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Global impacts of hydrological and climatic extremes on vegetation (SAT-EX)

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Global warming is expected to increase the frequency and severity of droughts, extreme precipitation events and heatwaves. Recent studies have underlined the critical impacts of these extremes on the terrestrial carbon cycle, particularly on the dynamics of vegetation. Yet, the latest IPCC report reveals large uncertainties in extremes trends and biomass impacts. Conversely, new advances in satellite Earth observation have led to the recent development of consistent global historical records of crucial environmental and climatic variables – like surface soil moisture, soil water storage, terrestrial evaporation or vegetation water content. These datasets provide alternative means to unravel the processes driving past climate extremes, uncover the spatiotemporal scales at which these extremes operate and understand their impact on terrestrial biomass.

The SAT-EX project (funded by BELSPO) recently raised with the purpose of exploring the potential of the state-of-art remote sensing datasets to study the causes and consequences of the spatiotemporal changes in wet, dry and warm spells over the past three decades. Core methodologies involve the analysis of satellite-based climate extreme indices and vegetation characteristics through a novel combination of machine learning methods, fingerprint identification approaches, and spatio-temporal clustering. First results will show how droughts, heatwaves and extreme rain events have changed in frequency and intensity since the ’80s, and attribute these changes to on-going processes like the widening of the tropical belt, ocean-atmospheric teleconnections, the intensification of land-atmospheric feedbacks or the overall rise in greenhouse gasses (and expected acceleration of the hydrological cycle). A specific focus will be given on large-scale vegetation response to climate extremes throughout our analyses.

Further phases in the project will involve the evaluation of IPCC Earth System Models on the basis of their skill to reproduce the effects of climate extremes on vegetation. In the long run, SAT-EX findings will advance towards the timely forecasting of climate extremes, provide valuable insights about the management of water resources during these events and reduce the uncertainty in long-term IPCC predictions of climate extremes and global vegetation variability.