

1 Study area: Cévennes-Vivarais (CV) region

Mediterranean mountainous region intense rainfall

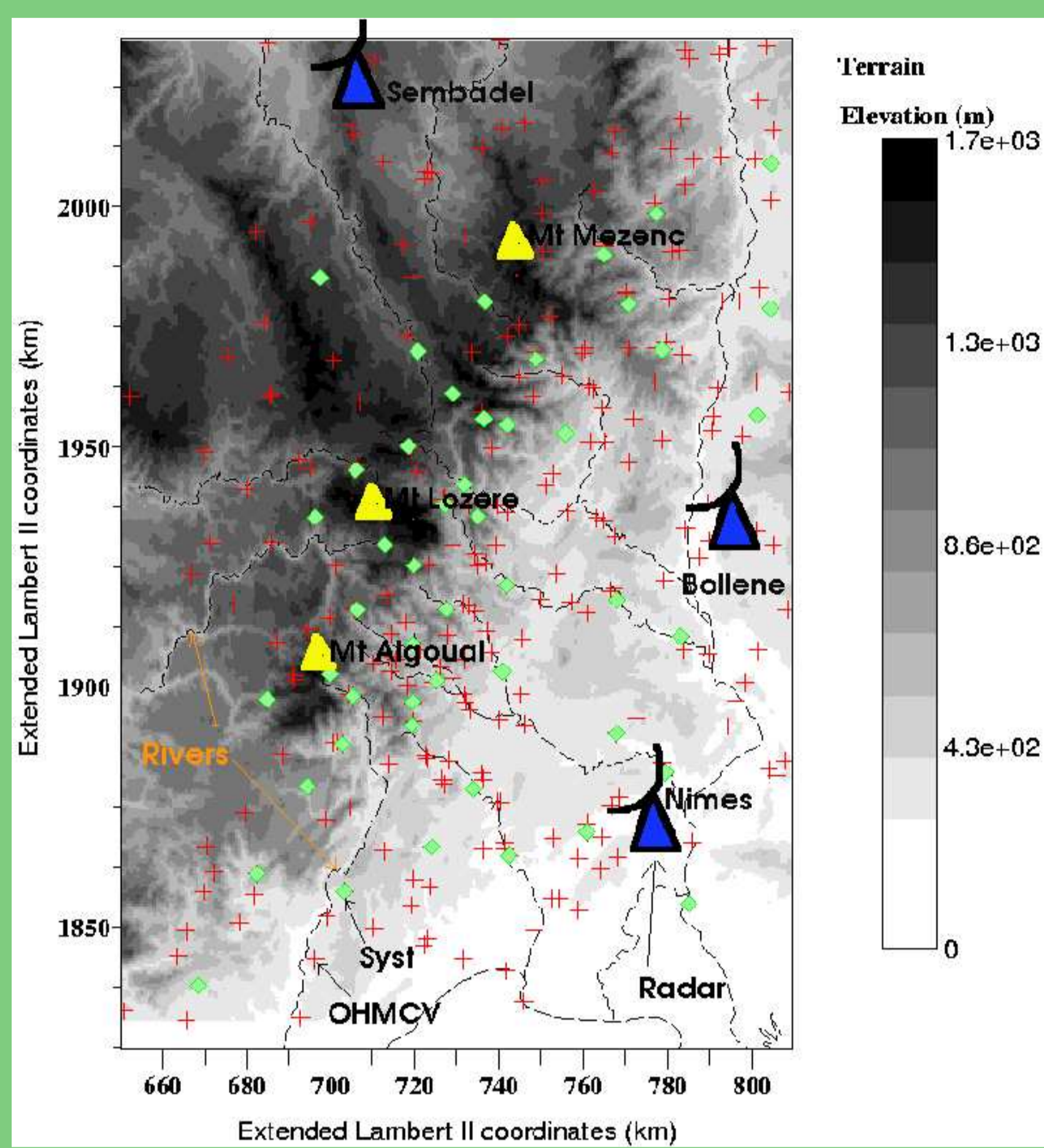


FIGURE 1: Hourly rain gauge (Syst. \equiv 1958-2000 and OHMCV \equiv 2000-04) locations superimposed to terrain elevation.

Investigating

rainfall features

using :

- Data analysis
 - ▷ statistics
 - ▷ geostatistics
- Non-hydrostatic mesoscale simulations of atmospheric flows (MesoNH).

2 Rainfall climatology

★ Mean rainfall rates computed from 16 fall-seasons hourly-rainfall rates (spreading between 1970 and 2004).

Highest mean rainfall rates over the main south-east slope of CV.

★ Extreme rainfall rates

- weekly rainfall maxima during fall seasons between 1958 and 1983 (Bois et al., 1997).
- 100-year return value (100YRV) modeled using double exponential laws.

1h and 24h 100YRV \rightarrow different patterns

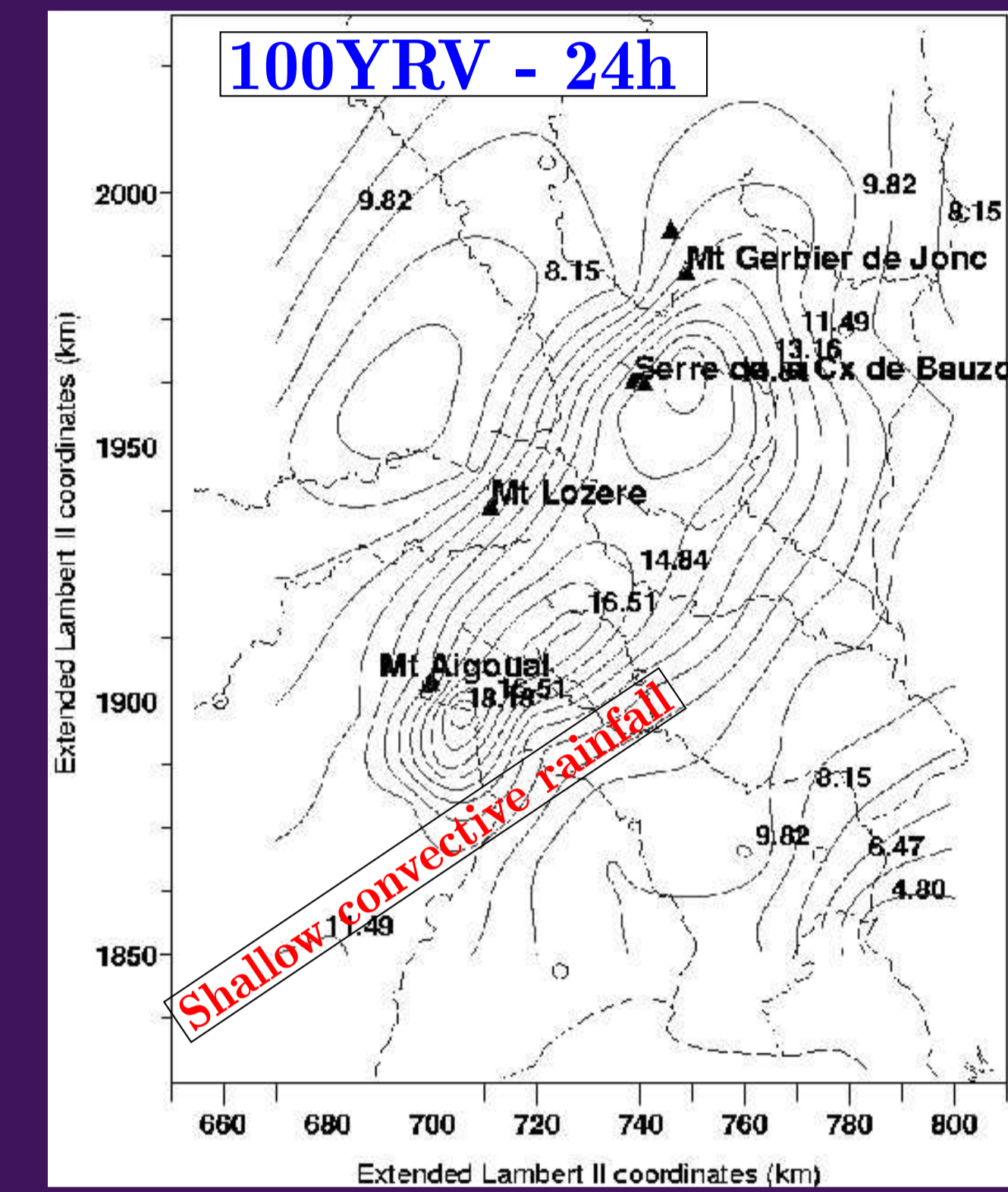
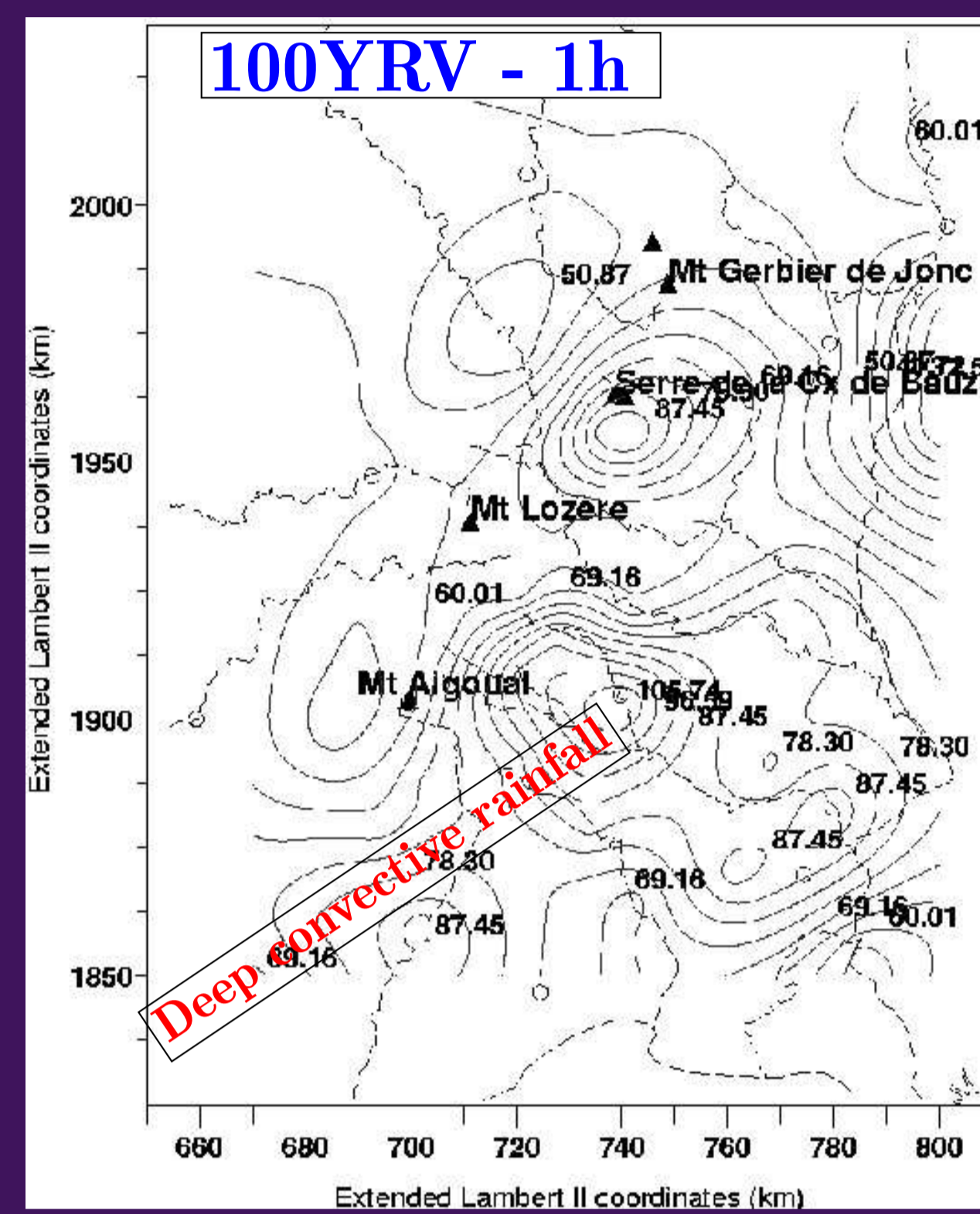


FIGURE 2: Rainfall rate (mm/h) maps (Molinié et al. (xxxx))

Shallow and Deep convective rainfall physical processes

3 Shallow convective rainfall

Featuring **orographic rainbands**

(Miniscloux et al., 2001)

1. Long-duration (day)
2. Stationary \Rightarrow up to 100 mm day^{-1} ;

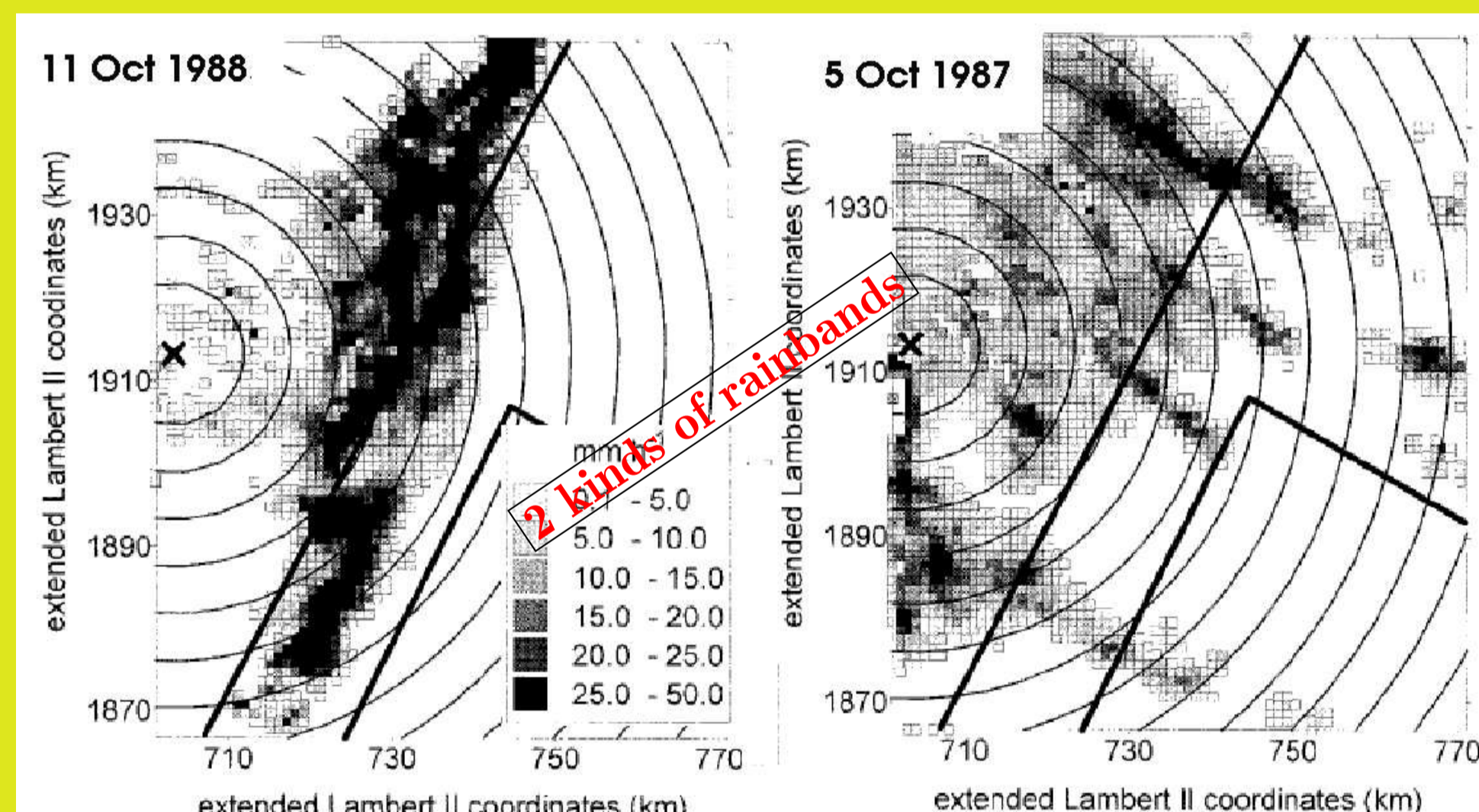


FIGURE 3: Radar echo maps (Miniscloux et al., 2001)

Generic initial conditions (Godart (2006))

Statistics on radio-soundings of shallow convective events featuring:

1. High rain accumulation;
2. Mean rainfall increases and intermittence decrease with altitude;
3. Northward blowing wind, low vertical shear, velocity $> 7 \text{ m s}^{-1}$.

\Rightarrow 79 events extracted from the period 1976-2005.

- Low layer
 - ▷ moist;
 - ▷ conditionally unstable;
- Wind velocity $> 10 \text{ m.s}^{-1}$.



FIGURE 4: Average radio-sounding associated with shallow convective events

Initial conditions for numerical simulations \Rightarrow

Mechanisms structuring rainbands?

Academic mesoscale non-hydrostatic simulation of atmospheric flows (MesoNH) \Rightarrow

1. **Relief Forcing** Convections result from relief involved convergences (Cosma et al. (2002), Anquetin et al. (2003)).
2. **Synoptic flow forcing** (Fig. 5) (Yates (2006))
 Incident wind orientation relatively to the relief \Rightarrow convergence area locations and geometries
 Atmosphere stability relatively to the relief height

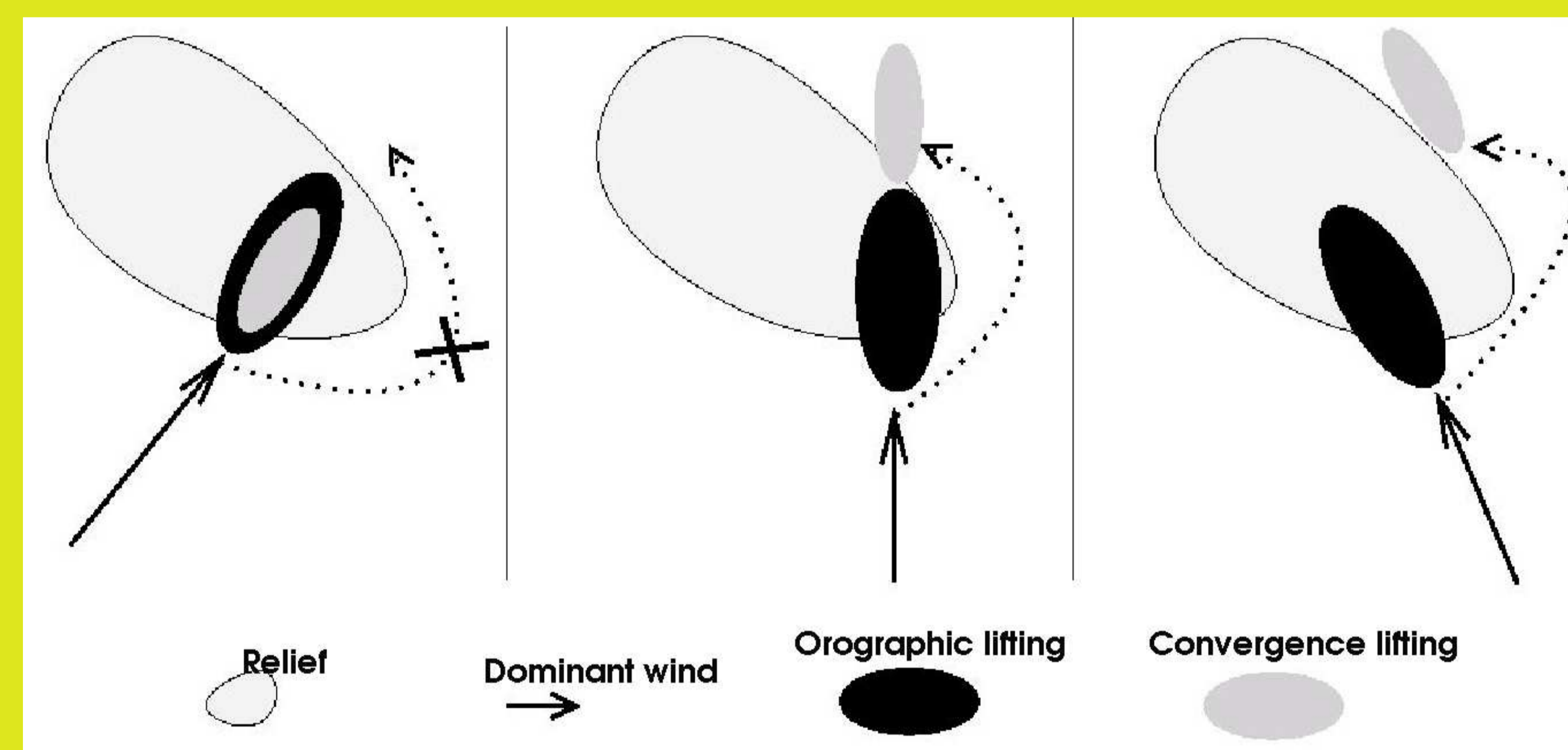


FIGURE 5: Wind flow orientation-relief interactions (Yates, 2006)

3. **Vertical wind shear-relief interactions** (Yates (2006))[5mm]

3D shears of the horizontal wind \rightarrow the greatest rainfall rates

because in some configurations, air masses can be lifted both on the up and down side of the relief.

4 Perspectives

1. Investigate **deep convective rainfall** using both **geostatistics on extreme rainfalls** and **academic numerical simulations**;

2. Toward identifying **weather regimes**.

References

- Anquetin, S., F. Miniscloux, and J. D. Creutin, 2003: Numerical simulation of orographic rainbands. *J. Geophys. Res.*, 108(D8), doi:10.1029/2002JD001593.
- Bois, P., H. Mailloux, C. Obled, and F. De Saintignon, 1997: Atlas expérimental des risques de pluies intenses dans la région Cévennes- Vivarais. Technical report, Pôle Grenoblois des risques naturels, LAMA BP93 38041 Grenoble Cedex.
- Cosma, S., E. Richard, and F. Miniscloux, 2002: The role of small-scale orographic features in the spatial distribution of precipitation. *Quart. J. Roy. Meteor. Soc.*, 128, 1-18.
- Godart, A., 2006: Climatologie des pluies en zone de relief marqué - recherche des paramètres atmosphériques associés à la convection peu profonde. Master's thesis, M2R Sciences de la Terre, de l'Université et de l'Environnement Université Joseph Fourier de Grenoble.
- Miniscloux, F., J. D. Creutin, and S. Anquetin, 2001: Geostatistical analysis of orographic rainbands. *J. Appl. Meteorol.*, 40, 1835-1854.
- Molinié, G., E. Yates, P. Bois, B. Boudevillain, S. Anquetin, and J. Creutin, xxxx: Rainfall regimes in a mountainous mediterranean region: Statistical analysis at short time steps. In preparation.
- Vetter, J., 2004: Contribution d'un code de calcul météorologique méso-échelle à la climatologie des pluies en zone de relief. PhD thesis, Institut National Polytechnique de Grenoble.
- Yates, E., 2006: Convection in région Cévennes-Vivarais : Etude de données phéonométriques, simulations numériques et validation multi-échelles. PhD thesis, ENSHMG, INP, Grenoble, France.

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