INTRODUCTION

Grünloch basin

- Limestone sinkhole in the eastern Alps of Austria
- Diameter: ≈ 1 km, depth: ≈ 100–200 m
- Three major saddles intersect the surrounding ridgeline (Fig. 1): Lechner Saddle (≈55 m above the basin floor), Seekopfalm Saddle (≈130 m), and Yblstaler Saddle (≈180 m).

Model simulations

- CM1 (Bryan and Fritsch 2002, MWR, 130, 2917–2928)
- Stretched grid: $\Delta x \approx 30–150$, $\Delta y \approx 10–400$ m
- The simulations are initialized with a quiescent atmosphere and temperature and humidity profiles from nearby Vienna radiosoundings.
- The model topography is a simplified and smoothed representation of the Grünloch topography (Fig. 1): Lechner Saddle (≈50 m above the basin floor) and Seekopfalm Saddle (≈150 m).

NIGHTTIME SIMULATION

- The katabatic winds that separate from the slope near the top of the inversion layer flow across the basin towards the Lechner Saddle, where the air drains down the adjacent Lechner Gorge.
- The jet-like flow across the basin remains relatively narrow both vertically and horizontally.
- The outflow through the Lechner Saddle is mostly confined to heights below the elevation of the Seekopfalm Saddle, the second-lowest gap in the surrounding topography.
- Downslope winds do not have sufficient negative buoyancy to penetrate the basin-floor inversion but separate from the slopes near the top of the most stable layer.
- Increased downslope winds occur downstream of gaps in the surrounding topography to the east and southwest.
- A steady south-southeasterly outflow occurs through the Lechner Saddle.
- Qualitatively good agreement exists between near-surface observations and simulation.

MORNING SIMULATIONS

- Simulations are run with different amounts of snow cover, approximating the effect of snow covering the grass at low elevations and trees extending above the snow at high elevations.
- An inflow develops through the Lechner Saddle into the Grünloch, which warms faster than the adjacent Lechner Saddle.
- A weak easterly cross-basin flow towards the more strongly irradiated east-facing sidewall develops over the basin floor.
- The cross-basin flow is replaced by northerly winds as the inflow through the Lechner Saddle pushes farther towards the basin center and continues up the south and east sidewalls.
- The strength of the inflow through the Lechner Saddle increases strongly with the presence of a snow cover in the basin.
- The stronger inflow leads to an earlier destruction of the easterly cross-basin flow over the basin floor.

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