Modelling approach for evaluating impacts of seasonal drought on the perennial grasslands in the Czech Republic

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Introduction: Perennial grasslands constitute an important element of the landscape as well as part of the agricultural production system in the Czech Republic. These grasslands, however, generally enjoy less precipitation as they are situated in areas that are comparatively drier than it is common e.g. in Austria with annual precipitation being frequently more than 700 mm per year and mostly without access to irrigation. Therefore grassland production varies considerably among sites, individual years and also during the growing season due to climatic factors. This is of major importance to dairy farmers since the whole farming system must account for the risk of unfavorable weather conditions. To satisfy the present and expected needs in Czech Republic for reasonably accurate grassland drought stress and yield estimates (following e.g. 2000 or 2003 droughts), a relatively simple approach relying on the established statistical linkages between a limited number of daily or seasonal variables is being developed by group of seven research organizations. Operational use is expected during season of 2012.

Methodology: The contribution summarizes the architecture, methods and data flow selected for the modelling system which will be capable of near-real time monitoring of eventual drought stress and yield variability but will be useful for assessment of climate change impacts. The resolution of the system is 500 m and it uses the state-of-the-art datasets available within the Czech Republic and it will be combined with remotely sensed data of vegetation stress (based on NDVI from MODIS) since 2012. After all input data are prepared and quality controlled for each of 51 377 grassland and semi-grassland grids two step procedure is initiated. As the first step a dynamical daily soil water balance model is applied and its outputs are then used to estimate biomass production either for a given cut or the whole season within the grid. The grassland yield model is based on the temperature sums, global radiation and water stress as well as cutting and fertilization to estimate grassland production. In order to produce a probabilistic seasonal forecast with a lead time of up to 30 days a stochastic weather generator is being combined with monthly weather forecast. Modelling scheme is presented at the main diagram.

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CONCLUSIONS: Grassland productivity in the Czech Republic is significantly affected by the weather variability including floods as well as drought episodes that both affect yield stability. The negative effects of drought could be partly prevented by a system combining a body of knowledge obtained from past long-term grassland experiments with spatially explicit information about the soil water availability in the given season and to issue a probabilistic forecast of seasonal water stress and yield levels. Then appropriate measures could be taken and economical losses reduced. Of far the system, which is under development was shown to well represent between-year yield variability (R² between 0.6-0.9) at individual sites and provide useful forecasting ability surpassing standard statistical forecasts methods.