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"WP6 – product W1"

Meeting #4 – July 3 to 5 2012

ENDORSE (Energy DOwnstReam SErvices)

Providing energy components for GMES

Introduction

Reminder of the status in mid-December and the improvements required in v2:

- Change of the surface elevation (in v1, SRTM was used, whereas the values used by Merra should better have been used. These are found in a different subset containing all the constants used by the system)
- The methodology should be validated again, as results may change significantly
- The wind regime over Belgium has to be mapped again (a few areas were missing in v1)
- A wake model needs to be implemented

Change of surface elevation

- Changing the surface elevation had a significant impact in hilly regions (Wallonia)
- Moreover, It was found out that the logarithmic fit used in v1 (to interpolate/extrapolate wind speeds from pressure levels to a constant height above ground) was not the most appropriate
- A polynomial fit proved better in many cases, because the assumption of a logarithmic profile is not always true when looking at instantaneous wind profiles (only true on average over the long-term)
- Using such a fit (of the 6^{th} order, as the number of pressure levels used is maximum 7), an interpolation at 150m gives better results than using log fit at 200m

Wind speeds recalibration

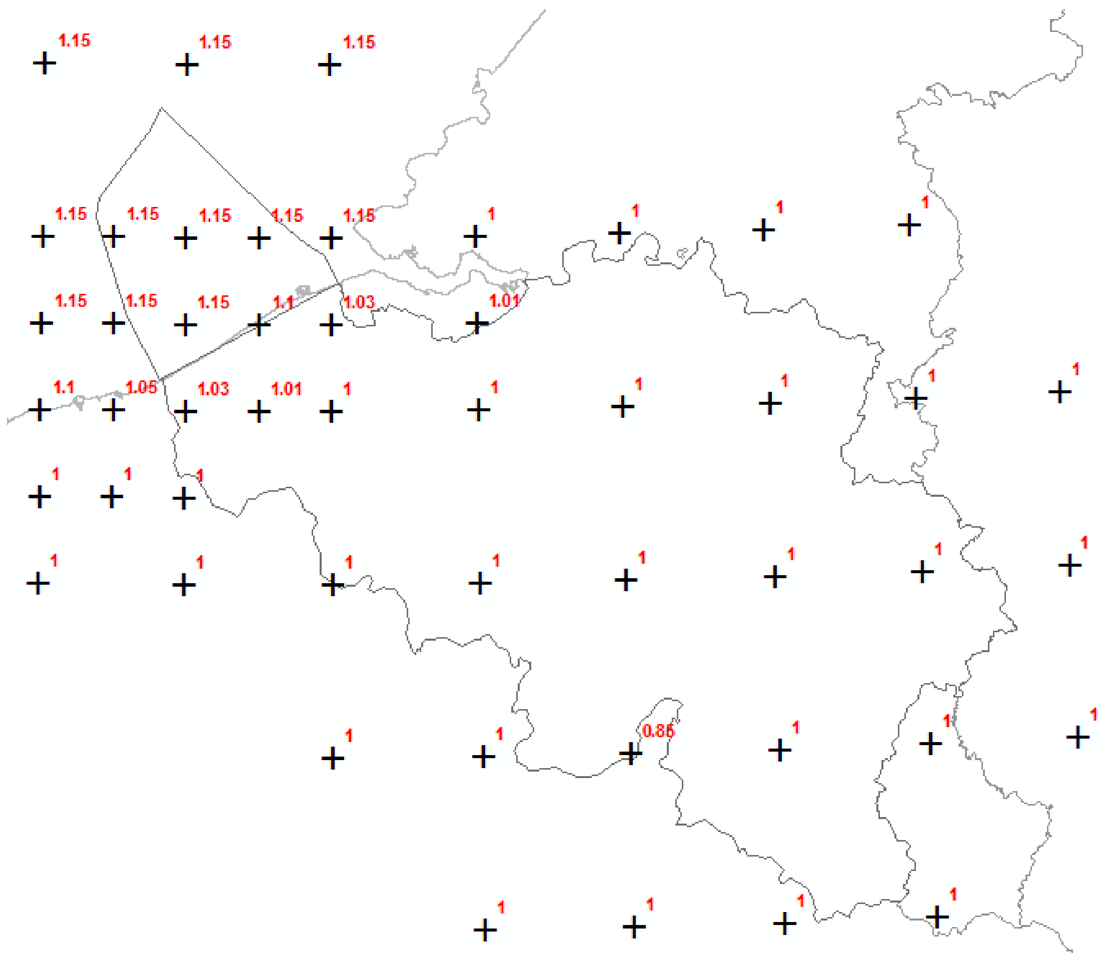
- In v1, Merra data at a number of grid point had to be calibrated
- With the new interpolation/extrapolation method, only the wind speeds offshore/at the coast, and at 1 grid point inland had to be calibrated
- The grid point inland is located in a mountaineous part of Ardennes. It was calibrated according to the wasp result obtained from the surrounding grid points (*0.85)

- The overestimation is due to the use of a finer elevation model than used by Merra (this terrain feature is not considered by Merra)

Wind speeds recalibration

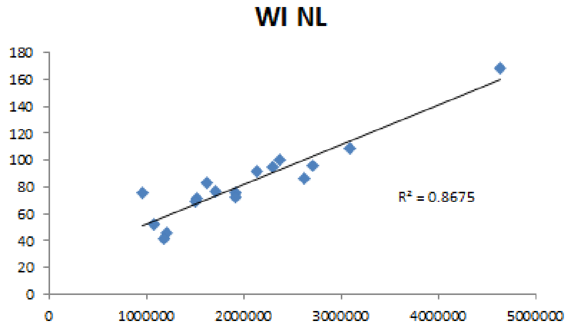
- The previous remark suggests that the methodology can only be extended abroad provided that the elevation around Merra grid points is relatively simple
- Offshore calibrations:
  - Offshore: *1.15
  - Shore: *1.10
  - Within 10km onshore: *1.05
  - Within 15km onshore: *1.03
  - Within 25km onshore: *1.01

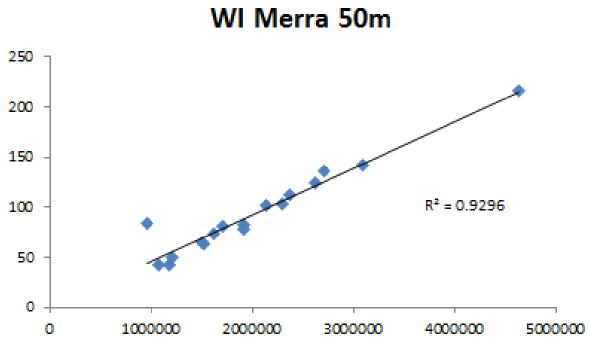
Wind speeds recalibration



Validation of v2

- In v1, 33 validation datasets were used (7 SPE wind farms + 26 other wind farms), whereas in v2, 42 validation datasets were used (7 SPE wind farms + 29 other wind farms + 5 tall met masts + 1 Lidar
- In v1, the NL wind index was used for the LT extrapolation of yields to 2001-2010. But papers published at EWEA this year suggest that the NL WI is not consistent in time, and that reanalysis data such as Merra may prove more reliable. Wind indexes were computed from Merra (50m agl.) They provide much better fits to the operational data, as illustrated below for a given wind farm located in the centre of Wallonia

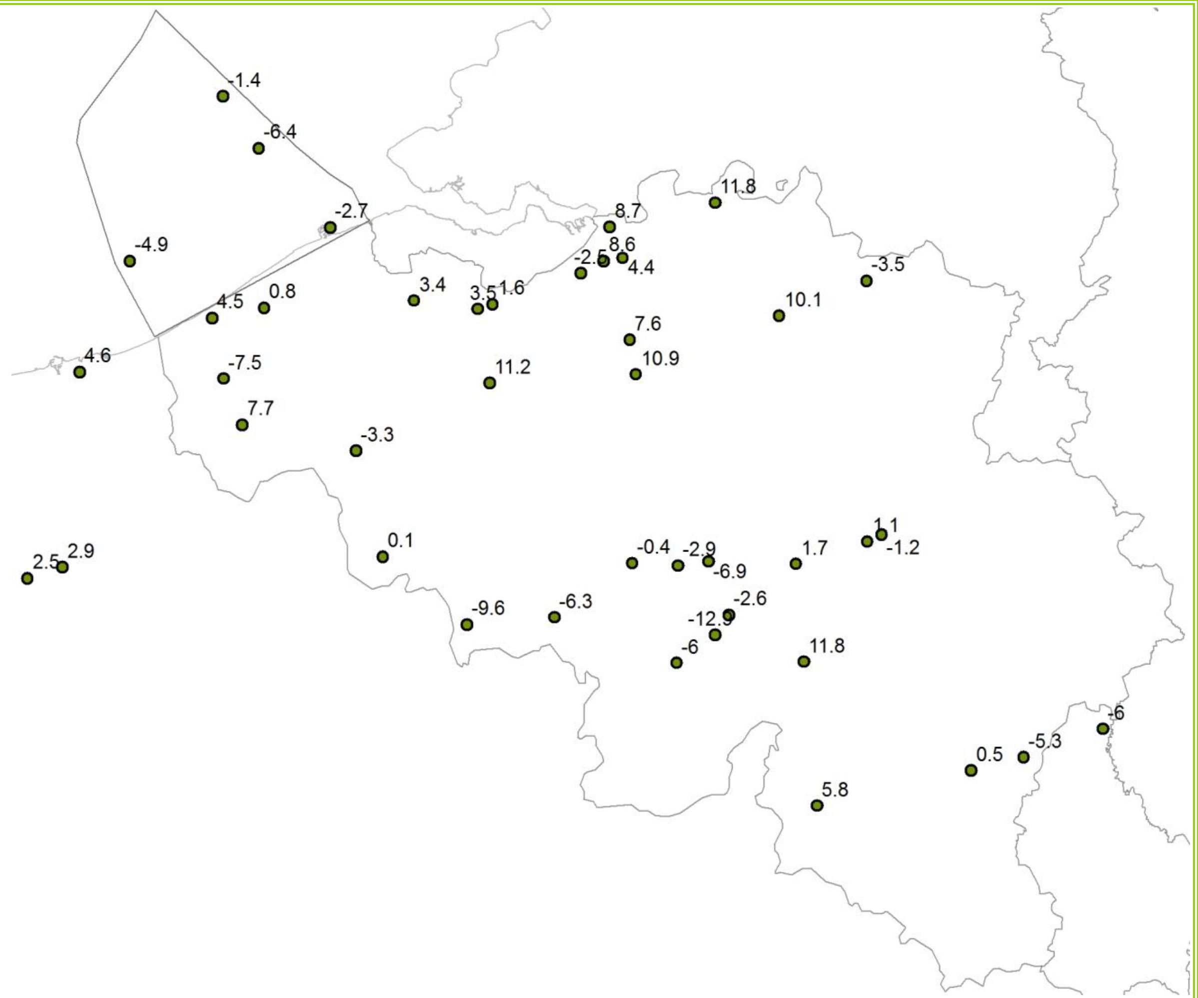




Validation of v2

The results obtained in v2 are as follows:

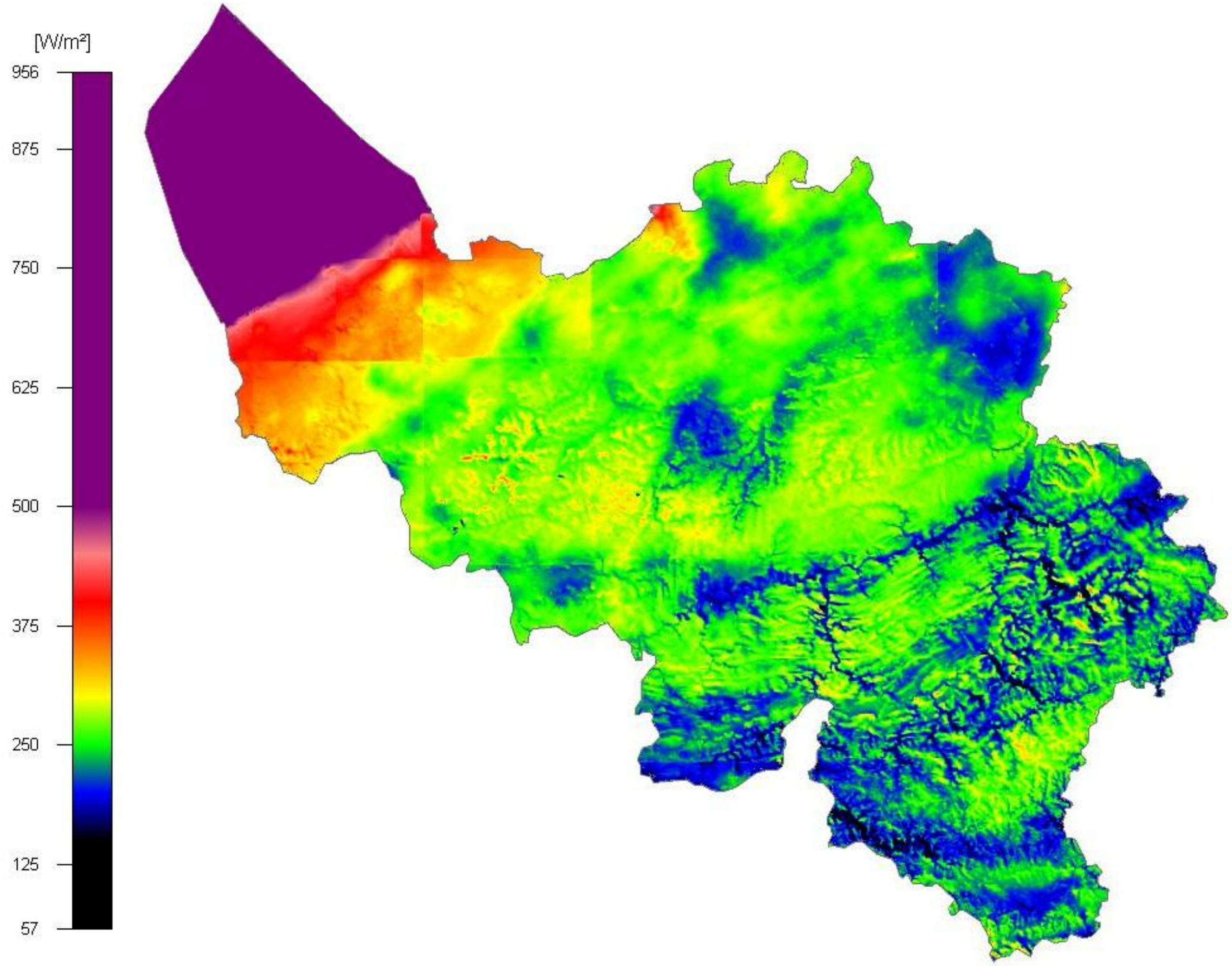
- Average error: 0.8%
- St. dev.: 6.3%



Wind regime database

A wind regime database was computed, with the same resolution as in v1:
500m (horizontal)
20m (vertical)

Here is the resulting power content map In W/m² at 100m agl.



Wake model implementation

Finally, the wake model was implemented:

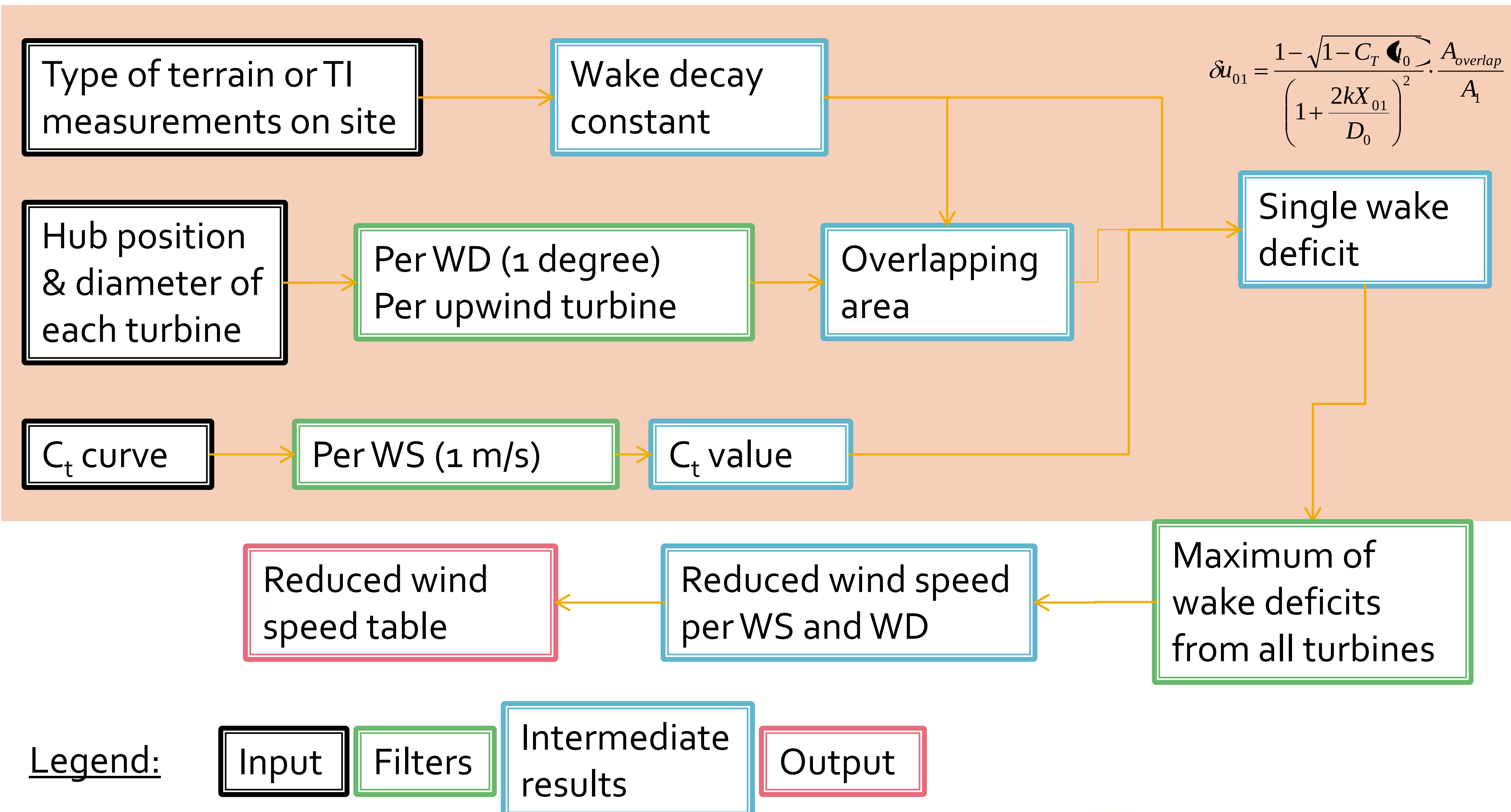
- Until now, the system built to compute yields based on a user's request was developed in Excel VBA
- However, for the final service, it was decided that it should better be translated to Python, which is currently the standard language used for software development at 3E
- It was also decided that it was more efficient to implement the wake model directly into the final service, than in the product.

Wake model implementation

Technical details on the wake model:

- Jensen wake model (which proved the best for relatively small onshore wind farms on flat terrains, as part of a research project that 3E is involved in)
- Implementation based on the OpenWind code, as well as the WindPRO documentation

Wake model implementation



Thank you

Quality Guarantee

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