

Dynamical Seasonal Forecasting for Agriculture in Australia

Oscar Alves

**Centre for Australian Weather and Climate Research,
Australian Bureau of Meteorology**

Acknowledgements

POAMA Team,

Senthold Asseng and Peter McIntosh, CSIRO

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Outline

Latest dynamical prediction system

- Brief description
- Skill levels
- Products

Applications to Agriculture

- Wheat farming in Western Australia
- Mixed Wheat/Sheep farming

Summary

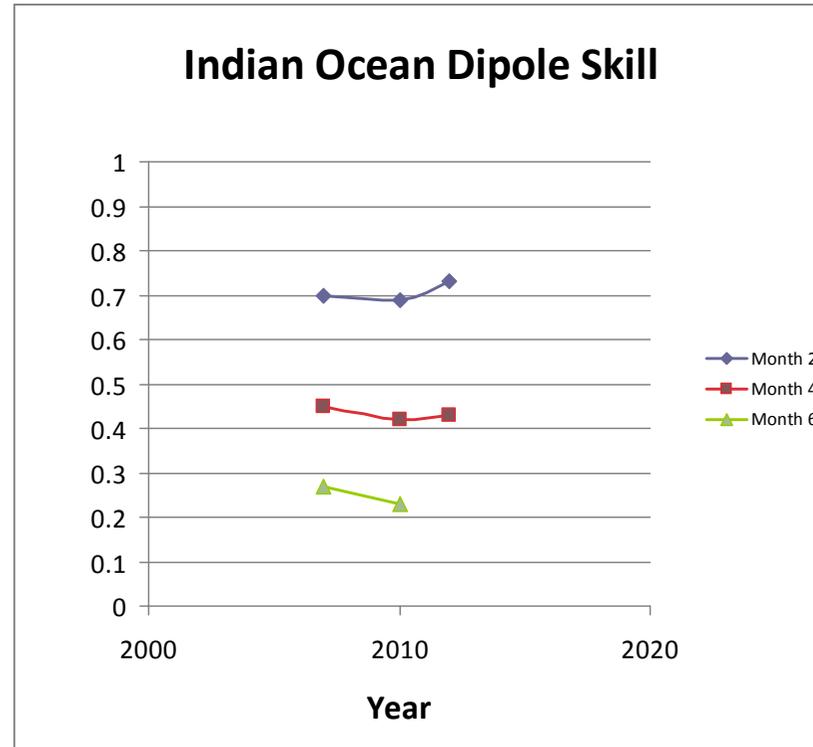
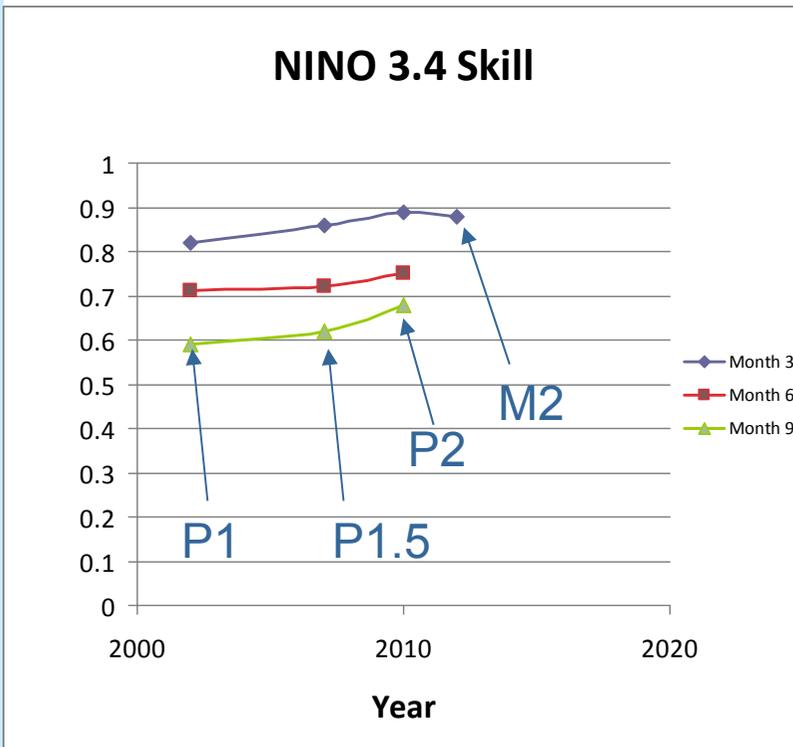


POAMA-2M Model

Distinguishing Features

- T47L17 Bureau Atmosphere/MOM2 Ocean (250km)
- Pseudo Multi-model (3 model versions)
- Ensemble Kalman Filter for ocean assimilation
- Coupled bred vectors used for perturbations
- 33 member ensemble each week
- Seamless predictions from 1 week to 9 months
- 33 member hind-casts 3x per month 1980-2012

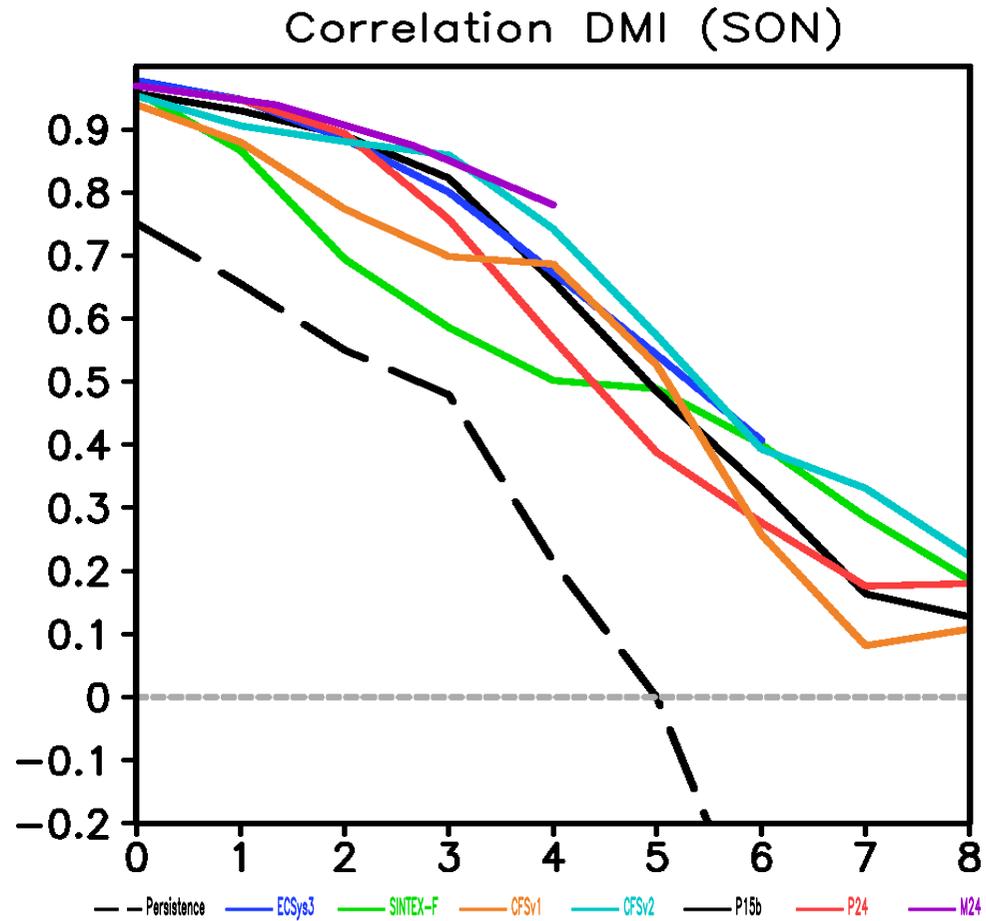
POAMA Progress – SST Skill



Improvements due to

- Increased supercomputing
- Improved forecast system (model, physics, initialisation strategy)
- New observing Systems

Indian Ocean Dipole Skill

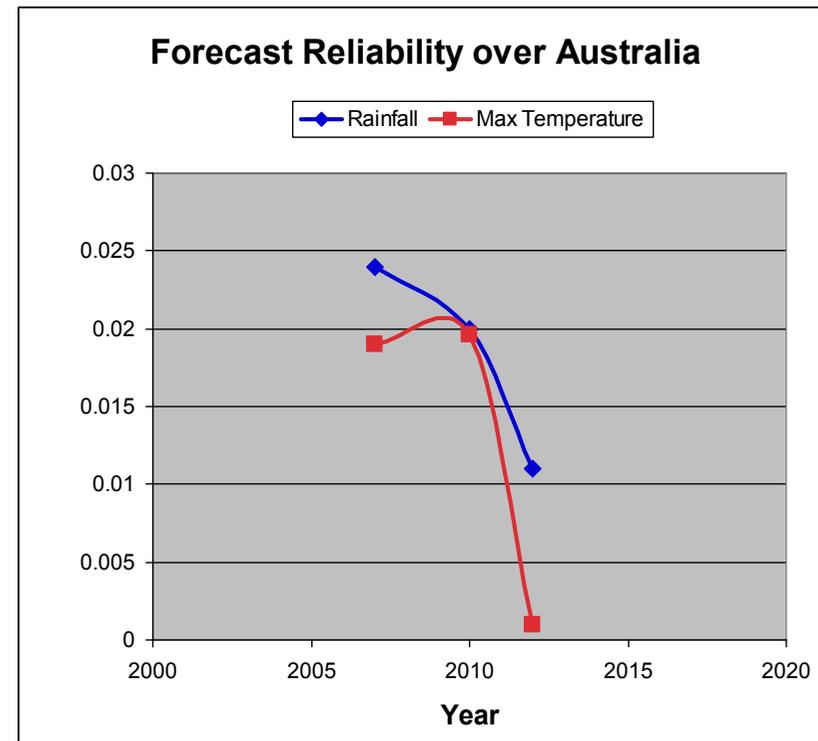
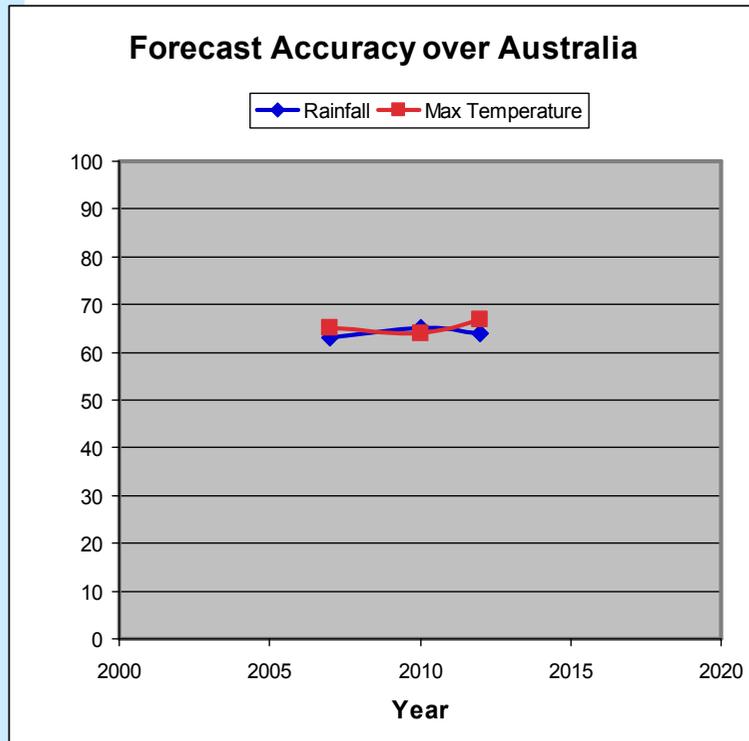


Rainfall Skill



POAMA Progress – Regional Skill

First Seasonal Rainfall/Max temperature – skill scores for upper tercile forecasts

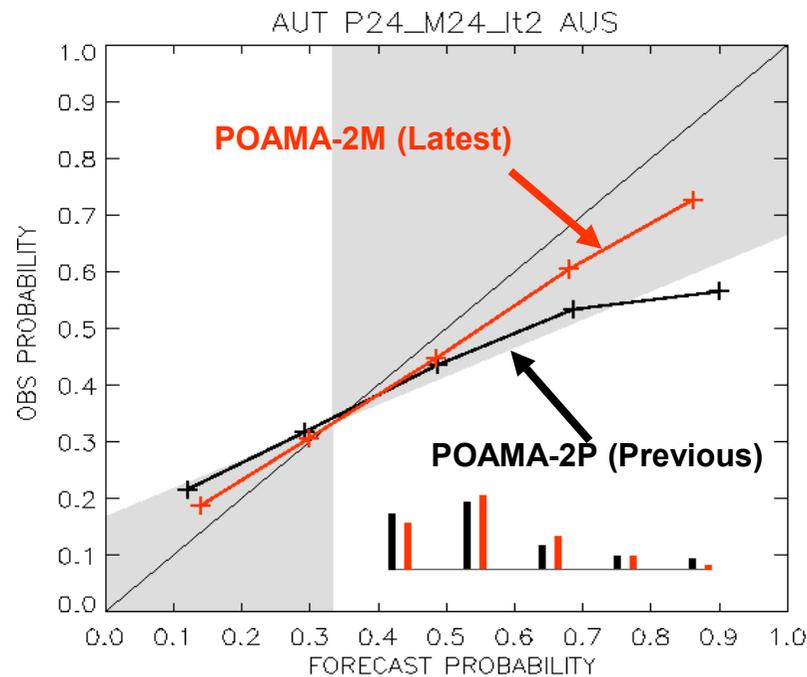


Good reliability is critical as farmers will stop using forecasts that are too emphatic
 Improvements come from better ensemble generation strategy

POAMA-2M Seasonal Forecasts

Ensemble generation strategy and pseudo multi-model approach leads to significant improvements in reliability

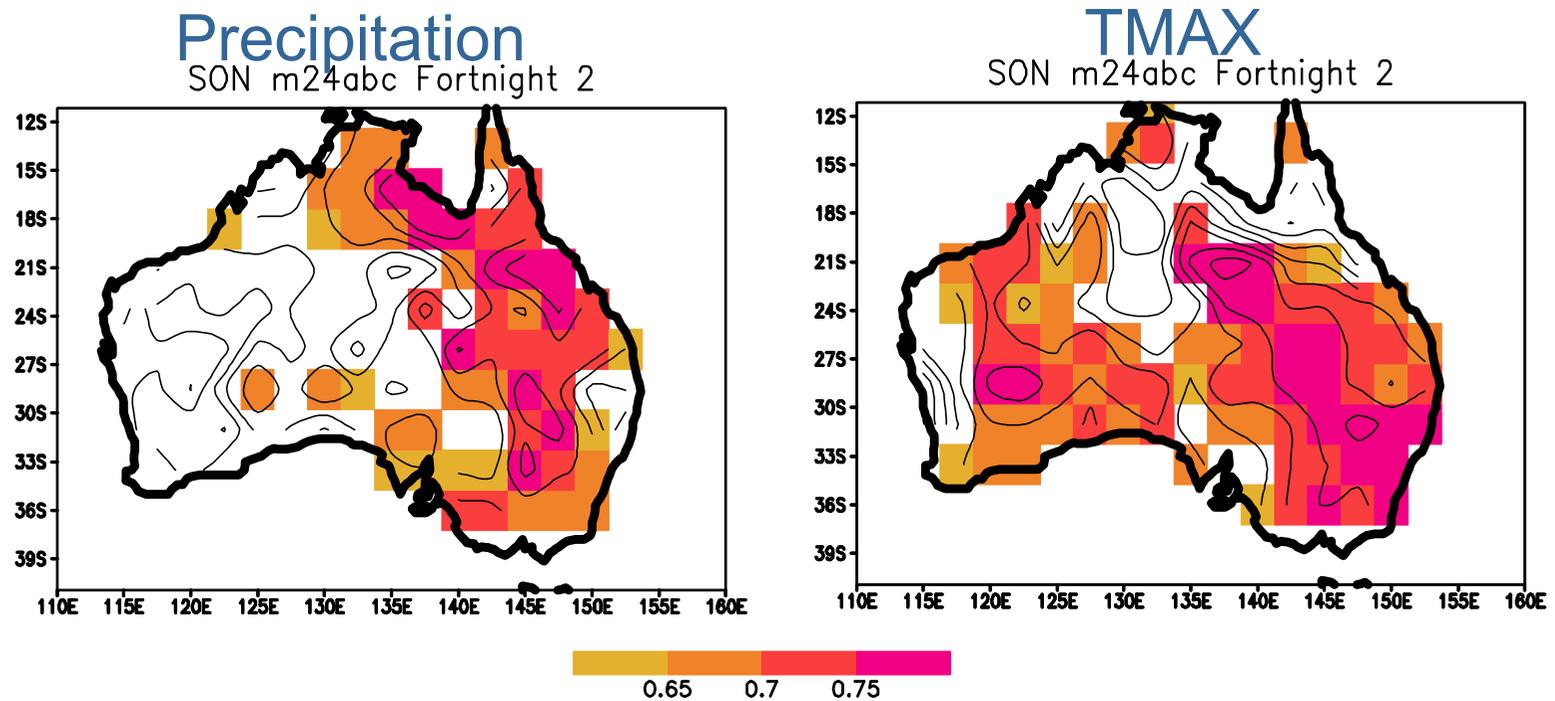
Rainfall (above the upper tercile) Reliability: Skill of **first season**



Multi-week Skill

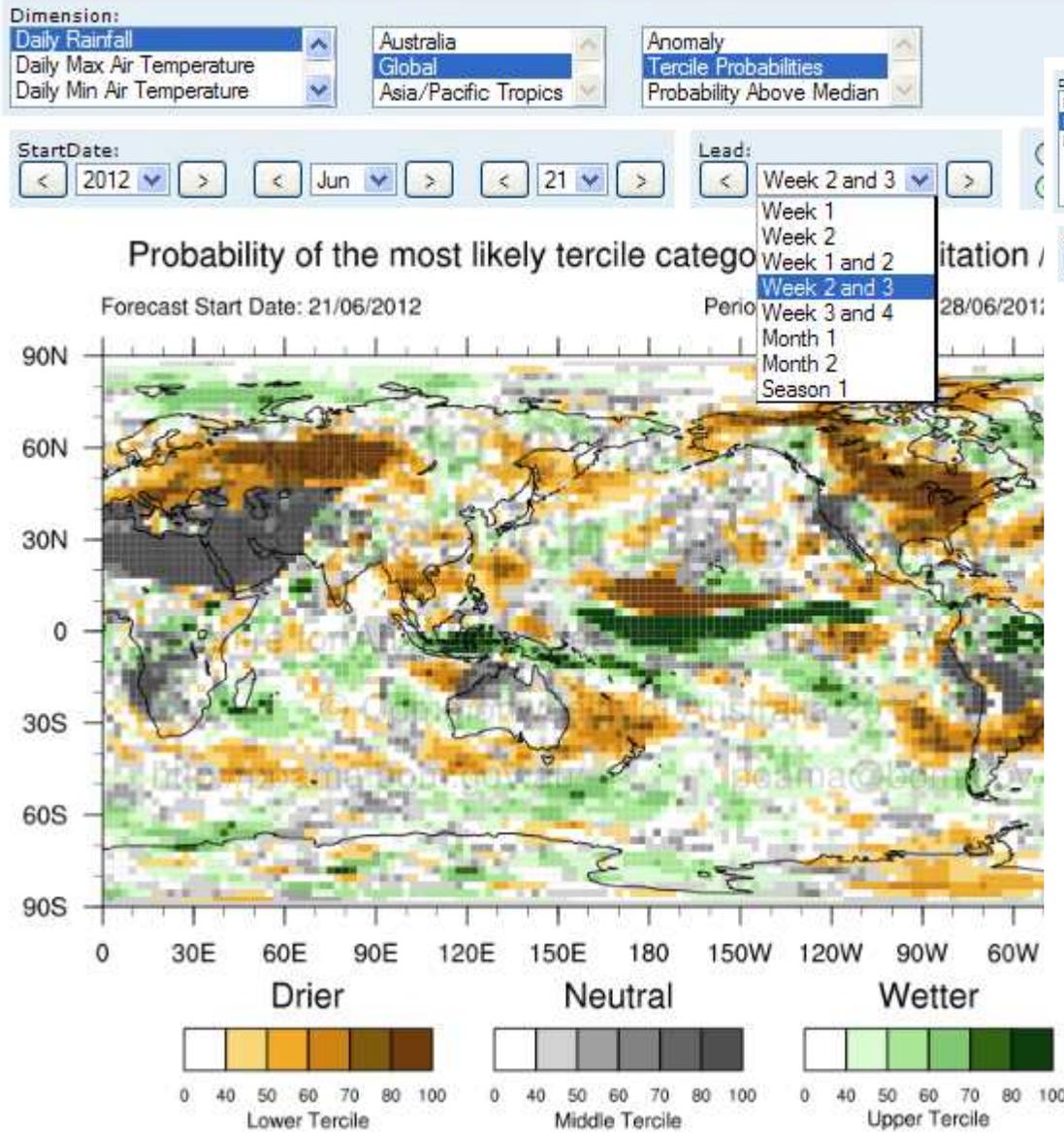


POAMA has good skill in predicting rainfall and TMAX over eastern Australia in the second fortnight of the forecast, particularly during spring forecast months.

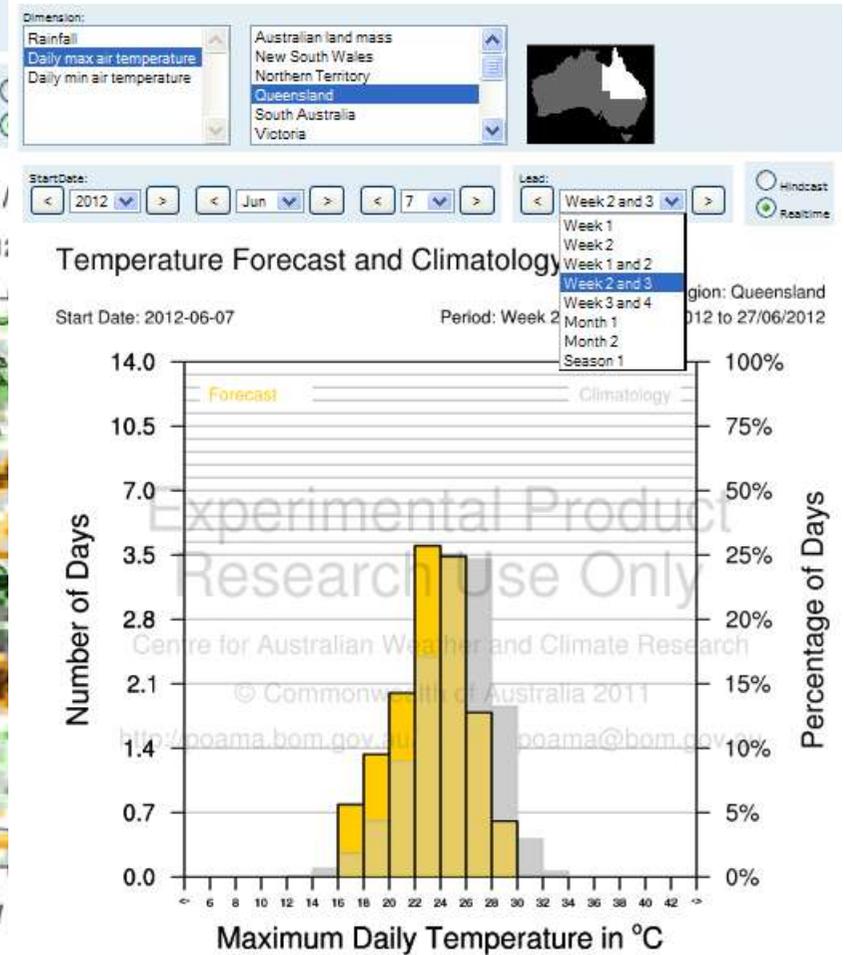


ROC area of the probability that rainfall (left) and TMAX (right) for the 2nd fortnight of the forecast is in the upper tercile for spring forecast months (SON, 1989-2006). ROC areas significantly more skilful than climatology are shaded (5% significance level).

Seamless Products <http://poama.bom.gov.au/>



Created: 2012-06-24 10:26:28 +0000 - Climatology: model_clim_1981-2010 - Period: 0521 - Resource: fla_



Agriculture applications



POAMA-1.5 Skill for above median rainfall

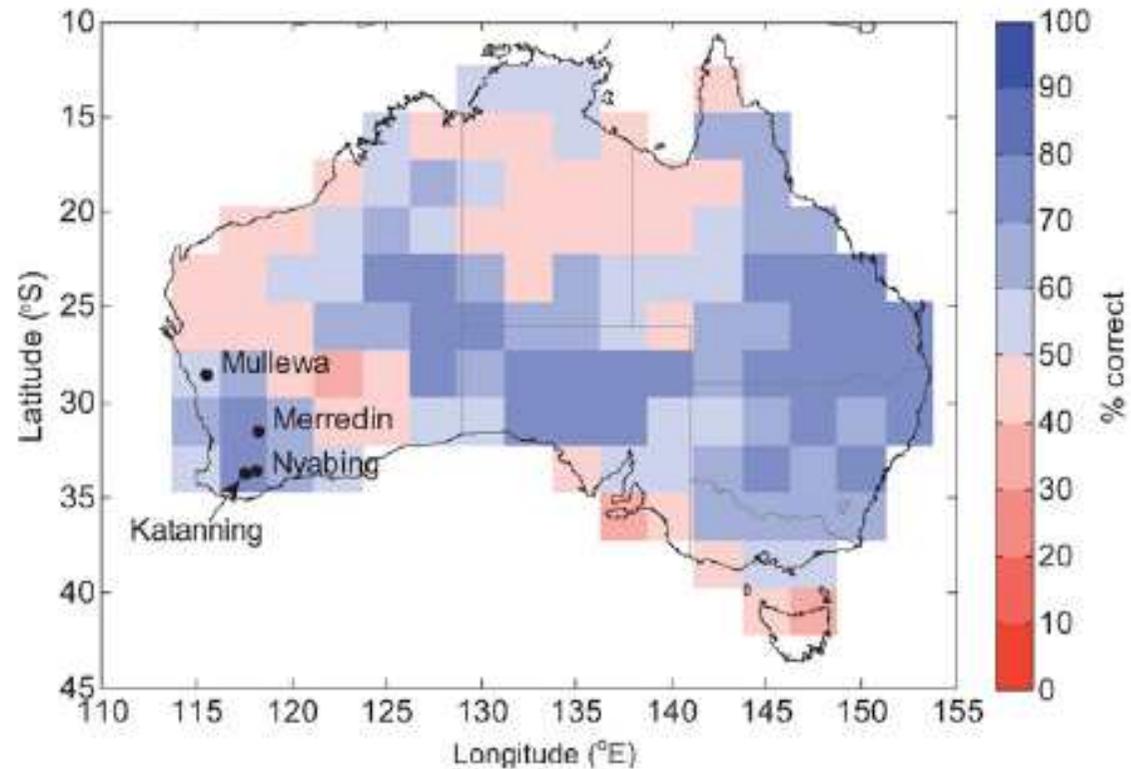


Fig. 1. Percent correct 2-category (above and below median) seasonal (May–October) rainfall forecast across Australia using POAMA. Study sites in Western Australian wheat-belt (Table 1) are indicated.



Wheat Farm in Western Australia

Asseng et al, 2012, European Journal of Agronomy

Forecasts for May-Oct rain for forecasts starting 1st May (1980-2006)

Basic idea is to increase fertiliser in wet years to increase yield and decrease in dry years to reduce input costs

Strategy used:

- Below median rainfall – no fertiliser
- Above median rainfall – apply N fertiliser

Value of a POAMA forecast for N management

(2500 ha wheat at Nyabing, WA)

	Climatology (history)	POAMA forecast (70% skill)	Correct forecast	POAMA % of best possible
Realistic risk averse (\$1 N for \$2 return)	\$235,000	\$402,500	\$490,000	66%
Maximise GM (risky!)	\$410,000	\$420,000	\$527,500	9%

The Lesson: A realistic risk-averse management strategy can benefit greatly from even a moderately skilful forecast.

Sensitivity to prices

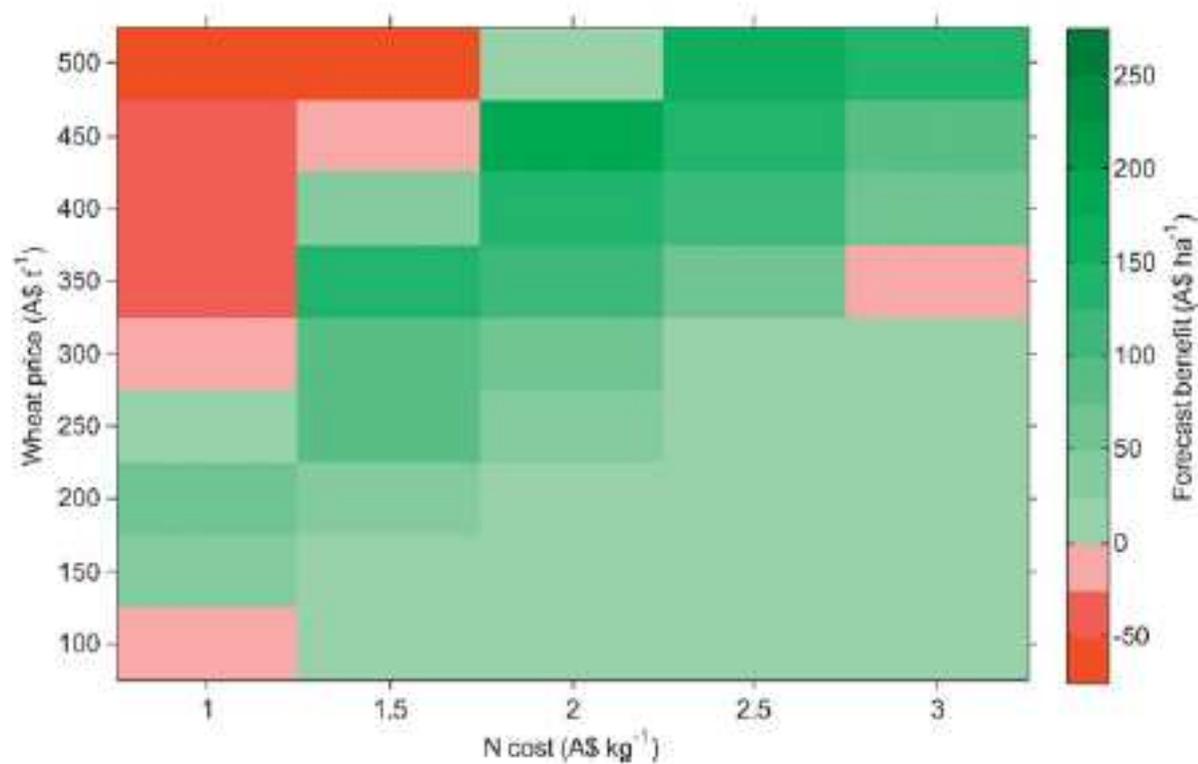
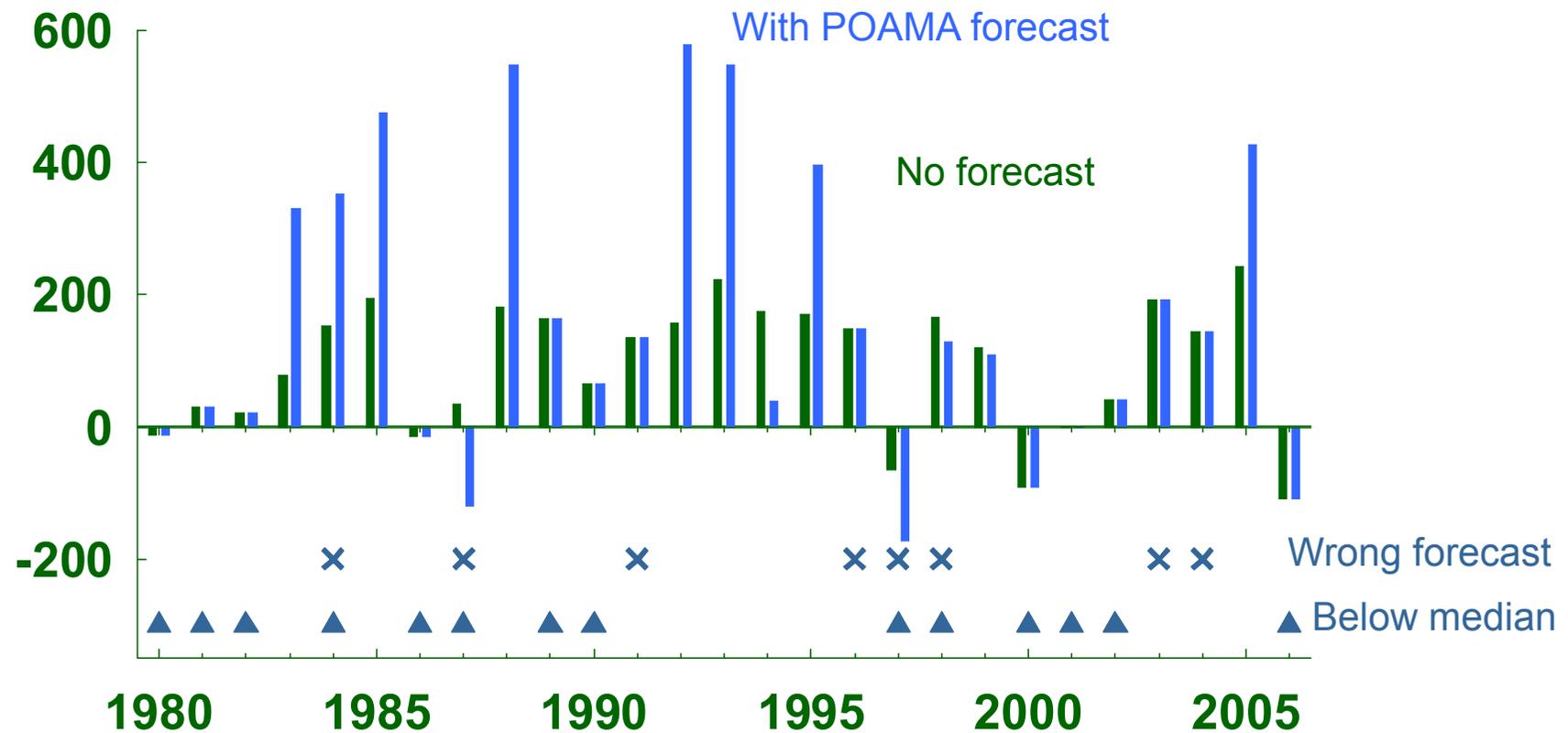


Fig. 5. Simulated benefits (A\$ ha⁻¹) of using a 2-category POAMA seasonal rainfall (May–October) forecast for N fertiliser management compared with not using a seasonal forecast for a clay soil versus wheat price and versus N cost. Simulations are for an initially dry soil at Nyabing in the southern wheat-belt of Western Australia.

Benefit of POAMA forecast year by year

Gross margins (A\$/ha)

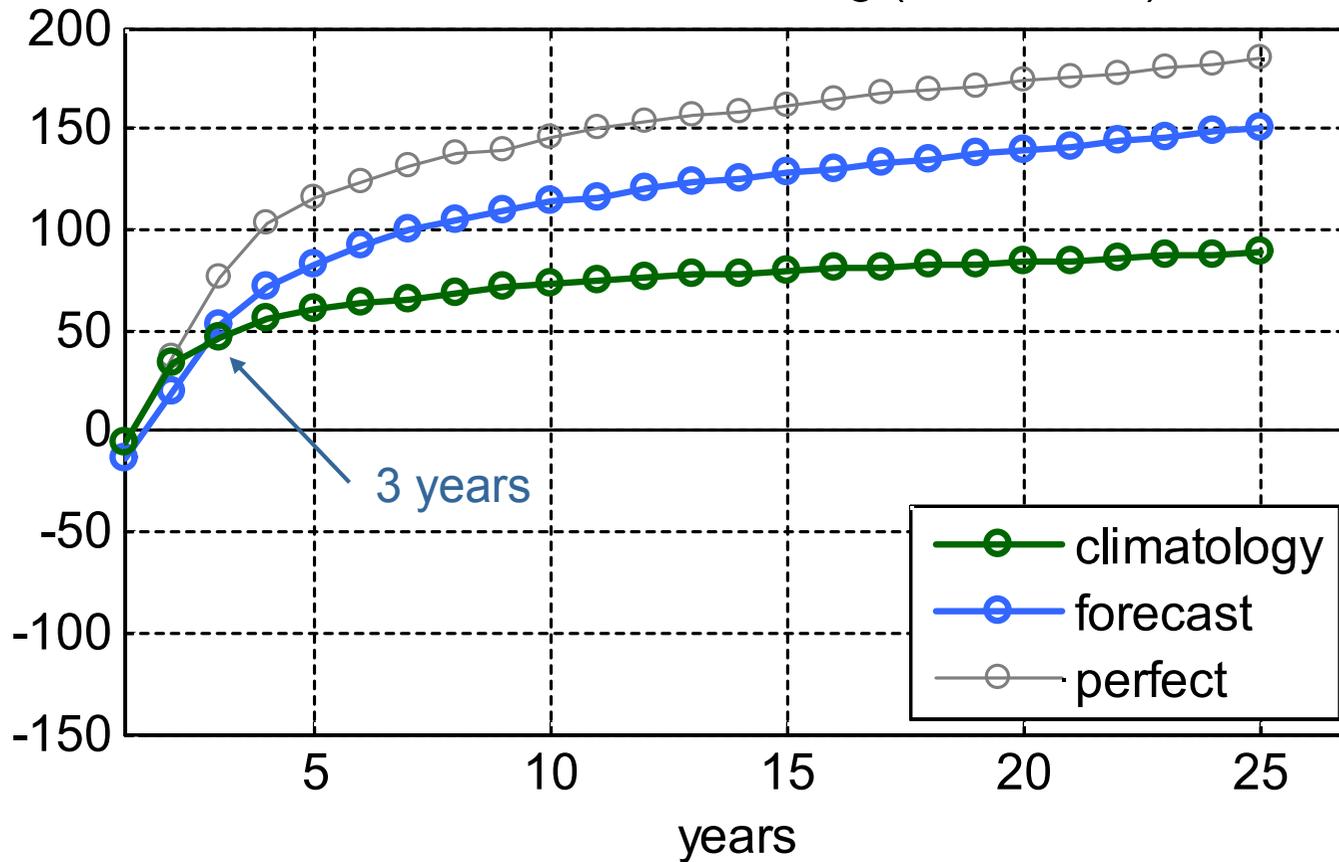


Realistic (risk averse) N application

Peter McIntosh and Senthold Asseng

How long for a forecast to pay off?

80% chance of exceeding (risk averse)



The Lesson: A farmer is 80% sure of making more money after just 3 years of using the POAMA forecast at Nyabing.

Mixed Sheep/Wheat Farm in Western Australia

Asseng et al, 2012, Agricultural Systems

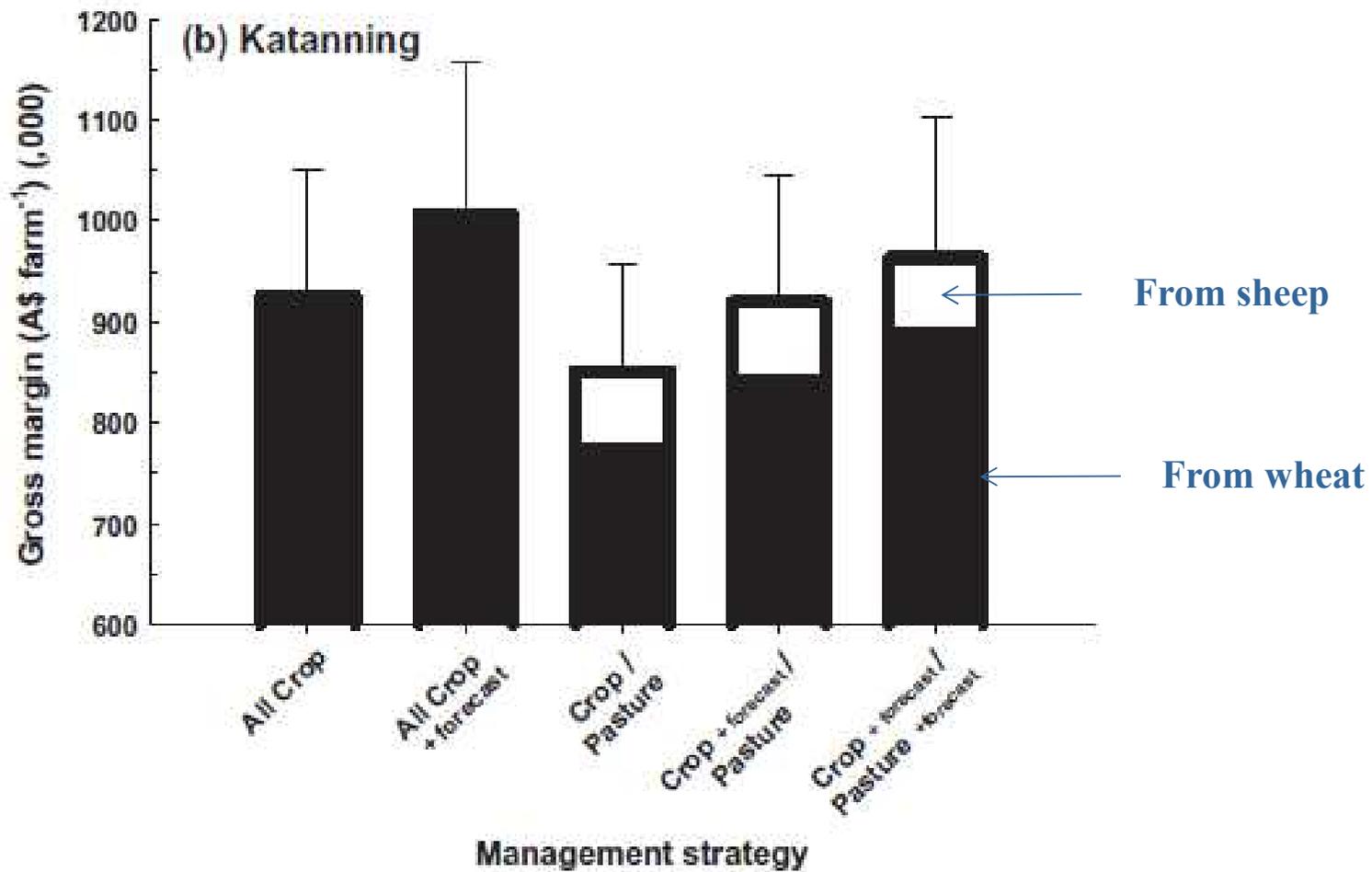
Forecasts for May-Oct rain for forecasts starting 1st May (1980-2006)

Below median rainfall – no fertiliser, standard stocking rate

Above median rainfall – apply N fertiliser, increase stocking rate, increase proportion of land used for wheat



Gross Margin



Summary

- POAMA-2M Good levels of skill and reliability
- In areas of high skill (accuracy ~70%) leads to significant profit increases for wheat farm when using realistic management decision making strategies
- Most benefit comes from increasing yield in wet years



Future

Agriculture remains largest external funder for seasonal prediction research

Model Features

- New model with higher resolution and better physics – hopefully increased skill
- Improve initialisation strategy
- Improved ensemble generation strategy

Farming

- A range of projects interfacing POAMA to various applications
- Ability to predict extreme events
- Seamless predictions from weeks to seasons (range of decisions)
- Specific products (horticulture, mango, wheat, cattle, etc)