Managing Climate Variability in Agriculture: Predicting the Onset of the North Australian Wet Season

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Introduction

• Project sponsored by Managing Climate Variability Program

• For this part of the project we are concentrating on long-lead predictions of wet season onset.

• We define onset to occur when a rainfall accumulation of 50mm is reached from 1st September.

• This definition is broadly applicable across a wide range of agricultural industries as it takes about 50mm of rain to make the grass turn green after the normally very dry winter.
What does the onset look like by this definition?

Example dry year

Example wet year
Median and year-to-year variability

Median Onset Date
50mm Accum 1960–2009

Onset Date IQR
50mm Accum 1960–2009

IQR = Inter Quartile Range
(difference between the 25% and 75% percentiles)
Wet season onset prediction

• Previous work (Lo et al. 2007) showed that skilful predictions of the year-to-year variability of onset could be made using the SOI as a predictor.

• In this work we investigate the use of the Bureau’s Predictive Ocean-Atmosphere Model for Australia (POAMA) for making these predictions.

<table>
<thead>
<tr>
<th>POAMA-2 Systems</th>
<th>Seasonal System</th>
<th>Multi-week System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atmosphere/land data assimilation</strong></td>
<td>ALI (Atmosphere Land Initialisation Scheme: nudging atmos model to ERA-40 or operational NWP)</td>
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</tr>
<tr>
<td><strong>Ocean data assimilation</strong></td>
<td>PEODAS (Multivariate pseudo-Ensemble Kalman Filter)</td>
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</tr>
<tr>
<td><strong>Ensemble generation</strong></td>
<td>30 members Multi-model (3 versions) Ocean perturbations from PEODAS; No atmosphere perturbations</td>
<td>33 members Multi-model (3 versions) Ocean and atmosphere perturbations from Coupled Ensemble Initialisation Scheme (CEIS)</td>
</tr>
<tr>
<td><strong>Hindcast</strong></td>
<td>30 members on the 1\textsuperscript{st} of the month out to 9 months (1960-2010)</td>
<td>33 members on the 1\textsuperscript{st}, 11\textsuperscript{th} and 21\textsuperscript{st} of the month out to 120 days (1980-2010)</td>
</tr>
<tr>
<td><strong>Operational</strong></td>
<td>30 members on the 1\textsuperscript{st} and 15\textsuperscript{th} of the month out to 9 months</td>
<td>33 members every 0z Thursday out to 120 days</td>
</tr>
</tbody>
</table>
We investigate the POAMA 2.4 seasonal hindcasts from:

1\textsuperscript{st} September (Lead 0)
1\textsuperscript{st} August (Lead 1)
1\textsuperscript{st} July (Lead 2)

For the 50 years, 1960-2009.

We compute the onset for each model run separately based on the same 50mm accumulation definition.

However, POAMA has a known dry bias over northern Australia. Therefore, we compute the probability of early onset relative to the median onset date computed separately for each model version.

E.g., if 20 out of 30 ensemble members produce an earlier onset than the model’s median (using a different median for each version and lead time) we predict a 66.7% chance of an early onset.
Example probabilistic onset predictions for 1960

Verifying observations
Example probabilistic onset predictions for 1975

Verifying observations
Hindcast skill at different leads

Percent Correct P24 Lead 0 1980–2009

Brier Skill Score P24 Lead 0

Percent Correct P24 Lead 1 1980–2009

Brier Skill Score P24 Lead 1

Percent Correct P24 Lead 2 1980–2009

Brier Skill Score P24 Lead 2

% correct

% improvement over climatology
Long term trends in wet season onset

Observed onsets have been trending towards earlier dates over western and central inland Australia.

A variety of mechanisms have been suggested for this: global warming, anthropogenic aerosols, Atlantic SSTs, etc..

However, the POAMA hindcasts do not reproduce this trend, despite being initialised with global oceanic conditions (which contain the global warming signal).
Summary

1. We concentrate on forecasts of an agriculturally-relevant definition of wet season onset – defined as the date of accumulation of 50mm from 1st Sept.

2. Skilful probabilistic predictions of the year-to-year variability can be obtained from POAMA using forecasts from 1st July, 1st August, or 1st September, with generally higher skill for the forecasts made from the later start date.

3. The hindcasts are found to exceed the 70% correct level over about 1/3 of the Northern Territory and parts of Queensland, and are quite reliable.

4. This skill is generally better than that obtained by Lo et al. (2007) using the SOI as a predictor, especially for longer leads and around the Gulf of Carpentaria and SE Queensland.

5. Further research is required to understand the observed trend in onset (to earlier dates) and the simulation of that trend with POAMA.

6. Next steps include the transfer of this product to NCC (Andrew Watkins) and the study of POAMA forecasts of monsoon bursts and breaks.
The Centre for Australian Weather and Climate Research
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Thank you

www.cawcr.gov.au
Extra slides
## Configuration of P1.5, P2-seas and P2-intra systems

<table>
<thead>
<tr>
<th></th>
<th>POAMA-2 (intra-seasonal)</th>
<th>POAMA-2 (seasonal)</th>
<th>POAMA-1.5</th>
</tr>
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<td>33 members Multi-model (P2a,P2b,P2c) Burst ensemble: Ocean and atmosphere perturbations from Coupled Ensemble Initialisation Scheme (CEIS)</td>
<td>30 members Multi-model (P2a,P2b,P2c) Burst ensemble: Ocean perturbations from PEODAS; no atmosphere perturbations</td>
<td>10 members Single model (identical to P2c) Lagged ensemble: Lagged atmosphere initial conditions; no ocean perturbations</td>
</tr>
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<td><strong>Hindcast configuration</strong></td>
<td>33 members on the 1st, 11th and 21st of the month out to 120 days (1980-2010)</td>
<td>30 members on the 1st of the month out to 9 months (1960-2010)</td>
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<td><strong>Real-time configuration</strong></td>
<td>33 members every 0z Thursday out to 120 days</td>
<td>30 members on the 1st and 15th of the month out to 9 months</td>
<td>30 members (daily lagged ensemble: 1 member per day)</td>
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Median onset from POAMA hindcasts

All 3 model versions have a **dry bias**

This bias must be taken into account for making predictions with POAMA.