

Pre-release experiences with 37h1 in HIRLAM: meteorological aspects

Xiaohua Yang, reporting contributions from

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- **From 36h1.4 to 37h1: Validation and tuning**
- **Lessons to learn**





ASM 2011 talk: Pre-release 36h1.3 validation

Prior to official tagging of 36h1.3, a multi-month validation for selected episodes was organised with a group of developers for quality assurance

Compared to previous taggings (35h1.3, 36h1.2)

Three domains, various configurations about coupling/DA

Obs verification and episodes examined

HARMONIE forecasts, grossly speaking, are found to have a comparable meteorological performances to those of HIRLAM

These refer mainly to average model properties (pmsl, t2m, cloud, precipitation)

Good potential shown for strong summer convection

Several obvious shortcomings were identified during the validation studies

Severe wind bias in AROME, --- corrected in 36h1.4

Severe problems in producing cold nordic winter temperature even though the bias in average is strongly negative

this talk:

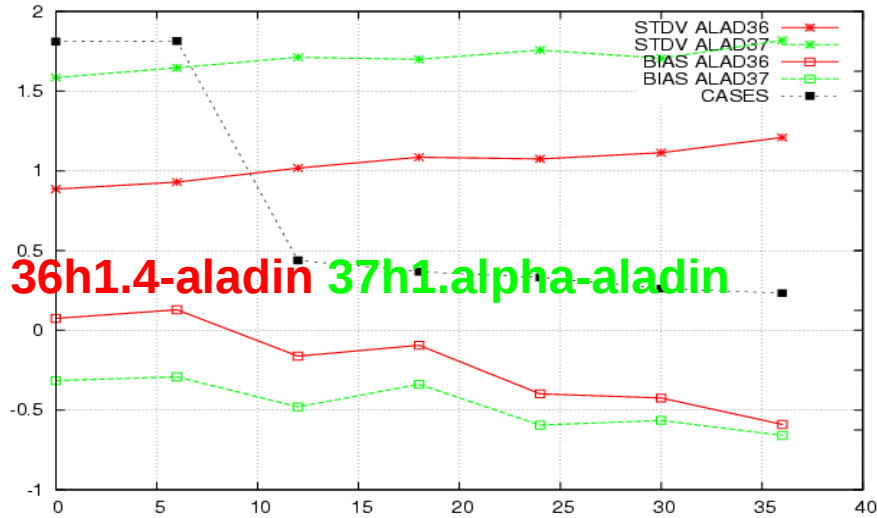
Pre-release 37h1 validation and tuning

- Real time trunk – 37h1.alpha (~Oct 2011)
“denmark”, “scandinavia_5.5”
- 37h1.beta1 (Dec 2012)
“denmark”, “finland”, “iceland”, “iberia”,
“lithuania”, “ireland”, “nuuk”, “scandinavia_5.5”
edmfpm vs edkf; blending vs 3dvar; L60 vs L65
- 37h1.beta2 (Feb 2012)
“denmark”, “finland”, “scandinavia_5.5”
edmfpm, bug fixes, lsmixbc
- 37h1: (“imminent?” – May 2012)
“denmark”
edmfpm, lsmixbc

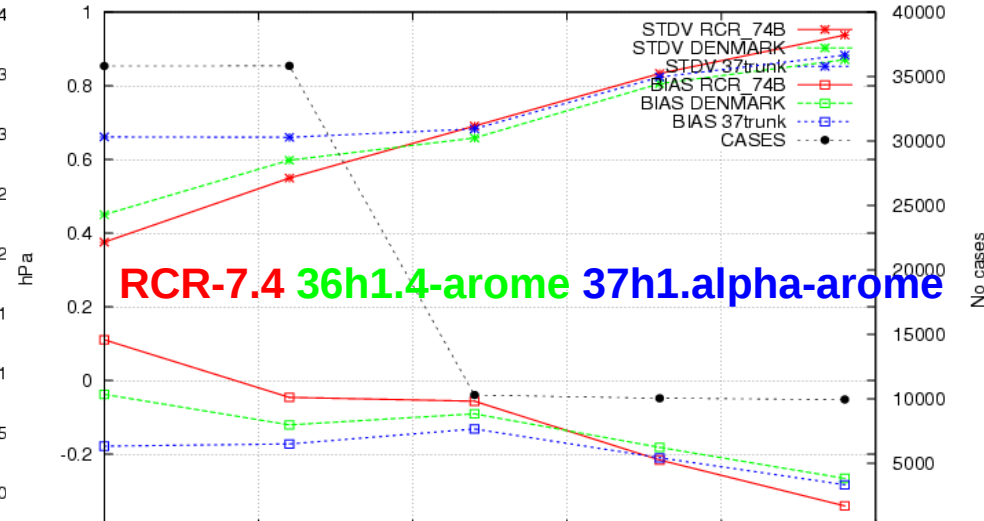


HIRLAM's initial encounter with 37h1

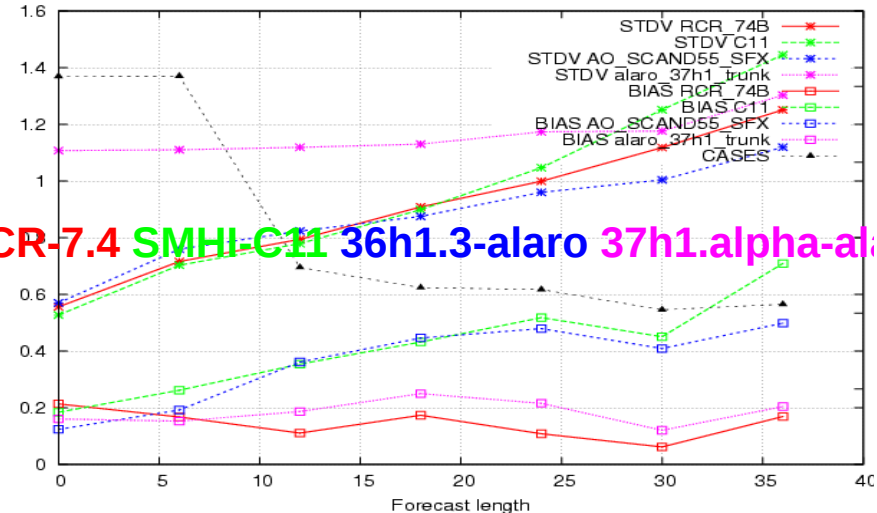
Selection: ALL using 1453 stations
 Period: 20110801-20110807
 Surface pressure Hours: 00,06,12,18



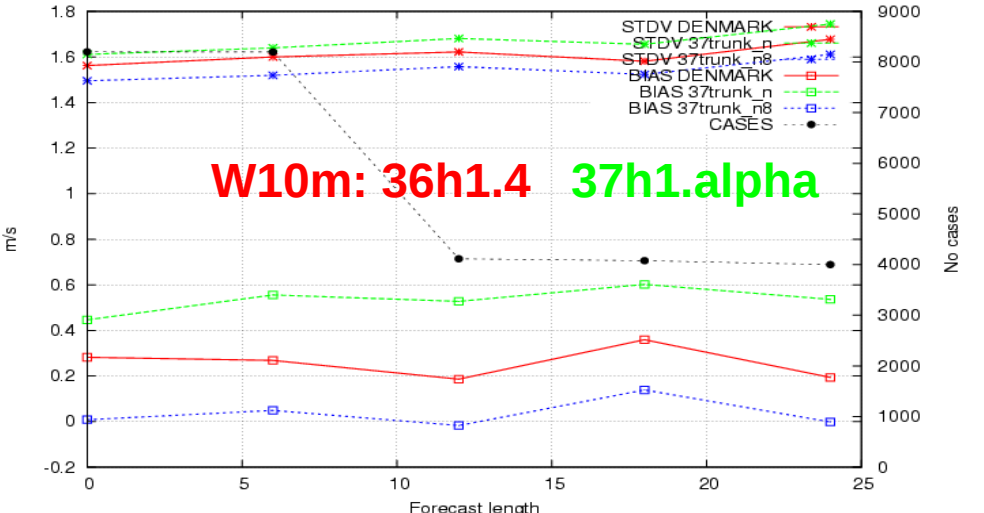
Selection: ALL using 192 stations
 Period: 20110705-20110830
 Surface pressure Hours: 00,06,12,18



Selection: ALL using 989 stations
 Period: 20110901-20110916
 Surface pressure Hours: 00,06,12,18



Selection: Scandinavia using 119 stations
 Period: 201108
 Wind speed Hours: 00,06,12,18



From 37h1.alpha to 37h1 Validation & tuning experiments

Harmonie_37h1/ValidationTests - HIRLAM - Mozilla Firefox

File Edit View History Bookmarks Tools Help

https://hirlam.org...D36_ALAD37_old/ Velkommen - Jægerhytten Surface significane test Fig: ALL;M... Harmonie_37h1/ValidationTests - ... Timeline - HIRLAM

hirlam.org https://hirlam.org/trac/wiki/Harmonie_37h1/ValidationTests CALIFORNIA SUITES HOTEL

Lists of validation experiments

Experiment	Domain	Model Version	Physics	UA Ana	Surface Ana	LSMIXBC	Condensation option	Start of Episode	End of Episode	Observation Verification
~snhfm_home/arome_DENMARK_r10577	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	no	edmf	20091220	20100131	⇒ compared to 36h1.4, 37h1.beta1, 37h1 with lsmixbc
~snhfm_home/arome_DENMARK_r10577_lsmixbc	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	yes	edmf	20091220	20100131	⇒ compared to 36h1.4, 37h1.beta1, 37h1 w/o lsmixbc
~nhzhm_home/arome_DENMARK_r10577	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	no	edmf	20100720	20100831	⇒ compared to 36h1.4, 37h1.beta1, 37h1 with lsmixbc
~nhzhm_home/arome_DENMARK_r10577_lsmixbc	DENMARK	trunk@10577	AROME	3DVAR	Canari_OI-main	yes	edmf	20100720	20100831	⇒ compared to 36h1.4, 37h1.beta1, 37h1 w/o lsmixbc
~nhzhm_home/37h1beta_arome_DENMARK	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20100720	20100831	⇒ compared to 36h1.4
~nhlhm_home/37h1beta_arome_DENMARK_LSMIXBC	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	yes	edkf	20100720	20100831	⇒ compared to 36h1.4, 37h1.4
~nlhfm_home/37h1beta_DENMARK_edmf_summer	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmf	20100720	20100831	⇒ compared to 37h1beta1 with edkf, and edkf_STAT
~nlhfm_home/nhlhfm_home/37h1beta_edkf_summer_STAT	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmf	20100720	20100831	⇒ compared to 37h1beta1 with edkf default, and edmf
~nhefm_home/37h1beta_arome_DENMARK	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20091220	20100131	⇒ compared to 36h1.4, 37h1.4 with lsmixbc
~nhzhm_home/37h1beta_arome_DENMARK_lmhc	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	yes	edkf	20091220	20100131	⇒ compared to 36h1.4, 37h1.4
~nlhfm_home/37h1beta_DENMARK_edmf_winter	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmf	20091220	20100131	⇒ compared to 37h1beta1 with edkf, and edkf_STAT
~nlhfm_home/nhlhfm_home/37h1beta_edkf_winter_STAT	DENMARK	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edmf	20091220	20100131	⇒ compared to 37h1beta1 with edkf default, and edmf
~fmhfm_home/37h1b_arome3dvar_fn_w	FINLAND	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20091220	20100131	⇒ compared to 36h1.4, ⇒ compared to 36h1.4 (FM)
~fmhfm_home/37h1b_arome3dvar_fn_w_sw1	FINLAND	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20091220	20100131	⇒ modified swi conversion, compared to 37h1beta1 & without warm up
~fmhfm_home/37h1b_arome3dvar_fn_w_sw2	FINLAND	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20100101	20100115	⇒ modified swi conversion, compared to 37h1beta1, with and without warmup
~fmhfm_home/37h1b_arome3dvar_fn_s	FINLAND	37h1.beta1	AROME	3DVAR	Canari_OI-main	no	edkf	20110720	20110831	⇒ compared to FM 36h1.4
~icbhm_home/mo37h1b	ICELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20110620	20110831	⇒ compared to ECMWF, HIRLAM-K05
~nhefm_home/37h1beta_arome_ICELAND	ICELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edmf	20111120	20111231	⇒ compared to ECMWF, HIRLAM-K05
~duihfm_home/fr25ag36h1p4bf1	IRELAND	36h1.4.bf1	AROME	3DVAR	Canari_OI-main	no	edmf	20111120	20111231	⇒ compared to 37h1.beta1
~snhfm_home/fr25ir25L60cy37trunk	IRELAND	37h1_r10386	AROME	3DVAR	Canari_OI-main	no	edmf	20111120	20111231	⇒ compared to 37h1.beta1
~duihfm_home/fr25ag36h1p4bf1_no3DVARL65	IRELAND	36h1.4.bf1	AROME	blending	Canari_OI-main	no	edmf	20111120	20111231	⇒ L65 no 3DVAR, compared to 37h1.beta1, 36h14.bf1 3dvar-L60
~duihfm_home/fr25ag37h1b1BD1_no3DVARL65	IRELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20111120	20111231	⇒ 1h ECBD, no 3DVAR, L65, compared to 36h14.bf1 and 37h1.4beta1 with 3h ECBD, 1h ECBD+3dvar+60
~duihfm_home/fr25ag37h1b1BD3_no3DVARL65	IRELAND	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20111120	20111231	⇒ 1h ECBD, no 3DVAR, L65, compared to 36h14.bf1 and 37h1.4beta1 with 3h ECBD, 1h ECBD+3dvar+60
~lmhfm_home/36h14bf1_it	LITHUANIA	36h14.bf1	AROME	blending	Canari_OI-main	no	edkf	20091220	20100131	⇒ compared to ECMWF, HIRLAM-HL8, 37h1
~lmhfm_home/37h1b1_it	LITHUANIA	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20091220	20100131	⇒ compared to ECMWF, HIRLAM-HL8, 36h1.4bf1
~nhlhm_home/37h1beta_arome_nuuk	NUUK	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20110620	20110731	⇒ compared to ECMWF, HIRLAM-K05, DM1-361.3
~nhefm_home/37h1beta_arome_nuuk	NUUK	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20111120	20111231	⇒ compared to ECMWF, HIRLAM-K05, DM1-361.3
~mdkfhm_home/aib_36h14bf1	IBERIA	36h14.bf1	AROME	blending	Canari_OI-main	no	edkf	20100720	20100831	⇒ compared to 37h1.beta1
~mdkfhm_home/aib_37h1beta	IBERIA	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20100720	20100831	⇒ compared to 36h1.4.bf1
~spbhfm_home/aib_36h14bf1	IBERIA	36h14.bf1	AROME	blending	Canari_OI-main	no	edkf	20091220	20100131	⇒ compared to HIRLAM-5km HNR, 37h1.beta1
~spbhfm_home/aib_37h1beta	IBERIA	37h1.beta1	AROME	blending	Canari_OI-main	no	edkf	20091220	20100131	⇒ compared to HIRLAM-5km HNR
~snhfm_home/ala_37h1b1_1	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	no	-	20091220	20100131	⇒ compared to alaro 36h1.4, 37h1beta1 with lsmixbc
~sblhfm_home/ala_37h1b1_1_lmhc_NEW	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	yes	-	20091220	20100131	⇒ compared to alaro 36h1.4, 37h1beta1
~nkoahm_home/ECISWI	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	yes	-	20091220	20100131	⇒ test of modified swi conversion, compared to alaro 36h1.4, 37h1beta1
~sn4fhm_home/ala_37h1b1	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	no	-	20100720	20100831	⇒ compared to alaro 36h1.4, 37h1beta1 with lsmixbc
~laghfm_home/ala_37h1b1_1_lmhc_NEW	SCANDINAVIA_5.5	37h1.beta1	ALARO	3DVAR	Canari_OI-main	yes	-	20100720	20100831	⇒ compared to alaro 36h1.4, 37h1beta1

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From 36h1 to 37h1

Issues seen & addressed

Scripts problems, namelist settings → many corrections & taggable now!

Lengthy soil spinup → swi conversion improved

Increased wind bias → improved with canopy_drag/sso tuning

Increased cloud bias → gone (bug correction or elsewhere?)

edmf update chaos → adjusted and back to default

Parallelisation and reproducibility of AROME, edmf → improved and assured

Stability of arome model

Bugs in spectral nudging code... → corrected

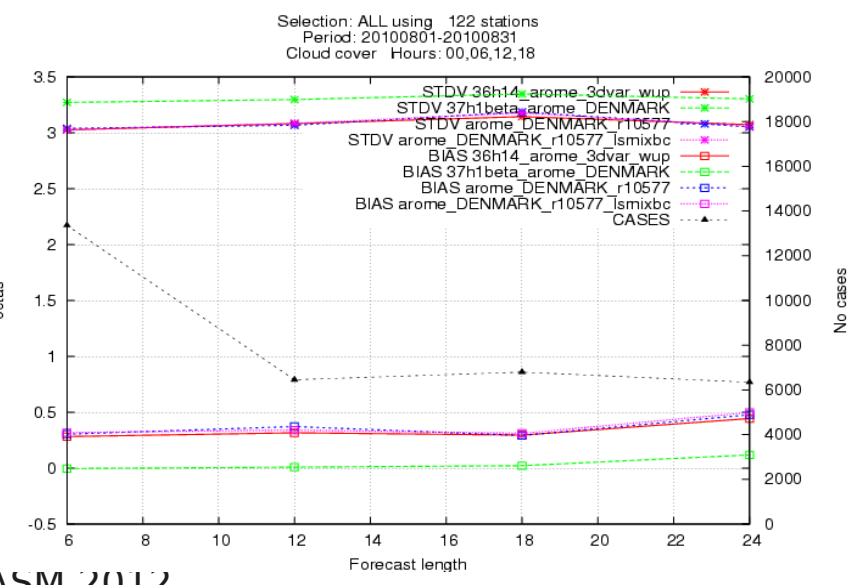
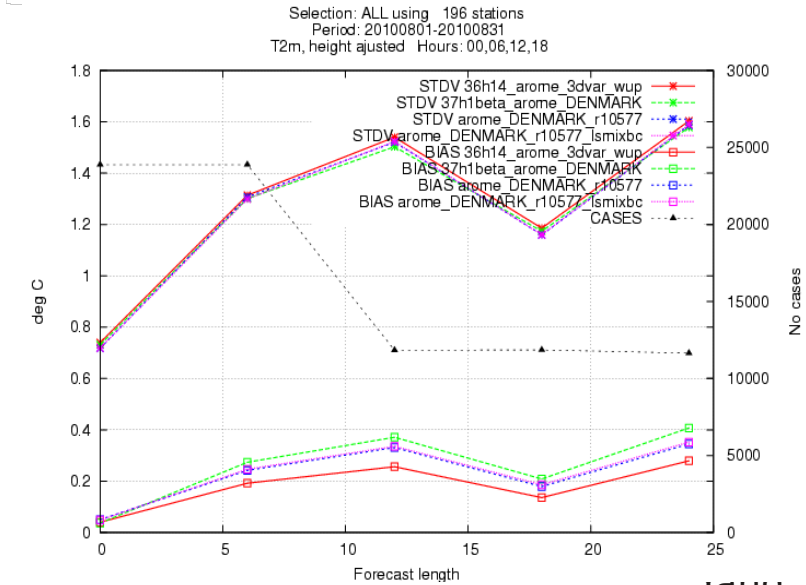
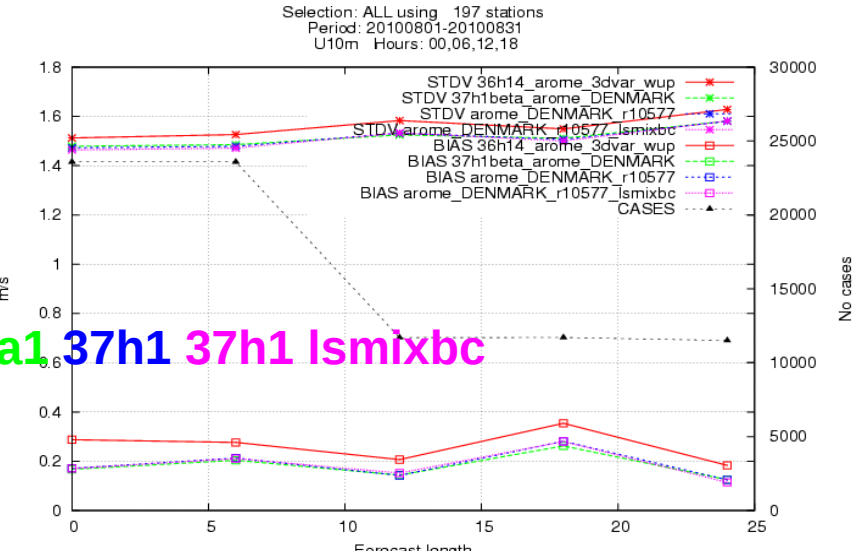
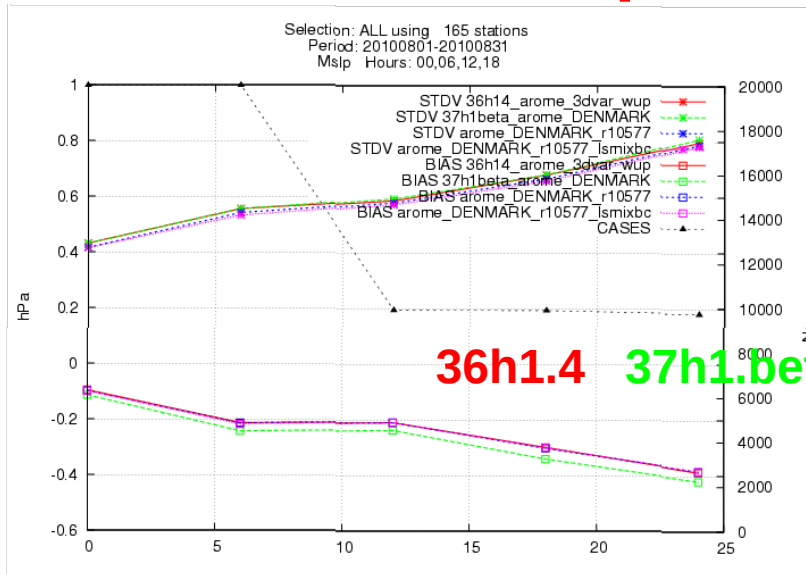
LSMIXBC → corrected and now default

Shortcomings in utility, post-processing → improved but incomplete



From 36h1.4 to 37h1

Summer episode: surface scores





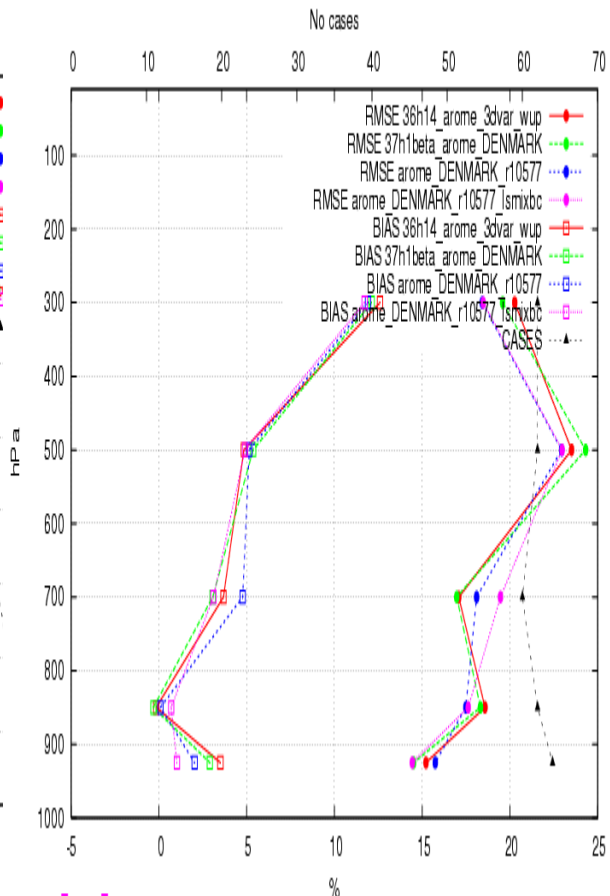
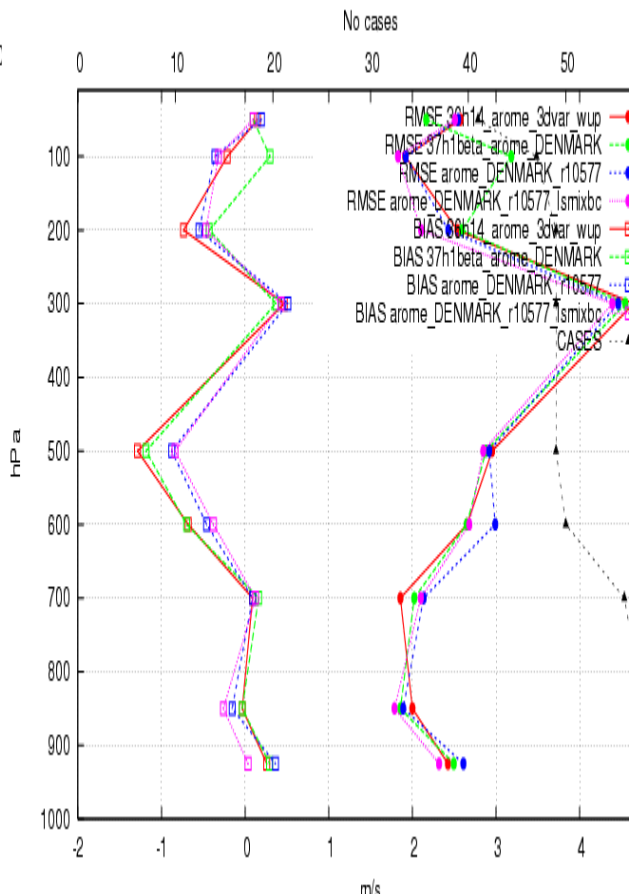
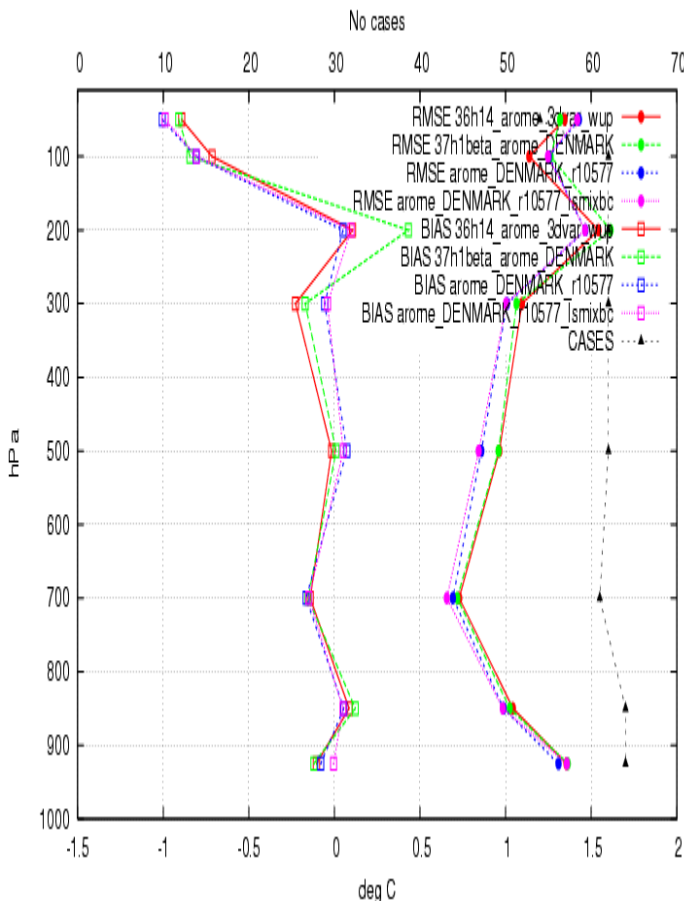
From 36h1.4 to 37h1

Summer episode: profiles

2 stations Selection: ALL
 Temperature Period: 20100801-20100831
 Statistics at 12 UTC Used 00,12 + 12 24

2 stations Selection: ALL
 Wind speed Period: 20100801-20100831
 Statistics at 12 UTC Used 00,12 + 12 24

2 stations Selection: ALL
 Relative Humidity Period: 20100801-20100831
 Statistics at 12 UTC Used 00,12 + 12 24



36h1.4 **37h1.beta1** **37h1** **37h1 Ismixbc**

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From 36h1.4 to 37h1

Summer episode: precipitation skill

Equitable threat score for Precipitation (mm/12h)

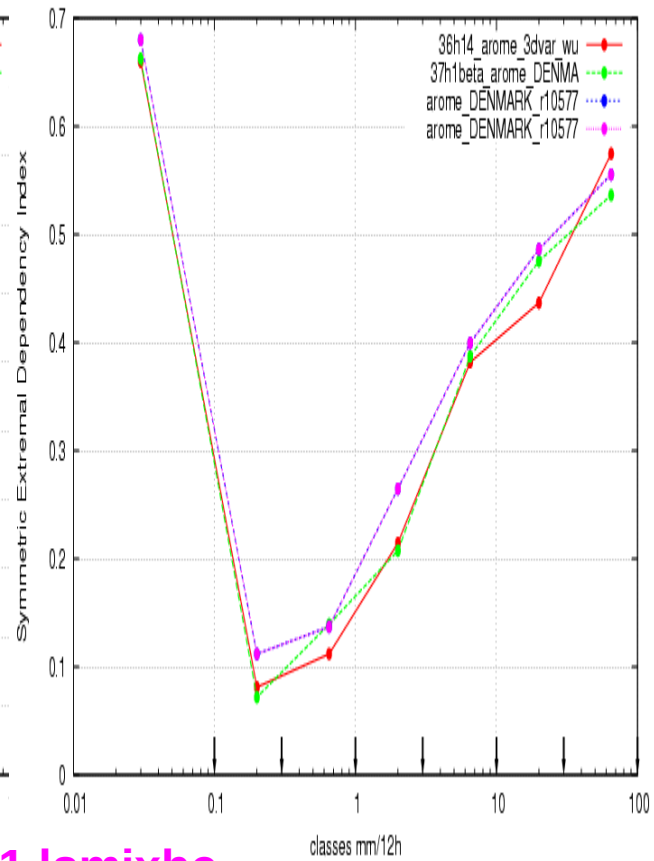
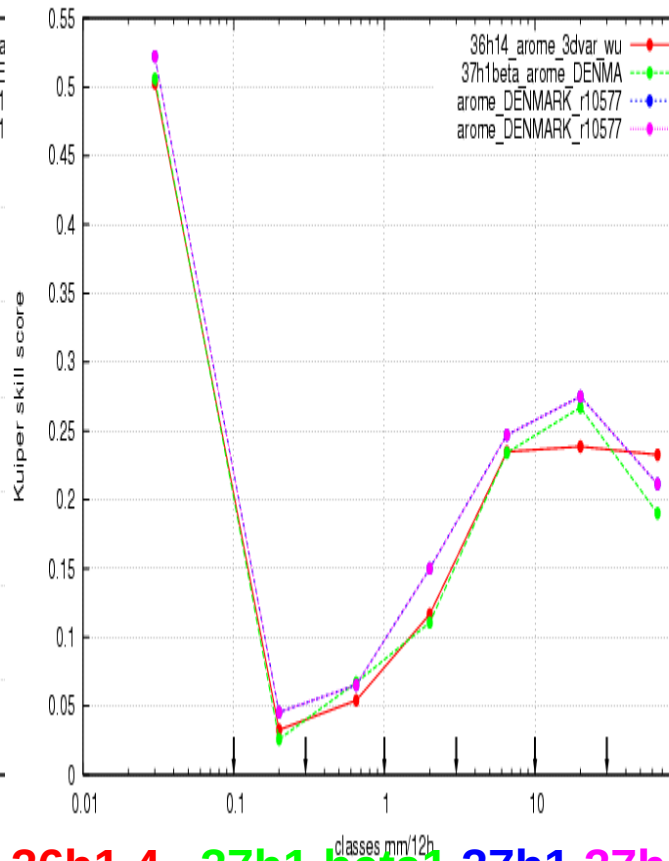
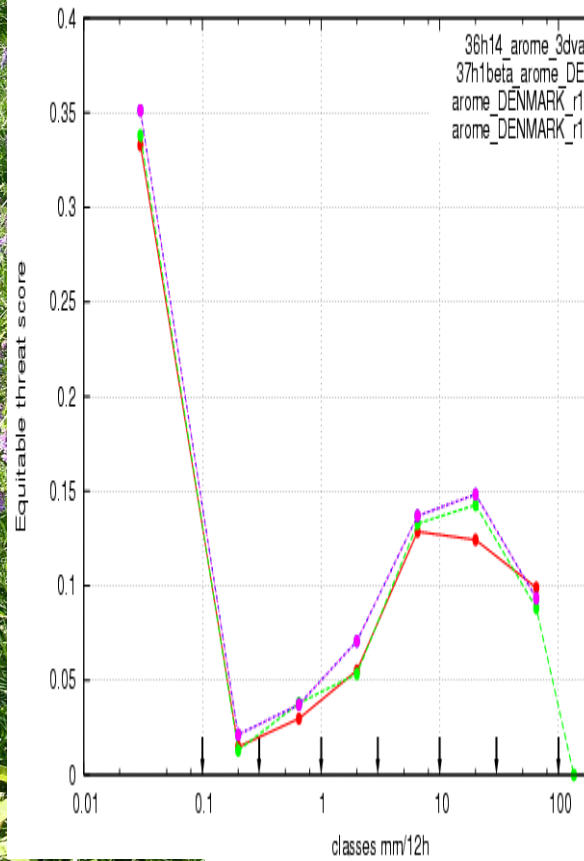
Selection: ALL 167 stations
 Period: 20100801-20100831
 Used 00,12 + 18-06

Kuiper skill score for Precipitation (mm/12h)

Selection: ALL 167 stations
 Period: 20100801-20100831
 Used 00,12 + 18-06

Symmetric Extremal Dependency Index for Precipitation (mm/12h)

Selection: ALL 167 stations
 Period: 20100801-20100831
 Used 00,12 + 18-06



36h1.4 **37h1.beta1** **37h1** **37h1** **Ismixbc**

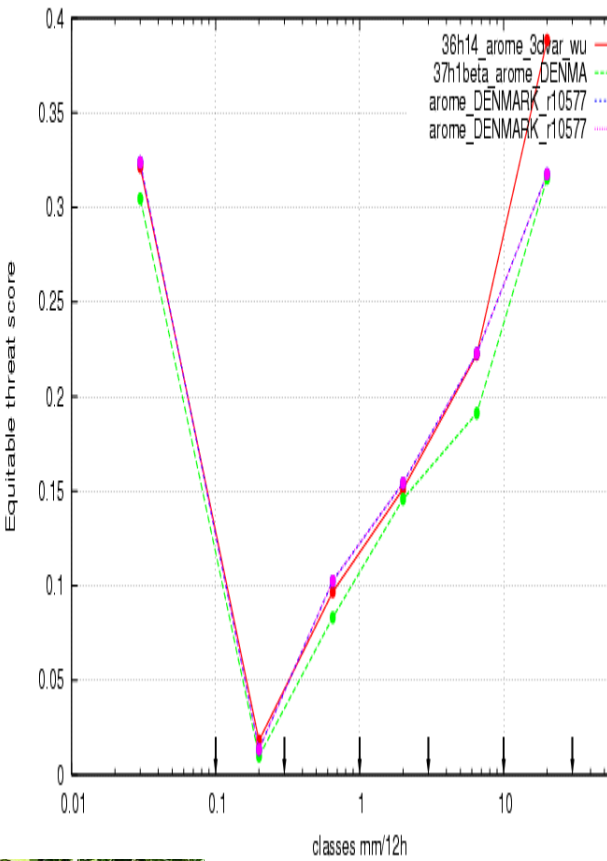




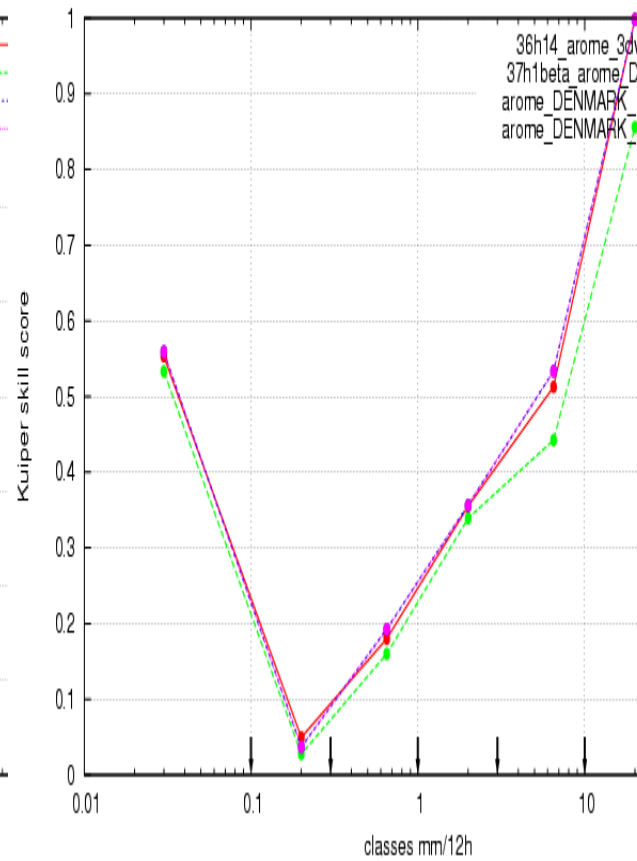
From 36h1.4 to 37h1

Winter episode: precipitation skill

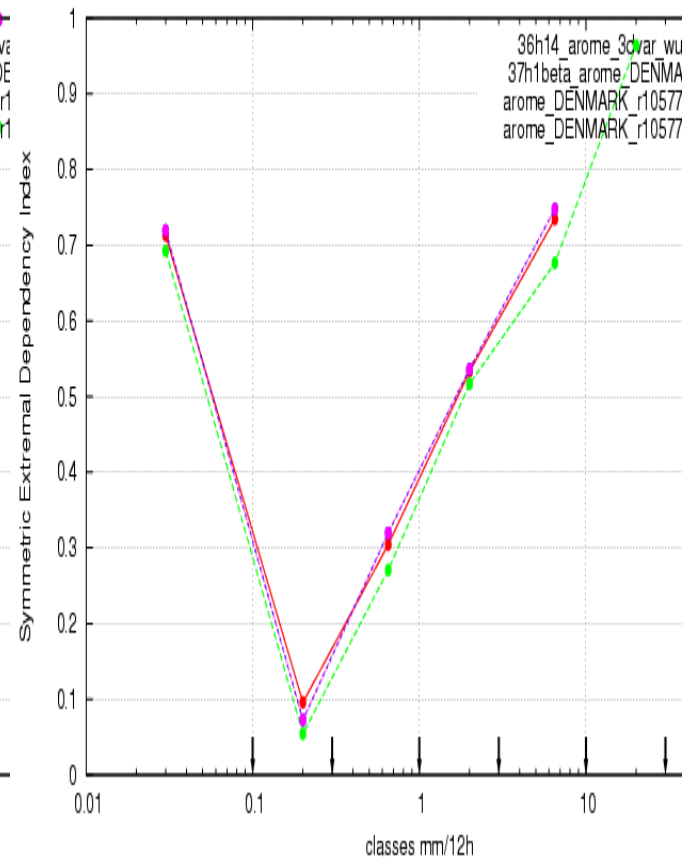
Equitable threat score for Precipitation (mm/12h)
 Selection: ALL 178 stations
 Period: 20100101-20100131
 Used 00,12 + 18-06



Kuiper skill score for Precipitation (mm/12h)
 Selection: ALL 178 stations
 Period: 20100101-20100131
 Used 00,12 + 18-06



Symmetric Extremal Dependency Index for Precipitation (mm/12h)
 Selection: ALL 178 stations
 Period: 20100101-20100131
 Used 00,12 + 18-06



36h1.4 37h1.beta1 37h1 37h1 Ismixbc

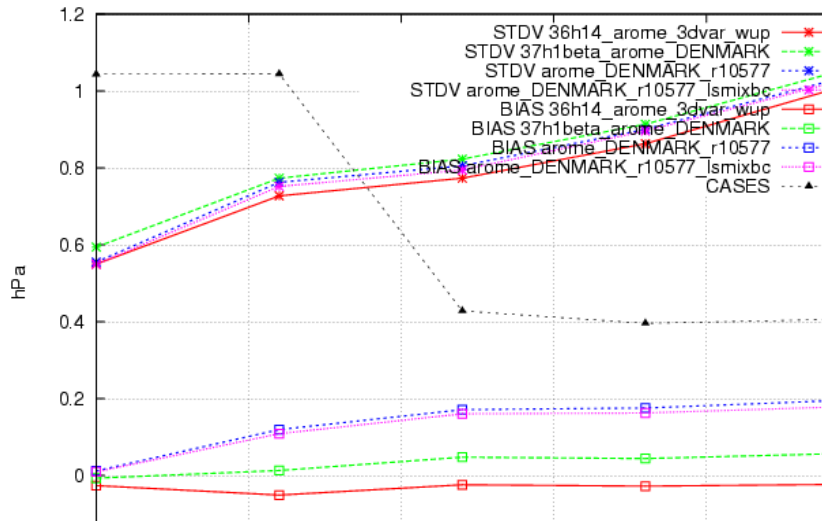
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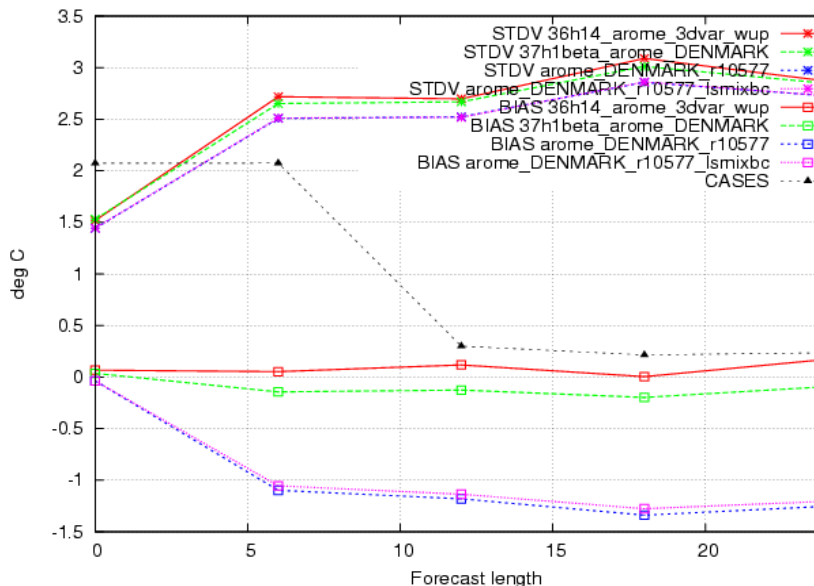
From 36h1.4 to 37h1

Winter episode: surface scores

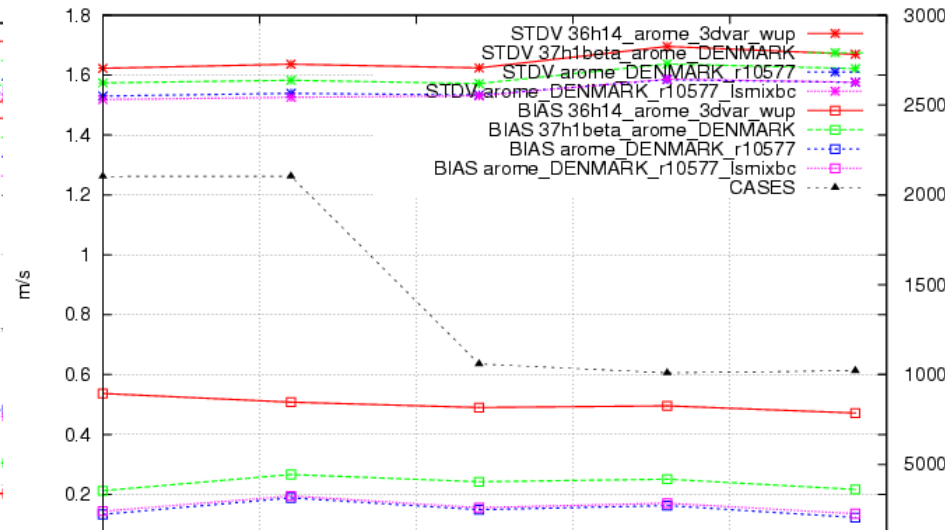
Selection: ALL using 176 stations
Period: 20100101-20100131
Mslp Hours: 00,06,12,18



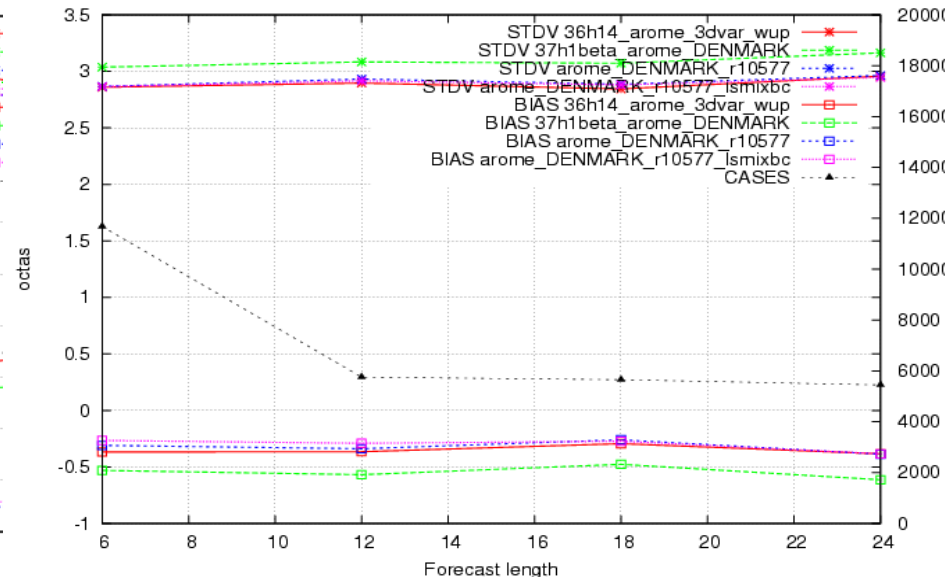
Selection: ALL using 214 stations
Period: 20100101-20100131
T2m, height ajusted Hours: 00,06,12,18



Selection: ALL using 209 stations
Period: 20100101-20100131
U10m Hours: 00,06,12,18

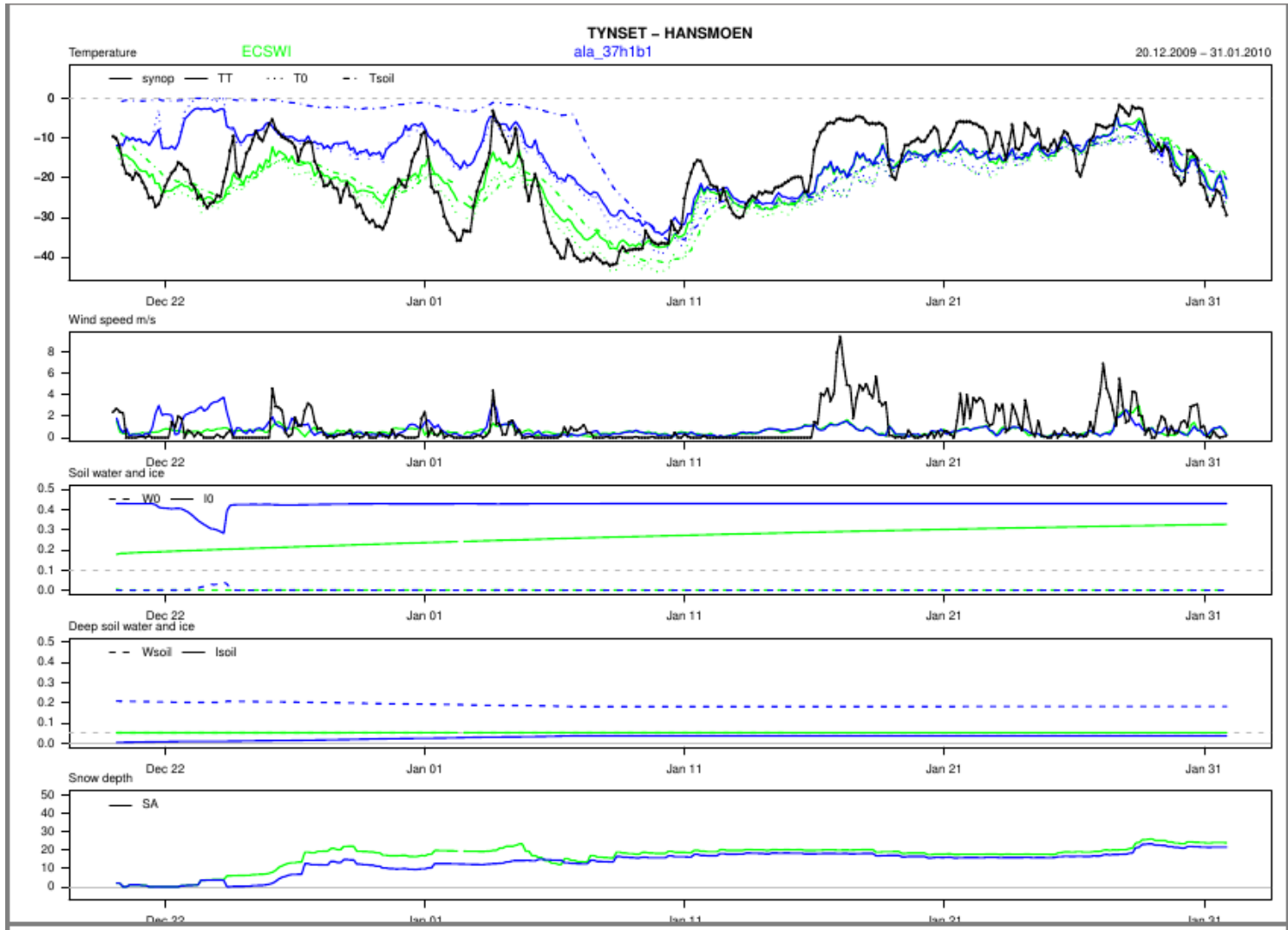


Selection: ALL using 121 stations
Period: 20100101-20100131
Cloud cover Hours: 00,06,12,18



From 37h1.alpha to 37h1.beta

Correction in swi conversion: alaro (by Sander Tijm)



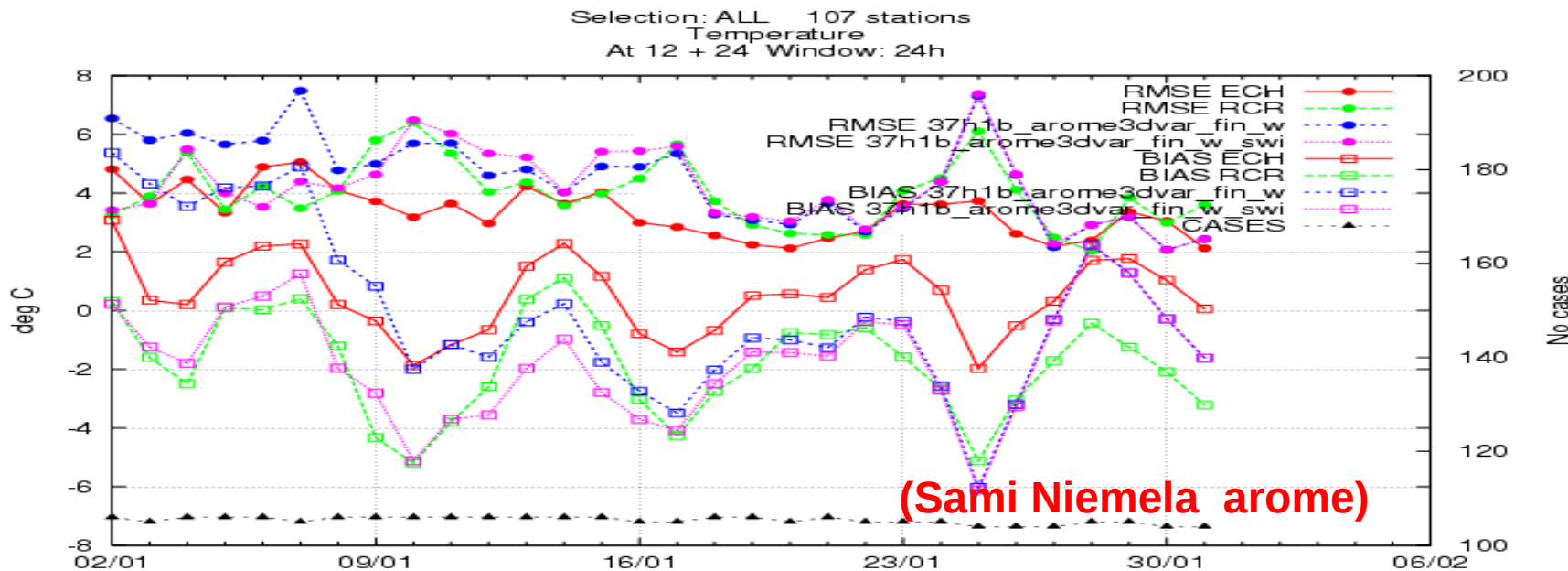
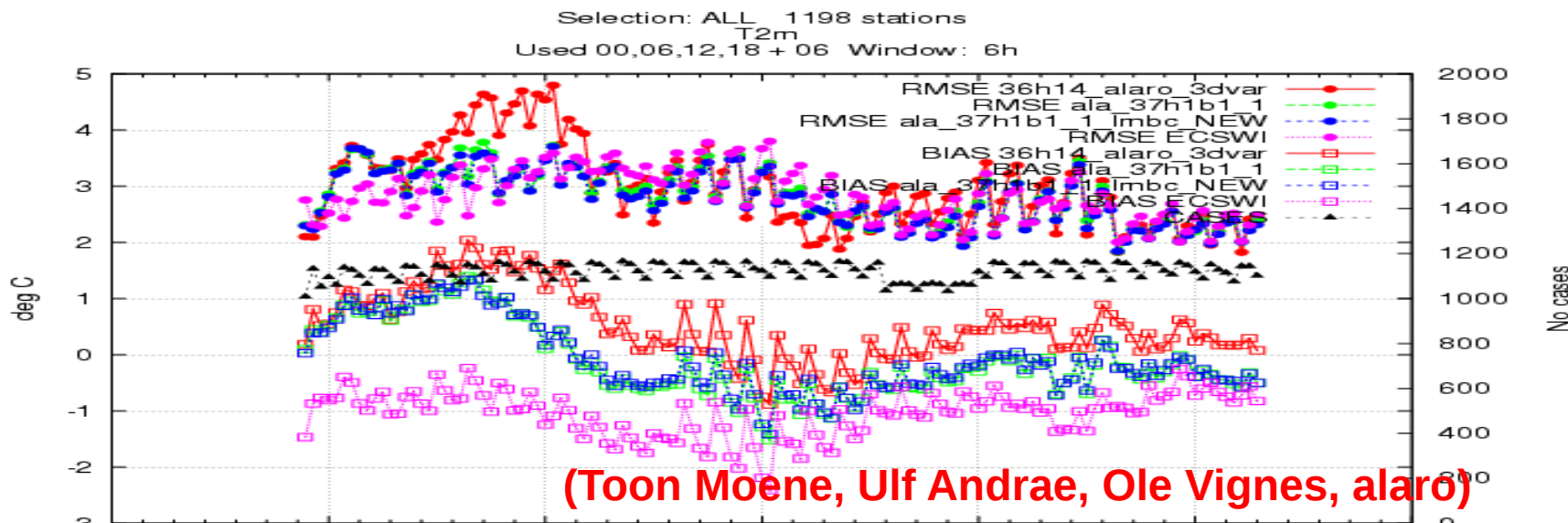
Yang, ASM 2012

(Mariken Homleid)



From 37h1.alpha to 37h1.beta

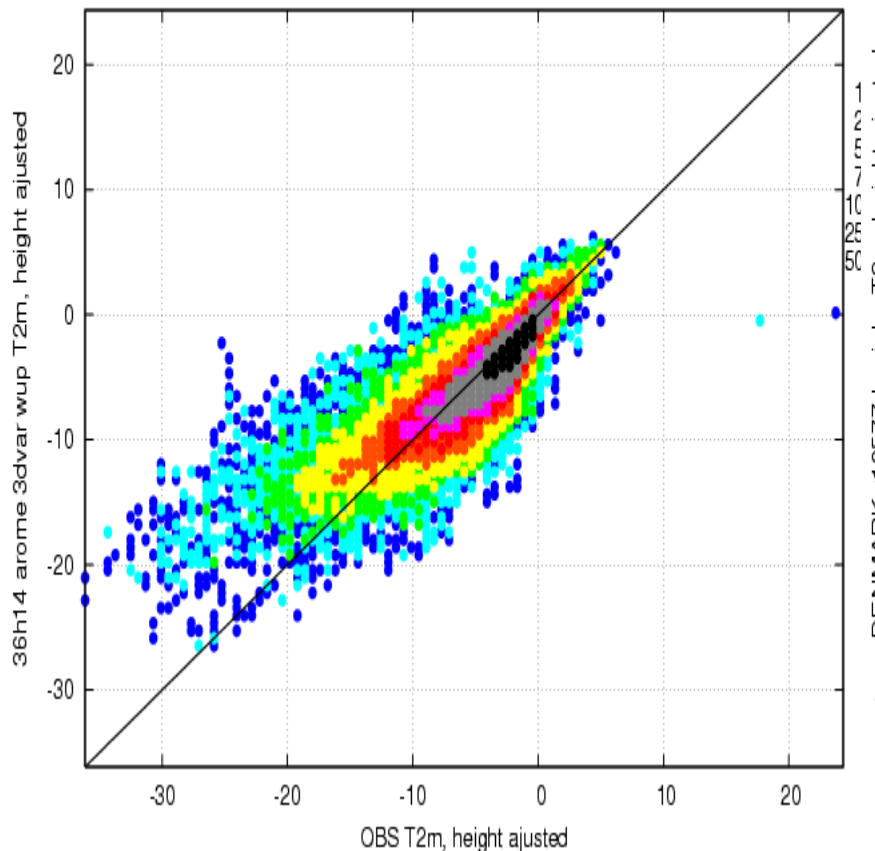
Correction in swi conversion



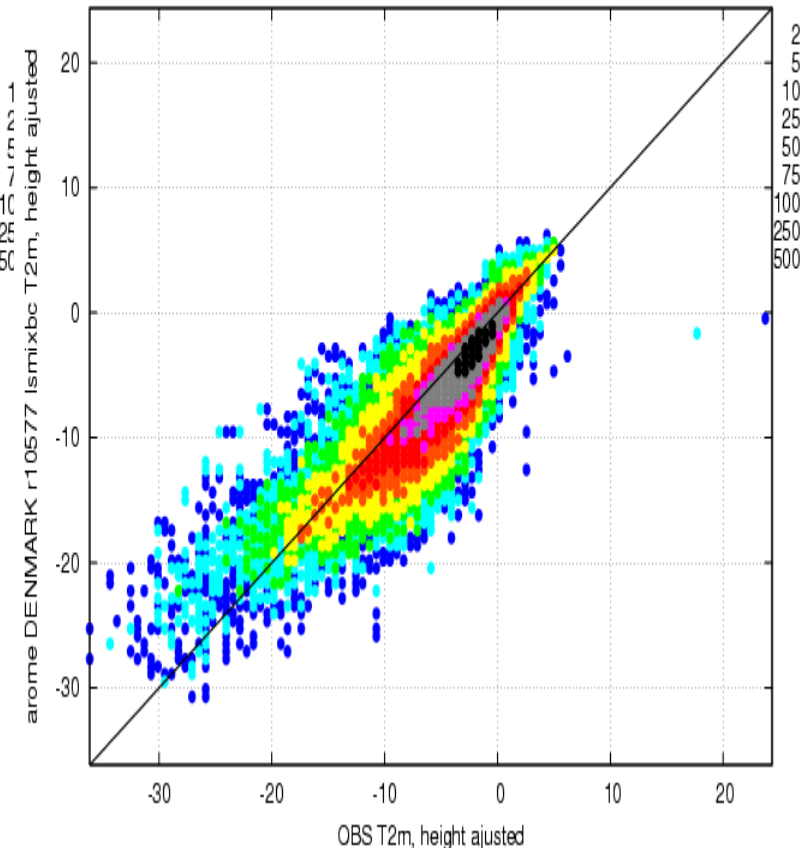
From 37h1.alpha to 37h1

Correction in swi conversion: arome

Scatterplot for 214 stations Selection: ALL
T2m, height ajusted [deg C]
Period: 20100101-20100131
Used 00,06,12,18 + 06 18



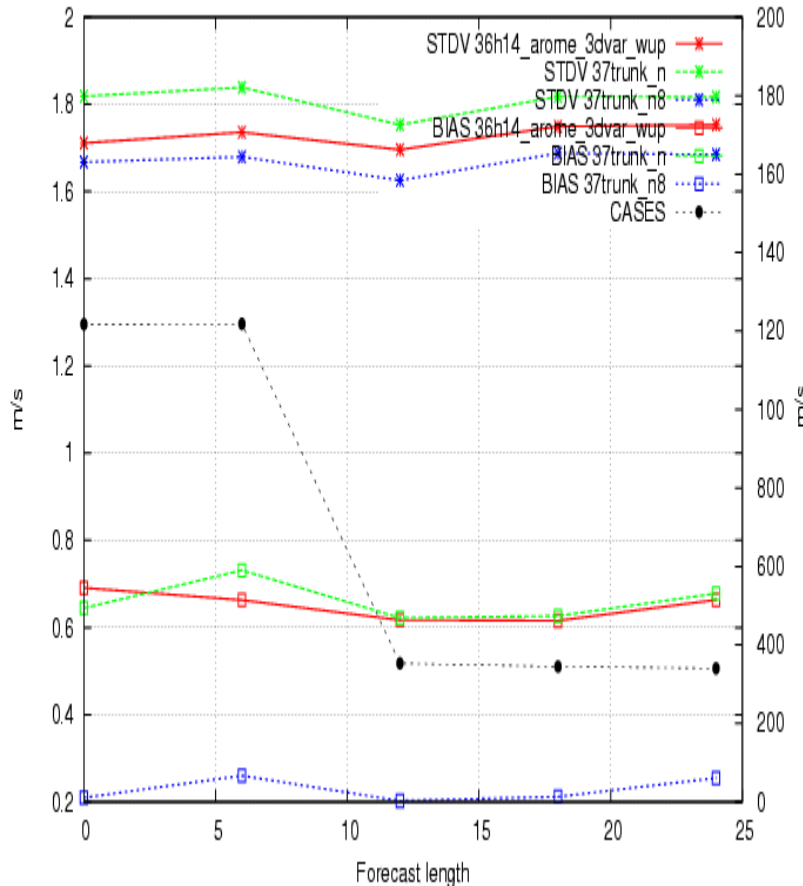
Scatterplot for 214 stations Selection: ALL
T2m, height ajusted [deg C]
Period: 20100101-20100131
Used 00,06,12,18 + 06 18



From 36h1.4 to 37h1

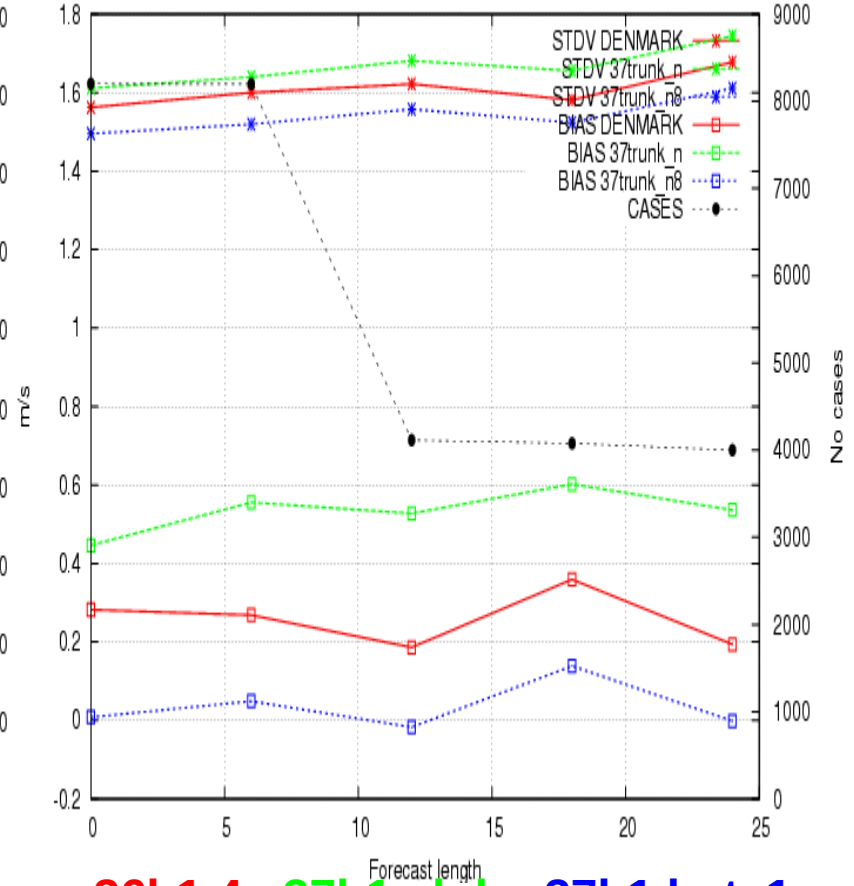
Impact of activating canopy_drag in surfex

Selection: Scandinavia using 134 stations
 Period: 201001
 Wind speed Hours: 00,06,12,18



36h1.4 **37h1.alpha** **37h1.beta1**
201001

Selection: Scandinavia using 119 stations
 Period: 201108
 Wind speed Hours: 00,06,12,18



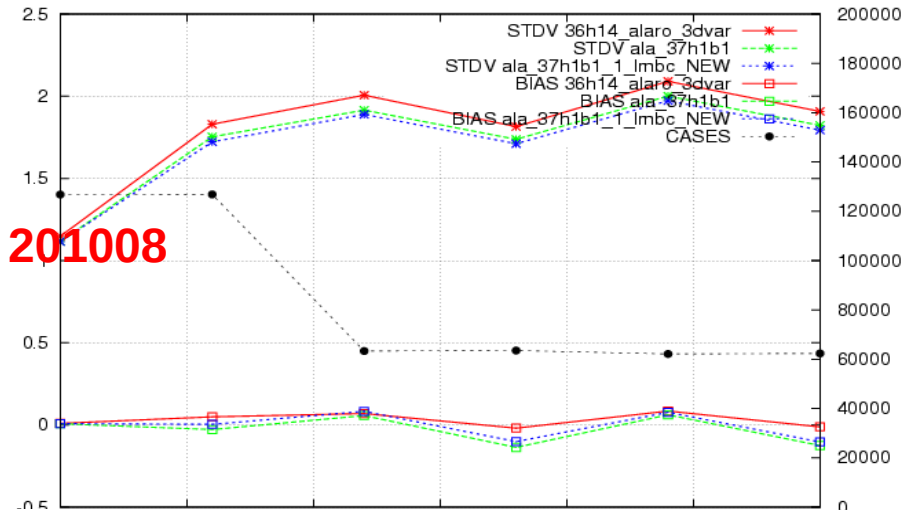
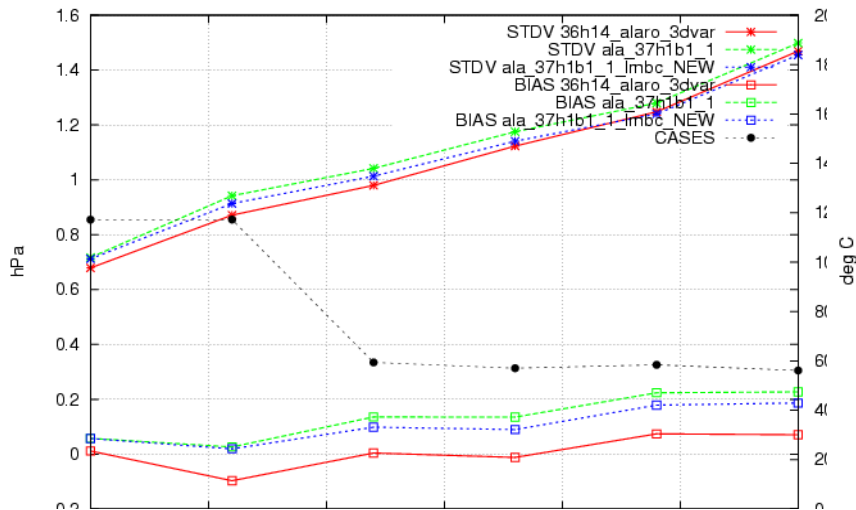
36h1.4 **37h1.alpha** **37h1.beta1**
201008



From 36h1.4 to 37h1 LSMIXBC (Ole Vignes)

Selection: ALL using 1009 stations
Period: 20100101-20100131
Mslp Hours: 00,06,12,18

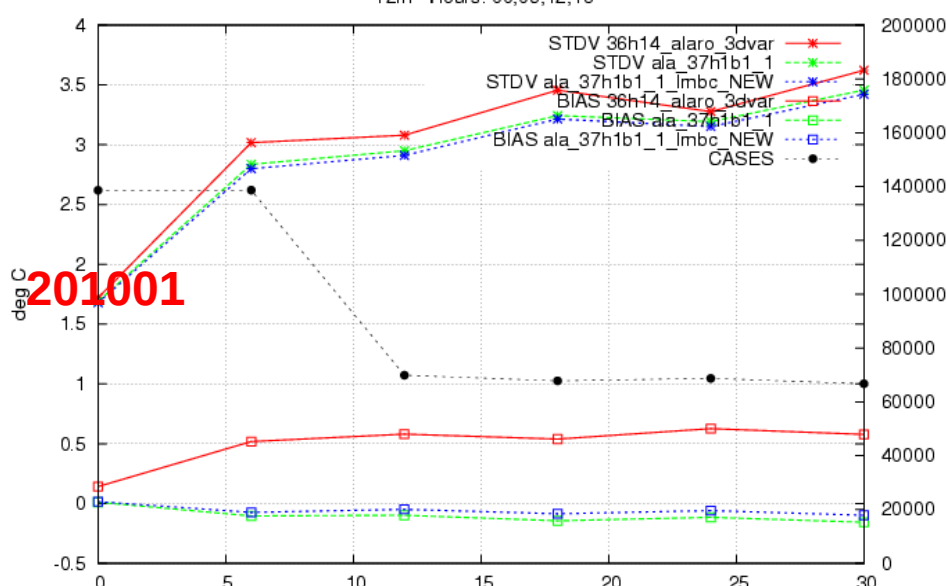
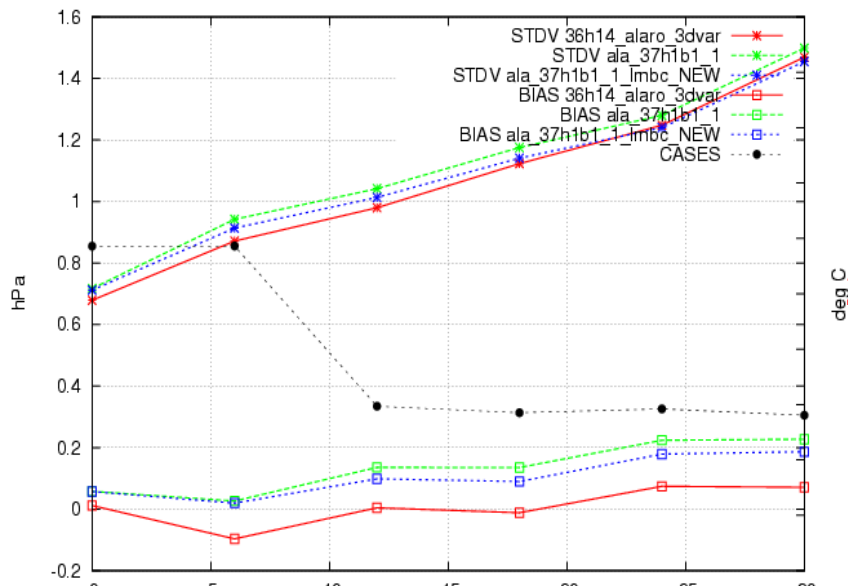
Selection: ALL using 1200 stations
Period: 20100801-20100828
T2m Hours: 00,06,12,18



Selection: ALL using 1009 stations
Period: 20100101-20100131
Mslp Hours: 00,06,12,18

36h1.4 37h1.beta1 37h1.beta1 lsmixbc

Selection: ALL using 1198 stations
Period: 20100101-20100131
T2m Hours: 00,06,12,18

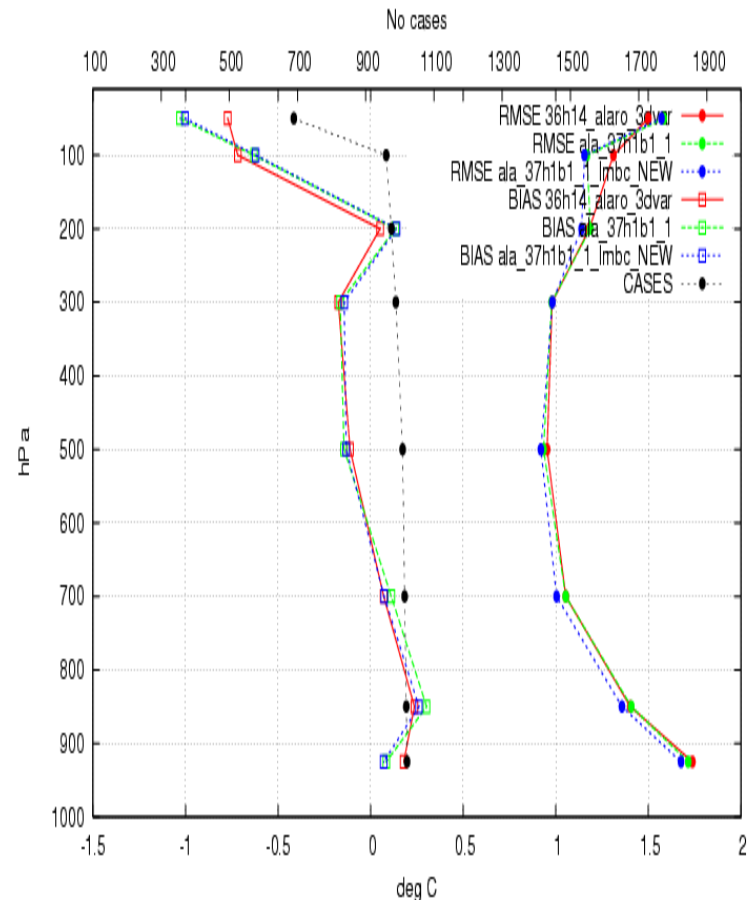
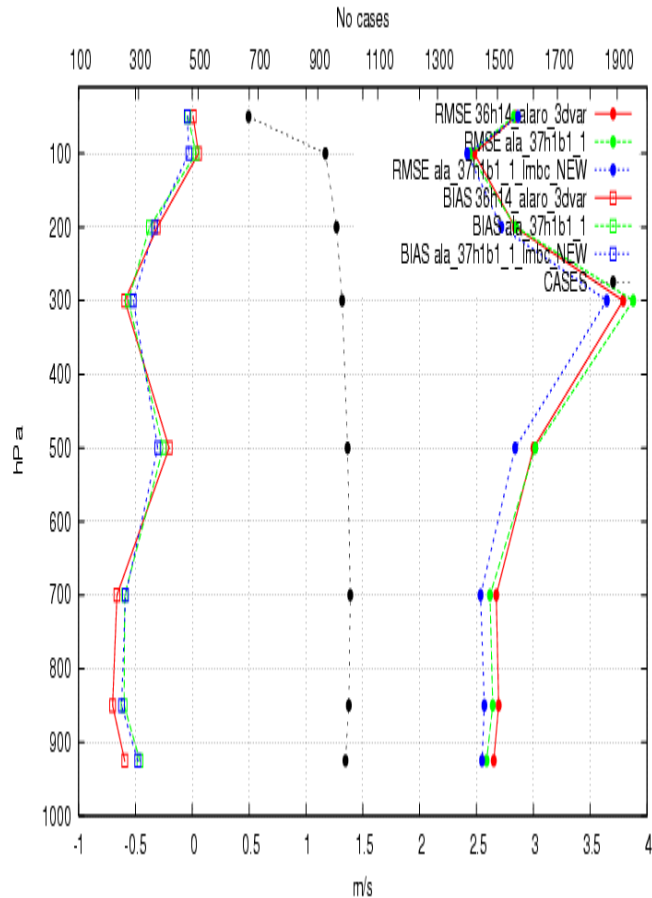


From 36h1.4 to 37h1

Impact of LSMIXBC: alaro

62 stations Selection: ALL
 Wind speed Period: 20100101-20100131
 Statistics at 00 UTC Used 00 + 06 12 18 24

63 stations Selection: ALL
 Temperature Period: 20100101-20100131
 Statistics at 00 UTC Used 00 + 06 12 18 24



36h1.4 **37h1.beta1** **37h1.beta1 lsmixbc**

Yang, ASM 2012



Main conclusions/outcomes

37h1 (arome, alaro) at least no worse than 36h1.4

Swi conversion, improves greatly soil spin-up

Surface wind reduced, mostly better except for mountain area

Mslp and upper air scores improved with LSMIXBC

Final tests with 37h1-arome indicates further improvement

Precipitation improved

No more degradation in cloud amount

As such, 37h1 is now recommendable to HIRLAM operational services, but pre-launch evaluation and tuning still necessary



Other general observations

HARMONIE (arome, alaro) has generally a very short, hence insignificant moisture spin-up

Noise issue yet to be studied

Tests between edkf/edmf so far indicates overall a minor sensitivity

Nordic winter temperature issue less pronounced but still exists, especially in clear and calm conditions

Many obvious work remain DA (tuning of scaling-factor, entry of remote sensing data)

Some Personal Reflections

Quite significant performance gain has been experienced throughout the evolution of 37h1

-Cy36h1.4 → 37h1.alpha → 37h1.beta1 → 37h1.beta2 → 37h1

Process of validation and evaluation benefited greatly from contribution of developers

Yet, in most cases, the evolution did not touch “core of science”

- Science has been pretty solid
- Technical adaptation has been pretty demanding

Can this community get more creative about the lengthy adaptation process??

Quite little tuning and innovative work on DA, PHYSICS, DYNAMICS during the porting

Reference HARMONIE has not become an effective development platform for the science team

Can HIRLAM and MF&ALADIN team make use of each other better?

