The impact of NAWDEX dropsonde and extra radiosonde observations on forecast quality and tropopause structure*

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MOTIVATION

- Over 1000 dropsondes deployed over Atlantic during NAWDEX and SHOUT
- Several hundred additionally launched radiosondes over Canada and Europe

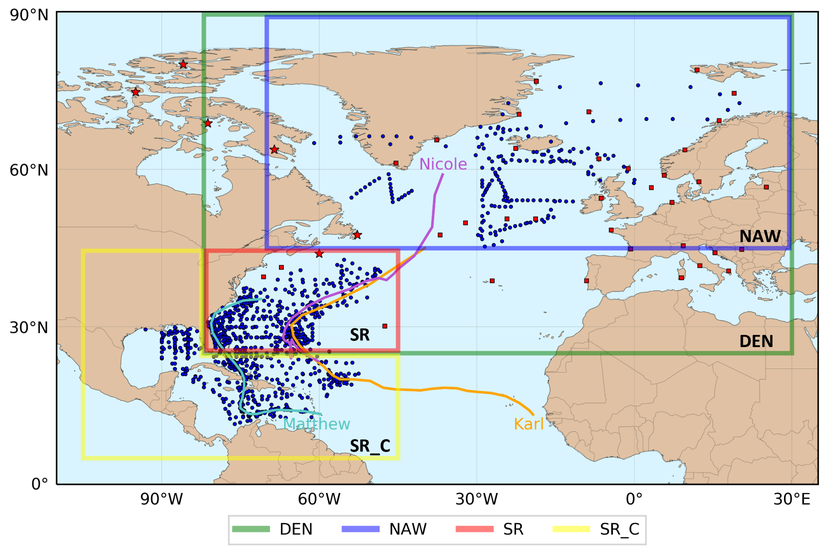

Fig 1: Dropsonde (blue) and additional radiosonde (red) observations, along with best tracks for Tropical Storm Karl and Hurricanes Matthew and Nicole. Specific verification regions are depicted by colored boxes (NAW, DEN, SR, SR_C).

APPROACH

- Data denial experiments with ECMWF IFS (cycled from 17.09.-18.10.16)
- Forecast Sensitivity to Observation Impact (FSOI)
- Influence of observations on forecast performance and tropopause structure

DATA DENIAL

Q: What is the impact of additional observations on forecast performance?

- Overall reduction in short-range forecast error due to collected observations

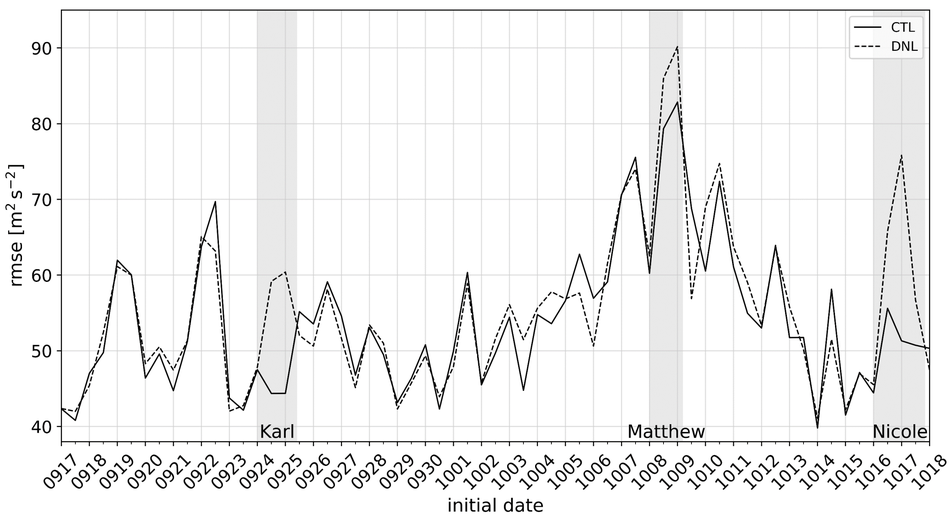

Fig 2: Time series of RMSE of the 2-day forecast of 500-hPa geopotential for control (CTL) and denial (DNL) experiment, averaged over the whole campaign period and verified against the operational analysis over DEN.

- Several cases indicate significant differences (Karl, Matthew, Nicole)

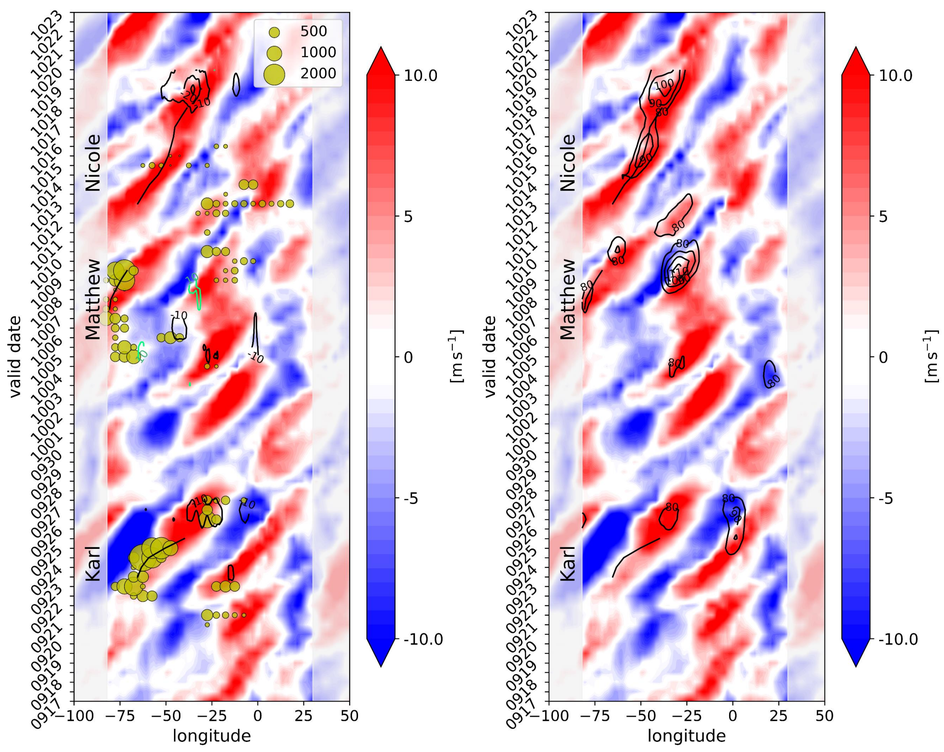

Fig 3: Hovmoeller of the meridional wind analysis at 300 hPa (red/blue colors), zonally accumulated dropsonde observations (yellow markers), best tracks of Karl, Matthew and Nicole, and a) difference in absolute forecast error (CTL-DNL) of 500-hPa geopotential and b) operational EPS spread, averaged over 30°-80°N (contour lines).

- Widespread forecast error reduction coinciding with regions of increased EPS spread for central NAWDEX IOPs and Hurricane Nicole

FSOI

Q: What is the impact of additional observations as measured by FSOI?

- Observations deployed in diabatically active regions and in vicinity of TCs

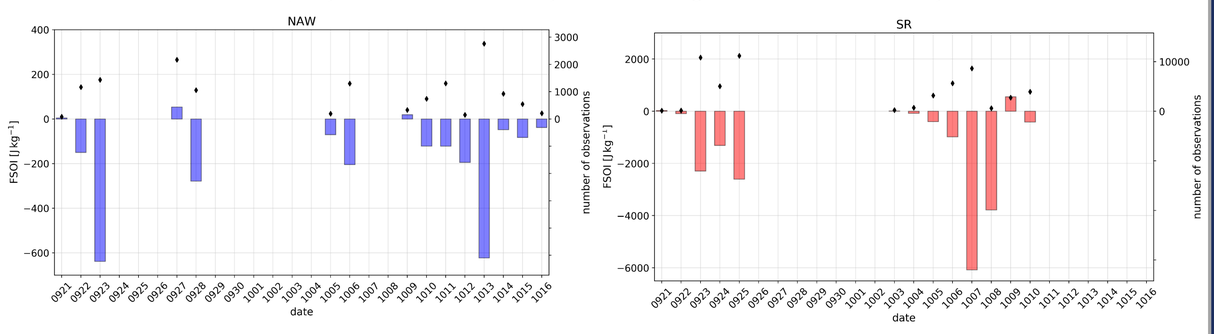

Fig 4: Time series of total FSOI (bars) and number of observations (markers) for NAW and SR regions.

- Large impact associated with sampled WCB and extended anticyclone (NAW)
- Large impact for observations of recurving TS Karl and Hurricane Matthew (SR)

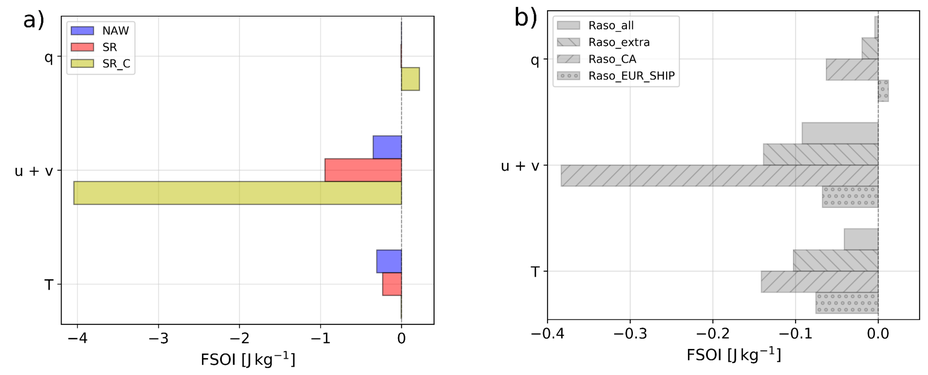

Fig 5: FSOI per observation for specific humidity, sum of horizontal wind components and temperature for a) dropsondes and b) radiosondes for experiment CTL, averaged over the campaign period.

- Significant impact of wind observations near TCs and observations of CAN rasos

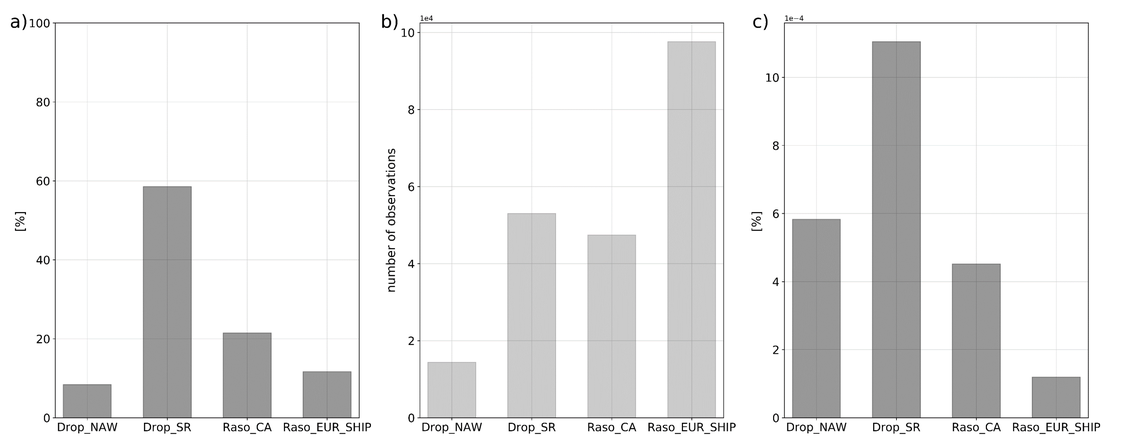

Fig 6: a) Relative total impact, b) number of observations and c) impact per observation for dropsondes and radiosondes.

- Largest contribution to total impact and impact per observation by SR dropsondes

TROPOPAUSE

Q: How does the assimilation of radiosonde data affect the tropopause?

- Over 400 radiosonde profiles analyzed in observation space

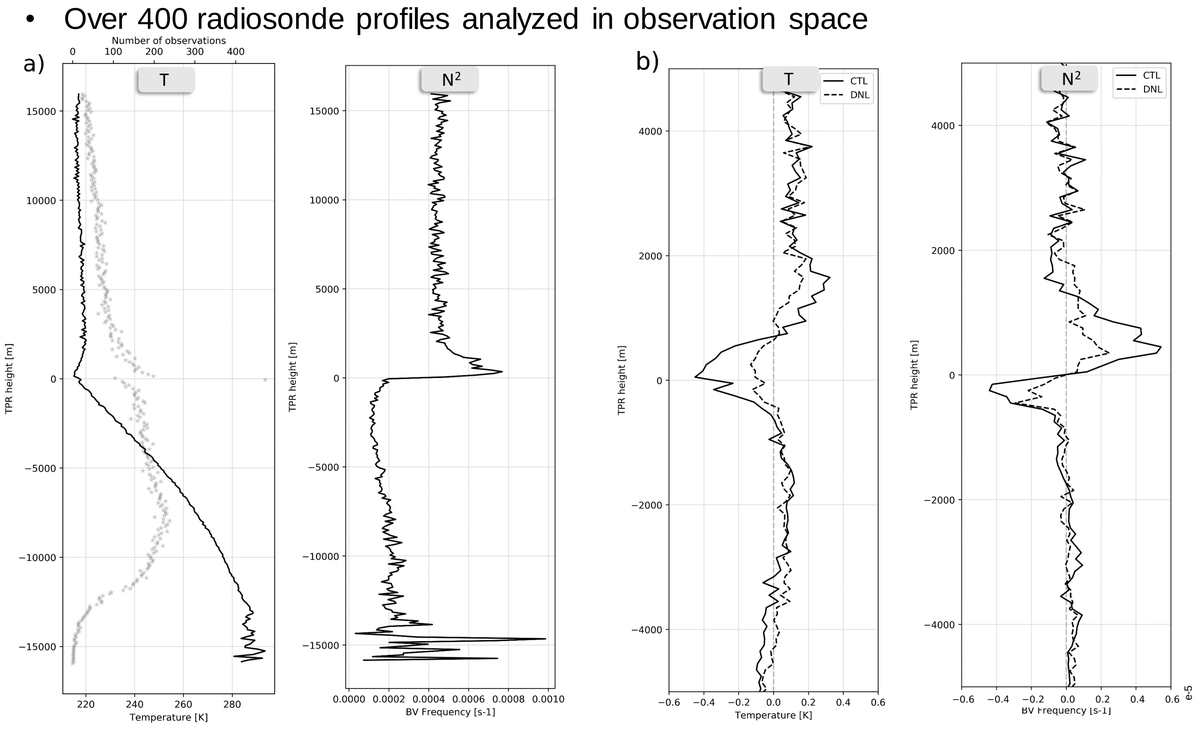

Fig 7: Tropopause relative a) mean temperature (left) and Brunt-Vaisala frequency (right) for 420 radiosonde profile observations and b) differences between xa and xb for CTL and DNL for T (left) and N² (right).

- Mean T profile with sharp inversion, mean N² profile with tropopause step change
- Analysis indicates stronger gradients in **xa**, when additional radiosondes are assimilated (CTL)
- Even if radiosonde observations are passive (DNL), assimilation system increases tropopause gradients

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