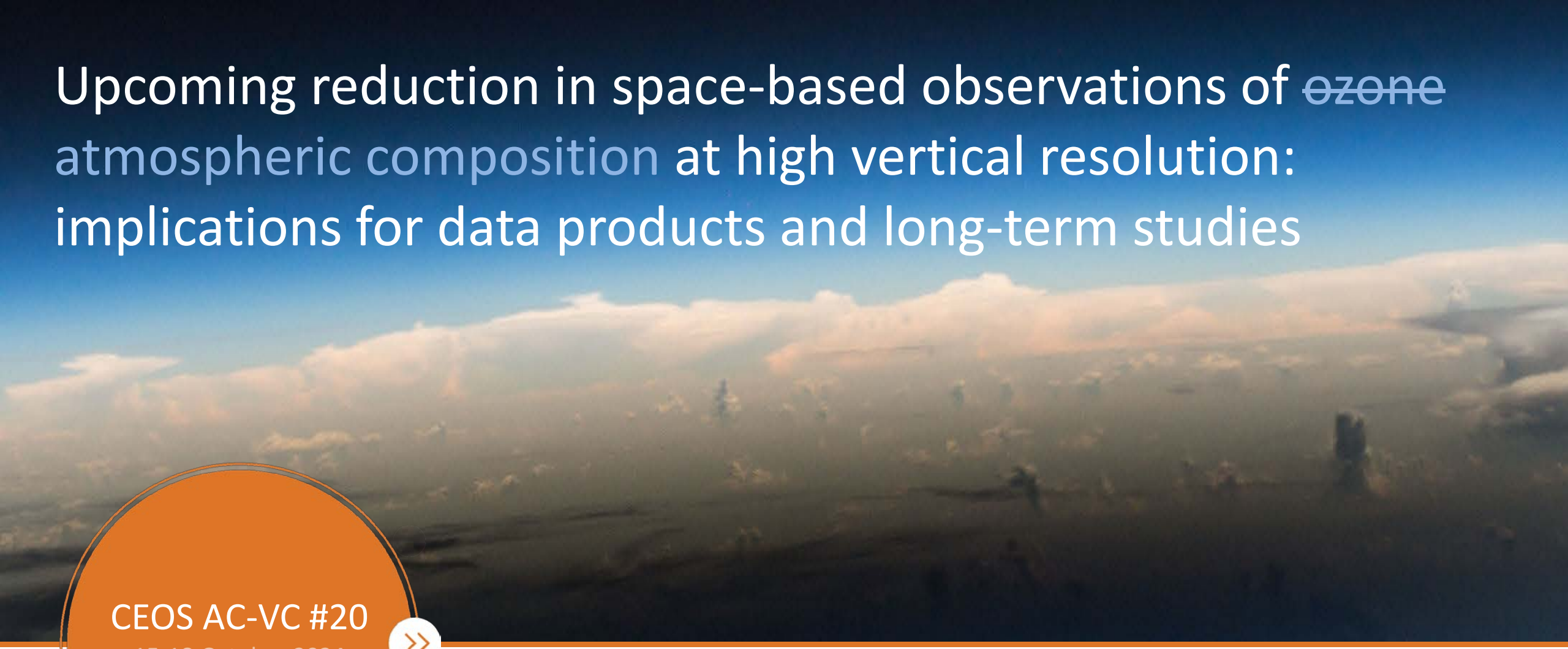
Upcoming reduction in space-based observations of ~~ozone~~ atmospheric composition at high vertical resolution: implications for data products and long-term studies



CEOS AC-VC #20

15-18 October 2024

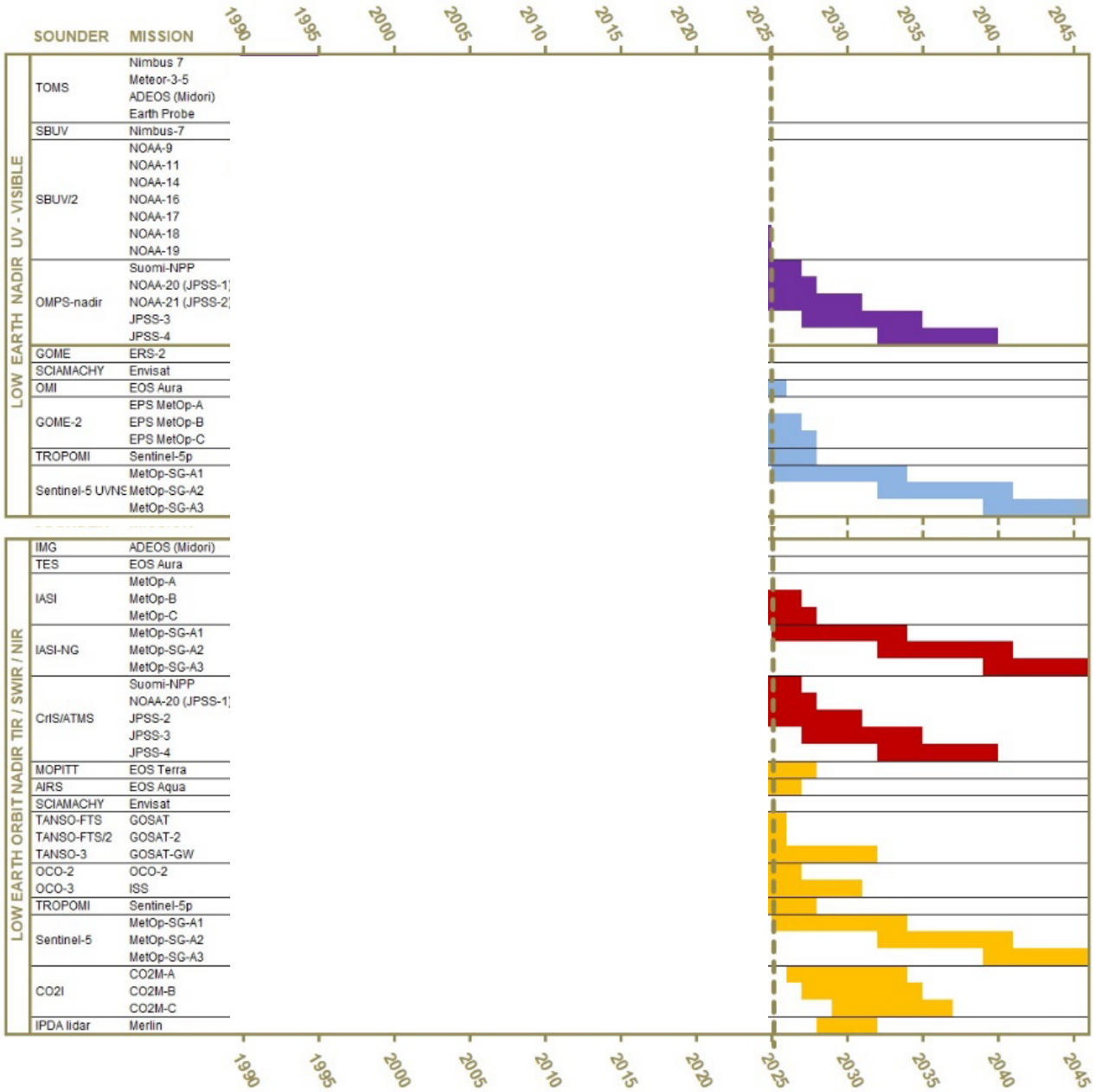
Daan Hubert[1], J.-C. Lambert[1], R. Salawitch[2], K. Wargan[3,4], S. Davis[5], V. Sofieva[6], M. I. Hegglin[7,8], E. Castelli[9], P. Thorne[10]

[1]BIRA-IASB, [2]UMD, [3]NASA-GSFC, [4]SSAI, [5]NOAA-CSL, [6]FMI, [7]FZ Jülich, [8]U Reading, [9]CNR/ISAC, [10]Maynooth U

BIRA-IASB

CEOS Committee on Earth Observation Satellites

Nadir observing system : continuity up to 2040+



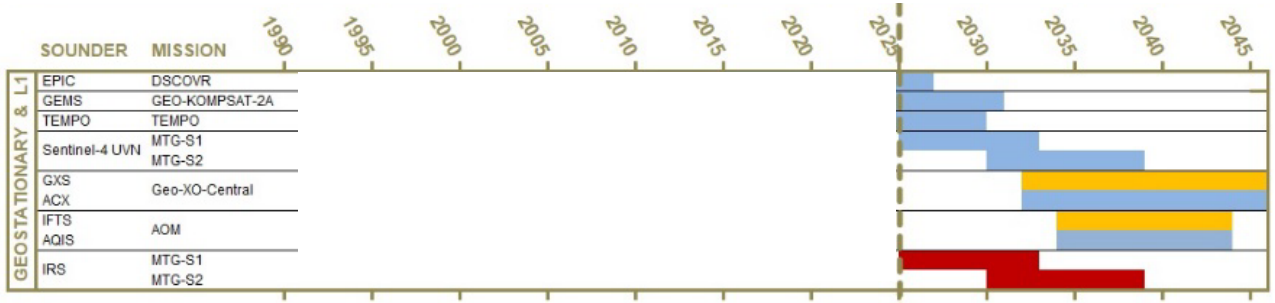


Fig. by J.-C. Lambert (BIRA-IASB)

Limb / occultation observing system

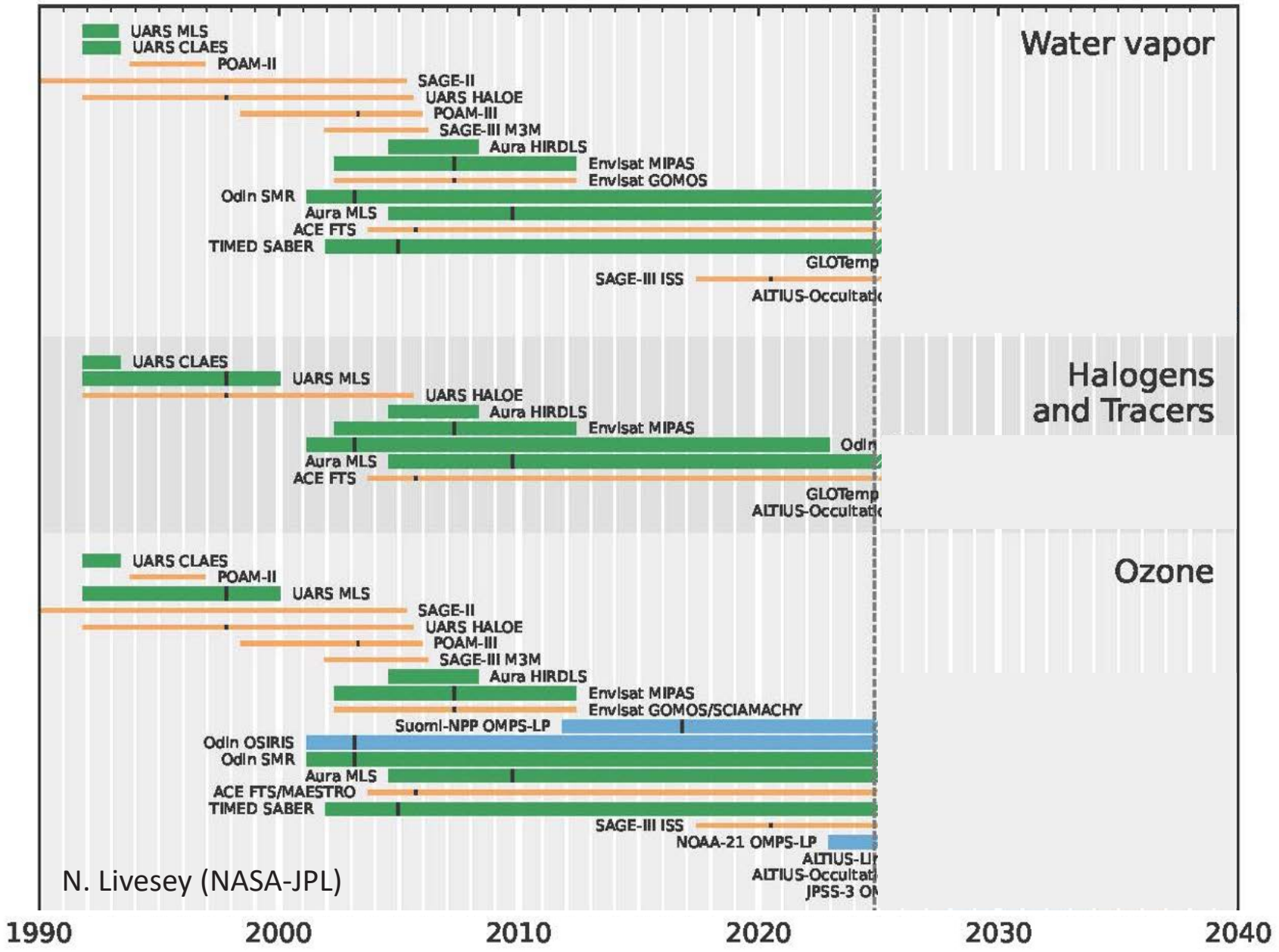


Fig. by N. Livesey (NASA-JPL), Salawitch et al., "The Imminent Data Desert: The Future of Stratospheric Monitoring in a Rapidly Changing World“, BAMS, submitted.

Large observed perturbations in recent years

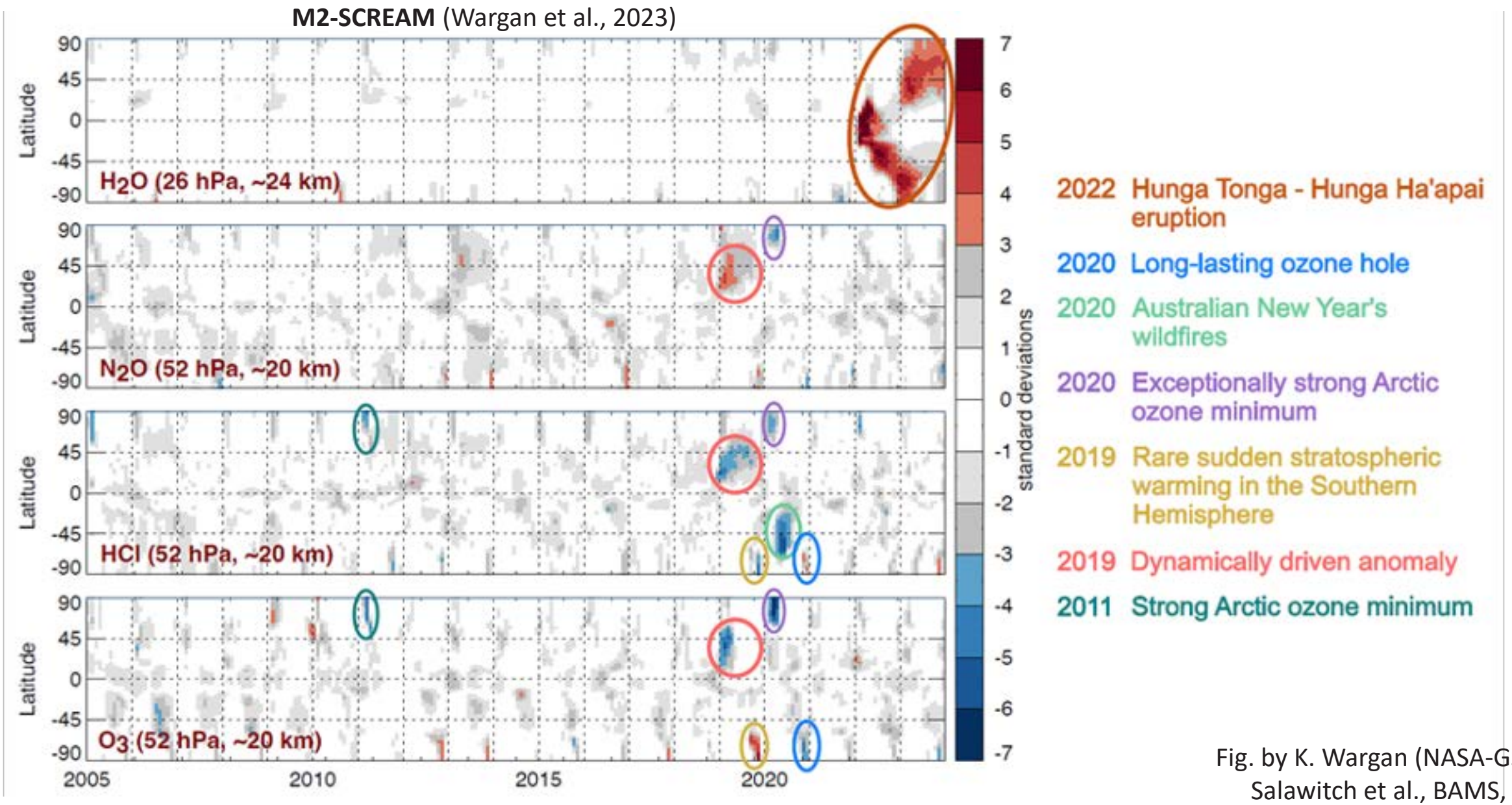


Fig. by K. Wargan (NASA-GSFC, SSAI), Salawitch et al., BAMS, submitted

Limb / occultation observing system

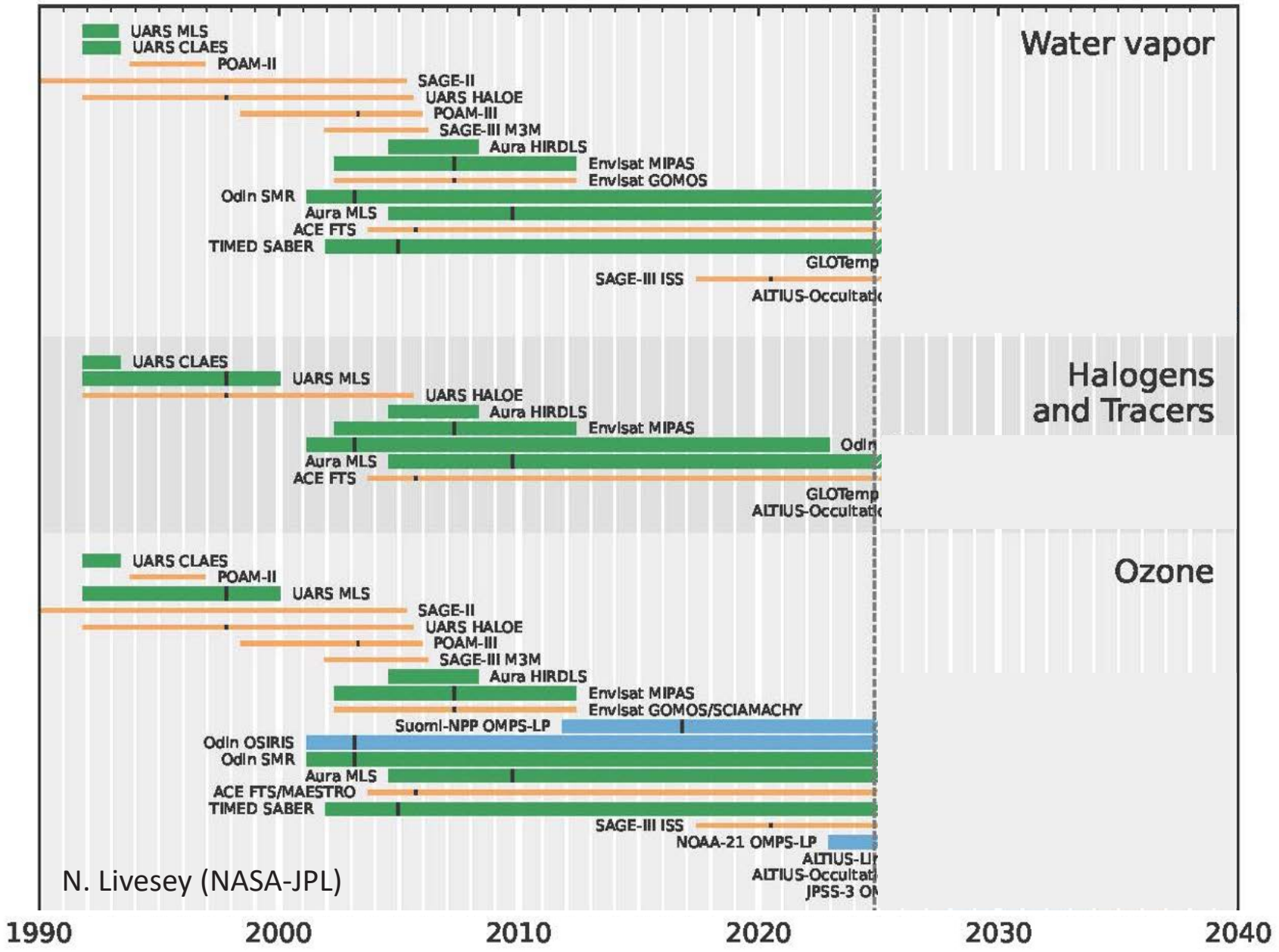
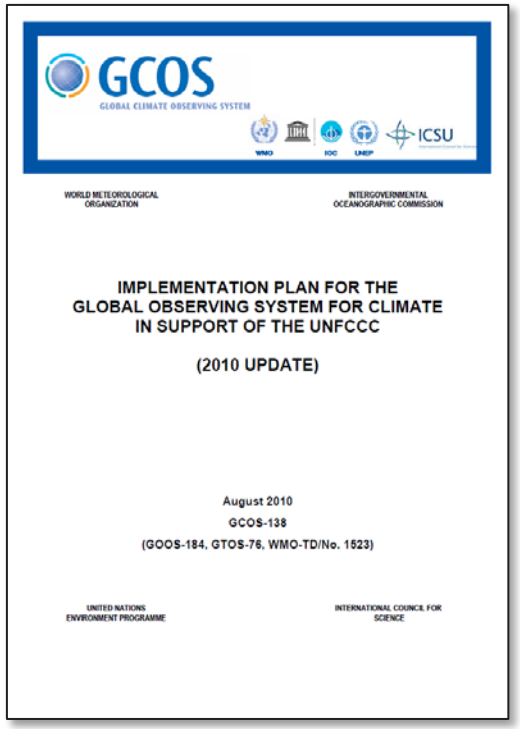


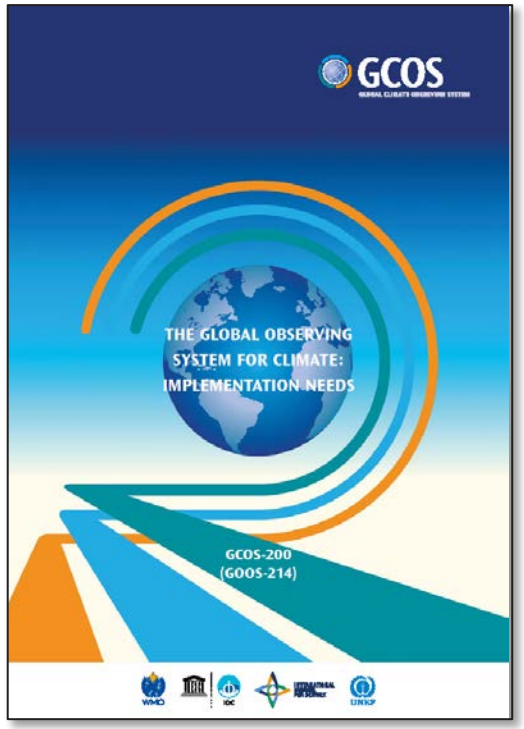
Fig. by N. Livesey (NASA-JPL), Salawitch et al., BAMS, submitted

GCOS Action since 2010…

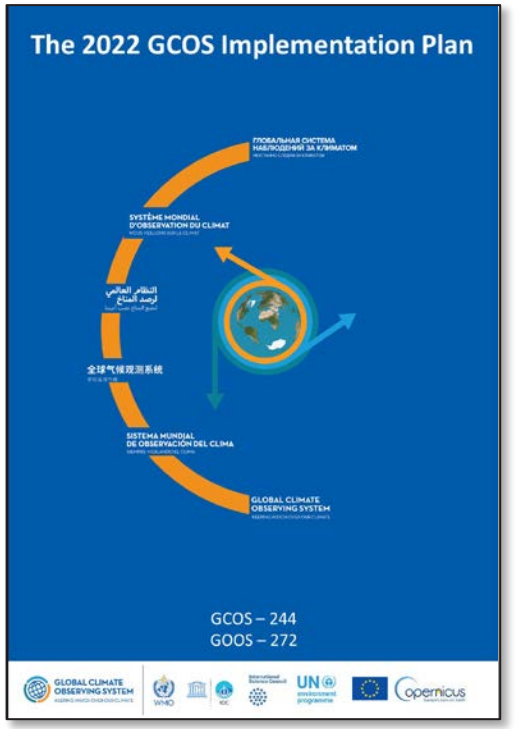
2010



2016



2022



Action A26

Action: Establish long-term limb-scanning satellite measurement of profiles of water vapour, ozone and other important species from the UT/LS up to 50 km.
Who: Space agencies, in conjunction with WMO GAW.
Time-Frame: Ongoing, with urgency in initial planning to minimize data gap.
Performance Indicator: Continuity of UT/LS and upper stratospheric data records.
Annual Cost Implications: 100-300M US$ (including mission costs) (Mainly by Annex-I Parties).

Indicator	
Annual cost	US$ 30–100 million

Fewer observations, fewer gases

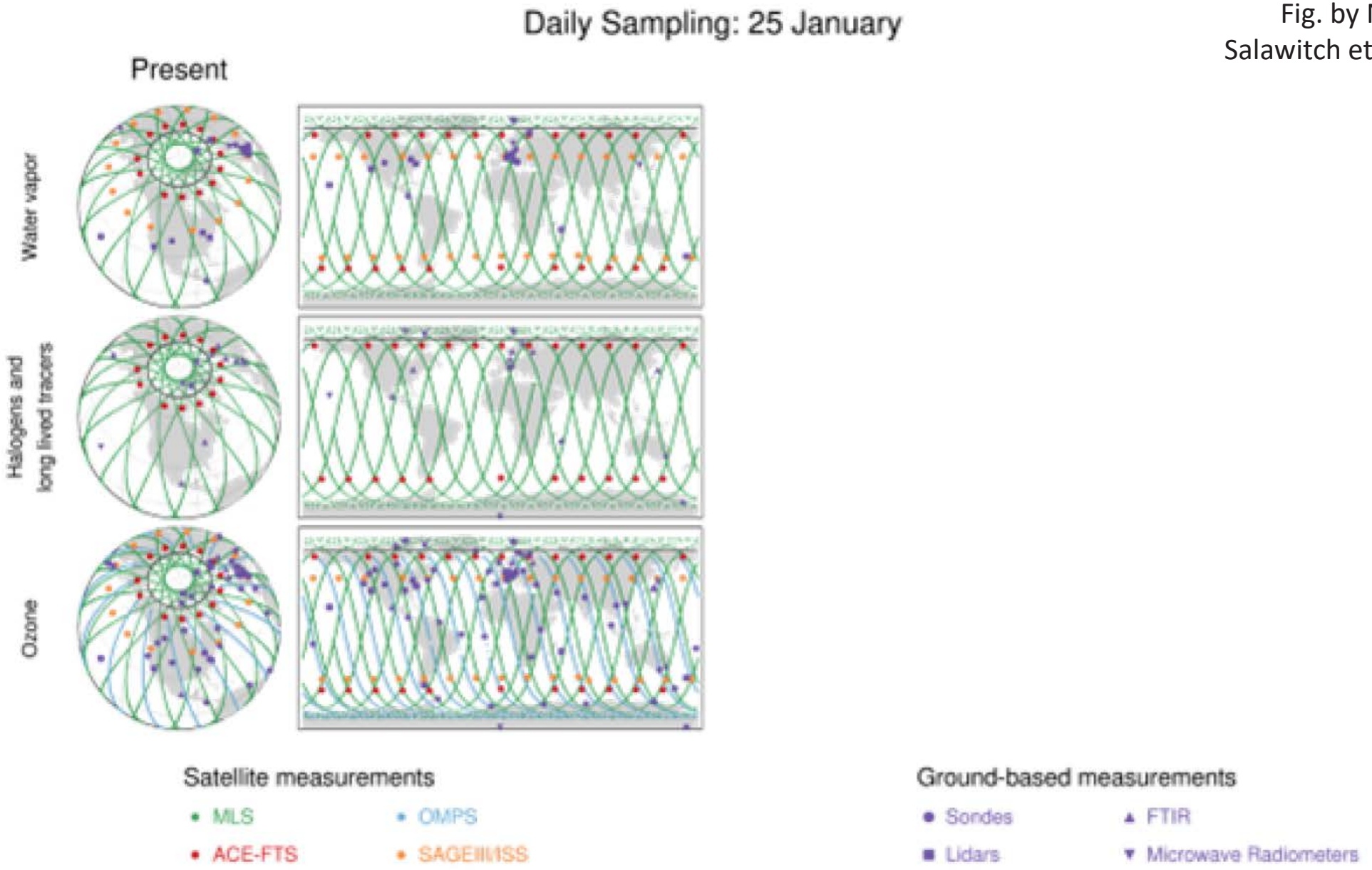


Fig. by N. Livesey (NASA-JPL),
Salawitch et al., BAMS, submitted

No detection, nor complete view on perturbations in future

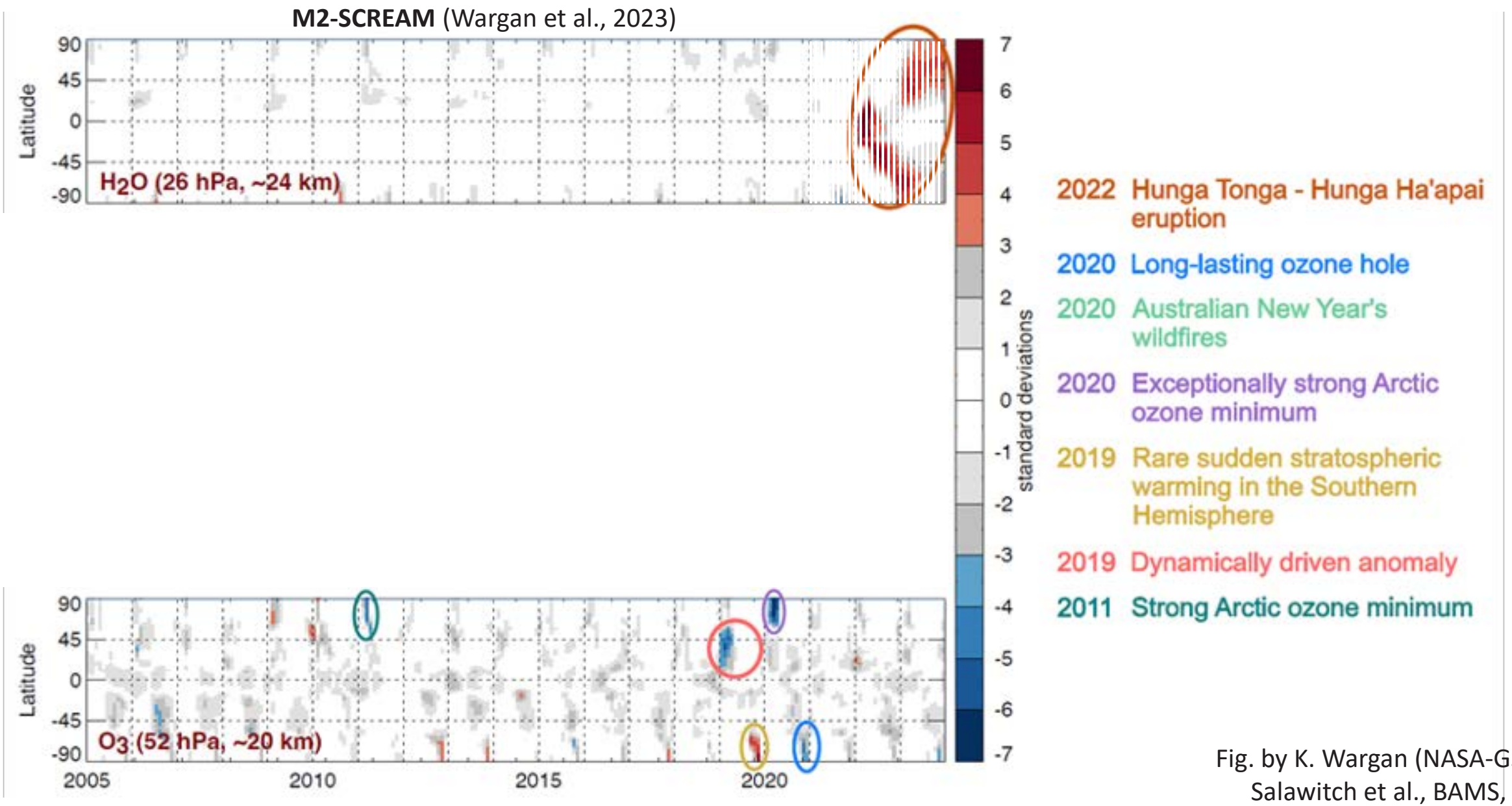
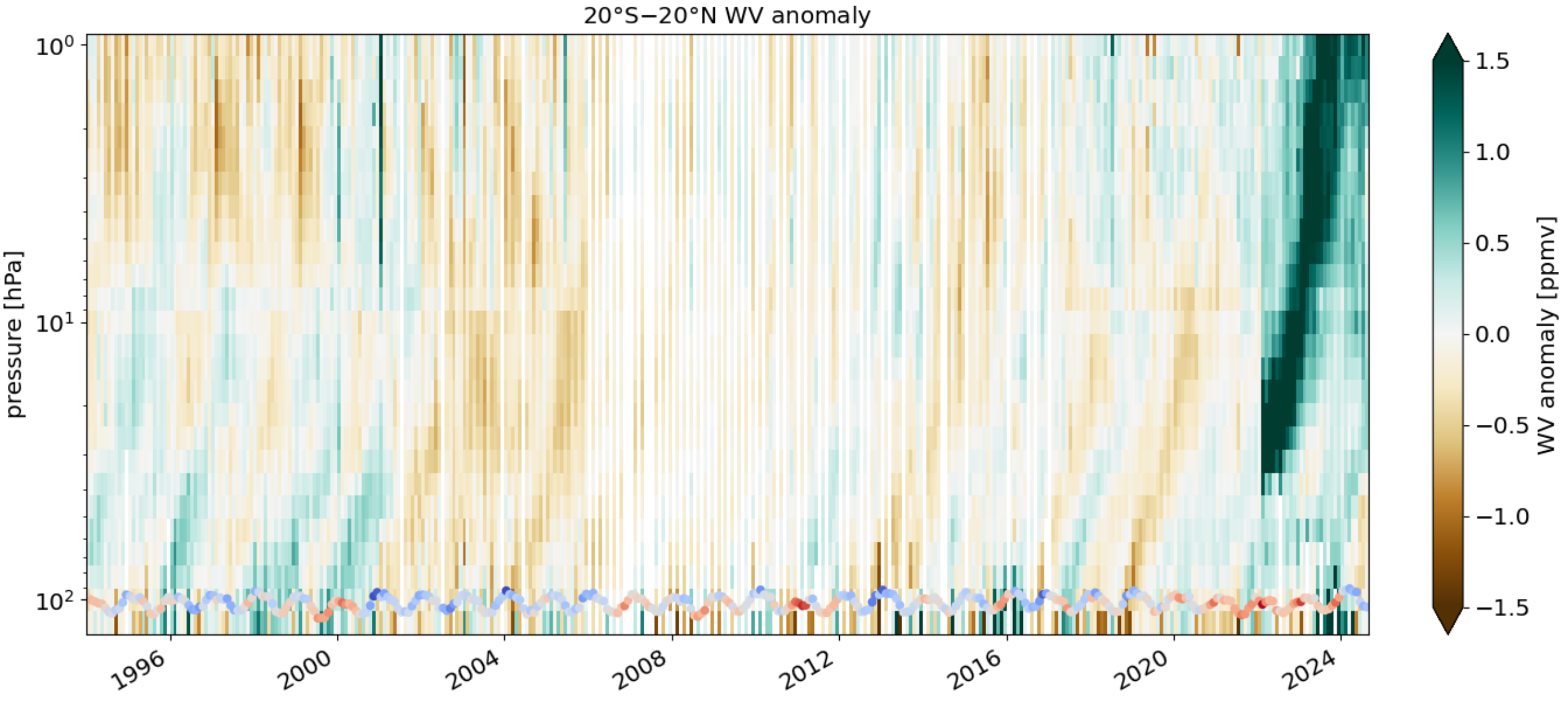


Fig. by K. Wargan (NASA-GSFC, SSAI), Salawitch et al., BAMS, submitted

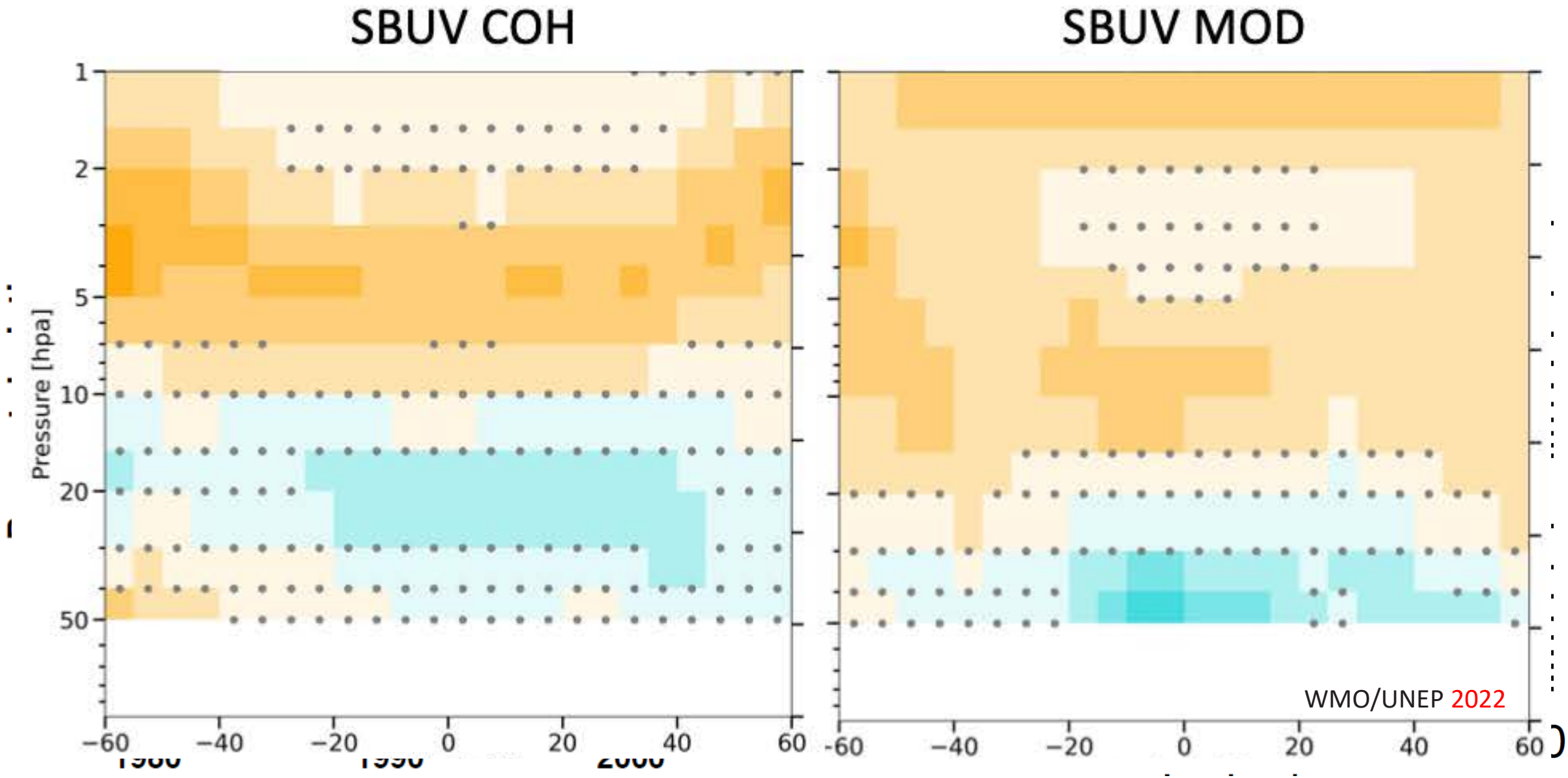
The tape recorder with/out Aura MLS

SWOOSH with Aura MLS SWOOSH without Aura MLS

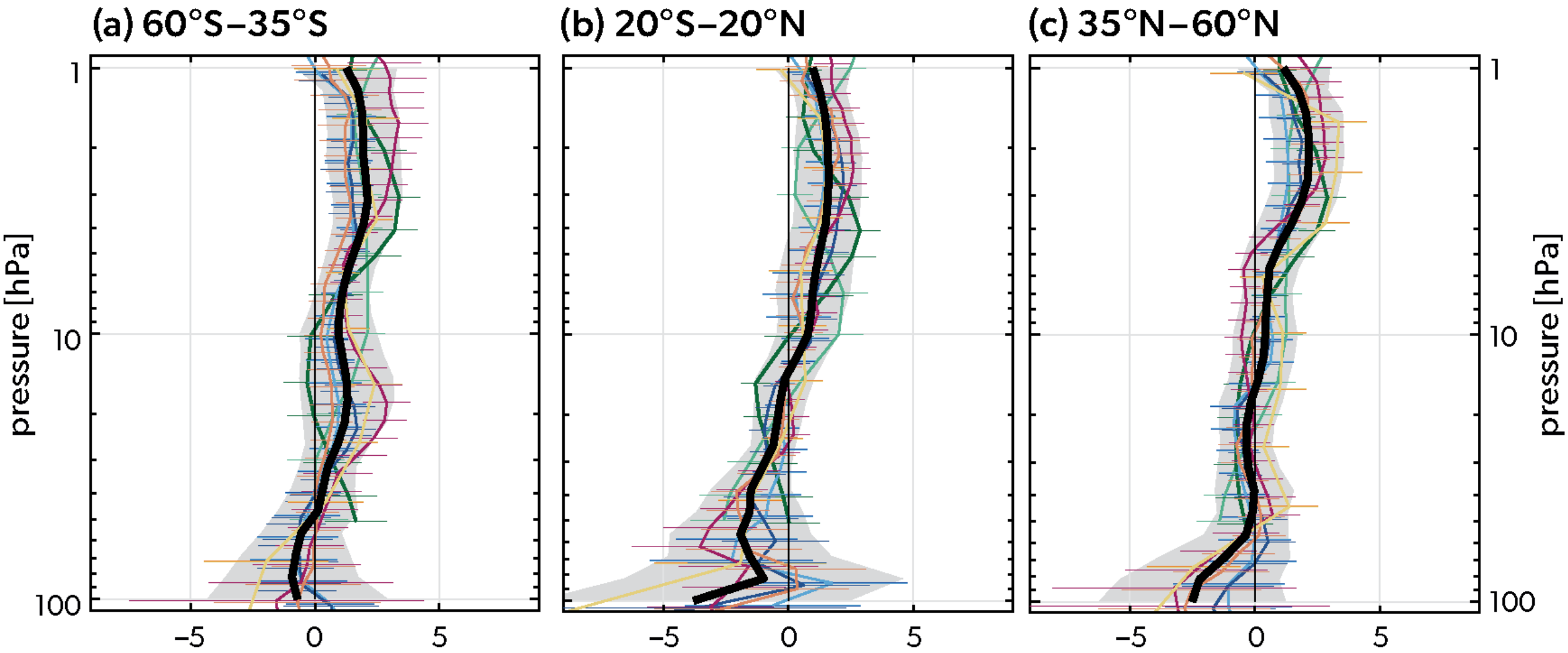
Fig. by Sean Davis (NOAA-CSL)



Increased uncertainty over few years → impacts nadir trends during many years



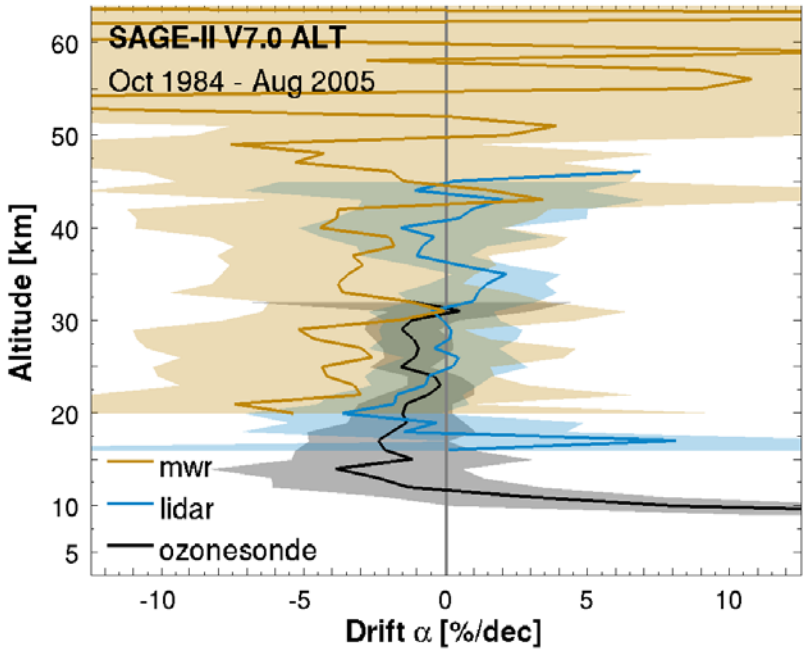
Future WMO O3 assessments : larger uncertainty?



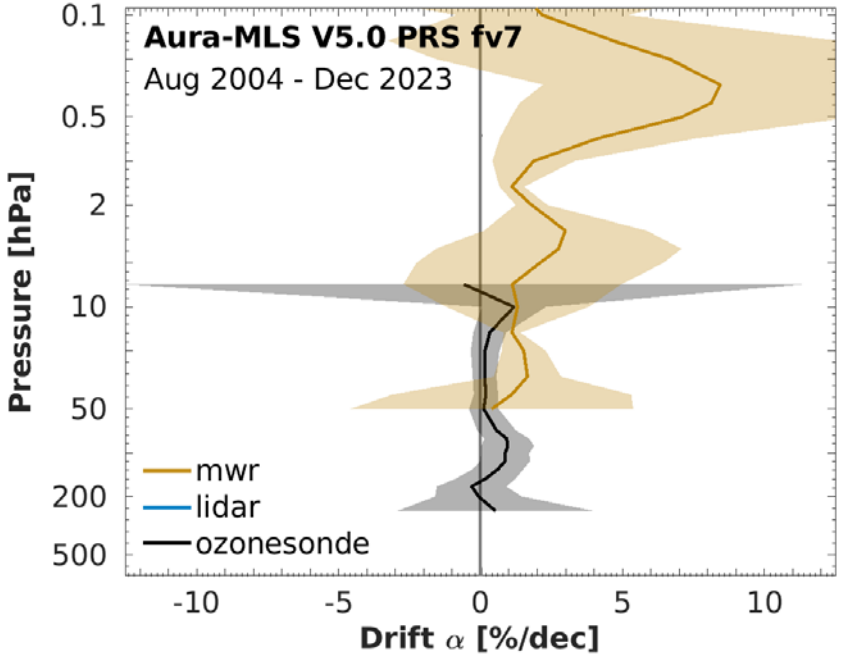
WMO/UNEP 2022

Pointing stability is a challenge for limb UV-vis scattering

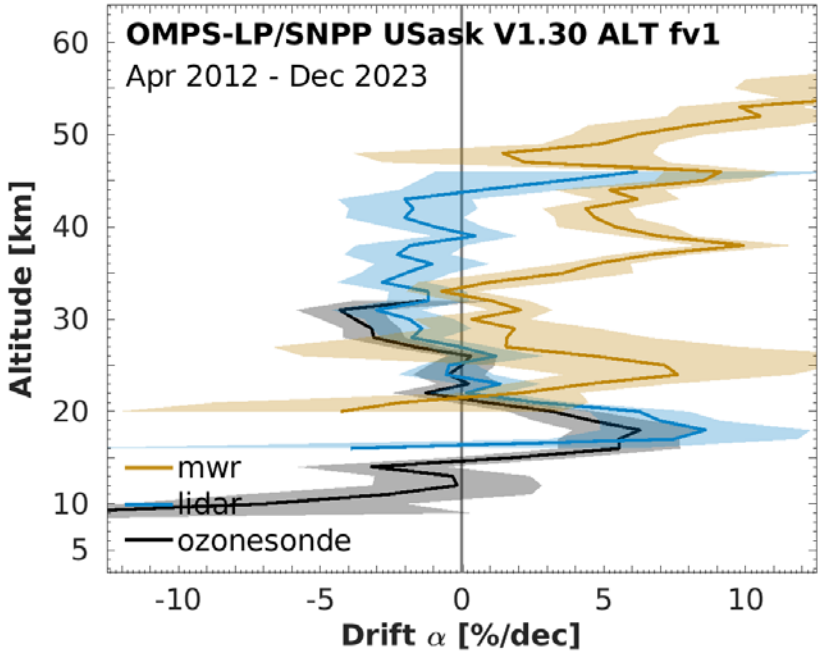
SAGE II



Aura MLS



OMPS-LP/SNPP



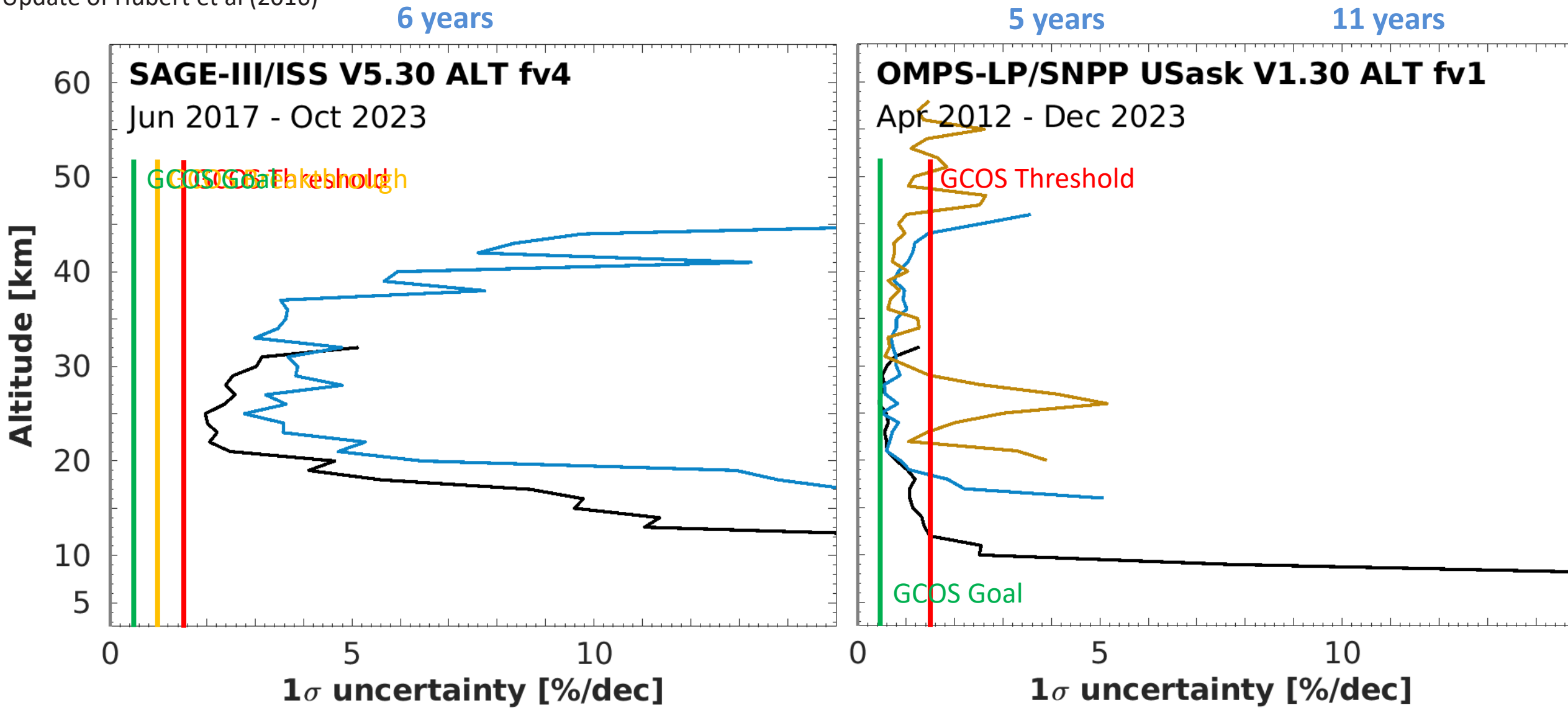
Update of Hubert et al (2016)

→ Limb IR/MW emission sensor data should be more stable

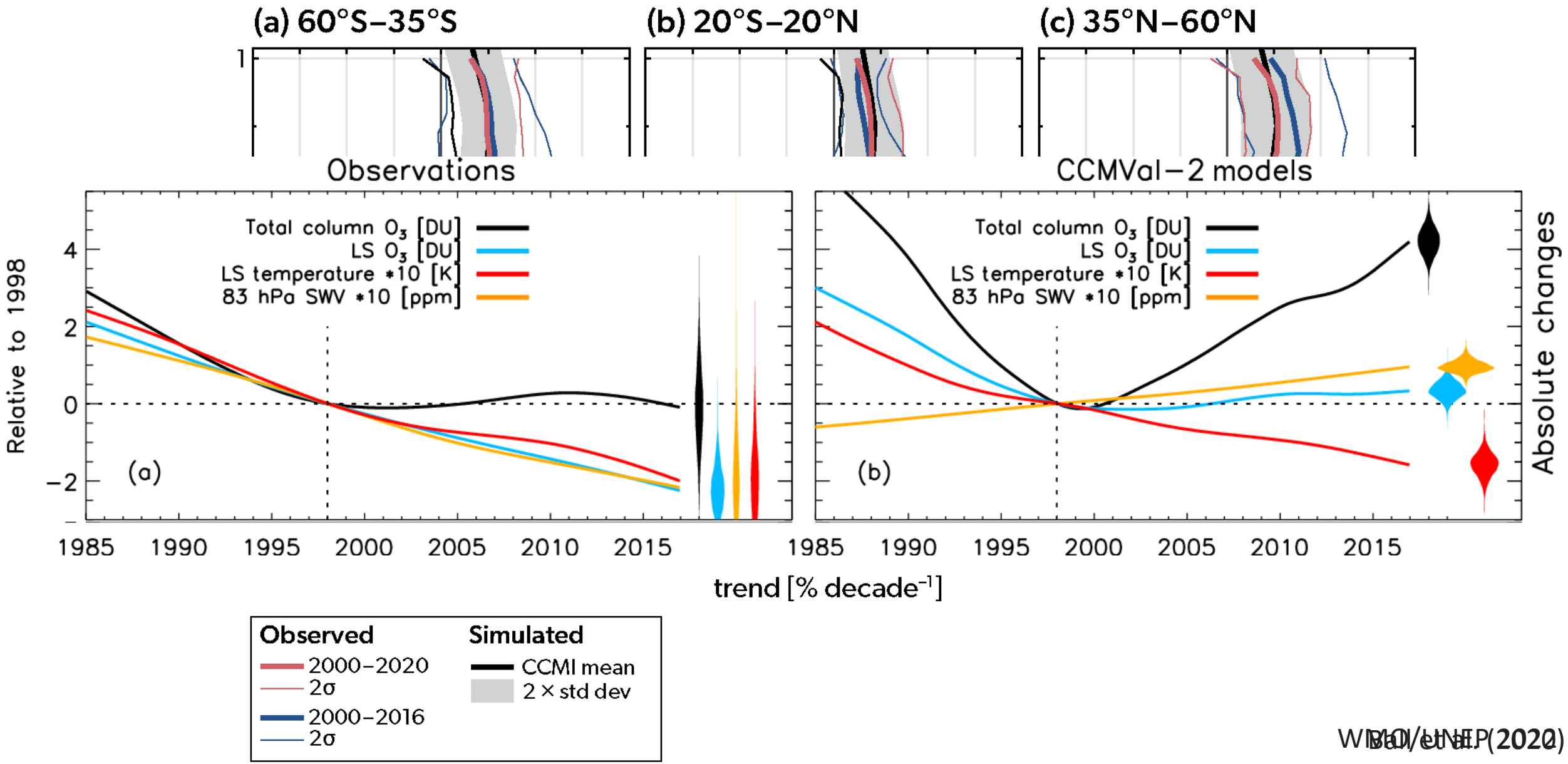
→ Solar occultation data as well, but …

It takes a lot of time to confirm stability of occultation data

Update of Hubert et al (2016)

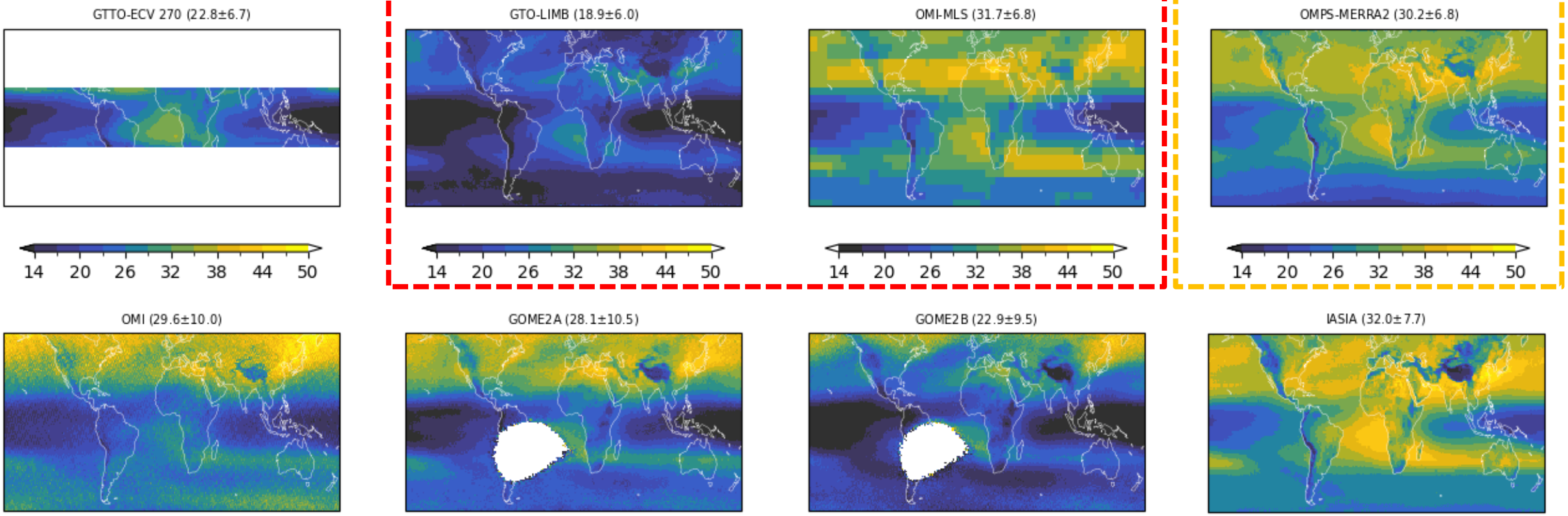


Tracer observations needed to understand → resolve tension in observed/simulated LS trends



WMO/UNEP (2022)

One tropospheric ozone technique relies on stable limb data



Keppens, Hubert et al. (in prep)

Recommendations

- Various communities are in urgent need of limb observations
  - Requested since more than a decade (GCOS 2010+)
  - Detect and study impact of special events (volcanic eruptions, wildfires, …)
  - Improve process understanding and modelling at different scales
  - Preserve ability to estimate long-term changes and their attribution (BDC, ODS, GHG, …)
  - Diversity & quality of products : strato/troposphere, L2/L3, observations/reanalyses
  - Validation : chemistry-climate models, satellite and ground-based measurements
- What is needed in addition to what planned sensors?
  - Limb IR/MW emission : dense sampling; H2O, tracers, halogens, O3
  - Solar occultation IR : stable pointing (but sparse): H2O, tracers, halogens, O3
  - **2x limb IR/MW emission** : “ensure” a new golden standard