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Overview on AROME in various region and next AROME-France ...

E. Bazile (AROME CSC) with input from many colleagues ..

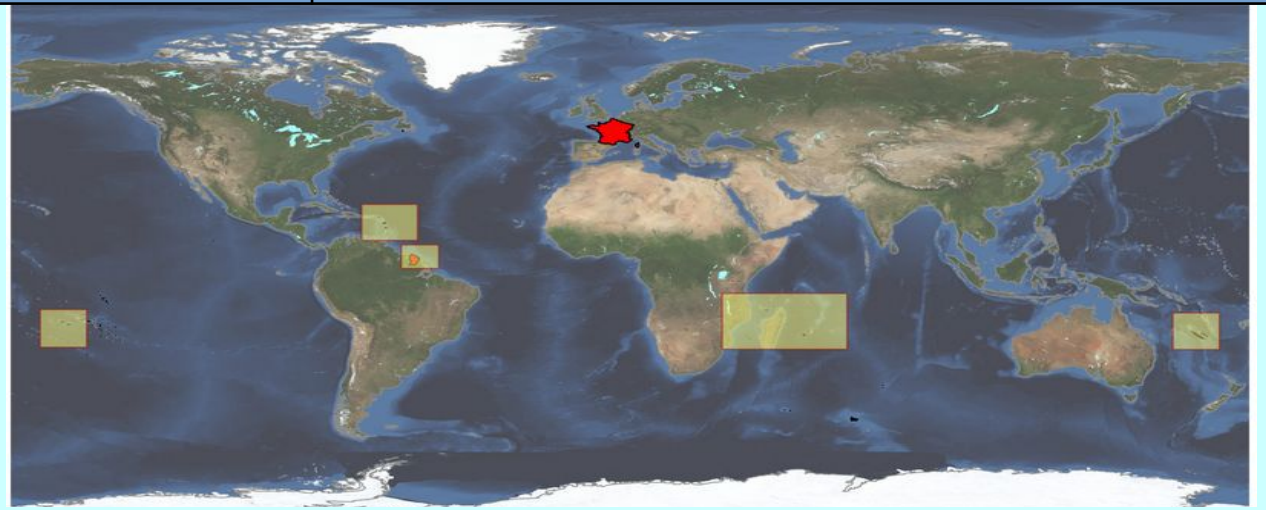
ASW2025, Zalakaros 31March – 4 April 2025

Outline

- **AROME-oversea : Unexpected impact in one domain**
- **Exotic domain :**
  - **AROME in Polar region : South Pole , Svalbard**
  - **AROME-SPEM : St-Pierre et Miquelon**
- **Some words about the AROME-TeamX models**
- **Recent problem with Low Cloud with AROME-France**
- **ACCALMIE**
- **Future plan for AROME-France (only forecast model)**

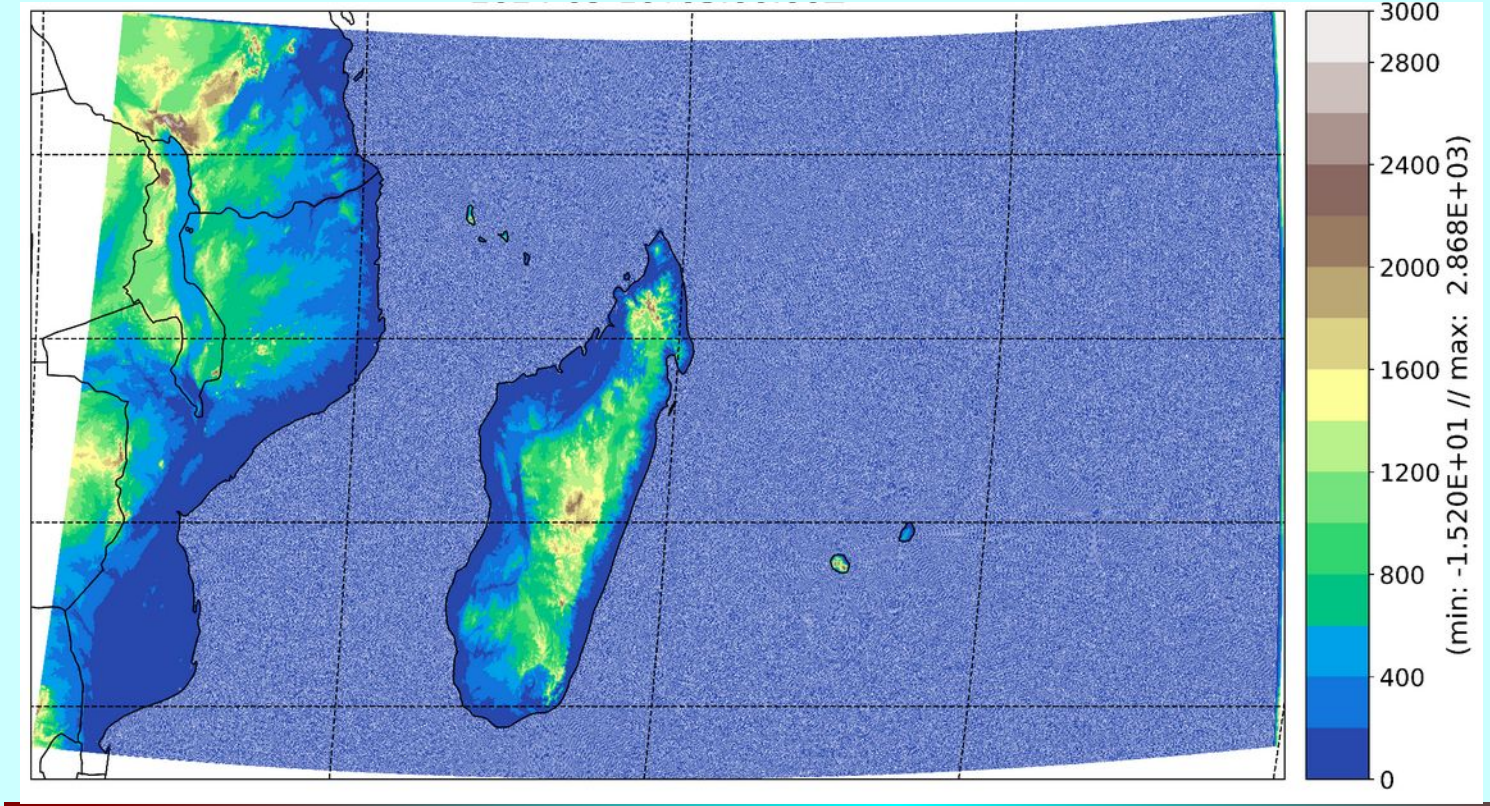
AROME-Overseas: since October 2024 cy48t1op1

Systems	Characteristics
AROME Overseas (5 domains)	1.3km L90 – Dynamical adaptation of IFS (altitude) and Arpege (surface) 4 forecasts per day up to 51h
AROME-EPS Overseas (5 domains)	2.5km L90 H – 15 members, Same initial conditions AROME Overseas Lateral conditions from PEARP, 2 forecasts per day up to 51h



physics from AROME-FR (updated in October 2024 with Ecrad (McIca), solar eclipse, mixing length modification) + Ocean Mixed Layer

AROME-Indien : old domain



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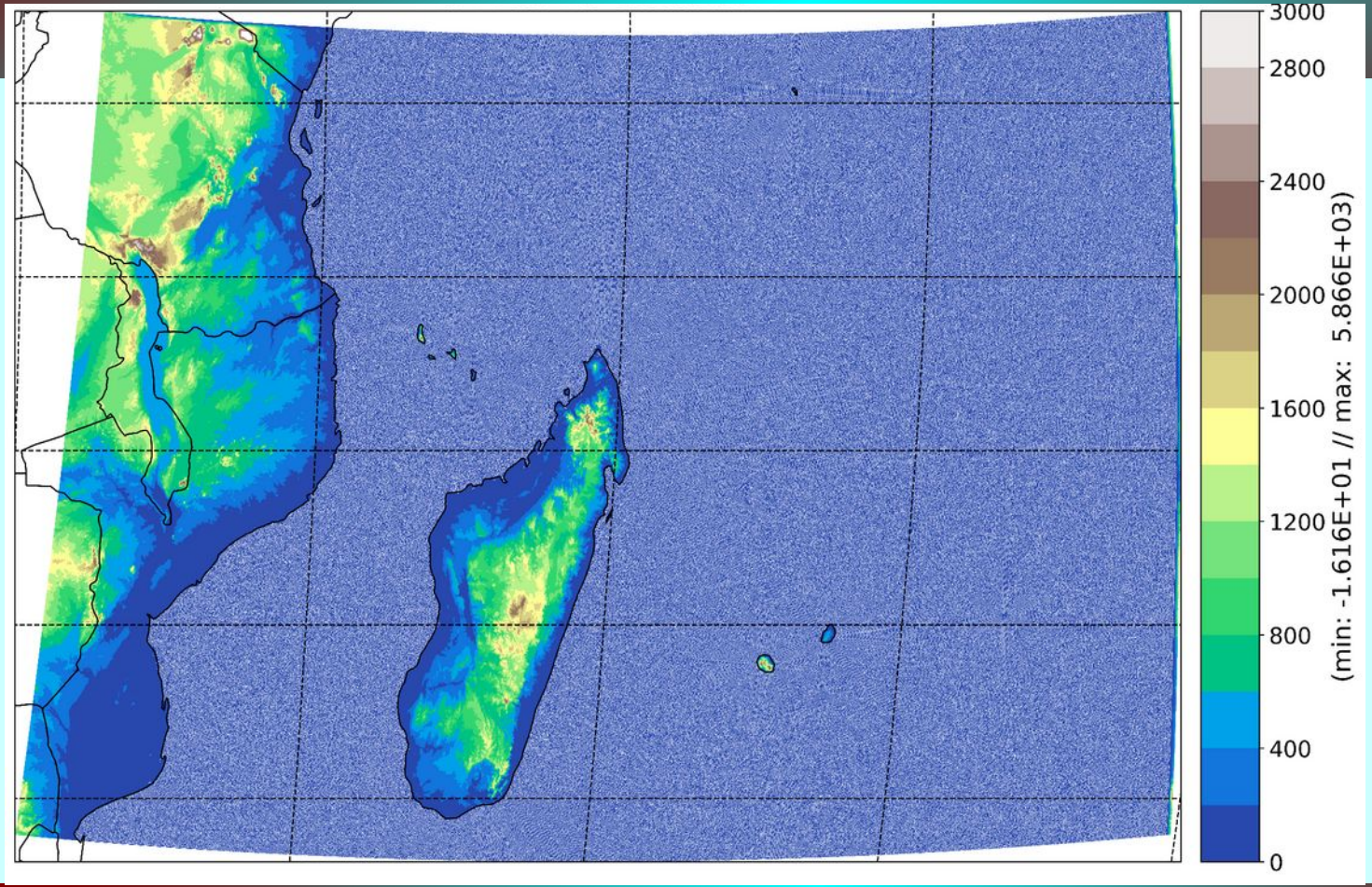
AROME-Indien : new domain



Requested by the forecaster to increase the domain to the North 7°S → 2°S

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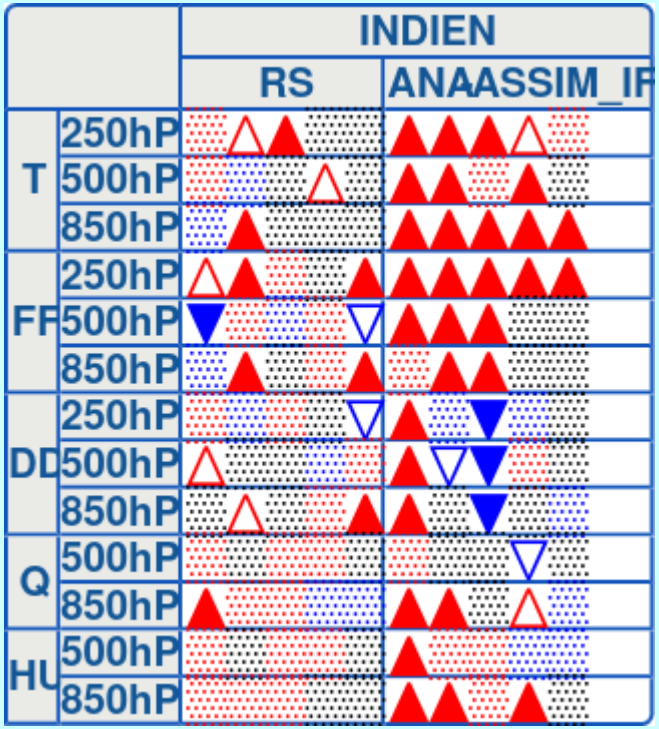
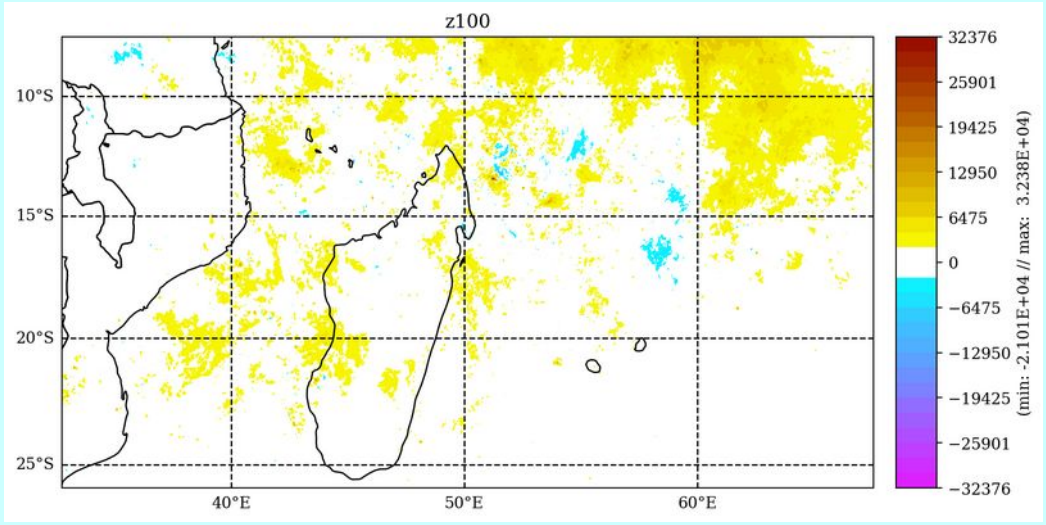
AROME-Indien : impact of the new domain





More errors in the Northern part of the domain, why ?
Domain size (less constraint) or/and new area with more active deep convection ?
Test is ongoing with the old domain size but moved to the North ….

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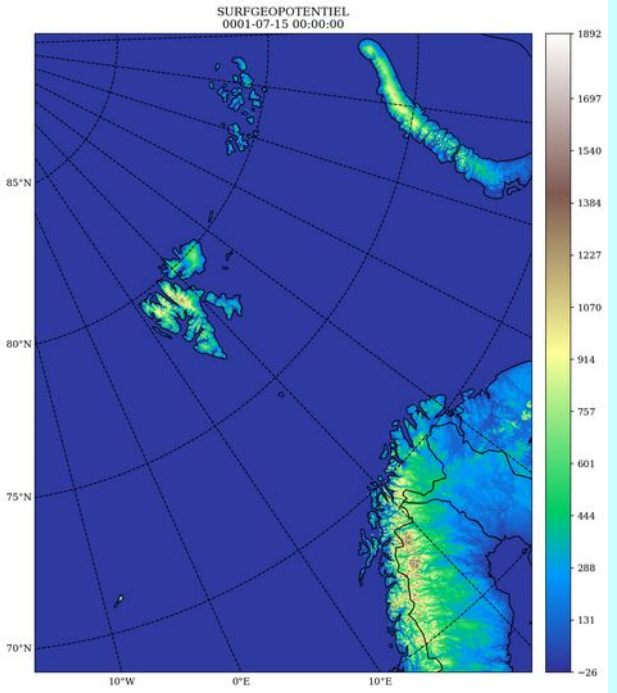
Exotic Area : **Svalbard**, St-Pierre-et-Miquelon, Antarctica

- AROME-MF-Svalbard 1.25km L90 1st Level 5m
  - Based on the AROME-MF al48t1_arome-op1.21
  - Same dynamics and physics as AROME-France
  - Initial and lateral BC from ARPEGE
  - GELATO-1D is activated (similar to ARPEGE configuration)

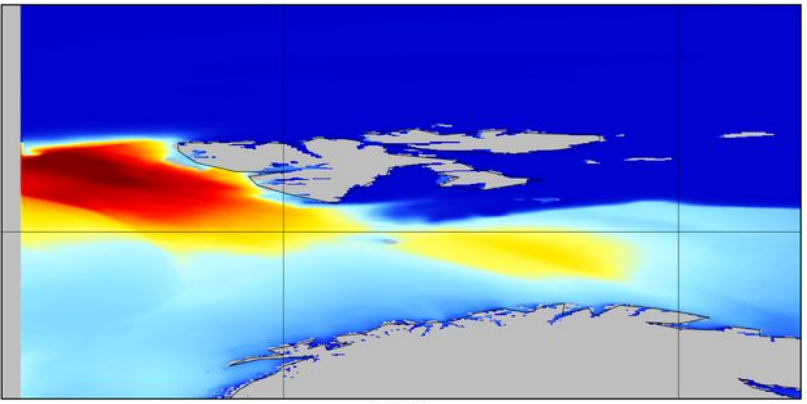
  - Previously used for YOPP, RALI-THINICE (August 2022, Svalbard), now used for the Marginal Ice Zone project (M. Muller, MetNo), and by Terasa M. Valkonen (MetNo) for comparison of clouds with AROME-Artic and IFS



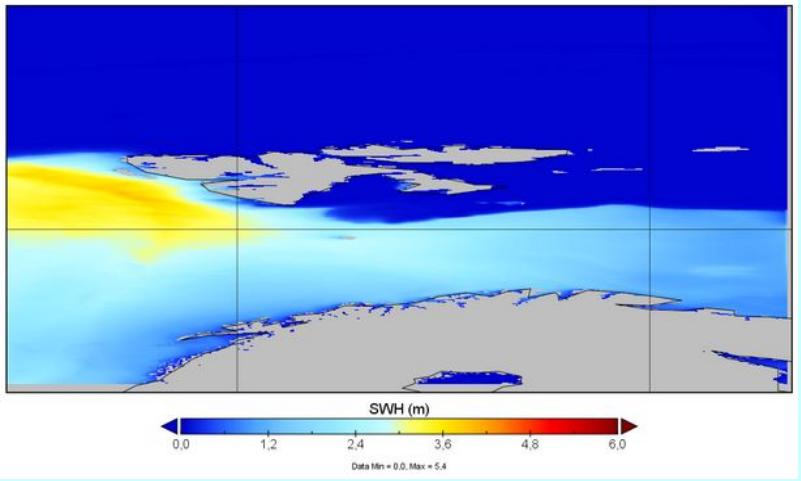
Exotic Area : Svalbard, St-Pierre-et-Miquelon, Antarctica

Marginal Ice Zone project (M. Muller)

MFWAM-AROME-FR



MFWAM-AROME-Artic-COUPLED



Significant underestimation of SWH. During Storm of 19 April 2024 when using wind forcing from couple AROME-Arctic (Met-No) (from Lotfi AOUF, MIZ workshop Feb. 2025)

Exotic Area : Svalbard, St-Pierre-et-Miquelon, Antarctica

Marginal Ice Zone project (M. Muller)

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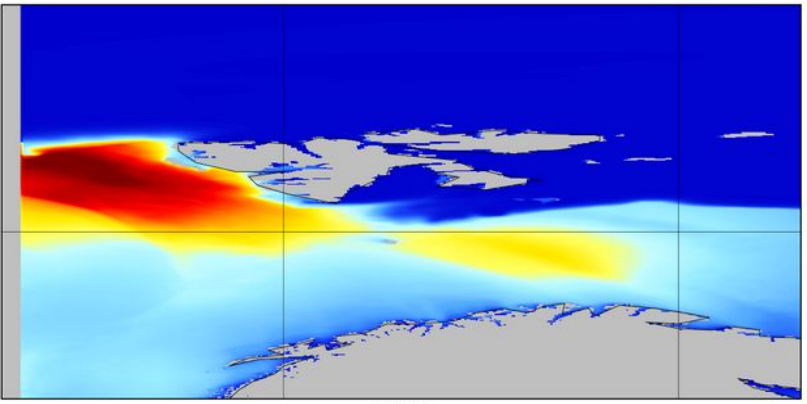
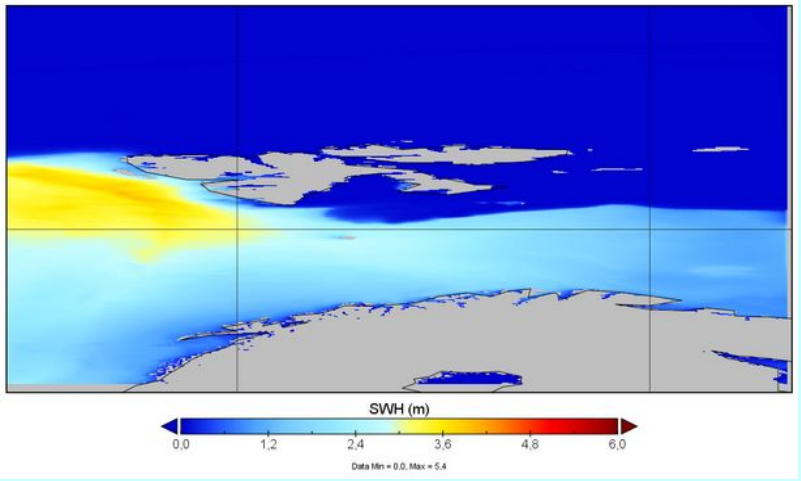


MFWAM-AROME-Artic-COUPLED

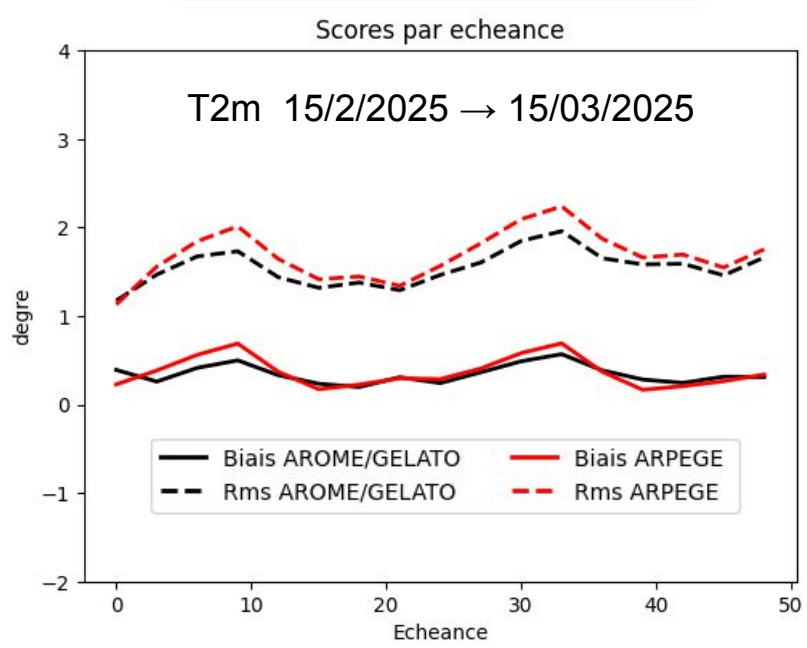


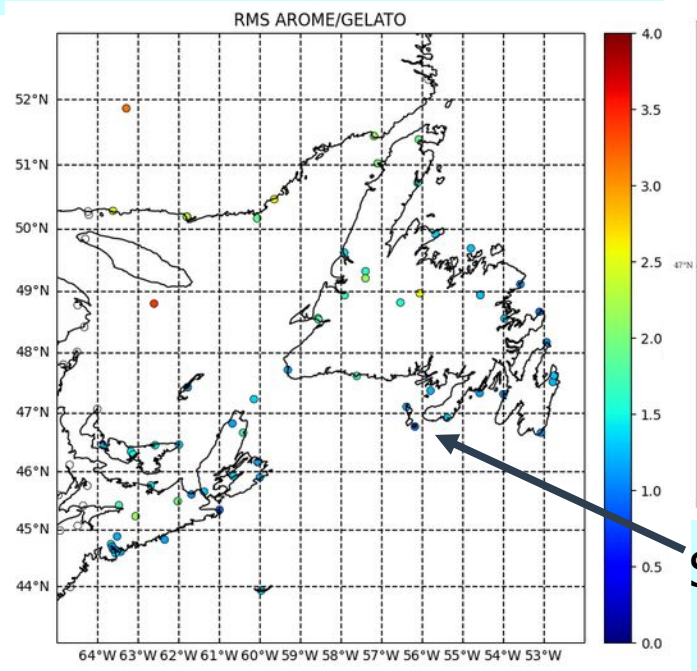
Significant underestimation of SWH. During Storm of 19 April 2024 when using wind forcing from couple AROME-Arctic (Met-No) (from Lotfi AOUF, MIZ workshop Feb. 2025)

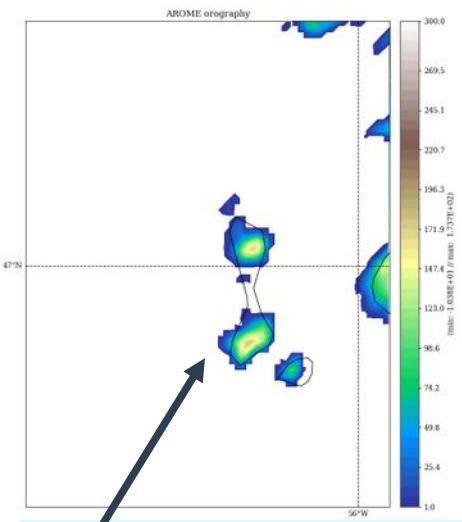
Next step : AROME coupled with MFWAM thanks to the AROBASE project (coll. with C. Lepaupin and L. Aouf)

Exotic Area : Svalbard, St-Pierre-et-Miquelon, Antarctica

AROME-SPEM: created after the first red-alarm 7/8 March 2024 with freezing rain and wind gust > 90km/h. Based on AROME-FR : 1.3kmL90 (1014x1024 pts), **with GELATO-1D, Init** and LBC from ARPEGE. Fc at 00UTC and 12UTC. Visualization available on website (thanks to F. Suzat) in a research mode.







SPEM

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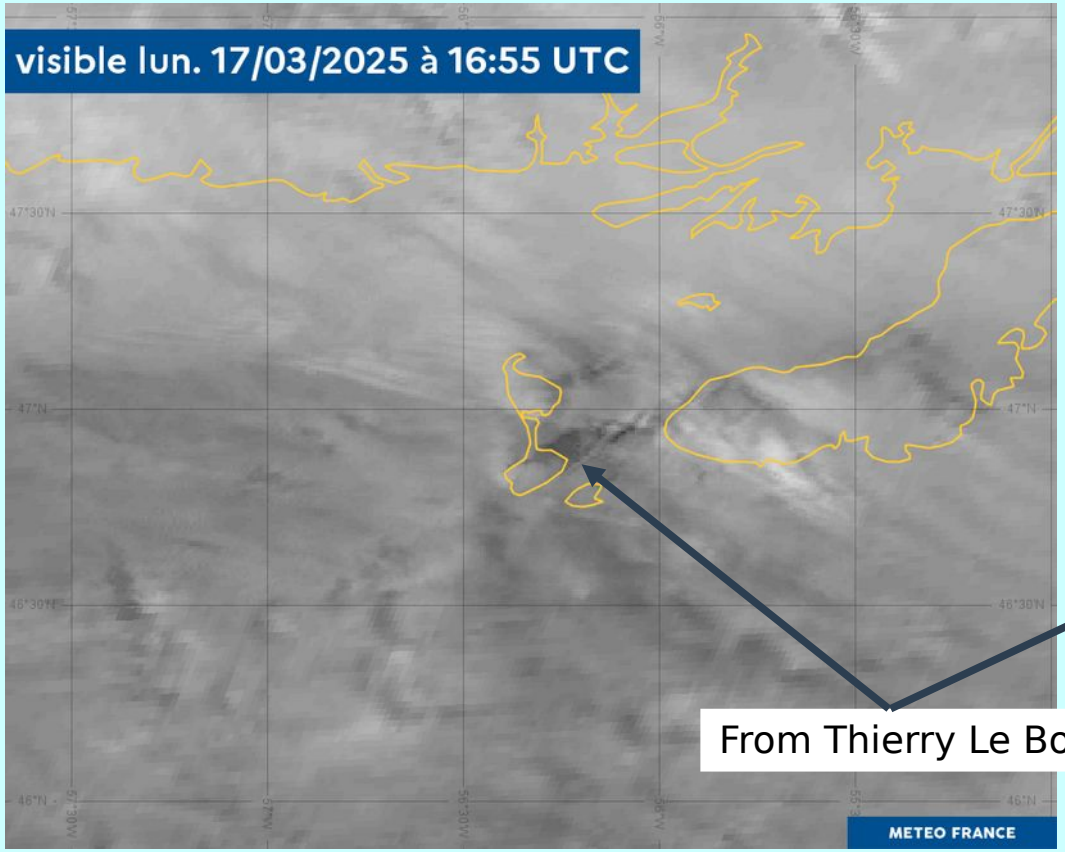
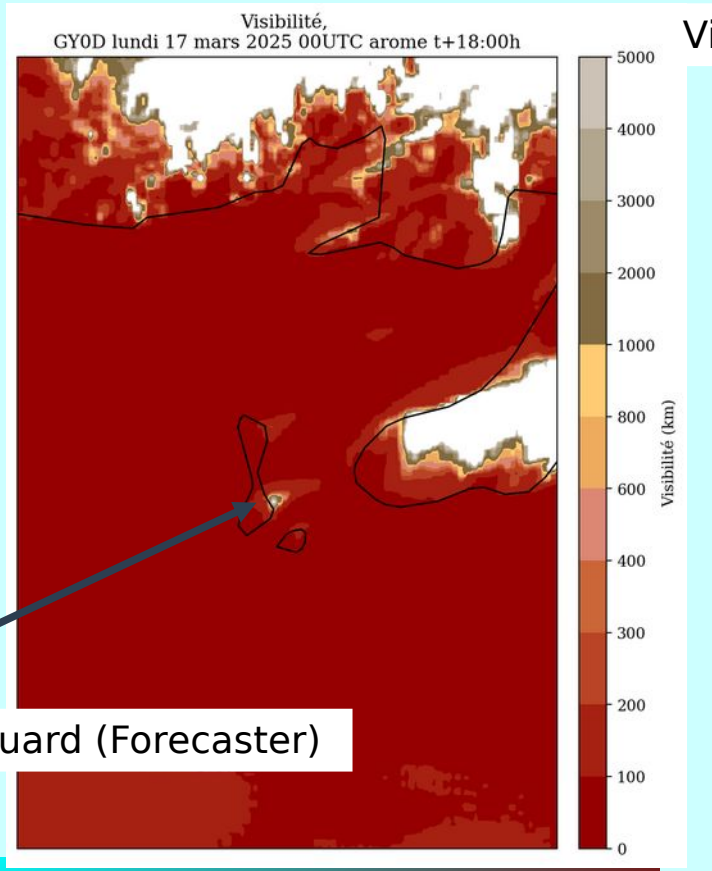
Exotic Area : Svalbard, St-Pierre-et-Miquelon, Antarctica

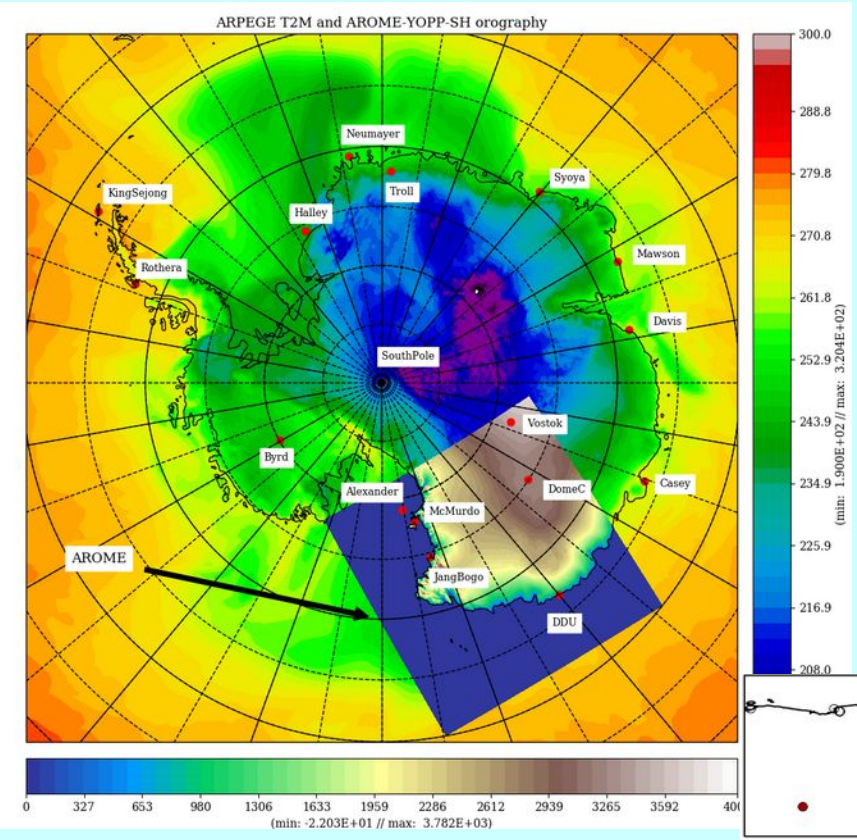




Visibility

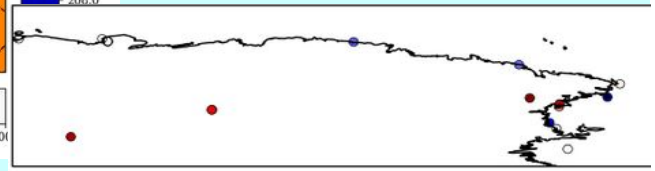
From Thierry Le Bouard (Forecaster)

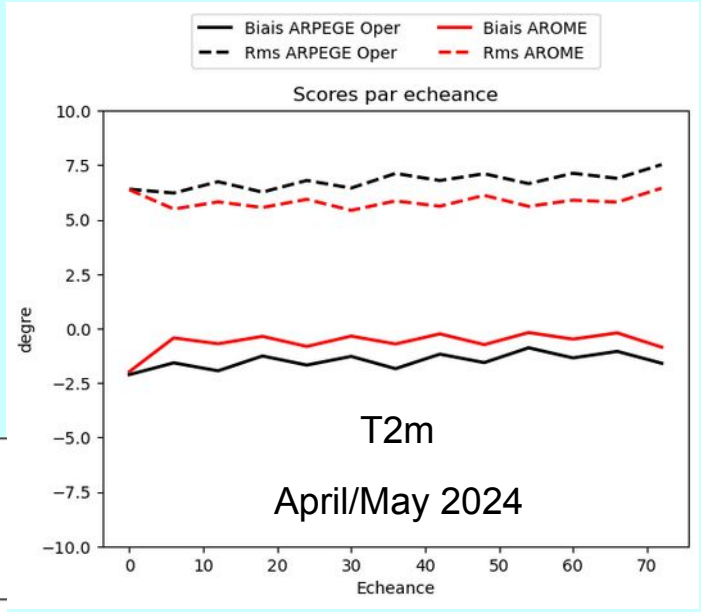
Exotic Area : Svalbard, St-Pierre-et-Miquelon, Antarctica



AROME-Antarctica (1.5Km L90) with GELATO-1D used during YOPP, was updated in cy48t1op1 for some studies at DomeC for supercooled liquid water (with P. Ricaud) and katabatic wind at DDU.

Less than10 obs.





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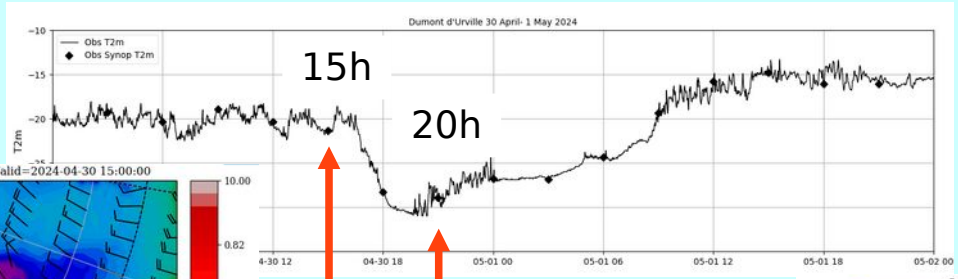
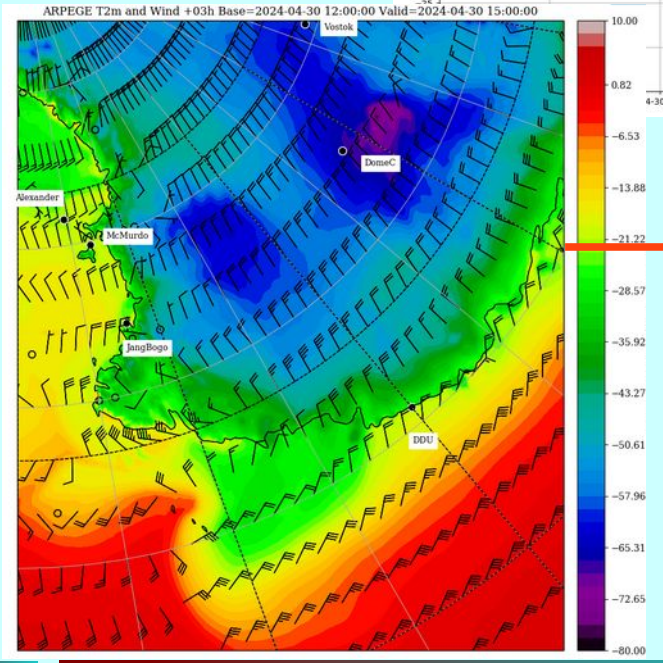
Exotic Area : Svalbard, St-Pierre-et-Miquelon, Antarctica

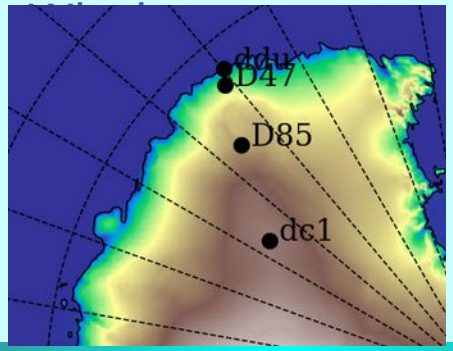
Katabatic wind at Dumont-d'Urville 2024/04/30

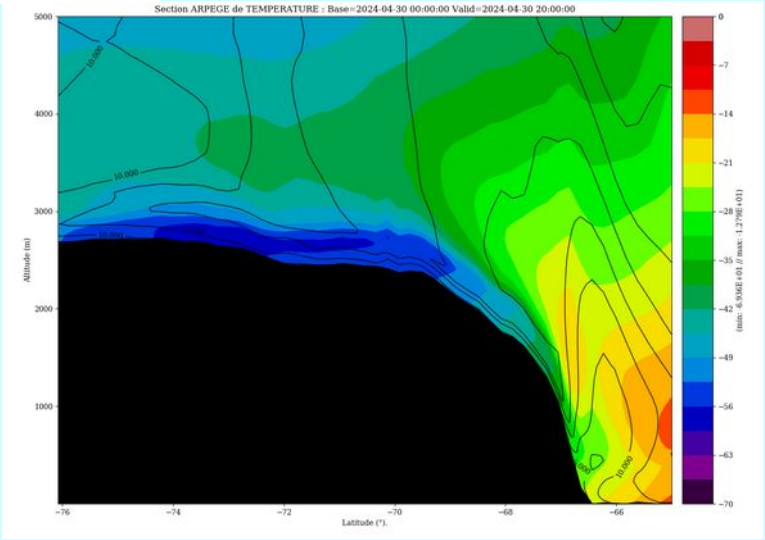
(obs from R. Honnert Météo-France, DSR/TAAF-Dumont d'Urville)





T2m and 10m





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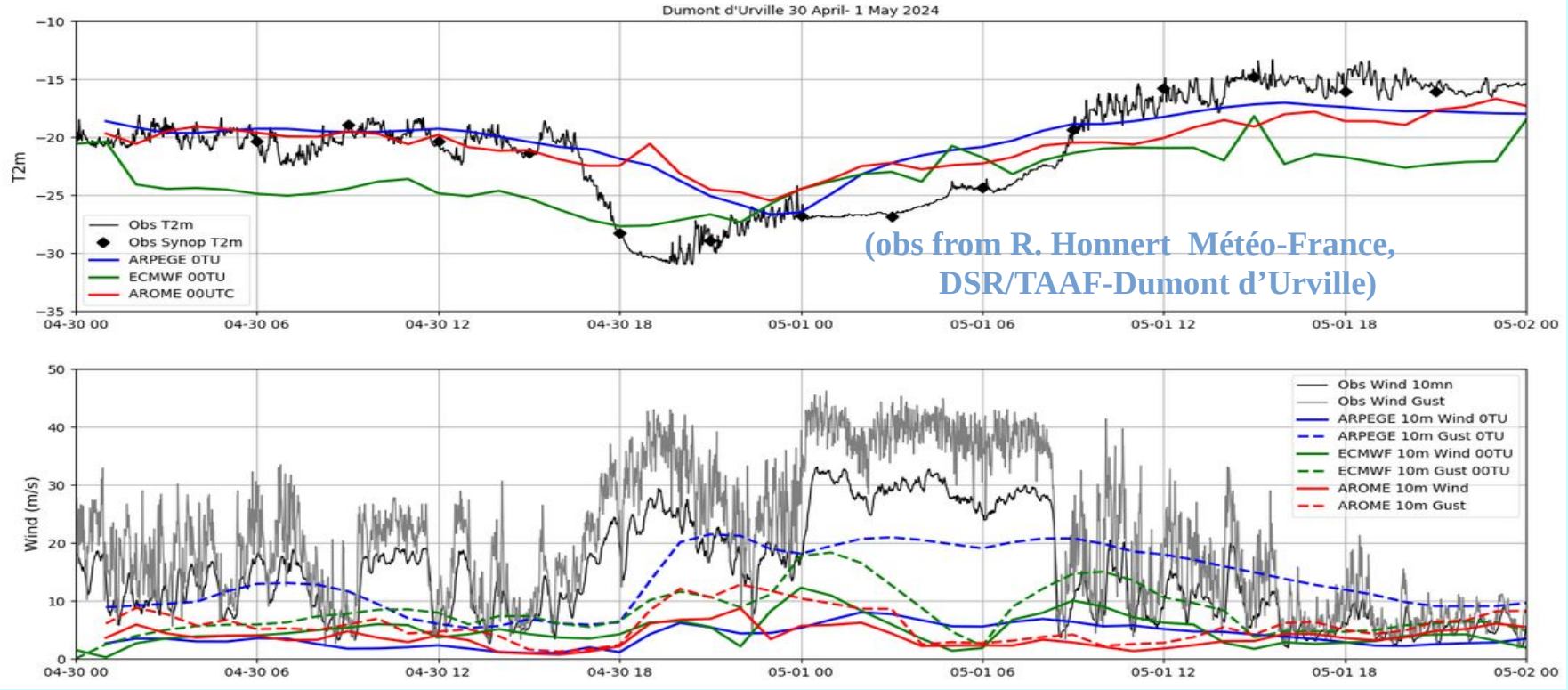

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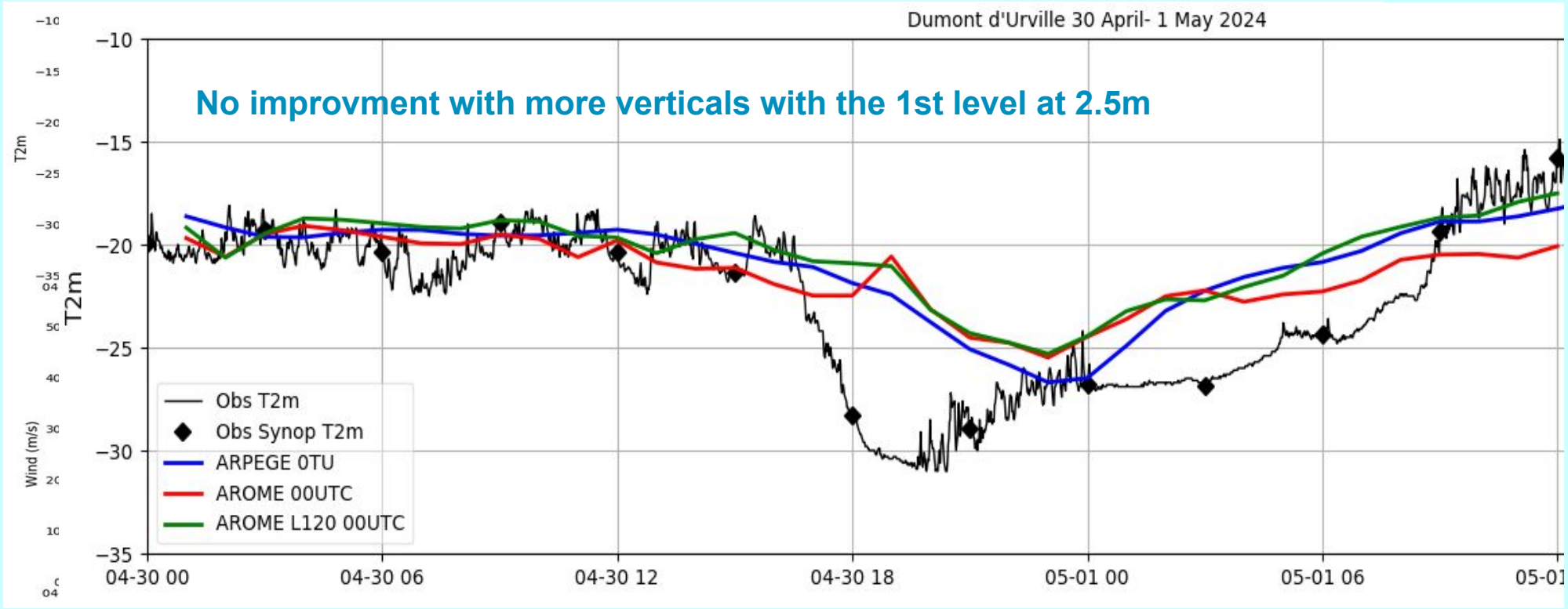

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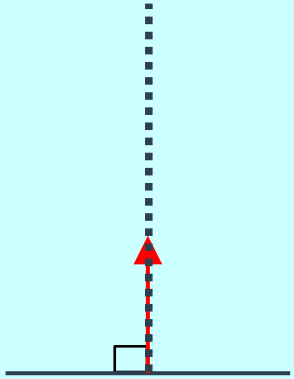
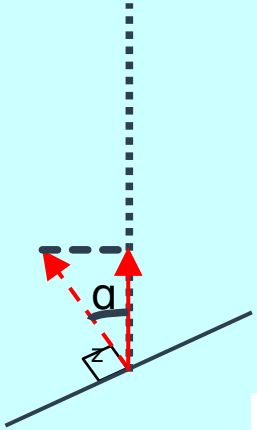
Differences with Meso-Nh for surface fluxes :

For the coldpool case in Innsbruck, Méso-NH has less warm bias than AROME, the better treatment of the surface fluxes along the slope in Méso-NH could explain a stronger cooling in the valley



Turbulence vertical flux

SURFEX output flux



AROME surface coupling:
SURFEX and turbulence surface flux both on the normal direction

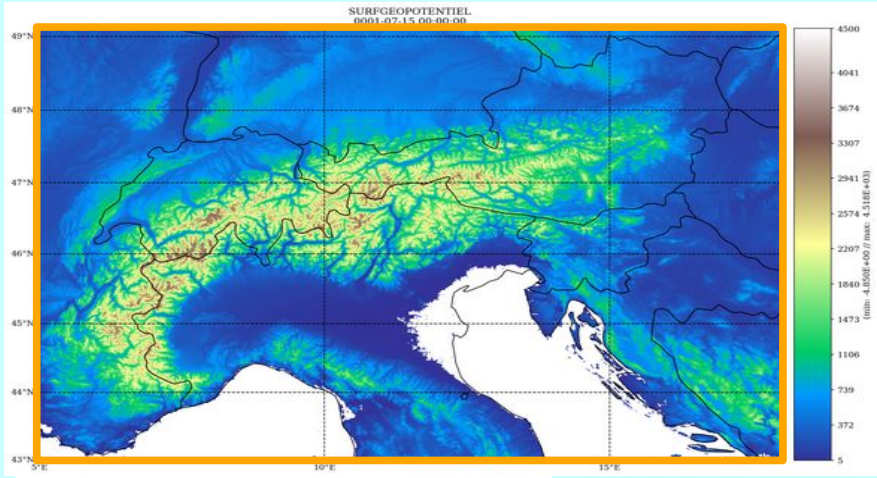
Méso-NH surface coupling:
SURFEX flux is reprojected on the vertical

$$\cos\alpha_z = \mathbf{n}\cdot\mathbf{k} = \frac{1}{\sqrt{1+\left(\frac{\partial z_s}{\partial x}\right)^2+\left(\frac{\partial z_s}{\partial y}\right)^2}}$$

L. Rogel, F. Voitus

AROME for TeamX :11/11/2024 → 28/02/2025

Conf.	Domain provided	dz surf.	dt	LBC	Assim. / Init.	Runs	XRIMAX
AROME oper	**TEAMXS**	~5 m	50 s	Arpege	3dEnVar	00h	0.2
AROME 1250m L90	**TEAMXA**	~5 m	50 s	Arpege	Arpege	00h 18h	0.2
AROME 1250m L120		~2.5 m	20 s	Arpege	Arpege	00h 18h	0.05
AROME 500m L90		~5 m	20 s	Arpege	Arpege	18h	0.05
AROME 500m L120		~2.5 m	20 s	Arpege	Arpege	18h	0.05



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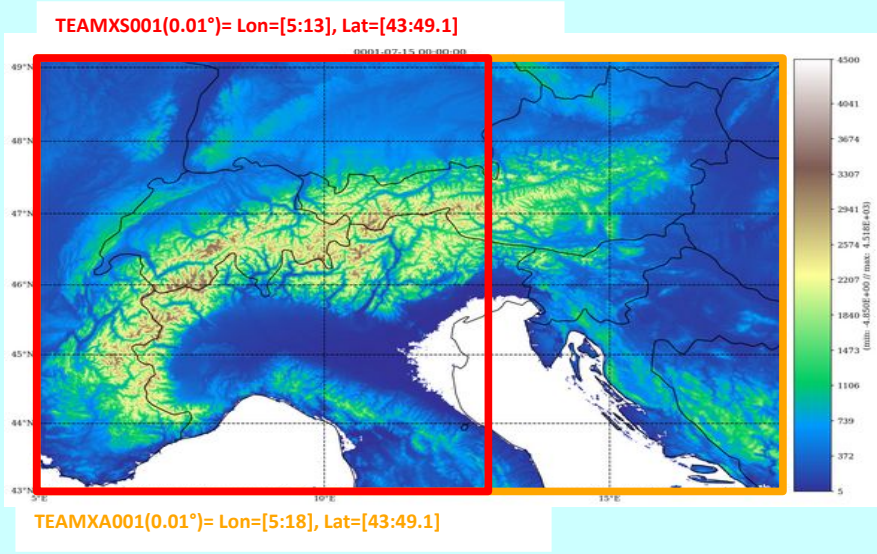
AROME 1250m L120		~2.5 m	20 s	Arpege	Arpege	00h 18h	0.05
AROME 500m L90		~5 m	20 s	Arpege	Arpege	18h	0.05
AROME 500m L120		~2.5 m	20 s	Arpege	Arpege	18h	0.05



Forecasts were available in real time
Also for the sEOP 16/06/2025 → 28/07/2025

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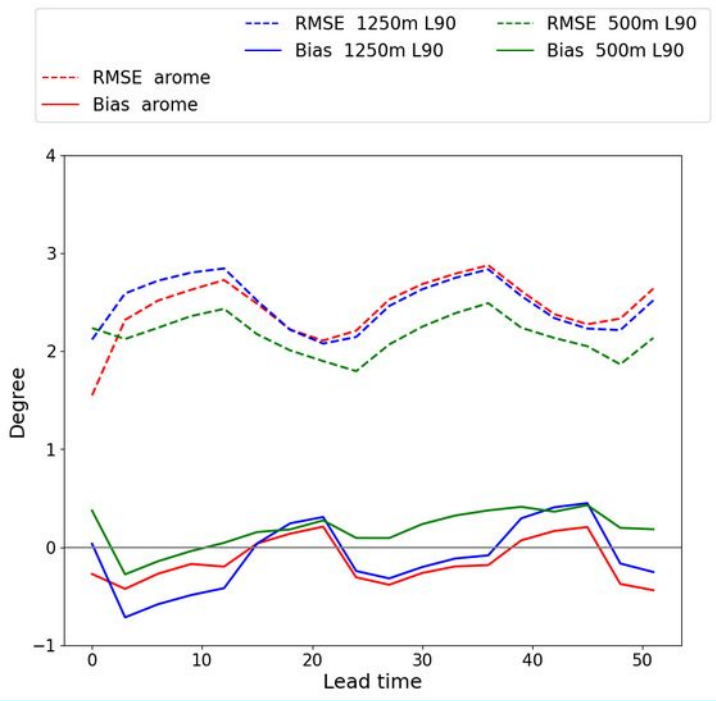
AROME for TeamX :11/11/2024 → 28/02/2025

TEAMXS domain Base: 18UTC



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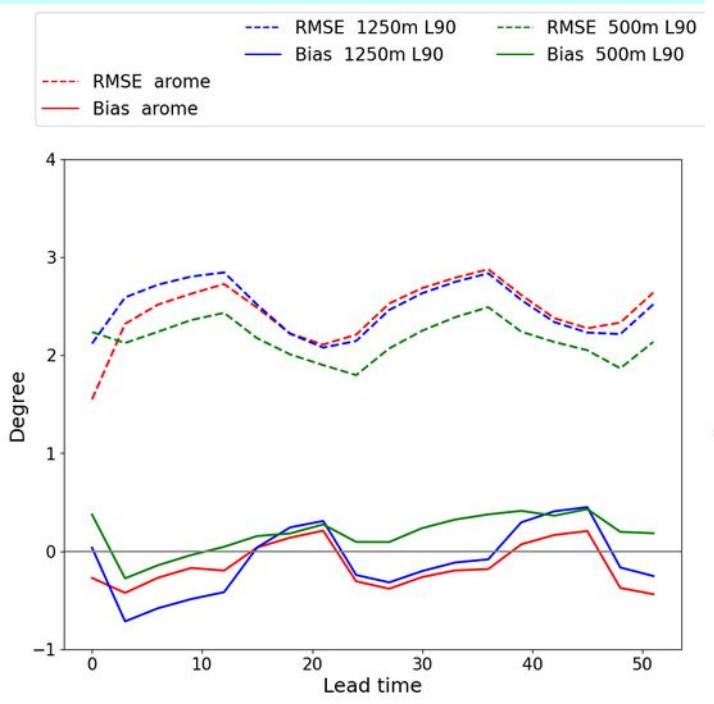
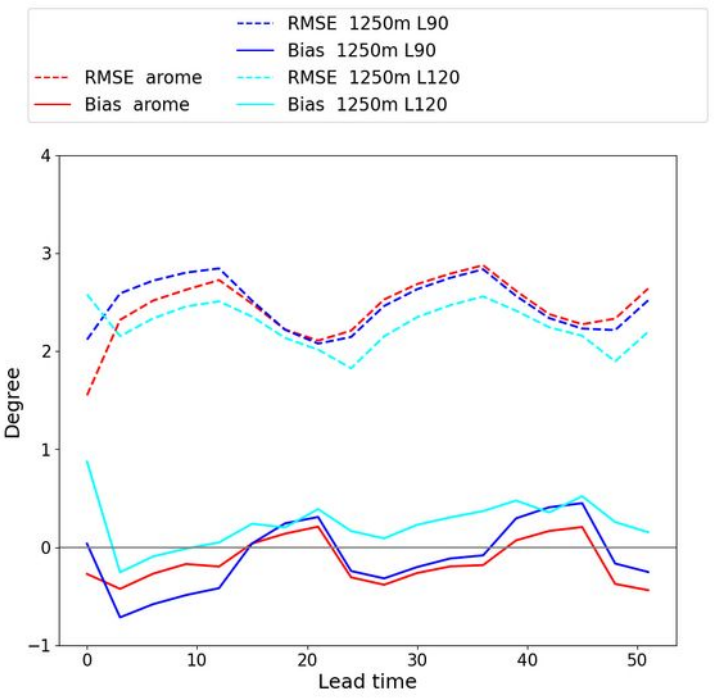
AROME for TeamX :11/11/2024 → 28/02/2025

TEAMXS domain Base: 18UTC





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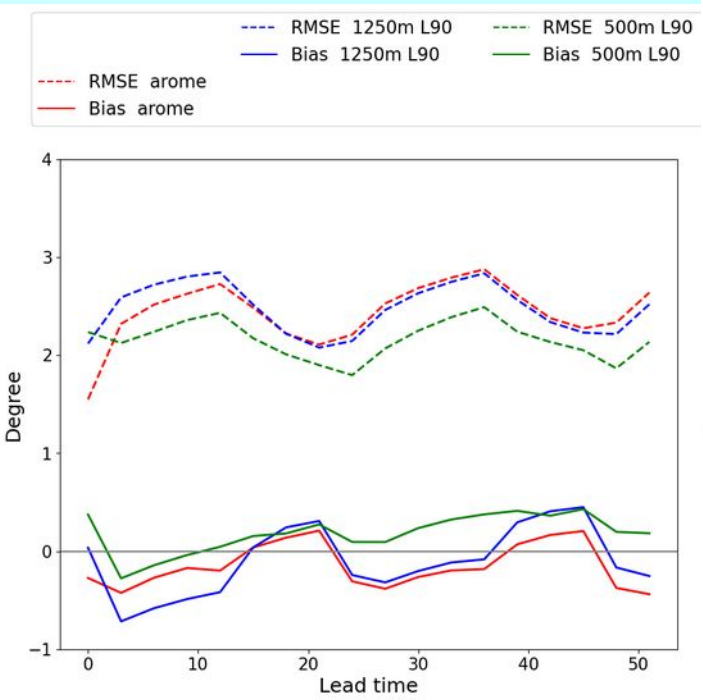

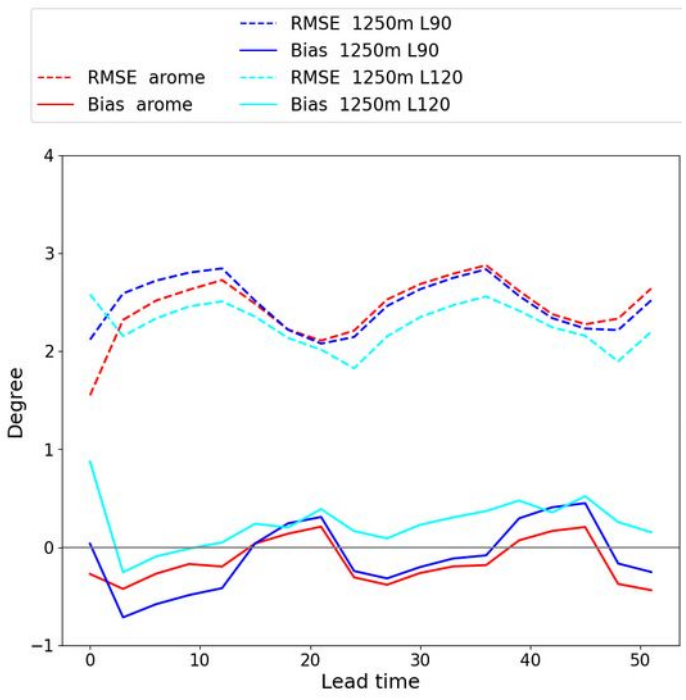

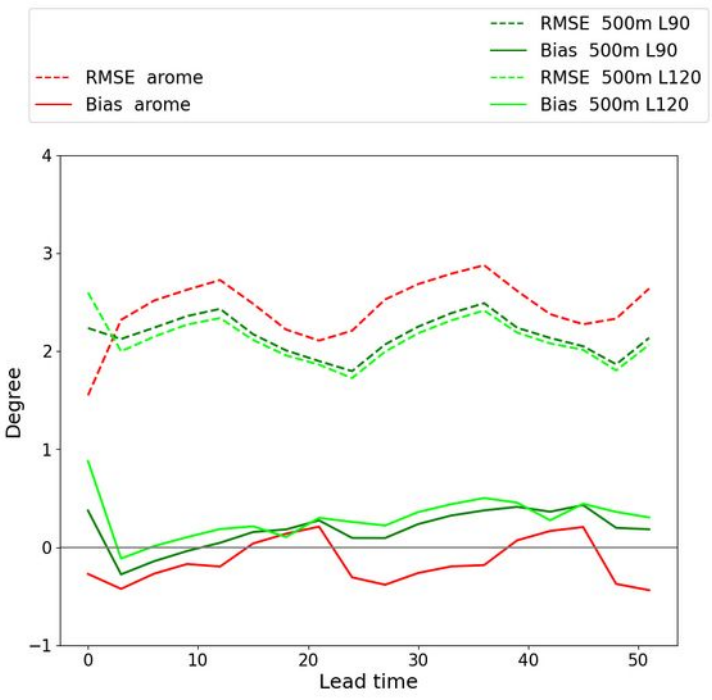

For this Alpine domain, impact of the vertical discretisation is more important at 1.25km than at 500m

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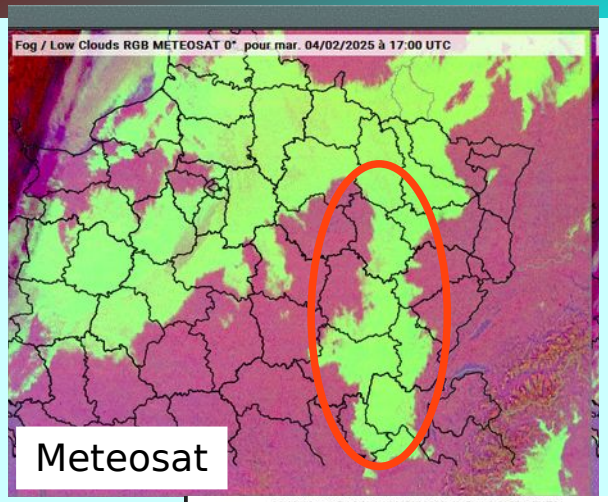
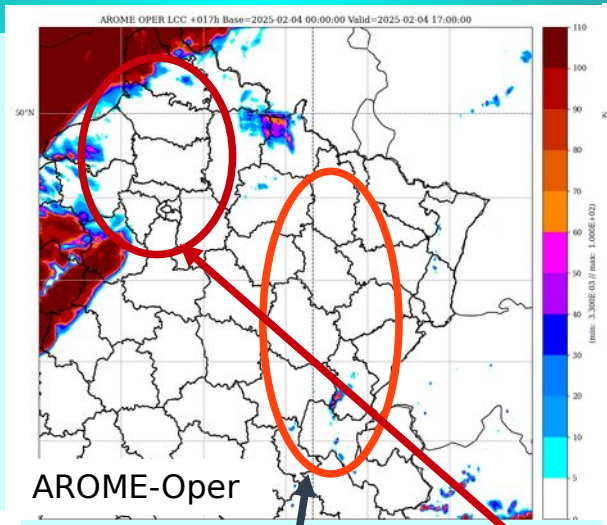
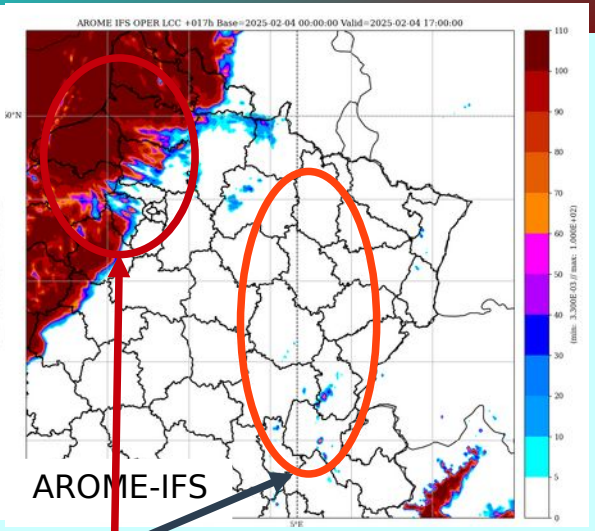
Low cloud problem with AROME 3/4 Feb. 2025 at 17UTC



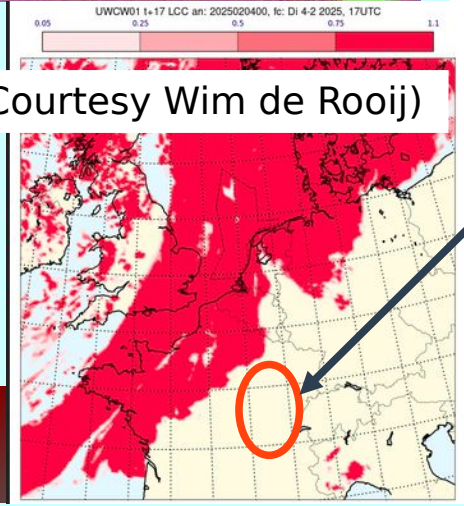
Meteosat



AROME-Oper



AROME-IFS



UWCW (Courtesy Wim de Rooij)

LCC are missing physics pb ?

Impact of the LBC IFS vs ARPEGE

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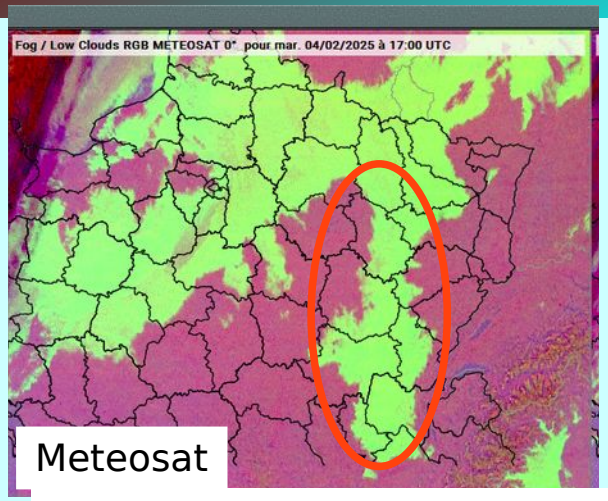
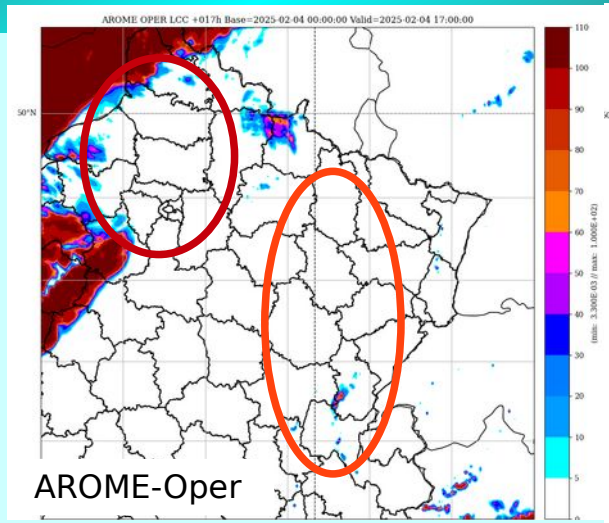
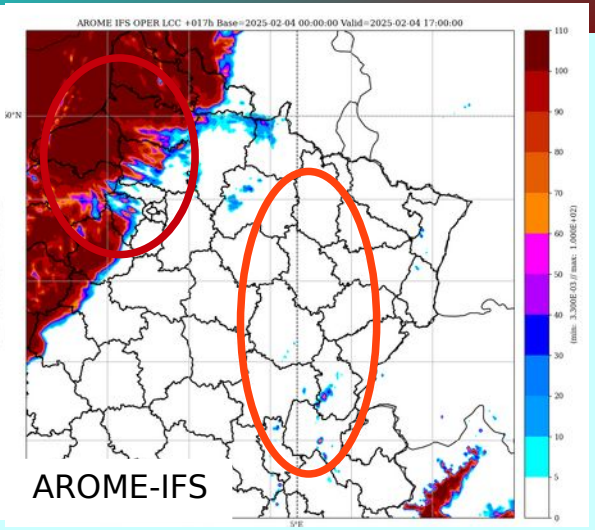
Low cloud problem with AROME 3/4 Feb. 2025



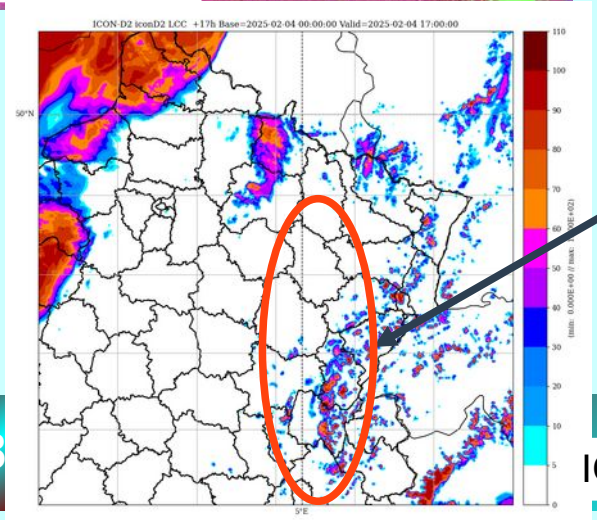
Meteosat



AROME-Oper



AROME-IFS



ICON-D2(Courtesy M. Koehler)

More LCC in ICON-D2
but not enough

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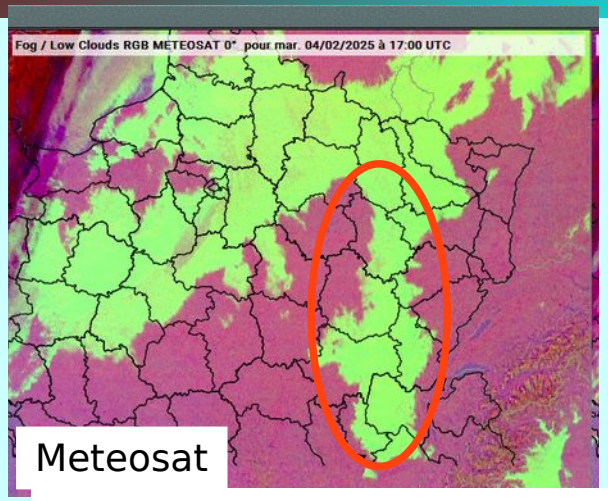
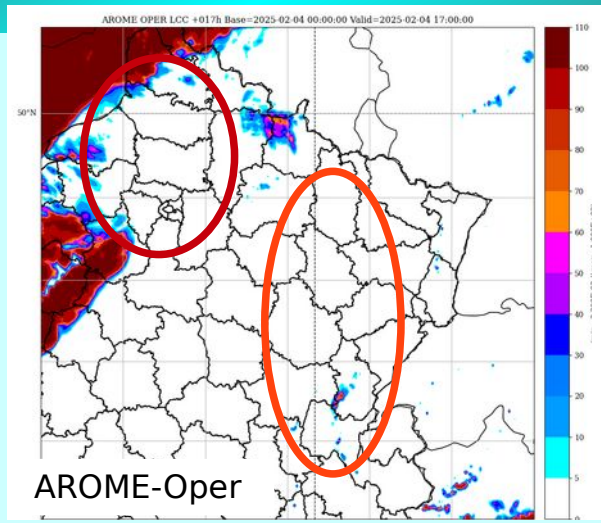
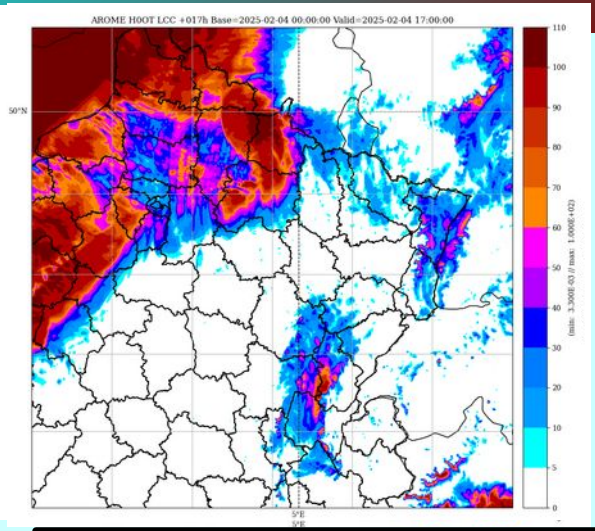
Low cloud problem with AROME 3/4 Feb. 2025



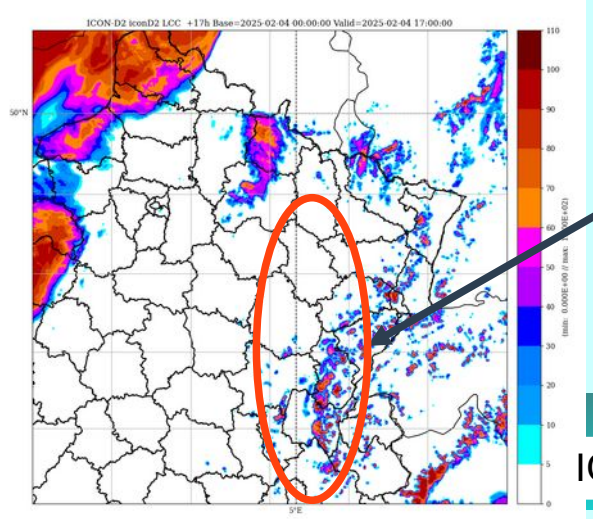
Meteosat



AROME-Oper



AROME-Oper with Vsigqsat=0.05 instead of 0.02 (exp. done by S. Riette)



More LCC in ICON-D2 but not enough

ICON-D2(Courtesy M. Koehler)

ACCORD
A Consortium for COnvection-scale modelling Research and Development

ACCALMIE

Contact Vincent.Guidard@meteo.fr

Coordinated Approach for Chemistry and Aerosols in CNRM Models, Inline and Offline.

Build a common framework for gazeous chemistry and aerosol modelling in NWP, climate and Chemistry models used and/or developed at CNRM/MF.
A common library aerosols – chemistry gathers all schemes used at CNRM/MF, **ACLIB** (Aerosol Chemistry LIBrary) will be shared under CeCILL-C.

Surface fluxes (emissions and depositions) are coded in **SURFEX (v9*)**

Interfaces in host models are coded / adapted to call the library and allow interactions with meteorological processes (radiation, microphysics)

ARPEGE, AROME (NWP + climate) → dev in cy49, target common cycle 51

End of phase 1 developments: end of May 2025
Existing configurations (eg. AROME-dust) will be ported

Plan for AROME-France 2027 ...

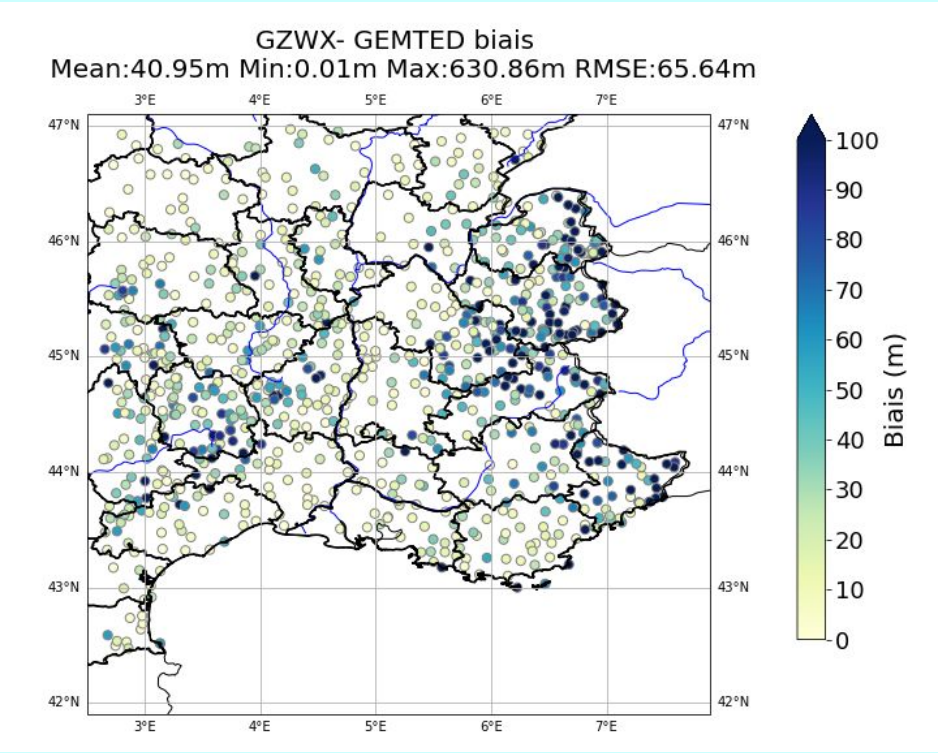
Same domain with AROME-750m and 120 levels

- CMO (1D Ocean Mixed Layer) (already used in AROME-OM) (A. Napoly)
- Use NRT-CAMS in EcRad (S. Antoine, S. Schaeffer) re-tune and updated shallow convection (?) (A. Marcel PhD, S. Riette)
- Use NRT-CAMS in ICE3 (or LIMA ?) M. Mazoyer & S. Antoine
- Pseudo 3D (?) and impact of the slope on the surface fluxes (Léo Rogel & F. Voitus)
- And may be depending of the MASCOT results use diff+ES+MEB+3 patchs ….
- But before ….

Plan for AROME-France 2027 ...

- Work on the orography options :
  - for the orography computation : LNEWORO, LNEWORO2, LSPSMORO (used by Harmonie-AROME ?)
  - Cubic grid vs the oper option (linear) ?
  - Impact on the z0, slope , etc ...
  - New SRTM file at 30m (new input larger domain created by Diane Tzanos)
- Optimize and safe dynamic with “adaptative SITRA,SIPR” (F. Voitus) ?

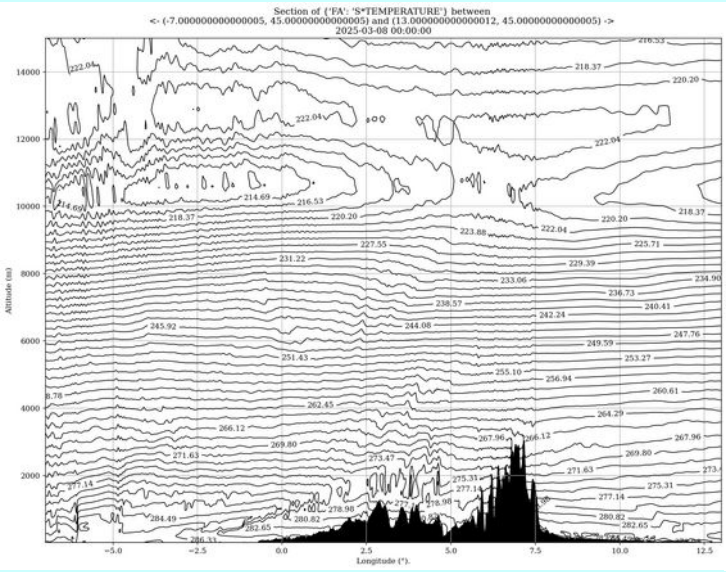
Impact of the input data and orography truncation



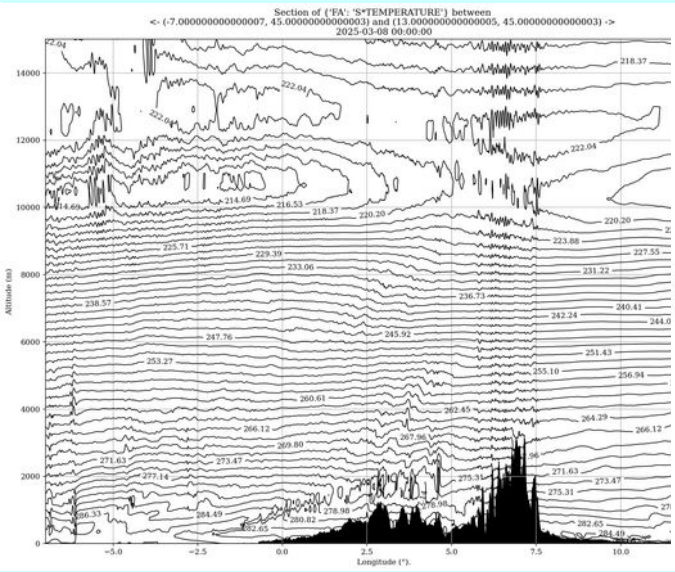
	Orography Grid	RMSE	Max Zs	Nx Ny	Tx, Ty
Oper	Quadra	100.89	4318m	1140/1536	719/767
750m GMTED	Quadra	65.64	4545m	2400/2560	1199/1279
750m SRTM30m	Quadra	64.73	4538m	2400/2560	1199/1279
750m SRTM30m	Quadra build pgd	52.85	4588m	2400/2560	1199/1279
750m SRTM30m	cubic	74.82	4381m	2400/2560	599/639

Some inconsistency after the spectral treatment, some fields used to compute z0 or used in ORORAD option are not recomputed only ZFX.ZS is updated in the PGD !

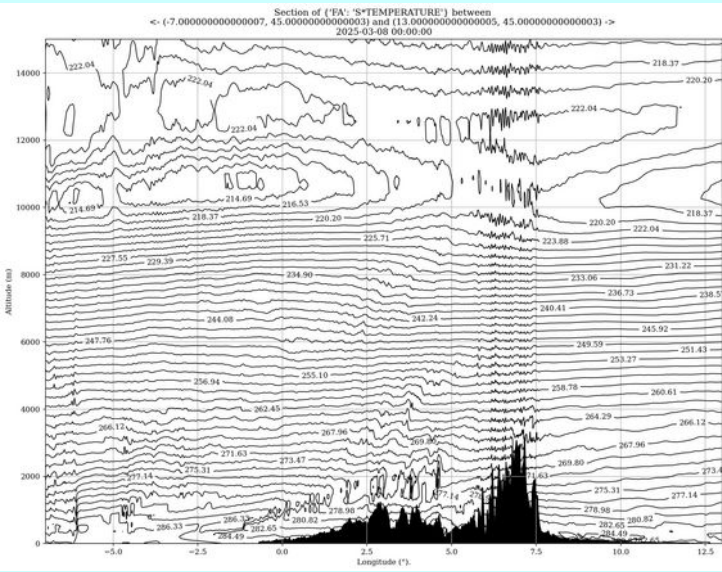
Very first results at 750m : cross-section 45N



AROME-OPER

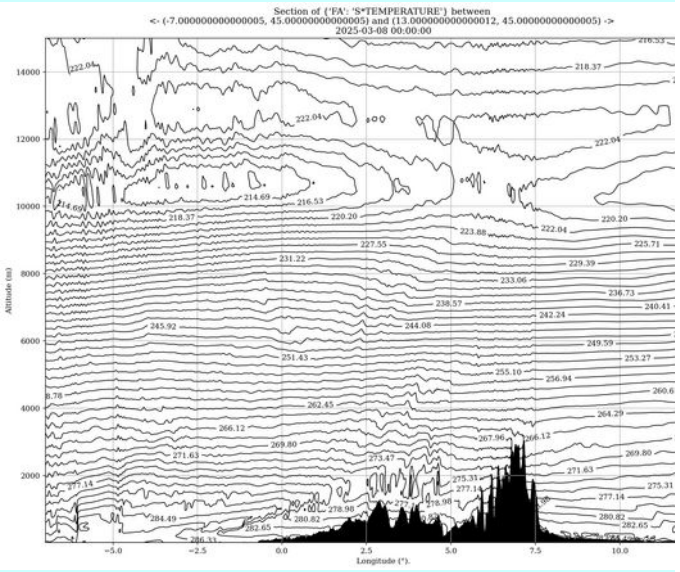


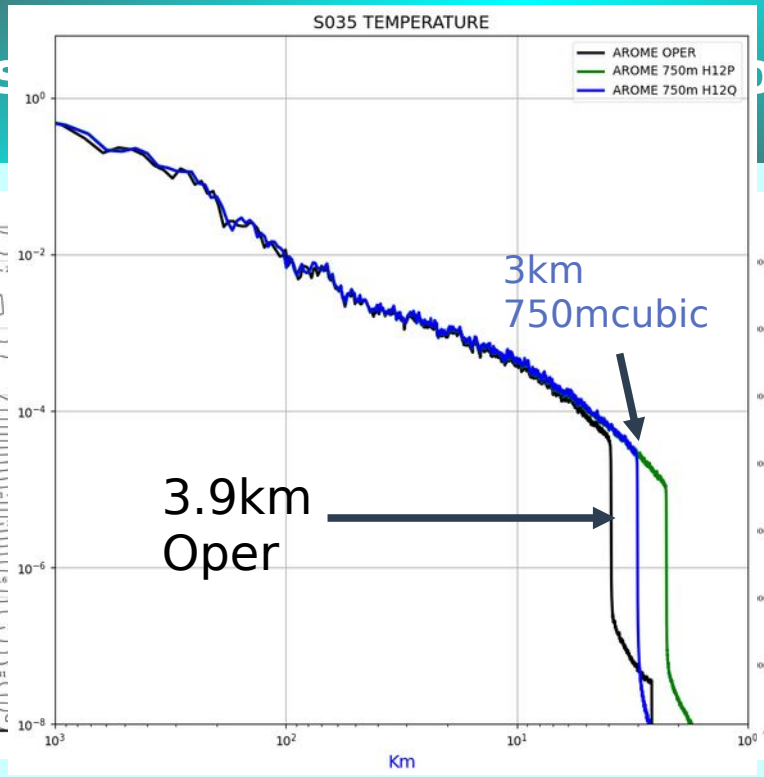
AROME-750m
(QLinear) 30s
RDAMPT=20

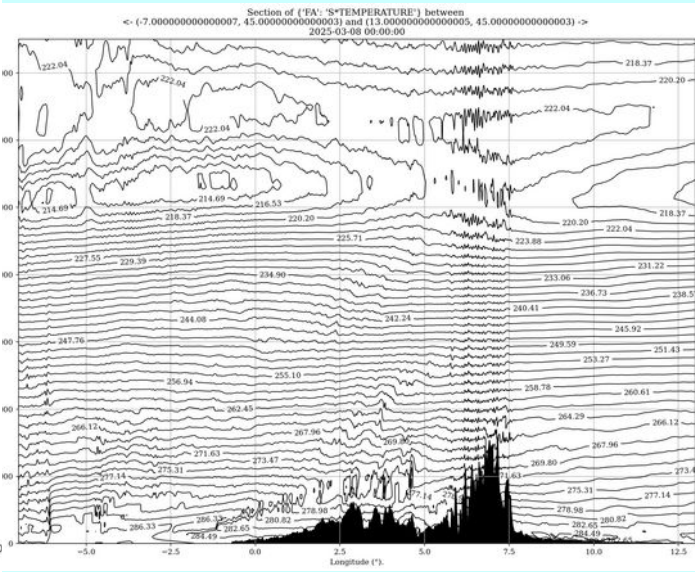


AROME-750m-
Cubic 30s
RDAMPT=20
20% cheaper

Very first results on 45N







AROME-OPER

AROME-750m
(QLinear) 30s
RDAMPT=20

AROME-750m
Cubic 30s RDAMPT=20
20% cheaper

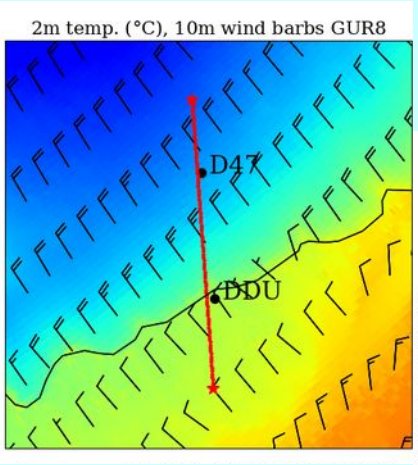
Test the Fabrice options (Thursday talk)

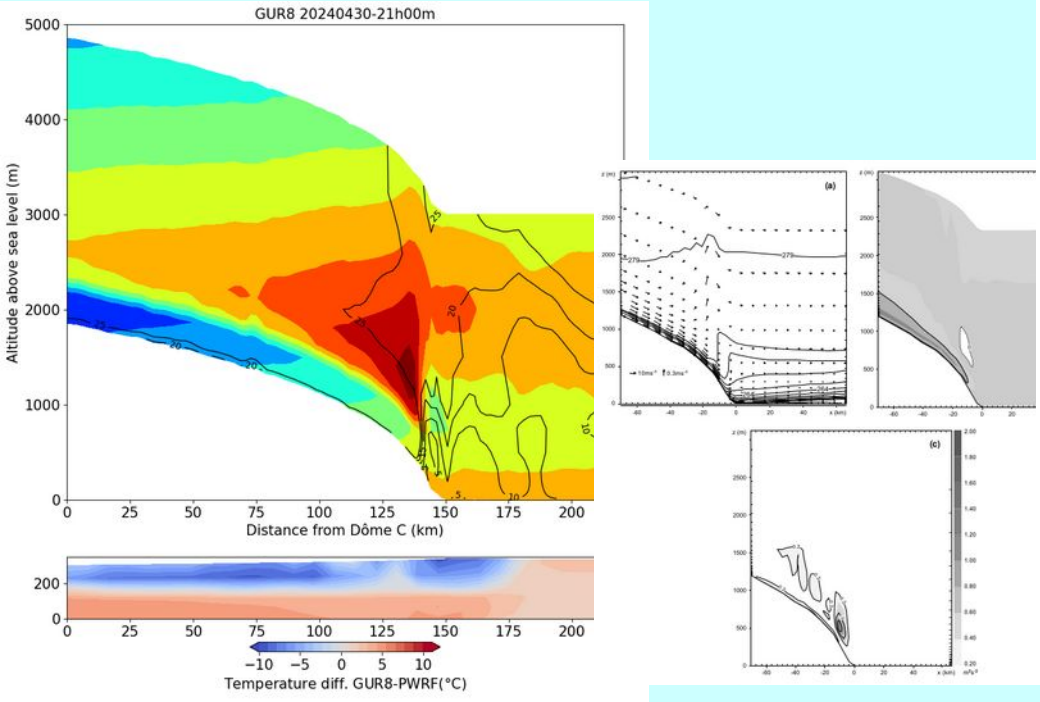
Near future :

- Running AROME in exotic area (outside Europe) is very useful to “push” the physics outside his comfort zone (not only the physics) : numerics problem in the Svalbard domain, katabatic wind at DDU
- Increasing the domain size does not automatically improve the score !
- More deeper analysis of the TEAMx run (500m and 120 levels) with the additional observations
  - TEAMx will be used for pseudo 3D evaluation and “slope” update
- Coupling AROME/GELATO and MFWAM for the MIZ project (with AROBASE)
- Start to evaluate AROME-750m with 90 levels & 120 levels before summer 2025
  - and after add physics udpdate (CMO, CAMS-NRT etc ...)

Exotic Area : Svalbard, St-Pierre-et-Miquelon, Antarctica

Katabatic wind at Dumont-d'Urville 2024/04/30





From F.K. Ball 1956 !

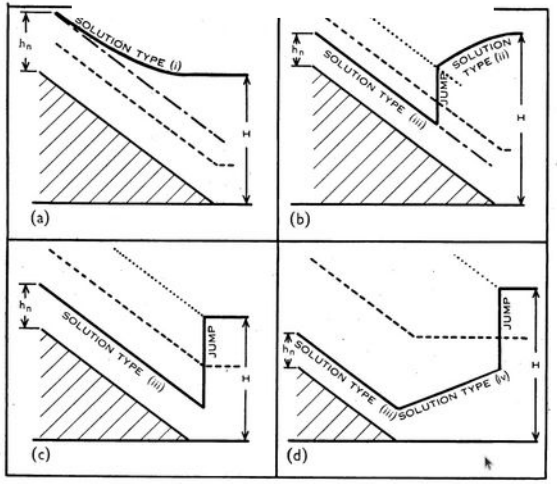


Fig. 2.—Flow types which can occur near the foot of a slope.
——— Inversion surface h. – – – – – Normal depth.
– – – – – Critical depth h_c. ····· $\hat{h}$.
—→ Direction of flow.

Yu,Y. et al. (BLM,2005)

S. Blein, E. Bazile

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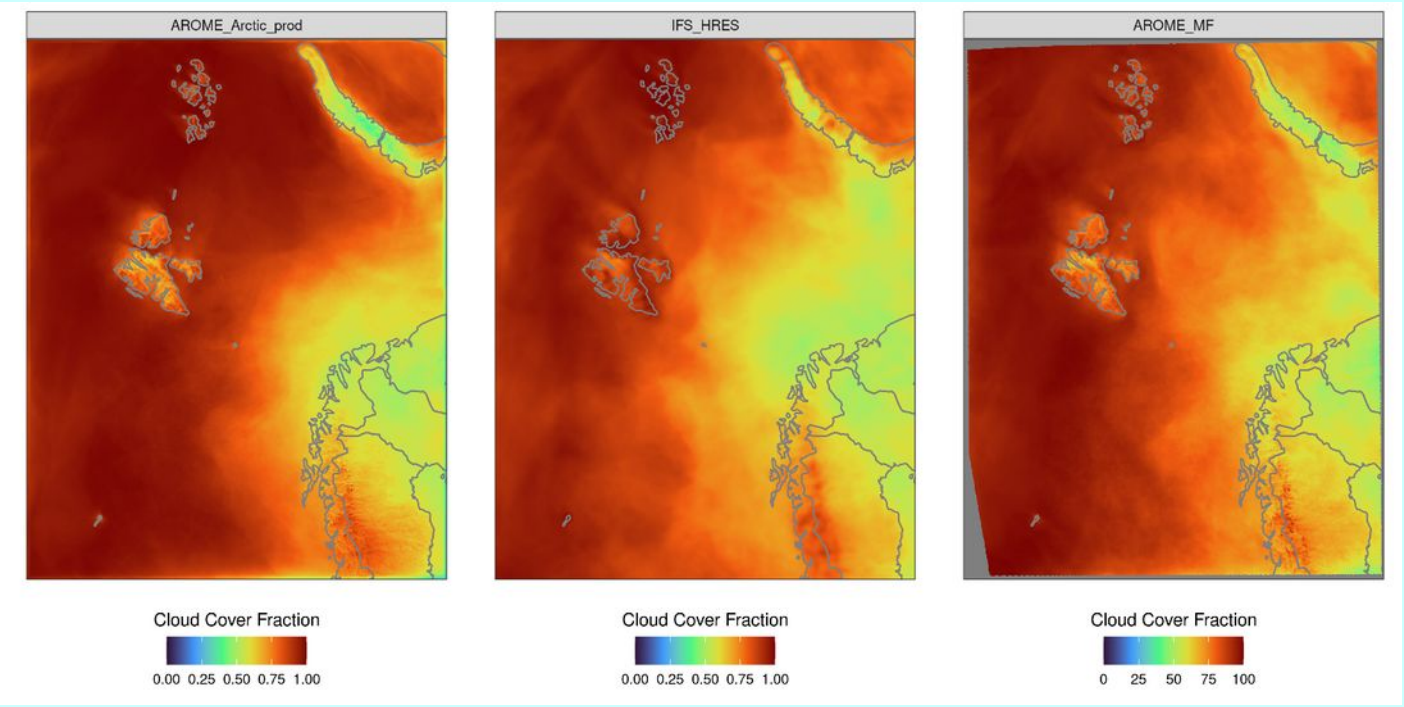
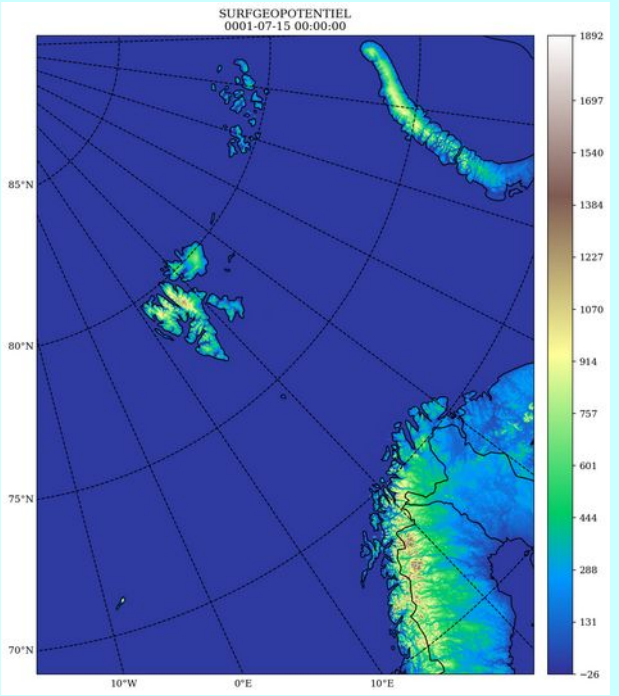
Exotic Area : **Svalbard**, St-Pierre-et-Miquelon, Antarctica

- 



Too much low clouds in AROME-Arctic (from the forecasters), IFS too dry and AROME-MF in between

From Terasa M. Valkonen (MetNo)