

MET&ROLL: THE WEATHER GENERATOR FOR CROP GROWTH MODELLING

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Met&Roll is a freely available (<http://ufa.anet.cz/met&roll.htm>) WGEN-like [Richardson, 1981; Wilks, 1992] four-variate stochastic weather generator [Dubrovsky, 1997]. It is designed to provide synthetic daily weather series representing present and changed climate conditions to be used in crop growth modelling [Zalud *et al.*, 1999; Dubrovsky *et al.*, 1999]. Precipitation (*RAIN*) is modelled by a first-order two-state Markov chain (occurrence) and Gamma distribution (amount). Standardised deviations of daily extreme temperatures (*TMAX* and *TMIN*) and daily sums of global solar radiation (*SRAD*) are modelled by a first-order trivariate autoregressive (AR1) model. The set of parameters of the generator includes:

- 2 parameters of the Markov chain model: probability of wet day occurrence, δ_1 , and probability that a wet day follows a dry day, δ_{01} (parameters are defined for each month of the year)
- 2 parameters of the Gamma distribution (defined for months)
- parameters of the AR1 model:
 - means and standard deviations of *SRAD*, *TMAX* and *TMIN* (defined for each day of the year, separately for wet and dry days)
 - two 3×3 matrices (defined for week)

Met&Roll may be operated either in an interactive mode or in a command-line mode. The latter approach allows to chain several procedures into a single batch which makes the data processing more effective.

Following procedures are available:

- *Analysis* of daily weather series = deriving parameters of the generator and some other statistical characteristics (including interannual variability of monthly means of the four daily weather characteristics and coefficients of skewness and kurtosis of *TMAX*, *TMIN* and *SRAD* /weekly/) from the input weather series. *Range checking* (detecting outliers /with respect to the mean annual cycle/ and checking for the unrealistic interdiurnal changes) may be optionally performed during the analysis.
- *Modification* of the generator's parameters according to climate change scenario. The scenario is typically given in terms of changes (additive or multiplicative) of monthly means of individual parameters. By default, the means of *TMIN* and *TMAX* are modified additively, the four parameters of the precipitation model and the standard deviations of *SRAD*, *TMIN* and *TMAX* are modified multiplicatively. As the basic model of the generator underestimates interannual variability of monthly means of the four weather characteristics (Dubrovsky, 1997), it is now allowed to vary the monthly means by a random component.
- *Generation* of synthetic weather series with use of the stochastic model. Parameters of the generator derived from the observed series are used to generate series representing present climate conditions; parameters modified in accordance with the climate change scenario are used to generate series representing changed climate conditions.

- *Generation* of synthetic weather series by direct modification of the existing series. The observed series of the four weather characteristics may be modified on a day-by-day basis using the same climate change scenario as above. The daily weather characteristics are modified either additively (*TMAX* and *TMIN*) or multiplicatively (*RAIN* and *SRAD*) by factors which are allowed to vary according to prescribed annual cycle. The daily changes may be optionally complemented by a random component.

Ability of Met&Roll to reproduce the statistical structure of observed daily weather series was examined in Dubrovsky [1997].

Application of Met&Roll in crop growth modelling and discussion on obtained results are addressed in separate contributions [Dubrovsky and Zalud, 1999; Zalud *et al.*, 1999].

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