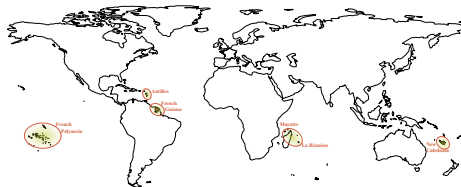




Météo-France New NWP Models in Tropical Regions



33rd Conference on Hurricanes and Tropical Meteorology, April 2018

Ghislain Faure, P. Chambon and C. Lebeaupin Brossier
CNRM, Météo-France and CNRS, Toulouse, France

Outline

- 1 Details about operational setup
- 2 Additional guidance provided by Arome OS
- 3 Conclusions and perspectives

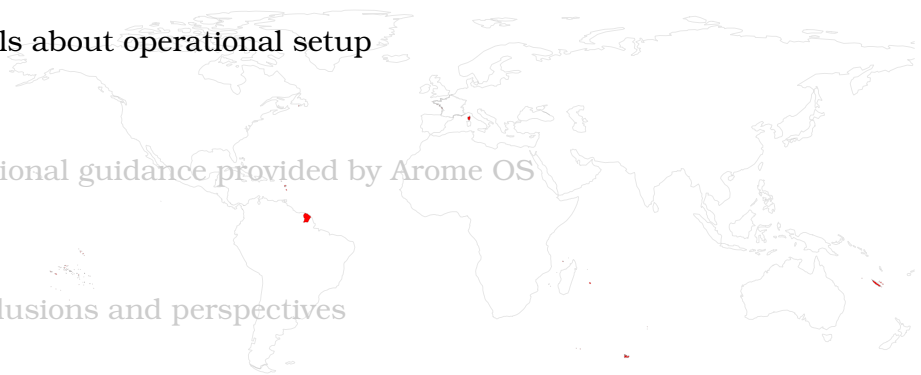


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Brief history of NWP in French tropical regions

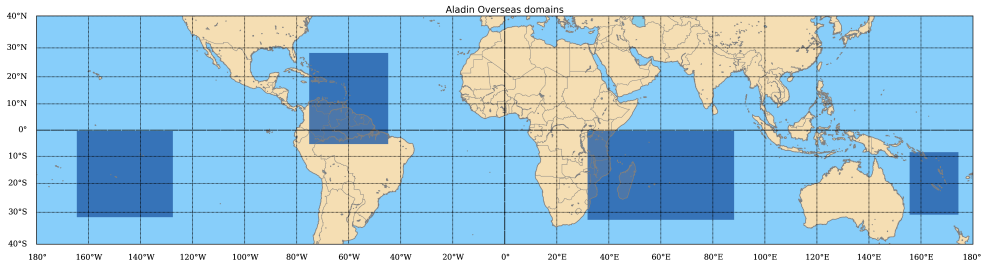
From Aladin to Arome

- ▶ **2006→2015 : Aladin-OS (12→8km)**
- ▶ 2016 (Feb.) : Arome-OS v1 (2.5km)
- ▶ 2017 (Dec.) : Arome-OS v2 (2.5km)

Runs performed in Toulouse and then broadcasted overseas

Arome-OverSeas

- ▶ New model generation : huge impact on forecasted fields ... and CPU cost (17→130 M gridpoints)
- ▶ Wave and storm-surge models are run offline : MF-WAM, WW3, Hycom 2D
- ▶ Coupling with 1D ocean model, enlargement of Antilles domain (wmo swr03), shorter spin-up



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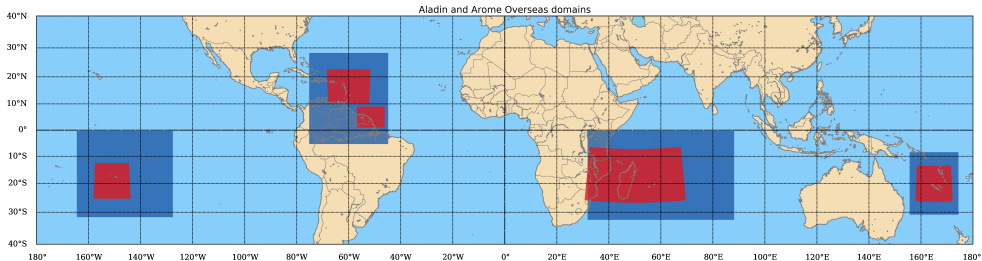
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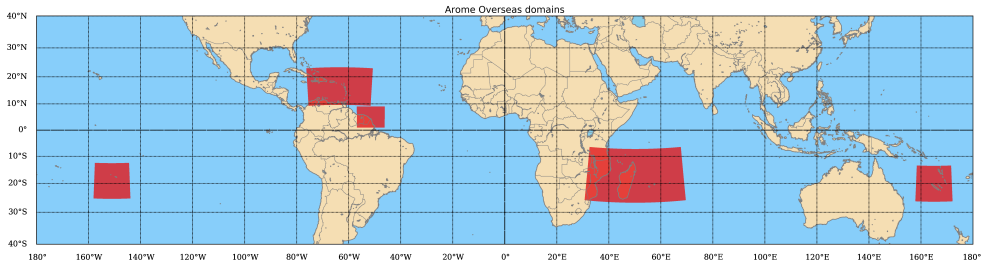
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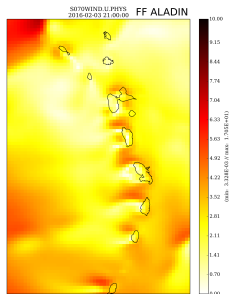
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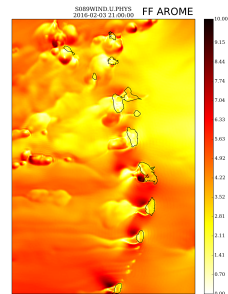


Arome OS vs Aladin OS



ALADIN 17m windspeed

	Aladin OS	Arome OS
Dynamics	8km L70 (16m), spectral, H	2.5km L90 (5m), spectral, NH
Microphysics	Enhanced Lopez	ICE3
Deep Conv.	Parametrized	Explicit
Shallow Conv.	KFB	PMMC09
Boundary	ECMWF HRES (1way)	ECMWF HRES (1way)
Forecasts	2 x day (+54h)	4 x day (+42h)
D.A.	3D Var each 6h	No



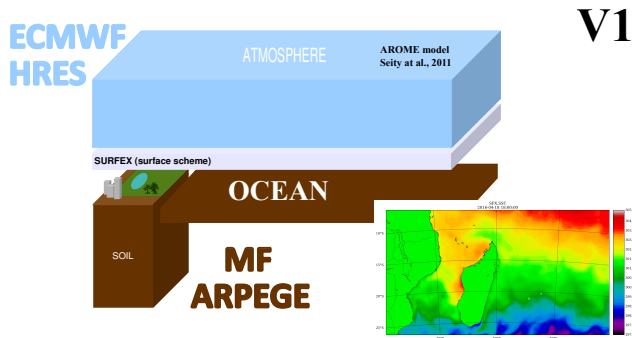
AROME 17m windspeed

Termonia et al. : The ALADIN System and its canonical model configurations

AROME CY41T1 and ALARO CY40T1 (GMD 2018)

Initial conditions of each run

Comparison of Arome OS V1 and V2



► Atmosphere :

- ECMWF HRES analysis
- previous 6h run relaxed to latest HRES analysis
→ *shorter spin-up*

► Continental surface :

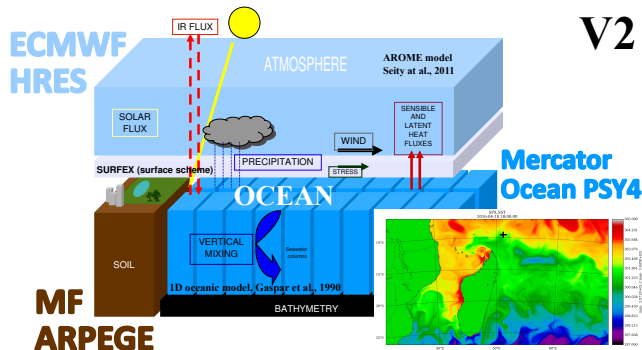
- from MF global model Arpege (stretched grid)

► Ocean :

- Arpege SST (from OSTIA + analysis of latest data)
- Mercator-Ocean global model (PSY4, 1/12°)
→ *ability to represent cooling in TC wake even with no obs*

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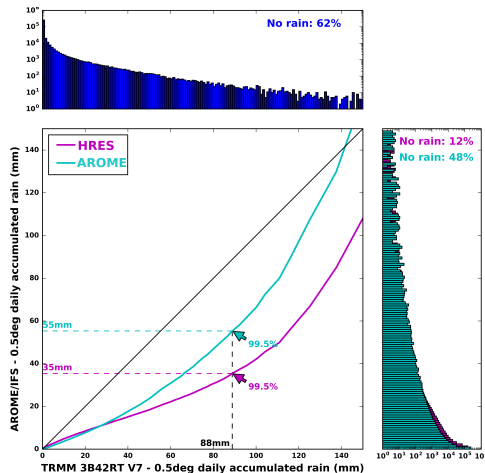
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Outline :

- 
- A light gray world map is positioned in the background. Several red dots are placed on the map to indicate specific locations: one in Western Europe, one in South America (Brazil), one in the Pacific Ocean near Japan, one in Southeast Asia (Philippines), one in the Indian Ocean (Madagascar), one in the Southern Ocean (Antarctica), and one in the Pacific Ocean (New Zealand).
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Comparison to rainfall satellite retrievals (0°5, daily)

Example Antilles domain (11 months)



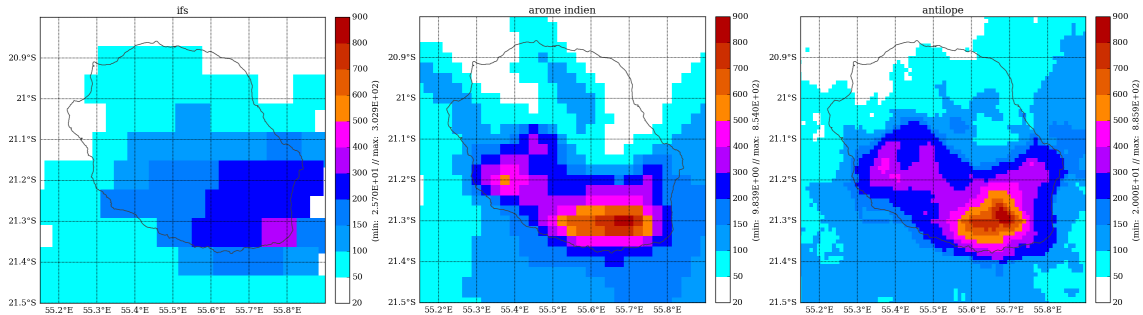
Brier skill score of daily rainfall with 0°5 spatial tolerance :

Threshold	Arome BSS	BSS AROME / HRES
0.1mm	0.70	+14%
5 mm	0.51	~
25 mm	0.26	+36%

Arome provides more realistic occurrences of heavy rain (> 30mm/day) and of no rain events

Arome and heavy rain forecast

La Réunion island (TC Berguitta in South West Indian Ocean)



IFS

AROME

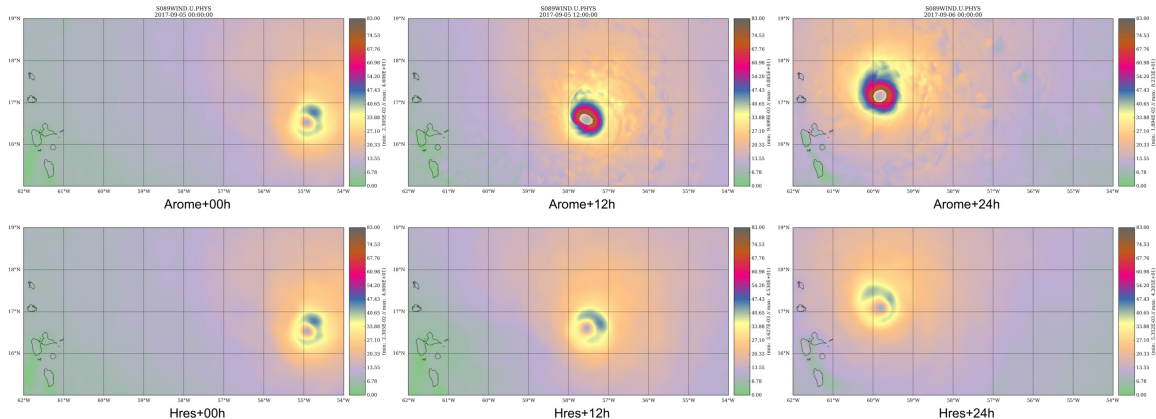
OBSERVATIONS

24h rainfall (mm) from 17th of January 2018 12h UTC

More realistic forecast by Arome compared to observations (radar rainfall corrected by rain gauges)

Reasons : better orography, explicit deep convection, and TC intensity

TC intensity : example of Irma



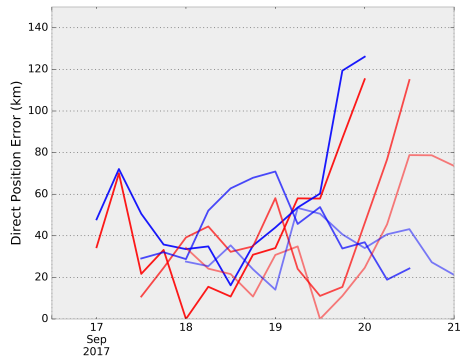
17m windfield of +24h forecasts of Arome (V1, top) and HRES (bottom)

Very large differences in intensity and structure occur quickly : **useful additionnal guidance ?**

TC guidance : e.g. of Irma & Maria

Arome keeps the -very- valuable track of ECMWF HRES

3 Arome runs (blue) and corresponding ECMWF HRES runs (red) 3 Arome runs (blue) and corresponding ECMWF HRES runs (red)



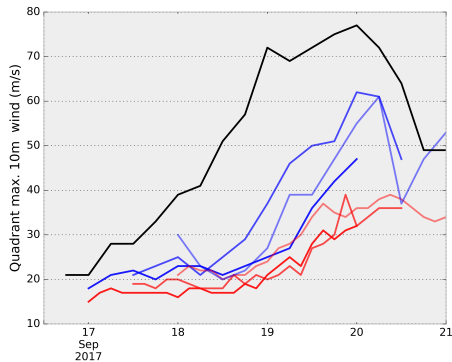
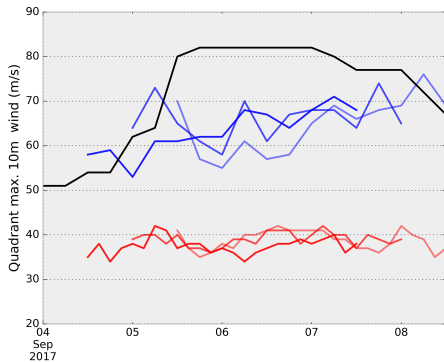
Hurricanes of 2017 season : Irma (left) and Maria (right) ; **72h** leadtime forecasts of ECMWF HRES (red) and AROME (blue)

TC tracker provided by LACy (La Réunion)

TC guidance : e.g. of Irma & Maria

Arome adds information on intensity

3 Arome runs (blue) and corresponding ECMWF HRES runs (red) 3 Arome runs (blue) and corresponding ECMWF HRES runs (red)

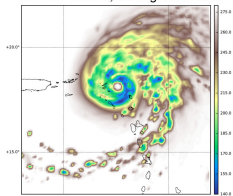


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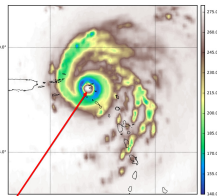
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TC guidance : structure simulated by Arome

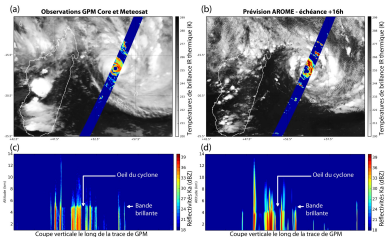
AROME +29h forecast
SAPHIR Ch6 simulated with
RTTOV-SCATT, averaged at 10km



SAPHIR observation on
September 6th at 11UTC



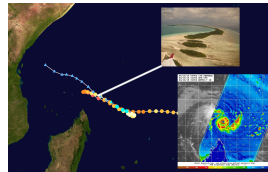
Saint Martin island



- Forecasters provide very interesting inputs on TC structure simulated by Arome (Matthew, Irma and Maria, ...); they find Arome guidance very useful
- We also use satellite data to assess the structure of simulated TC (Megha-Tropiques, GPM)
- We try to improve it through data assimilation of cloudy/rainy radiances (R&D, cf. P. Chambon talk)

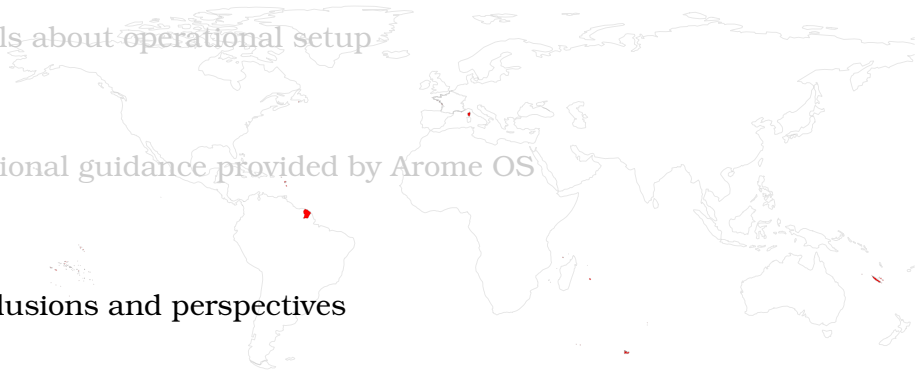
TC structure : ERC on TC Fantala

- ▶ From 11th to 24th of April 2016
- ▶ 2nd more intense of all time in SWIO
- ▶ First intense TC for Arome in operation
- ▶ Very unusual trajectory (3 times over Farquhar), ERC



Outline :

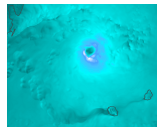
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Conclusion and perspectives

Currently in operations : simple but useful downscaling

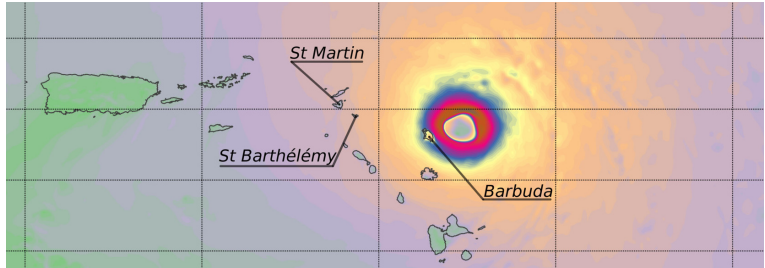
- ▶ 5 domains @2.5km, 4x a day, everyday, +42h leadtime, 1D ocean model
- ▶ Very valuable island effects
- ▶ Improve guidance for short term TC forecasts (intensity and structure)
- ▶ Waves and storm-surge models
- ▶ Data freely available and also shared within WMO SWFDP



What's next ?

- ▶ Extended leadtime (~72h) on demand (for TC threat)
- ▶ Many improvements possible :
 - ▶ better initial state through own 3D-Var scheme (cloudy MW radiances, radar data, ...)
 - ▶ Upgrade to 3D ocean model
 - ▶ Better horizontal resolution (1.3km as inland France) ...
 - ▶ ... or small ensemble @2.5km ?

Thanks for your attention



Additional slides

How to reduce (simply) the spin-up intensity and duration ?

Basic ideas

- ▶ some scale features are created during 6 hours
from previous run of IFS
- ▶ large scale features comme from freshest IFS run

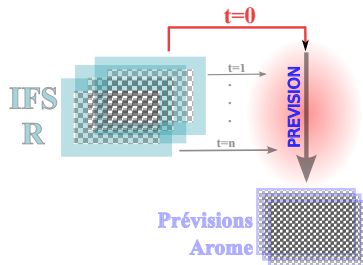
There is no permanent cycling like with data assimilation, just a 6h spin-up before the actual run

Implementation

- ▶ **Incremental Analysis Update** algorithm
- ▶ No impact in average after +12h of lead time

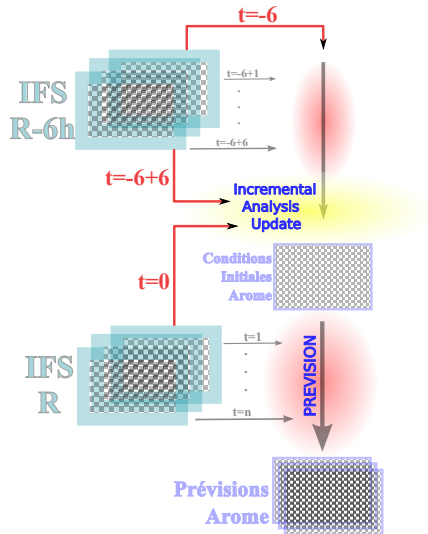
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Incremental Analysis Update



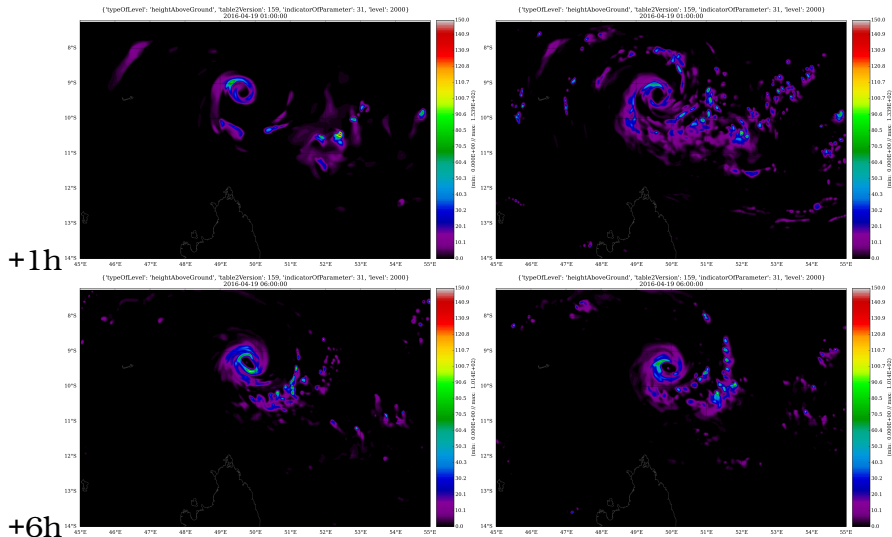
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How to reduce (simply) the spin-up intensity and duration ?

Examples without (left) and with (right) IAU (simulated radar reflectivities)



Enhanced orography

TC guidance : structure

Simulated BT, chanel 6 of SAPHIR (Megha Tropiques)