S1 Close-Up Plots of the NAWDIC AR IOPs

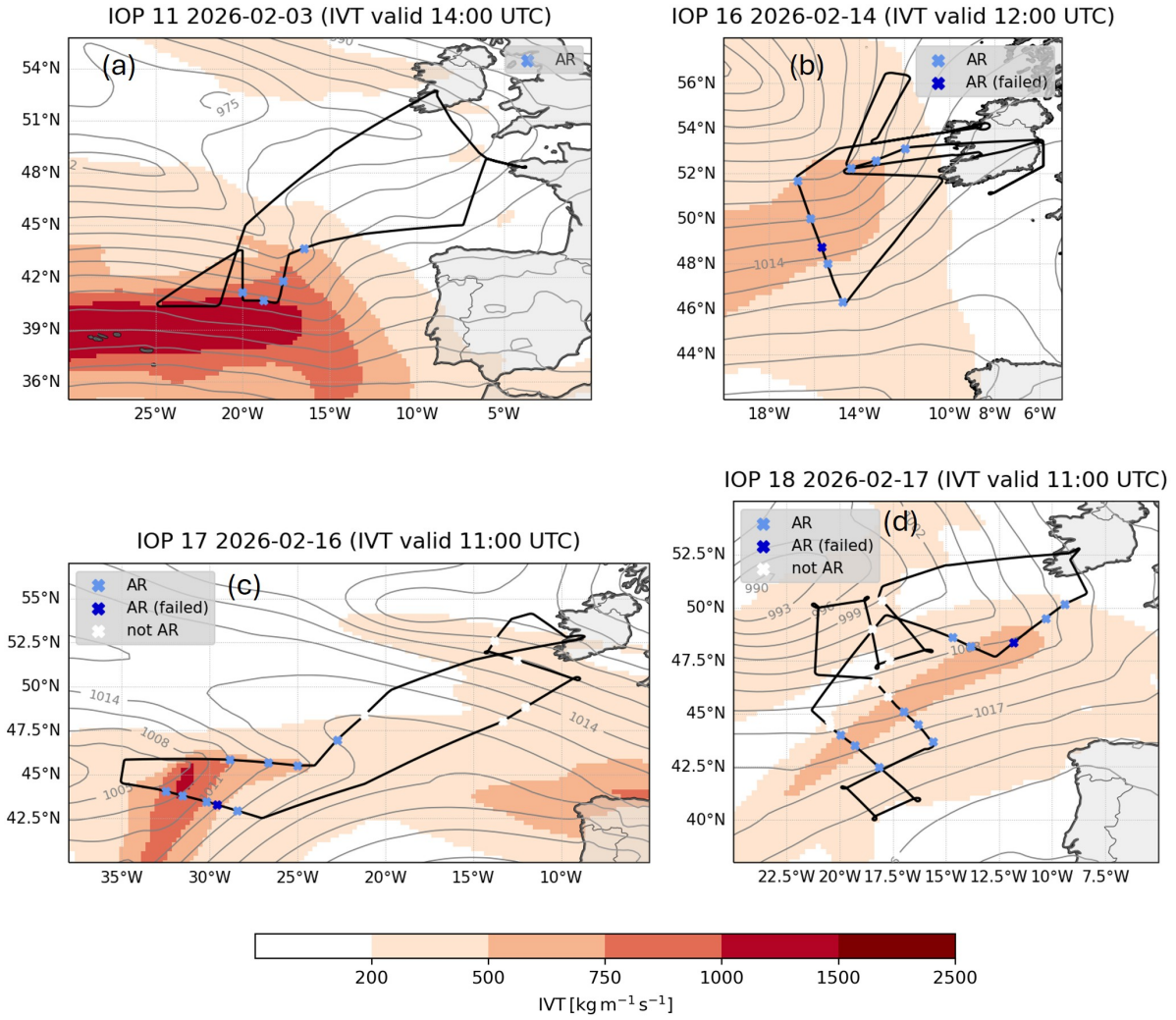


Figure S1. Close-up maps of IOP 11, IOP 16, IOP 17 and IOP 18, as shown in Fig. 1, but zoomed in on the flight track for a better visibility of the dropsonde positions. The Close-up maps for IOP 4 and IOP 7 can be found in Fig. 3 and Fig. 4

S2 Additional Material for the Case Study of IOP 7

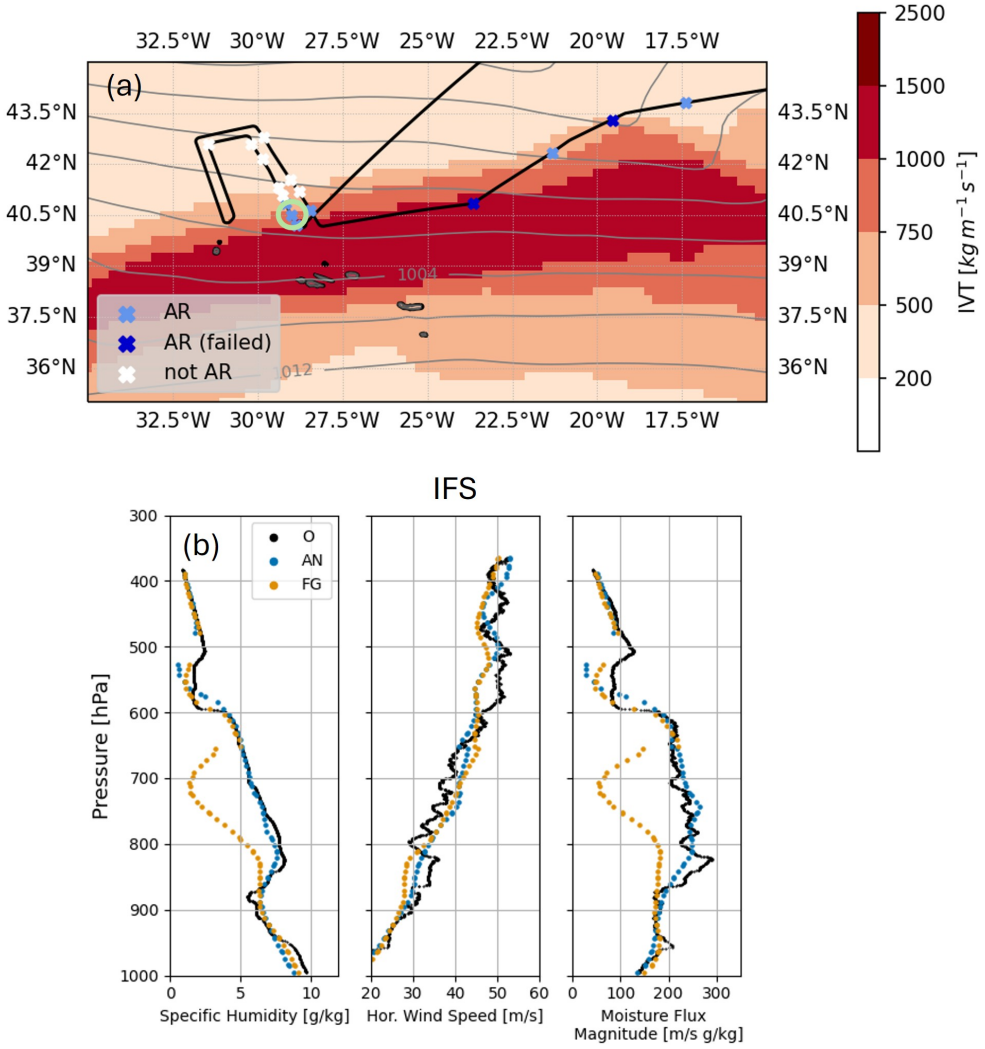


Figure S2. The dropsonde observation (O), the first guess (FG) and the analysis (AN) estimation for specific humidity, horizontal wind speed and moisture flux magnitude are displayed for a selected dropsonde during IOP 7 "Limerick" on 28 January 2026 (panel (a)). The red shading corresponds to the ERA5 IVT valid at 16:00 UTC, which matches approximately the release time of the dropsonde at 15:58 UTC. Panel (b) shows the IFS feedback data for all assimilated levels.

S3 Additional Results for Model Departures

This section displays the first guess (FG) and analysis (AN) departures considering all NAWDIC dropsondes ("All") and considering the subset of NAWDIC dropsondes released into ARs ("AR"). The results are derived following the methods described in Sect. 2.4, however, the data is now sorted into the three vertical layers from 1000 hPa to 900 hPa, from 900 hPa to 700 hPa, and from 700 hPa to 300 hPa, rather than into 50 hPa bins. In the IFS model, "All" includes 85 dropsondes and "AR" 35 dropsondes. In ICON, "All" includes 75 dropsondes and "AR" 26 dropsondes.

S3.1 IFS Model Departures

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	0.41$\pm$0.69	0.41$\pm$0.68	0.22$\pm$0.48	0.21$\pm$0.45
700-900 hPa	0.23$\pm$0.96	0.31$\pm$0.95	0.17$\pm$0.65	0.17$\pm$0.62
900-1000 hPa	0.04$\pm$0.91	0.03$\pm$0.91	0.03$\pm$0.76	0.07$\pm$0.72

Table S1. IFS FG and AN departures for temperature in [K], showing the mean $\pm$ standard deviation for three different vertical intervals. "AR" refers to the results derived considering only dropsondes from NAWDIC AR IOPs (compare Fig. 1). The results marked with "All" include all dropsondes released during the NAWDIC campaign that were assimilated in the IFS model.

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	0.16±0.57	0.13±0.44	0.08±0.26	0.06±0.21
700-900 hPa	0.44±0.89	0.24±0.85	0.20±0.40	0.11±0.39
900-1000 hPa	0.43±0.64	0.37±0.60	0.33±0.49	0.26±0.48

Table S2. Same as Table S1, but for the specific humidity in [$\mathrm{g\,kg^{-1}}$] in the IFS.

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	0.72±3.06	0.54±2.65	-0.08±1.72	-0.00±1.54
700-900 hPa	0.23±3.27	0.27±2.95	-0.15±2.18	0.08±1.89
900-1000 hPa	0.02±2.28	-0.29±2.61	0.01±1.78	-0.02±2.18

Table S3. Same as Table S1, but for the horizontal wind speed in $[\mathrm{m\,s^{-1}}]$ in the IFS.

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	5.94±21.93	4.39±15.97	2.01±10.07	1.84±7.85
700-900 hPa	15.02±32.30	8.32±27.57	4.67±15.85	2.95±12.74
900-1000 hPa	12.85±24.15	7.00±18.54	7.91±16.40	5.78±15.04

Table S4. Same as Table S1, but for the moisture flux magnitude in [$\mathrm{g\,kg^{-1}\,m\,s^{-1}}$] in the IFS.

S3.2 ICON Model Departures

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	0.40±0.72	0.37±0.75	0.18±0.50	0.15±0.48
700-900 hPa	0.26±0.99	0.41±0.97	0.12±0.54	0.13±0.51
900-1000 hPa	0.05±0.78	0.28±0.77	0.01±0.48	0.05±0.47

Table S5. ICON FG and AN departures for temperature in [K], showing the mean ± standard deviation for three different vertical intervals. "AR" refers to the results derived considering only dropsondes from NAWDIC AR IOPs (compare Fig. 1). The results marked with "All" include all dropsondes released during NAWDIC, that were assimilated in the ICON model.

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	0.17±0.52	0.11±0.39	0.06±0.30	0.05±0.23
700-900 hPa	0.37±0.66	0.29±0.74	0.16±0.36	0.12±0.49
900-1000 hPa	0.24±0.47	0.29±0.51	0.09±0.32	0.12±0.39

Table S6. Same as Table S5, but for the specific humidity in [$\mathrm{g\,kg^{-1}}$] in the ICON model.

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	0.78±2.68	0.93±2.47	0.21±1.73	0.21±1.54
700-900 hPa	0.09±2.85	0.38±2.43	0.08±1.86	0.11±1.58
900-1000 hPa	0.07±2.08	0.24±2.40	0.11±1.61	0.04±1.34

Table S7. Same as Table S5, but for the horizontal wind speed in $[\mathrm{m\,s^{-1}}]$ in the ICON model.

Layer	FG AR	FG All	AN AR	AN All
300-700 hPa	7.16±20.33	4.18±13.97	2.44±11.88	1.68±8.19
700-900 hPa	10.29±24.98	7.49±22.16	4.71±15.22	2.88±14.55
900-1000 hPa	4.65±20.91	6.16±18.06	2.71±14.23	2.08±10.17

Table S8. Same as Table S5, but for the moisture flux magnitude in [$\mathrm{g\,kg^{-1}\,m\,s^{-1}}$] in the ICON model.