Regional activities: ETH Zurich

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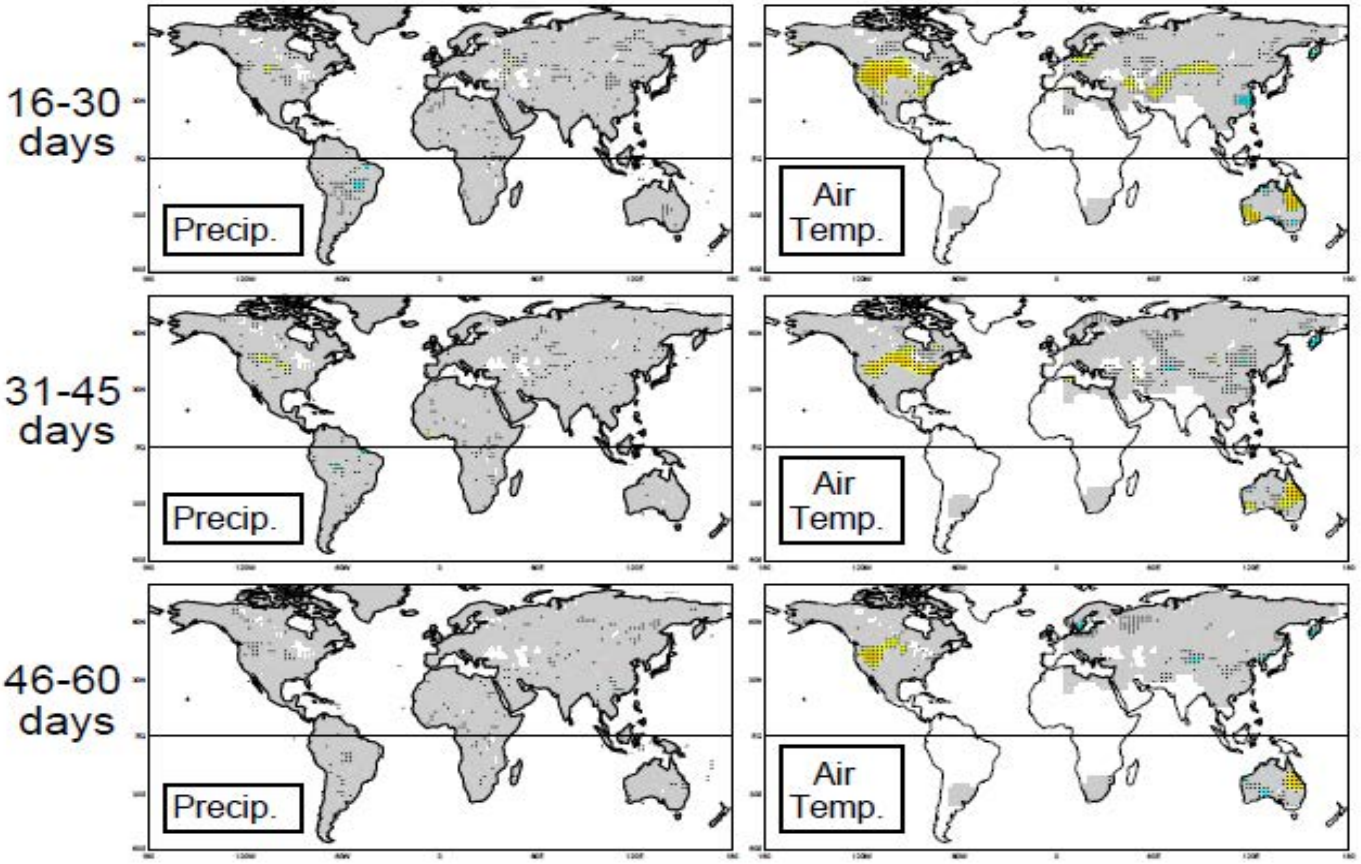
GLACE-2: Global analysis, skill from soil moisture initialization



GLACE-2: Despite satisfactory results for North America, overall global actual skill from GLACE-2 is low:

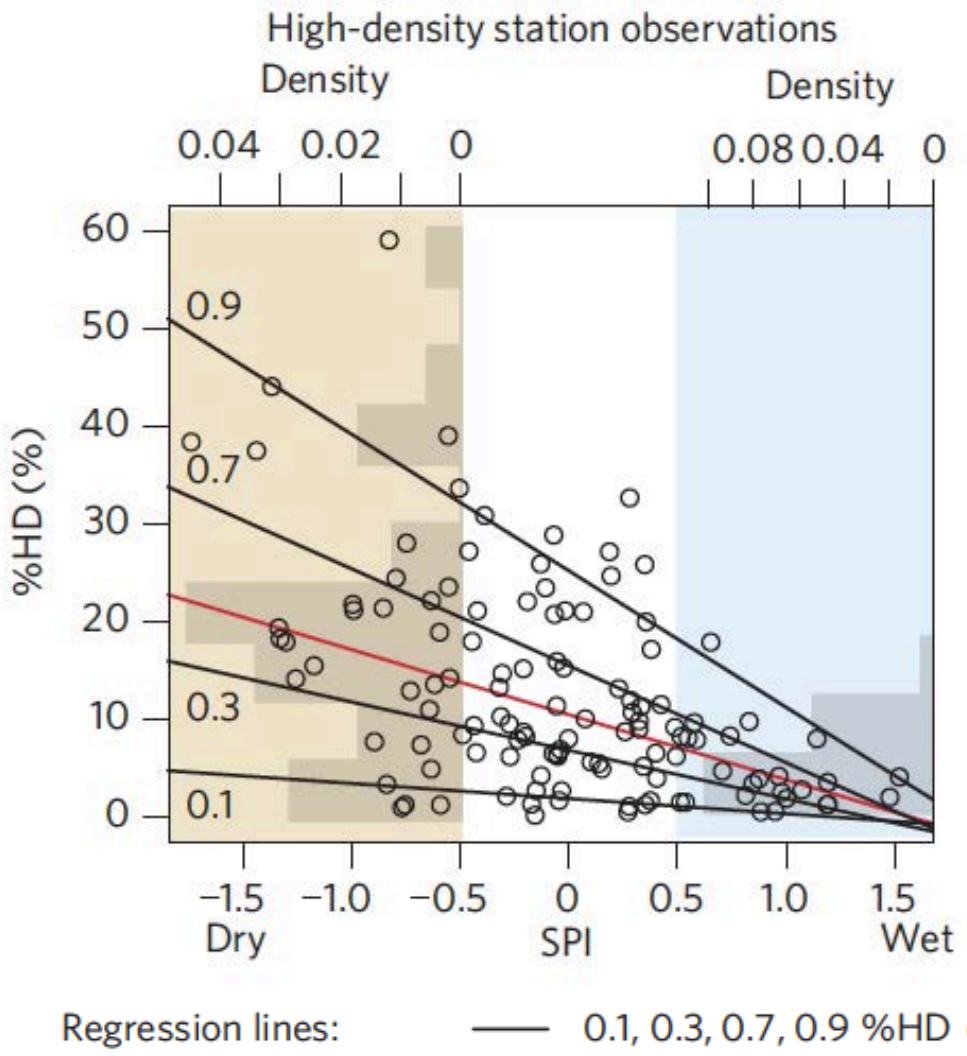
- **Underestimated skill?**

(Koster et al. 2011, JHM)

Soil moisture-temperature feedbacks: Extreme events

Analysis for Southeastern Europe

Quantile regression of percentage of hot days (%HD) with 6-month SPI



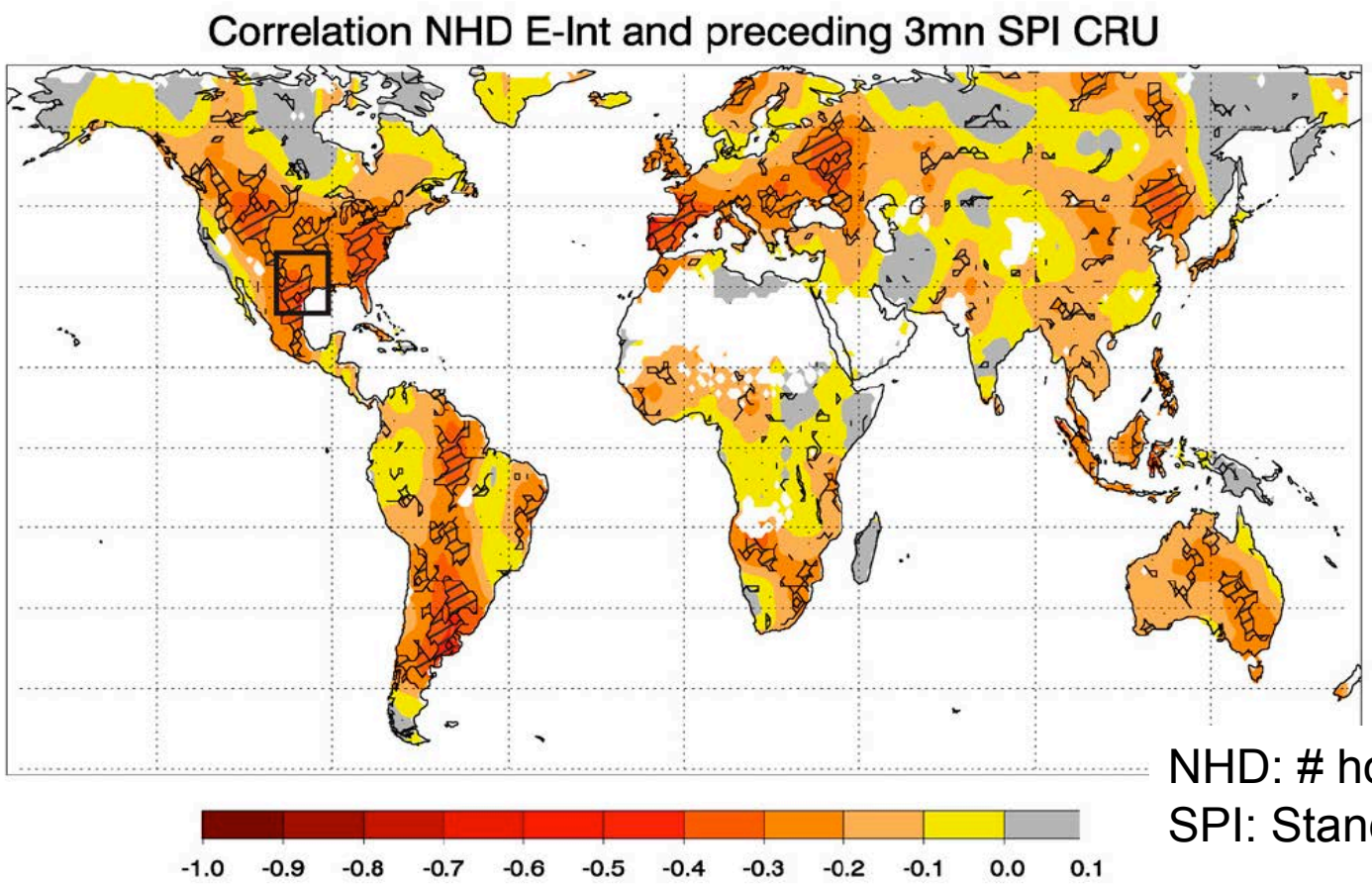
Ground observations reveal lag correlations between spring moisture conditions and summer hot extremes

➔ Suggests potential for forecast skill

(Hirschi et al. 2011, Nature Geoscience)

Soil moisture-temperature feedbacks

Global analysis for regional hottest month: Confirms strong lag correlation in several land areas (both northern and southern hemispheres)

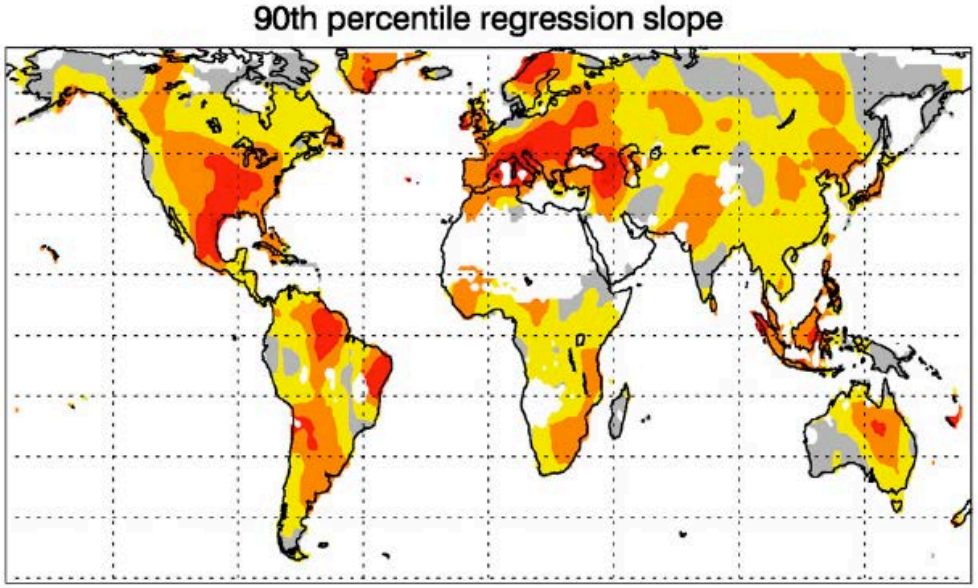


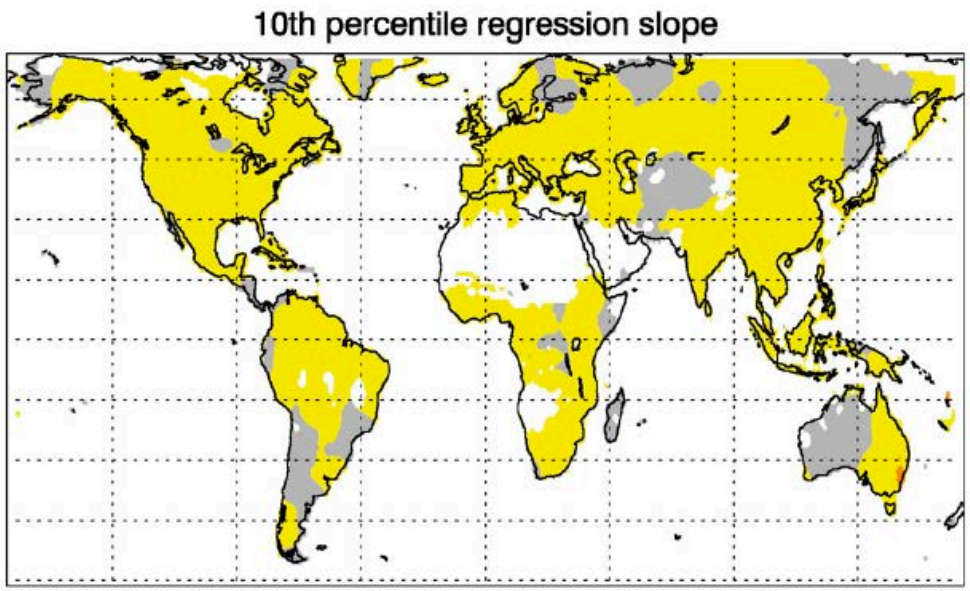
NHD: # hot days
SPI: Standardized Precipitation Index

(Mueller and Seneviratne 2012, PNAS)

Soil moisture-temperature feedbacks: Extremes

Quantile regression of NHD E-Int and preceding 3mn SPI CRU





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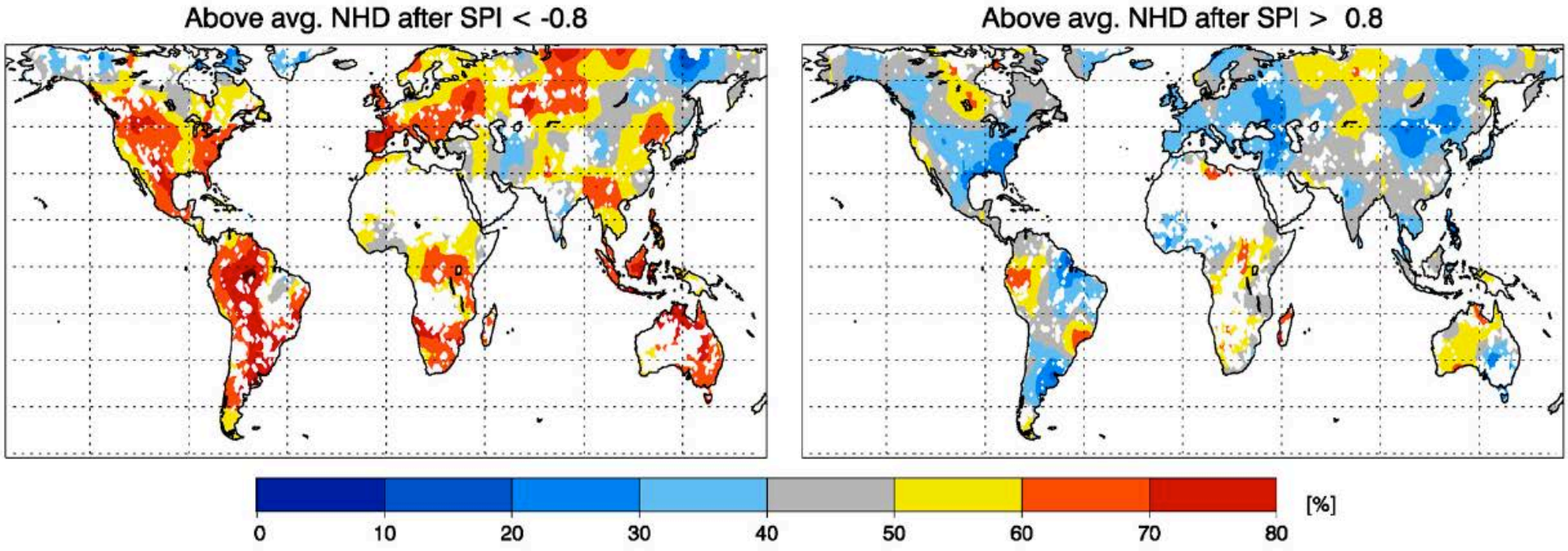
Soil moisture-temperature feedbacks: Extreme events

Link to forecasting: conditional probability



NHD: # hot days
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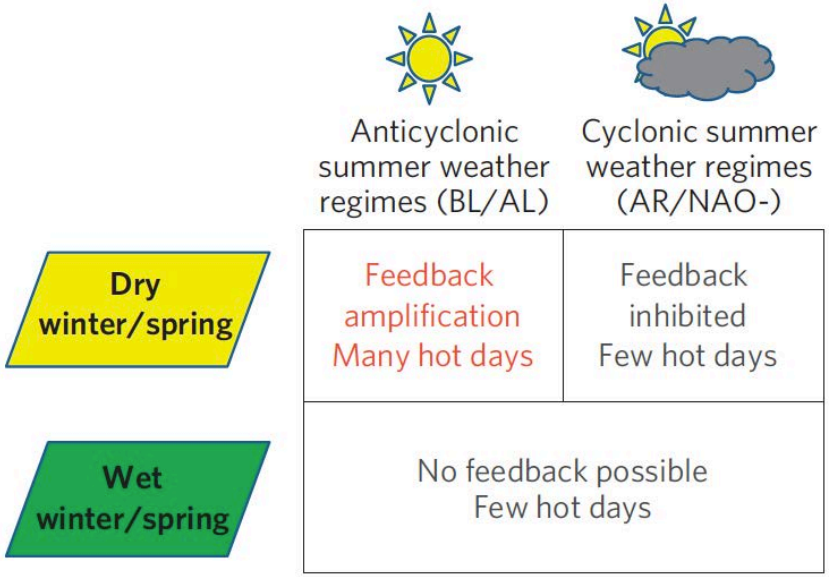
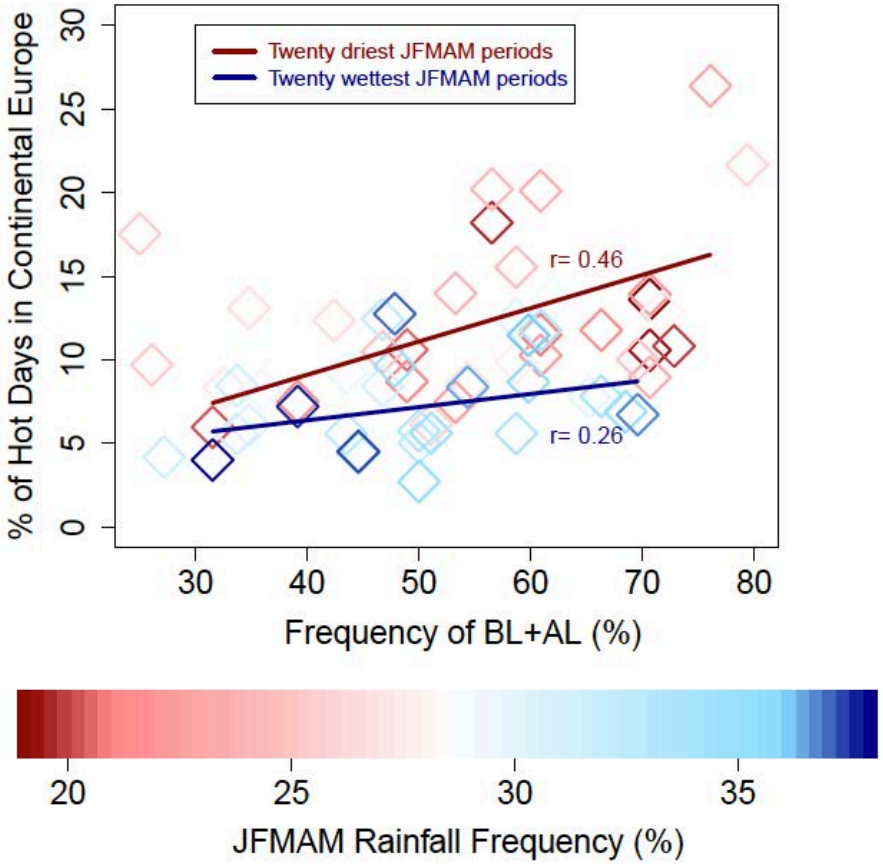
(Mueller and Seneviratne 2012, PNAS)

Combined roles of soil moisture & circulation

European analysis: High percentage of hot days found for combination of 1) dry springs and 2) anticyclonic summer weather regimes





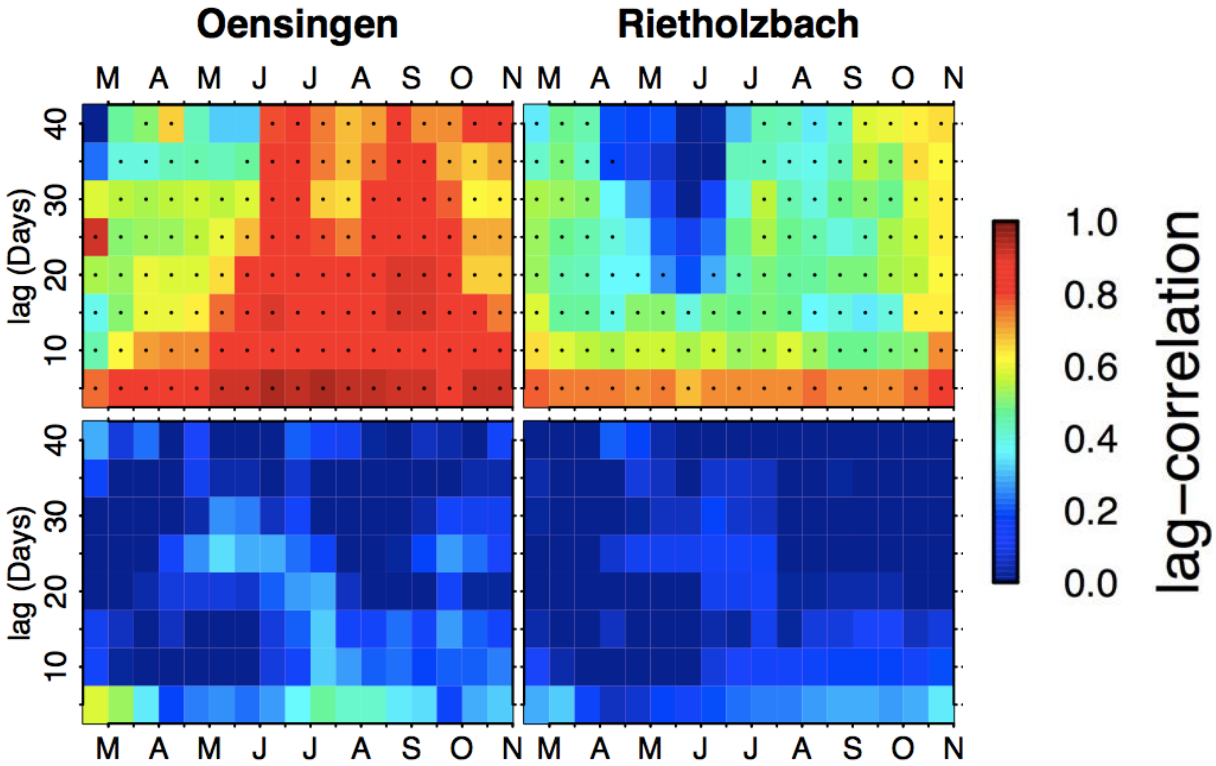
(Quesada et al. 2012, Nature Climate Change, published online)

Drought early warning and forecasting

- Soil moisture is characterized by long persistence
- This implies high potential for improved **early warning and subseasonal forecasting of drought based on land surface information alone** (from several weeks to several months)

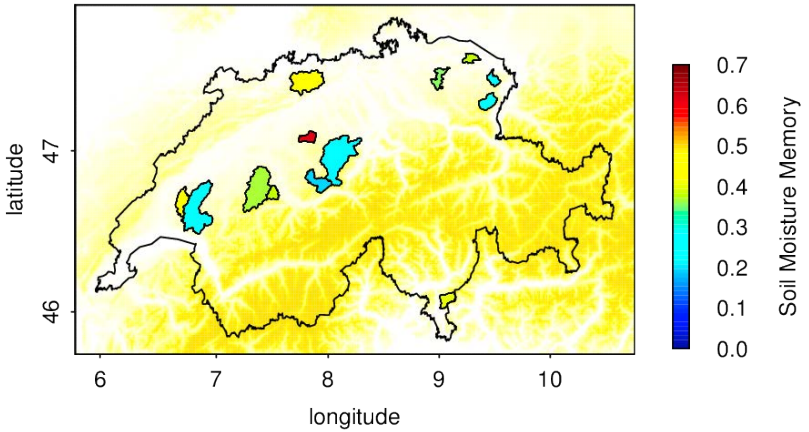
Soil moisture persistence ("memory")

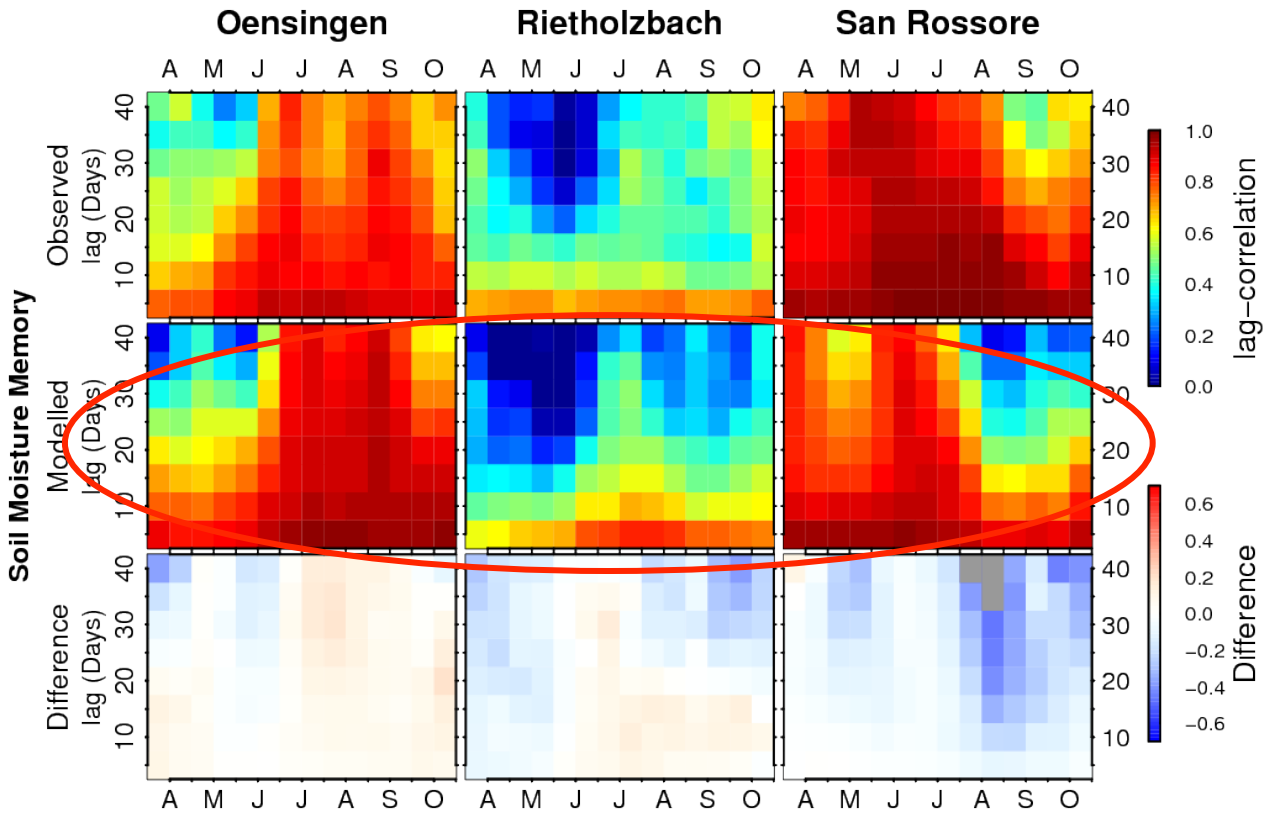
Temperature persistence

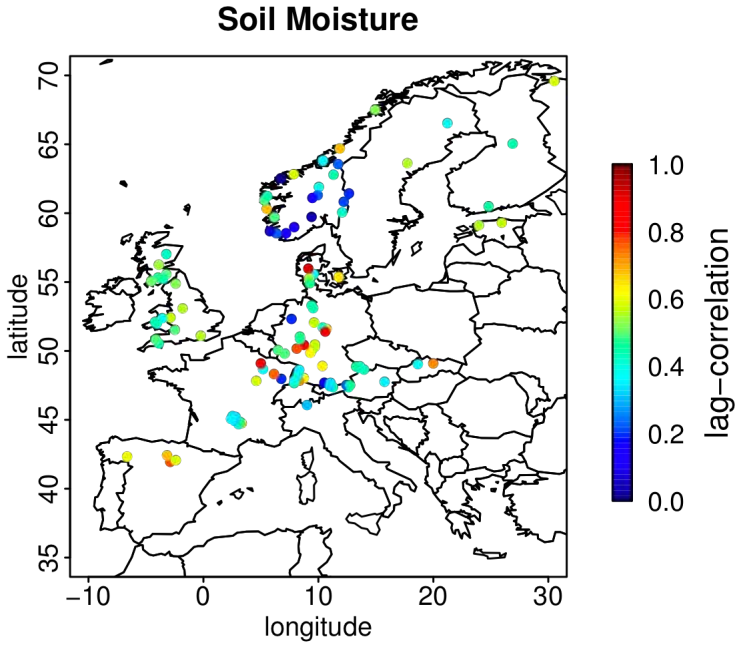


(Orth and Seneviratne 2012, JGR)

Drought early warning and forecasting



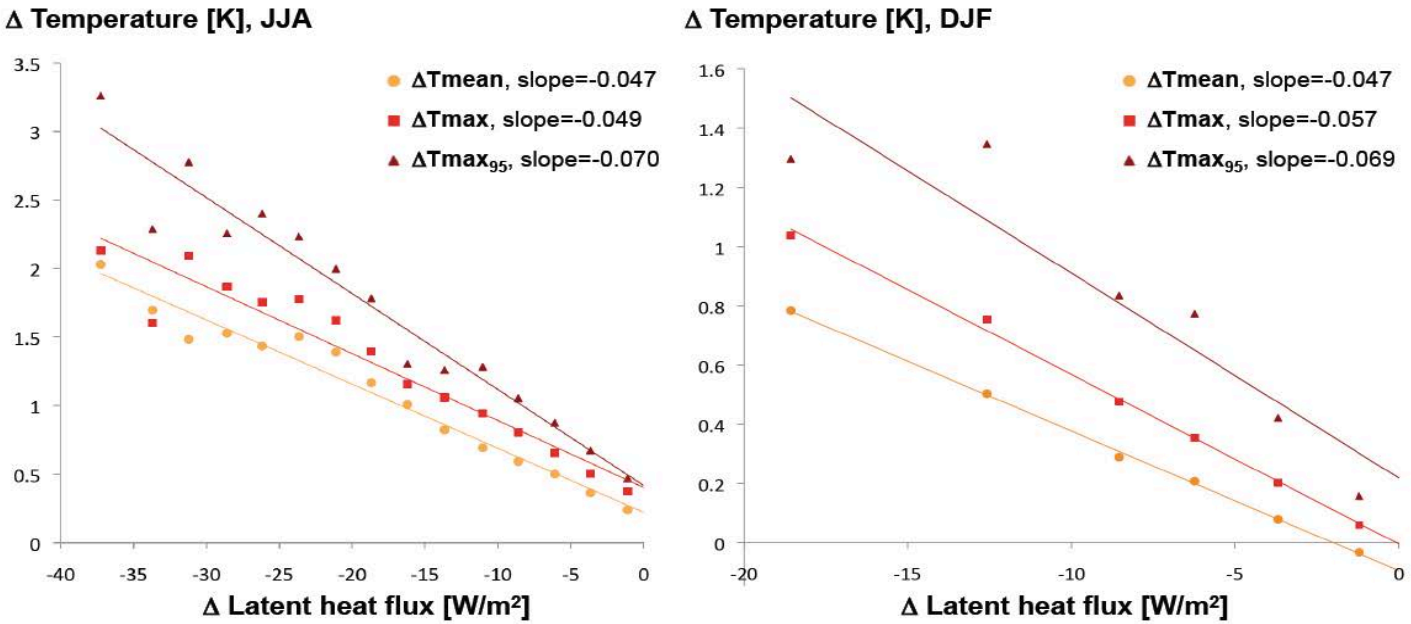




(Orth et al. submitted, JHM; Orth and Seneviratne, in prep.)

Soil moisture-temperature feedbacks in CMIP5 projections

GLACE-CMIP5: Assess impact of soil moisture-climate feedbacks for CMIP5 21st century projections (model participants: ECHAM6, GFDL, CESM, IPSL, EC-EARTH)



- Clear scaling between ΔLH and ΔT
- Different sensitivities for Tmean, Tmax, and Tmax95
- Effects of up to 3K

(Seneviratne et al. 2012, submitted)

Conclusions

- **Recent observations-based analyses suggest much stronger relationships between soil moisture deficits and temperature extremes than GLACE-2** on regional (Southern Europe) and global scale ➔ **Possible underestimation in GLACE?** (models' skill; only JJA; only 1985-1996, i.e. do not include more "extreme" recent years)

- **Developed new metrics** (e.g. quantile regressions SPI vs percentage of hot days) could be applied to seasonal forecasting ensembles (e.g. CHFP, SPECS) and to validate performance of GLACE-2 models

- Strong impact of soil moisture-temperature feedbacks for CMIP5 projections: **Relevant for decadal predictions?**