

Pollutant Load Estimation for GBR Catchments:

Accounting for uncertainty in monitoring and modelled data using data assimilation techniques

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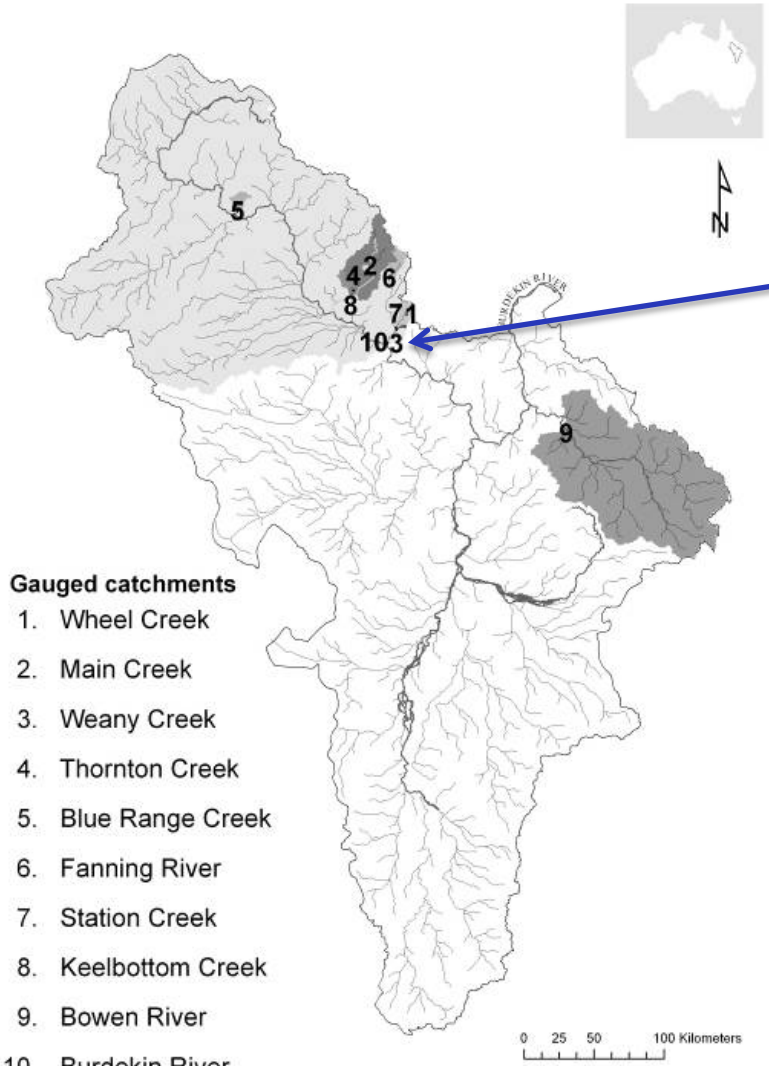
Queensland Government

Relevance of Work

- In the context of Loads for the GBR:
  - How do we prioritise areas within a catchment to obtain improvements in loads?
  - What are the sources of loads?
  - Where is information lacking (i.e. sources of uncertainty are high) and where do we need to invest more effort ?
- In complex systems science we have
  - Models of the world
  - Measurements of the world
- How do we blend these sources of information to provide improved levels of confidence for decision making?

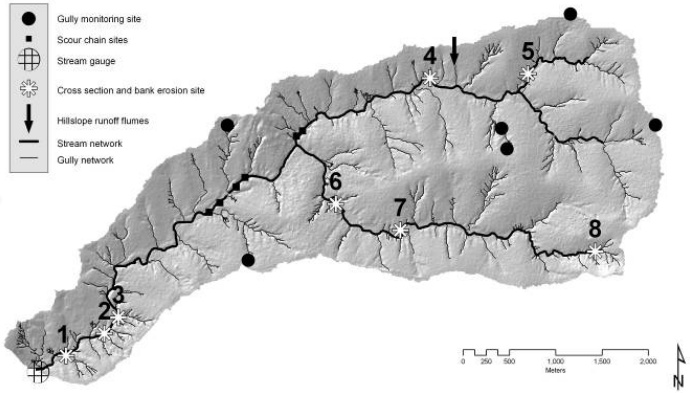
Case Studies



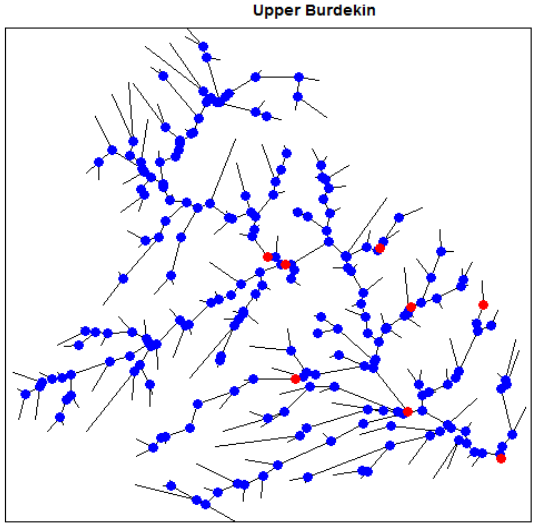
Gauged catchments

1. Wheel Creek
2. Main Creek
3. Weany Creek
4. Thornton Creek
5. Blue Range Creek
6. Fanning River
7. Station Creek
8. Keelbottom Creek
9. Bowen River
10. Burdekin River

Single Site:
Weany Creek (11 km^2)



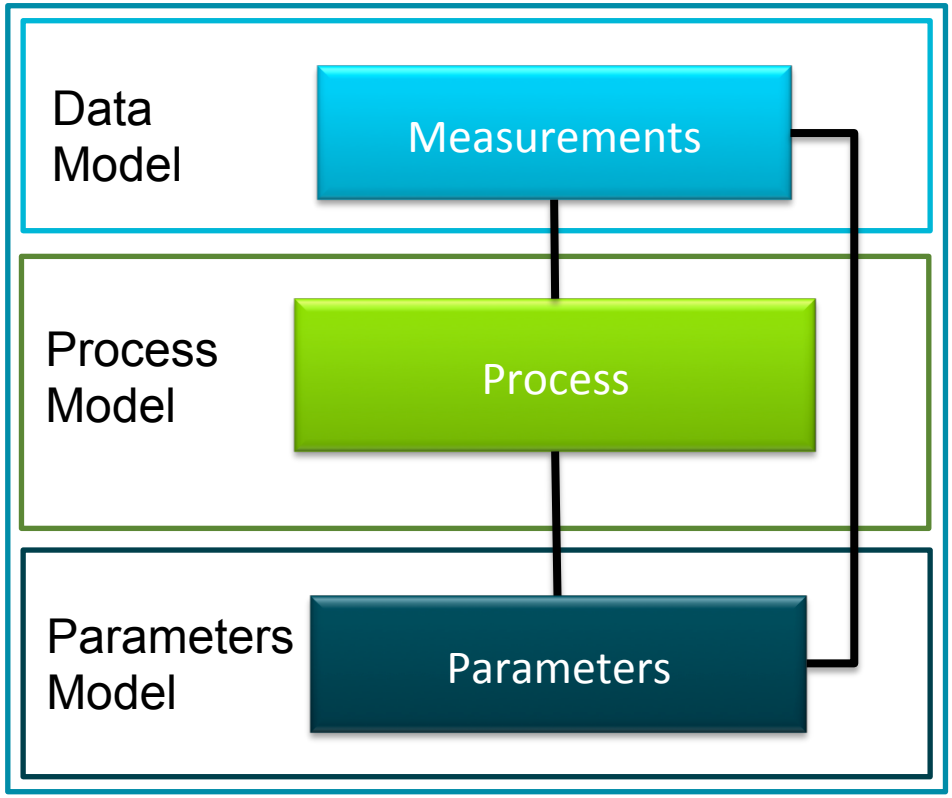
Multi-Site:
Upper Burdekin (~40,000 km^2)



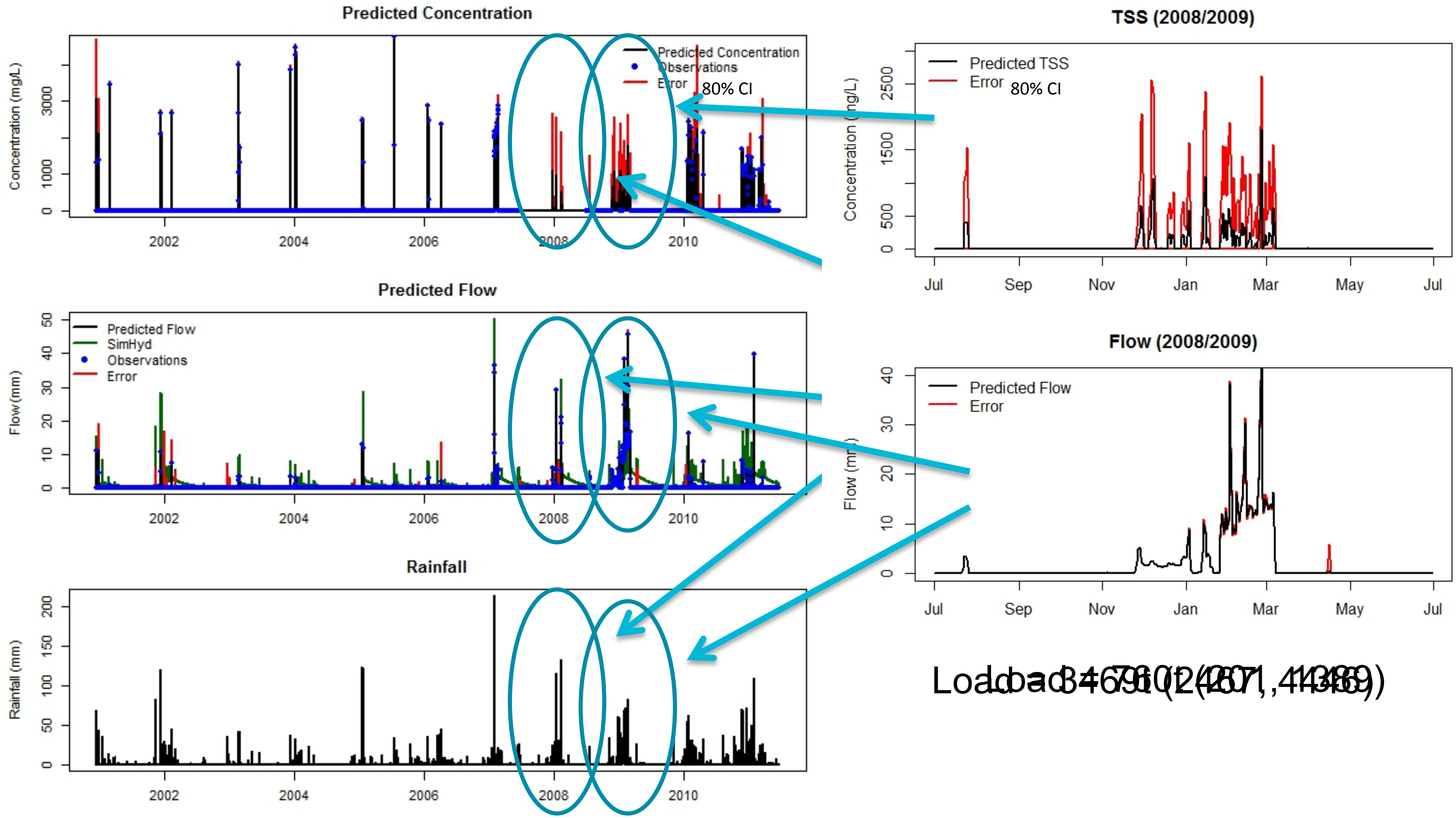
- SC nodes
- SC nodes with measurements

Bayesian Hierarchical Modelling Framework

State of the art technology – Our International collaborators are developing with NOAA and NASA (jet propulsion labs)



Results I: Weany Creek



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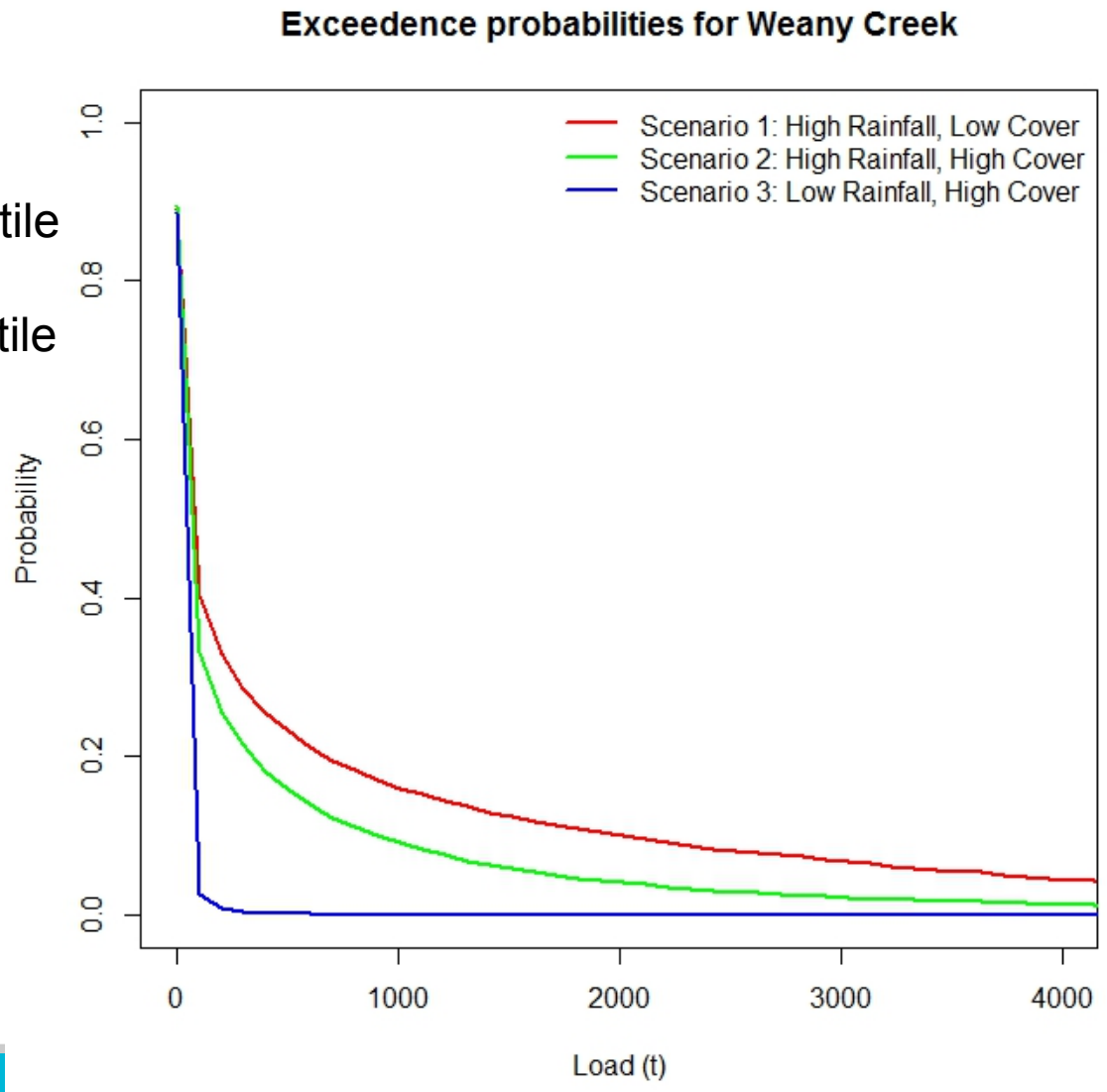
Results I: Weany Creek Exceedances

Low cover = 20th percentile of cover

High cover = 80th percentile of cover

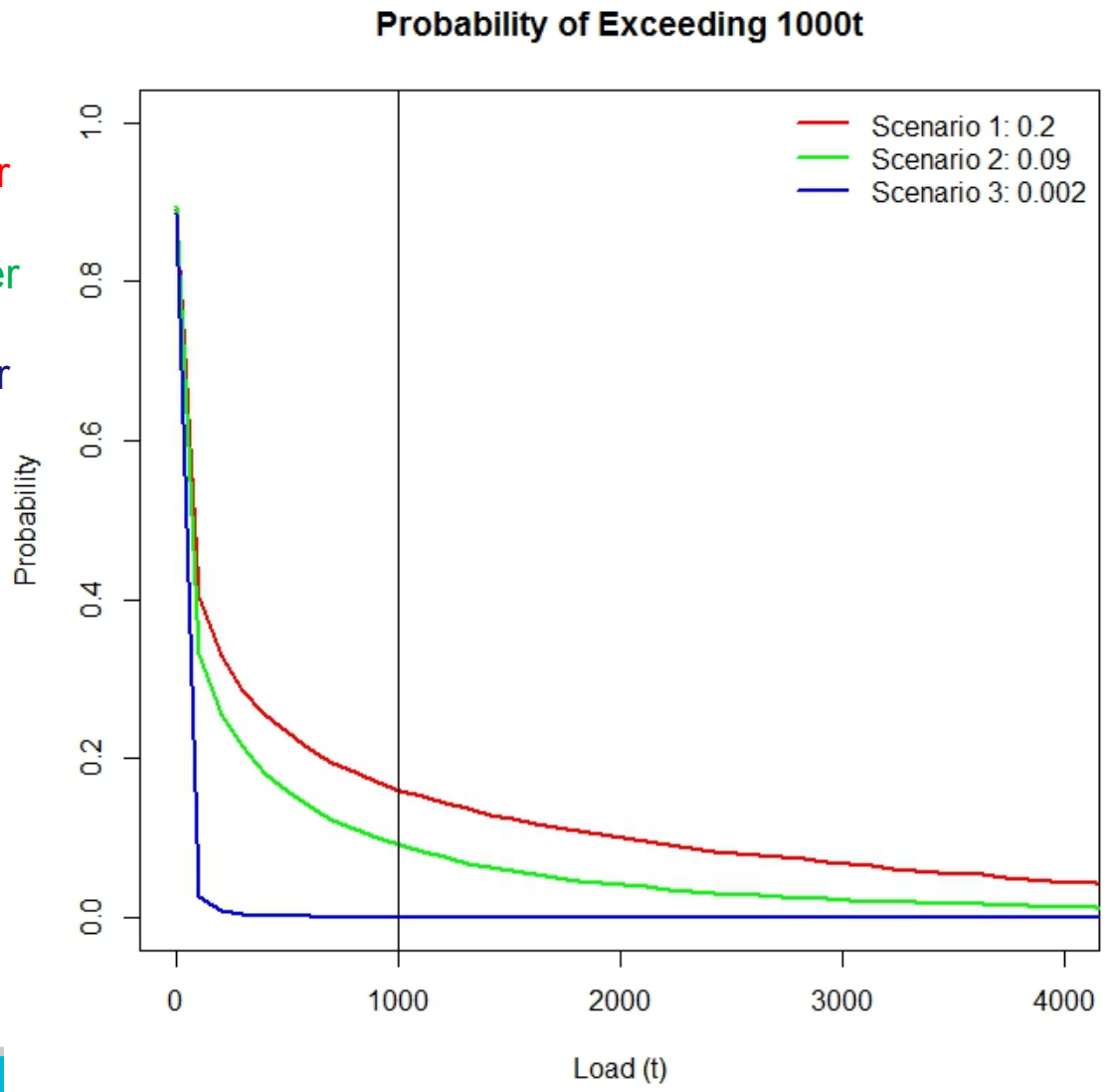


Results I: Weany Creek Exceedances

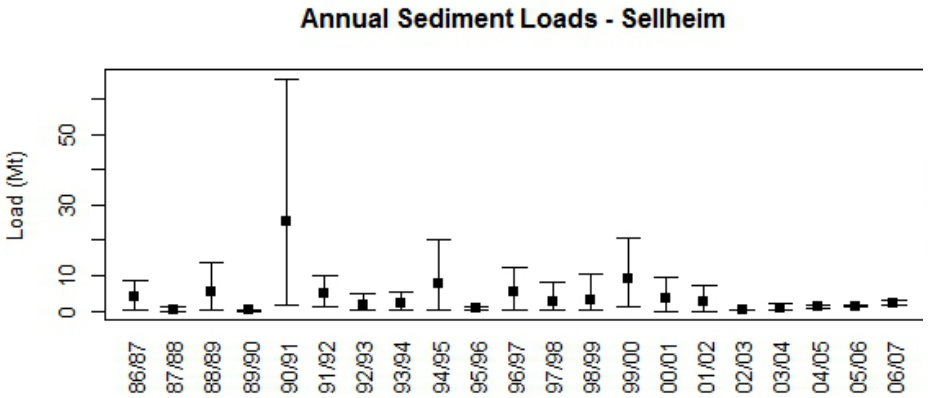
Scenario 1: High Rainfall, Low Cover

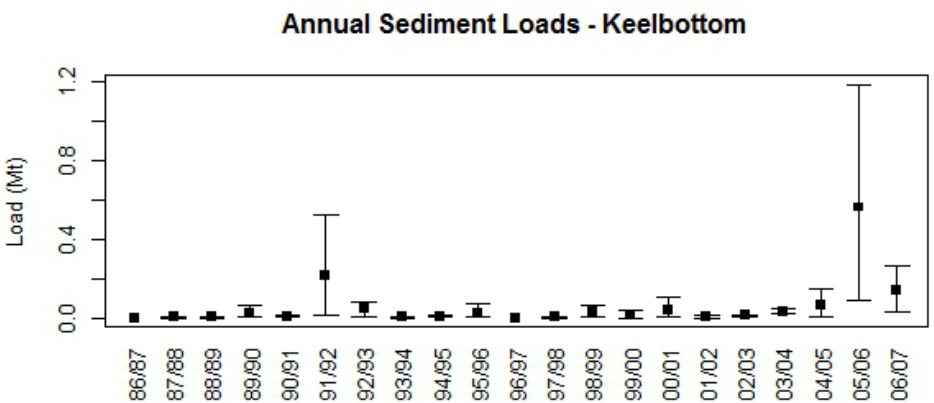
Scenario 2: High Rainfall, High Cover

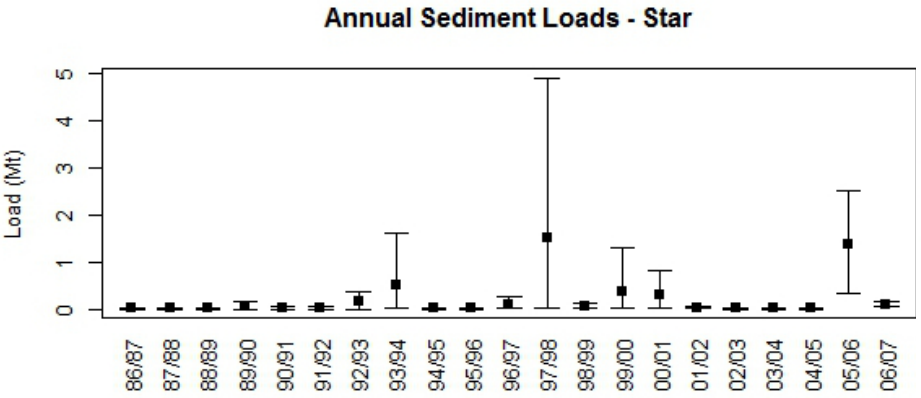
Scenario 3: Low Rainfall, High Cover

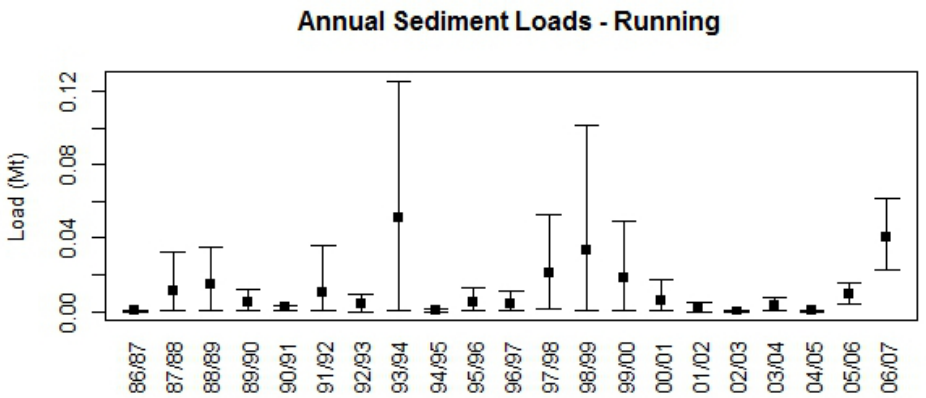


Results II: Upper Burdekin



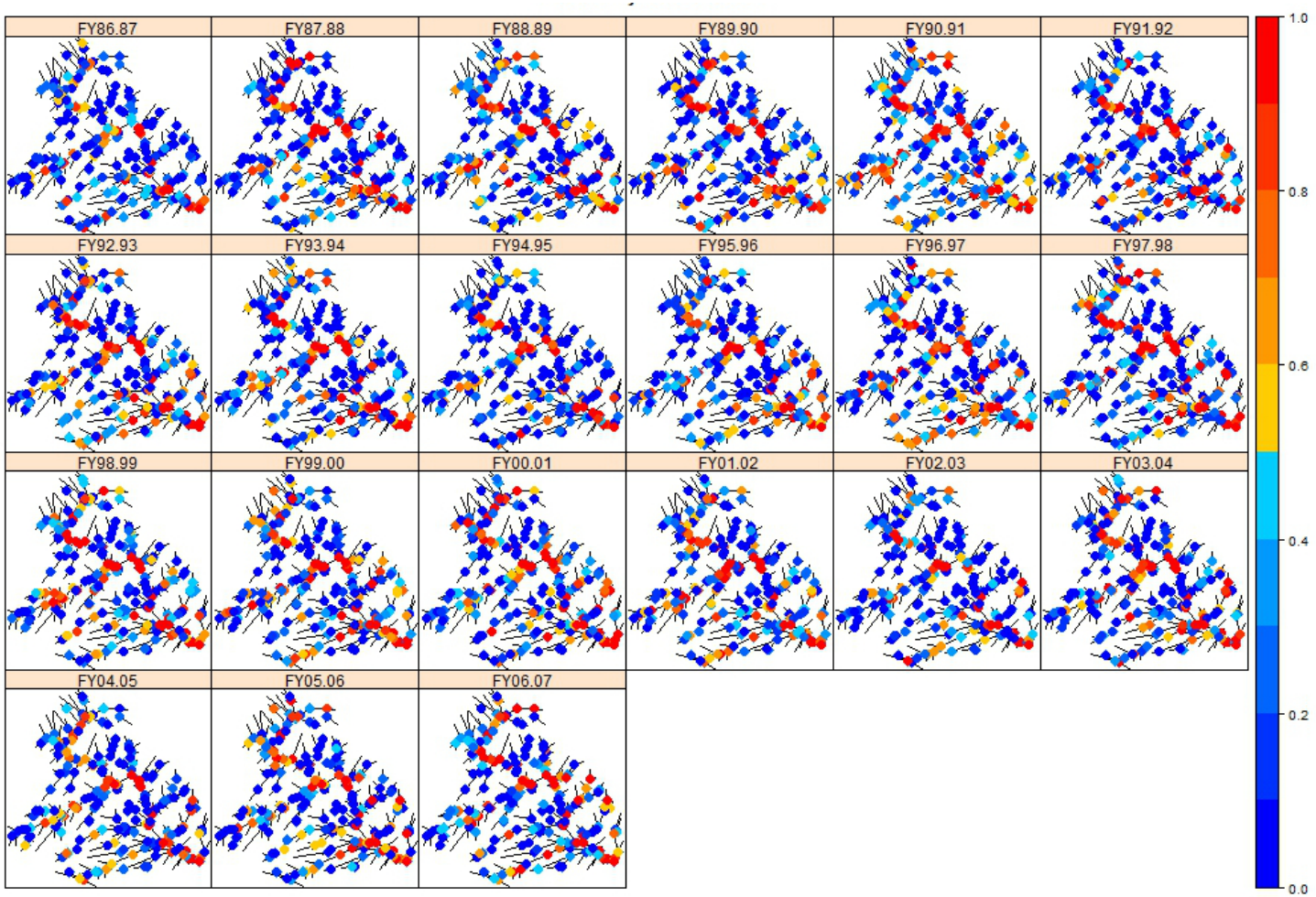






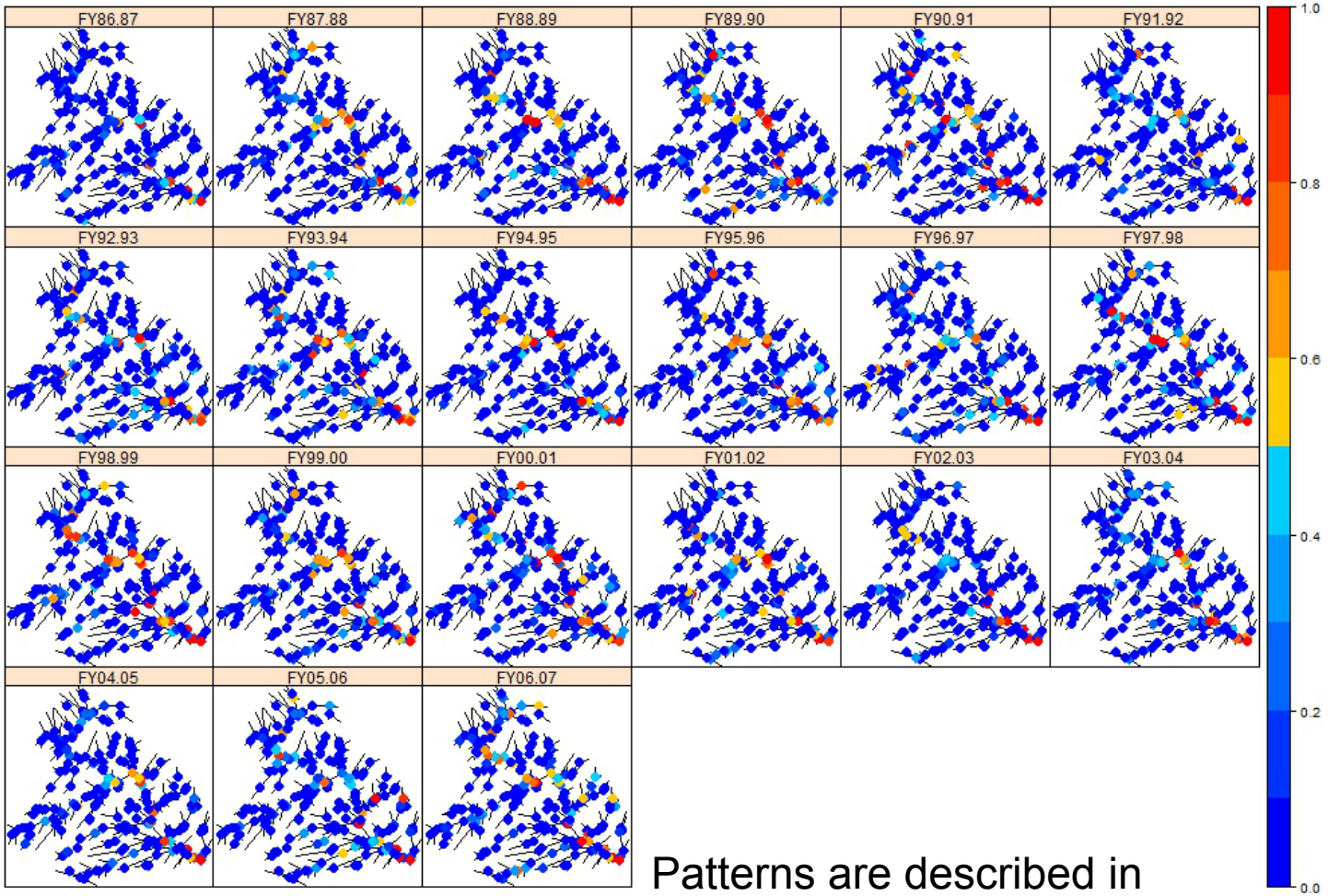
Exceedence Probabilities - Load

Probability Load > 5,000 t



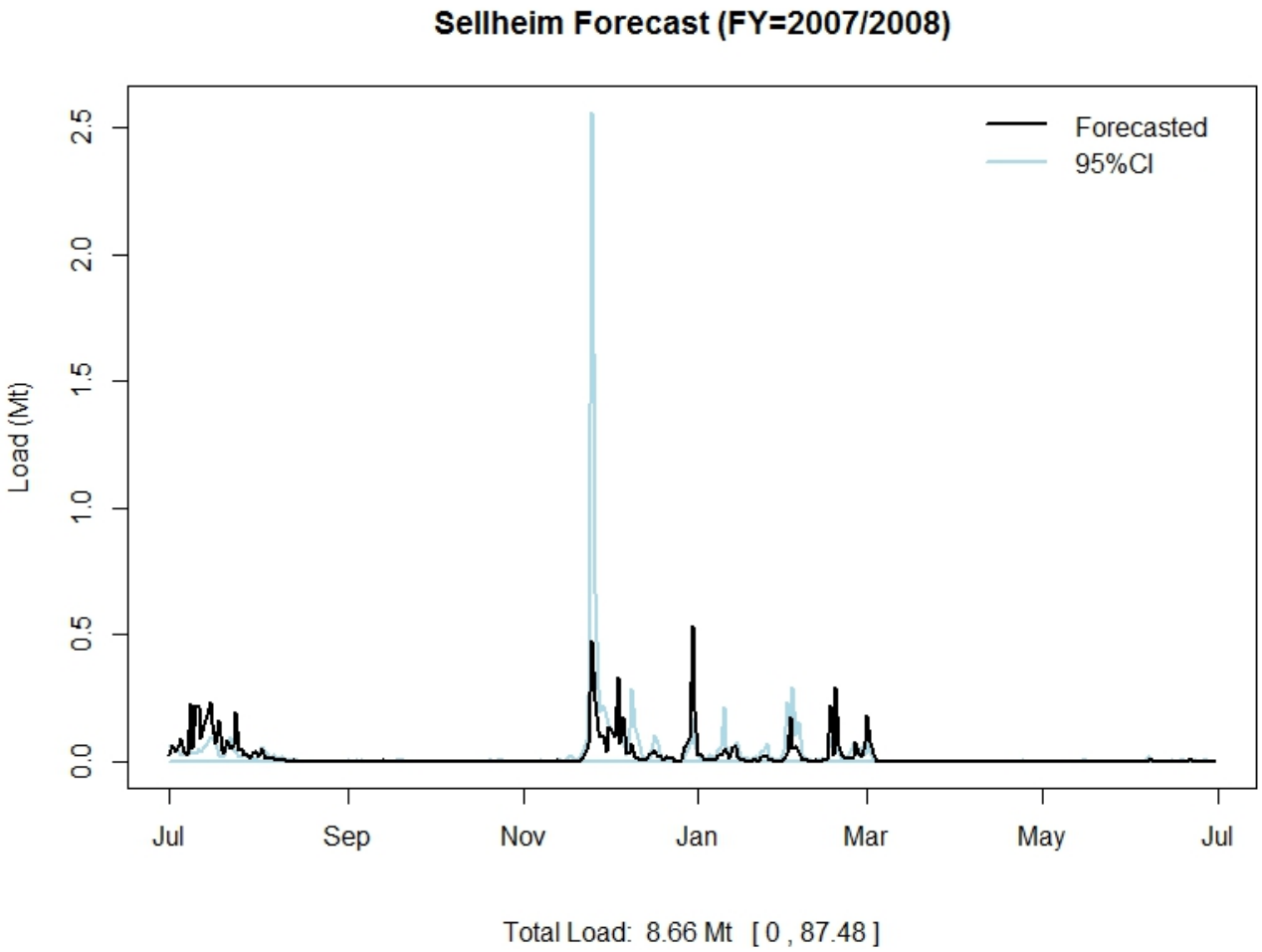
Results II: Exceedence Probabilities - Load

Probability Load > 100,000 t



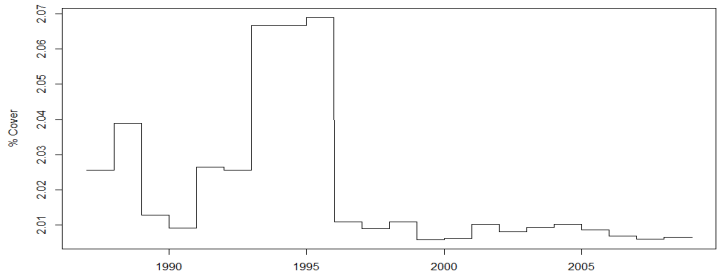
Patterns are described in Bainbridge et al. (2013) WRR paper.

Forecasting – Sellheim Site



Key Findings & Implications for MW-WQIP

- **Cover is significant:** Increase in ground cover indicates a significant decrease in TSS concentration across the catchment.



% Cover fit as a predictor in the model

- **Exceedence probabilities** offer a new way to interpret uncertainties from the model. They can highlight problem areas or sources of erosion.
- **Forecasting ability** is quite powerful.
  - Forecast concentration, flows and loads a year out with uncertainty.
  - Investigate forecast in response to changing ground cover or climate scenarios.
- **Providing a level of confidence** about modelled output for reporting.

Future Work

- Extensive validation and testing of the models is still required. Other monitoring sites in the Upper Burdekin can help inform the model further. Initial results are promising.
- CSIRO is investing heavily into this methodology:
  - Methods are very computational as this is a complex model. CSIRO funded project to speed up the code using CSIRO software (LibBi software) developed for these types of problems.
  - Investigating ways to link catchment modelling outputs with marine biogeochemical models.
  - Trials of methodology in another catchment e.g. Fitzroy.

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