Evaluation of TMPA version 7 for macro scale hydrologic prediction

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Introduction

- The TRMM Multi-satellite Precipitation Analysis (TMPA) provides two 3-houly data sets: near-real-time data (RT) and research quality data (RP). Both data have 0.25°× 0.25° resolutions (50° N to 50° S).

- The RT data are considered less accurate than RP due to the simplified data processing algorithm in RT and the gauge adjustments in RP.

- The RT data are most appropriate for near-real-time macro-scale hydrological applications such as drought and flood monitoring. Are they up to the task?

- Analysis (mostly) with TMPA v7 (reprocessed)

Motivating questions

- Are RT and RP data systematically consistent (on a monthly basis) from 2000 (the date v7 RT released) to 2012?

- If inconsistent, did the time series of RT increase or decrease relative to RP?

Method

- RT and RP data were aggregated to monthly data sets from Mar. 2000 to Feb. 2012 (144 months).

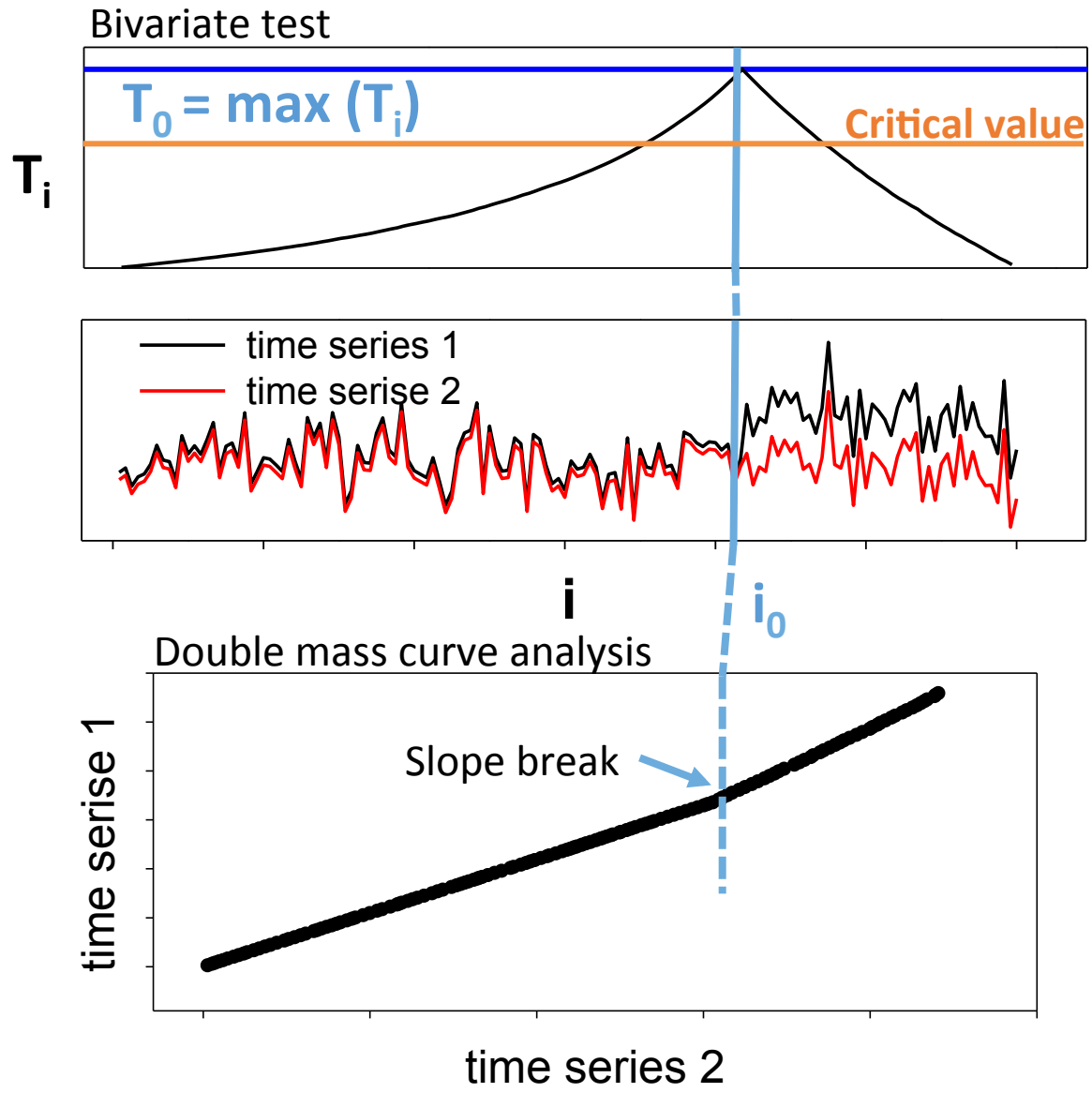
- Bivariate test (Potter, MWR 1981) provides a statistical hypothesis test framework for double mass curve analysis, which is widely used in hydrology to detect the systematic drifts of one time series relative to the other.

Method: bivariate test (example)

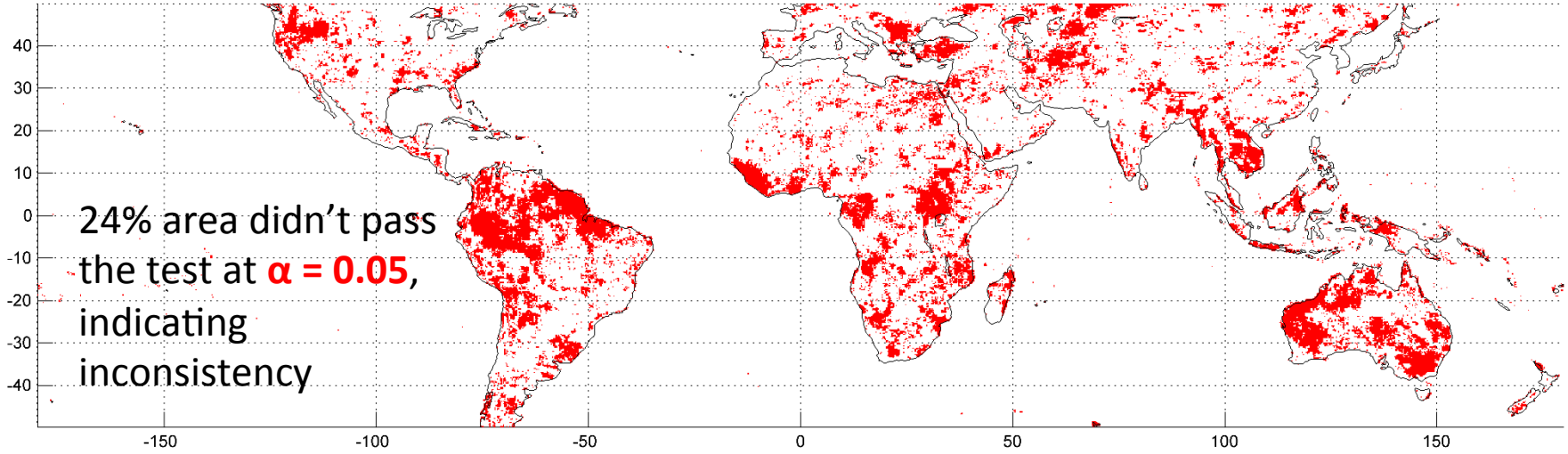
The test statistic of bivariate test is T_0, which corresponds to the time step where the drift occurs (i_0)

Time series 1 has a systematic shift at i_0.
It is increasing relative to time series 2

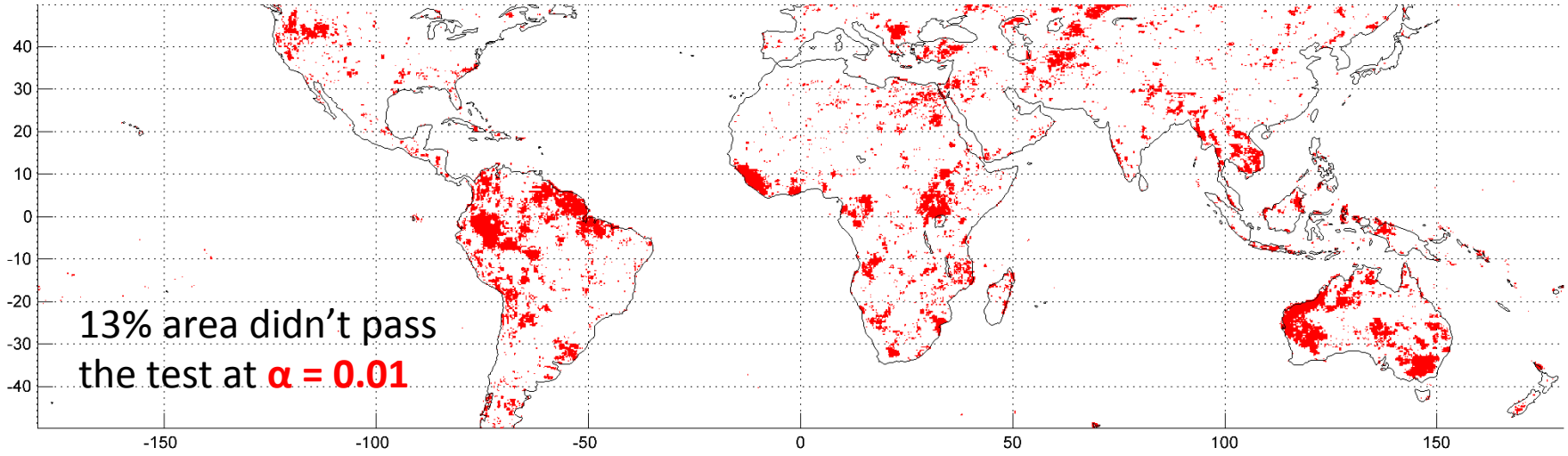
The slope break of the double mass curve indicates the drift of one time series from the other



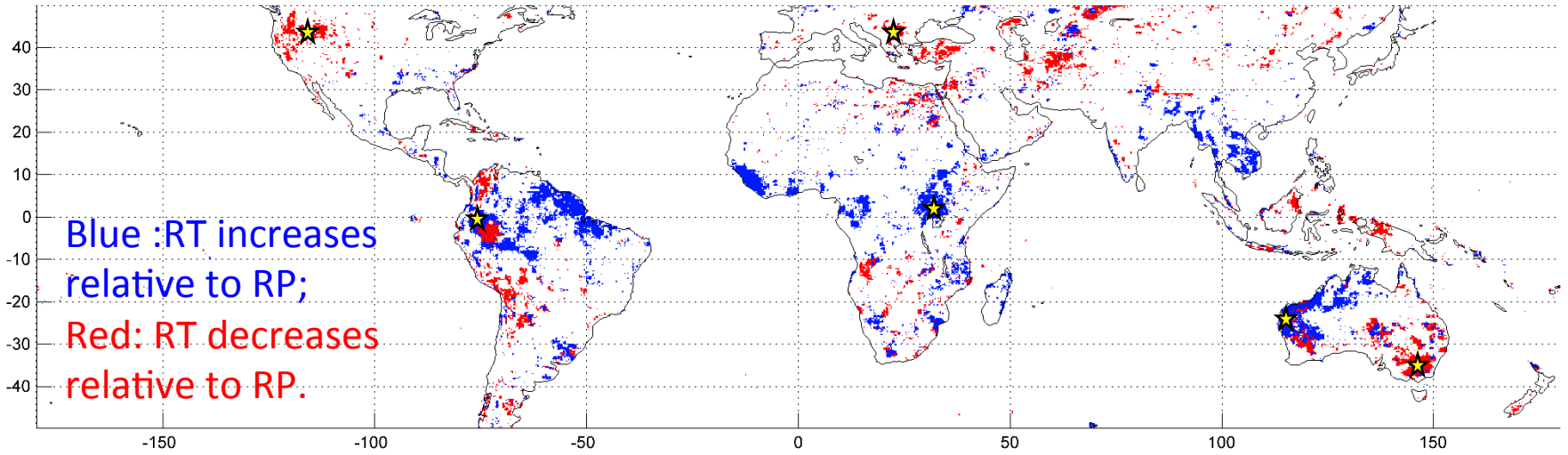
Results: Inconsistent areas



The test statistics in these areas are quite close to the 0.05 critical level. It is useful to focus on the areas in which the null hypothesis was rejected at a higher significance level.



Results: The direction in which the double mass curve breaks



It is useful to examine the time series and test statistics at single rejected cells
Six cells were tested:

western US 42.5°N 116°W

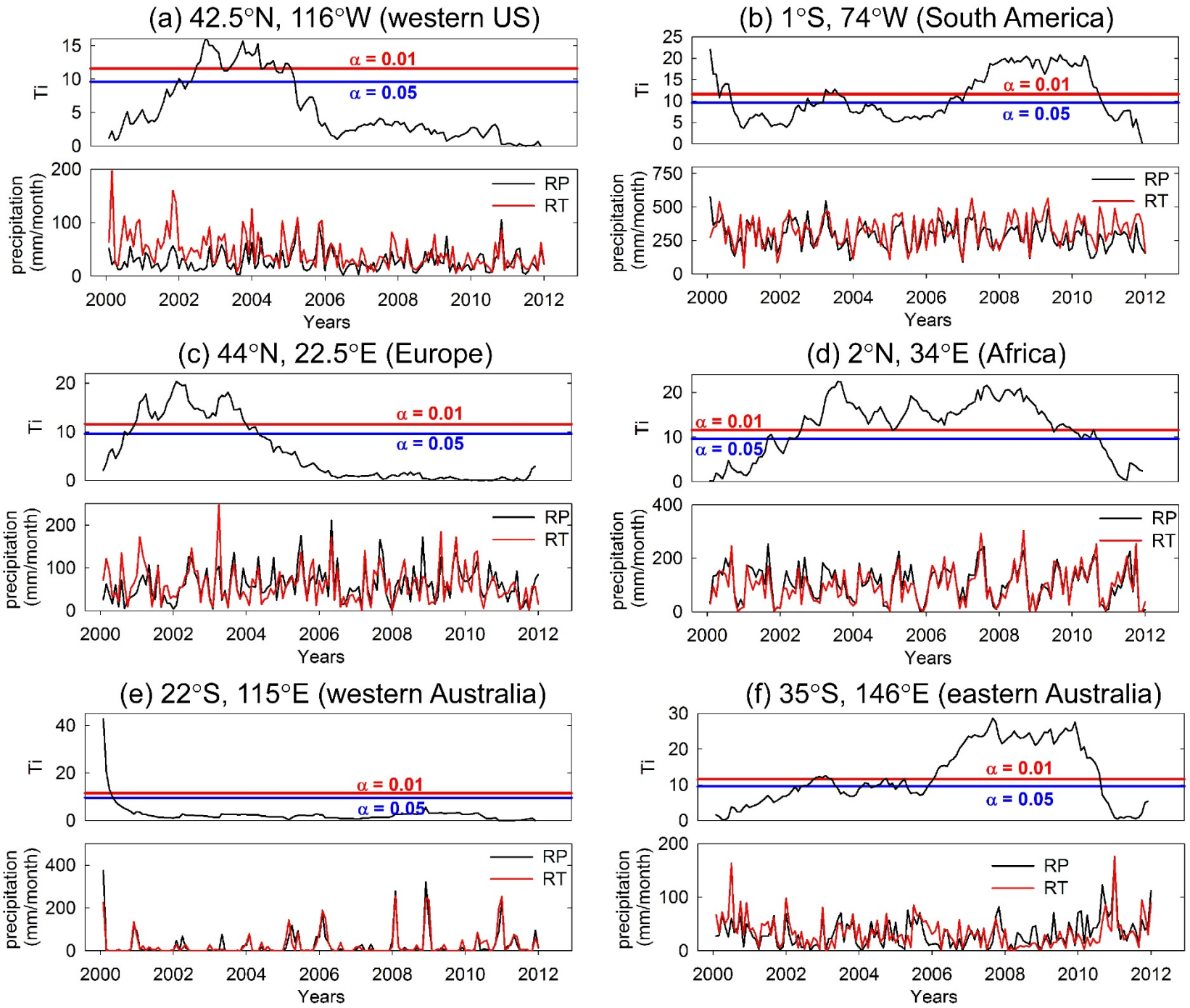
Europe 44°N, 22.5°E

western Australia 22°S, 115°E

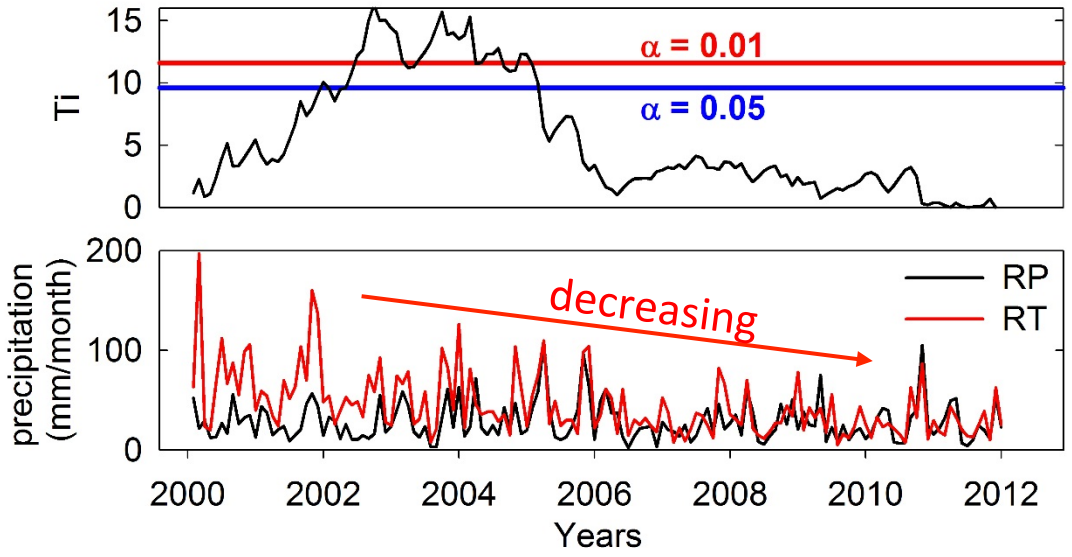
South America 1°S, 74°W

Africa 2°N, 34°E

eastern Australia 35°S, 146°E

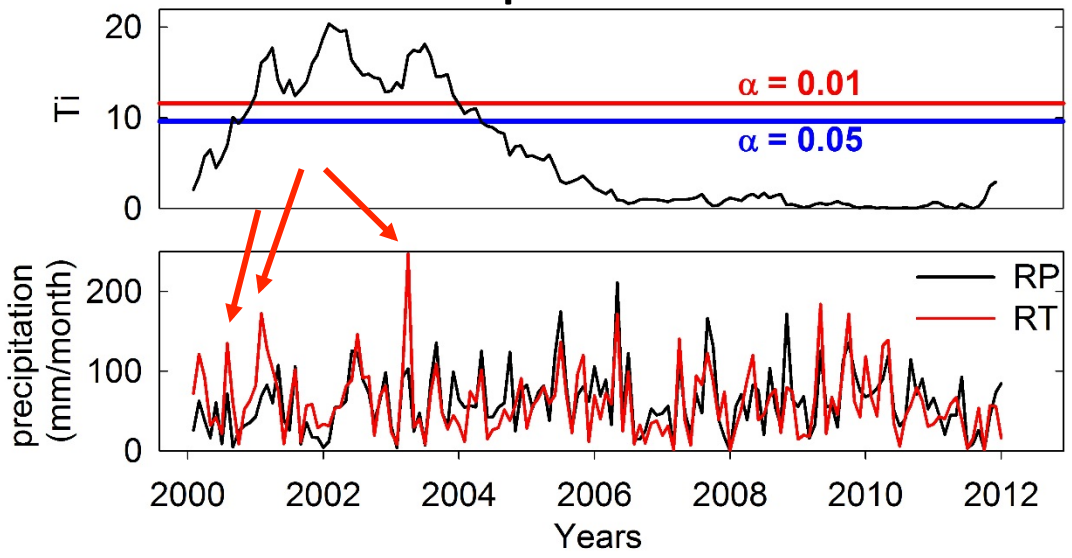

(a) 42.5°N, 116°W (western US)
(b) 1°S, 74°W (South America)
(c) 44°N, 22.5°E (Europe)
(d) 2°N, 34°E (Africa)
(e) 22°S, 115°E (western Australia)
(f) 35°S, 146°E (eastern Australia)
Ti
α = 0.01
α = 0.05
precipitation (mm/month)
RP
RT
Years
2000
2002
2004
2006
2008
2010
2012

Cell at western US



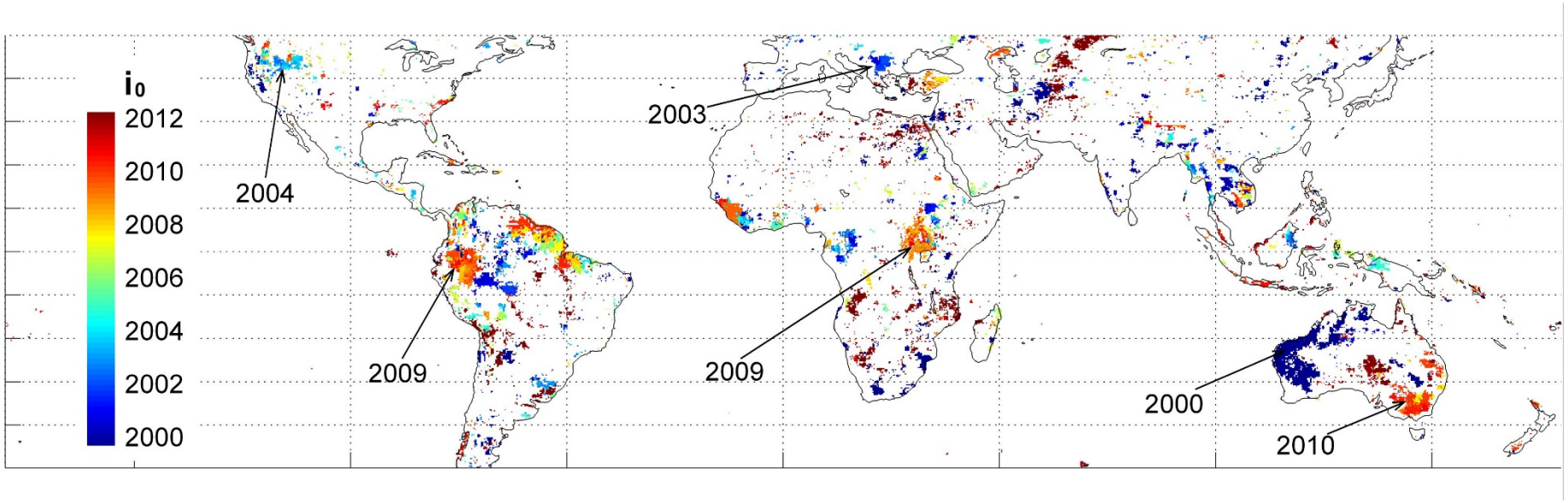
- Systematic drift occurred around 2003.
- RT decreased relative to RP.

Cell at Europe



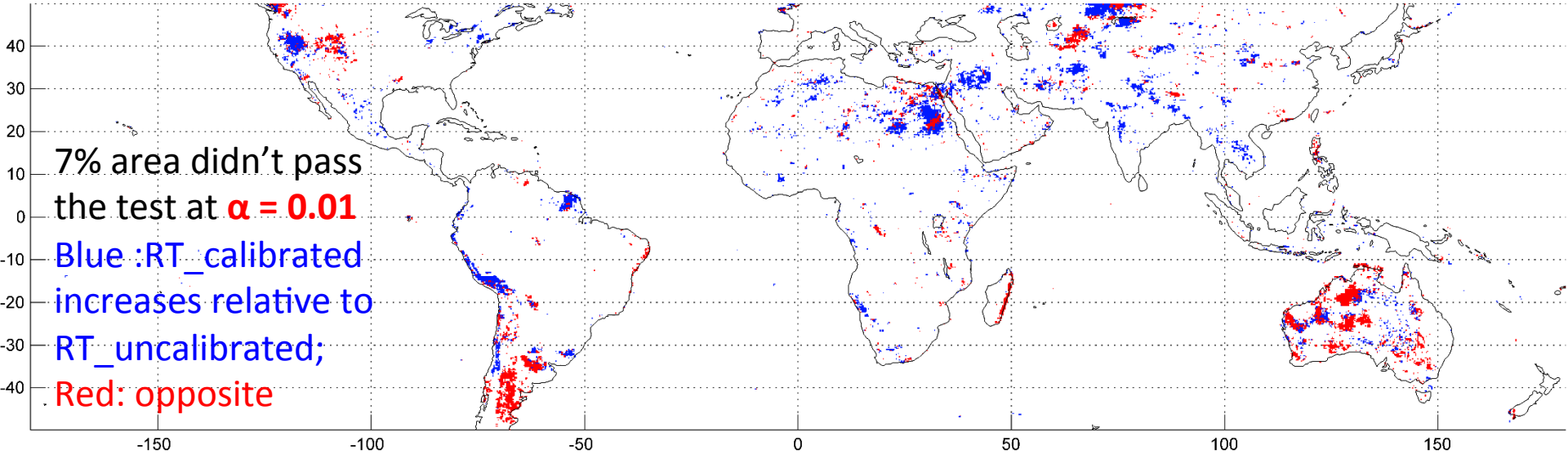
- Shift occurred around 2002, caused by overestimating peak values.
- no noticeable change in the overall bias between RT and RP

Results: The time at which shift between RT and RP occurred (i_0)

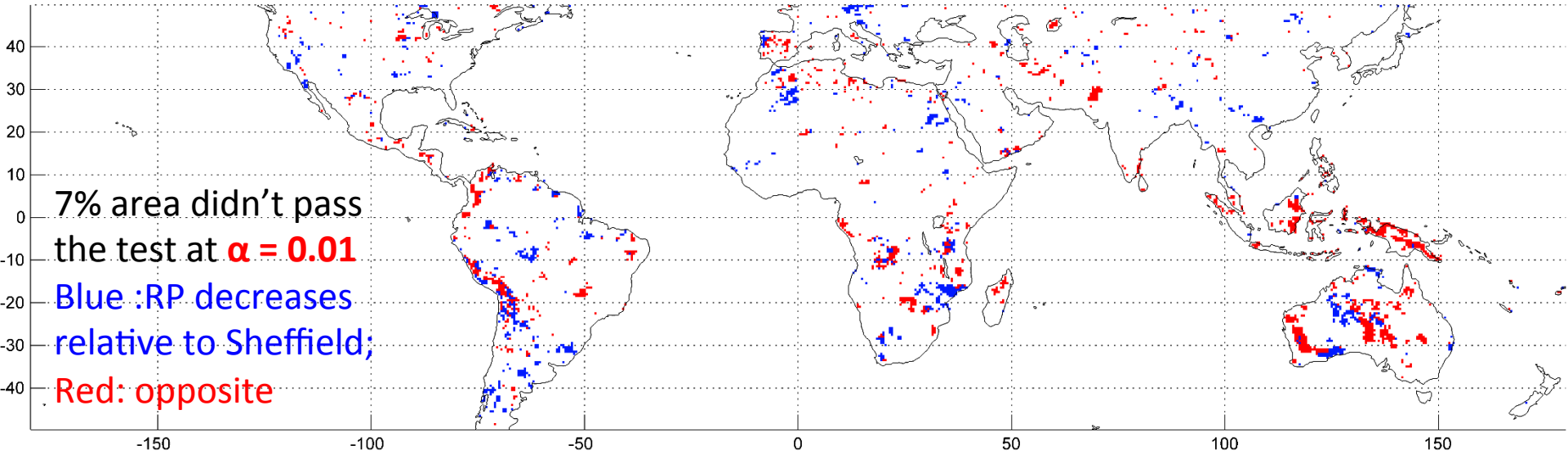


i_0 has a strong spatial coherence in these rejected areas, indicating that RT and RP have experienced a relative shift in each area at about the same time. It is therefore likely that the shift has the same underlying cause(s) within each area.

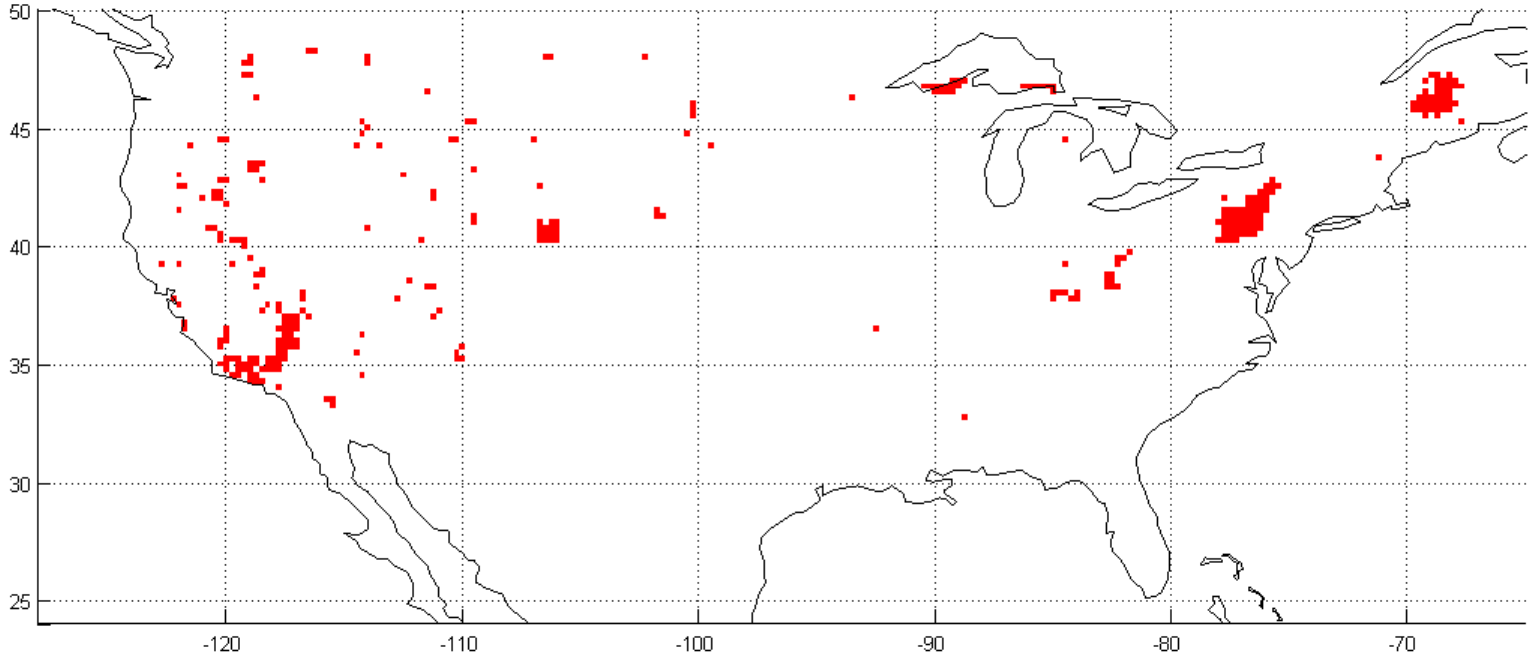
RT calibrated v.s. RT uncalibrated



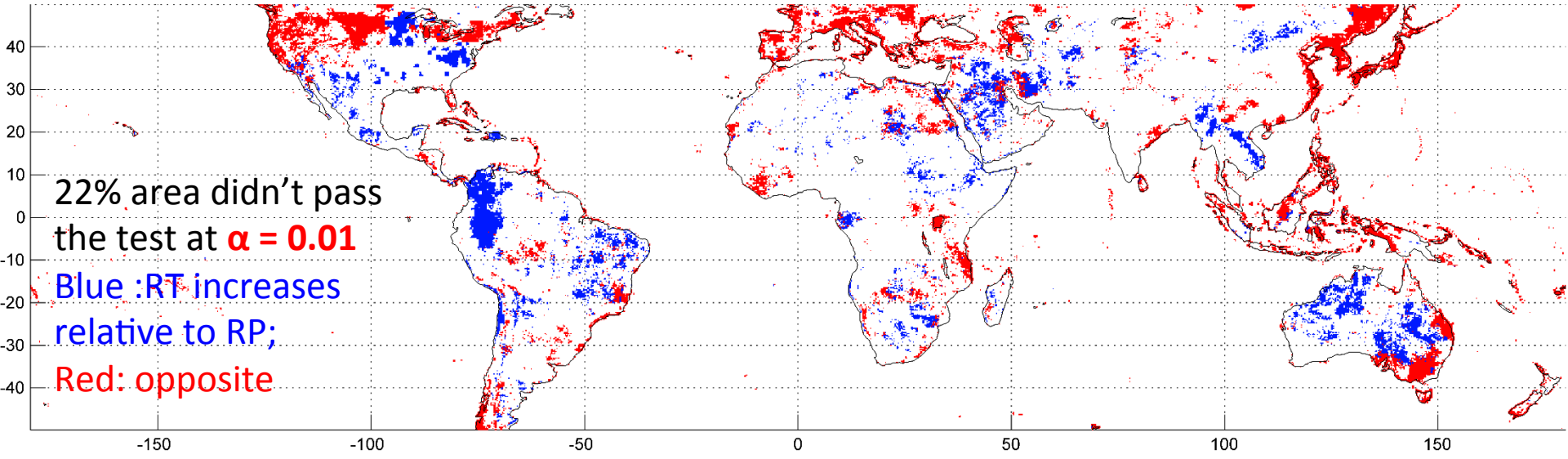
RP v.s. Sheffield (0.5° resolution, from 2001 to 2008)



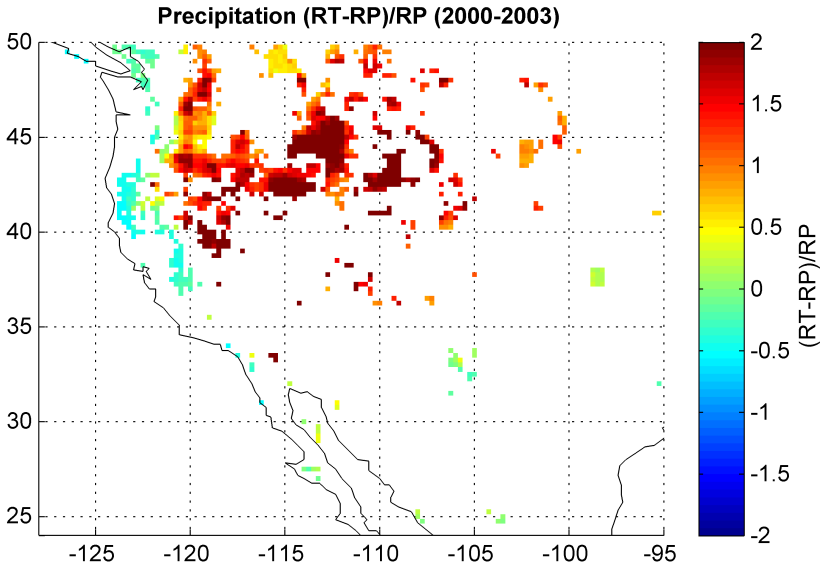
V7 RP v.s. Livneh's CONUS data (2001-2011) only 2% area (red) didn't pass the test at **α = 0.01**

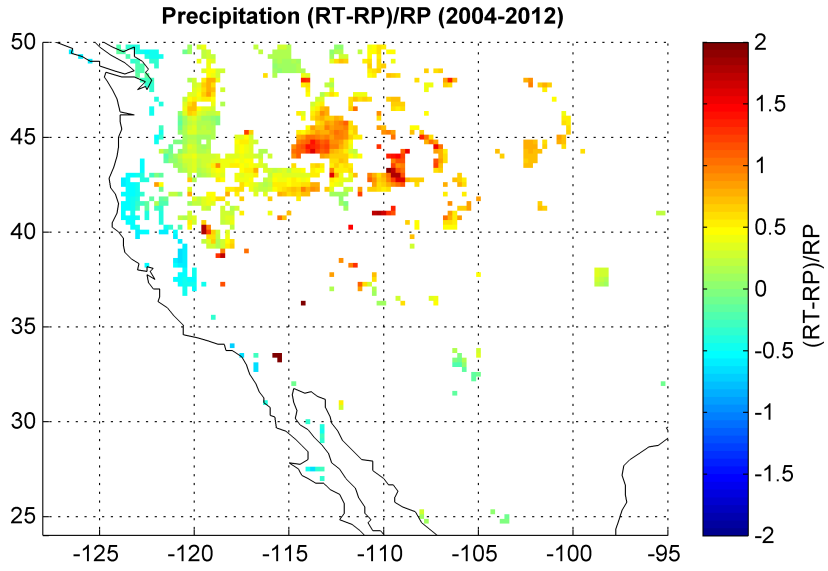


V6 RT vs RP (from 2004 to 2010)

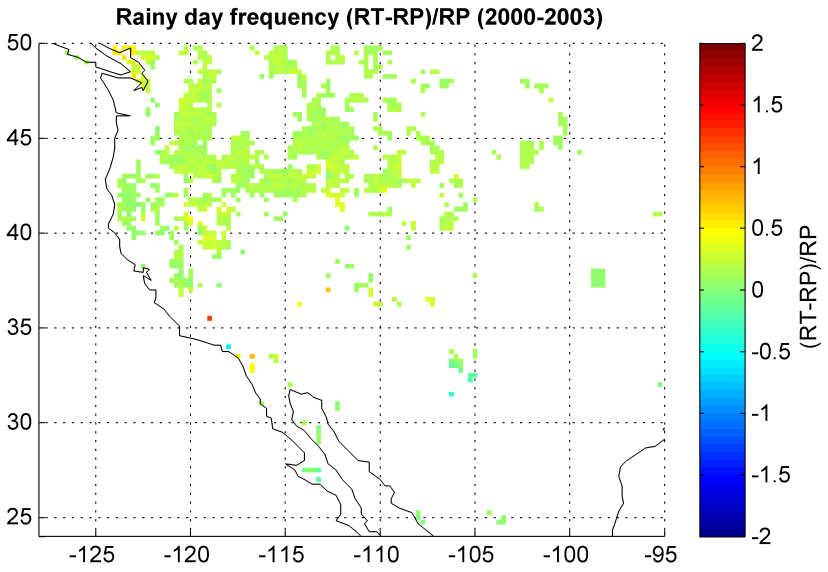


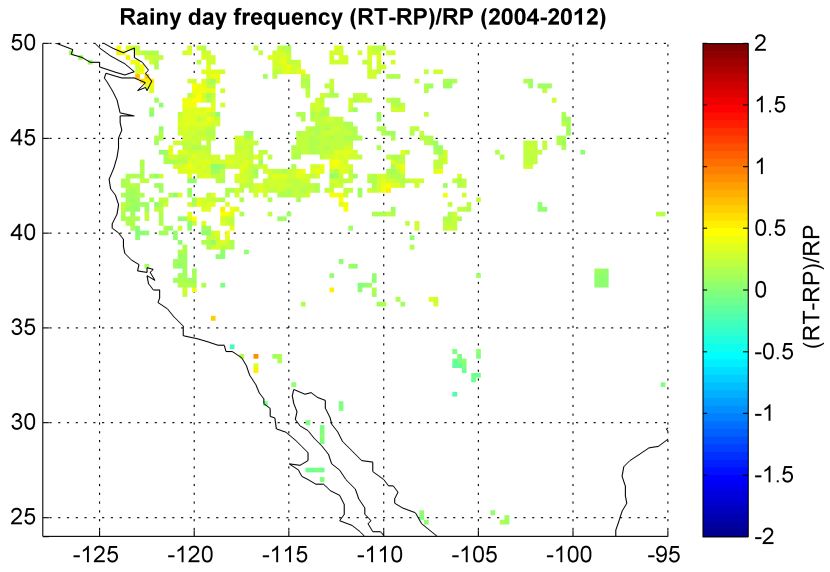
Relative mean precipitation difference between RT and RP before and after 2003 (shift) in western US





Relative rain day frequency difference between RT and RP before and after 2003 (shift) in western US





University of Washington Experimental Global Surface Water Monitor - Mozilla Firefox

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Experimental Global Surface Water Monitor

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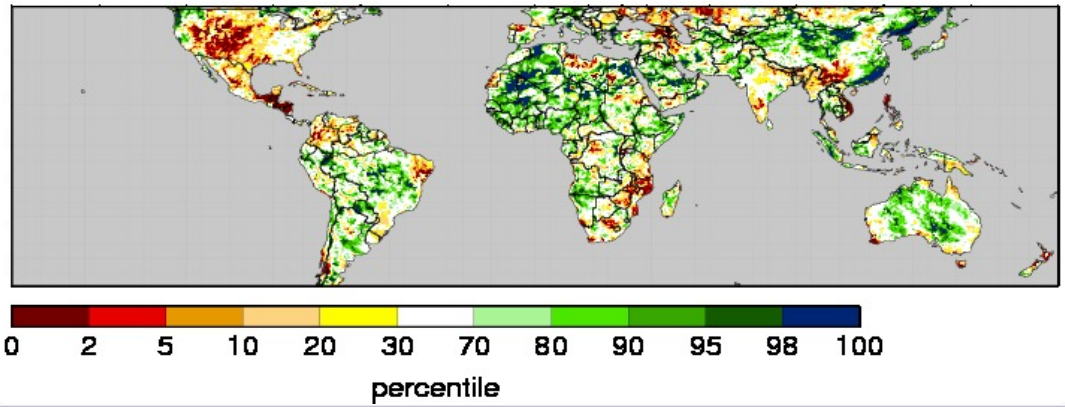
Current percentiles for soil moisture, SWE and other variables with respect to the climatological period (1916-2004 for CONUS and 1926-2004 for Mexico). These update daily by 11-12 pm PST, and have a lag of 1-2 days. **Roll the mouse over links below (or click) to see different maps**. *Note: SM & SWE maps are for daily values, whereas RO maps are for cumulative values.*

	Soil Moisture	SWE	Total Moisture Storage (SM+SWE)	Cumulative Runoff
Current Plots	~CPC [cmpr] ~DM [cmpr]	curr	curr	1mo 2mo 3mo 6mo 9mo 12mo 18mo 24mo 36mo 48mo 60mo WY
Recent Changes	1 wk 2 wk 1 mo	1 wk 2 wk 1 mo	-	

Regional Maps

SM: Experimental Surface Water Monitor for the Continental U.S.

VIC Soil Moisture Percentiles (wrt 1960-2008)
20131201

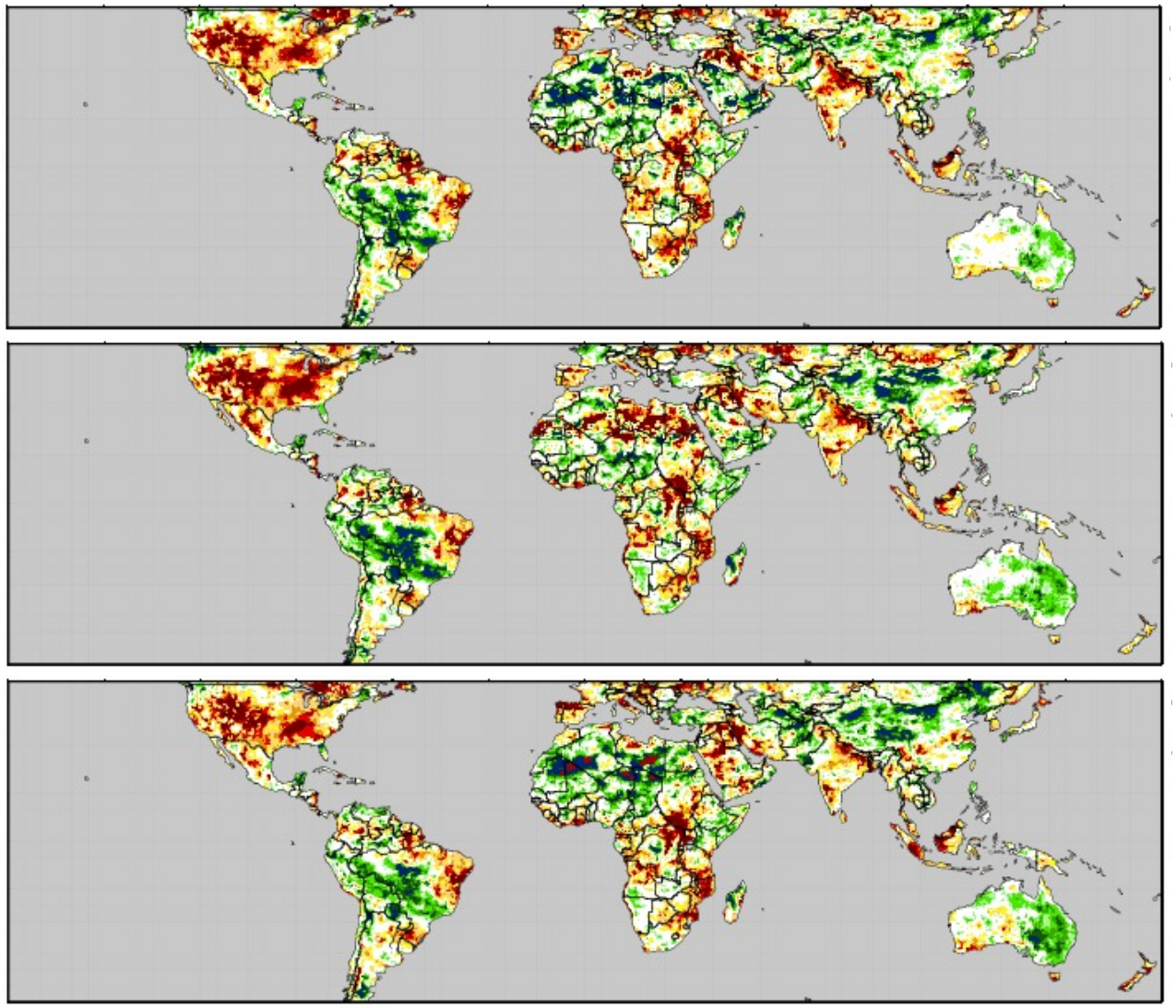


Recent Drought: individual models 2012/07/01

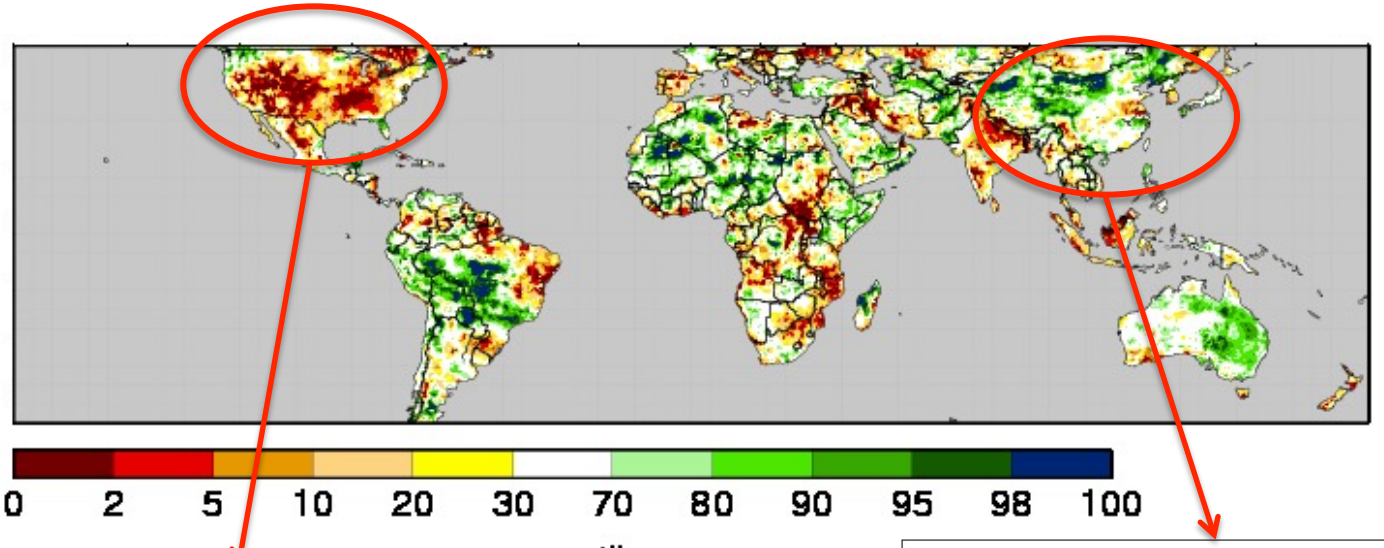
VIC

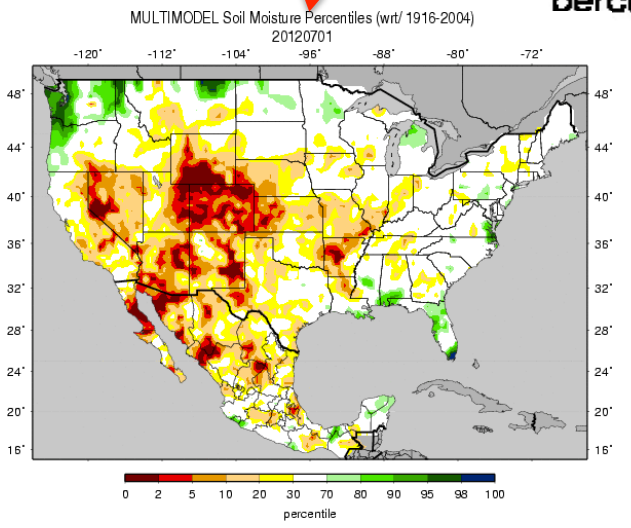
Noah

SAC

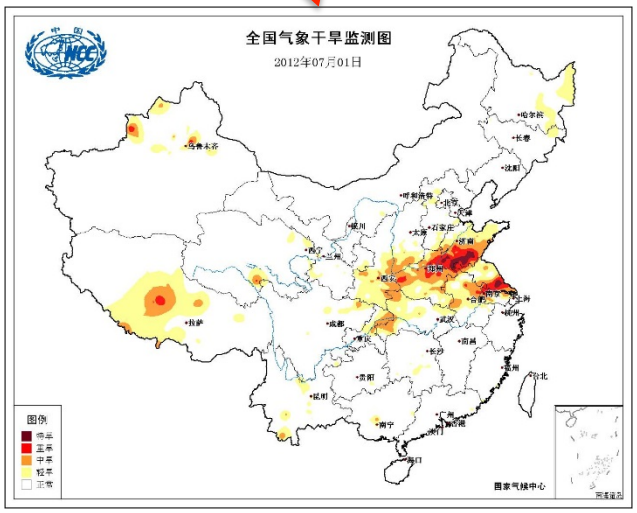


Comparison with other Drought Monitors 2012/07/01





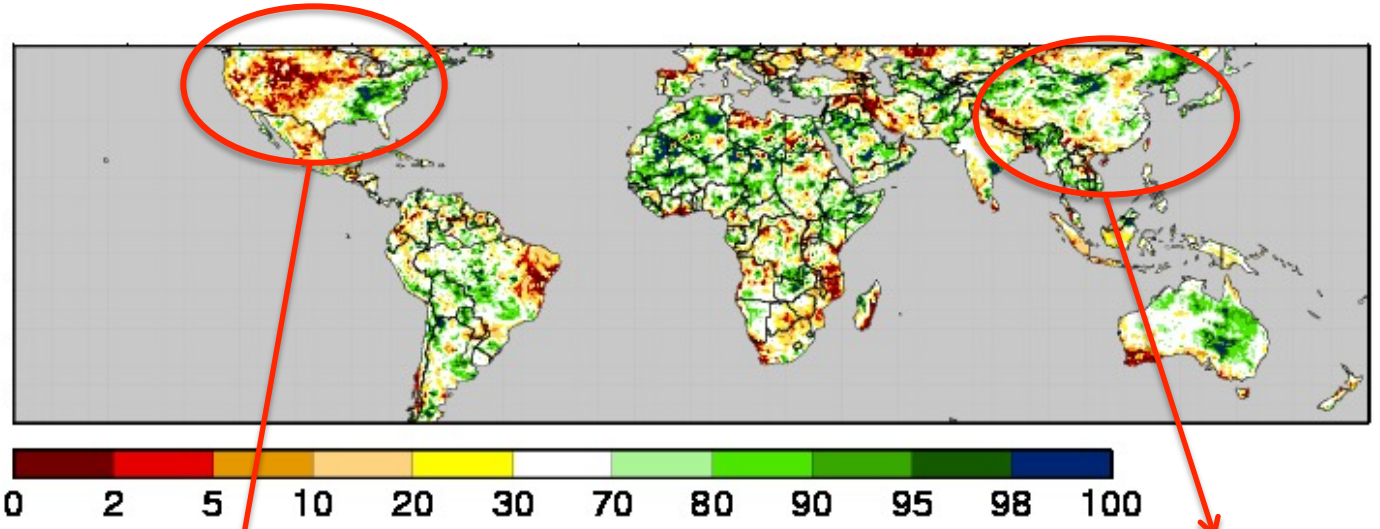
UW Surface Water Monitor

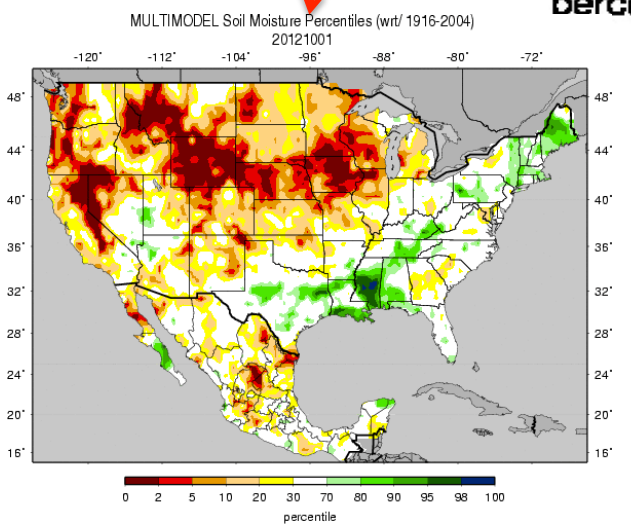


Chinese Drought and Flood Monitor

http://ncc.cma.gov.cn/influ/en_hljc.php

Comparison with other Drought Monitors 2012/10/01





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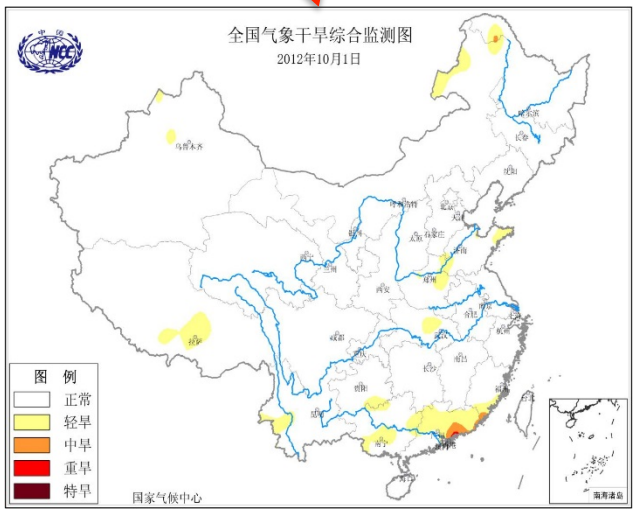
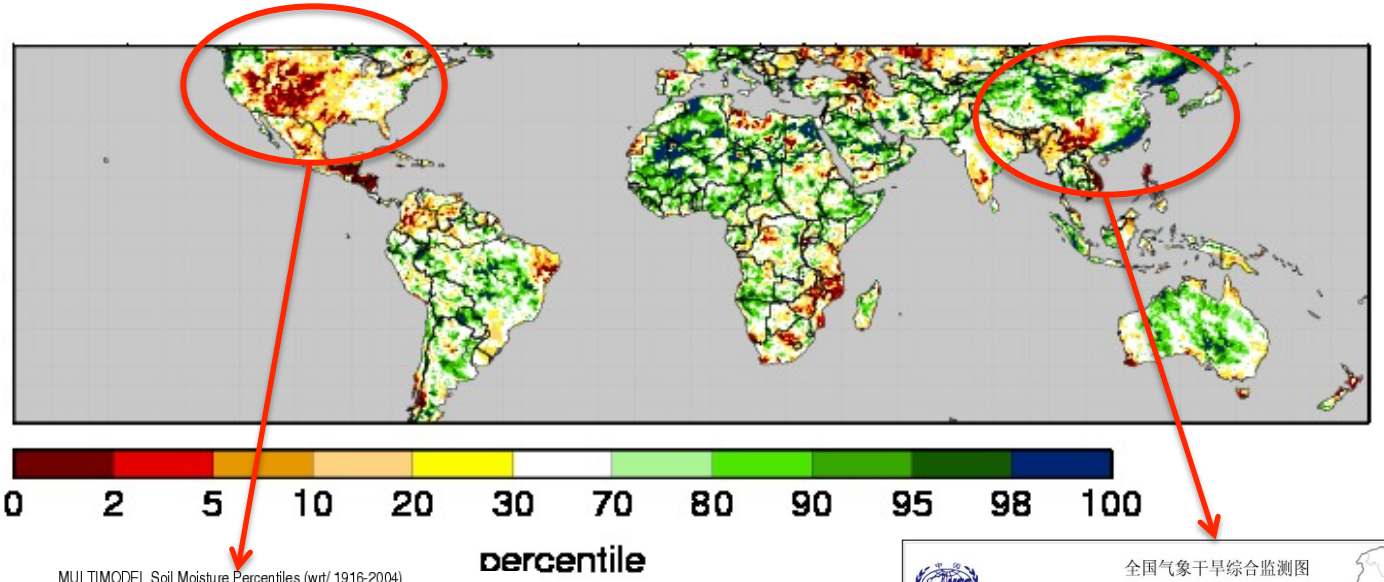
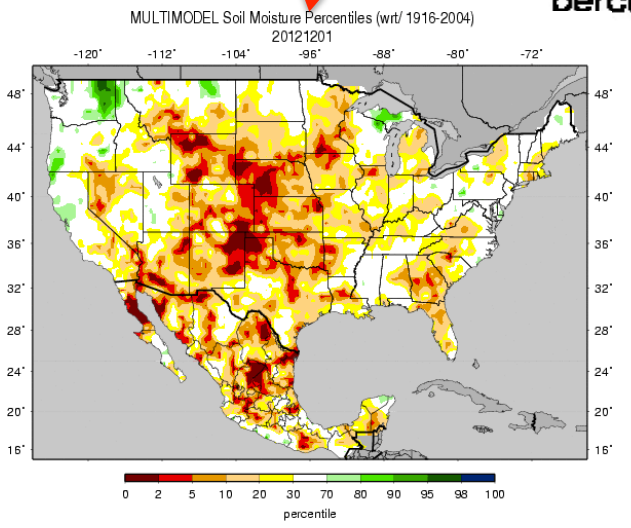


Chinese Drought and Flood Monitor
http://ncc.cma.gov.cn/influ/en_hljc.php

Comparison with other Drought Monitors 2012/12/01





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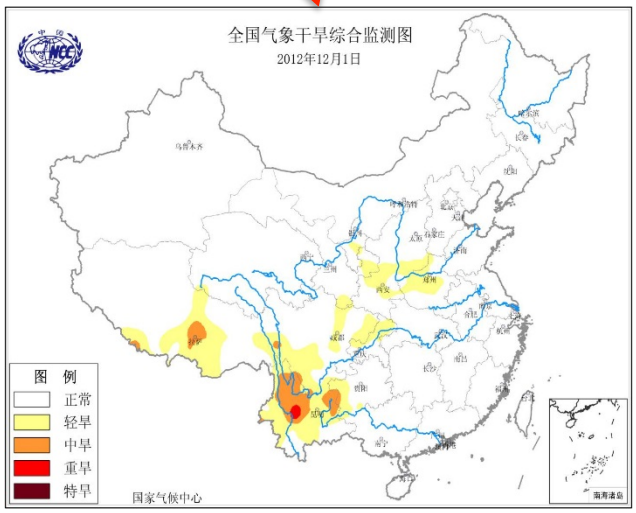

Chinese Drought and Flood Monitor

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Conclusions

- There is no shift in the mean between RT and RP for nearly 3/4 of the land area 50° N – 50° S at a significance level of 0.05 and for nearly 90% at a significance level of 0.01.
- The cumulative RT increases relative to RP in northern South America, central Africa, and Western Australia over time; while in western US and eastern Australia RT decreases relative to RP.
- Remarkable spatial coherence was observed in the date(s) at which the shifts occurred.