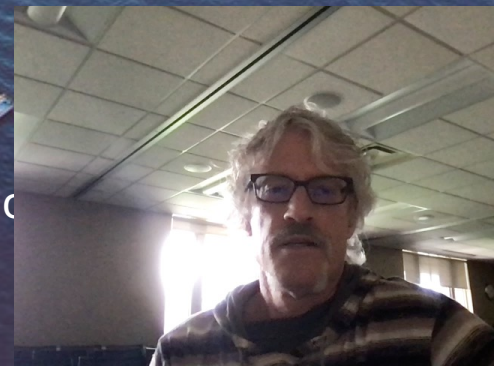# Development of Multi-Sensor, Level 3 Data Fusion Products: TROPOMI + NUCAPS
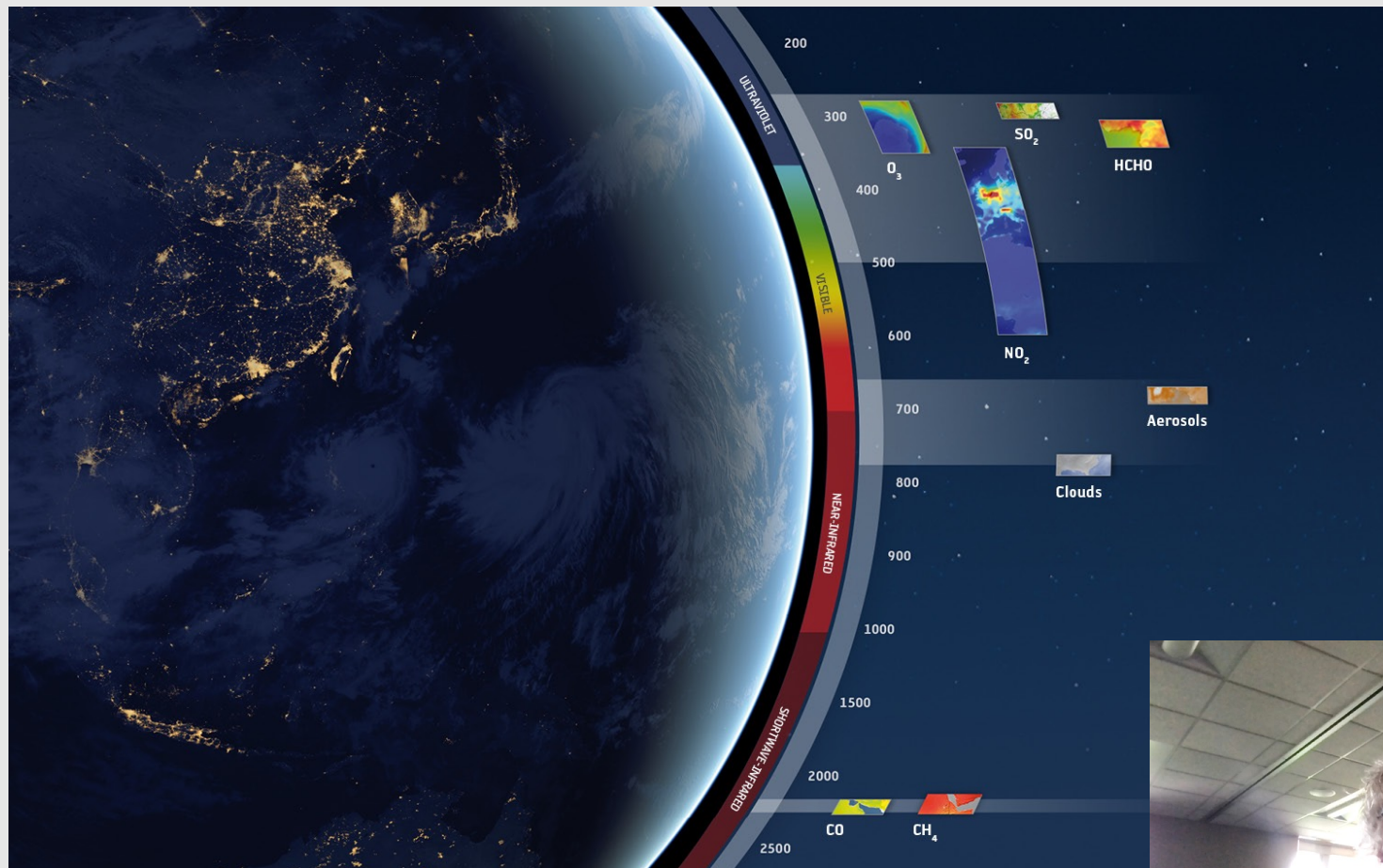
CSPP Users' Group Meeting
June 21-23, 2022
Tommy Jasmin, SSEC
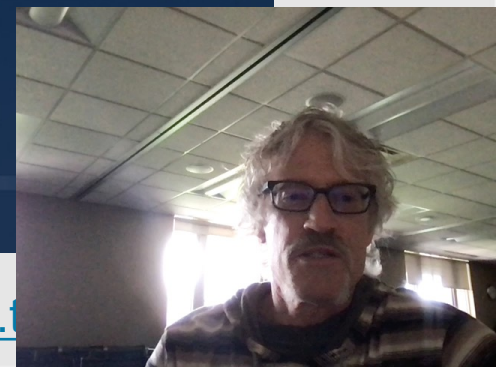(w/Dave Hoese, Allen Lenzen, Brad Pierce,
Jim Davies, Robert Carp)

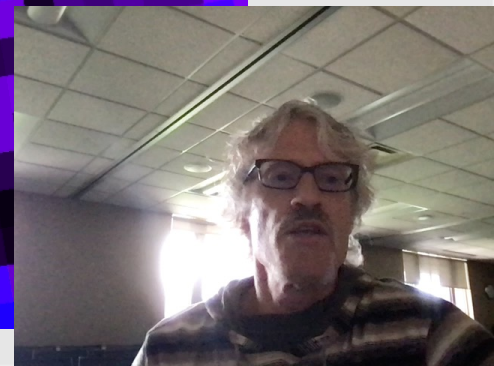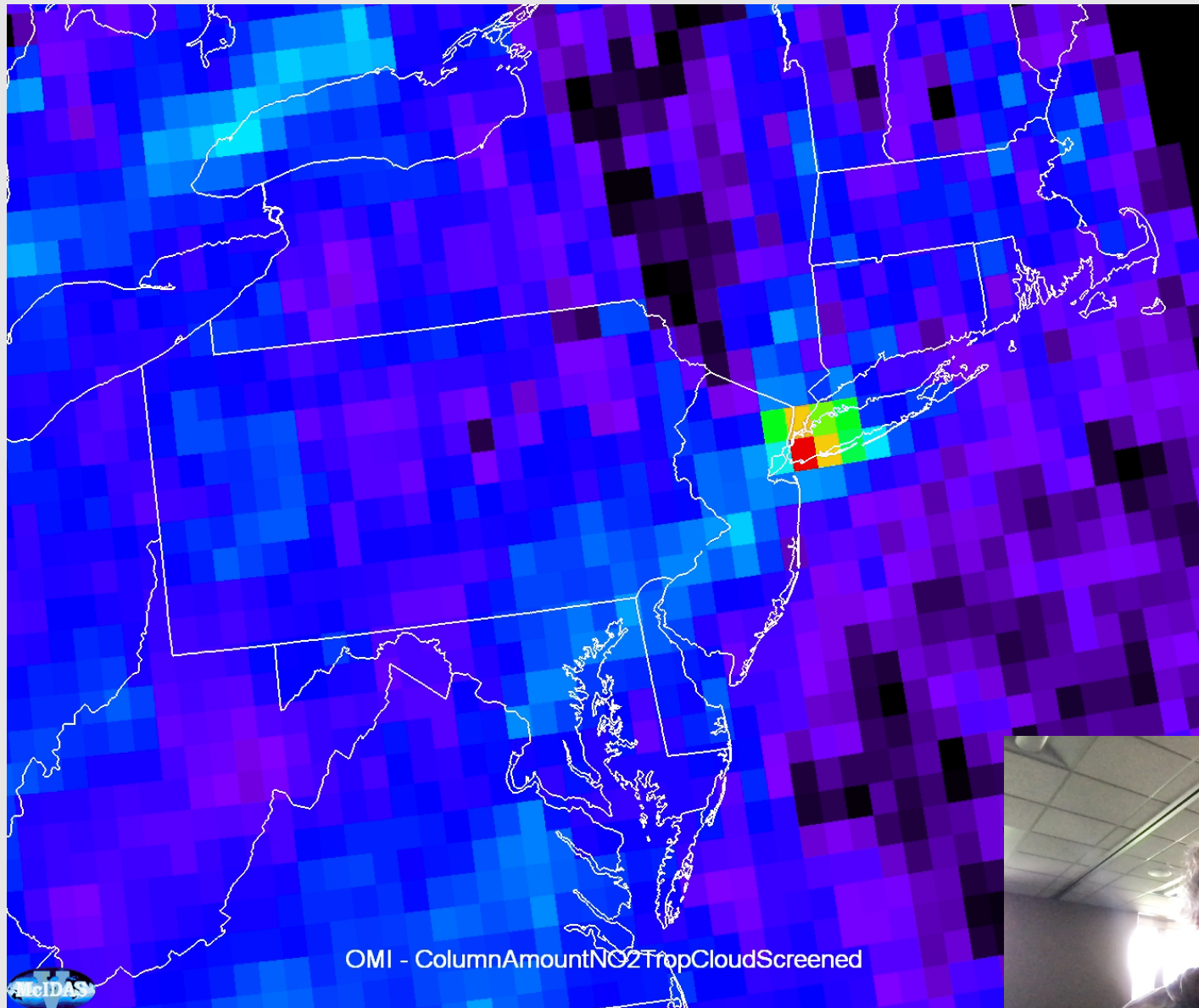Developed by ESA and NSO, TROPOMI measures trace gases at unprecedented resolution.



Air Quality, Climate Monitoring          http://www.t

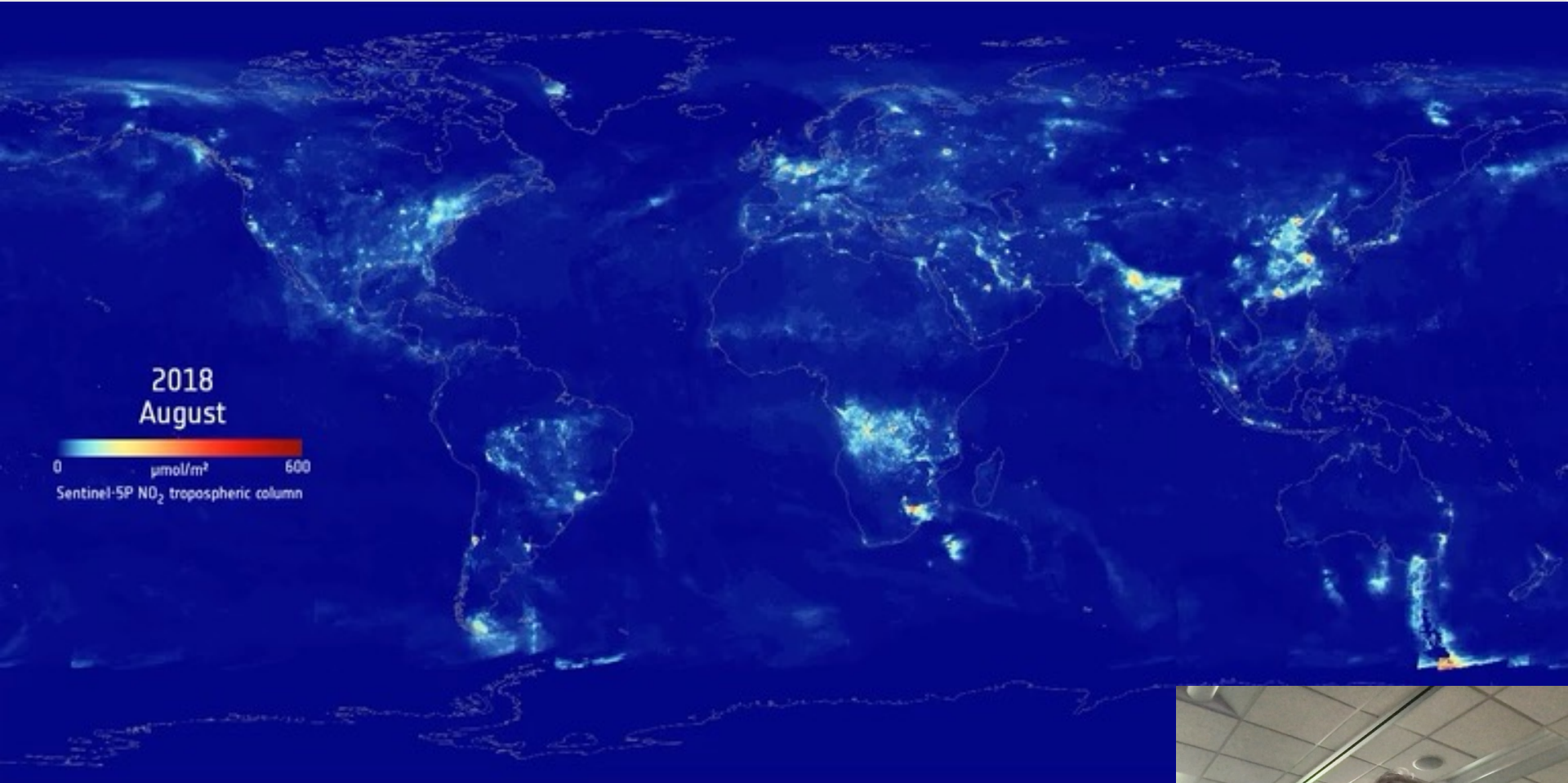OMI - ColumnAmountNO2TropCloudScreened

# Global NO$_2$ Animation



2018
August

0 — µmol/m² — 600
Sentinel-5P NO$_2$ tropospheric column
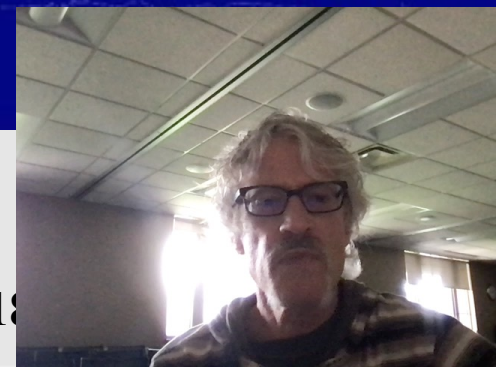
**Credit: TROPOMI Gallery – 6 month NO$_2$ animation, Aug 2018**

# NUCAPS

**N**OAA **U**nique **C**ombined **A**tmospheric **P**rocessing **S**ystem

Many purposes, including:

*Retrieved products such as profiles of temperature, moisture,* ***trace gases*** *and cloud-cleared radiances*

**Products are derived from** the Cross-track Infrared Sounder (**CrIS**) and Advanced Technology Microwave Sounder (**ATMS**) currently onboard the Joint Polar Satellite System satellites (SNPP and NOAA-20).

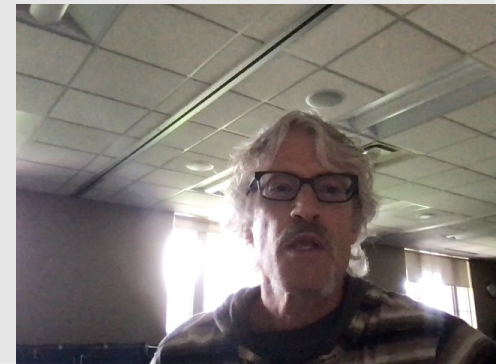Available from CLASS, or, researchers can gen code developed by Nadia Smith / STC)
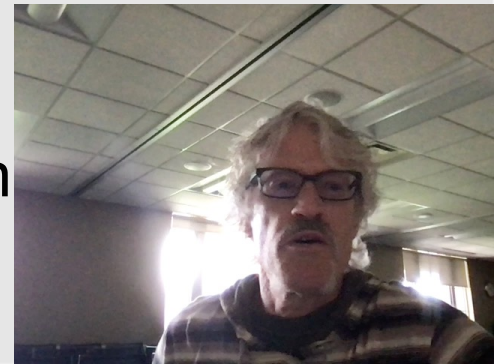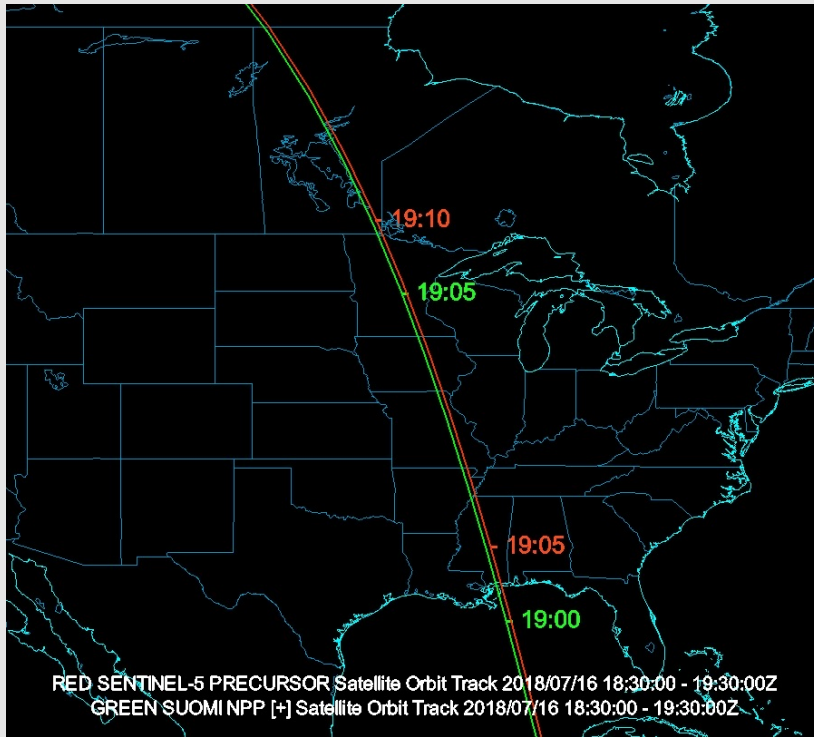
# When Data Fusion is Possible

**Why NUCAPS and TROPOMI?**

**Impediments to Data Fusion:**

<span style="color:red">**Differences in Spatial and Temporal Resolution**</span>

<span style="color:red">**Differences in Radiometric Resolution may not matter and may even be the key to Data Fusion**</span>

# Temporal Synergy with Suomi NPP



RED SENTINEL-5 PRECURSOR Satellite Orbit Track 2018/07/16 18:30:00 - 19:30:00Z
GREEN SUOMI NPP [+] Satellite Orbit Track 2018/07/16 18:30:00 - 19:30:00Z
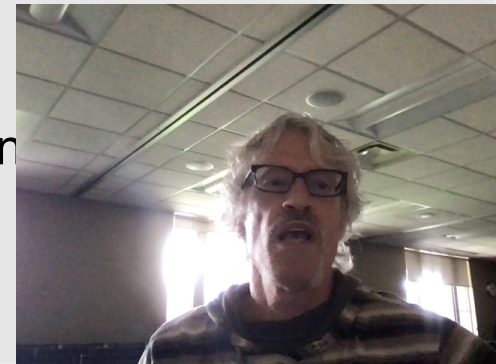
**ORBIT**

S5P is in a "loose formation" 3.5 minutes behind Suomi NPP.

**WHY DO THIS?**

If one sensor produces a product the other can leverage to great advantage.

If the data products of one sensor can help validate data products from the other.

Potential for "fusion

**Impediments to Data Fusion:**

**Differences in Spatial and Temporal Resolution**

**Experimental Product:**

**Focus on Total Column Carbon Monoxide (CO)**

**Why?**

- NUCAPS is most sensitive to middle tropospheric CO concentrations
- A difference product, TROPOMI minus NUCAPS, could highlight boundary layer CO detections
- Potential value for improving air quality forecasts, improved situational awareness during wildfire events
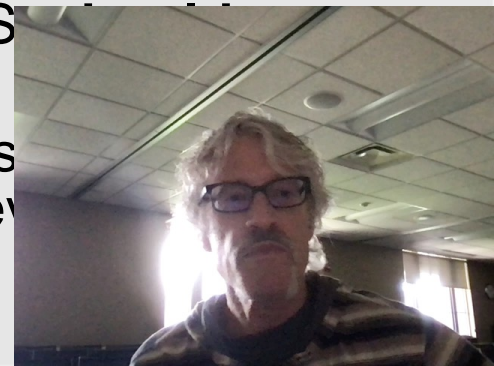
# How we developed this

Leaned heavily on (and contributed to) SatPy

Adapted IDL code to integrate NUCAPS CO (Pierce)

Data Sources:

    NUCAPS Science EDRs generated at SSEC

    TROPOMI obtained from NASA Earth Observatory
(there is also a nice Copernicus Open Access Hub)
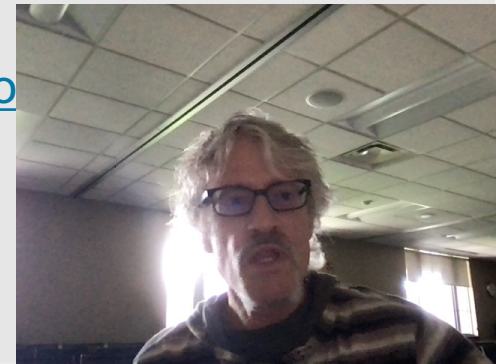
Model (this could be automated!):
  For each day:
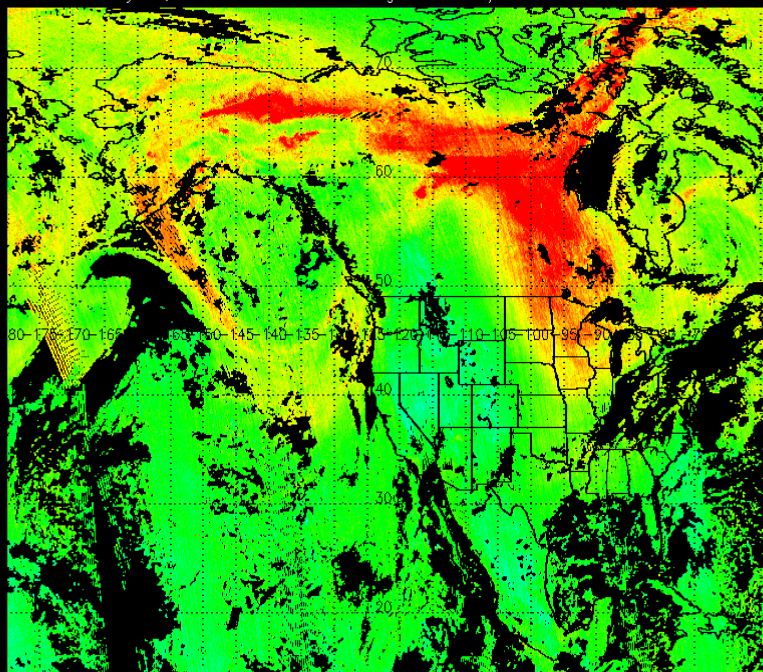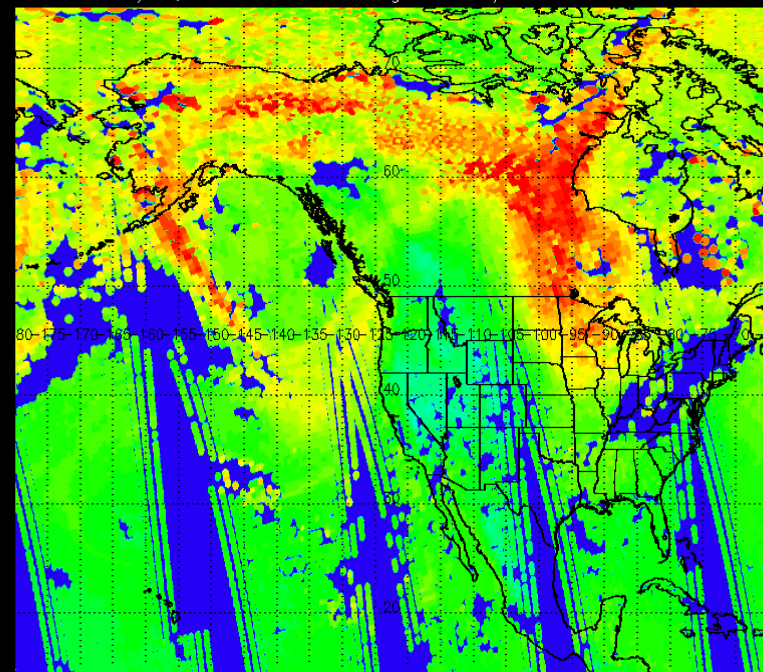    ~~Fetch data~~
    **Process data**    https://gitlab.ssec.wisc.edu/to
    ~~Nuke data~~
End

# Results – Very Promising



July 22, 2019 TROPOMI from Merged NUCAPS/TROPOMI CO Column

July 22, 2019 NUCAPS from Merged NUCAPS/TROPOMI CO Column

**Focused mostly on case study day of July 22, 2019 (large wildfire events).**

CO Difference (TROPOMI-NUCAPS) with Missing Data Check (mol/cm2)x10^18 - 20
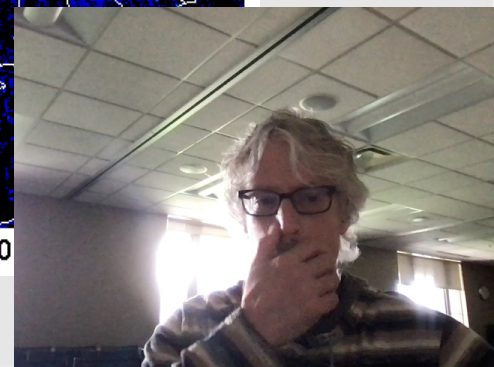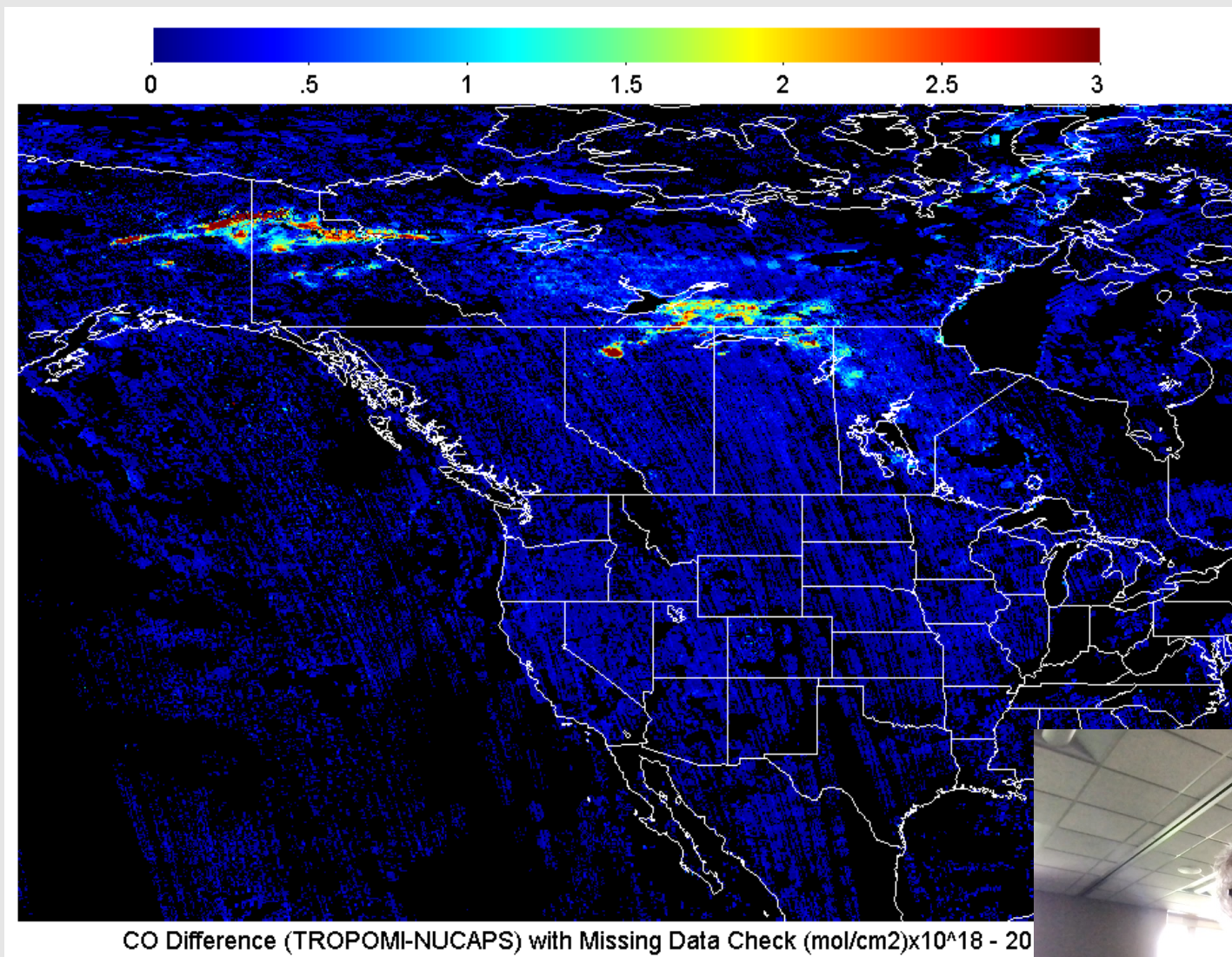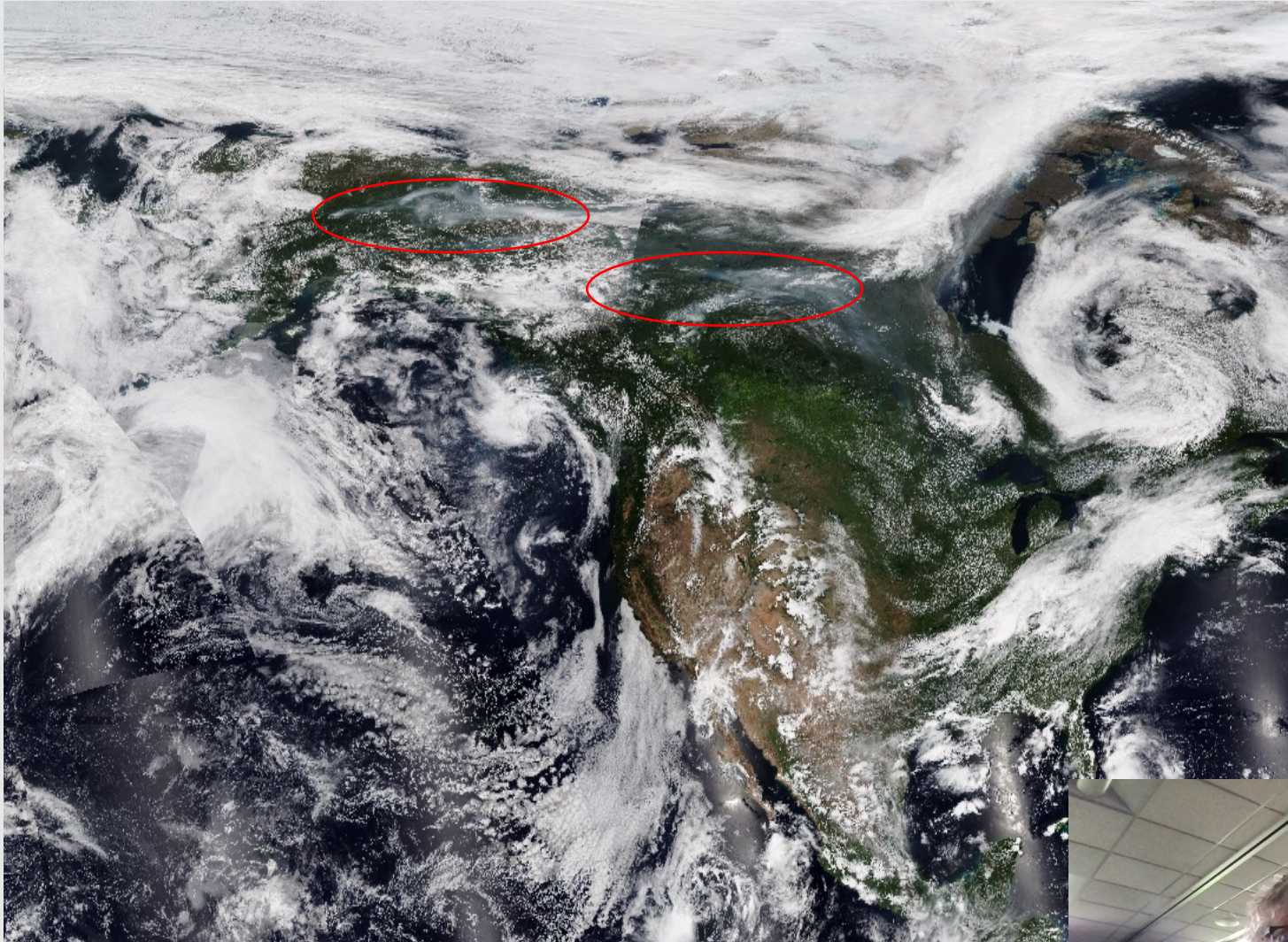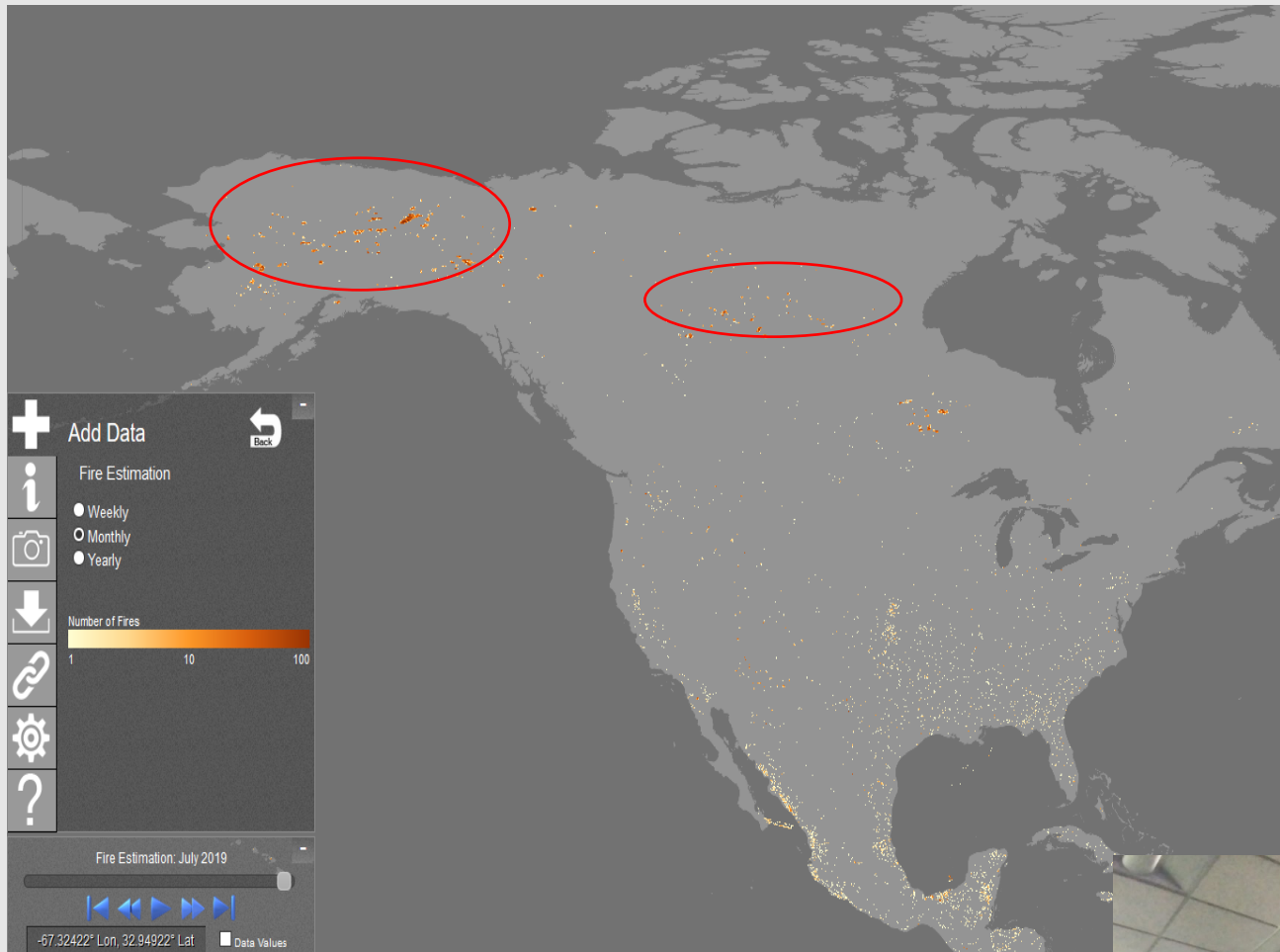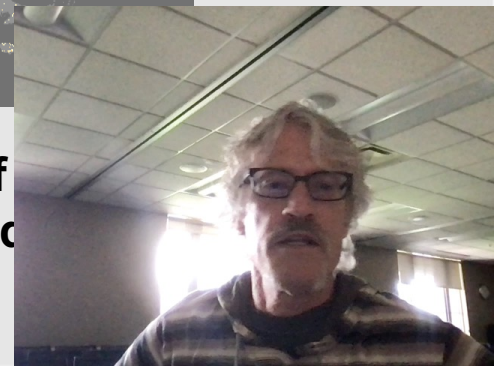
**Large Canadian wildfires detected in the L3 product are coincident with VIIRS true color imagery.**
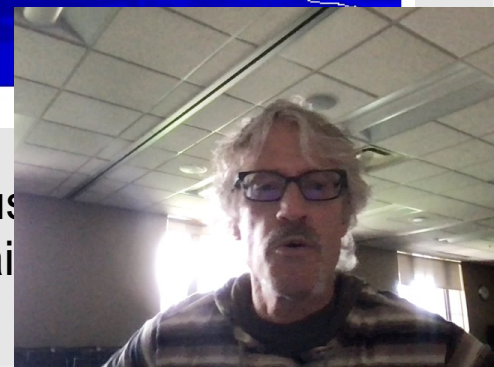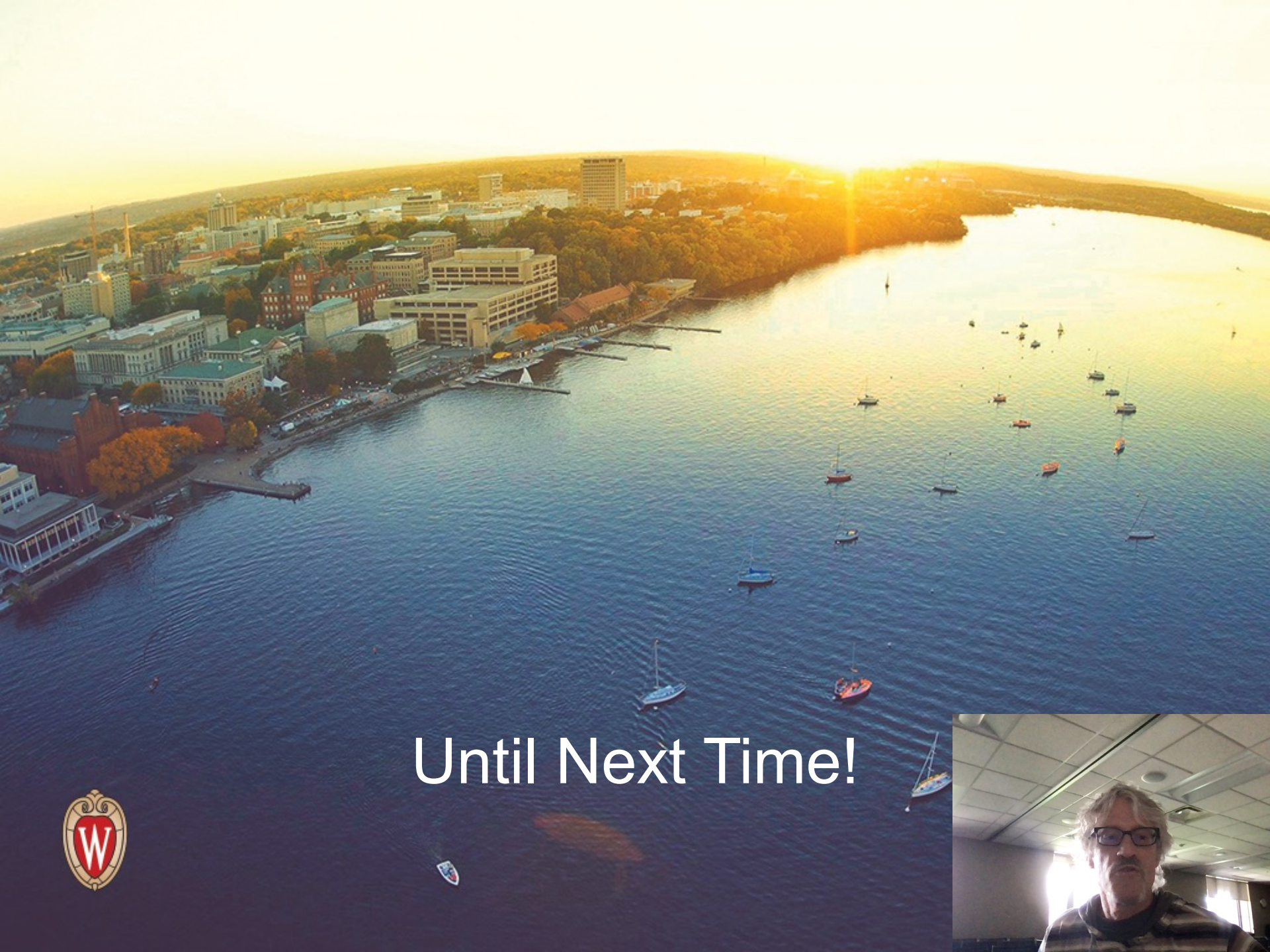
# Active Fires – July 22, 2019
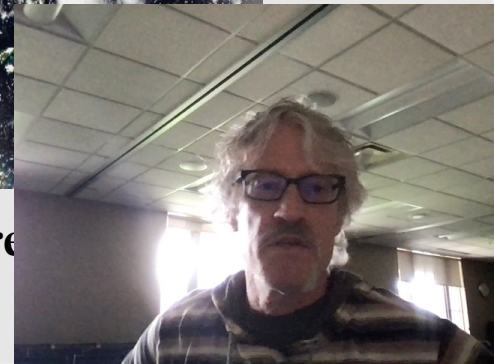


**Active fire detections from the case study date of 2019 are also spatially coincident with the L3 proc multi-sensor data.**

# In Summary



NUCAPS Total Column CO - 2019-07-22 00:00:00Z
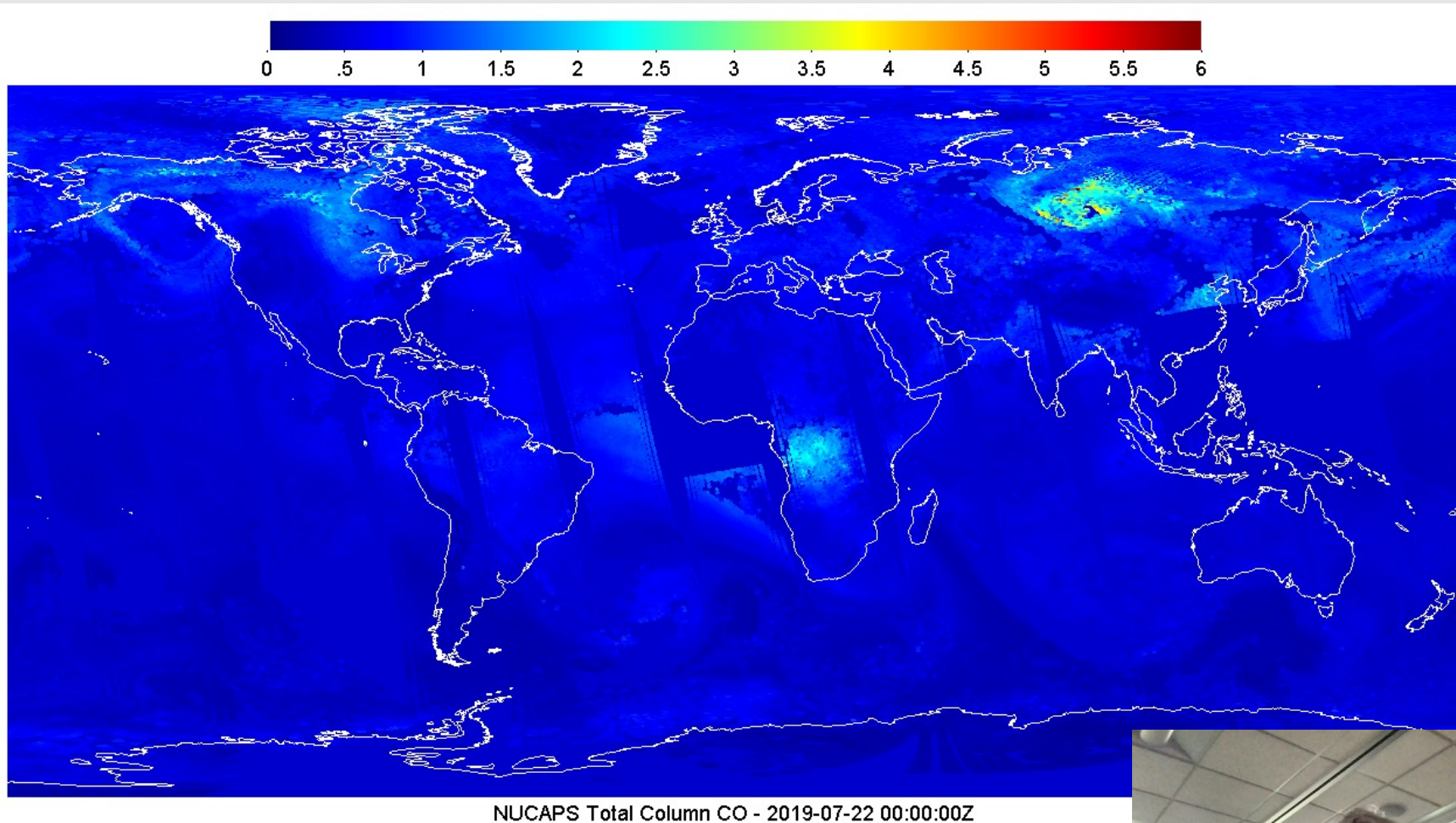
1) Demonstrated the promise of TROPOMI – JPSS data fus...
2) Next steps would be to automate and make publicly avai...

Until Next Time!