Ground-based remote sensing of the atmospheric boundary layer: Assimilating microwave-radiometer and Doppler-lidar observations into the ICON/KENDA system

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- improve NWP in ABL ⇒ project "Pilotstation" EMS2022-119, Knist et al.



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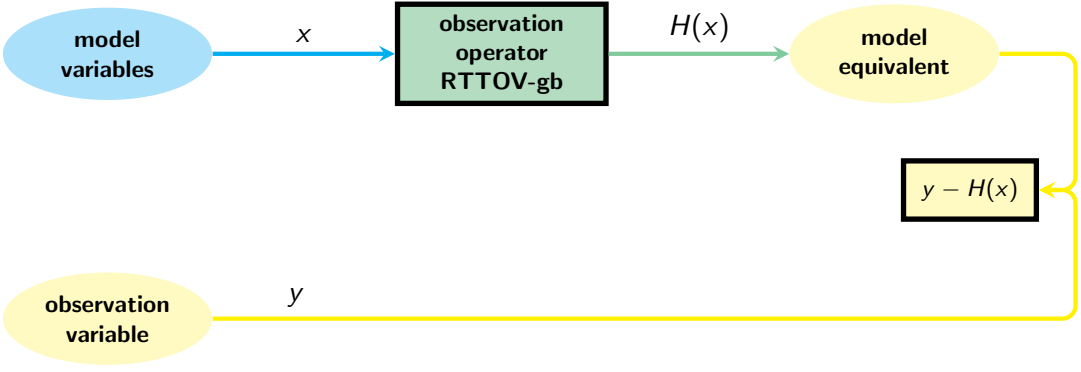

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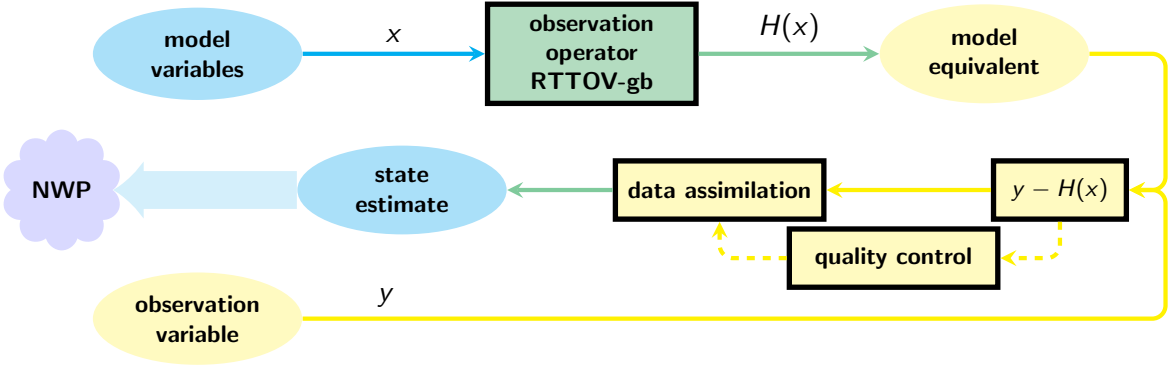
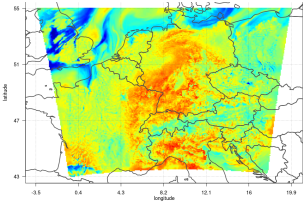


Setup of assimilation system

General

- assimilation: KENDA, LETKF with 40 ensemble members
- first guess & forecast: ICON-D2 ($\approx$ 2.1 km)
- subdomain of ICON-D2: $\approx 1/4$ disk space, $>$ 2 times faster
- all experiments in June 2021
- verification of 6h-forecast against radiosondes

ICON-D2 domain



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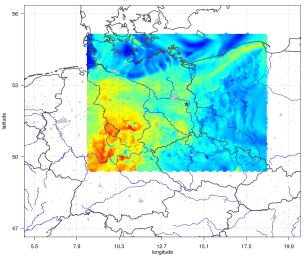

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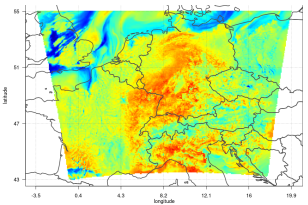
MWR

- zenith angle only
- adaptive bias correction
- no assimilation in cloudy conditions EMS2022-157; Löffler et al.
- no assimilation of radiosonde in Lindenberg
- tuning via channels, observation error, vertical localisation

ICON-D2 domain



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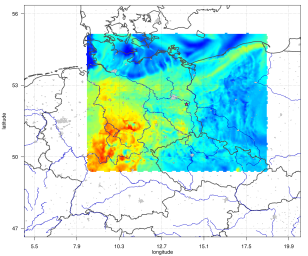
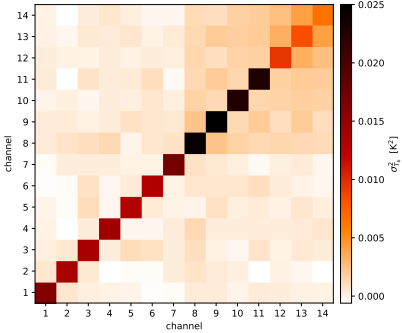


MWR – channel selection & observation errors

- 14 channels: too small observation errors with Desroziers
- cross-correlations not taken into account by DA (yet)



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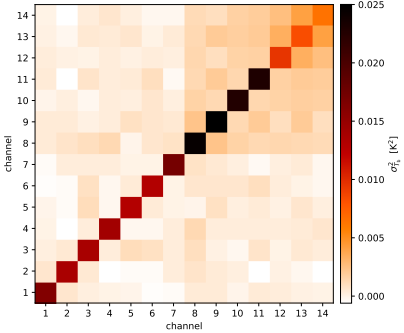
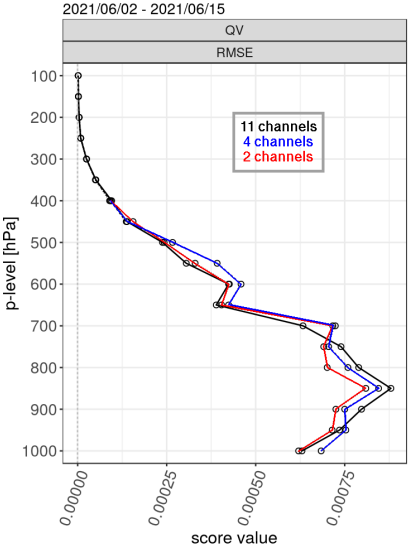


⇒ assimilate less channels

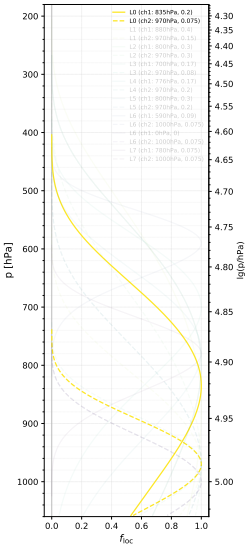
⇒ 1 channel per band

⇒ observation errors:

$$\frac{\epsilon_{23\mathrm{GHz}}}{\epsilon_{57.3\mathrm{GHz}}} \approx 4$$



MWR – vertical localisation



- localisation determines increment distribution

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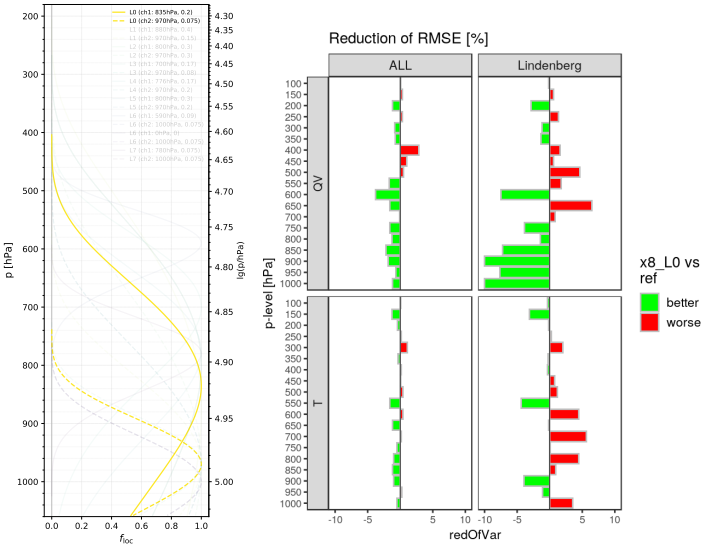

- localisation determines increment distribution
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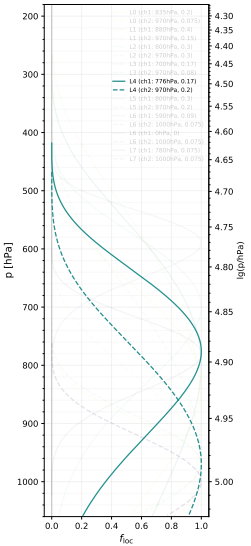

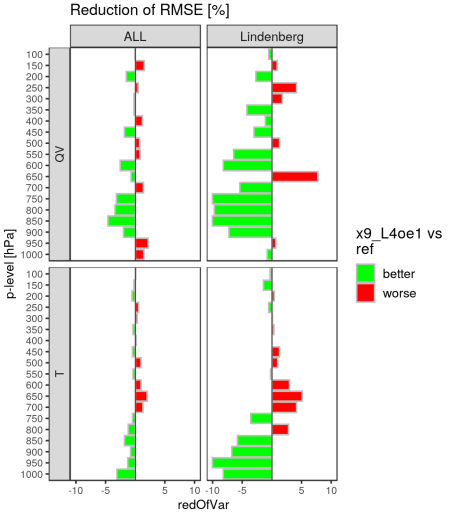

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$\Rightarrow$ find vertical localisation using cross-validation diagnostic*

*Stiller, O., 2022. New impact diagnostics for cross-validation of different observation types; https://doi.org/10.1002/qj.4339

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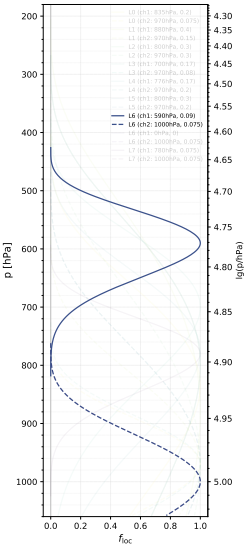

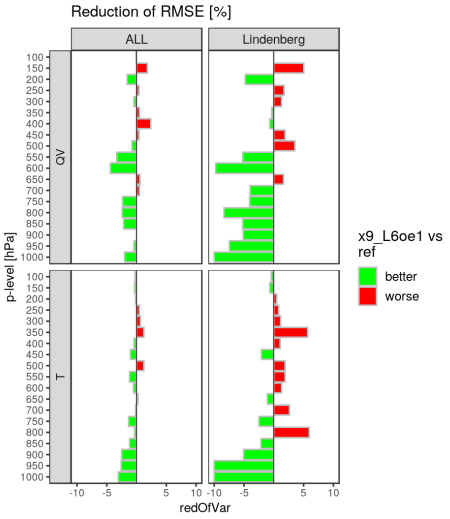

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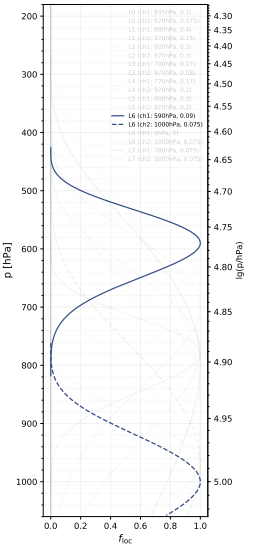

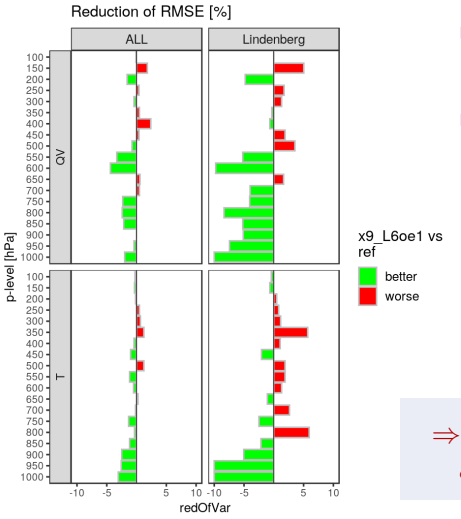

x9_L6oe1 vs ref

better

worse

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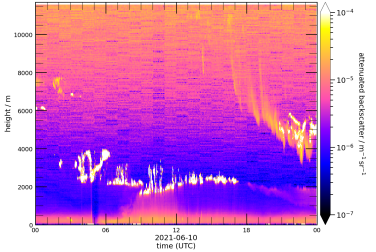
$\Rightarrow$ keep channels separated & sharply localised

Doppler-lidar (DL)

- Doppler velocities → u & v winds with VAD retrieval
- 250 height levels, 50 m sampling
- good agreement with radar-wind profiler (RWP)

  EMS2022-408, Kayser et al.



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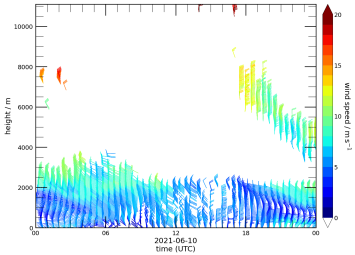

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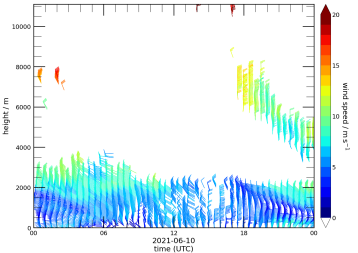

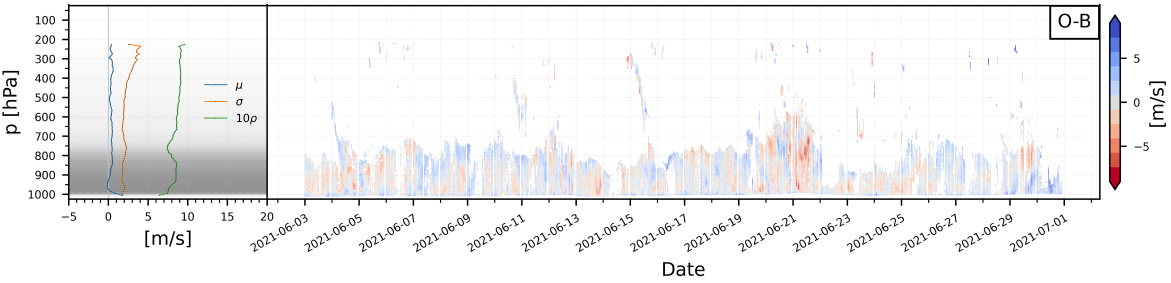

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- 6h forecast against radiosondes
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- reduction of RMSE [%]: better / worse

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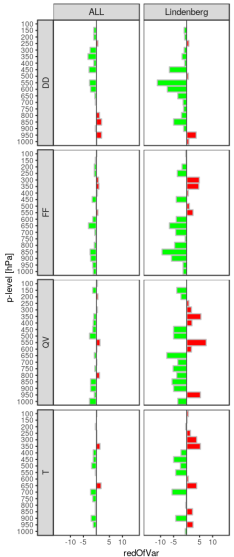

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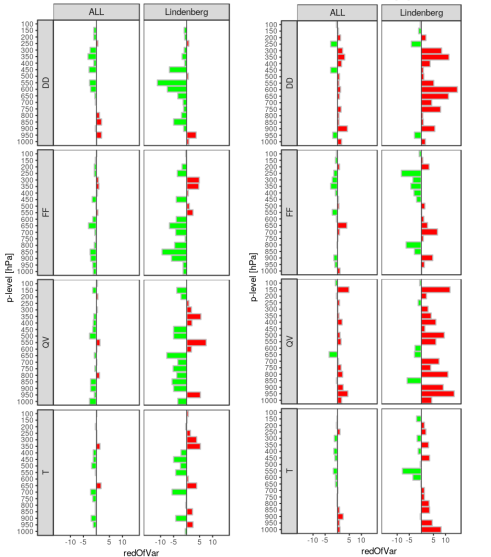

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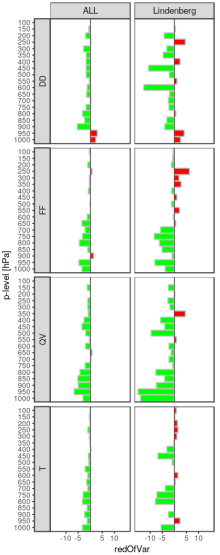

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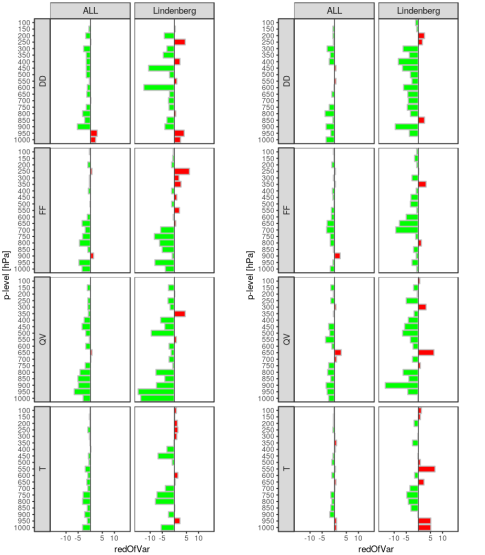

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⇒ good/neutral results for DL
... investigate longer periods!

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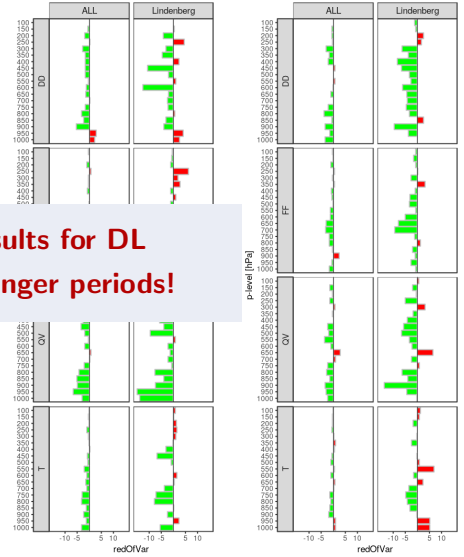

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assimilate both instruments combined