Recent developments in high-resolution wind field modelling in complex terrain for dispersion simulations using GRAMM-SCI

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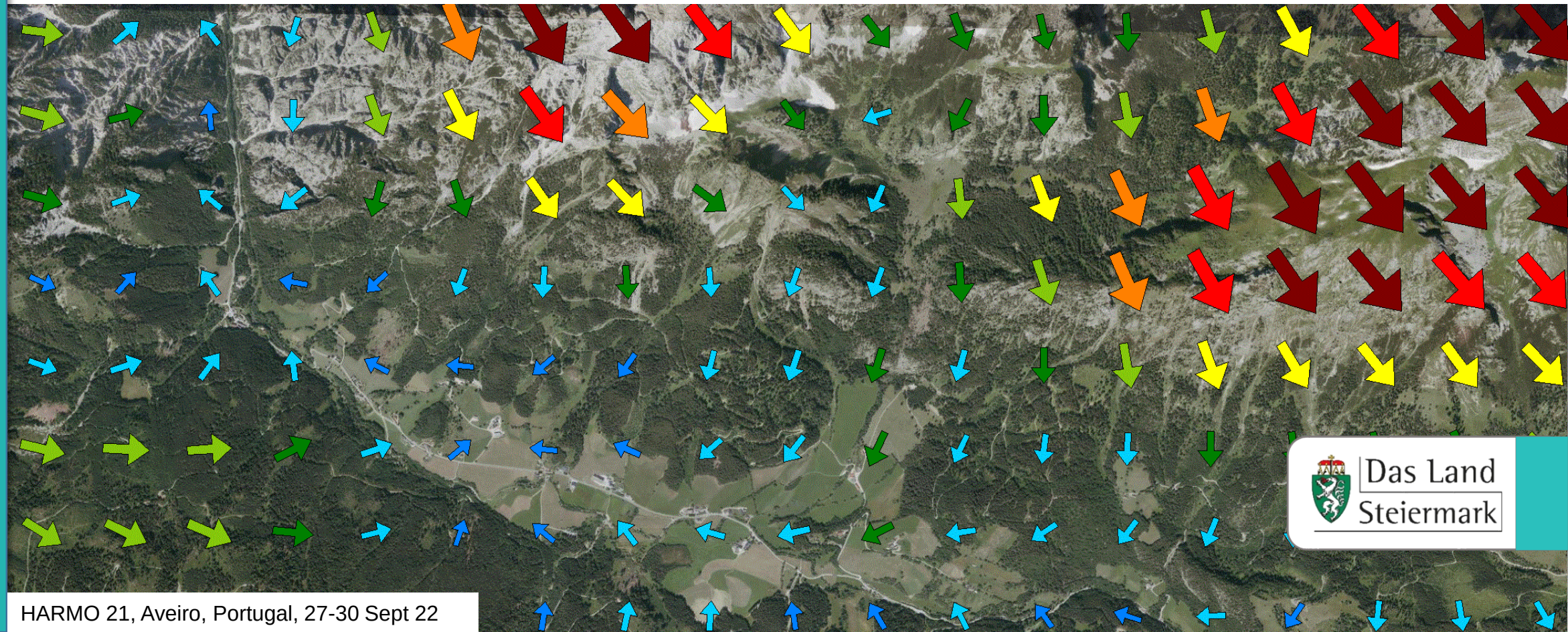
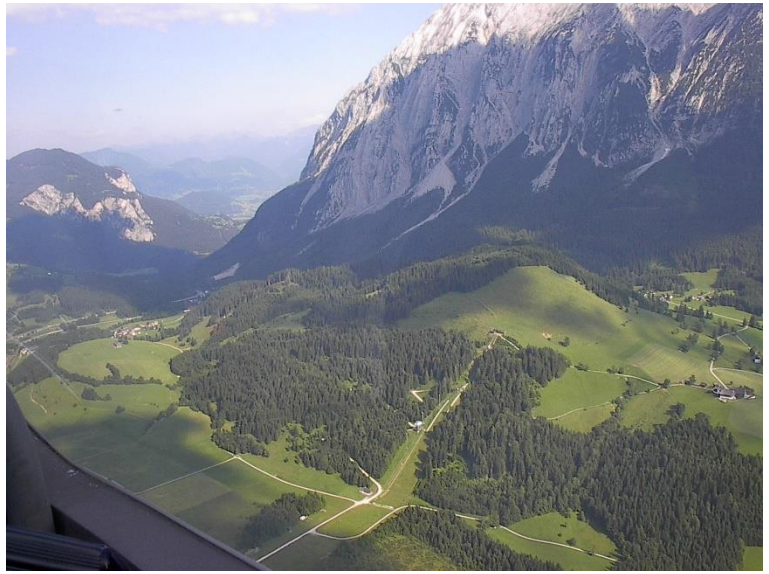
Regional Government of Styria, Austria



HARMO 21, Aveiro, Portugal, 27-30 Sept 22

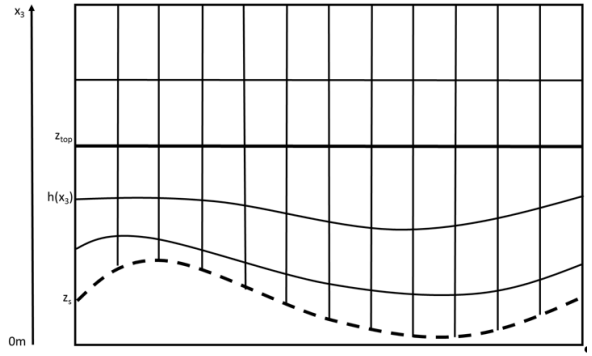
Styria – beautiful landscape, but…



Das Land Steiermark

GRAMM-SCI

- New branch of the Graz Mesoscale Model (GRAMM, since 1989)
- Developed at the Regional Government of Styria, Air Quality Section, since 2019
- Key features of GRAMM-SCI
  - Initialization and transient boundary conditions using ERA5 reanalysis data
  - Hybrid grid (terrain following in the boundary layer, above equal level heights)
  - Conservation equation for cloud-water content
  - Evaporation and condensation in the atmosphere
  - Cloudiness and snow cover considered
  - Improved soil heat flux scheme for lakes
  - Nesting and Downscaling methods introduced
  - Nudging techniques implemented
  - Forests considered as drag force



Oettl, D. (2020) Gefahrstoffe – Reinhaltung der Luft, 80, 318-324
Oettl, D., and G. Veratti (2021) Atmospheric Research, 249, 105288
Oettl, D. (2021) Atmosphere, 12, 298. https://doi.org/10.3390/atmos12030298
Oettl, D., and L. Bergamin (2022) Gefahrstoffe – Reinhaltung der Luft, (in print)

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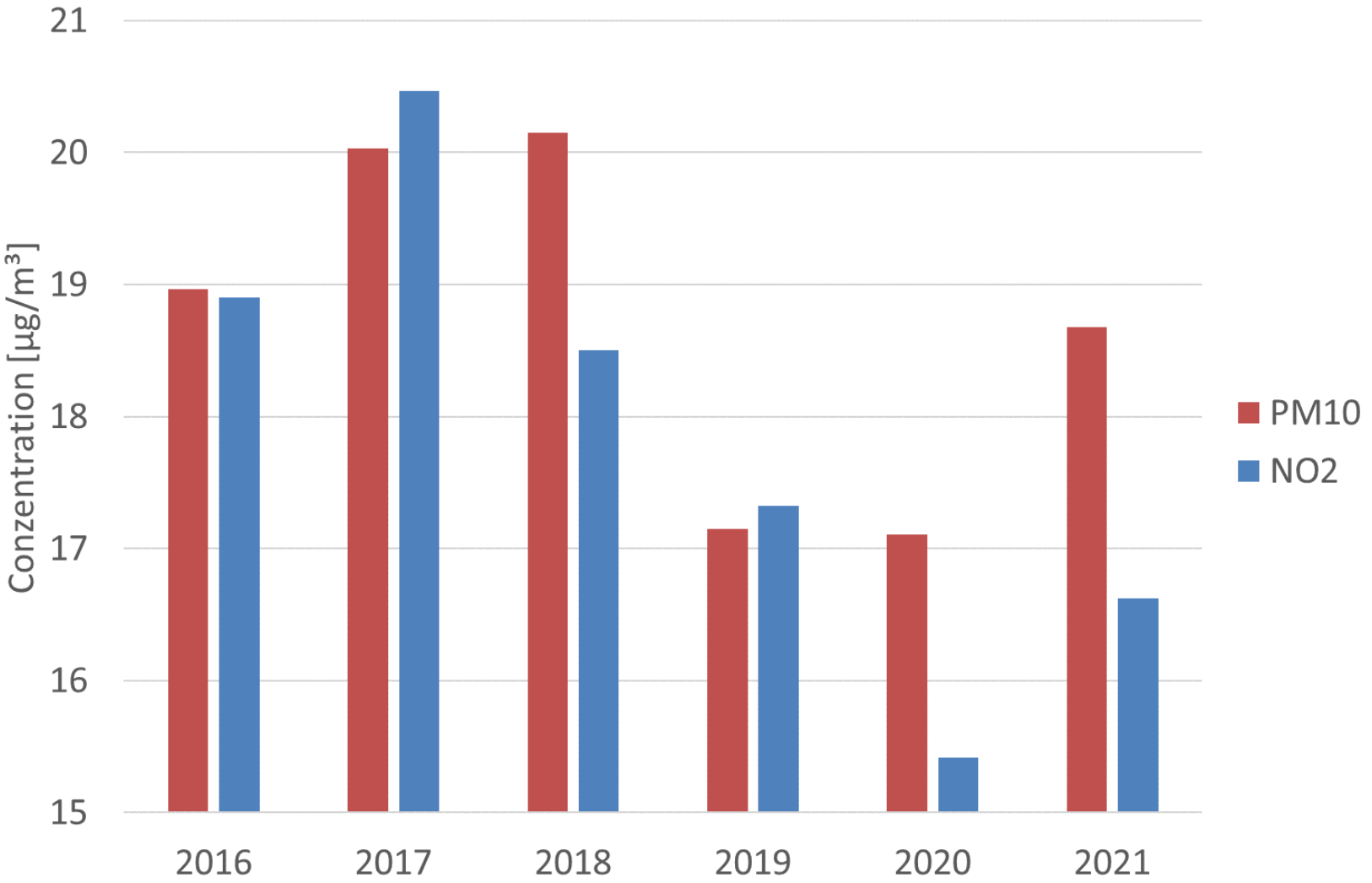
Methodology – Reference Year 2017



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Methodology – Modeling Strategy

3 nested modeling domains

	Δx [m]	Z1 [m]	#Layers	stretch	Top [km]	Δtmax [s]	Re-Initialization	Boundary-Conditions Update [h]
ERA5	1000	10	26	1,27	19	15	72 h	3
NESTING	400	10	26	1,26	16	10	72 h	-
DOWNSCALING	200	10	25	1,26	12	5	300 s	-

Simulated months: Jan, Mar, May, Jun, Aug, Oct, Dec 2017

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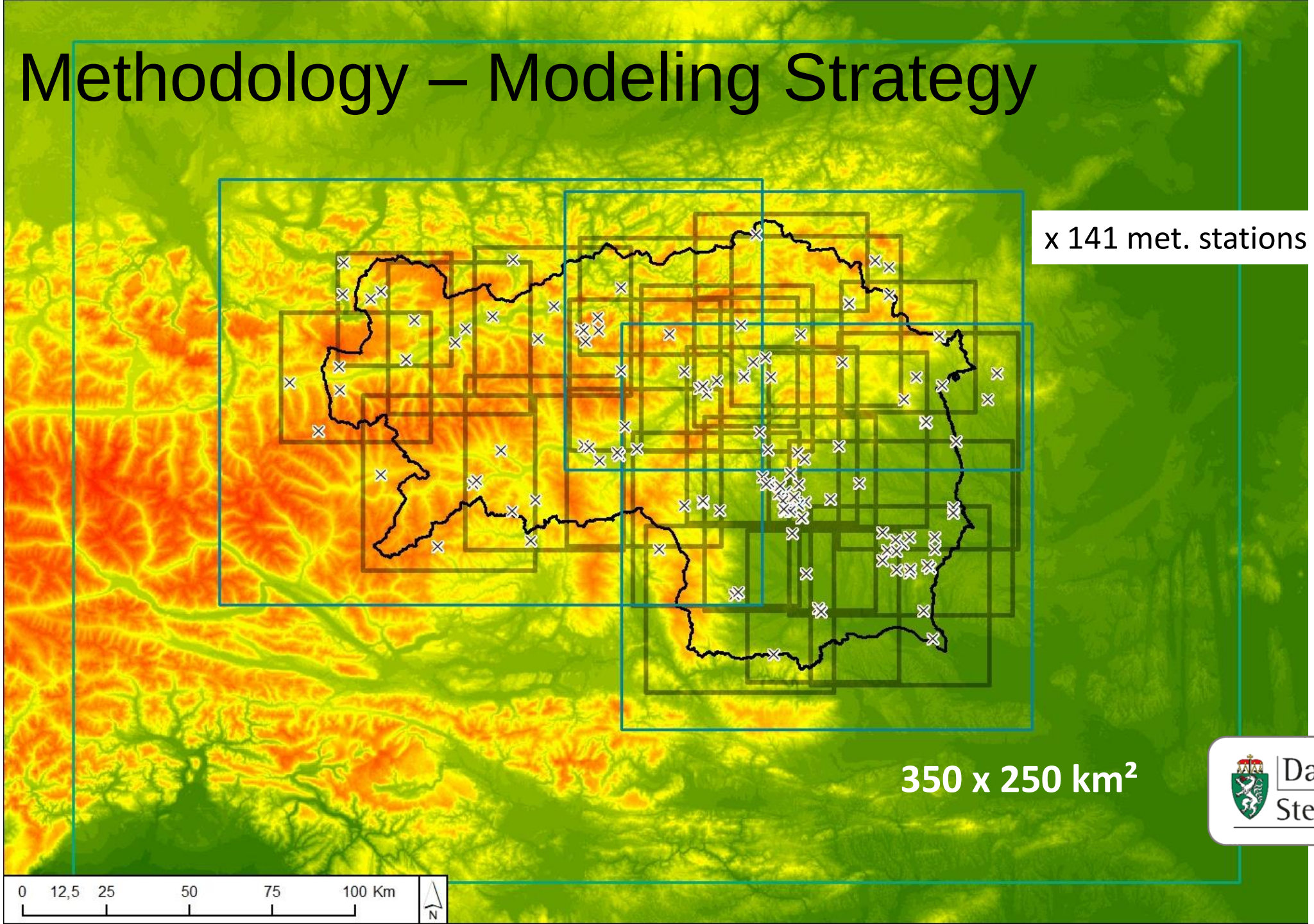
Methodology – Modeling Strategy



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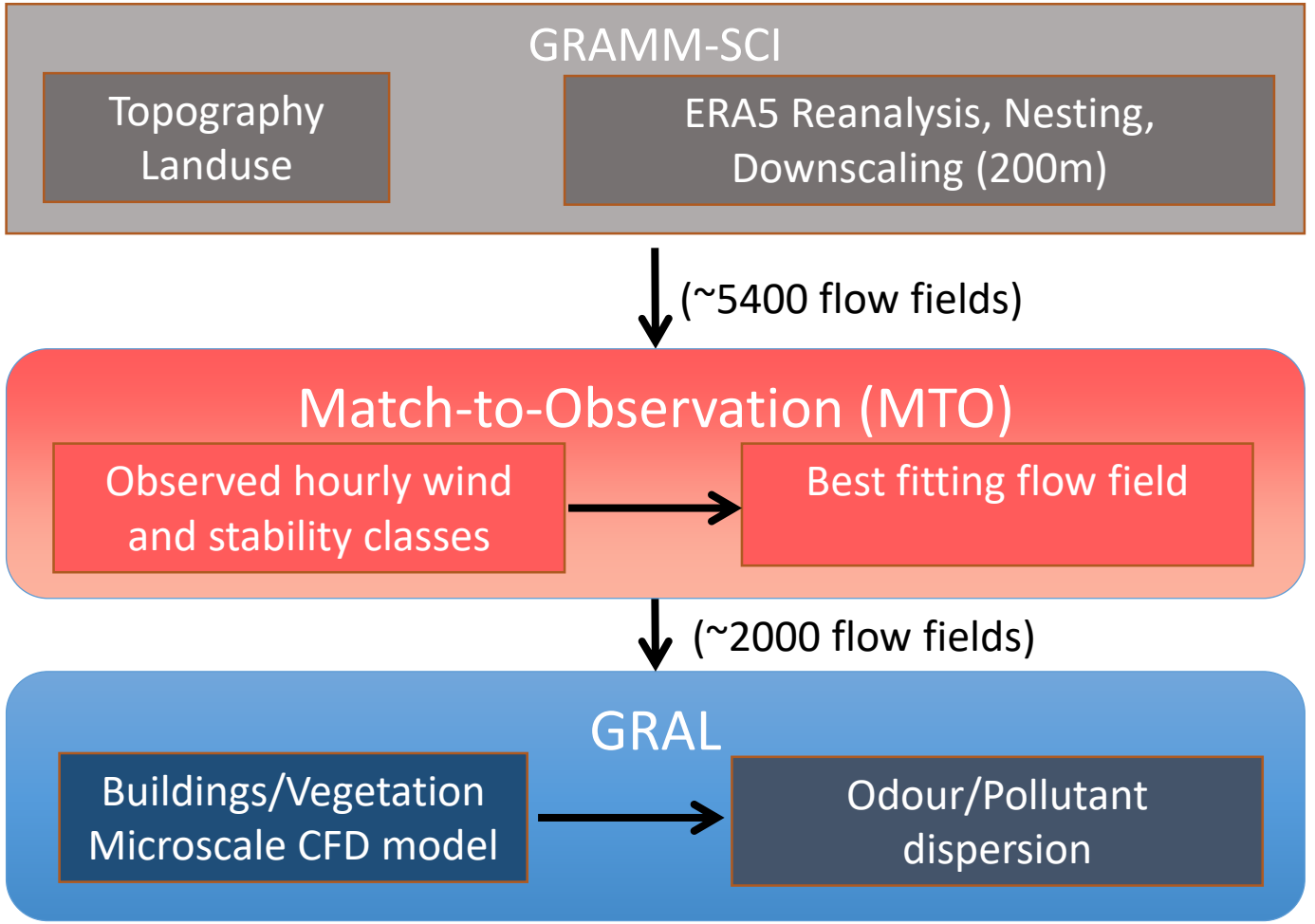
Match-to-Observation algorithm (MTO)

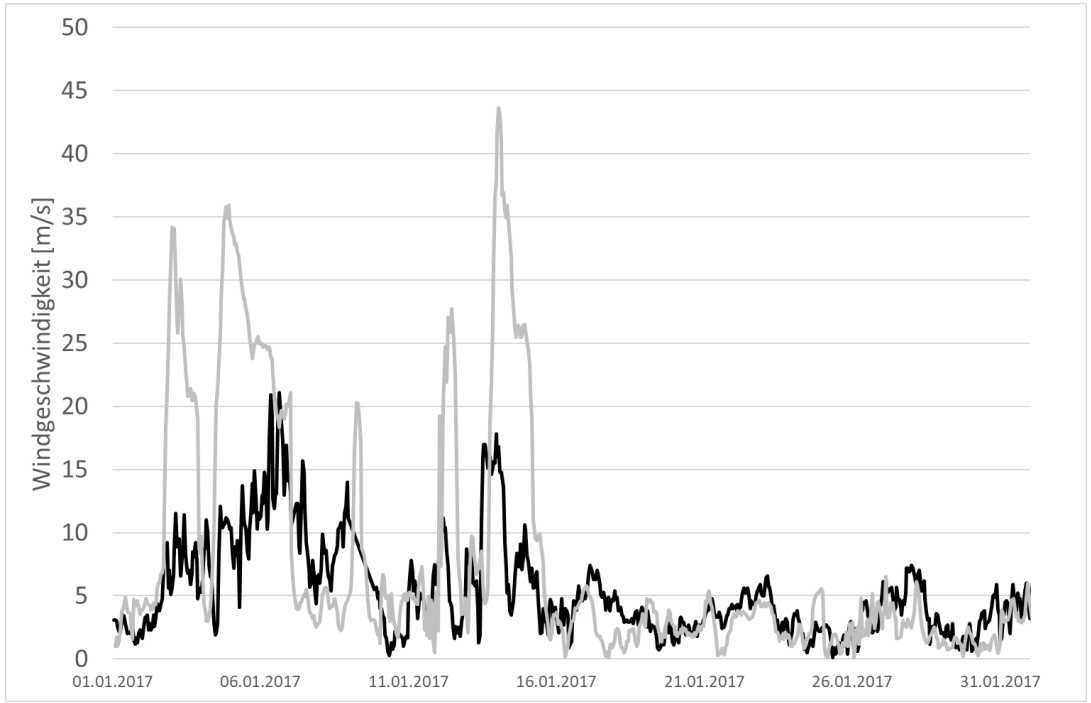


Das Land Steiermark

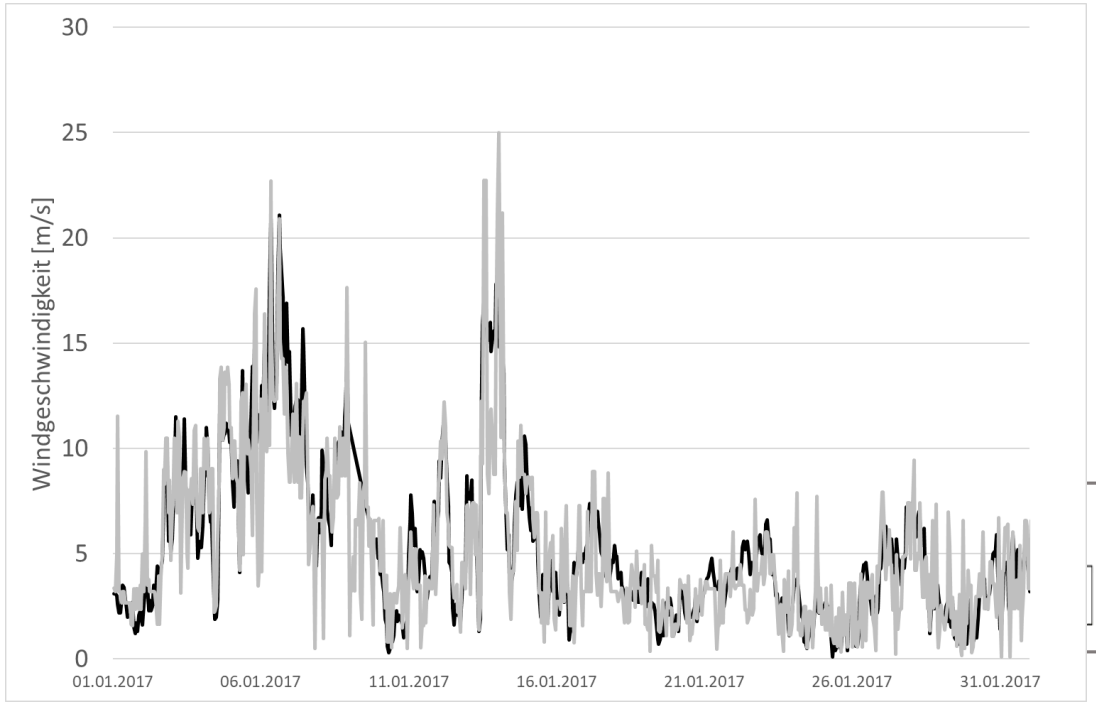
Results

Schoeckl, 1443m a.s.l., Jan 17

Raw data



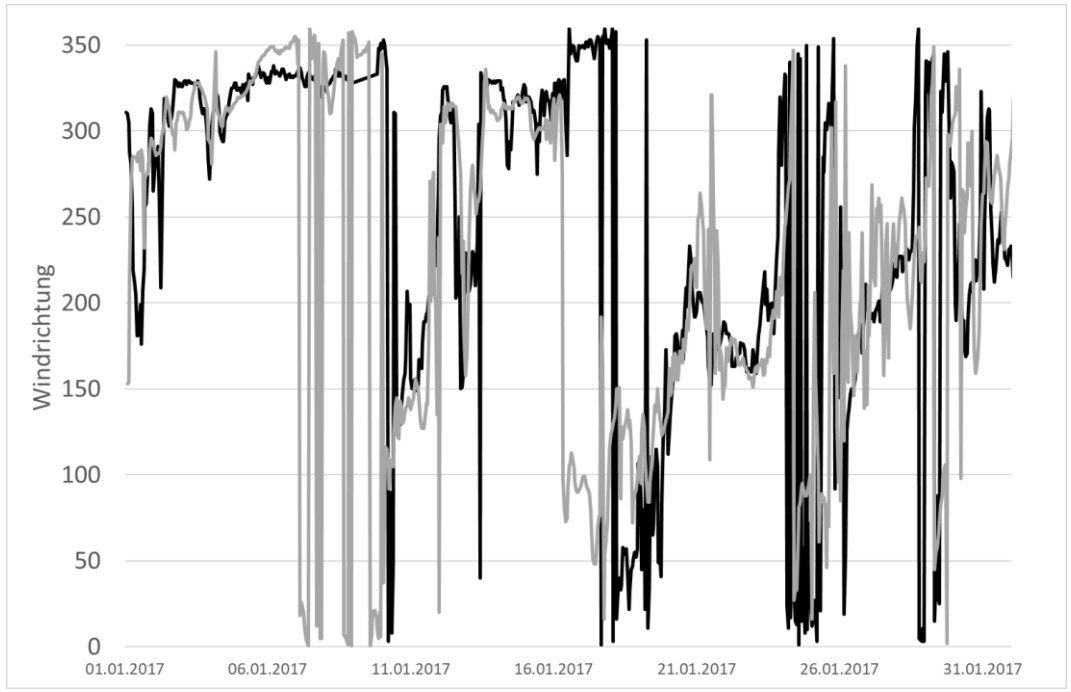
MTO



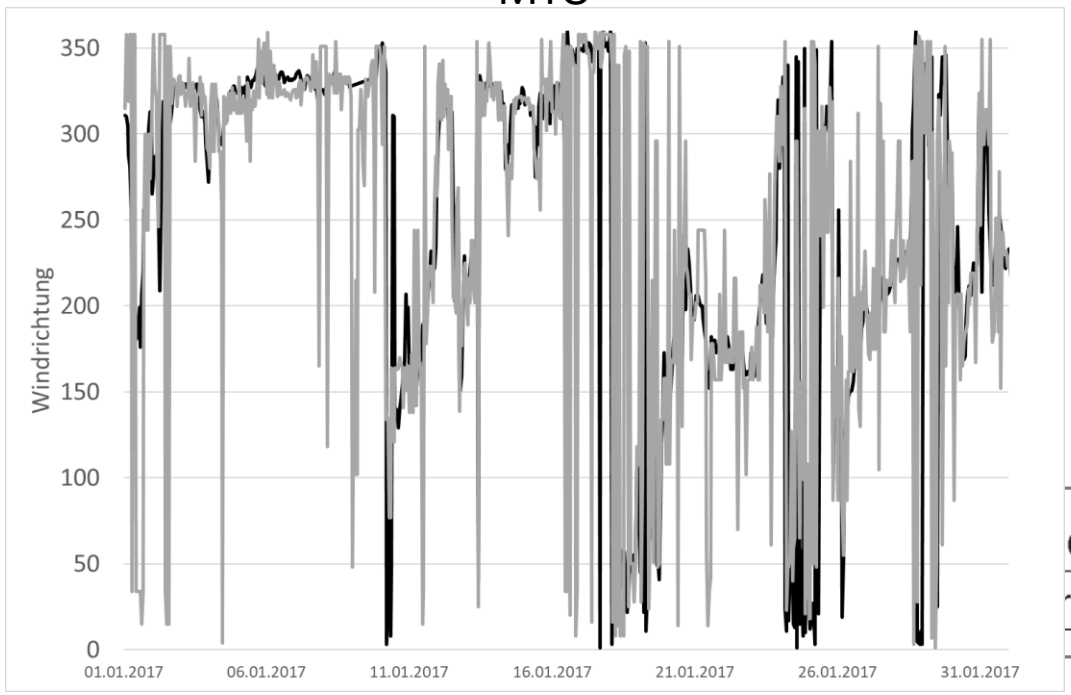
Results

Schoeckl, 1443m a.s.l., Jan 17

Raw data



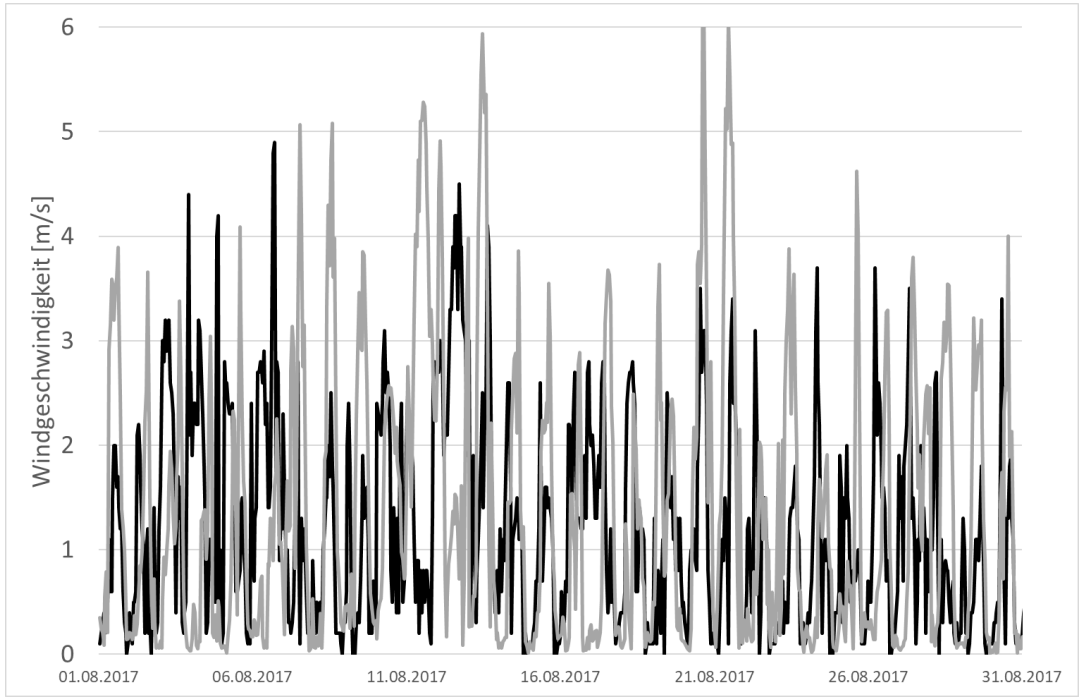
MTO



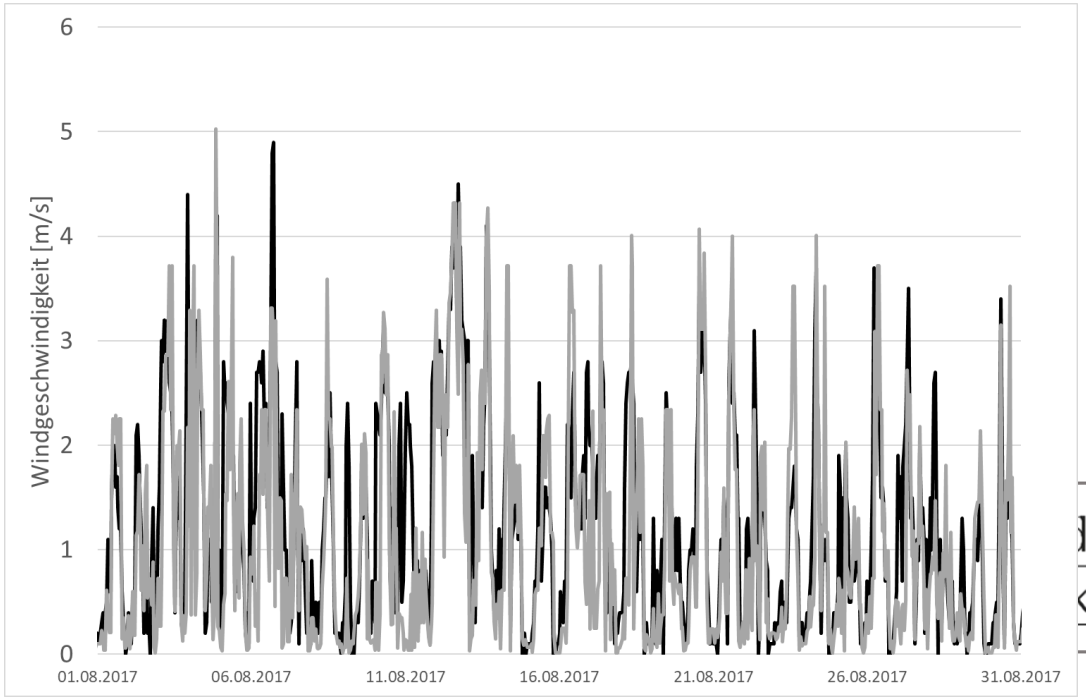
Results

Frohnleiten, 421m a.s.l. , Aug 17

Raw data



MTO

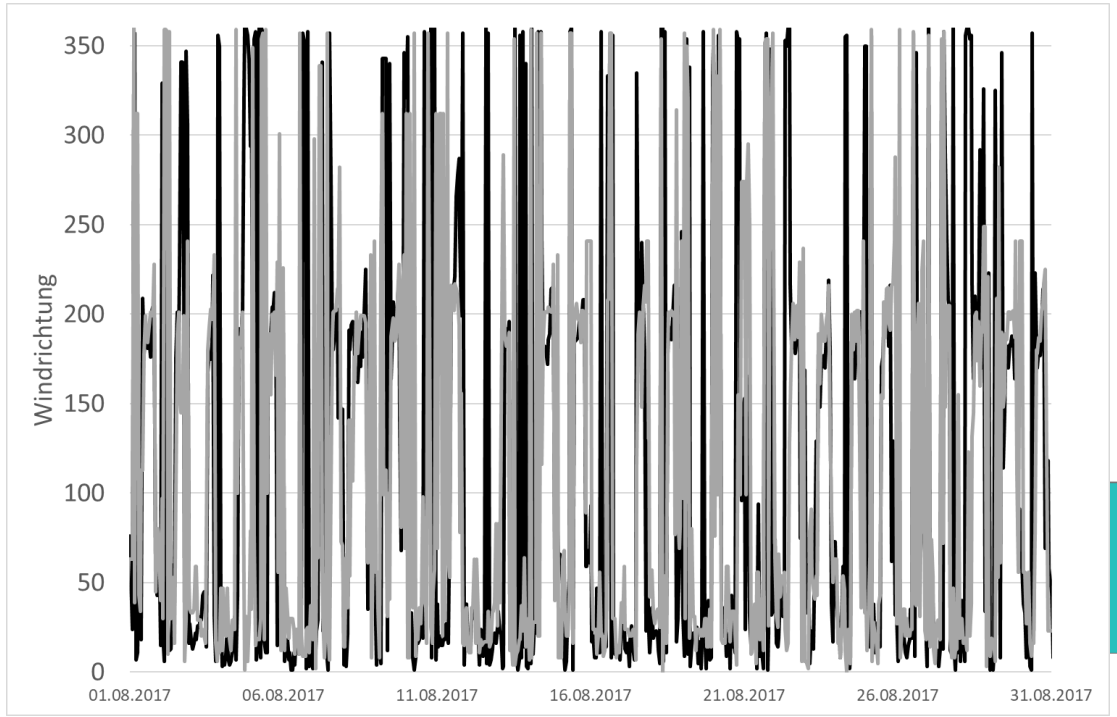


Results

Frohnleiten, 421m a.s.l. , Aug 17

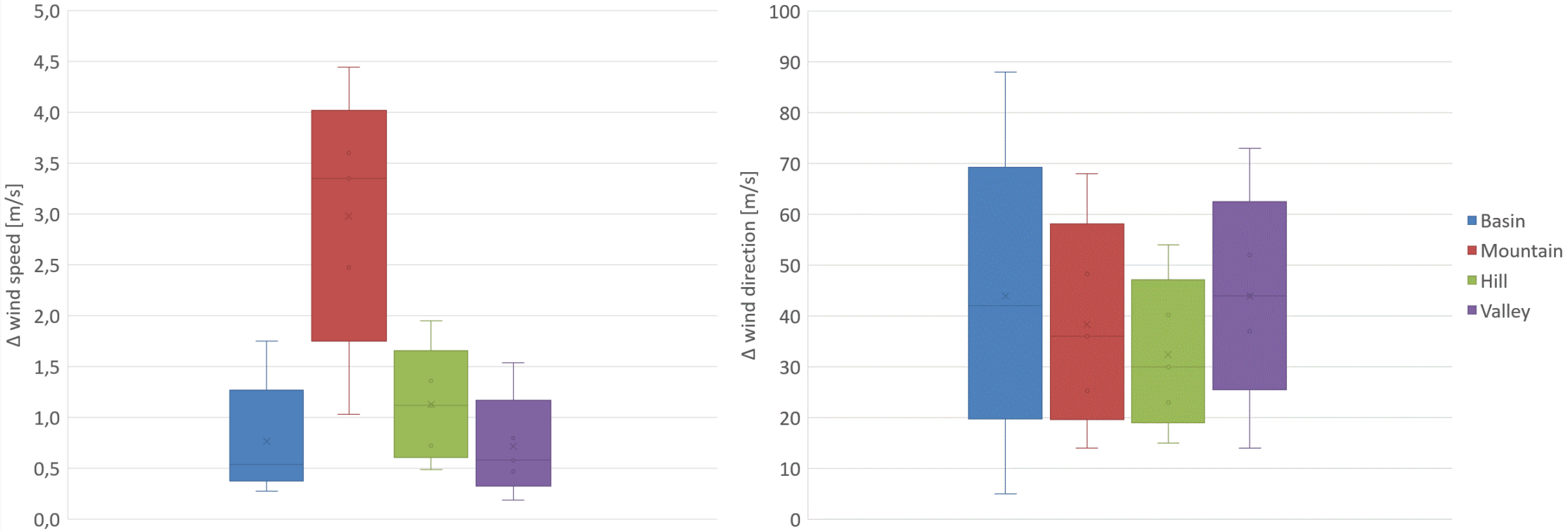
Raw data

MTO



Results

Hourly bias in wind speed and –direction

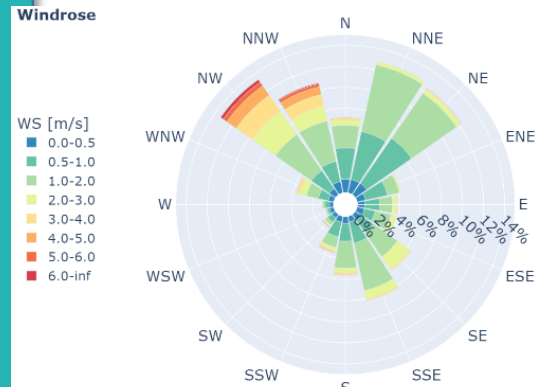


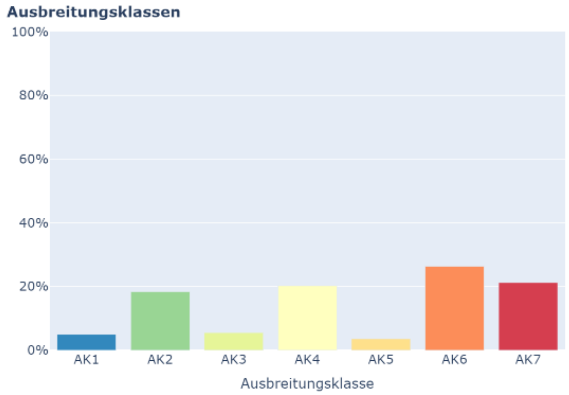
Das Land Steiermark

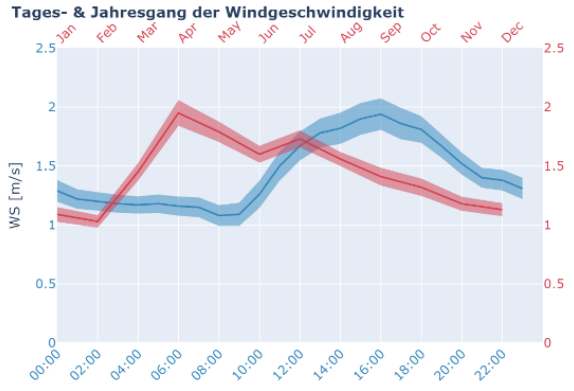
Results

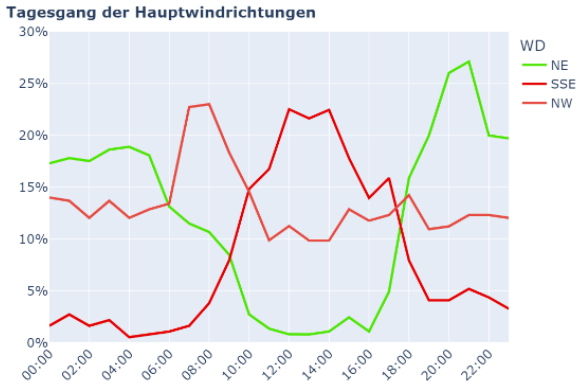
Graz-Universitaet, 367m a.s.l.
34 m a.g.l.

Obs

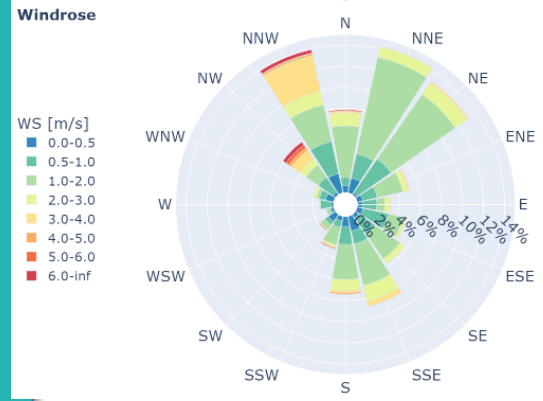


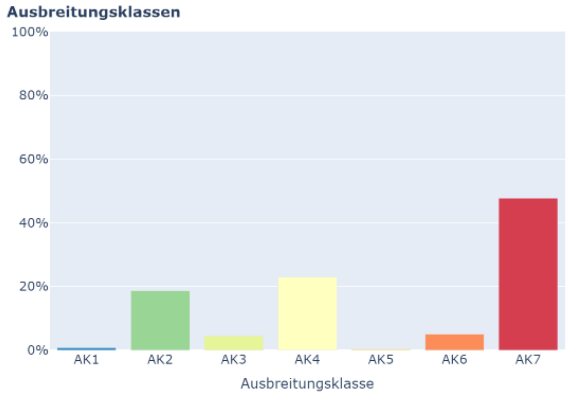


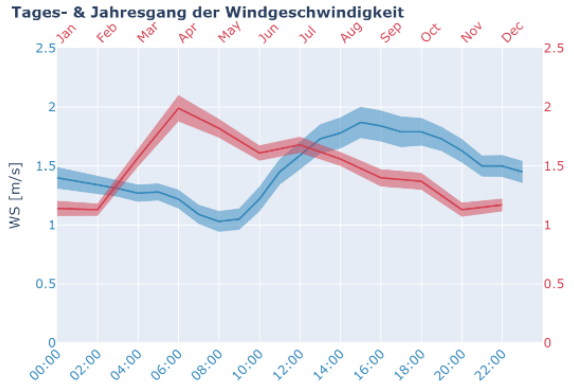


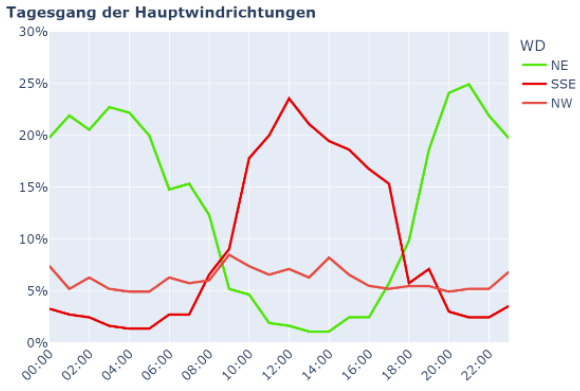


Mod





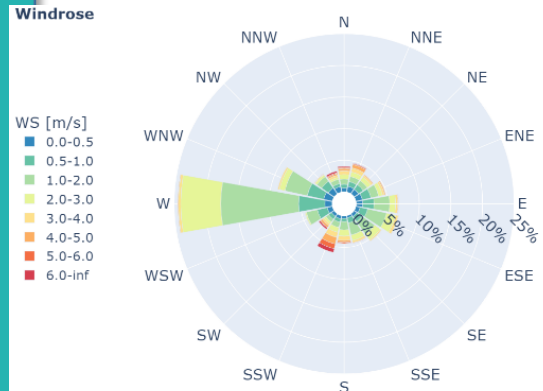


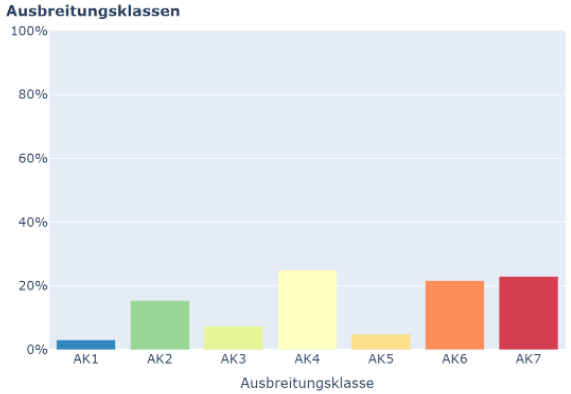


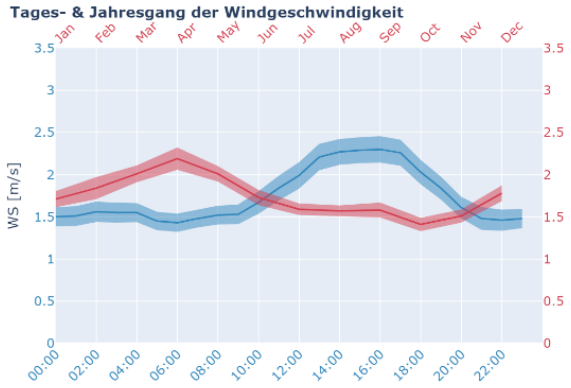
Results

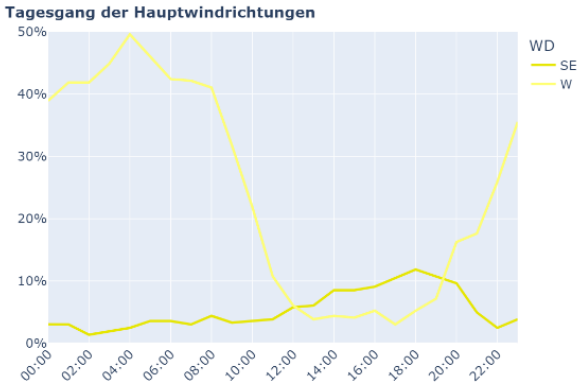
Bad Radkersburg, 207m a.s.l.
18 m a.g.l.

Obs









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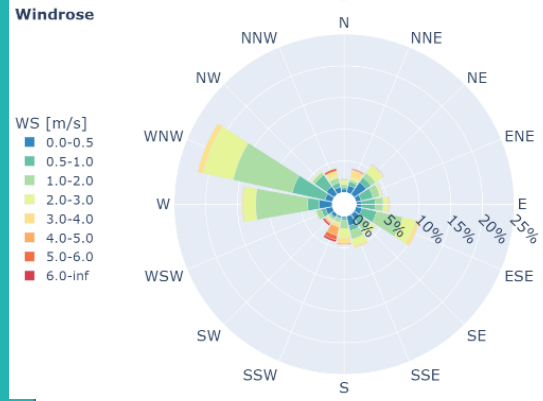
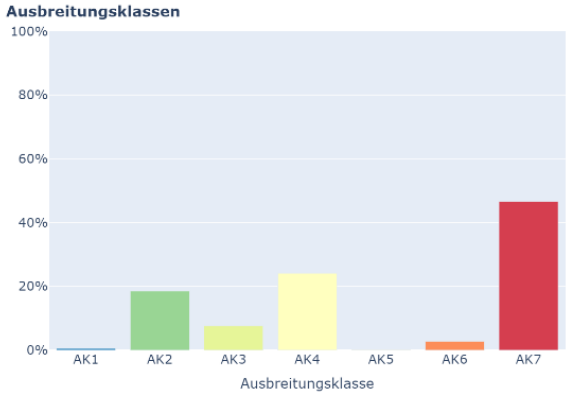
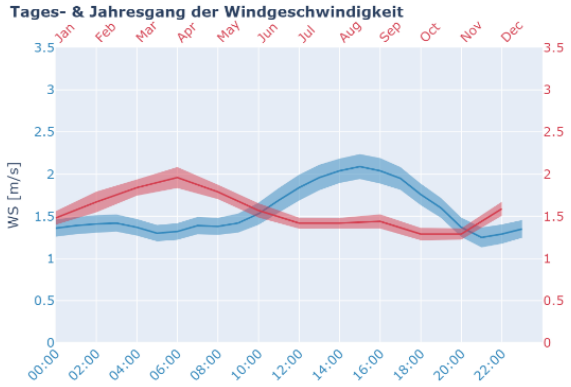
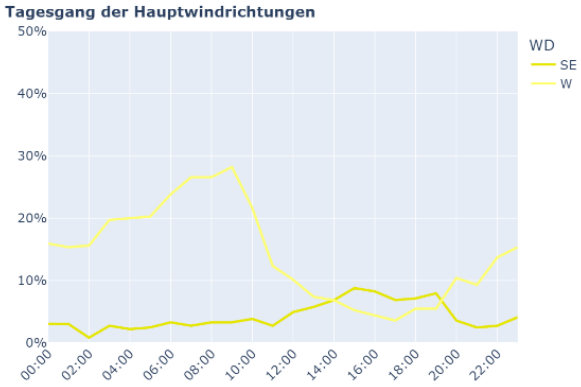




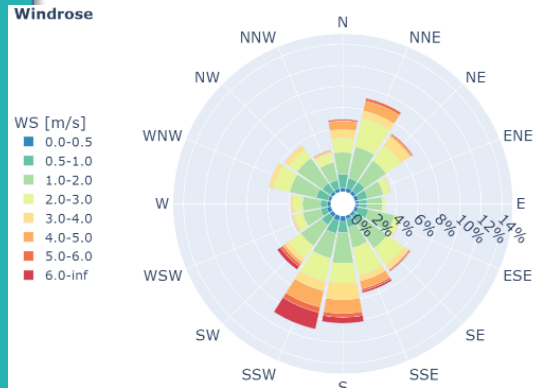


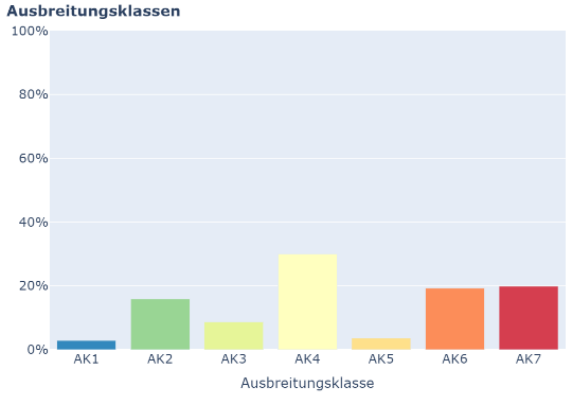


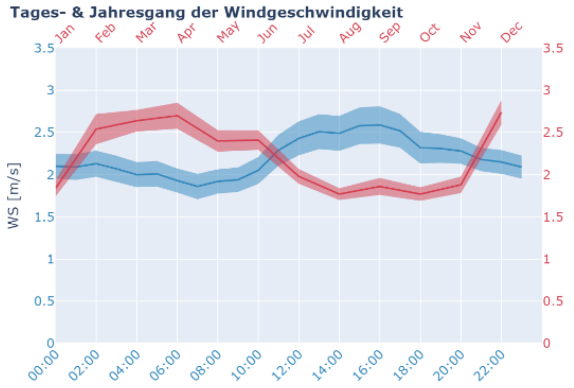
Results

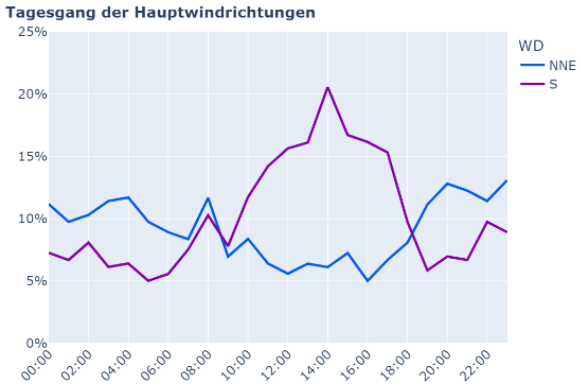
Klöch, 415m a.s.l.
8 m a.g.l.

Obs

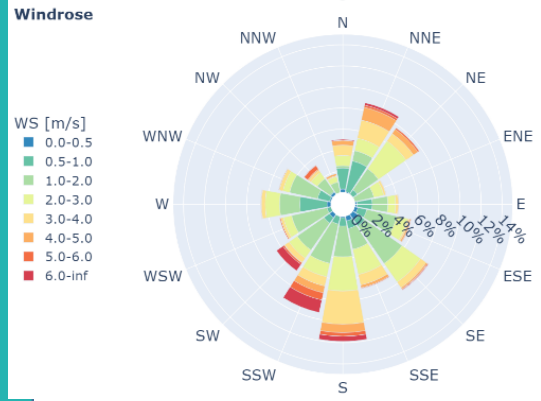


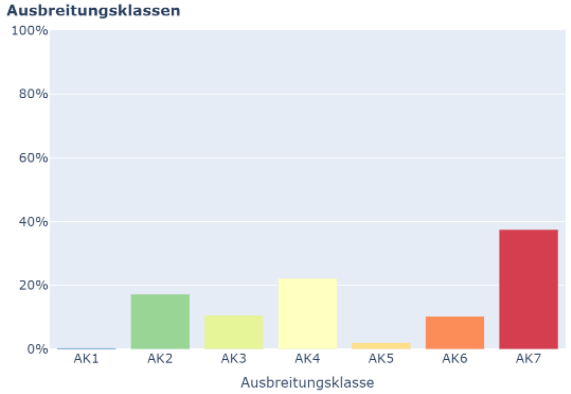


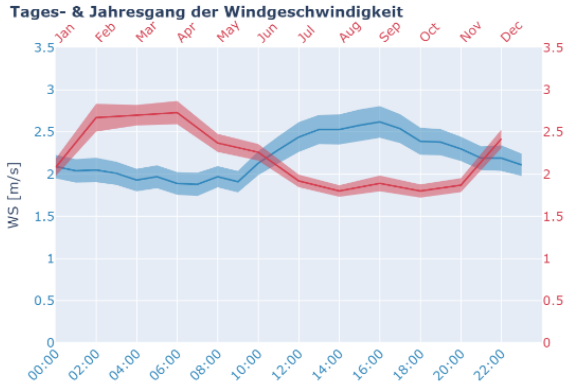


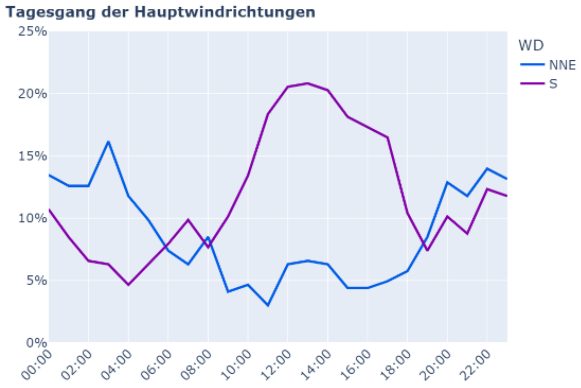


Mod





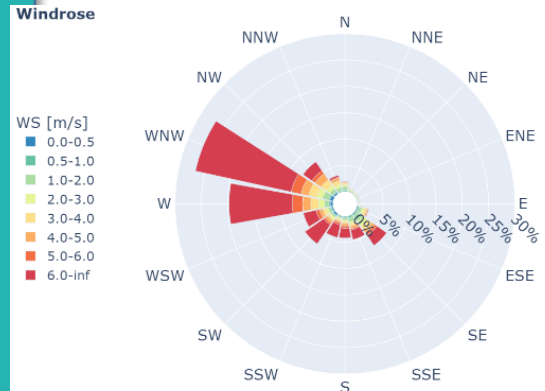


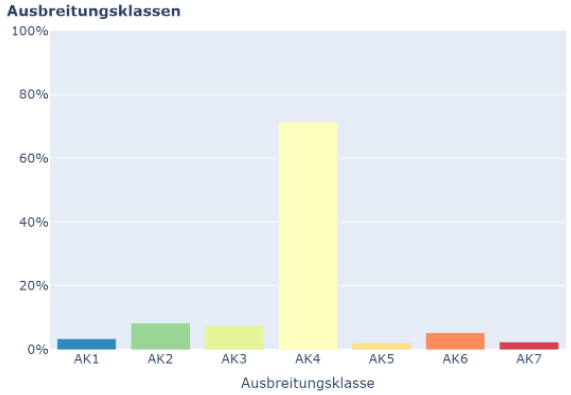


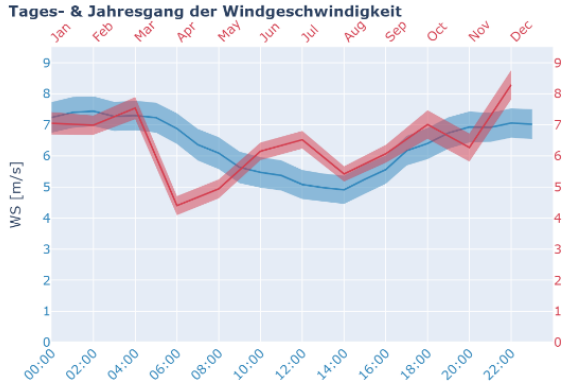
Results

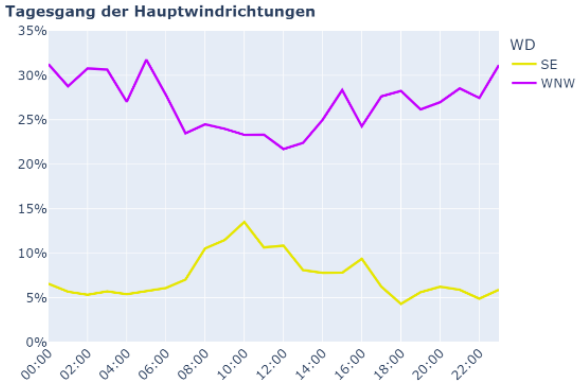
WN505, 2.191m a.s.l.
6 m a.g.l.

Obs









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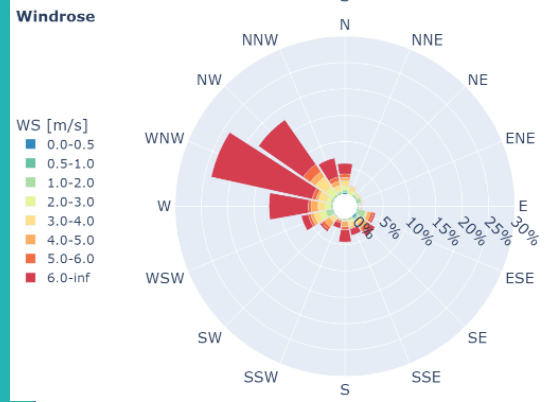

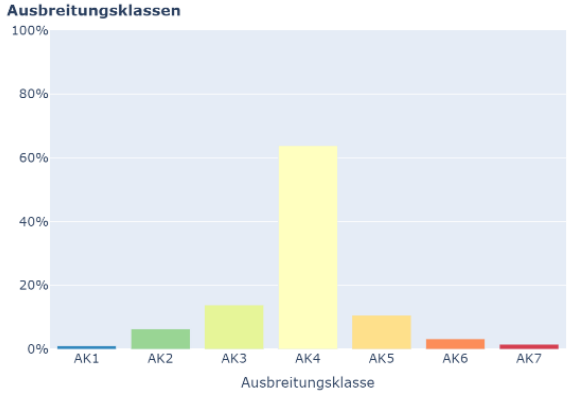

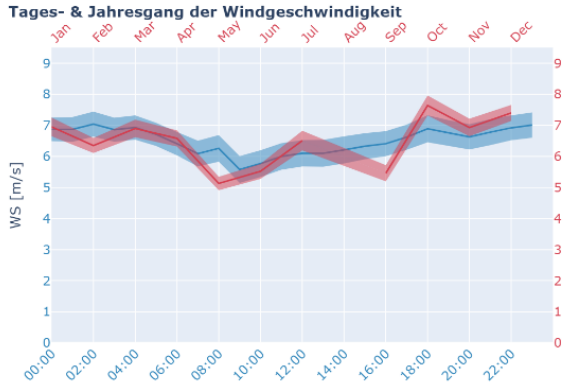

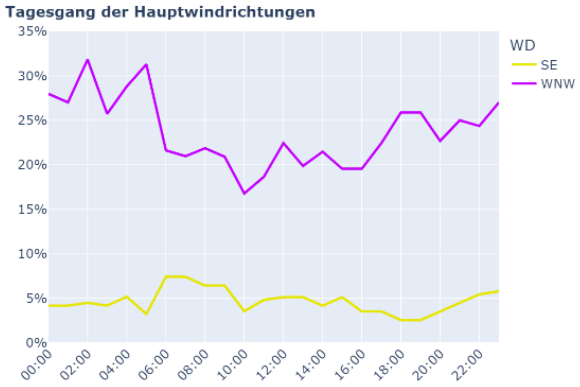

Renewable Energy?

Thank you for your attention!

I‘m a big fan

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Das Land Steiermark