10th Harmonisation within Atmospheric Dispersion Modelling For Regulatory Purposes

MICRO-METEOROLOGICAL SIMULATIONS OVER THE COASTAL AREA OF MARSEILLE DURING THE ESCOMPTE EXPERIMENT

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Materials & method

ARPS code
(Xue et al. 2000)

SUBMESO

UBL -ESCOMPTE experiment
(June-July 2001-Marseille)

Grid-Nested Method
(Pénelon, 2002)

Validation

Air-sea fluxes calculation

Soil Model SM2-U
(Dupont et Mestayer 2004)

Lateral Boundaries forcing :
3km RAMS model outputs
(LAMP)
+ relaxation zone

Canopy representation :

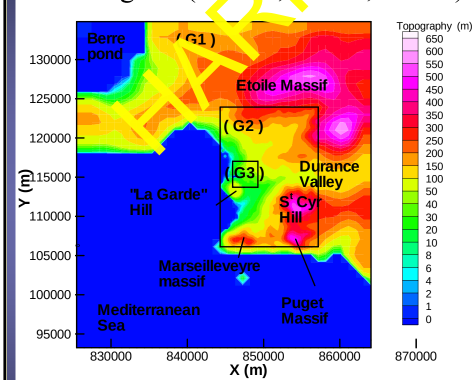
- Urbain : BD-Topo + DF-Map*(Long,2003)* + classification
- Rural : Corine Land Cover

Outline

1. Atmospheric model implementation
2. Air-sea interface fluxes calculation & SST
3. Canopy representation
4. Comparison with measurements during
   UBL - ESCOMPTE
5. Energy budgets on Marseille's districts
6. Flow analysis on June, 24th and June, 25th and urban effect
7. Conclusions & Future work

Atmospheric model implementation

3 nested grids (990 m, 330 m, 110 m)



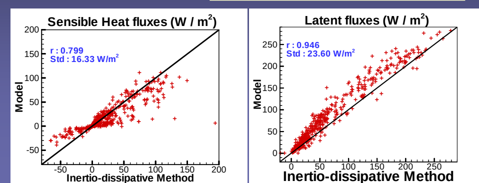
- Lateral boundaries forcing : hourly RAMS 3km outputs

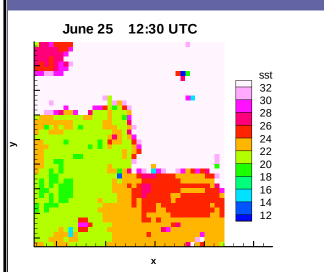
G	G1	G2	G3
Δx	990 m	330m	110m
nx×ny	41×44	41×56	32×32
Δt	0.9 s	0.3 s	0.1 s
Δt aco	0.03 s	0.03 s	0.01 s

- 41 vertical levels (22 / first 1500m)
- 1st vertical level : 15 m
- "Rayleigh" layer at 5600 m
- Topography : IGN
- Initialisation at 0:0 UTC with RAMS variables

Air-Sea fluxes

- Iterativ method based on LKB theory *(1979)*
- Aerodynamic roughness : *Smith 1988* → $z_0 = a_c \frac{u_*^2}{g} + 0.11 \times \frac{\upsilon}{u_*}$
- Stability functions :
  - stable : *Geerneart 1990*
  - unstable : *Fairall 1996 :* classic+ convective range
- Validated with the FETCH experiment (Mediterranean sea)





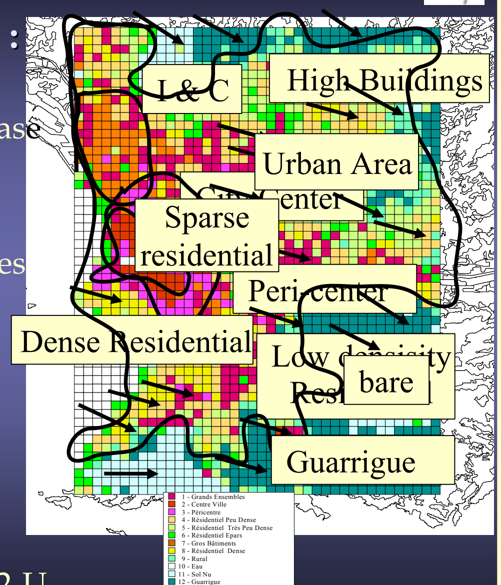
T radiative AVHRR (resolution :1.1km) — *algo. Mc Clain* → SST (1 or 2 im/day)

+ Diurnal amplitude: *f(U,Rns)*
(Clayson & Curry formulae, 1996)

Canopy representation (1)

Marseille urban fabric (G2) :

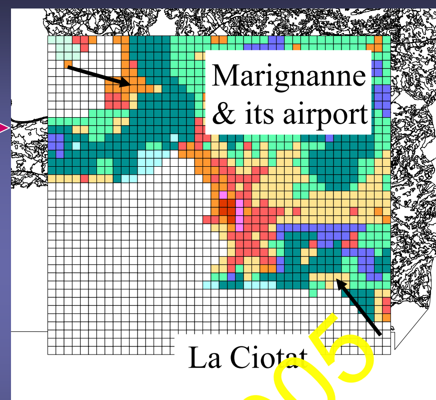
- Urban classification at 330m :
  - With BD Topo (IGN) database : parameters in each cell
  - k-means method
- 2 rural classes + 9 urban classes
- Aerial photos :
  - + 1class : Industrial & Commercial *(different material)*
  - Completing to have 100%
- For each class : parameters averaged to be entered in SM2-U

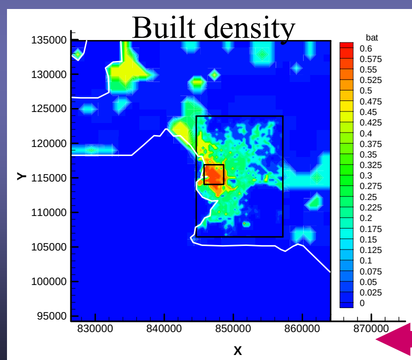


Canopy representation (2)

Around Marseille (G1) :

- Database *Corine Land Cover*
- Continuous, put on a grid





For the soil model

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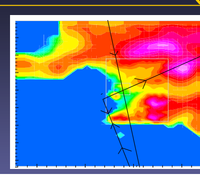
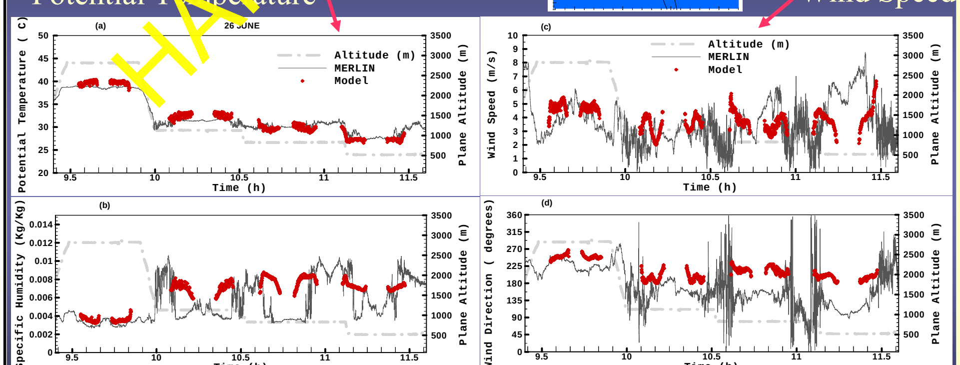
Aircraft measurements (1)

MERLIN: flight UBL (June 26th) just before noon



Potential Temperature

Wind Speed



Specific Humidity

Wind Direction

➢ Good agreement for θ, correct for wind speed & direction, correct for Qv (complex situation)

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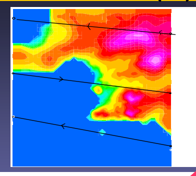
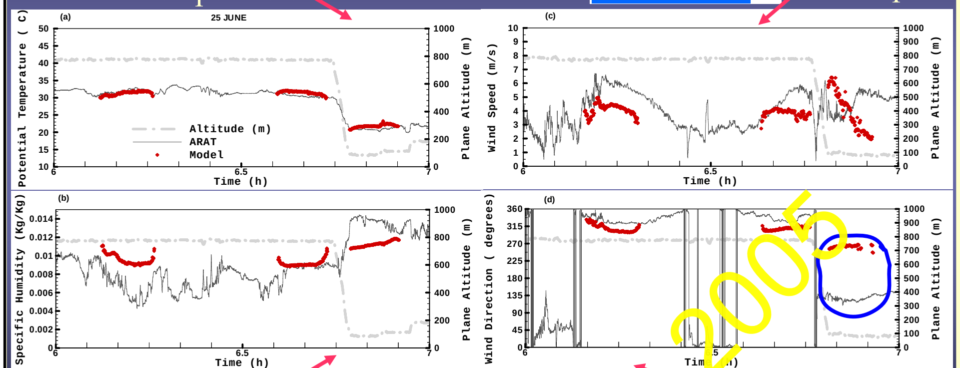
Aircraft measurements (2)

ARAT : flight Exploration (June 25th) early morning



Potential Temperature

Wind Speed

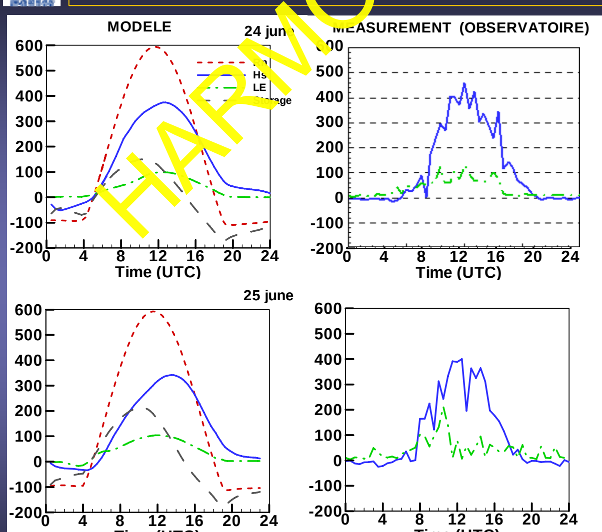


Specific Humidity

Wind Direction

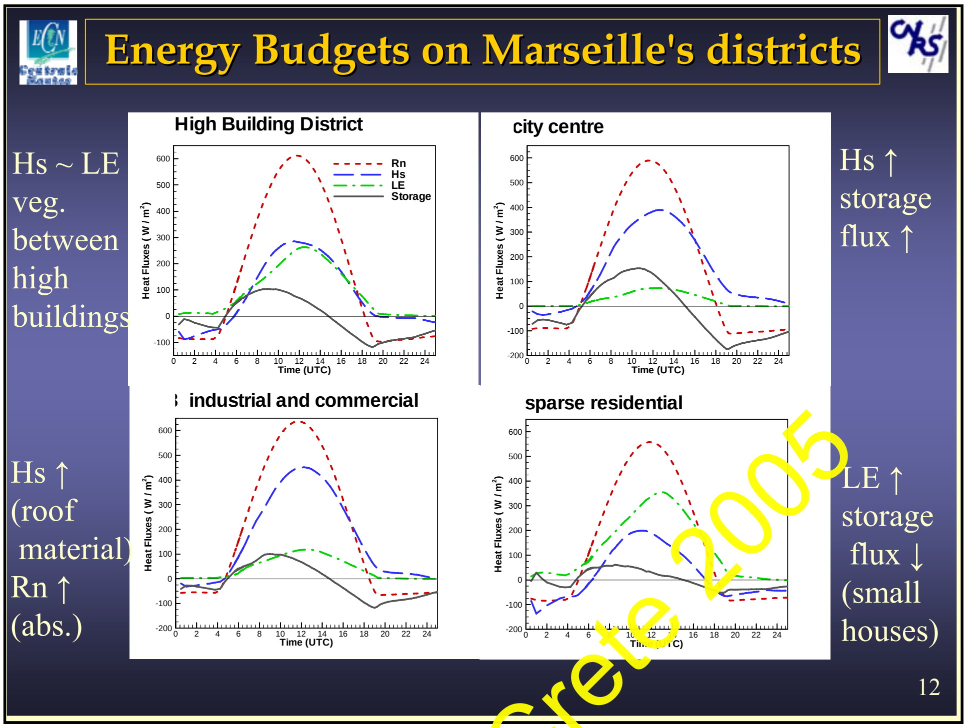
- ➢ Good agreement for θ, Qv , correct for wind speed
- ➢ Problem at low level for wind direction (W air mass seen too low)

Comparison with fluxes Measurements



5 stations for fluxes measurements

- ➢ Good agreement for Hs
- ➢ Less disturbances in the
- ➢ Earlier Max measured for LE


Energy Budgets on Marseille's districts
High Building District
city centre
industrial and commercial
sparse residential
Rn
Hs
LE
Storage
Heat Fluxes (W / m²)
Time (UTC)
Hs ~ LE
veg.
between
high
buildings
Hs ↑
storage
flux ↑
Hs ↑
(roof
material)
Rn ↑
(abs.)
LE ↑
storage
flux ↓
(small
houses)
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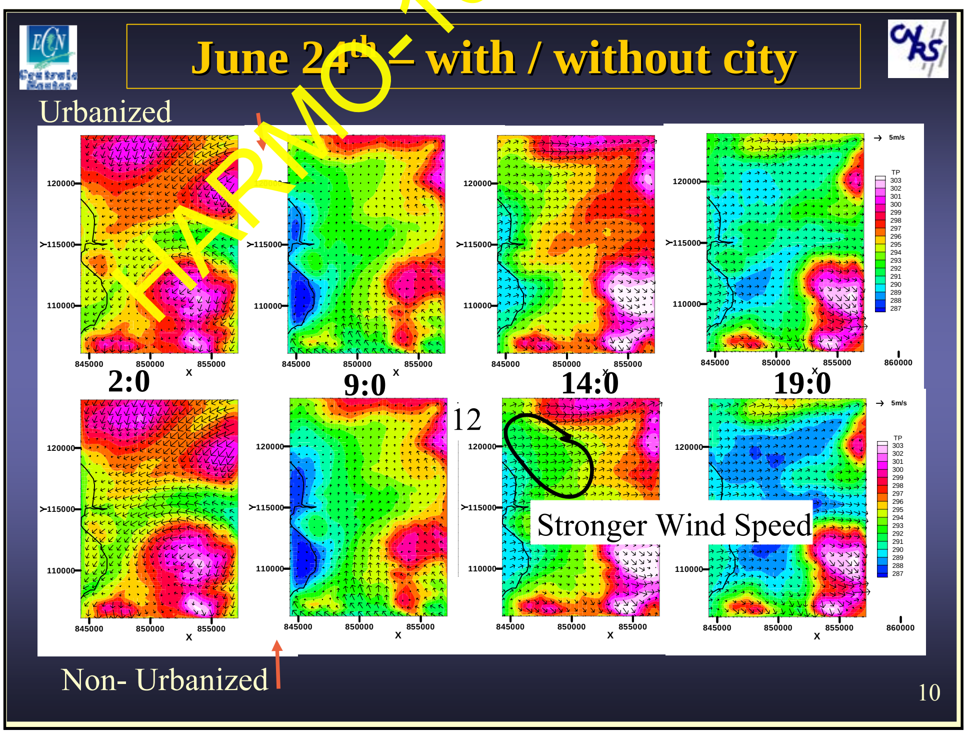
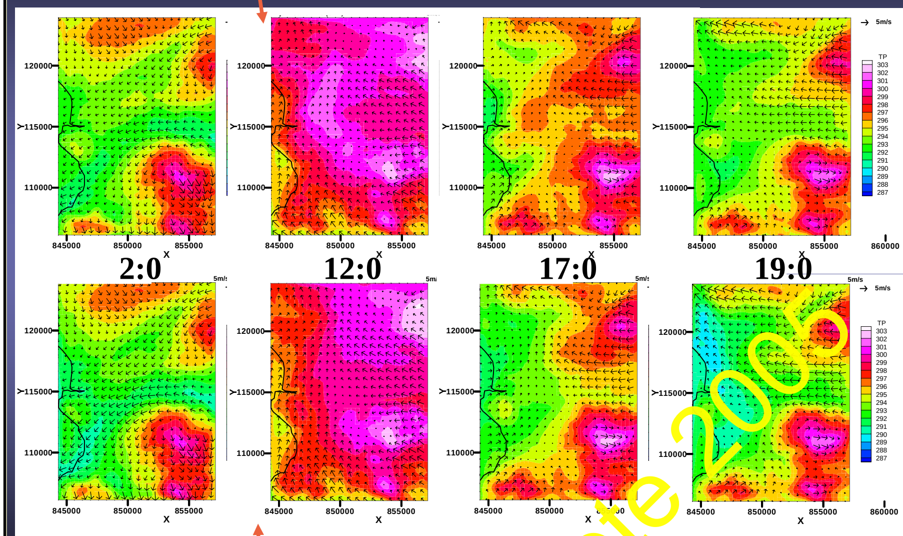

June 24th – with / without city
Urbanized
2:0
9:0
14:0
19:0
12
Stronger Wind Speed
Non- Urbanized
5m/s
TP
10

June 25th – with / without city

Urbanized



Non- Urbanized

➢ Evidence of urban effect on

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Conclusions & future work

✔ Simulations performed on the complex site of Marseille agglomeration, with accurate description of :

- Topography,
- canopy cover modes, streets morphology
- Air-sea interface fluxes

✔ First validation of the couple SUBMESO-SM2-U on a real case, during the UBL-ESCOMPTE experiment

✔ Study of districts energy budgets differences

✔ The urban presence has a clear effect on the flow even the sea proximity attenuate its effect

Next....

➔ Turbulence analysis on G1 (Large Eddy Simulation)

➔ Sensitivity study to topography...

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