Hunter, Lower North Coast and Central Coast Regional Climate Change Study

Executive Summary

Progress Report 1 to HCCREMS on Stage 1 of the Regional Climate Change Study

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EXECUTIVE SUMMARY

This is the first report on a research project focused on the identification of key climate change variables and impacts for the Hunter, Lower North Coast and Central Coast regions. The project partners are Newcastle Innovation and the Tom Farrell Institute for the Environment (University of Newcastle) and the Hunter and Central Coast Regional Environmental Strategy (HCCREMS). The project comprises four stages: (1) Identification of the key synoptic patterns relevant to the study region; (2) analysis of how the synoptic patterns drive climate and climate-related variability in the region; (3) downscaling CSIRO global climate model (GCM) predictions for New South Wales (NSW) to the study region; and, (4) determination of the potential climate change impacts on the region based on the statistical downscaling.

Stage 1 – Climate Data Analysis

Stage 1 focuses on the identification and collation of regionally specific climate data that will subsequently be used in Stages 2 and 4 of the project. The study region encompasses 14 local government areas of the Hunter, Central and Lower North Coast region of NSW. For the purpose of data selection only, a buffer of 50 km was also placed around the study boundary. The study region and 50 km buffer zone used for data selection is shown in Figure 1. A detailed quality assurance procedure has been implemented to identify data sets that are of a suitable nature for use in the Regional Climate Change Project. The data includes: Australian daily precipitation; Australian daily maximum and minimum temperatures; Australian hourly temperature, humidity and pressure; Australian daily evaporation; Australian daily wind data; Australian hourly wind data; Daily cloudiness, visibility and sunshine hours data for Bureau of Meteorology (BOM) districts 60, 61 and 62; Six minute pluvial data for districts 60, 61 and 62, NSW monthly ocean wave height, period and direction data, and monthly ocean tide gauge data on sea-level. At this point hydrological data (e.g. streamflow) has not been purchased or assessed. New LIDAR data on coastal zone topography elevations has been measured by the NSW Department of Planning in conjunction with some of the HCC. We have made a request to Lake Macquarie City Council and John Hudson, NSW Department of Planning, for access to this data. We have not received a response at this stage.

Data have been analysed for daily precipitation, maximum and minimum temperatures, daily average temperature, 9am and 3pm relative humidity, daily average windspeed, daily maximum wind gust speed and daily pan evaporation. These particular climate variables were chosen as they have been highlighted as key climate indicators for climate change impact assessment in the Hunter and Central coast region (as per the CSIRO stakeholders workshop survey on climate change impacts in the Hunter Valley conducted in 1999). In addition, these variables will be suitable for future research carried out during Stage 4 of the project that may involve climate change impact assessments for climate related variables such as drought, evaporation, bushfire risk, heat stress, frost and streamflow etc.

Synoptic Typing of Climate Patterns

An important component of Stage 1 of the Regional Climate Change Study is to define the key synoptic patterns that drive the climate variability of the region (which will be used in the downscaling of the Global Climate Model (GCM) output to a regional scale). This report summarises progress made in developing a methodology to identify the key synoptic patterns for the region. The synoptic patterns were determined using self organized mapping (SOMS) techniques using two reanalysis global climate datasets: (1) ERA-40 Reanalysis data from the European Center for Medium Range Weather Forecasting (ECMWF); and (2) NCEP/NCAR Reanalysis (NNR) from the US National Oceanic & Atmospheric Administration (NOAA). These data sets contain gridded 6 hourly, daily and monthly data for the full range of climate parameters, from the surface through the atmosphere. At this stage of the project we have obtained the NNR daily and monthly sea-level pressure, and 500 hPa geopotential height data between 1948 and the present.

Synoptic climate typing (ST) has been performed on monthly sea-level pressure data (SLP) from January 1948 through to December 2007 for the region. Thirty-five synoptic types have been generated based on the SLP data covering a region that is considered to capture the major synoptic weather patterns influencing the region. These patterns define the clear seasonal trend in the location and intensity of the subtropical anticyclone, the monsoonal trough, the circumpolar trough, and the longwave features in the Pacific and Indian Ocean sectors. Further analysis will reduce the number of synoptic types to the minimum number required to explain significant variability in the regional climate parameters and to serve as the baseline synoptic patterns for the impact assessment stage.

Each month from January 1948 through to December 2007 has been classified according to the 35 synoptic patterns, resulting in a monthly time series of synoptic types. This time series will be used during Stage 2 of the study to analyse the relationship between the regional synoptic patters and local changes in key climatic variables (i.e. the data sets analysed in this report). Further work being carried out with the synoptic typing involves the investigation of using daily pressure data and additional pressure levels to define the regional to hemispheric climate drivers of variability across the study site. Progress on this work will be reported in the second progress report due in September 2007.

The 35 synoptic patterns that have been generated using the SOM methodology and monthly SLP data are shown in Figure 2.

Discussion and Recommendations for Stages 2-4

The possibility of generating daily synoptic type (ST) patterns was investigated, particularly in regard to assessing the future likelihood of extreme weather events. The use of SOMS on daily and monthly data produces the same patterns. The patterns associated with extreme events is being examined using the upper and lower 10 decile climate data and linked to the monthly ST's. Hence, the ST's will be used in Stages 2-4 to examine mean climate change and the probability of a change in the frequency of extreme events based on the frequency of the monthly ST's. In addition, the reliability of GCM output on future climate patterns is currently best examined on monthly ST's. Paleoclimate or proxy climate data are also being examined to define the frequency or return periods of extreme weather events.

Whilst Stages 2 and 3 can be undertaken as stand alone scientific research exercises, Stage 4 will require detailed input from the key stakeholders and industries about the primary climate data that relate to the specific land uses, planning techniques or risk management. Hence, we need timely input from the proposed stakeholder workshops on which climate variables need to be defined in the examination of future climate variability and change, using the ST methodology and GCM downscaling techniques. We also need to discuss with the stakeholders the advantages and disadvantages of using monthly climate data, and further develop the appropriate methodology to analyse the present and future changes in extreme weather events.

Figure 1. Study region and buffer zone used in climate data selection.

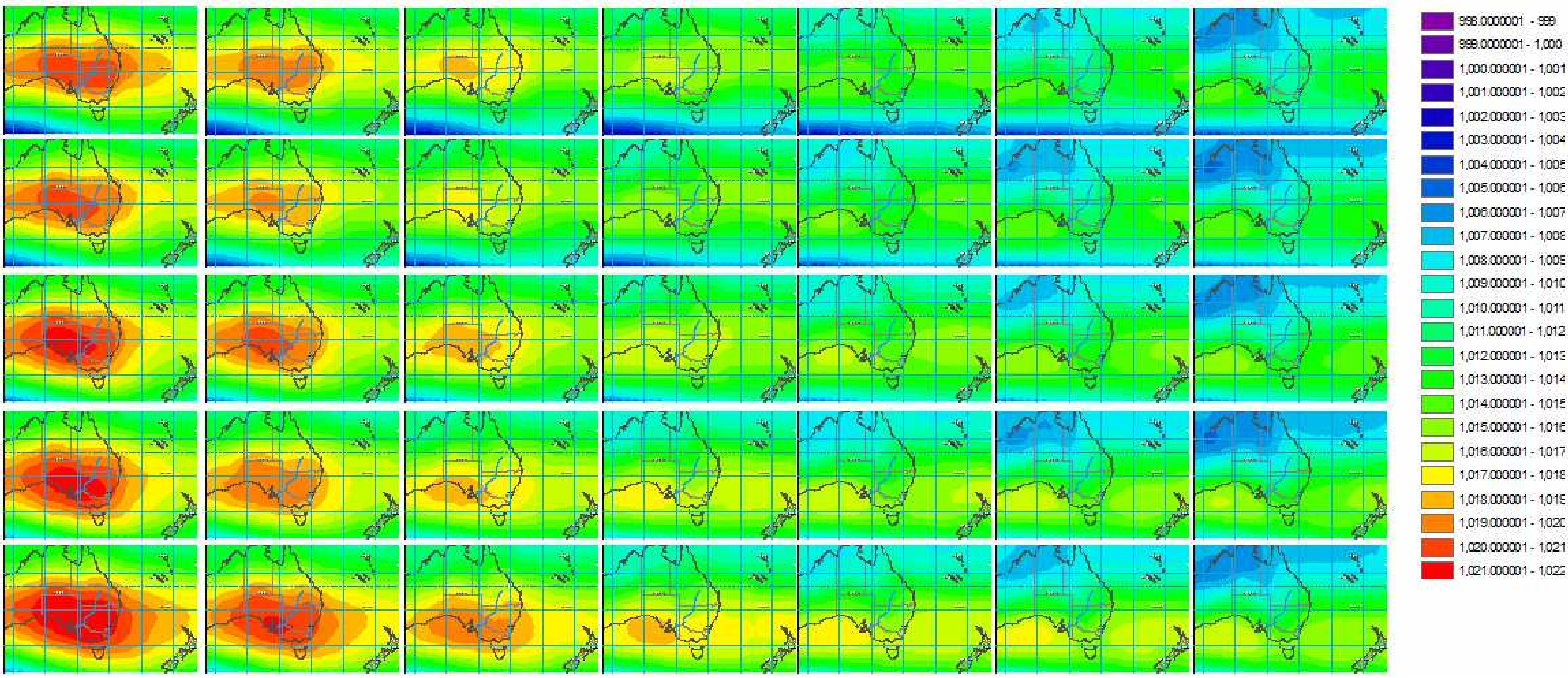

Figure 2. Diagram showing the 35 synoptic climate types of sea-level pressure defined in Stage 1.