

# Detection and retrieval of nitrous acid (HONO) in global fire plumes throughout the IASI time series

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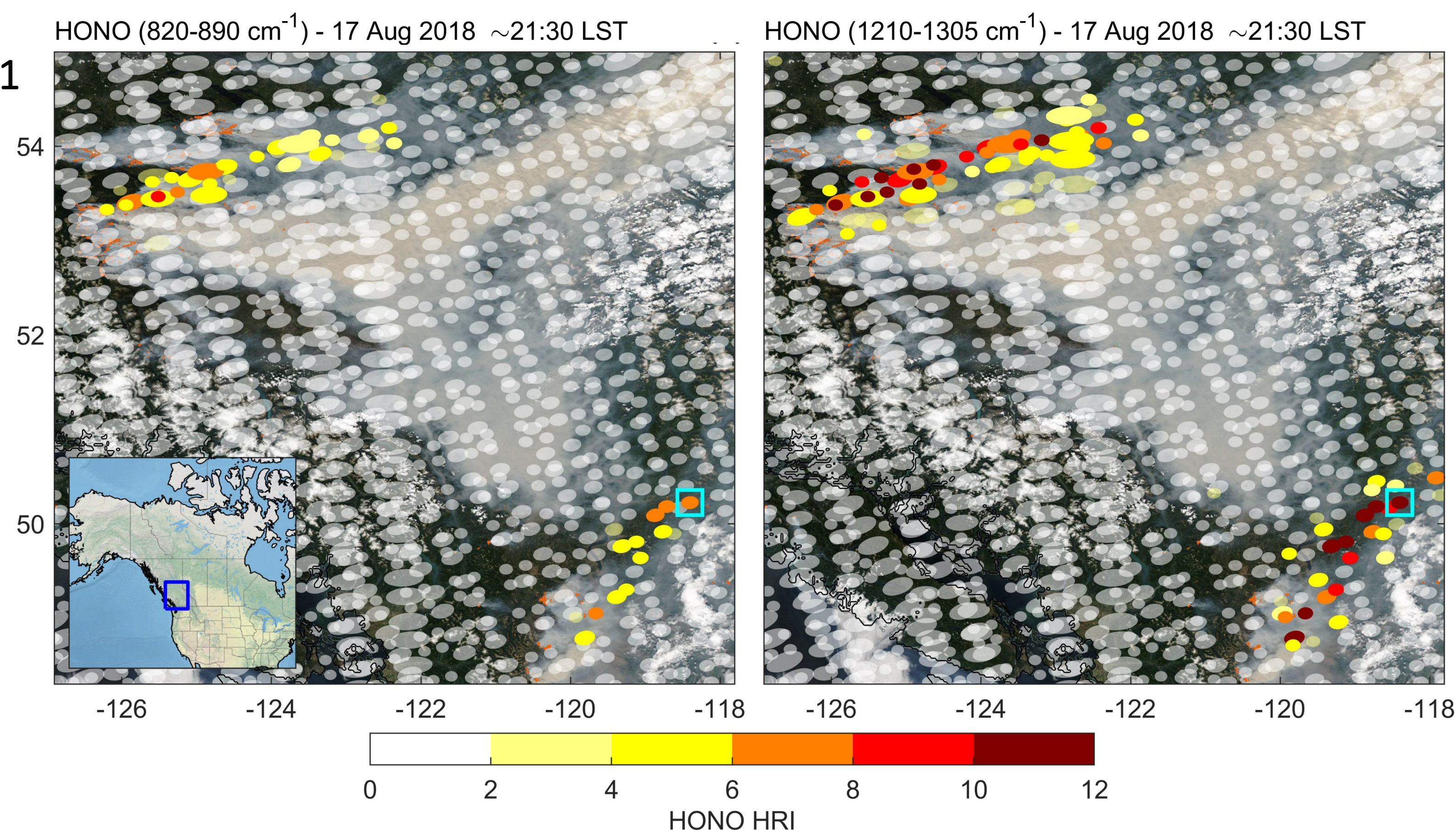
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## 1. Nitrous acid (HONO)

HONO is a major source of the hydroxyl radical (OH) but understanding its spatial and temporal variability remains a significant challenge. Recent TROPOMI/S5P UV-Vis measurements of fresh fire plumes shed light on the impact of global pyrogenic HONO emissions (Theys et al., 2020). So far, HONO has been identified with spaceborne TIR observations only in exceptional pyroconvective smoke plumes from the 2009 and 2019–2020 Australian bushfires (Clarisse et al., 2011; De Longueville et al., 2021; Dufour et al., 2022).

Fig. 1

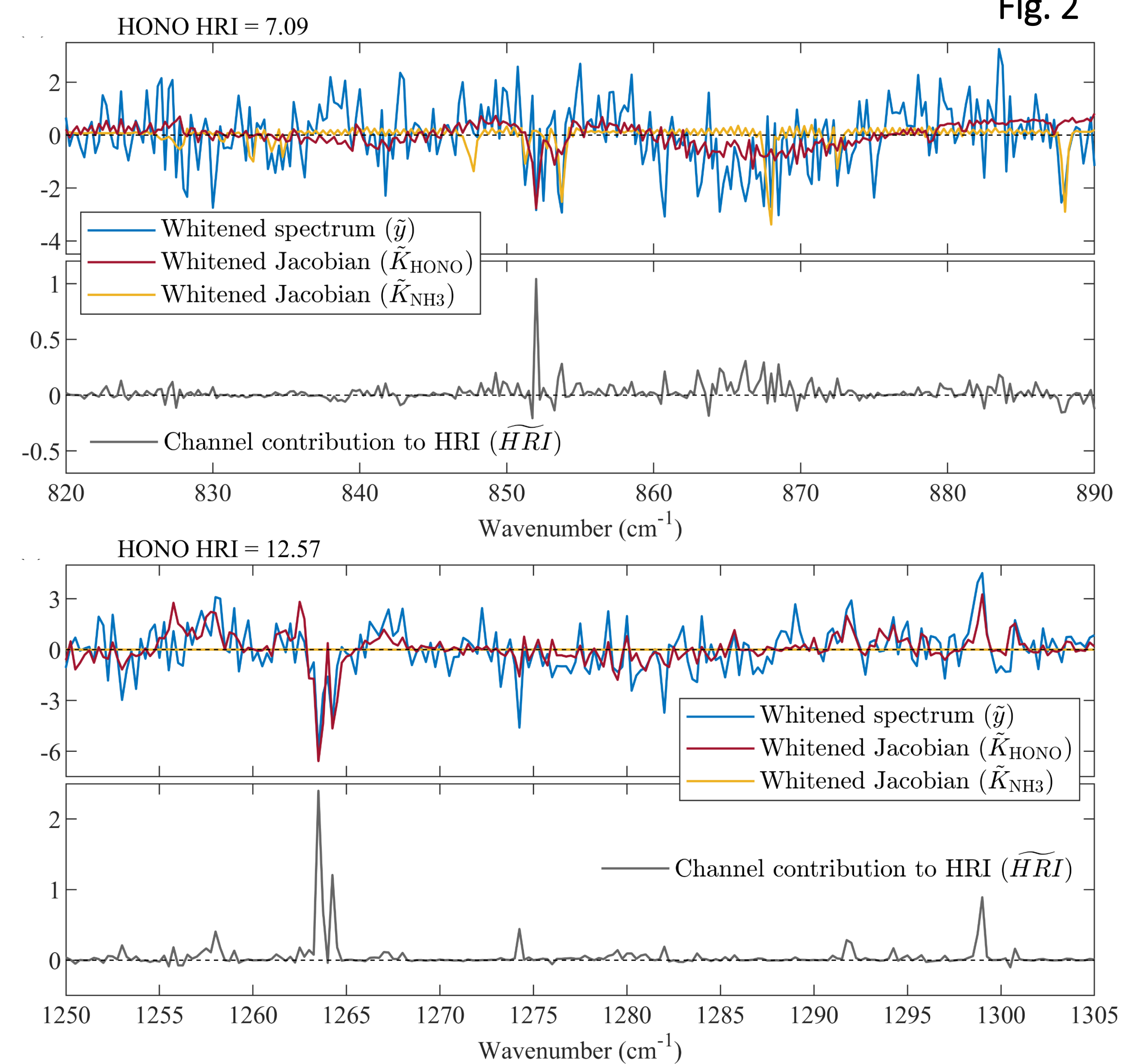


## 2. Global distribution of pyrogenic HONO

Over the 2007–2023 time series, most detections of HONO with IASI are in the Northern Hemisphere (NH) mid- and high latitudes (Figs. 3–4), where intense wildfires and high injection heights favour HONO detection. Due to its higher sensitivity to the lowermost layers and lower detection threshold for HONO, TROPOMI detects more low-intensity, low-altitude fire plumes in the Tropics (Fig. 3).

We leverage IASI measurements to detect and retrieve pyrogenic HONO in 2007–2023, employing a sensitive detection method (the Hyperspectral Range Index; HRI). We identify HONO enhancements within concentrated fire plumes worldwide, as in the example in Fig. 1. Through spectral analysis (as in Fig. 2 for the blue-marked observation of Fig. 1), we demonstrate the presence of the signature of HONO in the IASI spectra in the  $\nu_4$  and  $\nu_3$  absorption bands. It also confirms that HONO is the main contributor to the HRI enhancements in these fresh fire plumes.

Fig. 2



## 3. IASI retrieval of HONO

We employ a neural-network-based algorithm (Clarisse et al., 2023) for retrieving pyrogenic HONO VCDs from IASI and compare them with TROPOMI in the same fire plumes, as in Fig. 5. The results demonstrate TROPOMI's efficacy in capturing HONO enhancements in smaller fire plumes and in proximity to fire sources, while IASI's evening overpasses enable HONO measurements further downwind, highlighting the survival of HONO or its secondary formation along long-range transport in smoke plumes.

The IASI HONO product, developed through the DINAR project funded by ESA (<http://hono.aeronomie.be>), is described in Franco et al. (2024).

Fig. 5

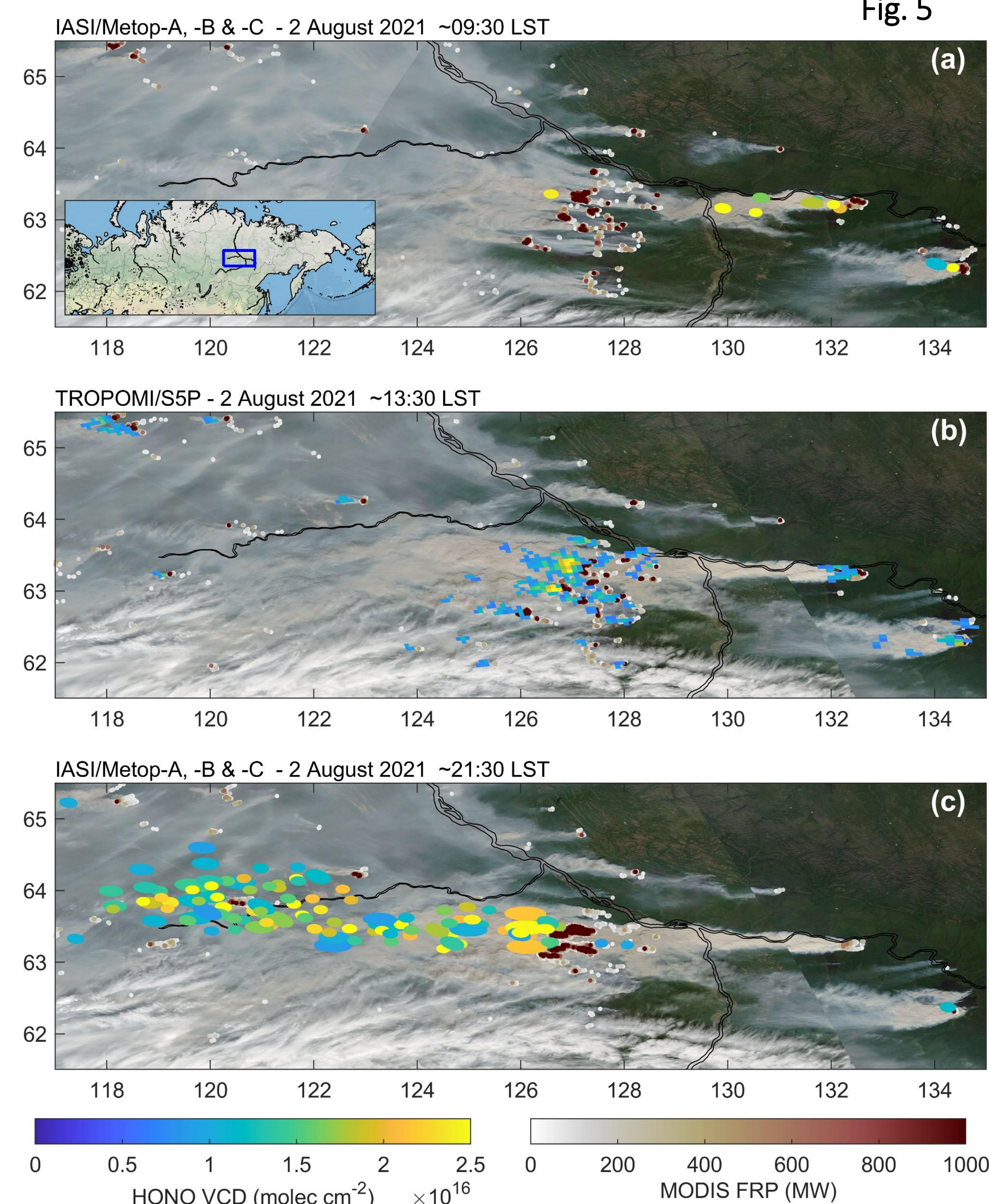


Fig. 3

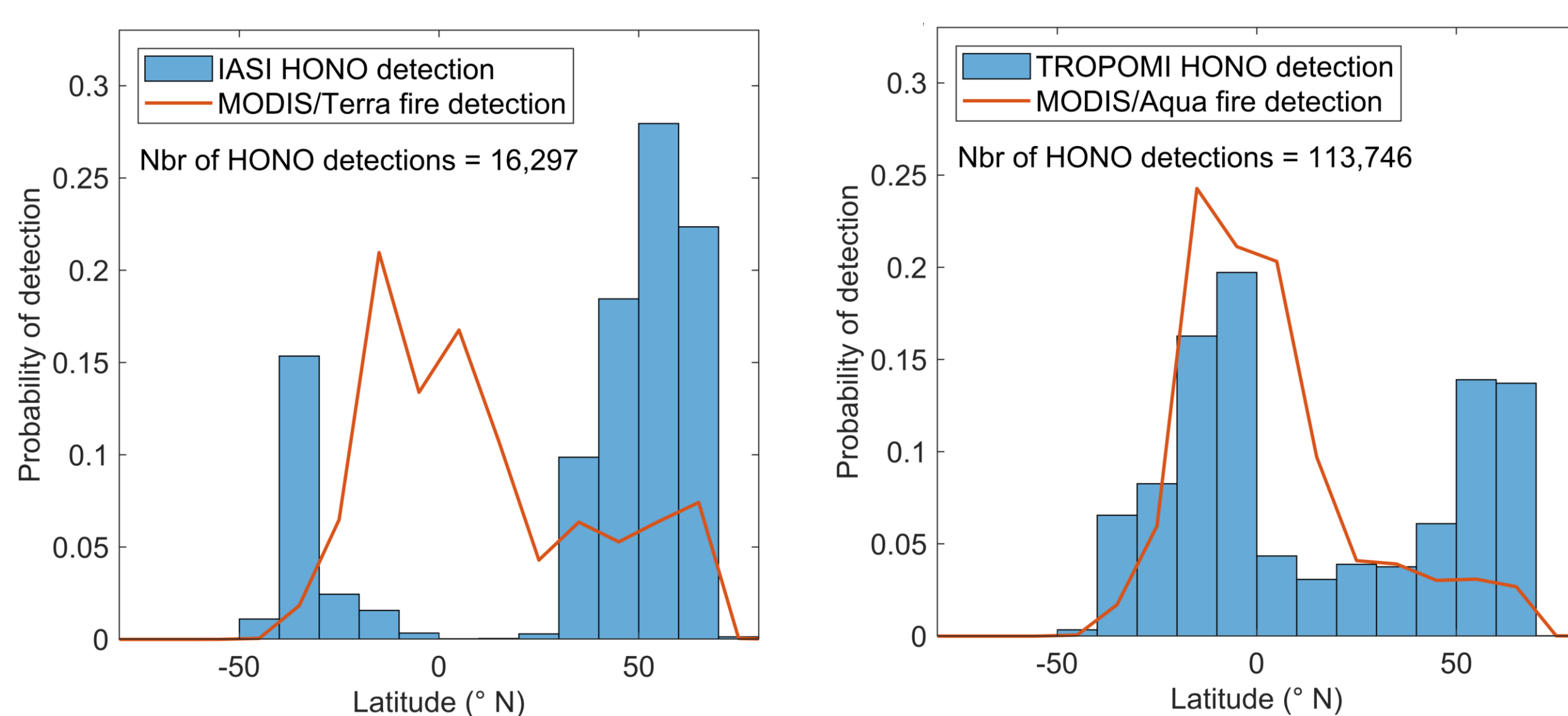
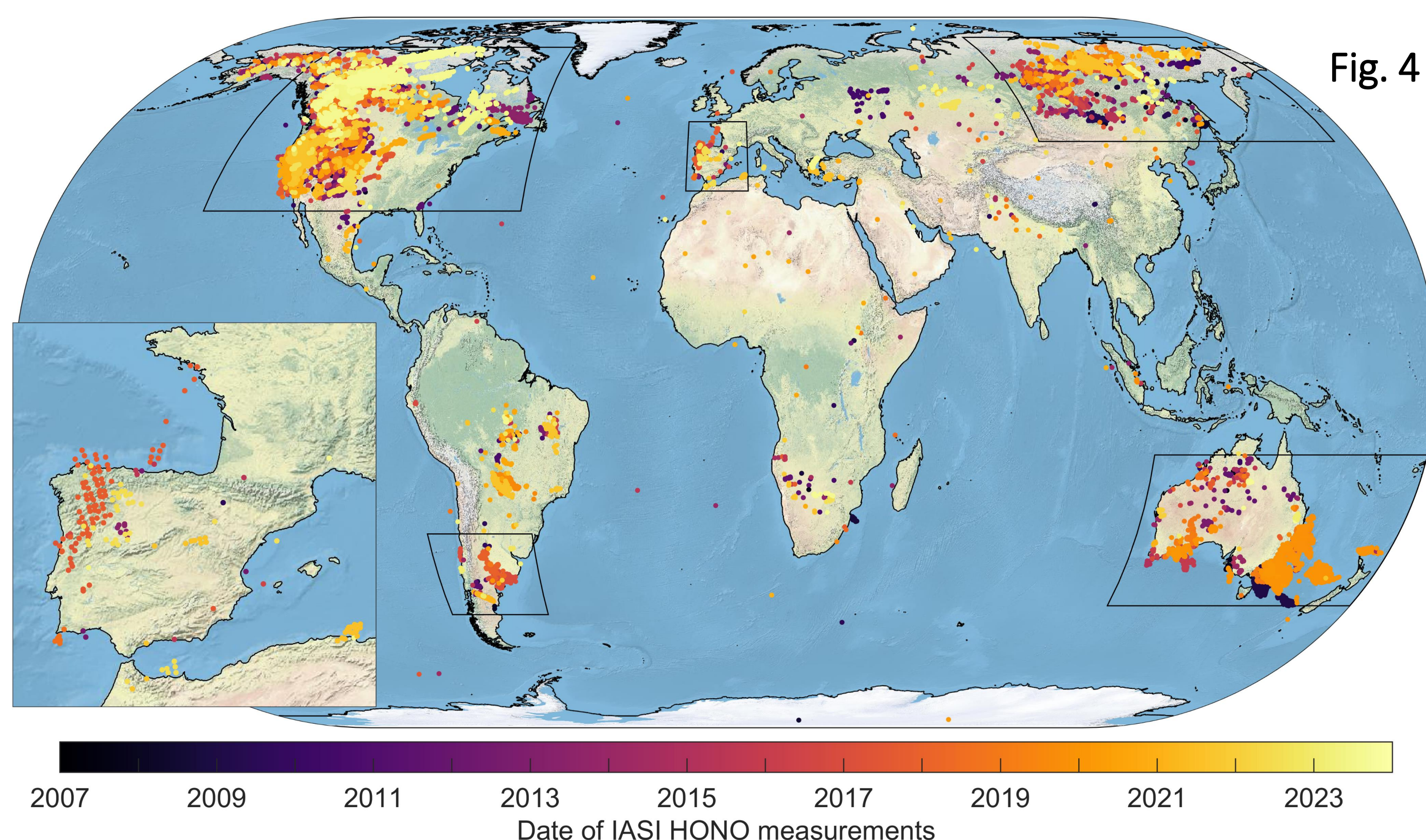


Fig. 4



## References

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