



Climate extremes as an essential climate service at MeteoSwiss

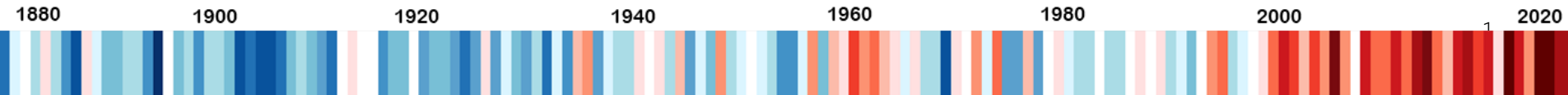
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Michiko Hama – Climate division & National Center for Climate Services (NCCS)

Lionel Moret, Lea Beusch, Irina Mahlstein – Development of Forecasting division

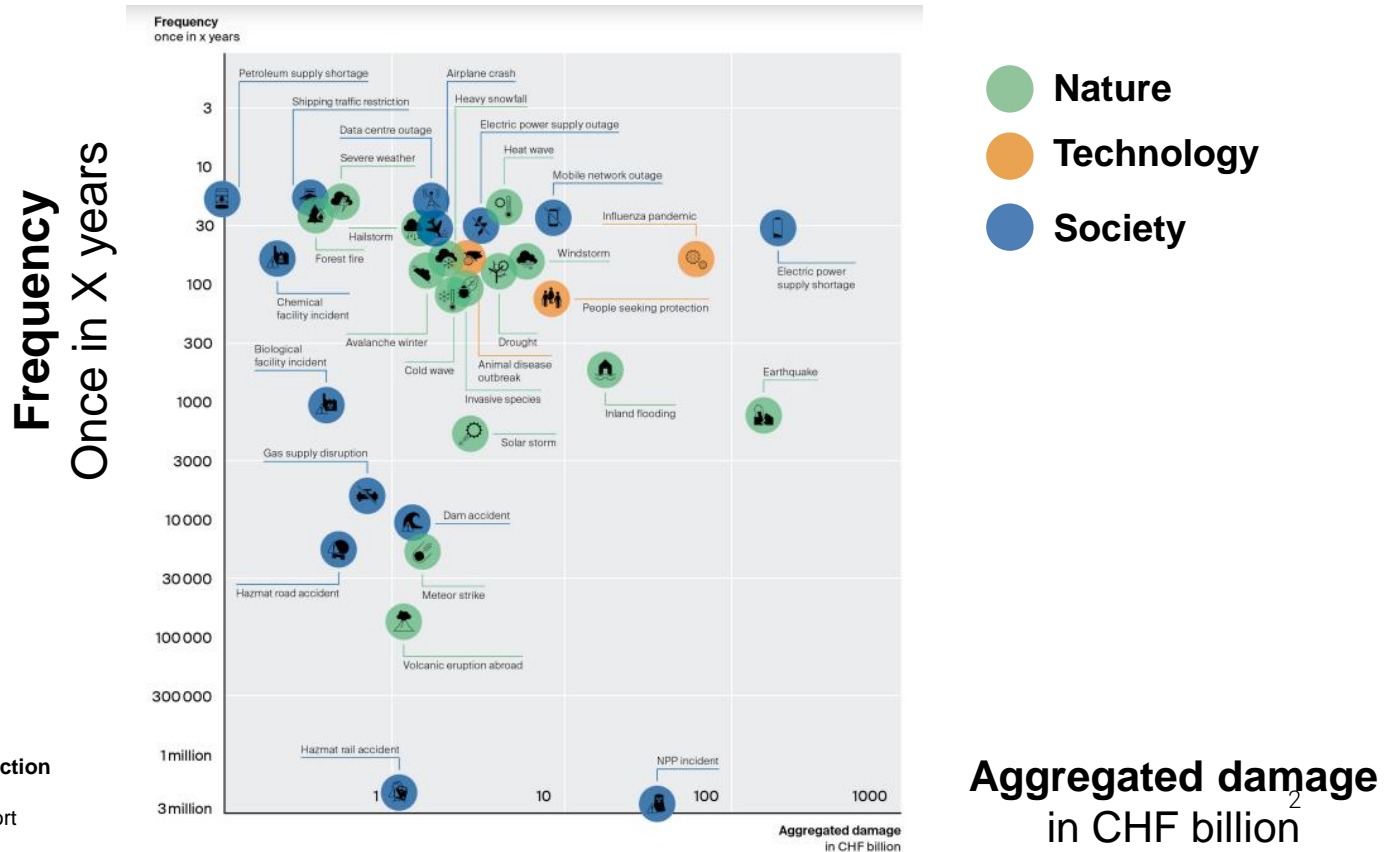
Isabelle Bey – Regional Center West Geneva

09.02.2024, ECCE Inauguration





Climate extremes : why should we care ?



Source: Federal Office for Civil Protection (2020): Disasters and Emergencies in Switzerland - National risk analysis report

Aggregated damage in CHF billion



MeteoSwiss duties - Why do we care about extremes ?

✓ **Monitoring /
detection of
extremes**



Weather and climate
measurements on the
territory of Switzerland



Weather **warnings**

✓ **Forecasting of extremes and
contextualisation of events**



Aviation **weather**



✓ **Prediction
of extremes**

Climate information, con-
tribution to ensuring a healthy
environment in the long term



Monitoring and
propagation of
radioactivity

MeteoSchweiz



Application-oriented
research and
development,
teaching



International
weather and climate
data exchange



Meteorological and
climatological **services** for
the needs of the general
public

✓ **Monitoring, detection, prediction, and
communication of extremes**



National Centre for Climate Services (NCCS)

A virtual center with the activities sponsored, planned and implemented by its members

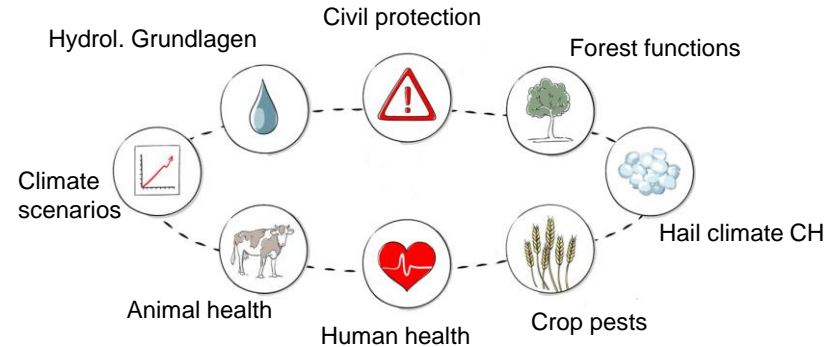
NCCS office hosted at MeteoSwiss

Goals



- Bundling existing climate services
- Initiating and promoting dialogue
- Co-producing climate services

Priority themes



...plus cross-sectoral activities

NCCS Members

Federal Office of Meteorology and Climatology MeteoSwiss
Federal Office for the Environment FOEN
Federal Office for Agriculture FOAG
Federal Office for Civil Protection FOCP

Federal Office of Public Health FOPH
Federal Food Safety and Veterinary
Office FSVO
Swiss Federal Office of Energy SFOE



Monitoring and detection

Providing analysis of extreme values for stations and gridded data

<http://www.climate-extremes.ch>

Swiss federal authorities

Federal Office of Meteorology and Climatology MeteoSwiss

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Homepage > Climate > The climate of Switzerland > Records and extremes > Extreme value analyses (version 2022)

Extreme value analyses (version 2022)

Web portal with extreme value analyses of precipitation, descriptions of selected severe precipitation events, and course of the strongest precipitation events at automatic stations.

Application: **Standard period 1961 - 2020**

Examples of use: compare stations or classify observed events. Use this approach when more than one point in space or time is of interest. Periods of analysis: 1961 - 2020 (daily sums) updates every 1...

Application: **Longest period**

Examples of use: single, local design. Use this approach in the context of specific, spatially and temporally confined applications. Period of analysis: From the earliest measurements onwards; year's...

Application: **Hyetographs**

Hyetographs of the 10 events with the highest cumulated precipitation over duration intervals of 1, 4, 8, 12, 24 and 48 hours.

Application: **Maps of extreme precipitation**

The following phase distinct precipitation amounts for extreme events. The spatially comprehensive representation describes the climate of heavy precipitation in Switzerland and its immediate...

Application: **Extrapolation for 2 and 5 minute precipitation**

Returns levels of 2 and 5 minute precipitation sums extrapolated from the extreme value analysis of 10 minute precipitation sums.

Currently at <https://www.meteoswiss.admin.ch/climate/the-climate-of-switzerland/records-and-extremes/extreme-value-analyses.html>



Monitoring and detection

Providing analysis of extreme values for stations

2-min and 5-min extreme precipitation (e.g. for building norms)

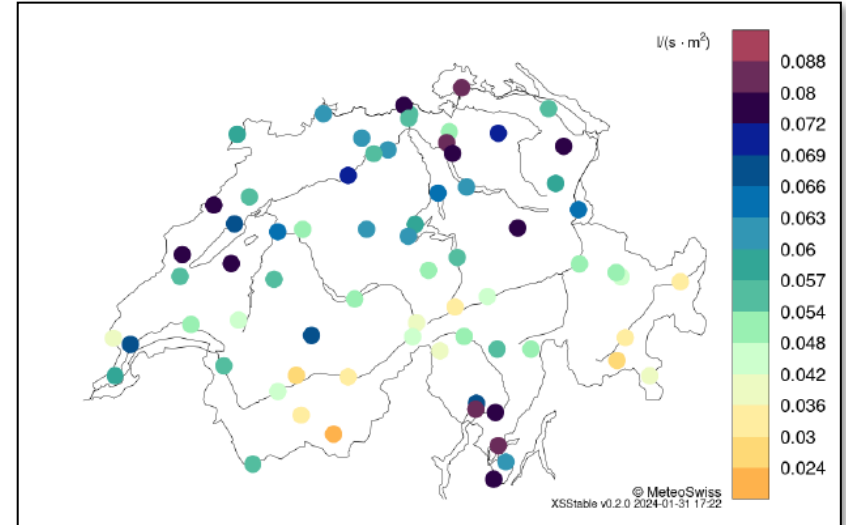
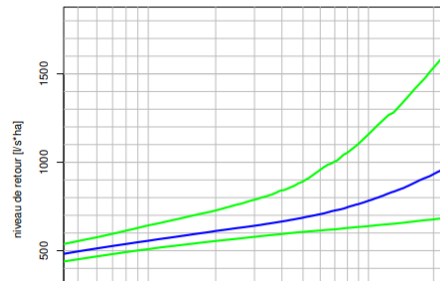
Pully : 456m, 46.51N, 6.67E

Analyse des Valeurs Extrêmes extrapolée

cumul des précipitations en 2 minutes

Graphique des niveaux de retour et de leur intervalle de confiance (ordonnée) pour une période de retour donnée (abscisse).

Le niveau de retour extrapolé est représenté en bleu. L'intervalle de confiance à 95% correspondant est dessiné en vert.



<https://www.meteoschweiz.admin.ch/service-und-publikationen/applikationen/ext/climate-extremes-xtra5.html>

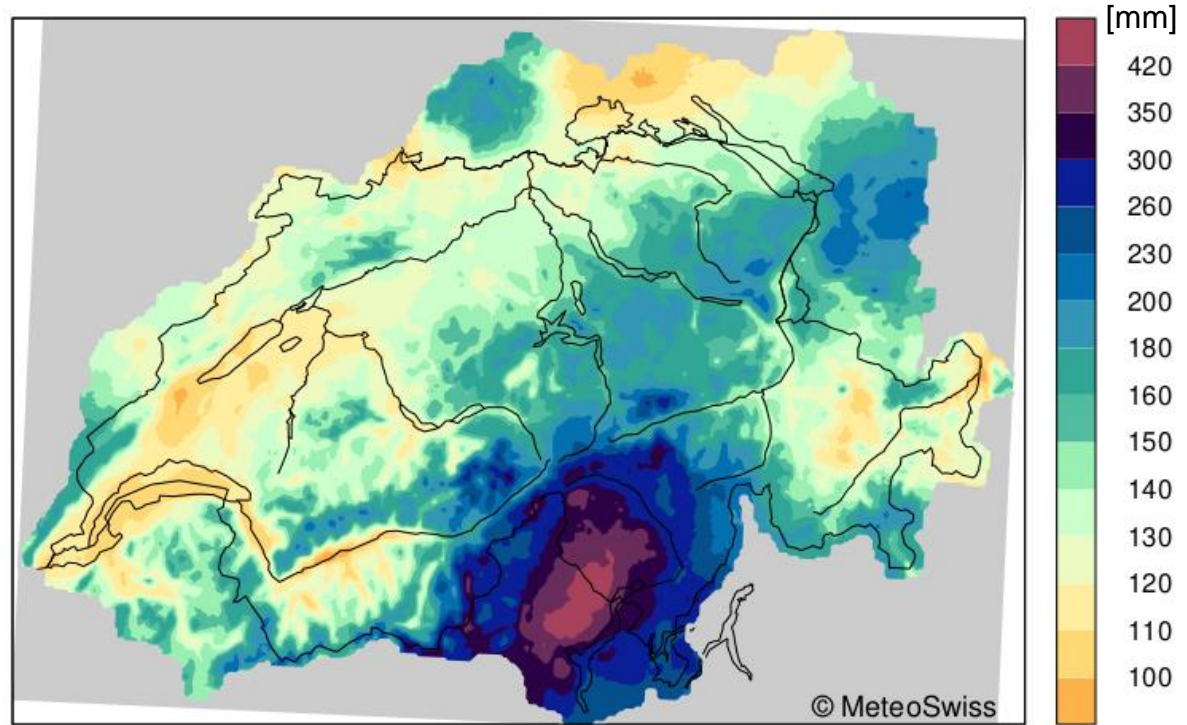
100yr return value for 5min precip



Monitoring and detection

Providing analysis of extreme values for gridded data

Spatial precipitation extremes : 100-year return level of 1 day precipitation extremes



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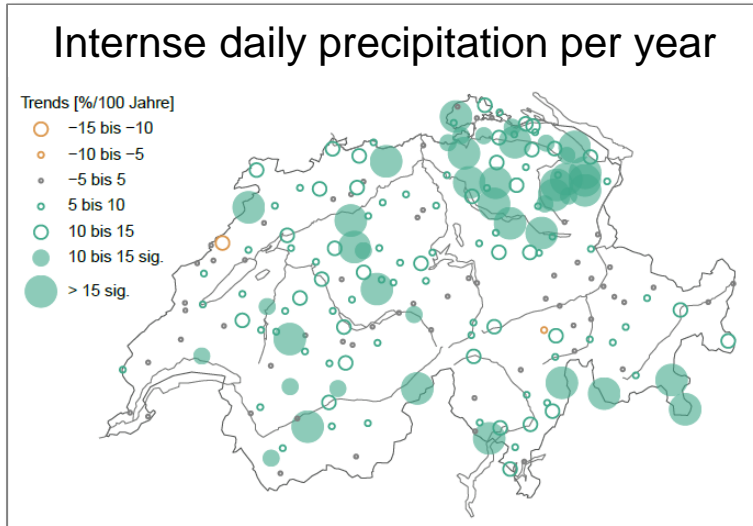
Source : Frei and Isotta (2019, <https://doi.org/10.1029/2018JD030004>)



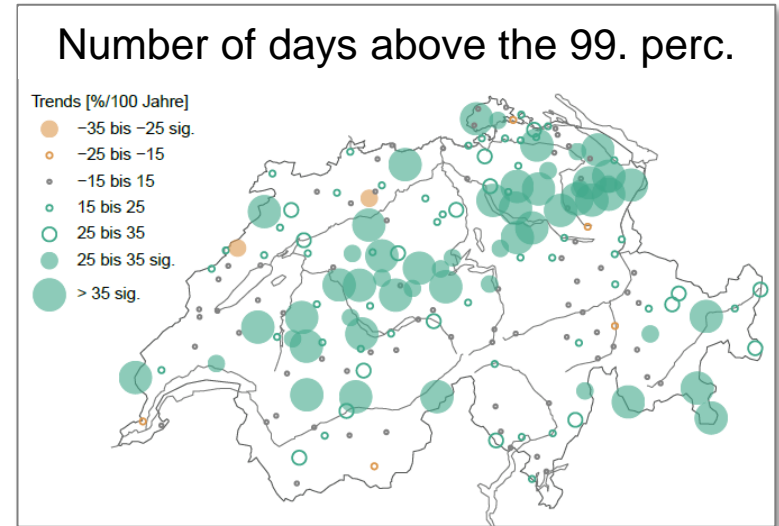
Monitoring and detection

Establishment of trends

Long-term (1901-2022) heavy precipitation trends in Switzerland



+10% more intensive



+24% more frequent



Monitoring and detection

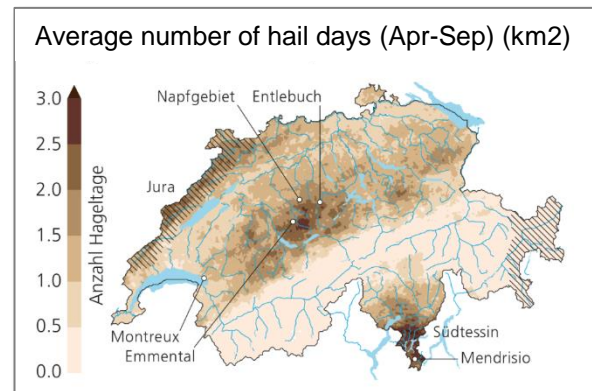
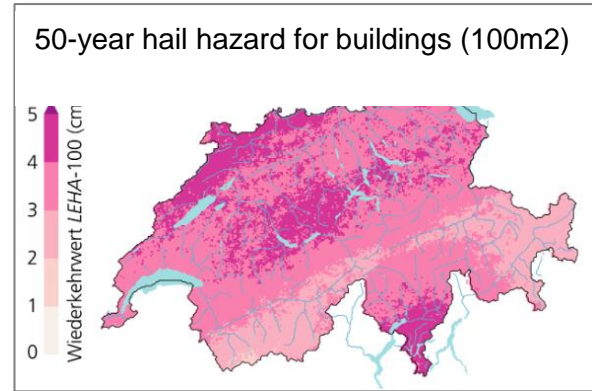
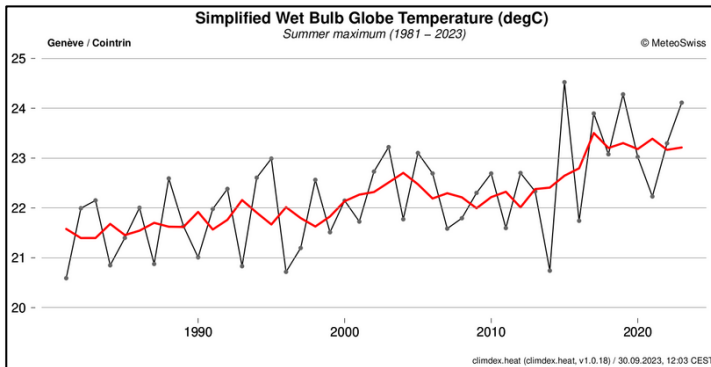
Covering a number of relevant parameters

- *Hail hazard and climatology*

<https://www.nccs.admin.ch/nccs/fr/home/le-nccs/themes-prioritaires/climatologie-grele-suisse.html>

- *Heat extremes and implications*

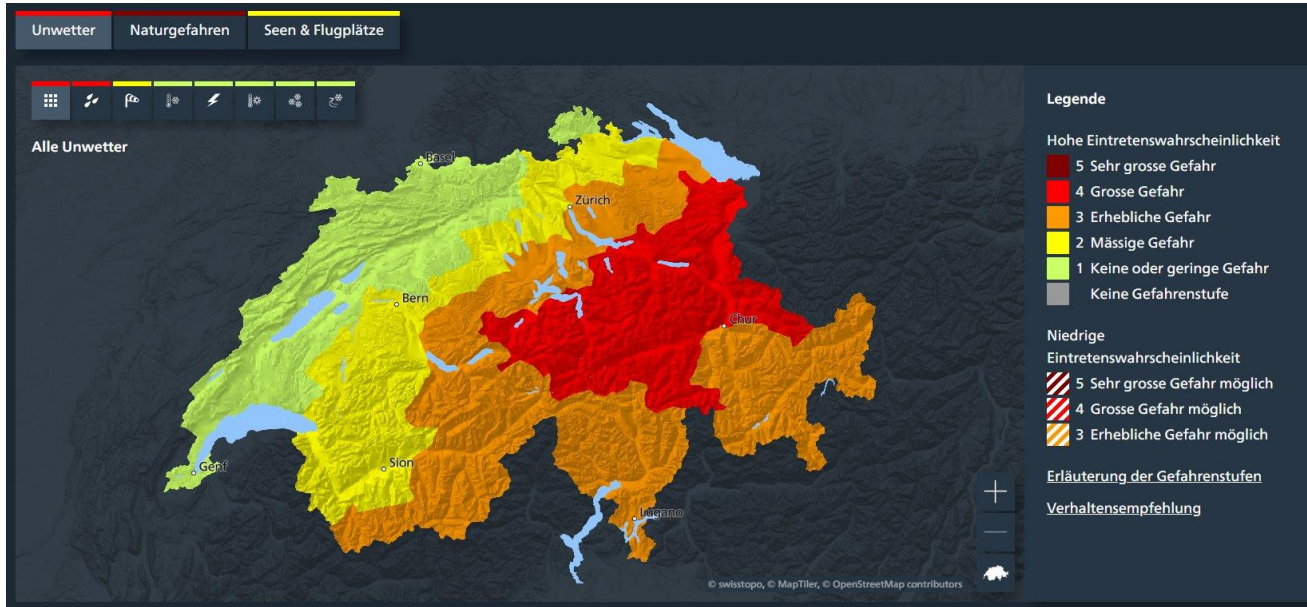
<https://www.meteosuisse.admin.ch/portrait/recherche-et-collaboration/projets/2017/heat-shield.html>





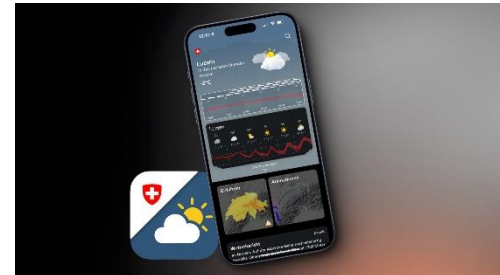
Forecasting of extremes

Issuing weather warnings



Example of the 27 August 2023

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Forecasting of extremes

Issuing weather warnings

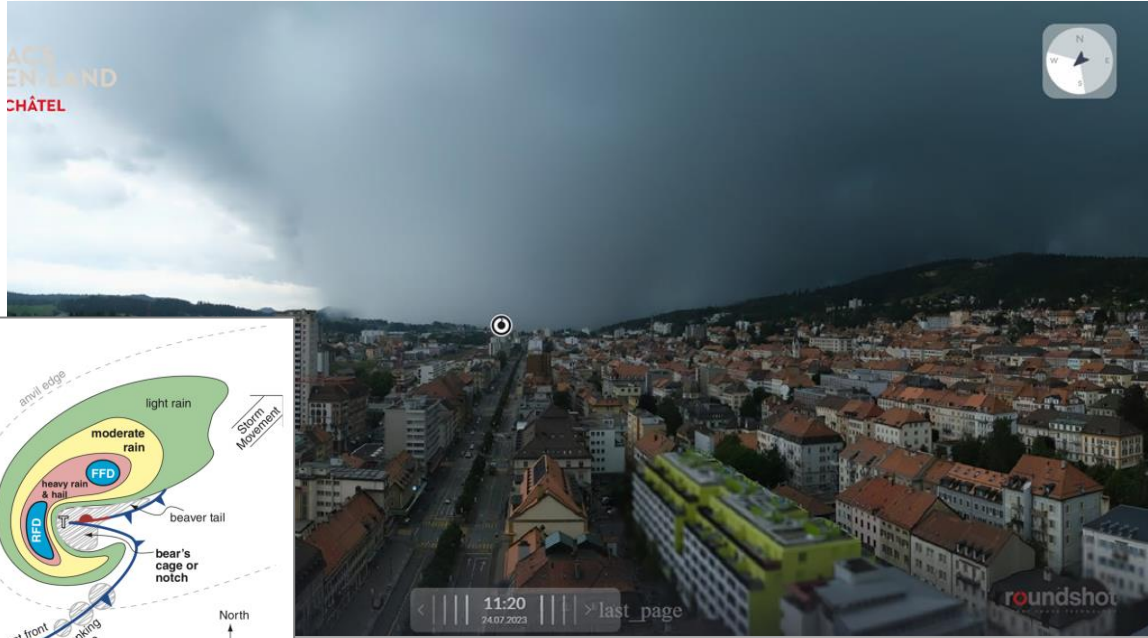


Figure 14.21
High-precipitation (HP) supercell thunderstorm in the N. Hemisphere. FFD = forward flank downdraft; RFD = rear flank downdraft. Hatched grey regions indicate updrafts.

Source : Webcam Roundshot La-Chaux-de-Fonds, 24 juillet 2023
<https://www.myswitzerland.com/fr-fr/destinations/panoramas/la-chaux-de-fonds/>



ARCINFO

A RÉSERVÉ AUX ABONNÉS

Tempête à La Chaux-de-Fonds: le coût dépasse déjà 18 millions pour la Ville

Mardi 29 août, le Conseil général se prononcera sur une demande de crédit urgente de 11,7 millions de francs pour faire face au coût de la catastrophe du 24 juillet. A ceci s'ajoutent 6,5 millions de francs pour les dommages aux immeubles en main de la Ville.

La Chaux-de-Fonds Tempête du 24 juillet

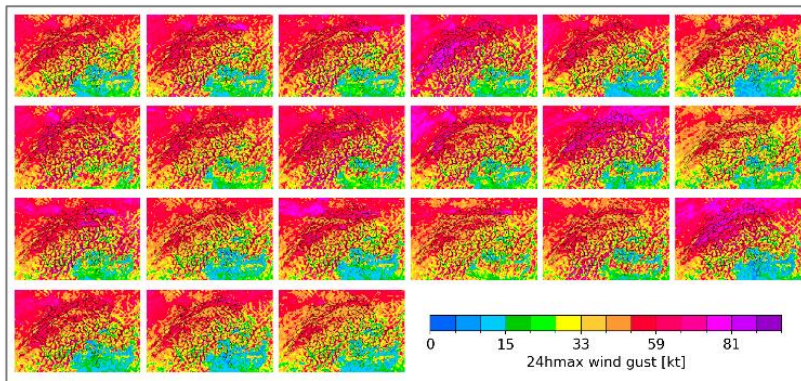
Daniel Droz
21 août 2023, 14:00



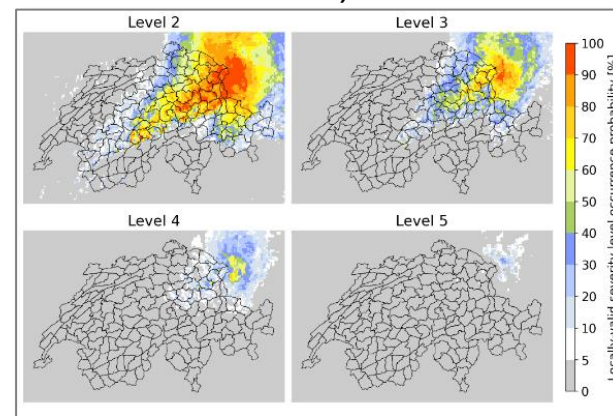
Forecasting of extremes

Improving the forecasting of extremes

- Adapting warning levels based on return periods using extreme value theories
- Development of methods to postprocess weather model forecasts for hazardous events
- Development of an automatic system to produce warning proposals for hazardous weather conditions (Extreme Weather Identifier)



Ensemble model data (COSMO-2E)



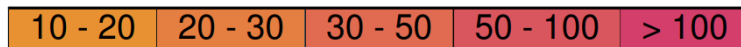
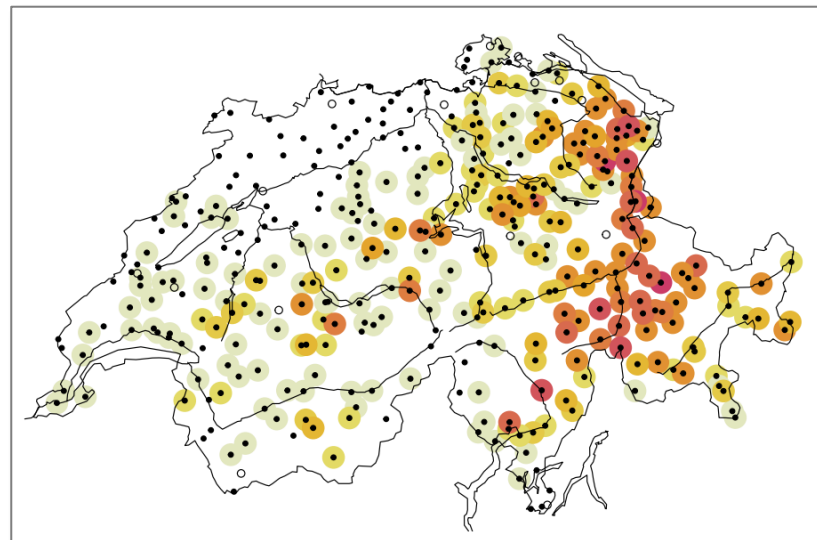
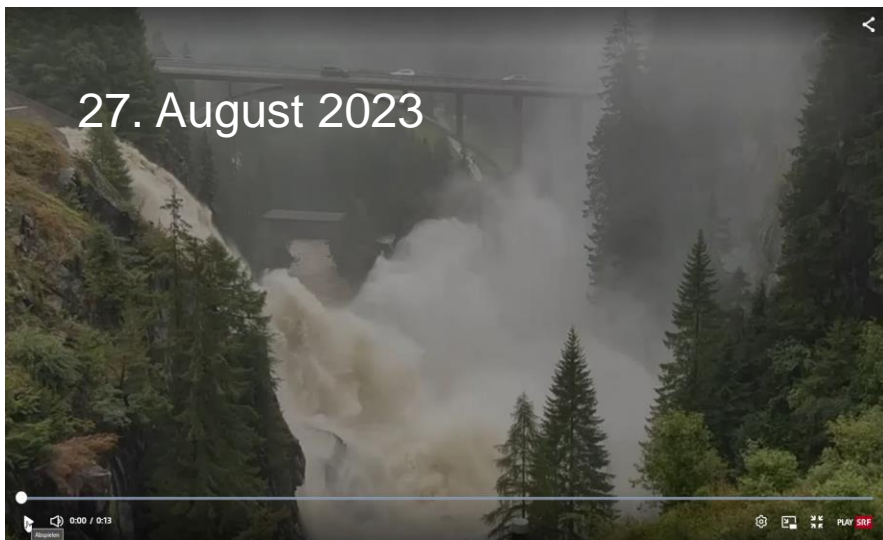
Proposals of wind warning occurrence probability



Forecasting of extremes

Contextualisation of events / events classification

Near-real time classification of temperature, precipitation and wind.



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Estimates of the return period based on extreme value statistics; reference period 1961 - 2020.



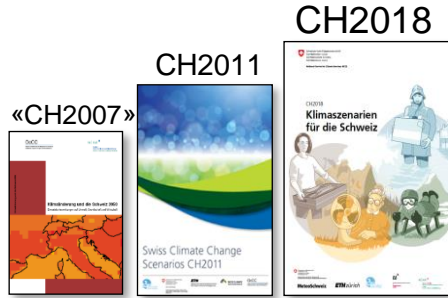
Research topics relevant for MeteoSwiss

- How will climate extremes change in the future ?
 - ⇒ Project Climate 2025
- Can ML/AI technics & methodologies be used for improving the prevision & prediction of extreme events?
- Attribution in Switzerland : how is a specific (extreme) event impacted by climate change ?



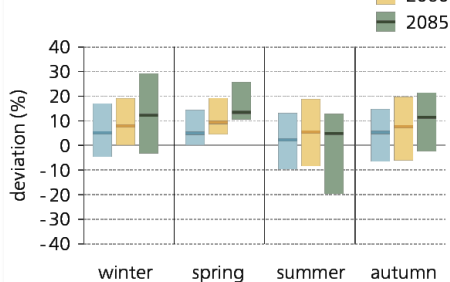
Future changes in extremes

Derived from convection-permitting climate model simulations

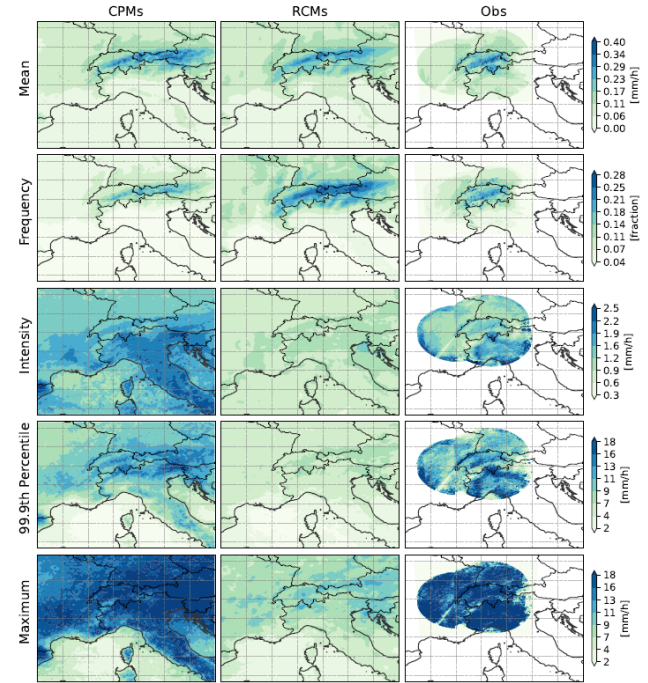


99th percentile of all-day precipitation
 deviation from the normal period 1981-2010

Northeastern Switzerland
 RCP8.5



© climate scenarios CH2018



(R. Estermann)



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Confédération suisse
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Confederaziun svizra

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