



ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE



AROME at HIRLAM institutes – the HARMONIE system

- What is HARMONIE and the HARMONIE system?
- Recent developments within HARMONIE.
- Near future plans.

Sami Niemelä¹, Ulf Andrae², Lisa Bengtsson² and Sander Tijm³

¹FMI, ²SMHI, ³KNMI

2nd Arome training course
IM, Lisbon, Portugal,
4 - 7 March 2008.

What is HARMONIE?

- During 2004 and 2005 HIRLAM and ALADIN consortia decided to deepen already existing cooperation in NWP. One of the main goals of the new cooperation is **to develop a km-scale operational NWP system.**

HARMONIE

Hirlam Aladin Regional/Meso-scale Operational NWP In Europe

- The learning process by running AROME (and/or ALADIN) on daily basis.

Institute	Version	Domain
SMHI	cy31t0	Southern and Northern Sweden (2.5km L60)
FMI	cy32h2	Southern Finland (2.5 km L40)
DMI	cy32t2	Denmark (2.5km L40)
KNMI	cy31h1	Netherlands (2.5km L40)



What is the HARMONIE system?

- Starting point for HIRLAM in 2004
 - Source code of ALADIN/AROME
 - Unknown compilation tool GMKPACK
 - Individual shell scripts and namelists for different processes.

CLEAR NEED FOR COMMON “HARMONIE” SYSTEM!

1. Combine all the important processes in one launch.
 - Compilation.
 - Climate and boundary generation (and data assimilation).
 - Forecast (Arome, Aladin and Alaro with different physics options).
 - Postprocessing and file conversions.
 - Verification.
2. An easy start for beginners and a flexible tool for researchers.
3. Easy access **for all of us** through HARMONIE repository (subversion).



Recent developments within HARMONIE (1/2)

- Most of the recent developments has been concentrated on developing the scheduling system (mini-SMS) for HARMONIE.
- To avoid the misunderstanding: **the system presented in the following slides is NOT going to be used in exercises!**
- However... anyone who is interested to try it during the week or later, please don't hesitate to ask advice!



HARMONIE repository

- <https://hirlam.org/trac/browser/trunk/harmonie>
 - **src**: Source code of ARPEGE/IFS **CY33T0**.
 - **nam**: Namelists for
 1. climate generation
 2. fullpos (postprocessing and boundary generation)
 3. different forecast options (Arome, Aladin, Alaro etc.)
 - **scr, sms, msms, config-sh**: Scripts for running the model(s). Configuration files for different platforms: environment and submission database.
 - **util**: Tools
 1. **gl** converter, LBC, interpolation tool etc.
 2. **monitor** verification and monitoring
 3. **gmkpack 6.2.4** compilation tool
 4. **ddh** tool for handling ddh files
- **Open access from all HIRLAM and ALADIN institutes!**
- Documentation at <https://hirlam.org/trac/wiki/HarmonieSystemDocumentation>



Functionality of HARMONIE system

How to make an AROME experiment on HPCE@ECMWF

1. Assumption: Installation of the *ROOTPACK* exists.

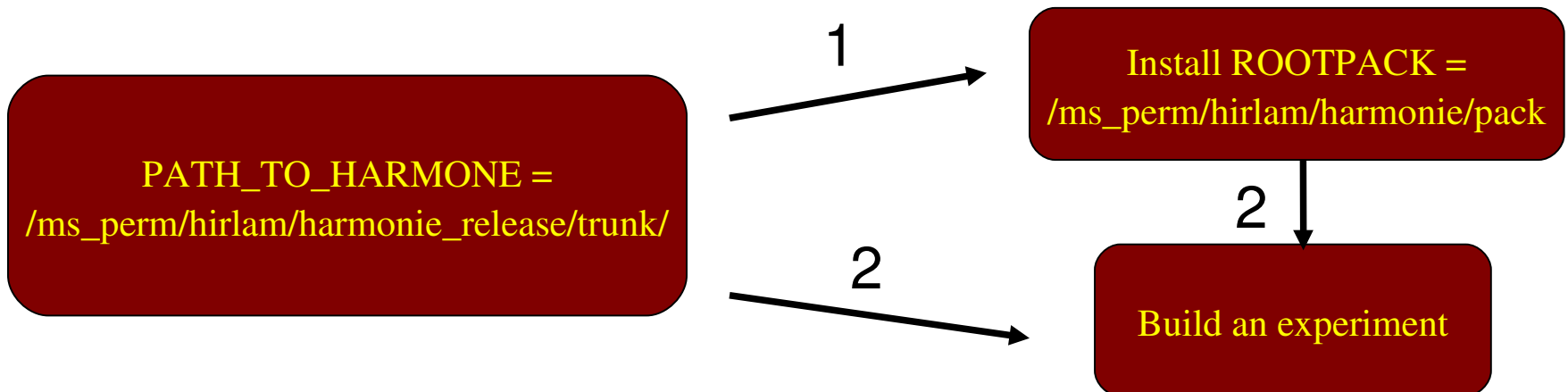
2. Preparations:

- i) Login to HPCE.
- ii) Setup your experiment directory

```
mkdir EXPNAME
```

```
cd EXPNAME
```

```
PATH_TO_HARMONIE/config-sh/Harmonie setup [-r release] [-h host]
```





Functionality of HARMONIE system

How to make an AROME experiment on HPCE@ECMWF

Configuration files

1. System configuration *config-sh/config.hpce*:

- Defines the environment, paths to work area, climate database, *ROOTPACK*, *HOMEPACK* etc.
- This you don't have to touch... unless you want to install the system on your own platform.

2. Submission directives *config-sh/submit.hpce*:

- Defines the batch job directives for all processes.
- Usually, you don't have to touch.

3. Experiment configuration *sms/config_exp.h*:

- Most important!
- Defines your experiment
 - i) model (Arome, Aladin h/nh, Alaro etc.)
 - ii) host model (IFS, Hirlam, Aladin)
 - iii) time-step, domain, resolution, cycling interval, boundary interval... etc.⁷



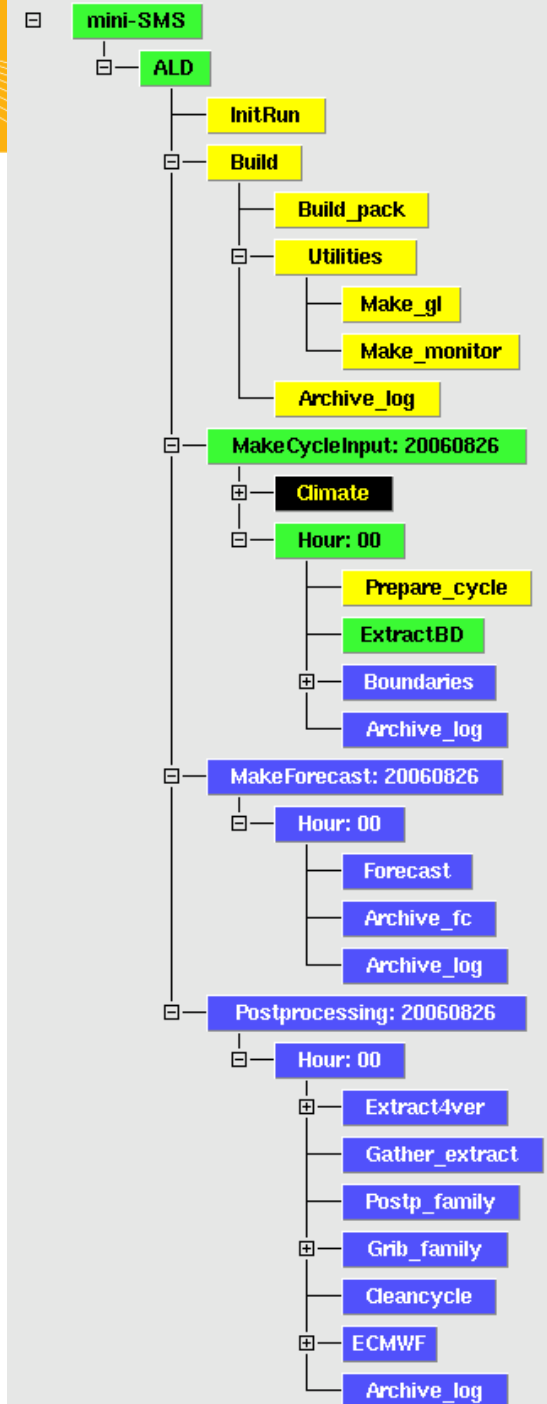
How to make an AROME experiment on HPCE@ECMWF

• Start your experiment

Harmonie start

DTG=2008010100 DTGEN=2008013100 LL=24

• Graphical mini-SMS window:





How to make an AROME experiment on HPCE@ECMWF

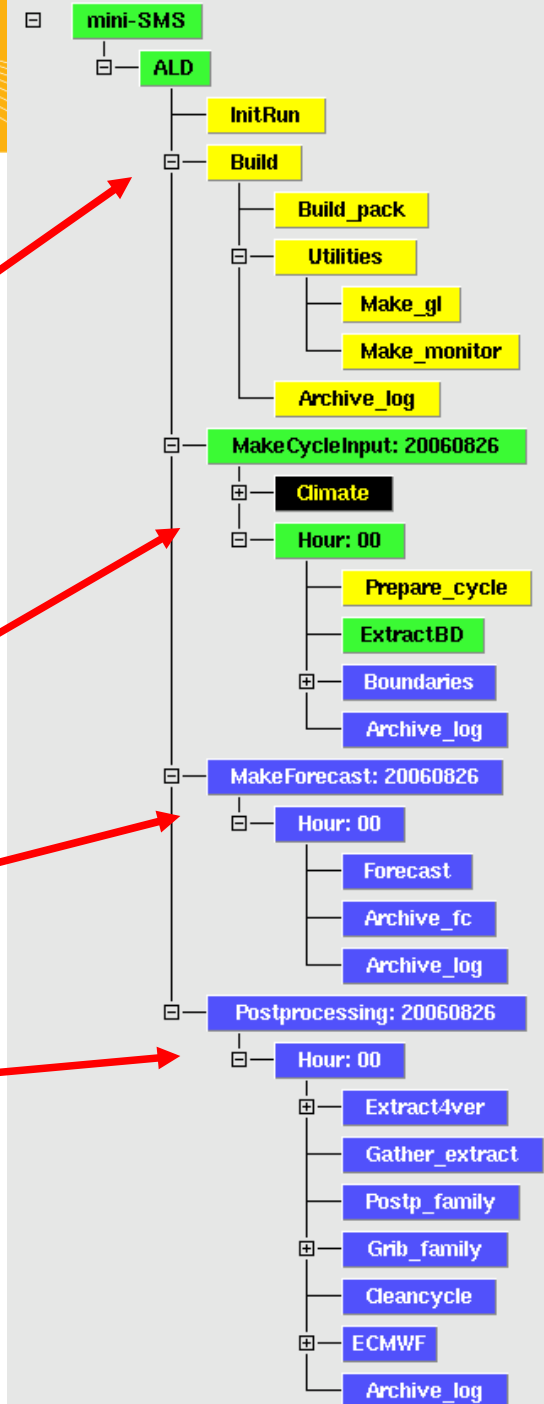
• Start your experiment

Harmonie start

DTG=2008010100 DTGEN=2008013100 LL=24

• Graphical mini-SMS window:

- Compilation (*Build*)
- Preparation (*MakeCycleInput*)
- Forecast (*MakeForecast*)
- Postprocessing (*Postprocessing*)

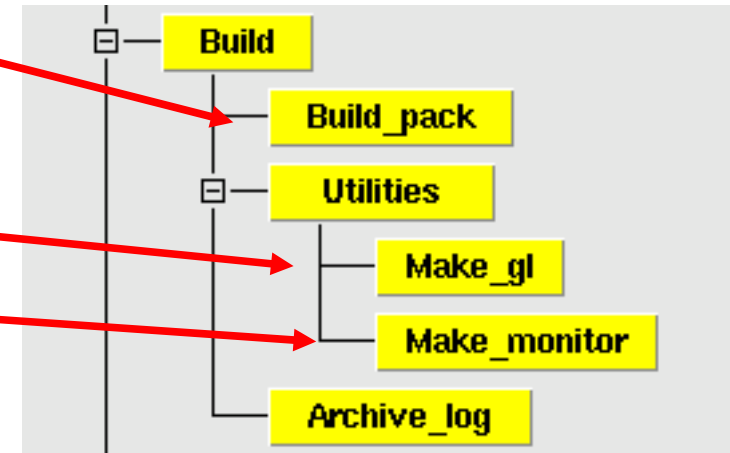




How to make an AROME experiment on HPCE@ECMWF

• Build

- *Build_pack*: compilation of source code modifications for model.
- *Make_gl*: compile the gl-tool.
- *Make_monitor*: compile the verification code.

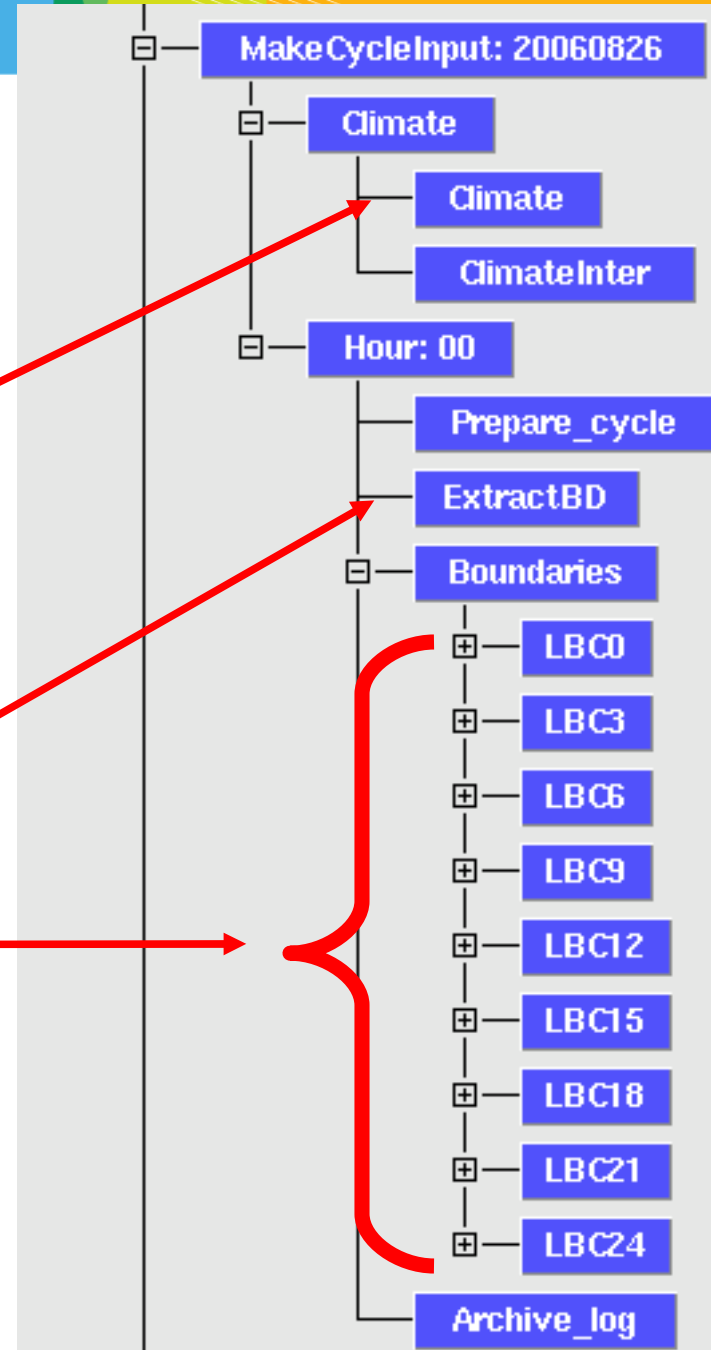




How to make an AROME experiment on HPCE@ECMWF

• MakeCycleInput

- *Climate*: climate file generation.
- *Prepare_pgd*: surfex physiography generation (not shown).
- *Extract_bd*: extract original boundary files from ECFS or MARS.
- *LBC*: boundary file generation by *gl* or *Fullpos*.

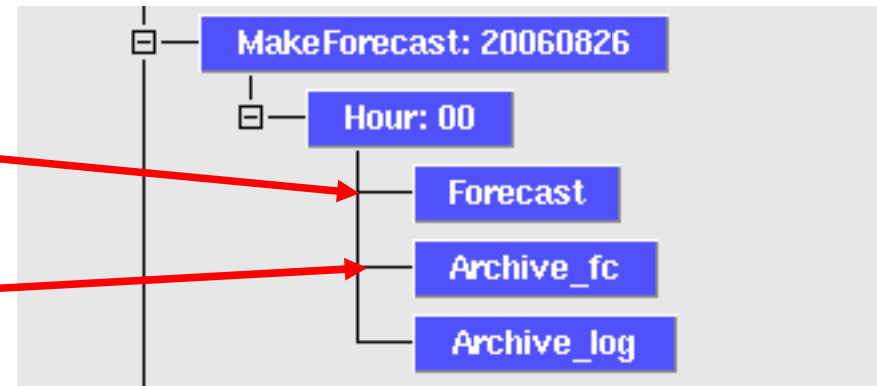




How to make an AROME experiment on HPCE@ECMWF

• MakeForecast

- *Forecast*: runs the model.
- *Archive_fc*: archives all forecast files to selected disk area.

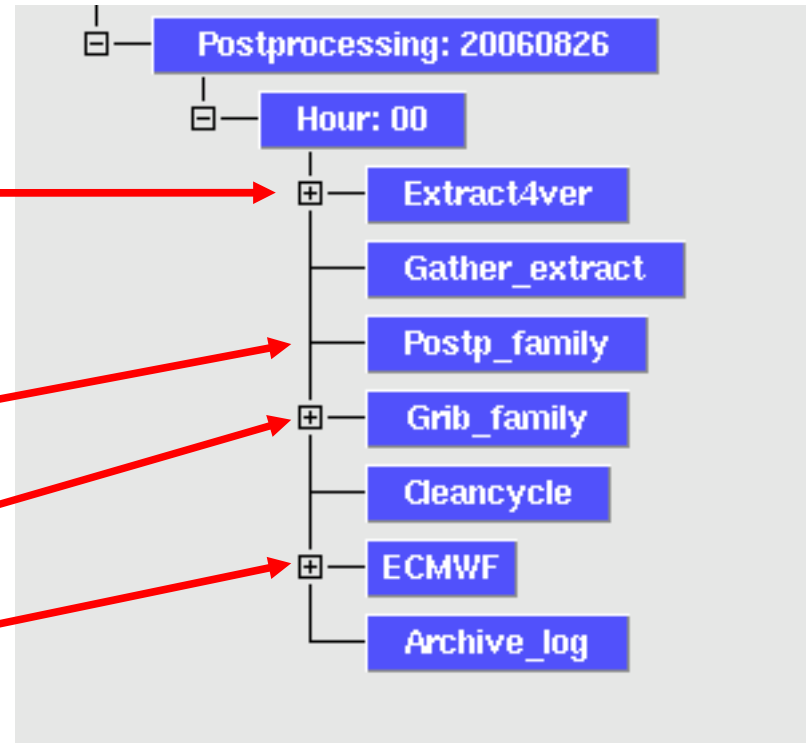




How to make an AROME experiment on HPCE@ECMWF

• Postprocessing

- **Extract4ver**: extracts the station equivalents from model data.
- **Postp_family**: postprocessing by *Fullpos*.
- **Grib_family**: conversion to *GRIB* format.
- **ECMWF**: at ECMWF, archiving to *ECFS* or *ECTMP*.
- **FetchOBS**: fetches observations from *MARS* for verification (not shown).
- **Verify**: verify the experiment (not shown).





The HARMONIE system doesn't yet provide

An assimilation system

- One important meteorological part is still missing.

Surfex physiography generation

- Code for Surfex physiography generation is not included in the HARMONIE system.
- At HPCE, the system relies on the pre-installed Meso-NH tools provided by Meteo France.



Recent developments within HARMONIE (2/2)

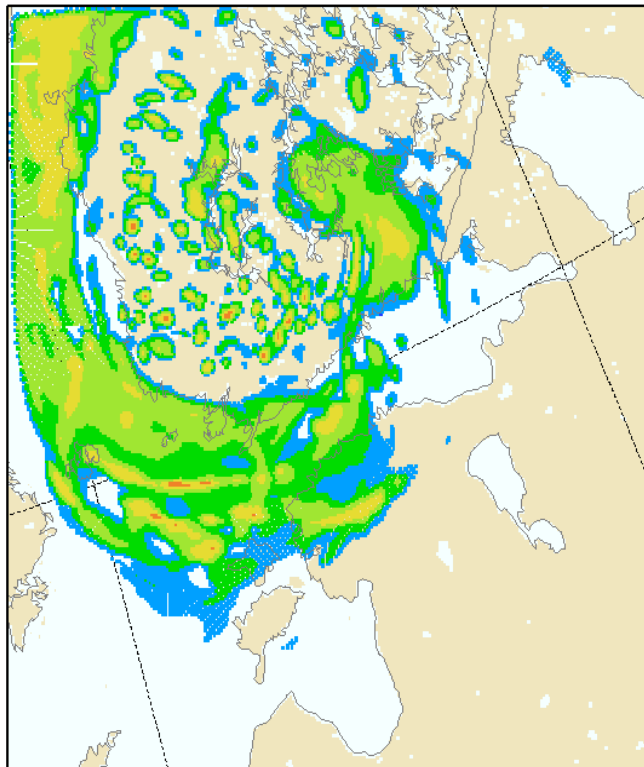
Scientific development:

- So far most of the scientific work has been concentrated on developing model diagnostics for validation purposes.
- Activity around model physics and data assimilation has been recently started.



Comparison against radar data (radar simulator)

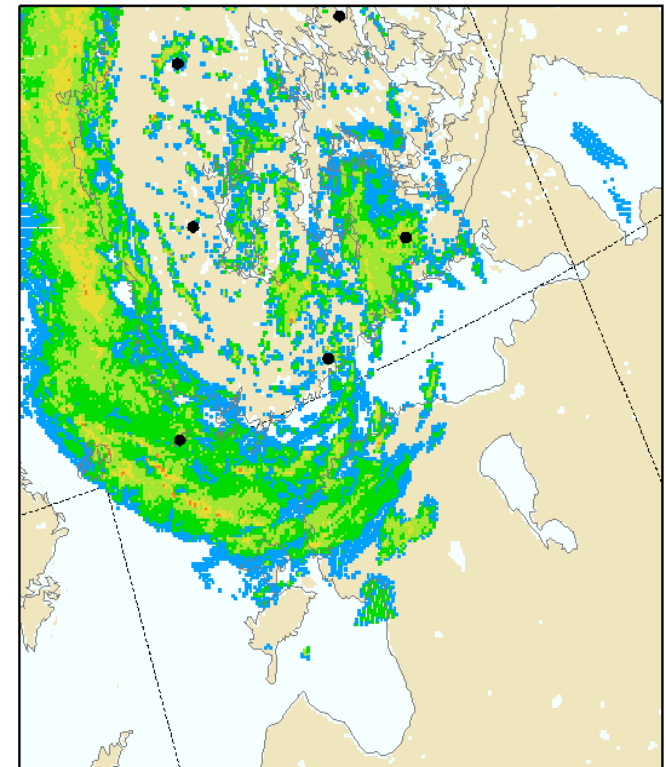
AROME 31JUL2007 00 UTC Forecast. Radar reflectivity [dBZ]
31JUL2007 09:00 UTC (ARO,2.5km).



Radars:VAN,IKA,ANJ,KUO,KOR,VIM
Antenna=0.3°

Max:
44.8418

Observed radar reflectivity [dBZ].
31JUL2007 09:00 UTC.



Radars:VAN,IKA,ANJ,KUO,KOR,VIM
Antenna=0.3°

Max:
46.5645

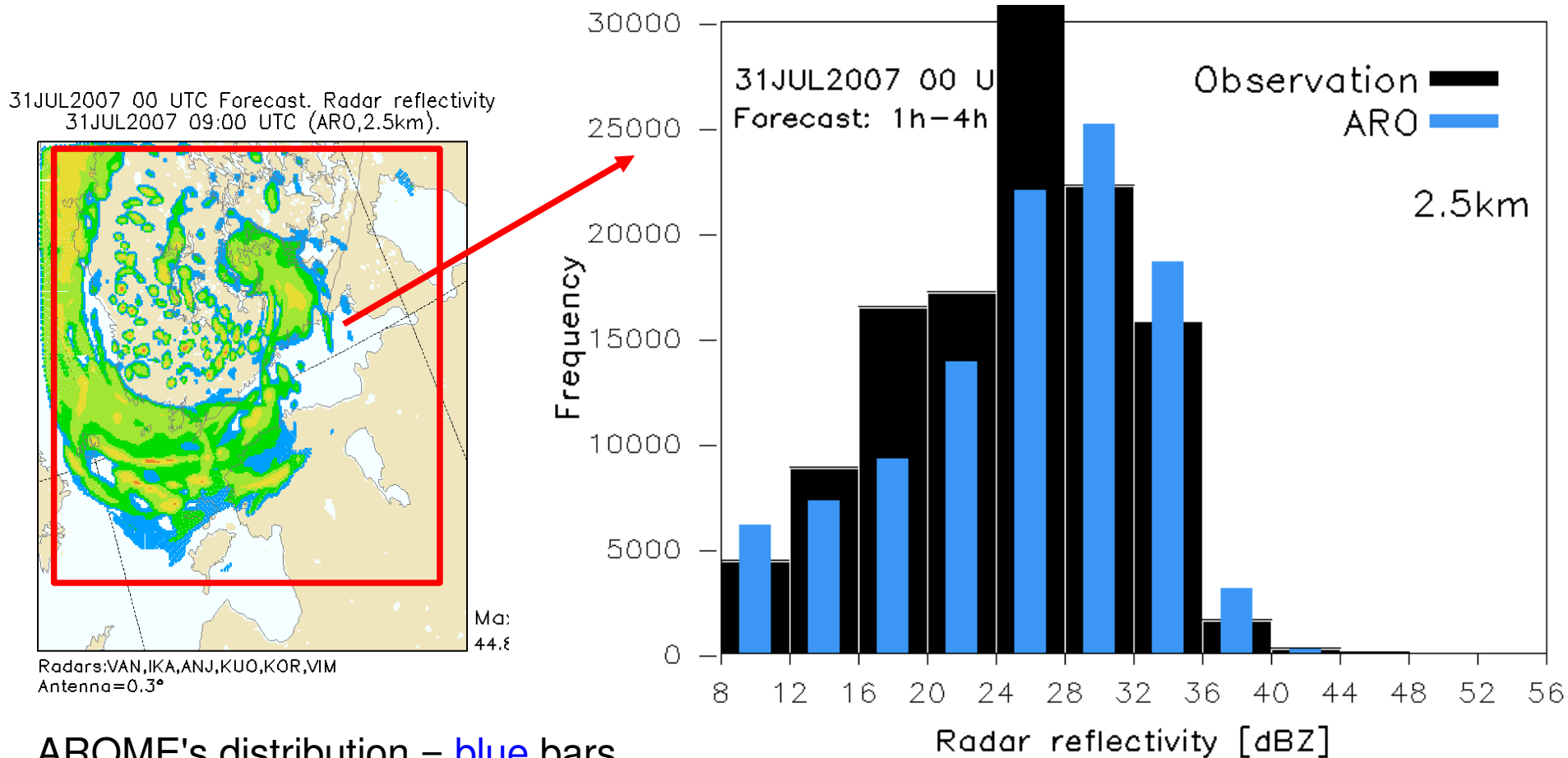
Radar reflectivity [dBZ] simulated
from **AROME** +9h forecast.

Observed radar reflectivity [dBZ].



Comparison against radar data (radar simulator)

Frequency distribution of radar reflectivity.



AROME's distribution = blue bars

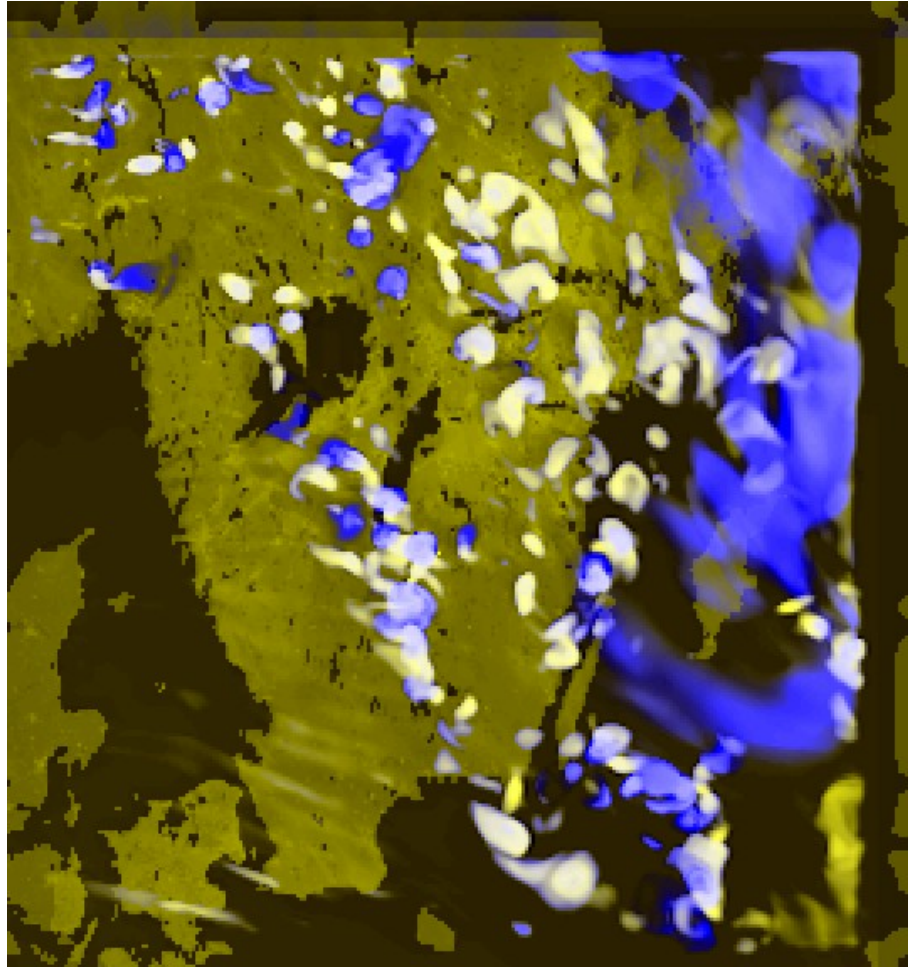
Observed distribution = black bars

Size spectrum analyser under development!

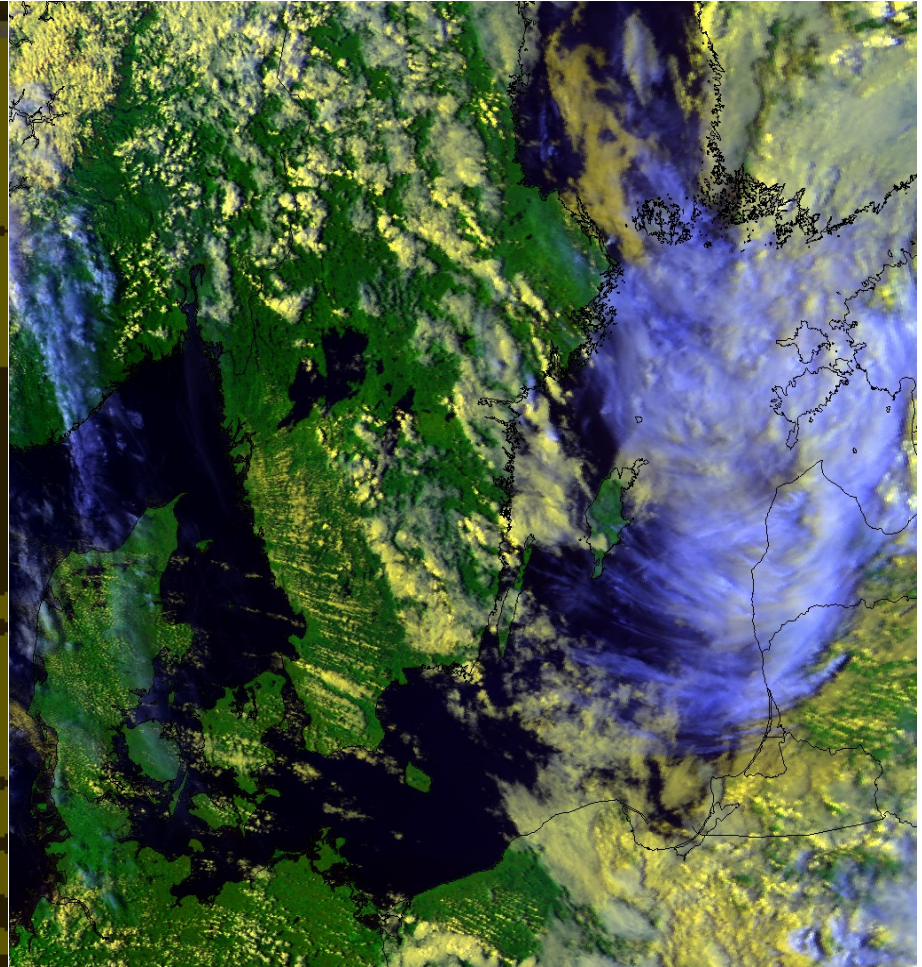


Comparison against satellite data

AROME



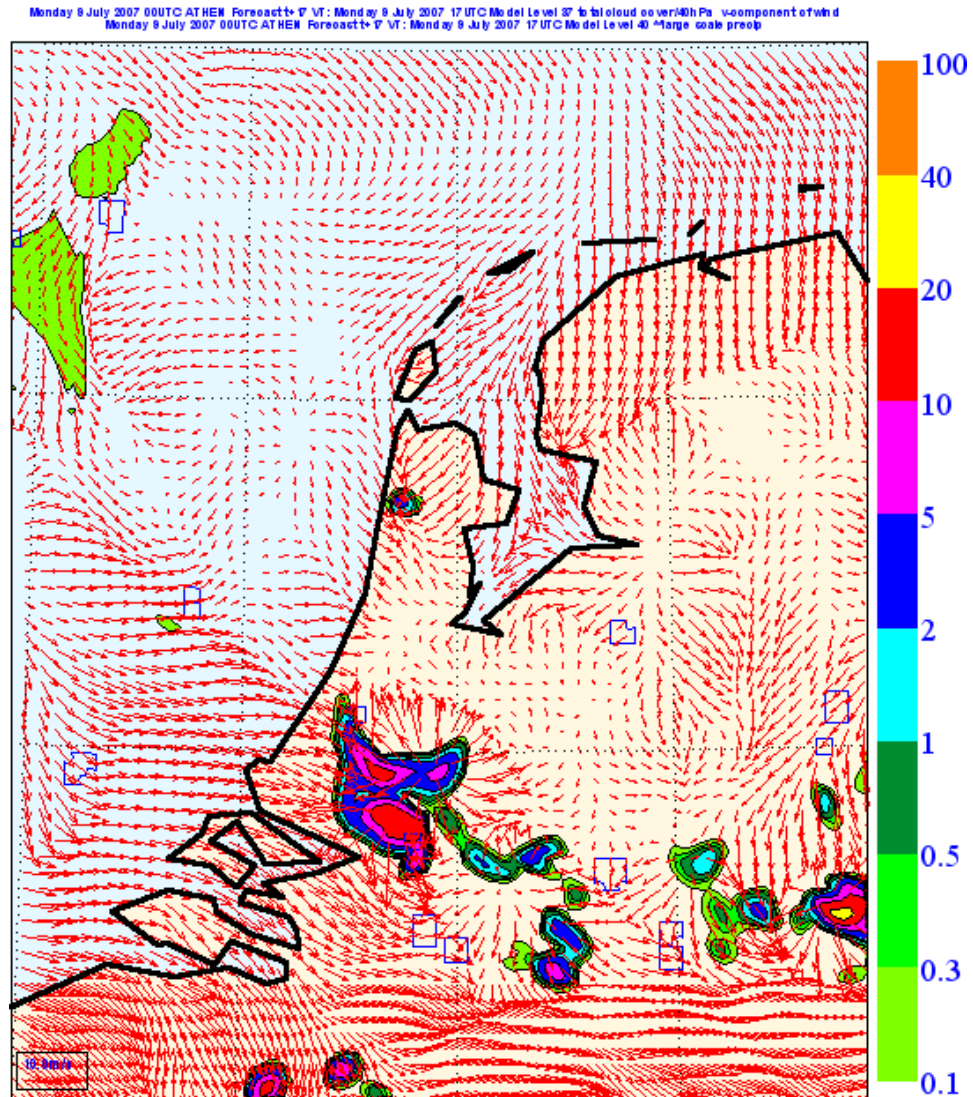
OBSERVATION



Evaluation of the cloud structure in AROME



Wind/precipitation studies at KNMI





Findings

- Too strong precipitation for deep convection.
- Too strong outflow from the convective systems (“fireworks”).
- Mesoscale convective systems seems to be too large in the model.
- Too weak winds near the surface over the land areas (KNMI).



Near future plans within HARMONIE

PHYSICS

- SURFEX developments (inclusion of forest tile).
- Inclusion of Lake scheme in SURFEX.
- Development of EDMF
- Impact of boundaries and initial conditions on AROME.
- Impact of deep convection parameterization on resolved deep convection.
- Radiation scheme intercomparison and optimization.

DATA ASSIMILATION (according to work plan)

- Construction and testing of a common 3D-VAR system based on ALADIN.
- Setup of a mesoscale surface DA-system (soil, water surface, snow etc.).
- Remote sensing data: radar reflectivity/winds, GPS, satellite data.