Regional reanalyses applications at Météo-France and further needs

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Toulouse, C3SRRA 2018, 20/11/2018

Agenda

- RRA applications at Météo-France :
    — ENTSO-E Pan European Climate Database (energy sector)
    — WIRE model (transportation & energy sector)
    — Transportation sector (roadweather)

- Summary

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RRA applications at Météo-France – ENTSO-E

- Energy sector (**ENTSO-E** European Network of Transmission System Operators for Electricity)

- <u>Context :</u> complete the **Pan European Climate Database (PECD) – adequacy studies, energy demand/supply**

- Hourly time series of several parameters since 1988 or before :
    - 100 m wind speed ;
    - 2 m temperature ;
    - 2 m population weighted average temperature
    - 2 m relative humidity ;
    - Global irradiance ;
    - Cloud cover ;

- Computed over market nodes (NUTS3 aggregation or countries) or cities
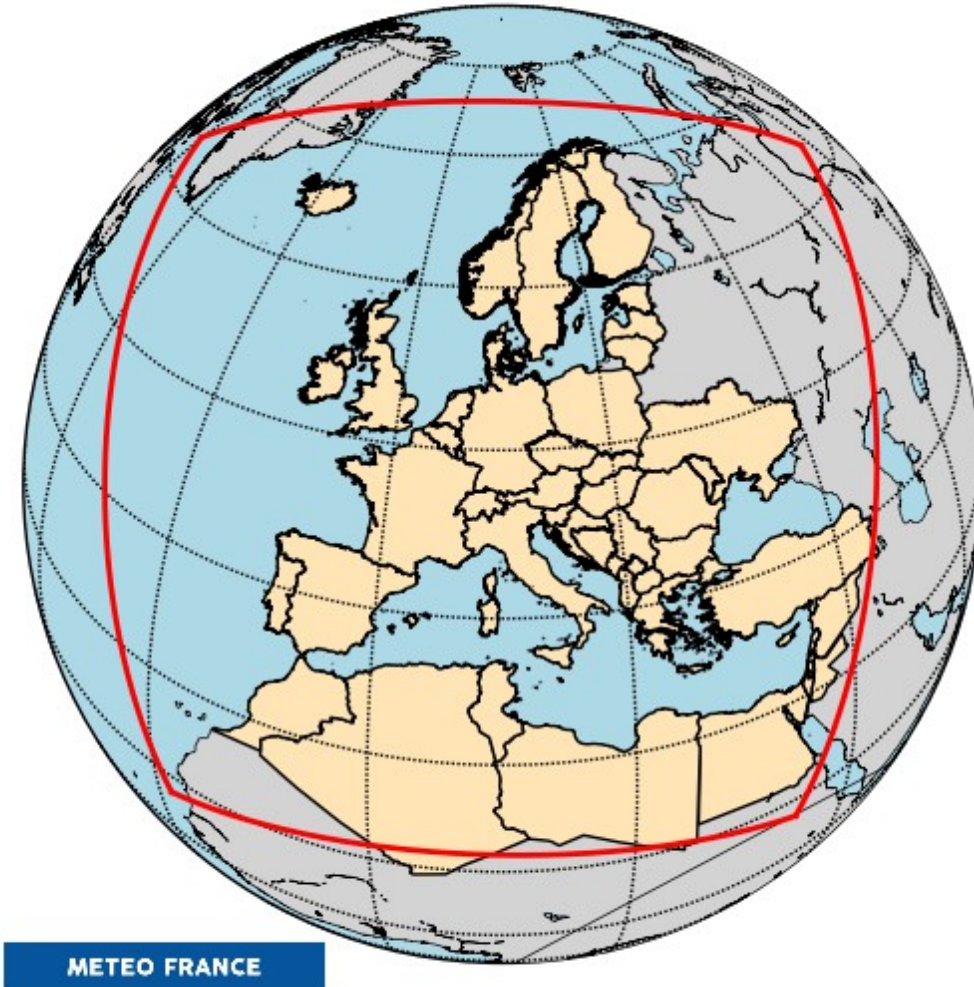
entsoe

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RRA applications at Météo-France – ENTSO-E UERRA – HIRLAM domain (1/)

- Spatial coverage (countries):
 - Europe ;
  - Iceland ;
  - Mediterranean countries :
    - ► Morocco
    - ► Algeria
    - ► Tunisia
    - ► Libya
    - ► Egypte
    - ► Israel
    - ► Jordania
    - ► Palestine
    - ► Lebanon
    - ► Syria
    - ► Turkey

HIRLAM domain
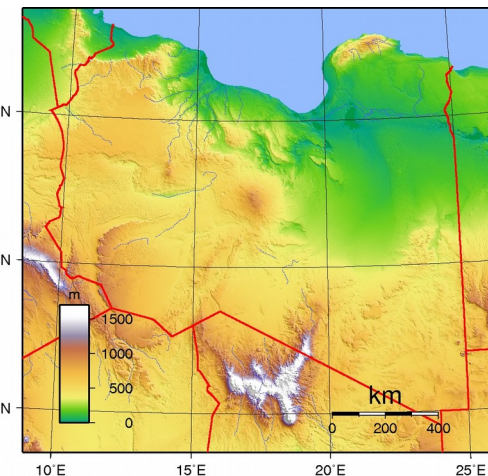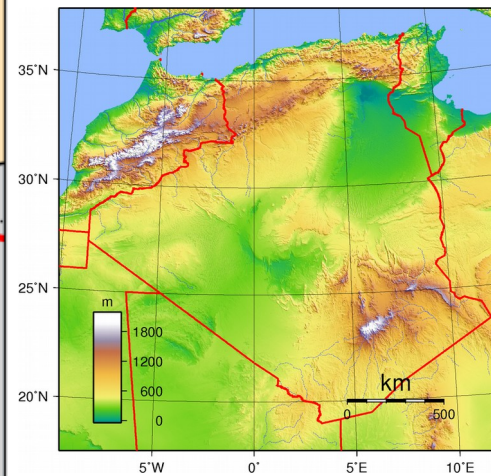
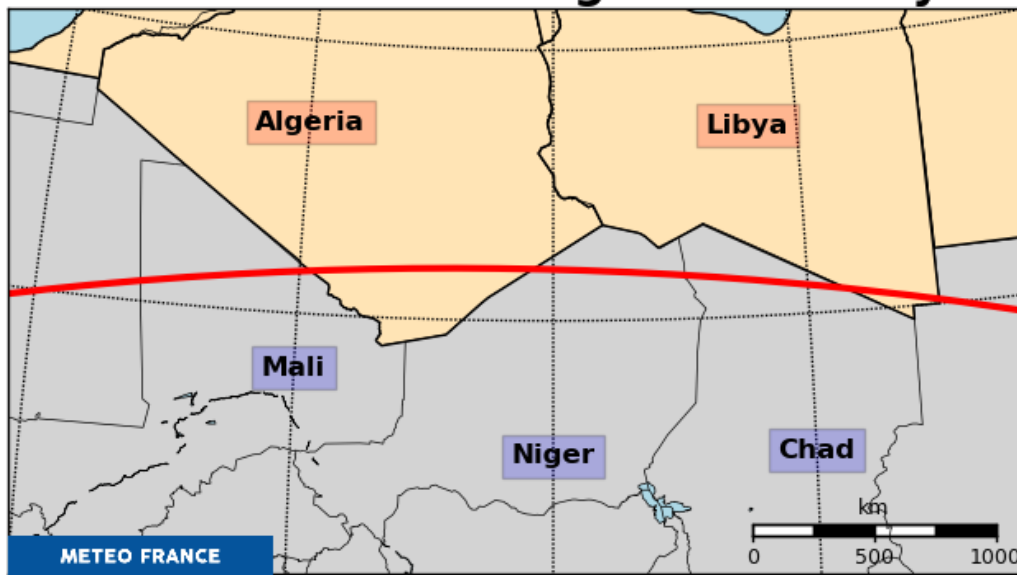

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RRA applications at Météo-France – ENTSO-E UERRA – HIRLAM domain (2/)

- **North-Africa – Algeria and Libya (southernmost part of the domain).** Köppen classification **BWh** (hot desert climates) with very moderate elevation and plateau (~300 – 500 m, relatively flat);

- *Algeria*: ~7 % ~ 170 000 km²

- *Libya*: <1 % ~ 15 000 km²
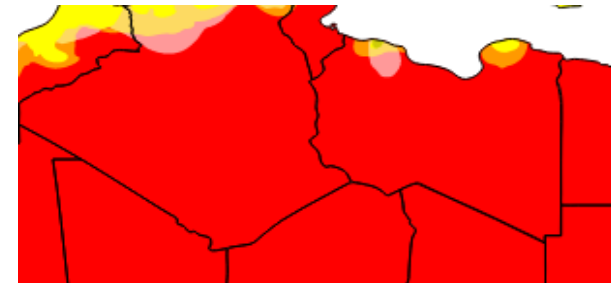
Peel, M. C. et al., 2007

HIRLAM domain - Algeria and Libya
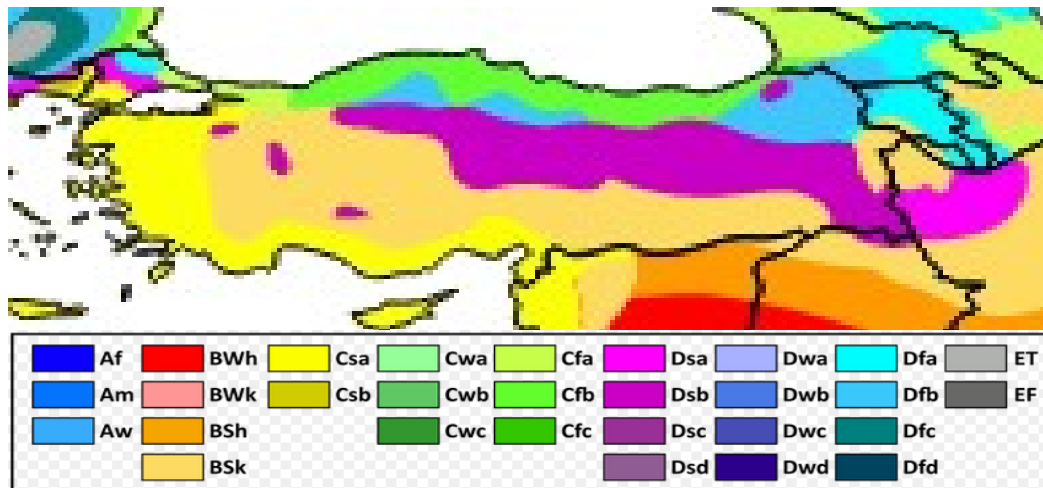
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RRA applications at Météo-France – ENTSO-E UERRA – HIRLAM domain (3/)
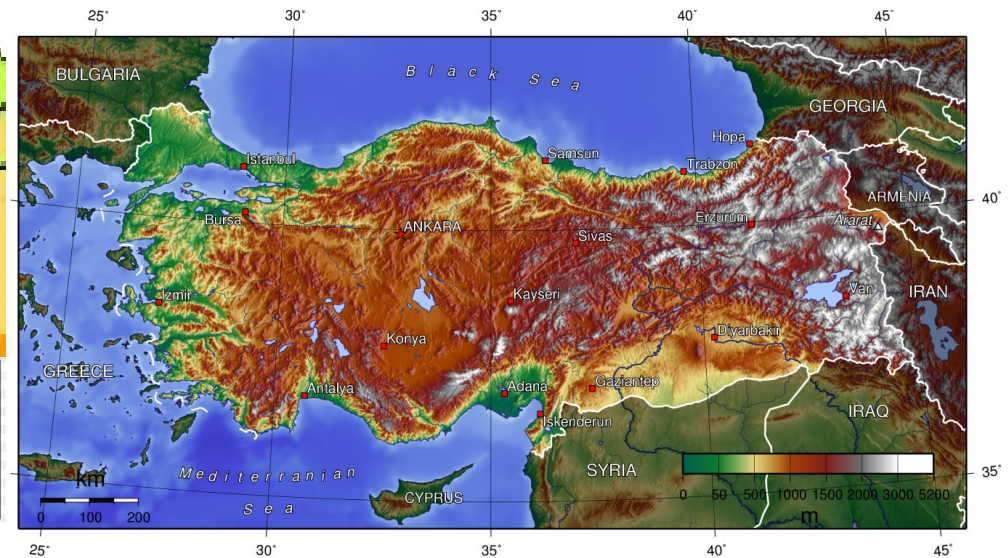

HIRLAM domain - Turkey

- **Turkey** Köppen classification **Dsa** and **Dsb** (dry summer continental climates) with very high elevation with sharps gradients (> 3000 m; 5166 m max.). *Turkey* < 1 % ~5 700 km²
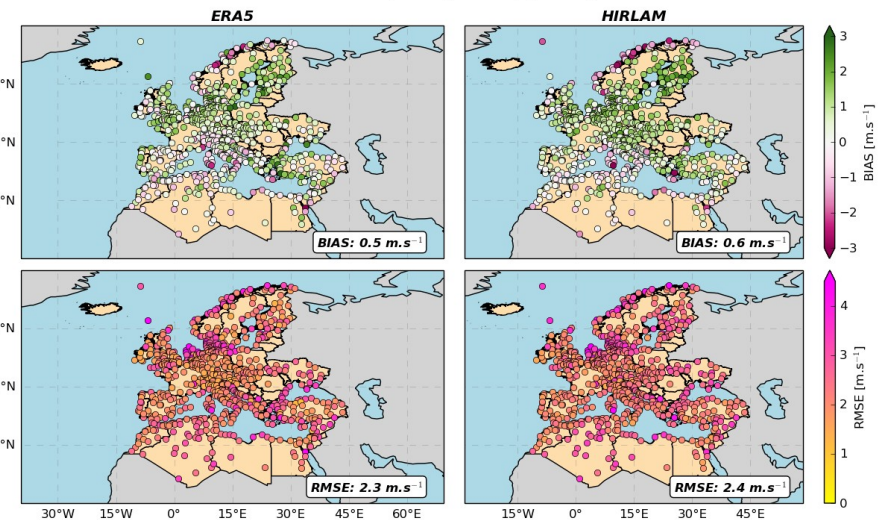

Peel, M. C. et al., 2007

RRA applications at Météo-France – ENTSO-E
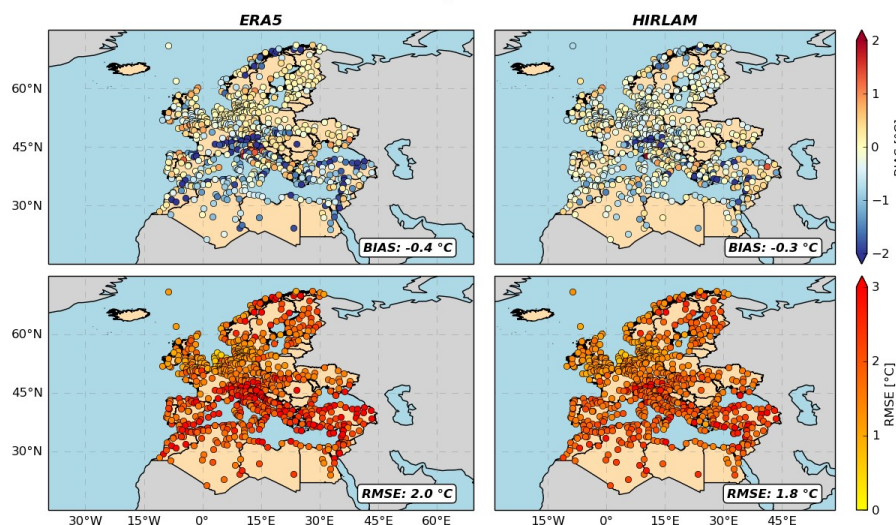# Some scores between ERA5 and UERRA HIRLAM

- Mean bias and RMSE between ERA5 / UERRA HIRLAM and observations between 2001-2017 (step 1h).
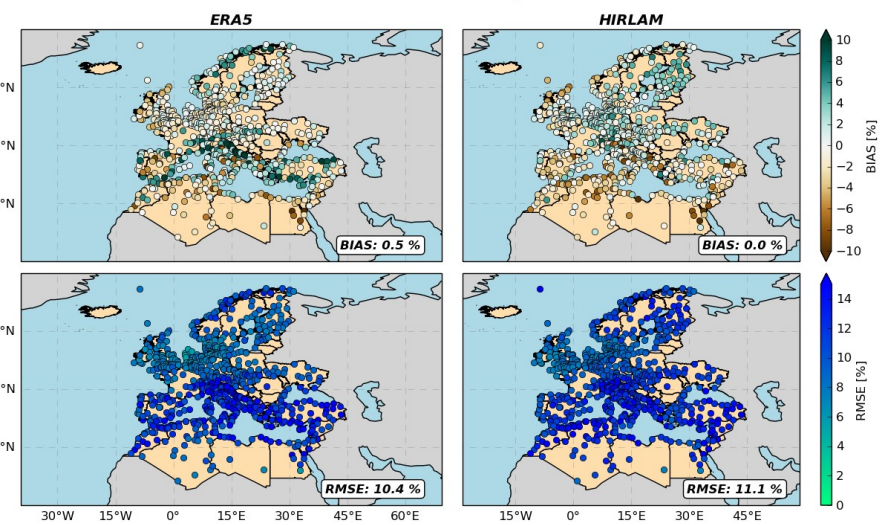
- Good agreement between ERA5 and UERRA HIRLAM

Model vs obs - Wind speed (100 m) [m.s^{-1}] 2001-2017

Model vs obs - Temperature [°C] 2001-2017

Model vs obs - Relative humidity [%] 2001-2017

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RRA applications at Météo-France – ENTSO-E UERRA – HIRLAM – summary

- *Further needs:*

  — *Extend RRA domain further East and South in order to cover full Algeria, Libya and Turkey.*

  — *Increase score quality with ERA5 forcings instead of ERA-I compared to ERA5 alone;*

  — *High frequency update ? Available on the CDS ?*

  — *Data since 1950 ? (**February 1956** in Europe).*

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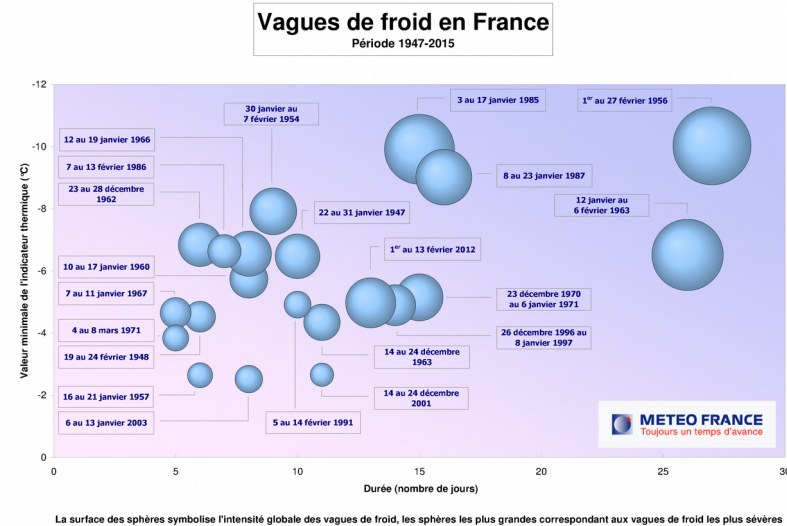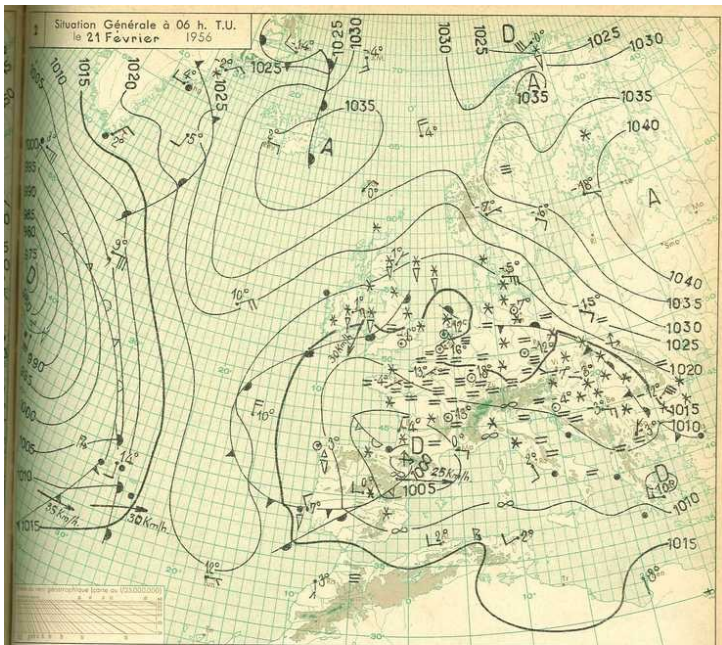
RRA applications at Météo-France – WIRE

- Strong impacts of wintry weather on <u>electric wires</u> and <u>catenary</u> because of ice accretion (iceload, freezing rain, etc.) or wet snow accretion.

- **WIRE** model – **WI**nter **R**isk for **E**nergy (based on Makkonen, 2000)
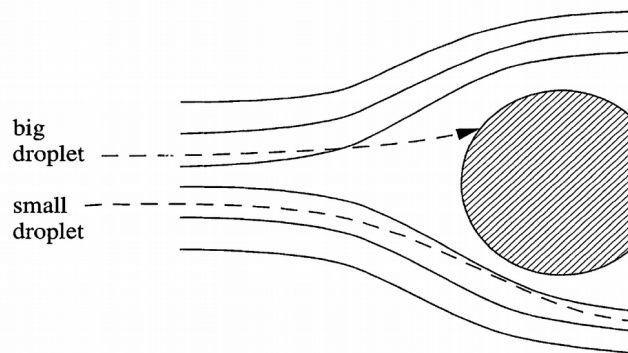
Mass accretion flux

$$\frac{dM}{dt} = \alpha_1 \alpha_2 \alpha_3 w v A$$

$\alpha 1$:*Collision efficiency*
$\alpha 2$:*Sticking efficiency*
$\alpha 3$:*Accretion efficiency*

big droplet
small droplet

- Weather inputs: microphysics parameters + T, U, V...
- External inputs: wire height and radius.

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RRA applications at Météo-France – WIRE

- Needs:
  - Microphysics parameters:
    - ► Cloud water
    - ► Cloud graupel
    - ► Cloud snow
    - ► Cloud rain
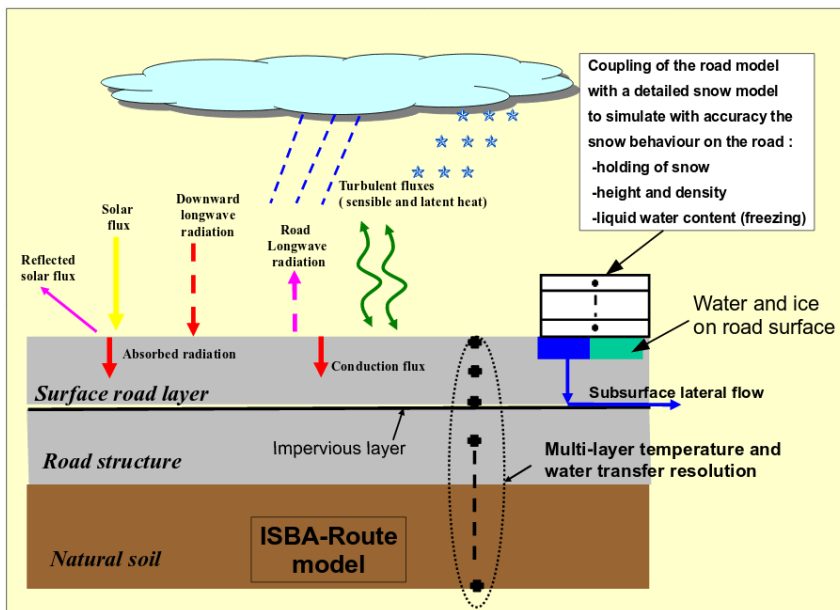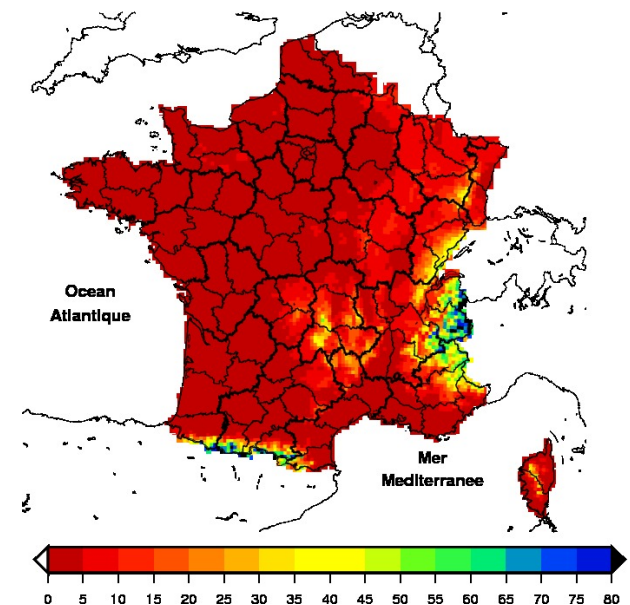   - ► Cloud ice

- Expectations:
  - Climatology of iceloads over wires and catenaries.
  - New model for wind turbines and atlas elaboration;

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RRA applications at Météo-France – Transportation

- **Transportation sector.**

- <u>Context:</u> Winter maintenance;

- Climatology of road weather parameters over France (french RRA combined with road model (ISBA-route)

Coupling of the road model with a detailed snow model to simulate with accuracy the snow behaviour on the road :
- holding of snow
- height and density
- liquid water content (freezing)

Solar flux

Downward longwave radiation

Road Longwave radiation

Reflected solar flux

Turbulent fluxes (sensible and latent heat)

Water and ice on road surface

Absorbed radiation

Conduction flux

Subsurface lateral flow

Surface road layer

Impervious layer

Multi-layer temperature and water transfer resolution

Road structure

Natural soil

ISBA-Route model

Number of days with snow height > 1 cm

Ocean Atlantique

Mer Mediterranee

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

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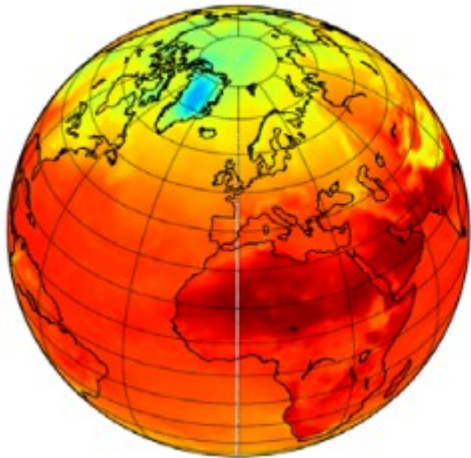# RRA applications at Météo-France – Transportation

- Perspectives: **European** roadweather reanalyses of based on C3SRRA:

  — Road surface temperature;

  — Road surface water height/ice accumulation;

 — Road surface snow characteristics (height, density);

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RRA as a way to bias-adjust climate models outputs

- Météo-France runs different climate models (globals and regionals) and need RRA in order to bias-adjust them).

- Reinsurance companies: to assess **the financial impact of climate change on natural disaster compensation scheme.**

- For energy companies: to assess energetic demand/supply evolution and to minimize black-out situations.

- Outputs are **bias-adjusted** thanks to **HIRLAM EURO4M**

ERA-I   *HIRLAM*

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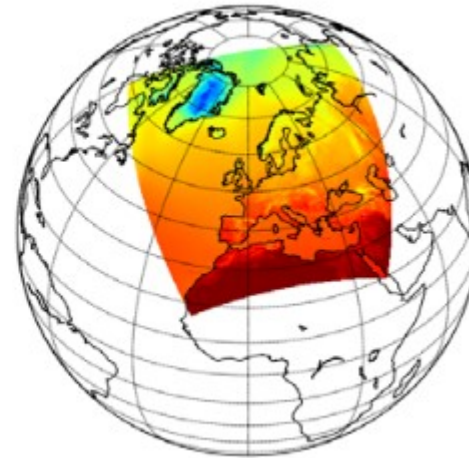
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Summary for next C3SRRA

- **RRA Applications at Météo-France (non-exhaustive list):**
    — Energy sector;
    — Transportation sector;

- **New needs:**
    — **Spatial coverage:** extend RRA domain further East and South in order to cover full Algeria, Libya and Turkey.
    — **Temporal coverage:** since 1950 ?
    — **Spatial resolution:** 5 km or less (2.5 km ?);
    — **Temporal resolution:** 1 hour
    — **Quality:** Provide high-value compared to ERA5
    — **Availability:** ASAP. On the CDS ?
    — **Parameters:** microphysics (cloud water, cloud rain, cloud graupel, cloud snow, cloud ice)

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