The challenges of making seamless pan-European flash flood impacts forecasts useful for local decision making

Calum Baugh*[1], Eleanor Hansford[1], Christel Prudhomme[1], Corentin Carton de Wiart[1], Paolo Battino[1], Juan Colonese[1], Martin Blick[1], Marc Berenguer[2], Shinju Park[2] & Wai-Kin Wong[3]

[1] ECMWF, Reading, UK, [2]UPC, Barcelona, Spain, [3]Hong Kong Observatory, Hong Kong, China; *email: calum.baugh@ecmwf.int

Funded by European Union Civil Protection and Humanitarian Aid

1. Introduction

The TAMIR project is a continuation of the SMUFF project, it aims to improve pan-European flash flood forecasting to support pro-active emergency response. The SMUFF project developed a seamless forecast system which blends radar and NWP (Numerical Weather Prediction) forecasts.

The aim of TAMIR is to make these forecasts more locally relevant by:

- Identifying flash flood hazard thresholds at which forecast-user actions are required
- Combining flash flood hazard with exposure information to estimate impacts
- Working with forecast users to develop new products and web services

2. Flash flood forecast system

The flash flood forecast system developed in the SMUFF and TAMIR projects forecasts has 4 components (Figure 1)

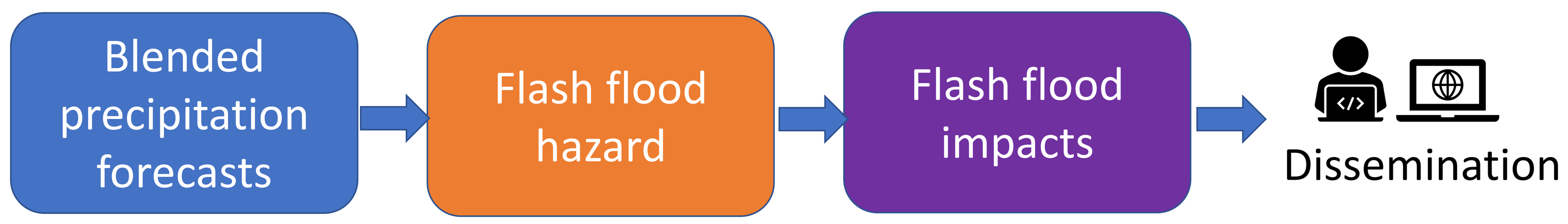

Figure 1: Component of the TAMIR flash flood forecast system.

Forecasts are produced every hour at 1km resolution and 1 hour timestep for the first 7-12 hours lead time and 6 hour timestep for lead times up to 120 hours

Blended precipitation forecasts

Created from: 1) 20 member ensemble nowcast from OPERA radar rainfall, 2) 51 member ECMWF NWP phase shifted and bias corrected to radar data. Lead time dependent blending using a hyperbolic tangent weighting function up to 6 hours lead time, beyond this the NWP is used.

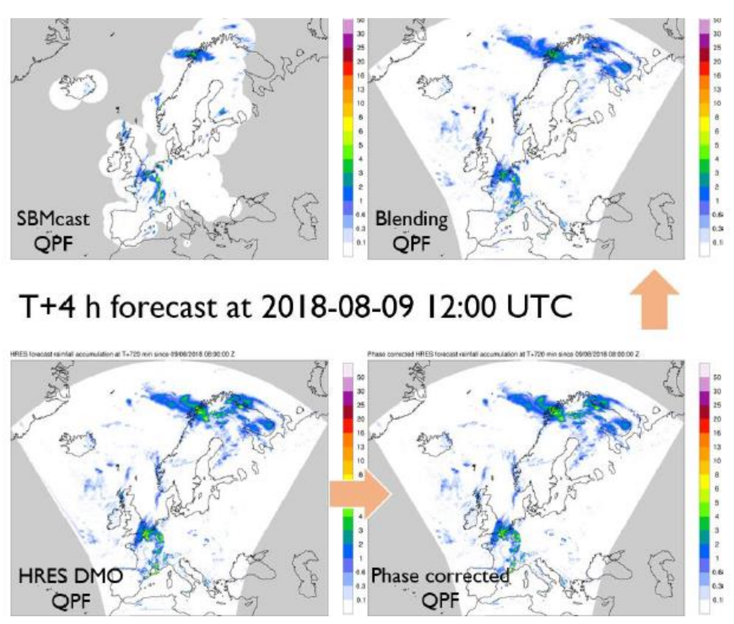

Figure 2: Example of blending the radar rainfall (top left) with NWP (bottom left) to produce a blended forecast (top right)

Flash flood hazard

Precipitation forecasts are accumulated on a 1km channel network. Accumulated values are compared to thresholds derived from model climatology. If many ensemble members exceed the threshold, a flash flood is likely – see box 3 for more information

Flash flood impacts

Flash flood hazard forecasts are combined with exposure information (see Hansford *et al.*, poster) to highlight areas at risk of high impacts. See box 4 for more information

3. Identifying flash flood thresholds for decision making

The forecasts will show the probability of exceeding a climatological threshold. Forecast users need to know beyond what exceedance probability it is optimal to take anticipatory action, this will be dependent upon forecast lead time

Flood hazard forecasts were verified against observations for 5 case studies (Figure 3):

- Mallorca, Spain 9th Oct 2018
- France/Spain 22nd-23rd Oct 2019
- Czech Republic/Hungary 13th-14th Jun 2020
- Zagreb, Croatia 24th July 2020
- France/Italy 2nd-3rd Oct 2020

Figure 3: Grey administration regions where the forecast verification was performed

At each lead time, different exceedance probability values were applied to generate flash flood warnings, these were compared against the observations.

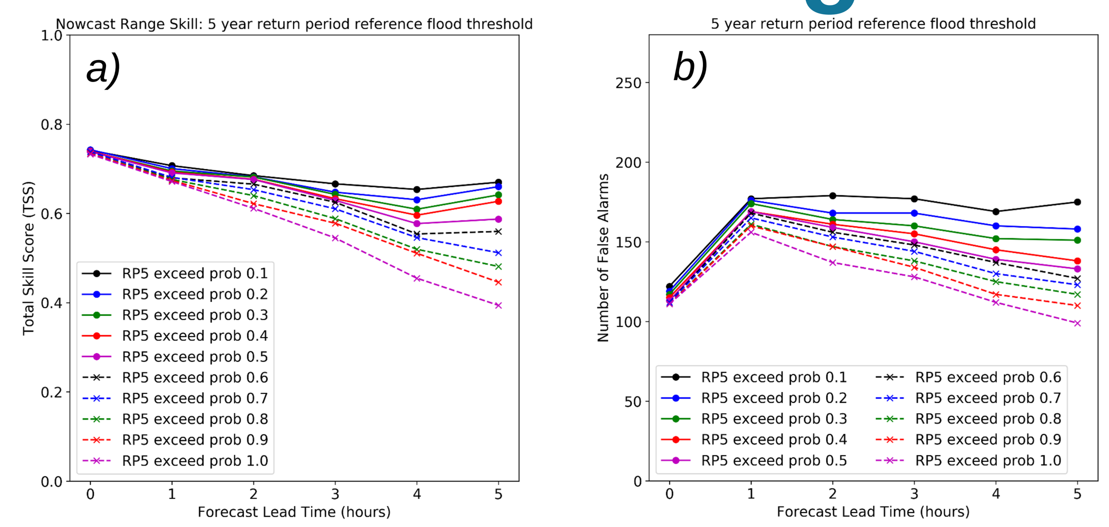

Figure 4: a) Total Skill Score (TSS) of the forecasts using different exceedance probability thresholds, b) false alarms for each exceedance probability threshold

Results show at short lead times (0-1hrs) exceedance probability is not important (Figure 4a), at 2-5 hrs an exceedance probability of 50% balances the need to minimize the number of false alarms (Figure 4b)

4. Creating flash flood impact forecasts

Flash flood hazard forecasts may highlight a broad at-risk area, forecast users wish to know where within this area the impacts may be greatest. Therefore, the flash flood hazard forecasts are intersected with exposure information on a risk matrix (Figure 5).

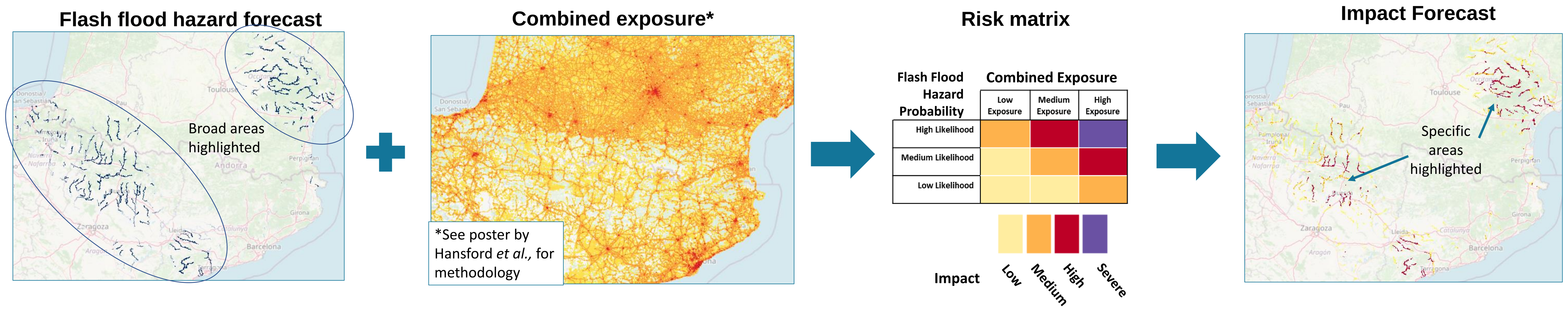

Figure 5: Procedure for generating flash flood impact forecasts from the hazard forecast, exposure information and the risk matrix

5. Forecast user engagement

TAMIR is engaging with forecast users through workshops held during the project, these are to ensure that the forecast products are useful.

Product design

Users are being consulted on a number of options for product design. Different options will be presented for a number of case studies (Figure 6). Feedback will influence the design of the final products

Product dissemination

We are working with users to identify how they wish to access the forecasts. Options are 1) via the EFAS web platform, 2) web services e.g. WMS-T for integration into their own systems

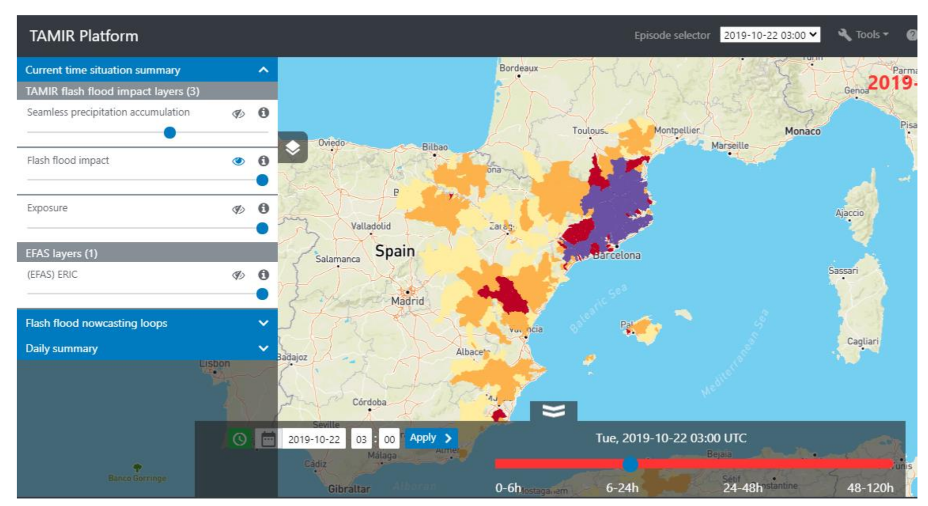

Figure 6: TAMIR web platform displaying an example of a forecast impact product, purple areas show catchments at risk of severe impacts

6. Conclusions

The TAMIR project will conclude in 2022, the next steps are:

- Evaluate the usefulness of the flood impact products versus the flood hazard products
- Decide with users on the final design of the flood impact products
- Release the products as part of a 24/7 operational service shown on the EFAS website and available as a WMS-T

For more information: tamir-project.eu

Grant number: 874435 – TAMIR- UCPM-2019-PP-AG