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Information content of soil hydrology in a west Amazon watershed as informed by GRACE

Elias C. Massoud et al.

Correspondence to: Elias C. Massoud (eliasmassoud@berkeley.edu)

Parameter	Symbol	Min	Max	Units	Basin 1	Basin 2
1) Porosity Layer 1	ρ_1	0.2	0.8		0.5006	0.5188
2) Porosity Layer 2	ρ_2	0.2	0.8		0.4432	0.4756
3) Ψ_field	Ψ_{field}	-0.1	-0.01	MPa	-0.0443	-0.0478
4) Layer 1 Depth (Rooting Depth)	L_{PAW}	1	100	m	11.0847	17.7702
5) Layer 2 Depth (PUW Depth)	L_{PUW}	1	100	m	13.4427	13.8686
6) Retention Parameter b	b	1.5	10		2.34	2.4207
7) Saturated Hydraulic Conductivity	K_0	1.00E-07	1.00E-05	m/s	1.09E-06	2.83E-06
8) Maximum Infiltration	I_{max}	100	2000	mm/month	1234.7	1238.6
9) SM@t=0 PAW	$SM_{1,t0}$	0.1	0.5	m^3/m^3	0.2021	0.1477
10) SM@t=0 PUW	$SM_{2,t0}$	0.1	0.5	m^3/m^3	0.3778	0.3687
11) ET scale factor	ET_{scale}	0.5	1.5		0.5622	0.7272
12) P scale factor	P_{scale}	0.5	1.5		1.0938	0.9508
13) Q excess factor	Q_{excess}	0.01	1		0.3244	0.1943

Table S1: Parameter estimation results for the Basins 1 (Acanaui) and 2 (Guayaramerin). Shown are the model parameters and associated symbols, prior ranges (Min – Max), units, and the posterior solution median estimates for each basin (Basin 1 and Basin 2).

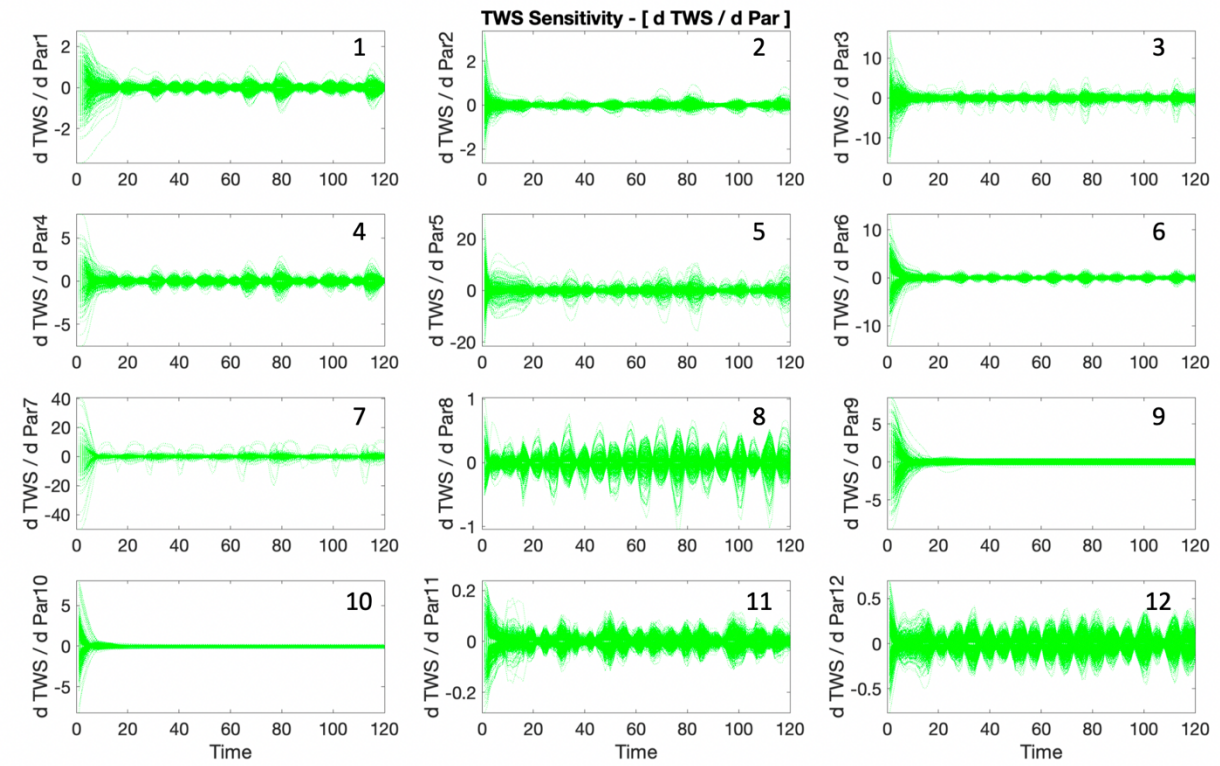


Figure S1: Sensitivity of the model simulated TWS to minor perturbations in parameter values. Shown here in green are the changes in simulated TWS (d TWS) when each parameter is perturbed (d Par) by 1% of its prior range, indicating the magnitude and the time steps of model sensitivity.

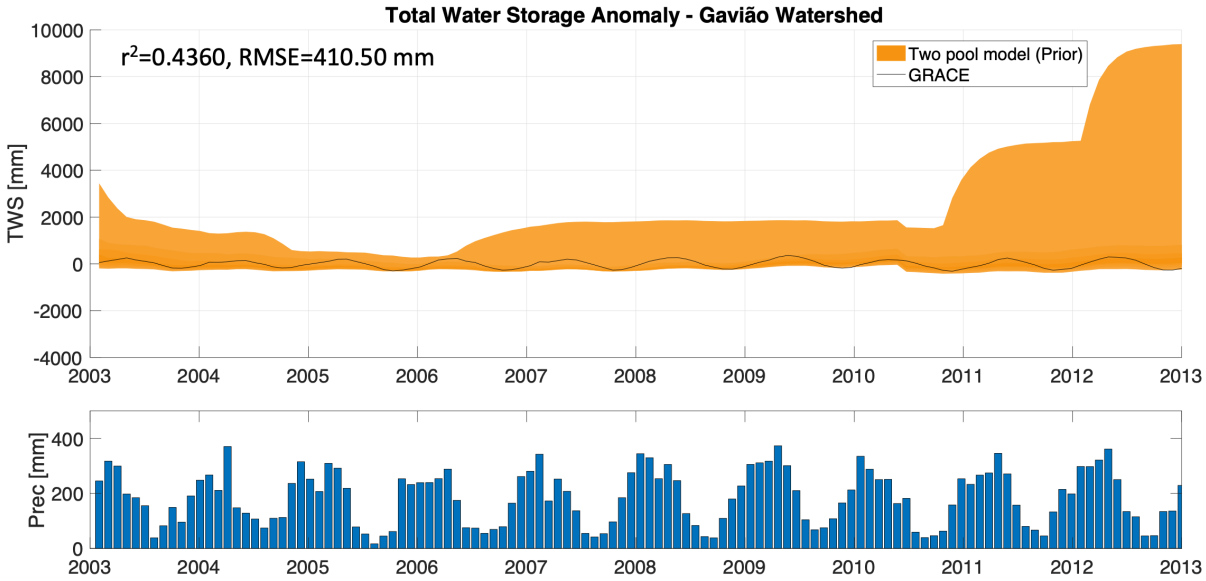


Figure S2: Monthly Total Water Storage (TWS) anomaly prior estimates from the model for the Gavião watershed. The prior ranges of the model simulated TWS are shown here in the orange envelopes and GRACE data is shown in black. Precipitation values used to drive the model are shown to indicate the seasonal cycle.

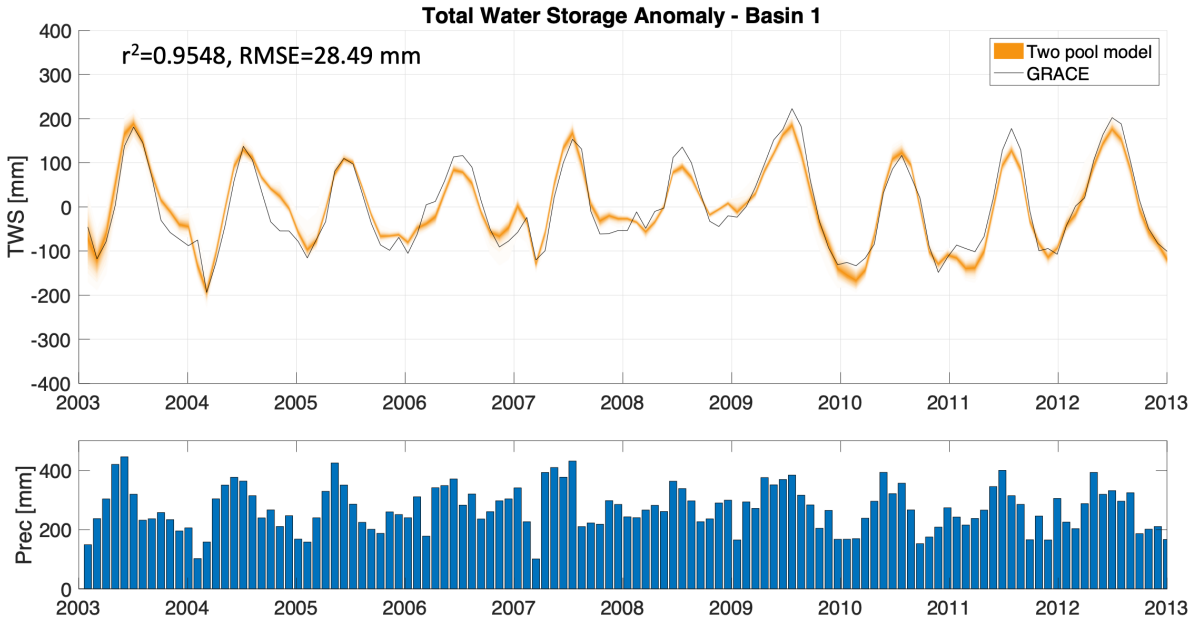


Figure S3: Monthly Total Water Storage (TWS) anomaly estimates from satellite data (GRACE TWS) and the data-constrained model for Basin 1 (Acanaui). GRACE-informed posterior ranges of the model simulated TWS are shown here in the orange envelopes. Precipitation values used to drive the model are shown to indicate the seasonal cycle.

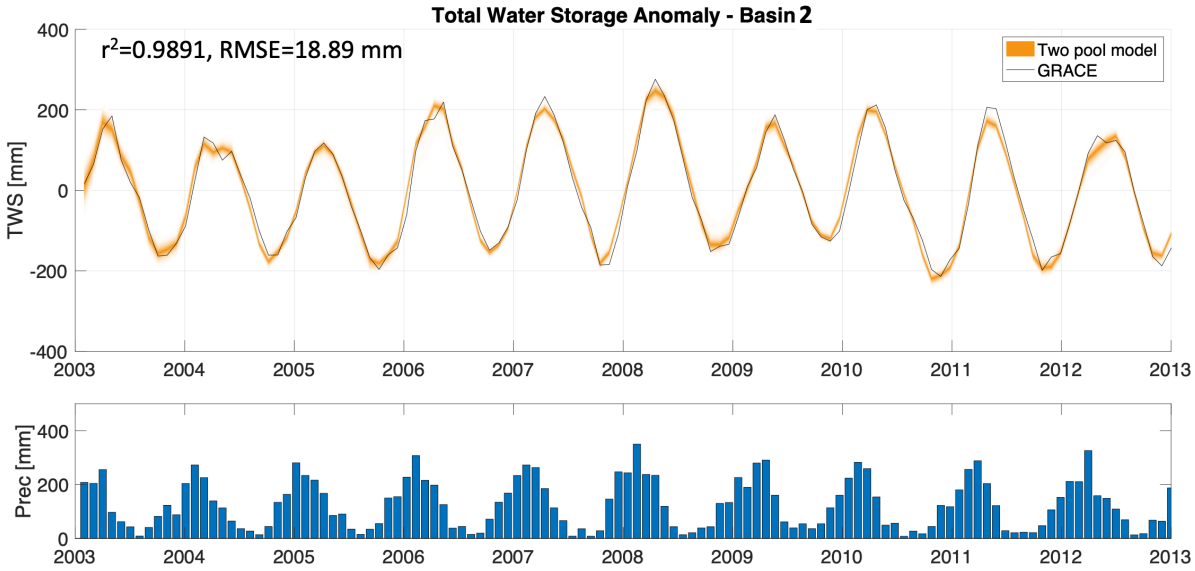


Figure S4: Monthly Total Water Storage (TWS) anomaly estimates from satellite data (GRACE TWS) and the data-constrained model for Basin 2 (Guayaramerin). GRACE-informed posterior ranges of the model simulated TWS are shown here in the orange envelopes. Precipitation values used to drive the model are shown to indicate the seasonal cycle.

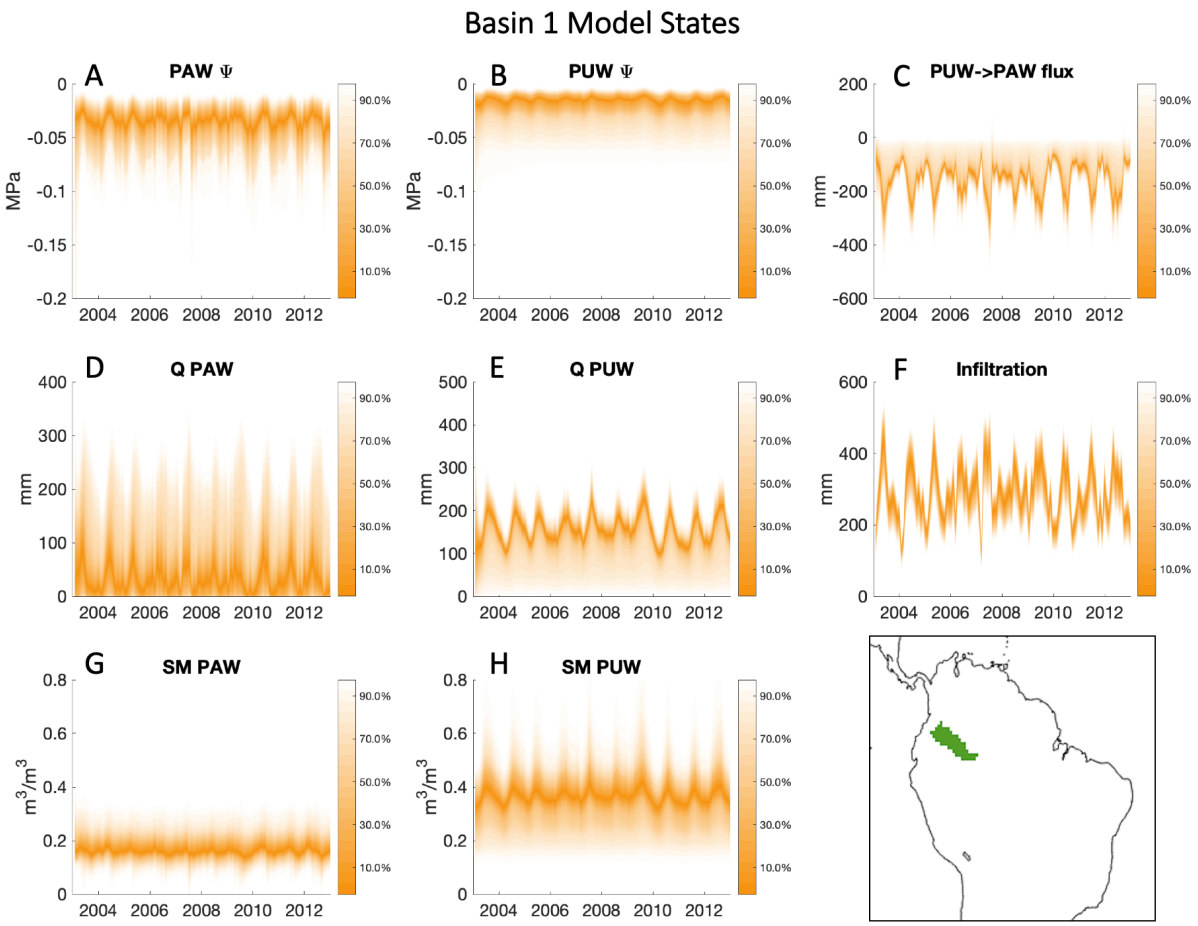


Figure S5: GRACE-informed model simulated states and fluxes for Basin 1 (Acanaui - basin shown in the bottom right panel in the context of the broader South American domain). These figures show specific model processes and state variables. The ranges shown here in orange envelopes indicate the GRACE-informed posterior ranges.

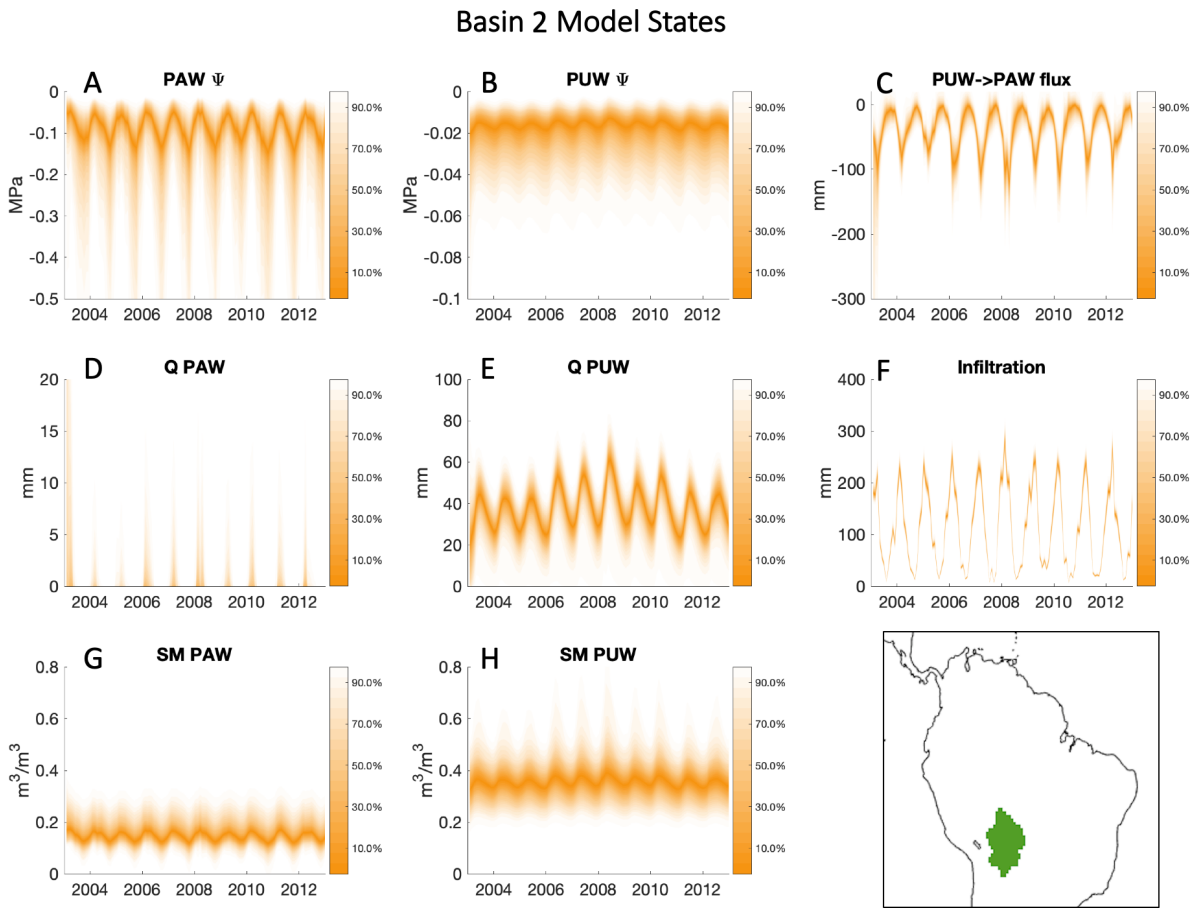
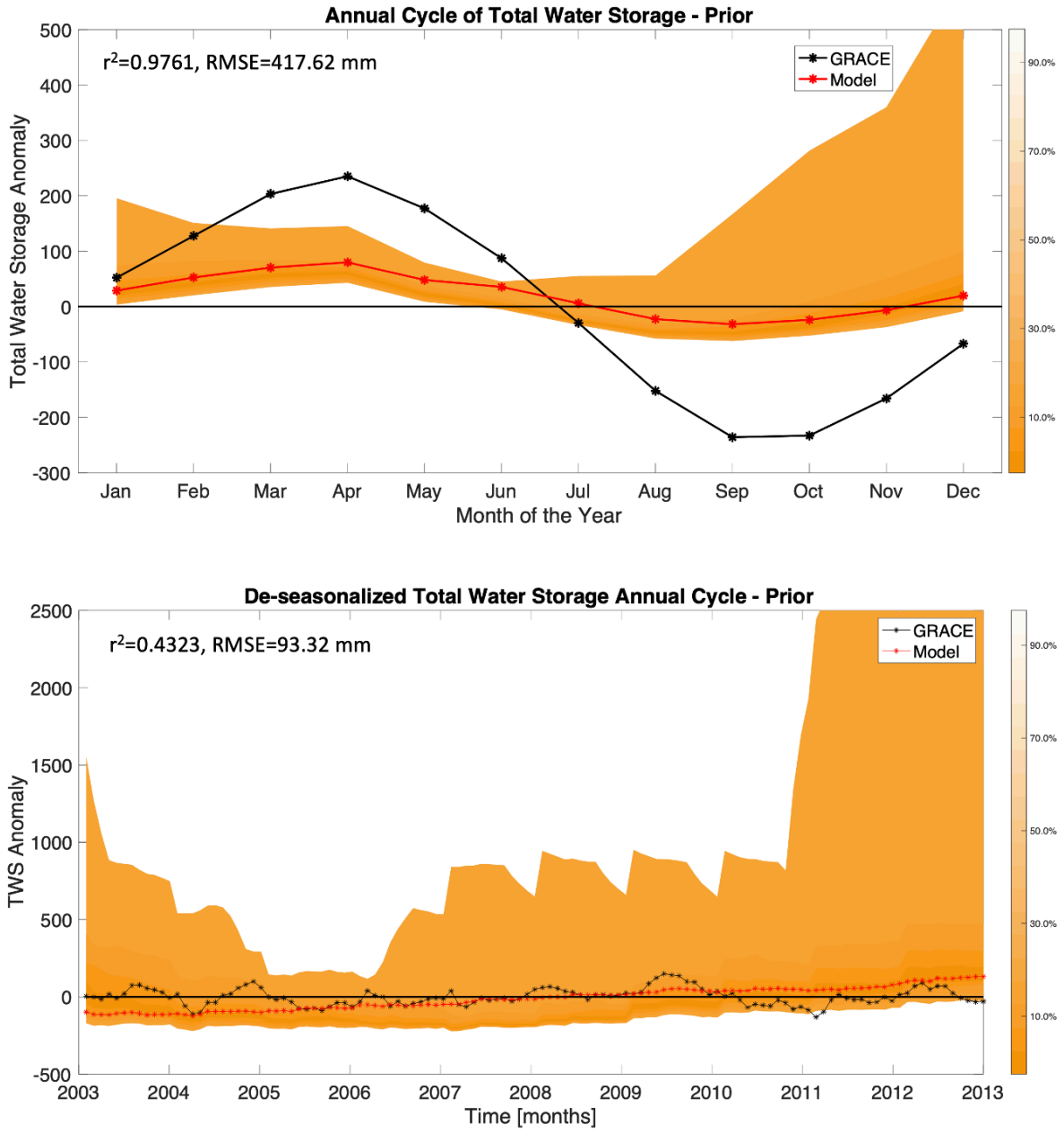


Figure S6: GRACE-informed model simulated states and fluxes for Basin 2 (Guayaramerin - basin shown in the bottom right panel in the context of the broader South American domain). These figures show specific model processes and state variables. The ranges shown here in orange envelopes indicate the GRACE-informed posterior ranges.



<u>Figure S7</u>: A) Annual cycle of the monthly TWS anomalies [mm], from satellite data (GRACE) and the model for the Gavião watershed. The prior ranges of the model simulated TWS annual cycle are shown here in the orange envelopes. B) To obtain the de-seasonalized values of TWS for the Gavião watershed shown in Panel B, we subtract the annual cycle in Panel A from each month's estimate shown in Figure S8.

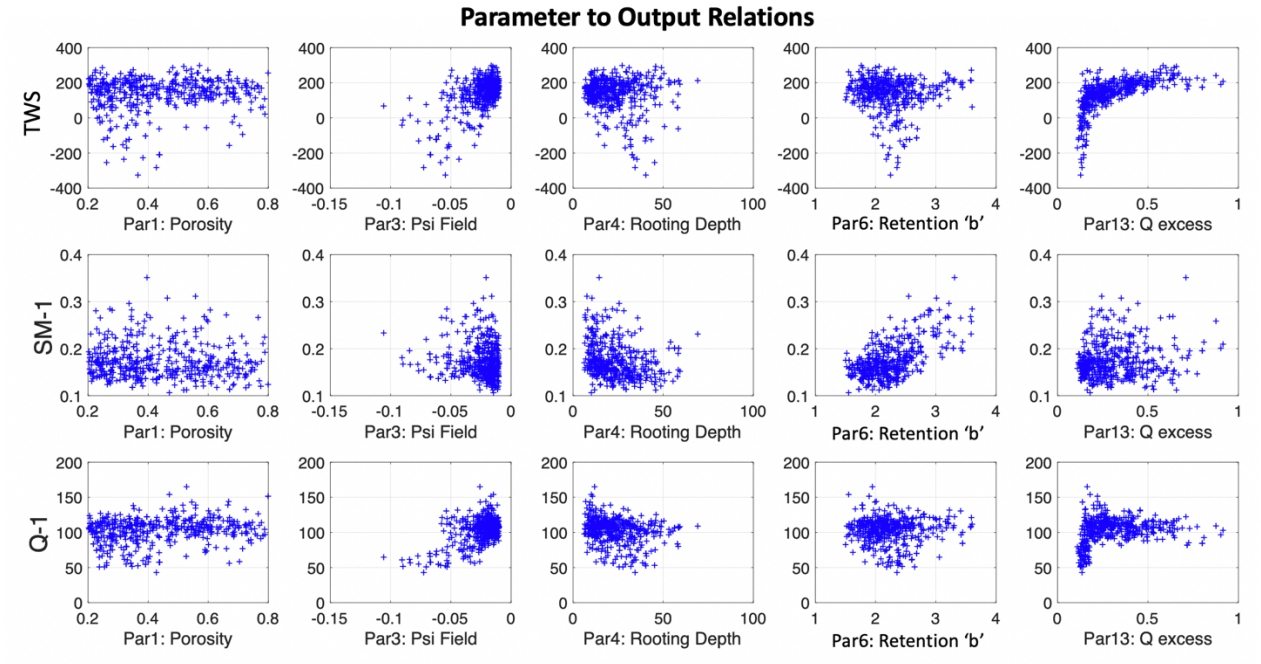


Figure S8: Scatter plots showing correlation of the posterior parameter values with corresponding model simulated values for Terrestrial Water Storage (TWS), soil moisture (SM-1), and discharge (Q-1). These plots portray the relationship and correlation between select estimated parameters and simulated model processes of interest as inferred by GRACE.

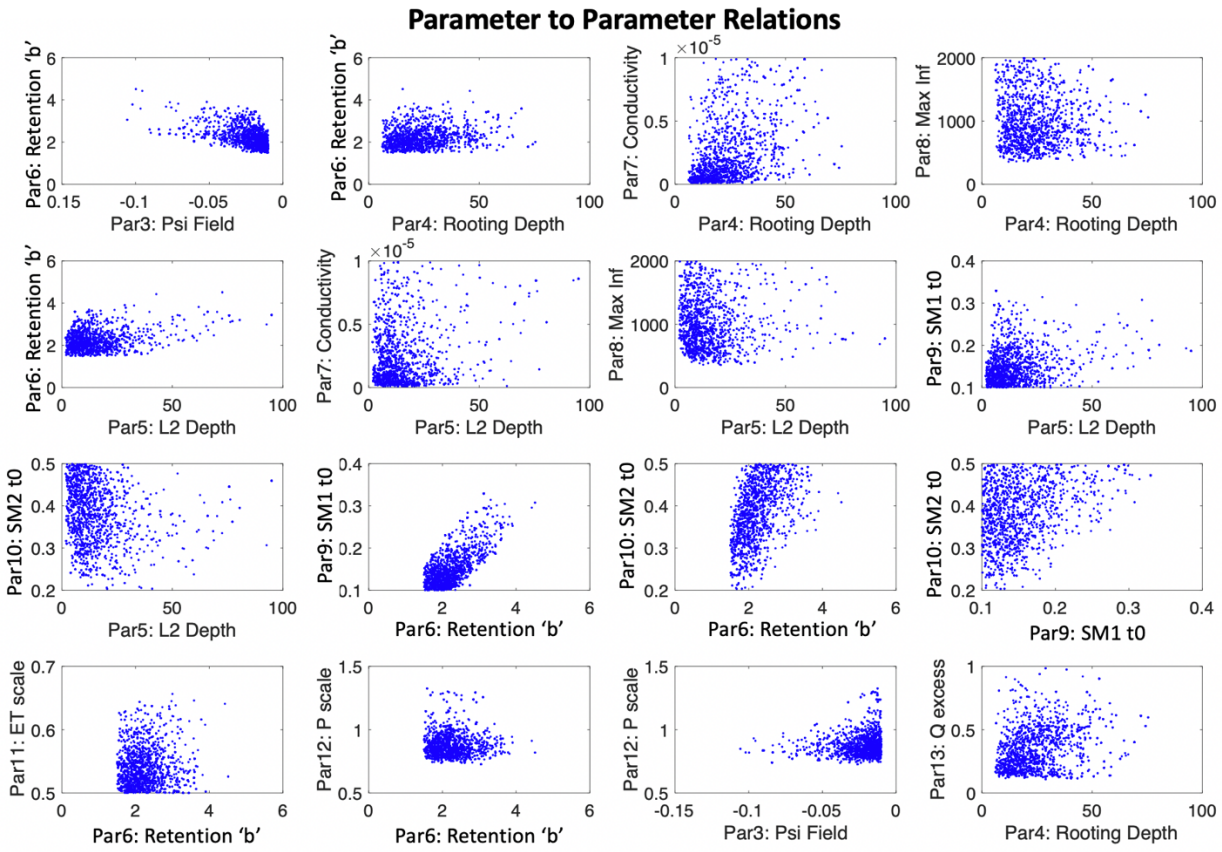


Figure S9: Scatter plots showing correlation of the posterior parameter values with other parameter posteriors. These plots portray the relationship and correlation between pairs of model parameters in the posterior space as inferred by GRACE.