AMS-BLT_2016 : LES results of the GABLS4 exercice: intercomparison of models over extremely stable conditions in Antarctica

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Motivations : **- explore and improve deficiencies of models in very stable conditions**
- more specifically evaluate LES uncertainties in very stable conditions

Data & Method:

GABLS4 Stage 3:f no radiation, no specific humidity, no LS advection, constant geostrophic wind

24 hours, Lx,Ly,Lz=(1km)^3; Δx=5m, Δz=2m

•**Observations:**

• 45m-tower with 5 levels with sonic anemometers (turbulent fluxes/ variances)

• Soundings

• Radiosoundings

Entire diurnal cycle

Focus on the convective BL conditions and the stable conditions

9 different LES models:

- Méso-NH (Lafore et al, 1998) *zo sensitivity*
- PALM (Maronga et al, 2015) *Δx, Δz, zo sensitivities*
- MicroHH (Van Stratum et al, 2015) *Δx, Δz, zo sensitivities*
- JPL-LES (Matheou and Chung , 2014) *zo, Δx, turb sensitivity*
- SAM-LES (Cheng et al 2011)
- CLMM-LES (Fuka et al, 2011) *turb sensitivity*
- NCSU LES (Basu et al, 2008) [Δx, Δz =10m]
- Met-Office LES (Gray et al, 2001)
- DALES (Heus et al, 2010)

Initially zo=10^{-2}, then zo=10^{-3} in better agreement with observations

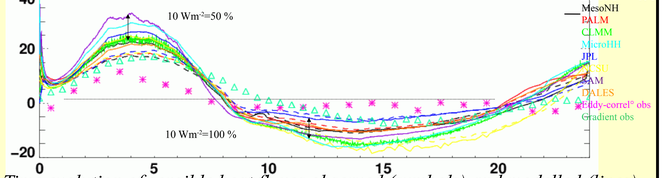
General comparison :

Main drawbacks:

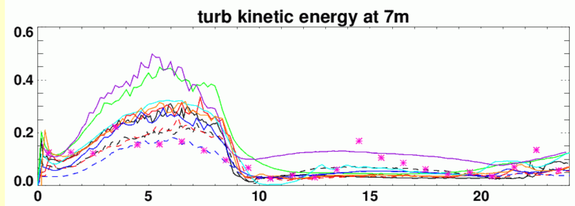
A **large variability among models in surface sensible heat fluxes and turbulence kinetic energy:** sensitivity to zo during daytime ; zo=10^{-3} in better agreement with observations

- Convective boundary layers during day time even though very cold temperature (-30°C), **very stable conditions at night (ΔT=15°C in 20m)**

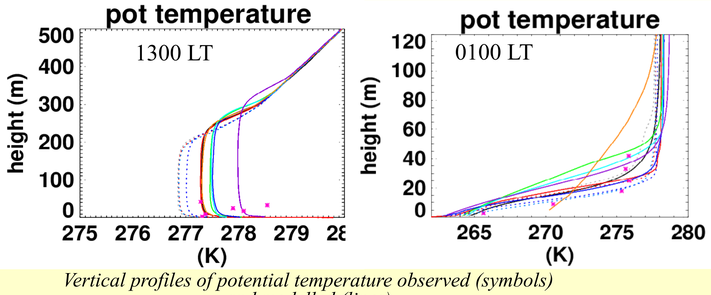
-=> need to investigate relationship between turbulence and surface fluxes :SAM highest fluxes, highest tke, highest CBL, HH large fluxes, moderate tke and CBL,...



Time evolution of sensible heat fluxes observed (symbols) and modelled (lines)



Time evolution of turbulent kinetic energy observed (symbols) and modelled (lines)



Vertical profiles of potential temperature observed (symbols) and modelled (lines)

Conclusions & Perspectives

- 9 LES intercompared for 24h during convective and extremely stable conditions

- Large scatter in sensible heat flux during day and night (even though Ts prescribed), partly explained by differences in turbulence scheme

- Larger discrepancies at night (distributions, spatial structures, Ri exploration...)

Future: intercomparison with higher resolution only for the night period

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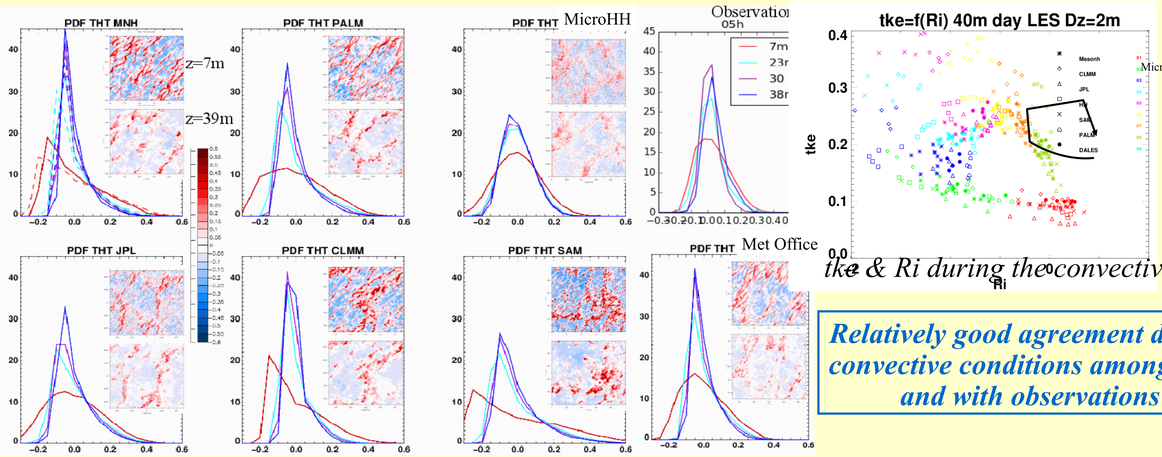
Convective conditions:

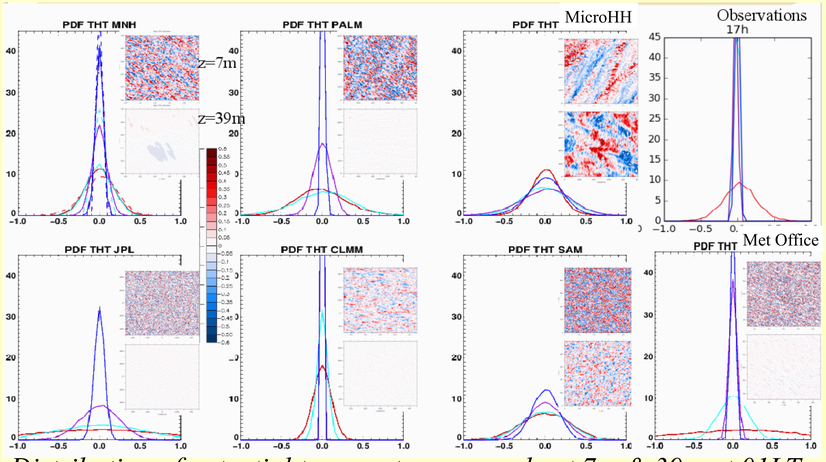


tke & Ri during the convective phase

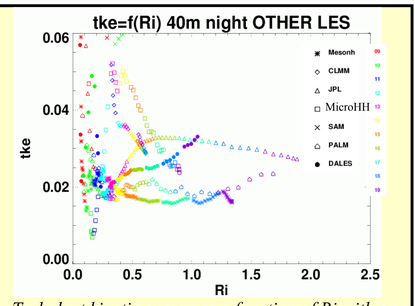
Distribution of potential temperature anomaly at 7m & 39m at 13LT

Relatively good agreement during convective conditions among LES and with observations

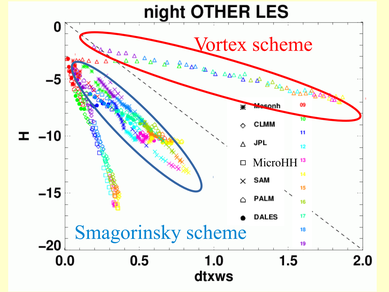
Stable conditions :



Distribution of potential temperature anomaly at 7m & 39m at 01LT



Turbulent kinetic energy as a function of Ri with one color for each hour, one symbol per LES



Sensible heat flux as a function of windspeed and T gradient: the slope being a diagnostic for the drag coefficient

Larger discrepancies during night time in term of distributions, spatial structures, spectra (not shown), Ri exploration.

Analysis of transfer coefficient in order to better understand the spread in surface sensible heat fluxes

For questions please ask:fleur.couvreux@meteo.fr

See also E. Bazile presentation on Friday

References:

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