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A phenology-based approach to identify climatic limiting factors for vegetation growth

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Given the current effort made by the scientific community to identify and quantify climate change impacts on the environment, understanding better the interaction mechanisms between climate and vegetation is definitely a key issue in this effort. The objective of our research is to analyze the interactions between climate variability and vegetation growth and more specifically to identify the meteorological factors which limit the development of croplands and grasslands in relation with their geographical localization.

For that purpose, we analyzed twenty-five regions located in a window covering Europe and Africa and characterized by dominant and stable cropland or grassland covers. Time series of SPOT-VEGETATION NDVI and ECMWF meteorological data were used to investigate how best the signature of climate control on vegetation growth can be individualized at regional scale using. Our results show that the relation between NDVI and a meteorological limiting factor such as temperature, rainfall, evapotranspiration or radiation cannot be considered as linear during the whole crop cycle and can vary highly through the seasons, from the green-up to the end of the growing season. Interactions must be studied at a smaller time scale in order to identify properly the limiting factors to vegetation growth. Moreover the main limiting factors are variable from a region to another. Cross-correlation analysis revealed that, in most of the cases, the best scores of Pearson's R are obtained when considering separately the vegetative phase (from green-up to maximum of NDVI) and the reproductive phase (from maximum of NDVI to maturity).

Beside this study also shows that limiting factors identified using a classical approach and not a phenology-based approach are not depicting correctly or completely the climate control on vegetation development. In that sense the complexity of the climate-vegetation relation, which is spatially and temporally variable, is underlined by this study.