

# **Mediterranean cyclones and Alpine heavy-rain flood events**

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Topographically influenced precipitation, with emphasis on heavy precipitation and flooding events, has been defined as the first scientific MAP objective. Part of the heavy-rain-flood events in the Alpine region result from the advection of warm and moist air masses from the Mediterranean, as the 'MAP Design' also mentions (Binder and Schär, eds., 1995). The aim of this contribution is to stress the possible role of some Mediterranean cyclones to provide and organize this warm and moist advection, as well as to introduce our catalogue on Mediterranean cyclones and severe weather to the MAP community.

The simple synoptic and subsynoptic view of many cases of non-Alpine Mediterranean heavy rain conducted us to consider the significant role of the Mediterranean cyclones in part, at least, of these events. Even the weak and small cyclones are a good way to organize limited warm and moist air streams within the Mediterranean or against its borders that provide very effective surface forcings to trigger deep convection in an appropriate environment (Jansà et al. 1986, Jansà 1987, Jansà 1992, Jansà et al. 1994, Ramis et al. 1994). For the most intense case never observed in Spain (Gandia 1987, 800 mm of rain in 24 hrs!) we performed some numerical experiments that reinforced the hypotheses, because the more accurately a model version forecasted a small cyclone as observed near the zone of heavy rain, the better resulted the prediction of precipitation (Jansà et al. 1991).

## **Alpine cases**

The above described role of a Mediterranean low in focusing and triggering deep convection looks also important in two - at least - of the five Alpine flood cases mentioned as examples in the 'MAP Design Proposal' (Vaison-la-Romaine 1992 and Brig 1993). Less clearly in the Piedmont case (1994).

Figs.1 and 2, taken from the 'Boletin PEMMOC', illustrate the surface pressure pattern and its evolution during the Vaison-la-Romaine and the Brig events.

In the first case - Vaison-la-Romaine, 22 September 1992 (see Rivrain 1993, Benech et al. 1993 and Senesi et al. 1995 for details) - a mesoscale low appears in the Pyrenean area and moves - meanwhile intensifying - to the Rhone mouth. A warm-moist Mediterranean airflow becomes more and more organized ahead of this depression. This is the necessary inflow to feed the convective systems that produced the heaviest rain.

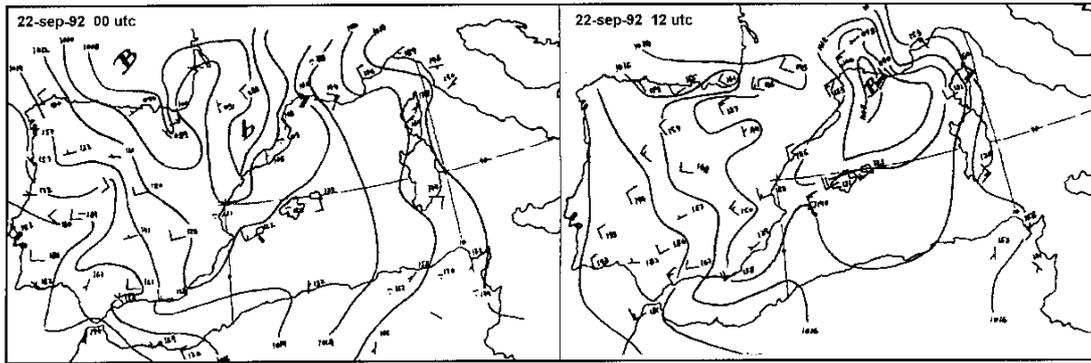


Figure 1. Vaison-la-Romaine 92. Surface hand analyses, 22-sep-92 at 00 UTC and at 12 UTC. From the 'Boletín PEMMOC'.

In the second case - Brig, 23-24 September 1993 - the Mediterranean depression, that organizes a warm-moist flow against the Alps, appears in the Balearic Sea and moves towards NE. Its presence and role is also very clear in Aebischer and Schär 1994, from where the cover for the 'MAP Design Proposal' was taken.

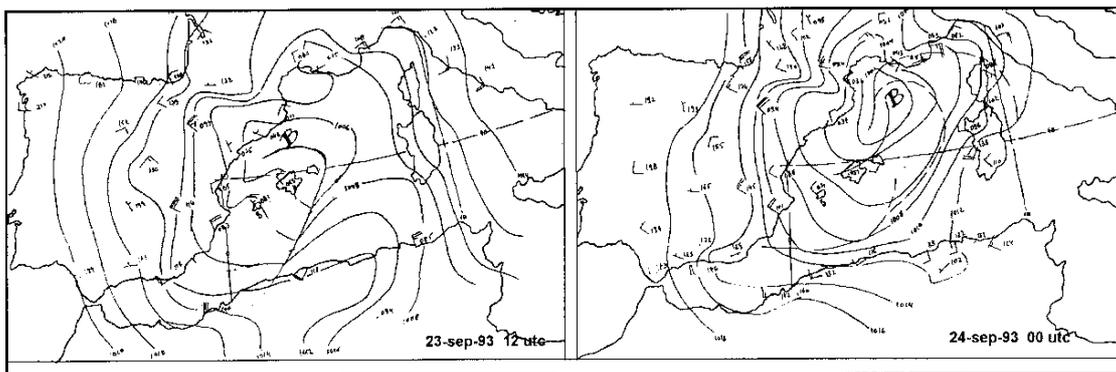


Figure 2. Brig 93. Surface hand analyses, 23-sep-93 at 12 UTC and 24-sep-93 at 00 UTC. From the 'Boletín PEMMOC'.

Fig. 3, concerning the Piedmont case, 4-6 November 1994, also shows the presence of a mesoscale Mediterranean depression - formed to the northeastern edge of the Pyrenees - that tend to spread to the east, although weakening. The synoptic warm-moist Mediterranean flow to Southern France and Northern Italy seems to be intensified by the depression and finally restricted to the Italian zone. The presence and role of this feeding airflow is stressed in the various available simulations and analyses ([Buzzi et al. 1995](#), [Paccagnella et al. 1995](#), [Binder and Rossa 1995](#)).



Figure 3. Piedmont 94. Surface hand analyses, 5-nov-94 at 00 UTC and at 12 UTC. Shaded and black correspond to zones with dew point above 16 °C and 18 °C.

### **Mediterranean cyclone and heavy rain catalogue.**

In the framework of the Spanish study programme called 'PEMMOC' and of the WMO Mediterranean Cyclone Project, the Meteorological Centre in the Balearics of the Spanish Meteorological Institute (INM) initiated a systematic task - since December 1991 - to obtain and archive data on every cyclonic perturbation observed in the Western Mediterranean basin. We also obtain and archive information on severe weather (heavy rain and strong wind) events. By this way, we are continuously updating a data bank on the cyclonic activity and the extreme weather events that can be partially related to it. Among other objectives about the cyclones and the severe weather events themselves, we are looking for a systematic base to validate this possible relationship.

From the data collection, we are also publishing a bulletin (the 'Boletín PEMMOC') that includes the basic information about the Mediterranean cyclones, as well as illustrated documentation about the most important events.

## Remark

In part of the deep convection and heavy rain events in the Alpine region the role of a Mediterranean cyclone - organizing the feeding flow - seems to be significant. Therefore, to obtain detailed surface pressure-wind-temperature-humidity analyses might be an important secondary objective for MAP. This implies improved observations and analysis techniques.

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