CYCLONE STRUCTURE AND EVOLUTION IN THE 23–26 SEPTEMBER 2012 UK FLOODS

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Extratropical storm Karin brought over 100 mm of rain to a large swathe of the UK (4-day accumulations were locally above 200 mm) on 23–26 September 2012, causing significant flooding. Global NCEP reanalysis datasets with 0.5º horizontal grid spacing are used to examine Karin's structure and evolution in more detail. In addition, the mesoscale precipitation field across the UK is studied using NIMROD gridded rainfall radar data with 1-km horizontal grid spacing.

Karin went through two distinct deepening phases, with neighbouring systems playing important roles in each. The first unfolded as an upper-level closed low with a distinct tropopause fold moved slowly southwards over the North Atlantic Ocean on 22 September. To the east, the lower troposphere was destabilising as the circulation around ex-Hurricane Nadine transported warm, moist air poleward, allowing deep, moist convection to widely develop.

The second deepening phase began late on 23 September as Karin moved northeastwards towards the UK and closer to a second extratropical cyclone, situated to the south of Iceland. The subsequent interaction resulted in increased baroclinicity and an environment favourable for cyclogenesis, with Karin's structure becoming consistent with that of a Shapiro–Keyser-type cyclone. High potential vorticity (PV) air from the lower stratosphere, associated with a separate tropopause fold, entered Karin's circulation from the west. Comparison of this NCEP data (upper-tropospheric PV) with the NIMROD radar data across the UK revealed a strong relationship between the high-PV air and the back edge of the precipitation along the bent-back warm front.

Reanalysis data and Weather Research and Forecasting (WRF) simulations will be used further to determine the lower-tropospheric PV field, specifically to diagnose the importance of diabatic effects (latent heat release) in Karin's first deepening phase, and the relationship between lower and upper-tropospheric PV anomalies throughout Karin's life-cycle. Additionally, the causes of the mesoscale precipitation features will be investigated. For example, two distinct bands of heavy precipitation were evident within the bent-back front for a time on 24 September, affecting western England and Wales. In addition, numerous linear, quasi-stationary convective bands developed in the English Channel late on 25 September and into 26 September, at a time when precipitation intensity was decreasing elsewhere.