



Mapping Climate: an Environment for Change.

Conference of the Australian and New Zealand Map Society,

State Library of South Australia, April 7-9 2010

Abstracts of Papers

Dr Rob Allan, ACRE Project Manager, Climate Monitoring and Attribution Group, Met Office Hadley Centre, U.K.

The International ACRE Initiative: Visualisations of historical weather reconstructions.

The International Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative (<http://www.met-acre.org/>) is run by a consortium of three primary partners, the Queensland Climate Change Centre of Excellence (QCCCE) in Australia; the Met Office Hadley Centre in the UK; and the US National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) and the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado.

With endorsement from organizations such as the World Meteorological Organisation (WMO), the Group on Earth Observations (GEO), the Global Climate Observing System (GCOS), wide international support and the aid of various working groups of GCOS and World Climate Research Program (WCRP), ACRE provides an umbrella that links together some 30+ projects, institutions, organisations, data rescue and climate applications activities around the globe.

ACRE is the only international initiative of its type, and consists of four interwoven elements which aim to:

- Undertake and facilitate the recovery of millions of historical instrumental surface terrestrial and marine global weather observations
- underpin a series of successive dynamical 4D global weather reanalyses or reconstructions with weather variables generated on a global grid every 6 hours at currently 2 latitude x 2 longitude resolution (with 56 realisations at each 6-hourly time step) by a numerical weather forecast model (used in hindcast mode) assimilating only surface synoptic pressure, monthly SST and sea-ice observations over the last 200+ years

20th Century Reanalysis Project: 1891-2006 [Just Released]

20th Century Reanalysis Project: 1871-2008 [Autumn 2010]

Surface Input Reanalysis for Climate Applications (SIRCA): 1850-2011 [Autumn 2012]

*Chemical and Surface Input Reanalysis for Climate Applications (CSIRCA): 1800-2016
[Autumn 2017]*

- for climate research; climate applications, extremes, risks and impacts needs worldwide; educators and students and the general public
- via a web-based interface that will store, allow free access to, and enable free visualisations of, the raw data, data images, meta data through to all of the variables generated by the 4D global weather reanalyses/reconstructions

After briefly providing an overview of the international ACRE initiative, this presentation will focus on a range of visualisation tools, encompassing a mixture of maps and spatial plots through to web-based Google Earth and Google Maps software that show the raw historical weather observations accumulated by ACRE's activities and the historical 4D global weather reanalyses/reconstructions generated from such data. Brief mention will be made of ACRE's engagements with the international student GLOBE Program, Galaxy Zoo and Climate Explorer, which in combination are providing the framework that will make the results of ACRE more readily and easily accessible to the wider global community.

What Can We Learn from Goyder's Line of Reliable Rainfall in a Changing Climate?

Peter Hayman¹, Uday Nidumolu^{1,2} and Mark Howden²

1. SARDI Climate Applications. 2. CSIRO Sustainable Ecosystems

In 1865 George Goyder, Surveyor-General of South Australia, drew a line of reliable rainfall to separate cropping and extensive grazing land. Although sometimes misunderstood as a line beyond which wheat could not or should not be grown, it is better understood as indicating the increased risk of wheat growth beyond the line.

Goyder's line has become an icon of sound resource planning in drought prone climates and a cautionary tale against overconfidence that arises from a run of above-average rainfall years. There has always been a fascination with the margin between the arable and the desert; the 'safe inner' and the 'dangerous outer'. That the location of this margin may shift with climate change resonates with people's perceptions of risk and the danger of climate change.

This study builds on earlier work that used long term climate data to model wheat production in a transect running from south of Orroroo which is on Goyder's Line to the more arid regions north of Goyder's Line. It stands to reason that a warming drying trend will lead to the risk and return of wheat production that was associated with practices and land values at Orroroo will shift south.

It is a general ecological principal that ecosystems move poleward and uphill in warming episodes. This is complicated by smart, adaptive human beings especially when they have a sense of place and a suite of technology from farming methods and new varieties. The shift will be the result of an arm wrestle between climate change and technology improvement.

This presentation will report on

1. How we have used spatial climate data and crop simulation models to study the consistency of Goyder's Line as it extends west across the top of the Yorke and Eyre Peninsulas and East across the Murray Mallee
2. A survey of over 300 farmers, students and policy decision makers on where they see Goyder's Line in 2030 and 2070.
3. A series of focus groups from farmers living on Goyder's Line in the Murray Mallee, Upper North (Orroroo) and Upper Eyre Peninsula where we worked on a map of land values to discuss the interaction of soil type, climate and farming practices.

Goyder was an extraordinary individual and ahead of his time in thinking about climate risk and reliability. It is this contribution rather than simple shifts of lines on maps that is his greatest contribution to coming to terms with our variable and changing climate.

Martin Woods: National Library of Australia

The historical cartographic collection of the National Library as a resource for climate analysis: a reconstitution.

A new cartographic product, the climate change map, has begun to appear in public map collections, as government departments repurpose, and special interest groups use maps to communicate the causes and impacts of climate change and global warming. While these focused and often forward-looking resources are relatively easy to locate and interpret, it is the combination of historical records and other sources of knowledge that is exciting interest as one means of reconstructing past environments and climate. Though not always as a central preoccupation, printed cartography over five hundred years has been concerned with every aspect of the environment, from the storms confronting mariners to the search for water on pioneering inland expeditions. Whether highly localised exploration sketches and charts, settlement maps and plans, or long-run resource mapping and aerial photography, it is tempting to envisage that assessment of a broad range of environmental features is possible based on historical cartography. Maps held by the National Library and other bibliographic collections are replete with historical data, sometimes obscured by an absence of cataloguing, in places deep and at times wide-ranging, perhaps including unique or unseen material. To what extent are these records helpful in reconstructing past climate, or revealing evidence of climate change, and how do we find them?

Mac Benoy: Australasian Meteorological Association

The Todd Weather-map Digitisation Project

The foundations of meteorological services in Australia were laid during the nineteenth century in the individual Colonies but this could only happen with the establishment of the inter-Colonial telegraph network that connected the Continent north to south and east to west. Sir Charles Todd, the polymath Astronomer General of South Australia was a key player in these developments. Todd's unique legacy included 31 years of weather history neatly bound in 64 volumes. Meteorological observations for each of the 11,000 days are recorded in a continental weather map accompanied by news articles of the day describing weather events across eastern Australia. The maps illustrate developments in weather observations from 1878 to federalisation of the Weather Bureau in 1909. The collection starts with early and informal use of isobaric maps and develops through more formalised maps when isobars were adopted as a standard technique

of documentation and finish with 'production maps' of pre-Federalised weather observations and forecasting. The maps are accompanied by in-house and later, published weather forecasts, the first rainfall maps of the colony, sailing ships' logs of weather observations, telegrams and letters, etcetera. A team of volunteers at the Weather Bureau's South Australian Office is digitising Todd's journals to ensure this unique collection is preserved and available for public access.

Kelly Henderson

Landscape and Legacy: Environmental Features of William Light's Adelaide

A masterpiece of topographical genius, William Light's design of an environmentally sensitive urban and regional spatial plan for the City and District of Adelaide demonstrates key philosophies, principles and methodologies that remain relevant to this day. In pursuance of his instructions, and having determined to create a beautiful and healthy city, Light underpinned his selection of the Adelaide plain with a detailed assessment of environmental features and factors, including coastline, topography, location and availability of fresh water, soil, vegetation, drainage and climate. First hand observations and detailed and accurate mapping of the Adelaide plain, as recorded by Light and his surveying team, identify land subject to natural inundation, delineate the distribution of open grassland and forested areas, and trace the original intricacies of watercourses.

Subsequent land clearances and constructions have altered the landscape Light observed resulting in a loss of natural features, and isolated remnants face an uncertain future. In the late nineteenth century recognition of climate change issues saw a relatively intact site, in Light's Adelaide Park Lands, play an historic role in the international Arbor Day movement – a plantation of trees now ironically vilified as 'environmental pests' and targeted for development into a 'natural' wetland. Although comparison with other cities demonstrates Light's legacy is unique, environmentally insensitive developments continue to threaten increasingly fragile remnant ecologies and have negative impacts upon quality of life. Positive measures will be needed if landscape and legacy are to be sustained for future generations.

Dr Janis Sheldrick

1855-1865: Goyder's long ride to mapping reliable rainfall

Goyder's Line is supposed to have been created in the 1865 drought to identify drought-affected pastoral areas, and only later adopted as an agricultural limit. But Goyder believed he could separate agricultural from pastoral land by defining a change in rainfall reliability *before* he went out to investigate the drought, and was using the pastoralist's situation to refine a line he already had in mind. His understanding was based on a decade of examining land for settlement, exploring the inland during drought and flood, and systematically observing vegetation across vast pastoral runs.

Graham de Hoedt, Melanie Harris and Darren Ray, Australian Bureau of Meteorology

Climate variability and temperature changes across Australia over the last 100 years.

The Bureau of Meteorology is the custodian of Australian meteorological data, some going back to the 1850s. These datasets are made available to the community in raw and analysed (visual) formats. This presentation, which will focus on more than a century of temperature data, will investigate the variability and trends in the temperature record. The presentation will highlight the importance of both station data and gridded data in understanding changes and variability. It will also provide insight into how the data are visualised and subsequently made available to general and specialist users.

Maggie Patton, State Library of New South Wales

Primary Evidence – rare surveys of Eastern Australia from the Sir William Dixson collection.

Sir William Dixson began collecting in the 1890s. Like David Scott Mitchell, he collected Australiana, with special emphasis on early navigation and geography, exploration of the Pacific, and early Australian settlement. Following his death in 1952, his entire collection including a magnificent map collection was transferred to form the Dixson Library.

The State Library has commenced a project to digitise over 1,000- sheet maps from the Dixson collection. Amongst the collection which dates from the sixteenth to the twentieth century are many original maps of Eastern Australia undertaken by early explorer-surveyors including Charles Grimes, Robert Dixon, George Barney, Felton Mathew and Thomas Livingstone Mitchell. These surveys provide some of the earliest documentary evidence of land formations, water courses, wetlands and vegetation in the new colony prior to European settlement.

Dr Carl Menges, Apogee Imaging International.

SAR for Emergency Mapping in Australia

Apogee Imaging International is an Australian owned and operated SME. Since 1995 we have supplied satellite and IFSAR data and services worldwide. Apogee is built on a solid foundation of scientists and engineers who are specialists in remote sensing. Apogee has exclusive access to a growing number of satellites and Intermap IFSAR precision elevation data. We have the capability to deliver raw, processed and value-added products and services to the following sectors: Defence, Peace Keeping operations, Disaster Monitoring, Emergency Services, Maritime Surveillance, Mapping, Personnel and Asset Tracking, Monitoring Critical Infrastructure and Utilities, Oil and Gas Exploration, Natural Resources and Agribusiness. Our present Partners and Data Sources are Intermap Technologies, ImageSat International, Infoterra, RapidEye, E-GEOS, Surrey Satellite Technologies, ARA LIDAR, IOJ Aerial, and Aerial Acquisitions. With a focus on SAR technology, Apogee has the capability of providing a unique capacity for national security and emergency management. Examples include the monitoring of the recent oil leak off the Northwest coast of Australia, inundation mapping during flood events, maritime monitoring capability and IFSAR acquisition in Australia.

Bill Syme: BMT WBM Pty Ltd.

Integration of Flood Modelling and Mapping using GIS

Floods cause more damage in terms of direct and indirect costs than any other type of natural disaster in Australia. In addition to property and infrastructure damage (direct costs), they cause

stress and anxiety, are a risk to life-and-limb, and are a major disruption to society (indirect costs). One of the challenges is to understand the risks associated with flooding and to alleviate these risks so as to minimise the cost to society.

Flood modelling is the science of using computer software to simulate flooding, and for developing flood mitigation strategies to alleviate the flood risk. The software, which is based on the principles of fluid motion, solves relatively complex mathematical equations producing large quantities of numerical output that is generally unintelligible to the layperson. One of the keys to making this output more easily understood is the production of flood maps using Geographical Information Systems (GIS). These maps have now become one of the most important media for disseminating flood modelling outcomes to clients (usually local councils) and to communities. Conversely, it has also enhanced the flood modeller's skills by making it easier to produce and proof their modelling.

Since the 1990s Australia has been at the forefront worldwide in developing new software for flood modelling, and in integrating GIS to produce useful and realistic flood mapping. This paper presents the evolution of this industry, and the challenges it faces.

Frank Urban

Australia's Enigmatic Inland Sea

The paper commences by describing the changing heart of Australia from warm sea 140 million years ago to the Great Artesian Basin which today provides an ever-diminishing supply of fresh water for mining and agriculture.

For decades explorers searched for the Inland Sea, missionaries and pastoralists battled the dry conditions, and scientists studied the occasional floods.

The paper also discusses whether:

Bradfield's scheme to resuscitate the inland sea would improve rainfall?

Filling Lake Eyre and other depressions from the oceans could help save seaside cities from rising sea level?

The removal of hard-hooved livestock north of the Goyder Line could eliminate the dust storms that periodically defile adjoining States?

Frank Urban is a member of the Australia and New Zealand Map Society, a former Director of the Central Mapping Authority of New South Wales and the author of *MAPMAKER - Life and Spice in Africa, Europe, Australia and Asia*.

Greg Wood

Uncertain Sources: Rainfall, Rivers and National Capital Site Selection.

The Canberra region first entered serious contention as the possible site for Australia's nation capital in 1906. The big question mark over Canberra's claims was whether it commanded sufficient water resources to supply a substantial city. This was a source of vulnerability for the Canberra site as its main competitor, Dalgety, was located on the seemingly inexhaustible Snowy River in southern New South Wales.

Most prospective supply sources around Canberra, the Cotter, Gudgenby and Queanbeyan/Molonglo rivers, had never been accurately or consistently measured. Apart the nearby town of Queanbeyan, and a few landholders' records, there were no reliable records of rainfall over much of the region. Nor had the most attractive supply source, the Cotter River, been surveyed or accurately mapped.

Over the next five years, NSW and Commonwealth experts began assembling the data to make a series of calculations, judgements and predictions about Canberra's water resources, including regional rainfall, the efficiency of the various river catchments and possible dam and storage locations. Their conclusions were frequently expressed through maps and cartography. Drawing on those maps and the accompanying reports the paper outlines the assessments and conclusions, comparing them with the records and experience now available a century later. In the background is the perennial question: "did they get it right?"