EGU General Assembly 2022

Nonstationarity in Global Hydrological Water Budget, Evidence-based on GRACE Satellite Mission

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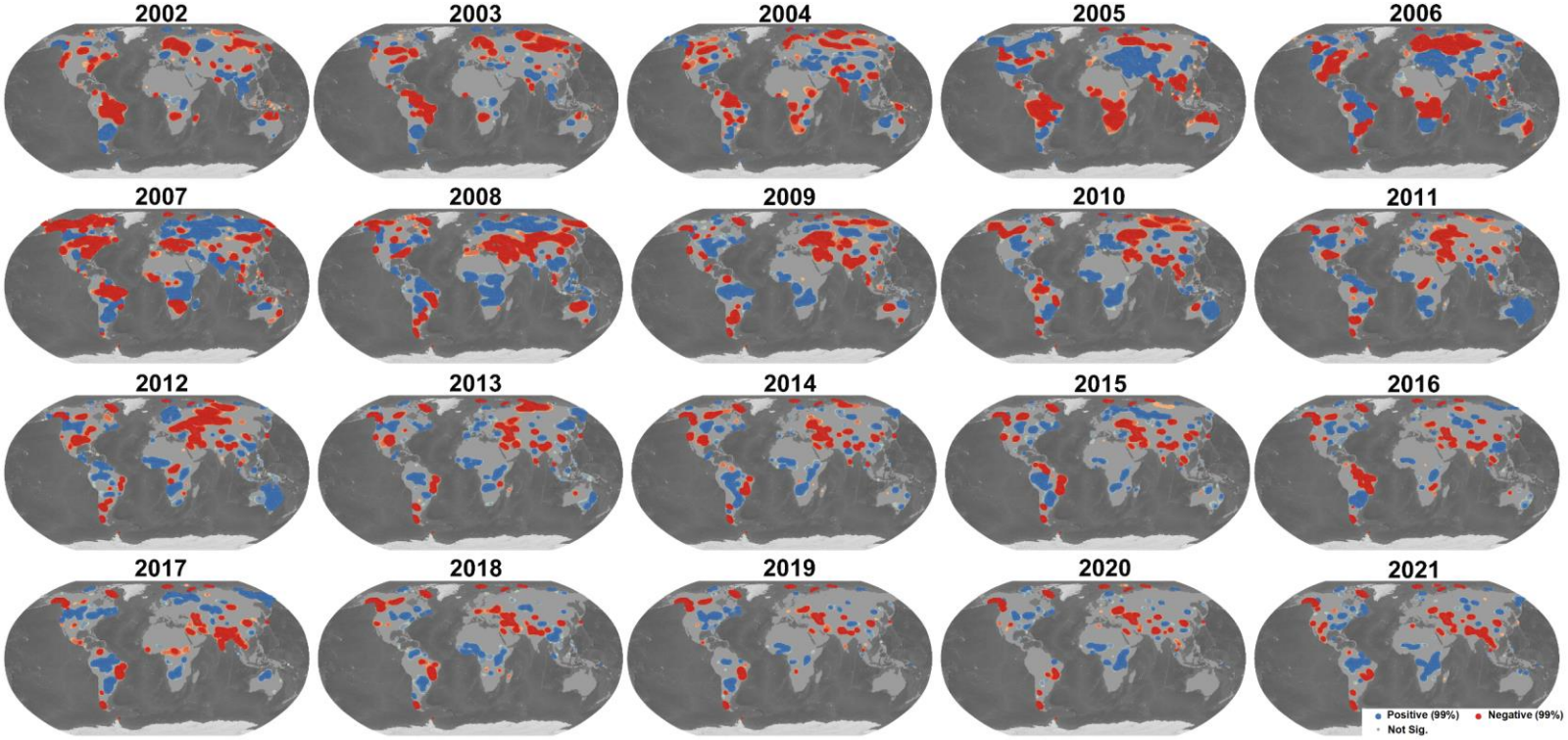
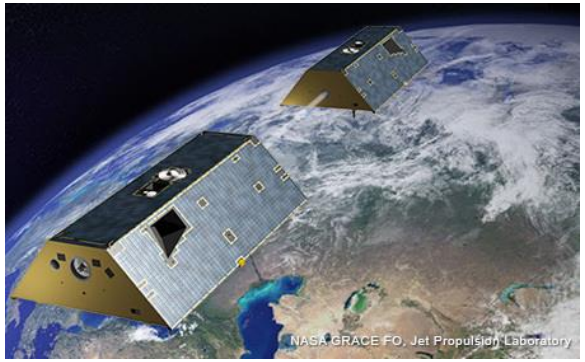
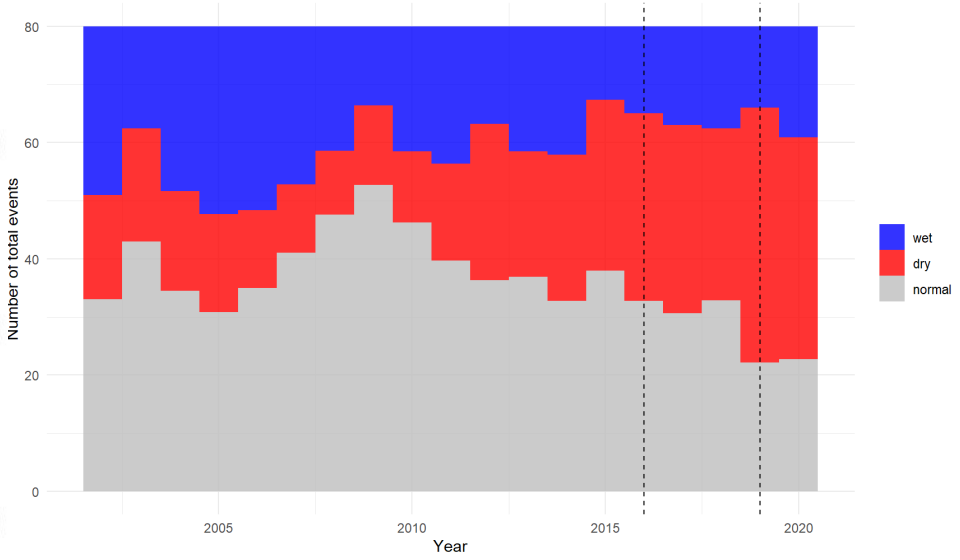
The Amazing GRACE

$$(P + R_I + G_I + H_I) - (ET + R_O + G_O + H_O) = \overline{\Delta S} = \Delta\text{TWS}$$

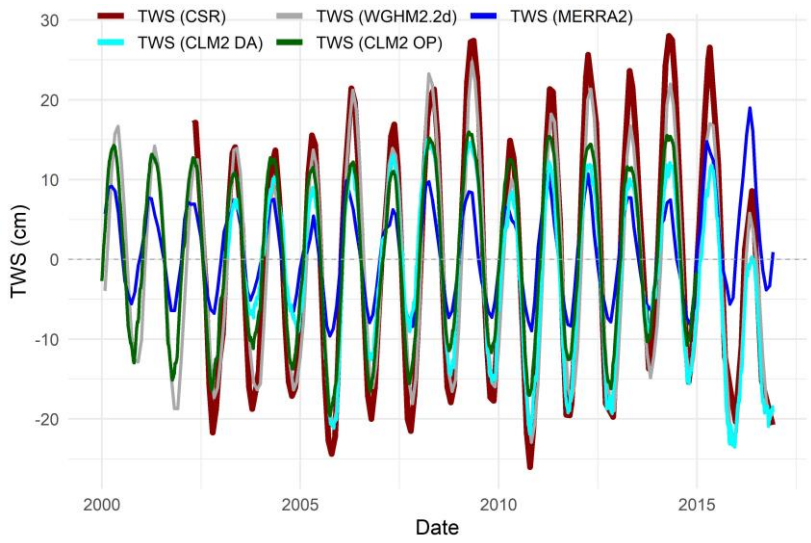




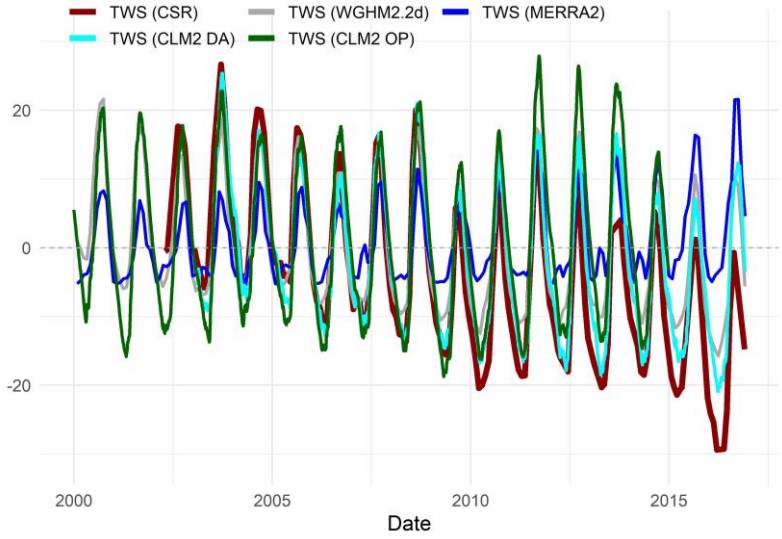


GRACE vs LSMs

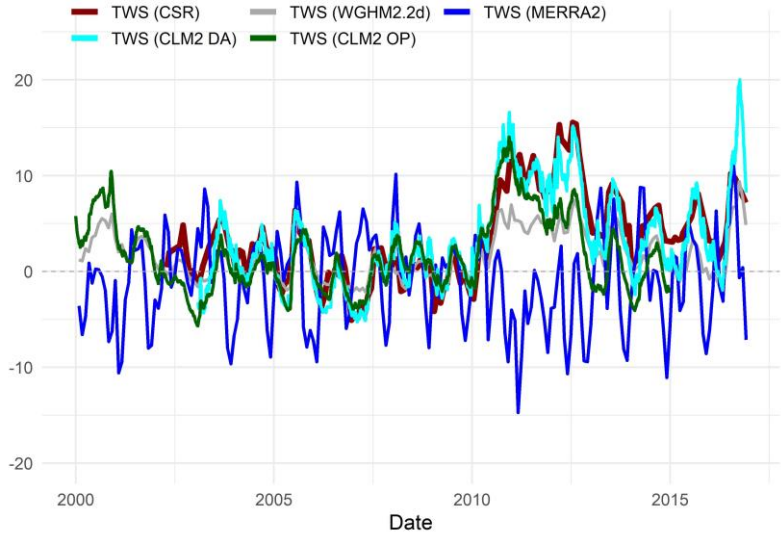
Amazon



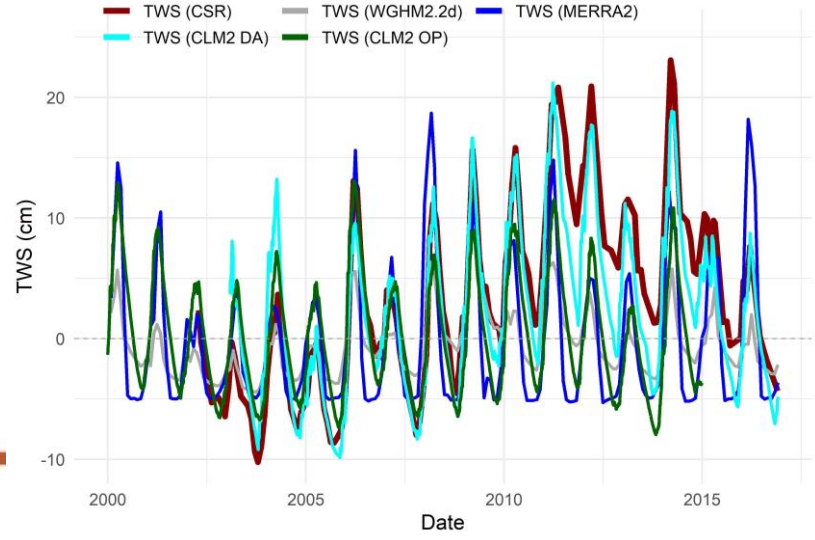
Ganges



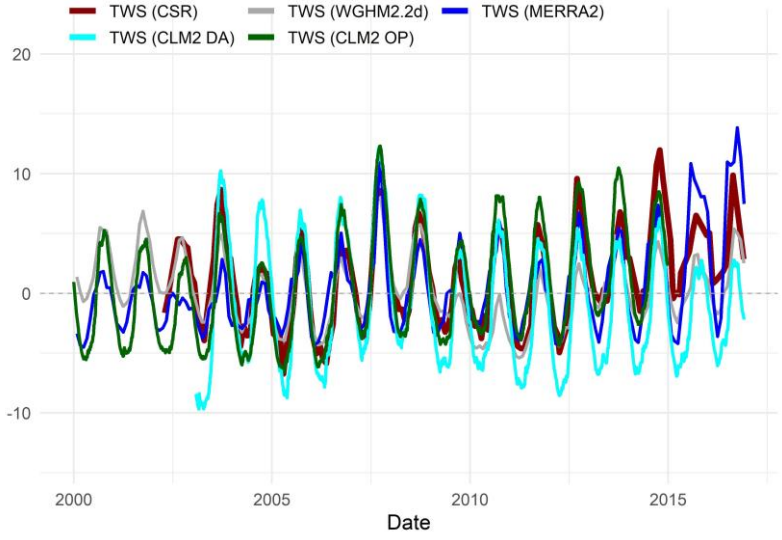
Murray Darling



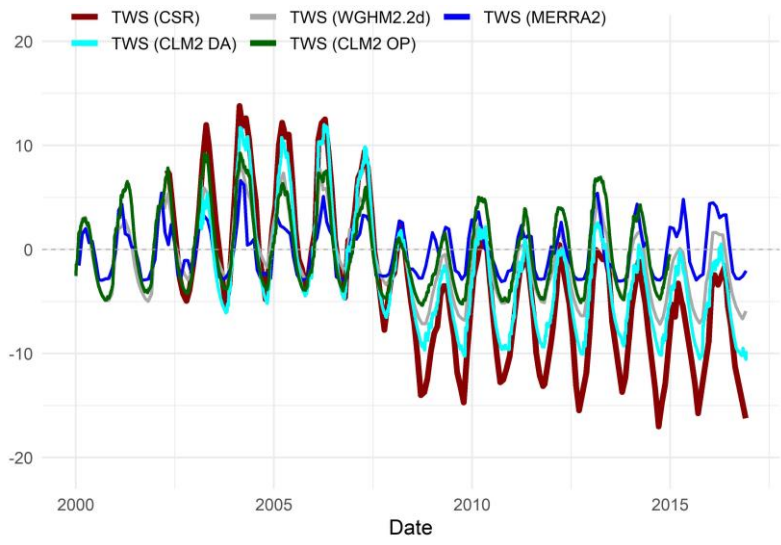
Okavango



Nile



Tigris-Euphrates



Background

Anthropogenic contributions

POLICYFORUM

CLIMATE CHANGE

2008

Stationarity Is Dead: Whither Water Management?

Climate change undermines a basic assumption that historically has facilitated management of water supplies, demands, and risks.

P. C. D. Milly,[1*] Julio Betancourt,[2] Malin Falkenmark,[3] Robert M. Hirsch,[4] Zbigniew W. Kundzewicz,[5] Dennis P. Lettenmaier,[6] Ronald J. Stouffer[7]

Advances in Water Resources 77 (2015) 17–36

Contents lists available at ScienceDirect

Advances in Water Resources

journal homepage: www.elsevier.com/locate/advwatres

ELSEVIER

Stationarity is undead: Uncertainty dominates the distribution of extremes

CrossMark

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AGU PUBLICATIONS

Water Resources Research

COMMENTARY

10.1002/2015WR017408

On Critiques of "Stationarity is Dead: Whither Water Management?"

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Center for Space Research

Order of integration

$y_t \sim I(0)$ AR(0)

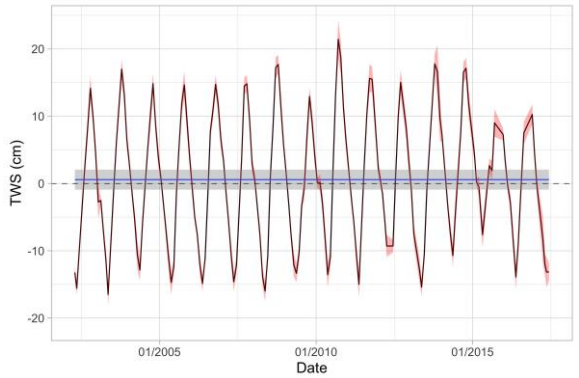
$y_t \sim I(p)$ AR(p)

Trend, level (KPSS)

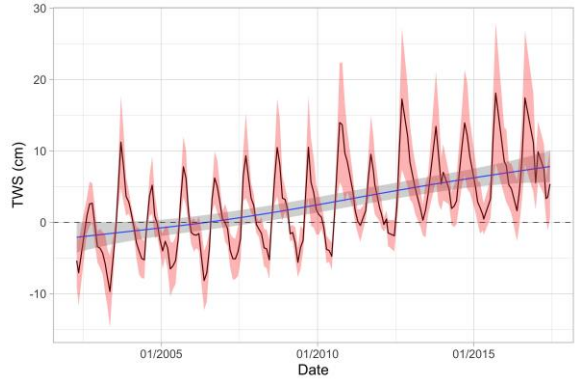
No trend (differencing)

- DF (AR 1) ADF (AR p)

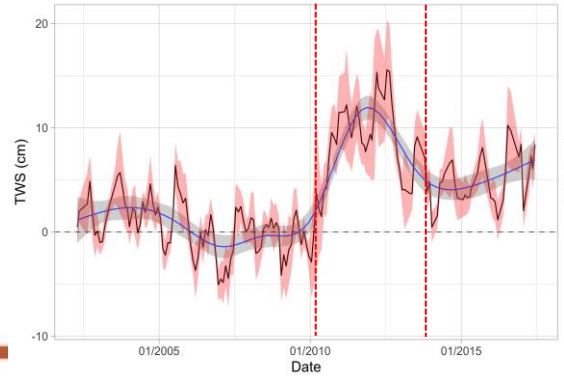
Godavari basin



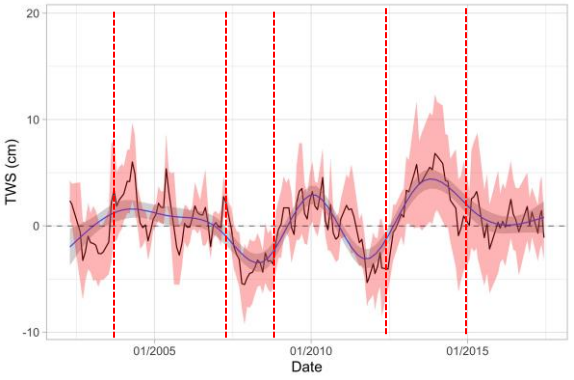
Northern Niger basin



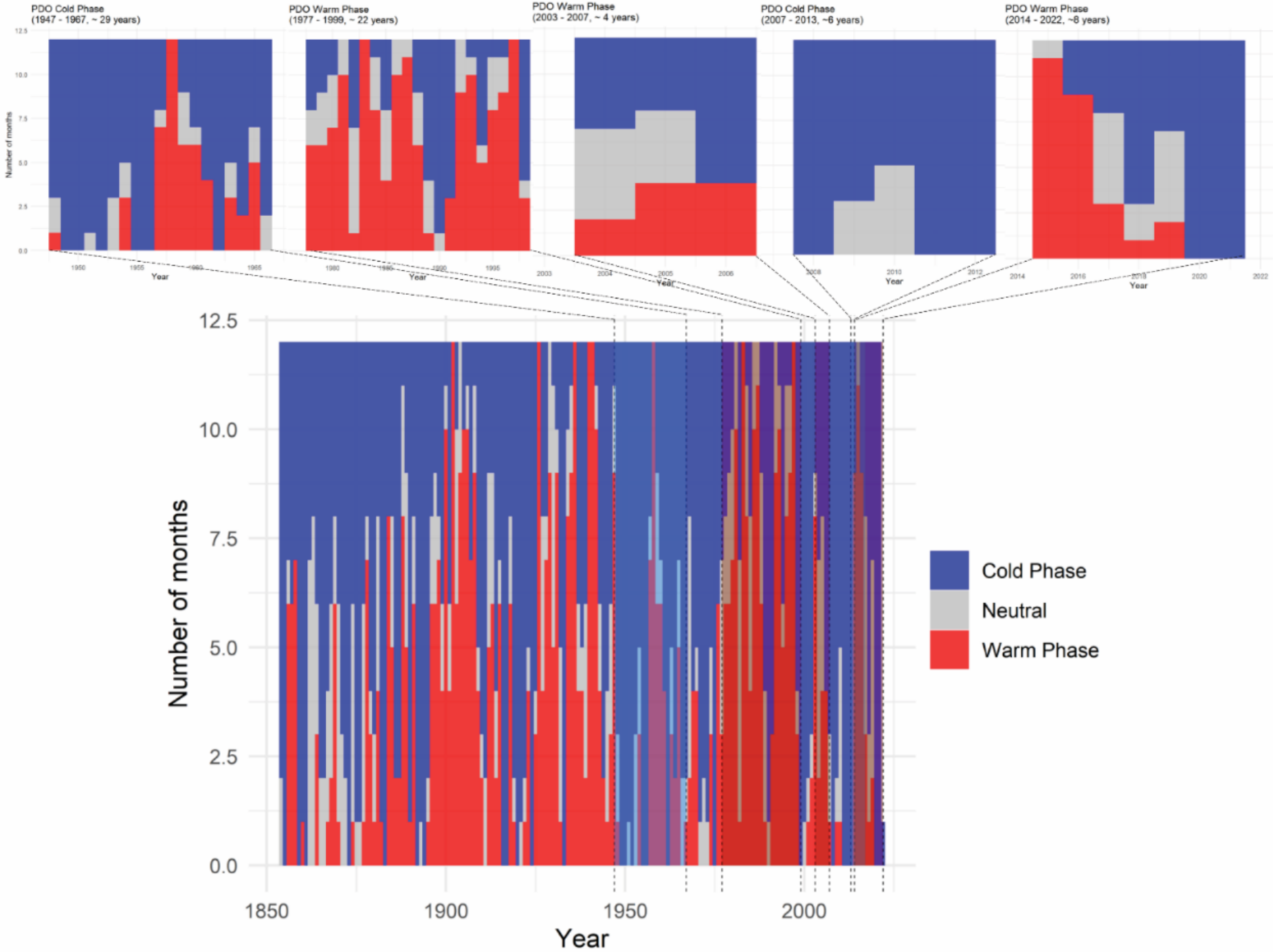
Murray-darling basin



Amur basin



Background



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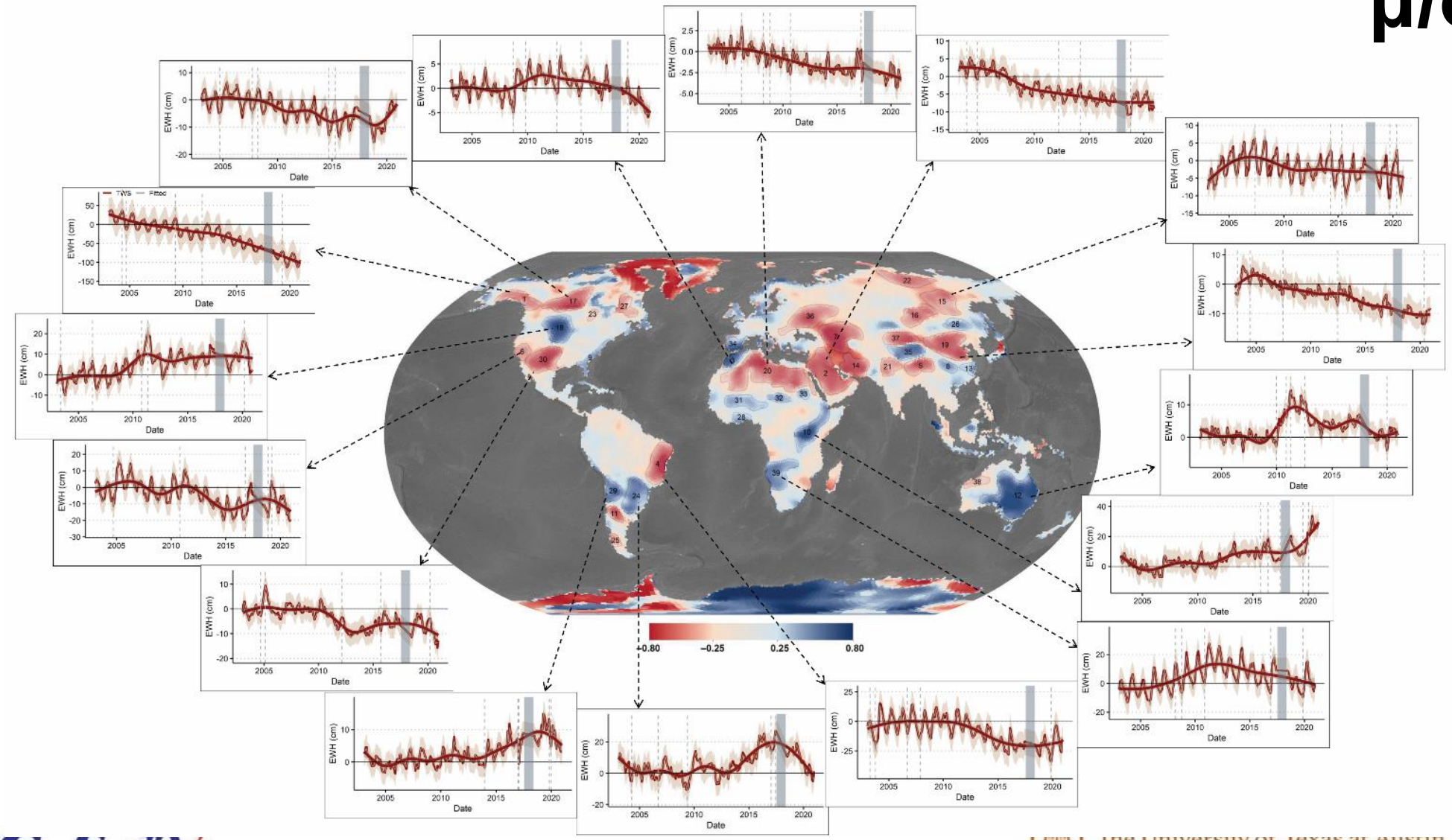
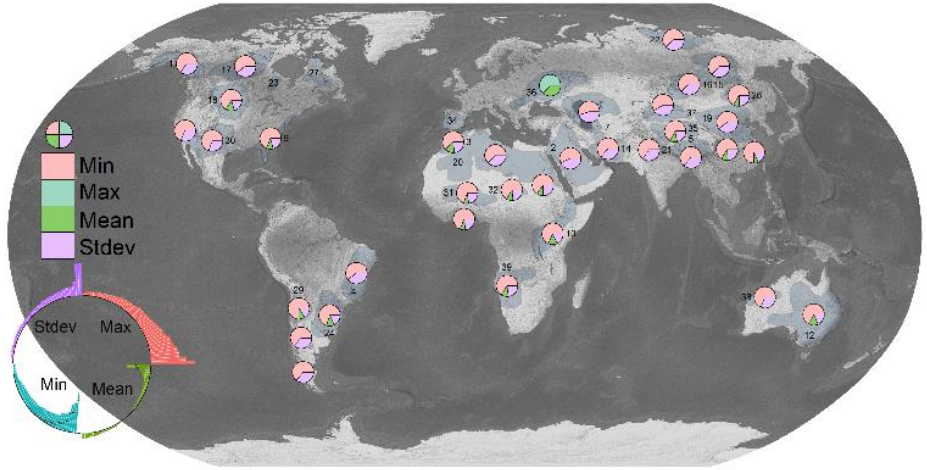
Stationarity testing

μ/σ

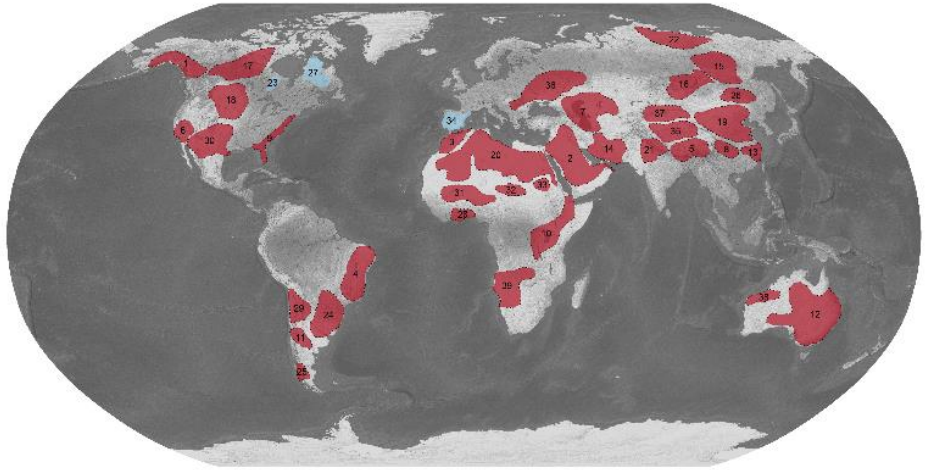


Stationarity testing

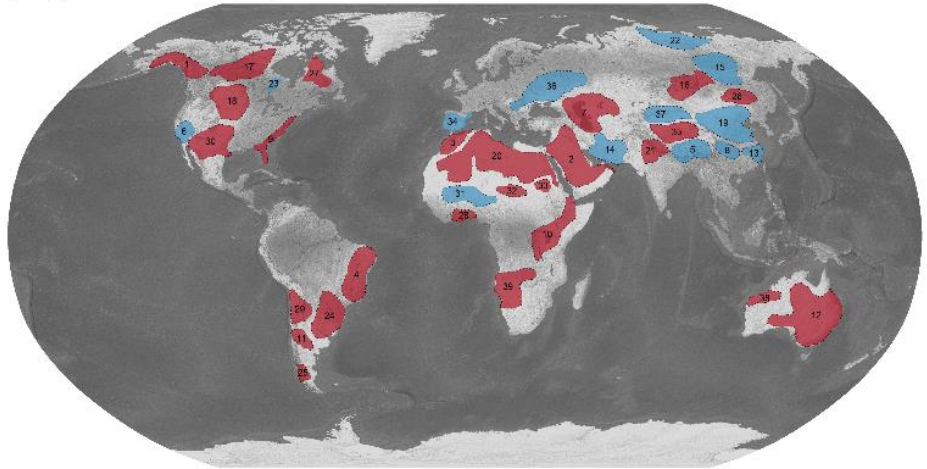
(a) Stats



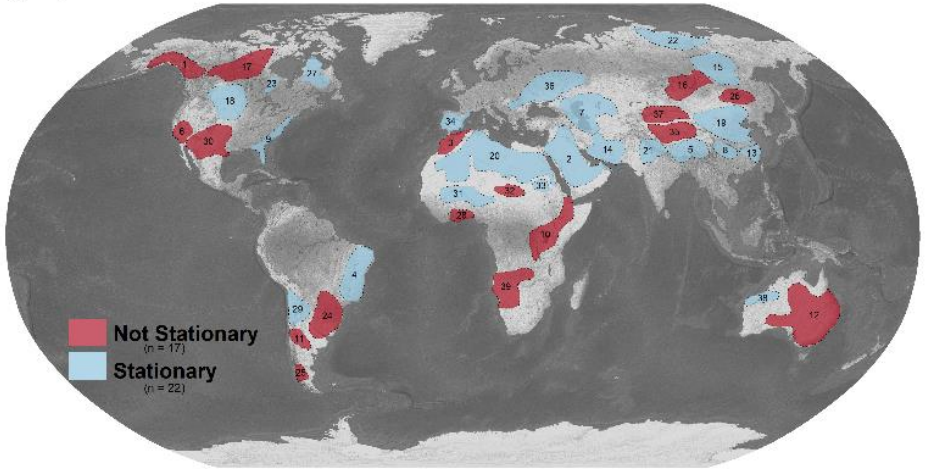
(b) KPSS (Level)



(c) KPSS (Trend)



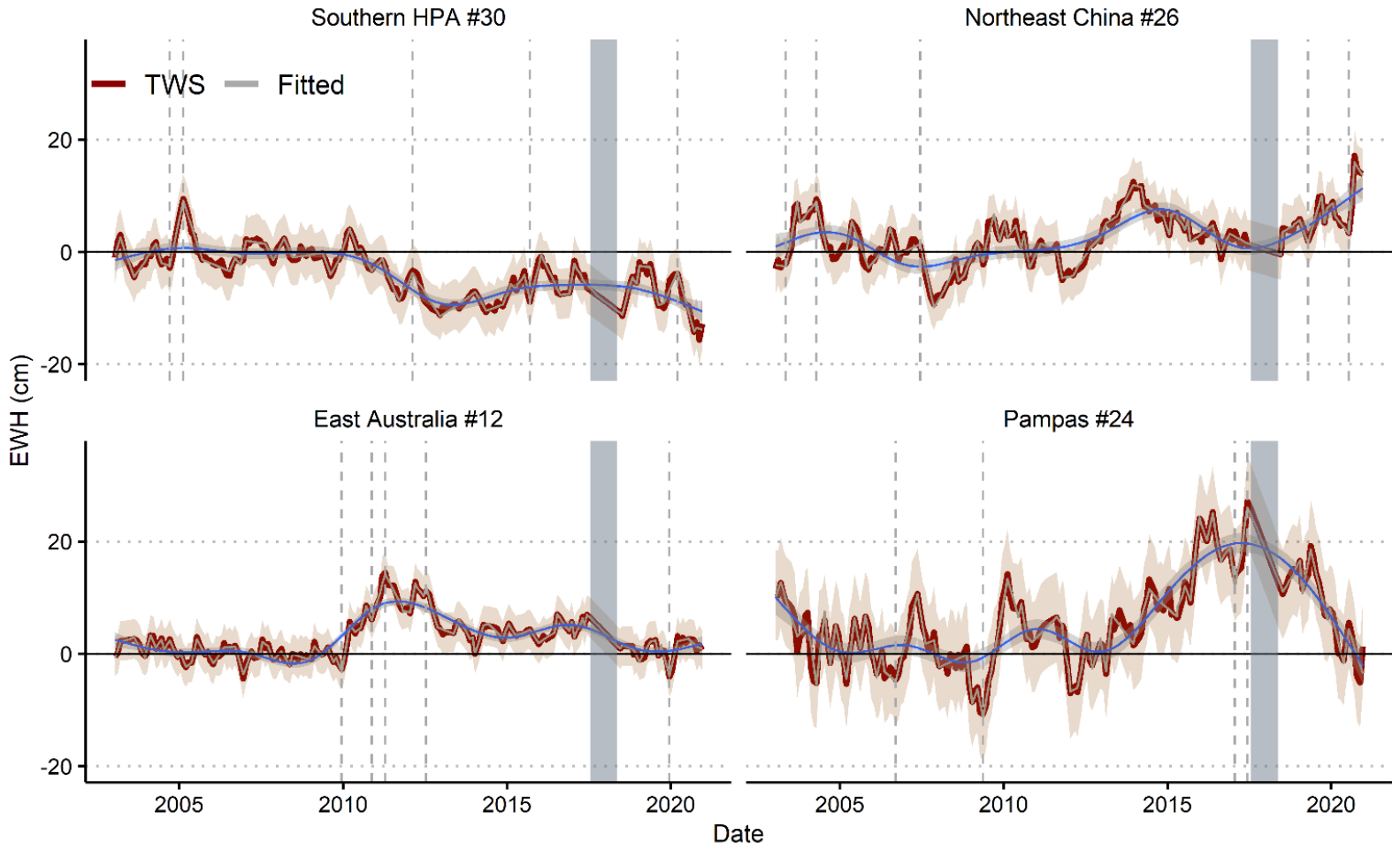
(d) ADF



Remarks

- The hotspot regions that were identified as nonstationary systems around all tested components, e.g., level, trend, and periodicity, are representing hydrologic systems that undergone significant anthropogenic and climatic forcings.

- The nonstationary hotspot regions indicate an increased susceptibility to hydrologic extremes and compromised capacities to timely cope, respond, and mitigate



Thanks!!!

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