



**Barcelona  
Supercomputing  
Center**

*Centro Nacional de Supercomputación*



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# EARTH SCIENCE SERVICES

Main research lines

Albert Soret and Nube González Reviriego  
*Services – Earth Science Department*



- Created in 2005; 350 employees
- Research, develop and manage information technology
- Facilitate scientific progress and its application in society



- Merging process between



- New structure: 4 groups (~ 50 people)

COMPUTATIONAL EARTH SCIENCES

ATMOSPHERIC  
COMPOSITION

CLIMATE  
PREDICTIONS

EARTH SCIENCES SERVICES

## OUR OBJECTIVE:

Facilitate technology transfer of state-of-the-art research from local, national to international levels in five areas:

Air quality assessments

Mineral Dust modelling

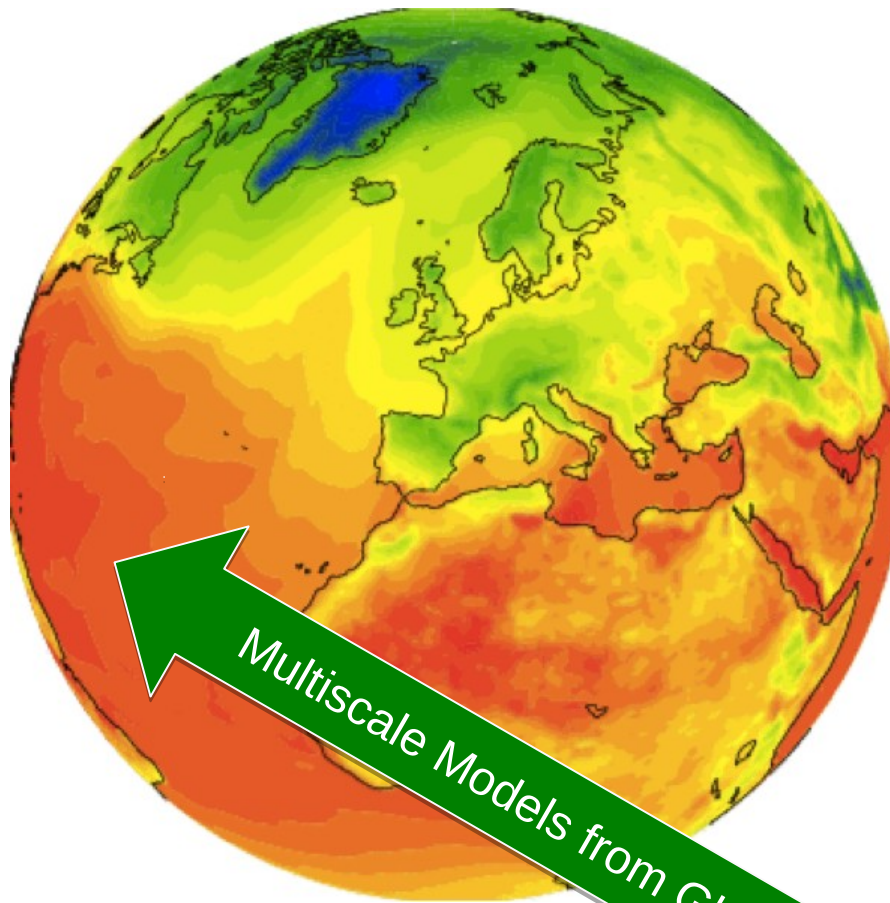
Weather forecasting

Climate predictions

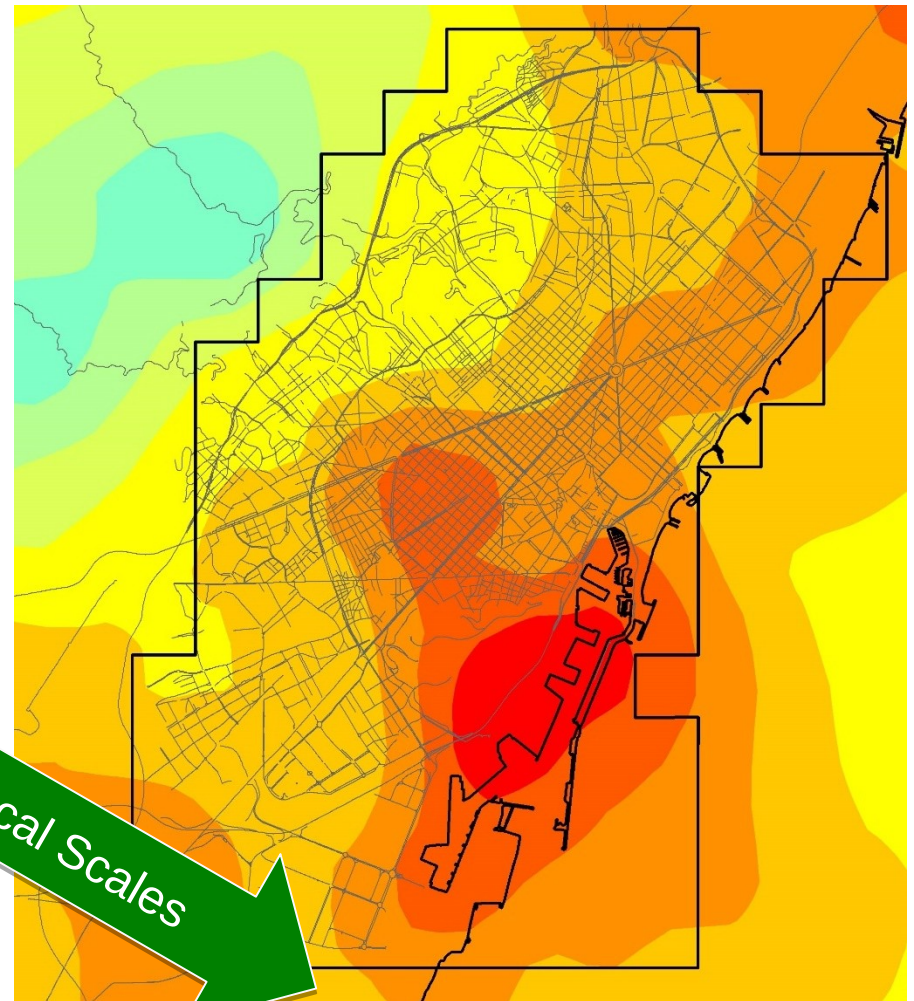
Computational Earth Services



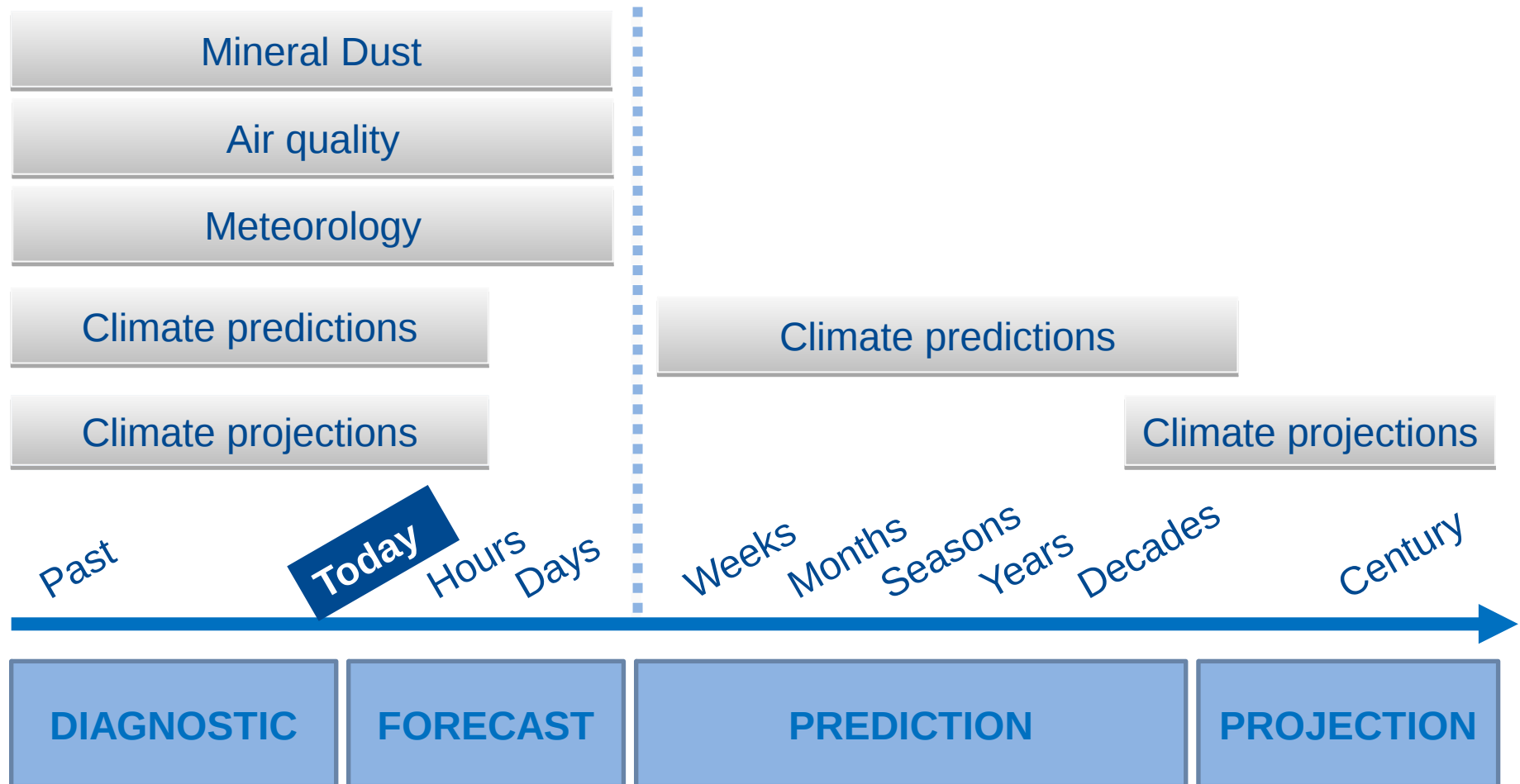
## Multi-scale models from global to local scales



Multiscale Models from Global to Local Scales



# Temporal scales

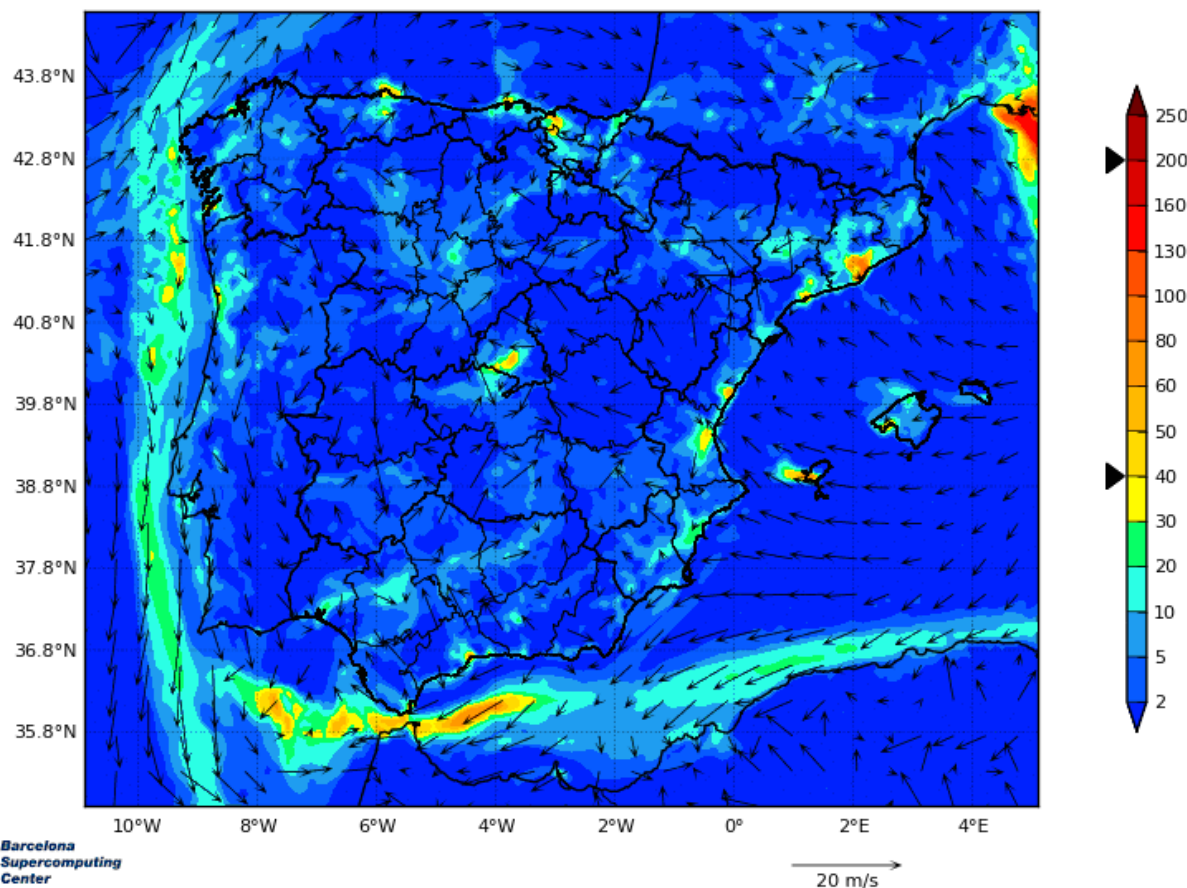




# Examples of our research lines

Provides air quality related information for the coming days and for the application of short term action plans for air quality managers.

BSC-ES/AQF WRFv3.5.1+CMAQv5.0.2+HERMESv2 Nitrogen Dioxide ( $\mu\text{g}/\text{m}^3$ )  
00h forecast for 00UTC 17 Jul 2015 - Iberian Peninsula Res: 4x4km



Information is delivered using both  
online or custom applications:

[www.bsc.es/caliope](http://www.bsc.es/caliope)



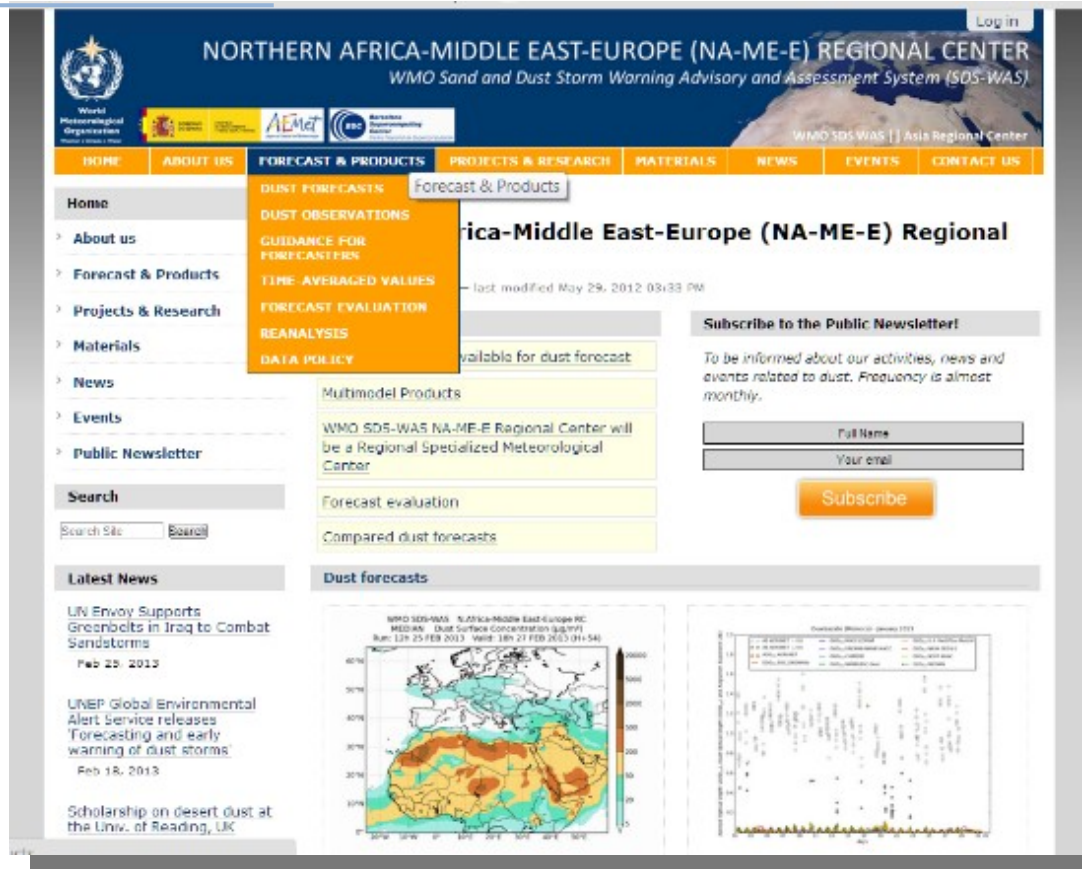


## Mineral dust forecasts SDS-WAS

North Africa, Middle East and Europe Regional Center

Early warning system

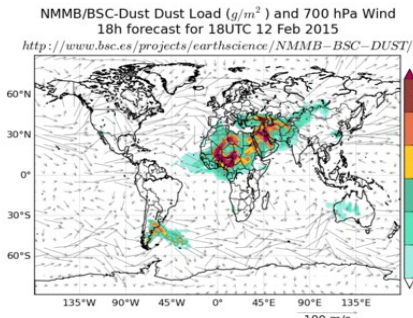
<http://sds-was.aemet.es>



The screenshot shows the homepage of the Northern Africa-Middle East-Europe (NA-ME-E) Regional Center for the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS). The page features a navigation menu with links to Home, About us, Forecast & Products, Projects & Research, Materials, News, Events, and Public Newsletter. A sidebar on the left contains a search bar and a 'Latest News' section with recent updates. The main content area displays a 'Forecast & Products' dropdown menu, a 'Subscribe to the Public Newsletter' form, and a 'Dust forecasts' section with two maps: a map of the region showing dust concentration and a time-series plot of dust concentration over time.

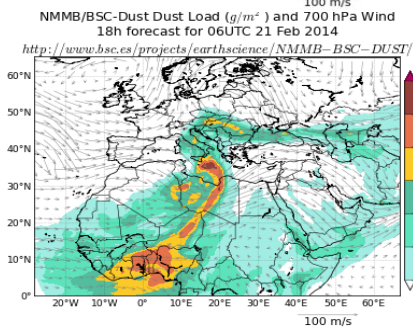
# Mineral dust forecasts assessment.

## Solar energy management



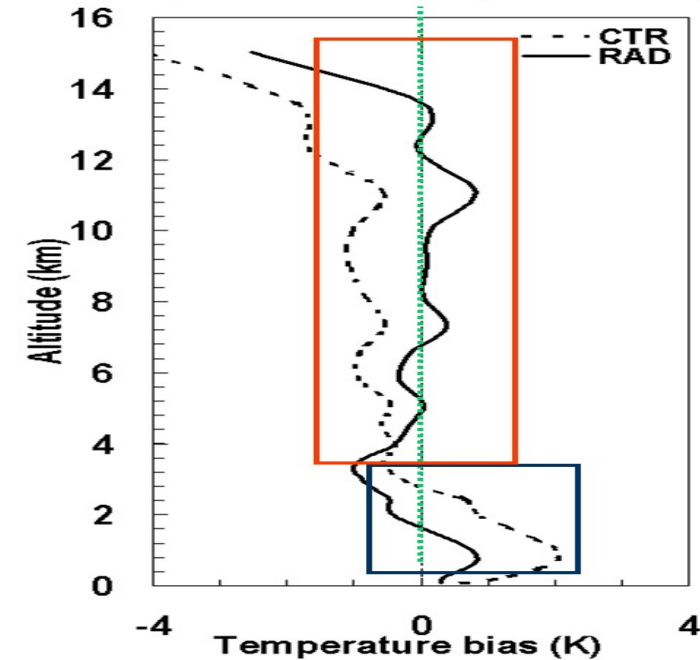
Forecast and  
diagnostic mode

Regional and  
global scales



On-line  
feedbacks:  
Dust-radiation  
interaction

BIAS 13 April 2002 at 00UTC (24h forecast)



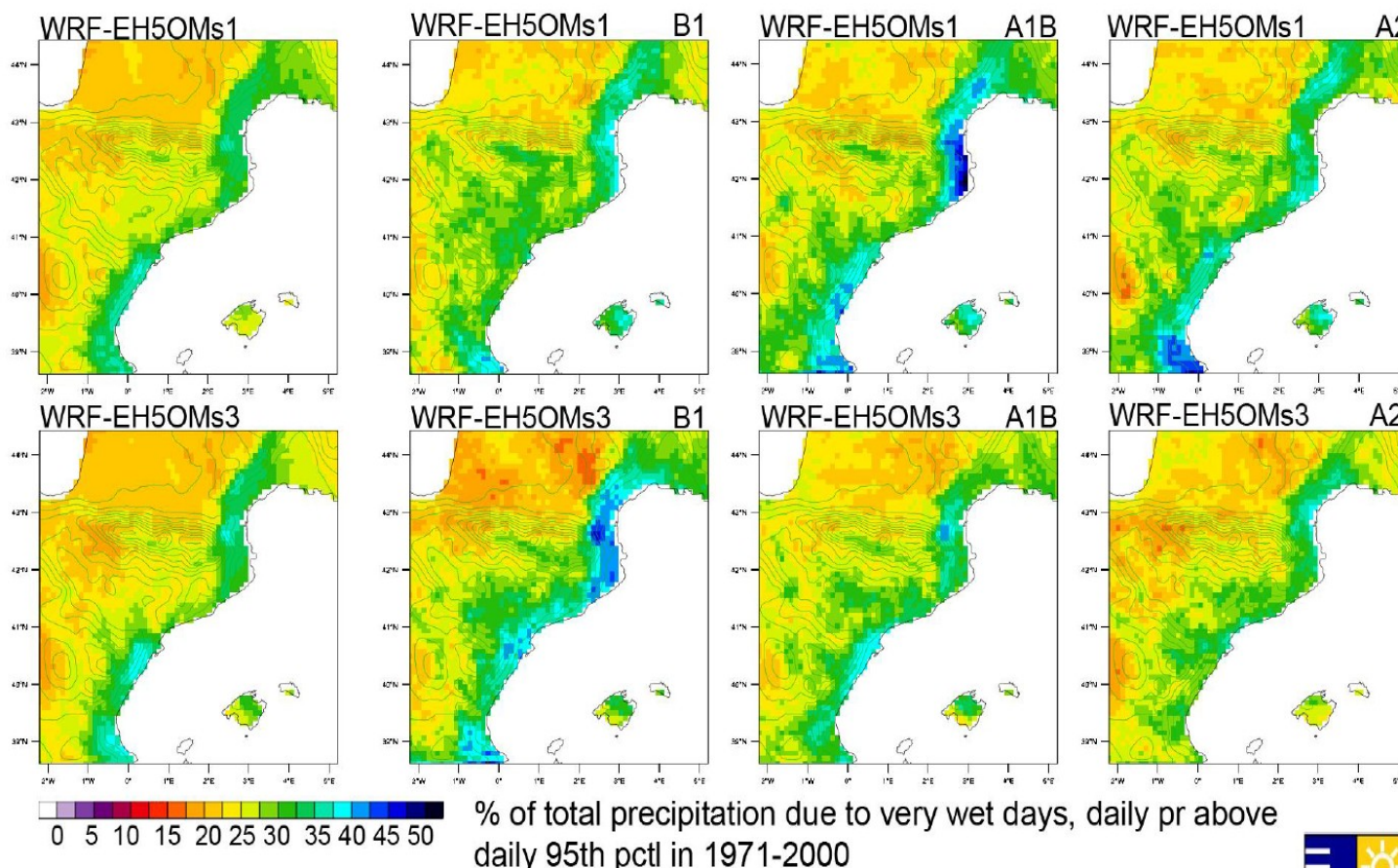
Services: Solar energy management

- Forecasts system to prevent energy loss and improve the management of solar power plants
- Geographical information to decide the location of future solar power plants



## Dynamical downscaling of climatic temperature and precipitation trends

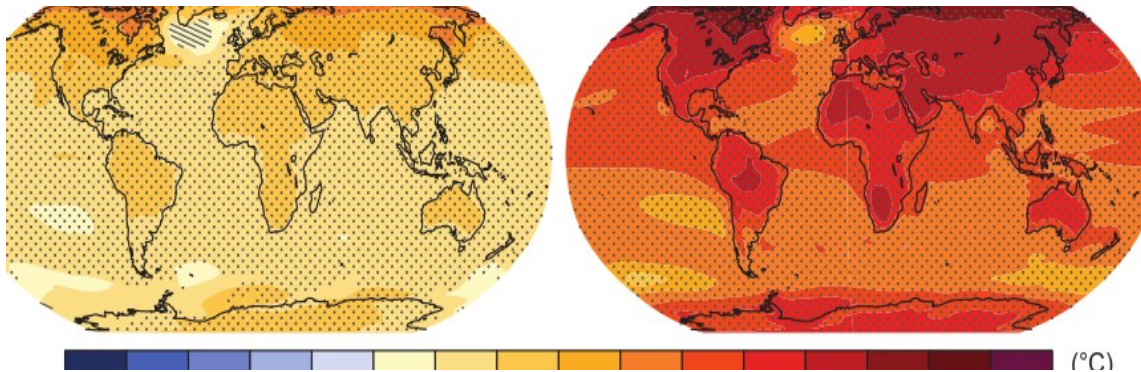
This work aims to provide an assessment of temperature and precipitation projections for mid-21st century in the North Western Mediterranean Basin (NWMB) at high resolution.





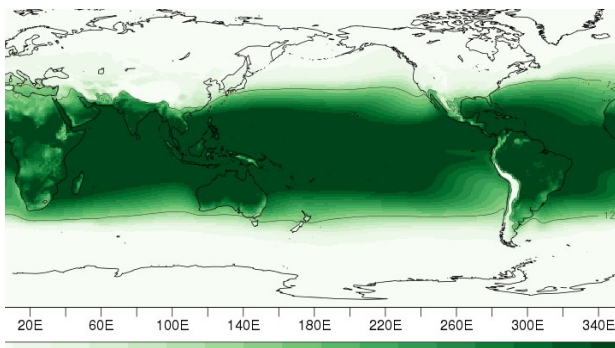
## Climate change estimated for the Wine Sector with CMIP5 models. (2081-2100 minus 1986-2005)

Scenario RCP2.6 ( $2.6 \text{ W m}^{-2}$ ) Scenario RCP8.5 ( $8.5 \text{ W m}^{-2}$ )

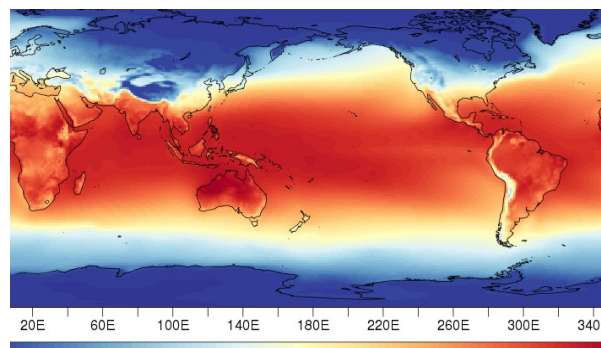


*IPCC, 5th Assessment  
report, 2013*

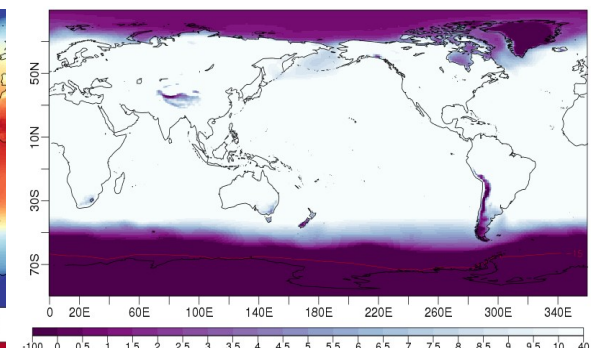
Winkler Index Oct-Abr



Mean Temperature Oct-Abr



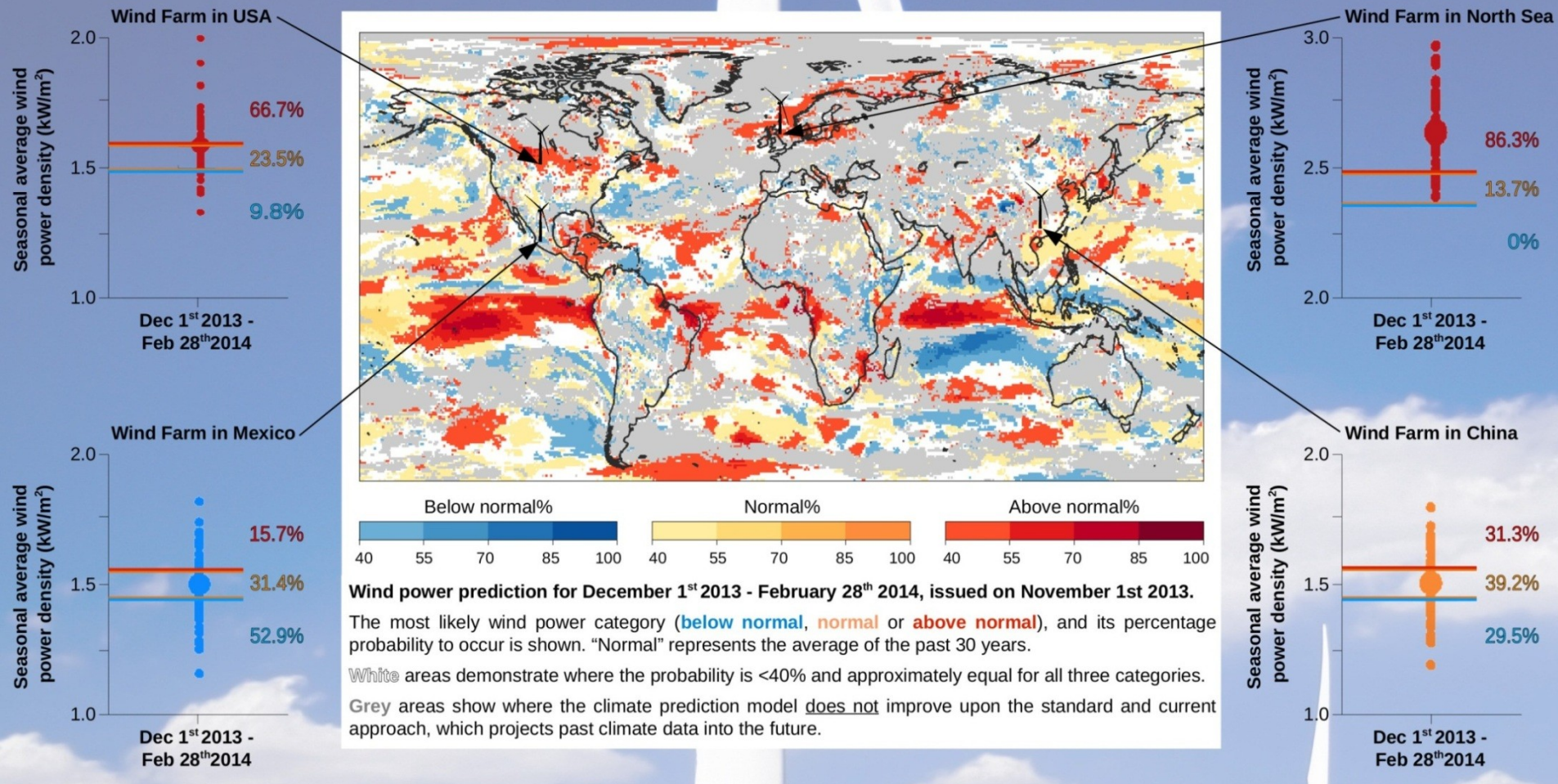
Winter Severity Index





# Example: wind power predictions

## Illustrative examples of seasonal wind power predictions

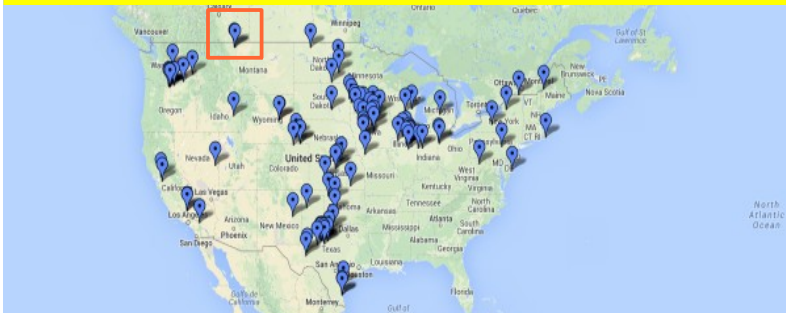


# Example: wind power predictions

Climate model: **ECMWF S4**

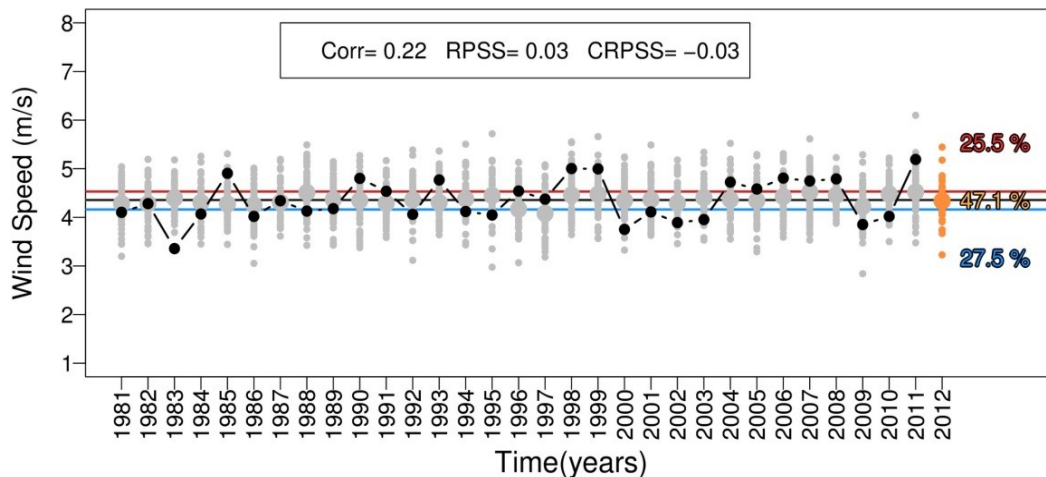
10m wind speed “observations”: ERA-Interim

**Winter season** forecast: 1 month lead time



- Data from **ECMWF** (European Centre for Medium-Range Weather Forecasts)
- We don't provide deterministic predictions. We assess the global behaviour providing a **probabilistic predictions**
- Aggregated output in **terciles**:
  - Above normal
  - Normal
  - Below normal

## Simple bias correction



# Projects on Climate predictions



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**SPECS:** Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

<http://www.specs-fp7.eu/>

**EUPORIAS**



**EUPORIAS:** EUropean Provision Of Regional Impact Assessment on a Seasonal-to-decadal timescale

<http://www.euporias.eu/>

NEW EUROPEAN WIND ATLAS  
**newa**



**NEWA:** New European Wind Atlas

<http://euwindatlas.eu/>



**RESILIENCE:** Refuerzo de la Red Energética Europea con el uso de Servicios Climáticos.



**PRIMAVERA, IMPREX, ...**

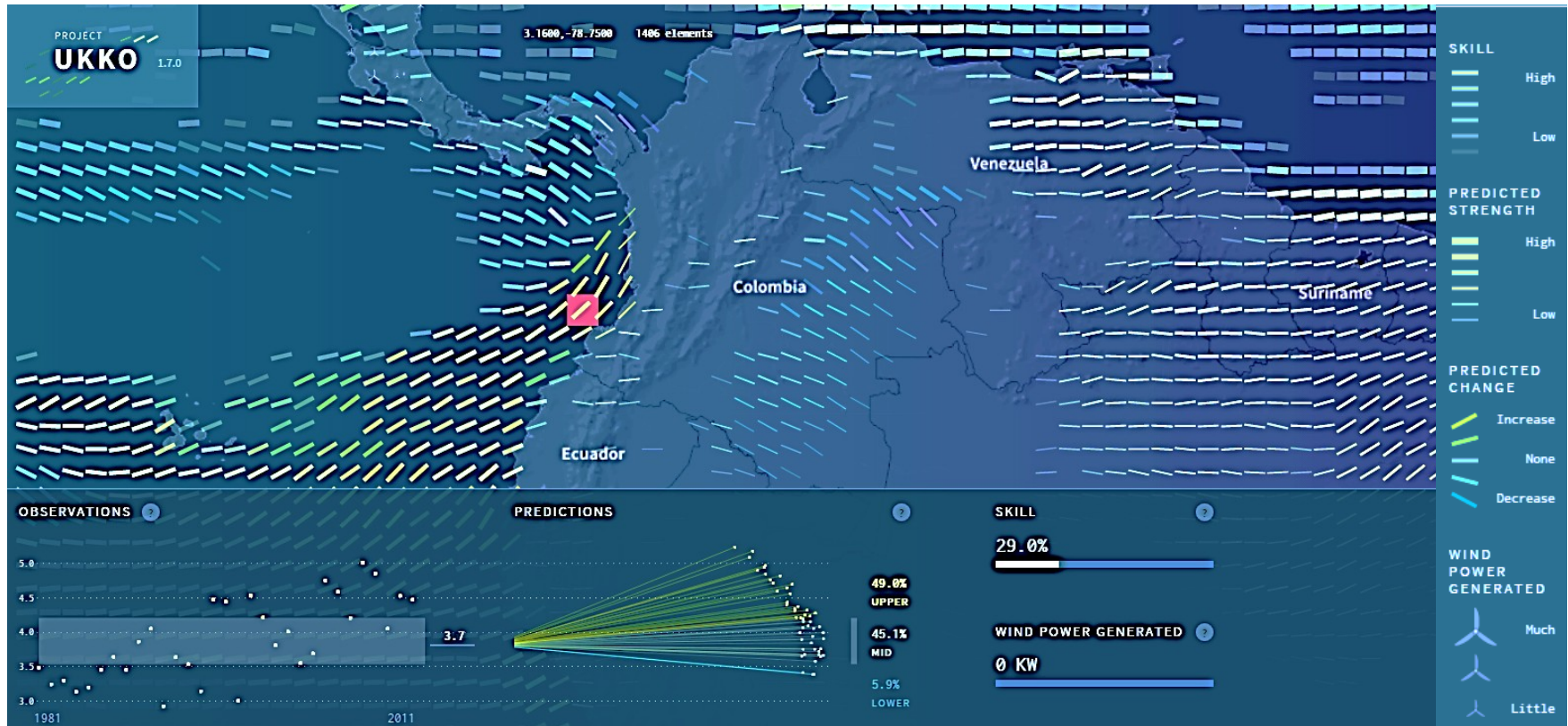


# Example: wind power predictions



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**RESILIENCE**  
PROTOTYPE

EUPORIAS





## Pre-Construction Decisions: **Annual to Decadal** Timescales

- **Wind farm planners:** Site selection
- **Wind farm investors:** Evaluate return on investments
- **Policy makers:** Understand changes to energy mix

## Post-Construction Decisions: **Monthly to Seasonal** Timescales

- **Energy producers:** Resource management strategies
- **Energy traders:** Resource effects on markets
- **Wind farm operators:** Planning for maintenance works
- **Wind farm investors:** Optimize return on investments

# National and International collaborations



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Agència d'Ecologia Urbana de Barcelona



**Generalitat de Catalunya**





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# Thank you!

For further information please contact  
**info-services-es@bsc.es**



- Wind farms viability plans are in a decadal timeframe (10-15 years)
- Need for sub-seasonal, seasonal and decadal climate predictions, new field in climate predictions
- Worldwide only BSC-ES + Met Office work in this timeframe
- Partners in European projects (FP7 and H2020) in collaboration with private wind sector (EDF, Vortex, EDPR...)





## How can we predict climate for the coming season if we cannot predict the weather next week?

### Weather forecasts

The forecasts are based in the initial conditions of the **atmosphere**, which is highly variable and develops a chaotic behaviour after a few days

### Climate predictions

The predictions are based in the initial conditions of the **sea surface temperature, snow cover or sea ice**, which have a slow evolution that can range from few months to years.

# Climate predictions and predictability



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Uncertainties on initial data could be large.  
To supply for this issue: ensemble  
technique with perturbed initial conditions.

