

Using NASA's VIIRS Visible Light Data to Study Surface PM_{2.5} and Fires

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Aerosol, Radiation, Remote-sensing, & Observation-based Modeling of Atmosphere



HAQAST4 Meeting

University of Wisconsin - Madison

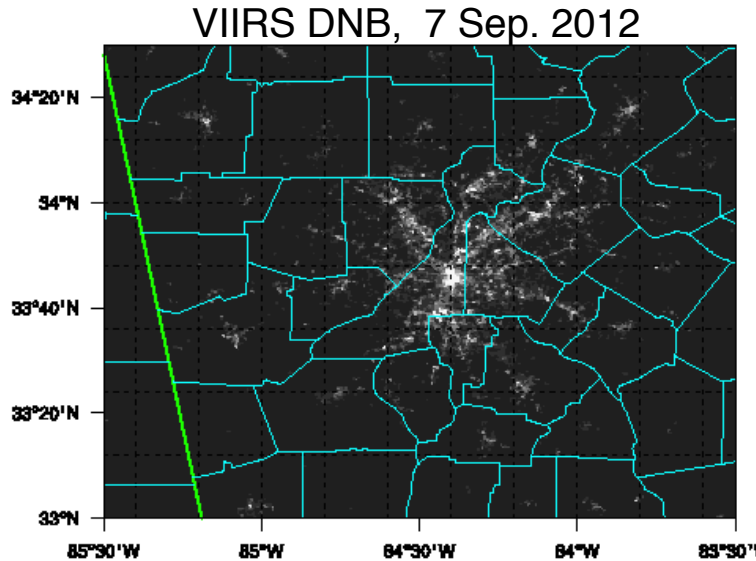
16 July 2018

NAAQS uses **daily** and annual averages of $\text{PM}_{2.5}$

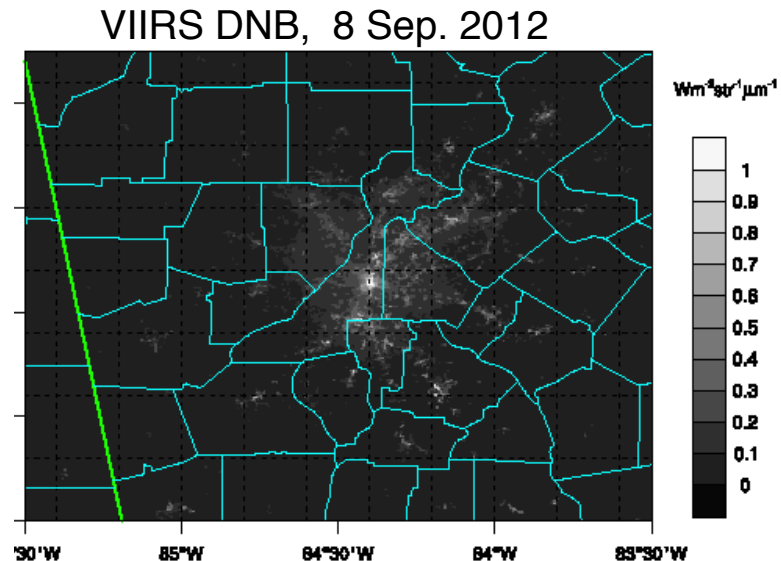
Can we use DNB to estimate surface $\text{PM}_{2.5}$ at night?

- At night, $\text{PM}_{2.5}$ concentration can be high because of shallow PBLH
- We made a first attempt to apply DNB for night time $\text{PM}_{2.5}$ air quality

$\text{PM}_{2.5}$: 5 $\mu\text{g}/\text{m}^3$



$\text{PM}_{2.5}$: 13 $\mu\text{g}/\text{m}^3$



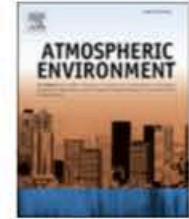
Atlantic, GA



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Potential application of VIIRS Day/Night Band for monitoring nighttime surface PM_{2.5} air quality from space



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H I G H L I G H T S

- VIIRS Day/Night Band (DNB) is much more sensitive to aerosols than to water vapor
- Modeling of outdoor light transfer in nighttime atmosphere for VIIRS DNB
- DNB potential for estimating surface PM_{2.5} is shown qualitatively and quantitatively
- PM_{2.5} at VIIRS night overpass time is much closer to daily-mean PM_{2.5} than at daytime
- Strategies for future DNB remote sensing of aerosols are elaborated



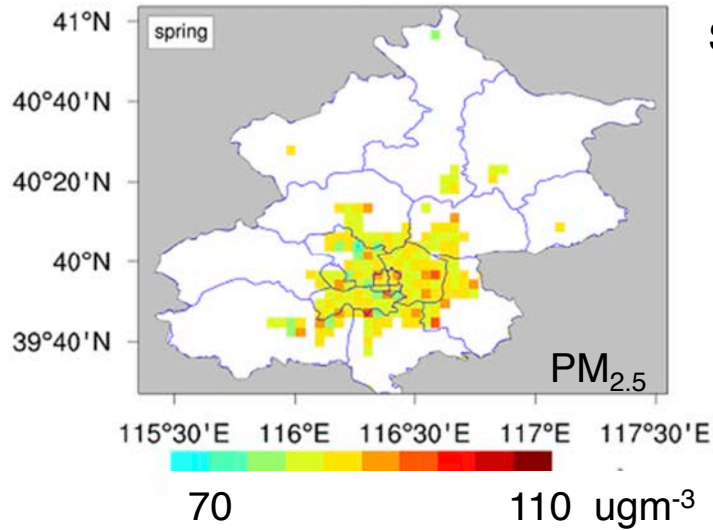
Acknowledgment

This study is supported by the NASA Applied Science Program (NNX11AJ03G) managed by John A. Haynes and the Suomi-NPP program managed by Diane Wickland and Paula Bontempi. We acknowledge Mr. Zhifeng Yang for his assistance in data analysis.

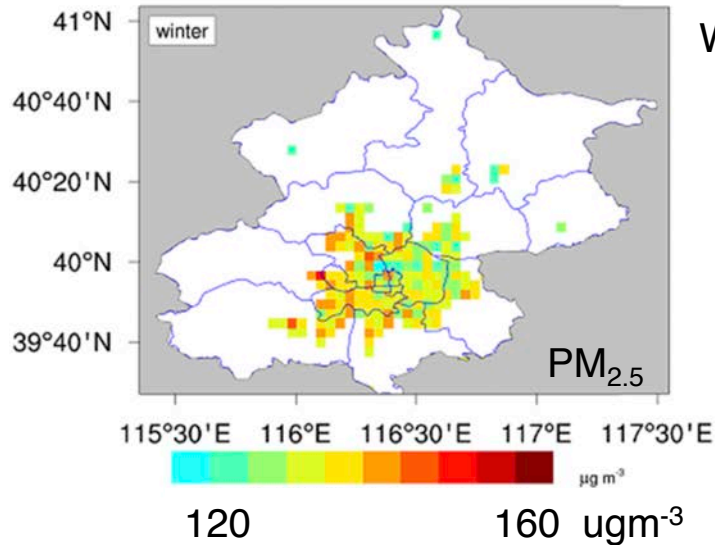
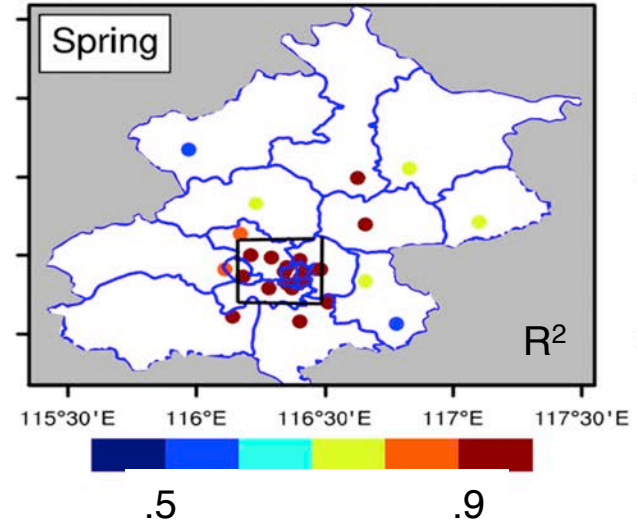
Thank you !

Mapping seasonal PM_{2.5} at night in Beijing

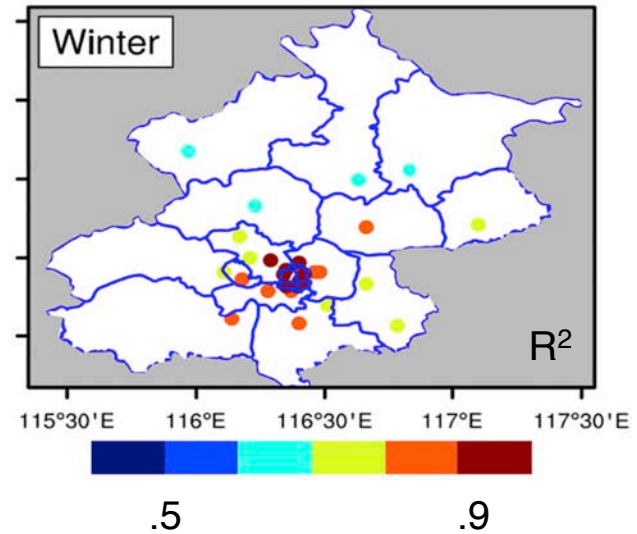
Fu et al., AE, 2018



Spring

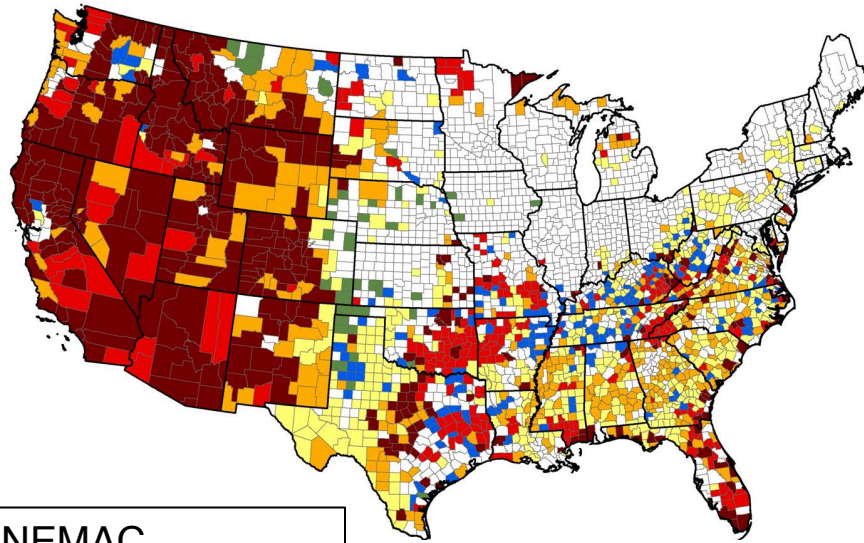


Winter

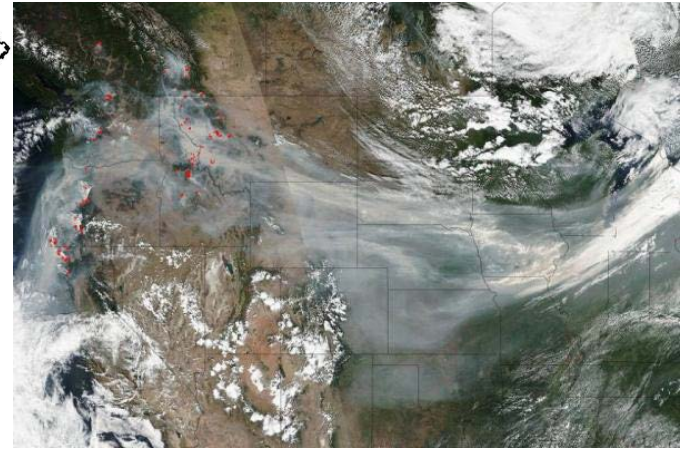


Fires are a big concern of U.S. Air Quality

Relative Risk of Fires of Concern (FOC)



NEMAC



A fire of concern is greater than 1 square mile in extent and requires two weeks or more to contain

IEEE TRANSACTIONS ON GEOSCIENCE AND REMOTE SENSING

A PUBLICATION OF THE IEEE GEOSCIENCE AND REMOTE SENSING SOCIETY



SEPTEMBER 2016

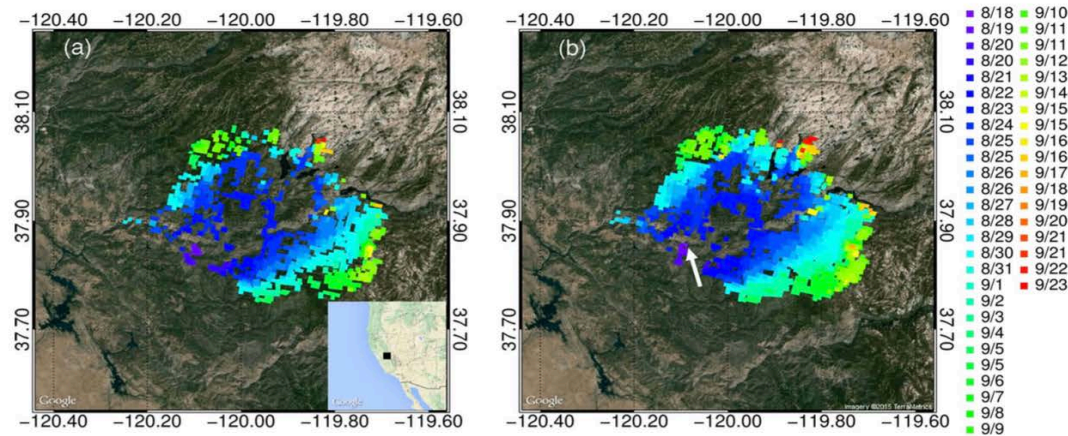
VOLUME 54

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IGRSD2

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Improving Nocturnal Fire Detection with the VIIRS Day-Night Band



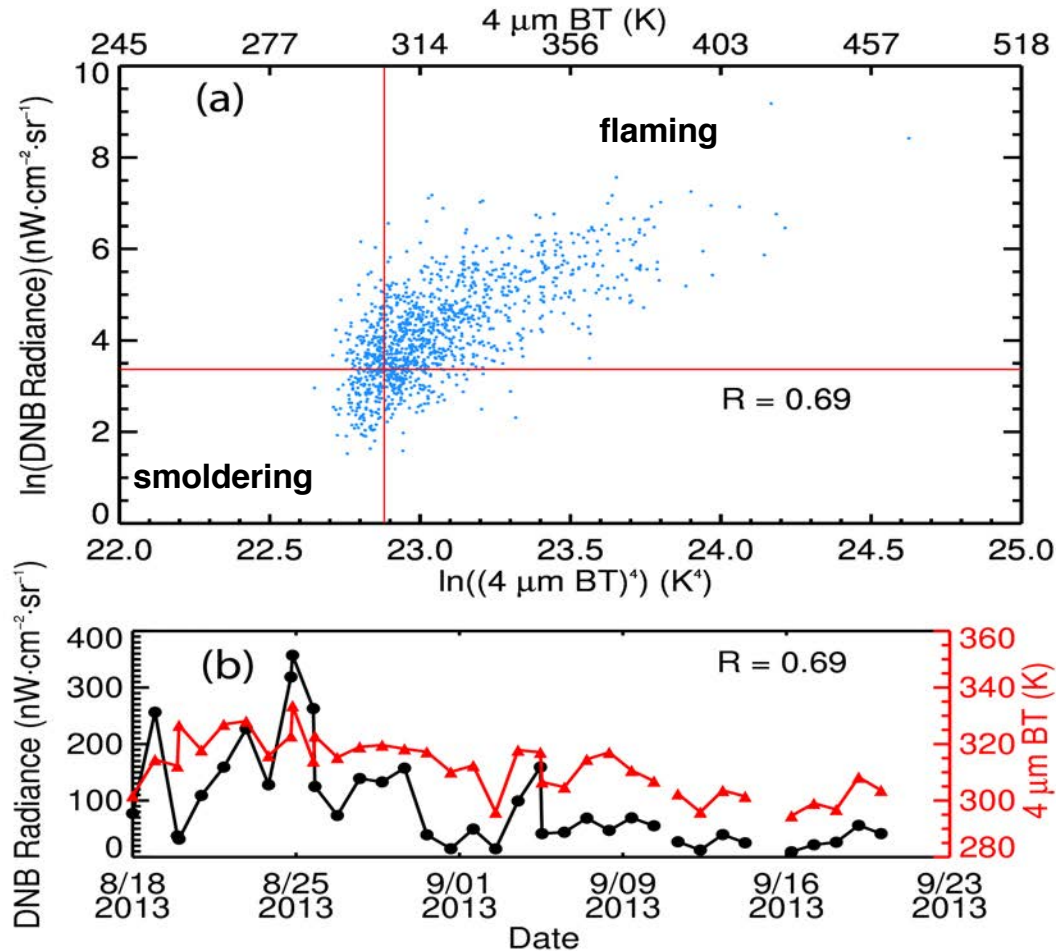
Progression of the 2013 Rim Fire from ignition to extinction, as revealed by the operational Active Fire Application Related Product (left) and the Firelight Detection Algorithm (right), both using the same input data from the VIIRS aboard the Suomi-NPP satellite.



Thomas Polivka

Polivka, T. N., J. Wang, L. T. Ellison, E. J. Hyer, and C. M. Ichoku (2016), Improving Nocturnal Fire Detection with the VIIRS Day-Night Band, *IEEE Transactions in Geoscience And Remote Sensing*, 54(9), 5503-5519.

Potential characterization of smoldering vs. flaming

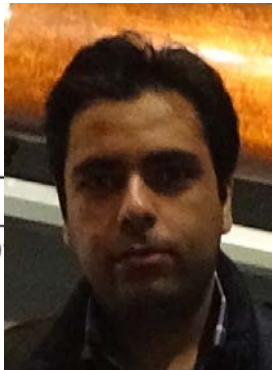
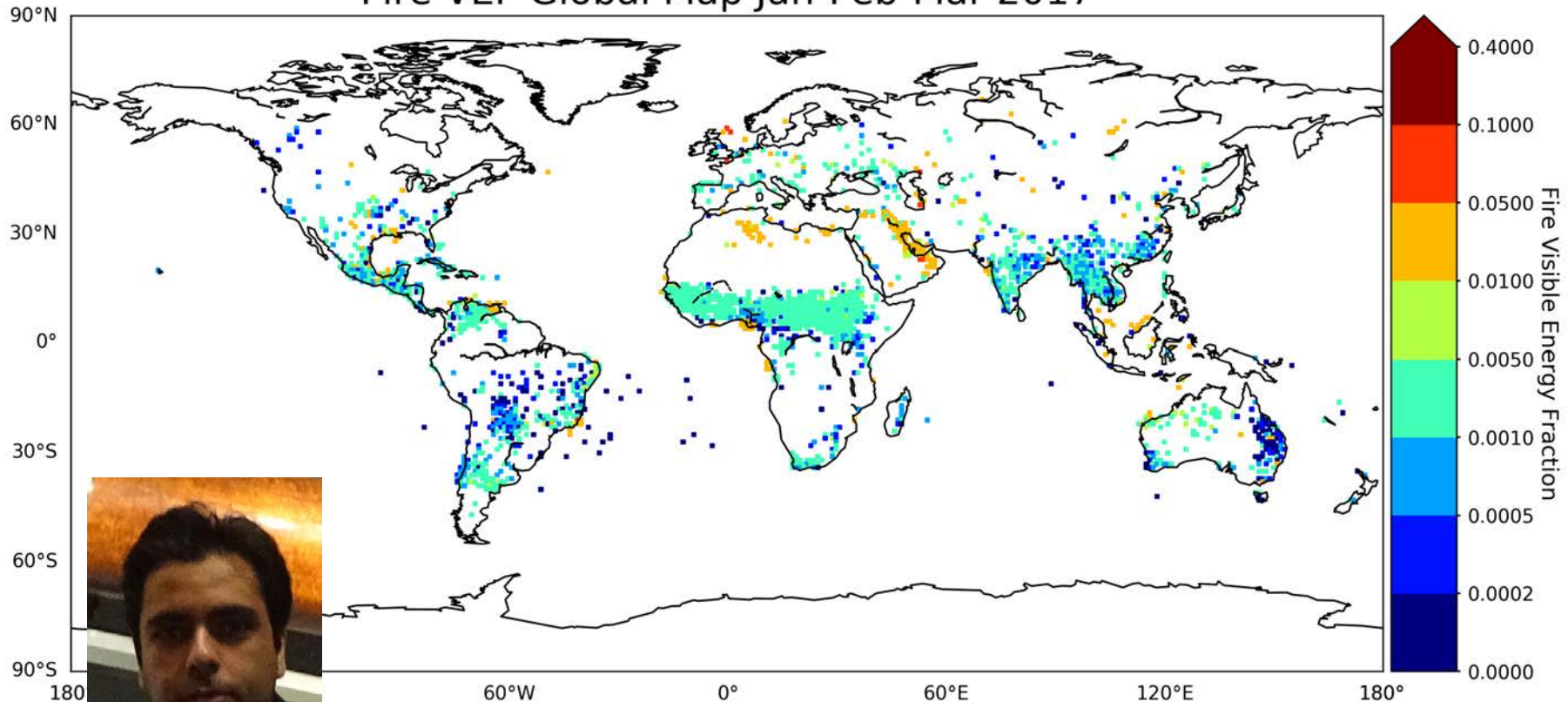


DNB Vis vs. IR

- Results shown are for 3:1 VIIRS aggregation zone
- Deviation from the best fit line is where we would look for combustion phase
- Cool+bright = initial flaming phase?
- Hot+dark = smoldering/pyrolysis?
- **Need observations to test this!**

Global Mapping of Fire Phase

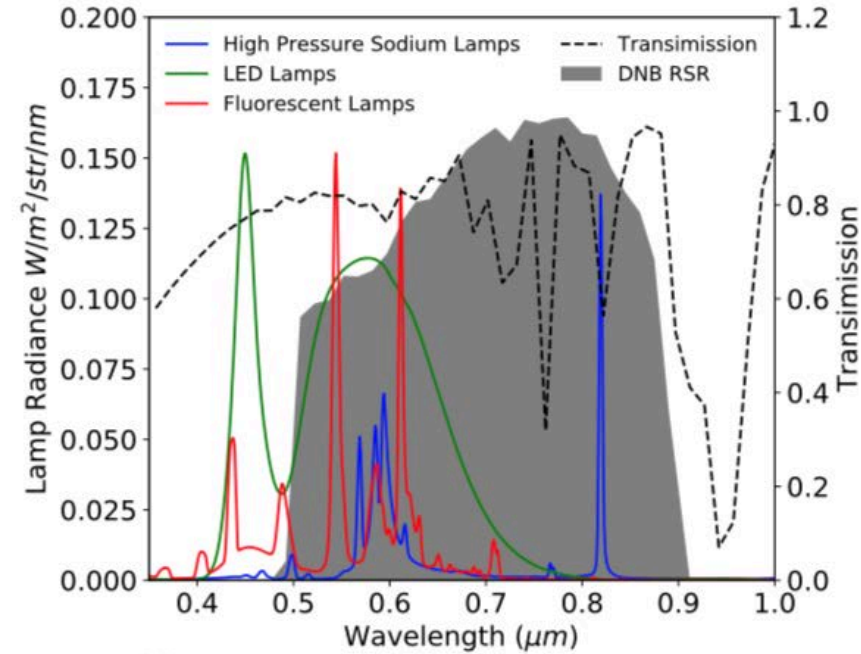
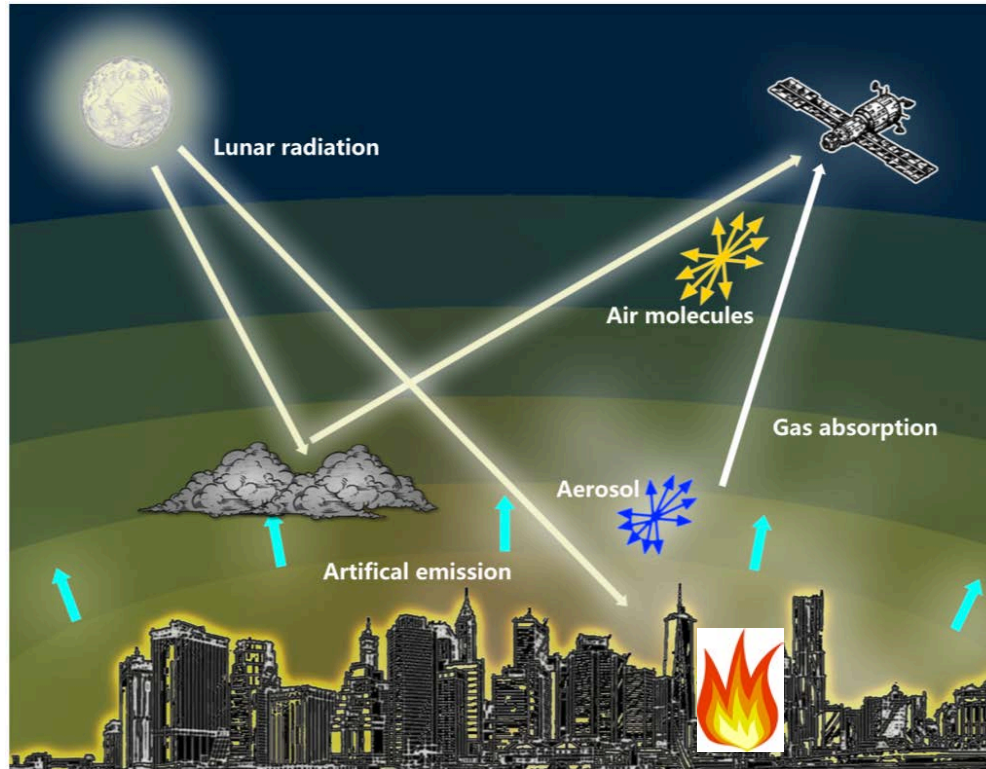
Fire VEF Global Map Jan-Feb-Mar 2017



Sepehr Roudini

Poster: Detecting Nighttime Fire Combustion Phase by Hybrid Application of Visible and Infrared Radiation from Suomi NPP VIIRS

Modeling of Fire Light, City Light, and Moon Light Transfer at Night

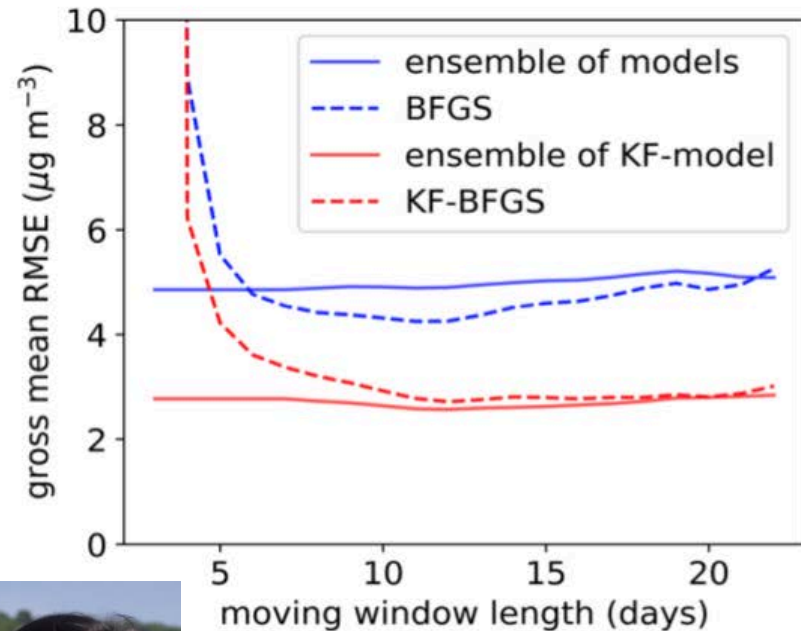
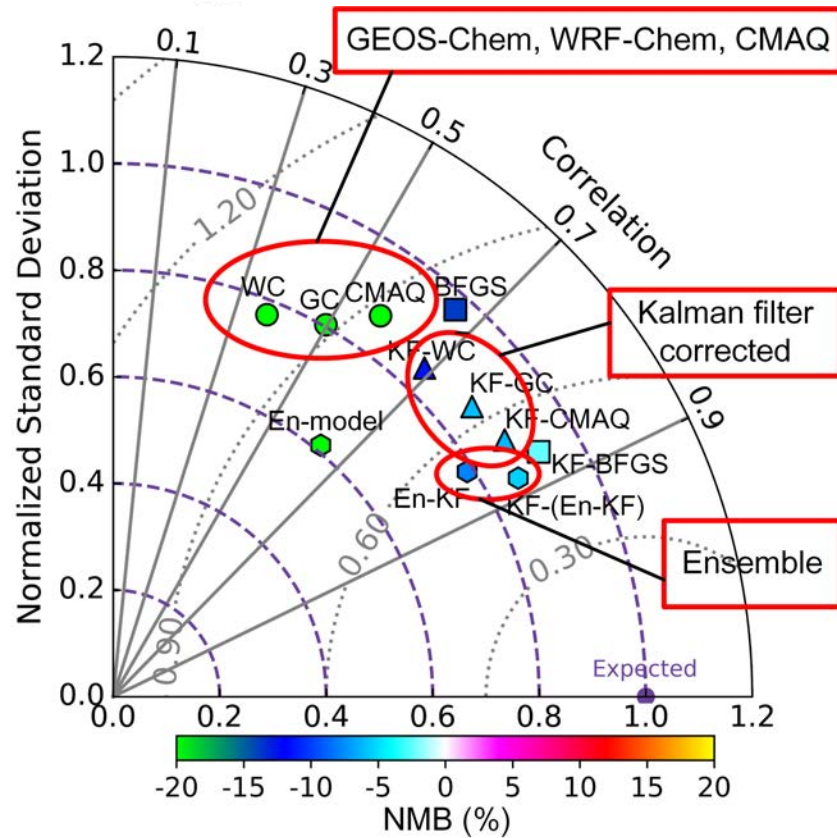


Poster: The Development of Night Time Radiation Transfer Model and Application to VIIRS Day Night Band (DNB)



Meng Zhou

Ensemble approach for using multiple models and multiple satellite datasets for prediction of PM_{2.5}



Poster: Estimates of satellite derived surface PM_{2.5} in the U.S. using an ensemble approach



Huanxin (Jessie) Zhang

Thank you !

