

# Towards high spatio-temporal fuel moisture content retrievals over the contiguous U.S. and Alaska based on VIIRS and ABI instruments



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## BACKGROUND

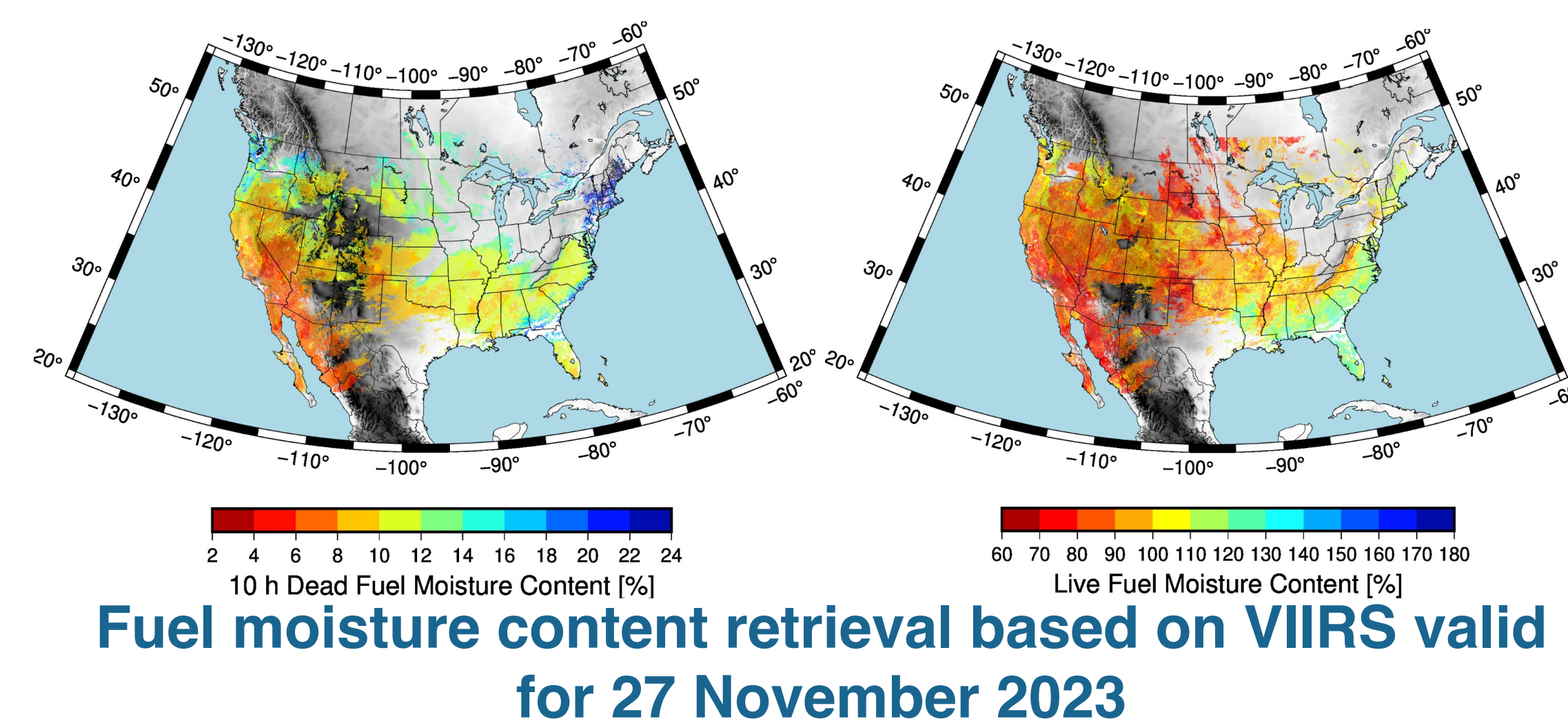
### Retrieving fuel moisture content

The fuel moisture content (FMC) exerts a strong influence on the rate of spread of wildland fires. Hence, it is desirable to monitor both the dead and live FMC to mitigate potential adverse impacts of wildland fires. Samplings of the dead FMC (10 h fuels) can be acquired via automatic weather stations whereas the live FMC has to be manually sampled. An alternative approach is to combine numerical weather prediction (NWP) outputs with satellite data to retrieve the FMC. Our objective is to retrieve the live and dead FMC at high spatio-temporal resolution over the contiguous U.S. (CONUS) and Alaska based on the VIIRS and ABI instruments.

## OBJECTIVES

### FMC retrievals

- VIIRS: 375 m grid spacing over CONUS and Alaska at the Suomi-NPP daytime overpasses
- ABI: Hourly over CONUS at 2250 m grid spacing
- ABI + VIIRS: Hourly over CONUS at 375 m (in progress)



## METHODS

### Regression models

The dead/live FMC is retrieved using regression models based on machine learning using XGBoost. The training dataset spans the period 2019–2021. Predictors include outputs from the High Resolution Rapid Refresh, the National Water Model, static datasets, and satellite products:

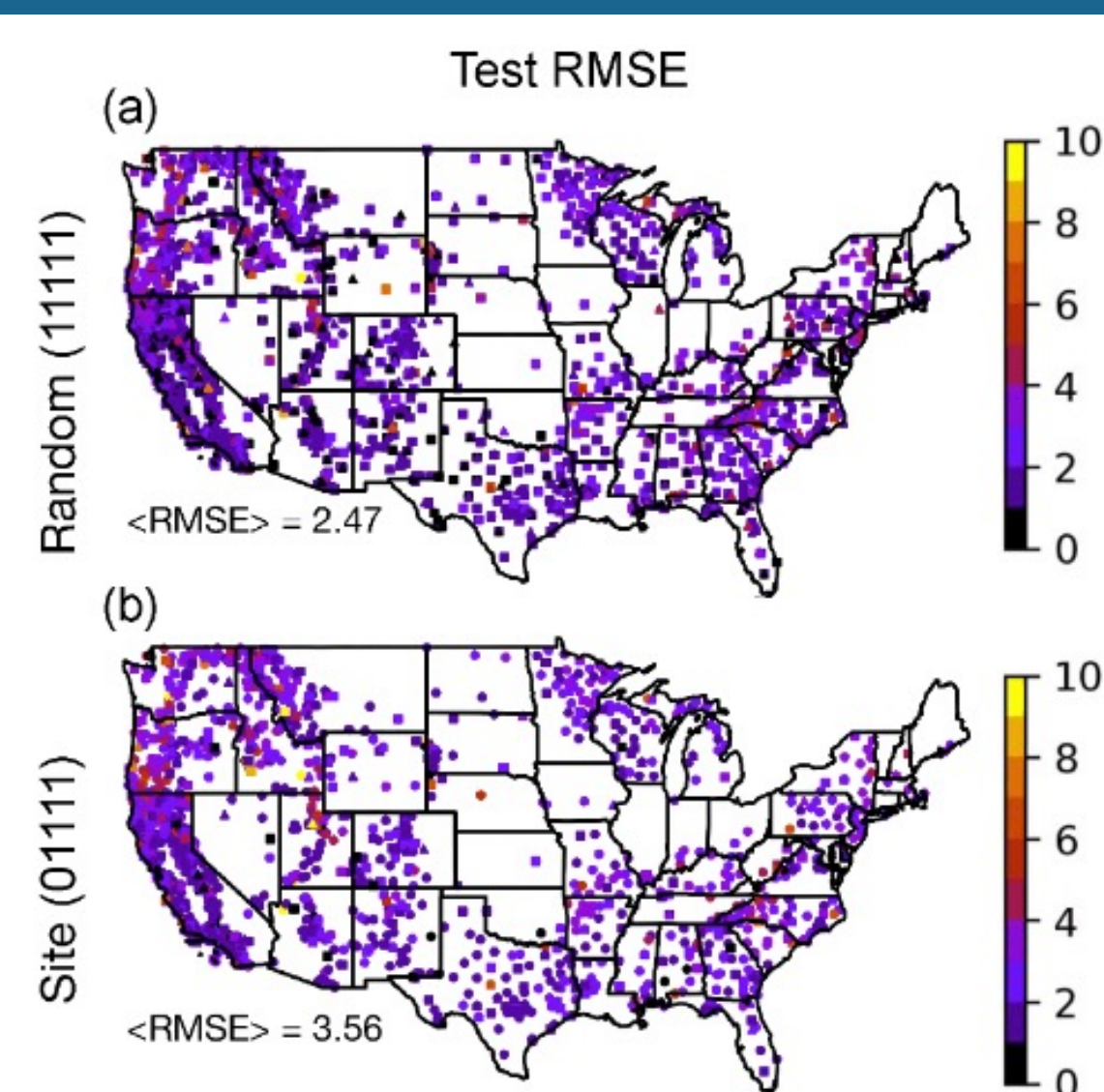
- VIIRS: surface reflectances and land surface temperature (LST)
- ABI: reflectances, brightness temperature, and LST

Predictands consist of the 10 h FMC from automated stations and manual samples of the live FMC across CONUS.

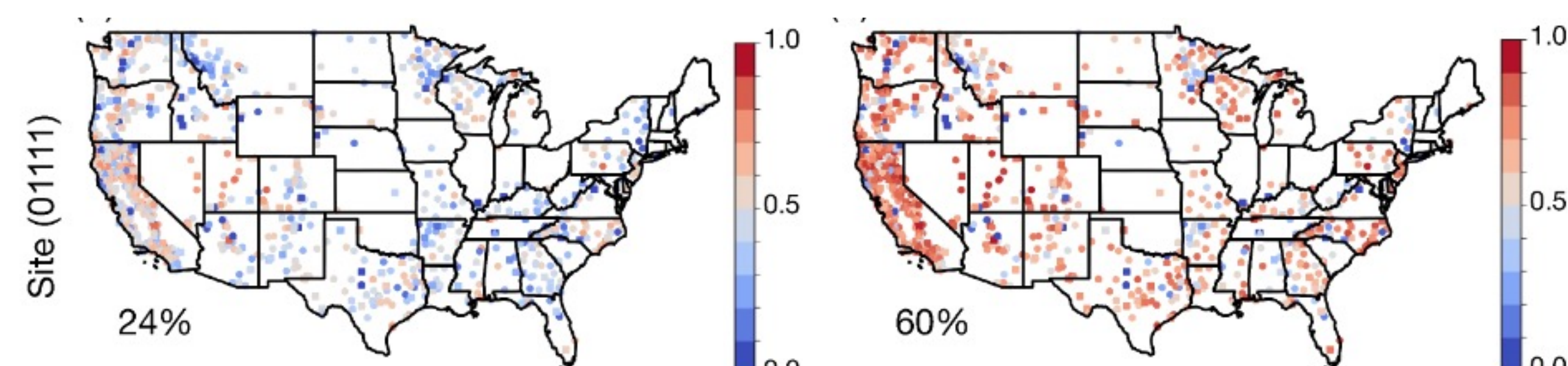
## RESULTS

### Performance of the retrievals

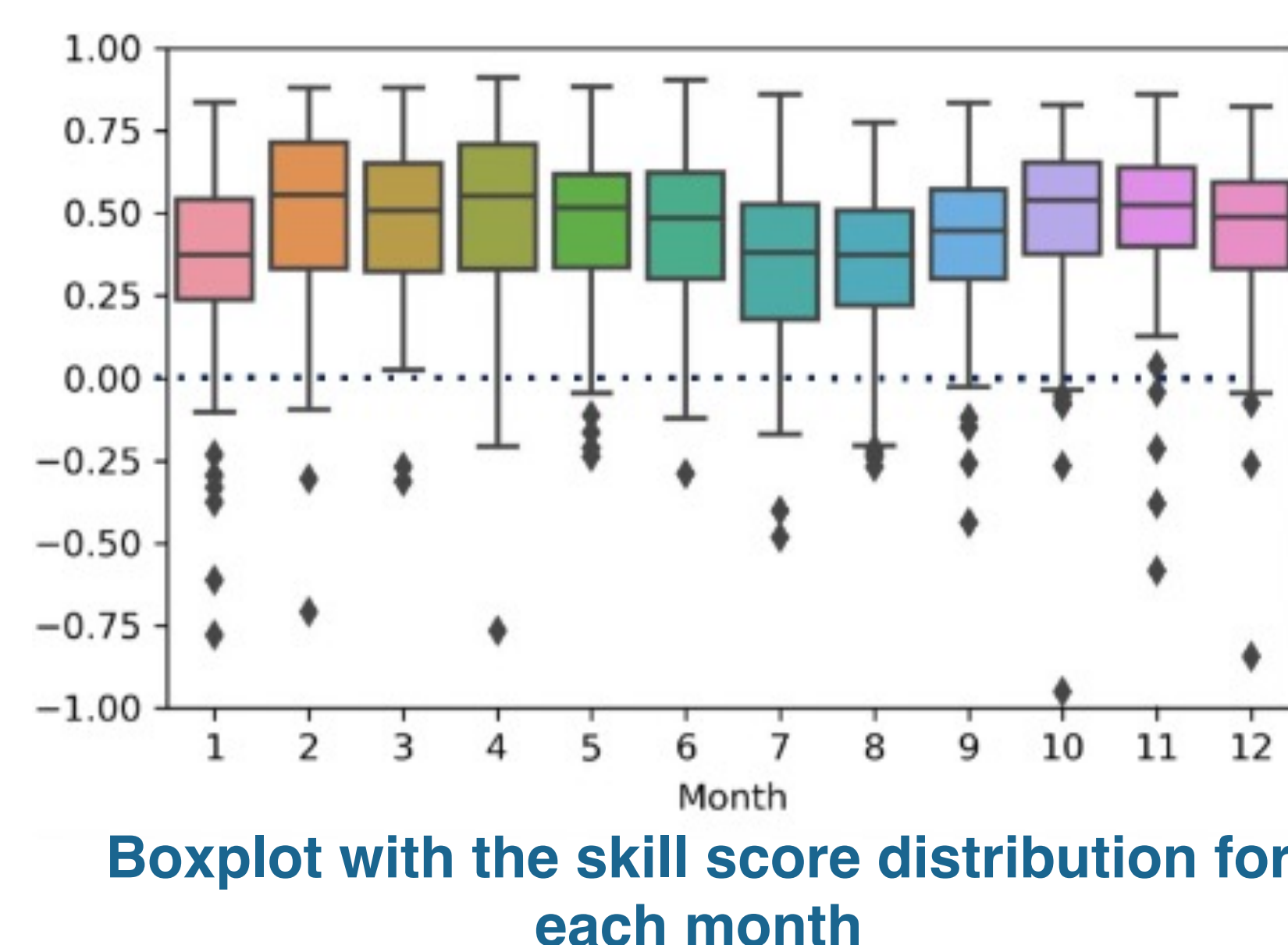
We evaluated the performance of the retrievals based on standard statistics such as RMSE,  $R^2$ , etc. (left figure) and a skill score using hourly climatology as a reference (bottom figures). The figures show the results for the 10 h FMC estimations based on Suomi-NPP VIIRS.



RMSE of the 10 h FMC using random split (up) or site split (bottom) of the data



Skill score of the 10 h FMC retrievals with respect to climatology based on the RMSE (left) and the coefficient of determination (right)



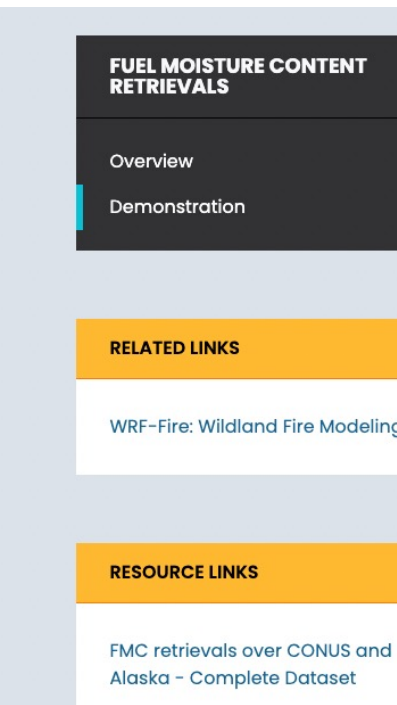
## CONCLUSIONS

### Fuel Moisture Content Retrievals Demonstration

In March 2023 we started a demonstration of the fuel moisture content retrievals based on Suomi-NPP. The retrievals are available at 2250 m and 3000 m over the contiguous U.S. (CONUS) and Alaska respectively. The following images show the latest set of daily retrievals over both regions. Together with the daily retrievals there is a composite figure filling the gaps with the previous retrievals (up to a maximum of 30 days). The Suomi-NPP based retrievals are also available at 375 m grid spacing over CONUS and Alaska.

Over CONUS, in addition to the daily retrievals based on daytime Suomi-NPP overpasses there are also hourly retrievals based on the geostationary satellite GOES16. The hourly fuel moisture content retrievals based on GOES16 are available at 2250 m grid spacing.

Complete dataset of FMC retrievals over CONUS and Alaska



Snapshot of the website of the demonstration

<https://ral.ucar.edu/tool/fuel-moisture-content-retrievals>

### Ongoing demonstration

It is possible to obtain skillful FMC retrievals (Schreck et al. 2023). There is an ongoing demonstration of the products (see link above). An upcoming graphical interface will facilitate more sophisticated display of the retrievals.

We are working on merging ABI and VIIRS retrievals.

## ACKNOWLEDGMENTS

Schreck, J., W. Petzke, P.A. Jimenez, T. Brummet, J.C. Knievel, E. James, B. Kosovic, and D.J. Gagne, 2023: Machine learning and VIIRS retrievals for skillful fuel moisture content monitoring in wildland fire management. Remote Sensing, 15, 3372.

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