



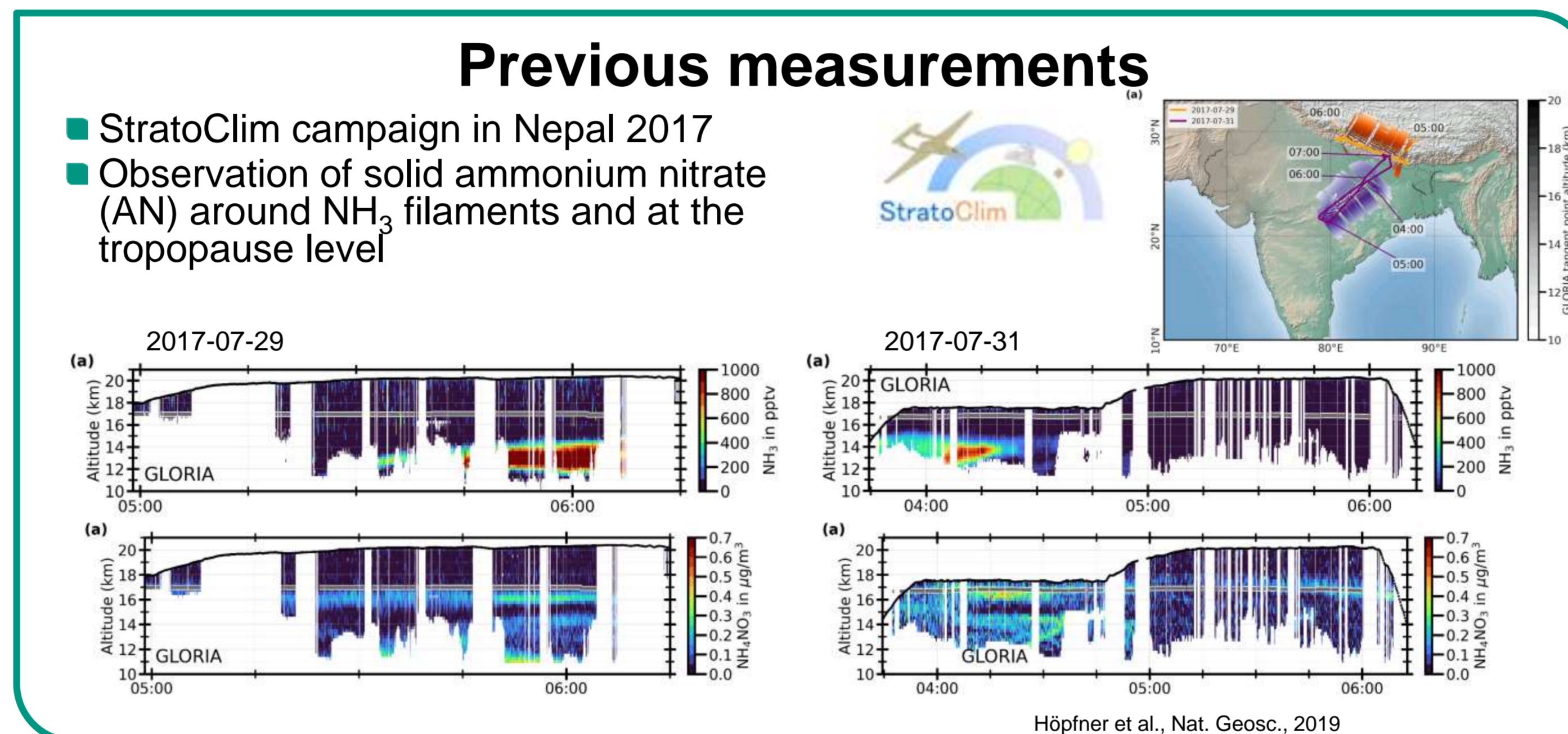
GLORIA observations of polluted air masses in the 2023 Asian summer monsoon outflow and in connection with wildfires in Canada

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PHILEAS campaign 2023

- Impact of the Asian monsoon anticyclone on the northern hemispheric UTLS
- Outflow transported to the Mediterranean or Gulf of Alaska
- 3 measurement phases from Germany and Alaska with the German HALO research aircraft
- Mission with 13 in-situ instruments and GLORIA for remote sensing
- In total 18 scientific flights
- Coordinated by Forschungszentrum Jülich and University of Mainz



The GLORIA instrument

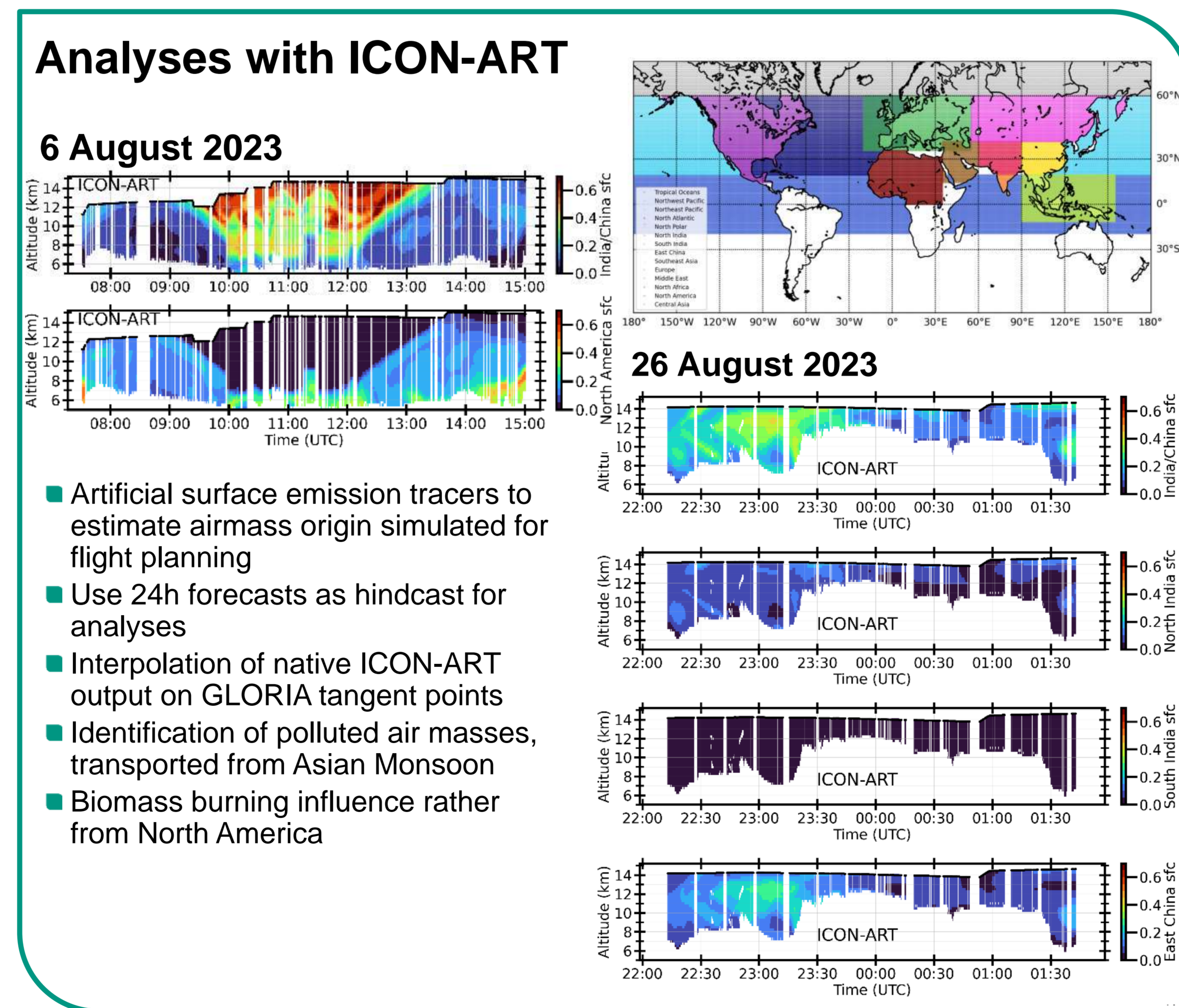
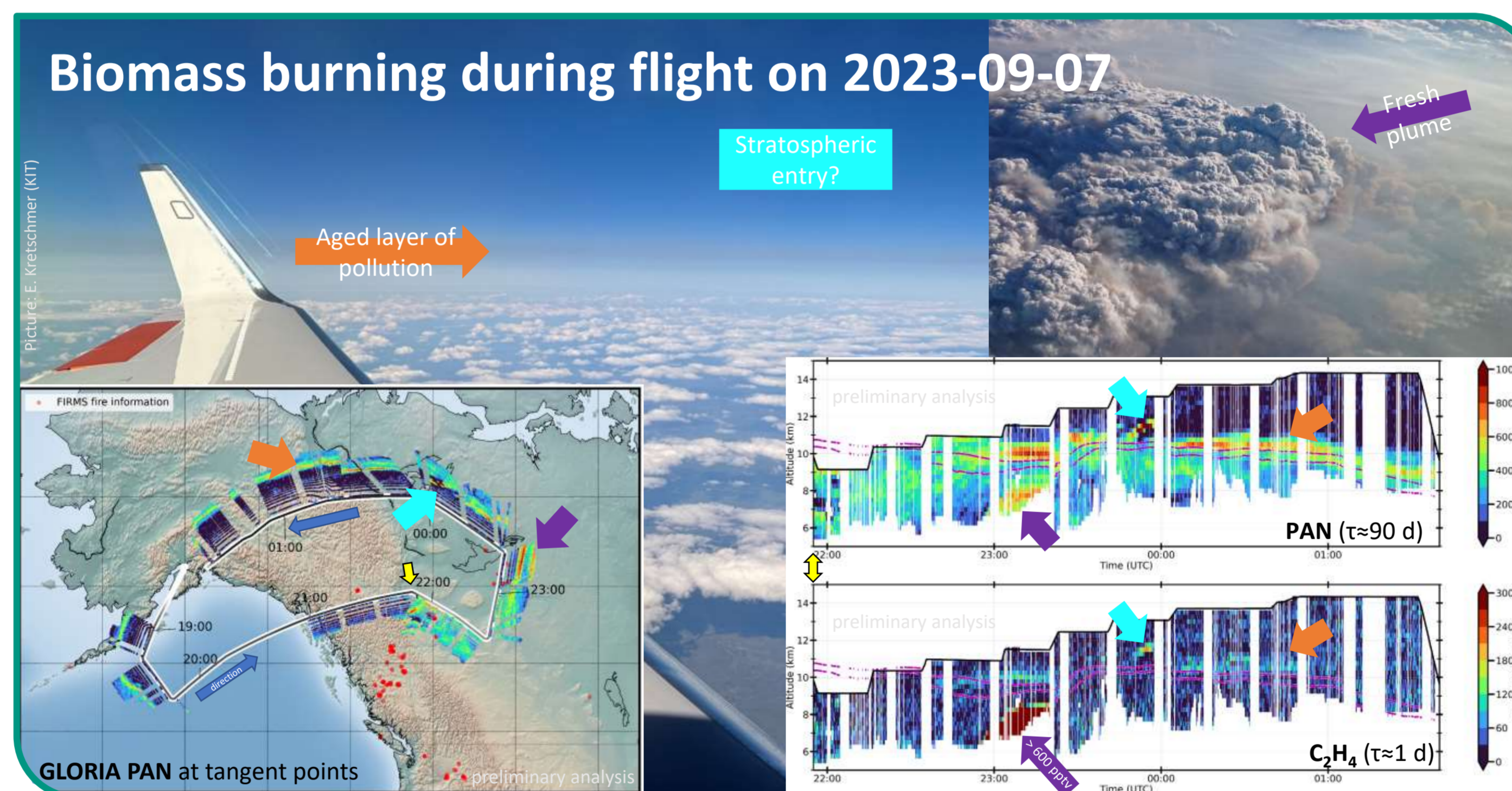
- "Gimballed Limb Observer for Radiance Imaging of the Atmosphere"
- Developed and operated by Karlsruhe Institute of Technology and Forschungszentrum Jülich
- Cooled Imaging Fourier-Transform Spectrometer (iFTS)
- Instrument consists of
 - Spectrometer
 - Gimballed frame
 - Two external blackbodies
- Unique iFTS for atmospheric limb-sounding

adapted from Ungermann et al. (ACP 2013)

Flight on 6 August 2023

- Peroxyacetyl nitrate (PAN)
 - Lifetime ~3 months in the UT
 - Filamented structures above eastern Mediterranean
 - Enhancements above northern Italy

- Ammonium nitrate (AN)
 - Previously observed in AMA 2017
 - Filamented structures above eastern Mediterranean
 - Same air masses observed twice
- Ammonia (NH₃)
 - Observed in AMA 2017
 - Tiny enhancement at flight altitude above Israel/Jordan
 - Large plume observed above Adriatic Sea (local source?)



Flight on 26 August 2023

- Strong layer of AN above Alaska in the lower stratosphere
- Horizontally and vertically confined
- No signal of NH₃ (not shown)

- Same layer visible in PAN
- Strongest enhancements at tropopause altitudes
- Further signals in the troposphere

Conclusions

- Observations of polluted air masses with enhanced solid ammonium nitrate aerosol particles, NH₃ and PAN (and other pollution trace gases); even in the stratosphere

- First analyses with models indicate origin from Asian Monsoon
- Distinction of pollution from AMA and pollution from biomass burning sometimes difficult
- Global observation of UTLS will be very interesting → CAIRT EE11

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