www.bsc.es

Barcelona, 25 May 2015

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

EARTH SCIENCE DEPARTMENT

Vodafone Ciudad Conectada
Vodafone and IBM meeting

Albert Soret Miravet
Services – Earth Science Department




Barcelona Supercomputing Center

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EXCELENCIA SEVERO OCHOA

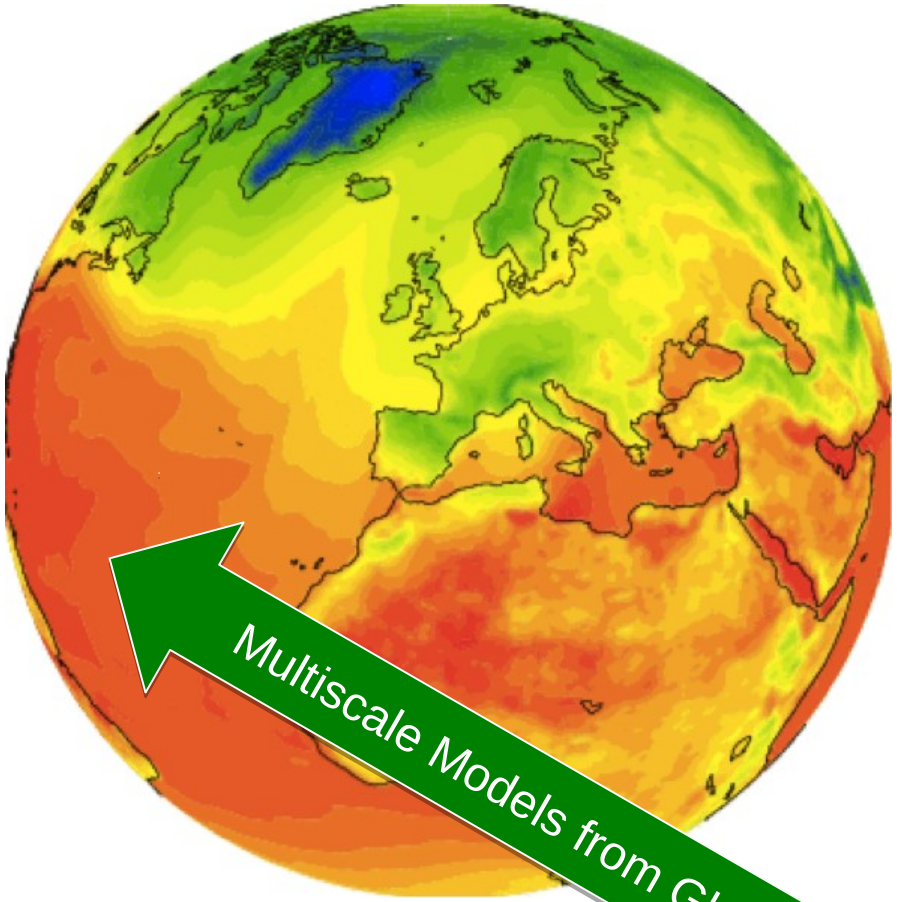
- Created in 2005; 350 employees
- Research, develop and manage information technology
- Facilitate scientific progress and its application in society

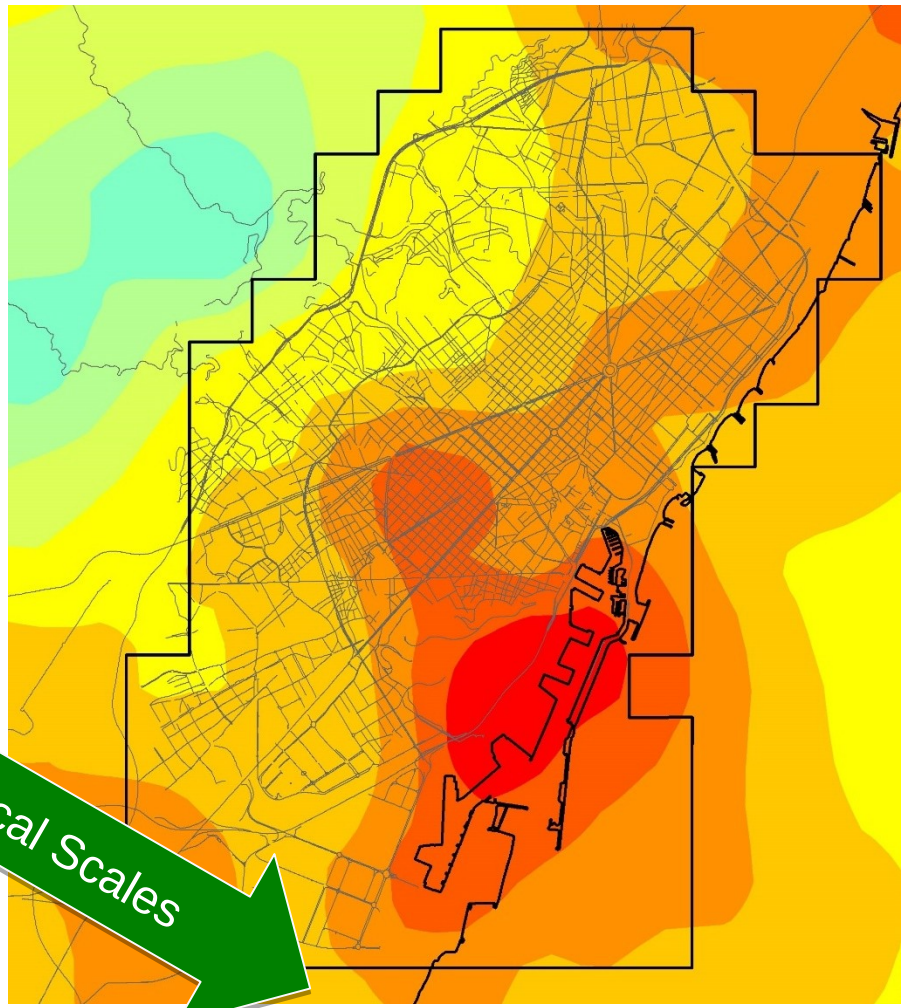
Earth Science Department

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

Spatial scales

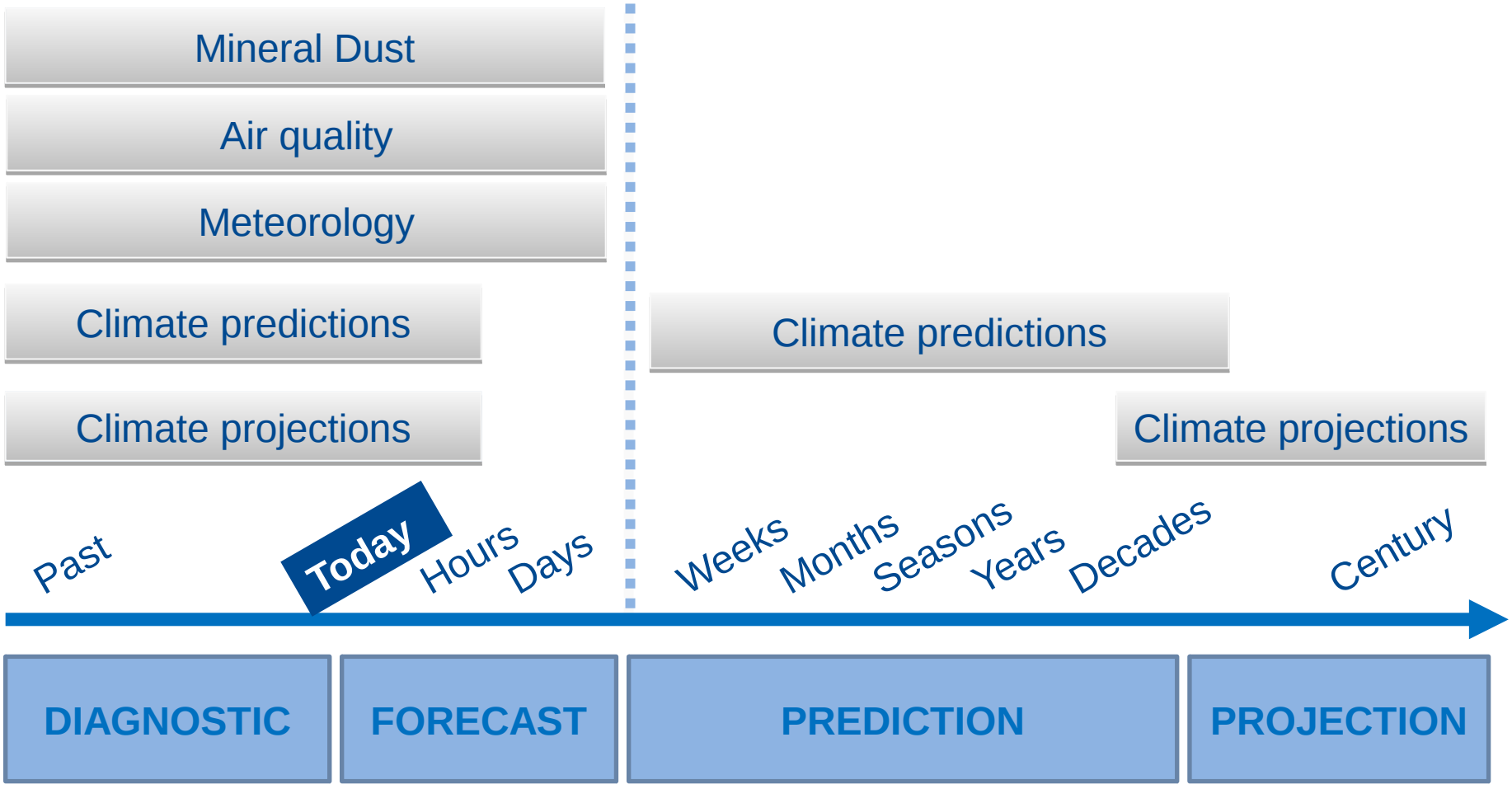
Multi-scale models from global to local scales





Multiscale Models from Global to Local Scales

Temporal scales



People in 2015

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Francisco Doblas-Reyes
Mar Rodriguez
Gabriela Tarabanoff

Computational Earth Sciences

Kim Serradell
Oriol Mula-Valls
Francesco Benincasa
Pierre-Antoine Bretonnière
Carles Carmona
Miguel Castrillo
Muhammad Asif
Domingo Manubens
Nicolau Manubens
Oriol Tintó
Dídac Roca

Climate Prediction

Virginie Guemas
Omar Bellprat
Louis-Philippe Caron
Eleftheria Exarchou
Neven Fuckar
François Massonnet
Martin Ménégoz
Chloé Prodhomme
Danila Volpi

Atmospheric Composition

Oriol Jorba
Sara Basart
Enza Di Tomazzo
Lorenzo Fileni
Antonis Gkikas
Maria Goncalves
Marc Guevara
Vicenzo Obiso
Michele Spada
Maria Teresa Pay
Victor Valverde
Lluis Vendrell

Earth System Services

Gustavo Arévalo
Melanie Davis
Nube González
Aida Pinto
Valentina Sicardi
Albert Soret
Enric Terradellas
Verónica Torralba

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Examples of our research lines

WMO mineral dust forecasts

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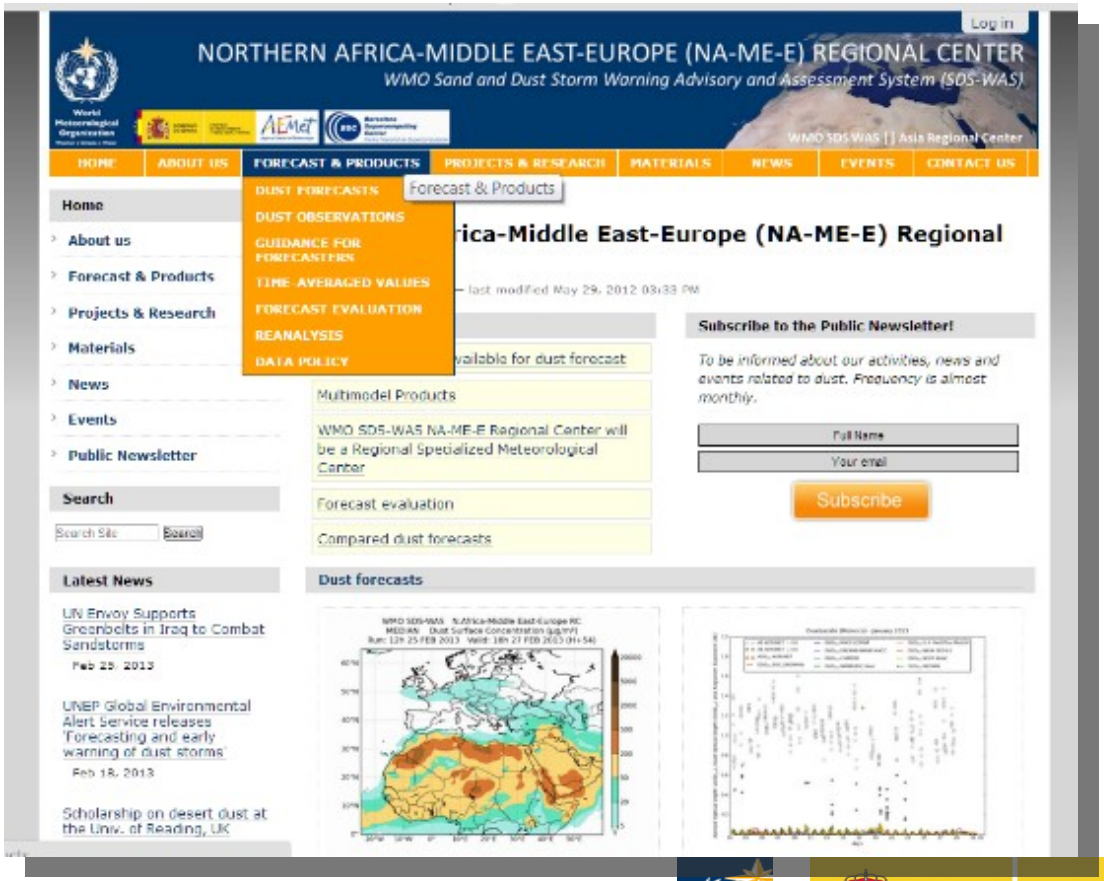
Mineral dust forecasts SDS-WAS

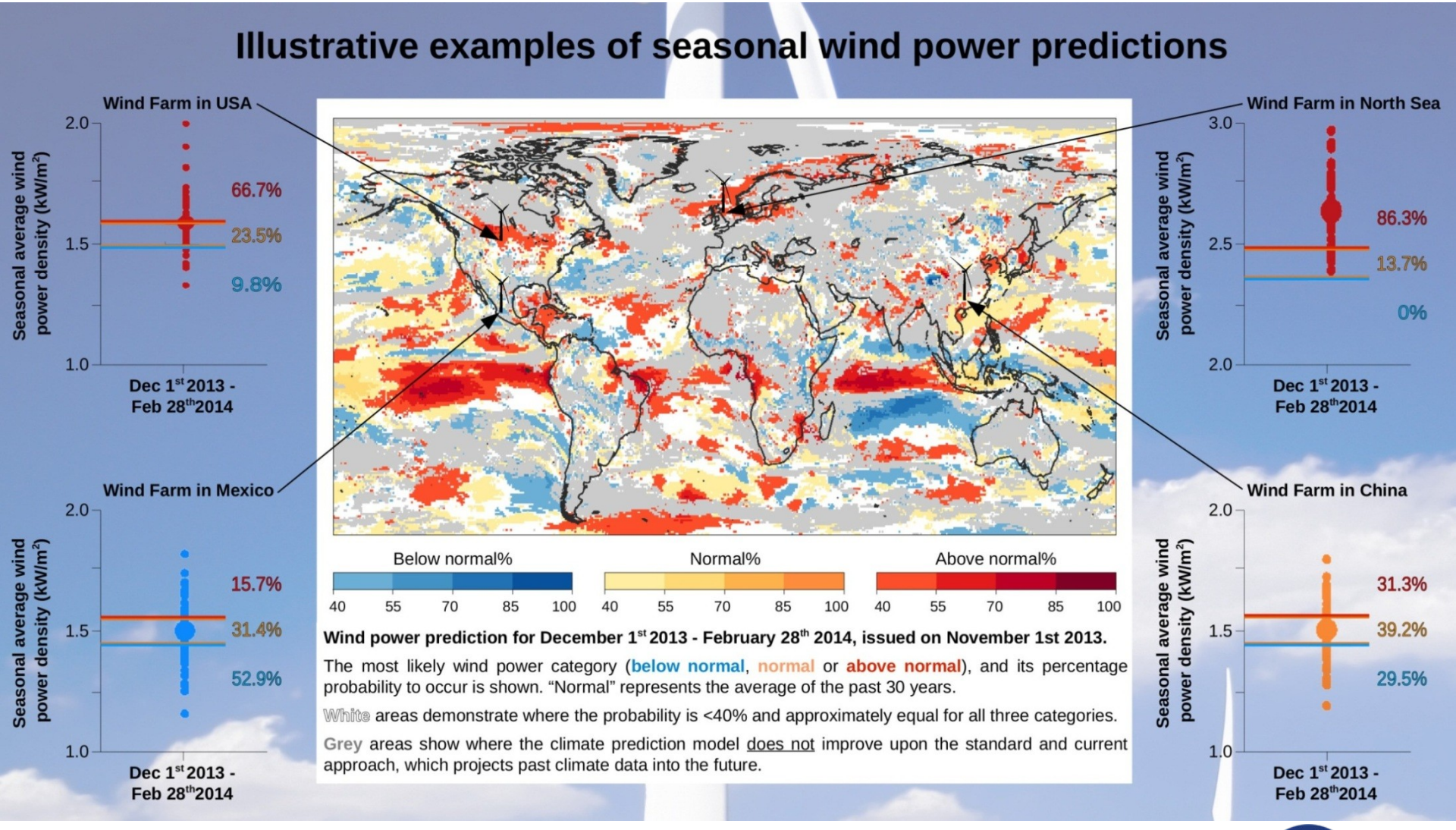
North Africa, Middle East and Europe Regional Center

Early warning system

http://sds-was.aemet.es



Seasonal wind power predictions



Regional climate modeling

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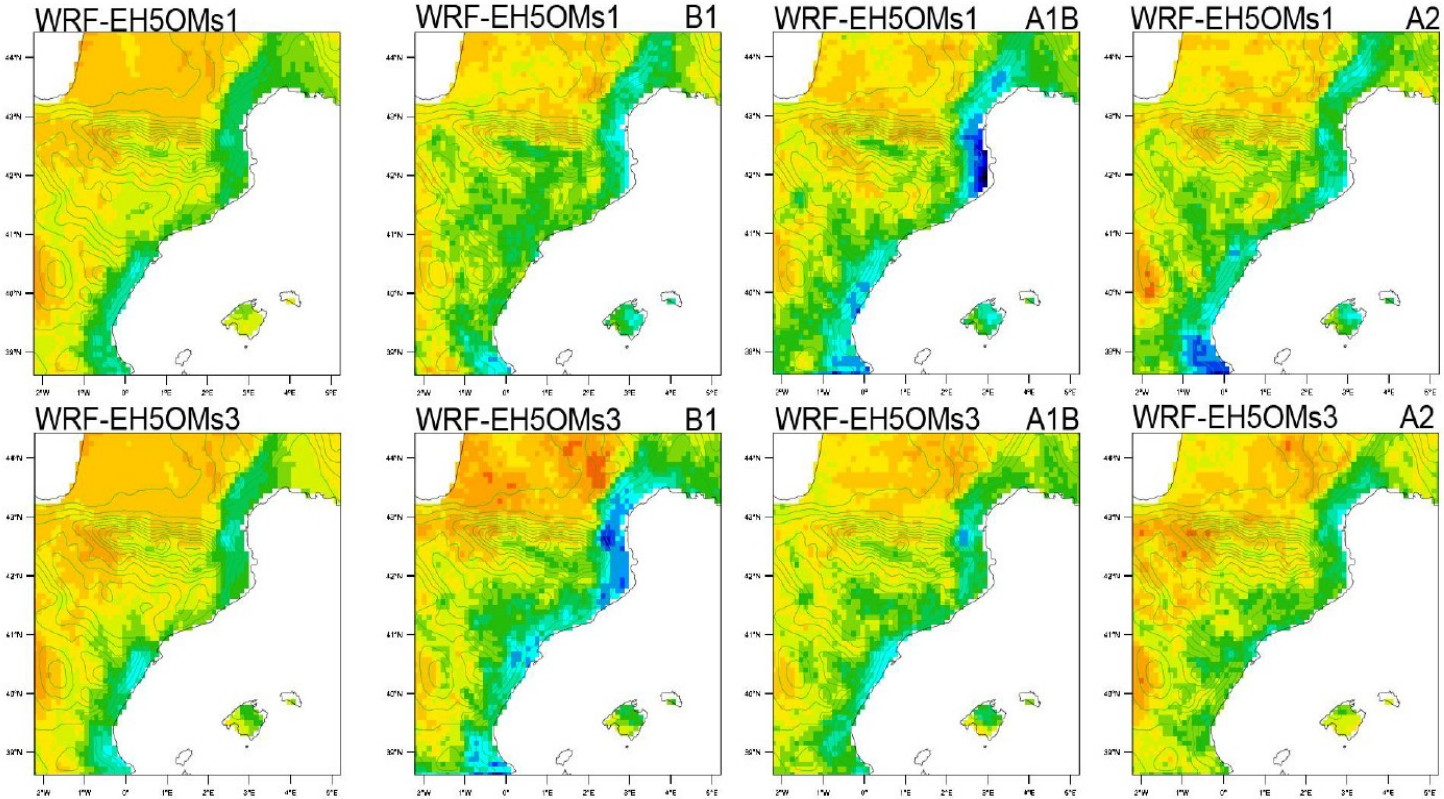
Dynamical downscaling of climatic temperature and precipitation trends

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.



This project has been conducted in collaboration with Servei Meteorològic de Catalunya:

meteo.cat

www.bsc.es

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CALIOPE air quality forecast system

CALIOPE air quality operational forecasts

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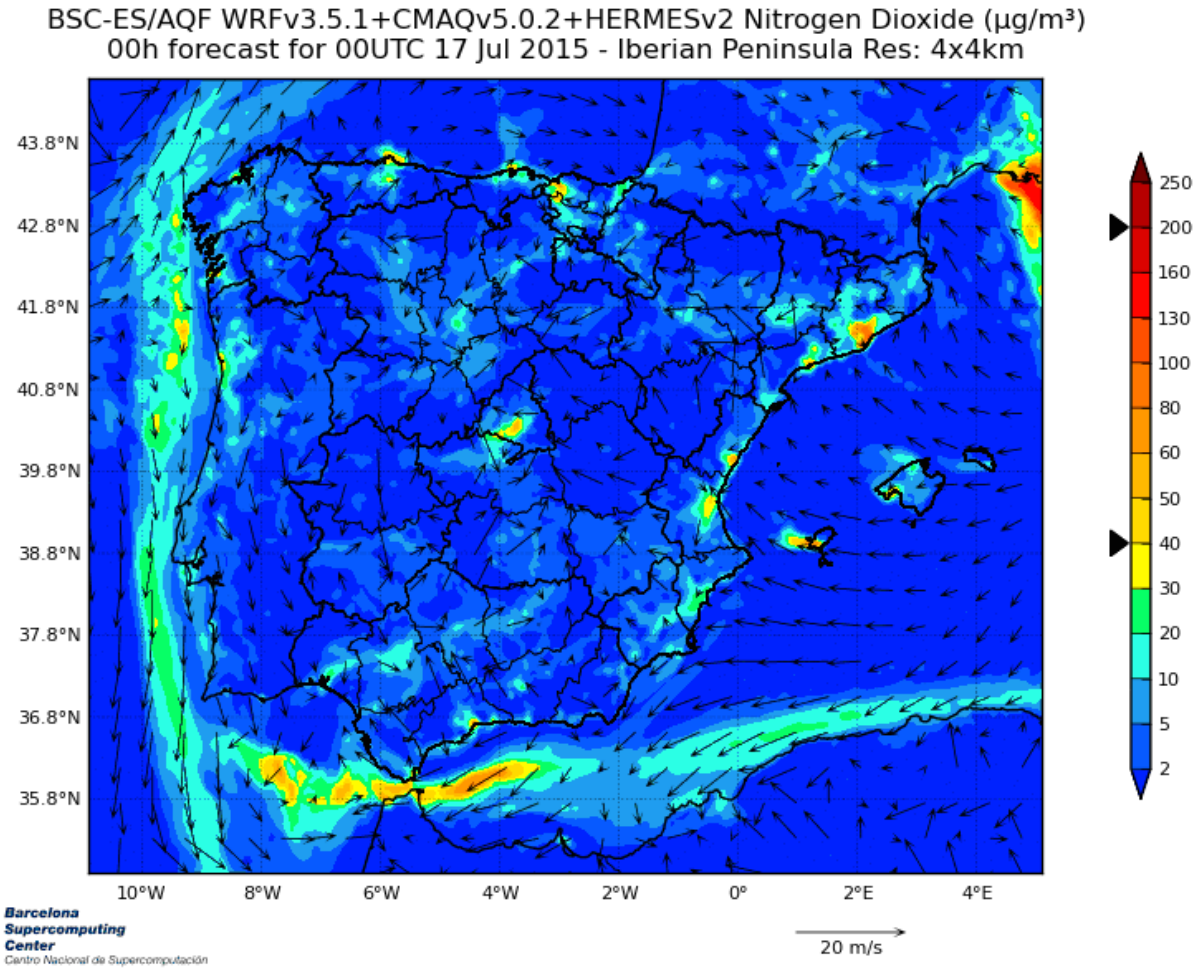
Provides air quality related information for the coming days and for the application of short term action plans for air quality managers.



Information is delivered using both online or custom applications:

www.bsc.es/caliope

CALIOPE app: First Call For Innovative Apps in the environmental and social

The CALIOPE app has been awarded by the JRC

European Commission

JOINT RESEARCH CENTRE

The European Commission's in-house science service

MYGEOSS
APPS FOR YOUR ENVIRONMENT

MYGEOSS is a two-year project (2015-16) by the European Commission to develop GEOSS-based (Global Earth Observation System of Systems) smart Internet applications informing European citizens on the changes affecting their local environment.

CALIOPE air quality forecast system

Barcelona Supercomputing Center
Centro Nacional de Supercomputación
EXCELENCIA SEVERO OCHOA

Módulos CALIOPE

Meteorología
- WRF-ARWv3.5
- 38 niveles sigma (top 50 hPa)
- IBC: GFS (NCEP)

Emisiones
- HERMESv2
  - Europa: HERMES-DIS (EMEP data)
  - España: HERMES-BOUP

Química
- CMAQv5.0.1
- CB05/AERO5
- BC: NCAR MOZART4
- 15 capas/ 50 hPa

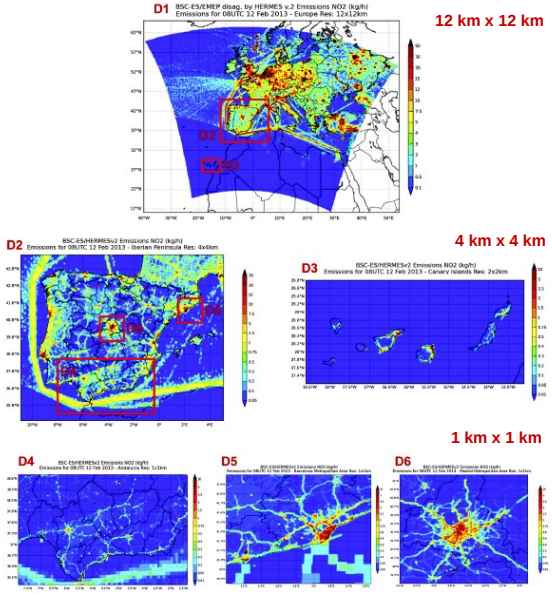
Polvo Mineral
- BSC-DREAM8bv2
- PM10 y PM2.5

Post-proceso
- Kalman Filter (1D and 2D)

Pronóstico calidad del aire

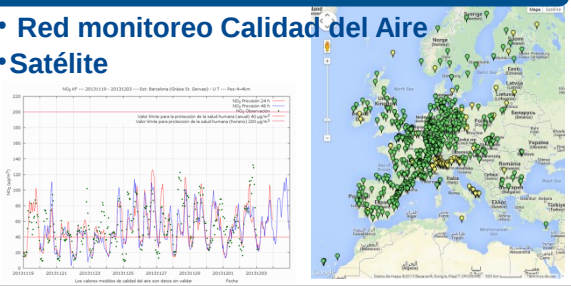
Pronóstico 24/48h

- Mapas (concentraciones, emis, meteo)
- AO índice/ Población expuesta



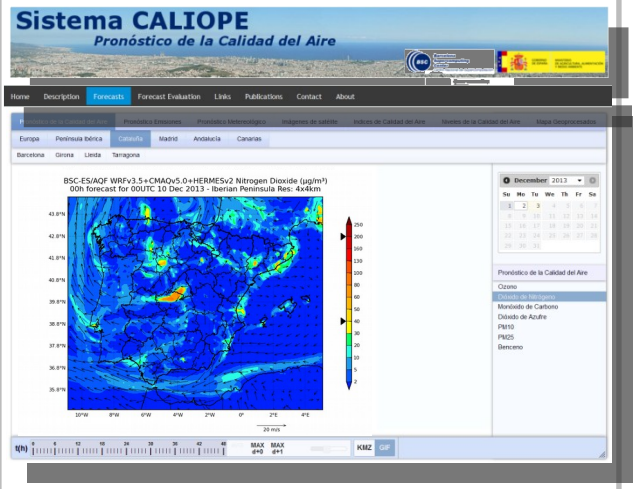
Evaluación Pronóstico (NRT)

- Red monitoreo Calidad del Aire
- Satélite



Difusión

- Web (www.bsc.es/caliope)
- Smart phone app



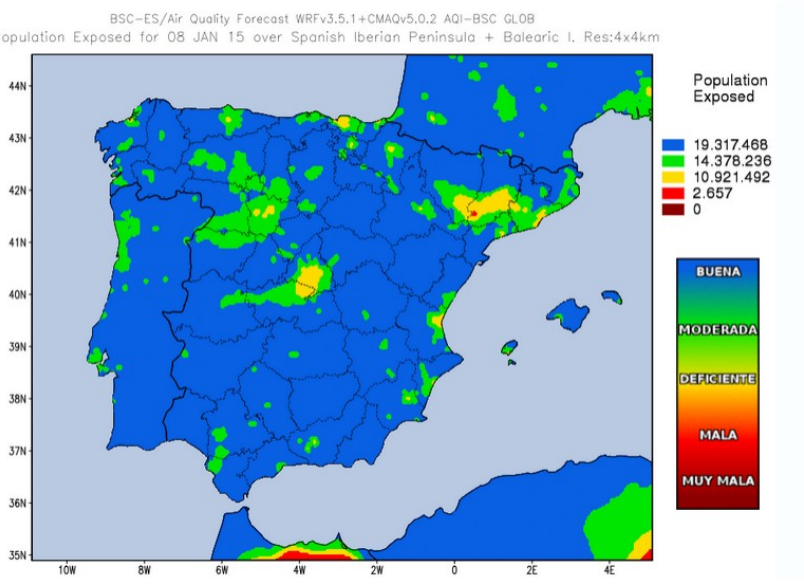
Generalitat de Catalunya
Departament de Territori i Sostenibilitat

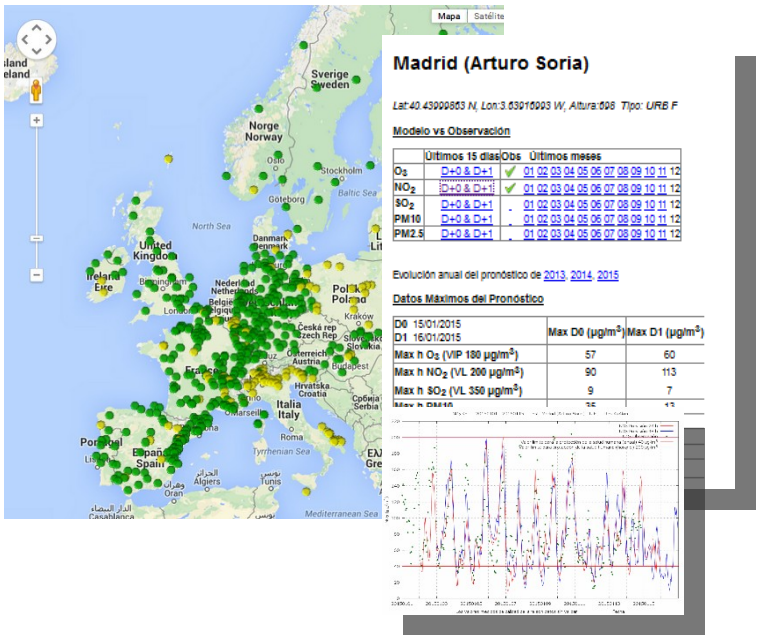
GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, ALIMENTACIÓN Y MEDIO AMBIENTE

Gobierno de Canarias
Consejería de Educación, Universidades y Sostenibilidad

JUNTA DE ANDALUCIA
CONSEJERÍA DE MEDIO AMBIENTE Y ORDENACIÓN DEL TERRITORIO

CALIOPE related products





Forecast products (24h and 48 h)

- **Meteorological fields**: temperature, precipitation, humidity, pressure, cloud cover, wind direction and speed, among other.
- **Emissions rates** and sector contributions: nitrogen oxides (NO and NO_2), volatile organic compounds (VOCs), carbon monoxide (CO), sulfur dioxide (SO_2) and particulate matter (PM).
- **Pollutant concentrations** (O_3, NO_2, CO, SO_2, PM10, PM2.5 and benzene):
  - Hourly and maximum concentrations.
  - Bias-corrected air quality forecast based on measurements.
- **Air quality index** and **pollution exposure**.

CALIOPE. Possible related services

Possible related services based on CALIOPE results:

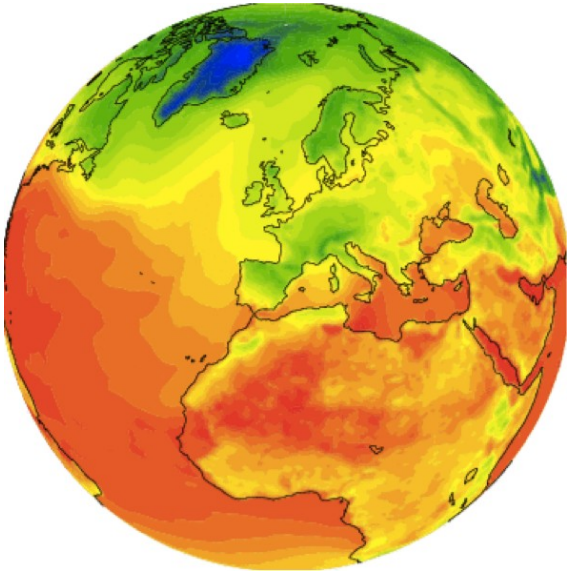
- To reduce resuspension emissions by better managing street cleaning fleets.
- Better manage water use for watering of gardens by using more detailed meteorological information.
- Forecast heat island metrological processes and prevent its adverse effects on human health and better manage energy demand.
- Meteorological and air quality Early Warning Systems (EWS) to advise people (asthmatic population, etc.) and to establish emission reduction measures (traffic reduction, etc.).

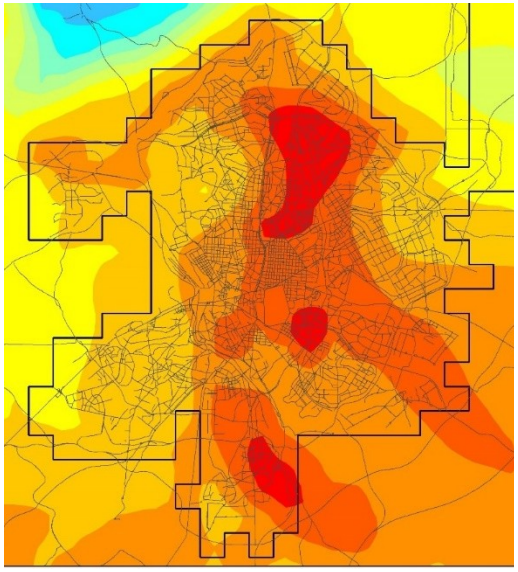
Other possible synergies under development

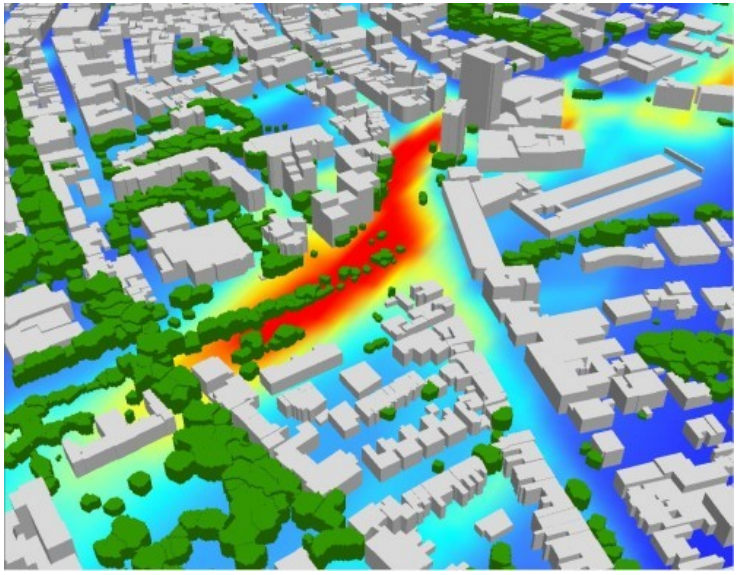
Air quality assessment at urban scales. Objective

Further understanding of local scales processes to allow the assessment of sustainable management of urban areas within the SmartCities context by using two key-elements:

- microscale atmospheric models
- observations from smart infrastructures



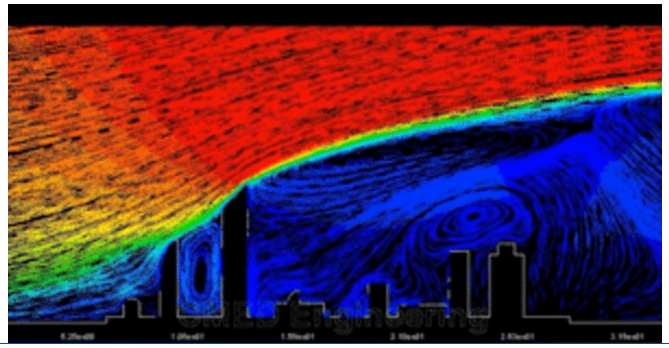




From global to regional scales

Next step: microscale

Air quality assessment at urban scales. Strategy: interdisciplinar approach



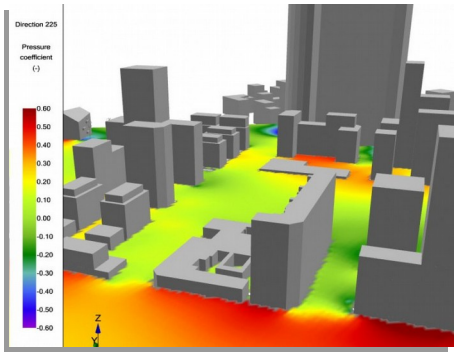
CDF air quality at microscale

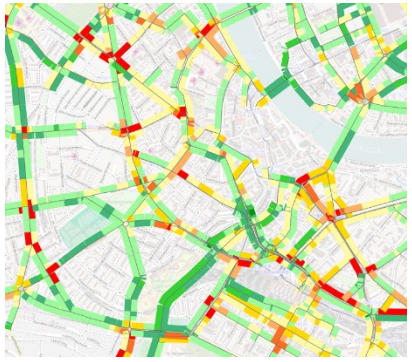
Meteorological core

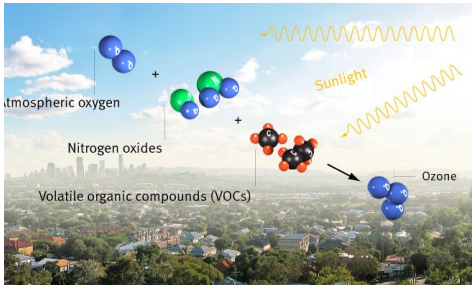
Emission module

Air quality module

Smart infrastructures







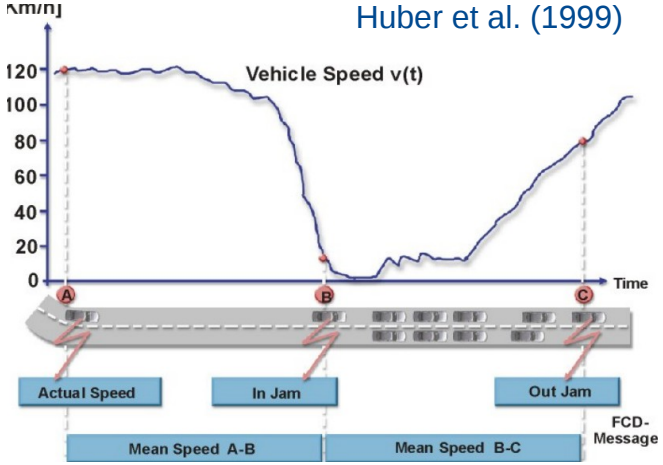
CASE dep. + Earth Sciences dep. + Computer dep.

Vehicle activity: Floating car data (FCD)

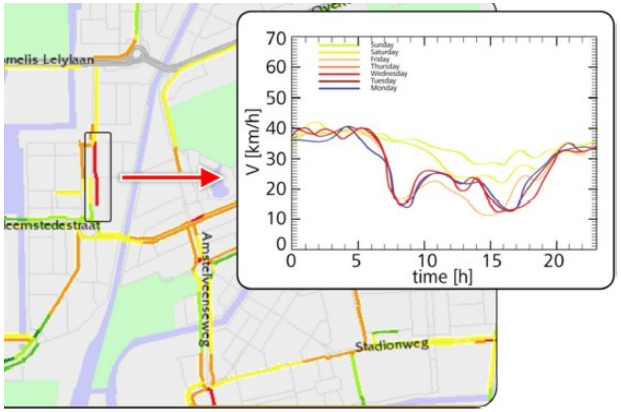
Collects real-time traffic state information from individual vehicles equipped with positioning (GPS) or cellular-based (e.g. GSM, GPRS) systems

✓ **Speed**. Very high spatial and temporal resolution

Huber et al. (1999)



Brower (2014)

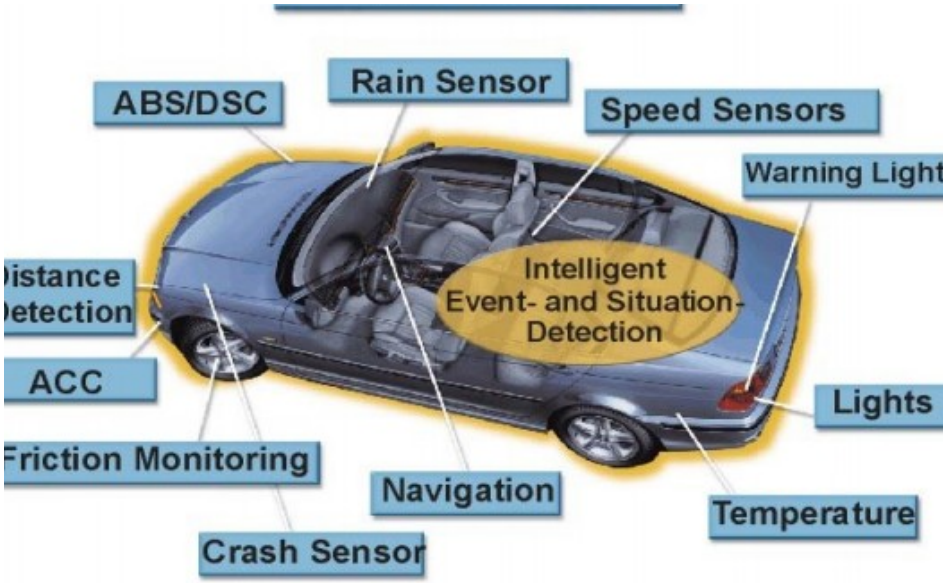


✗ **Volume**. Only equipped vehicles. **But….**

Vehicle activity:
Extendend Floating car data (xFCD)

Extended Floating Car Data (xFCD)

Beside the vehicle speed, there is a whole range of other operating and switching data available in digital form on the bus systems of modern vehicles



Huber et al. (1999)

Prummer (2014)

Car's fuel consumption

Car's CO_2 emissions

National and International collaborations

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RACC
SEAT
Applus IDIADA
BCN ECOLOGIA
Agència d'Ecologia Urbana de Barcelona
oca group
METEO SIM
inLab FIB talent & tech
Generalitat de Catalunya
JUNTA DE ANDALUCIA CONSEJERÍA DE MEDIO AMBIENTE
AEMet Agencia Estatal de Meteorología
meteo.cat

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Thank you!

For further information please contact

info-services-es@bsc.es
albert.soret@bsc.es