Geophysical Research Abstracts
Vol. 19, EGU2017-14124, 2017
EGU General Assembly 2017

Impacts on regional climate of an afforestation scenario under a $+2°C$ global warming climate

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Through surface-atmosphere interactions (SAI), land-use and land-cover changes (LULCCs) alter atmospheric conditions with effects on climate at different scales, from local/regional (a few ten kilometres) (Pielke et al., 2011) to global scales (a few hundred kilometres) (Mahmood et al., 2014). Focusing on the regional scale, in the context of climate change, LULCCs may either enhance or dampen climate impacts via changes in SAI they may initiate. Those LULCC-driven atmospheric impacts could in turn influence e.g. the functioning of terrestrial ecosystems, with consequences on mitigation and adaptation strategies. Despite LULCC impacts on regional climate are largely discussed in the literature, in Europe information is missing on LULCC impacts under future climate conditions on a country scale (Galos et al., 2015).

The latest COPs have urged the scientific community to explore the impacts of reduced global warming ($1.5°C$ to a $+2°C$) on the Earth system. LULCCs will be one major tool to achieve such targets. In this framework, we investigate impacts on regional climate of a modified landscape under a $+2°C$ climatic scenario. To this purpose, we performed sensitivity studies over western Europe with a fully coupled land-atmosphere regional climate model, WRF-ORCHIDEE (Drobinski et al., 2012, Stefanon et al., 2014). A $+2°C$ scenario was selected among those proposed by the "Impact2C" project (Vautard et al., 2014), and the afforested land-cover scenario proposed in the RCP4.5 is prescribed. We have chosen the maximum extent of forest RCP4.5 simulates for Europe at the end of the 21^{st} century. WRF-ORCHIDEE is fed with boundary atmospheric conditions from the global climate model LMDZ for PD (1971–2000) and the $+2°C$ warming period for the LMDZ model (2028–2057).

Preliminary results over the target domain show that, under a $+2°C$ global warming scenario, afforestation contributes by 2% to the total warming due to both climate change and LULCCs. During summer, the afforestation of 1000 km^2 increases the mean surface atmospheric temperature by $+0.18°C$. However, during the same season, afforestation reduces the occurrence of extreme temperatures ($> 30°C$).

By analysing LULCC impacts on both mean climate and extremes, this study aims to possibly raise awareness among decision-makers and land planners on the role LULCCs may play in the context of climate change.

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