EVALUATIONS OF AROME DURING SOFOG3D CAMPAIGN

Salomé ANTOINE
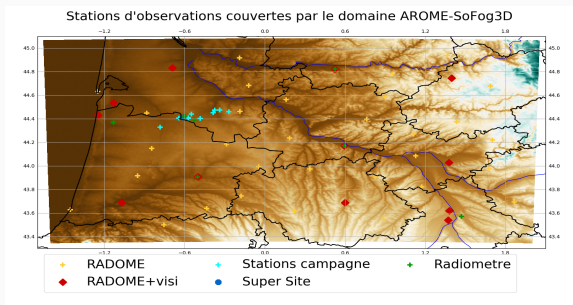Supervised by : Rachel HONNERT et Yann SEITY

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Météo-France - CNRM/GMAP/PROC

AROME configuration for the SoFog3D campaign

- Initialized and coupled with operational AROME (Seity et al. 2011 [1])
- 2 grids :

. 1250m horizontal resolution, 90 vertical levels, first level at 5m
. 500m horizontal resolution, 156 vertical levels, first level at 1m
(Philip et al. 2016 [2])

- A small domain covering the South West of France

Orography in AROME-500m on its forecast domain and location of observations

Stations d'observations couvertes par le domaine AROME-SoFog3D

RADOME Stations campagne Radiometre
RADOME+visi Super Site

Daily AROME run during campaign

2 daily runs in operational conditions with additional diagnostics during the campaign :
- 1250m horizontal resolution and
- 500m horizontal resolution
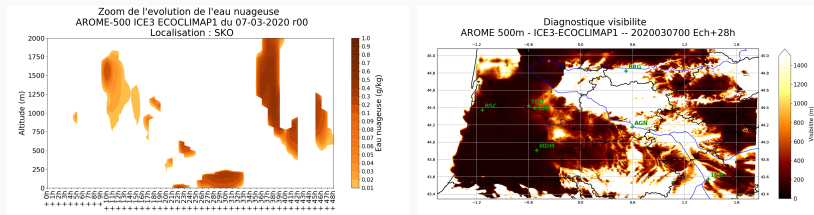
Example of forecast : AROME-500m time serie of liquid water vertical profiles (left) visibility diagnostics (right).

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

Some additional sensitivity tests

2 microphysic schemes

. **ICE3** (Pinty and Jabouille 1998 [3]) - 1 moment scheme
. **LIMA** (Vié et al. 2016 [4]) - 2 moment scheme

modification of the 2 microphysic schemes

. Take into account a **deposit term** (Mazoyer et al. 2017 [5])
(constant parameterized speed applied at the lowest model
level) (test for LIMA and ICE3)
. Improve **consistency between radiation and
microphysical** schemes (taken into account the dropplet size)
(test only for LIMA)

2 surface data bases

. **ECOCLIMAP1** - resolution of 1000m , operationnal
. **ECOCLIMAPSG** - resolution of 300m , test for
AROME-500m

Forecast separation of 6h section ; I use the **forecast lead time between 18 and 30**

Découpage des échéances modèles pour l'étude statistique
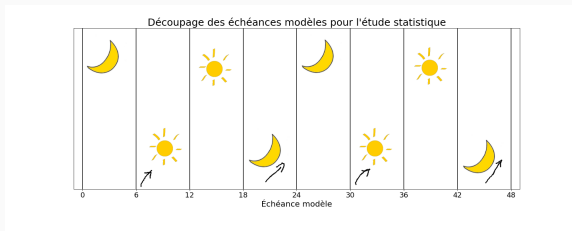
Study using the visibility parameter
I look for the first time when visibility falls below the 1000 m thresholds and the last, between the deadline 18 and 30.
The number of fog events in a night is the number of time where the visibility throught the 1000m threshold.

Study on all the RADOME stations (12) to have a global idea of forecast trends, then study on the Super site measures.

More fog events forecast by AROME-500m than by AROME-1250m :
best detection rate but also more false alarms.

Study using visibility

forecast lead time +18h à +24h

	CSI	DR	FAR	FBI
1250m	0.25	29.49	40.65	0.5
500m	0.32	44.87	46.97	0.85

forecast lead time +25h to +30h

	CSI	DR	FAR	FBI
1250m	0.38	49.81	37.74	0.8
500m	0.43	67.92	41.13	1.05

forecast lead time +31h à +36

	CSI	DR	FAR	FBI
1250m	0.34	60.78	55.87	1.38
500m	0.34	65.57	58.83	1.59

Hour of first fog event begining
AROME-1250m VS AROME-500m
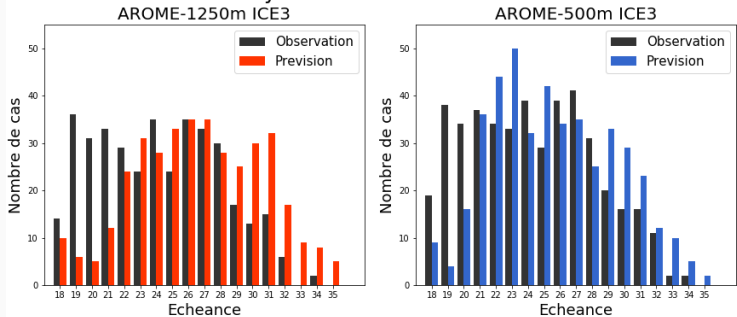
The forecast events begin later than the observed events (the **same thing could be observed at the dissipation of fog**).
The fog events forecast by models are longer and more persistant than observed events.

The fog events forecast by LIMA / ICE3 : worse detection rate but best false alarm rate with LIMA.

Study using visibility

forecast lead time +18h to +24h

	CSI	DR	FAR	FBI
ICE-3	0.41	68.97	50.0	1.38
LIMA	0.38	41.38	20.0	0.52

forecast lead time +25h to +30h

	CSI	DR	FAR	FBI
ICE-3	0.45	82.5	50.75	1.69
LIMA	0.39	50.0	36.67	0.79

forecast lead time +31h to +36

	CSI	DR	FAR	FBI
ICE-3	0.37	84.62	60.0	2.12
LIMA	0.34	52.0	50.0	1.04

AROME-500m ICE3 VS AROME-500m LIMA

Events duration
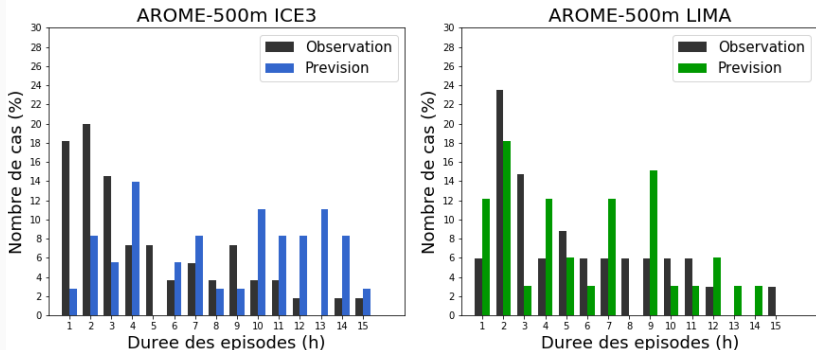
LIMA forecast more short event than ICE3.

Conclusion of the statistical study

- AROME-500m forecast more fog than AROME-1250m, best detection rate but worse false alarms
- Fog starts too late in forecast compared to observations.
- Few short fog event by ICE-3, a bit more by LIMA.

Choice of the IOP to study

I begin with the IOP-14 but AROME behaved quite well on this date and don't correspond at my general statistics.
Choice of the night :
- **4 to 5 December** : False alarm
- **5 to 6 December** : missing of fog dissipation
- **6 to 7 December** : issue at the dissipation
- **5 to 6 January** : One of the best campaign event, will well vertically developped fog event. **Show here.**
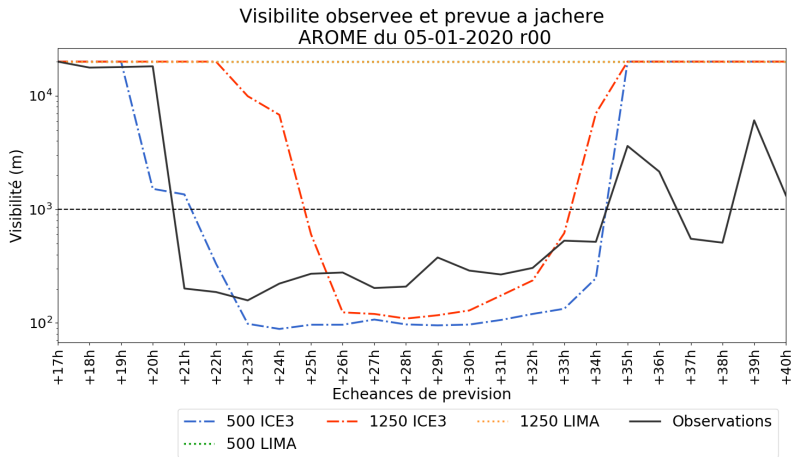
Fog forecast by ICE3 (good for 500m but too short for 1250m)
No fog forecast by LIMA

Satellite observation
06/01/2020 09UTC

AROME-500m ICE3 – 6/1/2020 9UTC
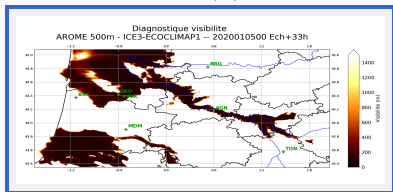
AROME-1250m ICE3 – 6/1/2020 9UTC
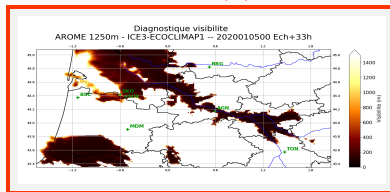
AROME-500m LIMA – 5/1/2020 23UTC
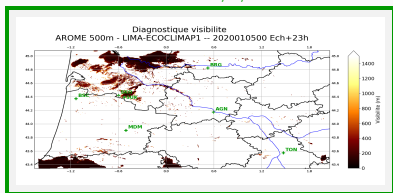
AROME-1250m LIMA – 5/1/2020 23UTC
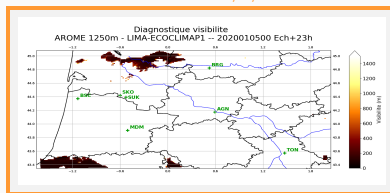
Fog thickness – IOP-6 (5/6 January)

Réflectivité observée au super site
Radar BASTA le 07 et 08-01-2020
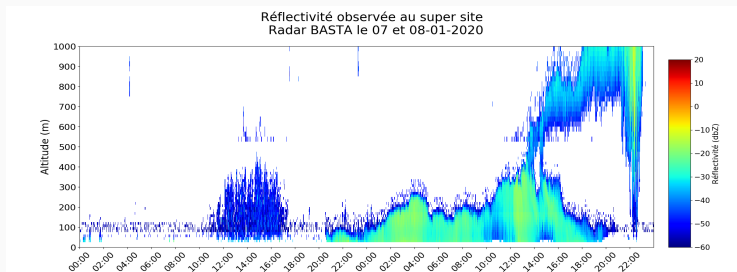
AROME-500m ICE3

AROME-1250m ICE3

Zoom de l'evolution de l'eau nuageuse
AROME-500 ICE3 ECOCLIMAP1 du 05-01-2020 r00
Localisation : SKO

Zoom de l'evolution de l'eau nuageuse
AROME-1250 ICE3 ECOCLIMAP1 du 05-01-2020 r00
Localisation : SKO
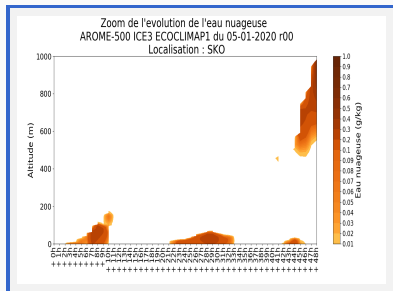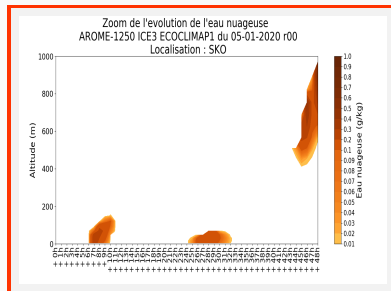
Comparison radiosounding and forecast – 18UTC IOP-6 (5/6 January)
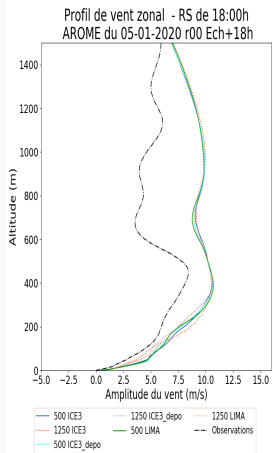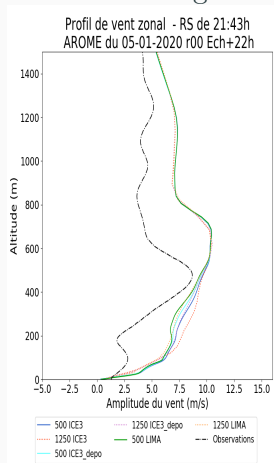

Wind strenght

Potential temperature
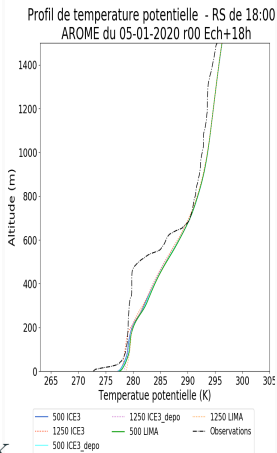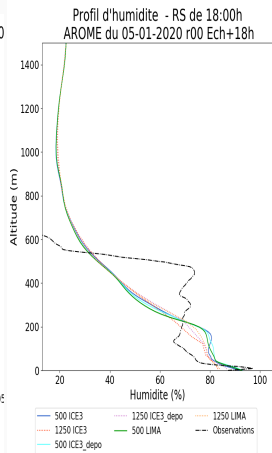
Humidity

Wind and humidity OK
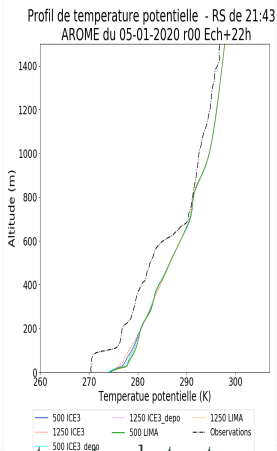
Potential temperature too hot and no forecast of inversion

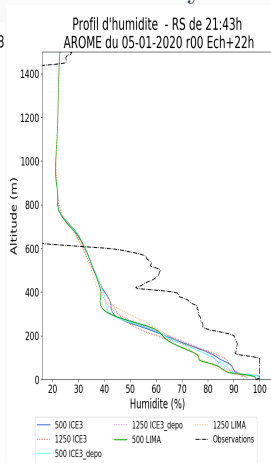# Comparison radiosounding and forecast – 22UTC IOP-6 (5/6 January)

Wind strenght

Potential temperature

Humidity

Wind too strong, temperature too hot, atmosphere too stable and too dry ...

On IOP-6, 5/6 January night

- ICE3 visibility OK, but fog too thin !

- LIMA miss the fog near the SuperSite. Why ?

Perspective

Understand why the fog is not enough developed or not forecast by AROME the 5/6 January night.
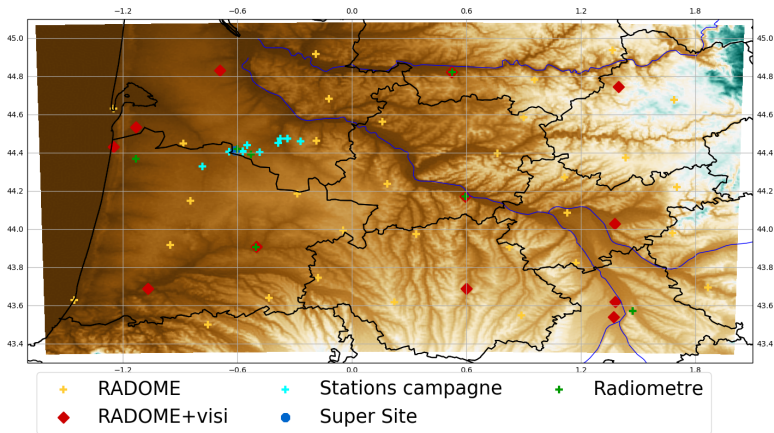
Studed 3 nights of IOP-2

Evaluate the impact of the new surface database
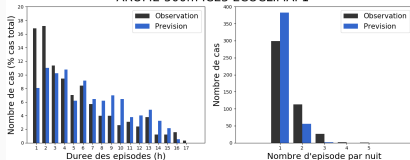
Thanks for your attentions !

Annexes

Stations d'observations couvertes par le domaine AROME-SoFog3D
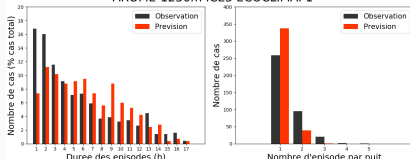
Fog events length

AROME-500m

The fog events forecast by models are longer and more persistant than observed events.

Fog events length

AROME-1250m

ICE3 + deposit - AROME-1250m - RADOME stations

Little reduction of number of fog events forecasted with take into account of deposit in ICE3.

Study using visibility

forecast lead time +18h to +24h

	CSI	DR	FAR	FBI
Without deposit	0.25	29.49	40.65	0.5
With deposit	0.19	22.44	43.09	0.39

forecast lead time +25h to +30h

	CSI	DR	FAR	FBI
Without deposit	0.38	49.81	37.74	0.8
With deposit	0.35	42.5	35.0	0.65

forecast lead time +31h to +36

	CSI	DR	FAR	FBI
Without deposit	0.34	60.78	55.87	1.38
With deposit	0.31	50.6	54.93	1.12

AROME-1250m ICE3 without deposit VS AROME-1250m
ICE3 with deposit

Events duration

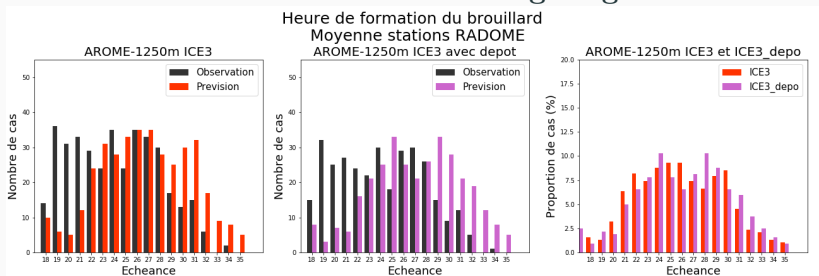Duree des episodes de brouillard
Moyenne stations RADOME
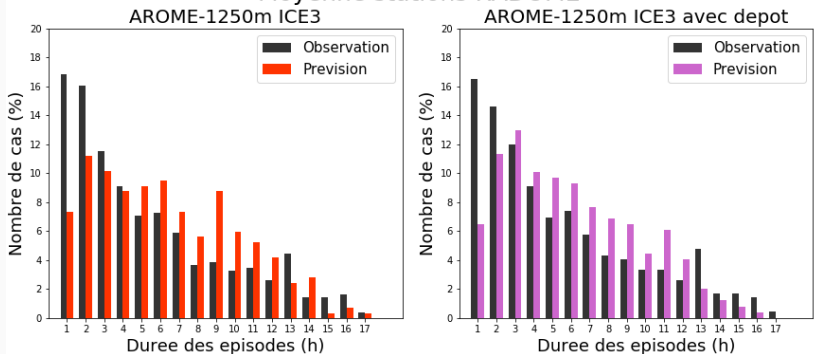
No real impact on the fog duration.

AROME-1250m ICE3 without deposit VS AROME-1250m ICE3 with deposit
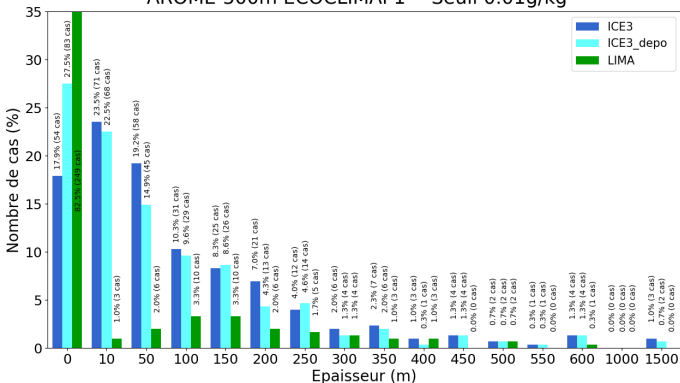
Hour of first event begining

Take into accound deposite delay a bit the hour of fog formation.

AROME-500m ICE3 VS AROME-500m LIMA

Thickness of fog

Much more fog event forecast by ICE3 than by LIMA.

Visibilite observee et prevue a jachere
AROME-1250m du 05-01-2020 r00
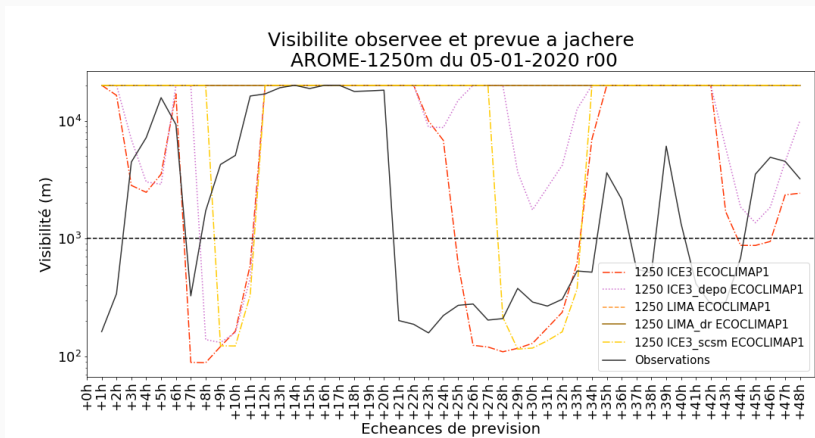
Visibilite observee et prevue a jachere
AROME-500m du 05-01-2020 r00
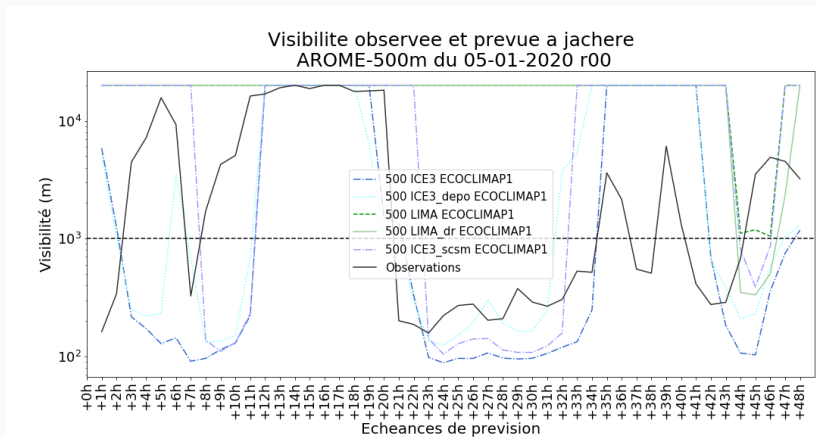
Acronymes I

[1] Y. Seity, P. Brousseau, S. Malardel, G. Hello, P. Bénard, F. Bouttier, C. Lac, and V. Masson. The AROME-France Convective-Scale Operational Model. Monthly Weather Review, 139(3) :976–991, 2011. doi : 10.1175/2010MWR3425.1. URL https://doi.org/10.1175/2010MWR3425.1.

[2] A. Philip, T. Bergot, Y. Bouteloup, and F. Bouyssel. The Impact of Vertical Resolution on Fog Forecasting in the Kilometric-Scale Model AROME : A Case Study and Statistics. Weather and Forecasting, 31(5) :1655–1671, 2016. doi : 10.1175/WAF-D-16-0074.1. URL https://doi.org/10.1175/WAF-D-16-0074.1.

[3] J. Pinty and P. Jabouille. A mixed-phase cloud parameterization for use in a mesoscale non-hydrostatic model : simulations of a squall line and of orographic precipitations. Proceedings of the AMS conference on cloud physics,, 1998.

[4] B. Vié, J.-P. Pinty, S. Berthet, and M. Leriche. Lima (v1.0) : A quasi two-moment microphysical scheme driven by a multimodal population of cloud condensation and ice freezing nuclei. Geoscientific Model Development, 9(2) :567–586, 2016. doi : 10.5194/gmd-9-567-2016. URL https://gmd.copernicus.org/articles/9/567/2016/.

[5] Marie Mazoyer, Christine Lac, Odile Thouron, Thierry Bergot, Valery Masson, and Luc Musson-Genon. Large eddy simulation of radiation fog : impact of dynamics on the fog life cycle. Atmospheric Chemistry and Physics, 17(21) :13017, 2017.