# Analysis of variability and trends in climate indices for the agricultural sector in Peru

K. Sedlmeier (1) , N. Imfeld (1) , S. Gubler (1) , C. Spirig (1) , K. Quevedo (2), C. Oria (2), C. Schwierz (1)

(1) Federal Office of Meteorology and Climatology MeteoSwiss, Zürich, Switzerland
(2) Servicio Nacional de Meteorología e Hidrología del Perú, SENAMHI

## Motivation

The agricultural sector depends strongly on climatic conditions during the growing season. Unfavorable weather and climate events, such as droughts or frost can lead to crop losses and thereby to large economic damages or life-threatening conditions.
In this context, it is of high interest to know about the climatic variability and trends of indices relevant for the agricultural sector during the different growing phases. This poster shows some first results of ongoing work within the Climandes project.

## Data & Methods

**Station Data:** Homogenized station data from SENAMHI for the Puno and Cusco regions [1,2]

**Gridded Data**: PISCO gridded dataset (5km resolution) [3]. For temperature the beta version was used Only data for grid points at elevations above 3000m were used

**Time period:** 1981-2010

All calculations and graphics were prepared using the R-package **ClimIndVis** (available on github June 2018).

## Indices

In user surveys, drought, frost and heavy precipitation were named among the meteorological conditions having the greatest effect on the harvest [4]. By expert opinion, indices were selected to represent each of these conditions. For results shown here, the following subset of indices was chosen:

| Index | | Definition | Relevant time period |
|---|---|---|---|
| **Heavy precipitation** | Rx7day | Maximum 7day precipitation | Nov-March |
| **Drought** | CDD | Maximum number of consecutive dry days | Nov-March |
| **Frost** | FD | Percentage of frost days (Tmin<0°C) | Dez-Feb |

## Results

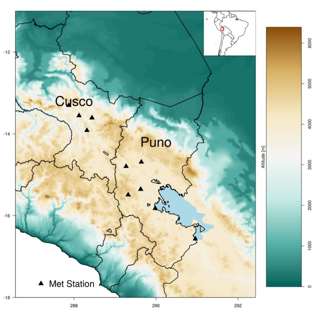

Fig. 1 Study area. For this analysis, all grid points with elevations higher than 3000m and 10 stations in the regions Puno and Cusco are considered. These are the pilot regions of the Climandes project.

### Drought

The number of CDD varies greatly within the study region. In the arid region towards the coast, spells span upto the whole time period whereas towards the amazon there are regions with no consecutive dry days. The interannual variability is also quite high. CDD does not show a significant trend in most of the study area for the months Nov-March.

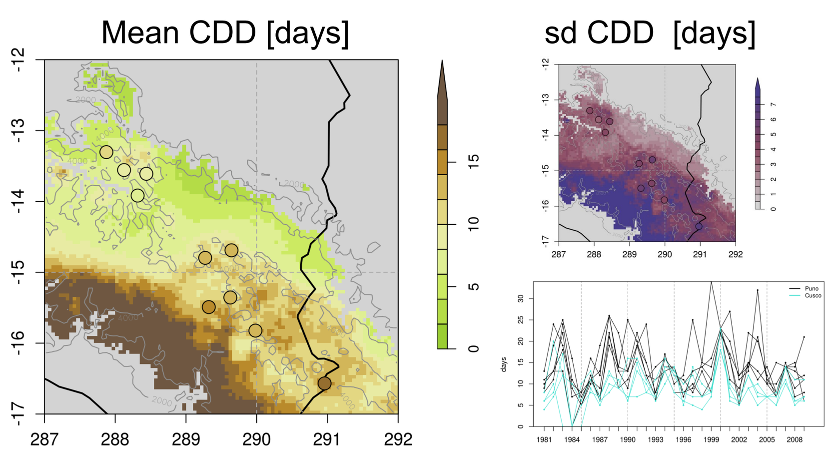


Fig. 2 Climatological mean (left) standard deviation (top right) of maximum number of consecutive dry days for Nov-March (1981-2010). Additionally time series of the 10 stations are shown bottom right).

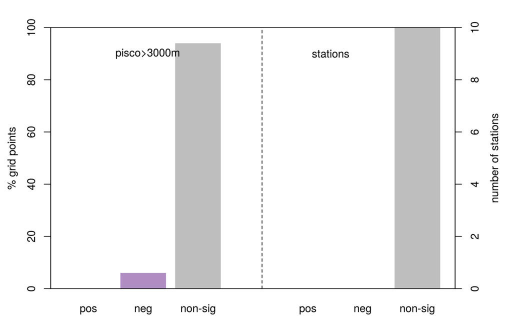

Fig. 3 Percentage/no of stations with a significant positive and negative trends as well as non-significant trends. CDD shows no notiveable trend in the study region.

### Heavy precipitation

The maximum 7-day precipitation lies between 40 and 140 mm in the study area with with standard deviations of up to 40mm (Fig.4).
Around 40% of the grid points show a significant positive trend as do two out of ten stations (Fig. 5). This is in accordance with the trend of mean precipitation for the same time period (not shown).

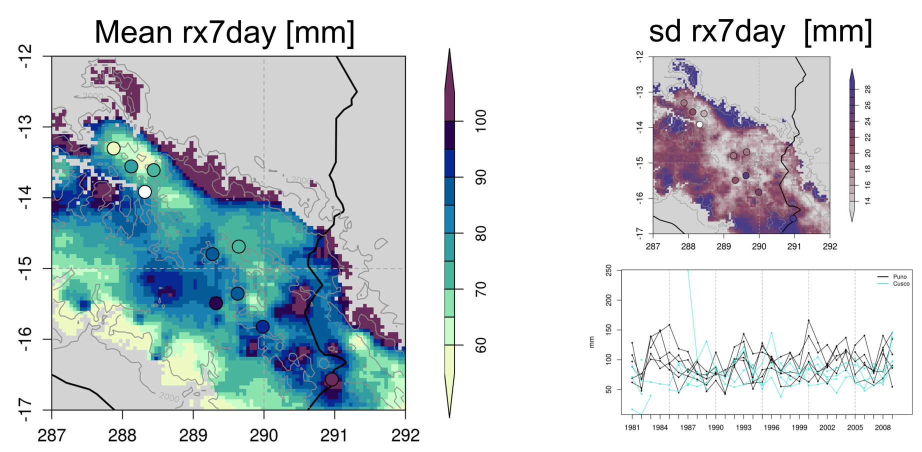


Fig. 4 Climatological mean(left) standard deviation(top right) of maximum 7-day precipitation for Nov-March (1981-2010). Additionally time series of the 10 stations are shown bottom right).

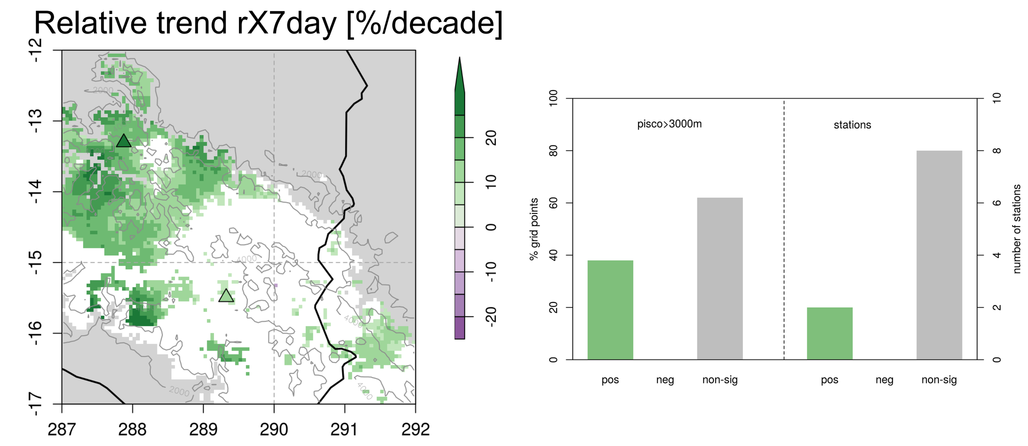


Fig. 5 Relative trend (left) and boxplots showing the percentage/no of stations with significant positive and negative trends as well as non-significant trends (right) for Nov-March (1981-2010).

### Frost

The percentage of frost days varies between 0 and 100% in the study area. In areas with non-zero percentages, the standard deviation is shows values up to 18% (Fig.6). The values were calculated in %days rather than days to lower the effect of missing values in the station data.
60% of the PISCO grid points show a significant negative trend while none of the stations shows any significant trend (Fig.7).

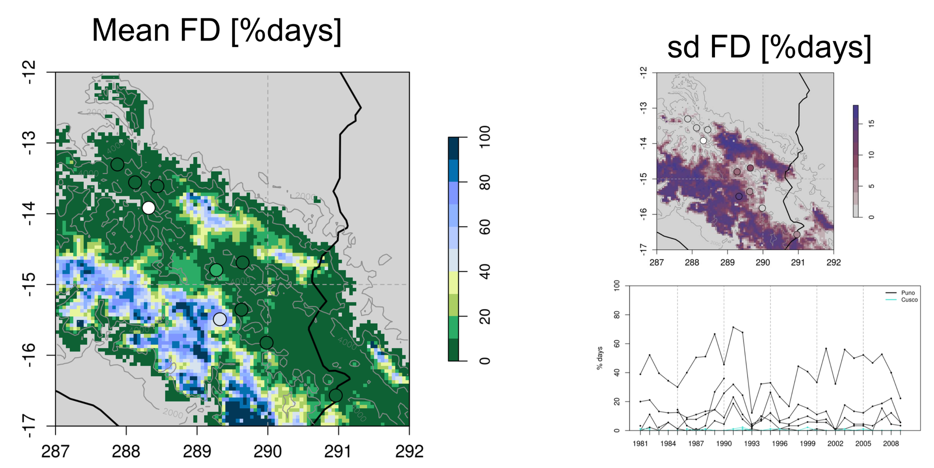


Fig. 6 Climatological mean (left) standard deviation (top right) of the percentage of frost days for DJF (1981-2010). Additionally time series of the 10 stations are shown (bottom right).

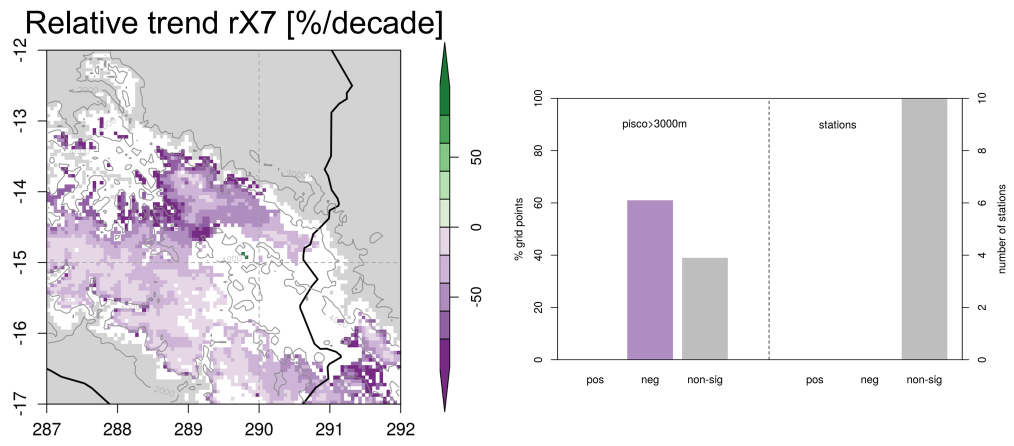


Fig. 7 Relative frost day trend (left) and boxplots showing the percentage/no of stations with significant positive and negative trends as well as non-significant trends (right) for DJF (1981-2010).

## Conclusions

- The mean climatological values of all indices vary greatly within the region due to the complex topography. All three indices show a high interannual variability.
- While the drought occurrence has not significantly changed, the selected indices for heavy precipitation/frost show an increasing/decreasing trend for parts of the study area. Trends between station data and gridded data do not always match and the results have to be taken with care because of the short record and data quality issues.

## Outlook

⇒ Further analyses with other datasets and longer time series for more robust results
⇒ Expand analysis to further indices and time periods which are relevant for the agricultural sector
⇒ Compare results to user perceptions on climate change and variability

## References

[1] Gubler, S., et al. (2017). *The infuence of station density on climate data homogenization*. International journal of climatology, 37(13):4670-4683.
[2] Hunziker, S., et al. (2017). *Identifying, attributing, and overcoming common data quality issues of manned station observations*. International journal of climatology, 37(11):4131-4145.
[3] Aybar, C., et al. (2017). *Uso del Producto Grillado "PISCOP" de precipitación en Estudios, Investigaciones y Sistemas Operacionales de Monitoreo y Pronóstico Hidrometeorológico.* Nota Técnica 001 SENAMHI-DHI-2017, Lima-Perú.
[4] Field study conducted within the Climandes project by M.Flubacher, N.Paredes et al. (publication in preparation)

Contact: www.meteoswiss.ch/climandes
Katrin.Sedlmeier@meteoswiss.ch