Modelling the Thau lagoon in southern France with FLake model : first results

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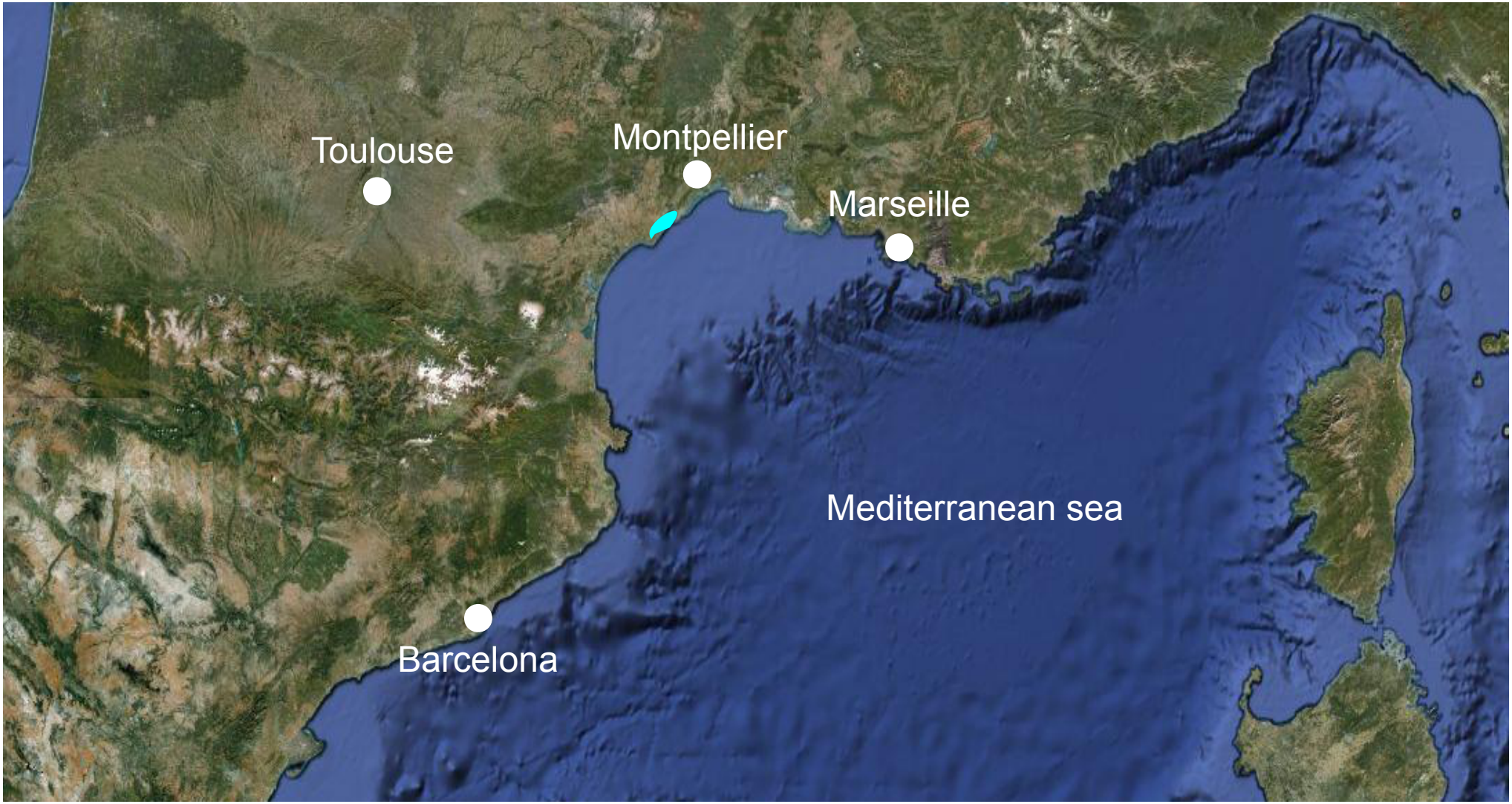
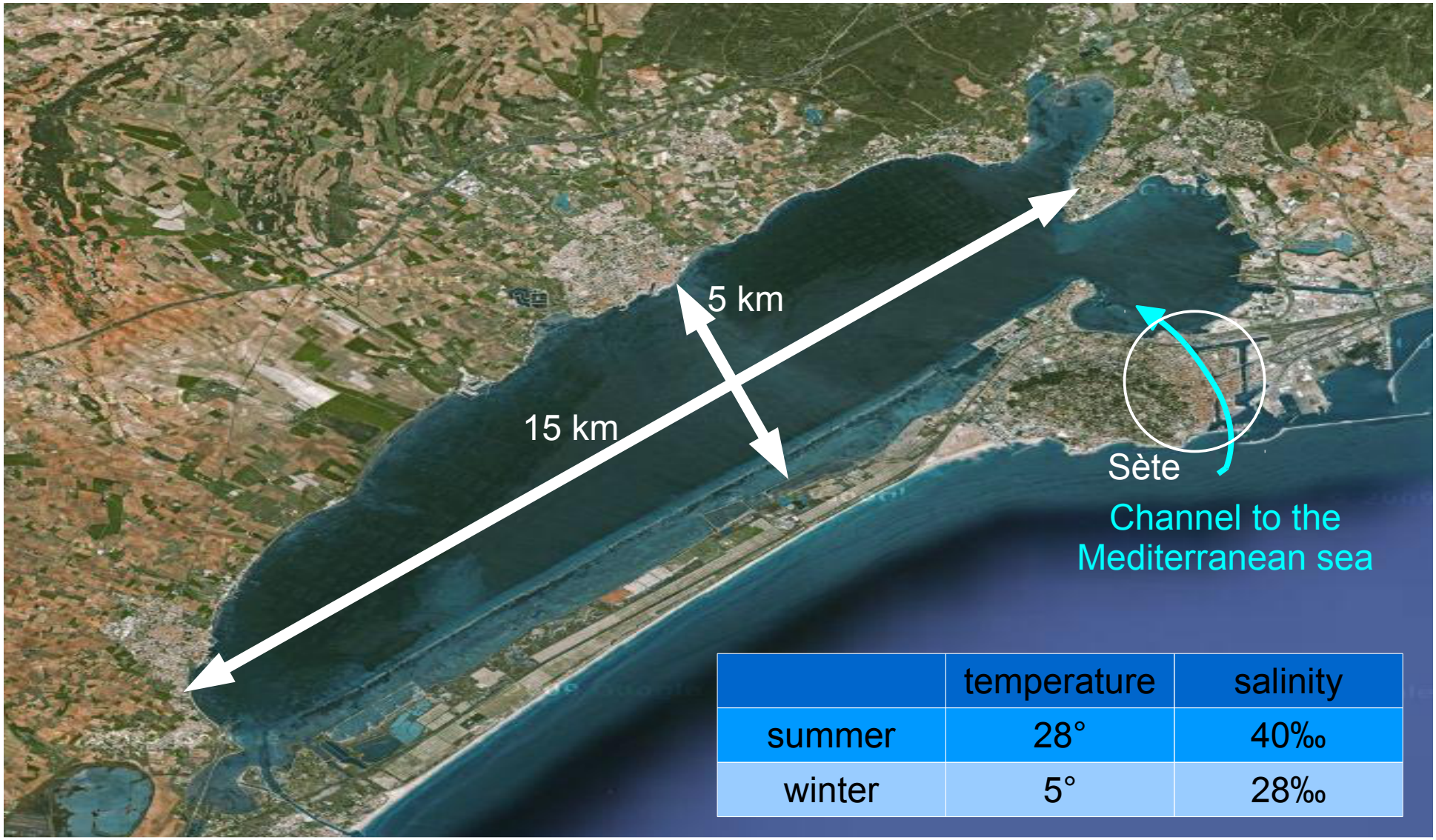
2. FLake forced by observations
3. FLake coupled to Meso-NH model
4. Conclusions and perspectives

THAU lagoon

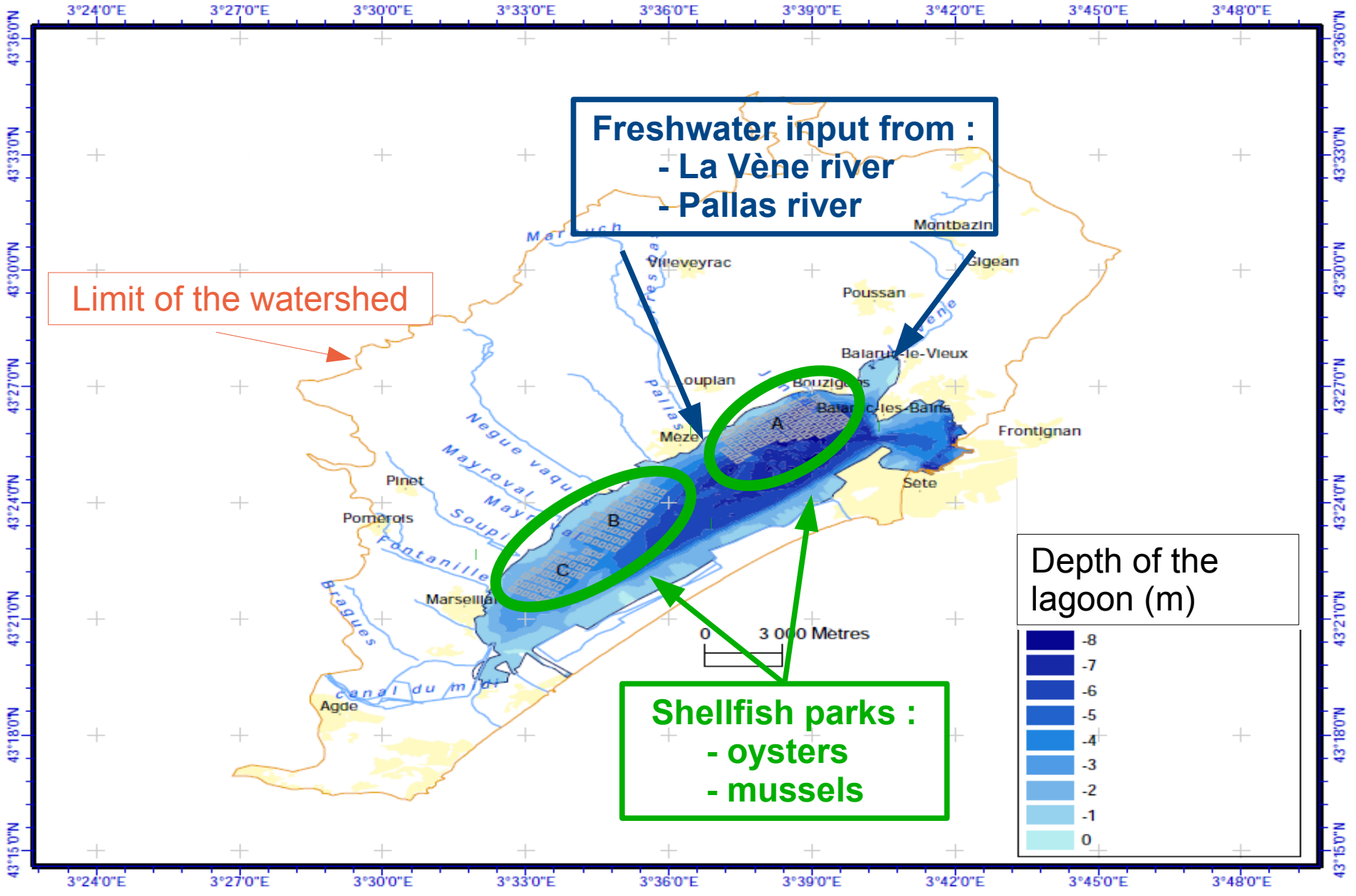

Toulouse
Montpellier
Marseille
Mediterranean sea
Barcelona

THAU lagoon : ~ 75 km2



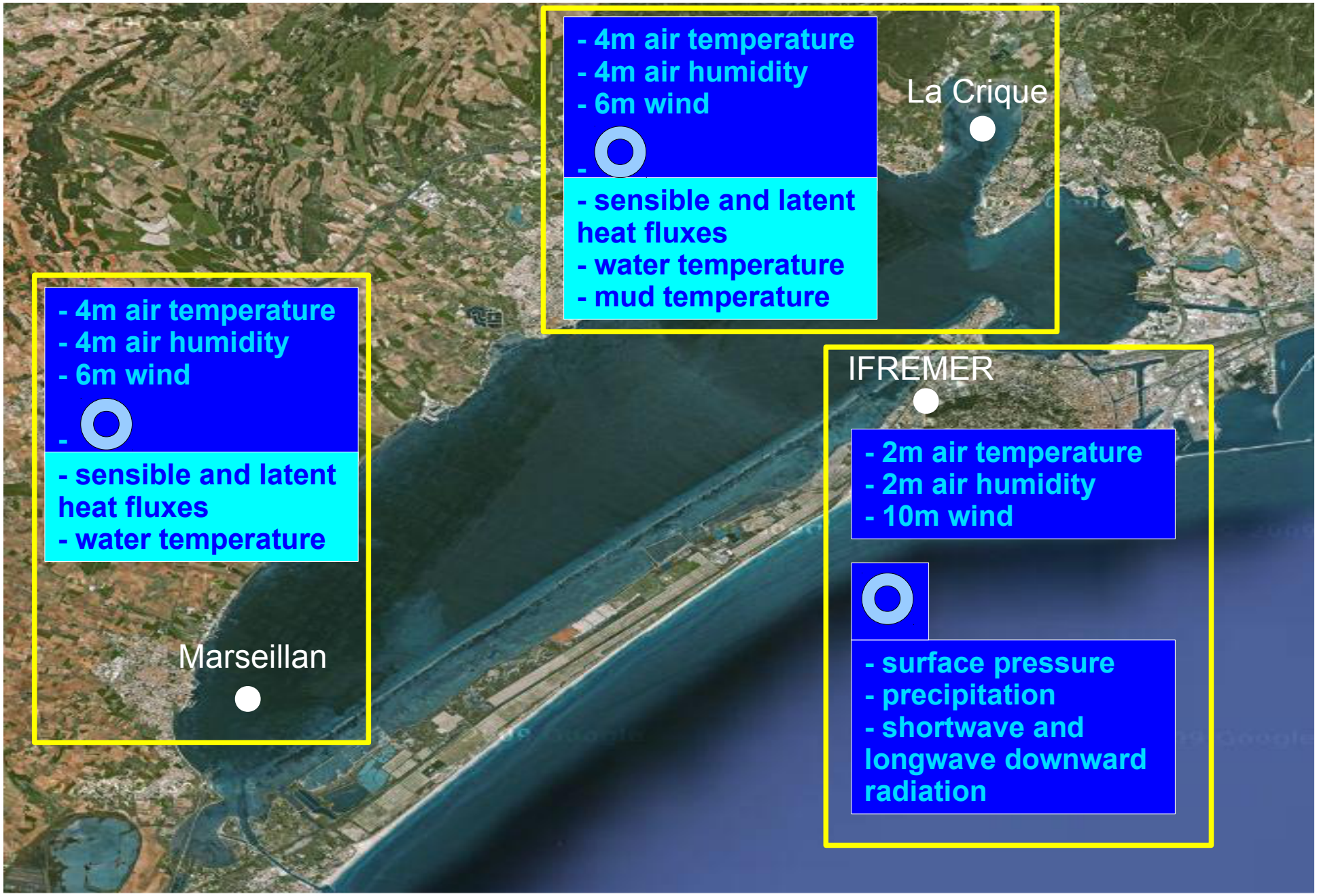
	temperature	salinity
summer	28°	40‰
winter	5°	28‰

THAU lagoon :


Freshwater input from :
- La Vène river
- Pallas river
Limit of the watershed
Shellfish parks :
- oysters
- mussels
Depth of the lagoon (m)
-8
-7
-6
-5
-4
-3
-2
-1
0
A
B
C
Montbazin
Villeveyrac
Gigean
Poussan
Balaruc-le-Vieux
Bouzigues
Balaruc-les-Bains
Frontignan
Sète
Mèze
Loupian
Pinet
Pomérols
Marseillan
Agde
Pallas
Mayroval
Soupié
Fontanille
Bragues
canal du midi
0
3 000 Metres
3°24'0"E
3°27'0"E
3°30'0"E
3°33'0"E
3°36'0"E
3°39'0"E
3°42'0"E
3°45'0"E
3°48'0"E
43°36'0"N
43°33'0"N
43°30'0"N
43°27'0"N
43°24'0"N
43°21'0"N
43°18'0"N
43°15'0"N

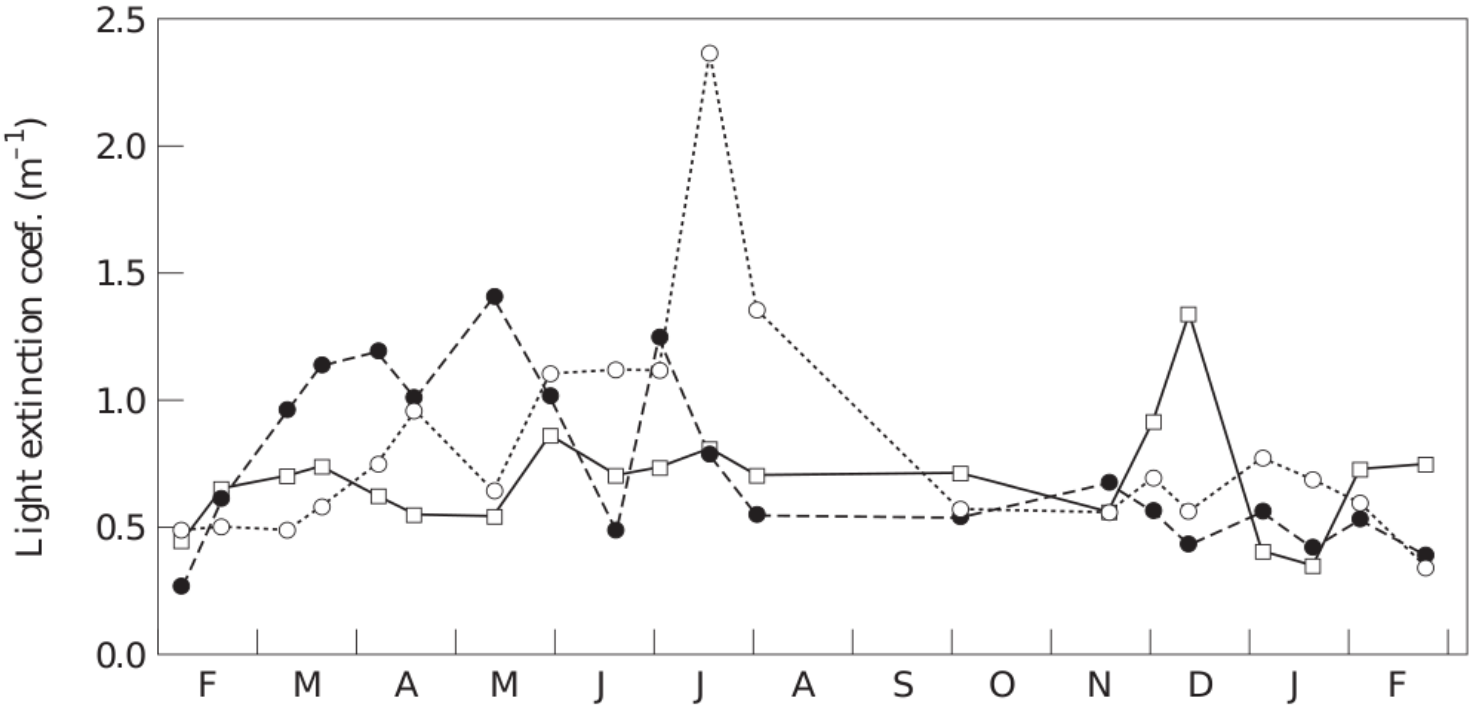
Measurements :

Every ½ hour from November 2008 to July 2009



FLake forced by observations

- What are the best depth and light extinction coefficient for Thau lagoon ?
  - From literature : mean depth = 4m and extinction coefficient ranges between 0.5 to 1.5 depending on the location and the month :

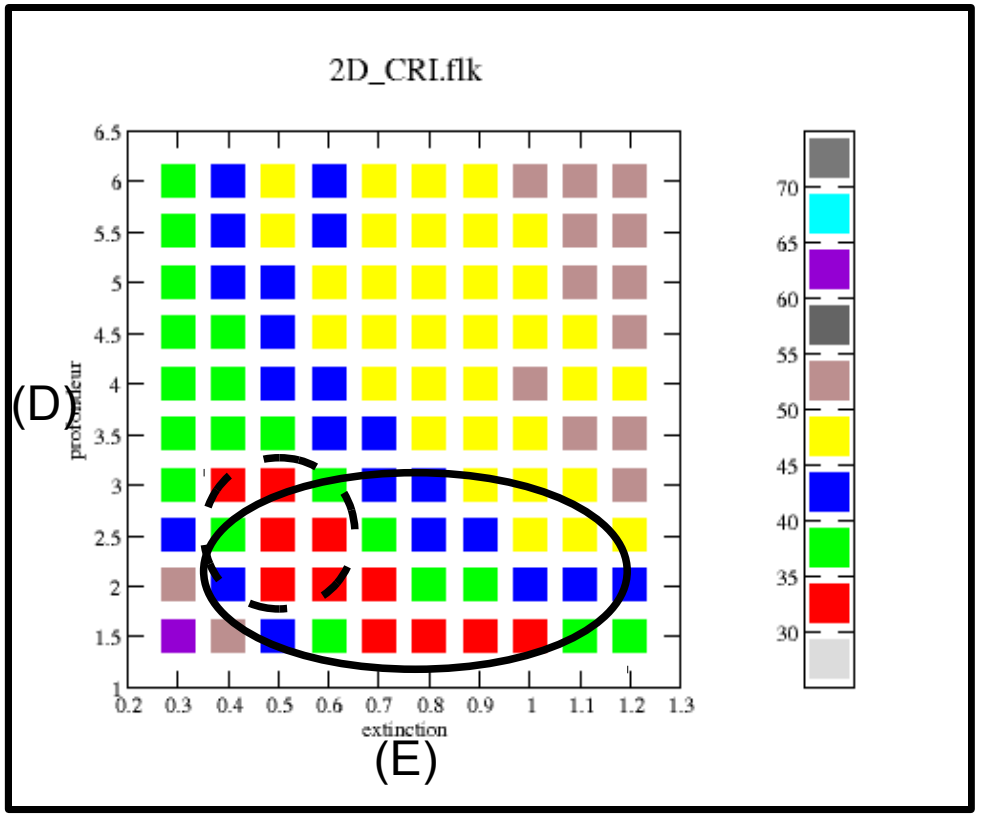


- Optimisation of depth (D) and light extinction coefficient (E) to minimise RMSE for water temperature and bulk surface heat flux (H+LE)
  - Applied between 11/2008 and 07/2009
    - for 2 models :
      - FLake with FLake fluxes (FLK)
      - FLake with Surfex fluxes (SFX)
    - at the 2 sites (CRI) and (MAR)
  - Offline simulations (100 runs) where
    - (D) ranges from 1m to 6.5m every 50cm
    - (E) ranges from 0.2 to 1.3 every 0.1m^{-1}
  - Computation and search for optimum values of
    - RMSE (TS_model – TS_obs)
    - RMSE ((H+LE)_model – (H+LE)_bulk)

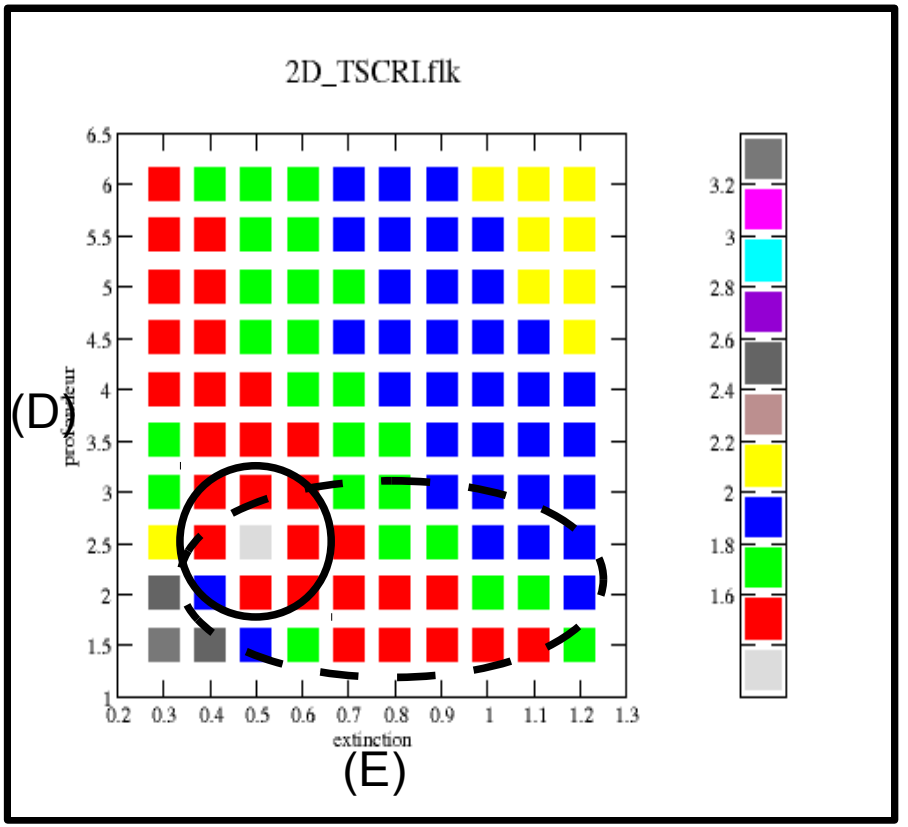
Results of the minimisation

Site : CRI Model : FLK

H+LE



Ts



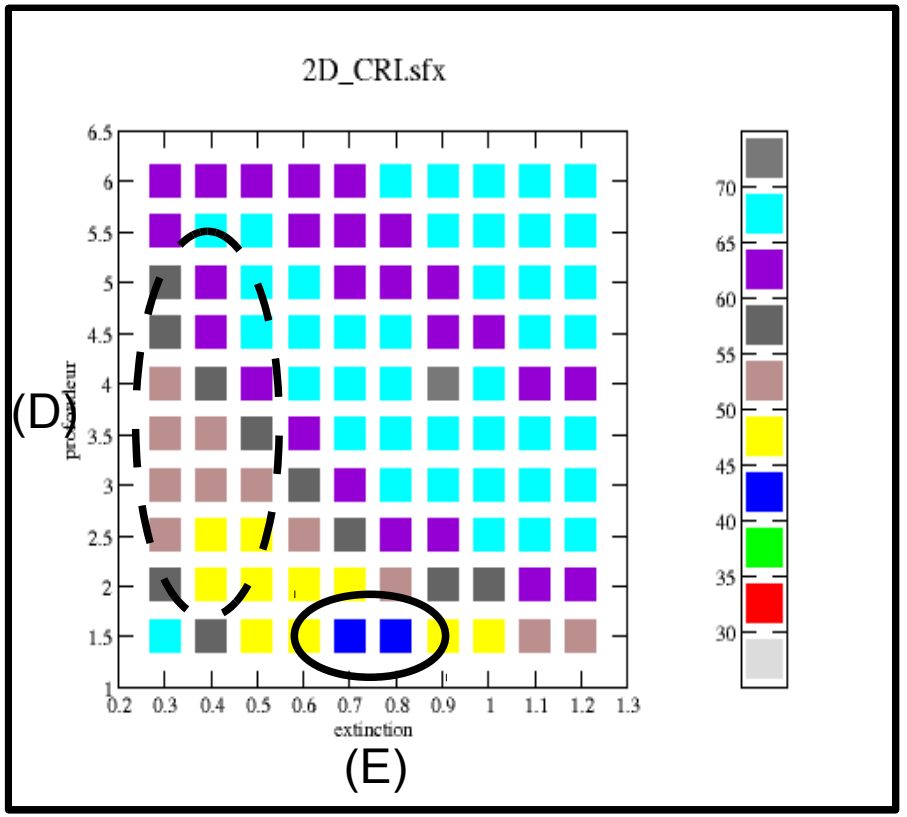
Optimum : D=2.5m E=0.5m^{-1}

RMSE(H+LE)=35W/m^2
RMSE(Ts)=1.4K

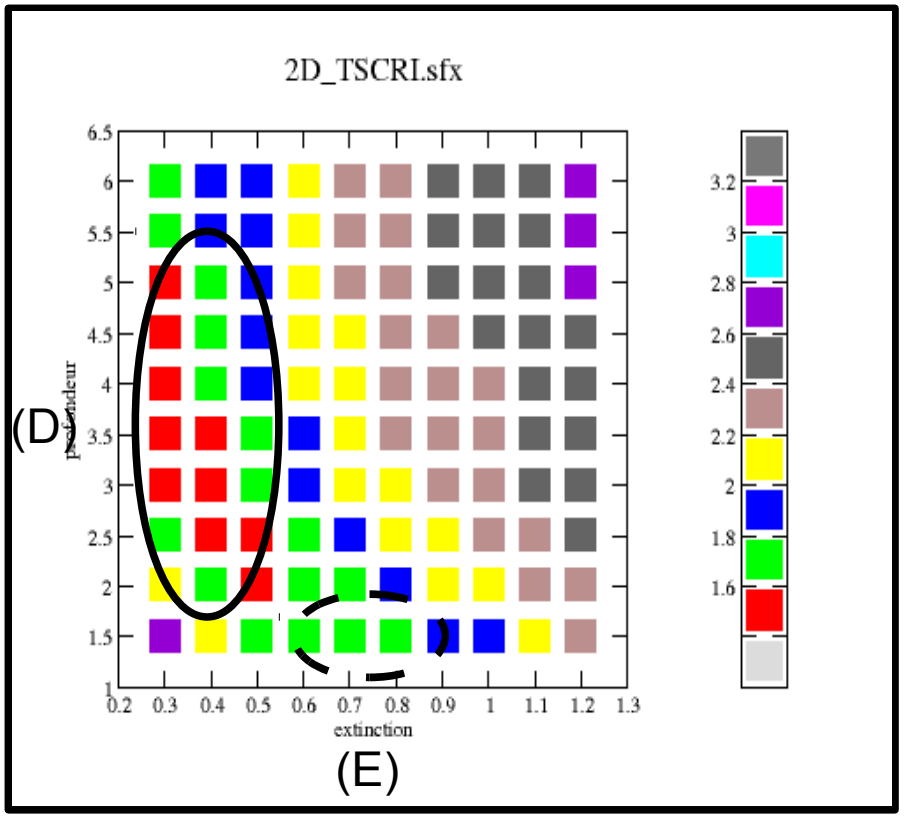
Results of the minimisation : RMSE

Site : CRI Model : SFX

H+LE



Ts



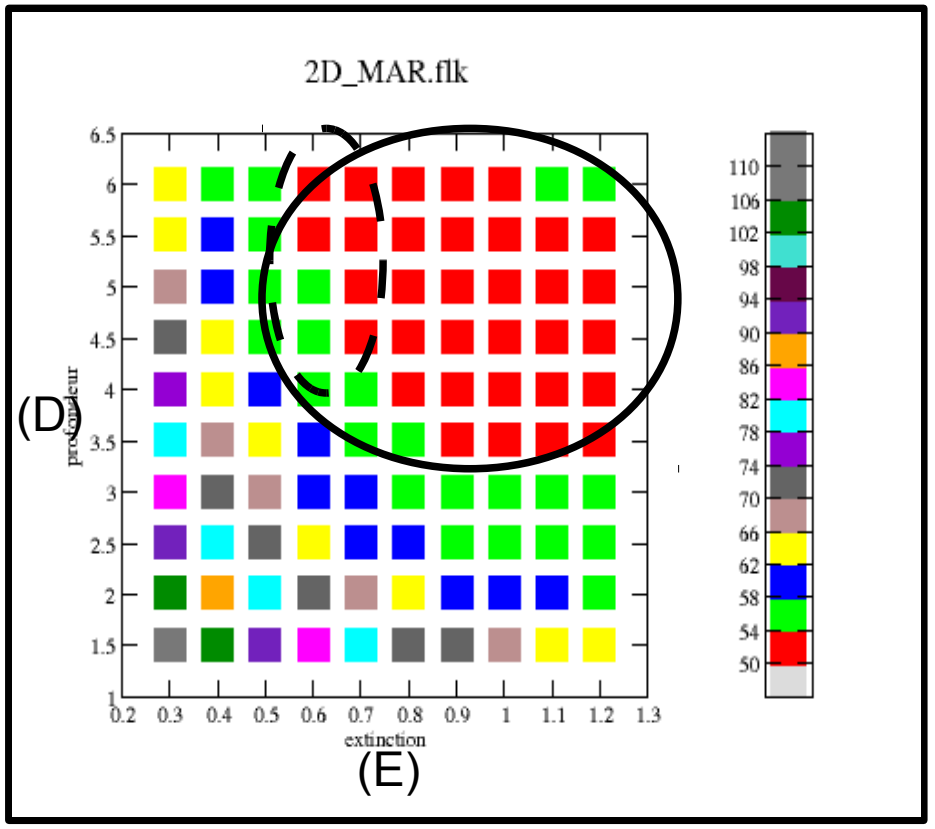
For: D=2.5m E=0.5m^{-1}

RMSE(H+LE)=50W/m^2
RMSE(Ts)=1.6K

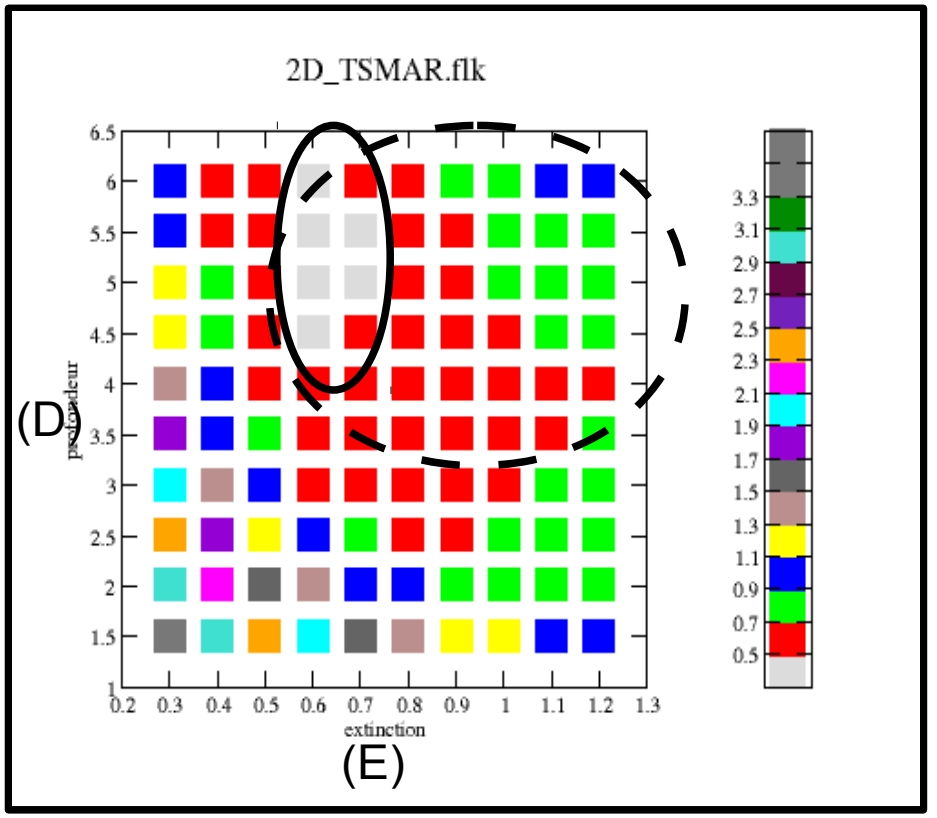
Results of the minimisation

Site : MAR Model : FLK

H+LE



Ts



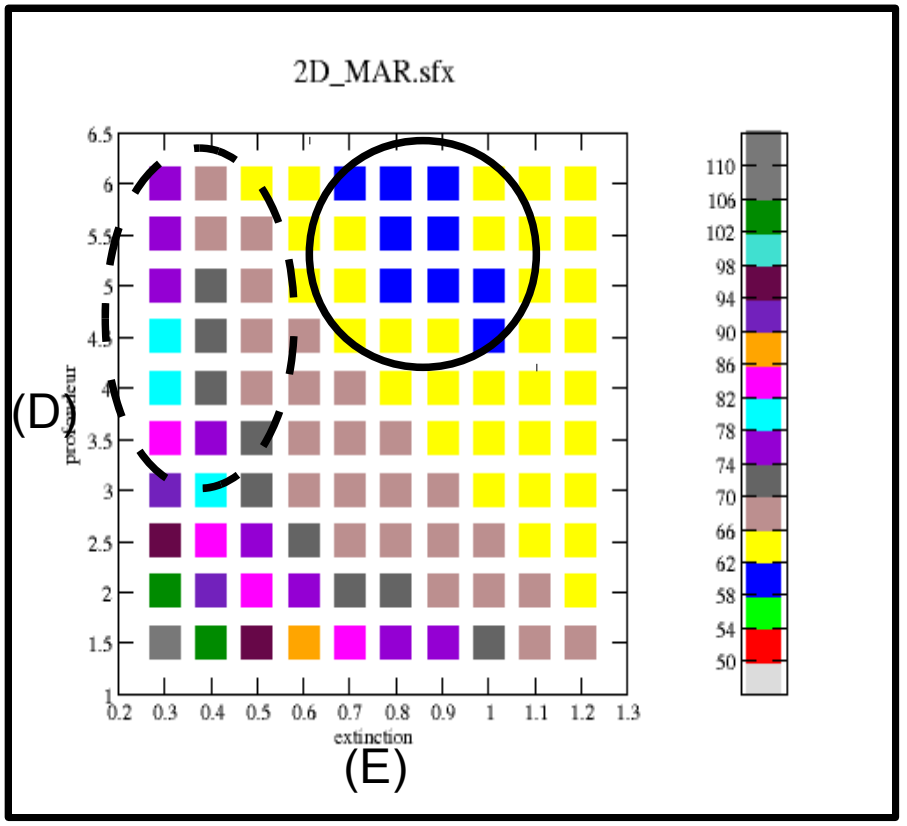
Optimum : D=5.5m E=0.7m^{-1}

RMSE(H+LE)=54W/m^2
RMSE(Ts)=0.5K

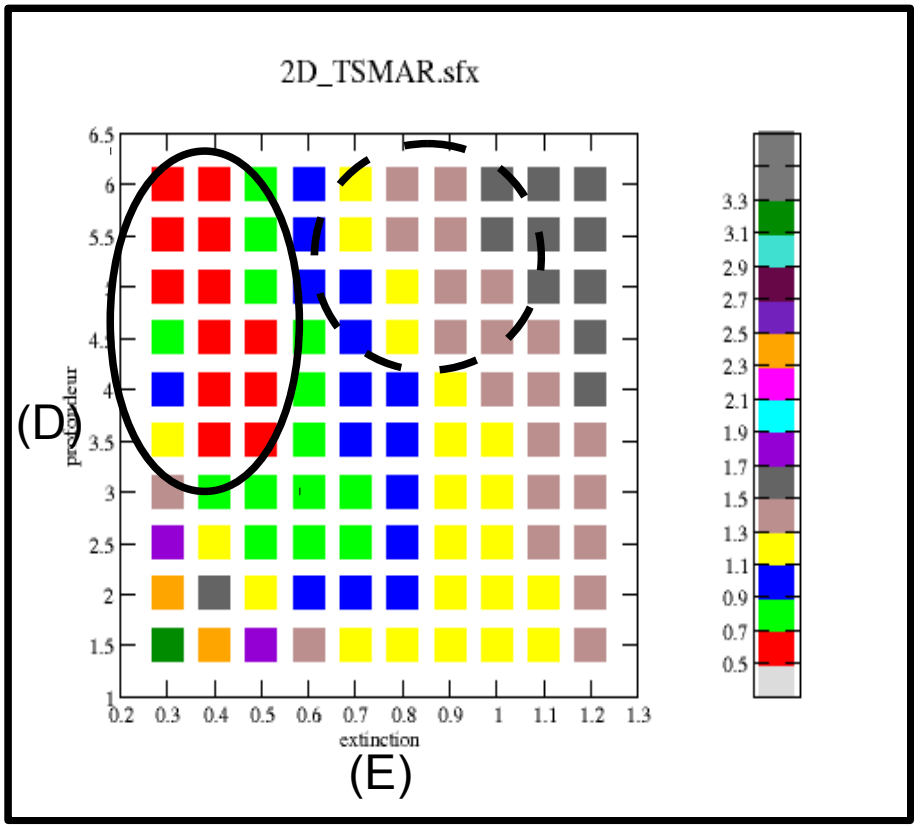
Results of the minimisation

Site : MAR Model : SFX

H+LE



Ts



For: D=5.5m E=0.7m^{-1}

RMSE(H+LE)=66W/m^2
RMSE(Ts)=1.3K

Conclusions of the minimisation

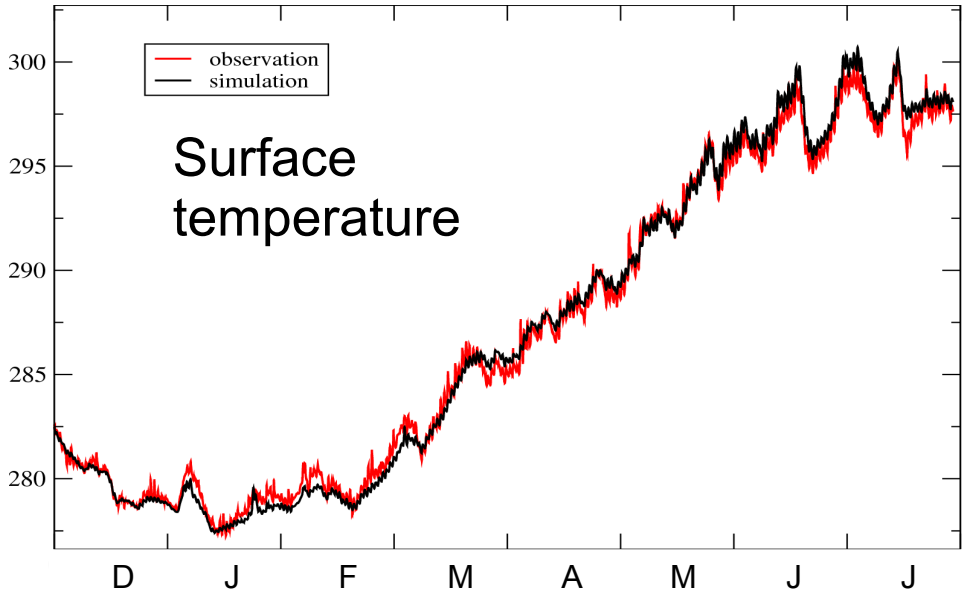
- FLK model optimizes at the same time Ts and total surface H+LE flux
- SFX doesn't
- FLK RMSEs are smaller than SFX RMSEs
- CRI results are worse than MAR's :
  - Measurement problems at CRI during spring and summer : « diving » probes
  - Site influenced by karstic underwater source, by tides and freshwater input from La Vène river

- Use of FLK recommanded within Surfex framework instead of SFX

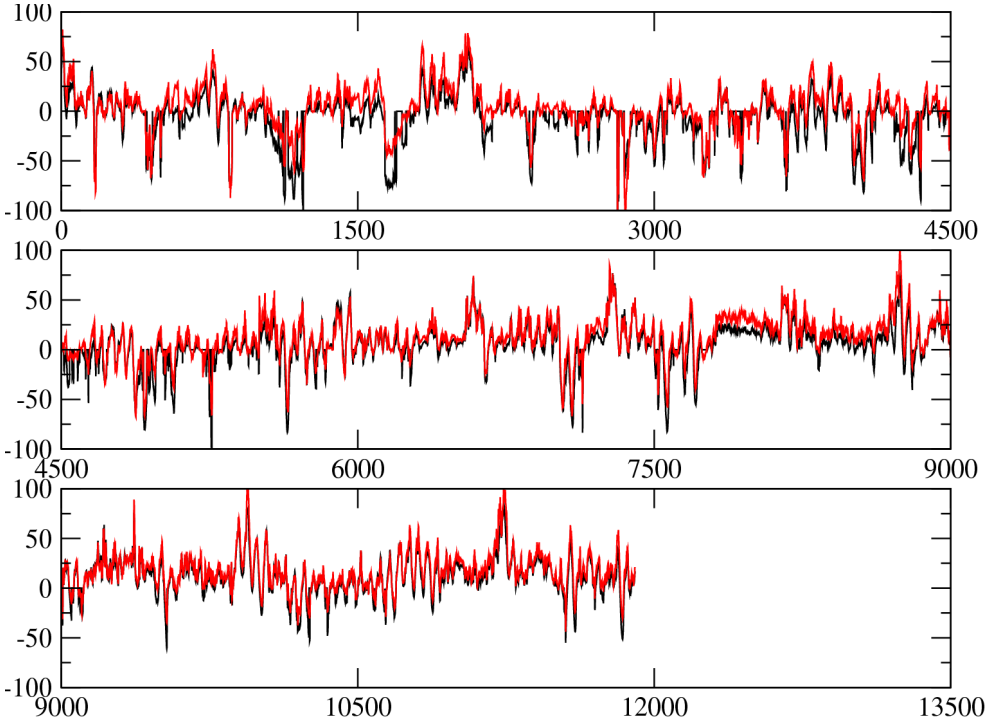
- (D) = 5.5m and (E) = $0.7m^{-1}$ at MAR site
- (D) = 2.5m and (E) = $0.5m^{-1}$ at CRI site

- Optimized (D) fits the real experimental depth

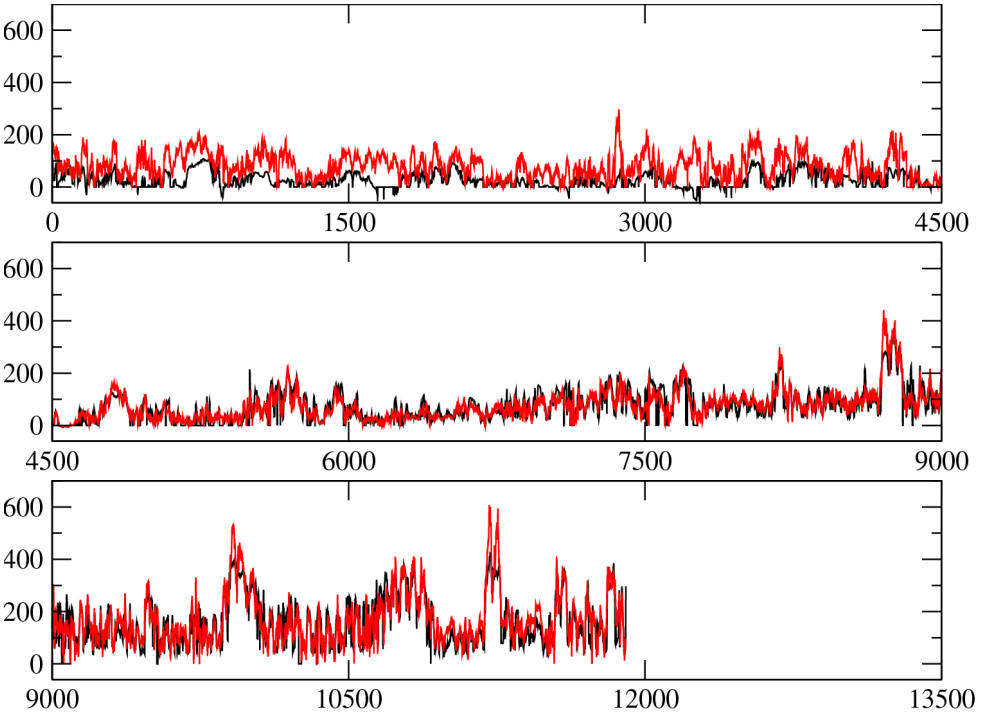
Model results at Marseillan :



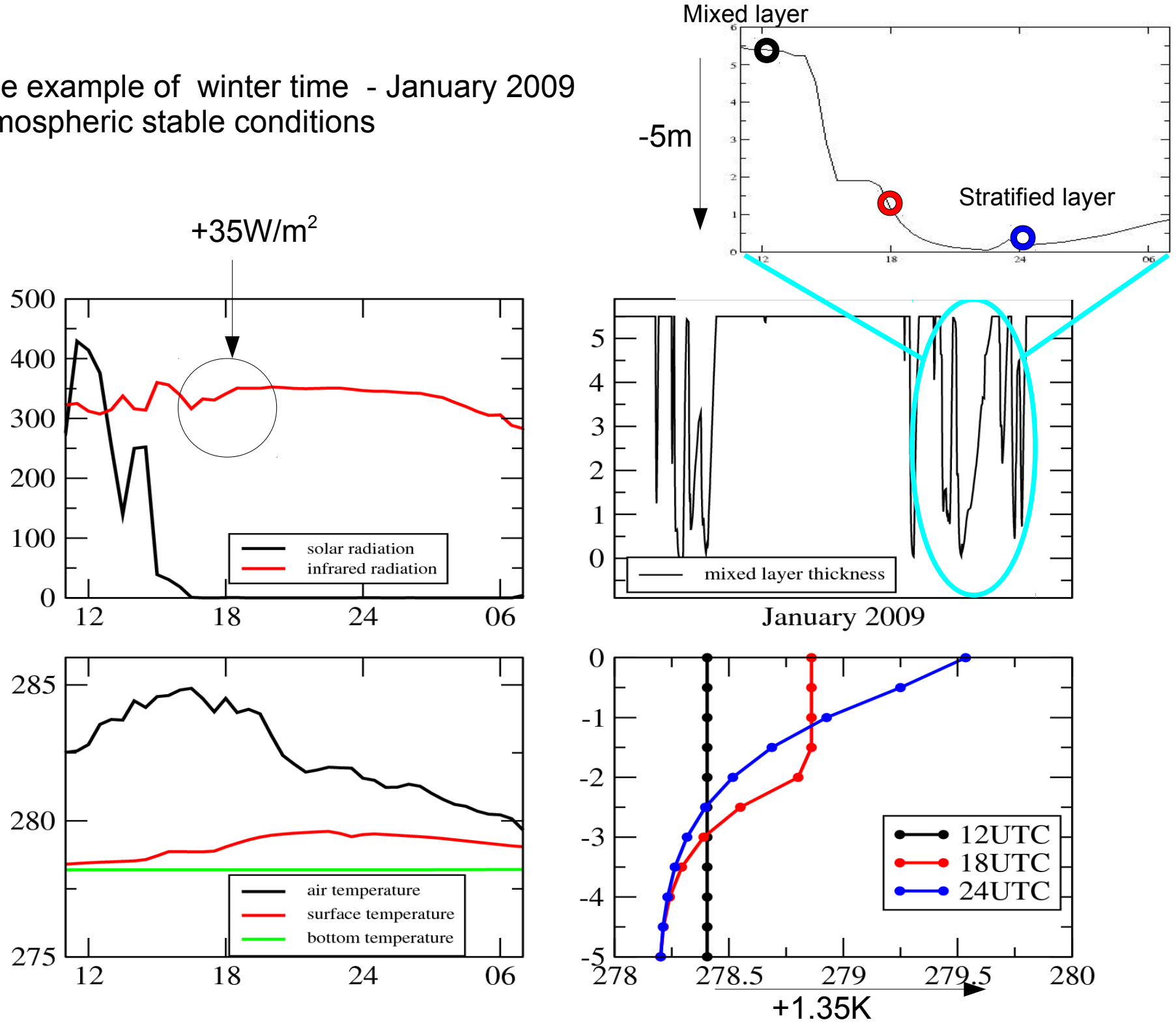
Sensible heat flux



Latent heat flux



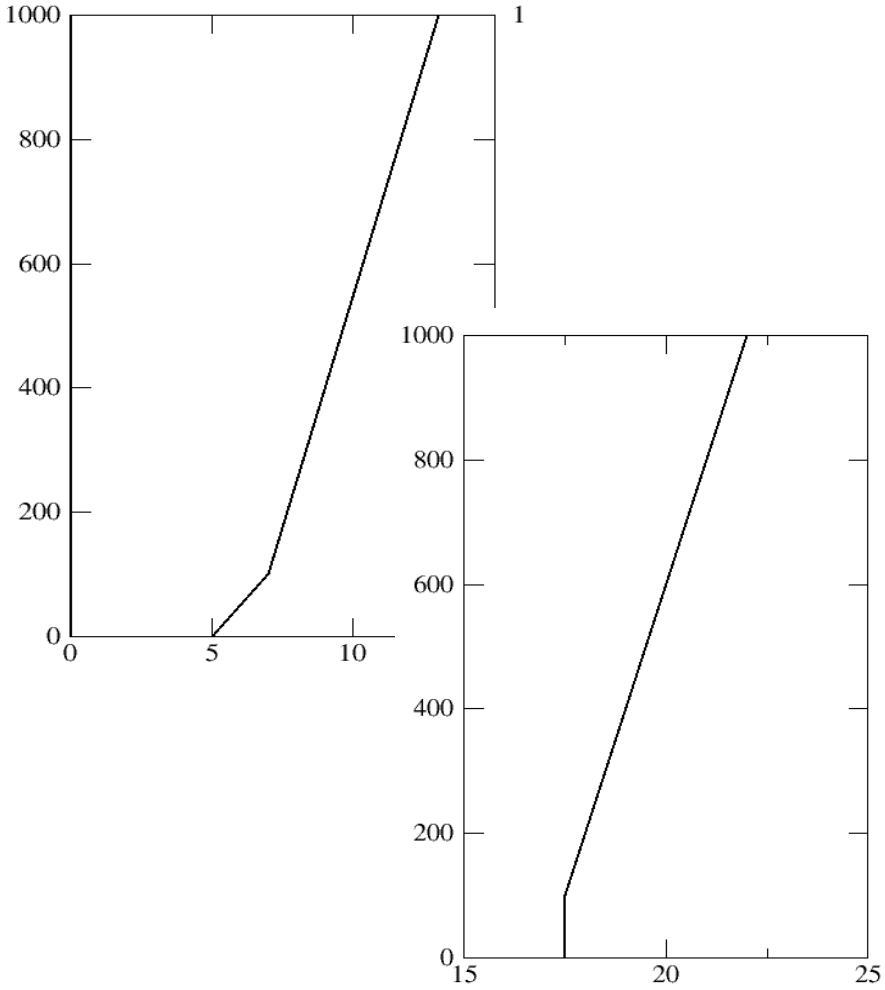
One example of winter time - January 2009
Atmospheric stable conditions



FLake coupled to 1D Meso-NH model

- Location : Marseillan site (MAR)
- 48 hours simulation (May)
  - Evaluate model behaviour
  - Test of model configurations : FLK, SFX, WAT

- Idealized initialization of theta and wind profiles



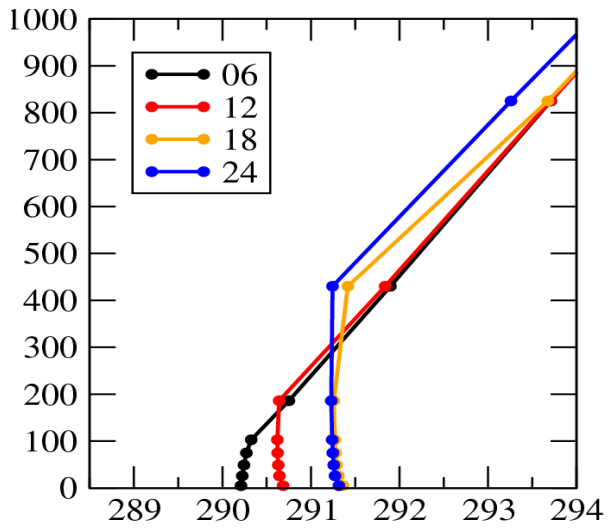
Sensitivity to model surface flux computation

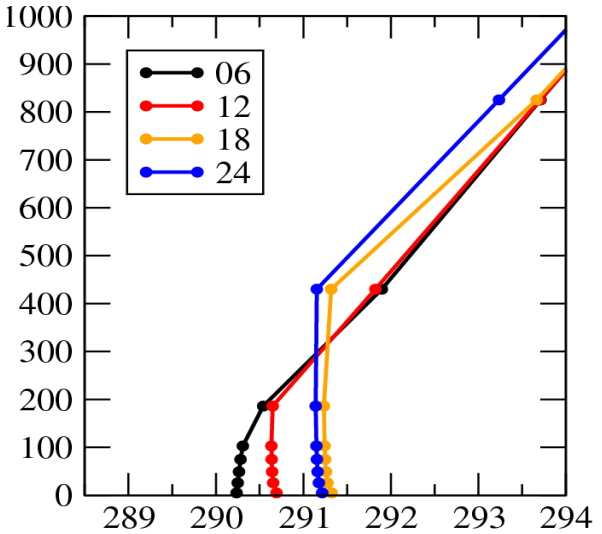
SFX

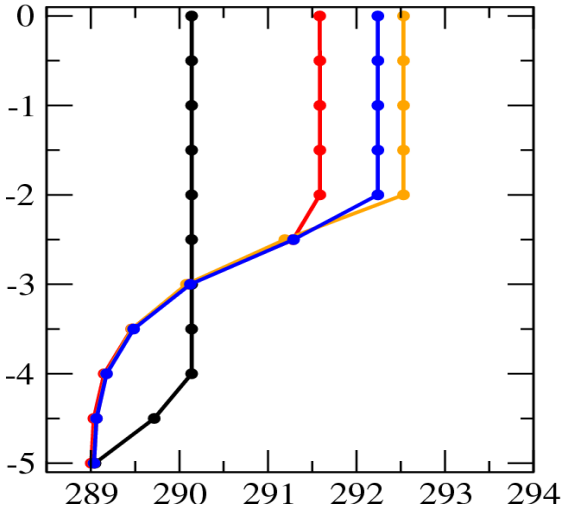
FLK

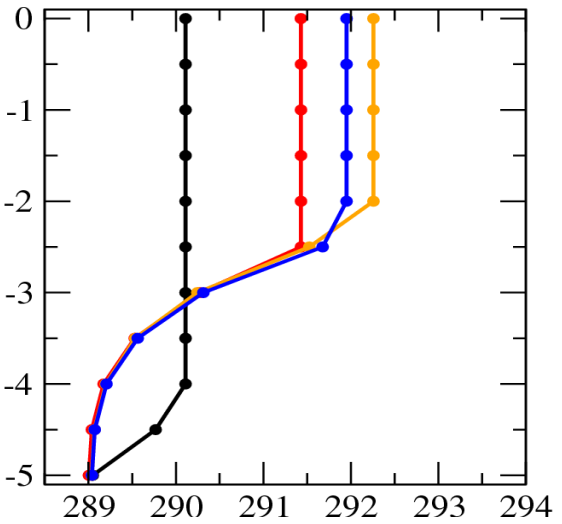
THETA

Water T





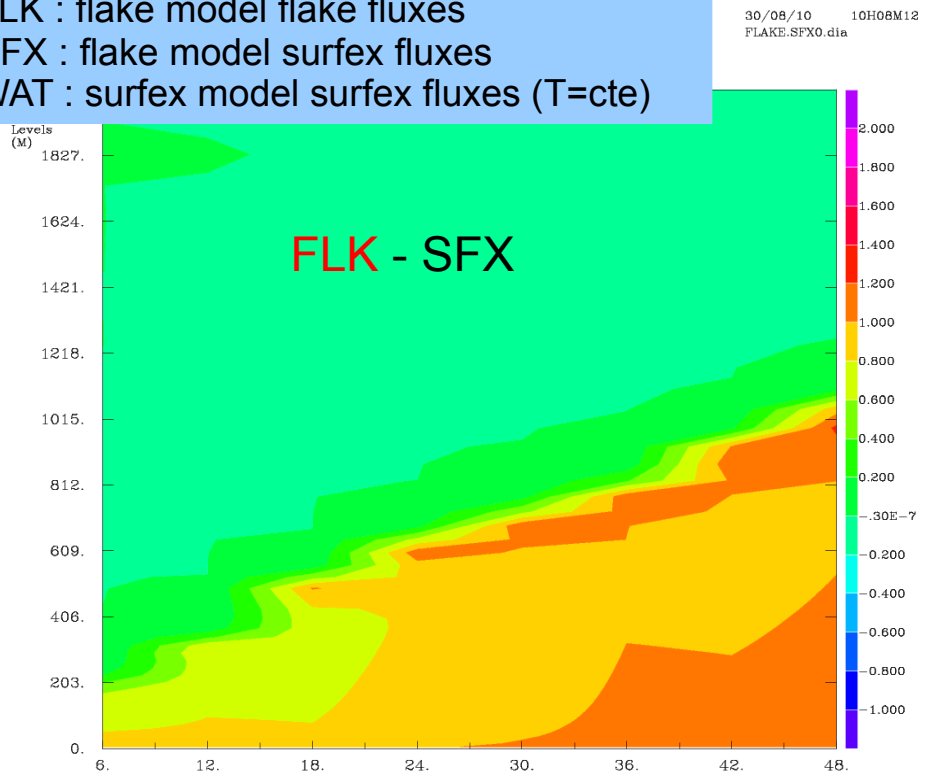




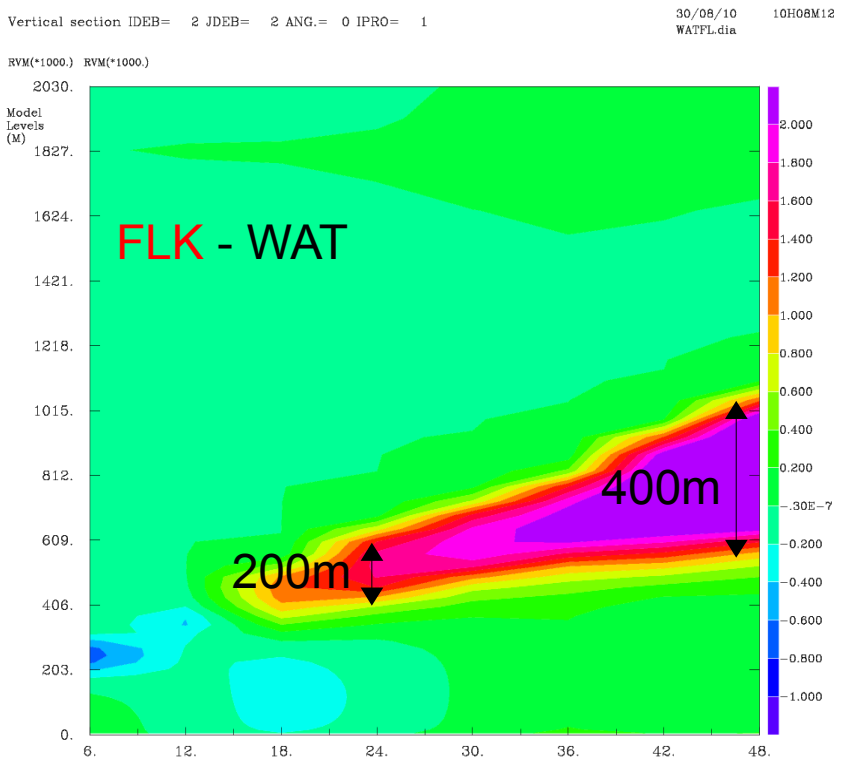
Small impact on temperature profile :

FLK colder than SFX due to stronger surface fluxes

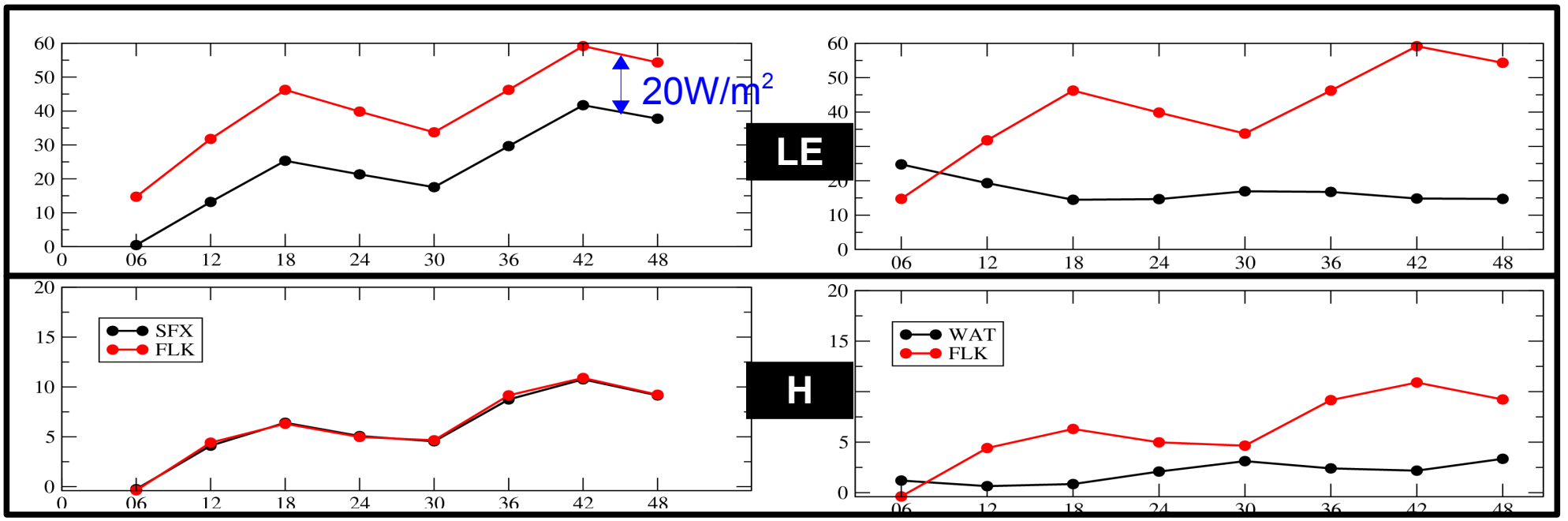
FLK : flake model flake fluxes
SFX : flake model surfex fluxes
WAT : surfex model surfex fluxes (T=cte)



Mixing ratio



Mixing ratio



Conclusions

- Optimized depth (D) corresponds to the real depth measured at the experimental sites
- At (CRI) and (MAR), optimized (E) are close to $0.5m^{-1}$
- Both (D) and (E) are crucial for shallow lakes
- At (MAR), both Ts and (H+LE) are optimized with FLK model configuration
- Use of FLake with its own fluxes are recommanded

- Boundary layer height impacted when using FLK rather than WATFLX : 200m after 24h run

Perspectives

- Extend the study : measurements available from November 2008 until August 2010
- Use EC fluxes for comparison
- Prepare THAUMEX field experiment at Marseillan in summer 2011 (1 month)
  - Temperature profile measurement
  - Mud temperature (sediment module)
  - Turbidity measurement
  - Radio-soundings on request to document the upper-air part and especially the lower layers


Thanks for your attention !

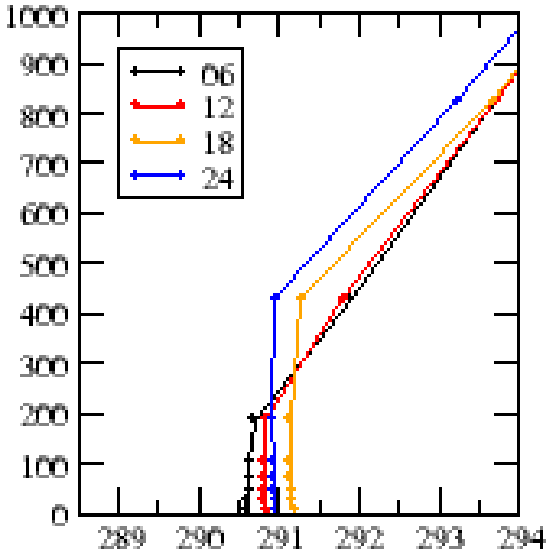
Sensitivity to initial water stratification

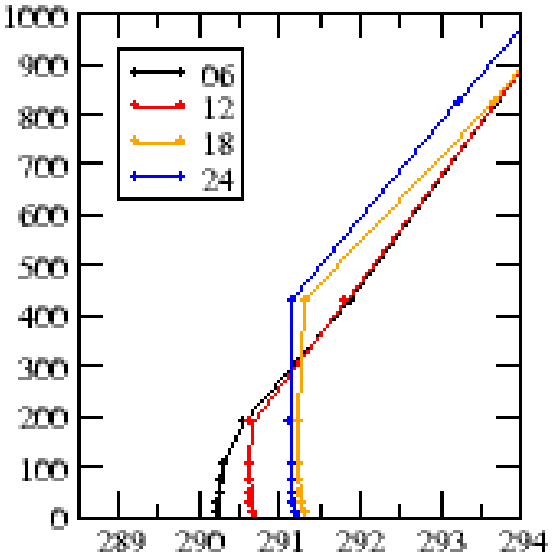
ST1m

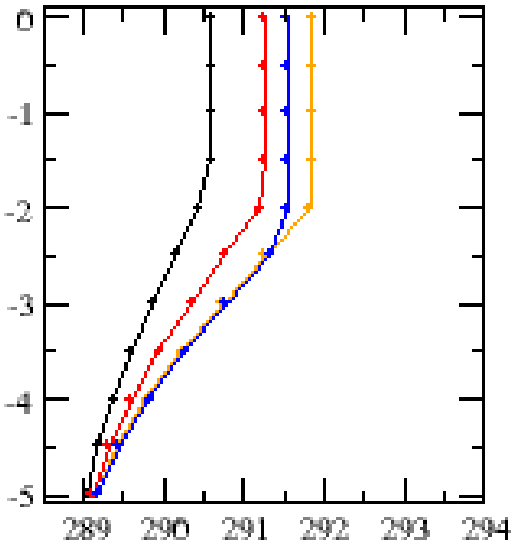
FLK

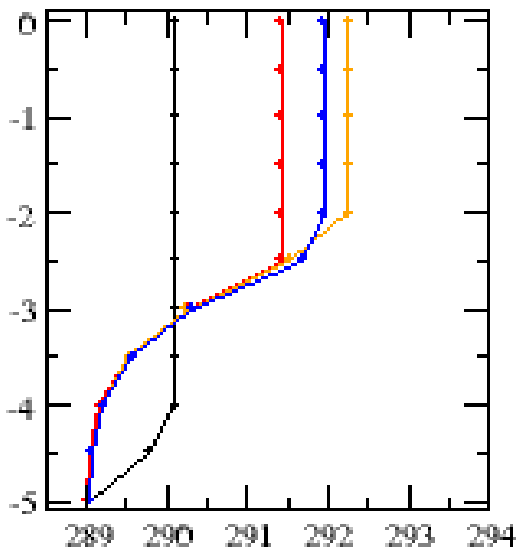
THETA

LST



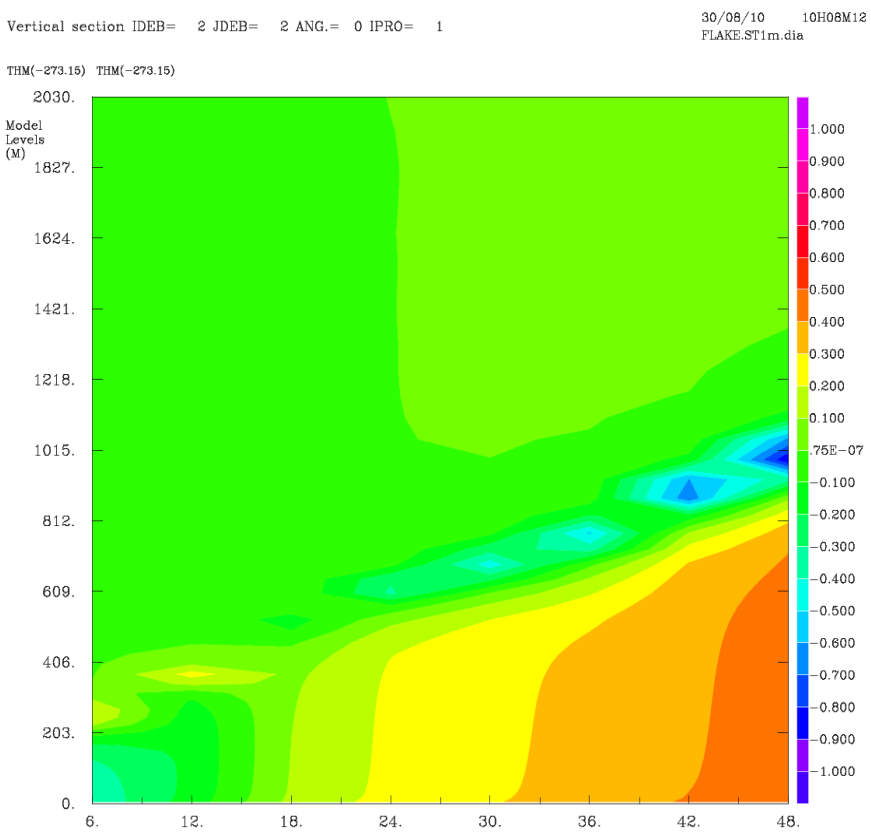




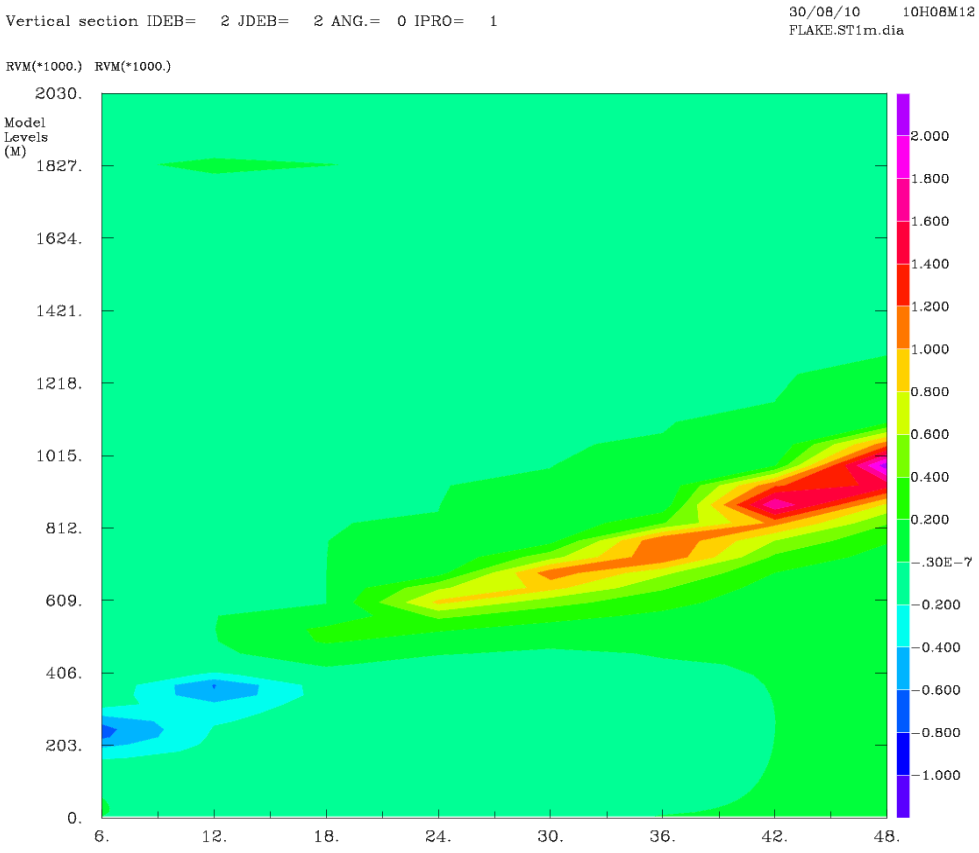


Sensitivity to initial water stratification

FLK - ST1m



RV



THETA