# #TEAM-DISENTANGLEMENT

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Agenda

# Temperature variation



Mean Temperature (R1)

- Mean temperature from simulation results R1 over the whole simulation time
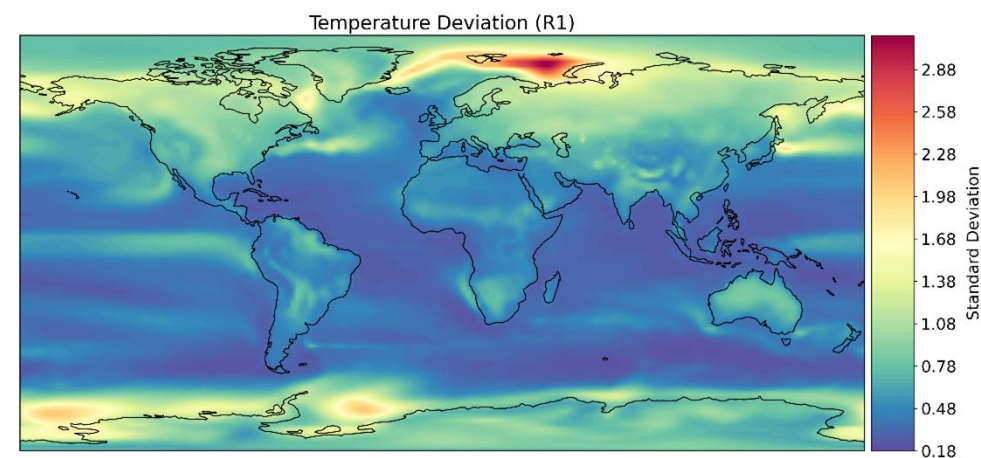
- Region-dependent temperature
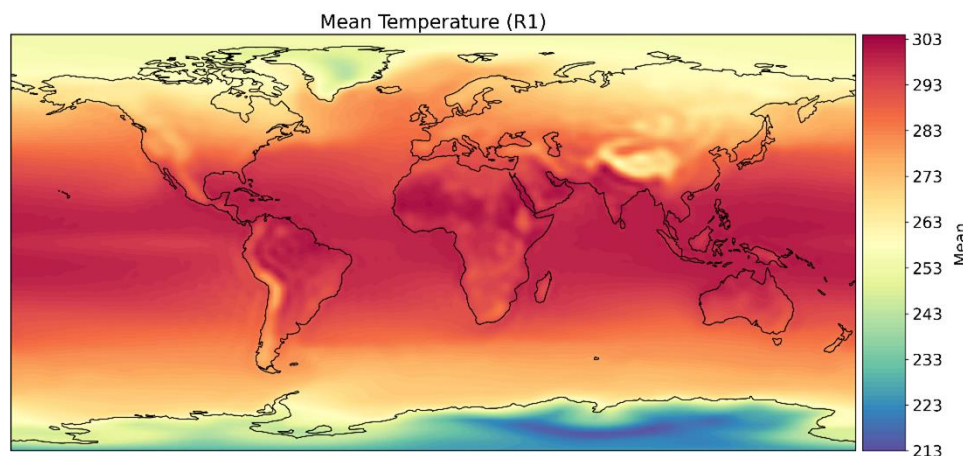
- Standard deviation from simulation results R1 over the whole simulation time

- Highest temperature variations around the north pole

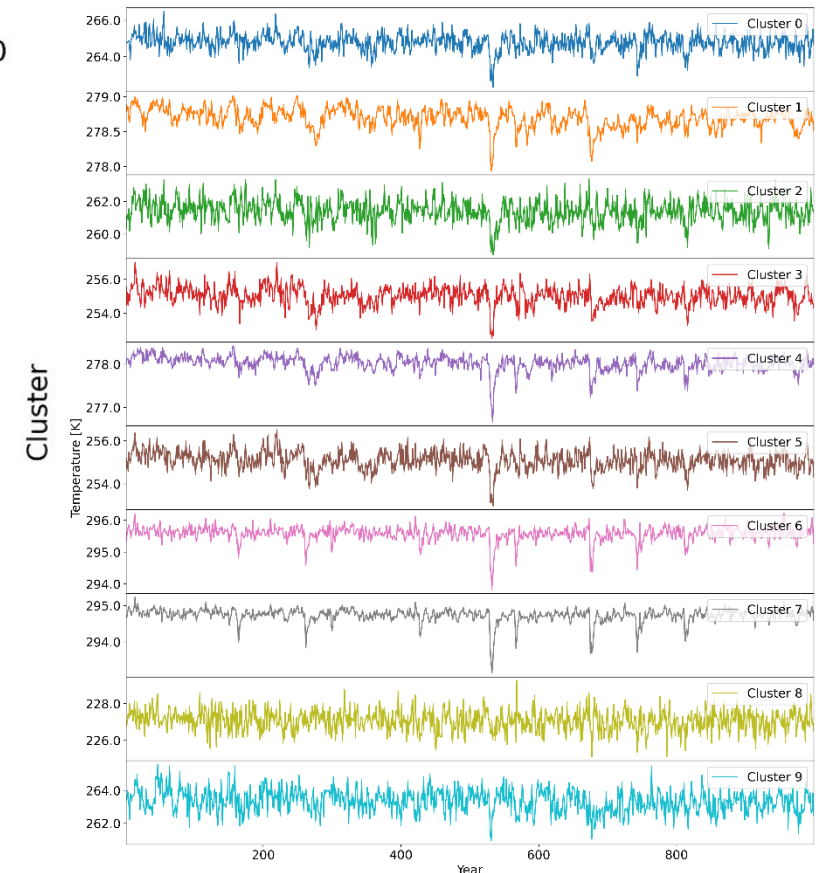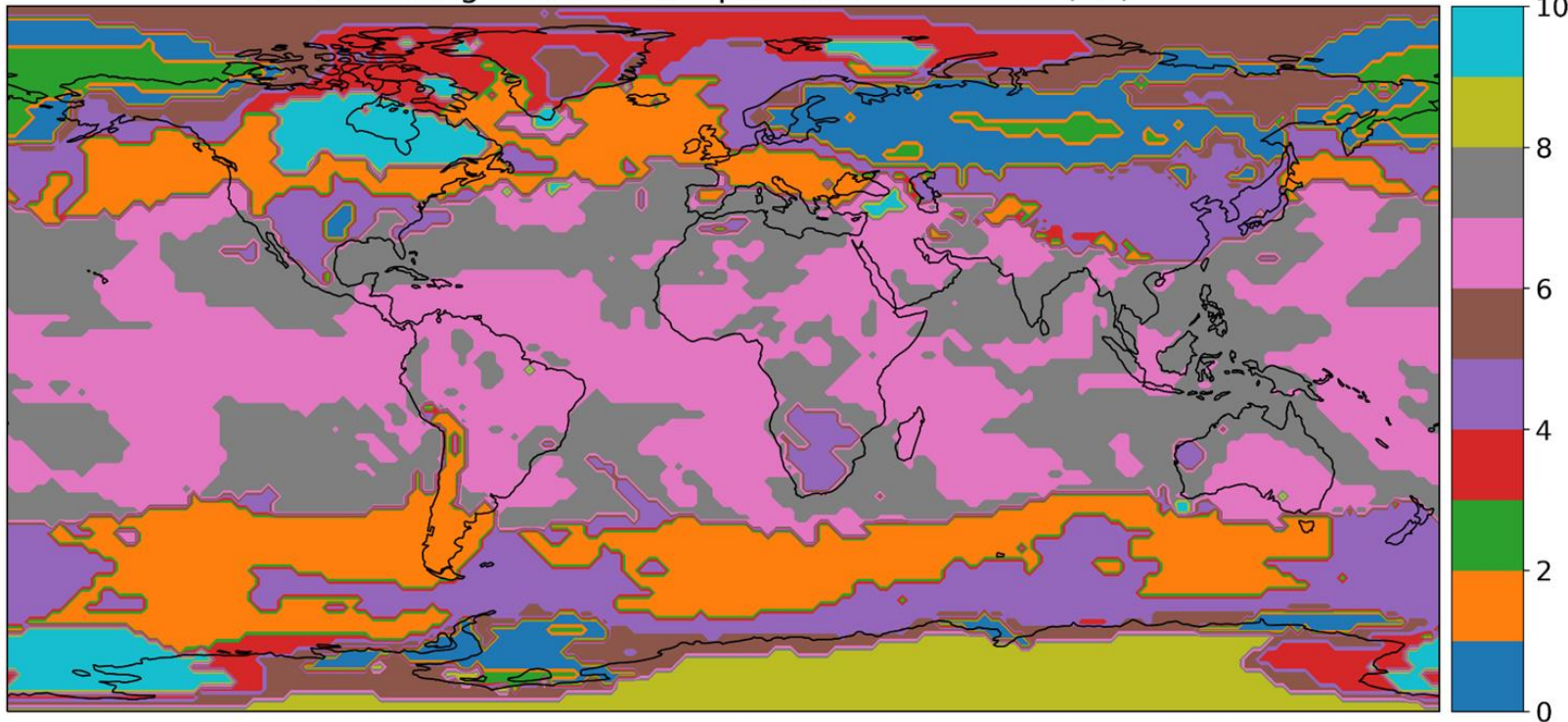

Temperature Deviation (R1)

# RQ1: Can we disentangle volcanic and solar forcing by region selection?

Hypothesis: We can disentangle volcanic and solar
forcing through region selection

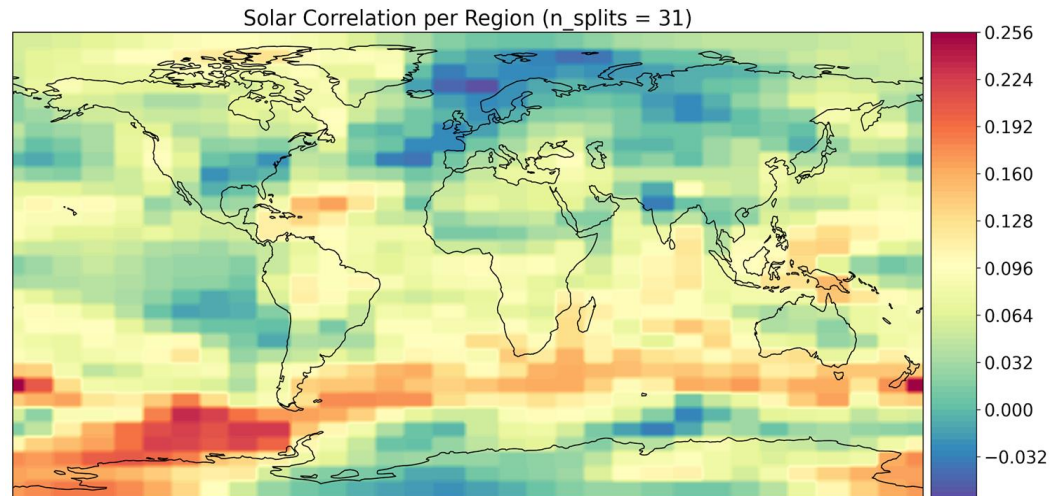# RQ1.1: Disentanglement based on temperature time series data

Selection of regions via k-means clustering based on the temperature differences T(yr)-T(yr-1) time series

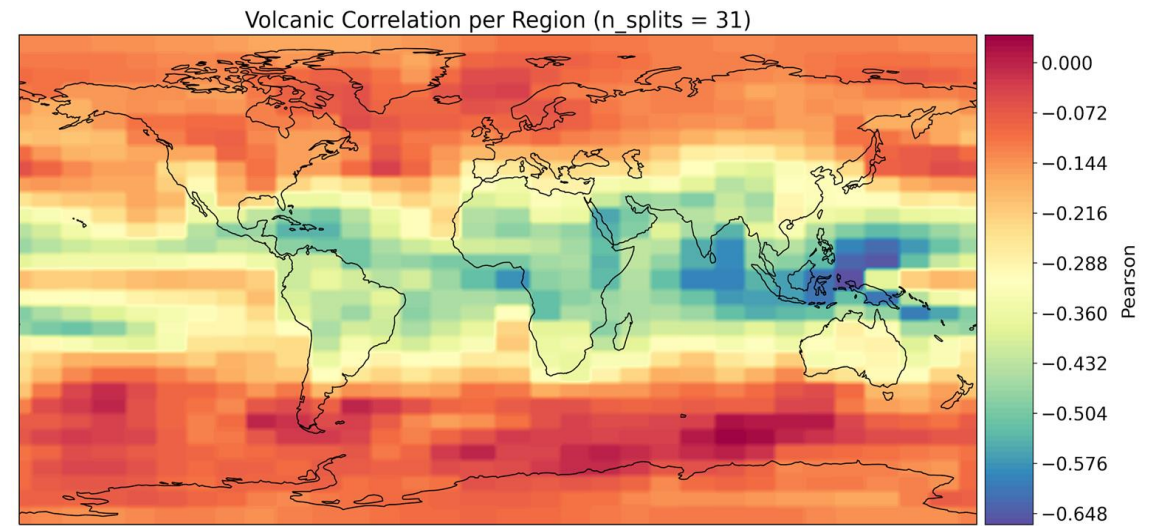# RQ 1.2: Disentanglement including prior knowledge of volcanic/solar activity



Solar Correlation per Region (n_splits = 31)

Pearson correleation coefficient to disentangle volcanic and solar activity.

Volcanic Correlation per Region (n_splits = 31)

# RQ 1.2: Disentanglement including prior knowledge of volcanic/solar activity

Impact of a filter for disentangling solar activity. Measured by pearson correlation coefficient between
      i) Solar force and average temperature
      ii) filtered solar force using a butterworth filter of 8th order and average temperature
      iii) filtered solar force and average temperature using a butterworth filter of 8th order

(i)

(ii)

(iii)
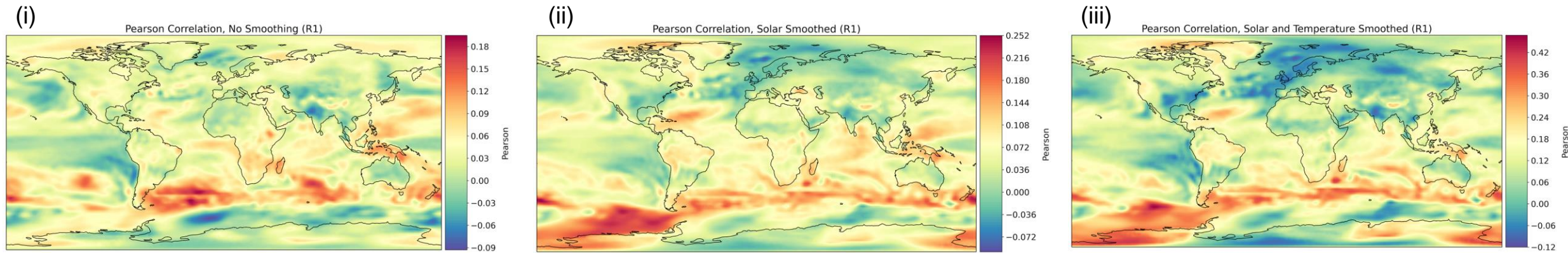


The filter method changes the regional areas with high correlation.

# RQ2: Selecting the appropriate regions, can we detect volcanic activities / regress solar activities?

Hypothesis: we can detect volcanic activities as outliers in the temperature time series data of a selected region
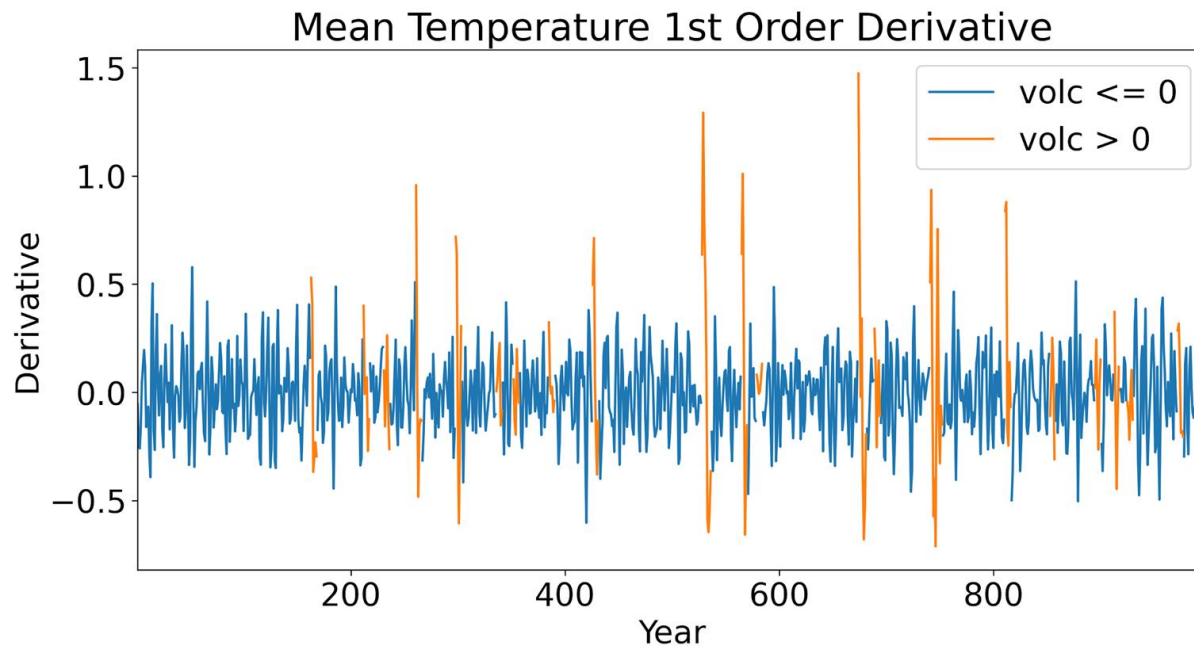
# RQ 2.1: Detecting volcanic activities as outliers

Approach:

- Selecting clusters 6 & 7
- Generating the first derivative of the temperature time series
- Outlier detection via Isolation Forest

Results:



Mean Temperature 1st Order Derivative

|  |  | Predicted | |
|---|---|---|---|
|  |  | out | in |
| True | out | 26 | 112 |
|  | in | 4 | 857 |

# RQ 2.2: Can we expect a correlation based on Pearson?

Experiment to check, whether Pearson correlation coefficient is actually meaningful:

|  | GT & temperature data | GT & 1000 simulated temperature time series (based on an autoregressive model AR(1)) |
|---|---|---|
| GT = TSI | 0.42 | 0.40 |
| GT = AOD | 0.68 | 0.56 |

# RQ 2.3: Predicting solar force using CNN

**Approach:**

- Selection progress of input data based on the disentangled high correlated & filtered solar forces between the average temperature

- 3-layered CNN designed for automatic feature engineering and a two layered dense network architecture for solving the regression task of predicting 50 years of solar force

**Result:**

- Low correlation between input and output data results in low correlation between predicted and true curves
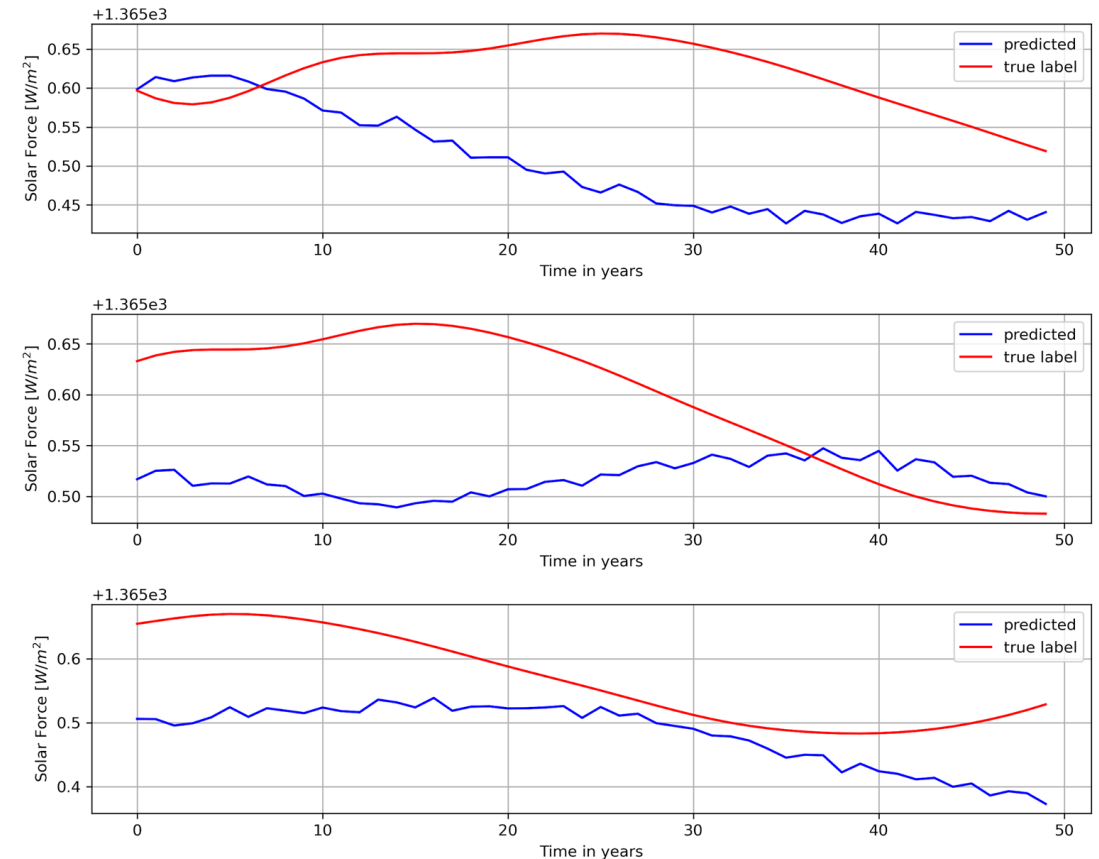
# Summary

- Regions to disentangle the impact of volcanic and solar forcing could be identified
- Phases of volcanic activity were detected using Isolation Forest on the first derivative of temperature data in a selected region
- Disentangled regions with highest correlation coefficient between solar forces and temperature were not enough to lead to acceptable results