Satellite surface soil moisture trends in Austria

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1 Motivation & Science Questions

Climate studies have shown significant drying trends over southern Europe, while northern regions are more likely to experience wetting *[1][2]*.

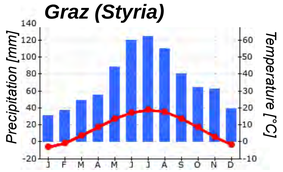
Austria (AT) is located in the transition region between north and south, where the development is still less clear. Since many sectors (e.g. agriculture, forestry, tourism) are threatened by a changing climate, it is an urgent need to investigate soil moisture (SM) trends in this region.

Science questions

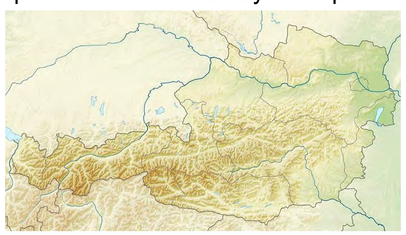
- Can **drying or wetting trends** be observed in satellite surface **soil moisture** data?
- Can observed trends be **related to changes in other climate variables**?

3 Methods

- Trend calculation using **Theil-Sen slope estimator**
- Separate analysis of **summer and winter months**
- **Masking** of urban areas, water bodies, mountain regions

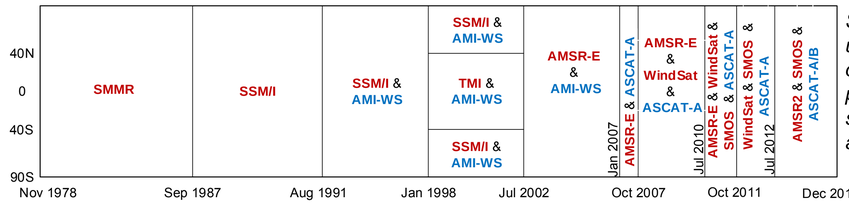


In Austria, more precipitation is falling in summer than in winter. The eastern part of the country is flat and dominated by agriculture, while the western part is characterized by the Alps.



2 Datasets

2.1 Soil Moisture



Sensor time periods used in the generation of the ESA CCI SM product. Passive sensors are in red, active sensors in blue.

The **ESA CCI soil moisture** (SM) product (http://www.esa-soilmoisture-cci.org) is a multi-decadal global satellite observed soil moisture dataset. The product combines various single-sensor active and passive microwave soil moisture products (see Figure above) into three harmonised daily products: ACTIVE, PASSIVE and COMBINED *[3]*. The operational production of these CDRs is being transferred to the EU Copernicus Climate Changes Services (C3S) (https://climate.copernicus.eu/).

2.2 Related variables

Soil moisture (SM), precipitation (P), potential evapotranspiration (Ep) and temperature (T) are all related through the water balance model. It is thus important to not only look at trends in one, but also in the related variables. The following datasets have been used in this study:

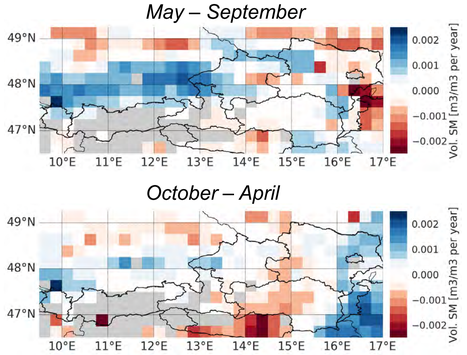
- **Precipitation (E-OBS Version 13.1):** daily dataset built up from quality controlled time series observed at over 10000 meteorological stations (in Europe) *[4]*
- **Potential Evapotranspiration (GLEAM v3.1a):** estimates of potential evapotranspiration based on observations of surface net radiation and near-surface air temperatures *[5][6]*
- **2m Air temperature (ERA-Interim):** based on climate reanalysis (combination of models and observations) *[7]*

All datasets have been analyzed for the **period 1992-2017**.

4 Results

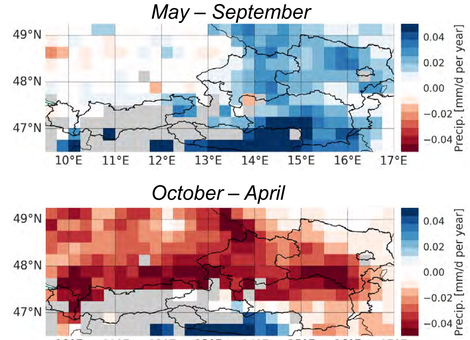
Soil moisture (SM)

- Heterogeneous trends
- Center: no significant trend in summer, drying trend in winter
- East: drying in summer, wetting in winter



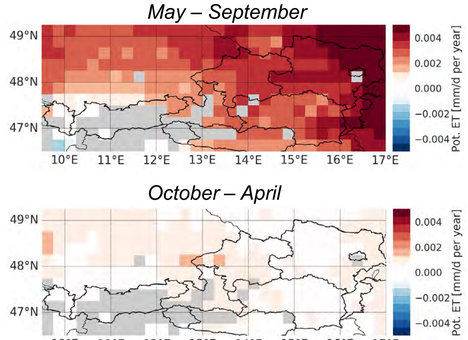
Precipitation (P)

- Trends similar over whole country, large differences between summer and winter
- Summer gets wetter, winter gets drier – seasons get more extreme



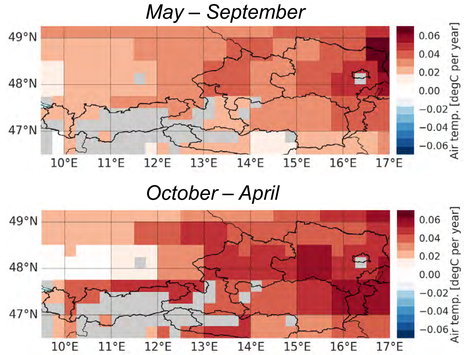
Potential Evapotranspiration (Ep)

- Higher and more variable in summer; strong increasing trends in this season
- Winter: less pronounced increasing trend
- Stronger trends in the flatlands of eastern AT

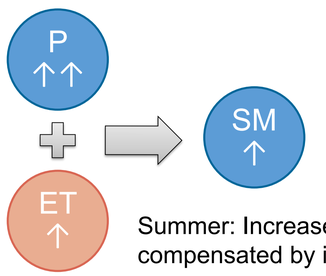


Air temperature (Ta)

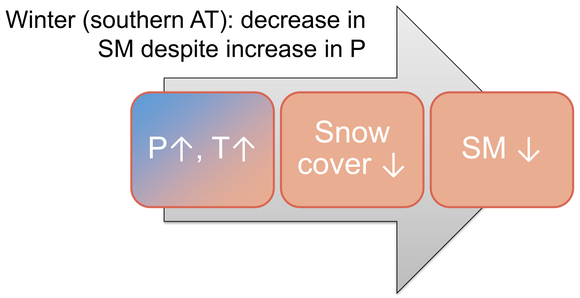
- Strong increasing trends both in summer and winter
- Stronger in the flatlands of eastern Austria than in mountainous western part of the country

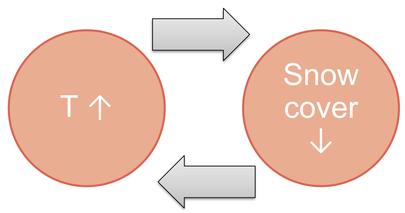


5 Discussion



Summer: Increase in P partly compensated by increase in ET





Stronger increase of T in winter than in summer

6 Conclusion

- **Both increasing (wetting) and decreasing (drying) soil moisture trends**
- **Partly possible to explain soil moisture trends** with trends in precipitation, potential evapotranspiration and air temperature
- **More datasets needed** (e.g. snow cover) to disentangle all effects

References

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