



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
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FROST-2014: Performance of HARMONIE 1km during Sochi Olympics

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FMI*

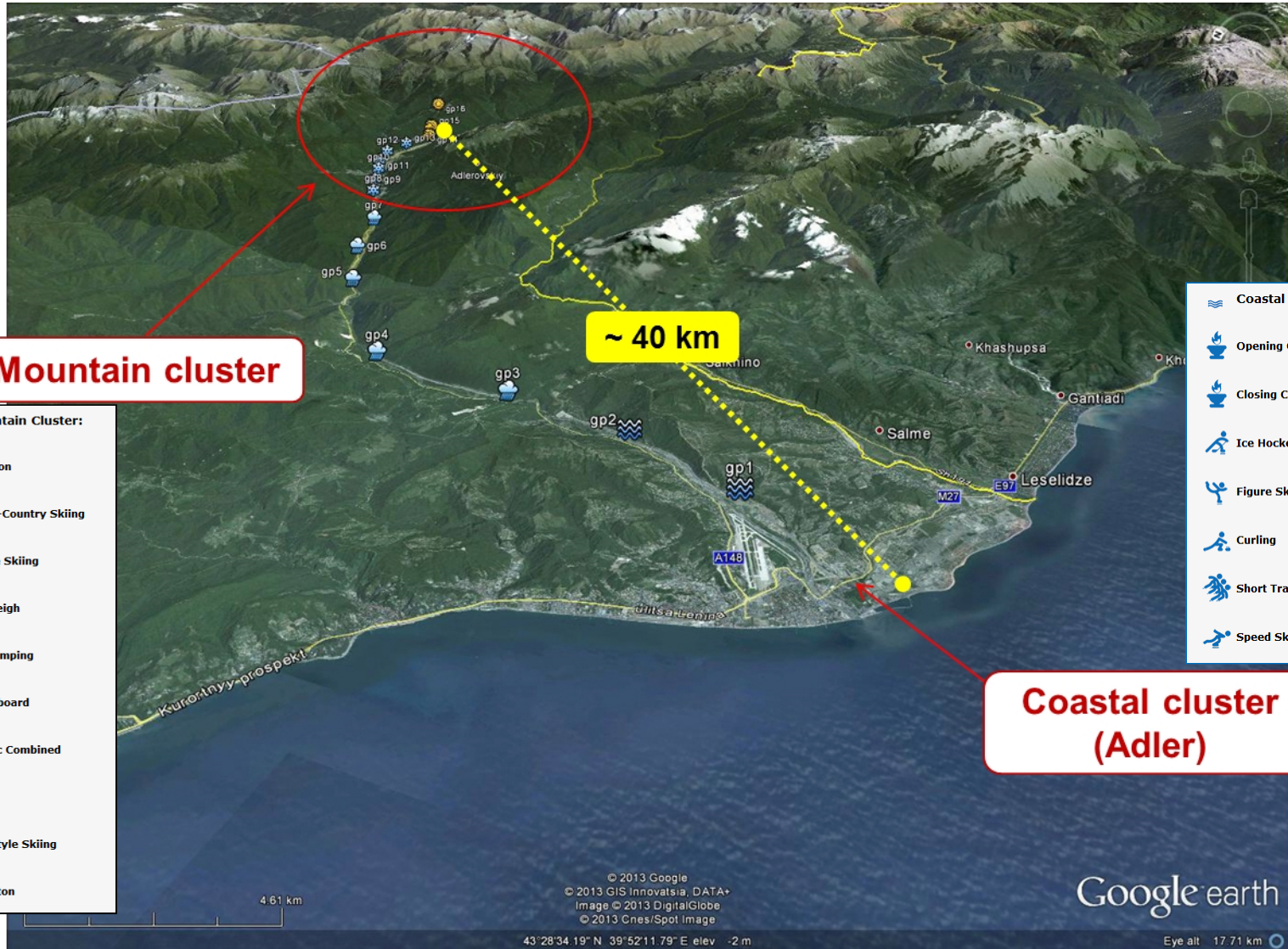
HIRLAM ASM / ALADIN WS 2014
Bucharest, Romania.
7 – 10 April 2014

Outline

- Sochi region
- Conclusions from the preliminary study (ASM/WS 2013)
 - *Model setup*
- User feedback
- Verification:
 - *HARMONIE vs. other models*
 - *Problems and (possible) fixes*
- Road weather pilot based on Harmonie data



Sochi region



Mountain cluster

~ 40 km

Coastal cluster (Adler)

- Mountain Cluster:**
- Biathlon
 - Cross-Country Skiing
 - Alpine Skiing
 - Bobsleigh
 - Ski Jumping
 - Snowboard
 - Nordic Combined
 - Luge
 - Freestyle Skiing
 - Skeleton

- Coastal Cluster:**
- Opening Ceremony
 - Closing Ceremony
 - Ice Hockey
 - Figure Skating
 - Curling
 - Short Track Speed Skating
 - Speed Skating



Sochi region





Conclusions from ASM/WS 2013

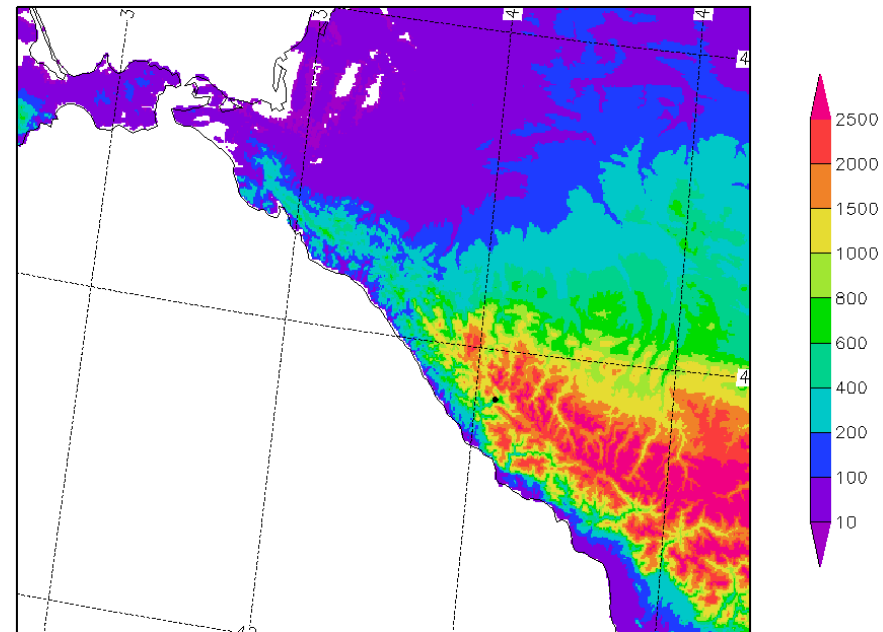
- HARMONIE (cy37h12) was superior over operational Hirlam and IFS in Sochi region.
 - At the time, only one station available (valley) from the venue.
- Test of SRTM vs. GTOPO30 orography data set showed neutral impact.
 - GTOPO30 used (technical problems with SRTM)
- Overall, HARMONIE 1km and 1.5km showed slight improvement over 2.5km. Local improvements significant!
 - HARMONIE with 1km grid size chosen.
- HARMONIE 1km and 1.5km suffered (yet) unresolved instability problems.
 - Instability problem (partly) resolved with help of MF/ALADIN colleagues

HARMONIE configuration

• HARMONIE - soc38h1b3

- Version cy38h1.beta.3
- Non-hydrostatic with AROME-physics
- **1 km grid size** (640 x 500)
- **time-step 30s**
- 65 levels in vertical (20 in lowest 1 km).
- data assimilation: 3D-Var for upper air, OI for surface
 - 6h assimilation interval
 - Jb by ensemble method (2.5km).
 - conventional observations
- Hourly boundary conditions: ECMWF-IFS
- Dec 2013 – Mar 2014, **4 runs/day, +36h**

HARMONIE 08MAR2014 00 UTC. Orographic height [m]
08MAR2014 00:00 UTC (soc38h1b3,1km)



Max: 5323.1
Min: 0

• Difference compared reference version

- PC-scheme (with 1 iteration) instead of SETTLS
- LSMIXBC → switched off
- ECOCLIMAP 1 instead of 2.



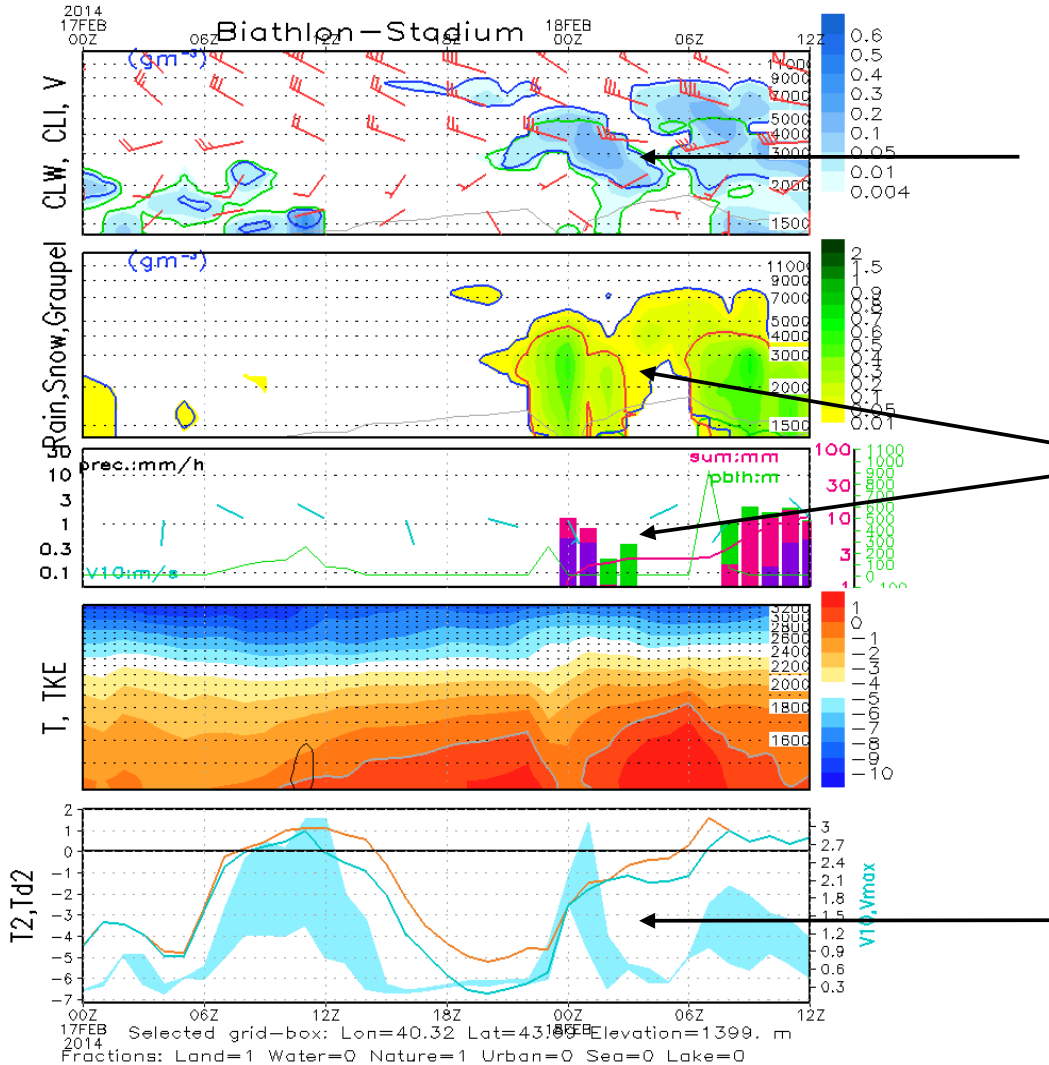
USER FEEDBACK

Acknowledgement: Teemu Lemmettylä, Finnish Olympic Committee (FOC)



User feedback

- dataset for FOC -



Cloud panel
 cloudy vs. clear sky day
 timing of fog

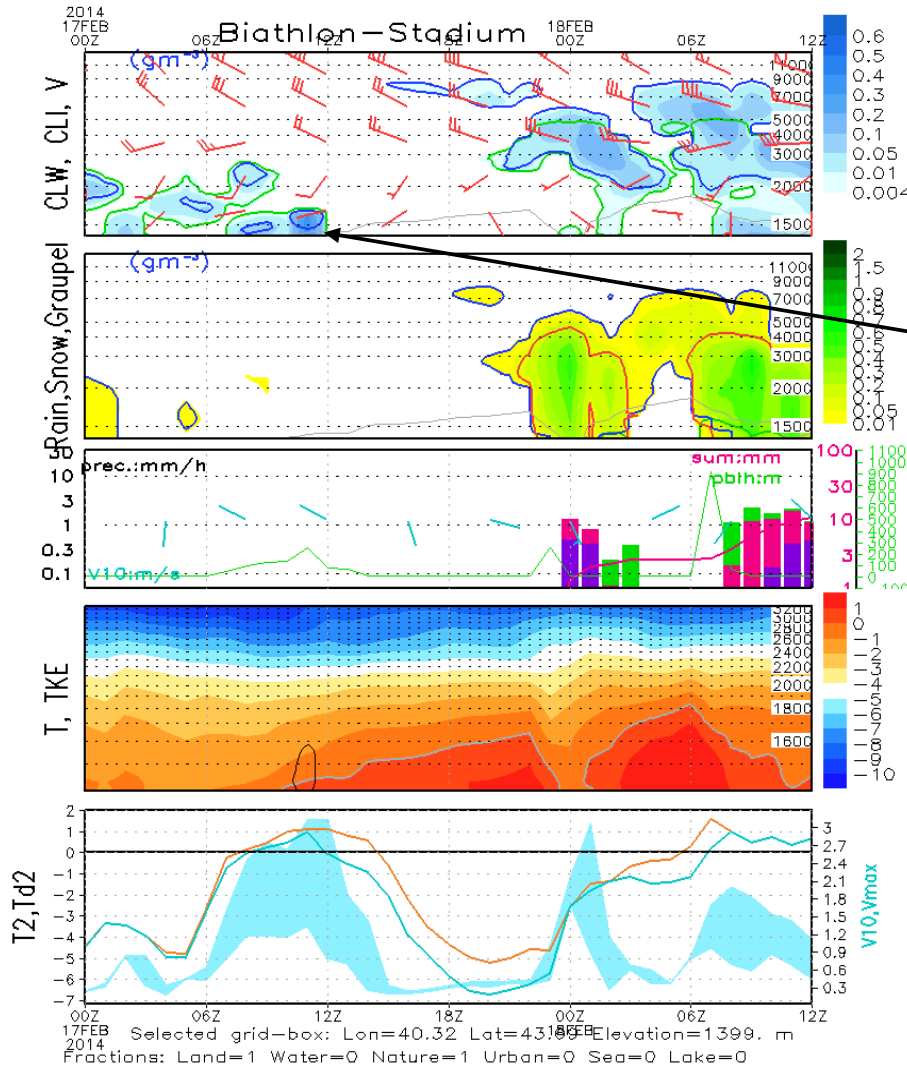
Precipitation panels
 timing of precipitation
 intensity
 precipitation type at sfc

Surface panel
 T2m
 V10m



User feedback

- comments from FOC -



- “HARMONIE was superior”
- “HARMONIE fog forecasts were excellent”
- “HARMONIE precipitation and cloud height forecasts were highly useful”
- “HARMONIE five-panel user interface was really good”

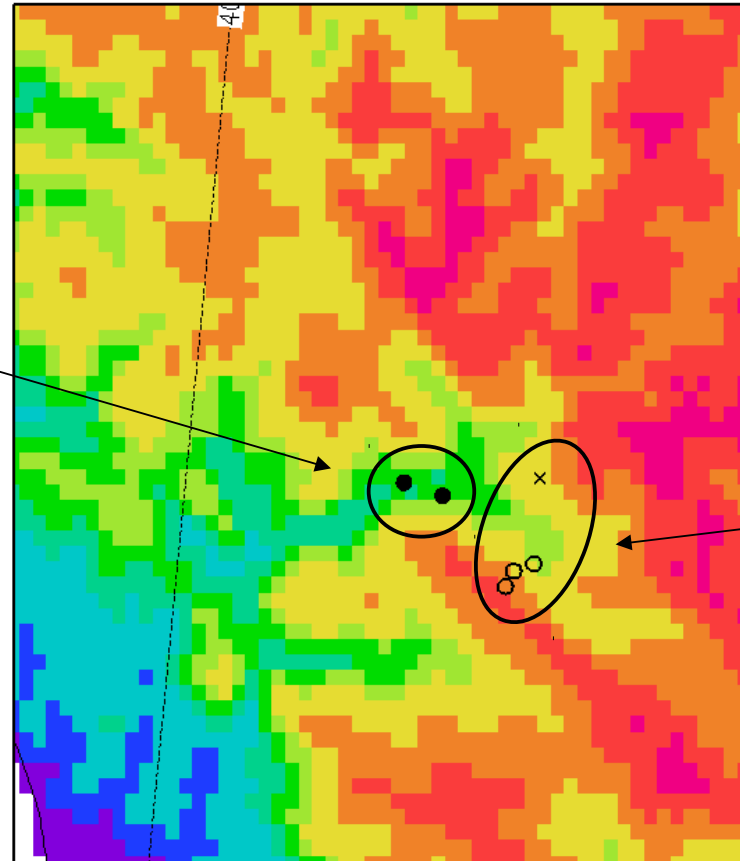


VERIFICATION

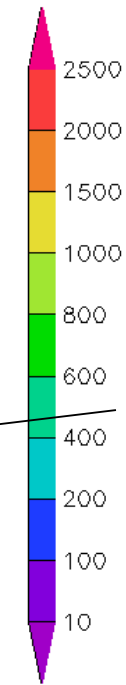
Main observation locations

HARMONIE 08MAR2014 00 UTC. Orographic height [m]
08MAR2014 00:00 UTC (soc38h1b3,1km)

Valley
Krasnaya Polyana
Ski-Jump



Mountain
Ski stadium
Alpine Middle



Max: 2885.56
Min: 0

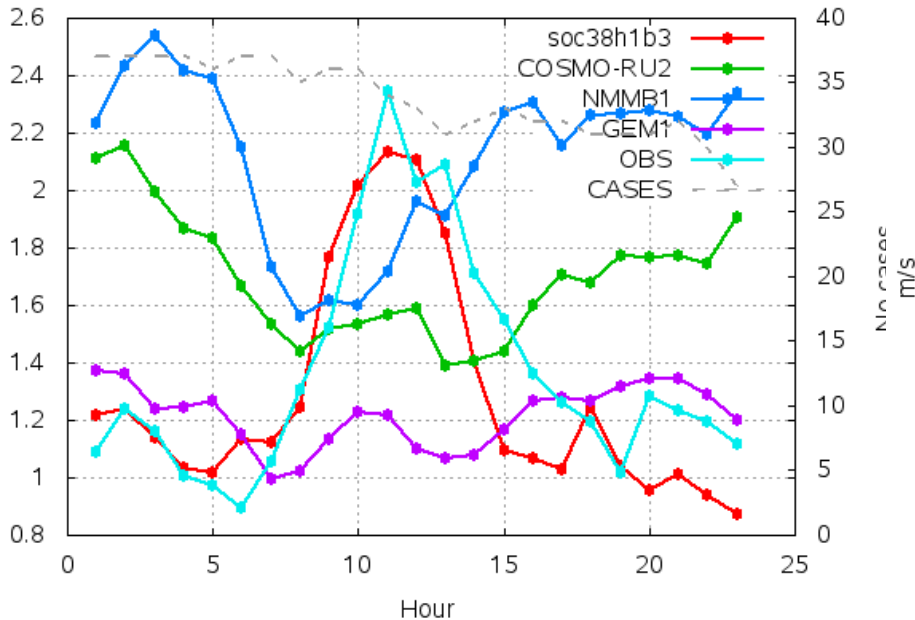
Study period: 7.2. – 16.3.2014

Verification, 10m-wind speed

HARMONIE – 1 km
COSMO-RU – 2.2 km
NMMB – 1 km
GEM – 1 km
Observation

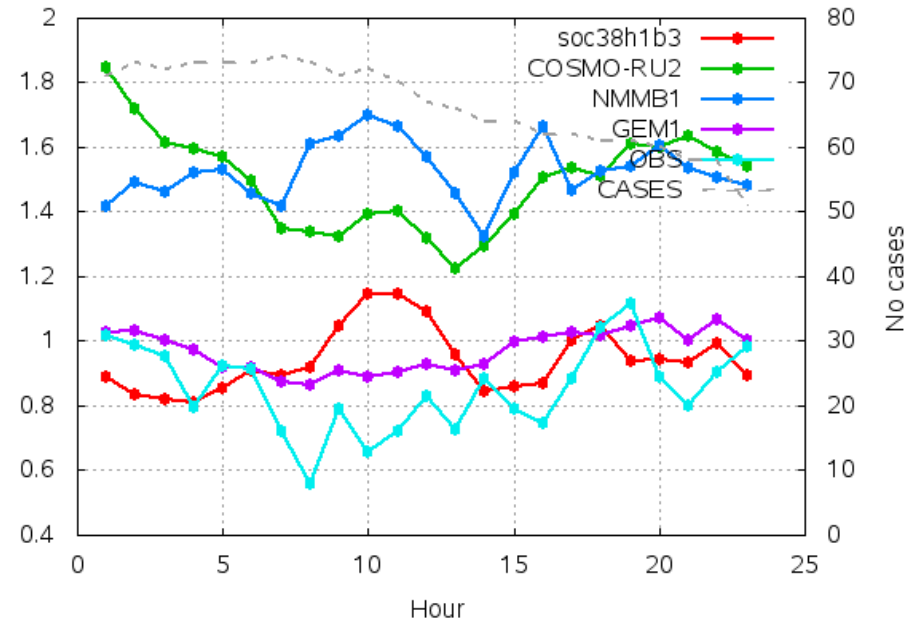
VALLEY

Selection: KrasnayaPolyana using 1 stations
 U10m Period: 20140207-20140315
 Used {00} + 01 02 ... 23



MOUNTAINS

Selection: Mountains using 2 stations
 U10m Period: 20140207-20140315
 Used {00} + 01 02 ... 23



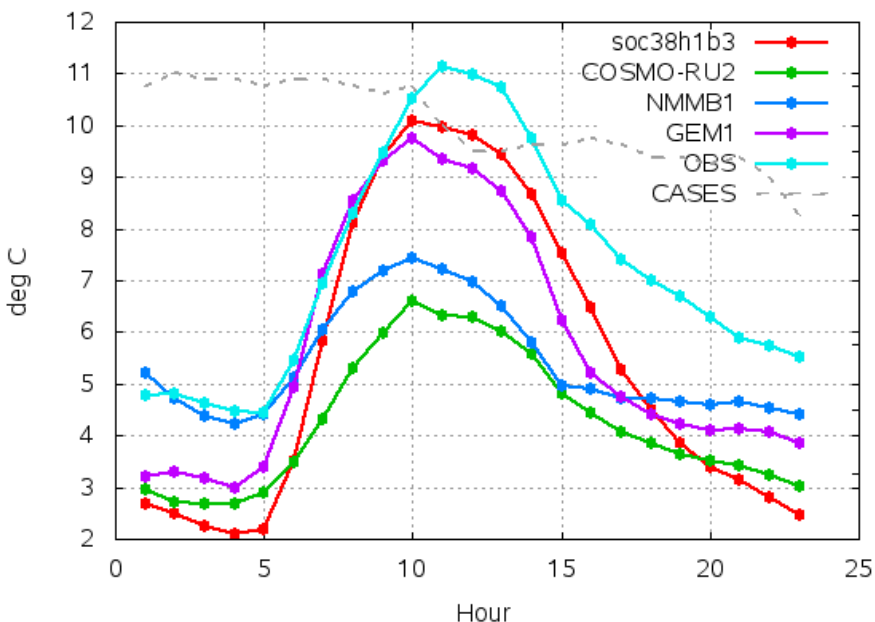
HARMONIE is the best in the valley, and among the best in the mountains

Verification, 2m-temperature

HARMONIE – 1 km
COSMO-RU – 2.2 km
NMMB – 1 km
GEM – 1 km
Observation

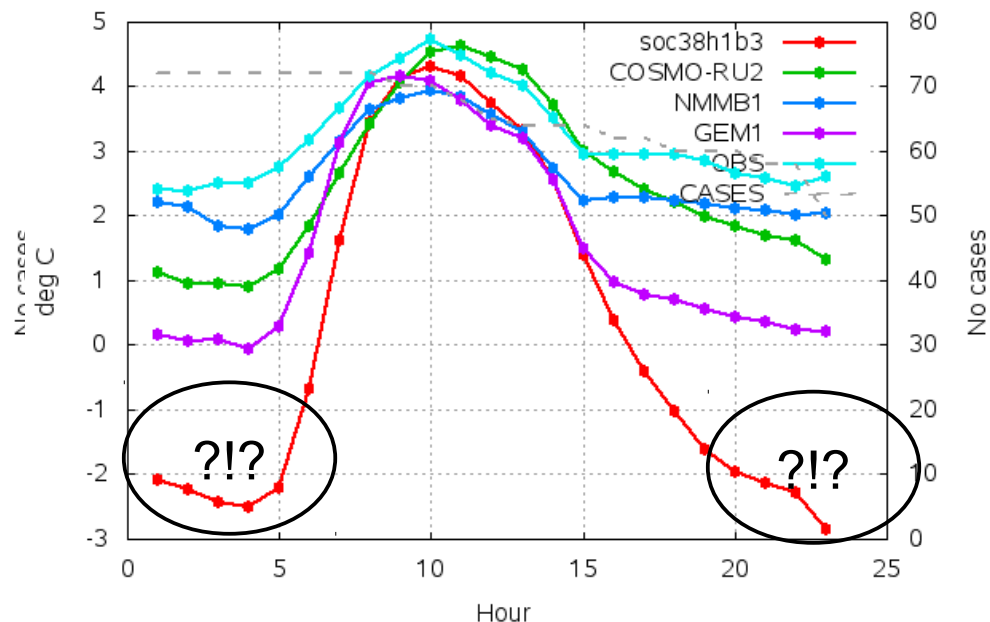
VALLEY

Selection: Valley using 2 stations
 T2m Period: 20140207-20140315
 Used {00} + 01 02 ... 23



MOUNTAINS

Selection: Mountains using 2 stations
 T2m Period: 20140207-20140315
 Used {00} + 01 02 ... 23



During day-time HARMONIE is the best or among the best.
During night-time HARMONIE is the worst, especially in the mountains 13



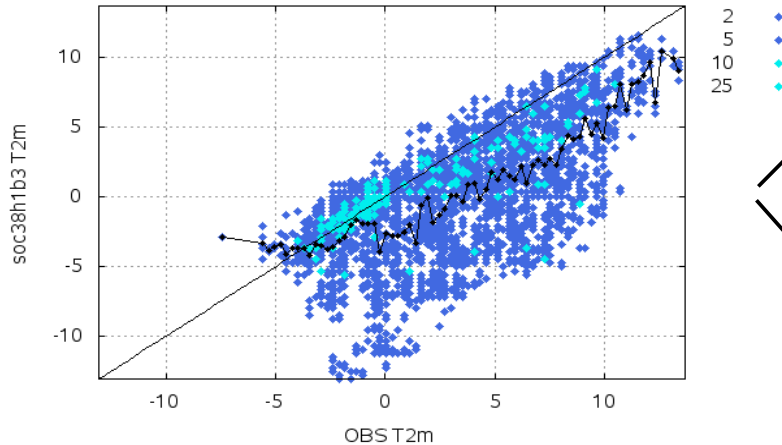
WHAT IS THE PROBLEM IN HARMONIE TEMPERATURE?



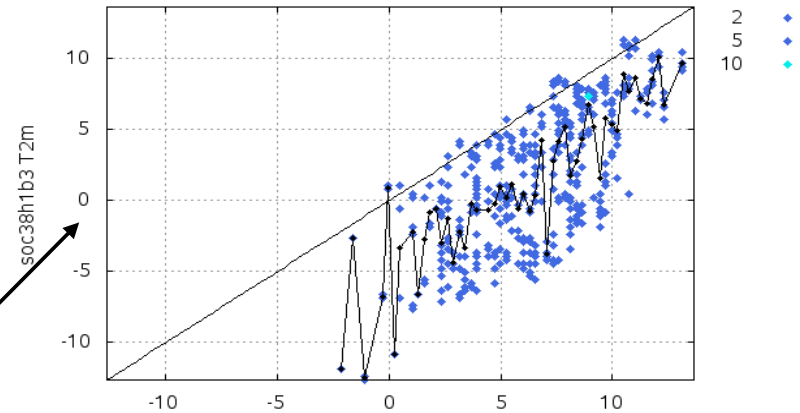
HARMONIE temperature problem

HARMONIE, T2m, mountains

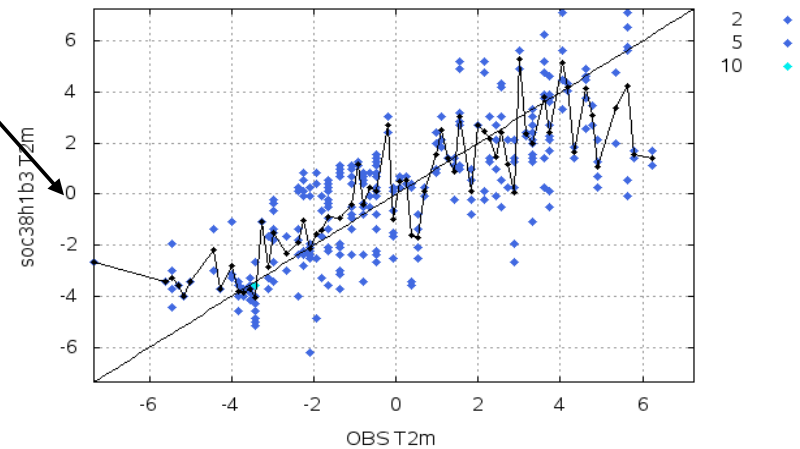
Scatterplot for 2 stations Selection: Mountains
T2m [deg C]
Period: 20140207-20140316
Used {00,12} + 01 02 ... 24



WIND < 1m/s & RH < 70%

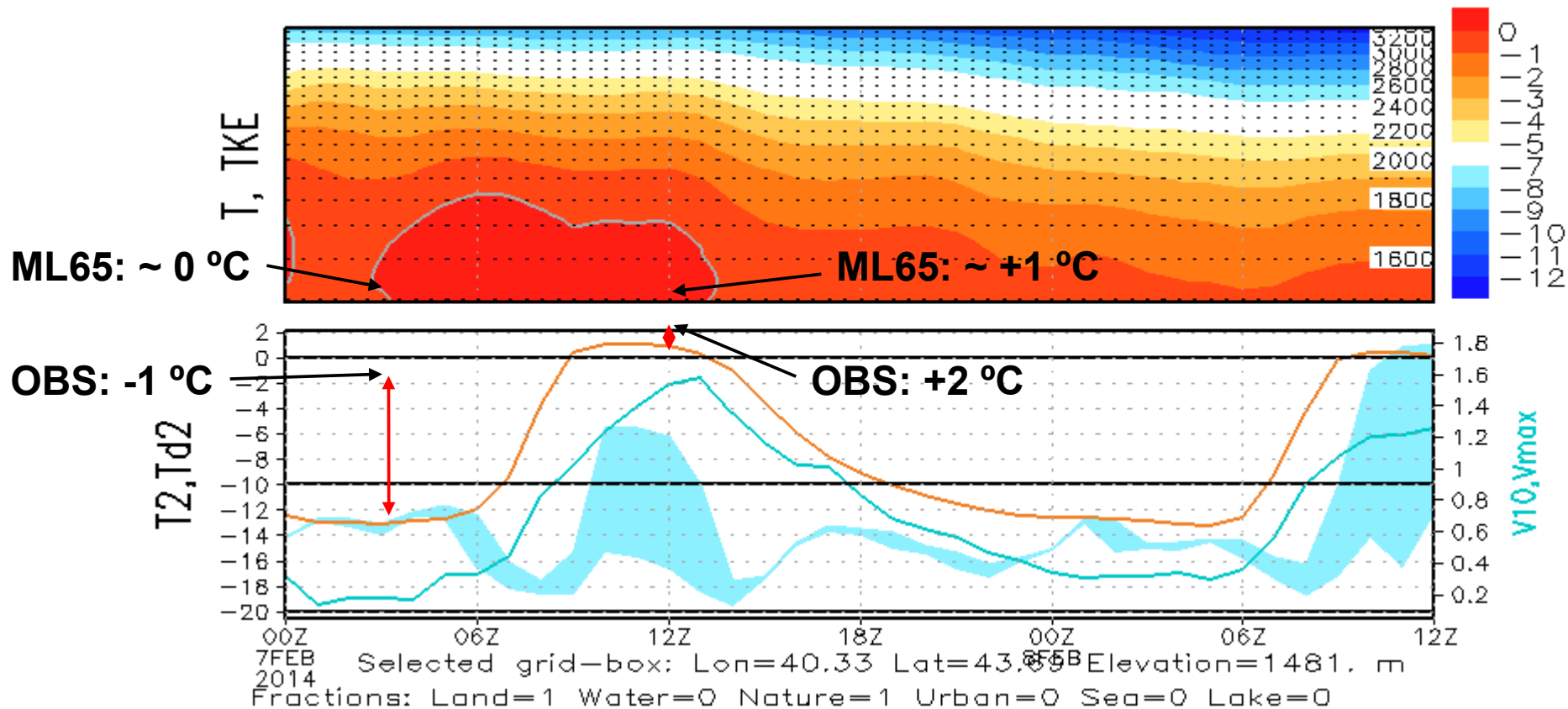


WIND >= 1m/s & RH >= 70%



Problem in calm and dry conditions

HARMONIE temperature problem



**Surface is detached from the atmosphere during night-time!
 What is the role of CANOPY scheme?**

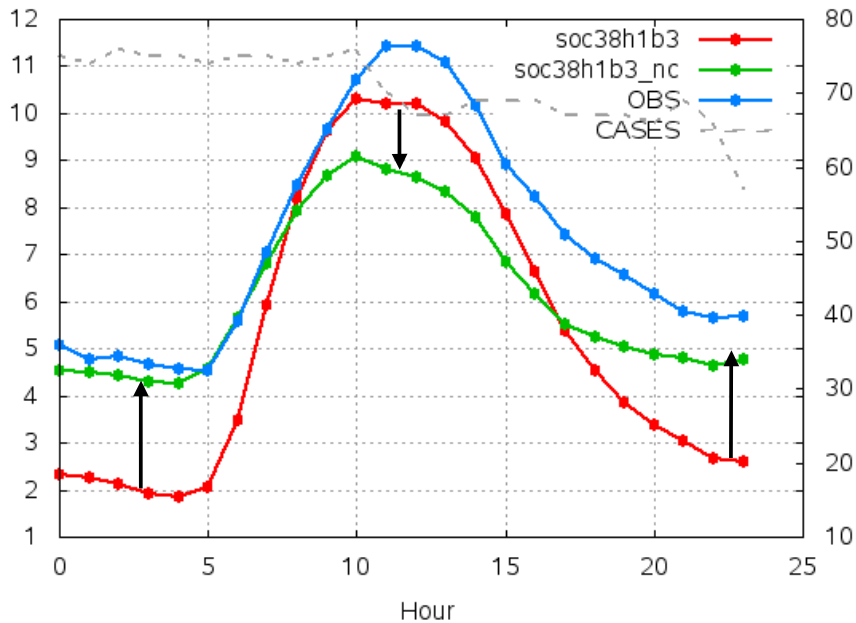
Verification, 2m-temperature

HARMONIE with CANOPY scheme
HARMONIE without CANOPY scheme

Observation

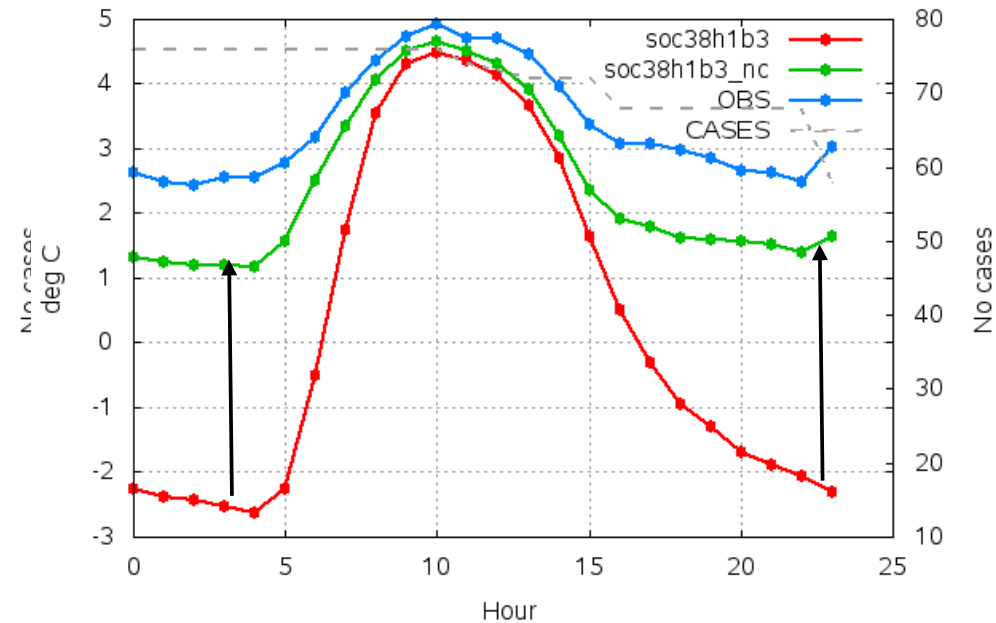
VALLEY

Selection: Valley using 2 stations
 T2m Period: 20140207-20140316
 Used {00,12} + 07 08 ... 18



MOUNTAINS

Selection: Mountains using 2 stations
 T2m Period: 20140207-20140316
 Used {00,12} + 07 08 ... 18



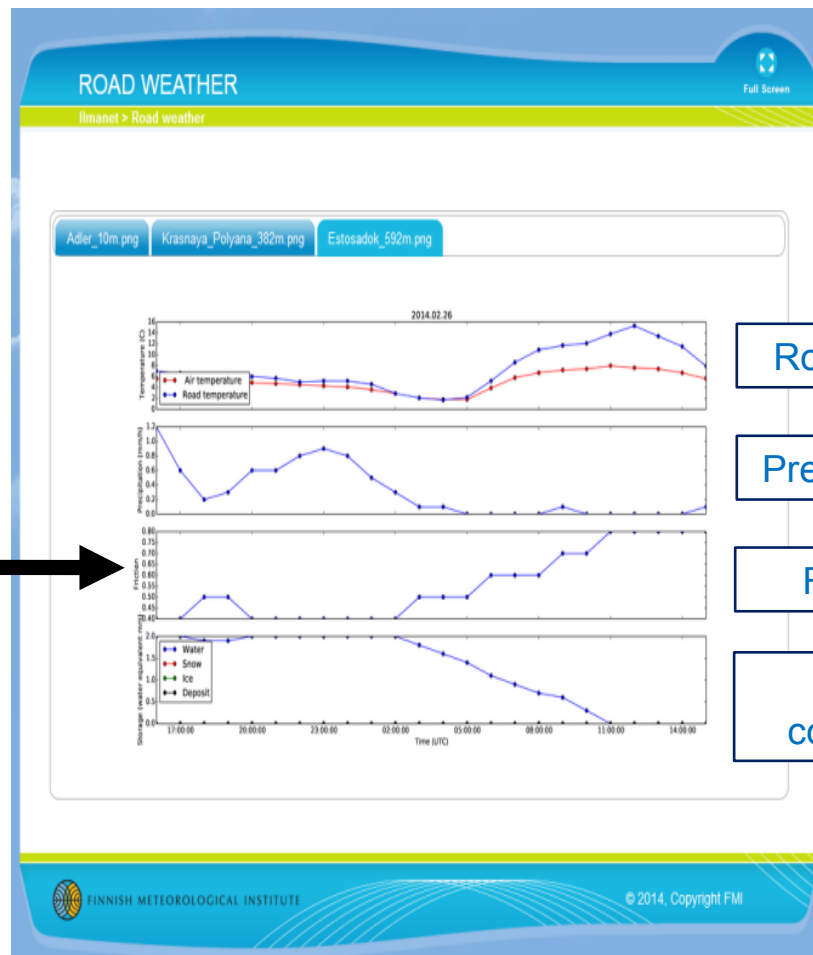
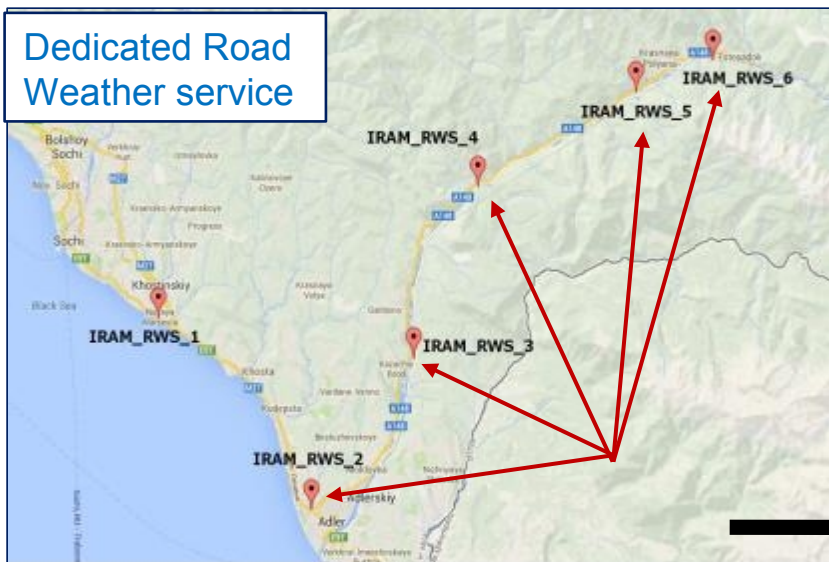
HARMONIE without CANOPY would have been...

In the valley: the best during night-time, 2nd during day-time

In the mountains: the best during day-time, 2nd during night-time

Road weather pilot based on HARMONIE data

Dedicated Road Weather service



Road temp

Precipitation

Friction

Road condition

- “En-route” RW forecast pilot from Black Sea coast to Olympic village.
- End-user: Finnish skiing service team

Summary

- HARMONIE got very good feedback from the users (FOC)
 - especially fog, cloud height and precipitation
- HARMONIE mainly among the best models in FROST-2014
- Large cold bias during night-time, especially over mountains.
 - surface detached from atmosphere (dry and calm cases)
 - running without CANOPY scheme improves the situation!
- Successful road weather pilot: “En-route” RW forecasts along the main road



THANK YOU



Verification, 10m wind speed

HARMONIE with CANOPY scheme
HARMONIE without CANOPY scheme

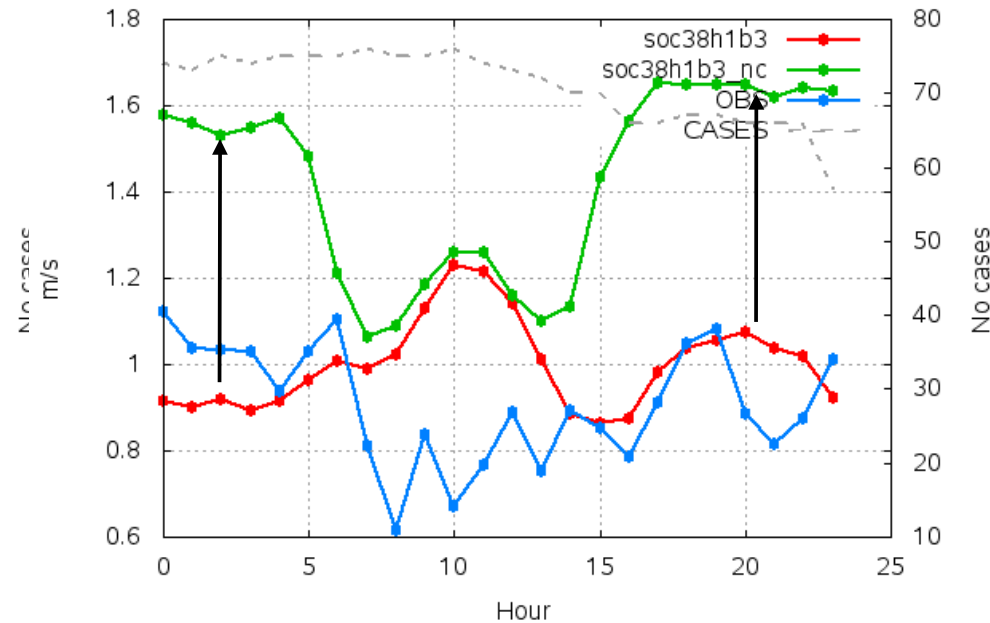
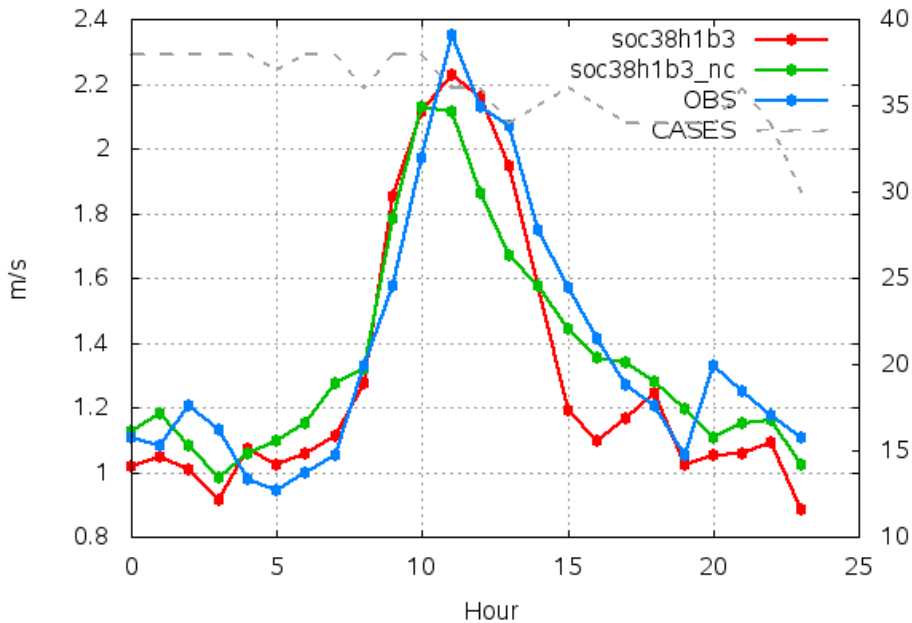
Observation

VALLEY

MOUNTAINS

Selection: KrasnayaPolyana using 1 stations
 U10m Period: 20140207-20140316
 Used {00,12} + 07 08 ... 18

Selection: Mountains using 2 stations
 U10m Period: 20140207-20140316
 Used {00,12} + 07 08 ... 18



HARMONIE without CANOPY would have been...

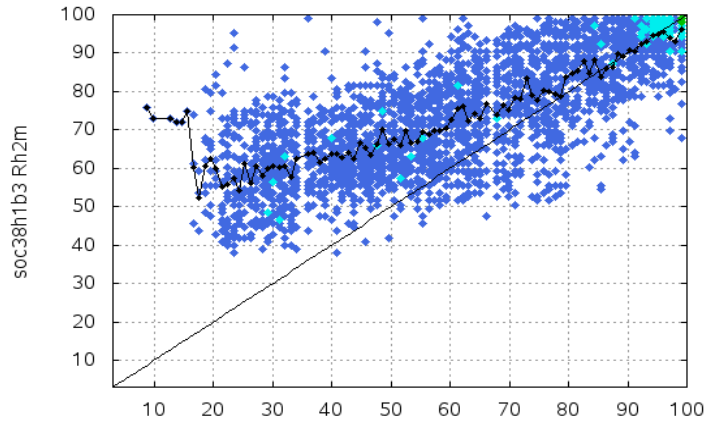
In the valley: still the best.

In the mountains: degradation night-time, among the best day-time

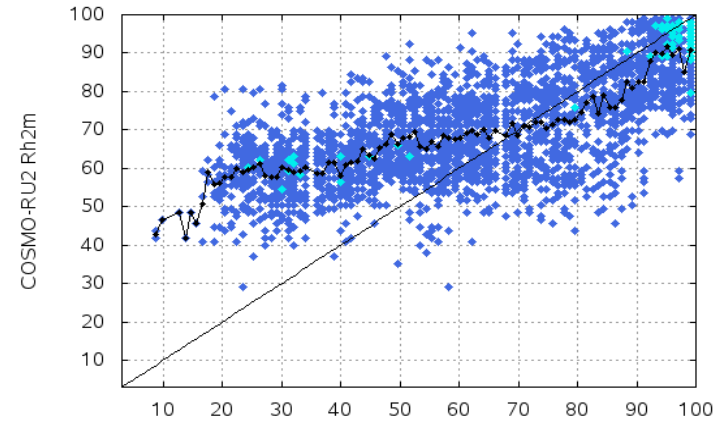


Verification, 2m relative humidity

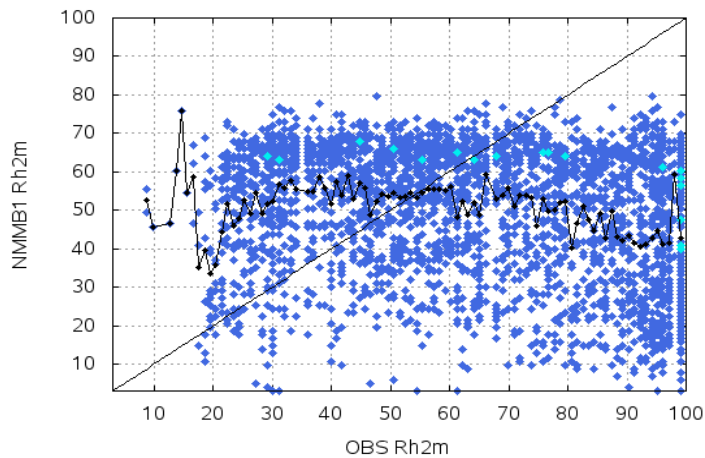
HARMONIE



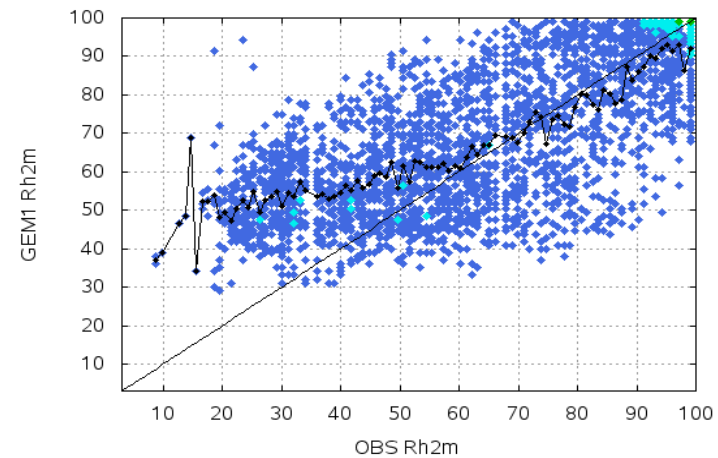
COSMO-RU



NMMB

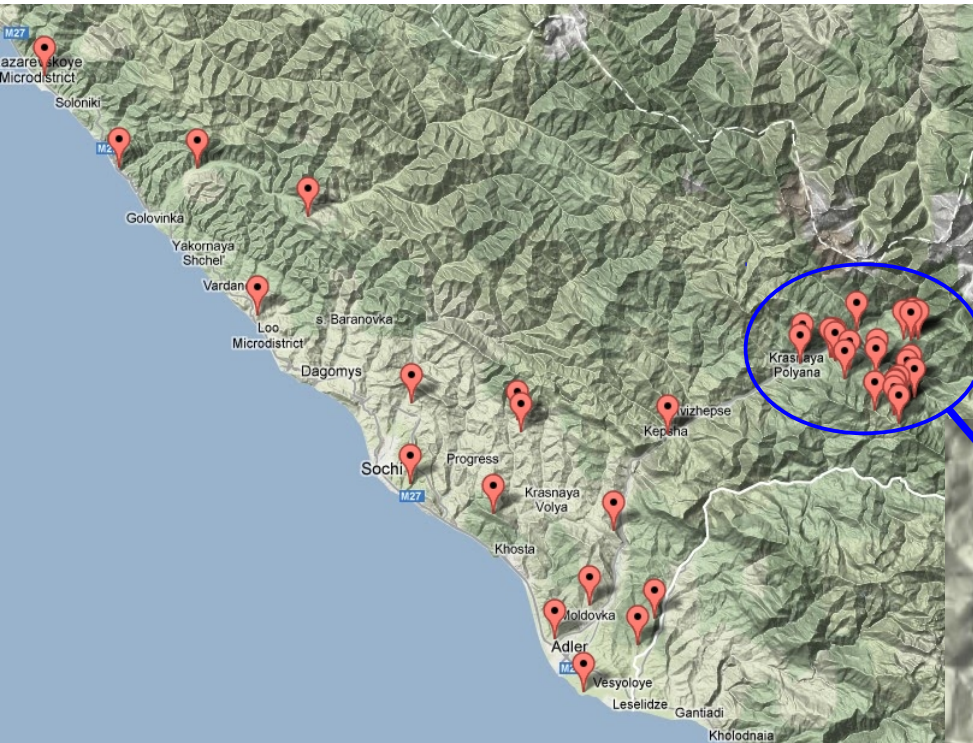


GEM



HARMONIE is among the best.

Observation stations



**42 additional observation stations
around Sochi region**



**24 additional observation stations
In the mountain cluster**