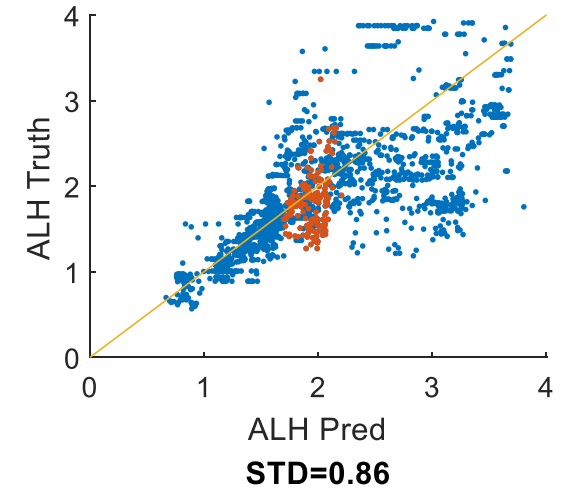
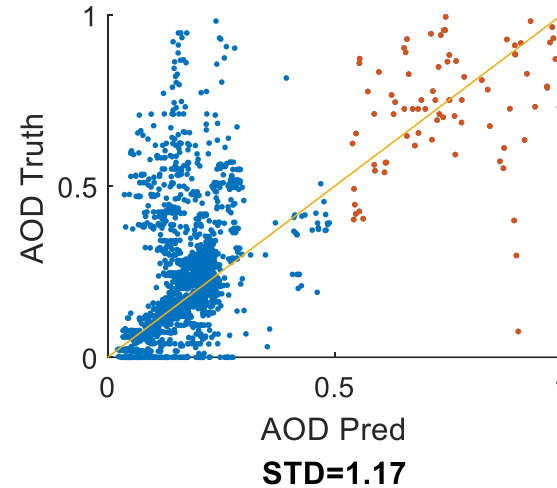
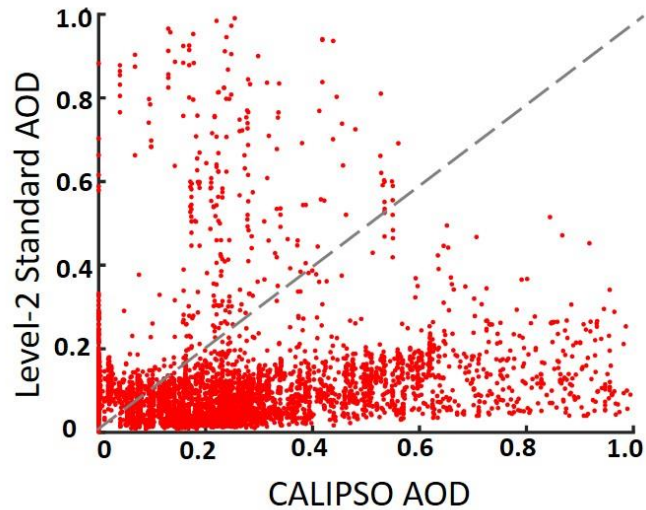
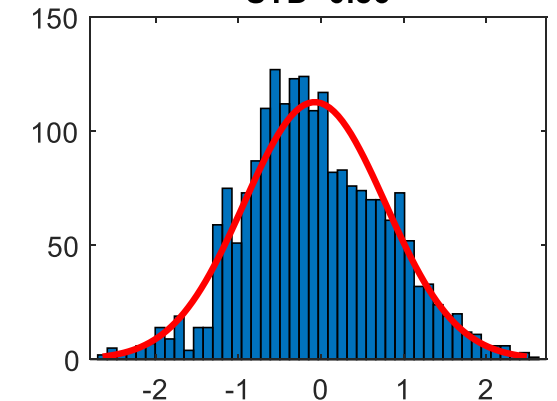
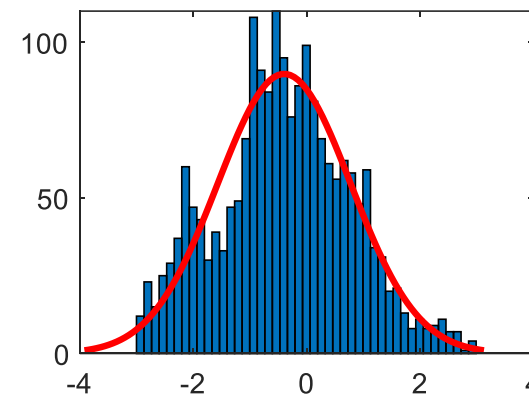


Improving OCO-2 XCO₂ Retrieval at Critical Albedo with Neural Network A-priori Constraints of Aerosol

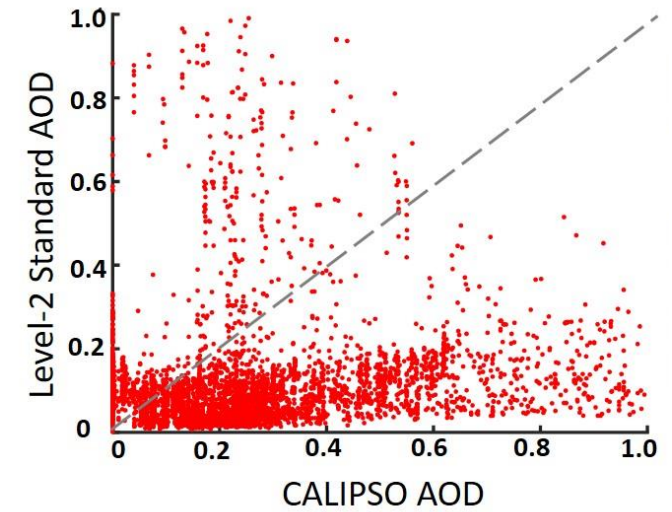
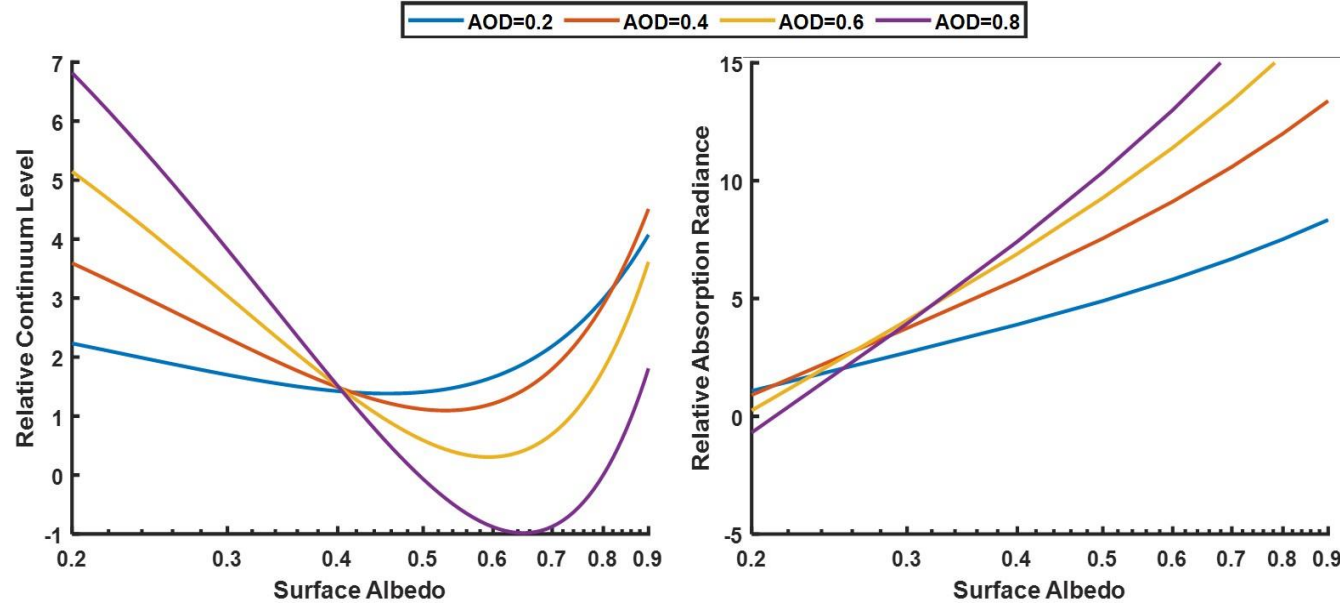
Sihe Chen, Zhao-Cheng Zeng, Vijay Natraj, and Yuk-Ling Yung



- We target to solve the problem of large error in OCO-2 Level-2 Standard data product's poor estimation of AOD.
- 2-Step Neural Network is applied.
- The improvement of this method to the current dataset is estimated.
- Simulated experiments are conducted to study the possible observational error.



What is the motivation of doing this?

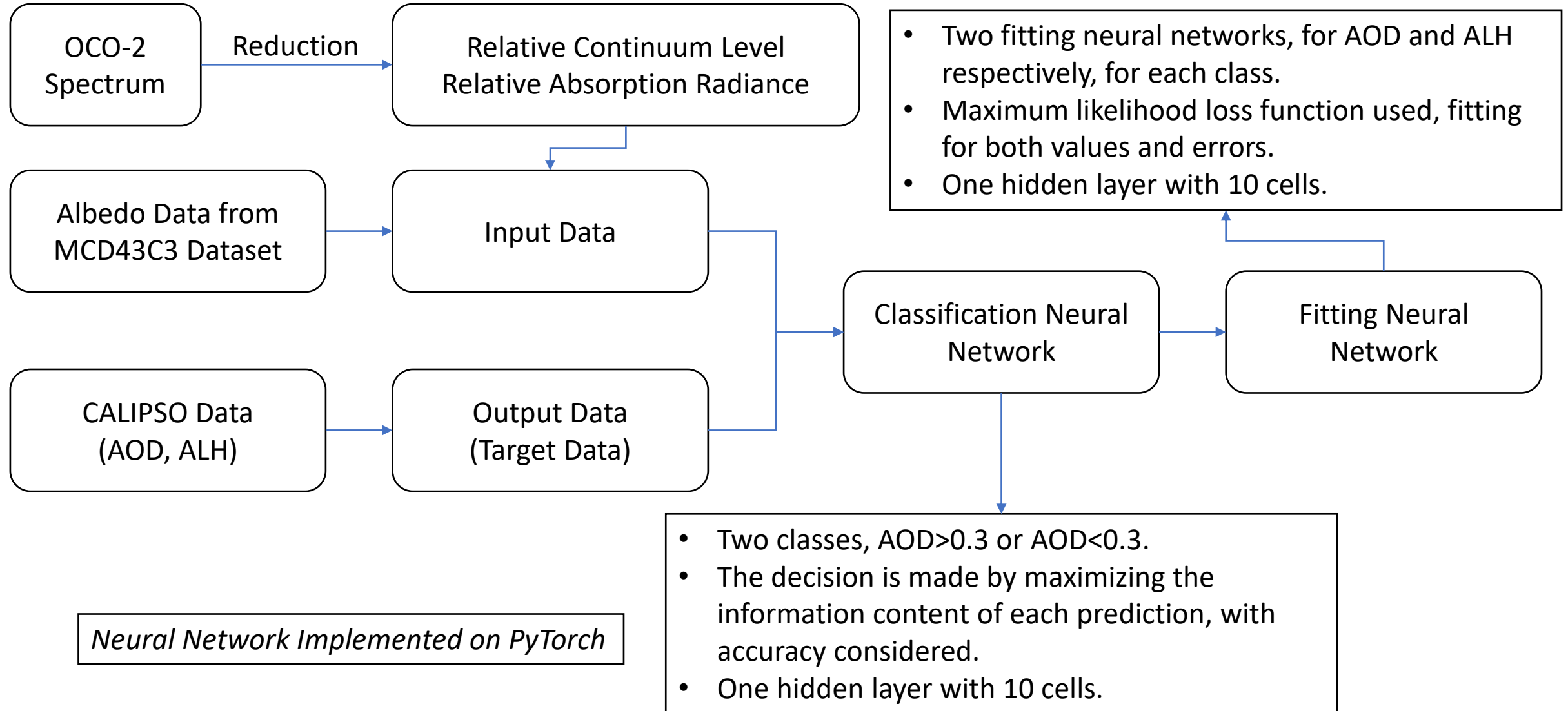


- The influence of critical albedo on spectral properties and thus retrieval accuracy.
- Poor agreement between Level-2 standard AOD data and CALIPSO AOD data.
- Introducing spectral-sorting method to give relative absorption radiance (Zeng, 2020), which breaks down the critical albedo influence.
- Using relative absorption radiance reduces the dimensionality of the spectral data. This facilitates the use of real data to train neural networks.

Reference

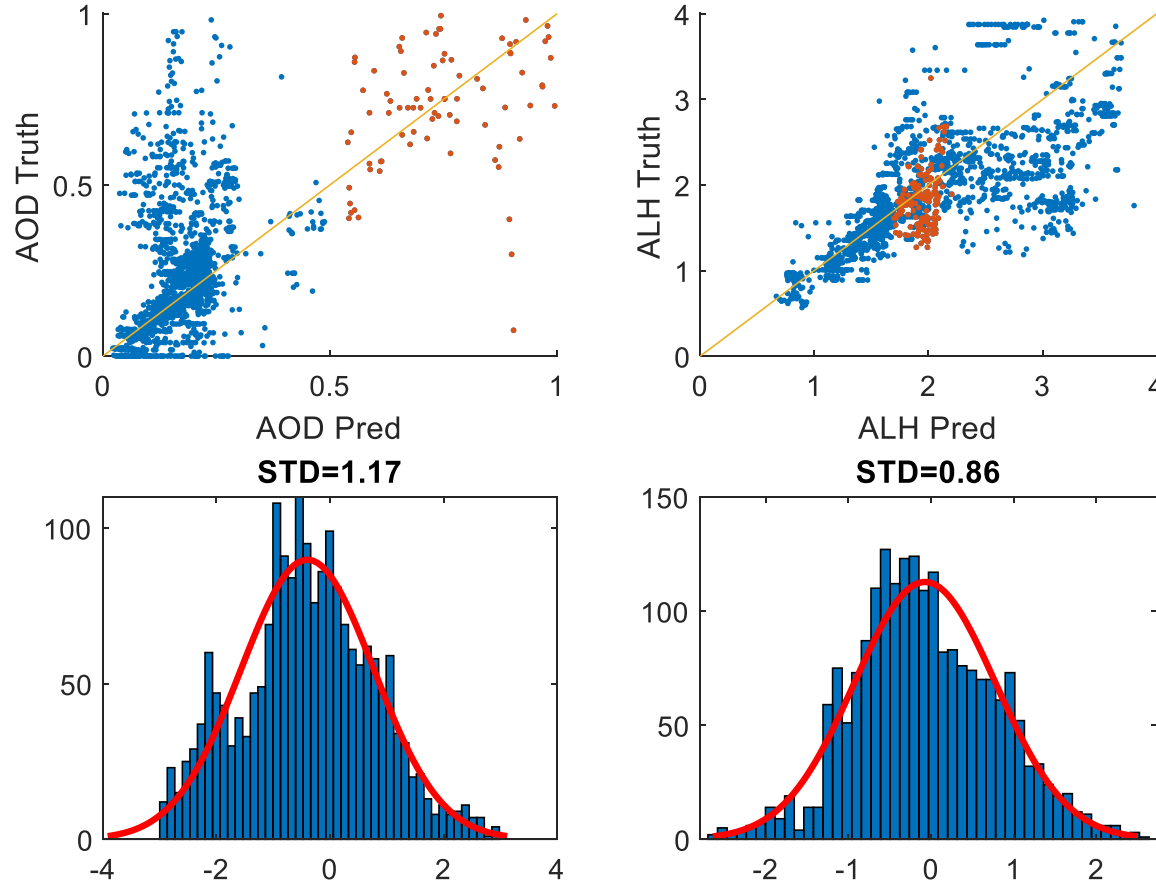
Zeng, Z.-C., et al, 2020. Constraining the vertical distribution of coastal dust aerosol using OCO-2 O₂ A-band measurements. Remote Sensing of Environment, 236.

The methodology



Results: performance of aerosol fitting

Note: The “Truth” of AOD and ALH refers to CALIPSO data



Performance of fitting

Mean squared error:

- AOD Prediction (On Linear Scale): 0.073
- ALH Prediction (On Pressure Scale): 0.0031

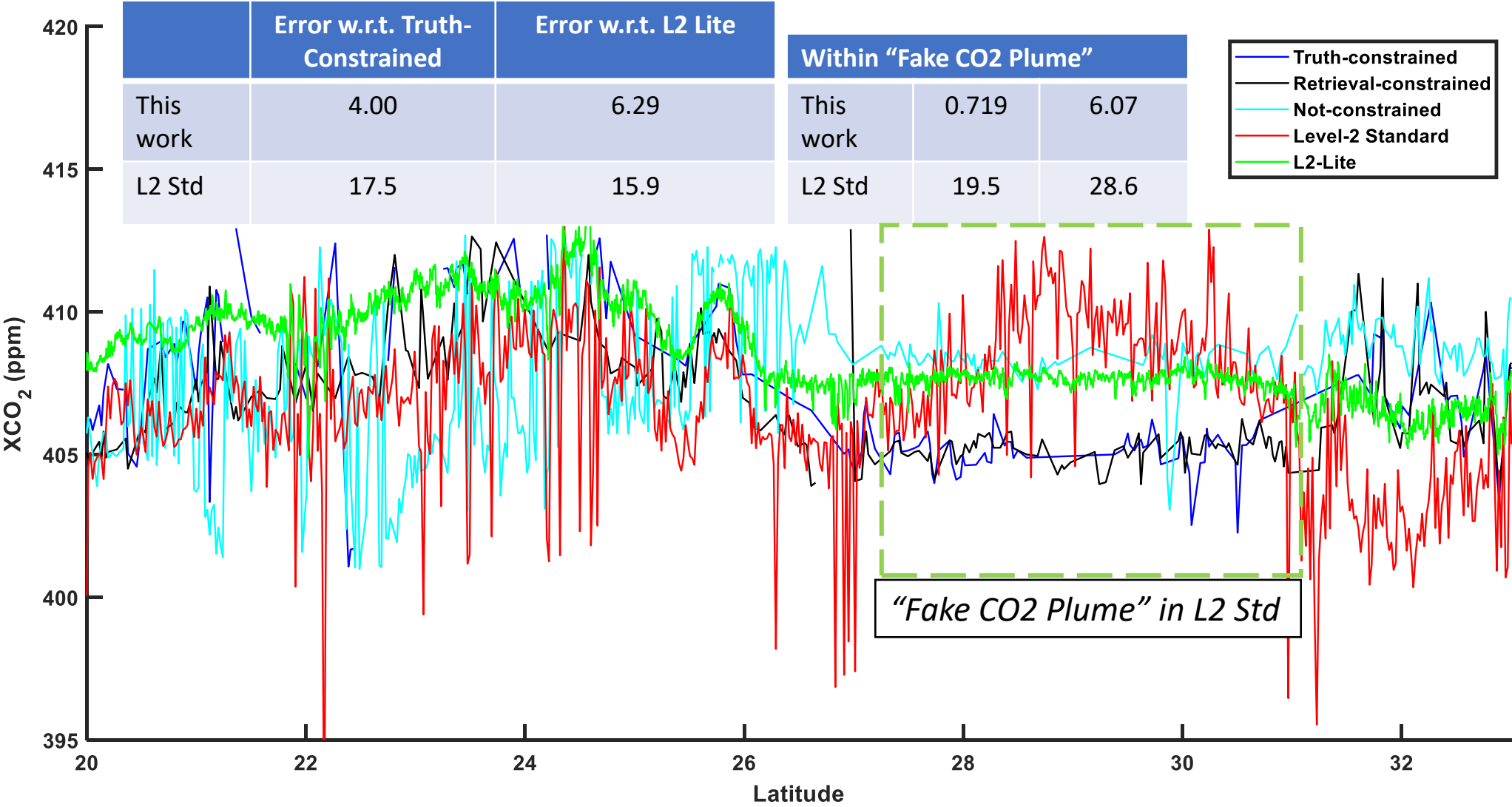
In comparison:

- AOD Mean Squared Error in Level-2 Std (On Linear Scale): 0.161

Error estimation

As seen in the figure, the actual error normalized by the estimation of error fits well to the standard normal distribution $N(0,1)$. This means that most of the large deviation from the truth is taken care of.

Results: performance of XCO2 retrieval



Validation: Simulated spectrum validation

Forward simulation:

- The actual Aerosol property, XCO₂, and surface albedo distribution follows the statistics of CALIPSO, OCO-2 L2 Lite Data, and MCD43C3 Datasets, respectively.
- We assume different error levels for the observation of AOD, ALH, and albedo.

Results:

- Small AOD is mostly not affected by the AOD observation, and it has good XCO₂ results. Large AOD has larger XCO₂ error for larger error level.
- Larger error levels of AOD/ALH are more sensitive to albedo error.

