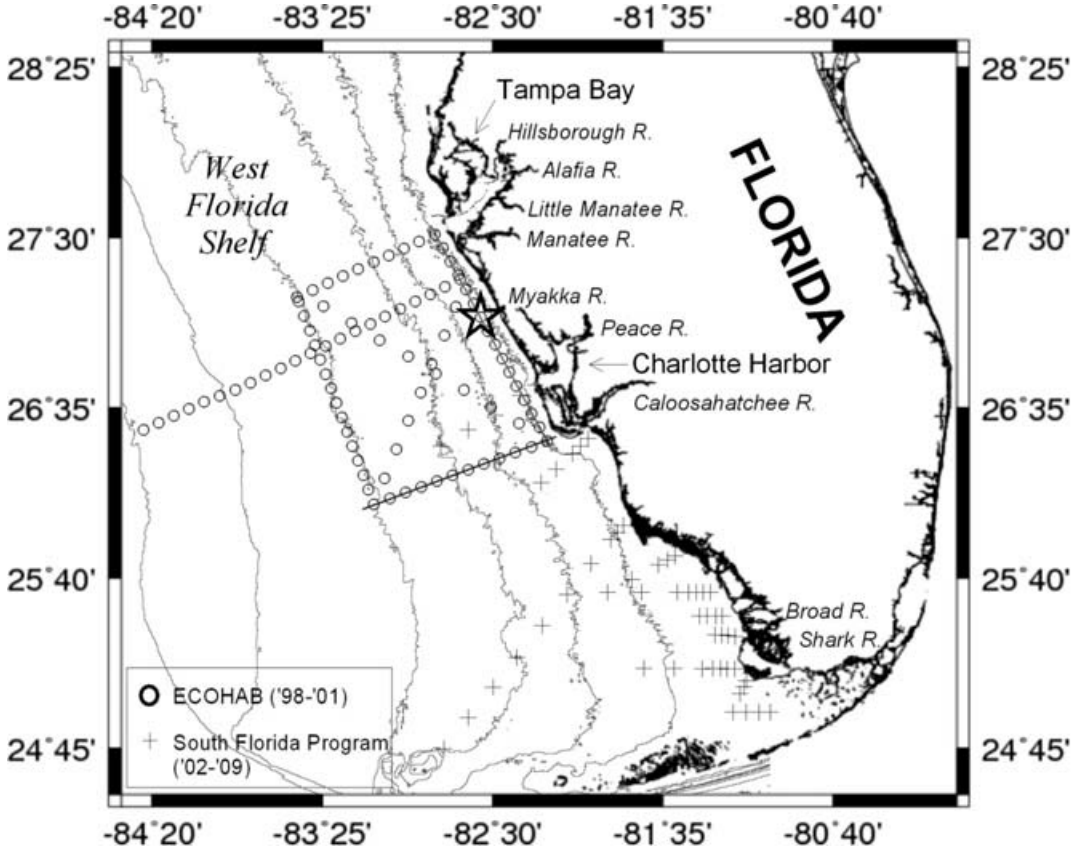
	UPD (%)	MAD (mg m^{-3})	N
-3 day	83.5	1.9	10
-2 day	83.1	3.2	33
-1 day	90.2	5.3	37
Same day	71.2	2.5	39
+1 day	67.7	3.1	25
+2 day	95.4	11.2	22
+3 day	65.9	4.2	30

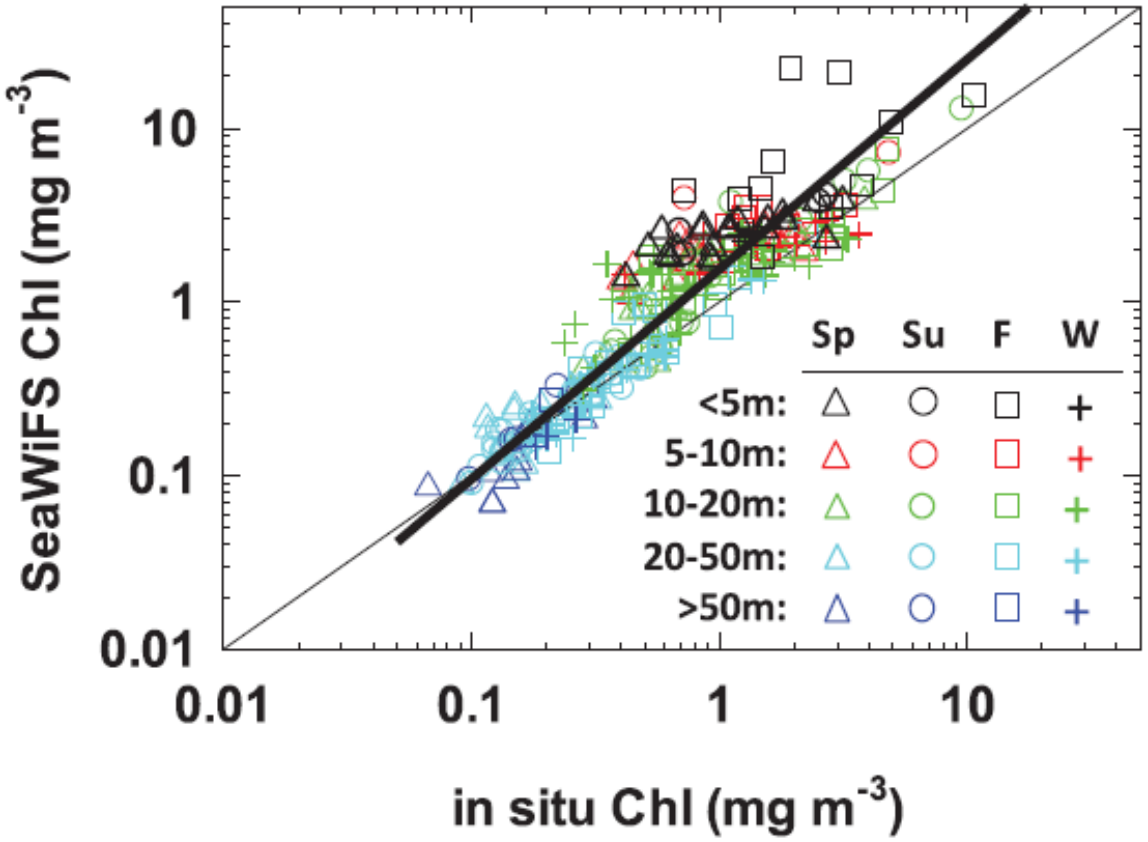
NOAA VIIRS

log-scale matchups between *in situ* and VIIRS chlor_a. Only same-day. Note that MOST of these points come from 2 consecutive dates of sampling within a HAB.



Typical algorithm problems over shallow waters



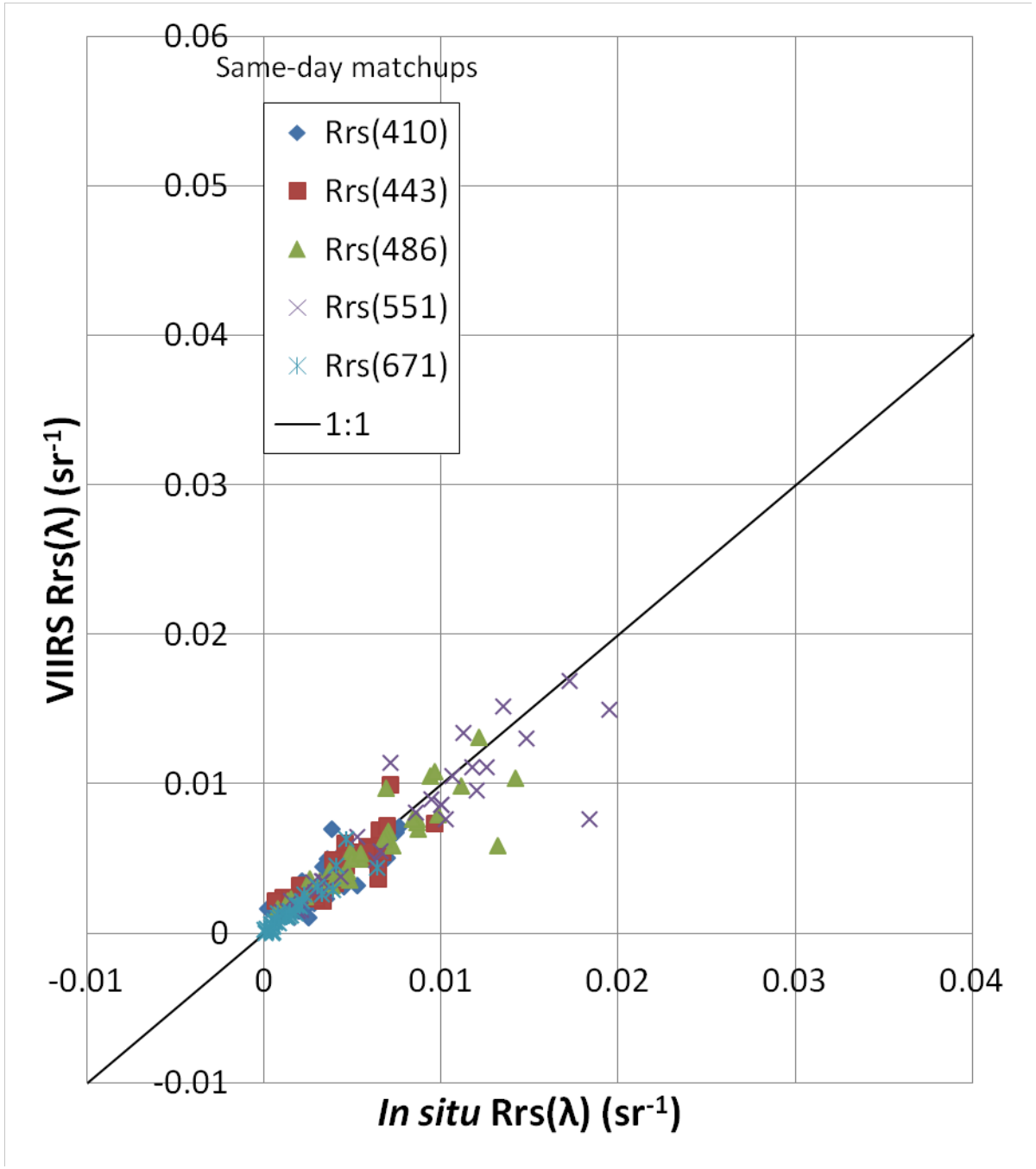


From Cannizzaro et al. (2013, JCR)

NASA VIIRS

NASA VIIRS

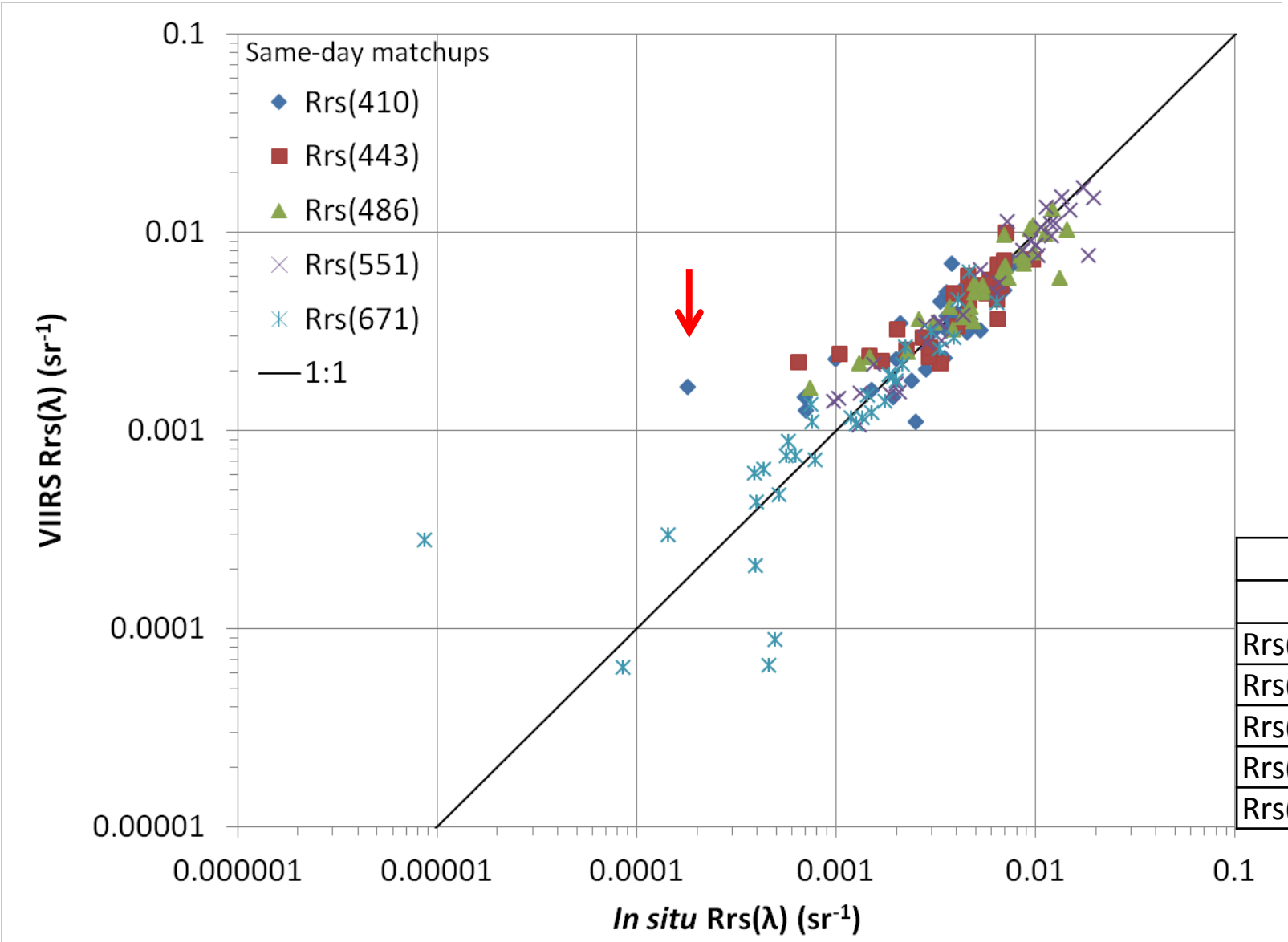
Linear-scale same-day matchups between *in situ* and VIIRS Rrs(λ). Note that there are fewer matchups (8-10 per band) for NASA data relative to NOAA. Much of this is due to spatial consistency.



	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	33	0.00089	31
Rrs(443)	23.8	0.00088	31
Rrs(486)	20.2	0.00115	32
Rrs(551)	19.4	0.00136	33
Rrs(671)	35.8	0.00035	33

NASA VIIRS

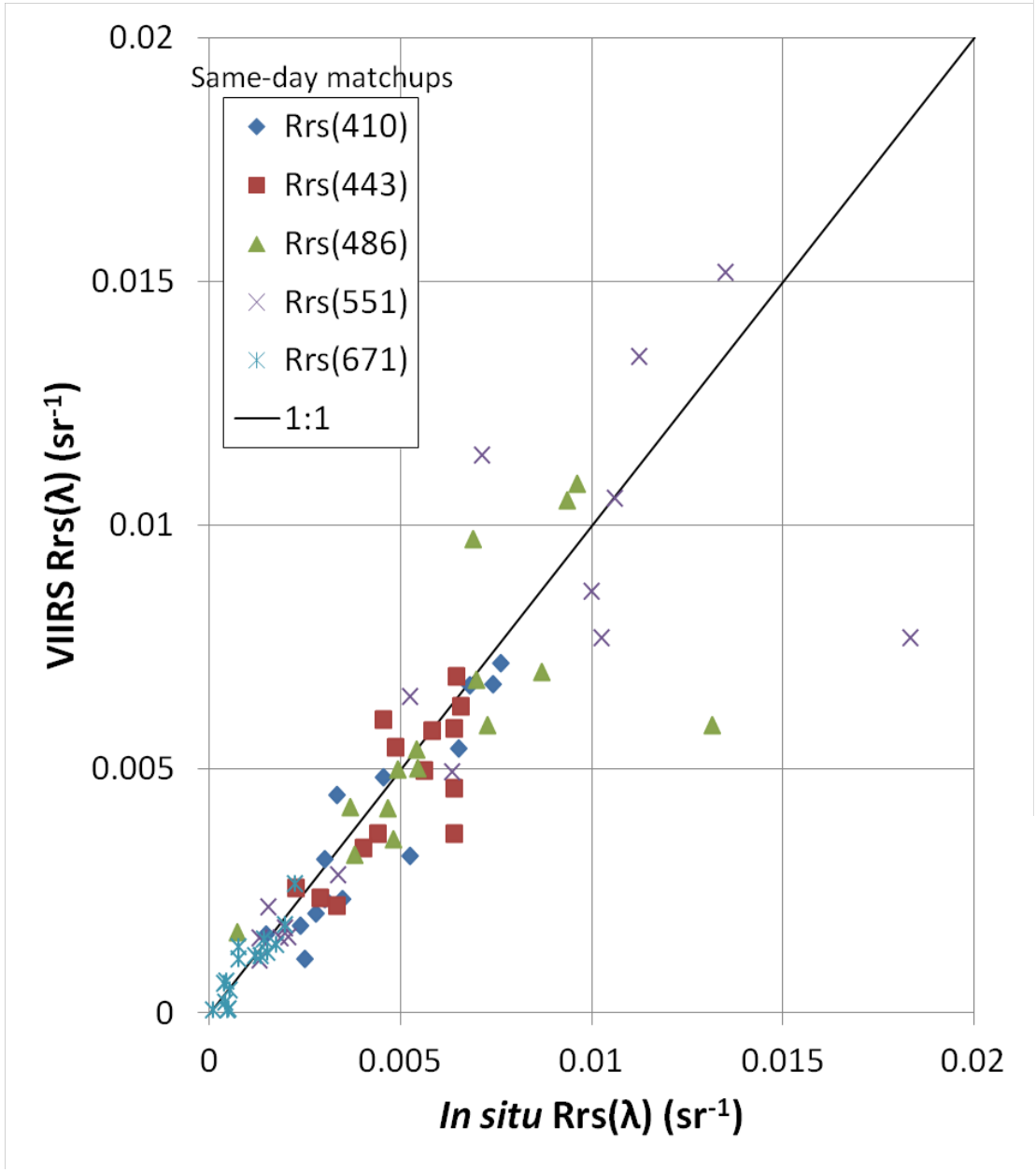
Log-scale same-day matchups between *in situ* and VIIRS Rrs(λ).

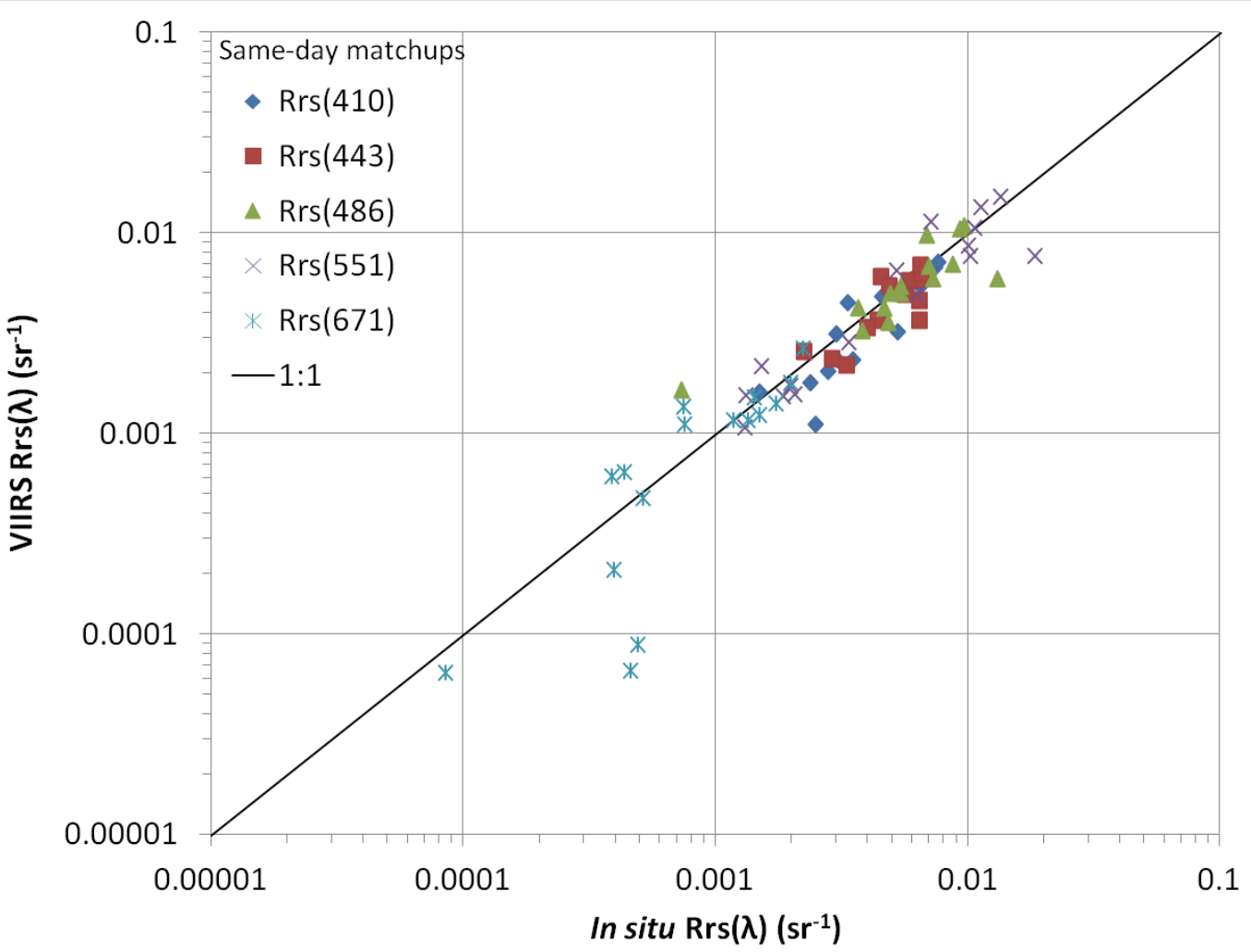


	All data			Without 1 outlier		
	UPD (%)	MAD (sr^{-1})	N	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	33	0.00089	31	28.8	0.00087	30
Rrs(443)	23.8	0.00088	31	21	0.00086	30
Rrs(486)	20.2	0.00115	32	19.2	0.00115	31
Rrs(551)	19.4	0.00136	33	18.8	0.00139	32
Rrs(671)	35.8	0.00035	33	34.7	0.00035	32

NASA VIIRS

USA only

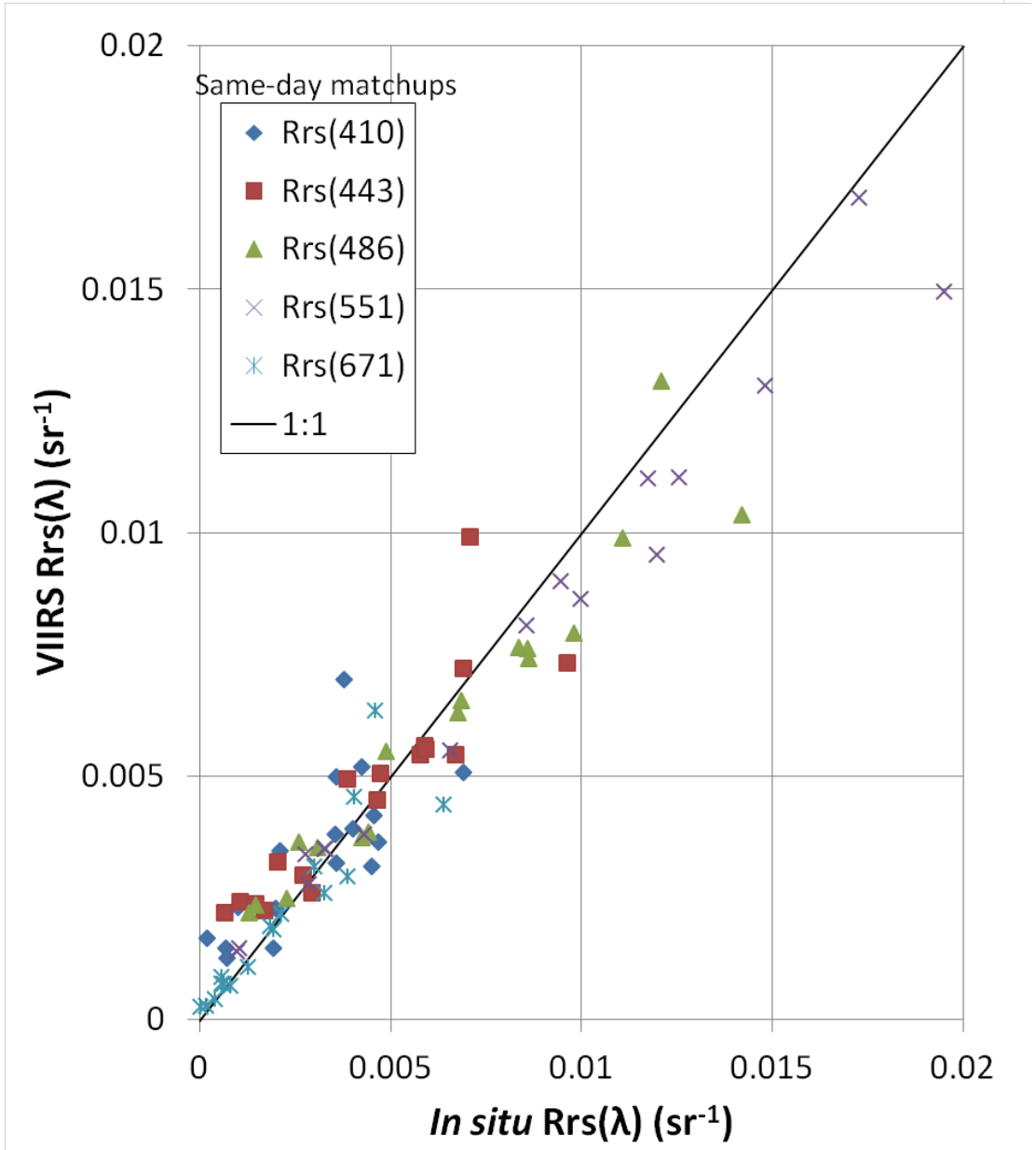


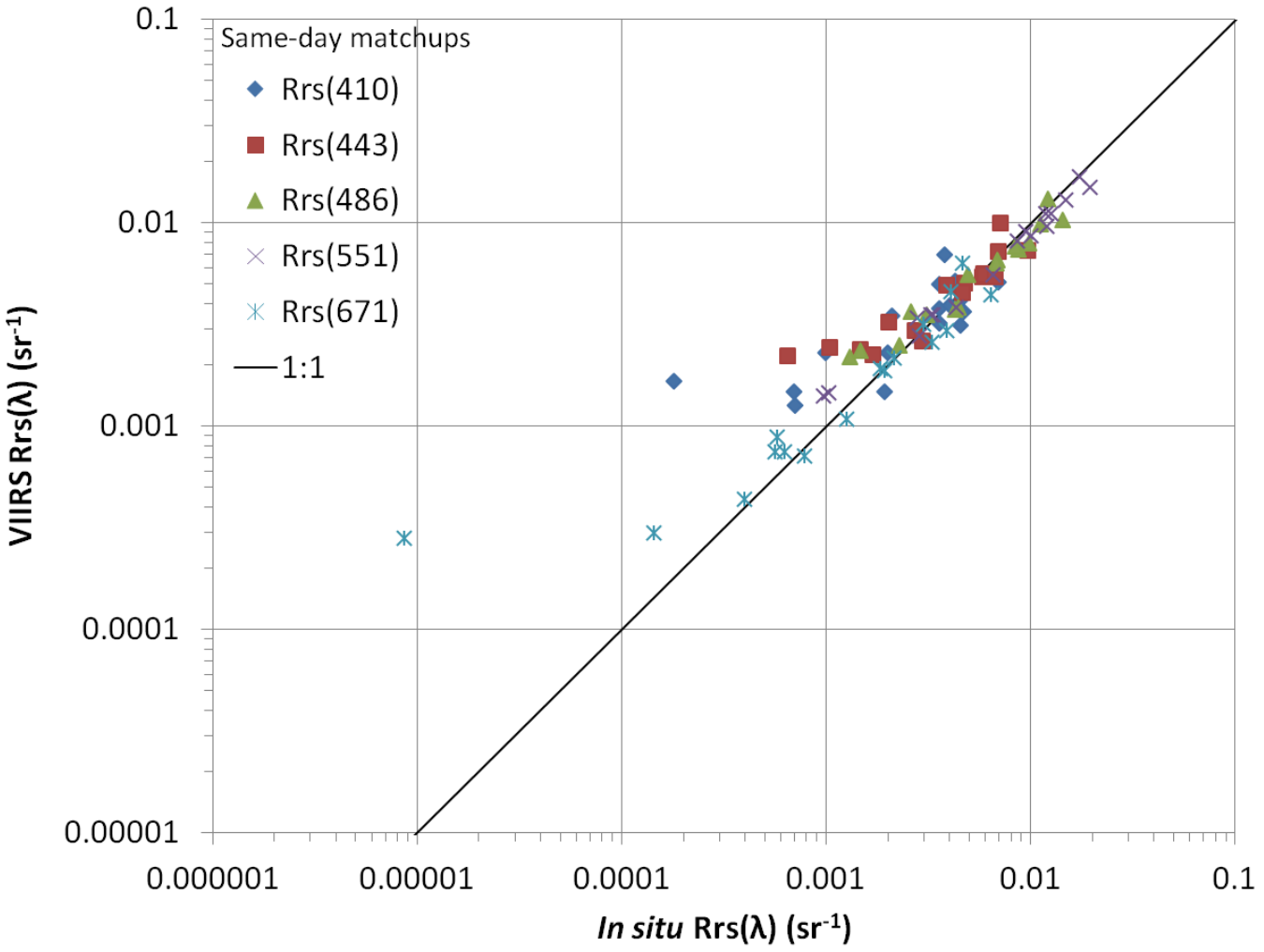


	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	23.8	0.00076	14
Rrs(443)	19.2	0.00085	14
Rrs(486)	22.4	0.00133	15
Rrs(551)	24.7	0.00176	16
Rrs(671)	40.8	0.00024	16

NASA VIIRS

China only

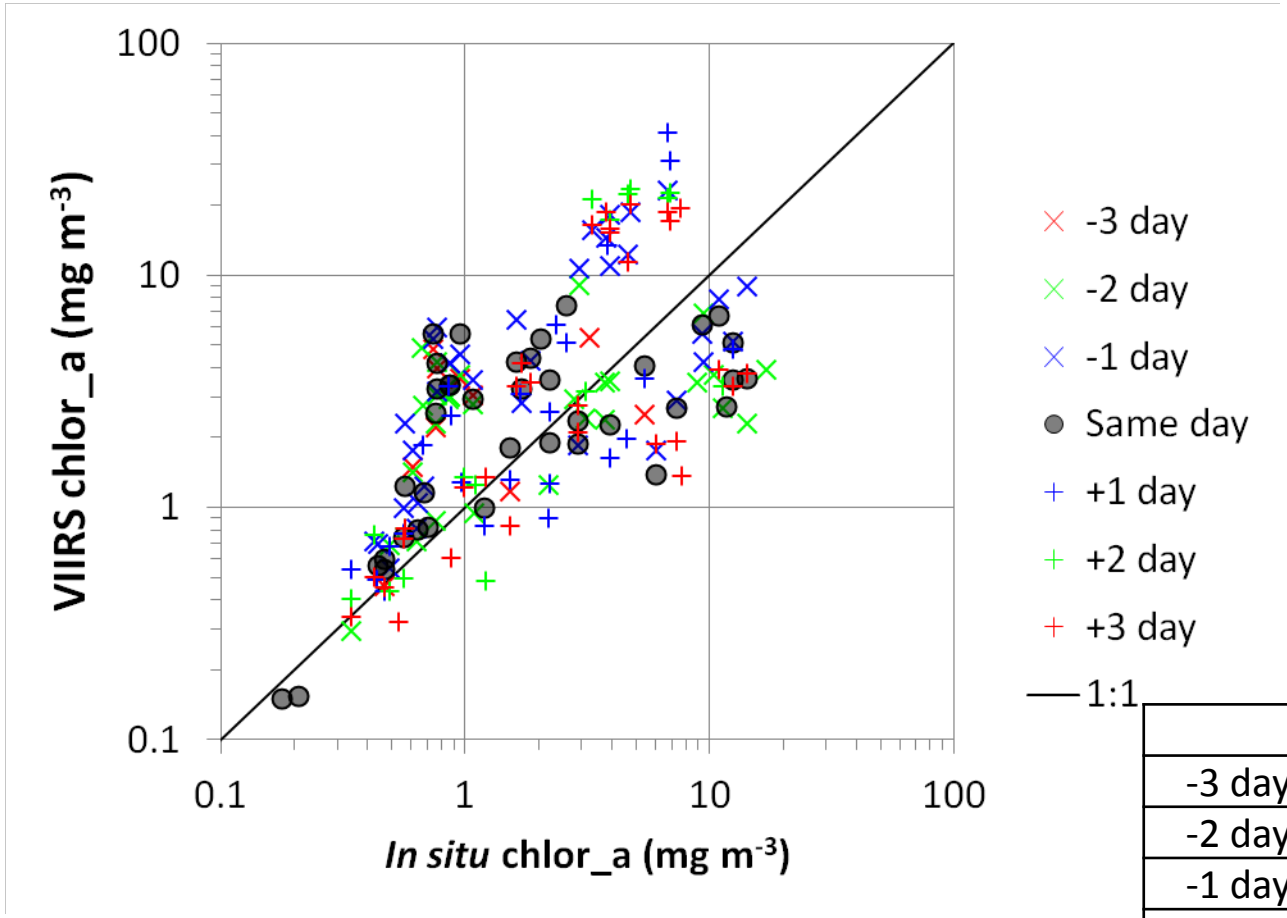




	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	40.7	0.00101	17
Rrs(443)	27.6	0.00091	17
Rrs(486)	18.4	0.00098	17
Rrs(551)	14.4	0.00099	17
Rrs(671)	31.1	0.00044	17

NASA VIIRS

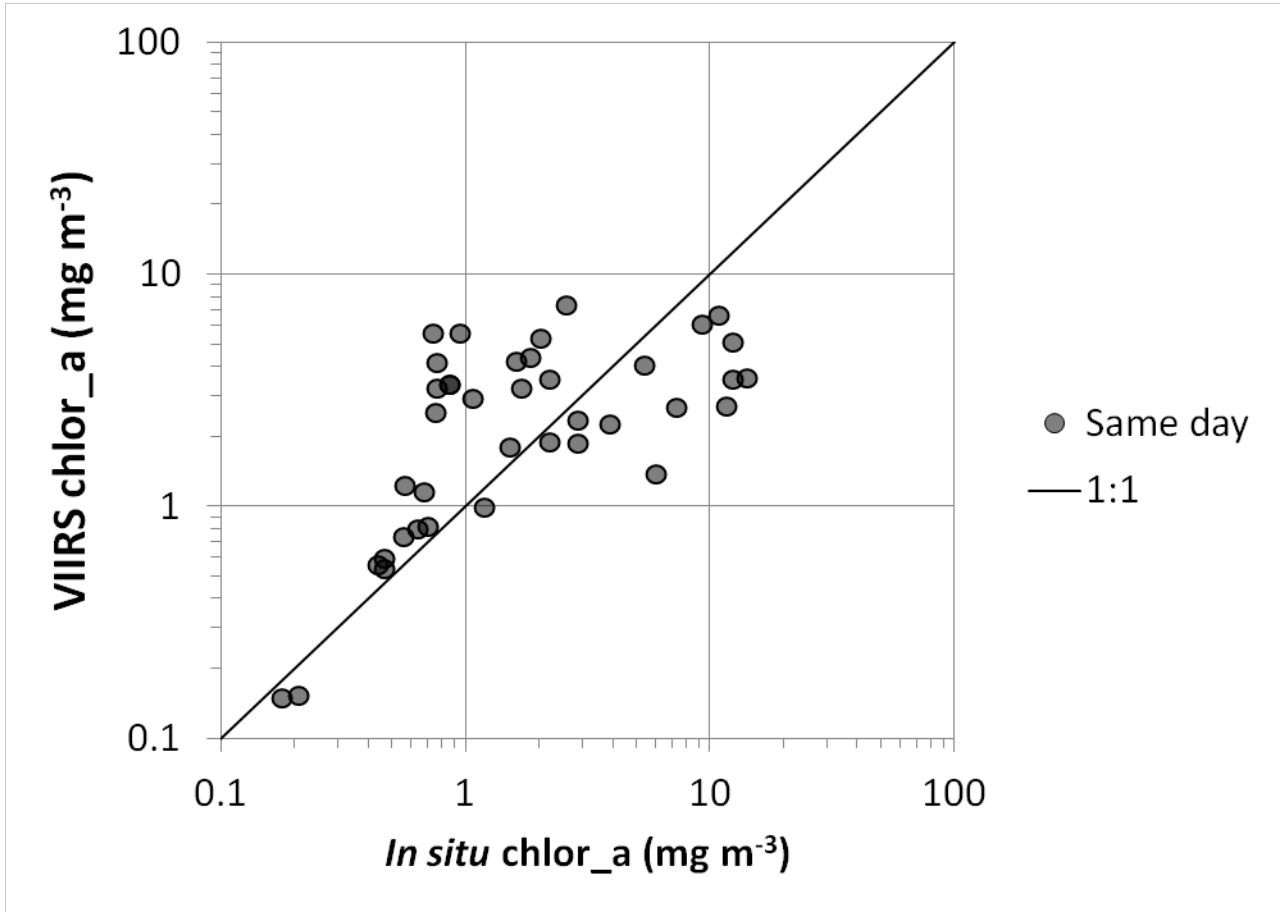
log-scale matchups between *in situ* and VIIRS chlor_a.



	UPD (%)	MAD (mg m^{-3})	N
-3 day	82.7	2.0	10
-2 day	75.6	2.9	29
-1 day	88.9	4.6	35
Same day	69.2	2.6	39
+1 day	64.8	4.1	24
+2 day	70	6.8	16
+3 day	72.4	5.3	30

NASA VIIRS

log-scale matchups between *in situ* and VIIRS chlor_a. Only same-day. Note that MOST of these points come from 2 consecutive dates of sampling within a HAB.



COMMON MATCHUPS

These tables include only the matchups that are in both the NOAA and NASA datasets. “Extra Matchups” is a count of the matchups unique to that dataset (e.g., NOAA captured 8 Rrs(410) matchups that were excluded by NASA, while 1 NASA Rrs(410) matchup was excluded by NOAA).

Chlor_a		UPD (%)		MAD (mg m^{-3})		Extra Matchups	
	N	NASA	NOAA	NASA	NOAA	NASA	NOAA
-3 day	10	82.7	83.5	2	1.9	0	0
-2 day	26	75.8	84.1	2.7	3.2	3	7
-1 day	34	90.2	89.2	4.8	4.5	1	3
Same day	38	68.7	69.3	2.6	2.4	1	1
+1 day	21	57.3	59.3	1.8	1.8	3	4
+2 day	15	74.6	80.7	7.2	8.5	1	7
+3 day	28	72.4	64.9	5.2	4.1	2	2

All Rrs		UPD		MAD		Extra Matchups	
	N	NASA	NOAA	NASA	NOAA	NASA	NOAA
Rrs(410)	30	32.2	29.4	0.0009	0.00085	1	8
Rrs(443)	31	23.8	22.5	0.00088	0.00086	0	8
Rrs(486)	32	20.2	18.3	0.00115	0.00111	0	8
Rrs(551)	33	19.4	19	0.00136	0.00143	0	10
Rrs(671)	33	35.8	38.3	0.00035	0.00044	0	10

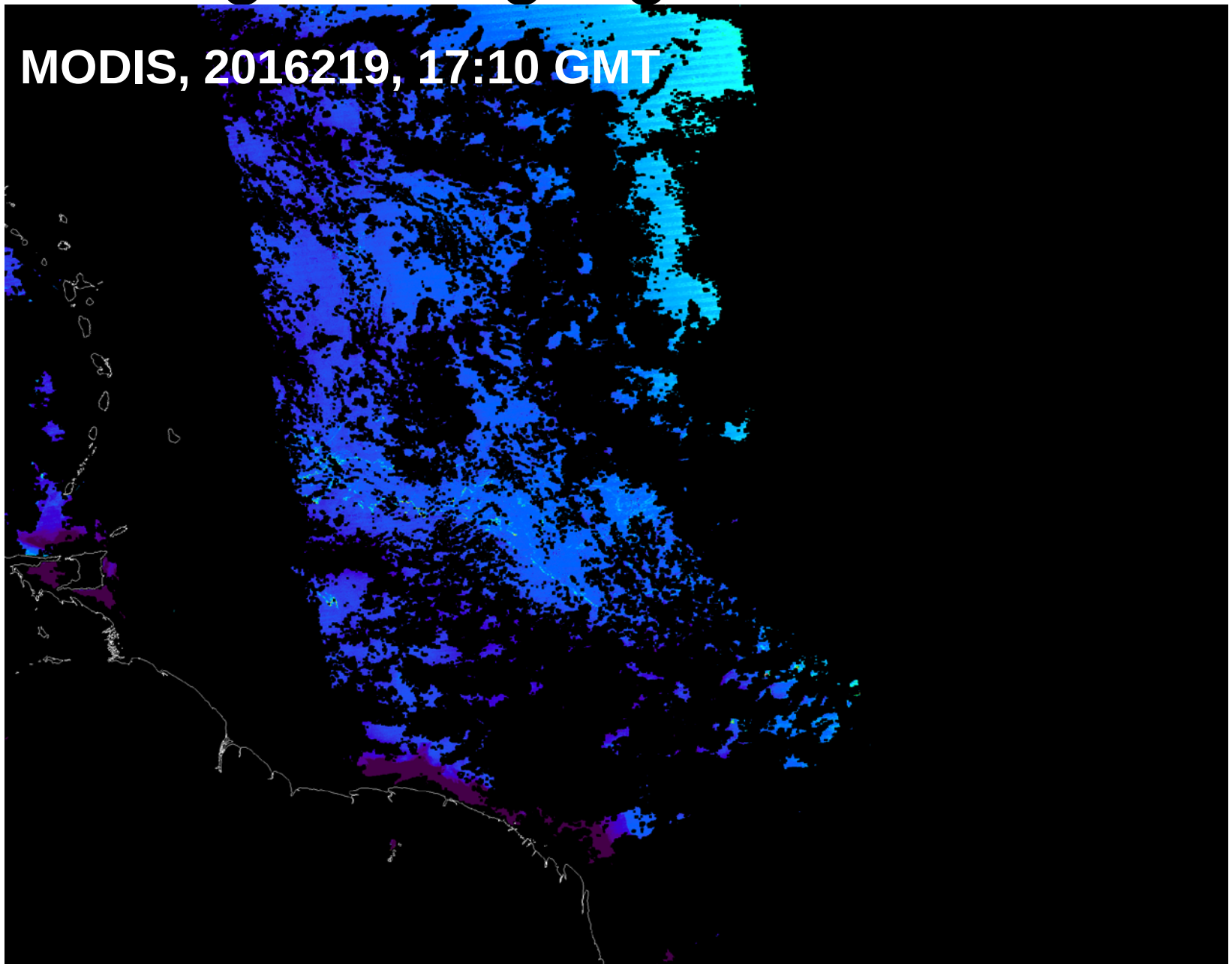
USA Rrs		UPD		MAD		Extra Matchups	
	N	NASA	NOAA	NASA	NOAA	NASA	NOAA
Rrs(410)	30	23.8	22.8	0.00076	0.00085	0	2
Rrs(443)	31	19.2	17.4	0.00085	0.00084	0	0
Rrs(486)	32	22.4	16.1	0.00133	0.0012	0	0
Rrs(551)	33	24.7	18.1	0.00176	0.0016	0	2
Rrs(671)	33	40.8	35	0.00024	0.00022	0	2

China Rrs		UPD		MAD		Extra Matchups	
	N	NASA	NOAA	NASA	NOAA	NASA	NOAA
Rrs(410)	30	39.7	35.1	0.00103	0.00085	1	6
Rrs(443)	31	27.6	26.7	0.00091	0.00088	0	8
Rrs(486)	32	18.4	20.2	0.00098	0.00103	0	8
Rrs(551)	33	14.4	19.8	0.00099	0.00127	0	8
Rrs(671)	33	31.1	41.5	0.00044	0.00065	0	8

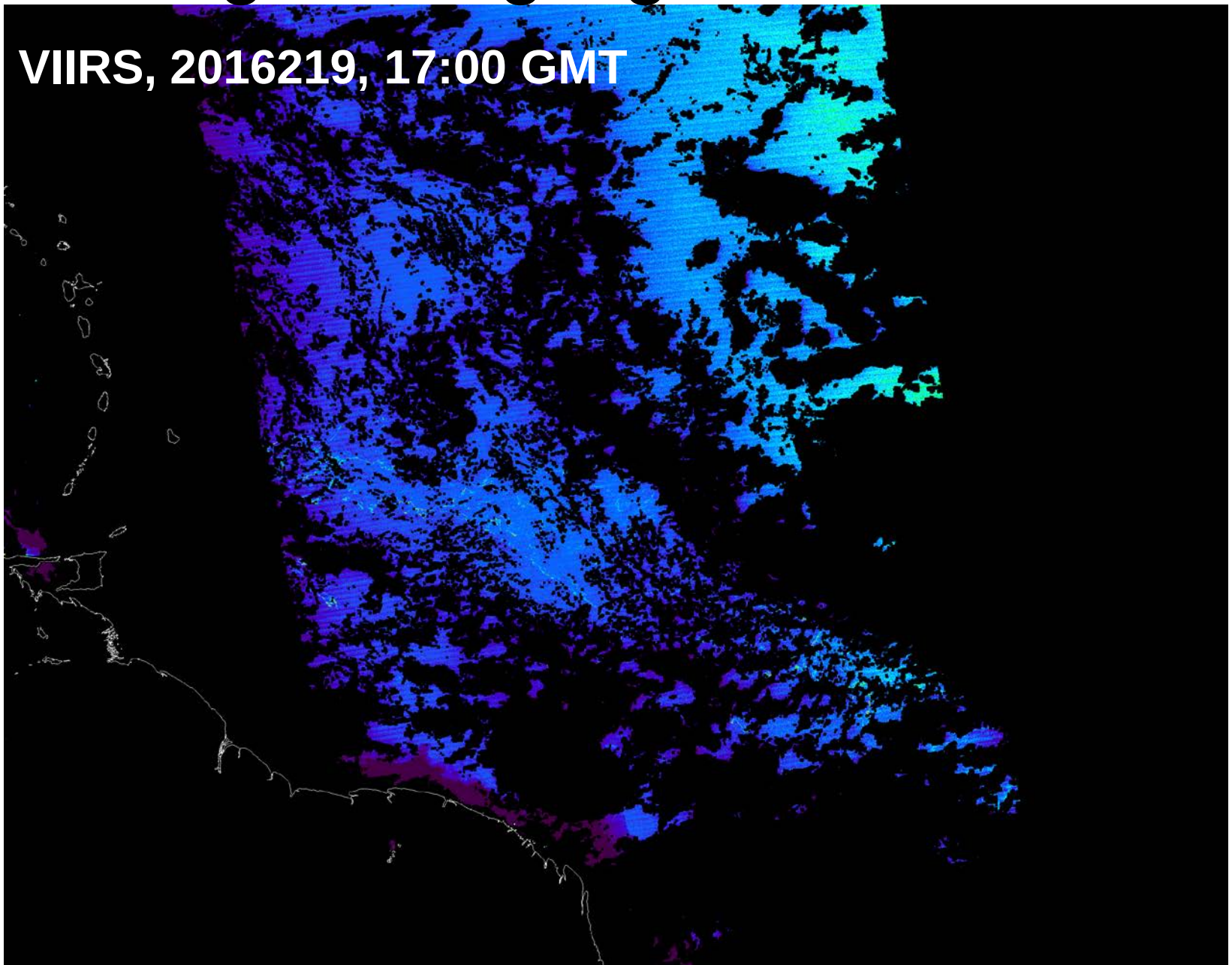
Conclusions from validation results

- MSL12 Rrs performance generally satisfactory in coastal waters (comparable to published MODIS results)
- Bio-optical inversion algorithms still need improvements
- MSL12 Rrs slightly better than L2gen Rrs for the same pixels
- MSL12 shows more retrievals than L2gen

Detecting floating algae



Detecting floating algae



Vertical migration of dinoflagellates