Cloudy air ascending along a cold front experiences significant warming and cooling due to diabatic processes such as condensation and evaporation. The net effect of these diabatic processes is manifest as a potential vorticity (PV) anomaly at midtropospheric elevation. The PV anomaly is typically aligned with the front [possibly extending for O(1000km)], and has a relatively small cross-frontal scale of O(10-100km). The aim of this investigation is to analyse the effect of this PV anomaly on the cross-frontal flow. A case study of a cold front that approached the UK from the southwest on 24 November 2009 is examined both in observations and in a high resolution simulation performed using The Met Office Unified Model. The detachment of the midlevel PV anomaly from the surface cold front led to the generation of a large amplitude gravity wave ahead of the front. Following the case study, a set of idealised experiments were performed using the Bryan Cloud Model. The idealised experiments demonstrate that the effect of the midlevel PV anomaly on the cross-frontal flow depends on the location of the anomaly relative to the front. If the PV anomaly is not stationary relative to the front, then the cross-frontal flow becomes unbalanced, leading to an acceleration of the surface front and the generation of internal gravity waves.