CLIMATE CHANGE, WATER BUDGET AND GRAPEVINES IN GERMANY

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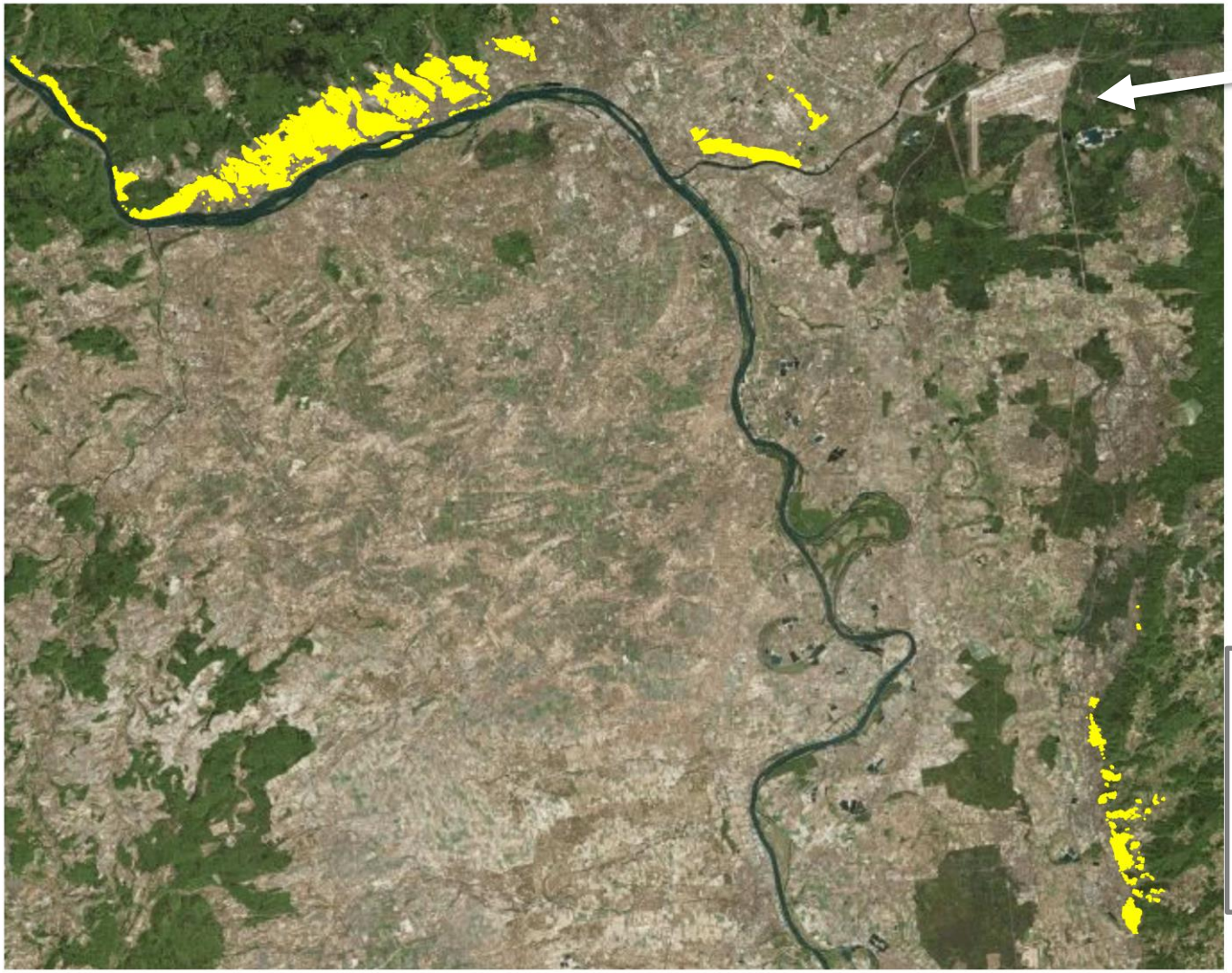
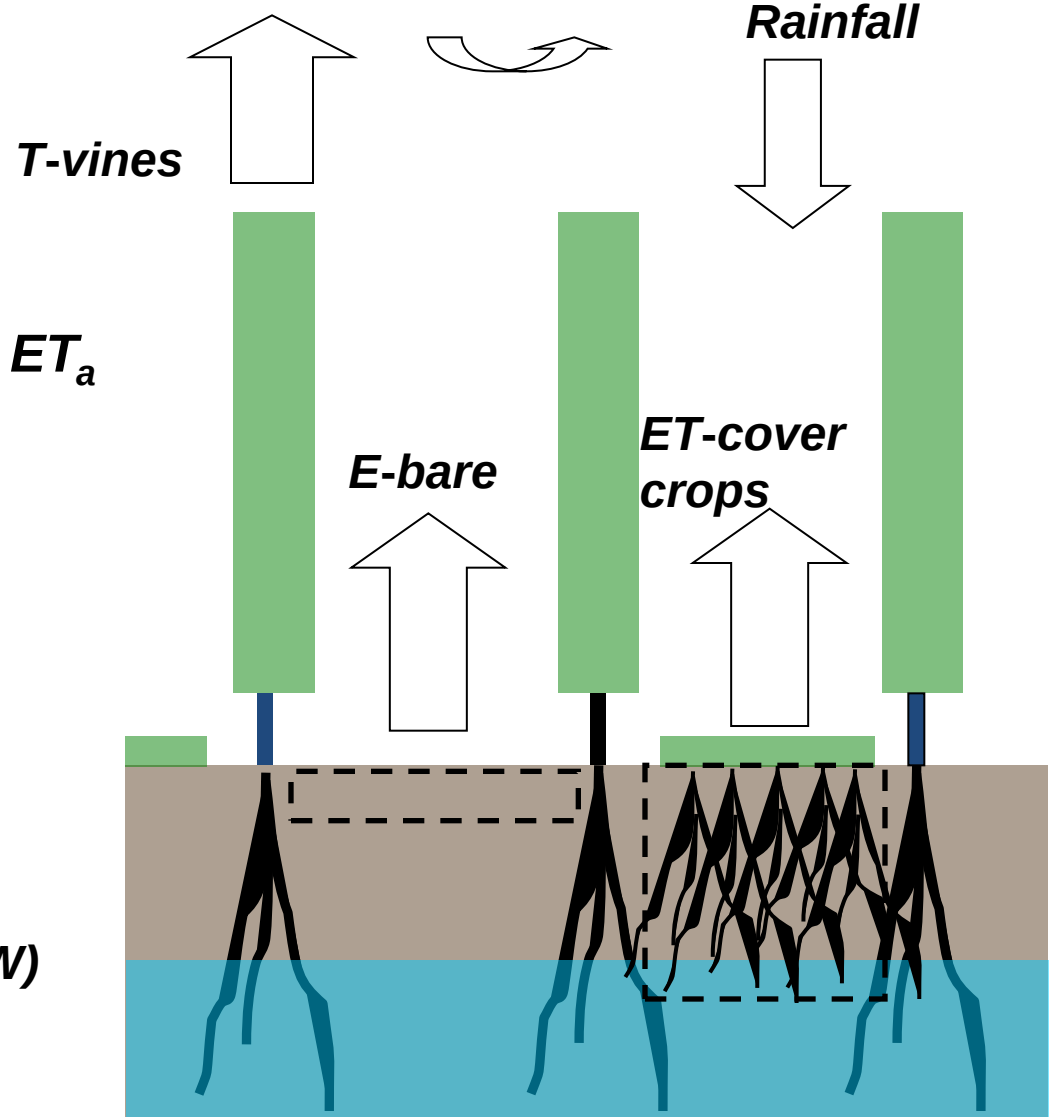
Rheingau, 3167 ha



Soil Moisture Water Balance Model

$$ET_a = T_v + E_{bare} + Et_{cover\ crops}$$

$$SW_d = SW_{d-1} + Precip. - ET_a$$



Plant available soil water (SW)

(Lebon et al. 2003; Celette et al. 2010; Hofmann et al. 2014)

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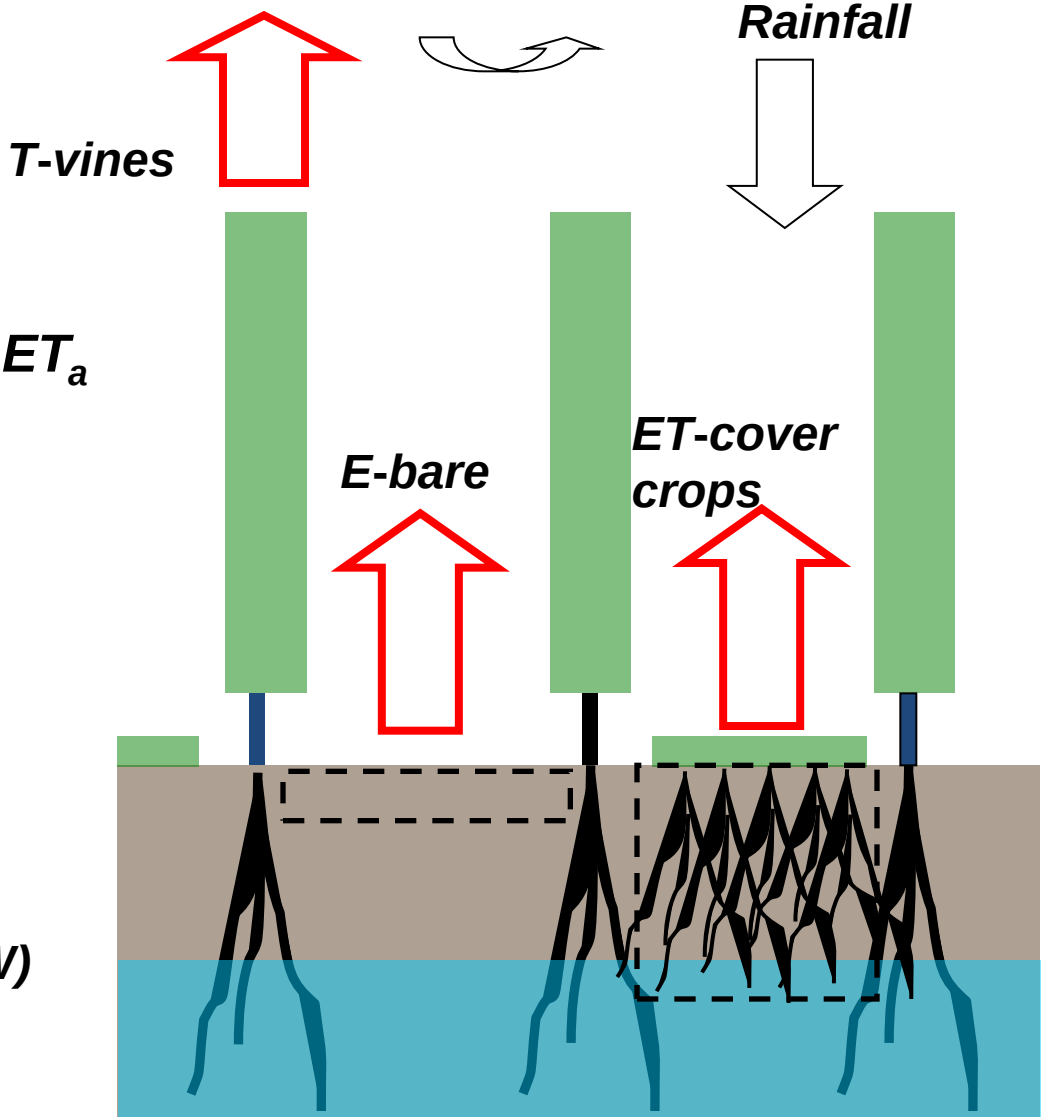

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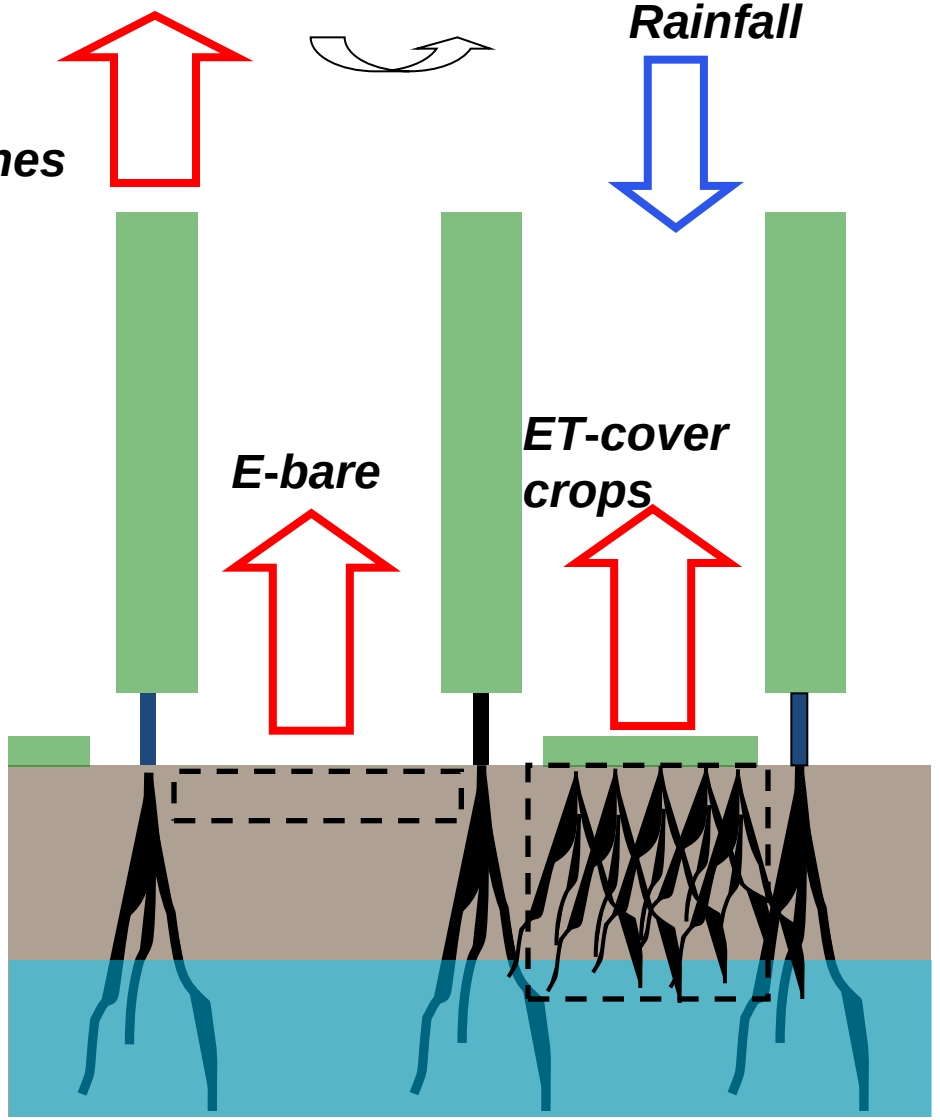

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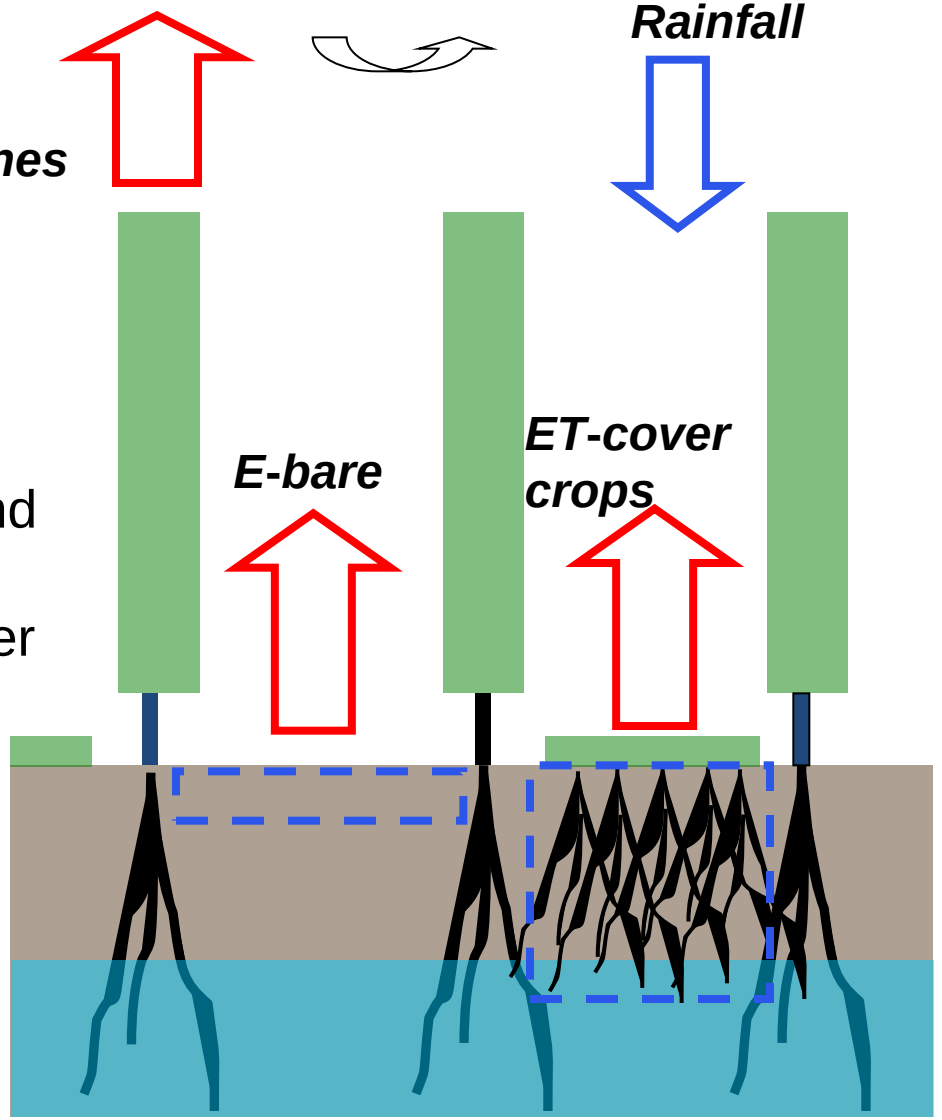
Sub-reservoirs for bare soil and cover crops, to calculate the feedback of available soil water on evapotranspiration



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ET0-CALCULATION FOR STEEP SLOPES

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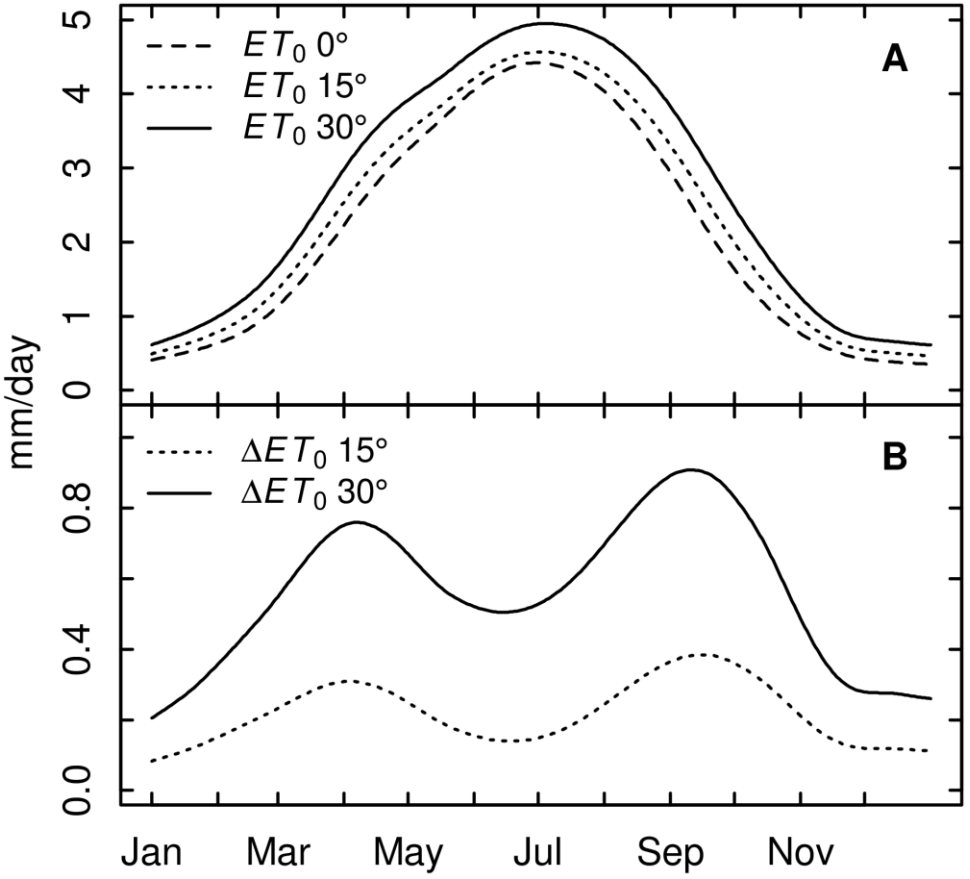
The soil water balance model was adapted to **steep slopes** by calculating the **impact of slope and aspect on potential evapotranspiration**

Daily mean of ET_0 (Data from Geisenheim 2000-2013)



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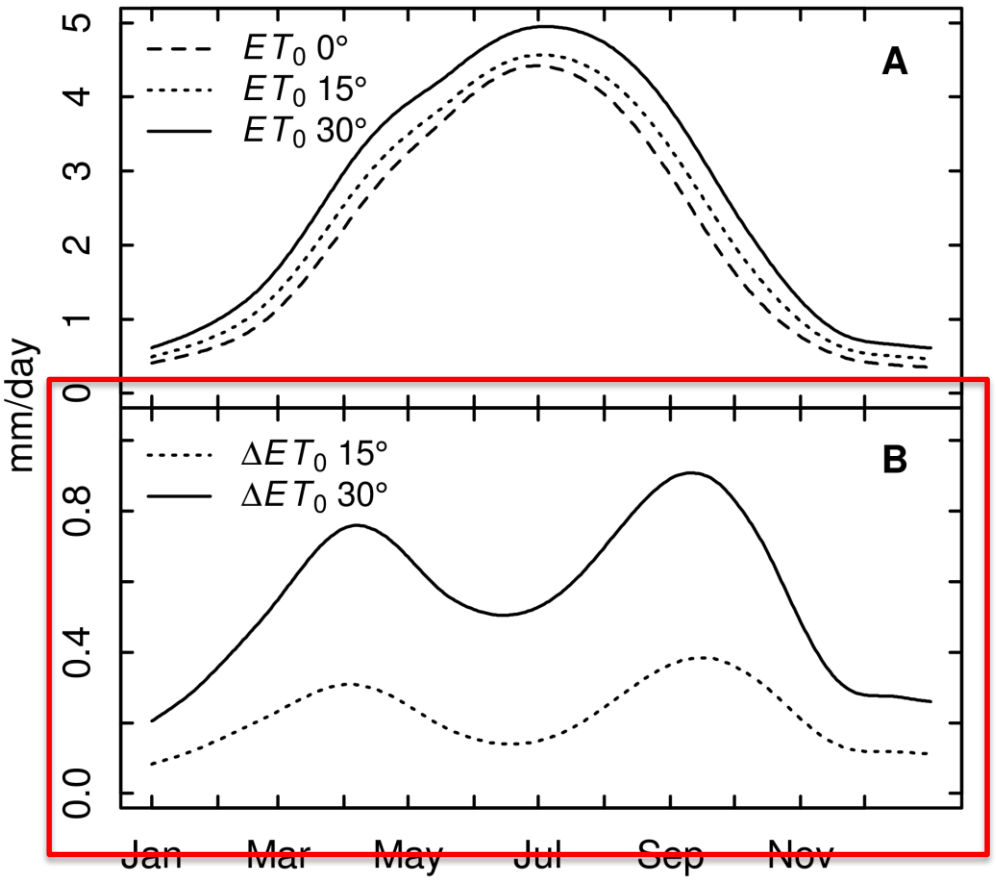
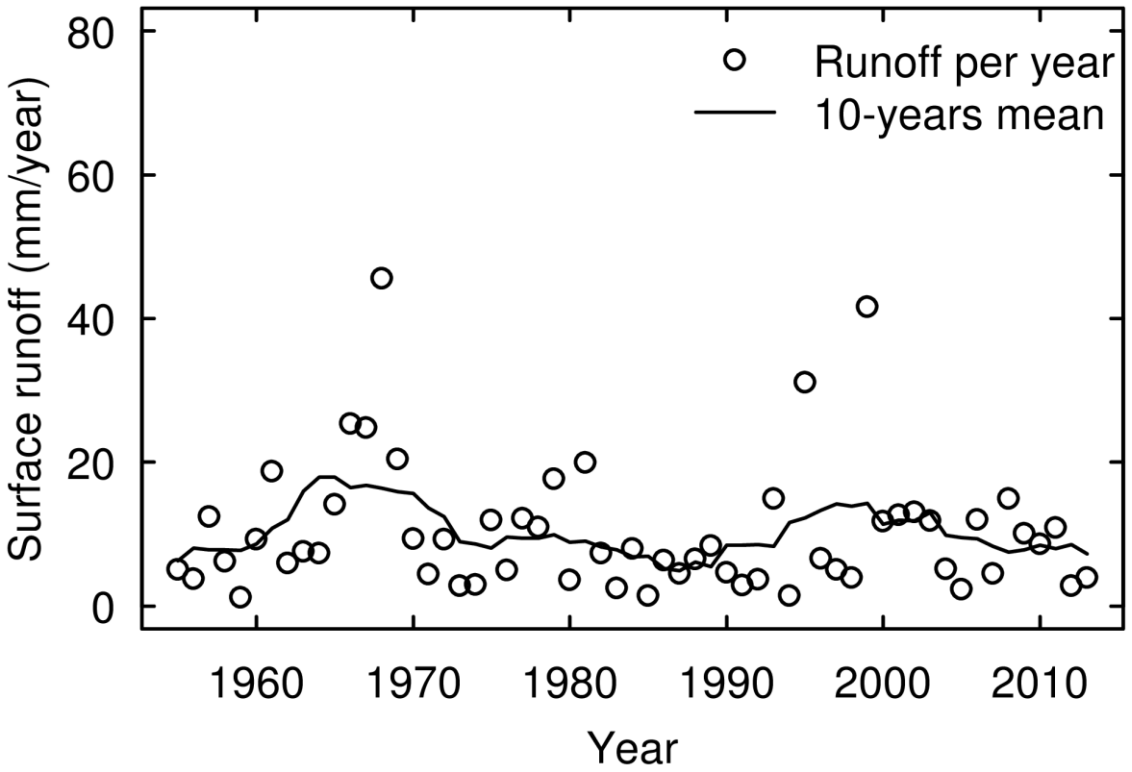
Slope	ET_0 (mm/year)
0°	791
15°	872 (+**81**)
30°	998 (+**207**)

Daily mean of ET_0 (Data from Geisenheim 2000-2013)



Surface runoff

- SCS (US Soil conservation service) Curve number method
- Soils are classified depending on **land use** and **infiltration ability** into tabled **CN-Values**, which were further adapted depending on antecedent soil moisture
- Empirical method , based on daily values



Station Geisenheim: Calculated surface runoff (SCS-CN method, CNII = 79, partly bare soil)

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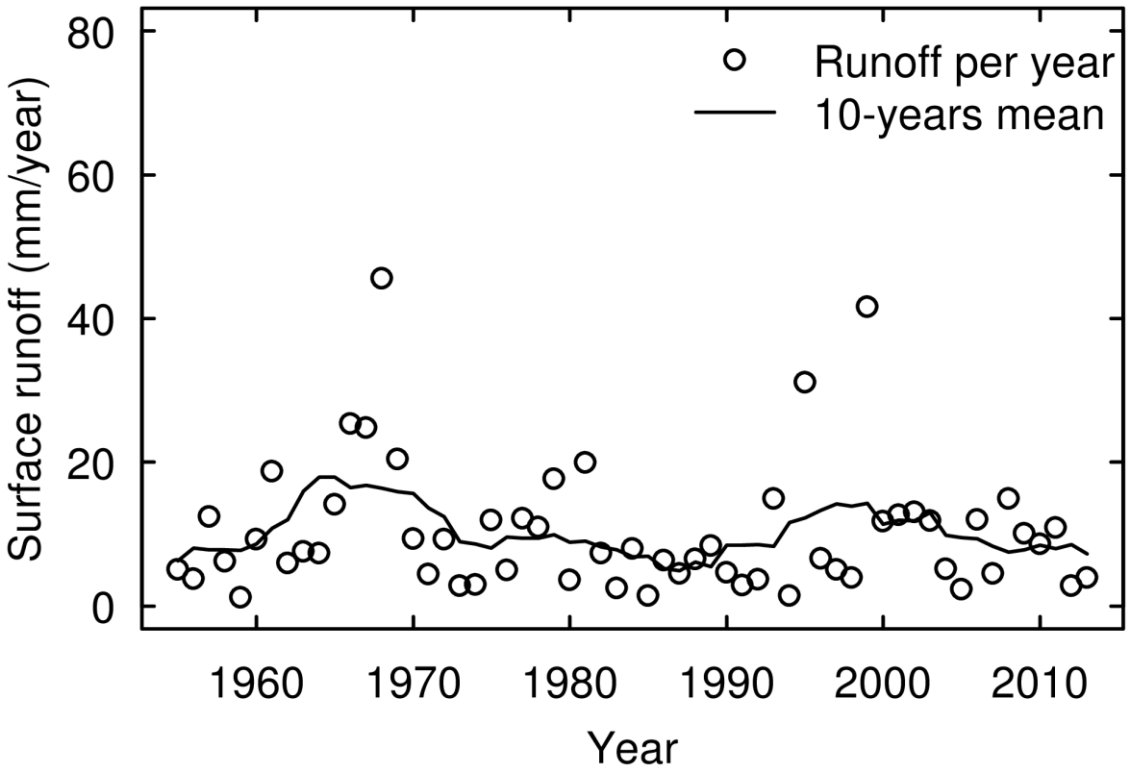

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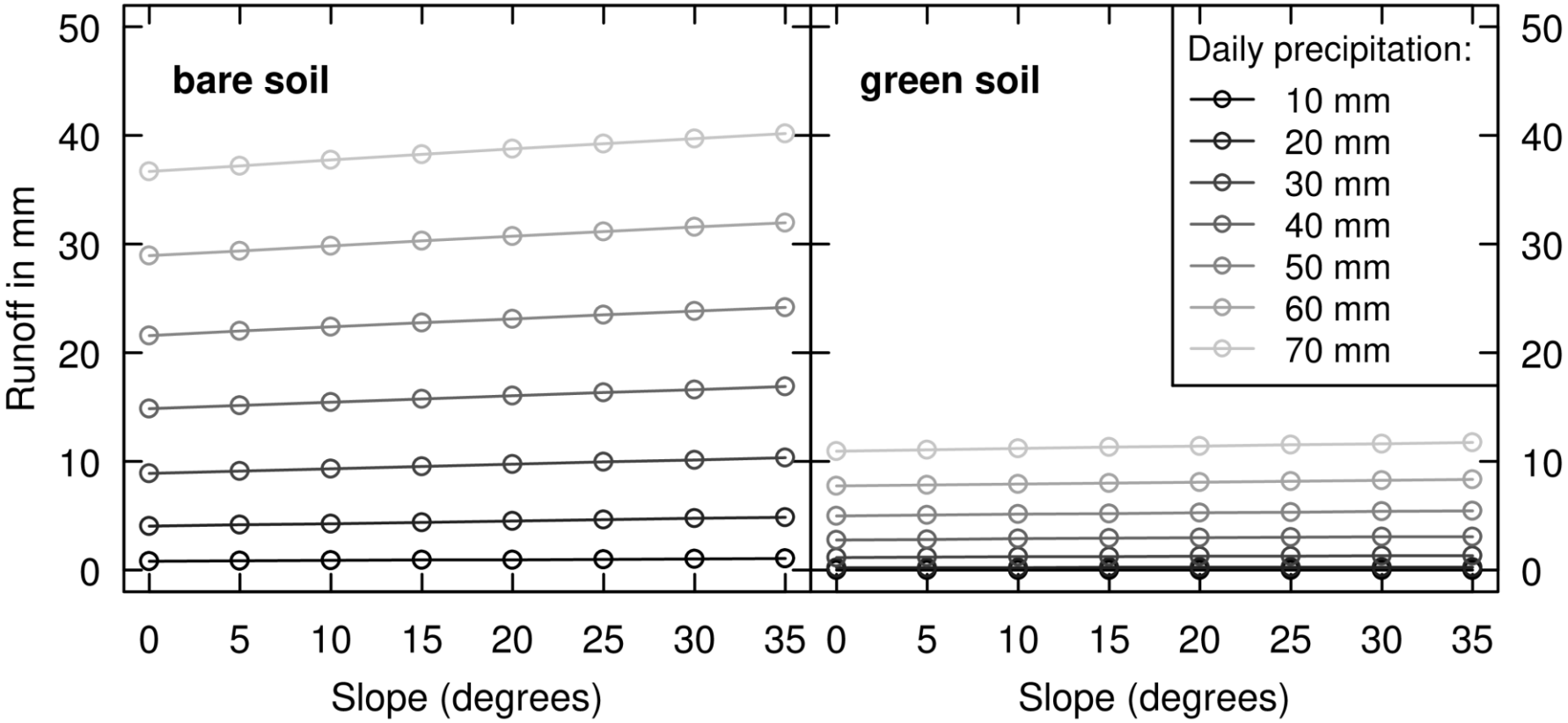
Surface runoff – impact of slope

- Little information about the impact of slope on runoff in literature
- **Land use** is much **more important** than **slope**



Calculated with an equation from Huang et al. (2006)

Validation of the soil water budget model for three different sites

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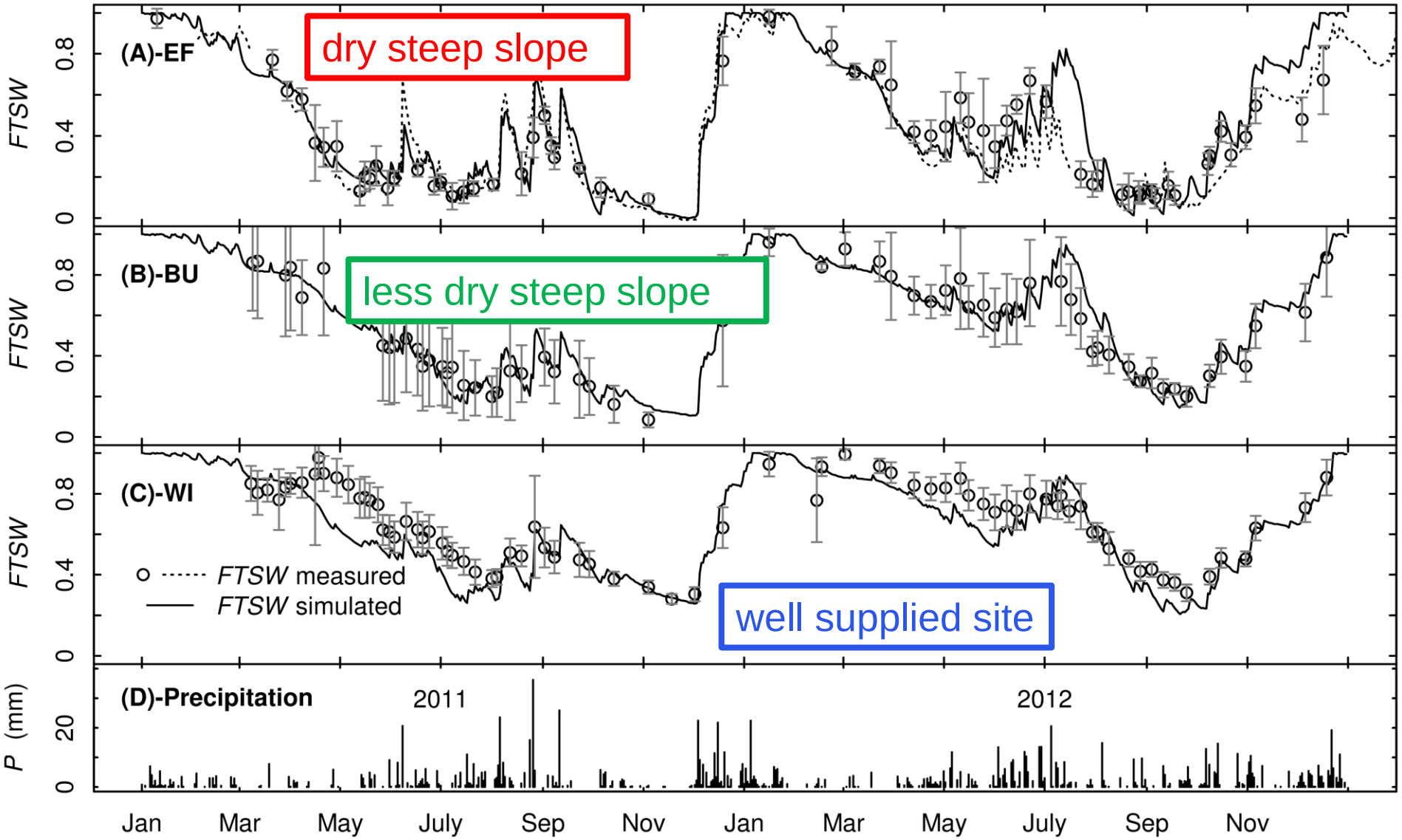

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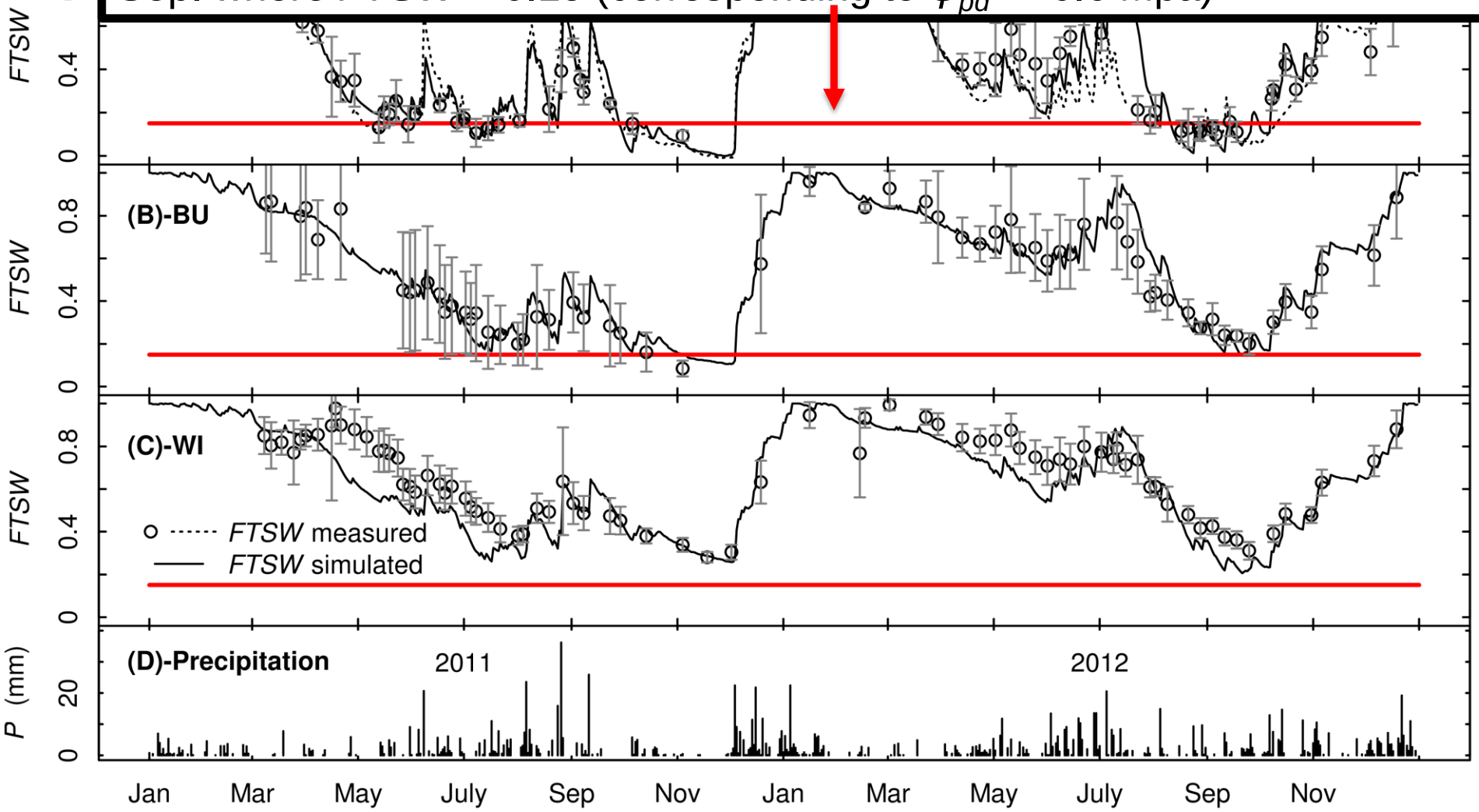
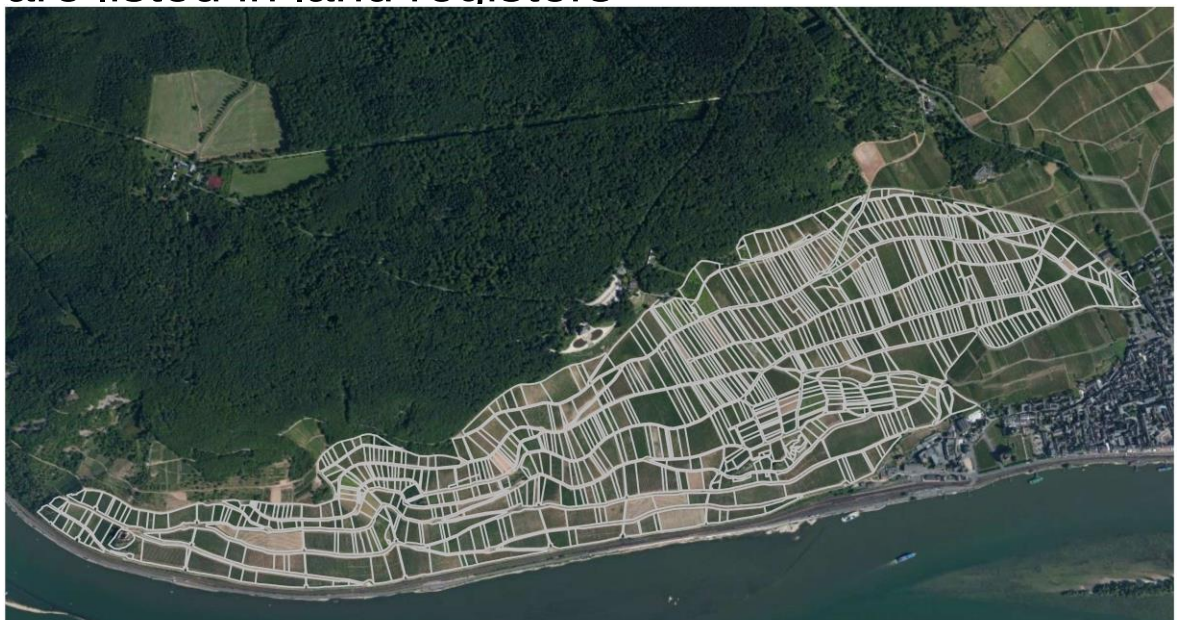
Indicator to assess drought stress risk: Number of days from May-Sep. where *FTSW* < 0.15 (corresponding to ψ_{pd} < -0.6 Mpa)



HOW TO BRING THE MODEL IN THE FIELD?

Calculation on the **scale of individual land parcels** as they are listed in land registers



- Set up database by a combination of a **digital elevation model** and **soil maps**, to extract **slope, aspect** , plant available **soil water of the vineyard** (up to 2 m soil depth), of the **cover crop reservoir** (up to 1 m soil depth) and the **total evaporable water of the bare soil**.

RISK ASSESSMENT FOR THREE SITES

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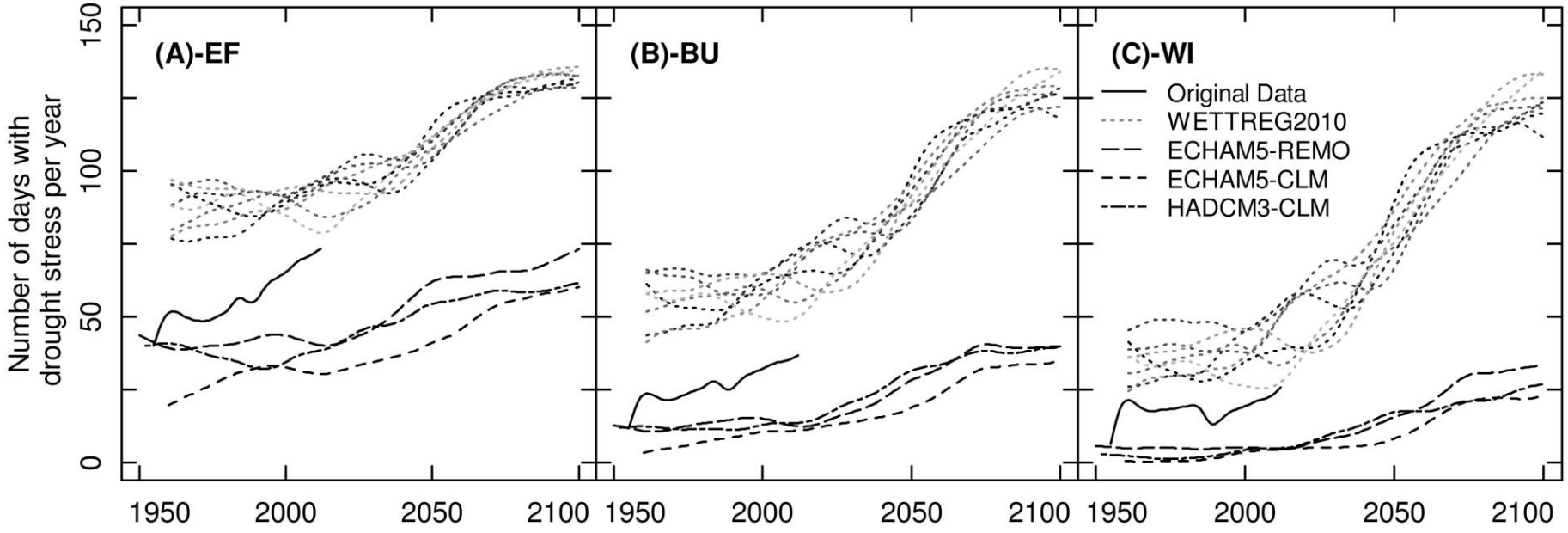
Number of days with drought stress per vegetation period, 30-year means



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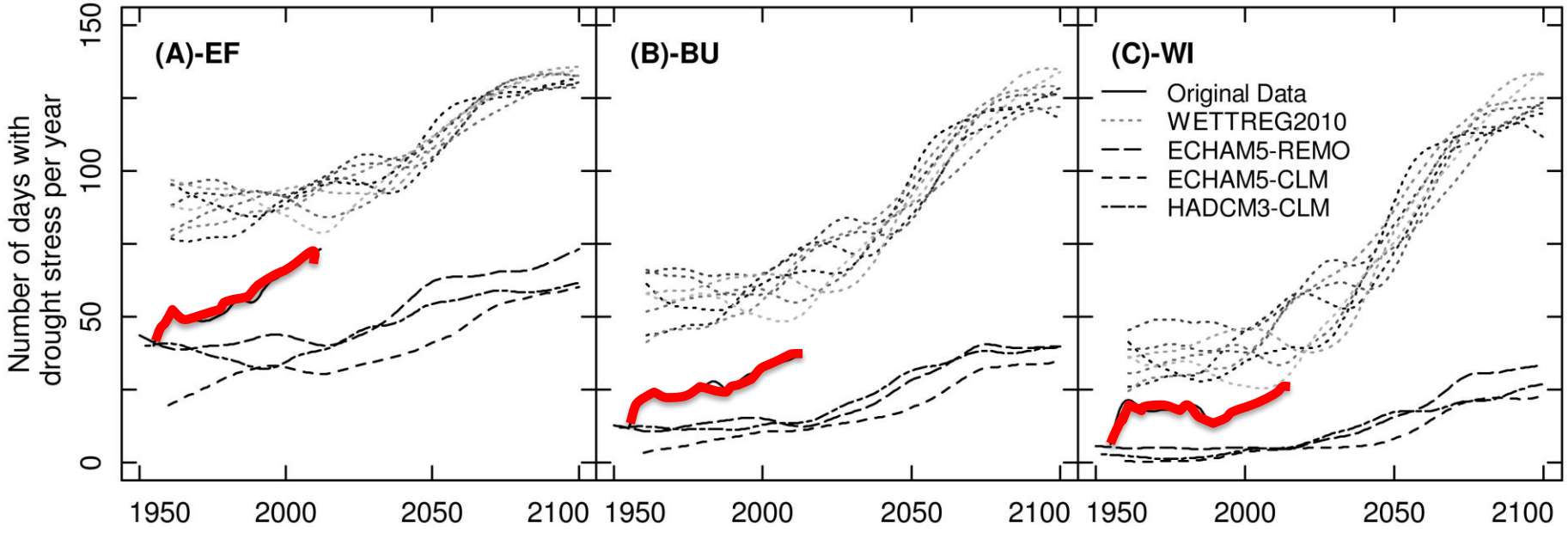

→ Absolut values of climate models are not meaningful

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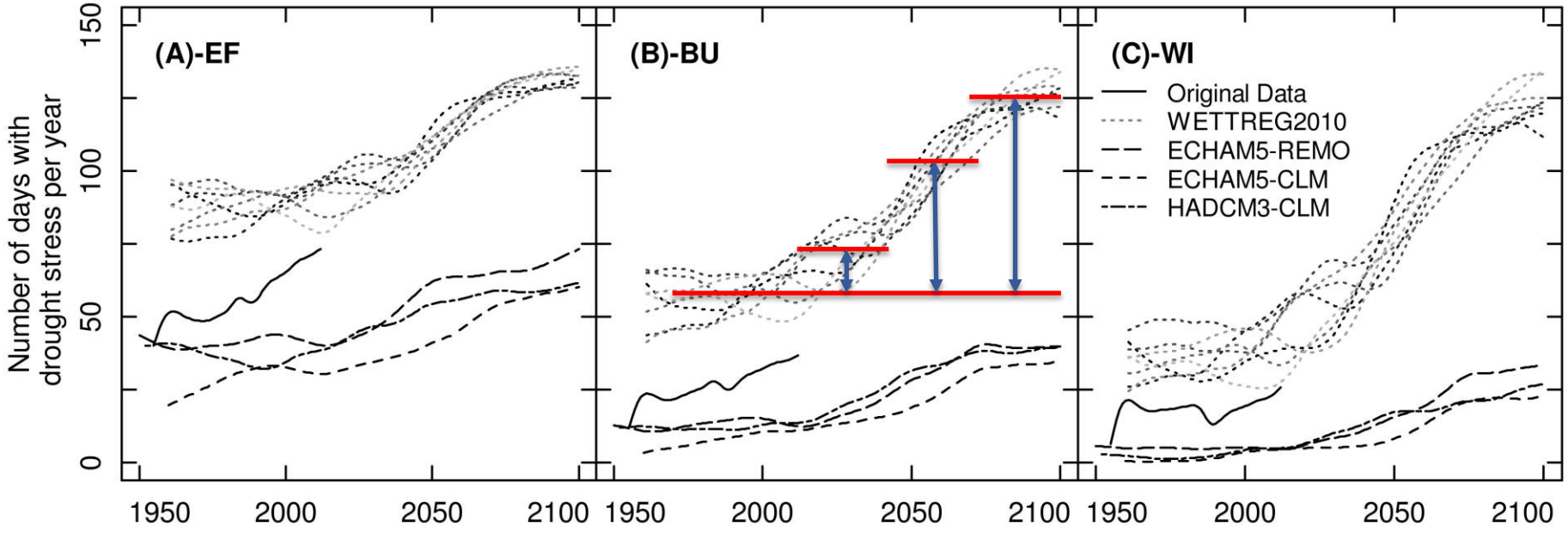
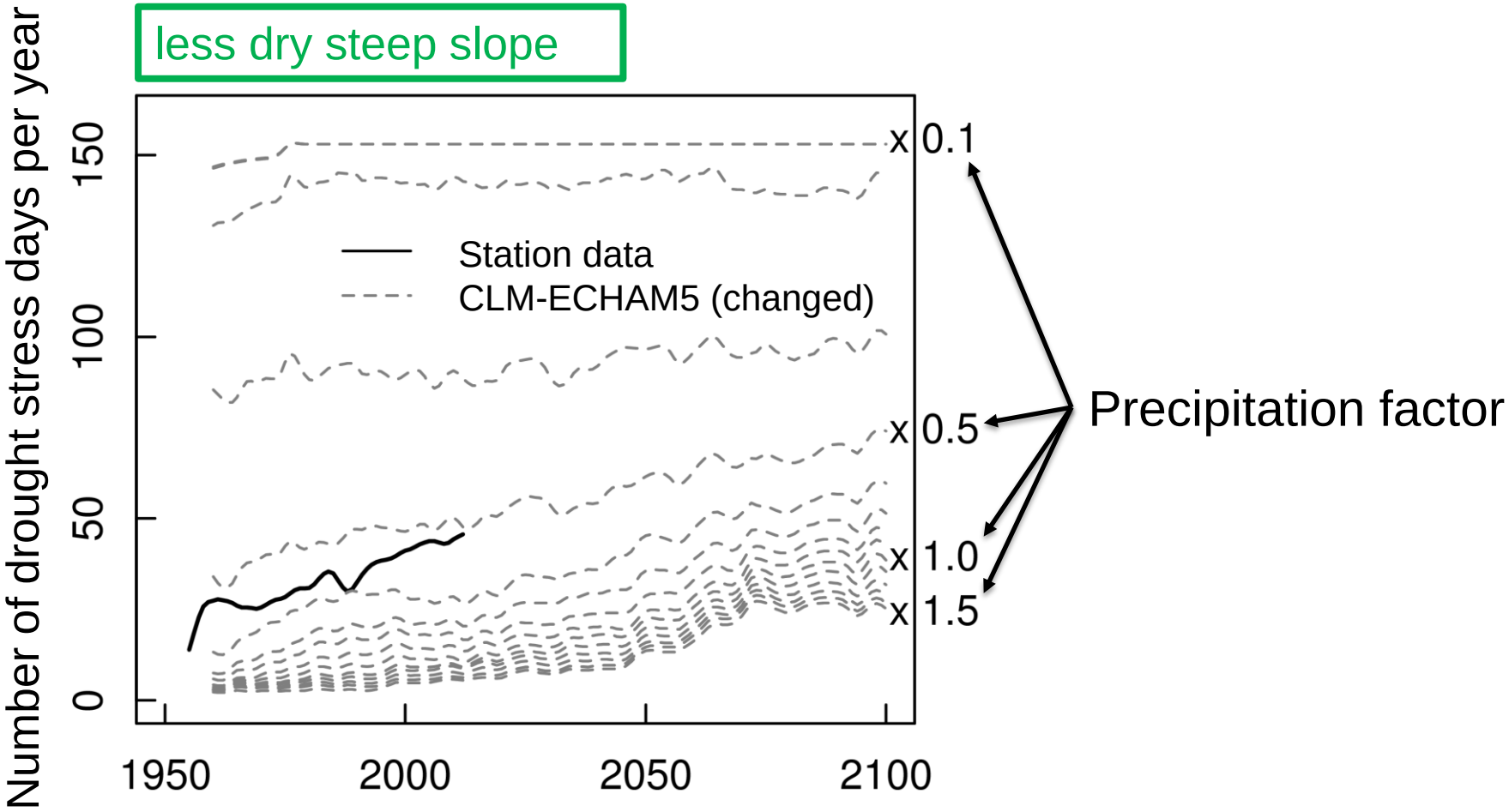


→ Absolut values of climate models are not meaningful

→ Model specific change signals are more reliable

Sensitivity of the impact model concerning to biases of precipitation



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CLM-ECHAM5: Change signals of drought stress days

Precipitation-factor	2011-2040 minus 1971-2000	2041-2070 minus 1971-2000	2071-2100 minus 1971-2000
150%	6	11	23
140%	6	11	23
130%	6	12	24
120%	7	13	25
110%	7	14	27
100%	7	14	28
90%	7	14	28
80%	6	15	28
70%	8	17	29
60%	8	17	27
50%	14	18	24

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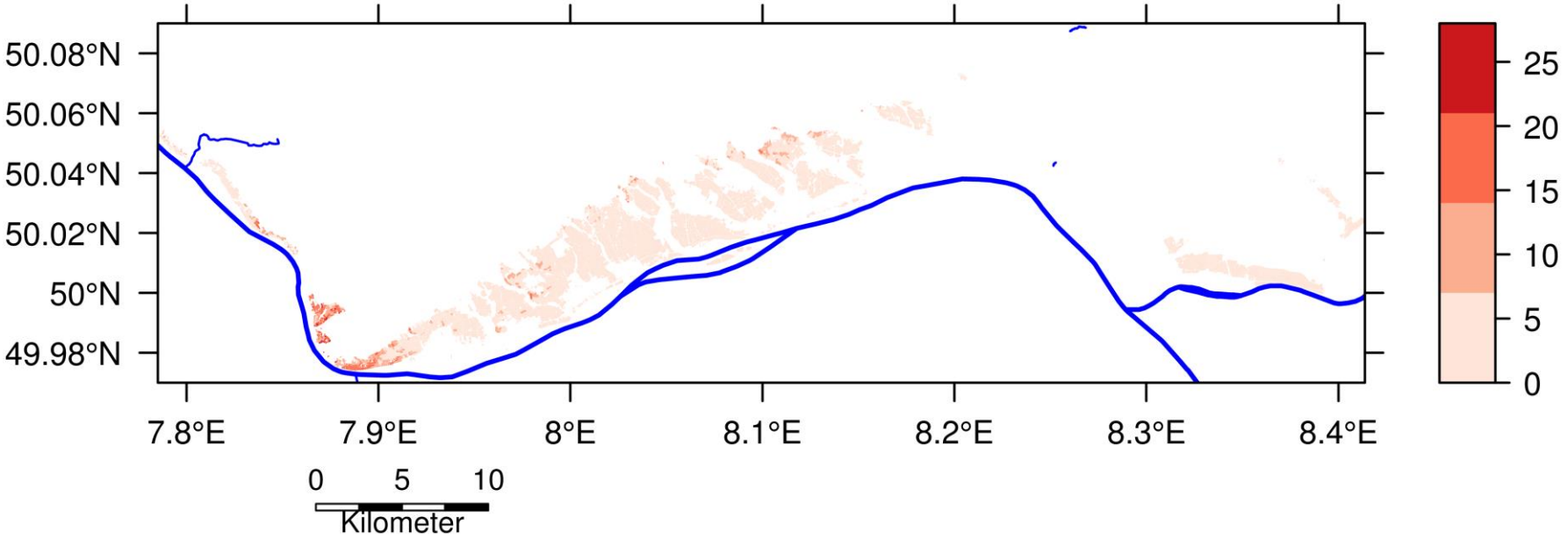
→ Change signals are quite stabile!

RESULTS IN THE FIELD?

REMO-UBA, Change signal of drought stress days, 2041-2070 minus 1971-2000, Rheingau



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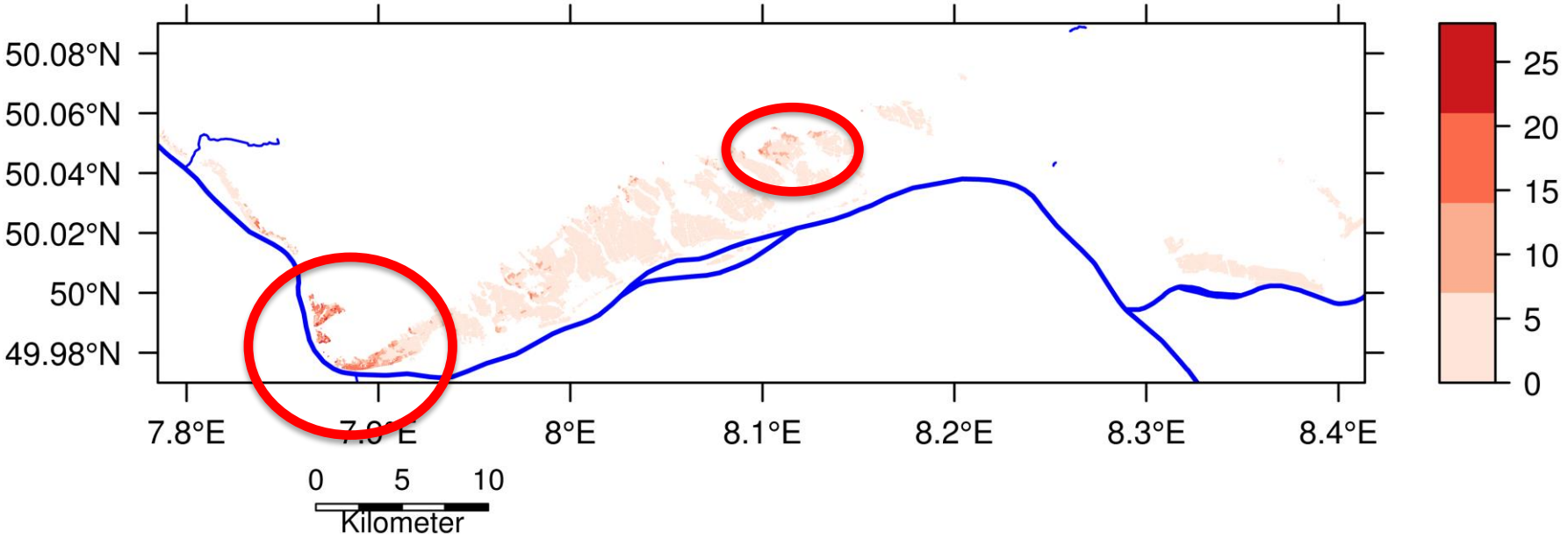
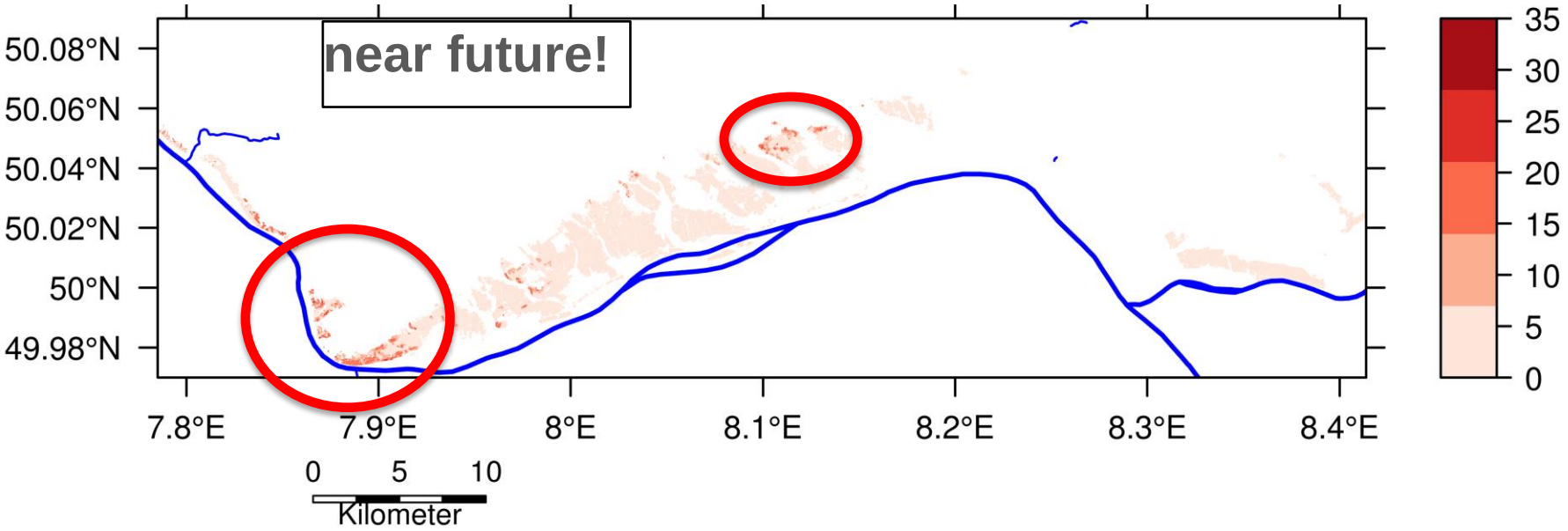


RESULTS IN THE FIELD?

WETTREG2010 (Wiesbaden), Change signal of drought stress days, Rheingau, 2011-2040 minus 1971-2000



CONCLUSION

- **Dynamic regional climate models project no serious increase of drought stress risk in the near future for wide parts of the Rheingau growing region, but steep slope regions are more affected**
- Possible risk areas are identifiable
- Questions like „In how many years (of the next ten or twenty) will it be neccessary to irrigate?“ are hard to answer, as they are largely affected by year-to-year variability effects and threshold values
- High resolution impact model studies are valuable tools to study climate change risk effects and help to develop adaptation strategies

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Acknowledgements

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Thank you very much for your attention!

Literature

Celette, F., Ripoche, A., and Gary, C. (2010). WaLIS--A simple model to simulate water partitioning in a crop association: The example of an intercropped vineyard. *Agricultural Water Management* 97**,** 1749-1759.

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Huang, M., Gallichand, J., Wang, Z., and Goulet, M. (2006). A modification to the Soil Conservation Service curve number method for steep slopes in the Loess Plateau of China. *Hydrological Processes* 20**,** 579-589

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