

Climate Risk Score

A framework to quantify an insurance portfolio's exposure to climate change

Samuel Lüthi^{1,2}, Michael Gloor¹, and Michael Walz¹

¹ Swiss Re, Cat Perils, Switzerland

² Institute for Environmental Decisions, ETH Zurich, Switzerland

Contact: Samuel.Luethi@usys.ethz.ch, Michael_Gloor@swissre.com



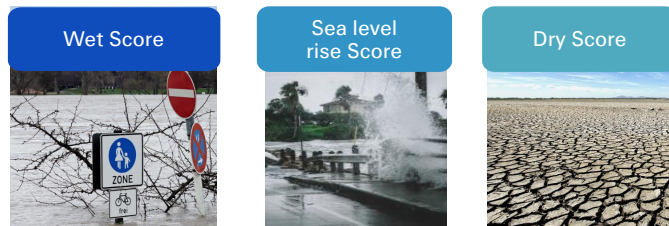
Climate Risk Score - Overview

Background

The (re)insurance industry is interested in how global warming affects climate extremes today and in the future and therefore could lead to biases in risk models for natural catastrophes, which are typically calibrated on past hazard and insurance-loss data. Depending on the region and peril, climate trends vary in direction, magnitude and confidence level. A climate risk score framework has been developed that allows to identify regions, insurance portfolios or specific insured locations which are particularly exposed to the consequences of climatic changes.

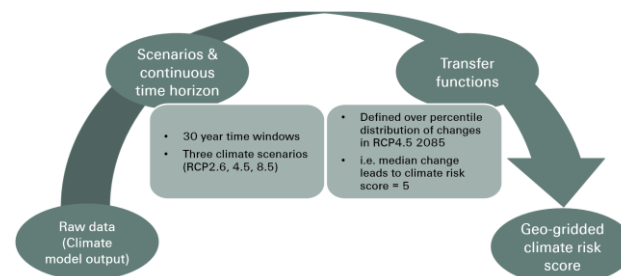
Concept

The Climate Risk Score is based on several sub-scores which reflect expected changes in mean and extreme precipitation and temperature as well as in mean sea level rise. These sub scores serve as proxies for a changing natural risk landscape and highlight likely changes to natural hazards such as flooding, storm surge, heat waves, wildfires, etc.

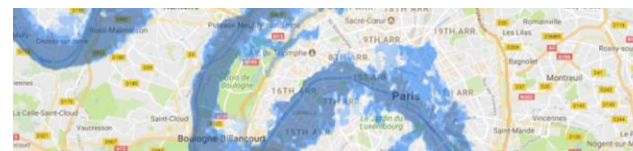


Method

Normalised precipitation, temperature and sea-level-rise data from several CMIP5 models are calculated for different climate scenarios (RCP2.6, 4.5, 8.5) and mapped to a time-dependent risk score. The normalisation is based on non-linear transfer functions that are derived to map changes in mean and extremes of climate-variable distributions to a non-dimensional physical risk score.



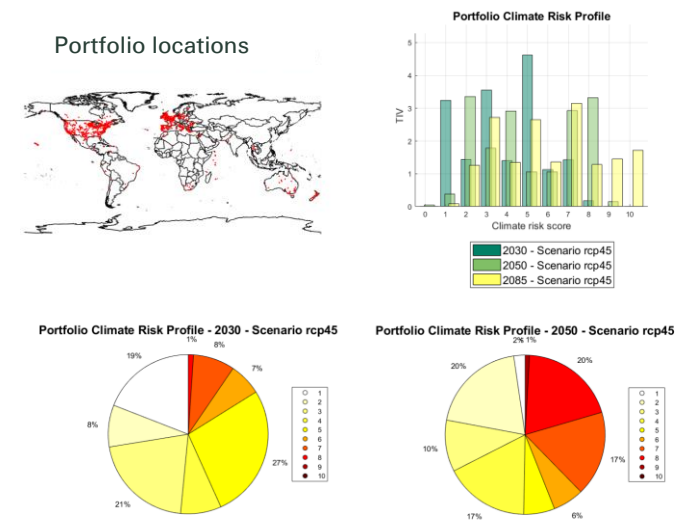
For the sea-level-rise and wet scores, Swiss Re's proprietary pluvial, fluvial and coastal flood zones are incorporated, allowing for a high-resolution (30 m) risk view.



Swiss Re's Global Flood Zones

Application

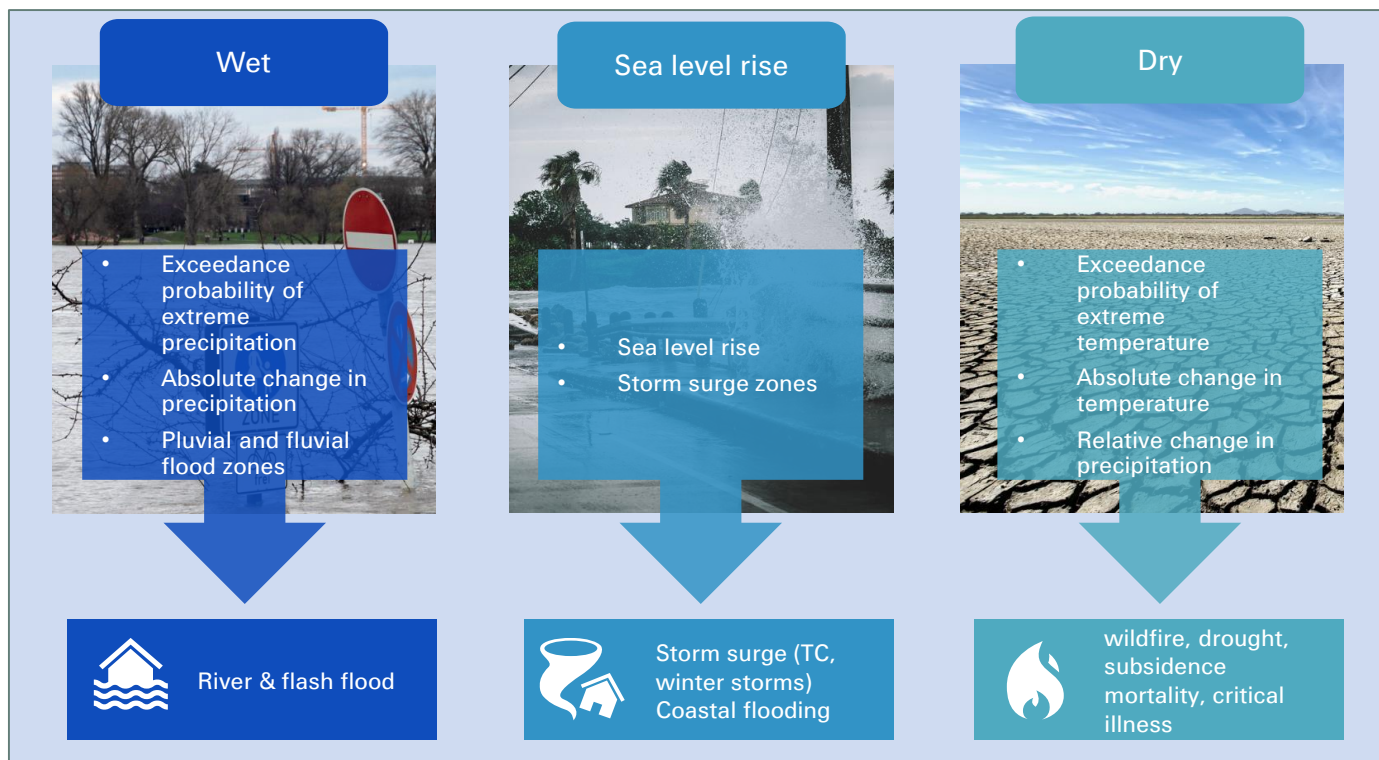
The Climate Risk Score framework can be used to assess how an insurance portfolio is exposed to a changing physical risk landscape using different time horizons and climate-scenario assumptions. The non-dimensional score allows for an easy comparison between portfolios to quantify relative affectedness but it also provides the flexibility to analyse the physical climate risk for a portfolio with respect to different perils.



Climate Risk Score statistics for a global insurance portfolio.

Climate risk score – what we consider

A proxy for changing NatCat risks



Input data

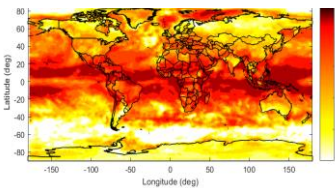
Data from below CMIP5 models have been processed to calculate the dry and wet scores. For the sea-level-rise score, the data set published by (Kopp, 2014) was used.

	Skin temperature	Precipitation
RCP 2.6	GFDL HadGEM MPI NorESM	GFDL HadGEM MPI
RCP 4.5	ACCESS CMCC GFDL HadGEM MPI NorESM	GFDL HadGEM MPI
RCP 8.5	ACCESS CMCC GFDL HadGEM MPI NorESM	GFDL HadGEM MPI
Spatial resolution	1.75 degree	1.75 degree
Temporal resolution	Monthly	Daily

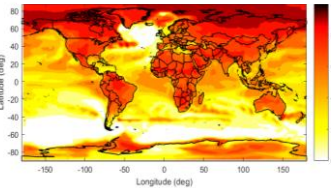
From Climate Data to a Climate Risk Score (CRS)

The CRS helps to identify global and regional changes in the natural hazard risk landscape

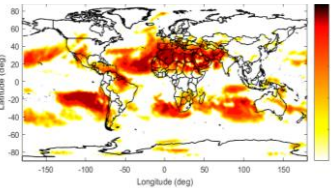
Change in exceedance probability for extreme temperature (RCP 4.5 2085)



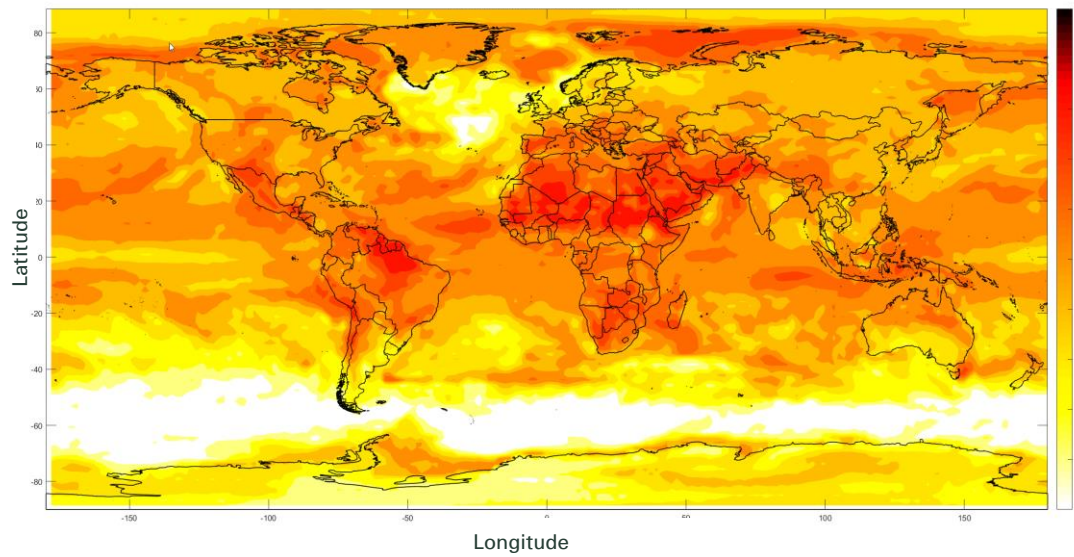
Change in average temperature (RCP 4.5 2085)



Relative decrease in mean precipitation (RCP 4.5 2085)



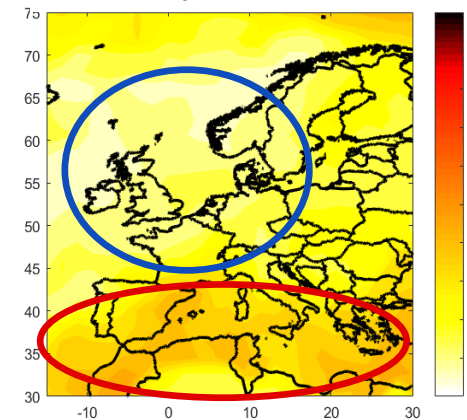
Dry score 2085 under RCP4.5



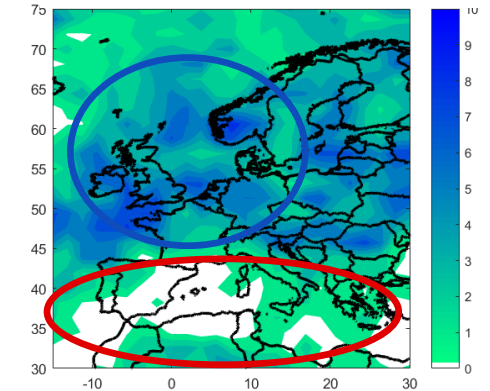
References:

Kopp, R.E., et al, 2014. Probabilistic 21st and 22nd century sea-level projections at a global network of tide-gauge sites. *Earth's future*.
Fischer, E.M. and Knutti, R., 2015. Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes. *Nature Climate Change*.
Blöschl, et al., 2019. Changing climate both increases and decreases European river floods. *Nature*

Dry score 2020



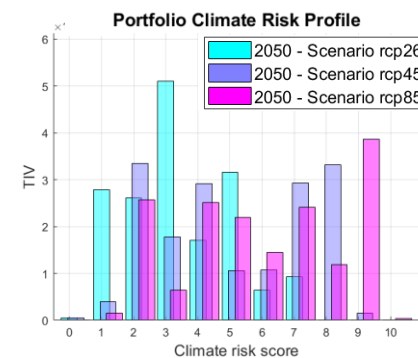
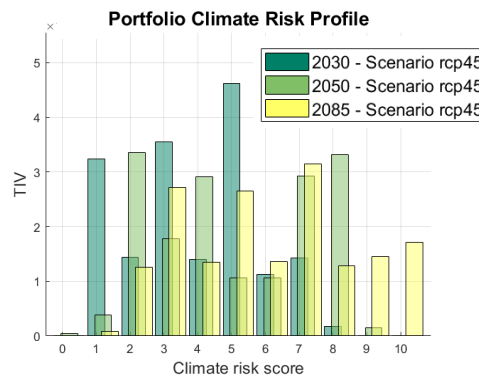
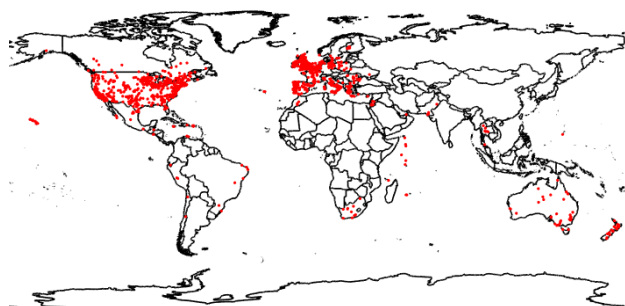
Wet score 2020



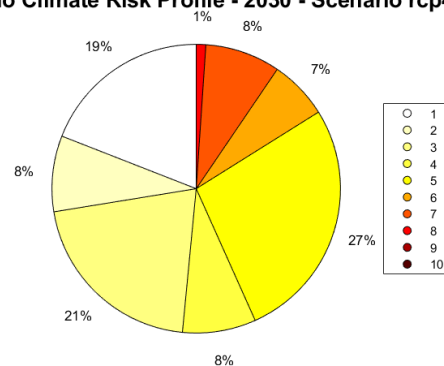
- The Climate Risk Score is calculated in a globally consistent way, which reflects several relevant climatic trends.
- The Climate Risk Score helps to study the impact of global and regional trends that affect natural hazards such as flood risk across Europe, which shows has a strong regional variation with increasing and decreasing trends (see e.g. Blöschl et al. 2019).
- The framework allows to assess the impact of such trends on global and regional portfolios.

Climate Risk Scores – portfolio analysis

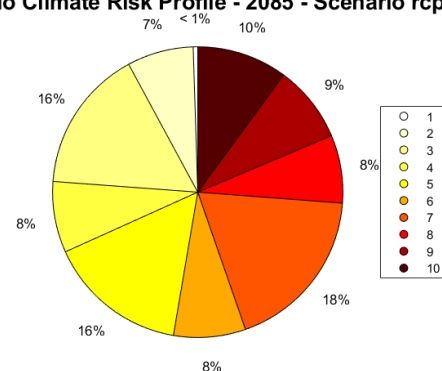
Portfolio Locations



Portfolio Climate Risk Profile - 2030 - Scenario rcp45



Portfolio Climate Risk Profile - 2085 - Scenario rcp45



- For any re/insurance portfolio, customized Climate Risk Score statistics can be computed for different climate scenarios and different time horizons.
- The non-dimensional score allows for an easy comparison between portfolios to quantify relative affectedness but it also provides the flexibility to analyse the physical climate risk for a portfolio with respect to different perils.
- Thanks to big-data infrastructure and capabilities, the CRS framework scales to exposure data of global re/insurance companies.



Legal notice

©2019 Swiss Re. All rights reserved. You may use this presentation for private or internal purposes but note that any copyright or other proprietary notices must not be removed. You are not permitted to create any modifications or derivative works of this presentation, or to use it for commercial or other public purposes, without the prior written permission of Swiss Re.

The information and opinions contained in the presentation are provided as at the date of the presentation and may change. Although the information used was taken from reliable sources, Swiss Re does not accept any responsibility for its accuracy or comprehensiveness or its updating. All liability for the accuracy and completeness of the information or for any damage or loss resulting from its use is expressly excluded.