



Freva for ClimXtreme: helping to systematize holistic analysis of extreme events

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Climate change is responsible for more extreme weather situations with damaging consequences. Public interest projects such as ClimXtreme [1, 2] were conceived to improve our knowledge on extreme events, the role of climate change, and their impacts. Focusing on an integrated approach, ClimXtreme evaluates the physical processes behind the extremes, their statistical assessment and their societal impact. On its second phase ClimXtreme [3] aims to open up its findings to a wider stakeholder base of different kinds.

Frameworks such as Freva (Free Evaluation System Framework [4, 5]) offer an efficient solution to handle customisable evaluation systems of large research projects, institutes or universities in the Earth system community [6-8] via the HPC environment and in a centralised manner. Mainly written in Python, Freva offers:

- Centralised access. Freva can be accessed via command line interface, web, and a Python module with similar functionality.
- Standardised data search. Freva allows quick and intuitive integration and searching of multiple, centrally stored data sets.
- Flexible analysis. Freva provides a common interface for user-defined data analysis routines to be plugged into the system, regardless of the programming language. These plugins are able to search from and integrate their own results back into Freva. This environment enables an ecosystem of plugins that promotes the exchange of results and ideas between researchers, and facilitates the portability to any other research project using a Freva instance.
- Transparent and reproducible results. Every analysis run through Freva (including parameter configuration and plugin version information) is stored in a central database and can be viewed, shared, modified and re-run by anyone within the project. Freva optimises the use of computing and storage resources and paves the way for traceability in line with the FAIR data principles [9].

The Freva instance of ClimXtreme (XCES [7]), hosted at DKRZ, provides fast access to more than 10 million data files from models (e.g. CMIP, CORDEX), observations (e.g. ERA5, HYRAS, stations) and plugin outputs. The ClimXtreme community has actively contributed plugins to XCES, its biggest asset, with nearly 20 plugins of different disciplines available to all within the project.

We would like to show a practical application of the capabilities of XCES by using it to systematise the characterisation (e.g. return periods, severity, co-occurrence...) of several past extreme events extracted from the ClimXtreme Phase 1 catalogue. Such an application can be extended to create workflows focused, for example, on the rapid assessment of the analysis of currently occurring events, allowing a quicker response to stakeholders or the public in general.

References:

- [1] <https://www.fona.de/de/massnahmen/foerdermassnahmen/climxtreme.php>
- [2] <https://www.climxtreme.net/index.php/en/>
- [3] https://www.fona.de/de/aktuelles/nachrichten/2023/231207_ClimXtreme_Phase_2_b.php
- [4] <http://doi.org/10.5334/jors.253>
- [5] <https://github.com/FREVA-CLINT/freva-deployment>
- [6] freva.met.fu-berlin.de
- [7] <https://www.xces.dkrz.de/>
- [8] www-regiklim.dkrz.de
- [9] <https://www.go-fair.org/fair-principles/>



accessibility

A horizontal bar containing three elements: a Python logo icon, a light blue rounded rectangle with the text "WWW.", and a dark grey rounded rectangle with a green "\$_" symbol.

A yellow rounded rectangle labeled "plugins" containing a line graph icon and a hand pointing at a screen icon.

A central green circle containing the text "XCES".

A purple rounded rectangle labeled "data" containing a stack of document icons, with the top one labeled "CMOR".

A light blue rounded rectangle containing three database icons: "MariaDB", "data storage", and "SOLR".

reproducibility

