08/08/08: CLASSIFICATION AND SIMULATION CHALLENGE OF THE FRIULI VENEZIA GIULIA OLYMPIC STORM

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I. INTRODUCTION

An unusually severe storm hit the Friuli Venezia Giulia region (hereafter FVG), northeastern Italy, in the late evening of the 8th August 2008. Noticeable damages (and two casualties) resulted from this storm, in particular in the town Grado, in prevalence due to very strong gusting winds (up to 45.3 m/s). This work aims to classify the event in terms of a recognizable mesoscale structure through the analysis of a mesonetwork of about 30 stations measuring 5 minutes meteorological data, the OSMER-ARPA Fossalon C-band Doppler radar data, the Udine-Campoformido radiosounding data and the Eumetsat MSG images. Moreover numerical simulations have been provided by different LAMs (WRF, ALADIN, MOLOCH), whose outputs have been compared in order to find out limits and good forecasting performances and to better understand the synoptic and mesoscale patterns which triggered this event.

II. DESCRIPTION

The uncertainty in the definition of the event immediately arose because of the contemporary presence of linear-wind compatible land damages and observed funnels and waterspouts over an area 15 to 20 km to the east of Grado, that could push the classification towards a tornadic supercell as done by media reports. Nevertheless, the results of the analysis highlight that the storm structure has many elements in common with "bow echo" convective system scheme, which includes mesovortex dynamics that can lead to water- and land-spout occurrence conditions other than strong linear winds (Wakimoto et al., 2006). The role of the strong gusting winds observed has been broadened after the consideration that a density current sloping downhill the Alps could act as a high momentum - high static stability flow injected inside a thunderstorm. It can generate a strong low level outflow by vertical momentum transfer and negative buoyancy acceleration (the well known "rear inflow jet", see Atkins and St. Laurent, 2009 and reference therein). A typical northwestern short wave with a cold front passing over the Alps, preceeded by warm and moist southwestern winds aloft over a potentially unstable low troposphere, triggered deep moist convection after an intense 300 hPa wind jet streak divergence, often turning into supercellular storms characterized by large hailstones (diameter up to 5 cm). The advection of cold and dry air, delayed by the presence of the alpine orographic barreer, resulted in a sudden increase in low level northwestern wind that feeded a preexisting convective cell at the bottom of the Alps, over Veneto and FVG plains, driving to a bow echo shaped VMI track associated to damaging winds along the gust front of the system (Fig. 1).

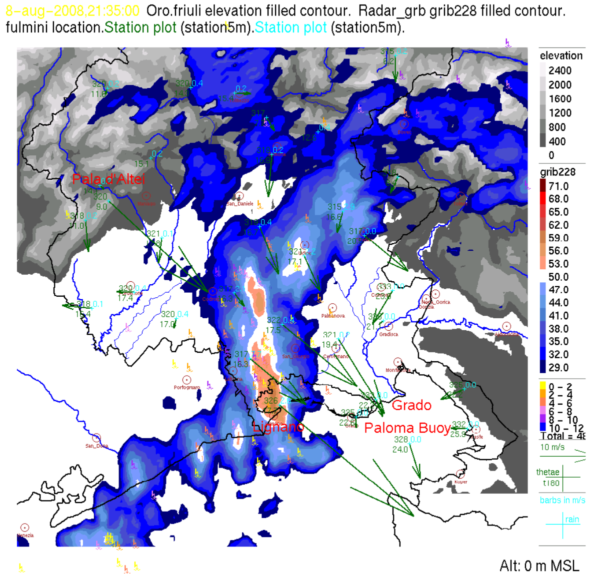

FIG. 1: VMI (dBZ) and stations data during the "bow echo" stage of the storm over FVG plain at 21:35 UTC.

Some considerations about winds and equivalent potential temperature behavior on different stations (over the alpine ridge and in the vicinity of the most damaged area along the coast) and about Doppler Radar signature follow the mesoscale analysis. In particular, a simple Bernoulli-based model has been applied to check the role of the convective process on the magnification factor between 1500m ASL wind value registered on Pala d'Altei and coastal meteorological stations (Lignano, Grado and Boa Paloma). Moreover, the Doppler signature shows tracks of mesovortexes along the leading path of the convective line, then destroyed by the strong outflow corresponding to the maximum gusting winds, according to the cold-pool shear balance theory (Rotunno et al., 1988). Some theoretical considerations about the role of the density current associated to the cold front acting as Rear Inflow Jet in the convective system have been considered.

The second part of the work collects 5 different simulations performed by 3 high resolution LAMs: WRF (two different versions initialized by GFS and ECMWF), ALADIN (initialized by ARPEGE) and MOLOCH (initialized by ECMWF). Performances seem quit poor as for the intensity of the winds (the real discriminant factor) while the general synoptic and mesoscale pattern have been properly captured by all the models. In addition, all models are not able to show the well-developed pre-frontal convection, whose role seems to be important in such an occurrence.

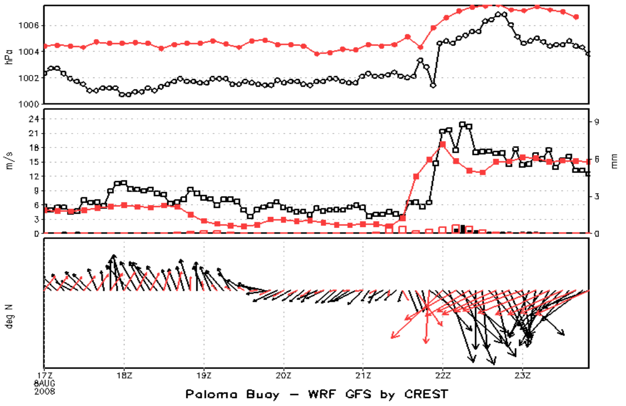

FIG. 2: pressure, wind and precipitation as observed at Paloma Buoy meteorologial station and as forecast by WRF model hours before, during and immediately after the "olympic storm".

III. RESULTS

The difficulty in classifying this severe weather event is due to enhanced intensities in the frame of a generally not unusual meteorological pattern that characterized the "olympic storm". We have collected all the measures available whose analysis seem to push ahead the idea of an early stage "bow echo" in the time window charactertized by the most severe and extended damages on the ground. Models cannot help in forecasting occurrences like that, but future research could underline correlations between meteorological measures able to improve the nowcasting reliability. In particular, the role of the Low Level Jet entering from the Pala d'Altei could be a good point for potentially strong storms trigger.

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