

INLINE – Integrated pan-European rainfall and floods impact forecasts for cooperation in emergency management

Real-time Production of Improved Storms and Flood Impact Forecasts

Milestone 9

15 July 2026

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**Funded by
the European Union**

DOCUMENT INFORMATION

Title	Real-time production of improved storms and flood impact forecasts
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Dissemination level	PU – Public
Document Reference	Baugh et al. 2026: Real-time production of improved storms and flood impact forecasts. INLINE Milestone MS9, 9 pp.

VERSION HISTORY

Version	Author	Organisation	Date	Comments
1.0	Calum Baugh	ECMWF	15 July 2026	

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1 Introduction and scope

This milestone report is about the real-time generation of the INLINE forecast products and how they are made available to the INLINE web platform during the demonstration period between months 6 to 24 of the project. There are three main types of forecast products:

- Storm impact products – developed at FMI.
- River flash flood impact products – developed at ECMWF.
- Pluvial hazard products – developed at UPC.

Each of the above products are created in real time at the respective institution, before being disseminated to UPC servers through an FTP (File Transfer Protocol) server. The INLINE web platform extracts the products from the FTP server and displays them to the users.

2 Generation of the storm impact products

Storm impact products are generated every 15 minutes at 00, 15, 30 and 45 using the latest OPERA rain rate composites. The spatial resolution and time step are 2 km and 15 minutes, respectively, and the maximum lead time range is three hours. The product generation is done in a server hosted by FMI using a set of scripts written in the Python programming language. Nowcasts are generated separately for three types of storm hazards and risks: precipitation, wind and lightning.

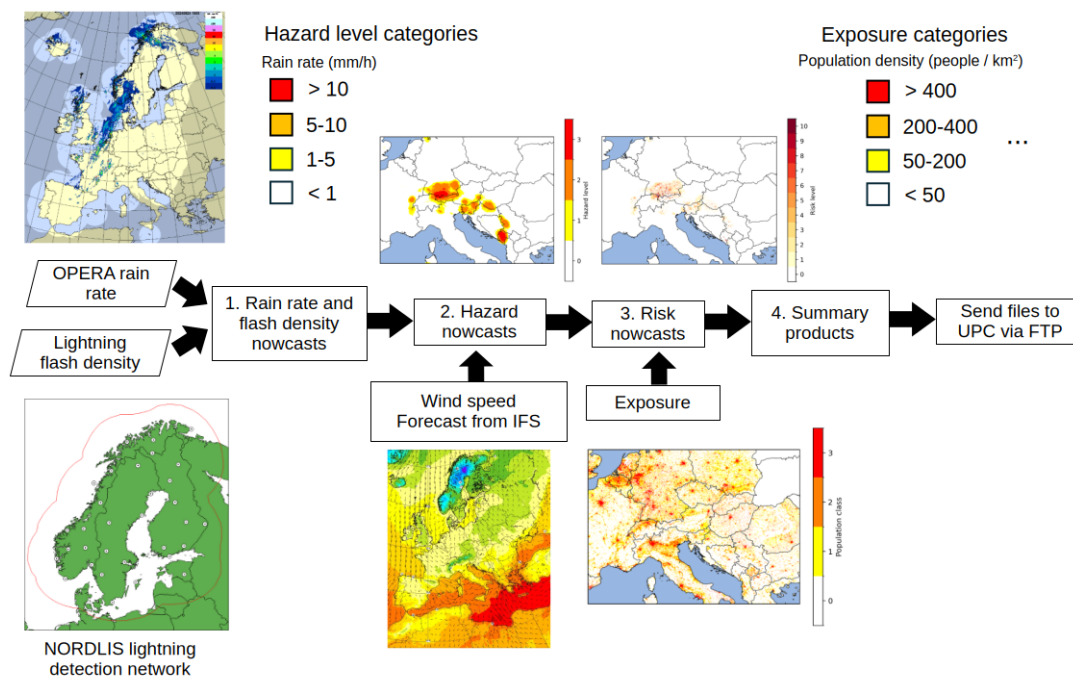


Figure 1. Overview of the INLINE storm hazard and risk product generation.

The product generation has four stages (Figure 1): 1) generation of nowcasts of meteorological variables (precipitation, wind and lightning); 2) translation of meteorological variables into hazard levels using specified thresholds; 3) further conversion of the hazard into risk by using exposure information; and 4) generation of summary products that give the maximum risk level predicted for the next three hours. Precipitation nowcasts are produced by using a neural network, and flash density nowcasts by simple extrapolation. Wind forecasts are taken from the IFS forecast system operated by ECMWF.

The produced hazard and risk nowcasts are stored in GeoTIFF format and are uploaded to the UPC server via FTP.

3 Generation of the River Flash Flood Impact Products

The river flash flood impact products are generated at ECMWF once per hour at 00. The products are created using a series of scripts written in the Python programming language. These scripts are organised to run within a suite (Figure 1), which was generated using ecFlow software (<https://ecflow.readthedocs.io/en/latest/>). The ecFlow generated suite automatically triggers the scripts to create a forecast product as soon as the latest radar observations are available. The suite also manages the running of each script within tasks, it also manages the dependencies between the tasks, for example it will wait for the task which generates the radar nowcast to complete before triggering the task which blends the nowcasts with the NWP (Numerical Weather Prediction) forecasts.

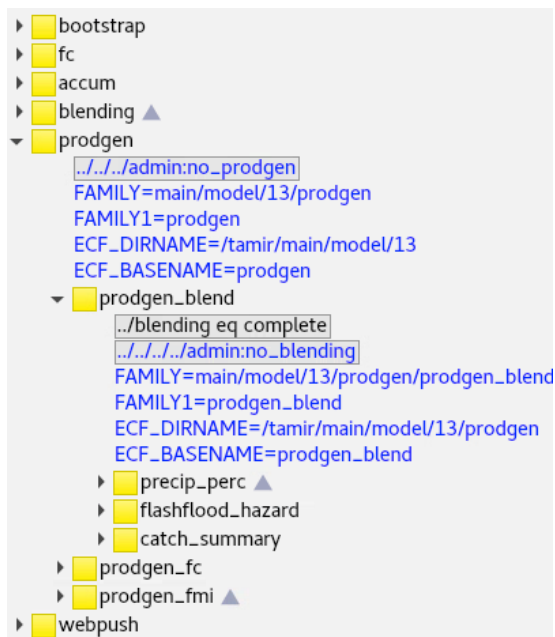


Figure 2. Excerpt of the ecFlow suite used to schedule the production of the hourly river flash flood impact products at ECMWF. For example, within prodgen > prodgen_blend, there is a task called flashflood_hazard, which contains the scripts used to calculate the river flash flood impacts on the 1 arcminute river network.

The suite is run in an experimental mode, meaning that issues with the running of the suite are only resolved during working office hours (Monday-Friday, 09:00 – 17:30 UK time).

Once the tasks within the ecFlow suite have finished generating the river flash flood impact products, a final family called *webpush* (Figure 2) contains a task called *diss2ftp* which transfers the products from ECMWF to a directory within an FTP server hosted on ECMWF's ECPDS (ECMWF Production Data Store). A web server hosted at UPC automatically retrieves new forecasts from the ECPDS directory and displays it on the INLINE web platform.

4 Generation of the pluvial hazard products

The pluvial flood hazard products are generated on UPC servers in real time whenever a new OPERA radar composite becomes available. The products are created using a series of scripts written in both the bash shell scripting language and Python. These scripts are organised to run automatically at regular intervals using the Debian *cron* scheduling service.

A first bash script downloads the latest OPERA radar composite files from the UPC FTP server, where the data are received from GeoSphere. Once the new radar observations are available, a Python processing script is automatically triggered to read the latest radar files and generate the different nowcasting products. These include radar reflectivity nowcasts, hourly precipitation accumulations, and the pluvial flood hazard product.

The generated products are stored directly as GeoTIFF files in a format that can be served by the [INLINE platform](#)'s Web Map Service (WMS), without requiring any additional postprocessing.

The processing chain runs continuously on dedicated Debian servers hosted in the UPC data centre, ensuring 24/7 operational product generation. The operational service currently runs in an experimental mode, meaning that any issues affecting product generation are resolved during working hours.