“Met Éireann’s Flood Forecasting Centre: Progress on establishing the Flood Forecast Centre and how we worked during Storm Ellen”

Rosemarie Lawlor
Flood Forecast Division Met Éireann
INTRODUCTION

• Background and Role of Met Éireann in Flood Forecasting
• Progress to date
• What happened during Storm Ellen
• What are the Next Steps
BACKGROUND AND TIMELINE

November 2002
“Parlon Report”

November 2009
Severe flooding
“JBA report”

Government Decision 2016
BACKGROUND AND TIMELINE
The aim of the National Flood Forecasting and Warning Service (NFFWS) is to ensure the effective delivery of operational flood forecasting products and flood risk information to its stakeholders.

This information helps the stakeholders to make impact-based decisions and take actions that will protect against the loss of life and that will protect and mitigate against damage to property.
The operational element of the NFFWS is to be in Met Éireann. Met Éireann has experience of operational weather forecasting since 1936 and we are good at providing this service.

A Flood Forecast Centre (FFC) was to be established in Met Éireann. This would be manned by hydro-meteorologists and they would be tasked with maintaining a river and coastal flood watch over the country (Stage 1).

The OPW will provide guidance and standards to the FFC.

In Stage 1 we are working at river and coastal risk at national and catchment level.
GOVERNANCE STRUCTURE

Interdepartmental Flood Policy Coordination Group

NFFWS Steering Group

- Flood Forecast Centre
- Sub-Groups
- OPW Standards & Performance Guidelines
FLOOD FORECAST DIVISION (FFD)

Why Met Éireann for the FFC?

- We are the Meteorological Service for Ireland
- We have the weather experts
- We operated 24/7 service
- We have operated ocean models
- The public trust us and are used to us issuing weather warnings
- We have the larger public engagement
FLOOD FORECAST DIVISION (FFD)

Flood Forecast Division - Services

The FFD is a Service Division and we will provide a valuable service to the people of Ireland through the provision of timely and actionable flood advisories and alerts.

Goal 3 of the Making Ireland Weather and Climate Prepared Strategy is “Deliver a high quality national flood forecasting service”.

In order to achieve this we place the Customer at the centre of our plans.
FLOOD FORECAST AND WARNING SERVICE

Bureau of Meteorology flood forecasting and warning system
INTRODUCTION

• Background and Role of Met Éireann in Flood Forecasting
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STAGE 1 (FIRST 5 YEARS 2016-2021)

- **Resources:** Recruit and train staff to work in the FFC. Accommodate staff in Glasnevin HQ.
- Identify and develop the optimal *river flood models* for use at National and Catchment level.
- Introduce National *Coastal modelling* into capability Met Éireann’s suite of operational forecast models.
- Develop a *Communication Strategy* for the NFFWS.
- Establish *interim operational arrangements* before trialling the operational NFFWS at the end of Stage 1.
1. Eight new staff including six Hydro-meteorologist have been recruited and training is ongoing.
2. Office space within Met Éireann is being developed for the staff.
CURRENT STEPS – RIVER MODELS

International Marine and Dredging Consultants of Antwerp, Belgium were awarded the Contract for the provision of “Services for the Review, Development and Trial of a Range of Hydrological Models and Integrator Systems for Use in Operational River Flood Forecasting in Ireland”

1. Literature Review to shortlist potential hydrological models and integrator systems
2. Build and calibrate the shortlisted models for 5 representative catchments (historical events) extended to 12 catchment phase
3. Model and integrator system trials using live weather data
4. Final Report and recommendations
A call was made in early 2018 to gather information on all river model that could be used operationally in the FFC. A similar call was made for integrator systems.

Met Éireann and the OPW provided IMDC with a list of 10 criteria that had to be met by the models. This formed a multi-criteria analysis and from this 4 models and 2 integrator systems were selected for trial.
STEP 1 LIT REVIEW RESULTS – RIVER MODELS & INTEGRATOR CHOSEN

- River Models chosen for trial:
  1. Unified River Basin Simulator (URBS) – Australian Bureau of Meteorology
  2. WRF-Hydro – US National Water Model
  3. HYPE – Swedish Meteorological Hydrological Institute
  4. WFLOW – Deltares (Dutch Company)

- Each is different: e.g. runtime, language, modelling approach, spatial configuration, data requirements, etc.

- IMDC had chosen two Integrator systems; FEWS (Deltares) and MIKE Operations (Danish Hydrological Institute)
STEP 2 MODEL SELECTION – RIVER MODELS

12 Catchments

Barrow & Ballyteigue- Barrow, Boyne, Munster Blackwater, Erriff-Clew Bay, Galway Bay South East, Lee, Liffey, Moy, Shannon, Nore
STEP 2 MODEL PERFORMANCE– RIVER MODELS

- Generally 2 models are outperforming the others HYPE and URBS – but there are other considerations
- IMDC trialling phase– move towards making operational the models in real time using live observed/NWP data
- Identify issues integrator and model performance in an operational setting
**STEP 3 FLOOD FORECASTING SYSTEM – RIVER MODELS INTEGRATOR SYSTEM**

- **Integrator system**: interface handles *import*, *model simulation* and *data processing*

- IMDC has tested two different systems; **FEWS (Deltares)** and **MIKE Operations (Danish Hydrological Institute)**

- IMDC **trialling phase** – move towards operationalizing the integrator systems in real time using live observed/NWP data

*Example of the Delft-FEWS user interface*
STEP 3 TRIAL & REPORT – RIVER MODELS

The Barrow model was inserted into the Integrator environment and the model and integrator systems were trialled in parallel.

A detailed report was published which provide Met Éireann and the OPW with the most suitable models for operational river forecasting in Ireland according to IMDC.

The report also detailed the various ICT requirements to run the selected models and integrator systems.

The final report has been issued and should be finalised in 2020.
PROGRESS TO DATE – RIVER MODELS

1. Literature Review to shortlist potential hydrological models and integrator systems is **Done**
2. Build and calibrate the shortlisted models for 5 representative catchments (historical events) extended to 12 **Done**
3. Model and integrator system trials using live weather data **Done**
4. Final Report and recommendations **Under review**

So overall 99% of work is complete

Tenders are being prepared by Met Éireann to procure the recommended integrated systems FUSE
PROGRESS TO DATE – COASTAL MODELLING

- Technical Trial underway with OPW, RPS, DHI, ECMWF
- The system ran for a week on the supercomputer @ ECMWF but lots of manual inputs required
- Second trail on the supercomputer due at the end of the year with limited manual input
To develop a communications strategy the National Flood Forecasting & Warning Service Steering Group established the Communications Working Group (CWG).

The Communications Strategy outlines the communication methods employed

• In both flood and non-flood conditions
• Details mechanisms for two-way communication

Comms Technical Sub-Group wrote the communication strategy and awaiting final comments before it is sign off
PROGRESS TO DATE– COMMUNICATIONS

7 Point Summary of the Communications Strategy

- Met Éireann will forecast for 2 types of flood risk: River & Coastal
- Establish a network of contacts within the Stakeholders organisations
- The PRAs are responsible for flooding emergency management
- Stage 1 products are on a national and catchment scale
- Matrix of different methods: “Cast a wide net”
- 3 groups of stakeholders
- 3 methods of communications
As a part of the Communication Strategy the National Flood Forecasting and Warning Service (NFFWS) recommends establishing a Severe Weather and Flood Liaison Manager (SWFLM) within the Local Authorities.

The main purpose of the SWFLM is to create a known contact network within the Local Authorities.

Each organisation shall nominate a SWFLM and a “backup” SWFLM to act in the SWFLM stead, during times of leave.
INTRODUCING THE SWFLM:

The SWFLM is:

• A point of contact between Met Éireann the Local Authority.
• Ideally a member of the stakeholders’ Severe Weather Assessment Team.
• Of a sufficient grade to co-ordinate the communication streams within the stakeholder organisation.
• A person who manages the stakeholder distribution list.- This could be individual email address or a distribution list
• A person who manages the method of communication to deliver the weather warnings and flood forecast and flood alerts.
• Demonstrate and introduce new products and services at the Network meetings
INTRODUCING THE SWFLM:

The SWFLM is not:

The single point of contact within the stakeholder organisation.

Solely responsible for alerts within the stakeholder organisation.

The LA and Met Éireann will both ensure that the stakeholder’s alert distribution list is up to date

How can this be done – possibly a dedicated email address for alerts and warning to be sent
Operation Outputs
(DFGS, Advisory, Alert, Operational Updates, Web Portals, General Enquiries)

- 1 Daily Flood Guidance Statement – 5 Day Flood Risk Forecast
- 2 Flood Advisory 3 Day “Be prepared” – More Specific than DFGS
- 3 Flood Alert Up to 24 Flood Forecast – “Take action”
- 4 Operational Updates
- 5 Mapping Portal Such as MetWeb, FEWS, Anywhere
- 6 General Enquiries
DEVELOP COASTAL PRODUCTS

Daily Tide Tables
24 locations around the coast
Marine Institute Data

Castletownbere
07:20; 1.27m
19:35; 1.21m

Time of High Tide (UTC) 2020-10-05 OD Malin

Supernan tides occur when the moon is closest to the Earth (at perigee). Spring tides occur when the sun and moon are aligned (full moon and new moon Phases). A Lunar Cycle takes 29.5 days to complete. Tides peak approximately once every 24 hours and 50 minutes.
DEVELOP COASTAL PRODUCTS

Wave ENSgram for 18 Locations using ECWMF WAM model outputs to match the OPW’s Coastal Model

They show:

• Wind Direction
• Wind Speed
• Significant Wave Height
• Mean Wave Direction
• Mean Wave Period
Overall Daily Map of High Tide Exceedance for the 18 locations using Current OPW’s Tide & Surge Model

Individual Graphs
- Total Water Level with thresholds
- Surge Level
- Tide Level
• Background and Role of Met Éireann in Flood Forecasting
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STORM ELLEN 19\textsuperscript{TH} & 20\textsuperscript{TH} AUGUST 2020
Warnings are issued & NECC Attended
STORM ELLEN : BRIEFINGS

NECC briefings carryout remotely using Webex

Met Éireann gave on update on the Weather & the potential Flood Risk

Multiple NECC briefings were held : Tuesday 18th August, Wednesday 19th August @ 12:00 & 20:00

Special meetings on Thursdays 20th August @ 10:00 & 15:00 for Cork City’s Flood Assessment Team
STORM ELLEN: BRIEFINGS
Harmonie Mean Winds & Gusts (Warning Colours) 20z,21z,22z,23z
MEAN WINDS (KTS)

IREPS 10m Mean Wind (Kts) - Warning Colours
Run: Wed 19.08.2020 0Z. Frame: Wed 23Z
STORM ELLEN 19TH & 20TH AUGUST 2020
STORM ELLEN 19TH & 20TH AUGUST 2020

Current Warnings
- 21:00 Wednesday to 23:59 Thursday
- 21:00 Wednesday to 06:00 Thursday
- 21:00 Wednesday to 23:59 Wednesday

Status Yellow - Wind warning for Ireland
- Met Éireann Weather Warning

21:00 Wednesday to 23:59 Thursday
Status Orange - Wind warning for Munster, Galway and Mayo
- Met Éireann Weather Warning

21:00 Wednesday to 06:00 Thursday
Status Red - Wind warning for Cork
- Met Éireann Weather Warning

21:00 Wednesday to 23:59 Wednesday
FLOOD RISK

Rivers

• 38% are below the 50th Percentile
• 1 gauges above LMED Maigue In Limerick
• 1% are below the 95th Percentile
• Rainfall accumulations 20-45mm/24hr
• SMDs slightly above saturation in east & south east. Saturated Elsewhere

Surface Water

• 3hrs & 6hrs thresholds expected to be exceeded everywhere
RIVER FLOOD RISK

Rivers

Percentage River Level (in relation to LMED)
- Below 95 Percentile Level [4]
- Below 50 Percentile Level [169]
- 0 to 25 Percentage River Level [81]
- 25 to 50 Percentage River Level [5]
- 50 to 100 Percentage River Level [0]
- Level above LMED [0]
- Above Highest recorded Level (Check Waterlevel.ie) [0]
STORM ELLEN 19\textsuperscript{TH} & 20\textsuperscript{TH} AUGUST 2020
COASTAL FLOOD RISK TIDES ONLY

TIDE TIMES - THURSDAYS

- Location
- Time of High Tides
- Water Level at High Tide
- Moon Phase
- Where the day is on the Lunar Cycle
## COASTAL FLOOD RISK SURGE PLUS TIDE

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<th>Longitude</th>
<th>Max_Wat</th>
<th>Max_Surg</th>
<th>Max_Surge</th>
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<th>T5</th>
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</table>
Tide Time: 13:15am
21/08/20
Surge: 0.54m
Total Water Height: 2.3m
Wind Direction: South-Westerly
Above HAT
Status: High
### COASTAL FLOOD RISK DUBLIN’S SYSTEM

55 forecast locations currently have adjustments

#### Select forecast

**Thursday, 20 August 2020**

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<th>Tide 2</th>
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<td>Sandymount Strand</td>
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An Roinn Tithíochta, Rialtais Áitiúil agus Oidhreachtta
Department of Housing, Local Government and Heritage
Tide Time: 19:15
20/08/20
Surge: 0.51m
Total Water Height: 2.12m
Wind Direction: South East
Above HAT Status: High
## COASTAL FLOOD RISK: LEE SYSTEM

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</table>

**LEE SYSTEM LEVEL 09:19 2.42 TO 2.67M IN THE CITY**
<table>
<thead>
<tr>
<th>Date</th>
<th>High Tide (hr:mn)</th>
<th>Tidal Height (mCD MMSL)</th>
<th>Median Surge Forecast (m)</th>
<th>Upper Surge Forecast (m)</th>
<th>Median Tidal Height (mCD MMSL)</th>
<th>Upper Tidal Height (mCD MMSL)</th>
<th>Surge Commentary</th>
<th>Rainfall Commentary</th>
<th>Wind Commentary</th>
<th>Conclusion</th>
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<td>Tue, 18-Aug-20</td>
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<td>Heavy rain (5mm/hr)</td>
<td>33mph &amp; southwesterly</td>
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<td>33mph &amp; southerly</td>
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<td>23mph &amp; westerly</td>
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</tbody>
</table>
COASTAL FLOOD RISK: CORK

**Tide Time:** 19:15  
**Date:** 20/08/20  
**Surge:** 0.51m  
**Total Water Height:** 2.12m  
**Wind Direction:** South East  
**Above HAT Status:** High
### COASTAL FLOOD RISK: CORK

<table>
<thead>
<tr>
<th>CONDITION</th>
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</thead>
<tbody>
<tr>
<td>1 Wind</td>
<td>2 Barometric Pressure</td>
<td>3 Fresh</td>
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</table>

**Tide Time:** 19:15  
**20/08/20**  
**Surge:** 0.51m  
**Total Water Height:** 2.3m  
**Wind Direction:** South East  
**Above HAT Status:** High
Operation Outputs
(DFGS, Advisory, Alert, Operational Updates, Web Portals, General Enquiries)

2. Flood Advisory 3 Day “Be prepared” – More Specific than DFGS
3. Flood Alert Up to 24 Flood Forecast – “Take action”
4. Operational Updates
5. Mapping Portal Such as MetWeb, FEWS, Anywhere
6. General Enquiries
Coastal Products Used

Daily Tide Tables

Wave ENSgram

Overall Daily Map of High Tide Exceedance 18 locations using Current OPW’s Tide & Surge Model

Individual Graphs for High Tide Exceedance
- Total Water Level with thresholds
- Surge Level
- Tide Level
• Background and Role of Met Éireann in Flood Forecasting
• Progress to date
• What happened during Storm Ellen
• What are the Next Steps
STAGE 1 (FIRST 5 YEARS 2016-2021)

- **Resources:** Recruit and train staff to work in the FFC. Accommodate staff in Glasnevin HQ

- Identify and develop the optimal *river flood models* for use at National and Catchment level

- Introduce National *Coastal modelling* into capability Met Éireann’s suite of operational forecast models.

- Develop a **Communication Strategy** for the NFFWS

- Establish **interim operational arrangements** before trialling the operational NFFWS at the end of Stage 1
NEXT STEPS STAGE 1 – INTERIM OPERATIONAL ARRANGEMENTS

1. Incorporate the 12 models into the integrated system
2. Build models for the remaining catchments
3. Source Hydrological Data for the models and set up service level agreements
4. Get ready for an operational trial in stage 2
5. Appoint Severe Weather and Flood Liaison Manager - SWFLM
6. Establish threshold flood levels
STAGE 2 YEARS 5-10 (2022-2027)

Establish the **operational arrangements** that were initiated in Stage 1

Improve national flood alerts service after reviewing the processes and performance during Stage 1

Develop and implement further regional/catchment flood forecasting and warning service

Develop and implement local flood forecasting and warning service for priority sites (sub-catchment and local level)

Develop pluvial flood forecasting capability and work with partners such as the OPW and GSI to produce ground water flooding products
STAGE 3 (YEARS 11 – 16+)

Continuously improve operational arrangements within the FFC

Develop and implement further regional/catchment flood forecasting and warning service

Further develop and extend local flood forecasting and warning service for priority sites
Thank you for your time!
Email rosemarie.Lawlor@met.ie
flood@met.ie