What have we learned so far from DICE?

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Acknowledgments: Anton Beljaars, Reinder Ronda,

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Sensitivity tests with ECMWF SCM + offline surface

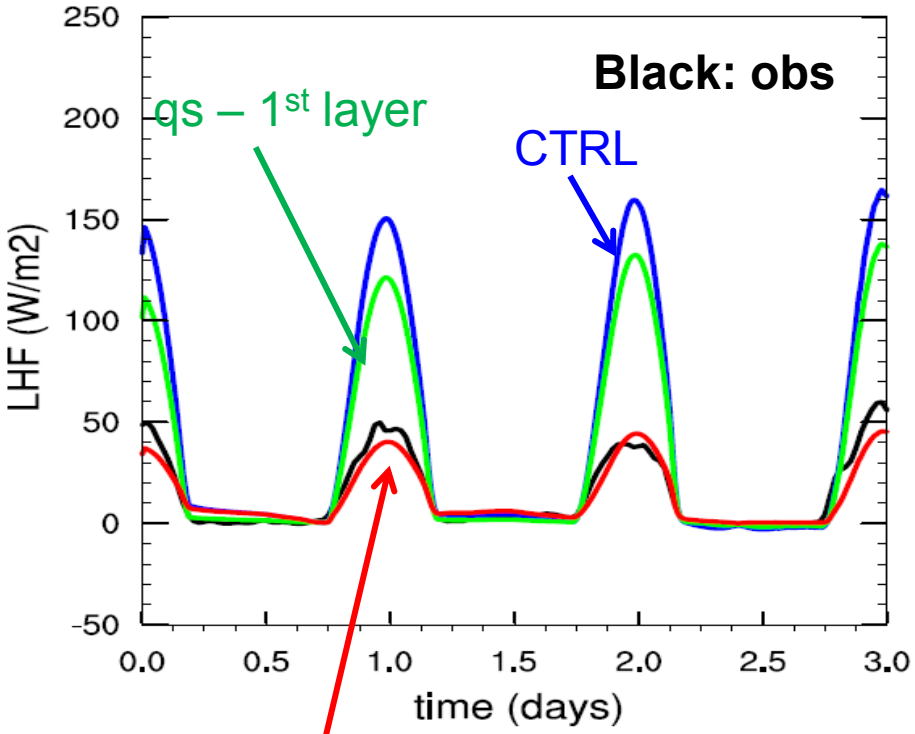
Motivation – in the coupled runs too big LHF

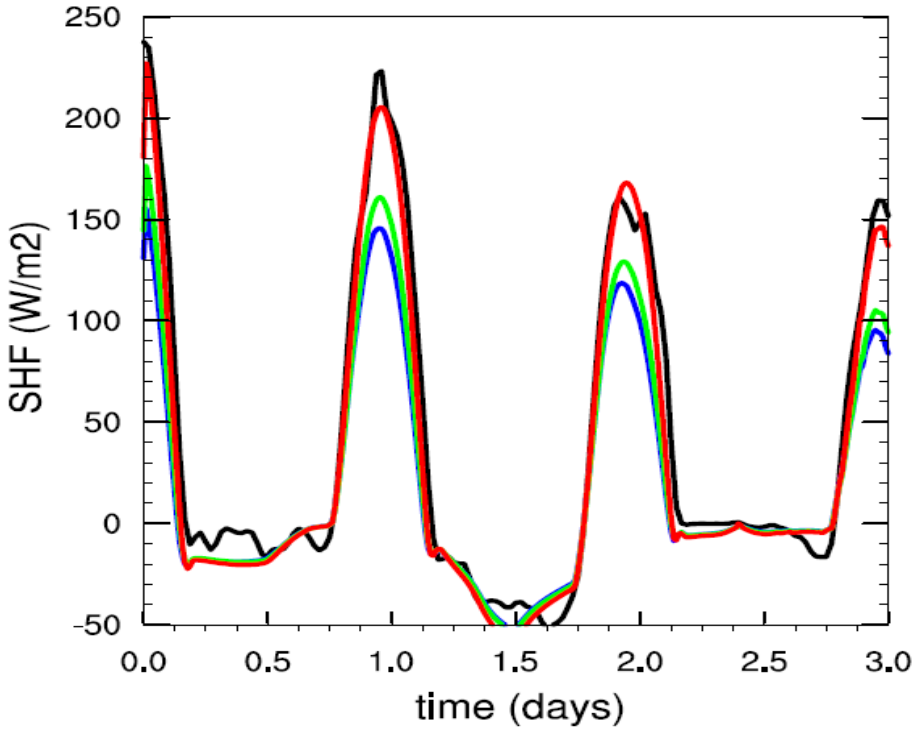
We evaluated the sensitivity to:

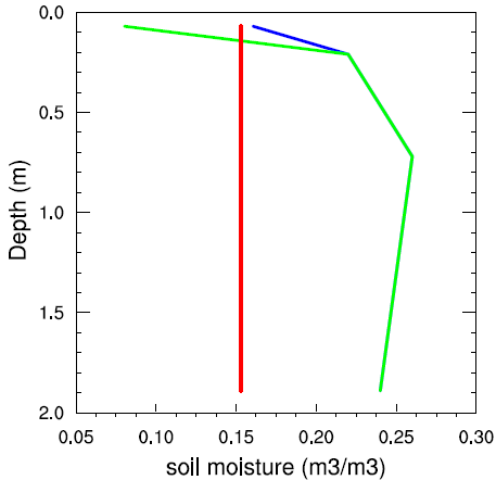
- soil moisture
- LAI
- vegetation type/no vegetation
- Soil texture

+ impact of changes in the vertical diffusion

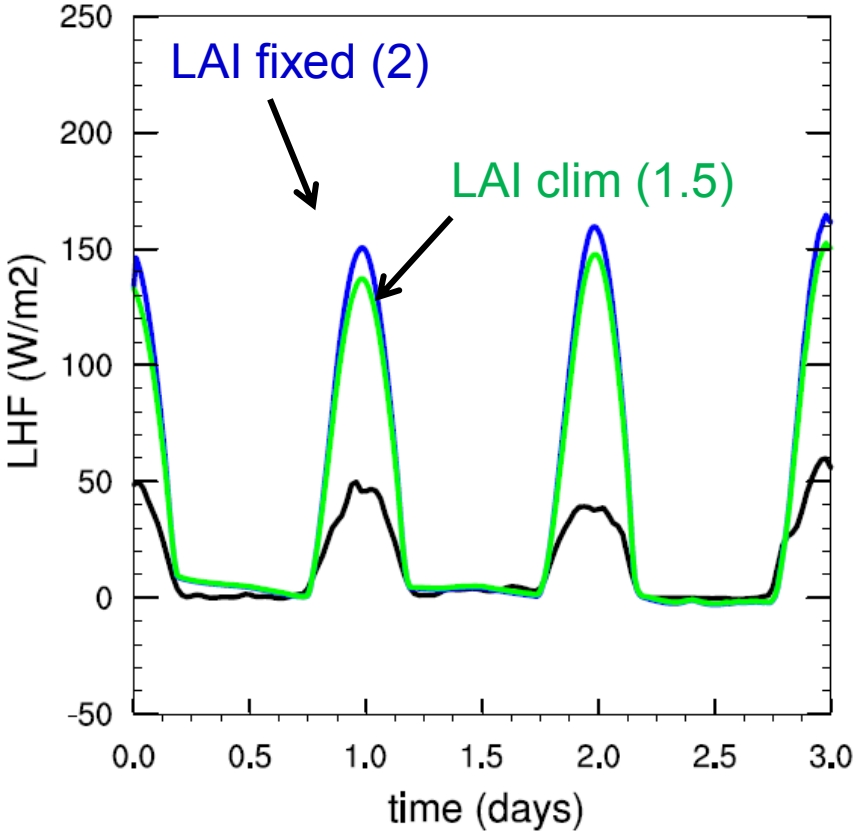
Impact of soil moisture

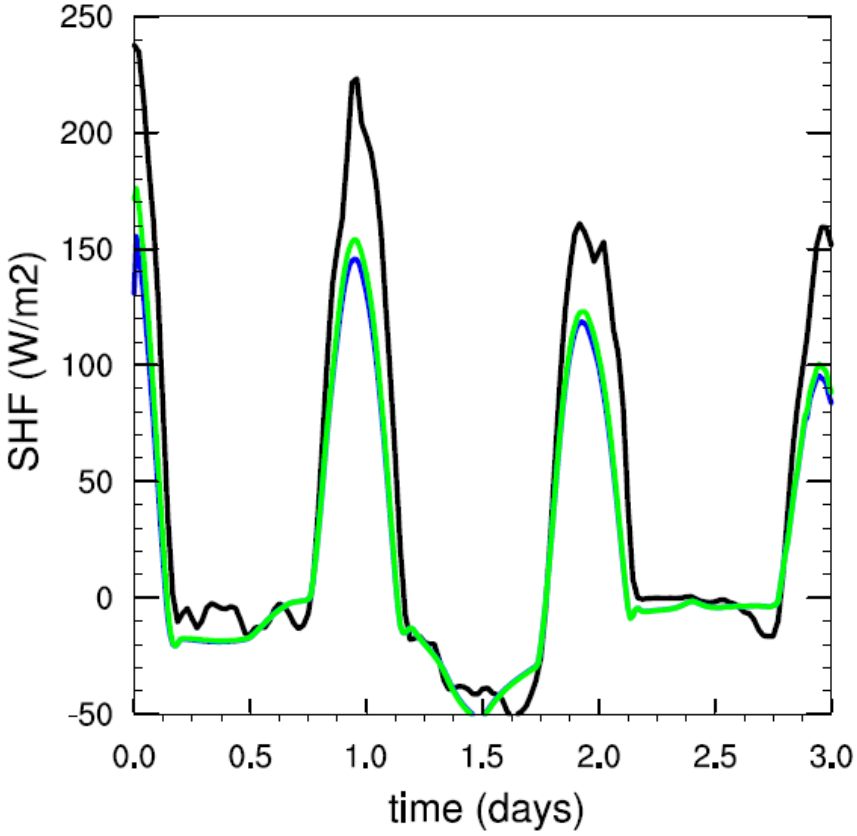




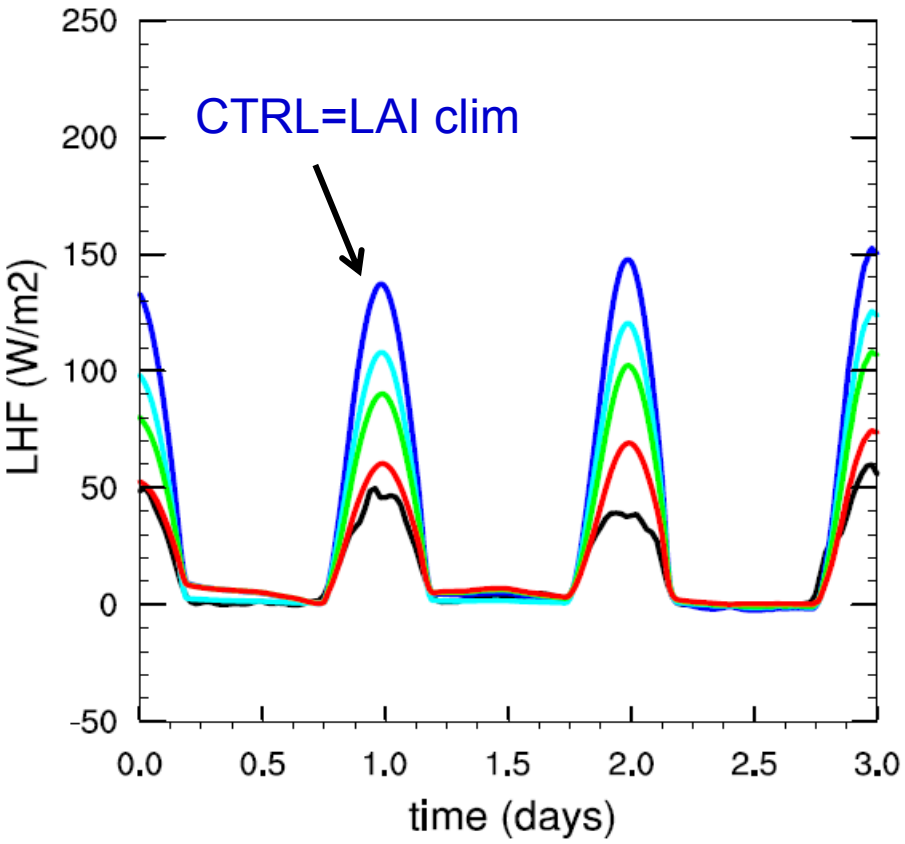


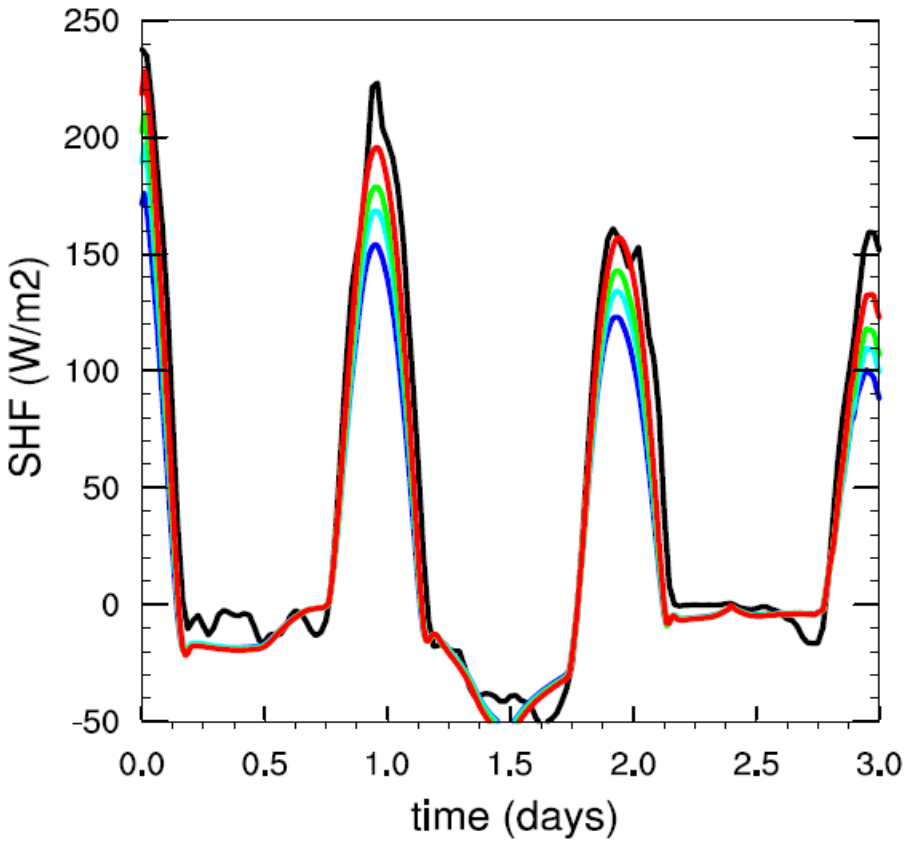
Impact of LAI (1)





Impact of LAI (2)



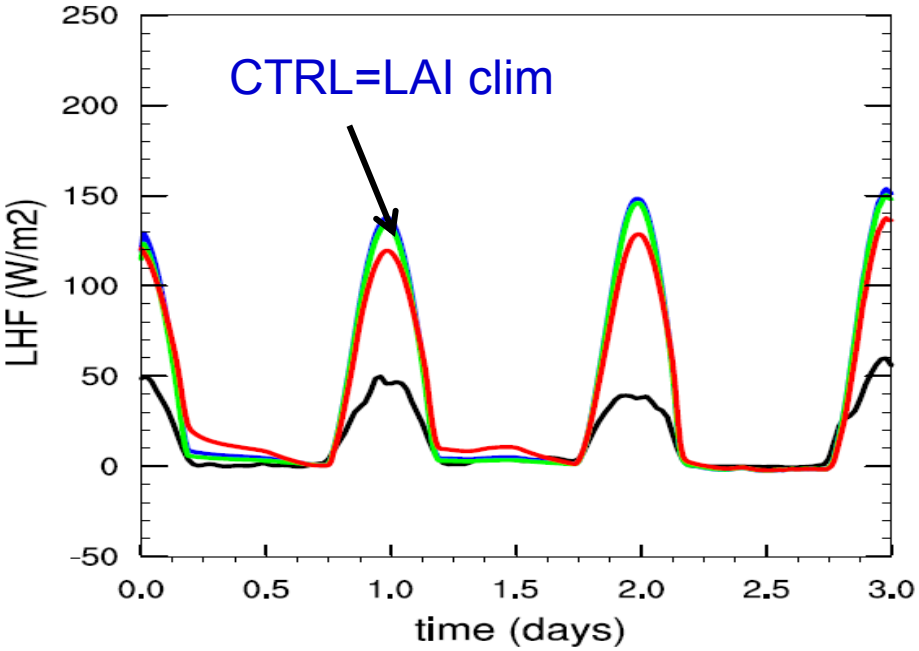


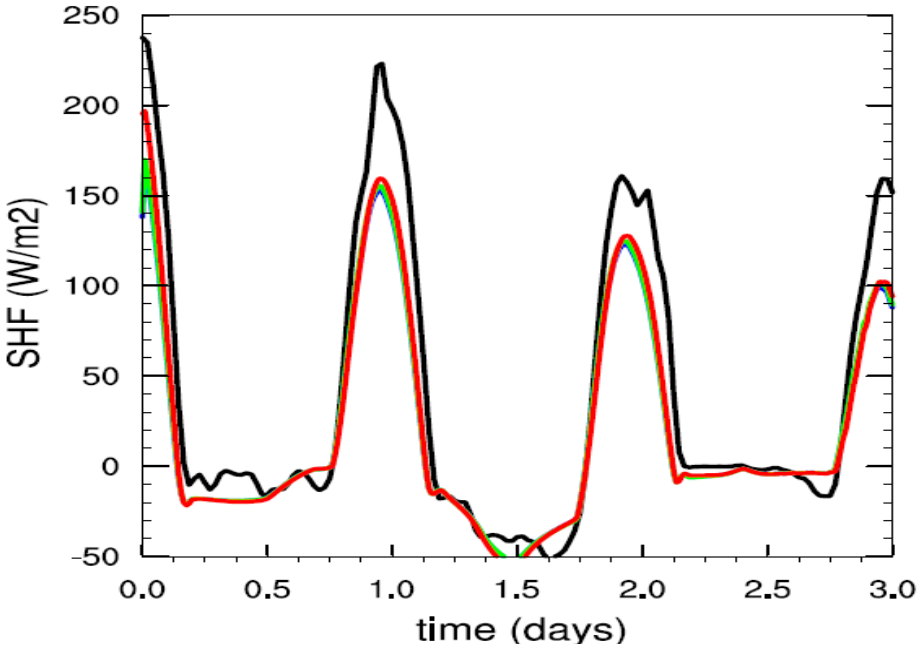
qs – 1st layer : halved - cyan

LAI = 0.5 green

LAI = 0.15 red

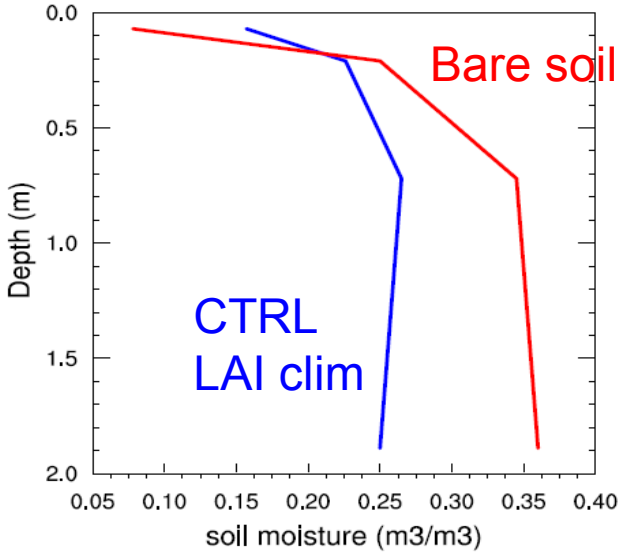
Impact of vegetation type/no vegetation



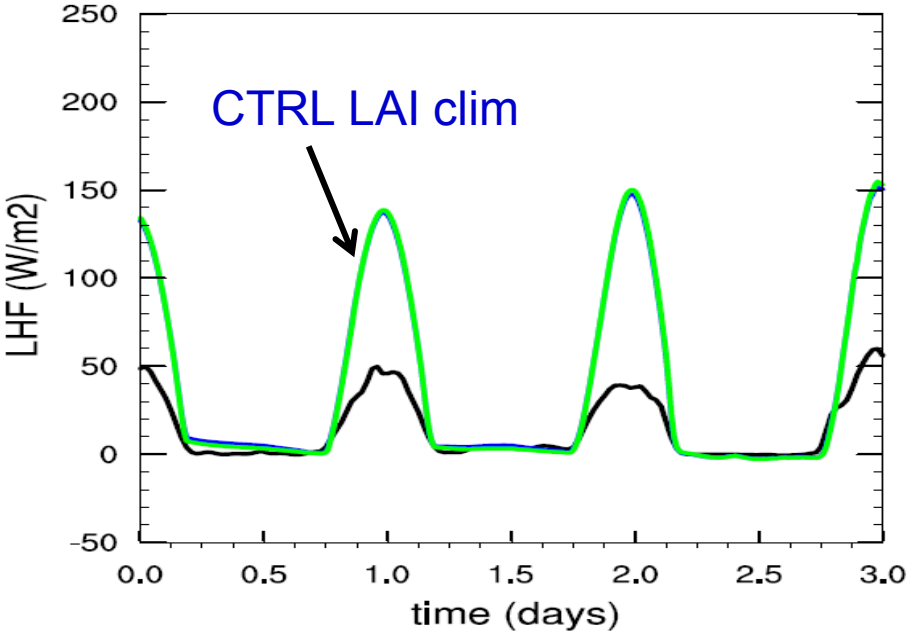


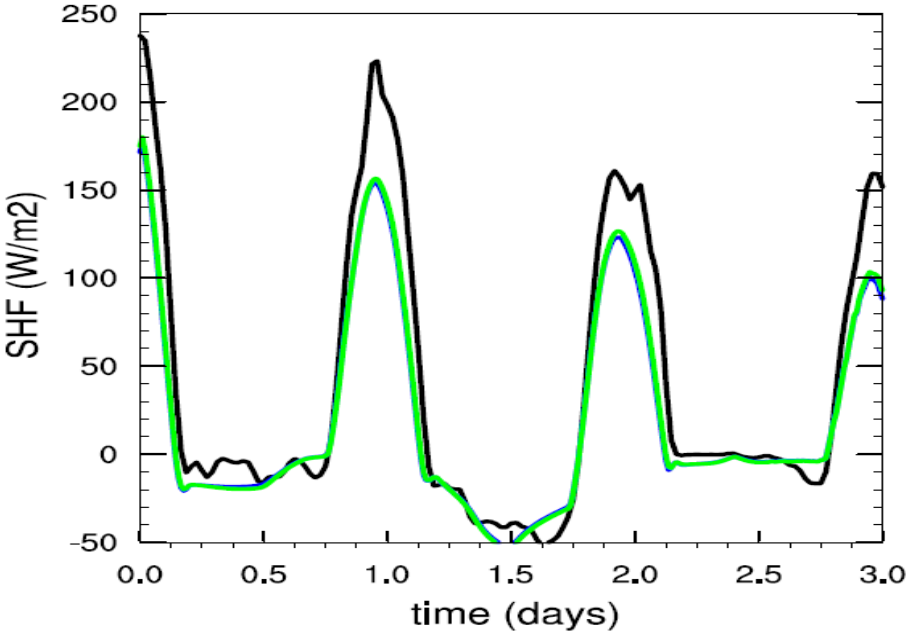
short grass instead of tall grass

bare soil instead of low vegetation



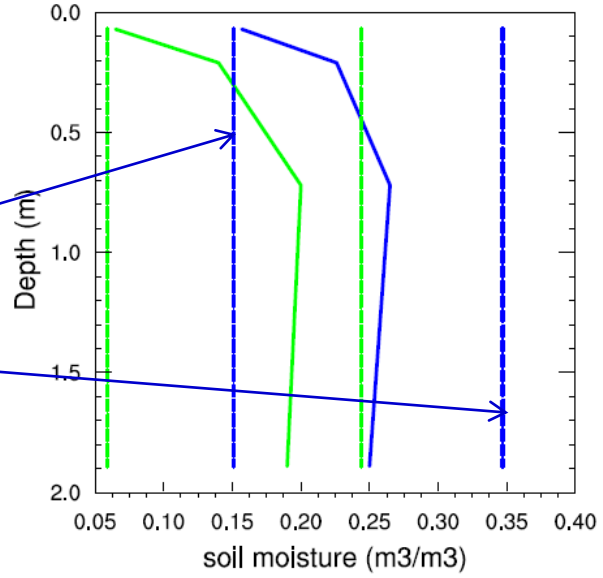
Impact of soil type : coarse instead of medium



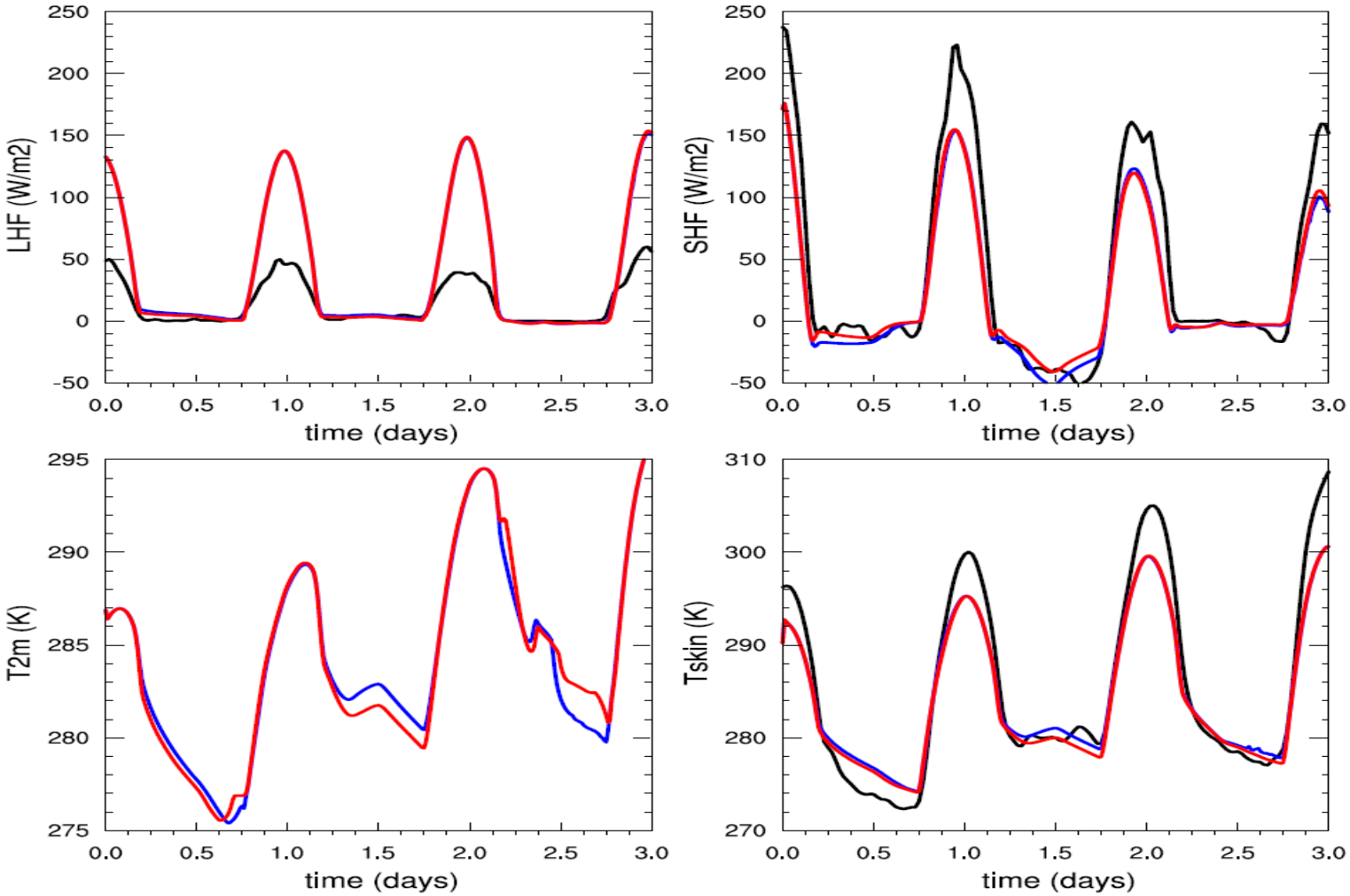


coarse soil instead of medium

$$\frac{\theta - \theta_{pwp}}{\theta_{cap} - \theta_{pwp}}$$



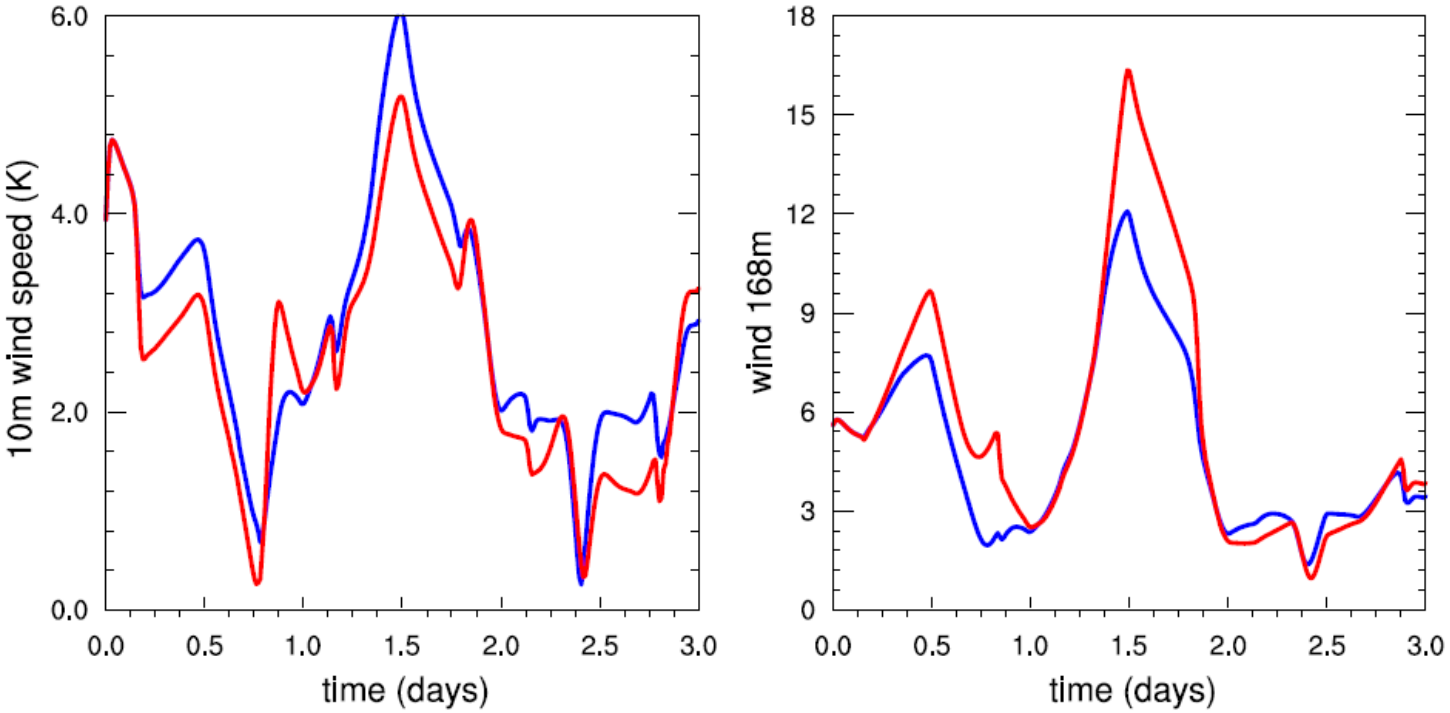
Impact of vertical diffusion



Control: long tails , asymptotic mixing length =150m

NEW:short tails, asymptotic mixing length = 30m

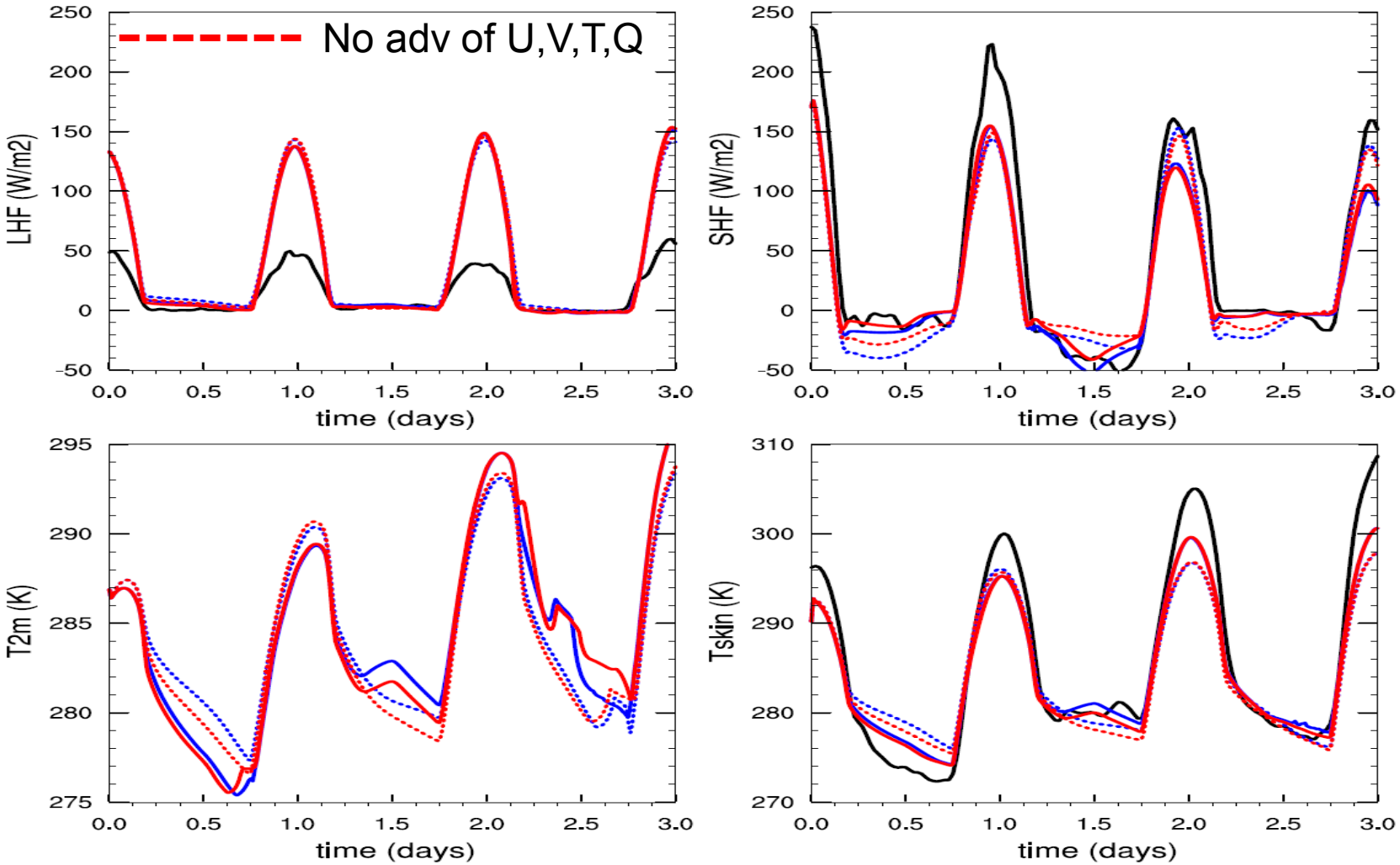
Impact of vertical diffusion



Control: long tails , asymptotic mixing length =150m

NEW:short tails, asymptotic mixing length = 30m

Impact of vertical diffusion + impact of forcing

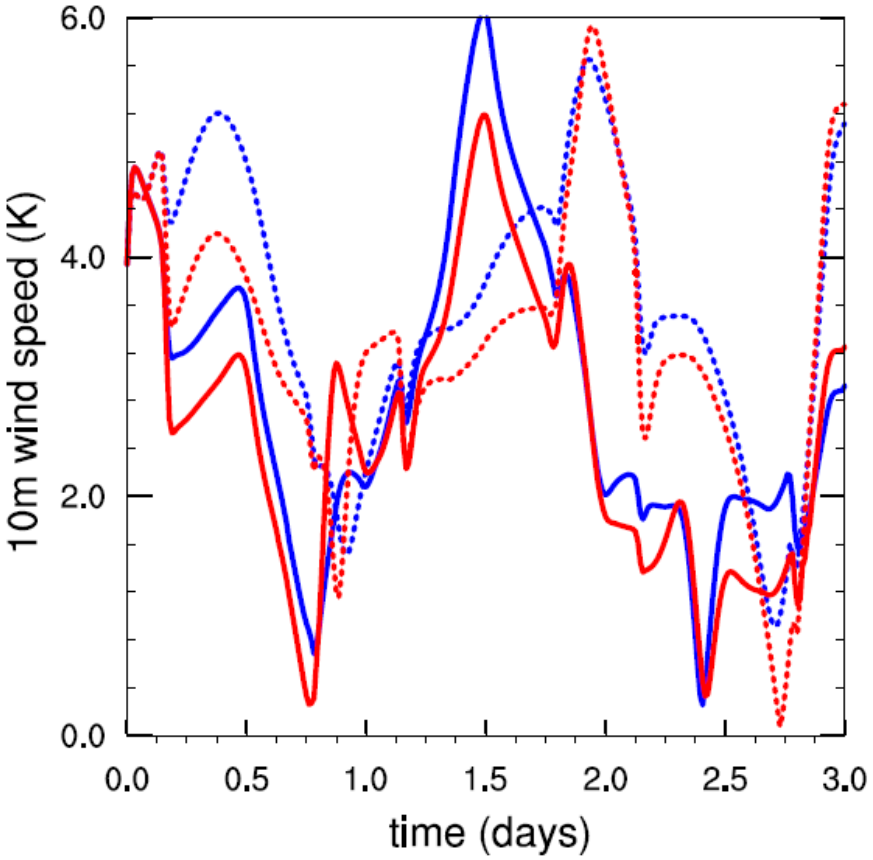


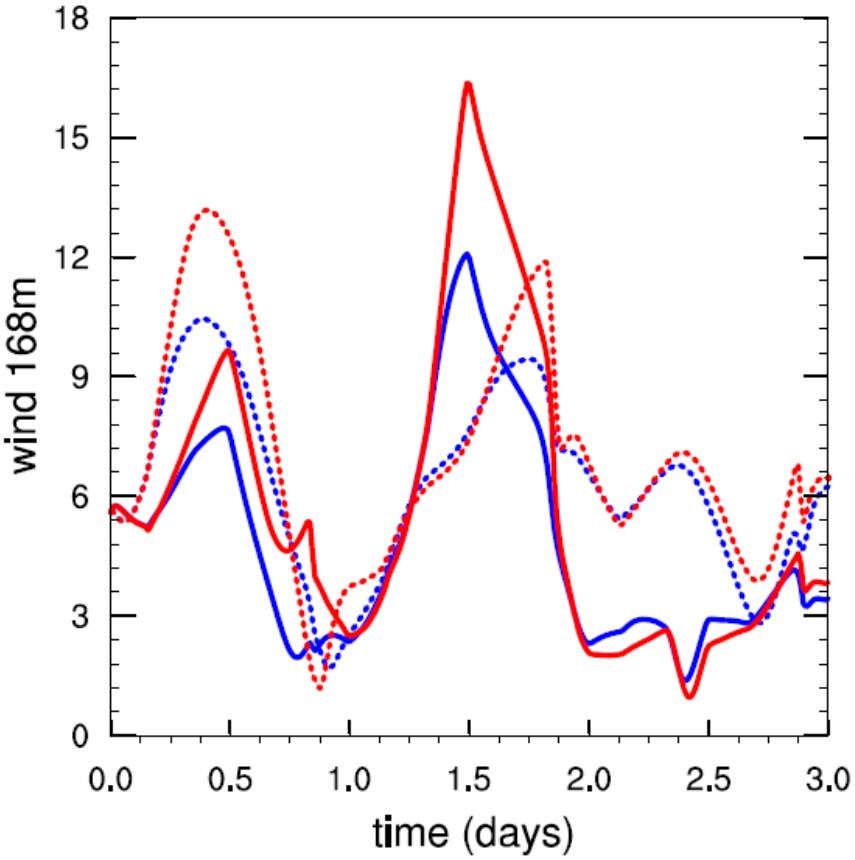
Control: long tails , asymptotic mixing length =150m

NEW:short tails, asymptotic mixing length = 30m

Impact of vertical diffusion + impact of forcing

No adv of U,V,T,Q





Control: long tails , asymptotic mixing length =150m

NEW:short tails, asymptotic mixing length = 30m

Our sensitivity tests suggest that:

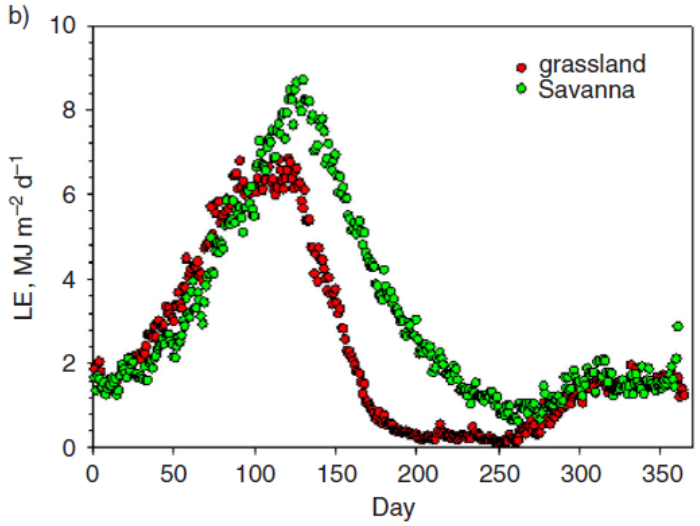
- LHF controlled mostly by root zone soil moisture
- LHF not very sensitive to soil texture, vegetation type or even lack of vegetation (bare soil)
- But very sensitive to the LAI, hence to canopy resistance
- Sensitivity to turbulence parameterization (perhaps other parameterizations too) somewhat hidden by the imposed forcing (?)

DICE very informative to study sensitivity to land/atmosphere parameterization, BUT

- Missing information on site physiography
- Missing information on soil moisture

Difficult to attribute the errors in LHF to a certain process

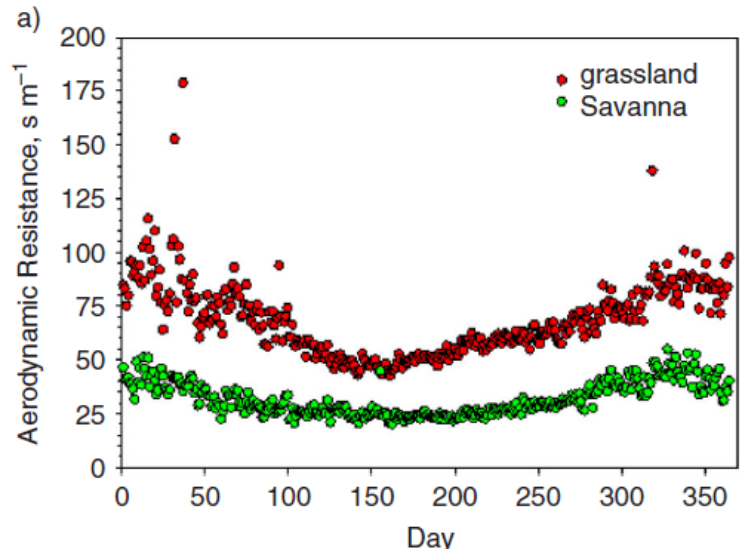
- LHF very sensitive to the LAI, hence to canopy resistance, BUT:

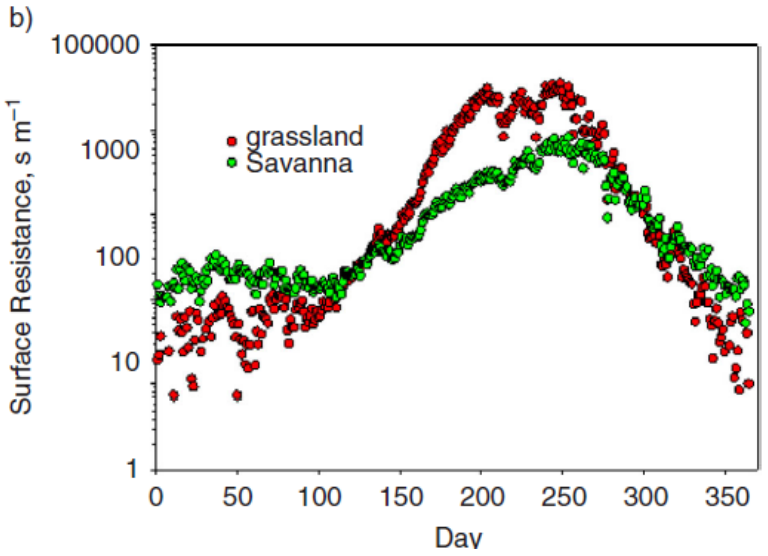


$$\mathrm{LHF} = \frac{\rho_\mathrm{a}}{r_\mathrm{a} + r_\mathrm{c}}\left[q_\mathrm{L} - q_\mathrm{sat}(T_{\mathrm{sk},i})\right]$$

$$r_\mathrm{c} = \frac{r_{\mathrm{S,min}}}{LAI} f_1(R_\mathrm{s}) f_2(\bar{\theta}) f_3(D_\mathrm{a})$$

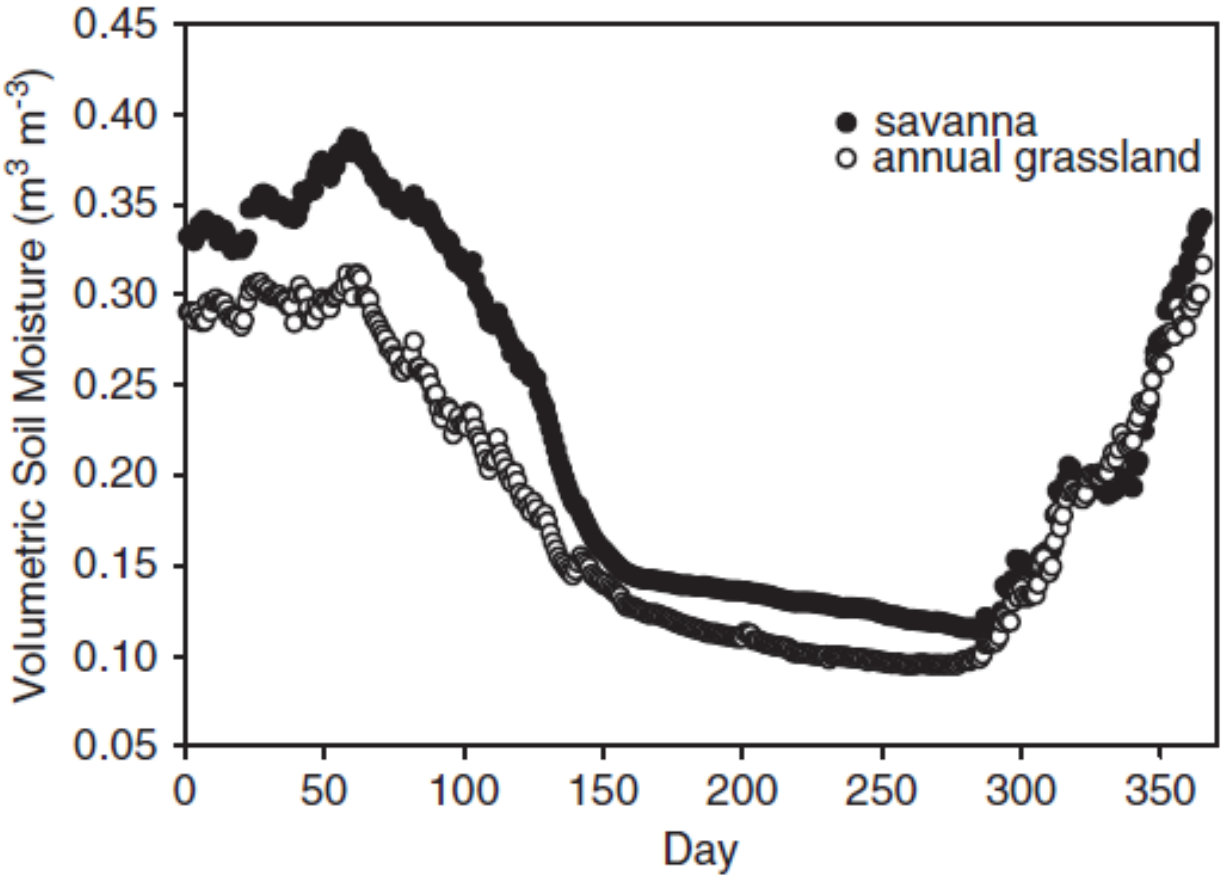
From which term should the annual cycle come?





Baldocchi and Ma, Tellus, 2013

- Knowledge on soil moisture permits to narrow the sources of error



Baldocchi and Ma, Tellus, 2013