Adaptation of the Meuse to the Impacts of Climate Evolutions

Hydrologic modelling and dendrochronology as tool of site-species adequation assessment in a changing climate context

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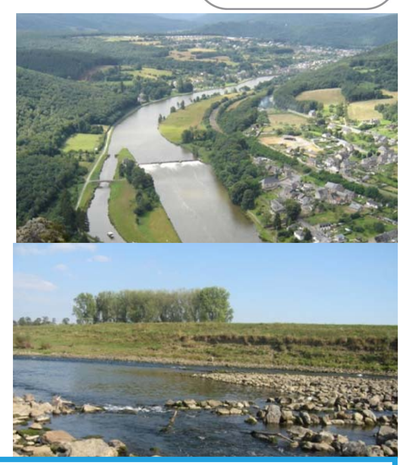


Context and study area:

Spruce is the main cultivated species of the Ardens. Nevertheless, in a warmer climate with a lower humidity during the growth season, as the climate change scenarios forecasts, spruce stands should show in the future a growth rate decrease and a declining health status.

The study area is a spruce stand of age 51, located in the Ardens at the altitude of 330 m, on a sunny slope (30°, orientation SSW) with a thick acid brown soil (20 cm deep) where hydric stress are relatively frequent.

Water reserve assessment: The EPIC-Grid model

The hydrologic model EPICGrid is a physically based distributed model.

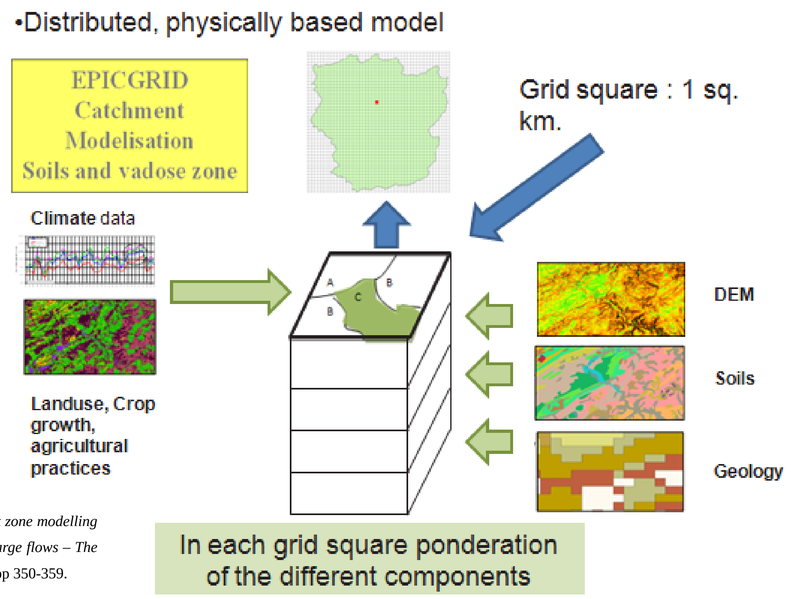
It is built upon a « major components » approach and takes into account the climate data, landuse, crop growth, agricultural practices, topography, soils and geology. For every cell, the different combinations are balanced.

It is adapted to the site concerning soil reservoirs depth, characteristic water contents, root profile and water uptake.

The hydrologic simulation runs from 1971 to 2005 at daily time step.

Weather data come from the Royal Meteorological Institute.

Outputs from the model are real evapotranspiration, surface runoff, interflows, deep percolation and soil moisture at daily time step.

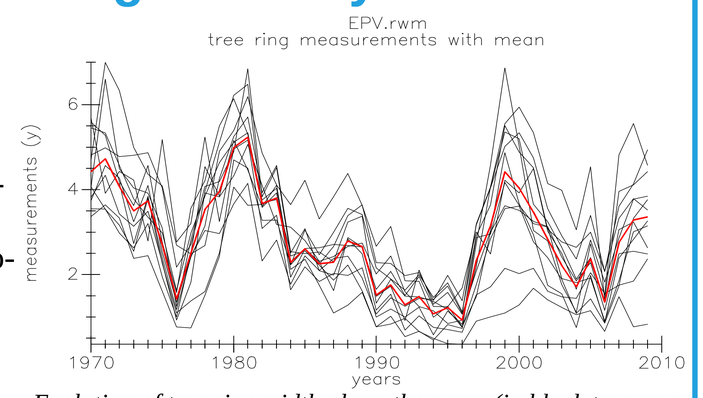


Sohier C., Degré A., Dautrebande S., (2009). *From root zone modelling to regional forecasting of nitrate concentration in recharge flows – The case of the Walloon Region (Belgium).* J. Hydrol., 369, pp 350-359.

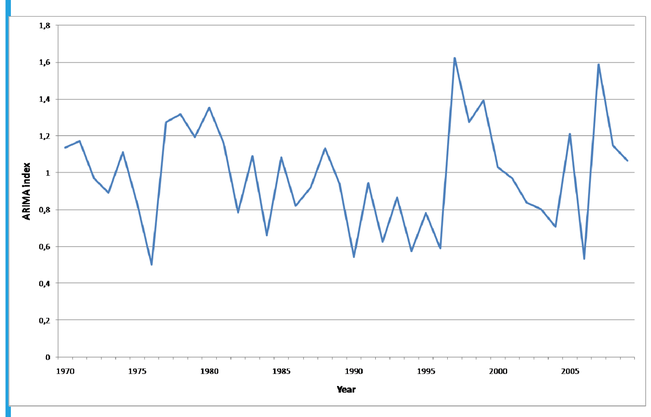
Tree ring growth assessment: a dendrochronological analysis

Core sample of spruce

12 dominant trees have been selected on the stand. 2 cores have been taken from each tree. Tree ring widths have been measured in the lab and master chronology curve have been calculated.



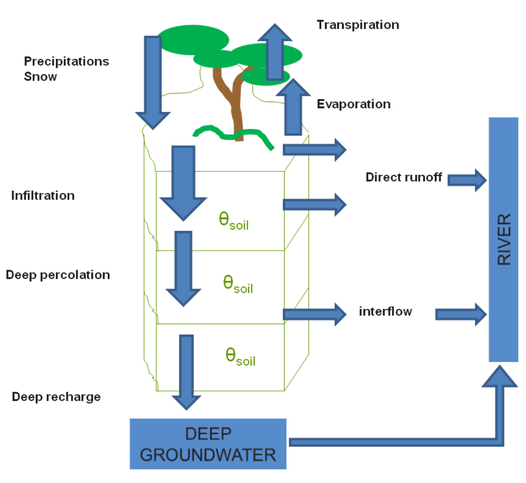
Evolution of tree ring width along the years (in black tree measurements, in red mean of measures)



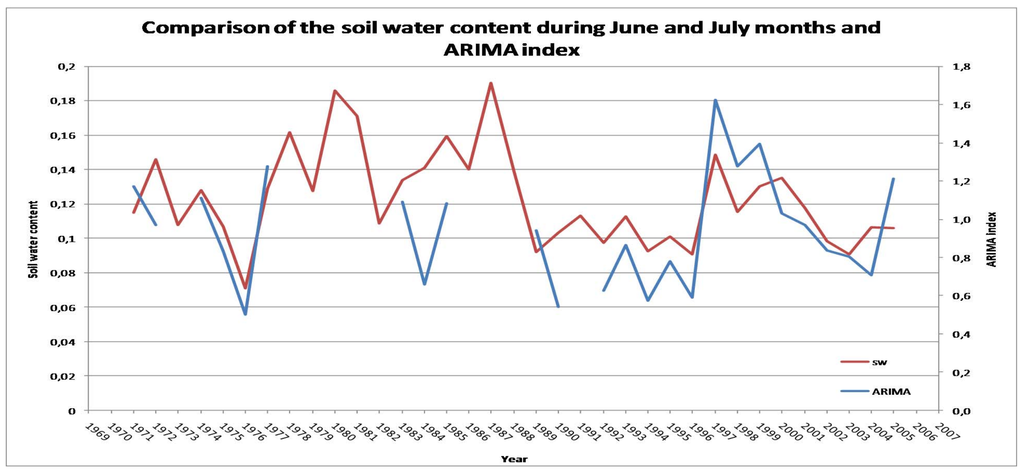
Evolution of ARIMA index along the years

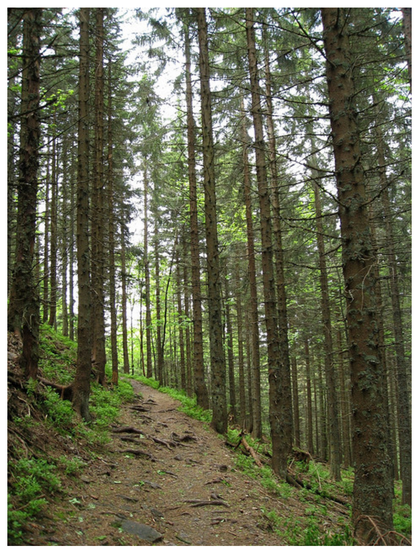
Tree rings profiles have been standardised with an ARIMA function to eliminate long term and medium term ring width variation and extract the annual variation that is considered as the climatic signal.

Debruxelles J, (2010). *Etude de l'impact des conditions climatiques annuelles sur la croissance radiale de l'épicéa au sein de stations à régimes hudriques contrastés : une approche dendrochronologique* . Travail de fin d'études, ULg,- GxABT, 75p.

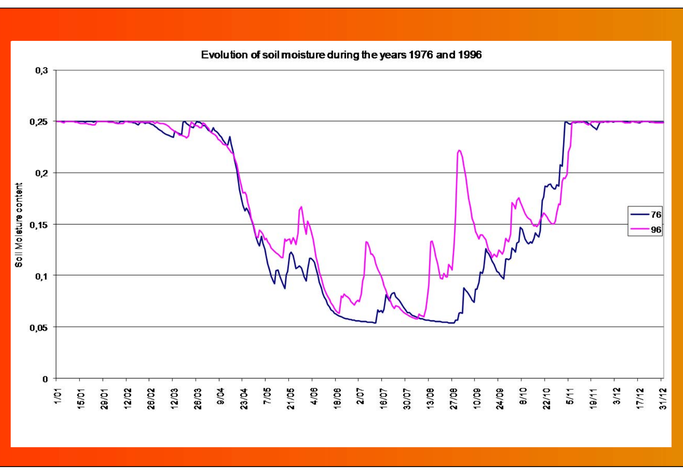


Water reserve modelling strengthens tree ring width measurements. Both can assess the impact of dry periods on tree ring growth

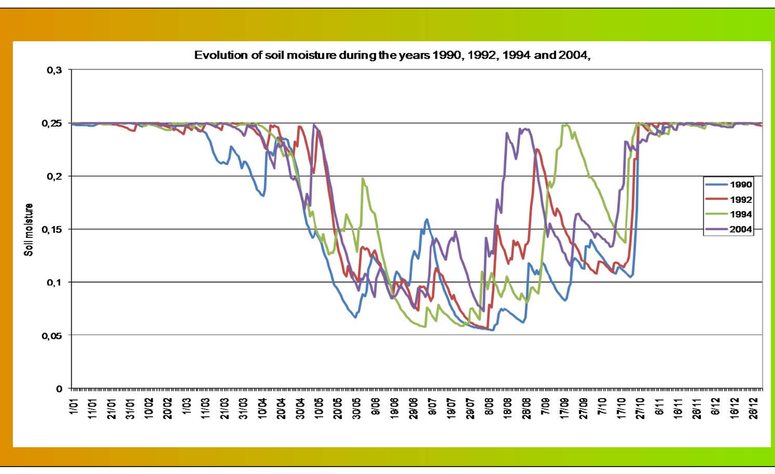




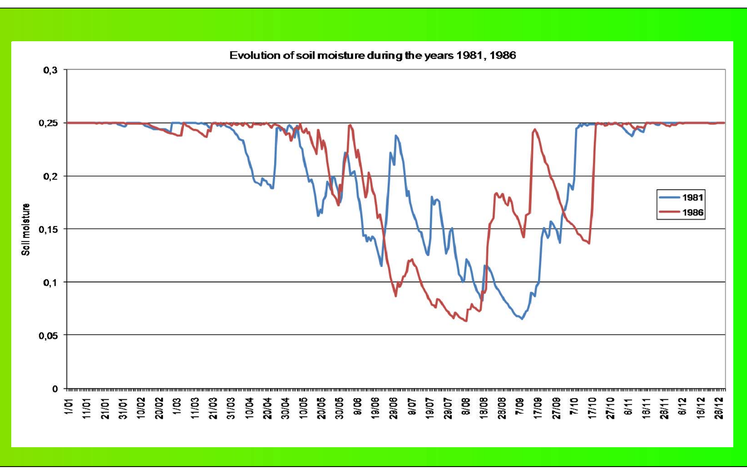
DRY YEARS



Years 1976 and 1996 are emphasized by both the modelling outputs and dendrochronological measurements as very dry. Model shows a severe drought and tree ring shows a very low growth.



Years like 1990, 1992, 1994 and 2004 show a less severe drought event but a drought occurs in June-July, which seems to penalize spruce's growth.



On the other hand, years like 1981 and 1998 show an important growth and a high value of mean soil moisture during June and July.

WET YEARS

Conclusion:

These considerations will allow us to progress towards forecasting forest trees reaction to climate events and change. With this in mind, we will use a climate scenario build up in the frame of the AMICE Interreg project.