Impact of Spire and COSMIC-2 data in the ECMWF and Met Office NWP systems

Katrin Lonitz[ECMWF], Neill Bowler[MetOffice] and Sean Healy[ECMWF]

katrin.lonitz@ecmwf.int

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Ongoing ESA Study (end July 2021): Contract No. 4000131086/20/NL/FF/an

Parties involved in this study: ECMWF, Met Office and EUMETSAT

ECMWF

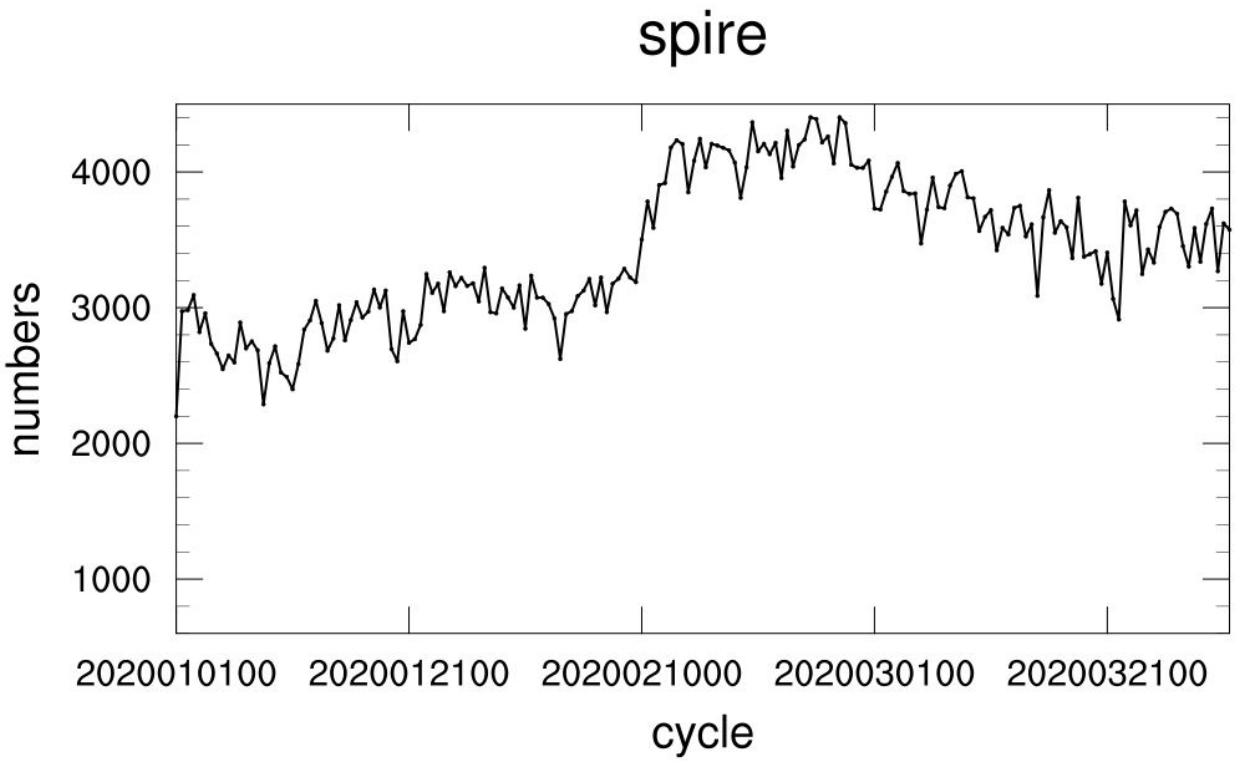
Setup and Data

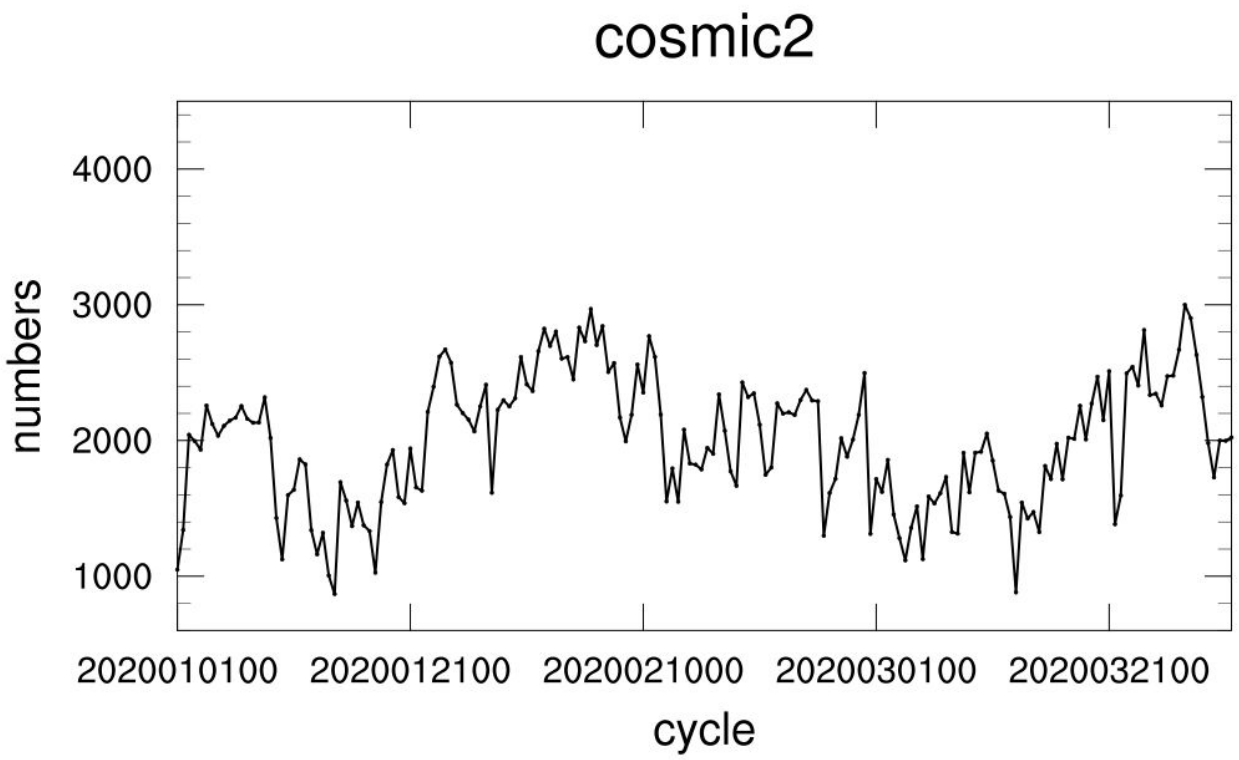
How is Spire and COSMIC-2 assimilated?

	Met Office	ECMWF
Bending angle operator	1D	2D
Observation error model	uses height, satellite ID and average temperature below 20km as the predictors	global bending angle error statistic
Bias correction	no	
Usage of data	Assimilated from surface to 60km^{MO}/50km^{ECMWF} impact height	
Model	N320 (40 km in mid-lat)	IFS CY47R1, Tco399 (25 km spacing)
Data assimilation cycle	6h	12h
Experiment period	Jan 1 – March 31, 2020	

Temporal distribution @ ECMWF

Jan-Feb-Mar 2020



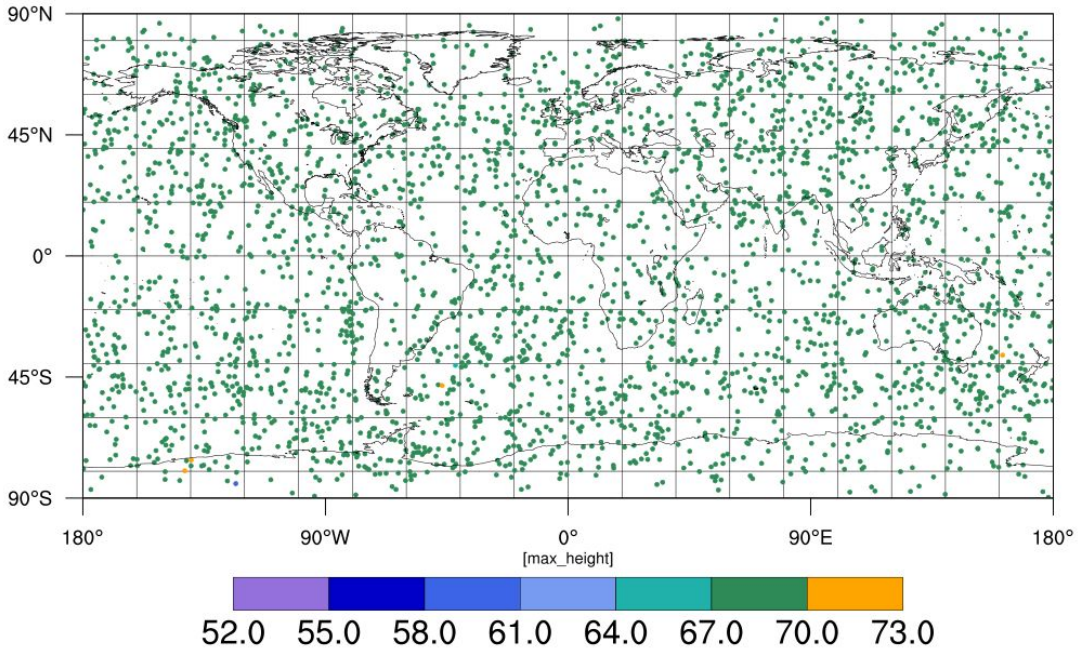


cycle = 12 hour window

Spatial distribution of data

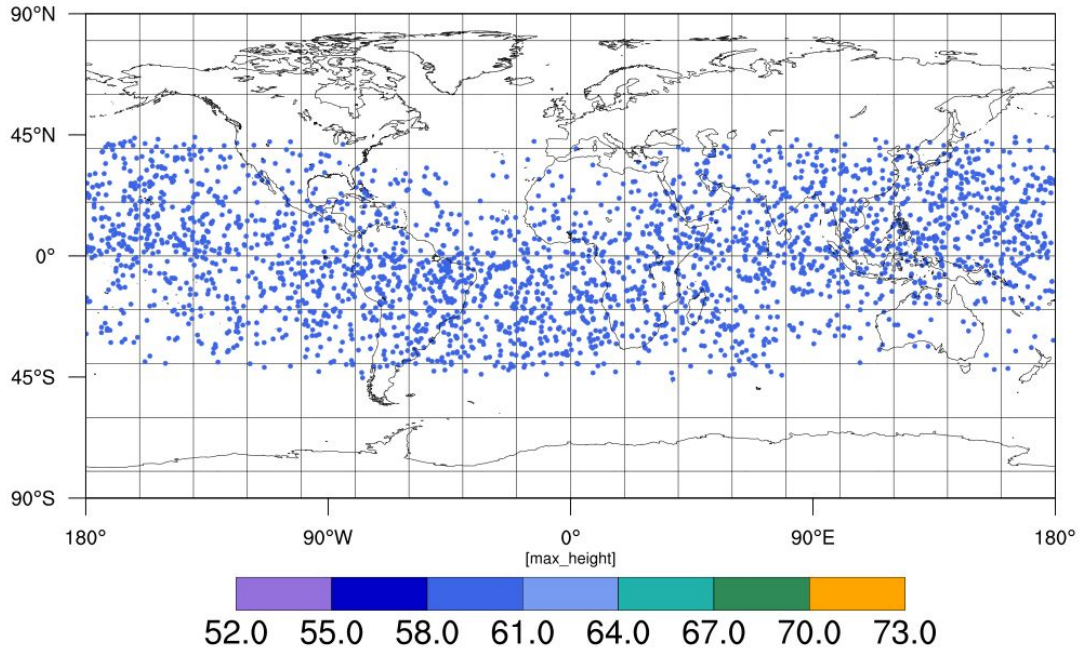
1 Feb 2020 00UTC cycle

Spire



3074 profiles

Cosmic2



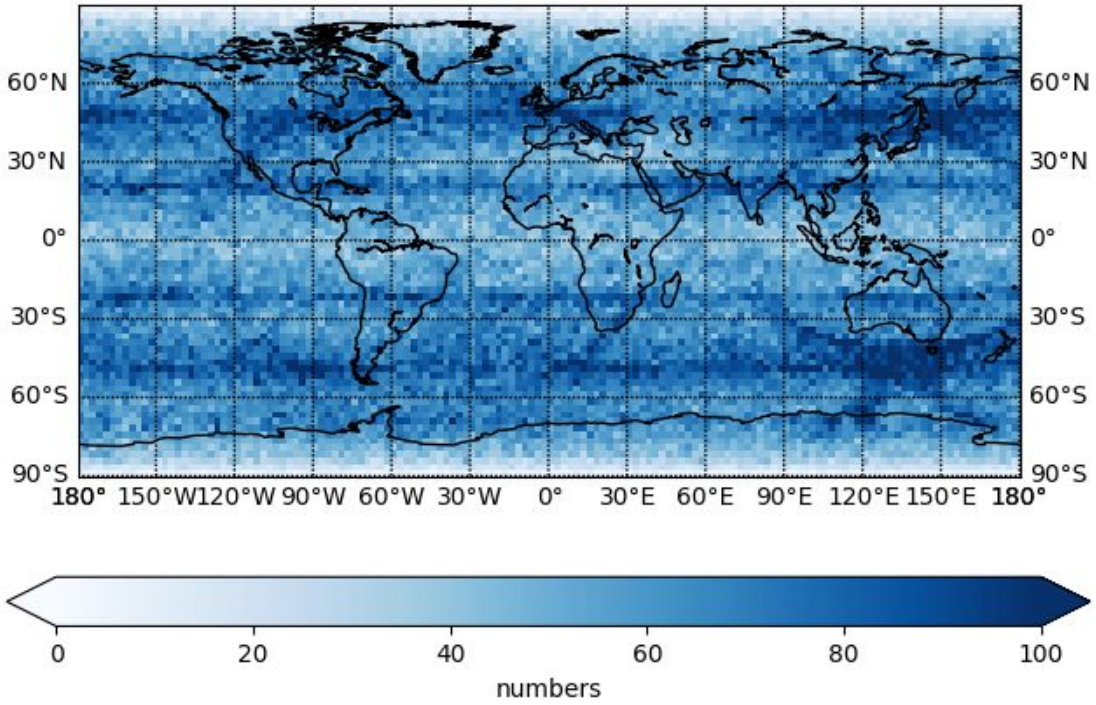
2658 profiles

Spatial distribution of data

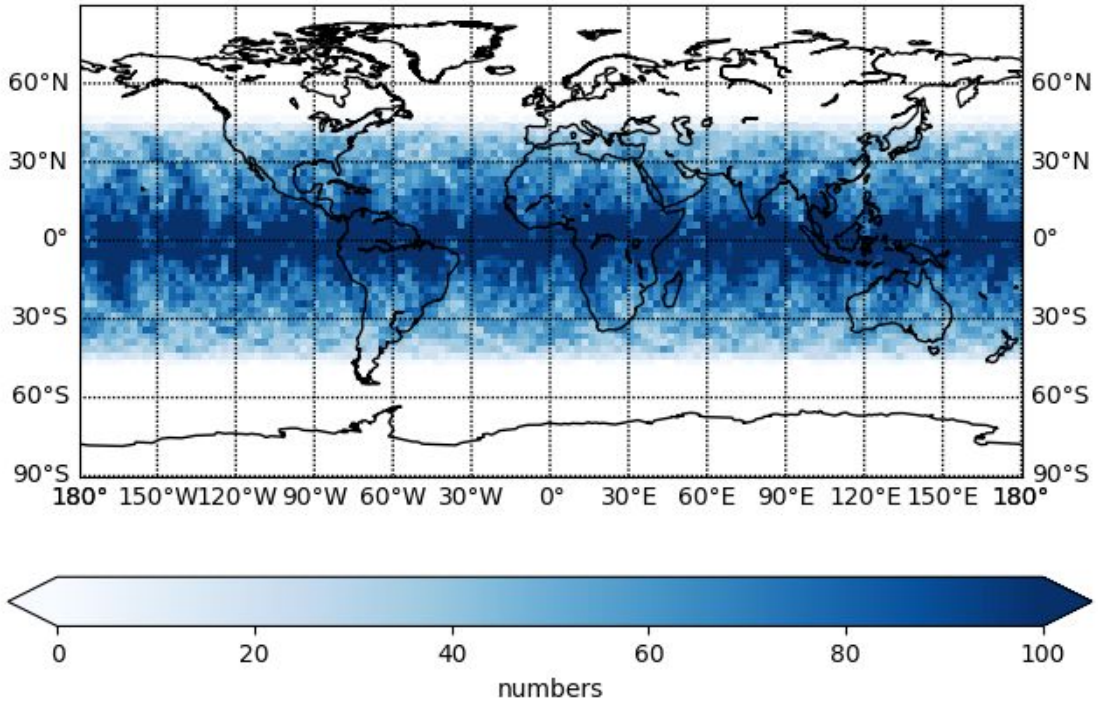
Jan,Feb,March 2020

(gridded to 2.5 x 2.5 lat/lon)

Spire



Cosmic-2



* ECMWF only

Experiments

- CTL: Operational data available for the period, including the GNSS-RO data

(e.g. ECMWF:3*Metop GRAS, KOMPSAT-5, FY-3C GNOS, TSX,TND =3000 profiles per day)

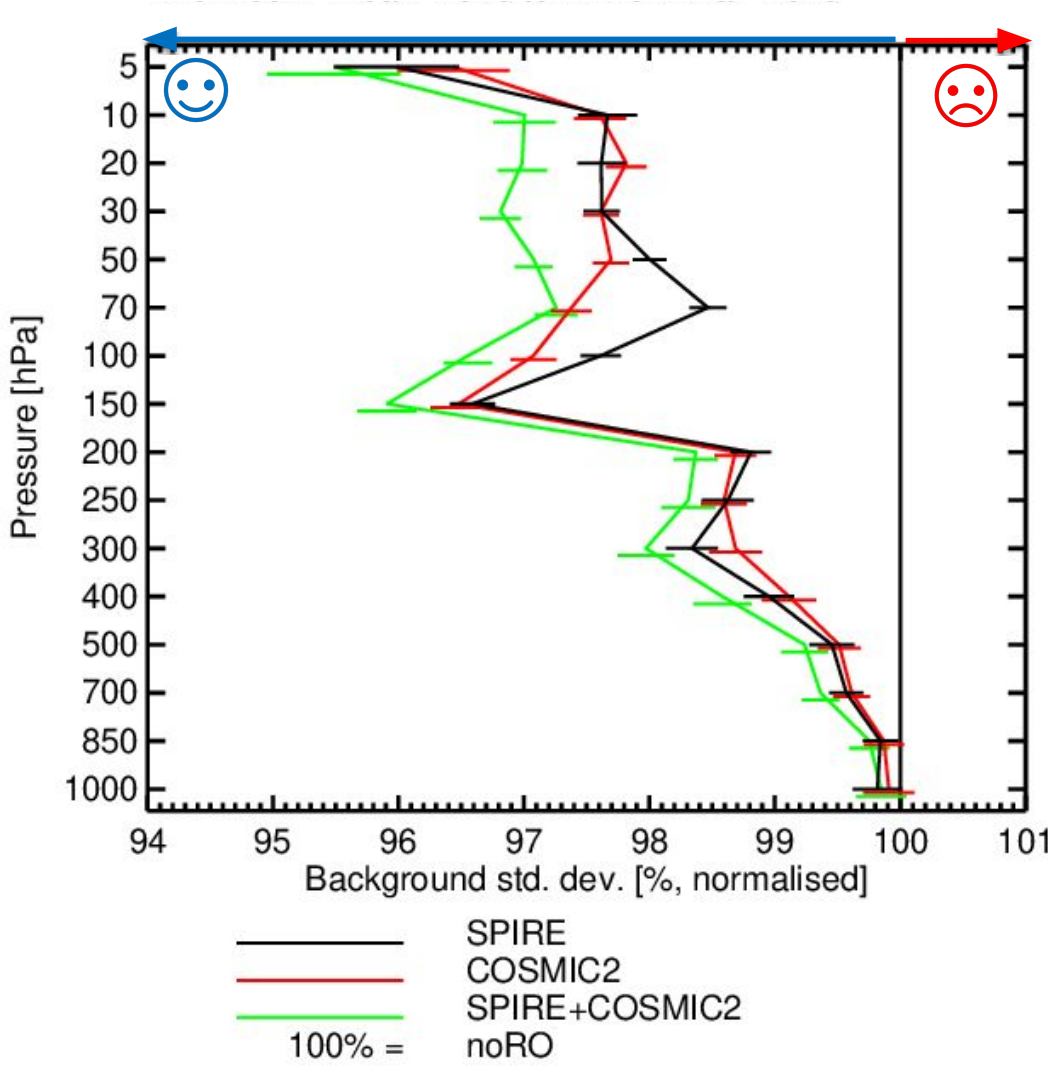
- **NoRO: CTL minus all GNSS-RO data**
- **COSMIC2: CTL + COSMIC-2 data (4000 profiles in ± 40 degrees latitude band)**
- **Spire: CTL + Spire (Spire > 5000 profiles globally distributed)***
- **Spire + COSMIC2: CTL + Spire + COSMIC-2**

Results

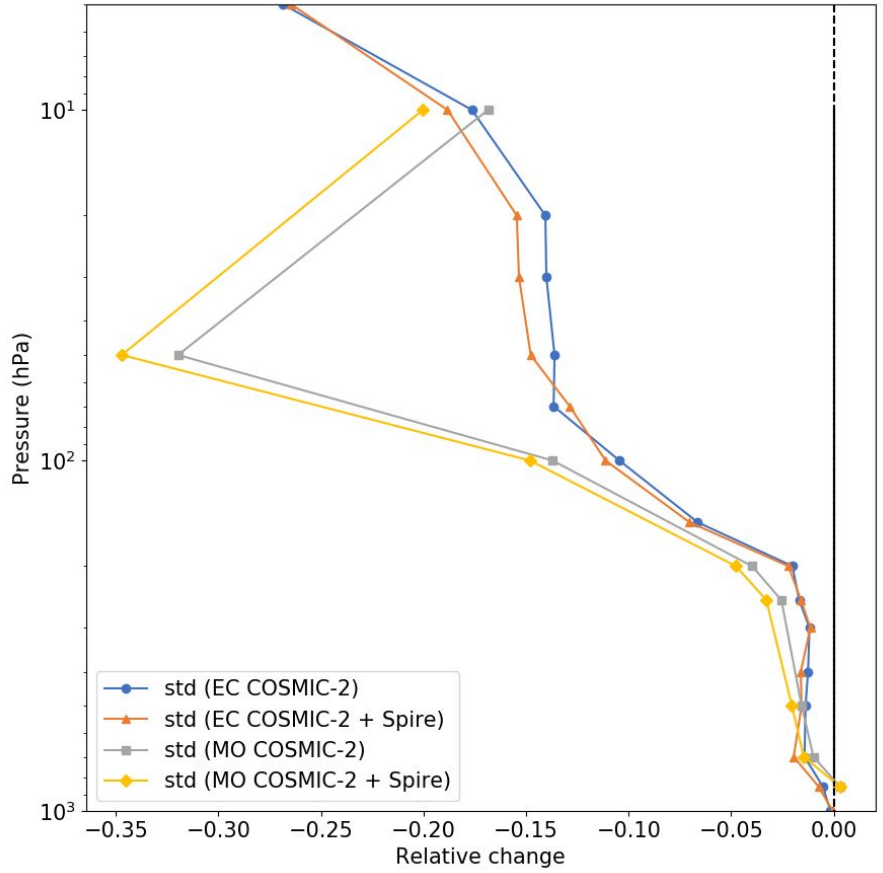
Fits to **radiosonde temperature** observations

Normalised standard deviation in FG departure

Global, ECMWF



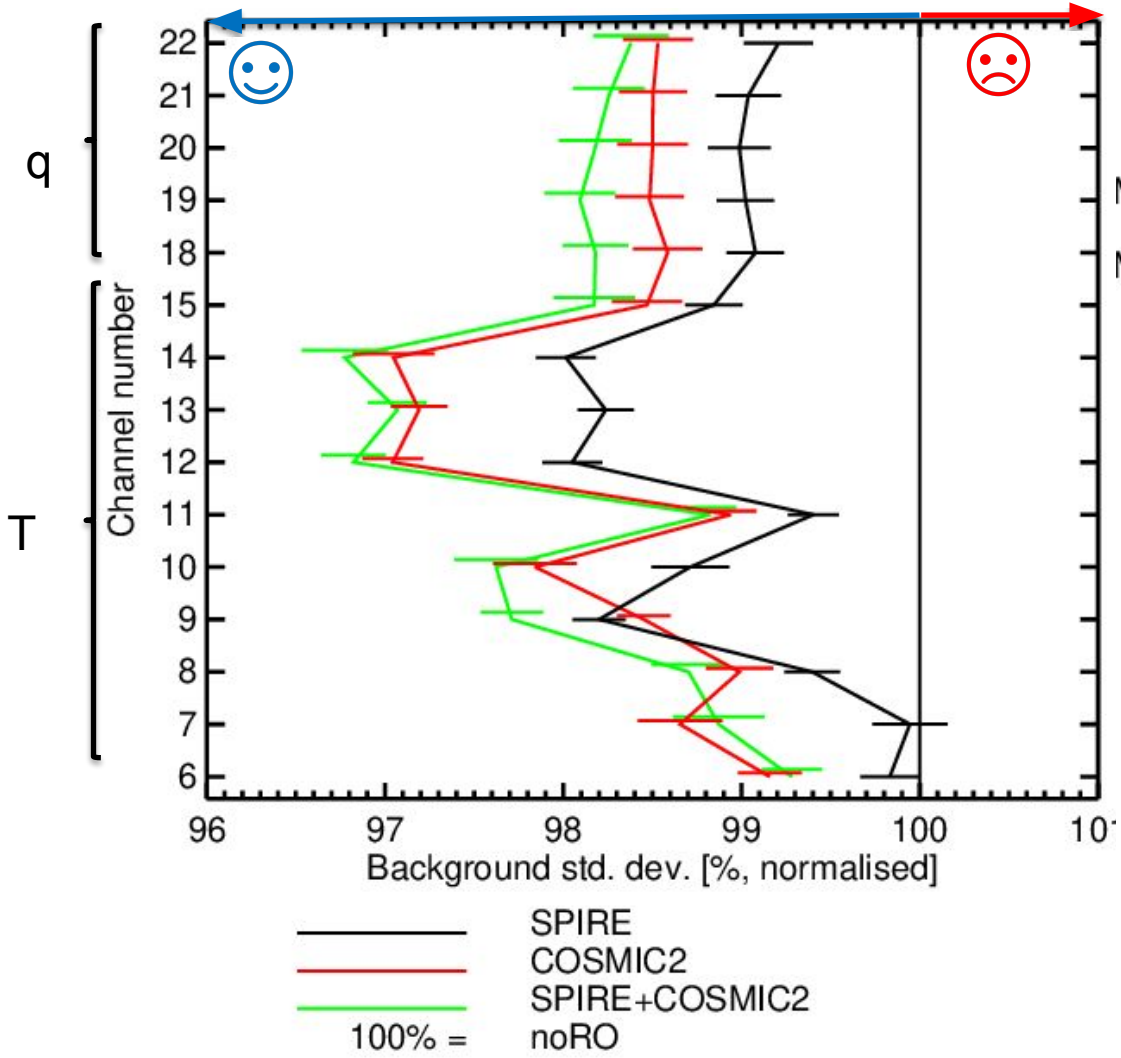
Tropics, MetOffice and ECMWF



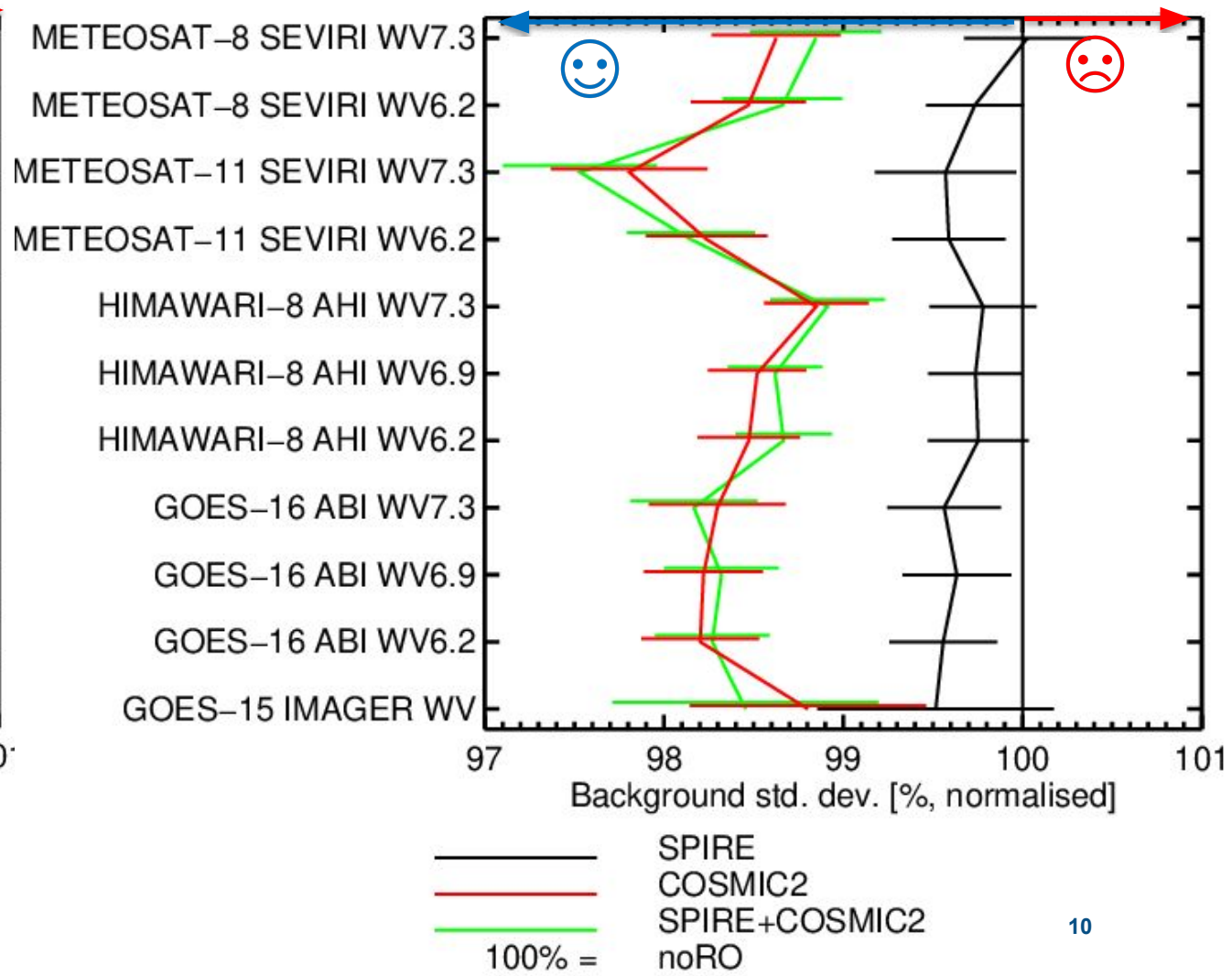
Fits to **tropical** observations@ECMWF

Normalised standard deviation in FG departure

ATMS

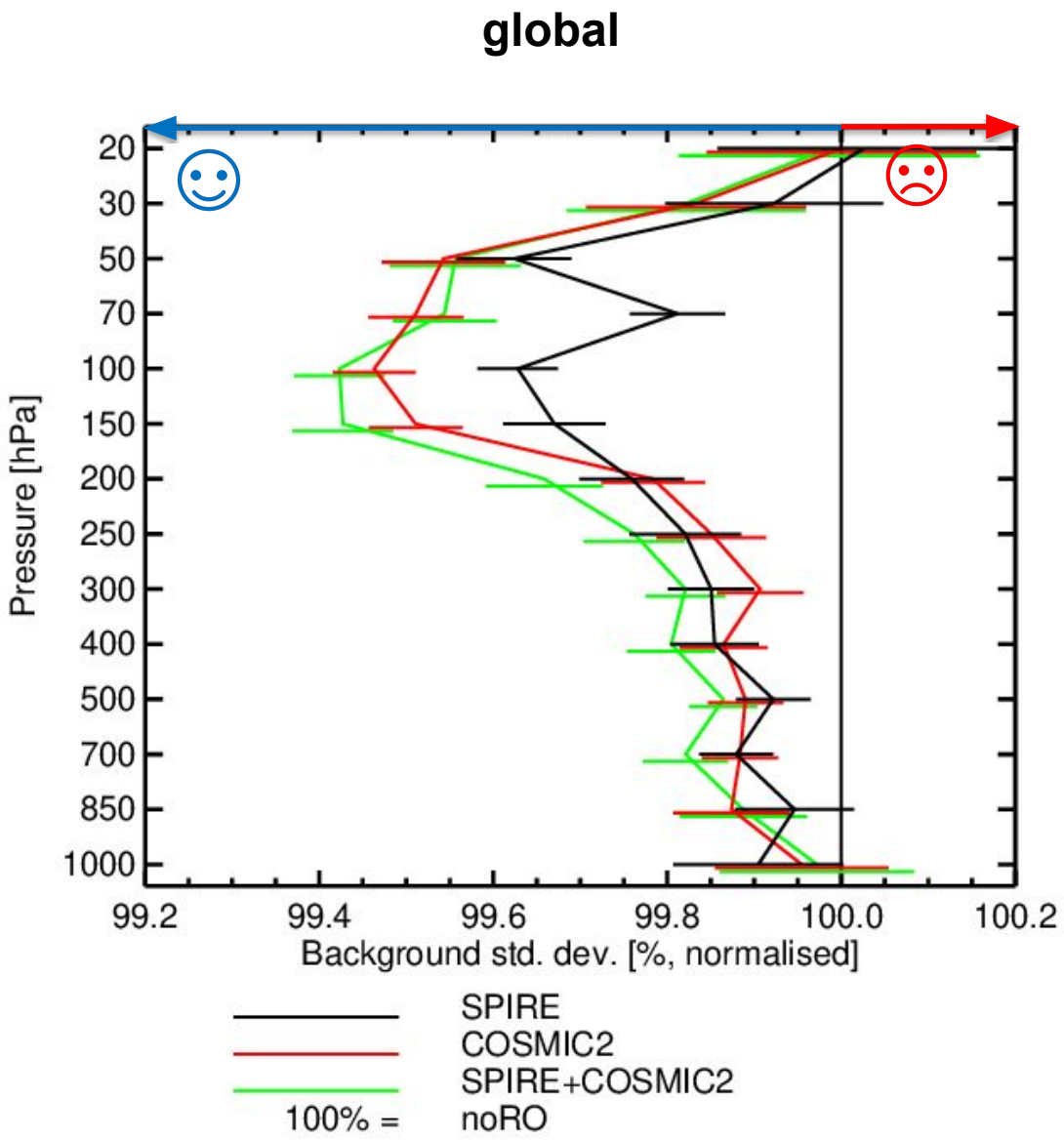


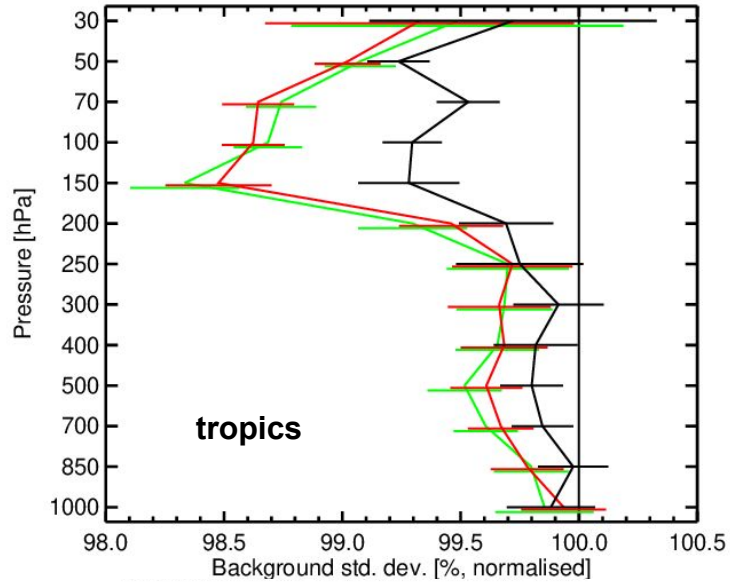
Geostationary radiance

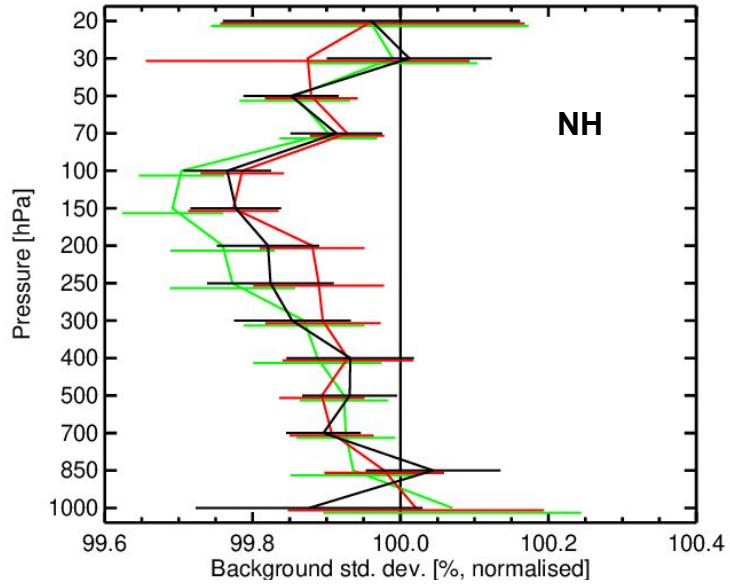


Fits to aeolus wind@ECMWF

Normalised standard deviation in FG departure



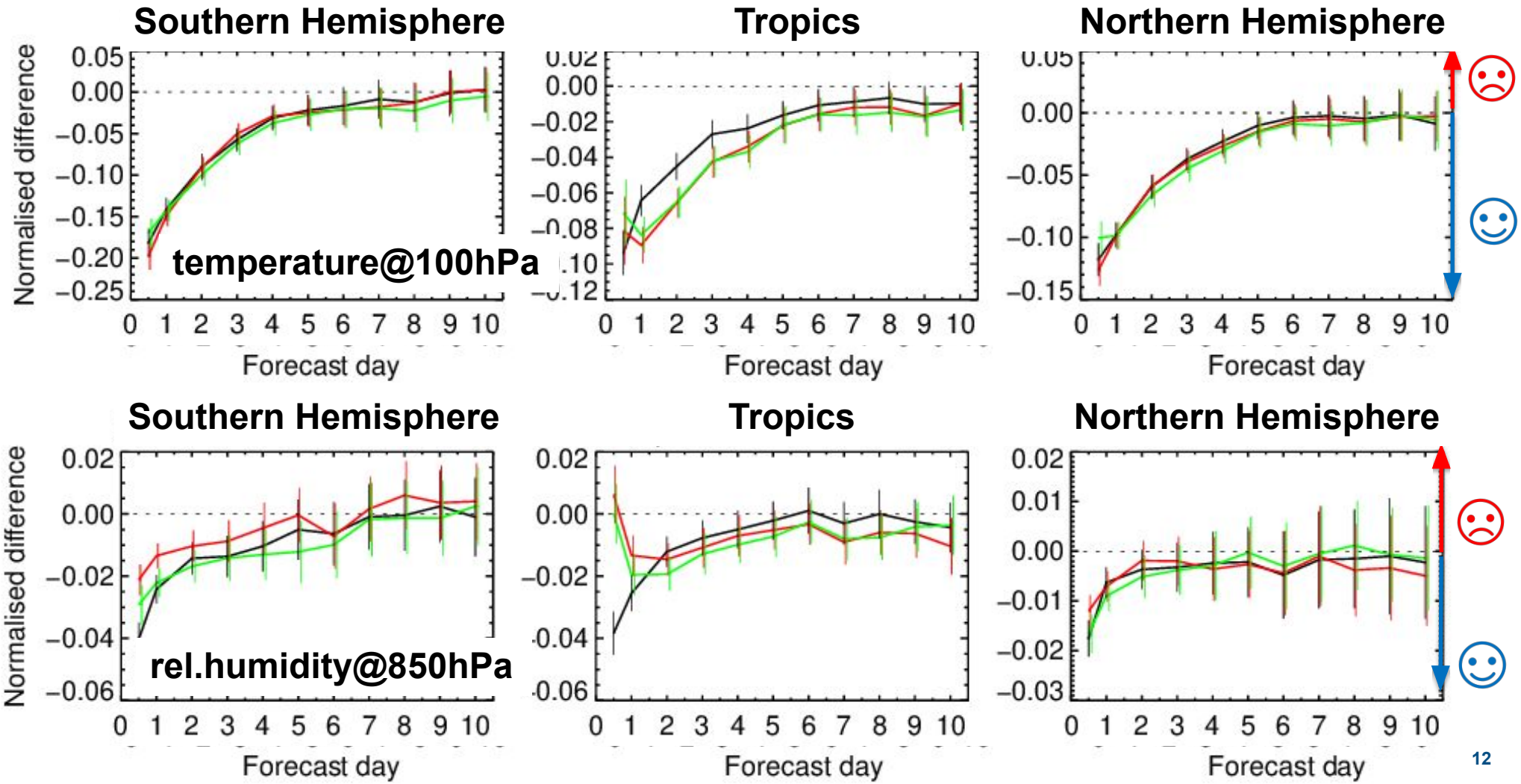




Medium Range Weather Forecast Scores@ECMWF

Normalised change of std. dev

SPIRE – noRO
COSMIC2 – noRO
SPIRE+COSMIC2 – noRO



Summary

Summary

- *Good impact on observing system and forecast scores from both Spire and COSMIC-2*

	Met Office	ECMWF
Similarities	Largest impact seen in higher levels	
	improved fits to temperature and humidity sensitive observation	
	COSMIC-2 has a bigger impact on humidity in the tropics than Spire	
Differences	Improved scores in vector wind	improved fits and scores in wind
	not evident	biggest impact of Spire in SH

- *Both centres would assimilate Spire data*

a bit more….

Ensemble of Data Assimilation experiments

Ongoing work @ ECMWF

Why?

To estimate how the impact of GNSS-RO measurements scales as a function of observation number in the ECMWF numerical weather prediction system

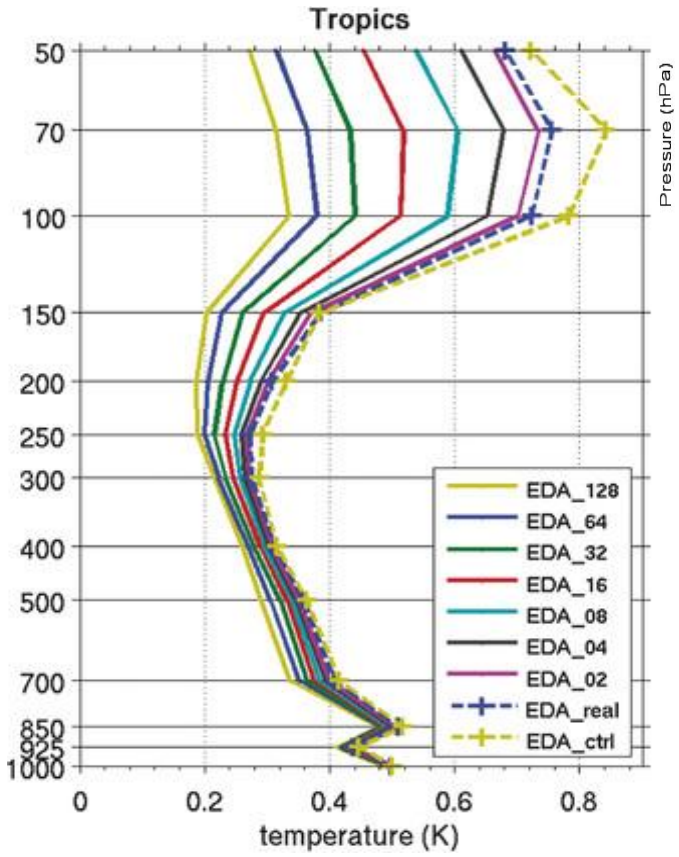
Background:

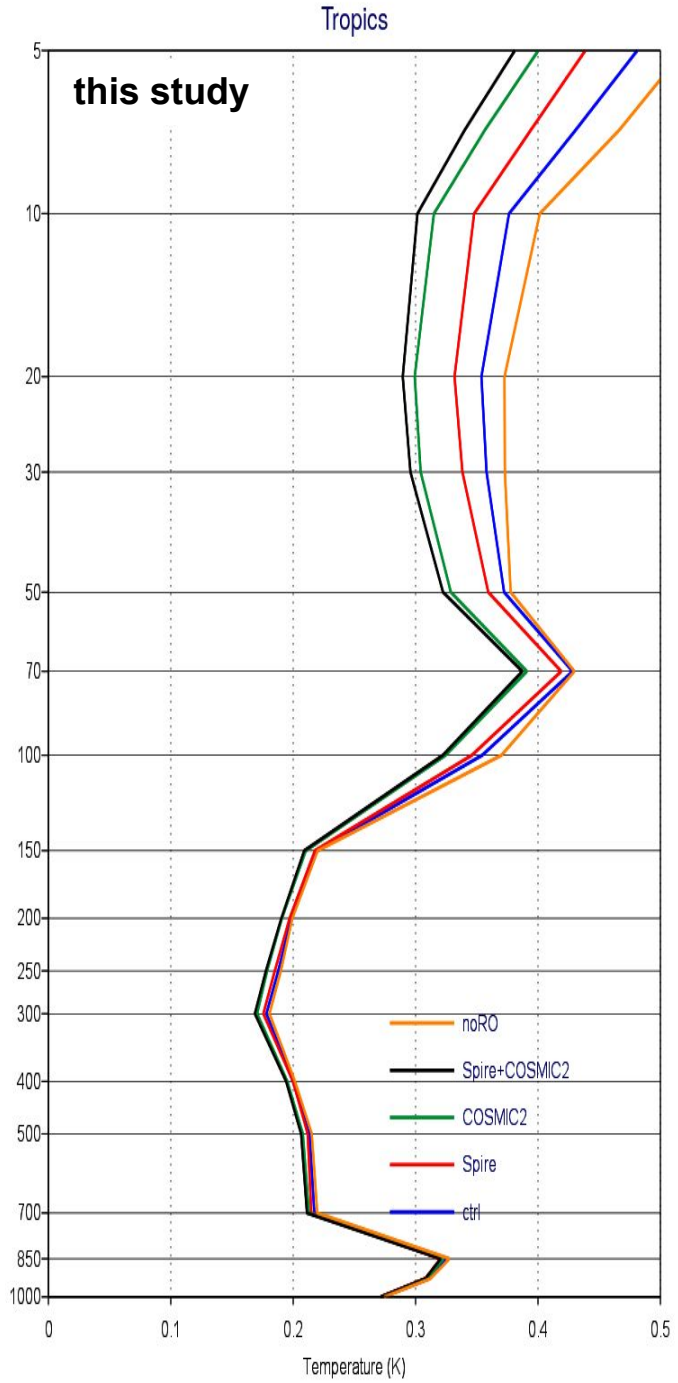
Theoretical short-range forecast error statistics can be estimated from the spread of ensemble members

Aim:

Test if the addition of real GNSS-RO data reduces the EDA spread as discussed in

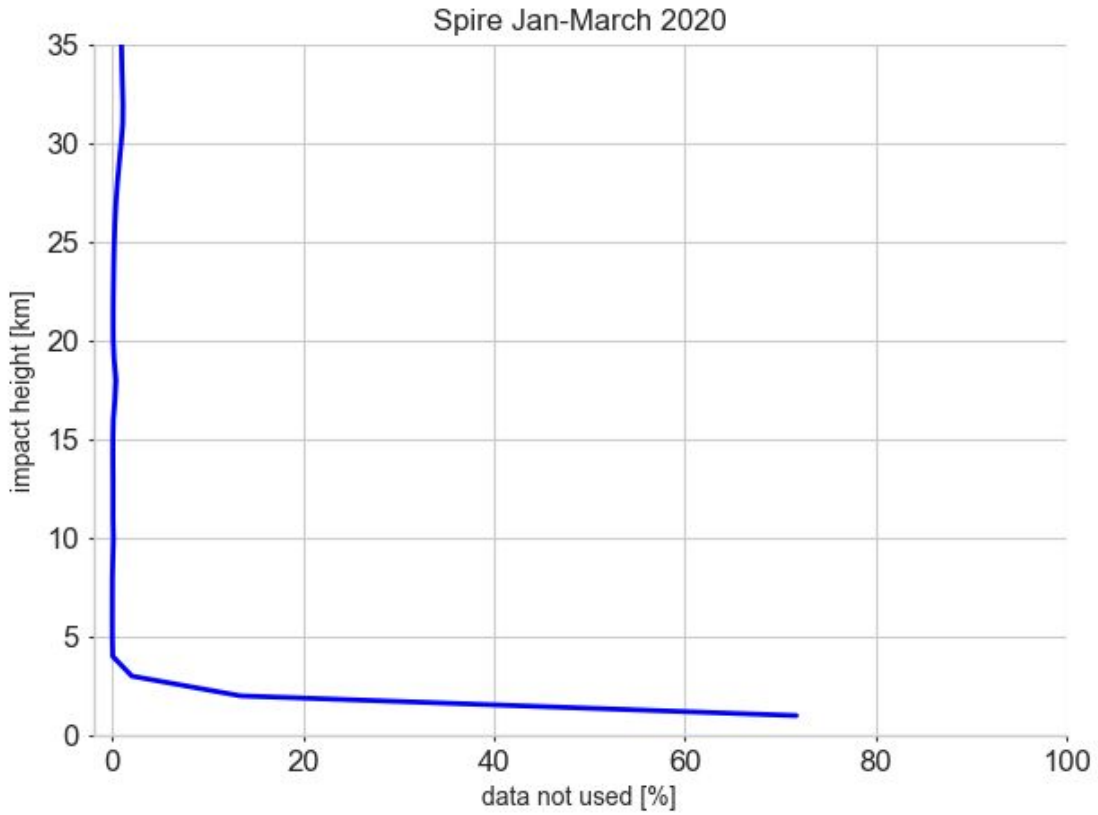
Harnisch et al. 2013

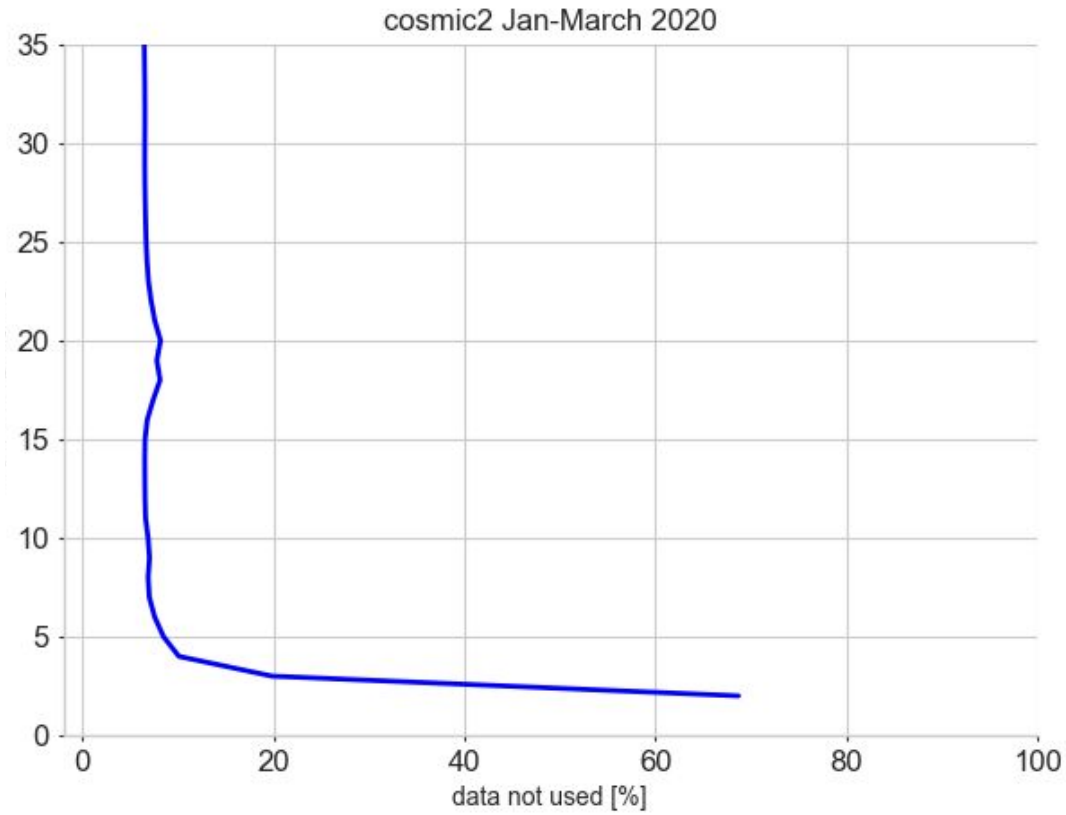




Backup

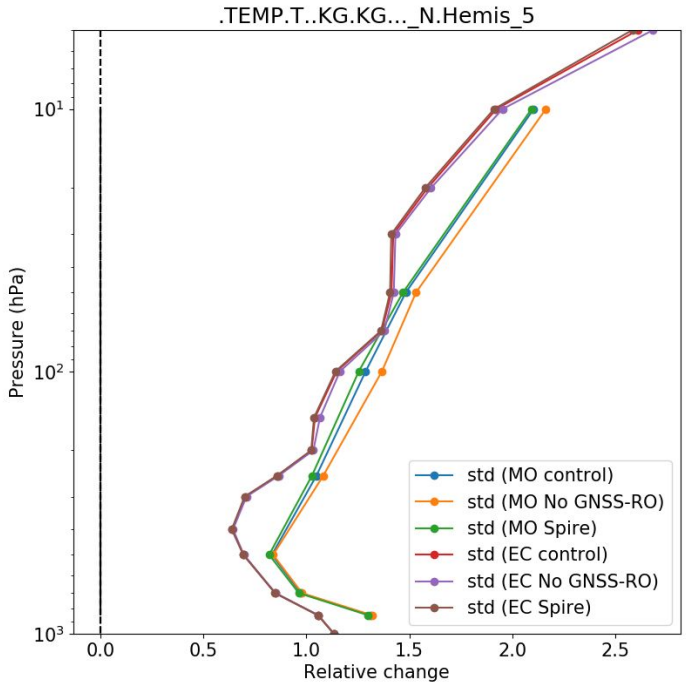
Vertical data usage of Spire and COSMIC-2

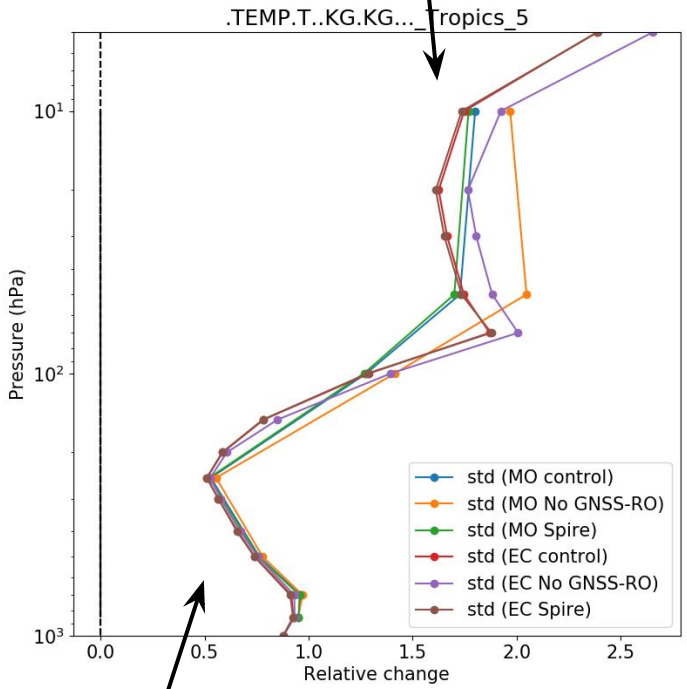


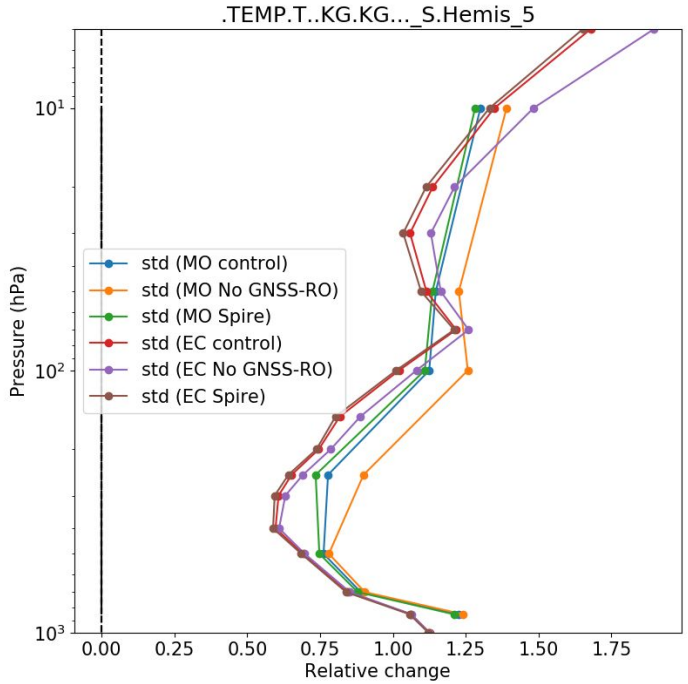


Std(O-B) temperature for Radiosonde T

Reductions in innovation due to less/extra data above 850 hPa



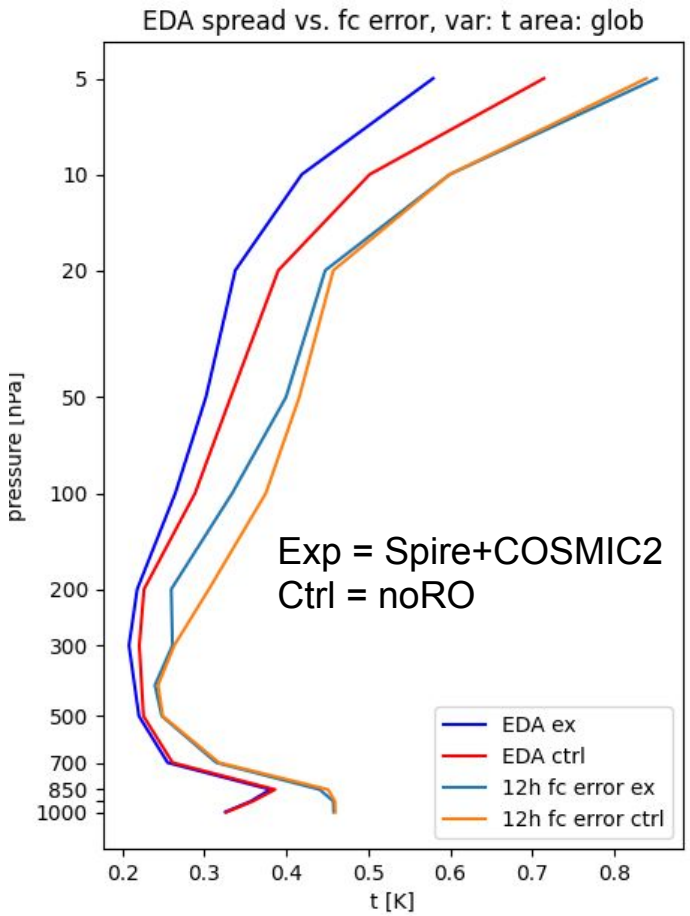




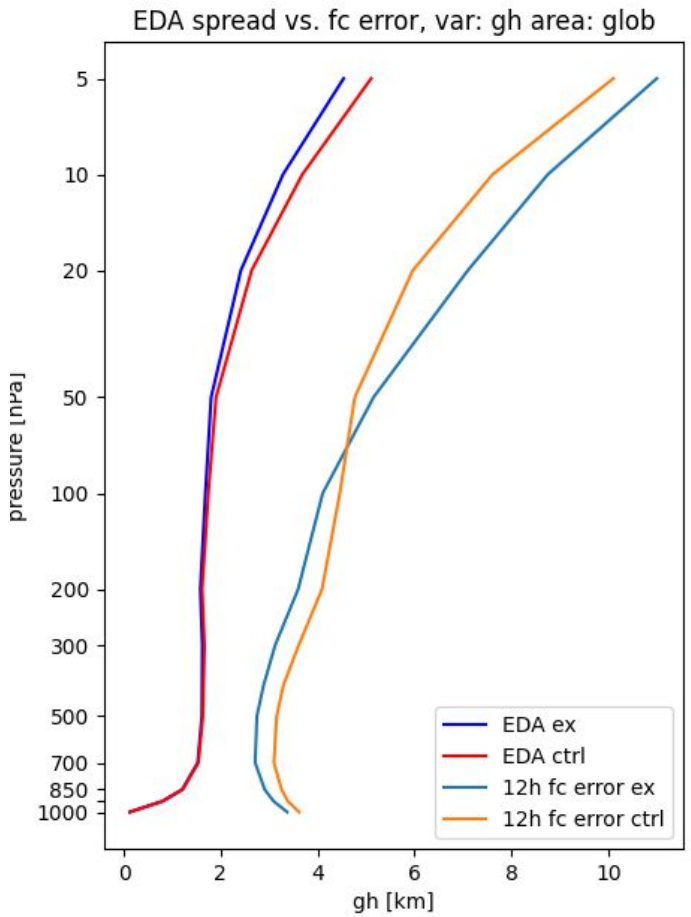
Much closer between ECMWF and MO

EDA spread versus FC error (global)

temperature



Geopotential height



U-wind