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Supplement of

Introducing a new floodplain scheme in ORCHIDEE (version 7885): validation and evaluation over the Pantanal wetlands

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S1 Statistical Indexes

Statistical indexes are precious tools to quantify and discuss the performance of a model. For this reason, different statistical indexes are used in this article to evaluate the behaviour of the simulated discharge at the Porto Murtinho station compared to the observed values. The statistical indexes used in this article are described in the present section, the mathematical formulations of these indexes use the following nomenclature: N is the total number of time steps considered, M_t represents the model value at the timestep t and O_t the observation corresponding to this time step, $\bar{O}$ will represent the mean value of the observations over the interval of timesteps $[1,N]$.

The Nash-Sutcliffe model efficiency coefficient (NSE) allows us to compare the performance of the model to the mean value of the corresponding observed variable. It can be calculated by the equation (1). Its values are in the range $]-\infty,1]$ with 1 corresponding to a model perfectly representing the observed variable. For values of NSE lower than 0, the variable might be better estimated by the mean value of the observations.

$$NSE = 1 - \frac{\sum_{t=1}^{N}(M_t - O_t)^2}{\sum_{t=1}^{N}(M_t - \bar{O})^2} \tag{1}$$

The Percent Bias (PBIAS) is an indicator allowing to evaluate systematic bias in the model compared to the observations. Positive values mean that the model might be overestimating the variable while negative values mean the opposite. The equation of the PBIAS index is represented in the equation (2).

$$PBIAS = 100\% * \frac{\sum_{t=1}^{N}(M_t - O_t)}{\sum_{t=1}^{N} O_t} \tag{2}$$

The Root Mean Square Error (RMSE) is a classical index that is used to evaluate the performance of the model. The RMSE is a positive number representing the error in the same unit as the variable evaluated. It can be calculated by the equation (3).

$$RMSE = \sqrt{\frac{\sum_{t=1}^{N}(M_t - O_t)^2}{T}} \tag{3}$$

The correlation between the simulated and observed discharge is also presented along with the information of the significance of this correlation at a 95% level using a two-tails test.

S2 Complementary Figures

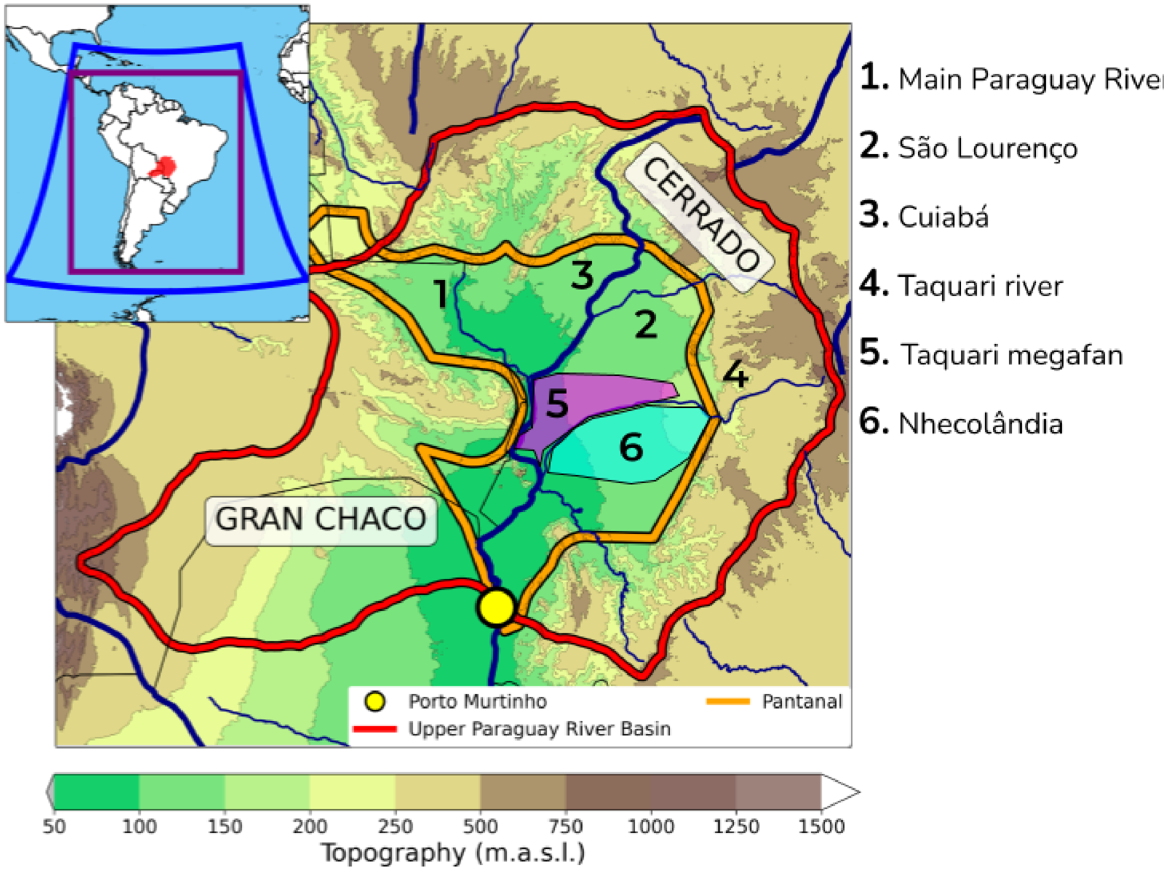

Figure S1. Description of the domain used for both simulations (AmSud$_{G}PCCandWFDEI_{G}PCC)aswellasthedescriptionoftheUpperParaguay$

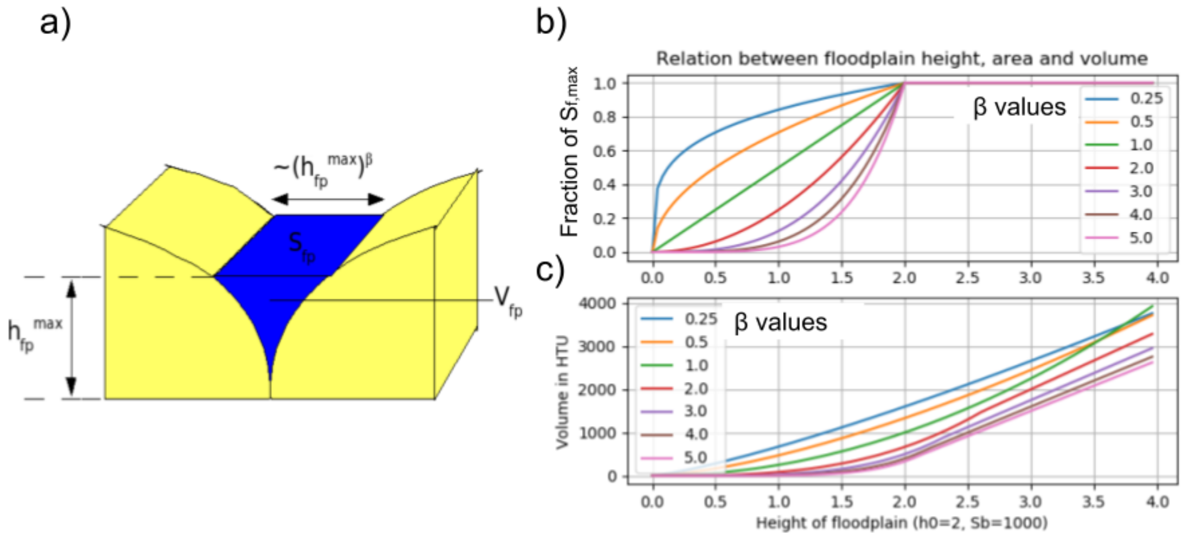

Figure S2. (a) Figure 4.9 from Tristan d'Orgeval's thesis (**?**) representing the parameterisation of the floodplains shape, (b) relationship between the floodplains area and floodplains height depending on β parameter with $h_0 = 2m$ and $f_{max} = 1$ and (c) relationship between the volume in the floodplains reservoir and the water surface elevation of the floodplains depending on the value of the β parameters for $h_0 = 2m$.

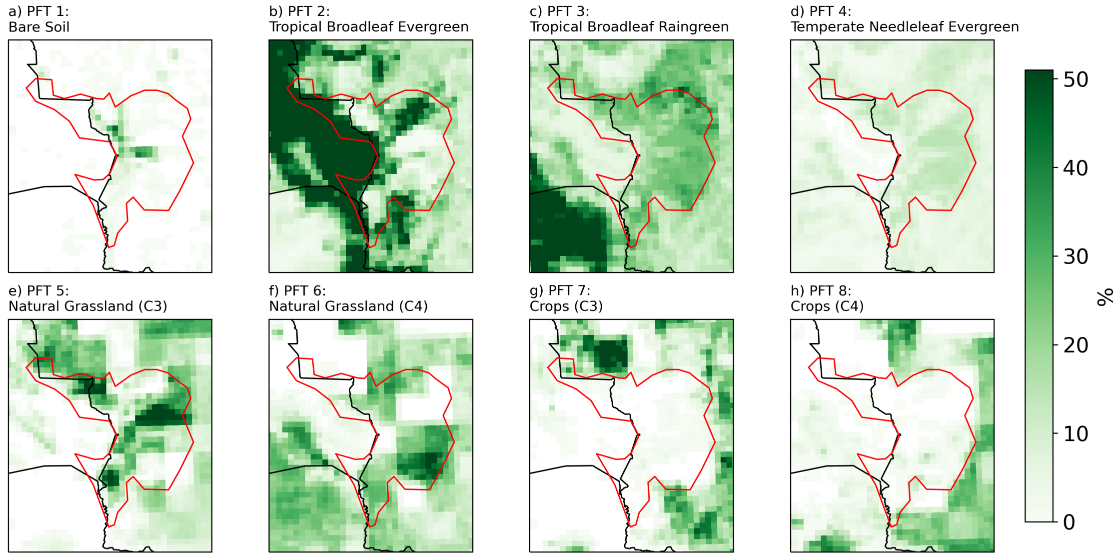

Figure S3. Description of the potential vegetation cover (maxvegetfrac) for all the vegetation types (PFT) existing over the Pantanal in the simulations. The PFT are constructed from the ESA-CCI database (European Space Agency-Climate Change Initiative; **?**).

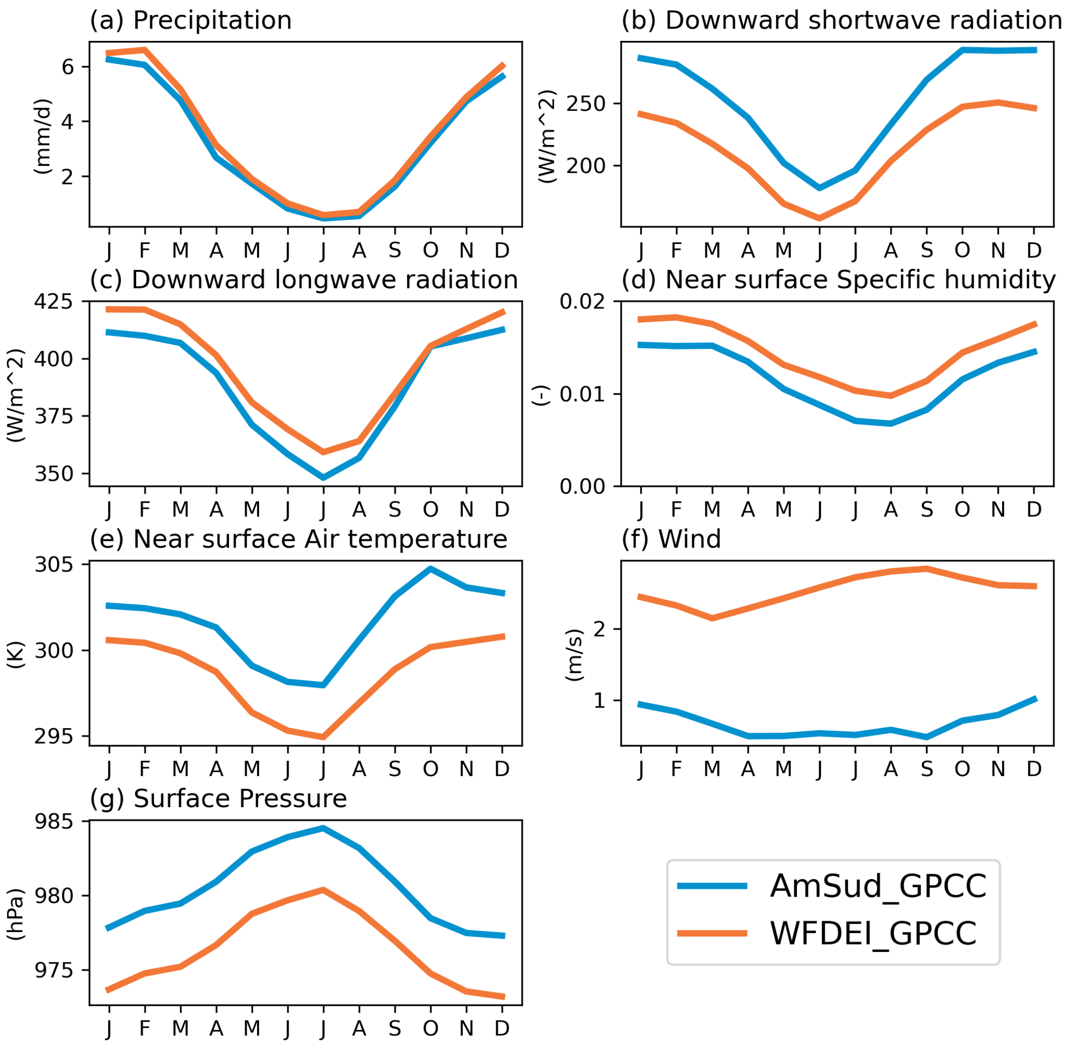

Figure S4. Annual cycle of the variables in the atmospheric forcings WFDEI_GPCC and AmSud_GPCC between 1990 and 2013 over the Upper Paraguay River Basin (UPRB).

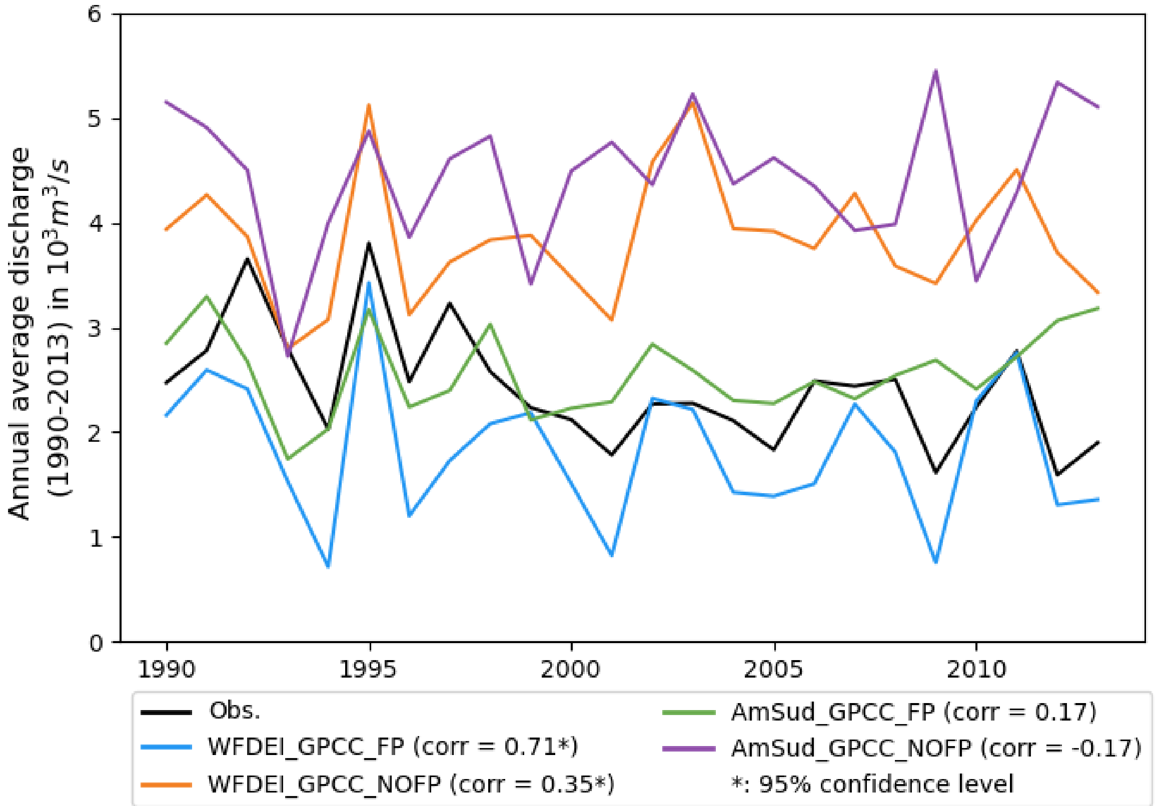

Figure S5. Time series of the annual average of the discharge at Porto Murtinho between 1990 and 2013.

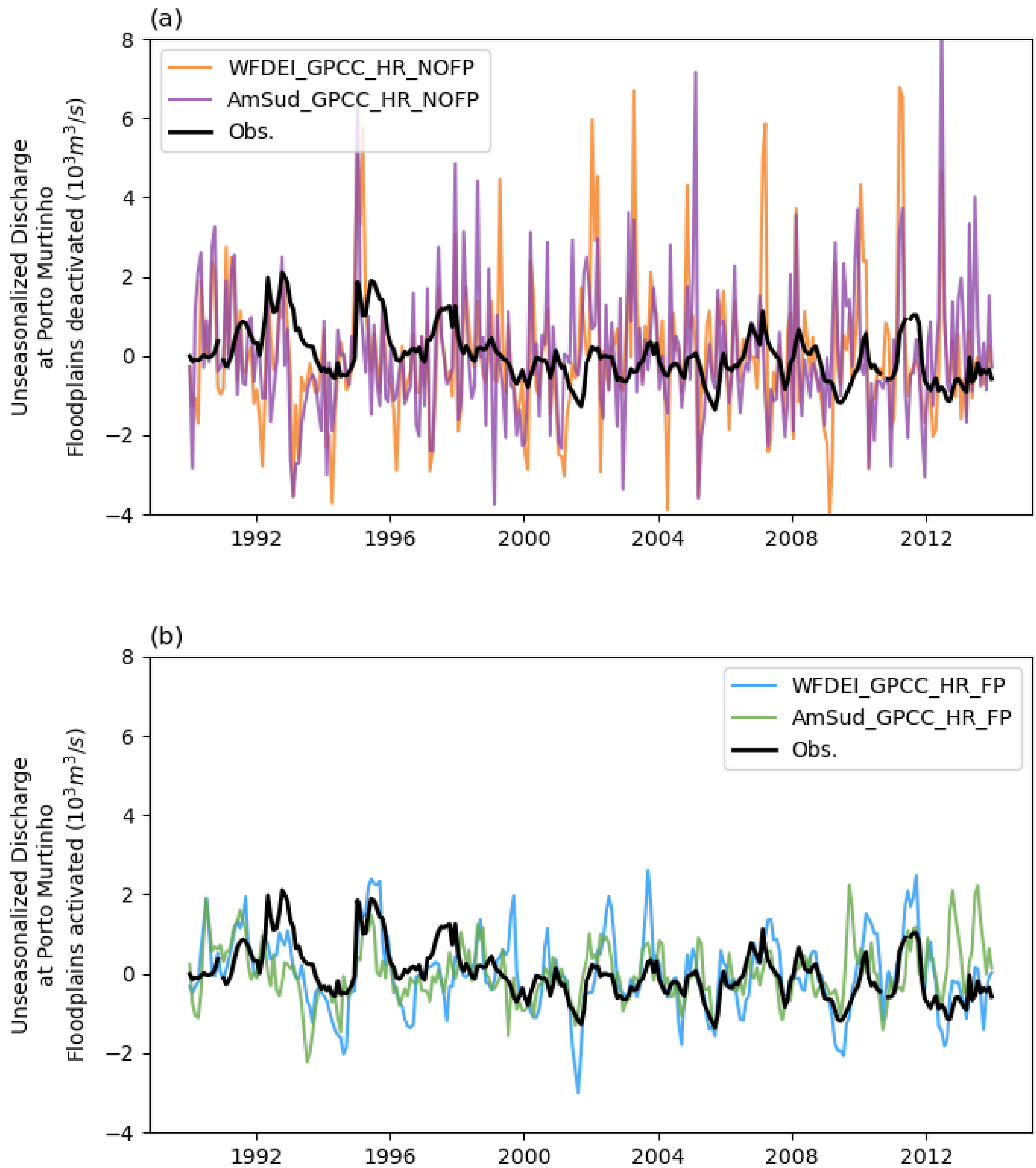

Figure S6. Time series of the monthly discharge at Porto Murtinho removing the annual cycle between 1990 and 2013 for (a) the simulations without floodplains and (b) with floodplains.

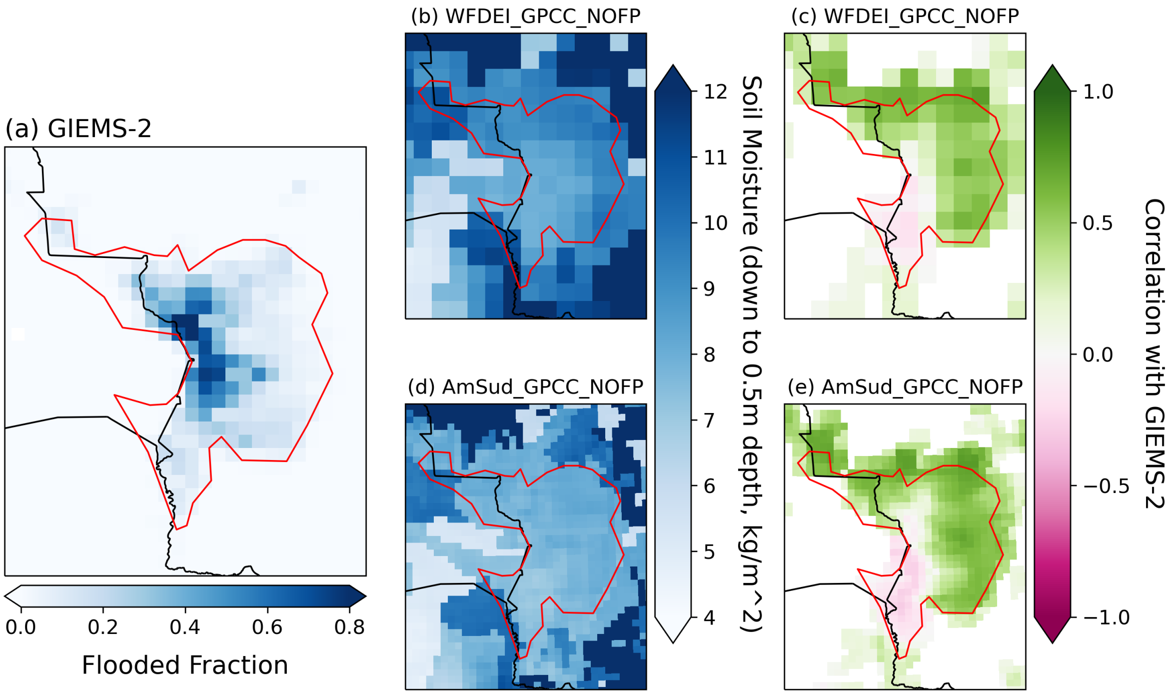

Figure S7. Considering the period 1992-2013, mean flooded fraction in GIEMS-2 (a), mean soil moisture down to 0.5m depth in WFDEI_GPCC_NOFP (b) and in AmSud_GPCC_NOFP (d), correlation between GIEMS-2 flooded fraction and the mean soil moisture down to 0.5m depth from the surface in WFDEI_GPCC_NOFP (c) and in AmSud_GPCC_NOFP (e).

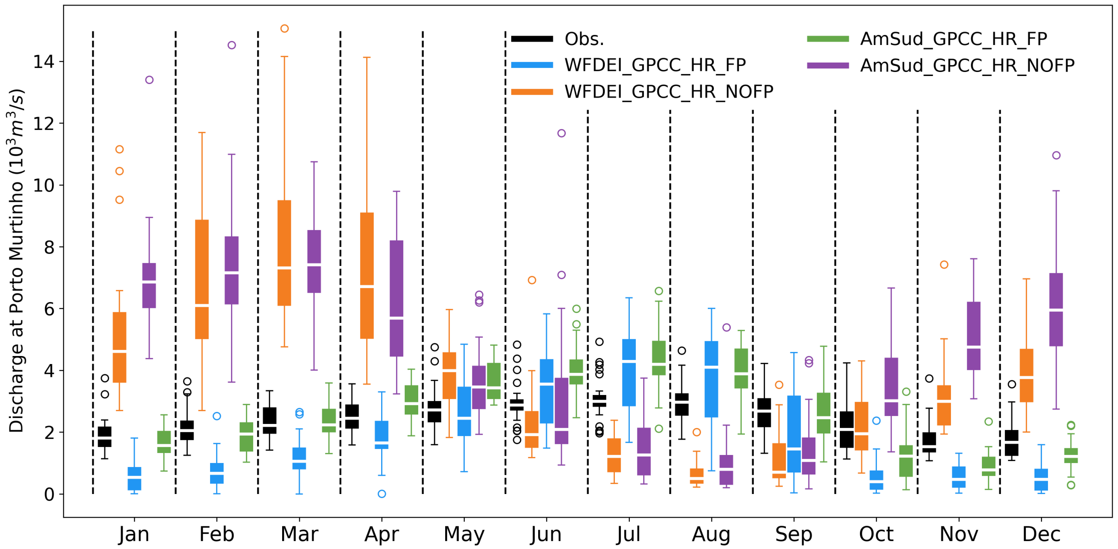

Figure S8. Observed and simulated boxplot representing the interannual variability of the average monthly discharge at Porto Murtinho between 1990 and 2013.

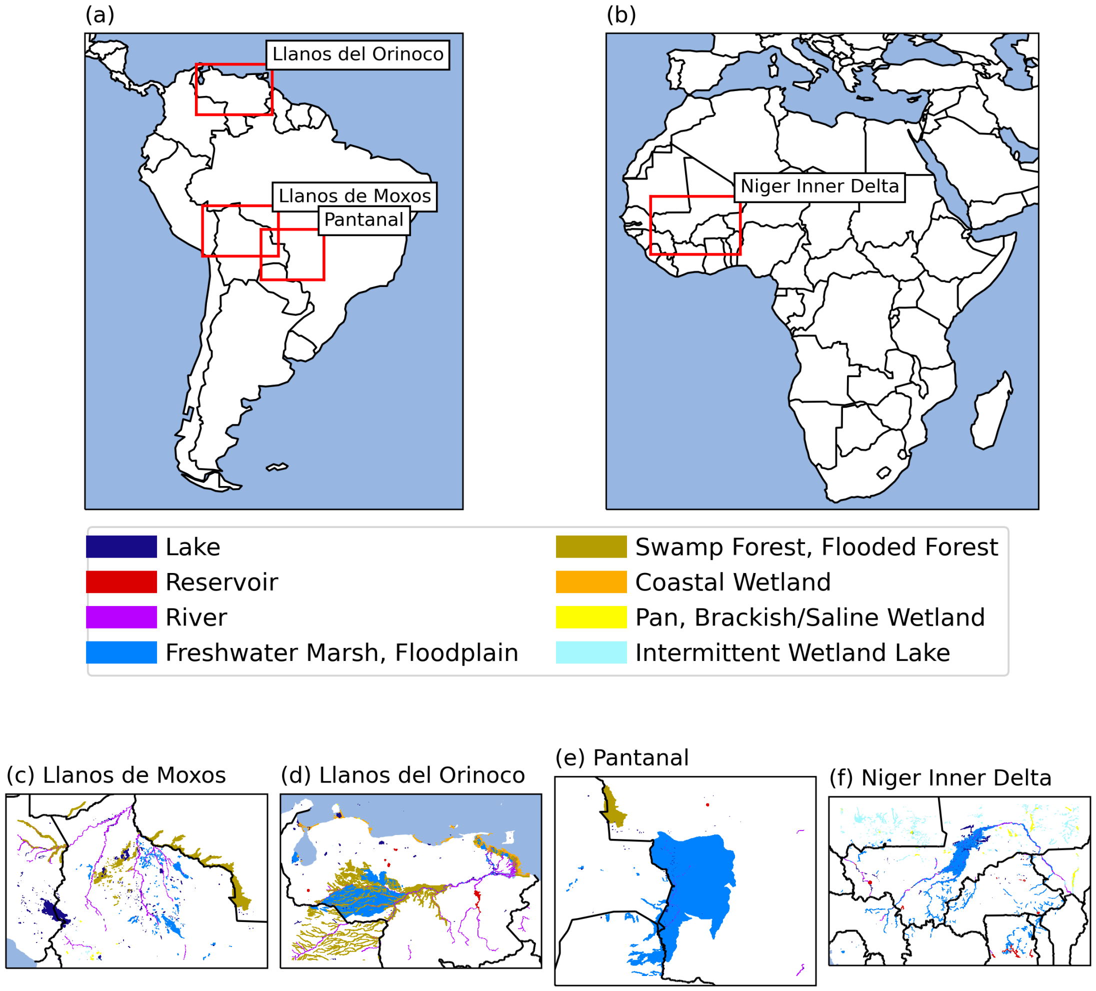

Figure S9. Description of the Lake and Wetlands over (c) the Llanos de Moxos, (d) the Llanos del Orinoco, (e) the Pantanal and (f) the Niger Inner Delta floodplains from the Global Lakes and Wetlands Database (GLWD, Lehner and Döll, 2004). The location c-f are shown in (a) for the South American regions and (b) for the African regions.

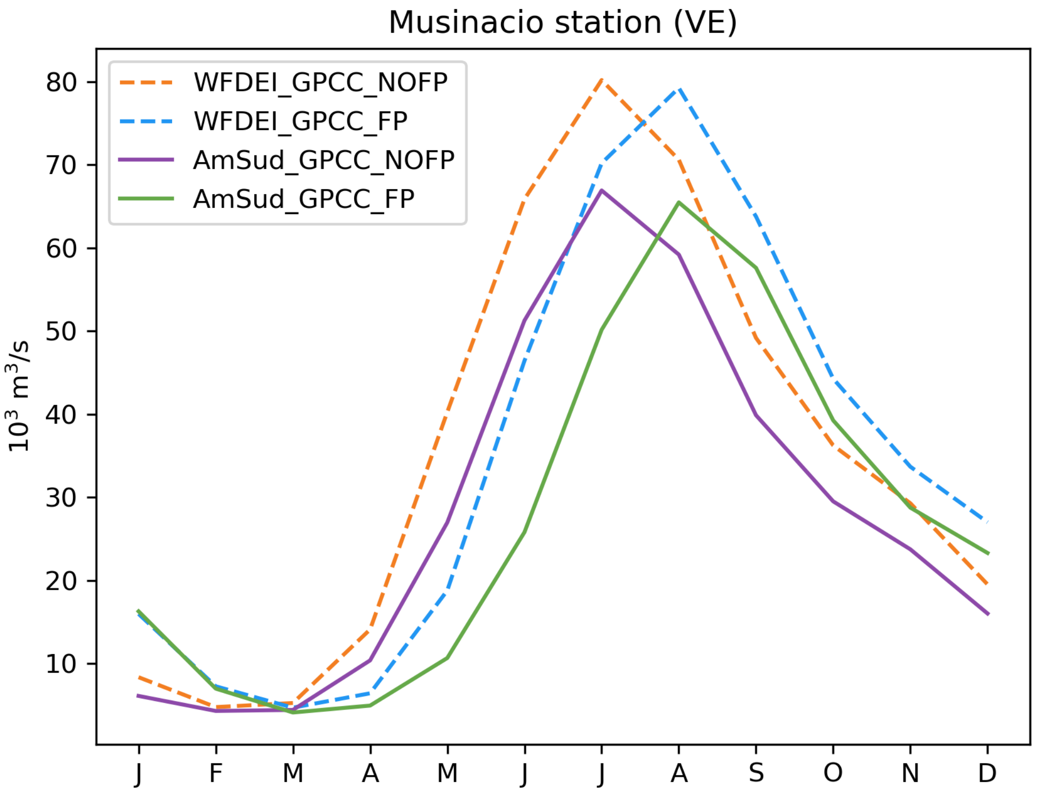

Figure S10. Annual cycle of the simulated discharge at the Llanos del Orinoco outflow river discharge station (Musinacio station in Venezuela) by the simulations FP and NOFP for WFDEI_GPCC and AmSud_GPCC between 1990 and 2013.

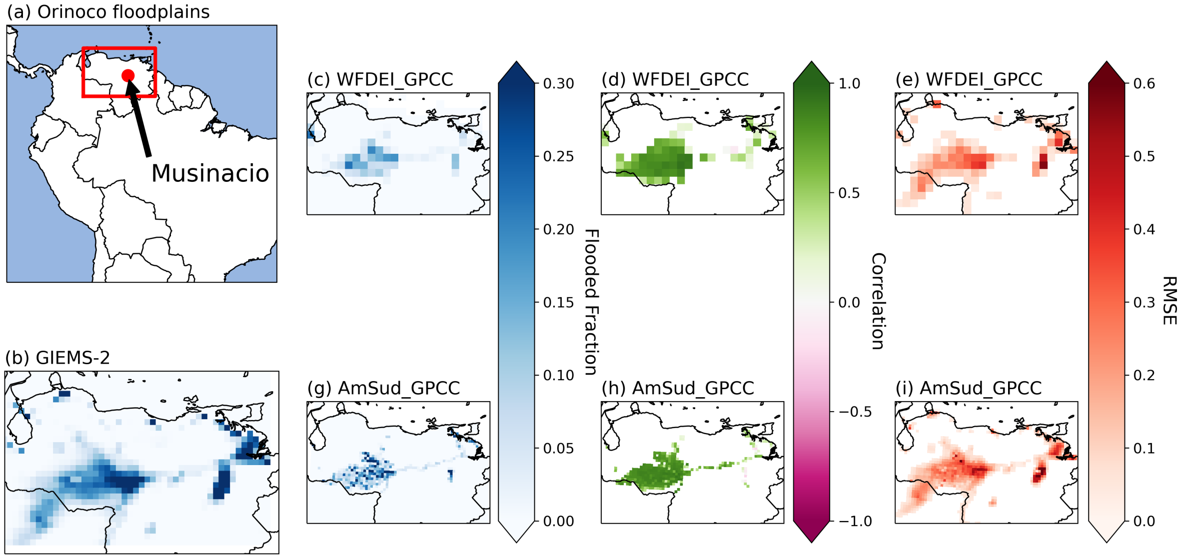

Figure S11. (a) Location of the Llanos del Orinoco region and mean flooded fraction in (b) GIEMS-2, (c) WFDEI_GPCC_FP and (g) AmSud_GPCC, as well as the (d) (respectively h) correlation between the flooded fraction in WFDEI_GPCC_FP (resp AmSud_GPCC_FP) and GIEMS-2 and also (e) (respectively i) the Root Mean Square Error of between the flooded fraction in WFDEI_GPCC_FP (resp AmSud_GPCC_FP) and GIEMS-2 for the period 1992-2013.

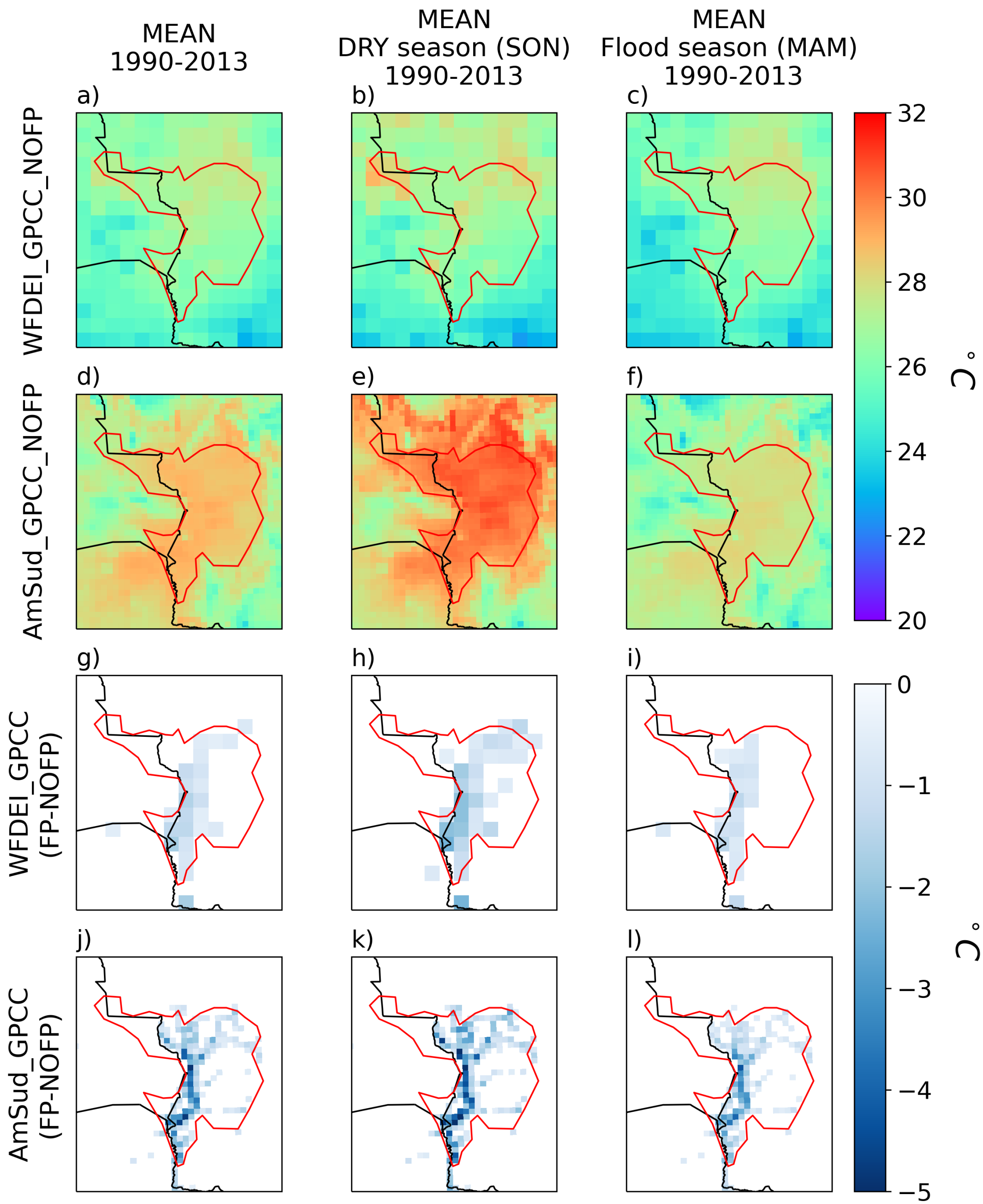

Figure S12. Average Surface Temperature in the NOFP simulation forced by WFDEI_GPCC (a,b,c) and AmSud_GPCC (d,e,f) and the difference between the FP and NOFP simulation for WFDEI_GPCC (g,h,i) and AmSud_GPCC (j,k,l) between 1990-2013 period considering the full period (a,d,g,j), the dry season (b,e,h,k) and the flood season (c,f,i,l).

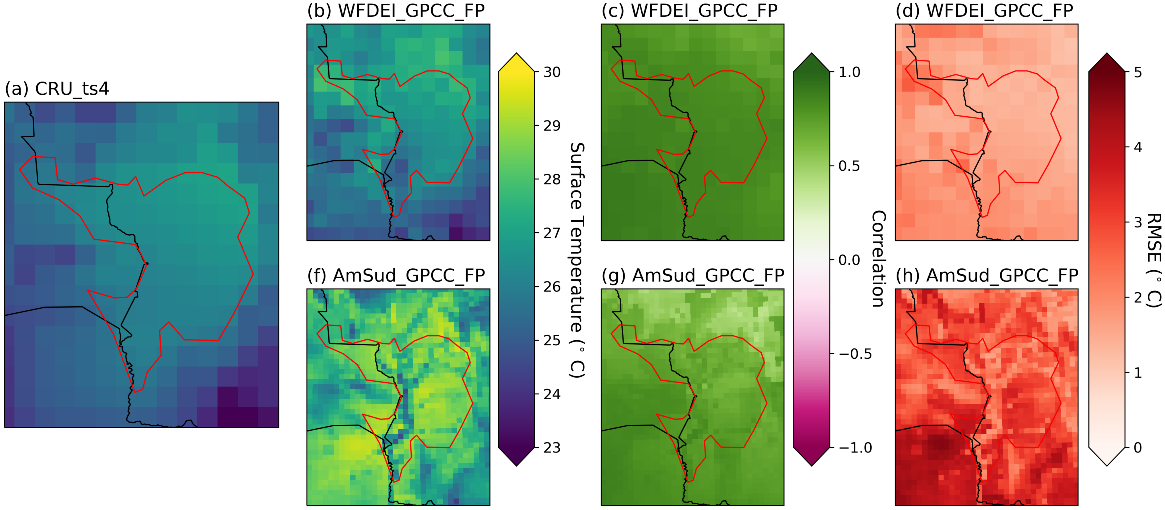

Figure S13. Mean surface temperature in CRU-TS4 (a), WFDEI_GPCC_FP (b) and AmSud_GPCC_FP (f) and comparison of the simulation with floodplains with CRU-TS4 using the correlation (c and g) and the Root Mean Square Error (d and h) for WFDEI_GPCC (c and d) and AmSud_GPCC (g and h).

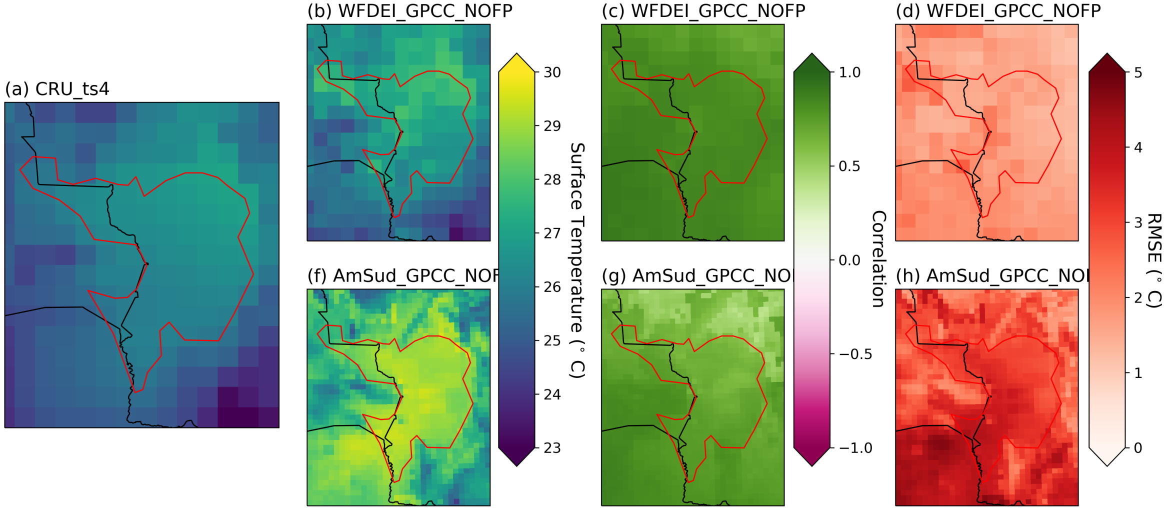

Figure S14. Mean surface temperature in CRU-TS4 (a), WFDEI_GPCC_NOFP (b) and AmSud_GPCC_NOFP (f) and comparison of the simulation without floodplains with CRU-TS4 using the correlation (c and g) and the Root Mean Square Error (d and h) for WFDEI_GPCC (c and d) and AmSud_GPCC (g and h).

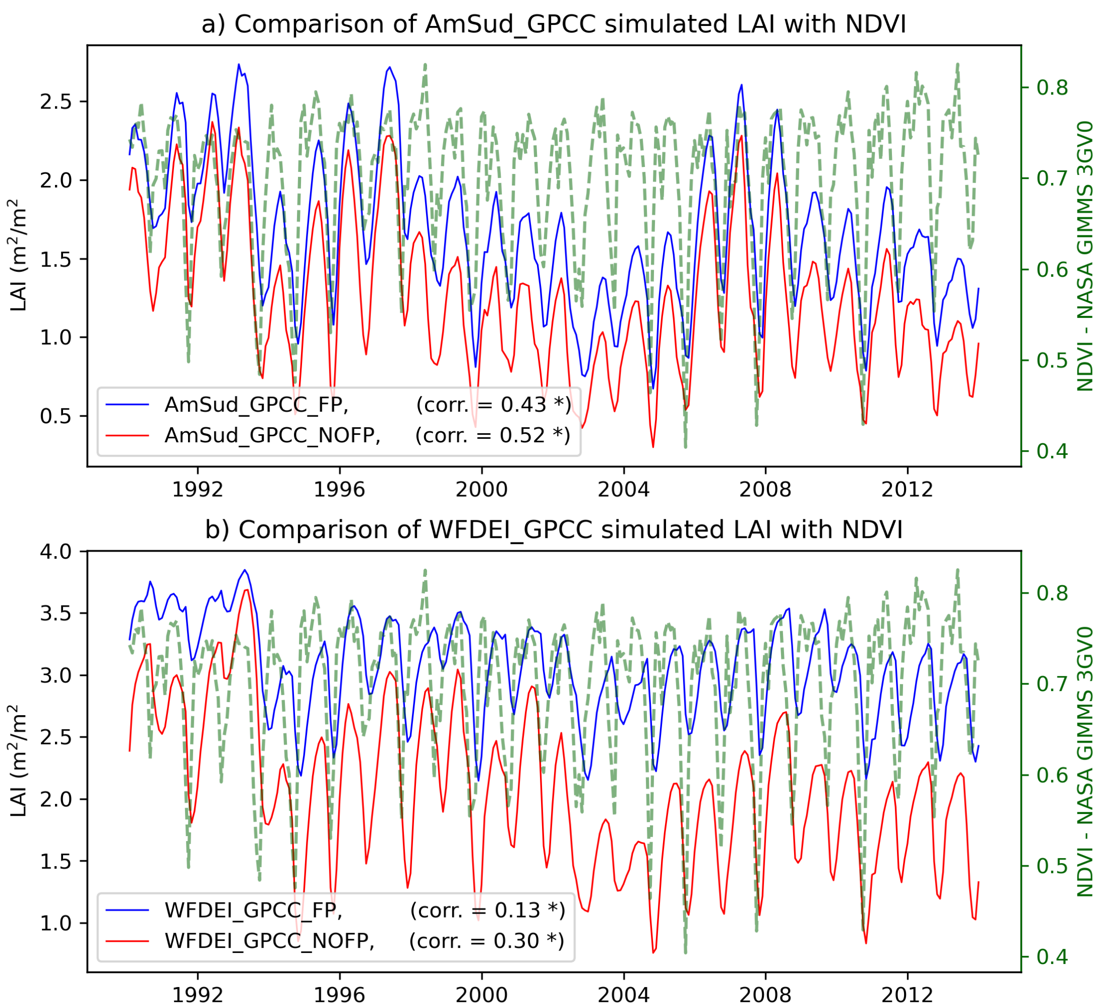

Figure S15. Comparison of the NDVI time serie from the GIMMS dataset and generated from NOAA's AVHRR with (a) AmSud_GPCC_FP and AmSud_GPCC_NOFP and also with (b) WFDEI_GPCC_FP and WFDEI_GPCC_NOFP over the Pantanal region. Correlations between