Recent Advances of the Météo-France global NWP system

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A new forecast system in operation: 43t2 >> 46t1

Significant update of physical parameterizations

- **Deep convection**: IFS deep convection scheme (Tiedtke 1989, Bechtold et al. 2004, 2008, 2014)
- **SW radiative transfer**: RRTM, McICA solver (Mlawer et al. 1997, Pincus et al. 2003, Morcrette et al. 2008)
- **turbulent surface fluxes at the air-sea interface** from a new version (v6) of our in-home scheme (ECUME, Roehrig et al. 2020)
- **sea-ice thermodynamics** from the CNRM sea-ice climate model (GELATO, Salas y Melia 2002)

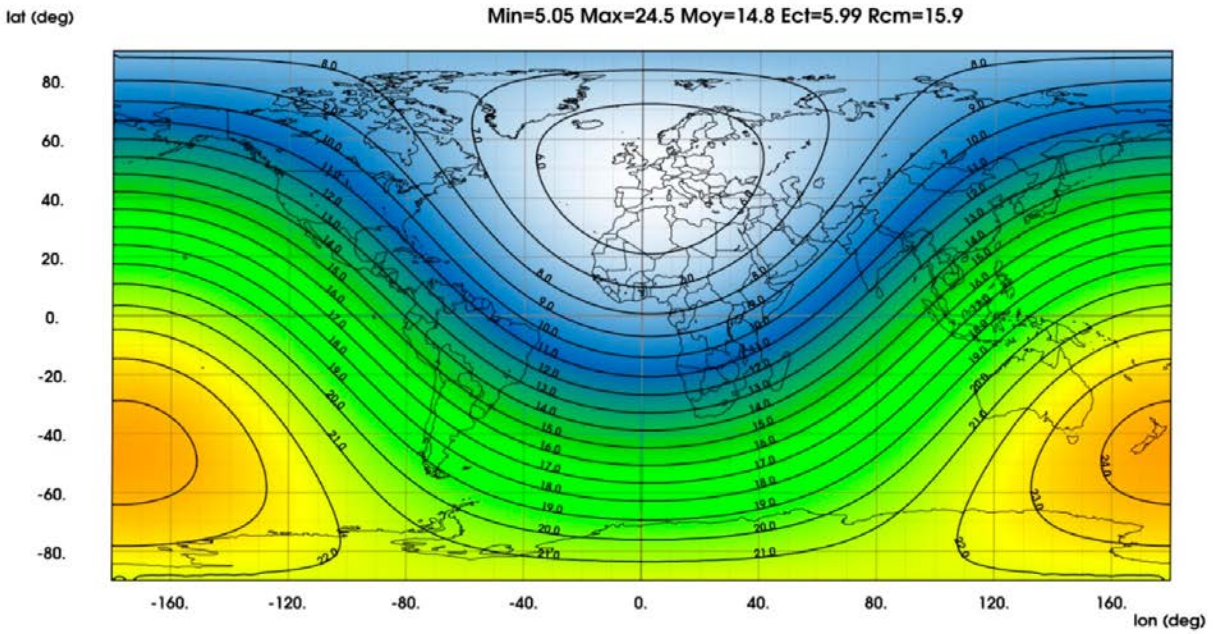
New assimilated data

- All-sky radiances from MHS and ATMS microwave water-vapor sounders
- MWHS-2 microwave radiance onboard FY3-D Chinese satellite
- Implementation of snow analysis
- New 2D operator for GNSS-RO observation curvature
- …

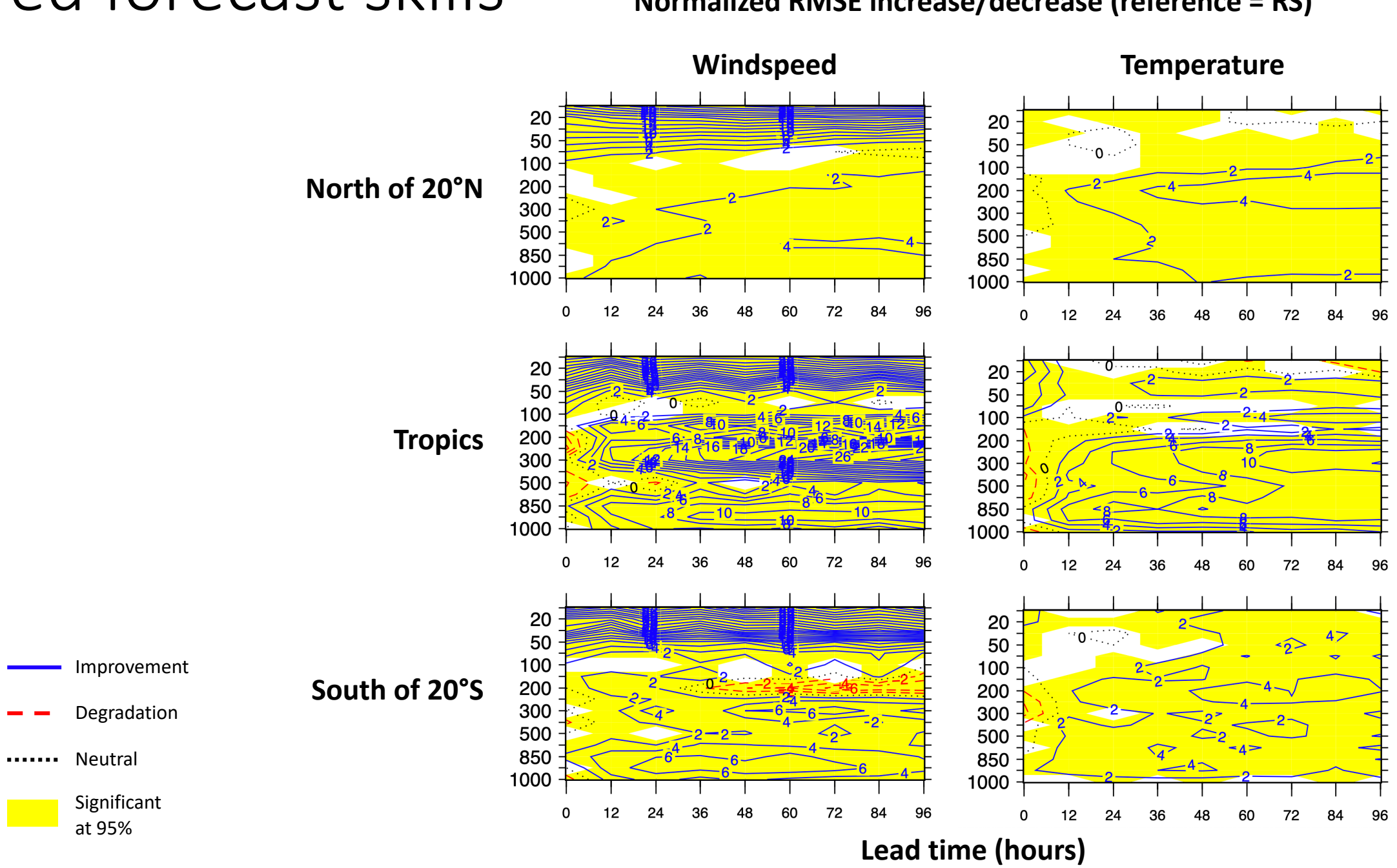
Technical updates

- From cy43t2 to cy46t1 (RTTOV12, SURFEX v8.0)
- New/updated diagnostics for convection/aeronautics

In operation late June 2022

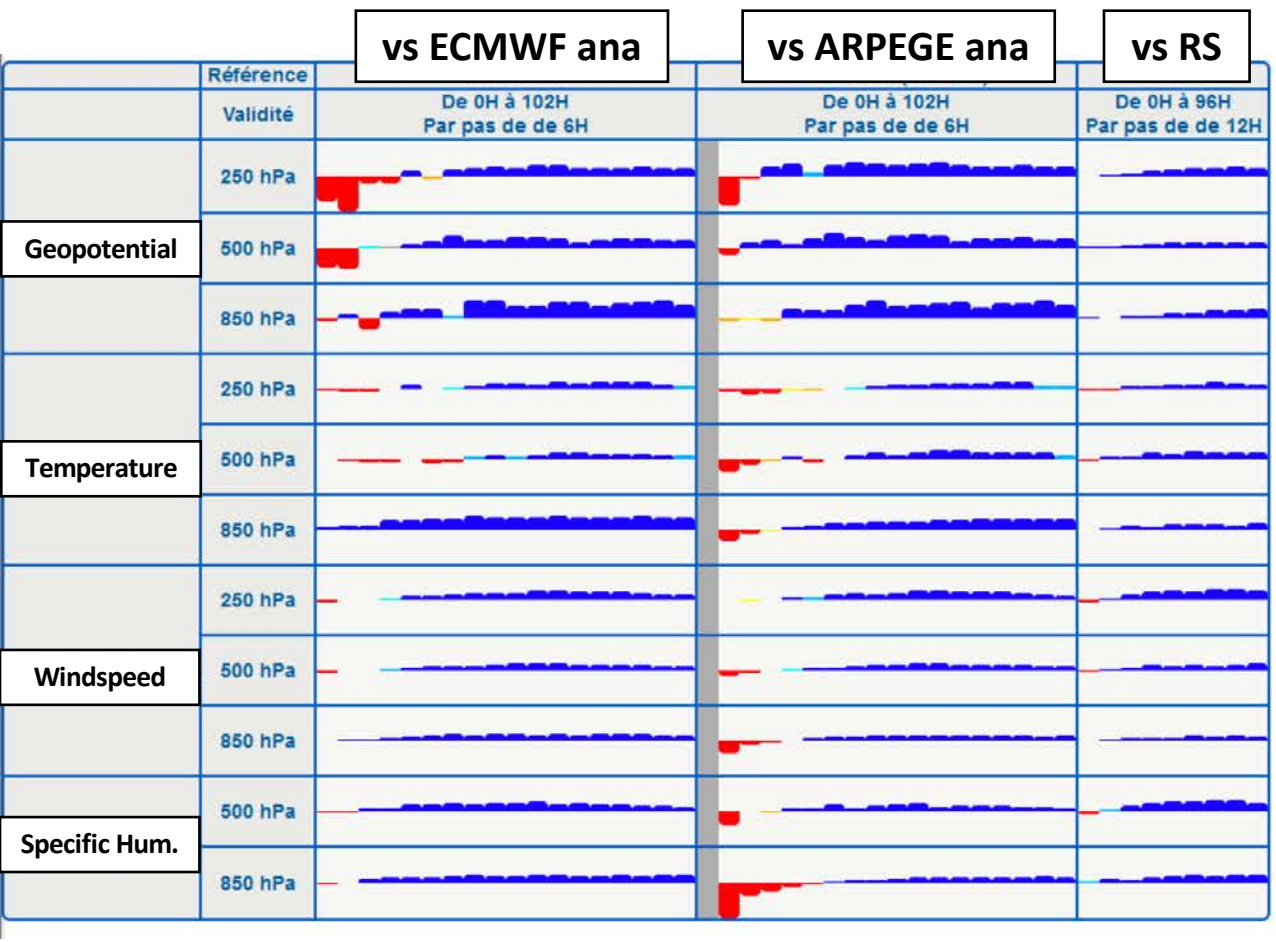


Improved forecast skills

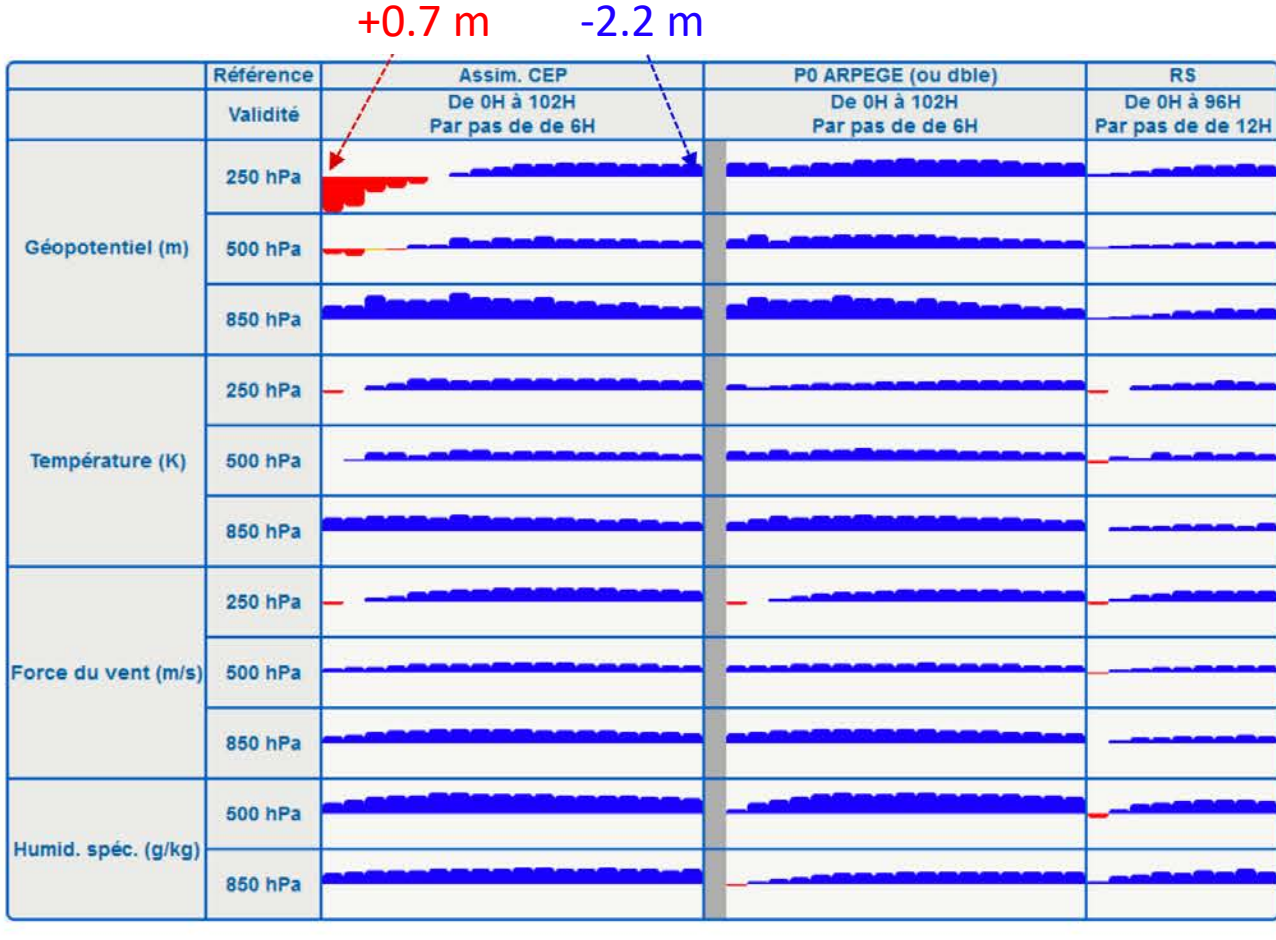


Improved forecast skills

Normalized RMSE increase/decrease



EUROPE

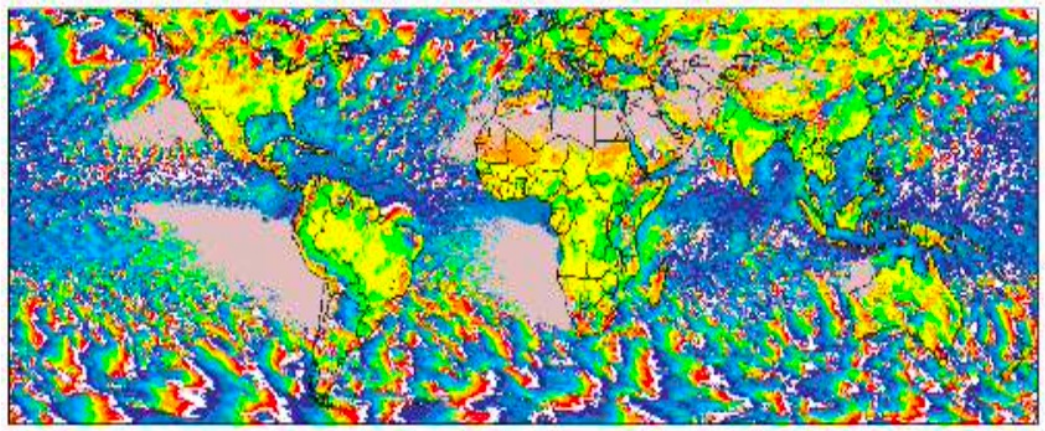


GLOBAL

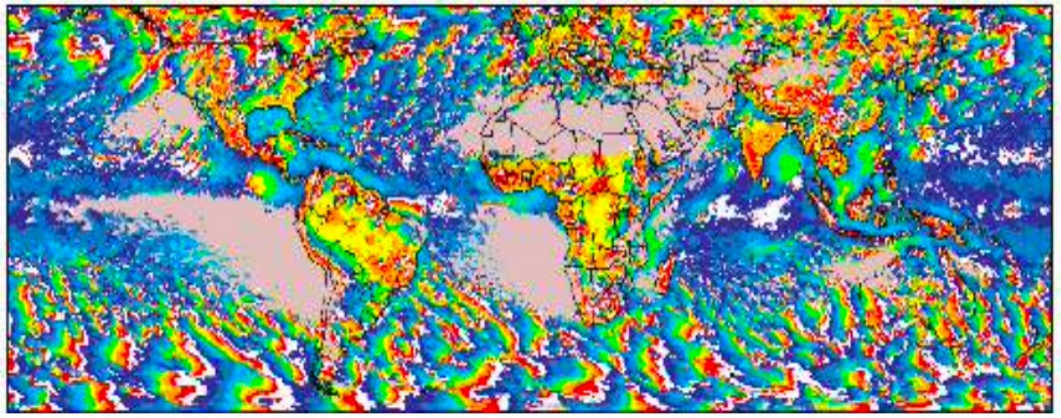
- Improvements mostly due to reduced error standard deviations, except in the stratosphere (reduced biases)

Improved diurnal cycle over tropical land

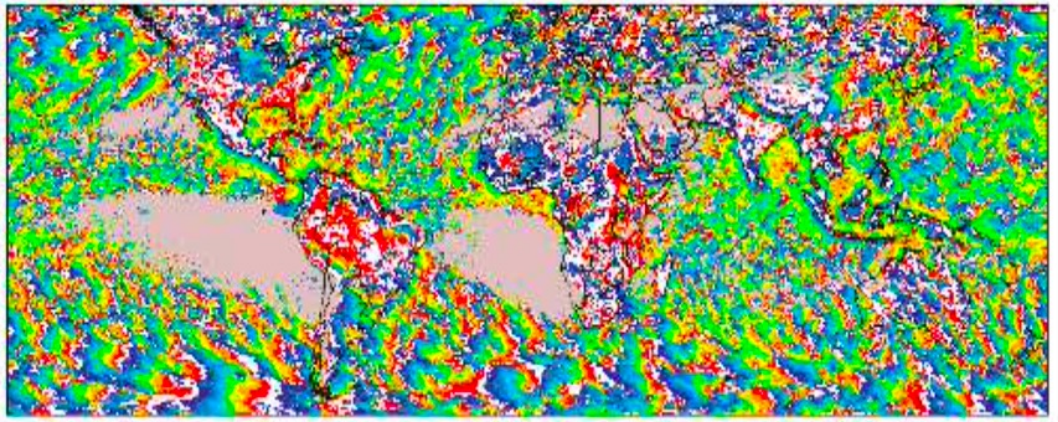
43t2



46t1



IMERG

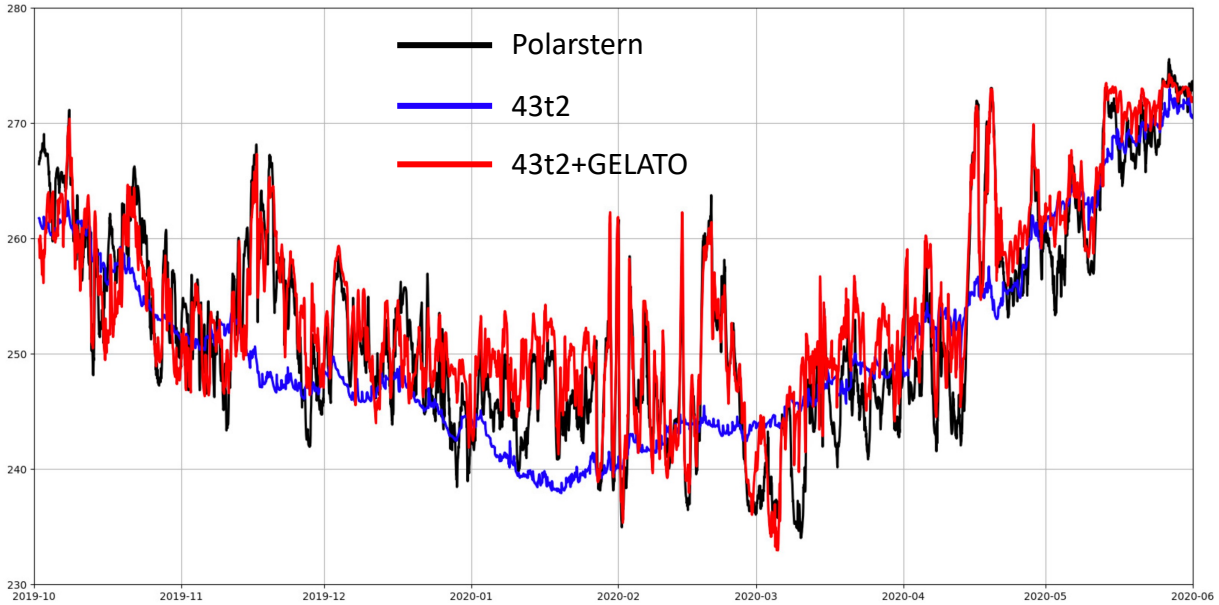


- Consistent with the revisited CAPE closure from Bechtold et al. (2014)

Courtesy J.-M. Piriou

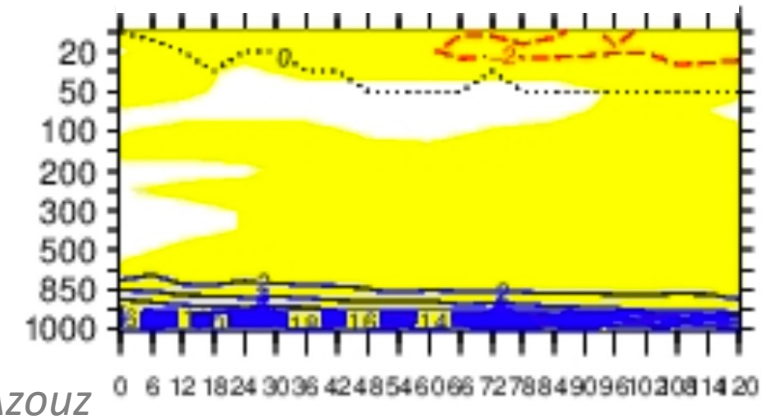
Adding sea-ice thermodynamics representation

2-m temperature

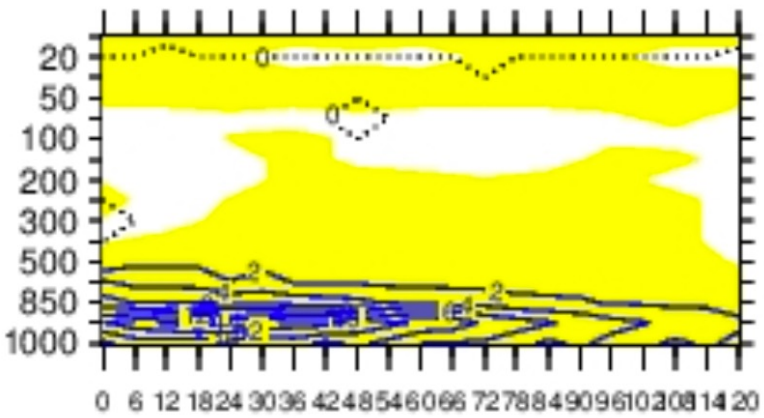


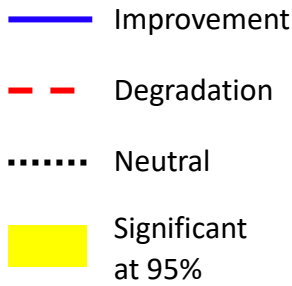
Temperature normalized RMSE increase/decrease (reference = RS)

North of 20°N



South of 20°N



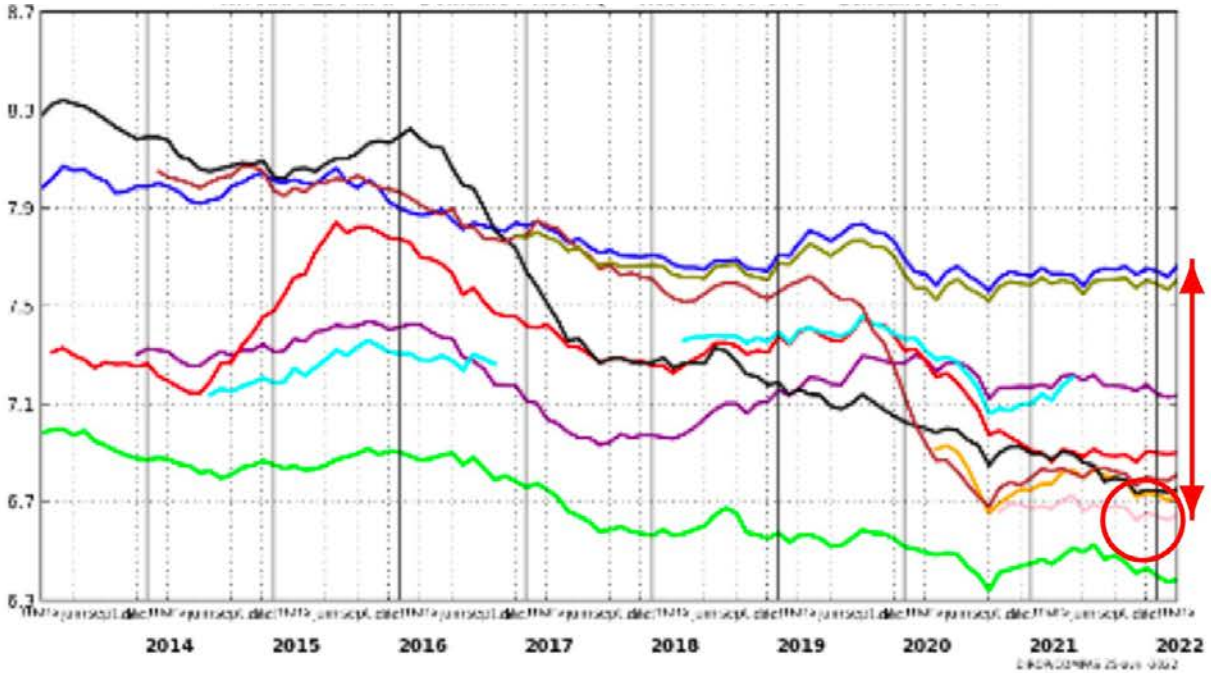


Courtesy A. Napoly, E. Bazile, N. Azouz

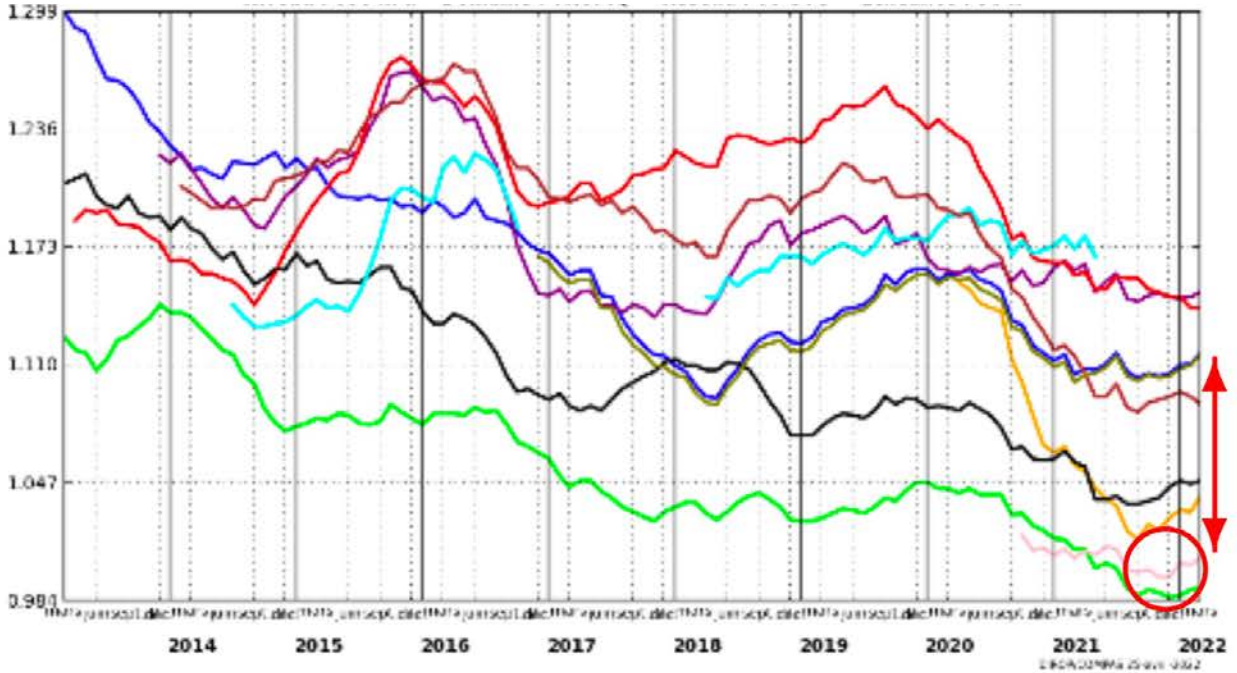
Improved forecast skills

RMSE vs. radiosoundings (Tropics, +96h)

Windspeed at 250 hPa



Temperature at 850 hPa

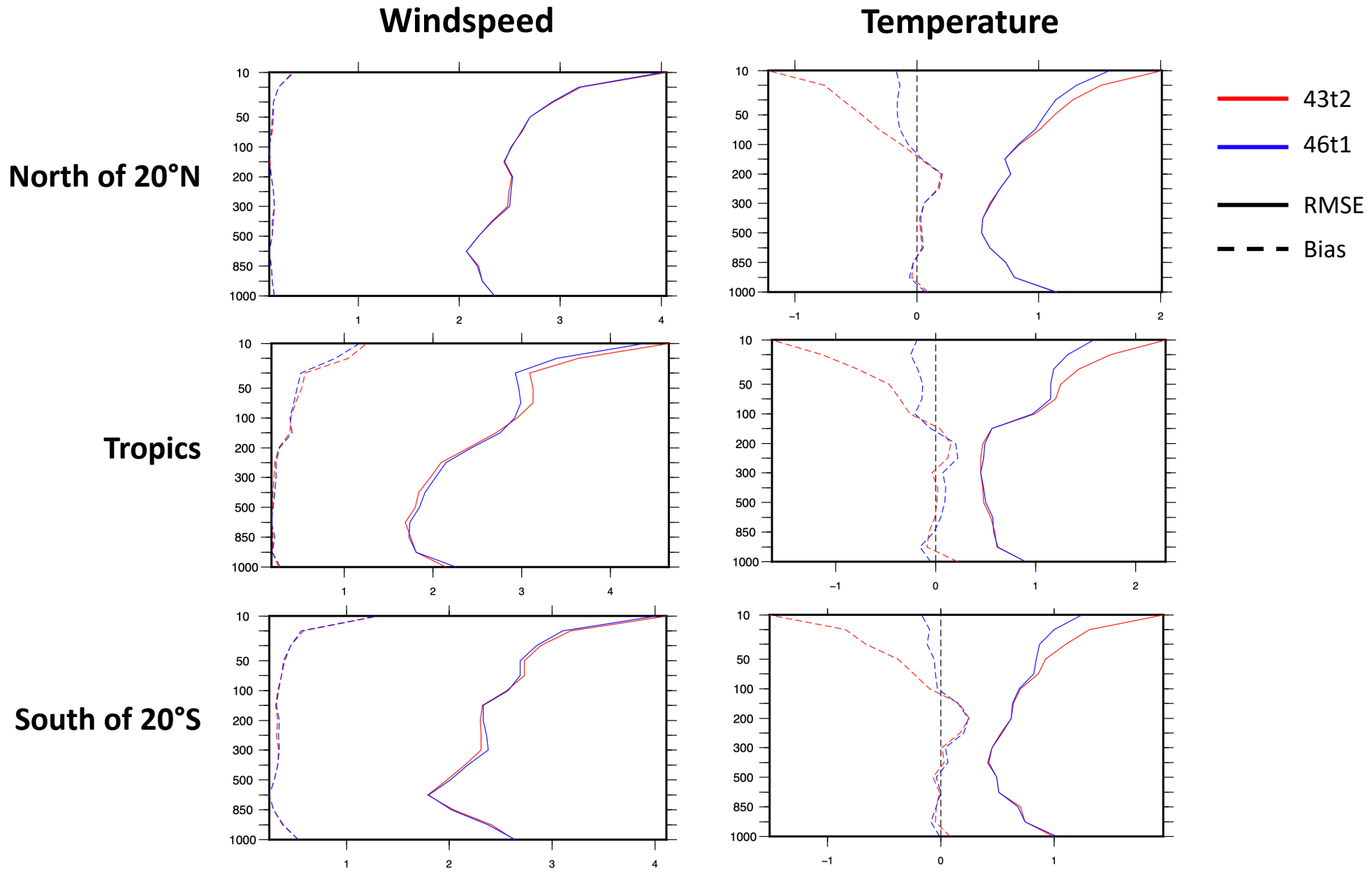


ECMWF UKMO DWD CANADA 43t2

JMA AUSTRALIA KMA 46t1

Improved analyses

Bias and RMSE



Conclusions and next steps

New physics package in ARPEGE (46t1) in operations since June 2022

- Strong efforts over the last 3-4 years to update several components of the model physics
- Significant improvements of model skills (analysis and forecast)

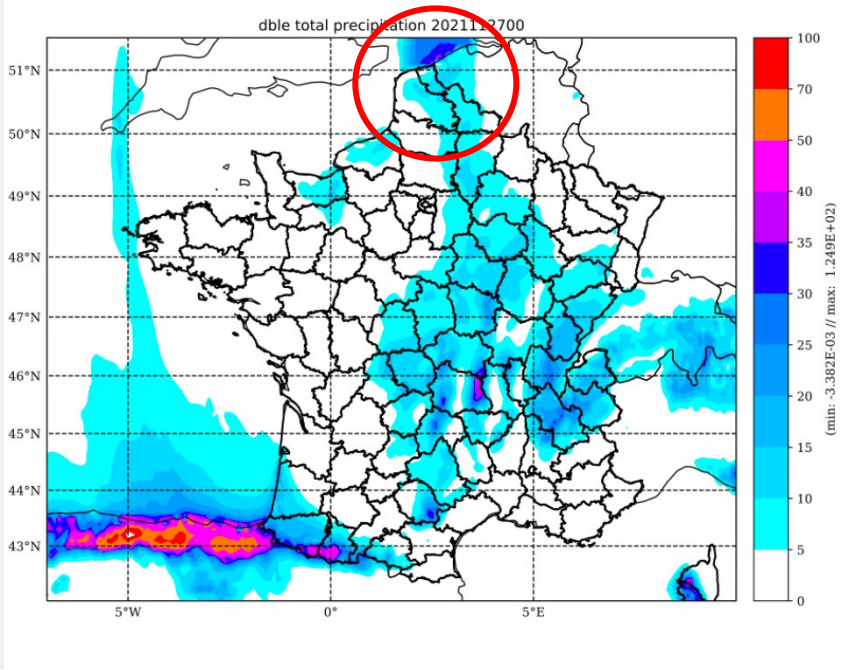
Next operational system (late 2023, 48t1)

- Update of IFS convection scheme (based on IFS 47r3)
  - possibly with mixed closure (CAPE and moisture convergence)
  - Modulation of the revised CAPE closure for the diurnal cycle to reduce coastal precipitation issues

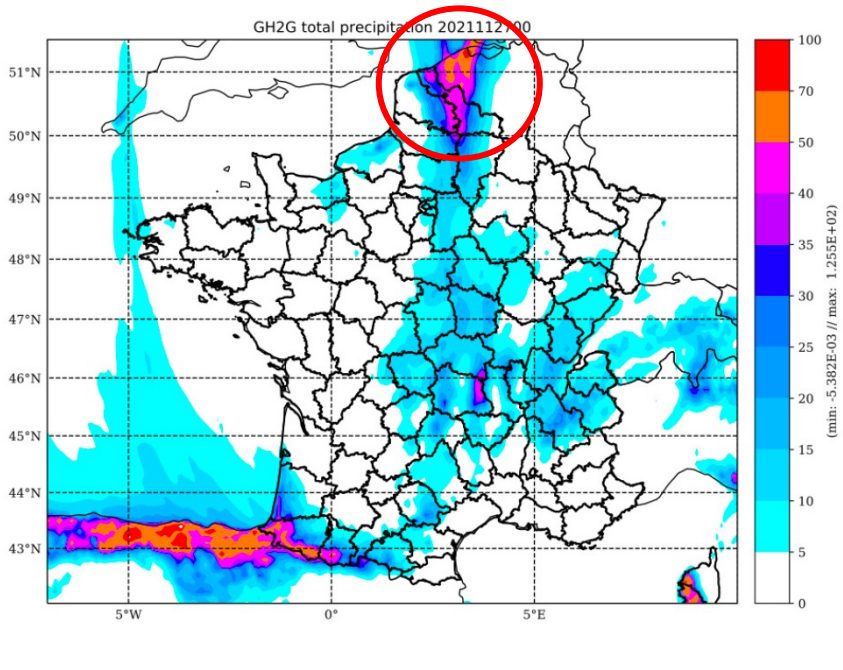
Coastal precipitation issue

Case of 28 November 2021

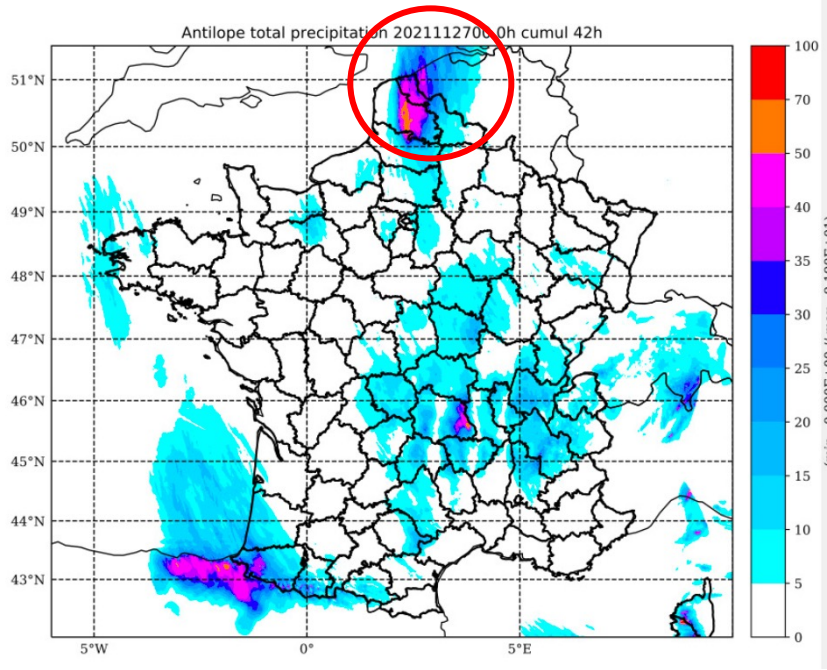
46t1



48t1



Antilope (Radar)



Courtesy Y. Bouteloup

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- Update of IFS convection scheme (based on IFS 47r3)
  - possibly with mixed closure (CAPE and moisture convergence)
  - Modulation of the revised CAPE closure for the diurnal cycle to reduce coastal precipitation issues
- Use of EcRAD, still with RRTM and McICA (20% more efficient)
- Testing the added value of a 1D oceanic mixed layer model
- Update of surface scheme (e.g., activate FLAKE lake scheme)