Climatology papers
An Annotated Bibliography

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References

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The simple i.i.d. test It can be very complicated to determine whether a time series is exhibiting some kind of systematic change through normal methods of TS analysis. A simple test is given here that can indiciate whether a series is made up of i.i.d. numbers. It is based on considering the probability of a new entry in the series being the most extreme entry, giving a simple predicting rule of E(n) = sum from i=1..,n of (1/i). If n is very large then exp(E(n)) is approximately linearly proportional to n. There is an apparent lack of such methods in the literature and it has a strength in that it assumes nothing about the pdf of the series, only that there is only one max value and that there is no upper limit on the values. Series ca be split into parallel streams of the data it can be more effective also. Examples of useage include looking at monthly temperatures for record values and studying future trends in extreme monthly rainfall. A 'failed test' does not imply there is a trend but can help identify a lack of i.i.d. data and thus a changing pdf. Some data needs to be sammpled correctly to be expected to be i.i.d. (eg. may contain seasonality effects).

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Gridded data of daily precipitation is useful for investigating spatiotemporal variability, including extreme precipitation values, but there are inherent uncertainties in many such datasets available. Three such products for Australian precipitation are compared to each other as well as to seven interpolated datasets created from in situ observations. Two of the available datasets combine both in situ oberservations and remote sensed (satellite) data. It was found that that all precipitation grids have similar climatologies for annual aggregated precipitation totals and annual maximum precipitation. The temporal correlations of

daily precipitation values are higher between the interpolated datasets, but the correlations between the most widely used interpolated product (AWAP) and the two remotely sensed products (TRMM and GPCP) are still reasonable. The results, however, point to distinct structural uncertainties between those datasets gridding in situ observations and those datasets deriving precipitation estimates primarily from satellite measurements. All datasets analysed agree well for low to moderate daily precipitation amounts up to about 20mm but diverge at upper quantiles, indicating that substantial uncertainty exists in gridded precipitation extremes over Australia and such datasets must be treated with caution. There are internal structural similarities between all the situ-based grids and between the remotely sensed grids but limitied similarity between the two types. The virtues and limitations of the several interpolation methods are also discussed with weighted averaging methods dealing with noise well but unable simulate results above the recorded data. The Cubic Spline method can inerpolate upwards but struggles with steep gradients in relative precipitation and is shown to often overestimate values.

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[7] J. Emile-Geay, K. M. Cobb, M. Carre, P. Braconnot, J. Leloup, Y. Zhou, S. P. Harrison, T. Correge, H. V. McGregor, M. Collins, R. Driscoll, M. Elliot, B. Schneider, and A. Tudhope, "Links between tropical pacific seasonal, interannual and orbital variability during the holocene," *Nature Geosci*, vol. 9, no. 2, pp. 168–173, Feb 2016.

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This was a large combined study looking at many global locations and analysing the change in daily maximum and minimum temperatures as well as the diurnal temperature range (DTR). Monthly mean maximum and minimum temperatures for over 50% (10%) of the Northern (Southern) Hemisphere landmass, accounting for 37% of the global landmass, indicate that the rise of the minimum temperature has occurred at a rate three times that of the maximum temperature during the period 195190 (0.84C versus 0.28C). The decrease of the diurnal temperature range is approximately equal to the increase of mean temperature. The asymmetry is detectable in all seasons and in most of the regions studied. The Northern Hemisphere reported decrease in DTR of 1.4 degrees/100 years compared to an increase in the mean temperature of 1.3 degrees/100 years. There are also reported locations where the minimum temperature has not changed but noticeable change in variability and some possible indication of anticorrelation between increasing mean temperature and decreasing DTR. Decrease in DTR may be aprtially related to increases in cloud cover in the same locations. A large number of atmospheric and surface boundary conditions are also shown to affect max and min temperatures.Paper is limited by access to a lot of global data and is slightly dated now. [note: look for more recent and more Australia focussed paper on diurnal ranges]

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Paper unavailable... check access. abstract: A new computer-based tool, the Rainfall Reliability Wizard, is described for rapid spatial assessments of rainfall reliability. It employs conditional statistical methods to analyse rainfall reliability using over 100 years of gridded monthly rainfall data across Australia. Features of the Wizard include analyses of long term inter-seasonal and intra-seasonal reliability, discrete events, and the ability to analyse in absolute and relative terms. The Wizard is an easy-to-use program that runs on personal computers and a simplified version of the software is available on the Internet. Selected functions of the Wizard are illustrated in this paper which includes an analysis of rainfall reliability and the drought event of 1994 across the Australian wheat belt.

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[still editing] Precipitation is influenced by multiple large-scale natural processes. Many of these large-scale precipitation drivers are not independent of one another, which complicates attribution. Moreover, it is unclear whether natural interannual drivers alone can explain the observed longer-term precipitation trends or account for projected precipitation changes with global warming seen in climate models. Separating the main interannual drivers from processes that may prevail on longer time scales, such as a poleward circulation shift or increased specific humidity, is essential for an improved understanding of precipitation variability and for making longer-term predictions.In this study, an objective approach to disentangle multiple sources of large-scale variability is applied to Australian precipitation. This approach uses a multivariate linear independence model, involving multiple linear regressions to produce a partial correlation matrix, which directly links variables using significance thresholds to avoid overfitting. This is applied to regional winter precipitation in Australia as a test case, using the ECMWF Interim Re-Analysis (ERA-Interim) and Australian Water Availability Project datasets. Traditional drivers and several drivers associated with the width of the tropics are assessed. The results show that the web of interactions implied by correlations can be simplified using this multivariate linear independence model approach: the total number of apparent precipitation drivers was reduced in each region studied, compared to correlations meeting the same statistical significance. Results show that the edge of the tropics directly influences regional precipitation in Australia and also has an indirect influence, through the interaction of the subtropical ridge and atmospheric blocking. These results provide observational evidence that changes associated with an expansion of the tropics reduce precipitation in subtropical Australia. The influence of many drivers and factor on MDB precipitation is given througout the paper and agreements and contradictions with other publications discussed. Comparison is made to the differing results of (Cai et al 2011) multiple times.

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High temperature extremes during the growing season can reduce agricultural production. At the same time, agricultural practices can modify temperatures by altering the surface energy budget, with increased evapotranspiration from cropland conversion and increased irrigation of crops cooling temperatures and increasing precipitation in a region. Here we identify centennial trends (data used from 1910-2014) towards more favourable growing conditions in the US Midwest, including cooler summer temperature extremes and increased precipitation, and investigate the origins of these shifts. Statistically significant correspondence is found between the cooling pattern and trends in cropland intensification, as well as with trends towards greater irrigated land over a small subset of the domain. Land conversion to cropland, often considered an important influence on historical temperatures, is not significantly associated with cooling. We suggest that agricultural intensification increases the potential for evapotranspiration, leading to cooler temperatures and contributing to increased precipitation. The tendency for greater evapotranspiration on hotter days is consistent with our finding that cooling trends are greatest for the highest temperature percentiles. Temperatures over rainfed croplands show no cooling trend during drought conditions, consistent with evapotranspiration requiring adequate soil moisture, and implying that modern drought events feature greater warming as baseline cooler temperatures revert to historically high extremes. Research needs to be expanded to a global scale to strengthen conclusions as there are other possible influences on the US Midwest climate identified for the time period such as tropospheric aerosol emissions and changes in the North Atlantic Oscillation index.

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A review paper focusing on known climate variation in Southeastern Australia (SEA), covering some but not all of the MDB. A large focus of the paper is looking at the 10 year period of low rainfall from 1997 to 2006. A protracted dry spell of this severity had been recorded once before during the 20th century, but drought conditions were exacerbated by increasing temperatures. There characteristics of this rainfall decline are studied with most of the rainfall decline (61(March-May). This shift in seasonal characteristics has widesread ramifications with carry on effects throughout the year. A characterisation of rainfall reliability was also used, where a year is reliable if each month in a window receives at least 75the early winter reliability seen to massively drop off in SEA over the drought period (see reliability wizard paper). Daily maximum and minimum temperatures were both found to be generally increasing. However some decrease in autumn minimums was seen which is closely linked to lower rainfall. A similar rainfall decline occurred in the southwest of western Australia around 1970 that has many common features with the SEA decline. The climate of the two regions is known to be correlated but the delay in the shift exhibiting in the SEA is likely due to the fact that it has additional climate factors. SEA rainfall is produced by mid-latitude storms and fronts, interactions with the tropics through continental-scale cloudbands and cut-off lows. El Nio-Southern Oscillation impacts on SEA rainfall, as does the Indian Ocean, but neither has a direct influence in autumn. Trends have been found in both hemispheric (the southern annular mode) and local (subtropical ridge) circulation features that may have played a role in reducing the number and impact of mid-latitude systems around SEA, and thus reducing rainfall. The role of many of these mechanisms needs to be clarified, but there is likely to be an influence of enhanced greenhouse gas concentrations on SEA climate, at least on temperature. Notes: References to specific studies made which are worth investigating. Look for any updates on this review, what has happened since 2006?

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Australia has more variable rainfall than would be expected from comparisons with similar climates globally. The El Nino Southern Oscillation (ENSO) has a large role in this and is itself not a constant influence. Changes in annual rainfall have been closely correlated to variations in the diurnal temperature range, annually and on the longer decadal scale, but this has broken down in the 1990s (dataset ends in 90s as well). This may signal a regional climate shift. Correlations can also be found between rainfall and max and min temperatures respectively but of opposite sign. There is also evidence of these relationships changing seasonally in QLD. Mean rainfall nationally rose from 1952-92 compared to 1911-51 and the variability also increased, but not significantly. Relative Variability of annual rainfall has been defined as the mean of the absolute deviations of annual rainfalls from the long term mean, given as a percentage of the long term mean. Rainfall variability decreases globally in locations with higher mean annual rainfall, but much of Australia does not fit the trend well. The MDB can be seen in figures to have higher than global average rainfall variability relative to its mean rainfall, falling in the range of 1-1.75 times the global average. On a national scale the annual rainfall is very variable and over the period of 1910-92 the histogram of the data cannot be fitted by a gamma distribution, as is commonly done, but instead require a Gumbel (or extreme) distribution. The Southern Oscillation Index (SOI) is the standardised difference between Tahiti and Darwin surface atmospheric pressure. A large SOI often leads to high rainfall (La Nina). The higher variability of Australia on a global scale is important to consider for research and practical activities.

[18] S. E. Perkins, D. Argeso, and C. J. White, "Relationships between climate variability, soil moisture, and australian heatwaves," *Journal of Geophysical Research: Atmospheres*, vol. 120, no. 16, pp. 8144–8164, 2015, 2015JD023592. [Online]. Available: http://dx.doi.org/10.1002/2015JD023592

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The consensus in the scientific community is that the intensity of extreme precipitation will increase in a warmer climate, but there is limited observational evidence on the matter. A lot of research id therefore focused on studying the relationship between temperature and precipitation. The expected trend is given by the Clausius-Clapeyron (C-C) relationship and is approximated by a 7capacity of the atmosphere per degree of warming and the precipitation rate is expected to increase at the same rate. there have been variable results in terms of agreement with teh C-C relationship from several studies over the world. The standard approach is to bin precipitation data into temperature bins and then deteremine the extreme percentiles (events above a certain threshold), whereupon the trends are investigated. The effect of covariates is found by splitting the data further into more bins (eg. for separate seasons). A large problem with this method is it progressively leads to smaller sample sizes in the bins which reduces accuracy considerably. The quantile regression approach allows the estimation of the scaling factor directly and does not have inherent bias from sample size as the binning approach is shown to exhibit. It also deals much better with analysing covariates as the accuracy does not descreas with number of covariates considered as with the previous approach. The effect of day/night and summer/winter covariates are analysed with the former showing no effect but the latter consideration showing a strong trend in winter and some reversing of the trend in the northern half of Australia during summer. The Q.R. analysis also permit hypothesis testing to determine the statistical significance of the results. It has been noted that the relationship between precipitation and temperature does not necessarily need to be linear, and may reverse after a 'peak point' temperature is reached. Q.R. can be adpated to allow for this. Thought: The study is only of rainfall extremes and there may be more to look at in other aspects of rainfall profile.