

Supplementary materials



Figure S1: Geographical domain for the Amazon LDAS retrospective and forecast simulations. The domain extent (red) is 6°N-21°S and 49°W-82°W encompassing the Amazon watershed (blue). Subbasins (black) are extracted from the HydroBASINS v1 dataset. The orange dashed box highlights the arc of deforestation subset region used in the fire risk analysis.

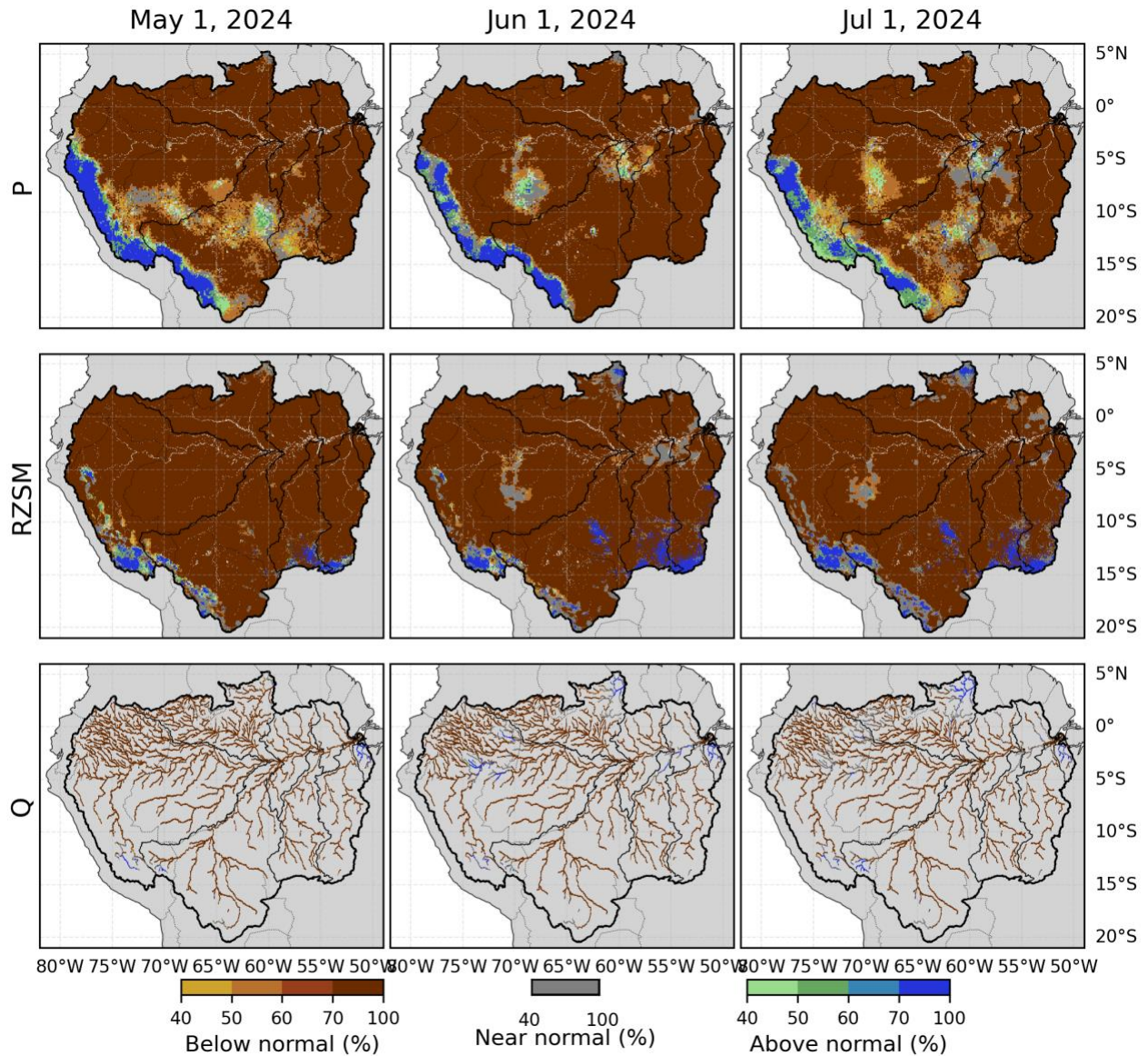


Figure S2: Probabilistic tercile forecasts for JAS 2024 precipitation (P), root zone soil moisture (RZSM), and streamflow (Q) across 1- to 3-month lead times. Colors indicate the most likely categorical forecast (Below Normal, Normal, or Above Normal), calculated using strictly independent tercile thresholds derived from the 2001–2023 base period.

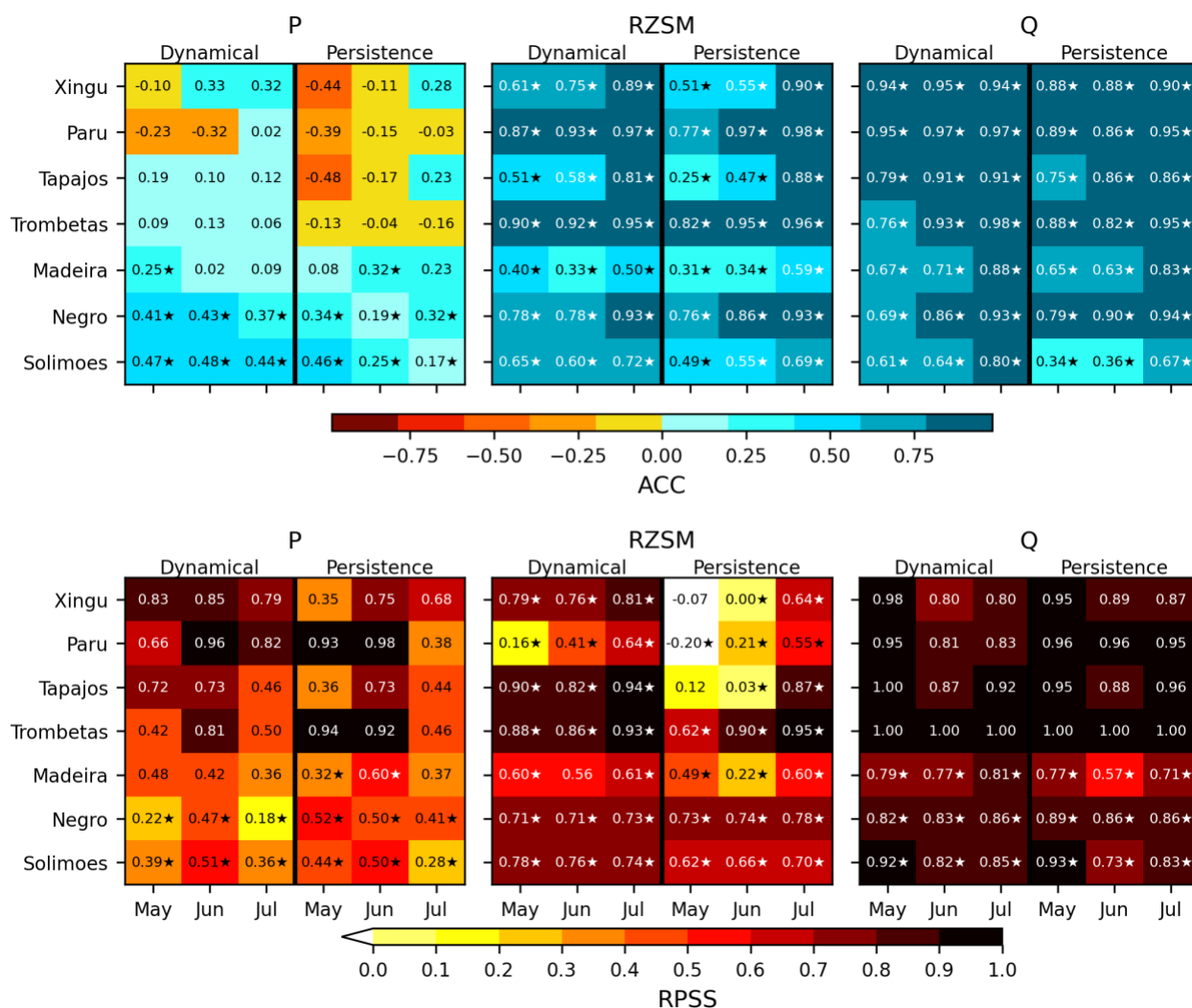


Figure S3: Subbasin scale evaluation of dynamical and persistence forecasts for all initializations. The top panel displays the anomaly correlation coefficient (ACC), and the bottom panel displays the ranked probability skill score (RPSS). Performance is compared across precipitation (P), root-zone soil moisture (RZSM), and streamflow (Q) for seven major Amazon subbasins. Asterisks denote statistically significant skill scores based on Monte-Carlo field significance.

RPSS — Dynamical Forecast (JAS 2024)
 (★ = field significant at $p < 0.05$)

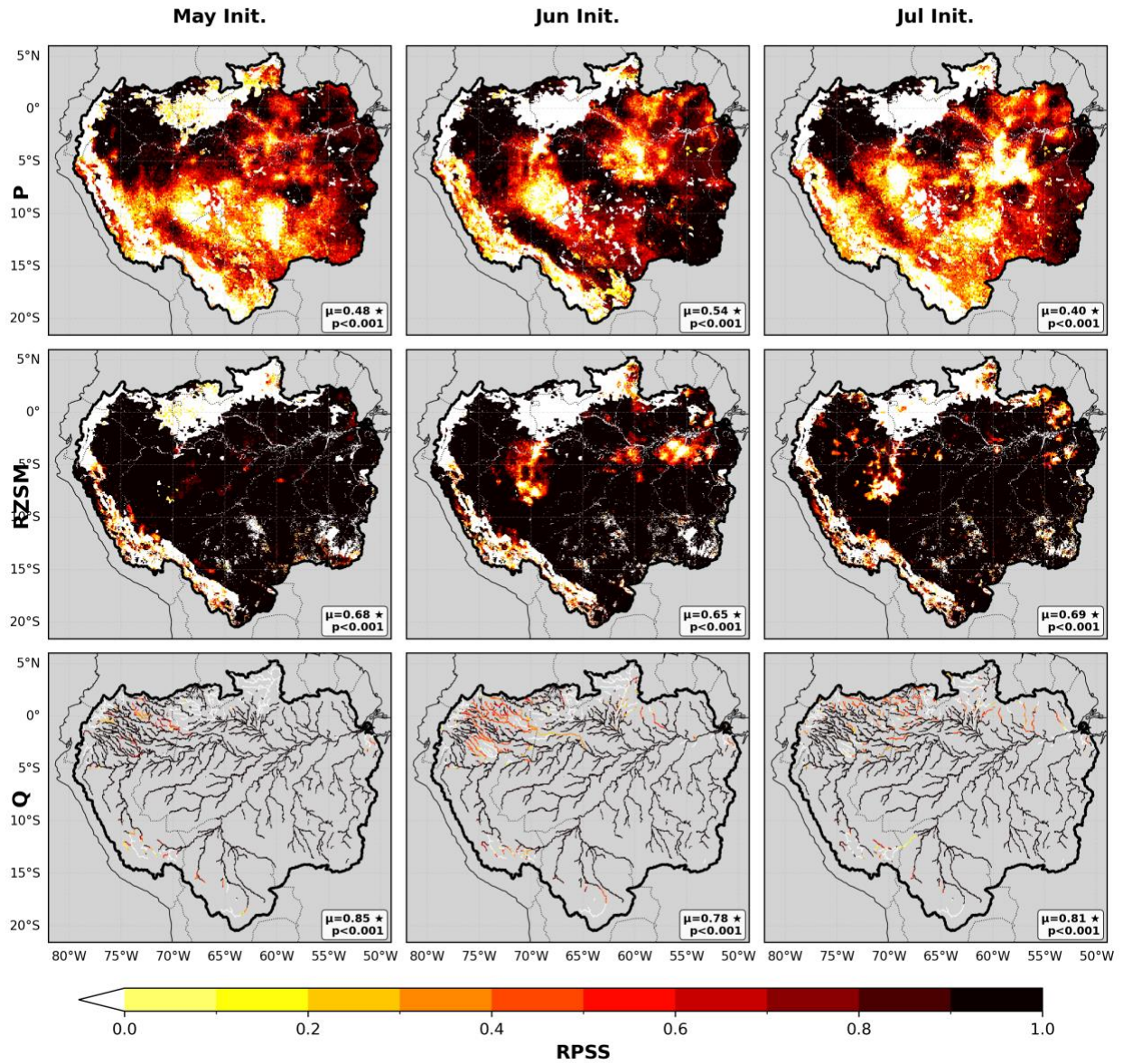


Figure S4: Spatial distribution of categorical Ranked Probability Skill Score (RPSS) from the dynamical forecasts for precipitation (P), root zone soil moisture (RZSM), and streamflow (Q) across the May, June, and July initializations. The inset text denotes the cosine-weighted domain average (μ) and Monte Carlo field significance (p -value).

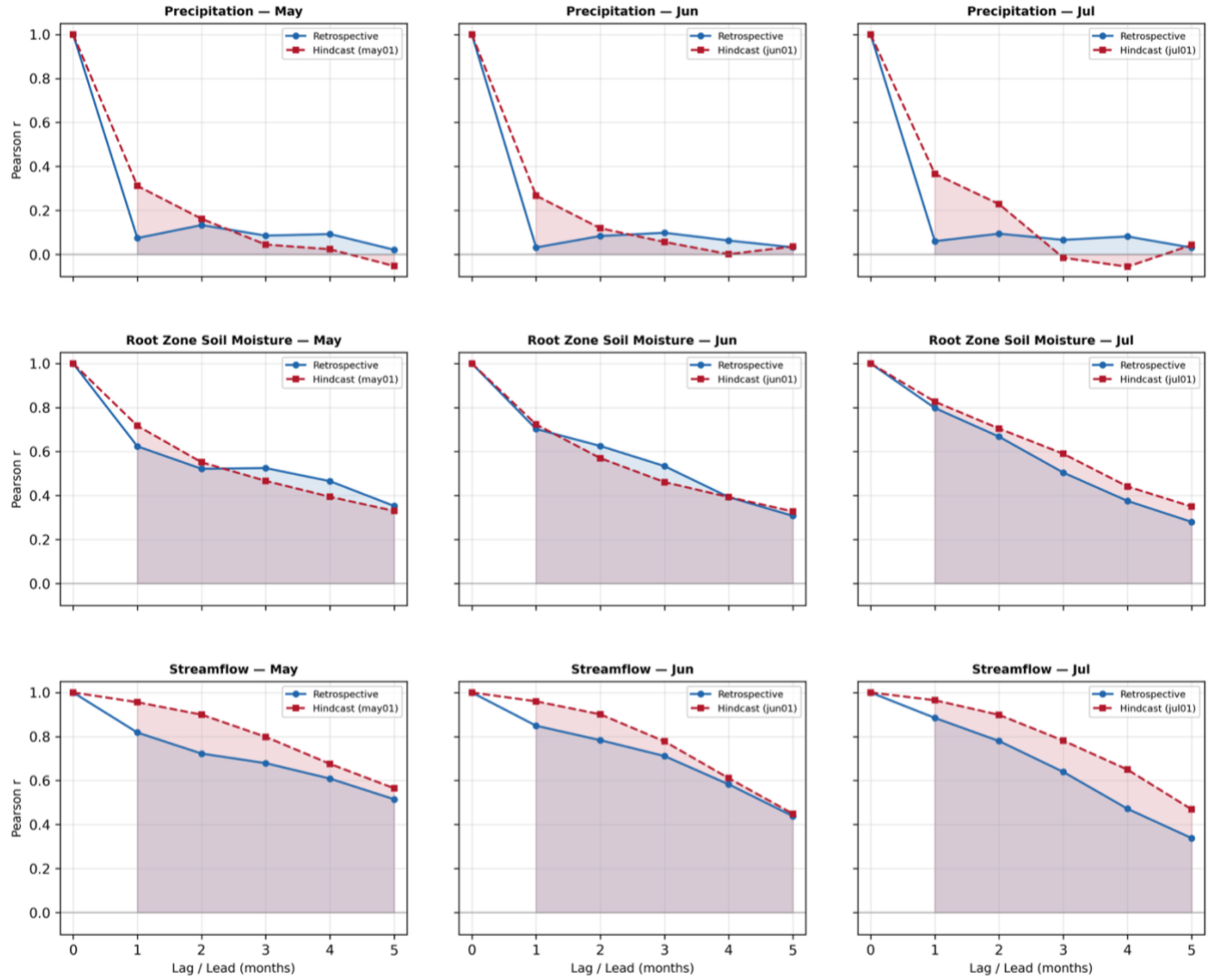


Figure S5: Domain-averaged autocorrelation decay curves for precipitation, root zone soil moisture, and streamflow across the May, June, and July initializations. The solid blue line represents the retrospective baseline, while the dashed red line represents the dynamic hindcast. Shaded areas represent the Integrated Autocorrelation (AUC) up to a 5-month lag. The horizontal dotted line denotes the $1/e$ (≈ 0.368) threshold used to calculate the -folding time scale.

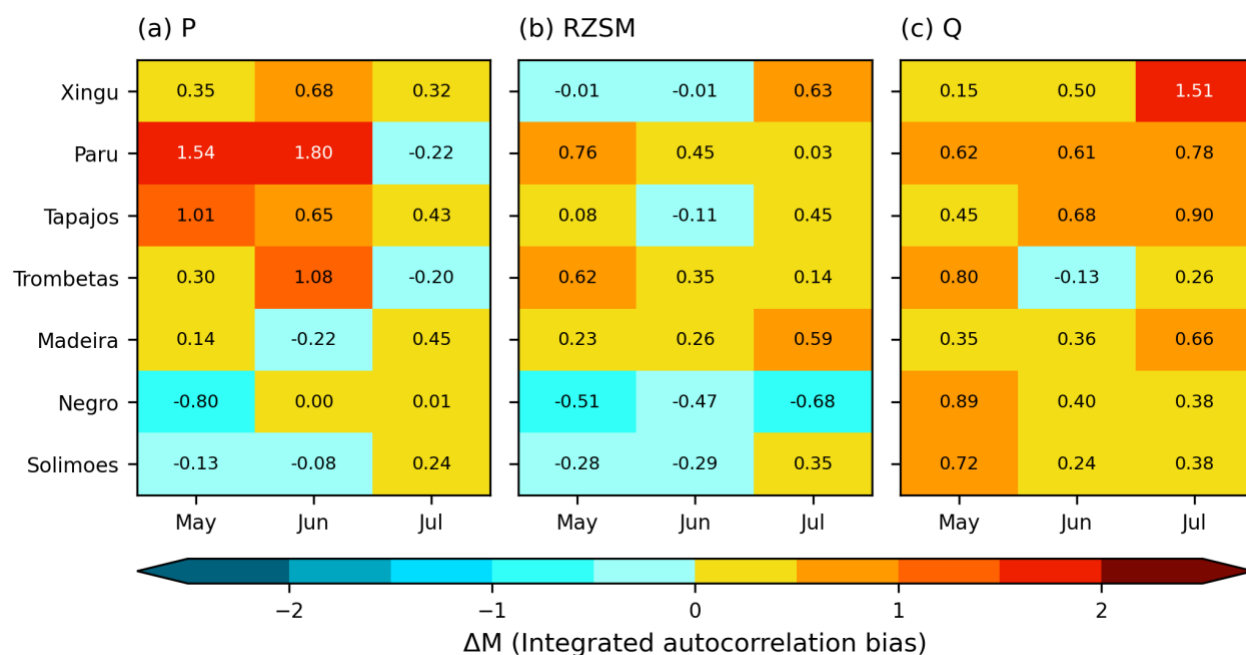


Figure S6: Hydrologic memory bias, quantified as the integrated autocorrelation bias, across seven Amazon subbasins for forecasts initialized in May, June, July. Panels display the bias for (a) precipitation (P), (b) root-zone soil moisture (RZSM), and (c) streamflow (Q).

Climatological Fire Prone Areas

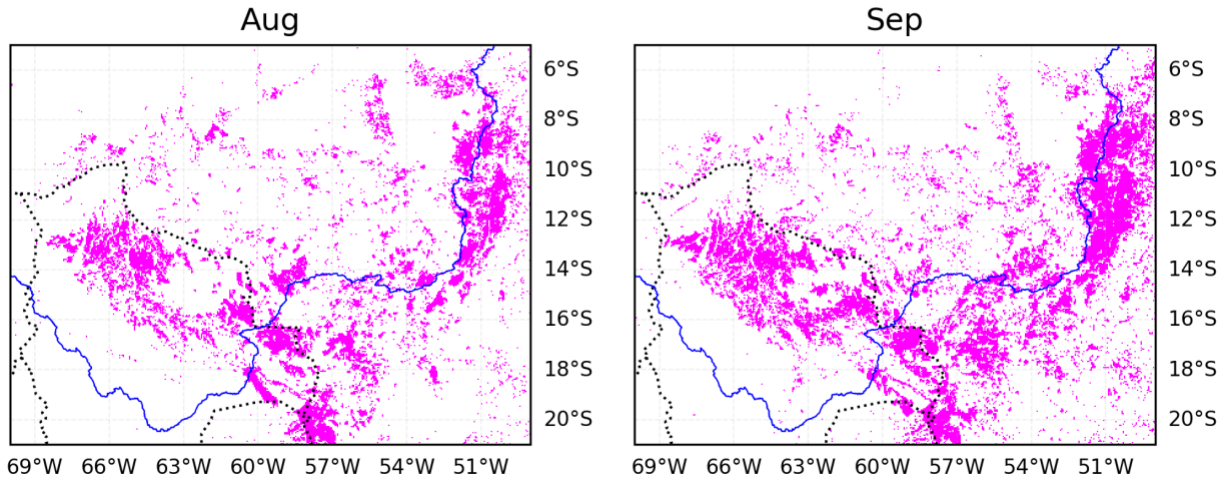


Figure S7: Climatological fire-prone mask within the Arc of Deforestation. Magenta pixels denote 5 km Amazon-LDAS grid cells where the underlying 500 m MODIS burned area product indicated $\geq 25\%$ burned area at least once during the 2001–2023 historical base period.

Table S1: List of outputs from Amazon-LDAS retrospective and forecast system.

	Short name	Long name	Unit
1	Swnet_tavg	Net downward shortwave radiation	W/m ²
2	Lwnet_tavg	Net downward longwave radiation	W/m ²
3	Qle_tavg	Latent heat flux	W/m ²
4	Qh_tavg	Sensible heat flux	W/m ²
5	Qg_tavg	Soil heat flux	W/m ²
6	Snowf_tavg	Snowfall rate	mm/day
7	Rainf_tavg	Precipitation rate	mm/day
8	Evap_tavg	Total evapotranspiration	mm/day
9	Qs_tavg	Surface runoff amount	mm/day
10	Qsb_tavg	Subsurface runoff amount	mm/day
11	Qsm_tavg	Snowmelt	mm/day
12	Albedo_inst	Surface Albedo	-
13	SWE_inst	Snow water equivalent	mm/day
14	SoilMoist_inst	Soil moisture content	m ³ /m ³
15	SoilTemp_inst	Soil temperature	°C
16	PotEvap_tavg	Potential evapotranspiration	mm/day
17	ECanop_tavg	Interception evaporation	mm/day
18	TVeg_tavg	Vegetation transpiration	mm/day
19	ESoil_tavg	Bare soil evaporation	mm/day
20	WaterTableDepth_inst	Water table depth	mm
21	TWS_inst	Terrestrial water storage	mm
22	GWS_inst	Ground water storage	mm
23	Wind_f_tavg	Wind speed	m/s
24	Tair_f_tavg	Air temperature	°C
25	Qair_f_tavg	Specific humidity	g/kg
26	Psurf_f_tavg	Surface air pressure	Pa
27	SWdown_f_tavg	Surface downward shortwave radiation	W/m ²
28	LWdown_f_tavg	Surface downward longwave radiation	W/m ²
29	LAI_inst	Leaf area index	-
30	Greenness_inst	Green vegetation fraction	-
31	Streamflow	Streamflow	m ³ /s
32	RiverDepth	River depth	m
33	FloodedArea	Flooded area	m ²
34	RiverVelocity	River flow velocity	m/s