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MODELLING THE IMPACTS OF CLIMATE CHANGE ON THE PERFORMANCE OF DOMESTIC HERBIVORES AT GRAZING

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Climate change may impact livestock both directly and indirectly through changes in the productivity, seasonality and quality of pasture production. In order to simulate changes in grazing animal performance, we have coupled a biogeochemical grassland model simulating grazing, PASIM[1] and an animal production model[2].

PASIM simulates C, N, water and energy fluxes exchanged between soil, plant, atmosphere and grazing animal compartments for managed grasslands. The model simulates forage intake, including diet selection among herbage age classes. Methane emissions are calculated taking into account the fiber and energy contents of intake. Model outputs include daily intake, milk production and methane emissions by dairy cows or sheep. Liveweight is assumed to remain constant, diet is limited to grazed herbage and only milking animals can be simulated with this model.

The aims of this work were to couple PASIM with the animal performance model developed by Jouven et al. within the framework of the SEBIEN model[2], in order to simulate: i) cow - calf production, ii) diets with hay and concentrates, and iii) methane emissions for both dairy and suckling cattle. We also set out to simulate the impacts of climate change on livestock performance, diet requirements and methane emissions.

Here, we present results of live weight (LW) and body score conditions (BSC) for suckler cows and their calves for the period January 1996-March 1997. An example is provided for the Laqueuille site (upland grassland in the French Massif-Central) and a traditional grass-based system[3] at low stocking rate (0,65 LSU.ha^{-1}). The simulated pasture was continuously grazed for 6 months per year (15 May to 18 November) during 4 years, by 8 Salers mature suckler cows, calving in early June and dried off in mid October.
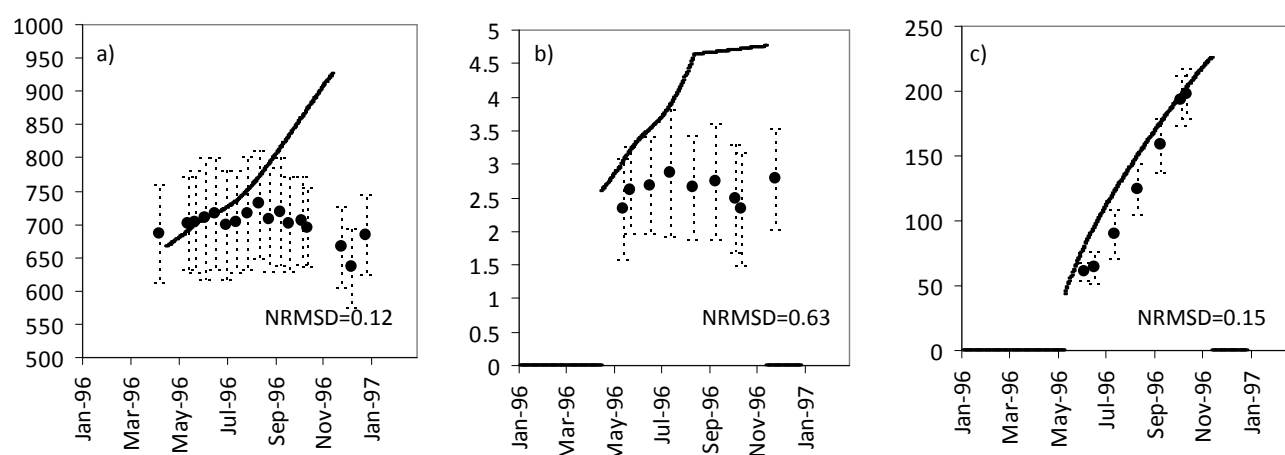

Figure 1: Comparison of simulations (lines) vs. observations (dots) of a) live weight (kg) and b) body score conditions (-) for suckler cows and c) live weight of calves (kg), at Laqueuille site (France); NRMSD is root mean square deviation normalized to the mean of the observed values ; Error bars (± s.d.) show the variability between animals during the grazing period.

As reported by Jouven et al. [2], the coupled model over-predicts BSC and LW of cows at the end of the grazing period. This could be due to the assumption of linear effects of energy balance on LW and BSC. Moreover, the bias in BSC could be linked with an inadequate calibration of its variation for young cows. The error of prediction for LW could also be explained by the assumption of a fixed increase of energy requirements for maintenance at pasture, in comparison with indoors. Model predictions for calves LW were much better. Model improvements, tests and parameterisation against data from other experiments are planned and should allow improving the quality of simulations. We also plan to simulate i) theoretical livestock systems at 12 French sites, comparing different fixed management practices for a range of IPCC SRES scenarios and climate models ii) for one combination of scenario and model, an optimization of the management practices (grazing, cutting and fertilization) under climate change.