Weather Forecasts
Renewable Energies
Air and Climate
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Rating of the suitability of LIDAR for measuring vertical wind speed in complex terrain (D-4.5)

Summary of the WP's main conclusions and their relevance to wind energy utilisation (D-4.6)

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1. Rating of the suitability of LIDAR in complex terrain

1.1. Introduction

Two LIDAR measurement campaigns were carried out within the SEEWIND project. In both campaigns, a ZephIR LIDAR has been used. At the time when the measurement campaigns took place, only very few units of the second commercial LIDAR instrument, the Leosphere WindCube, were available. Several efforts have been made to include a WindCube in the tests within the SEEWIND project without any success.

The ZephIR LIDAR has been shipped in three boxes. They could be transported in a Jeep-like car which made the handling and shipping fairly convenient compared to the transportation of a bulky SODAR.

The following list of strengths and weaknesses of a LIDAR for wind measurements is based only on two relatively short measurement campaigns carried out within the SEEWIND project. At Maligrad (Bosnia and Herzegovina) the LIDAR was - due to problems at custom - only three weeks operational. However, during these three weeks the instrument worked faultlessly. At Rudine (Croatia) the LIDAR was installed for four weeks. Due to a problem with data collection only three weeks of data were available for the analyses.

1.2. Strengths and weaknesses of ZephIR LIDAR for wind measurements

Complete documentations of the measurement campaigns and results are subject of deliverables D-4.1 and D-4.2. This section outlines very generally positive and negative aspects experienced during the SEEWIND LIDAR measurements:

Strengths of ZephIR LIDAR

+ relatively easy to deploy, still some fingering with cables and tubes
+ installed by one or two person(s) in half a day
+ high data availability until 150 m above ground (>90%)
+ high accuracy of absolute wind speed values (compared to SODAR)
+ no manual data filtering necessary
+ withstanding harsh climatic conditions
+ not affected by surrounding noise due to high wind speeds (surrounding noise affects SODAR measurements)
+ low power consumption and no noise

Weaknesses of ZephIR LIDAR

– uncertainty of accuracy of wind speed data in complex terrain, see remark below

- very expensive high-tech instrument
- slow data transfer (problem has been solved with the newest generation of LIDAR)
- no data for wind speeds below 4 m/s (problem has been solved with the newest generation of LIDAR)
- inaccurate vertical wind component
- affected by rain and low clouds

Remark: Since the LIDAR (and SODAR) data retrieval algorithm is based on the assumption of a homogeneous wind field - which is not true in complex terrain - the measurement results in complex terrain are afflicted with a higher value of uncertainty[1]. This is a reason for deviations between data retrieved by cup anemometers and LIDAR measurements. Lately, correction tools for remote sensing instruments have been developed using Computational Fluid Dynamics (CFD) models to account for inhomogeneous flow field in complex terrain.

1.3. Summary

The LIDAR technology proofed to be a promising tool for the wind industry. The instrument used within the SEEWIND campaign is one of the first generation commercial wind LIDAR. Some of the teething troubles encountered during the measurements at Maligrad and Rudine have been solved meanwhile. However, the research base on LIDAR instruments for wind measurements is still very limited. More validation studies and improvements of certain aspects (vertical wind component, turbulence, correction for inhomogeneous flow field in complex terrain) are needed.

[1] Bradley S., 2008; Wind speed errors for LIDARs and SODARs in complex terrain.