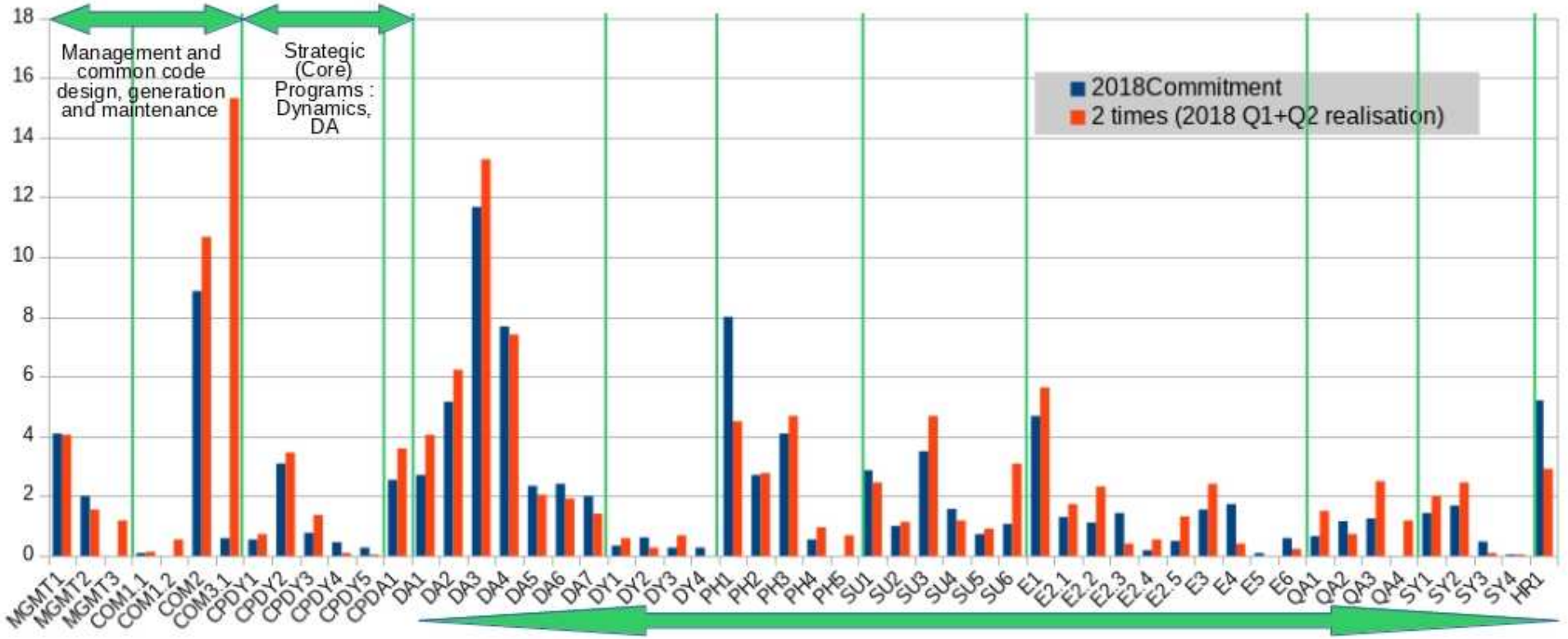
HIRLAM-ALADIN activity report

Highlights LACE/HIRLAM/ALADIN

Manpower (in F.T.E.) in 2018 RWP Work Packages

Committed for 2018 and "Realised" (twice the realisation during the first semester of 2018)



Prospective R&D activities :
Atmospheric data assimilation,Dynamics, Atmospheric physics parametrizations, Surface analysis and modelling, Probabilistic forecasting , Quality assessment and monitoring ,Technical code and system development,owards high-resolution modelling

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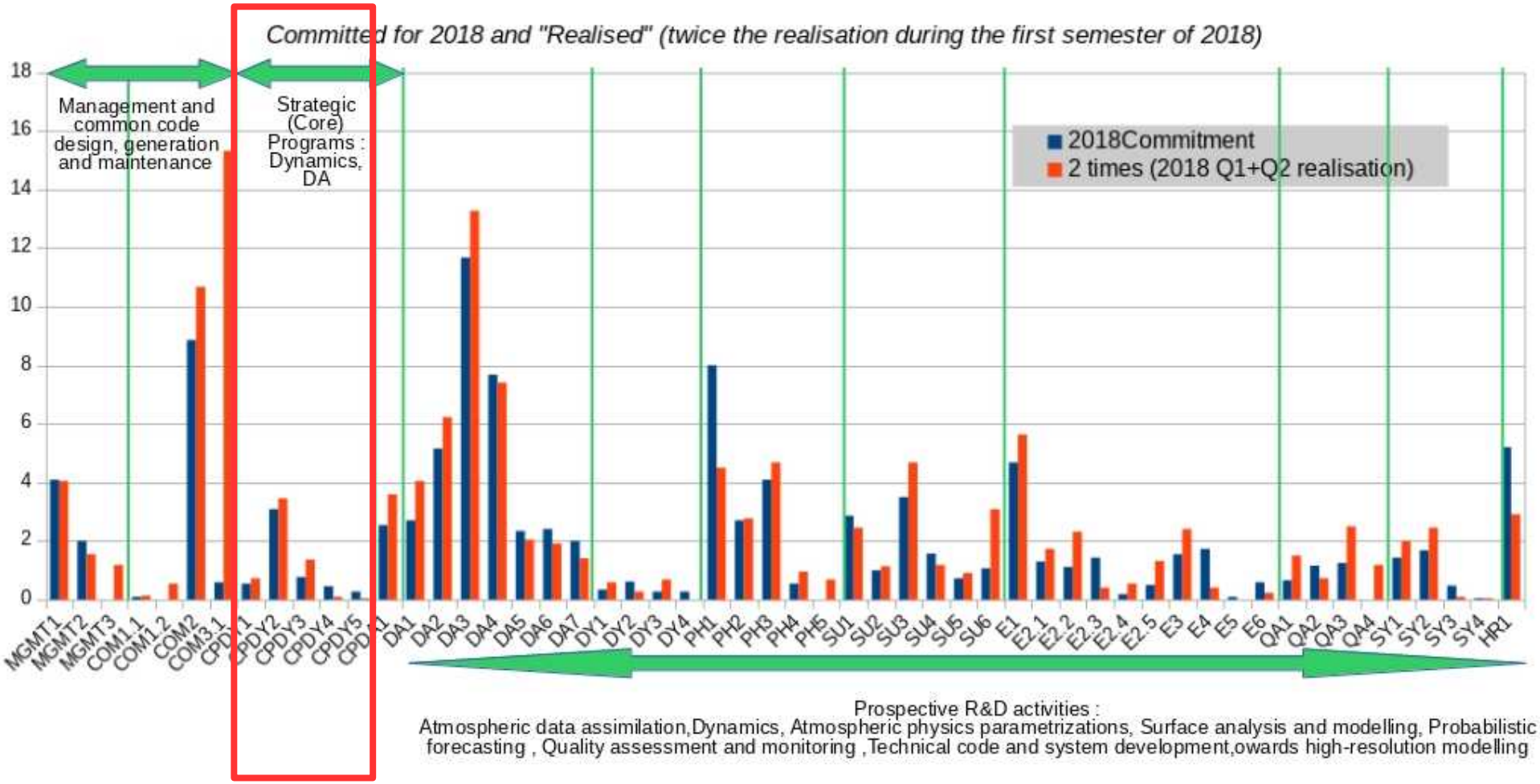


- The LAM aspects are included in WP4.
- Energy vs. wall-time profiling.
- Three Dwarves are studies (bi-FFT transform, ACRANEB, SL scheme) and have been profiled
- Preliminary results: Bi-FFT increases for wall-time, but decreases for energy (the energy of the communications not included in the test)

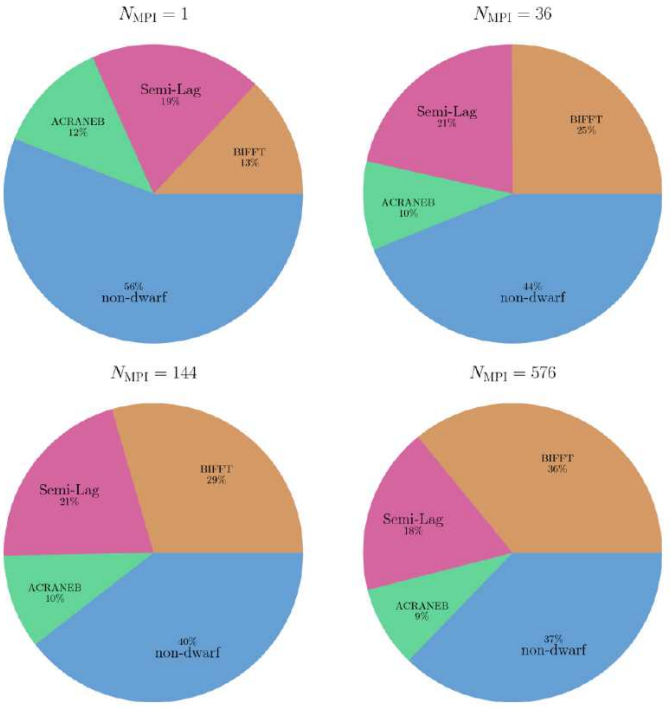


Figure 8: Distribution of the forecast runtime among dwarfs for the ALARO reference (2.5km).

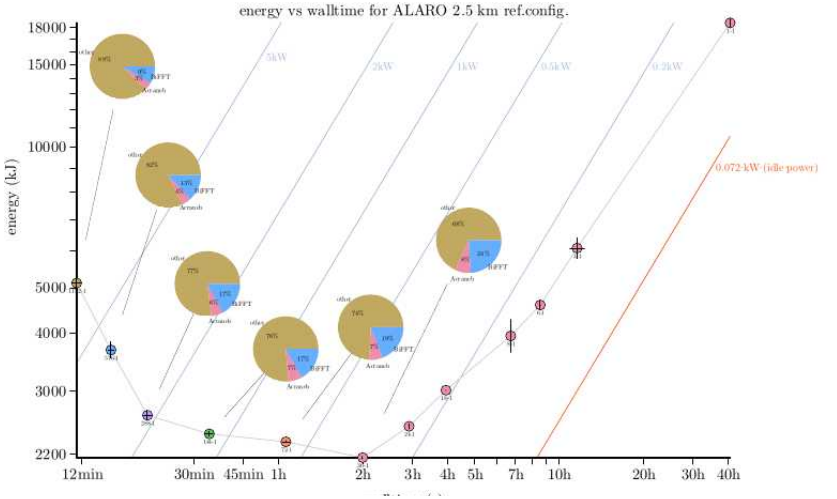


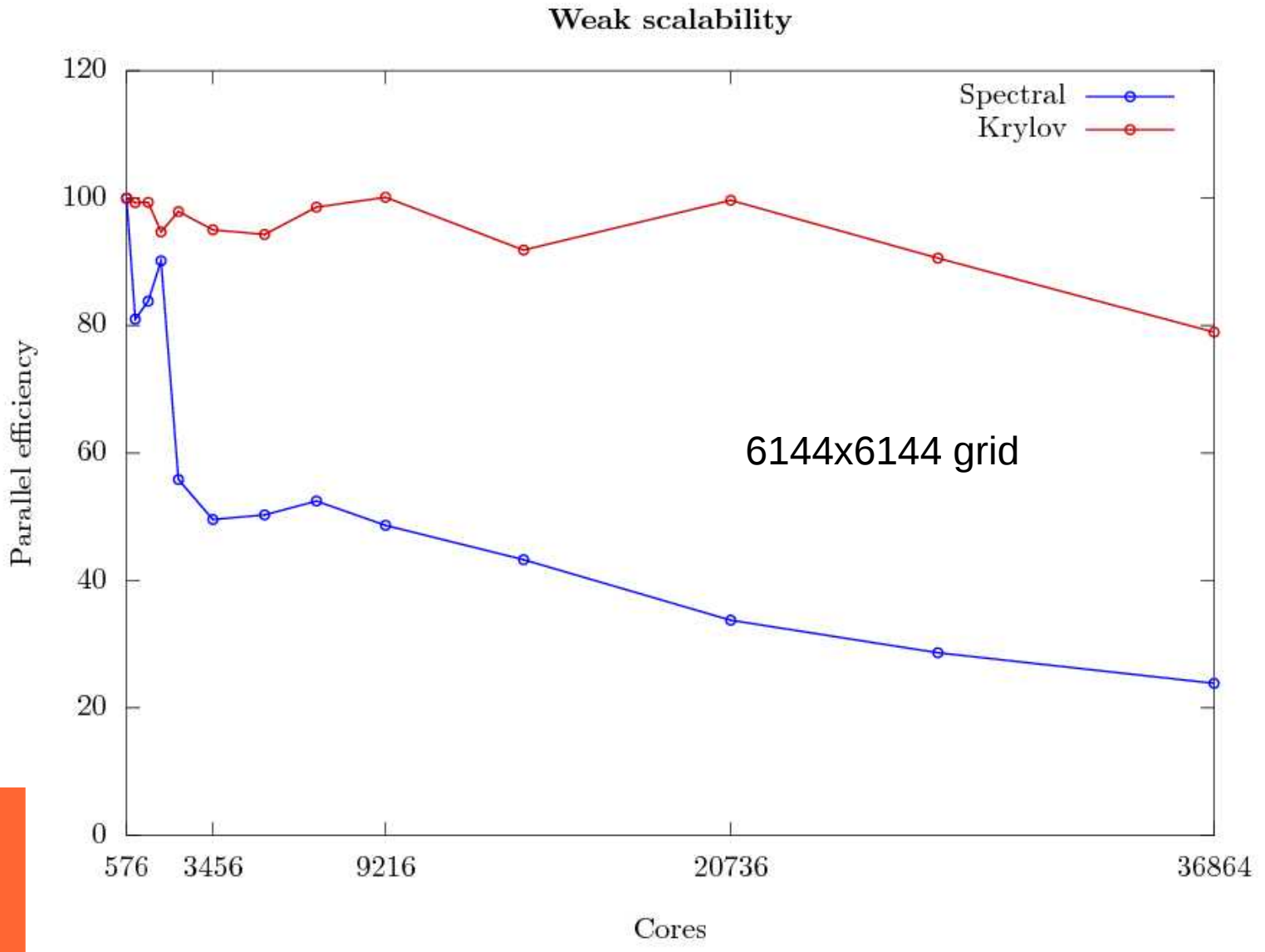
Figure 3: The energy consumption vs walltime for the ALARO 2.5 km reference configuration. Only pure MPI jobs were simulated. The colors and added lines have the same meaning as in Figure 2. The piecharts are estimates of the relative energy contributions of the BiFFT and Acraneb dwarfs for full-node runs.

Courtesy J. Van Bever

A non-spectral Helmholtz solver for ALADIN-NH

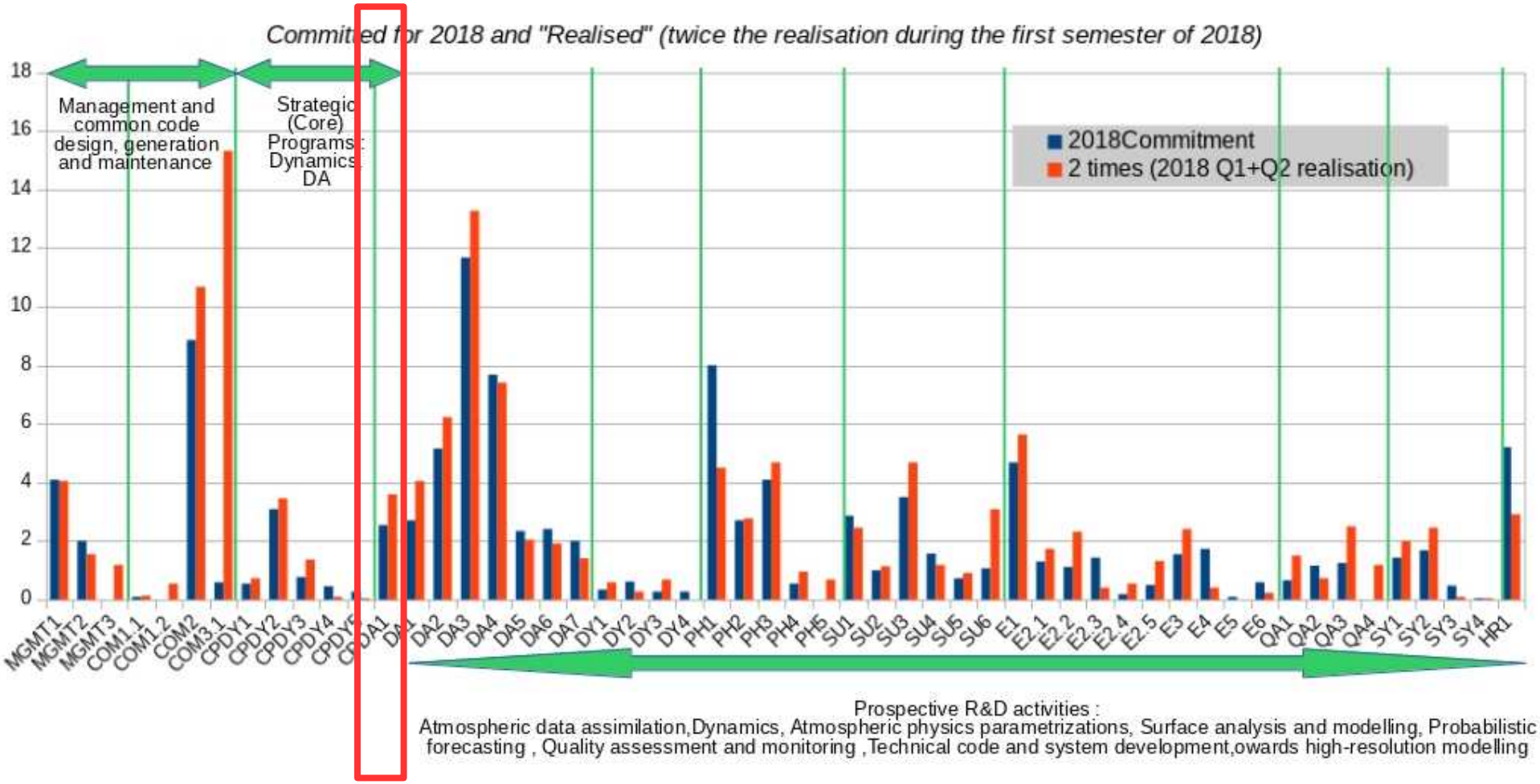
Scalability tests on ECWMF Cray

768x768 grid



Scalability of Helmholtz problem only!

Manpower (in F.T.E.) in 2018 RWP Work Packages



The Fires of 14-16 October 2017 in Portugal

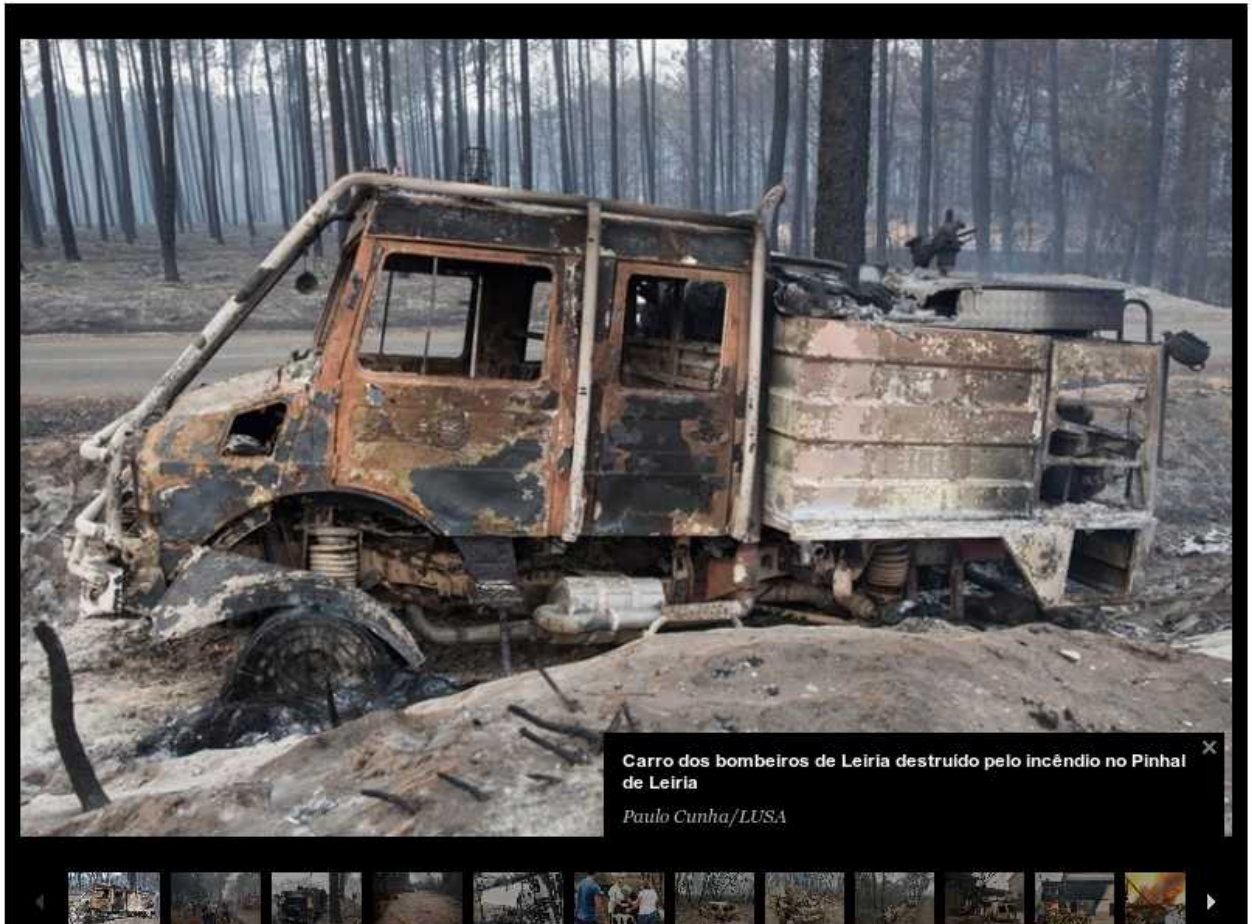
- 51people were killed
- 500 companies were totally or partially destroyed and more than 4500 jobs were affected

cm PORTUGAL

Número de mortos nos fogos já é de 42

Um dos feridos graves na tragédia não resistiu. Chamas fizeram ainda 70 feridos, 14 dos

Por João Tavares, Pedro Zagacho Gonçalves, Catarina Correia Rocha, Manuel Colaço, Daniela Vilar Santos, Catarina Figueiredo, Natacha Nunes



FIRESSTORM (funded project)

Project which aims at study the interaction between atmospheric flows and spot fires which cause high-intensity propagation.

In complex orography, between 200-1300 m, the high of boundary layer plays an important rôle. Extra localised surface stations will be placed to help monitoring the profile of temp, hum and wind; surface DA will assimilate this data to check its added value on the short-term forecasts.

1-hour surface DA with Iberian conventional data (2016-2017)

Hourly CANARI-AROME validation (00UTC *network*):
Summer (20170801 – 20170815)
Winter (20170110 - 20170207)
Table - RMSE and BIAS of screen level parameters analysis over Mainland for Portugal CAN-ARO and
CAN-ALA *vs*. ARO-OP initial fields

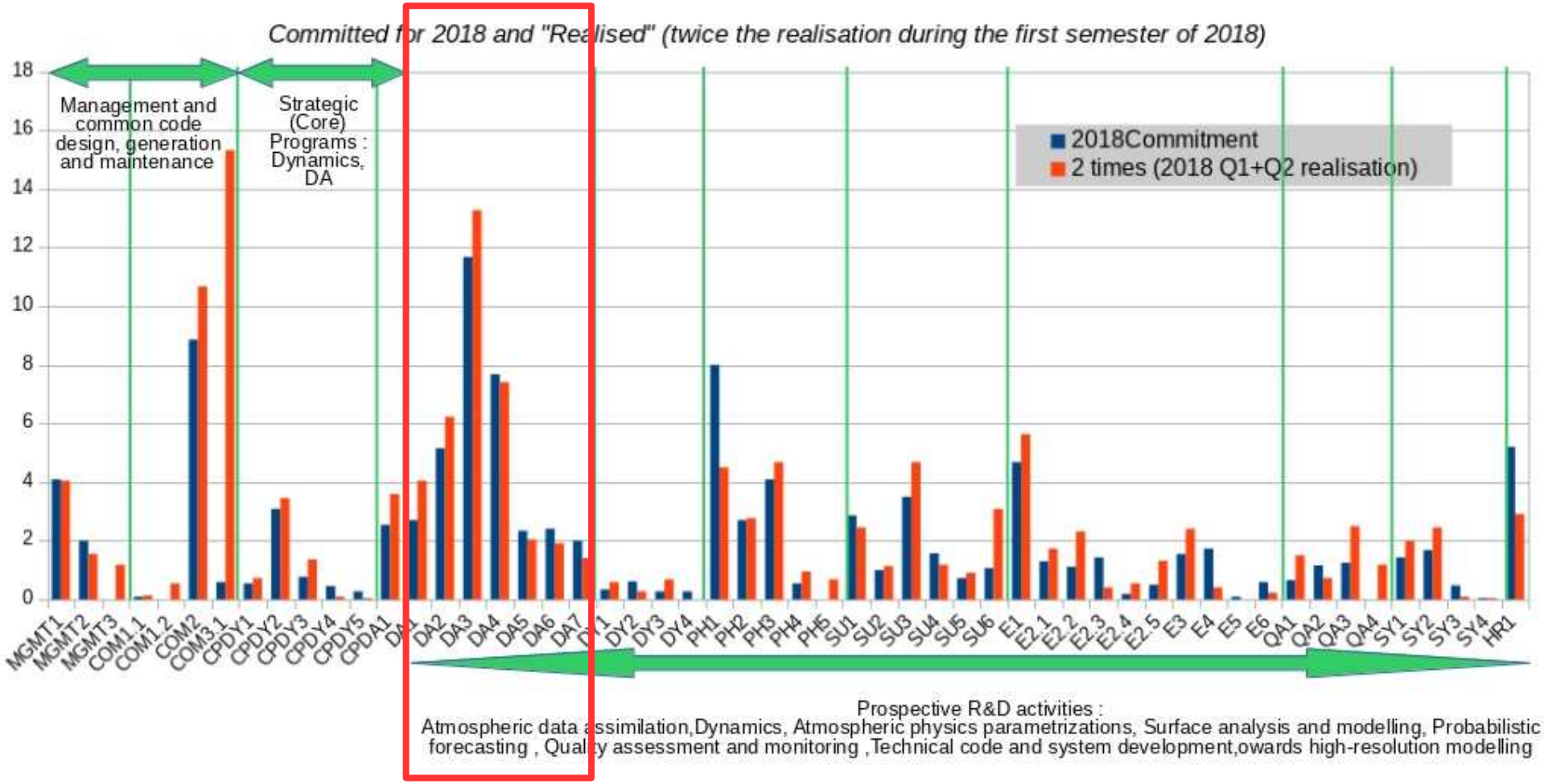
	T2M		H2M		V10M	
EXP	RMSE (C)	BIAS (C)	RMSE (%)	BIAS (%)	RMSE (m/s)	BIAS (m/s)
CAN-ARO(Summer)	1.52	0.18	8.86	-0.70	1.37	0.18
CAN-ARO(Winter)	1.63	-0.01	8.58	-1.36	1.35	0.03
CAN-ALA(Summer)	1.78	0.43	10.95	-0.76	2.18	0.92
CAN-ALA(Winter)	1.85	-0.09	10.66	-0.72	2.25	0.82
ARO-OP (Summer)	2.07	0.90	11.79	-4.69	2.50	1.63
ARO-OP (Winter)	2.06	0.27	12.69	-5.26	2.16	1.24

. CAN-ARO is closer to observations than any other product at 00UTC and 12UTC;

. daily analysis monitoring shows the results are consistent at any hour of the day.

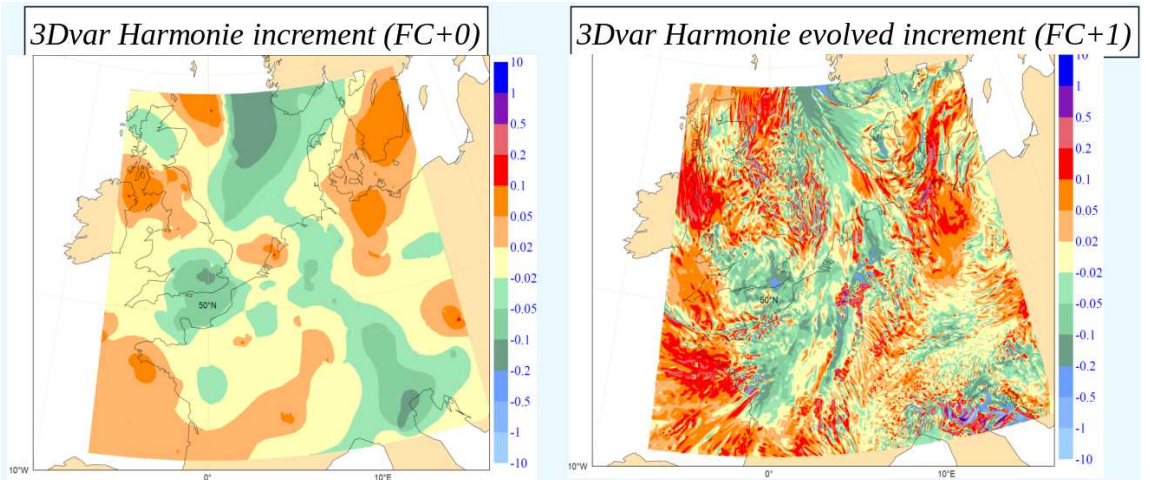
Assimilate extra station data to get the best a posteriori analysis

Manpower (in F.T.E.) in 2018 RWP Work Packages

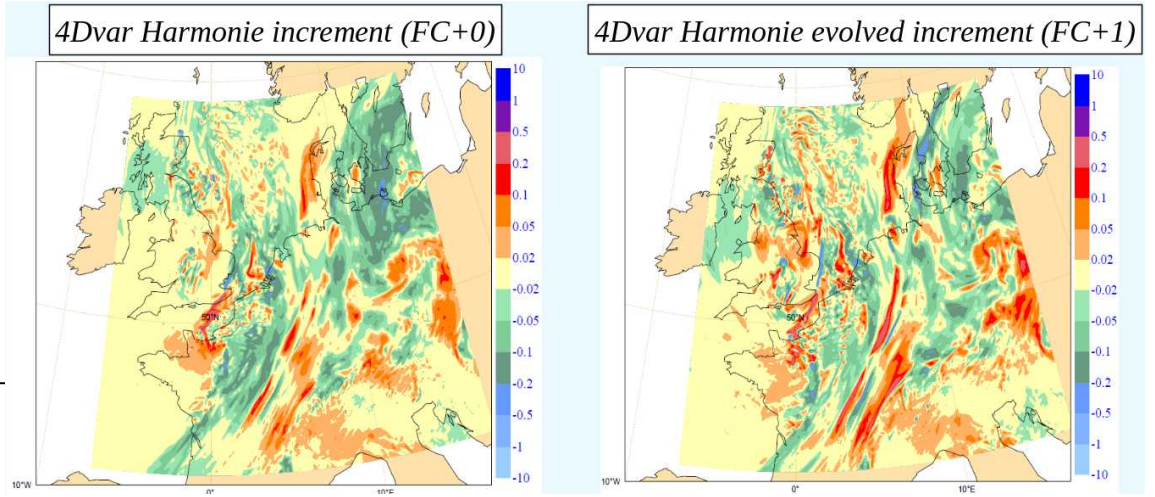


The potential of 4D-Var for nowcasting

3D-Var Humidity increment evolution
Low correlation between analysis and the 1-hour forecast
--> Model spinup



4D-Var Humidity increment evolution
Good correlation between analysis and the 1-hour forecast



High Resolution Hirlam Limited Area Model

Courtesy: Jan Barkmeijer, KNMI

EDA in Tunisia

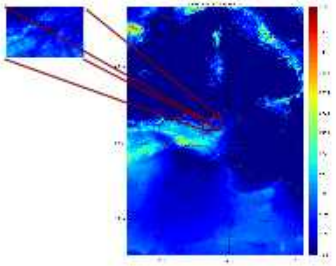
Operational & Parallel Suites

	ALADIN operational	AROME 2,5	AROME 1,3
Cycle version	CYCLE 40	CYCLE 40	CYCLE 42
Spatial Resolution	7.5 km	2,5 km	1,3 km
Vertical Levels	70	60	90
Boundaries	ARPEGE 10km	ARPEGE 10km	ARPEGE 10km
Time step	450 s	60 s	45 s

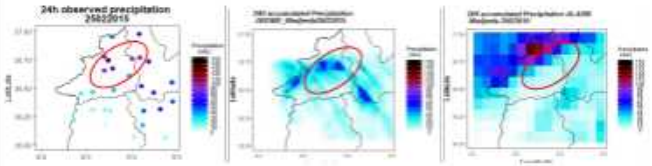
HPC Project: Enhancement of the computing capacity :
On going HPC tender

Hydrological Application with AROME-MEDJERDA: a small domain over Medjerda catchment

	AROME-MEDJERDA
Model version	CY40
Resolution	1.3 km
Vertical Levels	90
Boundaries	ARPEGE 10km
Time step	45 s
N° Points	128*85



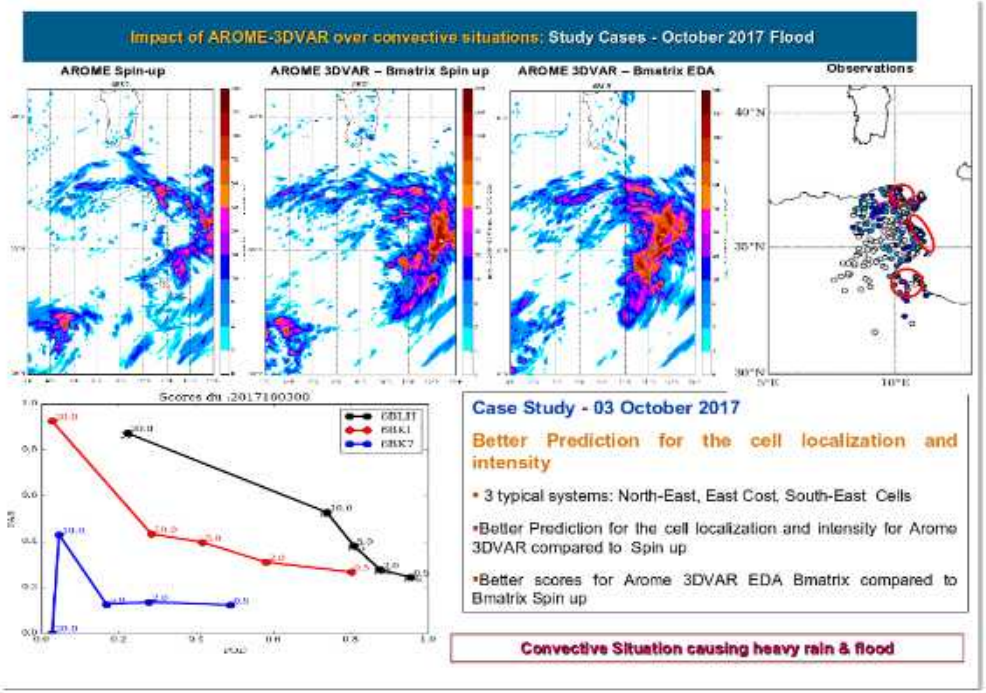
- The catchement of Medjerda, located in the north-western region of Tunisia, is an area at risk that suffers from severe flooding every year.
- As it holds the biggest river in Tunisia and several dams around it, Medjerda watershed represents an important hydrometeorological study area.



24H Accumulated precipitations of 25/02/2015 - from left to right : Observation, AROME-Medjerda 1,3km and ALADIN 12,5 km

3DVAR Data Assimilation Implementation

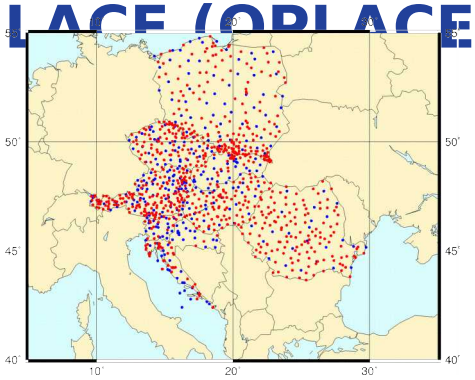
- B matrices are the average of 3 B matrices calculated over 3 periods: winter (rainy season) , summer (Hot & humid) and Fall (convective systems) → take on consideration all the Regimes that influence Tunisian Weather.
- In order to have a positive definite B matrix , we must have the number N of differences equal to or greater than the number of vertical levels of the model (60 for Arome 2.5 km et 90 for Arome 1.3 km)
- Same periods for B matrix - EDA and B matrix Spin-up → compare the matrices



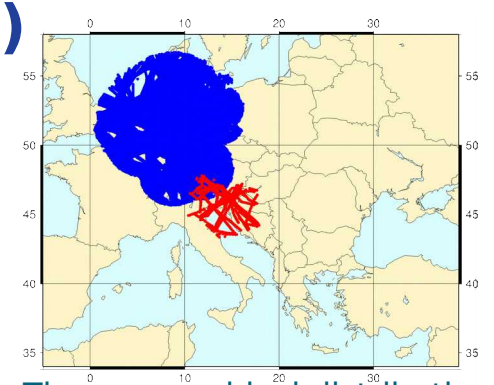
Data assimilation and Observation Preprocessing System for RC LACE (OPLACE)

A common observation preprocessing system:
- processed and quality checked met. obs. in an appropriate format for data assimilation in NWP models.
- NMSs exchange their dense national surface synoptic measurements and high-resolution aircraft data in real-time.
OPLACE ensures stable and reliable bases for operational NMS purposes.

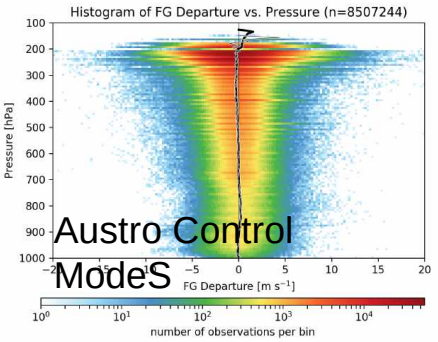
LACE radar data assimilation:
- use volume reflectivity first
- overview of ODIM HDF5 files from radars
- new pre-processing tool for OPERA data
- splitting of 15 min merged OIFS files
- rearranging the content according to specification in namelist
- retaining only the desired variables (e.g. reflectivity and/or radial winds)
- possibility to encode prescribed meta data separately for individual radars or for the whole data set



The coverage of surface observation available in the GTS (blue) and of denser national observations (red).



The geographical distribution of high-resolution aircraft Mode-S MRAR data from Slovenia (red) and of Mode-S EHS data from KNMI (blue).



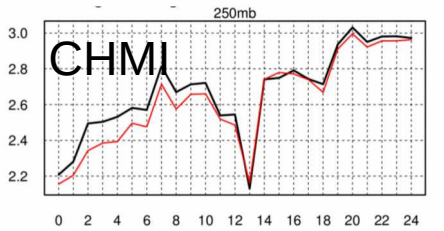
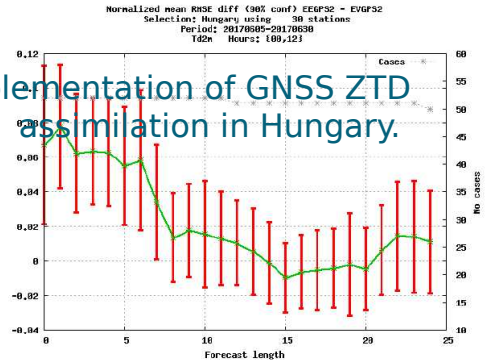


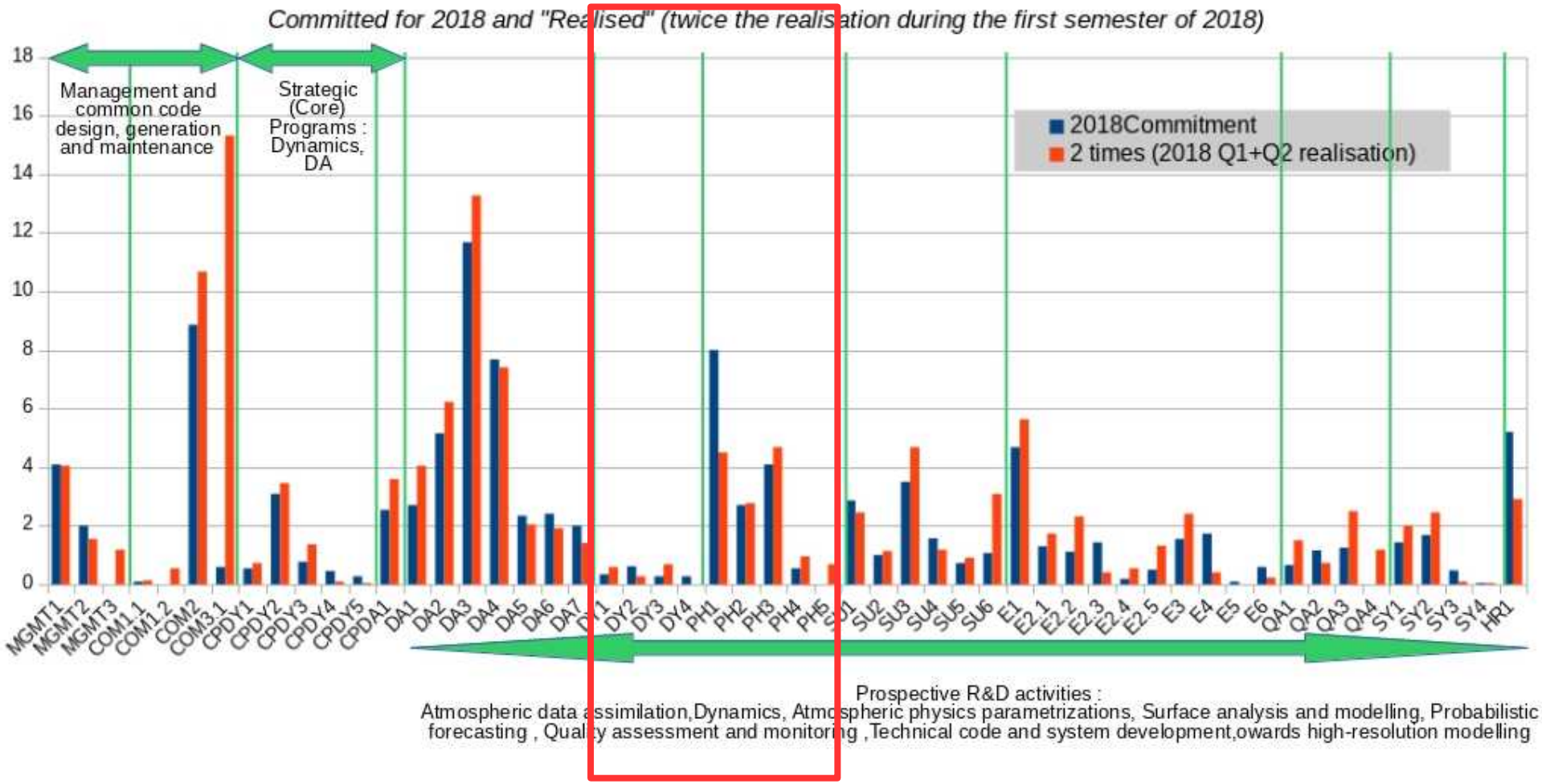
Figure 1: Time evolution of **RMSE for wind speed at 250hPa** verified against aircraft observations for period of 11 Jan – 9 Feb 2017 12UTC. **Reference** and Mode-S EHS experiment.



Operational implementation of GNSS ZTD assimilation in Hungary.

DHMZ · SHMÚ · ARSO METEO Slovenia · OMSZ · ZAMG · ROMANIA ANM

Manpower (in F.T.E.) in 2018 RWP Work Packages



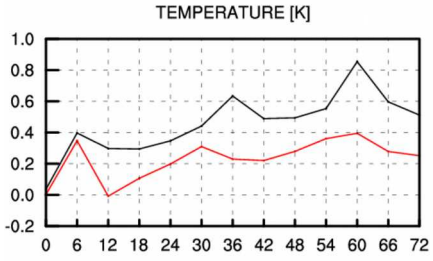
New dynamical variables and physics developments

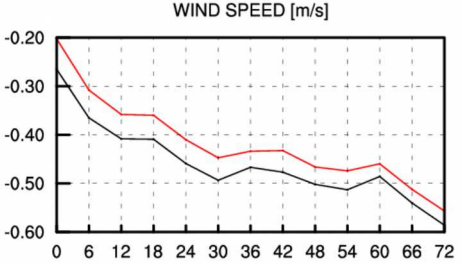
LACE
nwp central europe

ALARO physics package:
- shallow convection (Baštak Duran et al 2018) in cy42t1 export, operational in CHMI
- mixing length computations in TOUCANS and code re-organisation
- three-order-moment code analyzed
- DDH implementation of TKE and TTE equations
- non-saturated downdraft
- prognostic graupel
- surface roughness in SURFEX
- ALARO1 coupled with SURFEX
- coupling with the sea surface (ocean and waves)

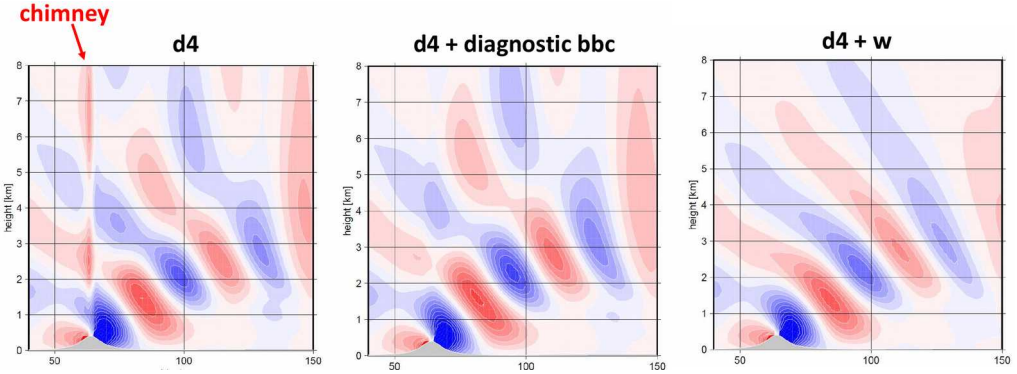
roughness computation in presence of snow – assimilation cycle

BIAS, averaged from 0h UTC forecast over period 14/01-31/01/2017.
black line – reference;
Red line – new grid-box snow fraction formulation with tuning,
sub-grid scale contribution is not included in thermal roughness.

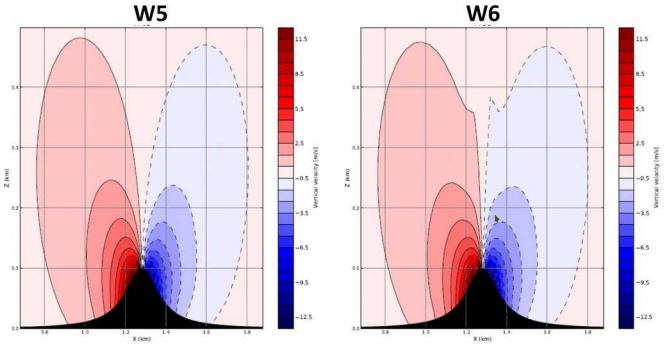




New diagnostic fields
– convective pack, lightning and visibility
Offline SURFEX



Removal of the remaining chimney effect through bottom boundary condition and new vertical motion variables
BBC must be done consistently with model dynamics otherwise problems appear.
It is very easy to overlook some inconsistencies in time and space discretised equations.
On the other hand it is very hard to say a priori which discretization details are innocent and which are harmful.
Correct BBC treatment in spectral model can be technically
difficult. Simple BBC can be beneficial.



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Forecast model developments

- Aerosol-radiation-cloud interaction:

  Case studies Spain:Importance of use of real-time MACC aerosol to improve fog/low cloud evolution may have been underestimated => to be studied in longer runs

- Surface modelling:

  Starting study of bias characteristics of

  new soil, snow schemes in climate mode

  assessment of higher resolution

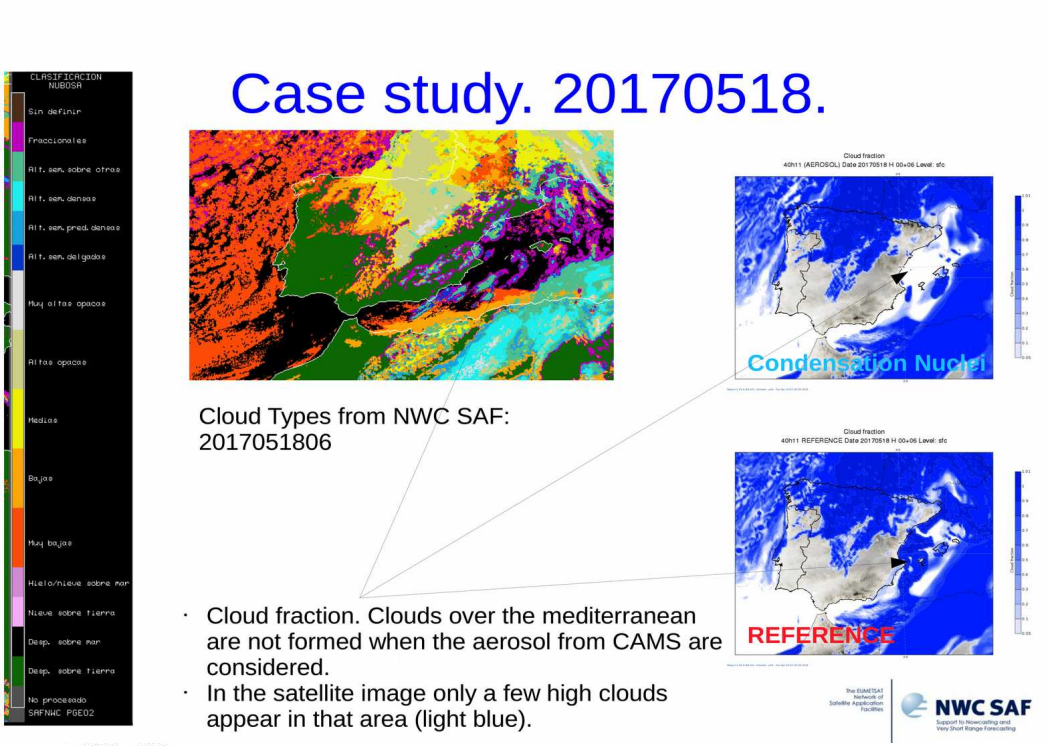
  physiographic data

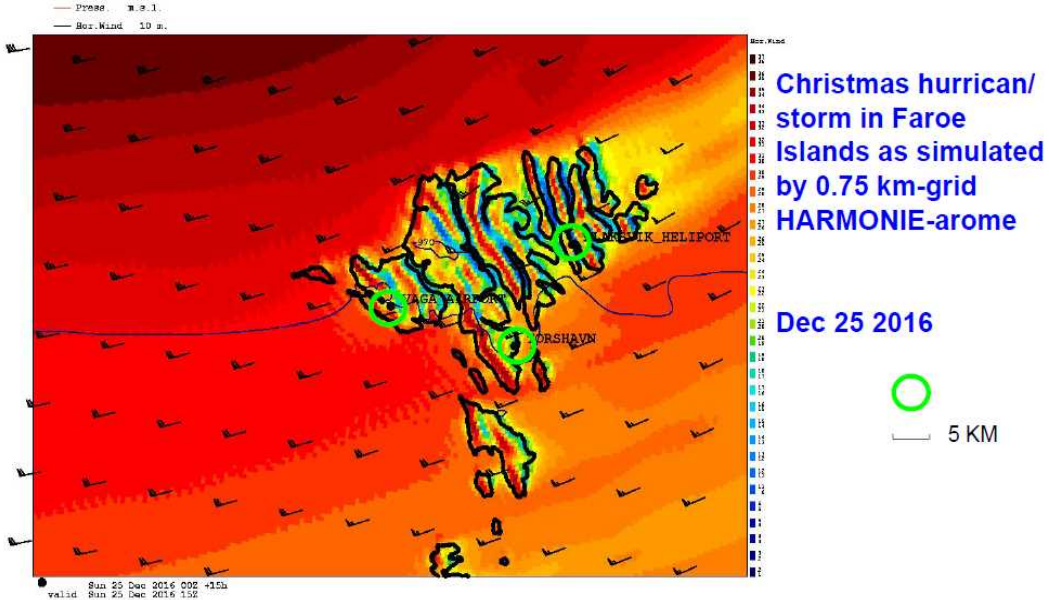
- Very high resolution modeling:

  Dynamics setting in various types of terrain

  Clear advantages seen over steep orography, complex land-sea transition, but also urban areas and small-scale convection

  DMI TAS domain operational in October





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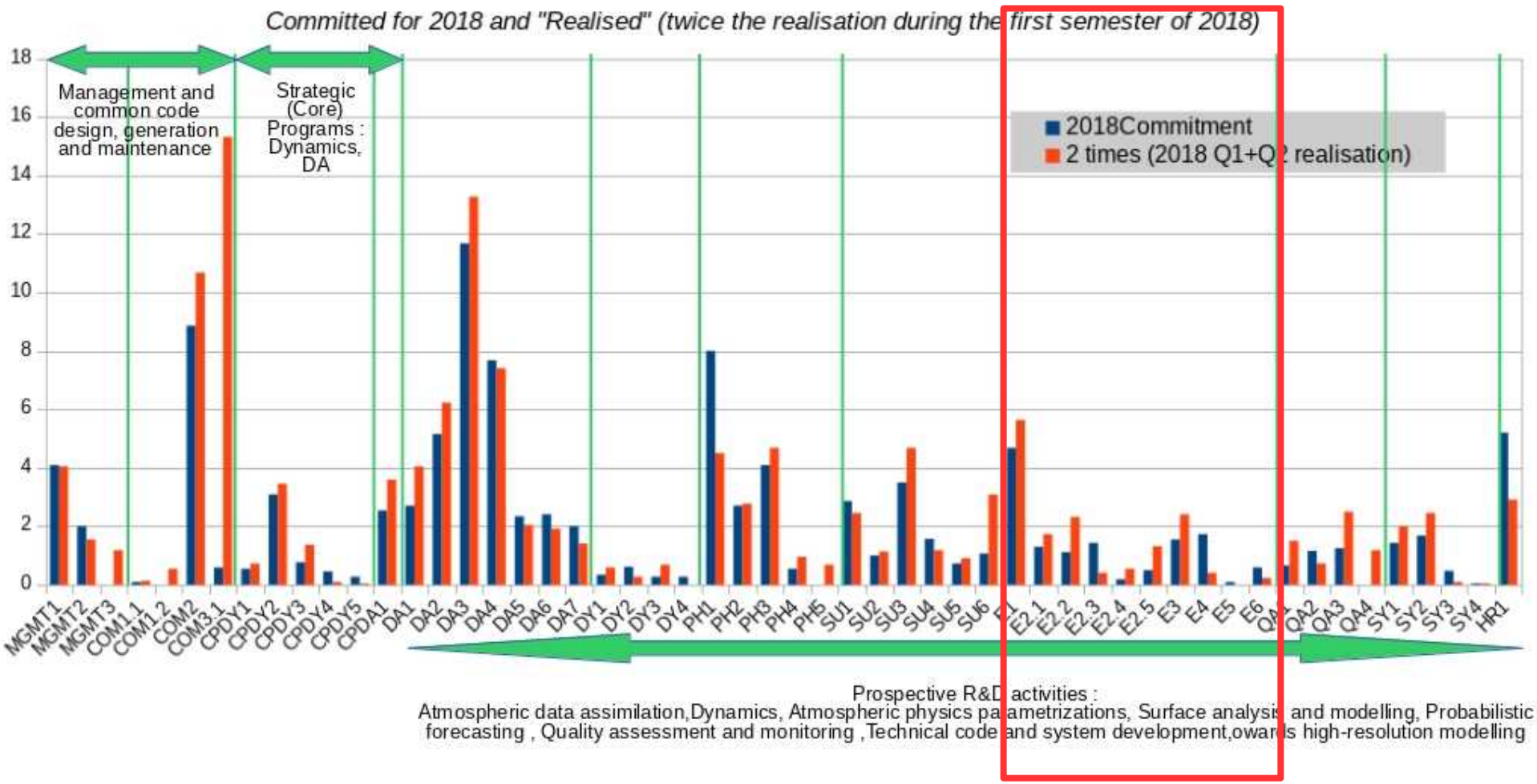


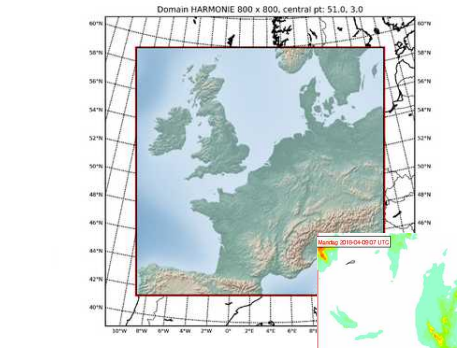
HarmonEPS ensemble systems
Extending and moving to (pre-)operational

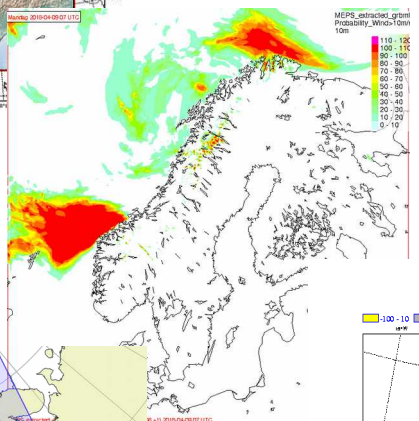
HarmonEPS

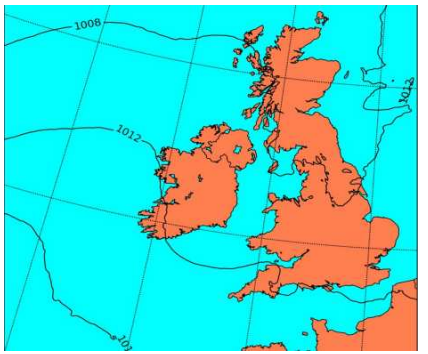
HarmonEPS with different configurations are now operational or being tested at several institutes:

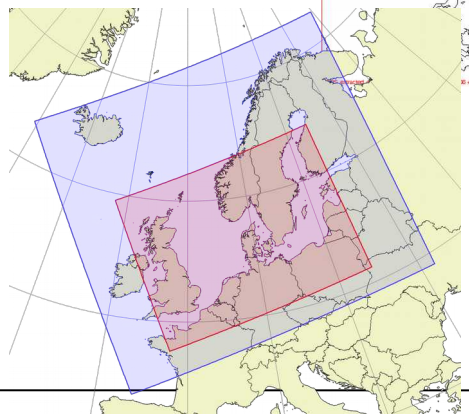
MEPS - COMEPS - IREPS - ɣSREPS - RMI EPS - KEPS

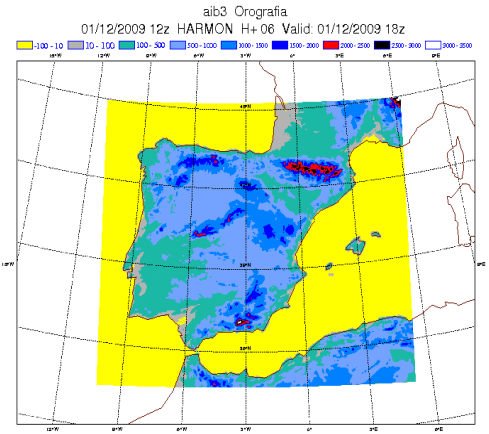
Configurations vary, but typically:
- 10-20 members
- Harmonie-Arome, or H-Arome and Alaro
- 2.5 km
- 3D-Var
- SURFEX
- 2-3 days forecasts







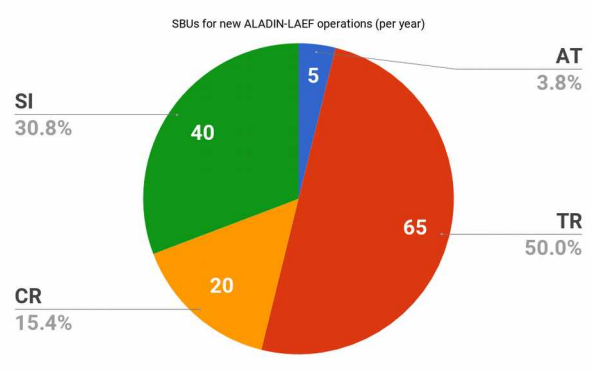




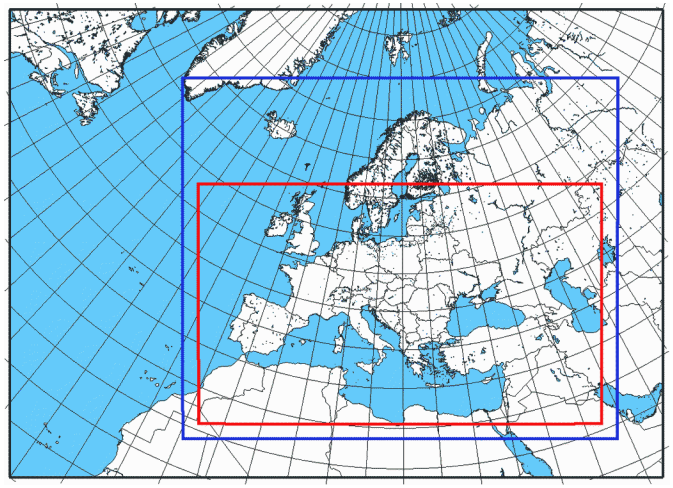
Aire Limitée Adaptation dynamique Développement InterNational - Limited Area Ensemble Forecasting (ALADIN-LAEF)

LACE nwp central europe

- meso-scale ensemble system ALADIN-LAEF
- based on the limited area model ALADIN
- developed in frame of RC LACE cooperation,
- short range probabilistic forecast
- advanced multi-scale ALARO physics.
- provide forecast on daily basis for the national weather services of RC LACE partners
- applied to hydrology, energy industry and even in the nowcasting.



Agreed distribution of billing units necessary for its operations at ECMWF HPS among the LACE partners and cooperating Turkey



Current ALADIN-LAEF domain (blue) and upcoming domain after upgrade to 5 km horizontal resolution (red).

ALADIN-LAEF	current	new
Code version	cy36t1	cy40t1
Horizontal resolution	10,9 km	4,8 km
Vertical levels	45	60
Number of grid points	500x600	750x1250
Grid	quadratic	linear
Time step	450 s	180 s
Forecast length	72 h (00/12 UTC)	72 h (00/12 UTC)
Members	16+1	16+1
IC perturbation	ESDA [surface], breeding-blending [upper-air]	ESDA [surface], blending (Phase I) / ENS BlendVar (Phase II) [upper-air]
Model perturbation	ALARO-0 multi-physics	ALARO-1 multi-physics + surface SPPT
LBC perturbation	ECMWF ENS	ECMWF ENS
SBUs consumed per year	~10 mil	~120 mil

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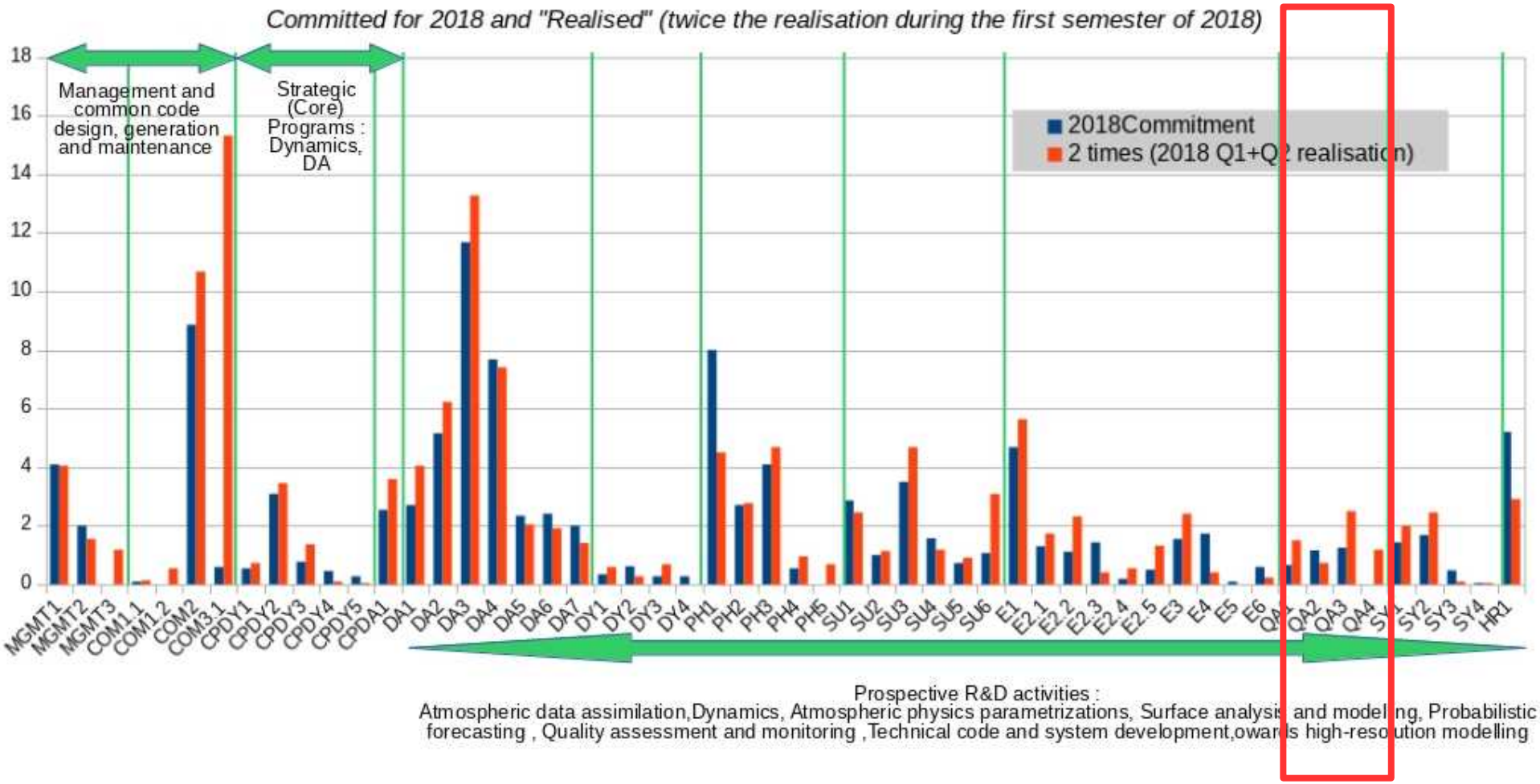

System, quality assessment and contacts with forecasters

- Preparation/release Cy43h2-alpha

- Code optimization: collaboration with BSC

- Good progress on HARP-v3 verification system:
addition of in-situ and conditional verification, more user-friendly interface

- Harmonie User meeting in Madrid, 6-7 November 2018