

Asia-Pacific Network for Global Change Research workshop

“Improving Pacific Island Meteorological Data Rescue and Data Visualisation Capabilities through Involvement in Emerging Climate Research Programmes”



*Simon McGree with the Sava Book
(Photo: Andrew Lorrey)*

Hosted by the National Institute of Water and Atmospheric Research, Ltd
(NIWA)
Auckland, New Zealand
Monday 27 September to Wednesday 29 September 2010

Program and Abstracts





**Asia-Pacific Network for Global Change Research workshop on
“Improving Pacific Island Meteorological Data Rescue and Data Visualisation
Capabilities through Involvement in Emerging Climate Research Programmes”**

**Hosted by the National Institute of Water and Atmospheric Research, Ltd
(NIWA)**

Auckland, New Zealand

Monday 27 September to Wednesday 29 September 2010

Program (Final)

Day 1- September 27, 2010

900AM- *Opening ceremony*
Powhiri, Apanui Skipper – NIWA
Sunny Seuseu – Samoa Meteorological Service
Michael Bruce – NIWA
Andrew Tait – NIWA

915AM- *Health and Safety*

Session 1- International Projects with a global focus
(Moderator/Scribe- Andrew Lorrey)

930AM- Rob Allan: *The International Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative*

1000AM- Gil Compo: *Developing the Surface Input Reanalysis for Climate Applications (SIRCA) 1850-2012*

1030AM- MORNING TEA (and Group Photo)

Session 2- International Projects with a Pacific Region focus
(Moderator- Philip Brohan; Scribe- Linden Ashcroft)

1100AM- Joelle Gergis: *The SEARCH (South Eastern Australian Recent Climate History) Project*

1130AM- Rob Allan: *Data rescue and digitisation projects in the West-Northwest Pacific*

1200PM- Andrew Lorrey: *The South Pacific Rainfall Atlas*

1230 to 130PM- LUNCH

Session 3 – International Projects with a Pacific Region focus (continued)
(Moderator- Rob Allan; Scribe- Simon McGree)

130PM- Jorge Guzman: *The ACRE contribution to historical reconstructions of climate and environment in Chile*

200PM- Dean Collins: *Overview of the Pacific Climate Change Science Program*

230PM- *Open panel discussion, with Q & A about the projects*

300PM- AFTERNOON TEA

Session 4 – Indigenous environmental research in the southwest Pacific
(Moderator- Sunny Seuseu; Scribe- Davina Ashford)

330PM- Darren NT King: *Māori coastal communities and climate change*

400PM- Apanui Skipper: *Ko Te Kawa Tūpanapana i ngā hau tūpua o Tāwhirimātea – The Validation, Revitalisation and Enhancement of Māori Environmental Knowledge of Weather and Climate*

430PM- Pene Lefale: *Ua afa le Aso - Stormy weather today. Traditional ecological knowledge of weather and climate, The Samoa experience*

500PM- *Icebreaker followed by group dinner*

<i>Day 2: September 28, 2010</i>

Session 5- Data holdings and data rescue
(Moderator/Scribe- Andrew Lorrey)

900AM- Tom Ross: *NOAA's holdings at the National Climatic Data Center's (NCDC) Foreign Data Library (FDL)*

930AM- Teddy Allen: *The International Environmental Data Rescue Organization (IEDRO) history, present, and future.*

1000AM- Mac Benoy: *Crowd Sourcing for Data Rescue - a Volunteer Model*

1030AM- MORNING TEA

Session 6- Rescued data analysis
(Moderator- Joelle Gergis; Scribe- Gil Compo)

1100AM- Georgina Griffiths: *Learning from a recent data digitization project*

1130AM- Simon McGree: *Climate Data Rehabilitation and Visualisation in Pacific Islands and East Timor*

1200PM- Jorge Guzman: *Inventory of historical sources of climate data in the Strait of Magellan, Tierra del Fuego Archipelago and Drake Passage for 1520- 1834*

1230 to 130PM- LUNCH

Session 7 – Data bases, information exchange forums, and end user linkages
(Moderator- Dean Collins; Scribe- Davina Ashford)

130PM- Andrew Howard: *Introduction to PCCSP CDMS (Climate Database Management System)*

200PM- Pene Lefale: *The Pacific Climate Information Service (PaCIS)*

230PM- Sunny Seuseu and Alan Porteous: *Development of a Climate Early Warning System (CLEWS) in Samoa*

300PM- AFTERNOON TEA

Session 8 – Marine climate data rescue and breakout sessions
(Moderator/Scribe- Andrew Lorrey)

330PM- Clive Wilkinson and Rob Allan: *Sources of Historical Marine Climate Data for the Pacific from Chilean and British Archives*

400PM- Breakout Session 1: *Identifying common research interests across the projects in the region*

430PM- Breakout Session 2: *Identifying how the Projects and Pacific Island Meteorological Services can help each other*

500PM- *Adjourn for the day*

<i>Day 3: September 29, 2010</i>

Session 9- Non-traditional archives and data visualisation
(Moderator- Jorge Guzman; Scribe- Andrew Lorrey)

900AM- Rob Allan: *An overview of non-traditional meteorological archives*

930AM- Howard Diamond: *The Development of an Enhanced Tropical Cyclone Tracks Database for the Southwest Pacific from 1840-2009*

1000AM Hands-on Session 1: *The Tropical Cyclone Graphical Interface Tool (GRIT)*

1030AM- MORNING TEA

Session 10- Data rescue experiences, non-traditional archives, and Google Earth
(Moderator- Simon McGree; Scribe- Joelle Gergis)

1100AM- Davina Ashford: *Experiences in Pacific Island data rescue at NIWA*

1115AM- Petra Chappell: *Identifying southwest Pacific historical weather data sources using the Log of Logs*

1130AM- Linden Ashcroft: *SEARCH Project –South Eastern Australia early instrumental data recovery*

1200PM- Andrew Lorrey: *The ‘Dirty Weather’ Diaries of Reverend Davis, Northern New Zealand, 1839-1851*

1230 to 130PM- LUNCH

Session 11 – Google Earth: application and visualization hands-on exercises
(Moderator/Scribe-Andrew Lorrey)

130PM- Philip Brohan: *Visualising observations, reanalysis, and uncertainty*

200PM- Craig Stanton: *Using Google Earth as a Visualisation Tool*

230PM- Hands-on Session 2: *SPRAT v2.1 and use of visualized reanalysis data in Google Earth*

300PM- AFTERNOON TEA

Session 12 – Feedback and future direction
(Moderator/Scribe- Andrew Lorrey)

330PM- *Feedback on SPRAT v2.1, visualized reanalysis data, and comments for improvements, additions & changes*

400PM- *Future directions for the Projects and Participants*

430PM- *Development of a Southwest Pacific regional working group for ACRE; communication strategy, goals, and timelines*

500PM- *Conclusion of workshop*

Abstracts (listed below alphabetically by presenting authors last name)

Allan, Rob

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The International Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative

The Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative (<http://www.met-acre.org/>) is an international undertaking which is facilitating the reconstruction of high quality global patterns of weather throughout the depth of the atmosphere, in order to provide a new baseline for the resolution of climate variability and climate change over the past 200 years. ACRE links projects recovering and improving the quantity and quality of historical weather observations, to global weather and climate reanalysis or reconstructions using the historical data, in order to facilitate the use of these reconstructions across all disciplines and user communities' worldwide.

ACRE is led by five core partners - the Queensland Climate Change Centre of Excellence (QCCCE) in Australia; the Met Office Hadley Centre (MOHC) in the UK; the US National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) and Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado; and the universities of Giessen in Germany and Bern in Switzerland. This core team provides an umbrella that links more than 35 projects, institutions and organisations, around the globe.

In 2010, ACRE and its activities were ratified by the WMO Commission for Climatology, extolled in a letter of recognition from Global Climate Observing System, and endorsed by the Joint WMO-IOC Technical Commission on Oceanography and Marine Meteorology Expert Team on Marine Climatology and by the World Climate Research Programme.

ACRE works closely with the international surface weather and climate observations community: particularly the International Surface Pressure Databank (ISPD) and the International Comprehensive Ocean-Atmosphere Data Set (ICOADS), the international RECLAIM (REcovery of Logbooks And International Marine data) (<http://icoads.noaa.gov/reclaim/>) and IEDRO (International Environmental Data Rescue Organisation) (<http://www.iedro.org/>) projects, and the National Climatic Data Centre (NCDC) in the US. These programs, together with various international academics and archives, are working to expand the recovery, imaging, and digitisation of historical instrumental weather observations.

Major current activities focus on data held in various UK repositories (e.g. The British Library, the National Meteorological Archive at the Met Office and The National Archives plus regional efforts in Chile, India and the India Ocean, the Pacific, southern Africa and China. However, these interactions need to be totally inclusive and to embrace collaboration, interactions and good will amongst all of those involved. Thus, ACRE strives to work with National Meteorological Services, data repositories and various organisations and institutions in countries across the world, so that they are not only part of what ACRE is trying to achieve, but are integral to it.

ACRE is a response to user needs, and through its core linkages between data, reanalyses and the tailoring, shaping and downscaling of that material in alignment with user requirements, the initiative is filling a vital role in making climate science products freely available and their generation transparent to all users. Through its efforts to develop state-of-the-art visualization technology, ACRE is building the infrastructure to deliver the initiative's output and outreach globally.

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Data rescue and digitisation projects in the West-Northwest Pacific

Several projects and activities are focusing on historical weather data recovery/rescue, imaging and digitisation in regions, and on the fringes of, the western-northwestern Pacific Ocean. This presentation will report on a number of these activities.

The Dutch and Indonesian National Meteorological Services are working together to coordinate a major digitisation effort, the KNMI-BMKG DiDaH (Digitisasi Data Historis) project. DiDaH is recovering and digitising historical weather and climate observations from terrestrial sources across the Indonesian Archipelago during the Dutch colonial period (plus more recent data from BMKG). The material recovered will be typed in, archived and published. During the digitization work, in 2010 and 2011, several experts from BMKG will visit and work at KNMI, to learn about methods and means of handling such historical climate data. For more details, see: (http://www.knmi.nl/~laagland/KIK/Documenten_2009/kik15okt2009.html).

At SEIKEI University in Japan, Masumi Zaiki is leading efforts to recover and digitise historical weather and climate data from land and island observation stations in Japan, Korea, China, the Philippines, and various islands across the northwest Pacific Ocean. Monthly and daily temperature and pressure records for the 19th century in Japan (Hakodate, Tokyo, Yokohama, Osaka, Kobe and Nagasaki) and China (Beijing) have been digitized, homogenized and made available to the public. Jointly-conducted digitization projects for the Philippines, French-Indo China (a large block of this data has also been digitised by NOAA's Climate Database Modernization Program [CDMP]-<http://www.ncdc.noaa.gov/oa/climate/cdmp/>) and Pacific islands (e.g. Palau, Saipan and Ponape) daily records (temperature, pressure and rainfall) from the late 19th century to the 20th century are currently in progress. These datasets are being, and will be, used for reconstructing pressure patterns, South East Asian monsoon variability and Typhoon characteristics.

For many years, the Human Resources section at the Met Office in the UK has had young adults with disabilities on placement in the Office. In return they are given the opportunity to gain office-based skills to secure future employment. In the last 3 years, the bulk of these placements have mainly assisted with ACRE's historical weather data digitalisation activities, primarily the twice daily historical pressure observations from stations around the South China Sea from 1894-1932 (covering locations in Russia, Japan, Korea, China, the Philippines, Vietnam and various islands) in the 'China Coast Meteorological Register' (http://docs.lib.noaa.gov/rescue/data_rescue_china.html). In addition, similar disabled people are working with ACRE and staff from the National Meteorological Archive at the Met Office to aid in scanning large amounts of historical weather registers, thus making them more accessible for digitisation (sometimes using Optical Character Recognition [OCR] software).

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An overview of non-traditional meteorological archives

The National Meteorological Services of countries in the ‘Old World’ were established around the middle decades of the 19th century, with the colonial extensions into most of the world from each of the major European powers, the French, English, Spanish, Portuguese, Dutch, German, Italian, Belgian and Austro-Hungarian, being developed in the following decades. It is also important to note that once the telegraphic network was established, from the 1860s-70s in particular, the various National Meteorological Services often accrued weather observations from neighbouring countries and territories, and this material is often published in their Daily Weather Reports (DWRs). Thus, in building station series, it is often advisable to seek out the DWR’s from other nearby countries or colonial powers, as they may also hold the material being sought, or more importantly, additional or missing data. Into the 20th century, many of the former colonies slowly gained their independence and established National Meteorological Services of their own, usually building on the colonial services, and by modern times communicating data via GTS and thus changing the nature and dynamic of data availability once again.

Many National Meteorological Services were built on observational stations and networks developed by bodies such as the Jesuit’s (e.g. Manila and Shanghai), while over the years there are a mixture of various administrative bodies, societies and organisations which have measured surface marine and terrestrial weather observations, often for purposes that are not directly meteorological. These include, astronomical observatories and expeditions, medical institutions (hospitals) and professionals (doctors and ship surgeons), military bodies (engineers), consulates and consular officials, botanic gardens, pilot and signal stations, lighthouses, port authorities (harbour masters), shipping companies, missionaries, and various learned societies, diarists, newspapers, government gazettes, pamphlets and similar.

The repositories where the bulk of the above material are held are also wide ranging, from national libraries and archives through to individual collections. Even within such entities, material may not be held in the most obvious catalogued locations, or have been bound in with other types of meteorological material – such as various lighthouse registers having been bound in with ship logbooks in the National Meteorological Archive at the Met Office.

Finally, it is also important in a region such as the Pacific Ocean to realise the value of not just historical island meteorological or weather observations, but also of marine data from ship logbooks. This is especially true when looking at tropical storm histories, and the wider patterns, tracks and intensities of such features, plus in the cross checking of harbour and port station series with those of vessels at anchor for additional quality control and homogenisation purposes.

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The International Environmental Data Rescue Organization (IEDRO) history, present, and future.

The International Environmental Data Rescue Organization (IEDRO) is a 501(c)(3) non-profit group that locates, rescues, and digitizes all historic environmental data worldwide to ensure that those data are available in a safe, open, and unrestricted data base. The IEDRO process involves active participation from the data owners, IEDRO volunteers, and contracting digitizing institutions. Examples of rescued environmental data include, but are not limited to weather observations, tidal measurements, precipitation strip charts, and historic maps and charts; some of which date back to the 1700s.

IEDRO takes responsibility for training the host nation in both pre-digitizing organization and sorting of the data as well as in the actual process of initial data transfer via digital photography. In addition, IEDRO provides the necessary equipment to accomplish this task. The resulting digital files are relayed via CD to the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center where they are digitized and resent to the NOAA world database and back to the original host nation.

IEDRO has experienced success through the production of strip chart digitization software that has dramatically reduced the time required to convert from analog to a digital format. Since 2005, IEDRO has digitized over one million observations in over 12 countries. Increasing the pool of rescued and digitized environmental data allows us to better understand the nature and extent of climate variability, aids in the prevention of the vector diseases, improves lifesaving flood forecasts, prevents famine and starvation, while also painting a clearer understanding of human history. Future success of IEDRO and global data digitization and rescue projects depend on continued support through a wide array of volunteers along with increased financial funding.

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SEARCH Project –South Eastern Australia early instrumental data recovery

One stream of the landmark SEARCH project is focused on locating, digitising and analysing early instrumental data for the southeastern Australian (SEA) region. This early instrumental data is of crucial importance, as it allows for calibration and verification of both paleoclimate records and documentary accounts of past weather. The data can come from many sources, including traveller's journals, government documents, early newspapers and long term weather station records. It can range in temporal resolution from annual averages to sub daily observations.

Work done in this area by previous researchers in the 1980s has been studied, and a ranked inventory compiled of potential sources of early instrumental records for SEA. The reliability of each dataset, including the potential amount of metadata available has been examined to make a quality assessment of each record.

A pilot study into the potential of an early instrumental network that can capture large-scale climate variability is being conducted for New South Wales (NSW), as this was the first area settled by Europeans. The preliminary results, using long-term temperature weather stations, will be presented as well as some initial analysis of records from historical sources, in an effort to extend the climate record of the Sydney region back to the 1840s. Examples of early instrumental sources for other regions of SEA will also be discussed, highlighting the large amount of potential for data rescue in this area.

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Experiences in Pacific Island data rescue at NIWA

This presentation is based on my experiences of rescuing historical climate data from across the Pacific. The project was funded by the New Zealand Government Climate Change Development Fund, through the Secretariat of the South Pacific Geoscience Commission (SOPAC). It began in 2005 and officially ended in 2009. The data rescue project process involved sorting and digitising historical daily rainfall, wind speed and direction, temperature, barometer readings, cloud cover and sunshine hours. By 2009 an estimated 800+ ‘station years’ of historical daily climate data were digitized from the Cook Islands, Tuvalu, Tokelau, Kiribati, and Samoa. While rescuing historical data and the digitisation step is crucial, it is only one in a long line of steps to get the data into the database. In this presentation I will review the key steps in this process – including commentary on quality assurance issues, exceptions, obstacles and others lessons learnt through this project.

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Crowd Sourcing for Data Rescue - a Volunteer Model

For the past three years, a volunteer group of nine, (not "sponsored ") hosted by the Bureau of Meteorology in Adelaide, South Australia has imaged 20,000 pages of weather history to the exacting standards of the Australian National Archives. At a notional hardware cost of \$15,000 and no labour costs, it has been a community-based project capable of producing industry standard results. This paper covers the practical aspects of organising, managing and completing the project with an emphasis on establishing guidelines and reference points for similar initiatives. Issues covered include workflow, hardware, imaging standards, freeware tools, staffing and funding.

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Visualising observations, reanalysis, and uncertainty

The collected historical observations and the 20th century reanalysis form a large and detailed reconstruction of the weather and climate of the last century or so. But the size and comprehensive nature of the reconstruction means that it is not easy to extract, from the terabytes of reanalysis output and hundreds of millions of observations, information for the region and time of interest. It is also difficult to judge the confidence that can be placed in the reconstructions. By processing the observations and reconstructions into overlays to be viewed in Google Earth it is possible to make the reconstructed weather fields, their confidence and the observations they are based on, viewable in a simple fashion.

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Identifying southwest Pacific historical weather data sources using the Log of Logs

The Log of Logs is a three volume set published from 1990-1999 that was authored by Ian Nicholson, and ex-commodore of the Royal Australian Navy. Nicholson made a catalogue of log books, journals, shipboard diaries, letters, and all forms of narratives for ships that entered Australian and New Zealand waters (as well as the South Pacific Ocean) between 1788 and 1998. The Log of Logs indicates a wealth of past meteorological information from maritime diaries that are currently untapped to their full potential, and they can usefully contribute environmental data for our region beyond the scope of modern land-based meteorological registers. The work undertaken thus far has included scanning and optical character recognition on the Log of Logs three volumes, which was needed because the entire Log of Logs set is rare. Sharing the Log of Logs digital copy amongst the researchers in the ACRE group was done solely for academic purposes. Subsequently, two searches of the volumes were conducted; one covered New Zealand, the other spanned Southeast Australia (to assist the SEARCH project). Findings from our analysis, including temporal spread of ships entering the regions, and locations that contain past log books will be discussed, and suggests resources in archives nationally and abroad can be located that will add to the compilation of past weather data for the southwest Pacific.

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Overview of the Pacific Climate Change Science Program

In 2008, the Australian Government established the International Climate Change Adaptation Initiative (ICCAI) to meet high-priority adaptation needs of vulnerable countries in the Asia-Pacific region. The Pacific Climate Change Science Program (PCCSP) is a key activity of the Initiative and is designed to improve the understanding of climate change in the region, as well as build local capacity through the provision of education, training and awareness of climate change science.

The PCCSP will assist decision makers and planners in partner countries (Cook Islands, East Timor, Fiji, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Tonga and Vanuatu) to better understand how their climate has changed in the past, and how it may change in future.

The PCCSP includes projects to:

- improve the security and accessibility of historical climate records
- develop datasets suitable for the reliable analysis of climate variability and trends
- better understand the major climate features of the Pacific region, including the South Pacific Convergence Zone and the El Niño-Southern Oscillation
- improve knowledge of tropical cyclones, including climatologies, interaction with broadscale climate drivers and future behaviour
- assess and downscale global climate models to produce climate and ocean projections for individual countries for the 21st century
- enhance the current understanding of sea-level rise and extreme sea level events, and past trends and future projections for ocean acidification in the region.

PCCSP research is undertaken as a partnership between Australian science agencies, primarily the Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). Research outcomes will be made available by November 2011 through a series of scientific papers, interactive data portals, a technical report, partner country summaries, brochures and posters. Active engagement with partner countries and regional organisations (eg. SPREP, USP) is on-going to build local capacity in the preparation and application of these research results.

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Developing the Surface Input Reanalysis for Climate Applications (SIRCA) 1850-2012

Climate change studies are increasingly focused on moving beyond understanding and predicting global scale changes to regional scale changes, especially changes in the statistics of severe weather and droughts. Assessing the evidence for such variations over the last 150 years, and evaluating the quality of models making predictions for the next hundred, requires a sub-daily (as opposed to monthly or longer-term average) tropospheric circulation dataset. The only large-scale dataset available for the early 20th century consists of error-ridden hand-drawn analyses of the mean sea level pressure field over the Northern Hemisphere. Modern data assimilation systems have the potential to improve upon these maps, but prior to 1948, few digitized upper-air sounding observations are available for such a “reanalysis.” National and international plans to study climate change specifically require global gridded reanalysis datasets to achieve their goals. Under the 20th Century Reanalysis Project, we have demonstrated that the quantity of newly recovered surface pressure observations is sufficient to generate useful reanalyses of the entire tropospheric circulation back to 1891. We have found that using an Ensemble Kalman Filter that blends an ensemble of 6-hour numerical weather prediction model forecasts with the available surface observations, one can produce high-quality reanalyses of even the upper troposphere using only surface pressure observations. For the end of the 19th century, the accuracy of such upper-air circulation fields for the Northern Hemisphere in winter would be comparable to that of modern two to three day weather forecasts. Under SIRCA, we are using the Ensemble Filter, as developed at the University of Colorado and NOAA’s Earth System Research Laboratory, and surface pressure observations gathered in international collaboration with the Atmospheric Circulation Reconstructions over the Earth initiative to produce the first-ever reanalysis dataset for the period 1850-2011. This will more than double the record of 6-hourly tropospheric gridded global fields from 60 years to 162, spanning a period for which no gridded upper-air analyses are currently available. These tropospheric circulation fields will also be the first to have objective uncertainty estimates for every analyzed variable. In addition to validating and improving climate models, our dataset will be used to study climatic variations that could not previously be addressed observationally, such as the 1877 El Nino and Indian famine, the 1930’s U.S. Dust Bowl and the 1920’s to 1940’s Arctic warming. The dataset will also be used to reduce current uncertainties in several societally critical aspects of climate change such as trends in the frequencies of hurricanes and severe winter storms.

Diamond, Howard

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The Development of an Enhanced Tropical Cyclone Tracks Database for the Southwest Pacific from 1840-2009

The ecosystems and economies of small islands of the tropical Southwest Pacific region are widely agreed to be among the most vulnerable in the world to climate variability. The region is particularly vulnerable to weather and climate extremes, such as Tropical Cyclones (TC), and to the exacerbation of existing hazards by climate change. In order to do proper climate studies in the region, a key element is the development of as comprehensive a database of TC tracks as possible. The work documented here builds on similar work done both regionally and internationally for several years. The recent International Best Tracks for Climate Stewardship (IBTrACS) project, under the auspices of the World Data Center for Meteorology, has its aim the compilation of TC best track data from 12 TC forecast centres around the globe, producing a unified global best track data set. The work described enhances what IBTrACS has done by scouring the paper archives around the region to capture and digitize as much additional data as possible and also to quality control new as well as existing data. As a result of this work, new storms have been found; redundant or erroneous data have been discovered, and other data have been enhanced by combining new partial track information into existing track data in order to construct more complete tropical cyclone (TC) tracks. A significant part of the quality control was done by developing a new method, the Graphical Interpretation of Tracks (GrIT), to visually inspect the data interactively, help make judgements about data, and better refine the overall dataset. The intent of this work is to produce an enhanced dataset to better characterize the climatology of TCs in the Southwest Pacific. A hands-on demonstration of the GrIT quality assurance method will follow the presentation of the paper.

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The SEARCH (South Eastern Australian Recent Climate History) Project

The SEARCH (South Eastern Australian Recent Climate History) project combines palaeoclimate, documentary and early instrumental data to extend the climate record of south eastern Australia (SEA) over the past 200–500 years. Drawing together historians, librarians, climate scientists and water managers, it is the first of its kind in Australasia.

We present recent progress in developing rainfall and streamflow reconstructions for the SEA region using annually-resolved tree ring, coral and ice core records back to 1783. The importance of using early instrumental and documentary records to verify apparent changes in palaeoclimate reconstructions are discussed.

To co-ordinate the examination of documentary and instrumental records by multiple researchers, the SEARCH project has developed a pilot volunteer database called ‘OzDocs’ (<http://ozdocs.climatehistory.com.au>). This ‘citizen science’ initiative will allow interested members of the public to help locate and digitise valuable weather data from historical documents available online or in library collections.

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Learning from a recent data digitization project

NIWA recently undertook concurrent data digitization projects, which aimed to complete the digitization of remaining paper climate records held in New Zealand, originating from Tonga, Cook Islands, Tuvalu and Kiribati, as well as scanning and digitization of associated metadata. The ultimate aim of the data digitization was to enable an analysis of daily rainfall and temperatures in order to assess whether extremes have altered in these countries. It soon became evident that the preservation and digitization of the Pacific Island metadata was critical to the extremes analysis. Over the last 60 odd years, a widespread increase in the frequency of warm days/warm nights was observed, and cool days/cool nights have become much less common. However, there was a strong regional response in daily rainfall extremes. Increases in both mean and extreme rainfalls were observed to the north of the SPCZ. In comparison, decreases were seen to the south of the SPCZ, west of the dateline. The region south of the SPCZ and east of the dateline showed a decrease in mean annual precipitation, but an increase in daily extremity.

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The ACRE contribution to historical reconstructions of climate and environment in Chile

Since the discovery of the Chilean coast (around 1520-39), numerous documents with geo-scientific data content have been produced. This data became abundant after the decade of the 1850s, when the republican Chilean State was organized, and different state owned entities began to systematically collect meteorological and hydrographical records.

In the context of ACRE activities (and funded by NOAA), a recent visit to Chilean archives permitted a clear picture to be made of the potential that Chilean records could provide to different fields of the earth-sciences. Archives belonging to the Chilean Navy, MeteoChile, other public agencies and, also, to private companies (i.e., collections of logbooks belonging to shipping companies active in the Pacific Ocean after 1870), constitute a corpus of high quality data that covers - for more than a century - terrestrial and maritime Chilean territories.

Recently, ACRE facilitated the formal involvement of both MeteoChile and the Chilean Navy in a wider project, under FP7 of the E.U, which, in 2011, will permit the digitalization and analyses of both terrestrial and maritime Chilean weather records. This will include the development of a comprehensive national catalogue and weather database for Chile as part of an historical reanalysis of climate, climatic variability and change over the Southeast Pacific Ocean, the south western regions of South America and the American sector of the Southern Ocean.

The implementation of ERA-CLIM/ACRE-Chile through the identification and digitalization of historical records with geo-scientific data, and their use in generating global historical reanalyses of weather, could be considered a model for organizing and using other national catalogues and databases of historical weather to study climate and environment. This would enable States not just to participate in international cooperative ventures and projects, but to actually use a scientific tool that could become of strategic importance for their respective social and economic developments.

This paper deals with the procedure and methodology employed to build such a national catalogue and weather database, as well as with the importance that this could have for Chile, both for its commitments in the field of international cooperation, and for designing and implementing public policies intended to tackle climatic variability and change.

A Chilean national catalogue of geo-scientific historical sources and a comprehensive digital database of historical Chilean weather observations contributing to historical reanalyses of global weather, would constitute major ACRE contributions to scientific and political cooperation between countries and other entities concerned with global warming and environmental change.

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Inventory of historical sources of climate data in the Strait of Magellan, Tierra del Fuego Archipelago and Drake Passage for 1520- 1834

This paper proposes a methodology for constructing an inventory of historical published and unpublished sources for the study of climate and environment in coastal and maritime areas of the region comprehended between the Strait of Magellan and the northern sector of the Drake Passage (for methodological reasons, 58°South). The period to be scoped covers from the discovery of the Strait of Magellan in 1520 (and the production of the first reports on the hydrographical and environmental characteristics of the area), to the diffusion in 1836 of the reports of the second survey of the area made by HMS Beagle.

In order to propose a clear picture of the information to be available, the mentioned period should be divided into two sub-periods, namely:

- A first sub-period corresponding to early surveys and descriptions and ranging from the documents produced by Spanish authorities during the questioning of the survivors of the Magellan expedition and the publications of the texts of Maxilimianus Transilvanus (1523) and Antonio Pigafetta (1525), and the printing of the reports and cartography made by Amadée-Francois Frezier (1716), which, for the purpose of this study, should be considered as the first properly scientific survey of the Strait and of the Fuegian Archipelago.
- A second sub-period corresponds to proper hydrographical and scientific surveys. This would covers from Frezier's second visit to the area to the revision and publication in 1836 of the scientific material produced by British Naval surveys of 1828-34.

Unpublished material will be grouped by Archives were it is preserved (i.e. Spanish reports in Archivo de Indias; logbooks of whaling voyages, Whaling Museum of Bedford). Printed material will be ordered in chronological order following the date of the survey or voyage.

In each case the sort of data possible to be rescued will be identified. In both cases the information will be summarized in tables with the necessary information to guide researchers to find the existing data.

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Introduction to PCCSP CDMS (Climate Database Management System)

This talk will start with the PCCSP project context and stated aims for the Climate Database Management System (CDMS) as part of PCCSP. The project's scope and limitations are discussed, and how these led to the key design considerations and principles. Architecture is Open Source using web technologies. The focus for now is solid foundations that can be built upon in the future: extendable, maintainable, robust, and affordable.

The main benefits of the CDMS are:

- Enhanced data security and access using a robust database designed specifically to meet small country needs,
- A simple-to-use database designed for current operating systems;
- Open Source software requiring no ongoing license fees;
- Ability to upload electronic data from a variety of sources and compatibility with previous climate databases in wide use;
- Capability to develop forms for the ingestion of hardcopy data types used in your country;
- Enhanced quality checking with capability to develop a quality monitoring system;
- Ability to generate reports and capability to meet common data requests;
- Ability to export data in a variety of formats to support in-country climate applications such as seasonal prediction and adaptation research; and
- Standard database types across neighboring countries encouraging regional co-operation in maintenance, data back-up and development of output products.

The main functions of the Graphical User Interface (GUI) will be demonstrated. Major functionality is Station metadata, key entry forms optimised for the existing paper records, a data review and QA function, as well as file ingest and basic products including CSV file dumps and basic printed reports.

Next the future steps will be listed. This includes the implementation plan which will include at least one pilot install. From then there will be an emphasis on fixing bugs and learning from each installation so as to improve the process. A process of constant improvement based on user feedback is anticipated. A users email group and/or website will be established to facilitate the product's future improvements.

Finally the on-going future of the CDMS, challenges and opportunities will be discussed.

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Māori coastal communities and climate change

NIWA and its partners have received a 3-year grant from New Zealand's Foundation for Science Research and Technology to create the necessary information and tools to enable adaptation by government and communities to the impacts of climate-induced change on the coastal environment. This presentation outlines the key components of a community-based participatory research (CBPR) project coordinated by NIWA's Māori Environmental Research Centre (Te Kūwaha o Taihoro Nukurangi) in close collaboration with the tribal group Ngāti Whanaunga from Manaia Township in the Coromandel, New Zealand. Specifically, this project seeks (i) to better understand the context-specific vulnerability, risks and adaptation options currently facing a coastal Māori community to climate-coastal hazards, and (ii) to explore a range of climate change scenarios to ascertain how the present vulnerabilities and adaptive capacities of the 'community' at Manaia will change under altered environmental conditions. Given this project is still underway, attention will centre on the research process – and will include consideration of the research context, methodology, investigative techniques and analytical methods – all of which are underpinned by Māori values and aspirations. Note there are strong calls for research of this kind to clarify and confirm distinct Māori realities and to provide policy makers with evidence to appropriately shape policies in equitable ways.

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Ua afa le Aso - Stormy weather today. Traditional ecological knowledge of weather and climate, The Samoa experience

This paper examines traditional ecological knowledge of weather and climate in Samoa, a Polynesian community in the South Pacific. The research found Samoans have their own unique seasonal calendar. The Samoan seasonal calendar is predominantly based on the observations of local environmental changes, which are in turn influenced by weather and climate. Monitoring changes in plants and animal behaviour, for example, are key indicators used by the Samoans to forecast changes in weather and climate. In addition, their communal and family social activities like hunting, fishing and feasting are driven by the seasonal calendar. The Samoans knowledge of cloud formation, conditions conducive to the formation and onset of severe weather systems and seasonal changes in climate, helped them anticipate, plan and adapt to extreme weather and climate events. The ability and knowledge of the Samoans to forecast the onset of extreme weather and climate events, relying predominantly on local environmental changes are vital tools that should be incorporated in the formulation of human induced climate change adaptation strategies.

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The Pacific Climate Information Service (PaCIS)

This presentation provides an overview of the United States NOAA led Pacific Climate Information System (PaCIS) initiative. PaCIS provides a programmatic framework to integrate on-going and future climate observations, operational forecasting services and climate projections, research, assessment, data management, outreach, and education to address the needs of American Flag and U.S.-Affiliated Pacific Islands (USAPI). The PaCIS regional vision is resilient and sustainable communities using climate information to manage risks and support practical decision-making in the context of climate variability and change. The presentation focuses on the creation of PaCIS, its core activities, with particular focus on the activities of PaCIS Working Group 2; Operational Climate Observations, Products, and Services and Working Group 3: Research and Assessment. PaCIS seeks collaboration and contribution from similar initiatives in the Asia-Pacific region.

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The South Pacific Rainfall Atlas

Precipitation is highly relevant to the welfare of southwest Pacific island nations. Significant impacts linked to rainfall or lack thereof has included seasonally-sustained heavy events or acute storms that caused floods and significant drought in the recent past. Questions often arise within the public sector and are subsequently directed at the Pacific Island National Meteorological Services (PINMS) about the causes of these events and for some type of historical context.

Rainfall variability in the region is currently monitored remotely by the NASA Tropical Rainfall Monitoring Mission (TRMM) satellite measurements and outgoing longwave radiation (OLR) anomalies, and land-based stations. The remotely sensed measurements help to illustrate regional precipitation as well as positional changes in the South Pacific Convergence Zone (SPCZ) and the Intertropical Convergence Zone (ITCZ). Satellite monitoring is temporally short, so this hampers our understanding of past regional climate variability and therefore what might be expected in the future.

Rainfall was closely monitored in the South Pacific since the mid-to-late 1800s and Pacific Island National Meteorological Service archives include dozens of stations that blanket the region. We are attempting to collate new and existing climate and weather data into an atlas that is driven in Google Earth which contains long-term reference material. Included in the atlas are documentation of regional rainfall signatures that are linked to the El Nino Southern Oscillation (ENSO) and SPCZ. The easily accessible series of monthly, seasonal, and biannual maps that comprise the South Pacific Rainfall Atlas (SPRAT) will be made available to the PINMS as a resource, and help to surmount a current information resource gap for the region.

A serendipitous outcome of undertaking this work has highlighted that regional rainfall anomalies are a useful 'bucket on the ground' proxy for reconstructing ENSO and SPCZ patterns in the pre-satellite era. We are also learning that the SPRAT rainfall anomaly maps covering unique ENSO case studies are a particularly useful for verifying the SPCZ position derived from new atmospheric circulation re-analysis datasets (see Compo et al., this volume). The Google Earth visualisations also indicate interesting relationships between tropical cyclone trajectories and the SPCZ motions. Current work has pointed to spatial and temporal holes in the southwest Pacific regional rainfall network that indicate where future data rescue efforts could be focused.

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The ‘Dirty Weather’ Diaries of Reverend Davis, Northern New Zealand, 1839-1851

A two volume historical weather diary was recovered from the rare manuscripts archive at the Auckland City Library using a portable digital scanner. This work was authored by Reverend Richard Davis (1790-1863), who was a missionary in the Far North of New Zealand in the early to mid-1800s with the Church Missionary Society (affiliated with the Church of England). Davis was a prolific writer, evidenced by a biography that included transcriptions of letters he sent back to England. Davis was a self-taught academic, and kept meticulous meteorological records while stationed at Waimate North and at Kaikohe in the Far North of New Zealand. Recordings from these two sites comprise both parts of the meteorological diary set and collectively they cover nearly nine years across the 1839-1851 timespan. Richard Davis’ contribution to science has provided one of the earliest surviving land-based meteorological registers for New Zealand from the Colonial era.

Temperature measurements were taken at 9 AM and noon daily, and the journal also contains noon pressure data. It also has qualitative comments about prevailing windflow, wind strength, cloud cover, observations of climatic effects (such the influences of drought on vegetation and fauna) and weather extremes such as heavy rainfall with floods, thunder and lightning, hail, and even snowfall (which may actually be a description of a significant hail event). There are many comments scattered throughout the diary noting “dirty weather”, which Davis affectionately (and appropriately) uses to describe disturbed conditions characterized by strong winds and rainfall. Preliminary analyses suggest the Davis pressure and temperature data, and descriptions of local weather, could be corroborated using ship log data from Bay of Islands and elsewhere (including that penned by Captain Ross of the HMS Erebus which temporally overlaps with the Davis measurements). It is anticipated that the analysis of the Davis diaries will contribute to the ACRE project, and that this work will also extend our understanding of synoptic weather variability and climate changes that have taken place in the Far North of New Zealand during the latter part of the Little Ice Age to the present day.

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Climate Data Rehabilitation and Visualisation in Pacific Islands and East Timor

The climate of the Pacific is changing. Several scientific papers describing climate trends and variability in Pacific Island countries underpin our current understanding of climate change in the region. Complementary to the formal scientific process is the routine updating of climate change analyses. Currently, there is no operational, online source of climate variability and change information for the South Pacific.

A new climate change monitoring website has been developed for the upload, analysis and visualisation of climate data for observation stations in the southwest Pacific. The website is being developed under the Current Climate (data management and rehabilitation) component of the Pacific Climate Change Science Program (PCCSP). It is intended to be a robust and convenient source of climate change information, and the primary source of observational data for the research components of the PCCSP.

At present, climate variables available in the data portal include temperature, rainfall and mean sea level pressure at monthly, seasonal and annual timescales. Climate data is presented as timeseries graphs, and basic site information (metadata) is provided to assist users choose the location most appropriate to their needs. Data access is enhanced using MapServer and OpenLayers technologies to provide a range of interactive navigation controls such as map overlying, zooming and panning, and geospatial information layer rendering and switching.

The PCCSP station data portal includes both raw and homogeneous data series. RHtest, a software package developed by Environment Canada, is used to homogenise data. This normally complex task is especially difficult for the Pacific Islands and East Timor as little historical metadata is available, particularly for the last two decades. Regardless, data adjustments are generally only made where there is metadata support. Raw and adjusted trends for Samoa and Niue will be presented as examples.

Recent work on revising and updating the South Pacific Convergence Zone Displacement Index (SPI) will also be presented. Here recently discovered Suva and Apia metadata, nearby Suva Airport MSLP data and an alternative data homogenisation technique has resulted in an improved index which has a stronger association with Pacific Island rainfall and ENSO indices.

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NOAA's holdings at the National Climatic Data Center's (NCDC) Foreign Data Library (FDL)

This presentation will concentrate on paper holdings of mainly daily and monthly precipitation and temperature data existing for island areas in the Pacific east of New Zealand and in areas near the International Date Line. NCDC also has archived synoptic observations taken during the WWII era and beyond in the broader Pacific region. In addition, various data and summaries were exchanged between Foreign Meteorological Services and NCDC from the 1950's into the 1990's. This presentation will highlight these data sources - insuring that these (mainly) copies are archived at the host Meteorological service. However, NOAA's Climate Database Modernization program (CDMP) will also explore the need to image, scan, and or digitize some of these data and make it available for scientific research.

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Development of a Climate Early Warning System (CLEWS) in Samoa

The establishment of a Climate Early Warning System in Samoa follows many years of engagement by Samoa in international climate change fora. As a response to potential risks of climate change on the country's economy and infrastructure, and following intensive community and stakeholder consultations, Samoa's National Adaptation Programme of Action (NAPA) was developed. This presentation highlights the priority adaptation needs and projects of the current NAPA implementation phase, and reports on some progress and plans for the coming year. Current implementation work is focusing on the development of the climate network, the installation of the new climate database, and the improvement of climate services to agriculture and health.

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**Ko Te Kawa Tūpanapana i ngā hau tūpua o Tāwhirimātea –
Revitalising Māori Environmental Knowledge of Weather and Climate**

Indigenous knowledge systems are increasingly being recognised as alternative domains of understanding that in many cases are relevant to present-day societal challenges such as climate change. In New Zealand, rapid social, political and environmental changes have led a growing chorus of Māori to express the need to share “what we know” about the environment – including knowledge of environmental processes, change, risk and management. This presentation (i) reviews work conducted to date exploring the nature and character of Mātauranga Taiao Maori (MTM) or Māori Environmental Knowledge (MEK) – with a specific emphasis on local weather and climate, and (ii) explains the next steps (and challenges) involving Apanui’s PhD work ahead.

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Using Google Earth as a Visualisation Tool

A picture is worth a thousand words, and a geographically accurate picture of data is even better. Using free tools such as OpenOffice and Google Earth, environmental data can be migrated out of spreadsheets and projected onto the globe. This talk covers fundamental steps that are needed to transform climate and weather data into a format that can be understood by Google Earth, enabling its use as a visualisation platform and scientific research tool. A demonstration of basic visualisation will be offered, with examples from the Southwest Pacific. Key examples will include rainfall anomaly maps that can be played to show evolving regional patterns, differences within and between Pacific Island groups that change through time, spatial signatures that are related to La Niña and El Niño events, and tropical cyclone tracks. In addition, a demonstration using a seasonal climate forecast map projected in Google Earth amply demonstrates how multiple visualisation layers can be combined to provide useful climate guidance and forecast verification platforms for Pacific Island National Meteorological Services.

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Sources of Historical Marine Climate Data for the Pacific from Chilean and British Archives

The Pacific Ocean and in particular the south-east Pacific and high southern latitudes are significantly under represented with historical meteorological observations needed for computer generated historical weather reconstructions or reanalyses. For the 19th and 20th centuries, this deficiency can be corrected by the digitization of the high resolution sub-daily instrumental observations to be found in the logbooks of the navies of Chile and Great Britain, the meteorological registers of British and Chilean merchant shipping and the network of lighthouses along the coast of Chile. A significant portion of the relevant archive collections of both countries have been recently assessed and documented in detail in preparation for digitization projects aimed at retrieving instrumental air pressure, air and sea surface temperature (SST), wind direction and wind force observations as far back as 1790. Significant numbers of instrumental observations can be found from c.1840. The British Navy's Pacific Squadron was based at Valparaiso with frequent sailings north to the west coast of North American or south around Cape Horn. It is estimated that the British Navy logbooks alone will yield at least 600,000 pressure and 300,000 SST observations. Chilean archives contain Spanish logbooks from 1862 -1865 as well as the logs from the Pacific War 1879-1884, in which Chilean vessels, blockading Callao and Mollendo, recorded sea temperatures and meteorological observations at 4-hourly intervals. There are over 3,000 Chilean logbooks for the 20th century to 1960. From the 1850s onwards, the UK Met Office Archive has ship's meteorological registers recording 4 hourly instrumental observations on vessels sailing to and from Australia and New Zealand, Callao, Valparaiso and San Francisco. There are also vessels, mostly steamships, sailing from Hobart and Wellington towards the Drake Passage. Significantly some of these pass just north of the Antarctic Circle between 110° and 140° west longitude, where observations are particularly scarce. These sources should be a high priority for digitization and processing into climate databases, including the International Comprehensive Ocean-Atmosphere Data Set (<http://icoads.noaa.gov/>).