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Integrating SPOT-VEGETATION 13-yr time series and land-surface modelling to forecast the terrestrial carbon dynamics in a changing climate – The VEGECLIM project: achievements and lessons learned

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Vegetation is a major carbon sink and is as such a key component of the international response to climate change caused by the build-up of greenhouse gases in the atmosphere. However, anthropogenic disturbances like deforestation are the primary mechanism that changes ecosystems from carbon sinks to sources, and are hardly included in the current carbon modelling approaches. Moreover, in tropical regions, the seasonal/interannual variability of carbon fluxes is still uncertain and a weak or even no seasonality is taken into account in global vegetation models. In the context of climate change and mitigation policies like "Reducing Emissions from Deforestation and Forest Degradation in Developing Countries" (REDD), it is particularly important to be able to quantify and forecast the vegetation dynamics and carbon fluxes in these regions. The overall objective of the VEGECLIM project is to increase our knowledge on the terrestrial carbon cycle in tropical regions and to improve the forecast of the vegetation dynamics and carbon stocks and fluxes under different climate-change and deforestation scenarios. Such an approach aims to determine whether the African terrestrial carbon balance will remain a net sink or could become a carbon source by the end of the century, according to different climate-change and deforestation scenarios. The research strategy is to integrate the information of the land surface characterizations obtained from 13 years of consistent SPOT-VEGETATION time series (land cover, vegetation phenology through vegetation indices such as the Enhanced Vegetation Index (EVI)) as well as in-situ carbon flux data into the process based ORCHIDEE global vegetation model, capable of simulating vegetation dynamics and carbon balance. Key challenge of this project was to bridge the gap between the land cover and the land surface model teams. Several improvements of the ORCHIDEE model have been realized such as a new seasonal leaf dynamics for tropical evergreen forests, the introduction of spatial soil phosphorus to improve the spatial distribution of simulated woody biomass and an assimilation of smoothed seasonal pattern of satellite-based EVI used as a proxy to vegetation productivity. The outputs of the ORCHIDEE simulations over both Amazon and Congo Basins are discussed with regards to the observed phenology by remote sensing.