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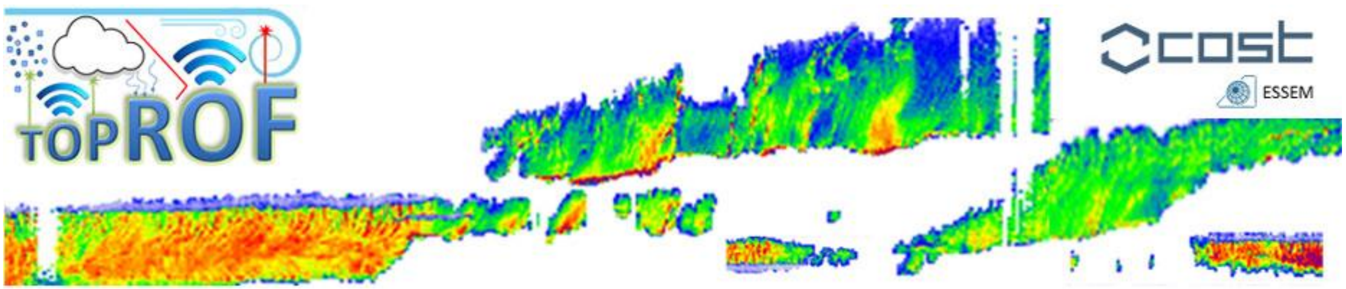
WG2 Doppler lidar



Report

Damyan Barantiev, Alain Dabas, Sven-Erik Gryning, Christoforos Halios, Anne Hirsikko, Stephan Kral, Volker Lehmann, Ronny Leinweber, Antti Manninen, Tobias Marke, Ewan O'Connor, Nína Petersen, Jana Preissler, Eileen Päschke, Juan Luís Rascado, Lucie Rottner, Umar Saeed, Jan Schween, Irene Suomi, Ludovic Thobois, Minttu Tuononen, Ville Vakkari, Sybille von Loewis, Curtis Wood, Shu Yang.

Updates since Varna

- **Instrument characterization**
  - Methods for improving data quality and sensitivity

- **Instrument retrievals**
  - Wind
  - Wind gusts
  - Turbulence
  - BL classification

Updates since Varna

- **Obtaining turbulent retrievals from Leosphere instrument**
  - Standard retrieval from vertical stare
  - VAD retrieval from scans at multiple elevations

  - Shu Yang – presentation tomorrow

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Wind gusts – paper published

Suomi, I., Gryning, S.-E., O'Connor, E. J. and Vihma, T. (2017), Methodology for obtaining wind gusts using Doppler lidar. Q.J.R. Meteorol. Soc., 143: 2061–2072. doi:10.1002/qj.3059

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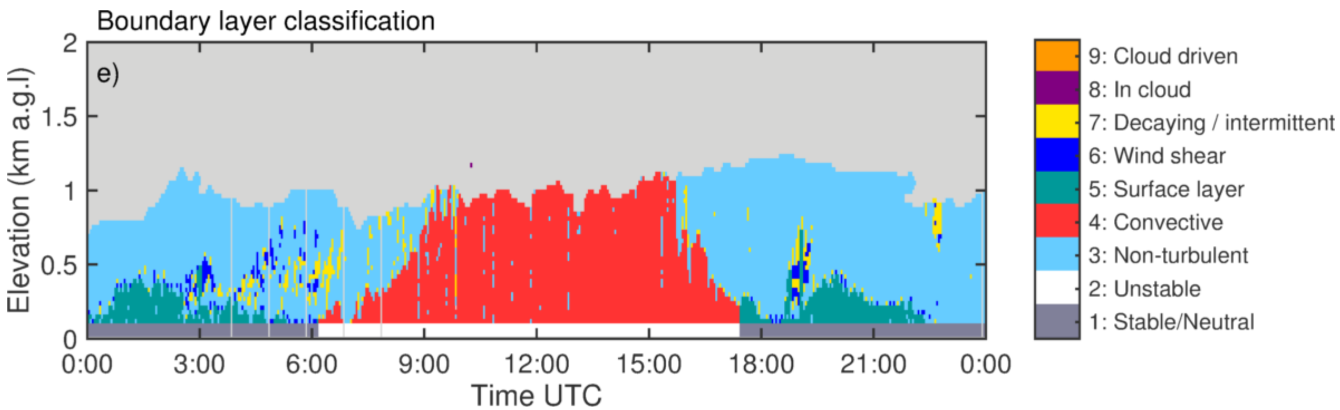
LLJs – paper in press

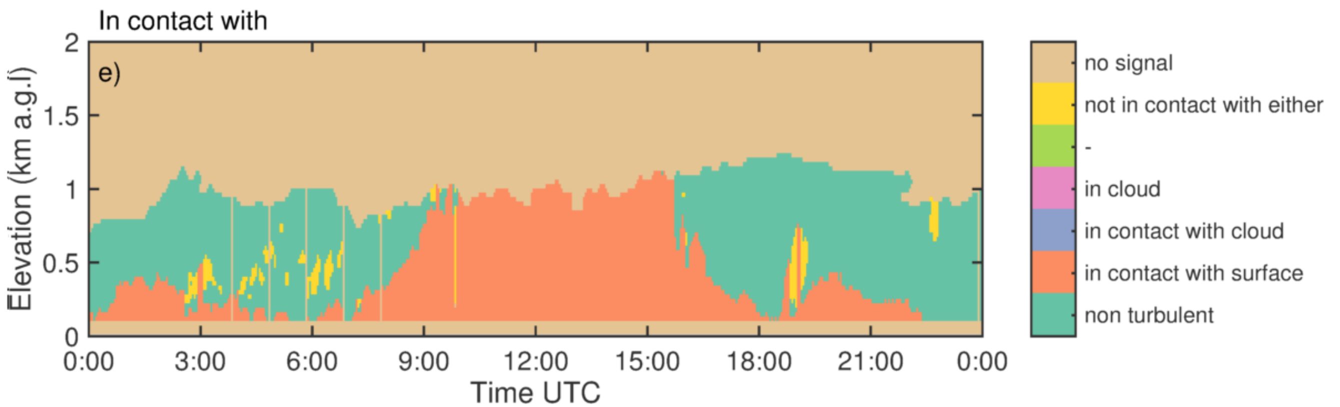
Suomi, I., Gryning, S.-E., O'Connor, E. J. and Vihma, T. (2017), Methodology for obtaining wind gusts using Doppler lidar. Q.J.R. Meteorol. Soc., 143: 2061–2072. doi:10.1002/qj.3059

Boundary layer classification – more updates

Fields: Turbulent source, and in-contact-with

Includes: LLJ





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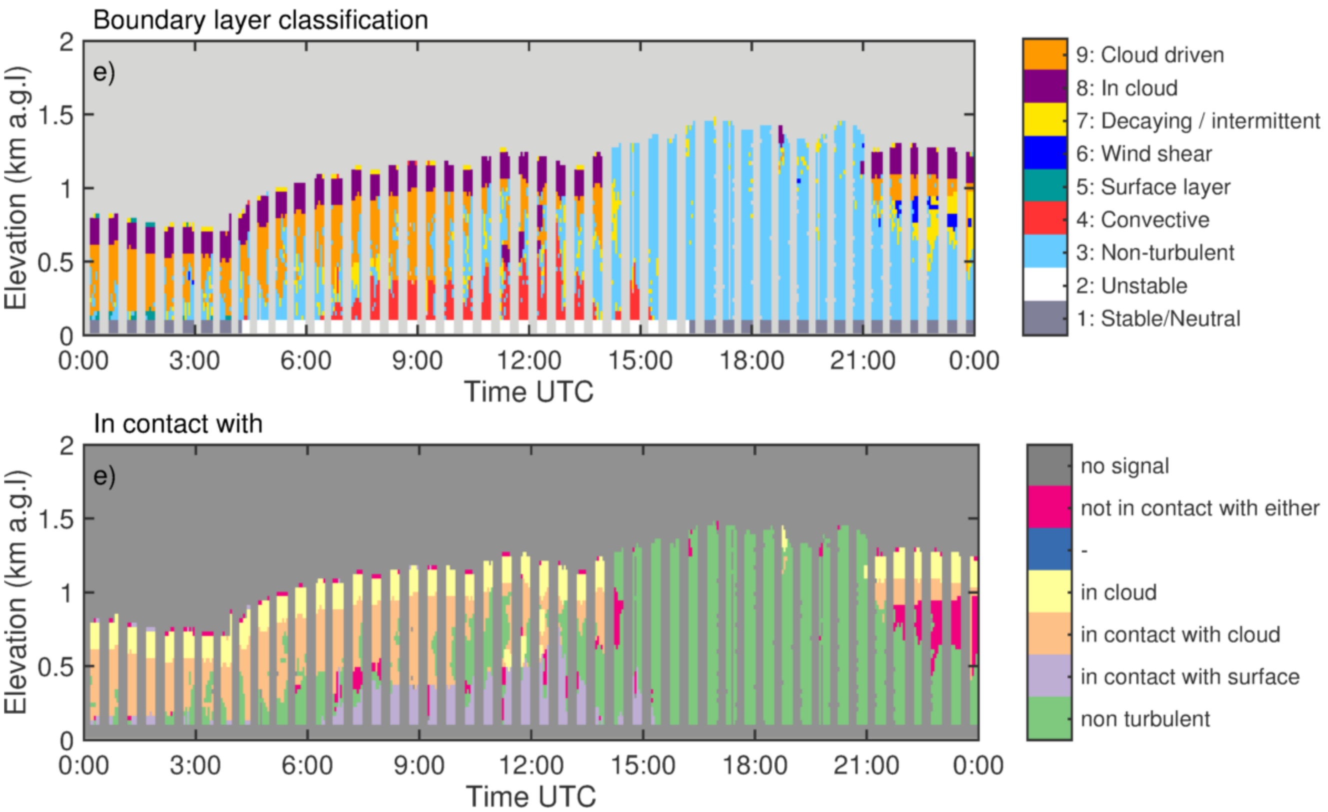


SWG and 3 STSMs

- **SWG for winds, turbulence, …**

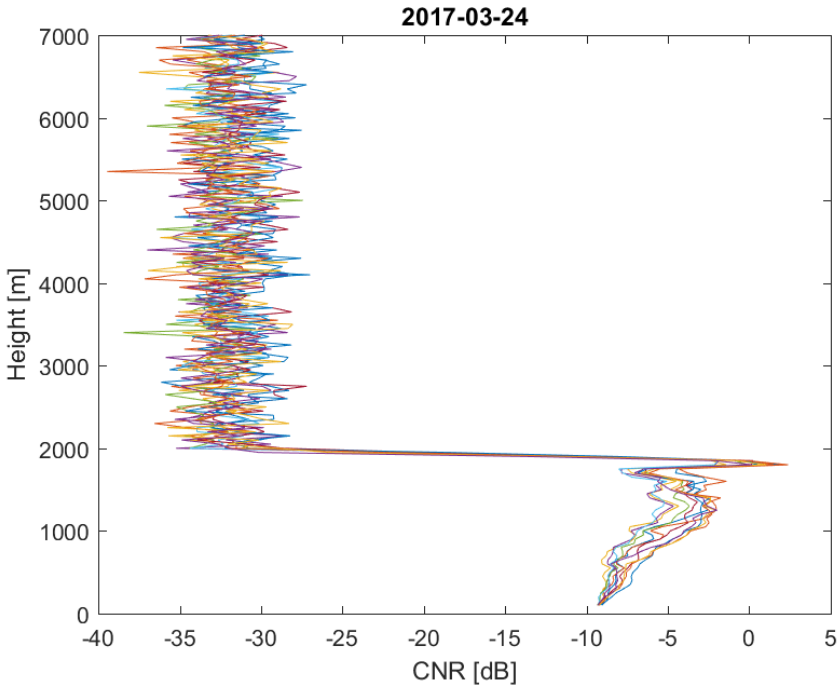
- **STSM – Shu Yang, to FMI**
  - Leosphere characterization
- **STSM – Umar Saeed, to FMI**
  - Combining DWL + MWR
- **STSM – Ekaterina Batchvarova, to DTU**
  - DWL forecast verification

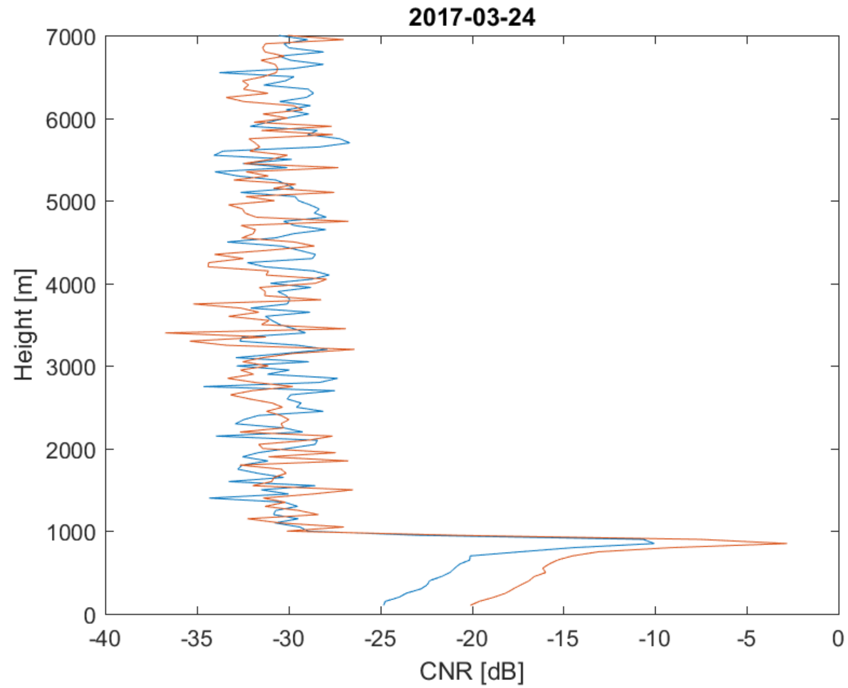
SWG on winds, turbulence

- **Recommendations for winds**
  - Retrieval methods
  - Scan selection
  - Paper plans
    - SOPs for siting, operation, pre-processing, network
    - Wind retrieval – VAD vs DBS
    - Contribution to BAMS ‘TOPROF’ paper

Leosphere background correction - STSM

- **Instrument usually stable, but occasional jumps**

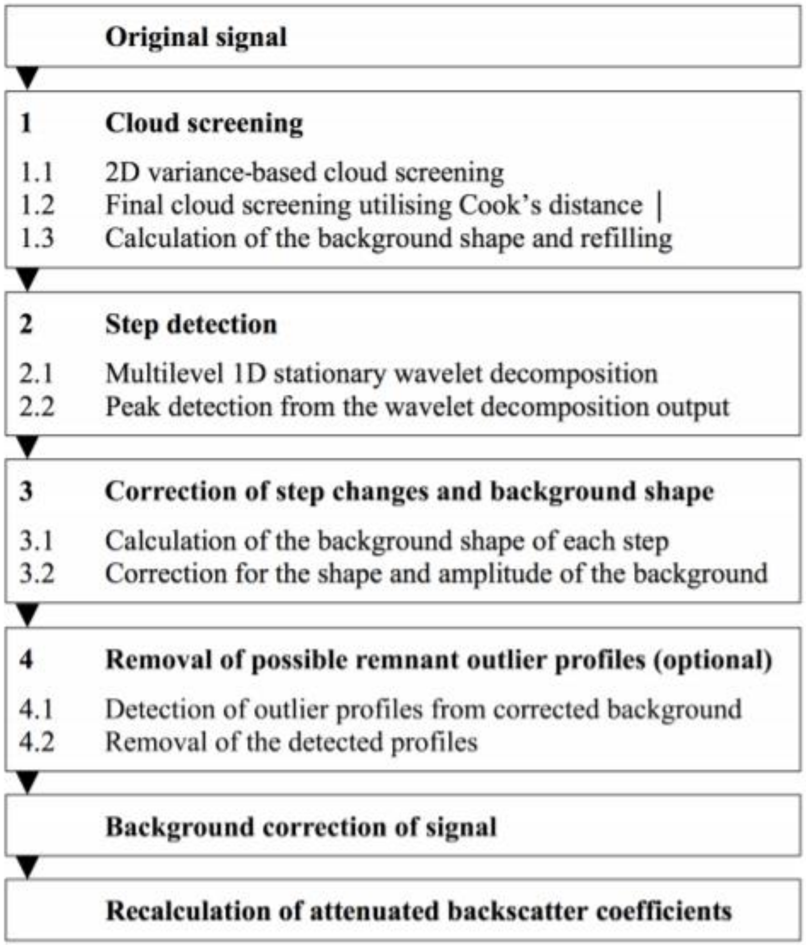




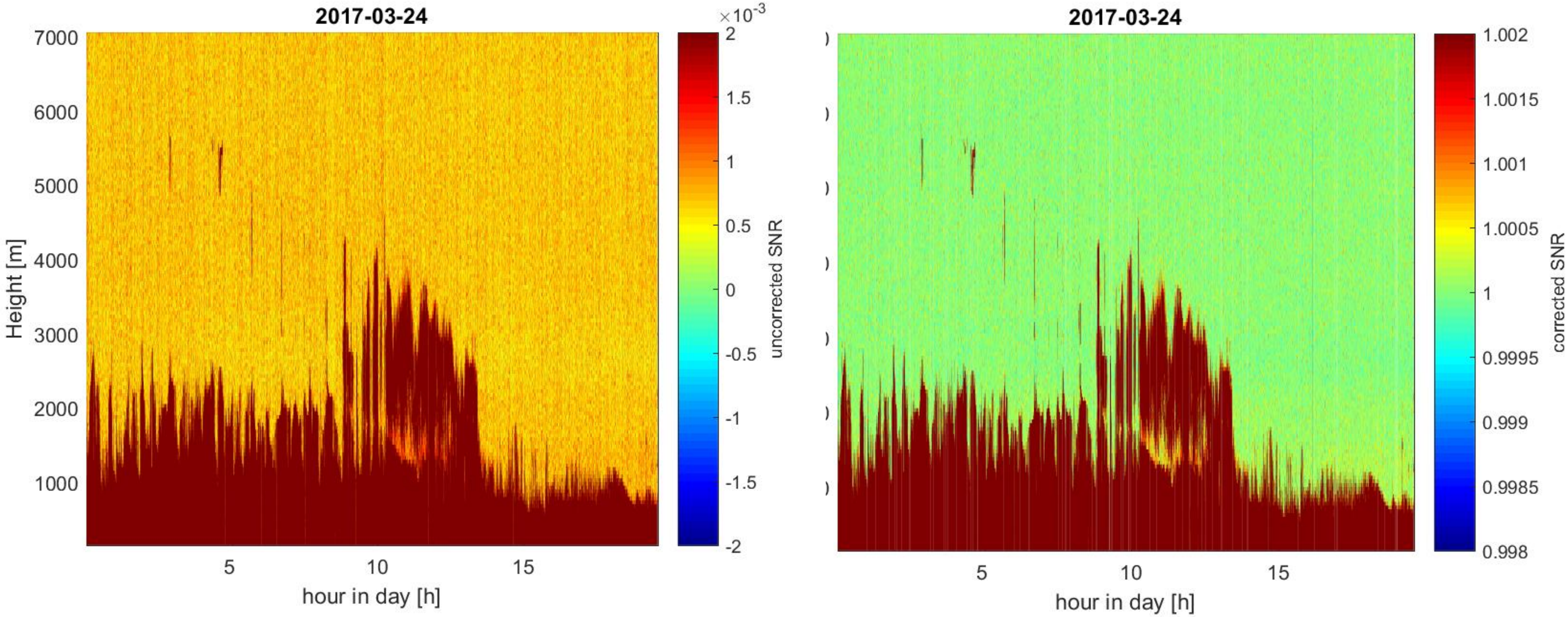
Leosphere background correction - STSM

Apply ‘similar’ correction to that applied to Halo systems.

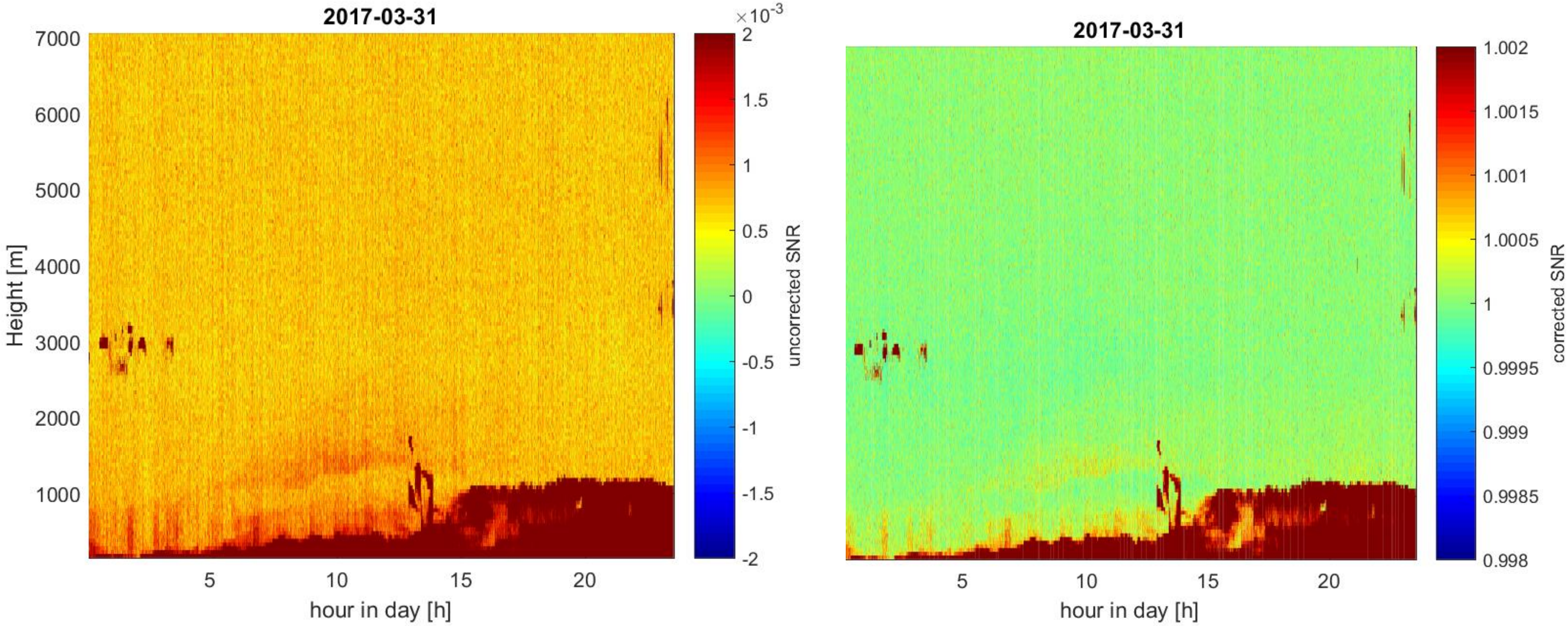
Some differences because of slightly different internal processing implementation



Leosphere background correction



Leosphere background correction



Combining DWL and MWR - STSM

- **‘High-resolution’ MWR retrieval**
  - Identify stable, neutral, unstable

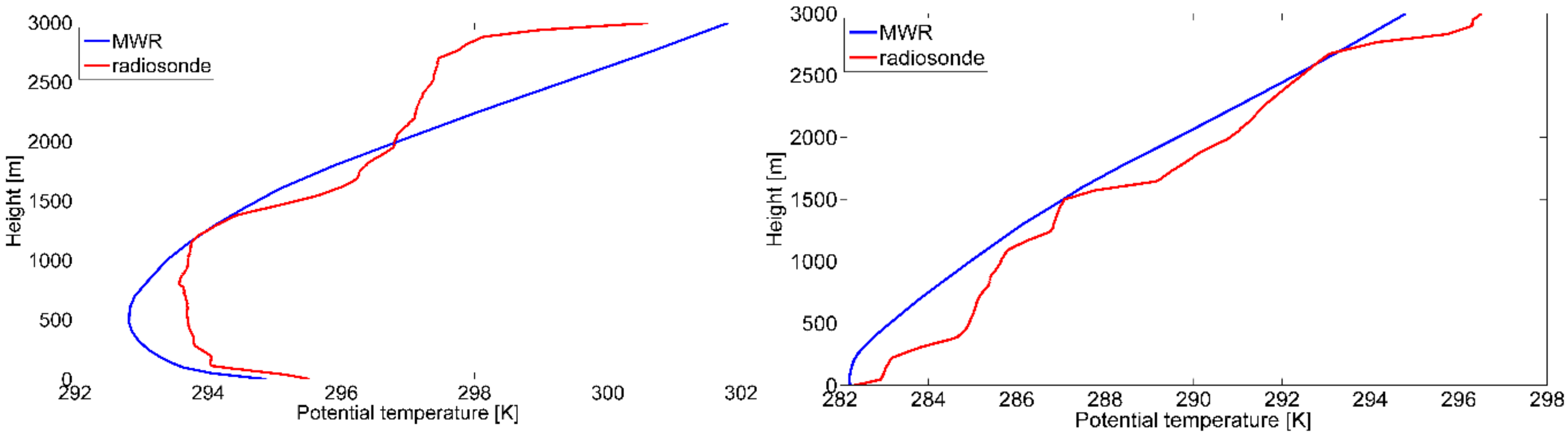
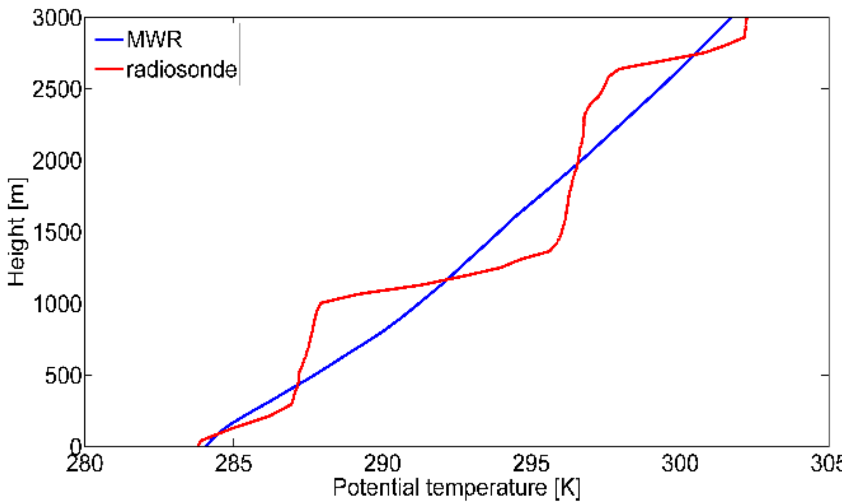
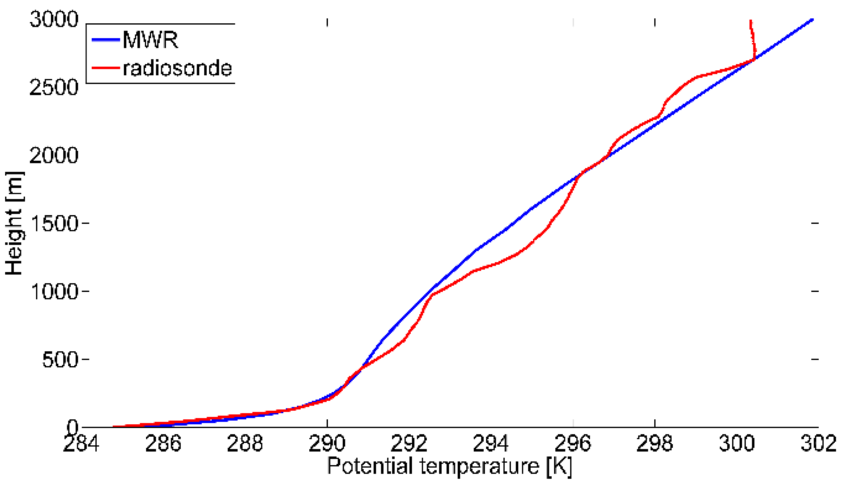


Figure1. Comparison of MWR and radiosonde temperature profiles under convective-driven mixing

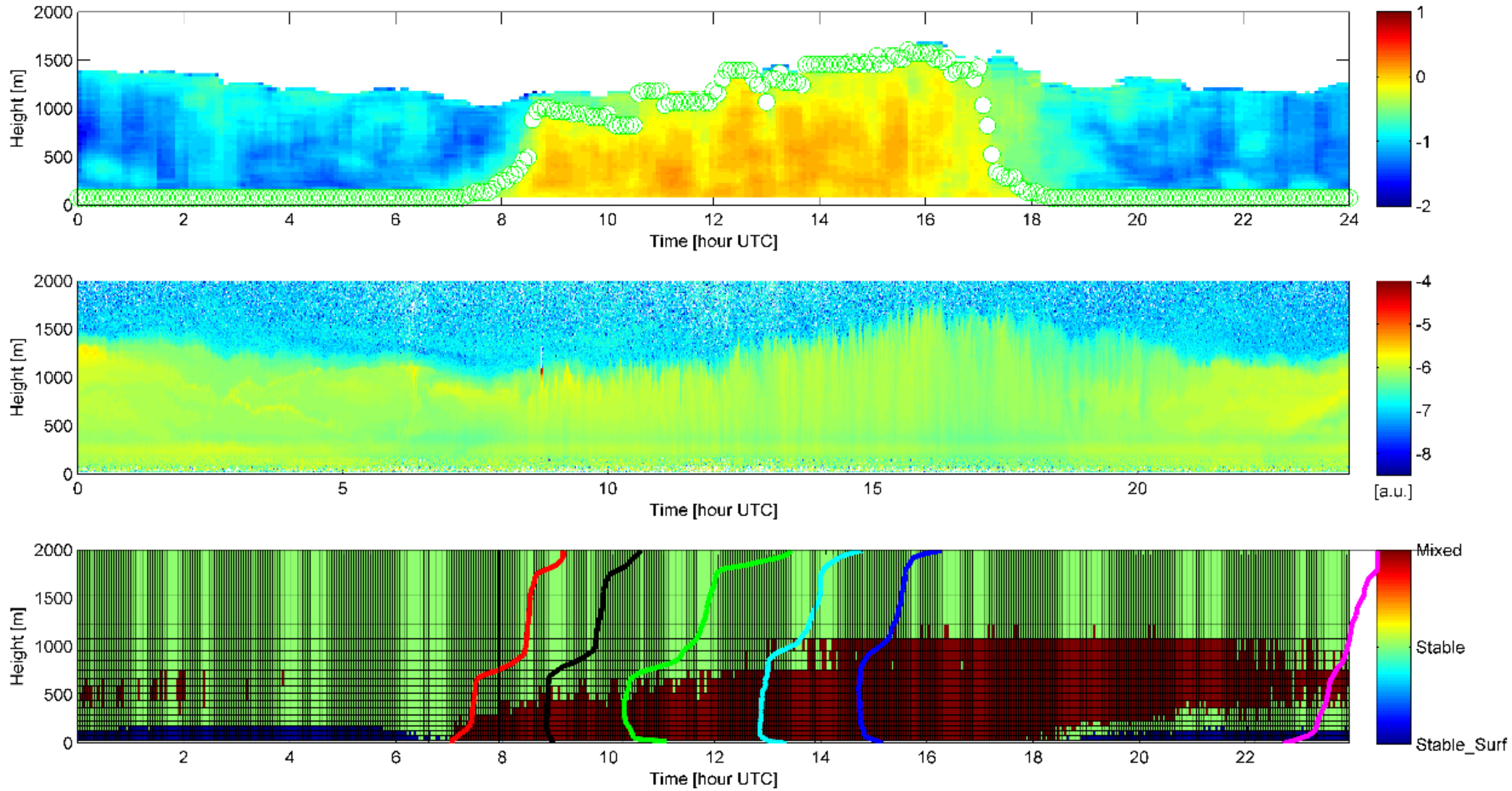
Combining DWL and MWR - STSM

- **‘High-resolution’ MWR retrieval**
  - Identify stable, neutral, unstable





Combining DWL and MWR - STSM



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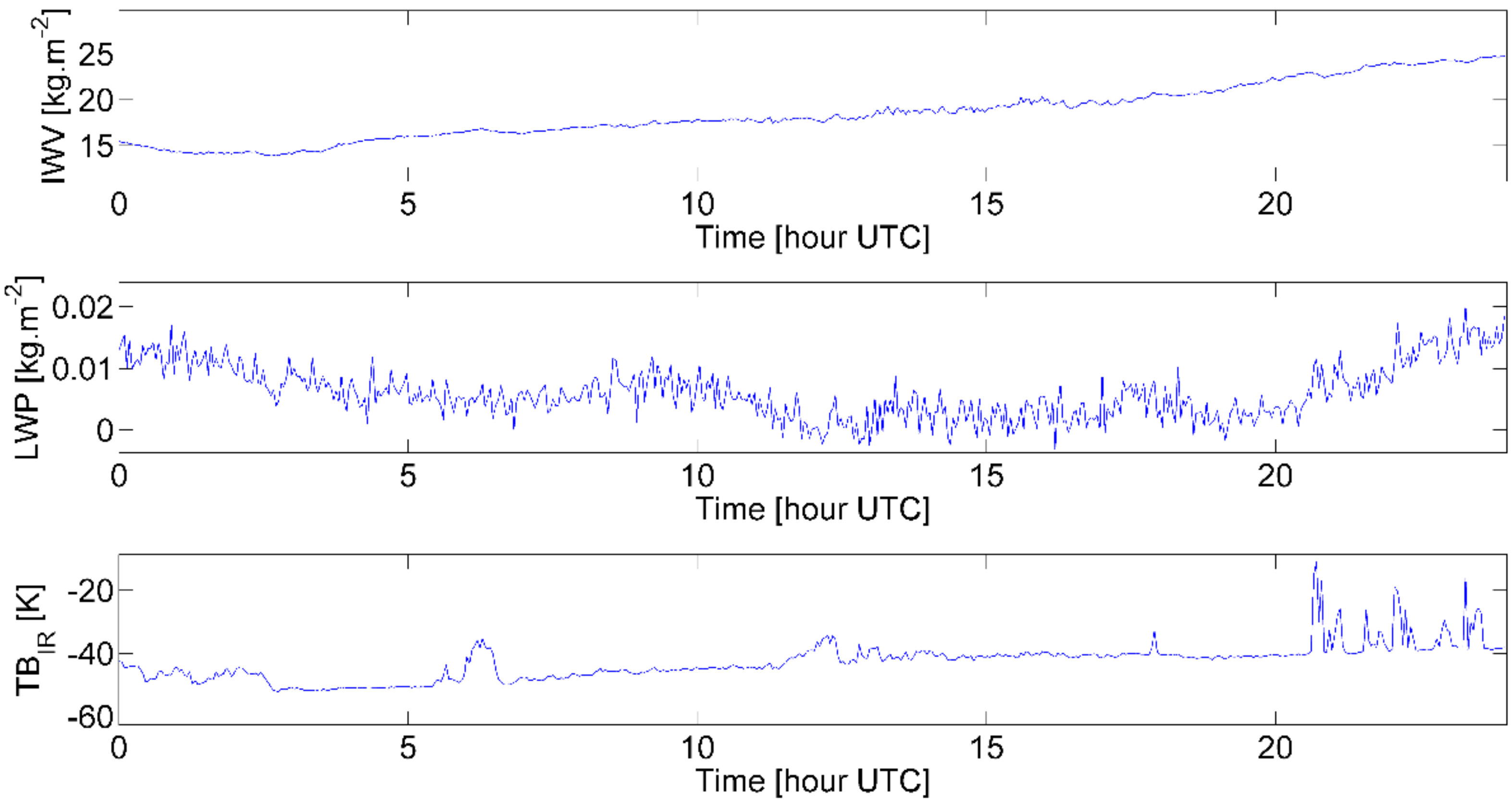
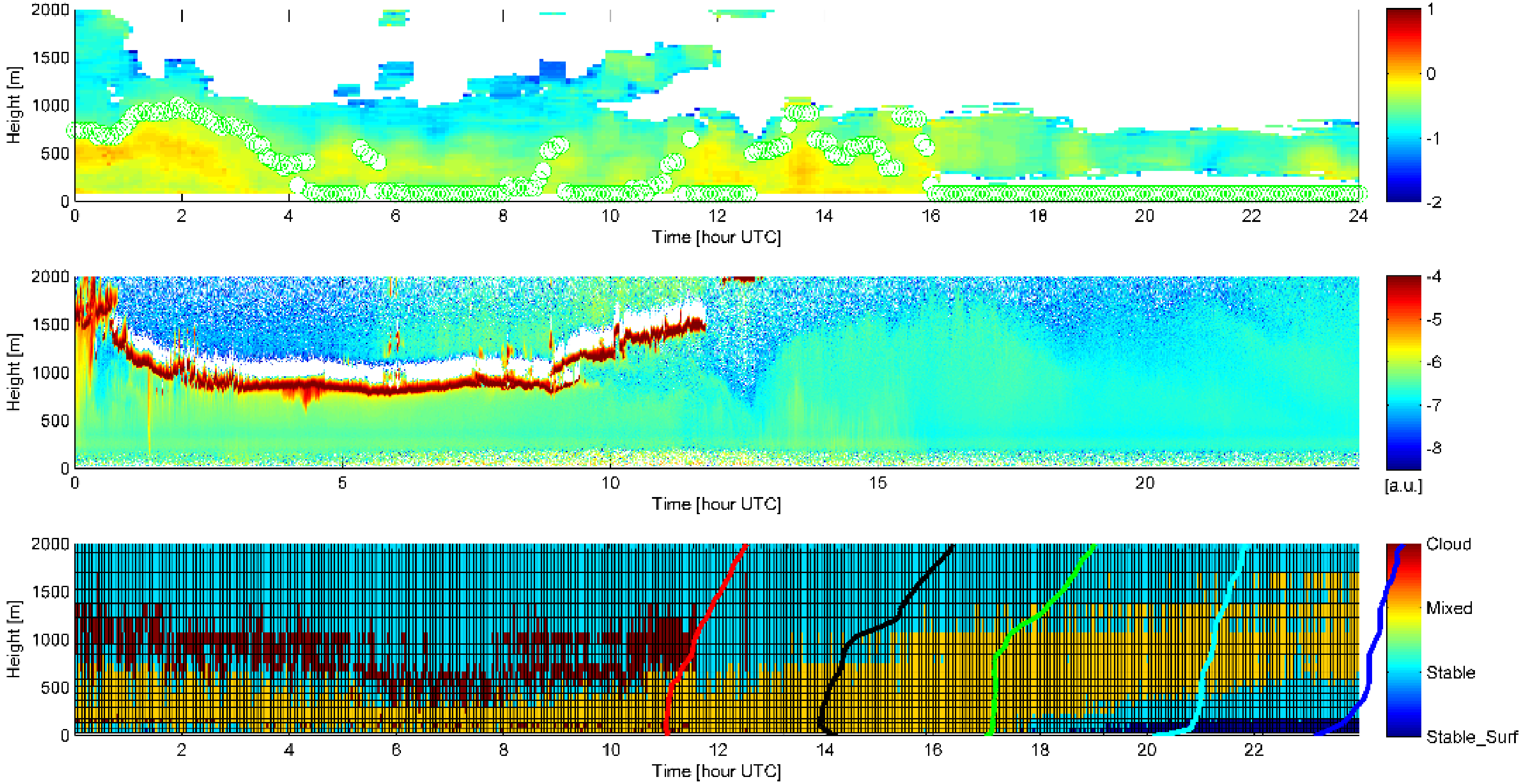
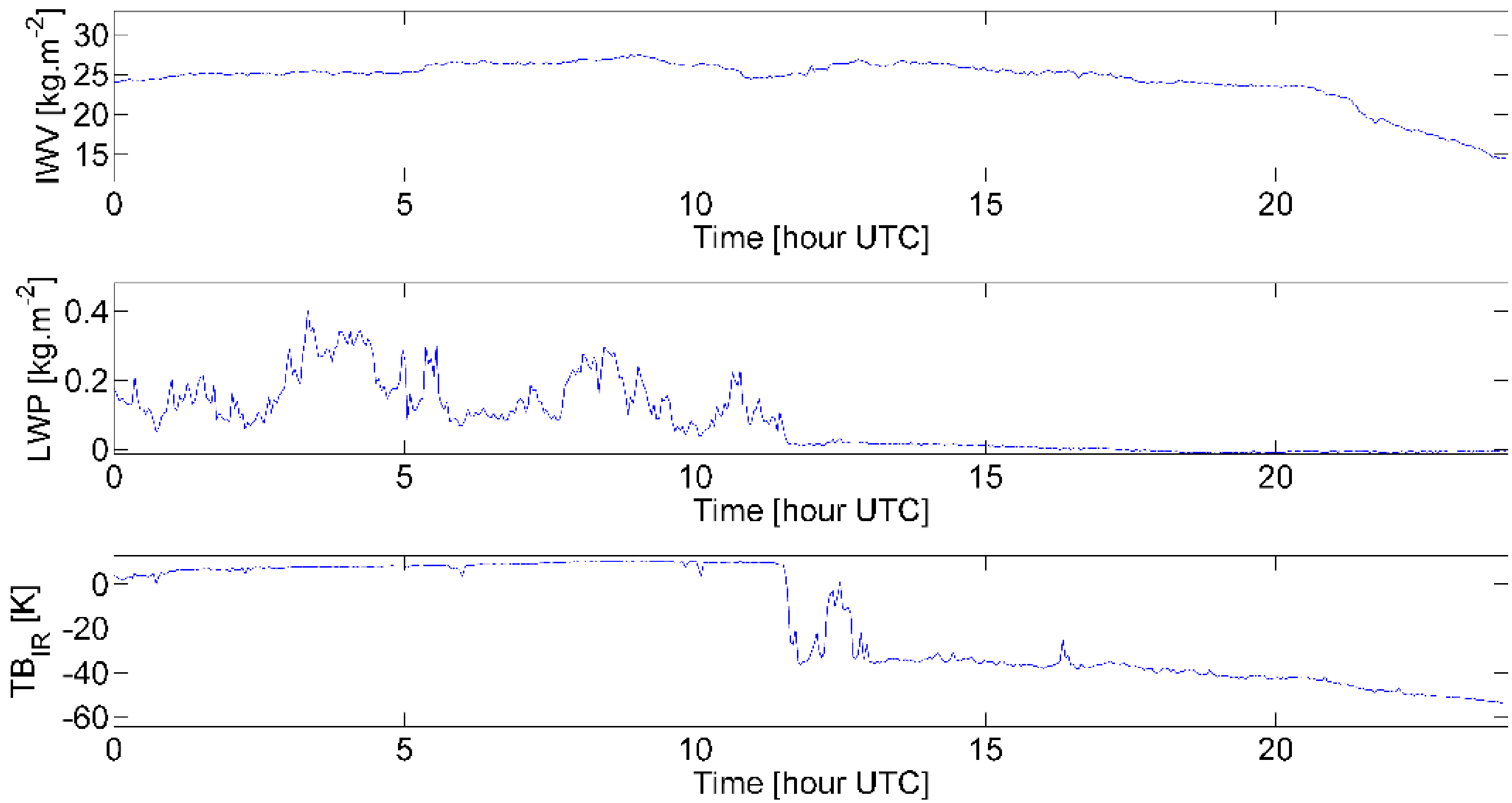


Combining DWL and MWR - STSM

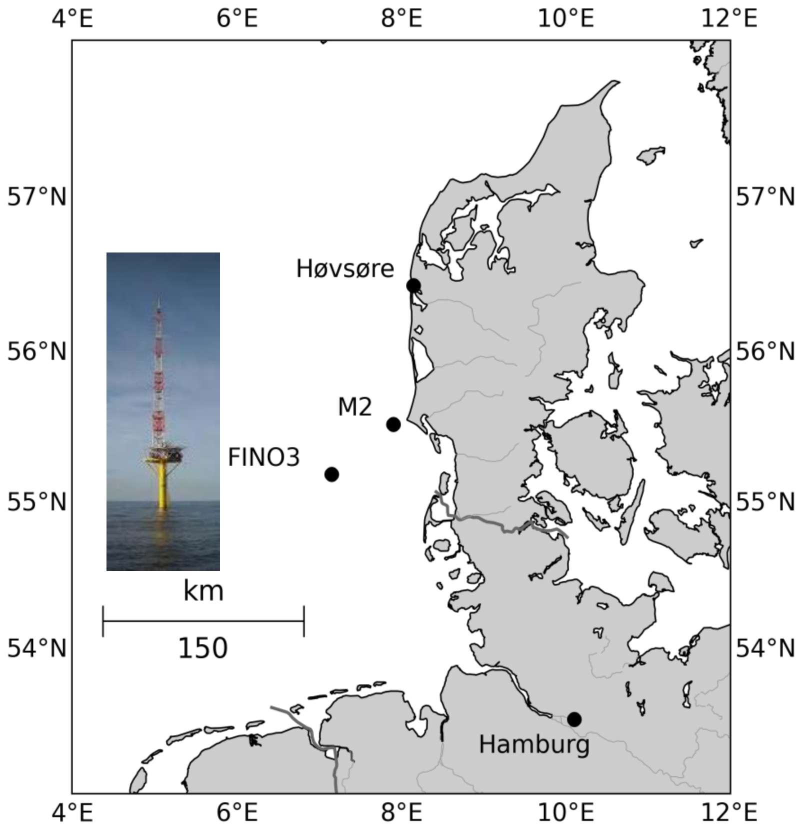


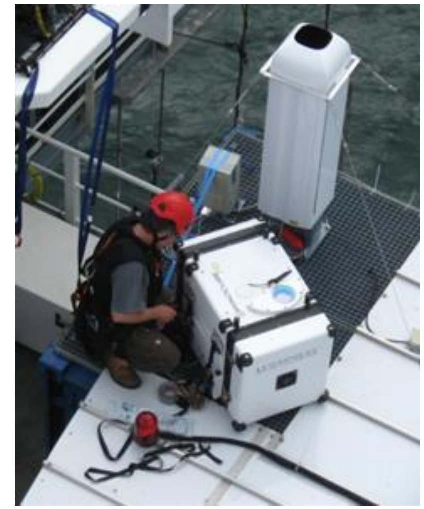
Combining DWL and MWR - STSM

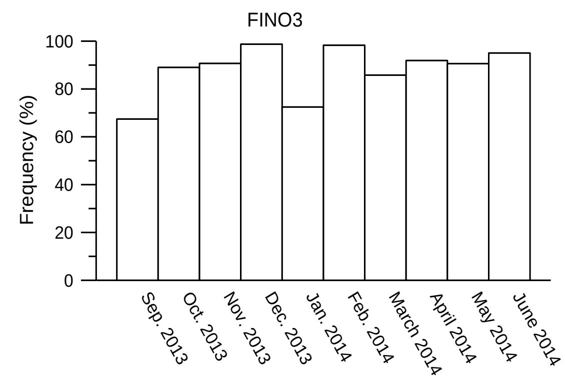


SCIENTIFIC REPORT

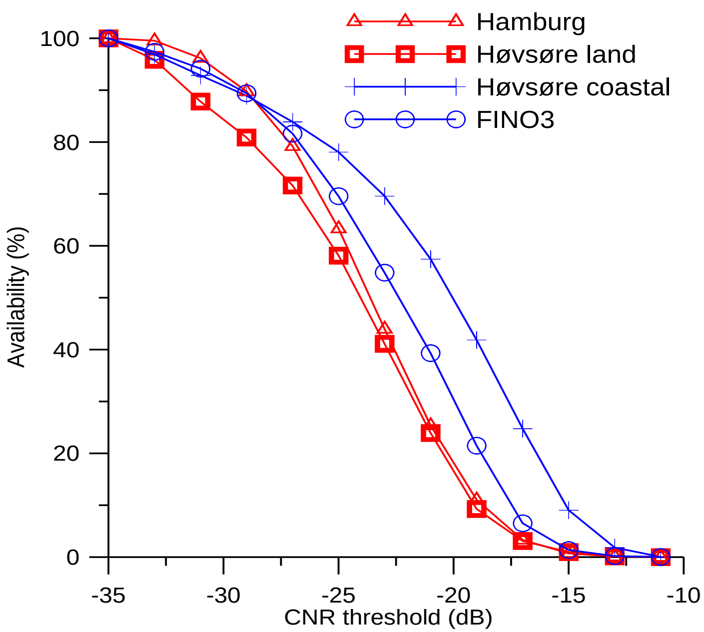
- **ACTION: ES1303 TOPROF**
- **STSM: COST-STSM-ES1303-38266**
- **TOPIC: The use of lidar measurements for evaluation of wind-speed prediction by numerical models**
- **VENUE: DTU Wind Energy, Denmark**
- **PERIOD: 08 August - 16 August, 2017**
-
- **Host: Jake Badger (DTU Wind Energy, Denmark)**
- **Applicant: Ekaterina Batchvarova (NIMH-BAS, Bulgaria)**
- **Submission date: 03.09.2017**
-
- **Contribution by: Ekaterina Batchvarova (NIMH-BAS, Bulgaria) and Sven-Erik Gryning (DTU, Denmark)**


4°E
6°E
8°E
10°E
12°E
57°N
56°N
55°N
54°N
Høvsøre
M2
FINO3
Hamburg
km
150




FINO3
Frequency (%)
0
20
40
60
80
100
Sep. 2013
Oct. 2013
Nov. 2013
Dec. 2013
Jan. 2014
Feb. 2014
March 2014
April 2014
May 2014
June 2014

Data availability for different CNR values



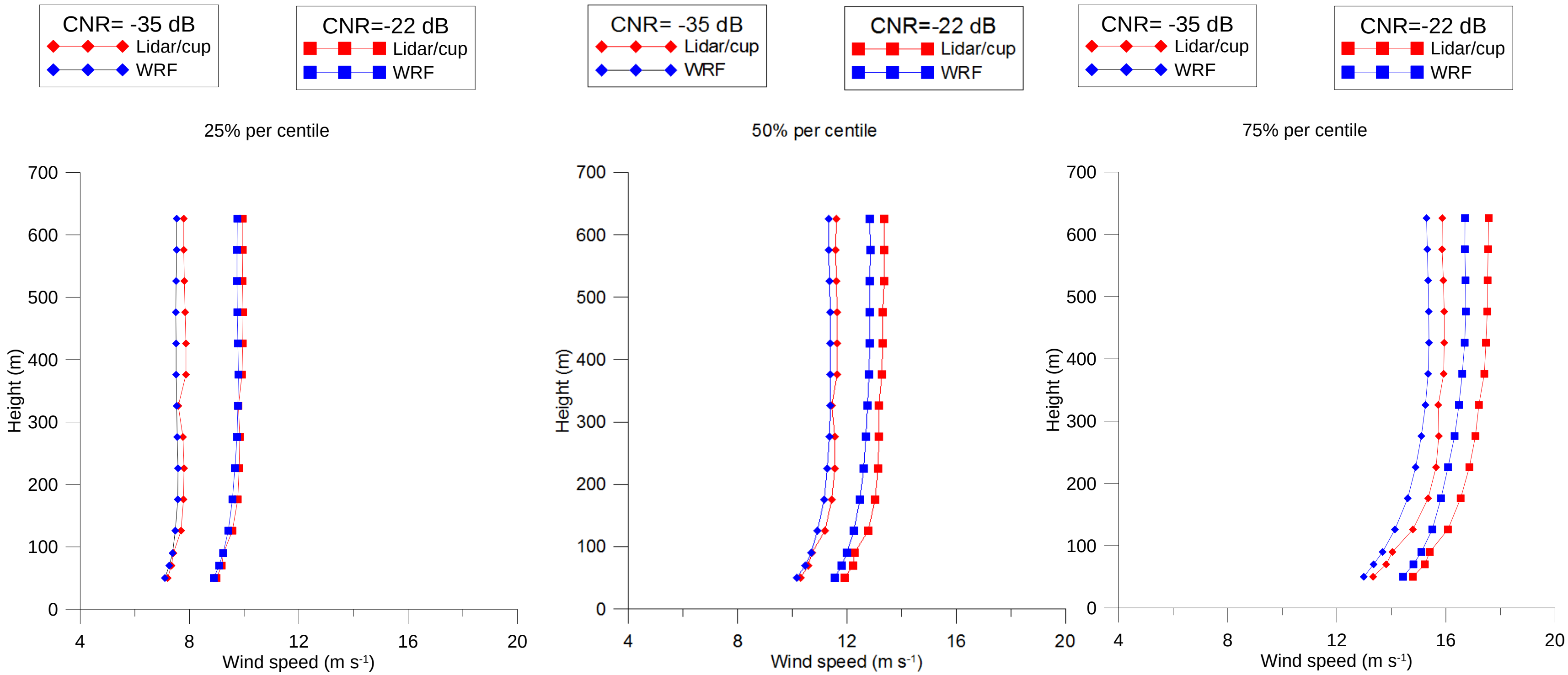
For the same CNR more data are available in the marine air compared to the air over land

The WRF simulation – courtesy to Roger Floors, DTU

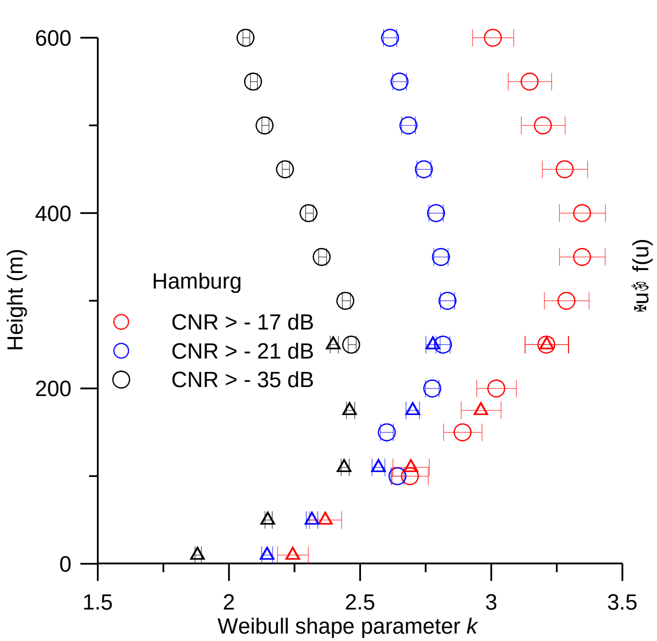
The model data set is created with the Weather Research and Forecast model WRF (Skamarock et al, 2004) in analysis mode; FNL global boundary conditions available every 6 hours on a 1° x 1° grid; two nested domains of horizontal grid size of 18 and 2 km; Noah land surface scheme (Chen and Dudhia 2001), MYNN surface layer scheme (Nakanishi and Niino 2009), Thompson microphysics scheme (Thompson et al. 2004), and the 1.5 order closure Mellor-Yamada Nakanishi and Niino level 2.5 (MYNN, Nakanishi and Niino (2009) planetary boundary-layer (PBL) scheme.

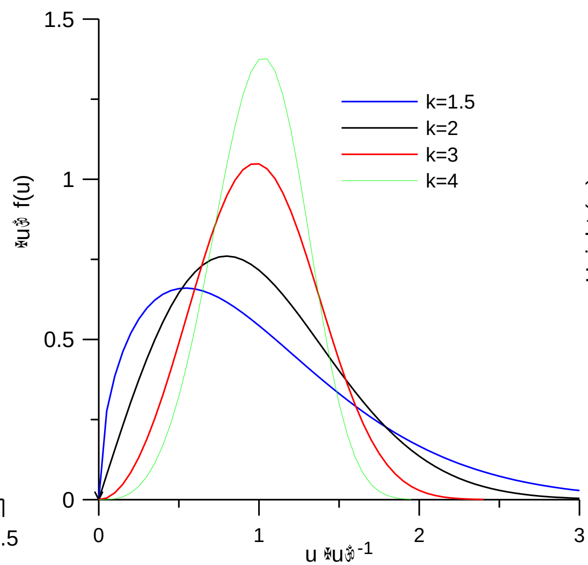
The WRF model was configured to calculate the meteorological parameters at 41 vertical levels from the surface to pressure level 100 hPa. Eight of these levels were within the height range of 600 m and the first model level was at ~14 m. The simulations were initialized every 10 days at 12:00 GMT and after a spin up of 24 hours a time series of 10-min output was picked out from the simulated meteorological data from hour 25 to 264. In order to prevent the model from

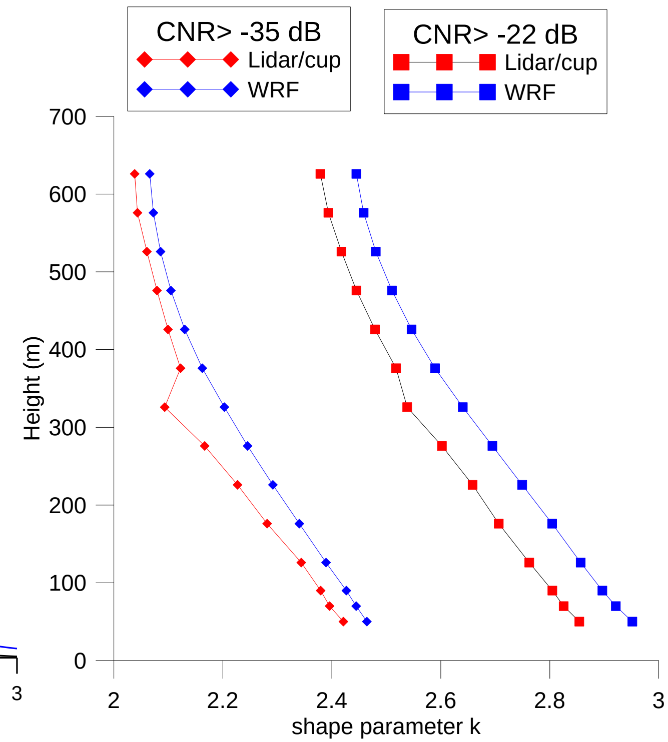
Applying CNR=-22 dB leads to higher mean wind speeds compared to CNR=-35 dB
WRF is always underestimating the wind speed at FINO3
For CNR=-22 dB the difference is smaller compared to CNR=-35 dB



Different k-parameters profiles over land and over sea
Smaller variability /bigger k/ for CNR=-35 dB compared to CNR=-22 dB
WRF overestimates k or underestimates variability







The outcome of the study can be summarized as:

In general, WRF underestimates the wind speed and overestimates the Weibull shape parameter at all levels, which means that the model suggests lower values and lower variability for the wind speed at all levels up to 600 m.

Thus, when comparing all WRF data to lidar data with strong CNR filter applied, the underestimation will be bigger than presented here.

Also, if high quality lidar data are assimilated into WRF, there will be shift towards higher wind speeds, which may reduce the difference between model and observations.