Measured (by SODAR) vertical profiles of Weibull parameters over a hill

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Flat terrain
For comparison:

flat homogeneous terrain

wind profiles (SODAR data)

daytime, convective

nocturnal, with low-level jet
For comparison:

flat homogeneous terrain (SODAR data)

- diurnal wind variation in four heights
- cross-over of daytime and nocturnal wind profiles
For comparison:

flat homogeneous terrain (SODAR data and empirical relations)

Weibull scale parameter

\[ A(z) = A_0 \left(1 - e^{-\gamma z}\right) \]

Weibull form parameter

\[ k(z) - k_A = c_2 \left(z - z_A\right) \exp\left(-\frac{z - z_A}{z_m - z_A}\right) \]

following Wieringa (1988)
Complex terrain
Complex terrain

different forms of complexity
Complex terrain

impact on boundary-layer structure

- free troposphere
- $\sigma(2000)$ m
- mountain boundary layer
- Ekman sublayer
- $\sigma(50) - \sigma(100)$ m
- constant-flux sublayer
- valley sublayer
Complex terrain

thermally induced secondary flows on different scales
Flow speed-up over a gentle hill (analytical model)
Flow speed-up over a gentle hill (analytical model)

as function of thermal stability

short dash: stable
full: neutral
dash: unstable
Flow speed-up over a gentle hill
diurnal wind variation in three heights (SODAR data)
Weibull parameters over hills

Well-mixed boundary layer

Stable BL
Flow over a gentle hill (SODAR data and empirical relations)

Weibull scale parameter

\[ A(z) = A_0 \left(1 - e^{-\gamma z}\right) \]

\( A_0 = 10.67 \text{ m/s}, \gamma = 0.035 \)

Weibull form parameter

\[ k(z) - k_A = c_2 (z - z_A) \exp\left(-\frac{z - z_A}{z_m - z_A}\right) \]

\( z_A = 10 \text{ m}, z_m = 50 \text{ m}, c_2 = 0.01 \)

following Wieringa (1988)
Summary

**flat terrain**

**hill top**

**diurnal wind variation**

**scale parameter**

**form parameter**

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**MiniSODAR, flat terrain, April 1999**

**MiniSODAR, hill top, September 1998**

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Prof. Dr. Stefan Emeis | Weibull parameters over hills

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Thank you for your attention