Karlsruhe Institute of Technology

# Frequency and properties of low-level jets from two years of sodar data

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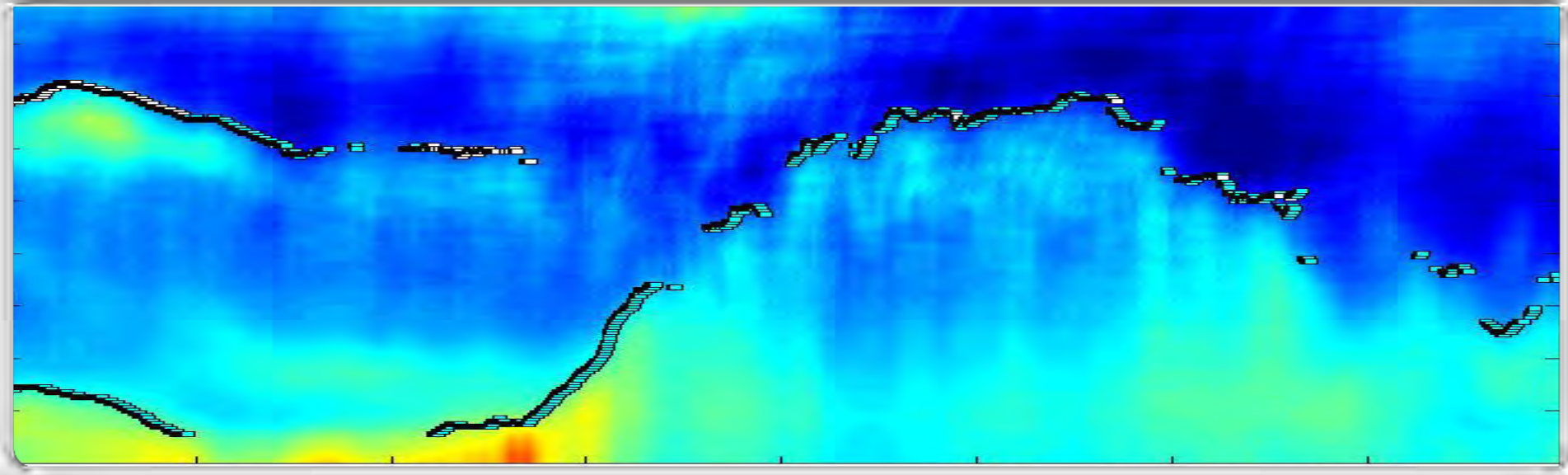
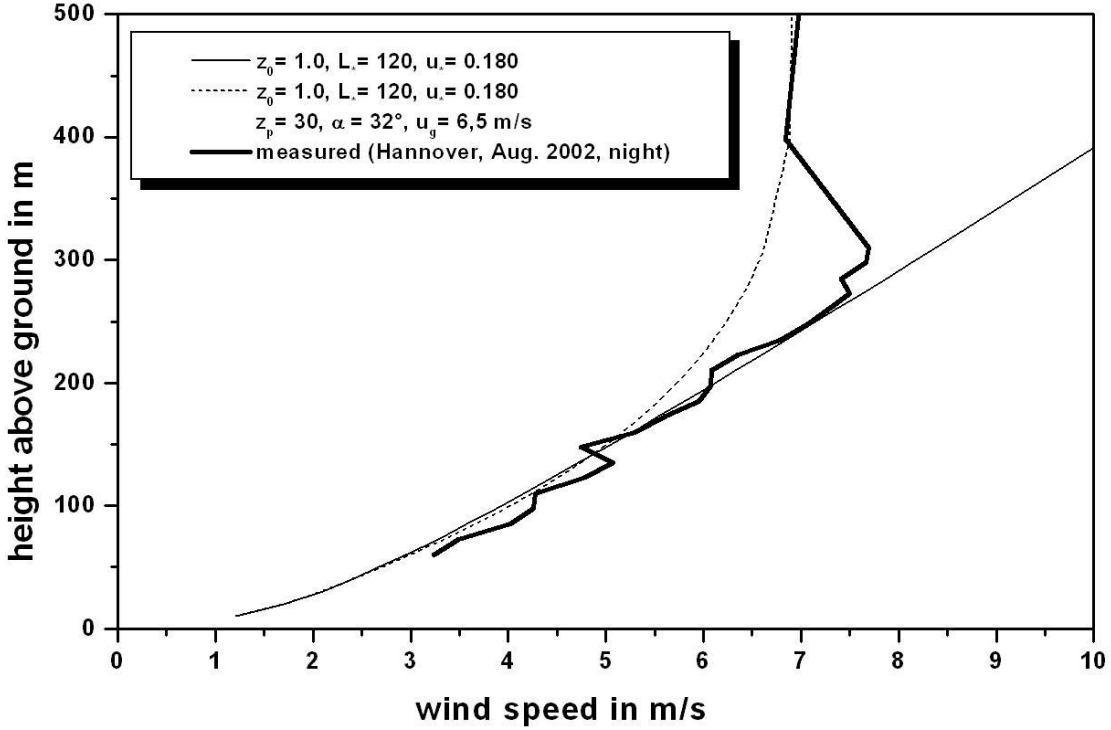


# Low-level jets

## results from SODAR observations

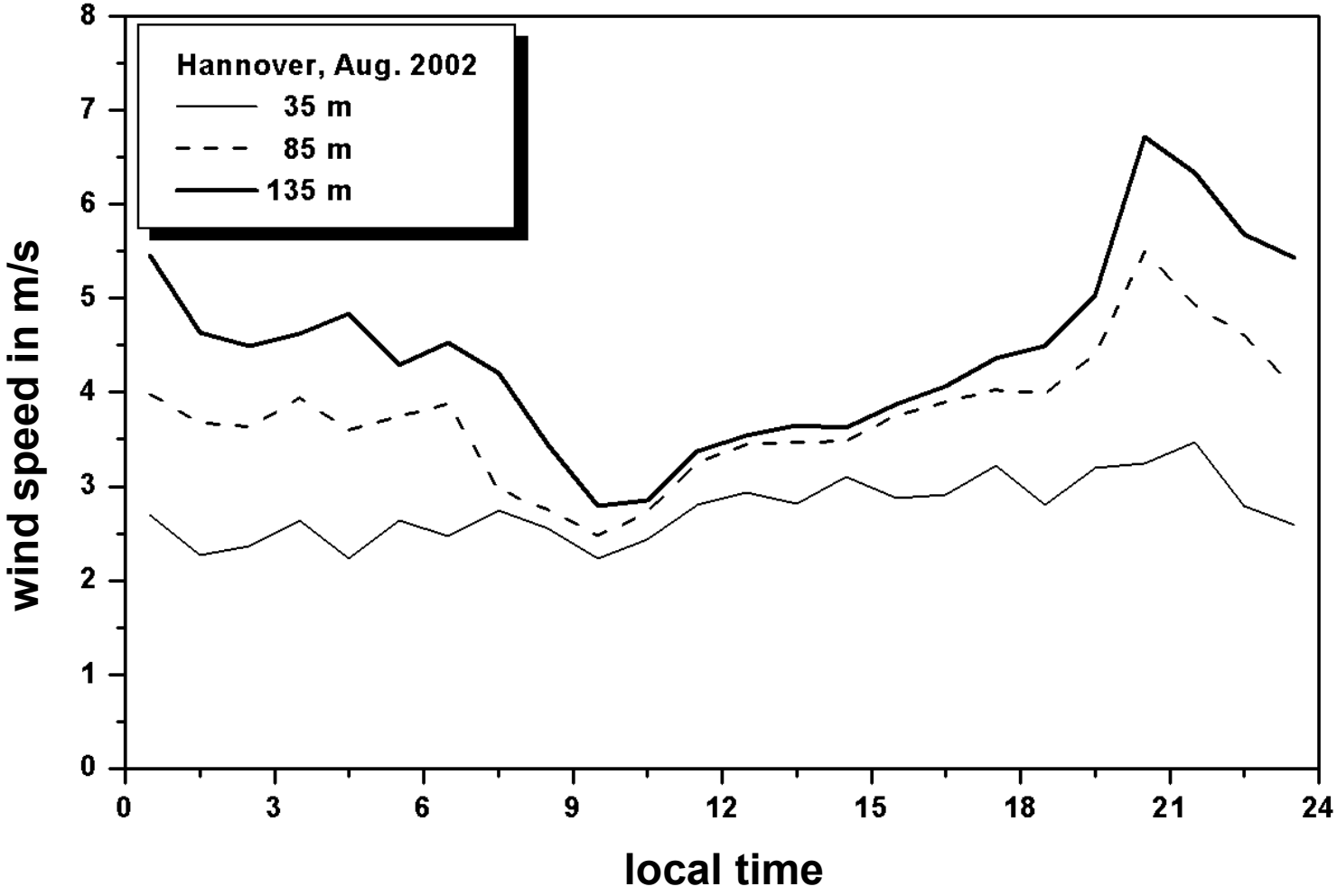
# Monthly mean vertical wind profile

## August 2002, 17 nights with LLJ



# Monthly mean diurnal course of wind speed

## August 2002, 17 nights with LLJ

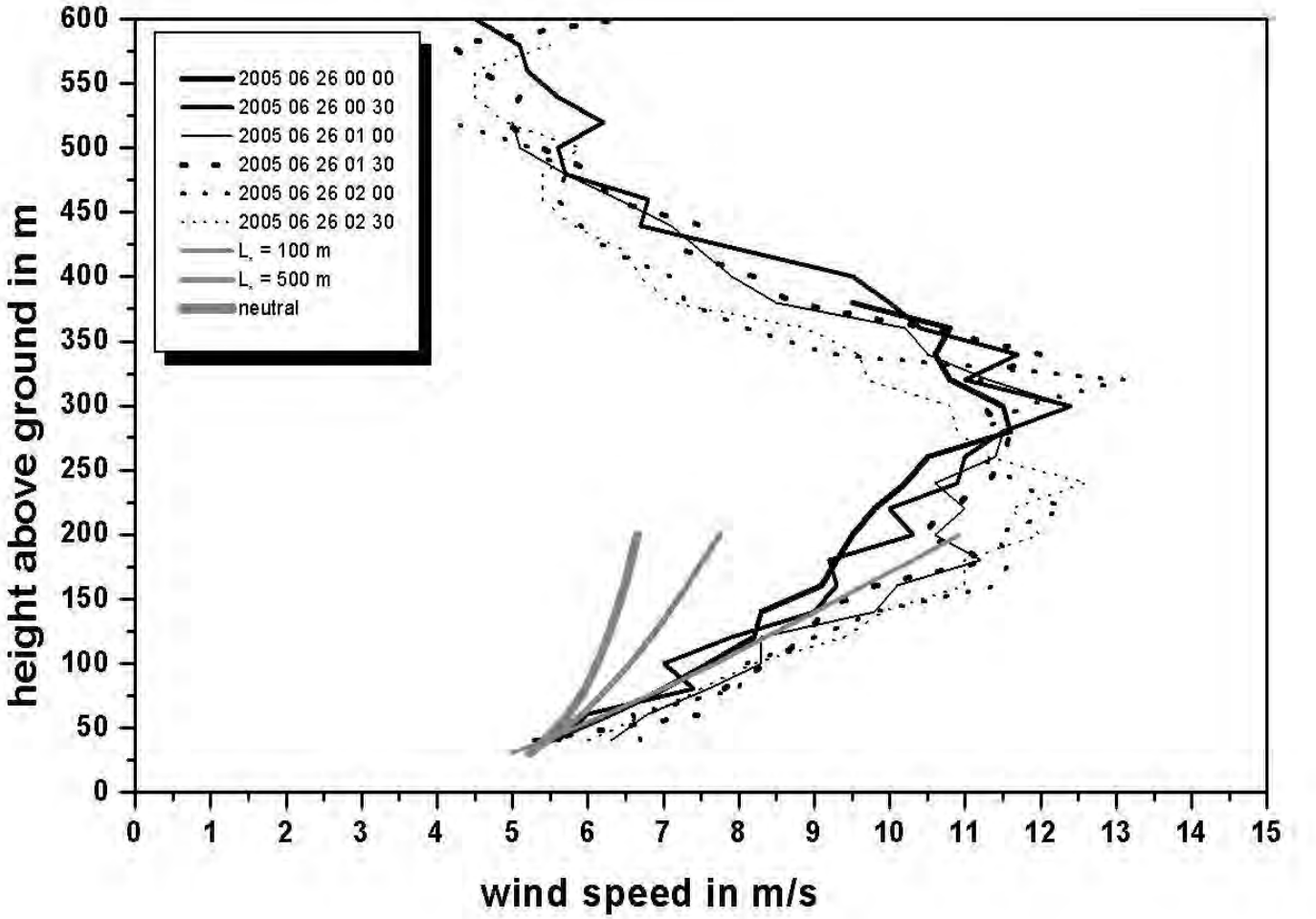


# examples for low-level jet observations with SODAR

**vertical profiles of wind speed**

**26 June 2005**

**AdP Ch d G**

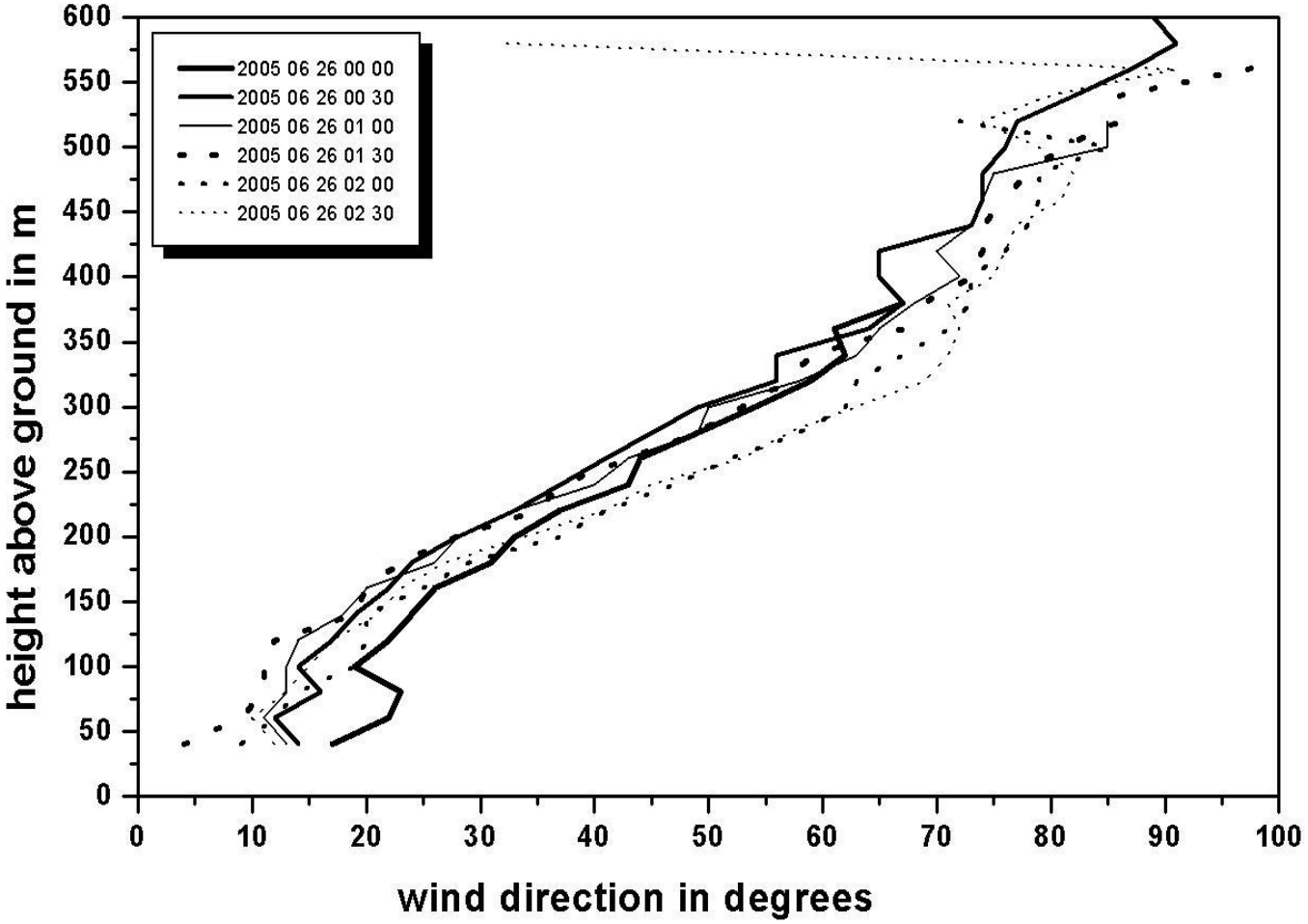


# examples for low-level jet observations with SODAR

**vertical profiles of wind direction**

**26 June 2005**

**AdP Ch d G**

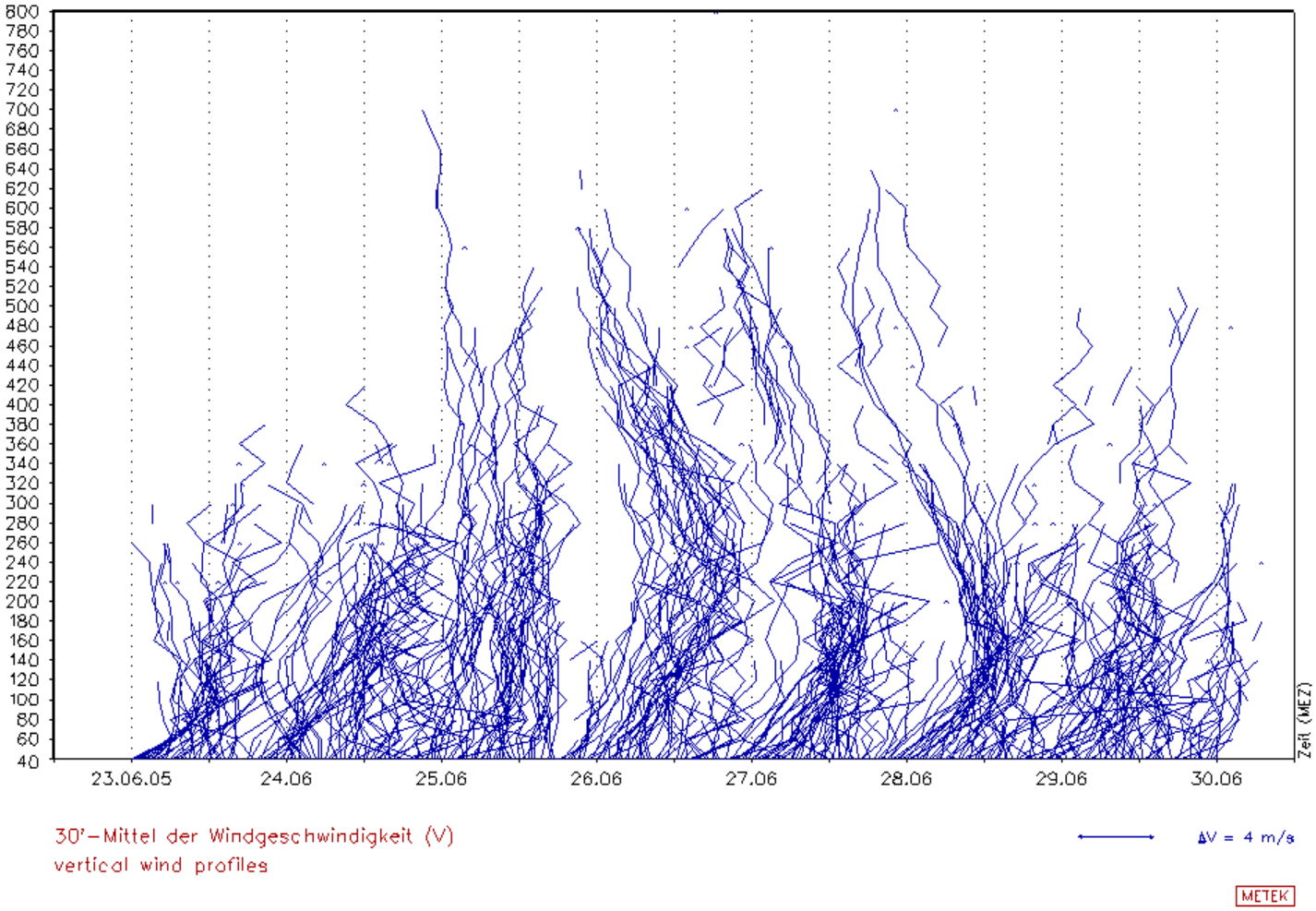


# examples for low-level jet observations with SODAR

**vertical profiles of wind speed (30 min means)**

**23-30 June 2005**

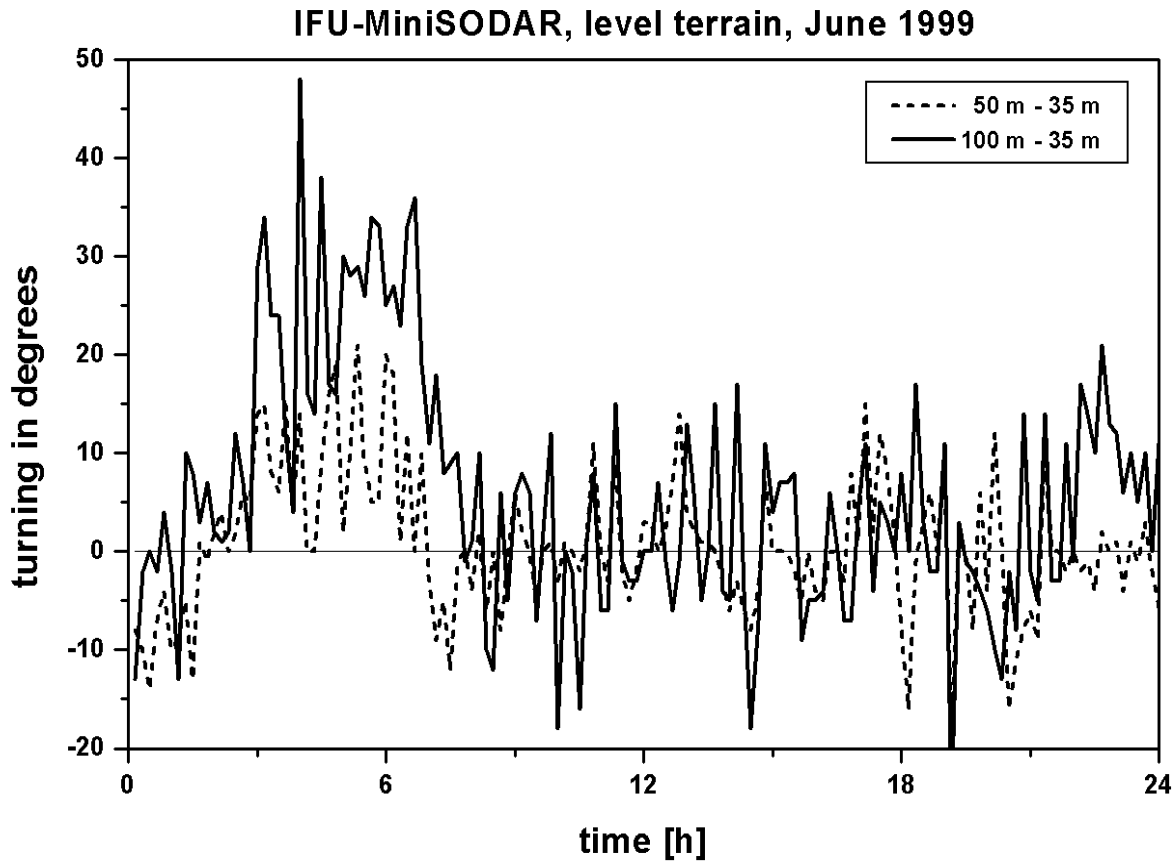
**AdP Ch d G**






Institute for Meteorology and Climate Research – Atmospheric Environmental Research

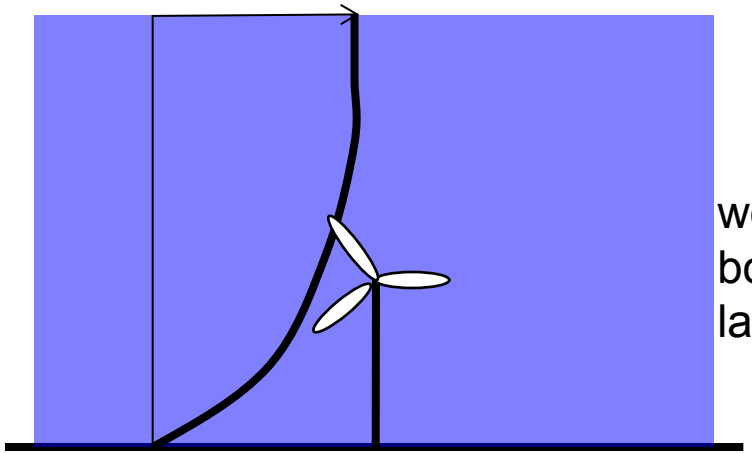
# Mean diurnal variation of the turning of wind direction with height



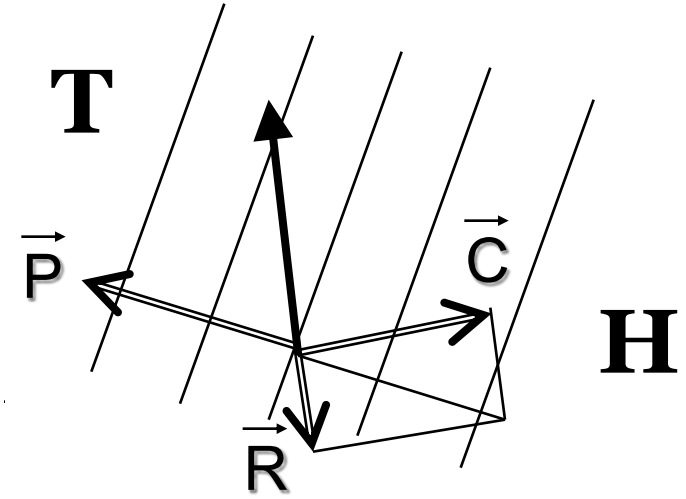

Emeis, S., 2001: Vertical variation of frequency distributions of wind speed in and above the surface layer observed by sodar. Meteorol. Z., **10**, 141-149.

# Nocturnal low-level jet and the turning of wind direction with height

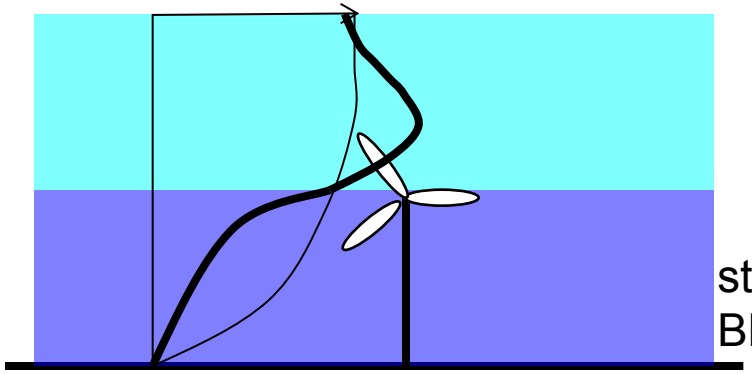
**Day**



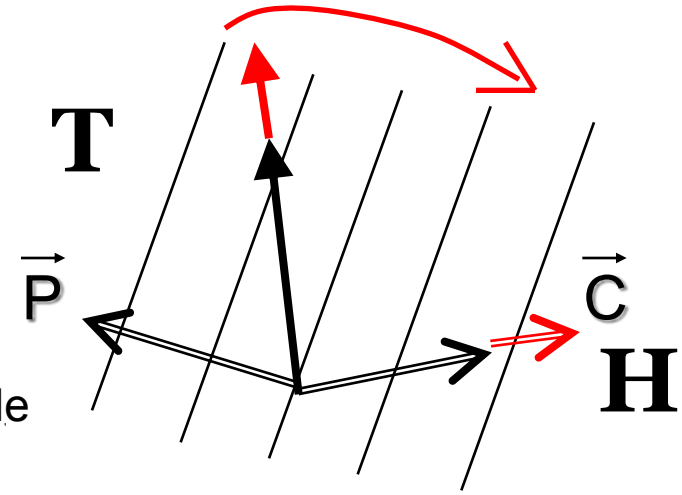
well-mixed boundary layer




**Night**



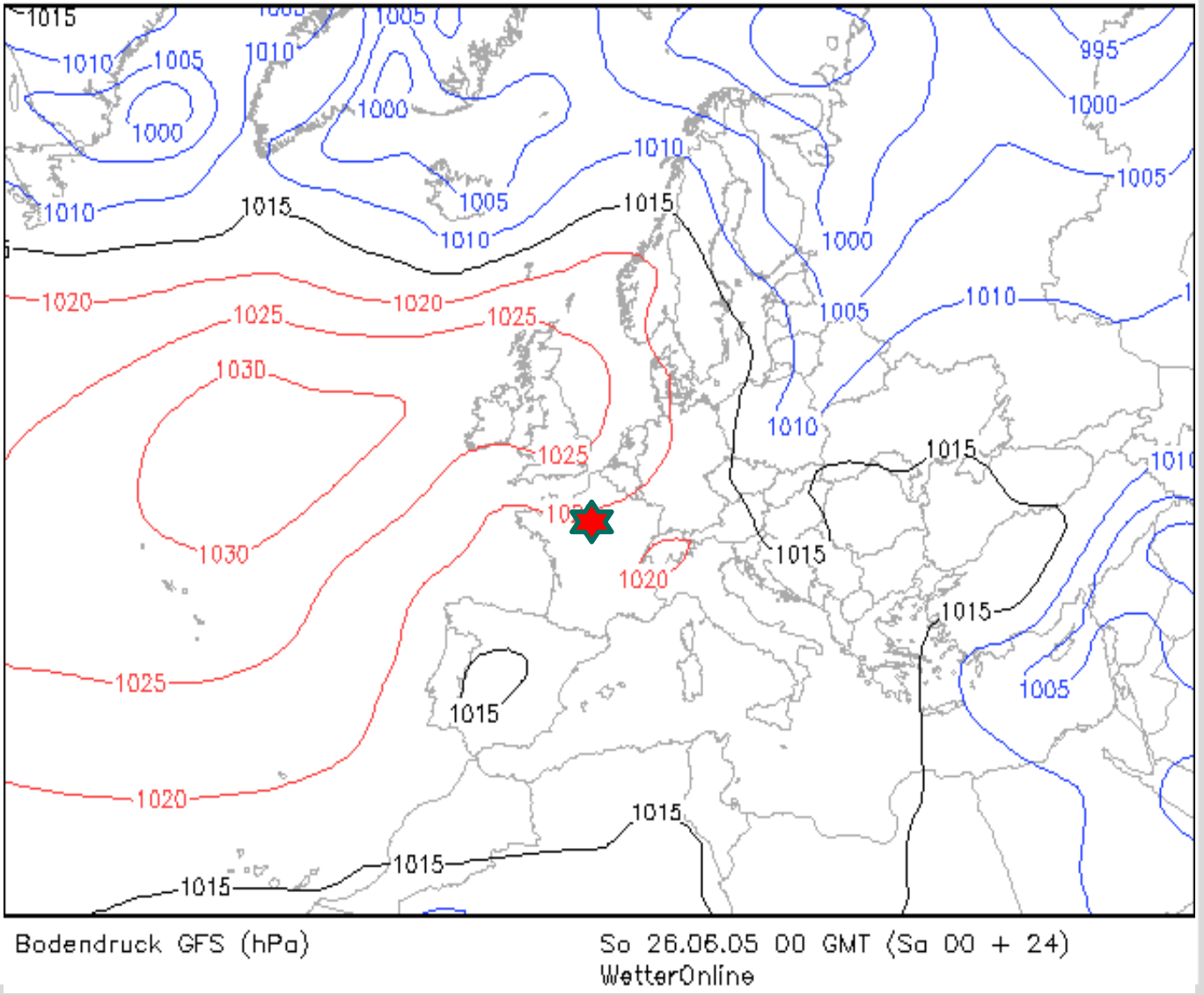
stable BL



**surface pressure**
**00 GMT**

**26 June 2005**

**asterisk denotes location where LLJ was observed**



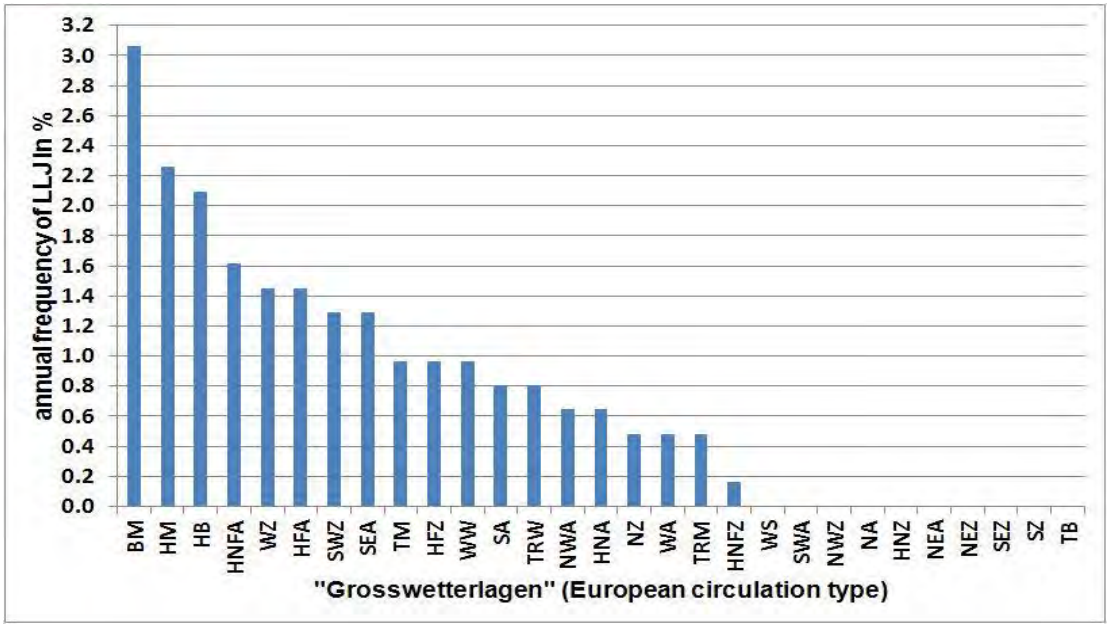
# One of the first larger SODAR campaign

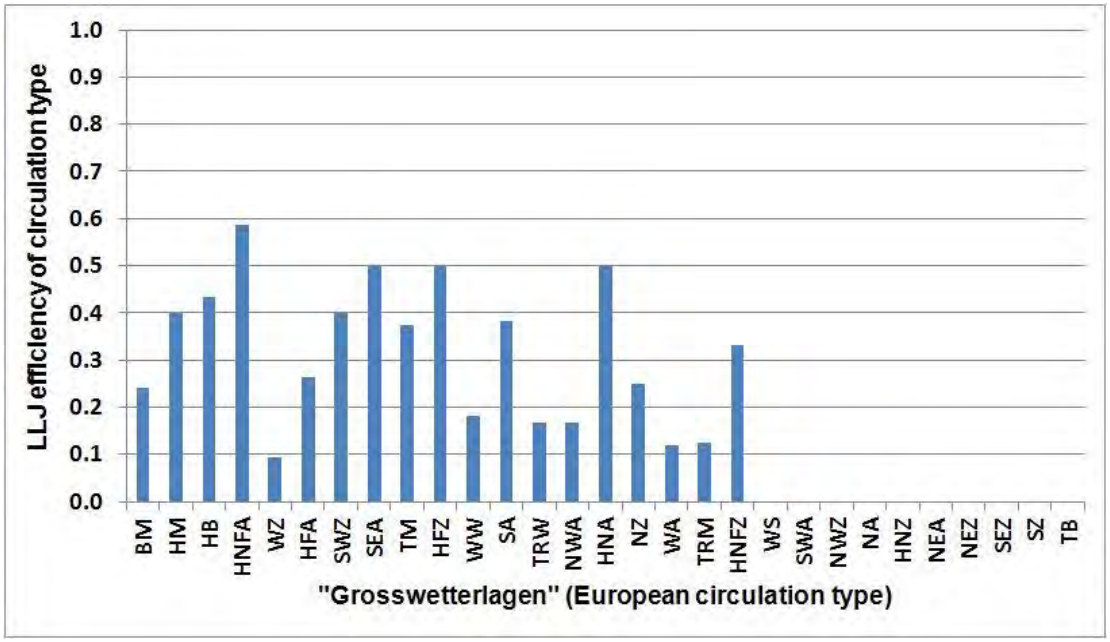
| | | |
|---|---|---|
| | 1 2002 | 1 2003 |
| | 2 2002 | 2 2003 |
| | 3 2002 | 3 2003 |
| | 4 2002 | 4 2003 |
| 5 2001 | 5 2002 | |
| 6 2001 | | |
| 7 2001 | | |
| 8 2001 | 8 2002 | |
| 9 2001 | 9 2002 | |
| 10 2001 | 10 2002 | |
| 11 2001 | 11 2002 | |
| 12 2001 | 12 2002 | |

AFO 2000
GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

**METEK DSDR3x7-SODAR of IMK-IFU in Hannover-Linden**

**Two years of measurements at one and the same site**




**frequency of LLJ over Hanover for 20 months in the years 2001 to 2003**

**total is 22 % of all nights**

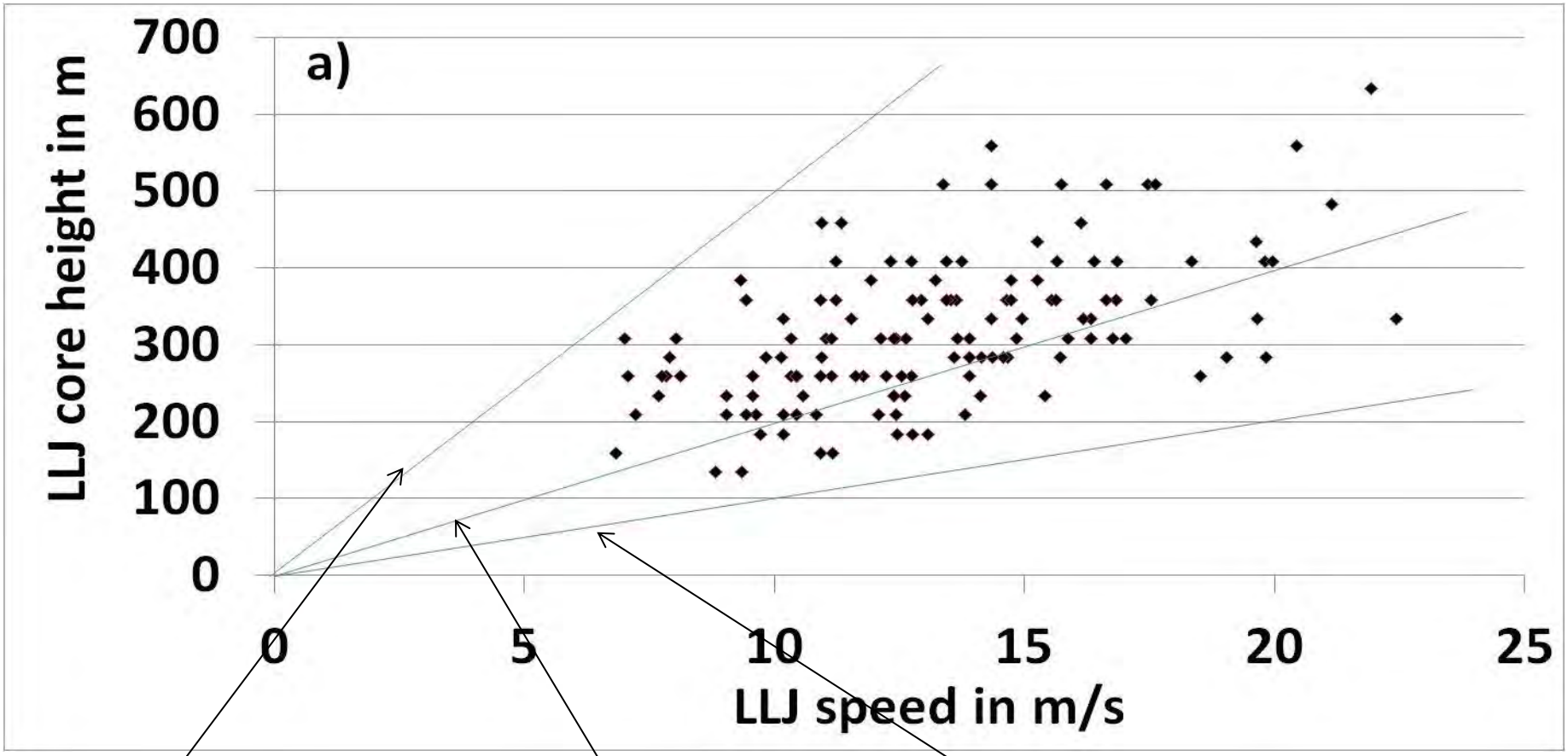
**circulation types:**

**BM ridge over Central Europe**
**HB high over British Isles**
**HM high over Central Europe**
**...**

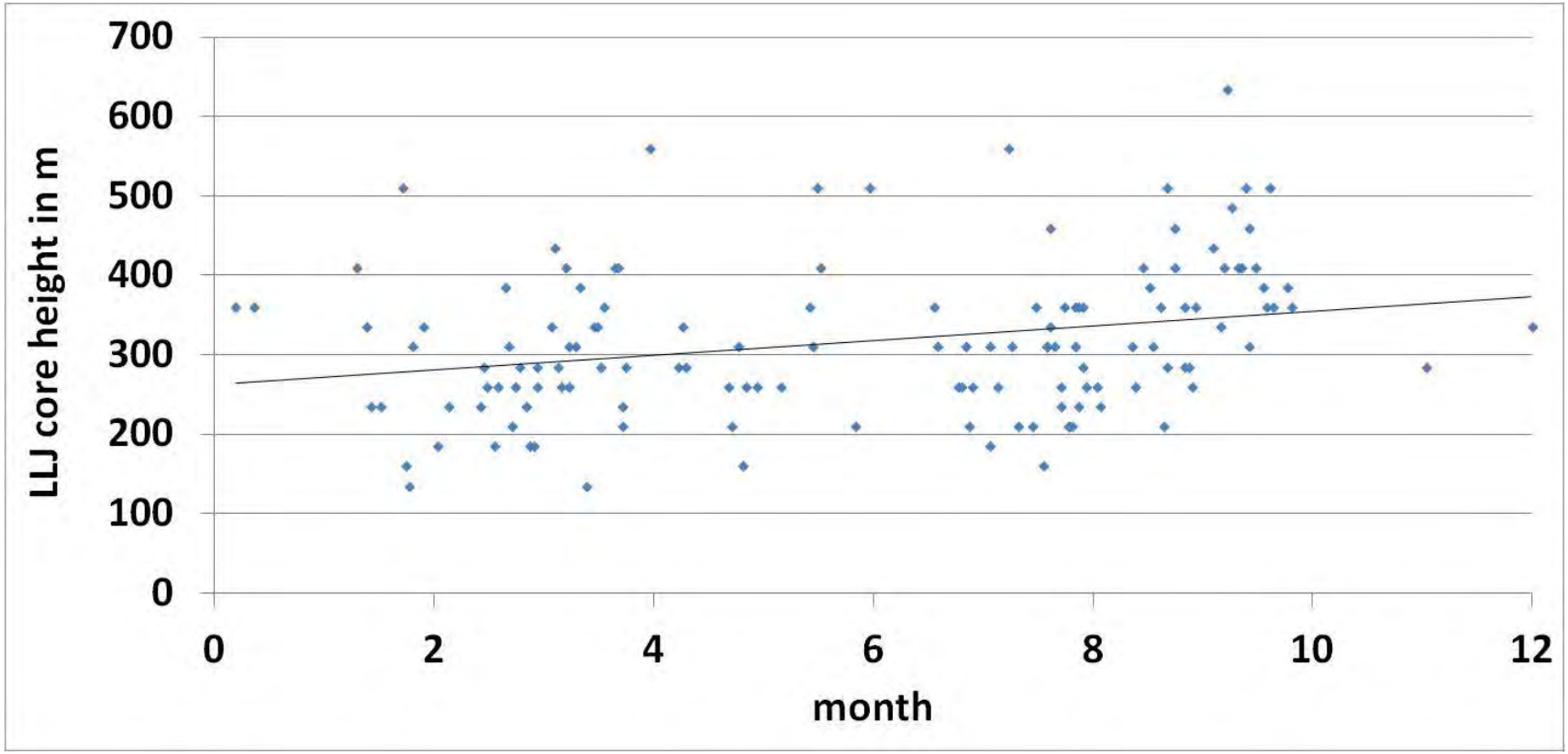
**HFZ high over Scandinavia**
**HNFA high over North Atlantic**
**...**

**“efficiency” of a circulation type to produce a LLJ over Hanover for 20 months in the years 2001 to 2003**

# height in m and speed in m/s of LLJ over Hannover 5.2001 – 4.2003

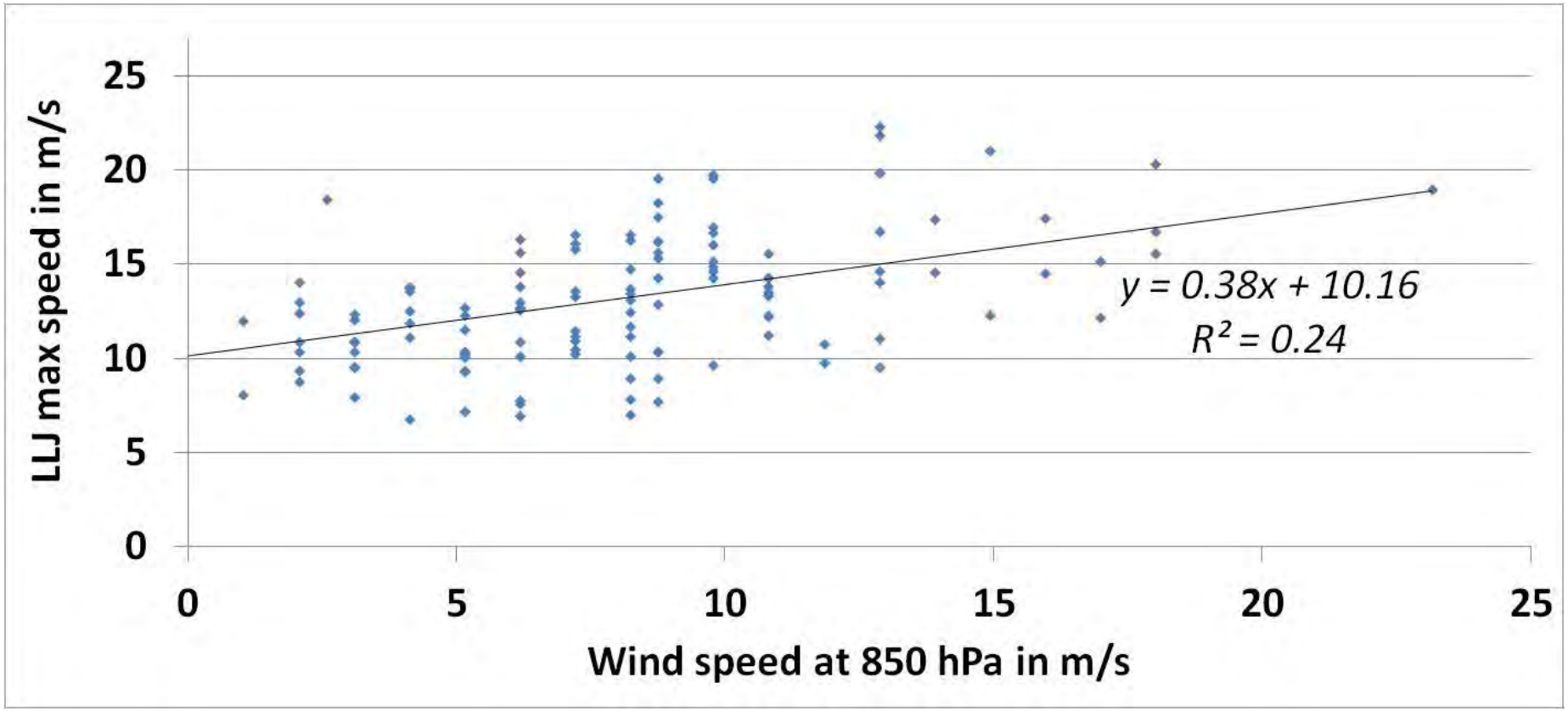


# annual variation of LLJ core height
# Hannover 5.2001 – 4.2003



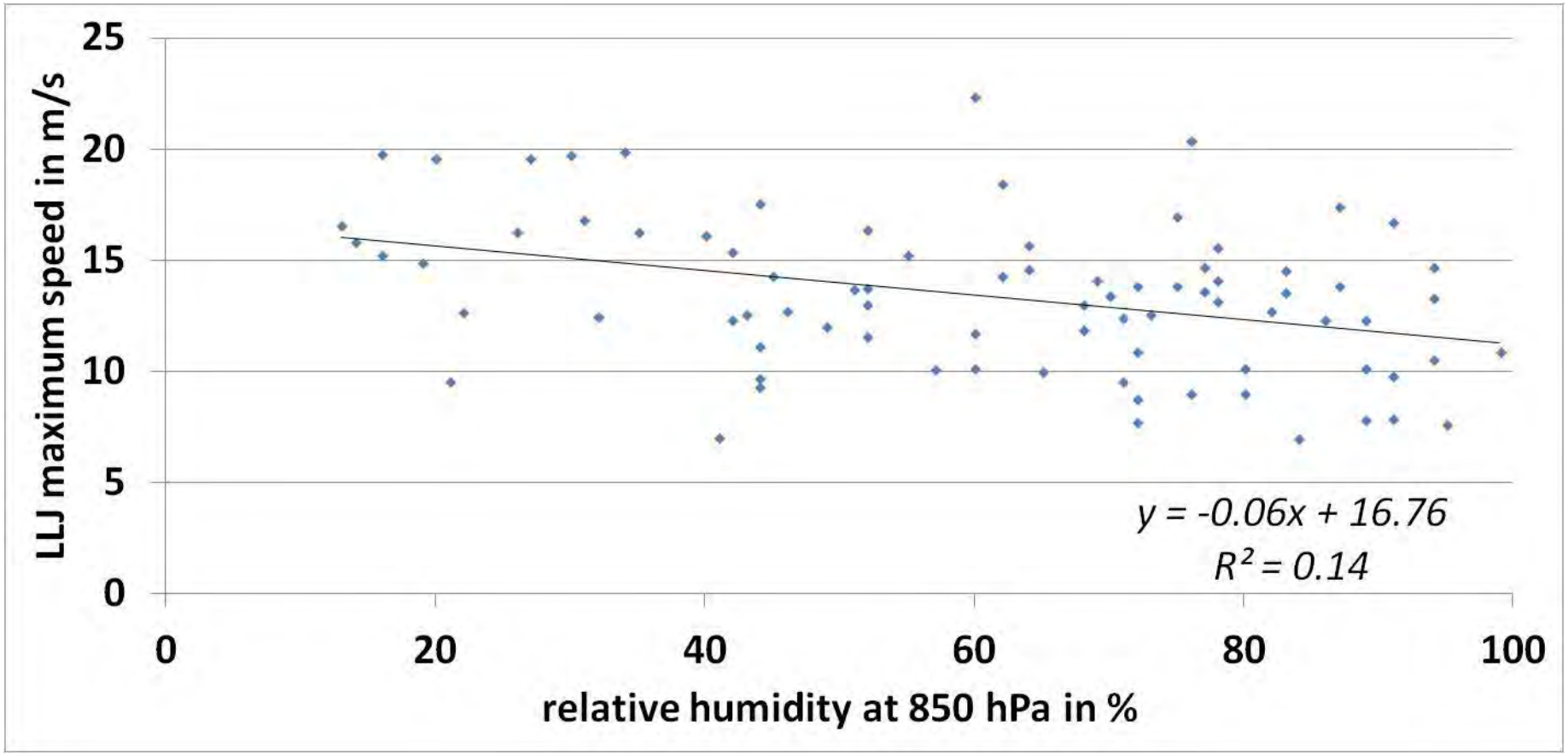
# LLJ wind speed compared to the driving pressure gradient force

**positive correlation**

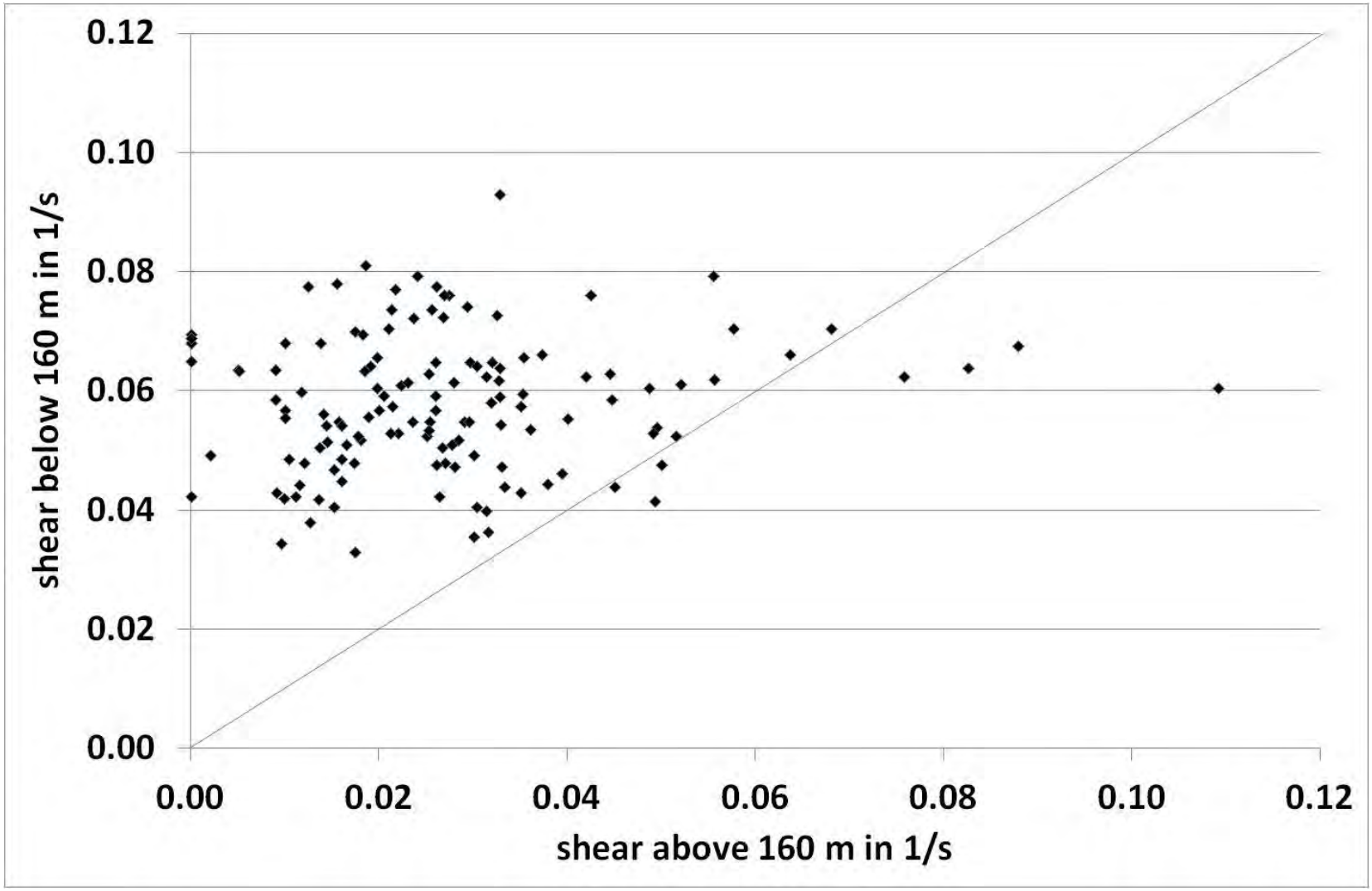


# LLJ wind speed compared to the relative humidity

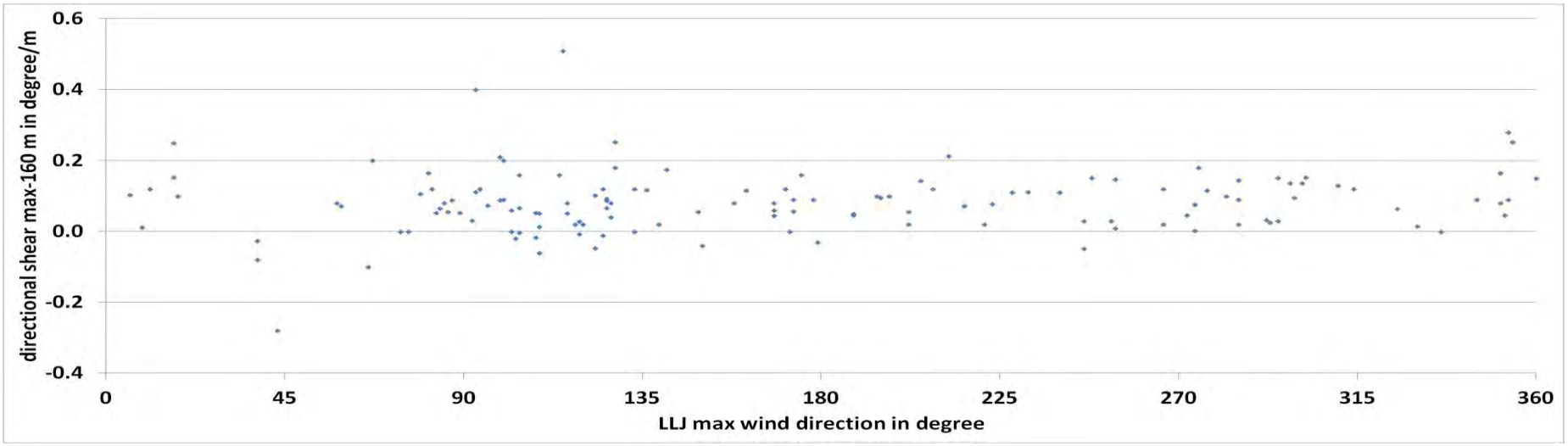
**negative correlation**

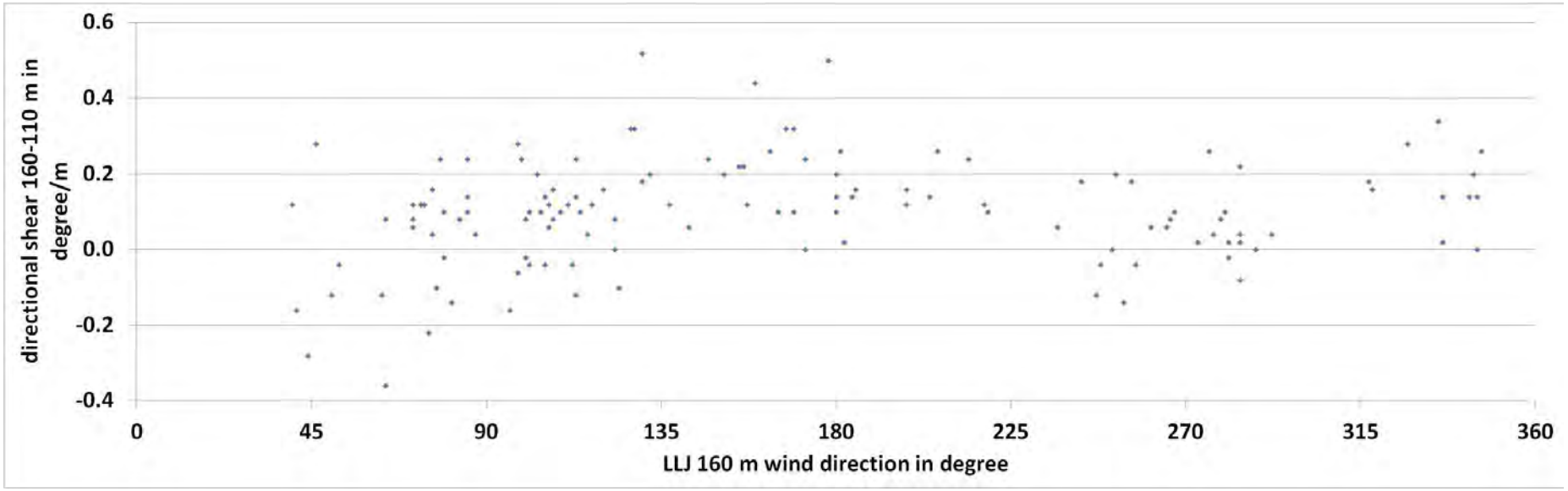


# shear above and below a height of 160 m in 1/s Hannover 5.2001 – 4.2003

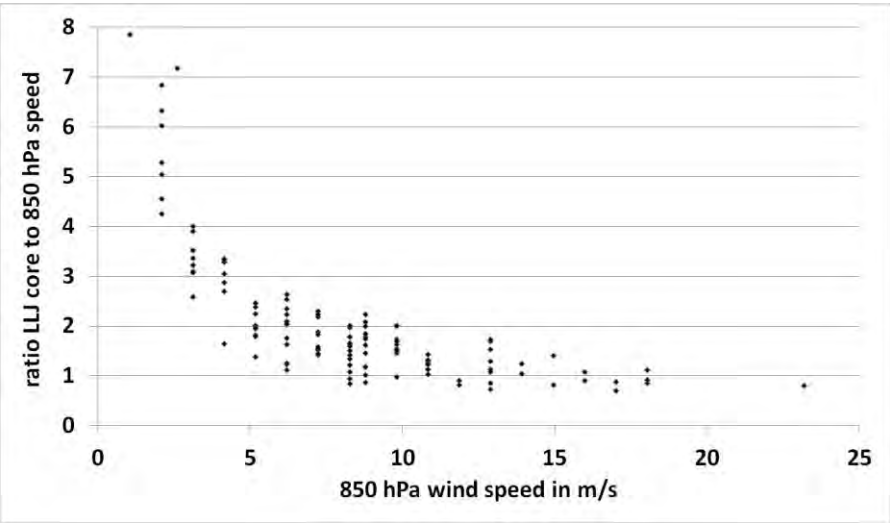


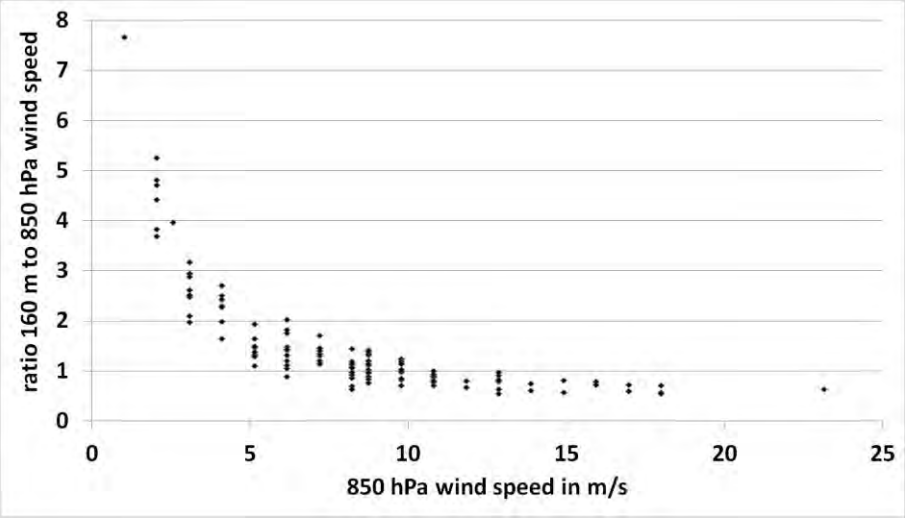
# directional variation of LLJ directional shear Hannover 5.2001 – 4.2003



# Geostrophy ratio vs. geostrophic wind speed
# Hannover 5.2001 – 4.2003




**speed-up until maximum shear is reached**
**further driving leads to higher LLJ core heights keeping shear constant**
**remaining scatter in maximum shear probably due to thermal stratification**

# Summary

## Climatology

- LLJ occur in nearly 22% of all nights (in de Bilt ca. 20%)
- jet cores between 135 and 650 m height (height slightly increases during the year)
- jet core speed at 7 to 23 m/s (core height and core speed positively correlated)

## correlation to driving forces

- 850 hPa wind between 1 and 18 m/s (Kottmeier et al. 1983: 6-11 m/s)
- jet core speed positively correlated to 850 hPa wind (maximum at 13 m/s)
- jet core speed negatively correlated to 850 hPa relative humidity

## dynamical implications on wind turbines

- speed shear over the rotor plane between 0.04 and 0.08 1/s
- directional shear over rotor plane between 0.1 and 0.2 degrees/m

## overall behaviour

- wind speeds up until the maximum shear between 0.04 and 0.08 1/s is reached
- further driving increases LLJ core height keeping shear constant


Thank you very
much for your
attention