

# Atmospheric boundary layer and complex terrain

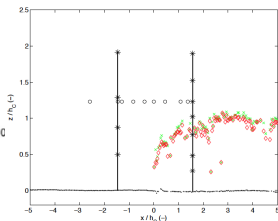
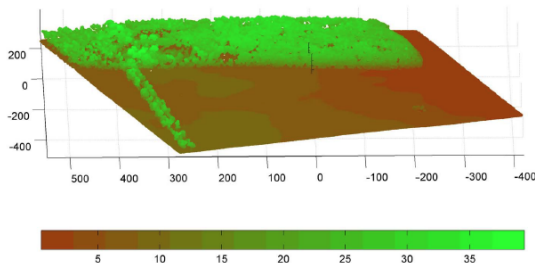
Jakob Mann

April 11, 2012 – DSF Flow center steering committee meeting,  
DTU, Lyngby

# M21(24) Ellipsys3D with SCADIS parametrization of forest provided to Vestas

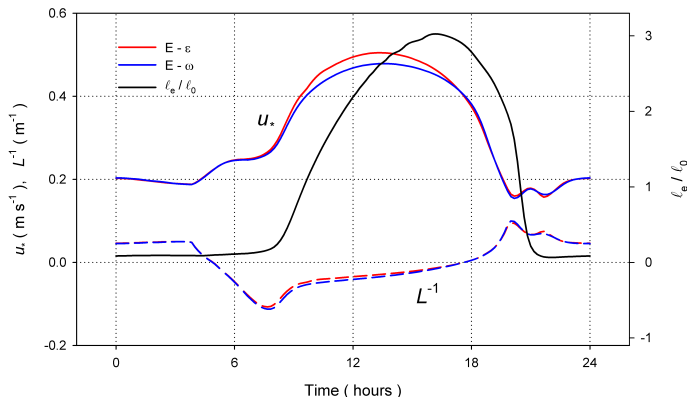
Version 1 provided.

PhD student Louis-Etienne Boudreault is testing the model in various way.



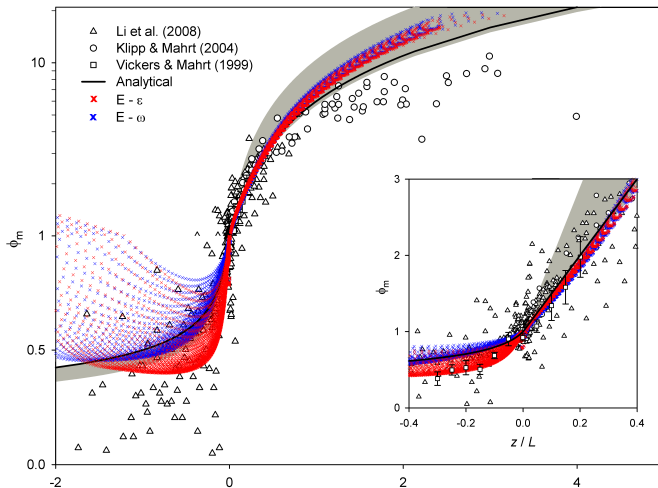
# RANS model with atmospheric stability for flat terrain

M22(40): Consistent two-equation modelling for atmospheric research: Bouyancy and vegetation implementations *Sogachev, Kelly and Leclerc*



# RANS model with atmospheric stability for flat terrain

M22(40): Consistent two-equation modelling for atmospheric research: Bouyancy and vegetation implementations *Sogachev, Kelly and Leclerc* Accepted in *BLM*



# M25(48) Development and verification of a model of the spatial structure of atmospheric turbulence under influence of stratification.

Work mainly by PhD student Abhijit Chougule.

Completed subtasks:

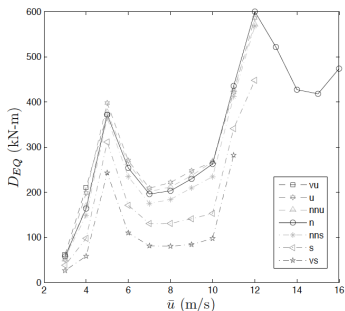
- Eddy life time from the Mann spectral tensor model is implemented into the stability dependent RDT equations
- The equations are solved in an efficient C program

Comparison with data will commence in 2012

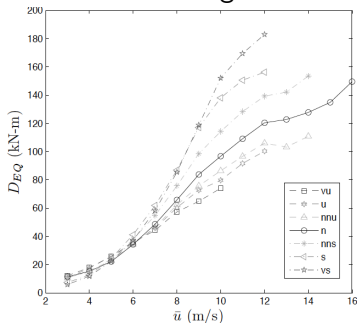
# M27(70) Assessment of stratification impacts on rotor performance.

Influence of atmospheric stability on wind turbine loads A. Sathe, J. Mann, T. Barlas, W.A.A.M. Bierbooms, G.J.W. van Bussel WE 2012

## Tower base fore-aft



## Tower overtuning moment



## Plans for 2012:WP4+5

M24(44) Complex terrain and stability in RANS model  
(Tilman/Andrey/Louis-Etienne)

## Plans for 2012:WP4+5

M24(44) Complex terrain and stability in RANS model  
(Tilman/Andrey/Louis-Etienne)

M25(48) Validate stability dependent spectral tensor model with data

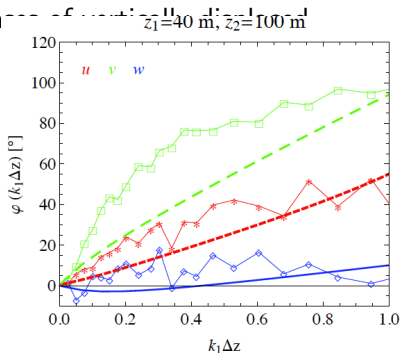
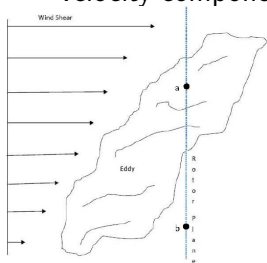


## Plans for 2012:WP4+5

- M24(44) Complex terrain and stability in RANS model  
(Tilman/Andrey/Louis-Etienne)
- M25(48) Validate stability dependent spectral tensor model with data
- M27(70) Hire PhD student to work on atmospheric turbulence and loads.

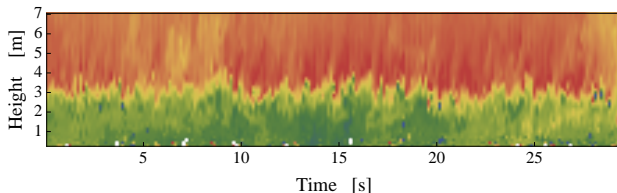
# Plans for 2012:WP4+5

- M24(44) Complex terrain and stability in RANS model (Tilman/Andrey/Louis-Etienne)
- M25(48) Validate stability dependent spectral tensor model with data
- M27(70) Hire PhD student to work on atmospheric turbulence and loads.
- M25(48) Submit paper on spectral phase  $\varphi(k_1 \Delta z)$  of velocity components



# Plans for 2012:WP4+5

- M24(44) Complex terrain and stability in RANS model  
(Tilman/Andrey/Louis-Etienne)
- M25(48) Validate stability dependent spectral tensor model with data
- M27(70) Hire PhD student to work on atmospheric turbulence and loads.
- M25(48) Submit paper on spectral phases of vertically displaced velocity components
  - Analyze Bolund Doppler laser scanning data and publish



## Plans for 2012:WP4+5

- M24(44) Complex terrain and stability in RANS model  
(Tilman/Andrey/Louis-Etienne)
- M25(48) Validate stability dependent spectral tensor model with data
- M27(70) Hire PhD student to work on atmospheric turbulence and loads.
- M25(48) Submit paper on spectral phases of vertically displaced velocity components
  - Analyze Bolund Doppler laser scanning data and publish
  - Estimate effect of non-Gaussinity on loads using NCAR LES (or DNS)

## Plans for 2012:WP4+5

- M24(44) Complex terrain and stability in RANS model  
(Tilman/Andrey/Louis-Etienne)
- M25(48) Validate stability dependent spectral tensor model with data
- M27(70) Hire PhD student to work on atmospheric turbulence and loads.
- M25(48) Submit paper on spectral phases of vertically displaced velocity components
  - Analyze Bolund Doppler laser scanning data and publish
  - Estimate effect of non-Gaussinity on loads using NCAR LES (or DNS)
  - Describe wind profile turning and cross-flow momentum flux

## Plans for 2012:WP4+5

- M24(44) Complex terrain and stability in RANS model (Tilman/Andrey/Louis-Etienne)
- M25(48) Validate stability dependent spectral tensor model with data
- M27(70) Hire PhD student to work on atmospheric turbulence and loads.
- M25(48) Submit paper on spectral phases of vertically displaced velocity components
  - Analyze Bolund Doppler laser scanning data and publish
  - Estimate effect of non-Gaussinity on loads using NCAR LES (or DNS)
  - Describe wind profile turning and cross-flow momentum flux
  - Start prepare *The Science of making Torque from the Wind 2014* to be held at DTU.