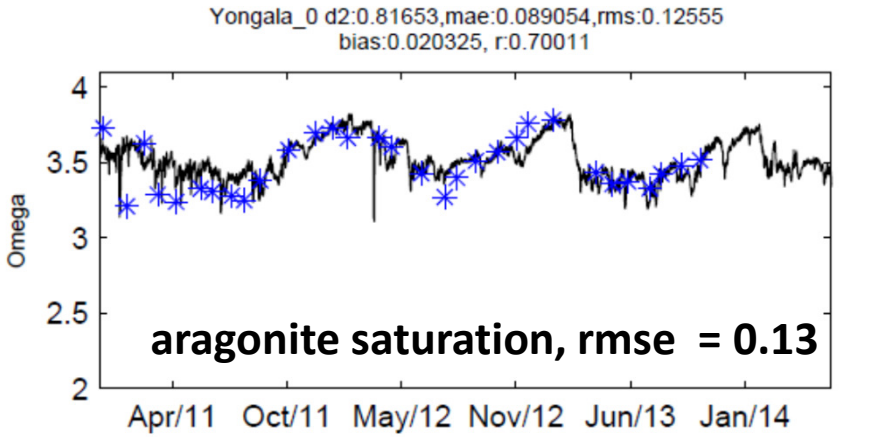
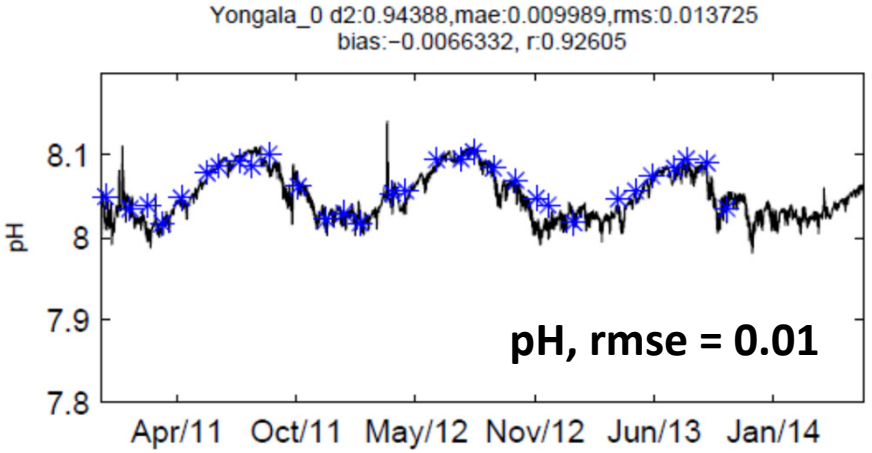
eReefs biogeochemical skill assessment.

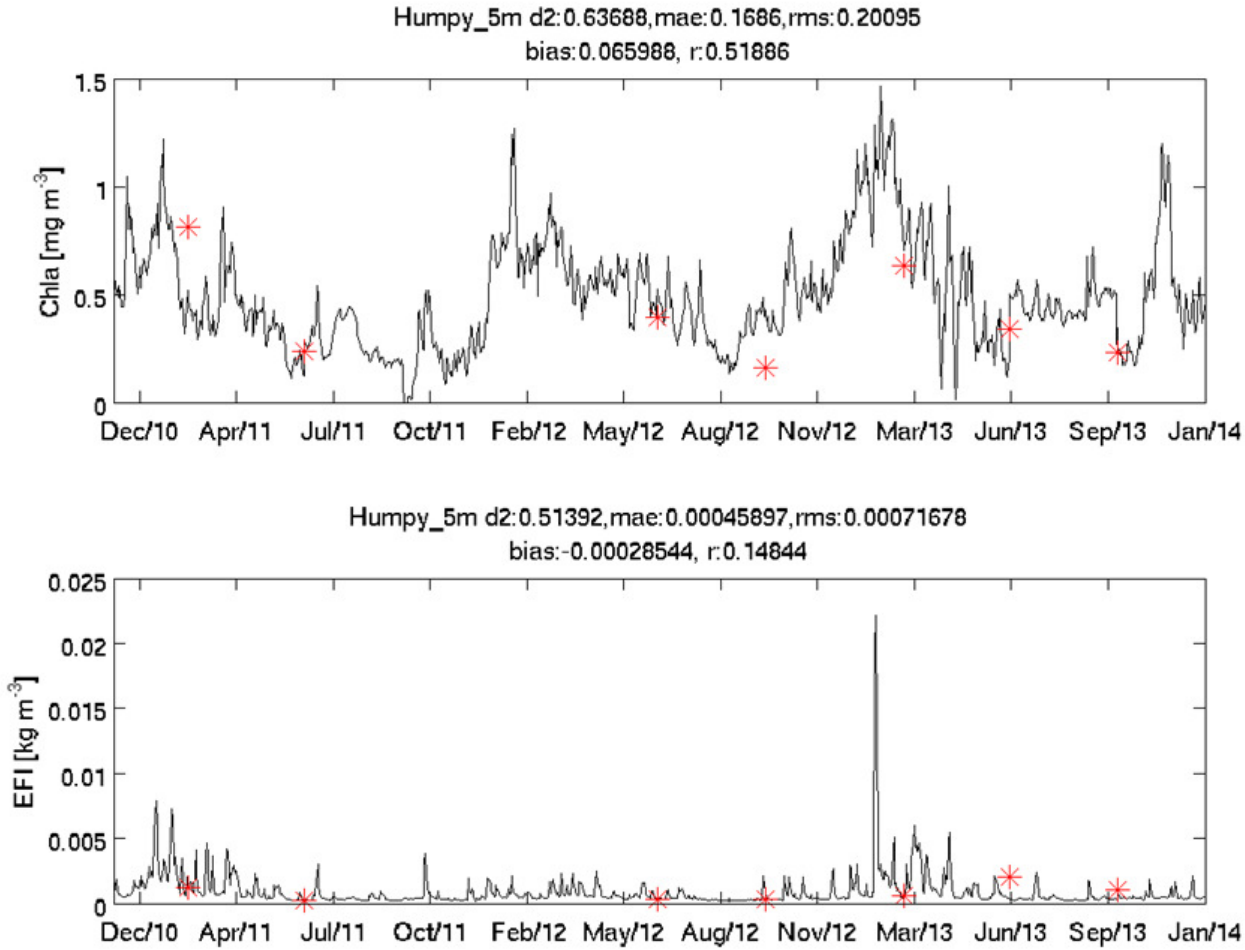
Skill assessment – varies with variable, space and time.

- As pointed out earlier in the day, the errors in pH (+/- 0.03) and aragonite saturation (+/- 0.23) are tiny.
- Also, note that aragonite saturation observations are extensive.
- The reasons for good skill are that the carbon chemistry processes are strongly physically-forced, initial conditions are mapped, and the length scales of variation are large.



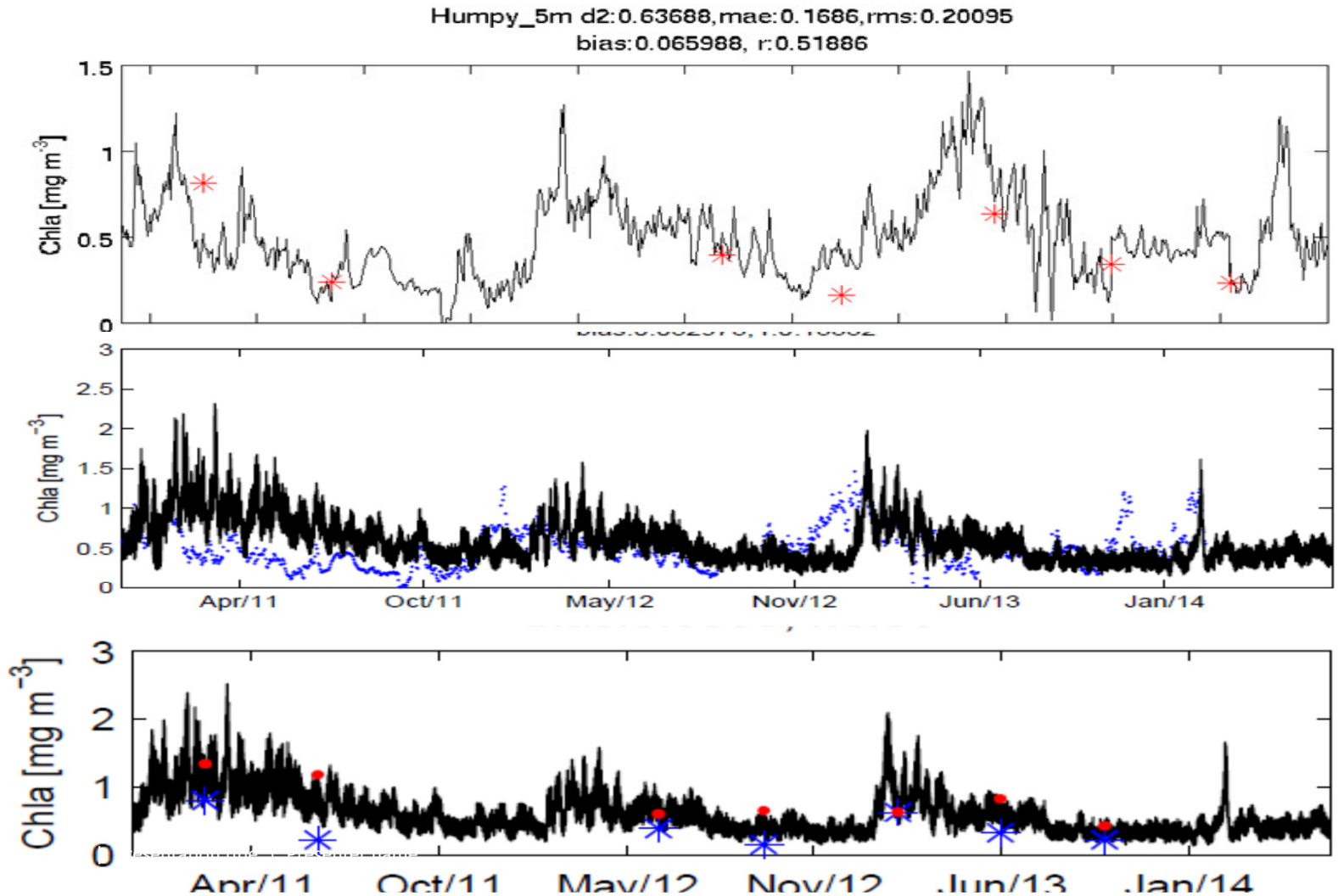


Time series at Reef Rescue sites are the most comprehensive data we have.



- Correlation coefficient (r) is challenging to line up point samples.
- We will use the root mean square error (RMS error - units of variable) as a measure of mis-match.
- Willmot score (d2 – value between 0 and 1) is considered in the report.

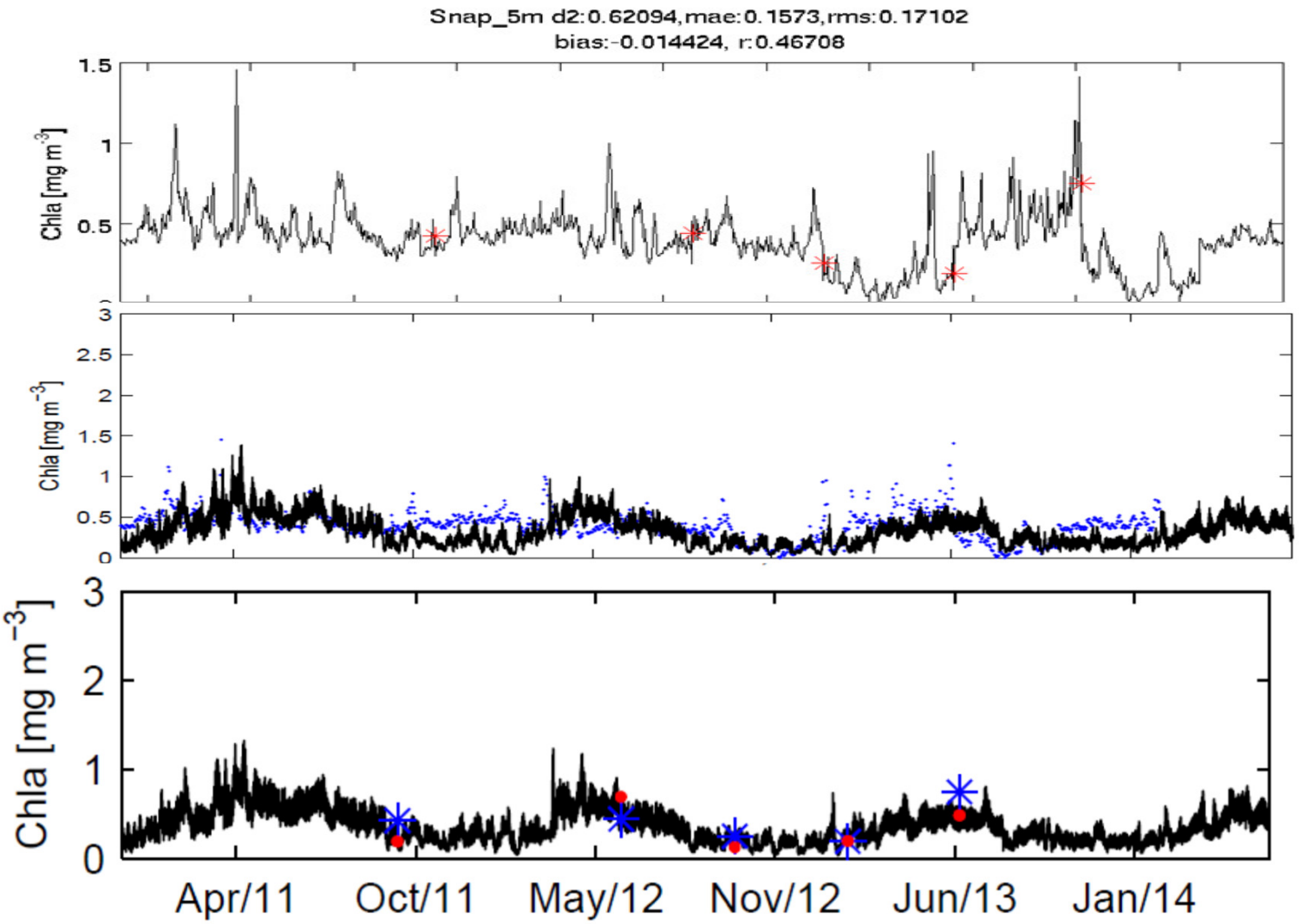
Full skill assessment (https://research.csiro.au/ereefs/models/ Appendix A – 184 pp



WQM vs extract
rms = 0.20

WQM vs model
rms = 0.33

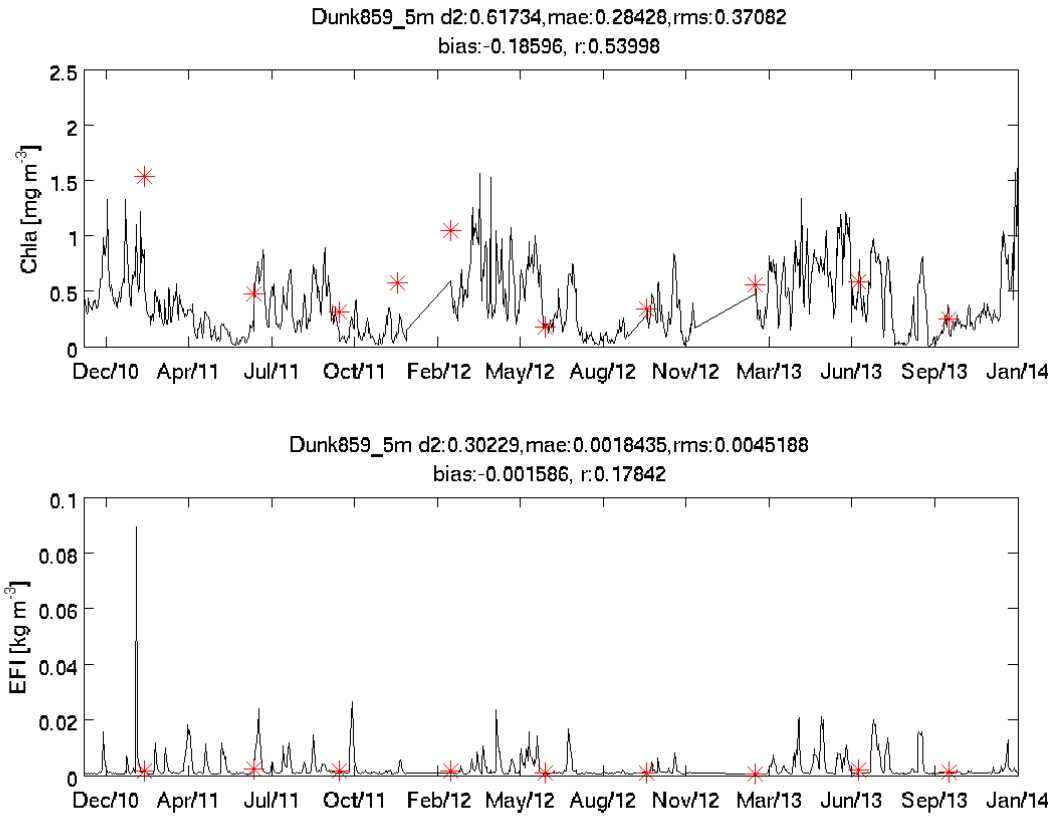
Model vs ext.
rms = 0.64



WQM vs extract
rms = 0.20

WQM vs model
rms = 0.23

Model vs ext.
rms = 0.24



The worst site for comparison of observations types was Dunk Island, with an RMS error of 0.37 mg m^{-3}.

Which is still not bad, esp. given the two worst matches were when chl > 1 mg m^{-3}.

Reef rescue chlorophyll extractions vs. WQM Chl fluorescence on mooring.

→

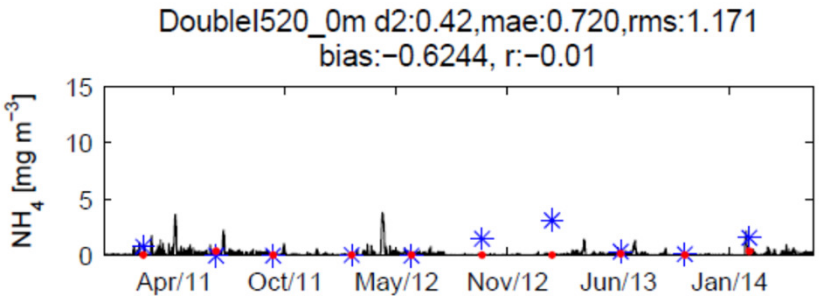
Mean RMS error = 0.21 mg chla m^{-3}.
Mean Bias = 0.0 mg chla m^{-3}

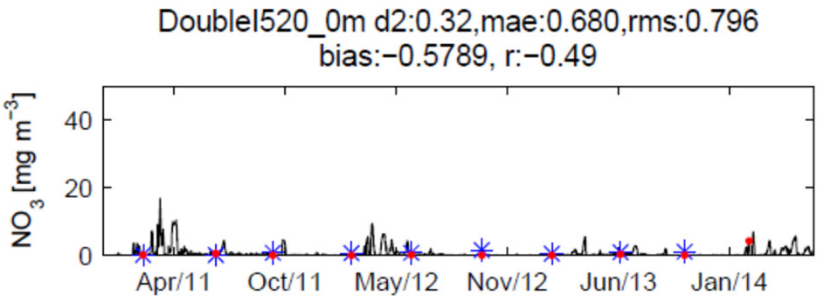
	wilmot		rms		bias	
WQM obs agains RR obs	Chlorophyll	TSS	Chlorophyll	TSS	Chlorophyll	TSS
Snapper Island	0.6209	0.2169	0.171	0.0006	-0.0144	0.0001
Fitzroy Reef	0.3959	0.3271	0.2139	0.0006	-0.001	-0.0002
High Island	0.5472	0.3912	0.2049	0.0008	-0.0802	-0.0003
Russell Island	0.5717	0.3143	0.14	0.0006	0.0718	-0.0003
Dunk Island	0.6173	0.3023	0.3708	0.0045	-0.186	-0.0016
Pelorus Island	0.6631	0.2521	0.2954	0.0007	0.0445	0.0001
Pandora Island	0.7048	0.4331	0.2049	0.0004	0.0647	0.0001
Geoffrey Bay	0.7872	0.6704	0.3077	0.0009	-0.04	-0.0001
Double Cone Island	0.9064	0.6185	0.1429	0.0011	-0.0141	-0.0006
Daydream Island	0.661	0.5384	0.2067	0.0021	0.0378	-0.0009
Pine Island	0.557	0.3273	0.1249	0.0052	0.052	-0.0014
Barren Island	0.9452	0.3258	0.0851	0.0003	0.0598	-0.0001
Pelican Island	0.822	0.0071	0.3193	0.0134	-0.0665	0.0047
Humpy Island	0.6369	0.5139	0.2009	0.0007	0.066	-0.0003
mean WQM obs v reef reescu	**0.67**	**0.37**	**0.21**	**0.002**	**-0.0004**	**-0.0001**

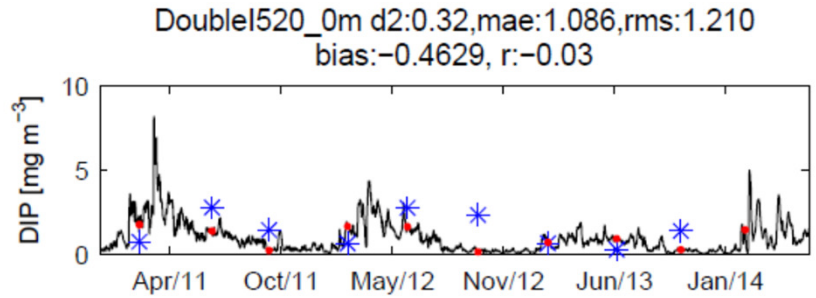
Now compare reef rescue chlorophyll extraction against model time series – with context that the observations

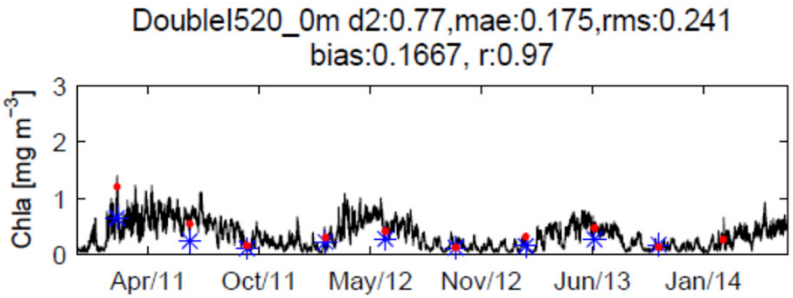
Double Island – near Palm Cove – p123 of the report.

Black line – model output
Blue asterisk ∗ - observation
Red dot • - model at observation time.

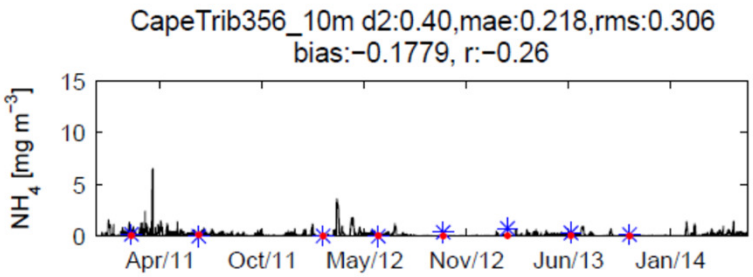


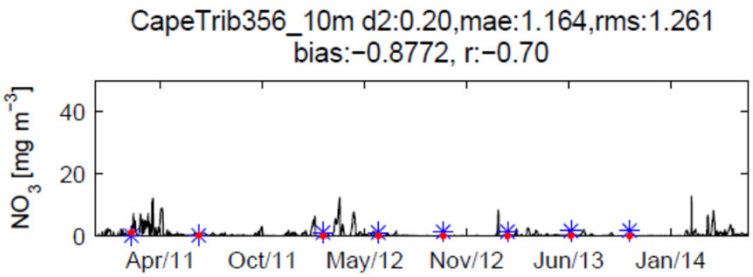


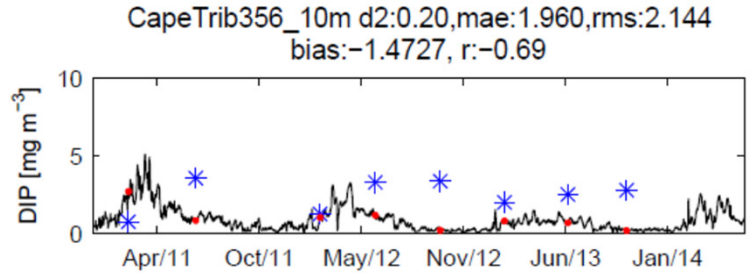


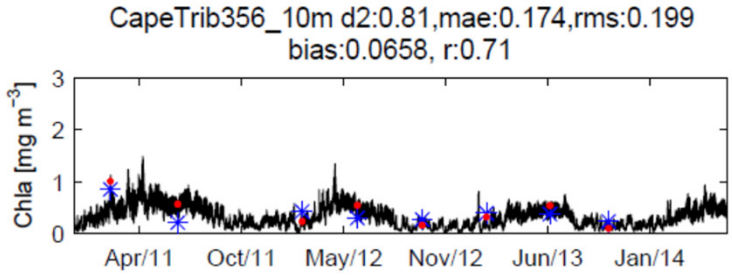


Cape Tribulation – p118 of the report.

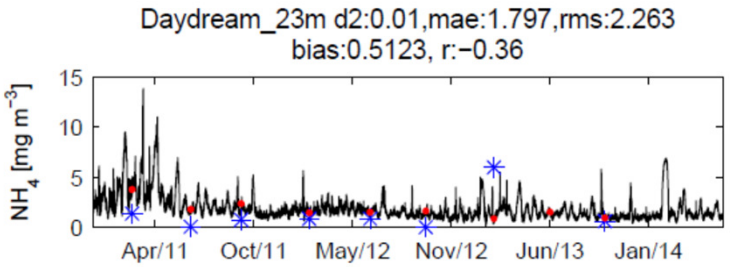


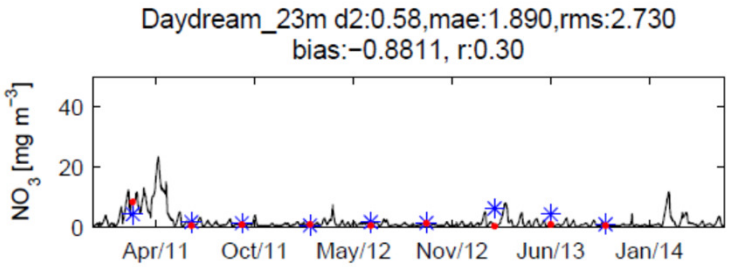


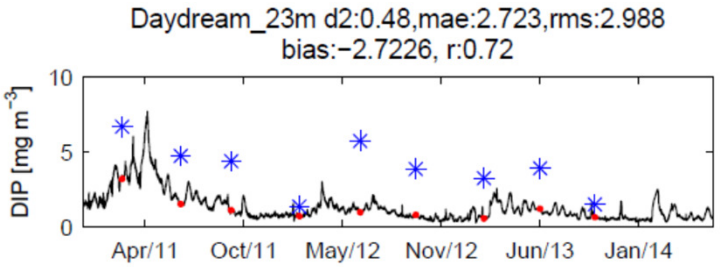


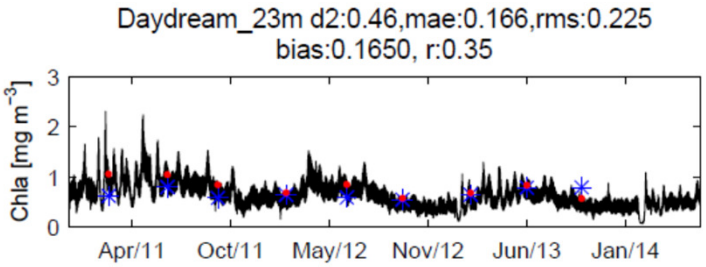


Daydream Island – p119 of the report.





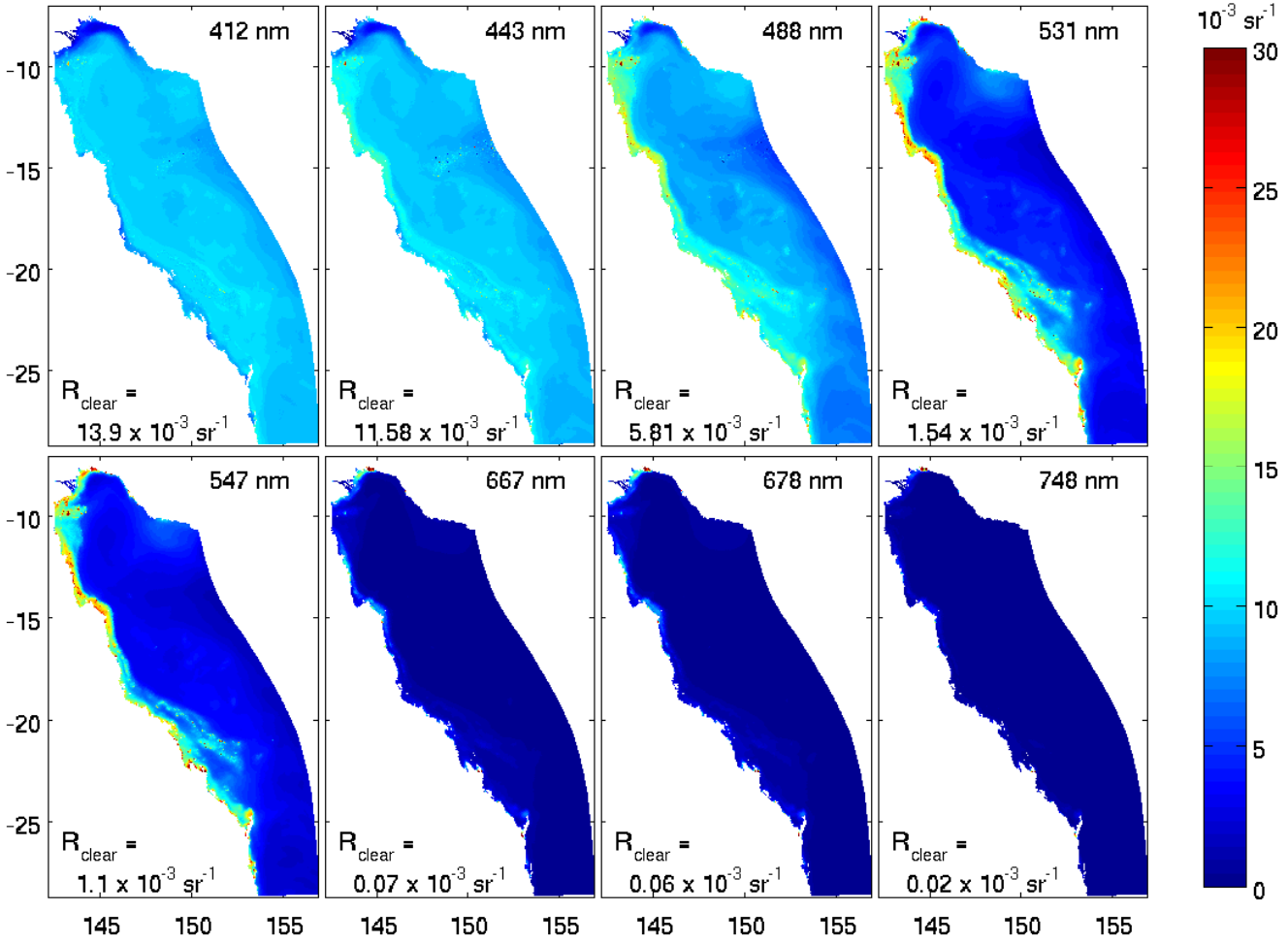




RMS error of model chl concentration vs. observed chlorophyll extractions.

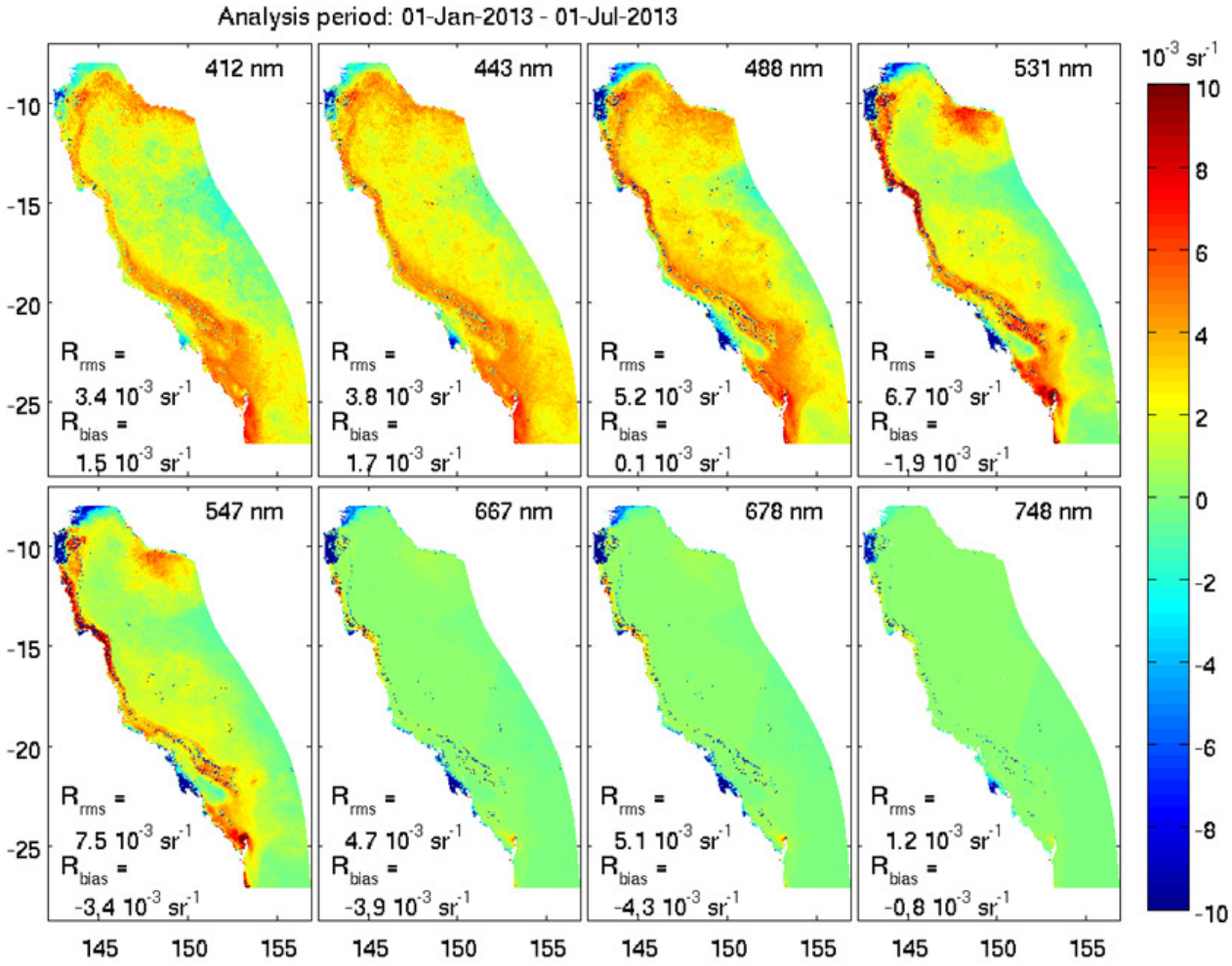
RMS	WQM	Chl ext.		
Snapper Island	0.23	0.23	0.0027	0.0004
Fitzroy Reef	0.25	0.27	0.0105	0.0008
High Island	0.25	0.28	0.0111	0.0009
Russell Island	0.24	0.30	0.0053	0.0006
Dunk Island	0.44	0.38	0.0224	0.0007
Pelorus Island	0.23	0.33	0.0051	0.0005
Pandora Island	0.28	0.20	0.0074	0.0007
Geoffrey Bay	0.70	-	0.0143	-
Double Cone Island	0.25	0.36	0.0038	0.0015
Daydream Island	0.29	0.26	0.0027	0.0016
Pine Island	0.27	0.26	0.0033	0.0059
Barren Island	0.47	0.48	0.0008	0.0005
Pelican Island	0.38	0.44	0.0087	0.0009
Humpy Island	0.33	0.63	0.0023	0.0013
RMS average	**0.33**	**0.34**	**0.0072**	**0.0013**

• Skill assessment using remote-sensing reflectance.



Error in the mean simulated remote-sensing reflectance for Jan – Jul 2013 at the 8 MODIS ocean colour bands.

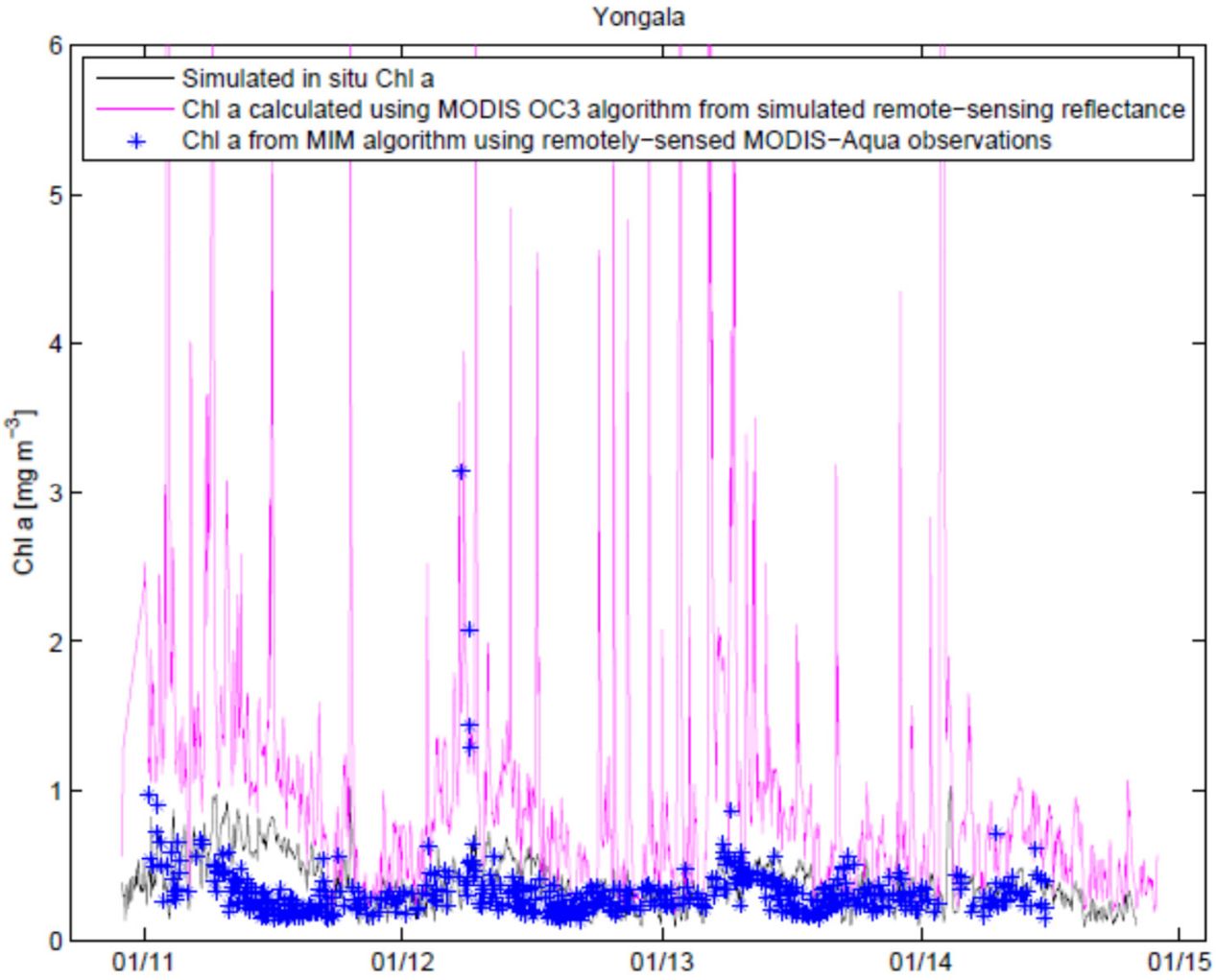
Bias and spatially-averaged error small relative to spatial variability or model – observation mis-match – thus errors in optics = errors in biogeochemical model



Is remote-sensing an accurate means to measure in situ chlorophyll if the CSIRO inversion method is applied (p152 – 184)?

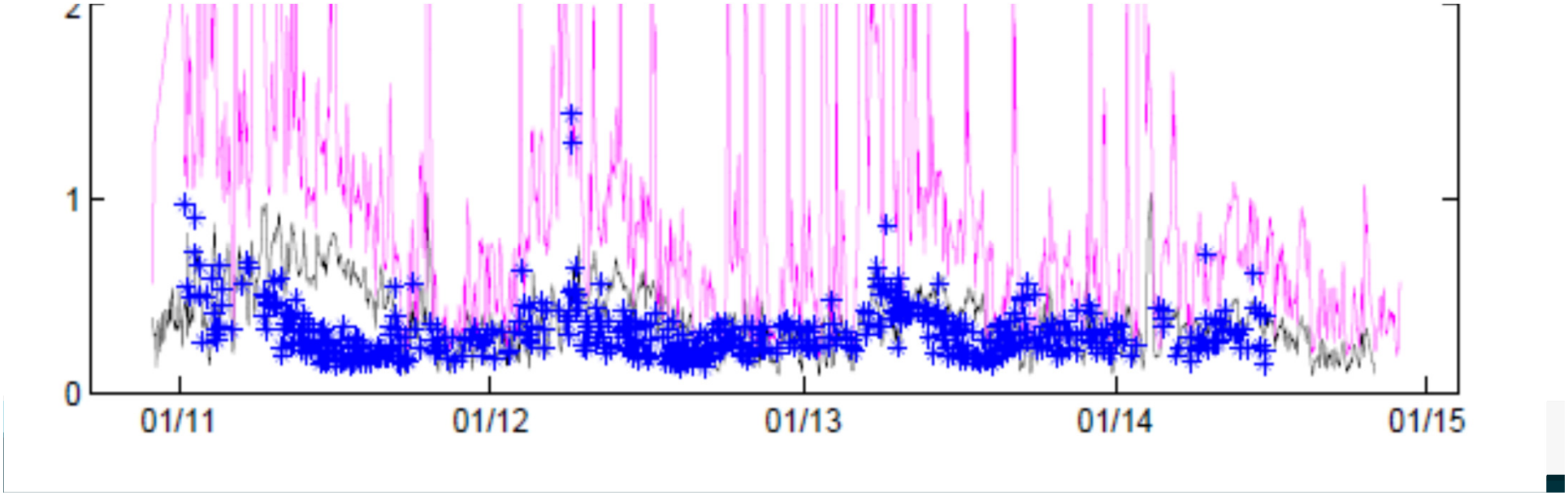
Model rms error at Yongala time series is 0.29 (p63).

Purple line is what the model predicts the NASA OC3 algorithm would give (due to CDOM, bottom etc.).

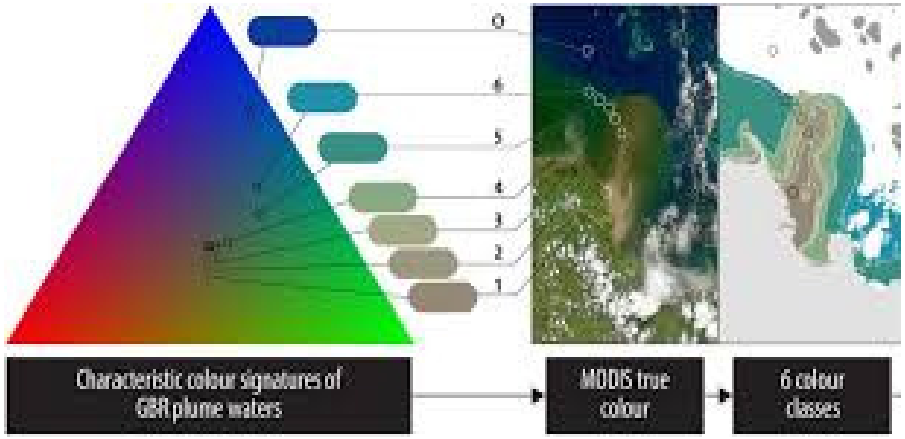


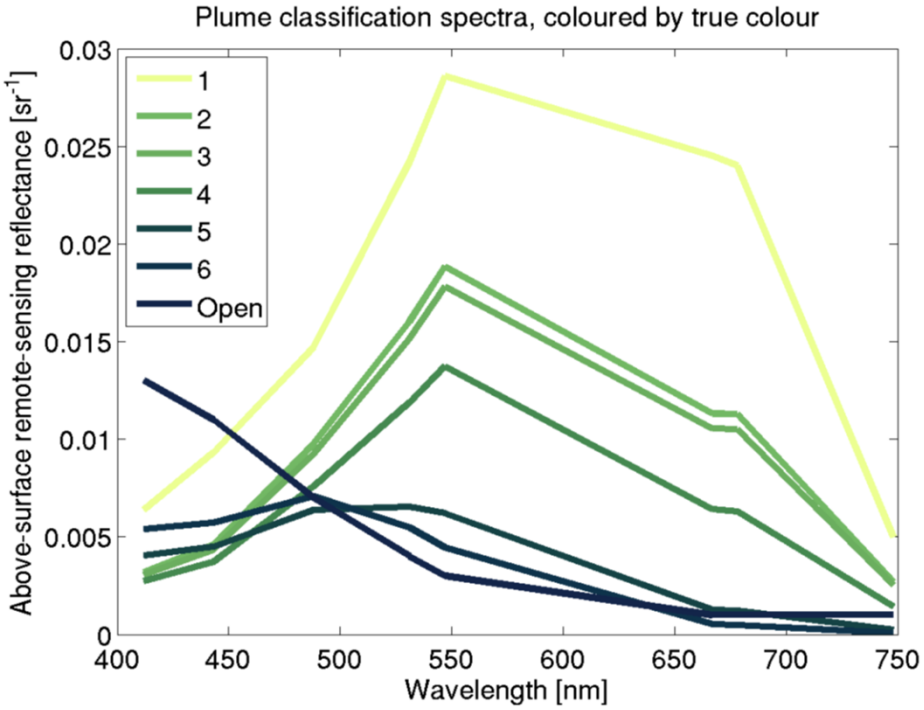
Is remote-sensing an accurate means to measure in situ chlorophyll if the CSIRO inversion method is applied (p152 – 184)?

eReefs matrix inversion method is not poorly affected by CDOM, and matches well with the skilful in situ predictions.



- **Plume dynamics** (thank you to Eduardo Teixeira da Silva and Michelle Devlin)
  - Eduardo identified the locations (see below) that were used to characterise plume classes.
  - I then looked at the MODIS colour bands at the same time, and came up with an 8 point spectra.

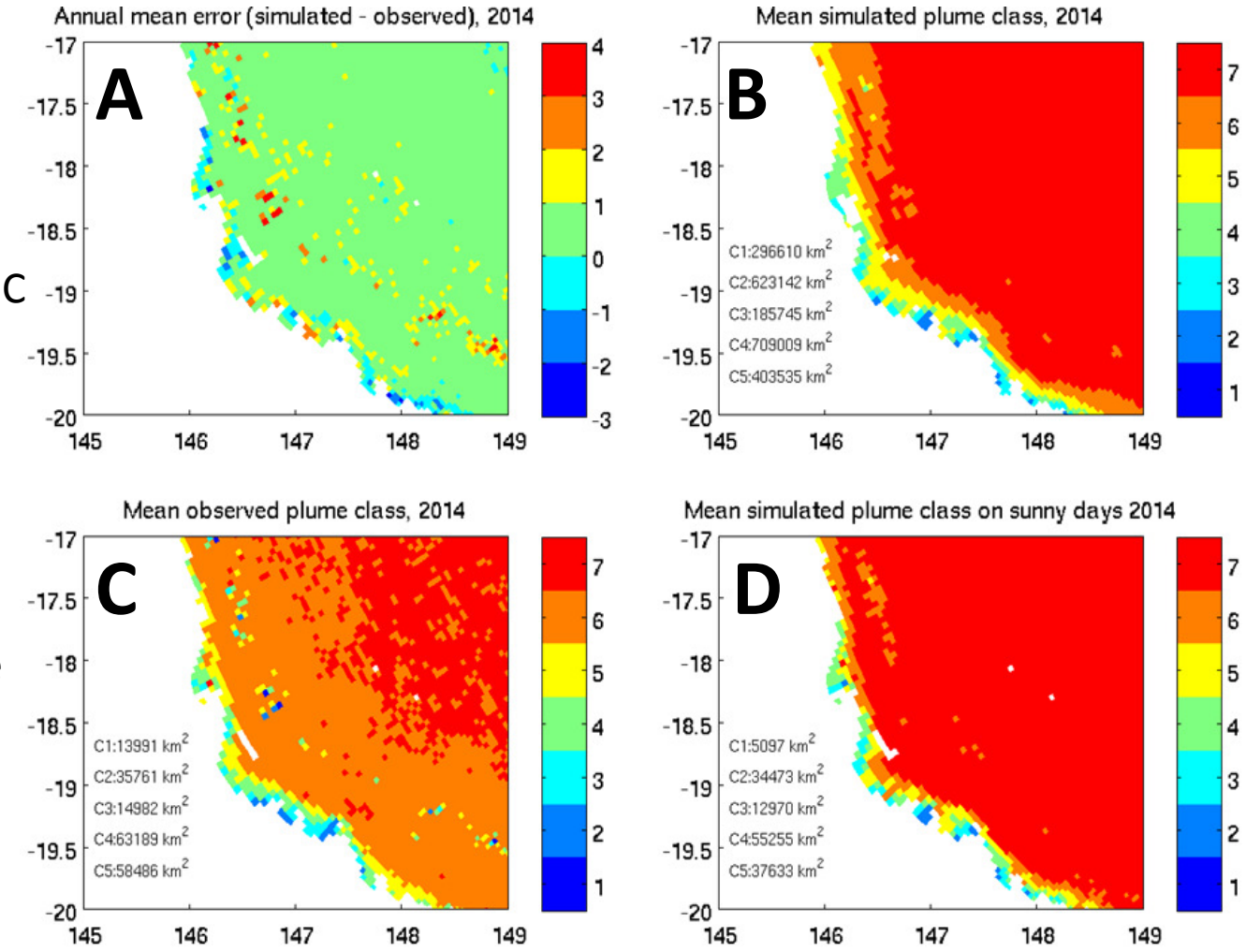


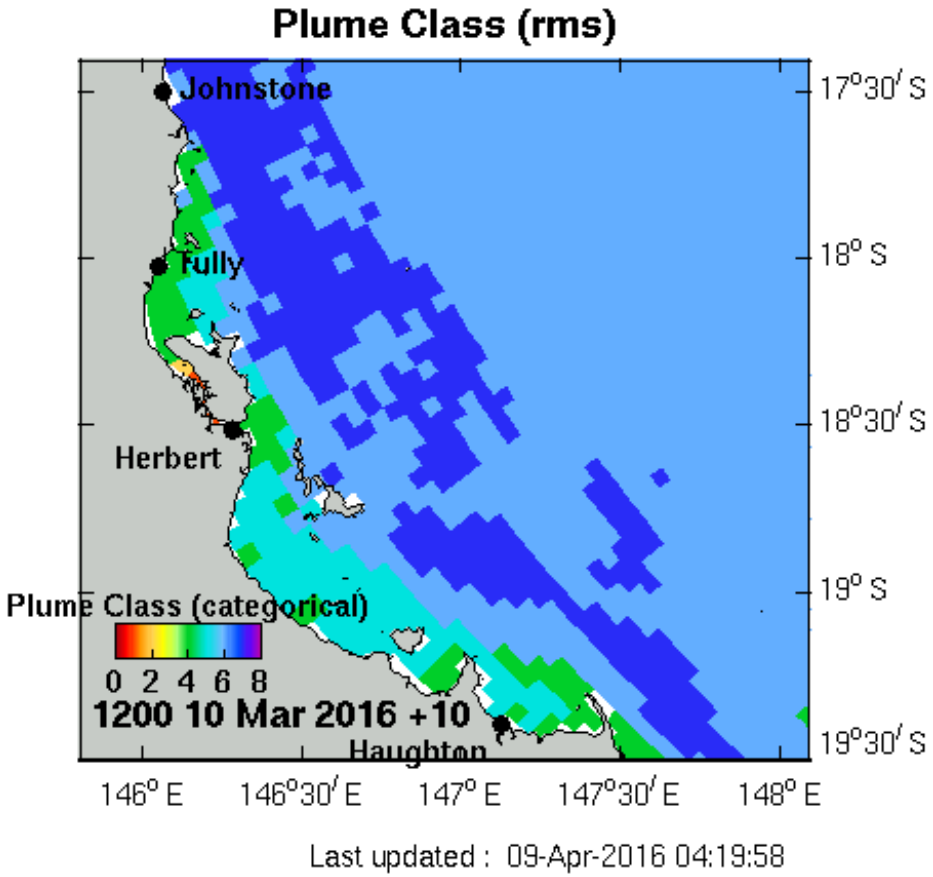


Spectral matching was then used to identify plumes from model generated remote-sensing reflectance.

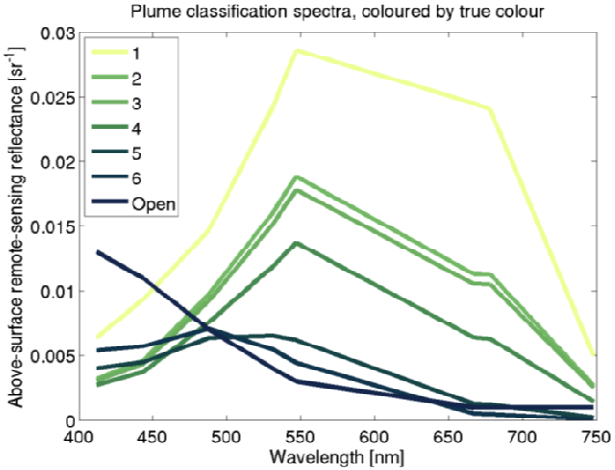
- Panel C shows the mean observed plume for 2004.
- Panel D shows the mean simulated plume class.
- Panel A = Panel D – Panel C

- Observed and simulated mean plume classes are similar between in 2014, showing the model is capturing the circulation and transformation of the optical plumes
- For 2014, clouds did bias the observation of plume extents in 2014.





- Apologies – colour bar reversed from last slide.
- Herbert River plume occasionally showing as 1, with coastal waters showing as between 1-5.
- Spectral matching struggles to distinguish between 6 and 7 – strongly reliant on 412 nm.



Glider transects.