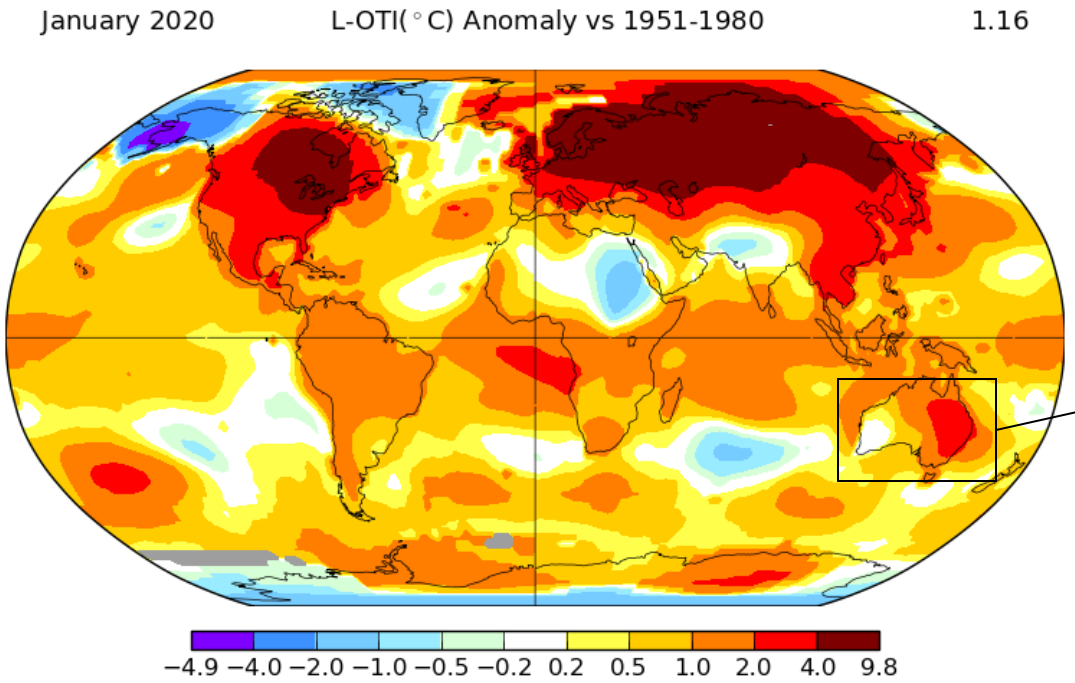
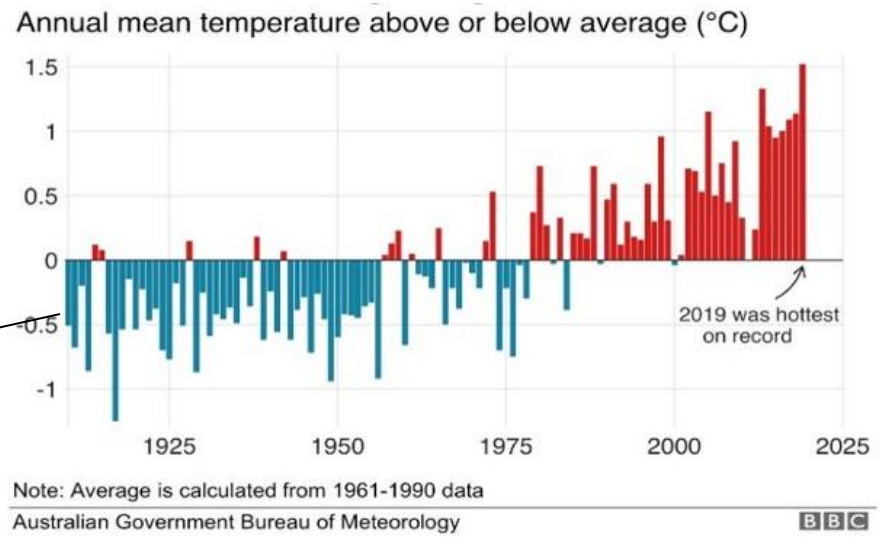
NATIONAL INSTITUTE OF AEROSPACE

The impacts of the 2019/2020 Australian Mega Fires on the stratosphere

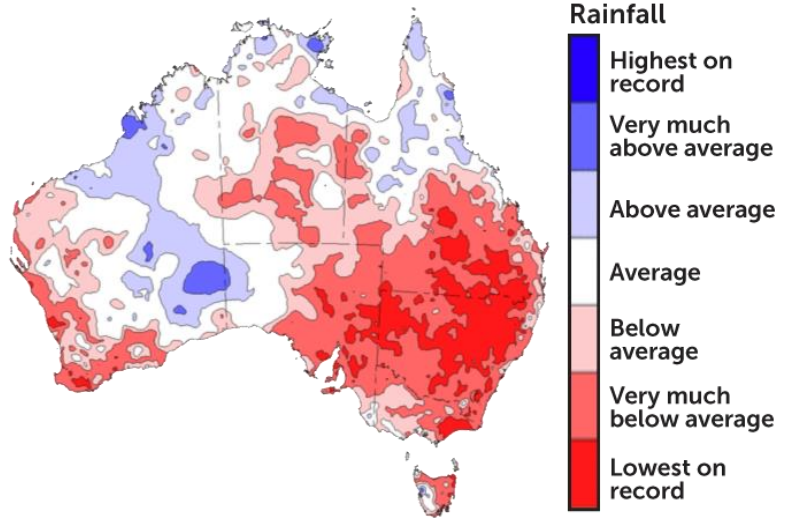
J.-P. Vernier; National Institute of Aerospace, NASA LaRC

Heat Waves and Long drought leading to the fires

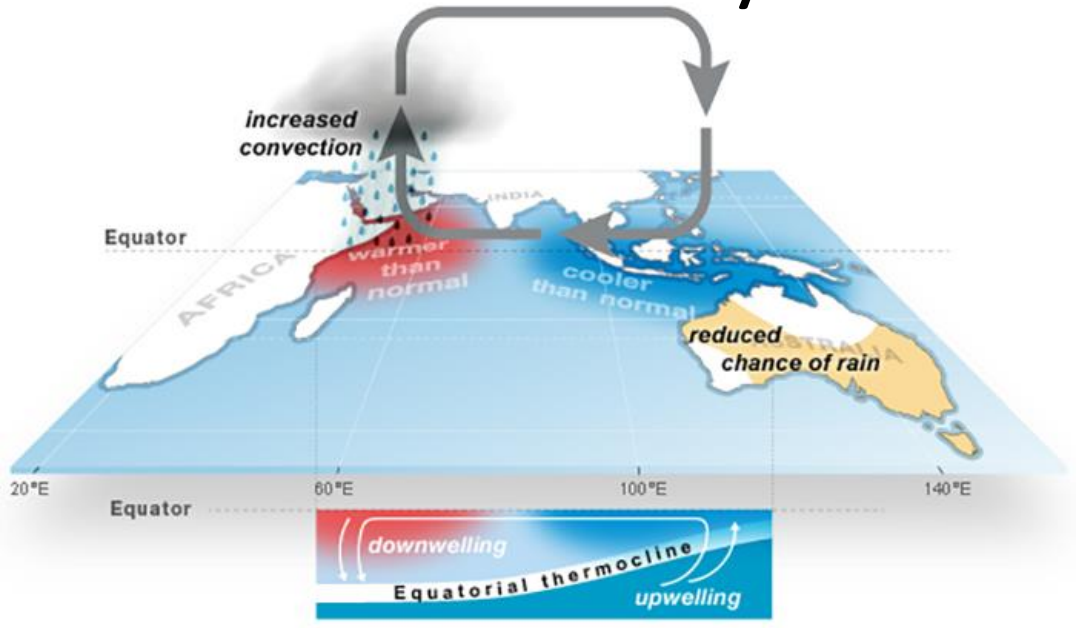




- ✓ Australia has been getting warmer (2019 hottest on record)
- ✓ Heat Waves are more severe; Canberra/Australia; 43°C 01/03/2020
- ✓ Drought exacerbated by heat and rainfall deficit for the past three years.



PyroCb development



Indian Ocean Dipole (IOD): **Positive phase**

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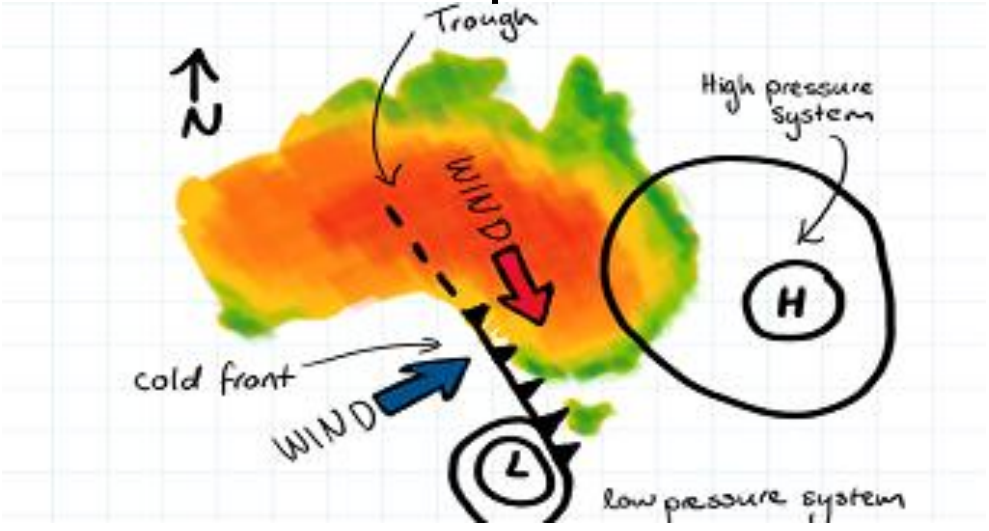

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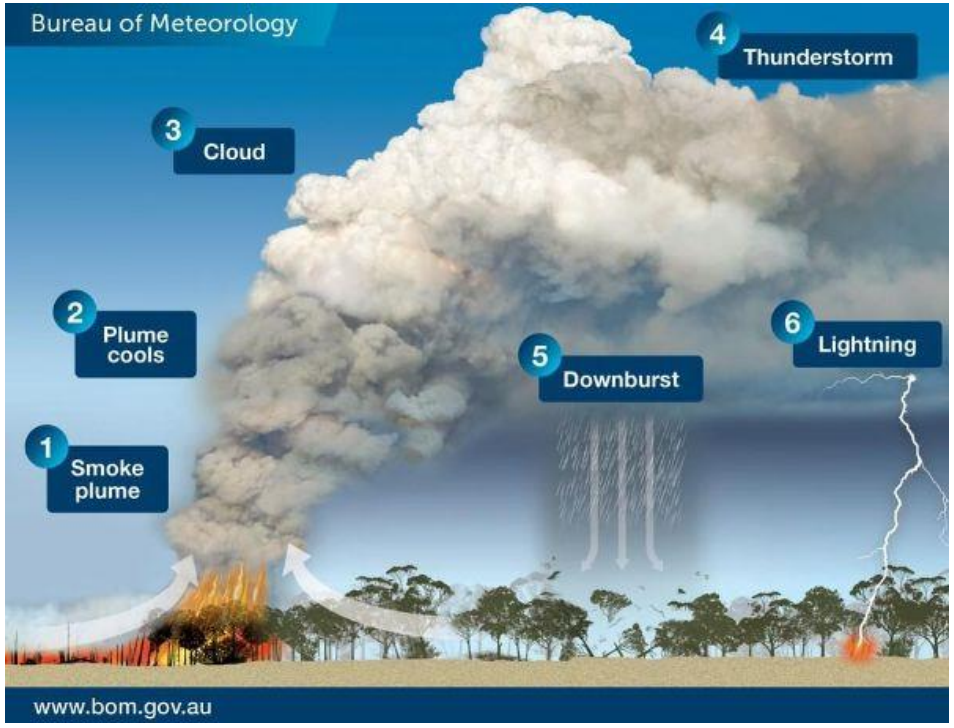
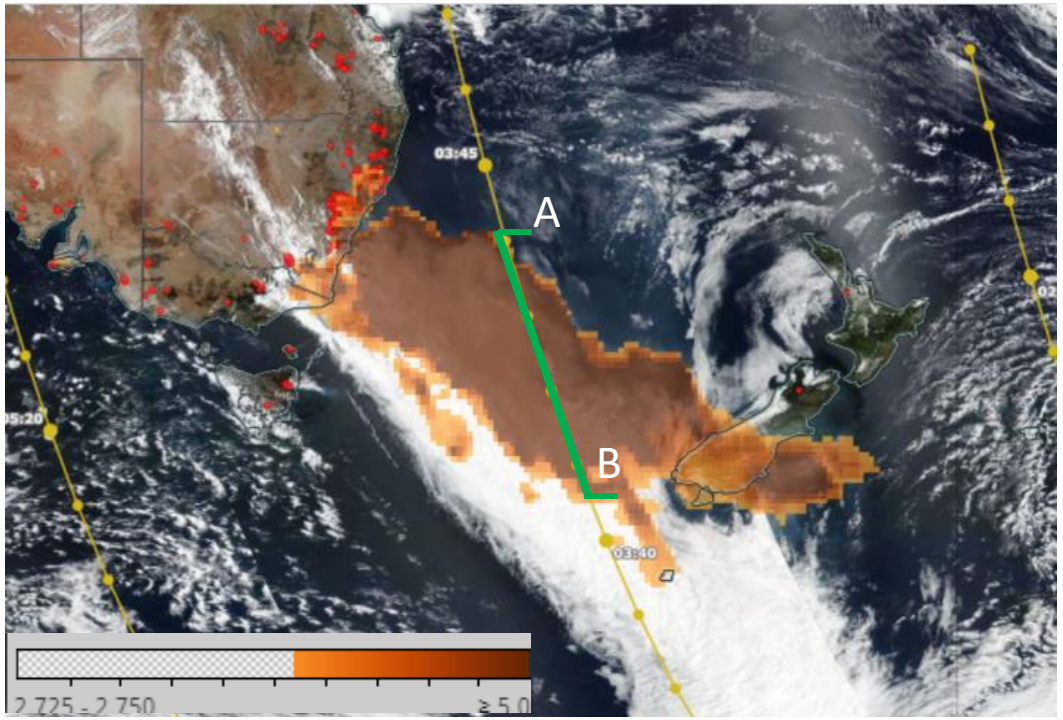


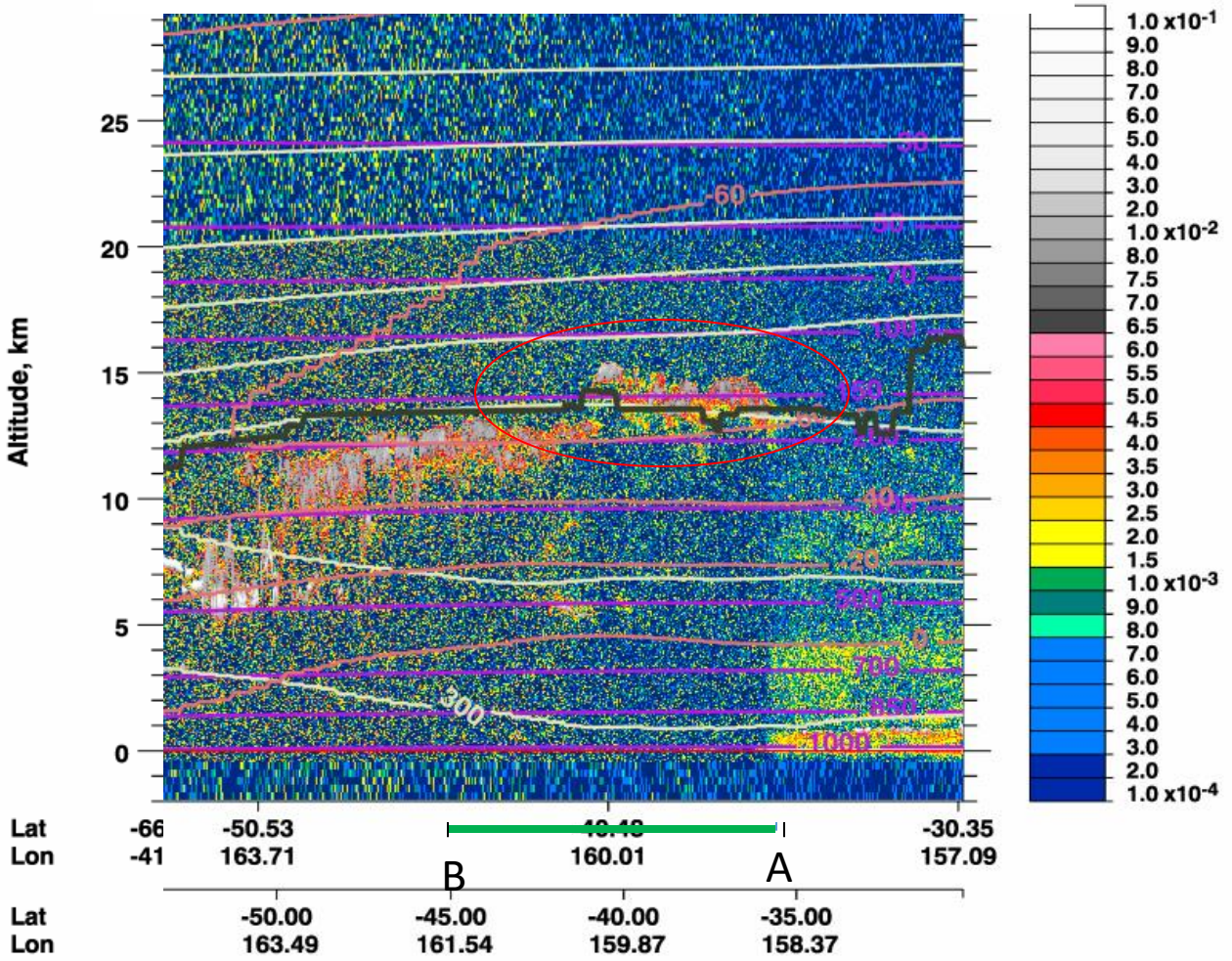
- ✓Indian Ocean Dipole also exacerbates droughts in SE Australia
- ✓Moving cold front with mid-level moisture can lead to PyroCb
- ✓ PyroCb transport smoke into the UTLS

First episode PyroCb activities
31 Dec 2019

OMPS Aerosol Index+VIIRS RGB 31 December 2019

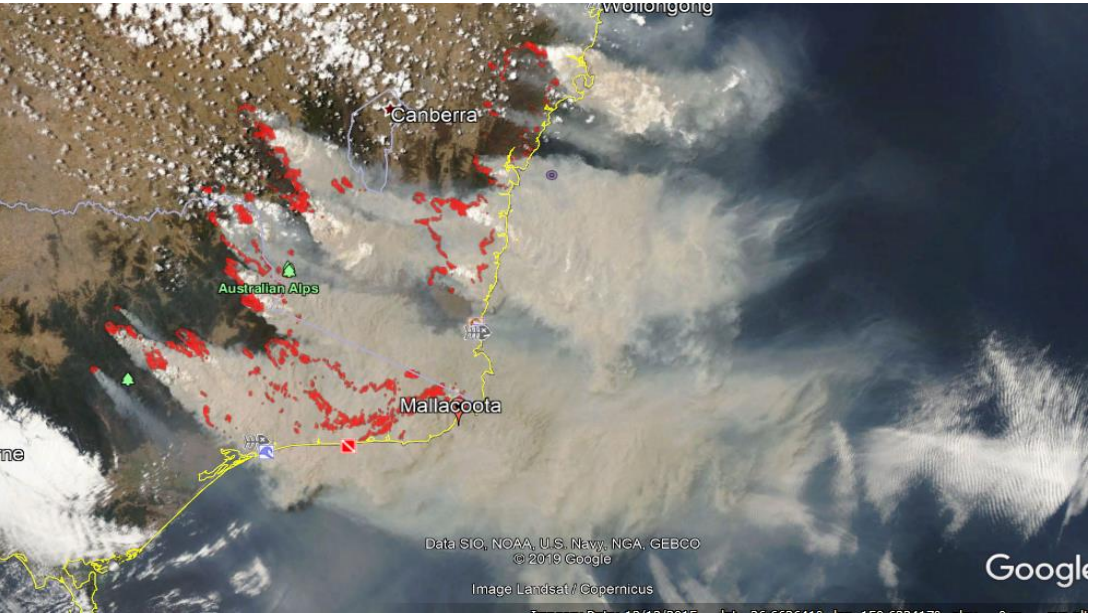


CALIOP/CALIPSO 31-12-2019 3:22



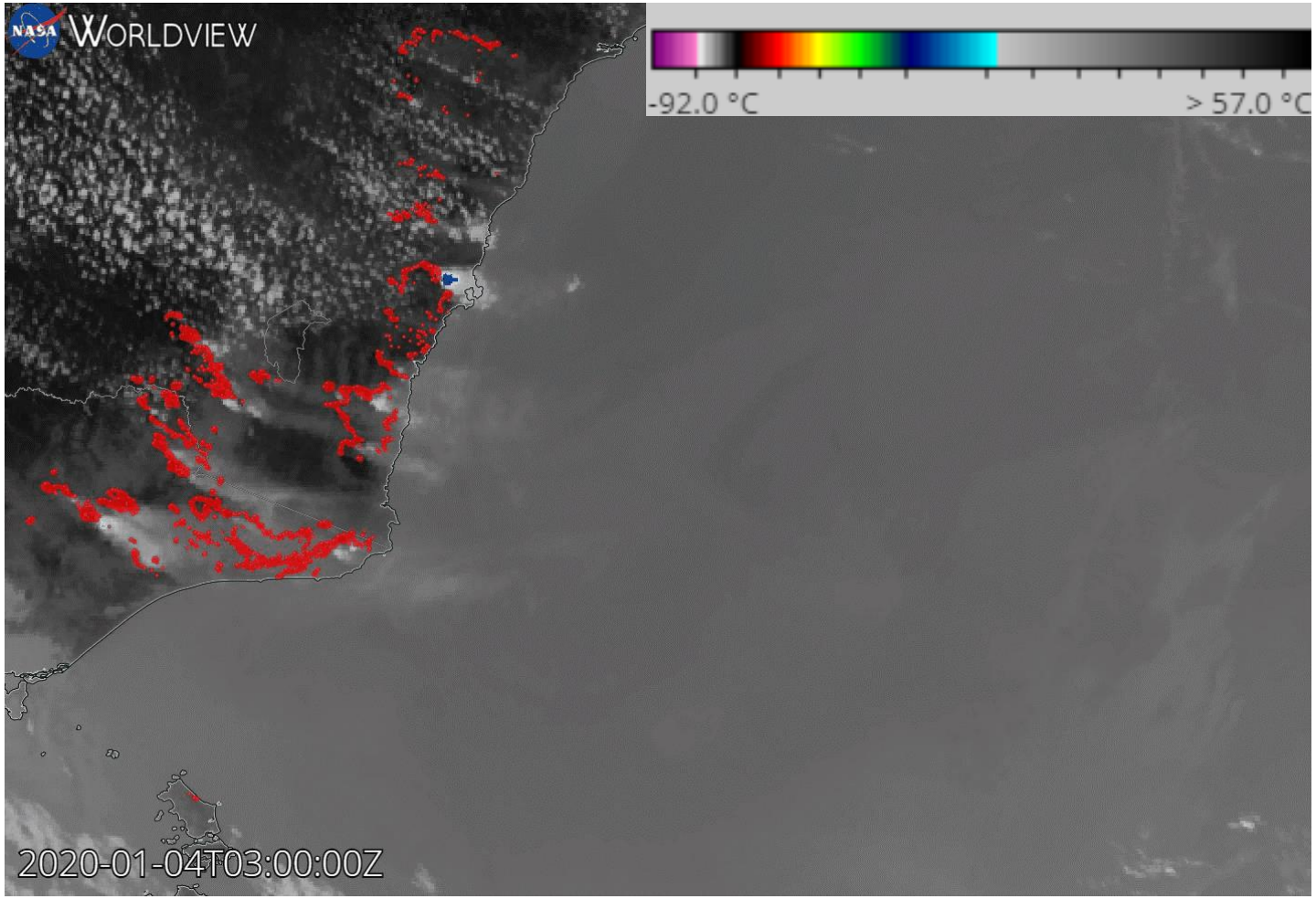
https://worldview.earthdata.nasa.gov/

Second Episode of PyroCb activities



MODIS/Aqua RGB image+ hot spots
January 4th, 2020

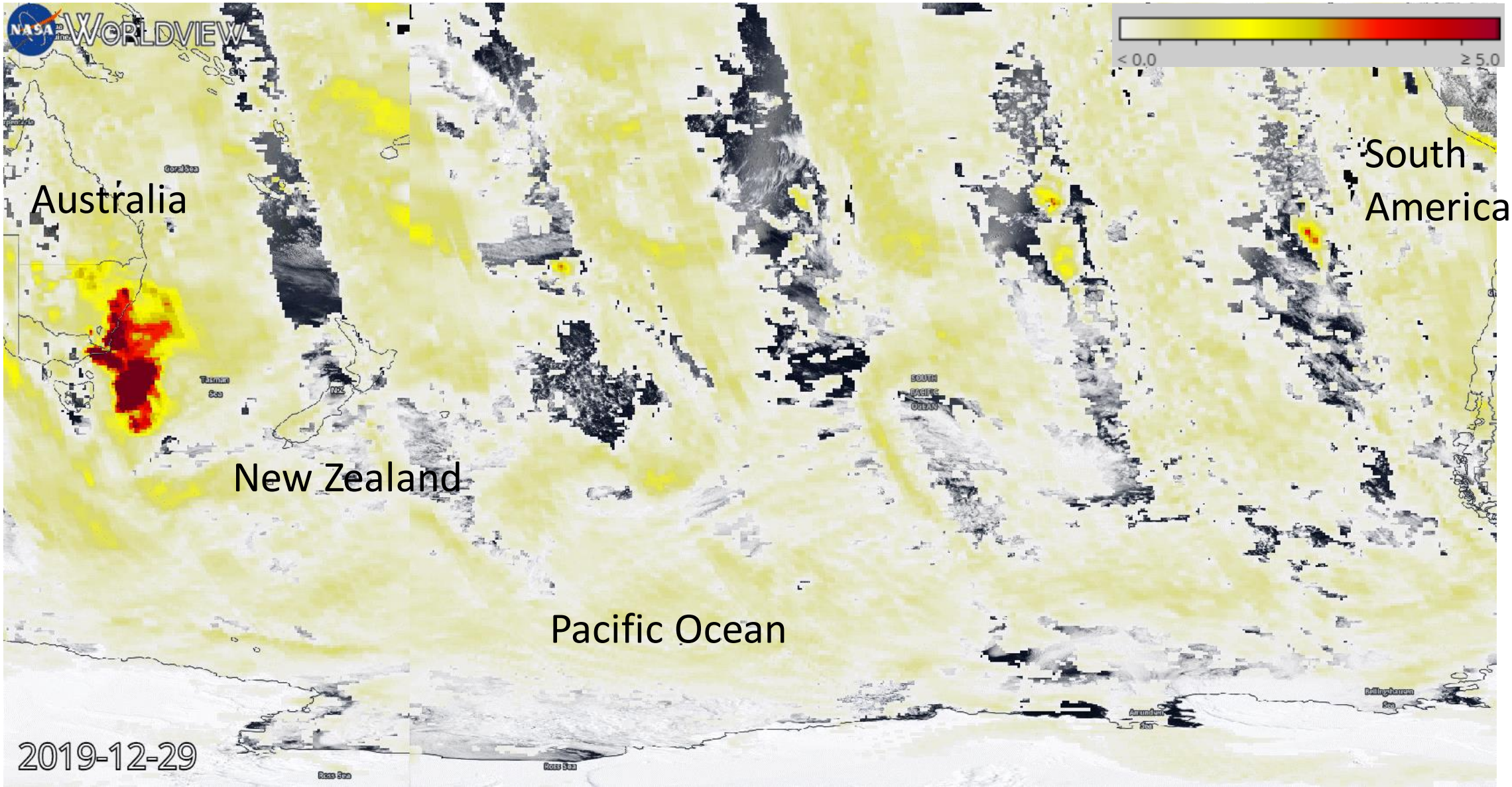
Minimum Cloud Top ~-70 °C (14-15 km]



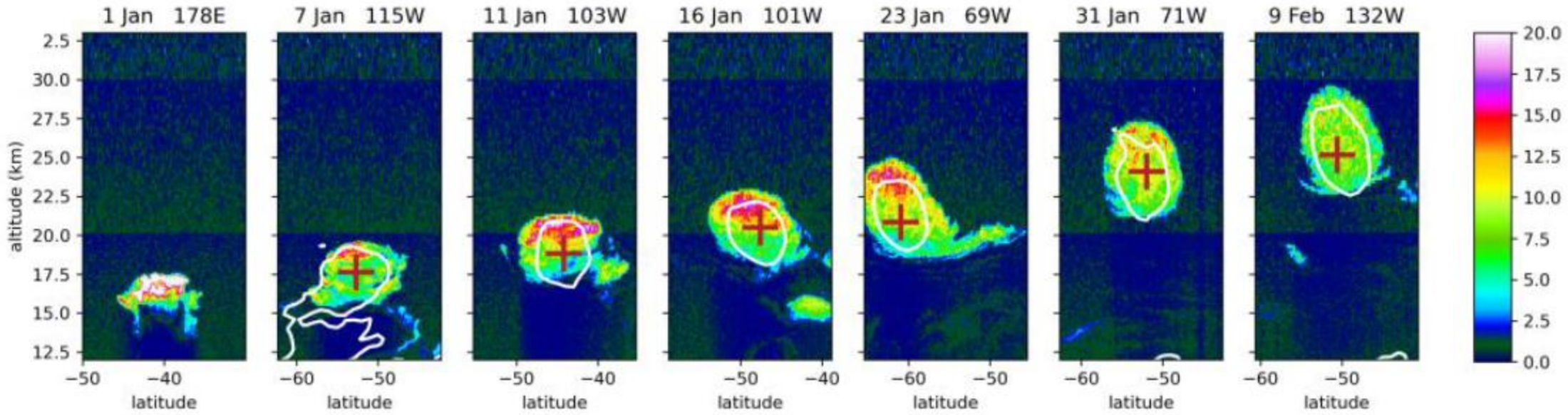
HIMAWARI-8 Cloud Top Temperature (10.3 micron)

https://disasters.nasa.gov/australia-fires-2020/satellites-provide-multiple-views-australia-fires-same-day

Early Transport of Smoke



Smoke rising into the stratosphere after the 2019/2020 Australian Bushfires

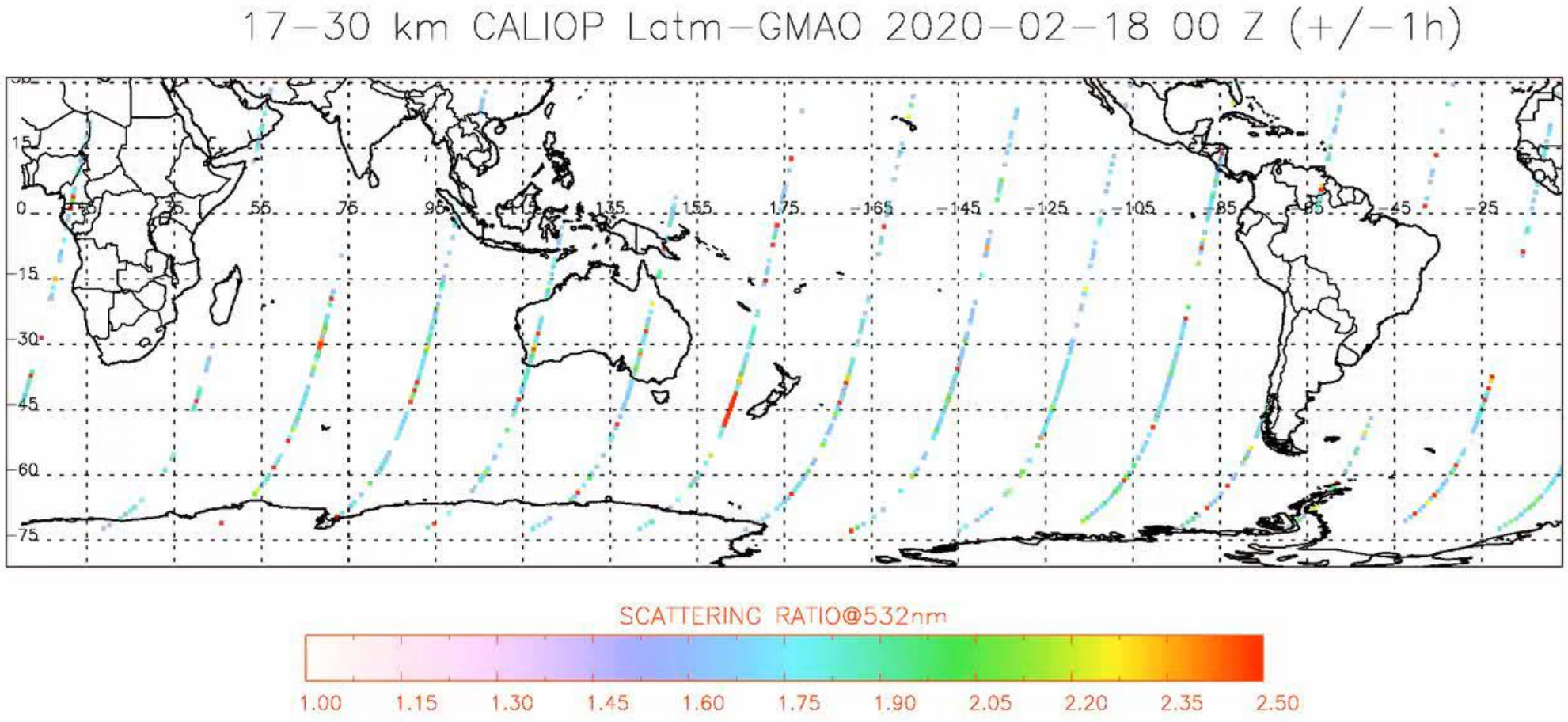


Khaykin et al., 2020

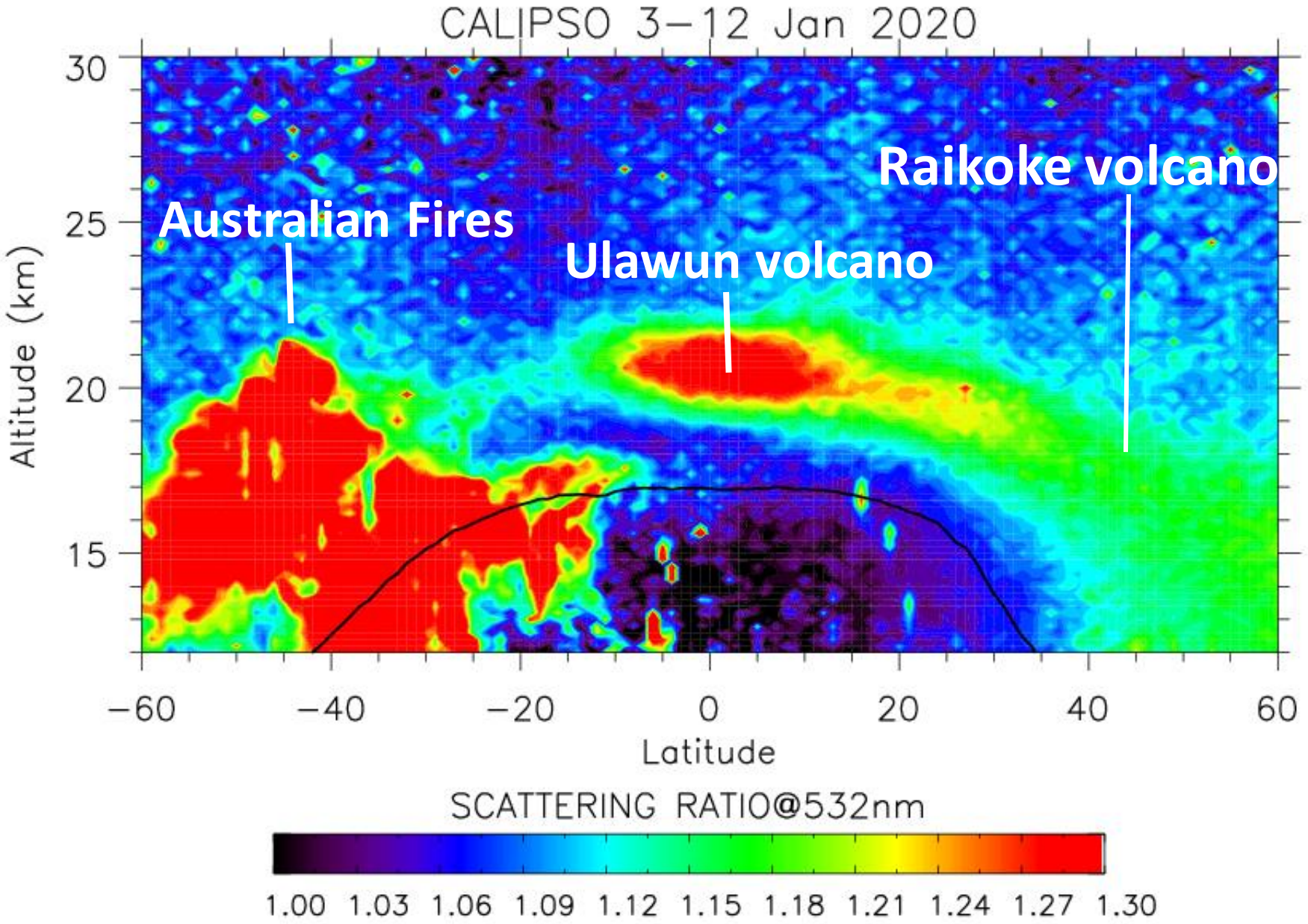
- ✓ 1000 km ellipsoid anticyclone
- ✓ Ascent rate 0.45 km/month and 0.2 km/month

A self-sustained smoky anticyclone

Trajectory mapping of CALIOP 18-23 Feb 2020

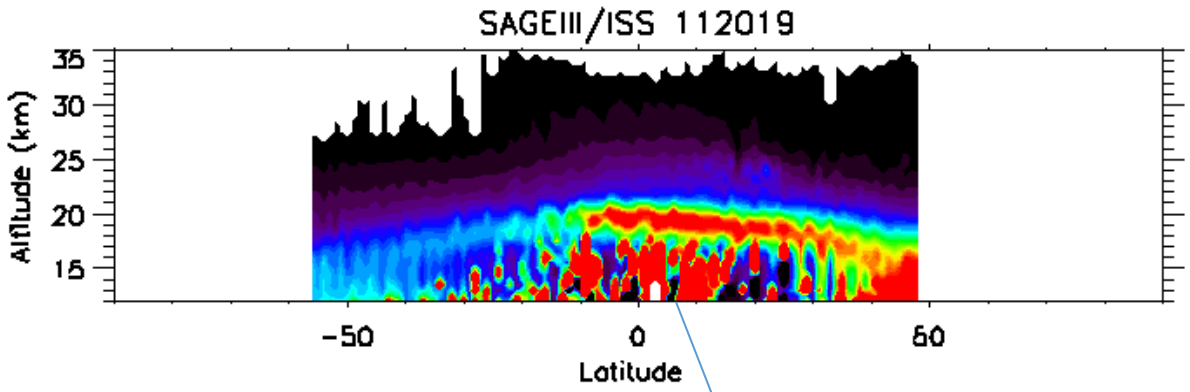


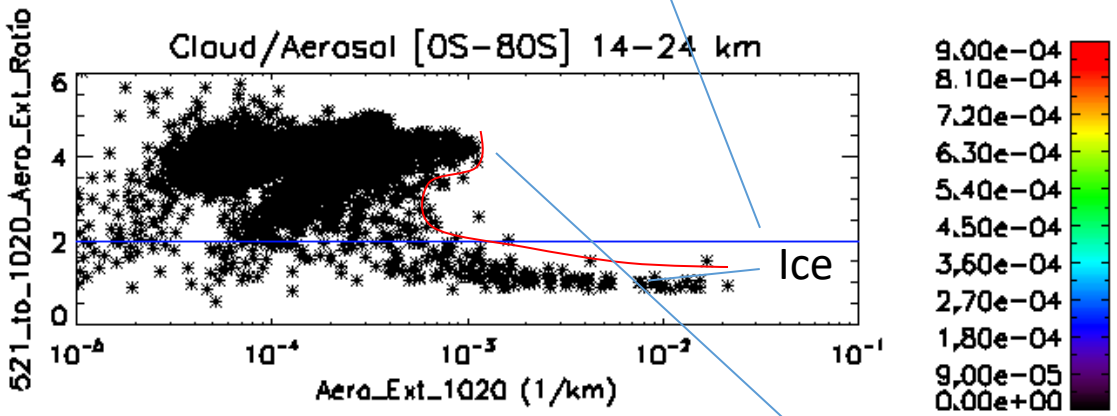
The Complexity of Stratosphere Aerosols

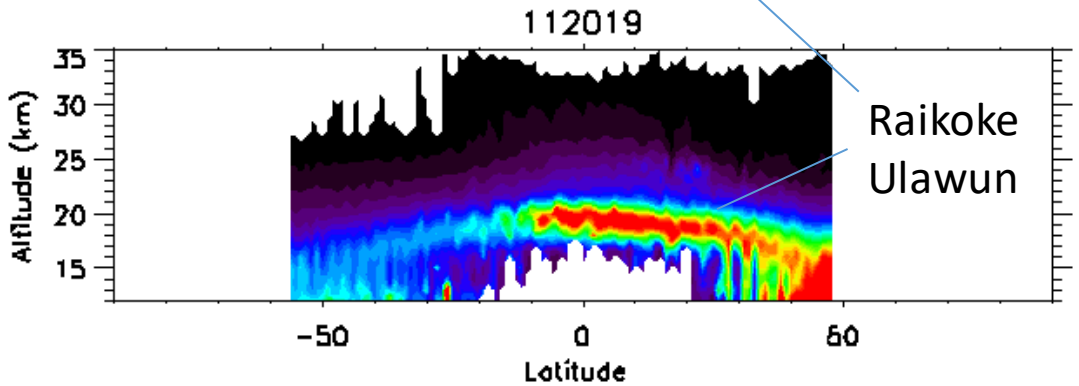


SAGE III/ISS Smoke detection/cloud filtering

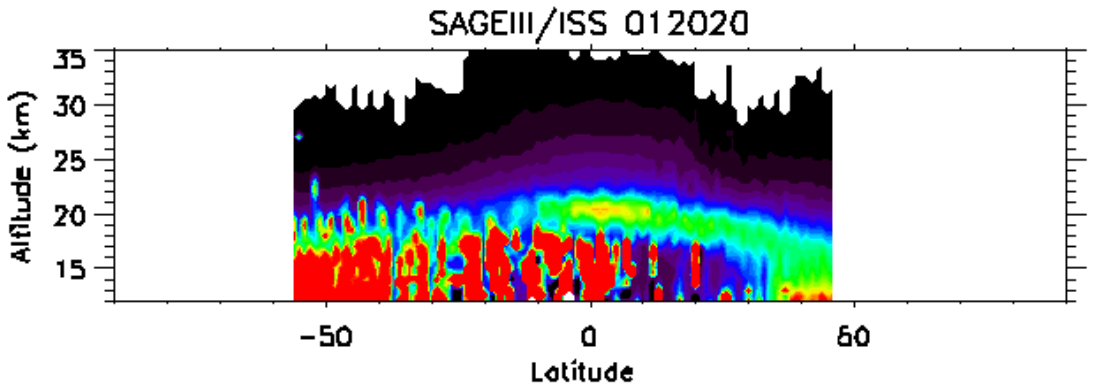
BEFORE

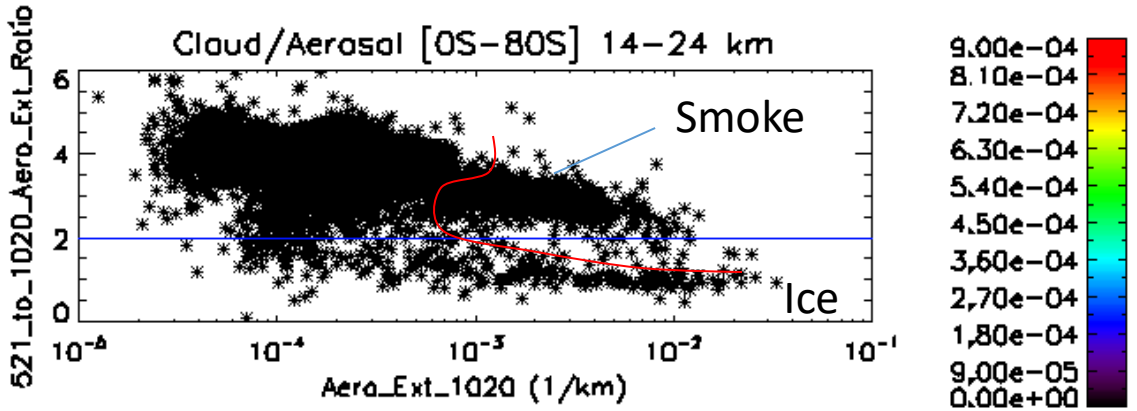


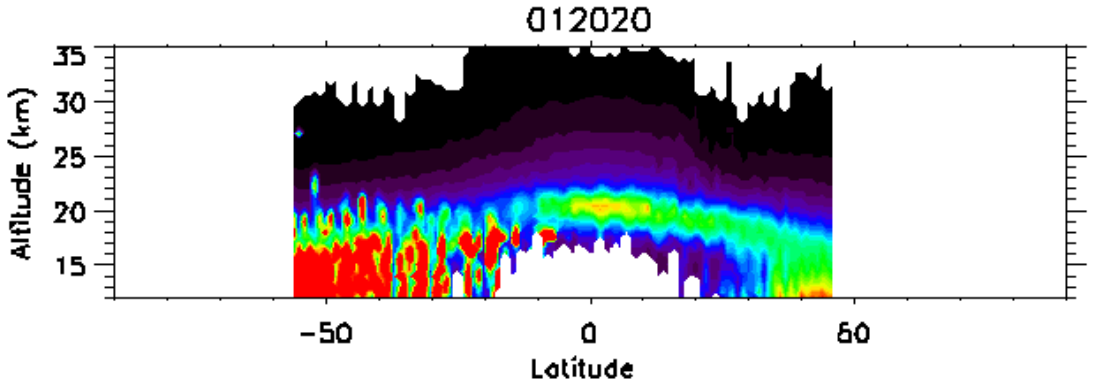




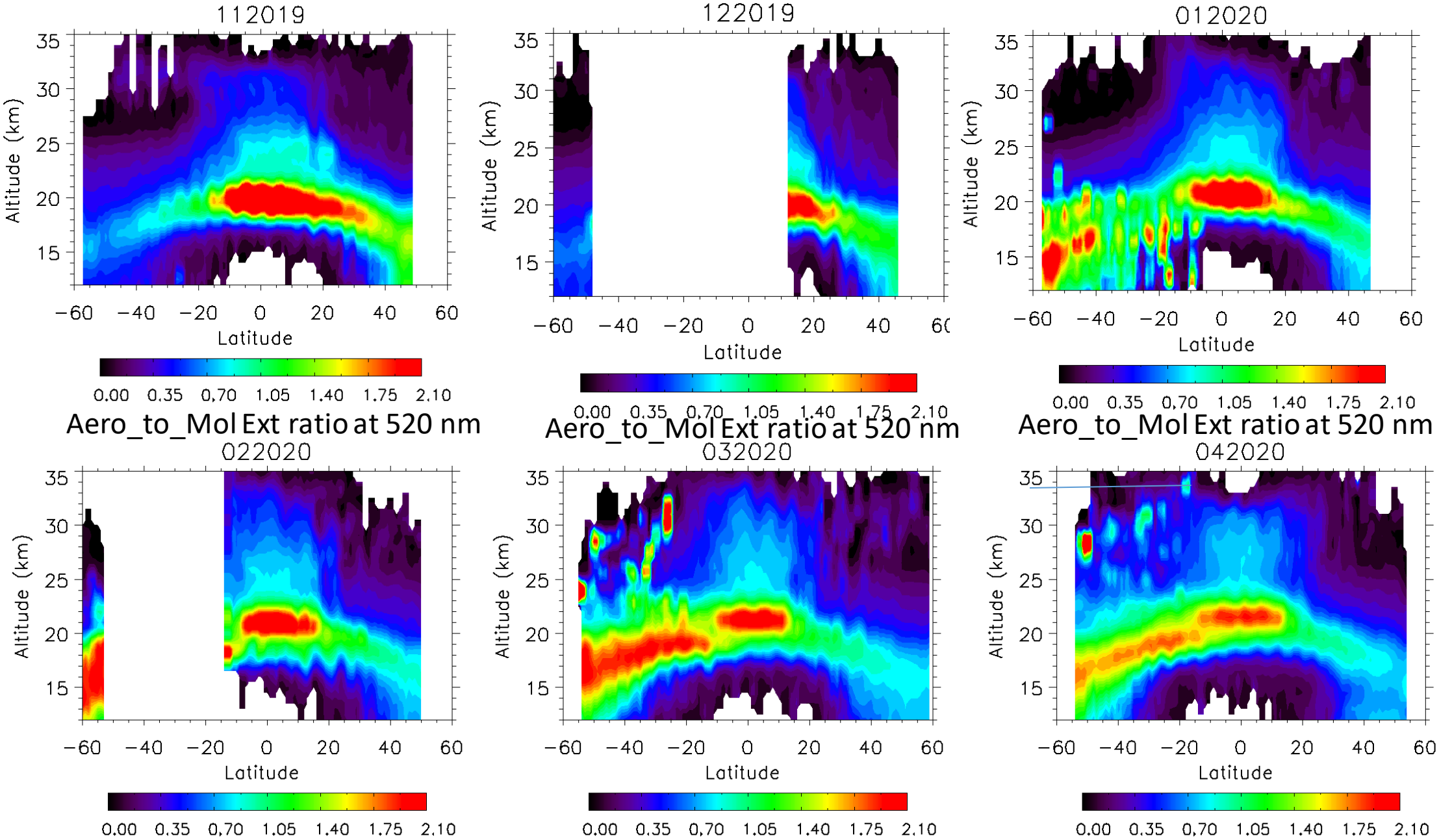
AFTER



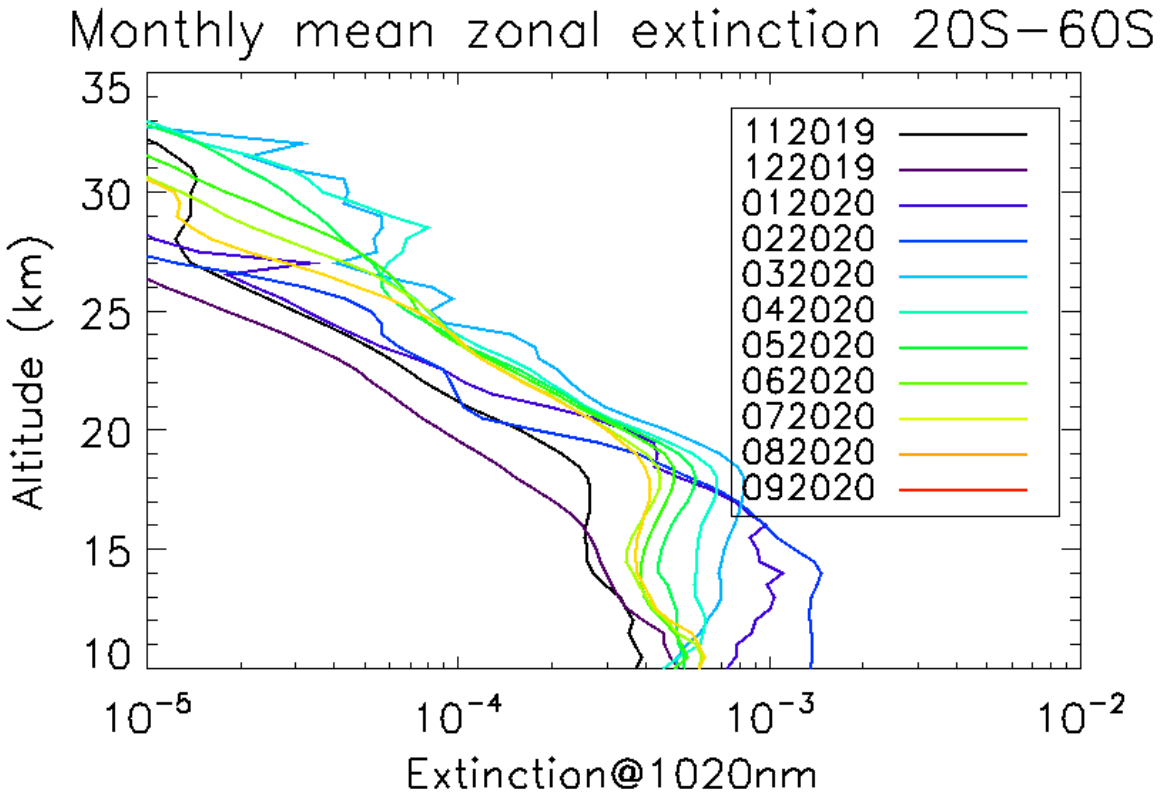


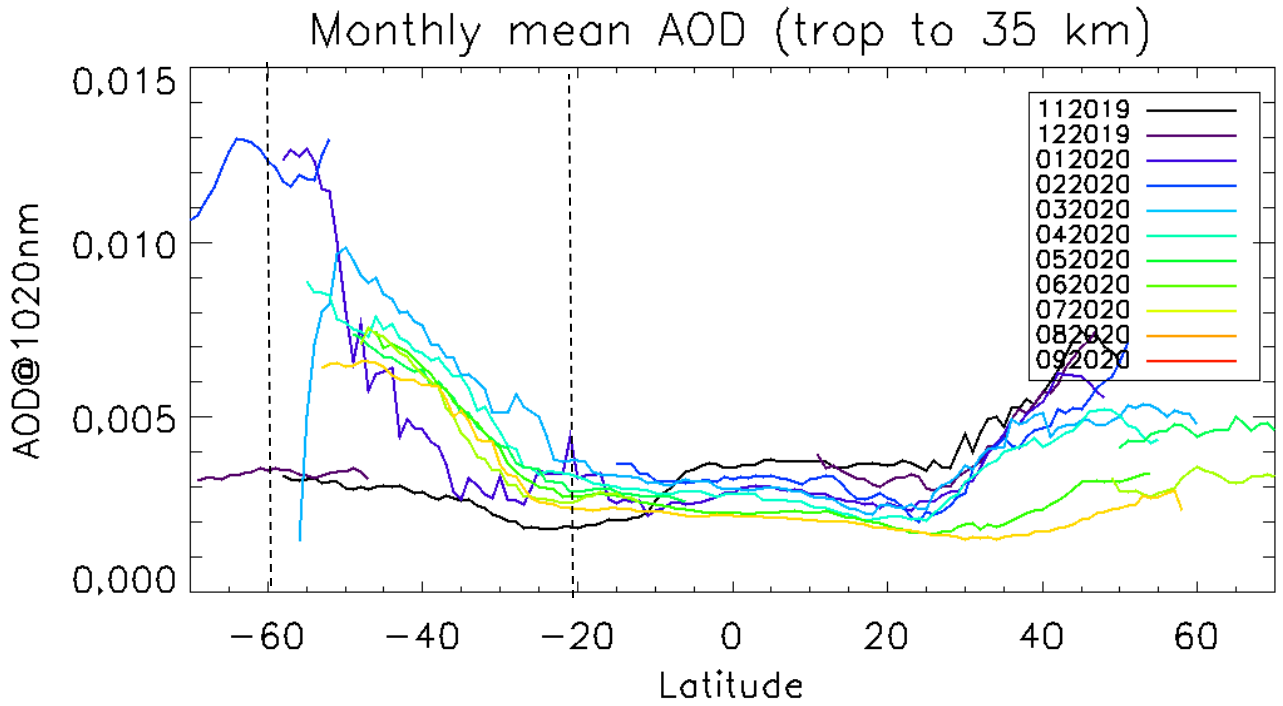


Smoke Evolution seen by SAGE III



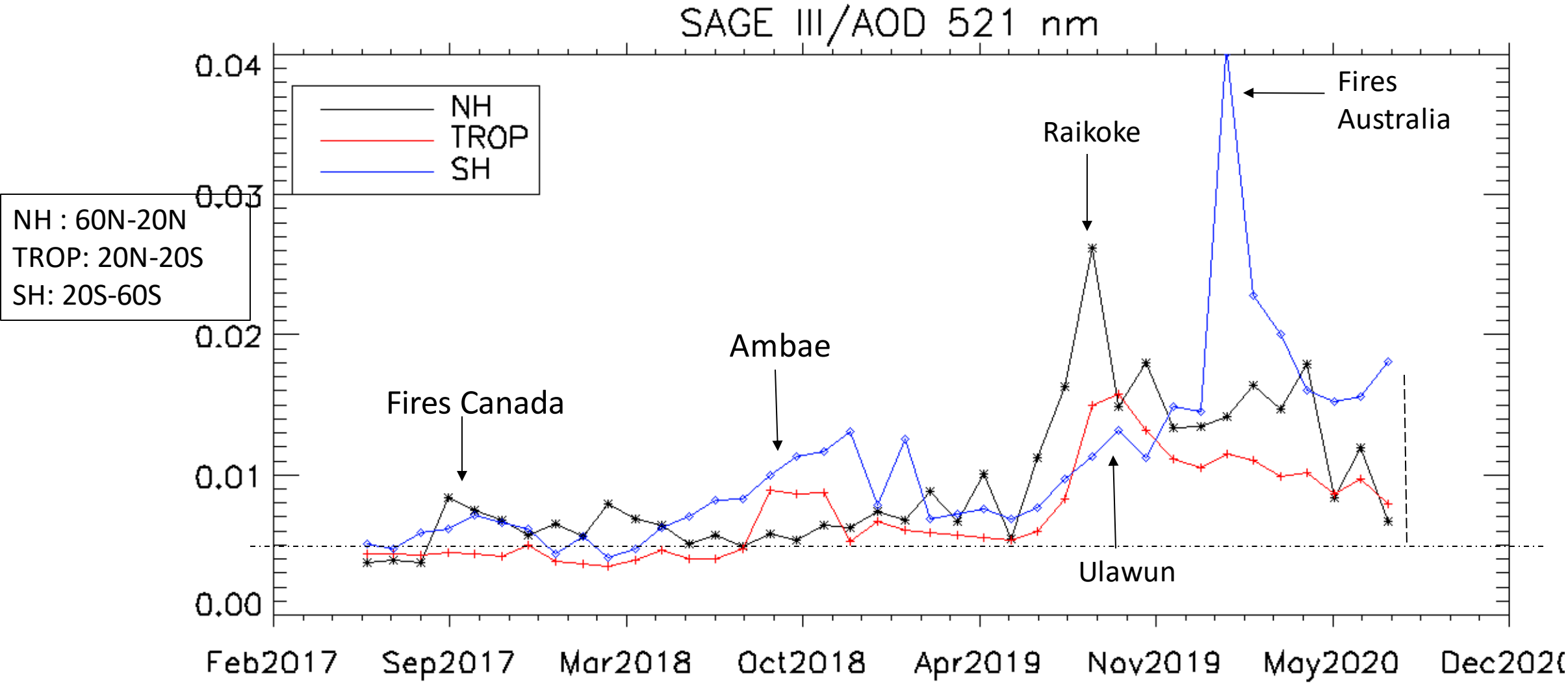
Impacts on the stratospheric aerosol layer





- ✓ Perturbation of the stratosphere up to 34 km (Never seen since Mt Pinatubo)
- ✓ Lon-lasting impact on stratospheric AOD (still two times higher than before the event)

Largest stratospheric aerosol perturbation on the SAGE III/ISS



Conclusion

- ✓ 2019/2020 was the worst fire season in Australian History
- ✓ Intense PyroCb activities led to smoke initial injection in the UTLS
- ✓ Diabatic heating resulted in the transport of smoke in the upper stratosphere (34 km)
- ✓ Largest AOD observed in the SAGE III record
- ✓ Increasing contribution from Mega Fires to stratospheric composition