

A statistical model to estimate crude protein of permanent meadows in South Tyrol

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Introduction

● Objective: a statistical predictive model, based on a large dataset of variables related to meteorology, botanical composition, geomorphologic factors, soil properties and the management of permanent meadows to achieve a quantitative prediction of crude protein

Material und Methods

Sampling

- Sequential sampling for a period of 7 weeks starting at the phenological stage of stem elongation (15 cm growing height)

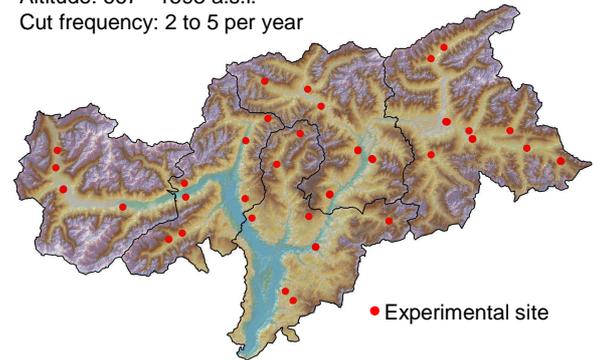
Independent variables

- Botanical composition (grass, mixtures, forbs, legumes) and assignment to a meadow type
- Meteorological and climatic variables calculated on the time interval between one week before the date of stem elongation and the cutting time:
 - Temperature and potential global radiation sums, sum and the average of daily departures of rainfall from a long-term daily average (20 years)
- Soil properties and management

Model development

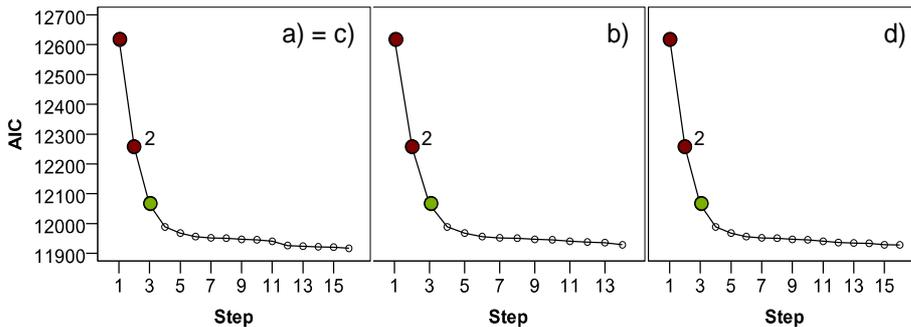
- Mixed models optimised using a stepwise forward selection, until no further improvement of the Aikaike Information Criterion (AIC) was achieved. Subsequently, the model was validated by a five-fold cross-validation
- Four different models developed on the assumption that not all independent variables may be always known to the users

Sampling: 2003 to 2014, 202 environments (location x year)
Altitude: 667 - 1593 a.s.l.
Cut frequency: 2 to 5 per year



Results and discussion

- Growing degree days sum (2 indicates the quadratic term of the polynomial)
- Botanical composition in terms of yield proportion of grasses, legumes and forbs



Change of AIC-values following the stepwise model development for crude protein, a) with all available variables, b) without the soil properties, c) without the meadow type, d) without soil properties and meadow type

- Growing degree-day sums and the botanical composition were the most relevant variables that could improve the AIC
- All in all, small differences have been found between the models

- The lack of correlation is the predominant source of errors for all models

| Parameter | Model | | | |
|--------------------------|-------|-------|-------|-------|
| | a) | b) | c) | d) |
| R ² | 0,702 | 0,680 | 0,686 | 0,680 |
| SB (Translation) | 0,002 | 0,003 | 0,002 | 0,003 |
| NU (Rotation) | 0,001 | 0,002 | 0,001 | 0,002 |
| LC (Lack of correlation) | 1,116 | 1,198 | 1,178 | 1,198 |

Conclusion

Statistical models were able to estimate the crude protein content of permanent grassland with reasonable precision. Temperature sums and botanical composition of the plants had the greatest impact during model development. However, the use of other variables pointed out a further improvement of prediction accuracy

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