



# eReefs model validation against emergent properties and large-scale patterns

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# Model performance characterisation

- Level 0: Structure

Is the model structure and behaviour plausible in light of ecological theory?

- Consultation with GBR experts such as yourselves!

- Level 1: Biomass and concentrations

Does the model reproduce observed time-series or spatial patterns?

- Reef Rescue Marine Monitoring Program, IMOS & and AIMS monitoring data

- Remote Sensing MODIS observations

- Level 2: Rates

Does the model reproduce observed rates and fluxes?

- Level 3: Emergent properties

Is the model able to reproduce emergent properties such as community structure that are not coded or calibrated in?

- Phytoplankton community composition

- Cross-seasonal relationships between flow and chlorophyll

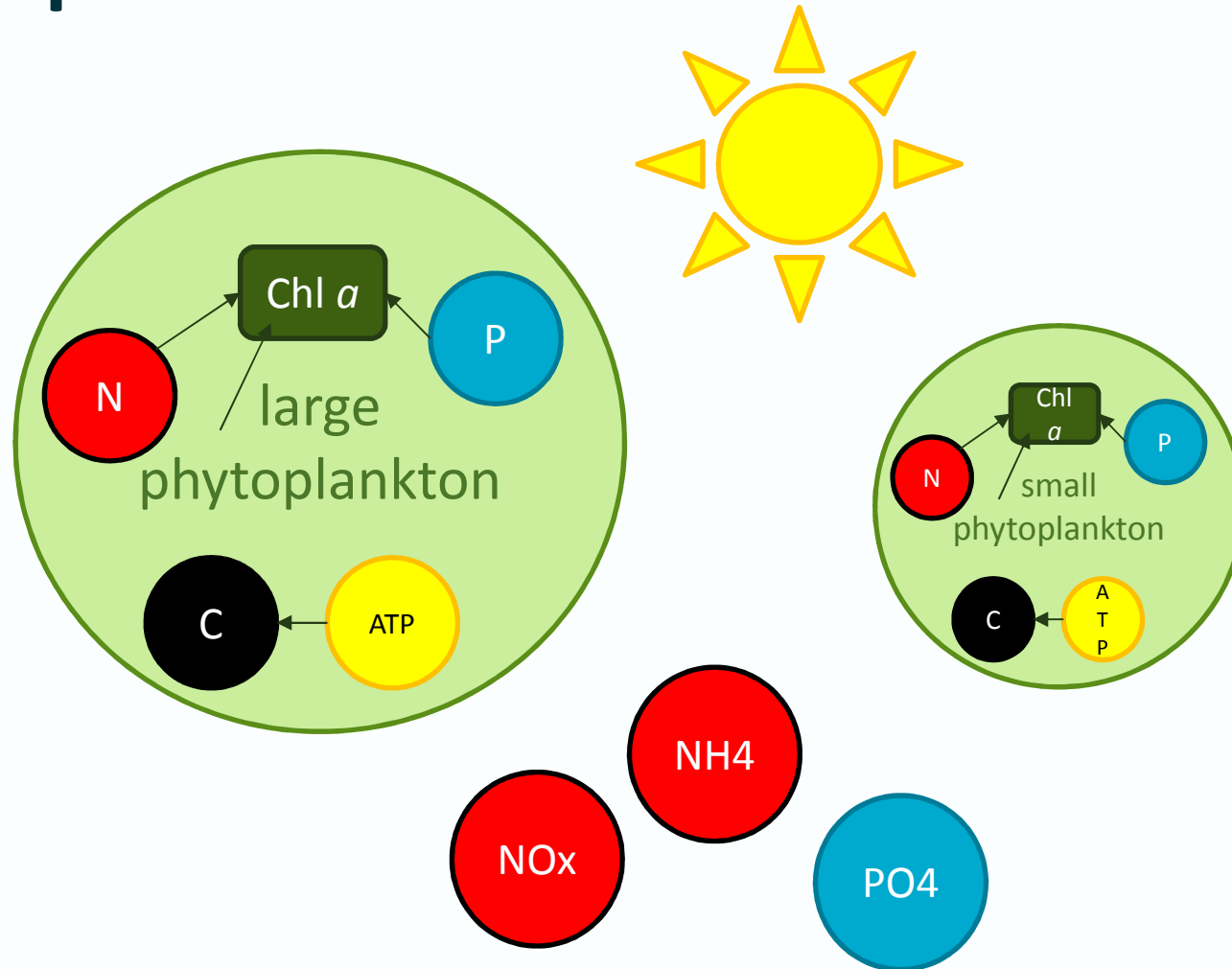
- Spatial patterns and temporal correlations

# Why look at emergent properties and large-scale patterns?

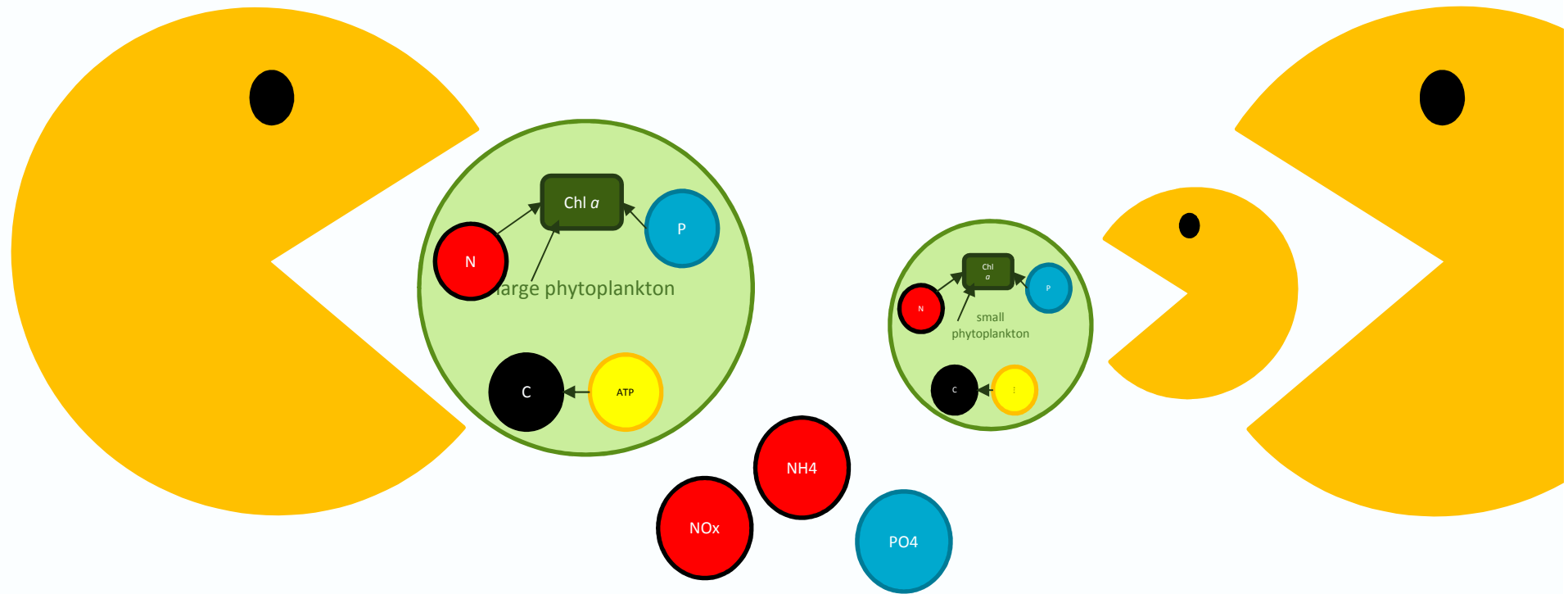
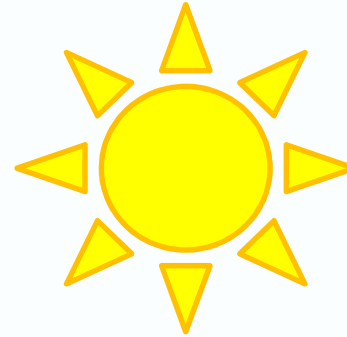
- As a check on model behaviour that is independent of calibration data.
- To give us confidence that the model is getting **the right results for the right reason**.
- To check that the model can predict the large-scale patterns that matter for management and policy.

# Phytoplankton community structure

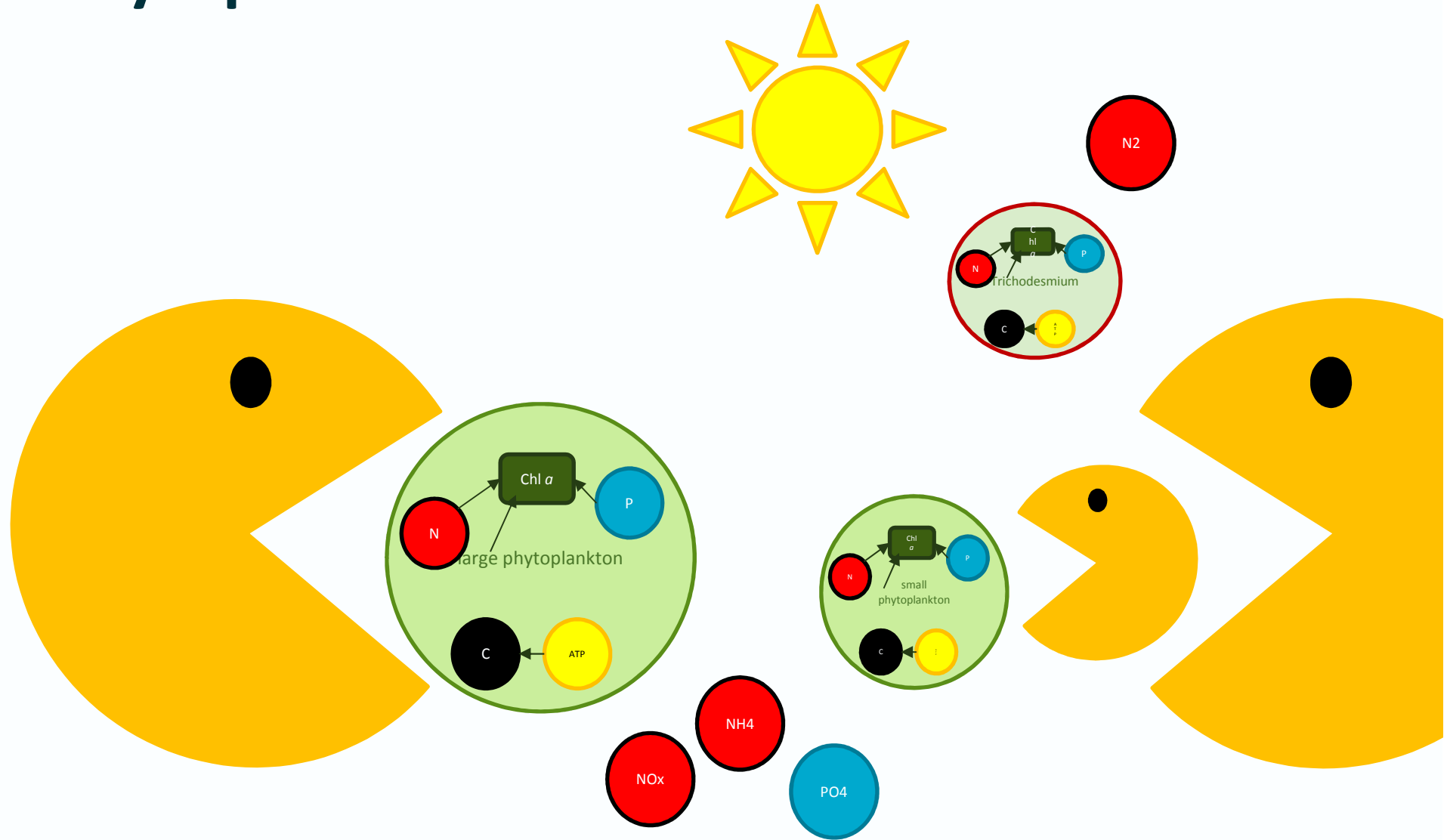
# Phytoplankton in the eReefs models



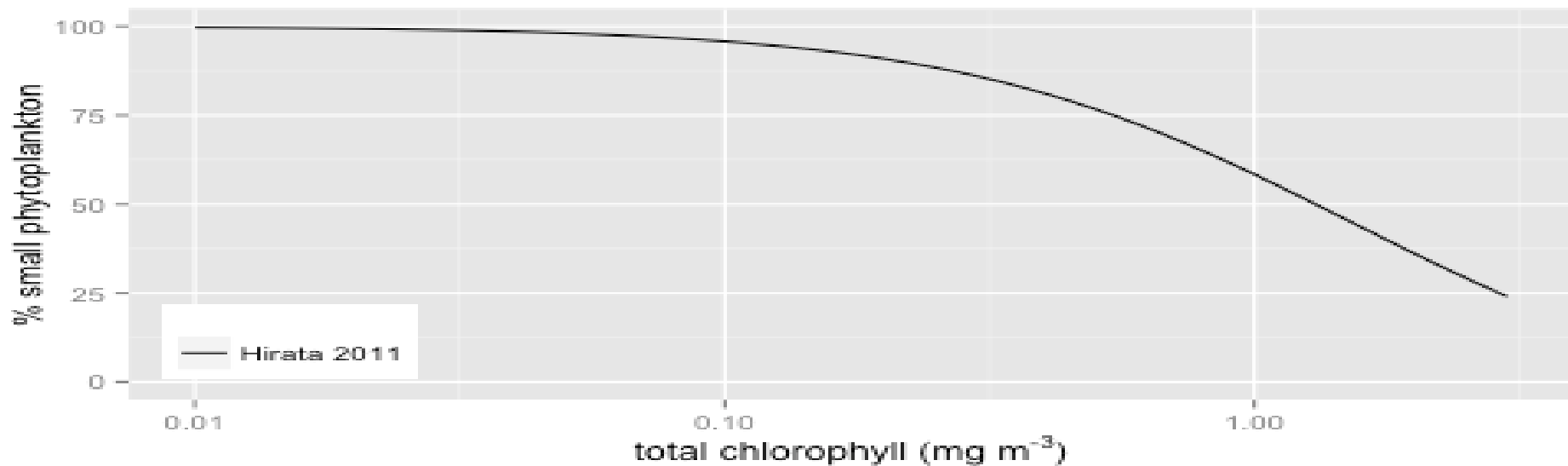
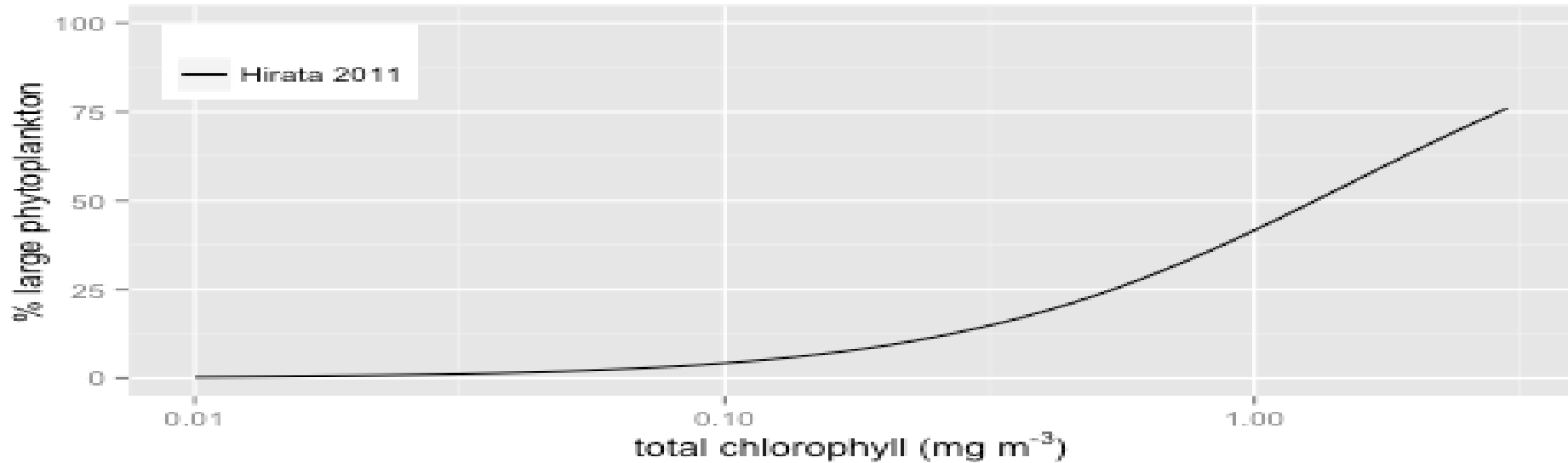
# Phytoplankton in the eReefs models



# Phytoplankton in the eReefs models

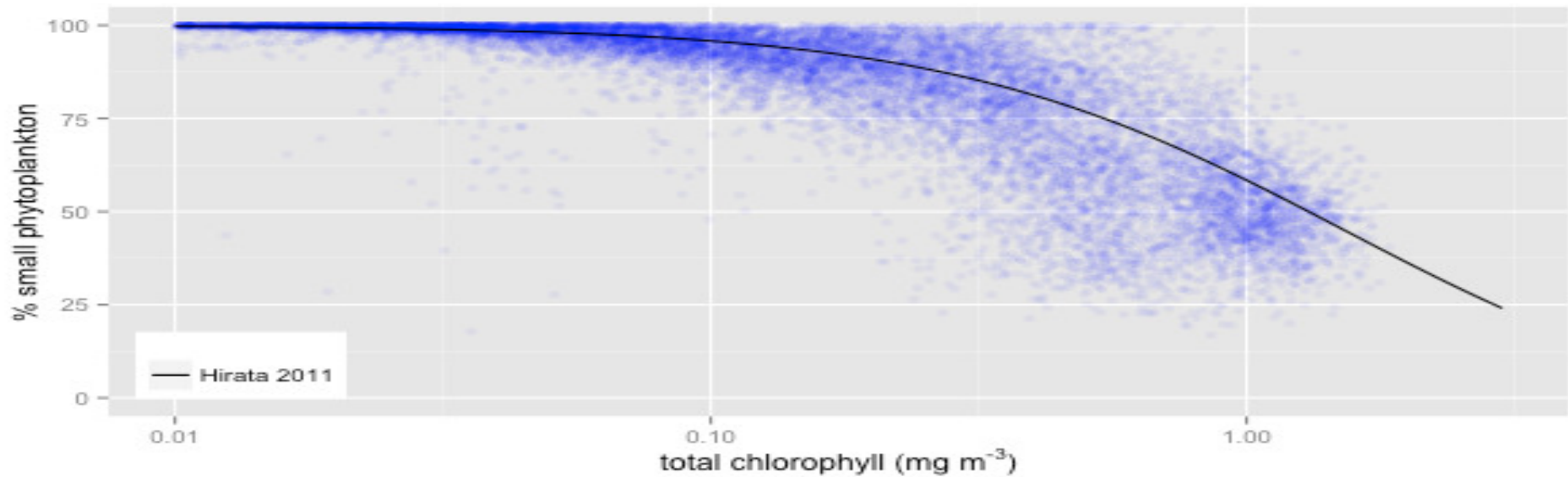
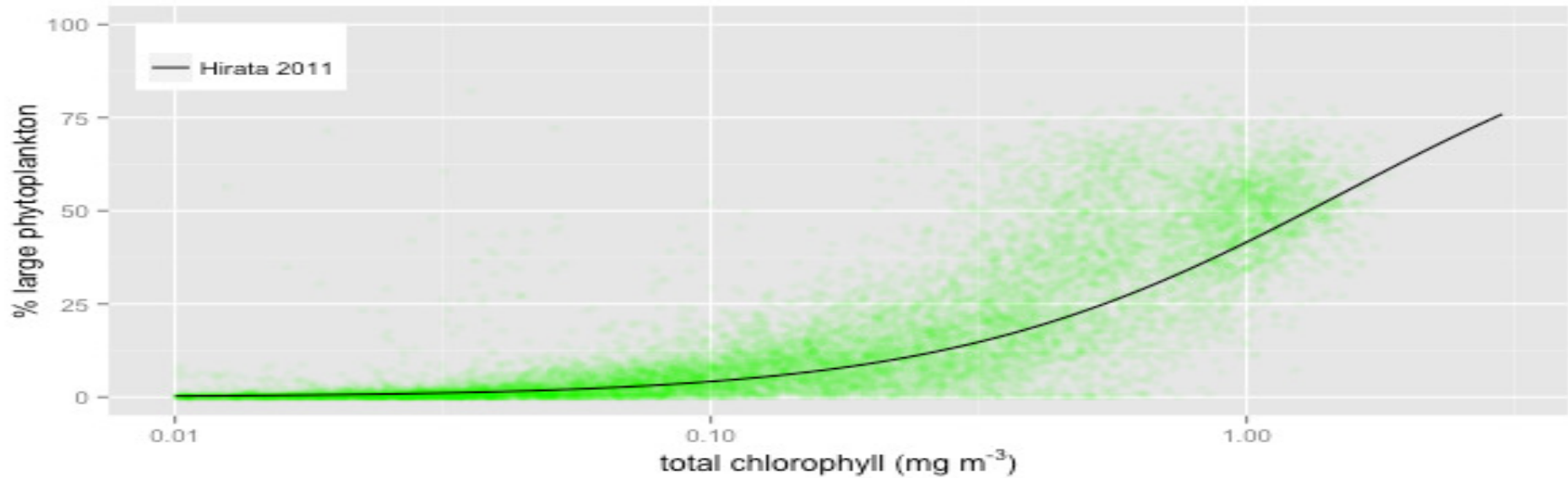


# Global phytoplankton size ratio patterns (Hirata 2011)



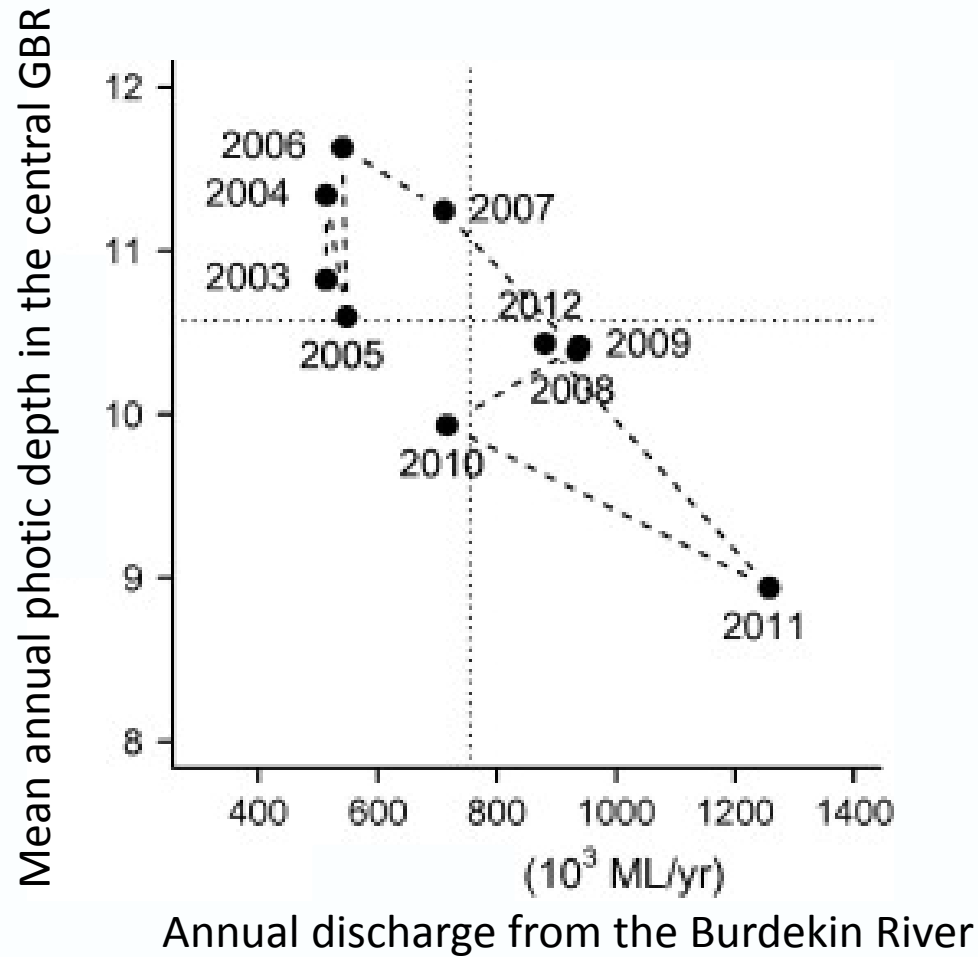


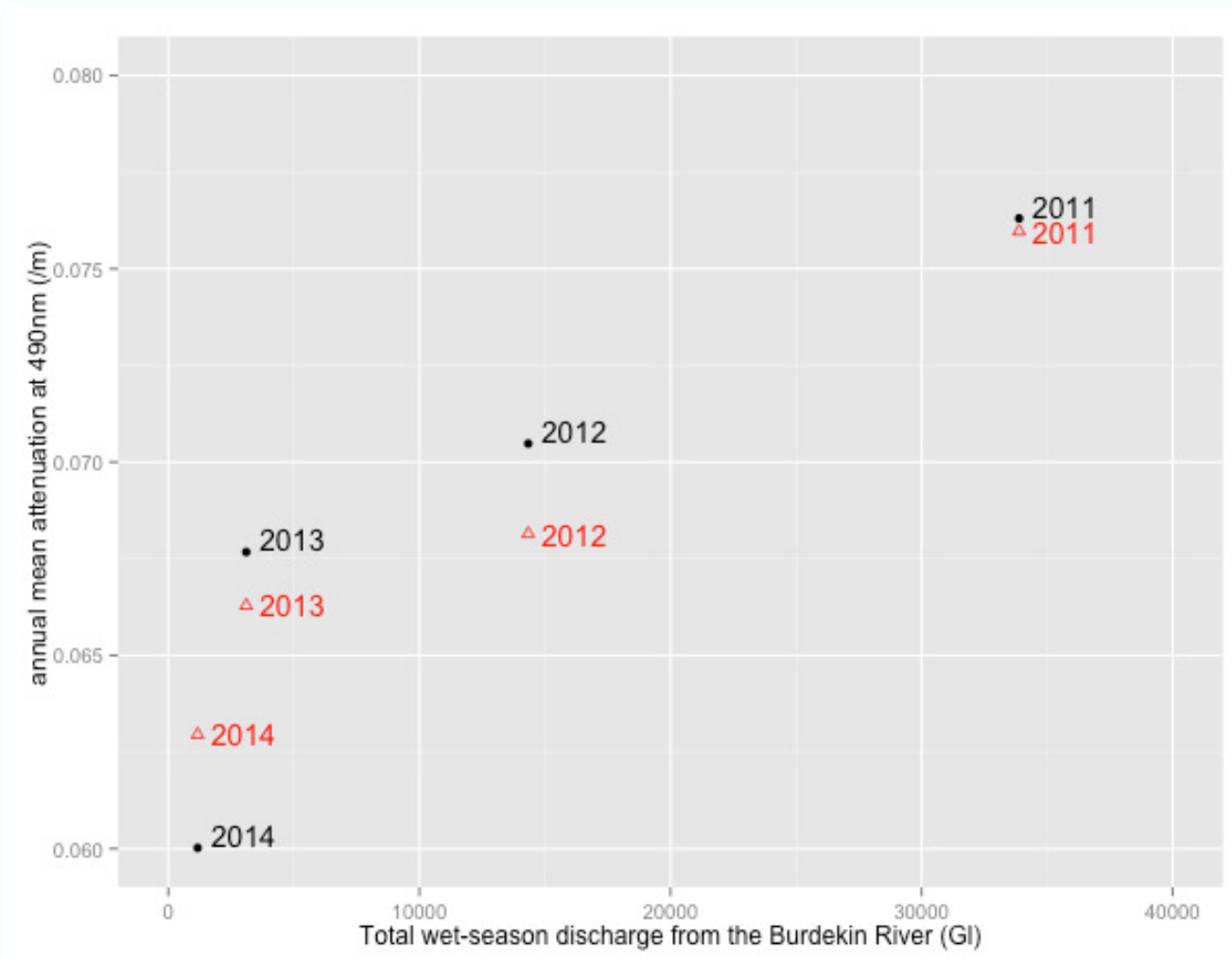
# eReefs model results overlain on observed curves



# Flood events affect water clarity all year

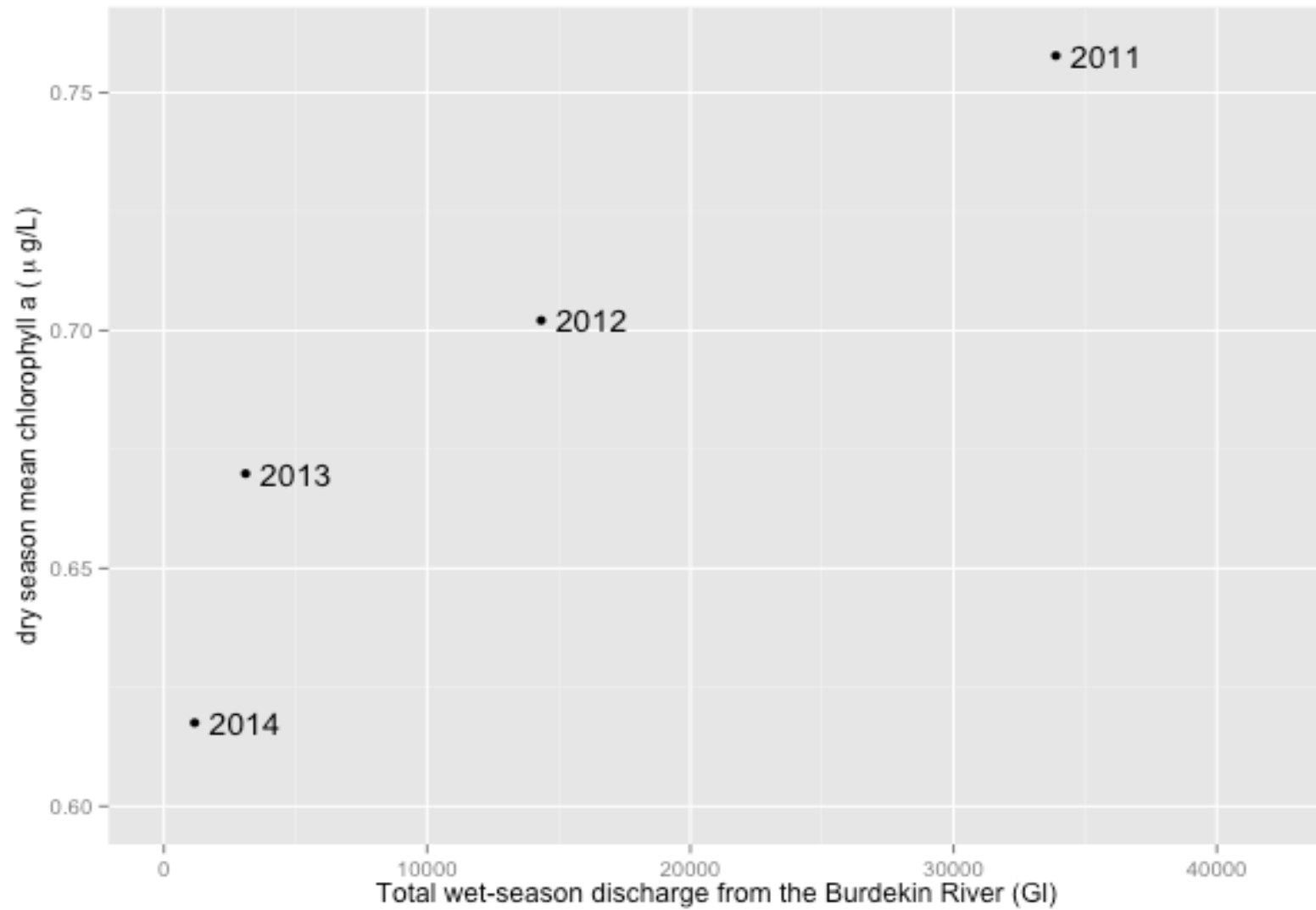
# Fabricius et al. 2014





Black: Dry-season mean Kd490 in the central GBR.  
 Red: annual mean Kd490.

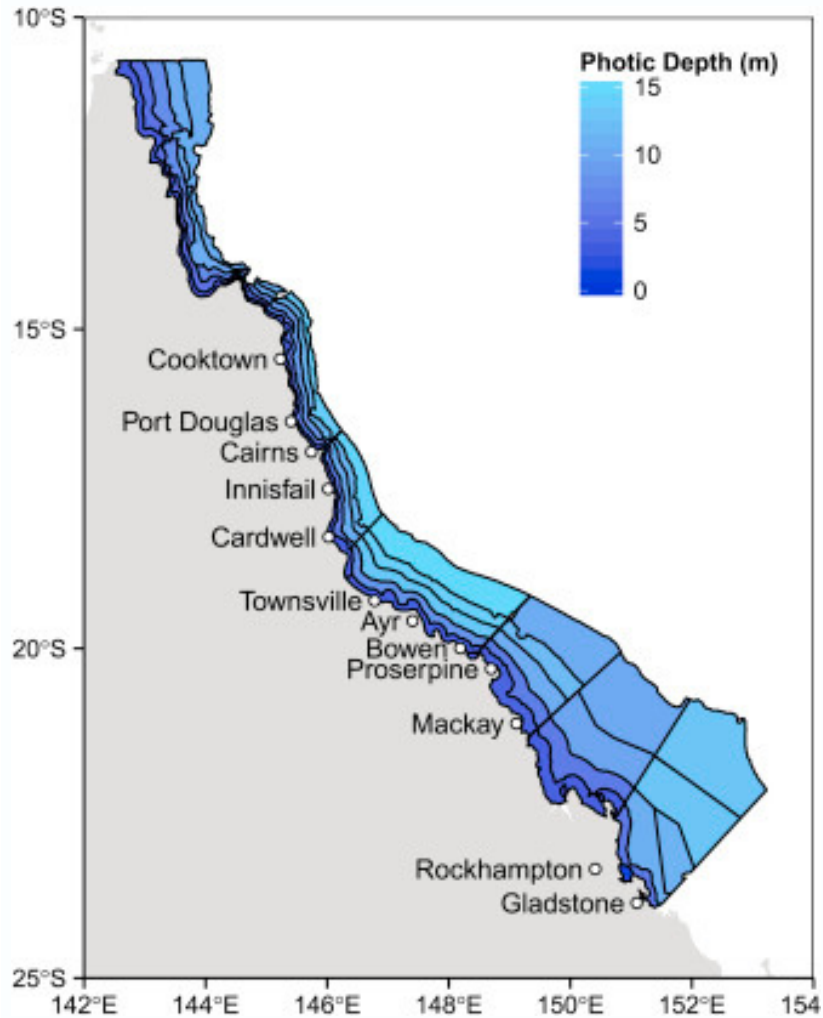
# Wet season discharge affects water quality all year



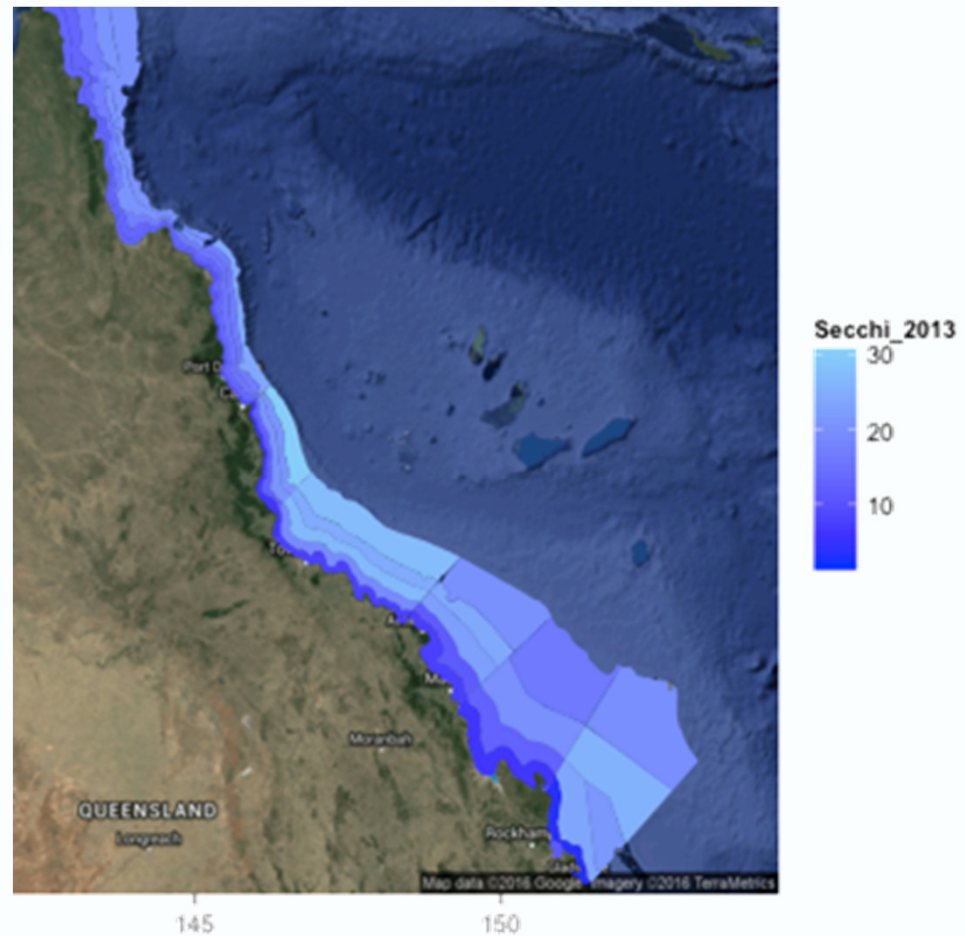
# Spatial patterns in photic depth

# Annual mean photic depth

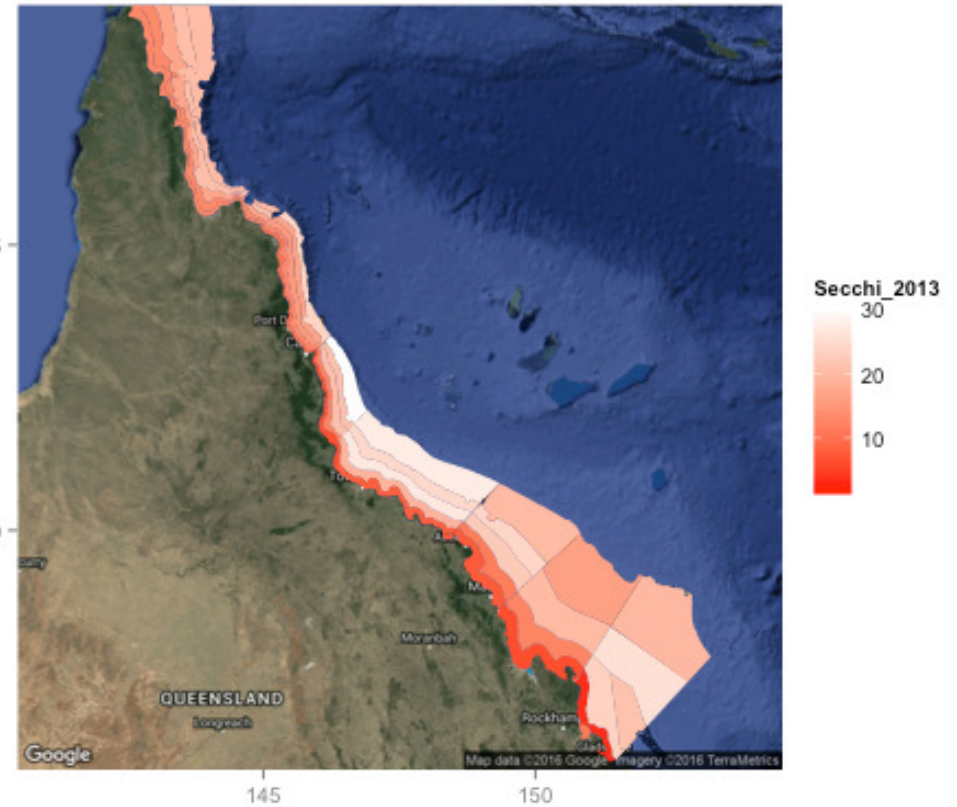
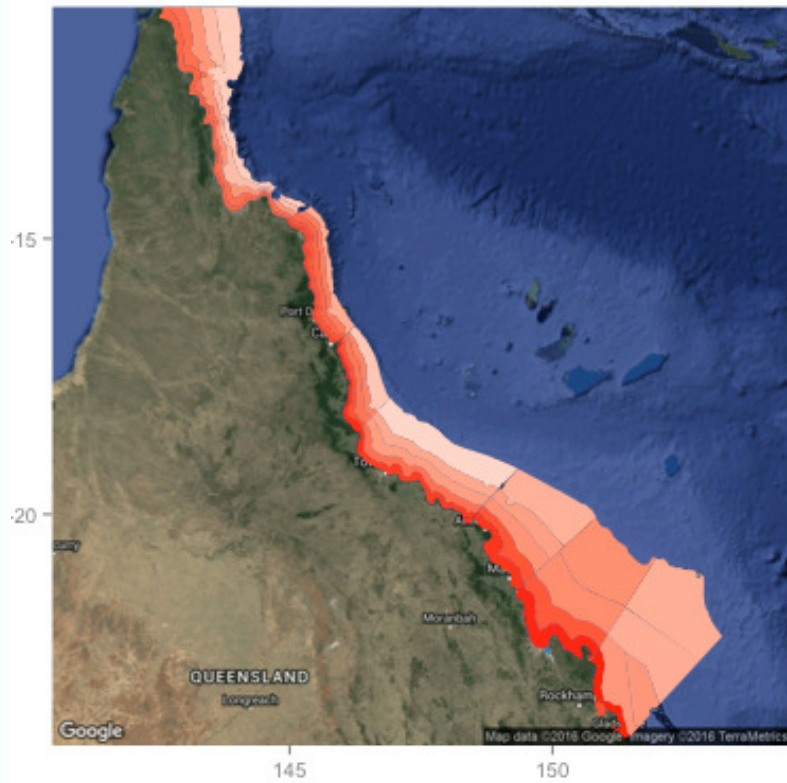
Fabricius et al. (2016)



eReefs simulation (2013 mean)



# Annual mean photic depth 2011 (wet year) versus 2013 (drier)

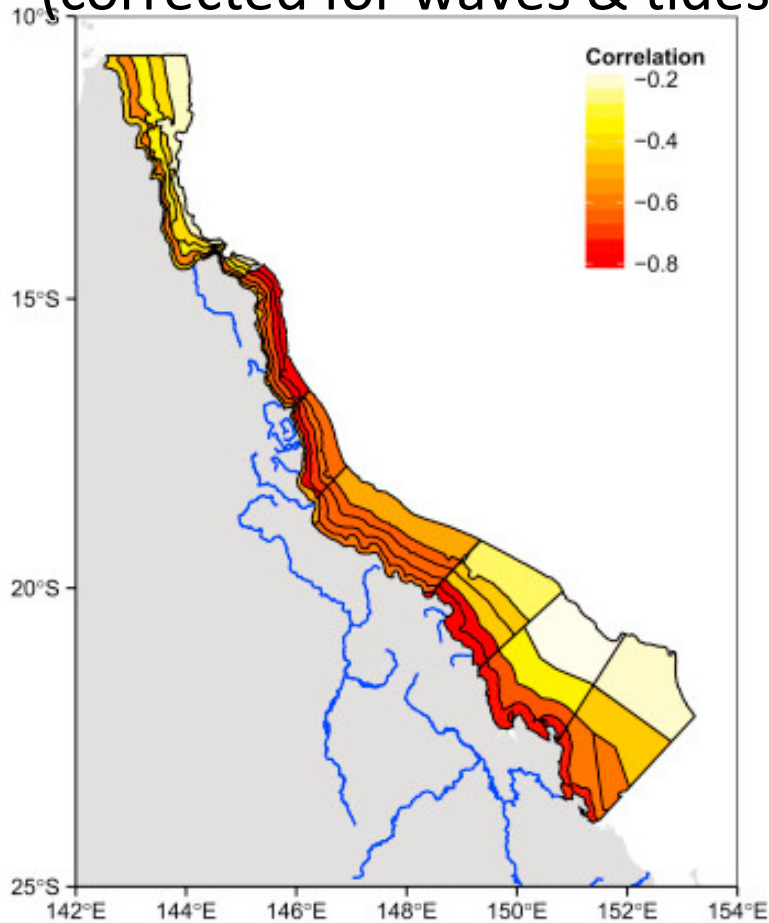




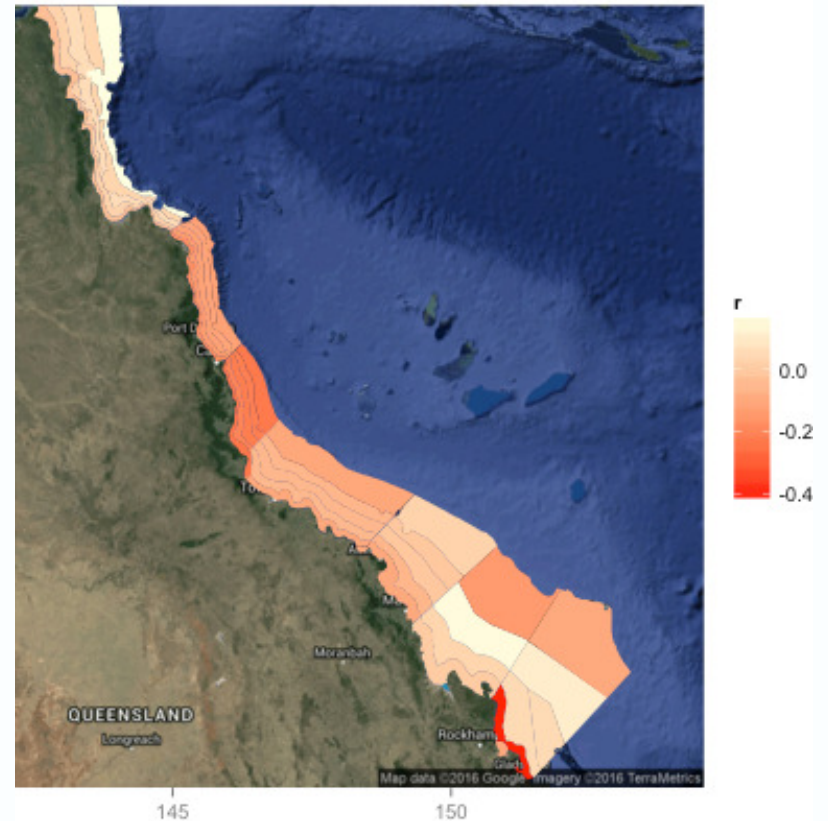
# Correlations between photic depth and river discharge

# Correlation: daily river discharge and photic depth

Fabricius et al. 2016 (2002-2013)  
(corrected for waves & tides)

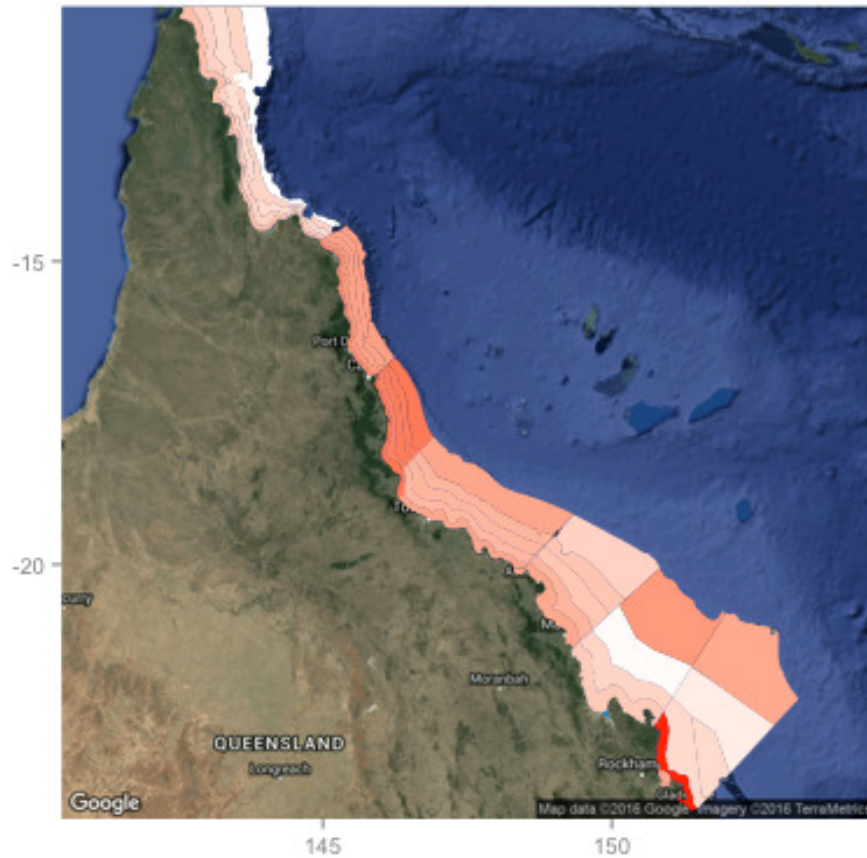


eReefs model 2011-2014  
(not corrected for waves & tides)

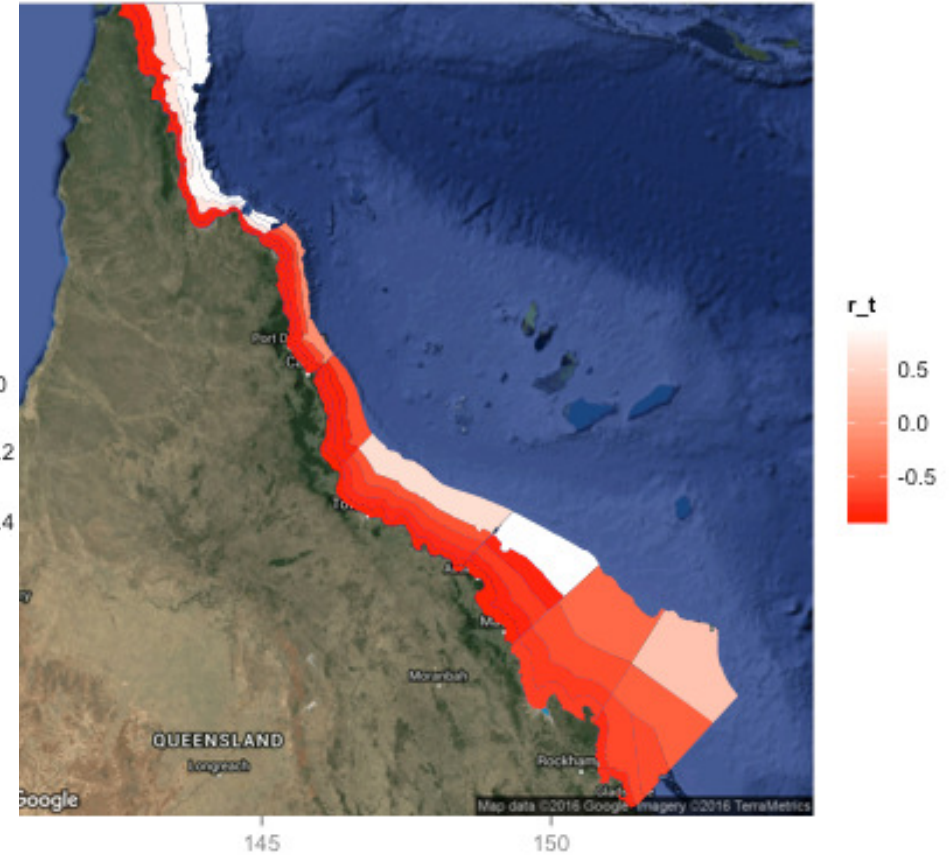


# Correlations between river discharge and simulated photic depth

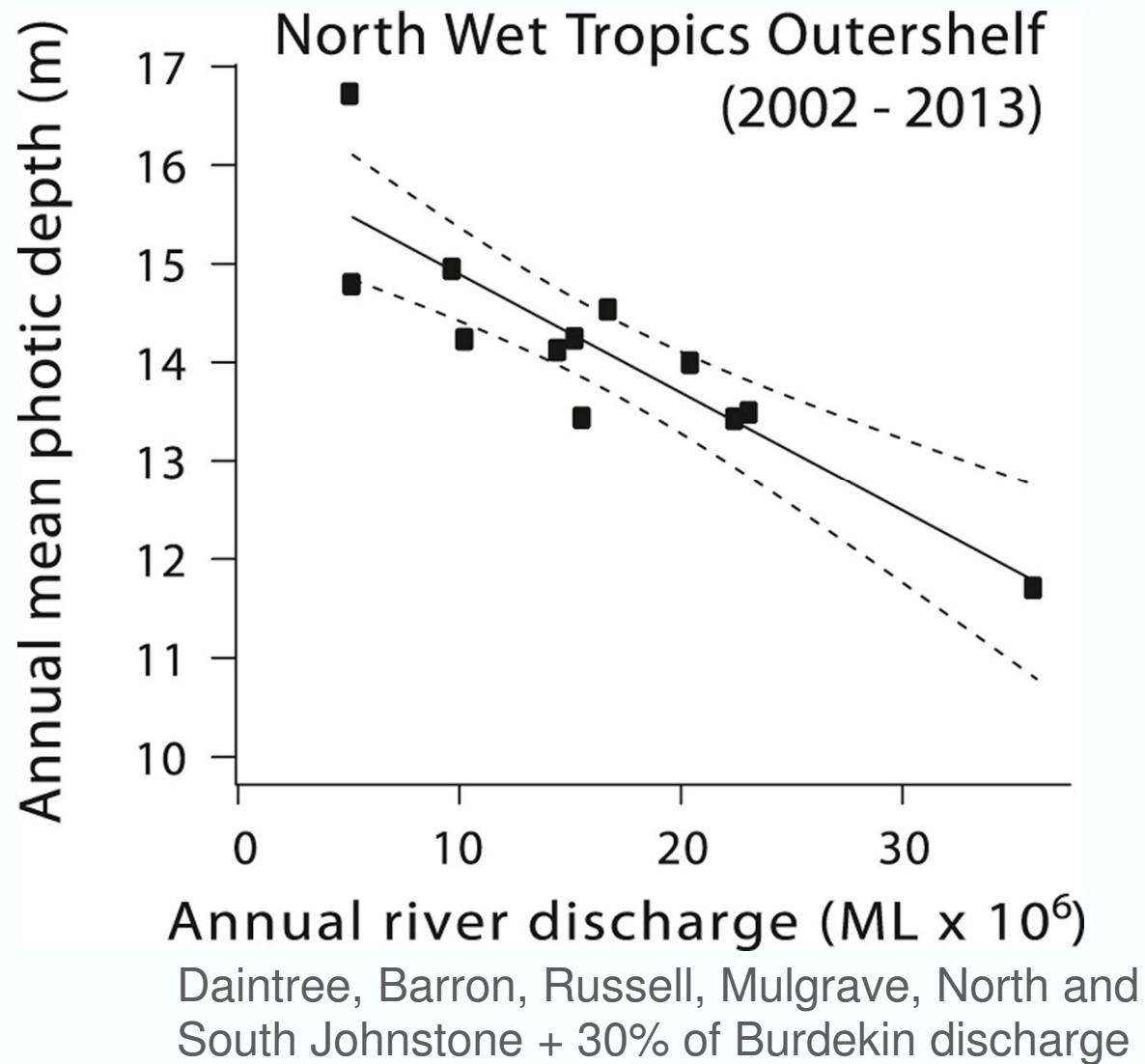
Daily residual



Long-term trend

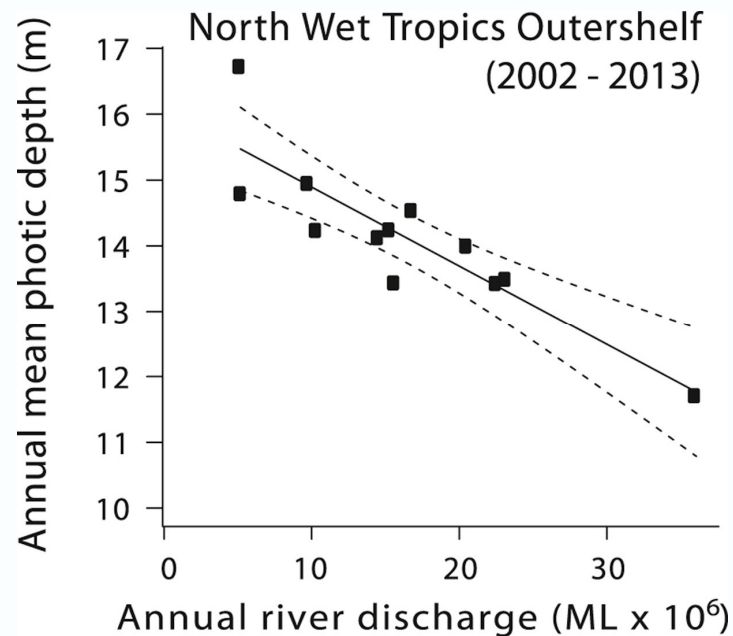


# Fabricius et al. (2016)

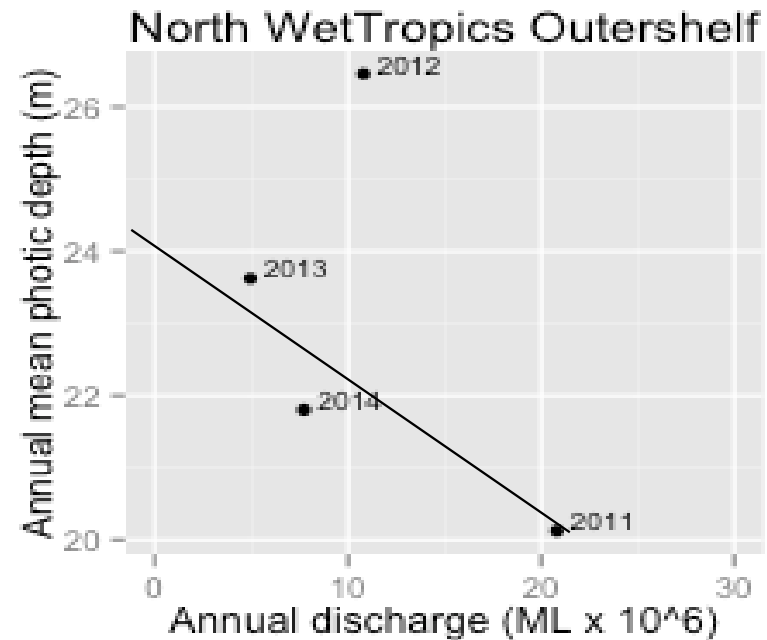


# Relationship between river discharge and outer shelf mean annual photic depth

Fabricius et al. (2016)



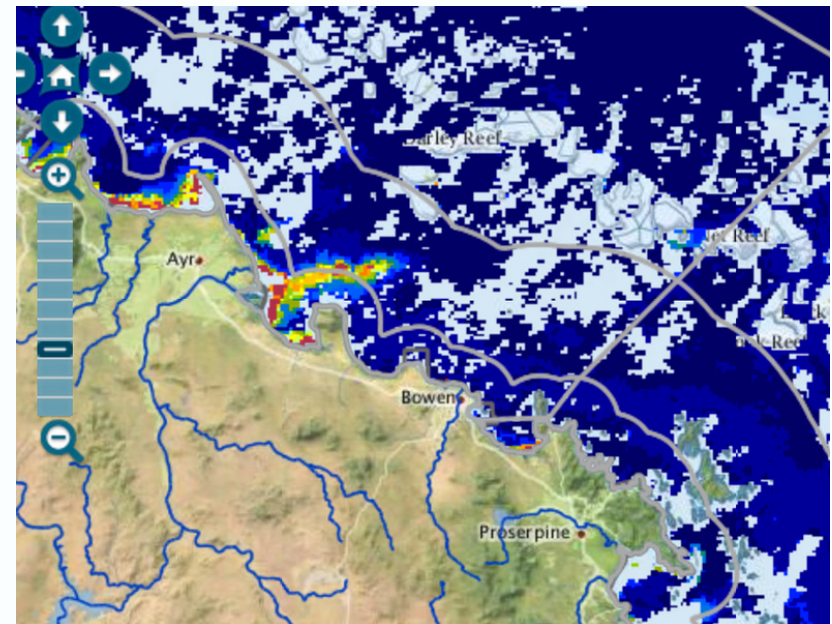
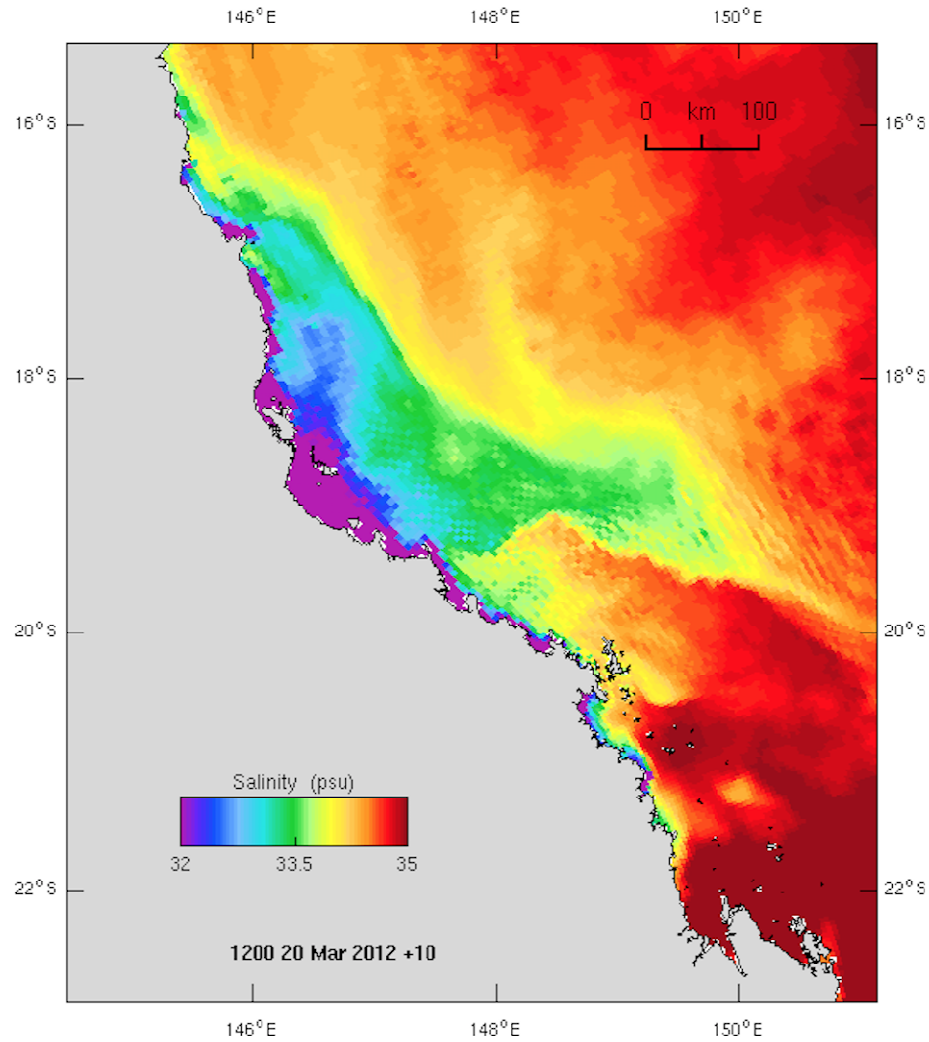
eReefs model



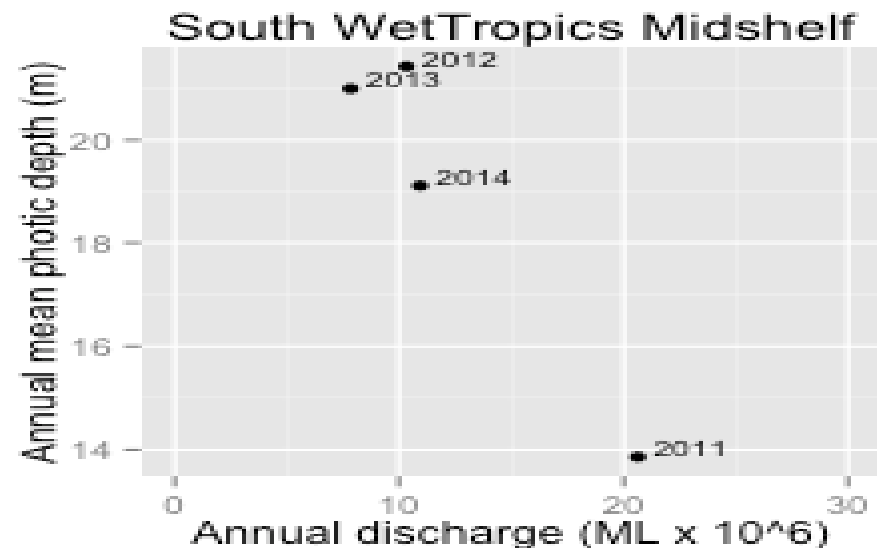
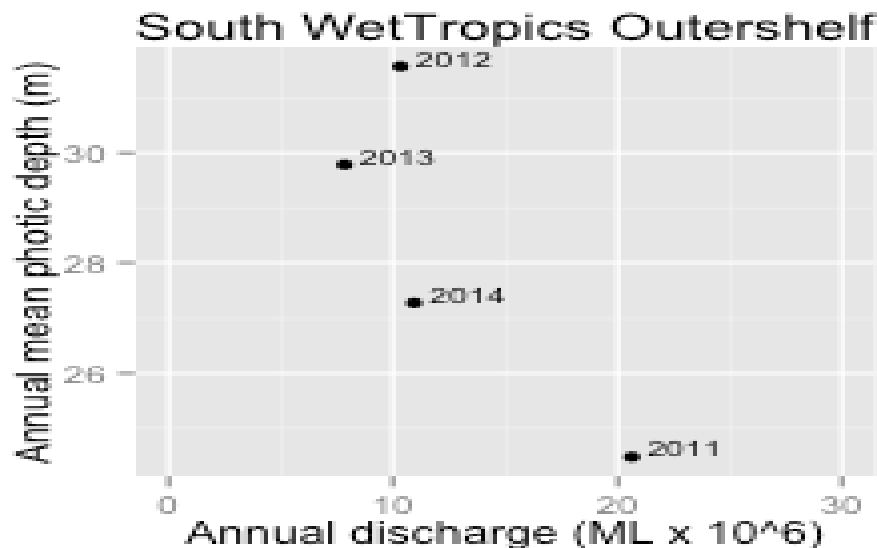
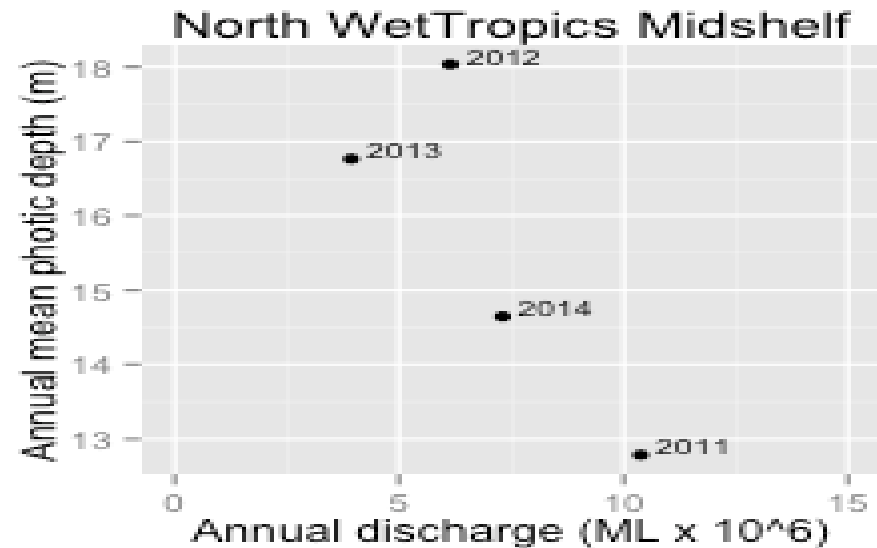
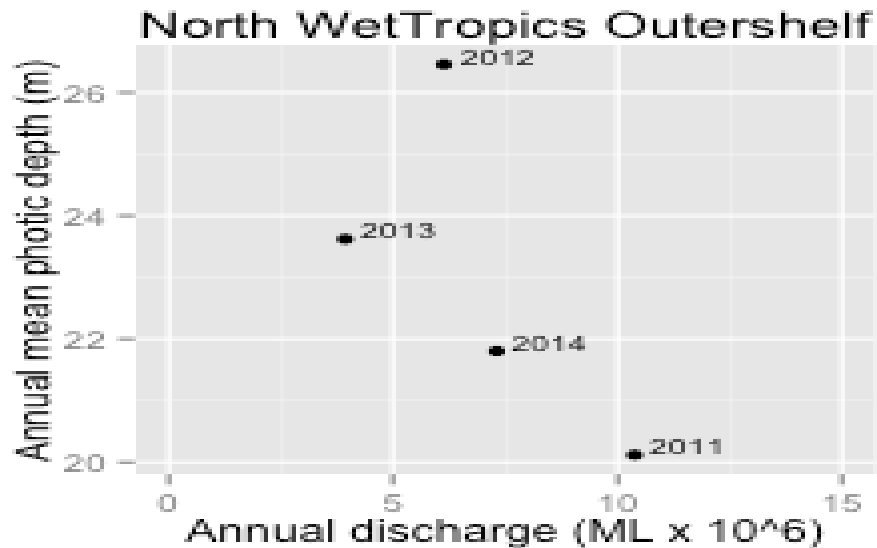
Daintree, Barron, Russell, Mulgrave, North and South Johnstone + 30% of Burdekin discharge



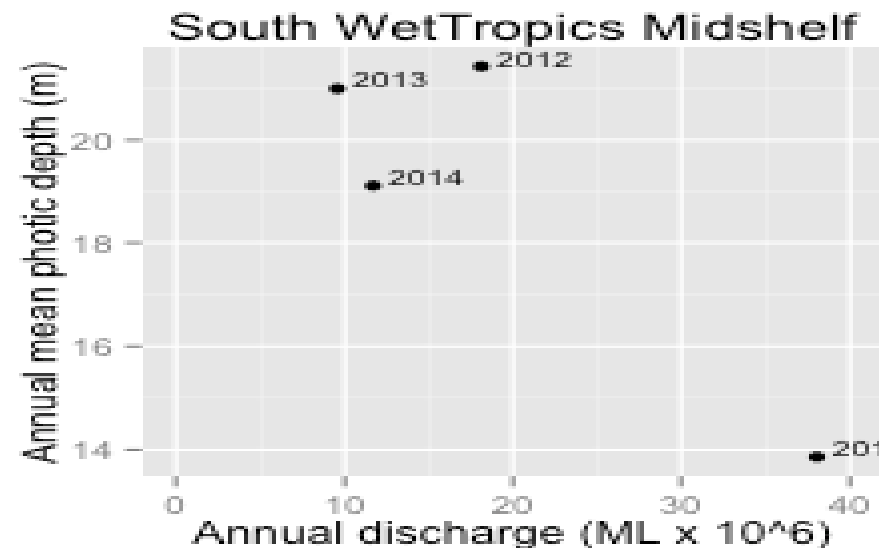
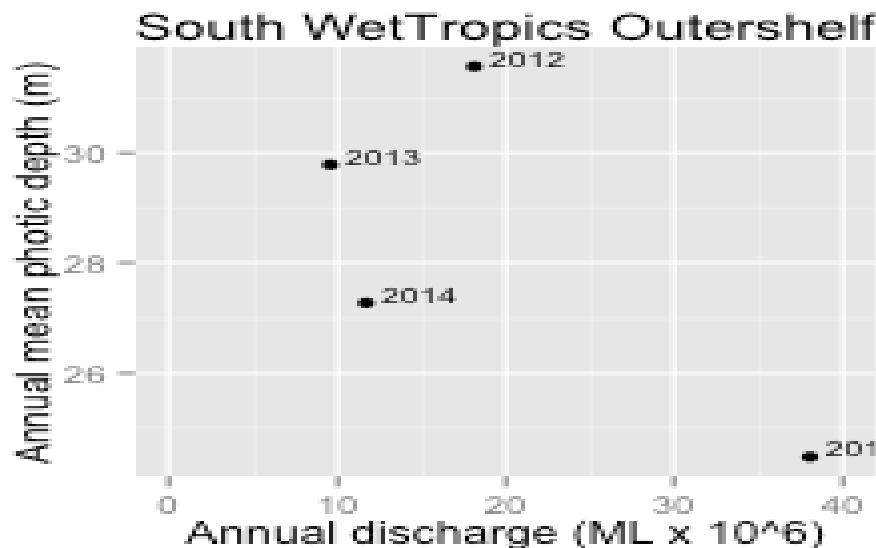
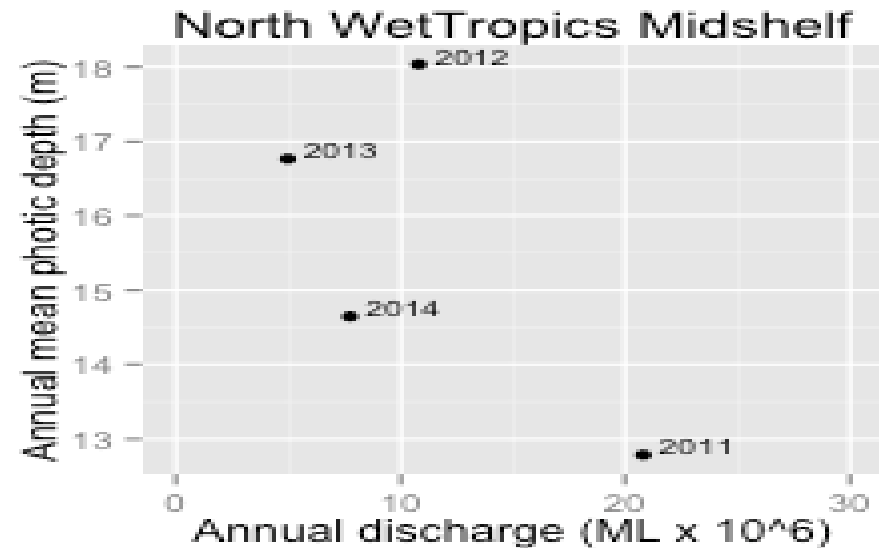
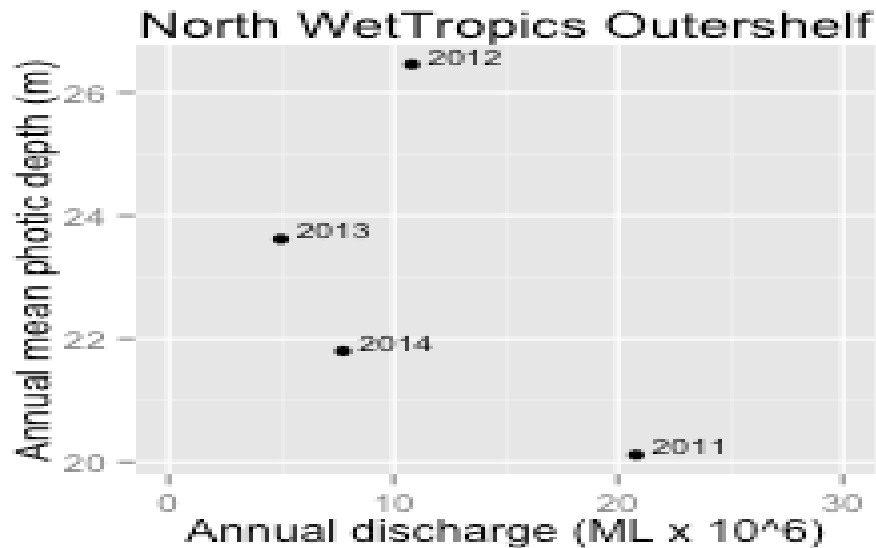
# 2012 Burdekin flood event



# ... with Burdekin removed from river list



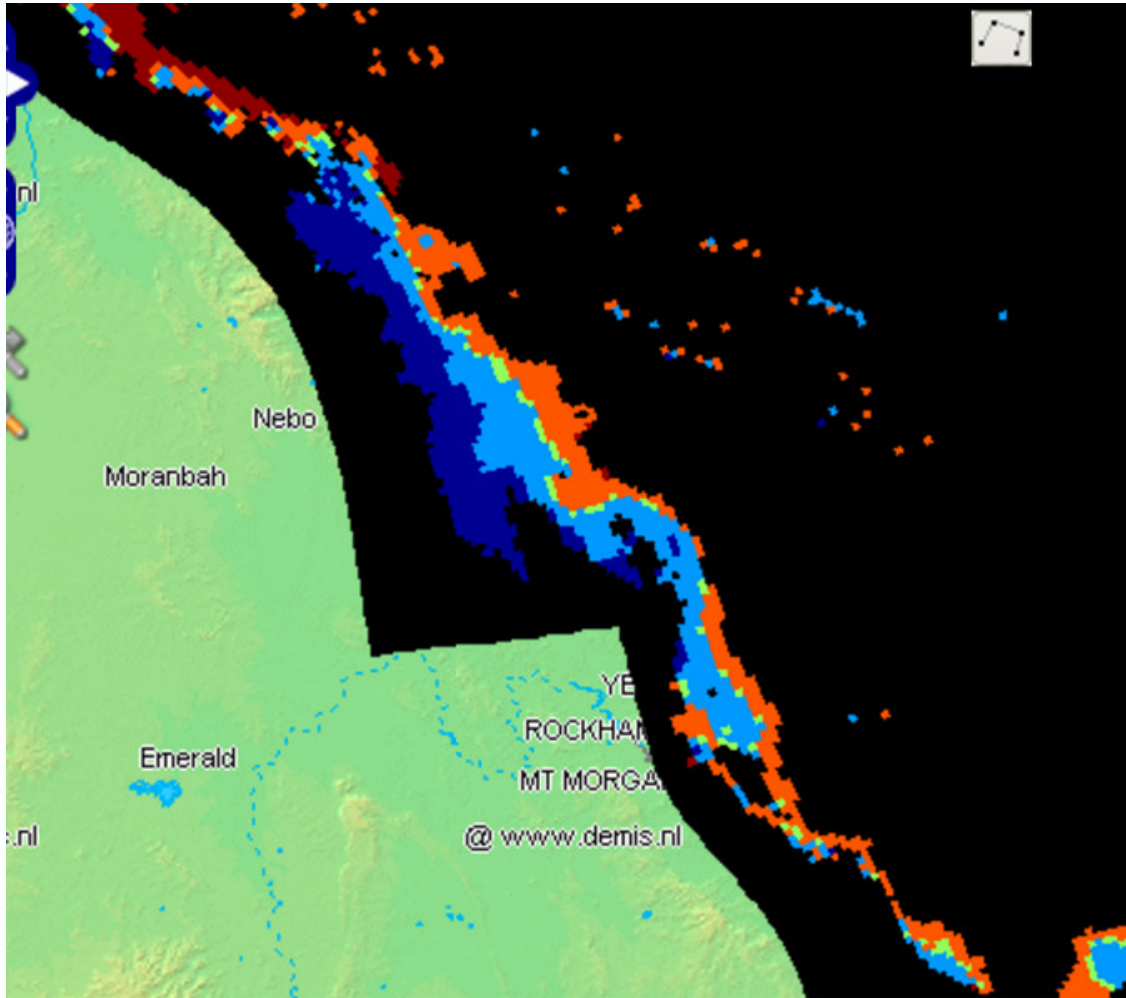
# Simulated discharge vs. photic depth



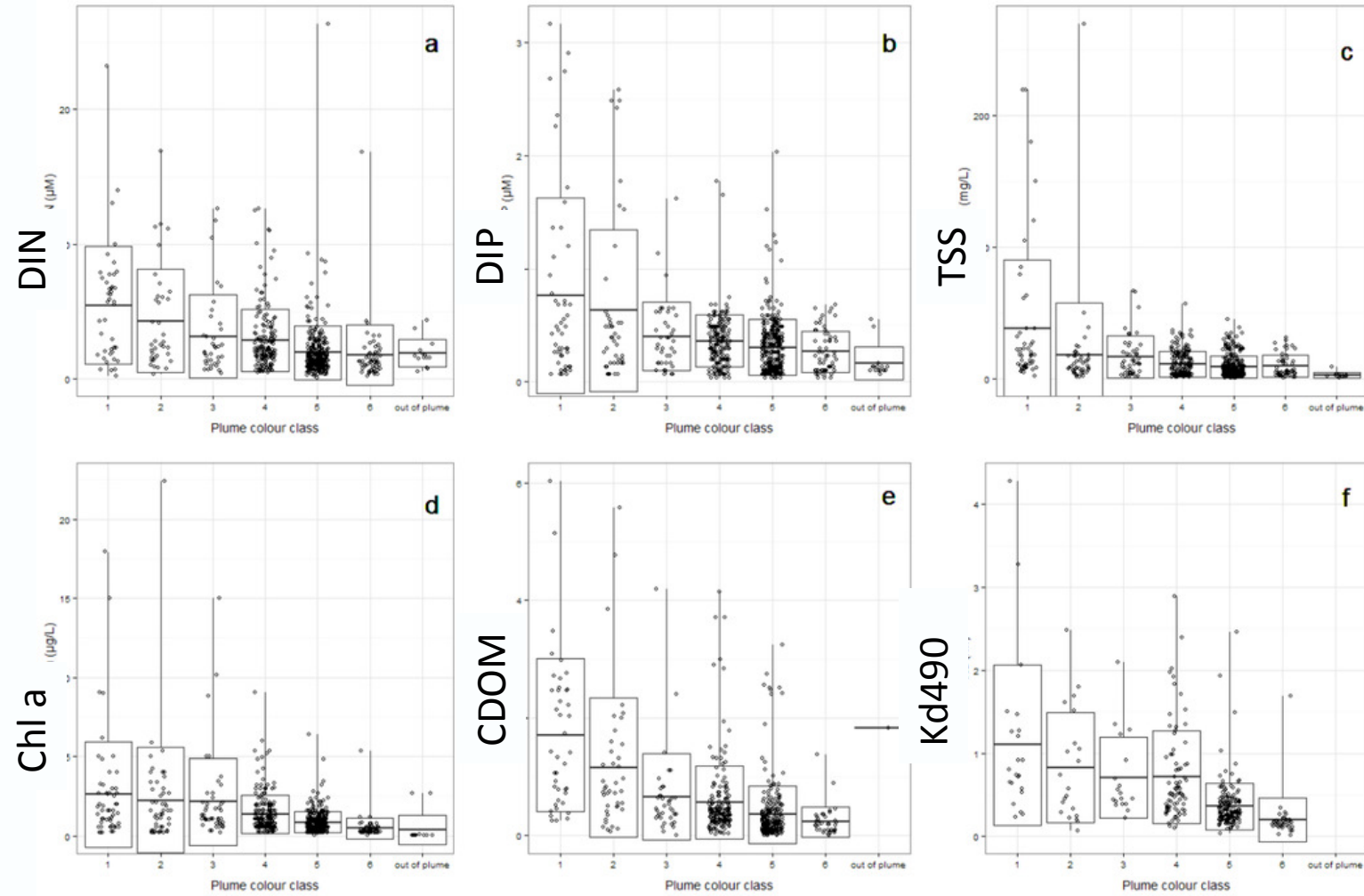


# To do: Flood plume water quality

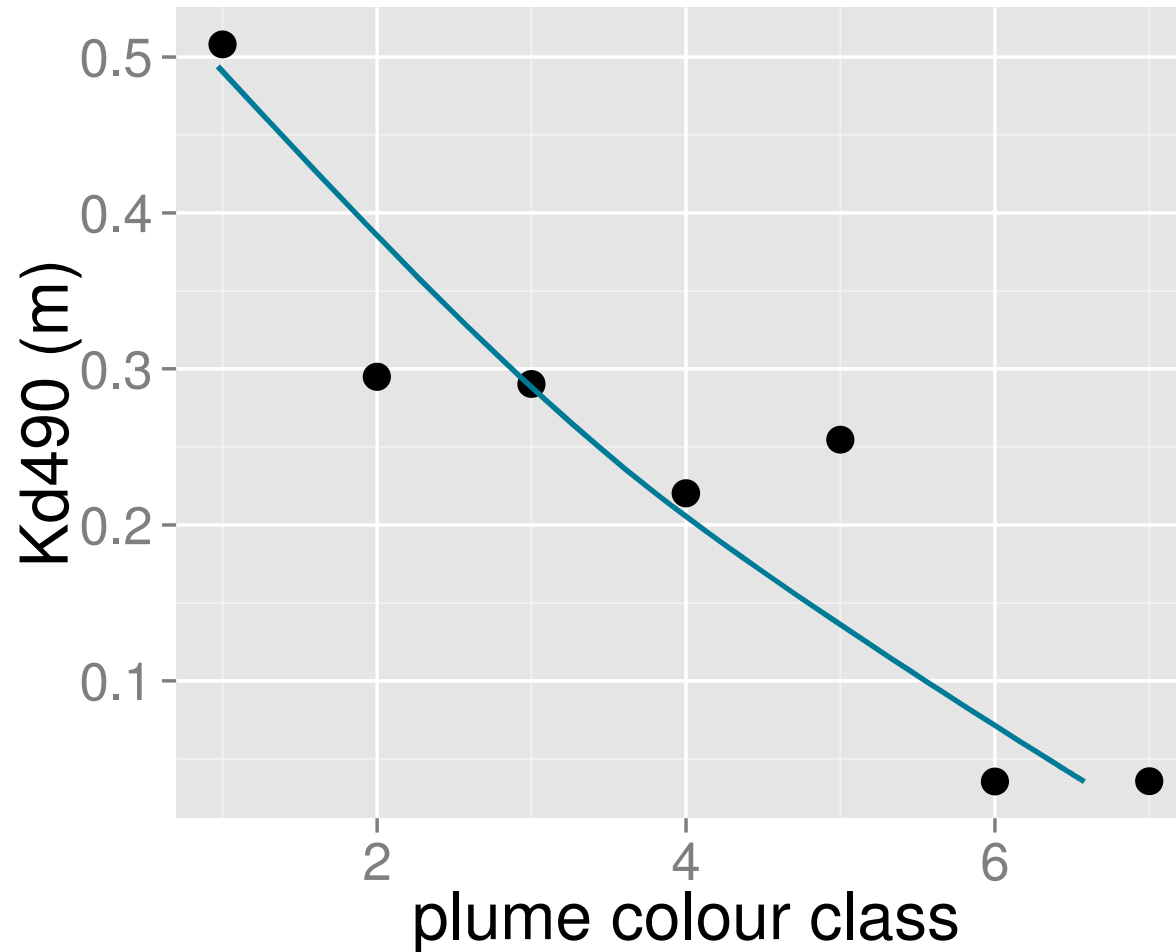
# Simulated flood plume colour class



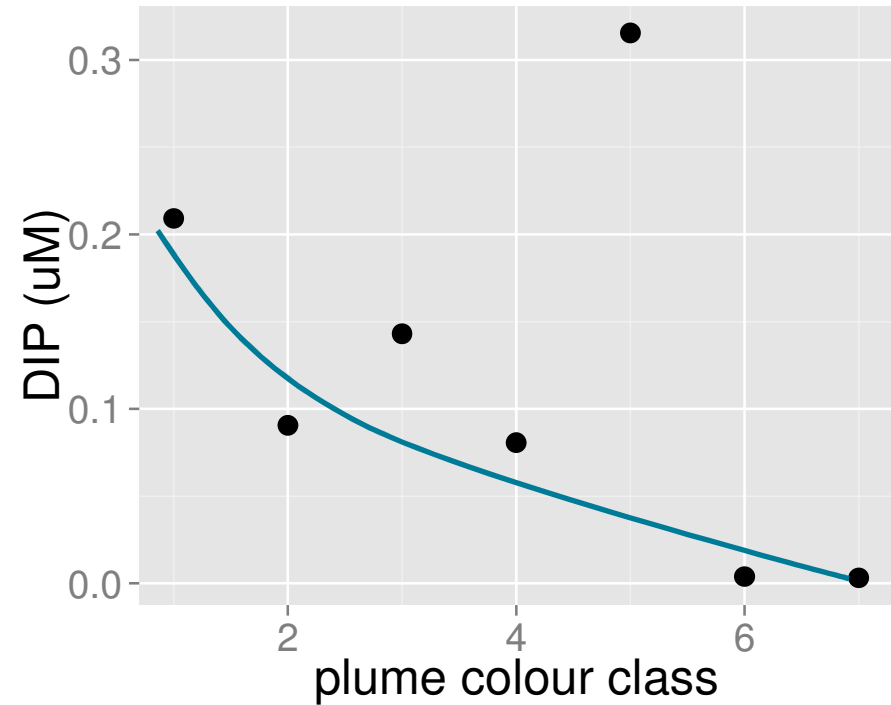
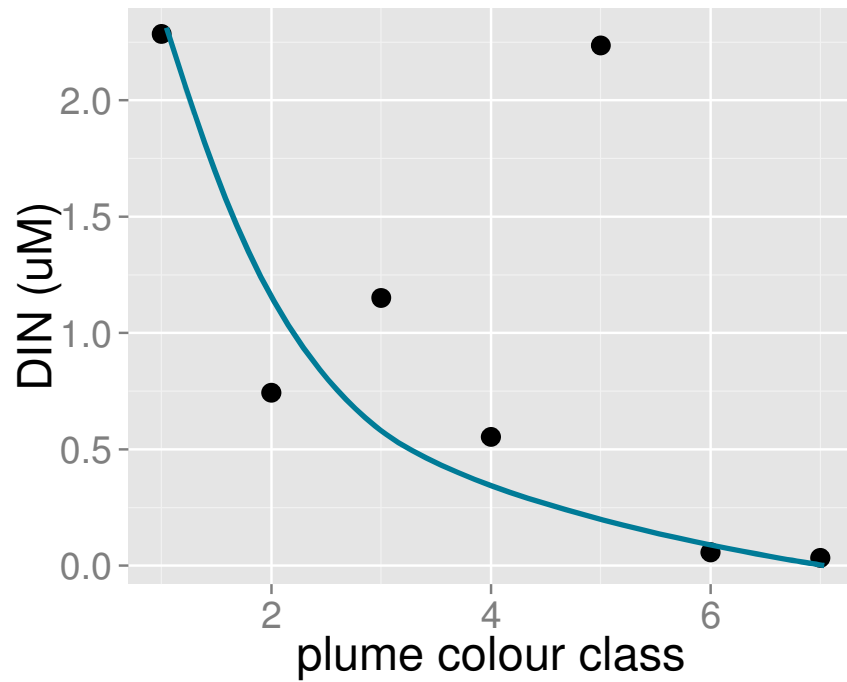
# Water quality by flood plume colour class (Devlin et al, 2015)



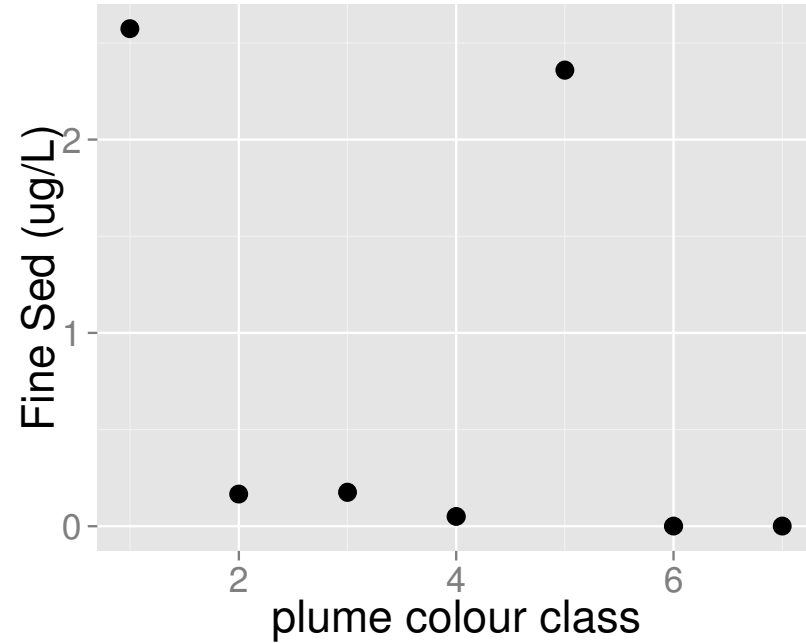
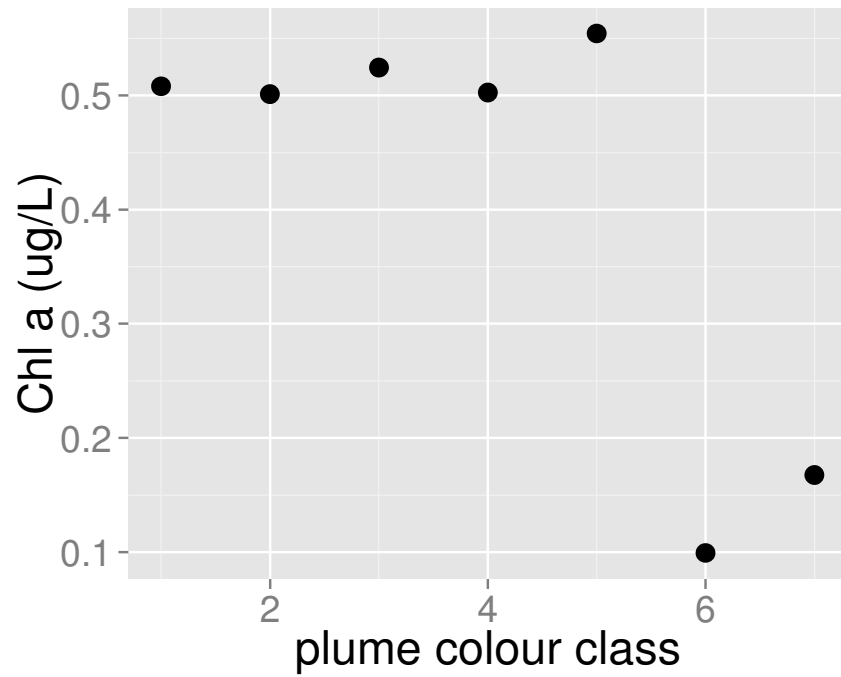
# 2013 model results



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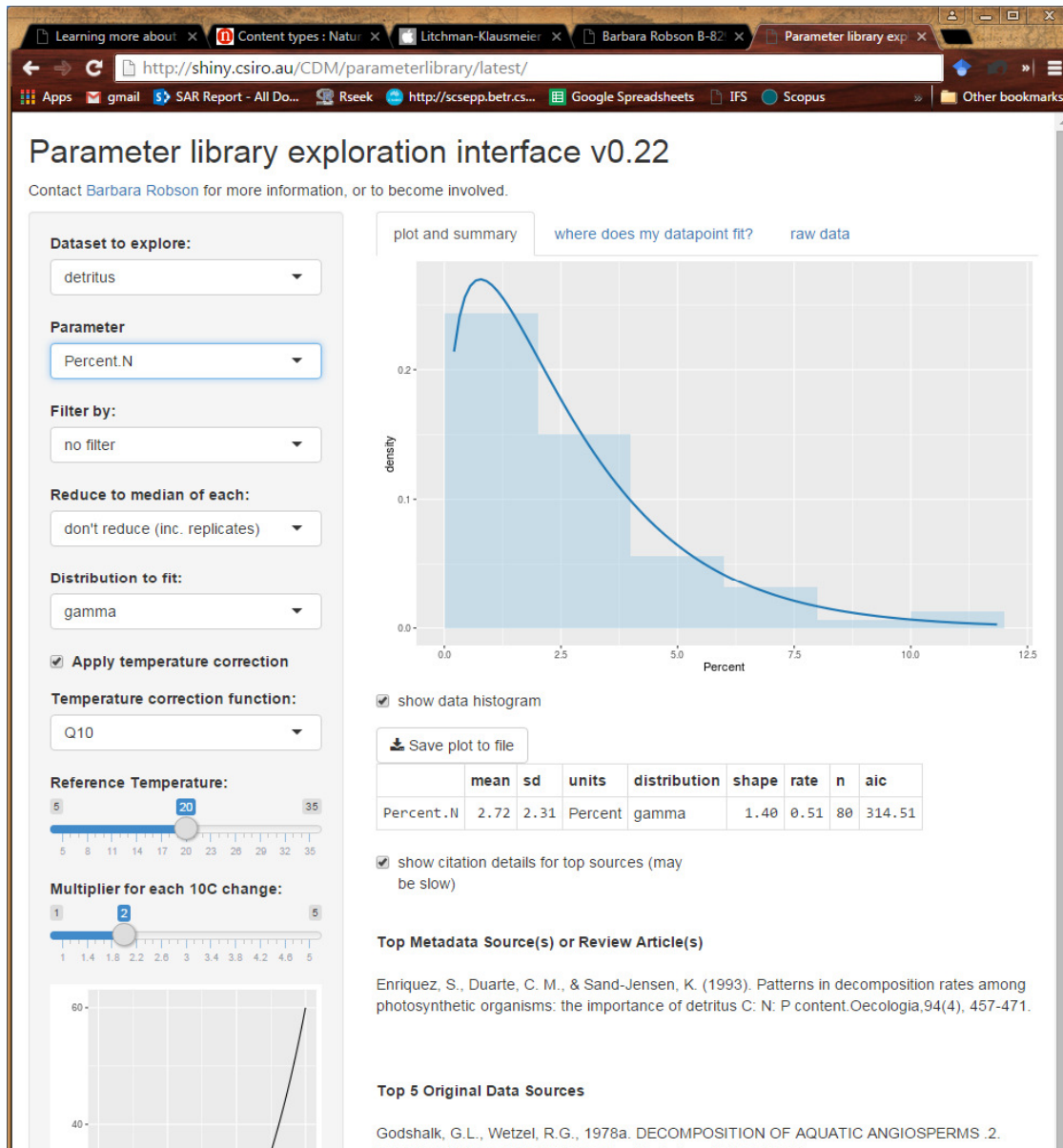
# 2013 model results



# Parameter library

# Specification of parameter values

<http://shiny.csiro.au/CDM/parameterlibrary/latest/>



- Parameter library (left) ties parameters to process rate observation literature
- Ensemble runs helped target sensitive biogeochemical parameters
- RS data assimilation optimised sediment transport parameters



# Thank You!

BARBARA ROBSON, TEAM LEADER, MODELLING WATER ECOSYSTEMS (LAND AND WATER)

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