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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Measuring the Inn Valley exit jet

Katrin Sedlmeier[1], Meinolf Kossmann[2], Ivan Paunovic[1], Lothar Bock[1], Oliver Nitsche[1], Gudrun Mühlbacher[1]
[1]German Meteorological Service, Munich, Germany
[2]German Meteorological Service, Offenbach, Germany

Introduction & Motivation

Previous studies have found a pronounced nocturnal low-level jet at the exit of the Inn Valley north of the valley contraction near Schwaigen which reaches into the Alpine foreland for several tenth of kilometers (e.g. Pamperin and Stilke, 1985 as part of the MERKUR experiment or a model study by Zängl, 2004). The exit jet forms under nocturnal stably stratified atmospheric conditions and is interpreted as a transition from subcritical to supercritical hydraulic flow.

As part of the pre-experiment of the TEAMx programme in June to August 2022, we conducted measurements to corroborate and extend the previous findings on the formation and maintenance of the Inn Valley exit jet.
This contribution shows the setup and some preliminary results of the measurement campaign.

Measurement Setup

Our measurements were conducted at the Inn valley exit between Kufstein and Rosenheim (see Fig.1) with our main measurement site at Brannenburg, north of the valley contraction indicated by the arrow in Fig.1 .
Our instrumentation consists of:

- **Mobile weather stations** (all 5 locations);
  June 2022- September 2024
- **Wind lidar** (Brannenburg);
  June – August 2022
- **Radio sonde launches** (BRA);
  IOP:18./19.7.2022
- **Drone measurements** (BRA);
  IOP:18./19.7.2022

The operational measurement network of the DWD as well as measurements of other TEAMx participants in the Inn valley are additionally available.

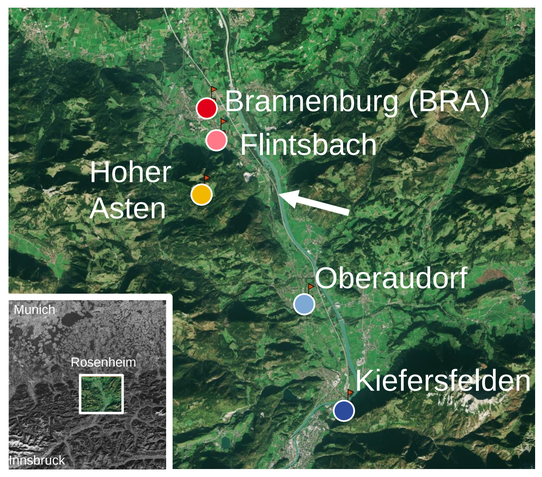


Fig. 1: Study area at the exit of the Inn Valley. The arrow marks the valley contraction near Schwaigen. The inset shows the location of the study area.

First results

Low cloud cover and high pressure weather conditions during the IOP (18/19 July 2022) favored the development of a diurnally oscillating Inn valley wind system (Fig. 2). Observed radiation balance at BRA (Fig. 3) shows that surface cooling of about -60 W/m^2 led to the formation of stable atmospheric conditions during the IOP night. Our upper air and surface winds measurements during the IOP captured a well pronounced Inn valley exit jet :

- Lidar and radiosonde measurements show the formation of the jet between 23:00UTC and 1:00UTC at altitudes above 100m. The jet extended downward and reached the surface at about 4:00UTC (Fig. 5).
- Vertical wind profiles of lidar measurements and radiosonde launches show very similar structures (Fig. 5).
- Ground measurements north of the valley contraction near Schwaigen capture the exit jet between 3:00UTC and 4:00UTC which fits well to the results of the vertical wind profiles from lidar and radiosonde data (Figs. 2 and 4).

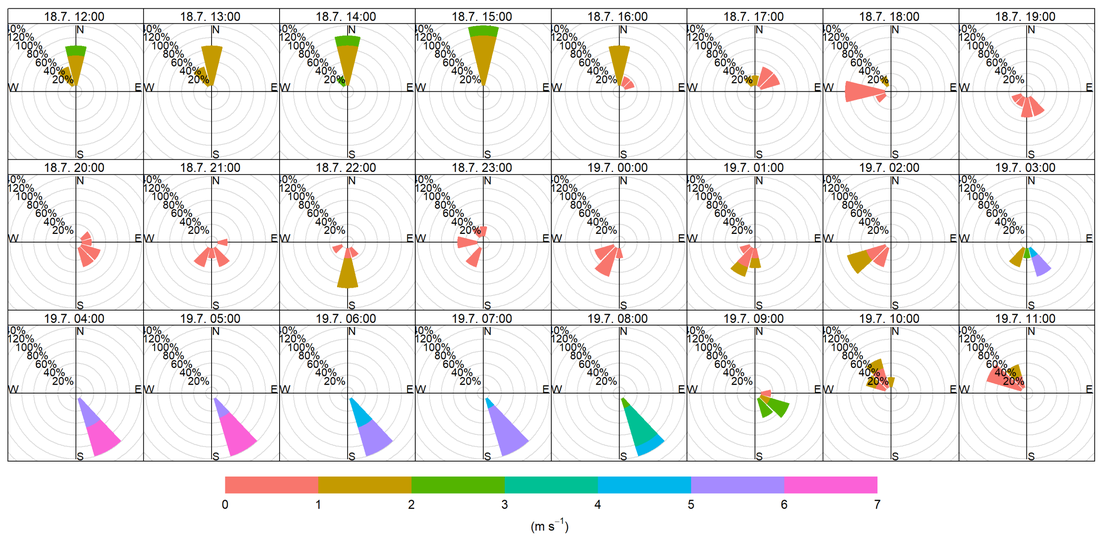


Fig. 2: Daily cycle of wind (2m) at Flintsbach , north of the valley contraction. The exit jet sets in between 3:00UTC and 4:00UTC and dissolves around 9:00UTC. The daily cycle at Brannenburg is similar albeit with slightly lower wind speeds.

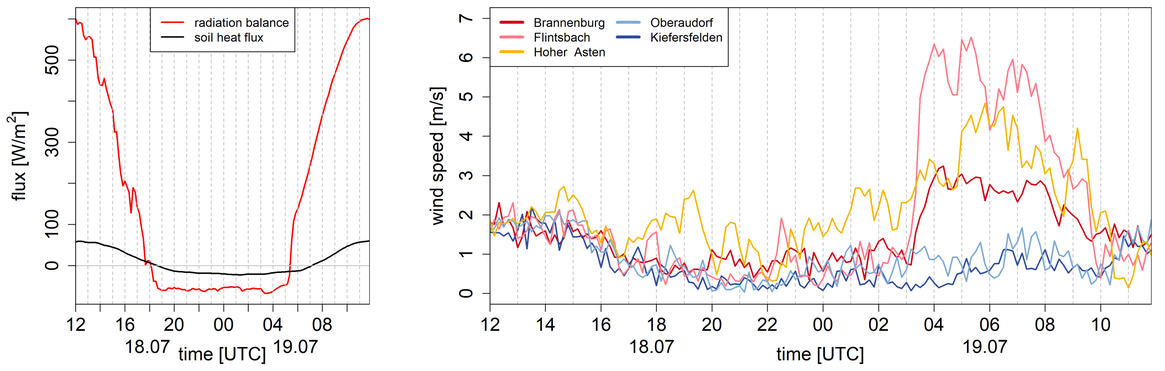


Fig. 3: Radiation balance and soil heat flux at Brannenburg during the IOP. The radiation balance has negative values between 18:10 and 5:20UTC, the soil heat flux between 18:40 and 7:00UTC.

Fig. 4 : Wind speed (2m) during the IOP for all five stations. Colors match those in Fig.1. The exit jet is evident at stations north of the valley contraction (red colors) whereas stations in the south of the study area did not observe an increase of wind speeds (blue colors).

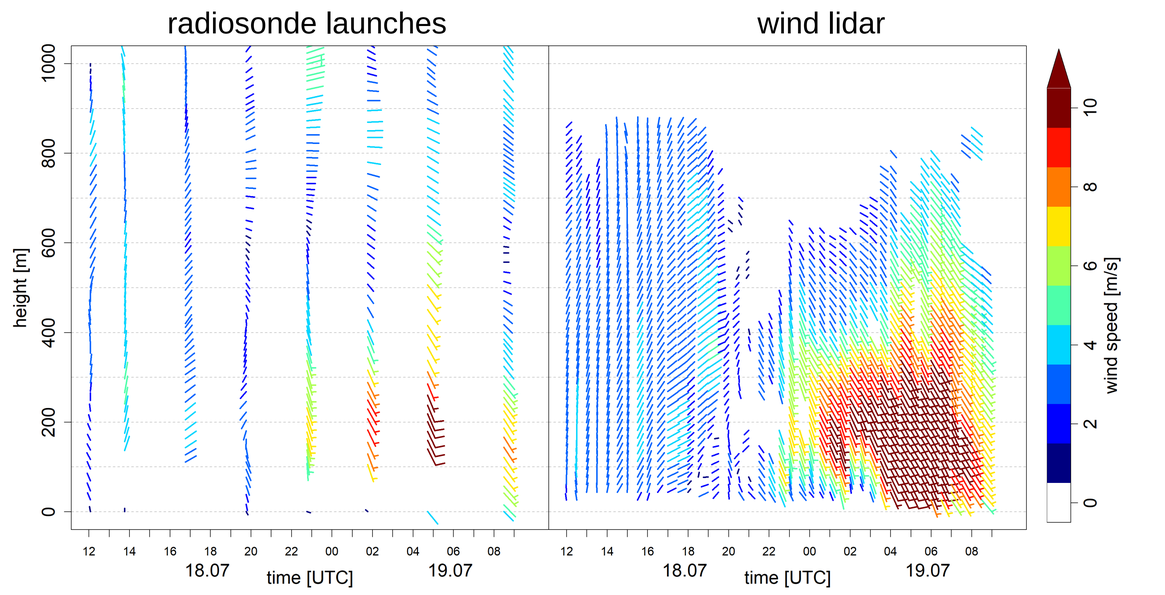


Fig. 5: Vertical wind profiles from radiosonde launches (left) and wind lidar measurements (right) during the IOP.

References & Links

- *TEAMx: http://www.teamx-programme.org/*
- *Zängl, G. "A reexamination of the valley wind system in the Alpine Inn Valley with numerical simulations." Meteorology and Atmospheric Physics 87.4 (2004): 241-256.*
- *Pamperin, H., and G. Stilke. "Nächtliche Grenzschicht und LLJ im Alpenvorland nahe dem Inntalausgang." Meteorologische Rundschau 38.5 (1985): 145-156.*

Conclusion & Outlook

Our measurements capture the exit jet and corroborate findings of previous studies. Our next steps are:

- ➢ Investigation of the formation and maintenance of the exit jet using whole pre-campaign period
- ➢ Studying the turbulence structure of exit jet
- ➢ Conducting simulations with PALM-4U to deepen our understanding of exit jet

katrin.sedlmeier@dwd.de