Changing sensitivity of carbon exchange to atmospheric and soil moisture controls the response and recovery of carbon stocks in tropical South America from the 2015-2016 El Niño

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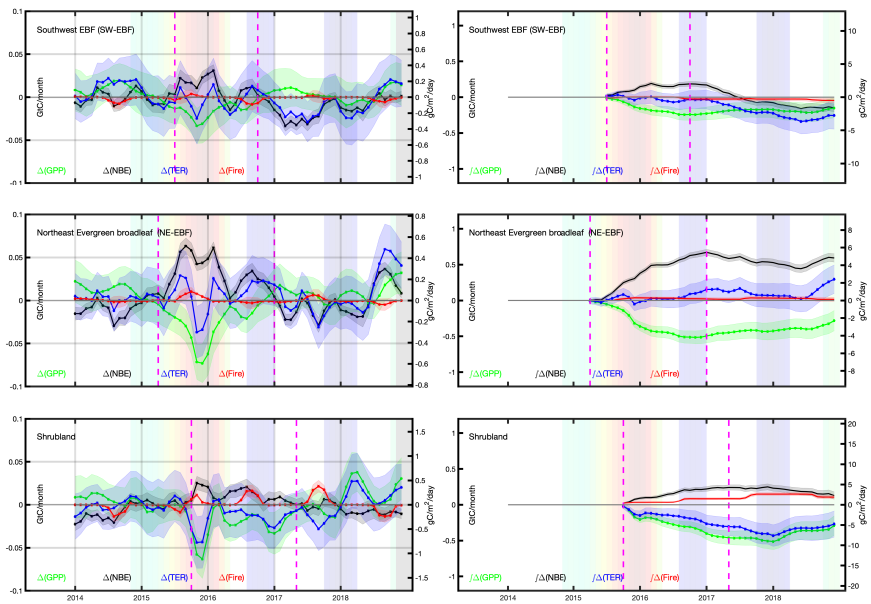
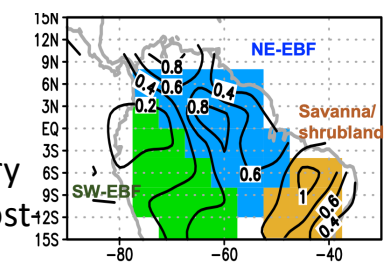
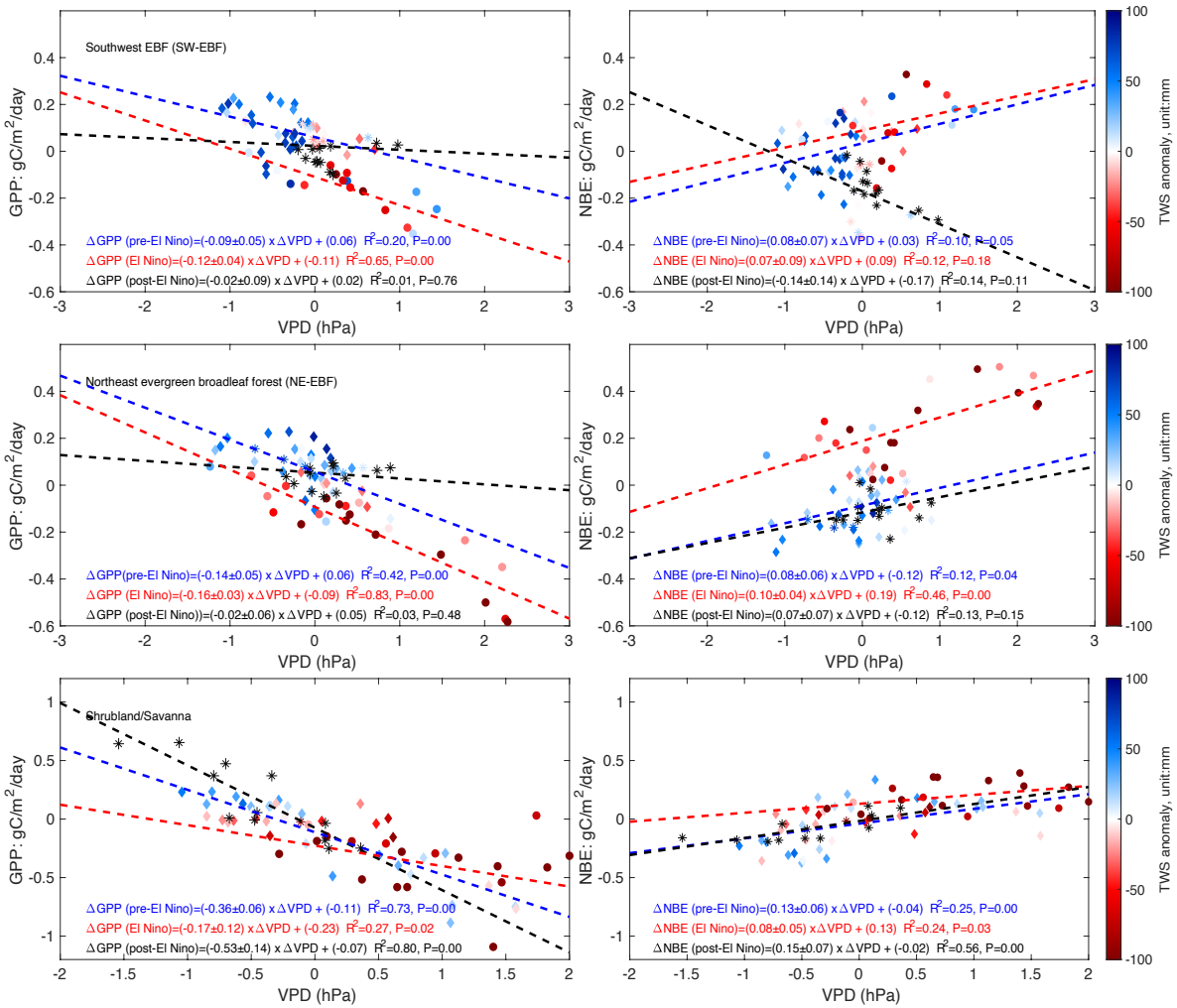


- The loss of total carbon pool over tropical south American (tropical SA) due to 2015-2016 drought has not recovered till the end of 2018;
- Carbon fluxes (i.e., GPP and NBE) has faster recovery rate than carbon pools.

	Drought			Post-drought		
	SW-EBF	NE-EBF	Savanna	SW-EBF	NE-EBF	Savanna
Δ(vpd) (hPa)	41.7	55.8	99.5	11.5	10.2	-38.0
Δ(TWS) (mm)	-20.4	-84.3	-110.1	NA	NA	NA
Δ(WUE) (%)	-4.0±	-1.5	-0.8	-0.49	0.89	4.7
Δ(GPP) (GtC)	-0.21±0.07	-0.50±0.10	-0.46±0.10	0.04±0.07	0.11±0.09	0.10±0.09
$\Delta GPP^{\{\frac{dC}{d(climate)}\}pre}$	0.04±0.03	-0.05±0.07	-0.56±0.06	0.09±0.01	0.10±0.01	0.02±0.02
$\Delta GPP^{change-sens}$	-0.25±0.08	-0.45±0.12	0.10±0.12	-0.05±0.07	0.01±0.09	0.08±0.09
Δ (NBE)	0.24±0.08	0.67±0.12	0.24±0.08	-0.34±0.08	-0.24±0.12	-0.06±0.16
$\Delta NBE^{\{\frac{dC}{d(climate)}\}pre}$	0.10±0.03	-0.12±0.07	0.10±0.07	0.08±0.01	-0.17±0.02	-0.07±0.16
$\Delta NBE^{change-sens}$	0.14±0.09	0.89±0.14	0.14±0.08	-0.42±0.08	-0.07±0.12	0.01±0.23

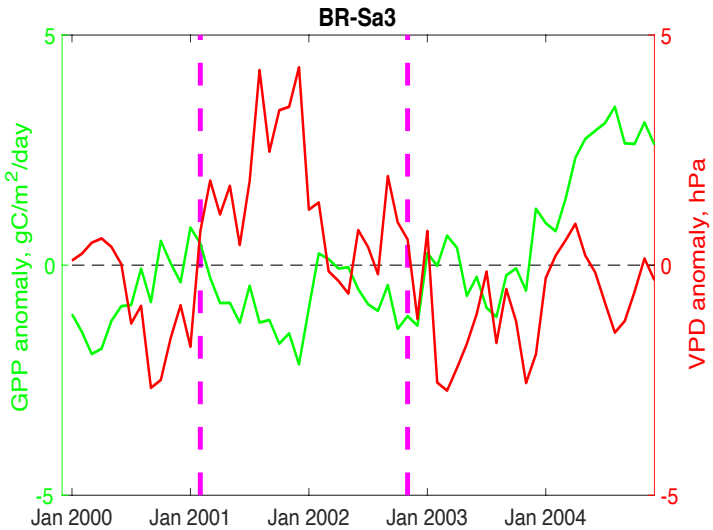
- Changing sensitivity of carbon fluxes to VPD greatly increases GPP reduction and NBE increases over the forest due to drought.
- The drought legacy effect slows GPP recovery but accelerates net carbon uptake during post-drought over SW-EBF.

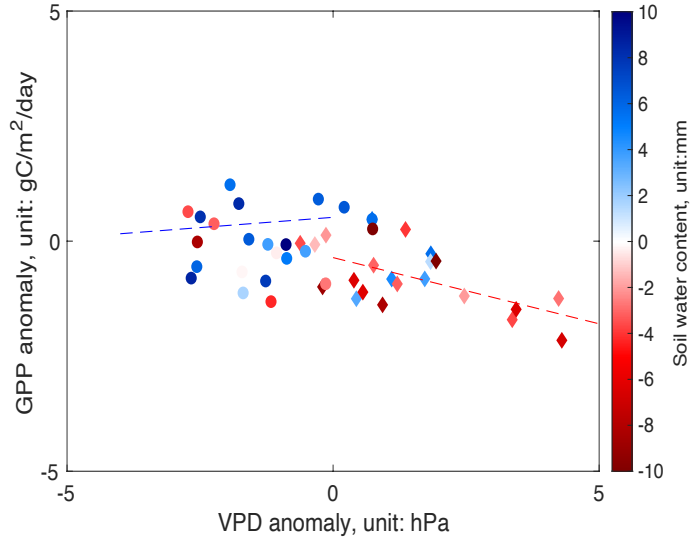


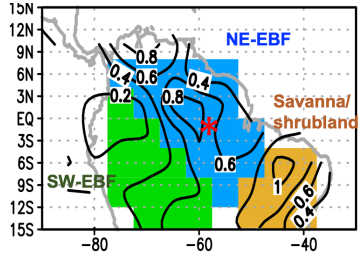


- The absolute GPP-VPD sensitivity increases during drought over both forest regions, but decreases over savanna/shrubland, reflecting enhanced land-atmosphere coupling and different adaptive strategy to drought among these regions;
- The overshooting recovery of GPP over savanna/shrubland is due to the enhanced absolute sensitivity of GPP to VPD.
- The NBE-VPD sensitivity increases during drought over all three regions, with increased GPP-VPD sensitivity as dominant contributor over the forest and the increased sensitivity of total ecosystem respiration (TER) as dominant contributor over the savanna/shrubland.
- The increased NBE uptake during post-drought over SW-EBF is primarily caused by the changing TER-VPD sensitivity.

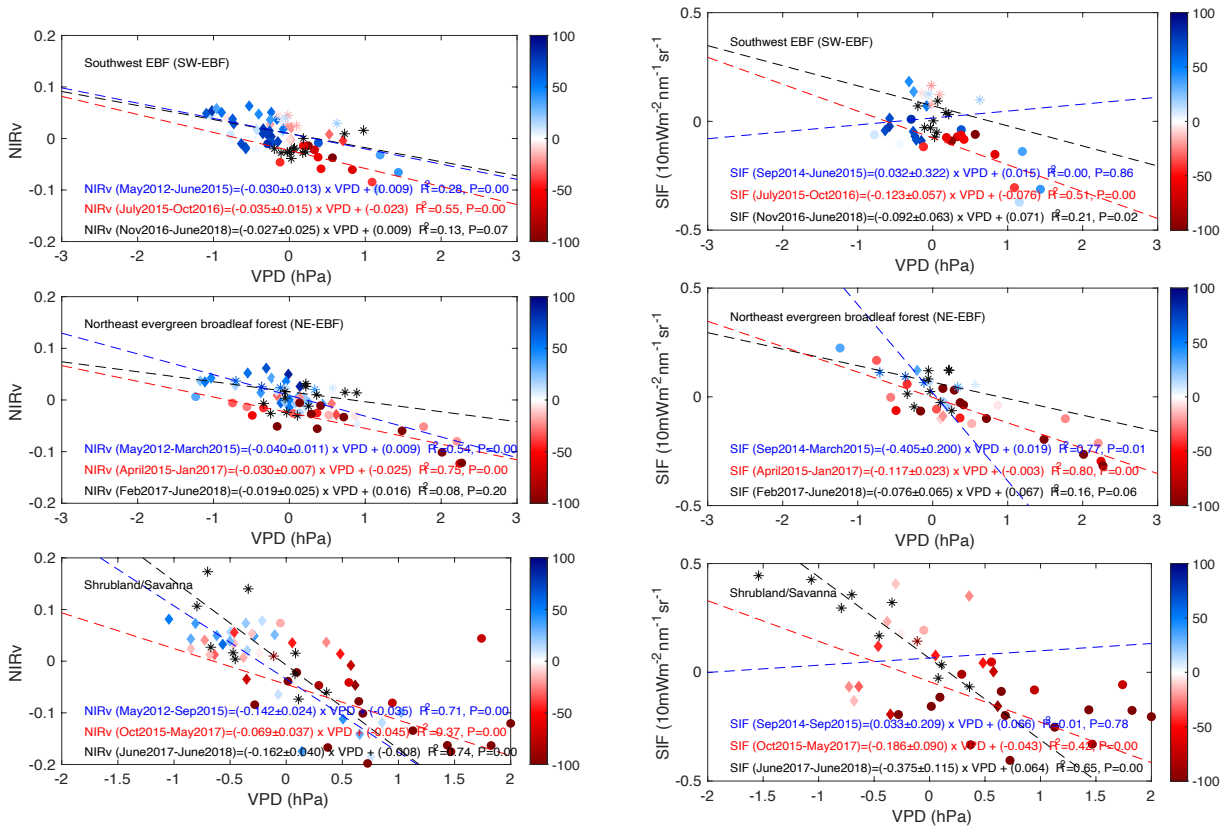
The changing GPP-VPD sensitivity during drought is supported by flux-tower observations







The changing GPP-VPD sensitivity during drought and post-drought is consistent with the changing sensitivity of NIRv and SIF to VPD during different drought stages



Enhanced land-atmosphere coupling, different adaptive strategies to drought stress, and the interactive effect between air aridity and soil water content deficit causes the changes of GPP-VPD sensitivities; changing sensitivity of TER to VPD further contributes to the changing GPP-VPD sensitivity.