



Water Security in Queensland

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Queensland's Climate Change Strategy



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Presentation Outline

- Context in SEQ
- Climate change and variability – impact on rainfall in SEQ
- Downscaled climate modelling – drought projections
- Impact on hydrology and dam inflows
- Concluding remarks



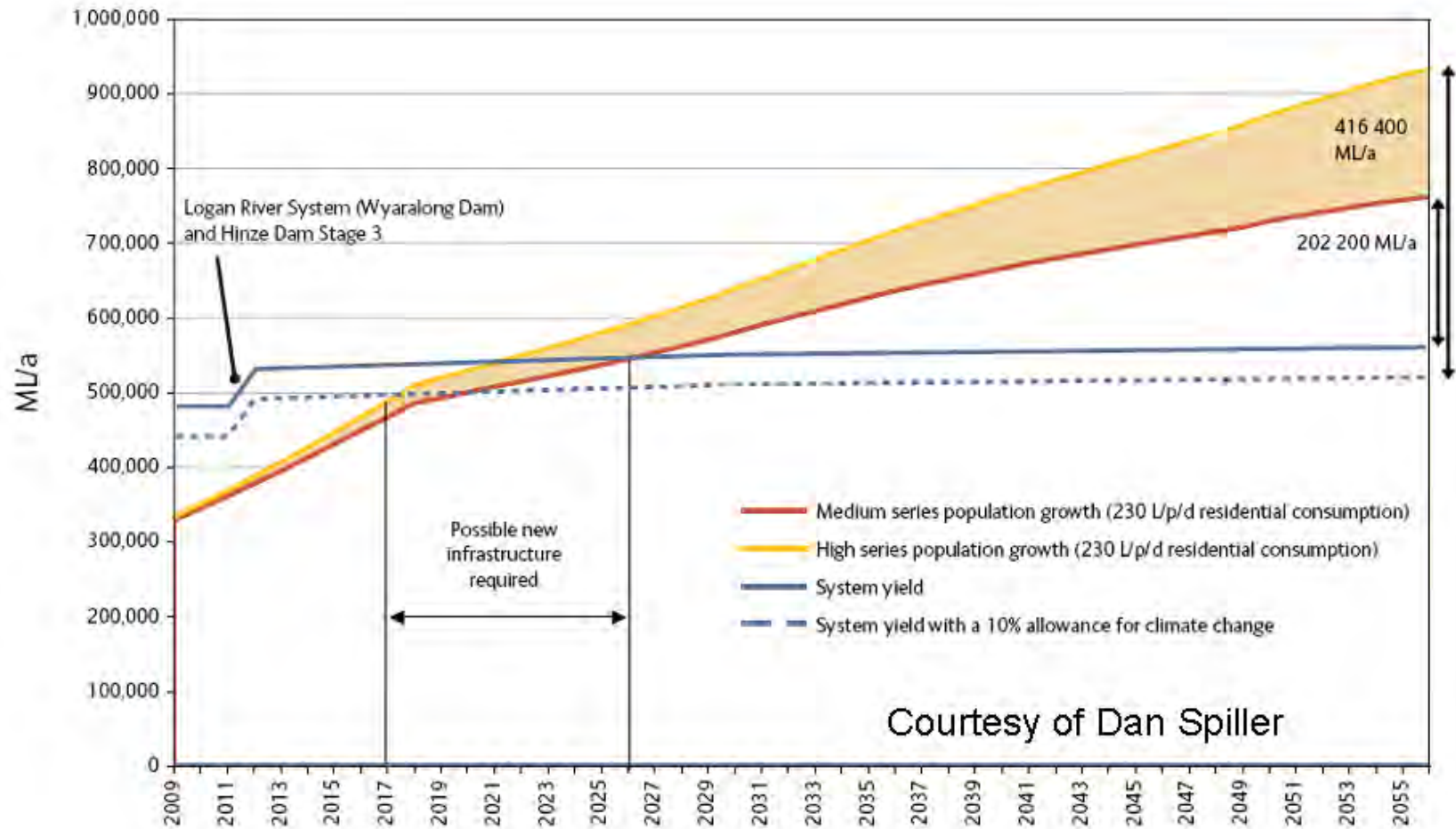
Combined dam capacity Wivenhoe, Somerset and North Pine



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Projection: SEQ water demand & supply

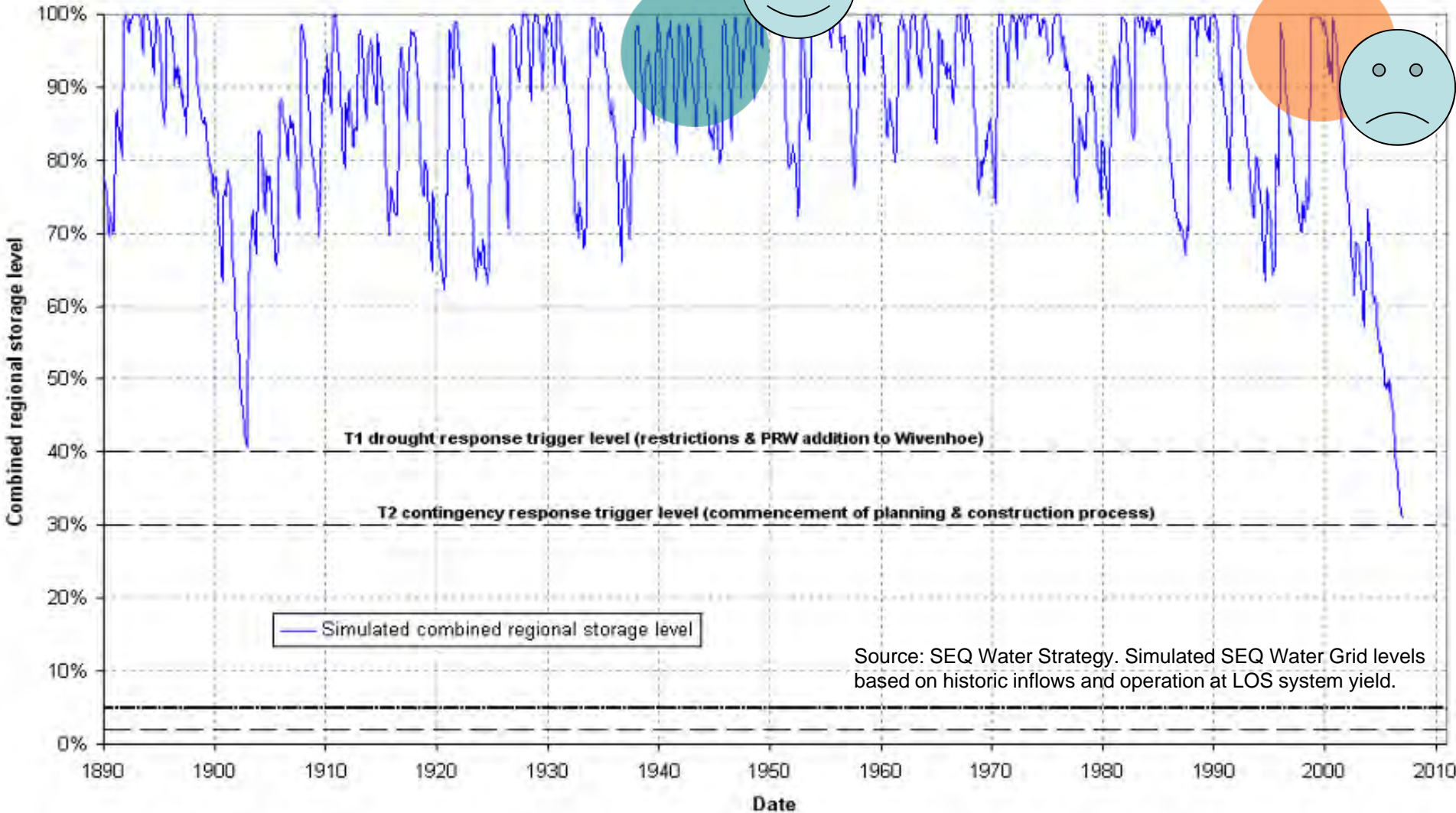
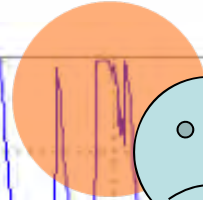
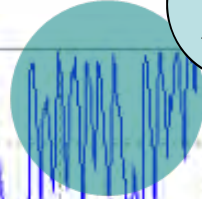
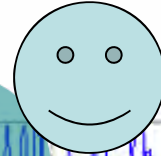


Long-term water security

Simulated SEQ water storage level (1890-2009)

Are we here?

Or here?



Research Questions ...

1. What causes drought in the SEQ region, and how the **intensity, duration and frequency of drought** may **change in a warming climate**, in addition to forcing by multidecadal variability. *(in conjunction with Qld Climate Change Centre of Excellence)*
2. How best to **translate global projections** of climate change (rainfall and other hydrological fields) into **future water availability** information. *(in collaboration with Department of Environment and Resource Management)*
3. How sensitive to the **resolution of climate information** is the SEQ **stream-flow** model IQQM (Integrated Quantity and Quality Model). *(in collaboration with Department of Environment and Resource Management)*



Downscaled drought projections

Palmer Drought Severity Index

- Simple water balance model, proxy to soil moisture conditions
- Driven by monthly rainfall, temperature
- Modified to use the downscaled potential evaporation data instead of deriving an approximation from rainfall and temperature
- Index with range of around -6 (**severe water deficiency**) to +6 (**anomalously wet**)
- Calibrated against 1971-2000 as 'normal' conditions

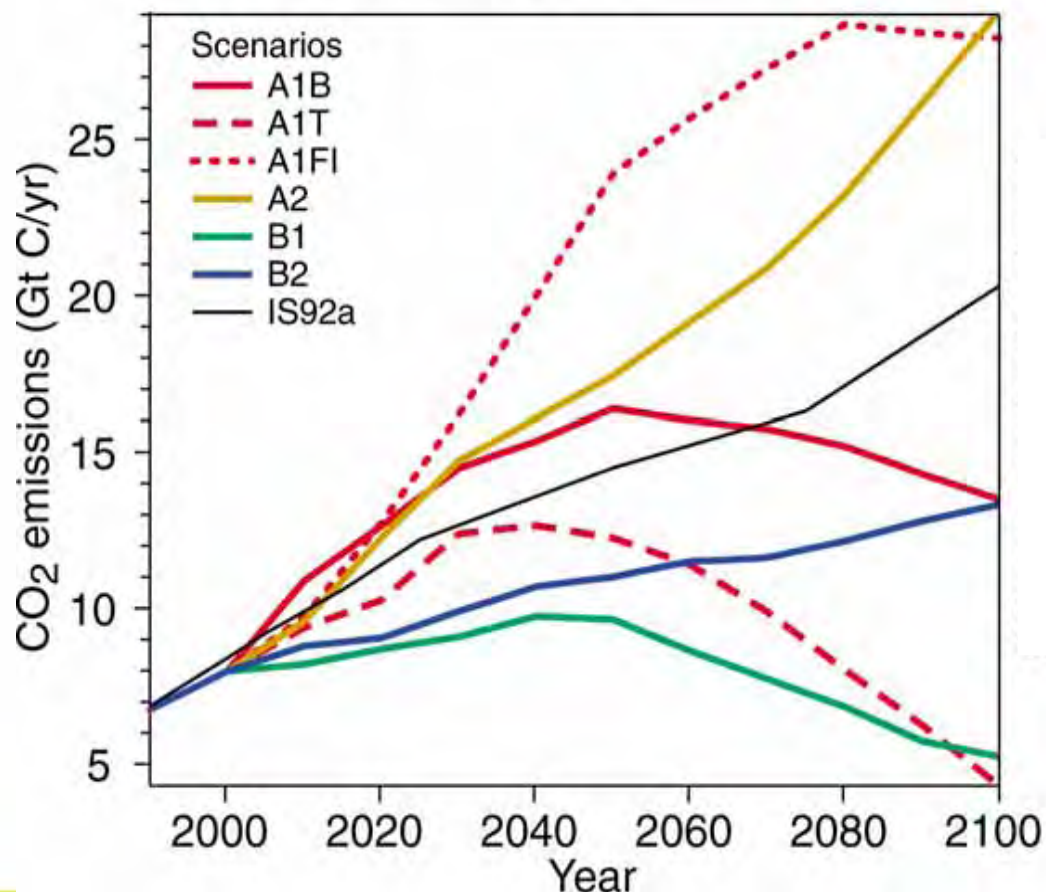


Downscaling experiments completed to date

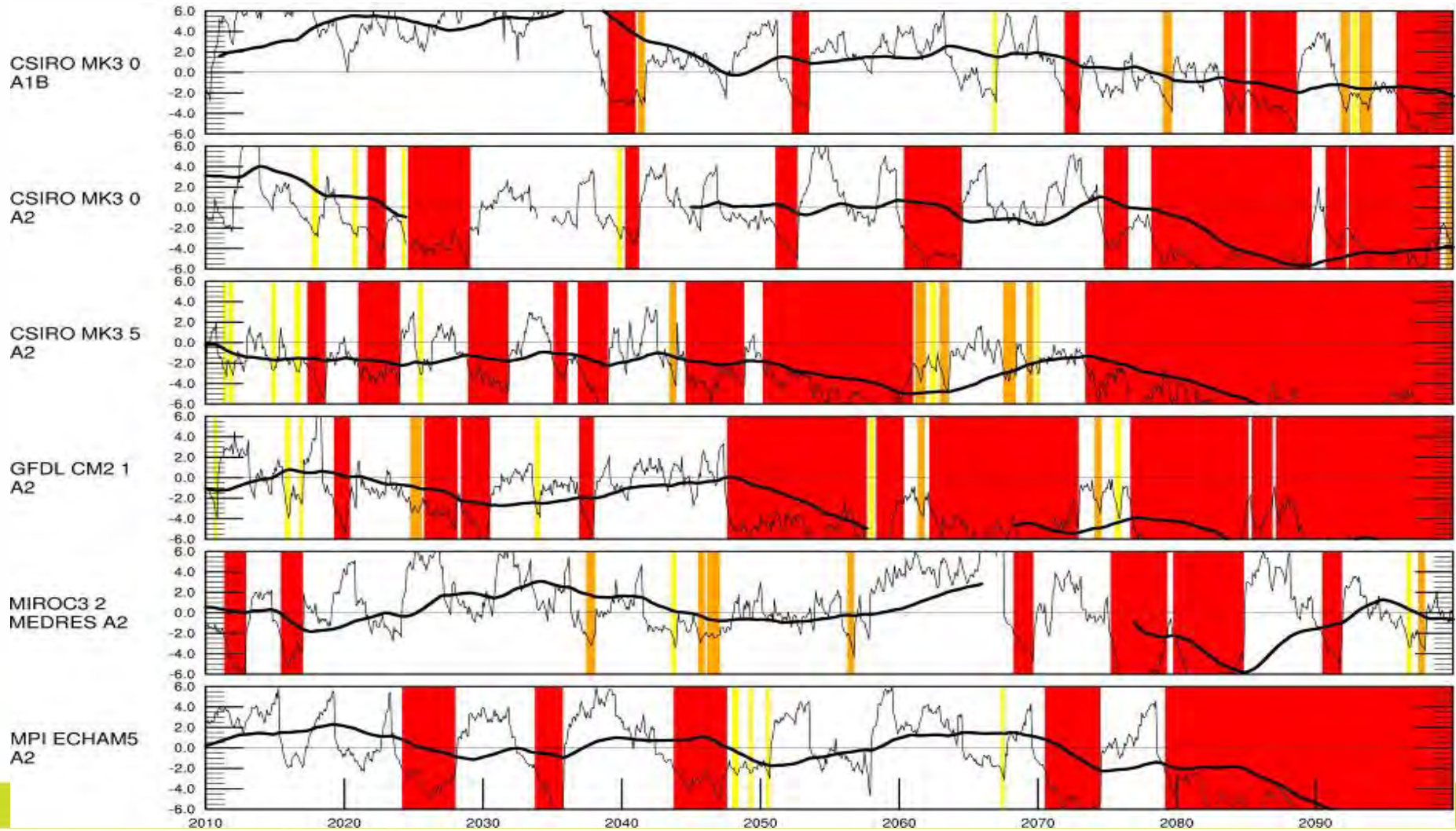
- CSIRO-MK3.0 **A1B**
- CSIRO-MK3.0 **A2**
- CSIRO-MK3.5 **A2**
- GFDL CM2.1 **A2**
- MIROC3.2 MEDRES **A2**
- MPI/ECHAM5 **A2**

- UKMO-Hadcm3 **A2**
- NCAR-CCSM3.0 **A2**
- UKMO-HadGEM1 **A2**

CO₂ emissions

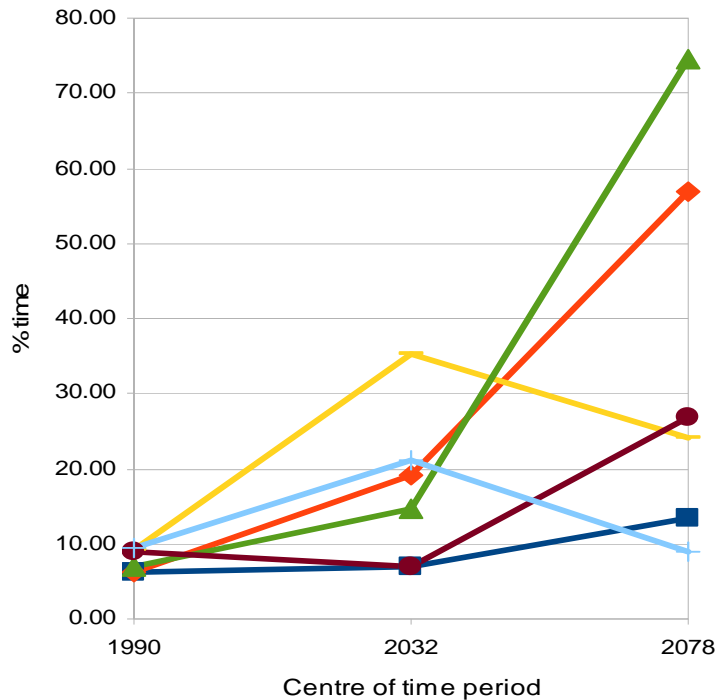


Downscaled drought projections (2010-2100)

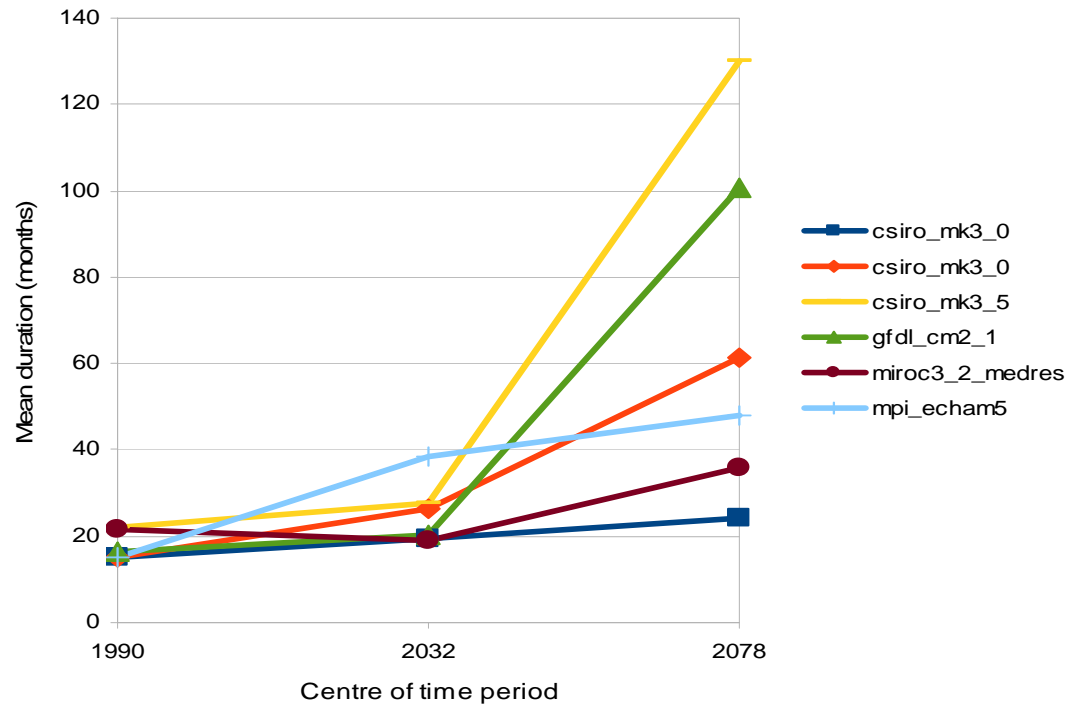


Projected percent time and duration in drought

Percent time in drought



Mean drought duration



- Large inter-model uncertainty
- Uncertainty increases with time
- All agree on **increased proportion of time** in drought
- All agree on **increased duration** of drought



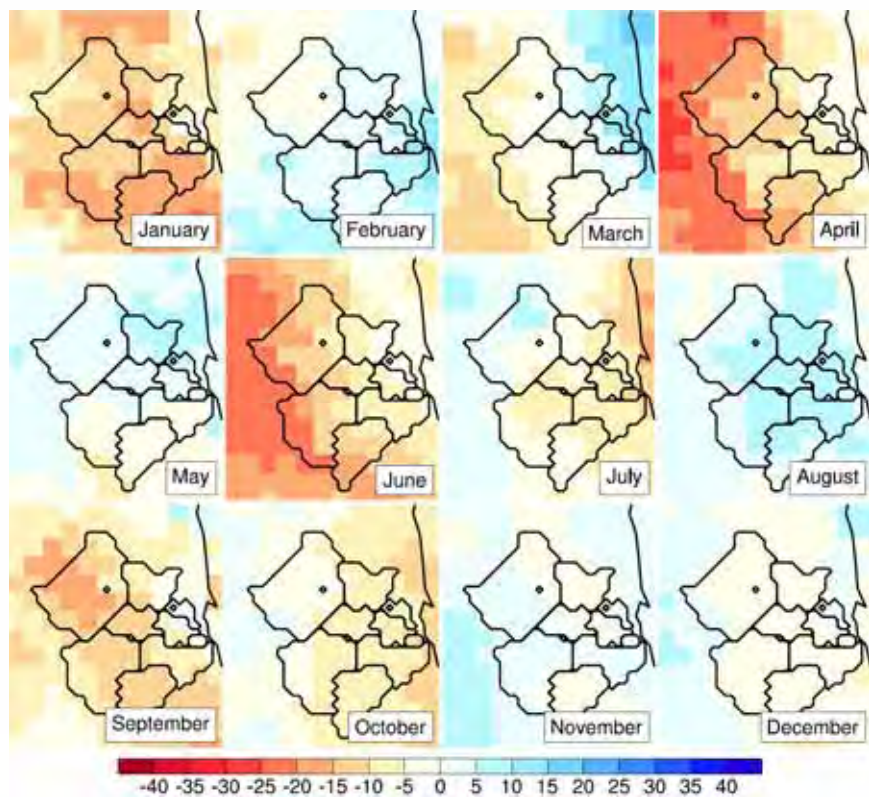
Climate impacts on hydrology

- Using downscaled climate model outputs to force Integrated Quantity and Quality Model (IQQM)
- Focusing on Wivenhoe catchment in SEQ region

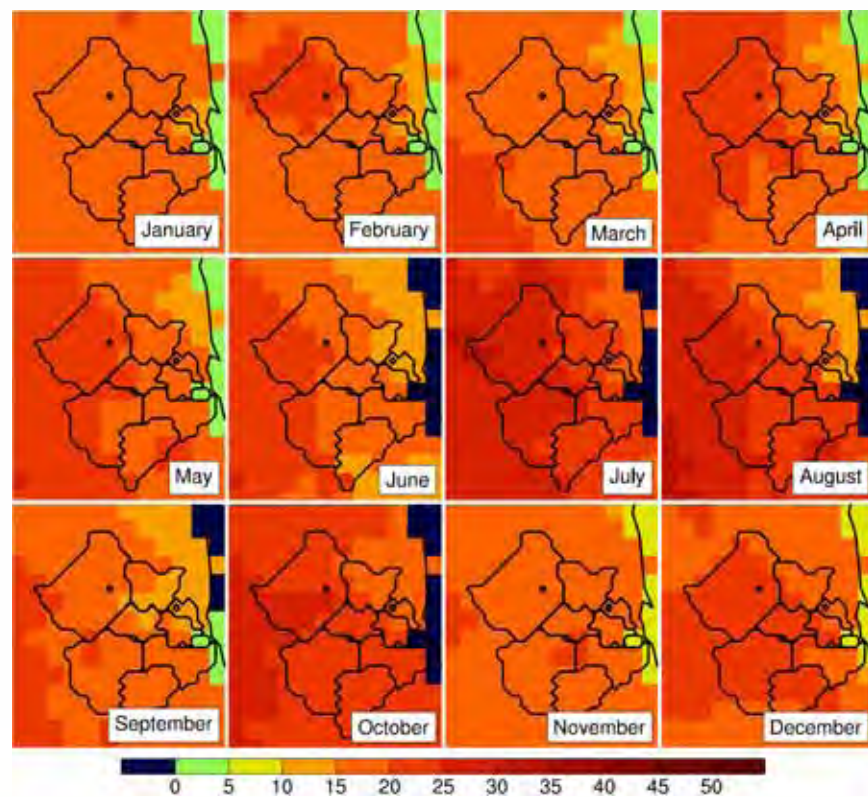


Projected change by 2050 under median climate sensitivity

Downscaled from CSIRO Mk3.5



Rainfall % change



Potential Evaporation % change

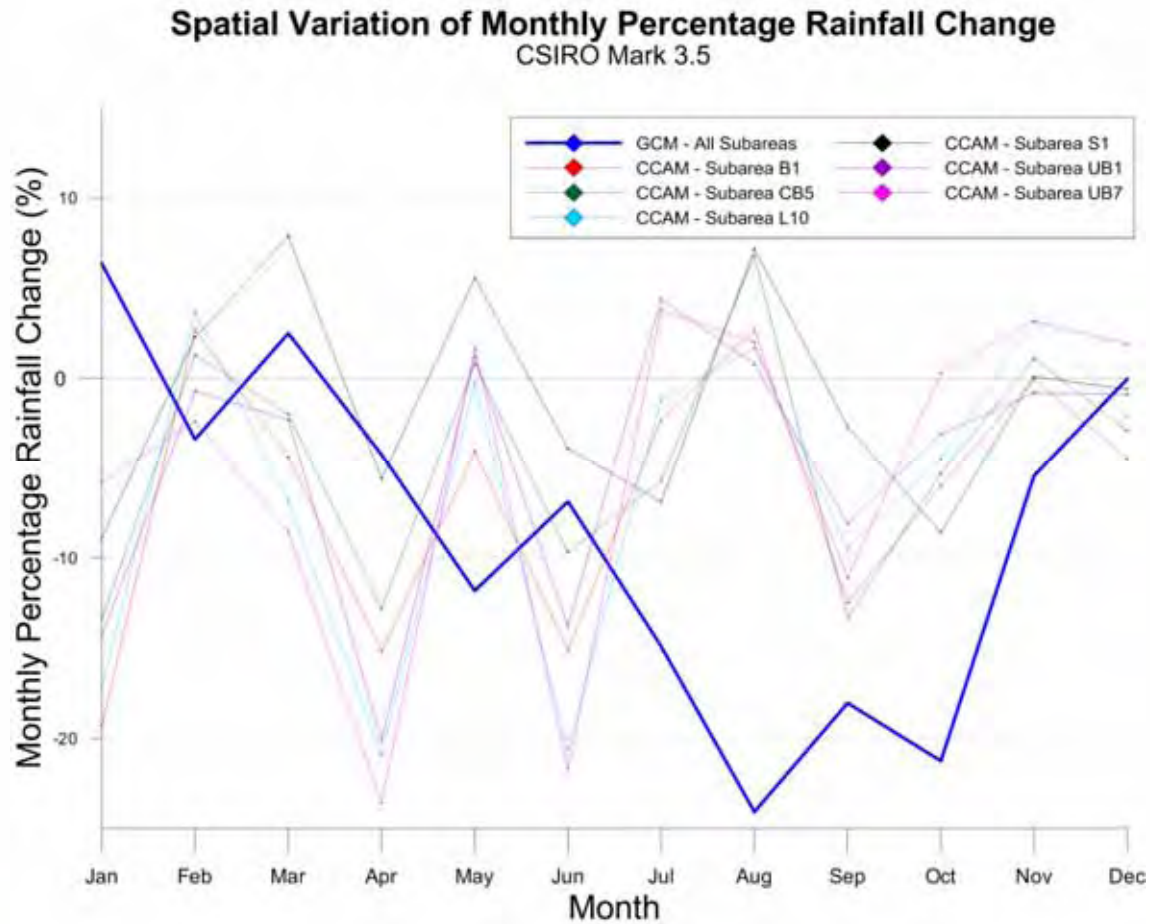
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Percent Rainfall Change for 2050

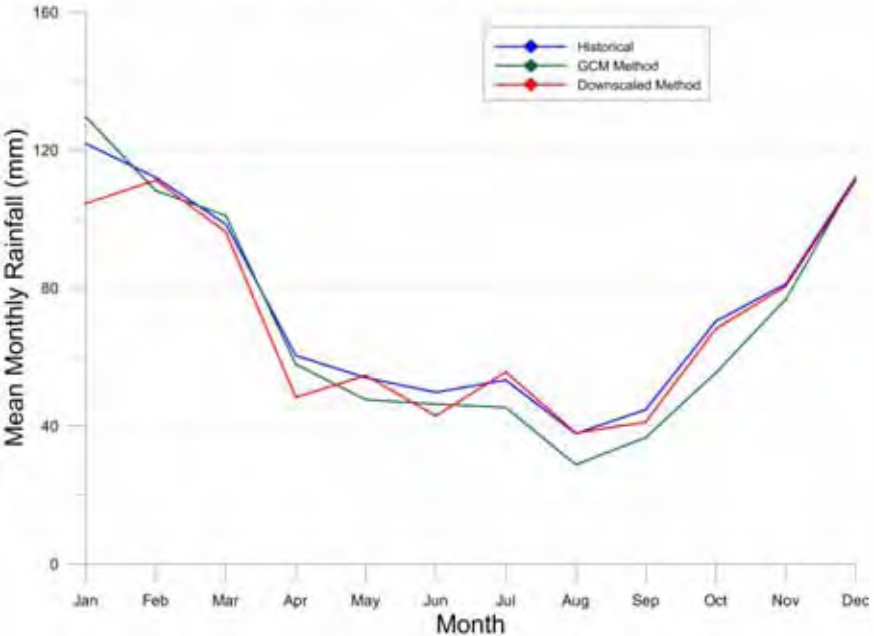


Downscaling results in both temporal and spatial variation from the original GCM climate change impacts

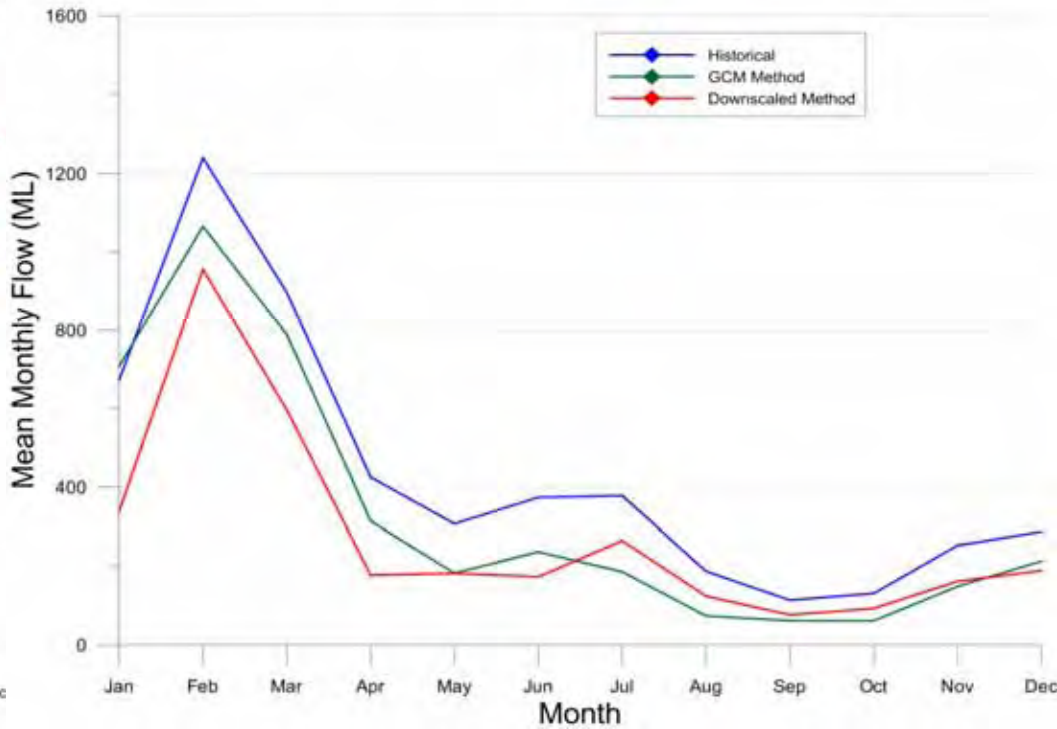


Using those % changes for 2050 and downscaling effects on hydrologic model inputs

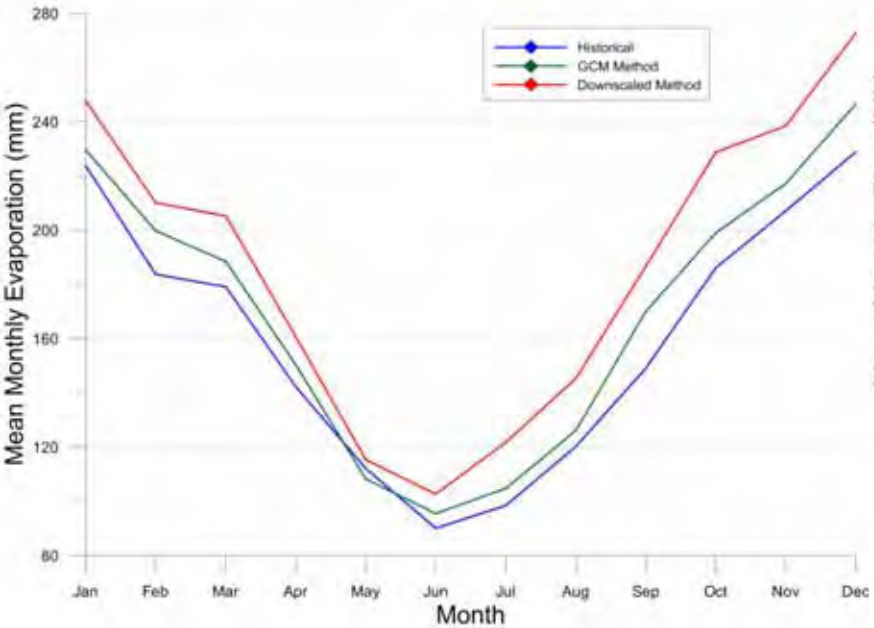
Mean Monthly Rainfall - UB1 (07/1889-06/2000)
csiro_mk3_5



Mean Monthly Inflow - UB1 (07/1889-06/2000)
csiro_mk3_5



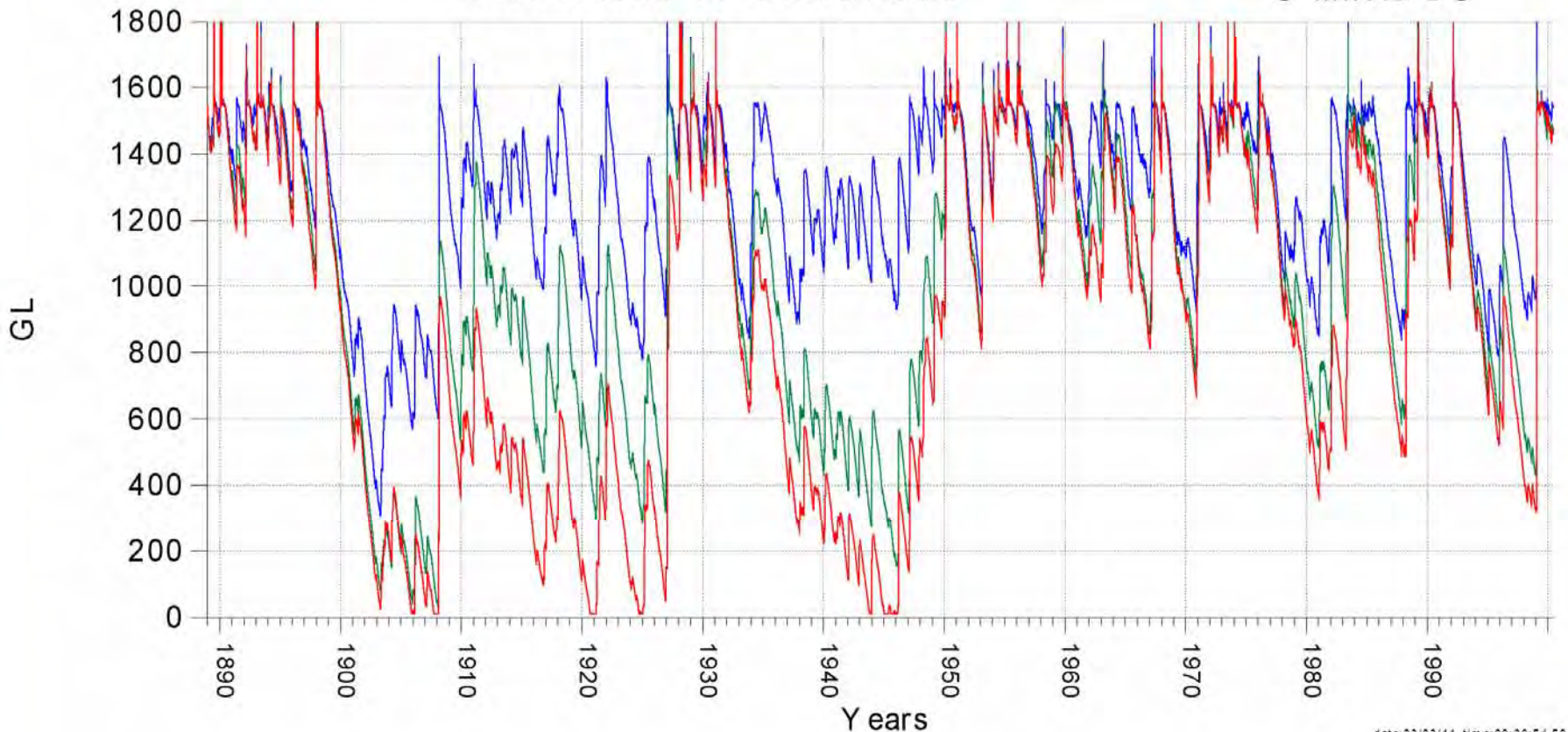
Mean Monthly Evaporation - Gatton (40082) (07/1889-06/2000)
csiro_mk3_5



Modelled storage behaviour

Combined Wivenhoe & Somerset Dam
Storage Behaviour comparing Historic,
CSIRO Mk3.5 GCM and Downscaled GCM
01/01/1889 to 30/06/2000

— Hist Climate
— C Mk3.5 GCM
— C Mk3.5 DS



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Consensus

- El Niño and La Niña cycle is the rain-generating mechanism for SEQ.
- The rainfall reduction since 1980 is mainly due to a breakdown of ENSO associated with decadal variability dominated by the Inter-decadal Pacific Oscillation
 - Climate change may not be the main driver.
- There is not yet a consensus in the models as to the direction of future **rainfall changes** over SEQ.
 - Recent weather events primarily reflect natural climate variability but the magnitude of such events over the longer term may increase with climate change.
- Impact of **rising temperature** may be significant
 - Good agreement on increased frequency and duration of drought and increased evaporation.
- Downscaling analyses to date shows that climate change assessments using Global Climate Models may underestimate the impact on available water resources in SEQ
 - Likely impact on reduced inflows to dams and increased time between filling events.



Future research

- Completion of a super-high resolution (~8km) downscaling experiment.
- Analysis of response of drought (intensity, frequency and duration) to climate change.
- Sensitivity of SEQ IQQM to downscaled climate forcing data.
 - Examine impact of increased evaporation on inflows assuming rainfall remains constant.



Urban Water Security Research Alliance

www.urbanwateralliance.org.au



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