



Initial Ground-Based Validation of GEMS Trace Gases Observations (March-July, 2021)

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Methodology:

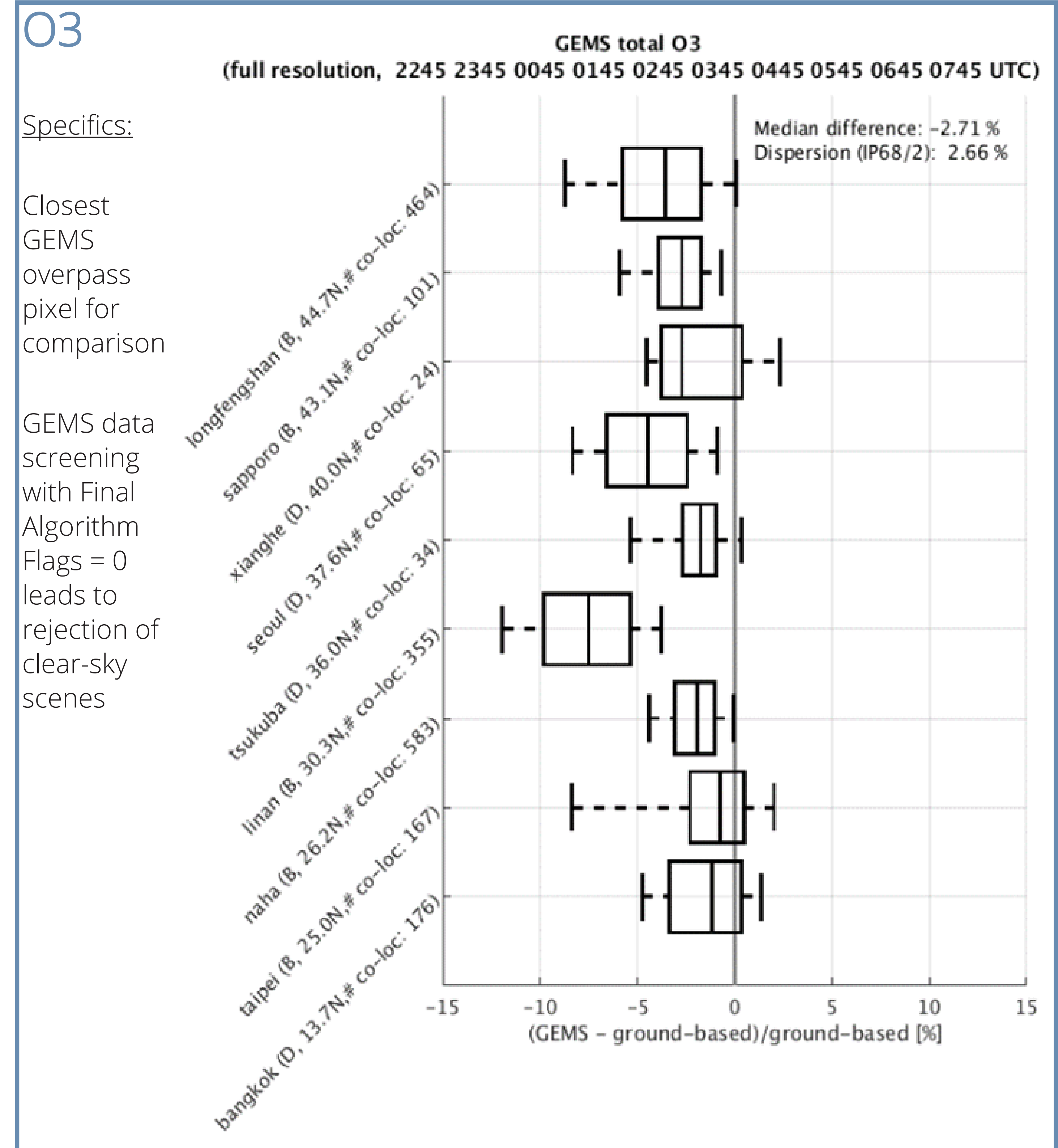
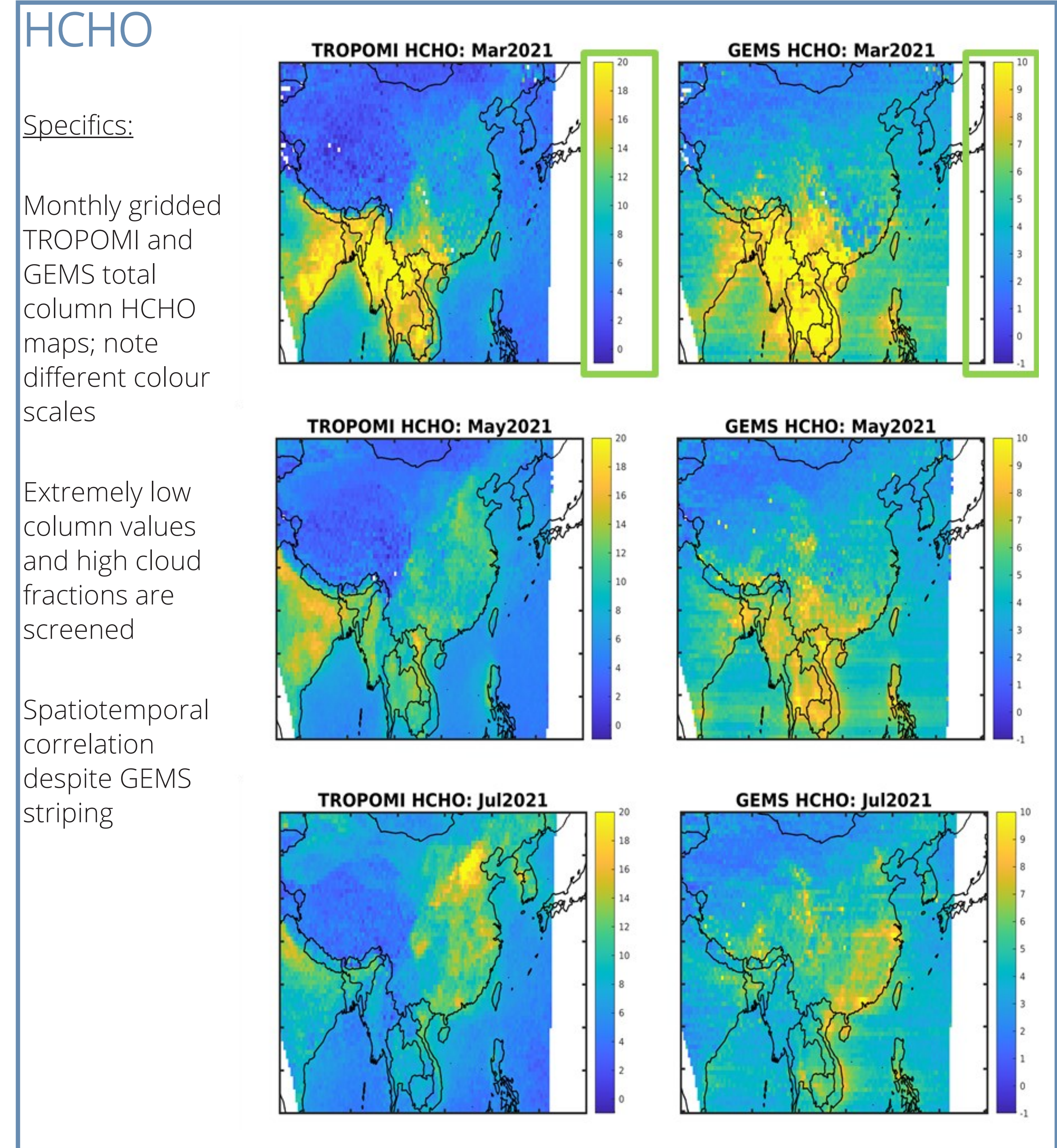
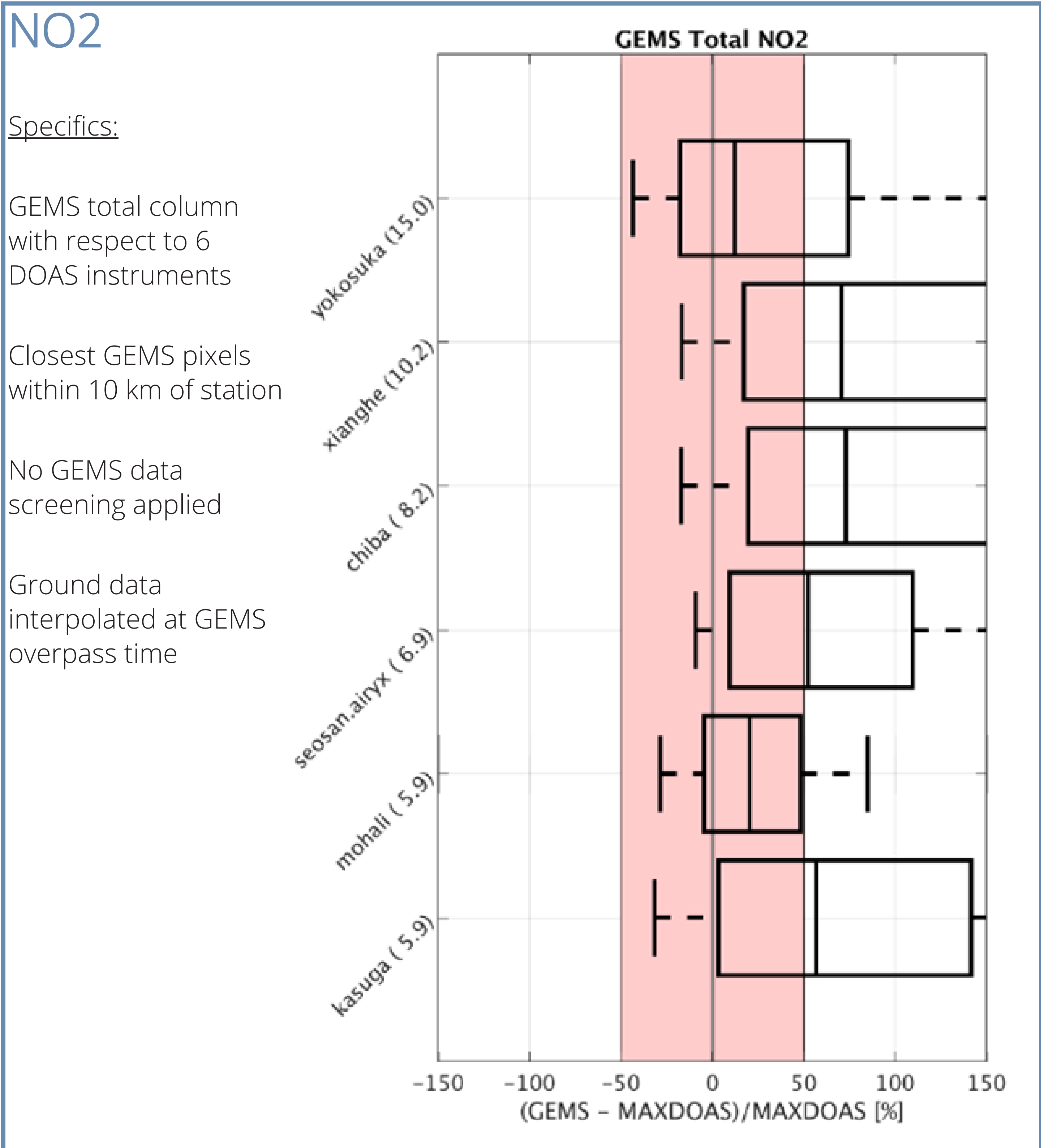
- GEMS data Quality Indicators from harmonized validation approach:
1. data and information content studies;
 2. traceable preparation of GEMS data and correlative measurements: co-location studies, representation conversions, handling of smoothing and sampling issues, (sub-)column integration, etc.;
 3. data comparisons leading to statistical estimates of bias and dispersion between GEMS and monitoring network data as a function of influence quantities;
 4. evaluation of GEMS ex-ante uncertainty estimates with respect to ex-post combined uncertainty estimates derived from data comparisons, and with respect to mission requirements.

Reference data sources:

	NO2	HCHO	SO2, CHOCHO	O3
MAX-DOAS	10 to 12 (tropospheric)	~8	1 to 6, tbc	
ZSL-DOAS	1 to 10 (stratospheric)			
Direct-sun DOAS, including Pandora	6 (total)	6 tbc	To be tested	6
FTIR	5 to 7	5 to 7		5 to 7
ozonesondes				3-8
Brewer				20
Dobson				13
Modelling support	x	x	x	

PRELIMINARY conclusions:

- Total ozone negatively biased by few %, similar dispersion, little effect of influence quantities
- Cloud screening requires update (also for other products?)
- Ozone profile retrieval successful above tropopause (bias < 10-20 %), but strong vertical oscillations and off-diagonal sensitivity (not shown)
- NO2 column shows ~50 % positive bias, higher dispersion
- Very noisy/negative GEMS HCHO column yields striping and ~50-100 % negative bias, but improved in updated version (TBC)
- Both promising results and room for improvement...



References: Pinardi et al., 2014, 2020; Keppens et al., 2015, 2018, 2019; Compennolle et al., 2020; Hubert et al., 2016, 2020; Lambert et al., 1996, 1999; Verhoelst et al., 2015, 2020; Vigouroux et al., 2009, 2018, 2020; Zhou et al., 2020.
Disclaimer: The GEMS data used in this work was provided by NIER as part of AO activity support for accuracy validation and improvement research.

