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Simulating the land-atmosphere exchange over mountainous terrain

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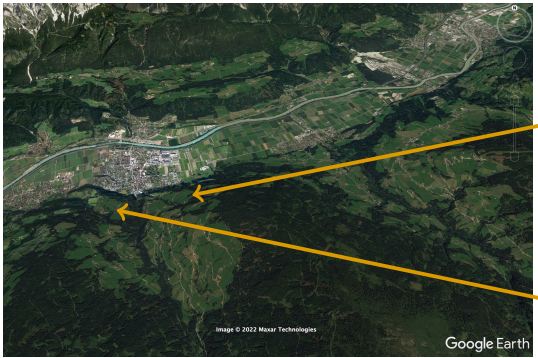
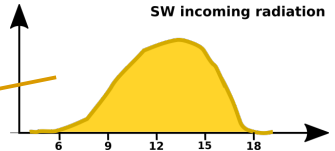
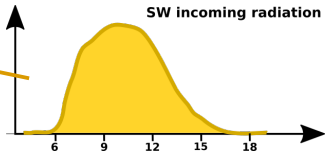
Land-atmosphere exchange over mountainous terrain

Land-atmosphere exchange over mountainous terrain

Differences in terrain orientation

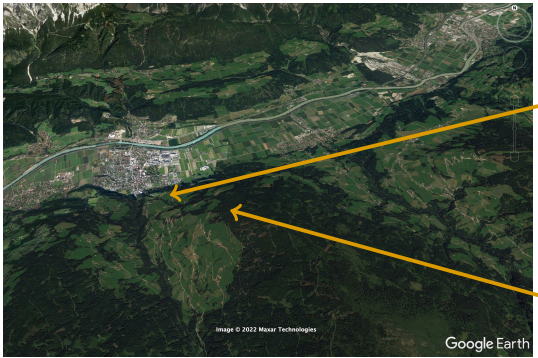






Land-atmosphere exchange over mountainous terrain

Differences in land cover

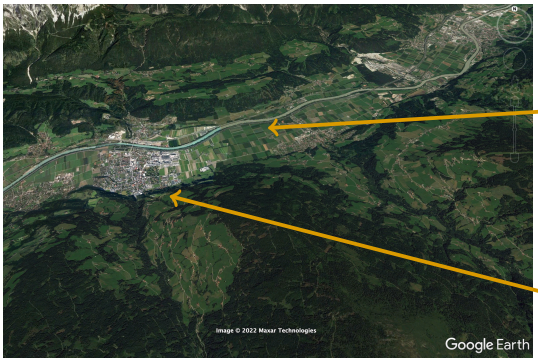


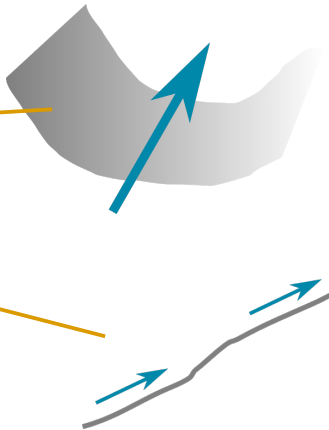
$\alpha \approx 0.2$, $z_0 \approx 0.05$

$\alpha \approx 0.1$, $z_0 \approx 1$

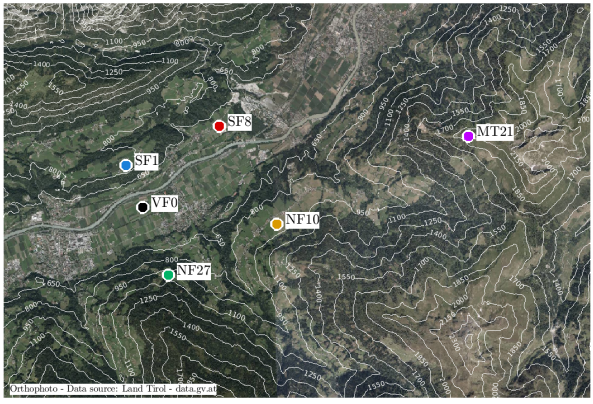
Land-atmosphere exchange over mountainous terrain

Differences in local flow characteristics





Observed turbulent exchange

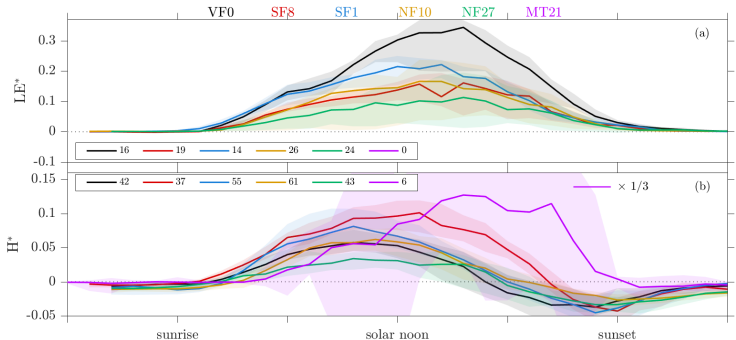


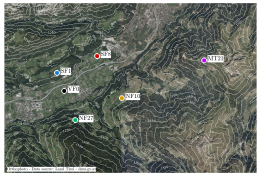
i-Box

Inn Valley, Austria

- six eddy covariance stations with different topographic and land-use characteristics
- approx. 6.5-km long section of the Inn Valley (2000 m deep, 2–3-km wide valley floor)

Observed turbulent exchange





Reference: Lehner et al (2021), QJRMS, 147, 2173–2196

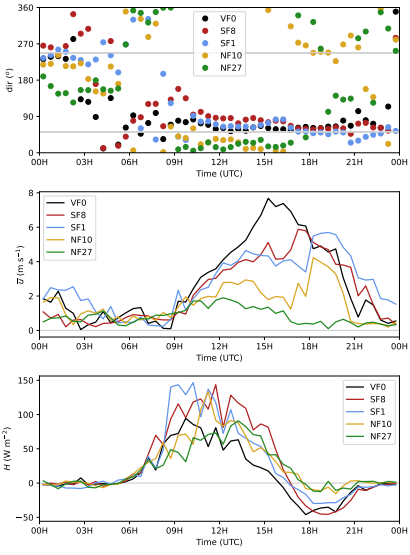
- Clear-sky, synoptically undisturbed days (74 days between 2014 and 2019)
- Weakest sensible and latent heat fluxes on the north-facing sidewall
- Largest sensible heat flux at the south-facing sidewall near a concrete surface
- Highest latent heat flux at the valley-floor site surrounded by agricultural fields
- Difference in the timing of the daytime maxima

Modeling turbulent exchange

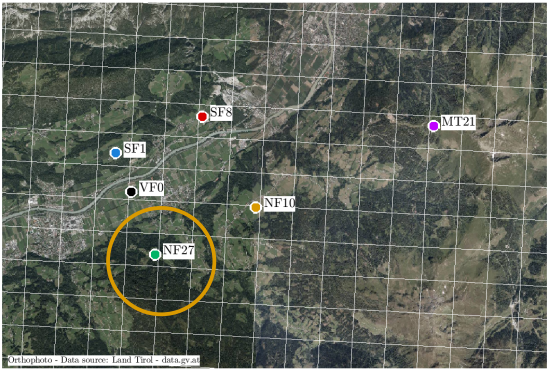
ASTER (Atmospheric boundary-layer modeling over complex terrain)

- Evaluation of model performance in forecasting near-surface and boundary-layer turbulent fluxes.
- Evaluation of model sensitivity to errors in parameterizations and input parameters.
- WRF simulations—1-km grid spacing

Case study: 22 August 2019



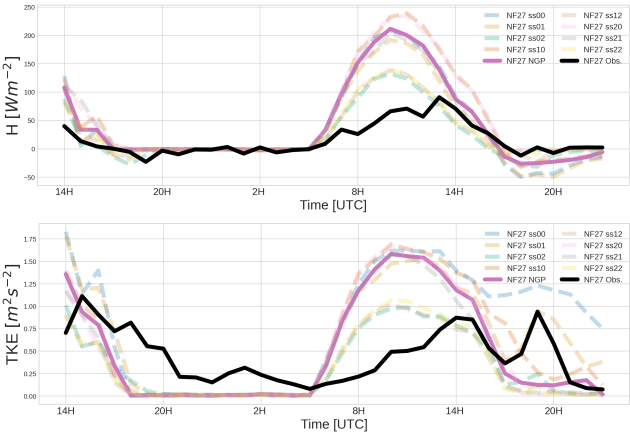
Model results—1-km grid



NF27—nearest model grid point

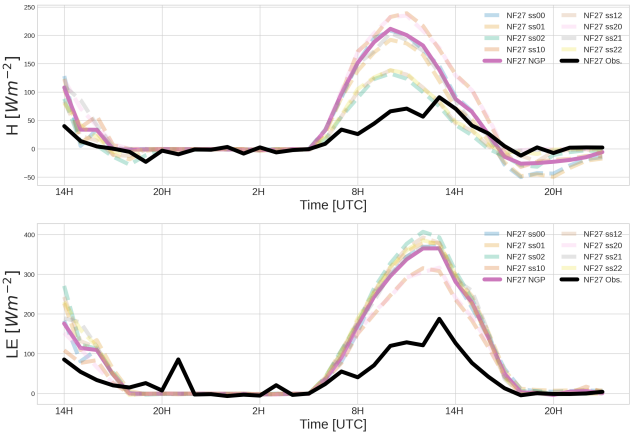
- Slope angle: 17° (reality: 25°)
- Evergreen needleleaf forest (CORINE land cover dataset)
- Roughness length: 0.5 m

Model results—1-km grid



- Strong overestimation of observed TKE and *H* at the nearest grid cell.
- Magnitude better represented by neighboring grid cells (cropland and pasture with z_0 =0.15).

Model results—1-km grid



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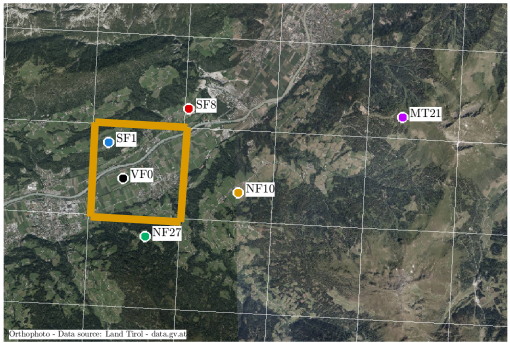
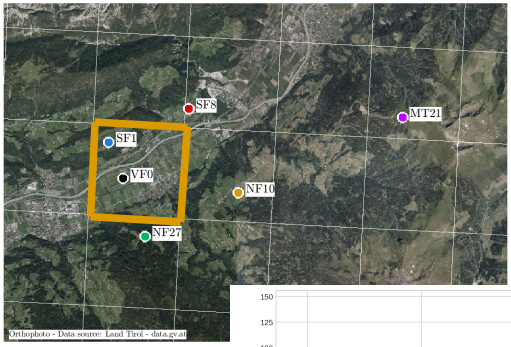
Model results—3-km grid



- Grid cells wider than the valley floor
- 2 stations represented by the same grid point
  - VF0: valley floor
  - SF1: plateau at the foot of the north sidewall

Model results—3-km grid



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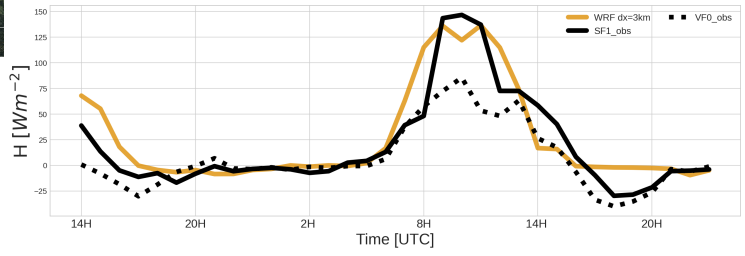
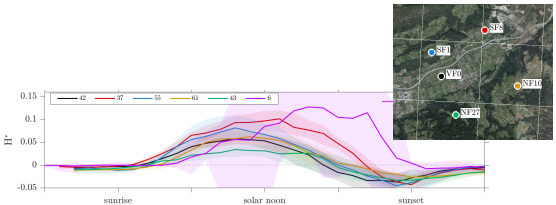


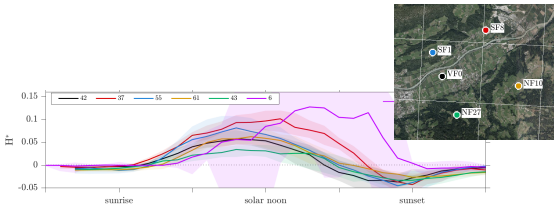
Conclusions



Large spatial variations in near-surface turbulent exchange because of

- differences in terrain characteristics.
- differences in land cover.
- differences in the local flow field.

~~Conclusions~~ Questions



Large spatial variations in near-surface turbulent exchange because of

- differences in terrain characteristics.
- differences in land cover.
- differences in the local flow field.

- What does the modeled land-atmosphere exchange represent?
- How to select representative measurement sites for model verification?