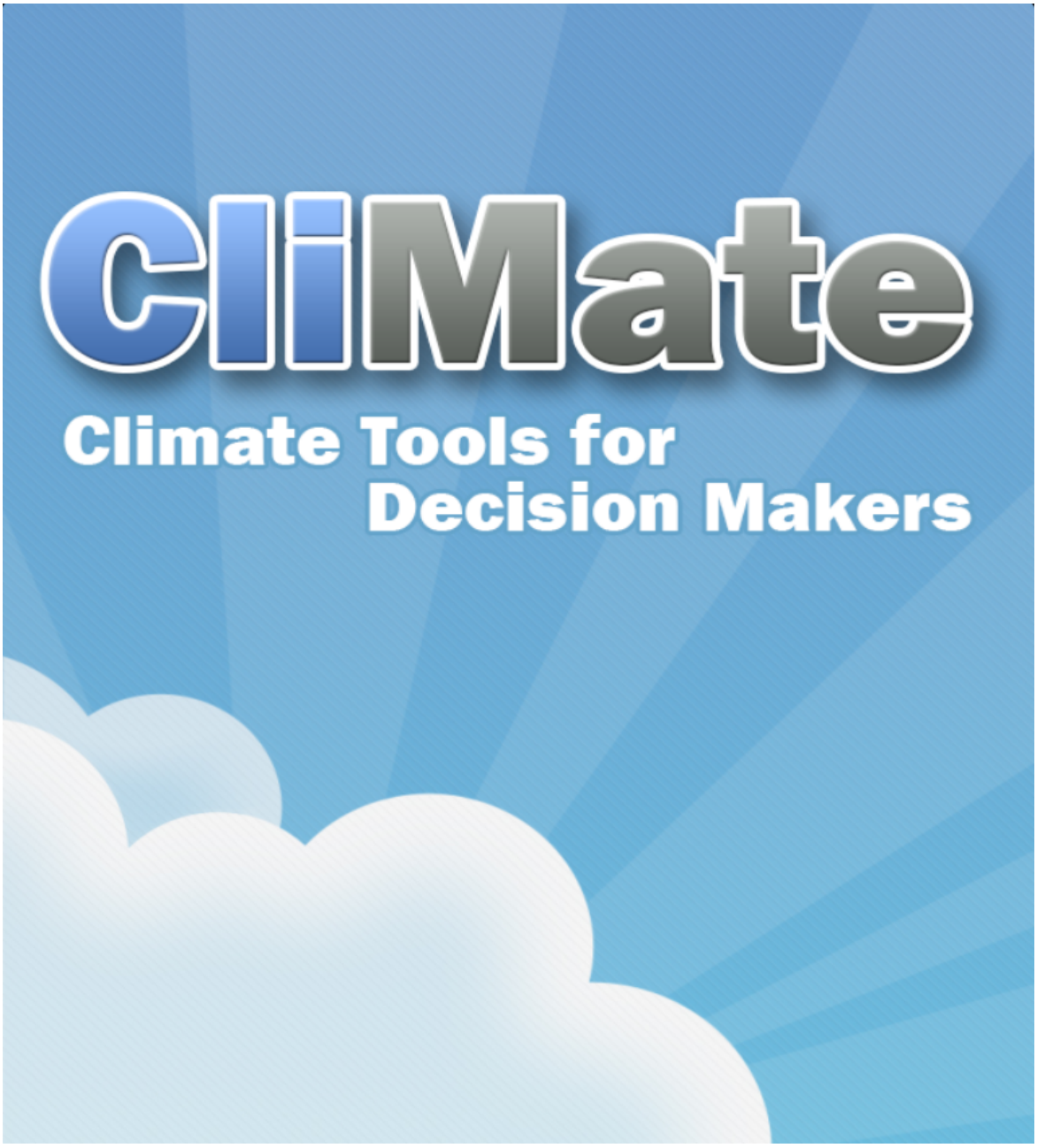
MANAGING CLIMATE VARIABILITY

R & D PROGRAM

Australian CliMate II factsheet



June 2017

CliMate –climate analyses for decision makers who rely on the weather

Australian Climate was first released in 2005 and redeveloped in 2017 for iOS (iPhone/iPad) Android devices and as a Web Ap. CliMate supports decision makers who require probabilities of weather events, seasonal forecasts, soil water and nitrate status drought status and climate trends. Nine analyses and one look up link are available.

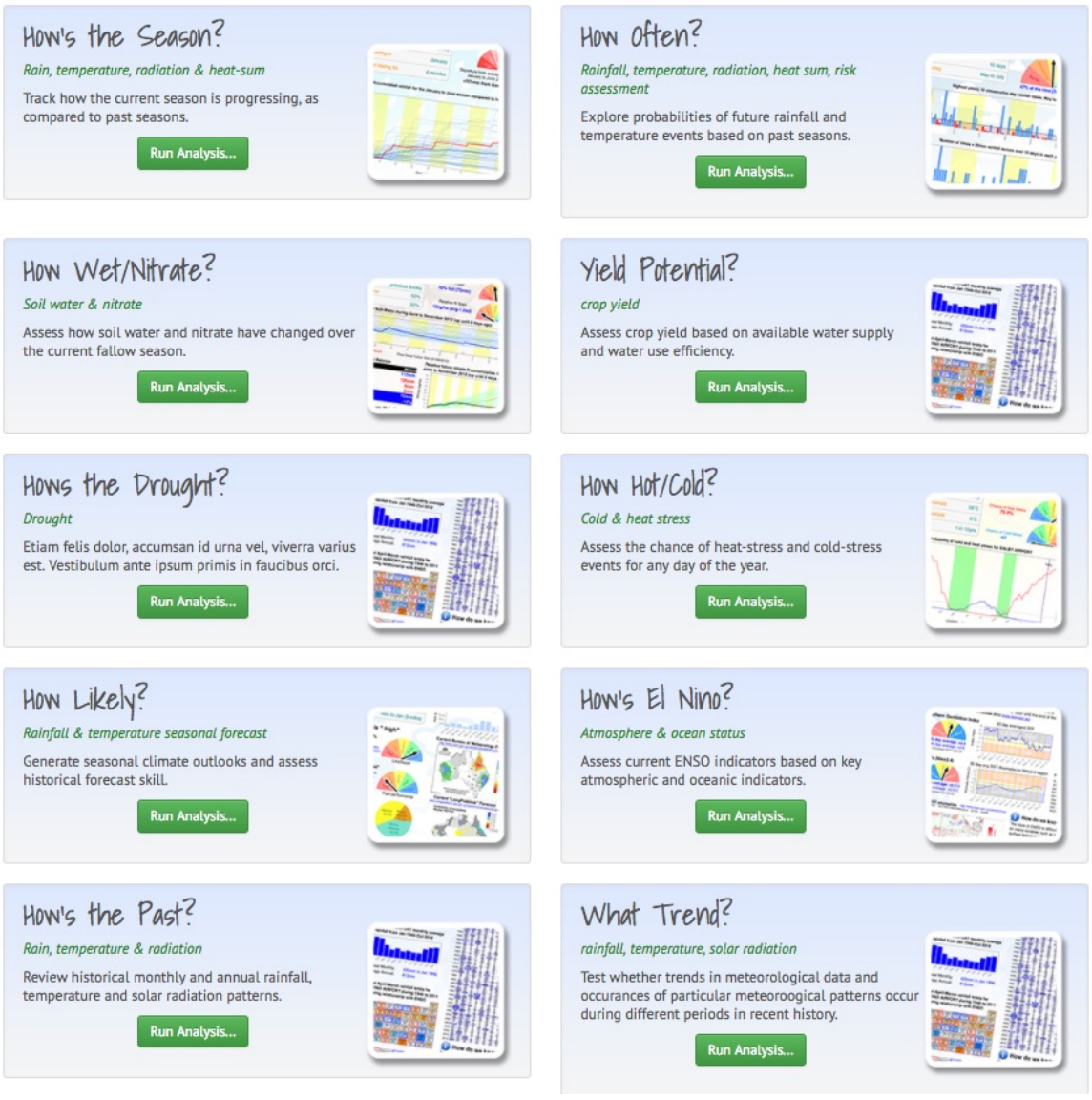
CliMate is available in the App store for iOS devices (search for 'Australian Climate'), any device with a web browser (www.climateapp.net.au) and Android (late 2017)

***CliMate** has been developed by the University of Southern Queensland for the Managing Climate Variability (MCV) program and builds on Bureau of Meteorology data from the Queensland Government's Silo database. **CliMate** builds on the many ideas developed by climate specialists.*

CliMate allows you to interrogate long-term and recent climate records, asking questions relating to rainfall, temperature, radiation, as well as derived variables such as heat sums, soil water and soil nitrate. CliMate also provides information on seasonal forecasts based on El Nino Southern Oscillation patterns.

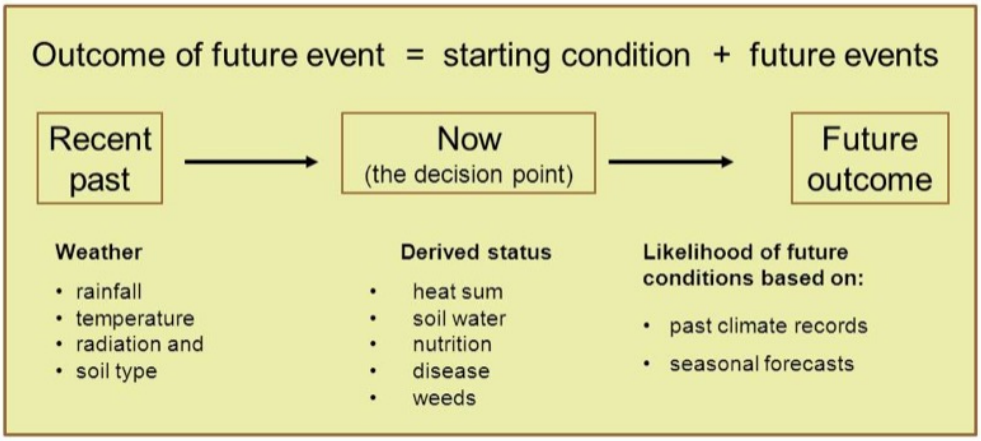
CliMate allows you to explore long term weather patterns and relationships. The aim is for you to derive a richer and objective assessment of probabilities of future events and current conditions.

Each analysis is caste as a question where you select the variable (e.g. temperature, rainfall, radiation) and period of interest. Analyses currently available are:



Who this tool is for?

Decision makers who use past weather statistics, forecasts and knowledge of system status (e.g. soil water, heat sum) to better manage their business. While we all have a good feel for probabilities, CliMate provides an objective measure of statistics based on long term records and uses the recent records to update information on system status. Forecasts add value to decision making when there is more confidence in the forecast – information on forecast reliability is also presented. A schema of agricultural systems driven by weather is shown below.



Schema of linkages between recent weather, future probabilities and future outcomes in applying weather data to agricultural decision making.

Three types of information can be derived from long term and recent weather data:

- 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);
- Probability of future events based on forecast systems such as ENSO and POAMA.
- Current status of the system (e.g. soil water, heat sum) based on real time data for the nearest climate station;

Questions this tool answers

CliMate has a number of analyses structured around the following questions.

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, temperature, heat sum or radiation?

How often? What is the chance 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?

Yield potential? Used a simple water use efficiency model to estimate yield potential for the season.

How hot-cold? When determining an ideal sowing date, when are heat and cold stresses lowest for the optimum flowering time?

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 that rainfall or temperature is greater than or less than key thresholds (e.g. terciles, median) and how reliable have these forecasts been in the past?

How's El Nino? What is the current ENSO status based on key atmospheric and oceanic indicators? What is the Australian Bureau of Meteorology's interpretation of this?

How's the Past? presents views of monthly and annual rainfall and temperature summaries to allow you to explore relationships and patterns.

Drought? describes development of drought conditions based on past rainfall distributions.

What trends? provides a visual assessment of past weather trends. It is designed to allow you to explore whether, in last 117 years, there are any visible trends in rainfall, temperature or incidences of extreme events.

What this tool does

Each analysis is structured as:

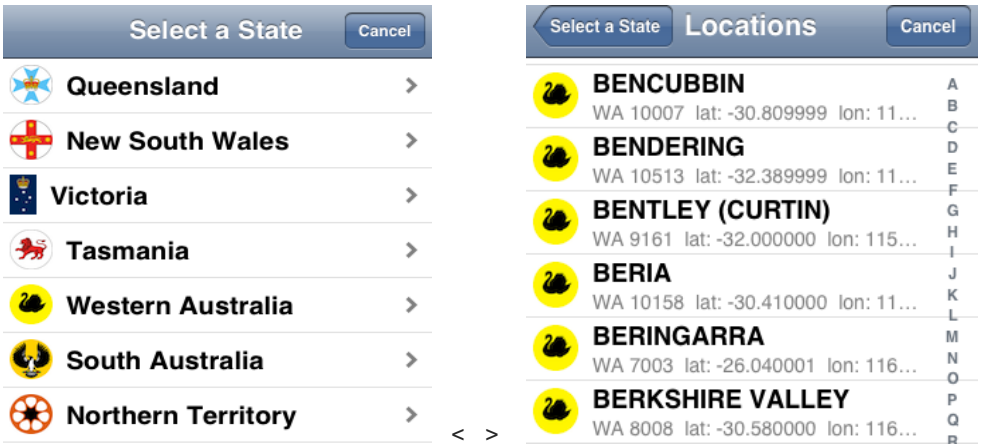
- A question relating to the climate variable of interest;
- A text answer and a "fire risk" chart;
- Charts showing more detail ;and
- A brief explanation of how the answer was derived.

For example:

Inputs

CliMate uses long-term Climate data (1900 to present) from SILO.
(http://www.longpaddock.qld.gov.au/SILO/)

Data for all regions of Australia are accessed when in 3G or Wi-Fi range and stored for later use. CliMate can be used in an area without wireless or 3G network coverage once the data has been downloaded. Most analyses will remain valid for some time between updates.



History

CliMate was designed to update a series of well used but unsupported decision support tools. Ideas and modes of presentation have been borrowed from these tools and made available on mobile and desktop devices. CliMate was initially developed by RPS Australia East Pty Ltd for the Managing Climate Variability Research and Development Program and is being further developed by the University of Southern Queensland.

Acknowledgements

This App has been developed as part of the Managing Climate Variability Research and Development Program with funding from a consortium including:

- Australian Government Department of Agriculture, Fisheries and Forestry
- Grains Research & Development Corporation
- Meat & Livestock Australia
- Rural Industries Research and Development Corporation
- Sugar Research and Development Corporation

Related products

Bureau of Meteorology (BOM), Australian Government. http://www.bom.gov.au/

CliMate Kelpie from the Managing CliMate Variability R & D Program, CliMate Change Research Strategy for Primary Industries http://www.CliMatekelpie.com.au/

Flower Power from Department of Agriculture and Food, Government of Western Australian. http://grains.agric.wa.gov.au/flower-power

Long Paddock from Queensland Government http://www.longpaddock.qld.gov.au/

Production Wise from GrainGrowers http://www.graingrowers.com.au/products/decision-support-tools/productionwise

SILO from Queensland Government http://www.longpaddock.qld.gov.au/SILO/

The Break from Department of Primary Industries, Victorian Government http://www.dpi.vic.gov.au/agriculture/about-agriculture/newsletters-and-updates/the-break-newsletters

Victoria Resources Online – CliMate, Department of Primary Industries, Victorian Government http://vro.dpi.vic.gov.au/dpi/vro/vrosite.nsf/pages/CliMate-home

WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

Yield Prophet from Birchip Cropping Group http://www.yieldprophet.com.au

Seasonal crop outlook by Agriculture, Fisheries and Forestry, Queensland Government. http://www.daff.qld.gov.au/26_6256.htm

ClimateARM Queensland Department of Agriculture, Fisheries and Forestry, a redesign of Australian Rainman http://armonline.com.au/ClimateArm/

A more detailed description of each analysis follows

Season's progress?

Season's progress? uses long term (1900 to present) weather records to assess progress of the current season (rainfall, temperature, heat sums and radiation) compared to the average and all years.

Who this tool is for?

Enterprises that continually assess seasons' progress compared to the average and adjust inputs accordingly. Crop progress and expectations are influenced by rainfall, temperature and radiation since

planting. Season's progress? provides an objective assessment based on long term records and recent conditions.

Questions this tool answers

- How is the crop developing compared to previous seasons, based on heat sum?
- Is there any reason why my crop is not doing as well as usual because of below average rainfall or radiation?
- Based on seasons progress and starting conditions - should I adjust inputs?

What this tool does

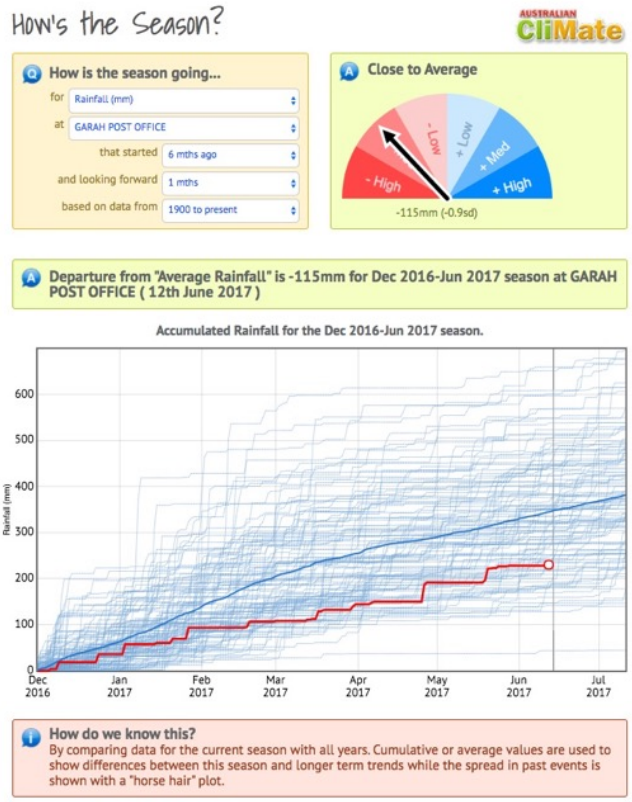
Season's progress? efficiently explores the readily available weather data and compares the current season with the long term average and graphically presents the spread of experience from previous seasons.

Inputs

- Season's progress? asks for the weather variable to be explored (rainfall, average daily temperature, radiation, heat sum with base temperatures of 0, 5, 10, 15 and 20 ^{o}C), a start month and duration.

Outputs

Text and two graphical presentations are used to show the current season in the context of the average and all years. Departures from the average are shown in a fire risk chart as the departure from the average in units of standard deviation.



Related products

The Break from Department of Primary Industries, Victorian Government http://www.dpi.vic.gov.au/agriculture/about-agriculture/newsletters-and-updates/the-break-newsletters

WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

Yield Prophet from Birchip Cropping Group http://www.yieldprophet.com.au

How Often?

How Often? allows you to explore probabilities of future rainfall and temperature events based on past seasons. How Often? is available as a stand-alone iOS App, Android and www App.

Who this tool is for?

Decision makers who use probabilities of past rainfall and temperature conditions to manage business risk.

Questions this tool answers

- How Often? tests for a rainfall or temperature condition (greater than or less than), a threshold value in a set number of consecutive days for a specified period of month(s).

What this tool does?

How Often? interrogates long term weather records to estimate probabilities of specified weather events.

Typical questions include:

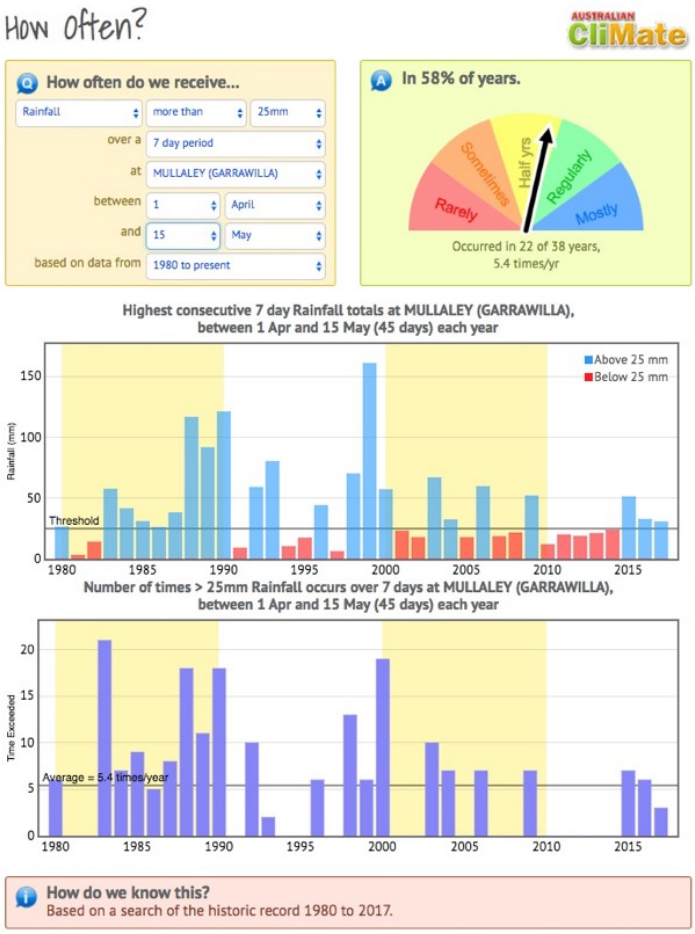
- What are the chances of a planting opportunity in my preferred planting window?
- How often will I get enough rain to fill my soil?
- What are the chances of wet weather during harvest?
- Howoften do I get a frost or heat wave?

Inputs

How Often? uses long-term rainfall data from SILO, (1900 to present), a specified variable (rainfall, temperature), a threshold value and a sample period.

Outputs

How Often? presents results as a text answer, as a fire-risk chart and histograms showing time series of events and number of events recorded each year.



Related products

WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

HowWet? N?

HowWet? N? uses records from a nearby weather station to estimate how much plant available water (PAW) has accumulated in the soil and the amount of organic nitrogen that has been converted to an available nitrate during a fallow. Howwet? N? tracks soil moisture, evaporation, runoff and drainage on a daily time step. Accumulation of available nitrogen in the soil is calculated based on surface soil moisture, temperature and soil organic carbon. A set of generic soil types from a database within the iOS App are available.

Who this tool is for?

Grain growers in regions where stored soil water and nitrate at planting are important in crop management decisions. This is of particular importance to northern Australian grain growers with clay soils where stored soil water at planting can constitute a large part of a crop's water supply.

Questions this tool answers

- How much longer should I fallow? If the soil is near full, maybe the fallow can be shortened.
- Given my soil type and local rainfall to date, what is the relative soil moisture and nitrate N accumulation over the fallow period compared to most years? Relative changes are more reliable than absolute values.
- Based on estimates of soil water and nitrate-N accumulation over the fallow, what adjustments are needed to the nitrogen supply?

What this tool does?

Looking back over the recent fallow period, HowWet? N? estimates:

- how much rain has been stored as plant-available soil water;
- how much nitrogen has been mineralised as nitrate-N in soil; and
- Provides a comparison between the current fallow and previous seasons.

This information aids in the decision of what crop to plant and how much nitrogen fertiliser to apply.

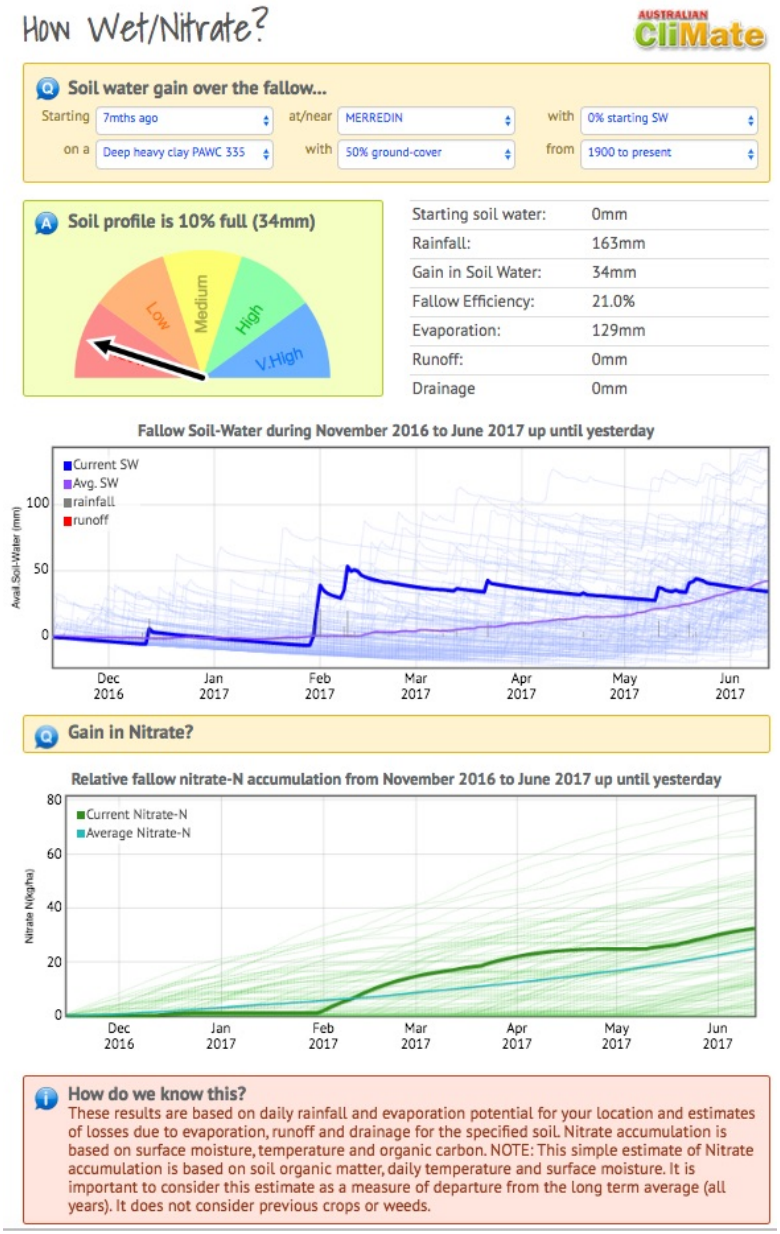
Howwet? N? estimates soil water gains in mm and nitrate in kg/ha. It is important to note that estimates are best related to previous seasons as a relative measure and care should be taken in using outputs in absolute terms.

Inputs

- A selected soil type (may be updated from time to time)

- Starting point of the fallow (months before now)
- An estimate of soil cover (%) and starting soil moisture (% profile fill)

Outputs



Related products

SoilWaterApp http://www.soilwaterapp.net.au/

Plant available soil moisture maps from Department of Agricultures and Food, http://www.agric.wa.gov.au

WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

Potential Yield?

Potential Yield? (PY?) is a re-enactment of the Potential Yield calculator (PYCAL) first developed by S and D Tennant, Western Australian Department of Agriculture in 1993 and 2000. Crop yield is directly related to the amount of water stored in the soil at planting and in-crop rainfall This simple estimate of crop yield is based on the Water Use Efficiency (WUE) model of French and Shultz (1984).

Who this tool is for?

Growers and consultants use this analysis for two applications: looking forward to estimate crop yield potential based on soil water and rainfall to date; and looking back at a previous crop to estimate the Water Use Efficiency (WUE) of a crop. When yield potential is well above average, inputs such as fertilizer may be increased, or reduced when a negative expectation is indicated.

Questions this tool answers

It allows decision-makers to answer questions such as:

- Crop management inputs, largely at planting or early in the growing season

For example, is my yield potential early in the crop above average? If so, I might consider increasing fertiliser inputs. Or, given above average rainfall and soil water, I might increase area planted or plant more high value (and high input) crops.

Both the potential yield and water use efficiency estimates made at the end of the growing season also provide benchmark values against which the success of the cropping enterprise can be assessed. If yields or water use efficiencies obtained do not approach respective benchmark values, then attention can be focused on what management changes might be needed to achieve better results.

What this tool does

Crop yield is related to the amount of water stored in the soil at planting and in-crop rainfall. This simple estimate of crop yield potential is based on the Water Use Efficiency (WUE) model of French and Shultz (1984).

Potential Yield? provides an estimate of crop yield for the current season based on up-to-date rainfall data and historic data looking forward. Crop yield is progressively calculated as the season develops, providing you with a picture of relative performance of the current season.

Stored soil water at planting or the start of the growing season is entered directly. This may be estimated from previous rainfall (given a percentage stored), push probe observations, soil cores or soil eater sensors. Current rainfall is charted against previous rainfall distributions. A forecast of yield potential is provided as the growing season progresses using the most recent rainfall observations from the Bureau of Meteorology network of rainfall stations.

Inputs

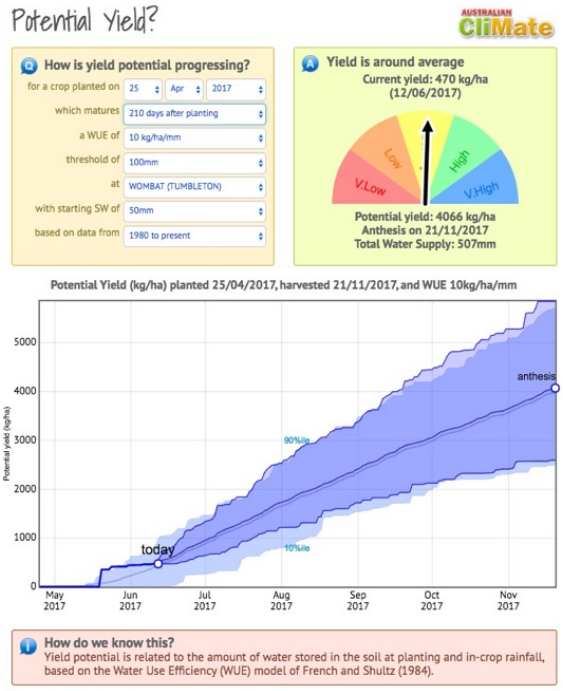
Potential Yield? asks the user for:

- A planting date and duration to maturity of a crop;
- A Water Use Efficiency (WUE) value (kg/ha/mm);
- A Threshold value (mm) representing water lost to evaporation or water that is not used by the plant;
- A location and soil type;
- Starting soil water (mm); and
- The duration of historic data (decadal to present) used to describe past outcomes and forward estimates.

Outputs

Potential Yield? provides output as answers in text and graphically as:

- A fire chart ranking the current yield estimate against historic yields as estimated with the WUE model
- Expected yield (kg/ha) and water supply for the current season
- A chart of historic and current seasons expected yields with a projection to the end of the current crop.



Related products

Potential Yield? is a re-enactment of the Potential Yield calculator (PYCAL), first developed in 1993 by Drs Shaun and David Tennant affiliated with the Western Australian Department of Agriculture. This program was originally written in GW Basic (MSDOS based) and was distributed on floppy discs. PYCAL was developed to estimate stored soil water at the start of the growing season or at planting and to forecast potential yield as the season progresses. PYCAL was rewritten for Windows in ~2000.

References

French RJ, Schultz JE. (1984) Water use efficiency of wheat in a Mediterranean-type environment. I. The relation between yield, water use and climate. Australian Journal of Agricultural Research 35(6) 743 – 764

Potential Yield Tool https://www.agric.wa.gov.au/climate-weather/potential-yield-tool

Tennant, D and S. Tennant. (2000) Potential Yield Calculator, software package. Department of Agriculture and Food, South Perth, WA.

Drought?

Drought? provides a monthly update of drought status using the Percentile Decile method for a user-defined "residence time". Previous droughts are categorised by intensity and/or duration and can be compared to ENSO conditions.

An appropriate residence time is dependent on the issue of concern. For example, an intensive pasture in a humid climate might have a residence time of 6 months before a rainfall deficiency seriously impacts on productivity, as "expected" rainfall is reliable. An extensive grazing system which routinely relies on a reserve of standing forage might have a residence time of 1-3 years while a water reservoir may have a residence time of 2-5 years, depending on catchment size and water demands.

An index value less than 40 percentile is considering a drought warning while a value below 10 percentile is considered drought for the Residence Time period under consideration.

How do we know this?

Drought in general means acute water shortage (http://www.bom.gov.au/climate/glossary/drought.shtml). BoM drought maps highlight areas considered to be suffering from a serious or severe rainfall deficiency. These classes are assigned by first examining rainfall periods of three months or more for selected places throughout Australia

to see whether they lie below the 10th percentile (lowest 10% of records). The terms serious and severe are defined by -

- **Serious** rainfall deficiency: rainfall lies above the lowest five per cent of recorded rainfall but below the lowest ten per cent (decile range 1) for the period in question,
- **Severe** rainfall deficiency: rainfall is among the lowest five per cent for the period in question.

Drought declaration is the responsibility of State and Federal Governments which must consider other factors apart from rainfall, however the Bureau of Meteorology's Drought Statement assists by providing rainfall information to all interested parties.

Droughts are often defined in a number of ways:

- Meteorological drought is brought about when there is a prolonged time with less than average precipitation.
- Agricultural drought affects crop and pasture production. Such droughts can arise independently from any change in rainfall levels when triggered by poor planning or management but are generally related to a meteorological drought.
- Hydrological drought occurs when the water reserves in sources such as aquifers, lakes and reservoirs fall below the statistical average. Hydrological drought tends to show up more slowly because it involves stored water that is used but not replenished.

Source: Wikipedia https://en.wikipedia.org/wiki/Drought_in_Australia

The severity of a drought/wet is defined by the Bureau of Meteorology as:

- Lowest on record - lowest since at least 1900 when data available.
- Severe deficiency - rainfalls in the lowest 5% of historical totals.
- Serious deficiency - rainfalls in the lowest 10% of historical totals, but not in the lowest 5%.
- Very much below average - rainfalls in the lowest 10% of historical totals.
- Below average - rainfalls in the lowest 30% of historical totals, but not in the lowest 10%.
- Average - rainfalls in the middle 40% of historical totals.
- Above average - rainfalls in the highest 30% of historical totals, but not in the highest 10%.
- Very much above average - rainfalls in the highest 10% of historical totals.

Source: http://poama.bom.gov.au/climate/drought/drought-definitions.html).

How is the end of a drought determined (BoM)?

Defining the end of a period of rainfall deficiency is a difficult matter, and presents more problems than defining the start. However, the following definitions provide guidance as to whether there has been significant relief from a period of rainfall deficit. They are only applicable to periods of about 12 months or less, and great care in their interpretation is needed in those areas which have a distinct wet and dry season in the annual rainfall cycle. The criteria are:

- The rainfall of the past month already exceeds the 30th percentile for the three-month period commencing that month, or
- Rainfall for the past three months is above the 70th percentile for that period

Who this tool is for?

Landowners, managers and policy makers who are seeking an indication of drought status (alerts, degree of drought).

Questions this tool answers

What is the drought status based on rainfall from one of the BoM's 4,600 rainfall recording stations?

What this tool does

The drought analysis in CliMate uses the Decile Method described in White et al. (1999). "Rainfall deciles rank the rainfall over the period of interest in terms of the relative quantity of rain that fell in that period compared with the total distribution of all recorded rainfalls over the same period. The total quantity of rain, TPn for an nth month accumulation period is:

$$TP_n = P_0 + \sum_{i=1}^{n-1} P_{-i}$$

Here P_0 is the rainfall for the current month, P_{-i} is the rainfall for the previous i^{th} month (-1 is the previous month and so on). The ranking of rainfall against the total record is expressed as a percentile of the total distribution. Thus rainfalls in the lowest 10^{th} percentile, or lowest decile, are in the lowest 10% of all recorded rainfalls. Because this ranking is relative to the total distribution of rainfall over the time period of interest at a location, it is relative to the climatologically appropriate moisture supply at that location, as required by the definition of meteorological drought.

Rainfall deciles are a non-parametric measure of drought since, unlike the standardised precipitation index, they are calculated without any assumptions about how rainfall is distributed in time. Moreover, they directly provide a normalised measure of dry and also wet conditions that can be compared between different sites and times. Deciles of 6-monthly rainfalls are closely connected to the Palmer Index and are as efficient in identifying periods of declared agricultural drought. In addition, rainfall deciles have a much higher spatial coherence than actual monthly rainfall totals. This is because deciles are essentially normalised departures from average conditions and are related to broad-scale synoptic patterns (Smith et al. 1992). The decile method is used in the Australian Drought Watch System and forms the basis for declaring drought and providing drought relief (White and O'Meagher, 1995)." White et al. 1999.

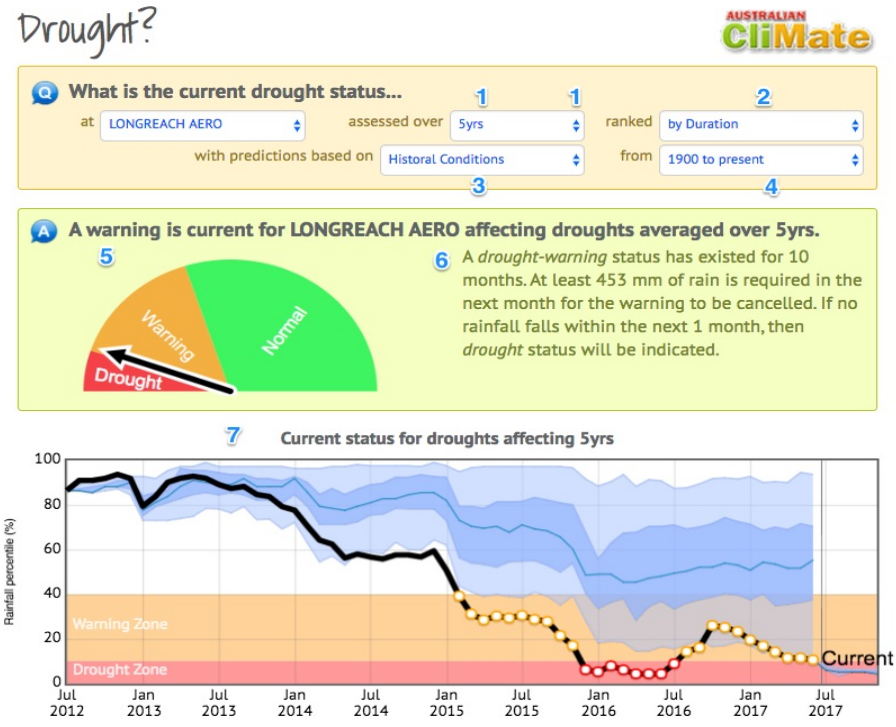
There are many variations in definitions of drought and approaches to calculating drought indices. The Decile Method is used in CliMate as has common application in Australia, is relatively straight forward to estimate and provides very identical answers to the Standardised Precipitation Index and the Rainfall Depreciation Method gave identical results to the Decile Method. The greater simplicity of the decile method and the ease of understanding of rainfall rankings makes it well suited as a general drought indicator. Case studies have shown that seasonality has insignificant impact on rainfall rankings for rainfall periods >12 months. For periods of < 12 months, seasonality does have some impact does not affect the identification of drought periods (White et al 1999).

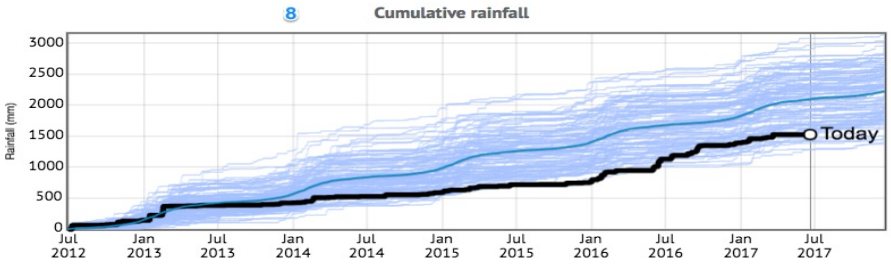
Inputs and outputs

1. The residence time of period over which rainfall percentiles are calculated.
2. Droughts can be ranked according to duration, depth or intensity or both duration and depth. This selection impacts on the order of tabulated droughts shown in (9).
3. Provides options for the using data from: all years, La Nina, El Nino, or neutral years.
4. Allows for selection of different time periods

Outputs are shown as:

5. A fire chart showing drought status
6. A statement summarising drought status and duration and providing estimates of rainfall required to change status
7. Shows a time series of rainfall percentiles for the given residence period
8. A plot of cumulative rainfall for the given residence period, and
9. Tabulated droughts ranked in order of duration, depth or intensity or both.





9 **Historical Droughts affecting 5yrs from 1900 to 2017 sorted by Intensity**
Legend: El Ninos and La Ninas

Rank	Drought Period	Drought Length	Drought Depth	Drought Integral	Warning Start	Warning Length	Warning ENSO State	Drought ENSO State	Actual Revovery Rainfall
1	Aug 1968 to Nov 1971	40mths	0%ile	242%mth	Aug 1968	0mth	La Nina	La Nina	886mm
2	Feb 1929 to Apr 1932	39mths	0%ile	267%mth	Jan 1927	25mths	Neutral	La Nina	1086mm
3	Dec 1904 to Jan 1906	14mths	0.9%ile	102%mth	Dec 1904	0mth	Neutral	Neutral	275mm

Related products

Bureau of Meteorology rainfall deficiency maps - http://www.bom.gov.au/jsp/awap/rain/index.jsp?colour=colour&time=latest&step=0&map=drought&period=daily&area=nat

References

Smith DI, Hutchinson MF, McArthur RJ (1992) 'Climatic and agricultural drought: Payments and Policy.' RES 7. Centre for Resource and Environmental Studies, ANU, Canberra, 103 pp.

White DM, G'Meagher, B. (1995) 'Coping with exceptional droughts in Australia. 'Drought Network News, Vo1 7, p. 13-17.

White, I., Falkland, T. and Scott, D. (1999) "Droughts in Small Coral Islands", UNESCO-IHP Humid Tropics Programme, Public Works Department, Republic of Kiribati. Water Research Foundation of Australia Centre for Resource and Environmental Studies, Australian National University, Canberra

How Hot – Cold?

How Hot –Cold? uses long term temperature records (1900 to present) to assess risks of a heat and cold stress values occurring throughout the year, and for a specified date (based on analysis from CropMate).

Who this tool is for?

Any enterprise that assesses the balance between heat and cold stress for any time of the year. Crop flowering is the most common issue that challenges farmers; timing flowering to avoid frost risk at the end of a winter season and avoiding a fast approaching heat stress period.

Questions this tool answers

- When is the best time for a crop to be flowering, based on avoiding both heat and cold or frost stress?
- When will the minimum temperature exceed a threshold for successful crop establishment?

What this tool does

- Estimates the risk of daily maximum temperature exceeding a specified heat stress value and the daily minimum temperature being less than a specified cold stress value.
- Shows the period of the year when both heat and cold stress are less than a specified probability of occurrence.

This information aids in decisions that have to deal with reducing risks associated with heat and cold stress.

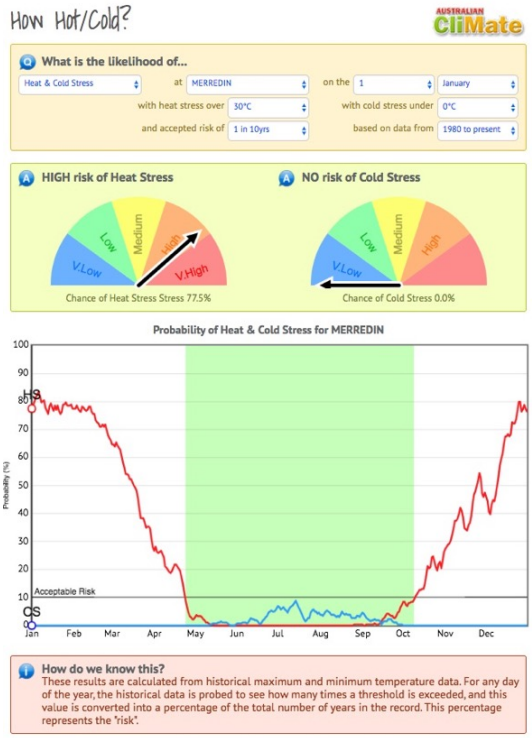
Inputs

- A selected weather station.
- A specified date for assessment
- A heat and cold stress temperature
- An acceptable risk probability

Outputs

Text and graphical presentations are provided:

- or the specified date as a fire-risk chart, and
- line graph showing the probability of heat and cold stress for each day of the year.



Related products

Bureau of Meteorology (BOM), Australian Government. http://www.bom.gov.au/

Flower Power from Department of Agriculture and Food, Government of Western Australian. http://grains.agric.wa.gov.au/flower-power

WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

How likely?

How Likely? is used to generate probabilistic seasonal rainfall and temperature outlooks for 3 to 6 month periods at user-defined locations, accompanied by an assessment of past forecast skill. A statistical methodology is used to calculate the forecast probabilities based on the understanding that there is a correlation between Australian climate and selected sea surface temperature data that replicates patterns of the El Niño Southern Oscillation and the Indian Ocean Dipole, and using data back to 1949.

Who this tool is for?

How Likely? is designed for you to explore seasonal (3 to 6 month) rainfall or temperature forecasts and the historical skill of these forecasts for different periods of the year.

Questions this tool answers

- What is the rainfall outlook for the next four months?
- What is the probability of temperatures being greater than the median in the next 6 months?
- What periods of the year are these forecasts most reliable?

What this tool does

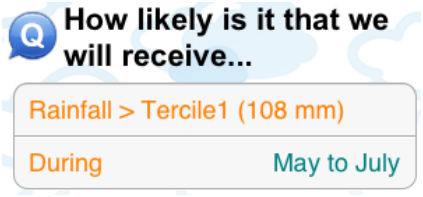
Provides rainfall and temperature forecast probabilities for the next 3-6 months based on a “discriminant-analysis” (statistical methodology) of local climate and ocean temperature patterns. An estimate of forecast reliability (skill) is also provided.

Inputs

The user selects:

- a variable (rainfall or monthly average temperature);
- a conditional operator (greater than or less than);
- a target statistic (median or tercile threshold); and
- a duration of 3 to 6 months.

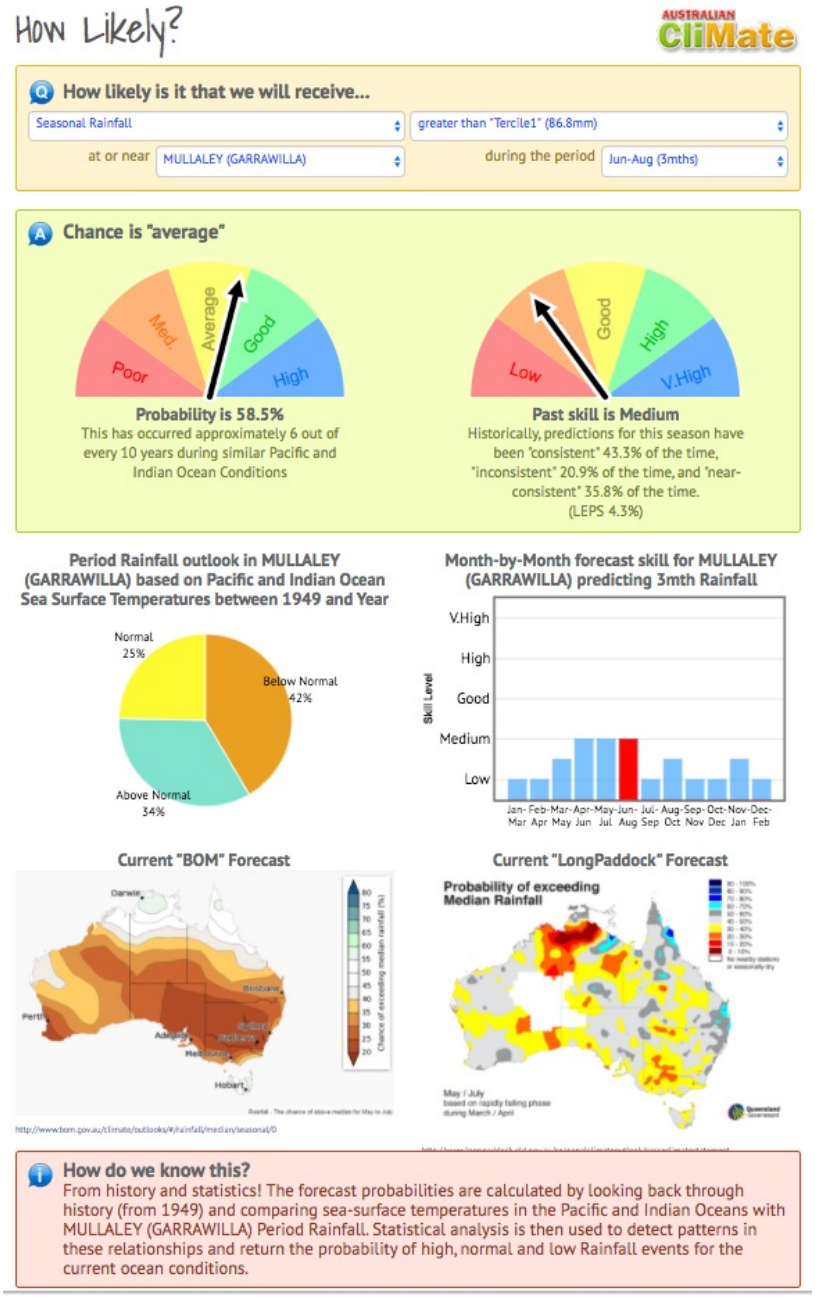
How Likely? uses long term climate/weather data from SILO, and ocean temperature anomaly data from the Australian Bureau of Meteorology.



Outputs

The results are presented in a range of graphical and textural formats focusing on the probability of an event occurring, and how reliable these predictions have been in the past. Forecasts are presented graphically

using a “fire-gauge” chart to show the likelihood of a specific event occurring, while “chocolate-wheels” or pie charts (terciles or median pie-charts) show a range of forecast probabilities for different rainfall categories.



Reliability

In addition to generating a forecast, How Likely? provides an assessment of historical forecast “skill” for the current forecast period, as well as at other times of the year. Users can then assess how reliable these forecasts have been in the past, as well as identifying periods of the year where there is more skill. Given the statistical nature of the forecasts, it is possible that How Likely? can show an optimistic forecast

associated with low or poor skill. Such a forecast should be viewed with caution as it has not been reliable in the past.

Related products

The Break from Department of Primary Industries, Victorian Government
http://www.dpi.vic.gov.au/agriculture/about-agriculture/newsletters-and-updates/the-break-newsletters

WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

How's El Nino?

How's El Nino? provides up-to-date information on the status of the El Niño Southern Oscillation (ENSO). It presents the current values of an Atmospheric Index (Southern Oscillation Index) and an Ocean Index (Oceanic Niño Index - Niño 4.3 SST's), as well as a time-series of these values over the previous 24 months. It also presents a summary statement direct from the Bureau of Meteorology's "Model Outlooks of ENSO Conditions and ENSO Wrap-up" (http://www.bom.gov.au/climate/enso/) and a map of sea-surface temperature anomalies for the Pacific and Indian Oceans.

Who this tool is for?

How's El Nino? is for users who understand the importance of the current status and development of ENSO cycles on local weather and climate. Monitoring these cycles can provide an indication of likely rainfall and temperature trends over the coming year. How's El Nino? can be used to monitor current mature ENSO patterns to observe if the pattern is currently breaking down, or if it is strong enough to continue on into a second cycle indicating that current climate patterns may continue for some time.

Questions this tool answers

- Provides an indication of what is the current ENSO pattern (El Niño, La Niña or Neutral conditions), how long it may last, or if a new pattern is developing.
- What are atmospheric (SOI) and ocean (sea surface temperature) indicators saying about weather in the coming months?
- What is the Australian Bureau of Meteorology's opinion on the current Status of ENSO.

What this tool does

How Likely? provides indicators of the current state of the ENSO cycle, along with BoMs current ENSO headlines, and seas surface temperature anomaly map.

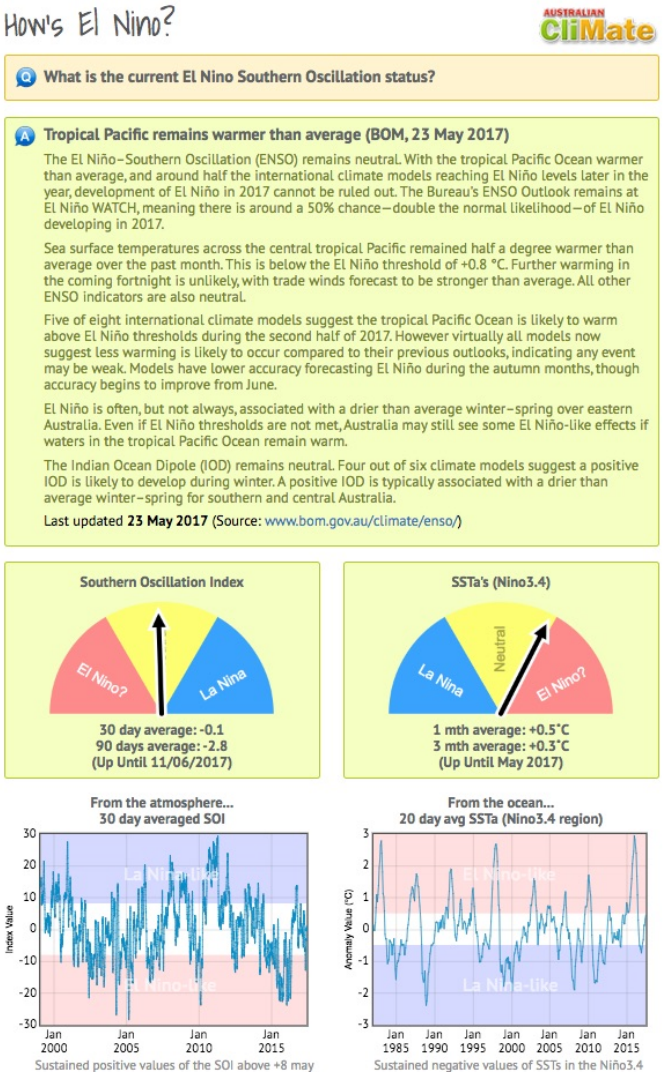
Inputs

How's El Nino? does not require any user-defined inputs. It automatically sources the following data from external sites:

- Current ENSO summary statement from the Bureau of Meteorology (www.bom.gov.au);
- Daily SOI data form Queensland Government (www.longpaddock.com.au)
- Monthly Nino3.4 SST anomaly data from NOAA (www.cpc.ncep.noaa.gov\data\sstoi.indices)
- Sea Surface Temperature map is sourced from (http://www.bom.gov.au/climate/enso/)

Outputs

Data retrieved is presented as text and graphically. A statement is provided from the Australian Bureau of Meteorology, while atmospheric and oceanic indicators are presented as Fire-gauge charts and line-plots. A map



Related products

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WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

How's the Past?

How's the Past? uses long term (1900 to present) rainfall and temperature data and presents sequences of monthly and annual values to allow you to explore relationships and patterns.

Who this tool is for?

How's the Past? is for people why wish to look through historic records to explore patterns of rainfall throughout the year and across years. It allows you to look at the big picture and to see if there are relationships between El Nino and La Nina conditions and weather.

Questions this tool answers

How's the Past? does not answer any specific question but rather provides a means to visually explore past weather variable (rainfall, minimum and maximum temperature and radiation) sequences and extremes. The aim is to provide you with an efficient way to build up a picture of seasonal and annual variability, and also to explore the strength and usefulness of ENSO in explaining past weather.

What this tool does

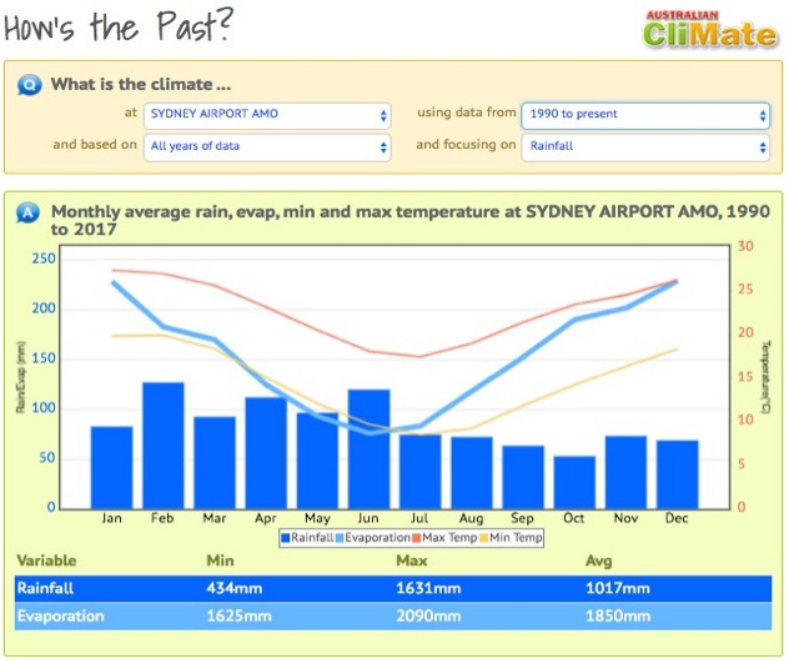
How's the Past? allows you to efficiently examine past weather and ENSO relationships.

Inputs

- Select rainfall, minimum and maximum temperature or radiation.

Outputs

- How's the Past? presents graphs of average monthly values, annual values and ENSO status, and a monthly "mud map" of values.



Related products

WATL - Water and Land for Agriculture and Natural Resource Management from the Bureau of Meteorology, Australian Government http://www.bom.gov.au/watl/index.shtml

What Trend?

What Trend? plots past weather records to observe trends in selected variables. A simple line of best fit (least sum of squares) is provided along with an estimate of whether the slope of the line is significantly different from zero (i.e. no trend).

How do we know this?

By plotting past weather records, What Trend? Allows you to visually explore trends in selected weather variables. A line of best fit (least sum of squares) is shown, along with an estimate of whether the slope of the line is statistically different from zero (i.e. no trend).

A graph of annual differences from the mean and cumulative differences (residual mass curves) provide another view of departures from the mean over the duration of available (or selected) data.

Note: This is a simple, visual analysis. The data length is relatively short, and most weather parameters are typically highly variable, making trend analysis difficult.

Who this tool is for?

What Trend? Is designed to allow the curious person to explore time trends in selected weather variables. While a line of best fit and slope is added to time series plots, no inferences are implied. Interpretation is up to the user.

Note: This is a simple, visual analysis. The data length is relatively short, and most weather parameters are typically highly variable, making trend analysis difficult.

Questions this tool answers

What Trend? allows you to explore a number of questions such as:

- Is the weather changing?
- Am I getting more or less rain compared to the long term?
- Is there a trend in rainfall or temperature?
- Are extreme events more or less frequent over the period 1900 to present?

What this tool does

What Trend? plots past weather records to observe trends in selected variables. A simple line of best fit (least sum of squares) is provided along with an estimate of whether the slope of the line is significantly different from zero (i.e. no trend). A graph of annual differences from the mean and cumulative differences (residual mass curves) provide another view of departures from the mean over the duration of available (or selected) data. Decadal periods can be selected from 1900 – 1990 to explore data in more detail

Inputs

What Trend? asks the user for a variable of interest

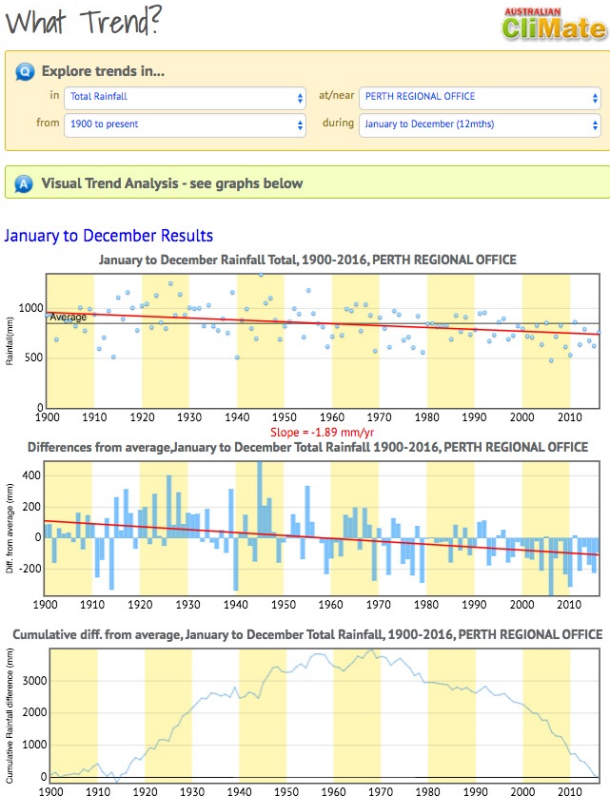
- Annual rainfall (mm), average maximum temperature; Annual average minimum temperature (0C); Annual solar radiation
- Incidences of: rainfall, maximum temperature, minimum temperature and solar radiation

When Incidences is selected, choose "greater than" or "less than", value of parameter and duration of "incidence"

- Years explored.

Outputs

What Trend? plots time series of selected variables: rainfall, temperature, radiation and incidences of specified occurrences. A simple line of best fit (least sum of squares) is provided along with an estimate of whether the slope of the line is significantly different from zero (i.e. no trend).



A graph of annual differences from the mean and cumulative differences (residual mass curves) provide another view of departures from the mean over the duration of available (or selected) data.

History

What Trend? Is a new analysis for Australian CliMate and is provided to allow users to explore whether there are observable trends in a specified variable. At this stage no statistical analyses are presented.

Related products

BoM http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries