



#14222

# SCIENCE APPLICATIONS FROM NAST-I IR ULTRASPECTRAL MEASUREMENTS OF FIREX-AQ FIELD CAMPAIGN

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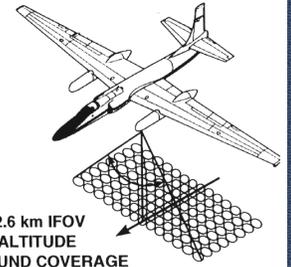
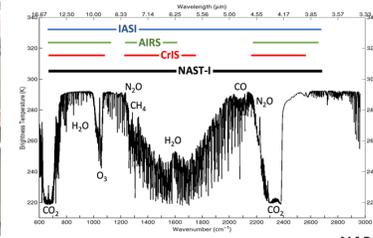
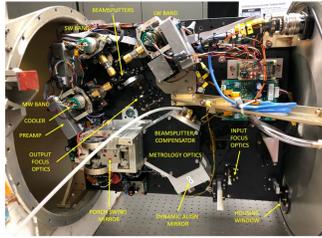
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## INTRODUCTION & NAST-I INSTRUMENT

The National Airborne Sounder Testbed-Interferometer (NAST-I) suborbital system serves as a spaceborne instrument simulator and pathfinder for future satellite capabilities and airborne science experiments. The NAST-I flown on high-altitude aircraft taking measurements to advance understanding of science critical for weather, climate, chemistry, and radiation applications. NAST-I provides high-spatial linear resolution equal to 13% of the aircraft altitude at nadir (i.e., 2.6 km IFOV) from the ground from an aircraft altitude of 20 km, and high-spectral resolution (0.25 cm<sup>-1</sup>) measurements within the spectral region of 645–2700 cm<sup>-1</sup>. Here we present some groundbreaking capabilities of NAST-I measurements and corresponding geophysical retrievals and their potential benefits toward improved atmospheric state and composition characterizations needed for air quality, wildfire, and other science applications, such capabilities could be also of particular importance toward enhancing characterization and understanding of the Planetary Boundary Layer (PBL).



NADIR 2.6 km IFOV  
20 km ALTITUDE  
± 23 km GROUND COVERAGE

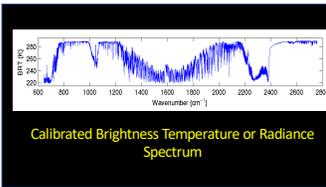
### NAST-I Field Campaigns:

- Before AIRS launch (<2002): 9 missions collecting geophysical field state characterization for satellite remote sensing system risk mitigation (sensors and algorithms).
- After AIRS launch (>2002): 13 missions for advanced satellite remote sensor Cal/Val (e.g., Aqua AIRS, MetOp IASI, & SNPP/IPSS Cris), and airborne science.
- The most recent field campaign: FIREX-AQ (August 2019).

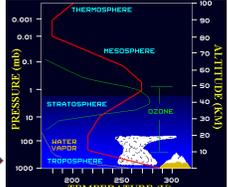
### Aircraft Accommodation:

- ER-2 wing super pod & nose cone
- PROTEUS underbelly pod
- WB-57 underbelly pallet.

## NAST-I LEVEL 2 DATA PROCESSING



NUMERICAL INVERSION



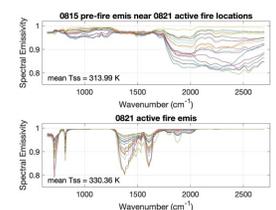
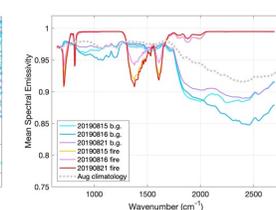
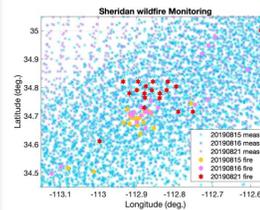
### Retrievals under cloudy conditions:

- Atmospheric profile through optically thin cirrus clouds and above optically thick clouds.
- Effective cloud parameters.

### Retrievals under clear conditions:

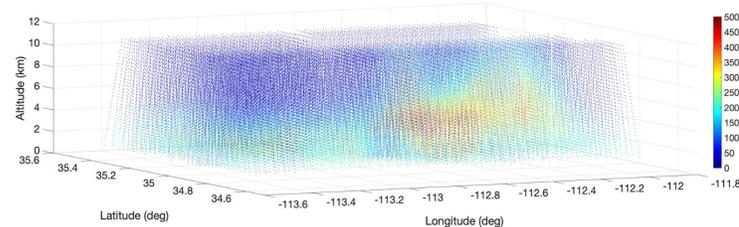
- Surface skin temperature and emissivity.
- Atmospheric temperature and moisture profiles; and atmospheric CO and O<sub>3</sub> profiles.

## TRACKING ACTIVE FIRE WITH SURFACE EMISSIVITY

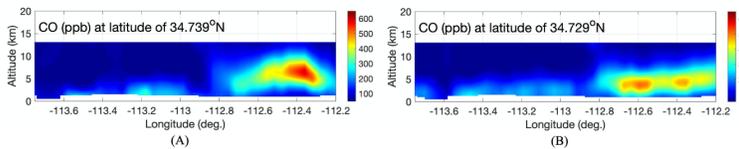


**Preliminary Result:** Active Sheridan fire location detected by NAST-I emissivity from the flights of August 15 to 16, then to 21, 2019. Sheridan fire spreads in north-east direction during this period.

## SHERIDAN FIRE INDUCED CO DISTRIBUTION AND EVOLUTION



NAST-I three-dimensional CO (ppb) distribution shows the plume evolution and transport near the Sheridan fire ground location (34.80° latitude, -112.85° longitude) from August 21, 2019.



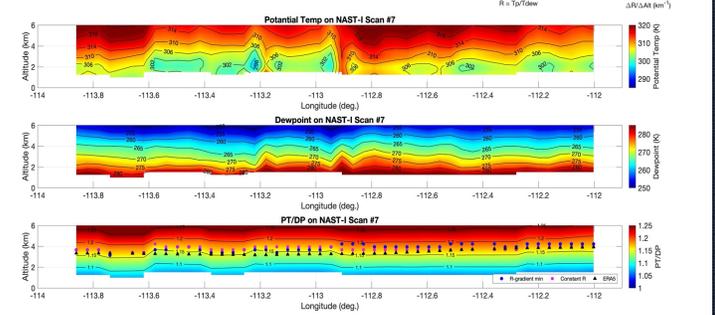
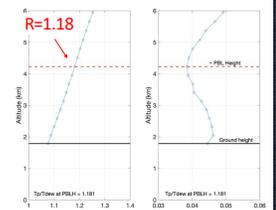
CO time-evolution shown in its vertical profile cross sections up- and down-wind of the Sheridan fire location (about 140 km) from (A) 23:28:13–23:39:37 UTC of August 21, 2019, to (B) 00:38:35–00:49:24 UTC of August 22, 2019. (A) and (B) are about 70 minutes apart.

## PBL TOP ESTIMATION

### PBL Height at minimum gradient of Tp/Td

The minimum gradient of (Tp/Td) falls around a constant of (Tp/Td) where is at the PBL top. PBL top estimated from minimum gradient of Tp/Td and constant Tp/Td agrees with that from ERAS.

- PBLH is affected by the wildfire (near -112.85 long.)
- NAST-I (2.6 km) and ERAS (~25 km) are at different spatial resolutions.



## PBL INFERENCE UNDER EVALUATION WITH FIREX-AQ NAST-I DATA (AUGUST 21, 2019)

Time evolution of surface skin temperature & PBL temperature and mixing ratio distributions (over Sheridan wildfire location near 34.8 latitude & -112.85° longitude). The PBL thermodynamic parameters are retrieved from NAST-I measurements, and PBL top is estimated.

