

How will climate change impact different generations?

Motivation

Due to rapid climate change, the climate experienced by different generations will be strikingly different. You'll extract point data from high-resolution regional climate simulations developed specifically for Switzerland and calculate the cumulated exposure to specific weather events for different generations of the population.

Research Questions

How many days of snow cover will a child born in 2020 experience compared to one born in 1970?

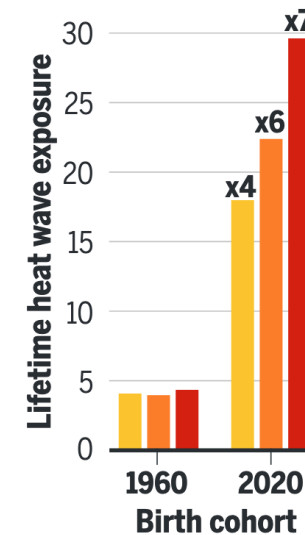
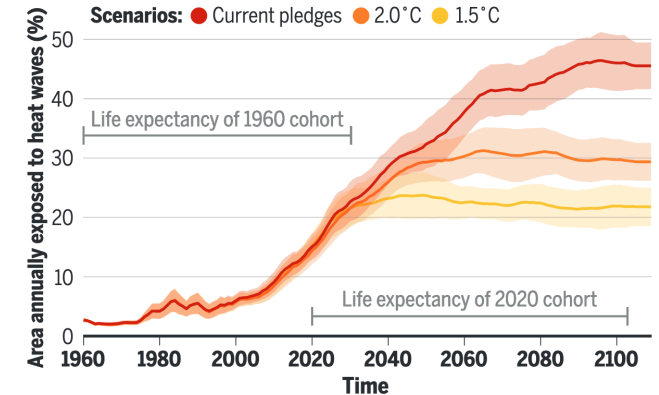
How many tropical nights will a person born in 2020 experience in their life compared to other generations?

Tasks

- Choose and analyze specific types of weather events and the lifetime exposure of different generations to them

Recommended skills

- You enjoy coding and analyzing data



Thierry et al. 2021,
Science

Maximizing information content in climate experiments

Motivation

More than 60 climate models have published hundreds of historical simulations within the Coupled Model Intercomparison Project (CMIP6). However, many models share the same code and are in fact subversions of each other. Is each model truly providing an independent data point, or is this abundance of models an illusion?

Research Questions

What metrics from statistics or information theory can we use to quantify the information content of a climate simulation?

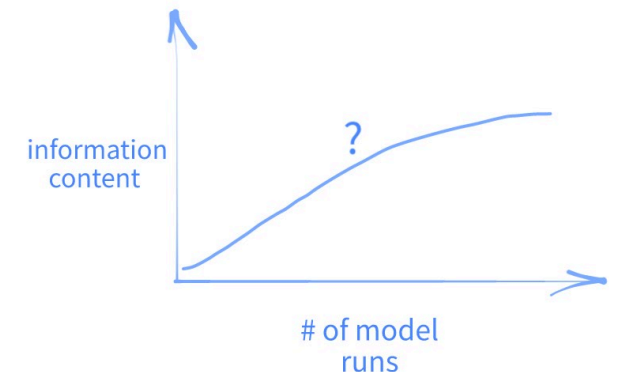
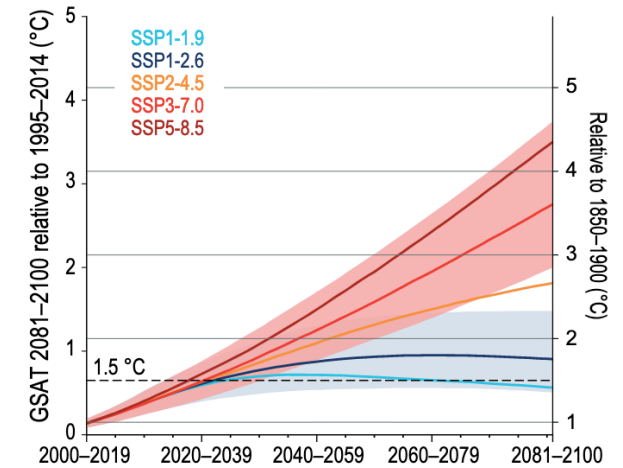
How many simulations are sufficient to characterize the full variety of CMIP6 warming trajectories?

Tasks

- Develop metric(s) to quantify information content and apply them to an existing ensemble of global time series

Recommended skills

- You enjoy coding and creating your own solutions



Vincent Humphrey
Vincent.Humphrey@env.ethz.ch

The Multi-Model Large Ensemble Archive as a climate noise generator

Motivation

Climate understanding is hindered by the length of the observational record. Combining model-generated climate noise with an observed signal increases the observational sample and provides additional climate storylines.

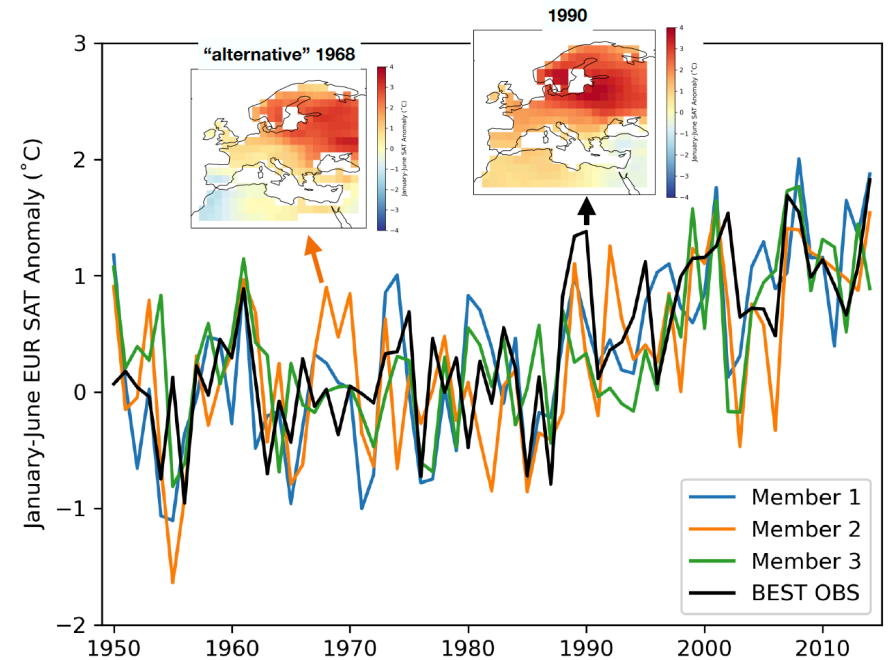
Research Questions

Validation: How does the model-generated climate noise compare to observed noise? How does the noise compare between different models? Are there regions of Europe where certain models perform better?

Storylines: Persistent heat events provide a potential preview of future average seasonal temperatures. Can you identify interesting European heat storylines (e.g., spatially extensive or especially persistent anomalies) within the larger observational sample?

Tasks

Statistical analysis of new climate data, Mosaic visualization, outlier detection



Anna Merrifield
anna.merrifield@env.ethz.ch

Observed trends in record-shattering extremes

Motivation

Recent heatwaves and heavy precipitation events shattered previous observed records by large margins.

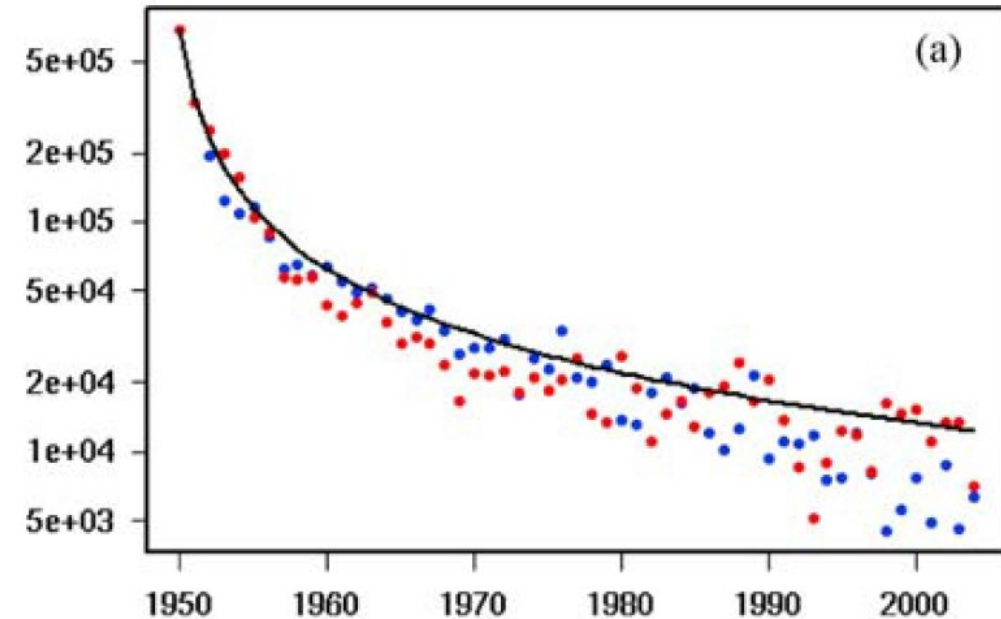
Research Questions

- How does the observed frequency of temperature and precipitation records change in updated observational datasets?

Tasks

- Calculate the frequency of temperature and precipitation record events in daily gridded and station observations and reanalyses.
- Aggregate the record statistics across continents and compare to the statistically expected behavior in a stationary climate.
- Quantify emergence of a climate change signal in record statistics.

Annual number of Tmin and Tmax records, summed over the US. Observations



Jitendra Singh & Erich Fischer
jitendra.singh@env.ethz.ch
erich.fischer@env.ethz.ch

Examining the first high-resolution storm-resolving global climate models in the Alps

Motivation

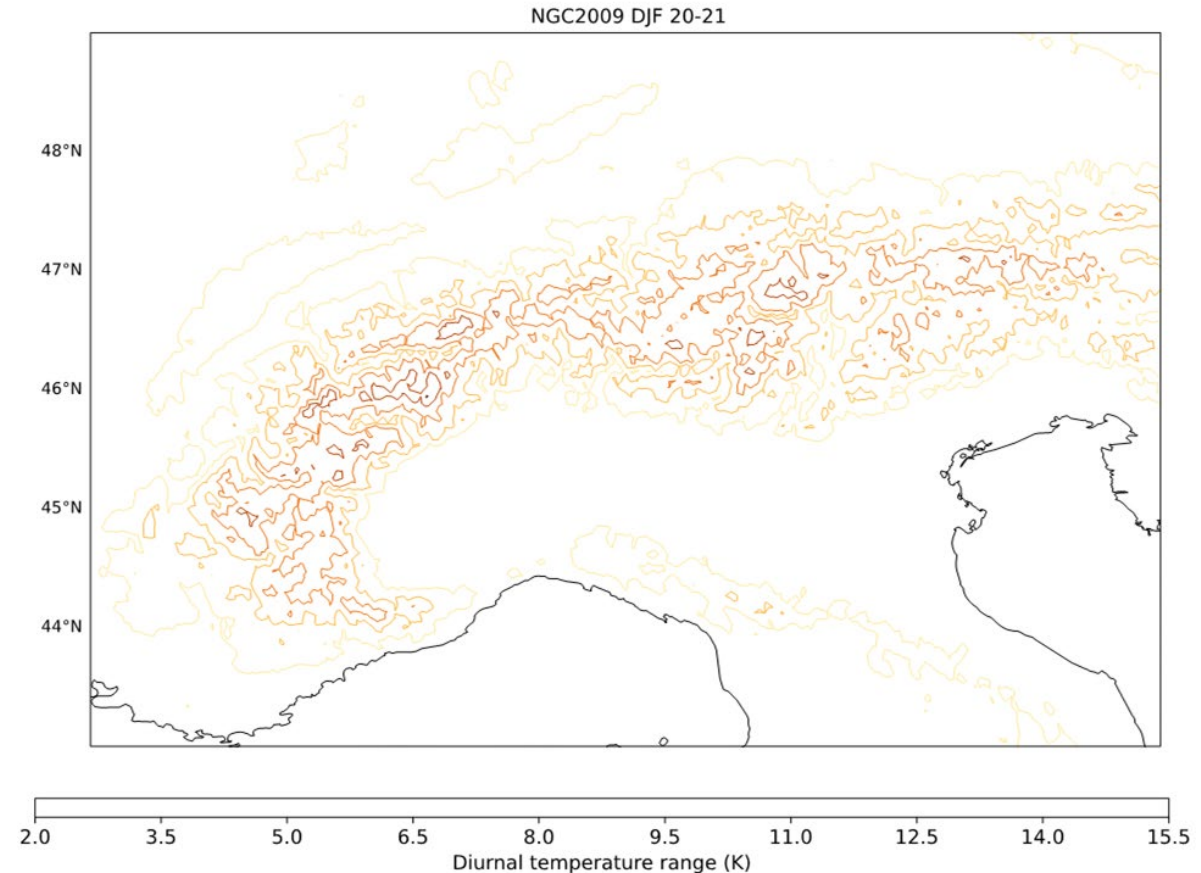
The NextGEMs project produced the first ever fully-coupled storm resolving global climate model simulations that no longer rely on convection parametrizations with potential benefits in representing the climate of complex topography.

Research Questions

- Can the first storm-resolving global climate models capture basic daily temperature and precipitation patterns in mountainous terrain?

Tasks

- Extract daily output variables from the 2.5km IFS model in the framework of the NextGEMS project (<https://nextgems-h2020.eu>).
- Compare temperature and precipitation behavior against station and gridded observations and reanalysis data over the Swiss Alps.
- Evaluate potential biases within the IFS model, particularly in representing tail-end climatological extremes



Jonathan Wille & Erich Fischer
jonathan.wille@env.ethz.ch
erich.fischer@env.ethz.ch

Polar amplification and offshore wind energy

Motivation

Offshore wind energy is essential to climate change mitigation, yet climate change also impacts wind energy. Climate models with strong changes in arctic temperatures also project strong wind reductions. In other words, polar amplification threatens offshore wind energy according to the models.

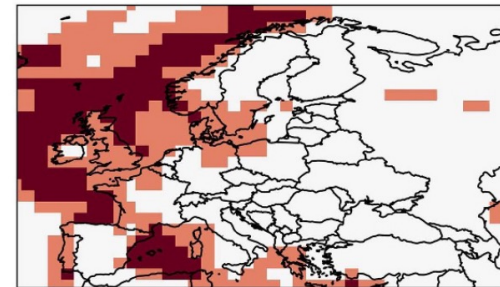
Research Questions

Was there a similarly clear link between temperature differences and offshore wind speeds in the last century that would back up the modeled results?

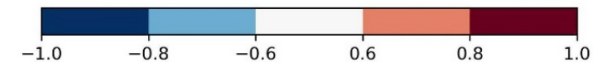
Tasks

Analyze long-term reanalysis data, validate with temperature measurements and evaluate the link between offshore wind and the meridional temperature gradient.

There is room for method refinement and your own creativity, for instance, by developing weighting schemes targeted at renewable energy applications.



Wohland, ERL, 2022



Correlation between wind speed reduction and equator-to-pole temperature difference

Jan Wohland
Jan.wohland@env.ethz.ch