

Project: Assessment of the operational potential of assimilating IASI L2 in a regional model

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EUMETSAT study EUM/CO/17/4600001975/TA

April 8, 2019



Outline

- 1 Next Steps proposed during last meeting
- 2 Evaluation of the MetOp combined retrieval L2 product v6.4
- 3 Recap and Results of data assimilation experiments
- 4 Closing Remarks

Next Steps proposed during last meeting

- Statistics of L2 product v6.4 **done**
- Add another period (15/May-15/Jul/2018) **in progress**
- More statistics will be provided (precipitation) **in progress**
- Detailed study of meteorological situation and precipitation evaluation (study cases) **in progress**
- 48 hours forecast starting 12 UTC (Summer and winter experiments) **not start**
- We will propose the paper structure, the figures and tables that will be used in the article **not start**

Evaluation of the MetOp combined retrieval L2 product v6.4

Evaluation of the MetOp combined retrieval L2 product v6.4

L2 product X AROME - Monthly Variation

Recapping data selection:

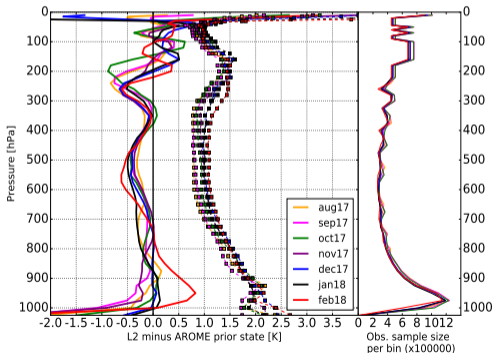
QCI Temperature $< 2\text{K}$

QCI Humidity $< 3\text{K}$ (dew point temperature)

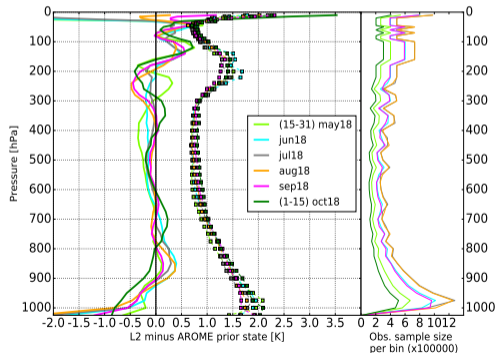
Difference between L2 data and AROME model altitudes $< 25\text{m}$

L2 product X AROME - Monthly Variation

Temperature - old version



Temperature - new version



Temperature - IASI L2 PPF v6.4 validation report

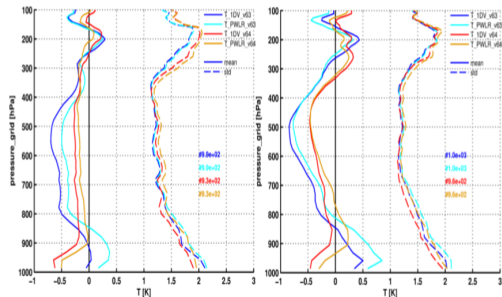
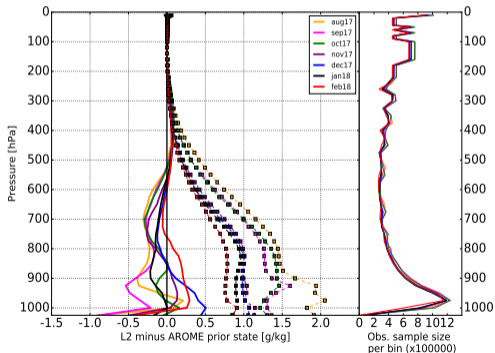


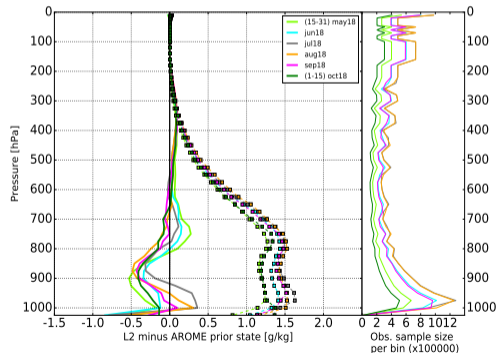
Figure 17: Metop-A (left) and Metop-B (right) temperature retrievals compared to radiosondes between 23 December 2017 and 13 February 2018 with the processor v6.3 (cyan: PWLR², blue: OEM) and v6.4 (orange: PWLR², red: OEM)

L2 product X AROME - Monthly Variation

Specific Humidity - old version



Specific Humidity - new version



Specific Humidity - IASI L2 PPF v6.4 validation report

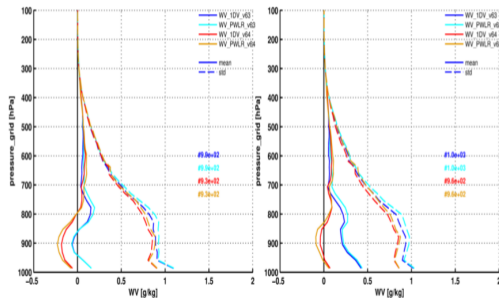
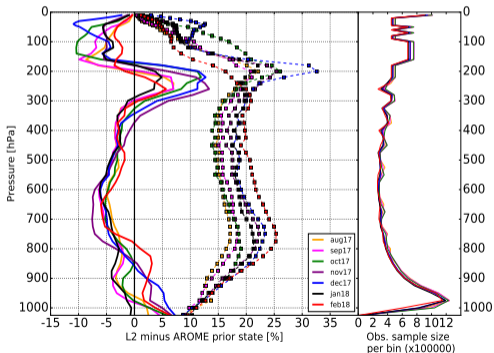


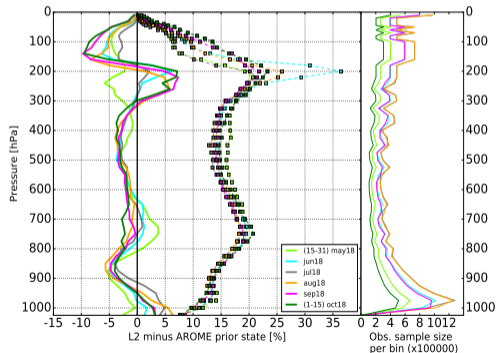
Figure 18: Metop-A (left) and Metop-B (right) temperature retrievals compared to radiosondes between 23 December 2017 and 13 February 2018 with the processor v6.3 (cyan: PWLR³, blue: OEM) and v6.4 (orange: PWLR³, red: OEM)

L2 product X AROME - Monthly Variation

Relative Humidity - old version



Relative Humidity - new version



Conclusion - Statistics Evaluation v6.4

- Temperature: Improvement in the bias between 400 and 800 hPa. The standard deviation is smaller near surface, the values are closer 2K in the v6.4.
- Specific Humidity: Improvement in the bias between 600 and 800hPa, below in the atmosphere there is a degradation, near 900hPa the bias have a negative peak in all months evaluated. The standard deviation has a small spread in the v6.4 when compared against v6.3. It is really evident near surface.
- The L2 product statistics against AROME model have behave similar to L2 product evaluated against radiosondes in the IASI L2 PPF v6.4.

Evaluation Long Period Experiments

Status and some results (update) of the long period experiments.

Experiments Configuration

Experiments Period 1: January and February/2018 - Done

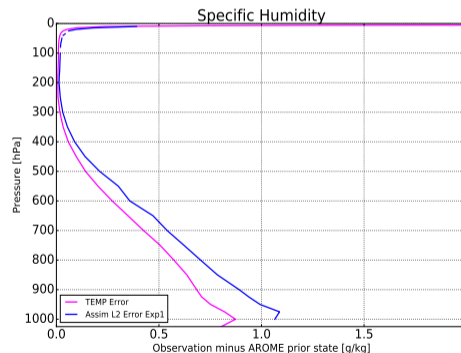
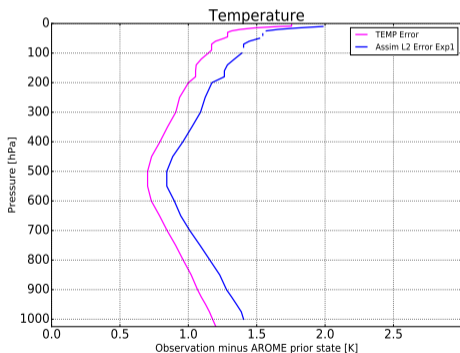
Experiments Period 2: July, 15th to Sep, 15th/2017 - Done

Experiments Period 3: May, 15th to Jul, 15th/2018 - In Progress

Observations assimilated : radar measurements, surface stations, buoys, ship, aircrafts, wind profilers, radiosondes, ATMS, SSMIS, GMI, SEVIRI, ASCAT and GPSSOL

Experiment	Configuration
Baseline	No IASI, AMSU-A and MHS data
Control	Baseline + IASI, AMSU-A and MHS L1 product
L2 Experiment	Baseline + L2 product

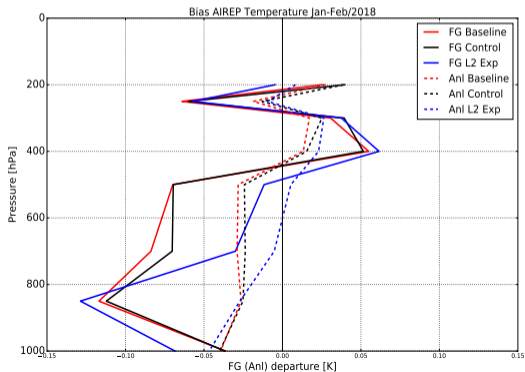
The observation error profile



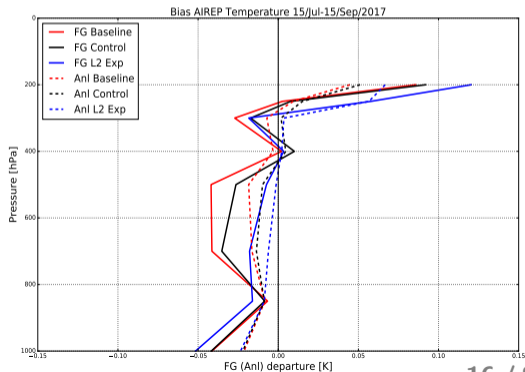
First Guess and analysis departure (OMF and OMA): AIRCRAFT Temperature, Radiosondes Humidity and radar (relative humidity and wind)

Impact in others observations Bias AIRCRAFT Temperature

Bias - Winter/2018

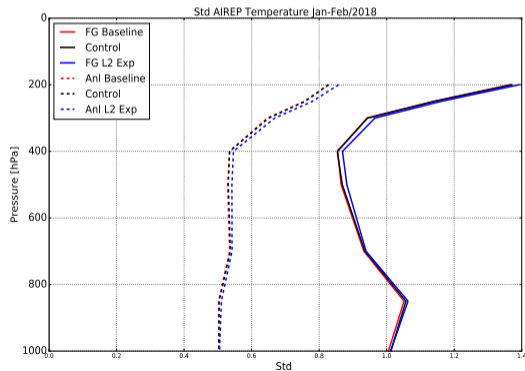


Bias - Summer/2017

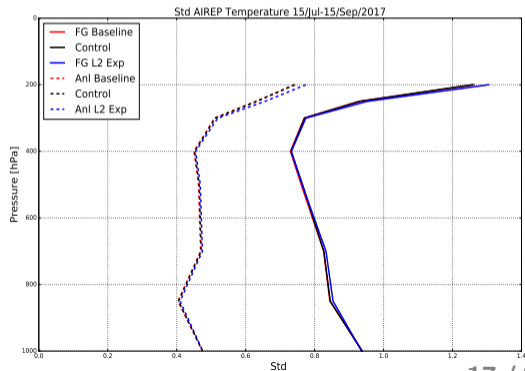


Impact in others observations Standard Deviation AIRCRAFT Temperature

Std - Winter/2018

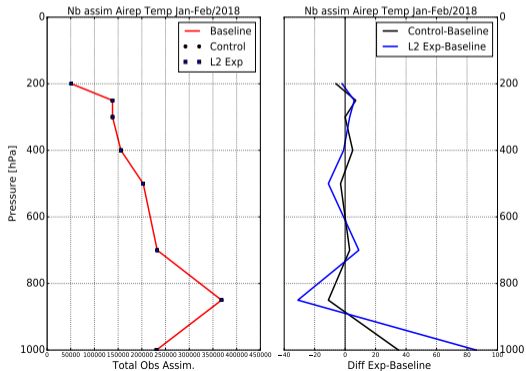


Std - Summer/2017

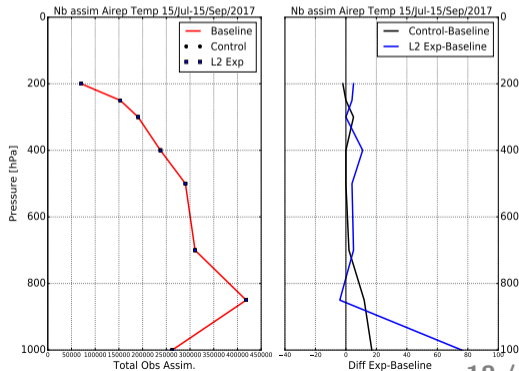


Impact in others observations - Number of Obs. Assim. AIRCRAFT Temperature

NObs.Assim. - Winter/2018

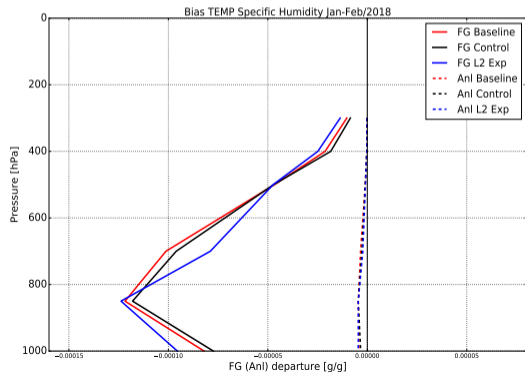


NObs.Assim. - Summer/2017

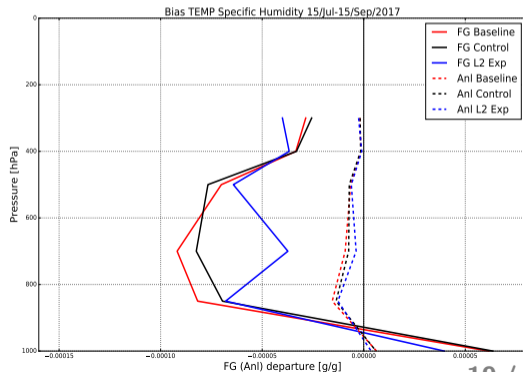


Impact in others observations Bias Radiosondes Specific Humidity

Bias - Winter/2018

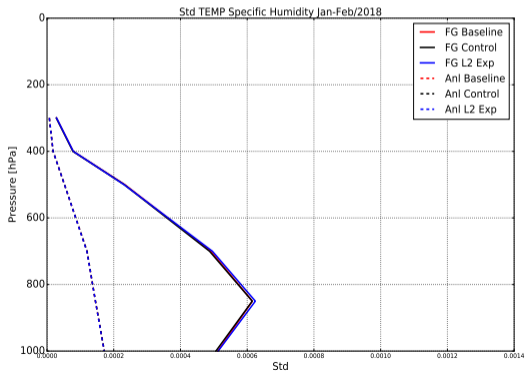


Bias - Summer/2017

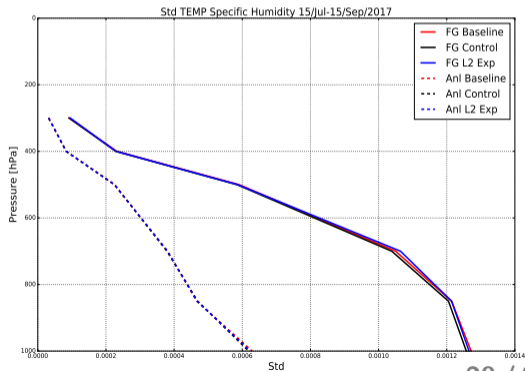


Impact in others observations Standard Deviation Radiosondes Specific Humidity

Std - Winter/2018

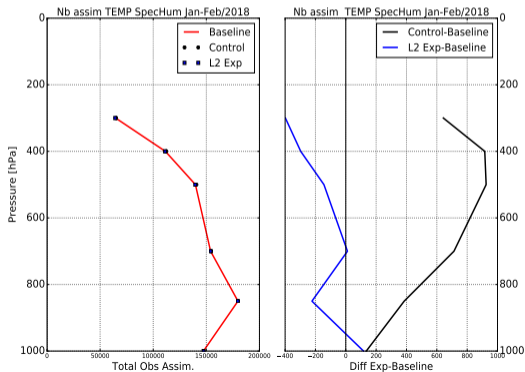


Std - Summer/2017

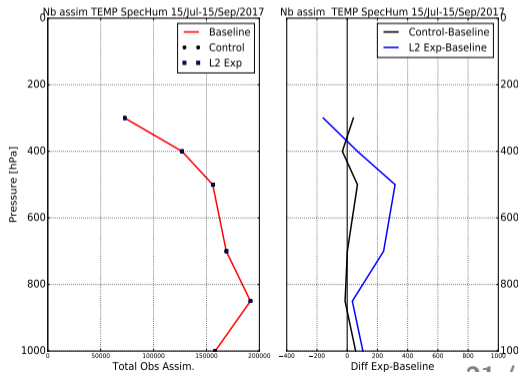


Impact in others observations - Number of Obs. Assim. Radiosondes Specific Humidity

NObs.Assim. - Winter/2018

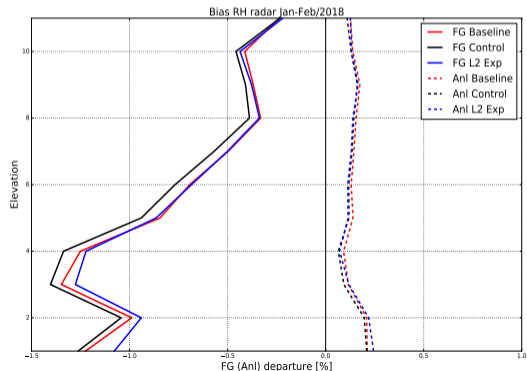


NObs.Assim. - Summer/2017

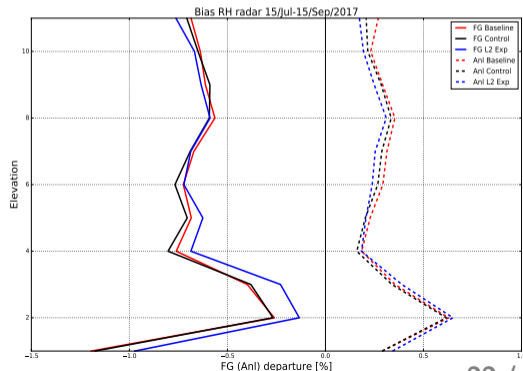


Impact in others observations Bias Radar Relative Humidity

Bias - Winter/2018

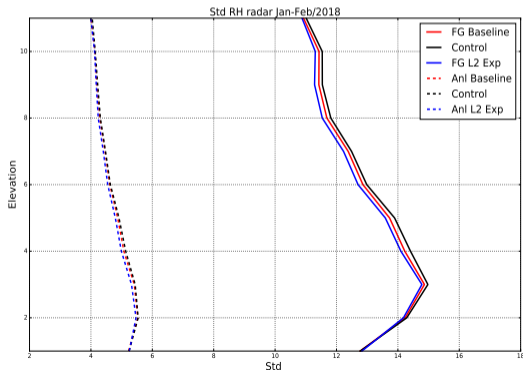


Bias - Summer/2017

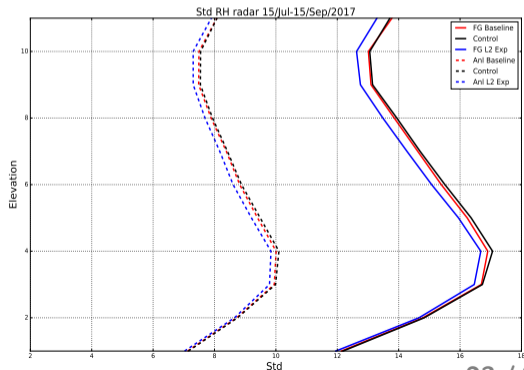


Impact in others observations Standard Deviation Radar Relative Humidity

Std - Winter/2018

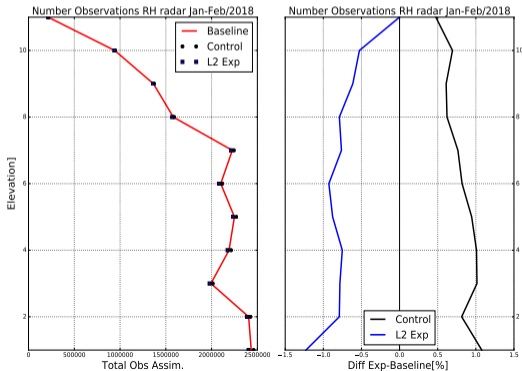


Std - Summer/2017

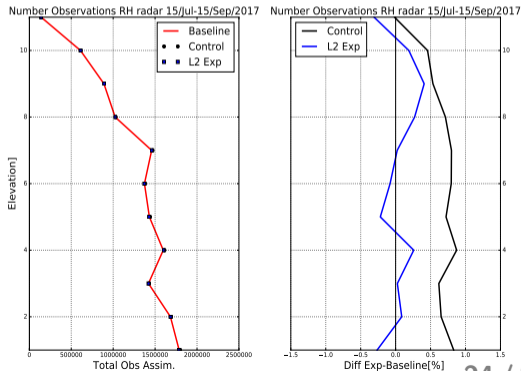


Impact in others observations - Number of Obs. Assim. Radar Relative Humidity

NObs.Assim. - Winter/2018

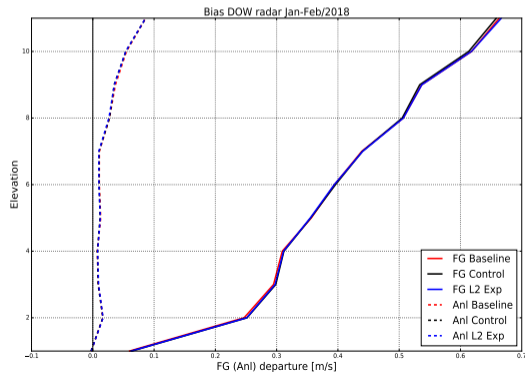


NObs.Assim. - Summer/2017

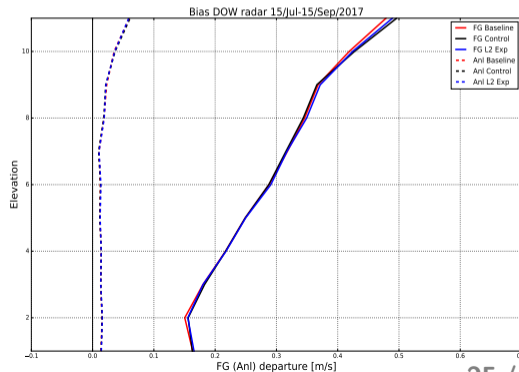


Impact in others observations Bias Radar DOW

Bias - Winter/2018

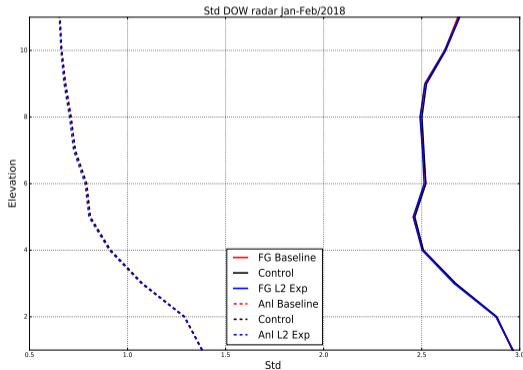


Bias - Summer/2017

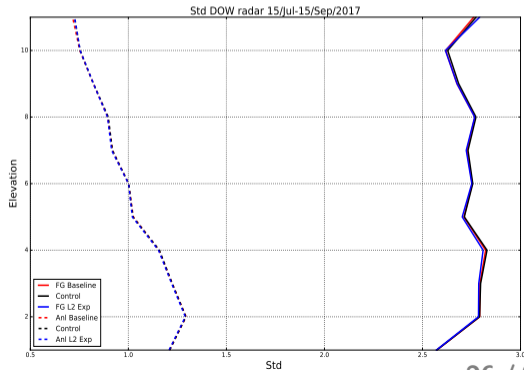


Impact in others observations Standard Deviation Radar DOW

Std - Winter/2018



Std - Summer/2017



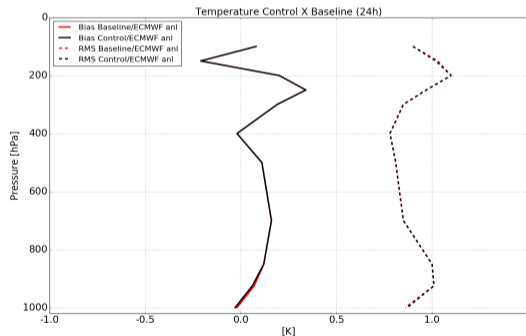
Experiments Forecast Skills

Period 1: Jan-Feb/2018

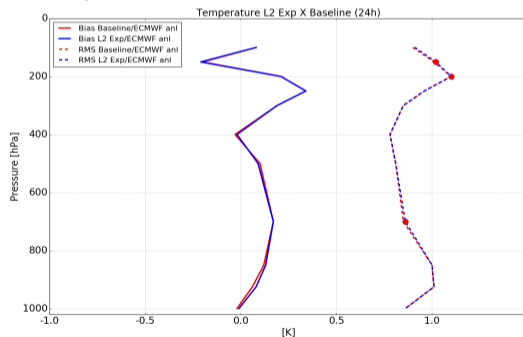
Reference is the ECMWF analysis

Experiments Forecast Skills - Temperature 24 hours Jan-Feb/2018

Control X Baseline



L2 Exp X Baseline



Experiment is better than the reference with **95 % of confidence** (t-student)

Reference is better than the Experiment with **95 % of confidence** (t-student)

Experiments Forecast Skills - Temperature Jan-Feb/2018

Control X Baseline

Domain	FRANGP05
100	== 🍷 == == ▲
150	== 🍷 == ==
200	== 🍷 == 🍷 🍷
250	== 🍷 == 🍷 🍷
300	▼ 🍷 🍷 == ==
400	🍷 🍷 == == ==
500	▼ == == == ==
700	== == == == ==
850	== == == == ==
925	== 🍷 == == ==
1000	== ▲ == 🍷 == ▼ ==

L2 Exp X Baseline

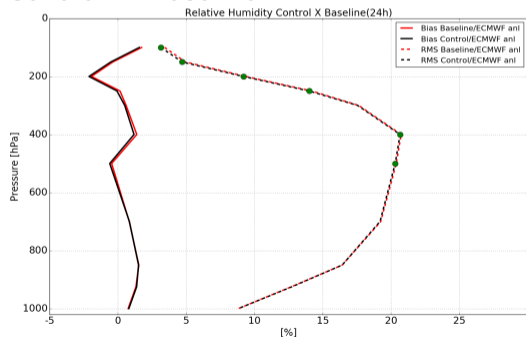
Domain	FRANGP05
100	== 🍷 == 🍷 🍷
150	🍷 ▼ ▼ ▼ ▼ ▼ ==
200	▼ ▼ ▼ ▼ ▼ == ==
250	▼ ▼ == == == ==
300	== == == == ==
400	🍷 🍷 == == ==
500	== == == == ==
700	== 🍷 ▼ == ==
850	▼ ▼ == == == ==
925	▼ ▼ ▼ == == ==
1000	== 🍷 == 🍷 ==

Experiment is better than the reference with 95 % of confidence (t-student)

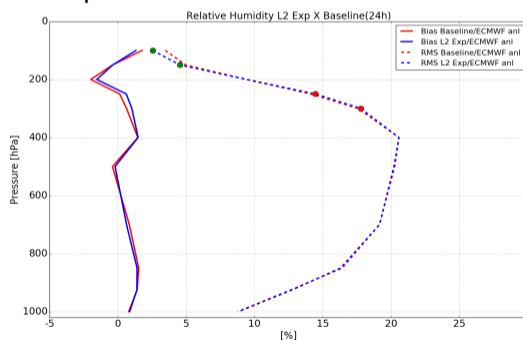
Reference is better than the Experiment with 95 % of confidence (t-student)

Experiments Forecast Skills - Relative Humidity 24 hours Jan-Feb/2018

Control X Baseline



L2 Exp X Baseline



Experiment is better than the reference with **95 % of confidence** (t-student)

Reference is better than the Experiment with **95 % of confidence** (t-student)

Experiments Forecast Skills - Relative Humidity Jan-Feb/2018

Control X Baseline

Domain	FRANGP05
100	▲▲▲▲▲▲▲▲▲▲
150	▲▲▲▲▲▲▲▲▲▲
200	= ▲▲▲ = ▲▲▲▲▲
250	▲▲▲▲▲▲▲▲▲▲
300	▲▲▲▲▲▲▲▲▲▲
400	▲▲▲▲▲▲▲▲▲▲
500	▲▲▲▲▲▲▲▲▲▲
700	=====▲▲▲
850	▲=====
925	=====
1000	▼=====

L2 Exp X Baseline

Domain	FRANGP05
100	▲▲▲▲▲▲▲▲▲▲
150	▲▲▲▲▲▲▲▲▲▲
200	=====
250	▼▼▼▼▼▼▼▼▼▼
300	▼▼▼▼▼▼▼▼▼▼
400	=====
500	=====
700	=====
850	▲▲=====
925	=====
1000	▼▼▼▼▼▼▼▼▼▼

Experiment is better than the reference with 95 % of confidence (t-student)

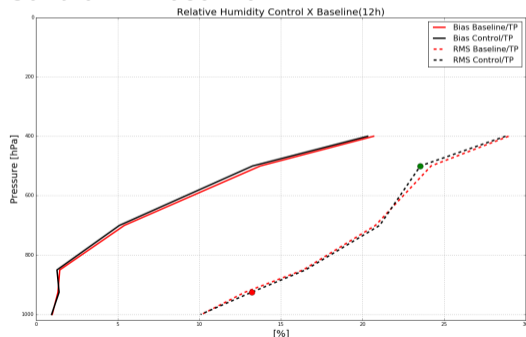
Reference is better than the Experiment with 95 % of confidence (t-student)

Period 1: Jan-Feb/2018

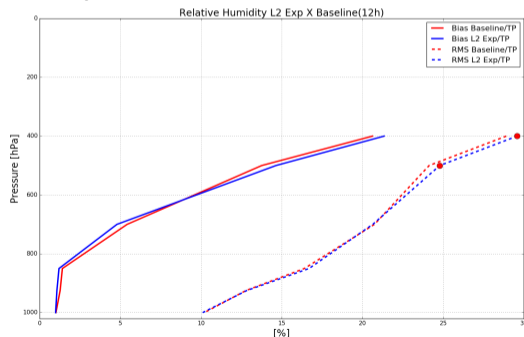
Reference is the radiosondes

Experiments Forecast Skills - Relative Humidity 12 hours Jan-Feb/2018

Control X Baseline



L2 Exp X Baseline

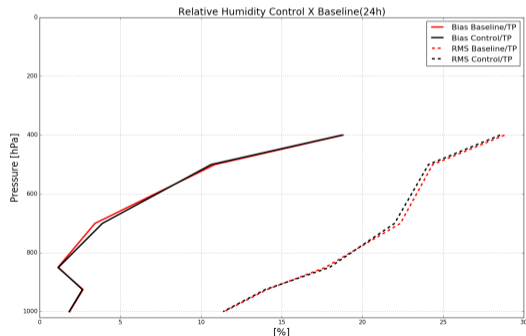


Experiment is better than the reference with **95 % of confidence** (t-student)

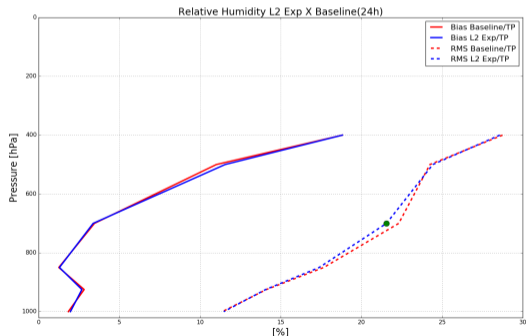
Reference is better than the Experiment with **95 % of confidence** (t-student)

Experiments Forecast Skills - Relative Humidity 24 hours Jan-Feb/2018

Control X Baseline



L2 Exp X Baseline



Experiment is better than the reference with **95 % of confidence** (t-student)

Reference is better than the Experiment with **95 % of confidence** (t-student)

Experiments Forecast Skills - Relative Humidity Jan-Feb/2018

Control X Baseline

Domain	FRANGP0025
100	
150	
200	
250	
300	
400	▲ = = = =
500	▲ ▲ = = ▲
700	= = = = ▲
850	= = = = =
925	= ▼ = = =
1000	▨ = = = =

L2 Exp X Baseline

Domain	FRANGP0025
100	
150	
200	
250	
300	
400	▼ ▼ = = =
500	= ▼ = = =
700	= = ▲ = =
850	= = = = =
925	= = = ▼ ▨
1000	= = = = =

Experiment is better than the reference with 95 % of confidence (t-student)

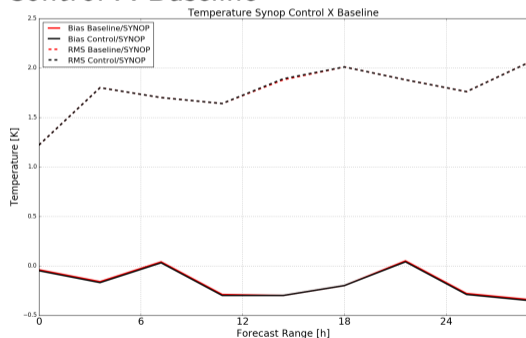
Reference is better than the Experiment with 95 % of confidence (t-student)

Period 2:Jan-Feb/2018

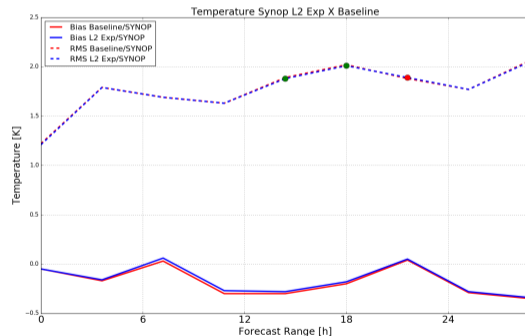
Reference is Synop data

Experiments Forecast Skills - Temperature Jan-Feb/2018

Control X Baseline



L2 Exp X Baseline

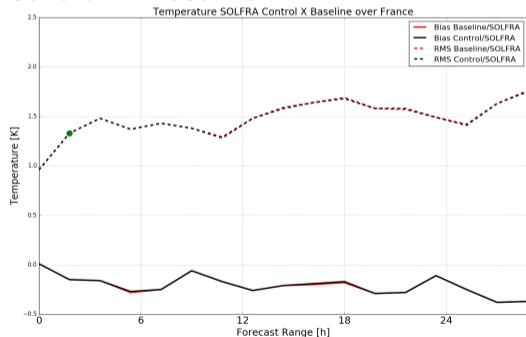


Period 2: Jan-Feb/2018

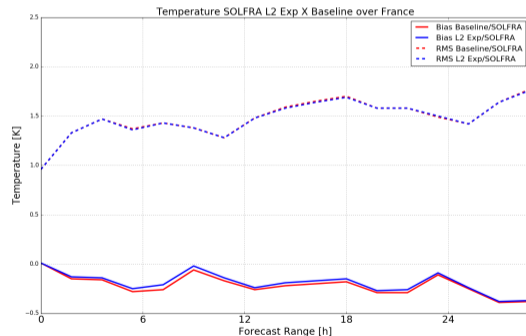
Reference is SOLFRA data

Experiments Forecast Skills - Temperature Jan-Feb/2018

Control X Baseline

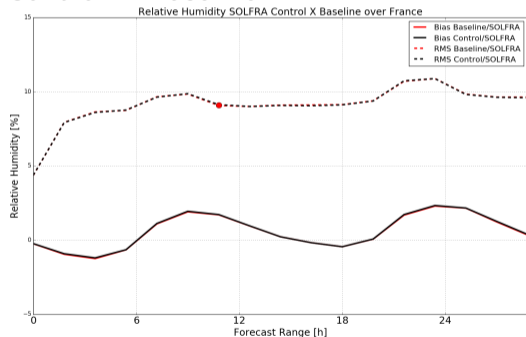


L2 Exp X Baseline

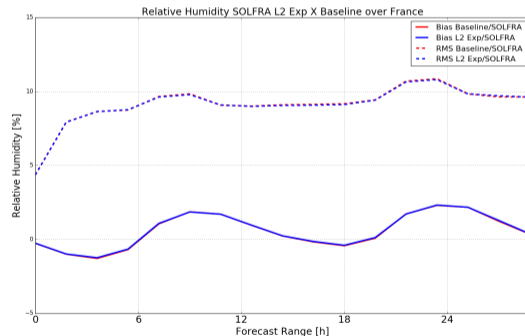


Experiments Forecast Skills - Relative Humidity Jan-Feb/2018

Control X Baseline



L2 Exp X Baseline



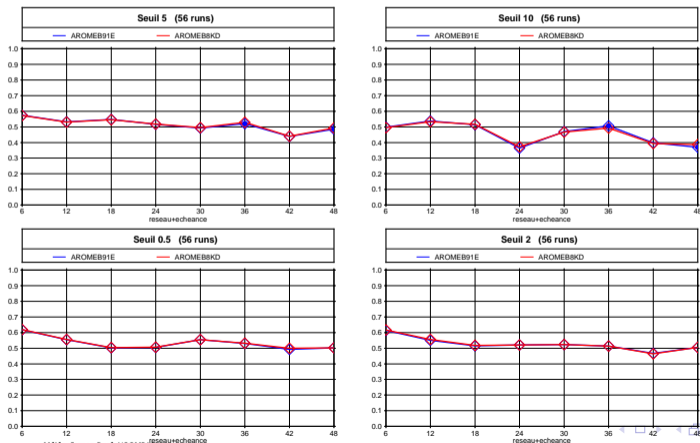
Precipitation scores (scores indicateur)

Brier Skill Scores (BSS_NO) with different neighborhood [1.3km](#), 20.6km, [52.8km](#) and 120.2km

The closer to 1 the score is, the best is the forecast.

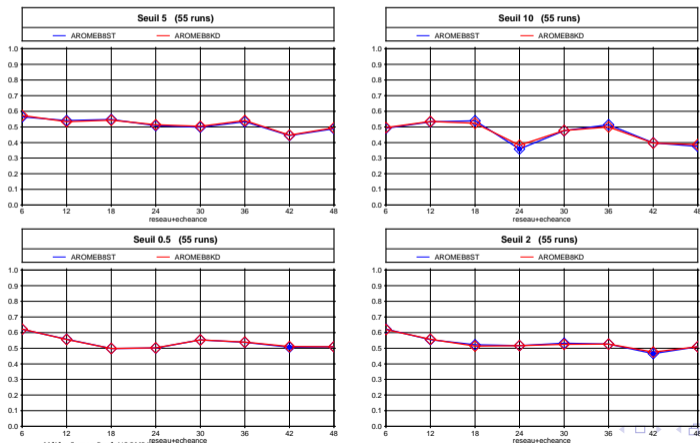
Control Experiment X Baseline

Contrôle probabiliste des précipitations 6h : Comparaison des modèles Réseau de 0 heure Voisinage 1.3 km
Grille FRANGP0025 BSS_NO en fonction de l'échéance+réseau / Période 20180102 - 20180302 / Référence BDCUMH

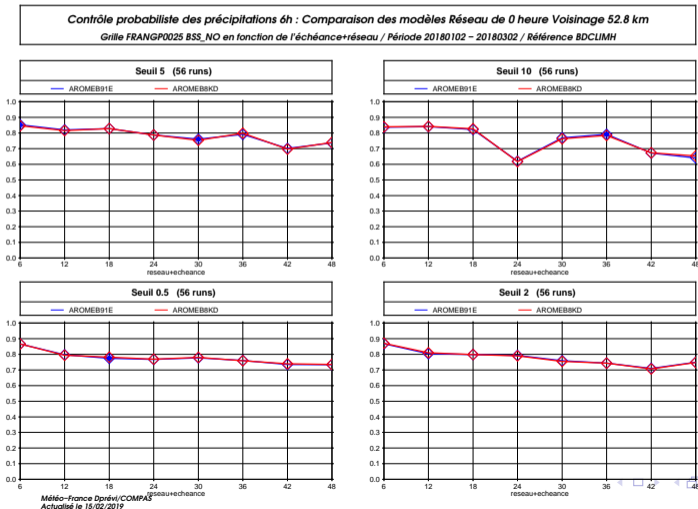


L2 Experiment X Baseline

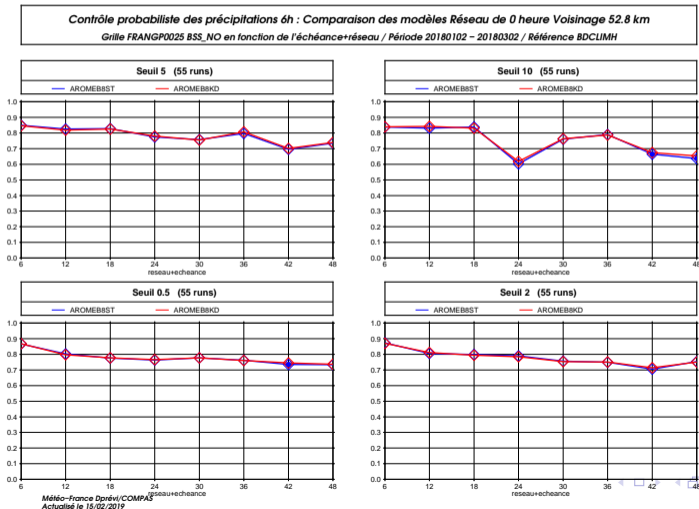
Contrôle probabiliste des précipitations 6h : Comparaison des modèles Réseau de 0 heure Voisinage 1.3 km
Grille FRANGP0025 BSS_NO en fonction de l'échéance+réseau / Période 20180102 - 20180302 / Référence BDCUMH



Control Experiment X Baseline



L2 Experiment X Baseline



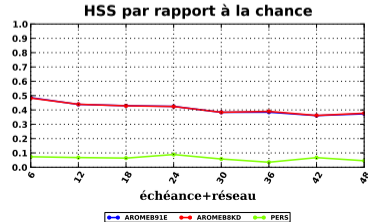
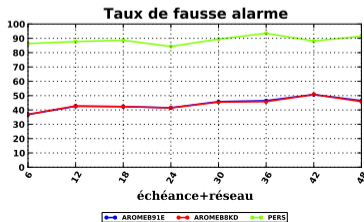
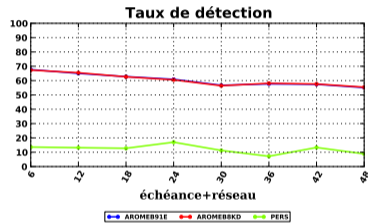
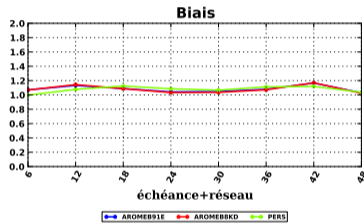
Precipitation scores (scores indicateur)

Bias frequency, detection rate, false alarm rate, Heidke skill scores (HSS)
0.5mm, 2mm, 5mm and 10mm

Control Experiment X Baseline - 5mm

Précipitations RR6 - réseau de 0 heure

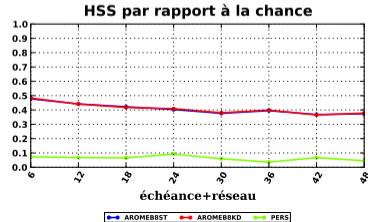
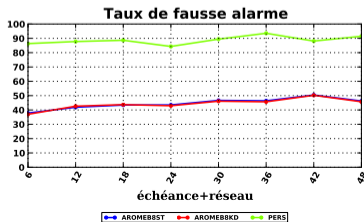
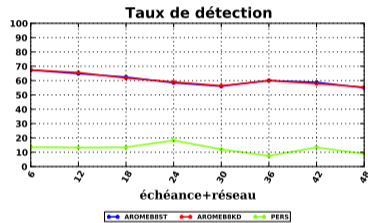
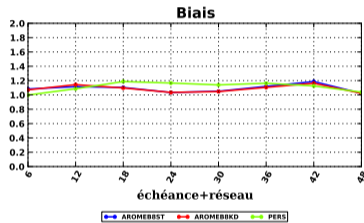
Période 20180102 - 20180302 - grille de contrôle FRANGP0025 - seuil 5.0mm - référence BDCLIMH



L2 Experiment X Baseline - 5mm

Précipitations RR6 - réseau de 0 heure

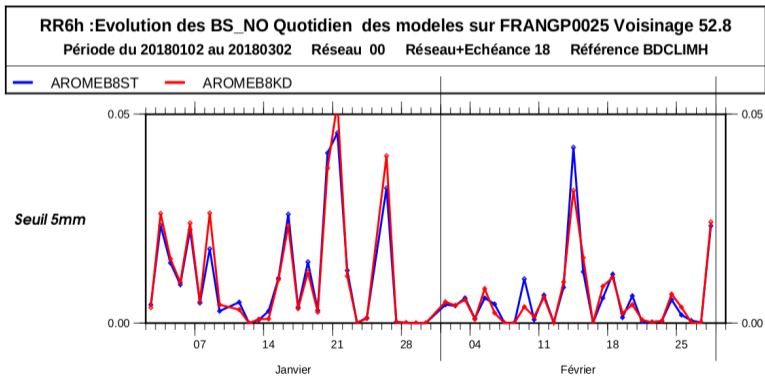
Période 20180102 - 20180302 - grille de contrôle FRANGP0025 - seuil 5.0mm - référence BDCLIMH



Precipitation scores (scores indicateur)

Brier Scores (BS_NO) with neighborhood 52.8km and 18h forecast

The closer to 0 the score is, the best is the forecast.

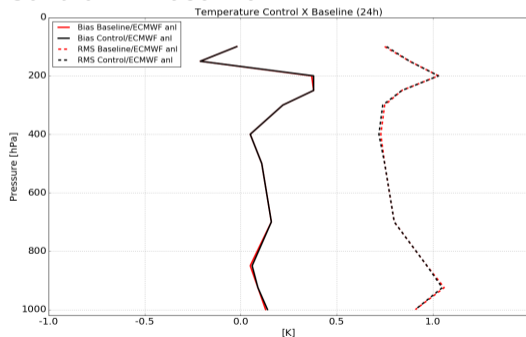


Period 2:15/Jul to 15/Sep/2017
Reference is the ECMWF analysis

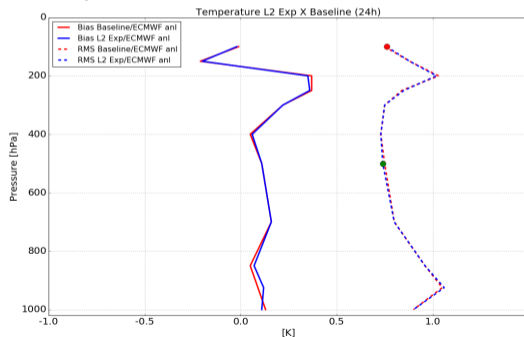
Experiments Forecast Skills - Temperature 24 hours

15/Jul-15/Sep/2017

Control X Baseline



L2 Exp X Baseline



Experiment is better than the reference with **95 % of confidence** (t-student)

Reference is better than the Experiment with **95 % of confidence** (t-student)

Experiments Forecast Skills - Temperature

15/Jul-15/Sep/2017

Control X Baseline

Domain	FRANGP05
100	▒▒▒ = = = ▒▒ = = = =
150	▒▒ = = = = = = = =
200	▲▲ = = = = = = ▼
250	= = = = = = = =
300	= = = = ▒▒ = = = =
400	= = ▒▒ = = = = = =
500	= = = = = = = =
700	▼▼ = = = = = =
850	= = = = = = = =
925	= = = = = = = =
1000	= = = = ▒▒ = = = =

L2 Exp X Baseline

Domain	FRANGP05
100	▼▼▼ = = = = = =
150	▒▒ = = = = = = = =
200	▼▼ = = = = = = = =
250	= = = = = = = =
300	= = = ▒▒ = = = = ▒▒
400	▲ = = = = = = = =
500	= ▒▒ = ▒▒ ▲ = = = = =
700	= = = = = = = =
850	= ▒▒ = = = ▒▒ ▒▒ ▲ =
925	= = = ▒▒ = = = = = =
1000	▲▲▲ = = = = = = =

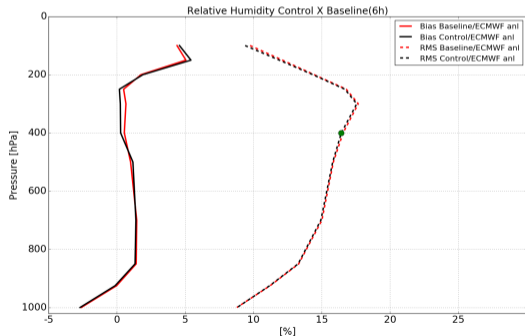
Experiment is better than the reference with 95 % of confidence (t-student)

Reference is better than the Experiment with 95 % of confidence (t-student)

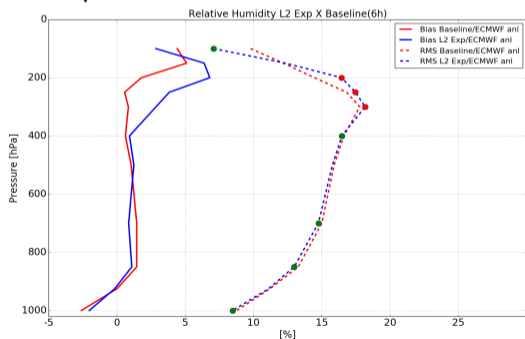
Experiments Forecast Skills - Relative Humidity 6 hours

15/Jul-15/Sep/2017

Control X Baseline

















L2 Exp X Baseline



















































































Experiments Forecast Skills - Relative Humidity

15/Jul-15/Sep/2017

Control X Baseline

Domain	FRANGP05
100	=====
150	=====
200	=====  =====
250	 =====  =====
300	  =====  =====
400	  =====  =====
500	=====  =====
700	=====  =====
850	=====
925	=====
1000	  =====  =====

L2 Exp X Baseline

Domain	FRANGP05
100	          
150	=====  ===== 
200	           
250	           
300	           
400	=====   =====
500	=====   =====
700	  =====  =====
850	  =====  =====
925	=====         
1000	           

Experiment is better than the reference with 95 % of confidence (t-student)

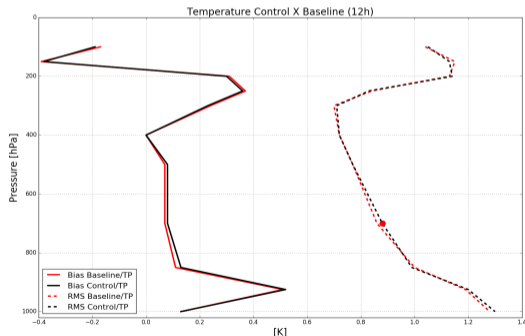
Reference is better than the Experiment with 95 % of confidence (t-student)

Period 2:15/Jul to 15/Sep/2017
Reference is the radiosondes

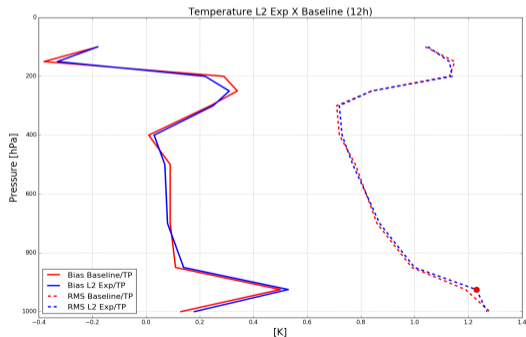
Experiments Forecast Skills - Temperature 12 hours

15/Jul-15/Sep/2017

Control X Baseline



L2 Exp X Baseline










Experiment is better than the reference with **95 % of confidence** (t-student)

Reference is better than the Experiment with **95 % of confidence** (t-student)



Experiments Forecast Skills - Temperature

15/Jul-15/Sep/2017

Control X Baseline

Domain	FRANGP0025
100	= = =  = =
150	= = = = =
200	= = = = 
250	= = = = =
300	= = = = =
400	= = = = =
500	= =  = 
700	=  = = =
850	= = =  =
925	= = =  =
1000	= = = = =

L2 Exp X Baseline

Domain	FRANGP0025
100	= = = = =
150	= = = = =
200	= = = = =
250	= = = = =
300	= = = = =
400	= = = = =
500	= = = = =
700	= =  = =
850	= = = = =
925	=  = = =
1000	= = = = =

Experiment is better than the reference with **95 % of confidence** (t-student)

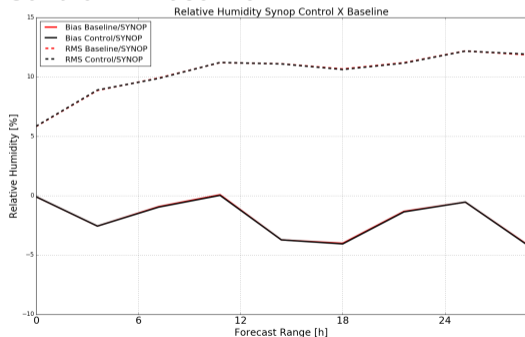
Reference is better than the Experiment with **95 % of confidence** (t-student)

Period 2:15/Jul to 15/Sep/2017
Reference is Synop data

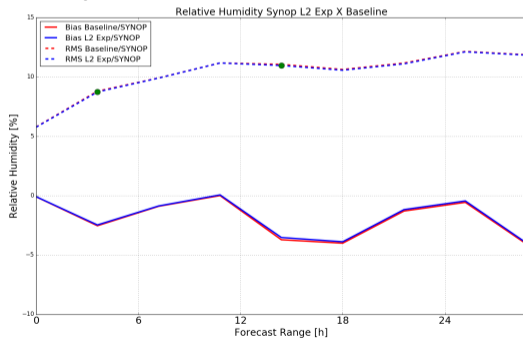
Experiments Forecast Skills - Relative Humidity

15/Jul-15/Sep/2017

Control X Baseline



L2 Exp X Baseline

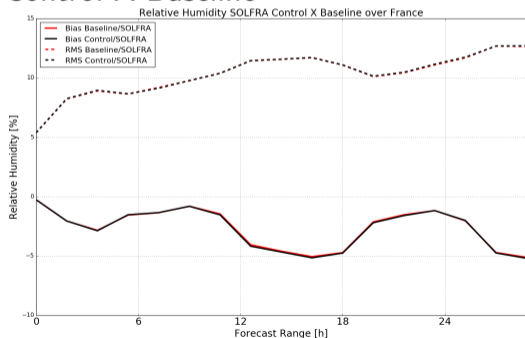


Period 2:15/Jul to 15/Sep/2017
Reference is SOLFRA data

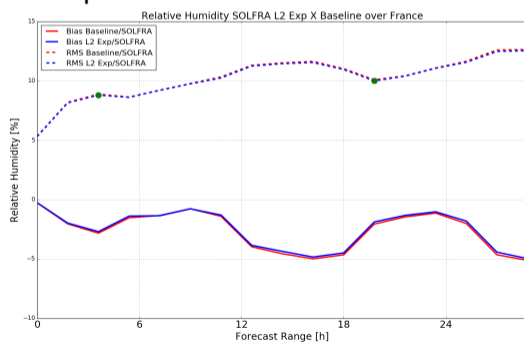
Experiments Forecast Skills - Relative Humidity

15/Jul-15/Sep/2017

Control X Baseline



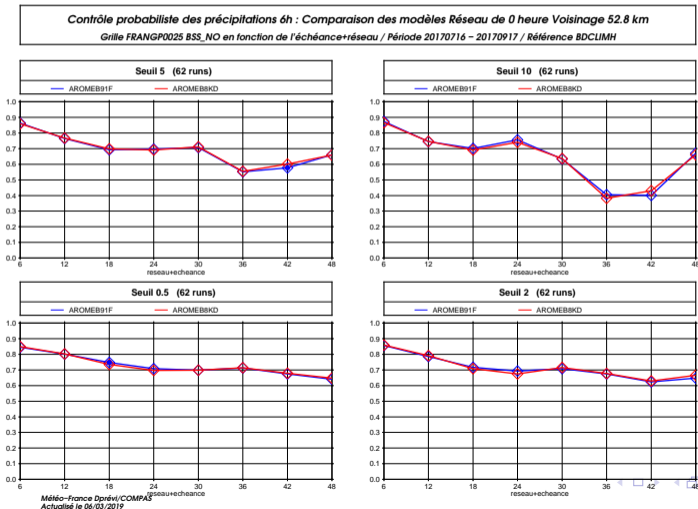
L2 Exp X Baseline



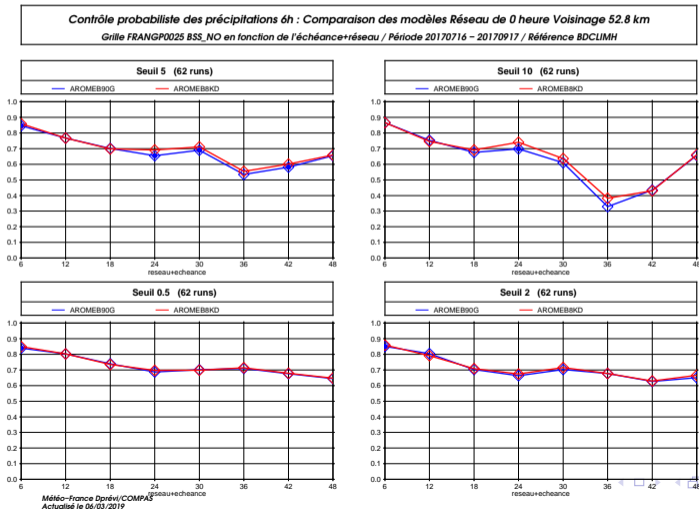
Precipitation scores (scores indicateur)

Brier Skill Scores (BSS_NO) with different neighborhood 1.3km, 20.6km, 52.8km and 120.2km The closer to 1 the score is, the best is the forecast.

Control Experiment X Baseline



L2 Experiment X Baseline



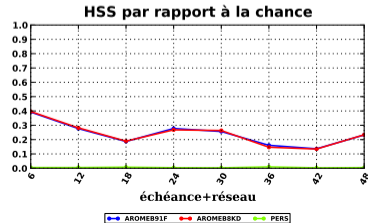
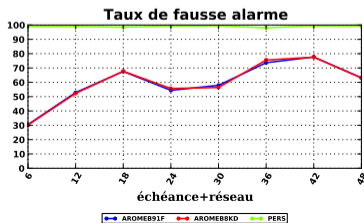
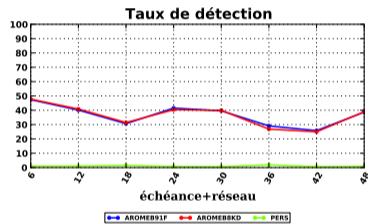
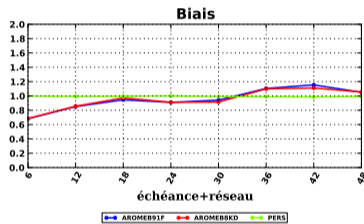
Precipitation scores (scores indicateur)

Bias frequency, detection rate, false alarm rate, Heidke skill scores (HSS)
0.5mm, 2mm, 5mm and 10mm

Control Experiment X Baseline - 10mm

Précipitations RR6 - réseau de 0 heure

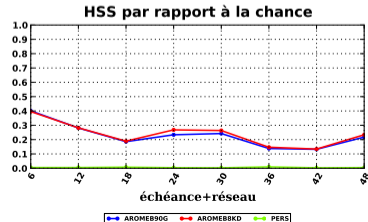
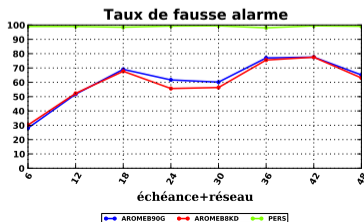
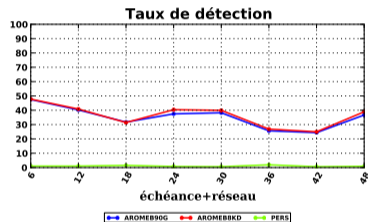
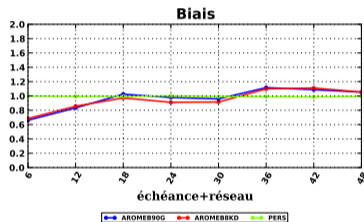
Période 20170716 - 20170917 - grille de contrôle FRANGP0025 - seuil 10.0mm - référence BDCLIMH



L2 Experiment X Baseline - 10mm

Précipitations RR6 - réseau de 0 heure

Période 20170716 - 20170917 - grille de contrôle FRANGP0025 - seuil 10.0mm - référence BDCLIMH



Conclusion - Experiments winter and summer

- The L2 experiment helped to decrease the first guess and the analysis departure of the other observations.
- L2 experiment has scores comparable with the control experiment (L1 product)

Next Steps:

The precipitation scores evaluation
(scores calculated by Pierre)

Case Studies

Thomas August suggested 2 case studies.

Experiments Case Study 1: May, 26th 2018

Hail storm in Bordeaux and Cognac

Experiments Case Study 2: July, 4th 2018

Storm in Dordogne

Case Study 1: May, 26th 2018.

Experiments: May, 23rd to May, 28th 2018

L'averse a duré une dizaine de minutes avec une rare intensité. Les trottoirs sont devenus blancs, couverts de grêlons.

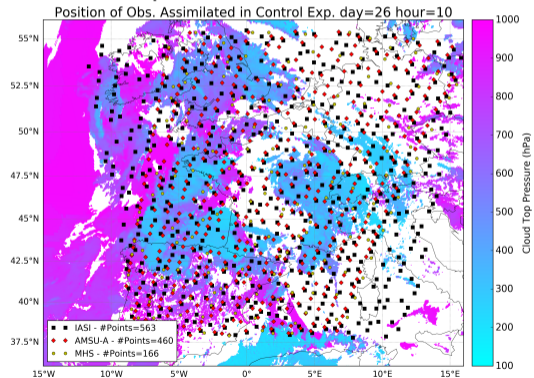


© Delphine Vialanet - France 3 Aquitaine

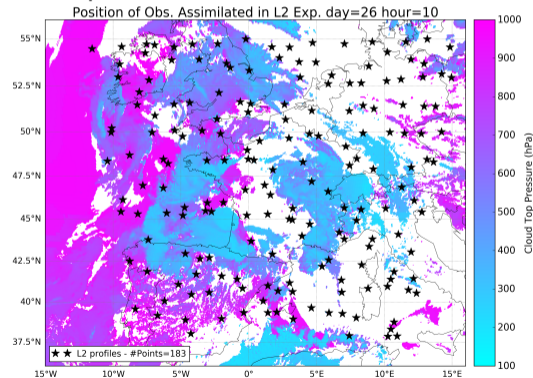
Les pompiers sont actuellement débordés d'appels.

Position of Observation Assimilated - Case Study 1

Control Experiment



L2 Experiment



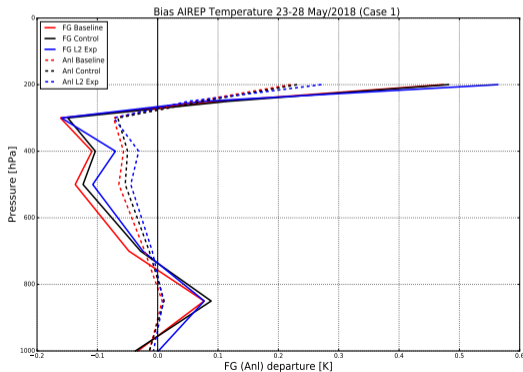
First Guess and analysis departure (OMF and OMA)

Observations: AIREP Temperature, Radiosondes Humidity and radar (relative humidity and wind)

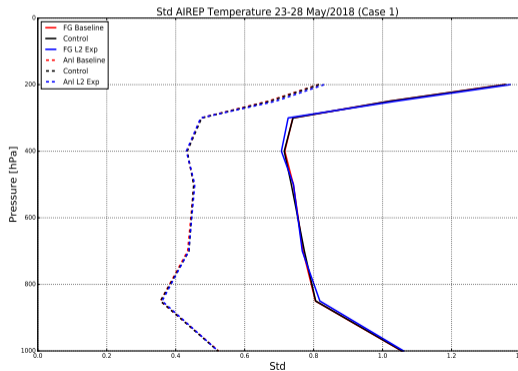
Impact in others observations May,23rd to May,28th 2018

AIRCRAFT Temperature

Bias



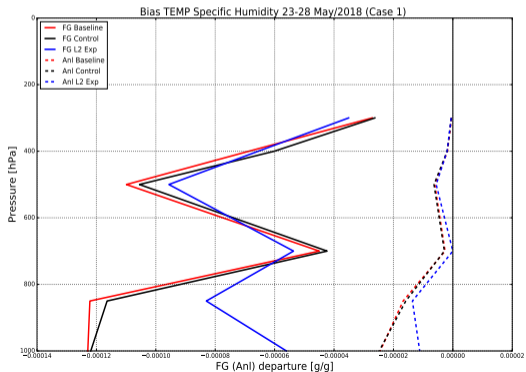
Standard Deviation



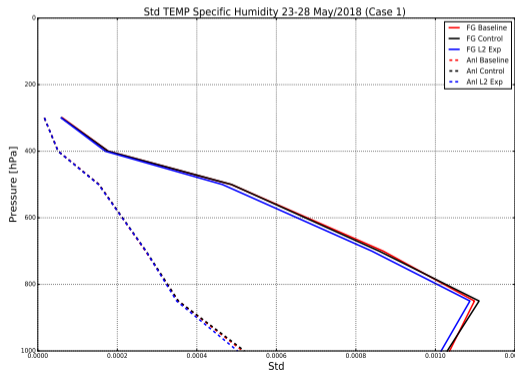
Impact in others observations May,23rd to May,28th 2018

Radiosondes Specific Humidity

Bias



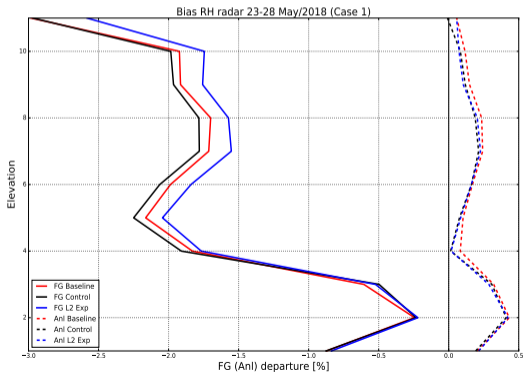
Standard Deviation



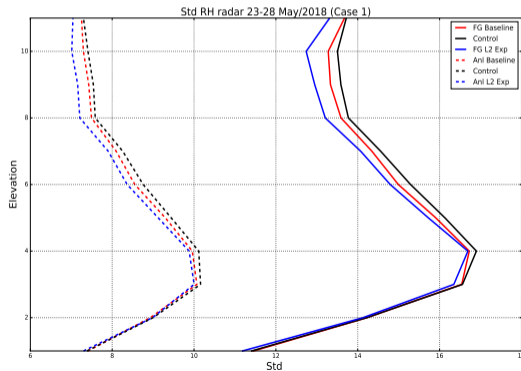
Impact in others observations May,23rd to May,28th 2018

Radar Relative Humidity

Bias



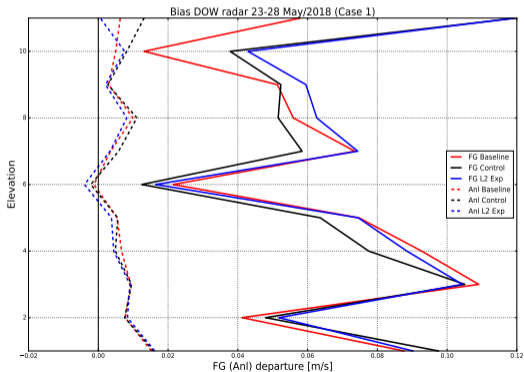
Standard Deviation



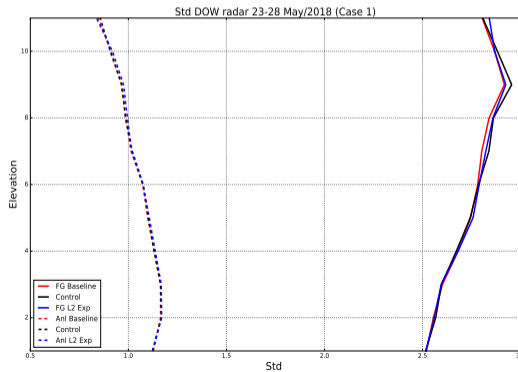
Impact in others observations May,23rd to May,28th 2018

Radar DOW

Bias



Standard Deviation



Case Study 2: July, 4th.

Experiment: July, 1st to July, 6th 2018

En images : le Sud-Ouest touché par les orages

À LA UNE / ENVIRONNEMENT / MÉTÉO / Publié le 04/07/2018 à 16h42. Mis à jour le 05/07/2018 par [SUD-OUEST.fr](#)

S'ABONNER À PARTIR DE € [f](#) [t](#) [8+](#) [in](#) 15 COMMENTAIRES



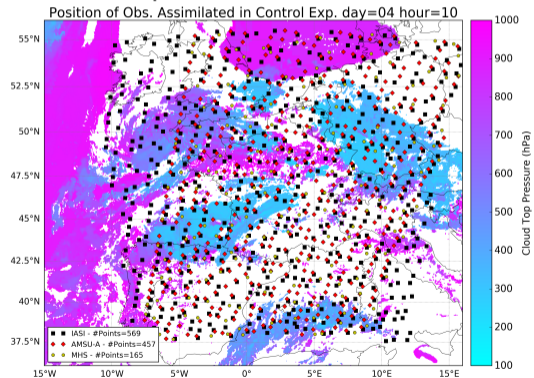
À La rue Pierre Semard à Périgueux sous l'eau ©PHOTO INTERVALITE

Les premiers éclairs et averses de grêle ont frappé la région mercredi après-midi. Tour d'horizon.

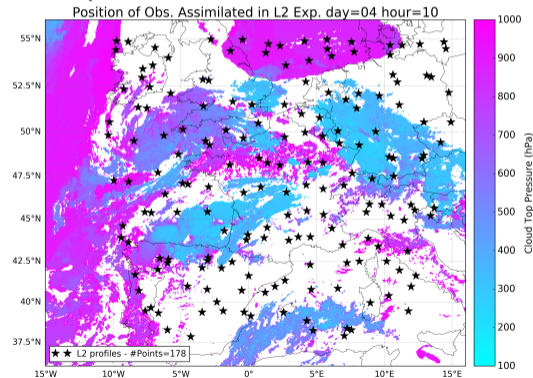
PREMIUM
Sur Web, Tablette et Mobile

Position of Observation Assimilated - Case Study 2

Control Experiment



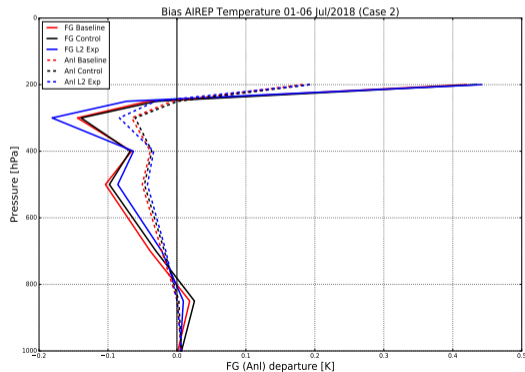
L2 Experiment



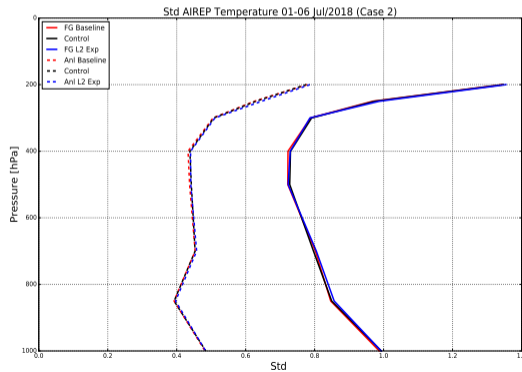
Impact in others observations July, 1st to July, 6th 2018

AIRCRAFT Temperature

Bias



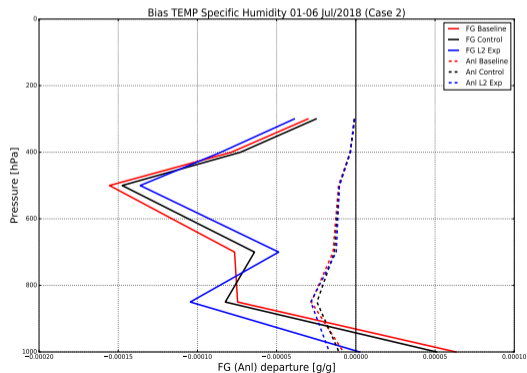
Standard Deviation



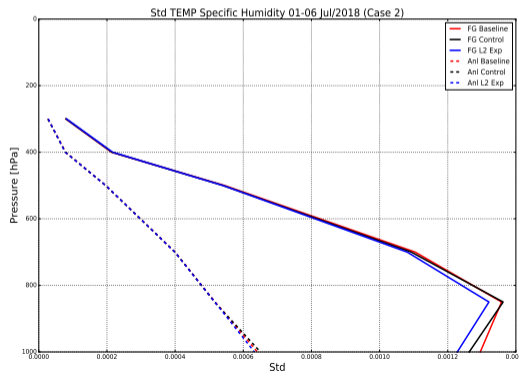
Impact in others observations July, 1st to July, 6th 2018

Radiosondes Specific Humidity

Bias



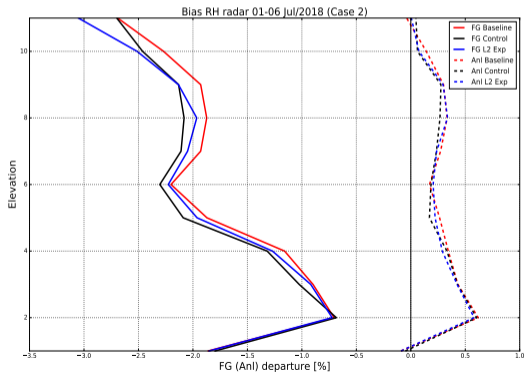
Standard Deviation



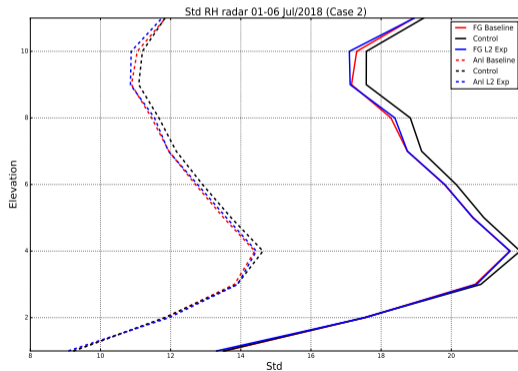
Impact in others observations July, 1st to July, 6th 2018

Radar Relative Humidity

Bias



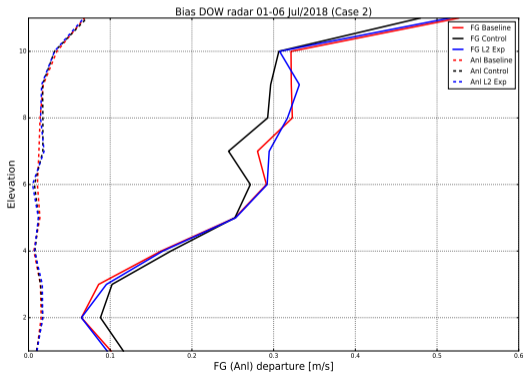
Standard Deviation



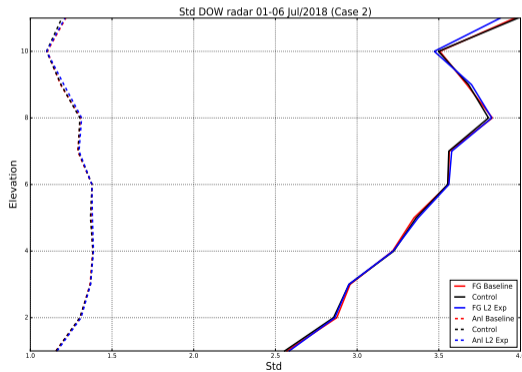
Impact in others observations July, 1st to July, 6th 2018

Radar DOW

Bias

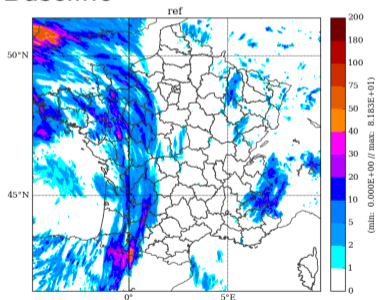


Standard Deviation

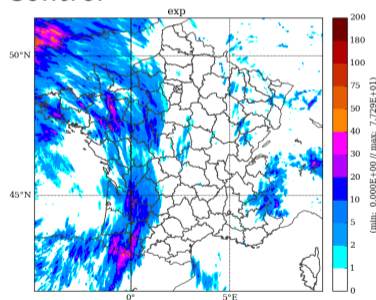


Precipitation accumulated in 24h - 2018-05-26 12UTC - 2018-05-27 12UTC

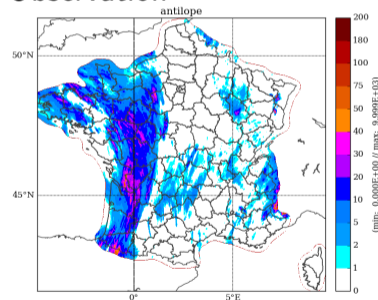
Baseline



Control



Observation



It is also possible evaluated the precipitation accumulated in different time scale, for example, 12 hours.

Conclusions - Case Studies

- The OMF and OMA of observations (radiosondes and AIRCRAFT) are similar between the two long period experiments. Notice an improvement in the humidity in the same levels.
- Detailed study of meteorological situation and precipitation evaluation

Next Steps

- Statistics of the new long period experiment (15/May to 15/Jul/2018) **not start**
- Perform different setup for study case 1
 - try to observation close to the surface (L2 Exp3) **in progress**
 - observation error used in the L2 Exp2 **not start**
 - try to assimilate data no thinned **not start**
- More statistics will be provided (precipitation) **in progress**
- Detailed study of meteorological situation and precipitation evaluation (study cases) **in progress**
- 48 hours forecast starting 12 UTC (Summer and winter experiments) **not start**
- We will propose the paper structure, the figures and tables that will be used in the article **not start**