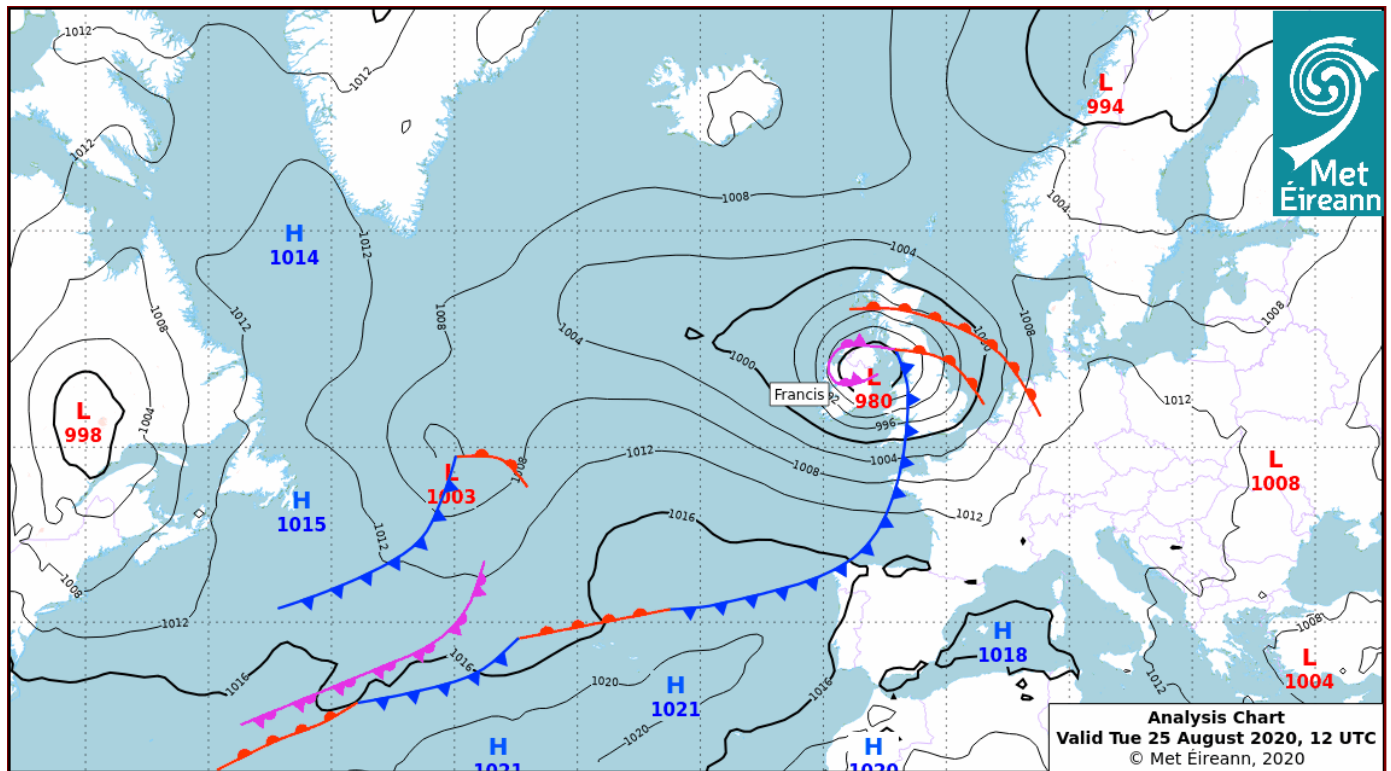


Storm Francis

Monday 24th and Tuesday 25th August 2020

The UK Met Office named Storm Francis on Monday the 24th August 2020. Another rapidly deepening Atlantic low-pressure system, less than a week after Storm Ellen, was forecast to cross Ireland and the UK on Tuesday the 25th August, exactly 34 years to the day since Ex Hurricane Charlie hit Ireland (*see below for comparison*). The first affects from Storm Francis were to be felt in the Southwest of Ireland on the evening of Monday the 24th, with the low pressure centre crossing the country through the day on Tuesday the 25th. The low centre was then forecast to continue moving east north-eastwards across the North of England and into the North Sea in the early hours of Wednesday the 26th. Status yellow wind warnings, along with yellow and orange rainfall warnings were issued for the Island of Ireland.

In a similar setup to the development of the previous named storm four days earlier, Storm Ellen, a low pressure system associated with a trough already in place in the mid-Atlantic interacted with an area of sub-tropical moisture enriched energy moving up from southwest (although this time not previously a tropical storm). The interaction with the left exit of the Jetstream associated with the trough in the mid-Atlantic again rapidly intensified the surface Low-pressure system, Storm Francis, which formed to the south of the parent low as it moved towards Ireland on Monday the 24th. However, this time Storm Francis merged fully with the parent low and became the dominant low-pressure centre. As such, Storm Francis was not steered by the parent low as it approached the Southwest of Ireland late on the 24th, resulting in Storm Francis taking a different path to Ellen, moving directly over the country along a line between Galway and Louth in an east-northeast direction with a minimum central pressure of 979 hPa.



Storm Francis was the ninth named storm of the 2019-20 season (the sixth on the official list of storm names by Met Éireann, the UK Met Office or KNMI). The first named Storm of the season, Lorenzo was an ex tropical system named by The National Hurricane Centre in the US and affected Ireland on the 3rd and 4th October 2019. Storm Atiyah, named by Met Eireann affected Ireland on the 8th and 9th of December 2019. A low-pressure system associated with Storm Elsa, named by the Portuguese weather service, affected Ireland on the 18th December 2019. Storm Brendan, also named by Met Eireann affected Ireland on the 13th January 2020. Storm Ciara, affected Ireland on the 9th and 10th of February 2020 and was named by the UK Met Office. Storm Dennis, also named by The UK Met Office affected Ireland on the 15th and 16th of February 2020. Storm Jorge, named by AEMET, the Spanish national meteorological service, was the 7th named storm of the season and affected Ireland on the 29th February 2020. Storm Ellen, named by Met Eireann, which affected Ireland on 19th and 20th August was the eight named storm of the season.

Storm Francis synoptic station data with warning criteria colours reached

Synoptic station data for 24th and 25th August 2020

Station Name	Maximum 24-hour Rainfall (mm)	Highest 10-minute mean wind speed (km/h).	Highest Gust (km/h)	Wind Direction (degree)	Hour of occurrence (utc) , all on the 25th
VALENTIA	53.9	57 (31 kt)	83 (45 kt)	240	0500
ROCHES POINT	46.4	70 (38 kt)	91 (49 kt)	260	0900
BELMULLET	44.9	59 (32 kt)	80 (43 kt)	40	0800
SHERKIN ISLAND	36.4	69 (37 kt)	89 (48 kt)	260	0800
MOORE PARK	33.9	48 (26 kt)	81 (44 kt)	260	0900
OAK PARK	31.6	65 (35 kt)	93 (50 kt)	250	1300
JOHNSTOWN	31.2	57 (31 kt)	91 (49 kt)	260	1400
CLAREMORRIS	31.3	39 (21 kt)	63 (34 kt)	90	0200
MALIN HEAD	31.2	78 (42 kt)	96 (52 kt)	50	1000
NEWPORT	30.7	44 (24 kt)	63 (34 kt)	320	1300
ATHENRY	30.3	39 (21 kt)	56 (30 kt)	90	0100
GURTEEN	30.2	50 (27 kt)	76 (41 kt)	250	1200
DUNSANY	29.7	44 (24 kt)	65 (35 kt)	260	1500
BALLYHAISE	28.1	30 (16 kt)	56 (30 kt)	80	0400
MULLINGAR	27.9	35 (19 kt)	59 (32 kt)	90	0300
MACE HEAD	24.5	72 (39 kt)	93 (50 kt)	290	1100
MT DILLON	21.5	37 (20 kt)	56 (30 kt)	90	0300
PHOENIX PARK	21.5				
FINNER	20.8	46 (25 kt)	70 (38 kt)	90	0500
MARKREE	17.5				

Rainfall 6-hour totals (mm)

St*	Station name	County	Date	Hour End (UTC)	Warning Criteria	Rain Total (mm)	
1	2275	Valentia Observatory	Kerry	Tue 25 Aug 2020	00	>30mm	48.8
2	1075	Roches Point	Cork	Tue 25 Aug 2020	01	>30mm	42.4
3	3904	Cork Airport	Cork	Tue 25 Aug 2020	00	>30mm	36.4
4	775	Sherkin Island	Cork	Mon 24 Aug 2020	23	>30mm	33.6
5	575	Moore Park	Cork	Tue 25 Aug 2020	02	>30mm	30.4
6	2375	Belmullet	Mayo	Tue 25 Aug 2020	08	>20mm	28.4
7	1575	Malin Head	Donegal	Tue 25 Aug 2020	11	>20mm	26.2
8	1775	Johnstown Castle	Wexford	Tue 25 Aug 2020	03	>20mm	25.8
9	375	Oak Park	Carlow	Tue 25 Aug 2020	03	>20mm	22.5
10	1375	Dunsany	Meath	Tue 25 Aug 2020	05	>20mm	20.5

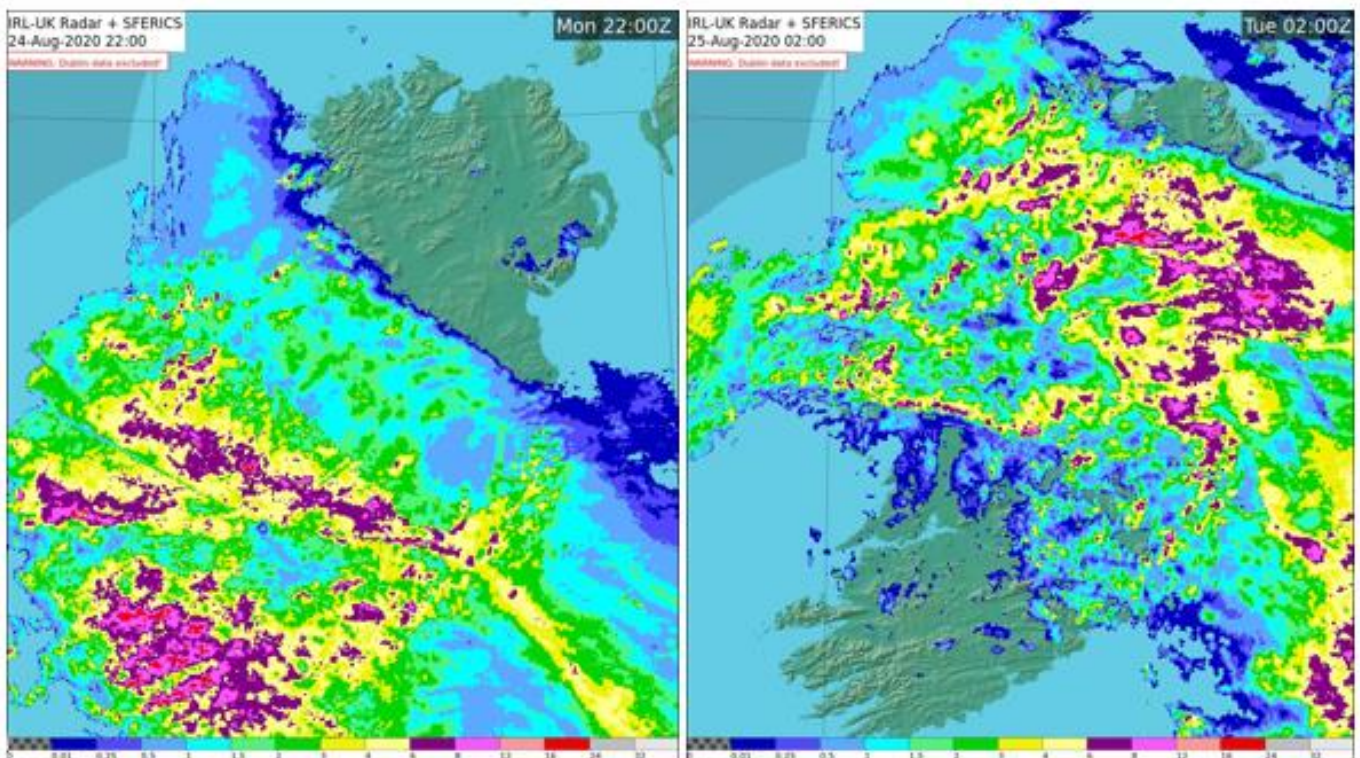
Rainfall 12-hour totals (mm)

St*	Station name	County	Date	Hour End (UTC)	Warning Criteria	Rain Total (mm)	
1	2275	Valentia Observatory	Kerry	Tue 25 Aug 2020	04	>40mm	53.1
2	1075	Roches Point	Cork	Tue 25 Aug 2020	05	>40mm	45.5
3	3904	Cork Airport	Cork	Tue 25 Aug 2020	00	>30mm	36.5
4	775	Sherkin Island	Cork	Tue 25 Aug 2020	03	>30mm	36.2
5	2375	Belmullet	Mayo	Tue 25 Aug 2020	08	>30mm	35.8
6	575	Moore Park	Cork	Tue 25 Aug 2020	06	>30mm	33.4

6 and 12 hour rainfall totals that reached warning criteria for Storm Francis



EUMETSAT infrared satellite of Storm Francis during rapid intensification on the evening of Monday 24th August 2020



Radar images of the active weather fronts crossing Ireland ahead of Storm Francis on the night of 24th/25th Aug

Impacts:

Heavy localised downpours on Tuesday associated with Storm Francis combined with overnight accumulations on already saturated ground led to flash flooding in places. Heavy rainfall on already elevated river levels caused some rivers to burst their banks, blocking roads in places.

- Bantry in west Cork up to 50 businesses incurred flood damage overnight. The local main drainage scheme was unable to cope with up to 25mm of rain falling in a two hour period.
- Flooding also occurred at Dunmanway, Rosscarbery, Connonagh, Clonakilty, Drimoleague, Leap, Ballydehob, Passage West and Youghal.
- Fallen trees and local flooding blocked roads in counties Clare, Kerry, Wexford, Cork, Kilkenny, Laois, Tipperary and Meath.
- Electricity outages left hundreds of premises without power, with Cork, Limerick, Tipperary and Galway worst affected.

August 1986 as a Comparison

August is usually the month with the lowest mean wind speeds across the country. August 2020 has broken that norm with two named storms within a week of each other. One other August in recorded history stands out as being a similarly stormy month in Ireland.

August 1986 saw numerous Atlantic driven storm systems affecting Ireland. Although there was no storm naming system used in Ireland at the time, one storm, Ex Hurricane Charley, kept its name given to it by The National Hurricane Center in Florida as it transitioned to a mid-latitude storm system. "The summer of '86 was a real wash-out. June was thundery; July was the dullest in over 30 years and August brought a succession of storms that caused Flooding in many areas".

Ex Hurricane Charley:

This storm of 25th/26th August 1986 was exceptional for many reasons. Due to the track of Ex Hurricane Charley along the South Coast, the heaviest of the rain was in the South and East of the Country. "By late Friday 22nd what was left of Hurricane Charley was in mid Atlantic, having weakened further so that it was no more than an ordinary depression with its associated occluding frontal system. However, on the Following day, the 23rd August, rapid deepening began to occur at the occlusion point and by midday on Sunday 24th this had developed into a separate depression, clearly visible on the satellite picture below. This depression moved quickly towards Ireland. At midnight on Sunday, the centre was about 300 miles southwest of Kerry and it was still deepening".

"The south coast got the worst of the storm during the morning with heavy rain and strong onshore winds. In the hour between 9 and 10 o'clock more than 12mm (half an inch) fell in Cork city. The Central Analysis and Forecast Office having issued warnings since early morning issued the Following severe weather alert at midday:

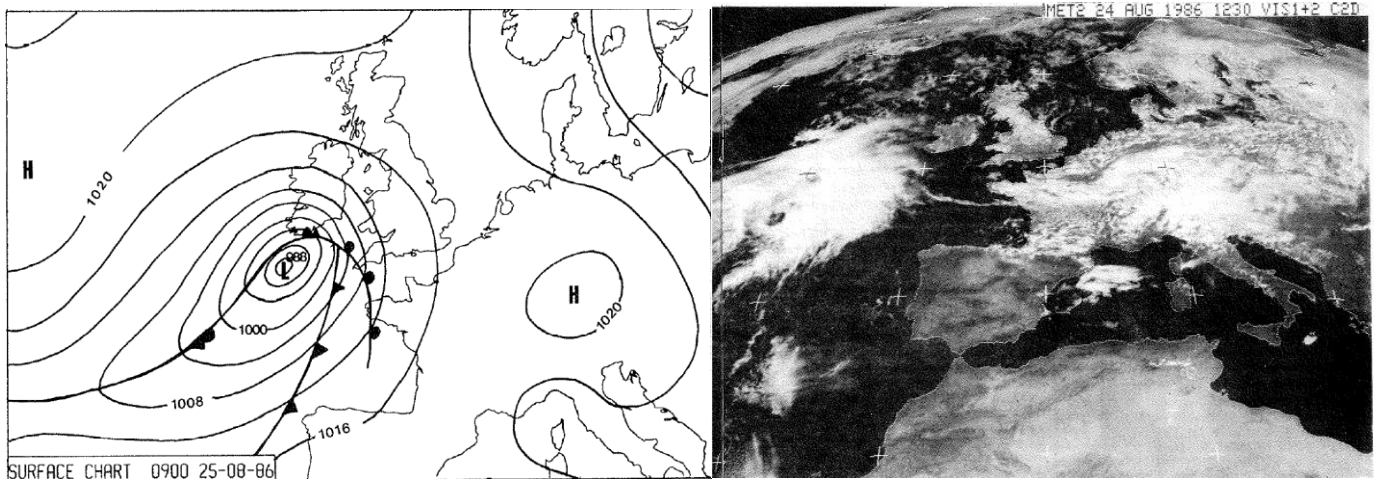
"Extremely heavy rainfall will cause local flooding today especially in Munster and Leinster. Strong gusty easterly winds will back northerly by tonight and increase with violent gusts in exposed places".

"The depression continued to track along the south coast during the evening. At Rosslare, the wind died away for a time as the storm centre passed just to the south. Over the country as a whole the wind backed around gradually to the northeast but there was no let-up in its strength: at 11 o'clock that night the Kish end Wicklow lighthouses reported winds of 55 knots, storm Force 10 and Roche's Point had a force 9 strong gale blowing during the early hours of the morning. By midnight, all stations in the south end east had reported gusts of 50 knots or over".

"As the night of the 25th/ 26th wore on, the rain slowly eased off. It was lunchtime on Tuesday 26th before it finely stopped however, and by that stage it was clear that Dublin, Bray and many other places, particularly in the east end south of the country, had just been through one of the worst storms in living memory".

"The heaviest rain fell on the mountains south of Dublin. At Kippura, which is 750 metres high, an estimated 280mm fell, which is about double the normal rainfall in that area for the whole month of August. Kilcoole south of Greystones, was remarkable among lowland stations: it measured some 200mm and thereby set a new record for

the greatest fall of rain in a day in Ireland” (extracts from a report on August 1986 and Ex Hurricane Charley - https://www.met.ie/cms/assets/uploads/2017/08/Aug1986_HurCharlie.pdf)



Surface analysis and satellite of Ex Hurricane Charley - https://www.met.ie/cms/assets/uploads/2017/08/Aug1986_HurCharlie.pdf

Rainfall 6-hour totals (mm)

St*	Station name	County	Date	Hour End (UTC)	Warning Criteria	Rain Total (mm)
1 1004	Roches Point	Cork	Mon 25 Aug 1986	14	>30mm	47.1
2 3723	Casement	Dublin	Mon 25 Aug 1986	22	>30mm	41.8
3 3904	Cork Airport	Cork	Mon 25 Aug 1986	12	>30mm	39.2
4 2615	Rosslare	Wexford	Mon 25 Aug 1986	16	>30mm	33.6
5 532	Dublin Airport	Dublin	Mon 25 Aug 1986	23	>20mm	29.5
6 3613	Kilkenny	Kilkenny	Mon 25 Aug 1986	11	>20mm	25.2
7 2922	Mullingar	Westmeath	Mon 25 Aug 1986	19	>20mm	20.2

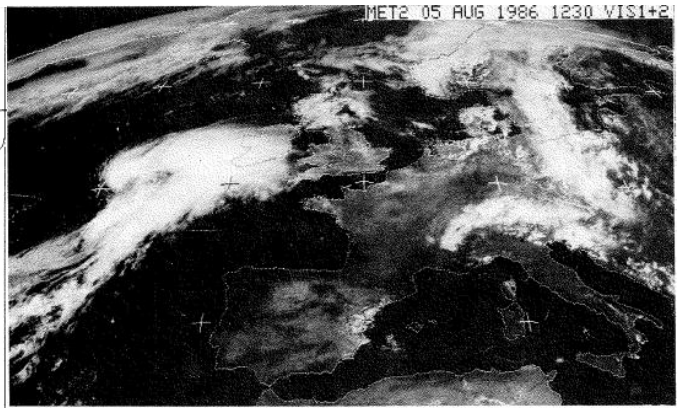
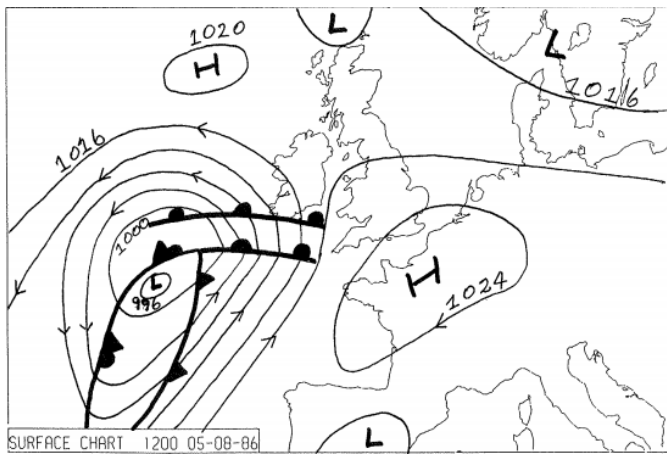
Rainfall 12-hour totals (mm)

St*	Station name	County	Date	Hour End (UTC)	Warning Criteria	Rain Total (mm)
1 1004	Roches Point	Cork	Mon 25 Aug 1986	16	>60mm	79.7
2 3723	Casement	Dublin	Tue 26 Aug 1986	00	>60mm	66.1
3 3904	Cork Airport	Cork	Mon 25 Aug 1986	17	>40mm	55
4 2615	Rosslare	Wexford	Mon 25 Aug 1986	19	>40mm	53.5
5 532	Dublin Airport	Dublin	Tue 26 Aug 1986	00	>40mm	51.5
6 3613	Kilkenny	Kilkenny	Mon 25 Aug 1986	17	>40mm	45.2
7 2922	Mullingar	Westmeath	Mon 25 Aug 1986	20	>30mm	34.2

6 and 12 hour rainfall totals that reached the current warning criteria for Ex Hurricane Charley

Storm on the 5th August 1986:

Another storm, which may have reached the criteria for naming if it happened today, affected Ireland on the Tuesday August 5th 1986. “A vigorous depression approached from the southwest and moved north-eastwards, preceded by active rain belts. The heaviest rain from this weather system was in the very moist air from lower latitudes ahead of the depression centre. Again the south was the area worst affected. The rain began in earnest in Cahersiveen, Co. Kerry, around noon and continued without respite until after midnight. There were 7 consecutive hours of continuous heavy rain (heavy rain is defined as rain falling at a rate of 6mm an hour or more). A total of 85.6 mm fell there that day, which is not far short of the station's normal rainfall for the whole month of August. 56mm of that total fell in the 6 hours between 1 o'clock and 7 o'clock. New records were set for 6 and 12 hour falls of rain”.



This picture from the European satellite METEOSAT shows the situation at 1230 GMT on the 5th as the first of the warm fronts reaches the Irish coast.

Surface analysis and satellite of the storm that affected Ireland on the 5th August 1986 - https://www.met.ie/cms/assets/uploads/2017/08/Aug1986_HurCharlie.pdf

Climate Projections for Ireland

As our planet warms, so does our atmosphere. Warmer air has the ability to hold more moisture. In Ireland, we have seen an increase in average annual rainfall by about 6% over the last 30 years (compared to the previous 30 years). The latest climate model projections suggest Ireland will likely see **a**) more frequent heavy rainfall events, as our planet continues to warm and **b**) a possible decrease in the frequency of mid latitude wind storms affecting Ireland by mid-century, but a likely **increase in the severity of the storms** that do.

WEATHER WARNINGS ISSUED FOR STORM FRANCIS

Status Orange - Rainfall warning for Connacht, Cavan, Monaghan, Donegal, Wexford, Cork, Kerry and Waterford

Met Éireann Weather Warning

Intense rainfall associated with Storm Francis is expected at times Monday night and Tuesday, leading to accumulations of 40 to 60mm (higher values in mountainous areas). The most intense rainfall is expected to ease off in southern counties during Tuesday morning. Some flash flooding likely.

This rainfall will further elevate river levels and may result in river flooding also..

Valid: 21:00 Monday 24/08/2020 to 17:00 Tuesday 25/08/2020

Issued: 11:00 Monday 24/08/2020

Status Yellow - Wind warning for Munster, Dublin, Wexford and Wicklow

Met Éireann Weather Warning

Very windy or stormy conditions are expected on Tuesday as Storm Francis crosses Ireland. Southwest winds veering westerly, reaching mean speeds of 55 to 65km/h, will bring widespread severe gusts of 90 to 110km/h (and possibly higher in exposed areas). Some disruption is likely and possibly structural damage.

Valid: 06:00 Tuesday 25/08/2020 to 19:00 Tuesday 25/08/2020

Issued: 10:55 Monday 24/08/2020

Status Yellow - Rainfall warning for Dublin, Carlow, Kildare, Kilkenny, Laois, Longford, Louth, Wicklow, Offaly, Westmeath, Meath, Clare, Limerick and Tipperary

Met Éireann Weather Warning

Intense rainfall associated with Storm Francis is expected at times Monday night and Tuesday, leading to accumulations of 30 to 50mm with surface flooding.

This rainfall will further elevate river levels and may result in river flooding also.

Valid: 21:00 Monday 24/08/2020 to 21:00 Tuesday 25/08/2020

Issued: 11:02 Monday 24/08/2020

