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Do we need to account for scenarios of land use/land cover changes in regional climate modeling and impact studies?

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By modifying the Earth's natural landscapes, humans have introduced an imbalance in the Earth System's energy, water and emission fluxes via land-use and land-cover changes (LULCCs). Through land-atmosphere interactions, LULCCs influence weather, air quality and climate at different scales, from regional/local (a few ten kilometres) (Pielke et al., 2011) to global (a few hundred kilometres) (Mahmood et al., 2014). Therefore, in the context of climate change, LULCCs will play a role locally/regionally in altering weather/atmospheric conditions. In addition to the global climate change impacts, LULCCs will possibly induce further changes in the functioning of terrestrial ecosystems and thereby affect adaptation strategies. If LULCCs influence weather/atmospheric conditions, could land use planning alter climate conditions and ease the impact of climate change by wisely shaping urban and rural landscapes?

Nowadays, numerical land-atmosphere modelling allows to assess LULCC impacts at different scales (e.g., Marshall et al., 2003; de Noblet-Ducoudré et al., 2011). However, most scenarios of climate changes used to force impact models result from downscaling procedures that do not account for LULCCs (e.g., Jacob et al., 2014). Therefore, if numerical modelling may help in tackling the discussion about LULCCs, do existing LULCC scenarios encompass realistic changes in terms of land use planning?

In the present study, we apply a surface model to compare projected LULCC scenarios over France and to assess their impacts on surface fluxes (i.e. water, heat and carbon dioxide fluxes) and on water and carbon storage in soils. To depict future LULCCs in France, we use RCP scenarios from the IPCC AR5 report (Moss et al., 2011). LULCCs encompassed in RCPs are discussed in terms of: (a) their impacts on water and energy balance over France, and (b) their feasibility in the framework of land use planning in France. This study is the first step to quantify the sensitivity of land-atmosphere models to LULCCs. RCP scenarios showing the largest impact on surface fluxes and carbon-water soil storage will be selected to force a coupled land-atmosphere model. Coupled land-atmosphere simulations will allow to account for atmospheric feedbacks in the assessment of the sensitivity of land-atmosphere models to LULCCs. In addition, this study aims to push further scenario development to build compelling LULCC scenarios. If the assessment of LULCC scenarios through numerical modelling may provide land planners with an established scientific basis to draw future land use policy, LULCC scenarios should depict realistic as well as extreme modifications at scales at which changes in landscapes are actually shaped.

References

de Noblet-Ducoudré, N., Boisier, J.-P., Pitman, A., Bonan, G. B., Brovkin, V., Cruz, F., Delire, C., Gayler, V., Van den Hurk, B. J. J. M., Lawrence, P. J., Van Der Molen, M. K., Müller, C., Reick, C. H. , Strengers, B. J., and Voldoire, A.: Determining robust impacts of land-use-induced land cover changes on surface climate over North America and Eurasia: results from the first set of LUCID experiments, J. Clim., 25, 3261–3281, 2012.

Jacob, D.,Petersen, J., Eggert, B., Alias, A., Christensen, O. B., Bouwer, L., Braun, A., Colette, A., Déqué, M., Georgievski, G., Georgopoulou, E., Gobiet, A., Menut, L., Nikulin, G., Haensler, A., Hempelmann, N., Jones, C., Keuler, K., Kovats, S., Kröner, N., Kotlarski, S., Kriegsmann, A., Martin, E., Meijgaard, E., Moseley, C., Pfeifer, S., Preuschmann, S., Radermacher, C., Radtke, K., Rechid, D., Rounsevell, M.; Samuelsson, P., Somot, S., Soussana, J.-F., Teichmann, C., Valentini, R., Vautard, R., Weber, B. and Yiou, P.: EURO-CORDEX: new high-resolution climate change projections for European impact research, Reg. Environ. Change, Springer Berlin Heidelberg, 2013, 1-16.

Mahmood, R., Pielke, R. A., Hubbard, K. G., Niyogi, D., Dirmeyer, P. A., McAlpine, C., Carleton, A. M., Hale, R., Gameda, S., Beltrán-Przekurat, A., Baker, B., McNider, R., Legates, D. R., Shepherd, M., Du, J., Blanken, P. D., Frauenfeld, O., W., Nair, U.S., and Fall, S.: Land cover changes and their biogeophysical effects on climate, Int. J. Climatol., 34, 929–953, 2014.

Marshall, C. H., Pielke, R. A., Steyaert, L. T.: Crop freezes and land-use change in Florida, Nature, vol. 426, p. 29, 2003.

Moss, R. H., Edmonds, J. A., Hibbard, K. A., Manning, M. R., Rose, S. K., van Vuuren, D. P., Carter, T. R., Emori, S., Kainuma, M., Kram, T., Meehl, G. A., Mitchell, J. F. B., Nakicenovic, N., Riahi, K., Smith, S. J., Stouffer, R. J., Thomson, A. M., Weyant, J. P., and Wilbanks, T. J.: The next generation of scenarios for climate change and assessment, Nature, 463, 747–756, 2011.

Pielke, R. A., Pitman, A., Niyogi, D., Mahmood, R., McAlpine, C., Hossain, F., Goldewijk, K. K., Nair, U., Betts, R., Fall, S., Reichstein, M., Kabat, P. , and de Noblet, N.: Land use/land cover changes and climate: modeling analysis and observational evidence, WIREs Clim Change, 2(6), 828-850, 2011.