PROJECT 1.4: REGIONALLY SPECIFIC CLIMATE DATA AND MONITORING FOR THE NORTH-WEST AND SOUTH-WEST TO SUPPORT THE UNDERSTANDING OF PAST, PRESENT AND FUTURE CLIMATE

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Objectives

- To apply rigorous scientific methods to the development and extension of climate change datasets for WA.
- To enhance the range of datasets used within IOCI 3.
- To increase the accessibility and usability of the datasets.

Milestone 1.4.1: High-quality and scientifically documented daily rainfall dataset extended back to 1900

(Completed)

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This milestone was extensively reported on in the previous Milestone Report. A brief summary is provided below.

The current 'gold standard' for daily rainfall data for Australia is the high-quality rainfall dataset developed by Lavery et al (1992). Recently, this data set was extended to allow more detailed analyses of observed rainfall trends in Western Australia. The resulting network of 157 high-quality daily sites (Marinelli et al 2011,

submitted) has improved the coverage over the state, especially for the two regions of interest: the southwest where a sharp decline in winter rainfall with accompanying drop in inflows to reservoirs has been observed and the north of Western Australia where rainfall during the monsoon season has increased.

As part of the quality control in developing this dataset, the homogeneity of the 157 daily rainfall series has been assessed using the software RHtest (Wang and Feng, 2010) and automated procedures were applied to flag suspicious data (Siriwardena and Seed, 2009). The automated checks where followed by manual assessments. These were required to identify whether values flagged as suspicious were indeed wrong or just unusual when compared with nearby stations.

While records for sites in the newly defined high-quality daily rainfall network are generally very complete, it was still be desirable to process the raw data to a) infill missing data and b) disaggregate rainfall accumulated over a number of days. The performance of techniques for infilling and disaggregating daily rainfall data proposed by Siriwardena and Seed (2010) for Western Australia was therefore assessed. Error statistics were used to describe the performance depending on season and region. Particular attention was being paid to values below 1 mm and the highest daily totals. Information of this type can be used to judge the suitability of the resulting series for further analysis like detecting trends in the number of wet days, extreme value analysis or trends in extremes.

A journal paper has been submitted and a poster was presented at a national conference.

References

Jakob, D. 2012: Developing a high-quality rainfall dataset for Western Australia – the effects of infilling and disaggregating daily rainfall, AMOS 18th National Conference 'Connections in the Climate System', Sydney, 31 January – 3 February 2012.

Lavery B., Kariko A., Nicholls N. (1992): A historical rainfall data set for Australia. Aust Meteorol Mag 40:33–39.

Marinelli, M., Braganza, K., Collins, D., Jones, D. Maguire, S, and Cook, G, (2011): Defining a high-quality daily rainfall candidate network for Western Australia, submitted to Australian Meteorological and Oceanographic Journal.

Siriwardena, L. and Seed, A. (2009): Detection of artefacts in the record of daily rain gauge data, FORTRAN Program Manual, Program – Stage 1.

Siriwardena, L. and Seed, A. (2010): Extension and Fixing Errors of Quality Coded Daily Rain Gauge Data (Disaggregation of flagged and unflagged accumulated data, infilling missing data and correcting some date shifted data), FORTRAN Program Manual, Program – Stage 2, 2010.

Wang, X., L. and Feng, Y. (2010): RHtestV3 User manual. Environment Canada. Available online at http://cccma.seos.uvic.ca/ETCCDMI/software.shtml.

Milestone 1.4.2: Extended high-quality and scientifically documented daily station temperature dataset extended back to 1910

(Completed)

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This milestone was extensively reported on in the previous Milestone Report. A brief summary is provided below.

The official launch of the updated temperature dataset, the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) was held on 23 March 2012, hosted by the Bureau of Meteorology and the Australian Meteorological and Oceanographic Society (AMOS). ACORN-SAT takes advantage of newly digitised data and employs improved analysis techniques. Including daily temperature records spanning over 100 years, it provides greater clarity in the surface air temperature trends we are observing.

The data set and associated documentation are available through the Bureau of Meteorology website at http://www.bom.gov.au/climate/change/acorn-sat/.

References:

Trewin, B.C. 2012. A daily homogenised temperature data set for Australia. Int. J. Climatol., submitted.

Trewin, B.C. 2012. Techniques involved in developing the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) dataset. CAWCR Technical Report 49, Centre for Australian Weather and Climate Research, Melbourne.

Milestone 1.4.3 Dedicated website providing access to relevant climate datasets for WA in support of IOCI 3 projects

(Completed 31/12/2010)

This milestone was completed and extensively reported in Milestone Report 2. Ongoing revision and enhancement will be made based on user feedback.

Milestone 1.4.4 Enhanced local capacity in climate analysis and monitoring, including an enhanced presence in the Western Australian Regional Office

(Ongoing over duration of project)

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Key Research Findings and Highlights

This milestone is on-going, and the report in the Milestone Report 2 is still relevant.

Milestone 1.4.5 A very high-resolution (e.g., 0.025°) regional historical analysis of rainfall, temperature and vapour pressure for the South-West of Western Australia, covering the key runoff and agricultural regions

(Completed 31/12/2010)

This project has been completed and had been extensively reported on in the Milestone Report 2.

Milestone 1.4.6 High-quality surface solar radiation data set for WA based on the newly developed Australian high-quality cloud dataset.

(Completed 31/12/2010)

This project has been completed and had been extensively reported on in the Milestone Report 3.

Milestone 1.4.7 Sector-relevant climatologies, baselines data and trend analyses for WA covering such measures as thermal heat-stress and fire indices.

(Completed)

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Sustained very high temperatures over a number of days can severely impact human health (e.g. deCastro et al 2011). Given that the last decade (2002-2011) was the equal warmest on record for Australia (0.52°C above the 1961-1990 average), heat stress is an increasing threat to Australian communities.

A set of three indices based on maximum daily temperatures has been developed for an objective analysis of heat stress for Australia (Nairn et al 2009). These indices allow quantifying:

a) significance of heat stress in a climatological context (exceedance of 95th percentile over a three-day period),

b) an acclimatisation component (based on a three-day period with a lag of 30 days), and

c) an integrated excess heat factor (the combined effect of these two measures).

Work was undertaken to develop sector-relevant information on heat stress based on gridded temperature data originally developed as part of the Australian Water

Availability Project (AWAP). Information is provided on both averages and extreme conditions encountered across regions of Western Australia. On the basis of these assessments decision makers can identify which regions are most vulnerable to heat stress. Analyses based on six regional centres (Carnarvon, Geraldton, Kalgoorlie, Perth, Esperance and Albany) allowed us to quantify the extent to which differences in heat stress estimates are affected by the quality of data by comparing gridded and station data. For these analyses we made use of both homogenised and 'raw' maximum temperature series. Temporal trends were explored on the basis of both gridded and station data. The results have been presented at a national conference and a journal paper is under preparation.

The reliability of our assessments is affected by the network density of stations available for developing gridded temperature data (Jones et al 2009). Relevant supporting information is therefore provided to assess the confidence in these assessments based on the period and region. The effects of relative humidity and wind speed, as used in the calculation of apparent temperature, were outside the scope of our current analysis.

Analyses of fire danger focused on the Grassland Fire Danger Index. The sensitivity of this index to estimates of wind speed was identified as a major challenge in producing meaningful climatologies of fire danger. Further work is proposed to develop techniques to optimally combine surface observations and model data.

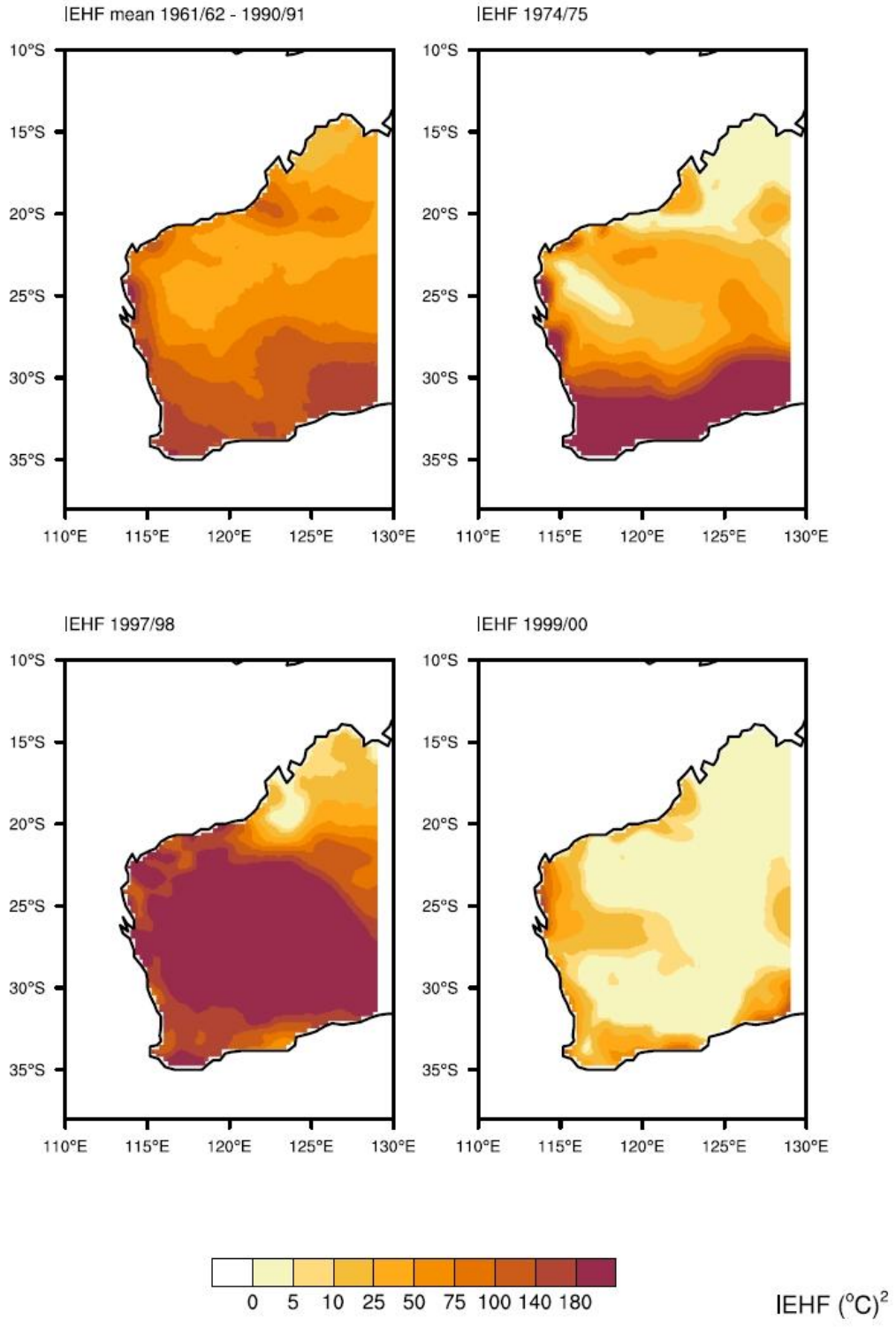

Figure 1 Integrated Excess Heat Factor (IEHF in $°C^2$) for Western Australia. The average annual IEHF (based on a 30-year reference period) is shown in the top left panel. Examples for the pattern of annual IEHF are shown for two strong La Niña

events (right column) and a strong El Niño event (bottom left). The calculation of annual values is based on the 12-month period from July to June.

References

deCastro, M., Gomez-Gesteira, M., Ramos, A., Álvarez, I., & deCastro, P. (2011). Effects of heat waves on human mortality, Galicia, Spain. Climate Research, 48(2), 333-341. doi:10.3354/cr00988.

Imielska, A. & Jakob, D. (2012): Developing climatologies of heat stress for Western Australia, AMOS 18th National Conference 'Connections in the Climate System', Sydney, 31 January – 3 February 2012.

Jones, D. A., Wang, W., & Fawcett, R. (2009). High-quality spatial climate data-sets for Australia. Australian Meteorological and Oceanographic Journal, 58, 233-248.

Nairn, J., Fawcett, R., & Ray, D. (2009). Defining and predicting Excessive Heat events, a National system. *Understanding High Impact Weather, CAWCR Modelling Workshop,* 30 Nov to 2 Dec 2009.

Milestone 1.4.8: Enhanced homogenised tropical cyclone database for WA providing base data for Project 2.2

(Completed)

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The rationale behind developing a homogenised database of tropical cyclones was the aspiration to answer questions like: 'Are tropical cyclones becoming more frequent or more intense?' In summary, no significant trends in frequency or intensity have been identified for the South Indian Ocean and the South Pacific. Where there are trends they may be due to changes in data quality.

Results of this work have been documented in a scientific paper and the database of tropical cyclones is now available online.

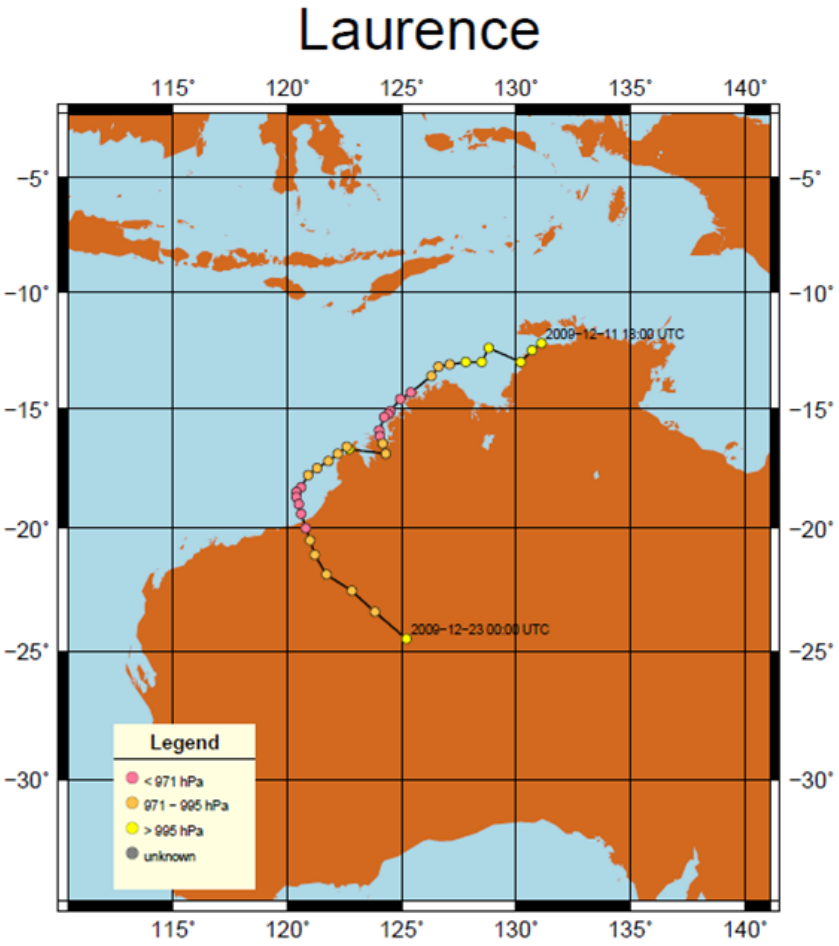

Figure 2 Best track information is available from the TC database as map (shown here) and in tabular form (csv format).

Summary of new linkages to other IOCI 3 Projects

As these data and associated analyses develop they will support Project 2.2 in particular.

References

Kuleshov, Y., R. Fawcett, L. Qi, B. Trewin, D. Jones, J. McBride, and H. Ramsay (2010), Trends in tropical cyclones in the South Indian Ocean and the South Pacific Ocean, J. Geophys. Res., 115, D01101, doi:10.1029/2009JD012372

PROJECT 1.4: Regionally Specific Climate Data and Monitoring for the North-West and South-West to Support the Understanding of Past, Present and Future Climate

Principal Investigator(s): Dr David Jones, D Jakob

• To be Completed for First Annual Report, and Included in Subsequent Annual Reports	• To be Completed for First Annual Report and Updated in Subsequent Annual Reports

Milestone description	Target completion date	Progress against milestone (1- 3 dot points)	Recommended changes to research plan (1- 3 dot points)
1.4.1 High-quality and scientifically documented daily rainfall dataset extended back to (at least) 1900: currently there is not a single station in this dataset for the North-West	31/12/2009	The new high-quality rainfall dataset has been defined and is available. The final science paper describing the dataset has been submitted for publication.	N/A
1.4.2 Extended high-quality and scientifically	31/12/2009	The new-quality temperature network	N/A

documented daily station temperature dataset extended back to 1910		has been defined. A beta version of the homogenised data set was completed in late 2010 and has been scientifically documented in the *ACORN-SAT analysis and results document: Report 3a for the Independent Peer Review of the ACORN-SAT data-set*. An additional science paper and a technical report describing the dataset have been submitted. The official launch of the updated temperature datasetwas held on 23 March 2012.	
1.4.3 Dedicated website providing access to relevant climate datasets for WA in support of IOCI 3 projects	31/12/2010	Completed. Ongoing revision and enhancements will be made based on user feedback.	N/A
1.4.4 Enhanced local capacity in climate	31/12/2011	On schedule.	N/A

analysis and monitoring, including an enhanced presence in the WA Regional Office			
1.4.5 Very high-resolution (e.g., 0.025º) regional historical analysis of rainfall, temperature and vapour pressure for the South-West, covering key runoff and agricultural sub-regions	31/12/2010	Completed	N/A
1.4.6 High-quality surface solar radiation data set for WA based on the newly developed Australian high-quality cloud dataset	31/12/2010	Completed	N/A
1.4.7 Sector-relevant climatologies, baselines data and trend analyses for WA covering such measures as thermal heat-stress and fire indices	31/12/2011	Completed	N/A
1.4.8 Enhanced homogenised tropical cyclone database for WA providing base data for Project 2.2	31/12/2011	Completed	N/A