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Improving High-Impact NWP with Lidar and Meteodrone Observations

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Current Observation Situation

Satellite

1000 km

100 km

10 km

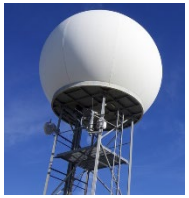
1 km

100 m

10 m

Aircraft

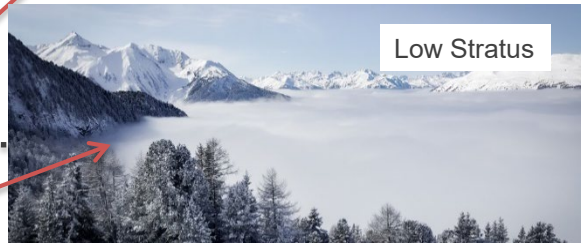
Radar



Balloons

PBL up to 1.5 km

Limited Obs



Weather station

Laser

Sound/microwave

Improving Observation Situation

Satellite

1000 km

100 km

10 km

1 km

100 m

10 m

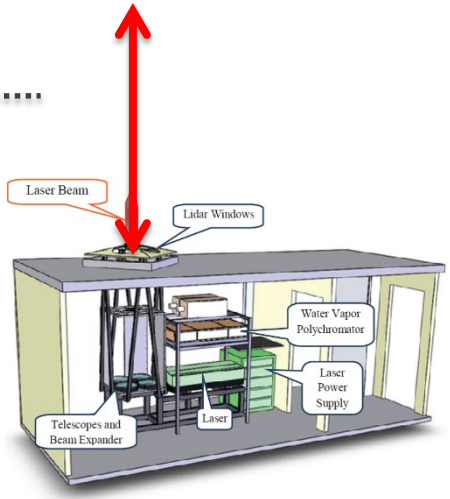
Aircraft

Radar

Balloons

PBL up to 1.5 km

Raman Lidar



Meteodrone

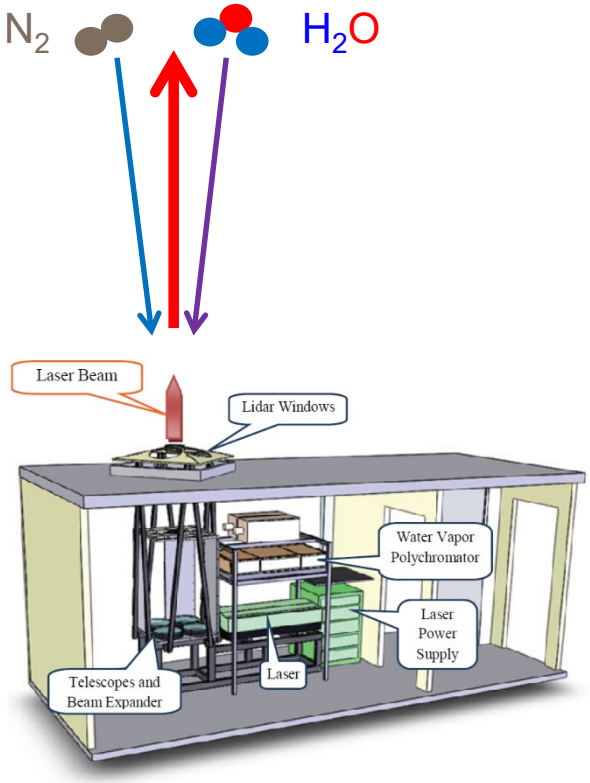
Weather station

Laser

Sound/microwave

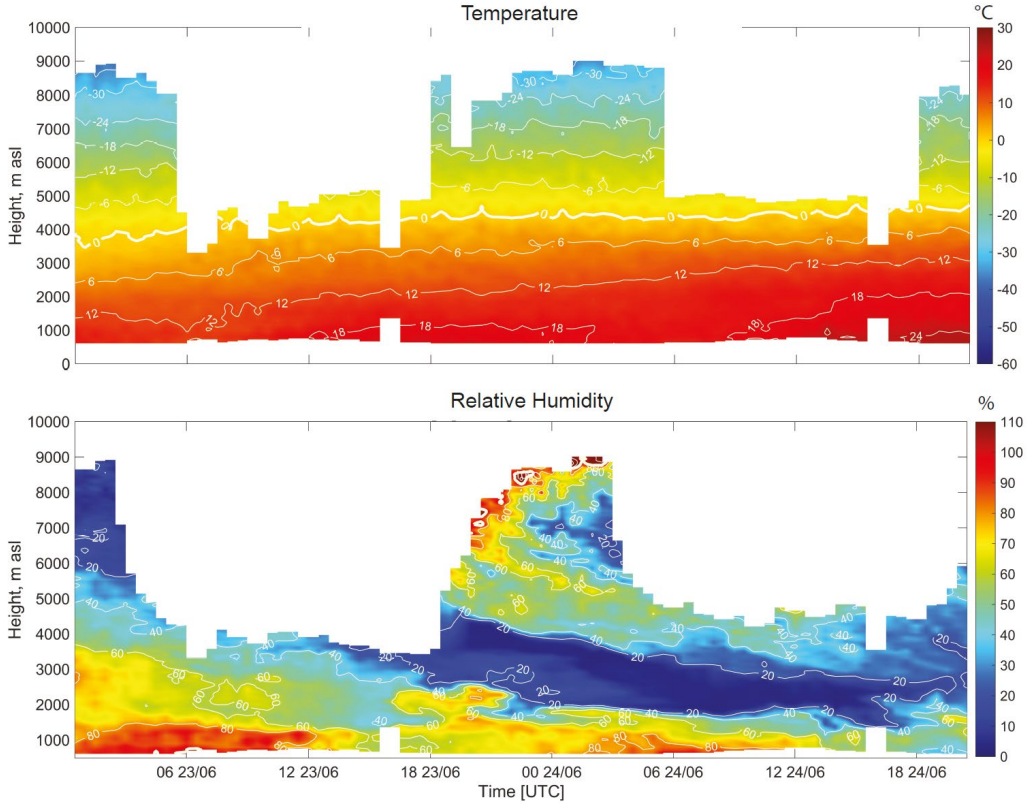
Raman Lidar: RALMO

- Situated at MeteoSwiss, Payerne
- Temperature and humidity profiles
- Time resolution: 30 min
- Vertical range (day / night):
  60 – 5000 m / 10’000 m
- Vertical height bins of 30-300m
- 7/24 automatic operation
- Not available in rain and low cloud conditions



Raman Lidar: RALMO

Observation Example: Payerne, 23./24.06.2019

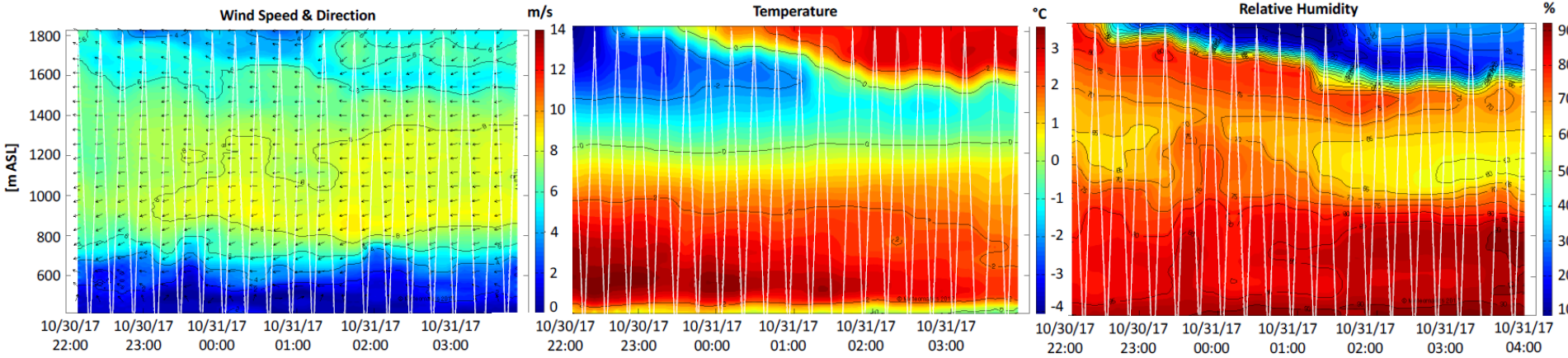


Meteodrones

- Developed and operated by Meteomatics AG (St. Gallen)
- In-situ observations of temperature, humidity, wind and pressure
- Time resolution: 15min
- Vertical range: up to 3’000m
- Vertical height bins: <1m
- Remote operation with Meteobase
- Difficulties in strong winds (>60km/h) and icing conditions
- Only available during night so far (airspace restrictions)

Meteodrones

Observation Example: Amlikon, 30./31.10.2017



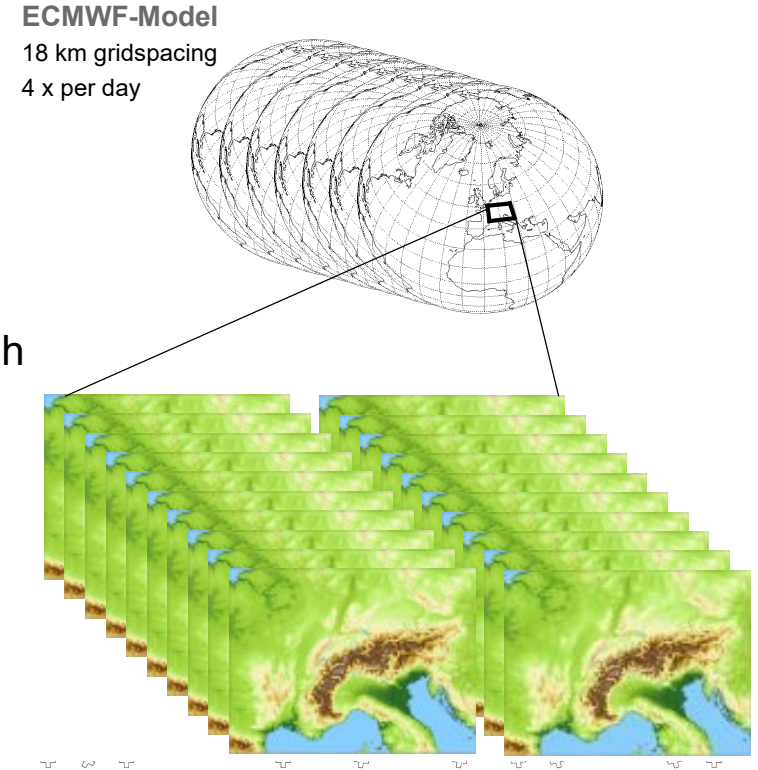
The MeteoSwiss NWP and DA System

The NWP System

- COSMO Model
- 2.2km grid spacing
- explicit deep convection
- 21 members
- 2 forecasts per day up to +120h

The DA System

- COSMO KENDA (Schraff et al., 2016)
- Based on LETKF (Hunt et al., 2004)
- 40 members
- Multiplicative and additive covariance inflation, RTPP



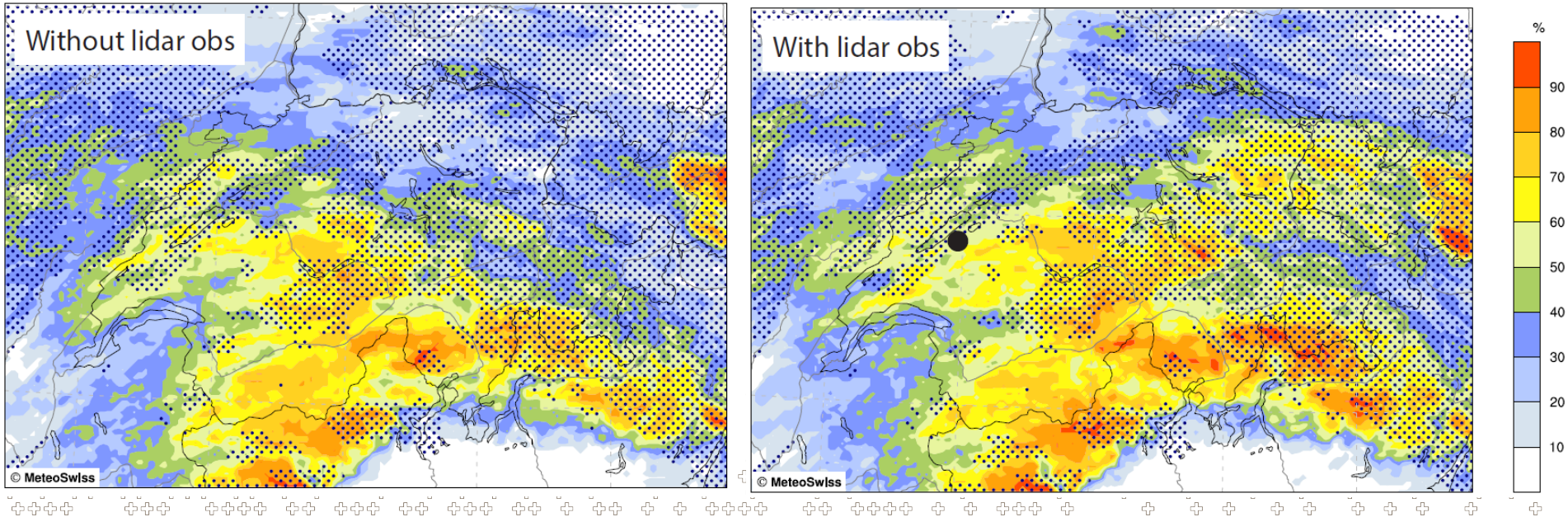
Assimilation Experiments

- Use of the operational MeteoSwiss COSMO-KENDA system
  - 2.2km grid size
  - LETKF (Local Ensemble Transform Kalman Filter)
  - 40 ensemble members
- Raman Lidar observations are fed into COSMO as additional TEMP obs
- Meteodrone observations are fed into COSMO as additional AMDAR obs

Raman Lidar Experiment

Convection case study of 8.7.2017

Probability of precipitation > 1mm/24h (color)
Radar/gauge obs > 1mm/24h (stippled)

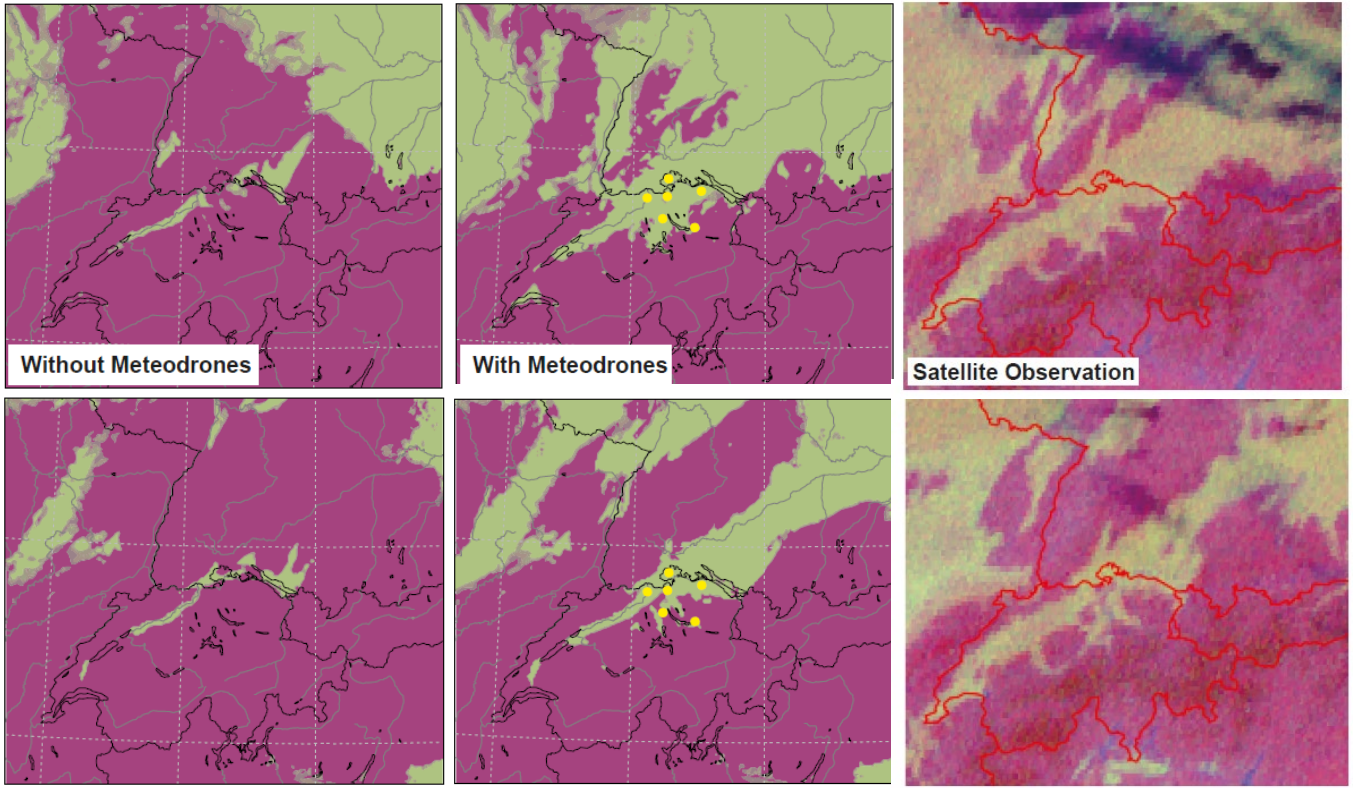


Meteodrones Experiment

Fog case study of 7.12.2017 Model cloudiness and satellite observation

Analysis

+6h Fore-cast



Summary and Outlook

- There is a gap in the current observing system for the ABL
- Raman Lidar and Drones can help filling this gap
- Several successful assimilation experiments with positive impact on ABL structure, precipitation, and cloudiness
- MeteoSwiss aims at the operational assimilation of both obs systems

Leuenberger et al., 2020, BAMS, https://doi.org/10.1175/BAMS-D-19-0119.1