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**Vulnerability assesment of livestock and grasslands to climate change and extreme events
(VALIDATE project)**

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The main objective of the VALIDATE project is to integrate extreme events into the assessment of impacts, adaptation and vulnerability to climate change in the grasslands and livestock sector. The project is centred on France. Then the simulations of impacts on grassland productivity and of feedbacks on climate through changes in carbon sequestration and in N₂O and CH₄ emissions will be extended to Europe. Our primary hypothesis is that the negative effects of a few extreme events may surpass the positive effects of a rise in atmospheric CO₂ and of a moderate average 2-3°C warming (Porter and Semenov, 2005, Tubiello *et al.*, 2007) on pasture productivity. A key objective of the project is to test this hypothesis using a combination of experimental and modelling approaches.

VALIDATE will evaluate for France the vulnerability of grasslands and livestock to climate change and extreme events, combining ecosystem manipulation experiments and modelling at three different scales such as from the plot, to the farm and to the region. High resolution climate scenarios based on a statistical disaggregation of precipitations will be used both for experiments and simulations. Three complementary experiments, using major scientific infrastructures (ORE, long-term ecological research and French ECOTRON) are invested. At four contrasted sites (Alps to Mediterranee), the experiments will test the effects of heat and drought extremes on grasslands acclimated, or not, to the mean climate conditions (temperature and precipitations) and to the CO₂ concentration projected for 2050 by scenarios (Fig. 1).

Two key mechanistic pasture models (PASIM and STICS) will be further developed by introducing heat and drought response functions (plant mortality, plant and animal physiology, soil functioning). The models will be parameterised and evaluated with the three complementary experiments and then used for simulating for France and Europe impacts (frequency and thresholds, Fig. 2) of downscaled climate scenarios on grasslands, in terms of potential production (forage, meat and milk) and of climate feedbacks (net fluxes of CO₂, N₂O and CH₄) (Vuichard *et al.*, 2007) (Fig. 3). Farm models forced by the scenarios will simulate in two contrasted regions (Bretagne, Massif-Central) the adaptations of livestock breeding practices and the vulnerability of livestock farms. Moreover, the ORCHIDEE biosphere model, which includes PASIM and STICS, will be used in its version coupled to the economic model AROPAGE to simulate adaptations and vulnerability of farming systems and agricultural land use. Finally, based on the results of the project, a stakeholders dialog will allow an assessment of the vulnerability of grasslands and livestock to climate change in France.

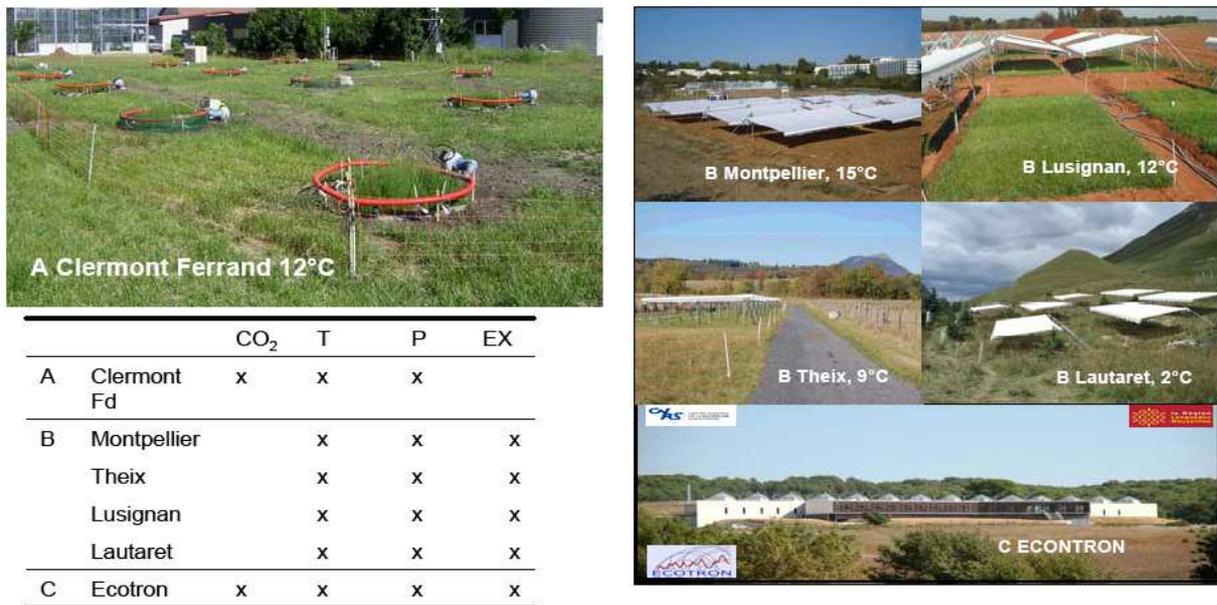


Figure 1. Three types of ecosystem manipulation experiments with warming (T), rain exclusion (P) and elevated CO₂. A single extreme (EX) heat and drought event will be applied in summer 2009.

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