Progress and plans of data assimilation in ARPEGE and AROME-France

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EWGLAM/SRNWP meetings, 2-5 October 2017, ECMWF, Reading (UK)

ARPEGE current oper DA config

Deterministic DA cycle :

- 4D-VAR: NL trajectory at TL1198C2.2 (7.5km); two outer loops with minimizations using a linearized cost function around low resolution trajectories at TL149C1.0 (135km, almost adiabatic) and TL399C1.0 (50km, with some simplified physics)
- Change of geometries using Full-POS 927; 105 levels (10m → 0.1 hPa)
- Hybrid B matrix using variance and some correlation information from daily EDA
- Surface OI (CANARI): RH2m and T2m provide increments for Ts and Ws

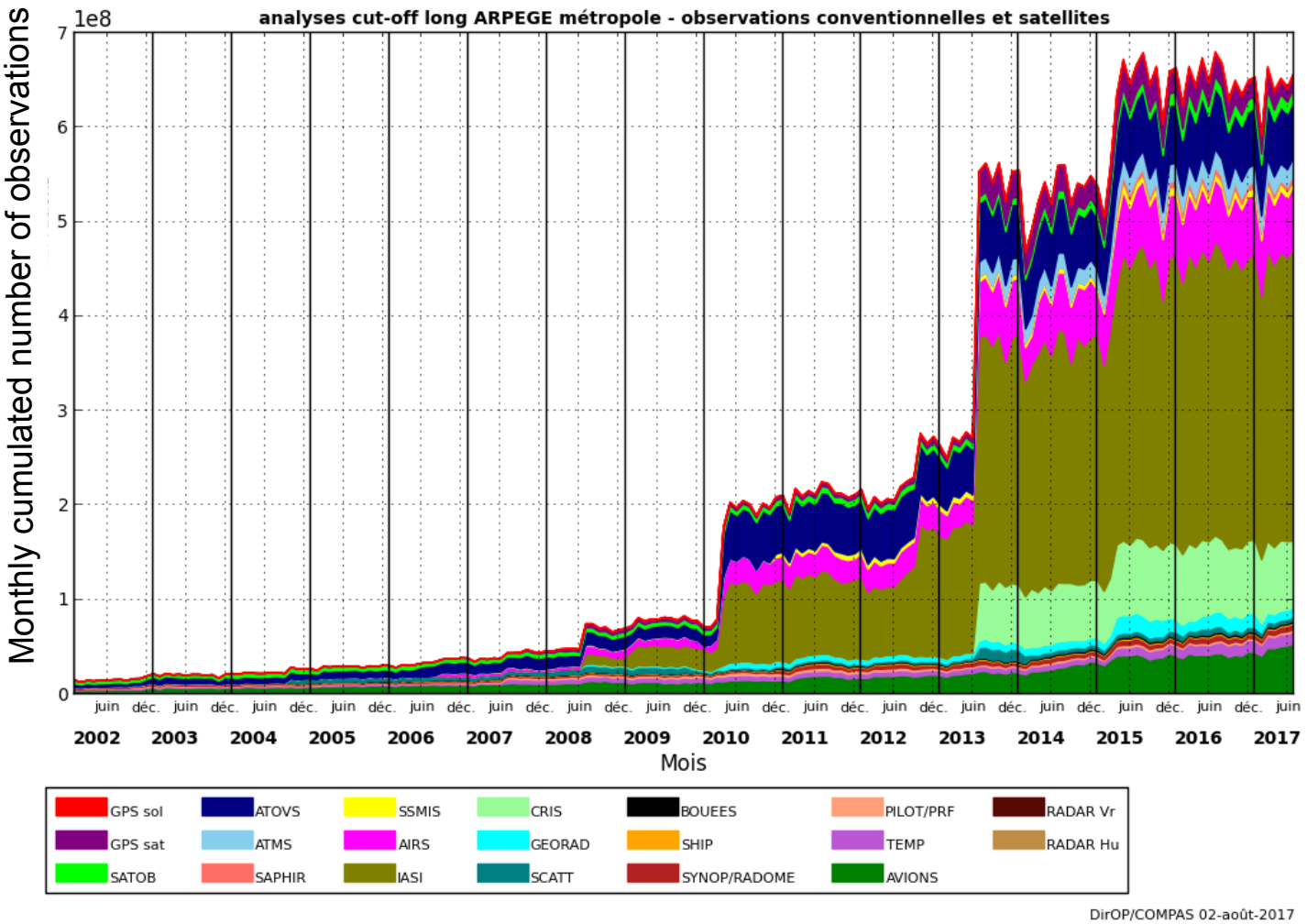
Ensemble DA (AEARP) :

- 25 members at TL399C1.0 (50km), 105 levels (one 4D-VAR minimization)

Operational CY41T1_op1 since 8 December 2015

Number of observations

Evolution of cumulated monthly number of observations used for each type

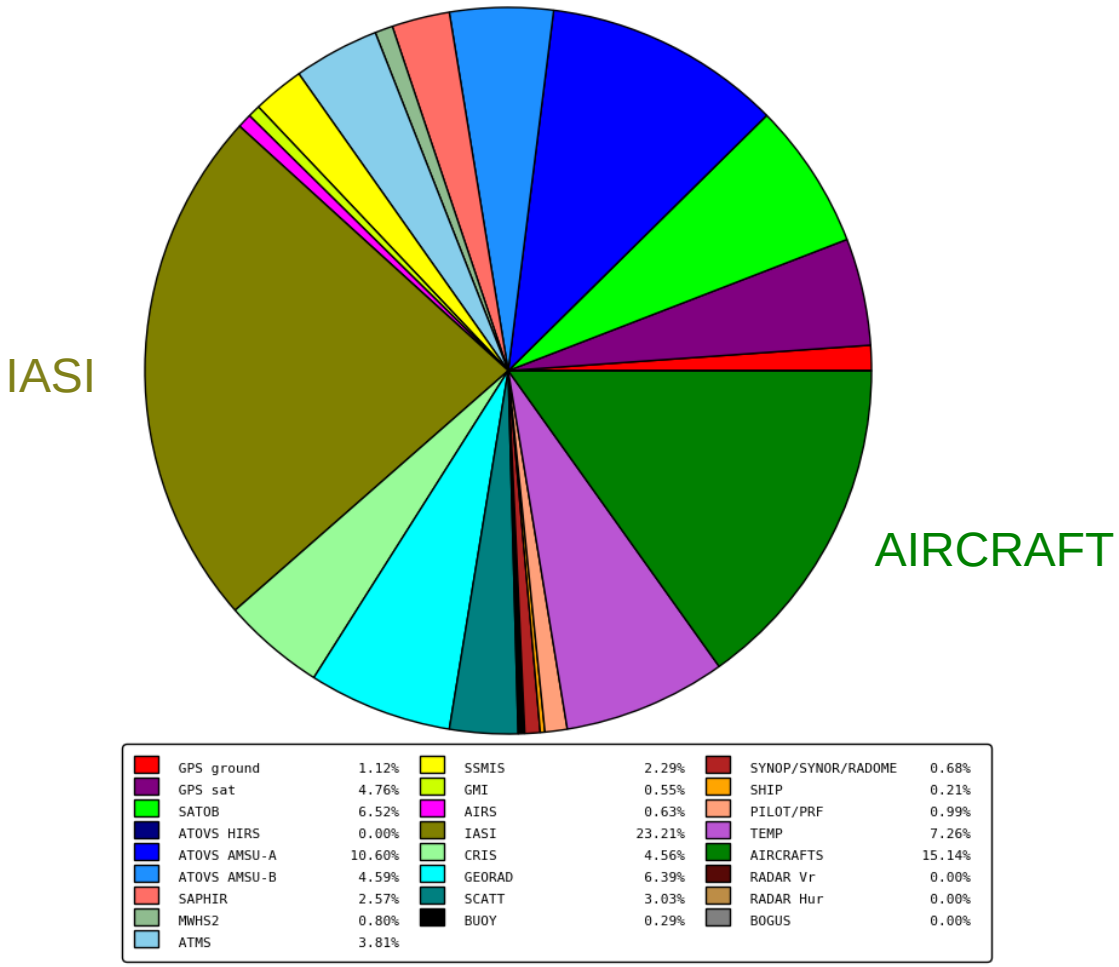


IASI

AIRCRAFT

Degrees of Freedom for Signal (DFS)

Part of DFS for each type of observations
Cumulated DFS from 2017011900 to 2017011918 : 528551



Current e-suite CY42_op2 : ‘ the cursed one ‘

- Description for ARPEGE / AEARP (EDA) / PEARP (EPS):
  - New convection scheme PCMT in ARPEGE and AEARP => *dropped off !*
  - New surface scheme: SURFEX model
  - Observations:
    - VarBC on ground-based GNSS ZTD observations
    - Assimilation of 2 water vapour channels (183GHz) of GMI on GPM
    - Assimilation of 3 water vapour channels (183GHz) of MWHS2 on FY3-C
    - Higher density of GEORAD (from 250 to 125km)
    - Assimilation of window SEVIRI channels (4, 6, 7, 8 over sea)
    - 5 new channels (ozone) for IASI; denser thinning (125km=>100km) adds 50%
  - Ensembles:
    - New physics in PEARP (ARPEGE EPS)
    - AEARP: resolution increase for the computation of background error variances
    - AEARP: normalisation of variances induced by wavelet modelling of correlations
- Description for Arome:
  - Most of observations changes transferred to AROME-France
  - AROME-Overseas: Incremental Analysis Update, 1D ocean mixing layer model activated (varing SST), MERCATOR SST initialization

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Follow-on changes : new horizontal resolution in global system

New horizontal resolutions for global systems (deterministic, EDA, EPS)

– ARPEGE: ~5km over France (T_l1798c2.2L105)

– 4DVAR: 2 minimisations in T_l224c1L105 (90km) and T_l499c1L105 (40km)

– EPS: 35 members (unchanged) at ~7.5km over France (~T_l1198c2.2L90) and four times per day

– EDA: 50 members in T_l499c1L105 (40km) => will sample B stats from 3*50 members instead of 6*25 as now

- Modifications in the physics: inclusion of prognostic graupel in Arpege's microphysics, revision of surface evaporation over sea, 1D version of GELATO sea ice scheme, Flake lake model, etc.

- European radar data (AROME), Humidity observations from aircrafts, variational bias correction for aircraft data, observation correlation between infra-red channels, 2D obs operator for GPS RO data, etc.

Scheduled from end of 2017 to mid 2018

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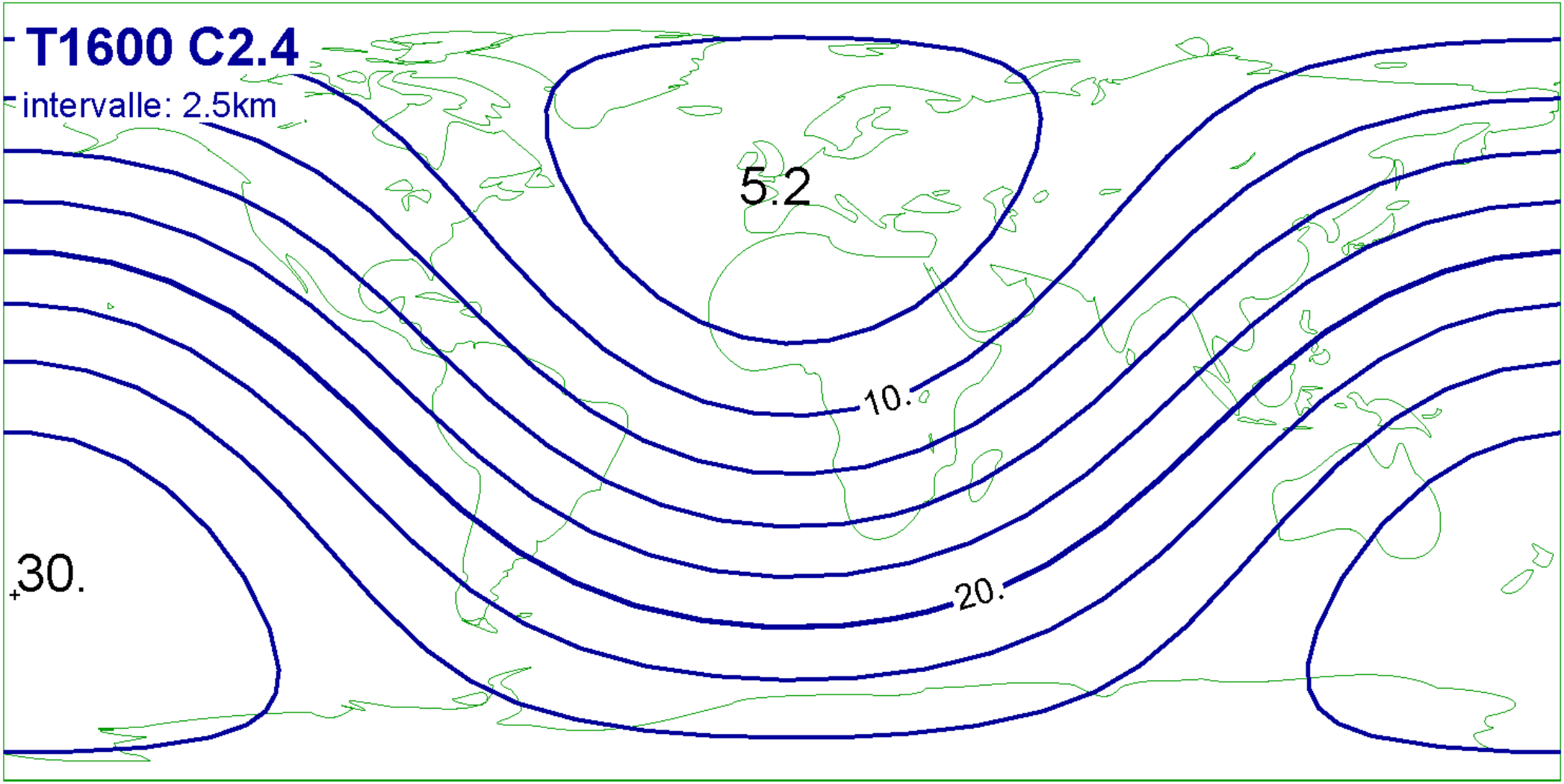
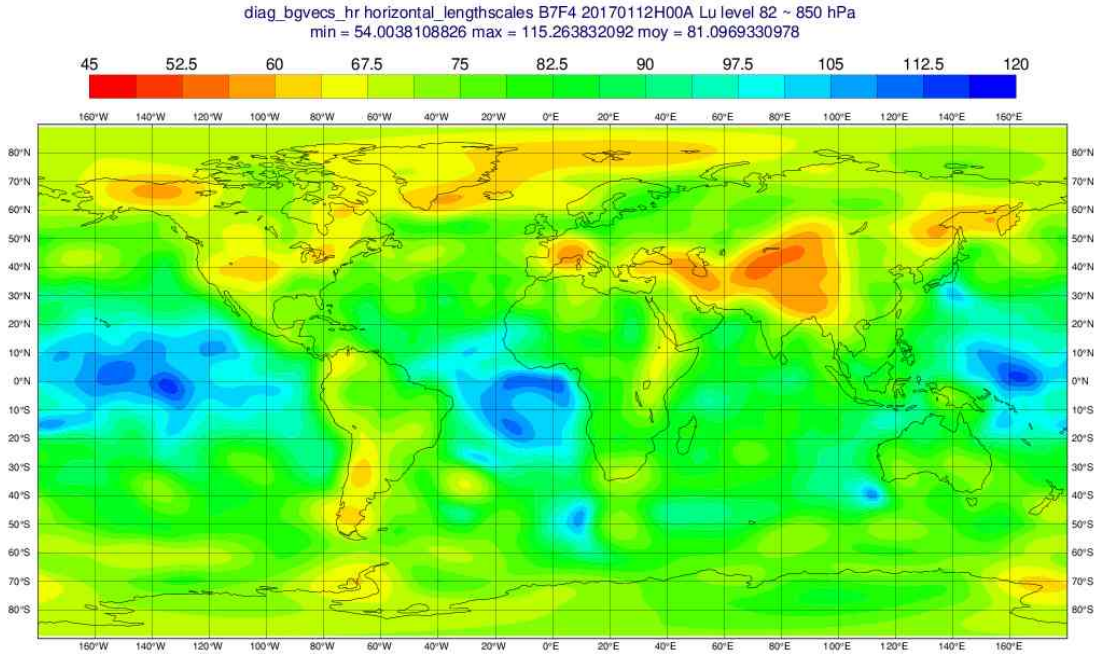
ARPEGE new resolution

- New horizontal resolutions for ARPEGE (about 5km over Western Europe), as well as global EDA and EPS systems

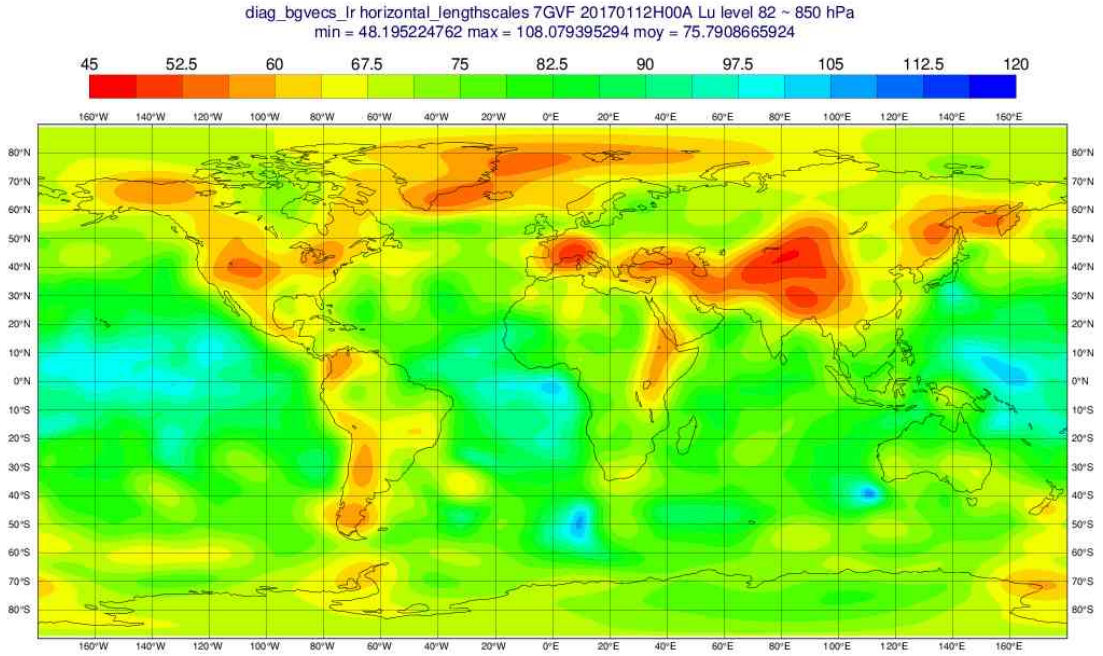


Increase of increment resolution (C. Loo, L. Berre, G. Desroziers)

Diagnosed
u length-scale
850 hPa
50 km (T399)

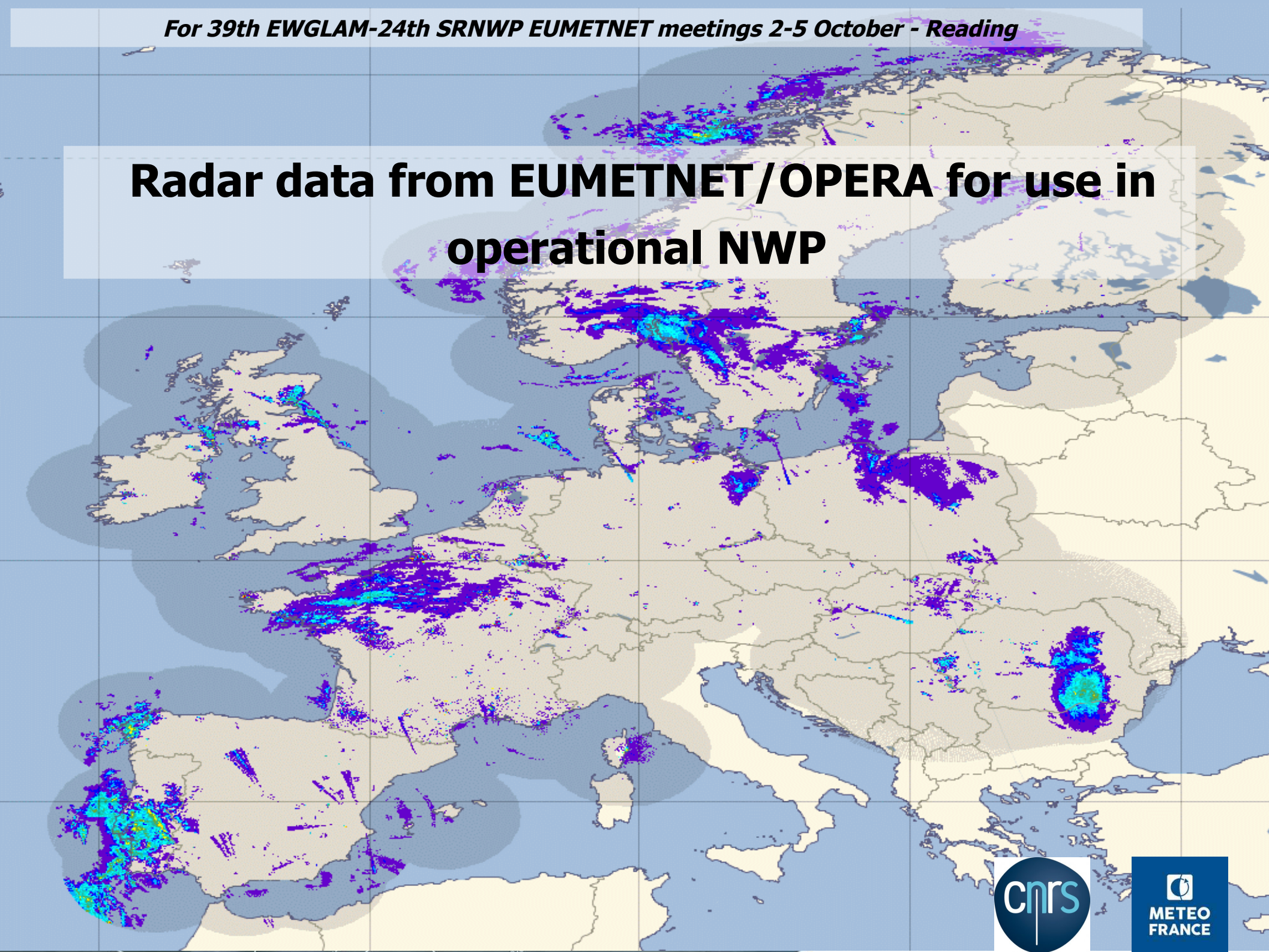


diagnosed
u length-scale
850 hPa
40 km (T499)



For 39th EWGLAM-24th SRNWP EUMETNET meetings 2-5 October - Reading

Radar data from EUMETNET/OPERA for use in operational NWP



Use of OIFS product: format and configuration

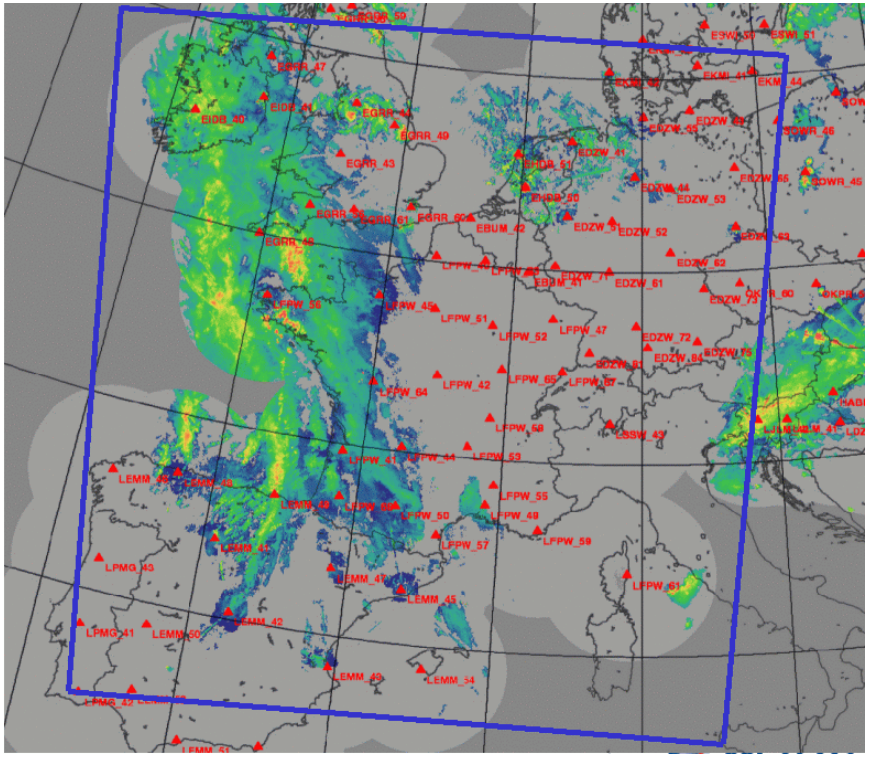
Use of OIFS product since Autumn 2016:

OPERA Data Information Model (ODIM)

- ❑ CONRAD software is no longer used
- ❑ Direct conversion and treatment of Odyssey HDF to ODB (AROME)
  (50 included in the AROME domain out of which 34 fully included)

Large variability of the configurations

- ❑ Various Resolution
- ❑ Various Volumic scan strategy
- ❑ Polar data of slanted columns (<u>needed for accounting for slanted columns</u>)
- ❑ Various PRFs (unfolded or not) and Nyquist Velocities



- courtesy by Eric Wattrelot

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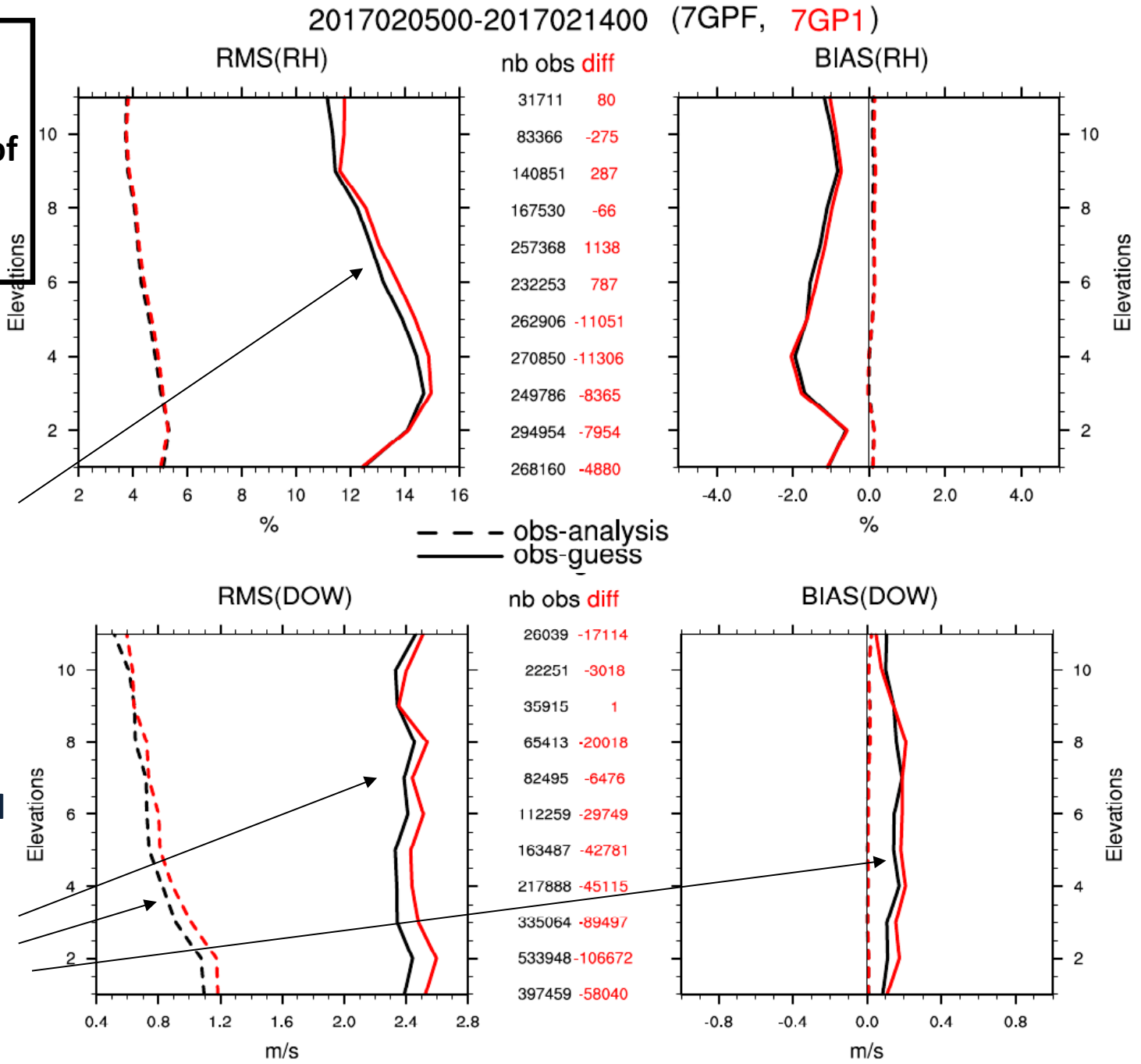
First monitoring against Arome

- RED: without OPERA foreign radars
- BLACK: OPTIMAL USE of OPERA foreign radars



Statistics of departures:

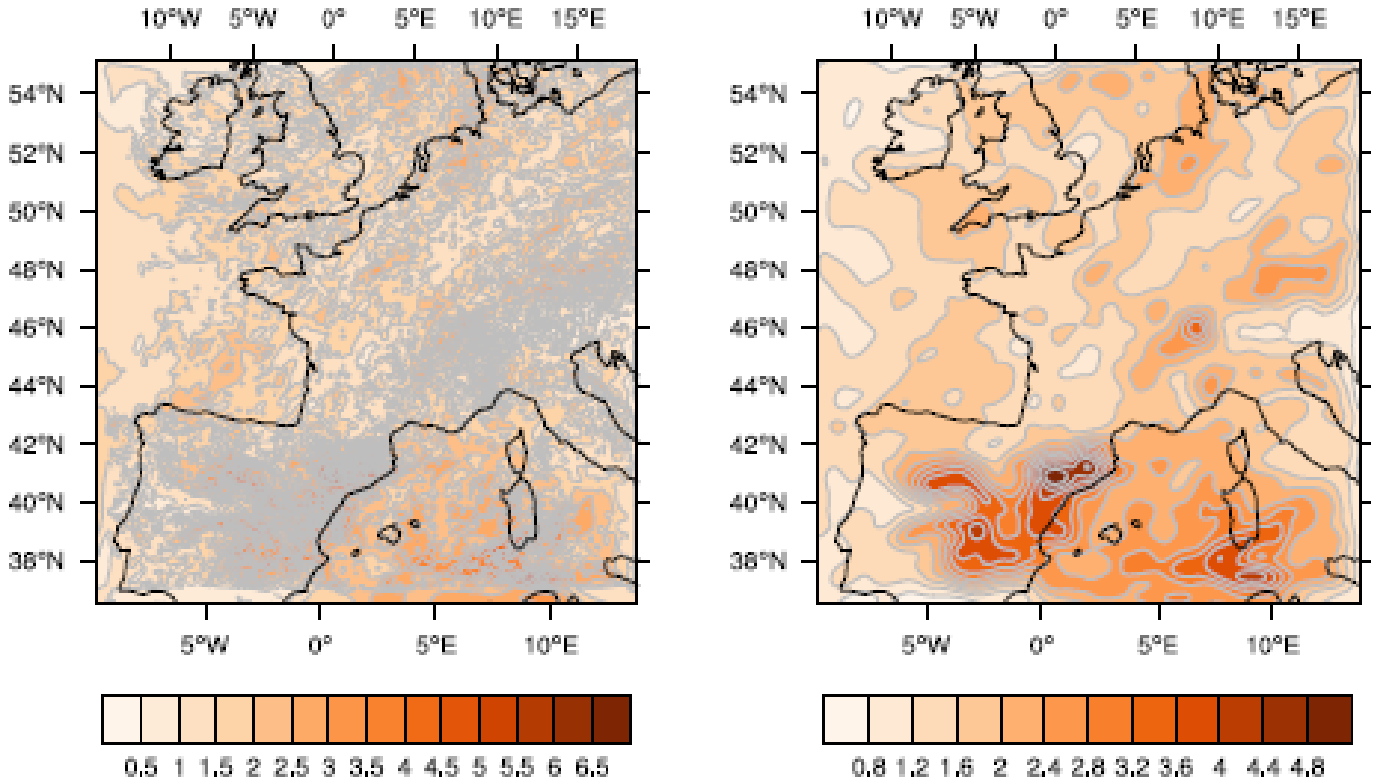
- Better fit of guess of relative humidity retrievals against all radars (french and foreign radars)
- Better fit of guess and analysis of radial wind against all radars (french and foreign radars)

- courtesy by Eric Wattrelot

Impact of using EDA information within the B-matrix of AROME-France 3D-VAR

- The EDA provides flow-dependent background error statistics (B-matrix) to the assimilation scheme ;
- but those statistics are noisy if ensemble size is small.

e	EDA
	3.8 km
	110 s
	Hydrostatic
)	512 × 540 L90
/ar	perturbed 3D-Var
	3H
	24 km
	5+1
	100

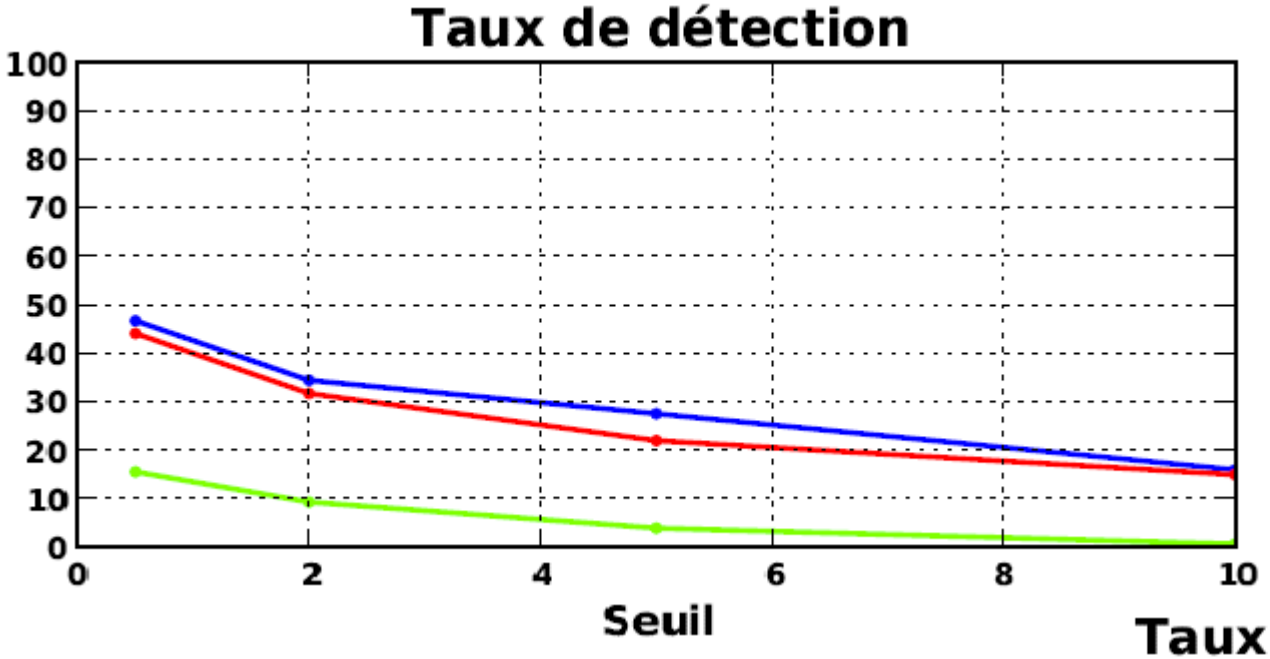


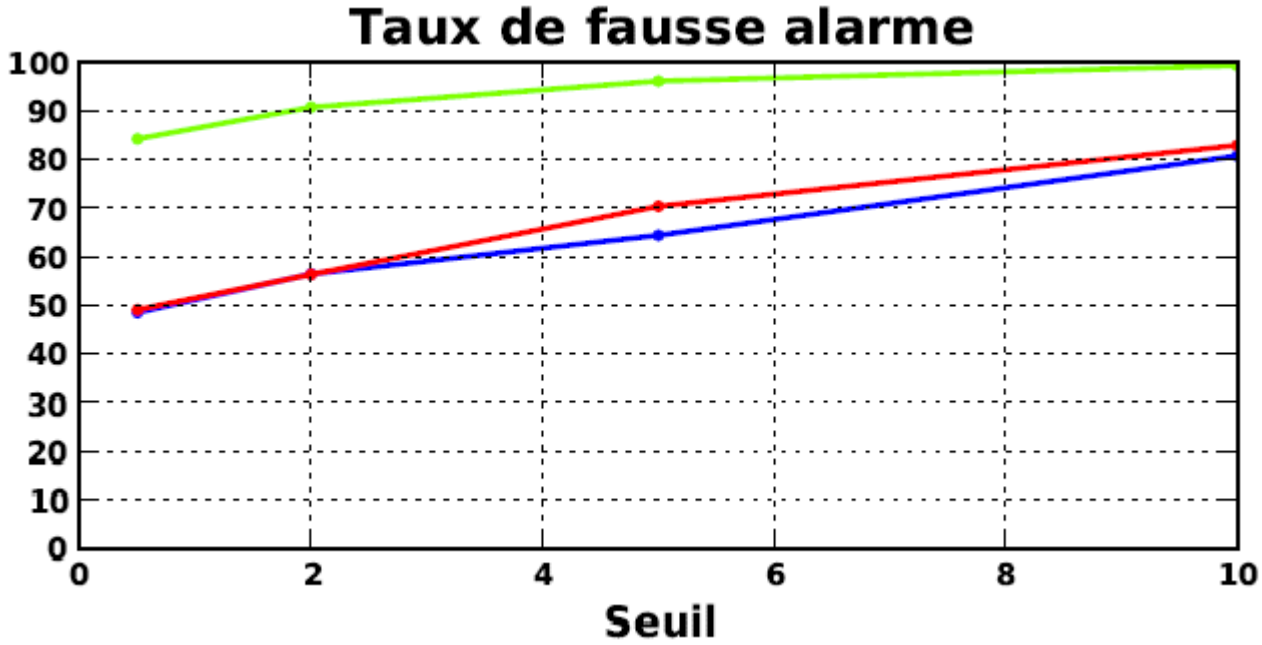
(a) Raw (b) Filtered

Figure: σ_b of AROME EDA (wind at 900hPa in m/s)

- courtesy by Yann Michel

Impact of using EDA information within the B-matrix of AROME-France 3D-VAR





Test period 24/06/16-31/07/16
Assessed RR6 [6h-12h] on 00 UTC runs
Green → persistence
Blue → σb(EDA)
Red → ref 3D-VAR (σb cst)

- courtesy by Yann Michel

Outlook for global and/or LAM system: longer term (2017 and beyond)

- Physics : new surface schemes in SURFEX, 2 moments microphysics scheme “LIMA”, coupling with ocean and wave models, etc.
- AROME DA : EDA in association with AROME-France 3D-VAR and also with AROME EPS (IC perturbations)
- DA Research: EnVar data assimilation, with major contributions to OOPS, 4D-EnVar including an advection of localization operator, LAM prototypes developed in pace with global geometry versions
- Observations: improved assimilation of aircraft data, satellite radiances (all-sky), add Lidar winds, European radar data (OPERA)
- Expect a long lasting effort of recoding the NWP system (OOPS, COPE, ESCAPE aspects) => likely to continue to experience fairly complex common code udpates (phasing) with ECMWF

Thank you for your attention

Спасибо за внимание
Spasibo za vnimaniye

ačiū už jūsų dėmesį