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Fine-scale observations of the structure and evolution of a tornadic cold front

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On 29 November 2011 a strong cold front crossed the UK. An intense, narrow rain band accompanied the front over northern England, along which several small tornadoes developed. The vertical structure of the front was sampled as it approached the UK, using dropsondes and in-situ aircraft measurements, as part of the DIAbatic influences on Mesoscale structures in ExTratropical storms (DIAMET) field campaign. One-minute-resolution data from the Met Office's network of automatic weather stations (AWSs) were used to investigate the structure of the surface front as it crossed the UK. 'Time-to-space' conversion of the AWS data, using a system motion vector estimated from sequences of radar data, permitted a fine-scale analysis of the surface frontal structure and its variation in the along-front direction.

On the 28th, operational Unified Model output and aircraft dropsondes showed two separate fronts in the eastern Atlantic Ocean. By the morning of the 29th, dropsondes south of Ireland presented some features consistent with kata (also known as 'split') fronts, with two distinct, but overlapping dry intrusions, each overrunning saturated air below. Each dry intrusion was associated with a local maximum in the cross-front wind component, with a forward-directed, front-relative flow of $\sim 5 - 10$ m/s.

Radar data showed the presence of multiple, narrow rain bands over Ireland and western extremities of the UK early on the 29th, as the front moved within range of the UK radar network. Over Ireland, the merger of at least two separate rain bands was observed. The merged band intensified and accelerated eastwards, leading to a single, intense, bowing line segment over northern England, along which the tornadoes occurred. In contrast, over southern England, no merger occurred, and the frontal zone was characterised by multiple rain bands for the duration of the observation period. The surface data showed markedly different structure in the temperature, wind and pressure fields in these two regions.

Observational analyses, derived from the surface and dropsonde data, will be presented, with a particular focus on the observed differences in frontal structure over northern and southern England. Possible reasons for the differences will be discussed. A comparison with available operational model data will also be presented.