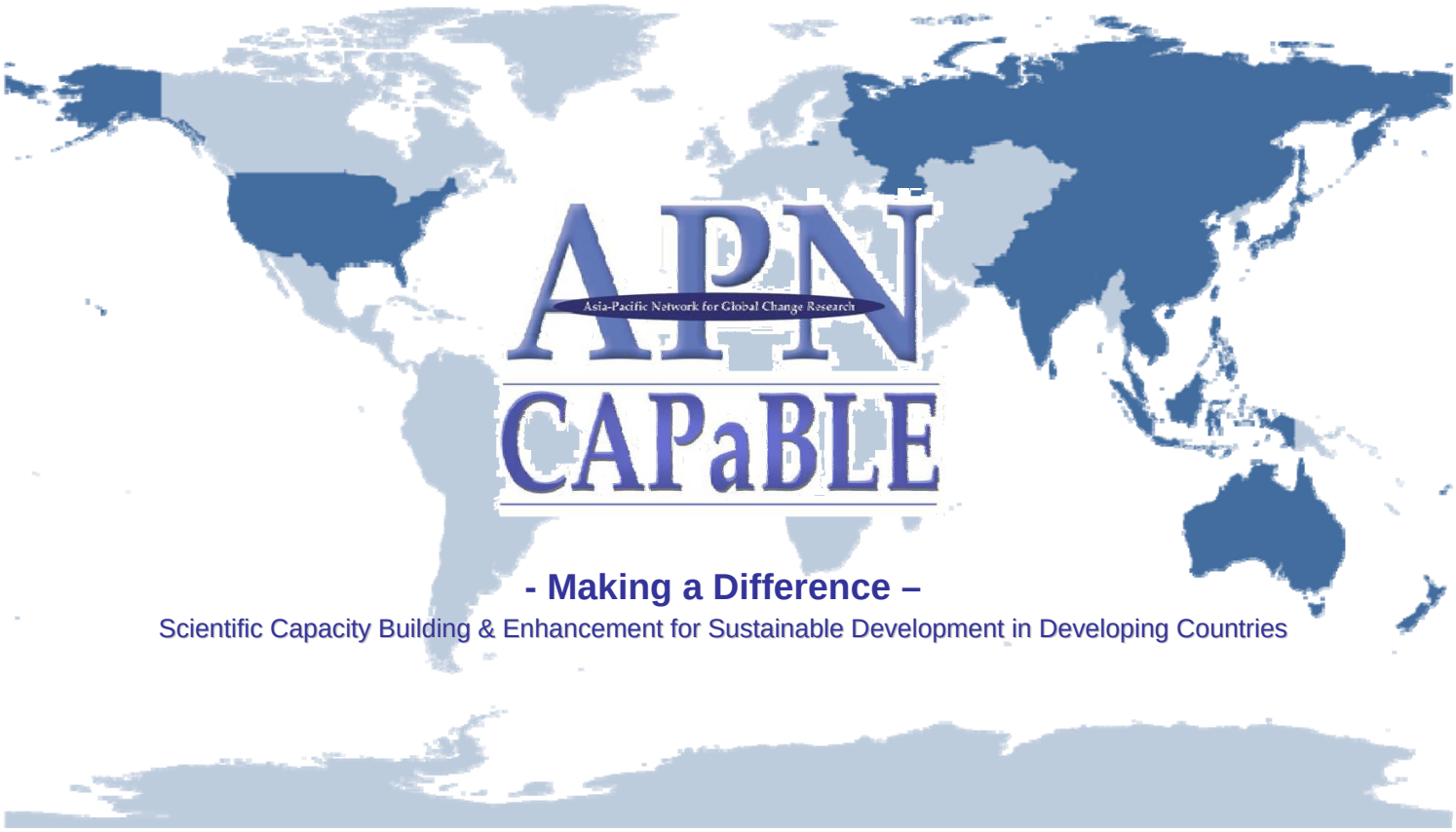
FINAL REPORT for APN PROJECT
Project Reference: CBA2010-05NSY-Lorrey



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

Andrew M. Lorrey, National Institute of Water and Atmospheric Research, New Zealand, a.lorrey@niwa.co.nz
Rob Allan, The Met Office, United Kingdom, allarob@gmail.com
Gilbert P. Compo, NOAA-CIRES, USA, Gilbert.P.Compo@noaa.gov
Howard Diamond, National Ocean and Atmospheric Administration, USA, howard.diamond@noaa.gov
Joelle Gergis, University of Melbourne, Australia, jgergis@unimelb.edu.au
Simon McGree, Bureau of Meteorology, Australia, s.mcgree@bom.gov.au
Representatives of the Pacific Islands National Meteorological Services

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

Project Reference Number: CBA2010-05NSY-Lorrey
Final Report submitted to APN

PAGE LEFT INTENTIONALLY BLANK

OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

A workshop was held in Auckland, New Zealand on emerging climate research programmes focused on the southwest Pacific region. Climate scientists, meteorologists, physical geographers, social scientists, and information technology specialists from many nations were in attendance. The participants included representatives of Pacific Island National Meteorological Services (PINMS), who were engaged about cutting-edge research techniques that use rescued climate and weather data from their region of the world. Amongst the many presentations about weather and climate research, training was provided on new visualization methods for analyzing weather and climate data using GoogleEarth and the NOAA 20th Century Reanalysis (20CR) (Compo et al., 2011).

The interests and concerns about climate and weather monitoring, data stewardship, database development and research using Pacific Island meteorological observations were raised by the PINMS representatives. All the attendees expressed their willingness to participate collegially in new research that clearly has potential to benefit the region. This workshop helped to address some of the gaps that APN GEOSS has identified for capacity building needs in the Pacific region, including collaboration with new science initiatives, increasing regional opportunities for gaining research experience, and with a central focus on the priority actions of rescue, interpretation, and use of archived meteorological and climate data.

The workshop representatives supported the formation of ACRE Pacific, which will seek to recover, digitize, share, and submit daily surface pressure measurement contributions from each Pacific island nation. This will be done to enhance the spatial and temporal coverage of the 20CR dataset. It is hoped that the contributions of the small island nations and territories in the southwest Pacific will result in large improvements in the quality of reanalysis data and climate science targeting understanding Pacific-region weather and climate variability. In particular, delegates in attendance wish to see increased opportunities for involvement on research related to the El Niño Southern Oscillation, tropical cyclones, climate and weather forecasting, and the South Pacific Convergence Zone.

Objectives

The main objectives of the project were:

1. Engage PINMS as contributing members in new research projects that are newly underway in the South Pacific region
2. Improve the knowledge streams between PINMS and new research projects on how major climate drivers and variability impact the region
3. Transfer skills in the use of visualization tools from the new projects to PINMS via training and support

Amount received and number years supported

The Grant awarded to this project was:
US$ 40,000 for Year 1:

Activity undertaken

The workshop consisted of a mixture of talks, question and answer panels, round-table discussions, demonstrations, and interactive tutorials. It was held over a four day period at the National Institute of Water and Atmospheric Research in Auckland, New Zealand.

Results

The primary goals of this APN project were to increase Pacific Island Meteorological Service awareness and stimulate their involvement in emerging climate and weather research initiatives that pertain to the Southwest Pacific. Primary aims of holding the workshop were to highlight the breadth of research currently active in the region, and identify new opportunities for training and expanding capacity for weather and climate research for climatology officers stationed in the vicinity. A commonality of the research projects that were presented at the Auckland APN workshop was recovered historical data. Data rescue is not a new topic or concern for the southwest Pacific, and there is a long-standing commitment from PINMS to the recovery of analogue data and climate archive stewardship in general. However there are some archives in the region that are perceived as being at risk, despite some initial steps that have been taken to ensure further deterioration of paper data will not occur in the future. An additional goal was to gain feedback about visualization tools that had been developed.

A key project that was highlighted at the workshop was the Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative. Many of the presentations showcased research at the workshop that draw on data that ACRE has either directly provided, or that use a new reanalysis data set (the 20th Century Reanalysis - 20CR) that ACRE data rescue efforts has helped to create (Compo et al., 2011). The urgency of obtaining access to meteorological data in analogue format that has been rescued but not digitized was discussed in terms of the improvements that could be made to 20CR. Coordination from the region will be needed in order to fulfill obligations to submit new data in a series of rolling updates planned for years ahead.

Moreover, new data visualization techniques and use of the rescued data for research and climate services initiatives were discussed with the representatives. Perceived benefits of this workshop suggest PINMS will gain increased access to emerging knowledge about regional climate dynamics, partake in generating that knowledge, and gain new access to tuition on rescuing data and use of the tools that are developed for the analyses. The thrust of data rescue and archive stewardship central to ACRE Pacific will also help regional efforts aimed at developing and maintaining databases, and enabling access to new tools that can support more effective communication about weather and end users of Pacific Island climate guidance. This activity is complementary to other initiatives in the region that are aiming to improve database capabilities and the interactive use of climate and weather data in portal-based analyses that can provide better advice to end-users (see Pacific Climate Change Science Programme).

Relevance to the APN Goals and Science Agenda, Scientific Capacity Development and Sustainable Development

Climate science experts from North America, Europe, Asia, Australia, and the Pacific region presented cutting-edge new research projects and tuition on visualization approaches that can be taken up by PINMS. The training and demonstration component of the workshops included use of GoogleEarth for analyzing spatial details in large data sets. Some scanning and recovery techniques were also demonstrated. The low cost of both the software needed to visualize the data and to obtain hardware for data rescue suggests tools developed through the research products, the research results, and the central initiative of teaching data rescue techniques have scope to be applied immediately.

The 'hands-on' learning session was an opportunity to gather valuable feedback about how the visualization tools underdevelopment can be rapidly improved for greater uptake and for communication purposes. The opportunity provided at the meeting for the APN scientists and other collaborators suggests a future symbiotic relationship in the Pacific climate science arena is developing. Through this relationship, mutual benefits of research using historical archives that can benefit applied science can be realized.

The lecture sessions were informative and educational for the PINMS participant standpoint. Many PINMS participants were climatology officers who regularly deal with information, and some have a good level of familiarity with current research on the topics that were covered. All participants had the opportunity to update their knowledge about emerging tools, and share ideas on how their specific PINMS situations could be improved with support in tool development visualization.

Self-evaluation

The workshop succeeded in arranging a wide array of participation from non-governmental assistance organization, meteorological services staff members, climate researchers and meteorological researchers, and there was general agreement on the potential for future collaboration.

Potential for further work

APN support for this workshop is critical to strengthening the South Pacific regional climate science network, and sharing knowledge about major climate drivers and variability that impact the region. Secondments at NIWA, pilot projects, improvement gradually to 20CR and its follow-on, SIRCA, are expected. Facilitation of future collaboration will be done through ACRE Pacific.

Publications

Diamond, H.J., A. Lorrey, K.R. Knapp, D. H. Levinson, 2011: Development of an enhanced tropical cyclone tracks database for the southwest pacific from 1840-2009. International Journal of Climatology, Accepted.

Lorrey, A. 2011. Improving Pacific Island meteorological data rescue and data visualization capabilities through involvement in emerging climate research programmes. APN Science Bulletin, 1, 64.

Lorrey, A.M., Dalu, G., Renwick, J., Diamond, H., and Gaetani, M., 2011. Reconstructing the South Pacific Convergence Zone position during the pre-satellite era: a La Niña case study. To be submitted to Monthly Weather Review.

References

Compo, G.P. and 26 others. 2011. The Twentieth Century Reanalysis Project. Q.J.R. Met. Soc. 137, 1-28.

Acknowledgments

We thank NIWA, NOAA and the New Zealand Ministry of Foreign Affairs and Trade for partly supporting related activities that contributed to this project.

TECHNICAL REPORT

Preface

Rescued weather and climate data can extend our understanding of the past, and improve our ability to make sustainable and well-informed development decisions, including the formulation of short- and long-term adaptation strategies. A workshop was held in Auckland, New Zealand to draw together researchers from emerging climate and weather science projects and representatives of the Pacific Island National Meteorological Services. The workshop had a wide array of presentations, demonstrations of visualization tools and discussion on data rescue. The consensus amongst participants saw the formation of ACRE Pacific, which will help to coordinate future data rescue efforts in the region.

Table of Contents

1.0 Introduction

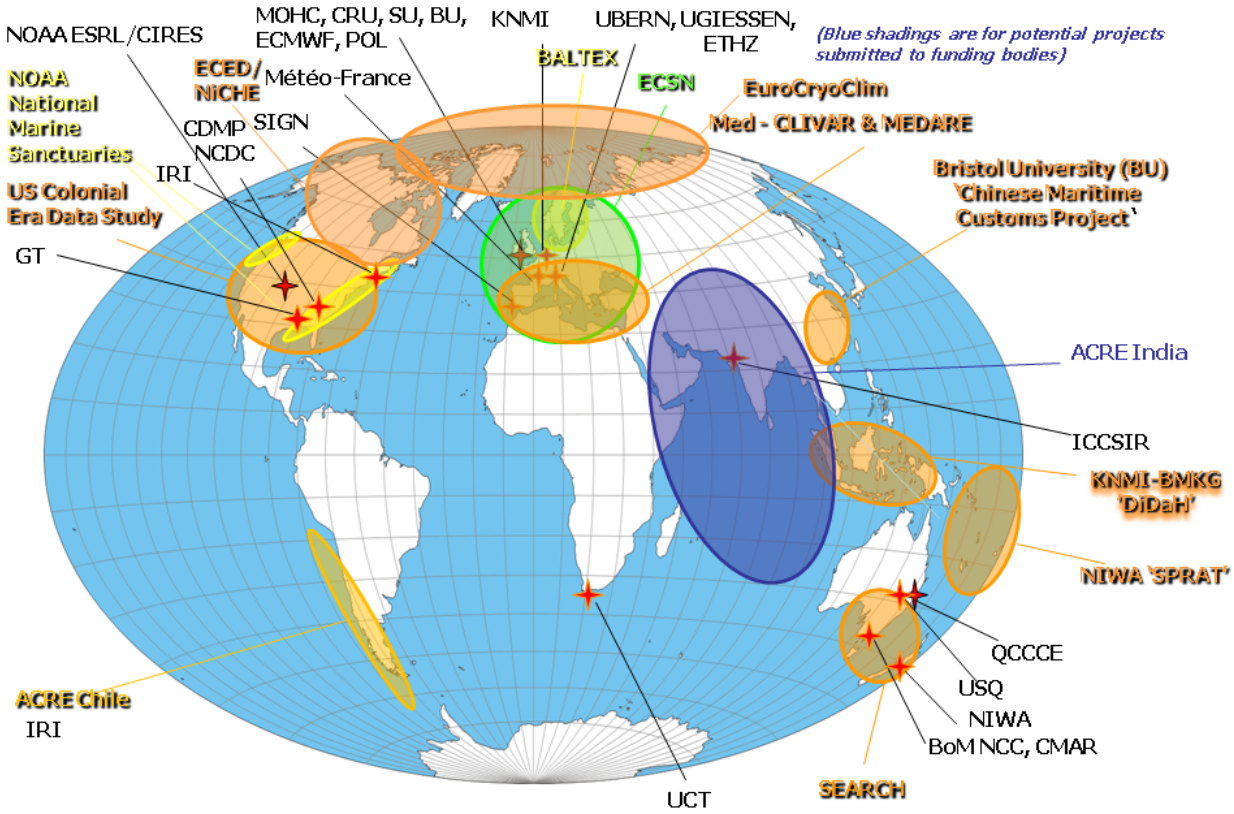
The collection, preservation, and digitization of climate observations from the Pacific region have recently been undertaken in a cooperative effort between Pacific Island Meteorological Services and the National Institute of Water and Atmospheric Research (NIWA, New Zealand). Collectively, the activity of obtaining archived paper data and securing it for future use is termed 'data rescue'. Many original meteorological records in this region still exist solely in paper format. There is a constant and significant risk of loss or degradation of these records in the Indo-Pacific region due to harsh tropical and sub-tropical environmental conditions. Many meteorological services in developing countries have insufficient funds to support climate-controlled archives. As a result, assistance toward securing weather and climate data and their associated metadata (complementary information such as site, sensor, or data descriptions and issues) in a digital format, as well as repatriating data from international archives to countries where they were gathered is essential to minimize data vulnerability, and to facilitate information access for scientific study of Pacific Island climate variability and change.

Use of rescued data in climate analyses can help improve Pacific Islanders ability to make sustainable and well-informed development decisions, and can greatly assist in formulating short- and long-term adaptation strategies. Choices Pacific Islanders currently face have to address significant challenges that are posed by climate variability and change from seasonal to multi-decadal time scales. Longer, detailed climate records can enable better climate prediction capabilities, and can improve testing runs for models that generate seasonal climate forecasts and future scenarios. Robust, spatially diverse and site-specific data sets and analyses that are enabled by rescued data therefore provide avenues toward improving decision-making within Pacific economic sectors that are impacted by climate variability and weather extremes.

In the Indo-Pacific region, meteorological data are presently being sought and utilized by four new climate research initiatives: **ACRE** (the Atmospheric Circulation Reconstructions over the Earth), **SPRAT** (the South Pacific Rainfall Atlas), **the Southeast Australia Project**, and the KNMI-BMGK '**DIDAH**' project in Indonesia (here forth referred to as 'the Projects'). The Projects are all aimed at improving our understanding about how the Earth's climate system works.

At the 13th Regional Meteorological Services Directors (13RMSD) meeting in Nadi, Fiji (May 2009), brief overviews of SPRAT and ACRE were provided to the delegation. A unanimous endorsement to support the Projects by supplying meteorological data was given, but also a recommendation was offered that further involvement of the meteorological services in the research should be achieved. The APN funding that was requested for this workshop in Auckland was a key stepping-stone toward that recommendation, and attempted to follow through on efforts to improve on data sharing and collaborative research suggested for WMO Regional Association 5 (RA5). All of The Projects are intertwined at an international level, and are still gaining momentum.

ACRE currently has a WMO, GEO, GCOS endorsement, and wide international support & the aid of various working groups of GCOS & WCRP, to provide 'an umbrella' that links together some 35+ projects, data rescue, climate science, climate applications, education, & outreach activities around the globe (see figure below).



International Projects, Sources & Repositories linked to ACRE

IEDRO ICOADS ISPD WMO DARE RECLAIM GLOBE GLOSS ETCCDI VACS ICHM Galaxy Zoo
CoRRaL EU FP7: EURO4M EU FP7: ERA-CLIM NERC: AUSTRAL

ACRE is actively undertaking and facilitating the recovery, imaging and digitisation of millions of historical instrumental surface terrestrial & marine global weather observations (ftp://ftp.ncdc.noaa.gov/pub/data/ispd/add-station/). This effort is helping to underpin successive dynamical 4D global weather reanalyses every 6 hours at currently 2 latitude x 2 longitude resolution (56 realizations) assimilating only surface synoptic pressure, monthly SST & sea-ice observations over the last 200-250 years.

A serendipitous outcome of all The Projects and their linkage to ACRE (to obtain and analyze new and previously unavailable historical climate data) is their potential to make a large contribution to the NOAA-CIRES 20th Century Reanalysis Project and SIRCA for the western and southwest Pacific region. The NOAA-CIRES effort is a state-of-the-art supercomputer integration of weather data to generate a reconstruction of Earth's weather into the 1800s. The NOAA-CIRES 'reanalysis without radiosondes' is based solely on atmospheric pressure data that are drawn from archived historical surface observations with daily and sub-daily resolution. It will surpass the classic ERA40 and NCEP reanalysis period, quintupling the time span that presently extends only to 1958. The exceptional length of time that will be covered by the new NOAA-CIRES reanalysis means significant and new analyses of the past can be undertaken to improve our knowledge of weather and climate. Undoubtedly, the effort of all these projects working in concert will help improve the quality of scenarios of future change in the Pacific region.

In essence, the reanalysis without radiosondes project is a major leap forward in climate and weather science, in that it allows the structure and dynamics of the atmosphere to be interrogated

in four dimensions and seen using visualisation tools. Major aims of having a reanalysis data set and tools to interrogate the reconstructions that extend beyond the mid-20th century for the southwest Pacific include the ability to conduct investigations on:

1) Historical tropical cyclone activity
2) Historical ENSO events and dynamics
3) Major drought episodes
4) Variability of large-scale atmospheric circulation indices
5) Key climate drivers of rainfall variability plus tracks and intensities of tropical and extra-tropical cyclones
6) South Pacific Convergence Zone (SPCZ)
7) The Southern Annular Mode
8) Inter-decadal Pacific Oscillation

The Projects all have a strong visualization element and a unique use of historical accounts and observations 'rescued' from archives to reconstruct past weather and climate change. Help is needed from the PINMS now to find, retrieve, and make more of this type of information available for the research. It was recognized early on that the tools used in the Projects to visualize rescued data could also benefit PINMS, and therefore there is a significant opportunity to provide new skills, resources and training that can assist in generating local weather and climate guidance products. Overall, this assistance and type of collaboration can improve capacity building with in PINMS and thereby lessen reliance on externally published visual aid resources.

The goals of hosting a workshop were to showcase the array of current research and raise awareness of being involved with PINMS representatives. Focuses related to the Projects, and sessions in the workshop covered:

1. Identification of terrestrial and marine paper records; Past, present, and future sources
2. Rescue of paper records into secure storage (deterioration prevention)
3. Assessing the value of older, non-meteorological service affiliated documentary
4. records (ship and missionary logs, harbour master series, agro-meteorology etc.)
5. Imaging, digitisation, homogenization, and post processing quality control
6. Use of data in meteorological service documents and analyses
7. Archiving digitized data, data formatting, and data access for regional research

2.0 Methodology

Dr. Andrew Lorrey convened the workshop as head coordinator, and was assisted at NIWA by support staff, including Davina Ashford who handled much of the groundwork organizing the participants travel and accommodation.

The organizational time line was as follows:

June 2010: We hosted the first planning meeting for the workshop at the NIWA-Auckland office. This was achieved via teleconferencing with PINMS representatives through the Island Climate Update monthly teleconference and international collaborators via Skype. A preliminary programme for the workshop was developed with the major collaborators on the project, and this included an outline of lectures on key regional projects using rescued data, demonstrations of data visualization techniques, and training sessions on analysis of data and generation of graphics outputs for climate forecasting bulletins using new tools. An unforeseen but valuable contribution to the programme was a special segment on traditional environmental knowledge in the southwest Pacific. This special type of weather and climate research generates observational, qualitative data through multidisciplinary social, physical geography and cultural lines of enquiry. As such it was important to recognize this research facet for the southwest Pacific region, which includes Polynesian, Melanesian, Micronesian, and Australian Aboriginal indigenous cultures. Moreover, this facet of research is complementary to the recovery of old instrumental data, and in some unique cases, it can be used as a way to corroborate colonial era instrumental recordings for extreme events (tropical storms, drought, floods, etc).

July 2010: Notification of the workshop activity was posted in the Island Climate Update Issue 118 and prospective participants were solicited via the ICU email list. The Pacific Island Delegates were requested from each PINMS via a letter of invitation to the meteorological service directors. This followed an oral notification provided via the Island Climate Update teleconference in the second week of July 2010. A group email list for interested parties was assembled, and a complete list of institutional affiliations and contact details of all prospective participants was compiled by the end of the month.

August 2010: An official invitation for participants was crafted and subsequently emailed out. Logistics for catering, flights, ground transport, per diems, and accommodation for PINMS participants and invited guest lecturers was arranged by NIWA staff. It should be noted for future activities similar to this one that accounting for the high costs of support staff who can focus on undertaking this activity is needed, particularly because logistics of transport span more than a dozen countries and frequent changes are often required. A second teleconference for prospective programme participants was held late in the month. A finalized workshop guest and participant list was issued to the group. Observers from SPREP and SOPAC were invited to attend, and those organizations were asked to publicize the event.

September 2010: The workshop was hosted in Auckland at NIWA. A summary of the workshop is included in the results section, and the presentation abstracts can be found in the Appendix. A photograph of meeting participants is shown below.

Participants of the Asia-Pacific Network for Global Change Research workshop on "Improving Pacific Island Meteorological Data Rescue and Data Visualization Capabilities through Involvement in Emerging Climate Research Programmes" Front Row (L-R): Pene Lefale , Brett Mullan, Philip Brohan, Georgina Griffiths, Kassis Inape, Simon McGree, Sunny Seuseu, Robson Tigona, Rob Allan, Andrew Tait, Fiona Tutai, Arieta, Andrew Lorrey. Middle Row (L-R): Gil Compo, Loia Tausi, Felicia Pihiga, Mac Benoy; Third Row (L-R): Tom Ross, Selu Finaulahi; Fourth Row (L-R): Teddy Allen, Reggie White, Lloyd Tahani; Top Row (L-R); Petra Chappell, Linden Ashcroft, Joelle Gergis, Alan Porteous (not shown: Lino Fiapati, Ueneta Torua, Darren King, Apanui Skipper)

October - November 2010: A draft workshop report was crafted with workshop collaborators via email exchanges.

December 2010-January 2011: Circulation of the draft report to all participants via email and receive feedback. Iteratively roll in comments during the review process.

February – May 2011: Internal review of a final draft at NIWA was done for quality control and the report and project recommendations were finalized.

June 2011: Project completion report and financial reporting of workshop outcomes to APN.

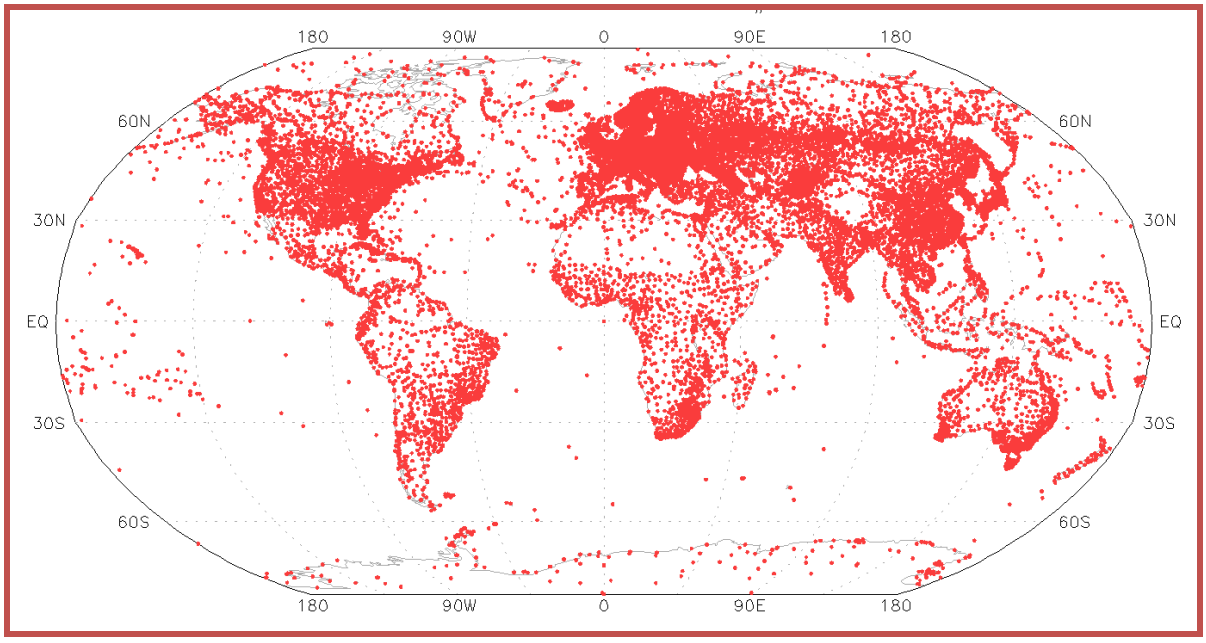
3.0 Results & Discussion

3.1 International Projects with a global focus

After a brief overview of the ACRE project by Rob Allan (UKMO), details of the 20th Century Reanalysis Project (20CR) and the follow on Surface Input Reanalysis for Climate Applications (SIRCA) were provided by Gilbert Compo (NOAA-CIRES). The purpose of this presentation was to inform the PINMS representatives of the opportunities for use of data collected in the region in the reanalysis visualizations. He demonstrated:

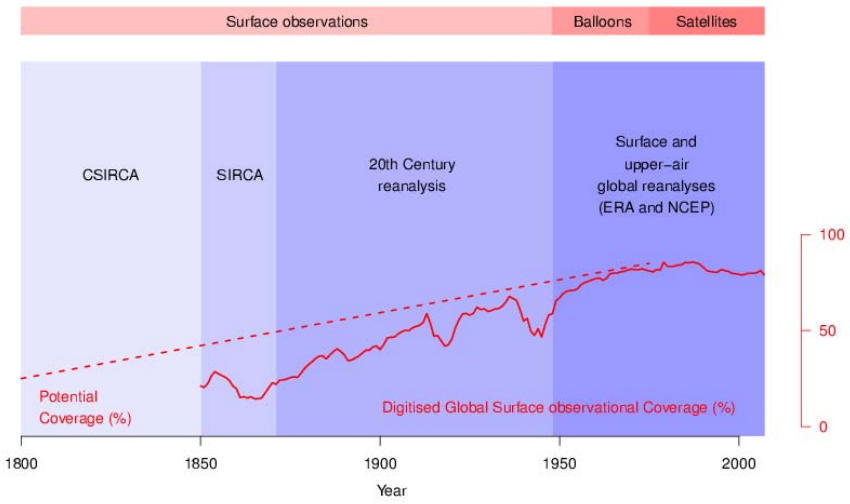
- The importance of 20CR and SIRCA for global climate research, climate applications, extremes analysis, risks and impacts needs assessments, relevant to educators & students & the general public,
- Demonstrated that a web-based interface to store, allow access to, & enable visualisations of the raw data, data images, metadata through to all of the variables generated by the 4D global weather reanalyses were the end goal of the project
- Pacific Island Meteorological services have the capability of improving the data quality and science conducted in the region that is based on 20CR and SIRCA by participating in the data rescue and data donation effort of ACRE.

The last point was made very clear using a depiction of the globe (below) which shows locations where some surface data for the reanalysis without radiosondes project has been sourced from. Essentially, the southwest Pacific Islands cover one of the largest portions of the map in the Southern Hemisphere but aside from the Antarctic and open ocean, have one of the least dense spatial coverage. Thus, any existing data are critical to include for the global representation in 20CR and SIRCA.

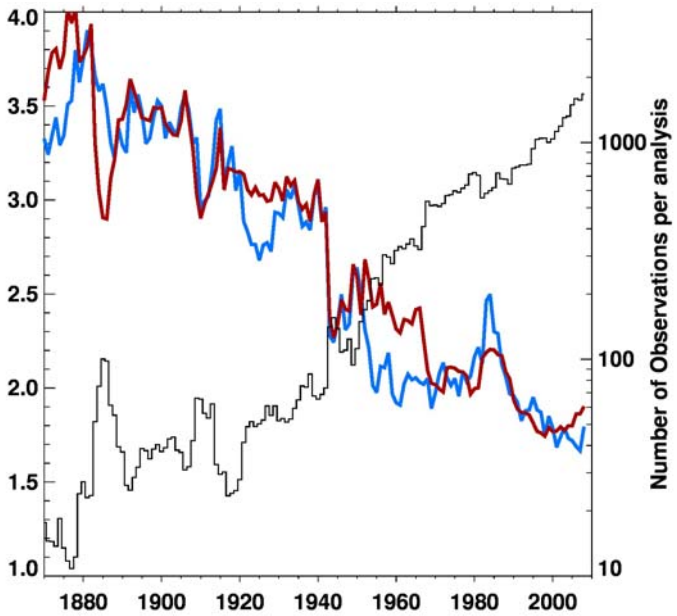


Dr. Compo also demonstrated how the variations in the surface data changes through time, and what might also be expected of the reconstruction offered by 20CR and SIRCA as a result. The figures below (drawn from his presentation) shows several thrusts of the reanalysis without

radiosondes project, aligned to targets of spatial coverage for the globe. Note the characteristic downturn of coverage during WWI and WWII, which may be able to be supplemented by de-classified military records. Overall, the diminishing number of stations back in time means alternative data sources (like those from ships logs exploring the region during the late 18th and early 19th century or personal diaries) might be required to raise the sample depth to critical levels for the southwest Pacific.



The presentation Gil Compo provided also suggested that the quality of the reconstructions offered by the reanalysis without radiosondes project very much hinged on the spatial and temporal density of data being fed into the analysis. The figure below shows surface pressure uncertainty estimates poleward of 20(S,N). The relationship suggests that the exponential decrease in observations translates to a linear increase in the error, indicating that even small additions from small island nations in the middle of the southwest Pacific can make a large difference in the quality of 20CR and SIRCA representation for the region.



3.2 International research projects with a Pacific Region focus

Historical climate and weather research using rescued data were covered by multiple presentations, and were kicked off with talks on a couple of key projects from the southwest Pacific. The first was from Dr. Joelle Gergis (University of Melbourne) who leads the SEARCH (Southeast Australia Recent Climate History) project, and a follow-on presentation was given by Ms. Linden Ashcroft who is a PhD researcher with SEARCH. The major aim of that project is to improve knowledge about the range of natural climate variability in southeast Australia, and one component includes examining pre-C20th historical source (early settler accounts, newspapers, government records, weather/farm diaries, early observatories).

Another project presented on was The South Pacific Rainfall Atlas (SPRAT), which is collating historical rainfall data from south Pacific Islands to look at the South Pacific Convergence Zone (SPCZ) and ENSO, and how the these two drivers are intertwined. Significant local impacts linked to the SPCZ have included acute events that caused floods recently seen in Vanuatu and Fiji (see photograph below). SPCZ displacement is also important for generating anomalous wet periods and droughts across the region (Lorrey et al., 2011). Having historical knowledge of past rainfall traits linked to SPCZ and ENSO behaviour is paramount for preparedness and risk assessments in the small island nations of the southwest Pacific. SPRAT is intended to be a resource that contains standardised reference maps derived from consistent climatologies to explain regional rainfall patterns and anomalies for the southwest Pacific. Regional reference material in atlas format will be able to be accessed by PINMS, and there will be additional versions for non-specialists. Both of the aforementioned historical climate and weather research projects are rescuing data relevant for the Southwest Pacific, and making submissions to ACRE. In addition, both projects have opportunities for PINMS to become involved in the data rescue process.

Flooding in Fiji during January 2009 due to SPCZ-related rainfall (photo courtesy of Fiji Meteorological Services)

3.3 Data holdings and data rescue of instrumental and traditional knowledge

Data rescue effort session was led off by Tom Ross (NOAA) who gave an overview of The Climate Database Modernization Program (CDMP), which is an international example that has relevance for archives in the southwest Pacific that need updating. CDMP has a goal of preserving and making major climate and environmental data available via the World Wide Web, and the project supports data stewardship through all of its activities. Types of data rescued through the CDMP include:

- Forecast Warning Analysis
- Voluntary U.S. Observers
- Global Weather Reports
- NCEP Weather Charts & Models
- Ship, Buoy Reports
- Rocketsonde
- Weather Balloons
- Storm Data
- Doppler Radar
- GOES, POES, NPOESS, and many other Satellites
- Aircraft Observations
- Wind Profiler
- Airport Weather Reports (ASOS)
- U.S. Climate Reference Network
- Climate Models

The premise of NOAA's CDMP programme is that "an informed society that uses a comprehensive understanding of the role of the oceans, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions." Analysis of environmental data of the past contributes to that understanding. Thus far, CDMP has made 54 million weather and environmental images available online, including hundreds of millions of digitized records (including historical photos relevant for climate change research – see photos below).

Imaged Records Example:
Glacial Pairs – Muir Glacier, Alaska

CDMP contractors have specialized equipment to scan difficult media while preserving its physical state. Tom's overview of this equipment was very relevant for the data rescue session, and

highlighted there are significant costs and infrastructure associated with data rescue. Some of the equipment includes digital cameras and camera stands (see photos below) used by technicians that are trained to image the documents (including checks of quality, exposure and completeness). Image capture and preservation noted by Mr. Ross' presentation highlight a very important second step in the data rescue process, which ensures that no further deterioration occurs. In addition, the digital files created helps by allowing access by multiple personnel to the same rescued document, which can inevitably speed up the rescue process. Also noted was that for some archives, the end-to-end process can take 1-3 years depending on complexity and amount of data to be imaged/keyed. This means substantial financial and human resources are often needed for data rescue projects.

A follow on presentation was given by Mr. Teddy Allen who represented the International Environmental Data Rescue Organization (IEDRO). IEDRO (www.iedro.org) works primarily with foreign national meteorological services to *organize*, *inventory* and *photograph* historic weather observations. IEDRO generally works with the United Nations list of poorest countries, and aims to recover the oldest data or data in greatest jeopardy. Recently there have been negative trends in the amount of data that IEDRO has recovered, despite a large contribution they have made in years past to the global rescue effort. The reasons provided for this negative trend in recovery were:

1. Lack of consistent funding: Government funds temporarily stopped for 8 months in 2008 resulting in *no replacement equipment*, and *no visits*. The sites that had been targeted lost interest. Equipment disappeared. Staff went on to other duties.
2. Lack of understanding by the sites of the worth of rescued data: Their reason for beginning a data rescue project was to primarily to clear up storage space.
3. Lack of a data rescue 'zealot' at each site: Regardless of the funding availability, the need for the data or any political pressure to perform, without a champion, most projects die.

Mac Benoy's presentation covered practical aspects of organizing, managing and completing data rescue projects (including workflow, hardware, imaging standards, freeware tools, staffing and funding) with an emphasis on establishing guidelines and reference points for similar initiatives using volunteers. This presentation echoed the sentiment of that covered by IEDRO representatives, and suggested volunteers hosted by a reputable weather and climate agency or an online initiative with quality control (much like a citizen science activity – see abstract and presentation of Brohan, this workshop) could help to image and key data to a high standard.

Several presentations also focused on rescue of indigenous traditional environmental knowledge in the southwest Pacific region. Darren King provided an overview of community-based participatory research conducted by NIWA's Māori Environmental Research Centre (Te Kūwaha o Taihoro Nukurangi). In that presentation, several case studies were used to demonstrate the importance of understanding the context-specific vulnerability, risks and adaptation options currently facing Māori coastal community to climate- and weather-related coastal hazards. It was also illustrated how traditional environmental knowledge, and methods used to gather that knowledge, are underpinned by Māori values and aspirations, and how this subsequently can play an important role in contributing to forming solutions. Apanui Skipper followed this with a presentation that suggested indigenous knowledge systems of New Zealand Māori can be gathered and shared – including knowledge of environmental processes, change, risk and management. Pene Lefale provided an overview of traditional ecological knowledge of weather and climate in Samoa, which shows Samoans have a unique seasonal calendar predominantly based on the observations of local environmental changes influenced by weather and climate. Monitoring changes in plants and animal behaviour, dictation of communal and family social activities like hunting, fishing and feasting are linked to 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.

All of the traditional environmental research that was presented in this session is multi-disciplinary in nature, and suggests recovery of information about past environmental changes, past severe events and the social stories connected to those events are complementary (and sometimes more comprehensive than) the reconstructions that are being attempted via 20CR and SIRCA using rescued surface data. As such, future work to examine the past (particularly extremes) using the extended reanalysis without radiosondes dataset should try to seek out corroboratory information from those involved in IEK research in the region. This suggestion has already had a test with recent tropical cyclone historical data rescue for the region.

3.4 Analyses and applications

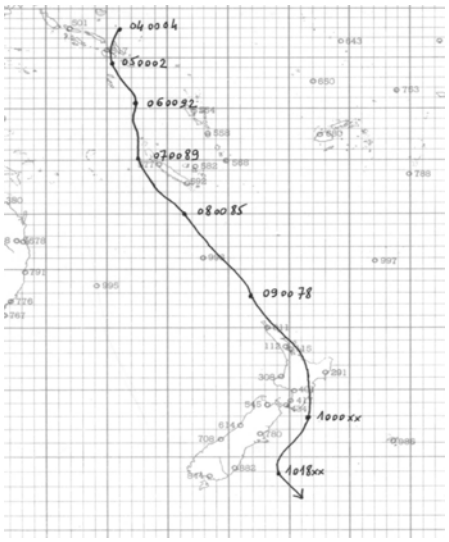
Georgina Griffiths (NIWA) and Simon McGree (BoM) presented analyses using rescued data. Their collective work indicated for the southwest Pacific:

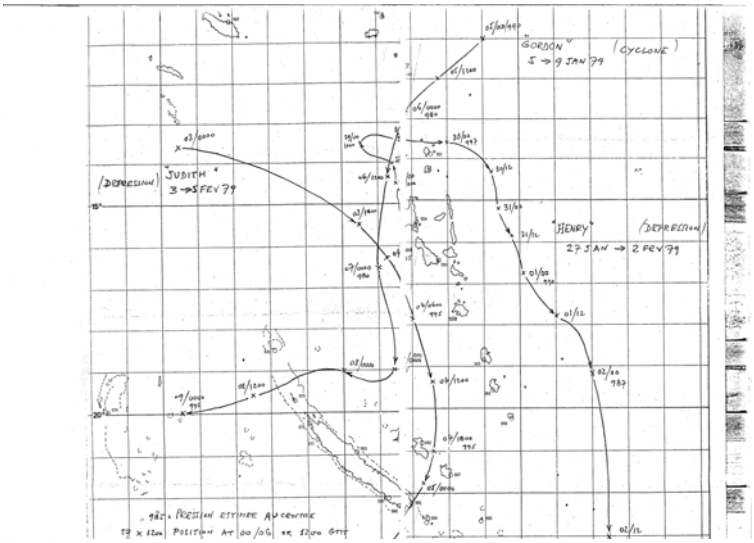
- There are large amount of scanned metadata and data
- Analyses of daily, monthly, seasonal and annual time series are desired,
- Analyses of daily Tmax, Tmin, rainfall extremes can be undertaken as quality allows
- An extremes analysis relies on data quality,
- Outliers (extremes) need to be checked – esp.(untagged) > 24 hour rain accumulations
- Some extremes/outliers are not real; i.e. typos, data entry problems, inches to mm conversion mistakes
- Need to carefully check exposure & site changes, too.
- Indices can be generated if there is enough data available
- Data rescue is crucial to understand past Pacific climate variability, as well as model future climate variability & change.

3.5 Interactive visualization exercises: tools using rescued data

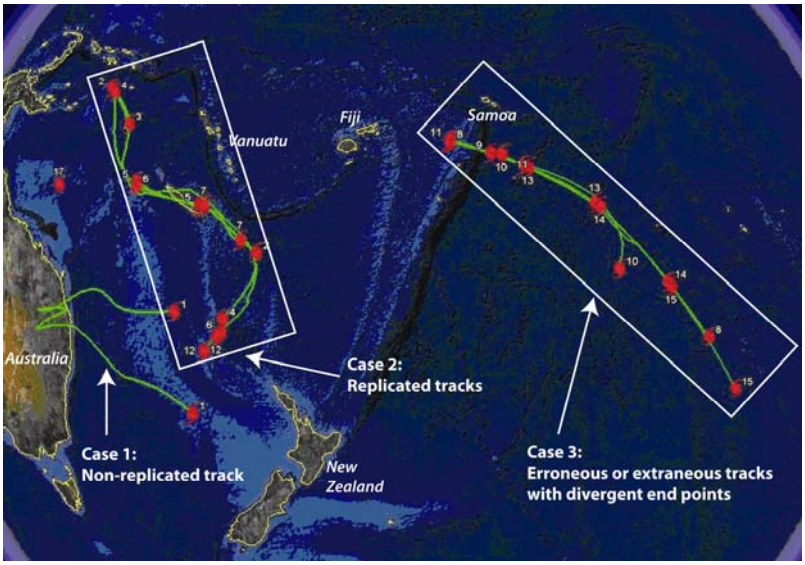
3.5.1 Tropical cyclone research

A presentation on the rescue of past tropical cyclone track data was provided by Howard Diamond, who demonstrated the breadth of data available for this area of research in the southwest Pacific region. Work Mr. Diamond has led utilized the International Best Tracks for Climate Stewardship (IBTrACS) project archive, and has enhanced what IBTrACS has done by scouring the paper archives around the southwest Pacific region to capture and digitize as much additional data as possible and also to quality control new as well as existing data. The scans below represent some of the old information that has been incorporated into the new analysis.





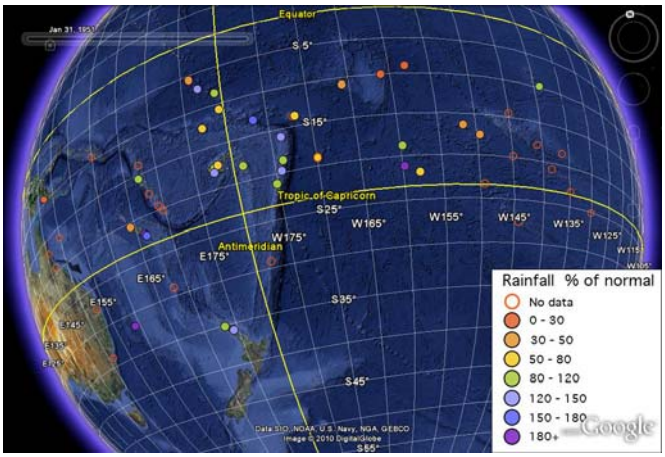
A significant part of the quality control on the rescued tropical cyclone data was done by developing a new method, the Graphical Interpretation of Tracks (GrIT), to visually inspect the tracks interactively (see figure below). This process was done in GoogleEarth uses a set of objective and subjective criteria to assist in making judgments about data quality, data repetition, and better refine the overall dataset. The result of that work produced an enhanced dataset that can now be used to characterize the climatology of TCs in the Southwest Pacific.

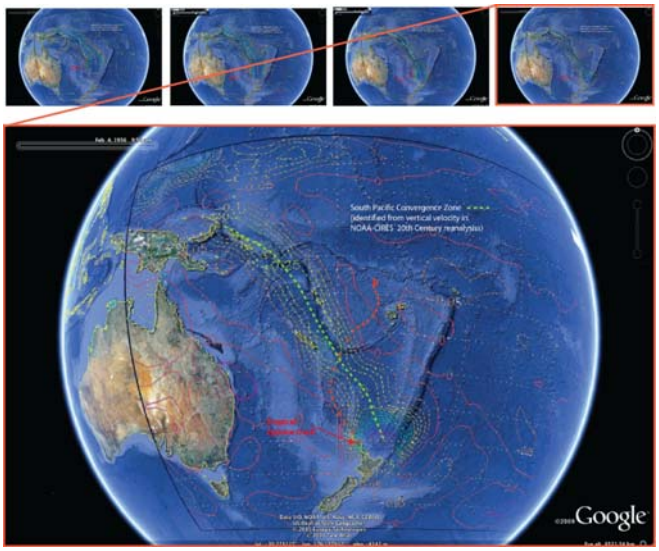


A hands-on demonstration of the GrIT quality assurance method was provided following the presentation by Mr. Diamond. Examples provided There were three cases of tropical cyclone track morphology variants discussed that were to be identified using GrIT in the hands on process: (a) non-replicated tracks – single storms, (b) replicated tracks - having similar spatial and temporal characteristics (start and stop) within a 7-day window, and (c) erroneous or extraneous tracks with divergent points.

3.5.2 Rainfall, ENSO, and SPCZ research

A presentation on the South Pacific Rainfall Atlas and visualising station-based rainfall anomalies and reanalysis data was provided in a training session. Each participant was given a test copy of a GoogleEarth KMZ file that contained several years of rainfall plots for various Pacific Island countries (below, upper part of figure). Navigation within the program was taught, including finding stations within countries and the metadata (station name, WMO number) and the meaning of plotted symbols. Subsequently and animation in GoogleEarth using graphics generated by 20CR was demonstrated (below, lower part of figure) for the audience to show the relationship of the South Pacific Convergence Zone to tropical cyclones. Feedback on those visualisation tools is discussed below.





3.6 Discussion about regional research and recommendations

3.6.1 Sentiment of Pacific Island Meteorological Service Representatives

For the PINMS representatives, there is a great desire to be involved in the research projects currently taking place. There is universal acceptance and support for stewardship of observational data that has been gathered in the past. It is seen as important to preserve, rescue, and pass on this data so researchers can use it. However, the number of observations in the region is currently in decline, and reasons for observing network deterioration cited include a lack of resource mobilization (financial assistance) to ensure no further slippage occurs. Maintaining current monitoring is elevated as a priority over data archive development. In this vein, PINMS representatives have asked for support in setting up new Automatic Weather Stations and for restoration of stations that have become defunct. The costs of ongoing upgrades and maintenance to the current weather and climate monitoring networks that are in place can be offset in the long-term through technical training on instrumentation maintenance, which are often conducted in concert between PINMS and outside parties that require significant funding. In essence, the focus and prioritization of PINMS is heavily weighted toward what is needed in an immediate sense to fulfill current operational duties of continued monitoring and reporting. The perseverance of this monitoring speaks highly of the PINMS fulfilling their current obligations to the international community and doing so to the best ability even using limited resources and equipment. Until that aspect of work is going smoothly, other activities, like research and data rescue, must have a lower priority or if they are to be achieved they must be leveraged using partnerships. It was also suggested that avenues to increase the ease of assistance to meteorological services should be identified, and that support for data rescue and data sharing networks should work toward improving national-scale sharing (ie within and between government departments).

Overall, the PINMS representatives voiced the desire to have more opportunities to see analyses with existing data in the 20CR and other products (like SPRAT and SPEAR-TC) that were presented at the workshop. The benefits of the data analysis tools were clear, in that extraction of meaning for local climate and weather can be linked to regional patterns and drivers. The improved understanding, visualization, and educational value of the tools would be helpful for the PINMS in communicating to the end users of climate and weather guidance. It was also suggested that raising awareness of the current research, the benefits of research participation, and the role small Pacific Island Nations play in various projects, was paramount to garnering public and institutional support for continued and new collaborations. The creation of educational awareness materials were recommended for ACRE Pacific, and the communication about the research should have inclusion of 'western science' elements as well as traditional indigenous environmental knowledge (see abstracts of King, Lefale, and Skipper in the appendix) of past weather and climate variability and change. The opinions of many participants suggested that this type of approach could serve to inspire the public and increase public support, while potentially helping to reveal new sources of data.

The sentiment of the PINMS officers present at the Auckland workshop suggests they would like the current situation (where there is presently diminished support for undertaking data rescue, archive development, and analysis) to change. Partnerships and training can help. Additional support in terms of increasing human resources, regional mentoring, and educational opportunities could serve

to enhance capacity building of scientific officers based at PINMS. It was also requested that more opportunities be created to work with scientists, particularly some of those at the workshop who are associated with high-profile global research networks. It was thought that by cultivating symbiotic relationships in the future with researchers and activities associated with ACRE, that some types of sustainable funding mechanisms could be set up for data rescue and in-house capability of contributing to the regional research effort.

In addition, there is a great disparity between the financial resources some PINMS have access to, and the officers present at the workshop recognized the importance of creating opportunities where there was equal access to project participation and training. Many PINMS climate officers would like to work more with new tools, understand models, and seize opportunities to undertake higher education. In part, the rationalization for support of ACRE's data rescue effort and 20CR/SIRCA visualization tool development and research for this region can provide a stepping stone toward addressing the needs mentioned.

3.6.2 Data types, capability to rescue, storage and access

The current focus of ACRE is to gather weather observations from land and marine sources. However, the data often consist of much more than just instrumental measurements; qualitative as well as quantitative data can be gained through the rescue process. As such well-organized data bases with the capacity to take on many data types are needed. Information that can be expected to be recovered include upper air measurements, Pressure, Temperature, Precipitation (and all other standard meteorological measurements), Metadata lists (sites, stations, geo-networks, countries covered, time periods, where records are), Station history files, metadata for stations updated, infrastructure of stations and data collected, GIS information, satellite measurements, other remotely sensed measurements, and historical elements of the climate research (eg. old logs with stories of people in the islands). Capacity to undertake rescue is dependent on the time available, training, and equipment that have been provided to PINMS, and the capability to do this is dependent on continued training on data rescue techniques and best practice approaches.

Storage of inert (lifeless) data that can be subsequently accessed and interrogated using tools or access to already integrated or interpretive outputs (reanalyses, reconstructions, resources like educational material) are desired. Pacific Island PINMS have continually professed the "Friendship Approach" for access to data for research. Data sharing importance was recognized at this APN workshop, and consideration of a networking approach on data storage and development (i.e. who has what data) as well as development of an informal policy on data sharing was encouraged by many PINMS representatives. Using this approach would facilitate sharing, establish a common understanding about date usage, and reaffirm the importance of sovereignty of data that has been collected (and recognition of the spiritual value and lineage of how data eventually ends up in a database). At present CliDe (a web-portal operating system for entry and storage of climate data) is being implemented by PCCSP (see abstract of Howard, this volume, and also presentation of Seuseu and Porteous), which is a secure database that could help in this regard, although implementing access and ease of obtaining permissions for researchers not affiliated with the individual meteorological services is still unclear. In addition, NIWA hold significant amounts of southwest Pacific climate and weather data on behalf of some PINMS, and this can be accessed via a secure portal. Another way forward, and one complementary to PCCSP and NIWA capabilities, is for ACRE Pacific to work through access permissions individually with each PINMS and come to agreements

about what pressure data can be forwarded on to the International Surface Pressure Databank, while at the same time agreeing to forward on new data (in addition to surface pressure) that is recovered. Discussion on the value of having a centralized system of data access for the southwest Pacific, and logistics on that front, are still ongoing.

There is a significant amount of Colonial-era data in hard copy that needs to be rescued, digitized and added to databases in the region. Digitisation and storage of data, temporal and spatial scopes need to be considered. In addition, creation of an imaging tool kit (potentially delivered in a box with instructions on a DVD) is warranted, and could be facilitated with the help of IEDRO and other agencies and established meteorological/climate agencies in the region (MeteoFrance, BoM, NIWA, NZ MetService). In this tool kit, guidance on rescue as well as templates for data recovery would assist greatly. Further instruction, either online, through workshops, or research collaborations could work toward the consolidation of newly recovered data with existing data in archive. This effort is suggested as a way to open prospects for 'stitching' longer time series together. Metadata included with recovery effort will help to alleviate station ID confusion.

There were also questions from the PINMS participants about where to begin with a new data rescue effort, and also how to locate volumes of data that might need to be recovered as well as what resources were at the highest risk of being lost. From a project stand point, if the data are to be valuable for upgrading the quality of 20CR and SIRCA, then spatial and temporal holes in the current analysis should be addressed first. Dr. Gilbert Compo can provide answers to partly answer these questions, as can Dr. Rob Allan. In addition, sufficient coverage over small and large Pacific Island Countries alike (both with small and large numbers of stations) should be a primary goal of the ACRE Pacific initiative. An inventory of pre-digitized data provided by ACRE is expected to reveal what has been keyed in and out of country, and a comparison of regional and global inventories should also help to highlight the gaps that can be progressively targeted.

3.6.3 Feedback on visualization tools

Participants at the Auckland APN workshop suggested navigation within the GoogleEarth platform for visualizing climate and weather data is excellent, and this tool could be used and understood by scientists and lay audiences alike. The overall impression was that the animations offered in GoogleEarth were a powerful way of visualizing data and engaging those outside science, and there could be opportunities to use this approach as a public illustration tool for stimulating intellectual input from outsiders into the science process.

The GoogleEarth platform received mostly accolades, and there were requests about changes to the speed of animations because with large, long datasets gathered at high resolution (sub-daily), the animation speeds are often still too fast (even turning down the speed to the lowest level). This suggests an enquiry directly to Google to request that an additional operator toolbar is created to set the minimum animation speed (in terms of time) is warranted. At present, it is partly dictated by length. In addition, for the keyhole markup language (KML) files created using weather and climate data, a checklist for operation of animations (speed, years, etc) might be better depicted than in the sidebar.

Overall, the exercise with SPEAR-TC and GrIT training exercise showed that GoogleEarth is a powerful way to make a regional TC climatology dataset available to the PINMS and the general public. Some key elements to add to this visualization tool in the future are:

- Winds (including maximum
- TC category
- Country specific statistics and metadata of cyclones passing within a certain radius of an island
- Names of tropical cyclones (with more easy identifiers than clicking on icon)
- Depiction of various track numbers, full time stamps/dates
- Central pressure of TC
- rainfall associated with TC
- Uncertainty of track plot (width of polygon could demonstrate this),
- Plots of long term TC behaviour for PI countries,
- A WMO RA 5 TC tool (all encompassing) for the regional meteorological service directors,
- TC travel speed
- TC origins (genesis regions)
- Linkages of past activity to seasonal guidance and risk tables

For the GoogleEarth versions of SPRAT, it was requested that the past rainfall anomalies be provided at the station level and if an overlay option contoured like METPI (Multimodel Ensemble Tool for Pacific Island) seasonal rainfall outlooks could be generated. A request was also made to provide plots for climate variables relative to different climatic normal periods of the 20th century. In addition, the plot of the reanalysis data that showed tropical cyclones and how they link to the SPCZ, but the clarity of the visualization (and understanding) is dependent on the speed of the animation and the number of files used in the KMZ file.

It was also noted that most of the presentations were given by scientists who have a high level of technical understanding for operating the visualization platforms. For beginners, a user interface specialist is probably needed so that an instruction manual for operators using different visualization modules can be made. It was commented on that writing an operational manual is an art form (programming vs operating), and that significant linkages with a communications specialist or retired academic could be helpful to facilitate transfer of the tools from the science realm to the public use and awareness domains.

4.0 Conclusions

The main objectives of the project were:

- Engage PINMS as contributing members in new research projects that are newly underway in the South Pacific region
- Improve the knowledge streams between PINMS and new research projects on how major climate drivers and variability impact the region
- Transfer skills in the use of visualization tools from the new projects to PINMS via training and support

Findings:

- The workshop demonstrated to all participant that ACRE and the 20CR/SIRCA, as well as the regional projects, will contribute to improving our understanding of how the Earth's climate system works
- Historical observations 'rescued' from archives are greatly needed for past weather and climate research
- The large area covered by the southwest Pacific Islands makes it one of the most important areas in the Southern Hemisphere to include in any global representation
- Help is presently needed from PINMS members to find, retrieve, and make more archived, undigitised information available for research
- PINMS need support to get involved in new research projects. Emerging projects have opportunities for them to become involved via the data rescue process
- There is a need for continued capability building on data rescue and archive development in PINMS
- The tools currently being developed in new research could be applied to help improve the uptake and use of historical meteorological data by PINMS, and improve end user outreach and communication.
- Coordination is needed in order to fulfill obligations to submit new data in a series of rolling updates planned for years ahead in SIRCA. ACRE Pacific will work toward these obligations in a lead coordination role.
- Fewer stations back in time means alternative data sources for the late 18th and early 19th century are required address sample depth issues for the southwest Pacific.
- Even small additions from southwest Pacific island nations can make a large difference in the quality of 20CR and SIRCA representation for the globe.
- Image capture and preservation ensures that no further deterioration occurs and enables access by multiple personnel to the same rescued document to speed up the rescue process.
- Process of data rescue can take years, meaning substantial financial and human resources are needed.
- There is a need for a champion of data rescue in each PINMS or for each project needing data
- Volunteer networks can be highly useful for rescue of data
- Recovery of traditional indigenous environmental knowledge of the past and the social stories connected to those events is a data rescue approach complementary to reconstructions from 20CR and SIRCA.
- Feedback provided from the interactive discussion on the projects, data bases, data sharing and visualization tools has provided a framework for development and guiding principles for ACRE Pacific (see section 3.6)

5.0 Future Directions

It is hoped that participation from PINMS members will greatly assist both the 20CR and Surface Input Reanalysis for Climate Applications (SIRCA) 1850-2012 via participation in ACRE Pacific. The data rescued from the southwest Pacific effort and submitted to SIRCA will:

1. Help to double the reanalysis record length for the region
2. Provide climate model validation dataset for large-scale synoptic anomalies during extreme events, such as droughts (related to El Ninos of the Early 20th C).
3. Improve understanding of high latitude processes impinging on the southwest Pacific.
4. Outline storminess and storm track variations over last 100-150 years.
5. Enable the development of new forecast products predicting changes in frequency and intensity of weather extremes, e.g., cold air outbreaks, severe storms.
6. Enable development and improve forecasts of low-frequency (Interdecadal Pacific Oscillation) atmospheric variations and their interannual to decadal variability.
7. Facilitate better knowledge of changing atmospheric background state associated with inter-decadal tropical cyclone activity,
8. Estimate risks of extreme events for insurance and re-insurance.

ACRE Pacific can and will serve as a key project for coordinating data rescue in the southwest Pacific and for facilitating improvements to SIRCA from this region. Aside from instrumental data, historical elements of the climate research (old logs/people in the islands/voyages) could provide serendipitous research opportunities linking cultural changes to climate and weather variability.

ACRE Pacific will seek to:

- Support research that is of benefit to PINMS and the southwest Pacific
- Support development and involvement of young PINMS climate officers in regional research
- Help draw up inventories of what data is available now and plans to target new sources
- Develop reporting template for stations that are available and new records that are discovered
- Align researchers and data rescue efforts under specific project based initiatives (eg. unifying processes – ENSO, MJO, Tropical cyclones, Instrumental-palaeoclimate linkages – calibrating palaeoclimate records, past variability and extremes)
- Promote and support opportunities to use analyses with existing data that has been rescued,
- Undertake submission of funding bids to support and lead key data rescue projects
- Help to coordinate citizen science efforts
- Contribute to WMO information system – extension of Resolution 40

References

n/a.

Appendix

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

Michael Bruce – Acting Regional Manager, NIWA - Auckland

Andrew Tait – Head of the National Climate Centre, 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*

Day 2: September 28, 2010

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*

Day 3: September 29, 2010

Session 9- Non-traditional archives and data visualization

(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*

Workshop Participants

AUSTRALIA

Mr Andrew Howard

Bureau of Meteorology

GPO Box 1289 Melbourne VIC 3001

Tel. Number: + 61 3 9669 4709

Fax Number: + 61 3 9669 4760

a.howard@bom.gov.au

Mr Simon John McGree

Bureau of Meteorology

GPO Box 1289 Melbourne VIC 3001

Tel. Number: + 61 3 9669 4256

Fax Number: + 61 3 9669 4678

s.mcgree@bom.gov.au

Mr Malcolm Benoy

Bureau of Meteorology

PO Box 421 Kent Town SA 5071

Tel. Number: + 61 4 1522 7599

Fax Number: + 61 8 8366 2651

m.benoy@bom.gov.au

Dr Joelle Gergis

School of Earth Sciences

University of Melbourne, Victoria 3010

Tel. Number: + 61 3 834 49868

Fax Number: + 61 3 834 47761

jgergis@unimelb.edu.au

Ms Linden Ashcroft

School of Earth Sciences

University of Melbourne, Victoria 3010

Tel. Number: + 61 3 8344 7672

Fax Number: + 61 3 8344 7761

l.ashcroft@pgrad.unimelb.edu.au

EUROPE

Dr Phillip Brohan

Met Office Hadley Centre

Fitzroy Road, Exeter, UK

Tel. Number: + 44 1392 884575

Fax Number: + 44 1392 885681

philip.brohan@metoffice.gov.uk

Dr Robert John Allan

Met Office Hadley Centre

Fitzroy Road, Exeter, UK

Tel. Number: + 44 1392 886904

Fax Number: + 44 1392 885681

rob.allan@metoffice.gov.uk

Mr Jorge Guzman

Scott Polar Research Institute

University of Cambridge

Lensfield Road, CB2 1ER Cambridge, UK

Tel. Number: + 44 1223 336 540

Fax Number: + 44 1223 336 459

jgg29@cam.ac.uk

United States of America

Dr Gilbert Compo

University of Colorado

Boulder, CO 80305-3328 USA

Tel. Number: + 1 303 497 6115

Fax Number: + 1 303 497 6449

compo@colorado.edu

Mr Theodore Lee Allen

The University of Miami

Representing IEDRO

Tel. Number: + 1 415 699 6003

teddyallen@yahoo.com

Mr Thomas Ross

NOAA

151 Patton Avenue- Room 145

Asheville, North Carolina, 28801 USA

Tel. Number: + 1 828 271 4499

Fax Number: + 1 828 271 4203

tom.ross@noaa.gov

Pacific Island Countries

Ms Turiongo Akavaanga

Cook Islands Meteorological Service

PO Box 127, Rarotonga, Cook Islands

Tel. Number: + 682 20603

Fax Number: + 682 21603

turi@met.giv.ck

Ms Felicia Pihigia

Niue Meteorological Service

PO Box 82, Hanan Airport,

Alofi, Niue

Tel. Number: + 683 4601

Fax Number: + 683 4062

f.pihigia@mail.nu

Ms Arieta Baleisolomone

Fiji Meteorological Service

Private Bag Mail

Nadi Airport, Fiji Islands

Tel. Number: + 67 24888

Fax Number: + 67 20430

Arieta.Daphne@met.gov.fj

Mr Ueneta Torua

Kiribati Meteorological Service

PO Box 486,Kiribati

Tel. Number: + 686 25444

Fax Number: + 686 26089

uenetat@gmail.com

Mr Sunny Seuseu

Samoa Meteorological Service

Private Bag Mail, Apia, Samoa

Tel. Number: + 685 20855 extn 409

Fax Number: + 685 20857

sunny.seuseu@mnre.gov.ws

Mr Lloyd Tahani

Solomon Islands Meteorological Service

PO Box 21, Honiara, Solomon Islands

Tel. Number: + 677 24218

Fax Number: + 677 23029

l.tahani@met.gov.sb

Ms Seluvaia Finaulahi

Tonga Meteorological Service

PO Box 845, Nuku'alofa

Tel. Number: + 676 35355

Fax Number: + 676 35123

seluf@met.gov.to

Ms Loia Tausi

Tuvalu Meteorological Service

Vaiaku, Funafuti, Tuvalu

Tel. Number: + 688 20537

Fax Number: + 688 20090

loia.tausi@yahoo.com

Mrs Lino Fiapati

Tuvalu Meteorological Service

Vaiaku, Funafuti, Tuvalu

Tel. Number: + 688 20095

Fax Number: + 688 20090

kilateli@gmail.com

Mr Philip Malsale Samson

Vanuatu Meteorological Service

PMB 9054, Port Vila, Vanuatu

Tel. Number: + 678 23866

Fax Number: + 678 22310

malsale@meteo.gov.vu

Mr Robson Silas Tigona

Vanuatu Meteorological Service

PMB 9054, Port Vila, Vanuatu

Tel. Number: + 678 23866

Fax Number: + 678 22310

robsontigona999@hotmail.com

Mr Kasis Inape

PNG Meteorological Service

PO Box 1240, Boroko, NCD

Papua New Guinea

Tel. Number: + 675 325 2557

Fax Number: + 675 325 5201

kinape@pngmet.gov.pg

Mr Reginald White

Weather Service Office, Majuro

Marshall Islands

Tel. Number: + 692 247 5705

Fax Number: + 692 247 3078

reginald.white@noaa.gov

NIWA

Mr Alan Porteous

NIWA - Wellington

Private Bag 14901, Kilbirnie, Wellington 6421

Tel. Number: + 64 4 386 0300

Fax Number: + 64 4 386 0574

a.porteous@niwa.co.nz

Dr Andrew Tait

NIWA - Wellington

Private Bag 14901, Kilbirnie, Wellington 6421

Tel. Number: + 64 4 386 0300

Fax Number: + 64 4 386 0574

a.tait@niwa.co.nz

Dr Anthony Clark

NIWA - Wellington

Private Bag 14901, Kilbirnie, Wellington 6421

Tel. Number: + 64 4 386 0300

Fax Number: + 64 4 386 0574

a.clark@niwa.co.nz

Dr Brett Mullan

NIWA - Wellington

Private Bag 14901, Kilbirnie, Wellington 6421

Tel. Number: + 64 4 386 0300

Fax Number: + 64 4 386 0574

b.mullan@niwa.co.nz

Mr Apanui Skipper

NIWA

PO Box 11115, Hamilton 3216

Tel. Number: + 64 7 856 7026

Fax Number: + 64 7 856 0151

a.skipper@niwa.co.nz

Dr Andrew Lorrey

NIWA - Auckland

Private Bag 99940, Newmarket, Auckland 1149

Tel. Number: + 64 9 375 2055

Fax Number: + 64 9 375 2051

a.lorrey@niwa.co.nz

Mr Darren King

NIWA - Auckland

Private Bag 99940, Newmarket, Auckland 1149

Tel. Number: + 64 9 375 2055

Fax Number: + 64 9 375 2051

d.king@niwa.co.nz

Ms Georgina Griffiths

NIWA - Auckland

Private Bag 99940, Newmarket, Auckland 1149

Tel. Number: + 64 9 375 2055

Fax Number: + 64 9 375 2051

gm.griffiths@niwa.co.nz

Ms Petra Chappell

NIWA - Auckland

Private Bag 99940, Newmarket, Auckland 1149

Tel. Number: + 64 9 375 2055

Fax Number: + 64 9 375 2051

petra.chappell@gmail.com

Ms Davina Hosking-Ashford

NIWA - Auckland

Private Bag 99940, Newmarket, Auckland 1149

Tel. Number: + 64 9 375 2055

Fax Number: + 64 9 375 2051

d.ashford@niwa.co.nz

NZ Met Service

Mr Penehuro Lefale

Meteorological Service of New Zealand

PO Box 722, Wellington

Tel. Number: + 64 4 4700 700

Fax Number: + 64 4 4735 231

Pene.lefale@metservice.com

Funding sources outside the APN

Attached evidence of co-funding submitted in confidence to APN.

List of Young Scientists

Include brief detail (full name, involvement in the project activity) and contact detail (name of institution/country and email address) of your scientists involved in the project. Also include short message from the young scientists about his/her involvement in the project and how it helps develop/build his capacity and the knowledge he gained.

Ms Davina Hosking-Ashford – presentation on data rescue experience and assistant coordinator of APN workshop

NIWA - Auckland

Private Bag 99940, Newmarket, Auckland 1149

Tel. Number: + 64 9 375 2055

Fax Number: + 64 9 375 2051

d.ashford@niwa.co.nz

"The Asia-Pacific Network workshop was very successful in terms of broadcasting the importance of the data rescue process in the Pacific. Being part of the organizing team for the APN workshop gave me the opportunity to build my communication skills (verbal and non-verbal) and presenting skills. The workshop also gave me the opportunity to mix and mingle with top researchers from the US, Europe and the Pacific and thorough this process I shared a bit of my knowledge while at the same time gained new knowledge from talking to them and listening to their presentations. To top of my experience I presented a short talk highlighting my experiences of digitizing paper climate data from the Pacific region".

Ms Petra Chappell – Presentation on the Log of Logs

NIWA - Auckland

Private Bag 99940, Newmarket, Auckland 1149

Tel. Number: + 64 9 375 2055

Fax Number: + 64 9 375 2051

petra.chappell@gmail.com

"I just wanted to say thanks for organising such a fantastic workshop this week. It was great to meet people from around the world who are really interested and what we're doing. Thanks also for giving me the opportunity to make the presentation today, it was a great experience :) "

Glossary of Terms
Include list of acronyms and abbreviations

Abstracts (listed below alphabetically by presenting authors last name)

Allan, Rob

International ACRE Project Manager, Met Office Hadley Centre, Exeter, United Kingdom.

allarob@gmail.com

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.

Allan, Rob

International ACRE Project Manager, Met Office Hadley Centre, Exeter, United Kingdom.

allarob@gmail.com

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).

Allan, Rob

International ACRE Project Manager, Met Office Hadley Centre, Exeter, United Kingdom.

allarob@gmail.com

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.

Allen, Teddy and Rick Crouthamel

International Environmental Data Rescue Organization

teddyallen@yahoo.com

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.

Ashcroft, Linden, Joëlle Gergis and David Karoly

School of Earth Sciences, University of Melbourne, Australia

l.ashcroft.pgrad@gmail.com

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 paleaoclimate 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.

Ashford, Davina

National Institute of Water and Atmospheric Research (NIWA)

Auckland, New Zealand

d.ashford@niwa.co.nz

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.

Benoy, Mac

Volunteer Project Manager

Australian Meteorological Association

M.Benoy@bom.gov.au

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.

Brohan, Philip

The Met Office Hadley Centre, United Kingdom

philip.brohan@metoffice.gov.uk

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.

Chappell, Petra, Andrew Lorrey and Davina Ashford

National Institute of Water and Atmospheric Research (NIWA)

Auckland, New Zealand

petra.chappell@gmail.com

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.

Collins, Dean, Gillian Cambers and Jill Rischbieth

Pacific Climate Change Science Program

National Climate Centre

Australian Bureau of Meteorology

D.Collins@bom.gov.au

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.

Compo[1,2], Gilbert P., Jeffrey S. Whitaker[2], and Prashant D. Sardeshmukh[1,2]

[1.] University of Colorado CIRES Climate Diagnostics Center

[2.] NOAA Earth System Research Laboratory Physical Sciences Division

Gilbert.P.Compo@noaa.gov

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

U.S. Global Climate Observing System Program Manager & Director, World Data Center for Meteorology, NOAA/National Climatic Data Center

howard.diamond@noaa.gov

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.

Gergis, Joelle

School of Earth Sciences, University of Melbourne, Australia

jgergis@unimelb.edu.au

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.

Griffiths, Georgina

National Institute of Water and Atmospheric Research (NIWA)

Auckland, New Zealand

gm.griffiths@niwa.co.nz

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.

Guzman, Jorge

SPRI-University of Cambridge

jgg29@cam.ac.uk

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 digitial 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.

Guzman, Jorge and Clive Wilkinson

SPRI-University of Cambridge

jgg29@cam.ac.uk

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 Fueguian 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.

Howard, Andrew

Pacific Climate Change Science Program

National Climate Centre

Australian Bureau of Meteorology

A.Howard@bom.gov.au

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.

King, Darren N.T.

Māori Environmental Research Centre

National Climate Centre

National Institute of Water & Atmospheric Research (NIWA)

Auckland, New Zealand

d.king@niwa.co.nz

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.

Lefale, Penehuro Fatu

New Zealand Met Service

Pene.lefale@metservice.com

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.

Lefale Pene[1] and John Marra[2]

[1]New Zealand Met Service

[2]National Oceanic and Atmospheric Administration

Pene.lefale@metservice.com

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.

Lorrey Andrew

National Institute of Water and Atmospheric Research (NIWA)

a.lorrey@niwa.co.nz

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.

Lorrey, Andrew and Petra Chappell

National Institute of Water and Atmospheric Research (NIWA), Auckland New Zealand

a.lorrey@niwa.co.nz

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.

McGree, Simon, Dean Collins, Sunny Seuseu

Pacific Climate Change Science Program

National Climate Centre

Australian Bureau of Meteorology

s.mcgree@bom.gov.au

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 visualization 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 overviewing, 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.

Ross, Tom

NOAA National Climatic Data Center, Climate Database Modernization Program

Tom.Ross@noaa.gov

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.

Seuseu, Sunny[1] and Alan Porteous[2]

[1]Samoa Meteorological Services

[2]National Institute of Water and Atmospheric Research (NIWA), Wellington New Zealand

sunny.seuseu@mnre.gov.ws

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.

Skipper, Apanui

Te Kūwaha-o-Taihoro Nukurangi

National Institute of Water and Atmospheric Research (NIWA)

a.skipper@niwa.co.nz

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 the speaker's PhD work ahead.

Stanton, Craig and Andrew Lorrey

Systems Development Team

National Climate Centre

National Institute of Water and Atmospheric Research (NIWA), Auckland New Zealand

c.stanton@niwa.co.nz

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 visualization platform and scientific research tool. A demonstration of basic visualization 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 visualization layers can be combined to provide useful climate guidance and forecast verification platforms for Pacific Island National Meteorological Services.

Wilkinson, Clive[1] and Rob Allan[2]:

RECLAIM Project, NOAA Climate Database Modernization Program

[1]Climatic Research Unit, University of East Anglia, United Kingdom

[2]International ACRE Project Manager, Met Office Hadley Centre, Exeter, United Kingdom.

allarob@gmail.com

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/).

The final project report must follow the template outlined in this document. Use Calibri font size 12 for all the headings and font size 11 for the text.

The report is to be submitted **one month before the end the Contract Period** in the following formats:

1. By airmail to the address below:
   a. **Soft Copy – 5 CD-ROMS**, appropriately labeled and covered using the design and information on the cover page of the Report Template
   b. **Hard Copy – 2 bound copies** appropriately labeled and covered using the design and information on the cover page of the Report Template

   Dr. Linda Stevenson
   APN Executive Science Officer
   APN Secretariat
   4F East Building
   1-5-2 Wakinohama Kaigan Dori
   Chuo-Ku, Kobe 651-0073 JAPAN

2. By e-mail and addressed to Dr. Stevenson (lastevenson@apn-gcr.org) and Kristine Garcia (kgarcia@apn-gcr.org).
   Kindly note that our server can also receive attachments of up to 8MB file size. In case that the final project report file size exceeds 8MB please try any of the following options:

   a. For a file size of more than 8MB but less than 10MB please send the report to our Gmail account at apngcr@gmail.com and notify us in our APN account so we could check for it immediately.
   b. For a larger file size please try the following:
      - Upload on your institution's ftp server and provide to us the download details (i.e. IP address, login details, etc)
      - Send through any of the free file hosting available in the internet. Please note that these free file hosting save your files for a limited number of days so it is very important to notify us immediately. Some of these are the following:
        - http://www.filefactory.com/
        - http://www.mediafire.com/
        - http://www.yousendit.com/

A separate CD containing other project outputs (i.e. publications, photos, etc)