ARSO METEO
Slovenian Environment Agency

Validation and use of IASI level2 data in various weather situations

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2 January 2018 in Ljubljana...

ARSO webcam

Temperature inversion

2 January 2018 in Ljubljana...

ARSO webcam

… and on Krvavec

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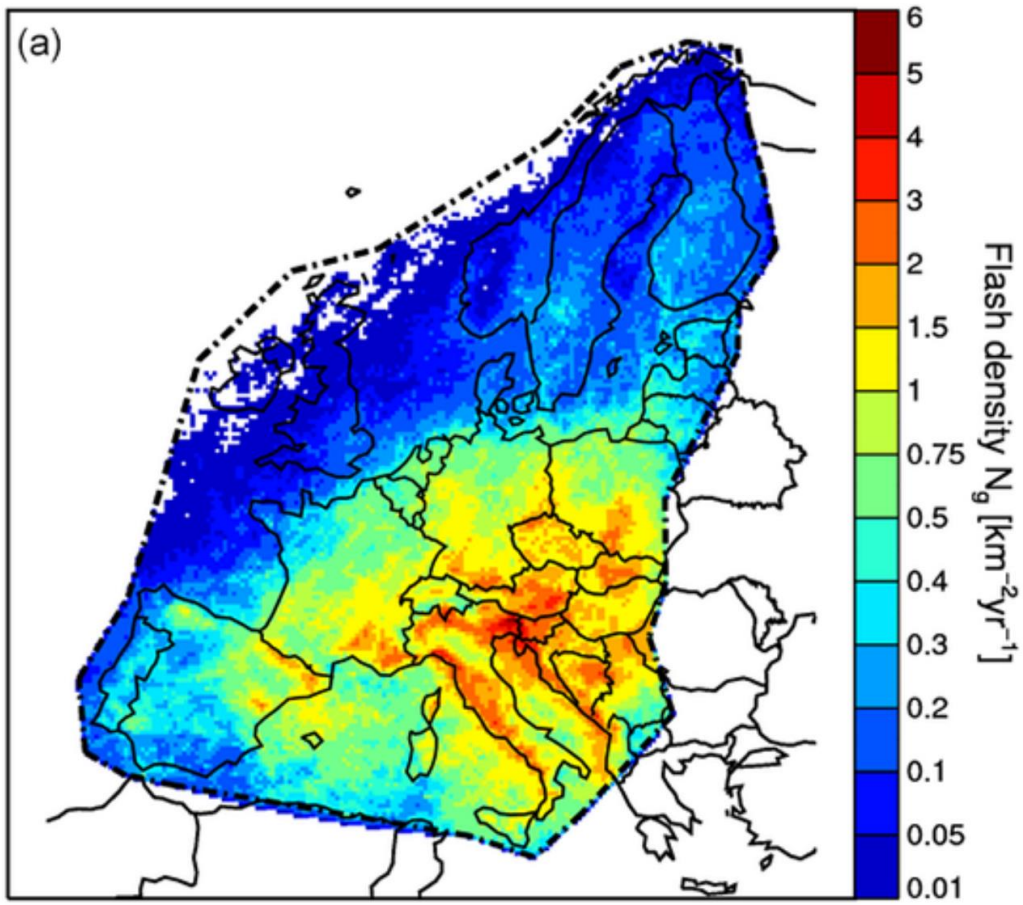
Convection



Poelmann et al., 2016

Can we use IASI level2 profiles directly in operational forecasting to improve forecasts in these situations?

Data – Mode-S MRAR temperature

Mode-S: Secondary air traffic surveillance radar process with selective communication

MRAR: **M**eteorological **R**outine **A**ir **R**eport (reported by ~5% of all Mode-S equipped aircraft)

- Reported data: wind speed, direction, temperature, turbulence, wind shear, microburst, icing
- T and wind speed measured directly (as opposed to Mode-S EHS)
- Data acquisition rate: 4 s
- Radar range at Ljubljana airport: 250 km
- Reported T error (location + measurement error): -0.7 - +0.5°C (Strajnar, 2012)
- Available in the vicinity of Slovenian and Czech air space

Data – AMDAR temperature and humidity

Aircraft **M**eteorological **DA**ta **R**elay –

WMO program to collect met. data from commercial airplanes

- Worldwide > 700,000 wind and T observations, > 11,000 humidity observations daily
- In Europe 10 Lufthansa aircraft equipped with humidity sensors (~ 3000 observations daily)

- Data acquisition rate: 20 s, switched off above 5.5/10 km
- Estimated T error: 0.4 °C, systematic errors of up to 1°C reported
- Humidity sensing limit 0.02g/kg (Hoff 2010, Strajnar 2012)
- Profiles from Venice, Rome, Vienna, Budapest, Munich and Frankfurt airport selected

Data – IASI level2 temperature and humidity

- 01 January – 10 December 2017
- Resolution: 12-39 km, 101 vertical levels
- 4-6 overpasses per day (08:15 – 10:15 am, 6:30 – 8:30 pm)

Data preprocessing

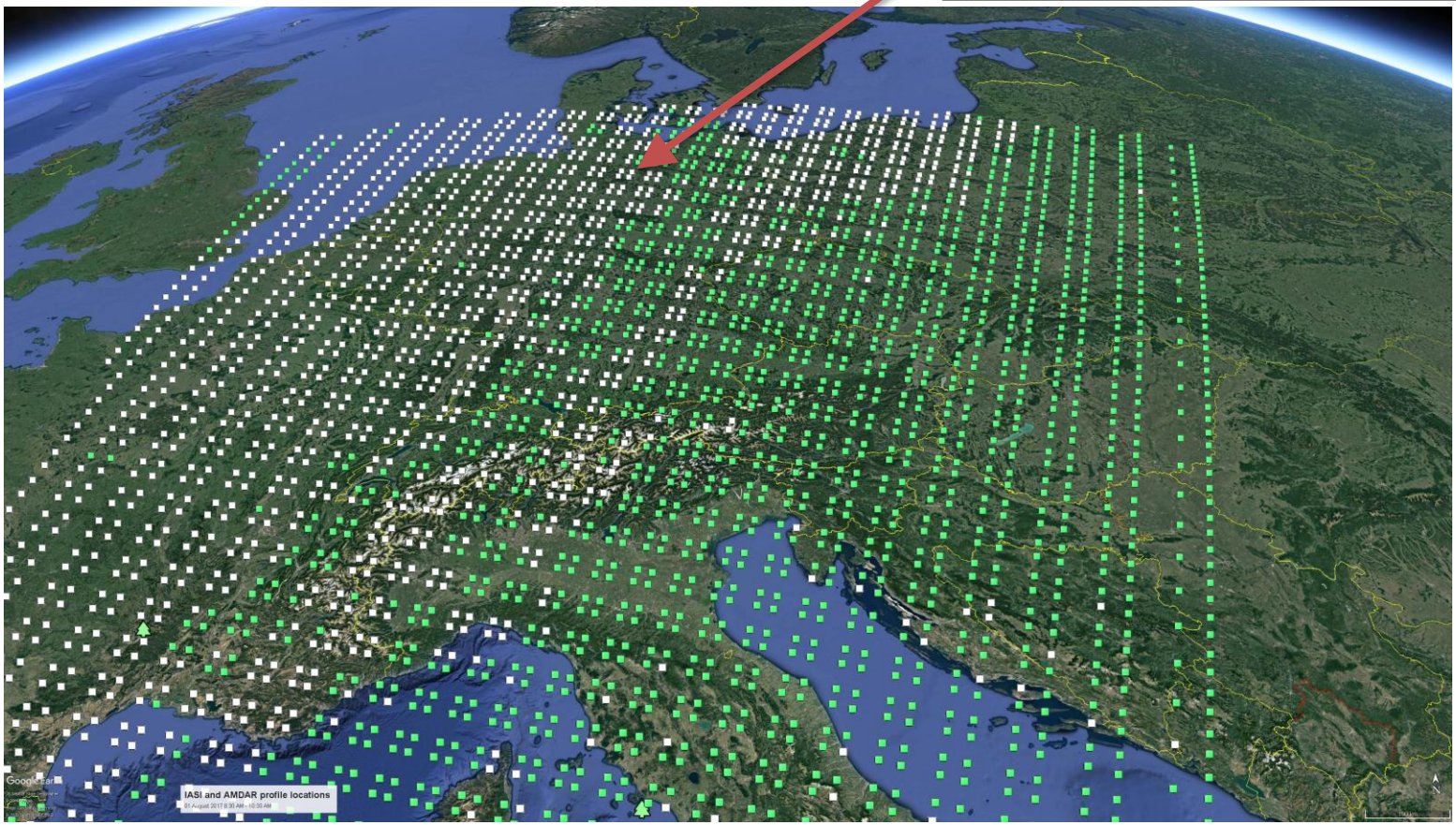
- Temporal smoothing (min 20 s)
- Quality control

  Whitelist generated from comparison of Mode-S data with operational NWP over a period of 22 months (B. Strajnar)
- Selection of the nearest pressure level (Mode-S) / Interpolation to IASI levels (AMDAR)
- IASI scan selection in the vicinity of mentioned airports

Data collocation

IASI scan locations
White: cloudy, green: clear sky

01 August ~9:30am



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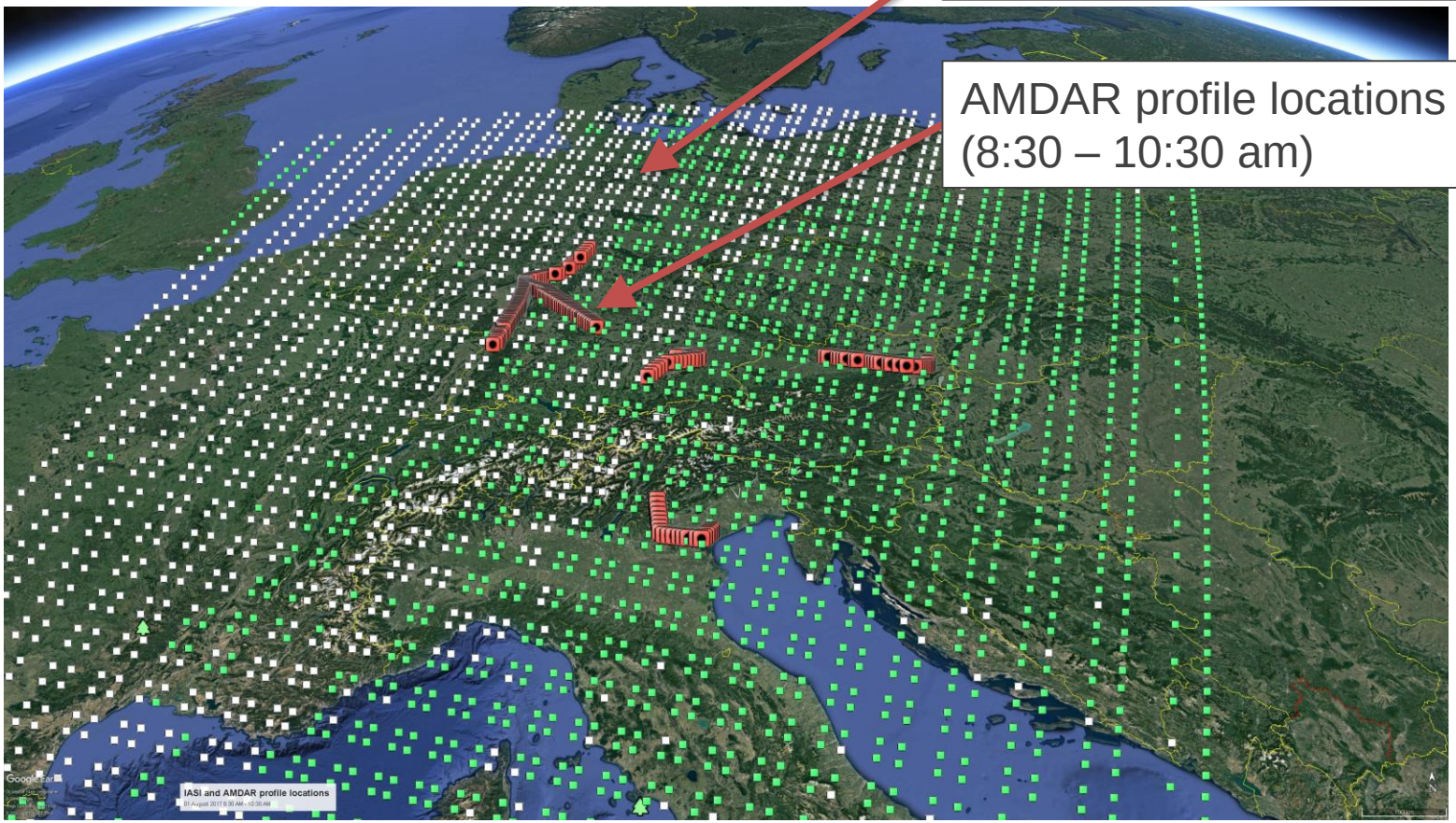
AMDAR profile locations
(8:30 – 10:30 am)



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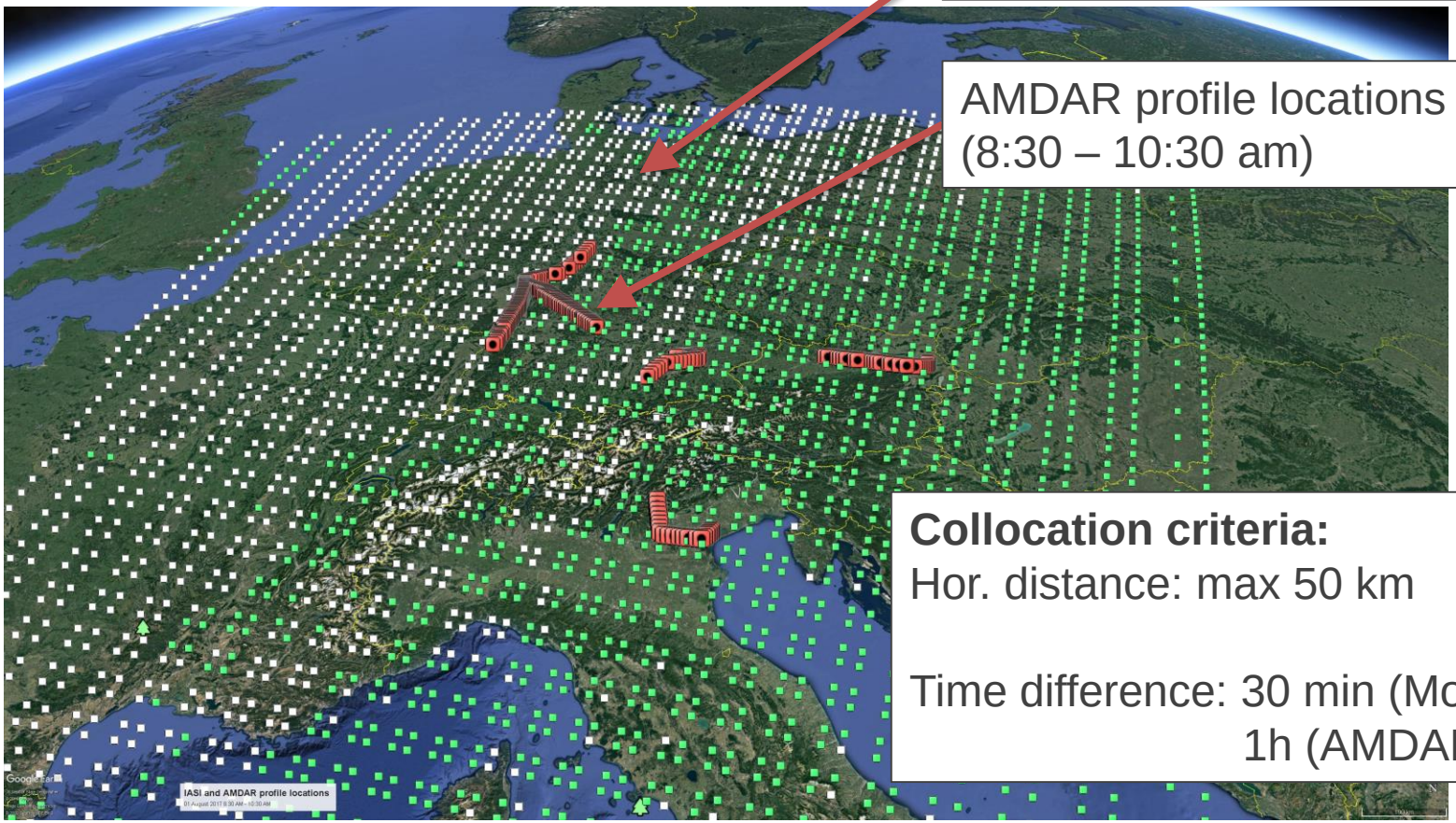
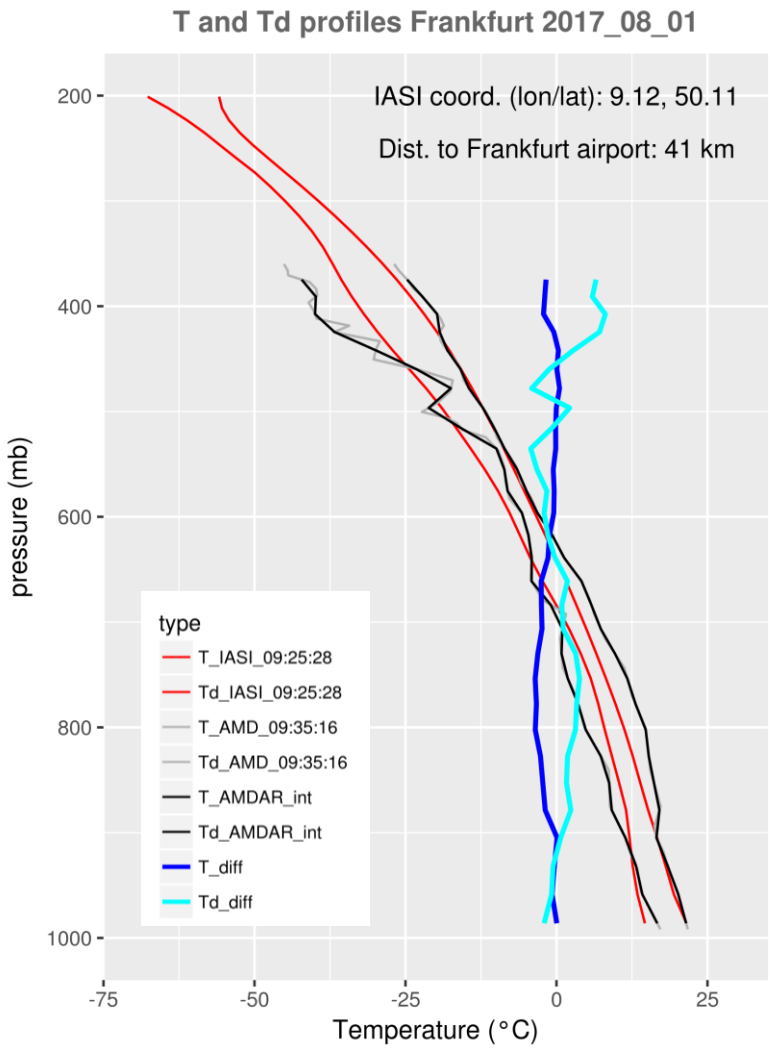
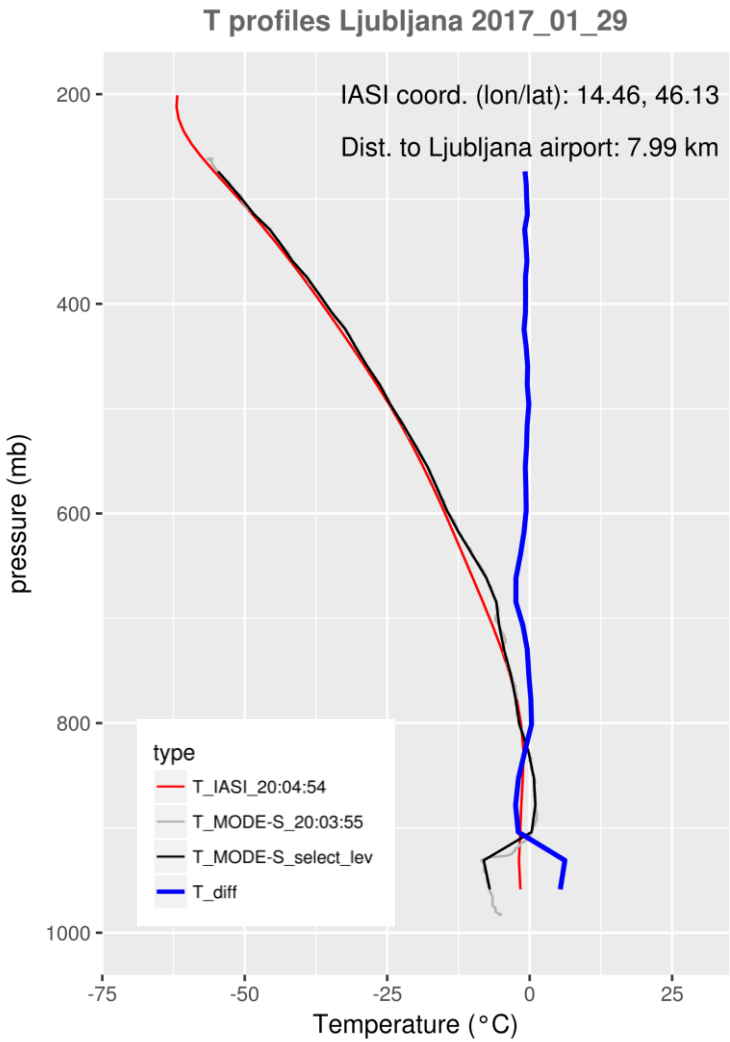


Collocation criteria:
Hor. distance: max 50 km

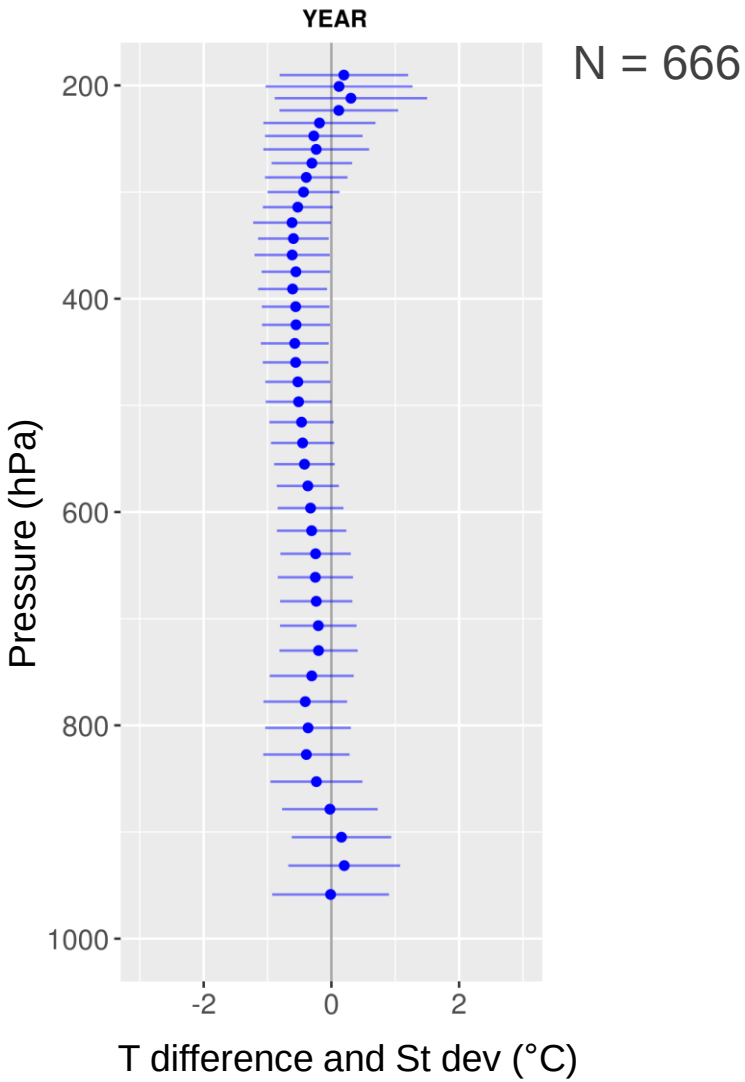
Time difference: 30 min (Mode-S)
1h (AMDAR)

Example profiles





IASI vs. Mode-S temperature



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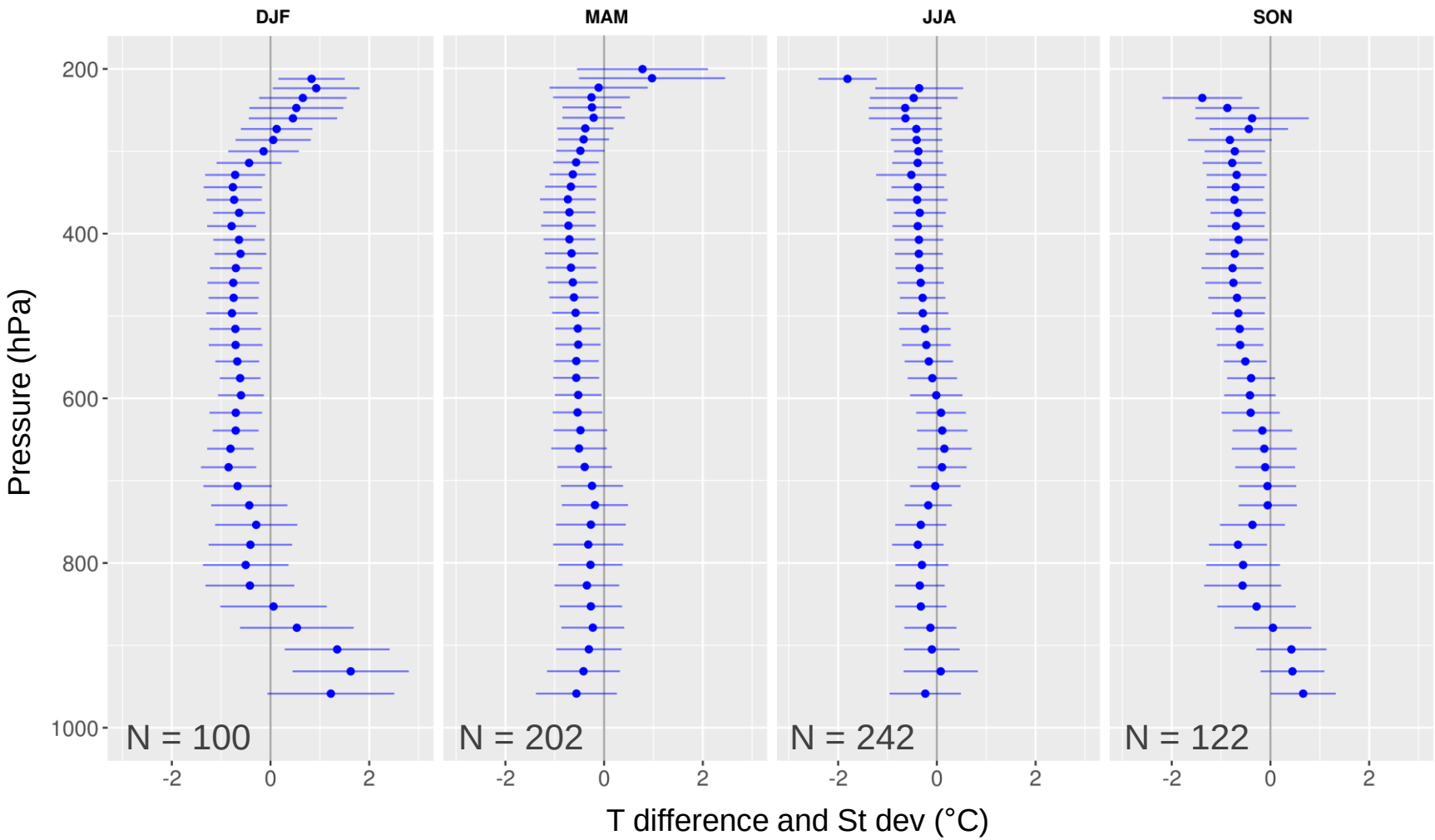
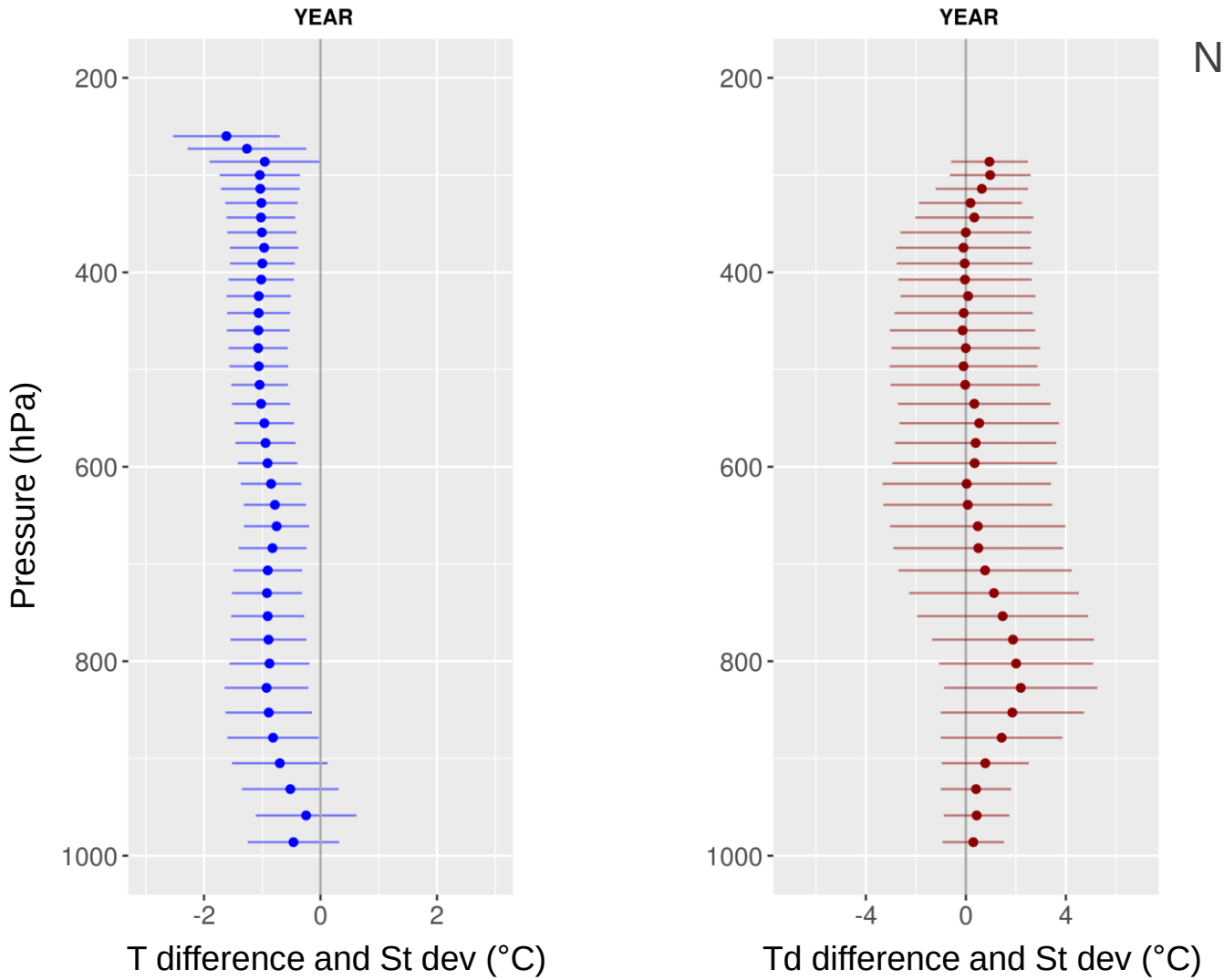
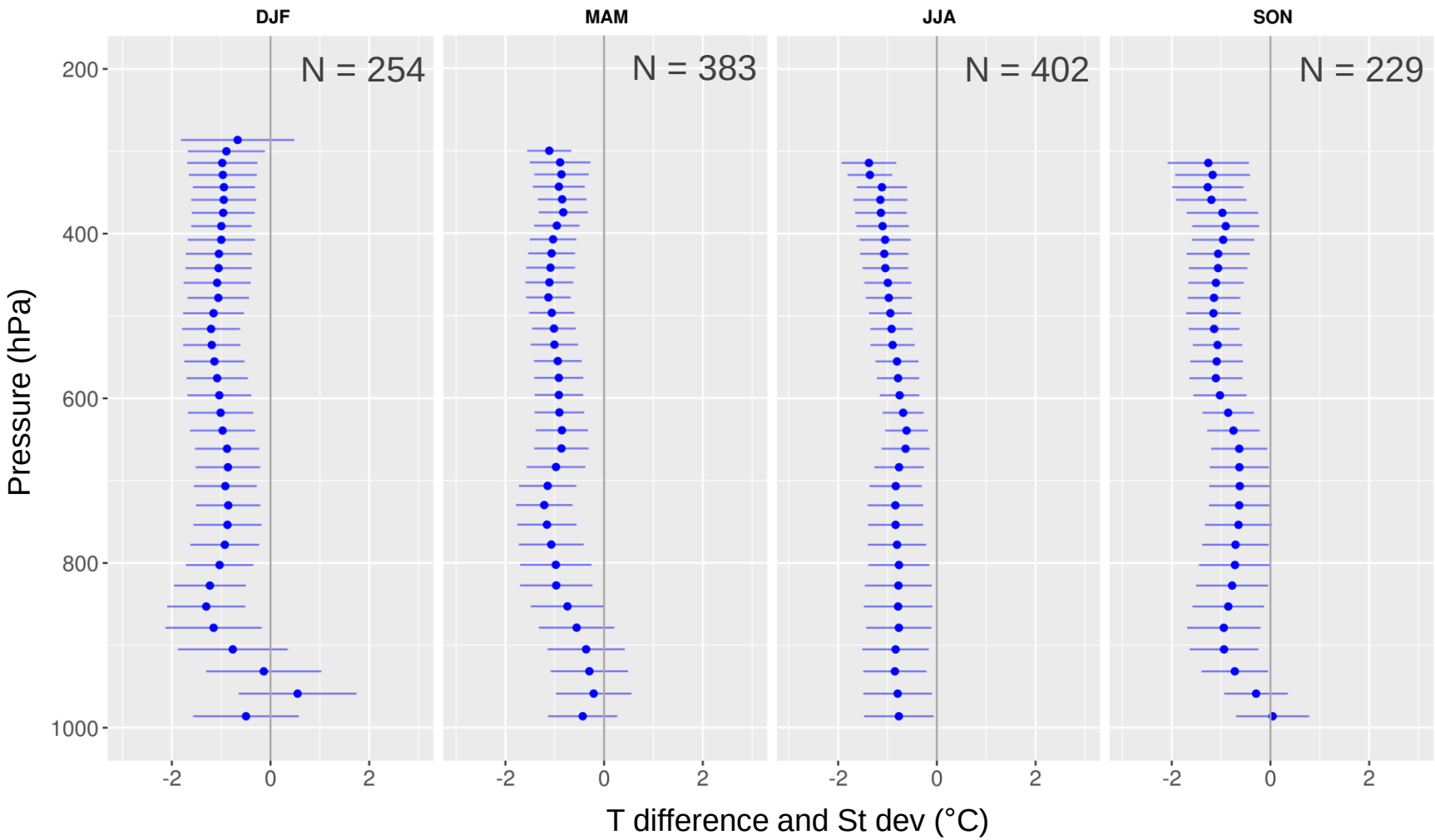


IASI vs. AMDAR T and Td

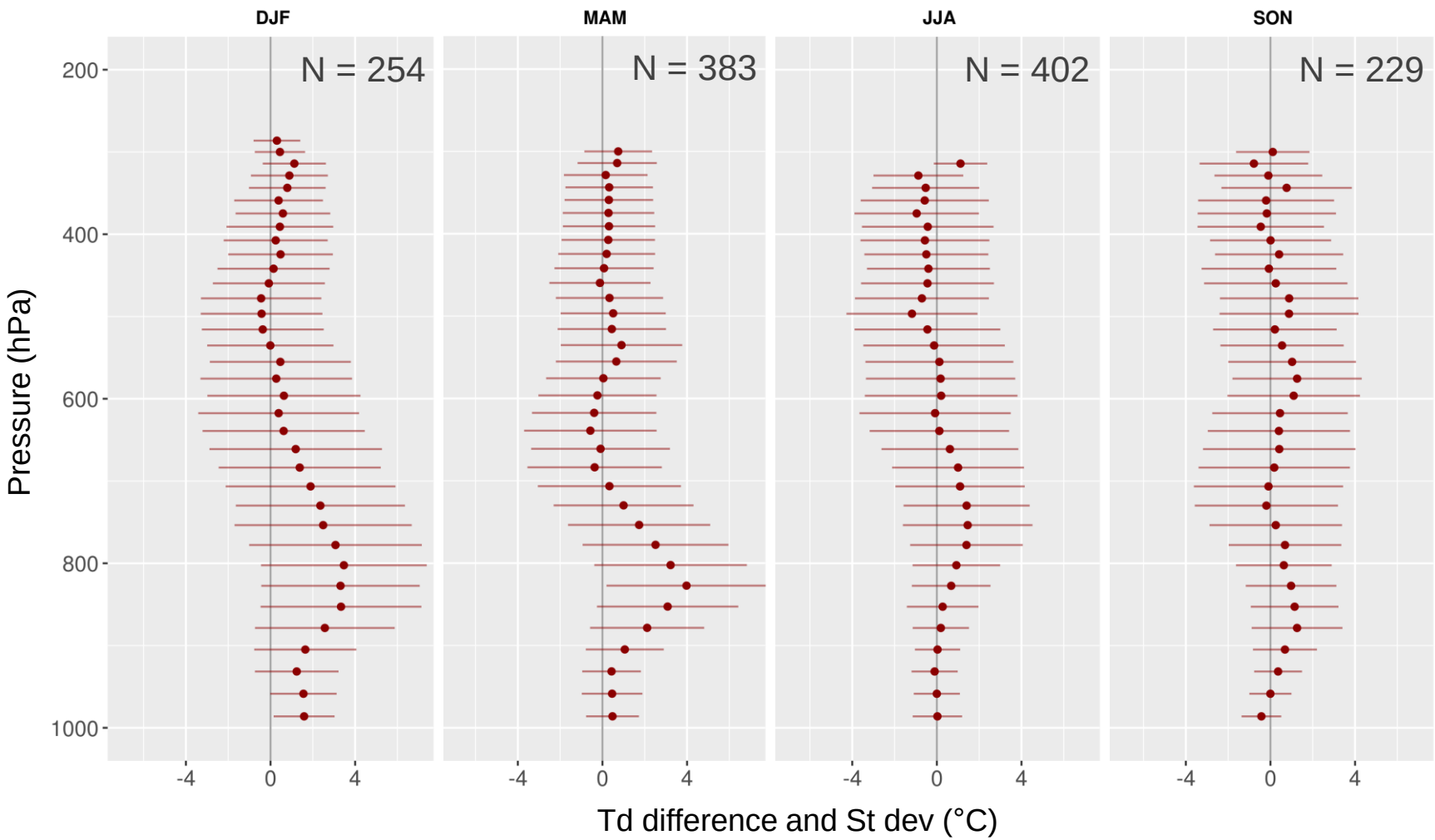


N = 1268

IASI vs. AMDAR temperature



IASI vs. AMDAR dew point temperature



Specific weather situations

Temperature inversion

- Definition: one occurrence of a positive vertical T gradient between 930 and 700 hPa (dT/dh > 0.)

Convection

- K-index:

  $K = T_{850} + Td_{850} - T_{500} - (T_{700} - Td_{700})$

- Showalter index:

  $SWI = T_{env_500} - T_{parcel_500}$ (lifted from 850 hPa)

Inversion IASI vs Mode-S

dT/dh_modes > 0.	IASI YES	IASI NO
Mode-S YES	15	263
Mode-S NO	2	386

POD = 0.05

dT/dh_modes > 5.	IASI YES	IASI NO
Mode-S YES	8	5
Mode-S NO	9	644

POD = 0.62

Inversion IASI vs AMDAR

dT/dh_amd > 0.	IASI YES	IASI NO
AMDAR YES	69	457
AMDAR NO	3	739

POD = 0.13

dT/dh_amd > 5.	IASI YES	IASI NO
AMDAR YES	15	0
AMDAR NO	57	1196

POD = 1.0

Convection IASI vs AMDAR

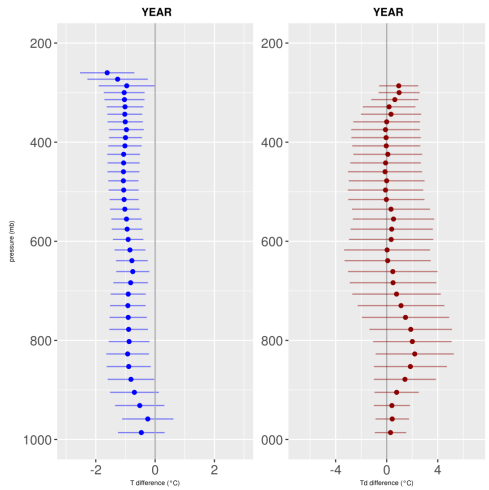
SWI < 0	IASI YES	IASI NO
AMDAR YES	40	28
AMDAR NO	10	784

POD = 0.59

K > 30	IASI YES	IASI NO
AMDAR YES	65	82
AMDAR NO	123	592

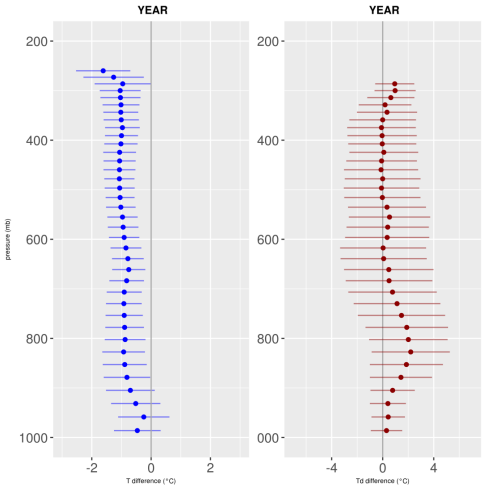
POD = 0.44

Summary



- Mean T diff < 1°C
- Mean Td diff < 2.5 °C
- Seasonal dependency (different weather situations)

Summary



- Mean T diff < 1°C
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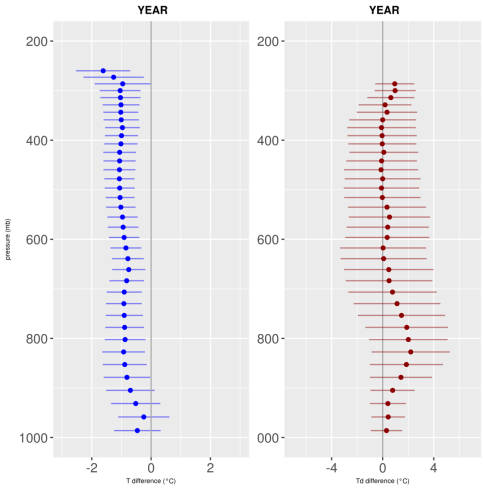
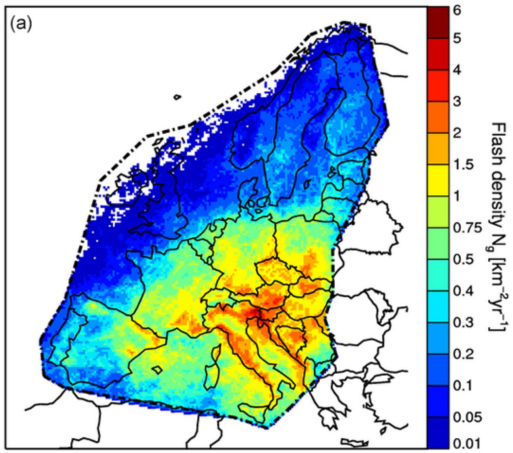
- Seasonal dependency (different weather situations)

- Limited performance in inversion situations (better for pronounced inversions)

Summary





- Mean T diff < 1°C
- Mean Td diff < 2.5 °C
- Seasonal dependency (different weather situations)

- Limited performance in inversion situations (better for pronounced inversions)

- Rel. high hit rates on K and SWI index
- Some false alarms due to moist bias

Convection IASI vs AMDAR

SWI < 0	IASI YES	IASI NO
AMDAR YES	40	28
AMDAR NO	10	784

SWI < 3	IASI YES	IASI NO
AMDAR YES	311	122
AMDAR NO	85	344

K > 30	IASI YES	IASI NO
AMDAR YES	65	82
AMDAR NO	123	592

K > 20	IASI YES	IASI NO
AMDAR YES	238	95
AMDAR NO	164	365