



## EXTREME WEATHER FORECASTING WITH EXTREME COMPUTING

**Weather-related natural disasters have, over the last two decades, led to the loss of thousands of lives and caused damage totalling billions of euros each year. Floods, droughts, windstorms, tropical cyclones: these can all be devastating.**

Forecasts of severe weather events provide vital early warning for authorities and the public, giving time to allow contingency plans to be put into place.

The European Centre for Medium-Range Weather Forecasts (ECMWF) provides forecasts to European Member States and Co-operating States. The national weather services use these to provide early warnings of severe weather to their customers, who include civil protection agencies and the general public.

ECMWF's Integrated Forecast System (IFS) is a piece of software used to provide medium-range weather forecast products up to 2 weeks ahead. It is paramount that IFS completes a 10-day forecast in less than one hour so that forecast products can be delivered on time to ECMWF member states.



ECMWF is an intergovernmental organisation supported by more than 30 states. Its principal objective is to produce operational weather forecasts for up to two weeks ahead and to disseminate this information to the national weather services of its Member States. At shorter range, national weather services issue more detailed warnings, using local observations and additional information from their own regional and local short-range forecast models.

A series of improvements to IFS have been carried out primarily to allow the calculations in the code to be carried out simultaneously (to overlap) with communication between processing cores. This has resulted in the code going 20% faster on 40,000 cores on the UK National HPC service, HECToR, a Cray XE6.



The importance of these improvements is clear – they will enhance the simulations carried out and allow IFS to continue to operate and improve well into the 2020s.

Hurricane Sandy hit New Jersey on 30th October 2012, leading to over 100 fatalities and causing significant damage to property. From as early as the 23rd of October, ECMWF's IFS had predicted the storm would strike the East Coast of the US, while most other models predicted the storm would move out to sea. This gave essential early warning to government and the general public.



This work was carried out as part of the Collaborative Research into Exascale Systemware, Tools and Applications (CRESTA) project, an EC-funded FP7 project. This focused on developing applications with exascale potential and, through a co-design process, developing the software required to support these applications at the exascale.



#### About ARCHER

ARCHER is the UK National Supercomputing Service. The service is provided to the UK research community by EPSRC, UoE HPCx Ltd and its subcontractors: EPCC and STFC's Daresbury Laboratory, and by Cray Inc. Laboratory.

The Computational Science and Engineering (CSE) partners provide expertise to support the UK research community in the use of ARCHER, and researchers can also apply for longer-term software development support through the Embedded CSE (eCSE) programme. The ARCHER CSE partners are EPSRC and EPCC at the University of Edinburgh.

#### The Case Study Series

The ARCHER service facilitates high quality science from a broad range of disciplines across EPSRC's and NERC's remits. The outcome is science that generates significant societal impact, improving health and overall quality of life in the UK and beyond. This science influences policy and impacts on the UK's economy.

This case study is one of a series designed to showcase this science. It has been produced as part of the ARCHER CSE service, supported by EPSRC research grant No EP/N006321/1.



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