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Impacts of drought at various time scales on forest growth in the Most coal forest reclamation areas in the Czech Republic

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We analyzed the impact of drought at various time scales on tree growth of nine tree species (Robinia pseudoacacia, Pinus strobus, Betula pendula, Quercus rubra, Quercus robur, Fraxinus excelsior, Tilia cordata, Larix decidua, Juglans nigra) during the period 1975-2010 growing in the Most coal forest reclamation areas in the north-western of the Czech Republic. The Standardized Precipitation Evapotranspiration (SPEI) was adopted as multi-scalar drought indicator to determine the influence of drought on trees growth and the drought time-scales that are affecting trees growth in one of the driest region in the Czech Republic. Since we cannot know in advance the growth responses to drought at different time scales, the SPEI series at timescales between 1 to 24 months was correlated with the standardized increment of trees series.
Tree species growing in coal forest reclamation areas showed relative high relationship ($r>0.66$) with SPEI$\leq$-1 drought series at longer time scales (up to 12 months), which it shows that cumulative water deficit during one year affect tree growth. We also found delayed response of trees growth to drought. The negative effect of extreme drought of 2003 on the increment of trees for the majority of species appeared to the next year (2004).
Thus, increment of trees in reclamation region is determined by precipitation recorded during year of tree-ring formation, but the rainfall that fell in previous year and high summer temperature anomalies. At the same time, the highest correlation coefficient between growth and drought index were obtained from May to August months, the period when growth rates are usually maximum and when water deficit in dry years is markedly (from -160 to -400 mm). High correlation between the SPEI and the annual tree growth is explained of three basic assumptions: (i) forest reclamation area is situated in the driest region; (ii) due to unfavourable properties of soil substrate (with low water holding capacity) leads to shallower rooting near all trees; and (iii) unavailability of groundwater level for the active part of the root system.

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