Quantifying 5G Radio Frequency Interference on Passive Microwave Radiometers

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BACKGROUND

- Weather forecasts ensure that the nation is more resilient and responsive to natural disasters
- Spaceborne passive microwave radiometers provide measurements of temperature, humidity, and cloud vapor that are critical for numerical weather prediction (NWP) models
- 5G emissions in the 24.24-27.5 GHz and 36.0-40.5 GHz bands are adjacent to those commonly used by MWR and may cause out of band interference
- 5G harmonics may impact 50-60 GHz channels

RESEARCH QUESTIONS

- Determine if Advanced Technology Microwave Sounder (ATMS) measurements have increased bias over urban areas than remote areas
- Determine if bias can be correlated to 5G mmWave deployments

METHODS AND MATERIALS

- Utilize ATMS observations from Suomi-NPP, NOAA-20, and NOAA-21
- Map 5G mmWave deployments to determine areas with high potential for RFI; detailed measurements exist for Chicago, Denver, Miami, and New York
- Create datasets over urban areas with 5G mmWave deployments and remote areas
- Compare to ground truth generated from JCSDA's Community Radiative Transfer Method (CRTM)
- Analyze the observation-minus-background (O-B) bias and determine if RFI can be detected in the ATMS channels that are sensitive to 5G interference
- Create foundation to be used for data denial studies with NWP models

RESULTS

Initial Validation

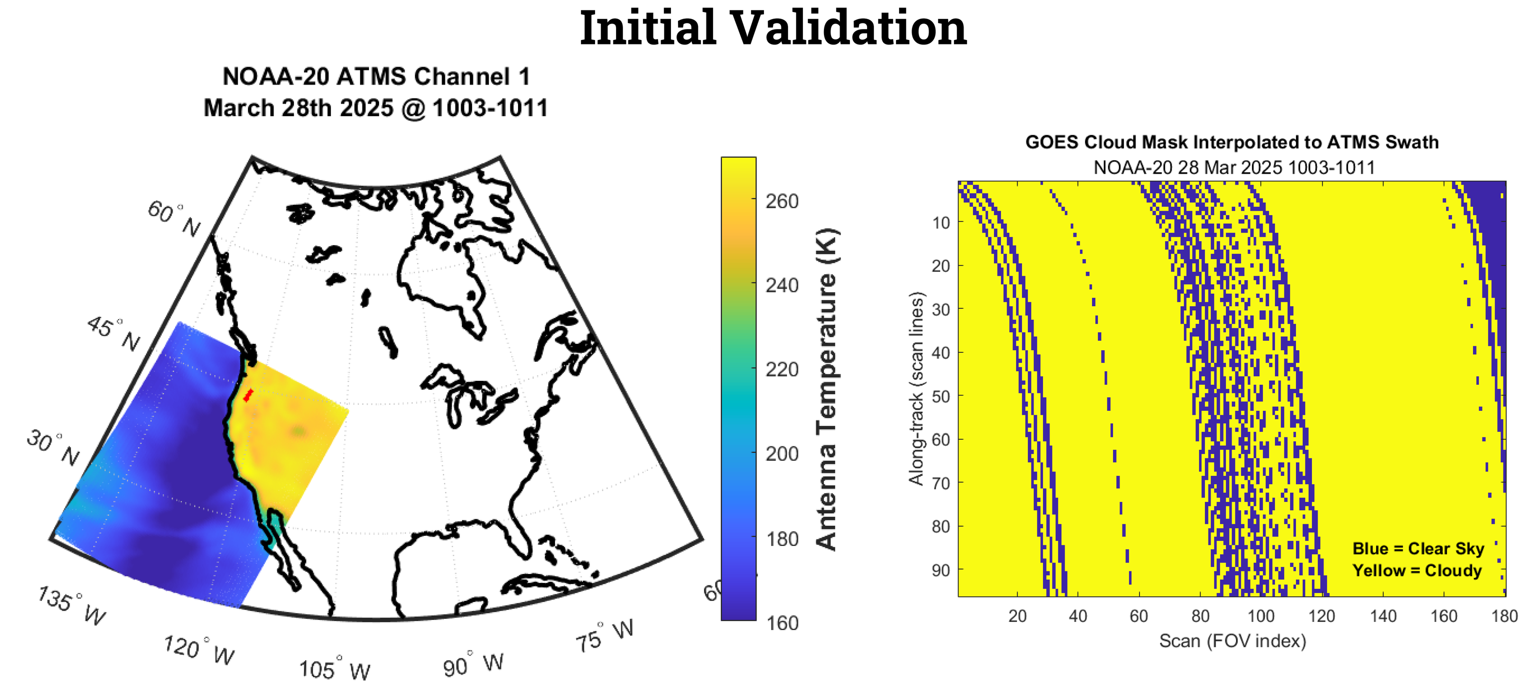

Fig 1: (Left) Experimental setup validated with initial ATMS observations from 28 Mar. (Right) GOES cloud mask interpolated onto ATMS swath. Yellow points are cloudy; blue are clear. Four clear sky points along nadir selected for validation.

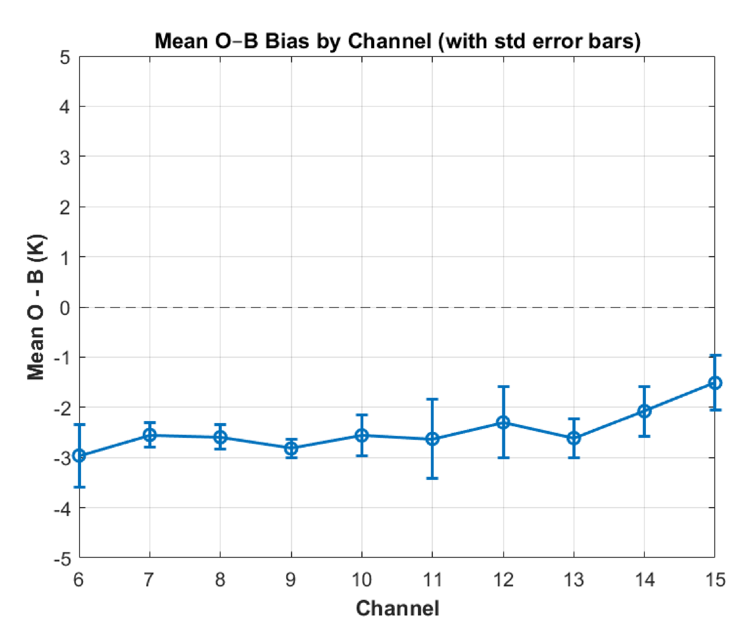

Fig 2: Calculated mean and standard deviation for O-B Bias. ATMS Channels 6-15 are less sensitive to cloudy conditions; mean O-B bias < 3 K.

Urban Area Validation

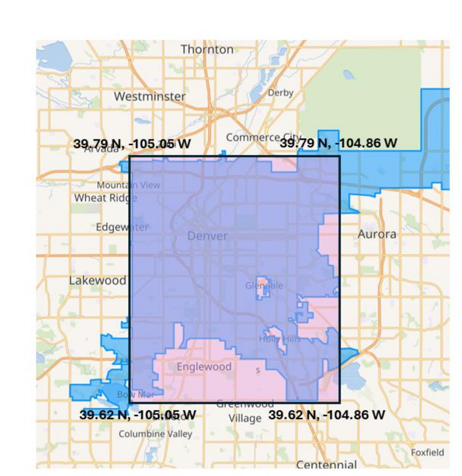

Fig 3: Bounding box over Denver metropolitan area used for analysis

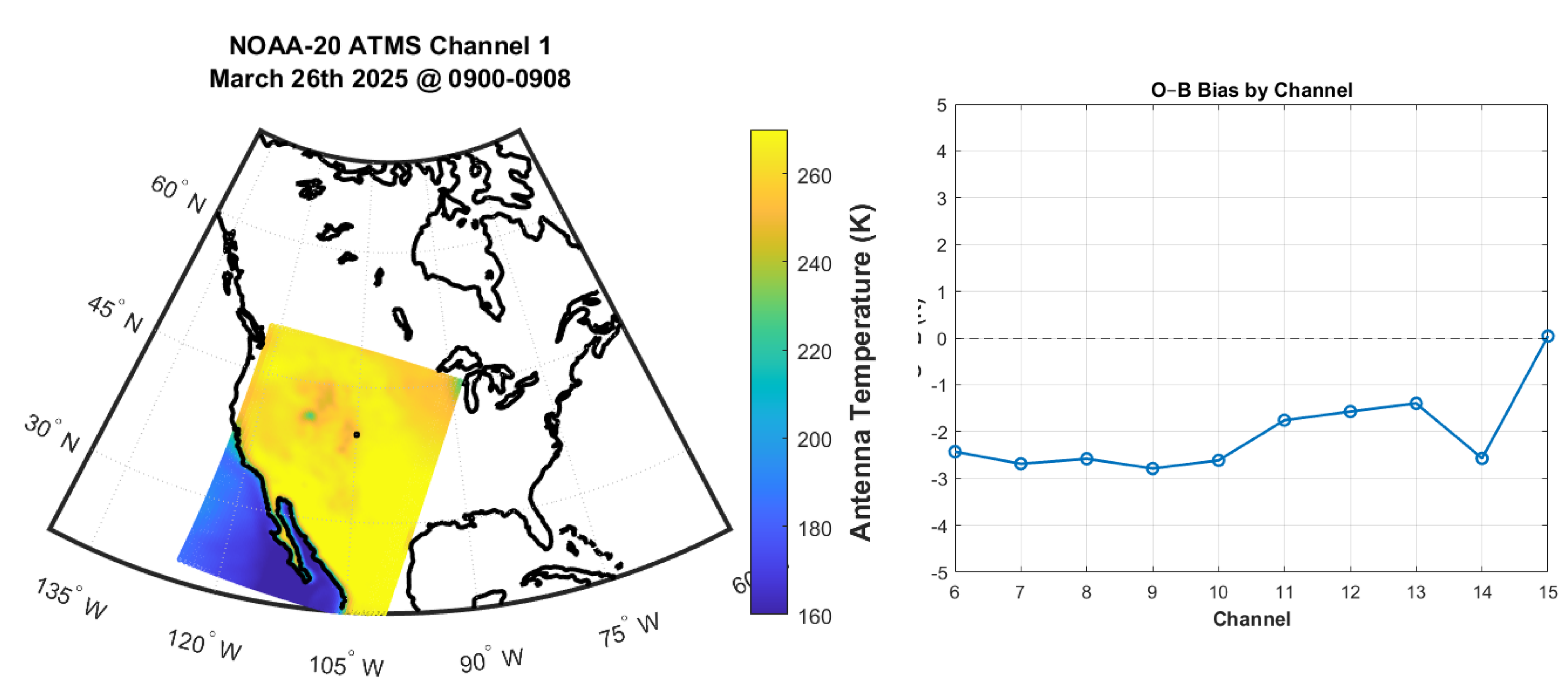

Fig 4: (Left) ATMS observations on 26 Mar. One data point available within bounding box of Denver metropolitan area. (Right) O-B bias for ATMS channels 6-15 are plotted. Bias < 2.8 K for all channels.

CONCLUSIONS

- Validated initial CRTM framework for analysis
- Selected first urban area over Denver
- Analyzed initial O-B bias over Denver urban area

FUTURE WORK

- Continue building datasets over greater time scale
- Add urban areas for analysis over New York, Chicago, and Miami
- Analyze available 5G mmWave activity datasets over urban areas and correlate with analysis
- Add remote areas for analysis and comparison
- Statistically analyze data to find indications of RFI

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