Preliminary results with upgraded horizontal resolution in ARPEGE

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ALADIN / HIRLAM
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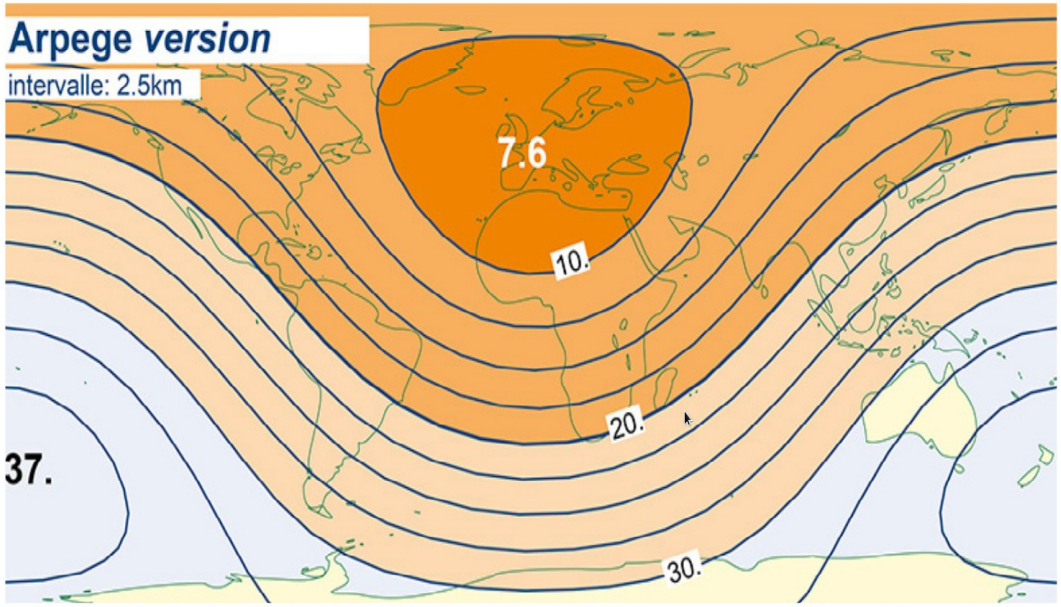
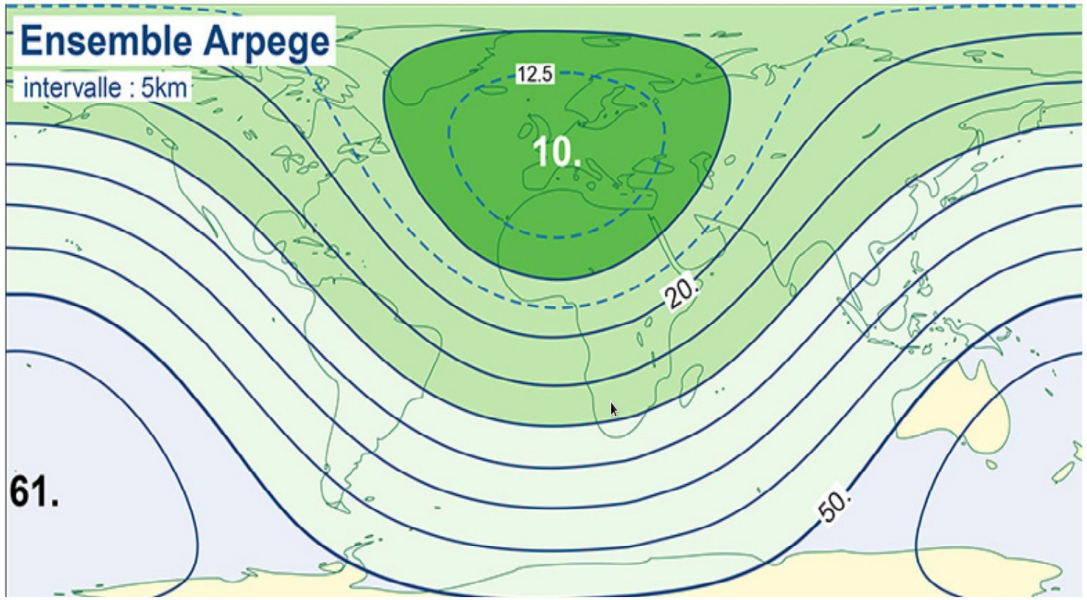
Global NWP systems based on ARPEGE

Systems	Characteristics
ARPEGE *Deterministic*	TI1198c2.2 L105 (7.5km on W Europe) 4DVar (6h cycle): TI149c1L105 & TI399c1L105 5 forecasts per day up to 114h
ARPEGE-EDA (AEARP)	TI479c1 L105 ; 25 members 4D-Var (6h cycle): TI149c1L105 Background covariances averaged on 30h and updated every 6h
ARPEGE-EPS (PEARP)	TI798c2.4 L90 (10km on W Europe) 35 members ; four times a day up to 108h Using 25 EDA members and singular vectors 10 physical packages

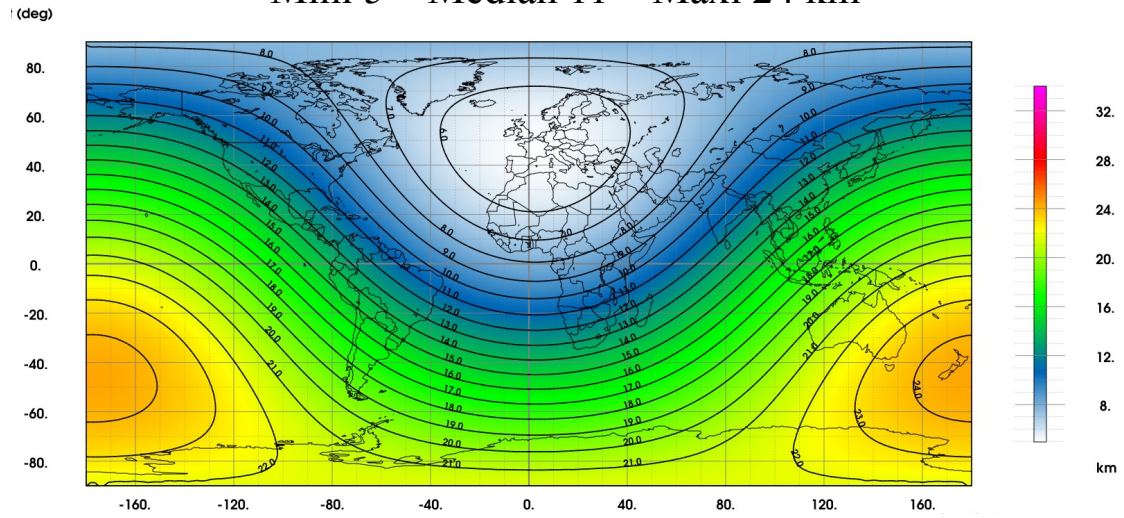




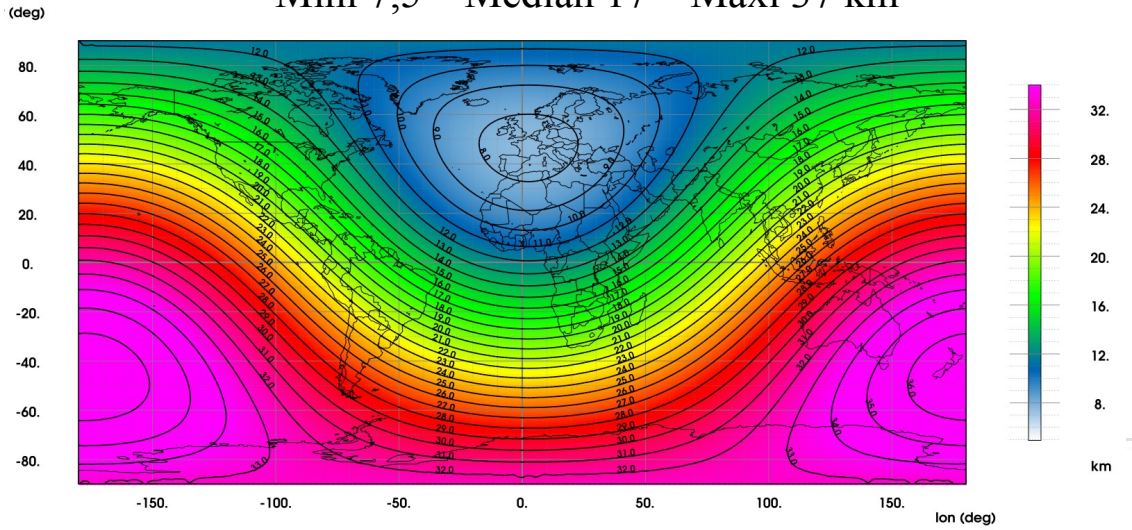
Next version of global NWP systems

Systems	Characteristics
ARPEGE *Deterministic*	TI1798c2.2 L105 (5km on W Europe) 4DVar (6h cycle): TI224c1L105 & TI499c1L105 5 forecasts per day up to 114h
ARPEGE-EDA (AEARP)	TI499c1 L105 ; 50 members 4D-Var (6h cycle): TI224c1L105 Background covariances averaged on 12h and updated every 6h
ARPEGE-EPS (PEARP)	TI1198c2.4 L90 (7.5km on W Europe) 35 members ; four times a day up to 108h Using 35 EDA members and singular vectors 10 physical packages

Future ARPEGE horizontal resolution
Mini 5 – Median 11 – Maxi 24 km



Future ARPEGE-EPS horizontal resolution
Mini 7,5 – Median 17 – Maxi 37 km



Considered additional changes in next e-suite

- CY43T2 including SURFEX v8.0
- VORTEX (Python library for scripting to ease R2O) for ARPEGE/AEARP and AROME
- GRIB2 format (instead of GRIB1) to encode FA fields in global historical files (native grid), not LAM yet, and post-processed fields on regular lat-lon grids
- Tuning in the dynamics
- Changes in the convection scheme
- Prognostic graupels
- Reduction of roughness lengths for snow
- New aerosols climatology originating from ARPEGE-Climat model
- Tuning of background standard deviation errors for humidity (~30% reduction)
- More IASI channels assimilated over land
- Observation correlation errors taken into account for IASI and CRIS
- Variational bias correction for GNSS observations
- Assimilation of GNSS-RO on FY-3C
- Assimilation of wind from ScatSat-1 (Ku band)
- Assimilation of AMVs from GOES-R (16)
- Monitoring of AMSR-2 from GCOM-W1
- Use of ATOVS, ATMS, MWHS-2 DBNet data
- New diagnostics: visibility, type of precipitations, etc.

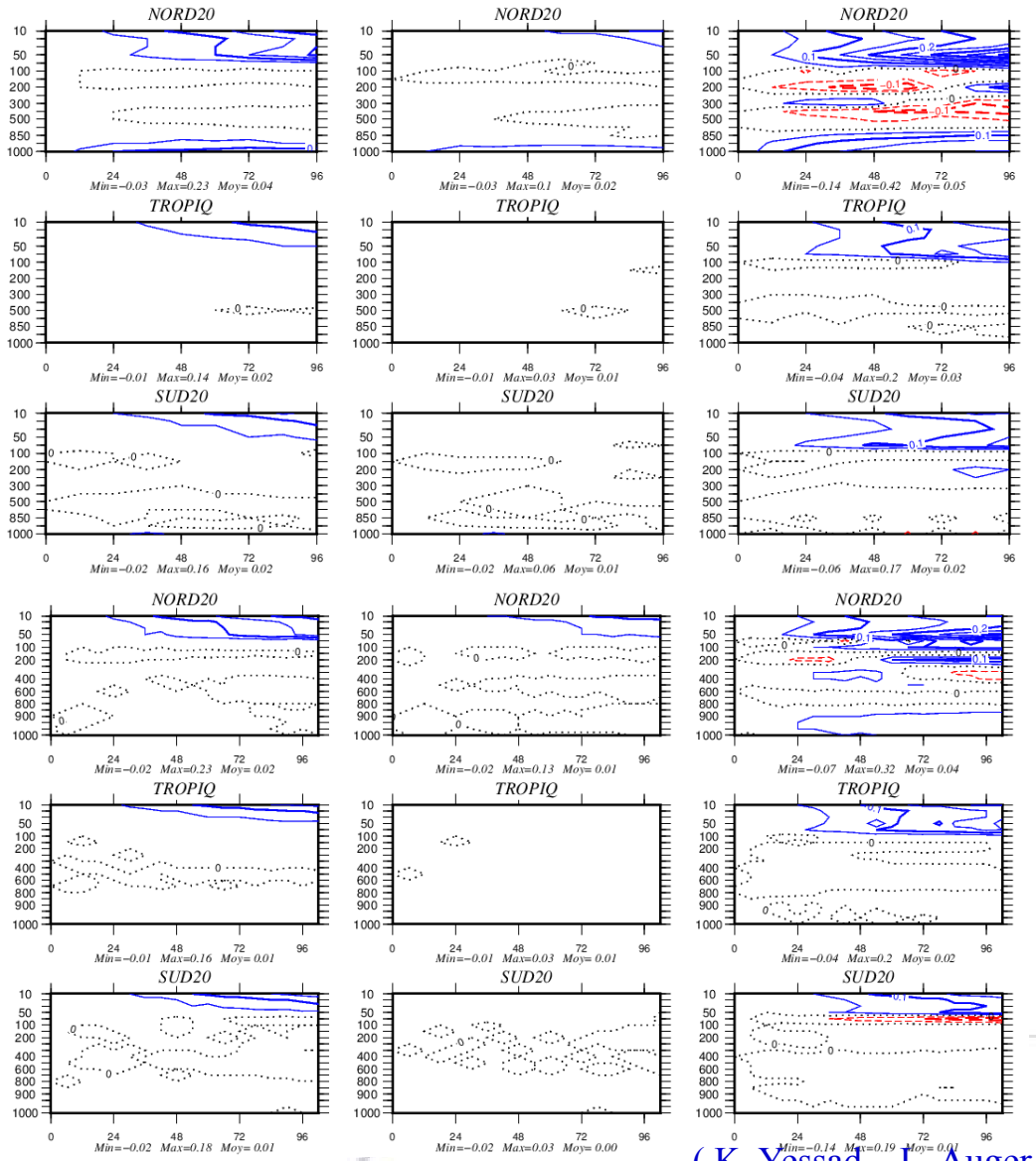
Changes in the dynamics

- Increase of spectral diffusion on wind in the stratosphere (necessary due to not enough vertical resolution)
- No spectral diffusion on temperature and humidity
- Increase of the number of iterations (3 → 4) for computing the origin point of the semi-lagrangian trajectory

Scores T (T1798c2.2L105 in dynamical adaptation)
(01/01/17 → 28/02/17)

TP

AC



(K. Yessad – L. Auger)

Preliminary AEARP/ARPEGE HR (hor res + dyn)

Vent

Différences d'EQM – EQM – Scores normalisés par rapport aux analyses
Période de validité du 20180101 au 20180220 47 simulations contrôlées à 102 heures

Significativité à 99 % (bootstrap)

RS — 100 * (EQM PA – EQM P7HUK)/EQM PA) — AC

EUROPE

AUS/NZ

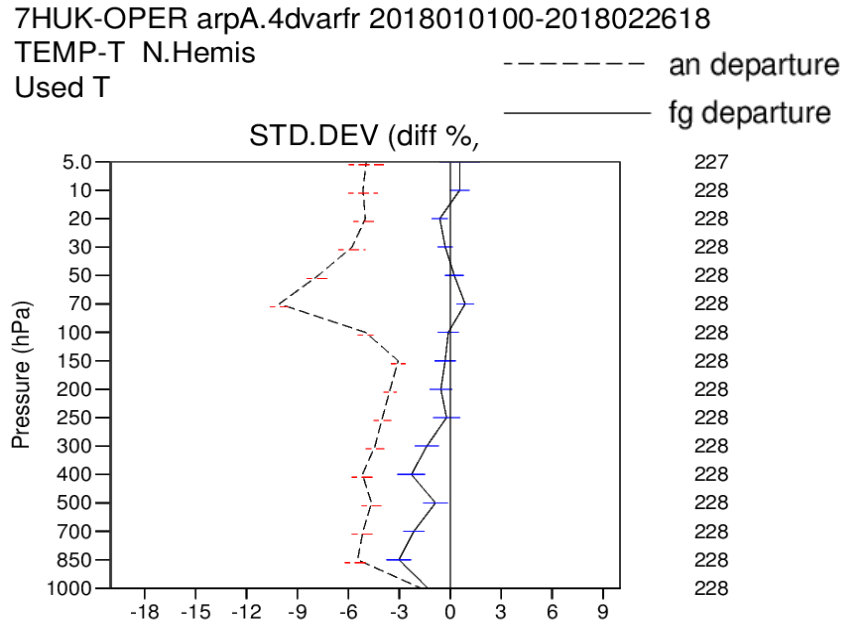
AMNORD

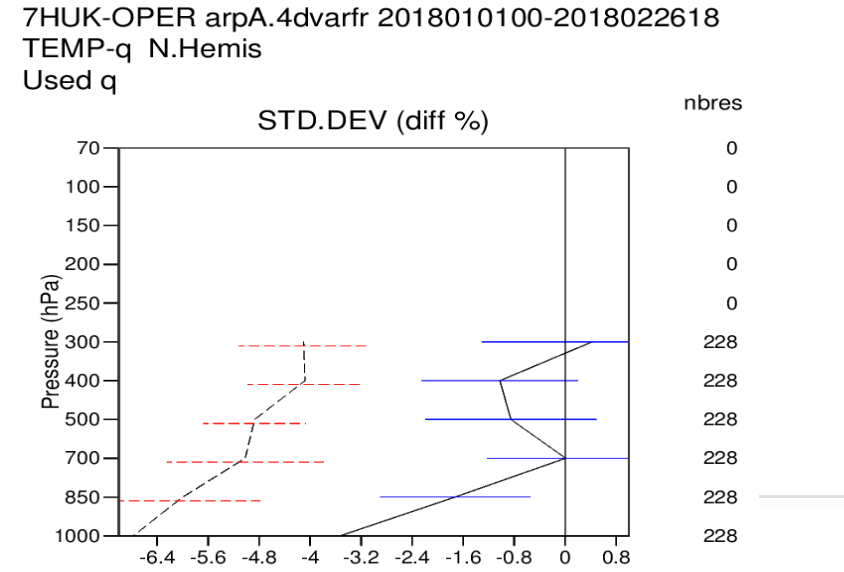
ASIE

NORD20

TROPIQ

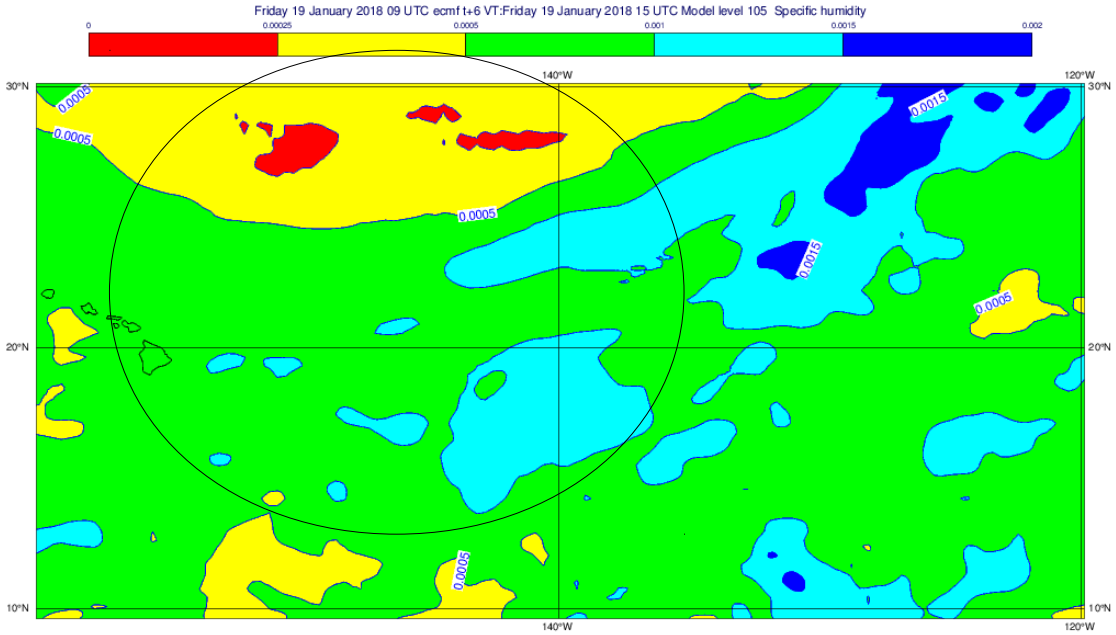
SUD20



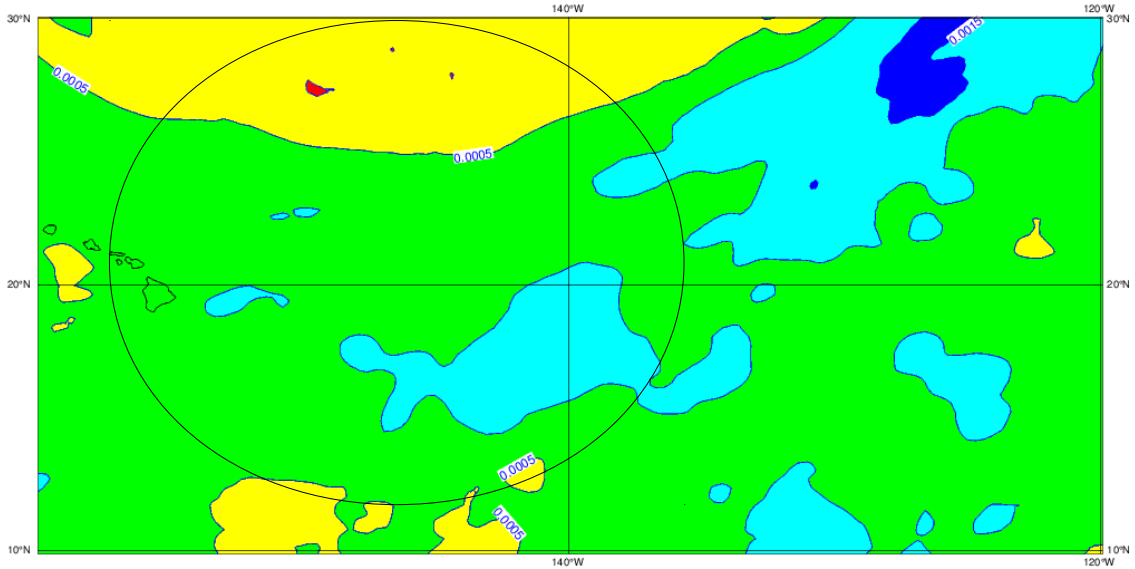


(L. Berre, B. Ménétrier, P. Chambon, V. Guidard, C. Loo, L.F. Meunier, P. Moll, F. Suzat, etc.)

EDA: Noise reduction due to sampling on variances
(50 members instead of 25)



Estimated standard deviation
(specific humidity at 1000 hPa)
with 25 members



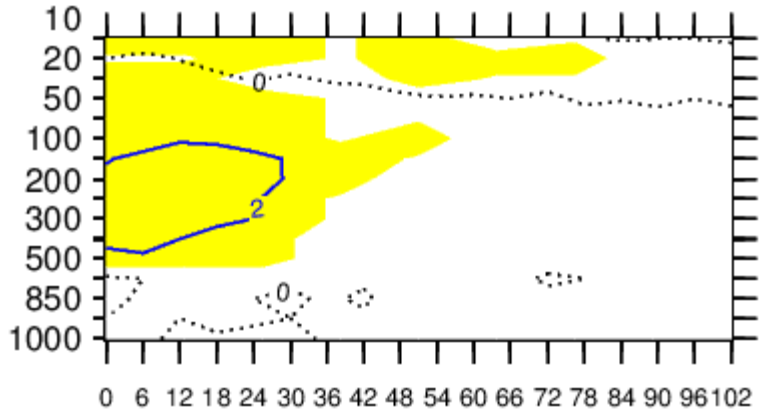
Estimated standard deviation
(specific humidity at 1000 hPa)
with 25 members

=> Reduction of small scales
artificial structures

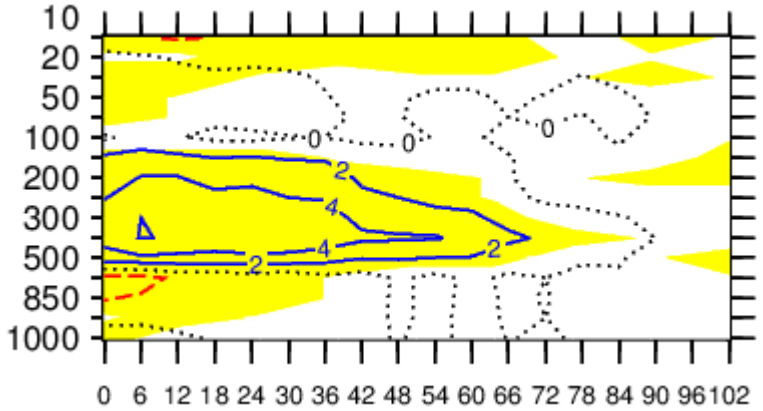
(L. Berre)

EDA: Tuning of background standard deviation errors for humidity (~30% reduction)

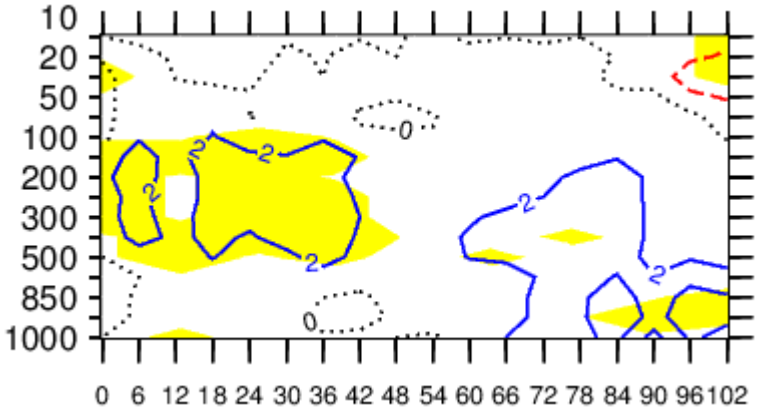
Validation over 1 month



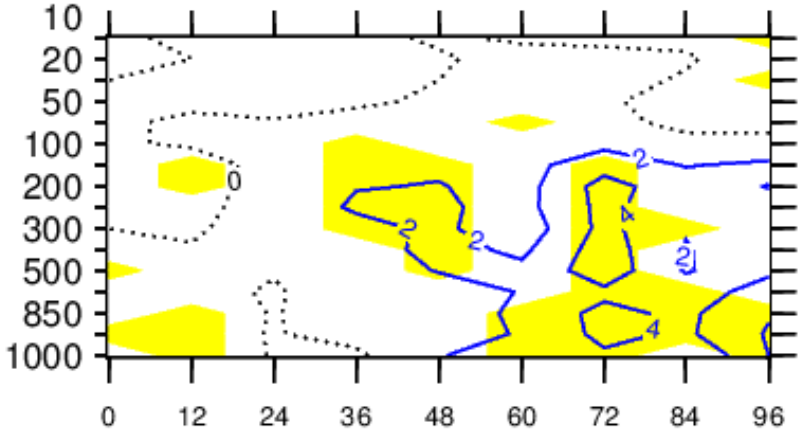
% diff RMS geop North20 (AC)



% diff RMS géop Tropics (AC)



% diff RMS geop Europ (AC)

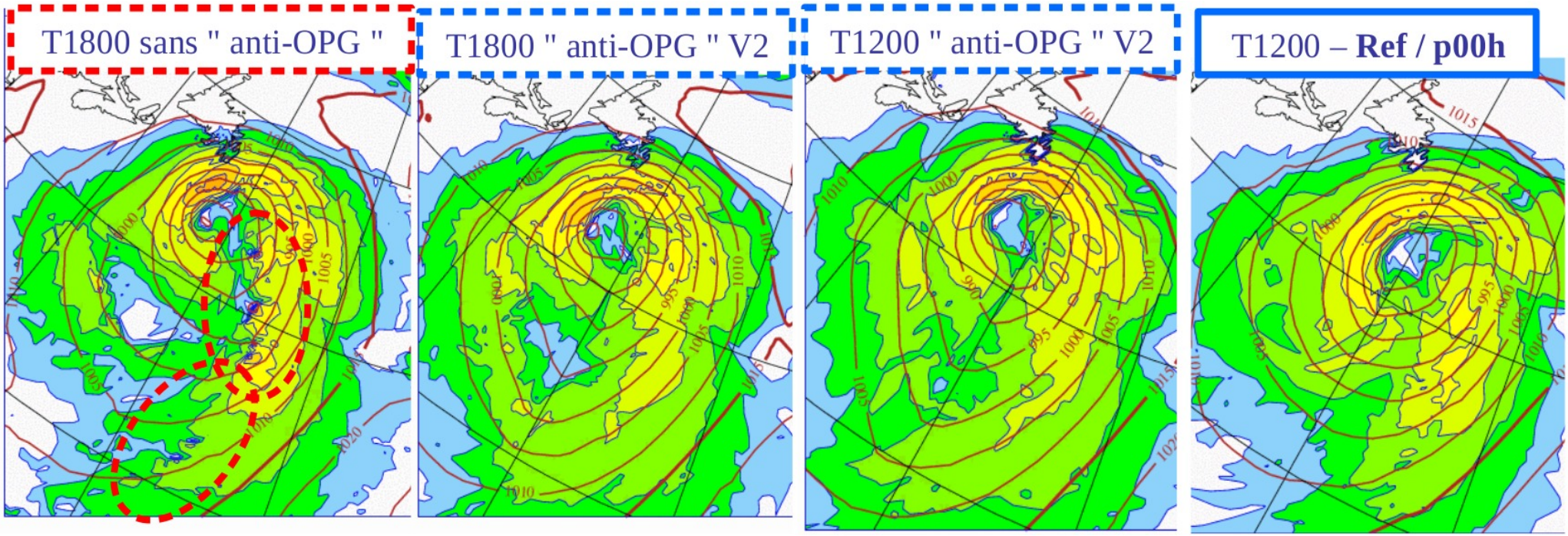


% diff RMS geop Europ (TP)

(L. Berre)

Tuning in the convection scheme (1)

- Grid point storm has been a long-standing problem in ARPEGE, enhanced when increasing spatial resolution
- Pragmatic modifications in the convection scheme have been implemented in the past to increase convection in case of intense resolved vertical velocity avec convective instability



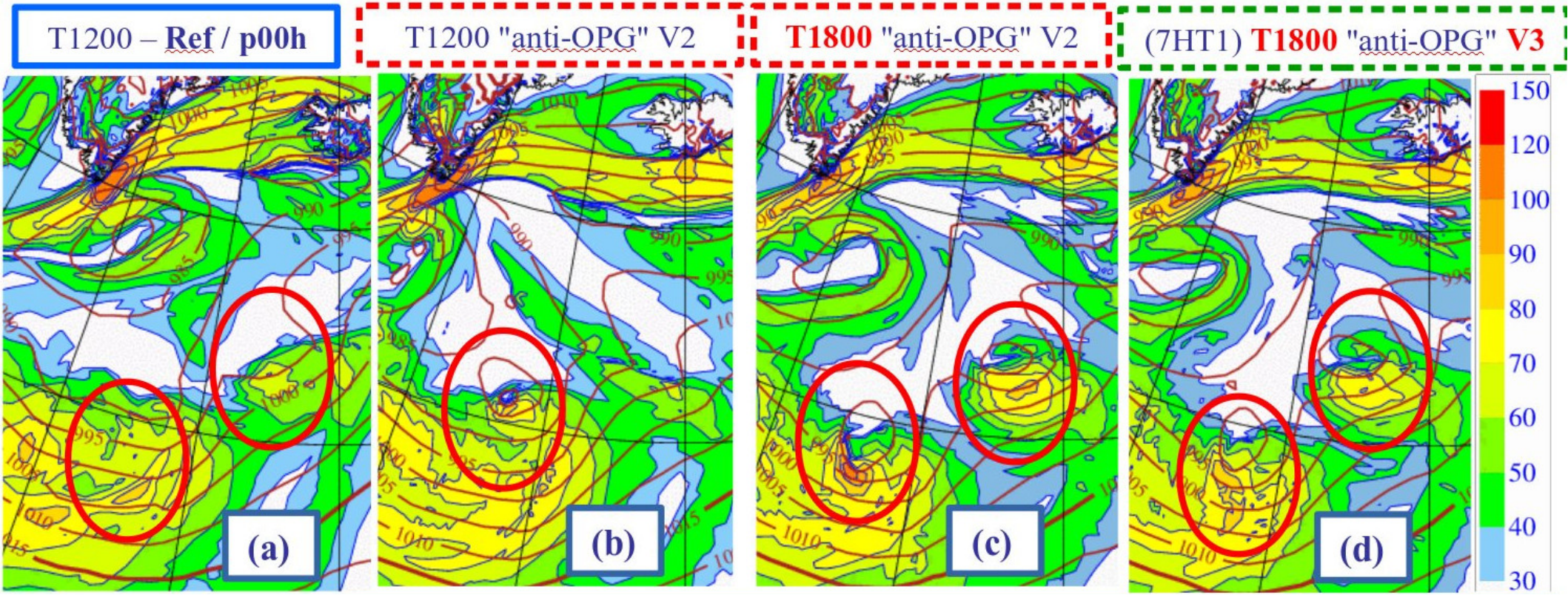
20170118-72h

Analysis

(L. Descamps – P. Marquet)

Tuning in the convection scheme (2)

- Some adaptations have been done to move from T1198 to T1798, and validated in terms mid-latitude storms, tropical cyclones, high precipitation events and objective scores



Analysis

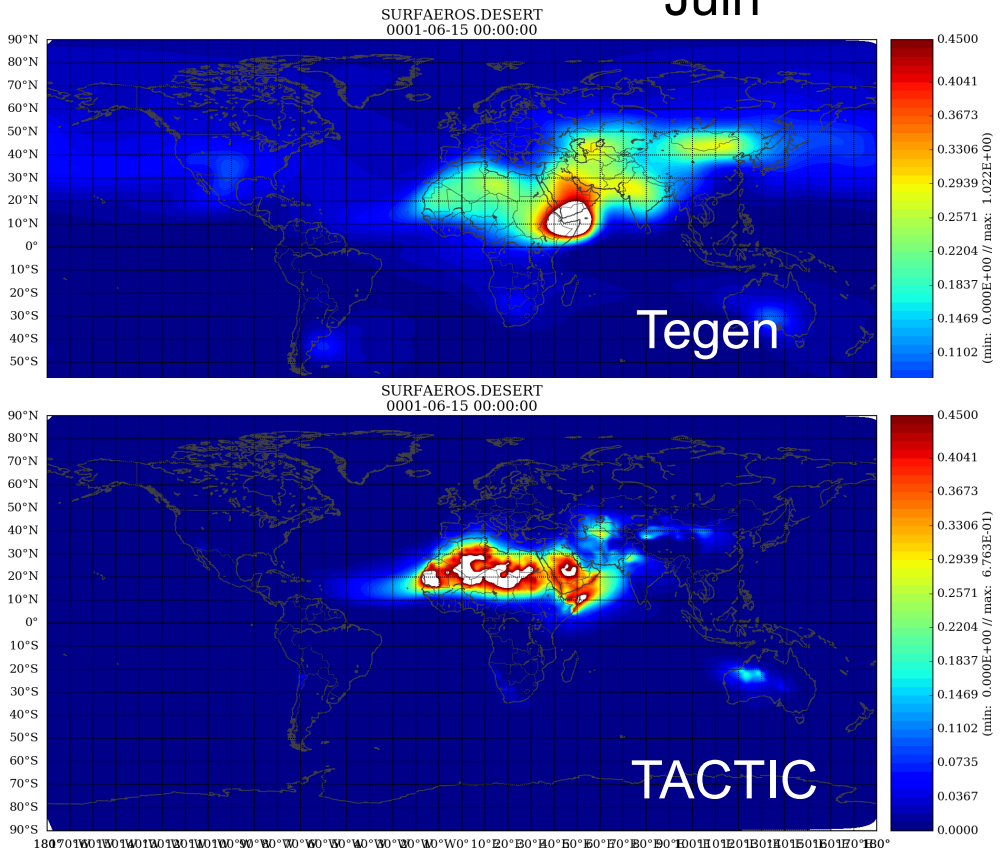
20170308-72h

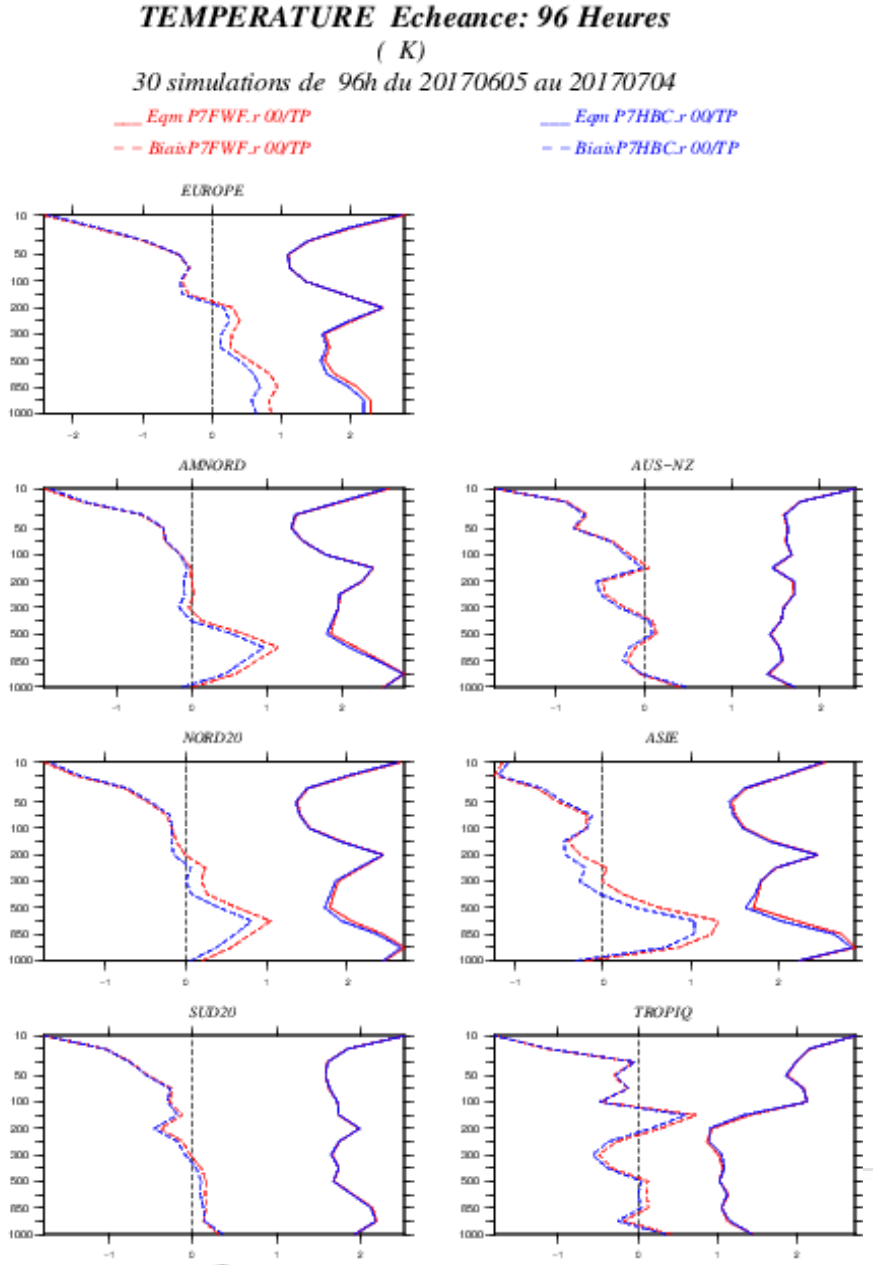
(L. Descamps – P. Marquet)

New aerosols climatology

- In operations : Tegen at al. (1997) : dust, sea salt, sulfate, carbonaceous aerosol. Résolution : 5°x4°
- New climatology : ARPEGE-Climat with aerosol scheme « TACTIC » 1.4°x1.4°

Juin



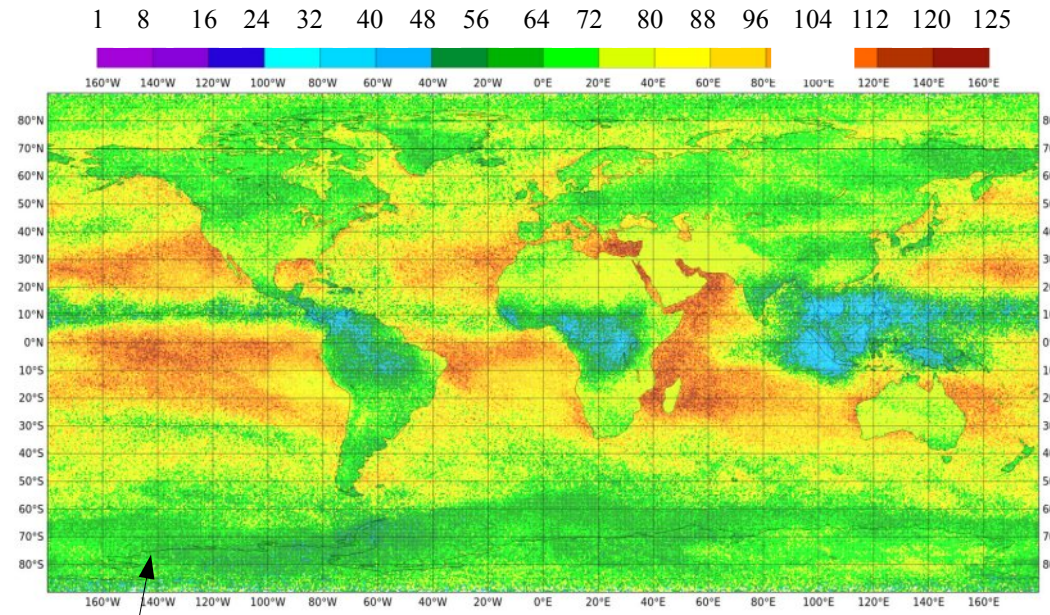


(E. Bazile – C. Loo – M. Michou - P. Nabat)

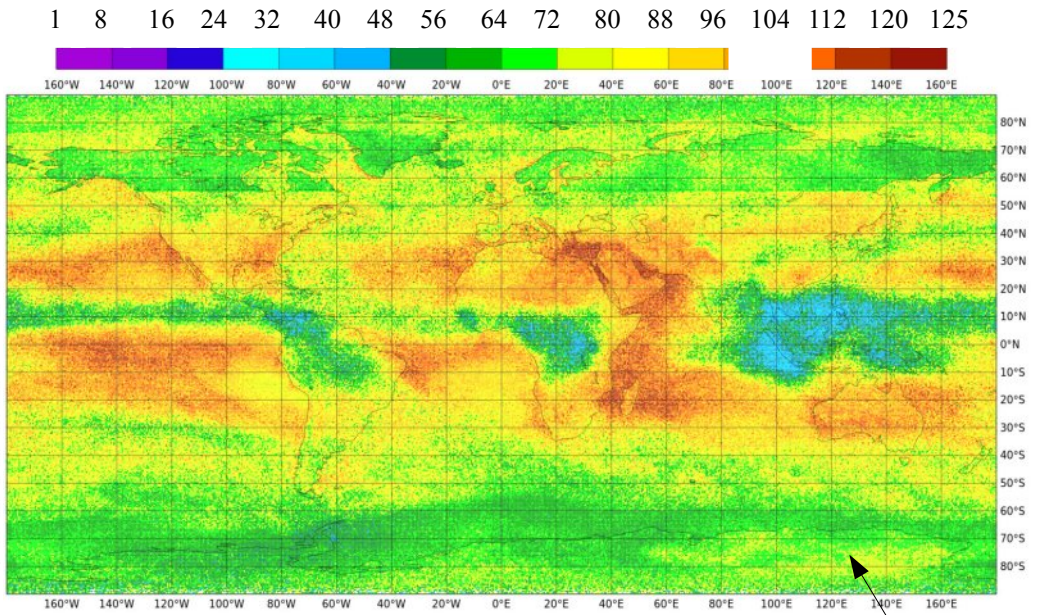
More IASI channels assimilated over continents

Methodology similar to SEVIRI radiances over land (Guedj et al., 2011) since 2013
⇒ Inversion of Ts from a window channel (N°1194 – 10.6 µm)
+ use of IR emissivity atlas (University of Wisconsin)

OPER



NEW



Number of IASI channels assimilated per pixel in REF (left) and EXP (right) in average per box of 0.5*0.5° for October 2016.

123 channels over sea
77 channels over land

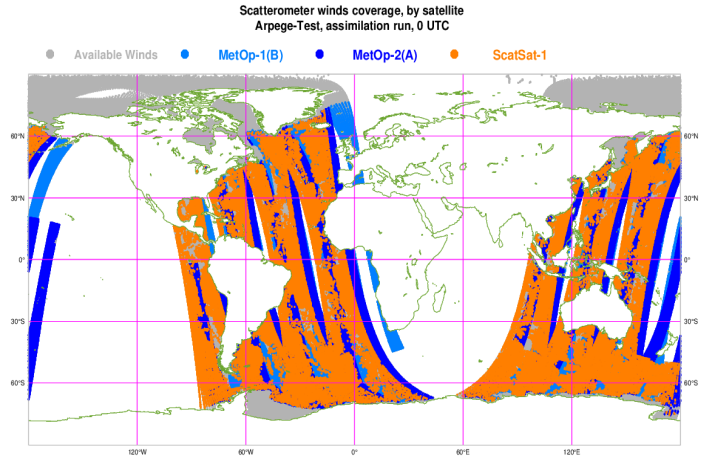
Increase of the number of assimilated channels (~7%)

123 channels over sea
122 channels over land

thesis Niama BOUKACHABA

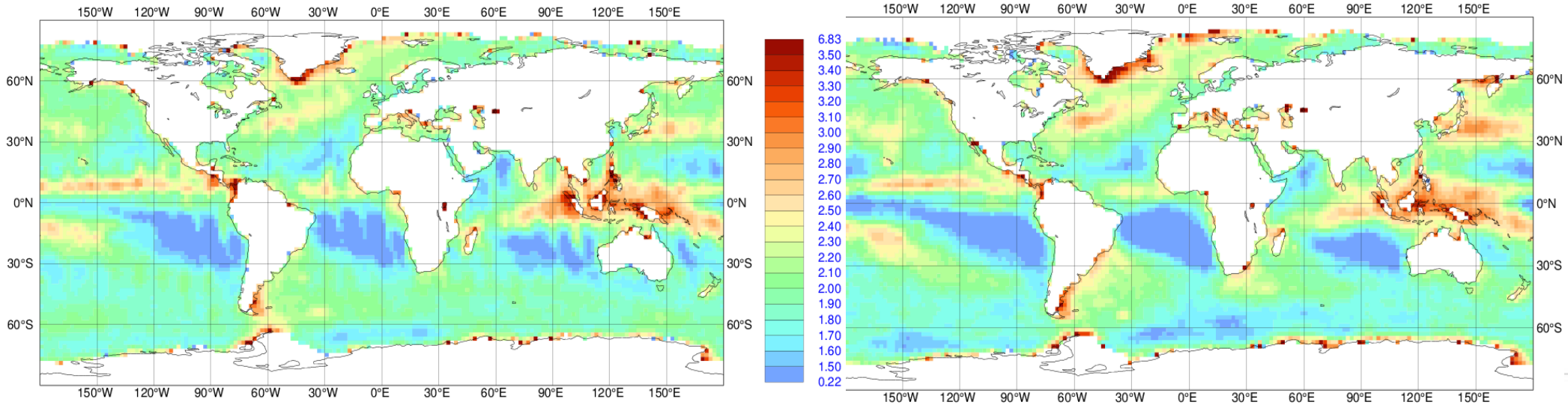
Scaterrometer winds from ScatSat-1 satellite

- Launched in sept. 2016 by ISRO
- Same instrument as OSCAT
- 50 km horizontal resolution



10m Neutral Wind Vector (m/s) from ScatSat-1/OSCAT
Best_Active_2fg data [time step = 6.00 hours]
RMS of fgdep_rms, All_surfaces, Area =global
exp = B7OS, Data period = 2017-09-10 21:00 - 2018-03-10 21:00
Grid : 2.0 x 2.0 / Min: 0.223 Max: 6.828 Mean: 1.943

10m Neutral Wind Vector (m/s) from MetOp-2(A)/ASCAT
Best_Active_2fg data [time step = 6.00 hours]
RMS of fgdep_rms, All_surfaces, Area =global
exp = B7OS, Data period = 2017-09-10 21:00 - 2018-03-10 21:00
Grid : 2.0 x 2.0 / Min: 0.510 Max: 9.087 Mean: 1.981



- O-G similar to ASCAT after quality control

(C. Payan)

Perspectives

- CY43T2 “E-suite” : implementation in June, operational switch end of 2018
- Following E-suite : Spring to Autumn 2019, maybe on CY46T1 (?)
- Medium term evolutions in ARPEGE : ECRAD radiation scheme, new convection scheme, use of more advanced schemes available in SURFEX, revision of observation error statistics, new satellite observations, snow analysis, stochastically perturbed parametrisations (SPP), etc.
- Devote more resources on NWP diagnostics to the benefit of our end-users
- Evaluate the impact of differences between IFS and ARPEGE systems
- Towards more integrated system (atm-aerosols-ocean-waves), NWP and Climat

Thank you for your attention