



Monitoring the ECMWF forecast system

David Lavers

Diagnostics Team, Forecast Department, ECMWF

david.lavers@ecmwf.int



The Weather Room

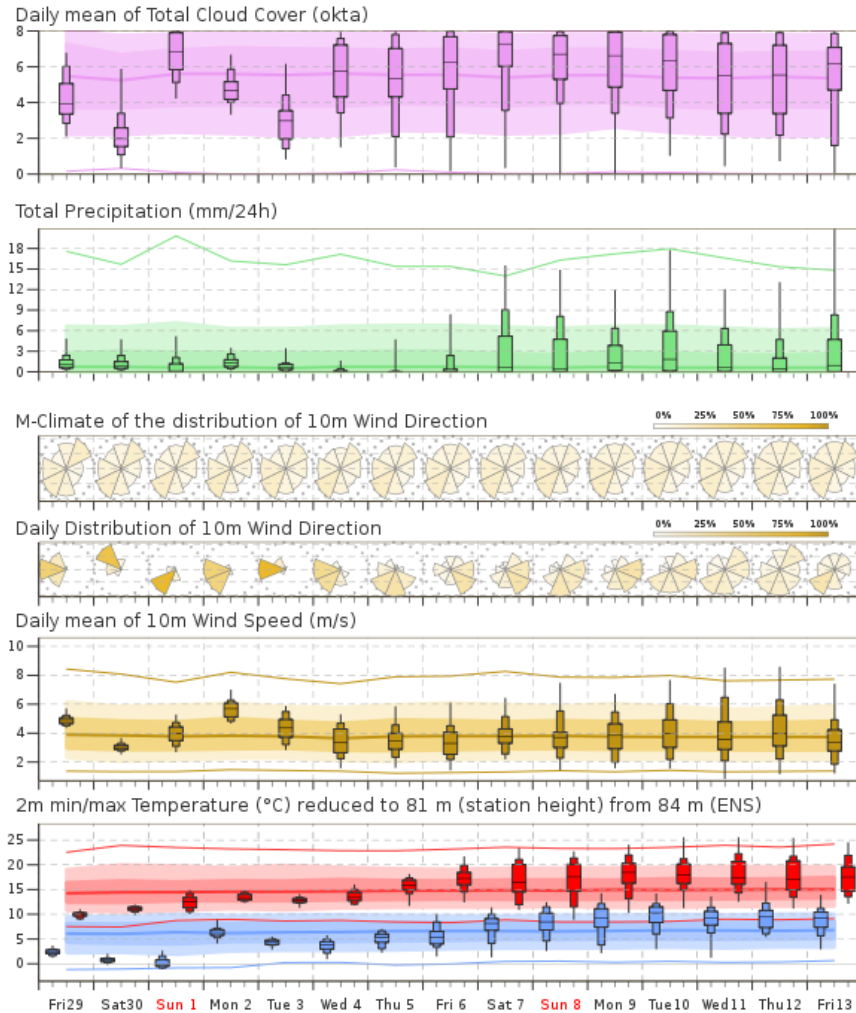


ECMWF operational forecasts

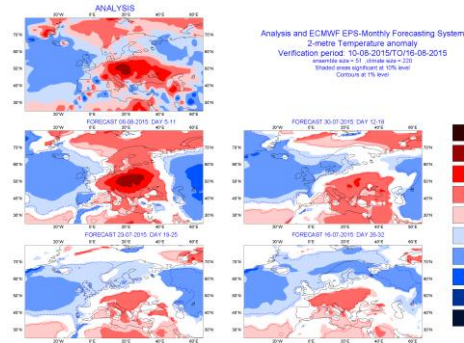
- High-resolution forecast (9 km grid, 137 levels) runs twice every day to 10 days
- Ensemble: same model but run at lower resolution (18 km, 91 levels; 36 km after day 15)
 - ensemble control (run from high-resolution analysis, no perturbation)
 - 50 perturbed members (account for initial and model uncertainties)
 - Ensemble coupled to ocean model from start of forecast
- Ensemble extended to 46 days twice per week for monthly forecast (00UTC Thursday, Monday)
- Seasonal forecast: once a month (coupled to ocean model) 51 members, ~36 km, 91 levels, to 7 months ahead

Products: a few examples

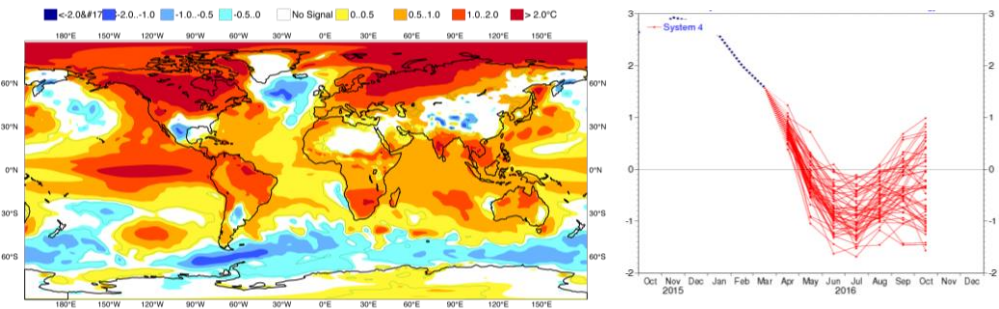
Medium-range



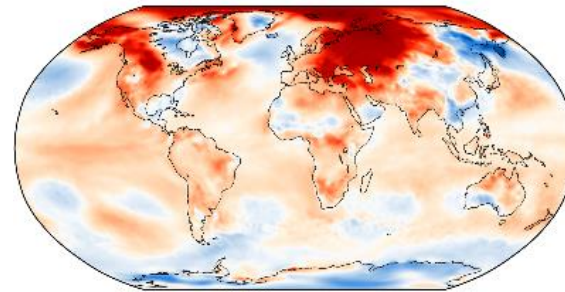
ENS-Monthly Forecasting System 2mt anomaly



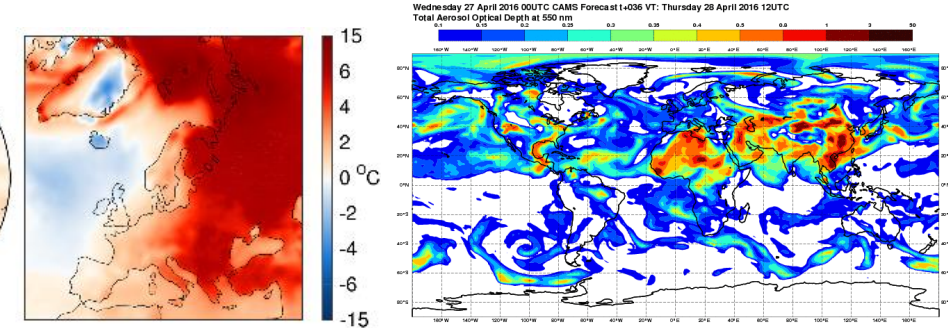
Seasonal Forecast



Global average temperatures



Forecast of Aerosols Optical Depth



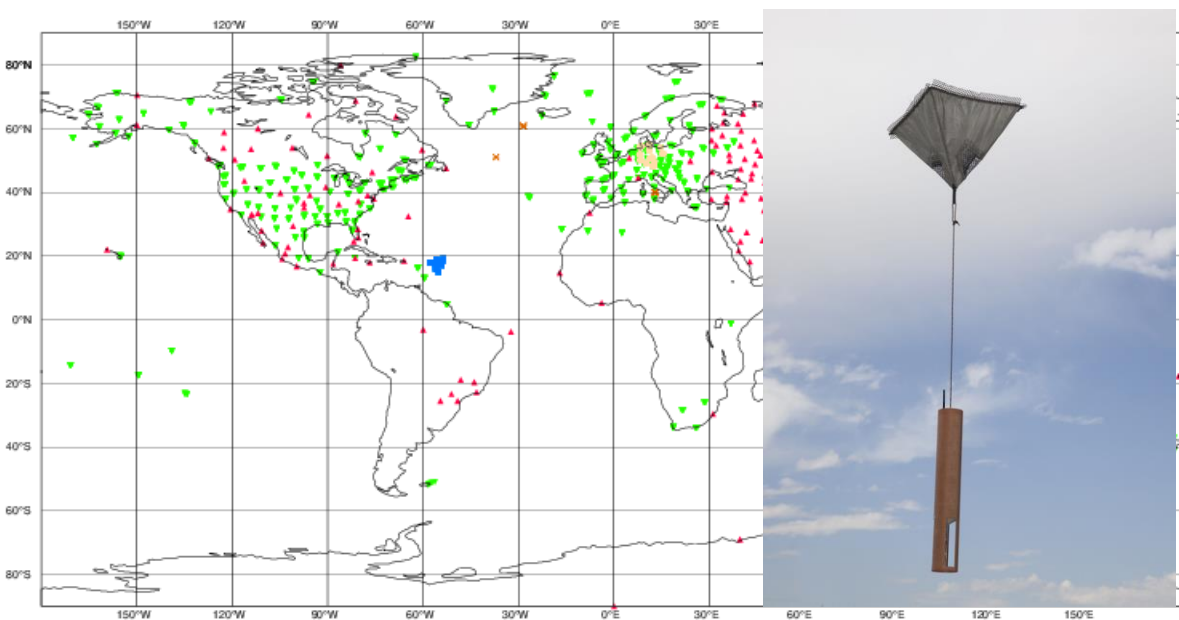
Observation Coverage

ECMWF data coverage (used observations) - RADIOSONDE

21/08/2020 00

Total number of obs = 642

- TEMP SHIP (1)
- ◆ DROP Sonde (0)
- ▲ Land TEMP (270)
- ▼ High Reso land (355)
- ✕ High Reso sea (4)
- High res DROP (1)
- BUFR TEMP DESCENT (11)

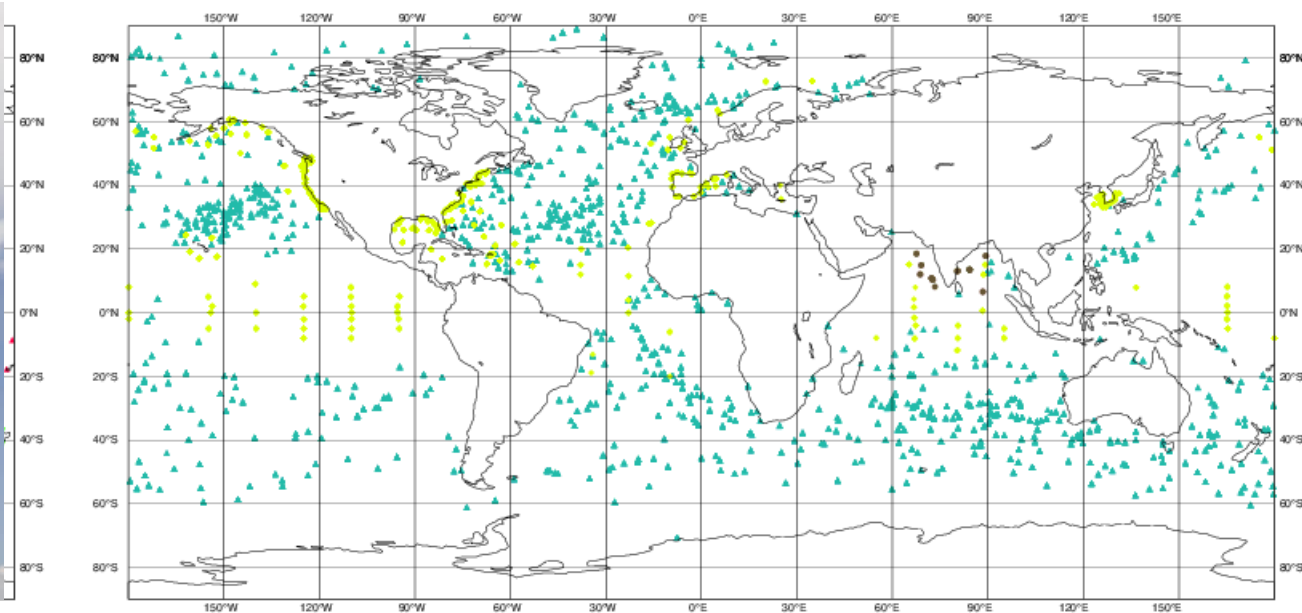


ECMWF data coverage (used observations) - BUOY

21/08/2020 00

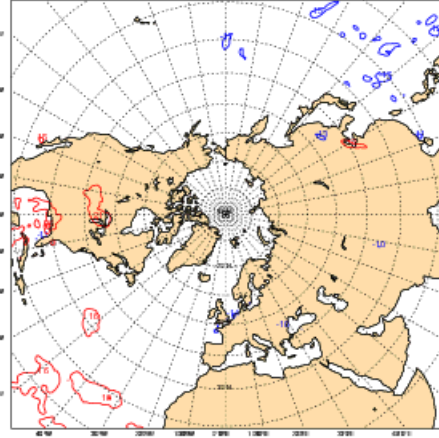
Total number of obs = 1190

- DRIBU (11)
- ◆ MOORED BUOYS (241)
- ▲ DRIFTING BUOYS (938)

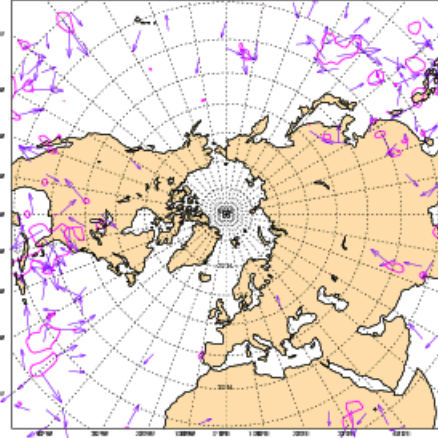


Producing the new analysis

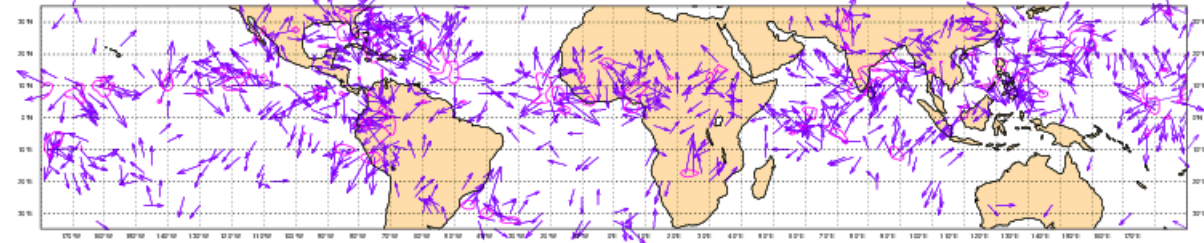
ECMWF Analysis Thursday 20 August 2020 18UTC
200hPa Geopotential
AN: stream=LWDA time=18 date=20200820 - FG: stream=LWDA time=6 date=20200820 step=12



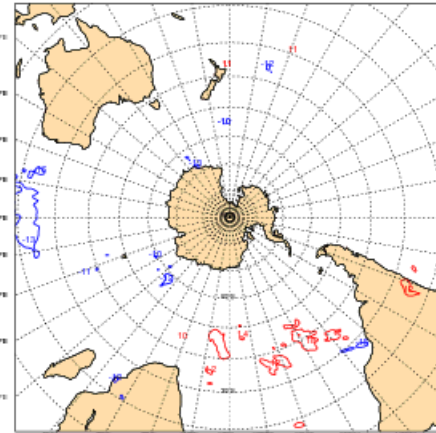
ECMWF Analysis Thursday 20 August 2020 18UTC
200hPa V velocity
AN: stream=LWDA time=18 date=20200820 - FG: stream=LWDA time=6 date=20200820 step=12



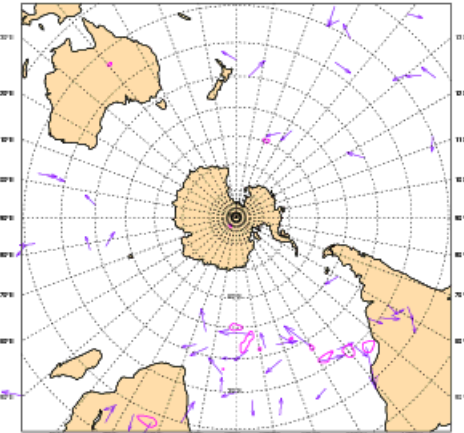
ECMWF Analysis Thursday 20 August 2020 18UTC
200hPa V velocity
AN: stream=LWDA time=18 date=20200820 - FG: stream=LWDA time=6 date=20200820 step=12



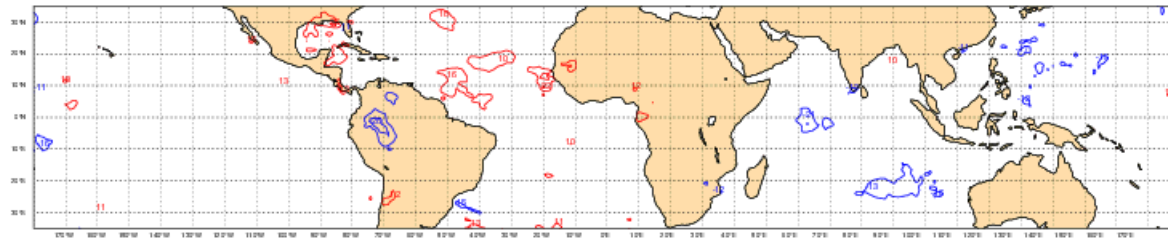
ECMWF Analysis Thursday 20 August 2020 18UTC
200hPa Geopotential
AN: stream=LWDA time=18 date=20200820 - FG: stream=LWDA time=6 date=20200820 step=12



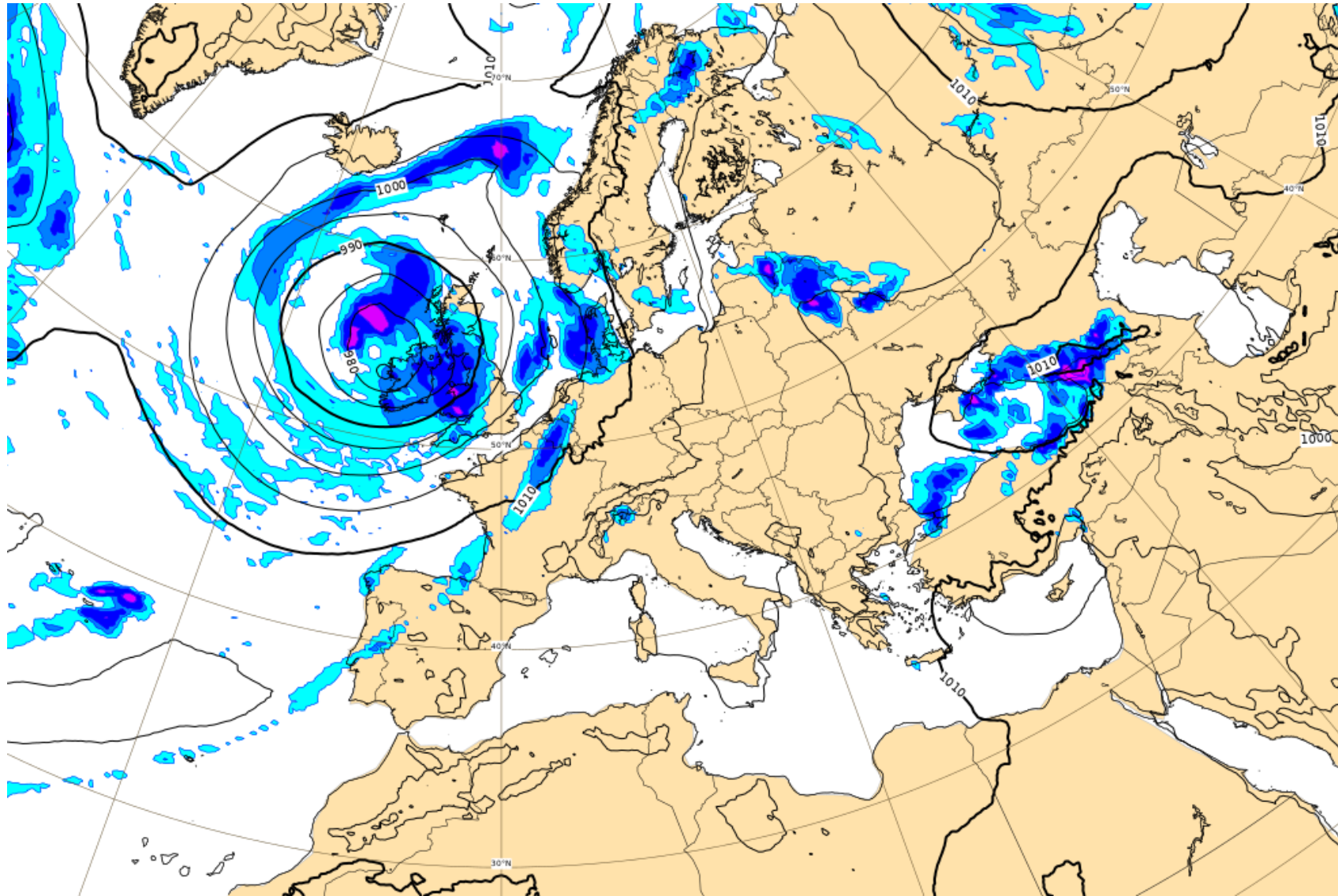
ECMWF Analysis Thursday 20 August 2020 18UTC
200hPa V velocity
AN: stream=LWDA time=18 date=20200820 - FG: stream=LWDA time=6 date=20200820 step=12



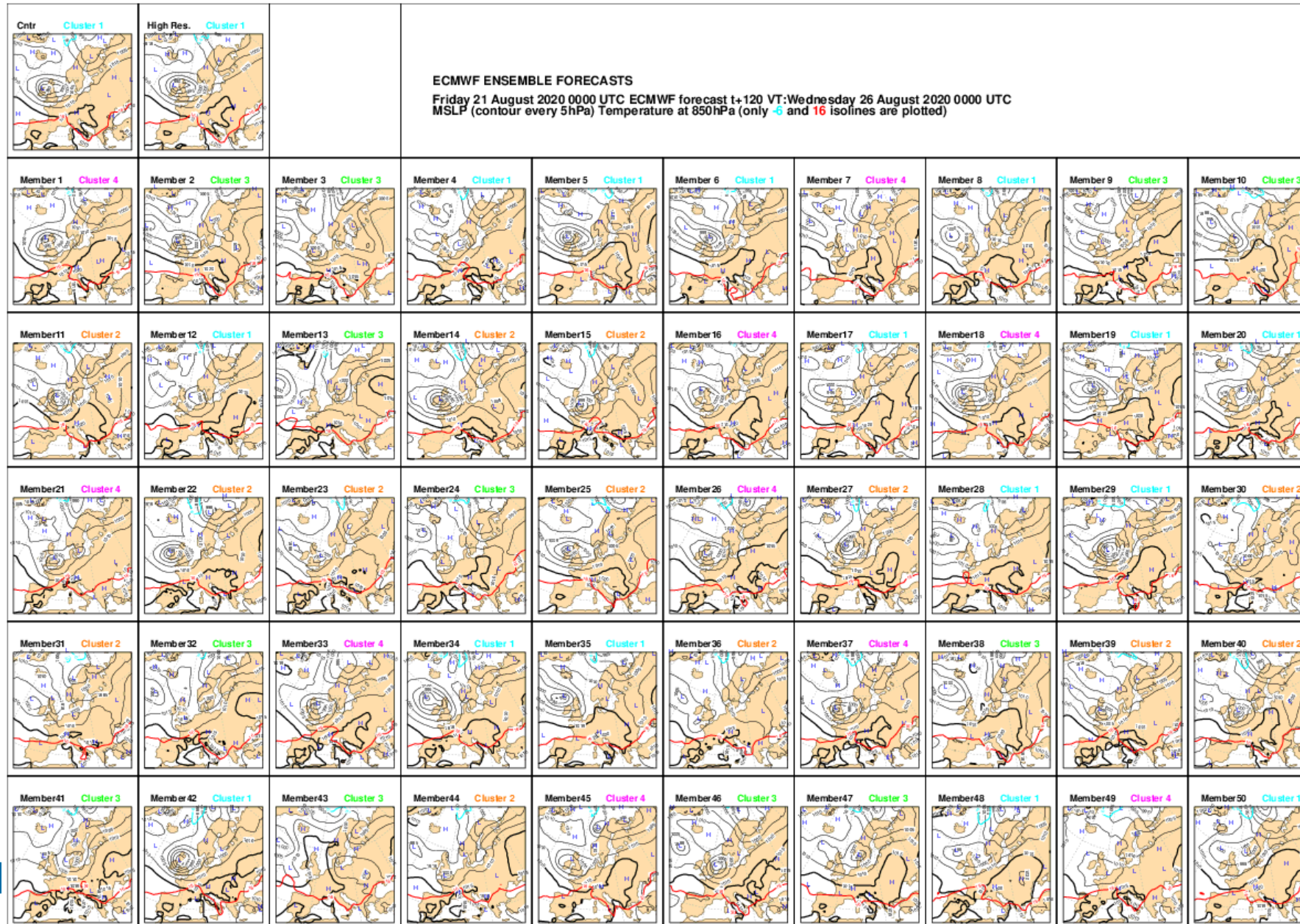
ECMWF Analysis Thursday 20 August 2020 18UTC
200hPa Geopotential
AN: stream=LWDA time=18 date=20200820 - FG: stream=LWDA time=6 date=20200820 step=12



HRES Forecast



Ensemble forecast



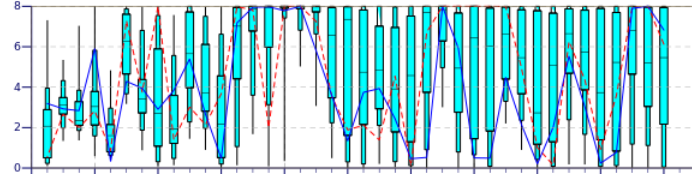
Ensemble forecast

ENS Meteogram

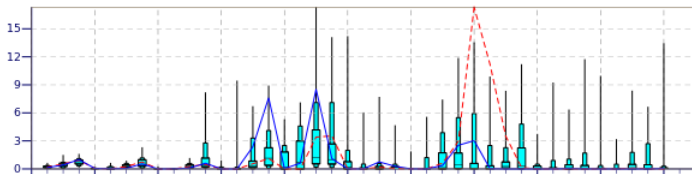
Reading, United Kingdom 51.52°N 0.97°W (ENS land point) 81 m

High Resolution Forecast and ENS Distribution Friday 21 August 2020 00 UTC

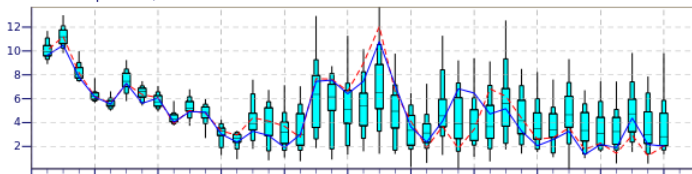
Total Cloud Cover (okta)



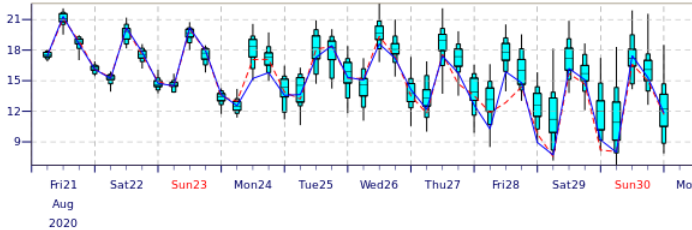
Total Precipitation (mm/6h)



10m Wind Speed (m/s)



2m Temperature(°C) reduced to 81 m (station height) from 85 m (HRES) and 84 m (ENS)

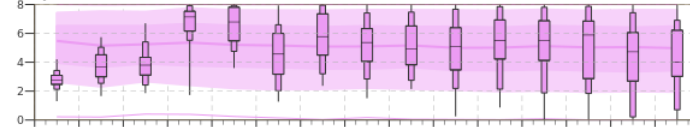


ENS Meteogram

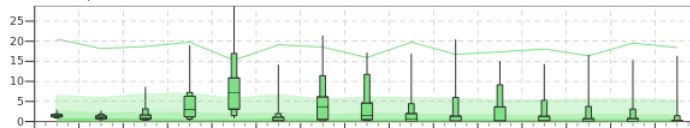
Reading, United Kingdom 51.52°N 0.97°W (ENS land point) 81 m

Extended Range Forecast based on ENS distribution Friday 21 August 2020 00 UTC

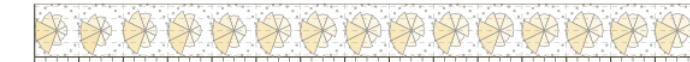
Daily mean of Total Cloud Cover (okta)



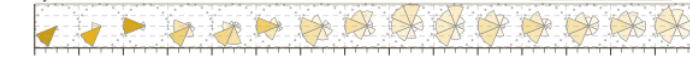
Total Precipitation (mm/24h)



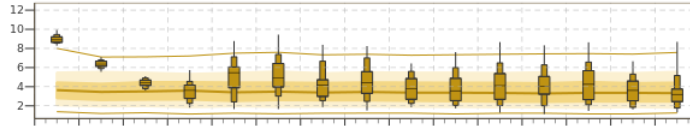
M-Climate of the distribution of 10m Wind Direction



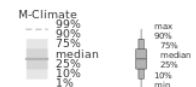
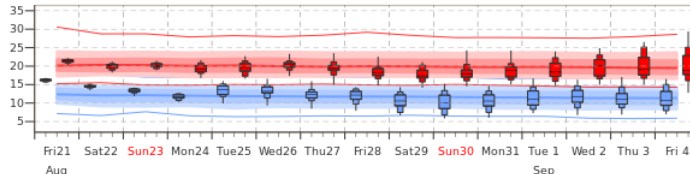
Daily Distribution of 10m Wind Direction



Daily mean of 10m Wind Speed (m/s)



2m min/max Temperature (°C) reduced to 81 m (station height) from 84 m (ENS)



M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning a 11 member ensemble over the last 20 years twice a week (1980 realisations). M-Climate is always from the same model version as the displayed ENS data.

ECMWF Ensemble forecasts

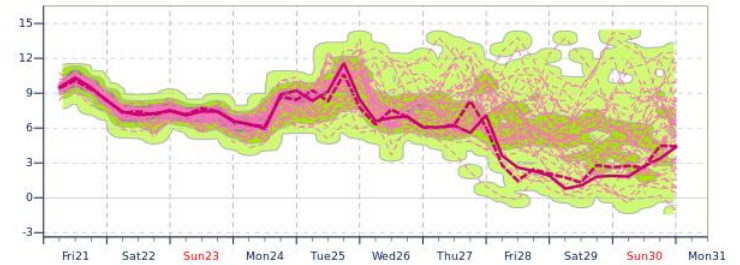
Reading, United Kingdom 51.52°N 0.97°W (ENS land point) 81 m

High Resolution Forecast and ENS Distribution

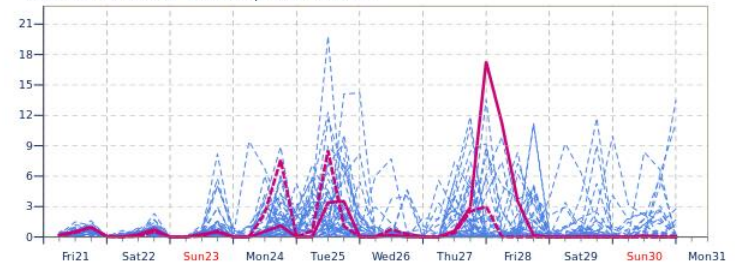
Friday 21 August 2020 00 UTC



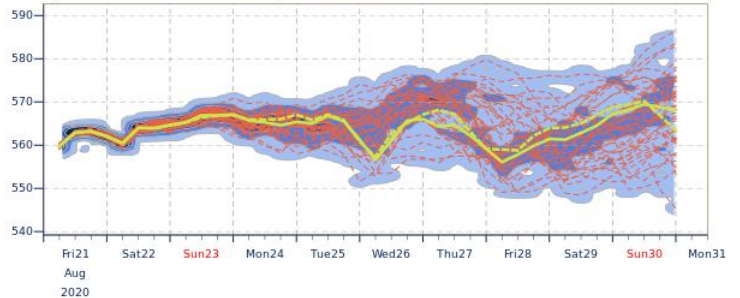
Temperature at 850 hPa - Probability for 1°C intervals



Ensemble members of Total Precipitation (mm/6h)



Geopotential at 500 hPa -- Probability for 2.5dam intervals



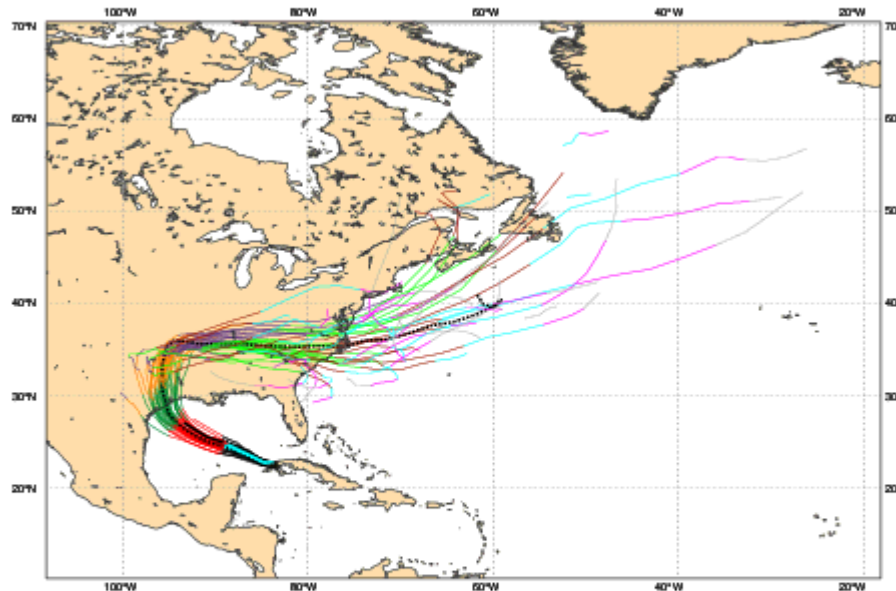
Tropical cyclone Laura

Date 20200825 00 UTC @ECMWF

Individual trajectories for **LAURA** during the next 240 hours

tracks: **thick solid**=HRES; **thick dot**=CTRL; **thin solid**=EPS members [coloured]

0-24h 24-48h 48-72h 72-96h 96-120h 120-144h 144-168h 168-192h 192-216h 216-240h

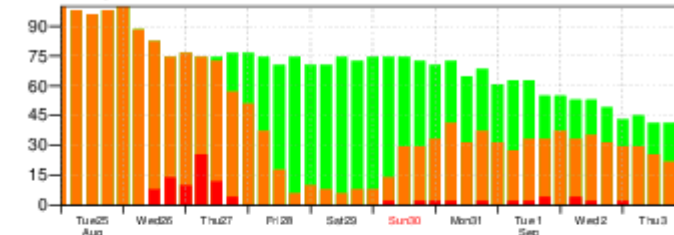


List of ensemble members numbers forecast Tropical Cyclone

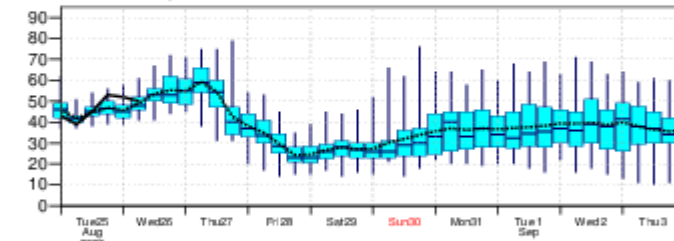
Intensity category in colours: **TD**[up to 33] **TS**[34-63] **HR1**[64-82] **HR2**[83-95] **HR3**[> 95 kt]

+024 h:	hr	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+048 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+072 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+096 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+120 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+144 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+168 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+192 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+216 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
+240 h:	cd	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50

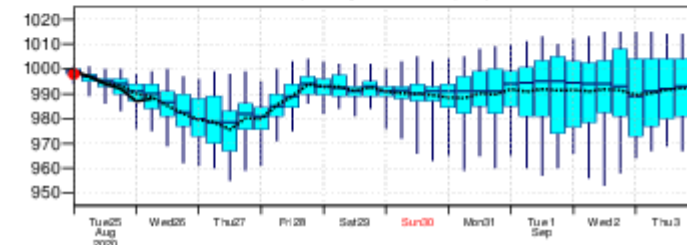
Probability (%) of Tropical Cyclone Intensity falling in each category
TD[up to 33] **TS**[34-63] **HR1**[64-82] **HR2**[83-95] **HR3**[> 95 kt]



10m Wind Speed (kt) **solid**=HRES; **dot**=Ens Mean



Mean Sea Level Pressure in Tropical Cyclone Centre (hPa) **solid**=HRES; **dot**=Ens Mean



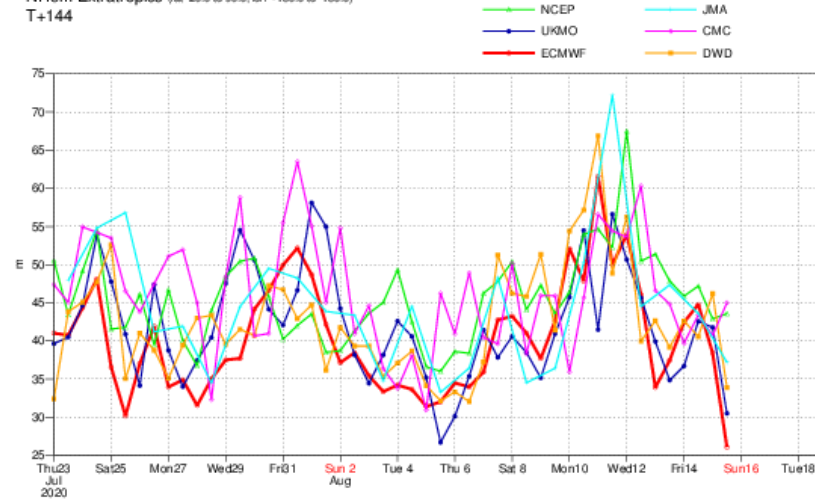
Forecast evaluation

500hPa geopotential

Root mean square error

NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)

T+144

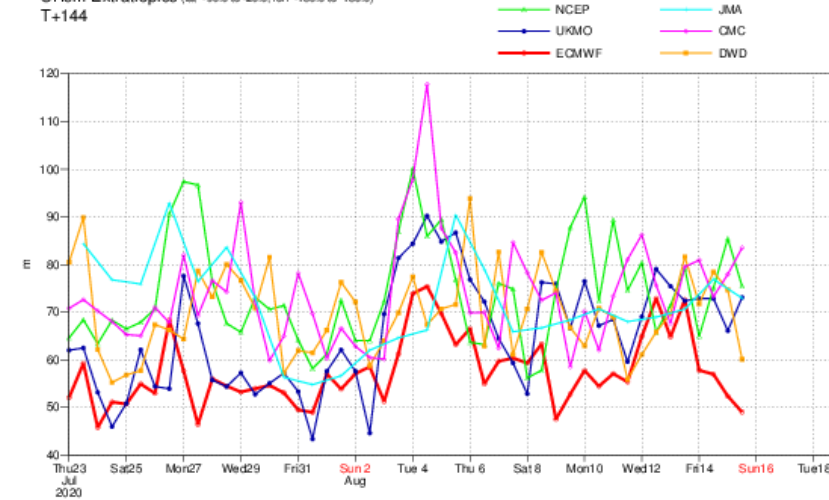


500hPa geopotential

Root mean square error

SHem Extratropics (lat -90.0 to -20.0, lon -180.0 to 180.0)

T+144

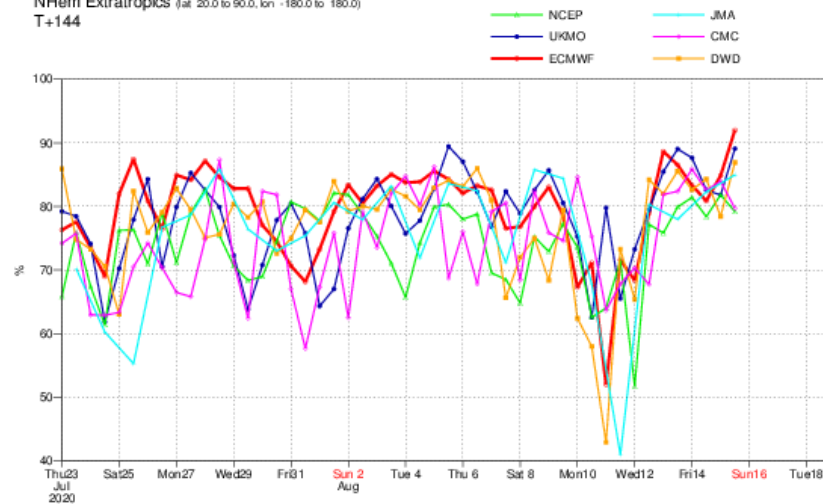


500hPa geopotential

Anomaly correlation

NHem Extratropics (lat 20.0 to 90.0, lon -180.0 to 180.0)

T+144

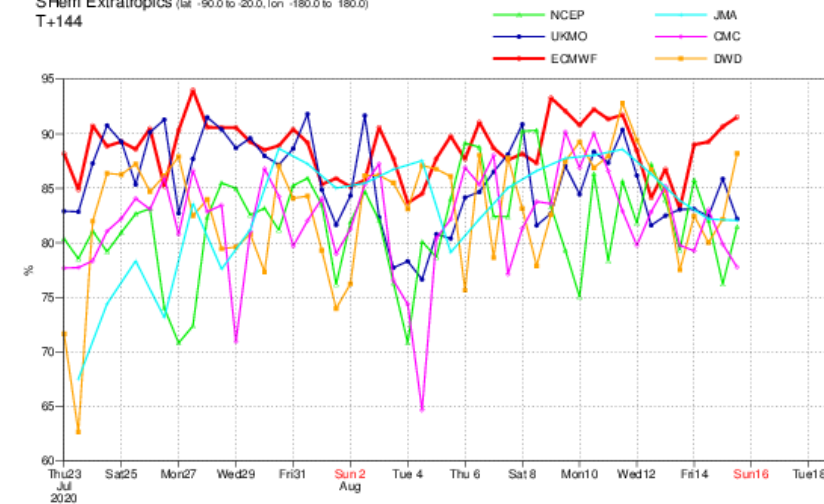


500hPa geopotential

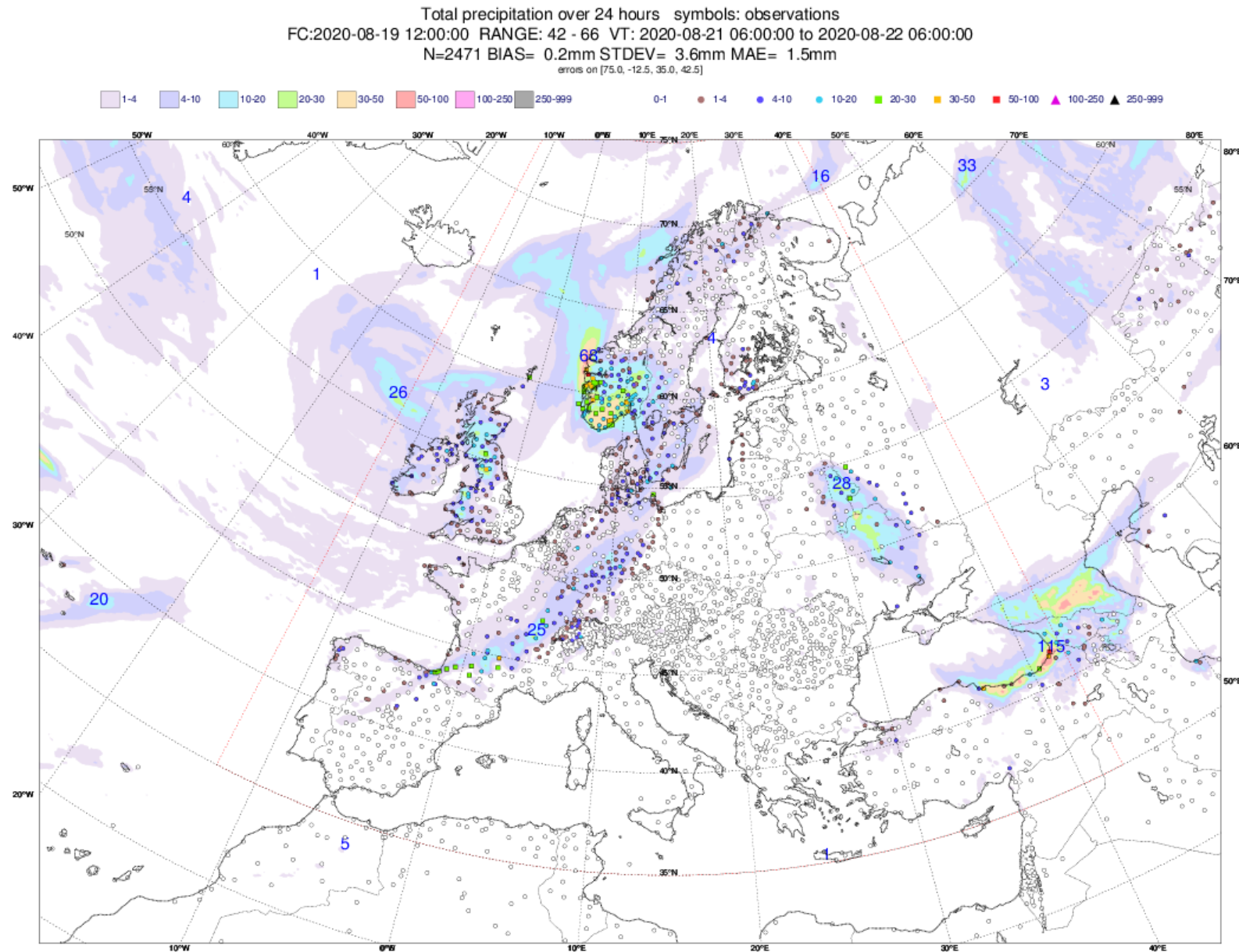
Anomaly correlation

SHem Extratropics (lat -90.0 to -20.0, lon -180.0 to 180.0)

T+144



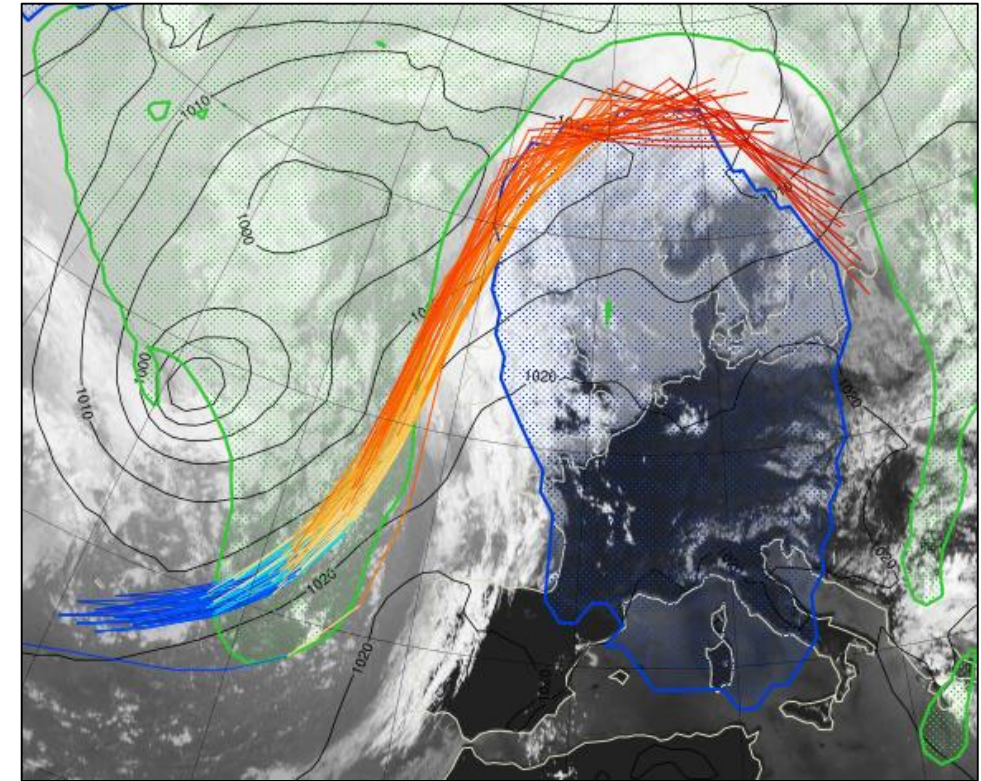
Forecast evaluation



Diagnostics

Diagnostic tools are continuously reviewed and developed:

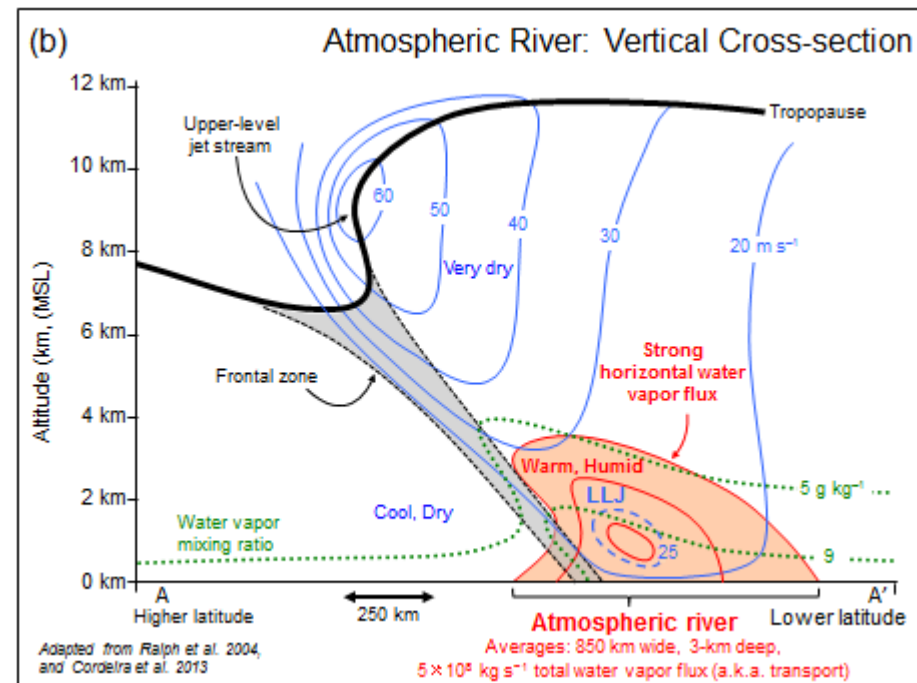
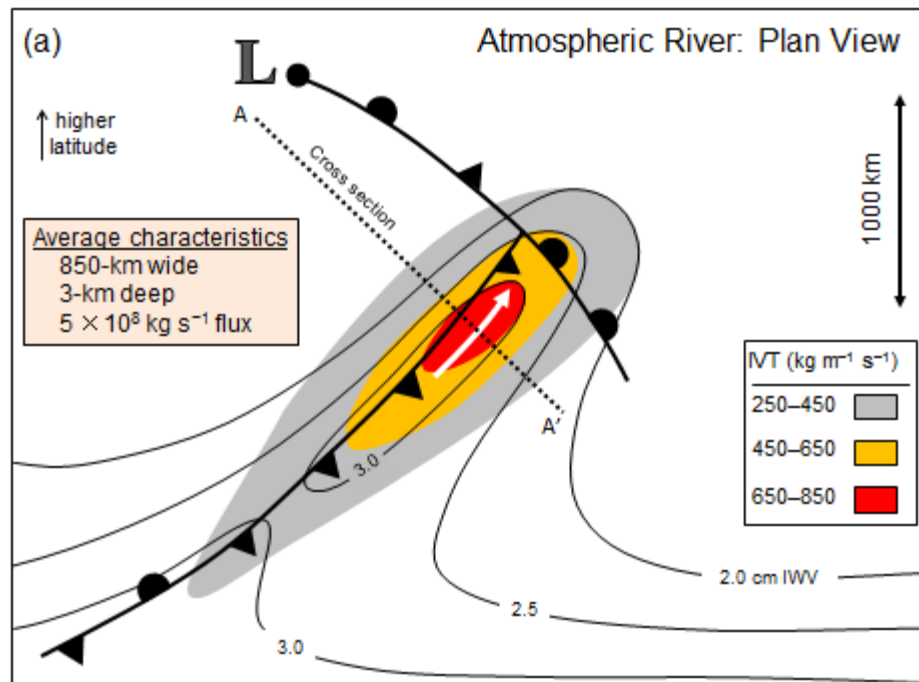
- EDA variance budgets
- EFI for water vapour transport
- Regime transitions
- Error tracking



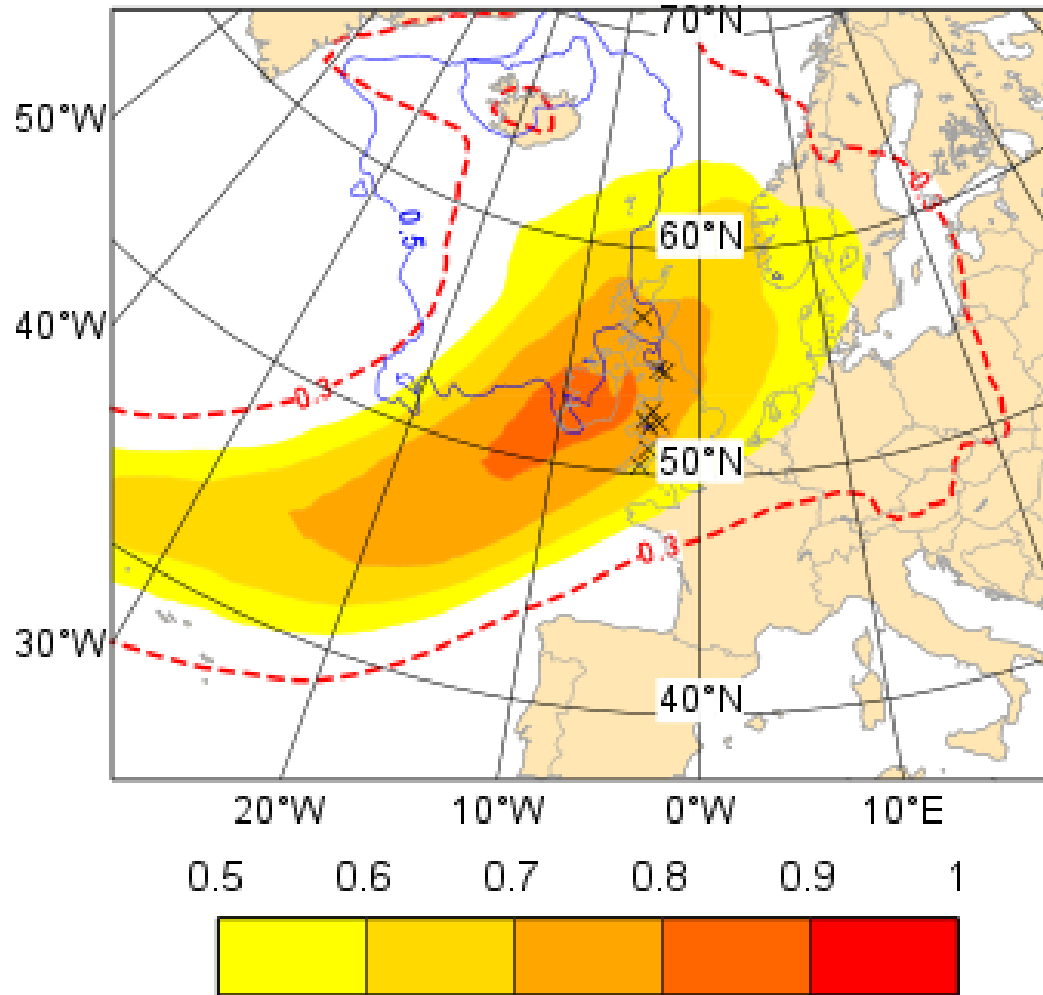
The aim is to improve ECMWF's abilities to access process-level information for diagnostic studies

Diagnostics – atmospheric rivers and extreme rainfall

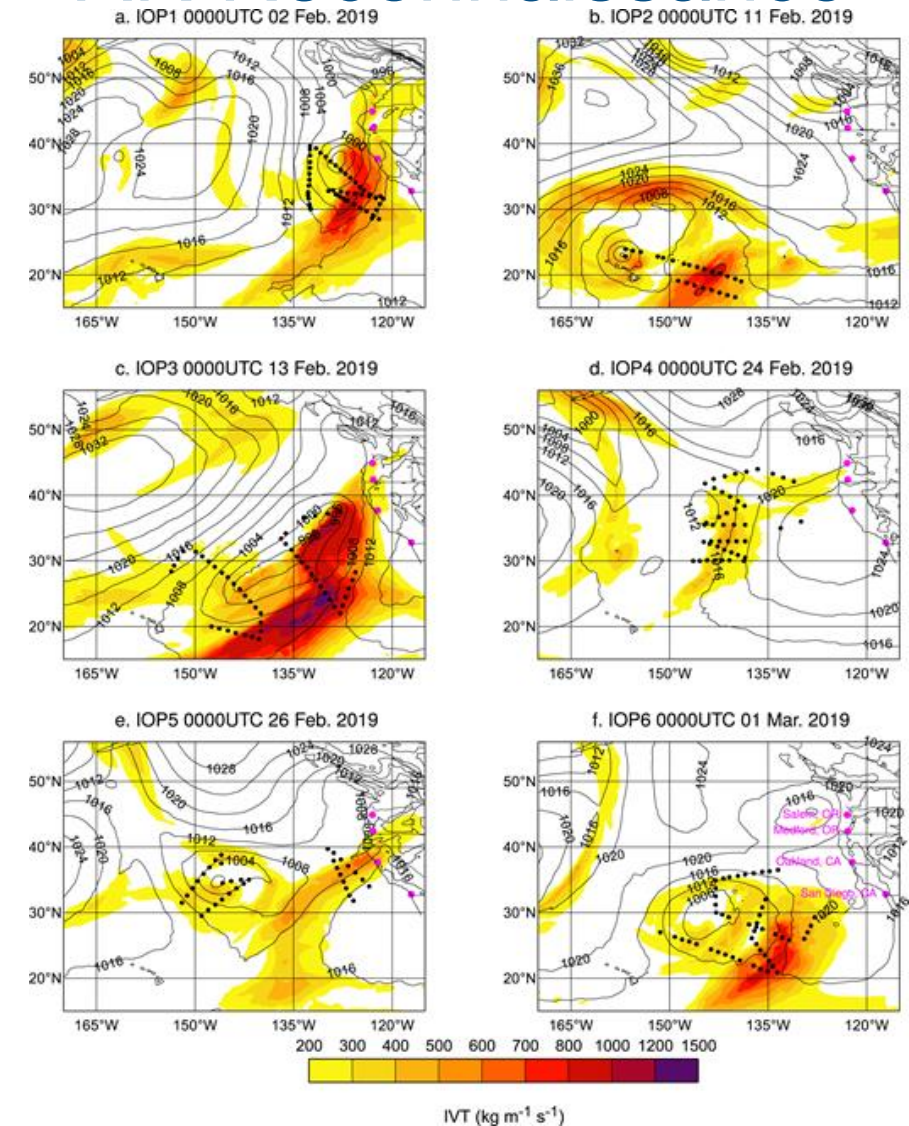
AMS Glossary



Atmospheric rivers (EFI for Storm Dennis)



AR Reconnaissance



Questions and thank you for listening