

Big data approach of wind resource and operational data analysis in cold climate

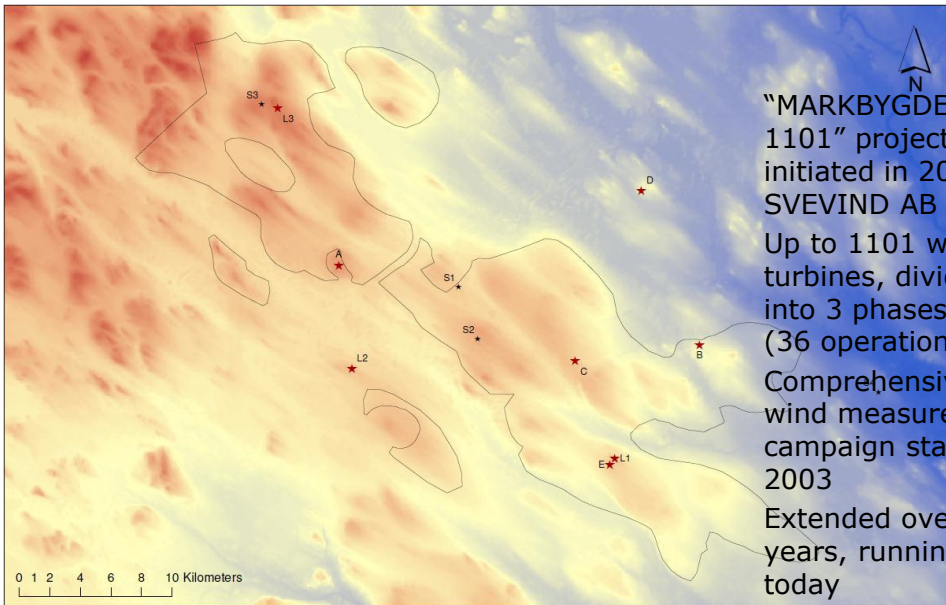
Martin Strack
Deutsche WindGuard
Consulting GmbH
Dr. Réne Pforte
Svevind AB

Contents

- Introduction of the project
- Measurement campaign
- Challenges of Measurement in Cold Climate
- Explanation of Big Data Approach

Introduction of the Project

DEUTSCHE
WINDGUARD



“MARKBYGDEN
1101” project,
initiated in 2002 by
SVEVIND AB
Up to 1101 wind
turbines, divided
into 3 phases
(36 operational)
Comprehensive
wind measurement
campaign started in
2003
Extended over the
years, running until
today

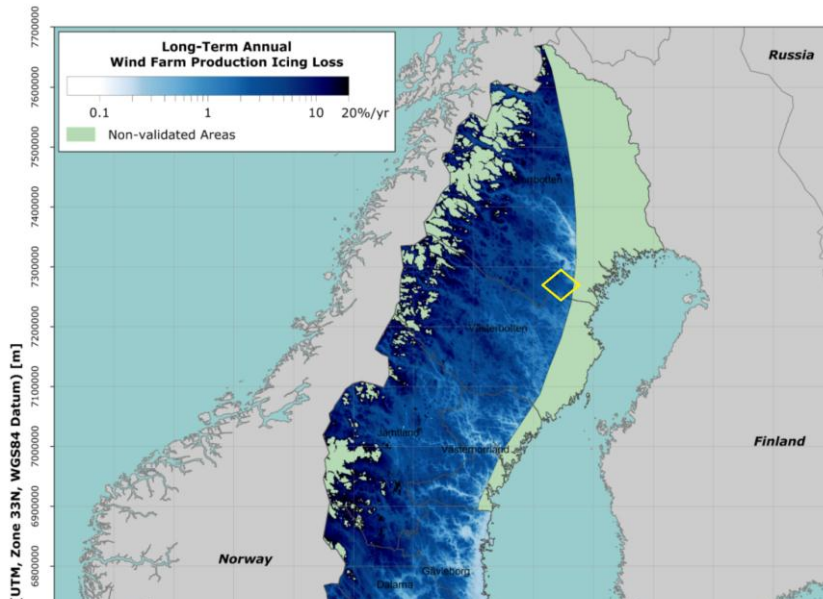
Measurement Campaign

DEUTSCHE
WINDGUARD

- Tallest mast: 152 m, remote sites
- Sensors: wind speed, wind direction, ice loads, temperature, humidity, air pressure
- Several types of heated and unheated cup anemometer as well as heated ultrasonic sensors
- Regularly replaced, recalibrated and maintained
- Important aspect: how to maintain the accuracy and quality of the data



Project Location and Icing Exposure



Source:
Carla Ribeiro,
Till Beckford –
Icing Losses, what can we
learn from
production and
meteorological
data.
WindEurope
Summit,
Hamburg,
2016

Icing at the Site



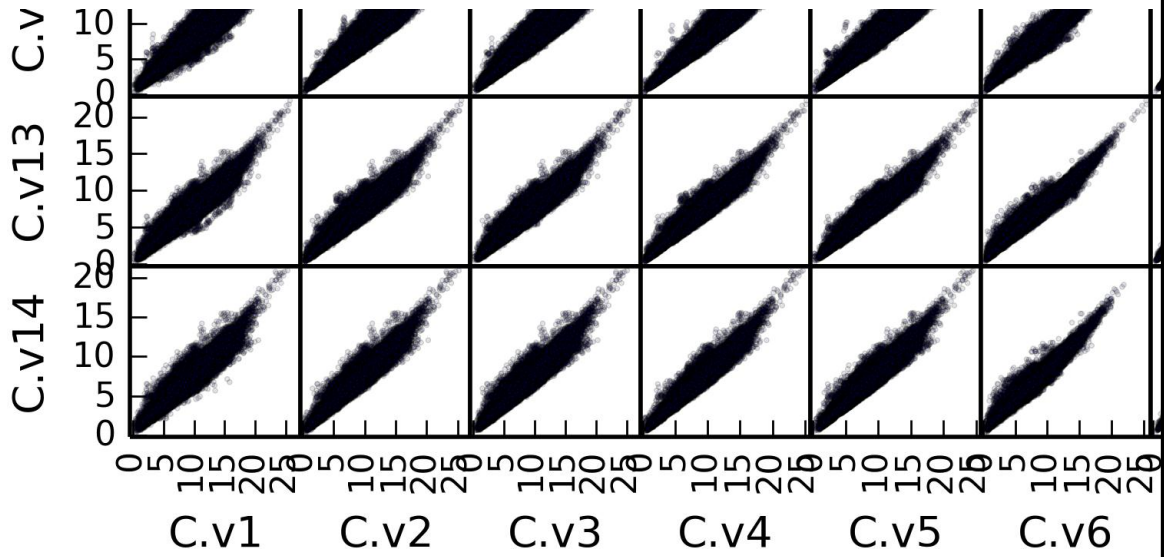
Challenges of Measurement in Cold Climate

- Icing issues in measurement
 - Detection, filtering
 - Filling (MCP methodology)
 - Avoid bias by seasonal effects
- Maintain high accuracy in spite of required MCP filling
- Define strategy, priority of data sources, methodology
- Relevant also for other applications
 - Evaluation of tall mast / remote sensing data
 - Wind farm operational data evaluation

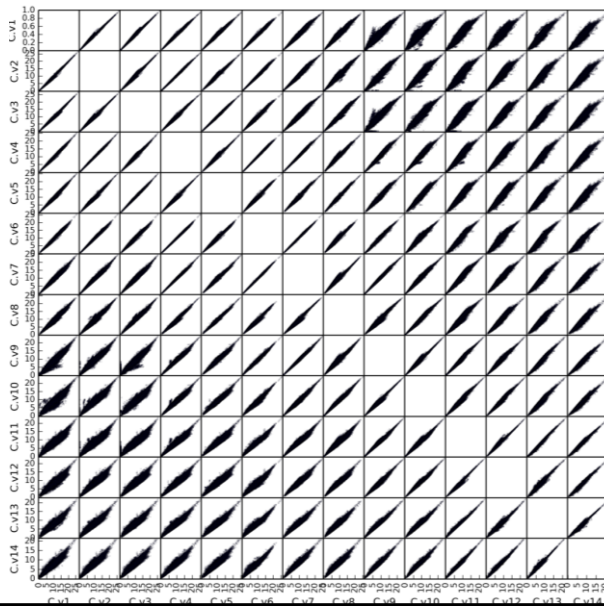
Big Data Evaluation Approach

- **Big data** is a term for data sets that are so large or complex that traditional data processing applications are inadequate. [Wikipedia]
- Here: comprehensive data evaluation procedure
 - evaluating all data sources available
 - doing automized processing and weighting
 - realizing optimum data properties (e.g. correlation) instead of exhausting manual and sequential processing
- Utilize conventional, physical approaches

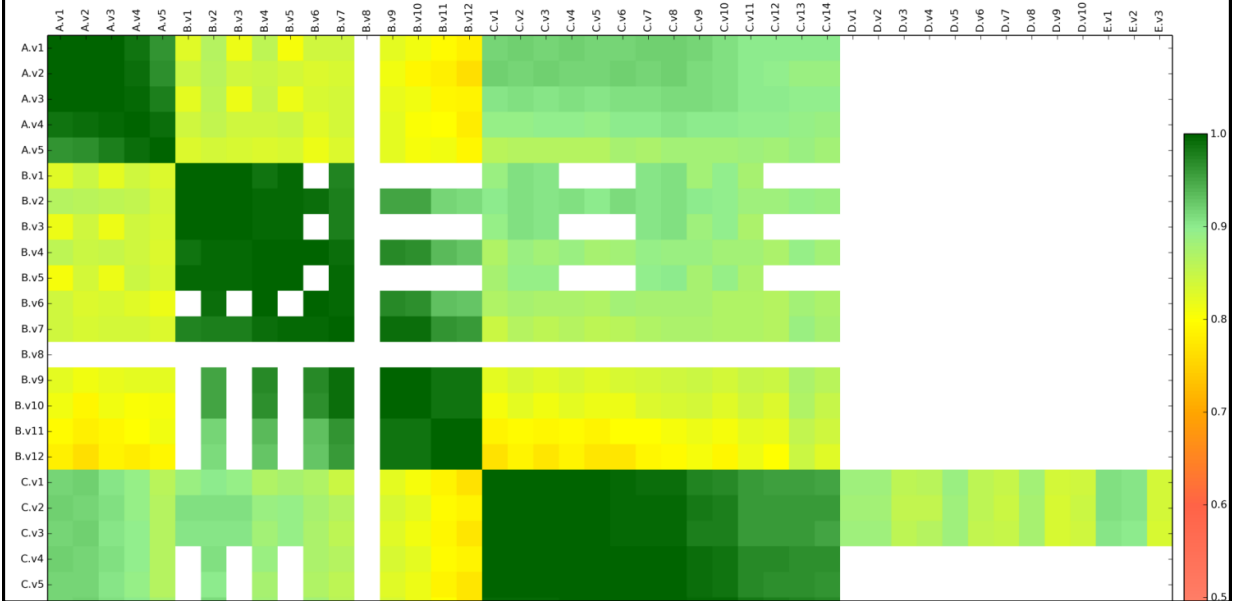
Wind Data Filtering



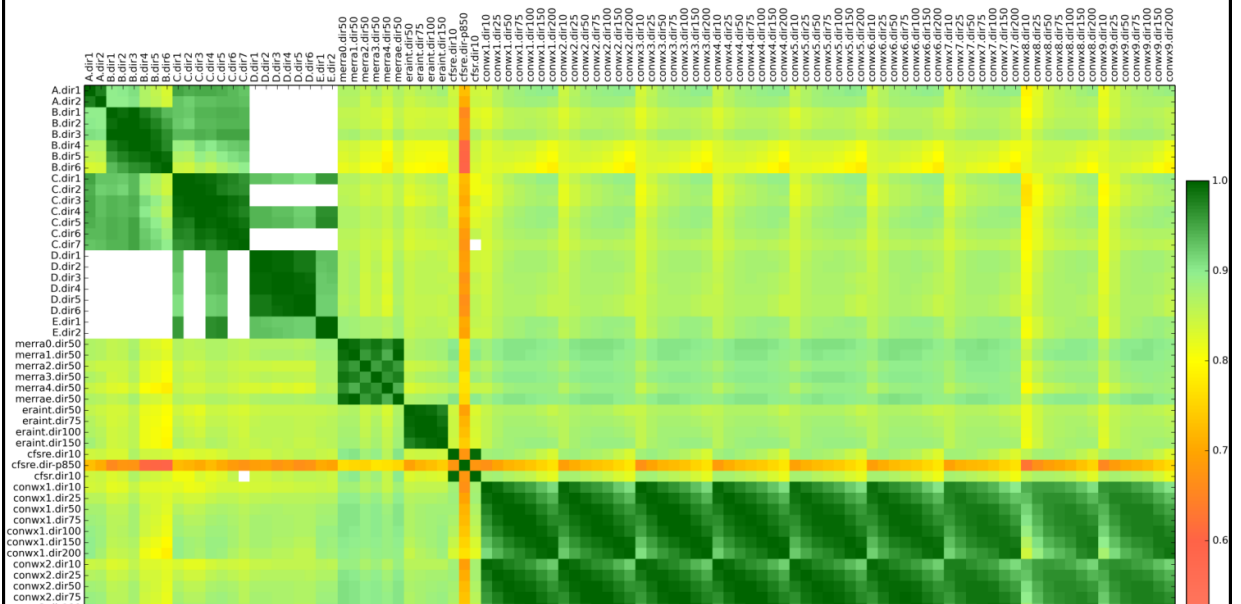
Wind Data Filtering



Wind Speed Correlation Matrix

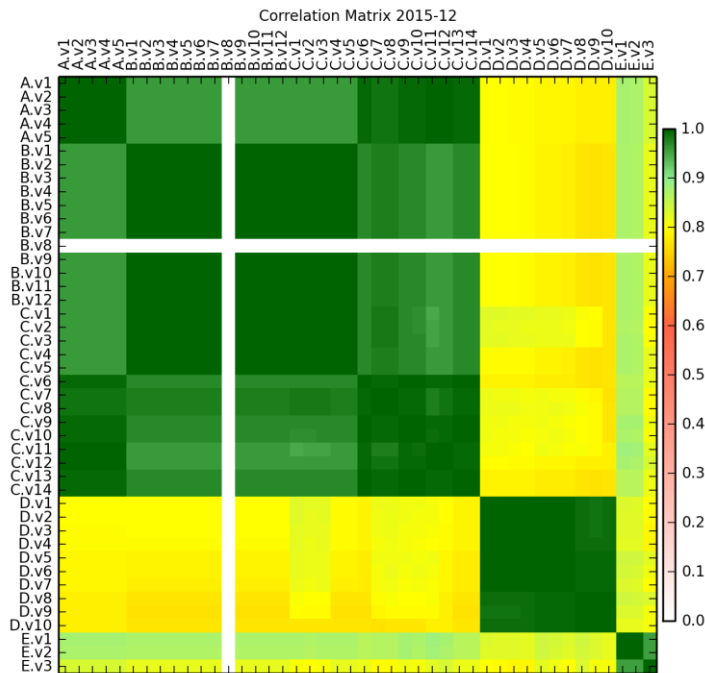


Wind Direction Correlation Matrix



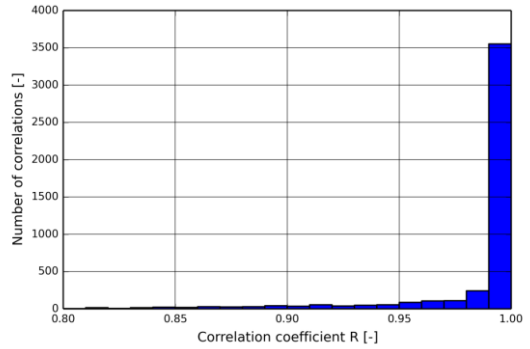
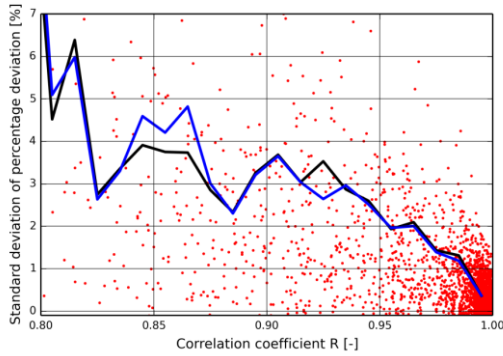
Big Data Filling (MCP) Approach

- Selecting data source with maximum correlation
 - for each wind direction sector
- Applying on moving window
 - in order to avoid seasonal bias



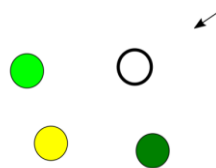
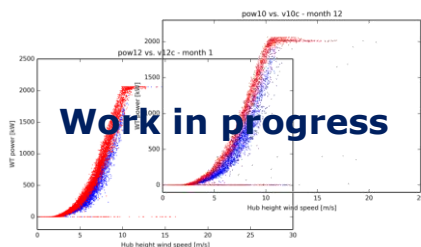
Application and Validation of Correlation

- Divide learning period and predict the other half
- Evaluate deviation dependent on correlation coefficient

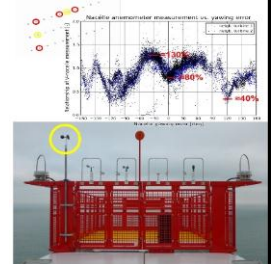


Big Data Evaluation for Operation Data

- Operational data assessment: work in progress
- Sectoral and seasonal correlation highly relevant
- Critical assessment and filtering of nacelle data required



Poster 329



Summary

- Measurement campaign in cold climate: challenging requirements on data evaluation
- Big data approach for data filtering and filling developed
- Improved correlation accuracy and uncertainty assessment
- Suitable procedure for all tall measurements where seasonal variation of wind profile needs to be addressed
- Helpful for operational data assessment

Thank you for your attention.

Feel free to contact for questions and comments:

Martin Strack, +49 4451 9515-190
m.strack@windguard.de