Synoptic Evolution and Dynamic Characteristics of the Extreme Norwegian Winter Storm Dagmar

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Dagmar was an extreme winter storm in 2011 that was recently ranked as the storm with the third most severe damage (in terms of total costs) in the history of Norwegian weather recordings. It originated in the western Atlantic and propagated to southern Norway within less than 3 days. Strong winds associated with a secluded warm front caused most of the damage along the southwestern coastline, whereas the eastern part of the country experienced strong and gusty winds due to downslope windstorms associated with gravity waves that were initiated by the westerly flow across the main mountain range in southern Norway. The overall predictive skill by the national weather service in Norway was good but there were significant shortcomings for the latter phenomenon in the eastern part of the country compared to the strong coastal winds, which were rather well predicted.

In this study we pinpoint the evolution of the storm with a particular focus on the energy conversions during the life cycle of this extra-tropical storm, identifying the key mechanisms for its growth and causes for its intensity. We also discuss the relevance of a convective moisture plume that stretched all the way from the Caribbean to southern Norway, providing extensive latent heating along the later part of Dagmar's path, i.e., from Iceland onwards, that acted to enhance the low- and mid-level baroclinicity. We also illustrate the impact of the gravity waves on the strong wind outbreak in the eastern part of Norway and comment on possible shortcomings in the weather prediction system of the Meteorological Institute in Norway.