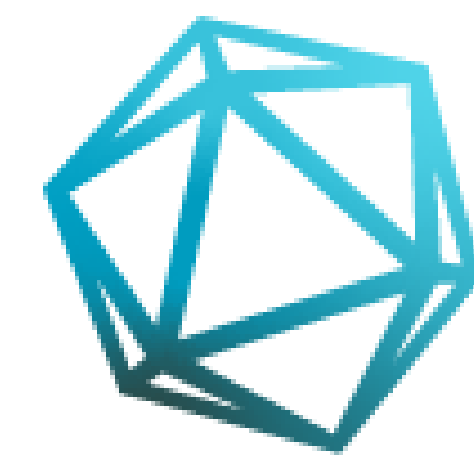
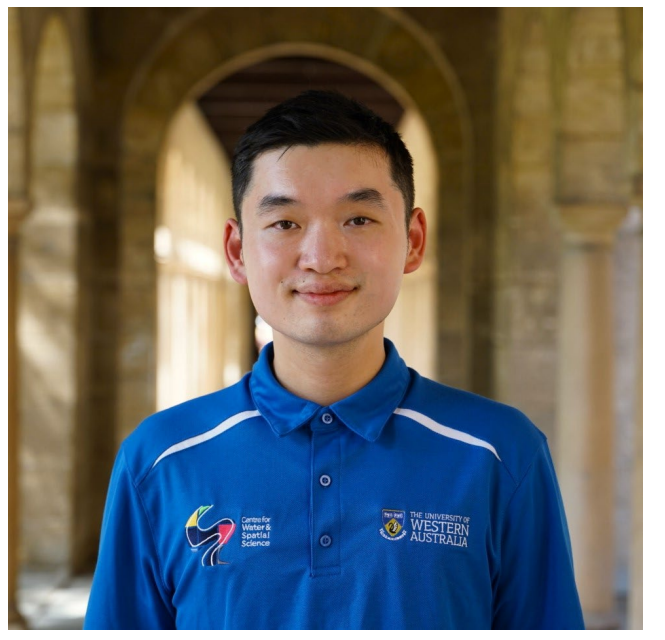


**Yang Chen**<sup>1,2</sup>, Qiaoyun Xie<sup>1,2</sup>, Sally E. Thompson<sup>1,2</sup>  
 yang.chen@research.uwa.edu.au

1. School of Engineering, The University of Western Australia  
 2. Centre for Water and Spatial Science, The University of Western Australia



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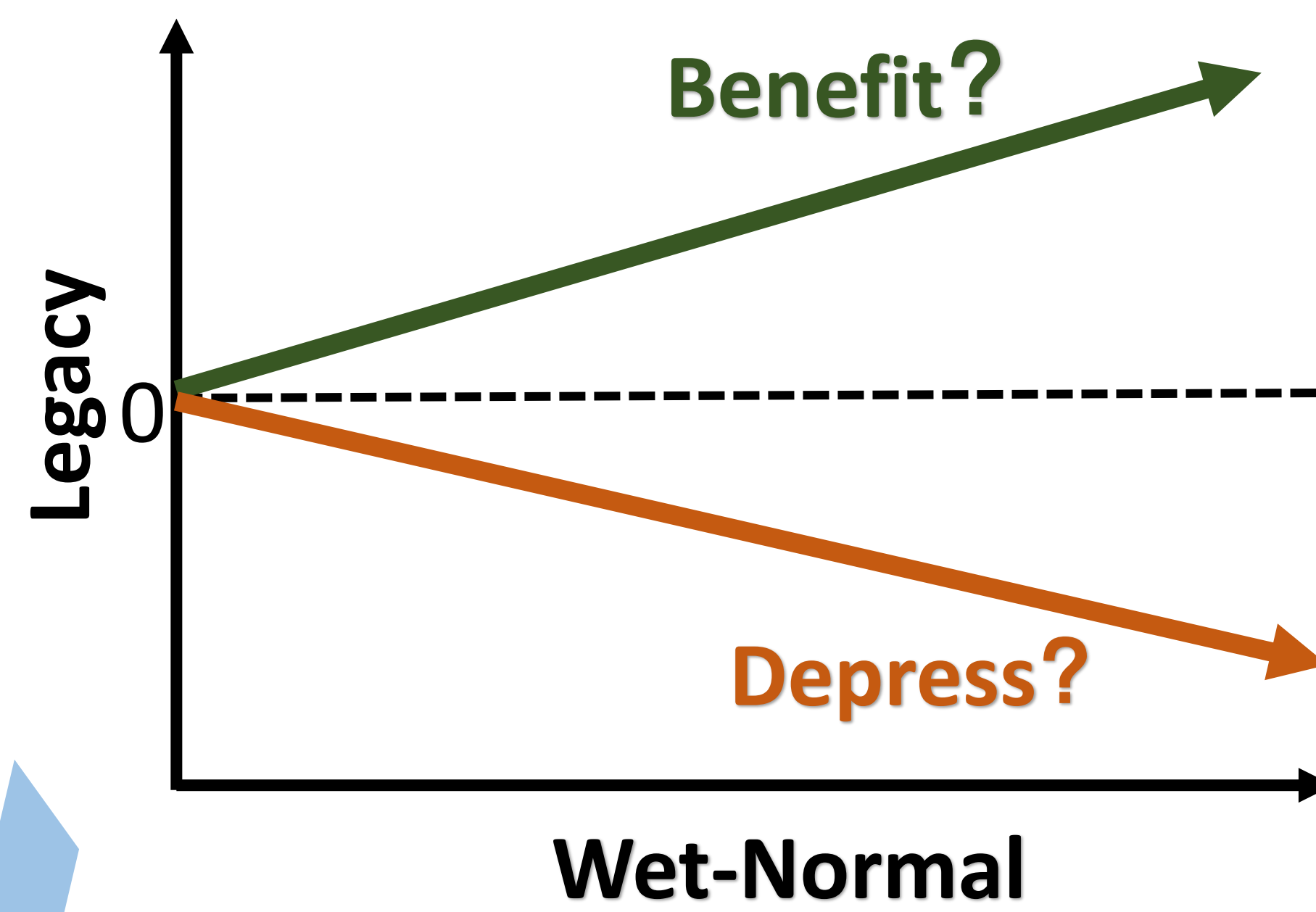
## Motivation:

Australian drylands govern the interannual variability and trend of the global terrestrial carbon cycle due to their high sensitivity to water availability<sup>2</sup>.

However, the lasting impact of such extreme wet years, known as 'legacy effect'<sup>3</sup>, is poorly understood, causing substantial uncertainties in climate-carbon models.

## Objectives:

- 1: To investigate whether extreme wet years benefit vegetation productivity in the following years.
- 2: To explore underlying mechanism behind legacy effects.



## Data and Methods:

### Productivity indicators:

- Normalized Difference Vegetation Index (NDVI): Satellite
- Gross Primary Productivity (GPP): Satellite and ground truth

### Water indicators:

- Standardised Precipitation-Evapotranspiration Index (SPEI)
- Soil moisture • Precipitation

### Method<sup>1</sup>:

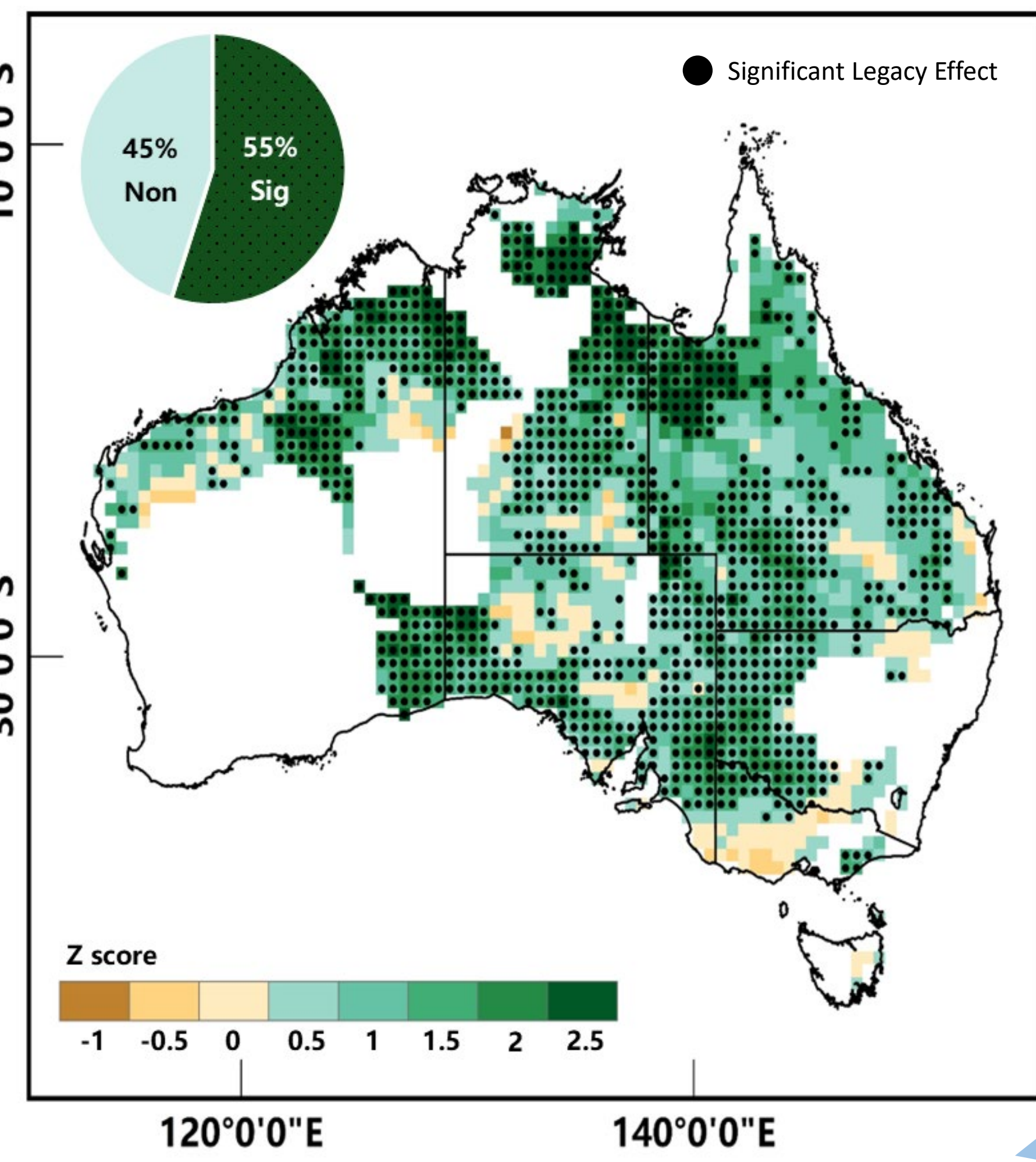
$$Legacy = P(obs) - P(\beta_0 + \beta_1 W_t) = \beta_2 W_{t-1} + \beta_3 P_{t-1} + e$$

$\beta_{2/3} = f_{(machine\ learning)}(factors)$   
 Factors importance: Shapley value

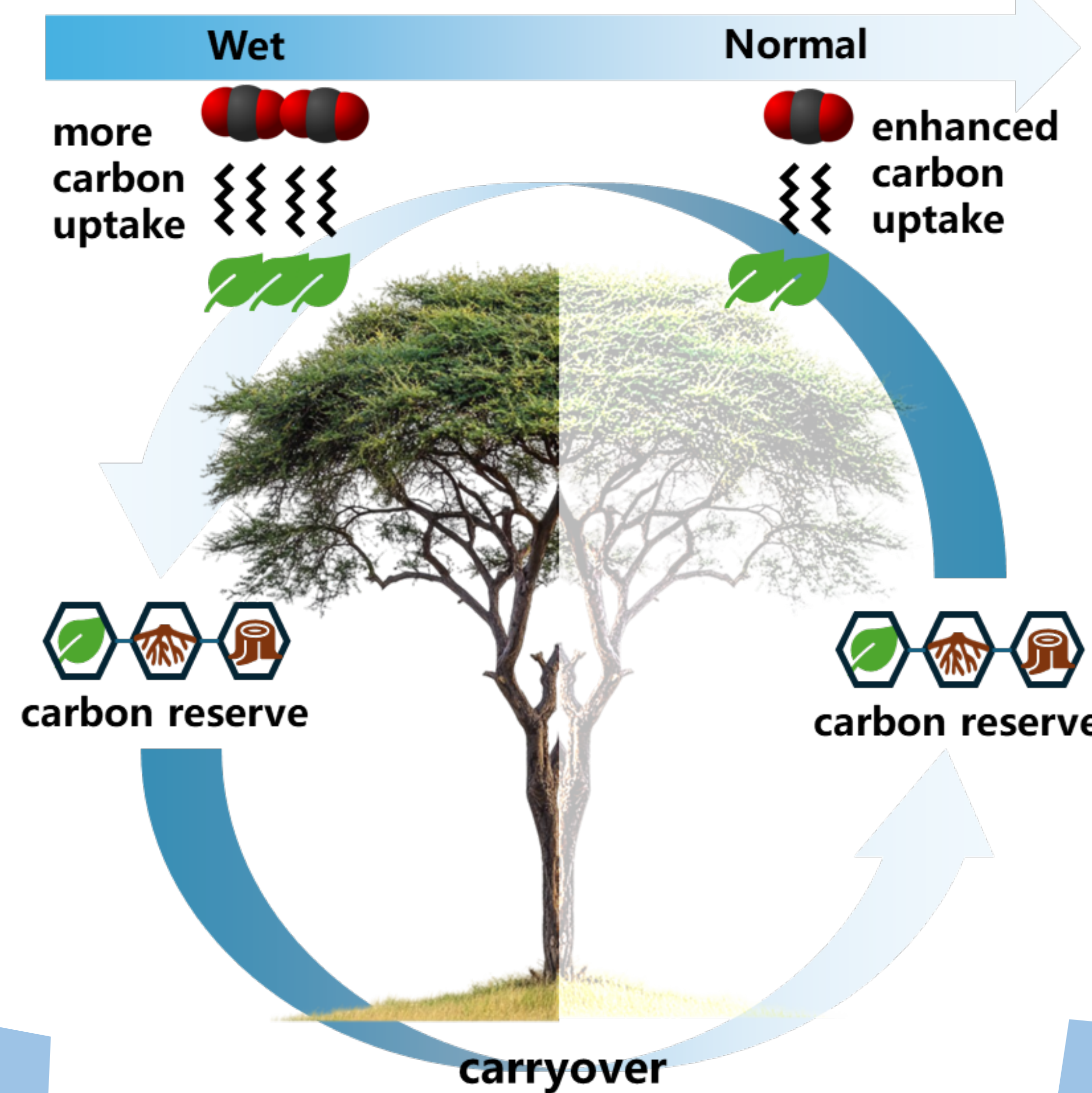
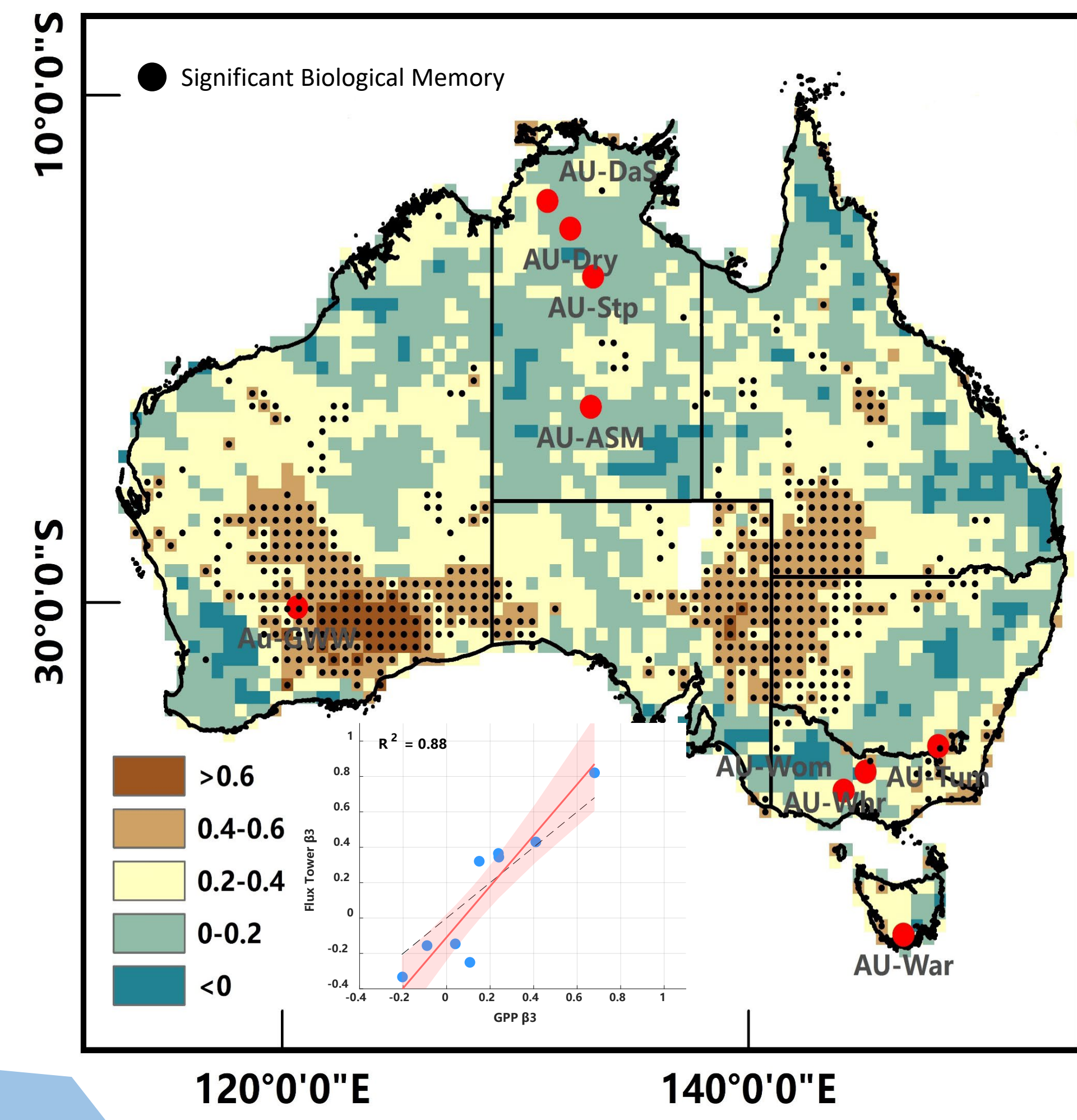
$\beta_2$ : abiotic memory

$\beta_3$ : biological memory

## 1. When: Positive legacy after 2010-2011 wet year

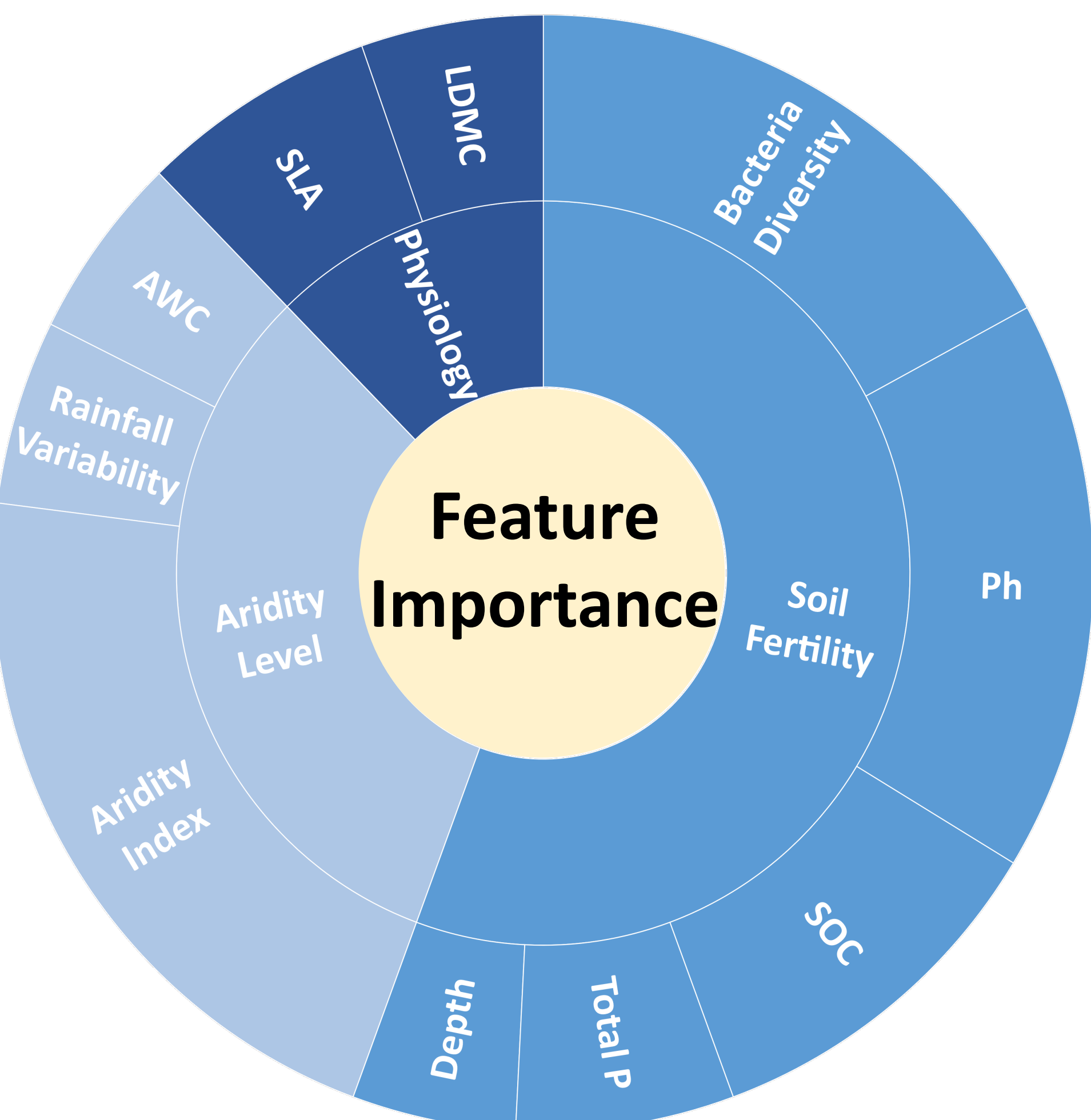


## 2. Why: Biological memory dominated the legacy



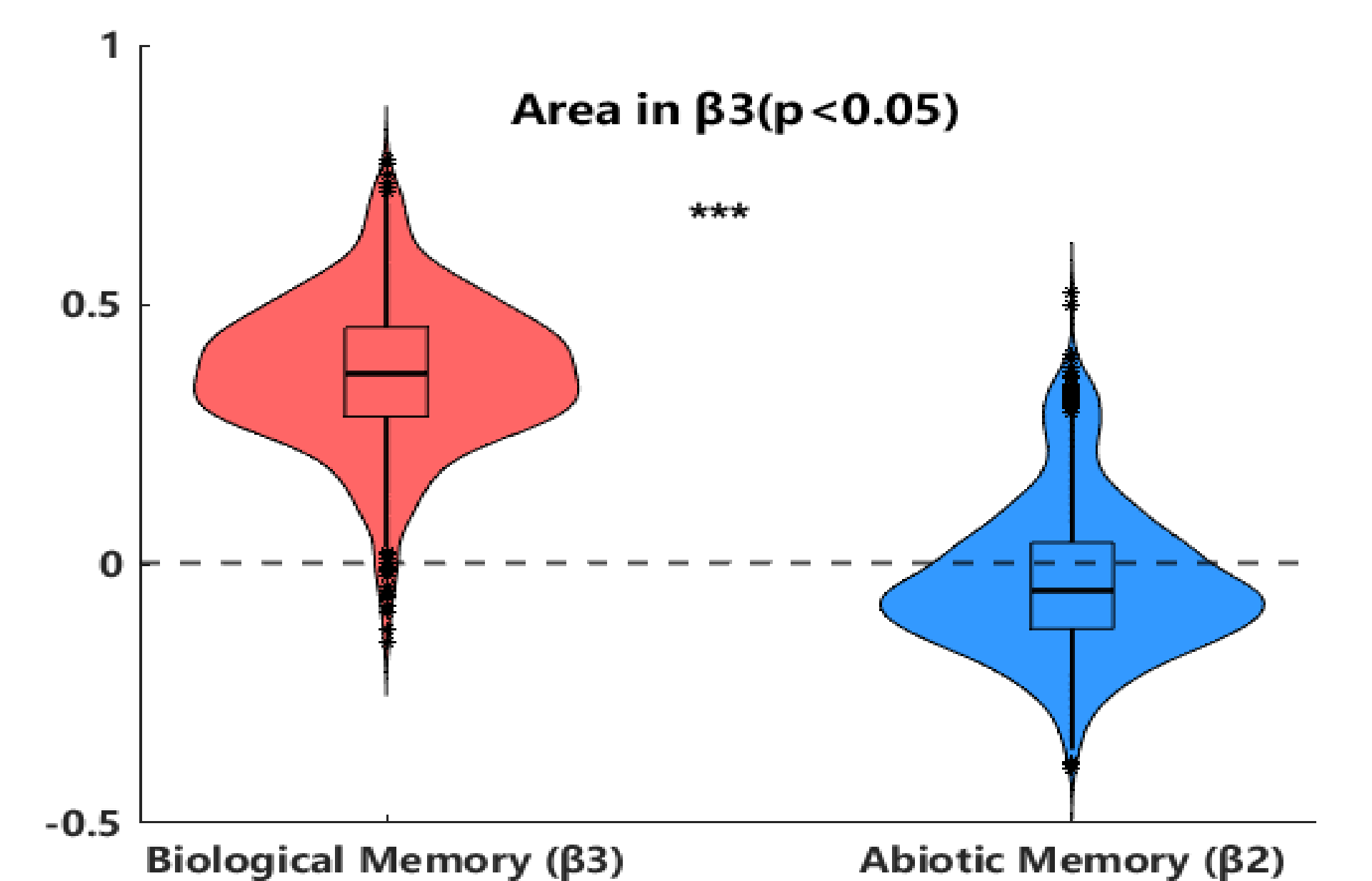
## 3. How: Drivers of biological memory

- High aridity
- High soil fertility



## Take-home Messages:

- ✓ A positive legacy effect was observed following the extreme wet year of 2010-2011.
- ✓ Biological memory is the dominate factor causing legacy. Carbon reserve carryover after extreme wet years could be the potential mechanism underlying biological memory.



## References:

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2. Ahlström, A., Raupach, M. R., Schurgers, G., Smith, B., Arneeth, A., Jung, M., Reichstein, M., Canadell, J. G., Friedlingstein, P., Jain, A. K., Kato, E., Poulter, B., Sitch, S., Stocker, B. D., Viogy, N., Wang, Y. P., Wiltshire, A., Zaehle, S., & Zeng, N. (2015). The dominant role of semi-arid ecosystems in the trend and variability of the land CO<sub>2</sub> sink. *Science*, 348(6237), 895–899.
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