



Recent progress and plans on the use of observations in NWP models at Météo-France

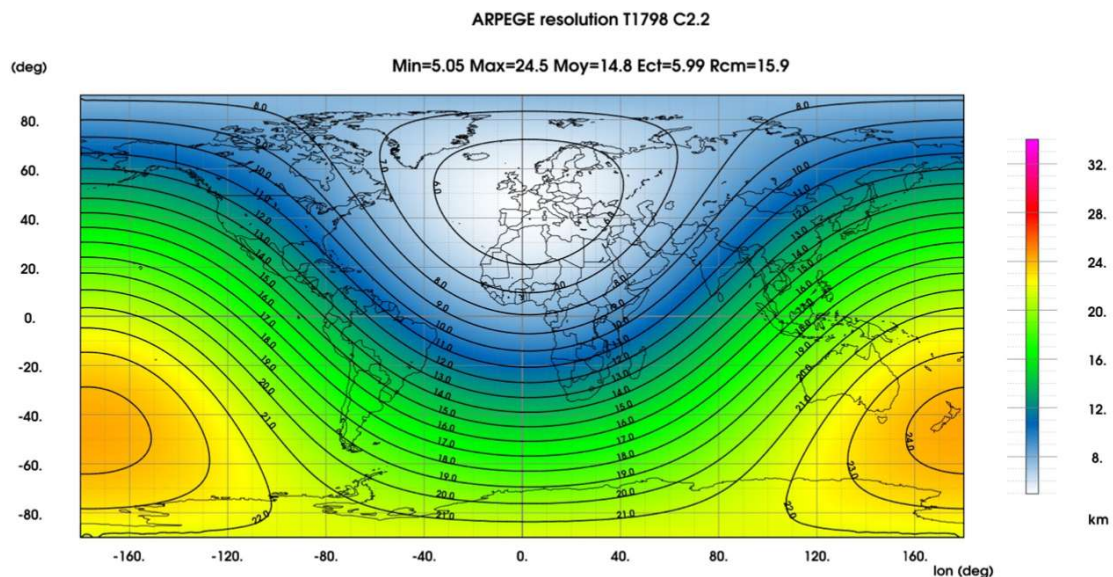
Claude Fischer on behalf of the NWP observation team
DESR/CNRM/GMAP/OBS (Toulouse, France)



Outline

- Observation usage in the global model ARPEGE
- Observation usage in the convective scale model AROME
- Planned changes for 2021

Global model ARPEGE



**Spectral model with
variable resolution:
T_L1798c2.2L105**

Δx from **5** to 25 km
105 vertical levels
from 10 m to 0.1 hPa

Incremental 4D-Var assimilation (6-h window and 30 min time-slots) :

- 2 loops of minimization: T_L224c1L105 (40 iterations) + T_L499c1L105 (40 iterations)
- Background error variances and correlation lengths from an EDA system (4D-Var at lower resolution: T_L499/T_L224) with 50 members (**AEARP**)

Forecasts (cut-off and ranges):

00 UTC (1h10/54h), 00 UTC (2h15/102h),
06 UTC (3h/72h), 12 UTC (1h50/104h), 18 UTC (3h/60h)

**Since
07/2019**

Major changes since October 2019 (1)



EUMETSAT - Metop-C

IASI: October 2019
ASCAT: January 2020



NOAA - NOAA-20

CrIS: October 2019

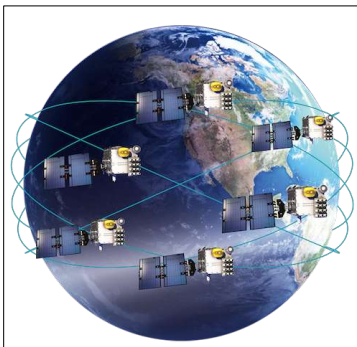
Major changes since October 2019 (2)

More recently to mitigate the loss of aircraft observations induced by the COVID-19 pandemic



ESA - Aeolus

Rayleigh and Mie HLOS winds
(June 2020)



NOAA USAF - COSMIC-2

6 GNSS-RO receivers
(June 2020)

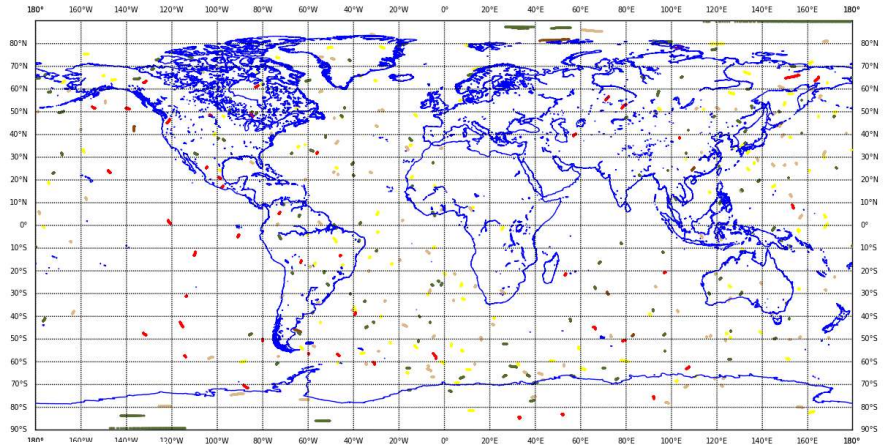
Additional receivers:
KOMPSAT-5, PAZ, GNOS/FY-3D

Monitoring of GNSS-RO bending angles

OLD (63949)

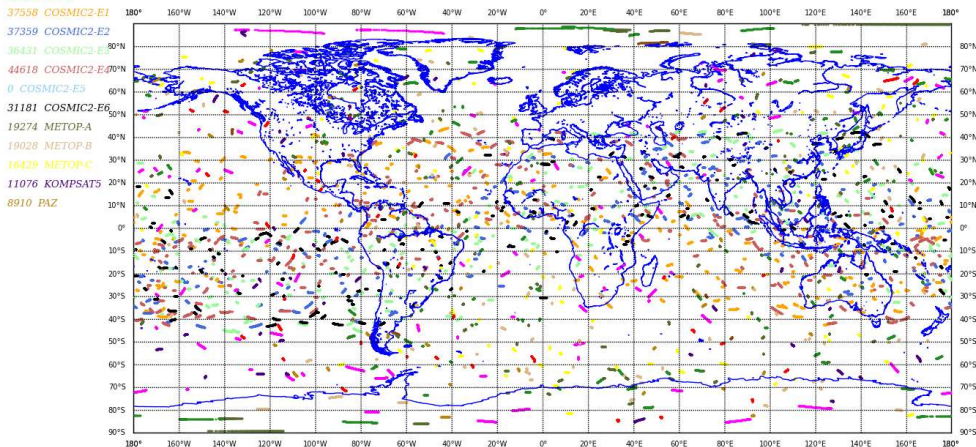
- 7623 TERRASAR-X
- 1281 TANDEM-X
- 0 FY3-C
- 0 FY3-D
- 0 COSMIC2-E1
- 0 COSMIC2-E2
- 0 COSMIC2-E3
- 0 COSMIC2-E4
- 0 COSMIC2-E5
- 0 COSMIC2-E6
- 19796 METOP-A
- 18914 METOP-B
- 16339 METOP-C
- 0 KOMPSAT5
- 0 PAZ

METEO-FRANCE couverture de donnees - GPS satellite - 2020/04/10 00H UTC cut-off long
 Nombre total d'observations apres screening : 63949



- 7685 TERRASAR-X
- 1294 TANDEM-X
- 17354 FY3-C
- 16160 FY3-D

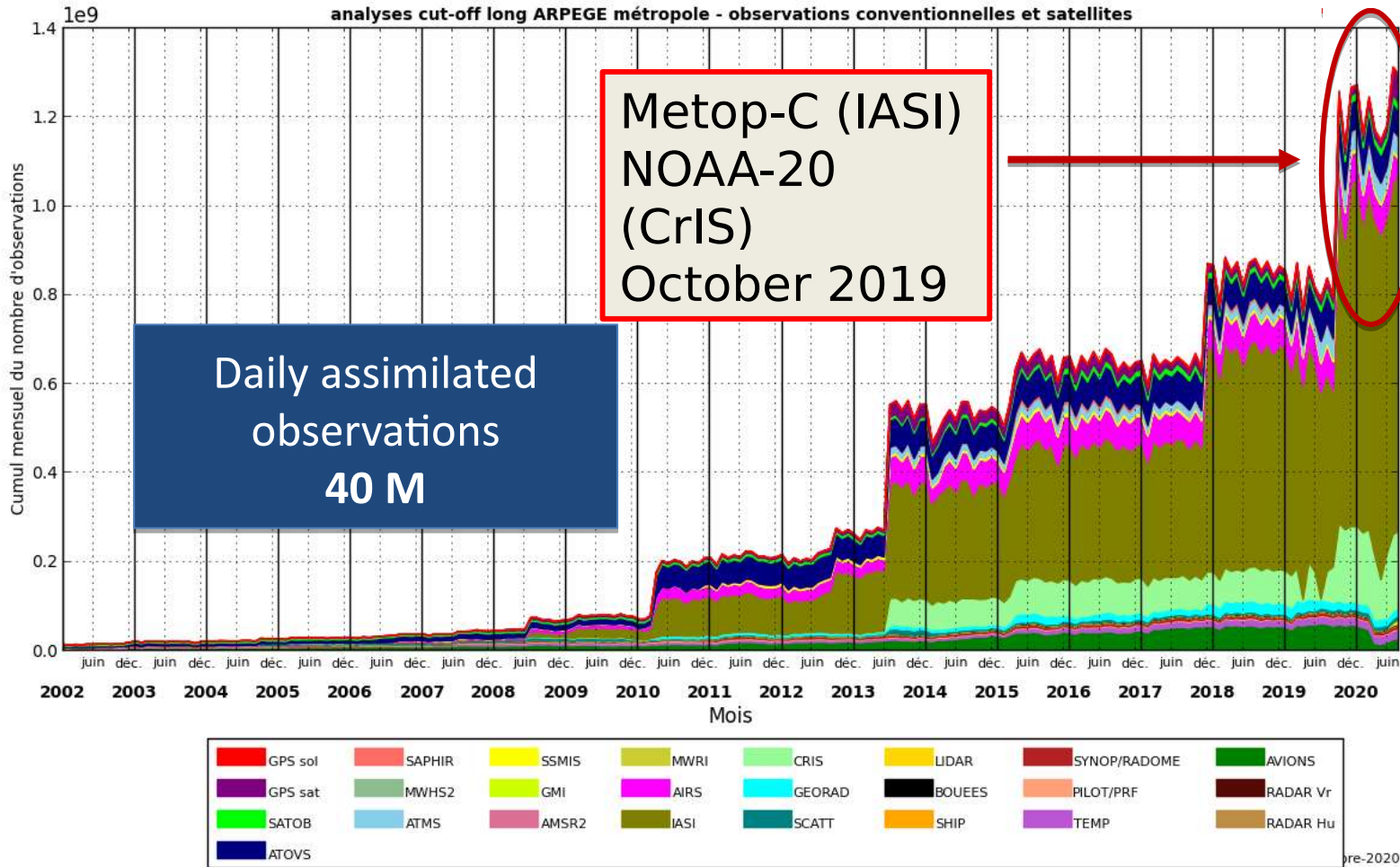
METEO-FRANCE couverture de donnees - GPS satellite - 2020/04/10 00H UTC cut-off long
 Nombre total d'observations apres screening : 304357



NEW (304357)

Observation evolution in ARPEGE

Evolution des cumuls mensuels de nombre d'observations utilisées par type d'observation



Impact study of Aeolus and GNSS-RO data

**One month 4D-Var assimilation (4 April - 5 May 2020)
coupled to the Ensemble Data Assimilation (AEARP)
- same configurations as operations**

Additional observations

HLOS winds Rayleigh clear + Mie cloudy (L2 with M1 bias correction)
GNSS-RO receivers : 6 COSMIC-2A, KOMPSAT5, PAZ, GNOS FY3-C/-D

Information content of observations

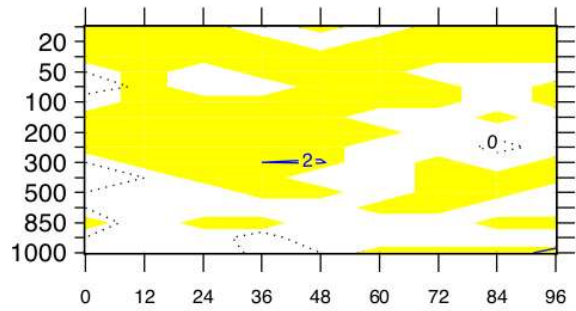
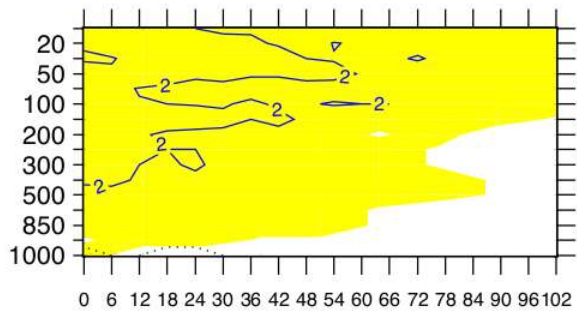
Obs type	Aeolus	GNSS-RO	RAOBs	IASI
% observation	0.42	2.90	1.49	62
% DFS	2.3	13.5	6.00	33

Forecast scores (winds)

ECMWF analyses

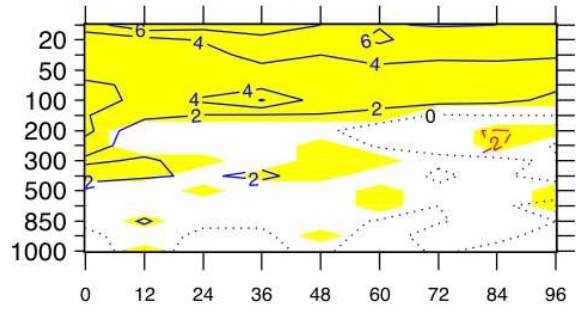
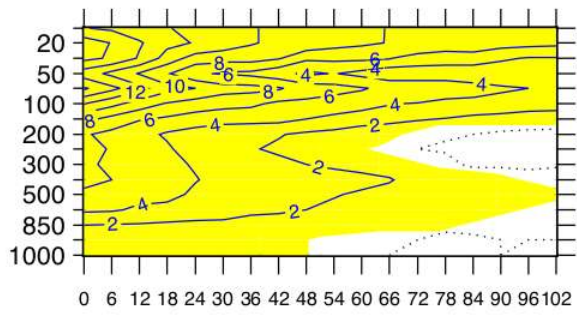
Radiosoundings

NH

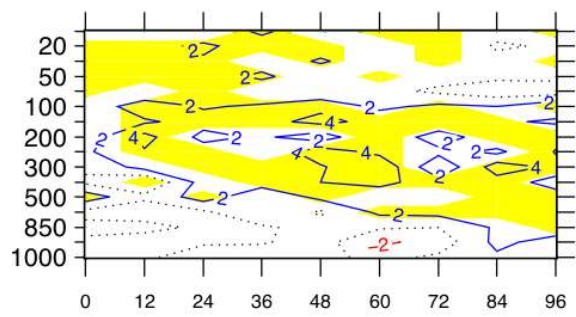
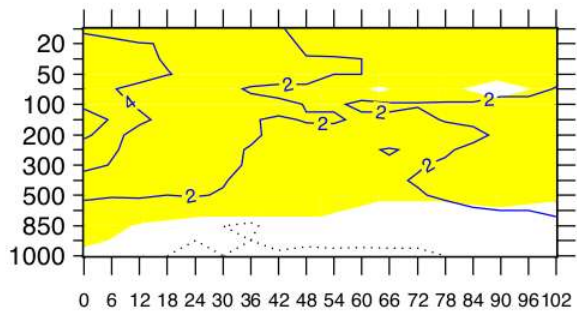


Normalized
RMSE differences
REF - EXP

Tropics



SH



significant

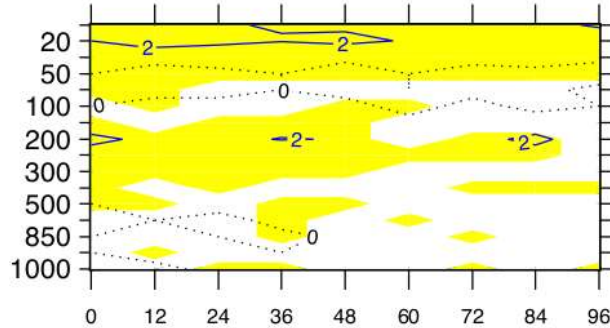
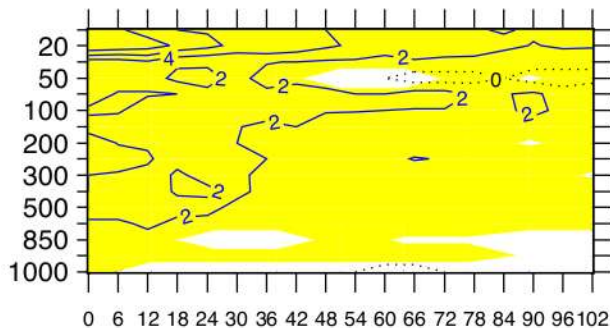


Forecast scores (temperature)

ECMWF analyses

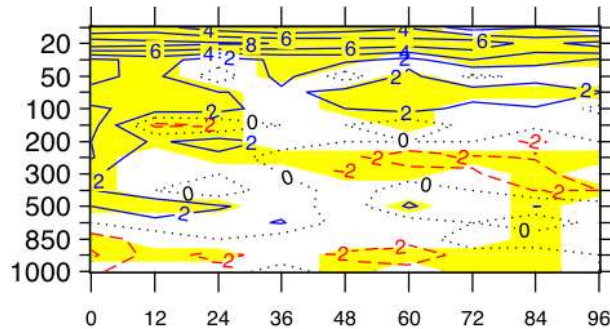
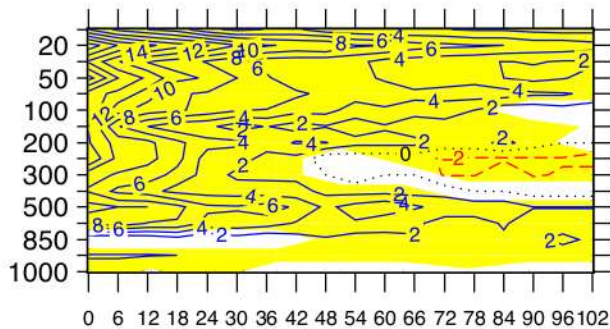
Radiosoundings

NH

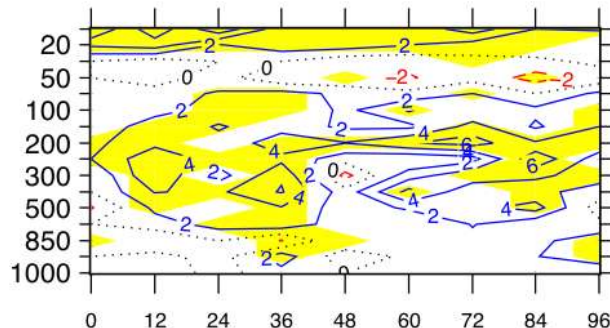
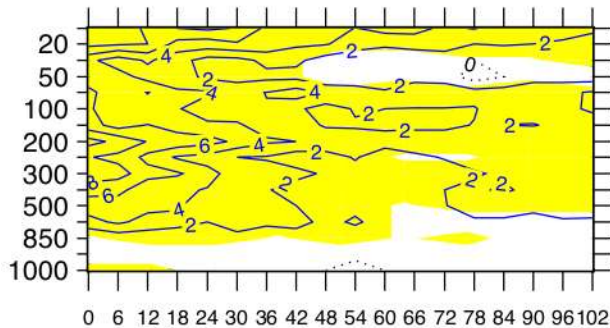


Normalized
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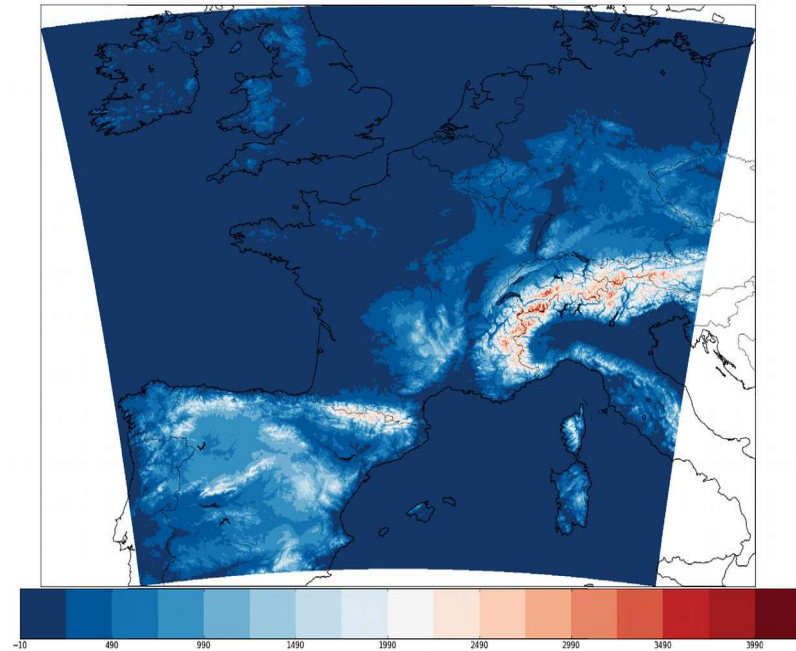


significant



Regional model AROME (France)

- Spectral limited area non-hydrostatic model with explicit moist convection (since 12/2008)
- Horizontal resolution: 1.3 km (*)
- 90 vertical levels (from 5 m up to 10 hPa) (*)
- 3D-Var assimilation (1-h window) + IAU (*)
- **Same observations as in ARPEGE:**
 - (+) radar Z (RH) & DOW (8 km) – raw SEVIRI radiances (NWC-SAF cloud mask + LSA- SAF emissivity atlas)
 - (-) GNSS-RO – CrIS and AIRS radiances
- Forecast range : from 7 to 48 hours (8 times a day) – cut-off: between 20 min and 3.5 h
- **Nowcasting version** (operational since 04/2016) :
 - forecasts up to 6 h issued every hour (assimilation not cycled)
 - Assimilation window [-10 min, + 10 min]
 - Cut-off : 10 min



(*) since 04/ 2015

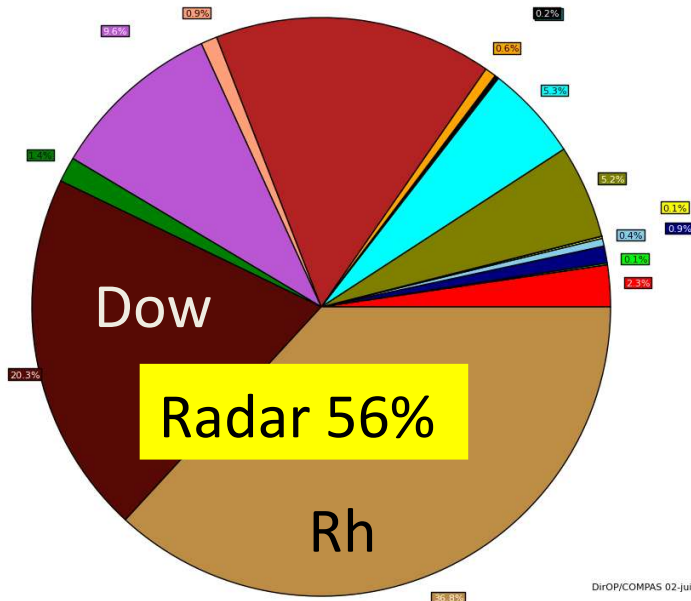
Observations in AROME 3D-Var

Satellite observations = 12 %

Proportions du nombre d'observations utilisées par type d'observation analyses AROME France

Observations conventionnelles et satellites
cumul mensuel du nombre d'observations utilisées pour 202005 : 36257887.0

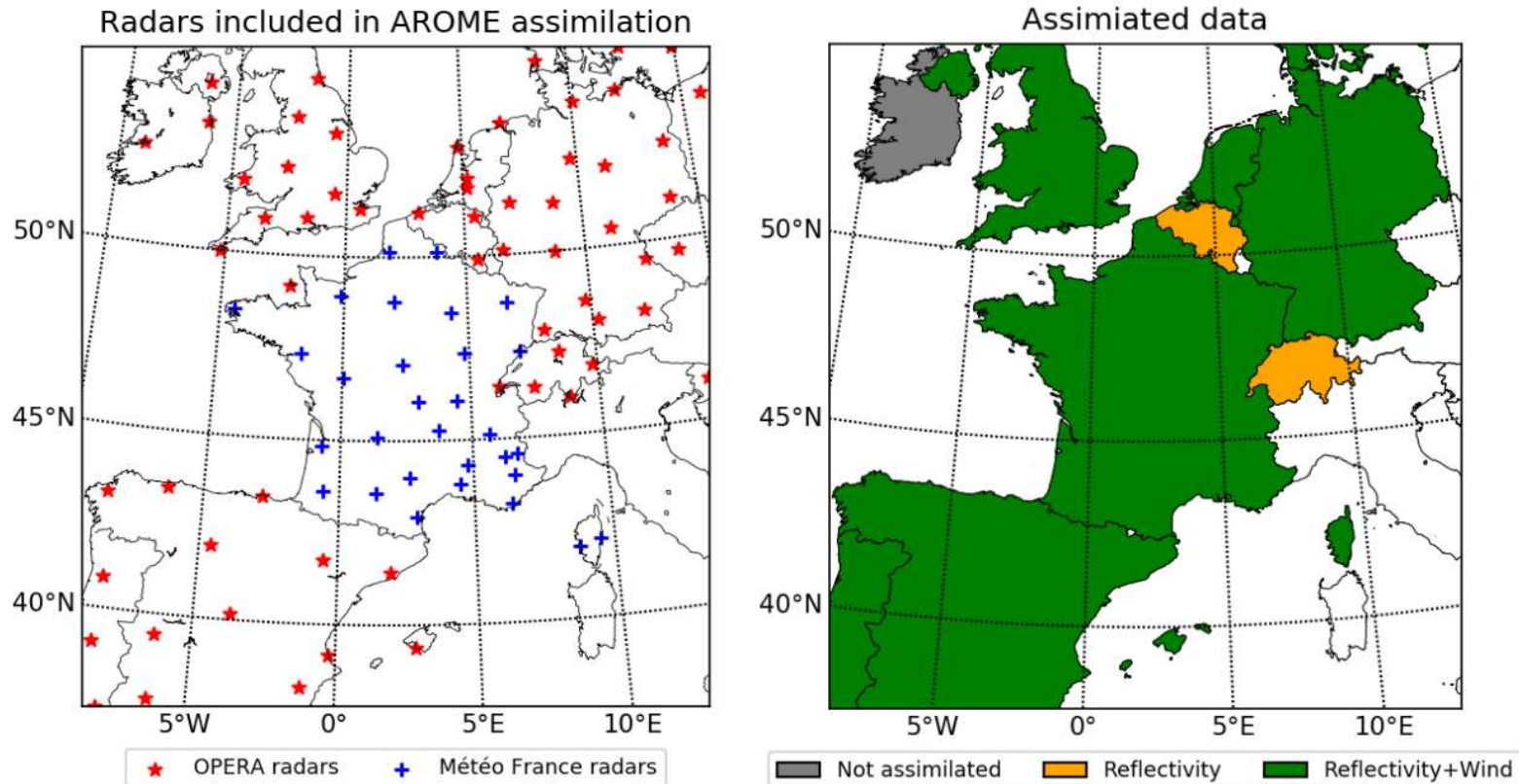
GPS_sat1	2.3 %	MMHS2	0.0 %	MMRI	0.0 %	SCATT	0.1 %	PILOT/PRF	0.9 %
GPS_sat	0.0 %	ATMS	0.4 %	AIRS	0.0 %	LIDAR	0.0 %	TEMP	9.6 %
SATOB	0.1 %	SSMIS	0.1 %	IASI	5.2 %	BOUEES	0.2 %	AVIONS	1.4 %
ATOVS	0.9 %	GMI	0.0 %	CRIS	0.0 %	SHIP	0.6 %	RADAR_Vf	20.3 %
SAPHIR	0.0 %	AMSU2	0.0 %	GEORAD	5.3 %	SYNOP/RADOME15.5 %		RADAR_Hu	36.8 %



- Radar DOW + Z (RH)
- Surface (SYNOP + RADOME)
- Radiosoundings (BUFR HR)
- Aircrafts
- GEO radiances (METEOSAT)
- LEO satellites (IASI, AMSU, AMVs, SCAT)
- Ground based GNSS (ZTD)

Spatial thinning of satellite obs between 80 and 125 km

Additional European radars for AROME

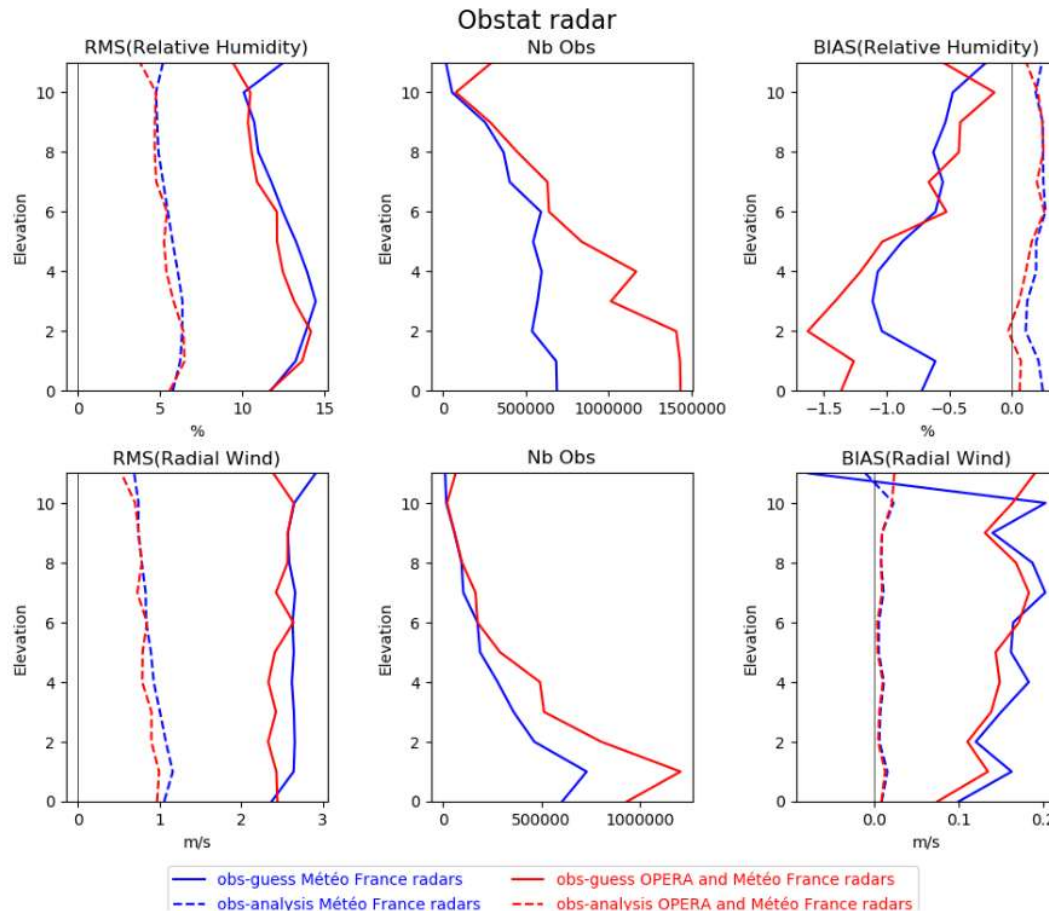


30 radars from French network

62 additional European radars (some on them located outside the AROME domain) available from **EUMETNET OPERA**

Assimilated in AROME since January 2020

Impact of OPERA radars in AROME



**OmB/OmA
statistics**

Relative humidity

MF
MF + OPERA

Radial winds

Very similar quality of selected radars from OPERA wrt to MF
Positive impact on case studies (heavy rainfall events)
Neutral impact on mean scores



Planned changes in observation usage (2021)

ARPEGE

- Assimilation of instruments from chinese polar orbiting satellite FY3-D (MWHS-2, MWTS-2, MWRI)
- Assimilation of raw radiances from ABI onboard GOES-16 and GOES-17 (using NWC SAF cloud classification)
- Assimilation of ocean winds from new scatterometers (HY-2B and CFOSAT)
- Assimilation of all-sky microwave radiances from cross-track water vapour sounders (MHS) using a Bayesian inversion for RH profile retrievals (similar to radar reflectivity in AROME)
- Improved spatial thinning (data selection) of satellite radiances

Planned changes in observation usage (2021)

AROME

- Assimilation of French radar data from a new unified processing chain (use of polarimetric variables for attenuation and echo types) consistent with OPERA format (HDF5, polar coordinates)
- Monitoring and/or assimilation of aircraft winds from Mode-S/ADS-B and Mode-S/EHS receptions (collaboration with French civil aviation to get data from SSR over France, network of Météo-France ADS-B antennas, EMADDC)
- Include interchannel correlation errors for SEVIRI radiances
- Use of descent radiosounding data (Germany, France, ...)
- Use of VarBC scheme to correct aircraft temperature biases



Thank you for your attention !





**Detlev, für dein Letztes
EWGLAM, sing doch mal was !**

