CliMate – a smartphone App for analysing climate data

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Abstract
A Smart phone App has been constructed in order to update a series of well used but now unsupported decision support tools. Ideas and modes of presentation have been borrowed from the aging tools and put into the ubiquitous mobile phone platform (initially Apple iOS) in order to make a range of climate analyses available with the same accessibility we have become to expect from mobile phone technology.
Three types of information are derived from near real time climate data: status of a system based on recent weather; probability of future events based on long term climate data (e.g. rainfall, temperature, heat sum); and probability of a future event based on "climatology" and available forecasts. The App is aimed at any decision maker where a better understanding of weather probabilities and current system status determined by weather events are useful.

Available analyses include: how often is a set of rainfall or temperature conditions met? What is the probability of a combination of heat and cold stress indicators? How is the season progressing in terms of rainfall, temperature or heat sum? How much water and nitrate has accumulated over the recent fallow period? How likely are rainfall and temperature conditions based on a current forecast? What is the status of current atmosphere and ocean based ENSO (El Niño Southern Oscillation Index) indicators? And, what is the status of drought?
When released in August 2012, version 1 will be used to further refine user needs.

Key Words
Climate, weather, decision support, risk assessment, mobile phone

Introduction

"Farmers and advisors want information on: rainfall amount; rainfall intensity; temperature; frost occurrence; and wind. Users want to be able to tailor forecast products to their needs at a particular time. They want to be able to choose the scale of interest, amounts in terms of deciles, amounts, and base temperatures. Information should be presented as maps, graphs and diagrams with accompanying by explanatory text. Most users want information on-line and linked to the range of seasonal forecasts tools best suited to their area and industry" (Econnect Communication 2008)

1. Key questions posed in the design of information products are; how can recent weather data, long term climate data and forecasts be integrated to support decision making and what are the best formats for presenting information to growers? As part of a Managing Climate Variability Project managed by the Grains Research and Development Corporation, we have designed and built a Smart Phone App for delivery of weather and climate data analyses. This App, and web based tools to follow are built on previous experience from tools such as Rainman, Potential Yield Calculator, HowWet and HowOften (see Climate Kelpie for details http://www.climatekelpie.com.au). CliMate is being developed in close collaboration with CropMate (http://cropmate.agriculture.nsw.gov.au/), a web based decision support tool developed by the NSW Department of Primary Industries.

Methods

The conceptual model of an agricultural system that is driven by weather (i.e. recent past and future expectations) is presented in Figure 1. This model recognises that recent weather conditions can be influential in setting up future expectations. For example, crops dependent on stored water and nitrate content are conditioned by recent rainfall and temperature conditions.

Three types of information are derived:

1. Probability of future events based on long term climate data (so called "climatology") using basic weather variables and derivatives (e.g. rainfall, temperature, heat sum);
2. Status of a soil at a point in time based on near real time data from SILO

(www.longpaddock.qld.gov.au/silo/ and the Bureau of Meteorology (www.bom.gov.au); and
3. Probability of a future event based on "climatology" and available forecasts. A forecast will include established indices with provision for new forecasting approaches as they come on line.

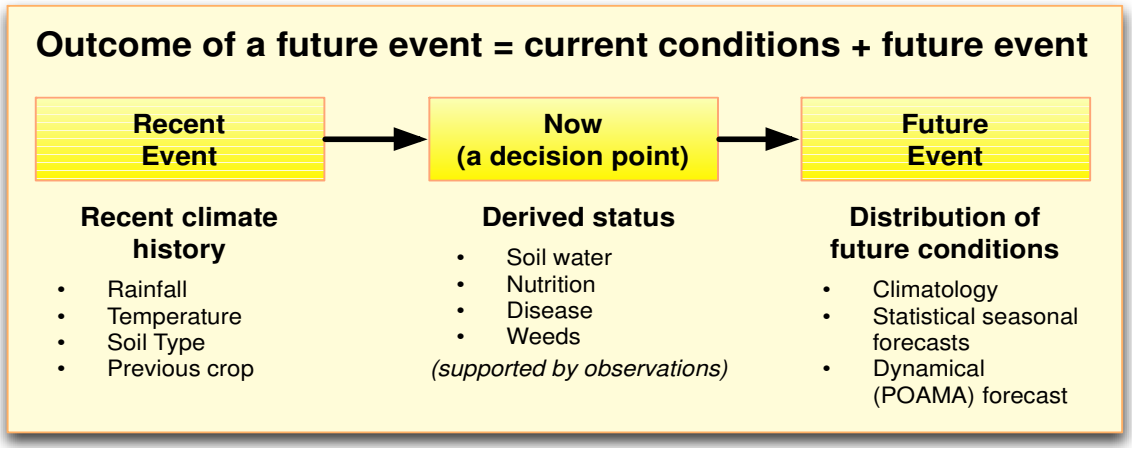

Figure 1. Schematic of the linkages between recent events and future probabilities in decision making. POAMA is the Bureau of Meteorology's Predictive Ocean Atmosphere Model for Australia (http://poama.bom.gov.au/poama2.shtml).

In order to be applicable to all agricultural industries, analyses are generic with each question being asked of climate data structured around each industry's issue. In short, CliMate gives answers to questions asked by the user within the framework "what is the chance of getting greater than or less than X (mm rain, ^{o}C temperature, ^{o}C days heat sum) in Y days between two dates? The user has to do some thinking about framing their questions about risk into the framework provided.

Analyses

Results are calculated in real time using the mobile device's own processor (as opposed to being calculated on a server) and are presented as numbers, text, and graphs. In order to create a similar look and feel, each analysis is presented as: the question; a short text and graphic answer; an explanation; and links to related information. A "fire risk gauge" is used in most analyses and line graphs and histograms are used to add detail on how the answer was derived and comparisons with previous seasons.

Version 1 of CliMate has seven analyses (Figure 2) that aim to cover cropping, pastoral, horticultural and other specialist industries where an understanding of risk associated with weather is important. This suite of analyses or questions also addresses the components of the framework in Figure 1 with a mix of recent weather and climate data to inform on current status and future probabilities respectively.

The initial screen allows the user to select any climate site in Australia. Long-term data is downloaded from the Silo database (http://www.longpaddock.qld.gov.au/silo/) which is sourced from the BOM and maintained by the former Queensland Department of Environment and Resource Management. A number of screen shots of CliMate are presented in Figure 3. The App sources climate data while in a mobile phone or wireless reception area and stores data until needed.

Typical applications

In order to describe the capability of CliMate, examples of applications of each analysis are presented below.

How often?

What is the change of a sowing event based on amount of rainfall over 5 days? How often is a heat sum achieved in a set period of time? What is the probability of temperature being below a critical level for germination or flowering?

How hot-cold?

When determining an ideal sowing date, when are heat and cold stresses lowest for the optimum flowing time?

Season's progress?
When adjusting inputs during a crop or pasture season, how does the current season compare with previous conditions in terms of rainfall and temperature?

How wet? N?
How much water and nitrate have I stored over the fallow? This may help me adjust inputs to better match yield expectations.

How likely?
Based on current ENSO conditions, what is the probability of rainfall or temperature being greater than or less than specified categories (e.g. terciles, median)? The level of historical forecast skill is also assessed.

How's El Nino?
What are the key atmospheric and oceanic ENSO indicators suggesting? This information is obtained from Australian and US sources.

How dry?
Based on recent rainfall records, are we likely to be facing a drought in the near future or are we in a drought now? And how do current dry conditions compare with previous droughts?

Figure 2. Main screen of CliMate showing seven analyses and the variables analysed.

Observations
Previous experience with a range of decision support tools has led us to conclude that:

- The simplest tools are generally the best;
- The easier a decision support tool is to use, the more chance it has of being used; and
- A rapid cycle of open questions and answers allows for iterative convergence on insight into system variability, a feature of effective adult learning.

The main advantage of delivery of information on a mobile device is that information is available anytime and all the time decisions are being made. Development of Smart Phone Apps for agriculture is at an early stage. Time will tell, but we believe that ready-access of near-real-time weather data, climate data and forecast indices opens up a new source of more definitive information for agricultural decision makers.

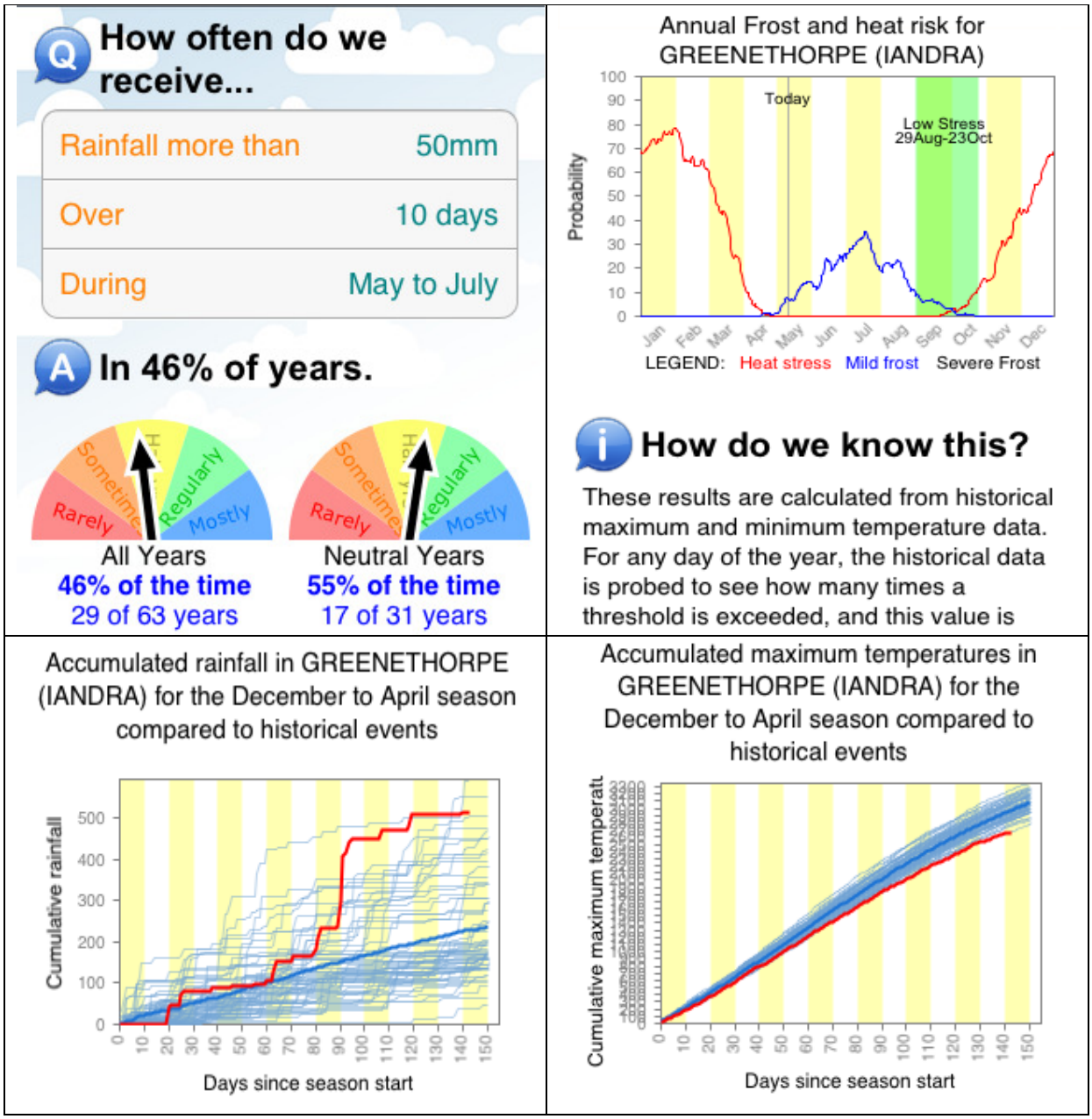

Figure 3. Four partial screen shots of CliMate analyses. From top right and clockwise: How often do we receive rainfall; heat and cold stress probabilities; seasons progress in rainfall; and seasonal progress in temperature.

A number of questions remain in the design and delivery of new climate analysis tools. Should these tools be available on all platforms (Apple iOS, Android and Microsoft smart phones, Web Apps and stand-alone applications)? Should a large number of analyses be available in one place or a range of separate applications? While the answer to these questions might seem obvious, the issue of cost and efficiency needs to be considered. Once developed, keen observation of user behaviour will point to refinements.