Flood Foresight: Real-time and forecast decision support system
DARE Workshop | 22 November 2017
Overview

- Background and rationale
- Flood Foresight
- India pilot
- Validation
- Data assimilation
The ‘common operating picture’

- Common data for multiple sectors
- Shared service opportunities for value-add data integrators
- International in scope
- Potential for DA to improve data
Goal

Develop a system that generates real-time and forecast view of flooding as it evolves

Modelled + EO approach
Near real-time and forecast rainfall and flood data for riverine flooding

Enables flood early warning and improved targeting of mitigation and response activities
Global flood hazard maps

- High resolution storm-surge, fluvial and pluvial maps in development
- High resolution maps available
- 30m storm-surge, fluvial and pluvial flood maps available
- 30m fluvial and pluvial flood maps available
- Not mapped
Simulation Library approach

1. Prediction of in-channel levels or flows
2. Lookup between in-river conditions and flood mapping
3. Select flood outline with closest match to forecast conditions
4. Intersect with flood receptors to derive impacts information
Flood Foresight framework

Meteorological forecast data

Ensemble modelling

Streamflow forecast (0-7 days)

Jflow® modelling

Global Flood Maps

Interpolation

Gridded data

Simulation library

Compute local rarity

Flood maps (forecast & current)

API

User system

Streamflows (gauges)

Real-time
Flood Foresight services

**RAINFALL SCREENING**
- Continental scale rainfall
- Grid & catchment view
- Forecast data (0-7 days)
- Daily updates

**FLOOD FORECASTING**
- National scale flood footprints
- Driven by rainfall-runoff model
- Extent & depth data
- Current & forecast (0-10 days)
- Daily updates

**FLOOD MONITORING**
- National scale flood footprints (for any country)
- Driven by near real-time river gauge data
- Extent & depth data
- Current status of flood
- 3-hourly updates (GB)

Data available through Web-App, API or FTP download
Approach

Simulation Library forecast of flood hazard and impacts

Real-time modelling of forecast information

Real-time data assimilation

Real-time observations of actual flooding (and impacts)
Current status & future plan

**Rainfall Screening**
- Europe currently available
- Other continents can be configured

**Flood Monitoring**
- GB currently available
- International pilots as data availability allows

**Flood Forecasting**
- UK & IRL currently available
- India pilot completed
- Can be configured internationally
India pilot
India demonstration

- Brahmaputra river basin deployed in one week:
  - 30 metre resolution flood footprints
  - Daily updates
  - 0-7 day forecast
  - Ensemble forecast (fluvial) – allowing uncertainty and likelihood assessment
- Validation using EO data

Flood Foresight inundation footprint (16 August 2017)
25 Aug 2017 (T+0d)

Results – flood peak animation

Legend
- Middle and Lower Brahmaputra Basin
- Forecast flood depth footprints (m):
  - < 0.3 m
  - 0.3 m - 1 m
  - 1 m - 3 m
  - 3 m - 6 m
  - 6 m - 9 m
  - > 9 m

Preliminary data

Click image to animate
Ensemble-based flood likelihood

Use of probabilistic footprints to assess the confidence of the forecasts at longer lead-times

Higher probability (dark colours) shows greater agreement of the ensemble and therefore higher probability of flooding. It is essential to understand uncertainty when used in public alert systems.
Validation
West Coast Main Line shut for 'several days' - Network Rail

The West Coast Main Line north of Carlisle will be closed for several days after eight feet of water flooded the railway.

The depth of the water, around two miles north of Carlisle station, has reached its peak but is not expected to clear until Tuesday (December 8).

Network Rail said a full assessment of the damage will take place as soon as the water recedes and everything done to reopen the railway as quickly as possible. A number of safety-critical cabinets, which house complex electrical equipment, are currently submerged and will have to be rebuilt once it is safe to do so.

West Coast Main Line re-opens

The first train to pass was the 1051 Edinburgh Waverley-London Euston, operated by Virgin Trains, which passed through the affected area just after 1300 today (December 8).

Network Rail engineers worked around the clock to carry out repairs after Storm Desmond caused widespread flooding in the North West.

The water subsided on December 7, and NR has subsequently removed debris and mud from the railway. Repairs to the track and infrastructure have also been completed.

Engineers will remain in place to repair damaged signalling and electrical equipment. Until that is completed speed restrictions will remain in place.
Storm Desmond - West Coast Main Line

Flood Foresight – Maximum extent

Photos: http://www.railmagazine.com

Direction of view
Validation – flood narratives
Validation – India EO

- Validation using EO data (range of platforms)
- Visual comparison + random sample
- Contingency tables (hit/miss/false alarm/correct negative)
Data Assimilation
Data Assimilation

Opportunities:

• Seek to provide a hybrid modelled-observational system, reducing inherent limitations of each dataset
  – Data fusion
  – Data assimilation

• Integration of observed river levels or flood inundation for real-time calibration of Flood Foresight:
  – Use of open EO imagery (i.e. Sentinel-1). Commercial partners also available (i.e. CosmoSkyMed (CSK) constellation).
  – Evidence of current flood used to ‘nudge’ model forecasts through modification of levels or localised rarity
Conclusions

- SLs provide rapid predictable method for real-time and forecast flood mapping
- Flood Foresight framework is flexible for including alternative data sources and models
- Combine with asset data to forecast impact and loss across whole portfolio
- Consistent, (trans-)national data. Globally scalable.
- User evaluations and validation in progress
- Seeking validation data (space/time)
- Opportunities for collaboration on DA