Modelling the impact of irrigation in the Ebro basin using the Meso-NH mesoscale model (preliminary study)

P. Le Moigne, S. Donier, A. Boone

CNRM Météo-France/CNRS, Toulouse

Outline

Motivation

Accounting for irrigation in Meso-NH model

Impact of irrigation on surface fields, and the boundary layer

Conclusions and Perspectives

Motivation of the study

To simulate irrigation with Meso-NH model in the Ebro basin

- How to identify and isolate the irrigated vegetation type
- How to simulate irrigation in the model

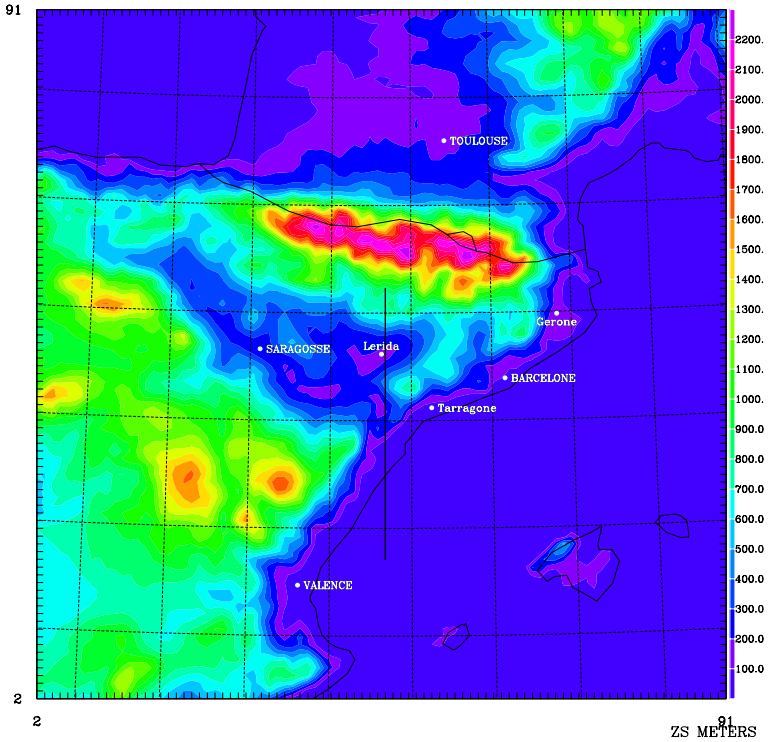
To assess the role of irrigation at mesoscale

- Using Meso-NH model in two configurations with and without irrigation
- Impacts on surface and PBL variables

To prepare for higher resolution simulations

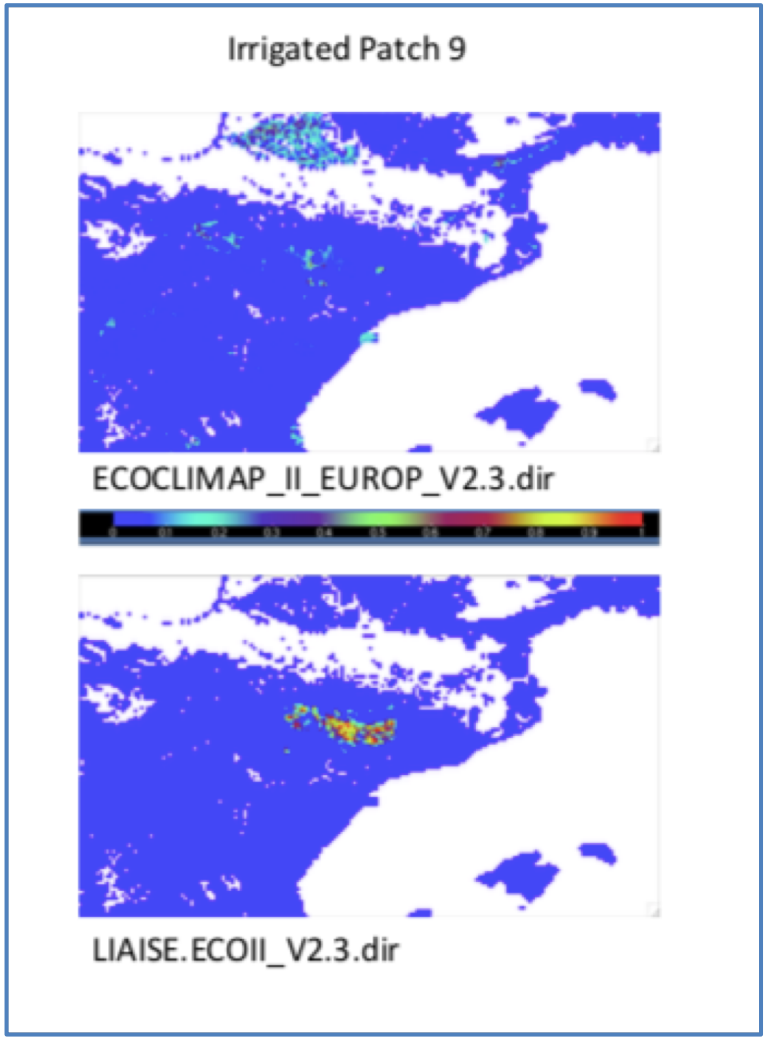
Meso-NH mesoscale model setup

- Non-hydrostatic model (Lac *et al.*, 2018)
- Scales from meters to kilometres
- 1d turbulence scheme (BL89)
- Shallow (EDMF) and deep convection (KF)
- Microphysics (ICE3)
- LBCs 3h from AROME operational model @1.3km
- Test case 16 July 2016, anticyclonic situation
- 90x90 points, 8km grid mesh, 8s tstep
- 90 vertical layers (44 in PBL < 2500m)
- Irrigation option:
  - ✓ Initial soil moisture at field capacity
  - ✓ Water supply of 10^{-4} kg/m^2/s (i.e. 8.6mm/d)



SURFEX Land Surface Model setup

- SURFEX LSM (Masson *et al.*, 2013) is coupled to Meso-NH
- ISBA model for vegetation (diffusive transfers)
- Representation of land covers is based on the 1km **ECOCLIMAP** global database, representative of vegetation types in the period 1999-2006
- SURFEX uses 19 classes, 1 for irrigation
- Modified land cover map
  - ✓ To irrigate only the Ebro basin on C3 crops
  - ✓ To increase the irrigated fraction
- **Sensitivity experiments:**
  - ✓ **ARO** without irrigation
  - ✓ **IRR** with irrigation

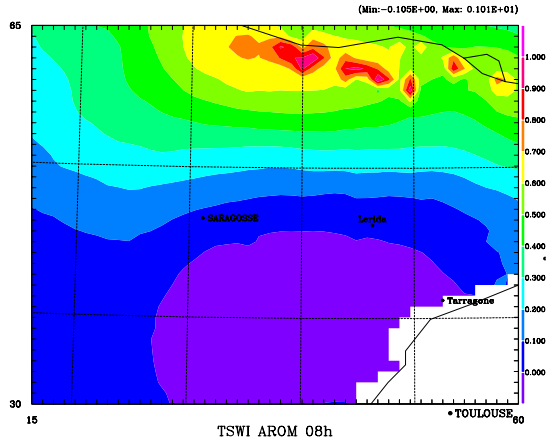


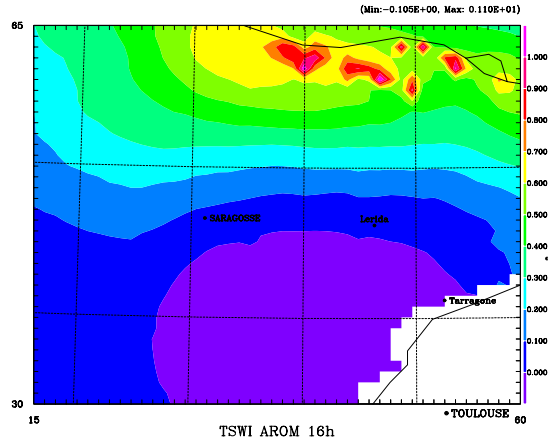
Soil Wetness Index

8UTC

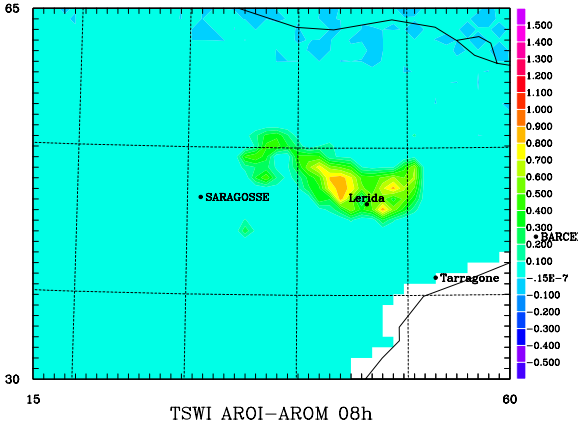
16UTC

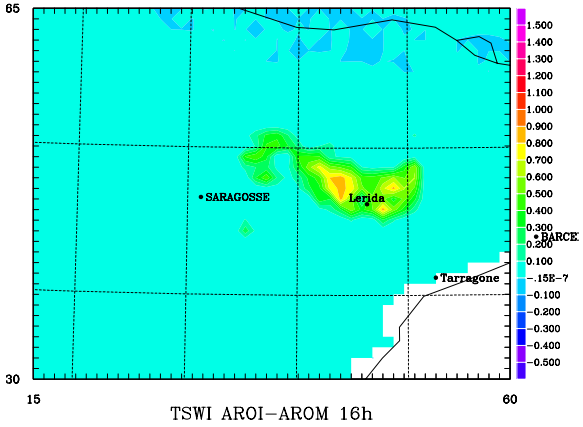
ARO





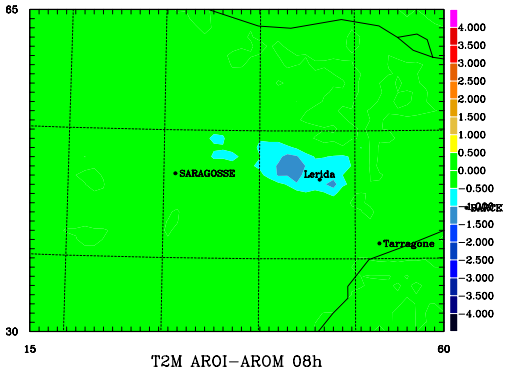
IRR - ARO



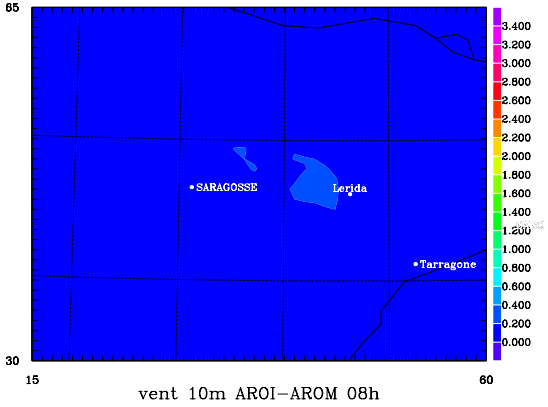


Impact on surface variables: IRR - ARO @8UTC

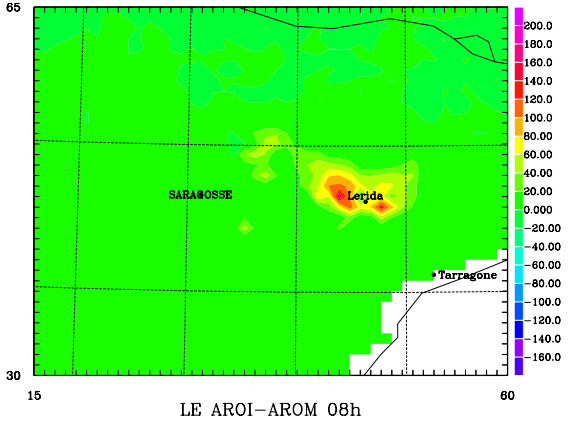
T2M



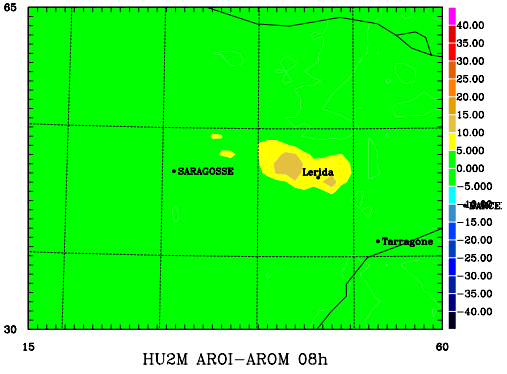
U10M



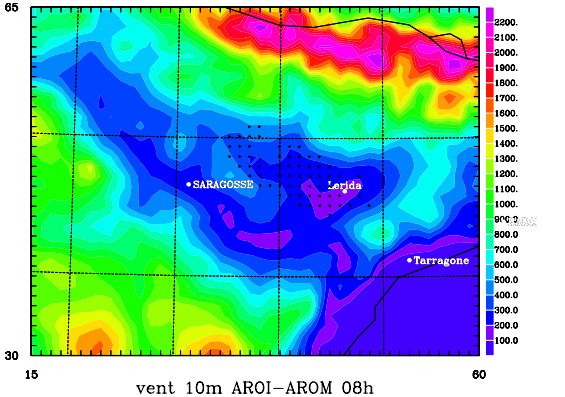
LE



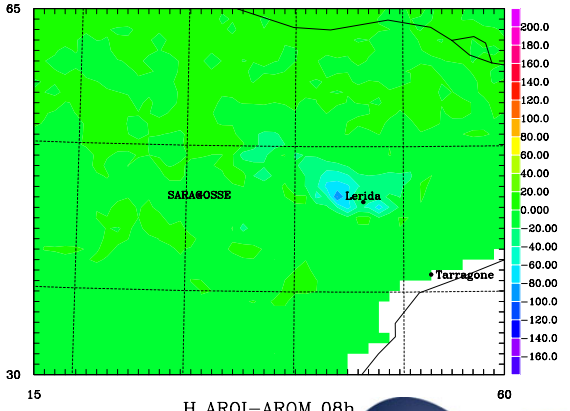
HU2M

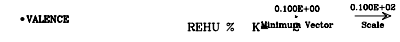


DIR10M



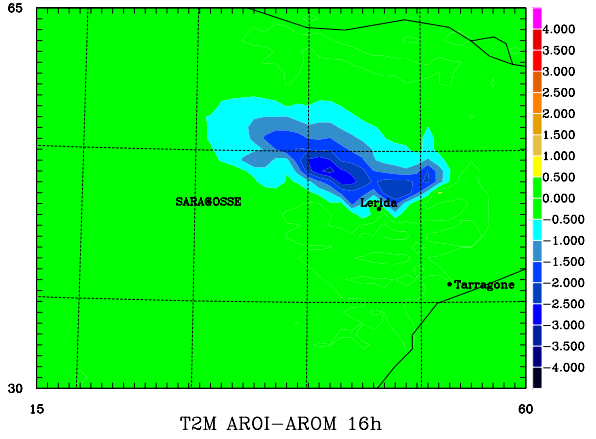
H



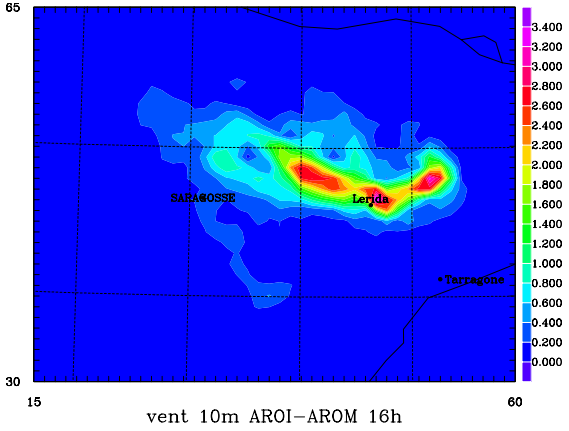


Impact on surface variables: IRR - ARO @16UTC

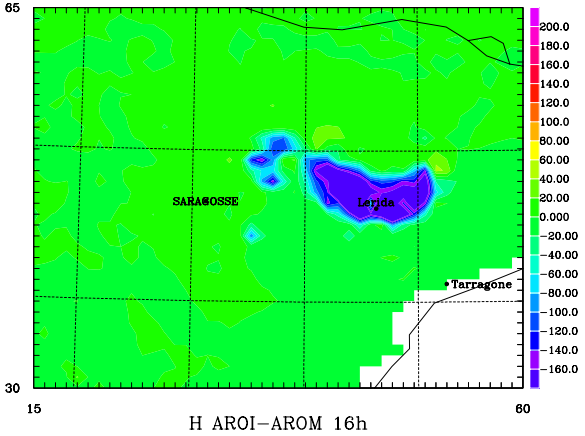
T2M



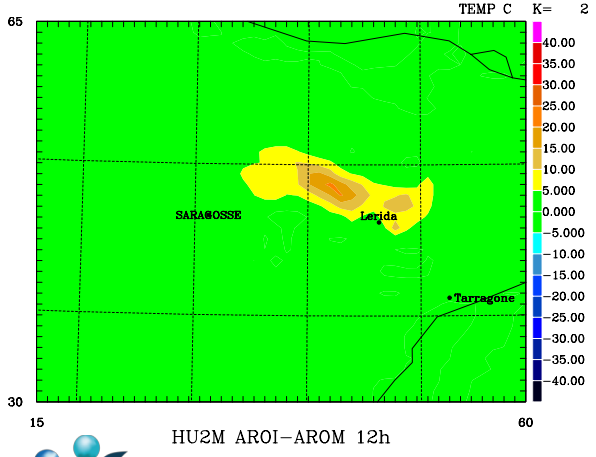
U10M



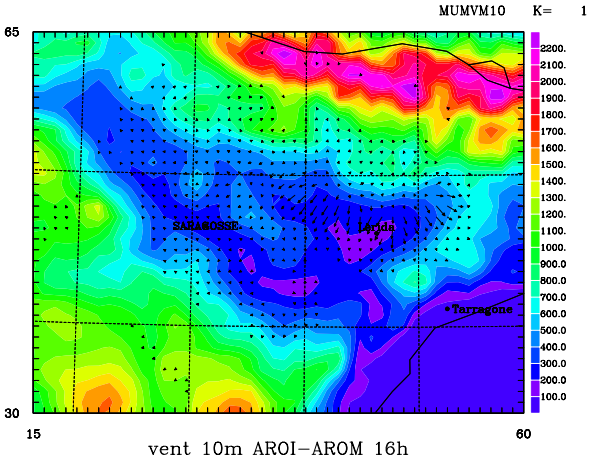
LE



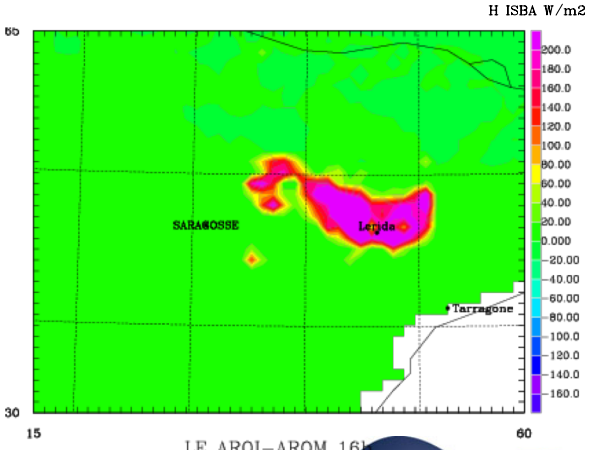
HU2M



DIR10M



H



vent 10m AROI−AROM 16h

0.100E+00 Minimum Vector 0.100E+02 Scale

REHU % K= 2

79200. ZS METERS

CNRM

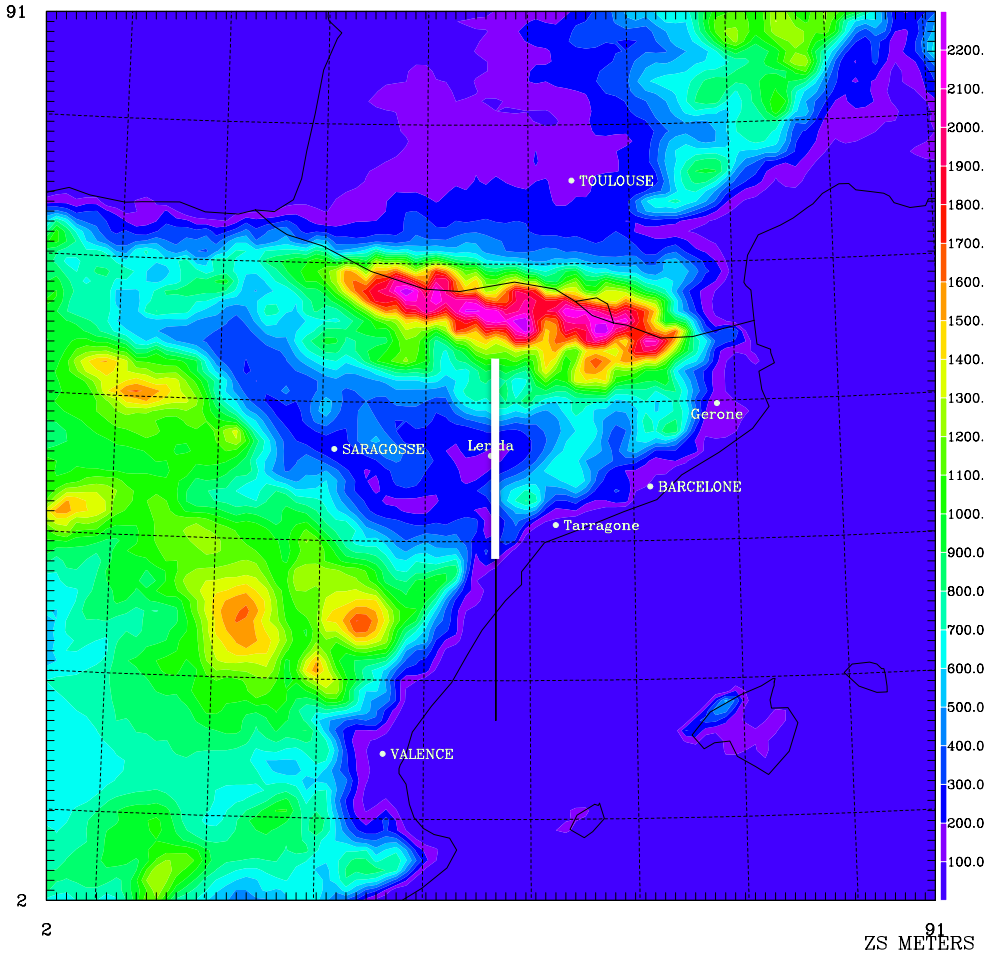
cnrs advancing the frontiers

METEO FRANCE

LE ISBA W/m2

Impact on PBL

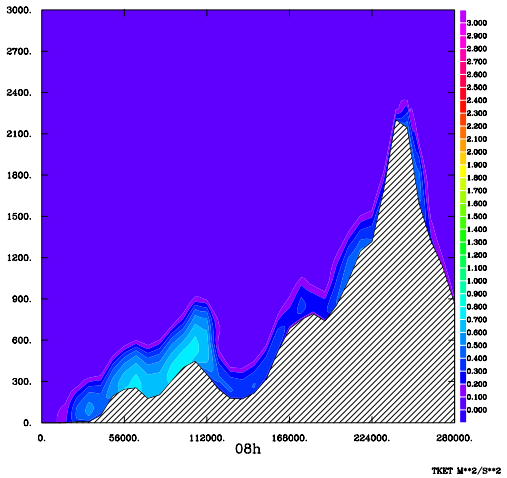
- Vertical NS cross section
- Potential temperature, Mixing Ratio, Turbulent Kinetic Energy

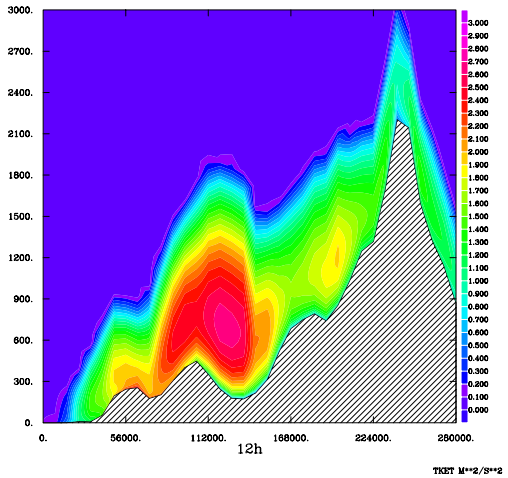


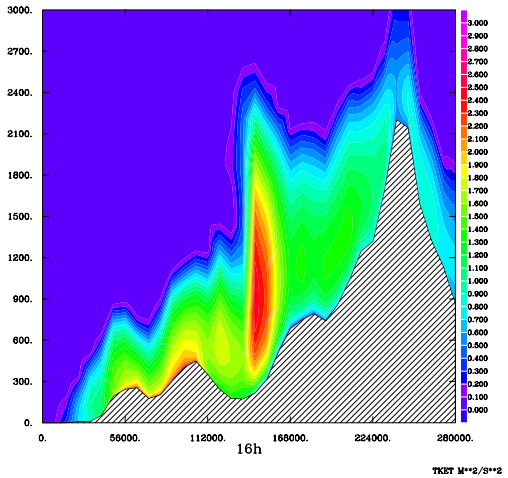
Turbulent Kinetic Energy TKE

8UTC 12UTC 16UTC

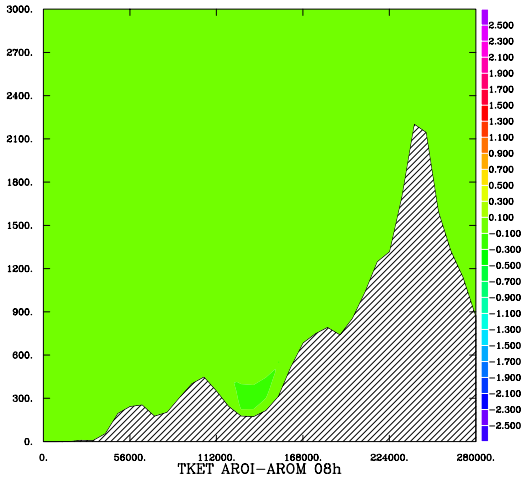
ARO

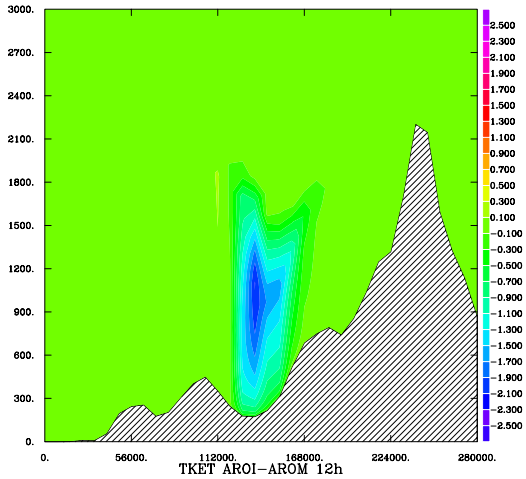


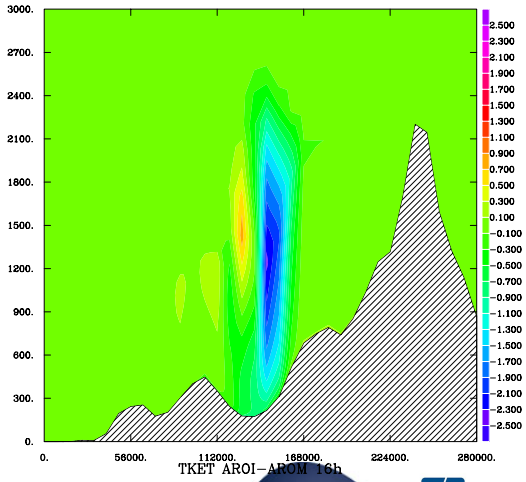




IRR - ARO







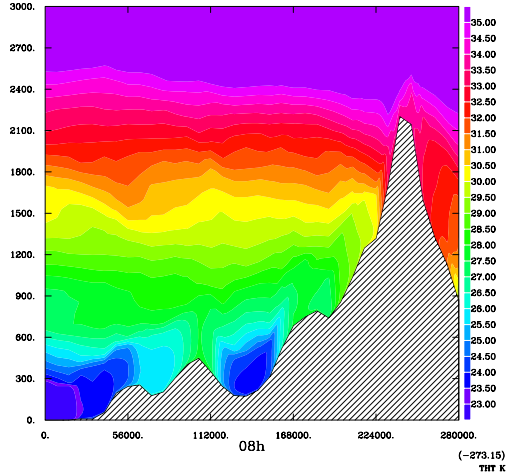
Potential Temperature Theta

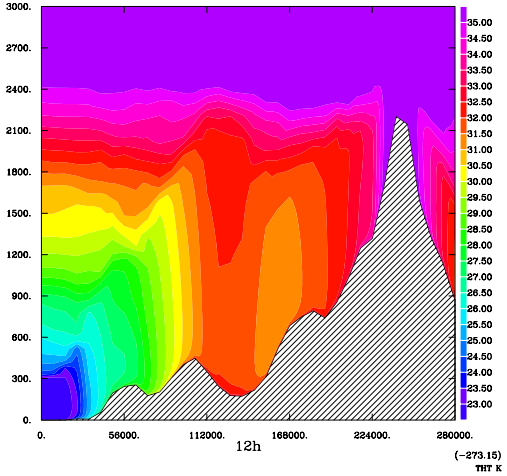
8UTC

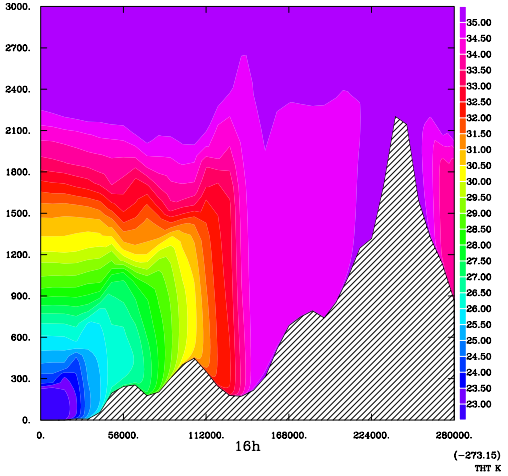
12UTC

16UTC

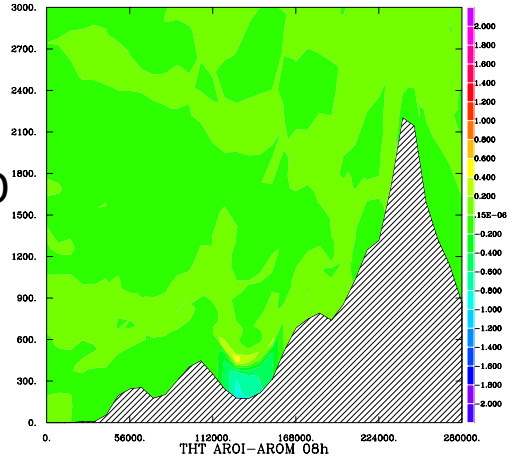
ARO

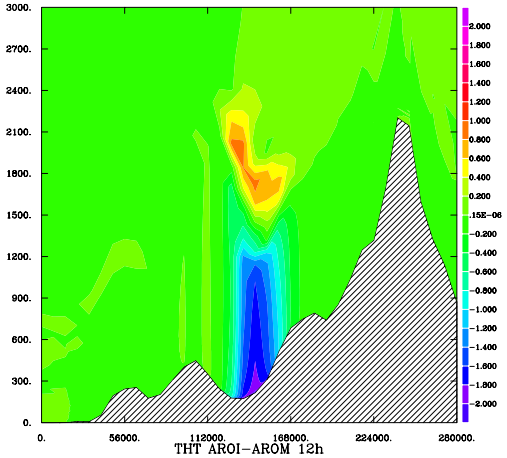


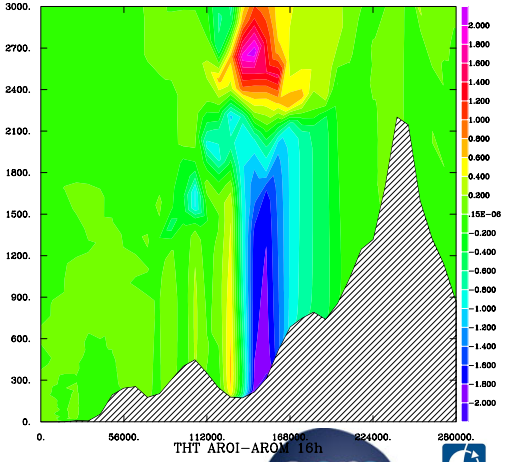




IRR - ARO







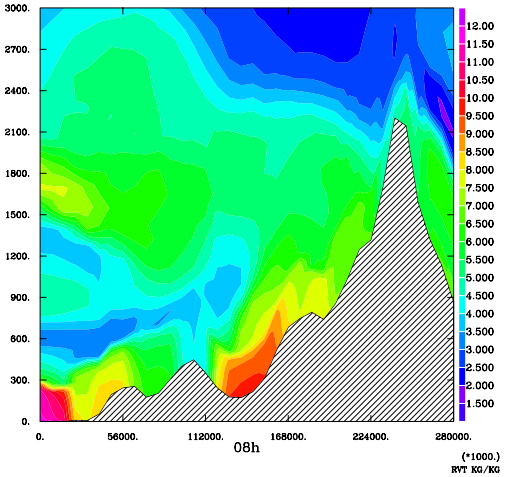
Mixing Ration Rv

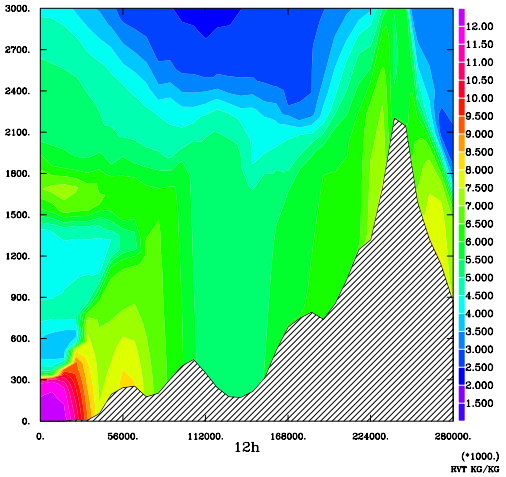
8UTC

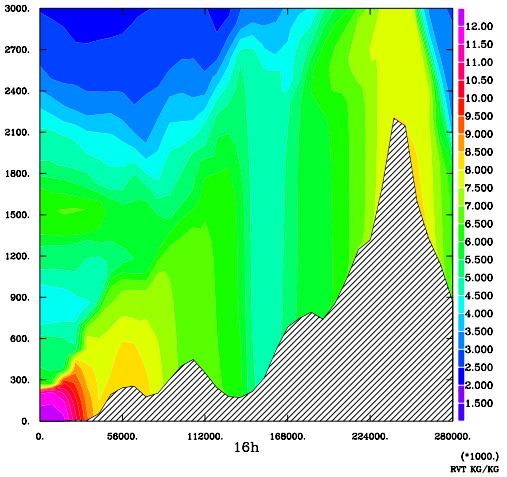
12UTC

16UTC

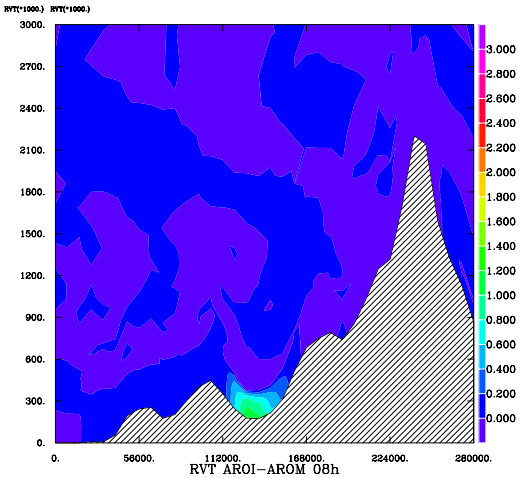
ARO

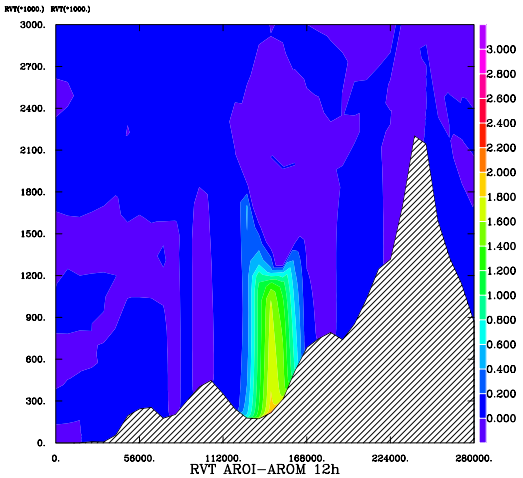


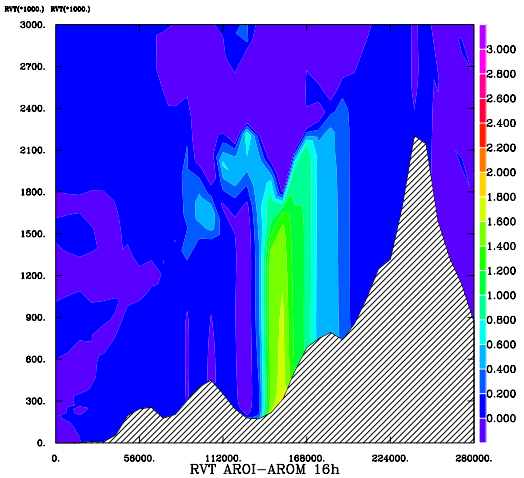




IRR - ARO







Summary and Outlook

- An irrigation parameterization was successfully tested in Meso-Nh model coupled to SURFEX
- A water supply of 8.6mm/d has a large impact on surface and boundary layer variables
- Important to select vegetation surfaces to be irrigated (land cover)
- Close to the surface, an important cooling is experienced associated to an air moistening
- Boundary layer height is impacted, as well as vertical transport of humidity, and vertical distribution of heat
- Starting point for higher resolution simulation (@2km) with Meso-NH
- Need to refine selection of irrigated areas
- Use of higher resolution ECOCLIMAP-SG @300m resolution