COLD AIR DAMMING OVER PO VALLEY AND ADRIATIC COAST

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Abstract: The " Cold Air Damming" consists in a weak cold air mass flux blocked by a mountain chain on the upward side, at low levels; is is not able to scavalcare the mountains in the lee side and is trapped topographically.. This event develops extended low-middle level cloudness, low temperatures, generally weak precipitations and sometimes, freezing or frozen rain. In terms of thermodynamics, the cold air mass is generated by weak advection, adiabatic cooling as air ascends the mountain slopes and finally diabatic cooling by melting or evaporation. In this presentation, we consider two CAD cases reported in Italy: trapped cold air on the east side of Appenninian mountainous terrain (Adriatic coast) and into Po Valley. Primary diagnostic features are a weak easterly flux coming from the Balcan region and a thermal inversion at low level (Met 8 elaborated images, soundings). In terms of prognosis, Local Models frequently capture the CAD features well (low cloud cover, wind precipitation); some errors depend on parametrizations at low levels as thermal ad humidity lapse rate structures, as water phase into the cloud (liquid, iced, snow, supercooled water) and finally the intensity of the wind.

1. GENERAL CONSIDERATIONS

Elements required for CAD diagnosis are represented by the terrain blocking a cold air flux and an inversion generated by low level anticyclone with weak wind blowing towards the mountains as well. Based on the Literature, CAD is classified in:

1. classical CAD
2. CAD in situ
3. Hybrid CAD

In the first type, the cold advection is indicated as the main role generating cloudiness and phenomenology into the interested area, especially with adiabatic cooling as air ascends slopes; in the second one, the diabatic cooling via melting or evaporation generates CAD and the cold advection is less dominant, initially at least. Finally, in the hybrid case, diabatic cooling and cold advection are both important, furthermore the advection is weak. All three cases generate sensible effects on the weather, causing cold temperatures, freezing precipitation and extensive cloud cover. Most common and strongest in winter months two or three cases are reported into Po Valley and Adriatic coast every year.
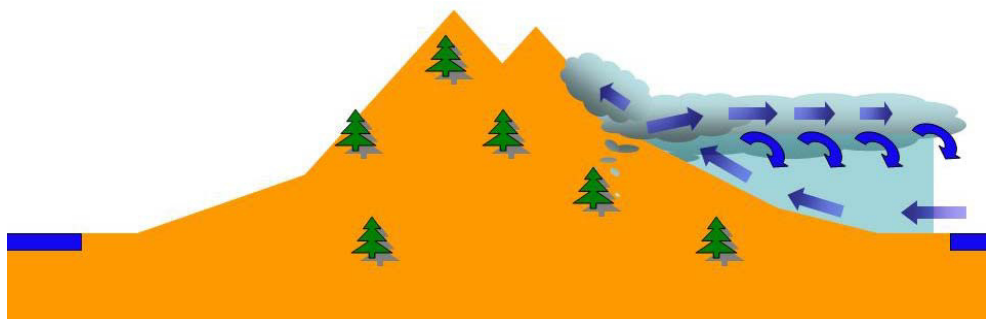
**Figure 1.** The Cold air Damming conceptual model

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2. A CASE STUDY OVER ADRIATIC COAST EXTENDED INTO PO VALLEY (HYBRID CAD)

It occurs in anticyclone area following cold air outbreak in weakening, generated by depression located on Ionian and Tyrrenian Sea or after the passage of cold front coming from Balcan region.
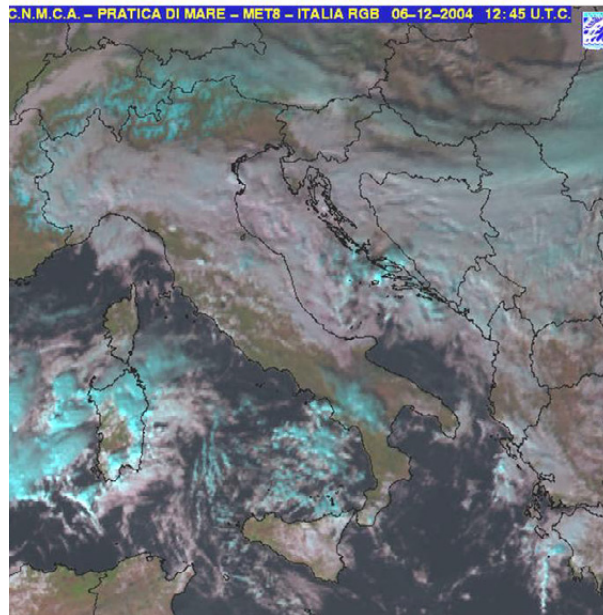

Figure 2. MET 8 RGB channel image: let observe the large extension of low cloudness in the most part of Po Valley and Adriatic Sea; a new cold front, actually interesting Austria and Hungaria, is approaching the south.

The typical mslp map (Fig.3) shows a:weak eastern cold flux loaded by an anticiclonic belt over Central Europe belonging Balcan region and a weak depression over Tyrrenian sea.
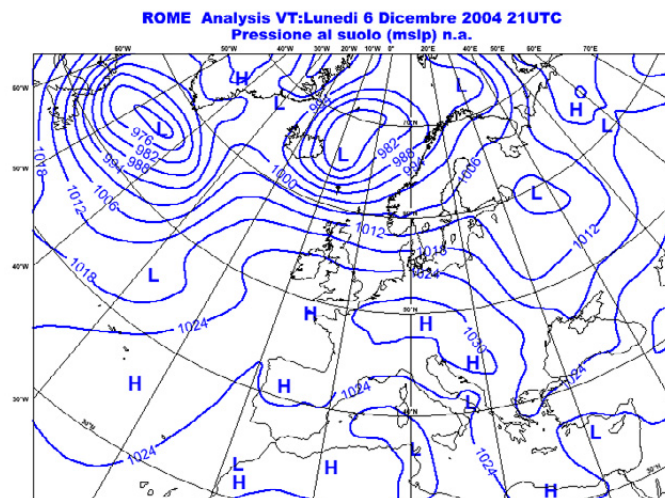
Figure 3. Typical MSL configuration with CAD

The Local Model. wind analysis (Fig.4) shows the cold air mass, coming from Balcans, is trapped topographically by Appenninian chain and deviating with Adriatic coastal direction, as it can be seen by fig.
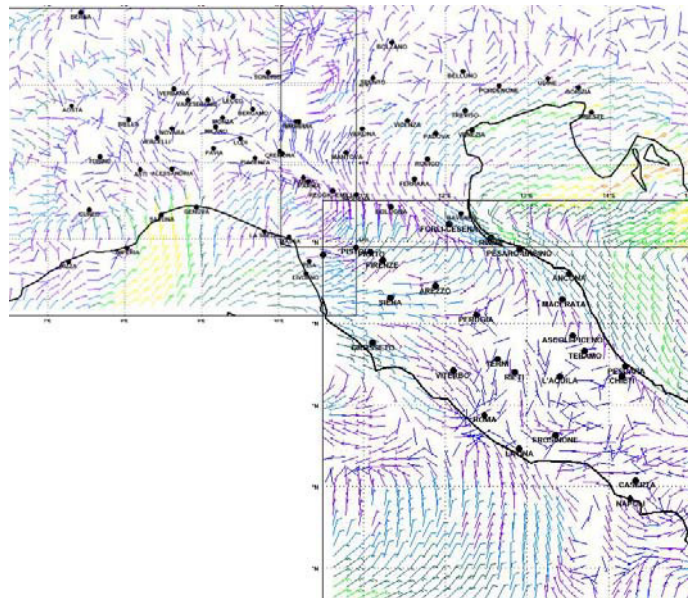

Figure 4. The wind regime analysis, as showed by Local Model

Widespread cloudiness, a shift in the type and location of precipitation, and persistent cold temperatures are some of the effects of this type of CAD. Surface winds *may* increase if a barrier jet develops in the cold air damming scenario, but no related cases are reported. Other effects may include potentially damaging icing conditions for low level flights. The end of this CAD is usually involved by approaching a new cold front or erosion of cold pool with southerly flow.

## 3. A CASE STUDY OF CAD LIMITED TO PO VALLEY (CAD IN SITU)

With the same circulation as well as the first case, but with very weak wind (eastern cold flux coming from Slovenia and translating over Po Valley). Local frozen rain is reported, especially in the south part of Piemonte.

In Fig. 5 we can observe saturation condition at low levels indicating low visibility and frozen rain, due to the temperature lower than 0°C. in the air column.
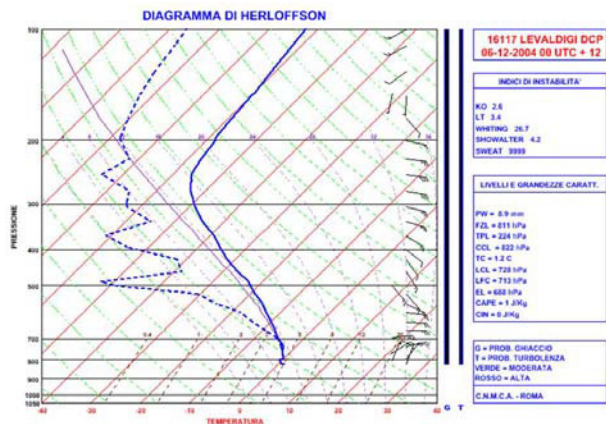
Figure 5. Typical sounding with CAD: The station is situated in the southwest part of Piemonte

The end of CAD is produced by warming, via insolation or advection and by approaching a new cold advection; in the last one, most part of cloudness over Po Valley changes into stratocumulus (Fig. 6).
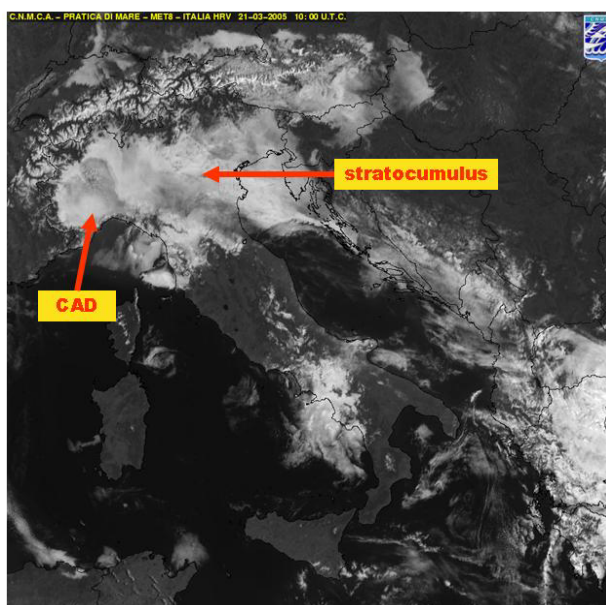
Figure 6. CAD over Po Valley with typical cloudness

REFERENCES

Bell, G.D., and L. Bosart, 1988: Appalachian cold-air damming. *Mon. Wea. Rev.*, **116**, 137-161.

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