Digiscape:
A one-platform solution for seasonal climate integration into Agriculture

Jaci Brown  Principal Research Scientist
Weather and Climate Decisions Team
Co-coordinator for Digital Ag.
April 2019
Four Industrial Revolutions

1. Iron Plough
   Mechanical Reaper
   Cotton Gin
   Telegraph

2. Haber-Bosch Process
   Mendelian Genetics
   Tractors
   Rail & Steamship
   Telephone

3. Controlled Traffic
   Quantitative Genetics
   Internet/Mobile Phone

4. ?
And the Social Scientists!
GRAINCAST – Finding the value of Yield Predictions

To estimate yield you need to know:
• The future climate
• Soil type
• What has been planted
• Management decisions
• On-going crop decisions.
Graincast: Interlocking Yield Forecasts

Ground Truth

CBH Group

Digiscape Future Science Platform
POAMA
35 years of hindcast, 33 Ensembles
Start 1st April, May, June, July, August, Sept, Oct.

Downscale and Calibrate to 57 stations across wheat belt. Use quantile-quantile mapping.

APSIM

460,845 Wheat Yield Predictions

Brown et al. (2018)
Example: Forecast in June for Ouyen (the best one!)
Percentage of 33 ensembles in each category

<table>
<thead>
<tr>
<th>Year</th>
<th>Low yield</th>
<th>Average yield</th>
<th>High Yield</th>
<th>SILO</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>6.1</td>
<td>87.9</td>
<td>36.4</td>
<td>6.1</td>
</tr>
<tr>
<td>2013</td>
<td>24.2</td>
<td>63.6</td>
<td>30.3</td>
<td>12.1</td>
</tr>
<tr>
<td>2011</td>
<td>12.1</td>
<td>90.9</td>
<td>30.3</td>
<td>9.1</td>
</tr>
<tr>
<td>2009</td>
<td>42.4</td>
<td>72.7</td>
<td>27.3</td>
<td>3.0</td>
</tr>
<tr>
<td>2007</td>
<td>36.4</td>
<td>54.5</td>
<td>24.2</td>
<td>9.1</td>
</tr>
<tr>
<td>2005</td>
<td>30.3</td>
<td>66.7</td>
<td>24.2</td>
<td>9.1</td>
</tr>
<tr>
<td>2003</td>
<td>33.3</td>
<td>54.5</td>
<td>18.2</td>
<td>9.1</td>
</tr>
<tr>
<td>2001</td>
<td>9.1</td>
<td>78.8</td>
<td>42.4</td>
<td>12.1</td>
</tr>
<tr>
<td>1999</td>
<td>15.2</td>
<td>81.8</td>
<td>36.4</td>
<td>12.1</td>
</tr>
<tr>
<td>1997</td>
<td>30.0</td>
<td>42.4</td>
<td>42.4</td>
<td>15.2</td>
</tr>
<tr>
<td>1995</td>
<td>15.2</td>
<td>60.6</td>
<td>57.6</td>
<td>24.2</td>
</tr>
<tr>
<td>1993</td>
<td>10.0</td>
<td>42.4</td>
<td>69.7</td>
<td>3.0</td>
</tr>
<tr>
<td>1991</td>
<td>6.1</td>
<td>69.7</td>
<td>27.3</td>
<td>3.0</td>
</tr>
<tr>
<td>1989</td>
<td>6.1</td>
<td>57.6</td>
<td>30.3</td>
<td>21.2</td>
</tr>
<tr>
<td>1987</td>
<td>21.2</td>
<td>72.7</td>
<td>21.2</td>
<td>9.1</td>
</tr>
<tr>
<td>1985</td>
<td>21.2</td>
<td>69.7</td>
<td>30.3</td>
<td>6.1</td>
</tr>
<tr>
<td>1983</td>
<td>48.5</td>
<td>48.5</td>
<td>3.0</td>
<td>9.1</td>
</tr>
<tr>
<td>1981</td>
<td>27.3</td>
<td>87.9</td>
<td>3.0</td>
<td>9.1</td>
</tr>
</tbody>
</table>

Brown et al. (2018) Ag and Forest Meteorology
Wheat Yield Forecasts for WA.
All stations, 35 years.

POAMA forecast
Climatology

April

June

August

Brown et al. (2018)
33 ensembles x 35 years = 1155 runs @ 57 stations.

Expect ~ 30% to be in lowest 3 deciles (~347 runs)

![No. runs in lowest 3 deciles for Apr, May, Jun and July.](chart)

This is clearly too many to be a statistical artefact! Major reason for the errors in the forecast.
Rainfall-Yield relationship at Parkes, NSW
Rainfall-Yield relationship at Parkes, NSW

Potential Yield

SILO ave: 377
POAMA ave: 344
AgScore:

A really fancy climate model metric related to growing grains.
The Solution ... on Senaps.

Called from Matlab, R or Python on desktop computer anywhere in the world.

**Inputs from Climate Scientist**
- Location e.g. Birchip
- Time Period e.g. 1980-2015
- Ensemble of climate forecasts
  - rainfall, max T, min T, radiation.

---

**AgScore**

**The Senaps Black Box**

---

**Outputs back to climate scientist.**

AgScore metrics
- Accuracy
- Distribution
- Comparison with climatology

NOT A REAL YIELD FORECAST
What we need to know from you (our customer):

• Would you use this tool?
• What file format would you submit to AgScore?
• What metrics are you interested in having come back?
• What sort of research questions would you address with this tool?
• Would you like to work with us on developing the tool?
Thank you

Agriculture and Food
Jaci Brown
Principal Research Scientist

+61 3 6232 5113
Jaci.Brown@csiro.au

www.csiro.au
Some Farming Enterprises:

70% of profits are made in 3 years out of 10.

Important to know which 3 years so you can maximise your profit.
Results

Based on what you entered, we predict the following potential yield ranges, depending on the rainfall decile of the season finish.

<table>
<thead>
<tr>
<th>Decile 1</th>
<th>Decile 2-3</th>
<th>Decile 4-7</th>
<th>Decile 8-9</th>
<th>Decile 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>VERY LOW RAINFALL</td>
<td>LOW RAINFALL</td>
<td>AVERAGE RAINFALL</td>
<td>HIGH RAINFALL</td>
<td>VERY HIGH RAINFALL</td>
</tr>
<tr>
<td>Yield Potential (t/ha)</td>
<td>2.4t/ha</td>
<td>2.7t/ha</td>
<td>3.8t/ha</td>
<td>4.7t/ha</td>
</tr>
</tbody>
</table>

POAMA predicts a greater than average chance of a dry season finish.

Historical decile probability

<table>
<thead>
<tr>
<th>Decile</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td>2-3</td>
<td>20%</td>
</tr>
<tr>
<td>4-7</td>
<td>40%</td>
</tr>
<tr>
<td>8-9</td>
<td>20%</td>
</tr>
<tr>
<td>10</td>
<td>10%</td>
</tr>
</tbody>
</table>

Likelihood

For more detailed data, sign up for Yield Prophet!
Mostly due to a really strong low yield bias at many locations!

e.g. Parkes