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## Rise and fall of projected vegetation primary production resilience to climate variability

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The SDGs recognize the importance of ensuring conservation, restoration and sustainable use of terrestrial ecosystems and their services and strengthening the resilience and adaptive capacity to climate-related hazards. Vegetation primary production is the main function of terrestrial ecosystems providing food and other services to society. Agricultural production is a main source of employment, livelihood and income for a large portion of population, especially in developing countries.

Anticipating the changes in vegetation primary production resilience – the plant capacity to cope with disturbances and shocks including such as those related to climate variability and extremes – is therefore critical to understand and project ecosystems' responses to global change and the impacts on the related ecosystem services, to support mitigation actions, and to define proper adaptation plans. However, the estimation of resilience is not straightforward.

Here, we applied a recently proposed resilience metrics – the annual production resilience indicator (Zampieri et al. 2019, 2020) – to quantify the changes in vegetation gross primary production (GPP) resilience computed from a large ensemble of state-of-the-art CMIP6 Earth System Model (ESM) simulations.

Our results indicate that climate change mitigation is necessary to significantly reduce the risk of losing terrestrial ecosystems production resilience. In the 'Sustainability (Taking the Green Road)' and 'Middle of the Road' scenarios considered here (ssp126 and ssp245), the areas where vegetation shows increasing GPP resilience (mainly boreal, African and Indian monsoon regions) are wider than the areas with decreasing resilience. The situation drastically reverses in the 'Fossil-fuel Development (Taking the Highway)' scenario (ssp585), mostly because the increase of GPP interannual variability outbalances the mean GPP increase due to the CO<sub>2</sub> fertilization effect in this high greenhouse gases' emission scenario.

To raise social awareness, identify adaptation plans, but especially to stimulate mitigation efforts, we analyse and discuss the gains and losses of vegetation GPP resilience for each World country. Among the larger countries, Brazil is exposed to the highest risk of losing vegetation GPP resilience, especially in the higher emission scenario.

This study explores the linkages between future climate, associated changes in resilience of global

vegetation gross primary production, and the mitigation pathways that society can undertake to conserve and restore ecosystems and their services, on which human well-being depends.