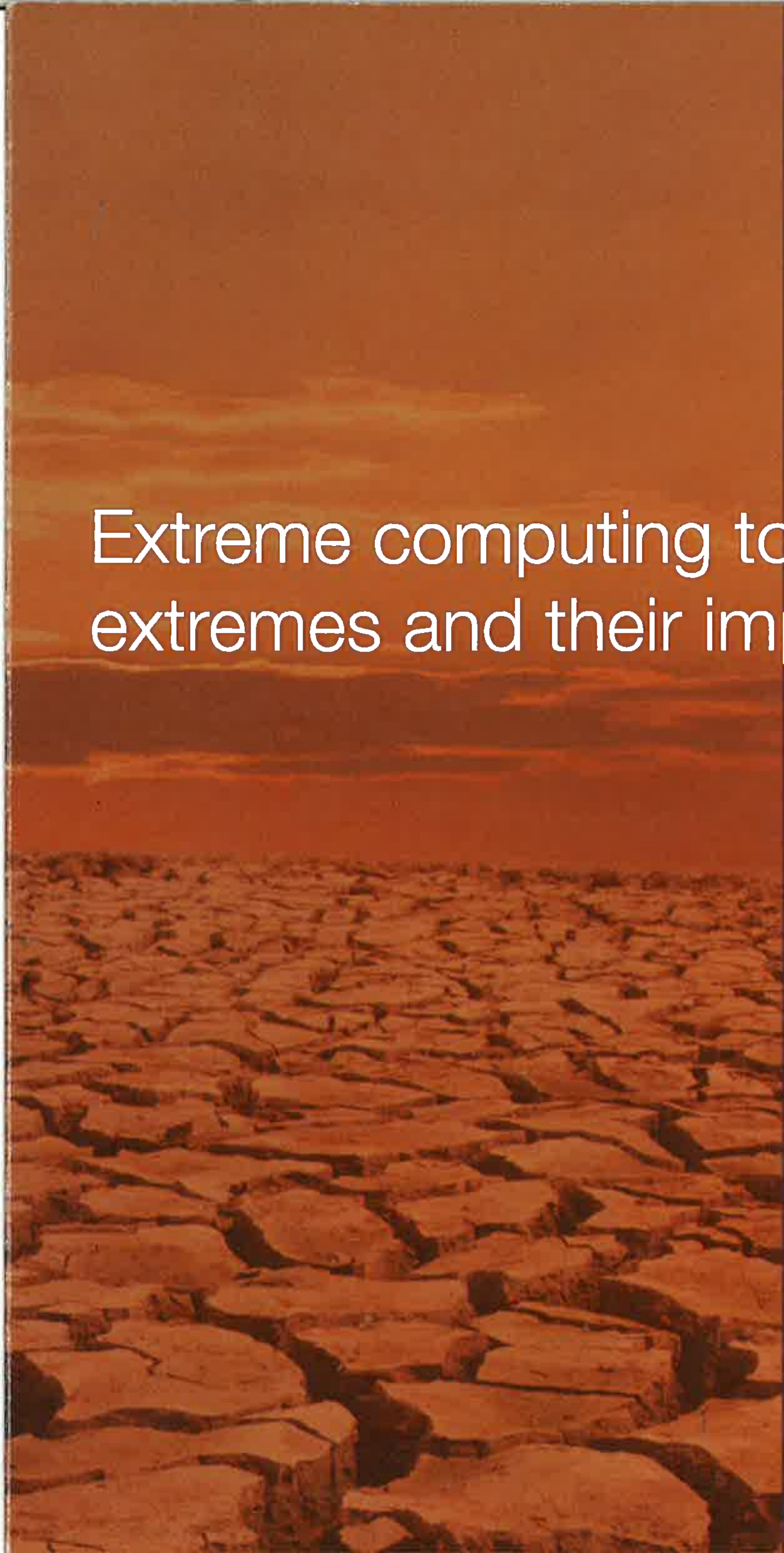


ExtremeEarth

Extreme computing to tackle environmental extremes and their impacts on society

While the understanding and prediction of natural hazards have improved significantly over recent decades, Europe continues to suffer billions of euros of damage and loss of life from extreme events. Much damage occurs because current forecasting systems do not predict the precise location, timing and magnitude or the actual impacts of extreme events and natural hazards with sufficient reliability and lead time to allow proactive management.

A 2018 study by the United Nations assesses the cost of natural hazards between 1998 and 2017 to be 1.3 million fatalities and 2.9 trillion US dollars of economic losses.

The World Economic Forum has identified:

- Extreme weather events (e.g. floods, storms etc.)
- Failure of climate-change mitigation and adaptation
- Major natural disasters (e.g. earthquakes, tsunamis,volcanic eruptions, geomagnetic storms)

As the top three risks combining likelihood and impact.

EXTREME COMPUTING TO TACKLE ENVIRONMENTAL

Solutions are within our reach, at the cost of a fundamental step change in the way we simulate the Earth system and exploit the wealth of simulations and observations for the prediction of extremes. At least a 1000-fold increase in computational and big data handling capability is required. New ways for Earth system sciences and technological innovations to interact are also needed. Such a transformation is a huge challenge and will only be possible through true co-design between science, technology and user communities, and within a foundational programme with sustained and coordinated efforts.

BUILDING BRIDGES

ExtremeEarth has been designed to bring together institutions, academia and industry with user communities to tackle devastating extremes by:

- Building and maximising existing capabilities, such as those from regional, national and international services, for example national meteorological-hydrological and EU-funded Copernicus services, disaster prevention and mitigation agencies, and commercial entities such as (re)insurers.

The project will also work closely with observational data providers to ensure that the wealth of observed information is used effectively in future prediction systems. It will be important to identify the breakthrough requirements for these services across the board and how to translate these requirements into specific science – technology goals for ExtremeEarth.

- Fostering and driving collaboration between the sectors is required to develop solutions. ExtremeEarth will invest in novel extreme-scale laboratories that will revolutionise methodology and technology developments across sectors, and produce natural hazard prediction demonstrators ready for operational implementation.

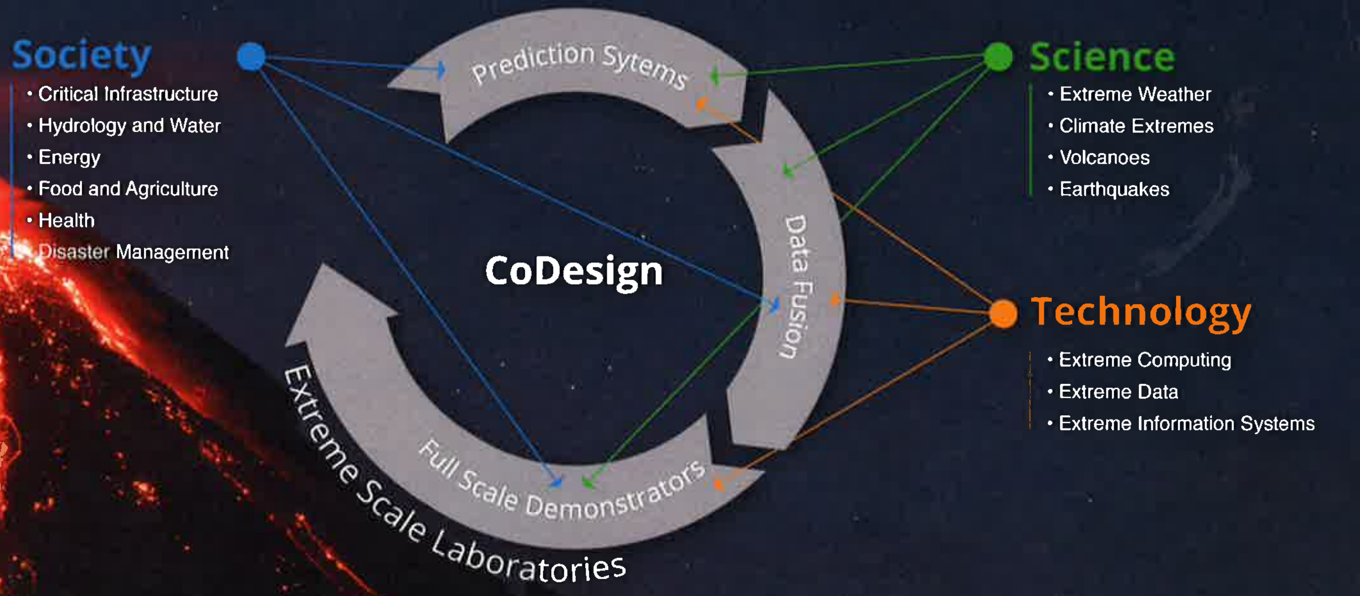
BRINGING TOGETHER SCIENCE AND IMPACTS

- Major advances in highly detailed Earth system modelling: aiming to resolve convection and ocean-eddies in the Earth's atmosphere and ocean, and faults in the Earth's crust, where advances in computing can be expected to lead to a step-change in predictive capability.

A key contribution is a much-enhanced utilisation of observed and simulated information through advanced data assimilation methods and artificial intelligence techniques.

EXTREMES AND THEIR IMPACTS ON SOCIETY

ExtremeEarth will co-design the technological transformation necessary for step changes in the ability of European society to anticipate weather and climate extremes, earthquakes and volcanoes; to collect and integrate Earth system data; and to access and adapt this information to the needs of an expanding user community.



- Major advances in combining Earth system physics and impact modelling: bringing together Earth system scientists and associated downstream impact communities to fully implement the value chain from very high-detail science-based information to socio-economic risk management in the water, energy, food, and health sectors.

Downstream applications will become an integral part of the prediction system, and workflow design will allow the application specific configuration of the upstream generation and extraction of information. The best geophysical information will be tailored for each impact sector using the full range of extreme-scale computing and data handling capabilities.

- Major advances in information technology and data handling: ExtremeEarth will develop the required extreme-scale processing capabilities at the interface between cloud, edge and centralised high-performance computing, also exploiting existing and emerging Earth observation data sources.

In turn, ExtremeEarth's development of highly detailed modelling capabilities of the entire Earth system value chain will accelerate the development of European cutting-edge computing systems and data platforms in the coming years. This marriage of extreme-scale science and technology does not exist today.

CONSORTIUM

ExtremeEarth will build upon expertise from its consortium members as well as national and international partners to deliver application-orientated solutions to the environmental extremes affecting the planet today.

ExtremeEarth Consortium Members   ECMWF European Member and Co-operating States

UK Research and Innovation

University of Oxford

CNRS

Meteo France

BSC Barcelona Supercomputing Center

University of Helsinki

DTU

netherlands eScience center

Deltares Enabling Delta Life

Universiteit Utrecht

Climate Centre

ETH zürich

cmcc

Istituto Nazionale di Geofisica e Vulcanologia

JÜLICH Forschungszentrum

ECMWF

The programme is coordinated by the European Centre for Medium-Range Weather Forecasts (ECMWF), an independent intergovernmental organisation serving its 34 Member and Co-operating States and partners around the globe with world-leading global numerical weather predictions.

extremeearth.eu