**Temporal Climate Analogues in the Central Slopes Cluster**

**Summary**

In the attached folder there are data provided to help identify possible climate analogue years for your region. The climate analogues are based on temperature and precipitation for annual, winter, and summer analogues. The following text helps explains the rationale behind such analyses, the data used, and an example is discussed to help with interpretation.

**Climate analogues**

Future climate projections for Australia and the Central Slopes (CS) region are produced primarily by General Circulation Models (GCMs) and downscaled GCMs. A methodology that is complementary to these, and can be used to supplement the projections, is that of climate analogue analyses: a comparative approach to understanding and assessing the possible effects of climate change (eg Williams et al 2007, Ford et al 2010; Hayman and Alexander 2010 ; Wilby and Dessai 2010). The essence of climate analogue analyses is to identify climates similar to a target climate (in either time and space) and assess the response or characteristics of particular exposure units (eg ecosystem, species, industry, community) to that analogous climate. Climate analogue analyses have been used in a variety of applications including urban modelling (Kopf et al 2008), socio-economic consequences (Hallegate et al 2007), snow conditions and avalanche risk (Mearns et al 2001), and agriculture (Webb et al 2013, Parry and Carter 1989, Darwin et al 1995, Mendelsohn and Dinar 1999). In addition to these, and perhaps of more relevance to this project, the climate analogue analysis technique has been identified in the literature as a means of enhancing the communication of climate change scenarios to user groups including media, popular science, and teaching in general (eg Kopf et al 2007, Hallegate 2007, Adam 2007). It can enhance linkages between GCMs and targeted extension groups.

In climate analogue analyses, future climates projected by GCMs for a specific location (in this case the Central Slopes region) are compared with existing climates found elsewhere in Australia (spatial analogues), or with the climate throughout the historical record in the CS region (temporal analogues). Temporal analogues use historical climates and responses to climate variability, climate change and climate extremes to provide insights for vulnerability to climate change. Resilient behaviour in times of drought can be utilised to provide insights regarding farm resilience (eg Doudle et al 2009).

**Data**

Temporal analogue information is provided for St George, Dalby, Glenn Innes, Gunnadah, Pallawallama, and Dubbo. Historical daily maximum and minimum temperature and daily precipitation is obtained for these locations (and others in the CS region if required) as detailed in Table 1. This historical climate data for these locations was obtained from the Queensland Government SILO database, <http://www.longpaddock.qld.gov.au/silo> (Jeffrey *et al.* 2001) which is a repository of historical data from the Bureau of Meteorology (in SILO this is called “Patched Point Data”).

The future climate projections for annual and seasonal temperature and precipitation have been obtained from the CSIRO Interim Climate Statement. Tables 1 and 2 identify the range of projected temperature and precipitation changes from the CMIP5 GCMs for the entire Central Slopes cluster (compared to 1986-2005 baseline) for the RCP4.5 for 2030 and 2090. This range of model output is displayed on the charts of historical climate as a rectangle encompassing the range of model projections. For most locations the 2090 temperature/rainfall projections are too great to fit on the scale of the historical data plots, and have not been included. Interestingly, when examining the resulting plots of data for all 5 locations, there was no common analogue across all the locations. This is a result of the regionally varying effect of the drivers of interannual climate variability of the CS region.

Additional data can also be displayed on the analogue charts. To demonstrate possible uses of the analogues charts we have included the Southern Oscillation Index (SOI) and wheat production information. The SOI was obtained from the Queensland Government Long Paddock website. The monthly values were averaged from June to May the following year to obtain an annual average. Wheat yield information was obtained from two sources:

1. GRDC regional yield data 1982-2013 for the NorthEast NSW/Qld zone (this one GRDC zone covered the entire CS region)
2. Simulated APSIM wheat yield for each location (provided by Brendan Power, QDAFF).

The two timeseries of yield provide different results, and may be elucidated upon in a future report.

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| **NRM region** | **NAME** | **NUMBER** | **LATITUDE (oS)** | **LONGITUDE (oE)** |
| **Border Rivers Maranoa-Balonne** | Goondiwindi | 41521 | -28.52 | 150.33 |
| Mitchell | 43020 | -26.49 | 147.98 |
| St George | 43034 | -28.04 | 148.58 |
| Roma/Waverley Downs | 43093 | -26.61 | 148.54 |
| **Condamine Alliance** | Chinchilla | 41017 | -26.74 | 150.6 |
| Dalby | 41023 | -27.18 | 151.26 |
| Warwick | 41176 | -28.22 | 152.02 |
| Toowoomba | 41103 | -27.58 | 151.93 |
| Pittsworth | 41082 | -27.72 | 151.63 |
| **Northern Tablelands** | Attunga | 55000 | -30.01 | 150.86 |
| Warrialda | 54029 | -29.54 | 150.58 |
| Glen Innes | 56011 | -29.74 | 151.74 |
| **North West** | Walgett | 48036 | -29.67 | 148.11 |
| Gunnadah | 55024 | -31.03 | 150.27 |
| Narrabri | 53030 | -30.34 | 149.76 |
| Pallawallama/Moree | 53033 | -29.47 | 150.14 |
| **Central West** | Nyngan | 51031 | -31.64 | 147.32 |
| Gilgandra | 64024 | -31.56 | 148.95 |
| Dubbo | 65012 | -32.24 | 148.61 |

**Table 1.** The CS locations for in-depth analysis and modelling. The highlighted locations have been used for temporal analogue analysis.

**References**

Adam, D., 2007. Heat, dust, and water piped in from Scotland. Welcome to London 2071. Climate change map sends 12 capitals further south. Warning to planners on future design of cities, The Guardian, <http://environment.guardian.co.uk/> climatechange/story/0,,2079750,00.html, 2007.

Darwin, R., Tsigas, M., Lewandrowski, J., and Raneses, A., 1995. World Agriculture and Climate Change: Economic Adaptations, Tech. Rep. AER-703, U.S. Department of Agriculture, <http://www.ers>. usda.gov/publications/aer703/, 1995.

Hallegatte, S., Hourcade, J.-C., and Ambrosi, P., 2007. Using climate analogues for assessing climate change economic impacts in urban areas, Clim. Change, 82, 47–60.

Kopf, S., M. Ha-Duong, and S. Hallegatte 2008. Using maps of city analogues to display and interpret climate change scenarios and their uncertainty. Nat. Hazards Earth Syst. Sci., 8, 905–918.

Mearns, L. O., Hulme, M., Carter, T. R., Leemans, R., Lal, M., and Whetton, P., 2001. Climate scenario development, in: Climate Change 2001: The Scientific Basis, edited by: Houghton, J. T., Ding, Y., Griggs, D. J., Noguer, M., van der Linden, P. J., Dai, X., Maskell, K., and Johnson, C. A., chap. 13, Cambridge University Press, [http://www.grida.no/CLIMATE/IPCC TAR/WG1/](http://www.grida.no/CLIMATE/IPCC%20TAR/WG1/) index.htm, 2001.

Mendelsohn, R. and Dinar, A.., 1999. Climate change, agriculture, and developing countries: Does adaptation matter?, The World Bank Observer, 14, 277–293, 1999.

Parry, M. L. and Carter, T. R., 1989. An assessment of the effects of climatic-change on agriculture, Clim. Change, 15, 95–116.

Ramírez-Villegas J, Lau C, Köhler A-K, Signer J, Jarvis A, Arnell N, Osborne T, Hooker J. 2011. Climate

analogues: finding tomorrow’s agriculture today. Working Paper no. 12. Cali, Colombia: CGIAR

Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available online at:

www.ccafs.cgiar.org