DICE: results from the CMC* model

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* CMC = Canadian Meteorological Centre

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Physics configuration based on that of the operational GDPS (Global Deterministic Prediction System)

Model	Global Environmental Multiscale (**GEM**)
Type of model	Global NWP
Reference	Charron et al.,2012: *The stratospheric extension of the Canadian global deterministic medium range weather forecasting system and its impact on tropospheric forecasts. Mon.Wea.Rev.*, **140**, 1924-1944
Time step	600 s
Turbulence scheme	**TKE 1.5**
Formulation of eddy diffusivity K	**E-l**
Formulation of mixing length scale	**Bougeault-Lacarrere**
Surface scheme	**ISBA**
Momentum surface condition in stage 1	Used u* to specify the drag coefficient
Other	- used explicit treatment of heat fluxes - used prescribed albedo of 0.22 for Swup - used model own climatology of ozone - mean-state temperature and moisture profiles given on native model (half) levels

Surface characteristics*

field	value	description
MF	436	topography elevation (m)
LH	63.6	launching height (m)
MG	1	land fraction
ZM	0.101	momentum roughness length (m)
ZT	0.02	thermal roughness length (m)
J1	11.8	percentage of sand (%)
J2	39.3	percentage of clay (%)
VF(13)	0.0008	fraction of short grass and forbs
VF(14)	0.808	fraction of long grass
VF(15)	0.157	fraction of crops
VF(26)	0.031	fraction of mixed shrubs

Obtained via interpolation, from the fields used by the GDPS to the latitude-37.65 N, longitude-263.265 E grid point.

Notes about our experience with the DICE setup

(1) 10-year initialization of the soil moisture and temperature

- convergence: OK
- but the resulting soil moisture seems to be quite sensitive to
  the soil characteristics (e.g. % of clay, sand, etc.)
- subsequent results quite sensitive to soil moisture (see next slides)

(2) SCM and forcing

- SCM for GEM physics is quite new (officially released in 2012)
- DICE is the first project where new SCM was used (lots learned)
- some challenges w.r.t. forcing setup and requested output, e.g.:
    > *unable to use prescribed u* (imposed drag coefficient Cd instead)*
    > *unable to use prescribed SW flux (used 0.22 albedo instead)*
    > *unable to provide a reasonable estimate of screen temperature or*
      moisture in stages 1b or 3b (because the operational calculation
      requires the surface temperature and moisture)
    > *unable to use prescribed ozone*

(3) Stage 3b forcing

- some technical difficulties (SCM would blow up!) when using some of
  the forcings (surface fluxes) from other models
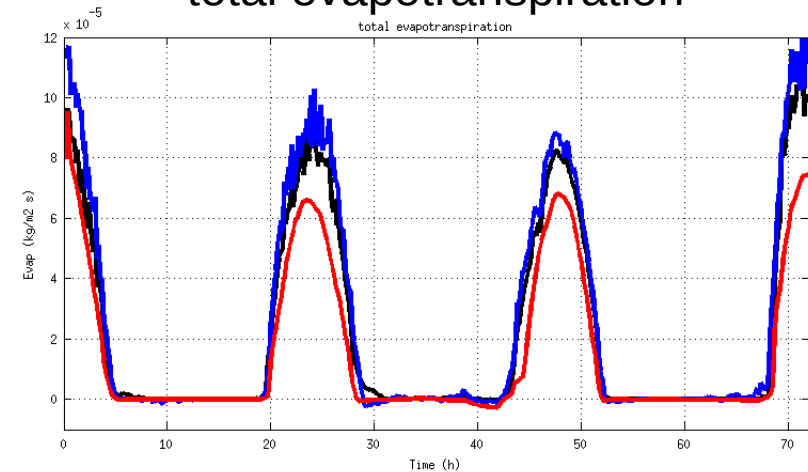
Selected results from stages 1 and 2

DICE - Surface: selected results from stages 1a and 2

Color code
stage 1a, forcing at 55m
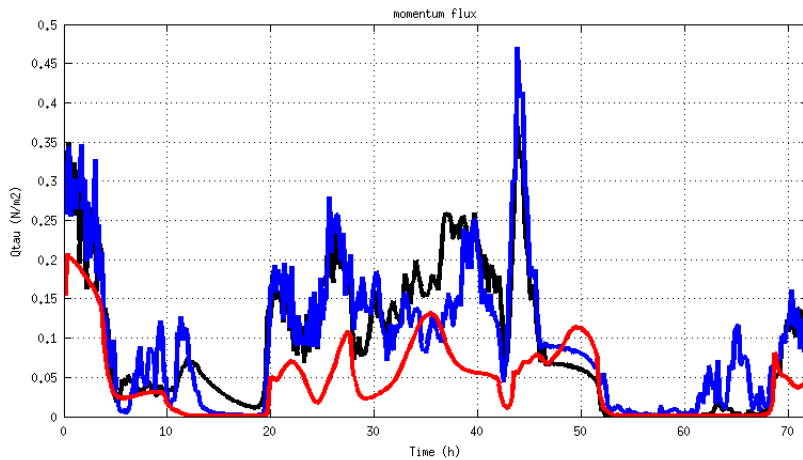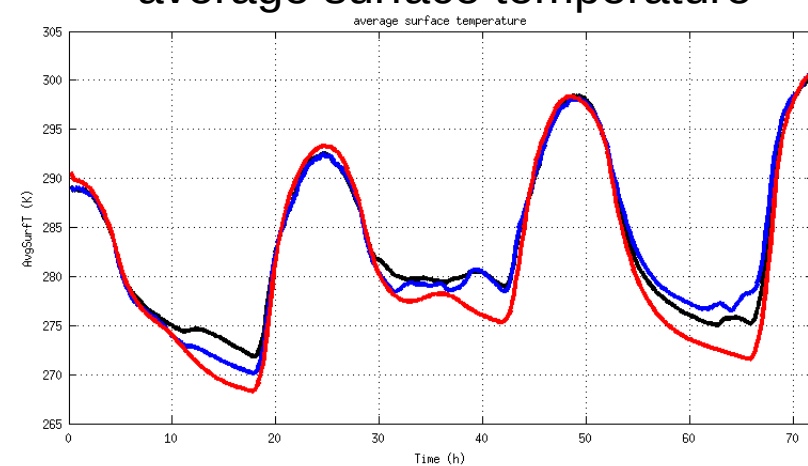**stage 1a, forcing at screen level**
stage 2

net SW radiation
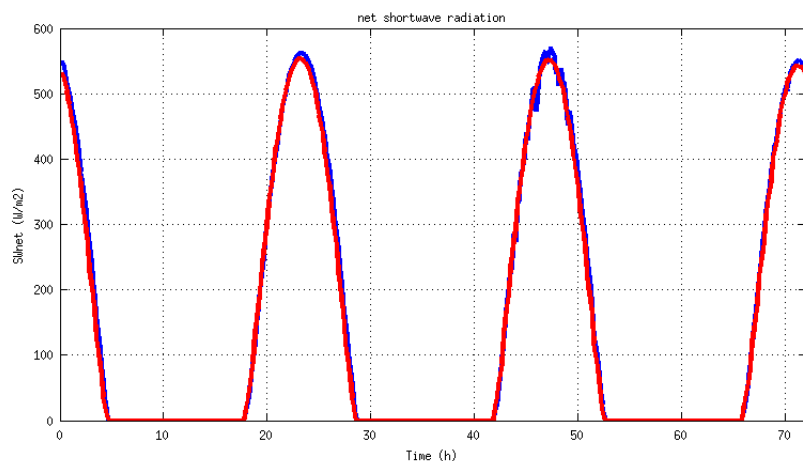
sensible heat flux
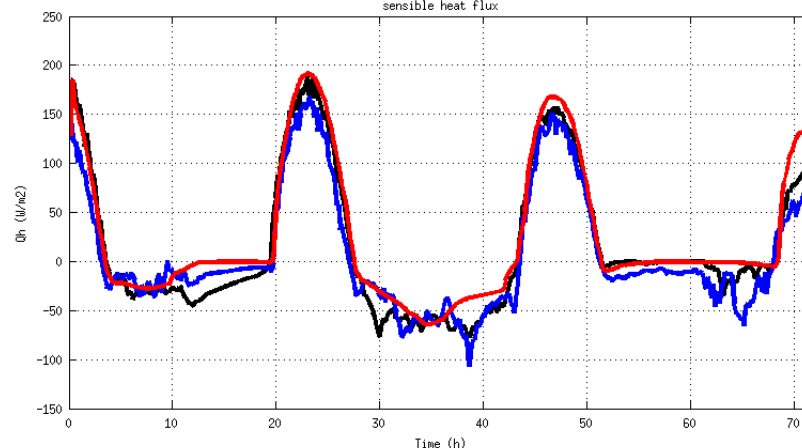
net LW radiation
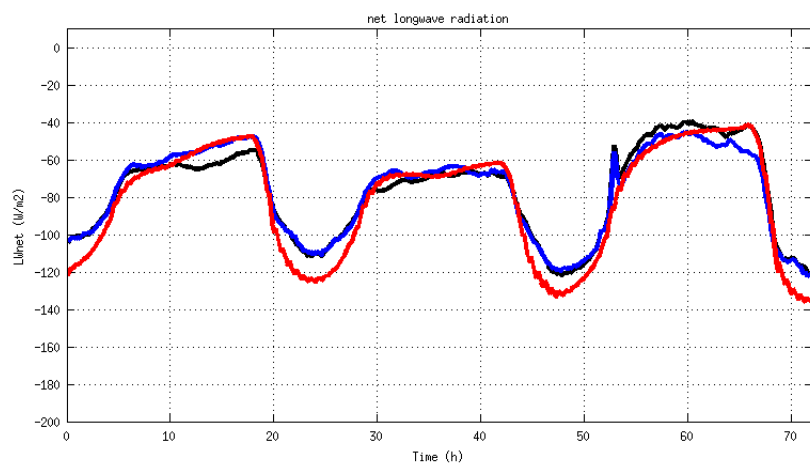
latent heat flux
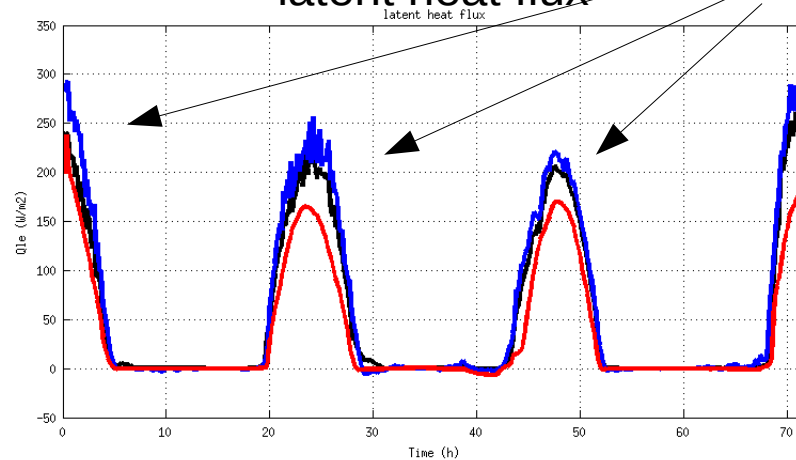
3-4 times larger than obs !

DICE - Surface: selected results from stages 1a and 2

Color code
stage 1a, forcing at 55m
stage 1a, forcing at screen level
stage 2

ground heat flux
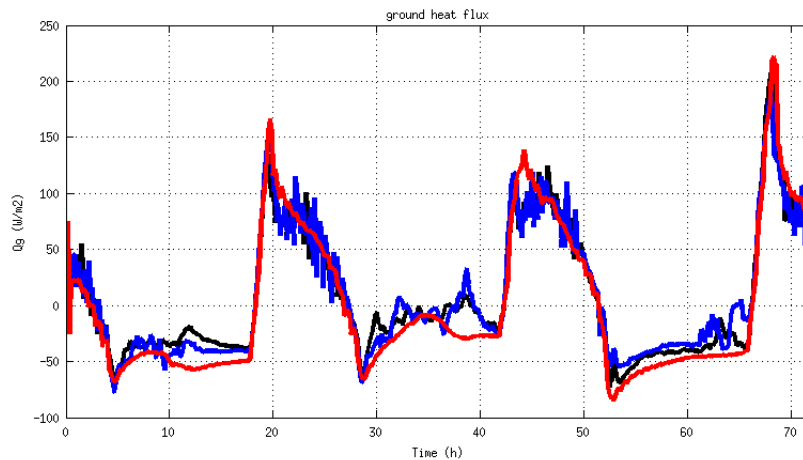
total evapotranspiration

momentum flux

average surface temperature

DICE - Surface: selected results from stages 1a and 2

Color code
stage 1a, forcing at 55m
stage 1a, forcing at screen level
stage 2

top layer (10cm) soil temperature
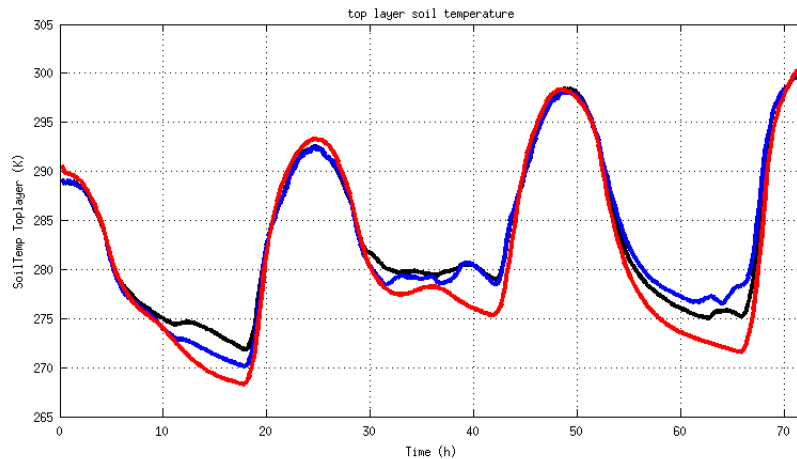
top layer moisture
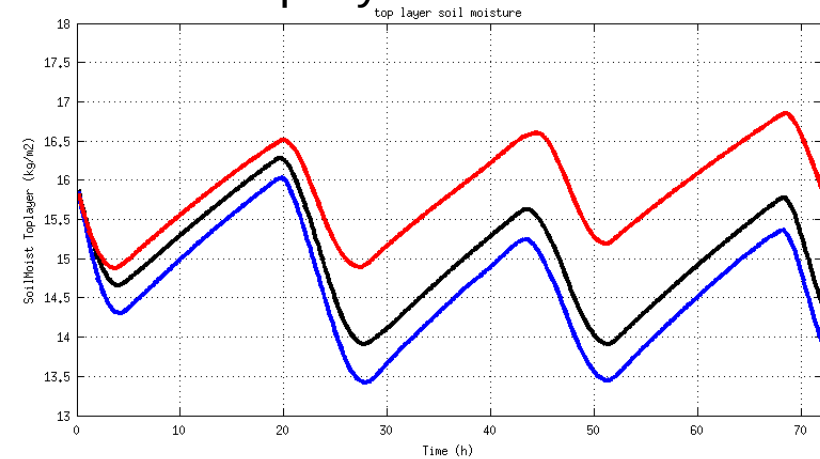
bottom layer (2m) soil temperature
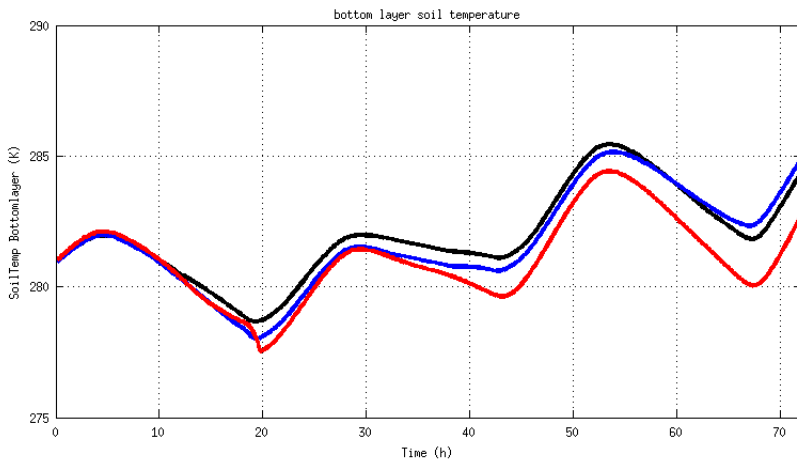
bottom layer moisture
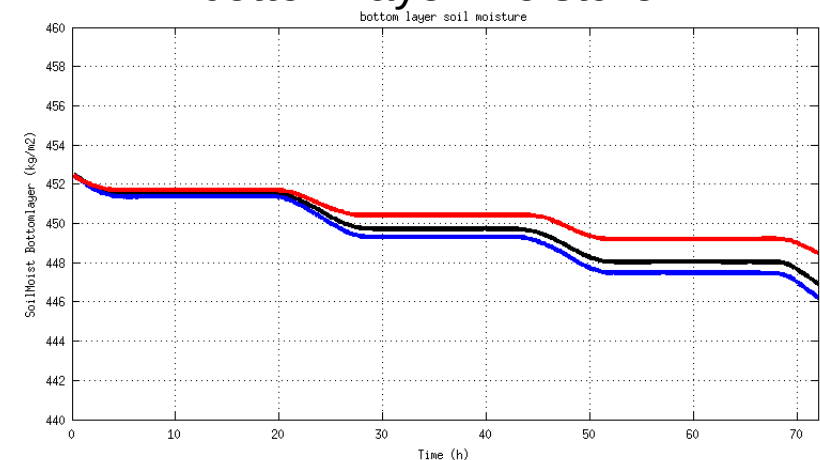
DICE - SCM: selected results from stages 1b and 2

Color code
stage 1b
stage 2

long wave downward radiation at surface
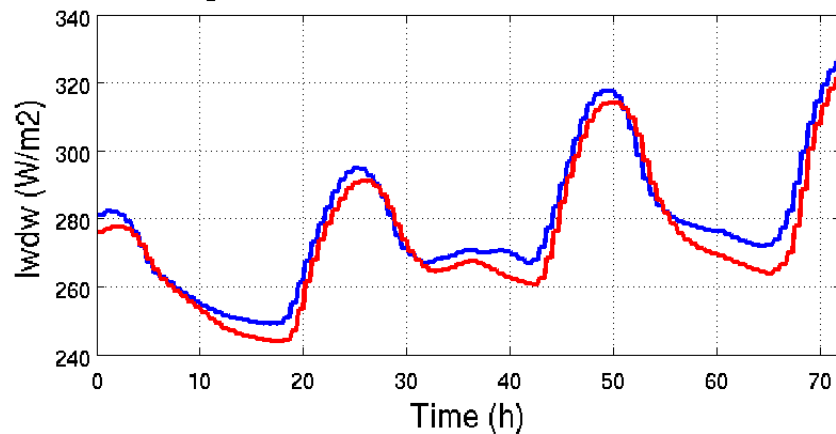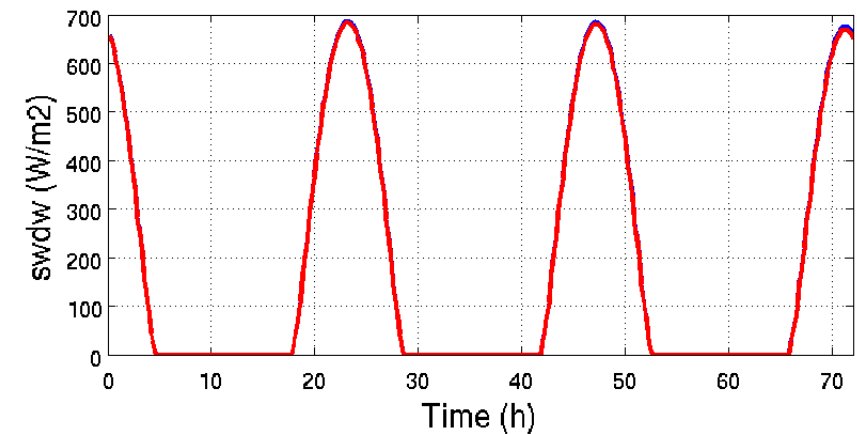
short wave downward radiation at surface

long wave upward radiation at surface

short wave upward radiation at surface

DICE - SCM:
selected results from
stages 1b and 2

Color code
stage 1b
stage 2

sensible heat flux

friction velocity

3-4 times larger than obs !

latent heat flux

boundary layer height
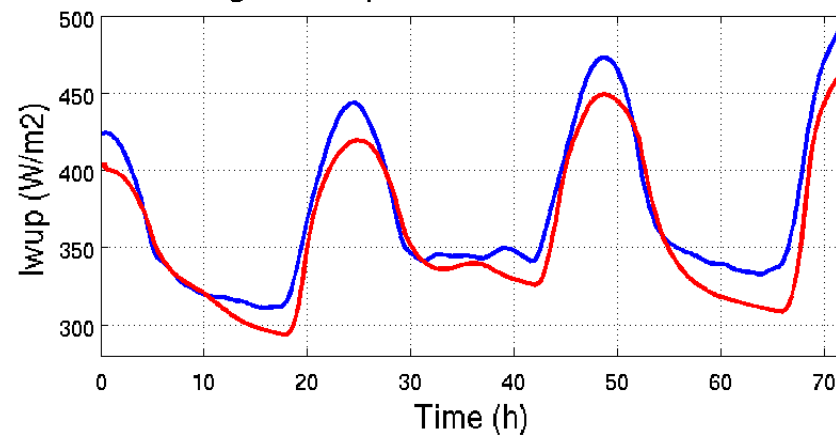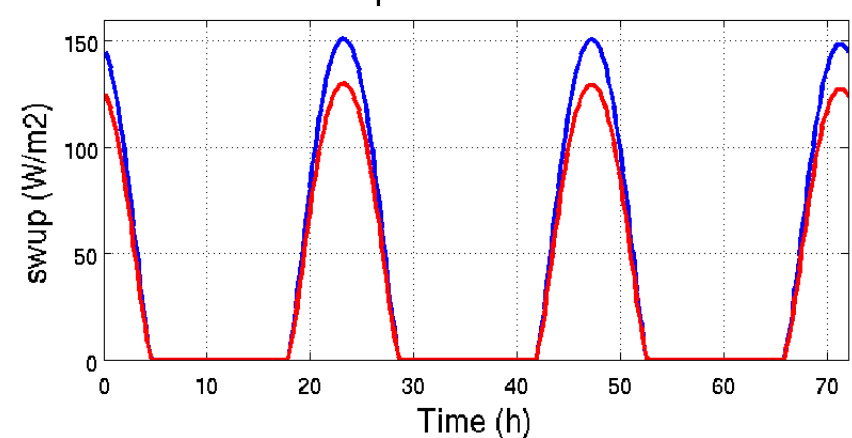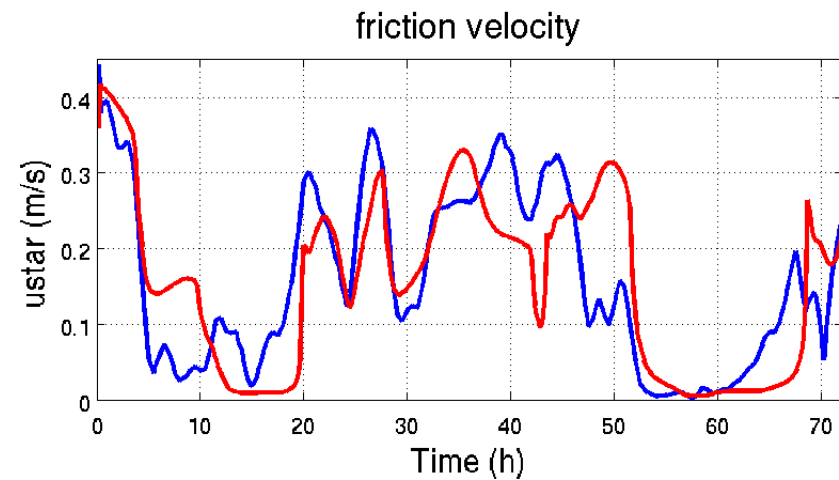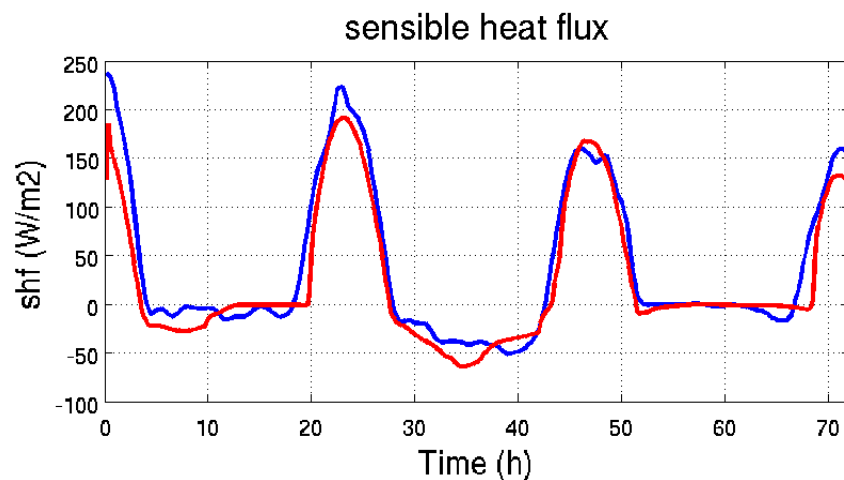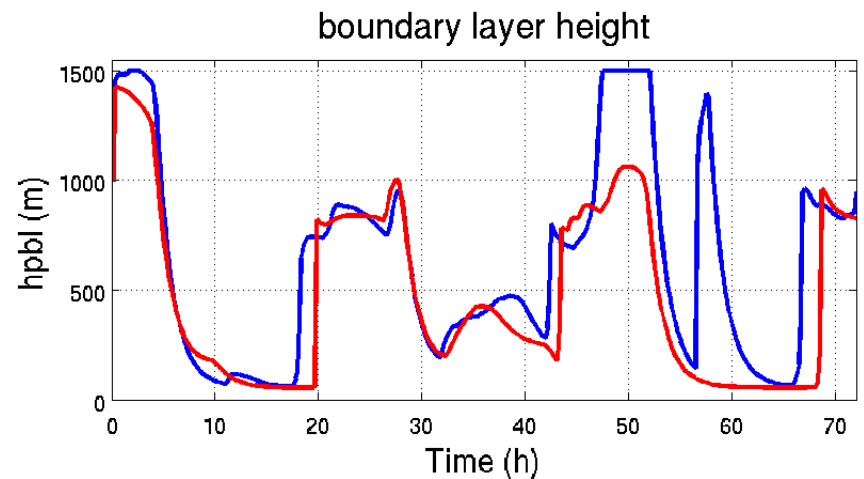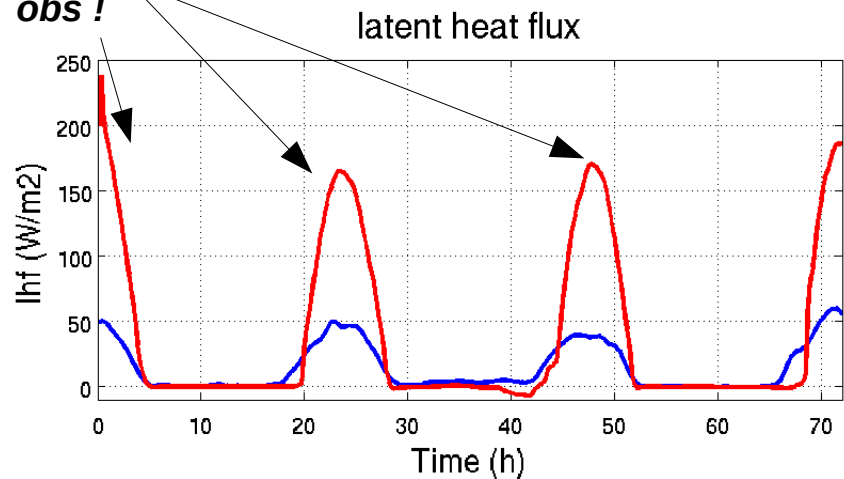
DICE - SCM: selected results from stages 1b and 2

Color code
stage 1b
stage 2

2m temperature
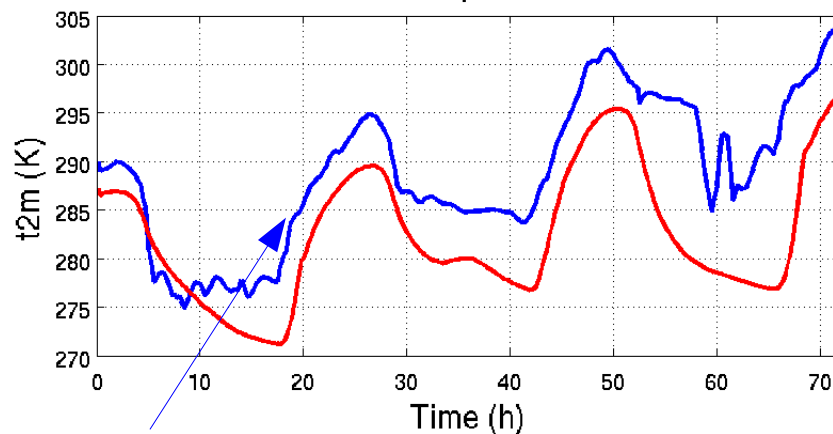
**stage 1b
rough estimates
(not submitted)**

10m u-component wind
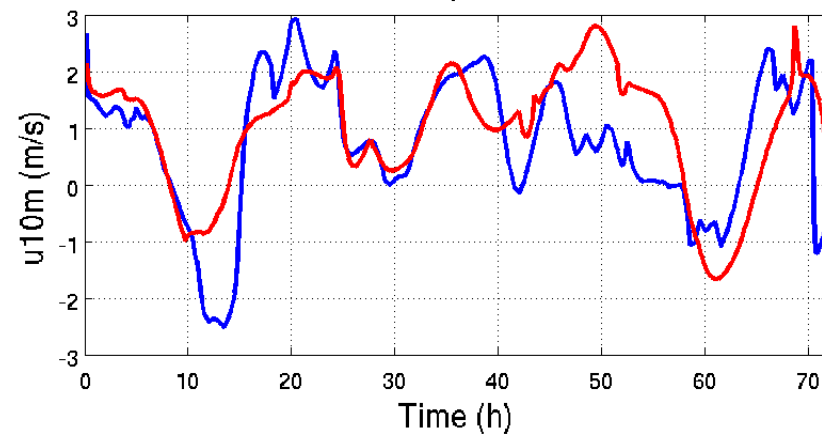
2m specific humidity
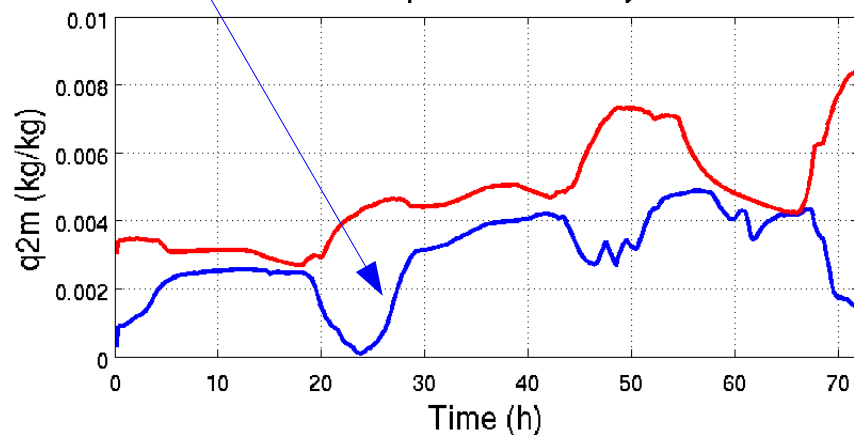
10m v-component wind
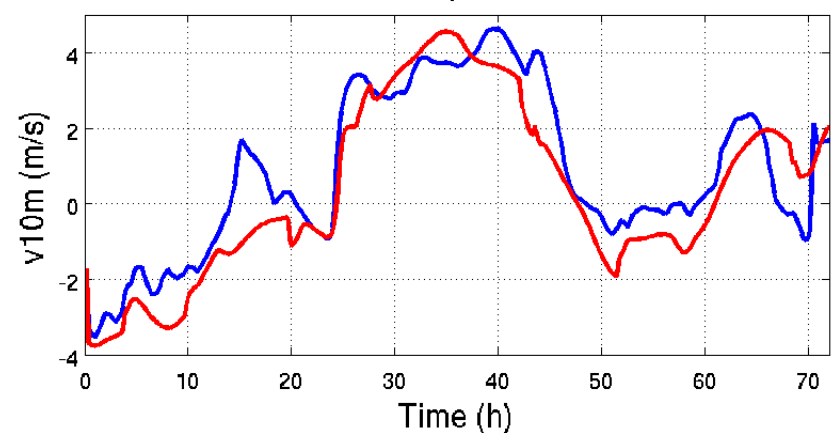
DICE - SCM: selected results from stages 1b and 2

impact of largely different lhf on the moisture profile
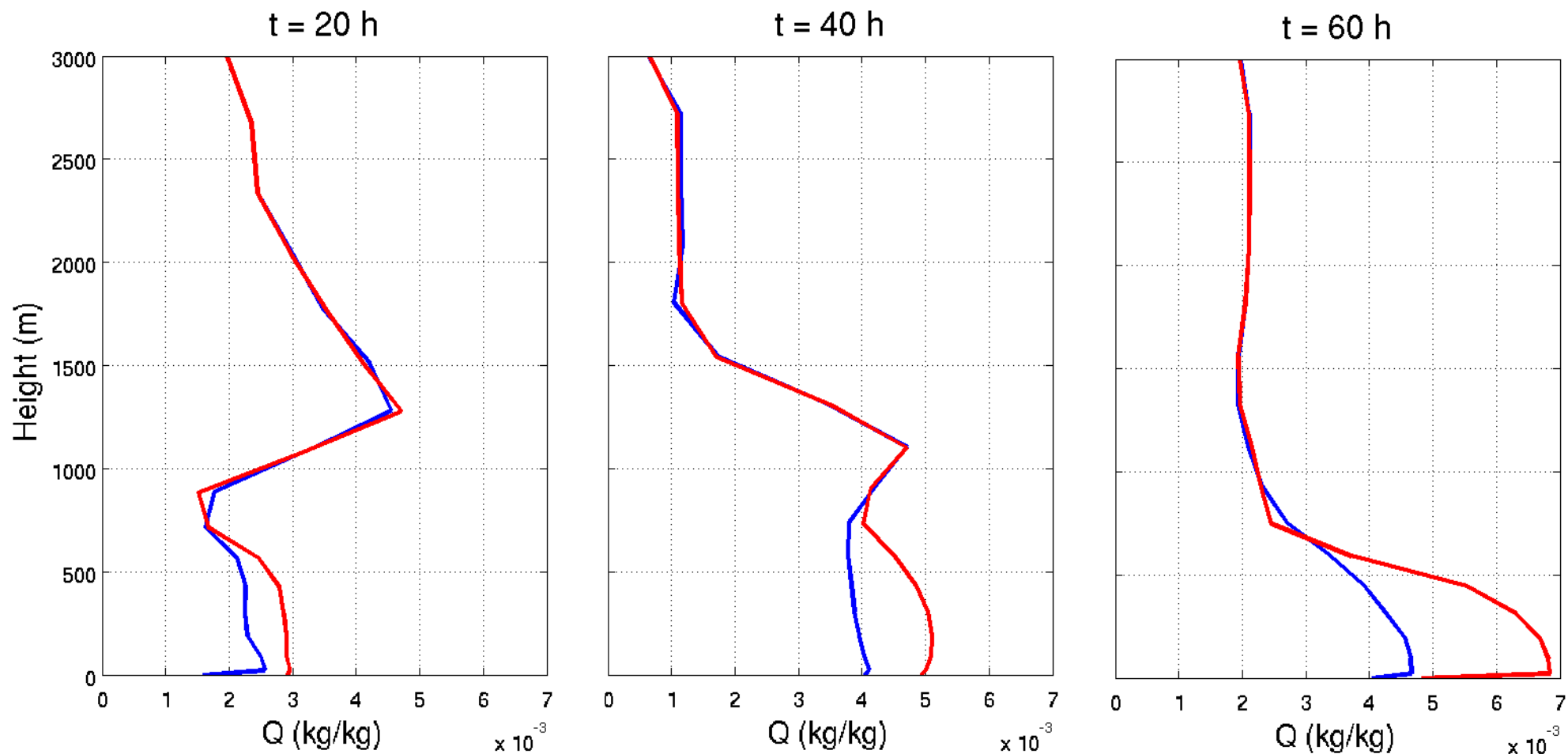
Selected results from stage 3

DICE - Surface: selected results from stage 3a
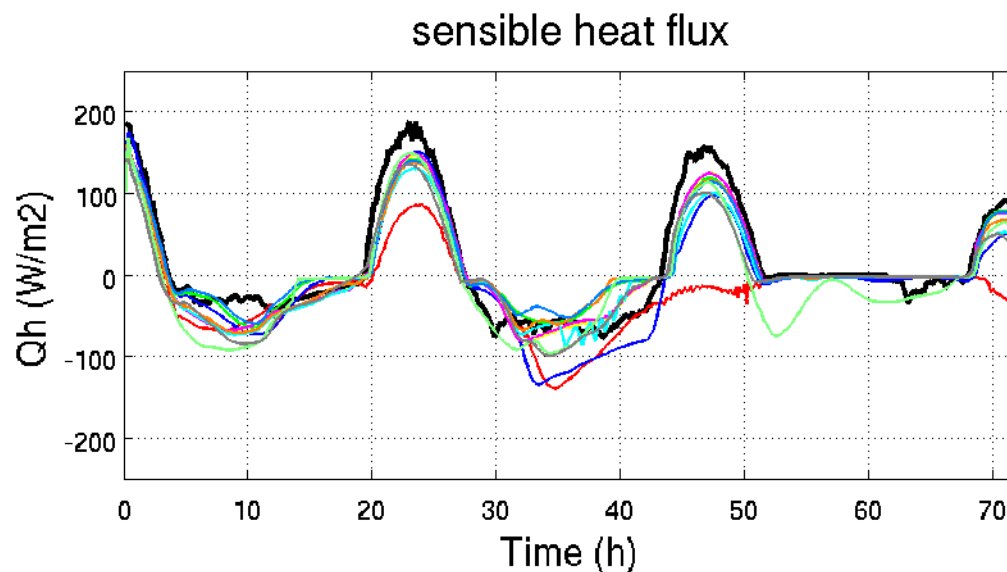
Color code
thick black**: **stage 1a
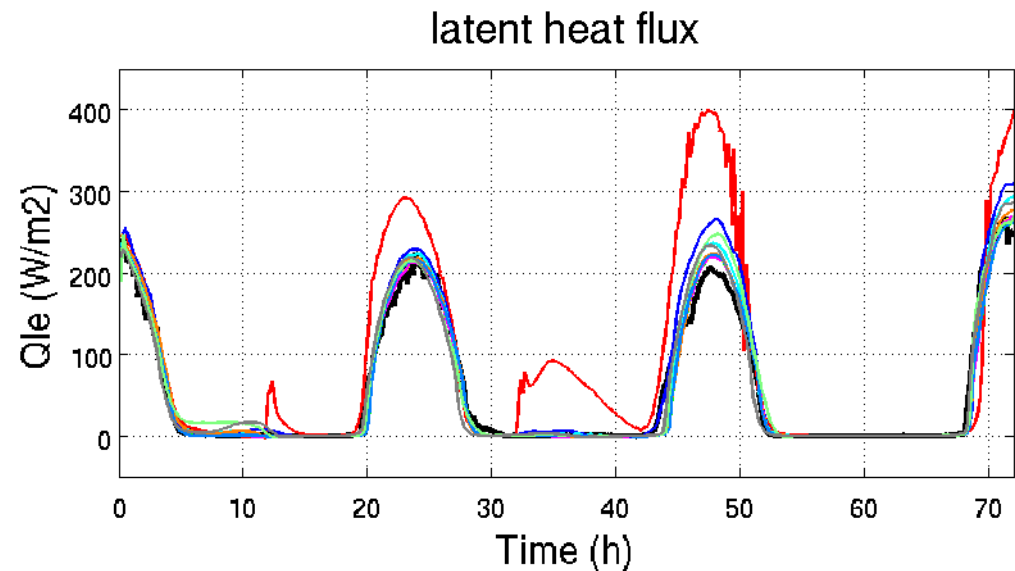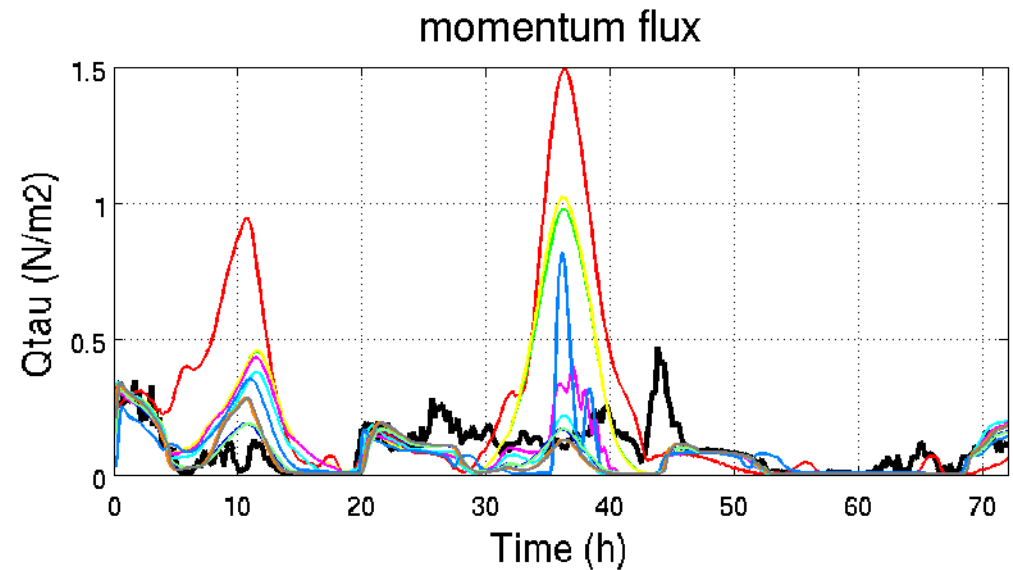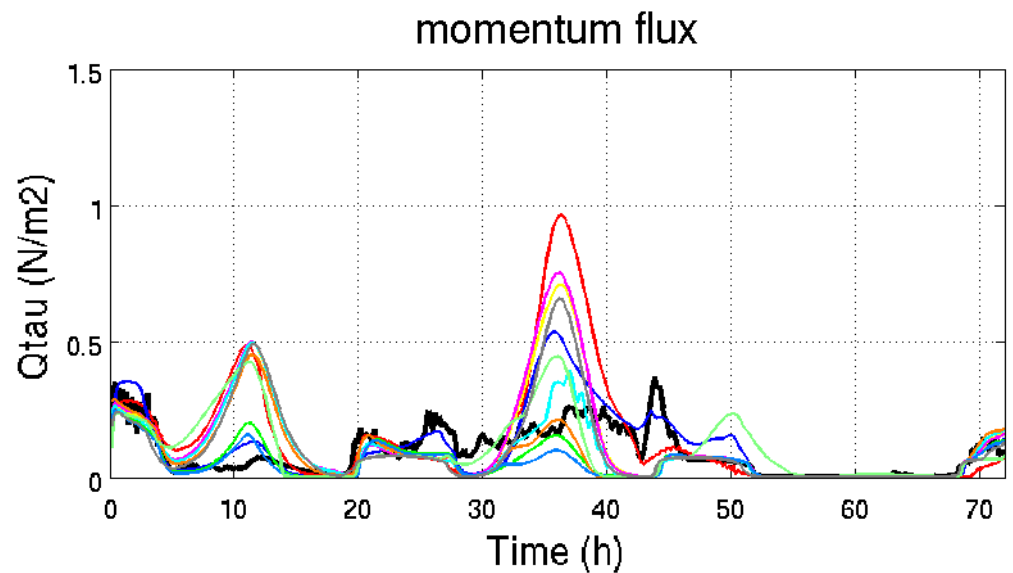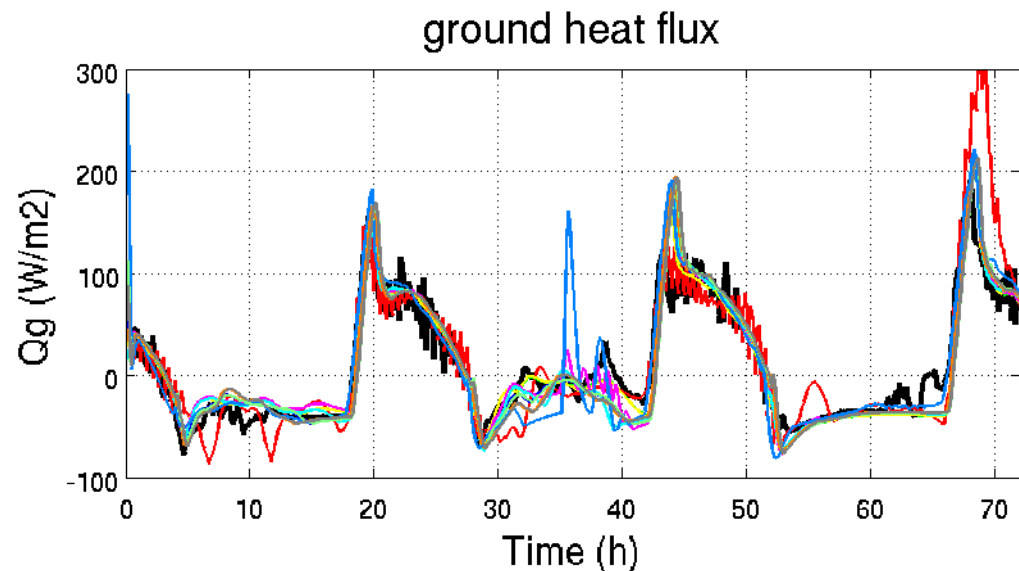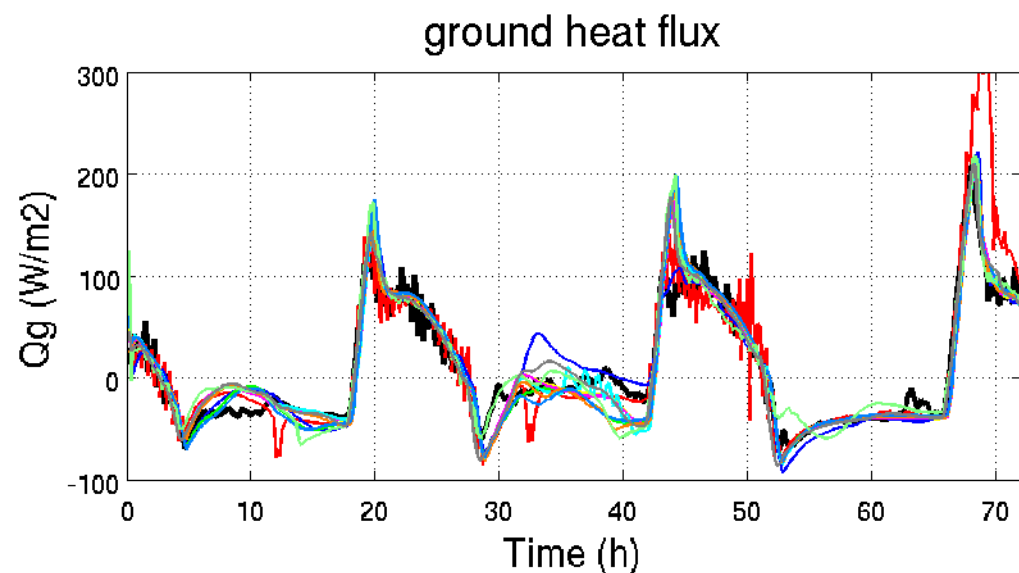*other colors: stage 3a*

forcing at screen level

sensible heat flux

forcing at 20m

sensible heat flux

DICE - Surface: selected results from stage 3a

Color code
thick black**: **stage 1a
other colors: stage 3a

latent heat flux
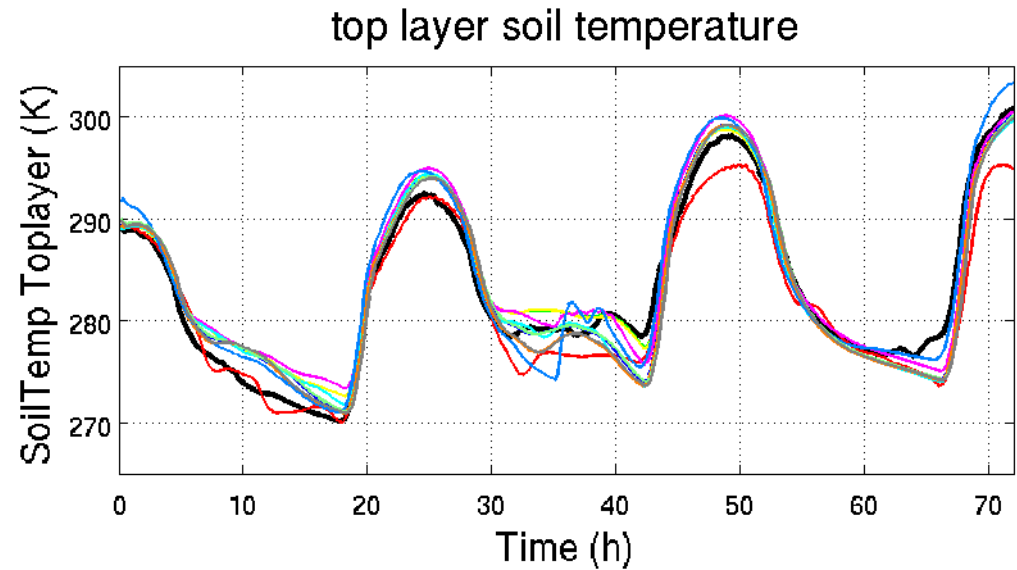
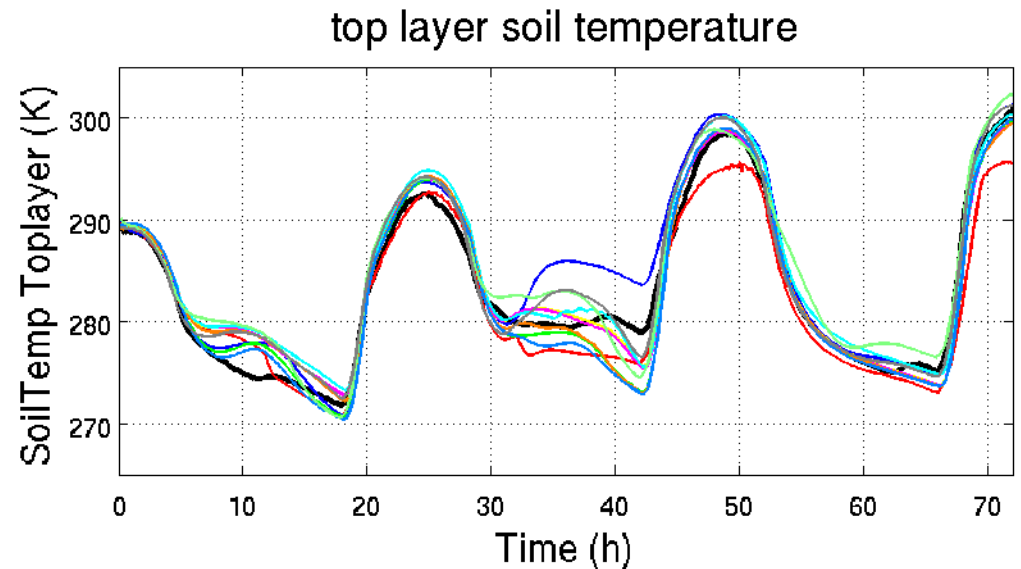forcing at screen level

latent heat flux

forcing at 20m

DICE - Surface: selected results from stage 3a

Color code
thick black**: **stage 1a
other colors: stage 3a

forcing at screen level

momentum flux

forcing at 20m

momentum flux
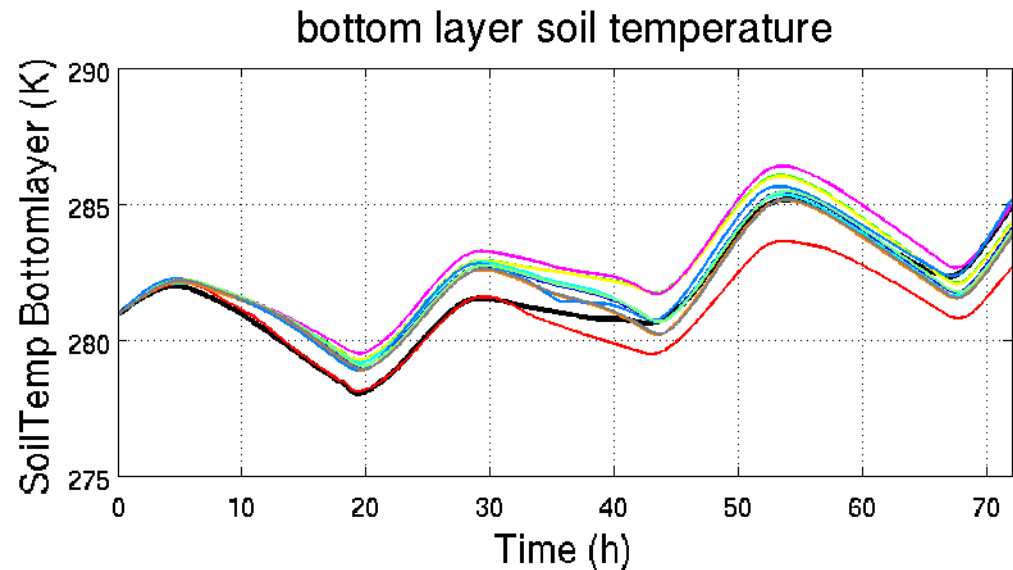
DICE - Surface: selected results from stage 3a

Color code
***thick black**: stage 1a*
other colors: stage 3a

forcing at screen level

ground heat flux

forcing at 20m

ground heat flux

DICE - Surface: selected results from stage 3a

Color code
thick black**: **stage 1a
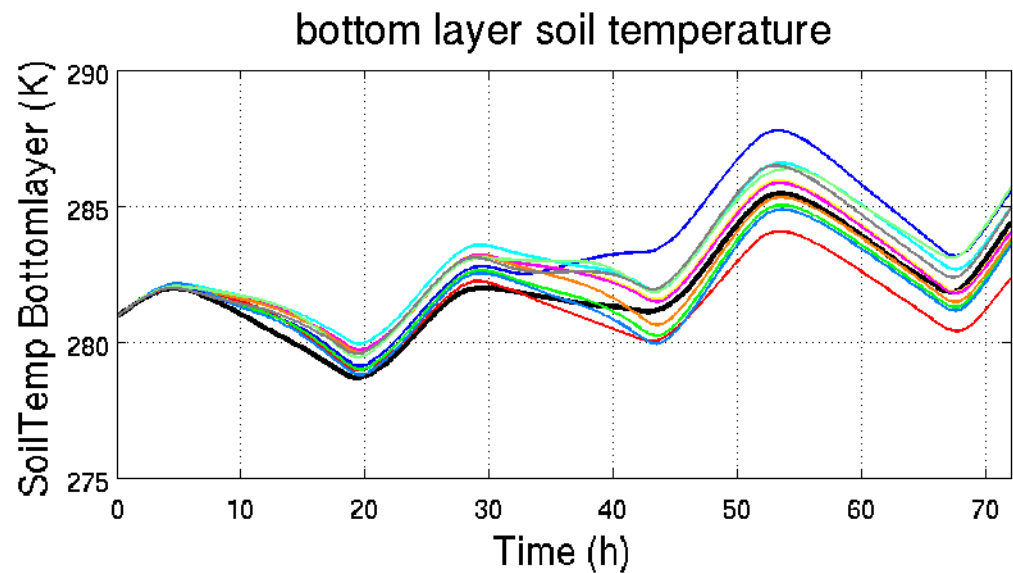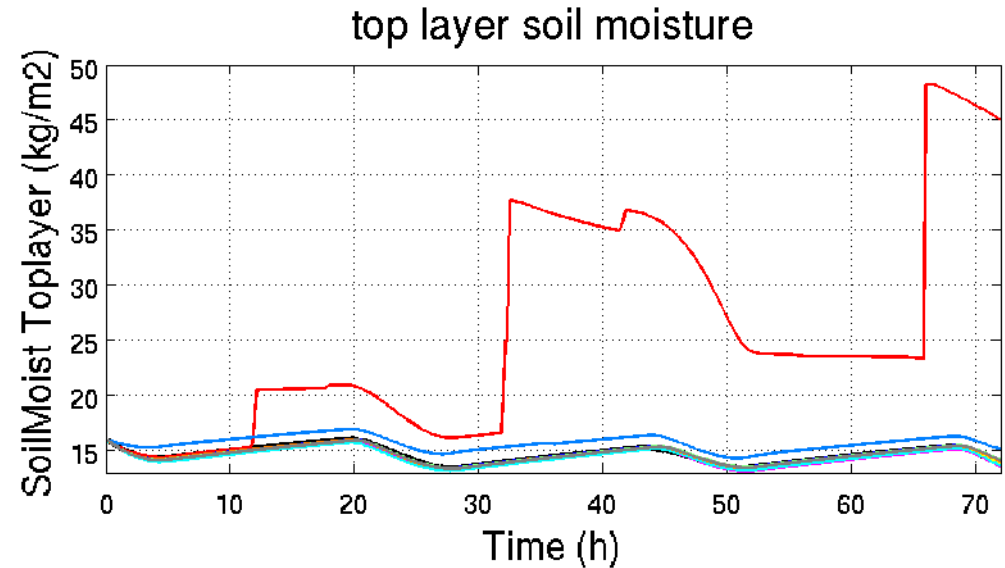*other colors: stage 3a*
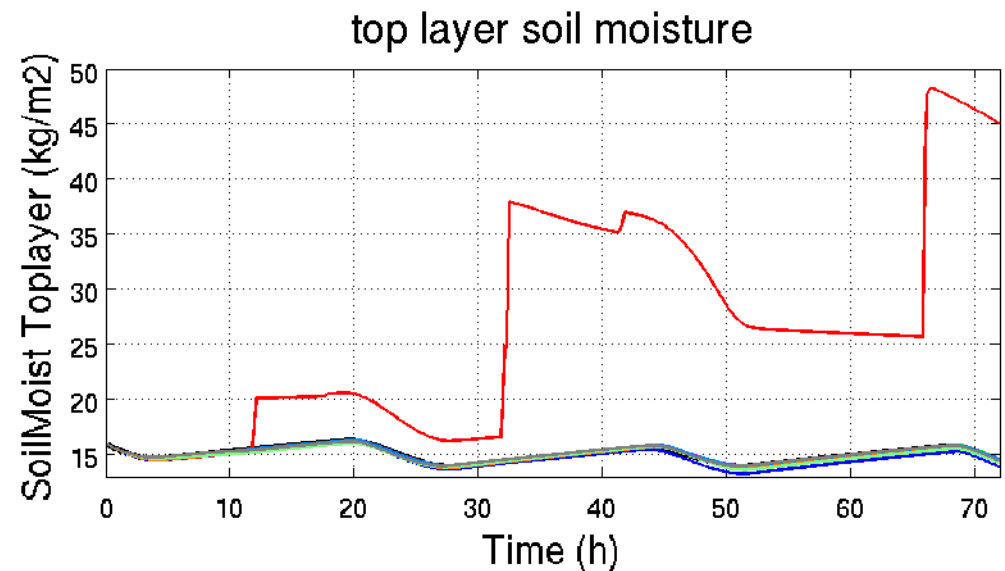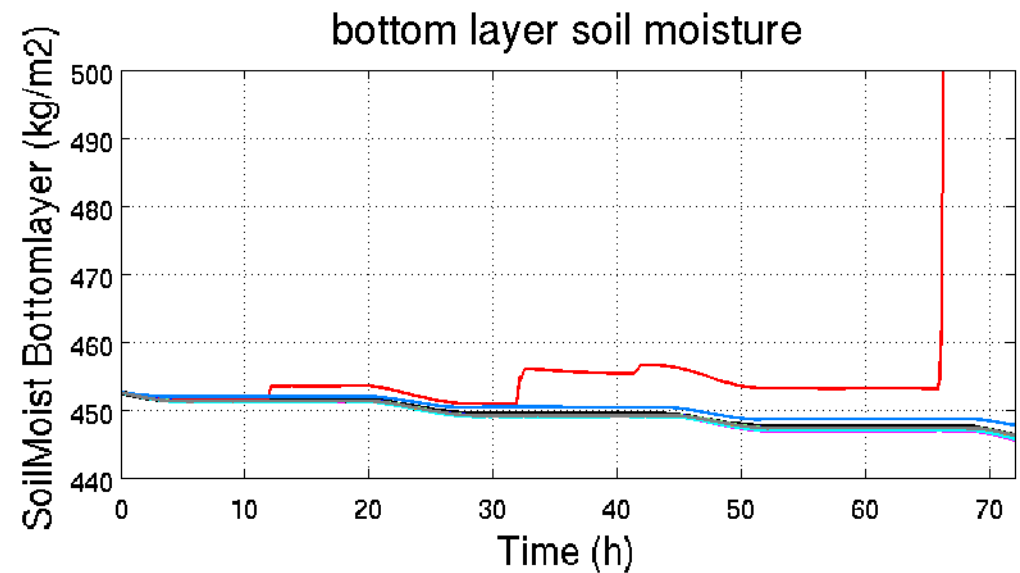
forcing at screen level

forcing at 20m

DICE - Surface: selected results from stage 3a

Color code
thick black**: **stage 1a
other colors: stage 3a

forcing at screen level
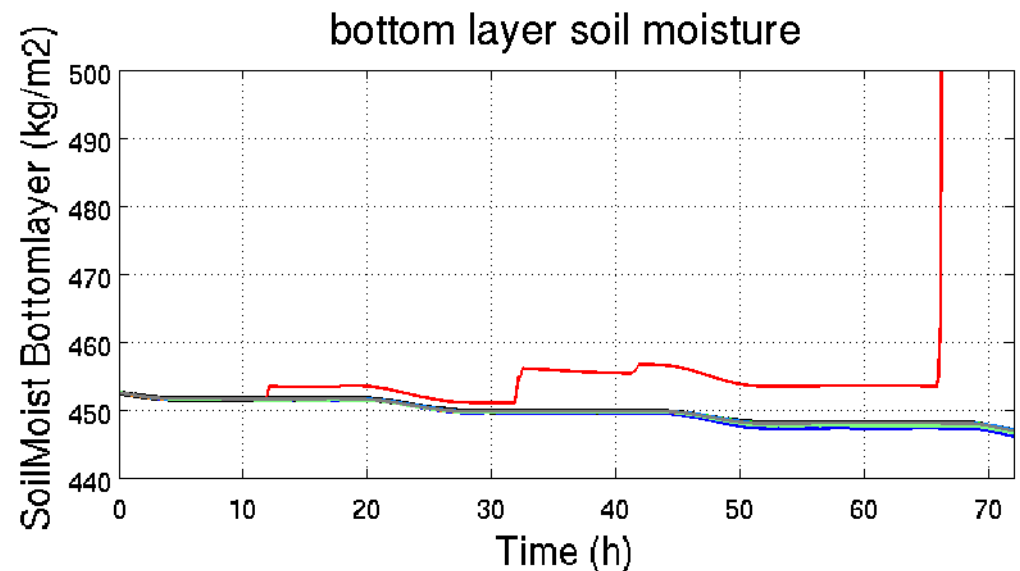
forcing at 20m

bottom layer soil temperature

bottom layer soil temperature

DICE - Surface: selected results from stage 3a

Color code
thick black*: **stage 1a***
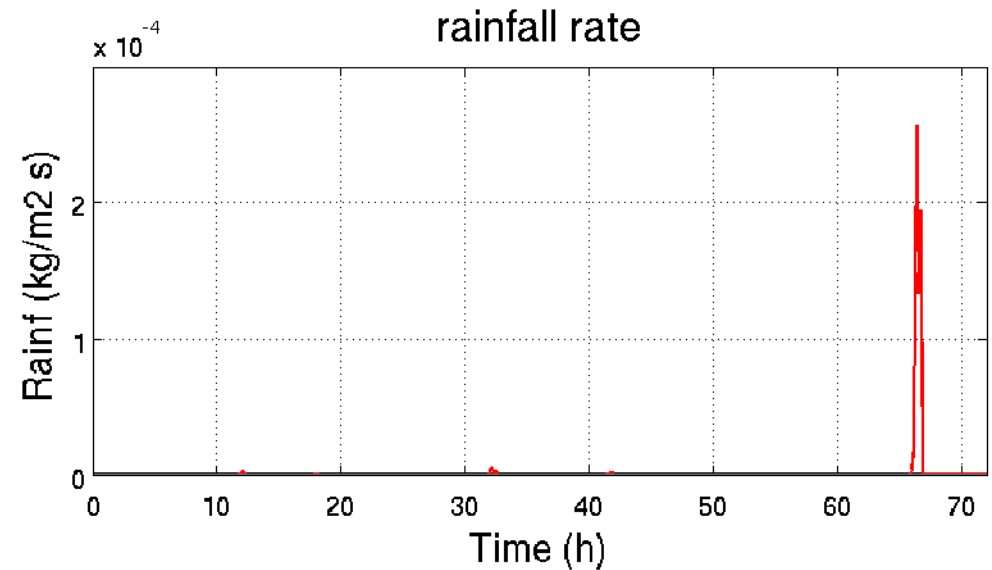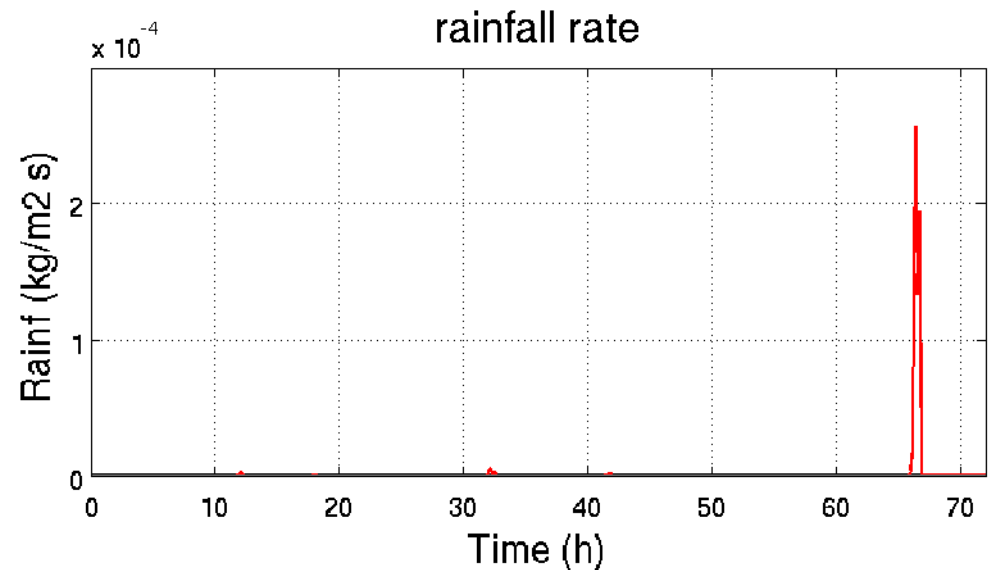*other colors: stage 3a*

forcing at screen level

top layer soil moisture

forcing at 20m

top layer soil moisture

DICE - Surface: selected results from stage 3a

Color code
thick black**: **stage 1a
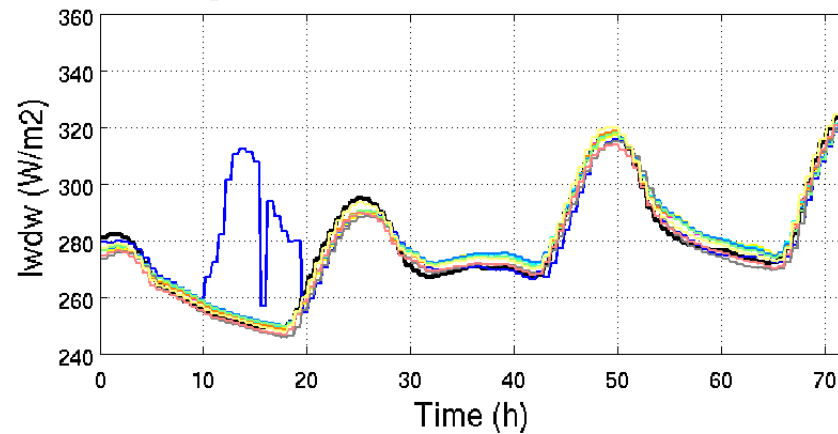*other colors: stage 3a*
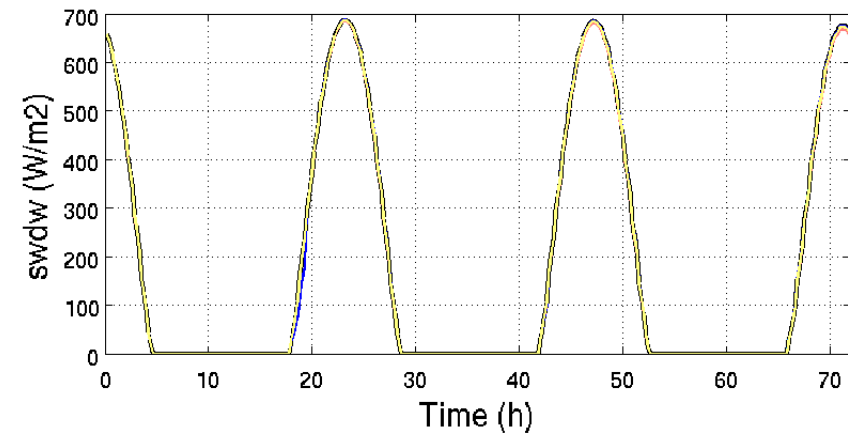
forcing at screen level

forcing at 20m

DICE - Surface: selected results from stage 3a

Color code
thick black*: **stage 1a***
other colors: stage 3a

forcing at screen level

rainfall rate

forcing at 20m

rainfall rate

DICE - SCM:
selected results from
stage 3b

Color code
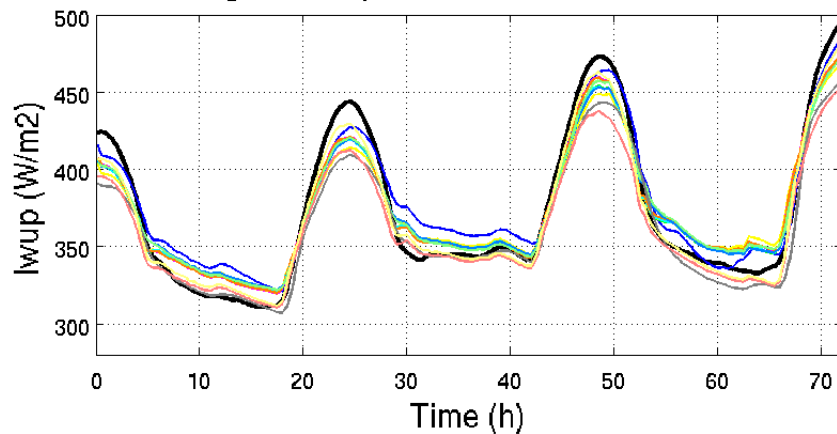***thick black****: **stage 1b***
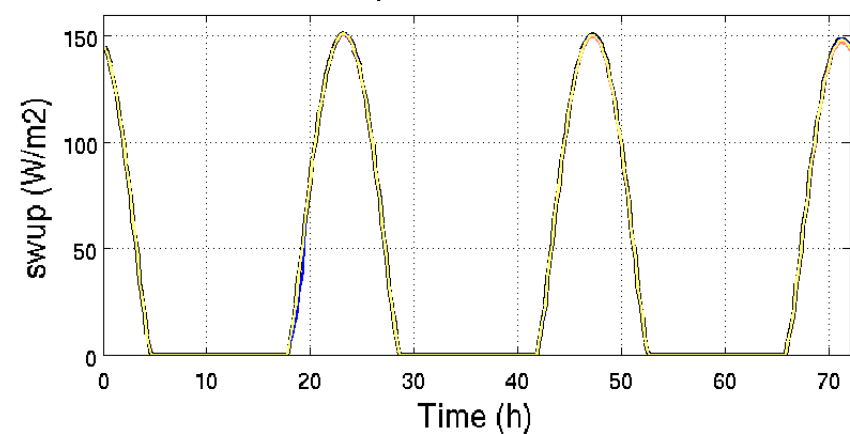*other colors: stage 3b*

long wave downward radiation at surface

short wave downward radiation at surface
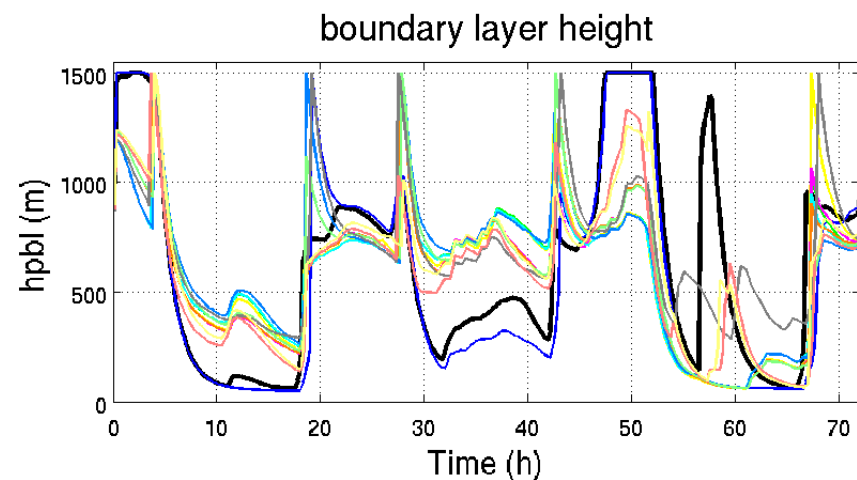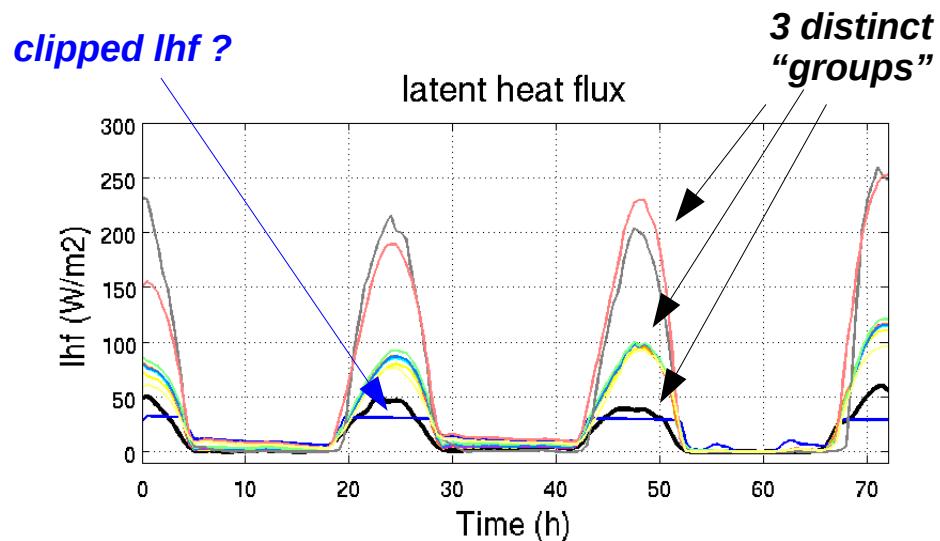
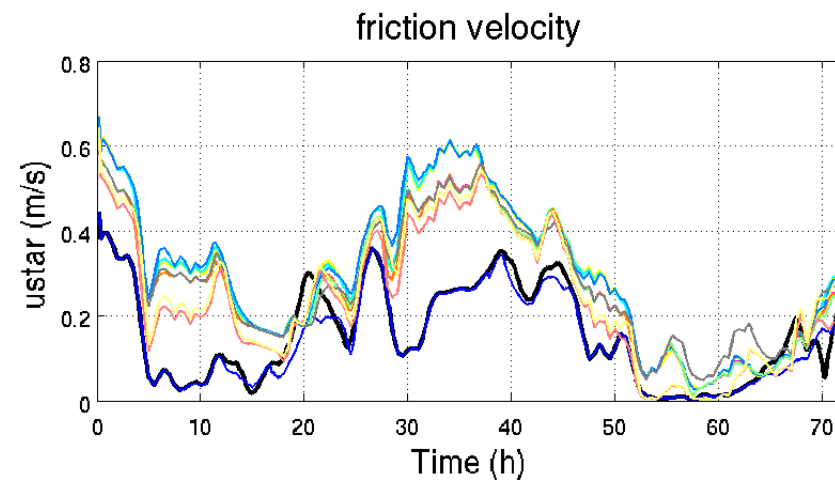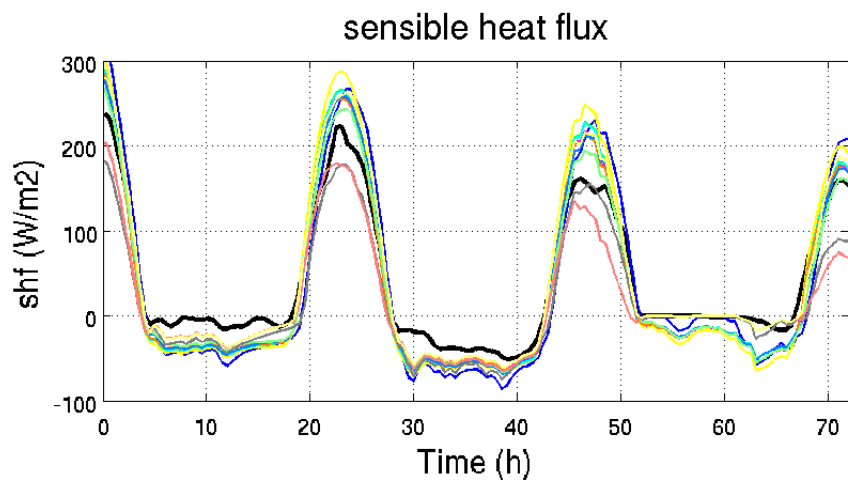long wave upward radiation at surface

short wave upward radiation at surface

DICE - SCM: selected results from stage 3b

Color code
thick black**: **stage 1b
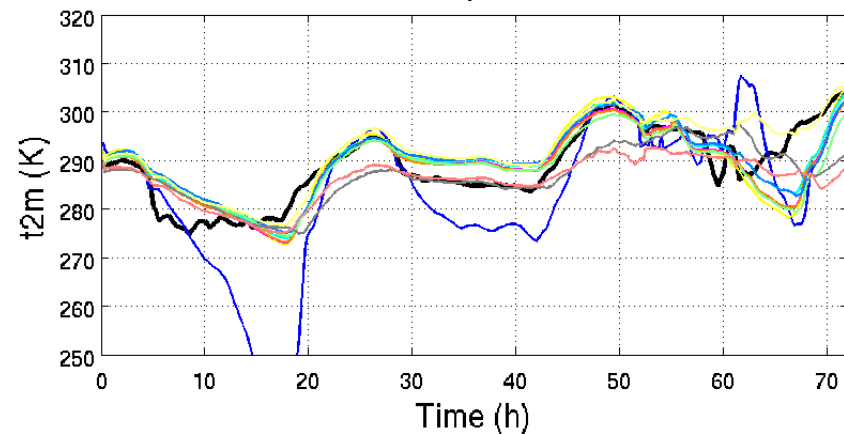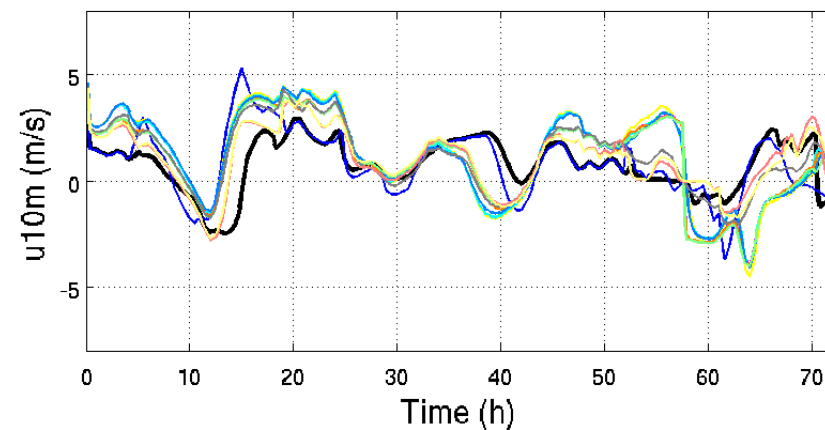*other colors: stage 3b*

sensible heat flux

friction velocity

clipped lhf ?

3 distinct "groups"

latent heat flux

boundary layer height

DICE - SCM: selected results from stage 3b

DICE - SCM: selected results from stage 3b

Color code
thick black*: **stage 1b***
other colors: stage 3b

DICE - SCM: selected results from stage 3b
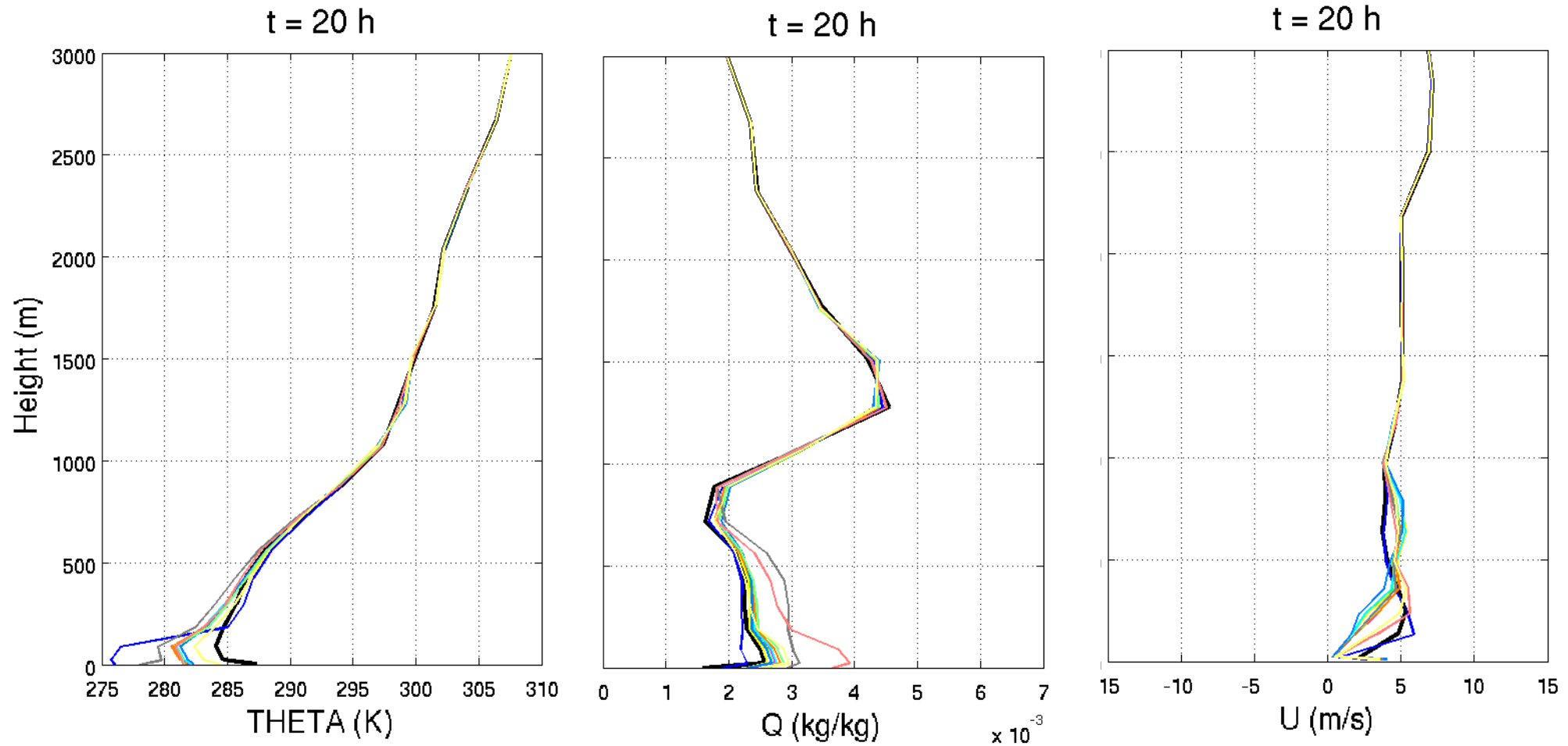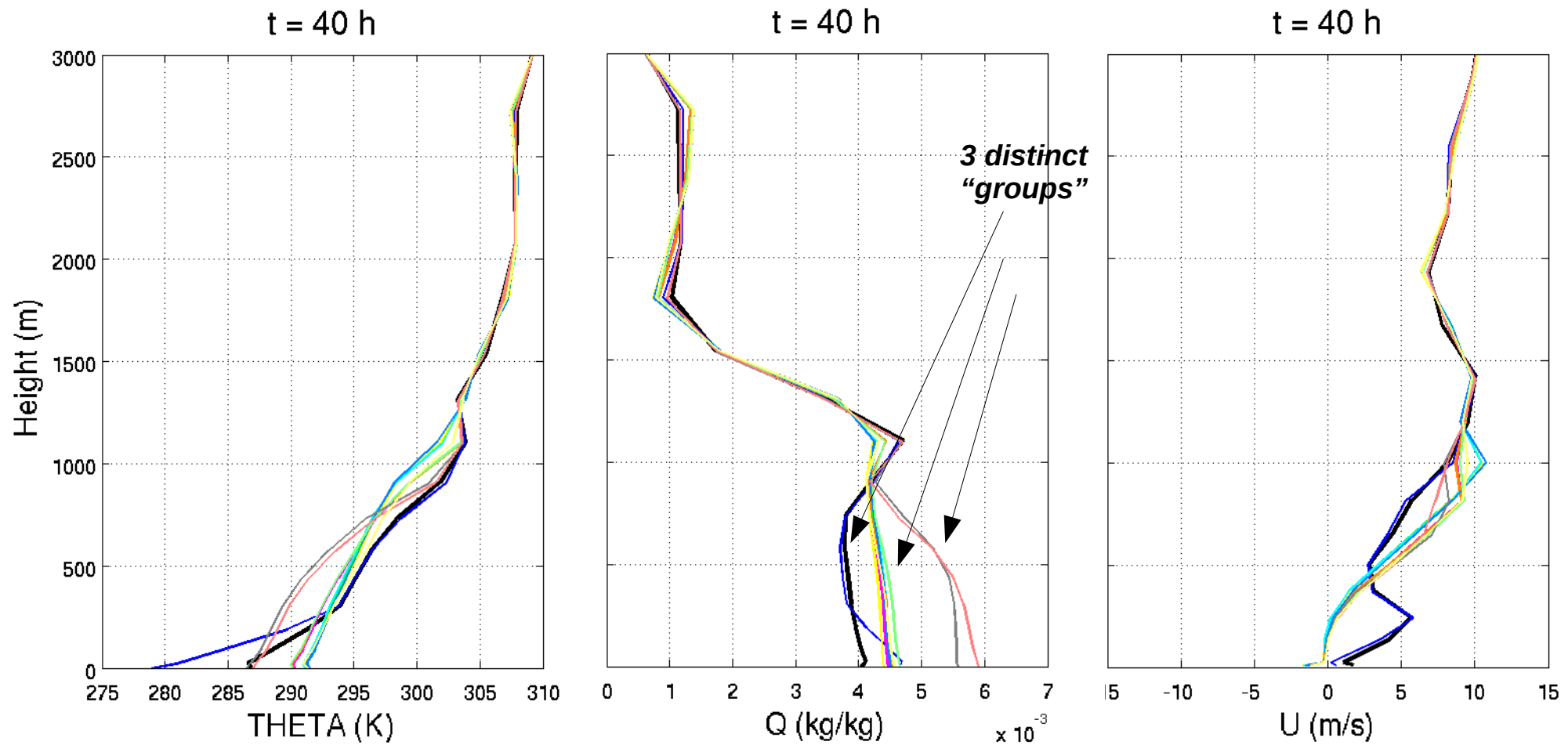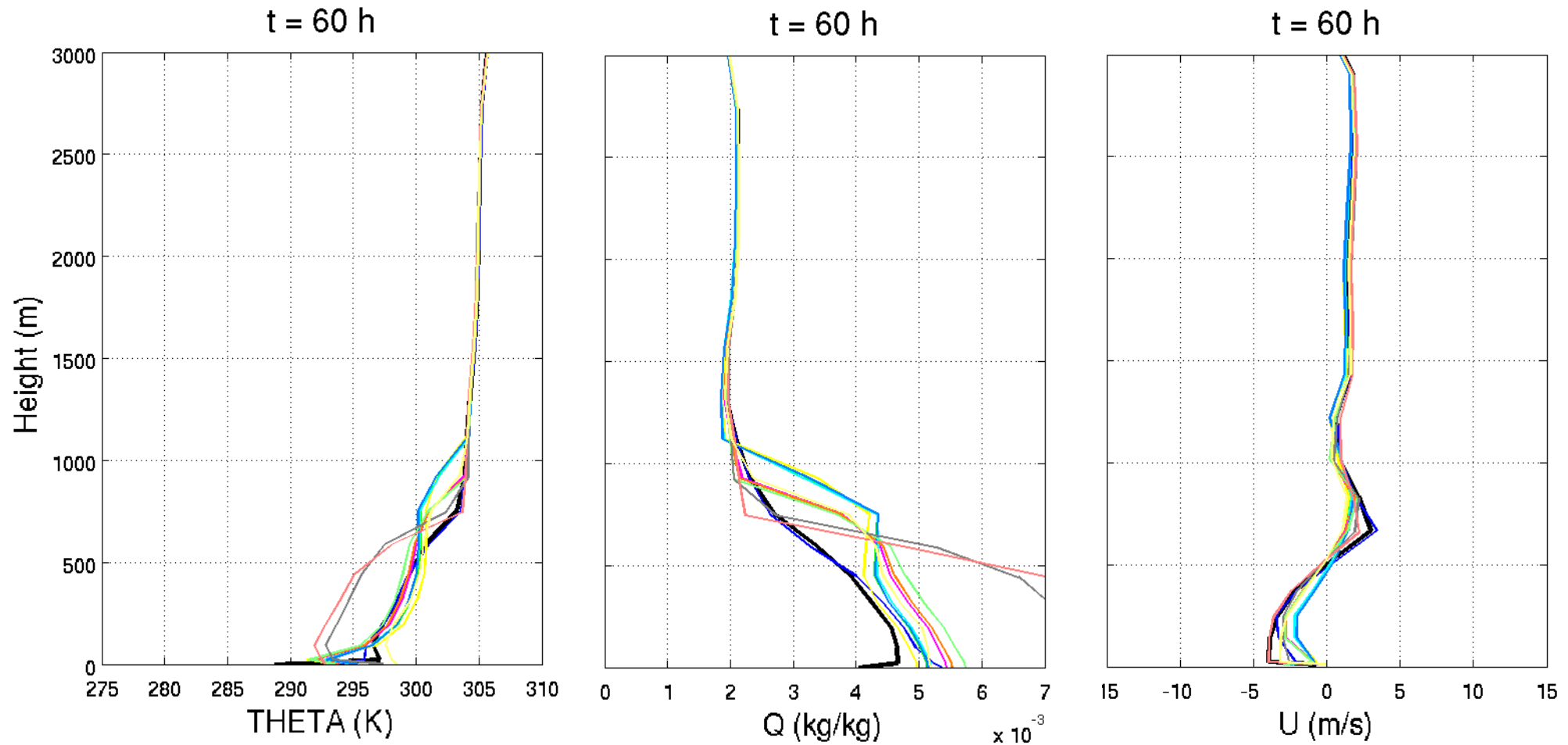
t = 40 h   t = 40 h   t = 40 h

3 distinct "groups"

THETA (K)   Q (kg/kg)   x 10⁻³   U (m/s)

Height (m)

DICE - SCM: selected results from stage 3b

Summary

- strongest sensitivity to soil moisture and latent heat fluxes
- constraints in the calculation of heat fluxes imply that model cannot easily
  take any type of forcings
- detailed analysis of results remains to-be-done

Acknowledgements

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- *Marco Carrera (RPN/EC) for help with surface scheme*