Impact of different rainfall thresholds on GRACE total water storage across Australia

A. Shadmehri Toosi, O. Batelaan, M. Shanafield, H. Guan

National Centre for Groundwater Research & Training (NCGRT),
College of Science & Engineering, Flinders University, Australia

Flinders UNIVERSITY

NATIONAL CENTRE FOR GROUNDWATER RESEARCH AND TRAINING

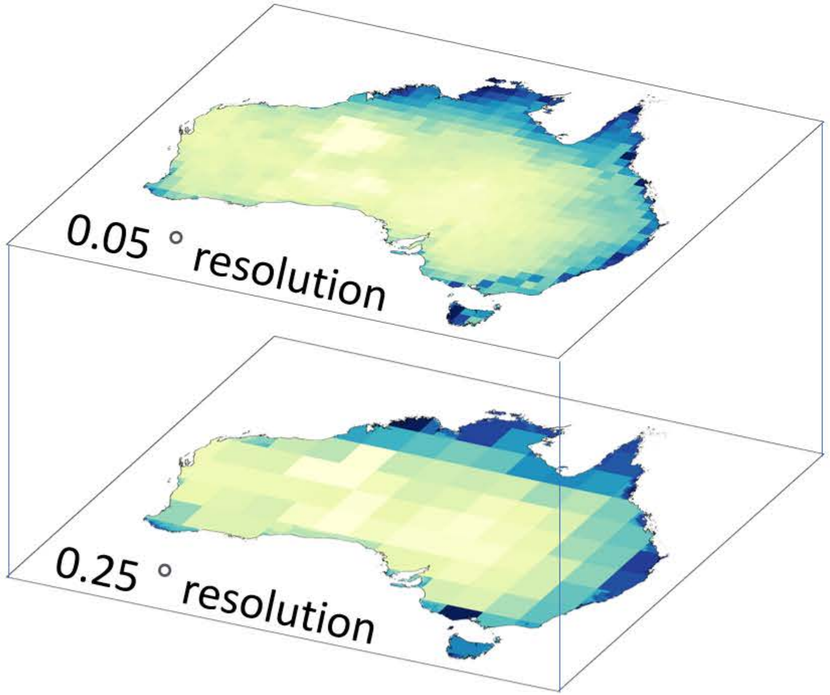
EGU General Assembly

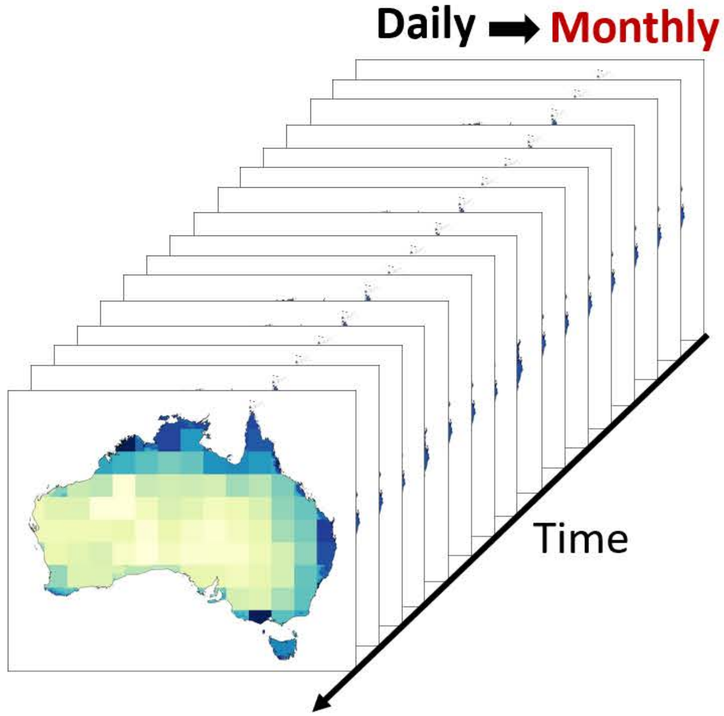
- Climate change has changed the global hydrological cycle
- Investigation of rainfall characteristics are limited to small scales
- Uncertainty in spatiotemporal distribution of global freshwater fluxes

*Image credit: https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts

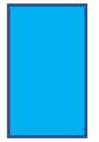
Datasets	Spatial resolution	Temporal resolution	Sources
Rainfall	0.05°	Daily	http://www.bom.gov.au/climate/maps/rainfall).
GRACE- TWS	0.25°	Monthly	http://www2.csr.utexas.edu/grace/RL06_mascons.html

Upscaling (Aggregation)

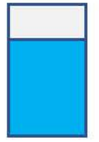




Defining daily rainfall thresholds



All rainfalls

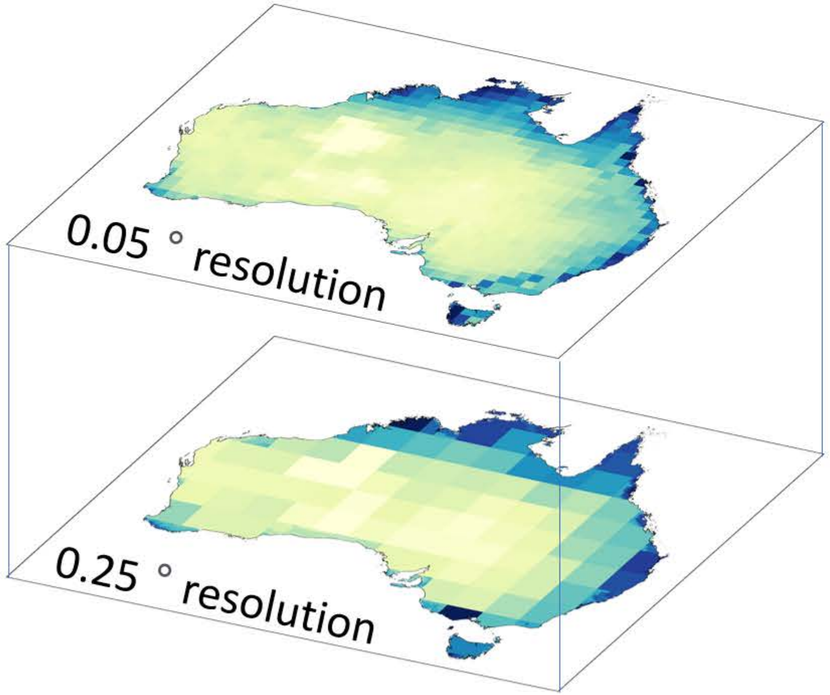


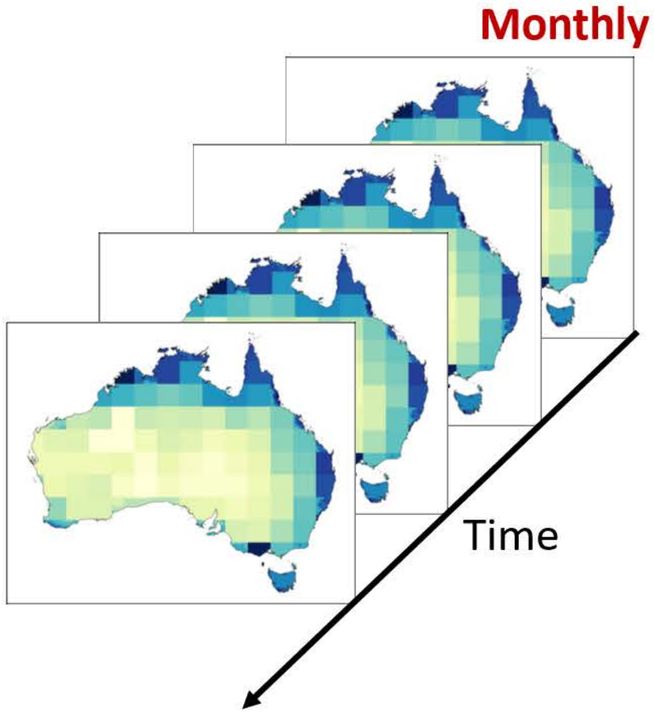
Daily rainfall greater than 5mm

Daily rainfall greater than 10mm

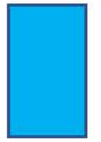
Datasets	Spatial resolution	Temporal resolution	Sources
Rainfall	0.05°	Daily	http://www.bom.gov.au/climate/maps/rainfall).
GRACE- TWS	0.25°	Monthly	http://www2.csr.utexas.edu/grace/RL06_mascons.html

Upscaling (Aggregation)

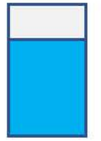




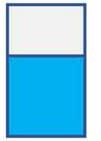
Defining daily rainfall thresholds



All rainfalls



Daily rainfall greater than 5mm



Daily rainfall greater than 10mm

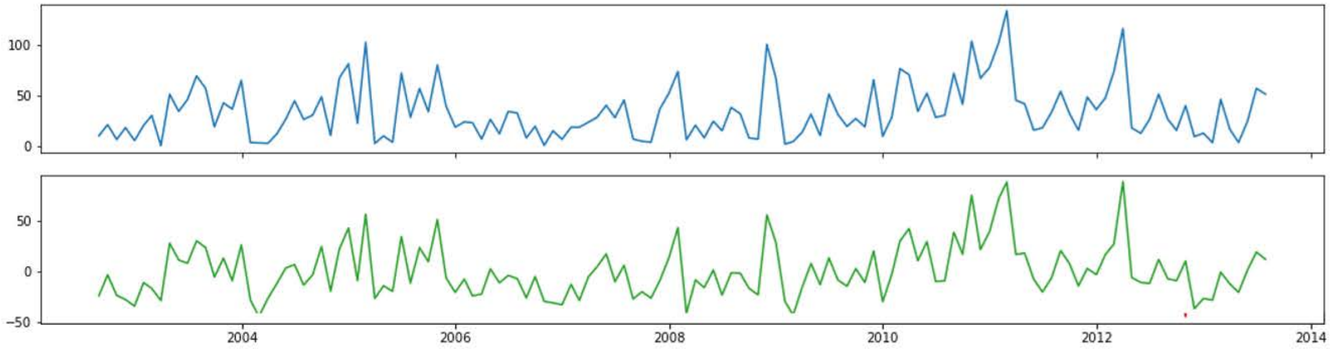
Calculating monthly anomaly

$$X_{anomaly}(i,j) = X(i,j) - \frac{1}{n}\sum_{j=1}^{n} X(i,j)$$

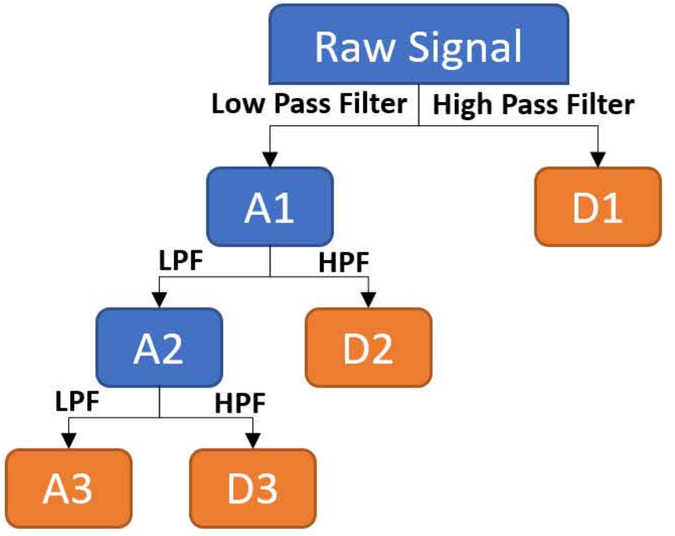
Where $X_{anomaly}$ is the anomaly for month i and year j, and n represents the total number of years.

Monthly rainfall

Rainfall anomaly

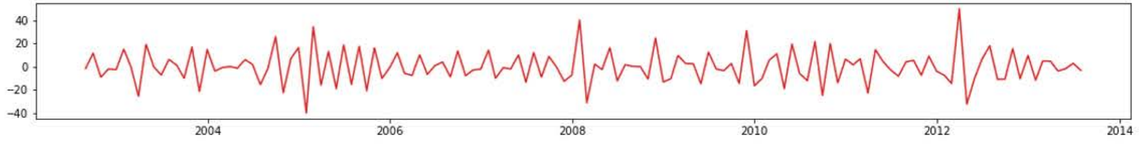


Discrete Wavelength Decomposition



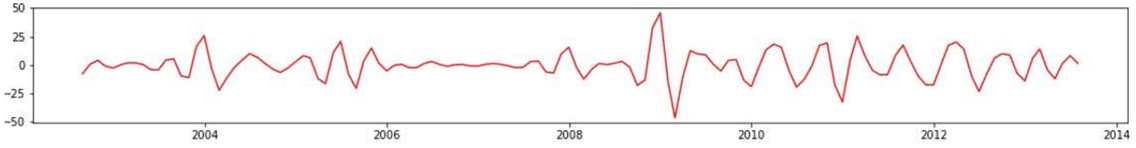
2-month cycle

D1



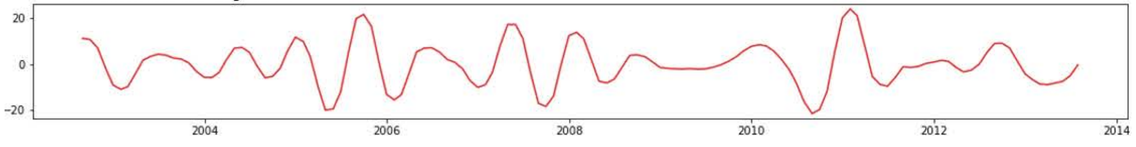
4-month cycle

D2



8-month cycle

D3



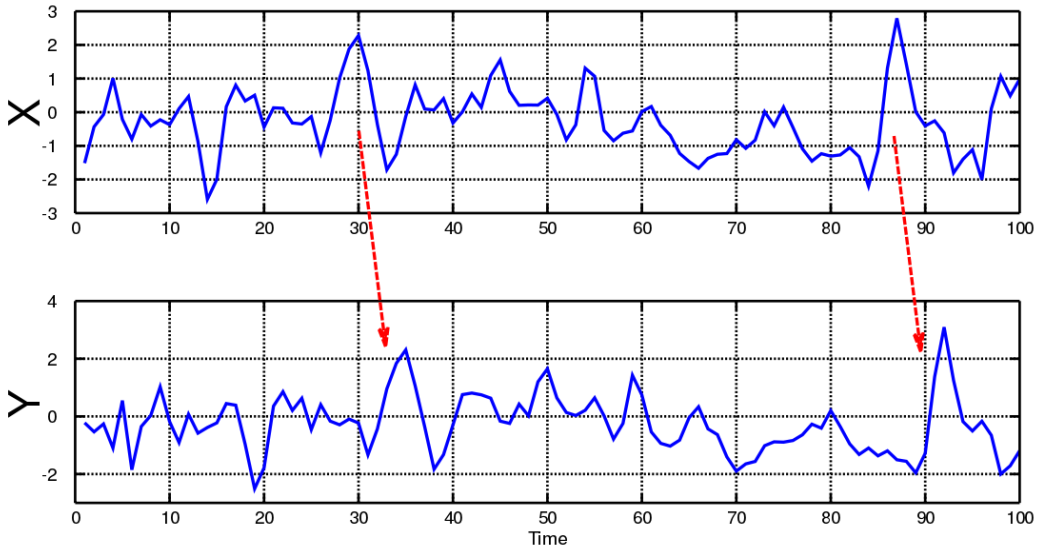
Granger Causality test

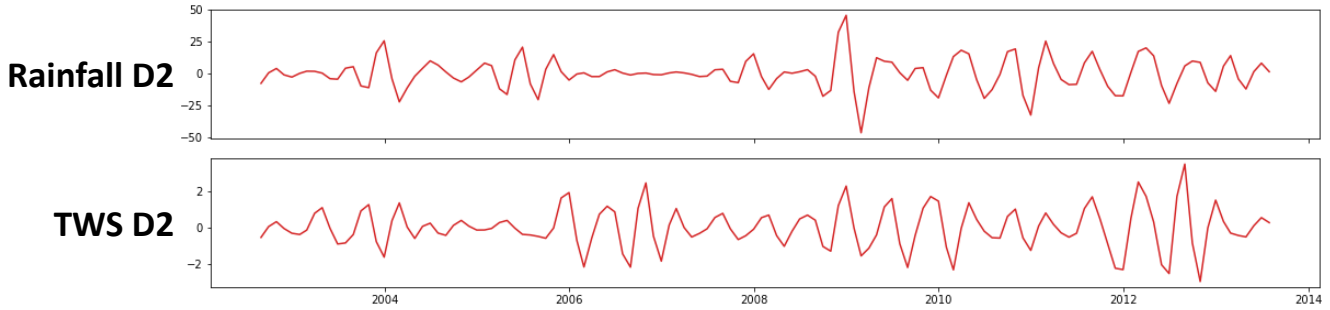
The Granger Causality test is used to determine whether one time series is useful in forecasting another?

$$y_i = \sum_{i=1}^{p} (\alpha_i x_{t-i} + \beta_i y_{t-i}) + \varepsilon_1$$

$$y_i = \sum_{i=1}^{p} \beta_i y_{t-i} + \varepsilon_1$$

predictive relationship
not a causal **relationship**





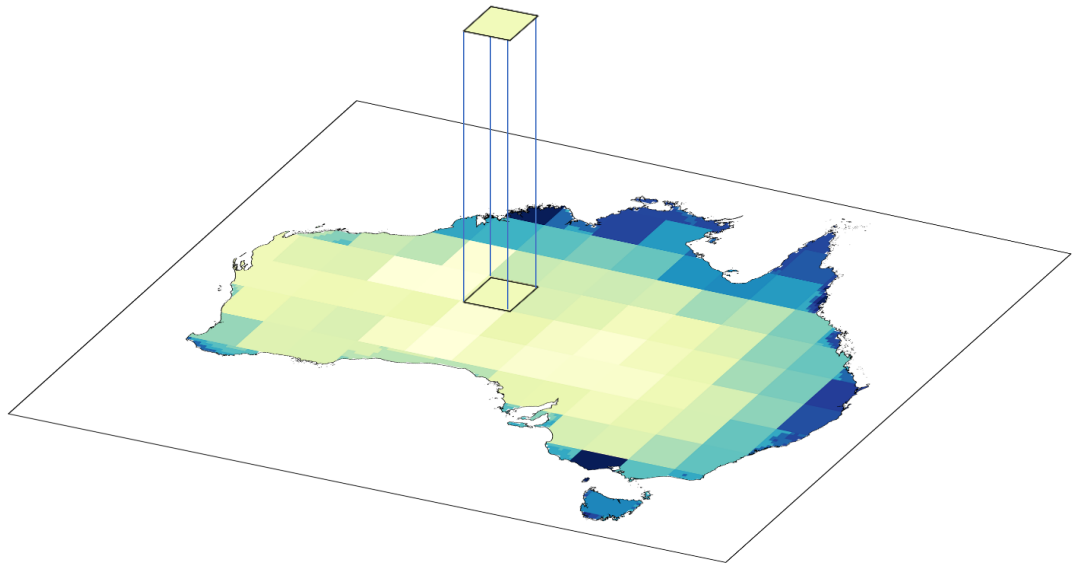
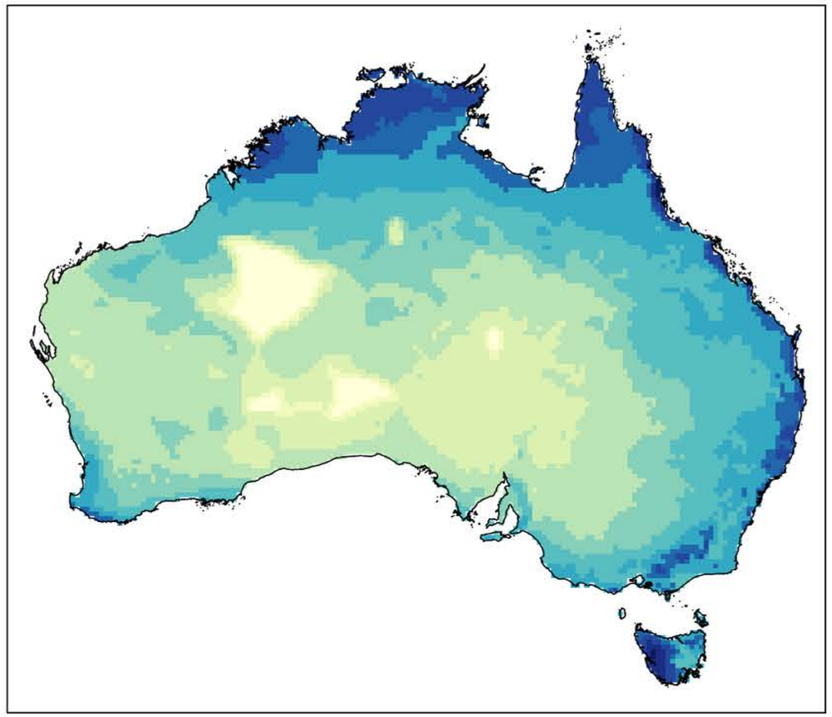


*Image credit: https://en.wikipedia.org/wiki/Granger_causality

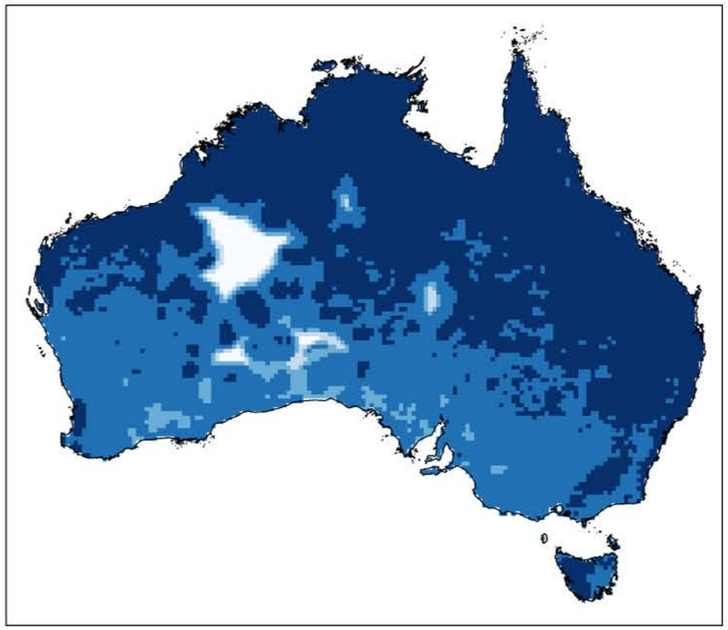
Total annual rainfall map



0-50
50-100
100-200
200-300
300-400
400-600
600-900
900-1200
1200-1800
1800-2400
2400-3700

(mm)

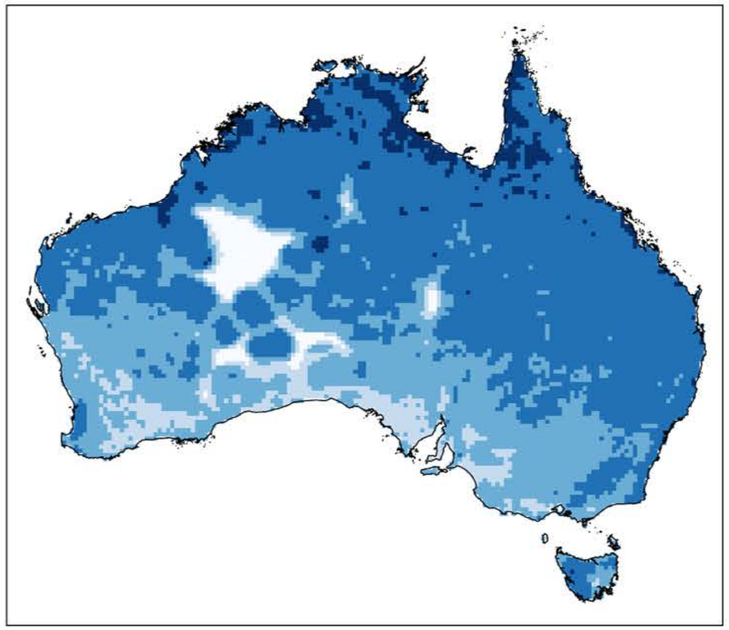
Percentage of rainfall above 5mm threshold



0-20
20-40
40-60
60-80
80-100

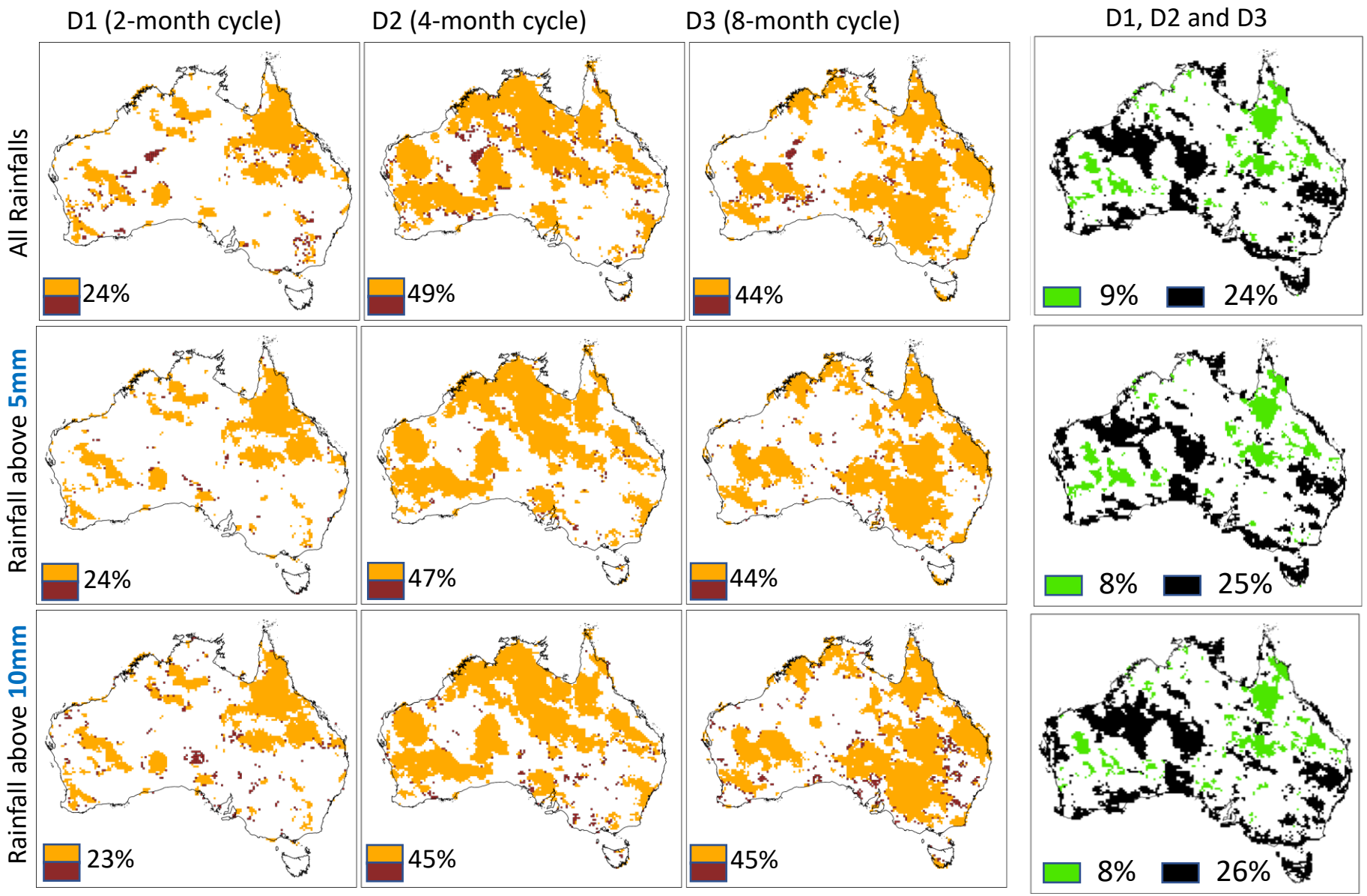
(%)

Percentage of rainfall above 10mm threshold



0-20
20-40
40-60
60-80
80-100

(%)


D1 (2-month cycle)
D2 (4-month cycle)
D3 (8-month cycle)
D1, D2 and D3
All Rainfalls
Rainfall above 5mm
Rainfall above 10mm
24%
49%
44%
9%
24%
24%
47%
44%
8%
25%
23%
45%
45%
8%
26%
Overlap of the areas that has passed the test for all decompose components for the given rainfall threshold)
The areas that Test has not passed for any of given decomposed components for the given rainfall threshold
Overlap between all thresholds for a given temporal scale
Areas that test has only passed for the given rainfall threshold

- ✓ Different clusters for different temporal scales
- ✓ In some areas no relationship found for any temporal scale
- ✓ The external factors should be further investigated to better understand patterns
- ✓ Exclusion of a large proportion of rainfall does not impact causality significantly
- ✓ More information is needed to come up solid conclusion


THANKS
For your
ATTENTION