



# SafeWind

Wind Power Forecasting with Focus on Extremes  
Workshop, Palais Brongniart, 31.08.12, Paris

## The role and benefits of forecasting for renewables integration in France

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01. Overview of wind power in France
02. RTE's missions
03. Impact of wind power on RTE's activities
04. Developments in dealing with wind power

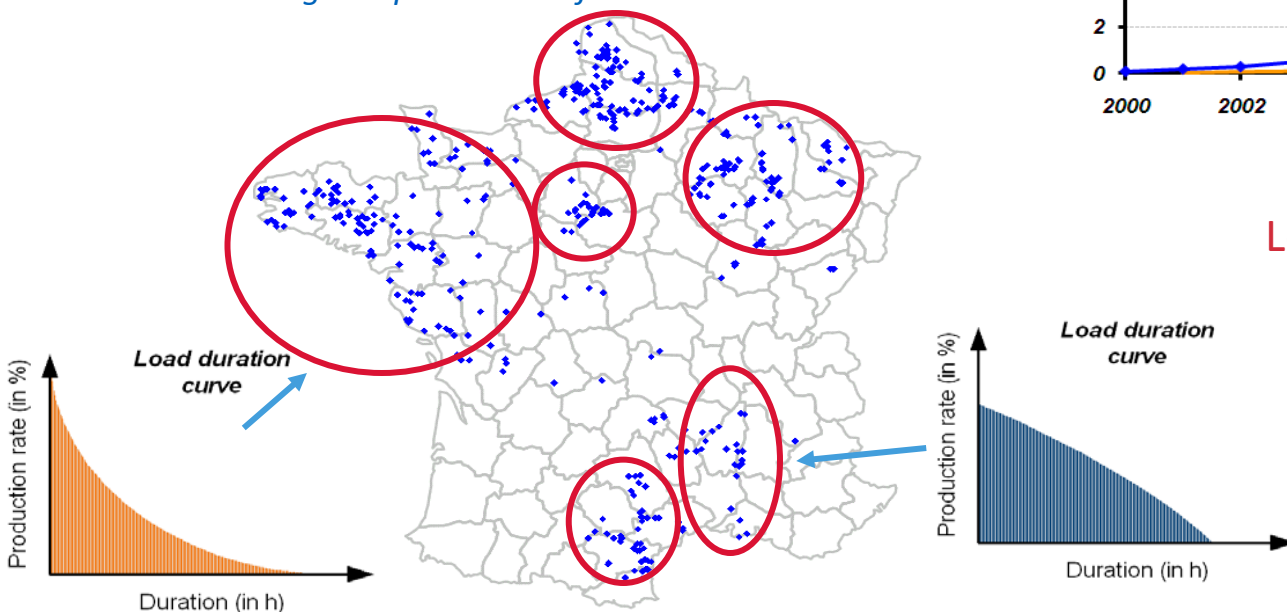
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# About wind power in France

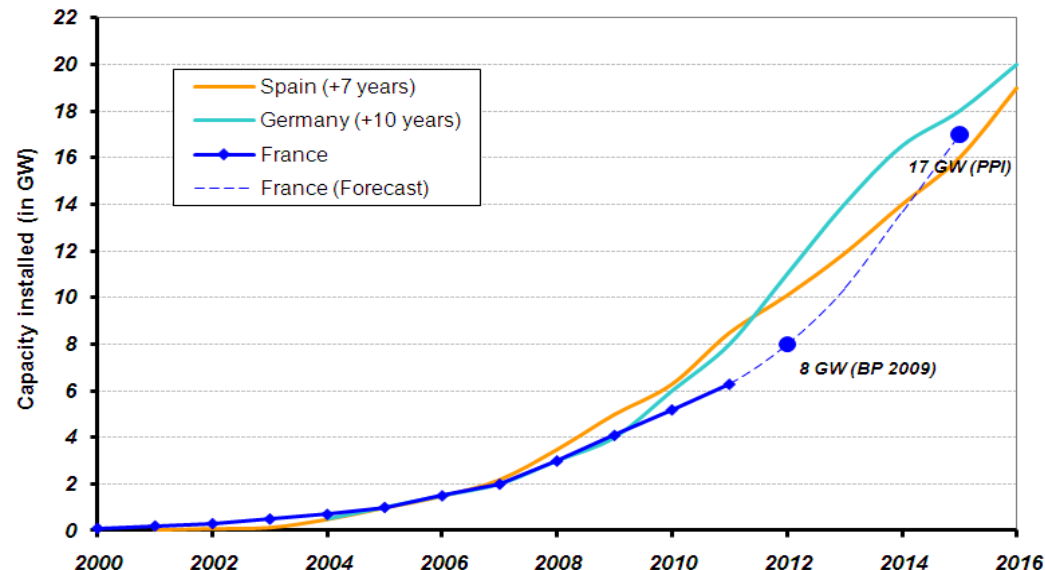
## A high rate of growth

- Total wind power capacity installed in January 2012 : about 6 670 MW
- Target expected : growth similar to neighboring countries
- Target 2020 : about 25 GW (6 offshore)
- More than 650 wind farms, mostly connected to the distribution grid

... compared to 110 GW of total capacity installed in France and the highest peak load of 102 100 MW



Growth of wind capacity installed  
Germany, Spain and France



## Location of this production:

- Variable production ...
- ... but “well” distributed, which allows “smoother” variations.

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02. **RTE's missions**

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The main missions, defined by law\*, are:

- **Managing network infrastructures**
  - ✓ RTE must, at the fairest cost to the local administration, maintain, strengthen and develop the network to meet demand, whilst striving to reduce its impact on the environment.
- **Managing electricity flows on the grid**
  - ✓ Operational responsibility to maintain load-generation balance and system security by calling for the reserves submitted by the market participants on the BM
  - ✓ Managing exchanges capacities with others European TSO
  - ✓ Congestions management (redispatch on BM, change network topology ...)
- **Contributing to the proper running of the electricity market**
  - ✓ To guarantee that all users of the electricity transmission system are treated in a non-discriminatory manner
  - ✓ To develop interconnection capacities with other TSO
- **Contributing to the integration of expanding renewable electricity generation**

\*: laws n°2000-108 and n°2004-803 .

More information on <http://www.rte-france.com/>

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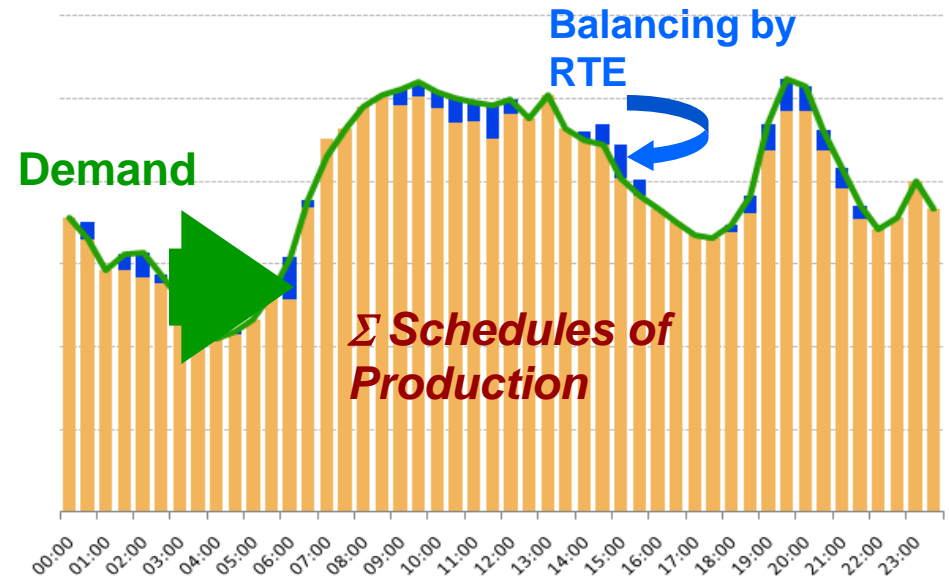
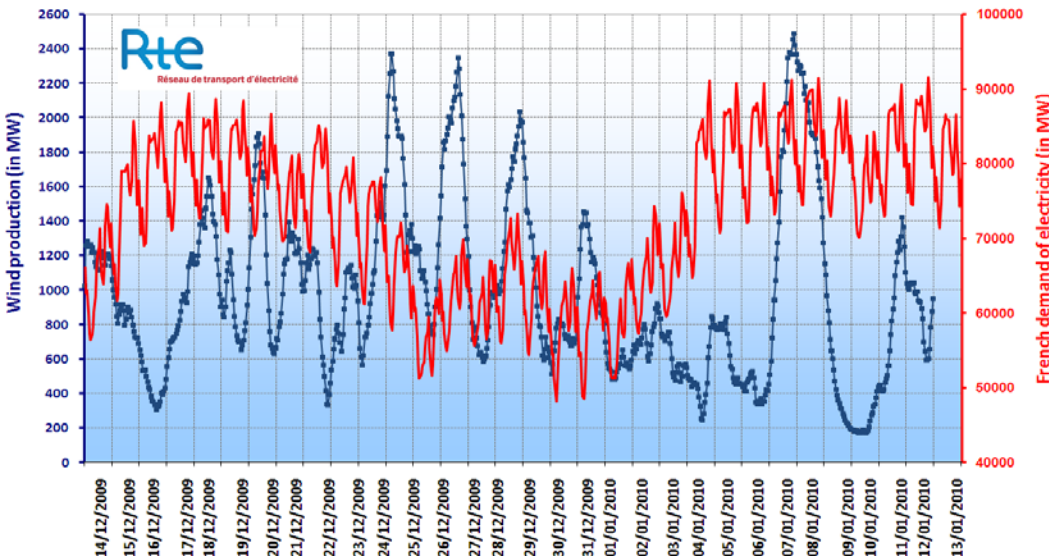
04. Developments in dealing with wind power

# Balancing production and demand (1)

A balance at any time...

- Between demand and production injected into the grid
- On behalf of users of the electricity transmission system
- Imbalances due to outages of power plants, error of forecast of consumption...

Example of wind production and french demand of electricity



... including also

- Variation of generation from renewable sources
- Forecast needed to ensure this balance in short-term



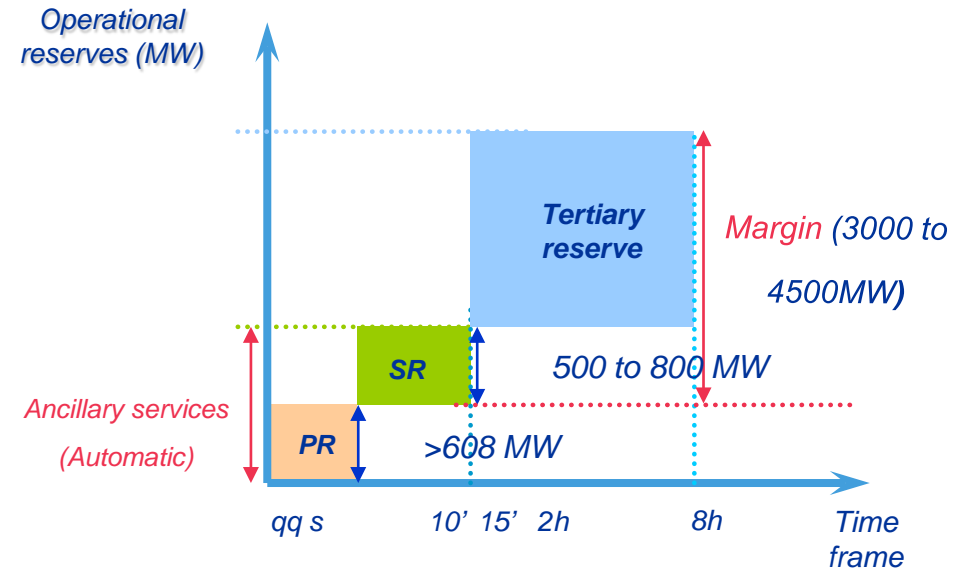
# Balancing production and demand (2)

## Reserves have to be available

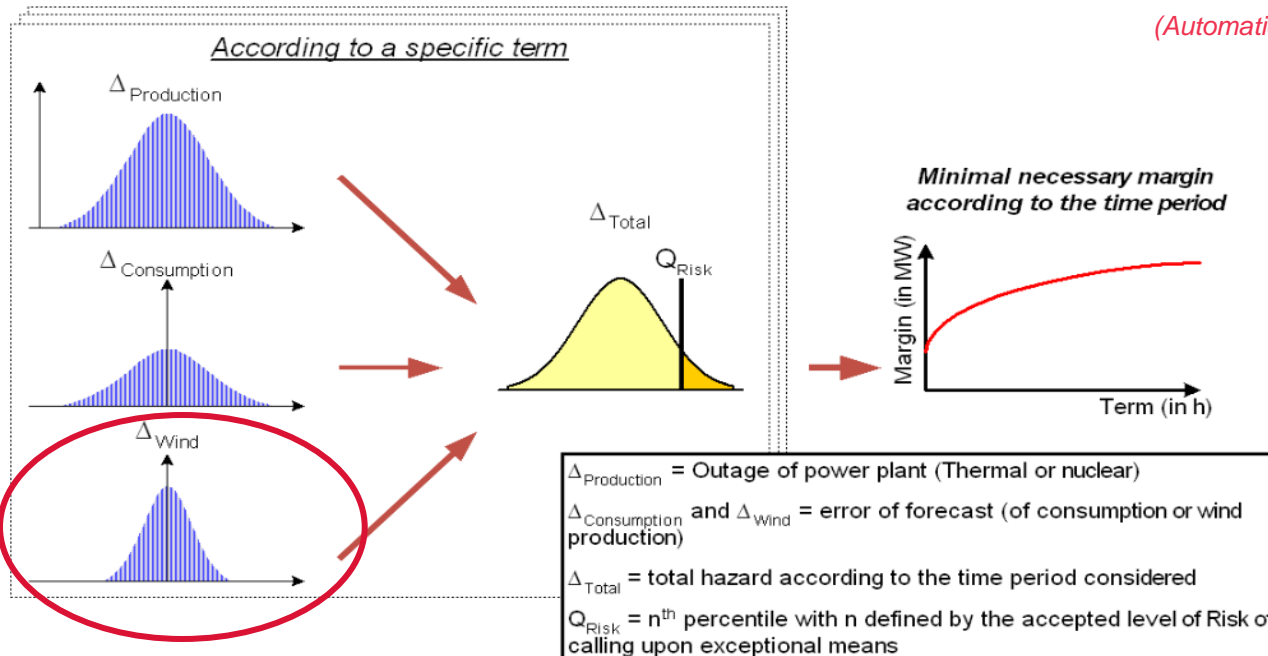
- To ensure this balance and the security of the system

## Wind generation and size of tertiary reserves

- Error of forecast of wind production taken into account in dimensioning total hazard RTE should to cope with.



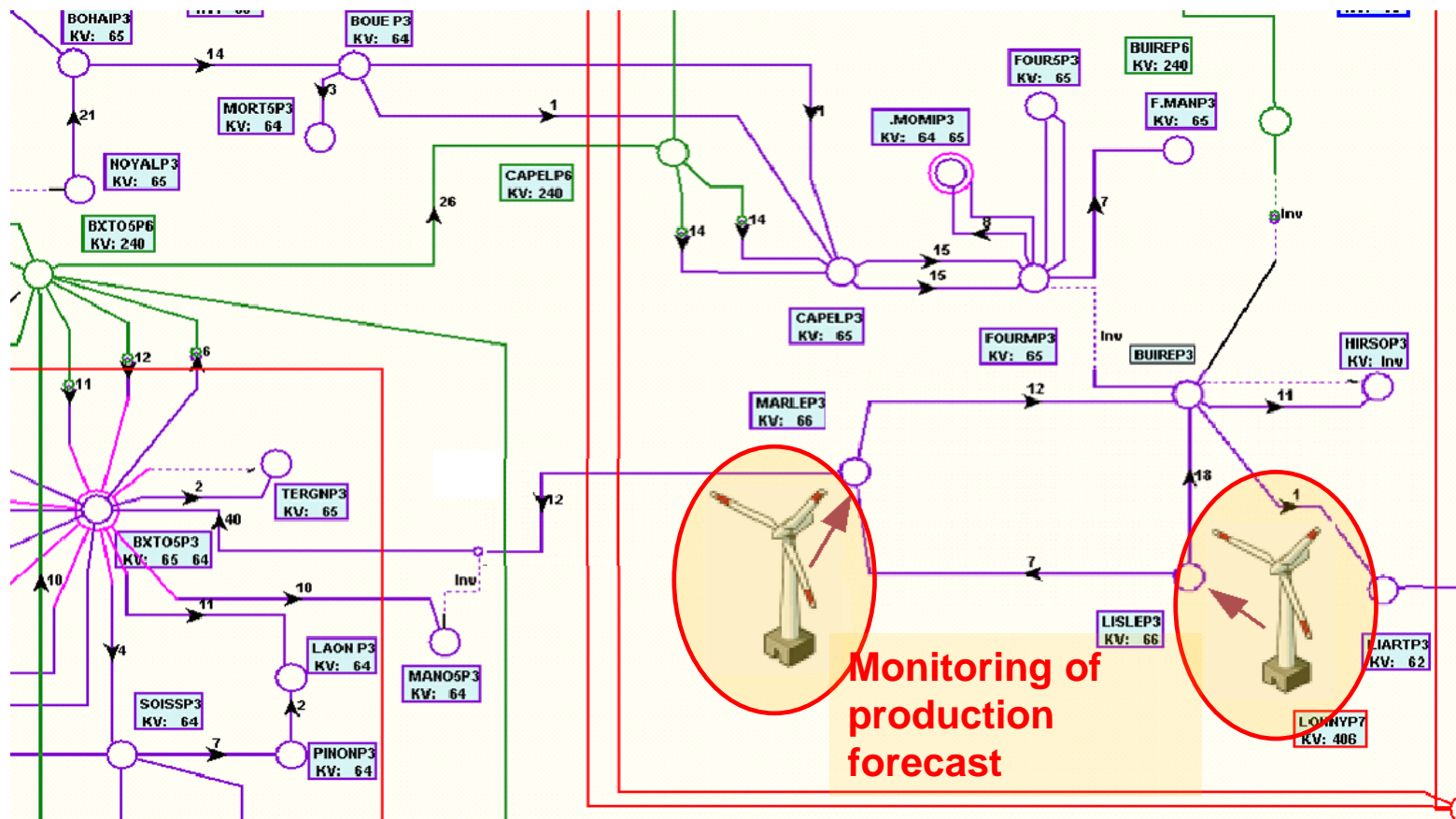
### According to a specific term



# Operating with wind generation

An example\* of network management:

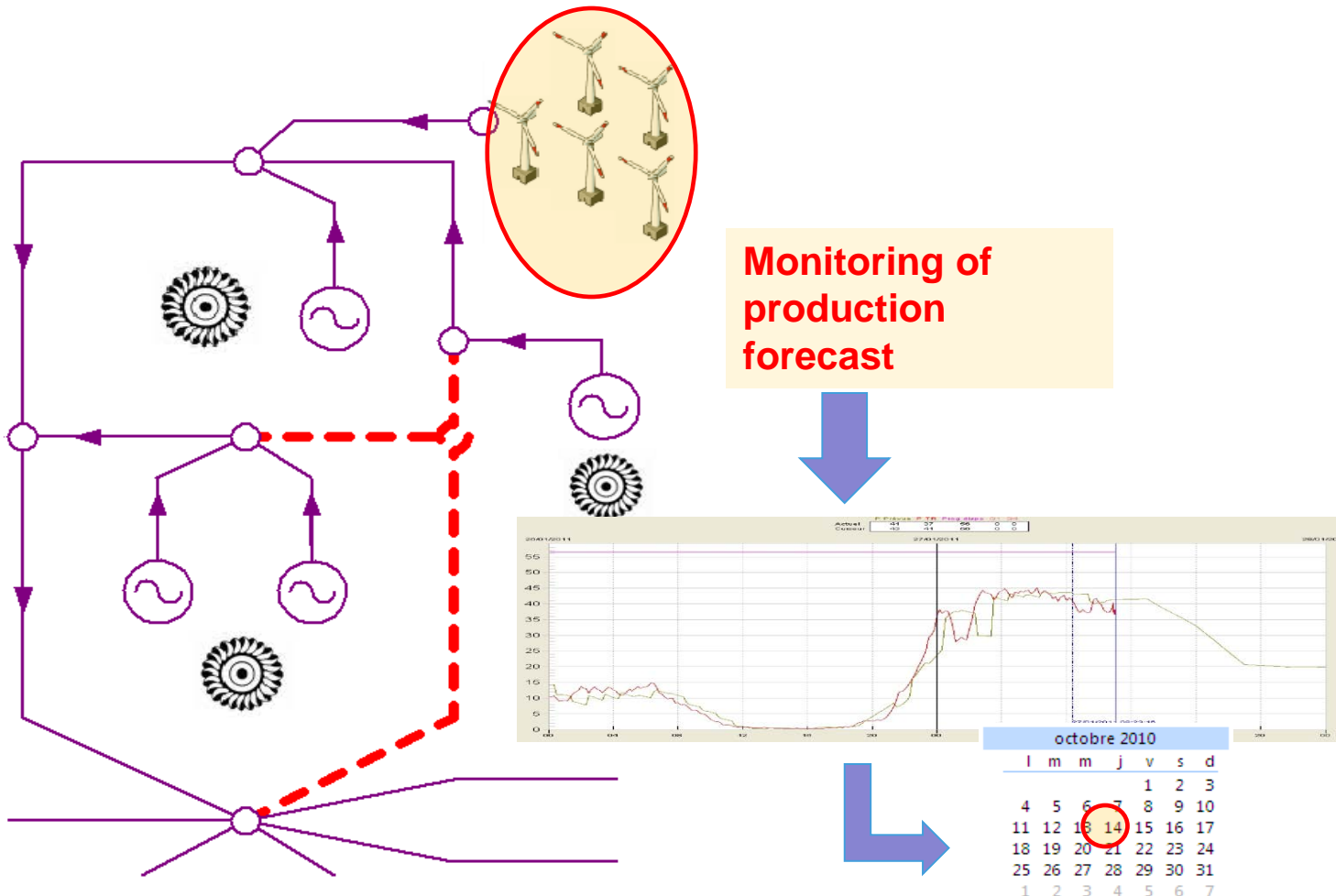
1. Illustration of grid with wind generation and low consumption
2. If constraint occurs in a power sub-station (N-1), injections from wind farms into the grid could bring flow over admissible limits (overload).
3. Forecasts of wind production are monitored (alarms configured) to anticipate overload situations.



\*: systems could also be inserted into the network to limit automatically production from wind farm in case of constraints

# Wind generation and grid maintenance

How forecasts could be used to optimize schedule of maintenance on the network (preventive maintenance on devices and facilities)...

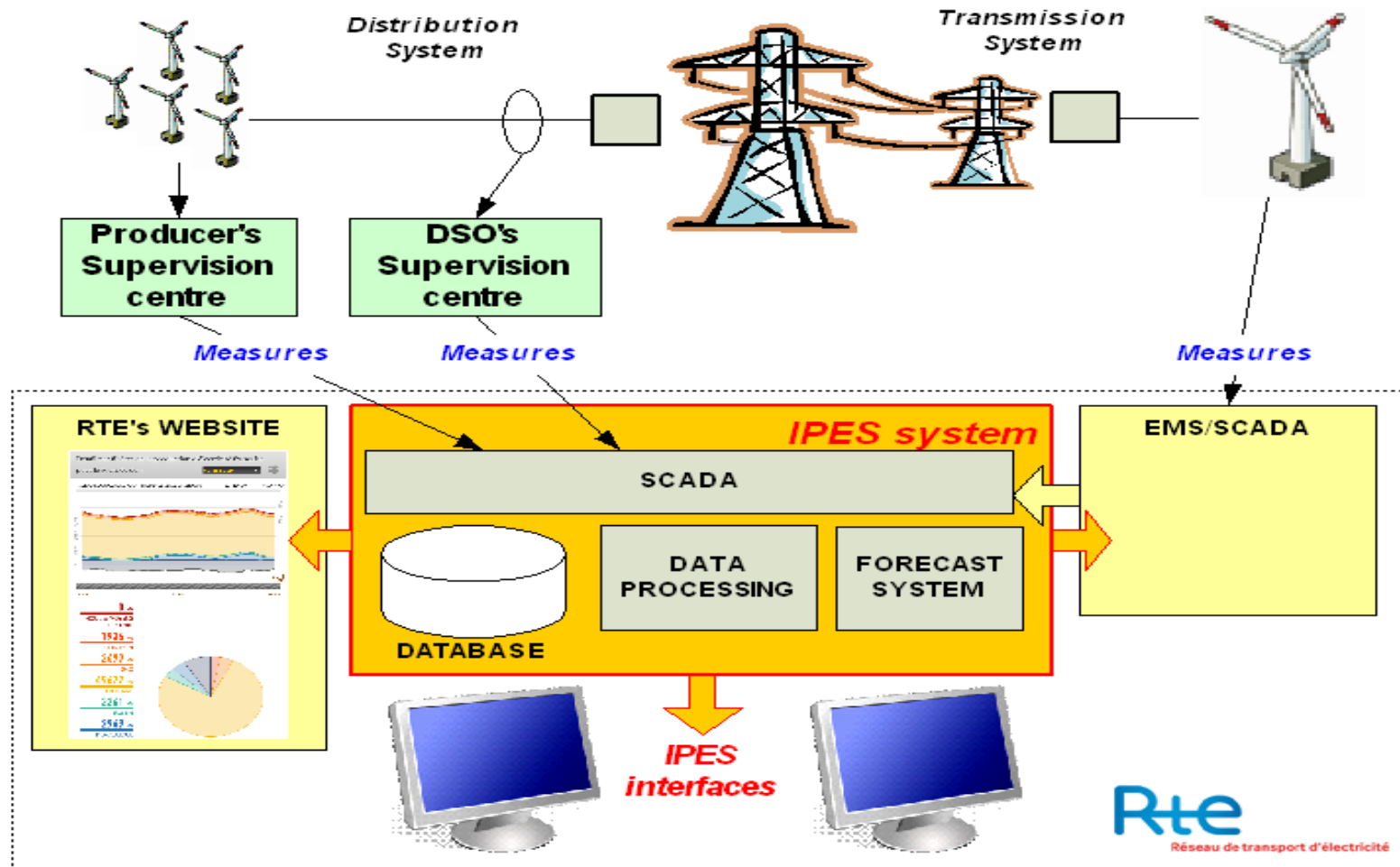


1. Part of network with mix production (hydraulic and wind)
2. Operation of preventive maintenance have to be scheduled on equipment (1 day operation)
3. Monitoring of wind forecast to optimize maintenance (available with low production from wind farms)

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# IPES: a system dedicated to wind power\*

A tool to collect data relative to wind farms and to provide information to end-users in charge of managing the grid.

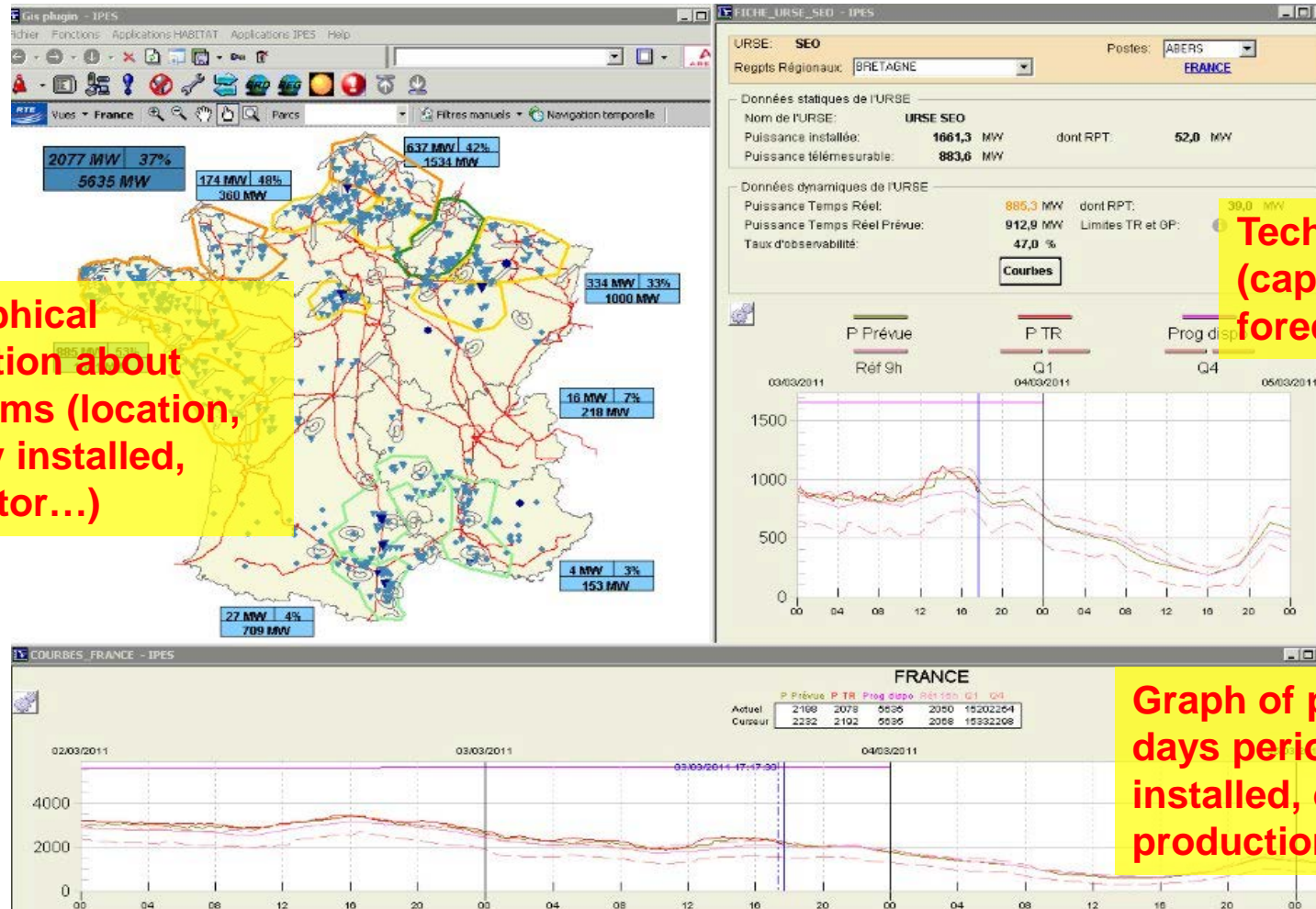


\*: PV production is also monitored by IPES



# Monitoring wind generation with IPES (1)

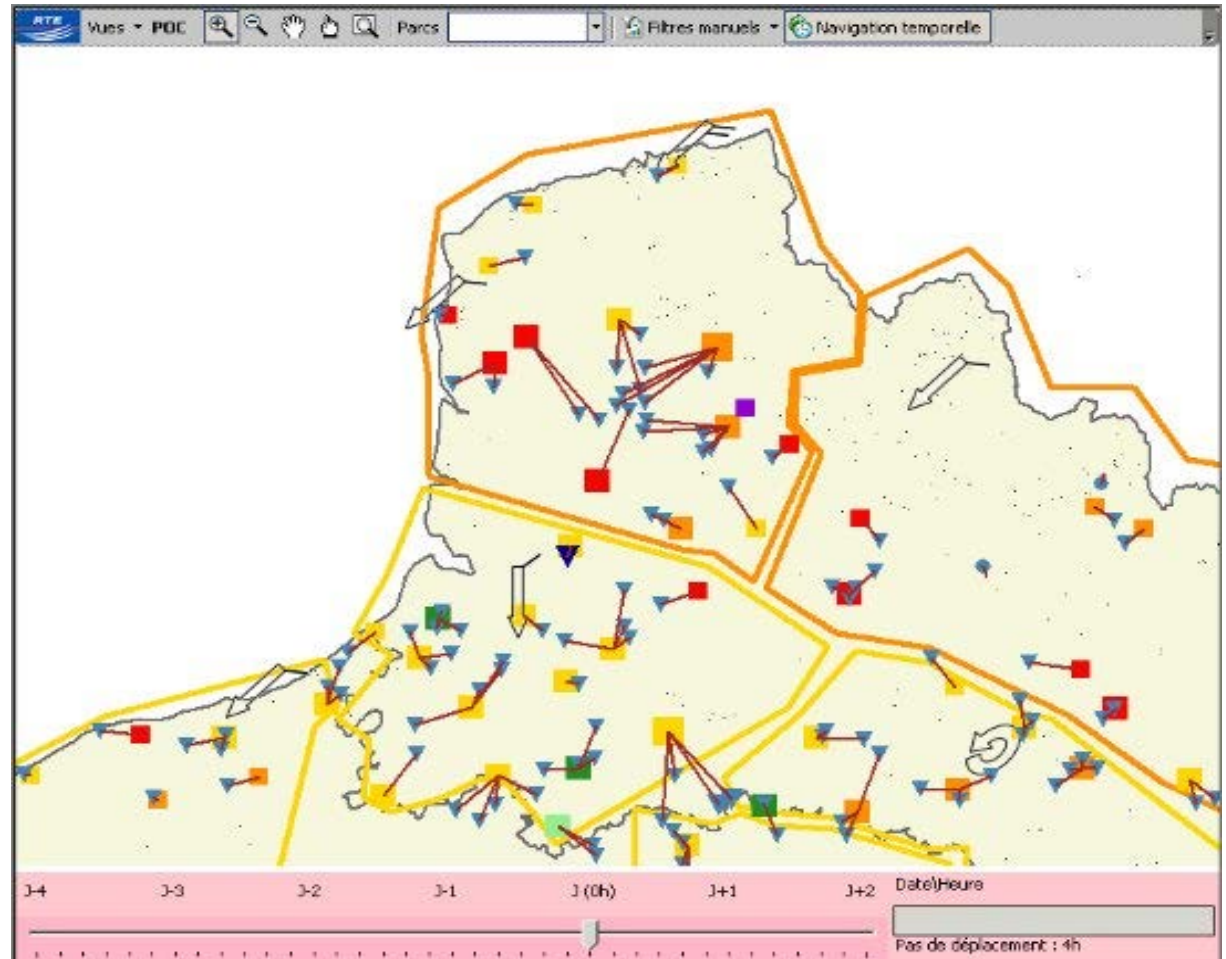
A complete interface to provide different types of data, from measures to forecasts and location of the wind production.



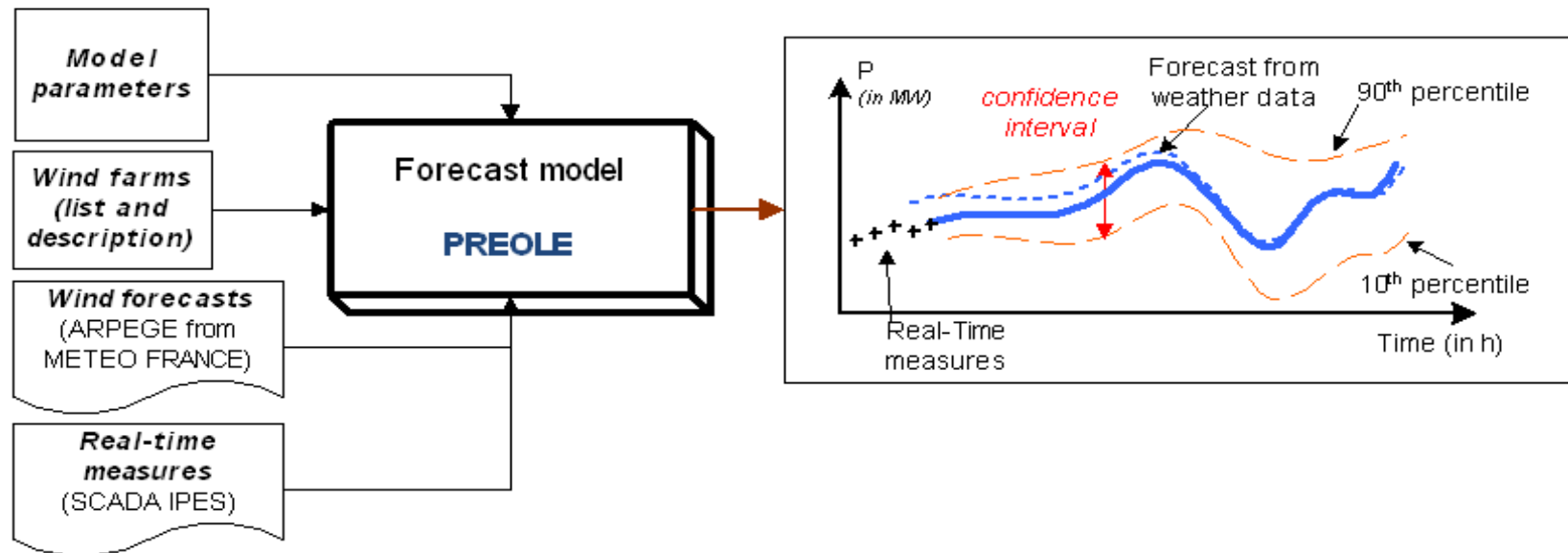
# Monitoring wind generation with IPES (2)

Different views and options according levels and needs for exploitation of the network

- Wind farms connected to power sub-stations
- Supervision of regional areas
- Set of alarms to monitor wind production according to potential constraints on the grid



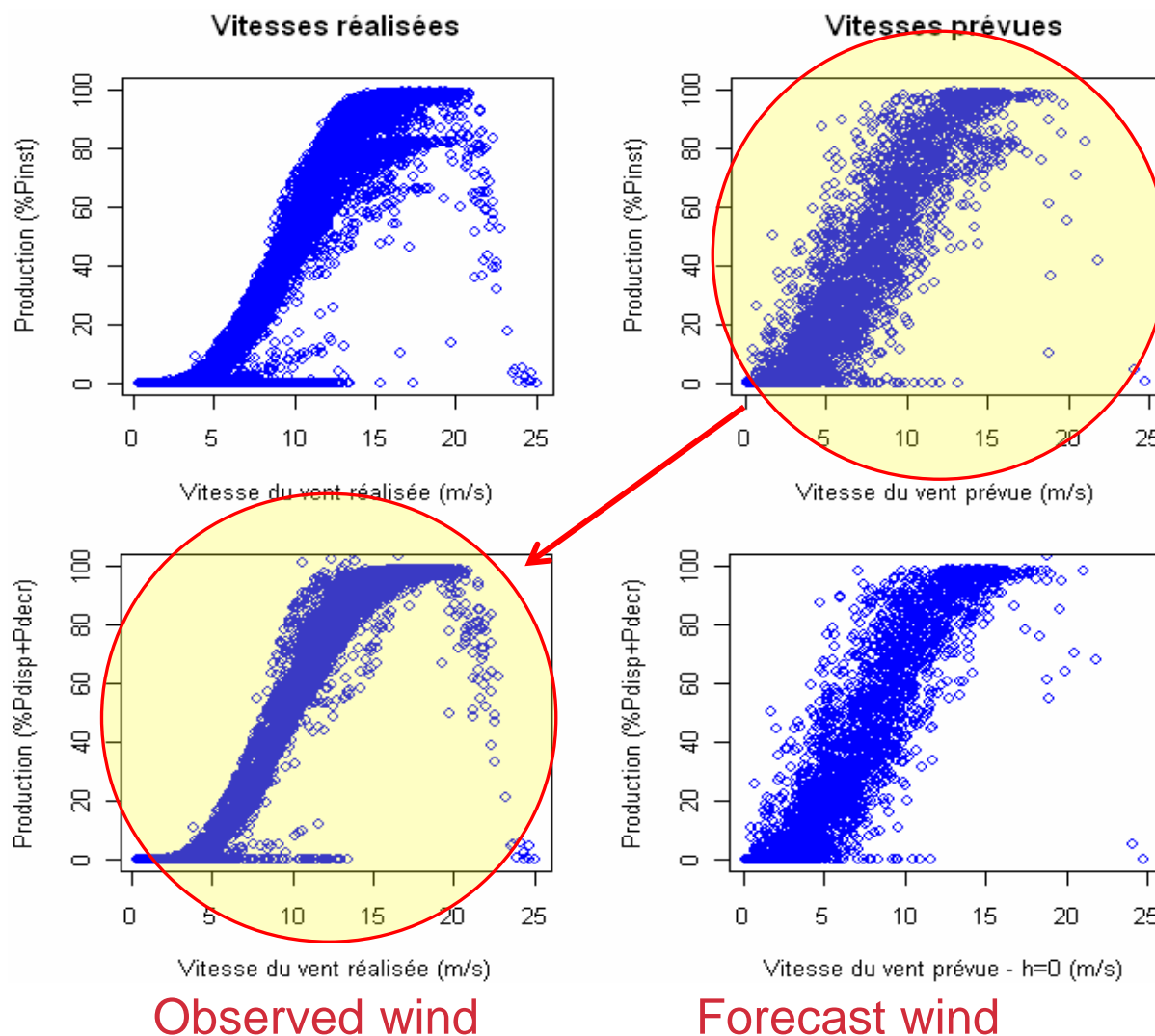
# Forecasting wind generation with PREOLE





# Link function and data

Power



Corrected  
power

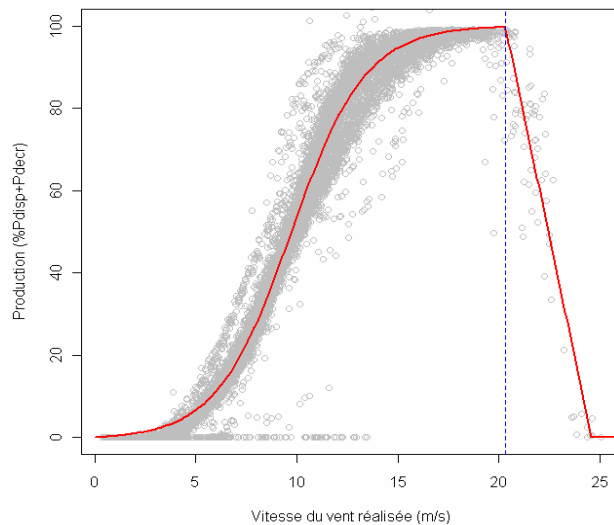
# Link function improvements

RMSE

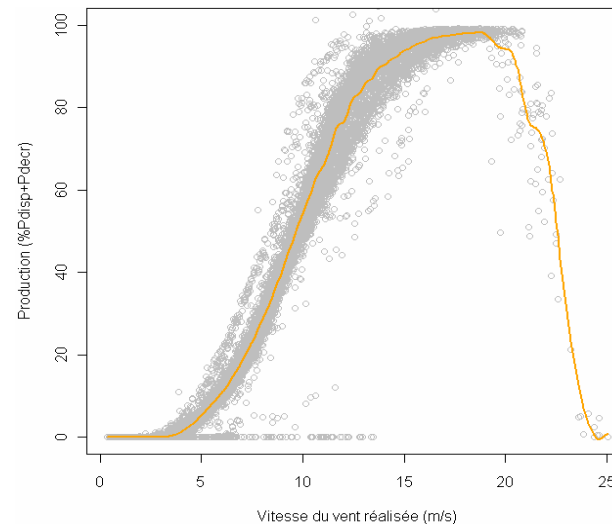
from 15-17%

to 5-6%

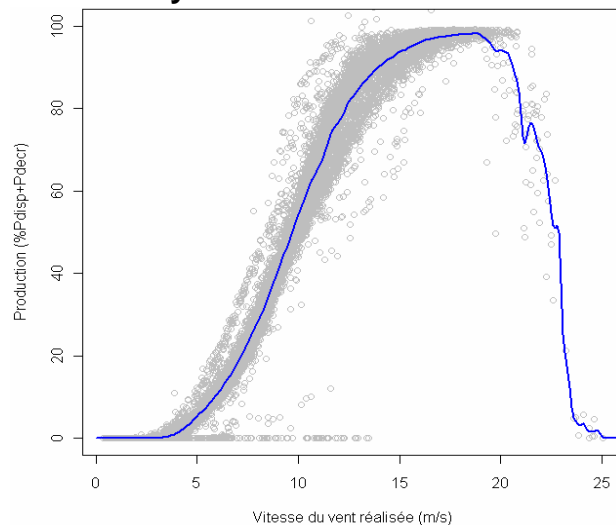
**Parametric method**



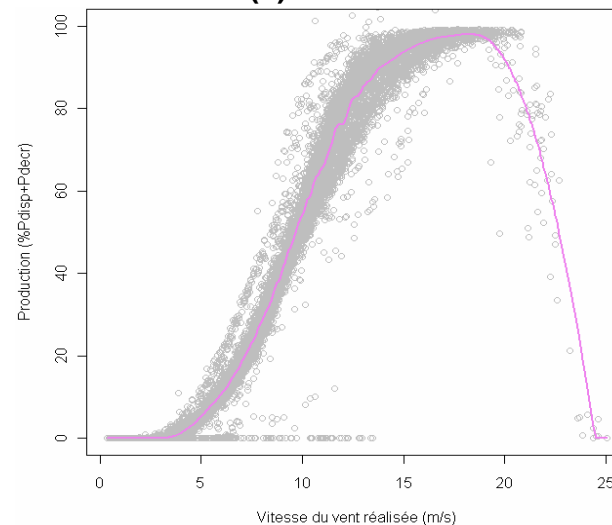
**Spline regression**



**Nadaraya-Watson method**



**LOESS (2) method**



Massive integration of wind (and renewable) production into the grid is technically and economically possible with ...

- *Dedicated tools and accurate forecasts,*
- *Coordination between Distribution and Transmission System Operators (DSO and TSO),*
- *Adapted rules for connection, more flexibility and services from wind farms*

... and coordination between European TSO to integrate these productions at a large scale.



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L'Auditorium, Palais Brongniart, Paris



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