Preliminary LES simulations with Méso-NH to investigate water vapor variability during IHOP_2002

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Méso-NH: a non-hydrostatic mesoscale atmospheric model of the french community (Lafore et al., 1998, *Ann. Geoph.*)

Configuration: Large Eddies Simulation from an initial sounding

	1D simulation	First 3D simulation
Δx, Δy, Δz	\, \, from 20m to 250m	100m, 100m, 100m to be increased
Radiation	ECMWF radiation code	ECMWF radiation code
Turbulence	1D (Bougeault-Lacarrere) 1.5 order	3D (Deardoff)
The 1D simulations :	With different initial profiles (MGL2-1120UTC, MGL2-1216UTC, composite of soundings) With different surface fluxes (station ISSF 1, station ISFF 2, Bo=1/2, surface scheme ISBA) Without or with L-S forcings deduced from MM5 or from soundings	

IHOP data used and data we wish to use :

•Model input:

-soundings (Mobile, ISS, NWS)

- ISSF (surface fluxes)

•Evaluation:

-AERI, MAPR, HARLIE, FMCW

-satellite

-radars (S-Pol: reflectivity and refractivity fields)

-lidars (LEANDRE II, DIAL,Scaning Raman Lidar)

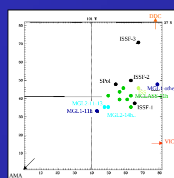
-surface stations

- soundings

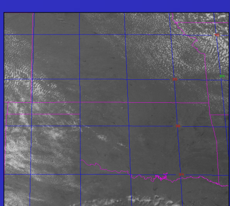
-King-Air in-situ data

14 June 2002, a Boundary Layer Evolution case

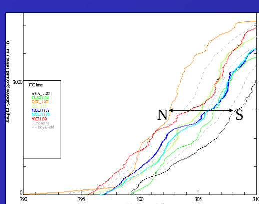
- Clouds : scattered cirrus
- Past : precipitation the two days before => wet soils
- Winds : light winds (< 6m/s) from N and NE
- BL structure observed: convective plumes and growing thermals in the afternoon, $h_{CBL} \approx 1500$ m



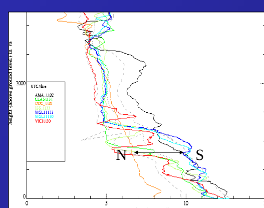
Visible satellite at 2000 UTC



θ Profiles at 1130 UTC



rv Profiles at 1130 UTC



This day is characterized by a high pressure and a North(-)-South(+) humidity gradient over the region. Several dry layers are visible on soundings (for example VICI) - complexe structures.

Definition of the LES: some 1D sensitivity tests

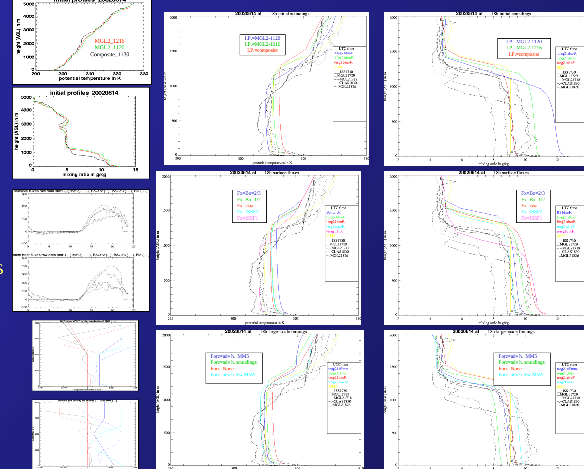
θ Profiles at 1800 UTC

rv Profiles at 1800 UTC

Sensitivity to initial profile

Sensitivity to surface fluxes

Sensitivity to L-S forcings



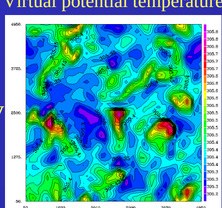
The definition of initial profiles, surface fluxes and large-scale advection is not straightforward. A significative small-scale variability (1-2 K in θ and 1-2 g/kg in rv). Large-scale advection cannot be neglected.

3D-preliminary results of BL structures :

Horizontal cross section in the middle of CBL (700 m) at 2100 UTC

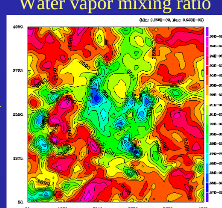
Virtual potential temperature

θv

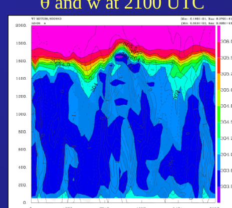


Water vapor mixing ratio

rv

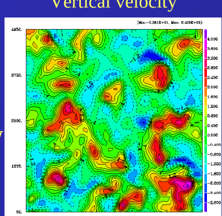


Vertical cross section of θ and w at 2100 UTC

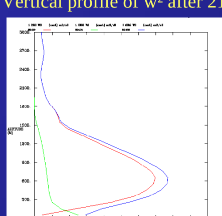


Vertical velocity

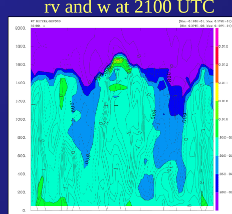
w



Vertical profile of w² after 21h

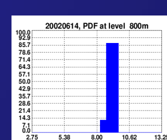


Vertical cross section of rv and w at 2100 UTC

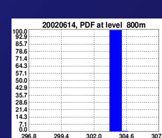


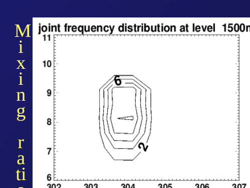
Large variability (θv, rv, w…) in the CBL, strongest variability in the inversion zone.
Available diagnostics to study statistical properties of the turbulence.
Importance of the role of thermals as a source of water vapor and potential temperature variability.

3D-preliminary results: Temperature and Water vapor mixing ratio PDF

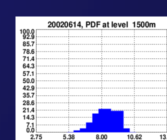


altitude =800m

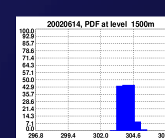




Potential temperature



altitude =1500m



Statistical tools available to study the distribution of water vapor

Conclusions :

•Definition of the LES case study (initial profile, surface fluxes and large-scale advection).
•Tools available to study turbulence and water vapor heterogeneities.

Perspectives :

•To determine and analyze water vapor variability simulated by Méso-NH in the lower levels of atmosphere (diurnal variations, horizontal heterogeneities...)
• To compare this variability to the observed one focusing on LEANDRE II data
• To use the model as a tool to understand : - processes involved in this variability
- the different sources of this variability (e.g., using Lagrangian trajectories)