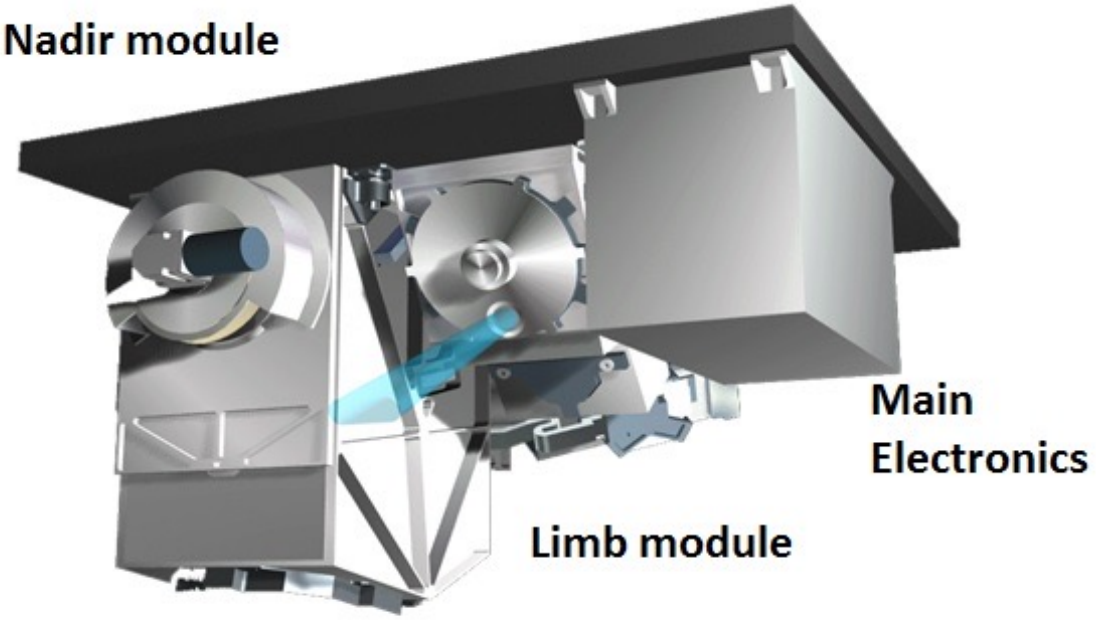
Updates on Limb Missions: OMPS Limb Profiler

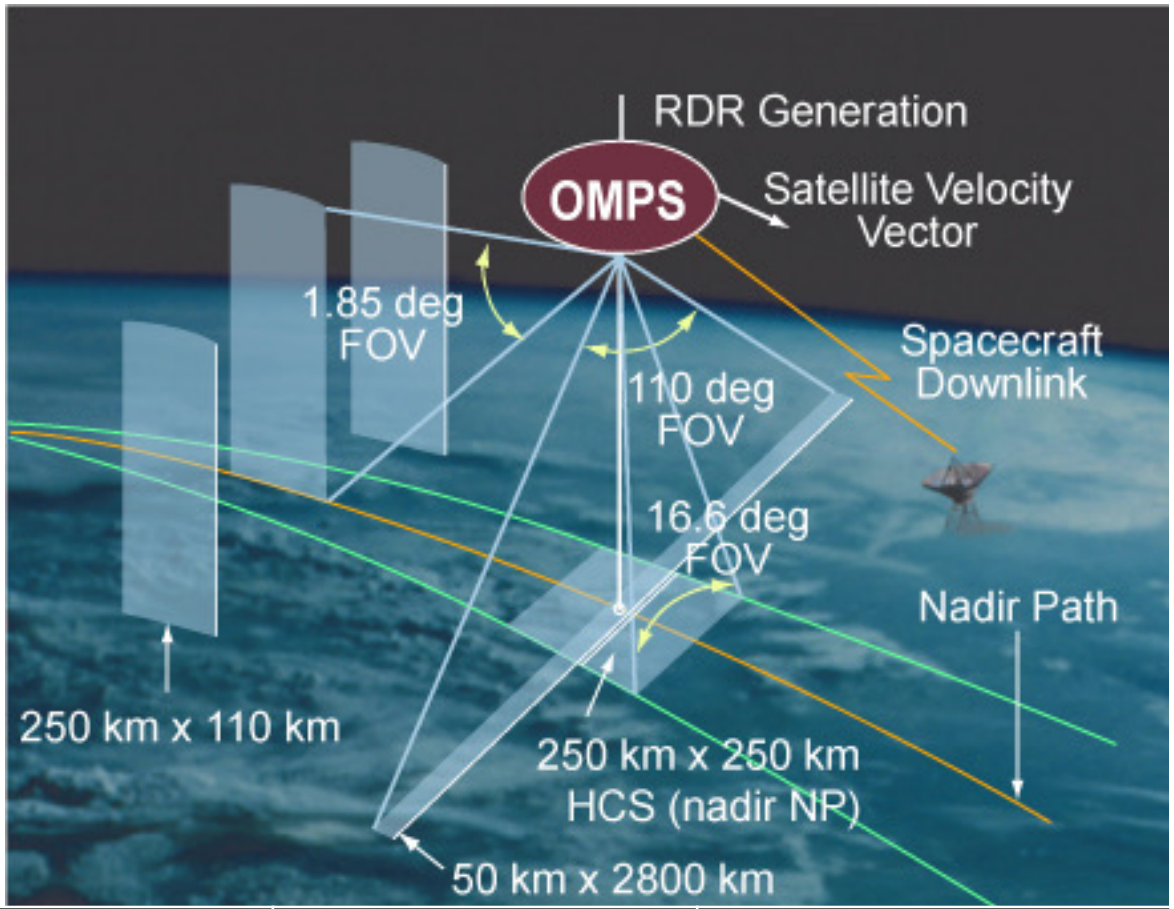


Natalya Kramarova[1], Glen Jaross[1], Ghassan Taha[2,1], P.K. Bhartia[1*], Matthew DeLand[3], Philippe Xu[4], Jungbin Mok[3], Leslie Moy[3], Stacey Frith[3], Jerald Ziemke[4] and OMPS SIPS

1-NASA Goddard Space Flight Center, Greenbelt, MD, USA; 2- Morgan State University, MD, USA; 3- SSAI, Greenbelt, MD, USA; 4- SAIC, Greenbelt, MD, USA; *- Emeritus

AC-VC-19 / ACSG Joint Meeting 2023, October 24-27, 2023

OMPS Limb Profiler (LP)



Missions	Launch	Data record
Suomi NPP	28 October 2011	April 2012 - present
NOAA-20 (nadir only)	18 November 2017	
NOAA-21	10 November 2022	Feb. 2023-present

- ✓ LP measures solar light scattered from atmospheric limb in spectral range 290-1000 nm, with variable resolution (1.5-40 nm);
- ✓ LP has three slits separated horizontally by 4.25 (about 250 km) to expand the sensor cross-track coverage;
- ✓ Altitude range = 0-80 km, 1 km sampling;
- ✓ LP collects radiance spectrum simultaneously at all altitudes;
- ✓ LP makes about 160 (SNPP) or 240 (NOAA-21) measurements per orbit with 14 orbits per day, corresponding to ~0.75° - 1° latitude sampling.

Natalya.A.Kramarova@nasa.gov

OMPS LP Data Products

Gridded Limb Sun-Normalized radiances (Level 1)

Level1B pixels have variable wavelength, altitude sampling across CCD

Level1G Interpolate radiances to regular grid for use in L2 retrievals

Ozone Profile (UV+VIS wavelengths)

Retrieved profile covers the altitude range from lower stratosphere to lower mesosphere (12.5-57.5 km)

Aerosol Extinction Profiles (VIS/near-IR wavelengths)

Retrieved aerosol extinction profiles at 6 wavelengths between 510-997 nm

Cloud Height (VIS/near-IR wavelengths)

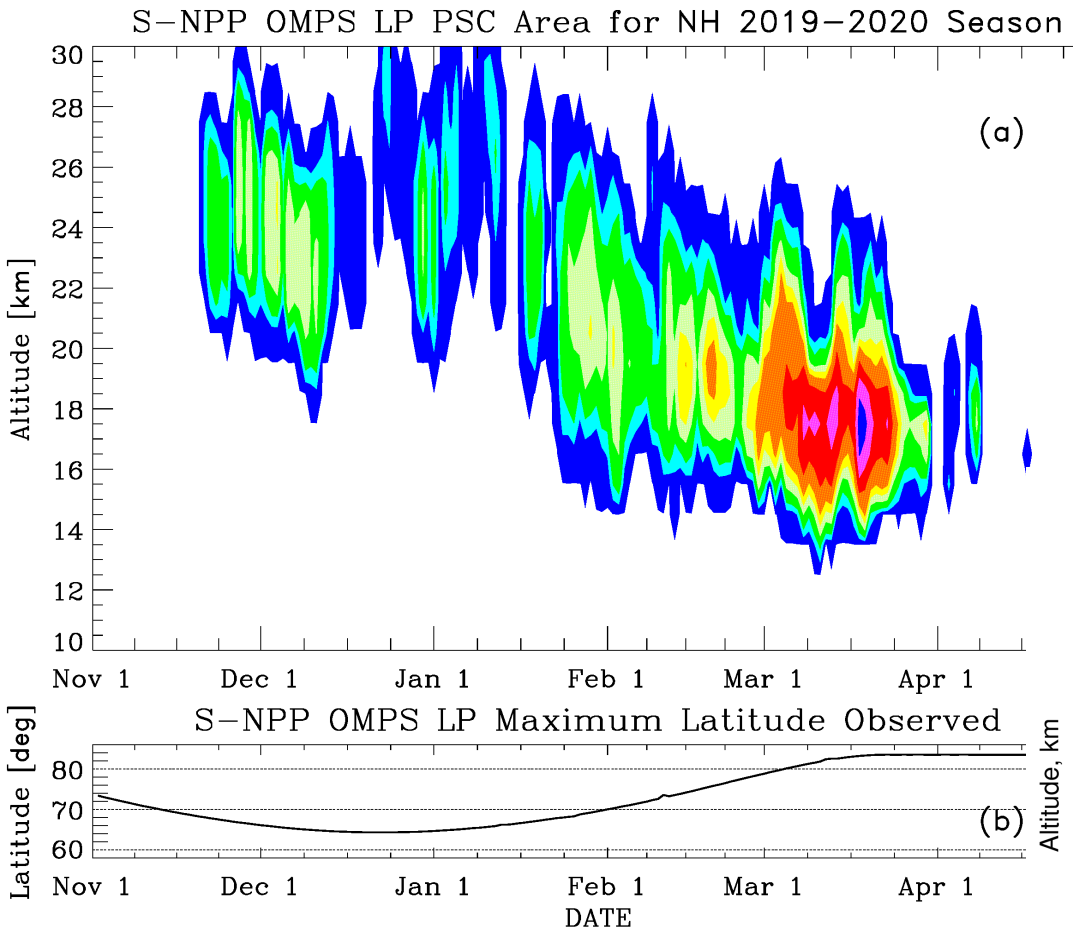
Cloud top heights [km] from the ratio of 674 and 868 nm

Research Products

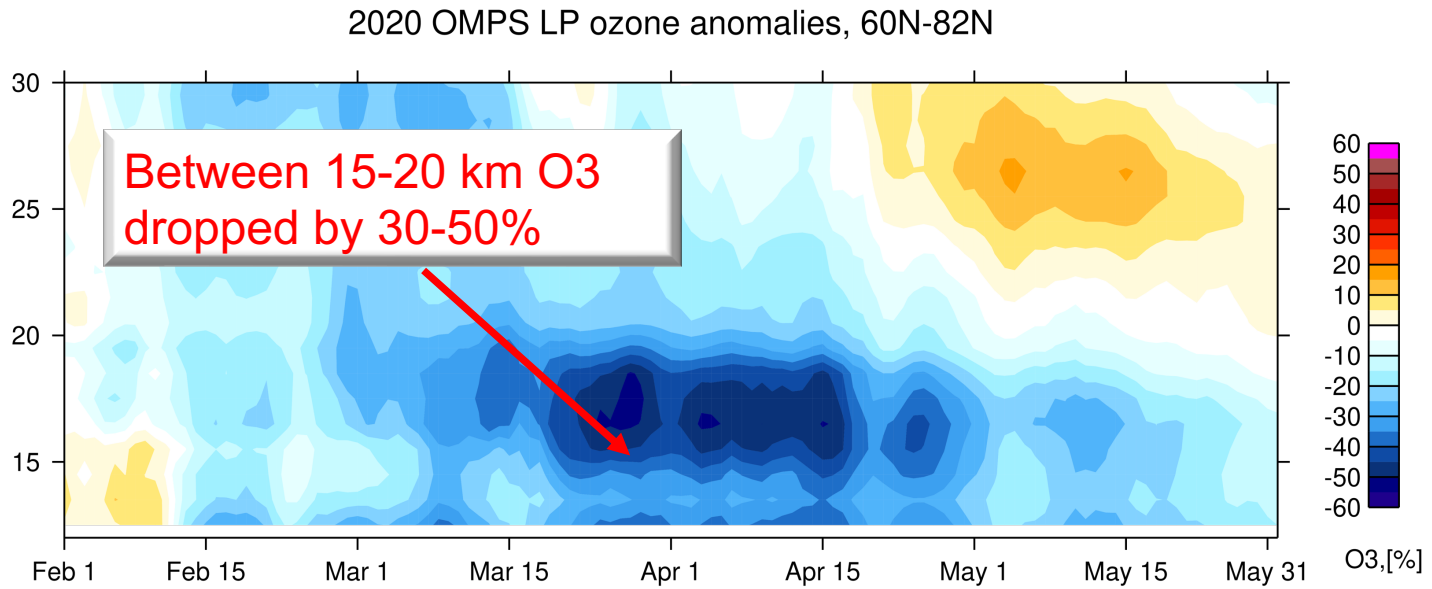
Upper stratospheric-mesospheric temperature, polar stratospheric clouds, mesospheric ozone, stratospheric NO_2

Natalya.A.Kramarova@nasa.gov

Monitoring of polar ozone depletion with the Suomi NPP OMPS



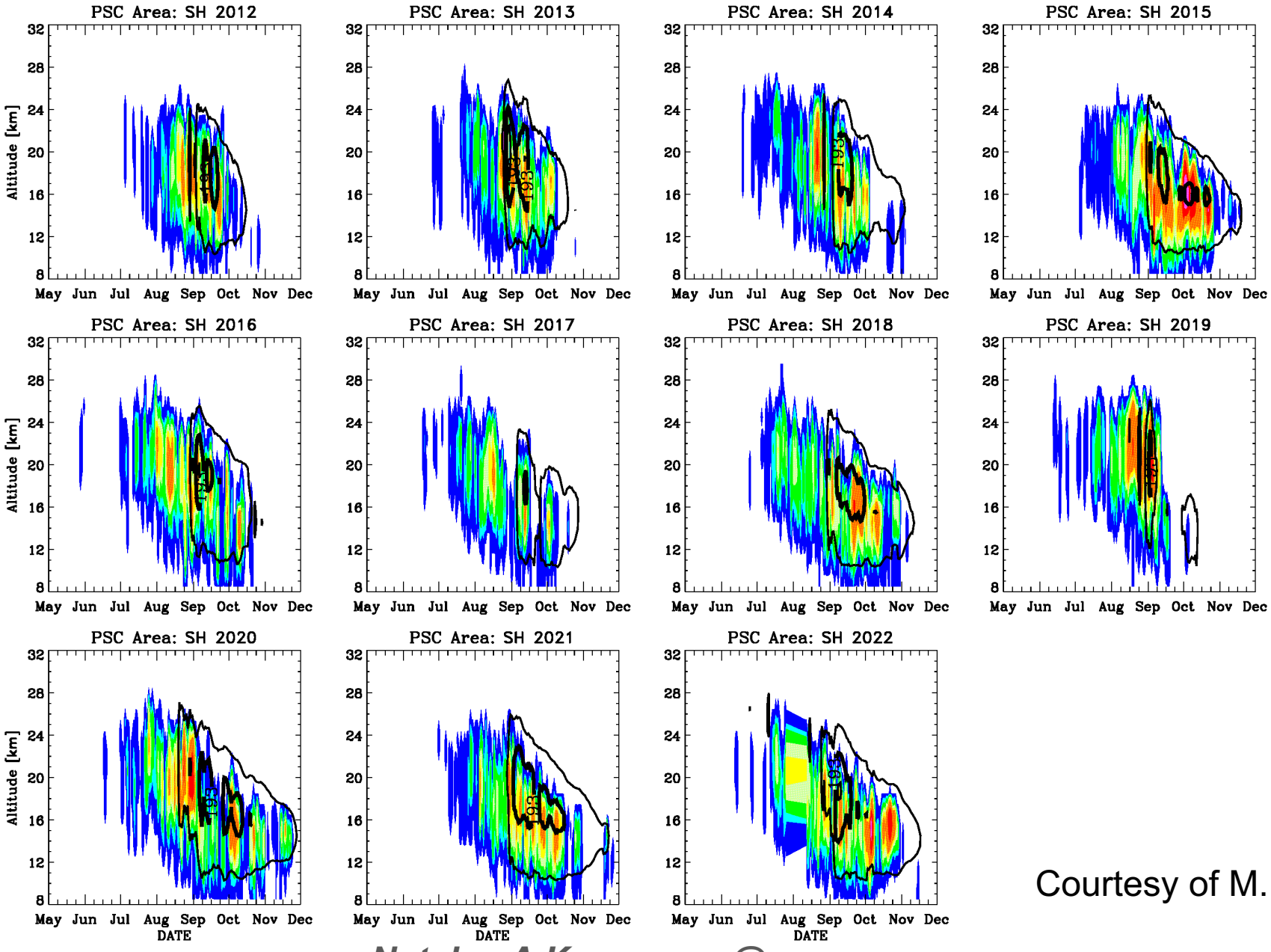
- Lack of planetary wave forcing in Feb-Mar 2020 kept the polar vortex intact and stratospheric T below average;
- Cold temperatures in 2019-2020 persisted into late March leading to increased volume of PSCs over the Arctic;
- The Arctic ozone depletion in March 2020 was the worst since 1979.



[DeLand et al., JRL, 2020]

Natalya.A.Kramarova@nasa.gov

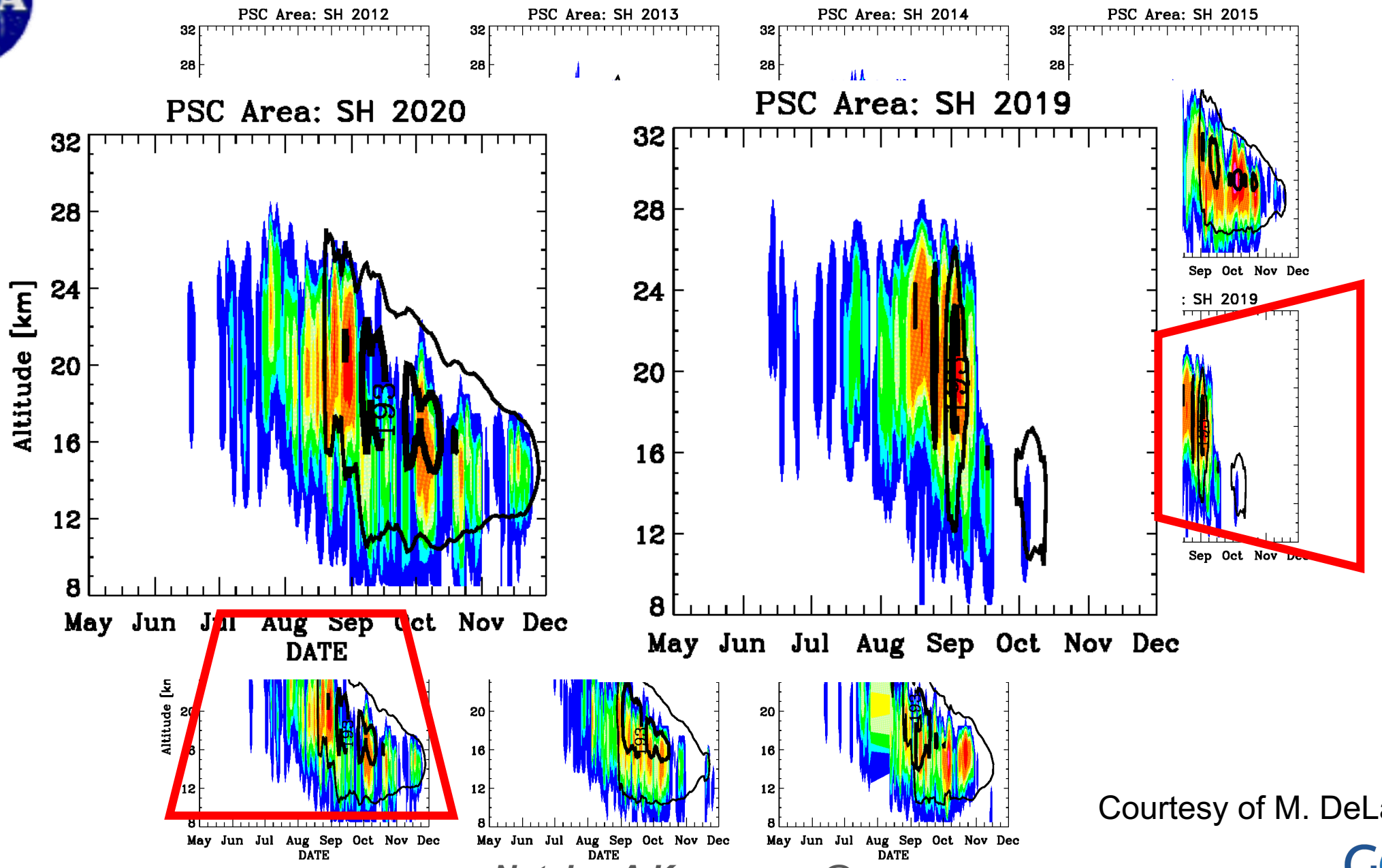
Polar stratospheric clouds record over Antarctica



Courtesy of M. DeLand

Natalya.A.Kramarova@nasa.gov

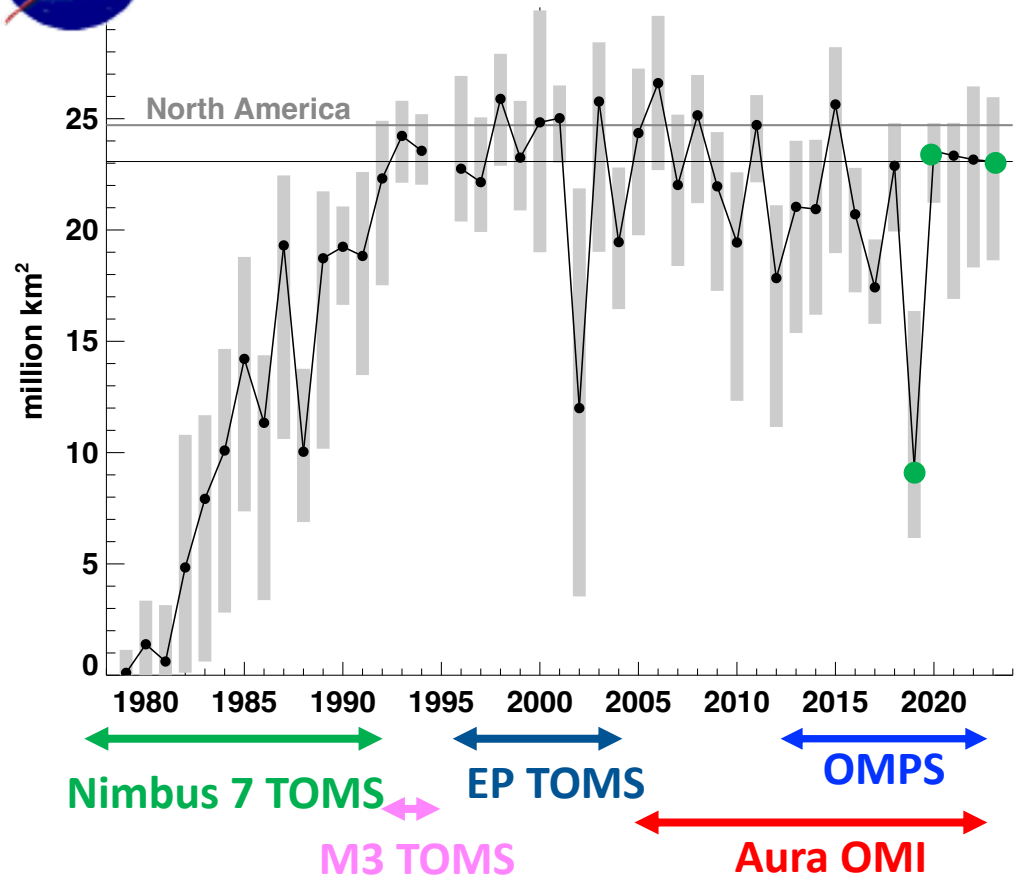
Polar stratospheric clouds record over Antarctica

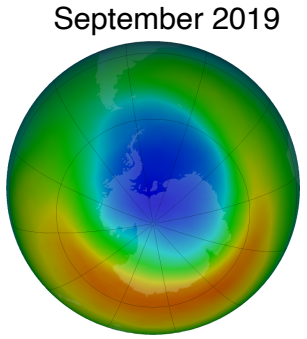


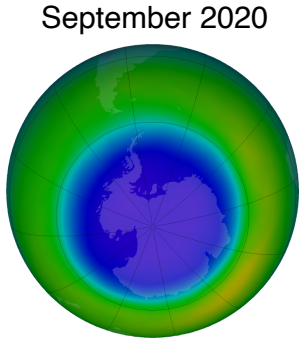
Courtesy of M. DeLand

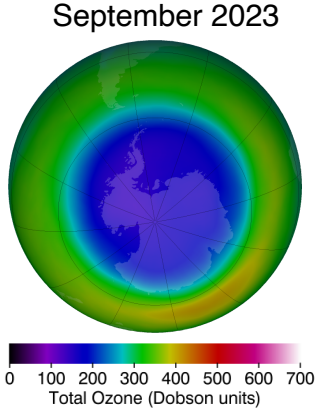
Natalya.A.Kramarova@nasa.gov

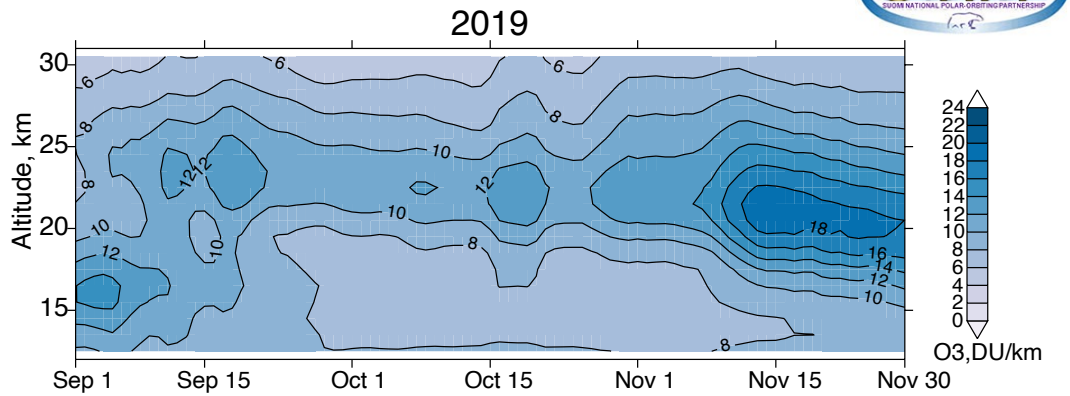
Monitoring of polar ozone depletion with the Suomi NPP OMPS

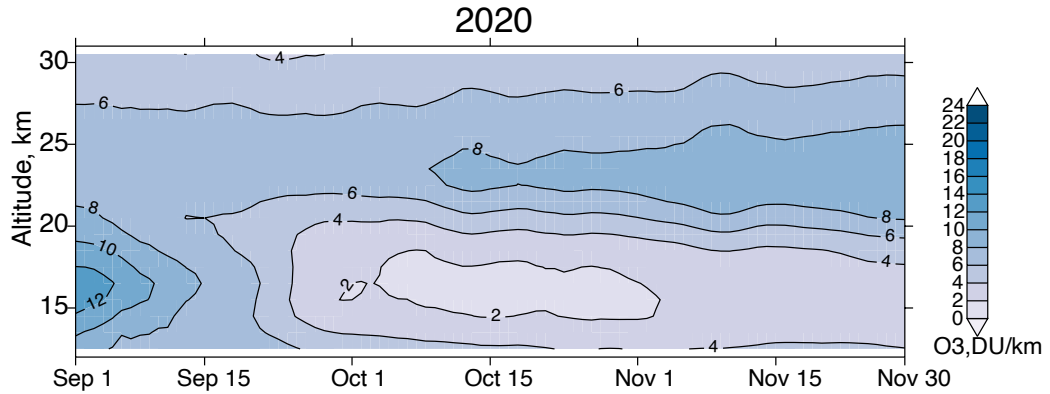


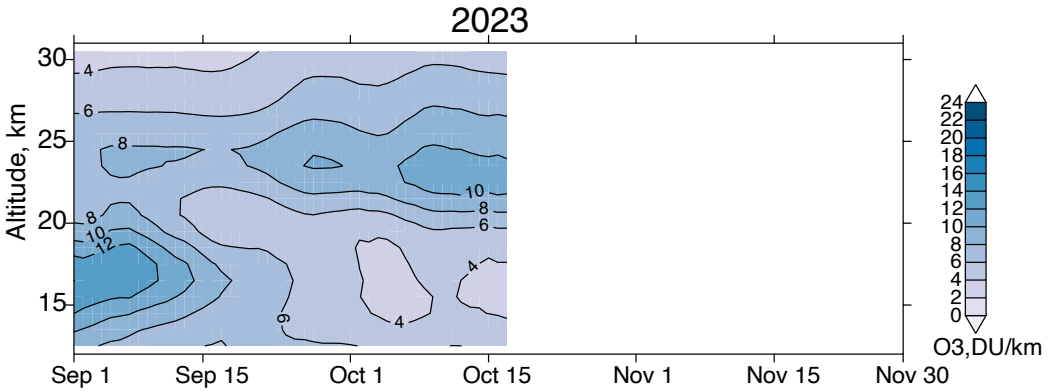










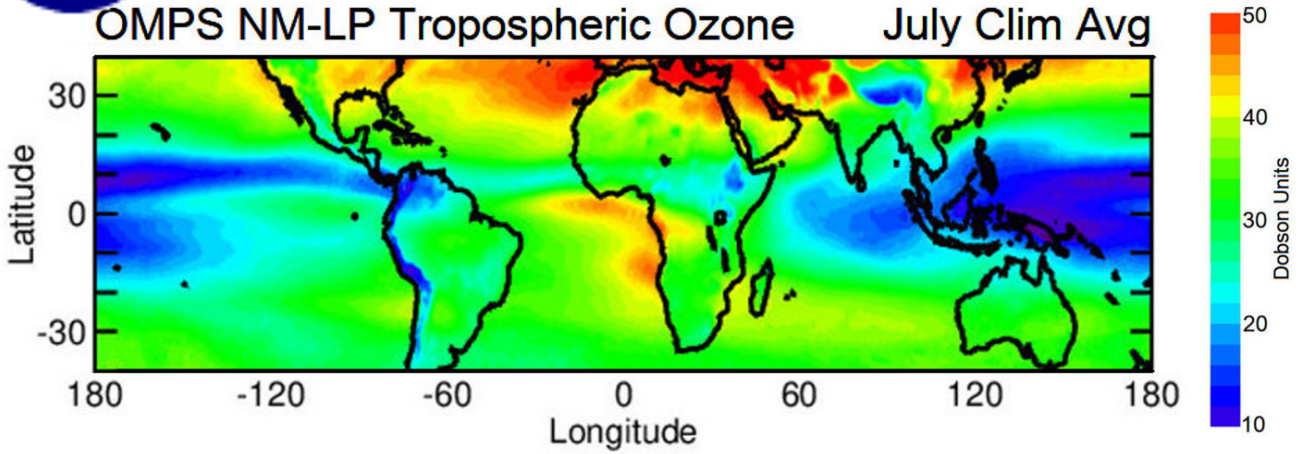


Suomi NPP OMPS continues the 40+ years NASA satellite record of global ozone observations.

Continuation of ozone observations with OMPS instruments on board of Suomi NPP, NOAA-20 and upcoming JPSS-2, -3 and -4 is critical for the next decades to monitor the Antarctic ozone recovery.

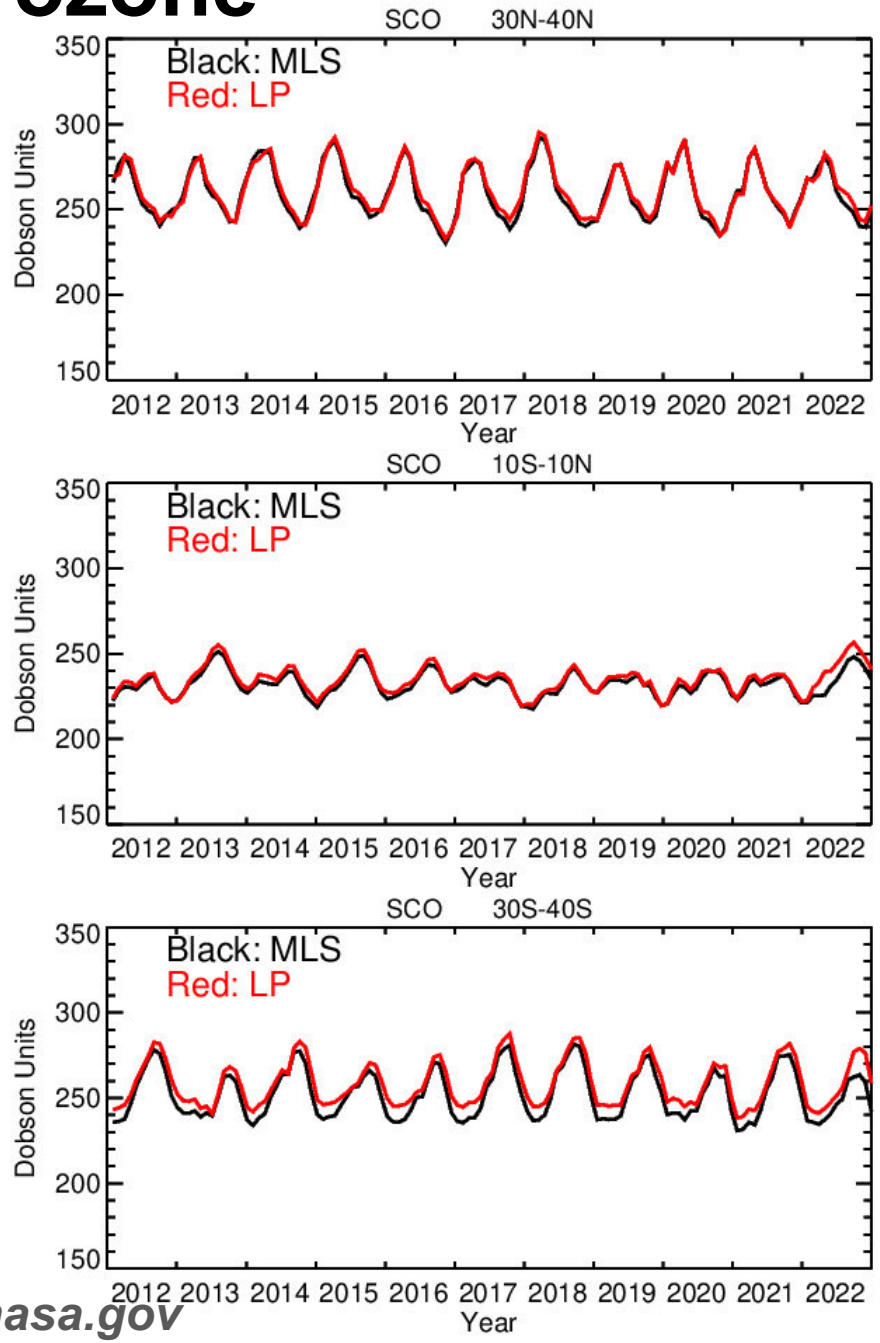
Natalya.A.Kramarova@nasa.gov

OMPS Tropospheric ozone



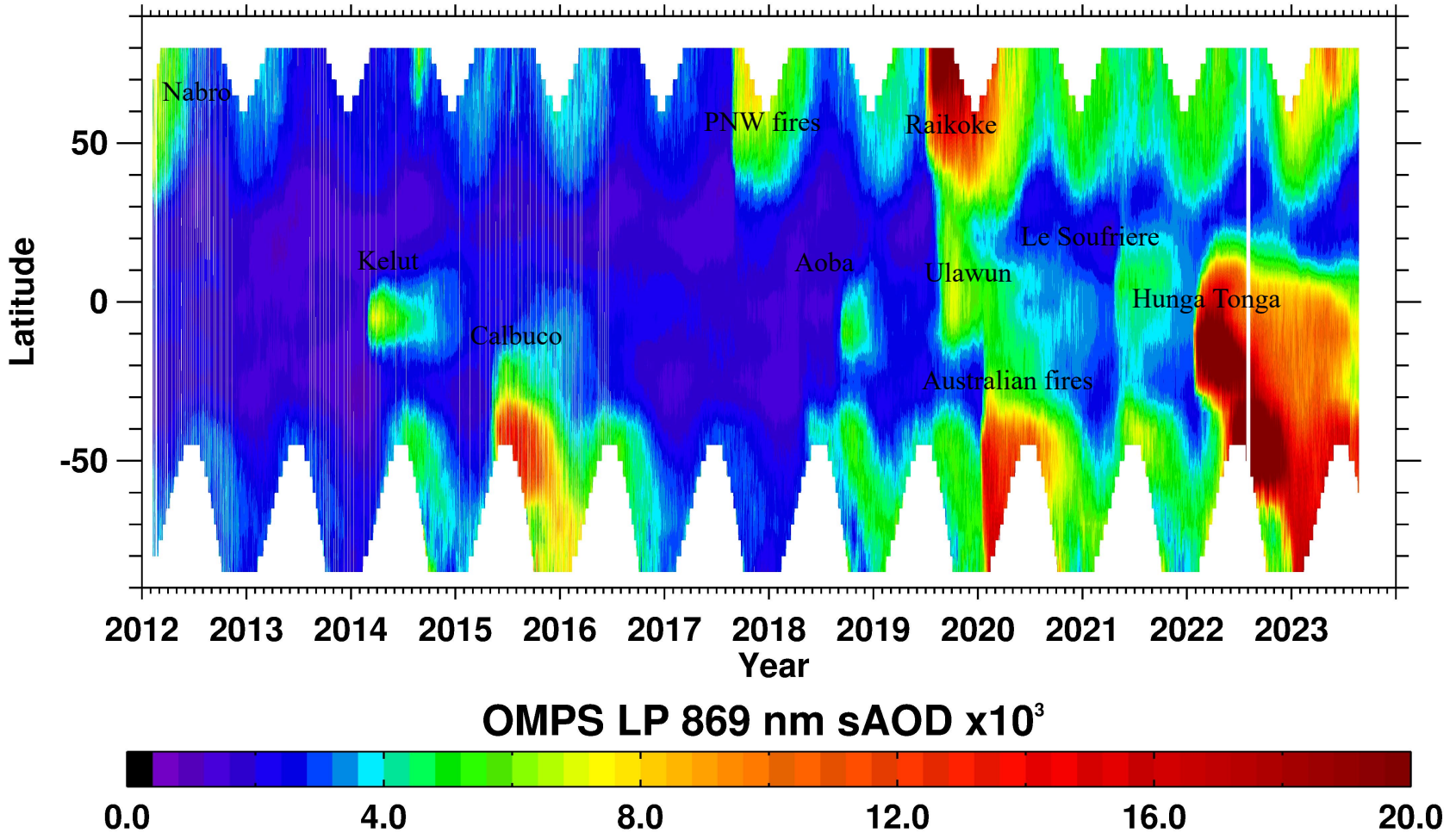
For daily tropospheric ozone maps, stratospheric ozone columns (SCO) from LP are highly consistent with MLS

However, the current 12.5 km low altitude cutoff for LP ozone profiles limits global coverage to about ±40° latitudes



Natalya.A.Kramarova@nasa.gov

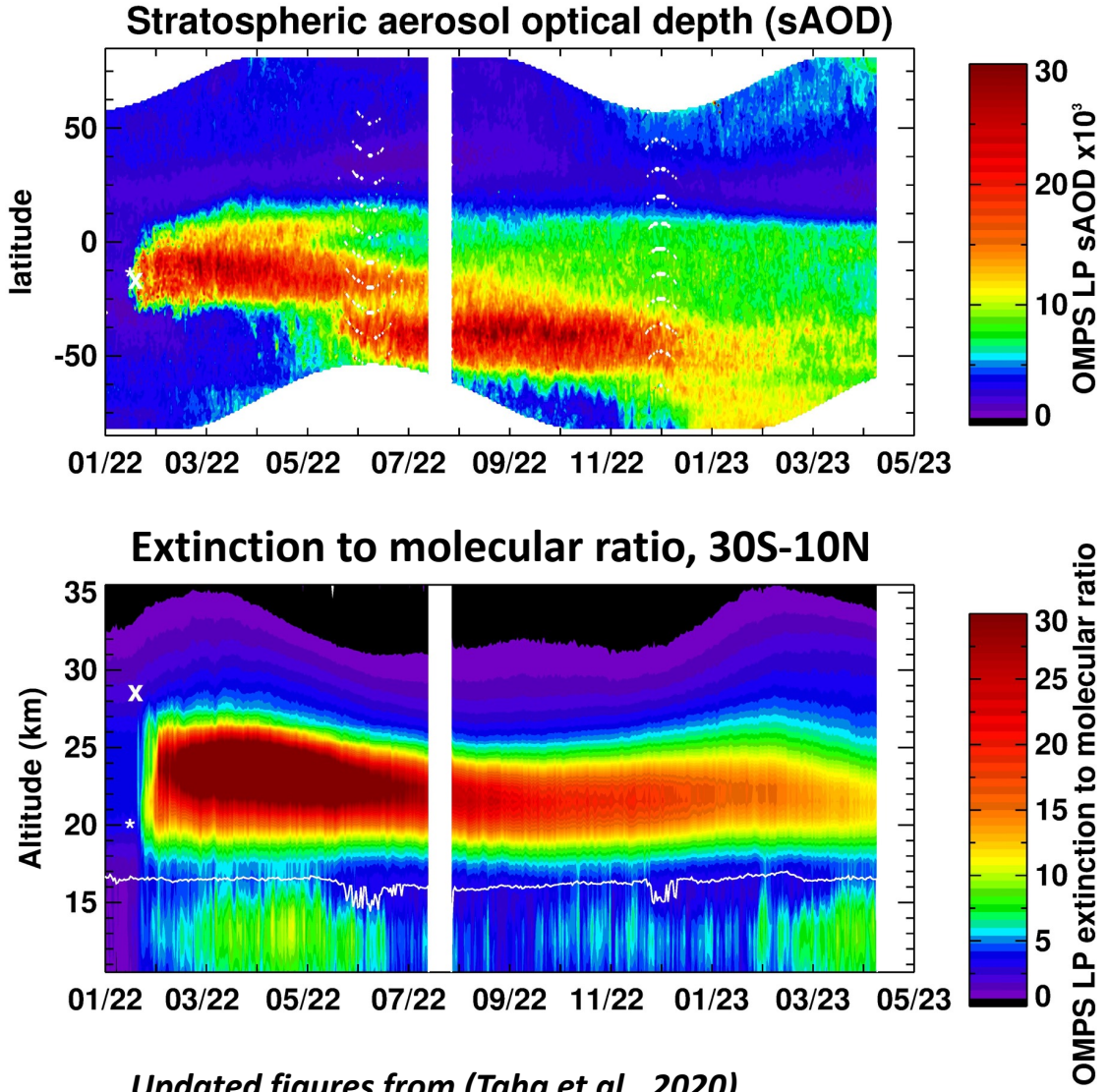
Stratospheric aerosol record from SNPP OMPS LP



- sAOD had increased in the last decade. Two out of four largest stratospheric injection events in 2012-2021 originated from regional outbreaks of intense pyroCb activity [*Peterson et al., 2021].*
- Hunga-Tonga eruption in January 2022 is the largest observed since Pinatubo, and stratospheric aerosol levels remain elevated after two years.

Natalya.A.Kramarova@nasa.gov

Stratospheric aerosol transport following the 2022 Hunga-Tonga eruption



Volcanic aerosol cloud was mainly confided in the tropical stratosphere in the first 3 months. In May 2022, significant parts of the stratospheric volcanic aerosols were transported toward southern polar latitudes.

The peak of volcanic layer was between 20 and 26 km and rapidly descended during the first few weeks; a second and slower descent was observed in April 2023.

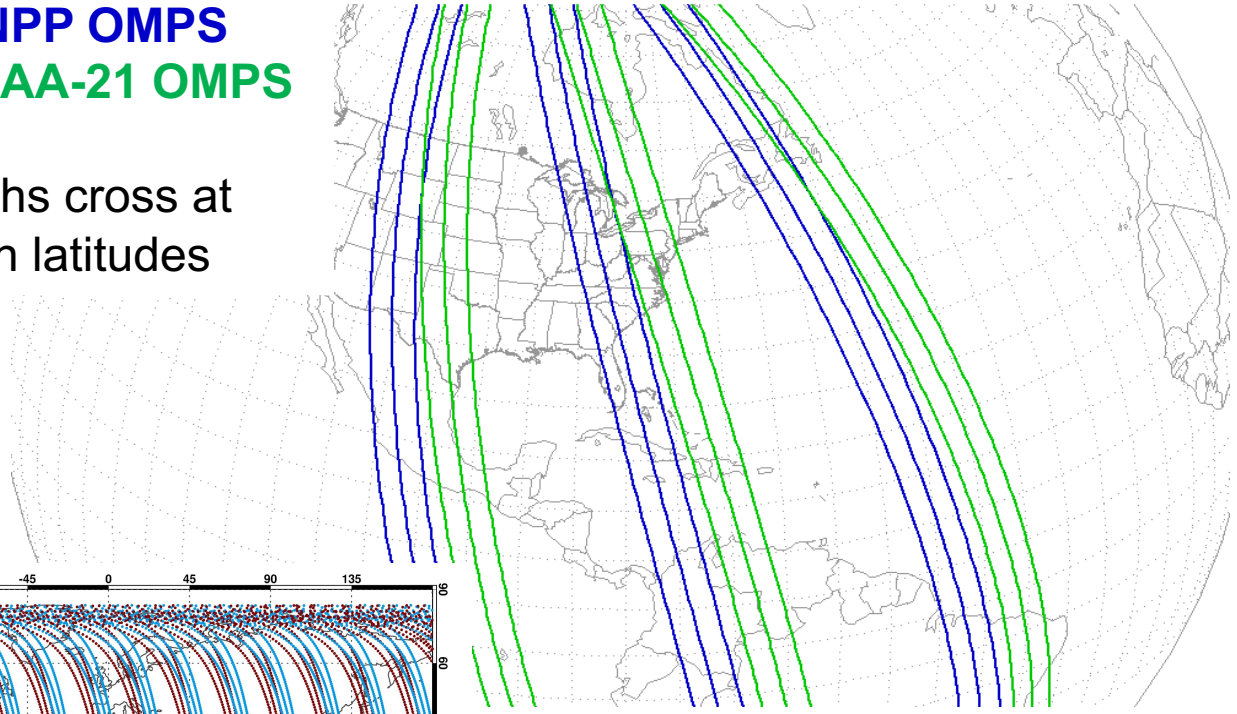
Updated figures from (Taha et al., 2020)

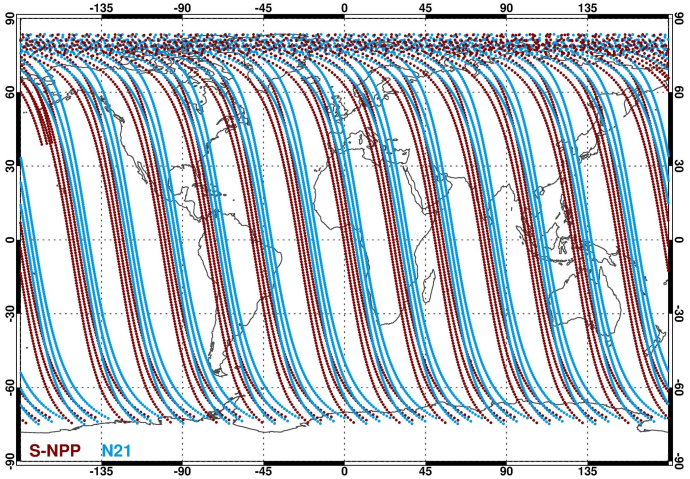
Natalya.A.Kramarova@nasa.gov

NOAA-21 OMPS Limb Profiler

S-NPP OMPS
NOAA-21 OMPS

Paths cross at high latitudes





NOAA-21 OMPS Limb Profiler:

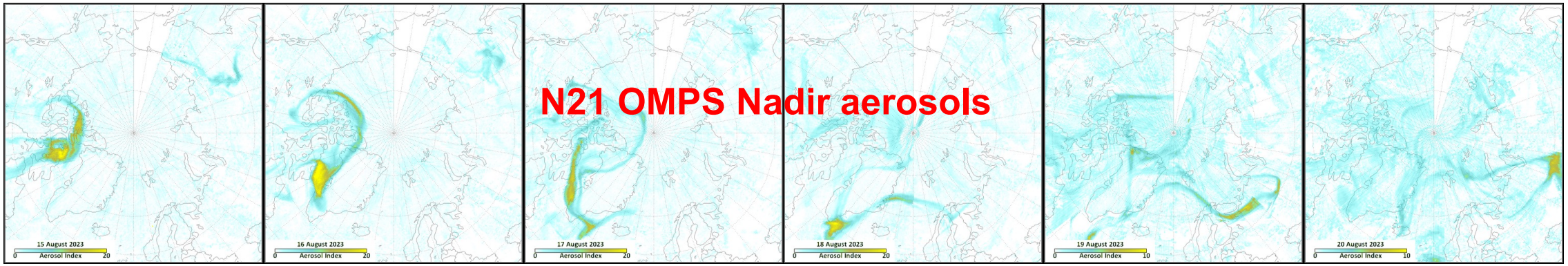
- Launched Nov. 2022
- NOAA-21 is a ¼ orbit ahead of SNPP
- The instrument is fundamentally the same as S-NPP LP; improved NIR performance
- First data products in Feb. 2023 (fully operational since April 2023)
- Public release of Level 1 data from NOAA-21 is expected in early 2024
- Release of ozone & aerosol products may follow soon after (pending evaluation)
- No decision on when or if SNPP will be decommissioned

Natalya.A.Kramarova@nasa.gov

GODDARD EARTH SCIENCES

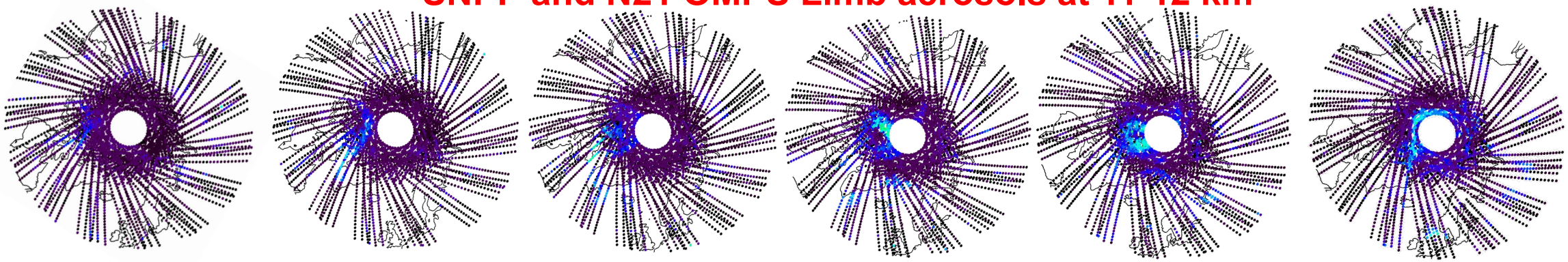
Observing Canadian fires in August 2023 with NOAA-21 and SNPP OMPS

Smoke from Great Slave Lake fires



15 August | 16 August | 17 August | 18 August | 19 August | 20 August

SNPP and N21 OMPS Limb aerosols at 11-12 km



Figures from N21 and SNPP Nadir and Limb courtesy of C. Seftor and G. Taha

Natalya.A.Kramarova@nasa.gov

Summary

- Suomi NPP OMPS LP is fully operational, and the record exceeds 11.5 years
- NOAA-21 OMPS LP started making measurements in February 2023, the first version of NOAA-21 data will be released next year
- OMPS LP provides ozone profiles with a high vertical resolution and dense spatial sampling offering an adequate alternative for extending MLS ozone record into the future for many applications
- Stratospheric aerosol measurements with the OMPS LP allows to study spatial aerosol distribution and transport after major volcanic eruptions and PyroCB injections
- Additional research products based on LP measurements are in development such as tropospheric ozone, polar stratospheric clouds, upper-stratospheric and mesospheric temperature etc.

Natalya.A.Kramarova@nasa.gov

Version 2.6 data can be found:

1. NASA official archive GES DISC (DOI 10.5067/8MO7DEDYTBH7):

https://disc.gsfc.nasa.gov/datasets/OMPS_NPP_LP_L2_O3_DAILY_2.6/summary

2. NASA public website OzoneAQ:

https://ozoneaq.gsfc.nasa.gov/data/ozone/#prods=54

3. OMPS LP overpasses for ground-based stations:

https://avdc.gsfc.nasa.gov/pub/data/satellite/Suomi_NPP/L2OVP/LP-L2-O3-DAILY_v2.6/

4. Near-Real Time OPMS LP v2.6 Ozone profiles are available !!!

Natalya.A.Kramarova@nasa.gov

Satellite Ozone Profile Measurements