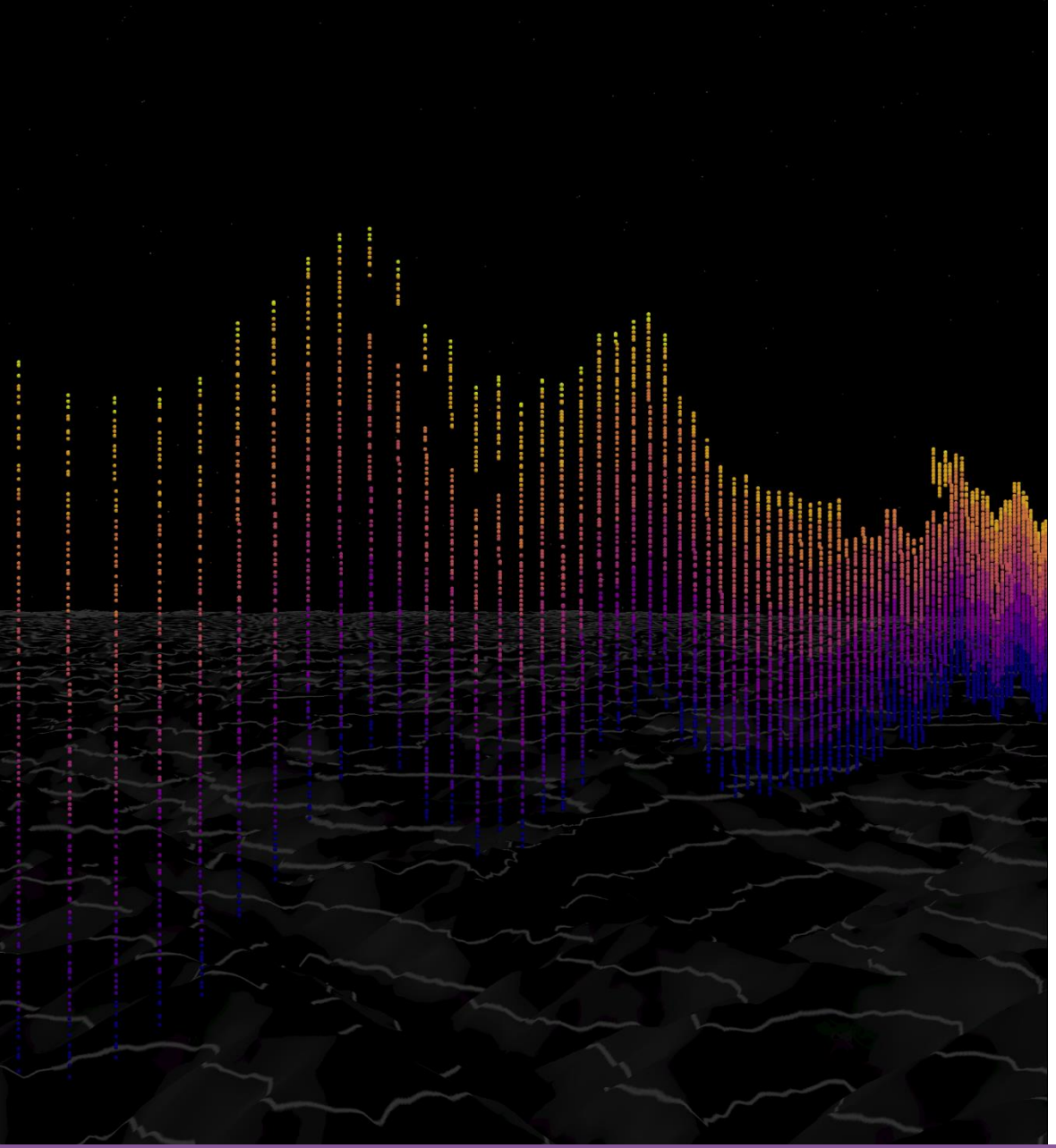


National Aeronautics and Space Administration

Southern Idaho
Health & Air Quality II

Evaluating Atmospheric Mixing Height Estimations in the Western United States

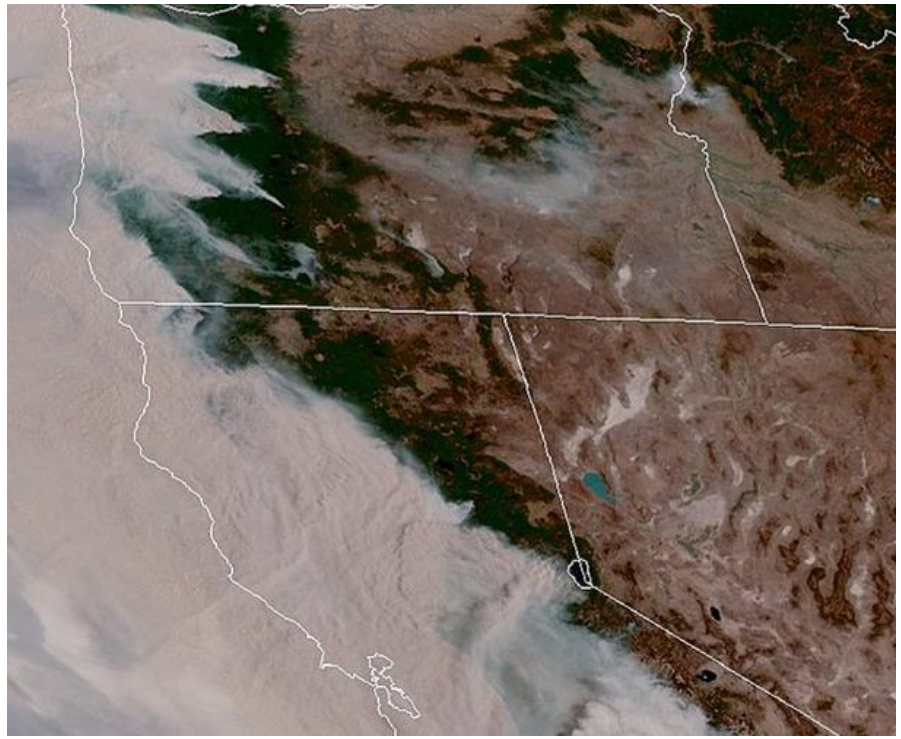
Dean Berkowitz, Jukes Liu, Lauren Mock, Chris Wright

Idaho - Pocatello | Spring 2021

DEVELOP

Motivations & Community Concerns

- Wildfires are increasing in frequency and intensity.
- Smoke pollution harms human health.
- Prescribed burns are often vetoed due to potential smoke hazards.
- There are inconsistencies in smoke forecasting across public agencies.

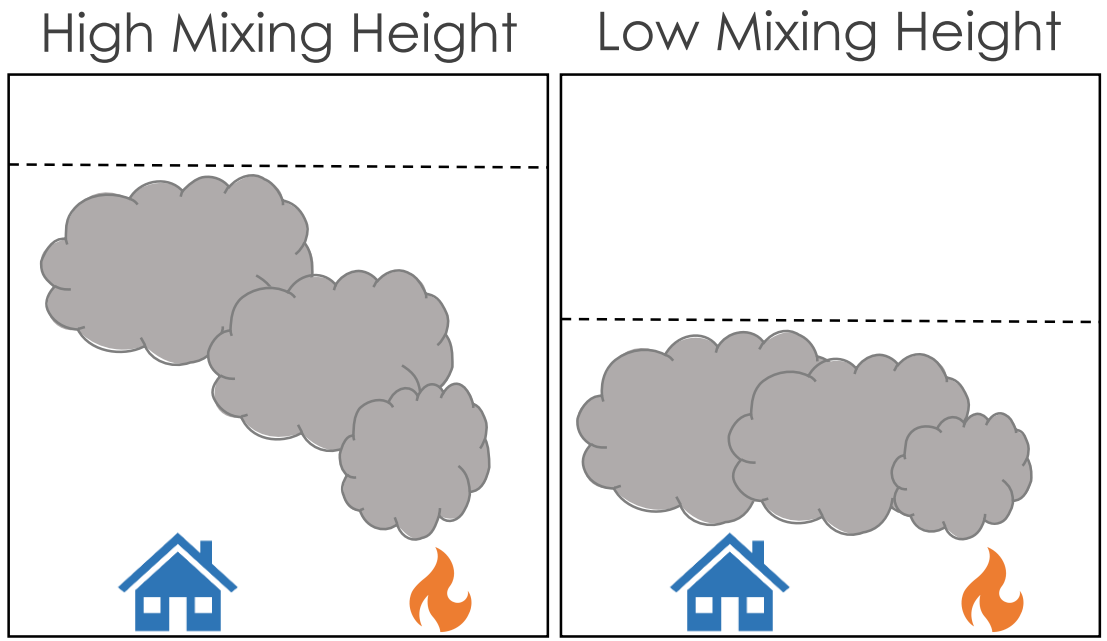


GOES-17 satellite view of smoke plumes from the 2020 California & Oregon wildfires

Icon Credit: Microsoft PowerPoint ClipArt

Image Credit: National Weather Service

Fires & Mixing Height

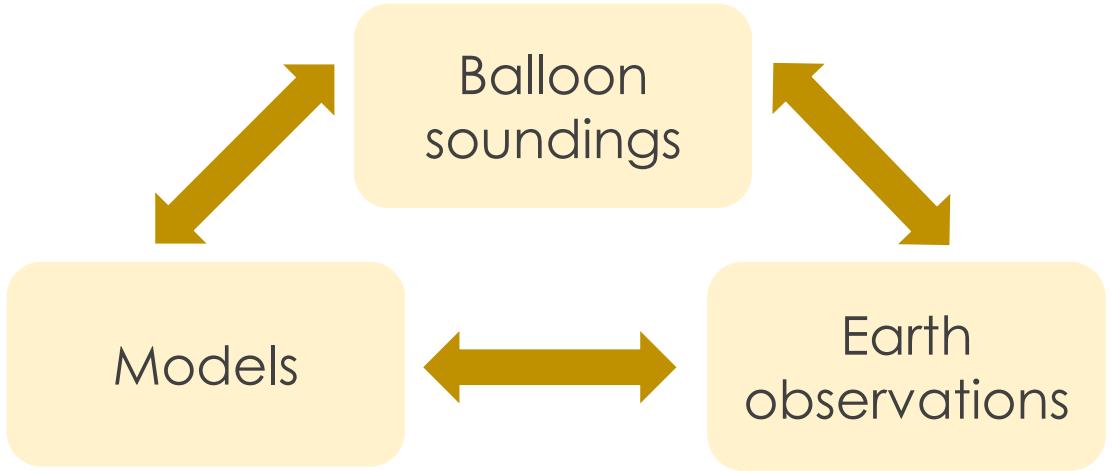


Mixing height acts as a lid on smoke pollution.

Mixing height estimations inform:

- Air quality forecasts
- Prescribed burn decisions

Estimation Methods:



Icon Credit: Microsoft PowerPoint ClipArt

Project Partners

NOAA's National Weather Service Fire Weather Program

Bureau of Land Management National Interagency Fire Center

National Park Service Fire Management Program Center

Objectives

Determine mixing heights over wildfire smoke plumes in the Western US utilizing NASA Earth Observations

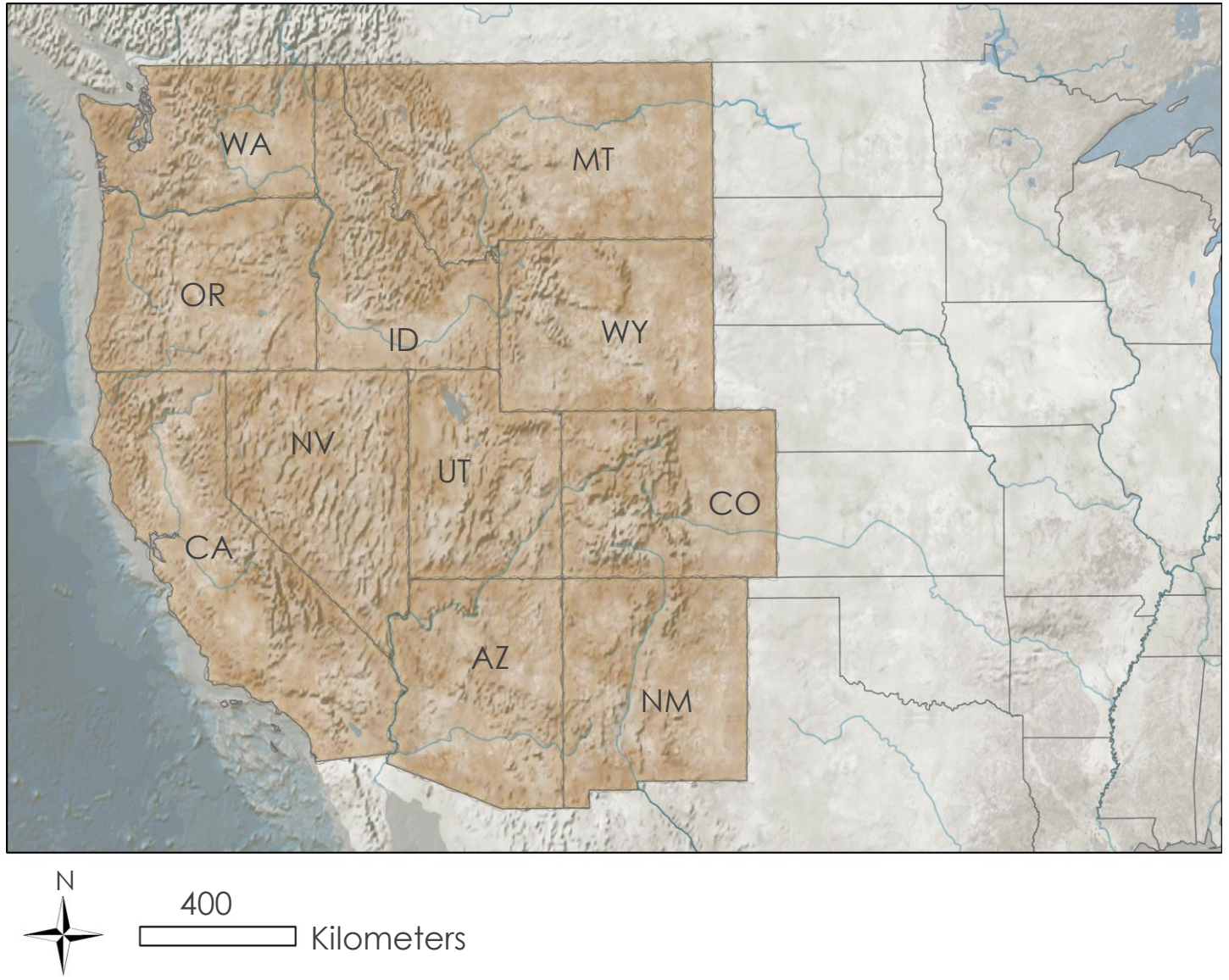
Compare with mixing heights forecasted by the National Weather Service

Icon Credit: ProSymbols and Creative Stall from The Noun Project

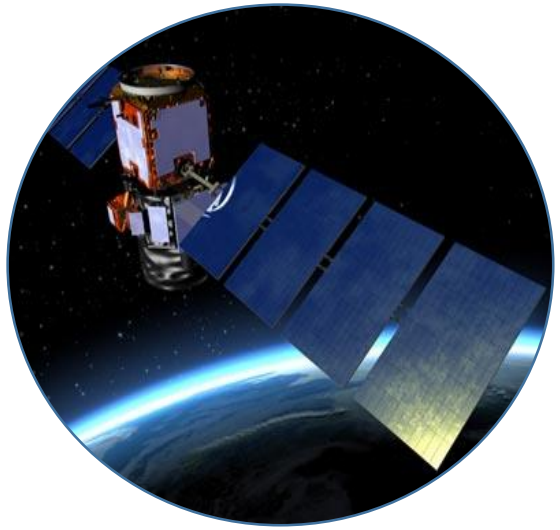
Study Area & Time Period

Western United States

2006-2020
July–September



NASA Satellites & Sensors

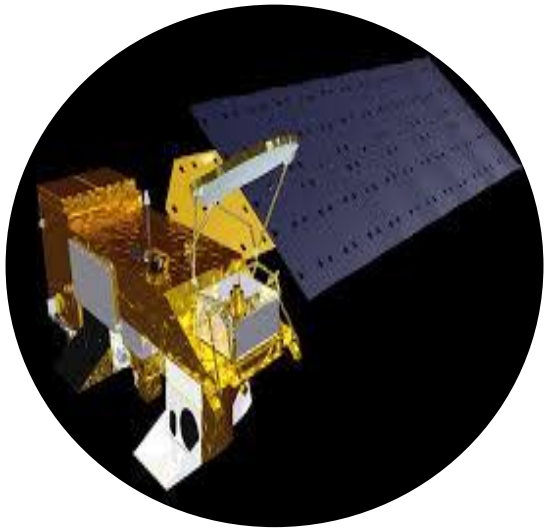


CALIPSO CALIOP

Vertical and horizontal distribution of cloud and aerosol layers

Terra MODIS

Vertical water vapor gradient and smoke imagery



Aqua MODIS

Active fire boundary and smoke imagery

Suomi NPP VIIRS

Historic fire approximation

Image Credit: NASA

Approach

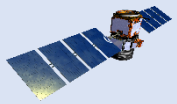
Data Acquisition

Processing

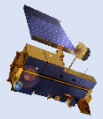
Intercomparison

Identify Plumes

CALIOP Aerosol Layer



MODIS Water Vapor



NWS Forecasts

AWIPS Model Output

Balloon Soundings

Forecaster Intervention

Statistical Evaluation of Systematic Bias

CALIPSO CIMSS

Image Credit: NASA

Mixing Heights from CALIPSO CALIOP

A-SMOKRE

L2 Vertical Feature Masks

Feature Classification Flags

Height of smoke aerosols

CALIPSO-CIMSS

L1B Calibrated lidar backscatter

Wavelet covariance transform

Height of Surface Attached Aerosol Layer (SAAL)

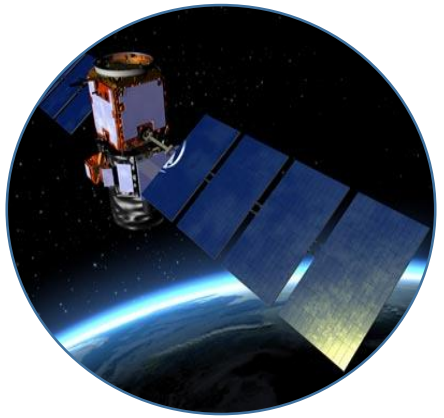
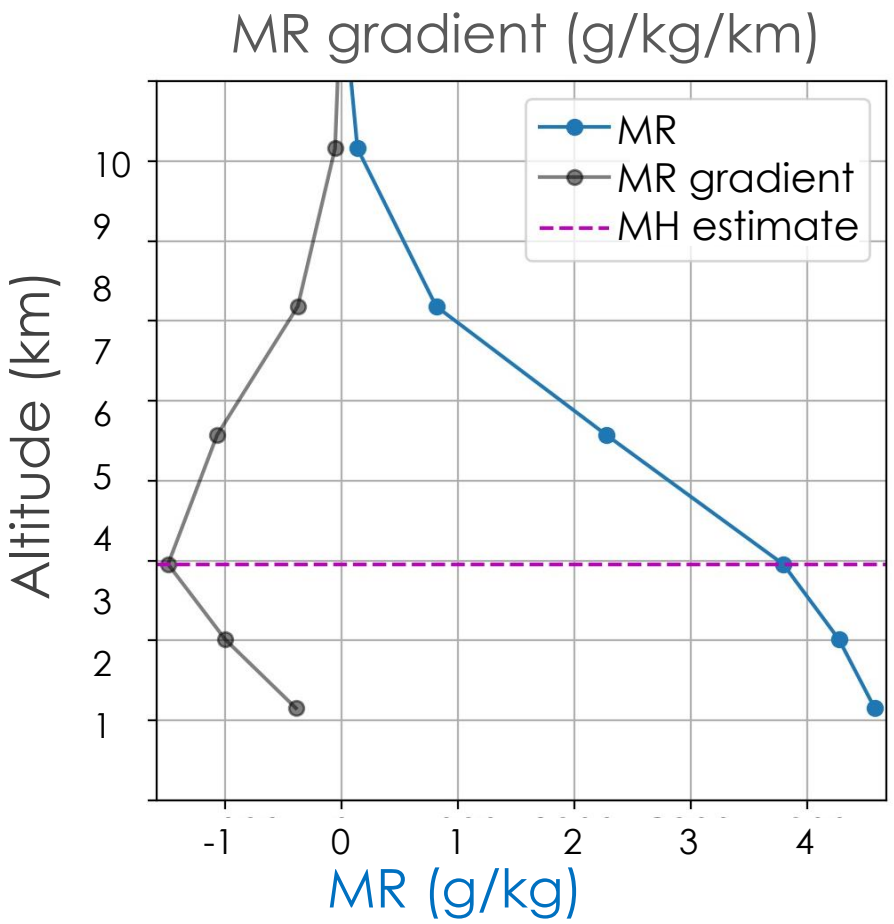


Image credit: NASA

Mixing Heights from MODIS Profiles

Followed radiosonde-validated method from Feng et al. (2015)



MODIS atmospheric profile over Elk Complex fire on Aug. 13, 2013.

Advantages

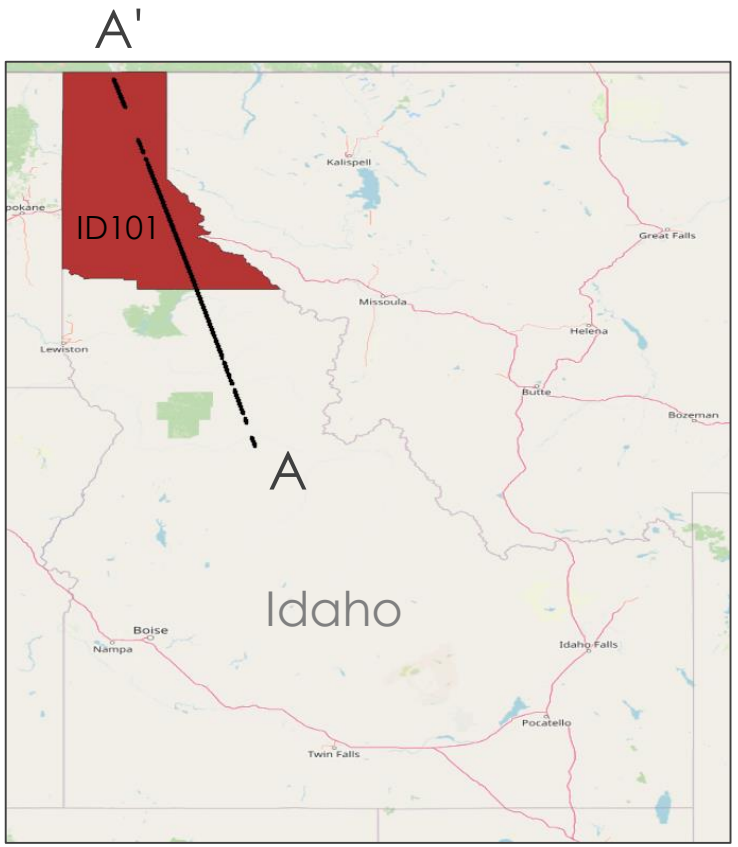
- Spatial coverage
- Temporal resolution
- Temporal coverage

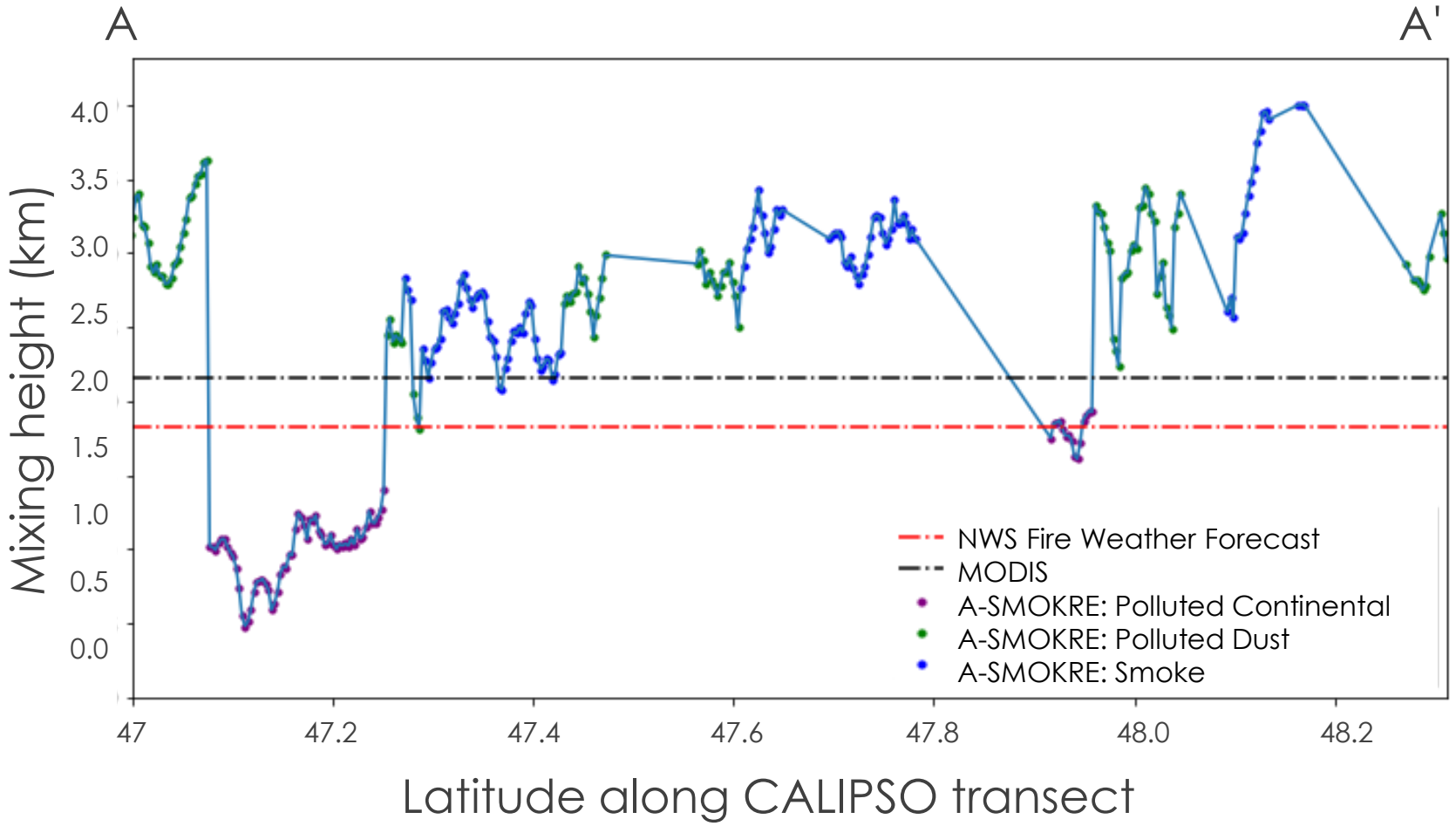
Limitations

- Cannot resolve below 1km
- Vertical resolution
- Missing values

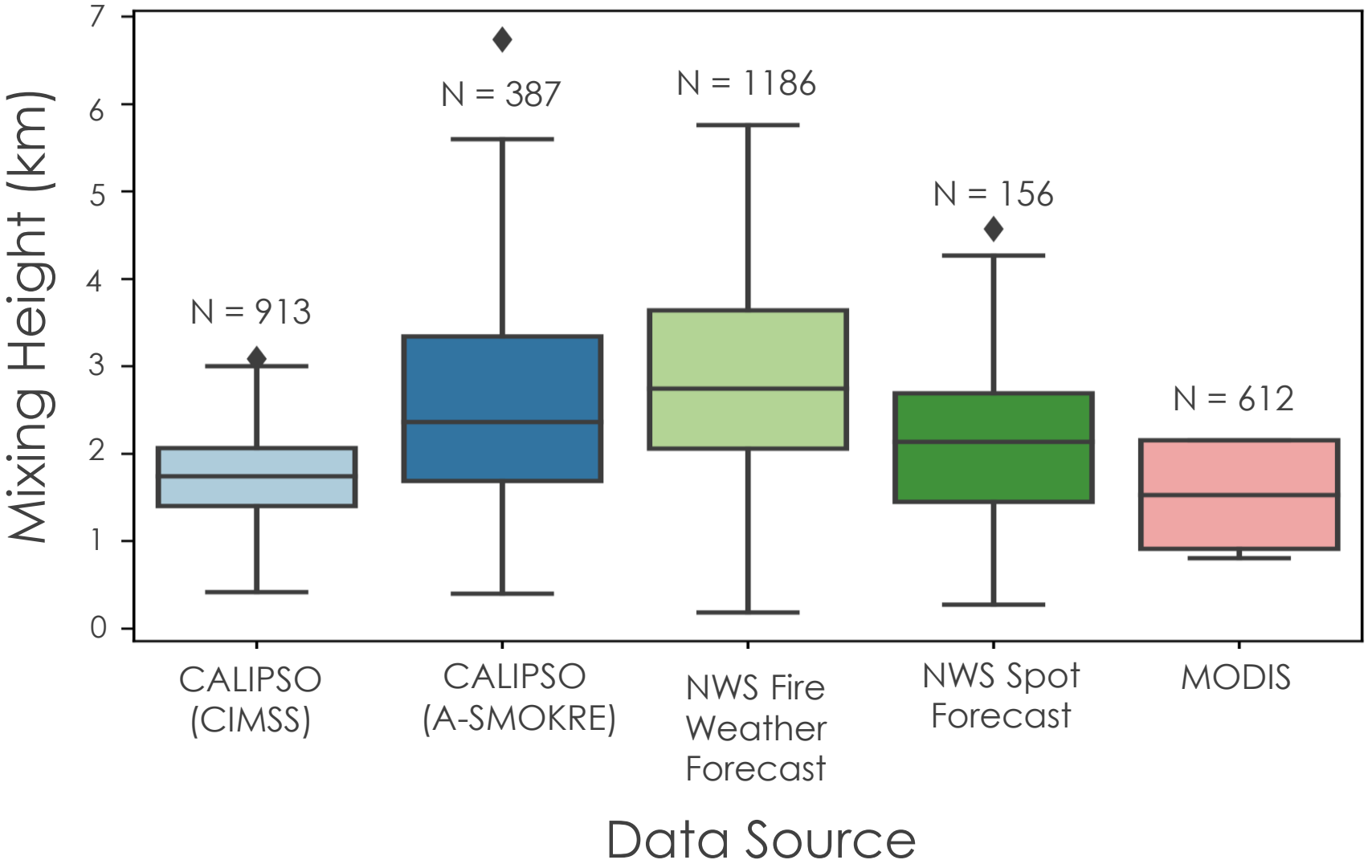
Case Study

Mixing heights on Aug. 27, 2015 in fire weather zone ID101

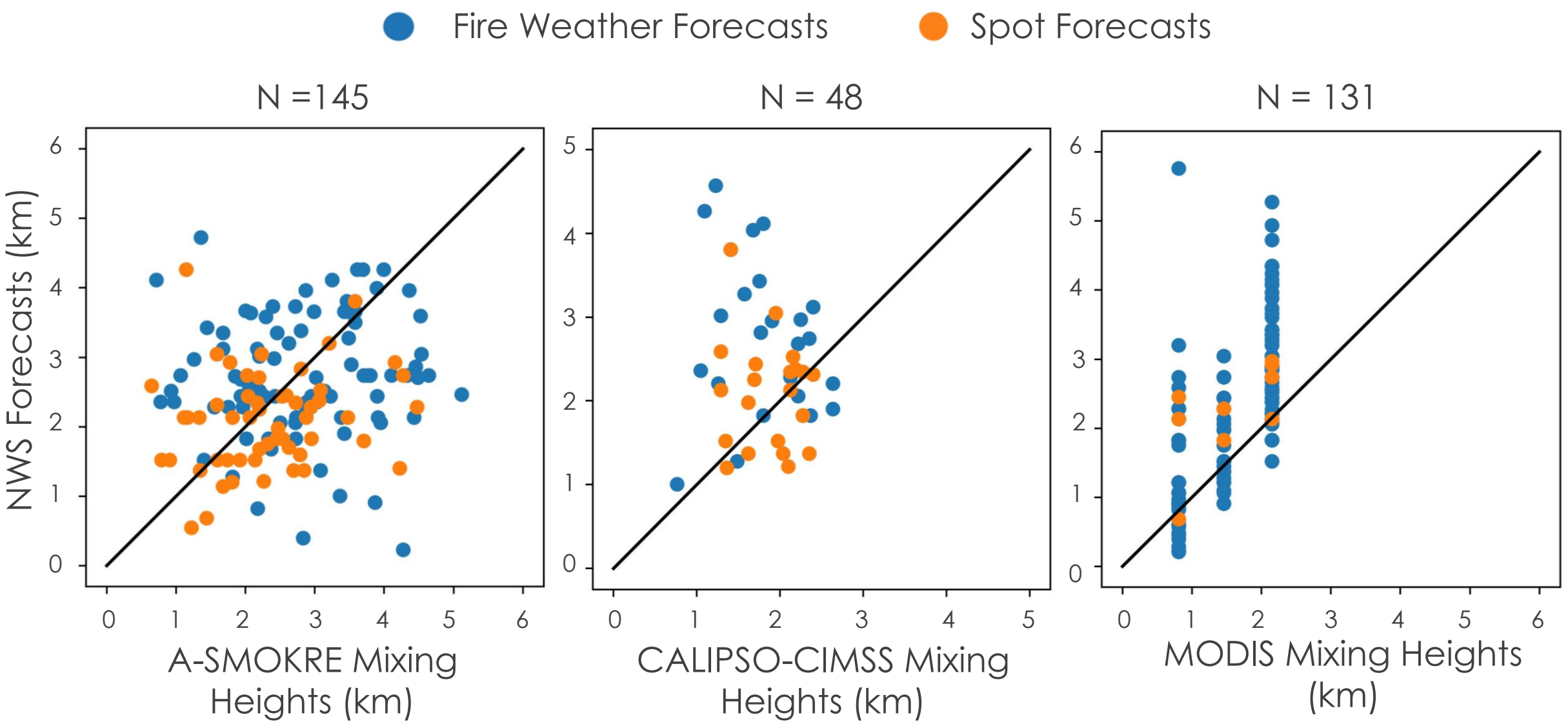




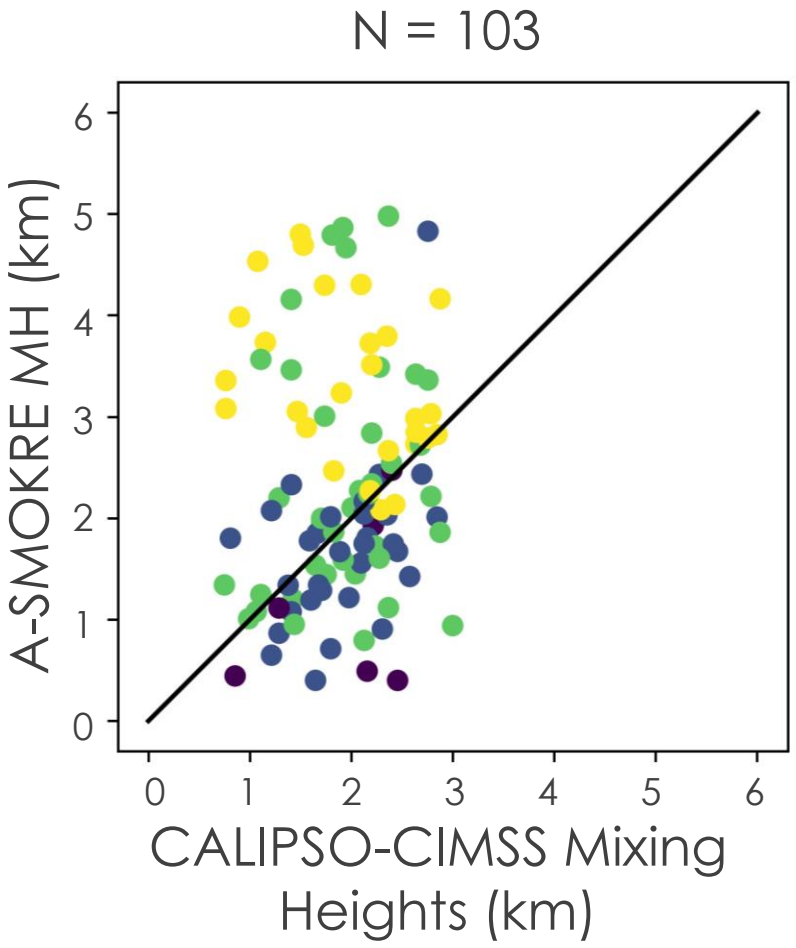
Mixing Heights by Data Source

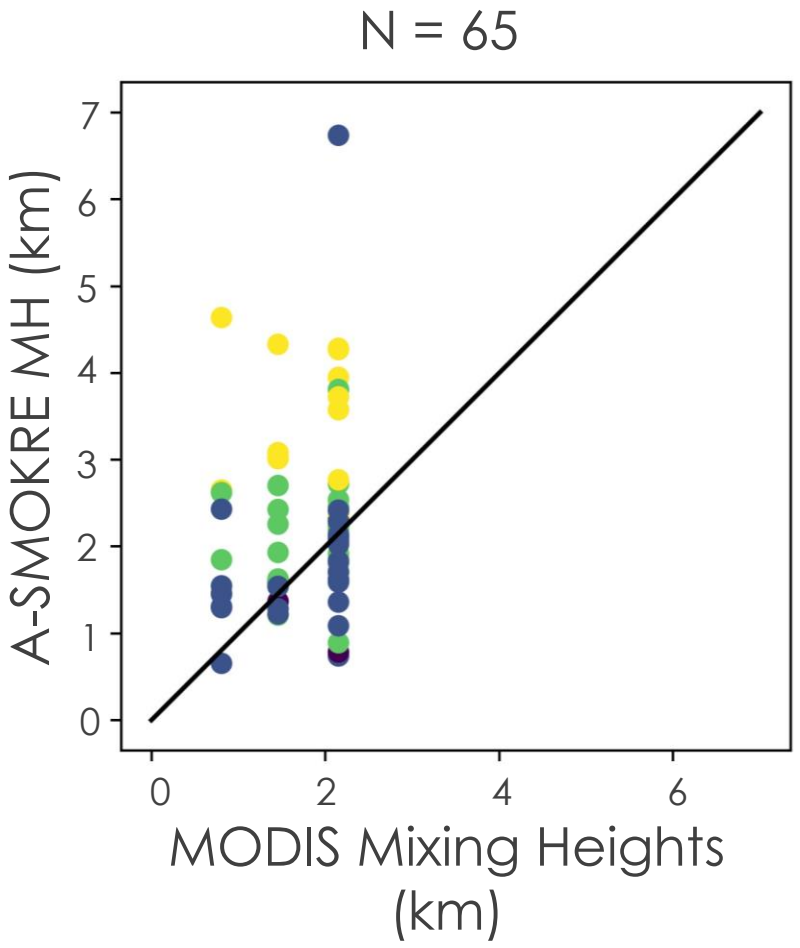


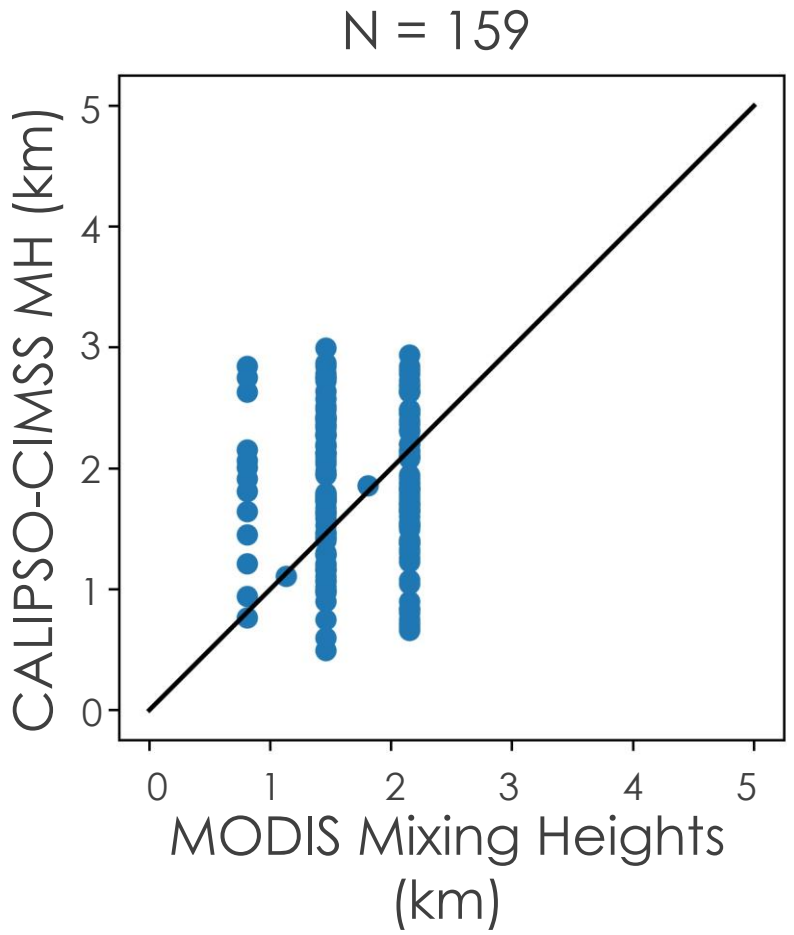
Comparison to NWS Forecasts



Comparison to CALIPSO



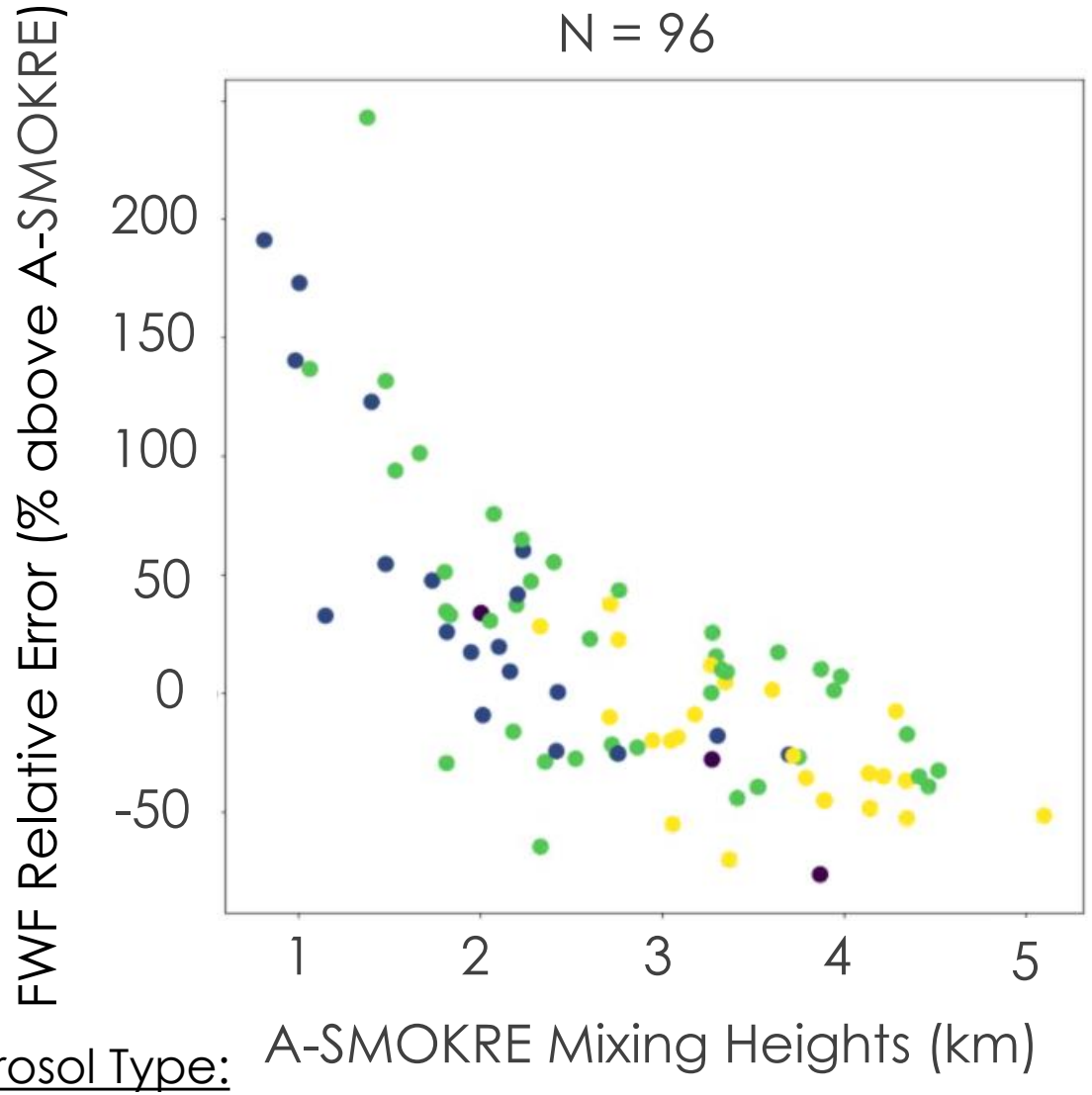


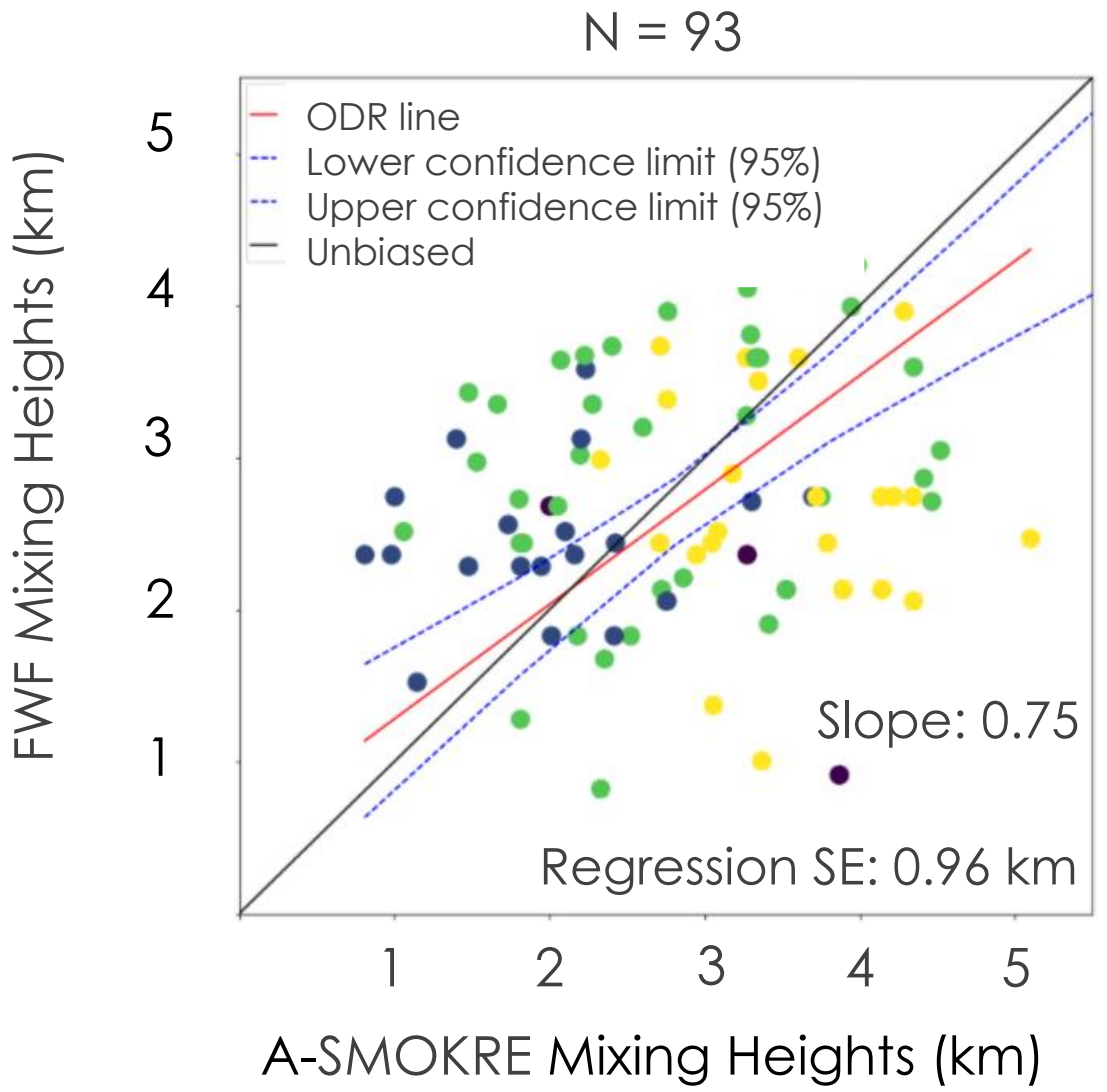


Aerosol Type:

Smoke Polluted Dust Continental Undetermined

Comparison to NWS Forecasts

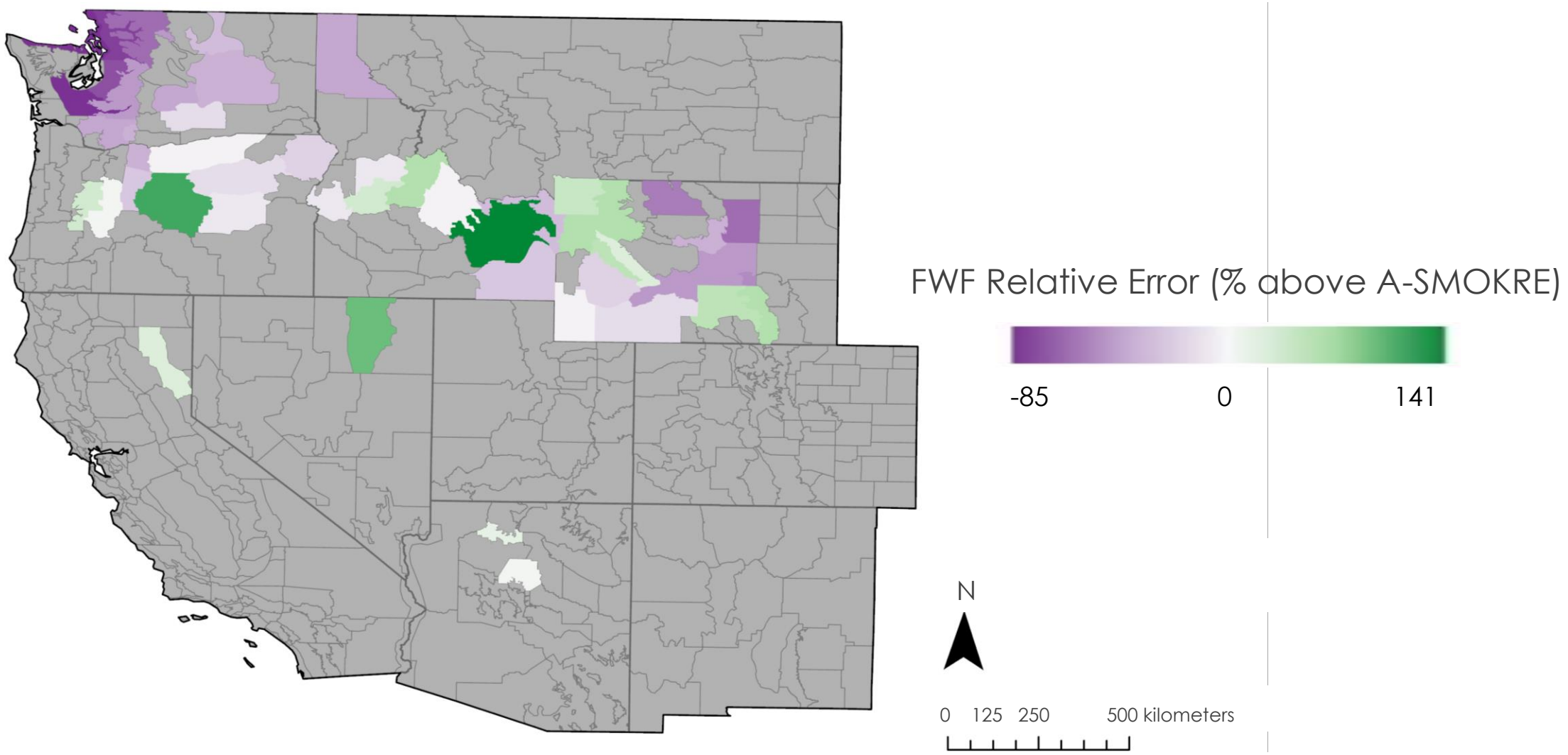




Aerosol Type:

Smoke Polluted Dust Continental Undetermined

FWF Relative Error Across Study Area



Preliminary Conclusions

NWS fire weather forecasts **generally align** with A-SMOKRE outputs

MODIS vertical profile resolutions are **too coarse** for meaningful comparison

CIMSS mixing heights are **different** from A-SMOKRE outputs

NWS fire weather forecasts are **different** from NWS spot forecasts

Future Work

Identify additional wildfire smoke events for validation

Explore alternative satellite products for comparison

Investigate variation between NWS FWF and FWS

Icon Credit: Microsoft PowerPoint ClipArt

Icon Credit: ProSymbols from The Noun Project

Acknowledgements

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Bureau of Land Management, National Interagency Fire Center: Dave Mueller

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