Air pollution modelling in highly complex terrain: The GRAMM/GRAL modelling system

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Air Quality Department Styria: ....our duties

200 – 300 Air Quality Assessments per year carried out by 6 experts mostly in highly complex terrain

Source: https://www.bohler-edelstahl.com/de/web-cam/
Styria – beautiful landscape, but...
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Highest peak 2995m

Inneralpine basins
Calm: 80-90%

Main alpine ridge

Side-valley winds
Mountain-valley winds
Slope winds

~200 km x ~130 km
GRAL

Odour/Pollutant dispersion

Buildings/Vegetation Microscale CFD model

(
~2000 flow fields)

Match-to-Observation

Best fitting flow field

Observed hourly wind and stability classes

(
~1000 flow fields)

GRAMM

Artificial categorized meteorology:
Wind and stability classes

Topography Landuse

TeamX Splinter Webmeeting, 6 May 2020
Windfield-Library
Reference year 2015, horizontal resolution 200m
Windfield-Library
Results

Valley station

TeamX Splinter Webmeeting, 6 May 2020
Windfield-Library Results

Mountain station

TeamX Splinter Webmeeting, 6 May 2020
Windfield-Library
Time series comparison with WRF simulations

WRF simulation, 1000m resolution

GRAMM, MtO, 200m resolution

Valley station

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Time series comparison with WRF simulations

WRF simulation, 1000m resolution

GRAMM, MtO, 200m resolution

Mountain station

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Conclusions

Pros:

• Current methodology based on the 'match-to-observation' methodology provides very accurate and highly resolved wind data in very complex terrain for long time periods (e.g. calendar year)
• The usage of categorized meteorological input data reduces the computational times, which is very important for the dispersion modelling including the microscale CFD model to take into account buildings/vegetation

Cons:

• Match-to-observation method may result in poor wind fields farther away from the stations used for the fitting
• The simple initialization procedure for GRAMM is not able to capture the complex interaction between synoptic scale flows and mountain-valley wind systems
The proper art of modeling: