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ECRA Collaborative Programme

High Impact Events and Climate Change



High impact events and vulnerable regions

There is growing awareness that climate change cannot be considered as a "mean state" modification. The impacts of climate change are closely tied to regional and local conditions. Changes in the characteristics, frequency, and severity of extreme weather events are amongst the most significant aspects of climate change. To understand and predict such events, which are typically responsible for the most disastrous climate impacts, is of paramount importance. Not all extremes lead to high impacts. However, high impact events are conditioned based on the exposure and vulnerability of particular regions or locations. Different types of extremes, e.g. droughts and extreme precipitation, might be associated with different regions. We examine how high impact events work, how they can be simulated accurately in numerical models, and how we might be able to project future changes reliably, highlighting the important regional differences regarding their impacts.

Key topics for ECRA – High Impact Events

- *Assessment of past and future high impact events (**understanding mechanisms**)*
- *High resolution climate and impact modelling (**projecting changes**)*
- *Downscaling with different methodologies (**producing climate information at relevant scales**)*
- *Climate risk analysis, vulnerability and adaptation (**co-creating climate services with users**)*

Recommendations for research priorities in H2020 and beyond

- *Need for basic research*
  Climate-related hazards with potential high impacts on human and/or natural systems include extremes such as storms, storm surges, hail, heavy rains and drought. Such events are often of low probability and subsequently existing knowledge drawn from past instances of similar extremes may be scarce or lacking. Therefore, a better understanding of many of the fundamental processes driving the occurrence of high impact events (including the dynamic links with human activities) is critically needed. Only an improved understanding of fundamental processes (including better models) will allow more reliable predictions and projections.

  - **Better estimates of historical occurrence frequencies.** For this task two time horizons can be considered: (i) The near past that is described by observations and reanalysis data (state analysis of the atmosphere and ocean) for the last 50 to 100 years allowing in-depth assessments of selected events (e.g. strong storms), and (ii) The faraway past that is described by carefully collected proxy data which in certain areas can provide a very long record of a particular high impact event (e.g. lake overturning).
  - **Improved regional and local modelling of extreme events.** Global high-resolution climate models and regional scale climate models require further developments to e.g. reduce the bias in simulations of the past and thus facilitate more reliable projections of the future. Smaller biases will also facilitate better coupling to impact models.
  - **Using statistical methods to improve the value of modelling climate extremes.** Statistical techniques such as empirical-statistical downscaling and extreme value statistics offer the possibility to enhance the results of climate models with respect to extreme events and provide a robust probabilistic framing of climate hazards based on e.g. ensembles of climate projections.
  - **Robust understanding of high impact events**. Better process understanding, driven by observations and models combined with narrative approaches will allow us to better understand which drivers are responsible for triggering high impact events.

- *Modelling for climate services*
  Enhancing current knowledge on high impact events and closing key gaps in the underlying science is required to fully realize the European Agenda for climate services. Establishing strong links to potential users of high impact events research are essential. Ensuring the usability of the most up-to-date scientific results will increase the quality and effectiveness of decision-making on e.g. adaptation measures.

- *Characterization of vulnerabilities*
  Better information produced by improved predictions requires better blending with information regarding exposure and vulnerabilities. This will help to create a resilient response to anticipated risks, taking into account the dynamics of socio-economic activities. **Not every extreme event might become a high impact event.**

Coordinators

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