WIND PROFILE AND TURBULENCE ON A MOUNTAIN IN LATERNS

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Abstract: First results and statistics for wind at 10 m and 30 m are presented. The variation and rough turbulence analysis shows influence of the topographical conditions. For 2196 data in ten minutes resolution wind speed in 30 m is 14 % higher than in 10 m agl. Difference in turbulence in two hights show the existence of wakes on the top.

Keywords : Wind distribution with hight, wind over orographic structure of 3 planes, distribution of direction in 3 main sector, distribution of turbulence, wake indication

1. INTRODUCTION

On the top of the mountain Nob in Laterns (lat: 47°16'53''; long: 9°45'44'') wind is measured in 30 m height (speed and direction) an in 10 m height (speed) in order to find out the wind energy potential. The mountain (1785 msl) consists of three planes.

2. DATA

The distribution of wind speed U30 and direction shows winds in a broad sector of south, southwest and NNW with maxima at 14 m/s in a measuring height of 30m for 2196 data (np). There is nearly no wind from 45 ° (Fig 1.). The reason for that is a number of mountains situated in this direction - shaddow of the alpine bow in this region.

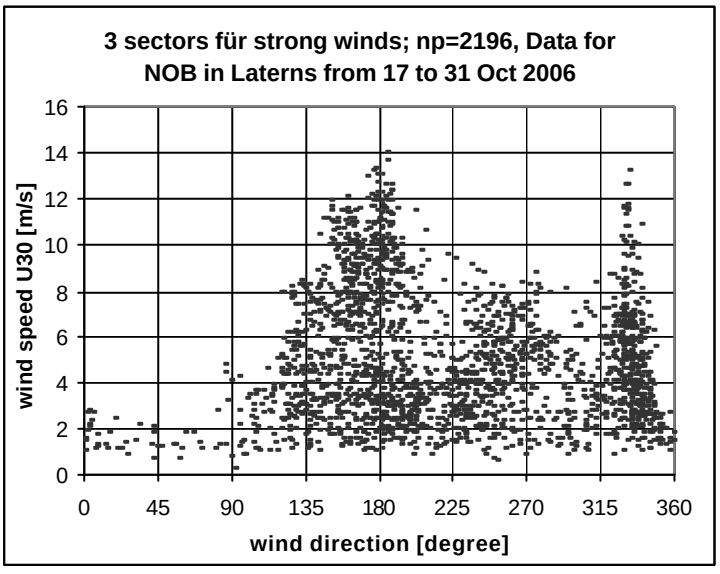

Figure 1: Distribution of wind speed and wind direction with 3 sectors with strong wind

3. RESULTS AND INTERPRETATION

The first aim was the wind profile which was analysed using 10min values in the two measuring heights 10 and 30m agl. We took a quotient of the wind speeds (Qu=U30/U10) derived from the ideas of the profile at the mountain Geiger to estimate which kind of profile we would get. A profile

of this Geiger-type was hardly found (u* and z_0 vary very strongly). In Fig 2. one finds a value of 1.14 for the 50percentile. This is equivalent to the median. The wind speed in 30 m is thus 14 percent higher than in 10 m. The 90percentile shows a value of 1.69 – in 10 percent of the cases the wind speed at 30 m is therefore 69% higher than at 10 m.

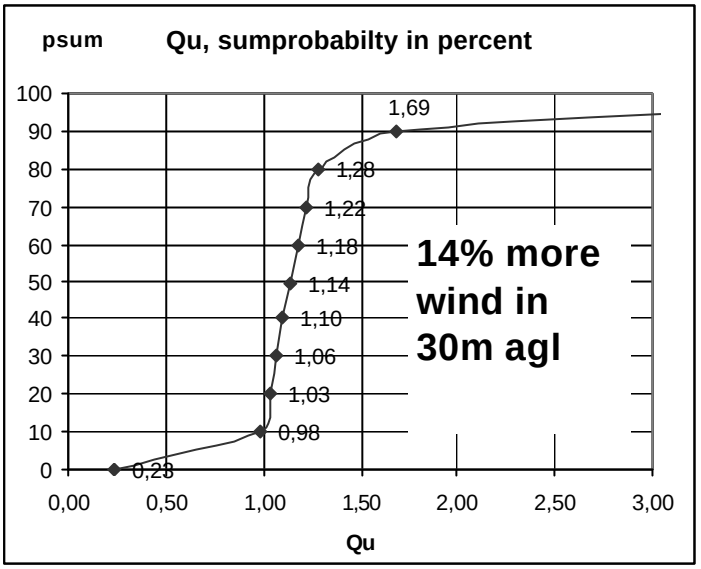

Figure 2: Summative probability of quotient of wind speed Qu;

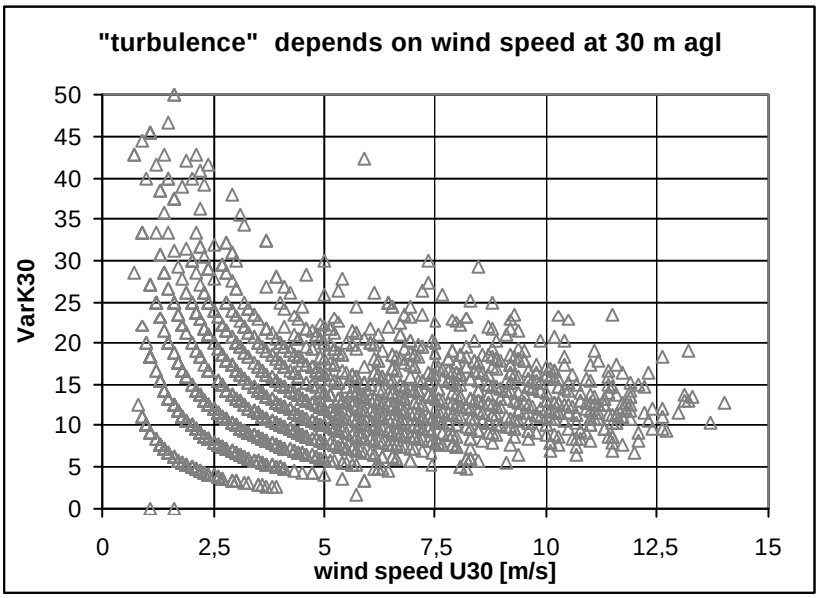

Figure 3: Turbulence depends on wind speed

From the measured standard deviation (SD) we calculated a variation coefficient VarK=SD/U. For low wind speeds the variation coefficient at 30m VarK30 ranges between 5 and 50. For wind speeds around 9 m/s we found a median (p50) of 13,3% as shown in Fig 3. The range of VarK30 at 9 m/s is from 7 to 21%. The distribution of the two VarKs is given in Fig 4. where this rough parameter for turbulence shows a 50percentile of 14,5% in 10 m height and of 12,3% in 30 m hight (turb30). This shows that in a greater height the turbulence on an mountain top is smaler than in lower heights.

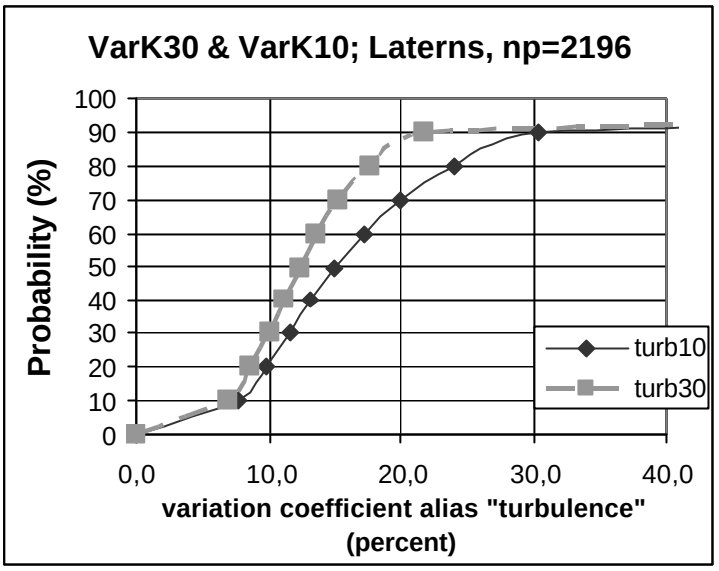

Figure 4: Probability of turbulence in two different hights (10 m and 30m agl)

The orography has an influence on the variation coefficient VarK. For all cases (np> 2000) VarK10 in 10 m agl shows the connection to the wind direction (Fig 5.1) in a broad band from 5 to 25 percent for direction 100 to 300 degrees and in another band from 5 to 45 percent for 315 to 350 degrees. In 30m VarK30 gives us 3 sectors of main wind directions and a band from 3 to 20 percent – Fig 4.2. The difference on turbulence in the northnorthwest-sector leads to a pronounced system of wakes (stationary or unstationary).

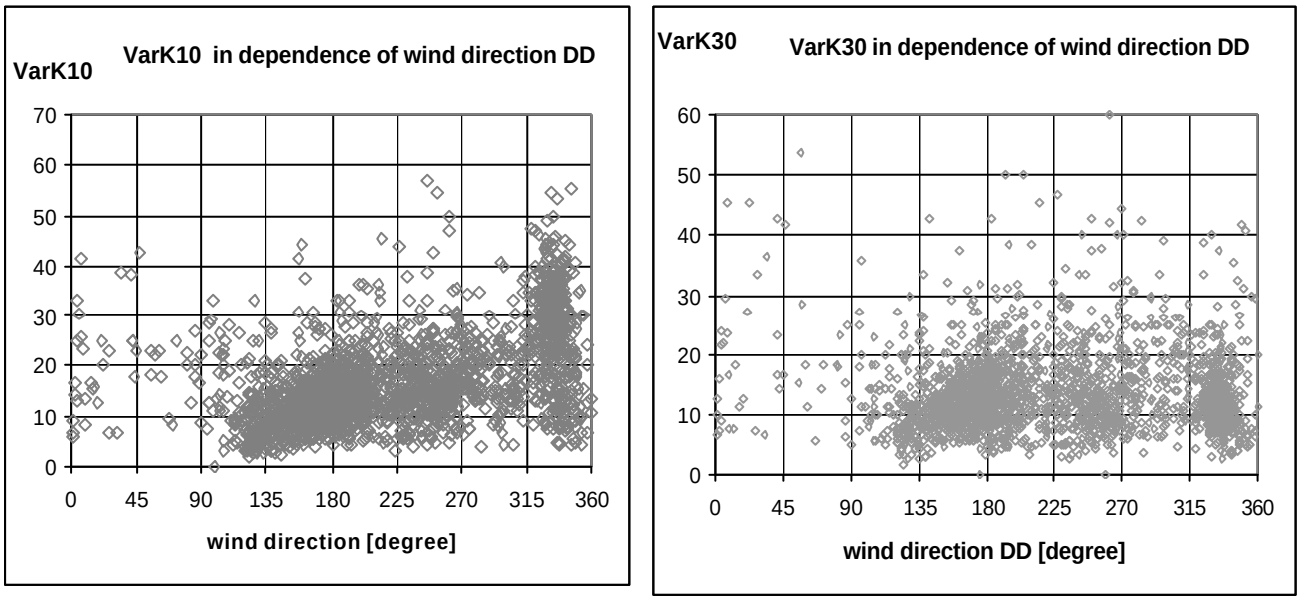

Figure 5: Fig 5.1 -Left: VarK10 as a indicator of turbulenc in 10 m agl; Fig 5.2 -Right: VarK30 as an indicator on turbulence in 30 m agl

We found also a signal of this structure in Qu – Fig 6. The quotient in this sector ranges between 1 an 4.5. In the other sector it ranges between 0.5 and 1.5. The localisation of the sensors in the microscale shows that for wind from 330° the real measuring height is nearly 5 m above a streamline. The strong edge in this direction may produce wakes with different diameters depending on the wind speed.

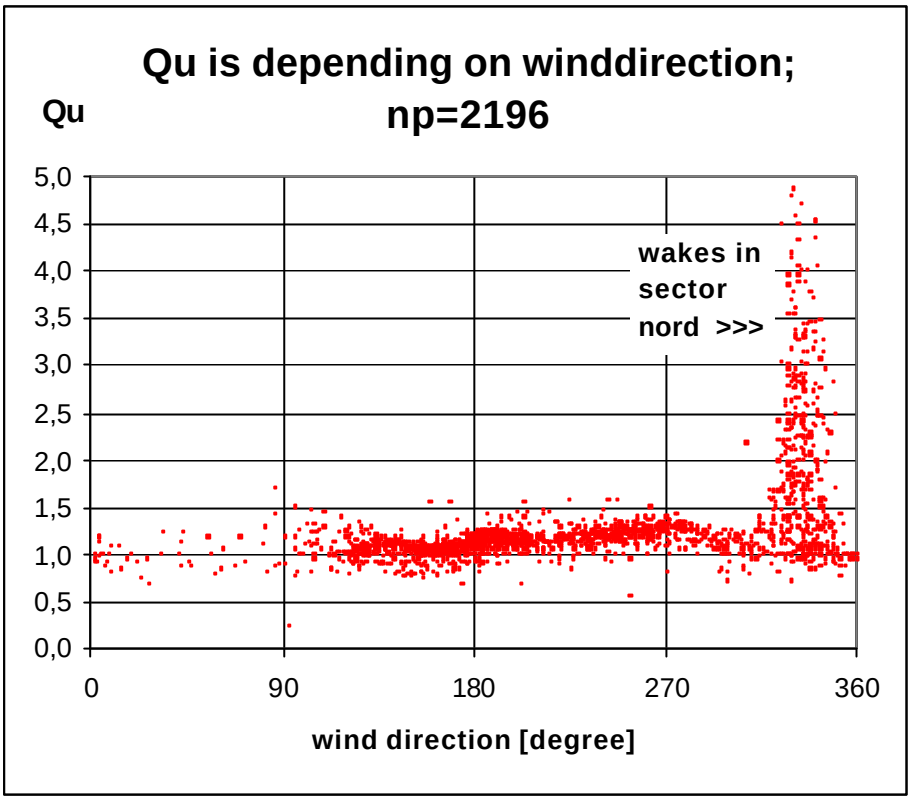

Figure 6: The quotient Qu is depending an wind direction with a mean value 1.0 to 1.3 and an extreme peak at direction of 330 degree.

A small variation can also been seen. Qu is in southwest direction connected with mean condition at 1.25. So the wind speed in 30 meters is 25% higher than in 10 m agl.

4. CONCLUSION

The consequence of the orographic structur consisting of 3 ridges and 3 planes (roughly) is found in the distribution of wind direction in 2 broad and 1 medium mainsector. The variabiltiy of wind speed shows two similar sectors (VarK10 ~ 15%) and one special sector (VarK10 ~ 35%). In 30 m agl the turbulence is more uniform (p10: 7% and p90: 23%) than in 10 m agl with the distribution keydata p10: 8% and p90: 30%. With higher wind speed turbulence is near to 13 percent.

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