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Boundary Layer Evolution under compensatory Mesoscale circulations

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The evolution of the coastal boundary layer observed during the 1978 Nanticoke Power Plant Plume Dispersal Study indicated that, rather than growing in a continuous fashion according to prevailing theories, the depth of the boundary layer experienced intense fluctuations that propagated inland. Similar anomalous behaviour was observed during the European Commission's 4^{th} and 6^{th} Campaigns for the Remote Sensing of Air Pollution in the Po Valley (Turbigo, Italy) and in the coastal area of FosBerre (France), respectively. All these evidences suggested that the evolution of the boundary layer at any one point could become dominated not only by local energy balances but also by larger mesoscale effects which imply compensatory subsidence. Subsequently, during five European Commission projects in the Western Mediterranean, this kind of behaviour was systematically observed.

This paper will present the accumulated experimental evidence on the evolution of the boundary layer over the Western Mediterranean sea and from the coastline to 80 km inland. Over the coastal areas the boundary layer grows rapidly during the morning and then sinks and becomes strongly confined below an average height of 200 m all the way from the coast to the measurement sites located 80 km inland. Over the sea the boundary layer can collapse to a depth of less than 50 m by late afternoon, as it becomes capped by an inversion as strong as 6 degrees in less than 200 m.

The challenge, therefore, is how to deal with the boundary layers that result from the local equilibrium at a specific site and time plus the memory acquired by the system surrounding the site up to 400 km away during the previous hours.