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Effect of climate change in herbivorous livestock systems, including arable crops, in the French area.

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The effects of atmospheric changes on climate are assessed through GCM (General circulation model). We have used the results of one of these models, the ARPEGE model, developed by the CNRM (Météo-France) concerning two scenarios of economic, technical and socio-economic development. There are the A2 scenario, with little attention to GHG emissions leading to a high CO2 concentration in the atmosphere at the end of the century (800 ppm) and the B1 scenario, a moderate scenario where the CO2 concentration would be better controlled, allowing to reach only 550 ppm at the end of the century.
Our study contains studies at 2 periods in the future, the near (2020-2049) and the distant (2070-2099) future, using a mean effect for each period, without any representation of the evolution inside each period.

We have done three types of analyses using the present and future climate data :
first, we analyzed the climatic data, with means, maps and multiple factor analysis
second, we used a crop model for grass, alfalfa and arable crops
third, we analyze the evolution of some agrometeorological criteria

In the climate analysis, out of the known effects (higher temperature, lower precipitation),
the most interesting part for the agriculture is the spatial distribution of the changes. We showed the spatial evolution of the 10 main climates defined using the MFA of spatial data : climates of the low mountains will go up and the part of the high mountain climate will be reduced, the area of the Mediterranean climate will be larger, and the Atlantic front will be dryer.

Main crop model results concern phenology and yield of crops. As phenological results, all the harvests are put forward, as well for cut crops (grass and alfalfa) as for arable crops. As adaptation, the sowing dates of the spring crops (maize) can be put forward too. The direction of the variation of yields depends on the period of the future, on the scenario and mainly on the effect of CO2 concentration. Because of its big and uncertain effect, this last influence is analyzed specifically in order to put it into perspective of the uncertainties in the knowledge on primary production and transpiration.

Agrometeorological indices are specifically drawn up to assess the effects of climate change on phenology of crops and above all on available periods for some agricultural works (sowing, drying, harvest,...) taking into account simply soil portability or length of drying periods for forage harvest.