Validation of different approaches to forecast near surface cloud water in NWP models

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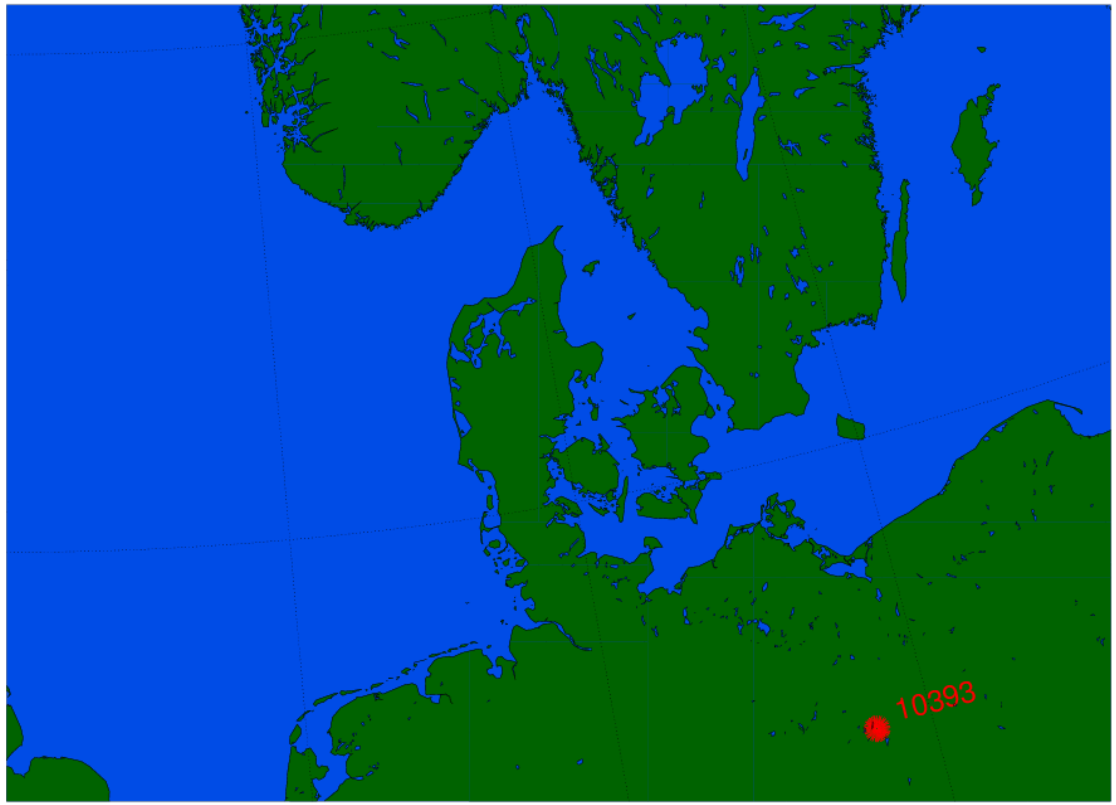
Motivation

- COST722: Comparison of 4 European High Resolution Fog Models
- Statistical comparison was done for a 4 months period for Lindenberg, Germany
- The models were compared in more details on 3 cases

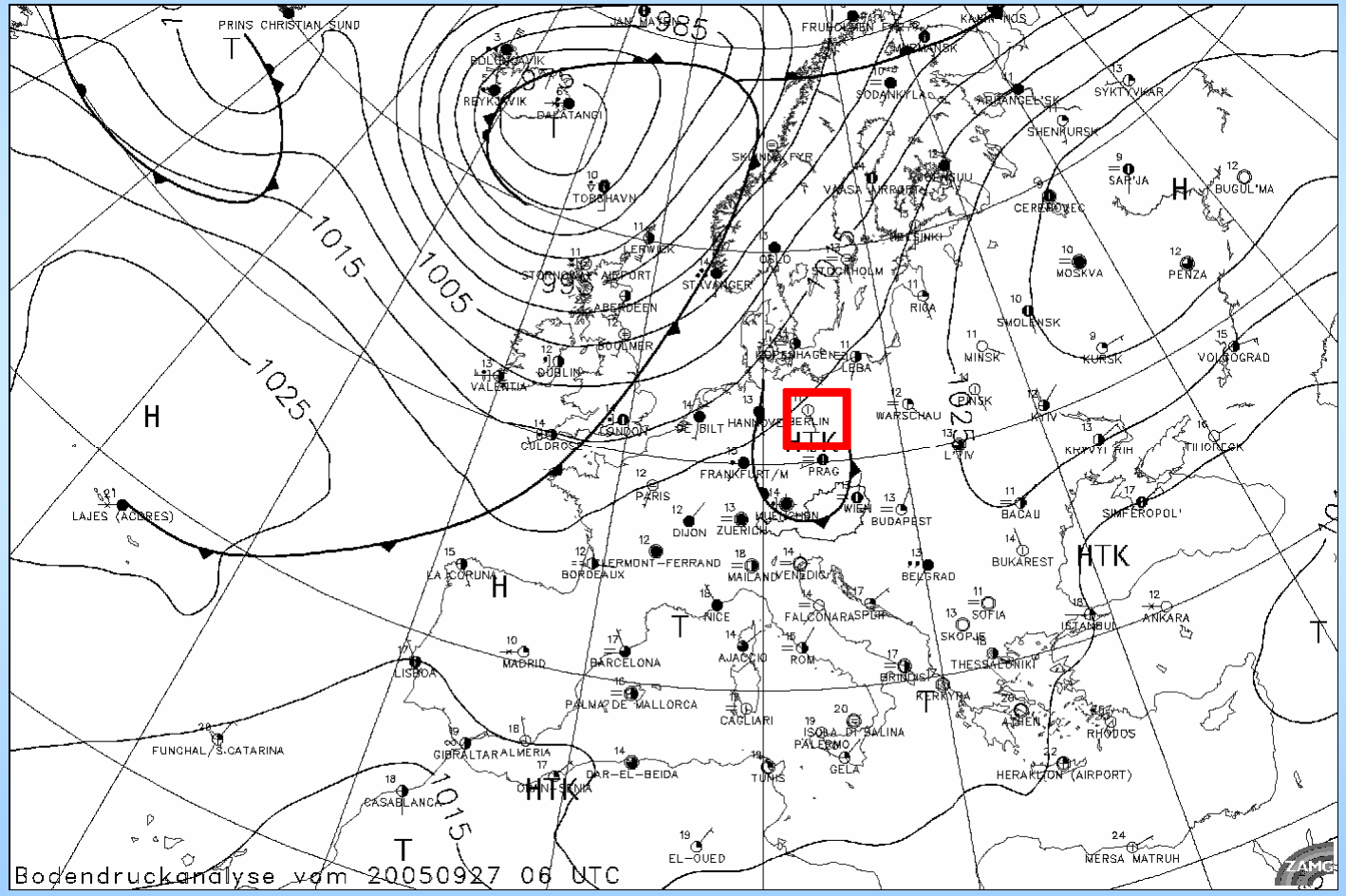
Models

1. Non-hydrostatic, non operational, high vertical/horizontal resolution, complex microphysics
    1. LM-PAFOG (Germany)
    2. NMM-PAFOG (Switzerland)
2. Statistical model
    1. MOS-ARGEGE (France)
3. Hydrostatic, operational, lower vertical/horizontal resolution, ad hoc treatment of cloud water near the surface
    1. DMI-HIRLAM (Denmark)
    2. ALADIN-AUSTRIA (Austria)

Location of Lindenberg site



Case 1: Fog episode with partial cloud cover. 27 September 2005 in the morning



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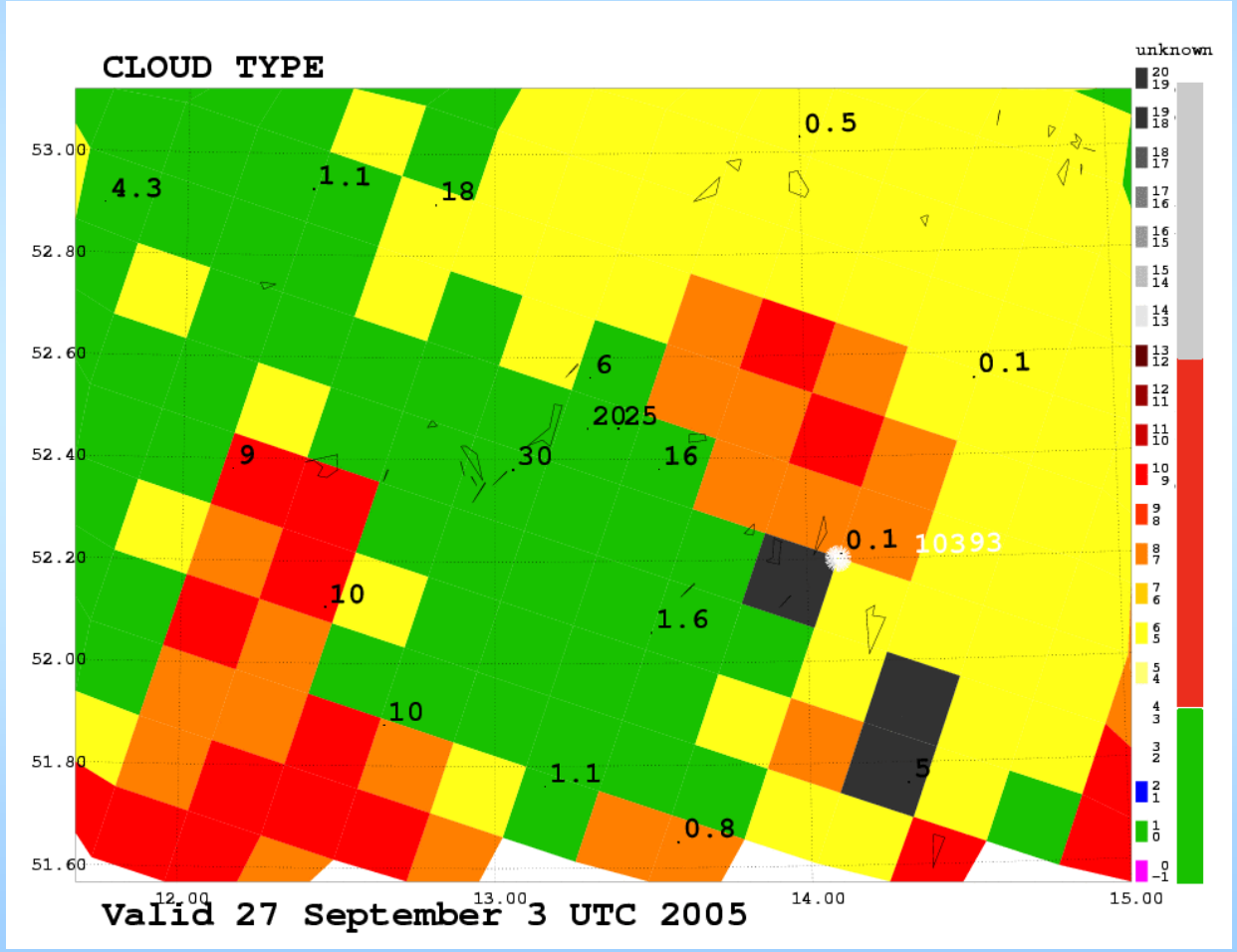
Observed visibility and derived cloud type



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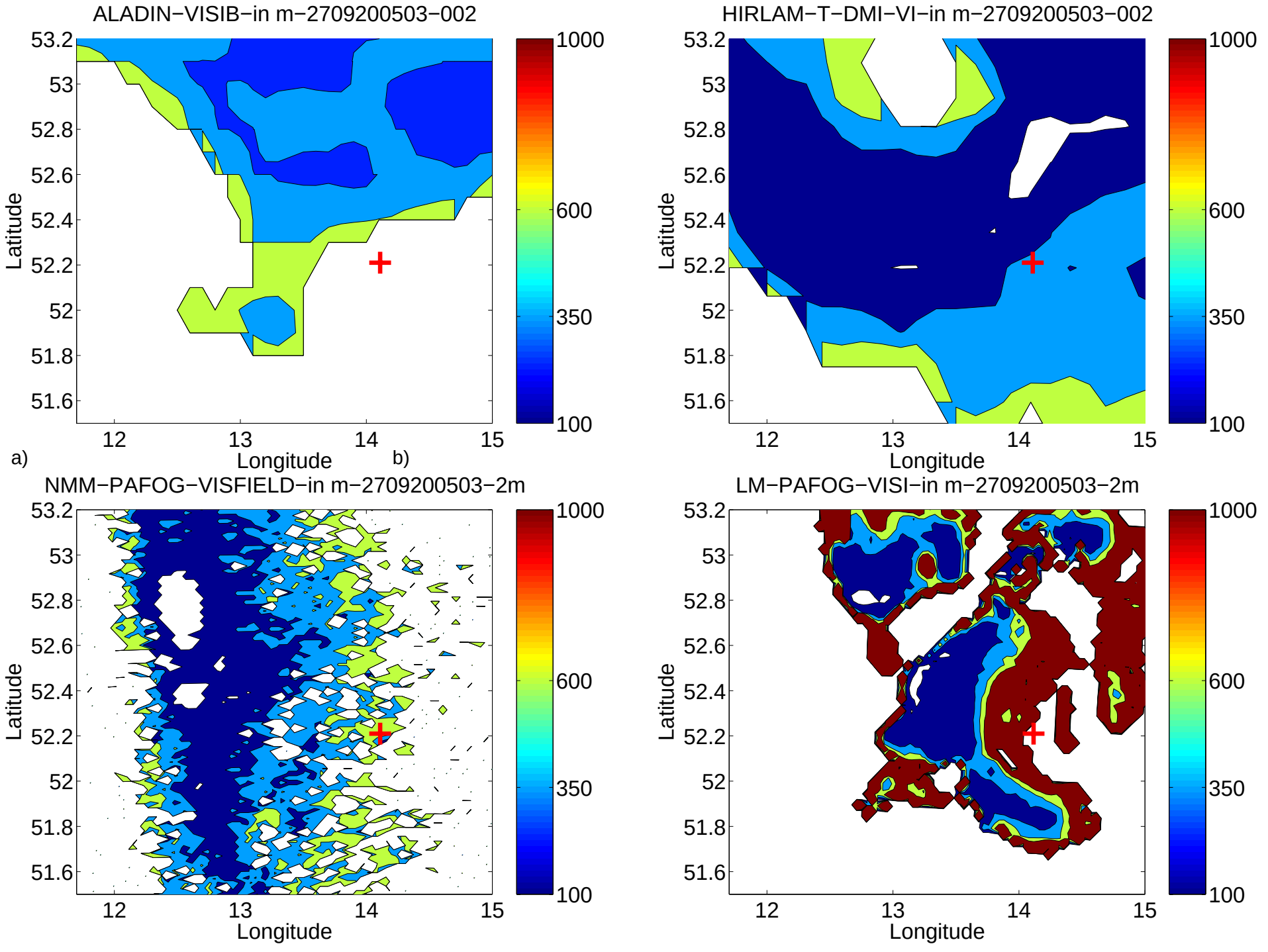
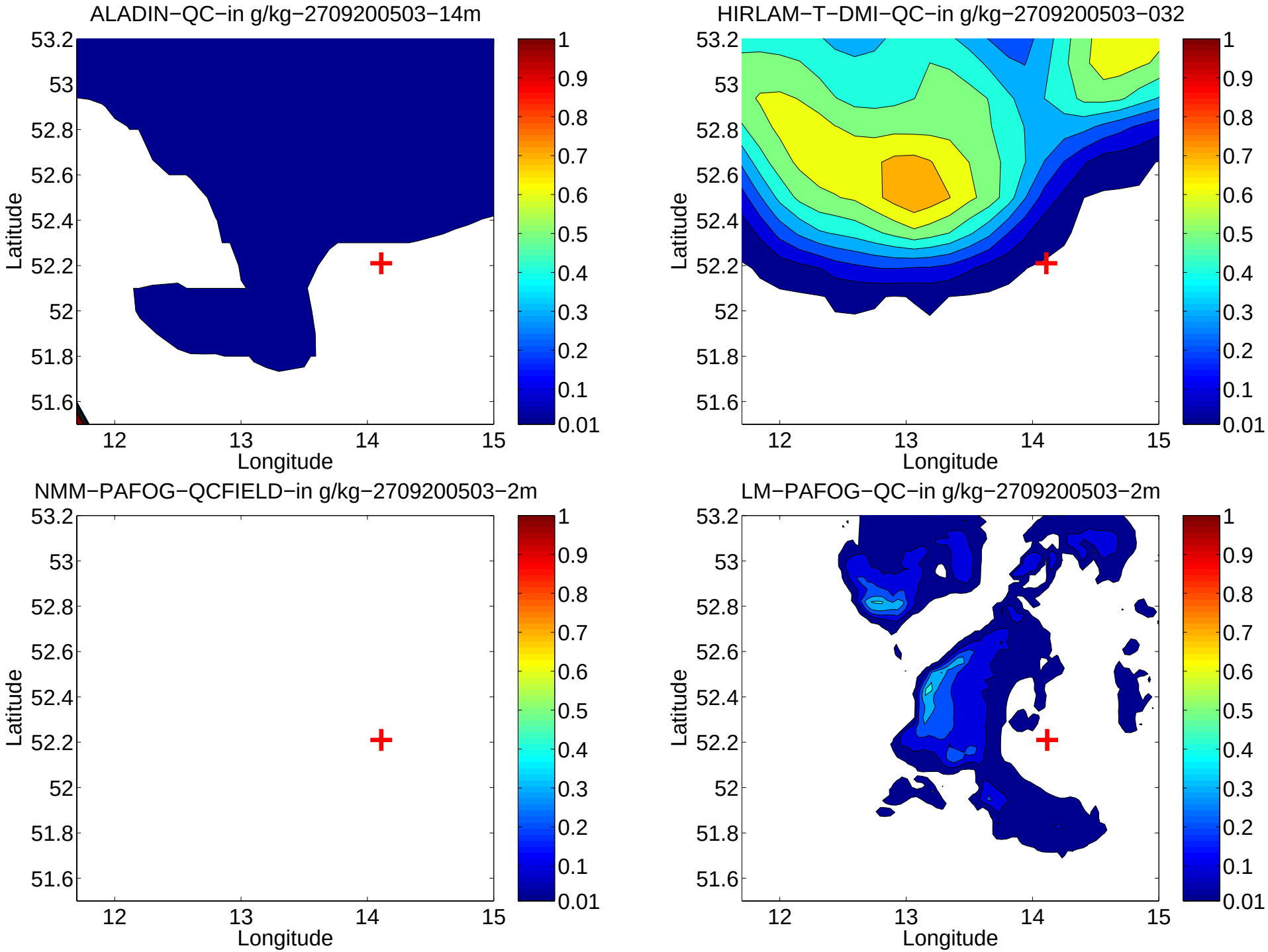

ALADIN−VISIB−in m−2709200503−002
HIRLAM−T−DMI−VI−in m−2709200503−002
NMM−PAFOG−VISFIELD−in m−2709200503−2m
LM−PAFOG−VISI−in m−2709200503−2m
Latitude
Longitude
53.2
53
52.8
52.6
52.4
52.2
52
51.8
51.6
12
13
14
15
1000
600
350
100
a)
b)


ALADIN−QC−in g/kg−2709200503−14m
HIRLAM−T−DMI−QC−in g/kg−2709200503−032
NMM−PAFOG−QCFIELD−in g/kg−2709200503−2m
LM−PAFOG−QC−in g/kg−2709200503−2m
Latitude
Longitude
53.2
53
52.8
52.6
52.4
52.2
52
51.8
51.6
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0.9
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0.7
0.6
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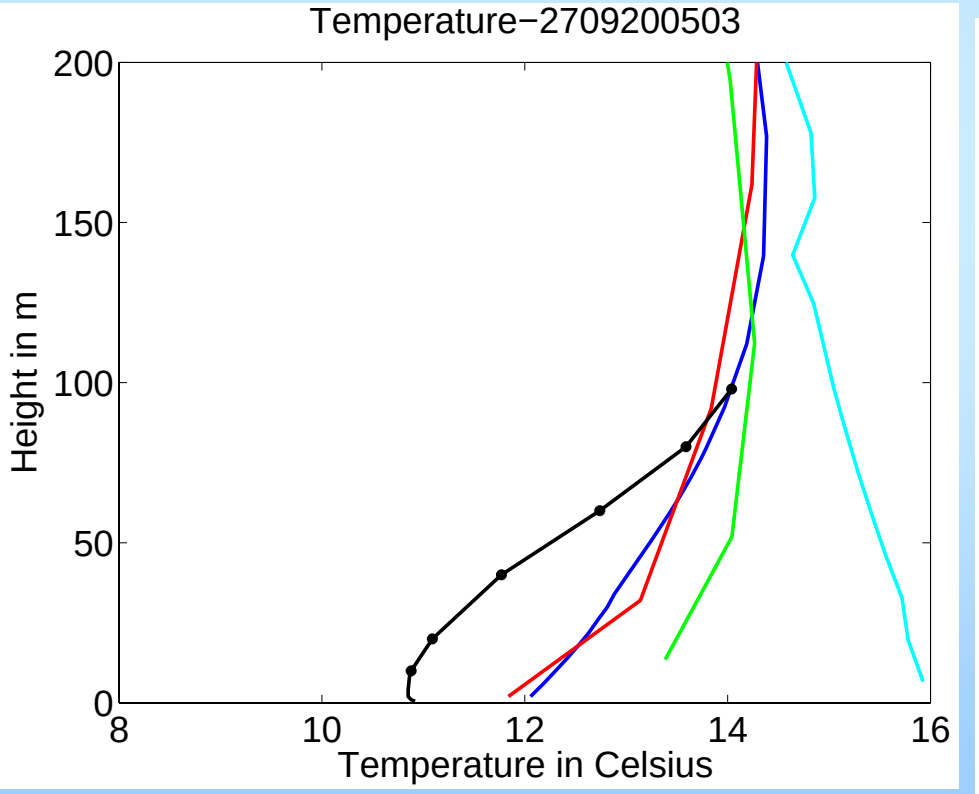
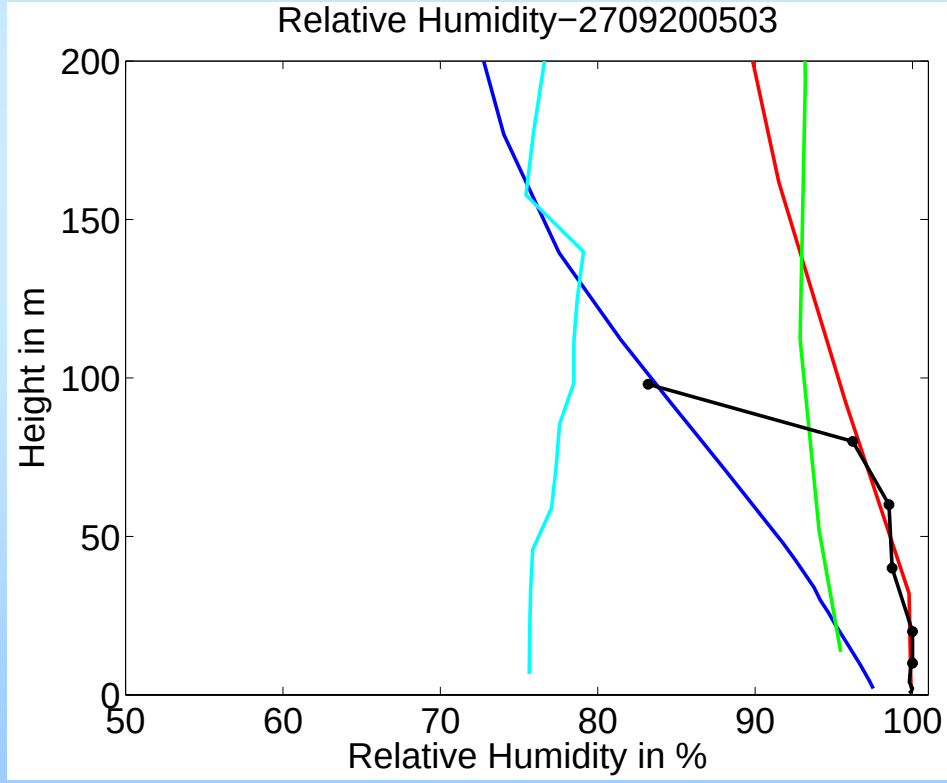
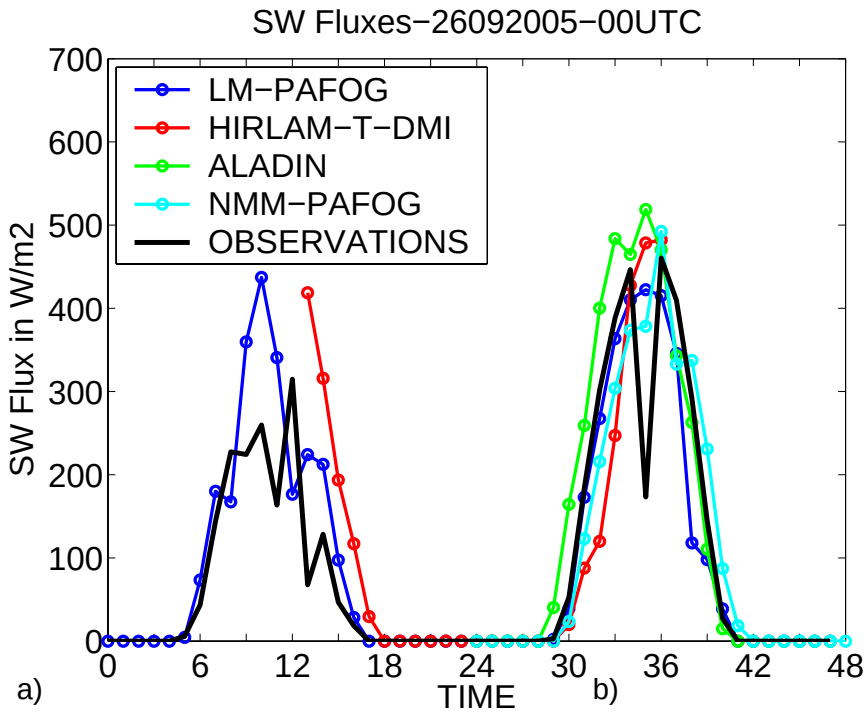
0.4
0.3
0.2
0.1
0.01

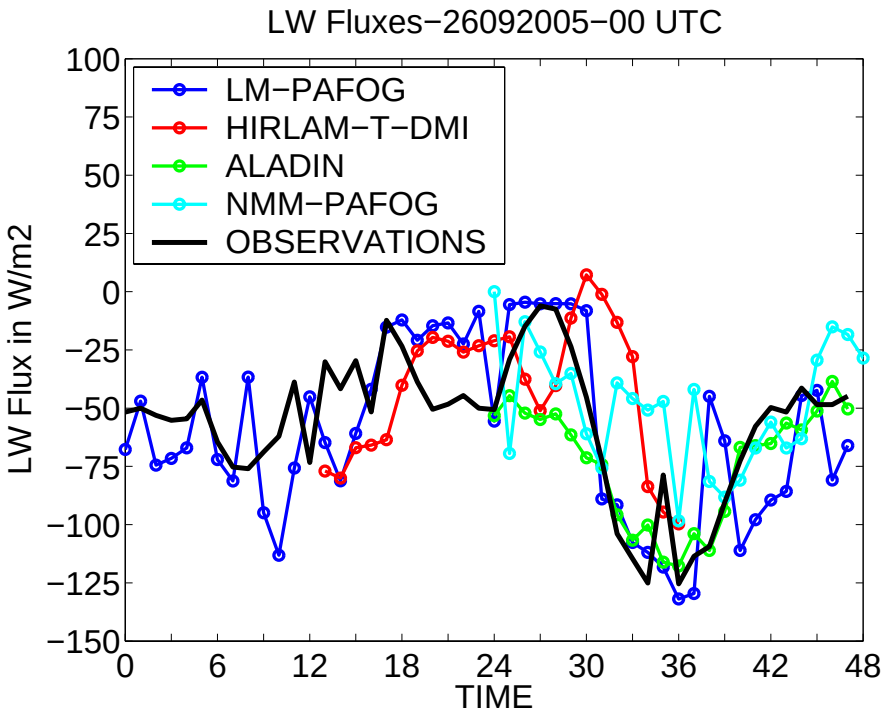
Vertical profile at Lindenberg

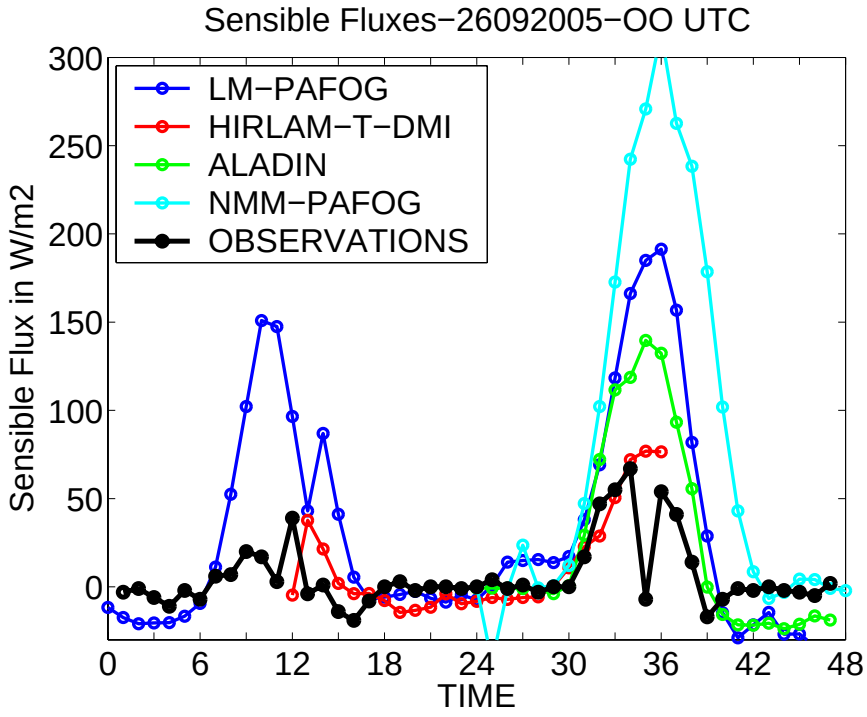
BLACK:OBSERVED RED: HIRLAM GREEN:ALADIN CYAN:NMM-PAFOG BLUE:LM-PAFOG

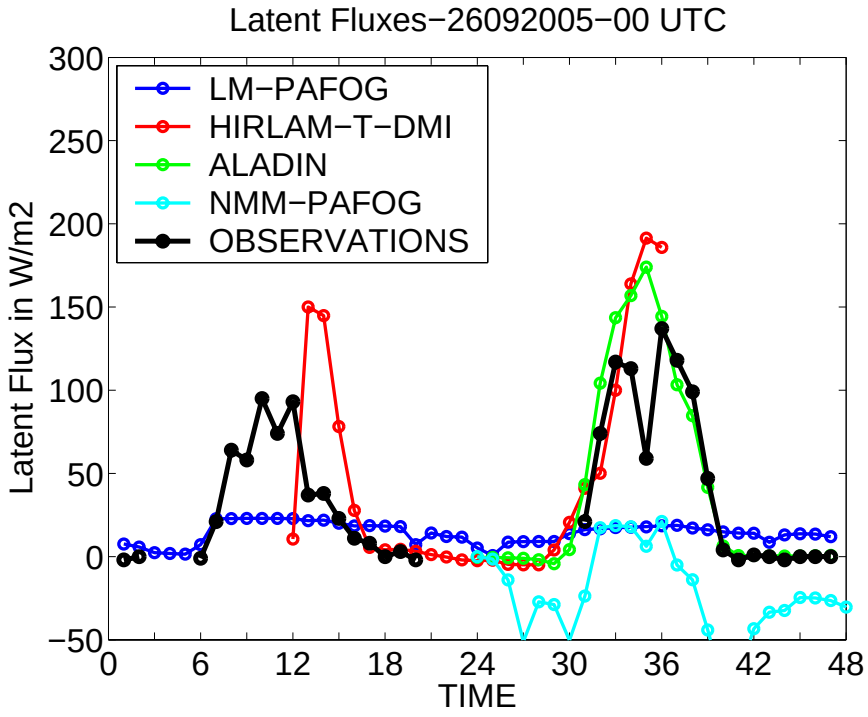


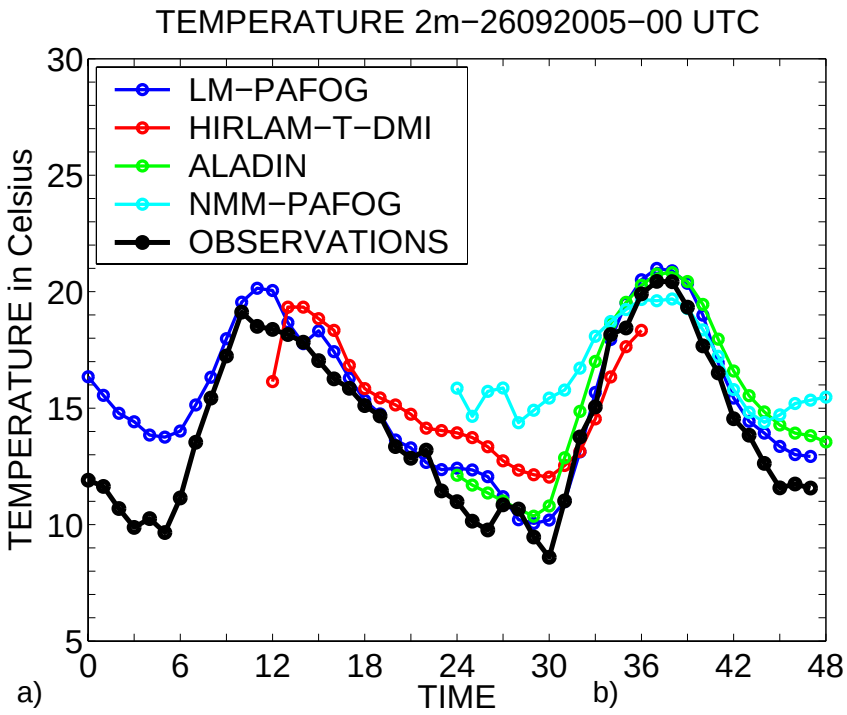


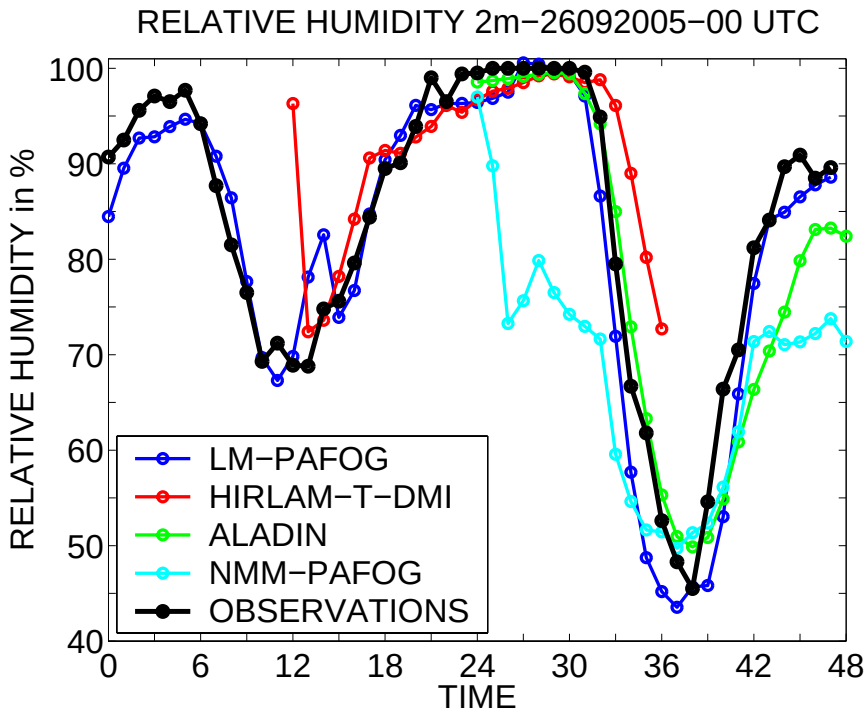

SW Fluxes−26092005−00UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
SW Flux in W/m2
TIME
a)
b)

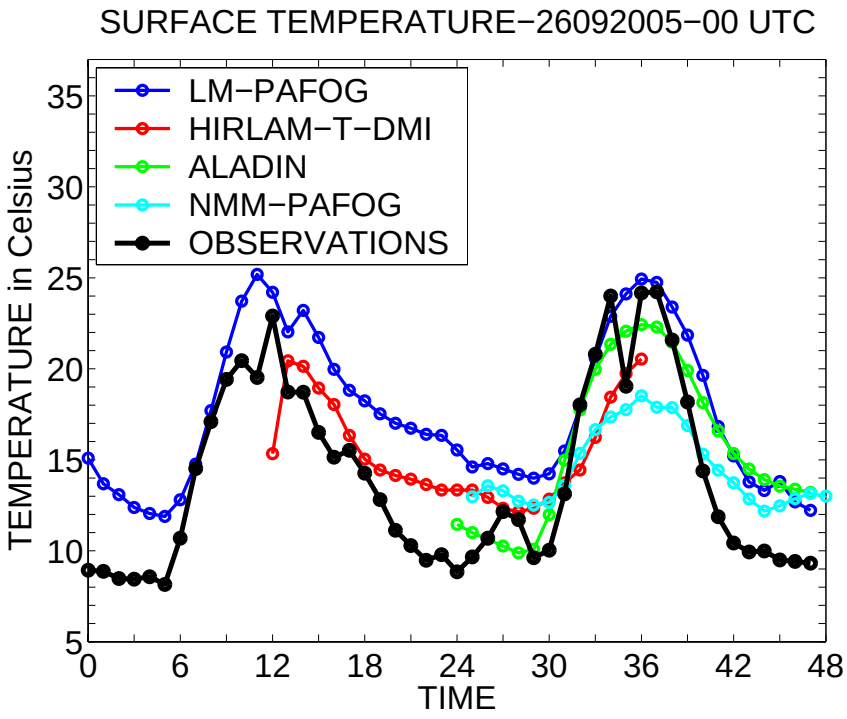

LW Fluxes−26092005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
LW Flux in W/m2
TIME

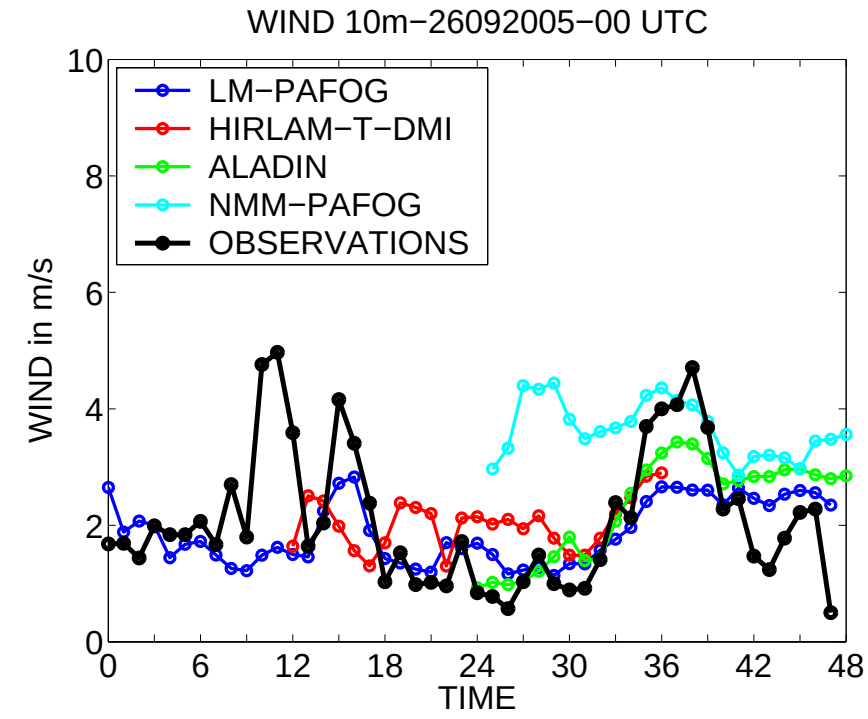

Sensible Fluxes−26092005−OO UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
Sensible Flux in W/m2
TIME


Latent Fluxes−26092005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
Latent Flux in W/m2
TIME

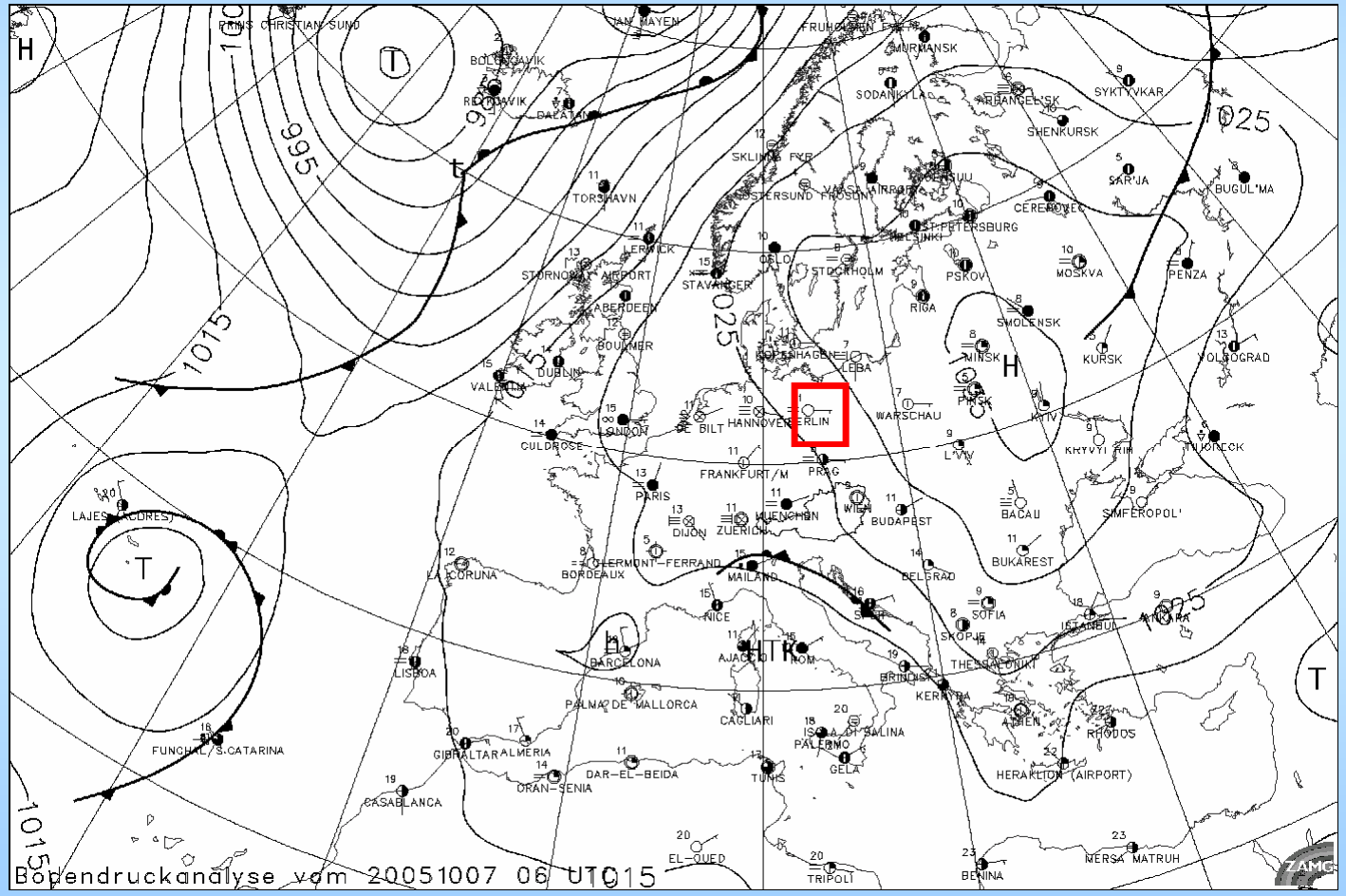

TEMPERATURE 2m−26092005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
TEMPERATURE in Celsius
TIME
a)


RELATIVE HUMIDITY 2m−26092005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
RELATIVE HUMIDITY in %
TIME
b)


SURFACE TEMPERATURE−26092005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
TEMPERATURE in Celsius
TIME


WIND 10m−26092005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
WIND in m/s
TIME

Case 2: Fog episode without cloud cover. 7 October 2005 in the morning



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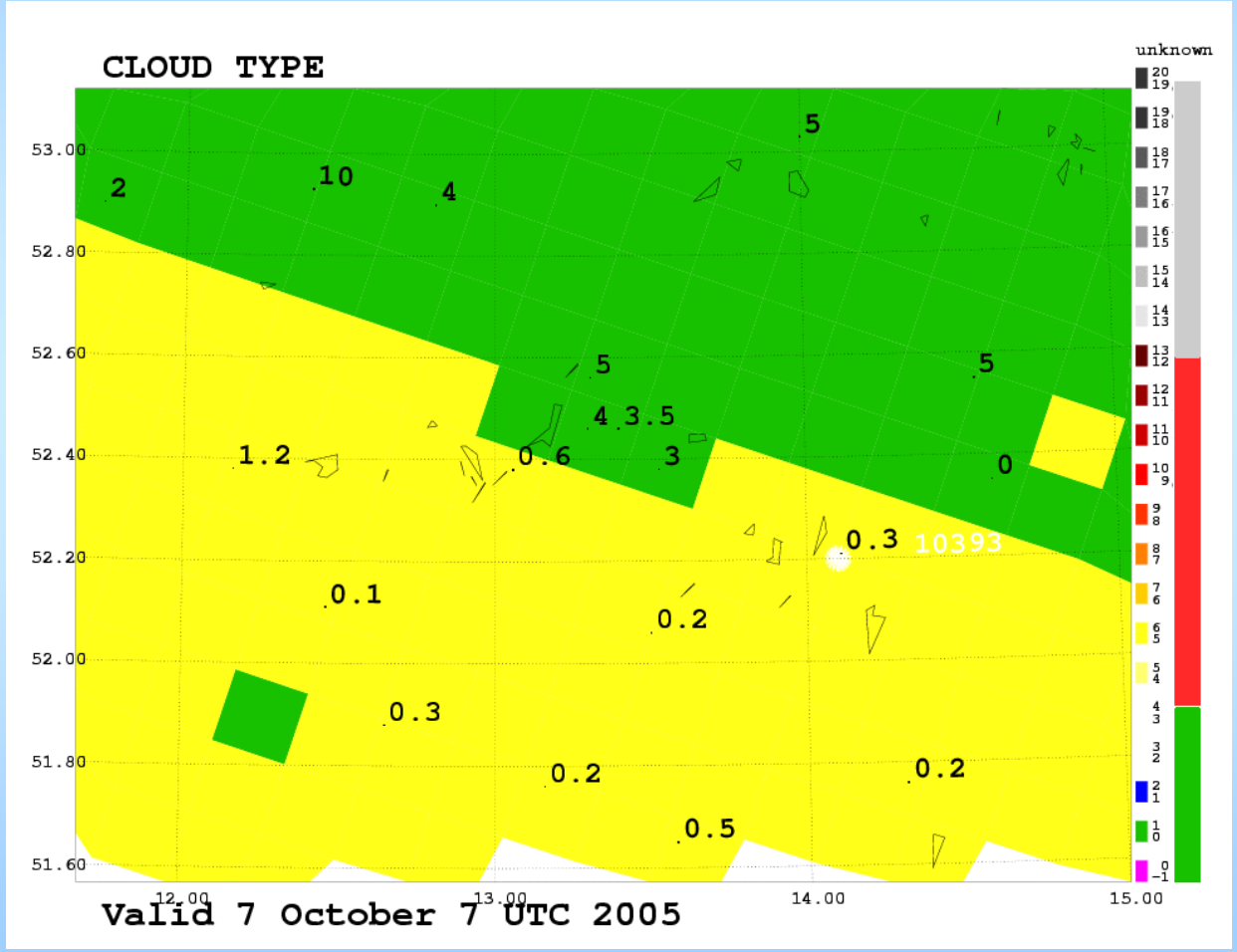
Observed visibility and derived cloud type



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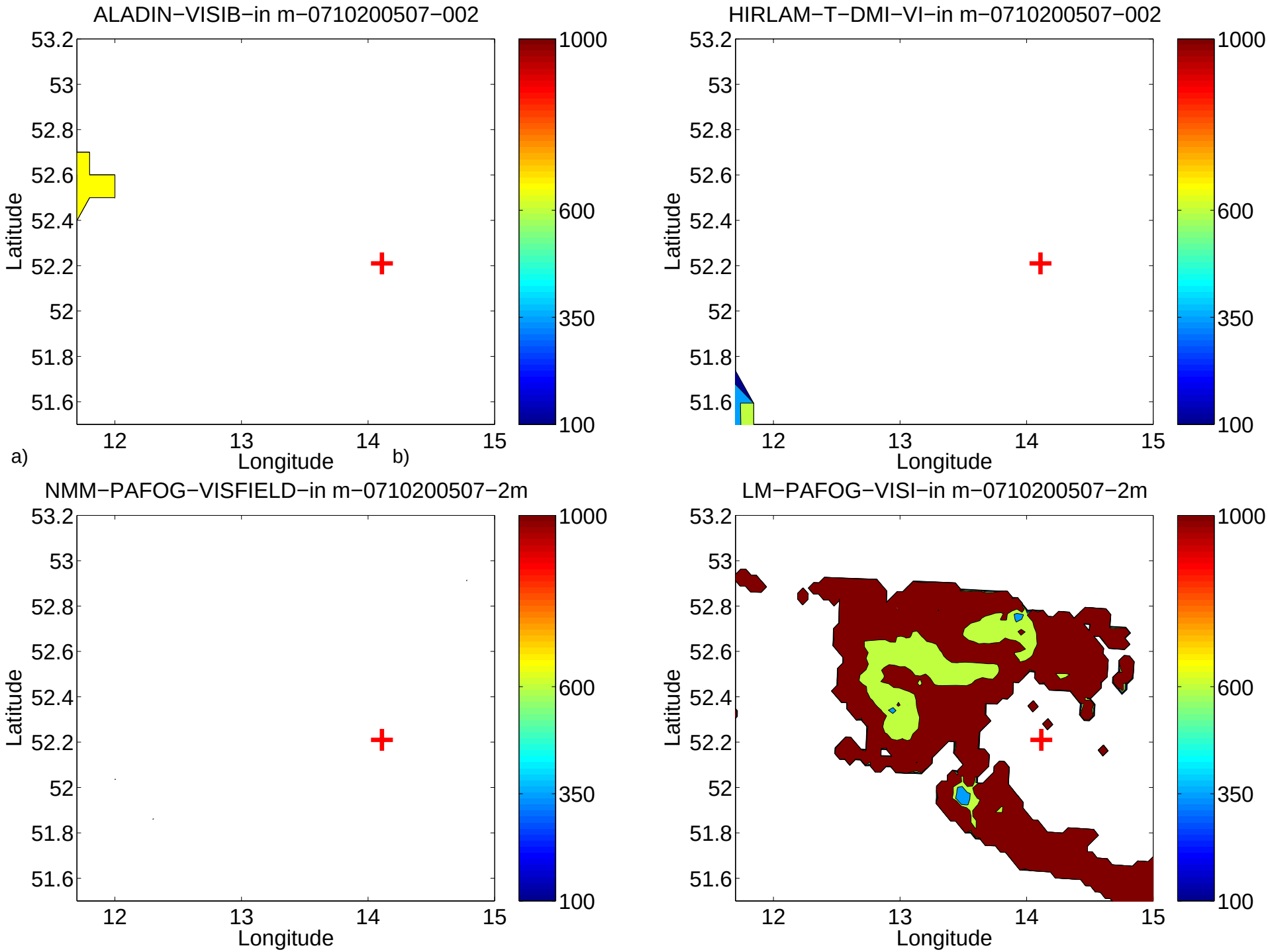
ALADIN−VISIB−in m−0710200507−002
HIRLAM−T−DMI−VI−in m−0710200507−002
NMM−PAFOG−VISFIELD−in m−0710200507−2m
LM−PAFOG−VISI−in m−0710200507−2m
Latitude
Longitude
53.2
53
52.8
52.6
52.4
52.2
52
51.8
51.6
12
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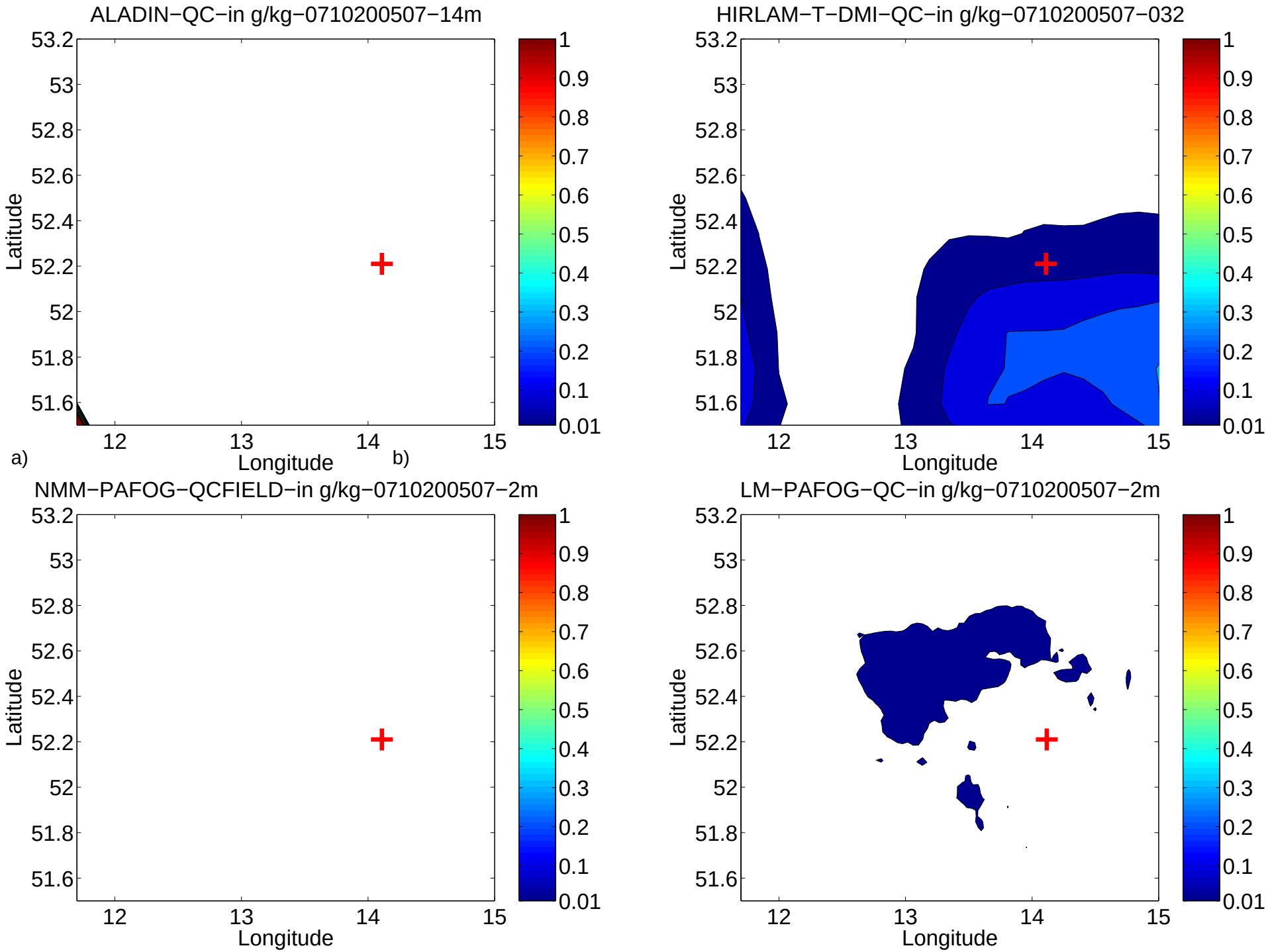
15
1000
600
350
100
a)
b)


ALADIN−QC−in g/kg−0710200507−14m
HIRLAM−T−DMI−QC−in g/kg−0710200507−032
NMM−PAFOG−QCFIELD−in g/kg−0710200507−2m
LM−PAFOG−QC−in g/kg−0710200507−2m
Latitude
Longitude
53.2
53
52.8
52.6
52.4
52.2
52
51.8
51.6
12
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1
0.9
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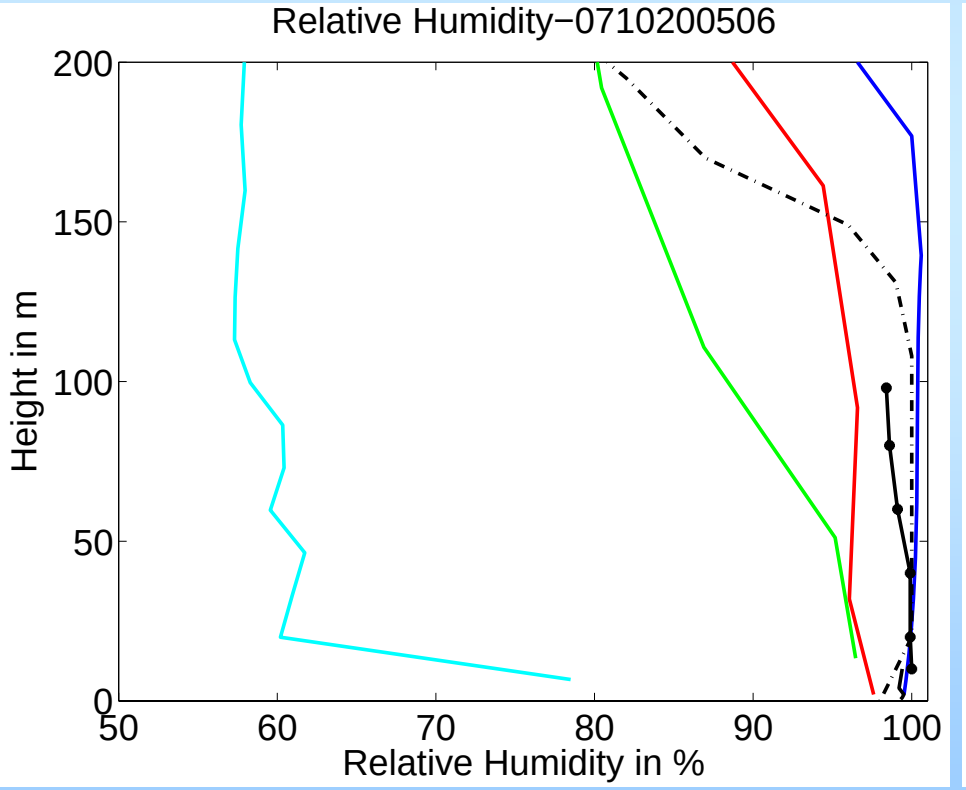
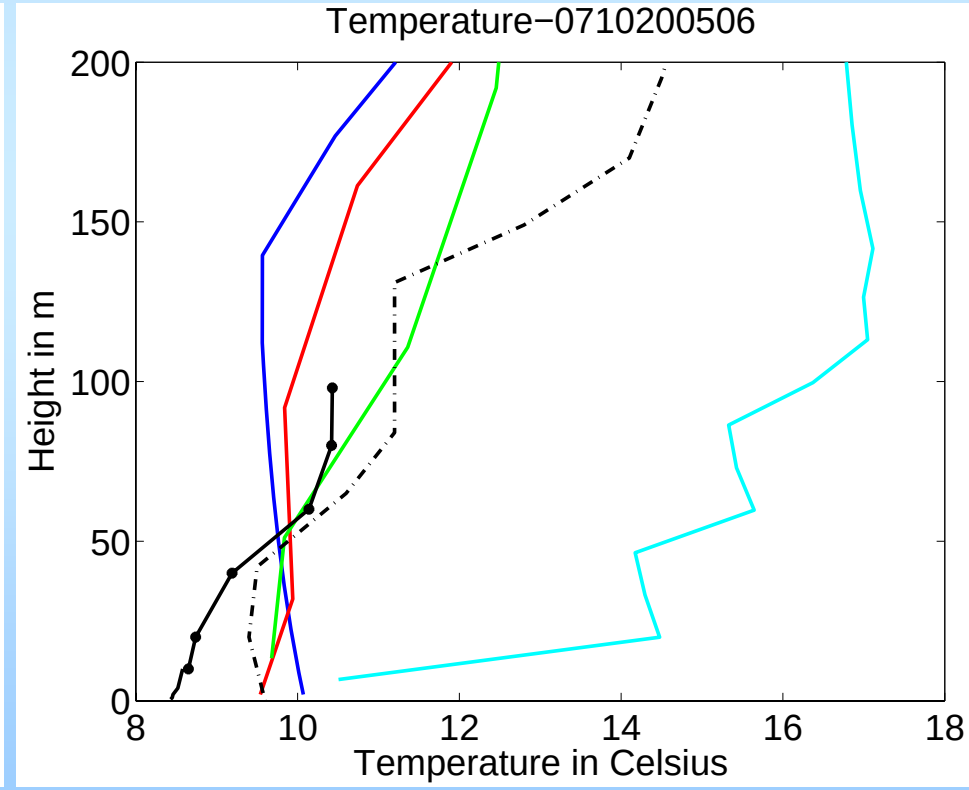
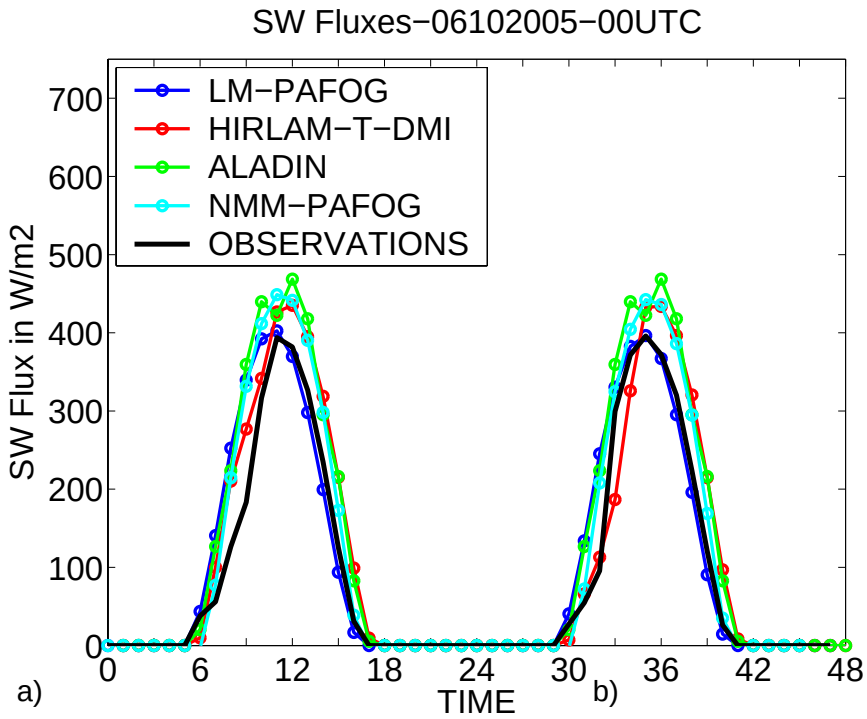
0.5
0.4
0.3
0.2
0.1
0.01
a)
b)

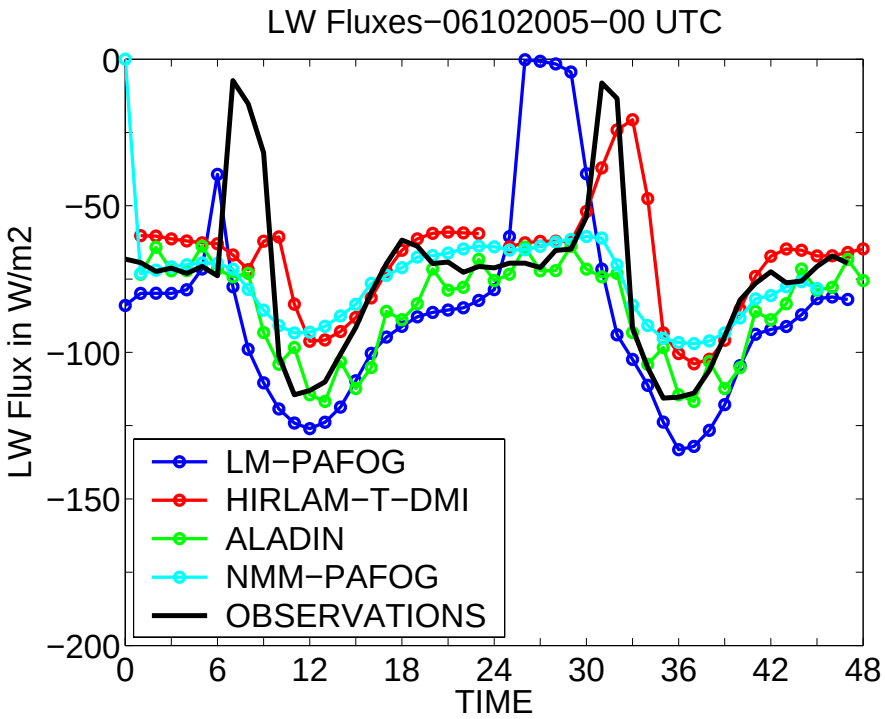
Vertical profile at Lindenberg

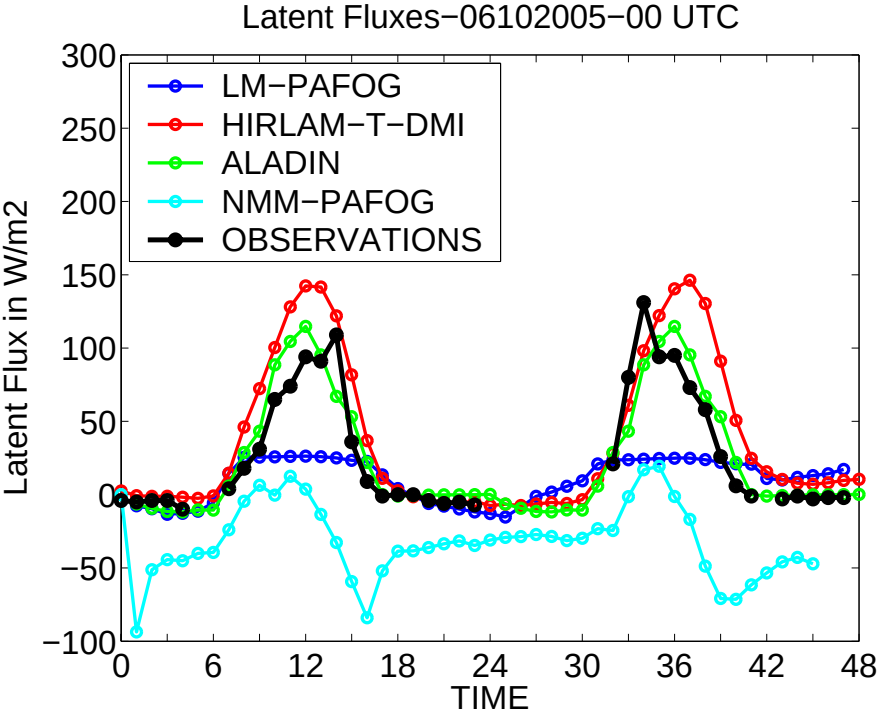
BLACK:OBSERVED RED: HIRLAM GREEN:ALADIN CYAN:NMM-PAFOG BLUE:LM-PAFOG

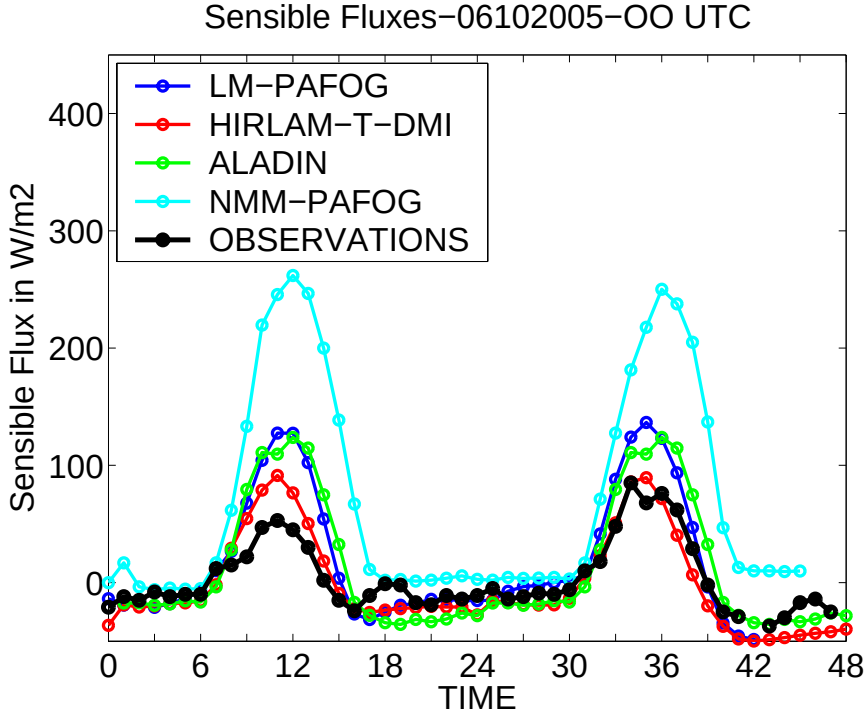


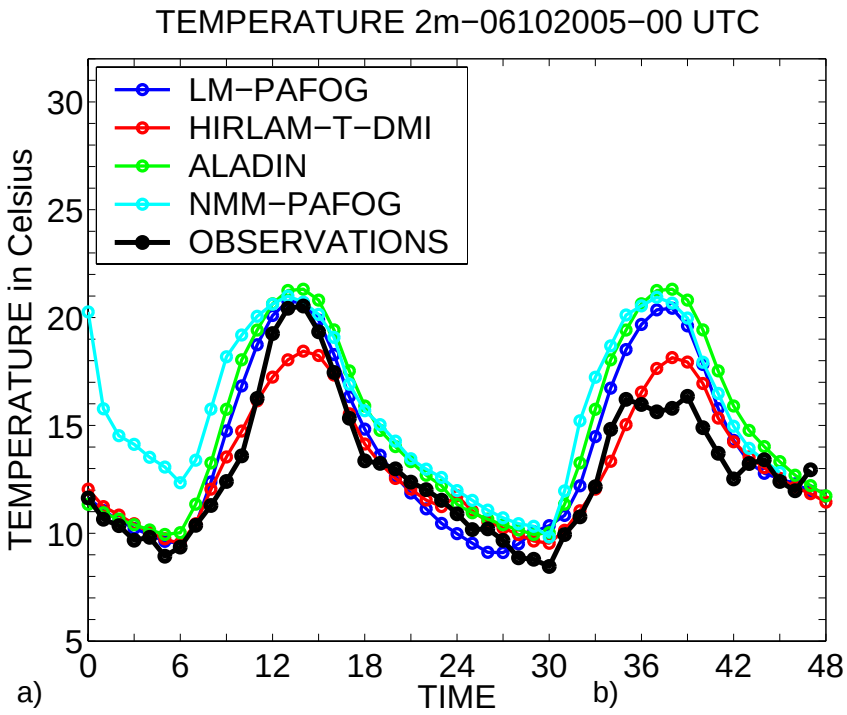


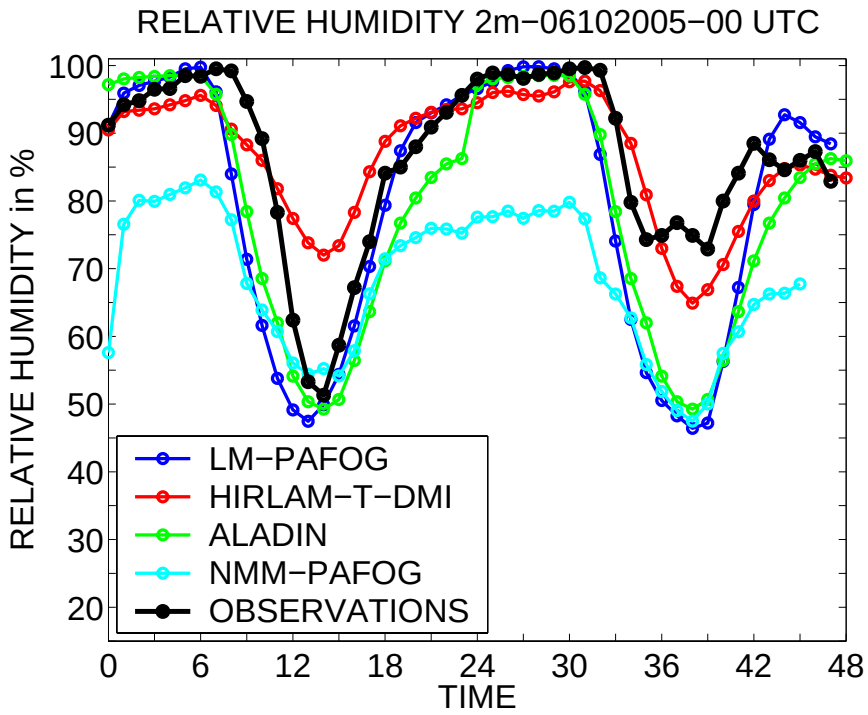

SW Fluxes−06102005−00UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
SW Flux in W/m2
TIME
a)
b)

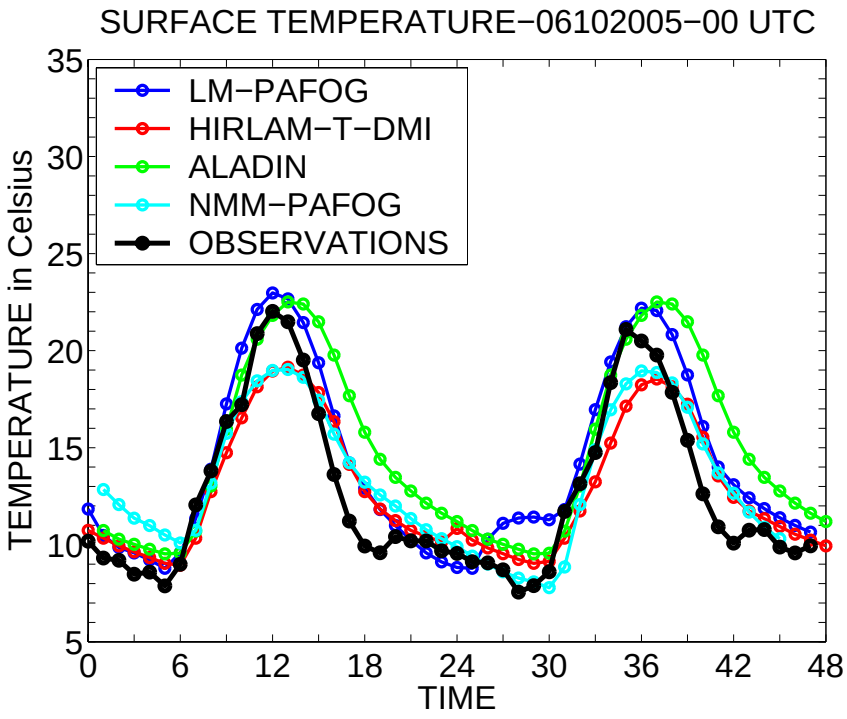

LW Fluxes−06102005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
LW Flux in W/m2
TIME

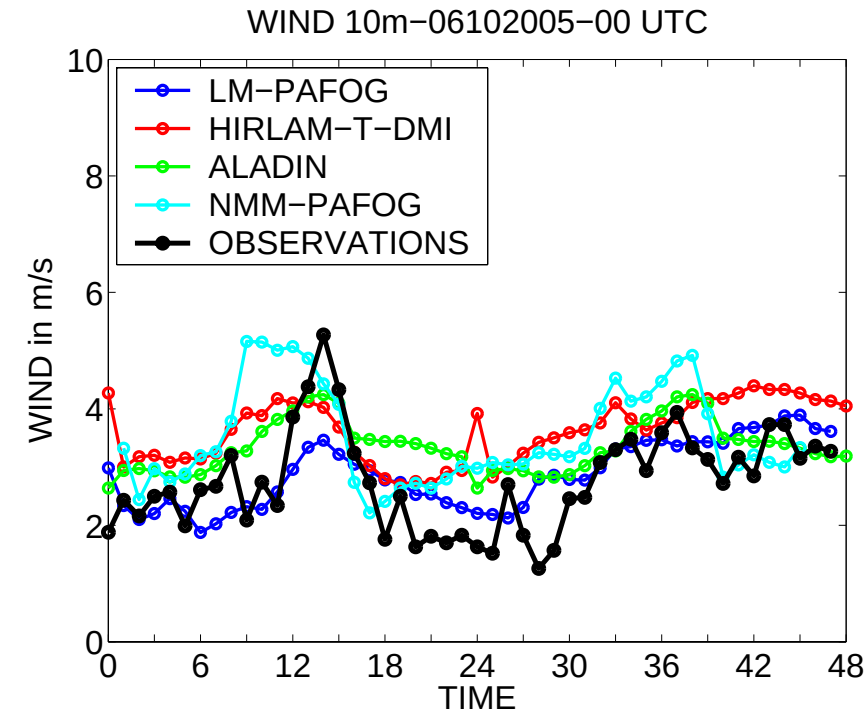

Latent Fluxes−06102005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
Latent Flux in W/m2
TIME


Sensible Fluxes−06102005−OO UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
Sensible Flux in W/m2
TIME

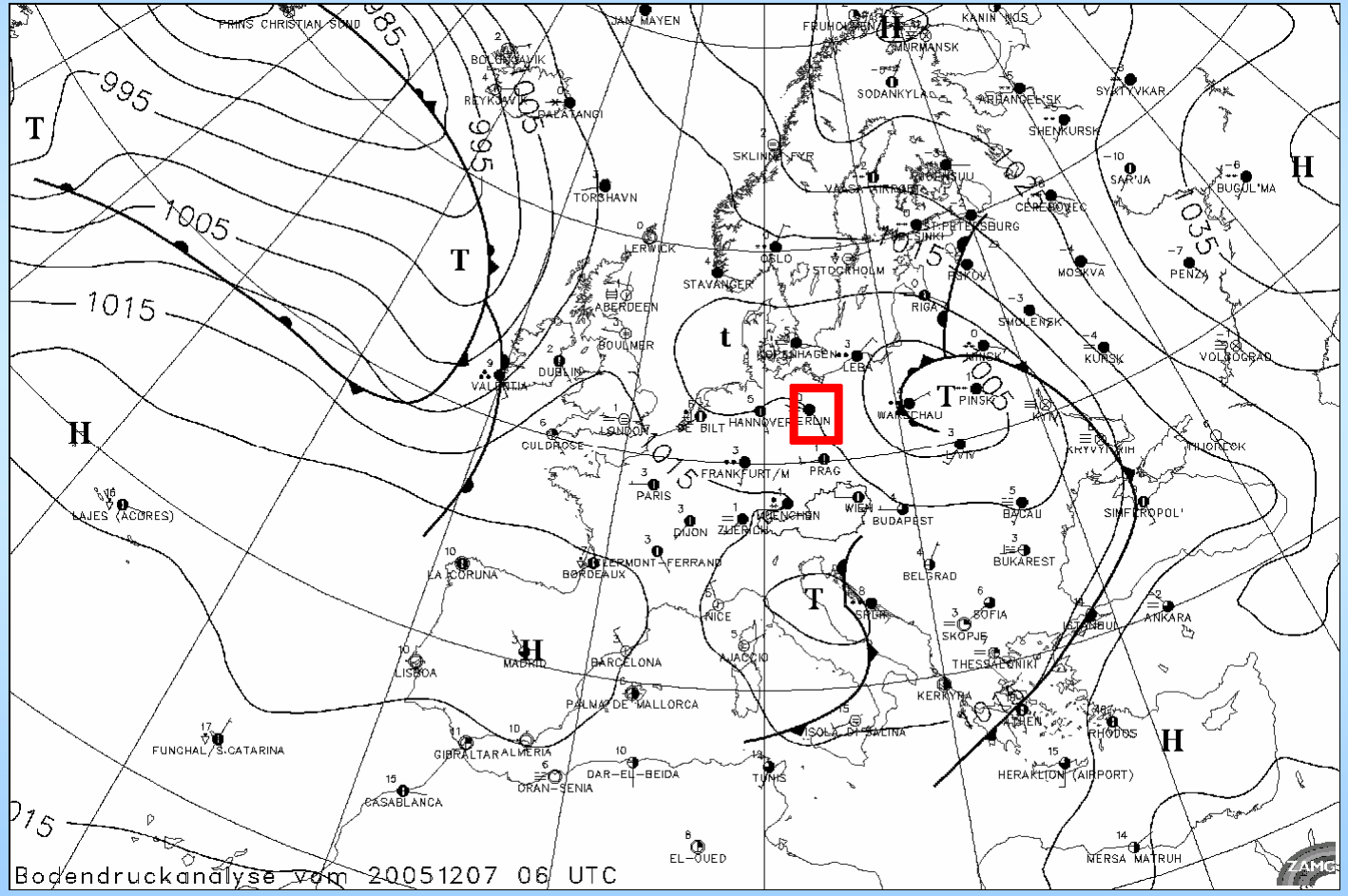

TEMPERATURE 2m−06102005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
TEMPERATURE in Celsius
TIME
a)


RELATIVE HUMIDITY 2m−06102005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
RELATIVE HUMIDITY in %
TIME
b)


SURFACE TEMPERATURE−06102005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
TEMPERATURE in Celsius
TIME


WIND 10m−06102005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
WIND in m/s
TIME

Case 3: Reduced visibility with stratiform low clouds. 7 December 2005



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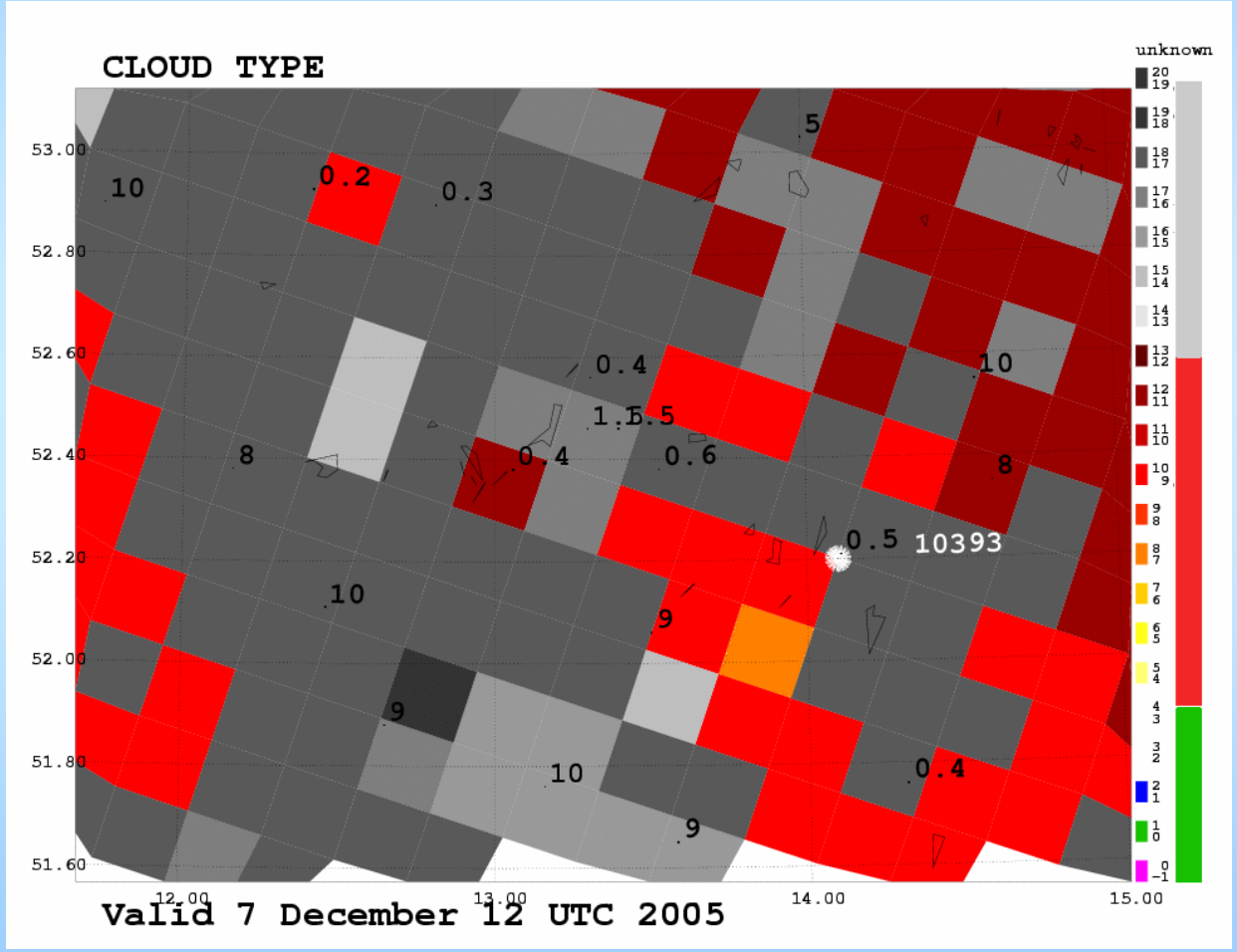
Observed visibility and derived cloud type



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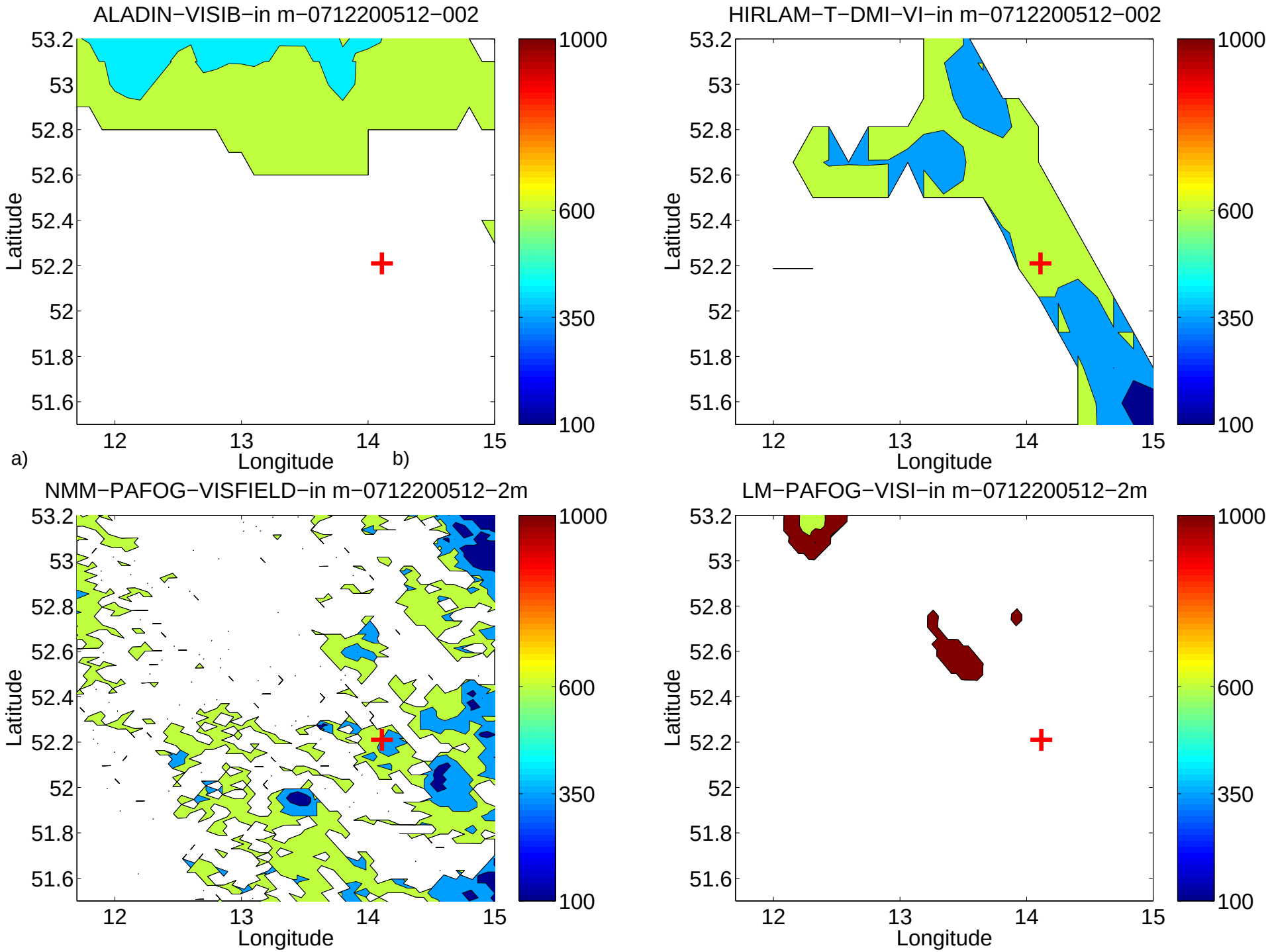
ALADIN−VISIB−in m−0712200512−002
HIRLAM−T−DMI−VI−in m−0712200512−002
NMM−PAFOG−VISFIELD−in m−0712200512−2m
LM−PAFOG−VISI−in m−0712200512−2m
Latitude
Longitude
53.2
53
52.8
52.6
52.4
52.2
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51.8
51.6
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1000
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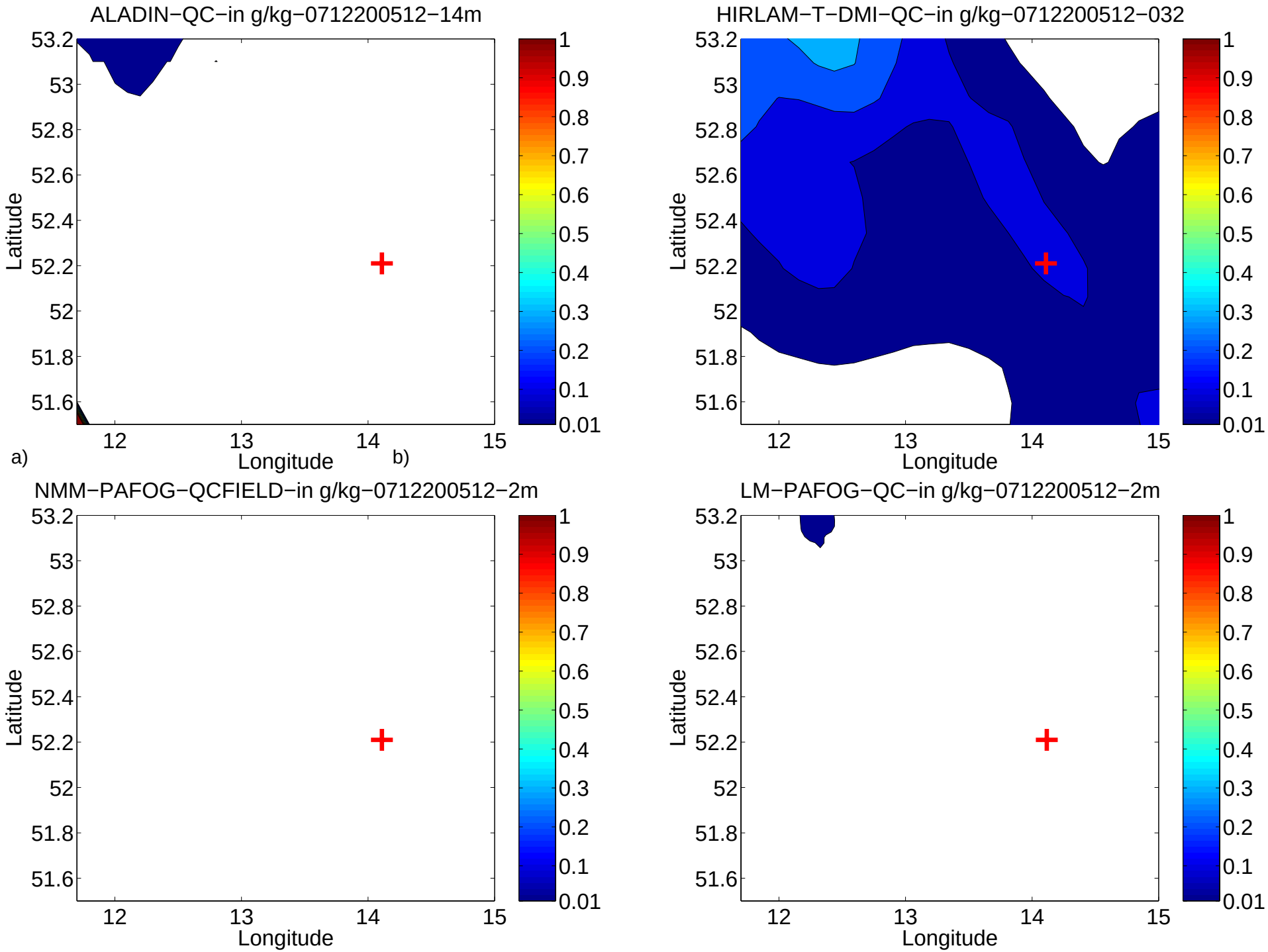
350
100
a)
b)


ALADIN−QC−in g/kg−0712200512−14m
HIRLAM−T−DMI−QC−in g/kg−0712200512−032
NMM−PAFOG−QCFIELD−in g/kg−0712200512−2m
LM−PAFOG−QC−in g/kg−0712200512−2m
Latitude
Longitude
53.2
53
52.8
52.6
52.4
52.2
52
51.8
51.6
12
13
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15
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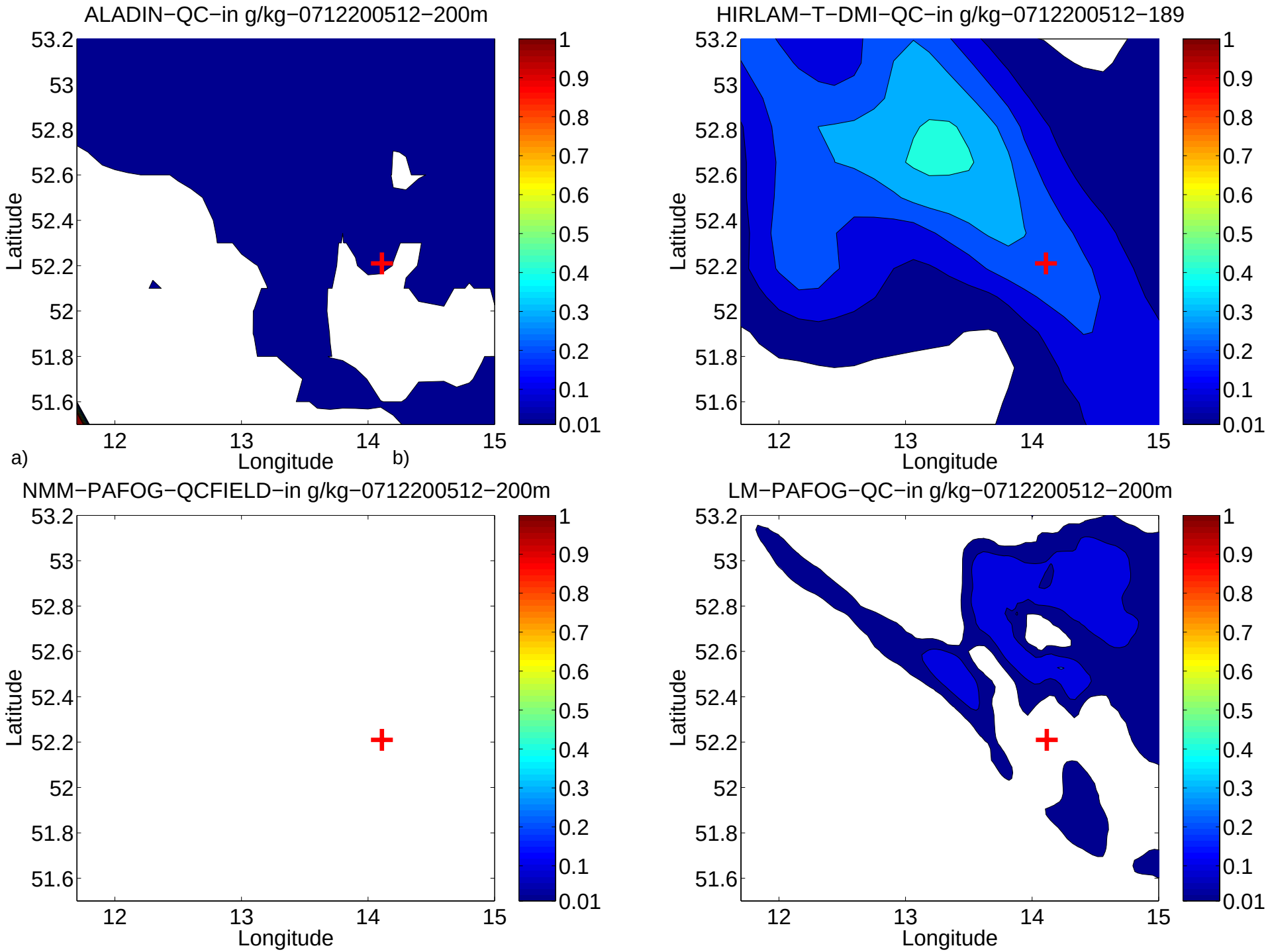
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.01
a)
b)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HIRLAM−T−DMI−QC−in g/kg−0712200512−189
NMM−PAFOG−QCFIELD−in g/kg−0712200512−200m
LM−PAFOG−QC−in g/kg−0712200512−200m
Latitude
Longitude
53.2
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52.8
52.6
52.4
52.2
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51.8
51.6
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15
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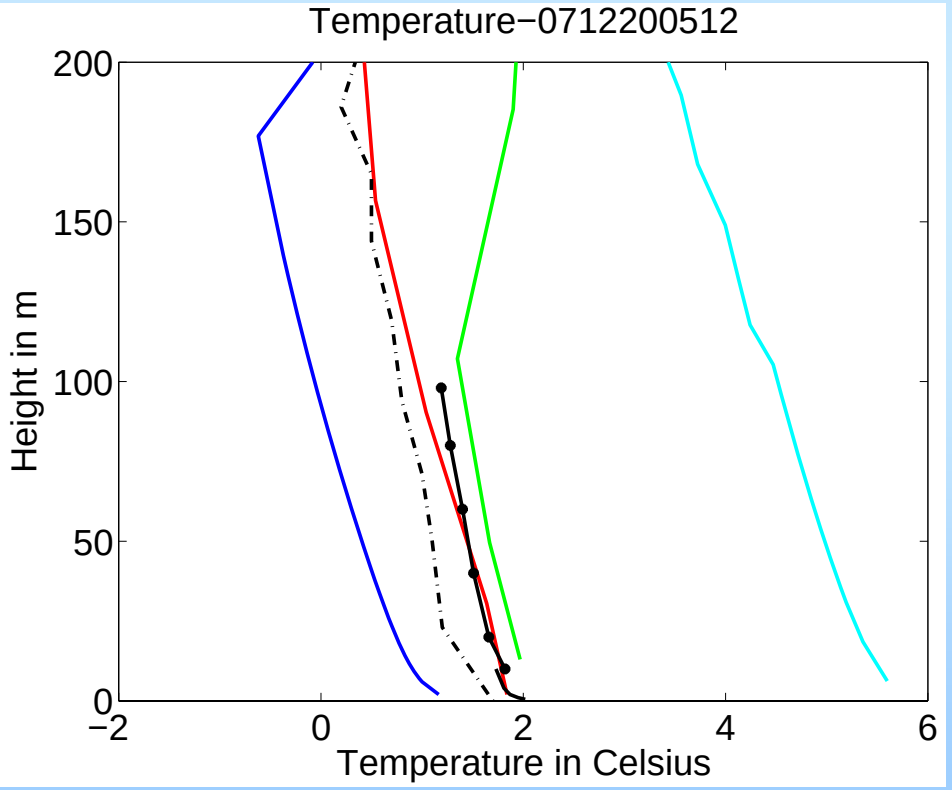
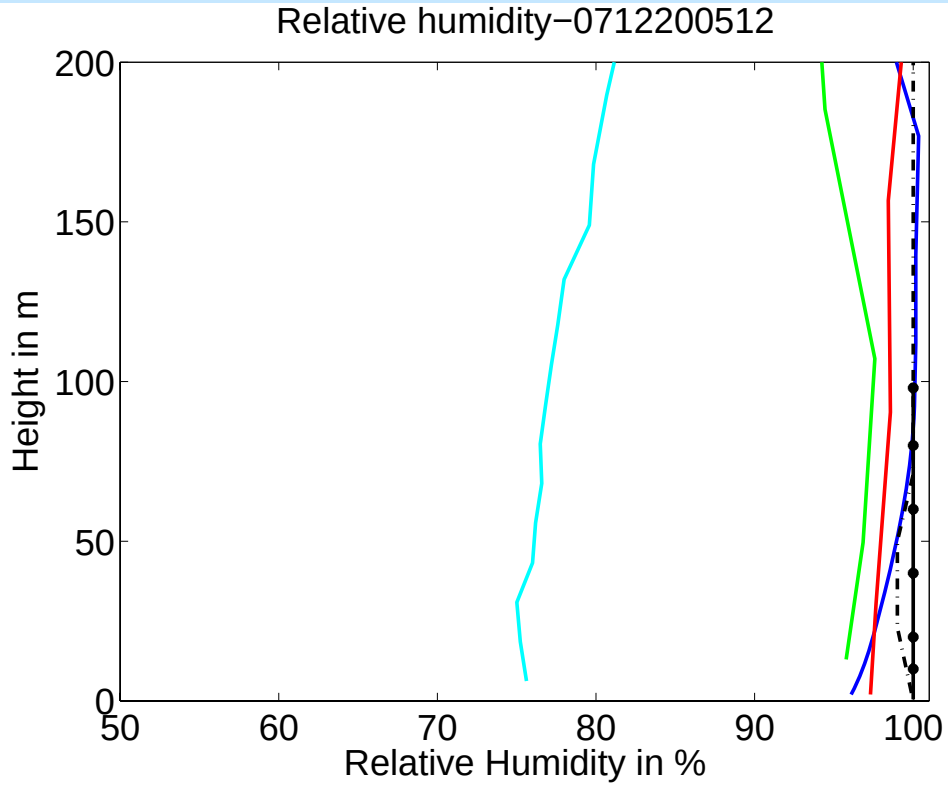
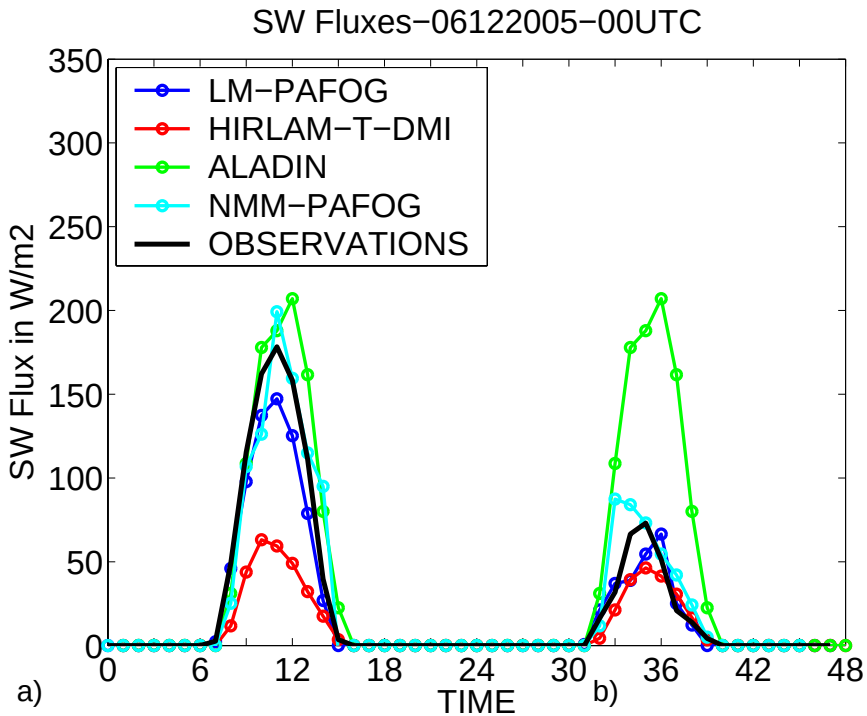
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.01
a)
b)

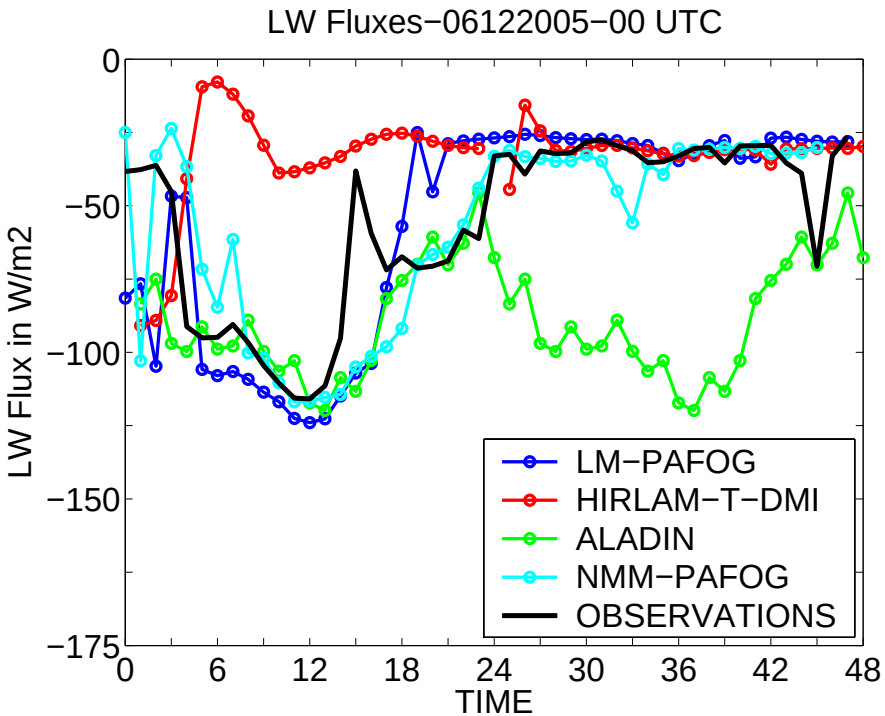
Vertical profile at Lindenberg

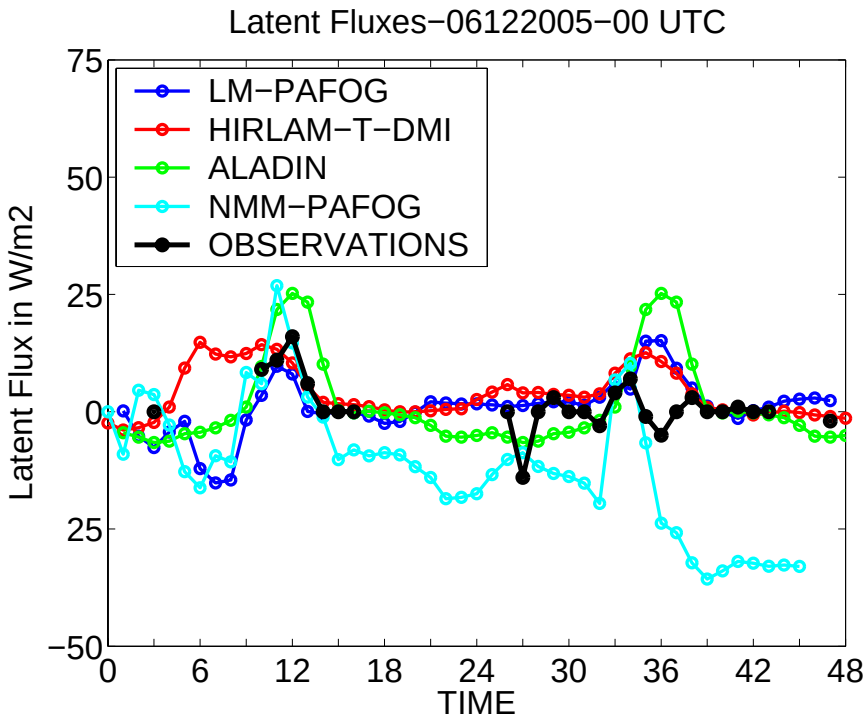
BLACK:OBSERVED RED: HIRLAM GREEN:ALADIN CYAN:NMM-PAFOG BLUE:LM-PAFOG

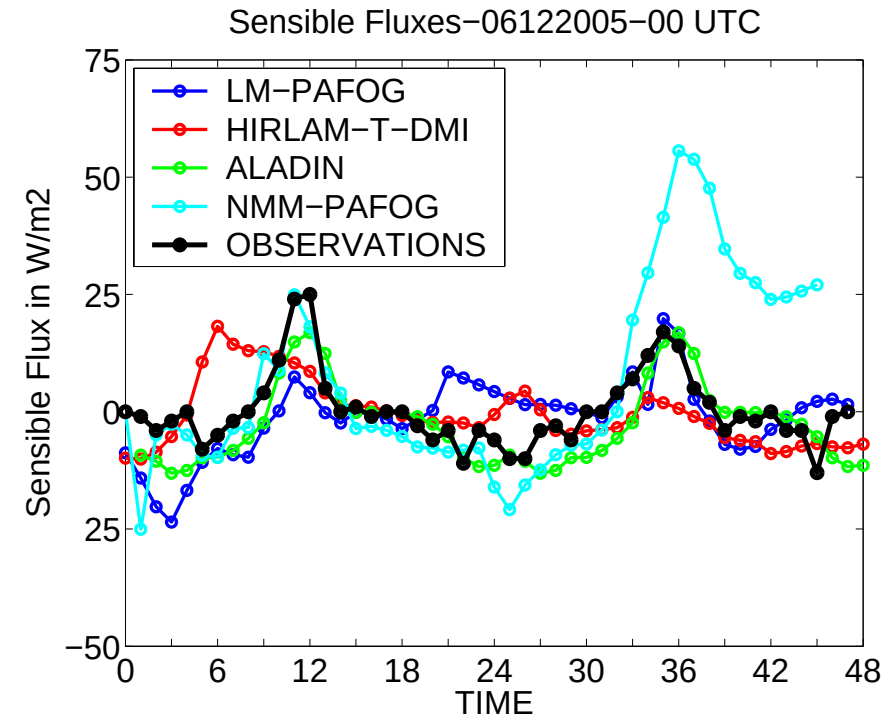


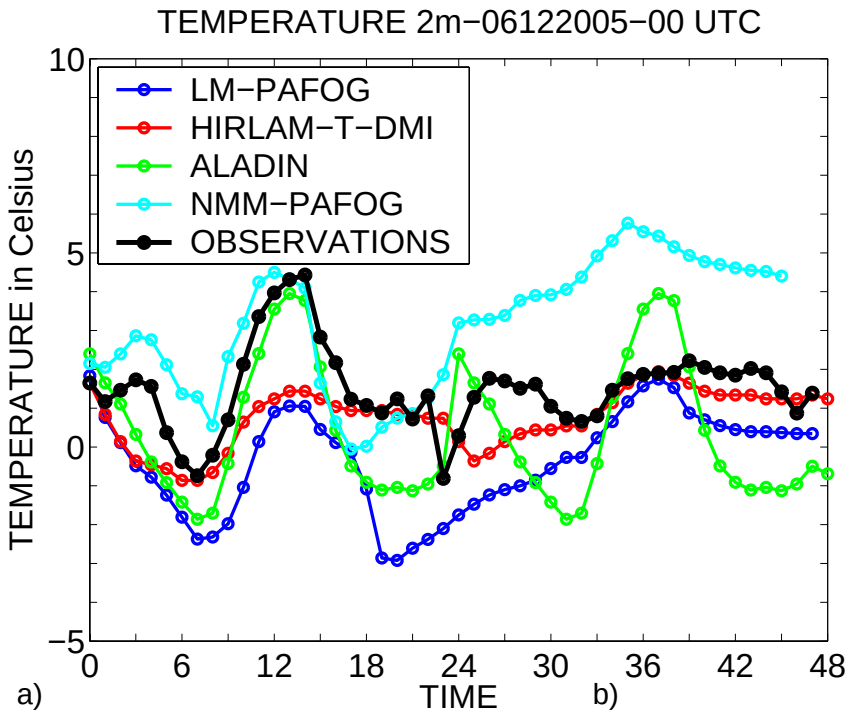



SW Fluxes−06122005−00UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
SW Flux in W/m2
TIME
a)
b)

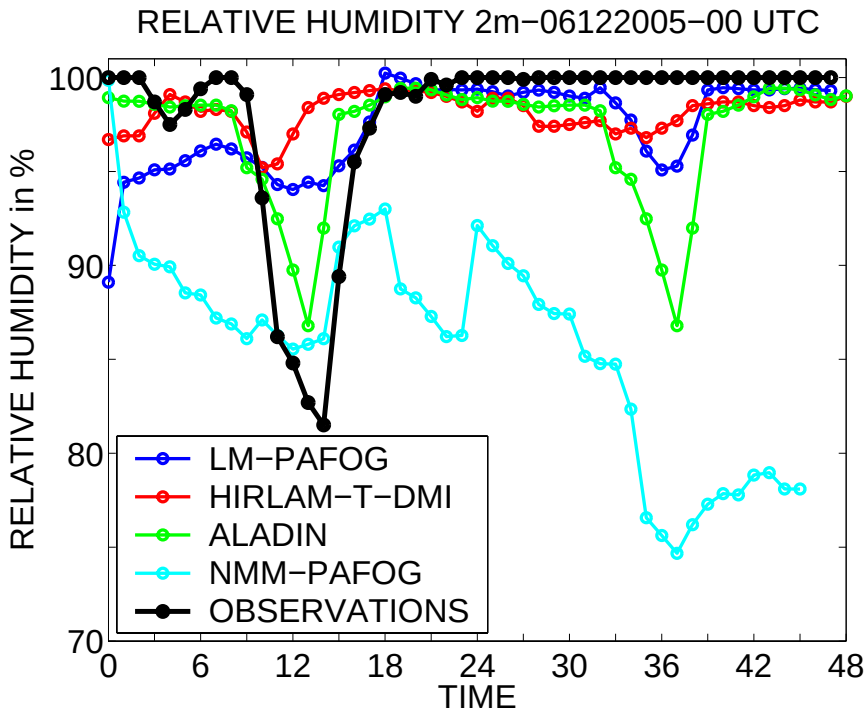

LW Fluxes−06122005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
LW Flux in W/m2
TIME


Latent Fluxes−06122005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
Latent Flux in W/m2
TIME

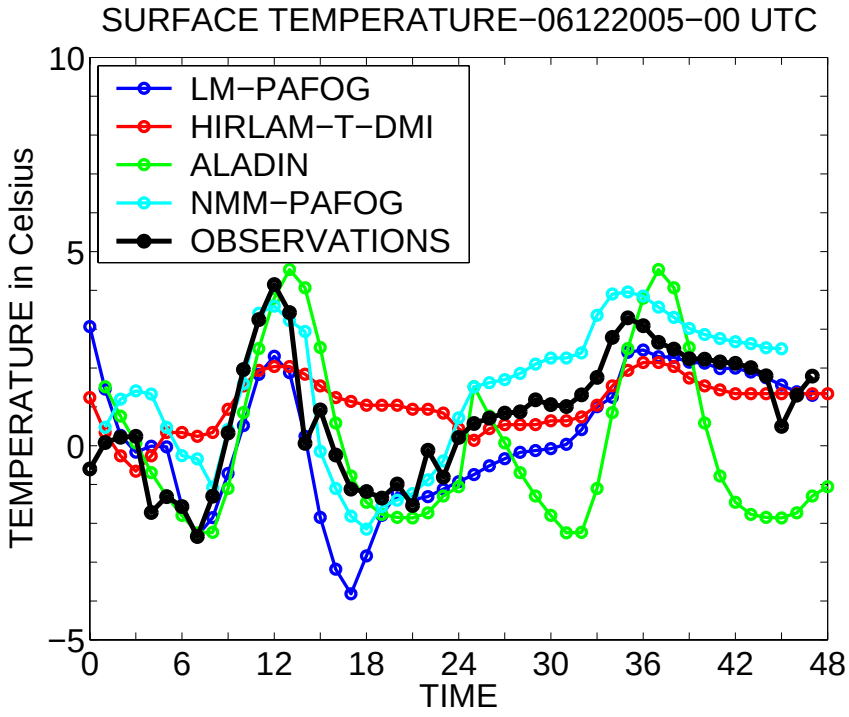

Sensible Fluxes−06122005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
Sensible Flux in W/m2
TIME

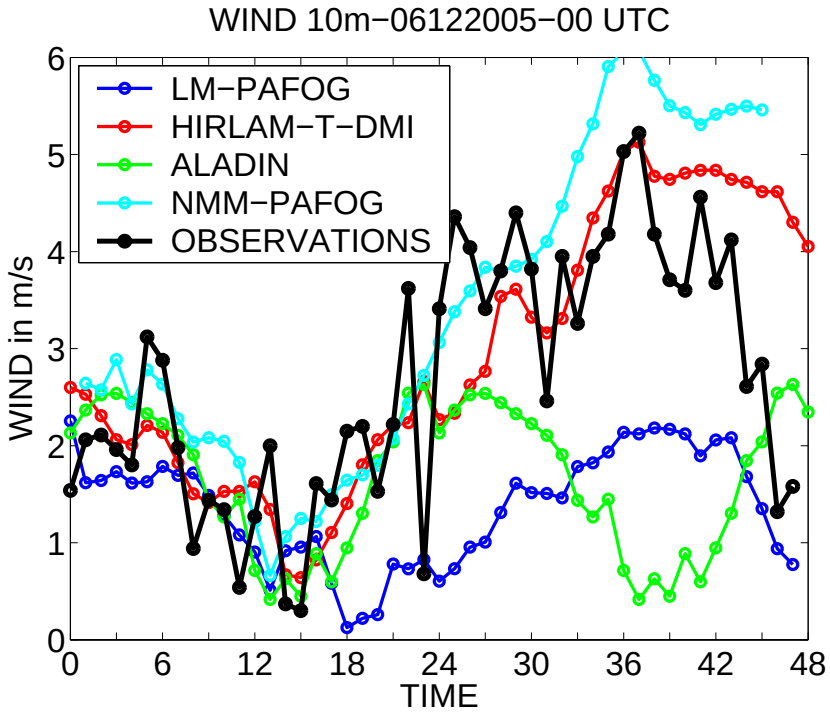

TEMPERATURE 2m−06122005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
TEMPERATURE in Celsius
TIME
10
5
0
−5
0
6
12
18
24
30
36
42
48

a)


RELATIVE HUMIDITY 2m−06122005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
RELATIVE HUMIDITY in %
TIME
100
90
80
70
0
6
12
18
24
30
36
42
48

b)


SURFACE TEMPERATURE−06122005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
TEMPERATURE in Celsius
TIME
10
5
0
−5
0
6
12
18
24
30
36
42
48


WIND 10m−06122005−00 UTC
LM−PAFOG
HIRLAM−T−DMI
ALADIN
NMM−PAFOG
OBSERVATIONS
WIND in m/s
TIME
6
5
4
3
2
1
0
0
6
12
18
24
30
36
42
48

Conclusions

- Initialization and data-assimilation of cloud water, near surface profiles and surface temperature/soil water are almost not existing or sufficient
- Condensation, convection, vertical diffusion schemes are usually not designed to work well near the surface

References

COST722 HOMEPAGE

http://137.248.191.94/index.php?id=120/index.html

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QUESTIONS?