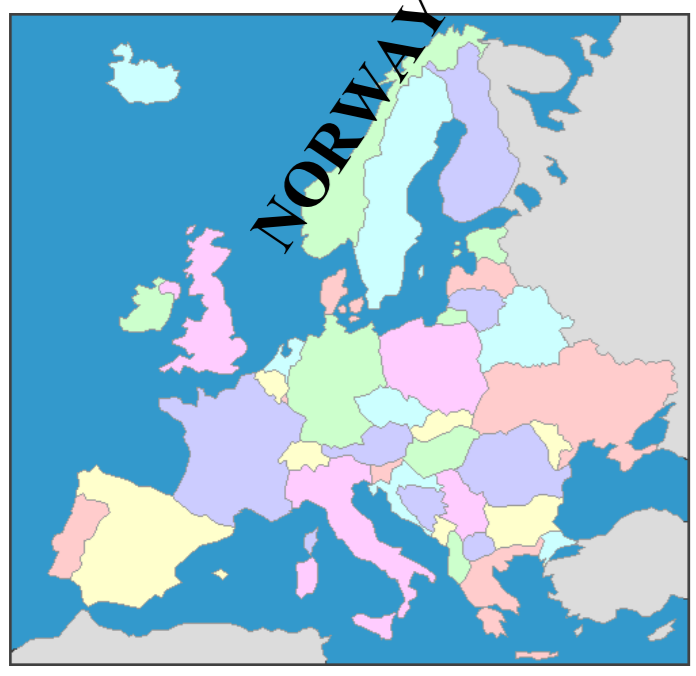# Process-based modelling of timothy survival in winter

M. Van Oijen[1], S.M. Thorsen[2], A.H.C.M. Schapendonk[3], M. Höglind[2]

CEH-Edinburgh, Bush Estate, Penicuik EH26 0QB, United Kingdom, E-mail: mvano@ceh.ac.uk
[2] Bioforsk, Saerheim, Norway, [3] Plant Dynamics, Wageningen, The Netherlands

Introduction

Timothy (*Phleum pratense*, L.) is the most widely grown silage/hay grass species in Scandinavia. Timothy is winter hardy, but does suffer from (1) frost and (2) anoxia due to ice-encasement.

Tolerance

The major tolerance mechanism is hardening, which can be quantified as the LT50 (Lethal Temperature for 50% of the plants in standard testing).

Model development 1998-2008

(1) Grassland model LINGRA (Schapendonk et al. 1998).

(2) Review of literature on timothy (Höglind et al., 2001). Model simulations showing the key role of tillering dynamics and the formation and loss of leaves from tillers.

(3) Measurements and modelling of tillering and leaf dynamics (Van Oijen et al. 2005)

(4) *We now have expanded the model to include simulation of snow and frost dynamics, and damage and tolerance mechanisms.*

Weather (radiation, wind, temperature, rain, snow, surface ice)

**Summer model for grass growth** | **Winter model for grass survival**

Soil physics model

The WINSUR model for simulating the year-round growth and survival of timothy grasslands consists of four submodels.

Results and Conclusions

The model was tested for sites in southern and middle Norway. The dynamics of tillering death and carbohydrate content (Figure below) showed reasonable correspondence with literature and observations.

However, the simulations of LT50 were not satisfactory: they showed less short time-scale variability (days, weeks) than the measurements. In the model, hardening is only controlled by ambient temperature and plant carbohydrate concentration. In reality, more factors may be involved. Experiments to resolve this are underway.
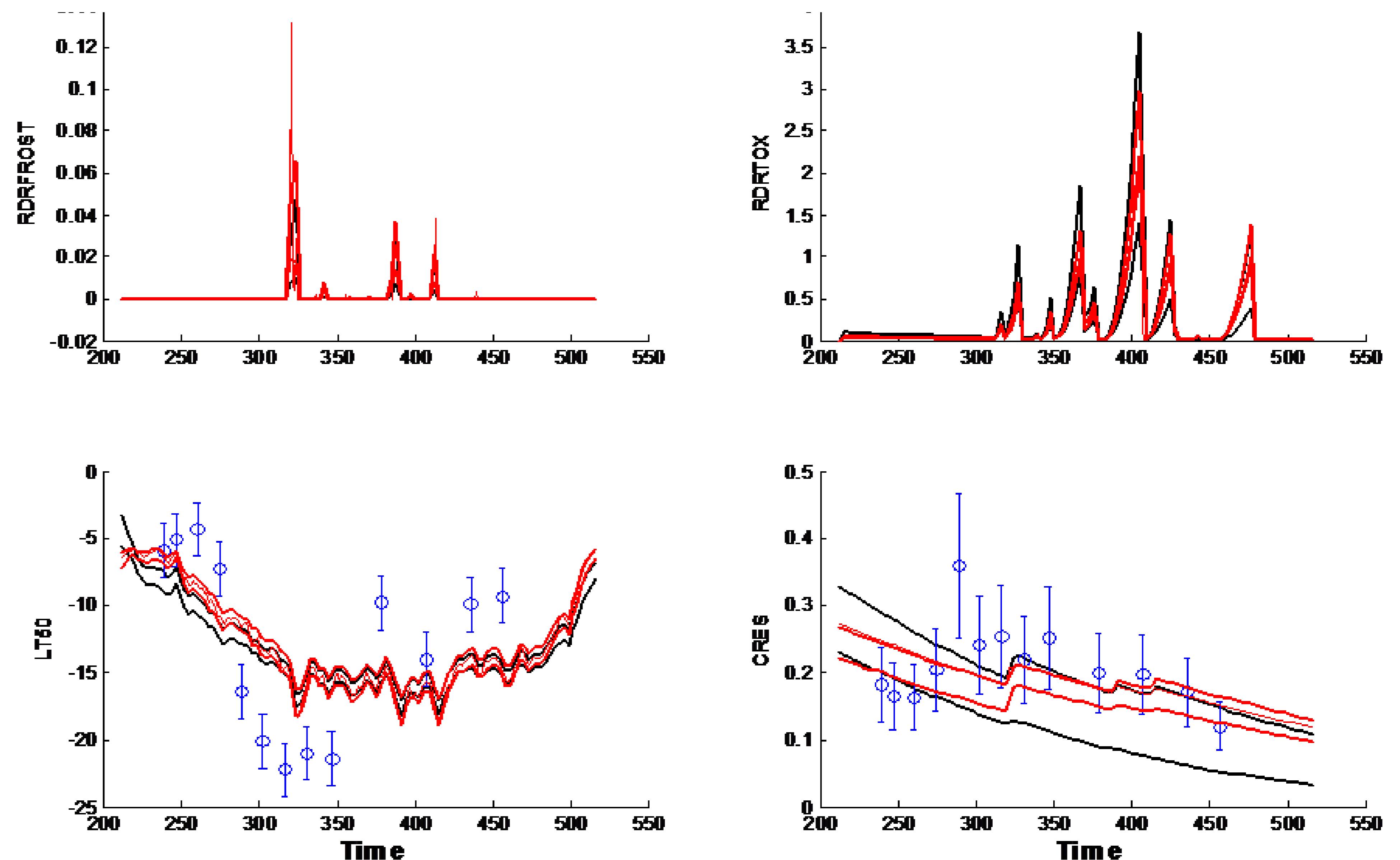
Simulation of winter processes in timothy for Apelsvoll (southern Norway). Top row: relative tiller death rate due to frost (left) and anoxia (right). Bottom row: LT50 (left) and carbohydrate content (right), including data measured on-site.

References

Höglind, M., Schapendonk, A.H.C.M. & M. Van Oijen (2001). Timothy growth in Scandinavia: a review of quantitative information on underlying processes and an analysis by means of simulation modelling. New Phytologist 151: 355-367.

Schapendonk A.H.C.M., Stol, W., Van Kraalingen, D.W.G. & B.A.M. Bouman (1998). LINGRA, a sink/source model to simulate grassland productivity in Europe. European Journal of Agronomy 9: 87-100.

Van Oijen, M., Höglind, M., Hanslin, H.M. & N. Caldwell (2005). Process-based modelling of timothy regrowth. Agronomy Journal 97: 1295-1303.

www.bioforsk.no

Centre for Ecology & Hydrology

NATURAL ENVIRONMENT RESEARCH COUNCIL