IC3 Climate Forecasting Unit

CLIMATE SERVICES FOR ENERGY

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EUPORIAS
SPECS
SEVENTH FRAMEWORK PROGRAMME
EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND
A WAY TO MAKE EUROPE
GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

OUTLINE:

1. OVERVIEW OF CLIMATE SERVICES FOR ENERGY

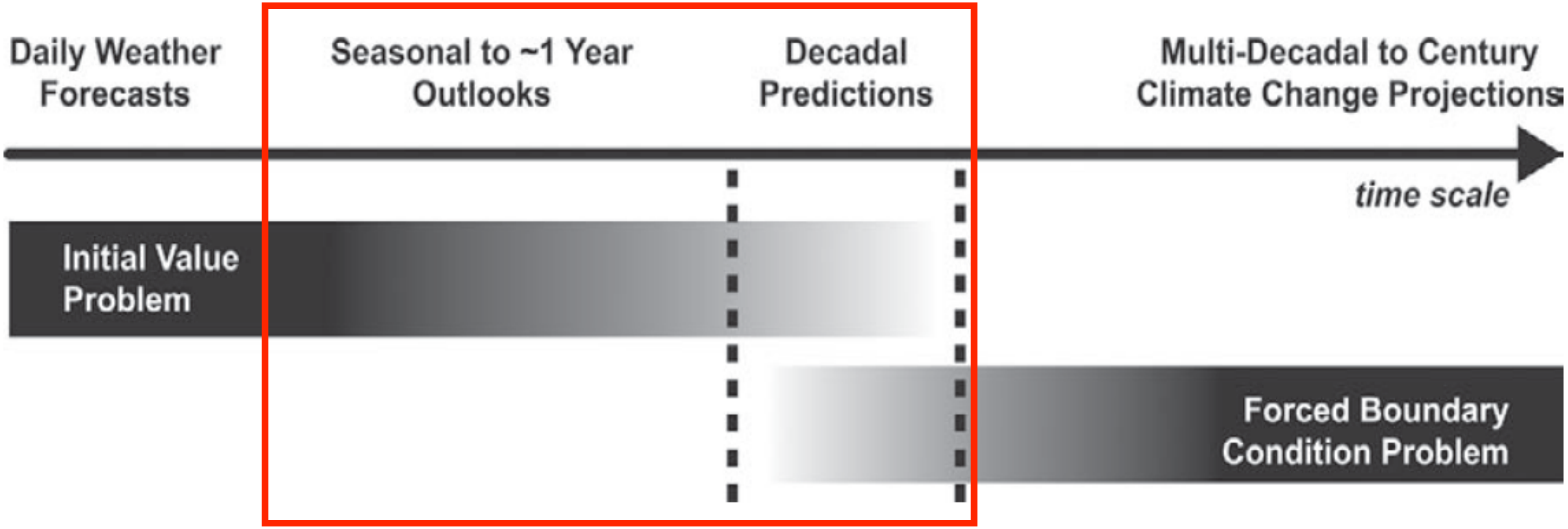
2. CLIMATE SERVICES PROJECTS

“[Renewable] energy provision may be anticipated, not only in the short and long term as it is today, but also at intermediate horizons, where a huge market niche appears.”

Ignacio Lainez Aracama, Professor of Wind Energy, EOI and Director of Energy Assessments, EDP Renewables. El País Article: 4th March 2014: Mix energético: las renovables y su predictibilidad

Time Scale Horizons

- Initial-value problems (weather forecasting) to forced boundary condition problem (climate projections)
- Climate forecasts (sub-seasonal, seasonal and decadal) in the middle



Meehl et al. (2009)

WHY Climate Services?

Anticipate and Identify Vulnerabilities and Risks

Facilitate strategic climate adaptation action

Ability to make decisions earlier

Avoid subjective decision making

Take calculated precautionary action

Potential cost saving

Pre-Constuction 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: Optimise return on investments

OUTLINE:

1. OVERVIEW OF CLIMATE SERVICES FOR ENERGY

2. CLIMATE SERVICES PROJECTS

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

IC3 role: Project coordinator

Call: FP7 Environment and Climate

Description: Deliver a new generation of European climate forecast systems, with improved forecast quality and efficient regionalisation tools.

Link to energy: IC3 and Vortex represent the renewable energy service provider and user group in the project.

Total budget: 11,989,174€

Timeframe: 2012-2016

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

IC3 role: Partner, WP leader and energy case study representative

Call: FP7 Environment and Climate

Description: Develop new technologies to exploit emerging capabilities from climate research. Engage with users to develop useful & usable tools.

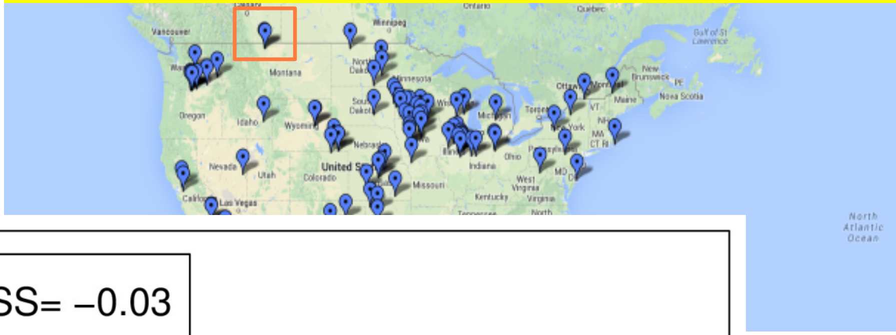
Link to energy: IC3 and EDF/Vortex represent the renewable energy service provider and user groups to develop semi-operational prototype for European wind forecasts over seasonal timescales.

Total budget: 12,962,917€

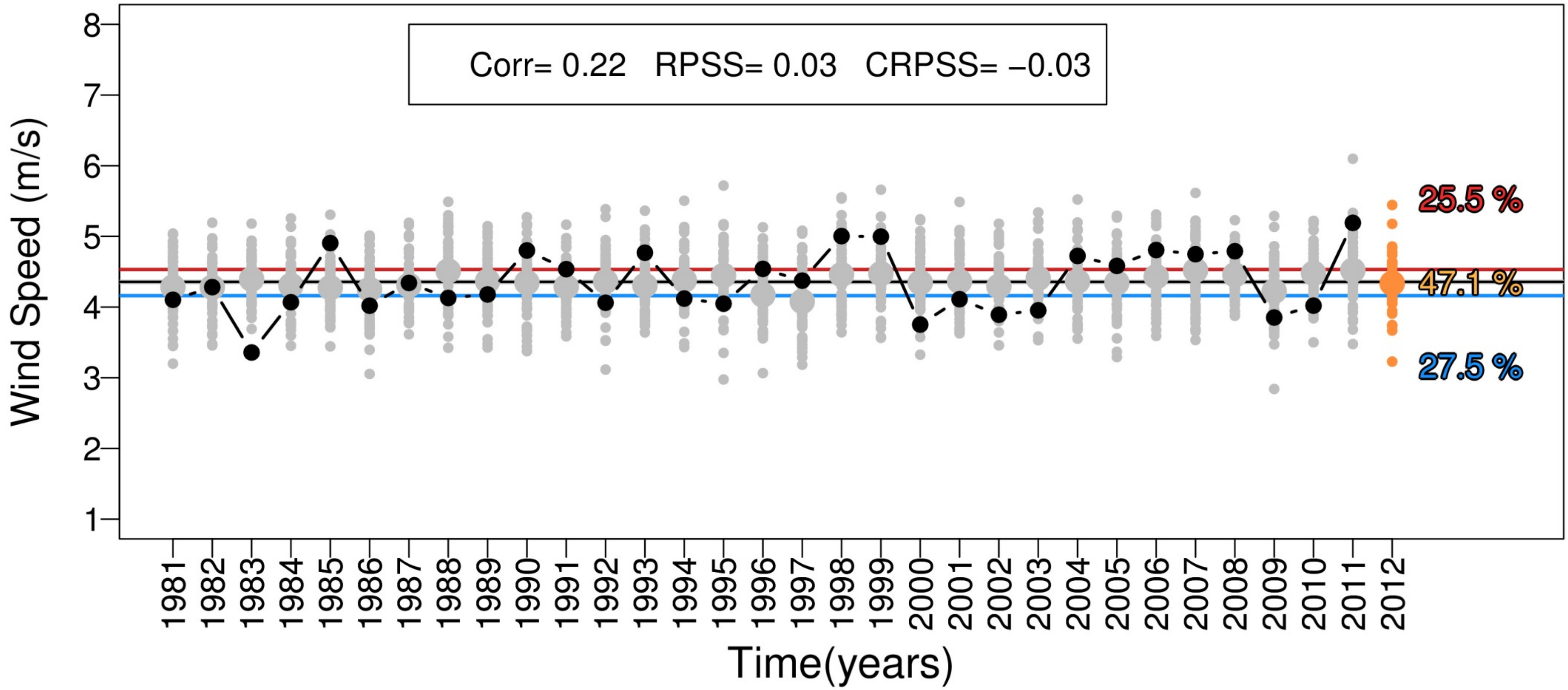
Timeframe: 2012-2016

Wind Speed Forecast

Climate model:ECMWF S4
10m wind speed “observations”: ERA-Interim
Winter season forecast: 1 month lead time



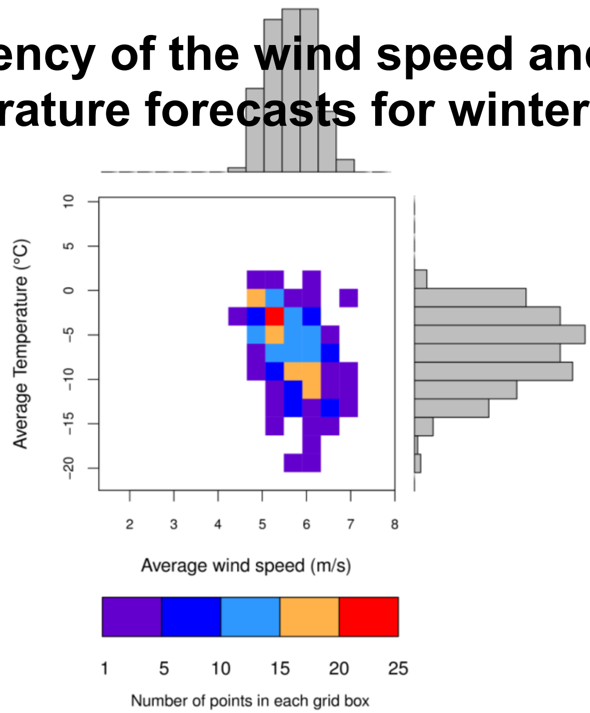
Simple bias correction

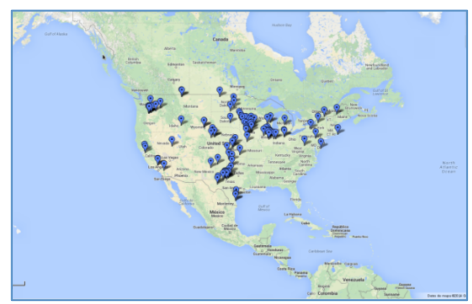


Climate Forecasting Unit

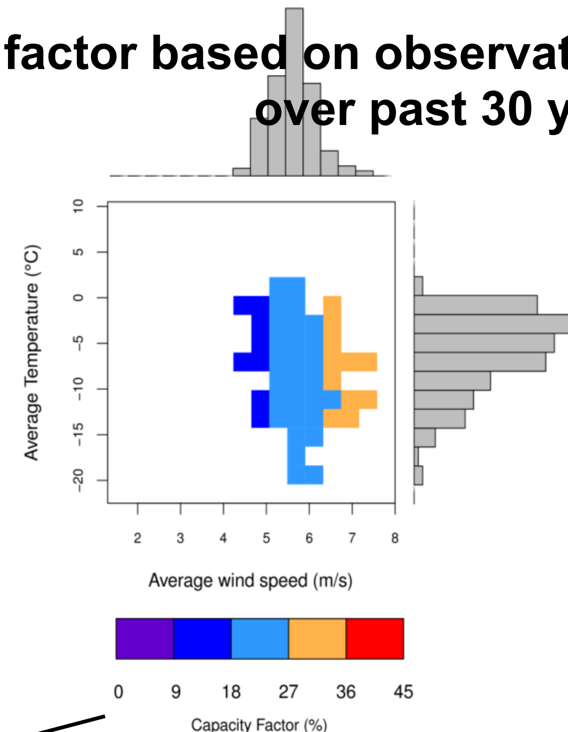
Translating Wind Forecasts into Power Capacity

Frequency of the wind speed and temperature forecasts for winter season 2012

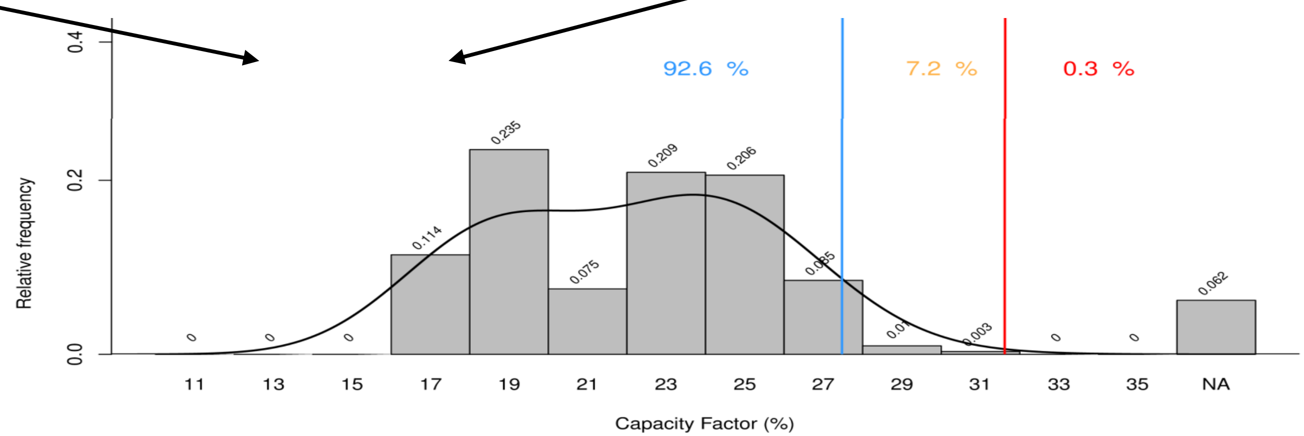




Capacity factor based on observations over past 30 years

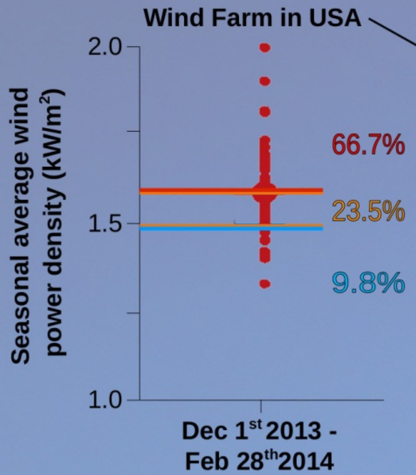


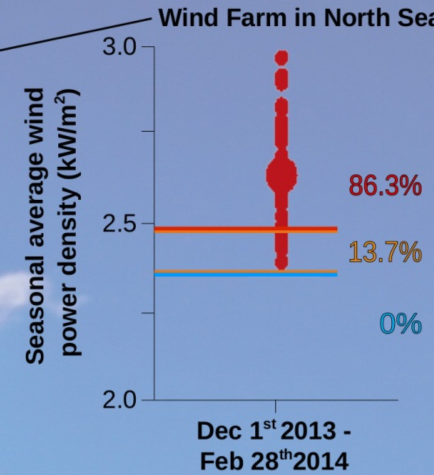
Forecast of capacity factor for winter season 2012

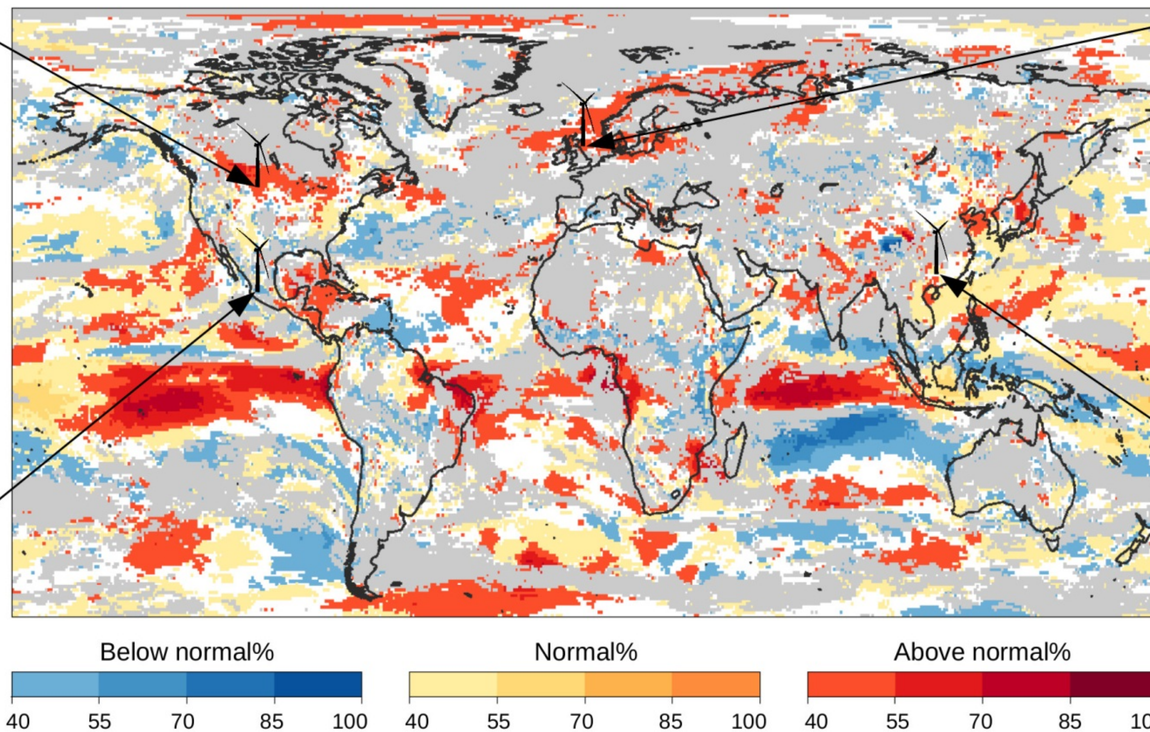


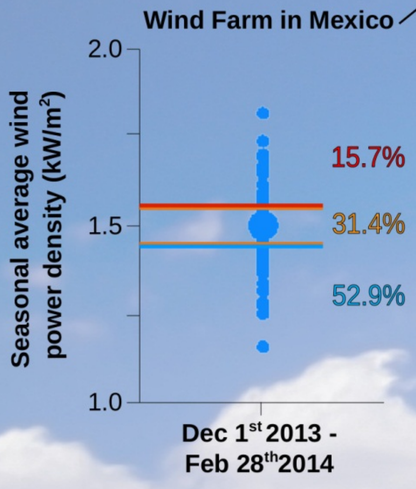
Climate Forecasting Unit

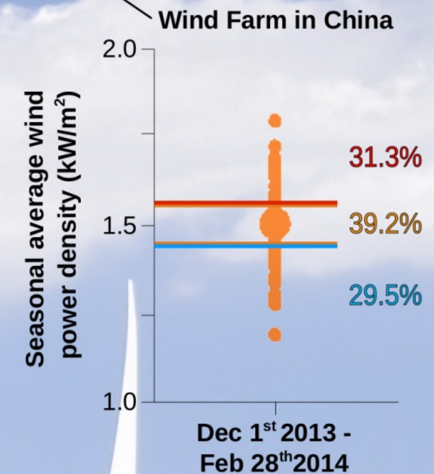
Illustrative examples of seasonal wind power predictions











Wind power prediction for December 1st 2013 - February 28th 2014, issued on November 1st 2013.

The most likely wind power category (**below normal**, normal or **above normal**), and its percentage probability to occur is shown. “Normal” represents the average of the past 30 years.

White areas demonstrate where the probability is <40% and approximately equal for all three categories.

Grey areas show where the climate prediction model does not improve upon the standard and current approach, which projects past climate data into the future.

RESILIENCE: Strengthening the European Energy Network with Climate Services

IC3 role: Project leader

Call: National – Spanish Ministry of Industry

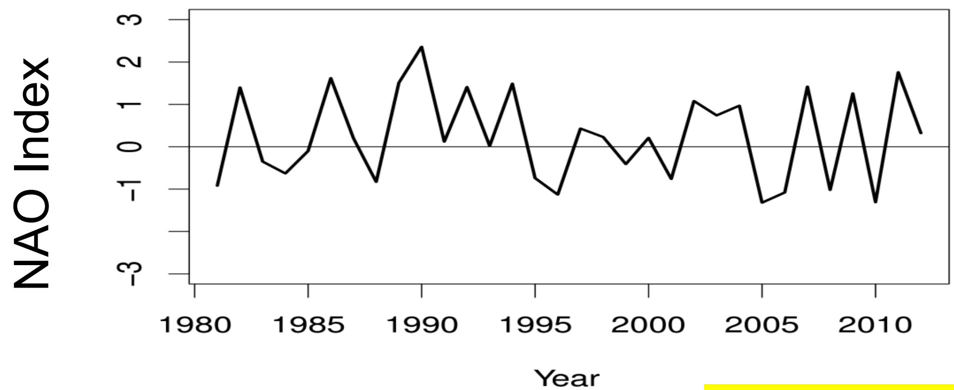
Description: Strengthen the efficiency and security of the European energy network using the state-of-the-art from subseasonal-to-seasonal climate predictions of wind power supply and temperature-related demand, developed in co-production with end users.

Link to energy: Special focus on the Iberian Peninsula and the North Sea region where wind power supply has significant impact.

Total budget: 224,000€

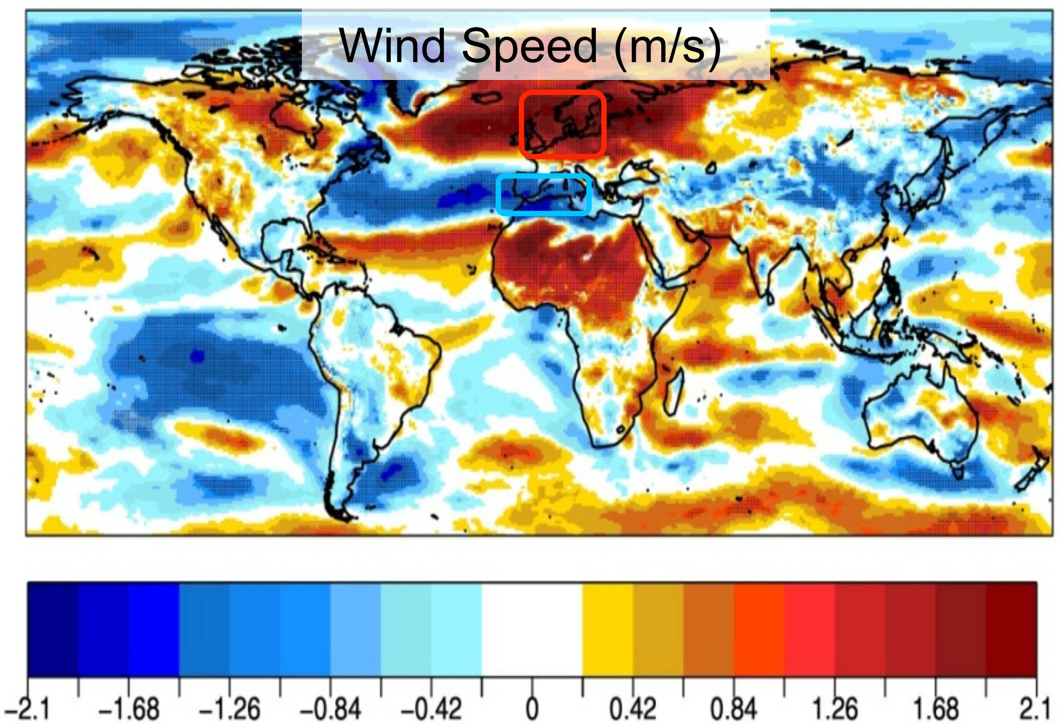
Timeframe: 2014-2016

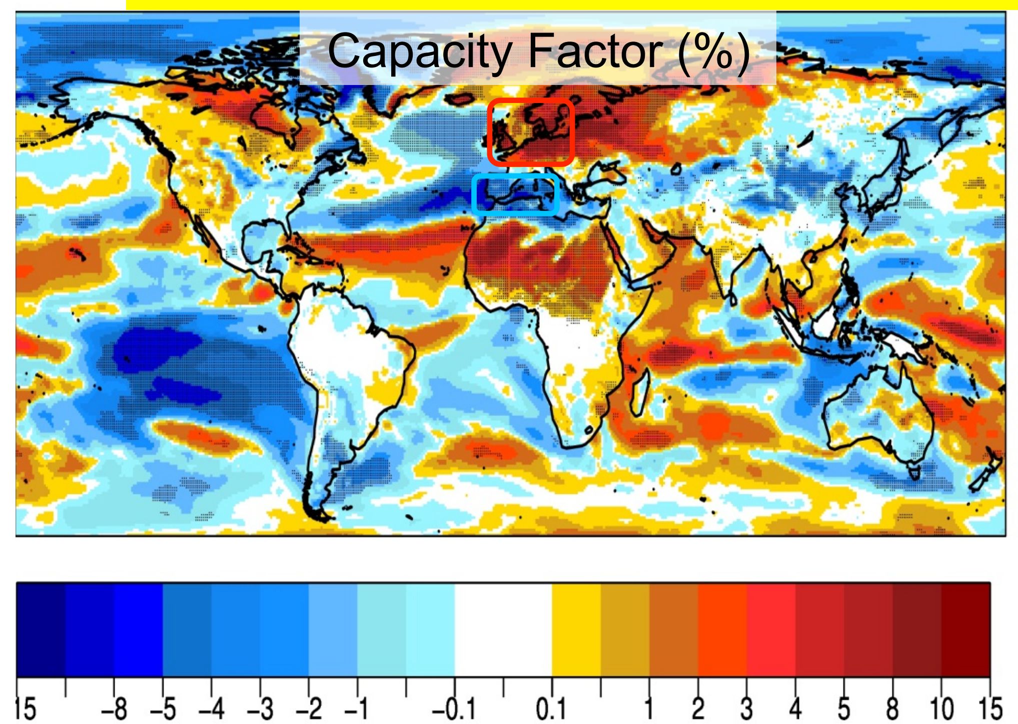
Impact of NAO on Wind Speed and Capacity Factor



Differences with NAO + and NAO - conditions

10m wind speed “observations”: ERA-Interim
Boreal winter season period 1981-2012





FUTURE WORK:

NEWA: New European Wind Atlas

Description: New EU wind climate database to reduce the uncertainty of wind project discrepancies between calculated and actual production and operating conditions.

PRIMAVERA: PRocess-based climate sIMulation: AdVances in high-resolution modelling and European climate Risk Assessment

Description: To develop a new generation of advanced and well-evaluated high-resolution global climate models, capable of simulating and predicting regional climate with unprecedented fidelity, for the benefit of governments, business and society in general.

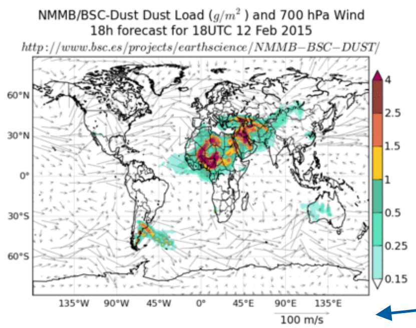
IMPREX: IMproving PRedictions and management of hydrological EXtremes

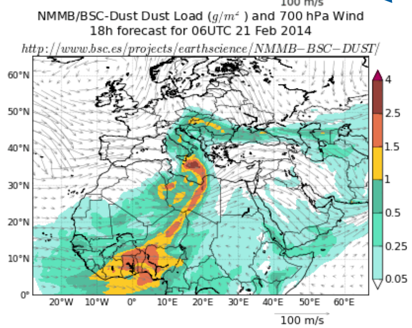
Description: To improve forecast skill of meteorological and hydrological extremes in Europe and their impacts, by applying dynamic model ensembles, process studies, new data assimilation techniques and high resolution modeling.

SHORT TERM FORECAST SERVICES FOR THE ENERGY SECTOR.

Mineral dust modelling for solar energy management

BSC has developed in collaboration with NCEP the **NMMB/BSC-Dust model**

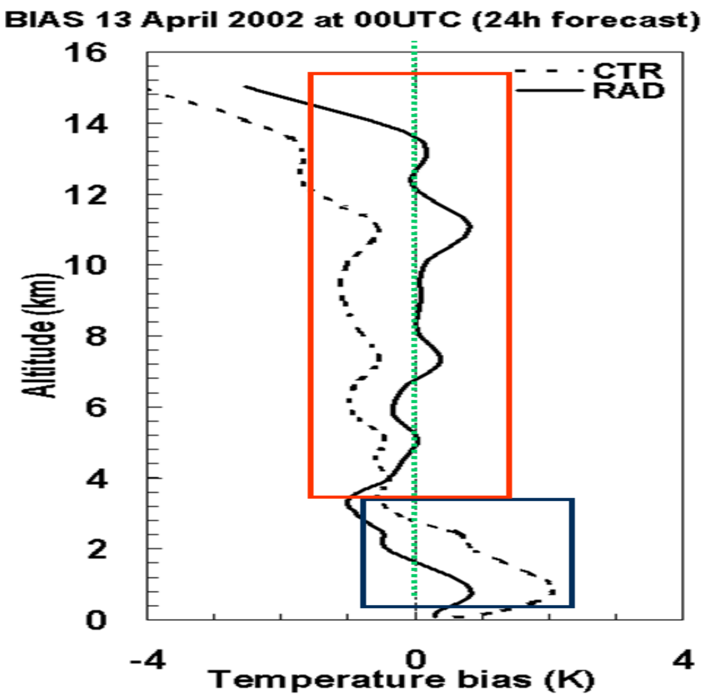




Forecast and diagnostic mode

Regional and global scales

On-line feedbacks: Dust-radiation interaction



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

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

NEWA: New European Wind Atlas

IC3 role: Partner, Climate predictions representative

Call: FP7 Energy ERA-NET

Description: New EU wind climate database to reduce the uncertainty of wind project discrepancies between calculated and actual production and operating conditions.

Link to energy: Database to include: wind resources, including extremes; their probability of occurrence and associated uncertainty; guidelines and best practices; development of dynamical downscaling methodologies and open-source models validated through measurement campaigns.

Total budget: 13,054,038€ **Timeframe:** 2012-2016

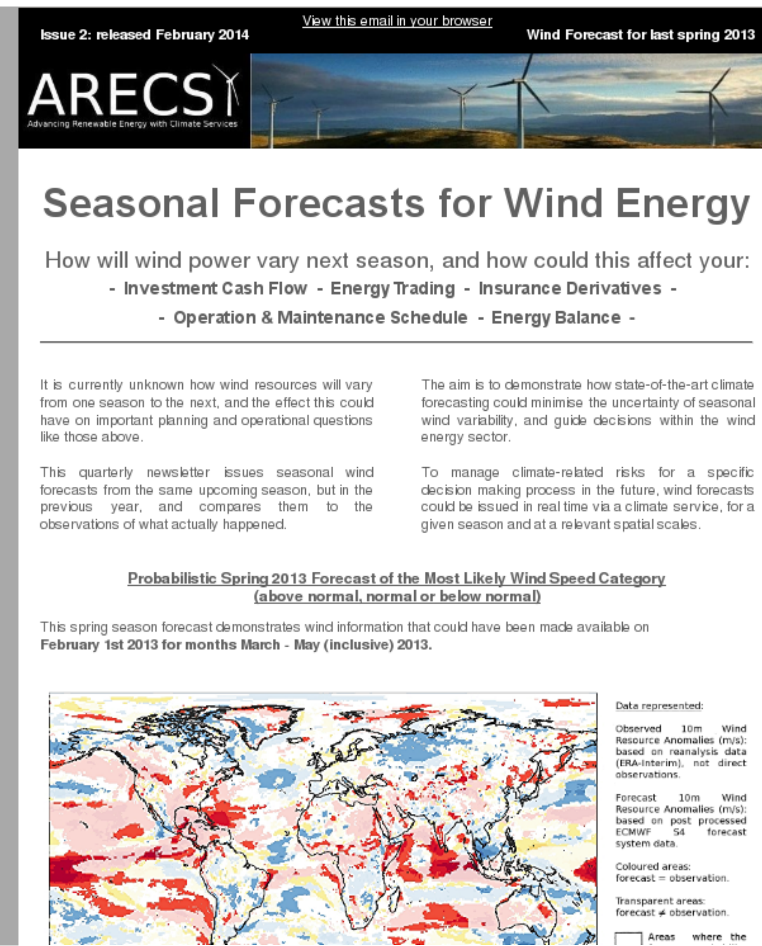
Advancing Renewable Energy with Climate Services (ARECS)

Join the initiative at: **www.arecs.org**

- ✓ Monthly, seasonal and decadal wind and solar forecasts
- ✓ Provide feedback, register your needs
- ✓ Receive a quarterly, seasonal wind forecast newsletter

Website

Newsletter



Climate Forecasts:
State-Of-The-Art Approach

Stage 1: Dynamical forecasts

- Initialisation of ensemble simulations

Stage 2: Post-processing

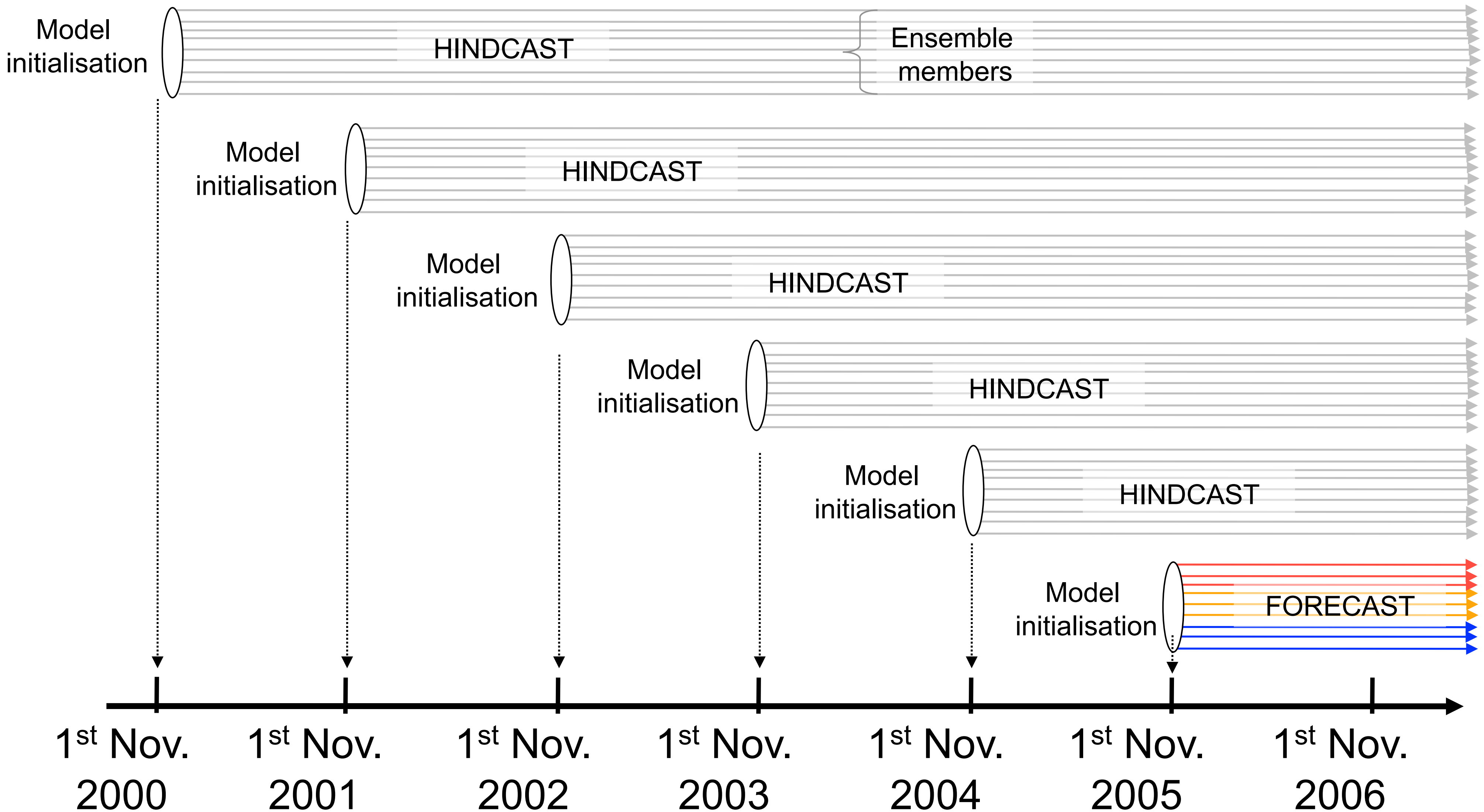
- Bias correction or calibration
- Combination: multi-model approach

Stage 3: Validation

- Verification: skill assessments

Stage 1: Dynamical forecasts

Initialisation of ensemble simulations



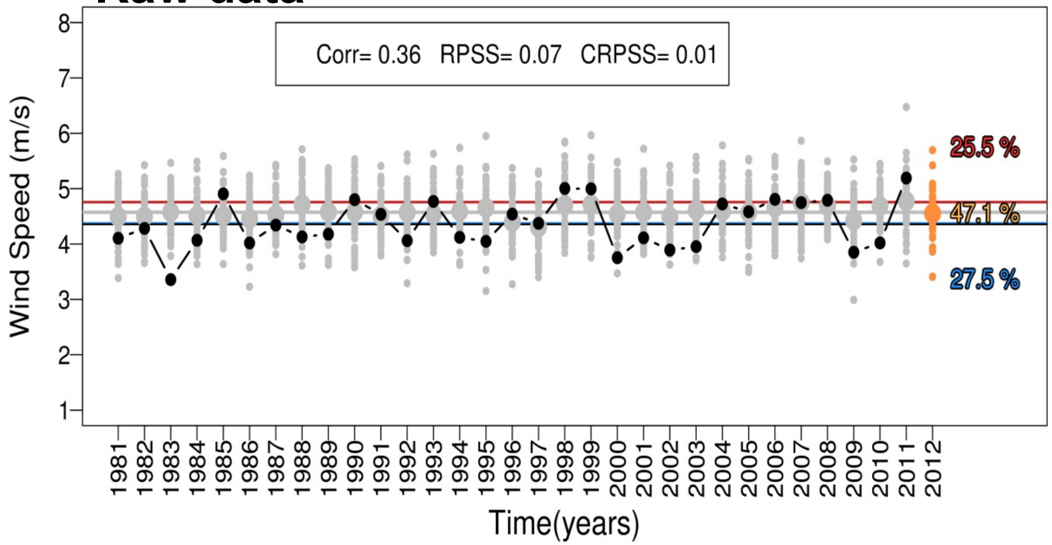
Start date November 1st each year over past 30 year period

1 experiment: 120Tb

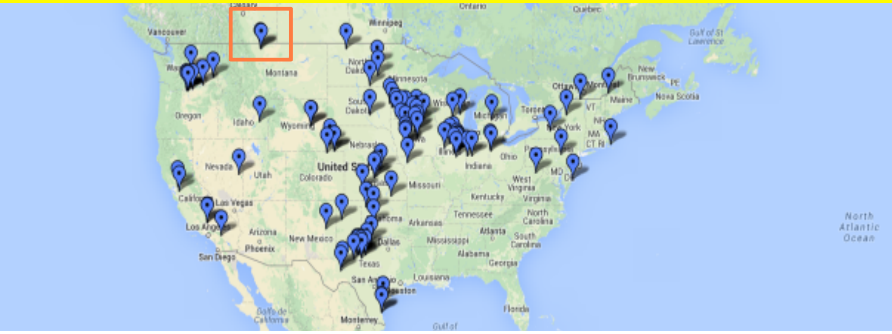
Stage 2: Post-processing

Bias correction or calibration

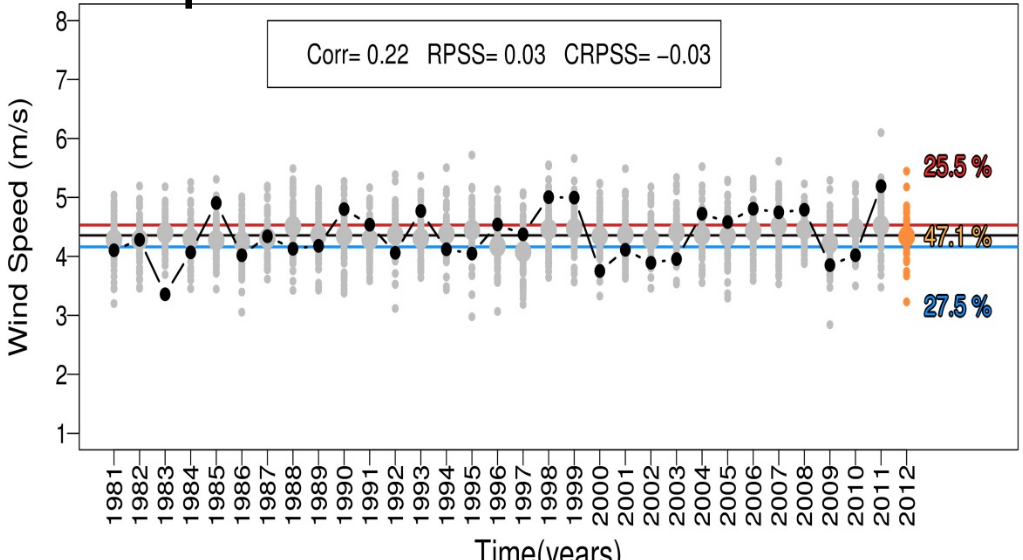
Raw data



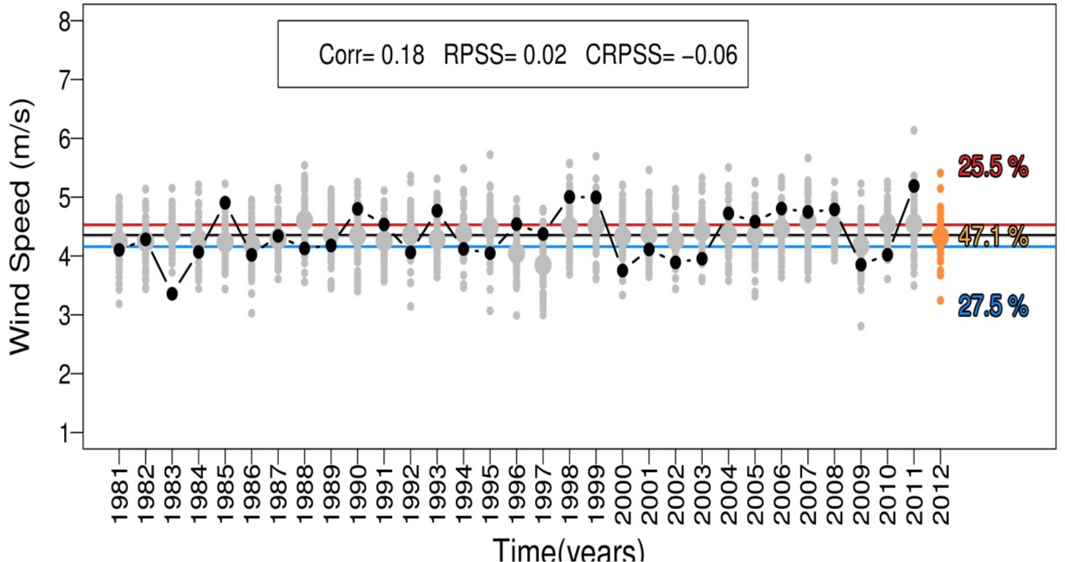
Climate model:ECMWF S4
10m wind speed “observations”: ERA-Interim
Winter season forecast: 1 month lead time



Simple bias correction



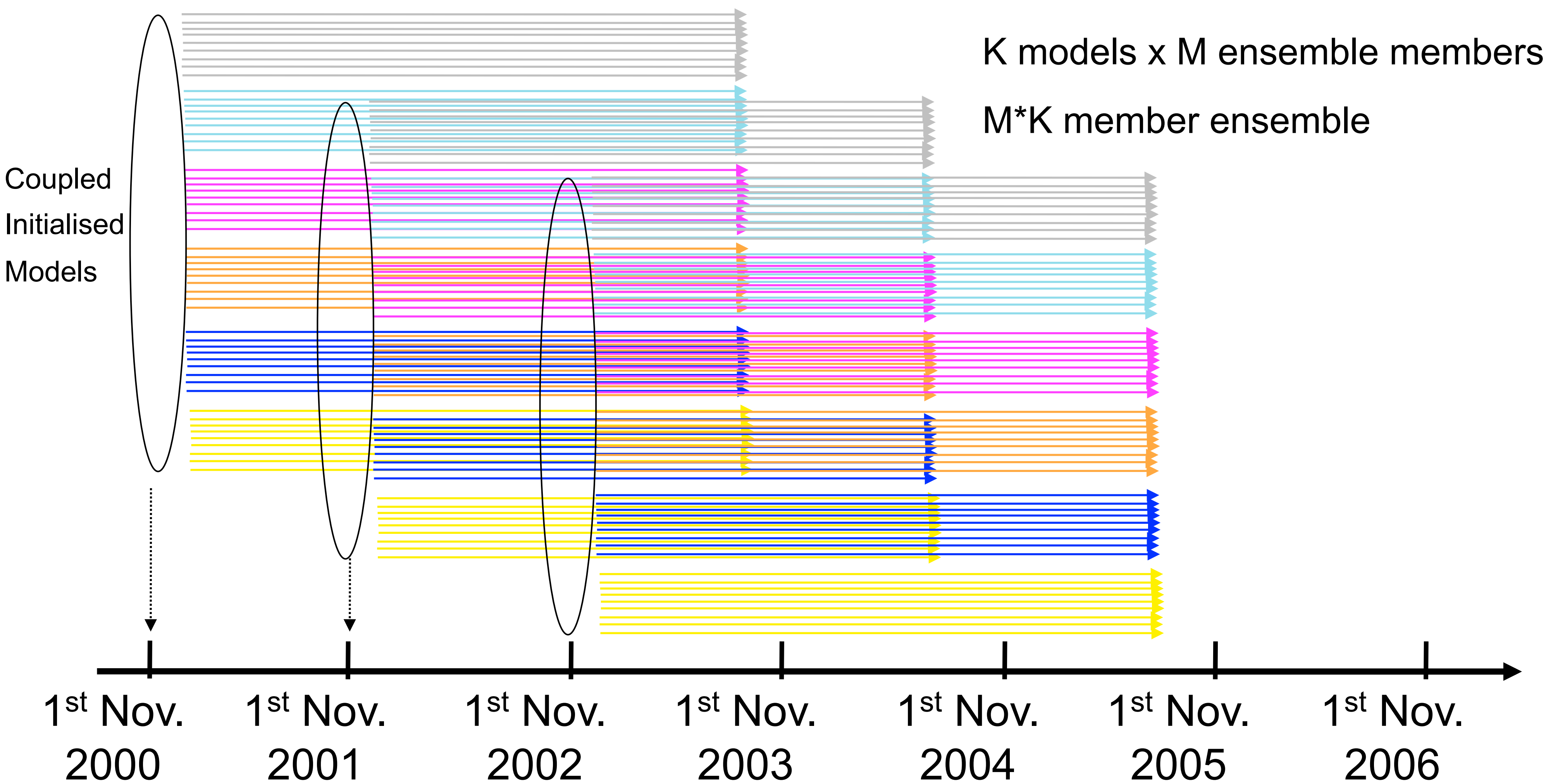
Calibration



Stage 2: Post-processing

Combination: multi-model approach

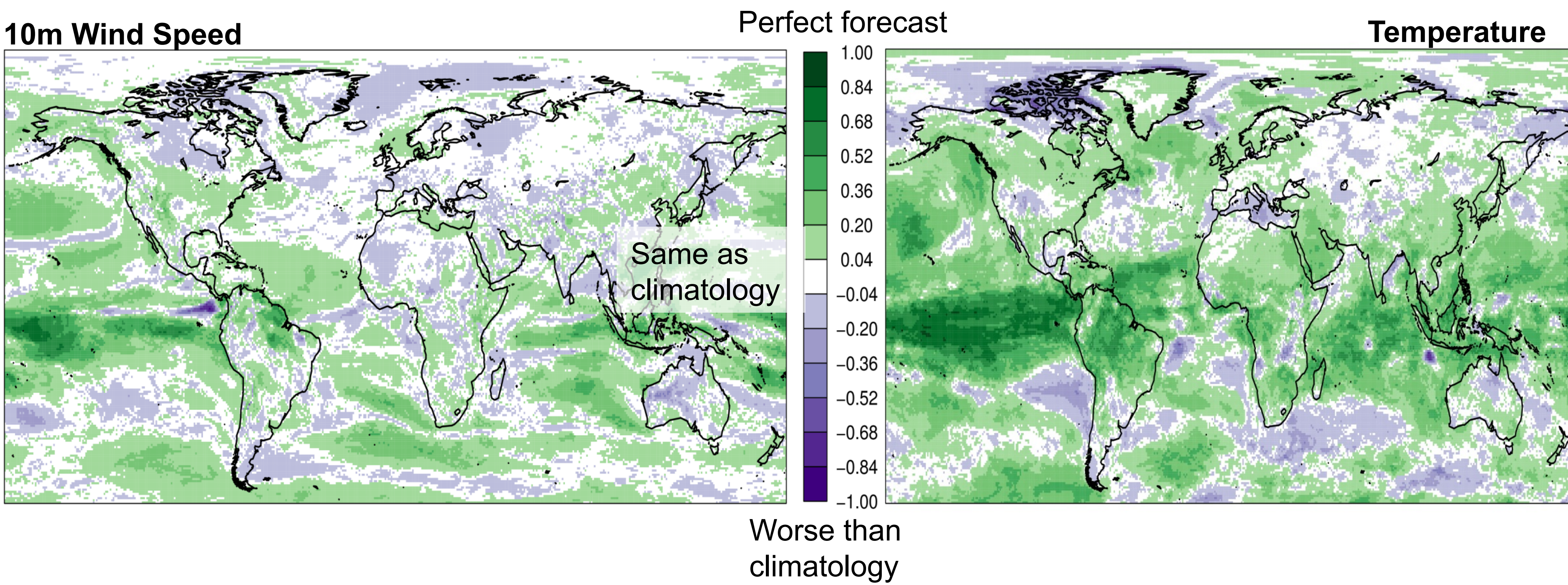
Model 1 Model 2 Model 3 Model 4 Model 5 Model 6



Stage 3: Validation

Verification: skill assessments

Climate model:ECMWF S4
“Observations”: ERA-Interim, past 30 years
Winter season forecast: 1 month lead time



FURTHER VALIDATION POSSIBLE BASED ON REAL MEASUREMENTS