

# Experiences on AROME forecasting fog and low clouds for Nordic conditions

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Parameterization of Stable Boundary Layer in Numerical Weather Prediction Models

Finnish Meteorological Institute, Helsinki, December 3 - 5 2012





# Outline

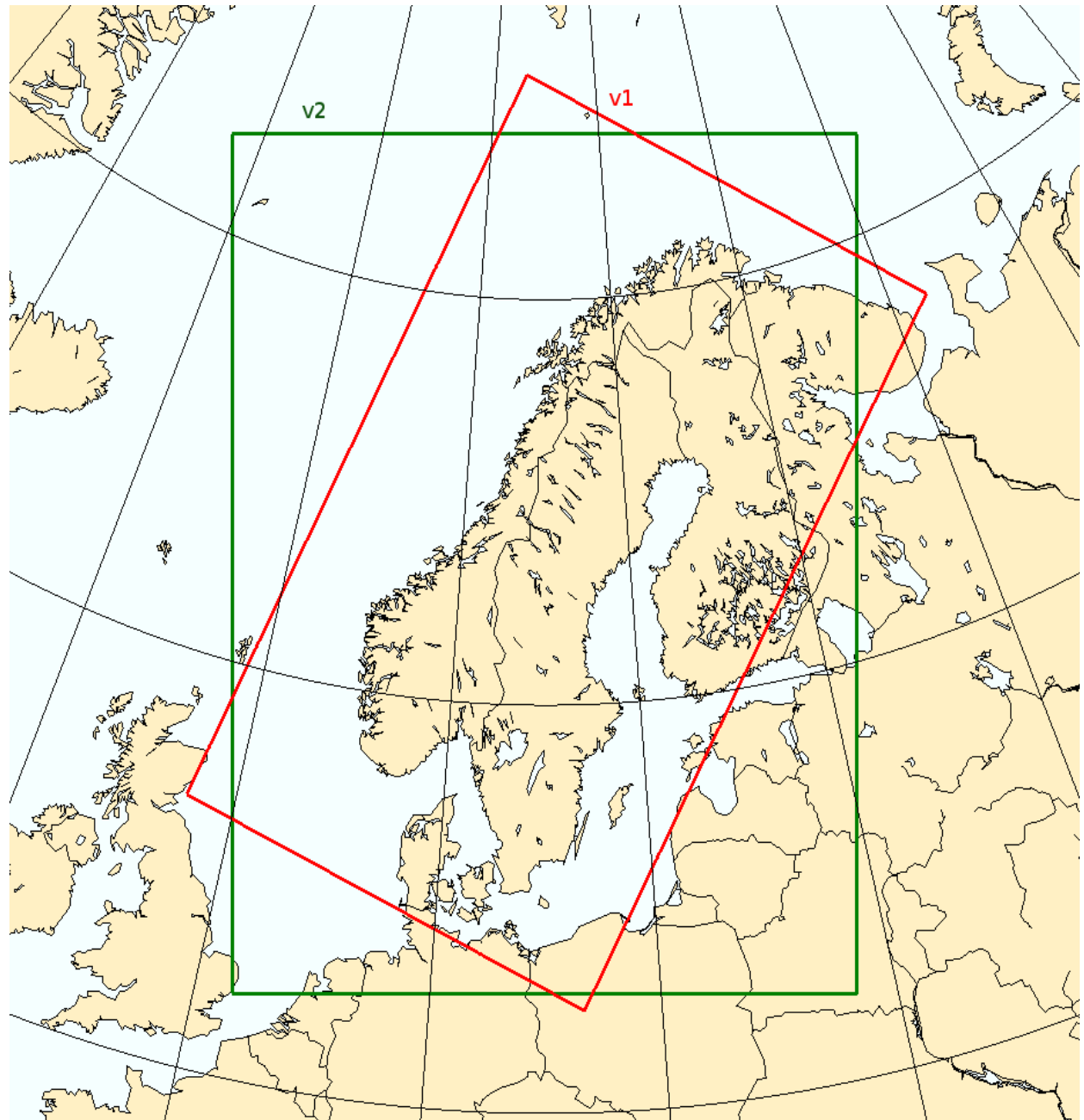
- Short about the MetCoop project
- Current model running
- Spring (36h1.4) results
- Autumn results (37h1.1)
- Winter (36h1.4, 37h1.1) results
- Summary

## Short about the MetCoop project

- Cooperation between Norway and Sweden on running limited area models
- Common model and domain
- Common computer(s)
- Computer(s) also for 'individual' runs
- Operational in March 2014

# Current model running (green borders)

- Arome 2.5km
- 739x949x65
- 3DVAR, OI-main
- 37h1.1

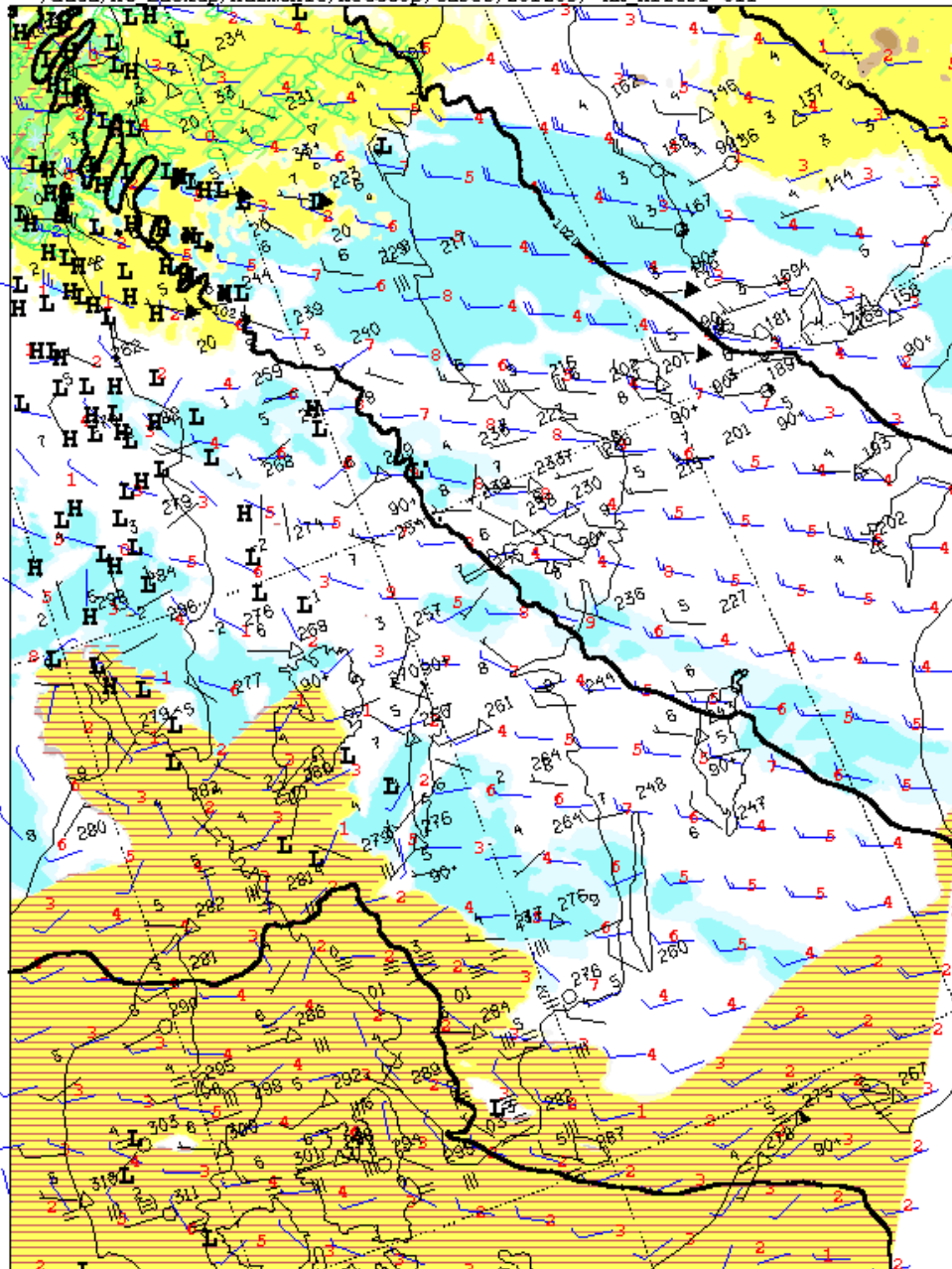


# Spring (36h1.4) results

- Too much fog at times (Example)
- Low clouds verification ('good' automatic stations)
- Cloud base >2 octas ('good' automatic stations)
- 'good' automatic stations sees up to 7.5 km, all cloud bases > 7.5km including cloud free set to 7.5km

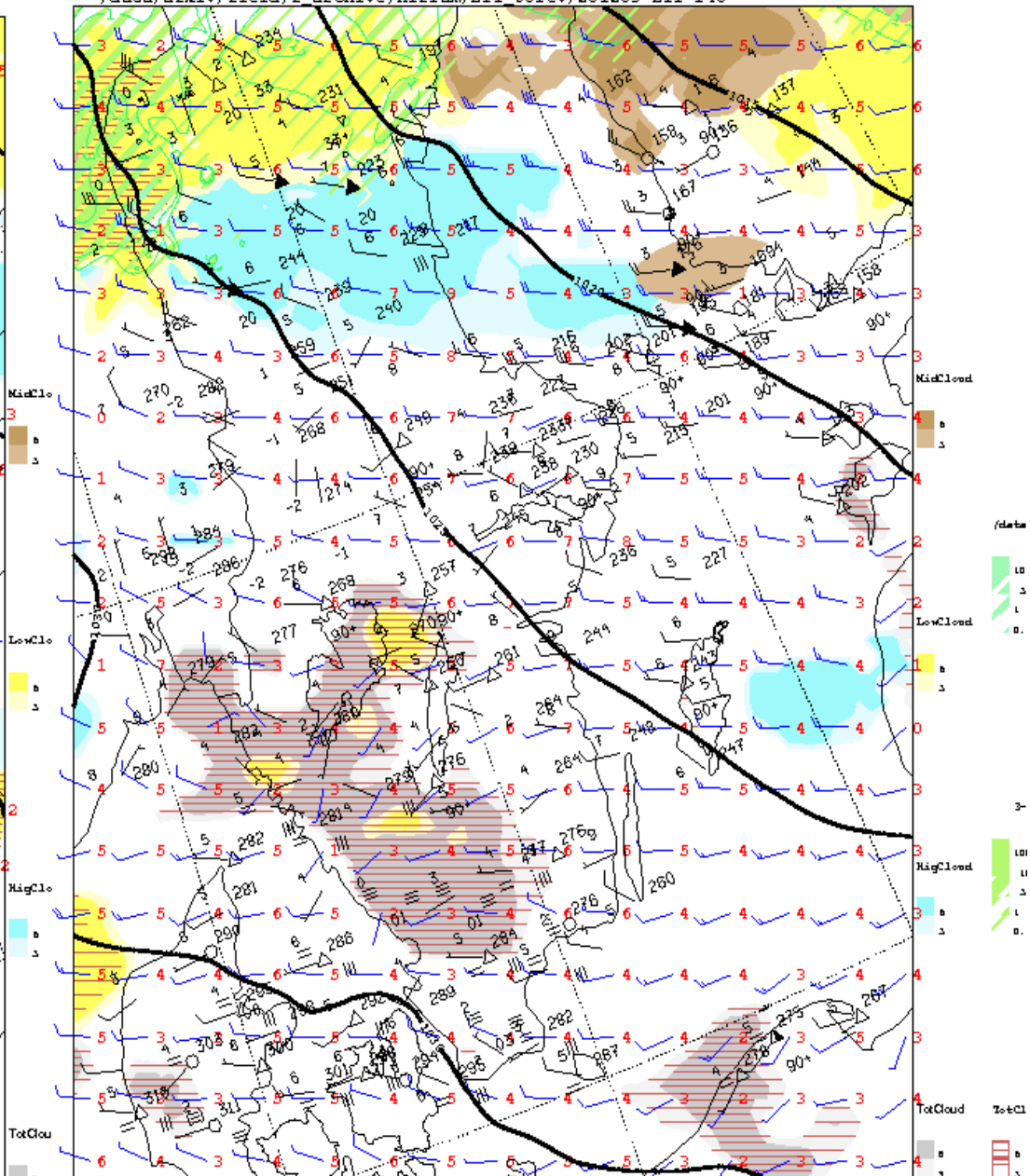
Too much fog at times (March 23-2012) Yellow=low clouds, brown horizontal lines = fog (Forecast fog = clouds on lowest level)

/data/no\_backup/harmonie/MetCoOp/cases/201203/ AM Hires1 011



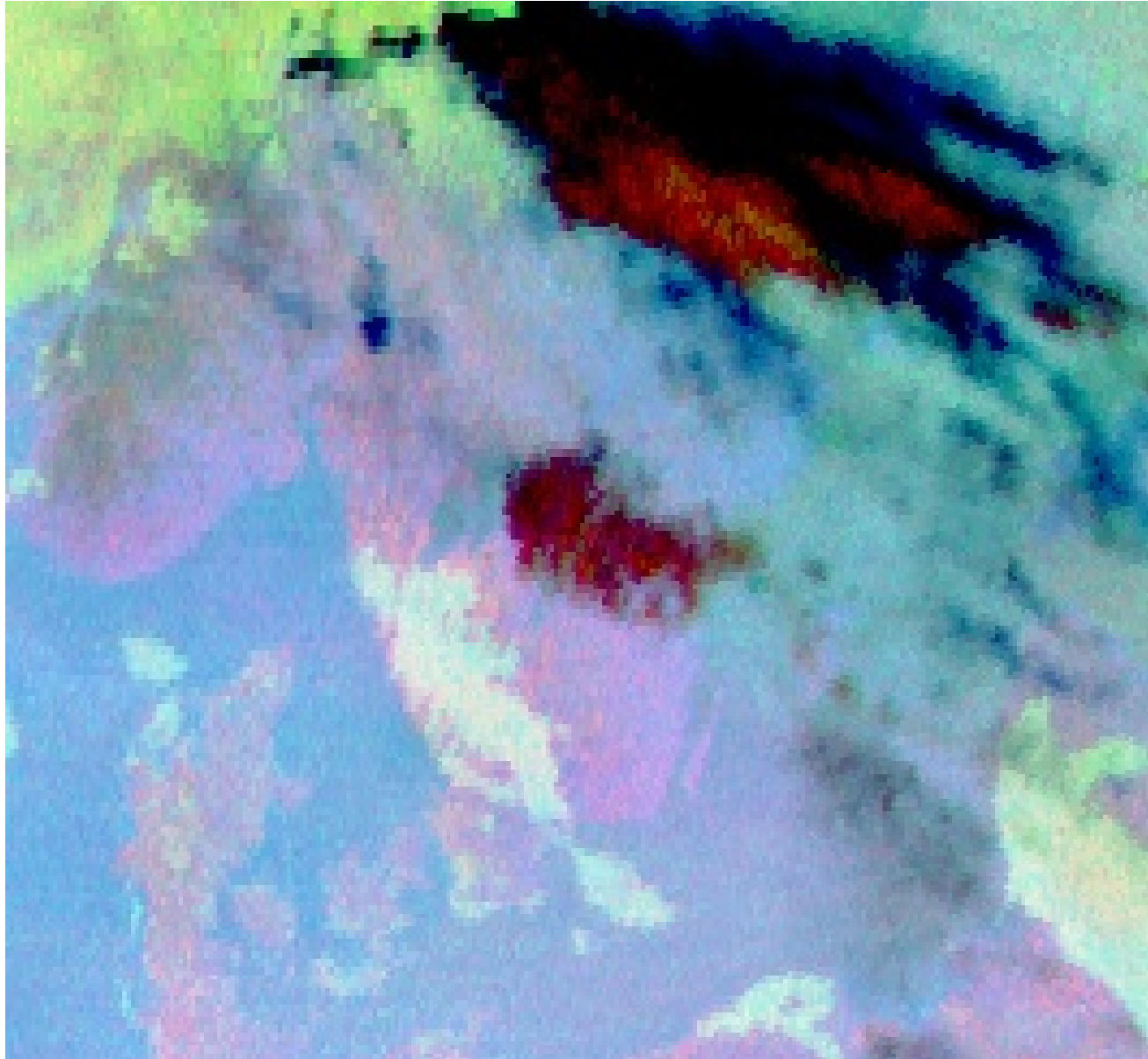
Wed 21 Mar 2012 12Z +36h  
valid Fri 23 Mar 2012 00Z

/data/arkiv/field/f\_archive/hirlan/E11\_60lev/201203 E11 140



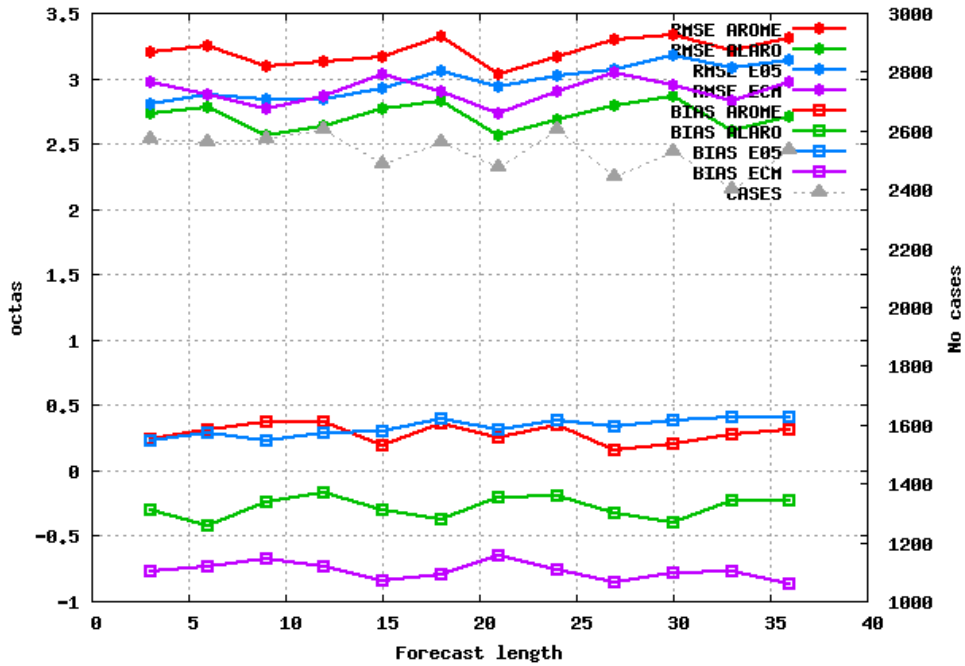
Wed 21 Mar 2012 12Z +36h  
valid Fri 23 Mar 2012 00Z

# Satellite picture

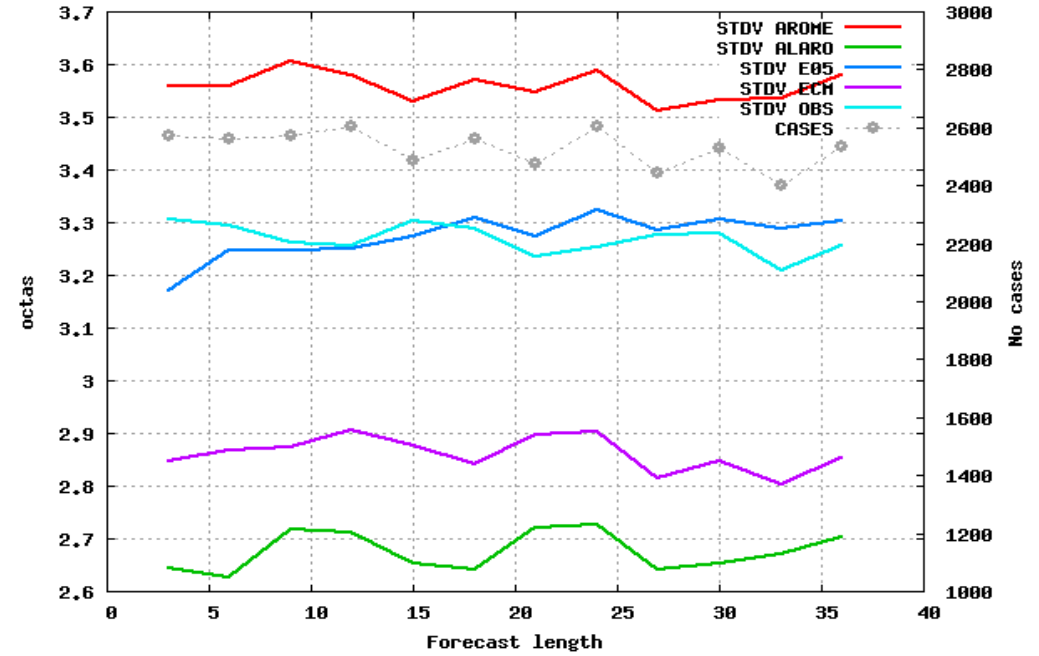


# Low cloud verification

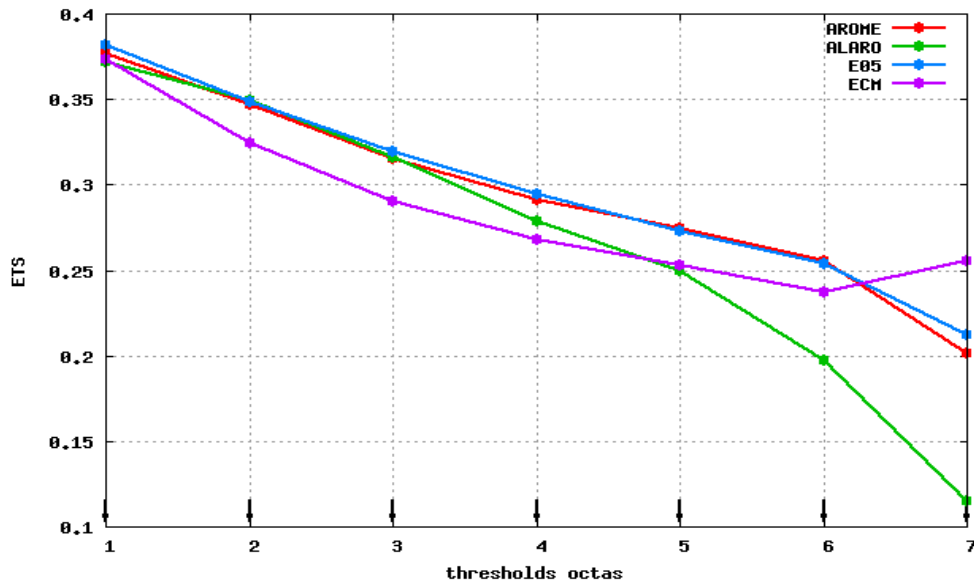
Selection: ALL using 39 stations  
 Period: 20120424-20120530  
 Low clouds Hours: {00,12}



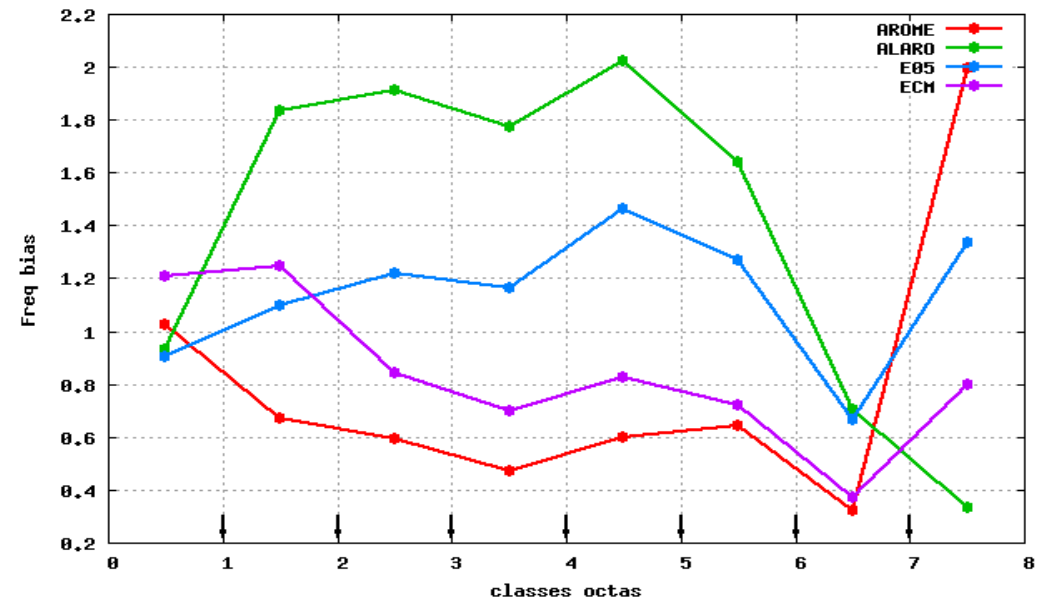
Selection: ALL using 39 stations  
 Period: 20120424-20120530  
 Low clouds Hours: {00,12}



Equitable threat score for Low clouds (octas)  
 Selection: ALL 39 stations  
 Period: 20120424-20120530  
 Used {00,12} + 03 06 ... 36



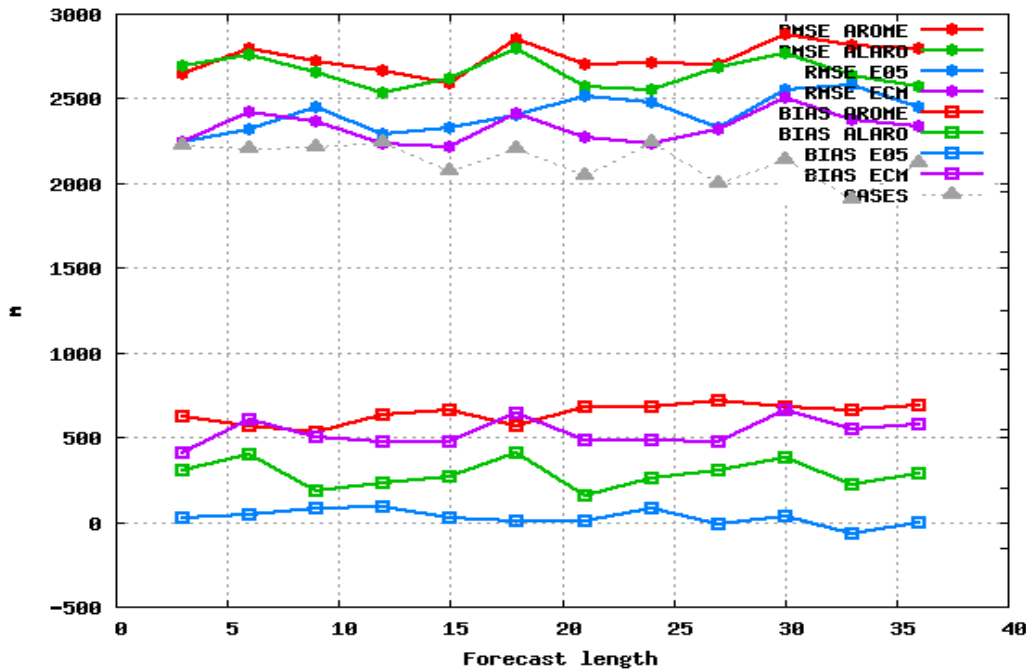
Frequency bias for Low clouds (octas)  
 Selection: ALL 39 stations  
 Period: 20120424-20120530  
 Used {00,12} + 03 06 ... 36



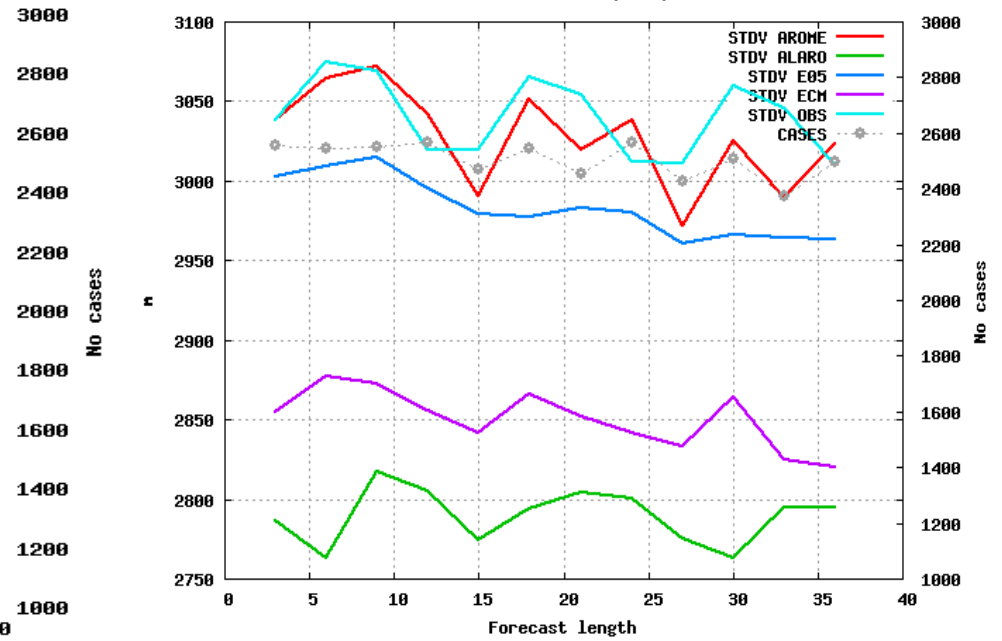


# Cloud base verification

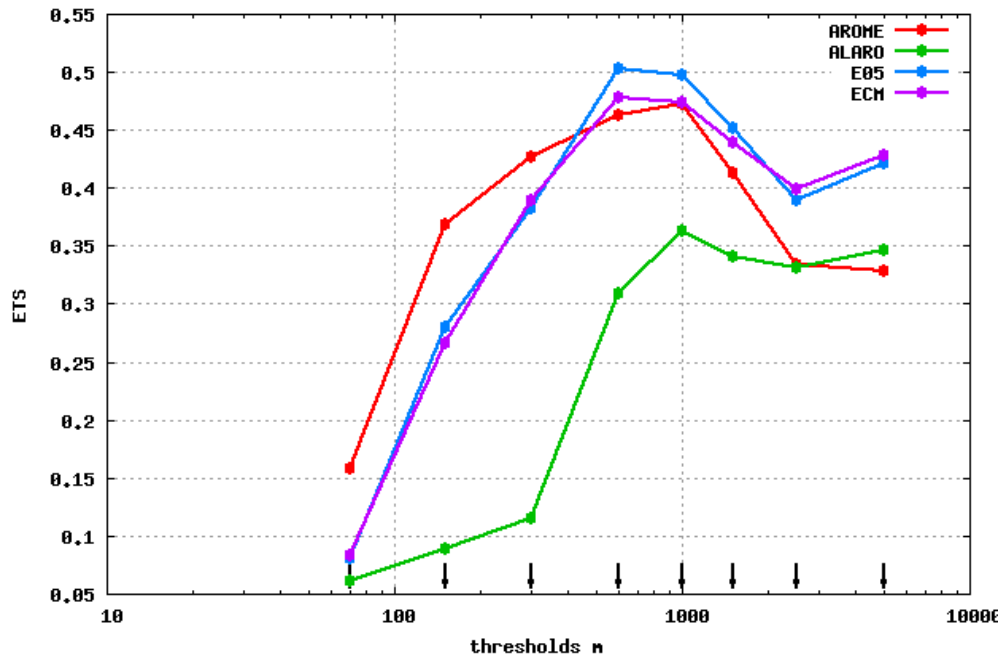
Selection: ALL using 39 stations  
 Period: 20120424-20120530  
 Cloud base Hours: {00,12}



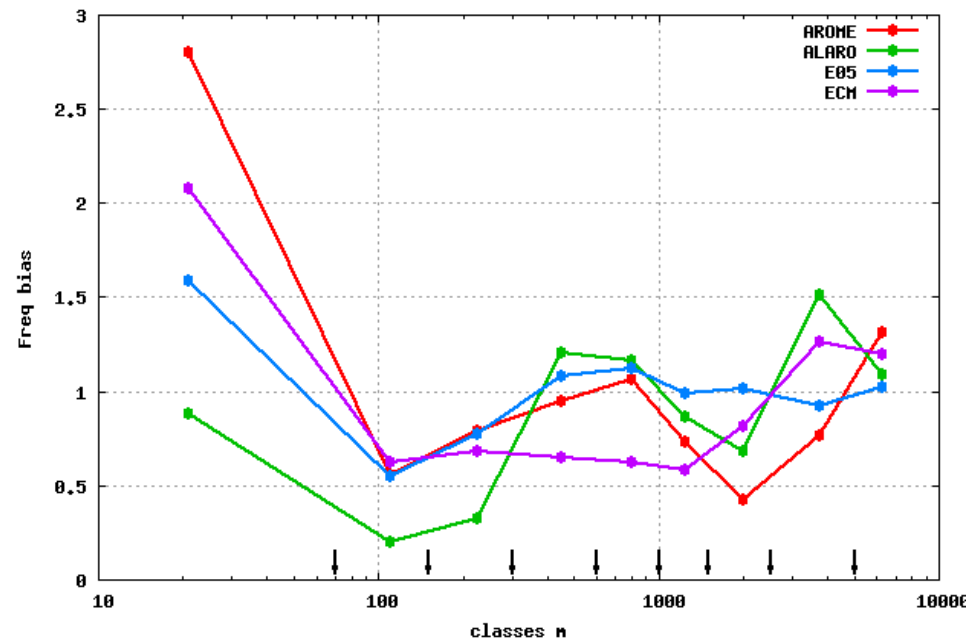
Selection: ALL using 39 stations  
 Period: 20120424-20120530  
 Cloud base Hours: {00,12}



Forecast length  
 Period: 20120424-20120530  
 Used {00,12} + 03 06 ... 36

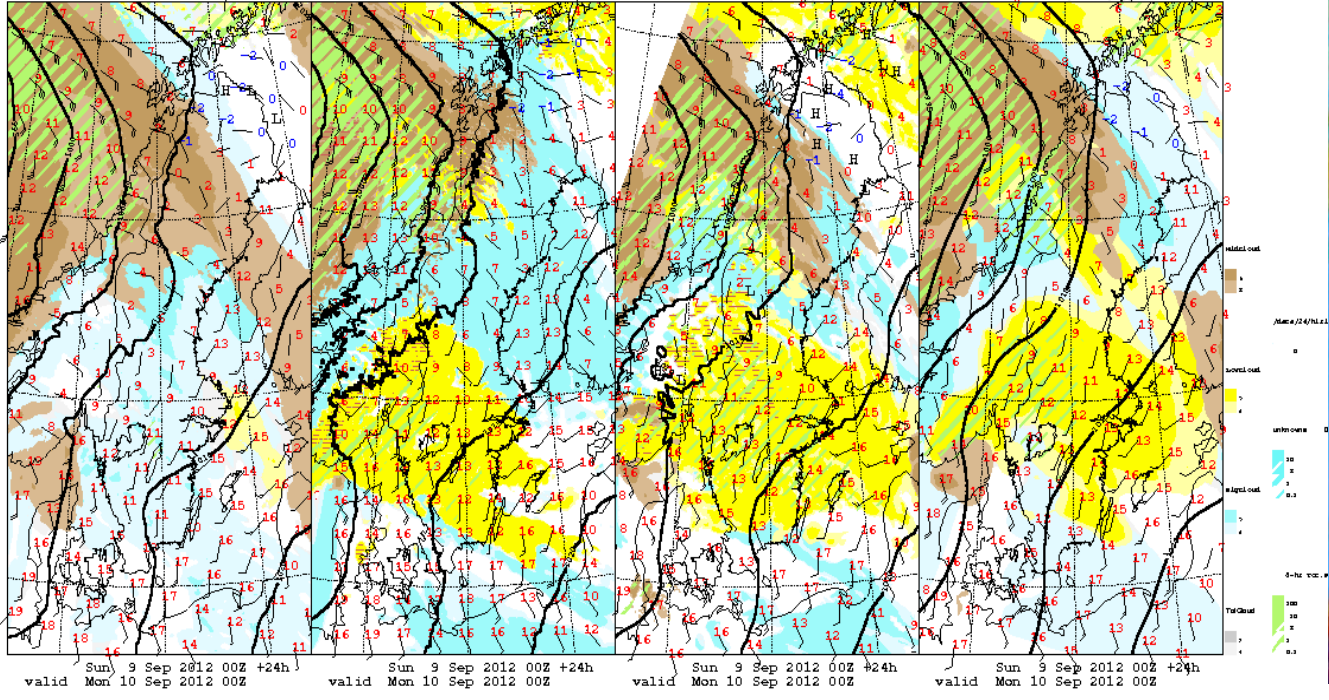
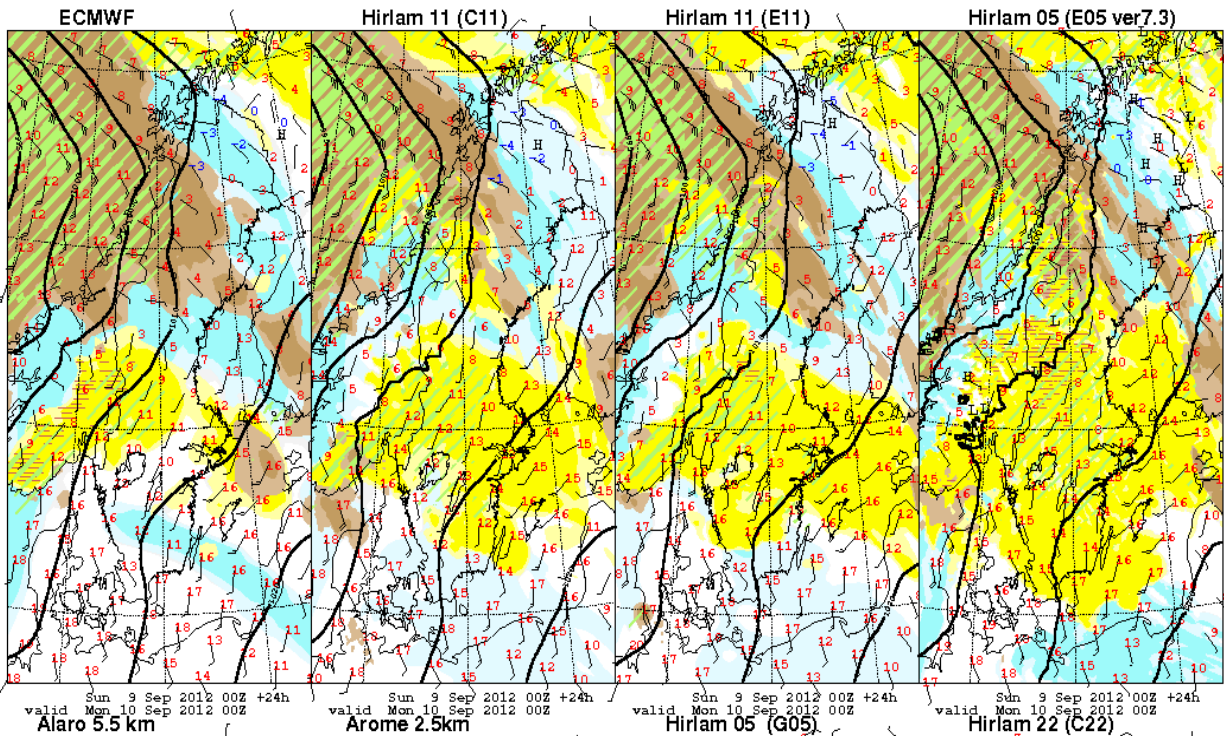


Frequency bias for Cloud base (n)  
 Selection: ALL 39 stations  
 Period: 20120424-20120530  
 Used {00,12} + 03 06 ... 36



# Autumn results (37h1.1)

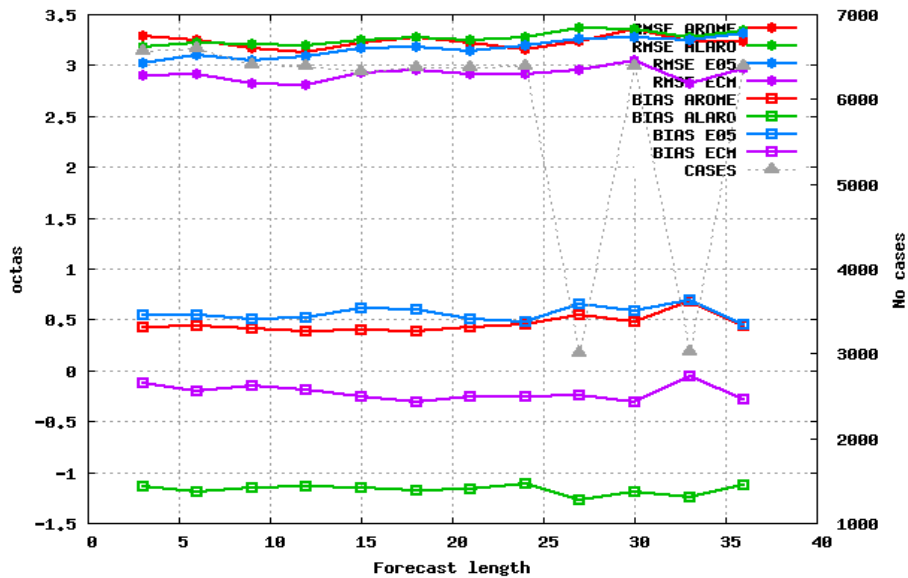
- Example
- Low clouds
- Cloud base



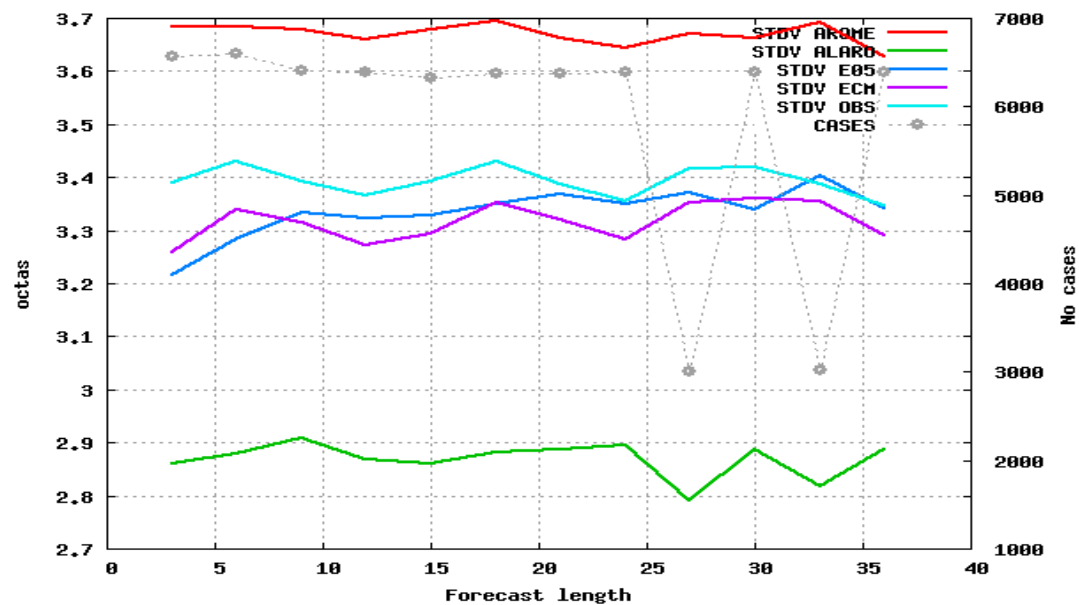


# Low cloud verification

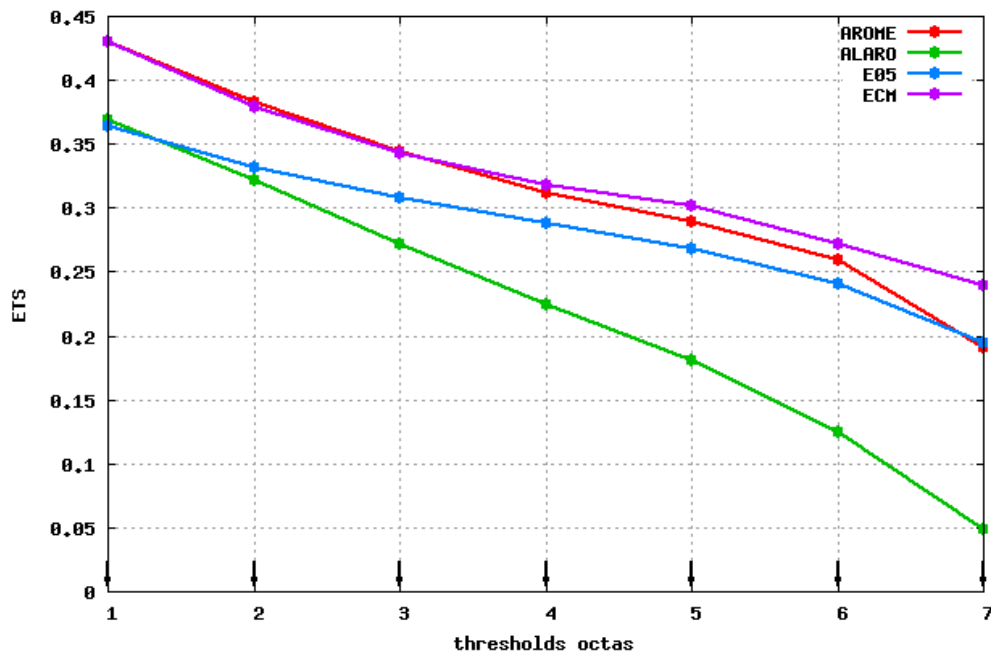
Selection: ALL using 40 stations  
 Period: 20120901-20121127  
 Low clouds Hours: {00,12}



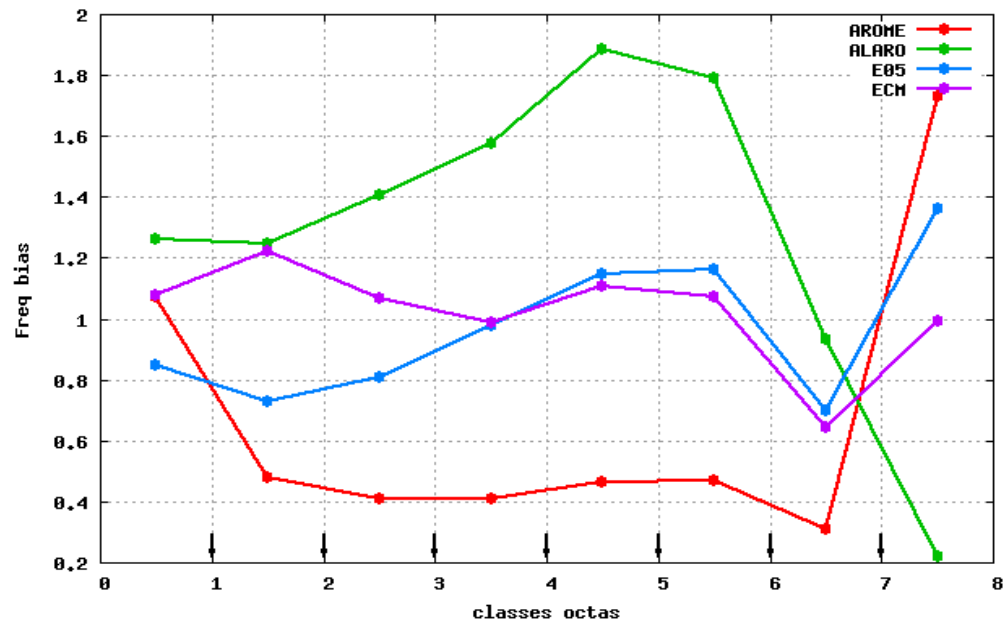
Selection: ALL using 40 stations  
 Period: 20120901-20121127  
 Low clouds Hours: {00,12}



Equitable threat score for Low clouds (octas)  
 Selection: ALL 40 stations  
 Period: 20120901-20121127  
 Used {00,12} + 03 06 ... 36



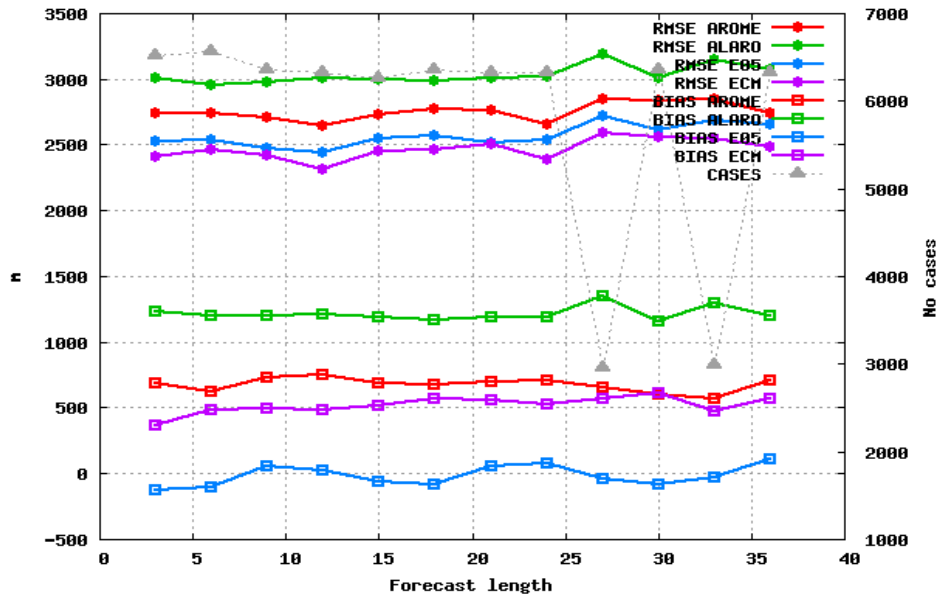
Frequency bias for Low clouds (octas)  
 Selection: ALL 40 stations  
 Period: 20120901-20121127  
 Used {00,12} + 03 06 ... 36



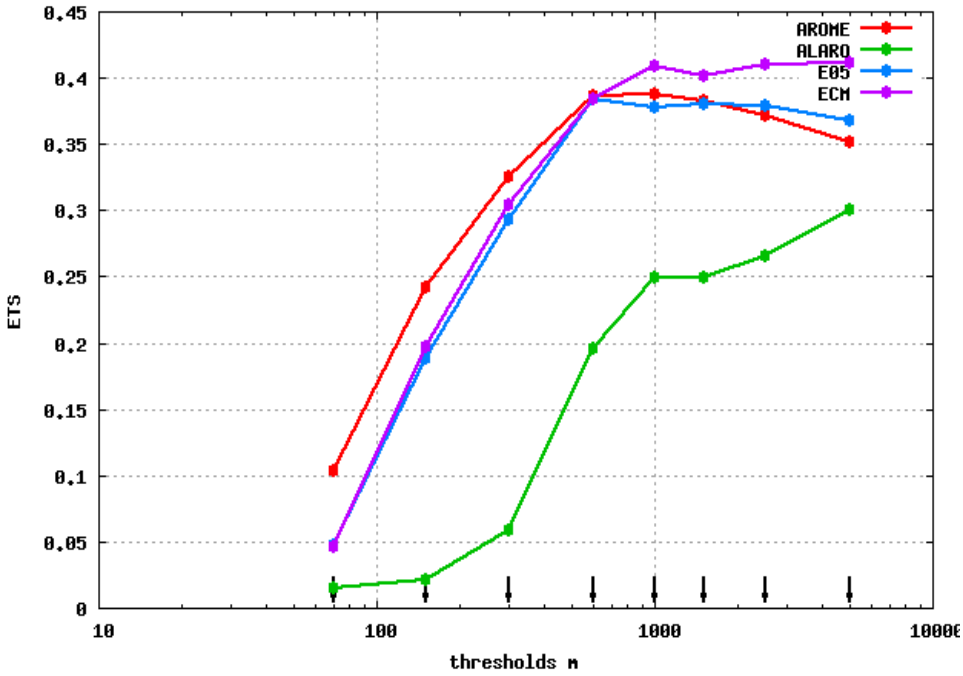


# Cloud base verification

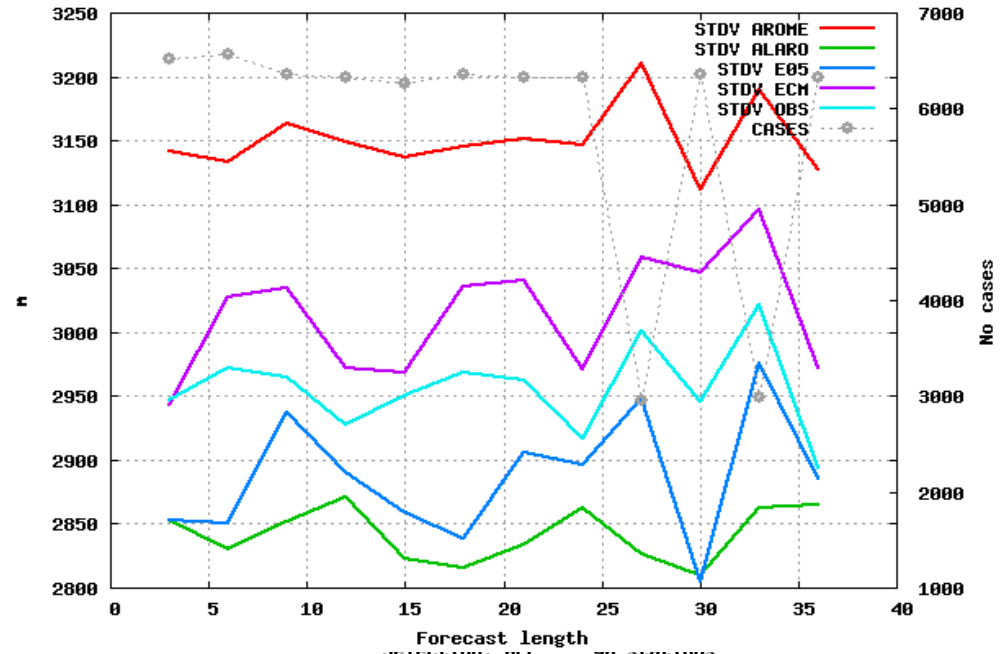
Selection: ALL using 40 stations  
 Period: 20120901-20121127  
 Cloud base Hours: {00,12}



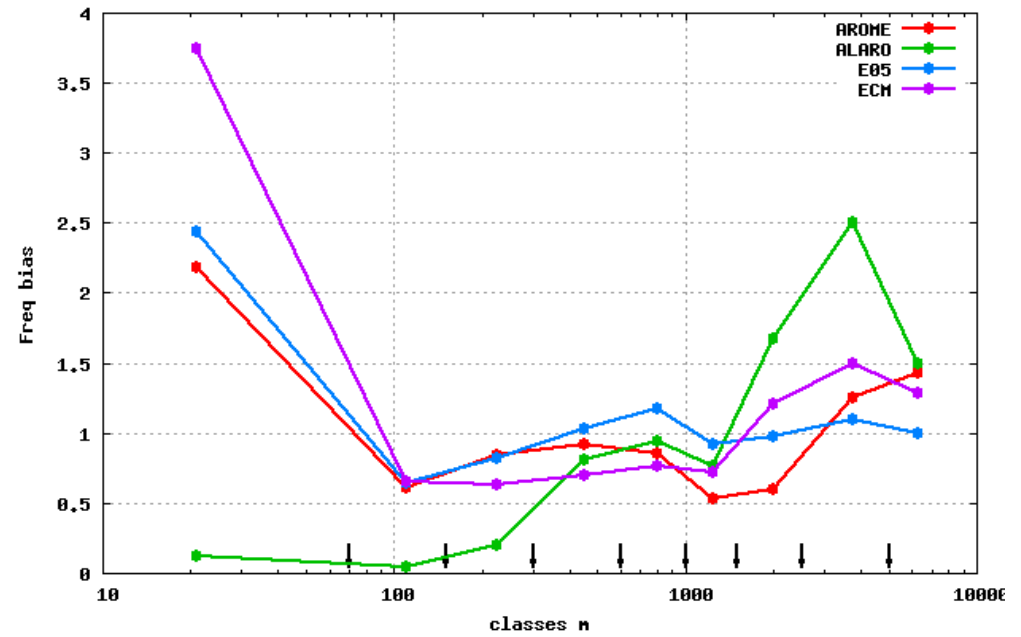
Equivalent on the score for cloud base (m)  
 Selection: ALL 40 stations  
 Period: 20120901-20121127  
 Used {00,12} + 03 06 ... 36



Selection: ALL using 40 stations  
 Period: 20120901-20121127  
 Cloud base Hours: {00,12}



Selection: ALL 40 stations  
 Period: 20120901-20121127  
 Used {00,12} + 03 06 ... 36

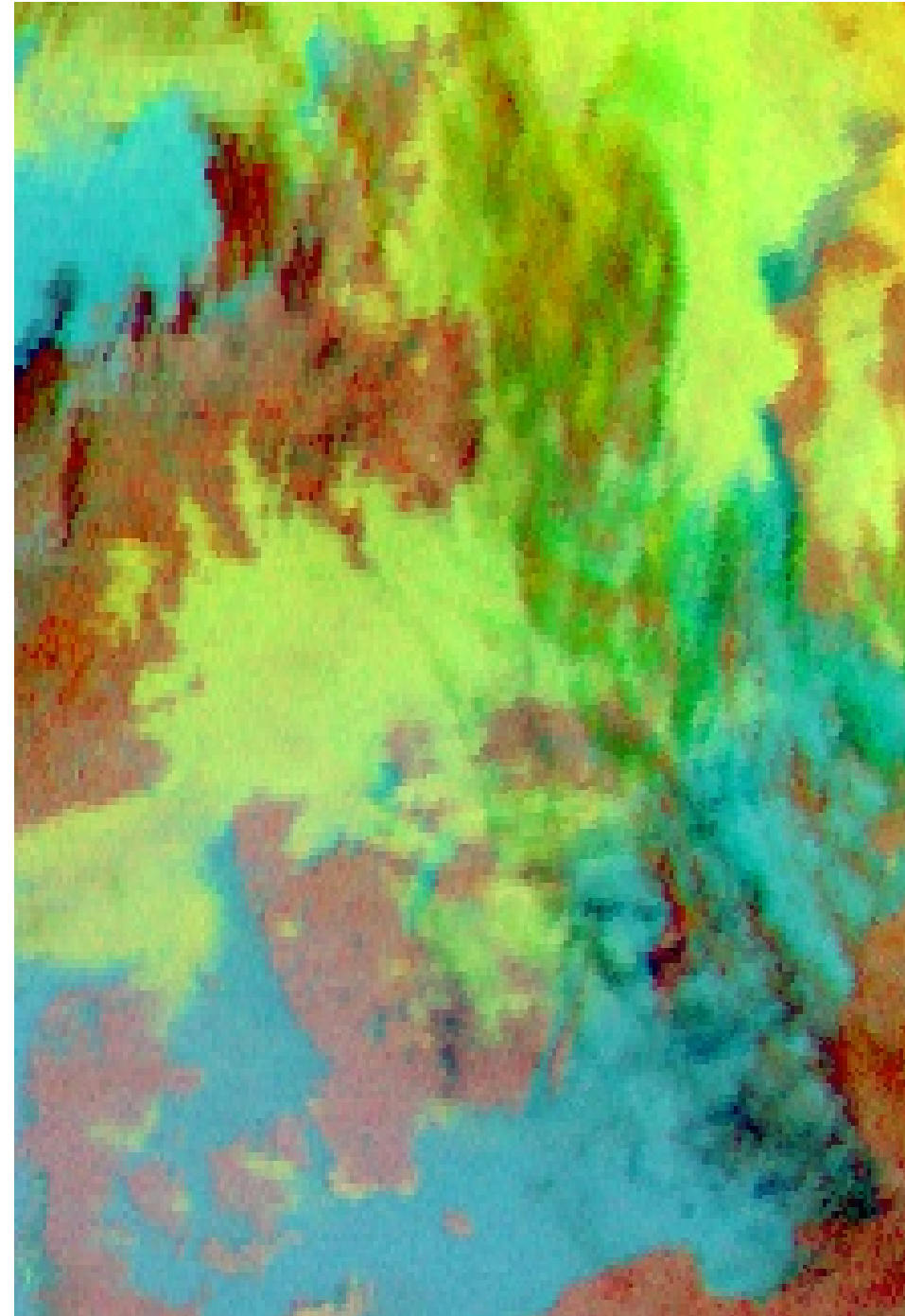
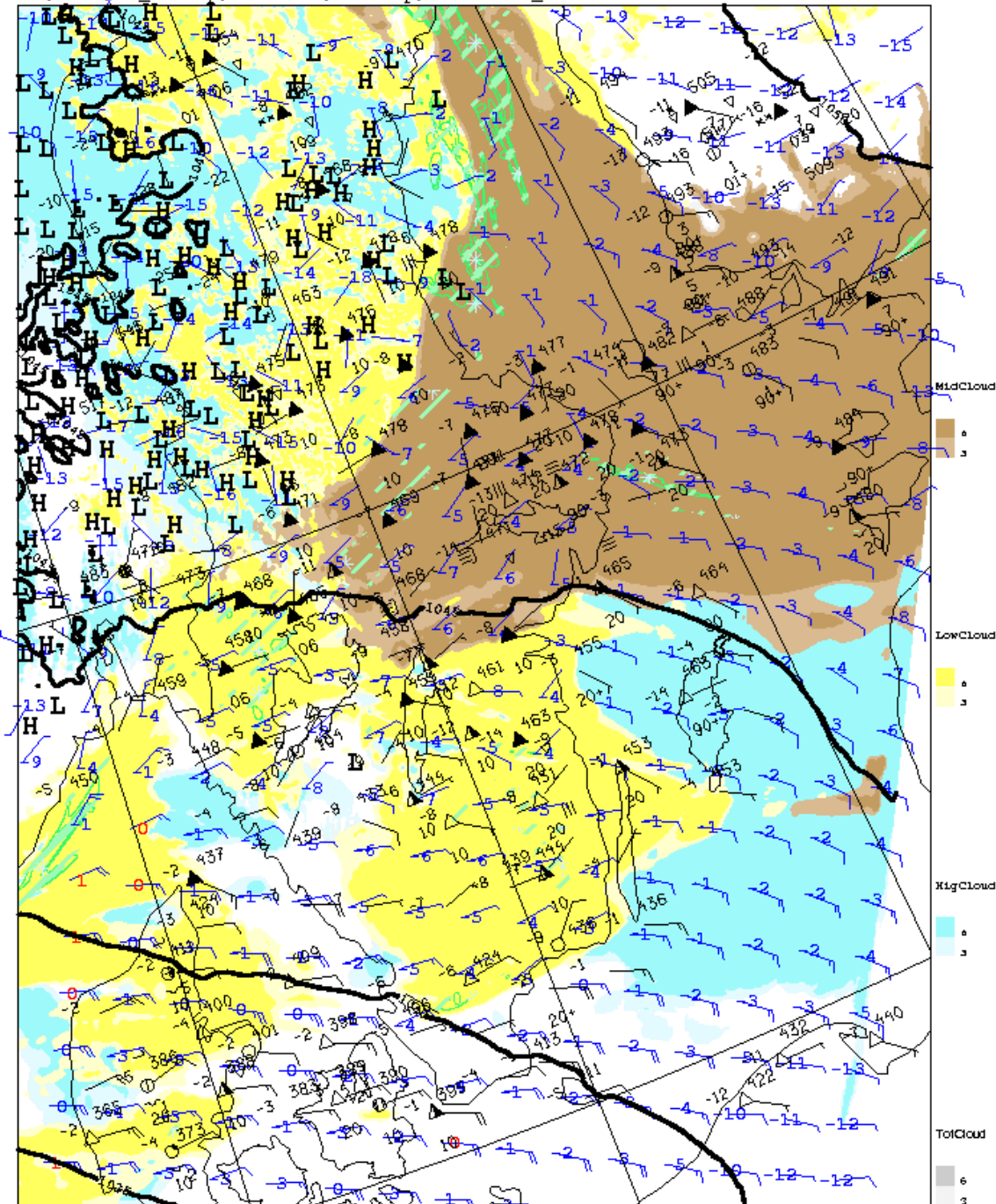


# Winter (36h1.4, 37h1.1) results

- Case studies
- Low clouds 2010-11-20 – 2010-12-09 (37h1.1)
- Cloud base 2010-11-20 – 2010-12-09 (37h1.1)

# Moderate cold weather (Jan 31 2012, 36h1.4)

/data/no\_backup/harmonie/MetCoOp/36h1.4 AM\_Bires1 011

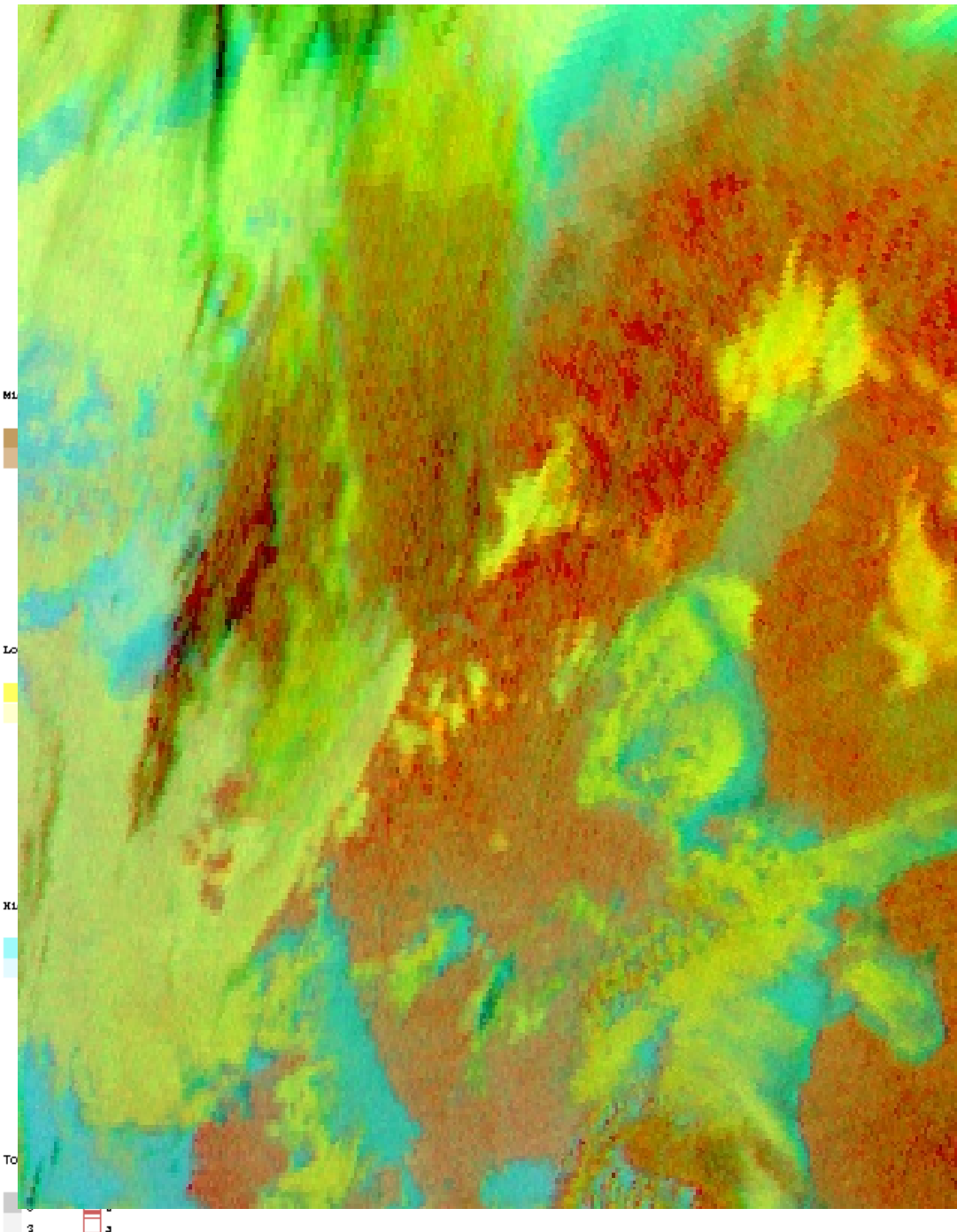
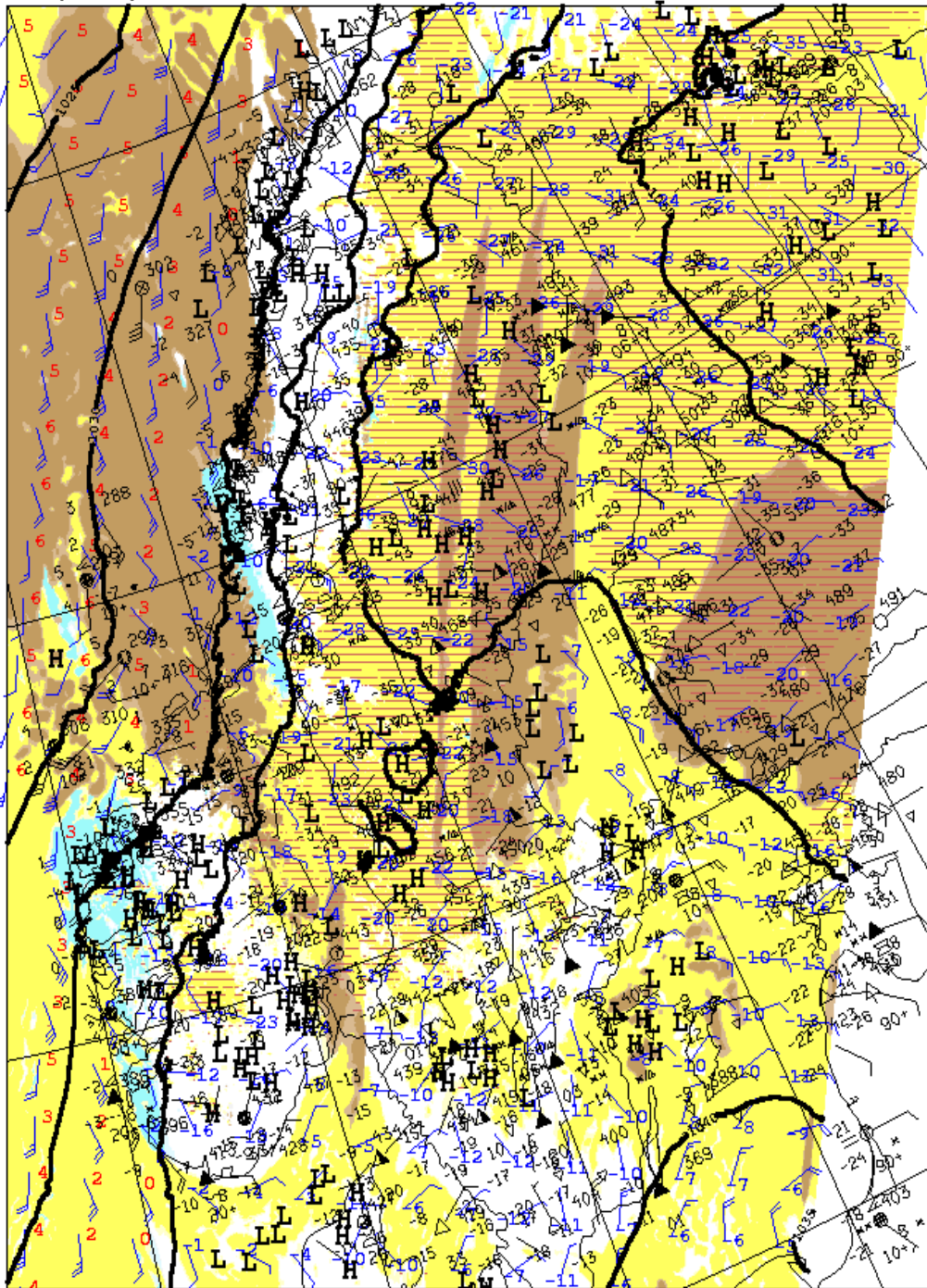


Mon 30 Jan 2012 00Z +24h

valid Tue 31 Jan 2012 00Z

# Severe cold weather (Feb 4 2012, h36h1.4)

../arome/ AROME 11



Fri 3 Feb 2012 00Z +30h

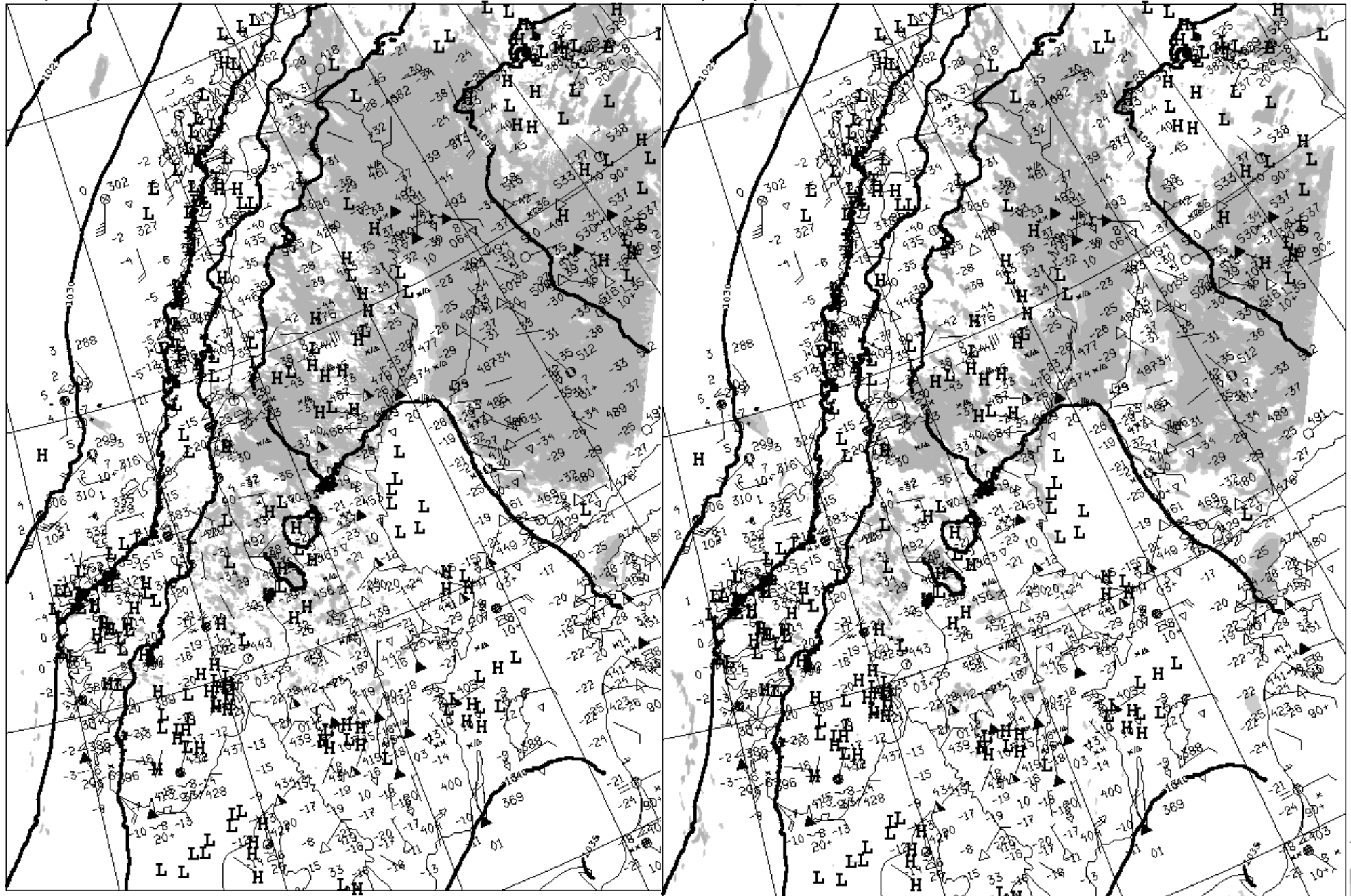
valid Sat 4 Feb 2012 06Z



# Clouds at lev 62 (~90m) and 59 (~180m)

../arome/ AROME lev= 62

../arome/ AROME lev= 59



Fri 3 Feb 2012 00Z +30h

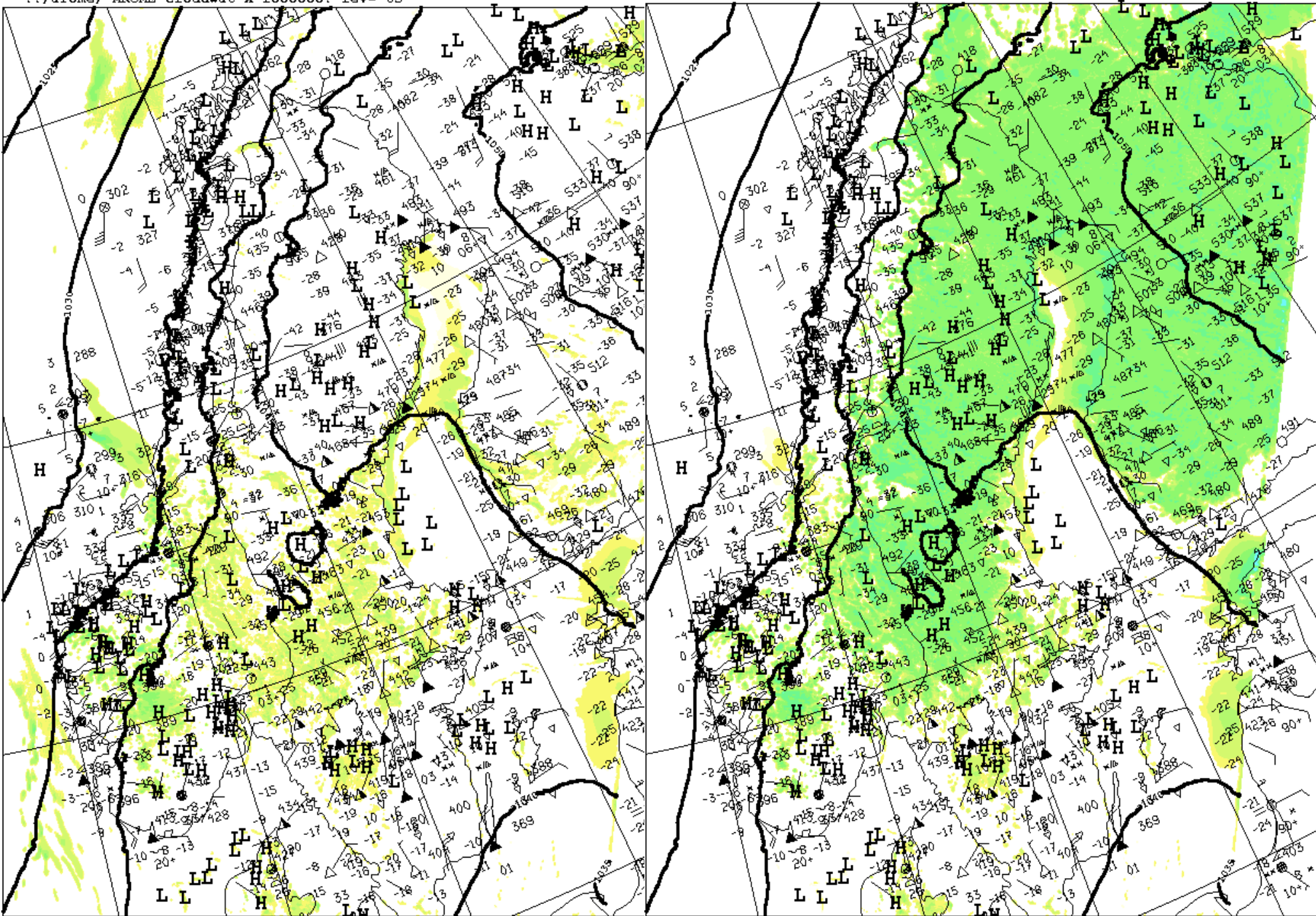
valid Sat 4 Feb 2012 06Z

Fri 3 Feb 2012 00Z +30h

# Cloud water(left) and ice (right) at lev 65

../arome/ AROME cloudwat x 1000000. lev= 65

../arome/ AROME cloudice x 1000000. lev= 65



Fri 3 Feb 2012 00Z +30h

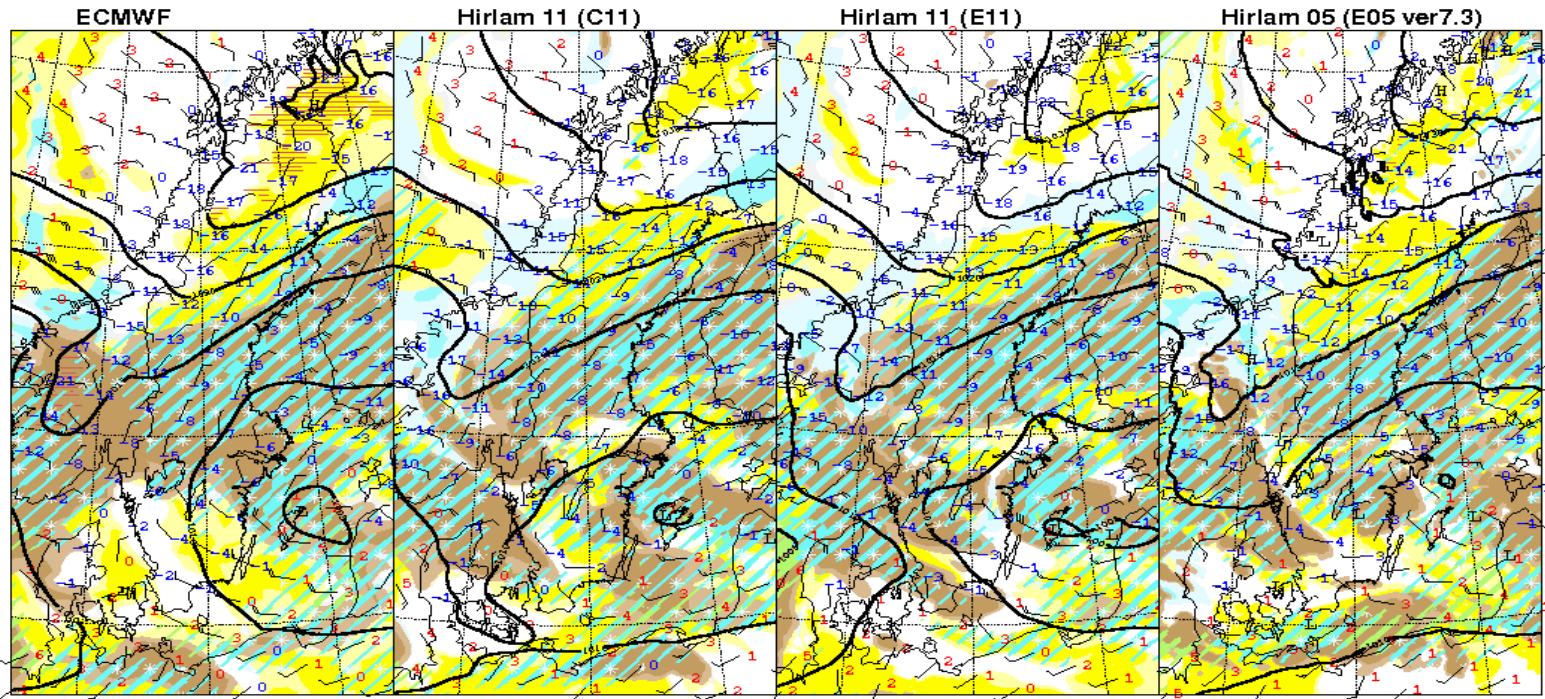
valid Sat 4 Feb 2012 06Z

Fri 3 Feb 2012 00Z +30h

valid Sat 4 Feb 2012 06Z



# Dec 1 2012 (is 37h1.1 different from 36h1.4?)

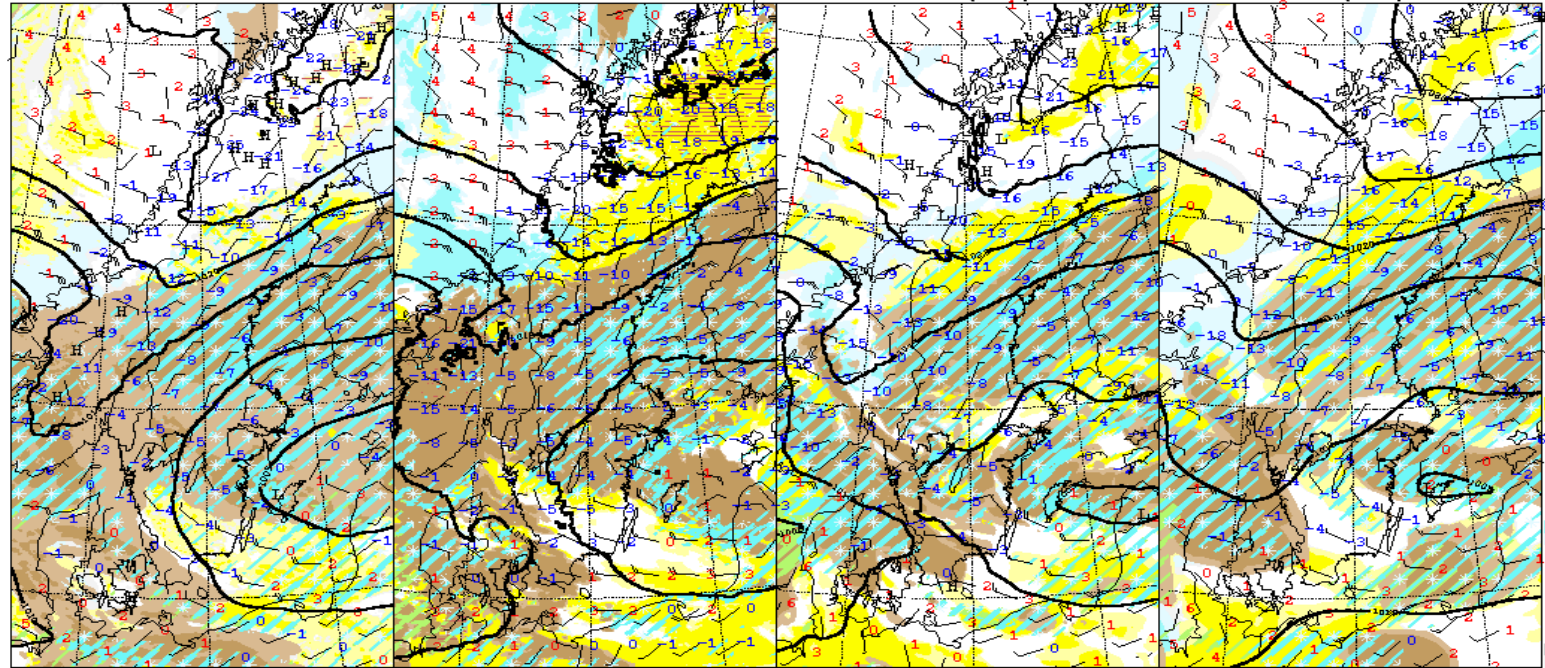


valid Fri 30 Nov 2012 00Z +36h  
Sat 1 Dec 2012 12Z  
**Alaro 5.5 km**

valid Fri 30 Nov 2012 12Z +24h  
Sat 1 Dec 2012 12Z  
**Arome 2.5km**

valid Fri 30 Nov 2012 12Z +24h  
Sat 1 Dec 2012 12Z  
**Hirlam 05 (G05)**

valid Fri 30 Nov 2012 12Z +24h  
Sat 1 Dec 2012 12Z  
**Hirlam 22 (C22)**

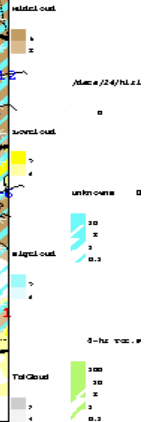


valid Fri 30 Nov 2012 12Z +24h  
Sat 1 Dec 2012 12Z

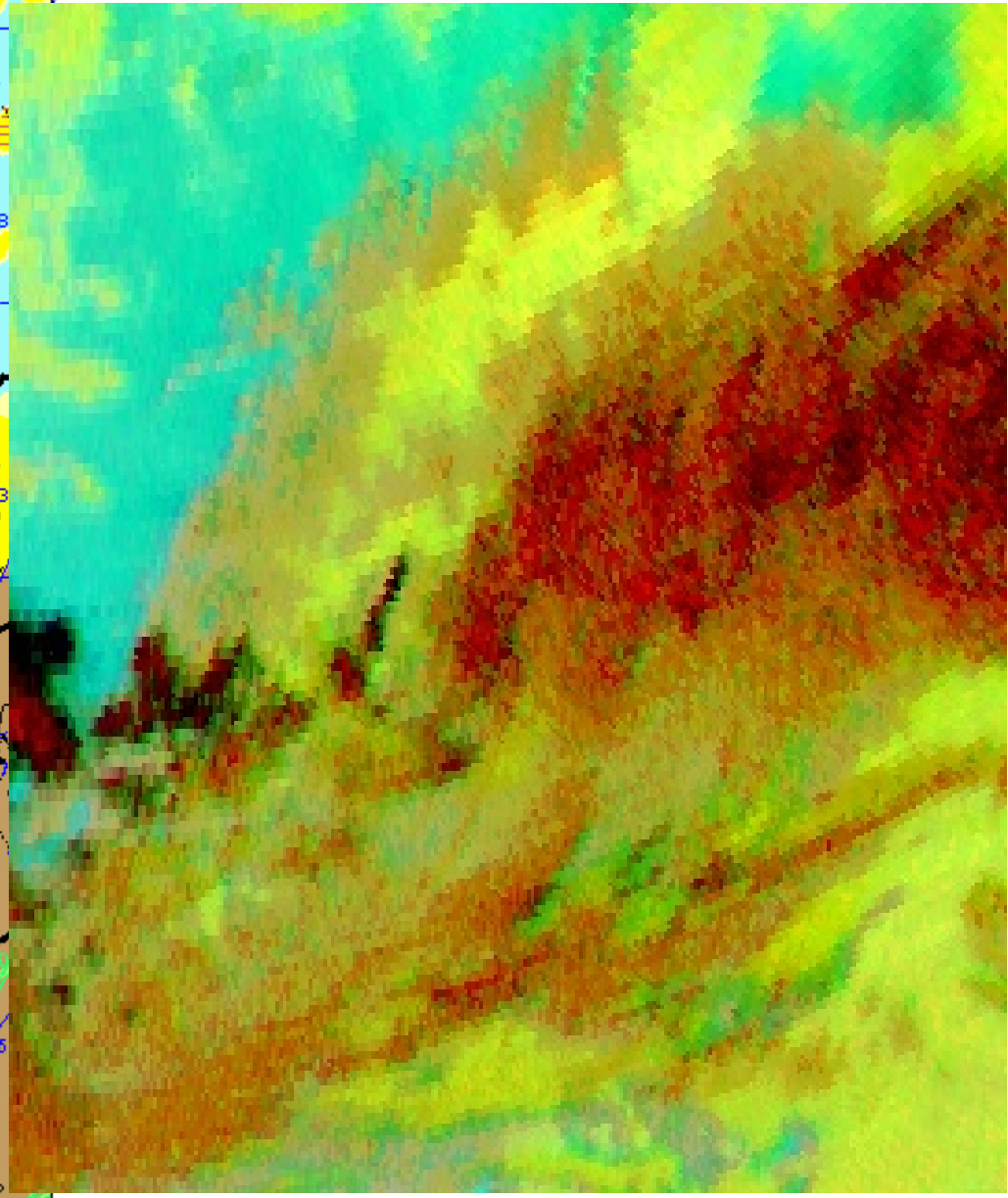
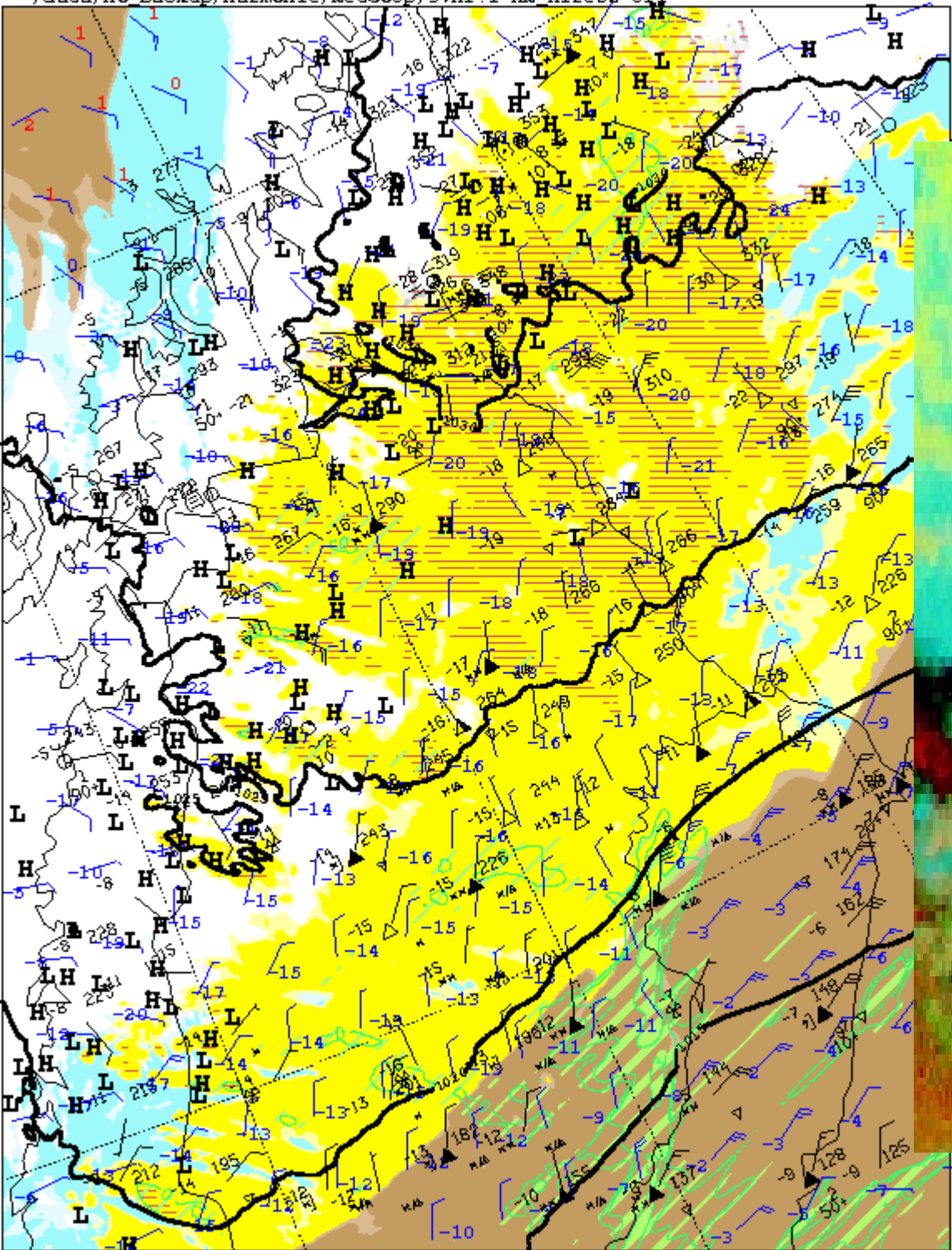
valid Fri 30 Nov 2012 12Z +24h  
Sat 1 Dec 2012 12Z

valid Fri 30 Nov 2012 12Z +24h  
Sat 1 Dec 2012 12Z

valid Fri 30 Nov 2012 12Z +24h  
Sat 1 Dec 2012 12Z







TotCloud    TotCl  
0            0  
3            3

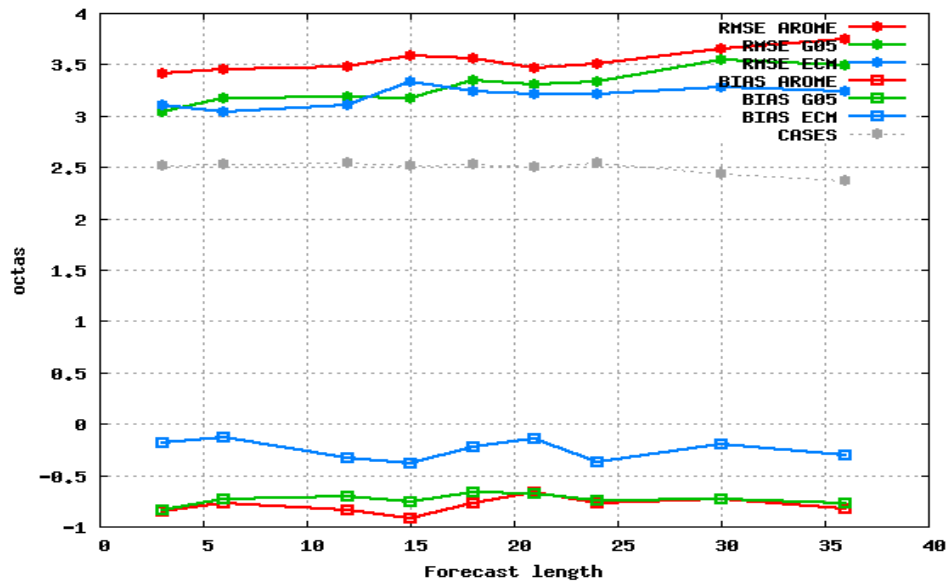
Fri 30 Nov 2012 12Z +24h

valid Sat 1 Dec 2012 12Z

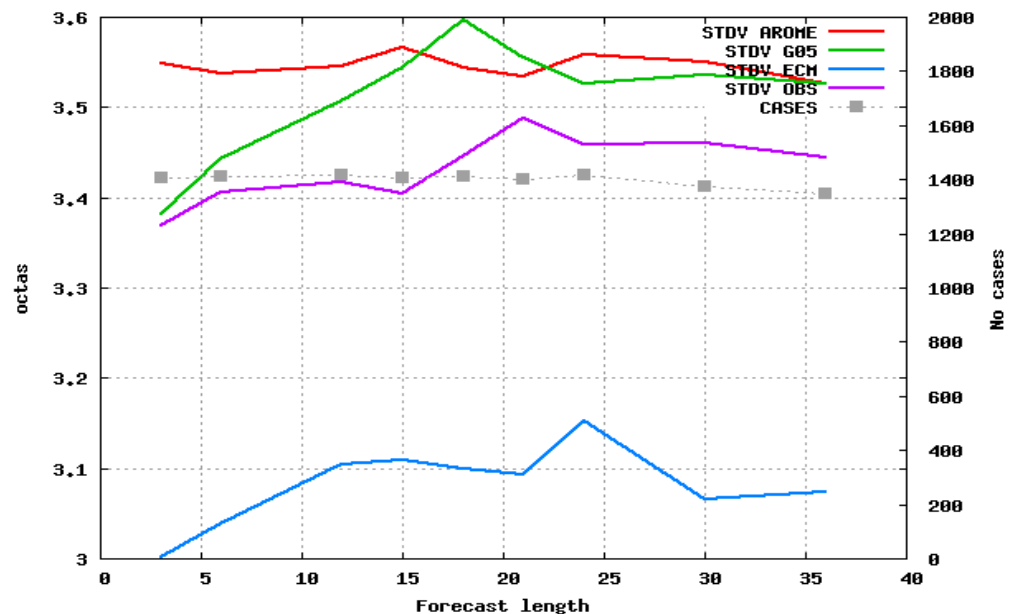


# Low clouds 2010-11-20 – 2010-12-09, 37h1.1

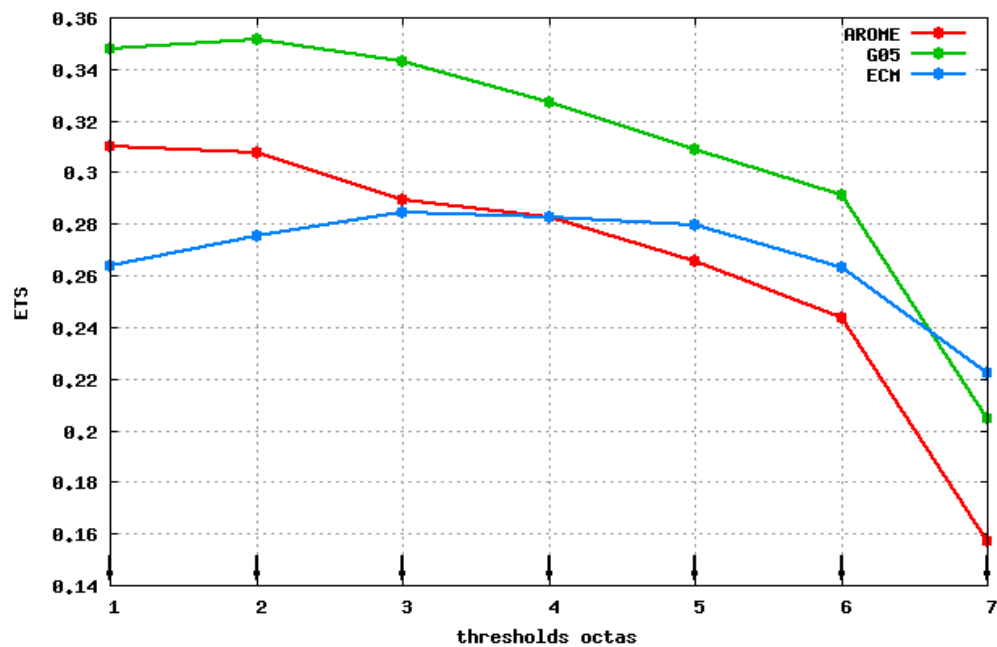
Selection: ALL using 38 stations  
 Period: 20101120-20101209  
 Low clouds Hours: {00,12}



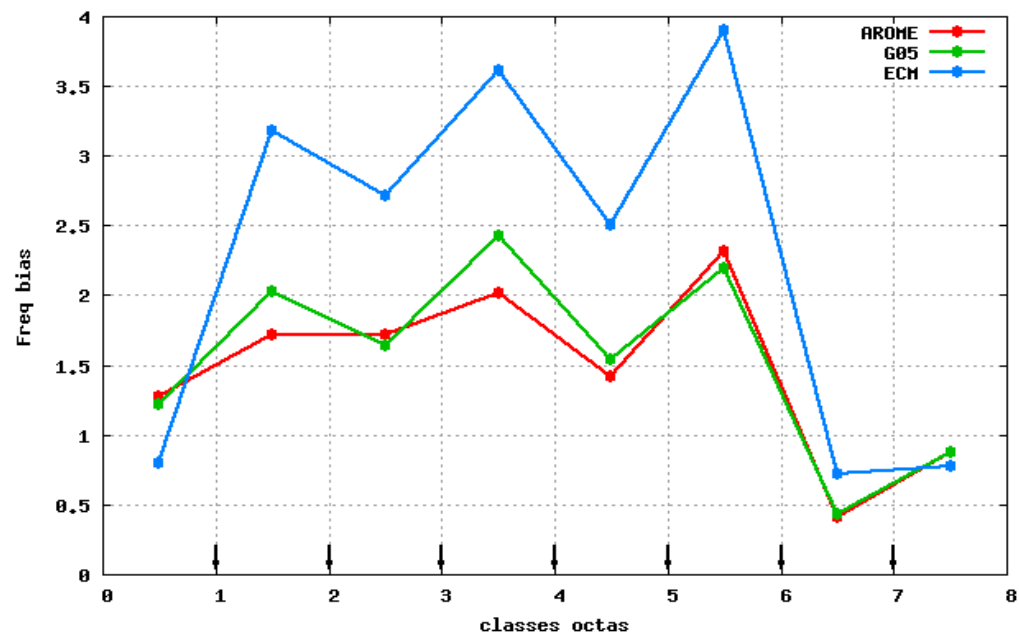
Selection: ALL using 38 stations  
 Period: 20101120-20101209  
 Low clouds Hours: {00,12}



Equitable threat score for Low clouds (octas)  
 Selection: ALL 38 stations  
 Period: 20101120-20101209  
 Used {00,12} + 03 06 12 15 18 21 24 30 36

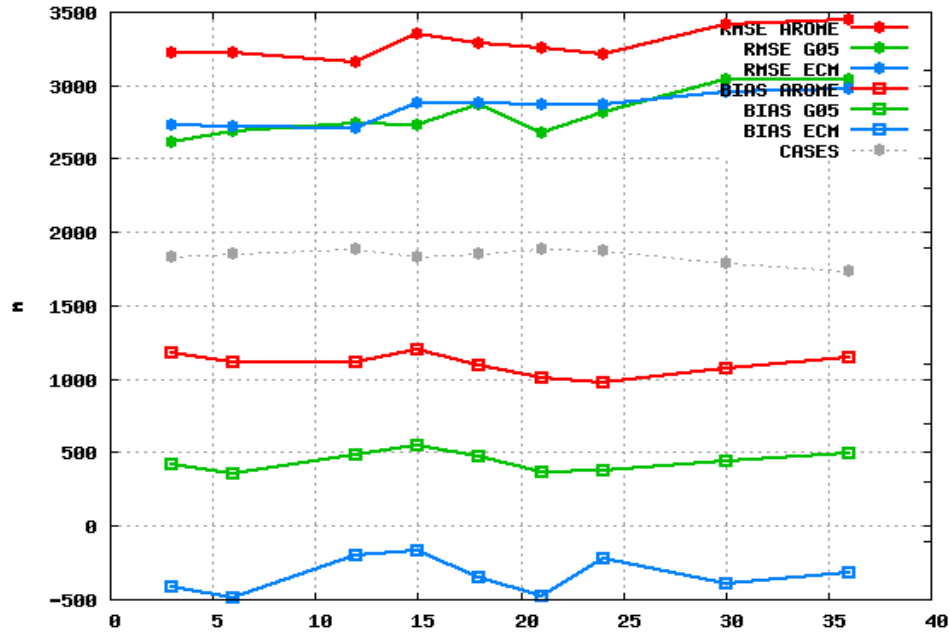


Frequency bias for Low clouds (octas)  
 Selection: ALL 38 stations  
 Period: 20101120-20101209  
 Used {00,12} + 03 06 12 15 18 21 24 30 36

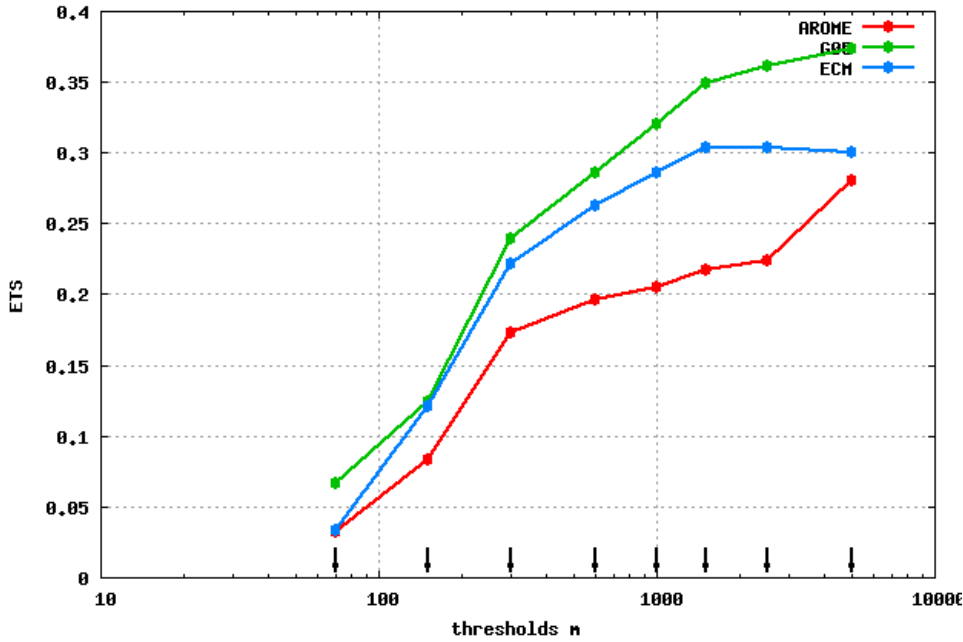


# Cloud base 2010-11-20 – 2010-12-09, 37h1.1

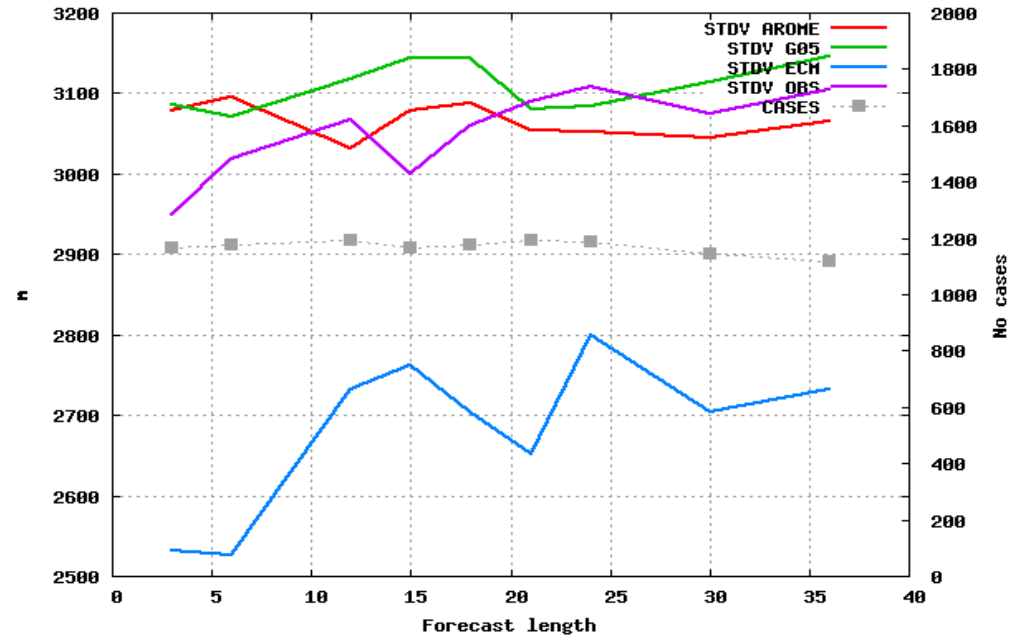
Selection: ALL using 38 stations  
 Period: 20101120-20101209  
 Cloud base Hours: {00,12}



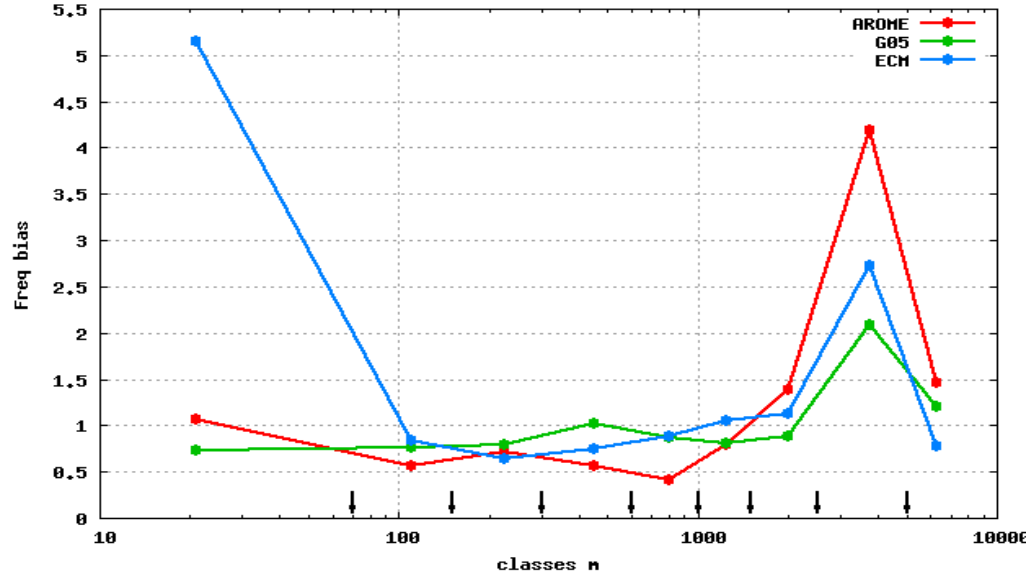
Equitable threat score for Cloud base (n)  
 Selection: ALL 38 stations  
 Period: 20101120-20101209  
 Used {00,12} + 03 06 12 15 18 21 24 30 36



Selection: ALL using 38 stations  
 Period: 20101120-20101209  
 Cloud base Hours: {00,12}



Frequency bias for Cloud base (n)  
 Selection: ALL 38 stations  
 Period: 20101120-20101209  
 Used {00,12} + 03 06 12 15 18 21 24 30 36



# Summary

- Arome works fairly well for Nordic SBL - conditions (Best skill of tested models for low cloud bases for non-winter conditions ) ...
- ...but...
- Some overprediction of fog ( springtime over water, cold inland surface  $< -20$  C, spurious ice-fog)
- Too much low clouds over cold inland surface
- Less performance for cold weather