



**Barcelona  
Supercomputing  
Center**

*Centro Nacional de Supercomputación*



EXCELENCIA  
SEVERO  
OCHOA

# CALIOPE Mobile

## European Air Quality Forecast at hand

Miguel Castrillo  
miguel.castrillo@bsc.es





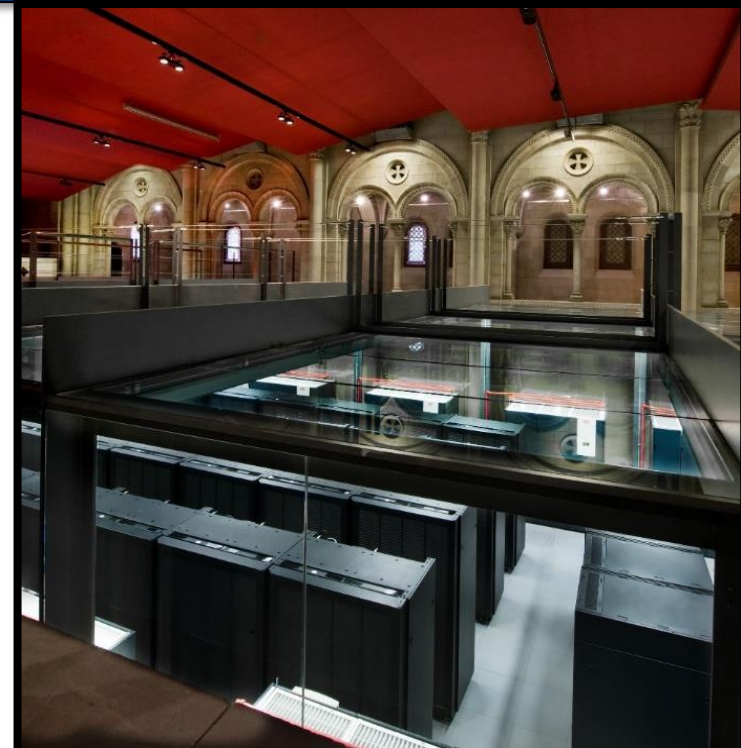
# CALIOPE Air Quality Forecast System

- Created in 2005; more than 400 employees.
- Research, develop and manage information technology.
- Facilitate scientific progress and its application in society.

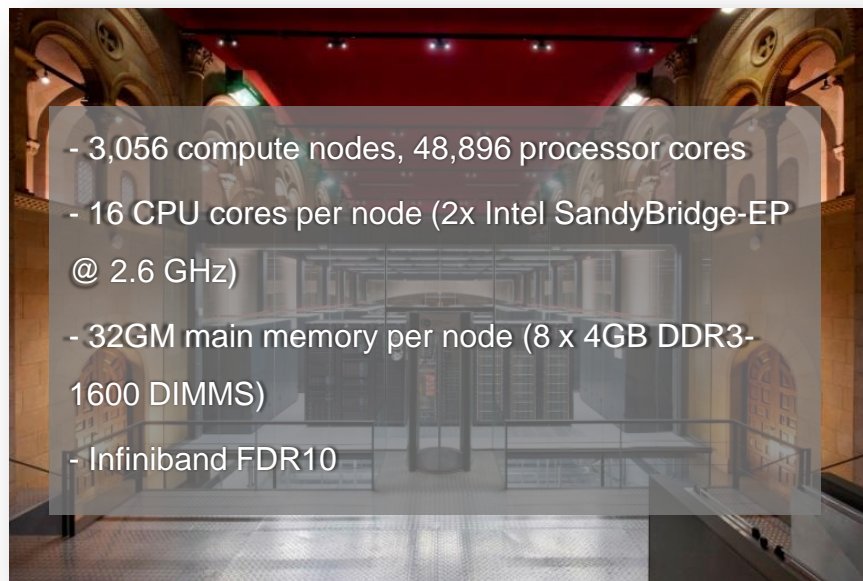
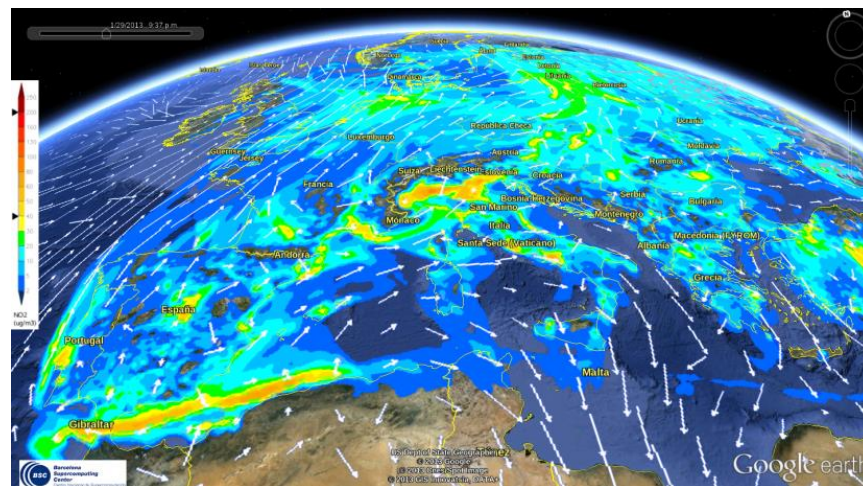


## Earth Science Department

- **Atmospheric composition modelling**
- **Climate prediction modelling**
- **Computational Earth Sciences**
- **Earth Sciences Services**

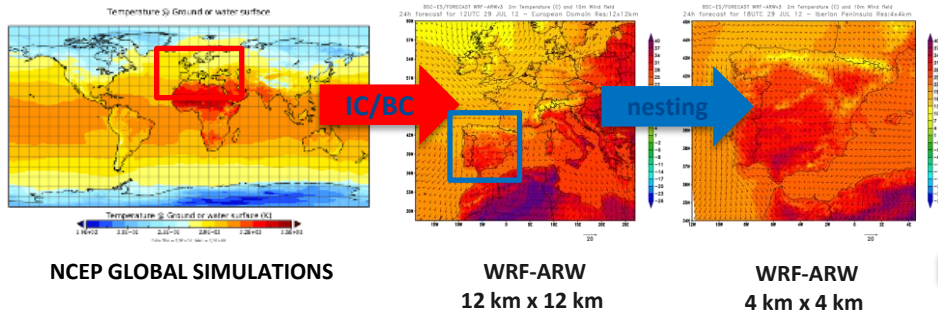


- Operational Air Quality Forecast System.
- 6 nested domains, from 12 to 1km spatial resolution.
- Meteorological, emission and air quality forecast.
- Run daily on Marenostrum III Supercomputer.
- Scientific support: 19 PhD thesis, > 50 papers
- International projects and companies.

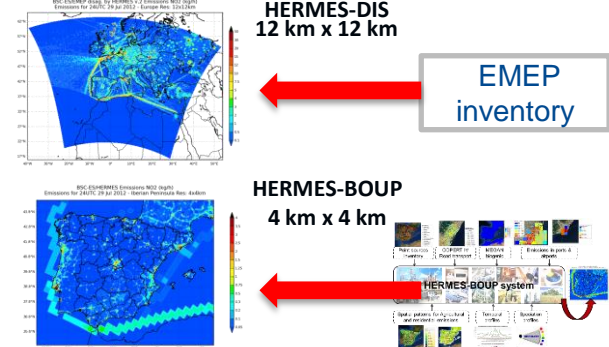


# CALIOPE system overview

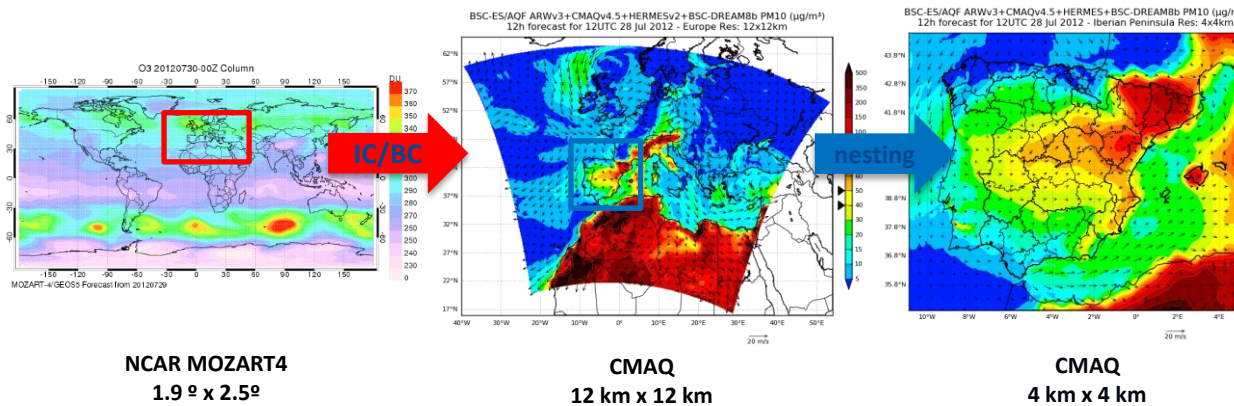
## METEOROLOGICAL FORECAST



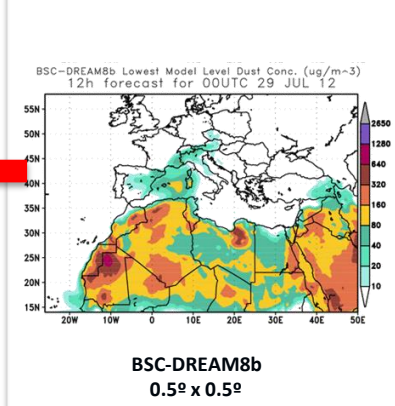
## EMISSION FORECAST



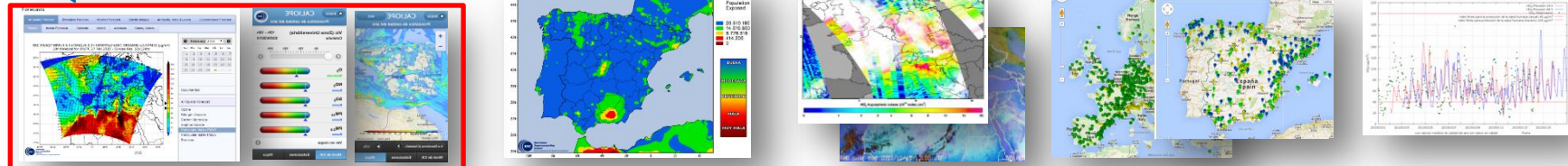
## AIR QUALITY FORECAST



## DESERT DUST FORECAST

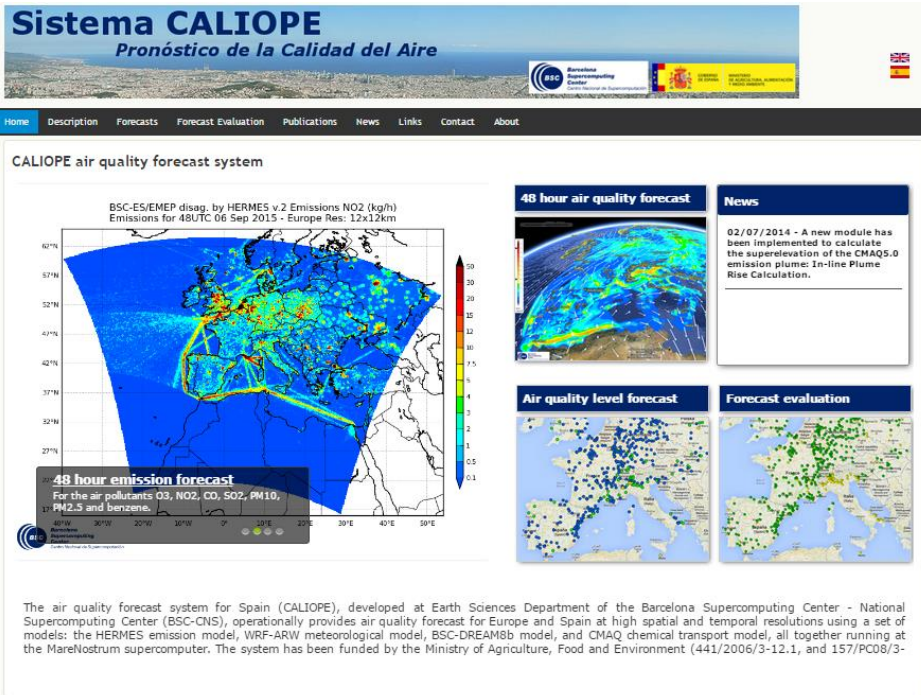


## AIR QUALITY PRODUCTS



## CALIOPE website (www.bsc.es/caliope)

## Air Quality Levels for Europe



**Sistema CALIOPE**  
Pronóstico de la Calidad del Aire

Home Description Forecasts Forecast Evaluation Publications News Links Contact About

**CALIOPE air quality forecast system**

BSC-ES/EMEP disag. by HERMES v.2 Emissions NO<sub>2</sub> (kg/h)  
Emissions for 48UTC 06 Sep 2015 - Europe Res: 12x12km

**48 hour air quality forecast**

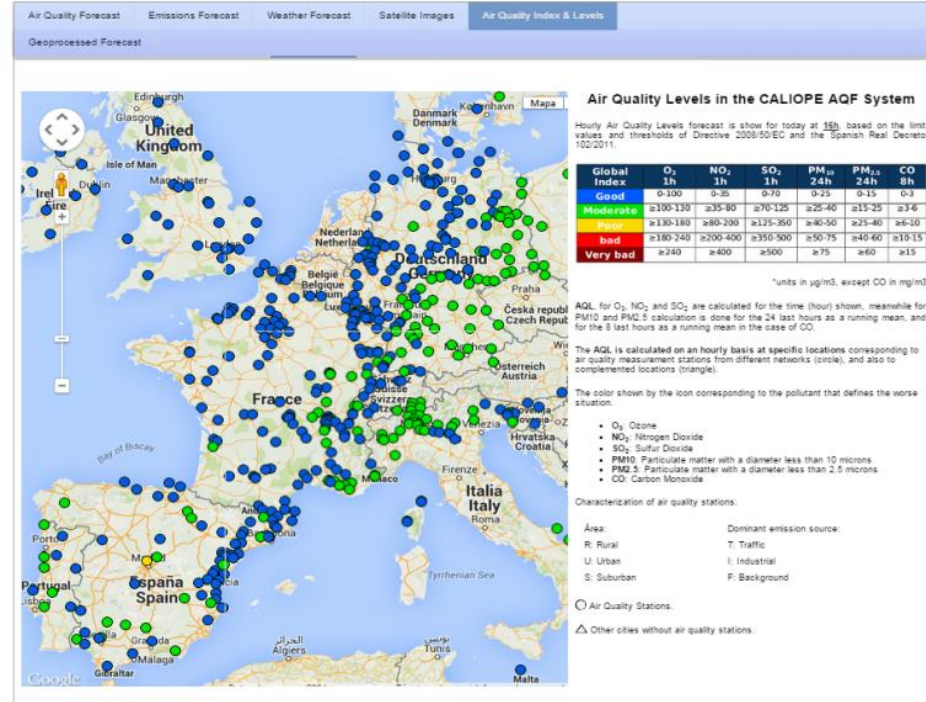
**News**  
02/07/2014 - A new module has been implemented to calculate the super-elevation of the CMAQS.0 emission plume: In-line Plume Rise Calculation.

**Air quality level forecast**

**Forecast evaluation**

**48 hour emission forecast**  
For the air pollutants O<sub>3</sub>, NO<sub>2</sub>, CO, SO<sub>2</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and benzene.

The air quality forecast system for Spain (CALIOPE), developed at Earth Sciences Department of the Barcelona Supercomputing Center - National Supercomputing Center (BSC-CNS), operationally provides air quality forecast for Europe and Spain at high spatial and temporal resolutions using a set of models: the HERMES emission model, WRF-ARW meteorological model, BSC-DREAM8b model, and CMAQ chemical transport model, all together running at the MareNostrum supercomputer. The system has been funded by the Ministry of Agriculture, Food and Environment (441/2006/3-12.1, and 157/PC08/3-



Air Quality Forecast Emissions Forecast Weather Forecast Satellite Images **Air Quality Index & Levels**

Geoprocessed Forecast

**Air Quality Levels in the CALIOPE AQF System**

Hourly Air Quality Levels forecast is shown for today at 15h, based on the limit values and thresholds of Directive 2008/50/EC and the Spanish Real Decreto 102/2011.

Global Index	O <sub>3</sub> 1h	NO <sub>2</sub> 1h	SO <sub>2</sub> 1h	PM <sub>10</sub> 24h	PM <sub>2.5</sub> 24h	CO 8h
Good	0-100	0-25	0-70	0-25	0-15	0-2
Moderate	≥100-130	≥25-90	≥70-125	≥25-40	≥15-25	≥3-6
Bad	≥130-180	≥90-200	≥125-300	≥40-50	≥25-40	≥6-10
Very bad	≥180-240	≥200-400	≥350-500	≥50-75	≥40-60	≥10-15
	≥240	≥400	≥500	≥75	≥60	≥15

\*units in µg/m<sup>3</sup>, except CO in mg/m<sup>3</sup>

AQL for O<sub>3</sub>, NO<sub>2</sub> and SO<sub>2</sub> are calculated for the time (hour) shown, meanwhile for PM<sub>10</sub> and PM<sub>2.5</sub> calculation is done for the 24 last hours as a running mean, and for the 8 last hours as a running mean in the case of CO.

The AQL is calculated on an hourly basis at specific locations corresponding to air quality measurement stations from different networks (circle), and also to complemented locations (triangle).

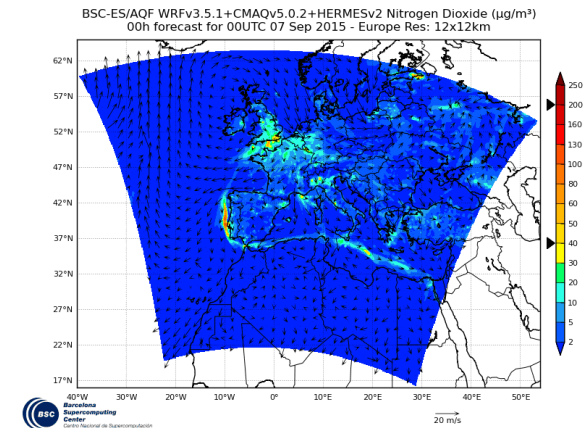
The color shown by the icon corresponding to the pollutant that defines the worse situation.

- O<sub>3</sub>: Ozone
- NO<sub>2</sub>: Nitrogen Dioxide
- SO<sub>2</sub>: Sulfur Dioxide
- PM<sub>10</sub>: Particulate matter with a diameter less than 10 microns
- PM<sub>2.5</sub>: Particulate matter with a diameter less than 2.5 microns
- CO: Carbon Monoxide

Characterization of air quality stations:

- Area: Dominant emission source
- R: Rural
- T: Traffic
- U: Urban
- I: Industrial
- S: Suburban
- F: Background
- Circle: Air Quality Stations
- Triangle: Other cities without air quality stations

- What's on CALIOPE website:
  - Air Quality, Weather, Emissions, AQI Forecast.
  - Satellite images.
  - Forecast evaluation.
  - Publications.





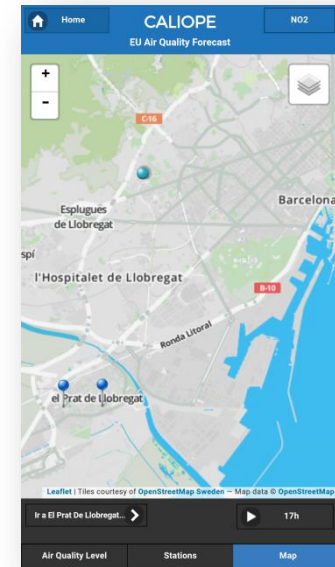
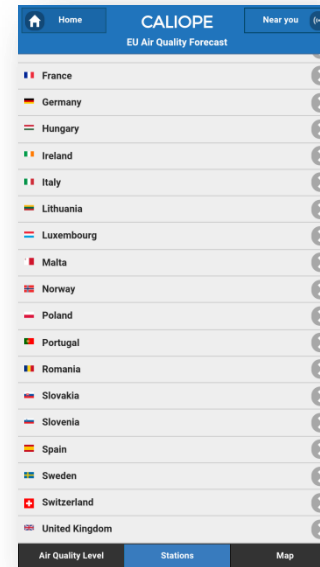
# CALIOPE EU mobile application



- V1.0, Nov 2013 → IP domain (4x4 km resolution, 431 stations).
- v1.6, Dec 2014 → Canary Islands domain (2x2 km resolution, 483 stations).
- Over 12,000 downloads (Android + iOS).
- EU v1.0, Sep 2015 → Europe domain version (12x12 km resolution, 563 stations) financed by **MYGEOSS**

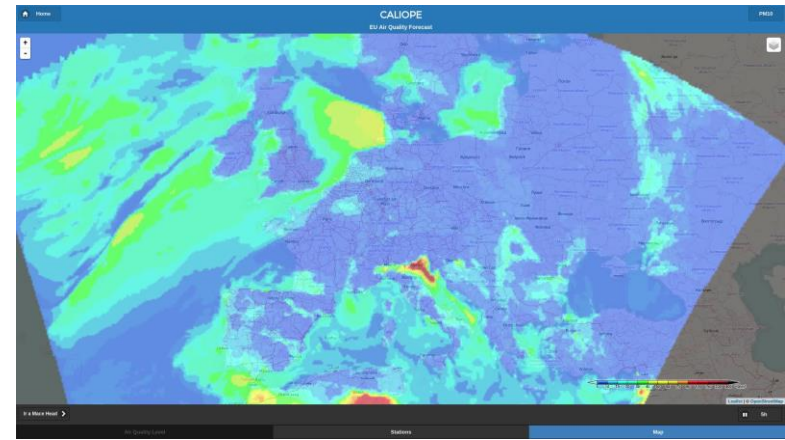
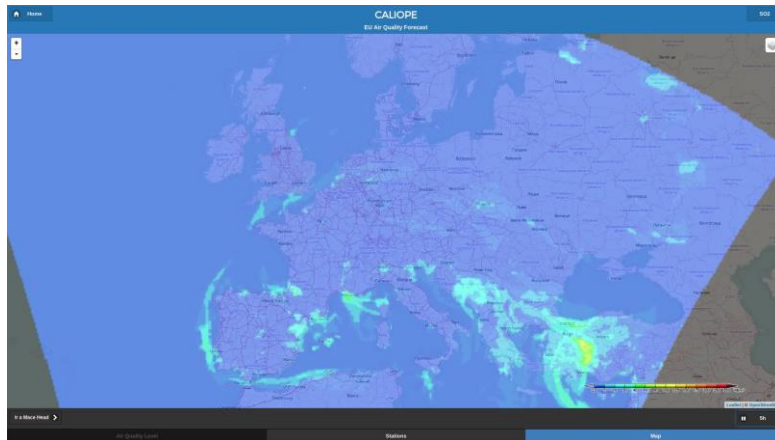
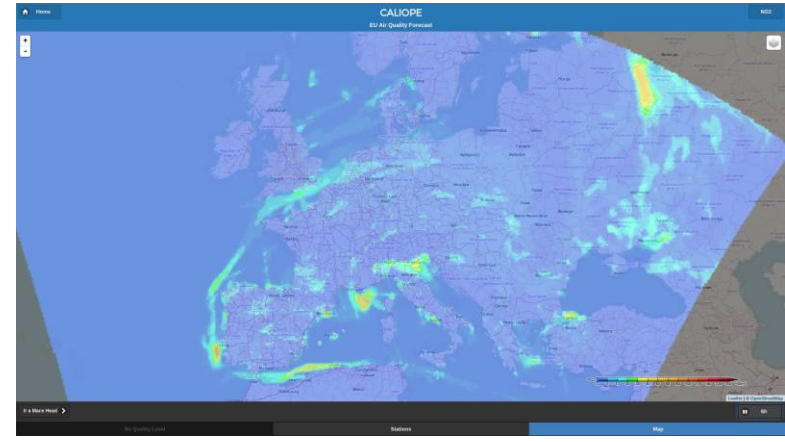
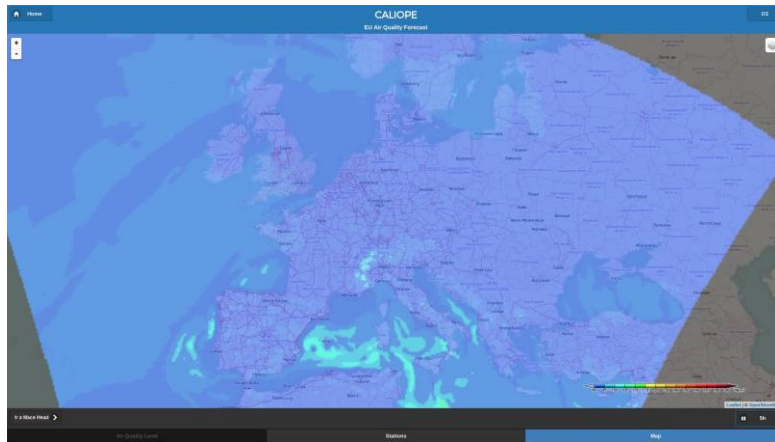


# CALIOPE EU mobile application



- 48-hour Air Quality forecast.
- Geolocation: Provides information for near stations by using the user device's GPS.
- Search: Stations can be found by country.
- Map visualization: Stations positioned on map.

# CALIOPE EU mobile application



- 48-hour five pollutant overlays.



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Center**

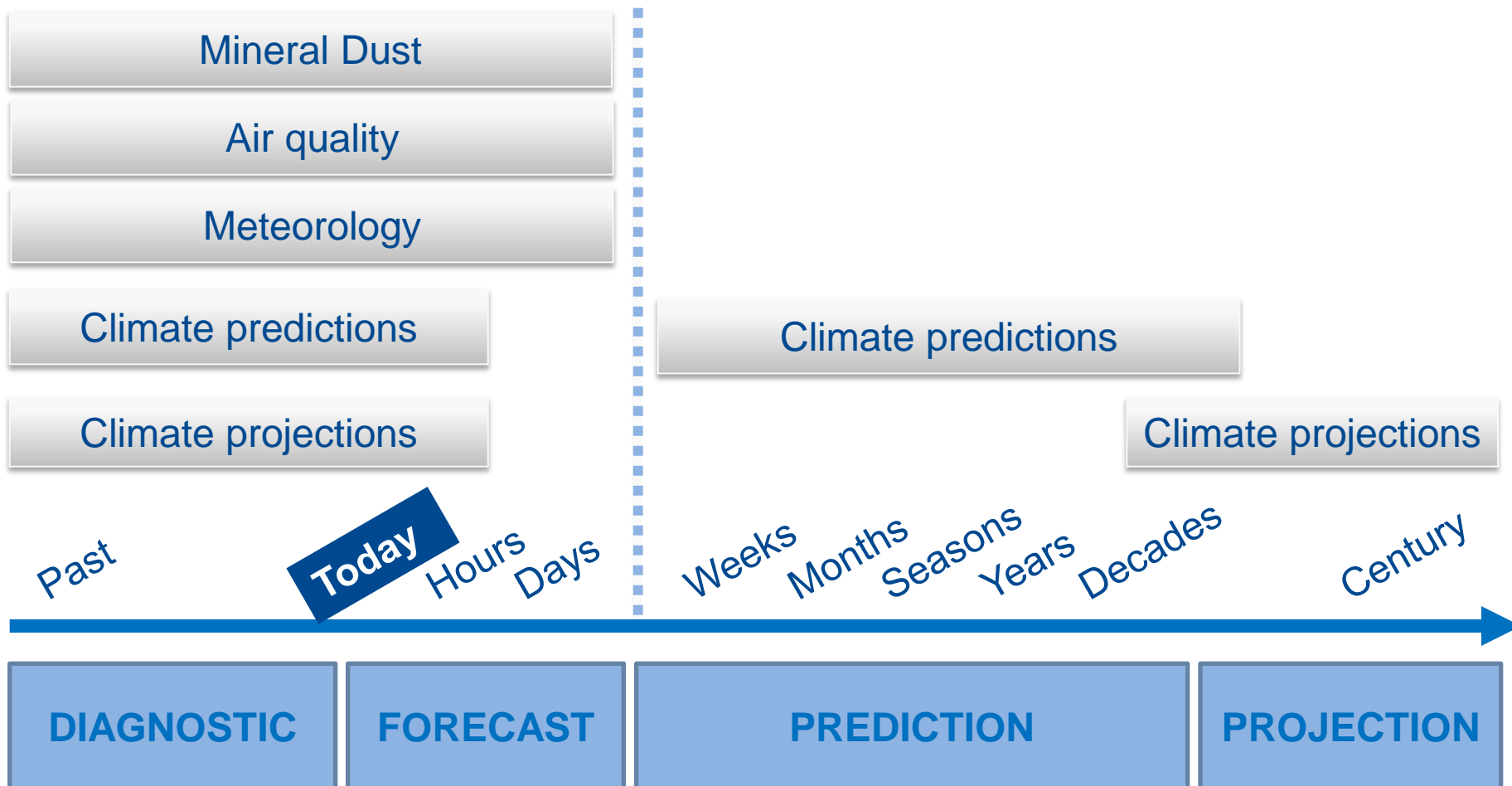
*Centro Nacional de Supercomputación*

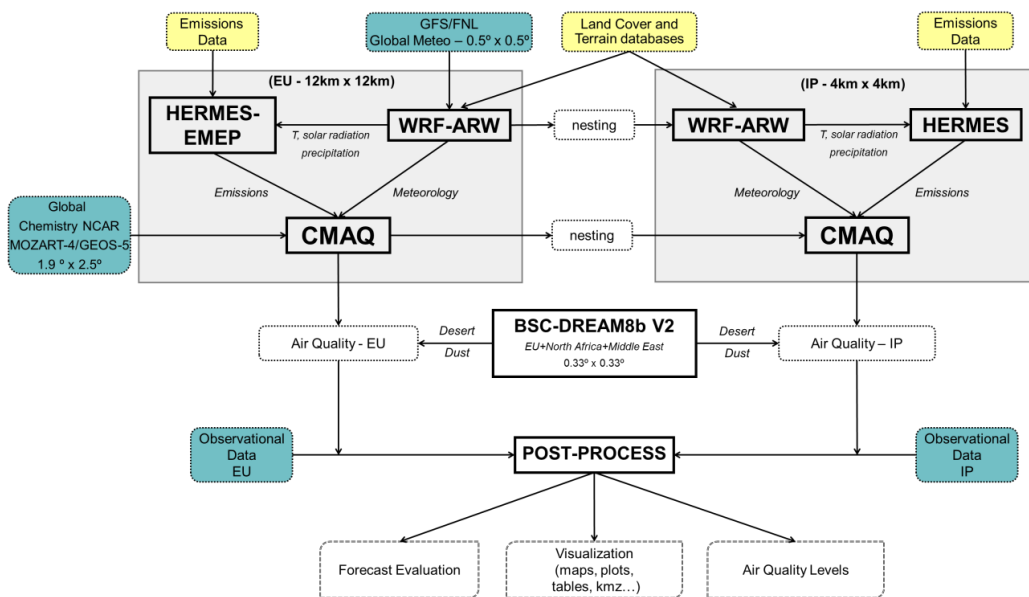


**Thank you!**

For further information please contact  
[caliope@bsc.es](mailto:caliope@bsc.es)

# Temporal scales





## External open data sources, used into the models (yellow):

- ✓ EMEP emission database (CEIP, 2015)
- ✓ CORINE Land Cover v16 04/2012 (EEA, 2012)
- ✓ SRTM DEM v4.1 90m (CGIAR-CSI, 2008)

## Open data sources used in operational mode, downloaded daily (green):

- ✓ GFS Meteorological initial conditions (UCAR/NCEP, 2015)
- ✓ Mozart4 /GEOS-5 Chemical boundary and initial conditions (UCAR/NCAR, 2015)
- ✓ The AIRBASE AQ e-Reporting (EEA, 2015).