Advances in the development and application of forecasts in water sector

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Acknowledgement

Contents of this talk are based upon collaborative work and wide ranging consultations over more than a decade. In particular, colleagues from the following agencies are acknowledged:

- Bureau of Meteorology, Australia
- Australian research sector: CSIRO, University of Adelaide, University of Newcastle, University of Melbourne, UNSW
- Industry partners: WaterNSW, Murray-Darling Basin Authority, eWater, Goulburn-Murray Water and other regulatory and operational agencies in Australia
- International partners: WMO Secretariat and SMEs, CEH UK, ECMWF, NCAR USA, RIMES Thailand and Indian agencies – NCMRWF, IITM, IMD, NIH

Outline

- Overview of the WMO HydroSOS initiative
- Global and local scale models – comparative assessments
- Water forecasting services development in Australia
  - reflections from the Australian experience over a decade
- Water sector needs, challenges and pain points
- Concluding remarks

HydroSOS – Global Hydrological Status and Outlook System

What will HydroSOS provide?

An overview of the current hydrological status

including groundwater, river flow and soil moisture

An appraisal of where the current status is significantly different from 'normal'

For example indicating drought and flood susceptibility

An assessment of whether this is likely to get better or worse

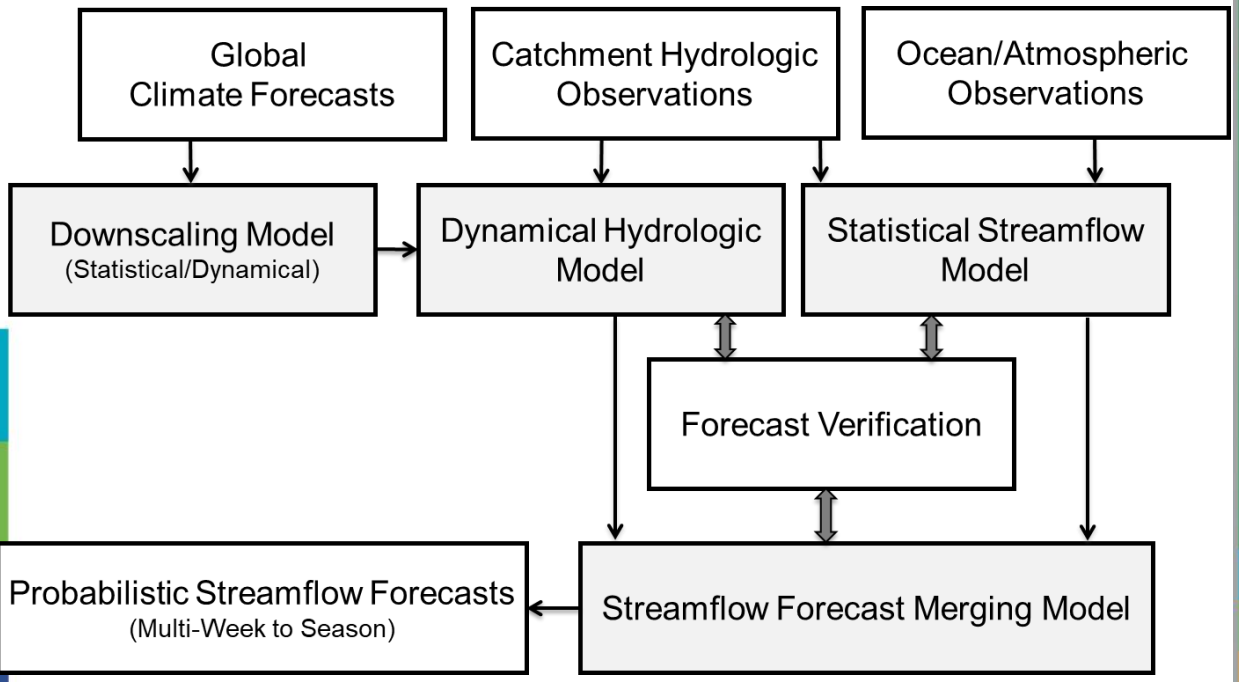
over coming weeks and months

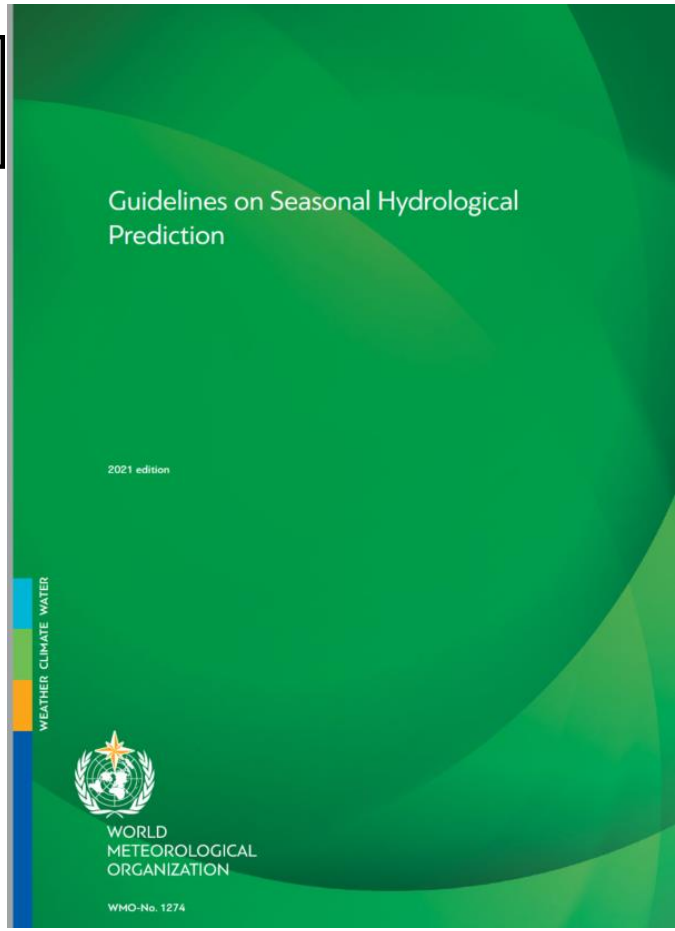
WMO OMM

HydroSOS is the link between monitoring and decision making

WMO OMM

WMO Seasonal Hydrological Prediction Guidelines

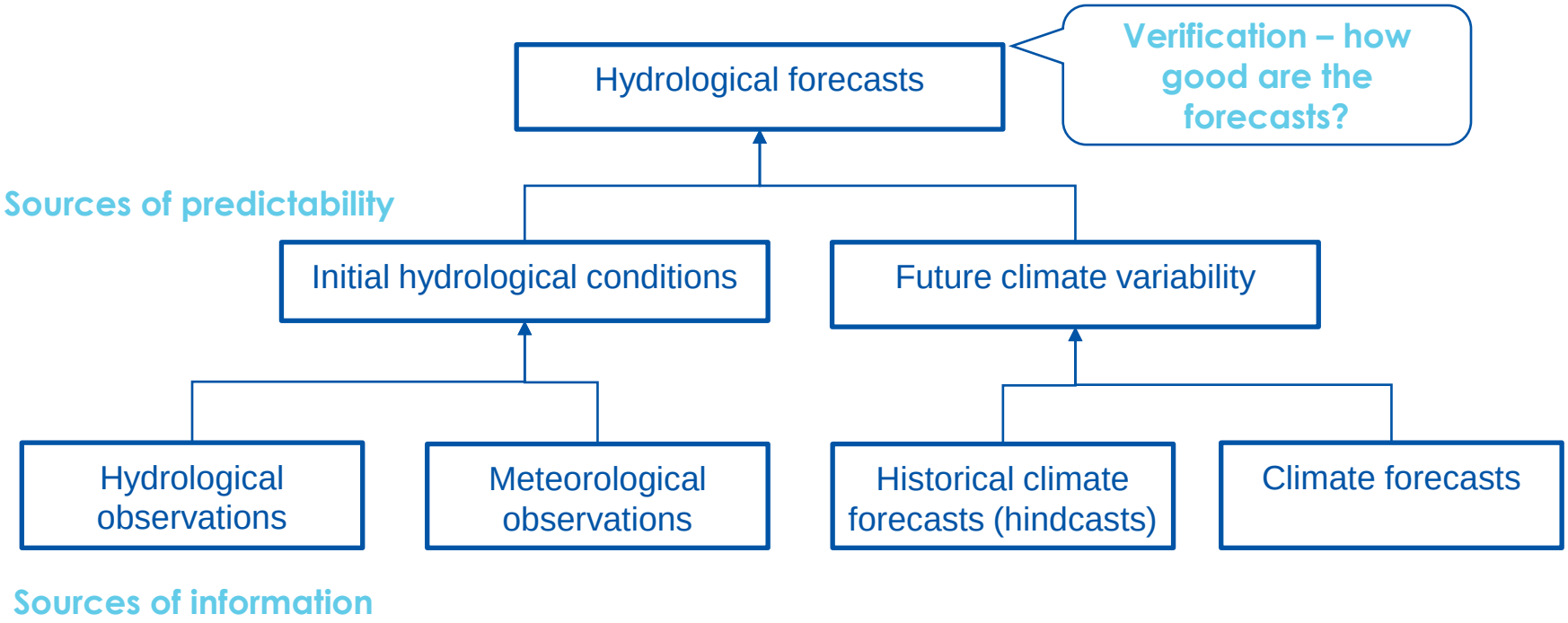




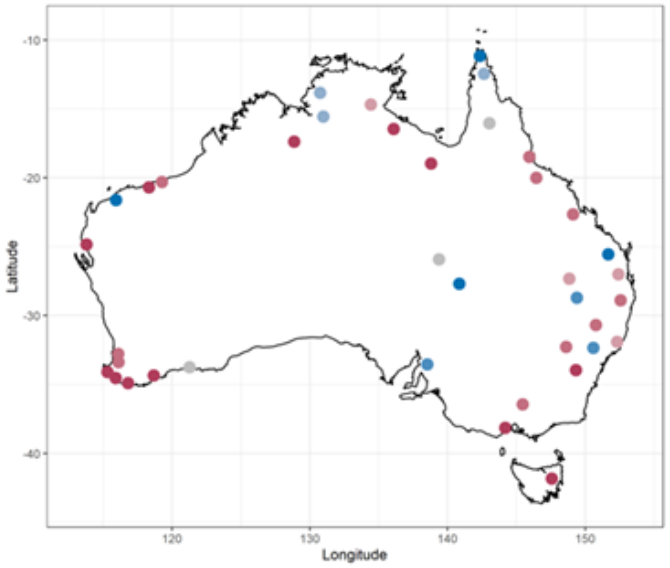
WMO OMM

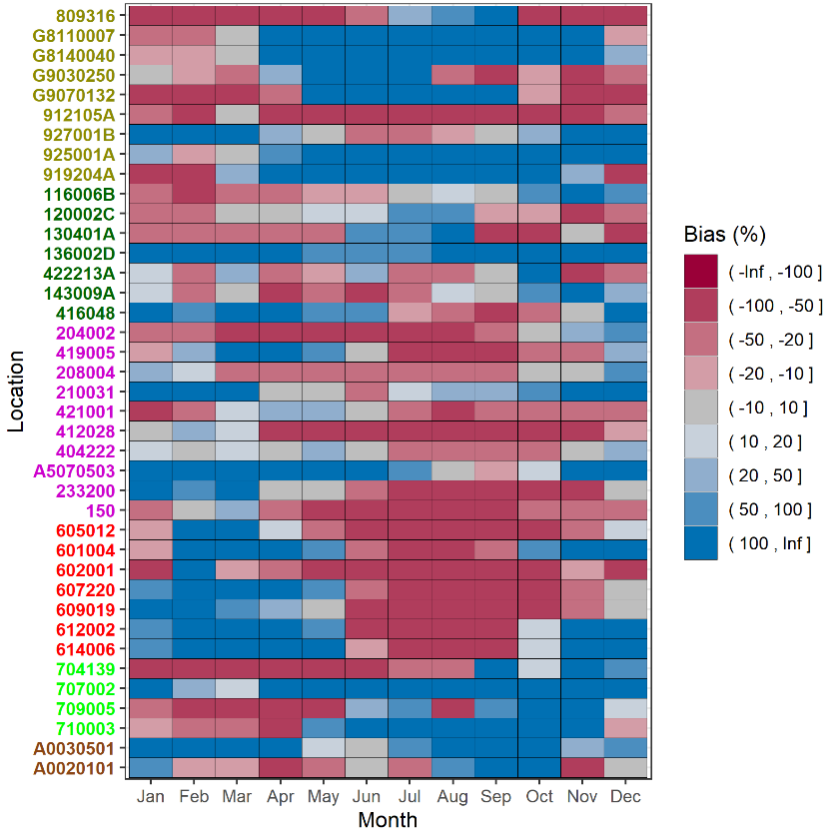
https://library.wmo.int/index.php?lvl=notice_display&id=22062

Sources of predictability



Reanalysis data at the catchment scale





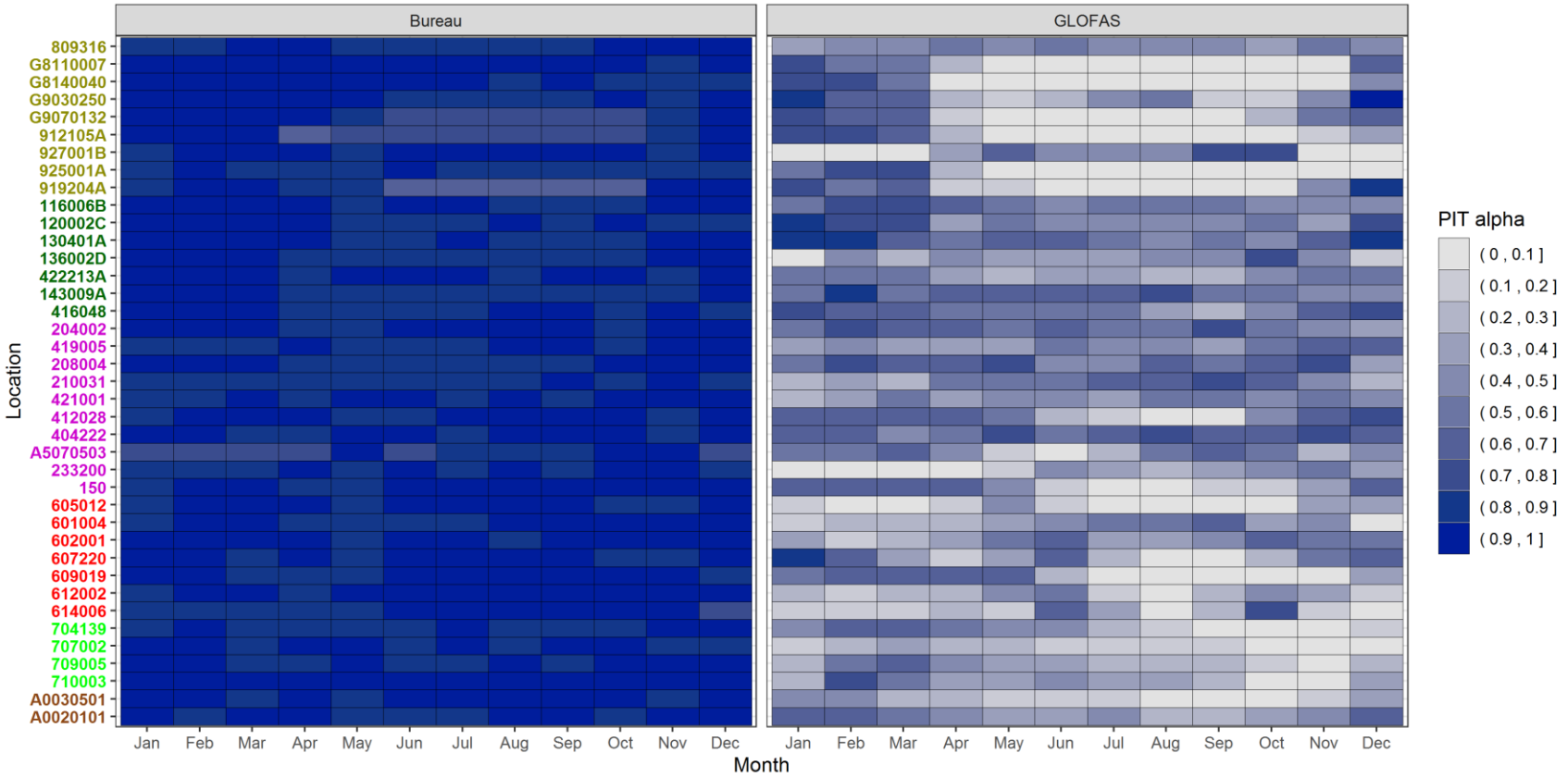
- Global models show large biases at catchment scale
- Too low in wet seasons and too high in dry seasons

WMO OMM

Benchmarking sub-seasonal streamflow forecasts from locally-calibrated and global hydrological models at the river basin scale

David E. Robertson[1*], Shaun Harrigan[2], Fitsum Woldemeskel[3], Urooj Khan[4], Ervin Zoster[2], Narendra K. Tuteja[5] Christel Prudhomme[2]

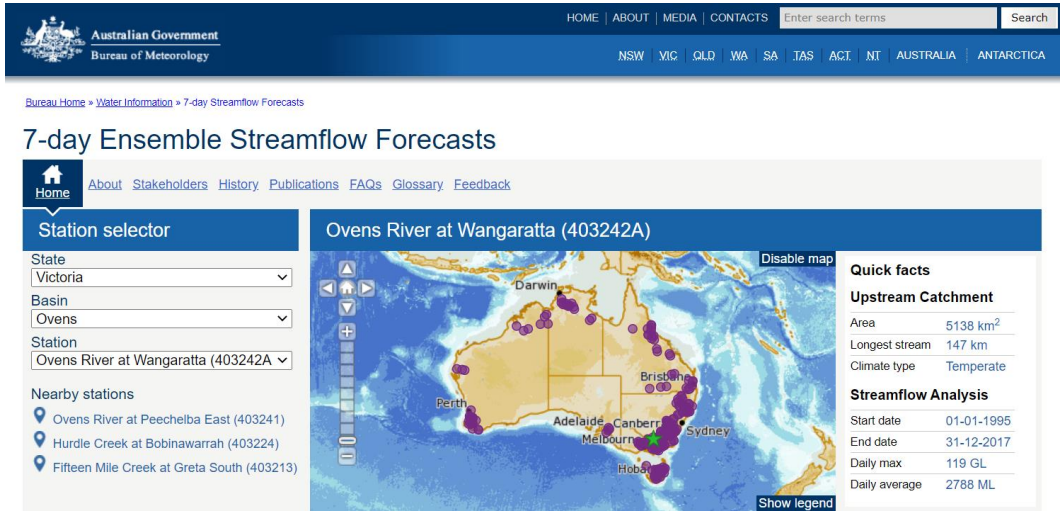
Reliability expressed as PIT-alpha index

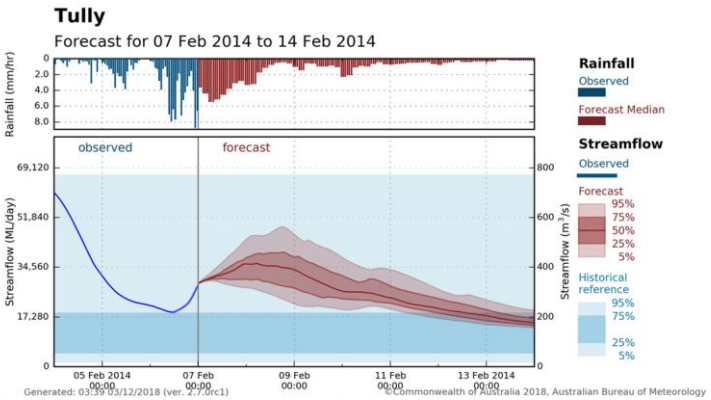


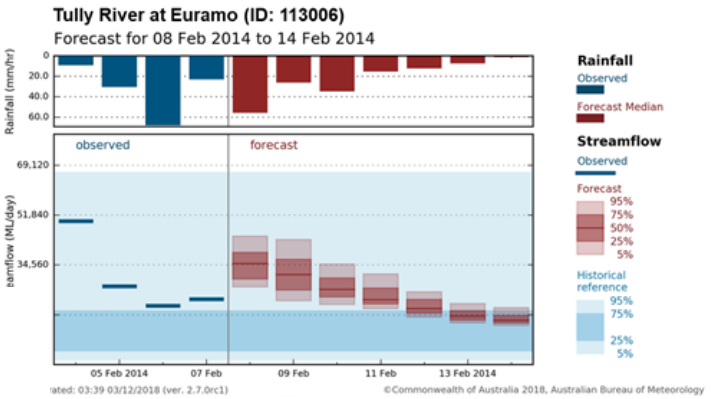
WMO OMM

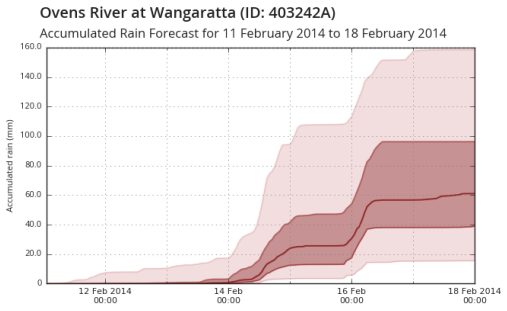
- Reliability: PIT-alpha index by forecast month and catchment for the local and global model
- Sharpness: Global model forecasts are sharper than those from local model (Inter Quartile Range, 5th and 95th percentile)
- Accuracy: Global model forecasts are less accurate than those from catchment models (CRPS skill score)

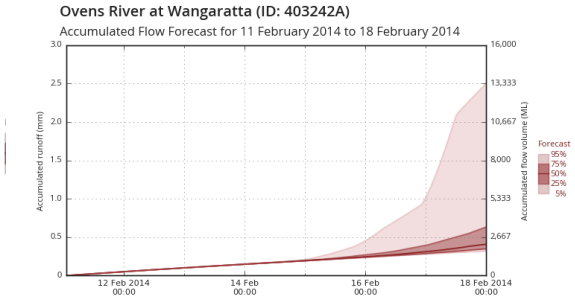
7-day flow forecasts

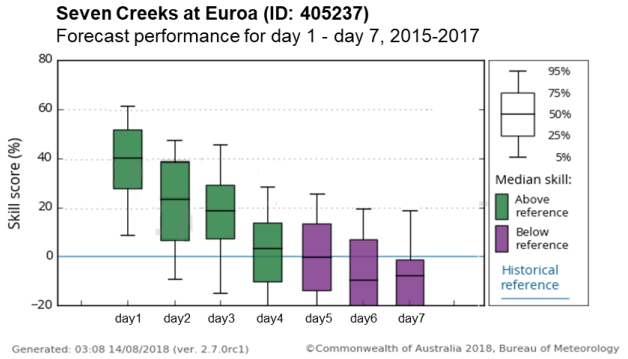






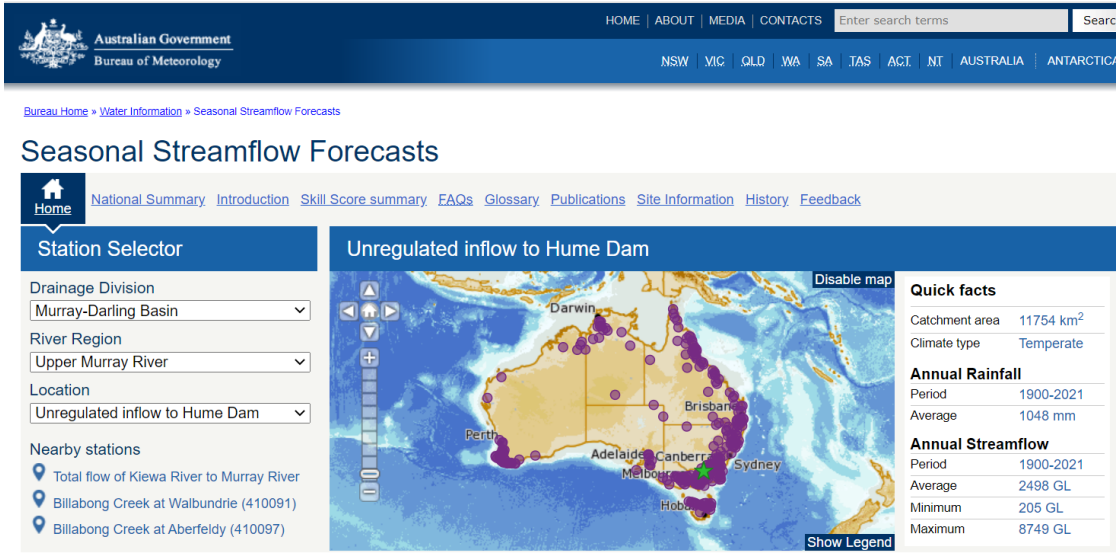


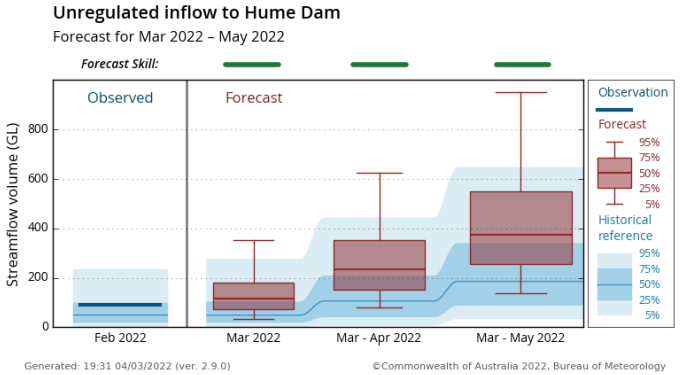


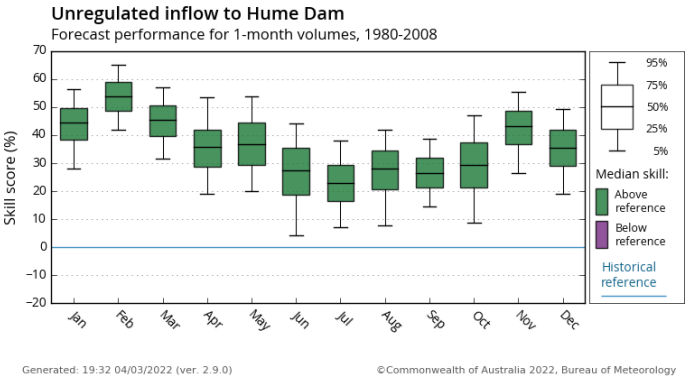


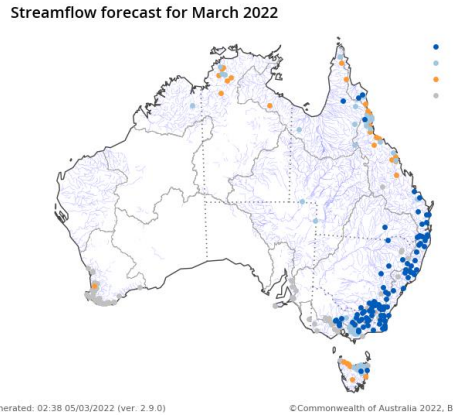
http://www.bom.gov.au/water/7daystreamflow

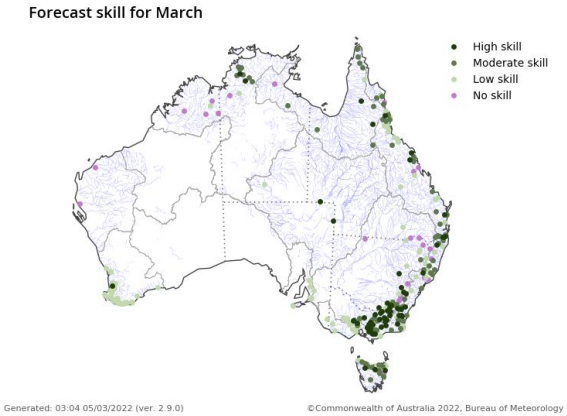
Seasonal flow forecasts

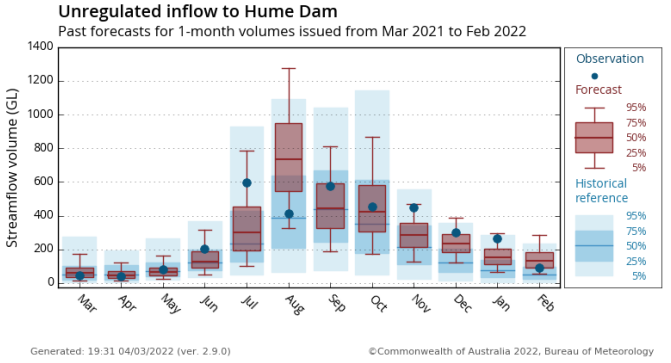












http://www.bom.gov.au/water/ssf

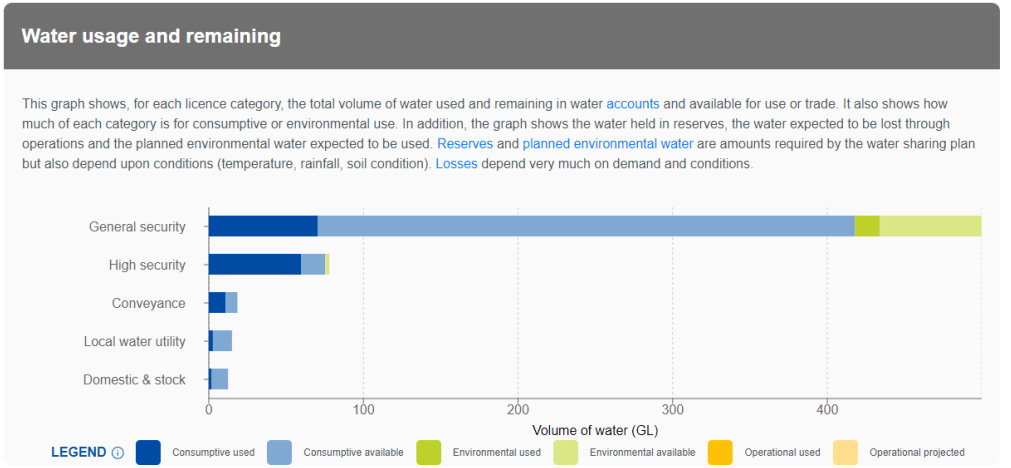
Water System Operations priorities

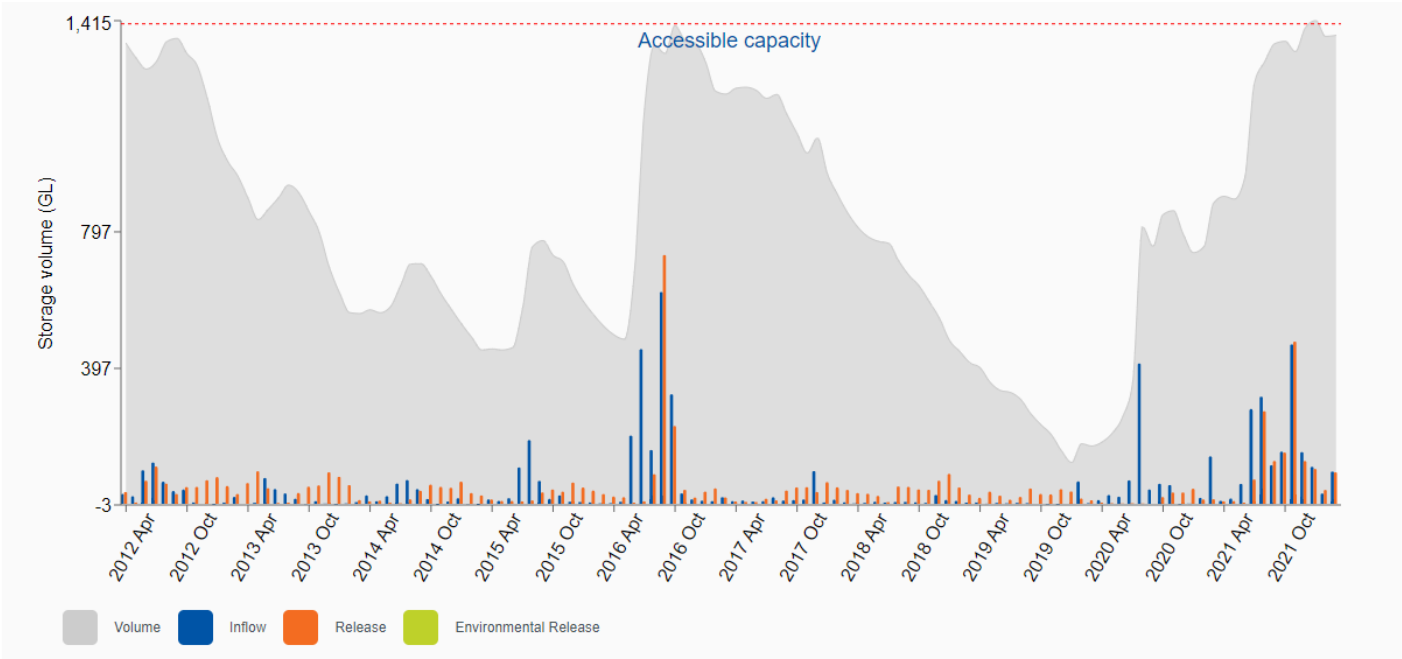
- Flood operations
- Dam airspace operations
- River operations
- Water demand forecasting
- Dam and valley inflows
- Climate change impacts
- Water security planning

River regulations and operational challenges

Rules	Storage	Allocation	Trading	Orders	Delivery
ACCESS LICENCE WATER SHARING PLANS ACCOUNTING RULES	ACCESSIBLE STORAGE ALL DAMS AND IMPOUNDING STRUCTURES IN THE VALLEY NEAR REAL TIME AND HISTORICAL	PERCENT ALLOCATION FOR EACH LICENCE CATEGORY HIGH SECURITY GENERAL SECURITY TOWN WATER SUPPLY DOMESTIC AND STOCK	ALLOCATION TRADE ENTITLEMENT TRADE $$/ML or 1000 m3 MARKET PRICE DEPENDS ON AVAILABILITY AND DEMAND	AUTOMATED SYSTEM FOR ORDERS WATER ACCOUNTS ADJUSTED AS PER ALLOCATIONS AND ORDERS OPERATOR RECEIVES ORDER EVERY DAY BUT SOMETIMES WITHIN A DAY	DEMAND AGGREGATED FROM END OF VALLEY TO UPSTREAM STORAGES INFLOW FORECASTS FOR STORAGES & TRIBUTARIES KNOWELEDGE OF TRAVEL TIME & LOSSES NEEDED MINIMISE UNUTILISED DEMAND

Water delivery – when and where it matters





WMO Designated Global Data-processing and Forecasting System Centres

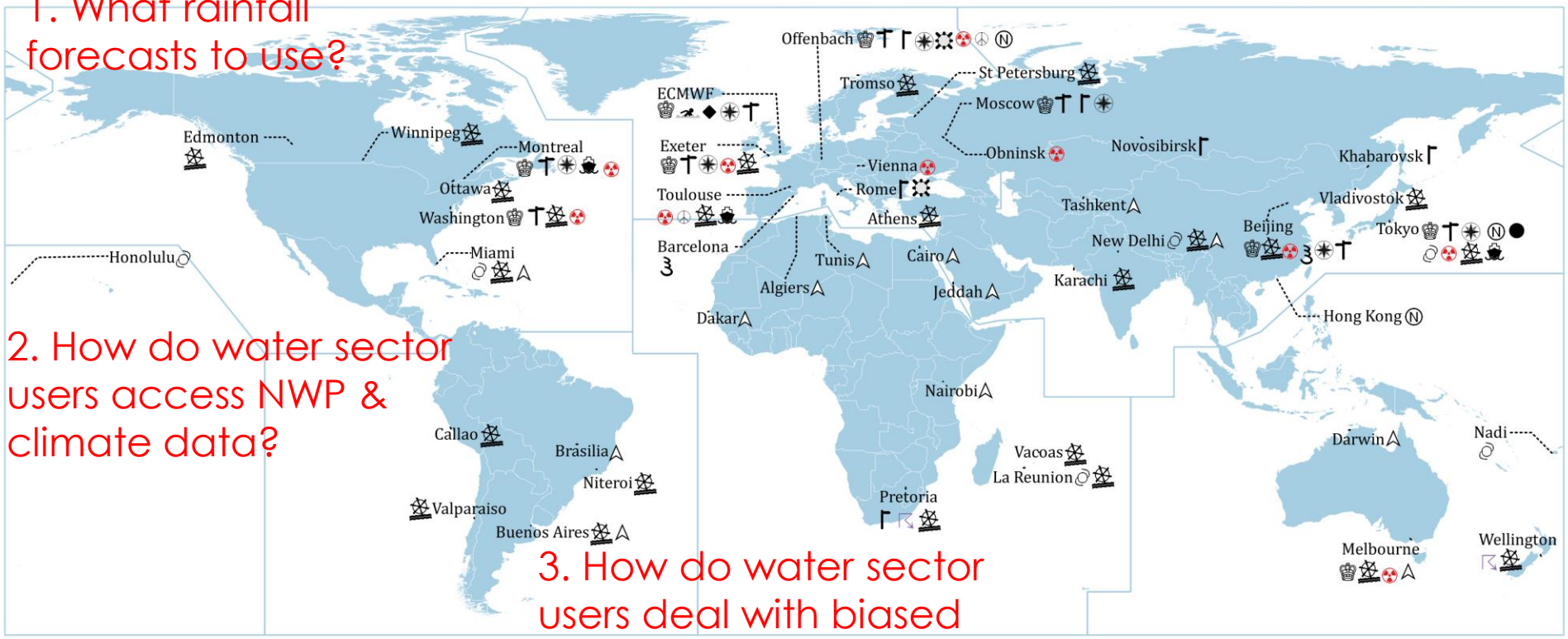
- Nowcasting and Weather Forecasting (upto 30 days)

Updated on 12 March 2019

1. What rainfall forecasts to use?

2. How do water sector users access NWP & climate data?

3. How do water sector users deal with biased global forcing data?



Legend

- World Meteorological Centres (WMCs)* (9)
- RSMCs Geographic (13)
- RSMCs(NRT***) Lead Centre for Coordination of Wave Forecast (1)
- RSMCs(NRT***) Lead Centre for Coordination of EPS Verification (1)
- RSMCs(NRT***) Lead Centre for Coordination of DNV (1)
- RSMCs Numerical Ocean Wave Prediction (3)
- RSMCs TC (6)
- RSMCs Severe Weather Forecasting (2)
- RSMCs Marine Meteorological Services (24)
- RSMCs Nuclear Emergency Response** (10)
- RSMCs Non-Nuclear Emergency Response** (2)
- RSMCs Sand Dust (2)
- RSMCs Nowcasting (3)
- RSMCs Limited Area Ensemble NWP (2)
- RSMCs Global Ensemble NWP (7)
- RSMCs Limited Area Deterministic NWP (6)
- RSMCs Global Deterministic NWP (8)

* World Meteorological Centres are also Global Producing Centres for a) Deterministic Numerical Weather Prediction, b) Ensemble Numerical Weather Prediction, and c) Long-Range Forecasts.
** RSMC for nuclear and non-nuclear emergency response have Atmospheric Transport and Dispersion Modelling (ATDM) capabilities.
*** NRT stands for Non-Real-Time

Concluding remarks

- Clarity needed for water sector users on climate forecast products to use including the rationale of fitness for purpose
- Access to NWP data including support for the enabling technologies for data harvesting over domains of interest
- The need for National Meteorology and Hydrology agencies to work with users from inception through to product design, delivery and review stages
- Understanding the role of global and catchment models for supporting needs of the water sector
- Verification is important for end user confidence – not just illustration of the metrics, rather intuitive products that demonstrate the value proposition
- While production and delivery of services for water sector are important, use of probabilistic forecasts for critical decisions is far more complex
- Water operators have compelling reasons to be risk averse, and therefore research in decision support systems warrant serious consideration

Thank you

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