



Large VOC enhancements in recent massive wildfires observed from space

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Overview

Massive wildfires erupted in Amazonia and through the subarctic region in summer 2019, and in Australia in winter 2019-2020. During such biomass burning events, sizeable amounts of volatile organic compounds (VOCs) were emitted directly by the fires as well as rapidly produced in plumes via the degradation of short-lived gas precursors.

Nadir-viewing infrared sensors onboard meteorological satellites, such as IASI (Infrared Atmospheric Sounding Interferometer) embarked on the Metop platforms, provide global and spatially dense observations that are very useful to track biomass burning events throughout the globe and to provide trace gas quantification in fire plumes.

We apply a general retrieval framework, based on an artificial neural network, to derive the integrated abundance (total column) of several major VOCs from the infrared radiance spectra recorded by IASI. Here, we present daily regional snapshots of VOC enhancements in the plumes from the recent Amazonian, Australian and subarctic wildfires.



U.S. Department of Agriculture

Picture: eumetsat.int



IASI: Thermal IR nadir sounder

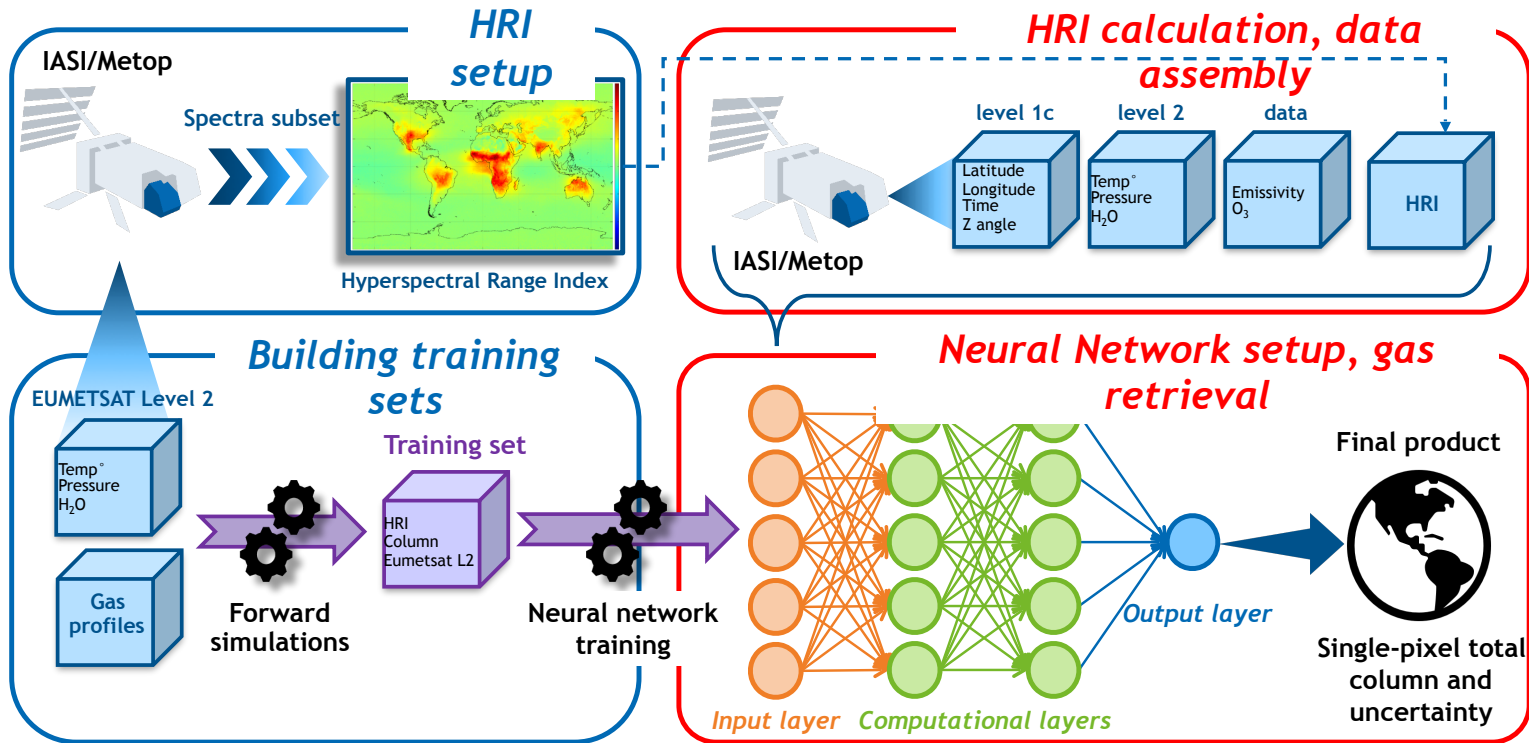


Metop: Polar orbiting satellite



Picture: esa.int

1. The **ANNI** (Artificial Neural Network for IASI) retrieval framework consists, for each individual spectrum, in the calculation of a **Hyperspectral Range Index (HRI)** to quantify the target gas absorption in the spectrum, and in its subsequent conversion into gas integrated abundance (total column) using an **artificial feedforward neural network** accounting for the state of the atmosphere and surface.



This retrieval method reveals particularly sensitive to the detection of weak, sometimes broadband, infrared absorbers, while its computing efficiency permits the processing of the entire IASI observational time series (2007 - ...).

Quasi-global distributions of single-pixel total columns and associated uncertainties are produced twice-daily (a.m. and p.m. satellite overpasses).

- Franco *et al* (2018) J. Geophys. Res.: Atmos., 123 (24), 13,963-13,984. <https://doi:10.1029/2018jd029633>
- Clarisse *et al* (2019) J. Geophys. Res.: Atmos., 124 (3), 1618-1647. <https://doi:10.1029/2018jd029701>

2. Originally developed for the retrieval of ammonia (NH_3) and dust, the *ANNI* framework now permits also the retrieval of a suite of VOCs:

- **Methanol (CH_3OH), formic acid (HCOOH) and PAN ($\text{CH}_3\text{C}(\text{O})\text{O}_2\text{NO}_2$)**
Franco *et al* (2018), JGR, 123 (24), 13,963-13,984. <https://doi.org/10.1029/2018jd029633>

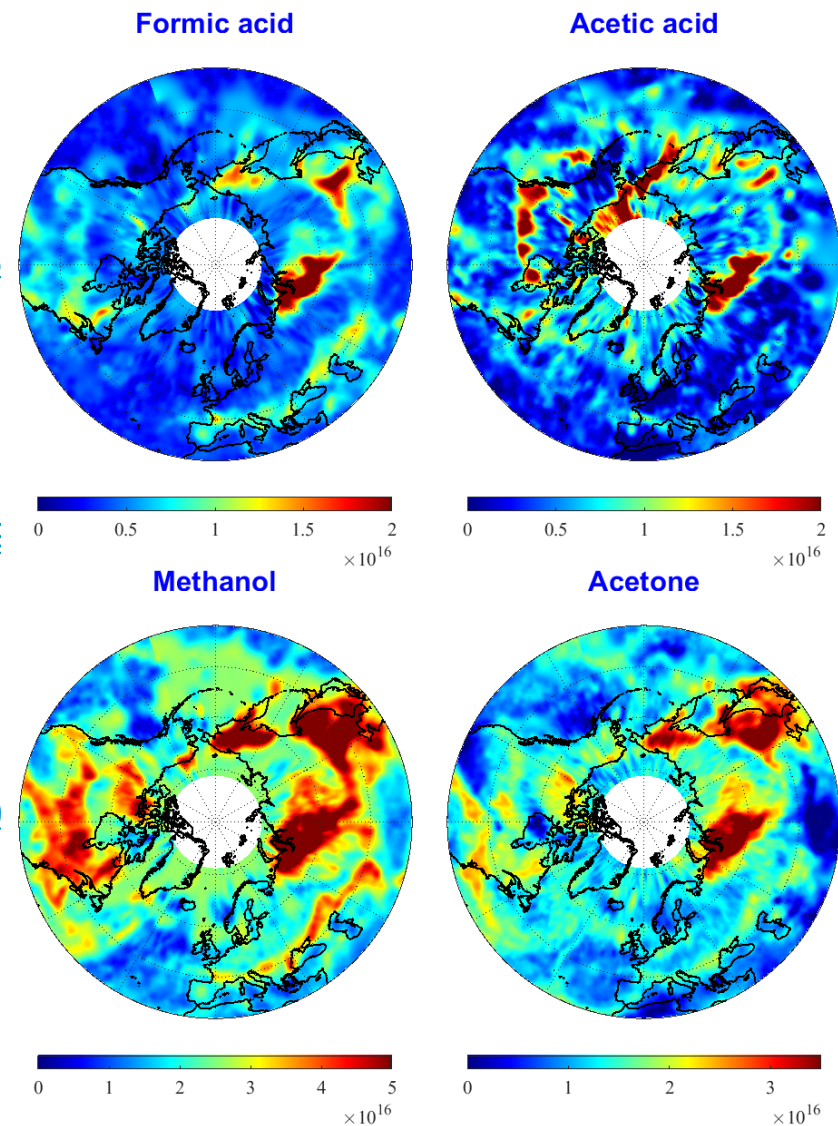
- **Acetone ($\text{CH}_3\text{C}(\text{O})\text{CH}_3$)**
Franco *et al* (2019), GRL, 46, 2884-2893. <https://doi.org/10.1029/2019GL082052>

- **Acetic acid (CH_3COOH)**
Franco *et al* (2020), GRL, 47, e2019GL086239. <https://doi.org/10.1029/2019GL086239>

- **Acetylene (C_2H_2) and hydrogen cyanide (HCN)**
→ under development

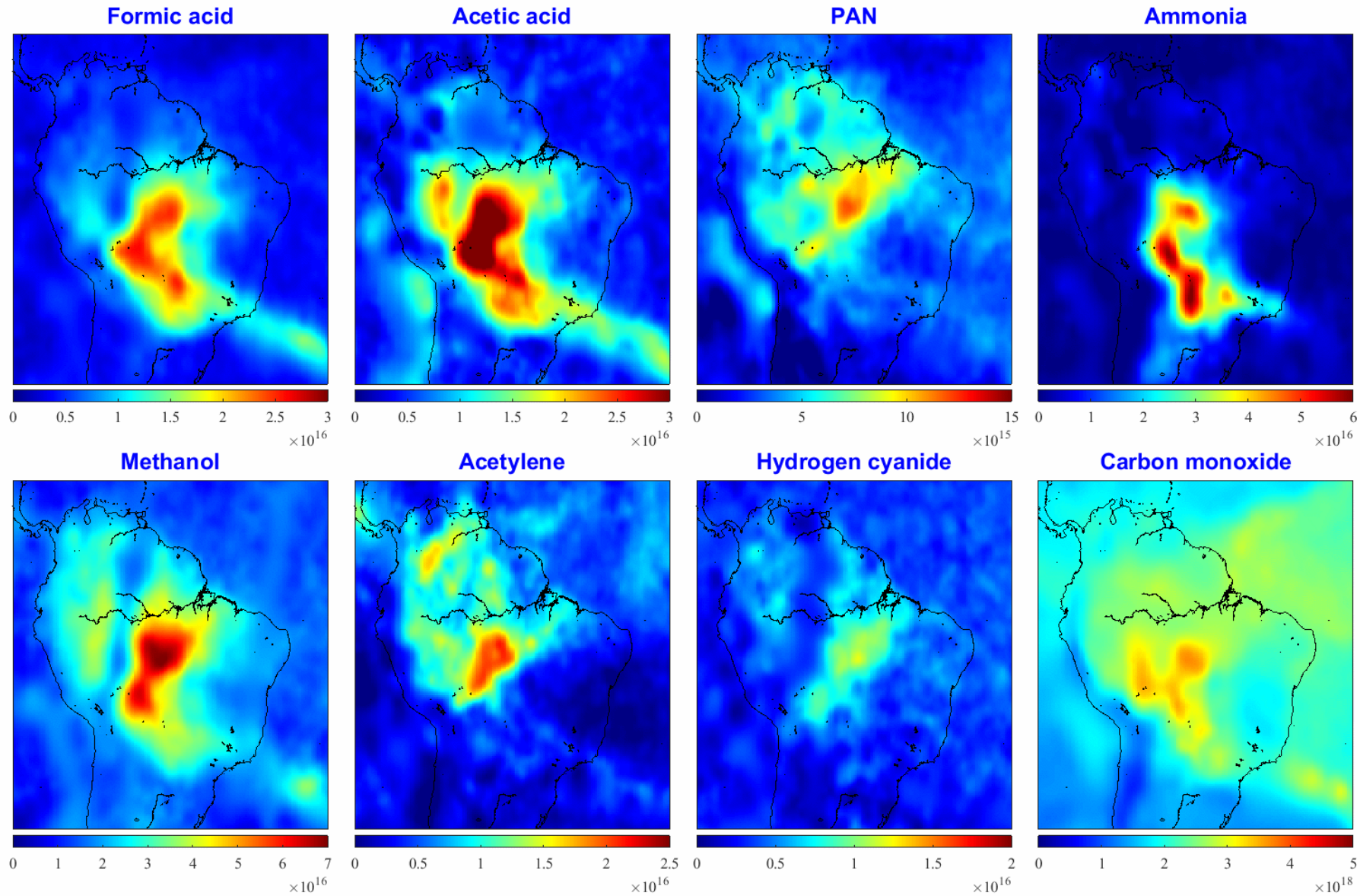
- **Ammonia (NH_3)**
Van Damme *et al* (2017), AMT, 10(12), 4905-4914. <https://doi.org/10.5194/amt-10-4905-2017>
Whitburn *et al* (2016), JGR, 121, 6581-6599. <https://doi.org/10.1002/2016jd024828>

- **Dust**
Clarisse *et al* (2019), JGR, 124 (3), 1618-1647. <https://doi.org/10.1029/2018jd029701>



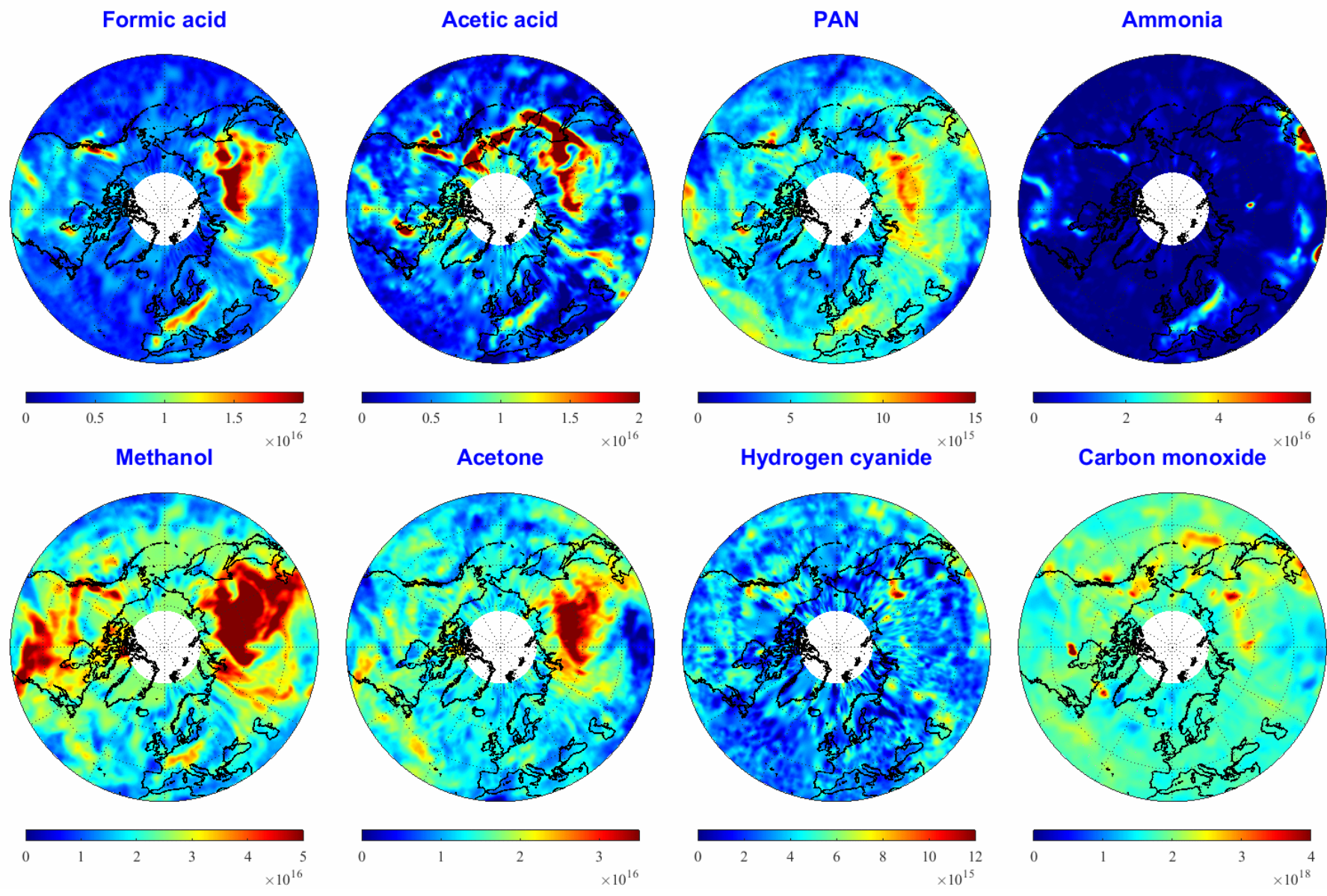
3.

2019 Amazonian wildfires



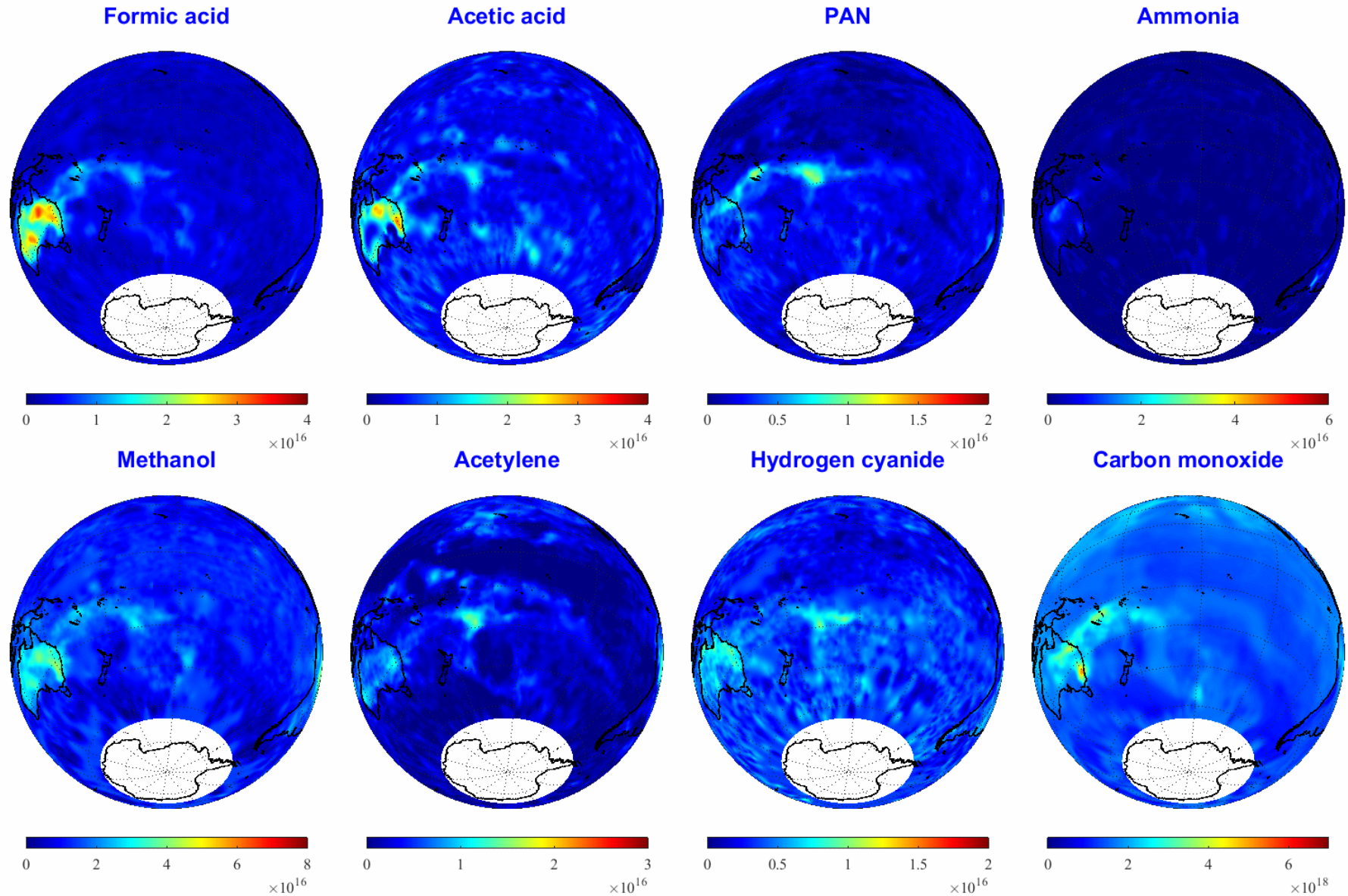
4.

2019 subarctic fires



5.

2019-2020 Australian bushfires



Acknowledgements

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