Regional Cooperation for
Limited Area Modeling in Central Europe

LACE
nwp central europe

LACE Physics Status Overview

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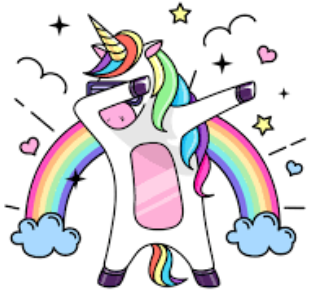
Summary

- code contribution for phasing CY47T1
- **ALARO1 working days SHMI, Bratislava, 11-13 March 2019**
- **Code Training, MF, Toulouse, 9-13 September 2019**
- new post processing output fields
- TOUCANS turbulence scheme
  - shallow convection
  - mixing length computation (cont.)
  - code check of TOUCANS
  - DDH
- Cloud scheme
- AROME microphysics: ICE3/4 and LIMA schemes
- prognostic graupel for ALARO
- operational applications: ALARO0 to ALARO1 +/- SURFEX
- computation of topographis characteristics from GMTED2010



Code contribution for phasing CY47T1

The first modset prepared by Bogdan Bochenek, containing **prognostic graupel code**. This time we hope for smooth phasing.

The second modset prepared by Jan Mašek, containing several contributions:
1) **DDH budgets** for prognostic TKE and TTE (in TOUCANS) added by Mario Hrastinski.
2) **New cloudiness treatment in vertical diffusion** by Radmila (introducing new options NDIFFNEB=4 and 5).
3) **Fixes in adjustment and microphysics** by Luc Gerard. These will be deactivated by local key, since they require more extensive validation.
4) **TOMs** (3rd order moments in TOUCANS) fixes by Peter Smerkol. These will be deactivated by local key as well.
5) Further **modularization and optimization of ACRANEB2**.
6) **Fixes of blend utility** (new FA date structure, split of ECHIEN to ERIEN, reintroduction of Z_NSIGN, making official version working). Recently, Jan Masek found that blend utility in cy47t0 is crashing, the problem might be related to xrd adaptation for single/double precision.

ALARO1 Working Days

SHMI, Bratislava, Slovakia, 11-13 March 2019
http://www.rclace.eu/?page=197
Presentations from **operational applications** (Belgium, Croatia, Czech Republic, Poland, Slovakia, Slovenia, Spain, Turkey) and **climate simulations** (Belgium)
EPS with ALARO(1): A-LAEF, Belgium RMI-EPS, Spain AEMET-gSREPS
Used operationally at 2-11 km km resolutions

- Radiation (Ján Mašek: ACRANEB2, 3D radiation)
- Turbulence-Diffusion TOUCANS (Ivan Bašták Ďurán: A two-energies turbulence scheme, Radmila Brožková: Shallow convection closure using mass-flux type approach, Mario Hrastinski: TKE-based mixing length in TOUCANS, Peter Smerkol: TOUCANS: Issues with computations in TOMs)
- Precipitations aspects (microphysics) (Bogdan Bochanek: Prognostic graupel in ALARO)
- Clouds (Radmila Brožková, Ján Mašek: Cloudiness: status, unification attempts and perspectives, Luc Gerard: Cloud reunification in the CSD context)
- Deep convection: complementary subgrid drafts; stochastic components
  (Luc Gerard: Status overview of the CSD adaptive convection scheme)
- ISBA, SURFEX (Martina Tudor: The quality of physiography data in clim files, Ján Mašek: New roughness treatment in ISBA scheme, Martin Dian: ALARO-1 with SURFEX - current status and plan, Ján Mašek(Rafiq Hamdi): ALARO-1 with SURFEX - some interfacing issues)

Turbulence scheme - TOUCANS

TOUCANS – Third Order moments (TOMs) Unified Condensation Accounting and N-dependent Solver (for turbulence and diffusion)

"A Turbulence Scheme with Two Prognostic Turbulence Energies" Bašták Ďurán et al. https://doi.org/10.1175/JAS-D-18-0026.1

The basic data flow from TKE/TTE solver to DDH input structure is completed and successfully tested with uniform input fields.

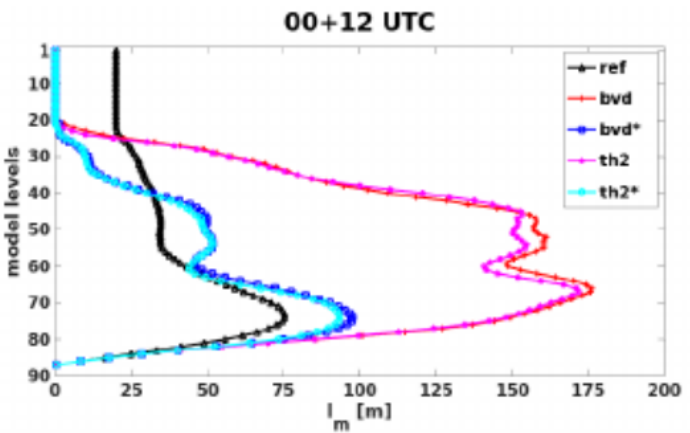
ddhb Postprocessing of TKE/TTE budget fields is completed

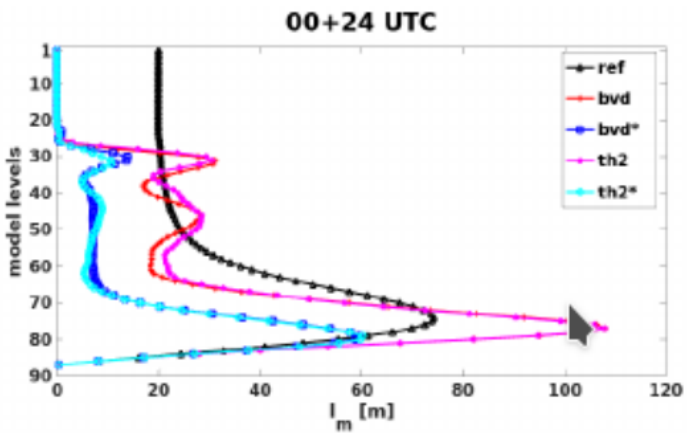
phasing this development within the next common cycle

TOUCANS – mixing length computation

- Implementation of TKE based mixing length
- New discretization of BL89 integral in the code affect vertical displacement

To strong mixing with local κ-scaling:





ALARO+SURFEX+New topography

Debugging

Differences in results corresponding to physiography differences (report due)

A procedure is created to compute variance, orientation anisotropy and topography roughness from GMTED2010 (RB)

Code with correct averaging of thermal and mechanical roughnesses (MD, JM)

-fixed problem with computation of Richardson number in SURFACE_CDCH_1DARP

- bug (missing C3TKE factor in same routine SURFACE_CDCH_1DARP) in calculation of thermal exchange coefficient in neutrality.

- remaining fibrilations in exchange coefficients. The solution is switching off the antifibrilation treatment, which is not necessary running with TOUCANS.

AROME microphysics

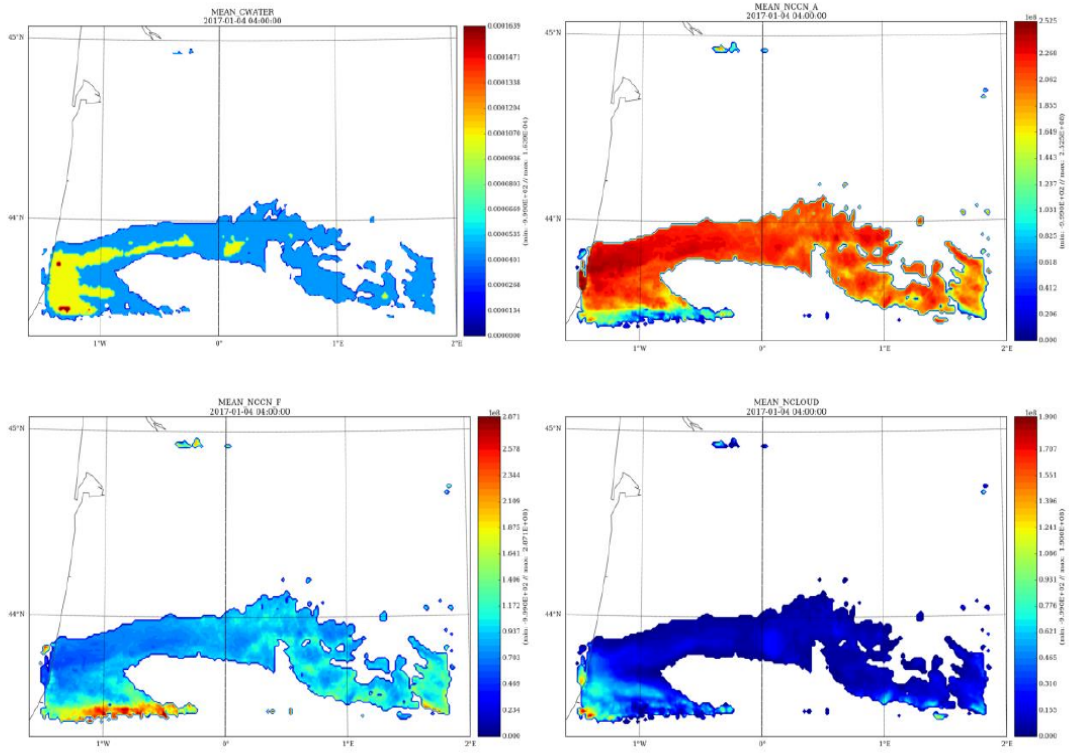


Figure 4. Average value fields of LWC (top left), number concentration of activated aerosols (top right), number concentration of free aerosols (bottom left) and number concentration of cloud droplets (bottom right) with LIMA scheme on 4th January 2017 (00UTC run +4h forecast).

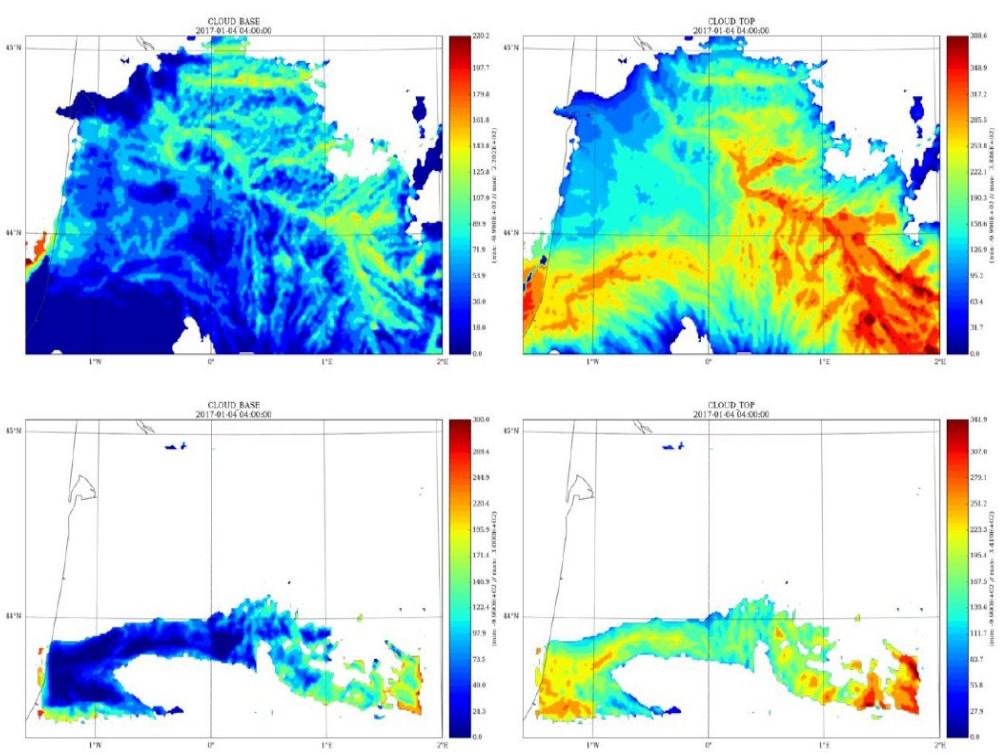


Figure 5. Cloud base (left) and cloud top (right) fields with ICE3 (top) and LIMA (bottom) scheme on 4th January 2017 (00UTC run +4h forecast).

Model output diagnostics

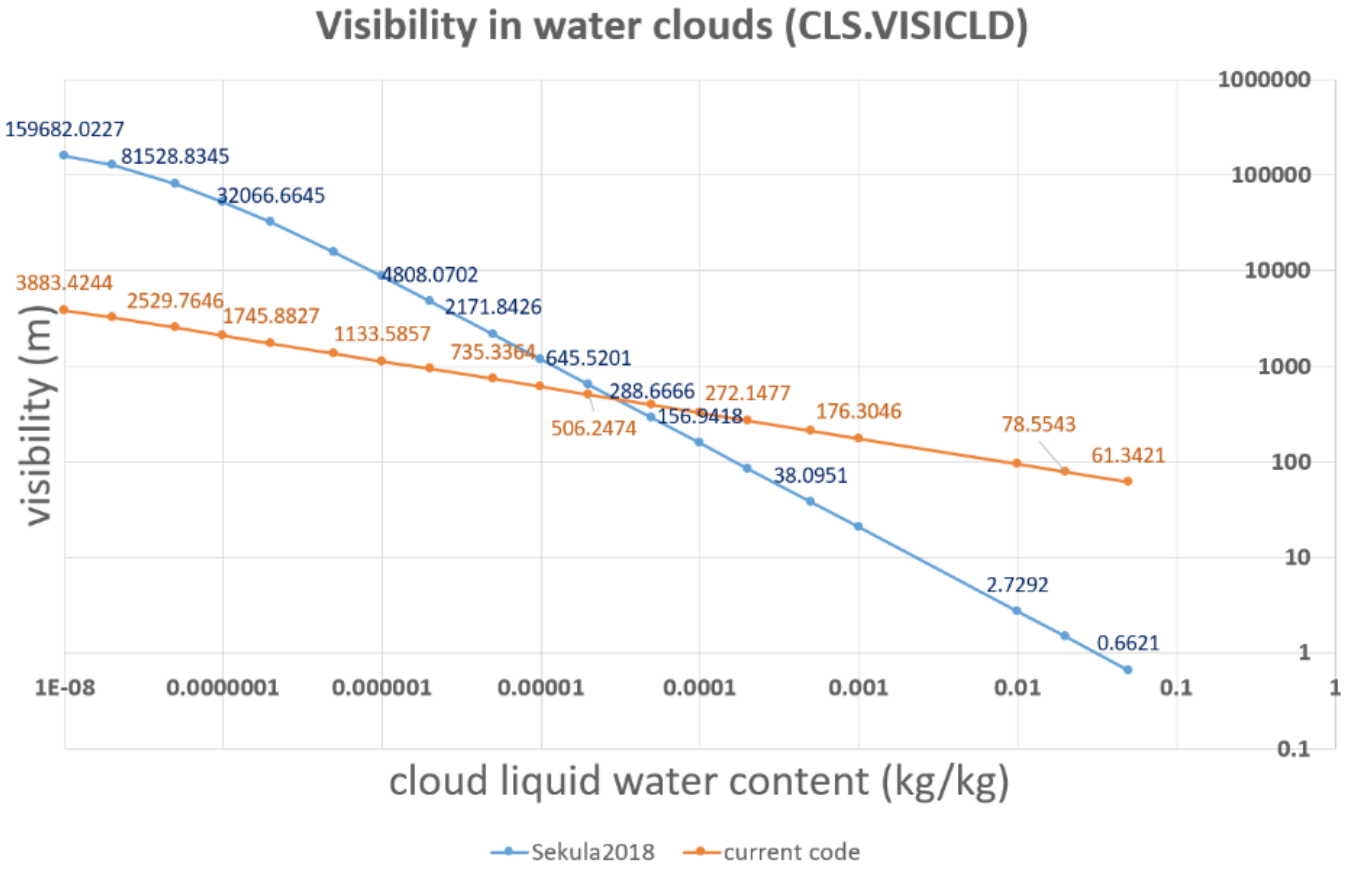
Precipitation type

- originally developed in MeteoFrance for AROME, ARPEGE,
- a pack is prepared based on Meteo-France operational branch (CY43T1) for ALARO.
- Testing, validation, tuning is ongoing in Ljubljana by Piotr (midAug-midSep),
- main issue is to tune the limits for graupel/hail as the graupel field differ from AROME one.

Visibility - ALARO and AROME

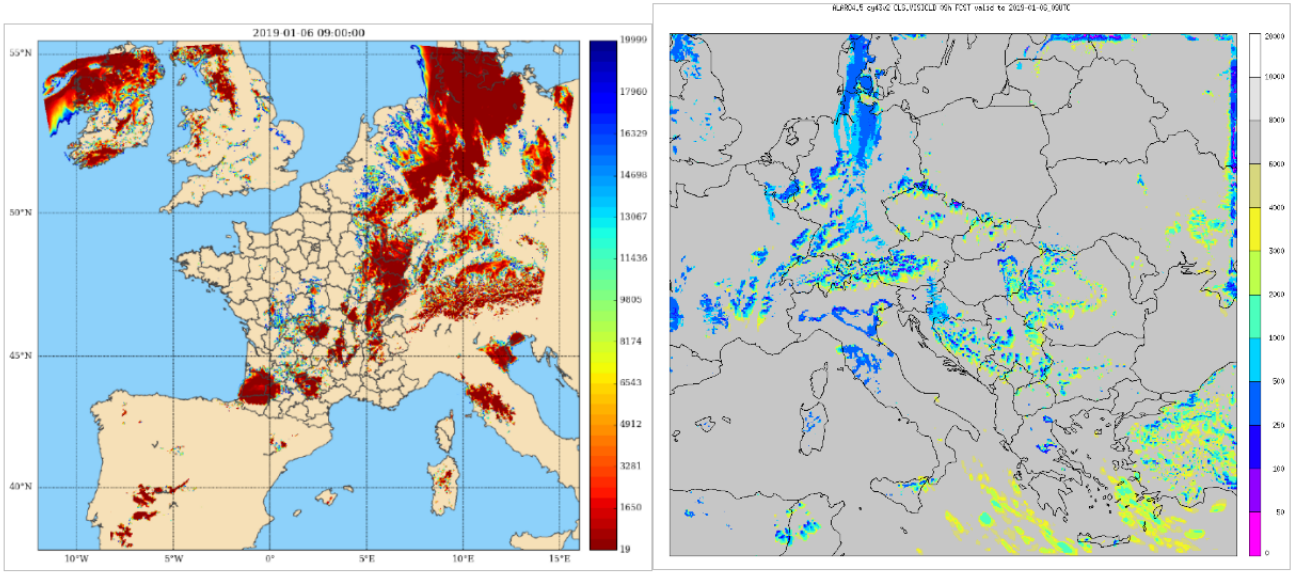
Implementation of daily updated LAI in AROME (from Surfex ISBA-Ags) (BS 2.5 pm) – link with data assimilation

Visibility (cloud and precipitation based)



Visibility (m) as function of cloud liquid water (kg/kg) in blue colour and as defined in the current code default settings, used in the presented tests (orange). Both axes use logarithmic scale. Some visibility records are emphasized by numbers.

Visibility (cloud and precipitation based)



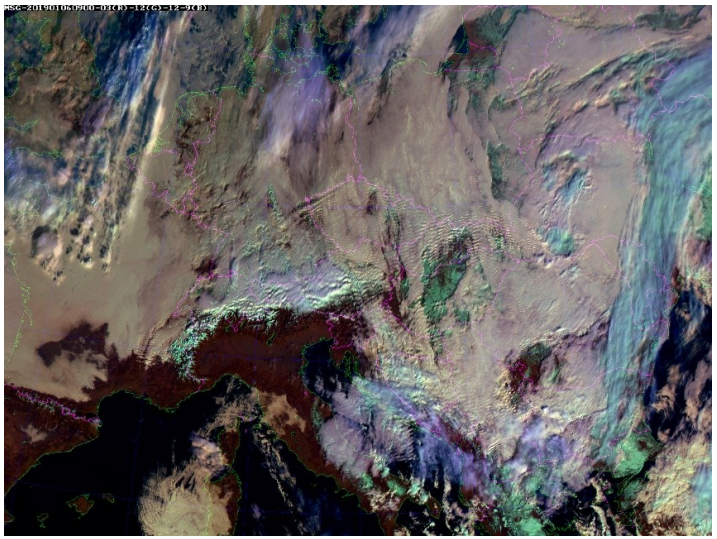


Fig. 3a: Left: 9h visibility (m) forecast from the AROME model valid to 06 January 2019 09 UTC (Piriou et al., 2019). Fig. 3b: Right: Forecast of 1h minimum visibility in clouds (CLS.VISICLD) from ALARO SHMU cy43t2 for the same date and time with default setting. Conditions for fog (visibility < 1km) are in bluish colors.

Visibility (cloud and precipitation based)

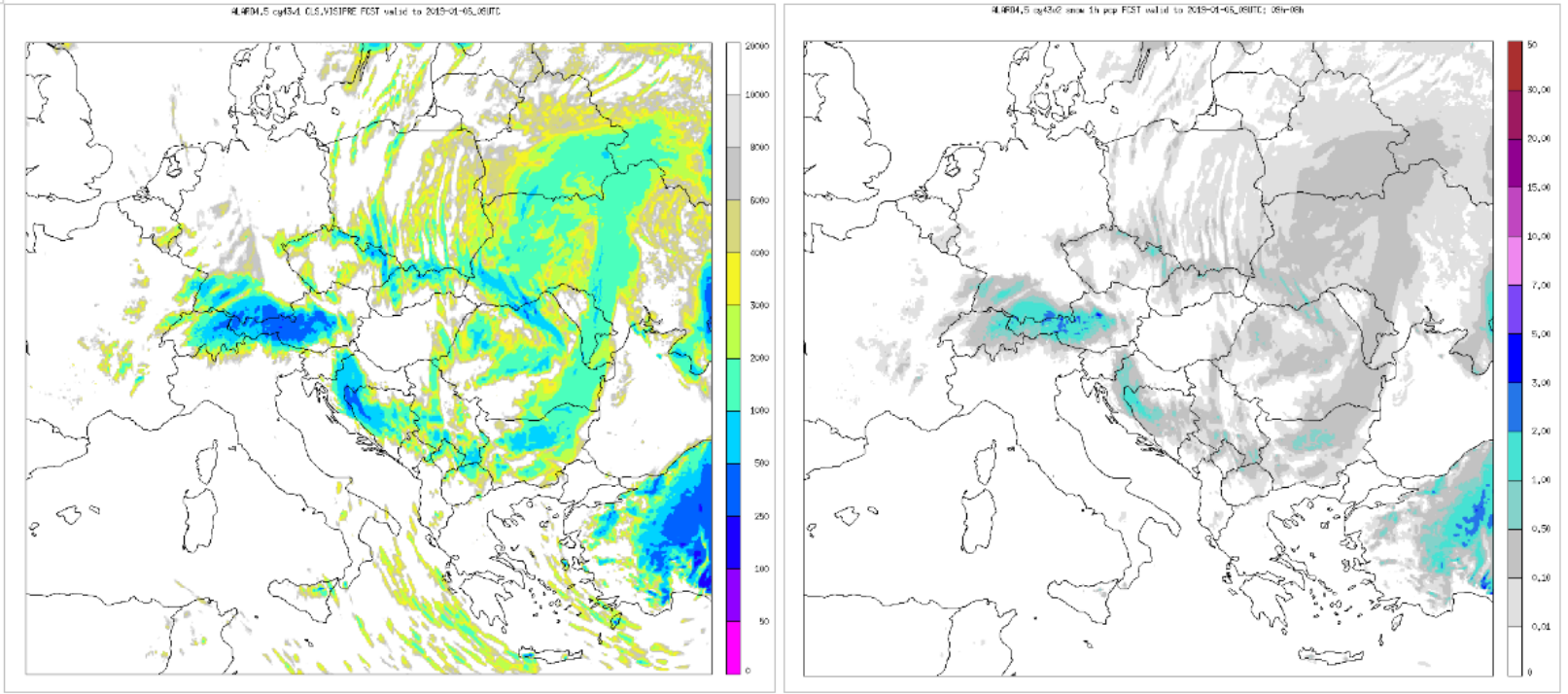
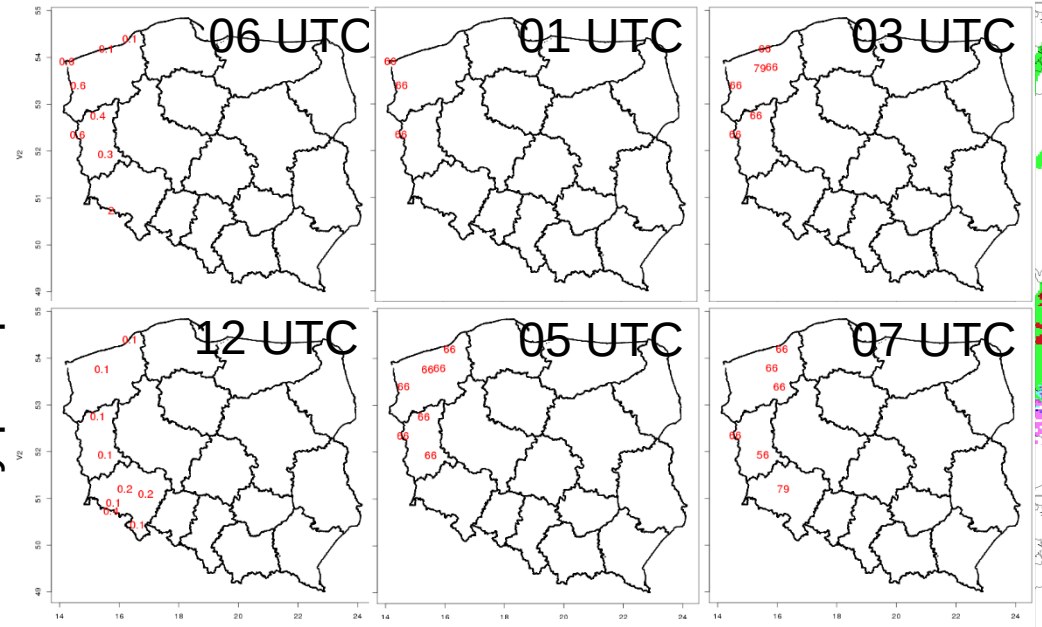
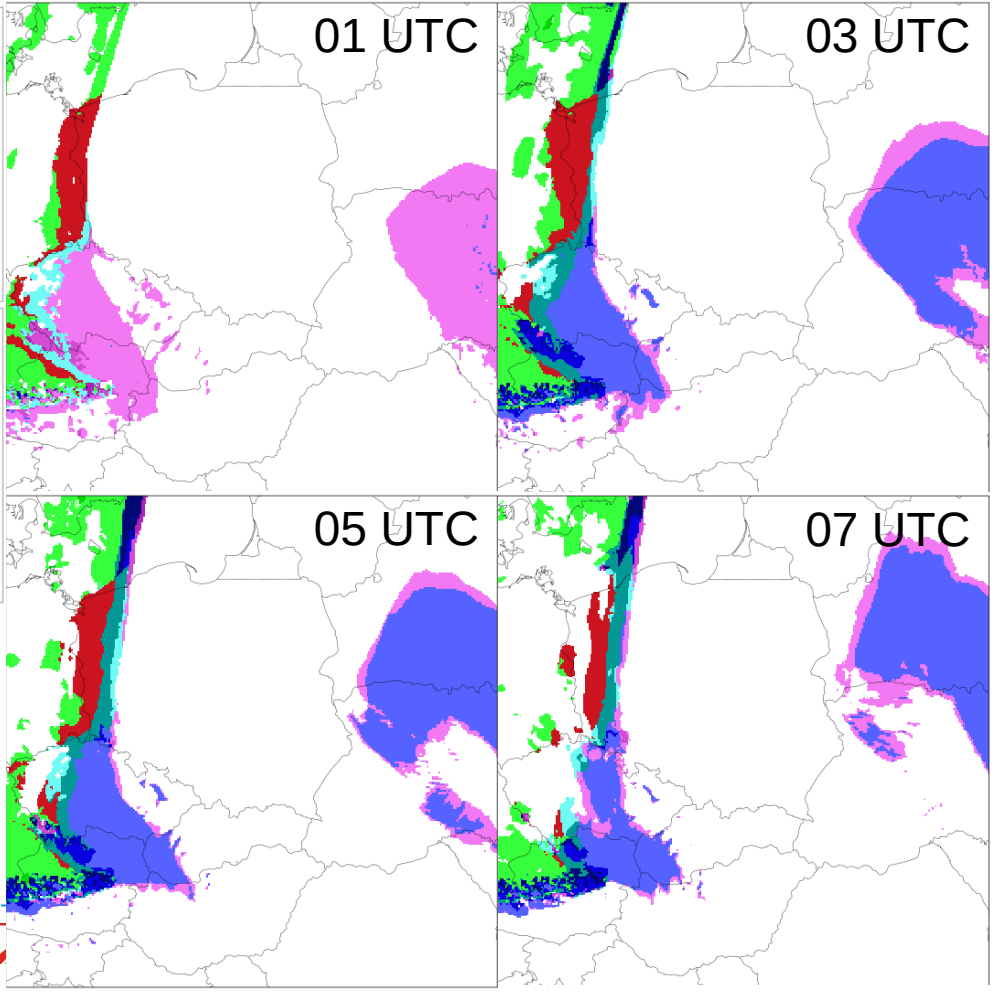


Fig. 6. a: (left) Forecast of 1h minimum visibility in precipitation (CLS.VISIPRE) from ALARO SHMU cy43t2 valid for 06 January 2019 09 UTC. 6b: (right) 1h precipitation forecast for the 08-09 UTC period.

Precipitation types ALARO (1.12.2018.)

6 hourly precipitation Poland



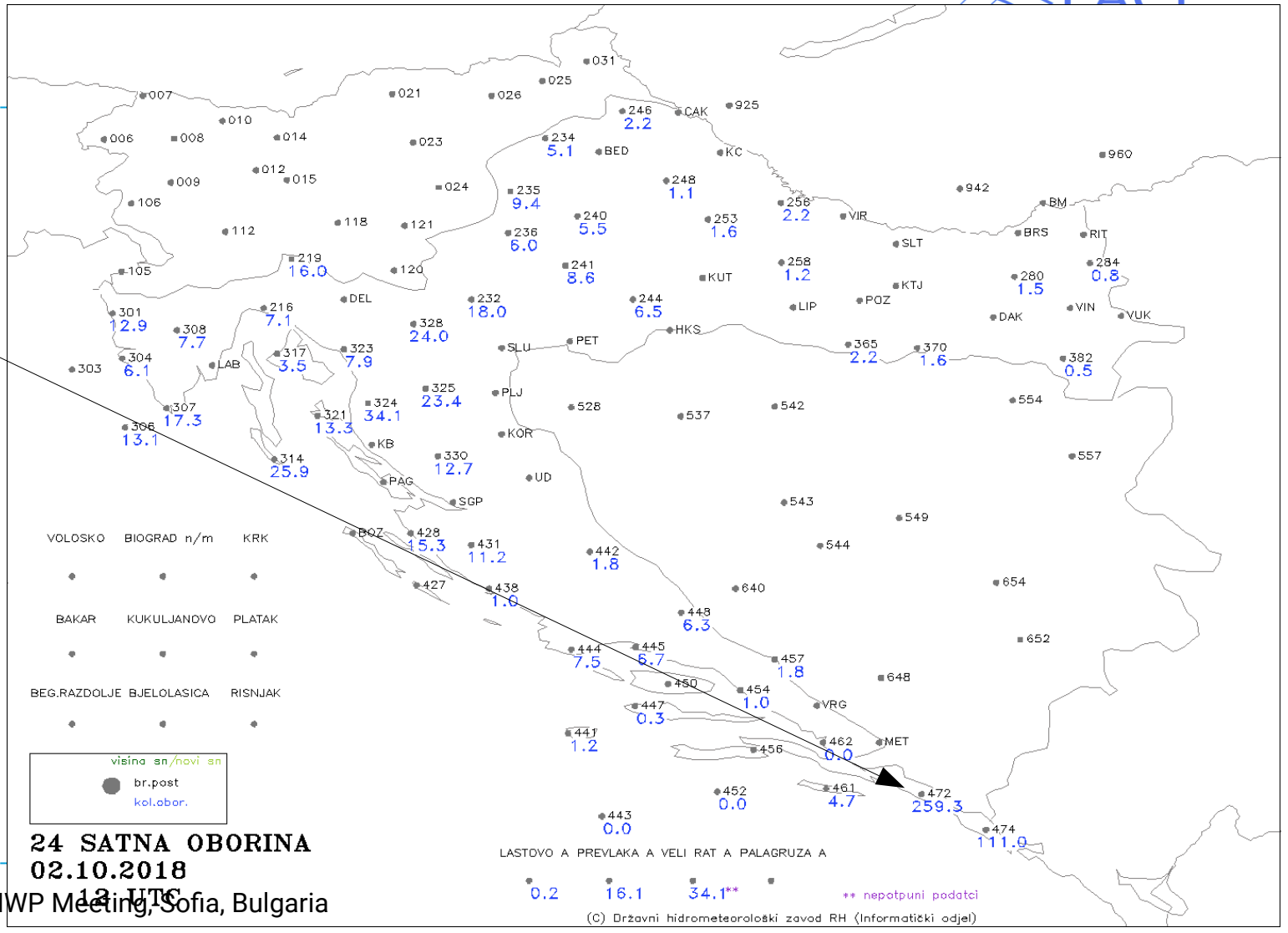


56 – light drizzle
57 – moderate/heavy freezing drizzle
66 – light freezing rain
67 – moderate/heavy freezing rain
79 – ice precipitation

Rain
Freezing rain
Dry snow
Wet snow
Rain snow mixture
Ice pellets
Graupe
Hail
Drizzle
Freezing drizzle
Moist snow/sleet
Inter. rain
Inter. dry snow
Inter. wet snow
Inter. rain snow mix.
Inter. moist snow/slee

Rain

Extreme rainfall
2.10.2018. morning
3-6 UTC
259.3 mm
In Dubrovnik

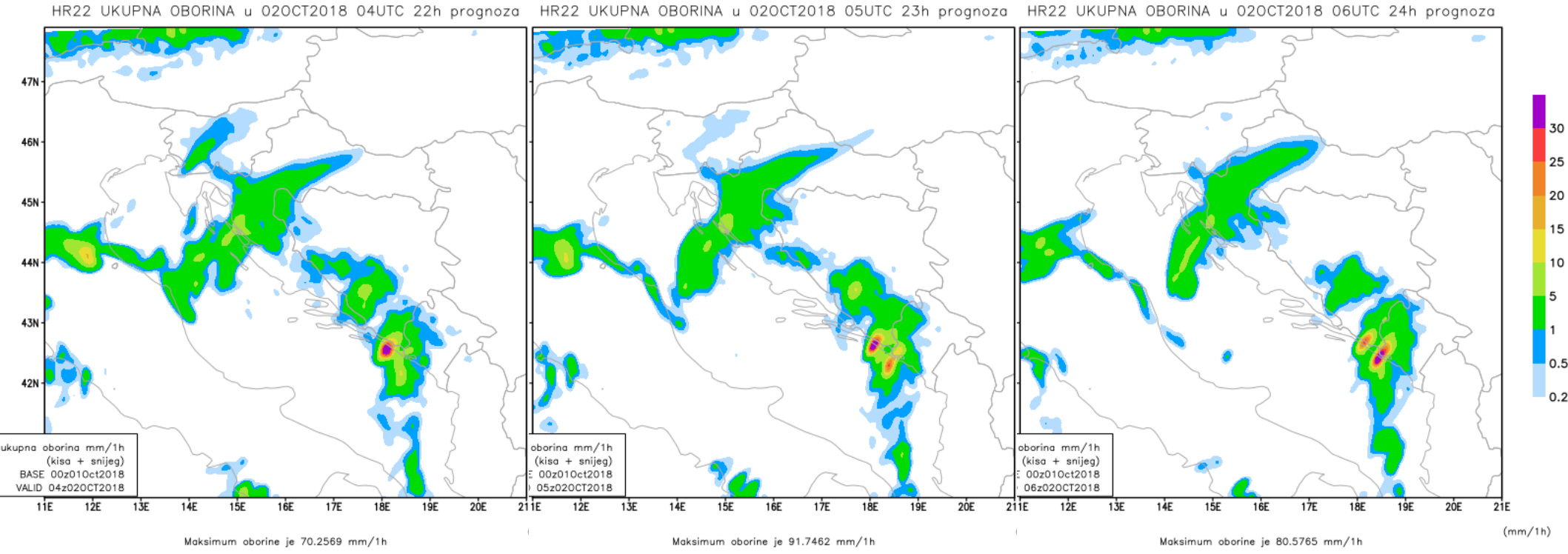


Rain

Dubrovnik
2.10.2018

ARSO METEO
Slovenia

Rain



Hourly accumulated precipitation from **operational HR22, 2 km res, ALARO NH run**
Max total ~ 240 mm/3hr

Bura 23. Feb 2019







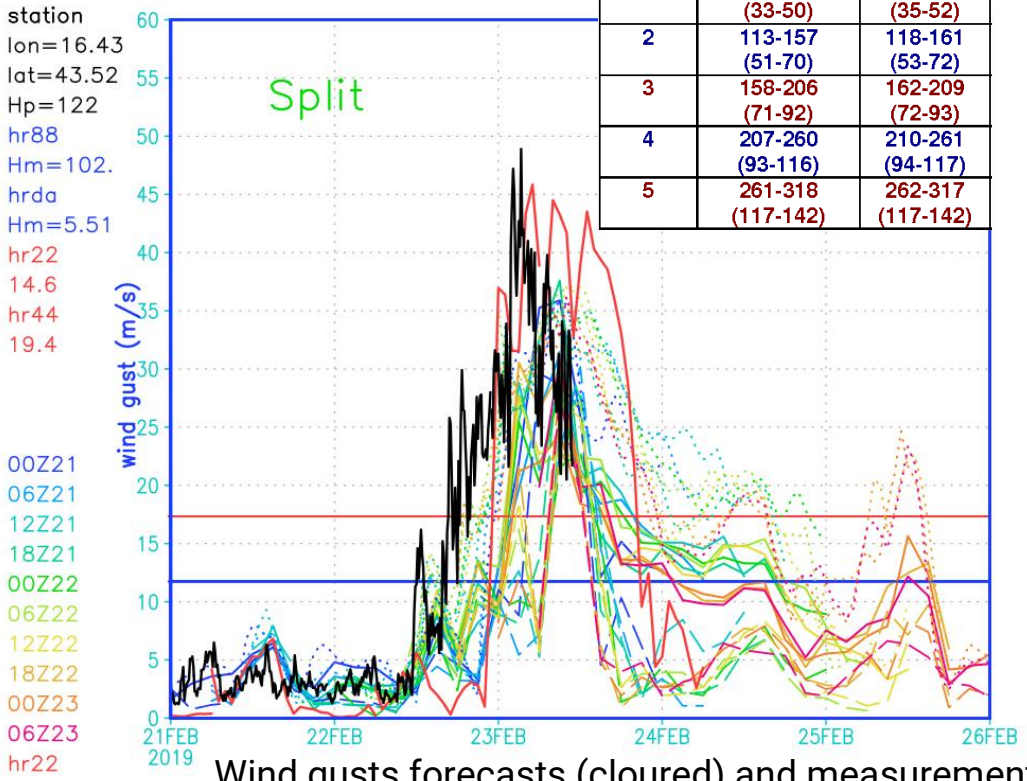


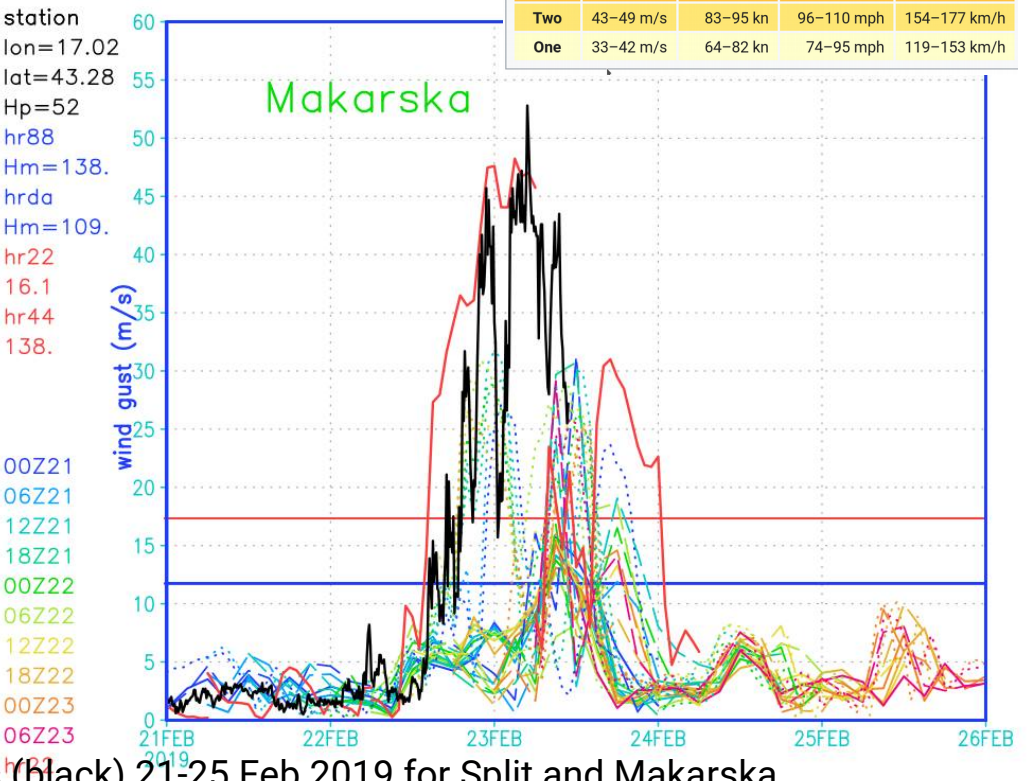
Bura

FUJITA SCALE		
F Level	Fastest 1/4-mi in mph ($m\ s^{-1}$)	3-s Gust in mph ($m\ s^{-1}$)
0	40-72 (18-32)	45-78 (20-35)
1	73-112 (33-50)	79-117 (35-52)
2	113-157 (51-70)	118-161 (53-72)
3	158-206 (71-92)	162-209 (72-93)
4	207-260 (93-116)	210-261 (94-117)
5	261-318 (117-142)	262-317 (117-142)

Saffir–Simpson scale

Category	Wind speeds (for 1-minute maximum sustained winds)			
	m/s	knots (kn)	mph	km/h
Five	≥ 70 m/s	≥ 137 kn	≥ 157 mph	≥ 252 km/h
Four	58–70 m/s	113–136 kn	130–156 mph	209–251 km/h
Three	50–58 m/s	96–112 kn	111–129 mph	178–208 km/h
Two	43–49 m/s	83–95 kn	96–110 mph	154–177 km/h
One	33–42 m/s	64–82 kn	74–95 mph	119–153 km/h





Wind gusts forecasts (cloured) and measurements (black) 21-25 Feb 2019 for Split and Makarska.
The full red line is the HR22 forecast (2km res ALARO NH), HR88 forecast (full), HR44 (long dash) and HRDA (dotted) forecasts are coloured differently according to analysis times (as denoted on the left side of the pannel).

MUSC testbed – working days/training

HIRLAM uses more regularly

MF – Eric Bazile
- issues with input files for AROME (SURFEX format)

Training programme:
- how to prepare and validate experiments
- preparations done at home
- CY46T1 installed on laptop (at least CY43T1)
- Daan promised technical help
- how to validate?
- how to prepare experiments?

wiki: HarmonieSystemDocumentation / MUSC

MUSC using the develop branch (CY43) in the git repository

Emily Gleeson and Eoin Whelan have committed a cycle 43 MUSC experiment which runs off the reference HARMONIE code (with no additional src changes).

This experiment can be found in harmonie/util/musc/test/musc_ref.

The 3 input files needed to run an experiment are attached to this page (an atmospheric, surface and pgd file). These need to be copied to harmonie/util/musc/test/musc_ref/input/ before starting an experiment.

Below are instructions to run the default MUSC experiment locally in Met Eireann:

1. Get MUSC

```
mkdir -p $HOME/harmonie_releases/git
cd $HOME/harmonie_releases/git
git clone https://git.hirlam.org/Harmonie -b develop Harmonie ## This just clones the develop branch
cd Harmonie
git branch
# If you already have a clone of the code but want to update it to the latest, use "git pull" rather than "git branch".
```

2. Create a MUSC experiment. In this example the METIE.LinuxRH7gnu system config file is used and the MUSC experiment name is musc_ref

```
mkdir -p $HOME/hm_musc/test_0001
cd $HOME/hm_musc/test_0001
$HOME/harmonie_releases/git/develop/util/musc/scr/setup_musc.sh -h
$HOME/harmonie_releases/git/develop/util/musc/scr/setup_musc.sh -r $HOME/harmonie_releases/git/develop -c METIE.LinuxRH7gnu -t musc_ref
```

3. Compile and run your experiment (still in $HOME/hm_musc/test_0001)

```
cd $HOME/hm_musc/test_0001
./compile_musc.sh -h
./compile_musc.sh -n 2   # n is the number of parallel make processors
                         # -- pick a sensible number for your laptop/PC/HPC
```

4. Get a copy of the input files

```
cd $HOME
wget https://hirlam.org/trac/raw-attachment/wiki/HarmonieSystemDocumentation/MUSC/muscCY43InputData.tar.gz
gunzip muscCY43InputData.tar.gz
tar -xvf muscCY43InputData.tar
```

5. Run your experiment

```
cd $HOME/hm_musc/test_0001
./run_musc.sh -h
./run_musc.sh -d $HOME/muscCY43InputData    # because we earlier defined the expt to be musc_ref, the files in this sub folder of $HOME/muscCY43Input
```

Attachments