VERTICAL STRUCTURE OF THE POLLUTED LOW TROPOSPHERE DURING ESCOMPTE 2001

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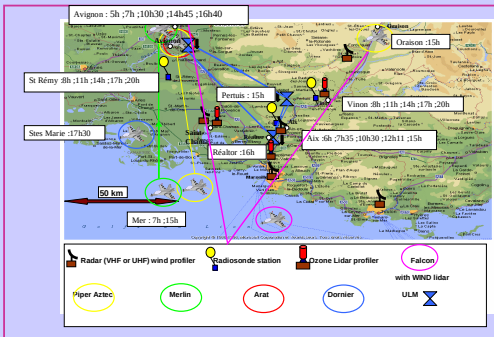
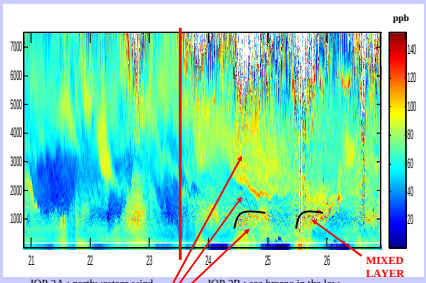
During IOPs 2A and 2B (June 21-26) of the ESCOMPTE 2001 campaign, a vertical stratification of the low troposphere was evidenced from measurements performed by lidars, UHF radars, radiosounding and aircraft.

The location of the various means used in this study is represented below for June 25.

A view of the stratification observed during IOPs 2A and 2B is shown on the left from lidar, radiosounding and aircraft profiles.



EPFL OZONE LIDAR IN St CHAMAS : 2001 JUNE 21-26

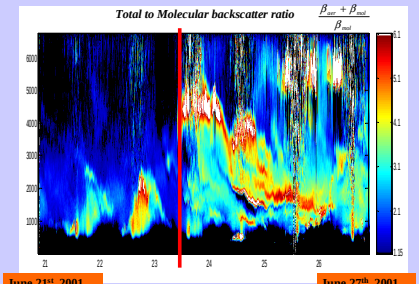


IOP 2A : northwestern wind

IOP 2B : sea breeze in the low layers with synoptic flow turning from westerly to southerly

3 SUPERPOSED LAYERS

ESCOMPTE MARSEILLE

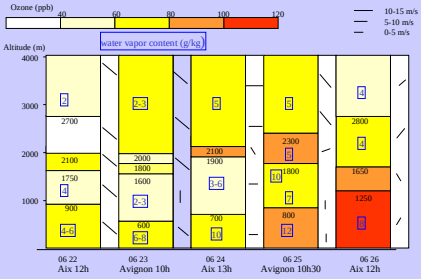


June 21st, 2001

June 27th, 2001

AEROSOL AND OZONE, ADVECTED IN UPPER LAYERS, SEEM TO BE TRANSPORTED DOWN TO THE MIXED LAYER TOP

OZONE PROFILES DURING IOP 2A and 2B



Top : Ozone concentration and molecular backscatter ratio obtained with the ozone lidar based in St Chamas during IOP2 A and B : IOP 2B (with sea breeze conditions) shows superposed layers with some kind of subsidence of the highest layers from 24 to 26.

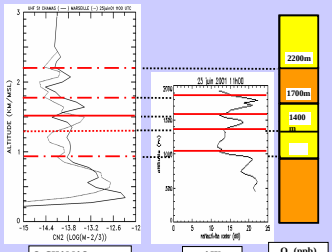
Bottom : Ozone profiles about 11h TU during IOPs 2 from radiosoundings (Aix) or aircraft profiles (Avignon) : Zi is around 1000m. 2 other layers can be distinguished above Zi : from 1000m (Zi) to roughly 1700m and from 2200m to the measuring boundary. The latter corresponds to the area under the influence of the synoptic wind whereas below, either the sea breeze or the synoptic wind or a composition of both may blow. However the water vapor content changes from one day to the other indicating that these layers are not steady, as it has been shown with the lidar data.

WHY IS IT SO IMPORTANT TO STUDY THE VERTICAL STRATIFICATION?

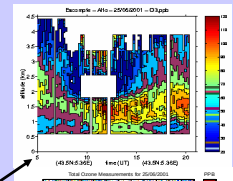
- to know with accuracy the depth of the mixing layer where pollutants are produced (spatial and temporal variability)
- to know the composition of the layers just above in case they mix with the ABL
- to calculate the radiative budget of the low layers since it drives photochemistry
- to study the vertical transport between superposed layers

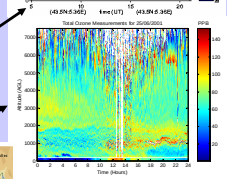
SPECIFIC STUDY OF JUNE 25th

UHF radars reflectivity measured at 11h TU at St Chamas, Marseille and Aix exhibits areas that correspond to the superposed layers similar to those obtained from aircraft profiles. The variability in radar reflectivity is kown to be linked to water vapor and temperature discontinuities as can be seen in the radiosounding profiles.



UHF reflectivity on June 25 : 11hTU



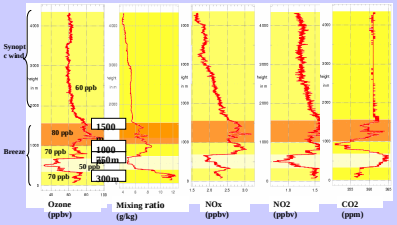


Top : ozone concentration from the Service d'Aéronomie lidar based at Aix les Milles for 06 25.

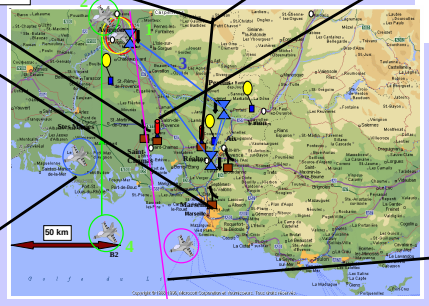
Bottom : same for the EPFL lidar based at St Chamas.

Both exhibit a quasi-steady stratification from 10 to 20 TU from Zi top (≈1 km) to 2 km and all the day long for the layer 2-4km : this confirms the spatial extent of the stratification as shown on the other data.

Saintes-Marie DORNIER : 06-25 17h30 TU

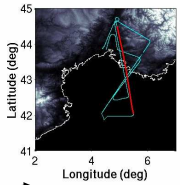


Vertical sounding from the Dornier over les Stes Maries de la mer under sea breeze flow.



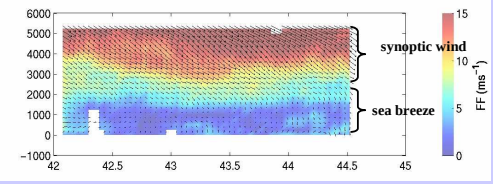
ESCOMPTE

25-Jun-2001 - 16:44:13 to 17:12:40 UTC

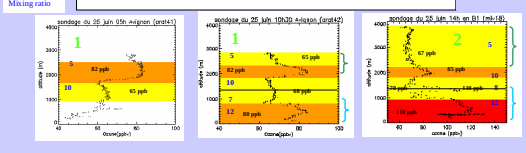


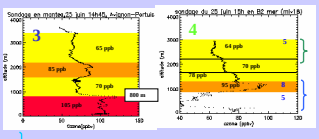
WIND lidar onboard the Falcon . The track is flown from south to north.

The sea breeze extends up to Montélimar to the North, from the surface to 1500-1800m. Synoptic wind is well established at 2200m.



OZONE PROFILES FROM AIRCRAFT EXPLORATIONS ON 06 25





3 different layers :

- layer 1- ABL with varying ozone, aerosols and water vapor concentrations according to the time of the day . Top does not systematically correspond to sea breeze depth.

- layer 2 - boundaries are around 900m and 1700m. Ozone (70 ppb) and water vapor (7-10 g/kg) are constant. Local heterogeneities (110ppb).

- an interfacial layer with often higher ozone concentrations

- layer 3 - between 2200m to 3000 or 4000m. Corresponds to the synoptic wind. Ozone is 65 ppb, water vapor content : 5 g/kg.

Layers 2 and 3 result from advection (no more chemical transformation) from remote areas. They extend on the whole ESCOMPTE area and are steady all along the day. Backplumes have to be calculated to find where they are coming from.

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