30^{th} ALADIN Workshop and HIRLAM ASM 2020

SoFog3D field campaign and improvement of fog forecast at hectometric scale

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The field campaign SoFog3D : Why ?

- Fog : high economical and safety impact (aeronautic)
- The challenges associated with fog prompted Météo-France to include the improvement of fog forecast in its target and performance contract of 2021
- Evaluate and validate the AROME's fog forecast at hectometric resolution
- Improve comprehension of 3D fog caracteristics (dynamics, radiation, microphysics and surface flux)

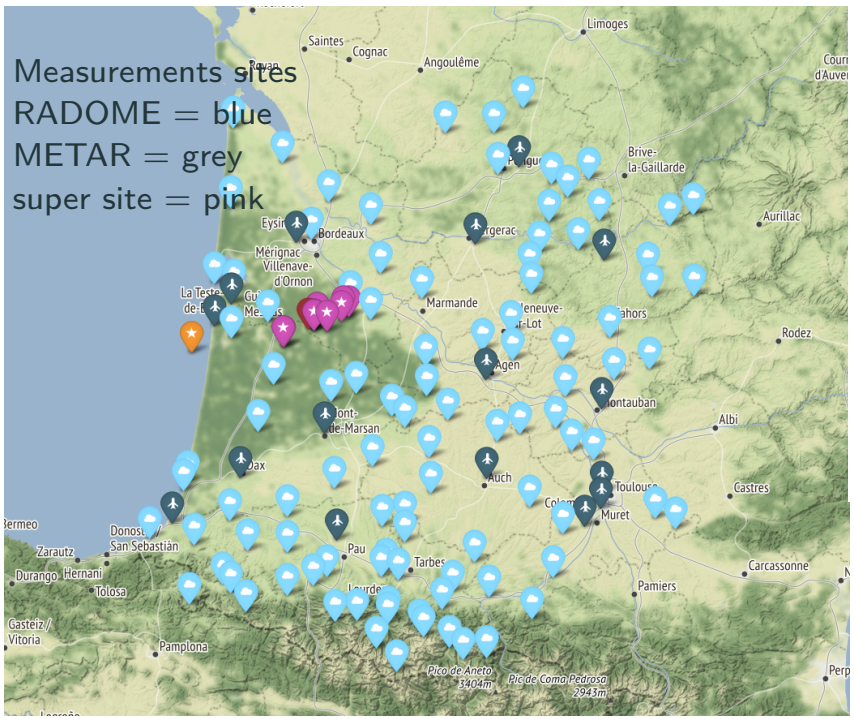
The field campaign SoFog3D : Who ?

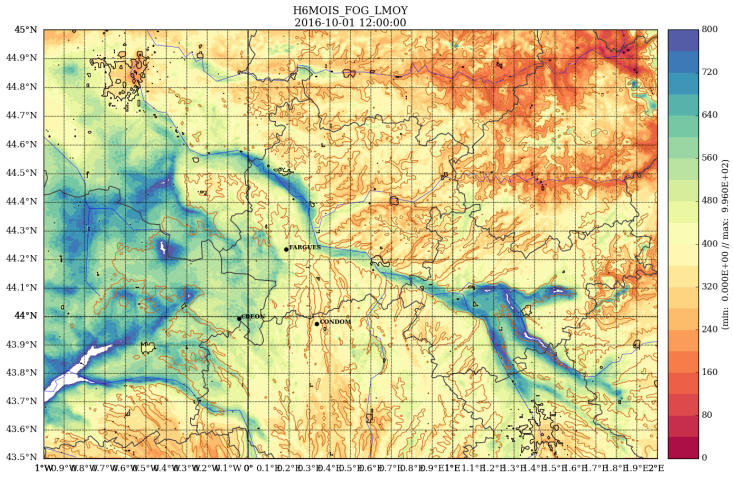
International project :

- Météo-France
- SoFog3D ANR project (4 years): IPSL/LMD, IPSL/LATMOS
- French lab / organisms : IRSN, ONERA, LA, IFSTTAR (LRPC)...
- UKMO : instalation of a measurement station with 50m mast (measurement of temperature, wind, humidity, visibility ..)
- MWR Network (TOPROF COST action) : University of Cologne (lent of a radiometer), MeteoSwiss, RPG, Attex

The field campaign SoFog3D : When and Where ?

- Between October 2019 and March 2020
- In the south west of France with a "super site" of measurements at St-Symporien

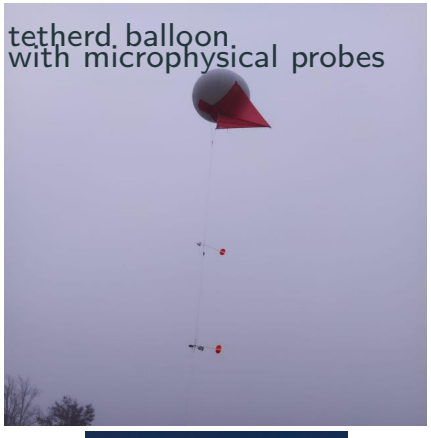




AROME fog climatology : total number of hours of fog over 6 months (October 2016 - March 2017).

The field campaign SoFog3D : How ?

- Continuous measurements with in-situ stations (17), BASTA radar, radiometer (6)
- IOP with tethered balloon, radiosounding and Unmanned Aerial Vehicle



IOP summary

- 15 IOPs and 20 nights of observation
- Observation of radiative fog, advective fog and stratus lowering fog
- 79h of fog observation with a mean of 4h, a minimum of 0h and a maximum of 12h
- fog often thin and not generalized

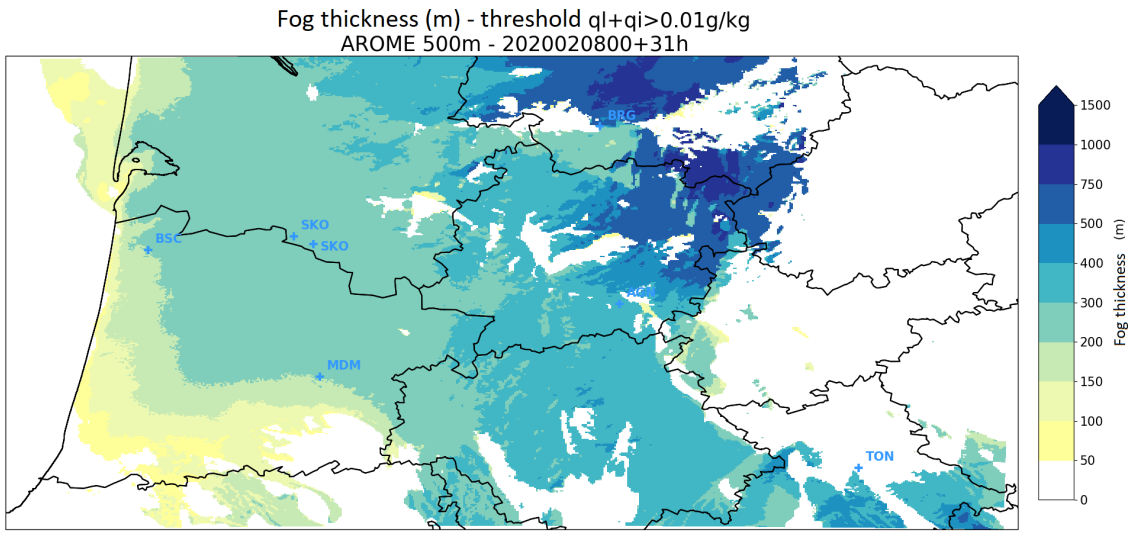
AROME configuration for the SoFog3D campaign

- Initialized and coupled with operational AROME
- A smaller domain covering south west of france
- 2 resolutions :

  . 1250m horizontal resolution, 90 vertical levels, first level at 5m

  . 500m horizontal resolution, 156 vertical levels, first level at 1m

(*Philip et al., 2016*)

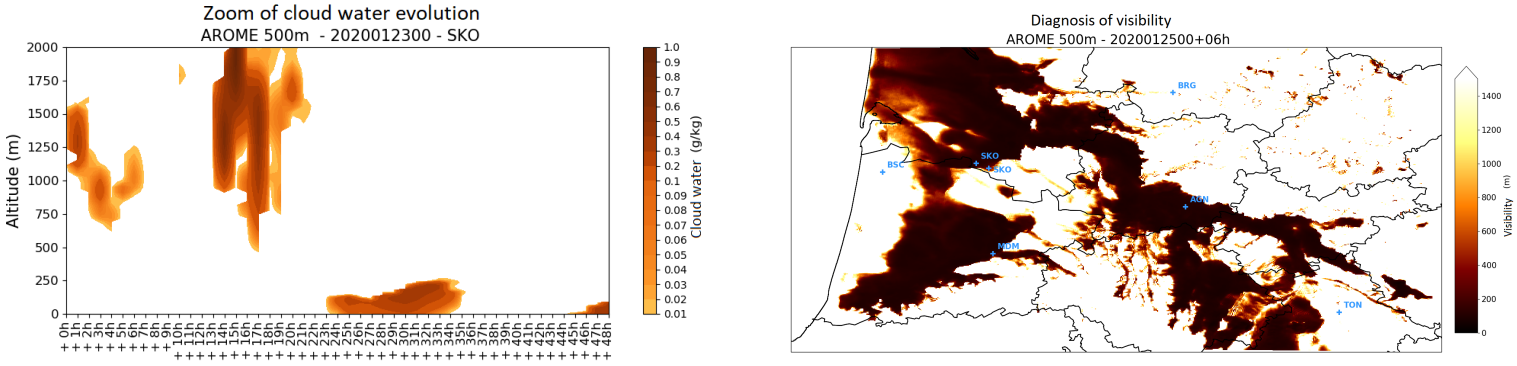


Domain of the daily forecast

Daily AROME run

2 daily real time runs with added diagnostics during the campaign :

- 1250m horizontal resolution, ICE3 and ECOCLIMAP1
- 500m horizontal resolution, ICE3 and ECOCLIMAP1



Example of forecast : AROME-500m time serie of liquid water vertical profiles (left) visibility diagnostics (right).

Available for all on `http://www.umr-cnrm.fr/arome-sofog3d/`

Some other AROME experiments

2 microphysic schemes :

ICE3 (Pinty and Jabouille, 1998) - 1 moment scheme

LIMA (Vié et al., 2016) - 2 moment scheme

2 microphysic schemes modification :

Taken into account a **deposit term** (Mazoyer et al., 2017) (constant parameterized speed applied at the lowest model level) - test for LIMA and ICE3

Improve **consistency between radiation and microphysical** scheme (taken into account the dropplets size) - only LIMA

2 surface data bases :

ECOCLIMAP1 - resolution of 1000m , operationnal

ECOCLIMAPSG - resolution of 300m , test for AROME-500m

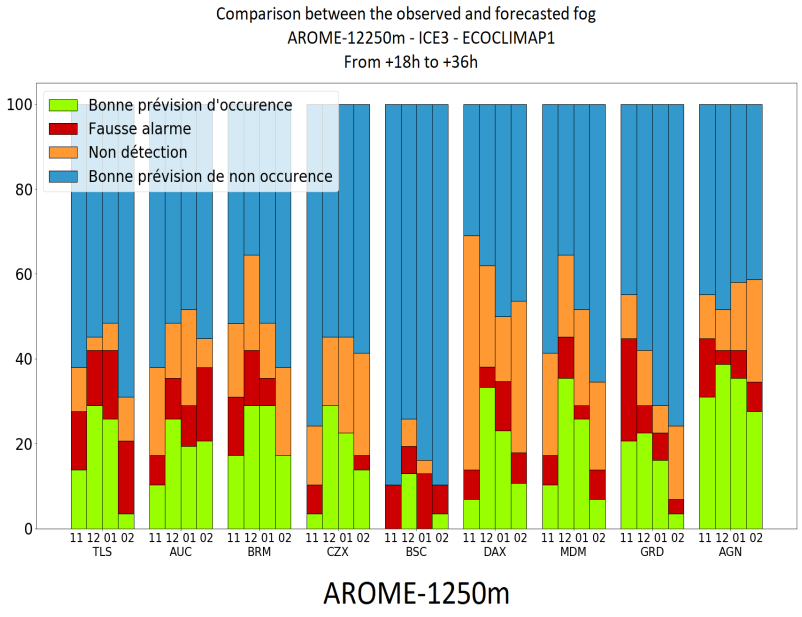
Evaluation of AROME fog forecast : IOPs

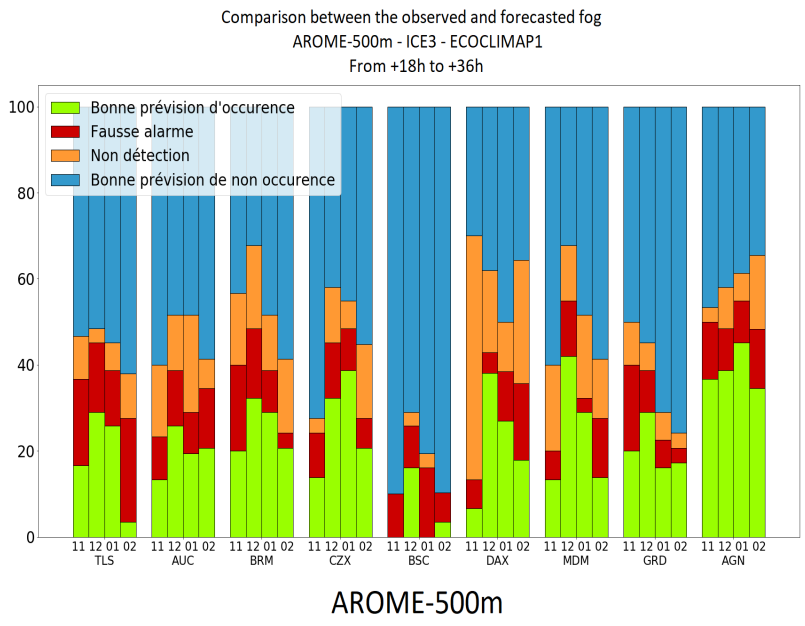
Results for the 2 reference experiments, forecasts on the super site during 15 IOPs with 20 nights of observations :

- 10% good forecast
- 15% false alarm
- 60% too long fog forecast
- 5% too short forecast

Too many too-long events forecast by the models : realy interesant to understand why !

Evaluation of AROME fog forecast : RADOME stations





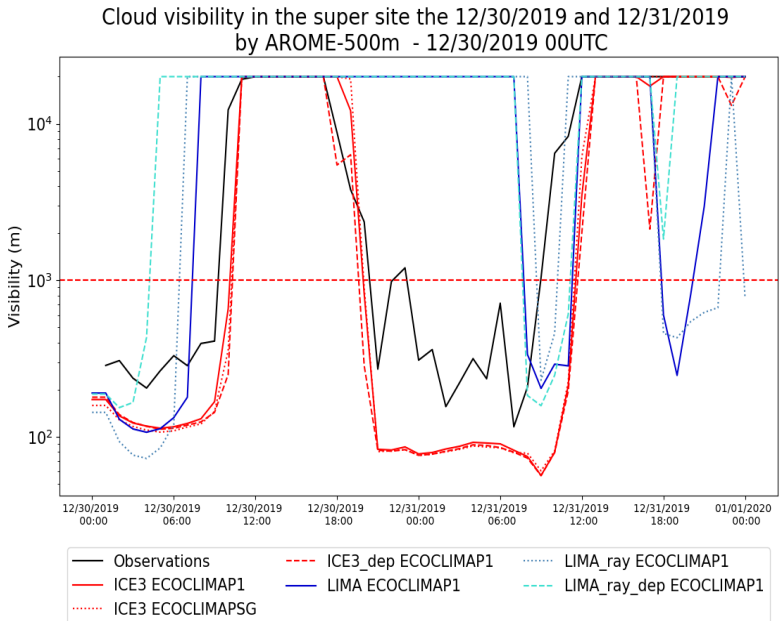
Good forecast (BPO), false alarms (FA) and no detections (ND) rates according to the months on several measurement sites, from +18h to +36h.

	From +18h to +36h		
	GFO	FA	ND
AROME-1250m	**18.8**	**8.6**	**15.9**
AROME-500m	**22.4**	**11.6**	**12.3**

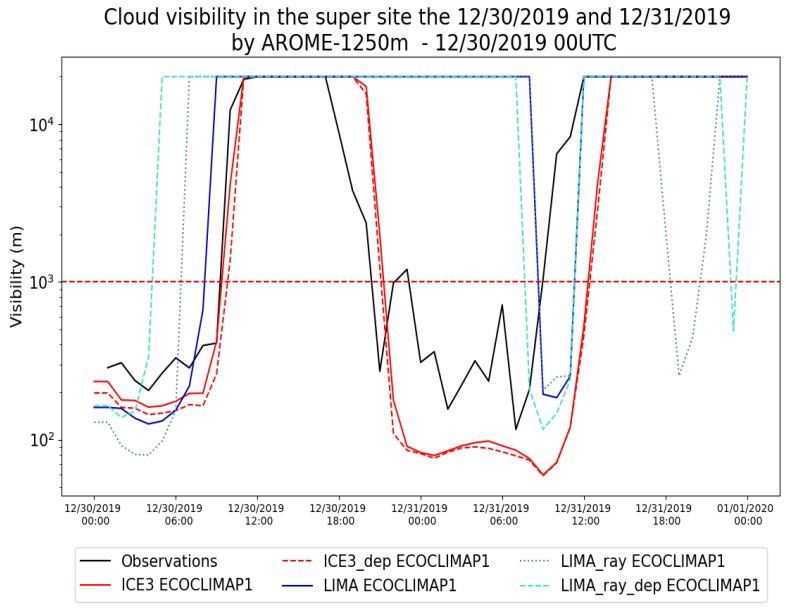
Case of the 30th December 2019

Minimum of visibility over the past hour

AROME-500m



AROME-1250m



- No hourly variability in the forecast
- Too low values of visibility for ICE3 but a relative good temporal evolution and no big differences between ICE3 experiences
- Not enough fog by LIMA's experiences
- LIMA's modifications reduce the fog duration

Outlook

- First evaluation of AROME fog forecast : too many fog events and too long fog events forecast by models.

When SoFog3D data will be available, possibility to :
- Evaluate the impact of the new surface data base ECOCLIMAPSG
- Evaluate and compare LIMA and ICE3 microphysics modifications on entire campaign period
- Improve the deposit term parametrisation

Thank you for your attention

Any questions ?

References

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