LM_2.19 Fights Against the 28-03-1997 Case

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1   Results

Exploration of the case shows that the whole process of dry stratospheric intrusion and associated explosive cyclogenesis is governed by two vortices: one slightly up-raised in the middle troposphere, located at the head of the attacking stratospheric stream, and the second, closely tied to the surface depression (explosive storm that passed over Germany and Poland). Both vortices preserve their individuality during the process (00 - 12 UTC) and merge over Poland at 12 UTC forming one mature developed hurricane - see Fig. 1. The final location of the simulated vortex tube, although quite pronounced in the relative motion framework, seems to be slightly moved (Parfiniewicz, 1999,2000). The location of the tube and the simulated vertical wind component, mostly dominated by upward motions, do not provide a clear explanation of the stratospheric intrusion process.

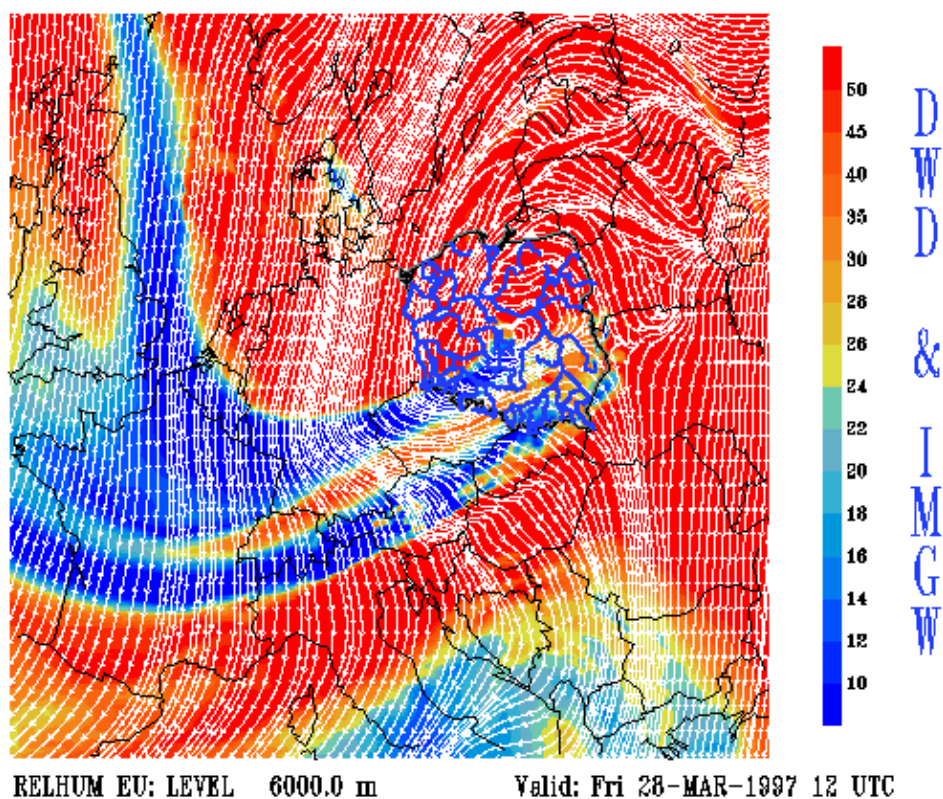RELHUM_EU: LEVEL   6000.0 m   Valid: Fri_28-MAR-1997_12_UTC

Figure 1: The relative humidity as a tracer of the stratospheric intrusion process. The vortex visible in the streamline pattern of the relative wind field can be seen over Poland.

2 Working hypothesis

The 2D vortices and the 3D vortex tubes seem to be excellent objects to focus on in order to understand the model dynamics (especially that related to non-hydrostatic processes). Indeed, the non-hydrostatic pressure (of the order of pascals - i.e., nearly two orders of magnitude less than that related to mass stratification), mirrors the wind acceleration system and is likely to affect the evolution of vorticity in the model. Properly arranged 3D streamlines of the relative motion seem to be a good tool to represent that 'ghostly' objects - see Fig. 2.
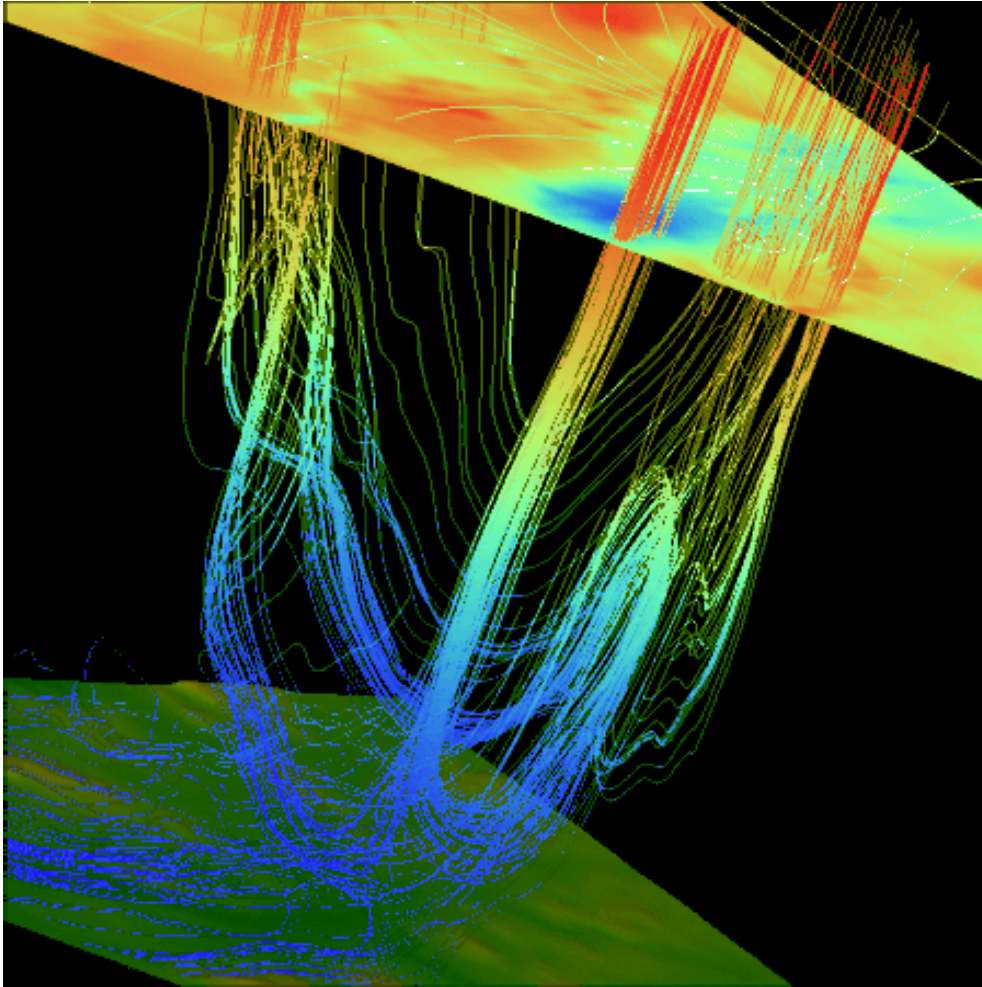

Figure 2: Flow visualisation for the picture "28031997_12UTC Poland, 'Inside the vortex'". The upper plane shows the colour plot of the vertical velocity at the tropopause level (8.3 km, downward velocities are in blue). Also shown are the streamlines (colours code height). The complexity of the streamline pattern reveals the intricate nature of the motion inside the hurricane's 'eye'.

3 Possible future improvements

To clarify the above ambiguities the following work is planned:

(1) To adapt the 'associated diagnostics system' (Parfiniewicz, 2000) to the LM GRIB output.

(2) To repeat the real data analysis (including the radar wind retrieval) presently based on the LM output as the 'first guess' fields.

(3) To increase the resolution of the model - the 'hurricane eye' was seen on 4km*100m grid. Starting from 7km*37 levels will see what is possible.

(4) To try the assimilation by backward nudging, as the first attempt to avoid ambiguity in the initial state.

(5) If accepted, we intend to cooperate on the better representation of the non-hydrostatic pressure forces in the model. It should best be done in 'Z'-geometry framework.

5   References

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