Gem Lloyd (Bureau of Meteorology)

Title: TP(AWS) – a cloud-deployed observation checking system with wider Bureau implications

Abstract:

ObsCheck is a service offered by BSG Agriculture & Water that allows external customers to send us their weather data to get a confidence score report – internally the system that provides this service is called TPAWS (Trusted Private Automatic Weather Stations).

I'll introduce you to some cloud basics and then talk through the TPAWS system from a technical perspective, showing some of the DDG tech we used and some of the problems already solved. I'll discuss our workflows, describing how we worked "cloud first" for TPAWS delivery. I will suggest a few of the common cloud-based setups I am seeing in SIG projects and how these might benefit you and your projects.

Come to this presentation to see a practical use-case of using cloud technology at the Bureau. Learn about cloud technology and get some ideas on how it can help you.

Ashish Sharma (UNSW)

A new perspective on improving satellite data through merging for hydrology and climate change assessments

Abstract

Availability of in-situ data greatly simplifies the process of specifying land surface models for variety of applications and scenario modelling simulations. This talk focusses on the bigger problem where in situ data does not exist or is insufficient to assist in improving model specification. In remote sensing, this issue is acute, especially as the variable of interest is not being observed but inferred, often in the presence of multiple (contradicting) satellite data sets. Here we present an overview of data merging in the absence of in-situ observations and propose a new algorithm to merge data when three or more data sources exist. Our proposed approach uses the signal-to-noise ratio (SNR) as the basis of formulating an optimal merged product, requiring a recursive procedure to ascertain parameters that can be expected to minimise the ensuing mean squared error. An application of the proposed approach to merge three satellite soil moisture products (SMAP, LPRM, ASCAT) is presented, and shown to offer consistent improvements over alternatives that currently exist. More details of the method are available from the publication below.

References

Kim, S., Sharma, A., Liu, Y. Y. & Young, S. I. Rethinking Satellite Data Merging: From Averaging to SNR Optimization. IEEE Transactions on Geoscience and Remote Sensing 60, 1-15, doi:10.1109/TGRS.2021.3107028 (2022).

QJ Wang (University of Melbourne)

Upskilling predictions from physical process models by using statistical spatial-temporal models

Many environmental models have been developed based on physical processes and become highly valuable for environmental predictions. However, these models can be subject to errors, and improvements to the predictions may be needed for practical applications. Statistical post-processing of model outputs is a cost-effective way to produce more accurate predictions. In this talk, I will introduce a recently developed method to post-process dimensionally high spatial-temporal model outputs by combining empirical orthogonal function (EOF) analysis and regression. The EOF analysis is to reduce the high-dimensional spatial-temporal data to time series of a small number of reduced variables. These reduced variables then become the target for improvement through statistical calibration. Finally, a reverse application of the EOF analysis to the improved predictions of the reduced variables leads to post-processed, and expectantly improved, predictions of the original high-dimensional variables in a spatial field.

I will demonstrate the effectiveness of the method through two applications. One application is to improve precipitation forecasts from numerical weather prediction models. With our new method, we post-process forecasts for all grid-cells in a large field at once, directly embedding spatial structures in the produced ensembles. This method contrasts with the commonly used approach of post-processing grid-cell by grid-cell, followed by spatially connecting the ensemble members of individual grid-cells - a problem yet to be satisfactorily resolved.

A second application is to improve flood inundation simulations of low-fidelity hydrodynamic models. The use of low-fidelity models is to reduce model run time for real-time deployment, as high-fidelity hydrodynamic models are generally computationally too intensive, especially for ensemble runs. However, low-fidelity model simulations need to be made more accurate before use. With our new method, we post-process simulations from the low-fidelity models to accurately emulate high-fidelity hydrodynamic models, while in total using only a fraction of the time needed to run the latter. It then becomes feasible to produce ensemble forecasts of the evolution of flood inundation ahead of events.

Christoph Rudiger (BOM)

Shaun Kim (CSIRO)

Improving river model predictions via structural modifications and simple state adjustments

Shaun S.H. Kim, Lucy A. Marshall, Justin D. Hughes, Julien Lerat, Ashish Sharma, Cuan Petheram, Russell S. Crosbie, and Jai Vaze

Abstract

One of the biggest challenges in hydrology is to produce reliable predictions in non-stationary environments. One obvious strategy is to improve model structures utilising advancements in process knowledge and observations. Another approach from a statistical angle is to develop better error models so that the uncertainty of the predictions can be more reliably estimated. These two approaches are obviously not mutually exclusive and, in fact, can complement each other. The river bed/bank storage (RBS) model allows better representation of transmission loss processes in basin-scale river system models, and provides additional states and fluxes that can be calibrated or validated (Kim et al., 2022). For example, the RBS riparian zone evapotranspiration can be calibrated against CMRSET, which is a remotely sensed actual evapotranspiration product (Guerschman et al., 2009). The introduction of the river bed/bank store allows the use of state adjustment techniques that generally provide more reliable predictions. For this, the State and Parameter Uncertainty Estimation (SPUE) (Kim et al., 2021) was used. Marked improvements in reliability were seen when the RBS model was combined with SPUE. The presentation will demonstrate that improving model structures combined with better state error characterisation can alleviate issues of non-stationarity.

References

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KIM, S., MARSHALL, L., HUGHES, J., SHARMA, A. & VAZE, J. 2021. Jointly calibrating hydrologic model parameters and state adjustments. *Water Resources Research,* 57**,** e2020WR028499.

KIM, S. S., HUGHES, J. D., MARSHALL, L. A., PETHERAM, C., SHARMA, A., VAZE, J. & CROSBIE, R. S. 2022. Modelling daily transmission losses in basin-scale river system models under changing hydrological regimes. *Hydrological Processes,* 36**,** e14625.

Claire Spillman & Wendy Sharples (BOM)

Vanessa Hernaman (CSIRO)

Christopher Leaman (UNSW)

A Multi-Scale Coastal Storm Hazards Early Warning System for Australia

Coastal storms pose a threat to livelihoods and assets along Australia's coastlines. By delivering timely information about approaching coastal storms, early warning systems (EWSs) can enhance community preparedness and inform risk-reduction measures, with the goal of reducing potential impacts to property, critical infrastructure, and loss of life. Worldwide, existing coastal hazard EWSs primarily centre around the forecasting of coastal flooding risks, which predominantly occur along surge-dominated coastlines. However, many of Australia's densely populated coastlines are wave-dominated, where erosion hazards feature more prominently. This pilot project has developed a multi-scale, coastal hazard EWS capability for Australia that uses state-of-the-art scientific methods for predicting both erosion and flooding impacts caused by coastal storms.

Development of the prototype system has been underpinned by consultation and guidance provided by potential end-users, to inform them of the nature and timing of erosion hazard predictions. It is envisaged that this prototype system will now operate in two test regions on the east and west coasts of Australia and will facilitate a future wide-scale deployment, with the goal of enhancing community preparedness to coastal storms.

The EWS operates simultaneously at two spatial scales: 1) a regional scale (~100km length of coastline) over which the type and intensity of coastal storm hazard(s) are predicted every 100 m alongshore; and 2) a local "hotspot" scale (e.g., a specific site) at which a range of quantitative indicators of open-coast erosion and flooding are predicted.

On a rolling 7-day forecast horizon, marine wave and water level forecasts are provided by the Australian Bureau of Meteorology (BoM). Wind-wave forecasts are generated using the AUSWAVE model, which is then enhanced using a refined nearshore mesh specific for each region and hotspot. Storm surge forecasts are produced using BoM's National Storm Surge (NSS) system.

Regional-scale beach erosion and coastal flooding hazard forecasts, with a 100 m alongshore resolution, are determined using a new Storm Hazard Matrix. This was identified as a key end-user need and has been developed for this project. This approach uses simple and readily available parameters to classify hazards into one of sixteen regimes of varying type and intensity, each likely to require different management responses.

It is anticipated that local-scale hazard forecasting can be implemented at pre-determined locations where the historic, present, or future risk of coastal hazards are high. At these locations, the process-based coastal erosion model XBeach (2DH, surf beat mode) is used to provide a quantitative assessment of the extent of erosion and total water level (surge + wave runup) during the forecast event. From this, a range of hazard thresholds and indicators can be locally defined to match local coastal managers' needs. Although computationally expensive, this approach provides coastal managers with a greater level of detail of potential hazards in high-risk locations.

The EWS workflow is managed using the Delft-FEWS platform, with Python packages used for pre- and post-processing tasks. The forecasts generated are available to coastal managers using the FEWS platform but are also imported into an online portal. Continued development of the system, along with the collection of validation data, is underway.

Kane Church (Moyne City Council)

Community Impacts of Coastal Hazards Port Fairy, Victoria

A presentation by Moyne Shire Councils Environment Services Coordinator Kane Church demonstrating current costal hazards and impacts on the community including past, current and future mitigation options.

Luke Bennets (U Adelaide)

Felicity McCormack (Monash)

Andrew MacKintosh (Monash)

Yi Huang (U Melb)

Chris Lucas (BOM)

Gen Tolhurst (BOM)

Title:

"Approaches to understanding decadal and long-term shifts in observed precipitation distributions in Victoria, Australia"

Abstract:

"Over the past century, rainfall totals in Australia's south-eastern state of Victoria have shown multi-decadal variability without clear trends. This has impacted agriculture, water security, ecosystem services, and flood hazards. Hydrological and meteorological evidence suggests that Victorian rainfall regimes have changed since the beginning of the Millennium Drought in 1997. Until now, Victorian precipitation intensity distributions have not been assessed in detail. We assess the time-varying aspect of precipitation intensity distributions not through trends, but by identifying temporal shifts in Victorian rainfall and using those different epochs to assess multi-decadal changes in rainfall characteristics. We analysed sub-daily to multi-day rainfall distributions from 1900 to 2020 for three regions and four seasons. Distributions are significantly different for the three epochs defined as 1900 to 1945, 1946 to 1996, and 1997 to 2020. We summarised precipitation distributions by categorising precipitation intensities, calculating histograms, and fitting gamma distributions.

"This study provides evidence that Victorian precipitation distributions have shifted over decades, and distributions depend on regional and seasonal differences. Recent rainfall declines are mostly due to decreasing light and moderate rainfall, despite increasing heavy rainfall. Heavy rainfall has shown a tendency to increase in frequency since 1997. Increases were greatest for six-hour springtime and summertime precipitation in northern Victoria and wintertime precipitation in southern and eastern Victoria. Observed precipitation distributions show changes that are consistent with climate projections. To better understand processes driving observed and projected changes to precipitation distributions across the world, interdecadal shifts, seasonal variations, and regional climates need to be considered."

Cathryn Birch (U Leeds)

Convection-permitting modelling: a powerful tool for tropical convection

A decade of convection-permitting modelling has allowed significant advances in both operational weather forecasting and our understanding of tropical convection. Weather forecast skill in the tropics has traditionally been low because models have struggled to represent convective storms realistically. Increases in computer power have allowed models with finer and finer horizontal grid-spacing, which allows a better representation of detail such as coastlines and orography, and removes the need for a convection parameterisation scheme. The result is a more realistic representation of tropical convection, which has allowed in-depth study of the physical processes governing convective storms. A decade ago it was possible to run single case studies in convection-permitting models. Now it is possible to run continental-scale ensemble weather forecasts and multi-year climate simulations. In this talk I will present some examples of research that were facilitated by these modelling advances, including the initiation and development of convection, the drivers of climate extremes and the upscale impacts of convection. I will look ahead to the next generation of high resolution models and how they might help us advance our understanding of the Earth system.

Huw Lewis (UKMO)

Chen Li (BOM)

Biases and teleconnections in GC5 – insights for seasonal prediction and Australia

Chen Li, Debbie Hudson, Xiaobing Zhou, Hongyan Zhu, Griffith Young*

Bureau of Meteorology

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The Bureau has been involved in the package testing and assessment process of the latest UK Met Office Global Coupled Model Version 5.0 (GC5) configuration. GC5 will underpin the Met Office's next seasonal prediction system, coupled NWP system and Earth System Model. It will also likely be the next version of the Bureau's seasonal prediction system. The GC5 configuration includes changes to almost all areas of model physics, including a new sea ice model and substantial updates to the atmospheric (UM) and ocean (NEMO) models. We have evaluated a50-year GC5 coupled simulation, at N216 atmospheric resolution (~60km) and ORCA025 ocean resolution (~25km); and compared it to results from the previous coupled model (GC4). A major focus of our assessment is the mean state biases in the Indo-Pacific region, key climate drivers of Australian climate variability and teleconnections to Australian climate. Results associated withthe representation of the El Niño Southern Oscillation (ENSO), the Indian Ocean Dipole (IOD),the Southern Annular Mode and the Madden Julian Oscillation will be presented. Notably, in comparison to its predecessor (GC4), GC5 shows significant improvements in the eastern Pacificmean state but a slight degradation in the Indian Ocean in terms of the mean state and variability. These and other results provide us with early insights of the potential performance of the next sub-seasonal/seasonal forecast system. Long-standing issues in the seasonal prediction system associated with the equatorial eastern Indian Ocean biases and an overactive ENSO/IOD will likely remain; however, improvements over the eastern equatorial Pacific in GC5 hold promise of improved prediction skill of ENSO and its teleconnections.

Michio Kawamiya (JAMSTEC) or Tomohiro HAJIMA

Chun-Hsu Su (BOM)

Yannick Tremolet (JCSDA)

Paul Field (UKMO)

Title

Implementing double moment cloud microphysics into the Met Office regional model configuration

Abstract

CASIM (Cloud AeroSol Interacting Microphysics) is the new double moment cloud microphysics scheme that will be introduced into the Met Office operational regional model next year. Results will be shown for performance in the Tropics and the UK. Improvements will be highlighted as well as a discussion about what challenges remain.

Hongyan Zhu (BOM)

Impacts of the new UM convection scheme (CoMorph) over the Indo-Pacific and Australian regions

Hongyan Zhu, Debbie Hudson, Chen Li and Li Shi

Research Program, Bureau of Meteorology

There are major long-standing model biases in the tropical Indian and Pacific Oceans in both the ACCESS coupled and atmosphere models that act to limit our prediction skill over Australia on a range of timescales.

Simulations with a climate version of the UK Met Office (UKMO) unified model (UM) indicate large negative precipitation biases over the Maritime Continent (MC) region (Neale and Slingo, 2003). Errors persist even in higher-resolution simulations of the same model, indicating deficiencies in the representation of the physical system. It is further argued that deficient rainfall over the MC could be a driver for other systematic errors, such as the excess precipitation over the western Indian Ocean (IO), the easterly wind bias over the eastern IO and the hyperactive Indian Ocean Dipole. The MC dry bias has been persistent in recent global atmosphere (GA) versions of the UM, including the latest versions GA7 and GA8 (Walters et al., 2017, Willett et al., 2020). Biases in rainfall over the MC region have also been reported to adversely affect simulation of the eastward propagation of the Madden–Julian Oscillation (MJO) across the region (e.g. Neale and Slingo, 2003).

The existing convection scheme lacks much of the structural flexibility needed to address systematic biases generated by the convection scheme and, given the growth in capability of regional modelling at kilometre scales, a scheme that can be scale-adaptive is required. To address this, a new mass flux convection scheme has recently been developed at the UKMO called CoMorph (Convection Morph). This scheme has removed ad-hoc structure assumptions which have hampered progress in the past and allows representation of new physical processes which were previously neglected. Initial results from the UKMO suggest that the CoMorph scheme has a positive impact in the Australian and Indo-Pacific regions.

In this work, we have evaluated the performance of CoMorph in the latest global model (GA8 and GC4). We found that compared to the standard configuration, there are significant improvements in rainfall bias, diurnal cycle of MC rainfall, tropical cyclone forecasts and the MJO when CoMorph is included.

References:

Neale RB, Slingo JM. 2003. The maritime continent and its role in the global climate: A GCM study. J. Climate 16: 834–848.

Walters D, and co-authors, 2017: The Met Office Unified Model Global Atmosphere 6.0/6.1 and JULES Global Land 6.0/6.1 configurations, Geosci. Model Dev. 10: 1487–1520, https://doi.org/10.5194/gmd-10-1487-2017.

Willett M. R., T. Graham, M. Brooks and D. Copsey, 2020: GC4 and GA8GL9 Acceptance Report, Met Office Technical report.

Emma Howard (BOM)

Christian Jakob - Monash University

Digital Earths - Rethinking Weather and Climate Prediction

The prediction of weather and climate with computer models and their fusion with observations in data assimilation have been one of the biggest scientific and technological revolutions of the 20th century. Through advances in the computational modelling of the atmosphere, ocean, land and cryosphere, weather forecasts have improved by about a day a decade. We are able to predict major modes of climate variability months ahead and we are able to assess the future of our planet for different scenarios of human behaviour.

Together with these advances, the advent of exa-scale computing is providing an opportunity for a significant leap in weather and climate prediction. It is in our grasp to explicitly resolve thunderstorms, small ocean eddies, rivers and catchments as well as individual large glaciers in global modelling systems, as well as streets and buildings in regional and local systems. In this presentation we summarise the ambition of the World Climate Research Program's Digital Earths Lighthouse Activity to carry out the research that fully integrates weather and climate models with those for human and natural systems to build comprehensive digital information systems. We will focus on the scientific, technological, and community challenges and opportunities that arise from the goal to design and implement digital twins of the Earth at both global and regional scale.

Hilary Oliver (NIWA)

Joerg Henrichs (BOM)

Claire Trenham (CSIRO)

Ilene Carpenter (HPE)

Andy Hogg (ACCESS-NRI)

ACCESS as a National Research Infrastructure

ACCESS is Australia's weather, climate and Earth system modelling framework. ACCESS is used across the research sector – to make predictions across timescales that range from days to millennia and spatial scales from local to global. Historically, ACCESS has been supported by research agencies and universities, but there has been no single coordinated investment strategy.

In late 2021, the ACCESS-NRI (National Research Infrastructure) was established as Australia's newest National Collaborative Research Infrastructure Scheme (NCRIS) facility. Based at the Australian National University, ACCESS-NRI now has a strategic plan and governance mechanisms, and is working to recruit the staff that can help fulfil this plan. As an NCRIS facility, ACCESS-NRI has a mandate to coordinate the maintenance and future development of the ACCESS framework for the benefit of researchers and their end users. The establishment of ACCESS-NRI provides an opportunity to unify the climate, weather and Earth system research community around common approaches – in terms of the flavour of model, the methods to diagnose and evaluate model output and the standard of software engineering, documentation and user training that supports ACCESS users.

In this presentation, I will outline initial progress that ACCESS-NRI has made and revise our near-term plans, including the establishment of our documentation hub, the definition of our Model Evaluation and Diagnostic toolbox and the model configurations we will (initially) support. I will also highlight the challenges that our national community faces in determining the future pathways from model development through to applications. A particular challenge is how we can support the translation of fundamental research innovations into enhanced skill in weather or seasonal forecasts, or into future climate projections on the decadal or centennial scale. In particular, I will make the case that we can use research software engineering as a mechanism to unite the scientific community around their common goals.

Linda Eitelberg (BOM)

AWS representative talk

Nash Palaniswany (Intel)

Abha Sood (NIWA)

Carlos Velasco (BOM)

Chris Griffin (BOM)

Valentin Louf (BOM)

Dai Yamazaki (U Tokyo)

CaMa-Flood global river model: its development and future perspectives

Dai Yamazaki

Institute of Industrial Science, The University of Tokyo

Prediction and impact assessment of river flood caused by extreme rainfall is important for flood risk assessment and disaster prevention. However, numerical simulation of river flood is difficult especially for large river basins, given the water dynamics in rivers and floodplains is regulated by basin-wide water balance and local topography relief. While supercomputers can perform high-resolution large-domain simulations, its practical applicability is limited for operational flood forecast which requires rapid and stable computations. To overcome this, We have developed a new global river flood model CaMa-Flood, which appropriately approximates micro-scale topography and simulates macro-scale flooding in continental-scale rivers by treating floodplain inundation dynamics as sub-grid physics. By this assumption, computationally very efficient simulation of large river hydrodynamics was achieved without significantly degrading the accuracy of detailed local-scale flood models. In addition, because a good numerical model solely cannot achieve precise flood simulations, We are recently focusing on the development of high-accuracy global topography maps (MERIT DEM & MERIT Hydro) by combining satellite big data and extensive numerical analysis. These model-data integration efforts enabled efficient-and-accurate global-scale flood simulation and its applications to flood forecast systems and climate risk assessment. Furthermore, the developed model and datasets are widely used as baseline tools in multiple science fields (e.g. biogeochemistry, climate projection, ecosystem and biodiversity) in addition to flood risk studies, suggesting the importance of researches on fundamental data and theory development.

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https://global-hydrodynamics.github.io/

Mandi Thran (BOM)

Jiawei Hou (BOM)

Jason Hunter (HydroTas)

Glenn Alderton (SES Qld)

Jacqueline Schopf (Department of Water and Environment Regulation)

Application of the Bureau of Meteorology's future climate projections for water resource management in Western Australia

Jacqueline Schopf

Department of Water and Environment Regulation, Western Australia

The Western Australian Department of Water and Environmental Regulation (DWER) recommends water managers use the Bureau of Meteorology's (BoM) National Hydrologic Projections (NHP). Using this tool ensures climate change is adequately incorporated, providing local scale data for a range of possible futures and means managers can assess the risk that climate change places on water resource objectives and decisions.

DWER has developed guidance to help water resource managers decide which BoM projections to use when considering future climate. The choice of projections depends on the nature of the water resource decision, the associated risk tolerance, hydrologic drivers, and system resilience to varying future climates.

As new sources of CMIP6 climate projections are made available, including those developed by WA's Climate Science Initiative and BoMs Australian Climate Service, they can be used to complement the National Hydrologic Projections. This may result in reduced uncertainty in climate projections, a more precise understanding and quantification of climate-related risks, through to enhanced adaptation measures and resilience to climate variability and change.

DWER has worked closely with the WA Water Corporation and BoM to apply the projections to several water resources demonstration projects across Western Australia. This presentation will focus on lessons learned from these applications, and potential areas for research and development. The Western Australian water sector would benefit from coordinated research to produce a range of outcomes, such as ongoing consistency in parameters of interest to the water sector, differences in the various GCMs and projections on a national and state scale, a better understanding of how well local climate drivers are represented in GCMs and RCMs, a better understanding of how water managers should factor downscaling and bias correction methods into their choice of projections, additional studies into whether the NHP regional runoff models are suitable for local scale rainfall-runoff models, and advice on how to communicate risk and uncertainty.

Ben Hague (BOM)

Michael Hutchinson (ANU)

Methods supporting ANUClimate 2.0 grids of daily and monthly climate across Australia

M.F.Hutchinson[a], Tingbao Xu[a] , I.J.Marang[b]

[a] *Fenner School of Environment and Society, The Australian National University, Australian Capital Territory*

[b] *NSW Department of Primary Industries*

ANUClimate 2.0 consists of high resolution grids of 18 sets of daily and monthly climate variables across the terrestrial landmass of Australia. Rainfall grids have been generated from 1900, temperature, vapour pressure and solar radiation grids from 1960 and pan evaporation from 1970. All grids have been generated to the near present, currently 2021. The underpinning spatial models incorporate enhanced approaches to the interpolation of Australia's national point climate data. Most climate values have been modelled by expressing each value as a normalised anomaly with respect to gridded 1976-2005 monthly means. These means and the anomalies were all interpolated by trivariate thin plate smoothing spline functions of longitude, latitude and vertically exaggerated elevation using ANUSPLIN Version 4.6, with additional dependences on proximity to the coast for the temperature and vapour pressure variables. ANUClimate 2.0 incorporates systematic upgrades to the methods and data quality assurance employed in ANUClimate 1.0.

It is well known that anomaly-based interpolation can separately account for the strong dependence of temperature on topography via "background field" parameters and on the broad atmospheric processes that give rise to the anomalies with respect to the background field. The accuracy and robustness of this approach has been enhanced by incorporating key physical process aspects of the climate variables and using regression procedures to estimate 1976-2005 monthly means for all stations with minimal records over the last century, whether or not they have records in the 1967-2005 period. This has substantially enhanced the coverage of the supporting spatial networks. In the case of monthly mean minimum and maximum temperature background fields, accuracy has been further enhanced by incorporating process-based coastal effects that have reduced predictive error in the coastal margins by around 25%. The ANUSPLIN package has also been extended to facilitate the systematic use of background fields in anomaly-based interpolation. This has enabled robust automation of the analyses for many thousands of days for each climate variable.

Daily rainfall has been modelled by separately interpolating daily rainfall occurrence and positive daily rainfall. This recognises the differing spatial coherence of the two rainfall fields and permits robust analysis that is resistant to common rainfall observation errors, particularly rainfall values recorded on the wrong day. Both the occurrence analyses and the positive rainfall analyses were obtained by fitting tri-variate thin plate smoothing spline functions of longitude, latitude and vertically exaggerated elevation. The daily occurrence surfaces are applied using a smooth adaptive occurrence threshold that minimises the bias of the interpolated rainfall and maximises occurrence accuracy.

All the spline analyses apply suitably large thresholds to extreme studentised residuals to provide automated quality assessment of the input point data values. This has removed around 1% of the daily rainfall values from the analyses and around 0.2% of daily maximum temperature values. Extensive close inspection of all data sets has verified the reliability of these assessments in detecting common observation errors. The thresholds are set quite conservatively and make little difference to overall summary predictive error statistics. The error statistics reflect improvements in Bureau of Meteorology data quality after the late 1990s.

Reference:

Hutchinson M.F., Xu T., Kesteven J.L., Marang I.J., Evans B.J. 2021. ANUClimate v2.0, NCI Australia. (dataset) https://dx.doi.org/10.25914/60a10aa56dd1b.

Alex Evans (BOM)

Improved gridded analysis of daily rainfall for Australia

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Abstract: The Bureau of Meteorology is committed to improving the services it provides to the Australian community and industry, including enhancing its public products. The Bureau of Meteorology published the Australian Gridded Climate Data set (AGCD version 2) in September 2020 as its operational national, real-time monthly gridded rainfall dataset, replacing the previous monthly gridded rainfall analysis, known as the Australian Water Availability Project (AWAP). AGCD version 2 incorporates enhanced analysis and scientific methods, as well as state of the art geostatistical computer modelling. That work continued and is now bringing into operations a new high resolution gridded analysis of daily rainfall. This work documents the new set of daily rainfall climate analyses for Australia. The analyses are updated in real-time and extends back in history to the beginning of the 20th century. The implementation of the new analysis scheme has seen an increase in spatial resolution of daily rainfall analyses from ~5×5 km grids to ~1×1 km grids, a substantial reduction in interpolation errors and bias, and a new capacity for inclusion of third-party data. When applied to a number of reference events, the analyses show an improved representation of daily rainfall extremes, which have previously tended to be heavily smoothed in the AWAP data. Furthermore, testing has indicated the method is appropriate for an extension to other climate variables such as temperature and vapour pressure, which will happen in the next year.

Susan Rennie (BOM)

Thorwald Stein (U Reading)