

Upstream wind field conditions in the north-western Mediterranean basin monitored by a wind profiler radars network.

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3 – 4D wind field computation from mesoNH individual profiles

Main hypothesis : use the first derivative of the 3D

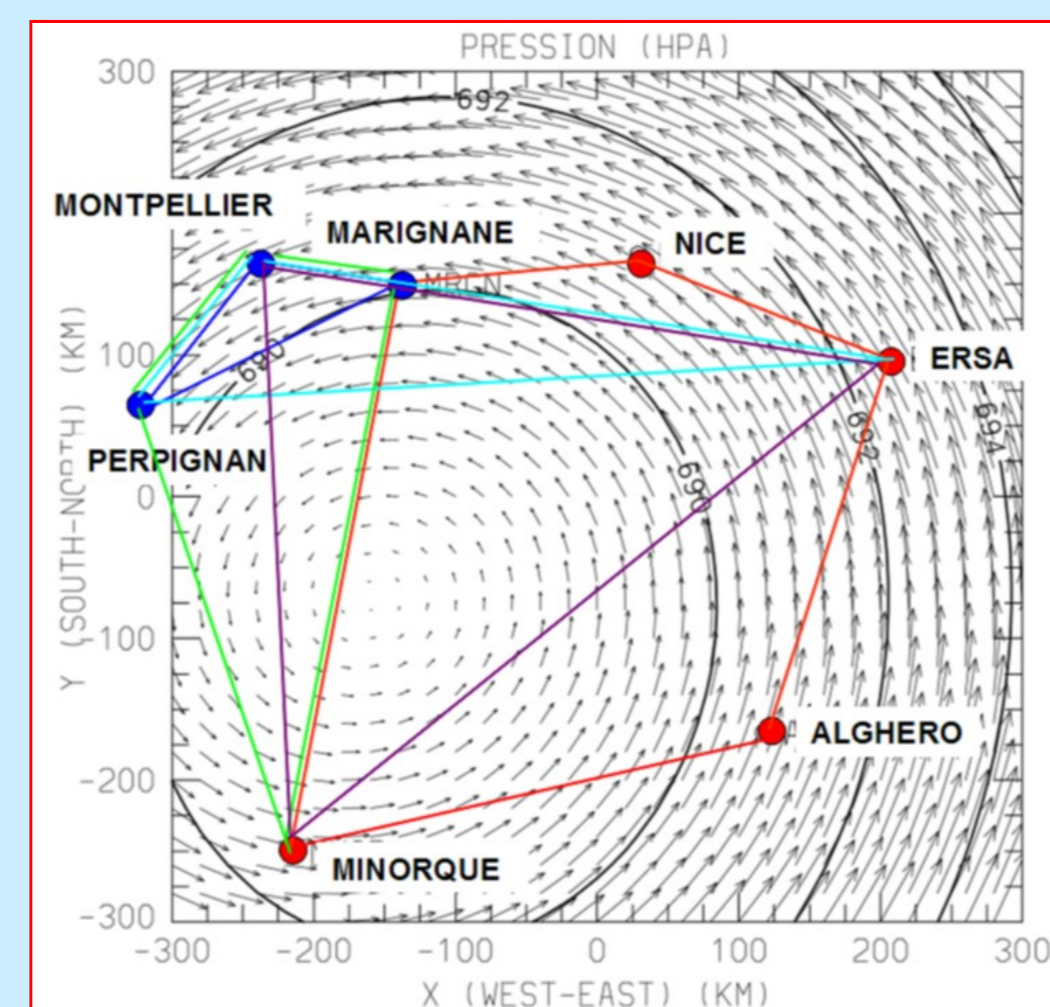
wind field :

$$f(t_i + dt, x_i + dx, y_i + dy, z_i + dz) = f(t_i, x_i, y_i, z_i) + \frac{\partial f}{\partial t} dt + \frac{\partial f}{\partial x} dx + \frac{\partial f}{\partial y} dy + \frac{\partial f}{\partial z} dz$$

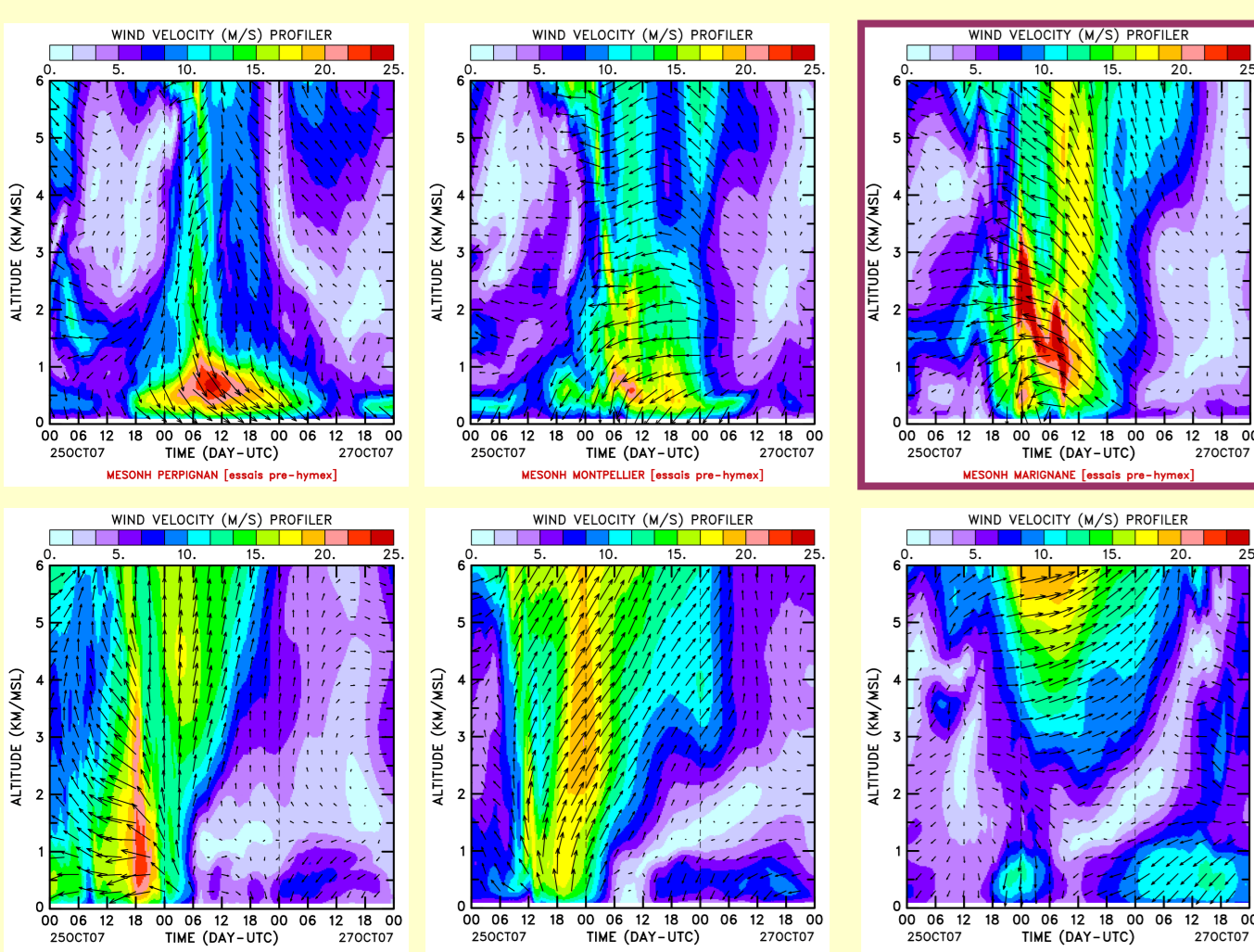
$\Delta T = 3h$ to remove small scales especially for divergence and vorticity, $\Delta z = 200m$.

MesoNH has been run from 2007 October 20 to 31. Some vertical profiles are extracted above different sites of the HYMEX area, over the western part of the Lion Gulf (western part of the Mediterranean basin). Each vertical profile is used to simulate a UHF profile. These virtual profiles are associated in order to build networks using at least 3 'radars' (see figure on the right). For each network, a 4D windfield (U,V,W,t) is calculated, using the linear method described above.

The aim is to find the best set of 'radars' to describe the simulated mesoscale wind field.

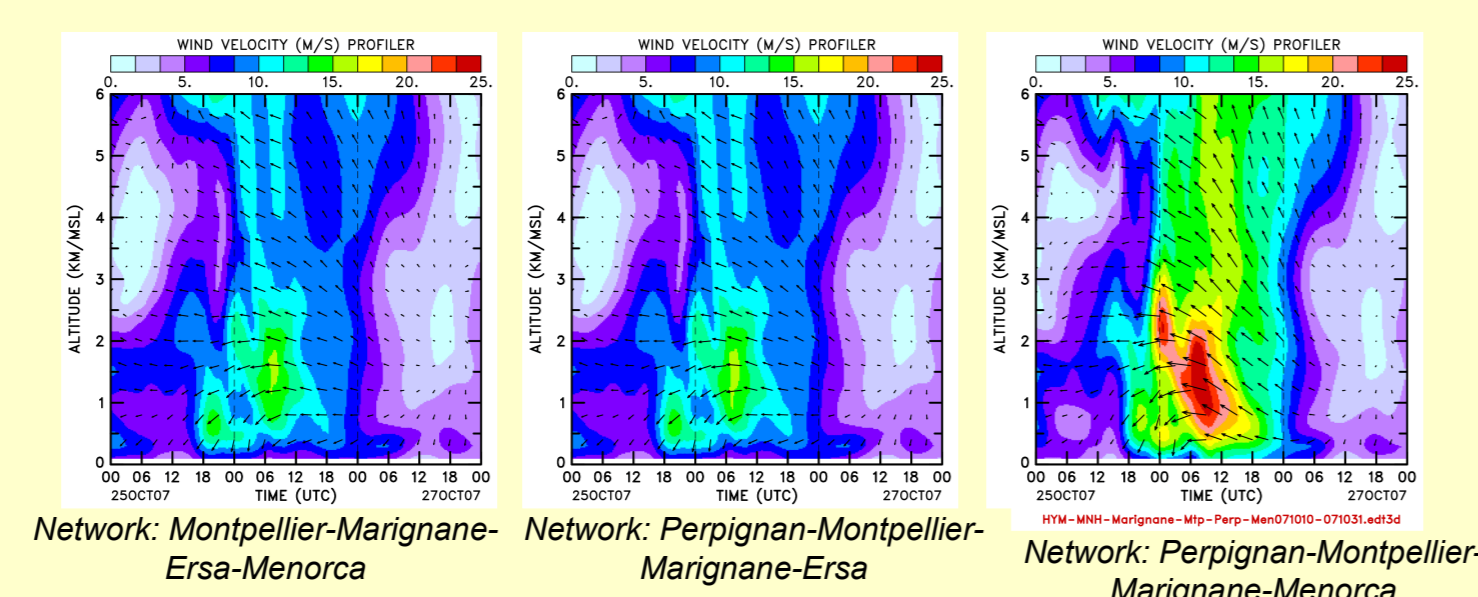


4 – Virtual profiles above the selected sites



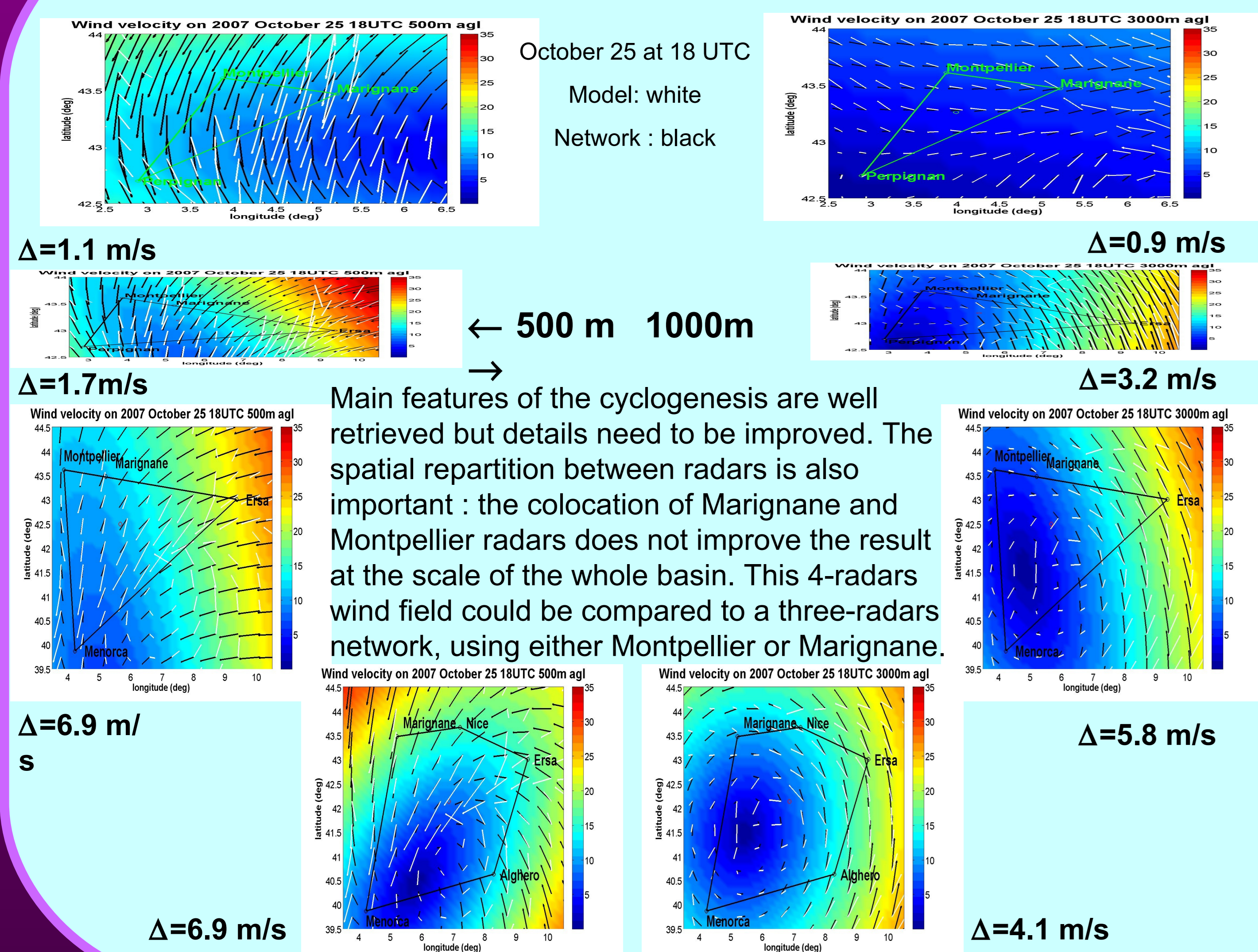
Time-height cross-sections of wind vector and windspeed (from mesoNH) between October 25 and 27 : rather different profiles.

5 – Restitution from the various networks over Marignane



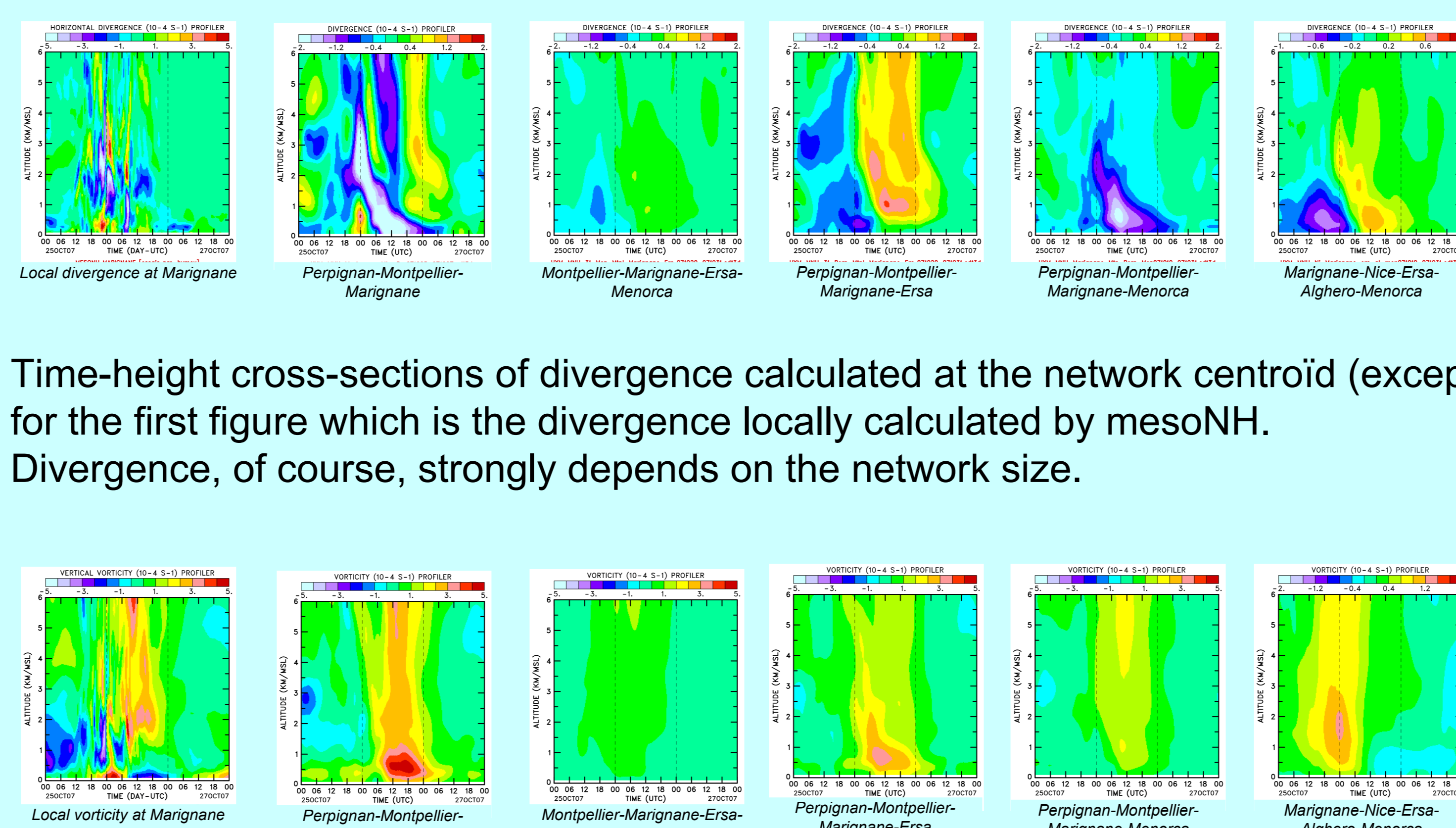
Time-height cross-sections of wind vector and windspeed, obtained at Marignane when using 3-4 or 5-points networks. To be compared to the initial time-height cross-section (framed figure on the left). The networks filter local features.

6 – Horizontal wind fields comparison



Main features of the cyclogenesis are well retrieved but details need to be improved. The spatial repartition between radars is also important : the collocation of Marignane and Montpellier radars does not improve the result at the scale of the whole basin. This 4-radars wind field could be compared to a three-radars network, using either Montpellier or Marignane.

7 – Mesoscale divergence and vorticity



Time-height cross-sections of divergence calculated at the network centroid (except for the first figure which is the divergence locally calculated by mesoNH). Divergence, of course, strongly depends on the network size.

Time-height cross-sections of vorticity calculated at the network centroid (except for the first figure which is the vorticity locally calculated by mesoNH). Vorticity as divergence depends on the network size.

Objectives in the HYMEX framework

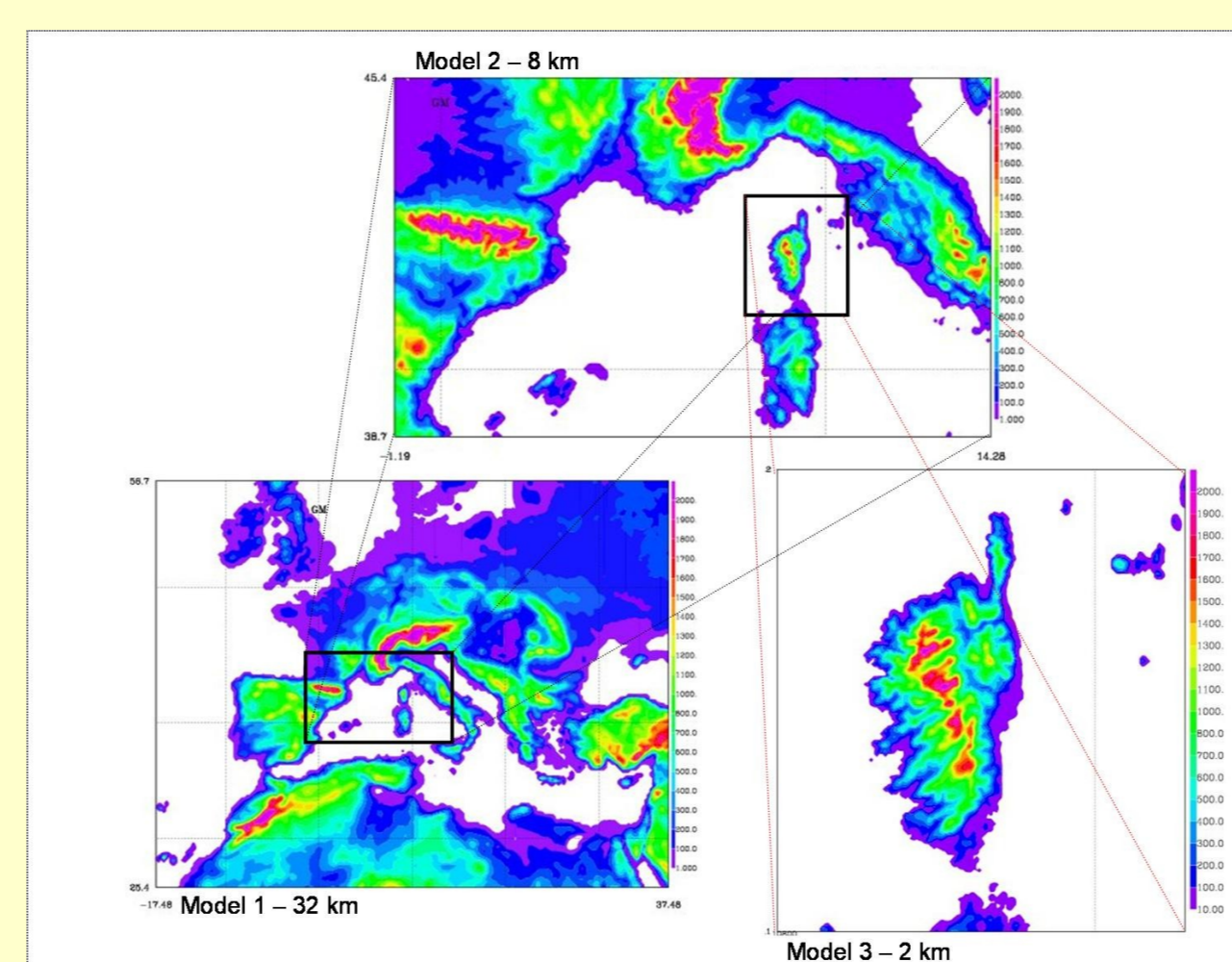
- describe the inland and offshore dynamical conditions to study the dynamics linked with the initiation of strong rainfall and flood events.
- study the inland conditions of air-sea exchanges in case of Mistral or Tramontana winds as well as coastal dynamics.

Present work : validation of the profilers network

As a preparation of the experiment, we simulate a 'virtual' network of UHF profilers by using vertical profiles obtained with a mesoscale model. The aim is to show that the profilers network is able to retrieve the main meteorological features and to optimize the number of profilers. This first step is only one example of the various situations of cyclogenesis that we plan to study.

Aim : pre-simulations with the French MesoNH non hydrostatic model to prepare the experimental plan.

Simulation domains are presented here, with some examples of simulations.



Simulation domains of the 3 MesoNH interactive 2-way nested models used to study heavy rainfall episodes in Corsica or along the Mediterranean coast.

The largest domain will be used as pre-simulations to optimise the implementation plan.

Domains 2 and 3 may be moved to other target areas during Hymex.

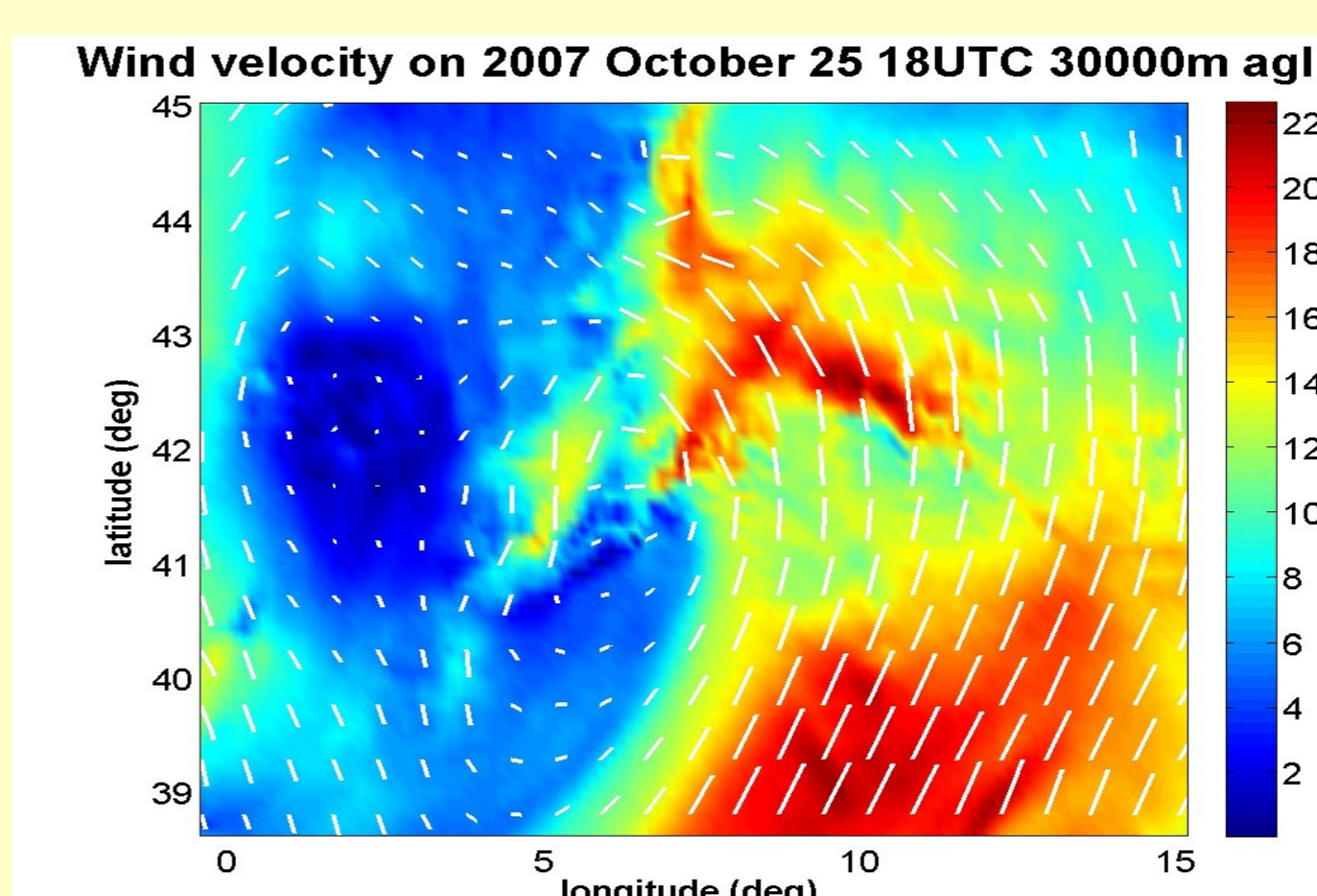
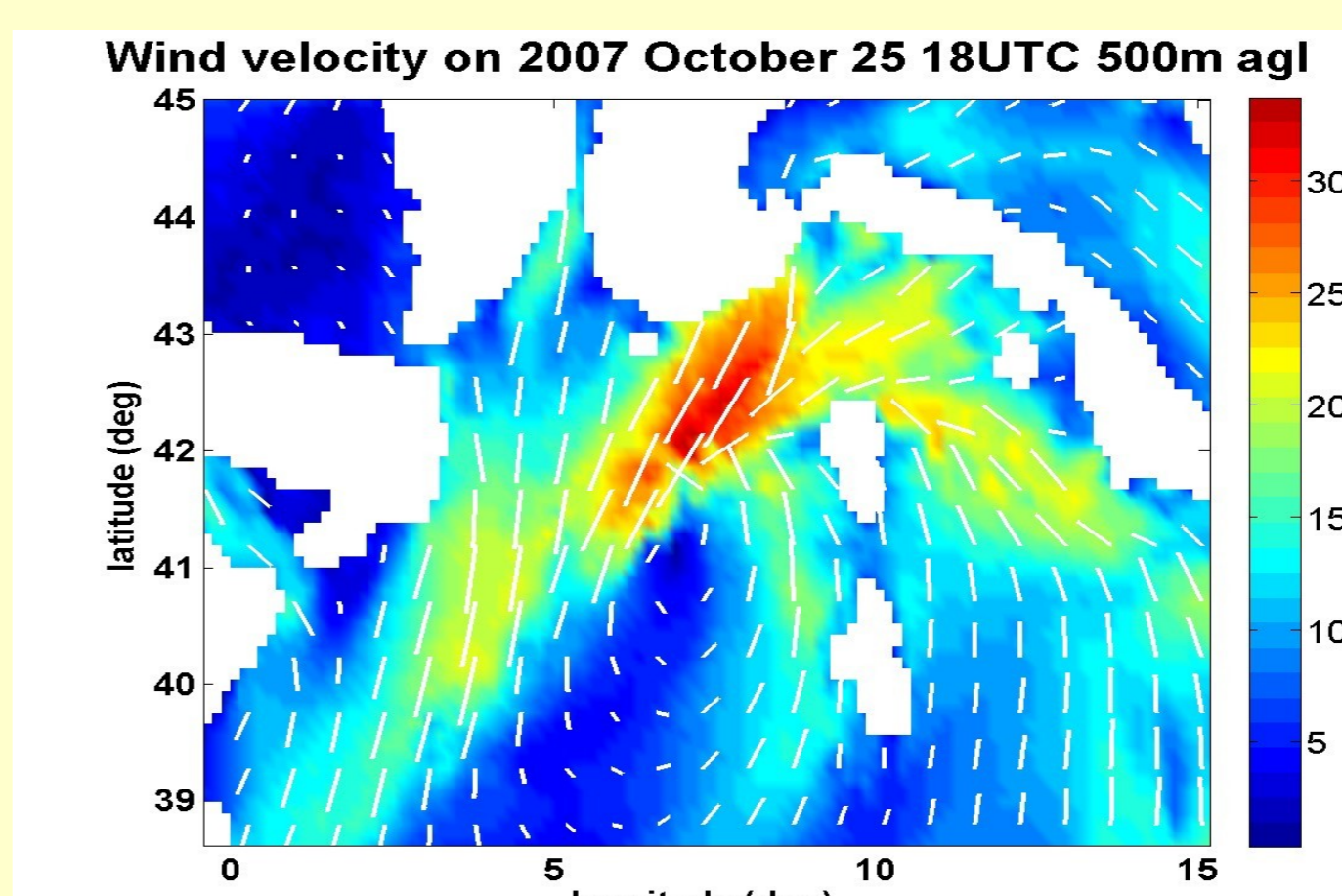
1 - Experimental project : a wind profiler network

- use a network of profilers on a long period to survey dynamics conditions on the western part of the Mediterranean basin.
- retrieve mesoscale vertical velocity (from mesoscale divergence and convergence at domains spanning from 10 000 km² to 100 000 km²), calculate trajectories.
- retrieve humidity profiles, with a better time resolution than with radiosoundings, to determine upstream conditions (in case of southern flows). Retrieve rainfall efficiency during rainfall events.
- assimilate profilers observations in mesoscale models to improve short term forecasts.

2- Mesoscale simulation description

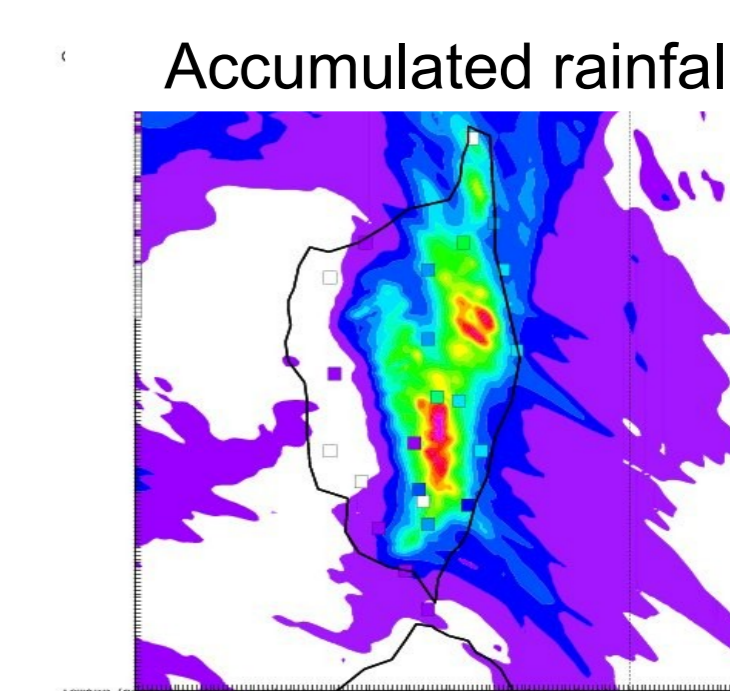
Heavy rainfall event in Corsica : MesoNH
initiated at 2007 Oct 20 0h
Forecast, valid for 2007 Oct 25 18h, initiated and coupled with ECMWF analysis

Domain 2 - 8 km. Wind vector and windspeed



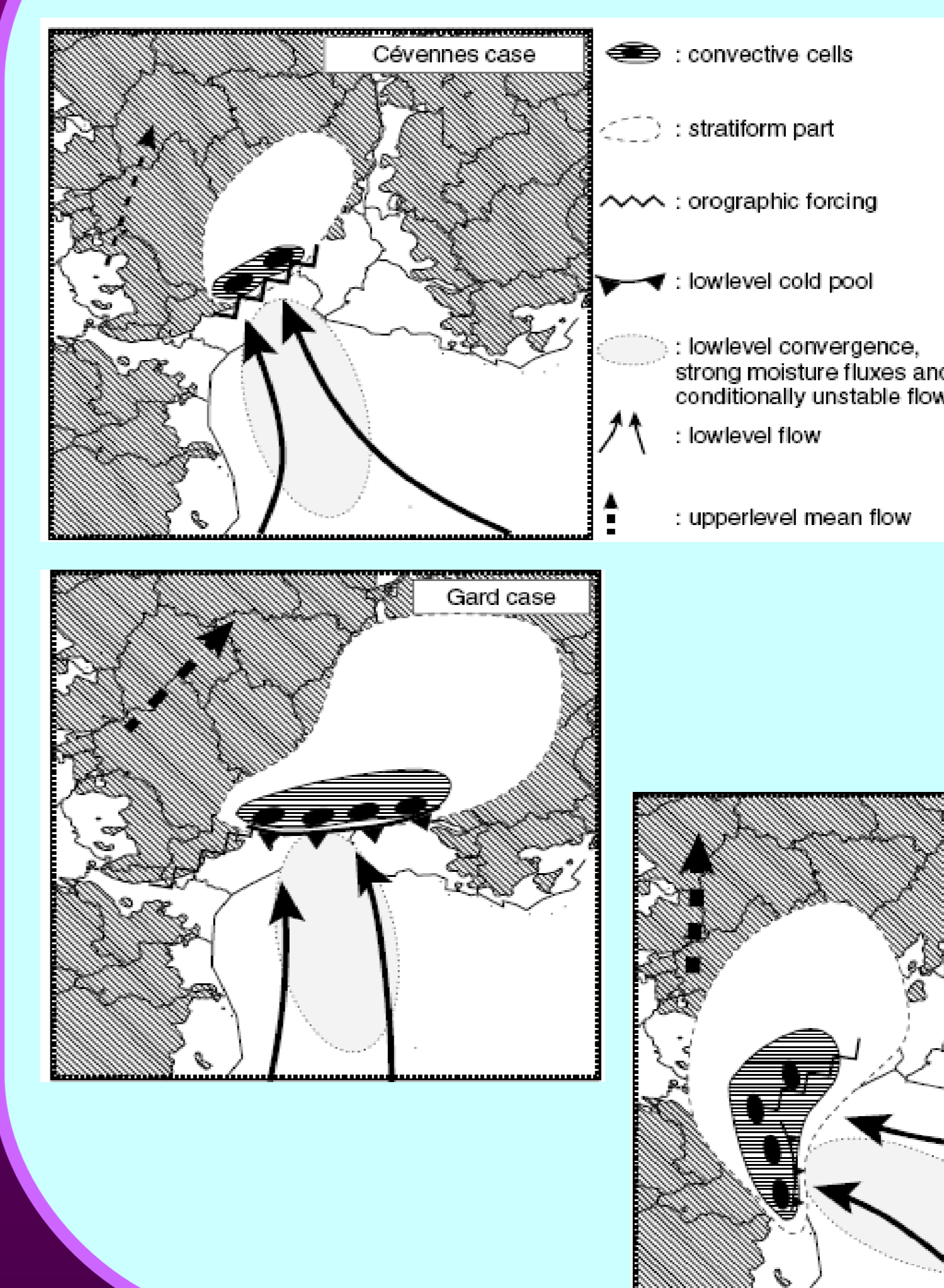
The aim was to reconstitute heavy rainfall that affected Corsica on 2007 October 25 and 26. The raingauge network on the island measured a maximal value of 219 mm between 10/25 6h and 10/26 6h.

The figure on the left (500 m) shows strong values of the wind (20 to 25m/s) upstream and downstream the island. The figure below displays accumulated rainfall forecast by MesoNH on the small domain. The rainfall episode is well reproduced with a good location but an overestimation of the rainfall (more than 370 mm). There is also some time shift in the forecast when compared to raingauges and to the Aleria radar (Intense weather episodes in Corsica: windstorms and heavy rainfall from Lambert D., Argenne S., Richard E., Jacq V., Garnaud C. and Paque G., 2nd HYMEX workshop, Paris 2008).



Domain 3 - 2 km

8 – Other situations to be studied



Three representative cases of high precipitation events over southeastern France have been investigated in Nussier, O., V. Ducrocq, D. Ricard, C. Lebeaupin, S. Anquetin, 2008 : A numerical study of three catastrophic precipitating events over southern France. I: Numerical framework and synoptic ingredients, *Quart. J. Roy. Meteor. Soc.*, 134, 111-130: two extreme flash-flood episodes (with large rainfall accumulations exceeding 500 mm in 24 hours) on 8-9 September 2002 and 12-13 November 10999, respectively, and a more typical event for the Cévennes foothills region (13-14 October 1995).

We plan to test different shapes of profilers networks on these 3 cases.