Analysis and ALADIN prediction of a heavy precipitation event on the Eastern side of the Alps during MAP IOP 5

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During the Mesoscale Alpine Program - Intensive Observing Period 5 (MAP IOP 5) heavy precipitation occurred in the early morning of 4 October 1999 along the border between Slovenia and western Croatia. Orographic influence on convectively unstable air advected by the warm and humid current from the Mediterranean caused a large amount of rain. The existing frontal zone was modified by the convergence between the southerly winds associated with the Alpine lee cyclogenesis, and the northerly flow around the eastern flank of the Alps after a splitting process in the north Alpine orographic blocking.

For special MAP IOP5 soundings, observations were made at 3- or 6-hourly time intervals, while prognostic TEMPs on the direct ALADIN/LACE mesoscale model output at every 3 hour were taken for Ljubljana, Udine and Zagreb. These datasets were used as the input data for objectively derived vertical/time cross-sections indicating both the observed and predicted atmospheric structure and its temporal changes at considered localities (Figs. 1 and 2). The diagnostic procedure was based on the HRID model (High Resolution Isentropic Diagnosis).

The analysis of the low tropospheric structure offers an explanation of this extraordinary case with a rapid frontal and orographic development. The basic features are:

1. the strong vertical wind shear and pronounced convective instability ahead of the front;
2. the very high humidity concentration inside the frontal zone;
3. a typical bora layer covered by temperature inversion after the frontal passage, and
4. a layer characterized by a weakening wind system above the temperature inversion

The latest process inhibits the vertical growth of convective clouds. Consequently, the observations of hourly precipitation amount in Zagreb and its surroundings show gradual decrease and, finally, cessation of rainfall.

It is shown that the ALADIN/LACE model and its application by HRID were able to predict the essential features of these phenomena with high reliability as well as their usefulness and applicability in making local forecasts and nowcasting.

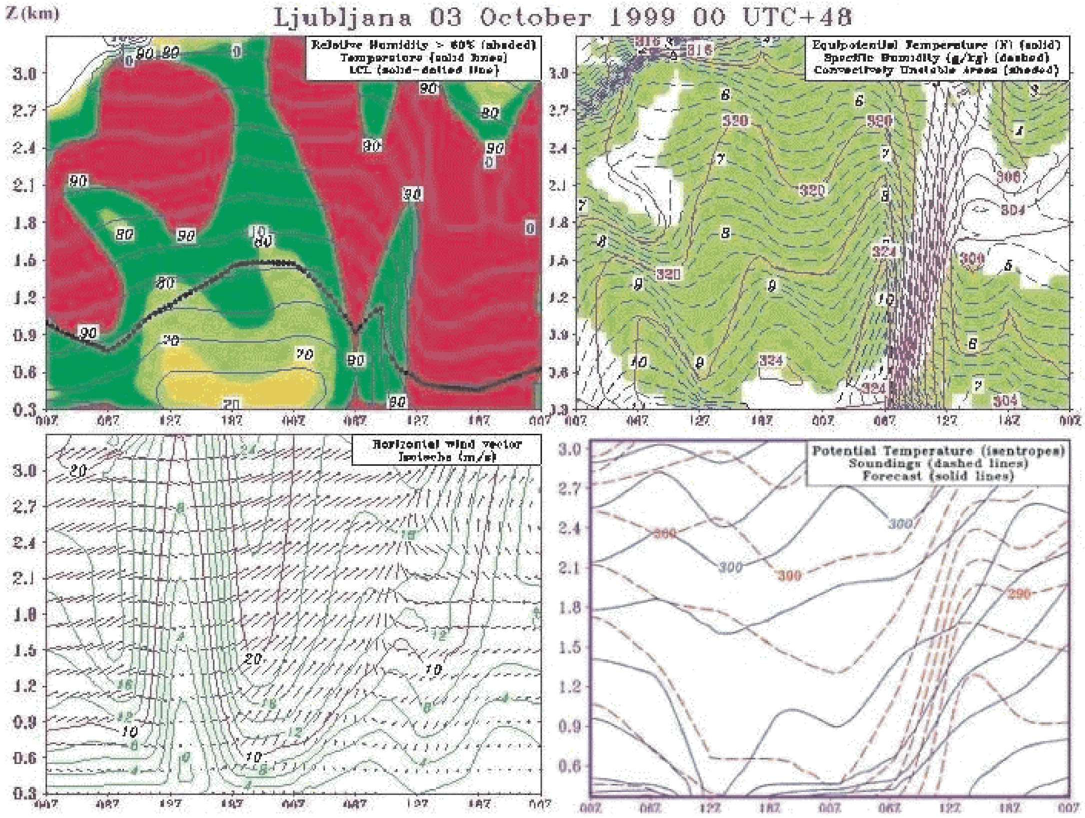

Figure 1: HRID composite vertical/time cross-sections for Ljubljana

3 October 1999, 00 UTC - 5 October 1999, 00 UTC based on 6-hourly soundings observations.

a) relative humidity > 60 % (shaded), temperature (°C, solid lines) and lifting condensation level (LCL line, dotted);

b) equipotential temperature (K, solid lines), specific humidity (g/kg, dashed lines), convective unstable areas (shaded);

c) ALADIN/LACE forecast of horizontal wind vector and isotachs (m/s);

d) potential temperature (isentropes): soundings (dashed lines) versus ALADIN forecast (solid lines).

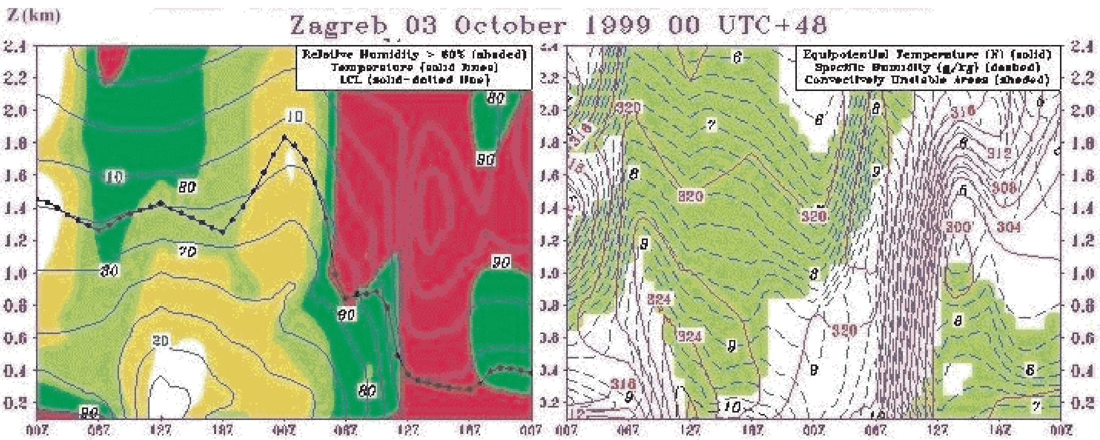

Figure 2: HRID composite vertical/time cross-sections for Zagreb

3 October 1999, 00 UTC - 5 October 1999, 00 UTC based on 3-hourly soundings observations.

a) relative humidity >60% (shaded), temperature (°C, solid lines) and LCL line (dotted);

b) equipotential temperature (K, solid lines), specific humidity (g/kg, dashed lines), convectively unstable area (shaded).