Model Enforced Post-Process Correction of Satellite Aerosol Retrievals

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- Idea is to take existing satellite retrievals and train a machine learning-based model to correct for the results given the retrievals and observations as inputs.
- Here we apply this method to MODIS Dark Target over land.
- AERONET is used as accurate aerosol data source when training the models and in validation
- We compare the post-process corrected AOD and AE, machine learning based AOD and AE, and the Dark Target AOD and AE with AERONET
- We see that post-process correction results in most accurate results

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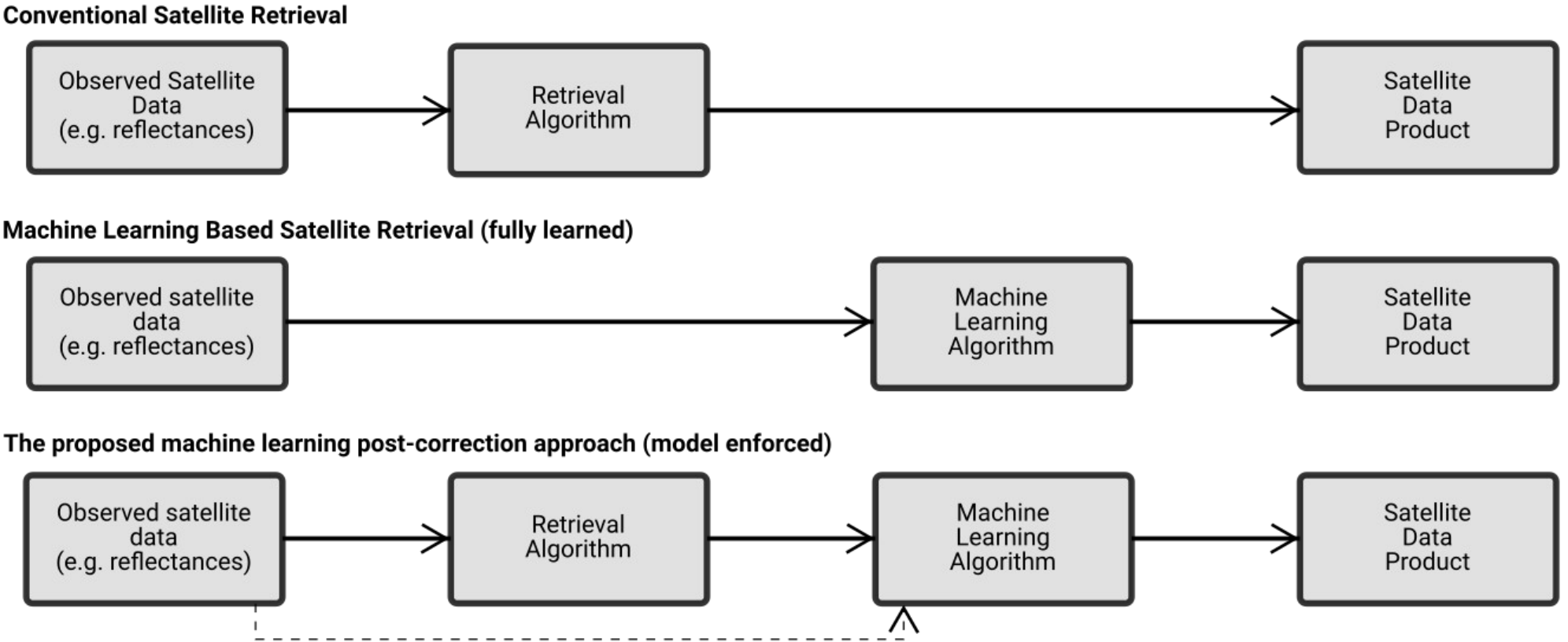

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Our model:

AOD or AE

$$y = f(\mathbf{x})$$
$$= \tilde{f}(\mathbf{x}) + \left[f(\mathbf{x}) - \tilde{f}(\mathbf{x}) \right]$$
$$= \tilde{f}(\mathbf{x}) + e(\mathbf{x})$$

Accurate retrieval algorithm (does not exist)

Satellite observations (e.g. TOA reflectances, observation geometry etc.)

Actual satellite retrieval algorithm (e.g. Dark Target)

Retrieval error

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Our model:

Random Forest as regression model

	Regression	Correction
Inputs	Mean_TOA_Reflectance_0.47 Mean_TOA_Reflectance_0.55 Mean_TOA_Reflectance_0.65 Mean_TOA_Reflectance_0.86 Mean_TOA_Reflectance_1.24 Mean_TOA_Reflectance_1.63 Mean_TOA_Reflectance_2.11 STD_TOA_Reflectance_0.47 STD_TOA_Reflectance_0.55 STD_TOA_Reflectance_0.65 STD_TOA_Reflectance_0.86 STD_TOA_Reflectance_1.24 STD_TOA_Reflectance_1.63 STD_TOA_Reflectance_2.11 Scattering_Angle Sensor_Azimuth Sensor_Zenith Solar_Azimuth Solar_Zenith Topographic_Altitude_Land	AE (computed from Corrected_Optical_Depth_Lands) Surface_Reflectance_0.47 Surface_Reflectance_0.66 Surface_Reflectance_2.13 Corrected_Optical_Depth_Land_0.47 Corrected_Optical_Depth_Land_0.55 Corrected_Optical_Depth_Land_0.66 Land_Ocean_Quality_Flag Aerosol_Type_Land Mean_TOA_Reflectance_0.47 Mean_TOA_Reflectance_0.55 Mean_TOA_Reflectance_0.65 Mean_TOA_Reflectance_0.86 Mean_TOA_Reflectance_1.24 Mean_TOA_Reflectance_1.63 Mean_TOA_Reflectance_2.11 STD_TOA_Reflectance_0.47 STD_TOA_Reflectance_0.55 STD_TOA_Reflectance_0.65 STD_TOA_Reflectance_0.86 STD_TOA_Reflectance_1.24 STD_TOA_Reflectance_1.63 STD_TOA_Reflectance_2.11 Scattering_Angle Sensor_Azimuth Sensor_Zenith Solar_Azimuth Solar_Zenith Topographic_Altitude_Land
Outputs	AOD at 550 nm or AE (AERONET-based)	Additive correction *e* for AOD at 550 nm or AE (AERONET/MODIS -based)

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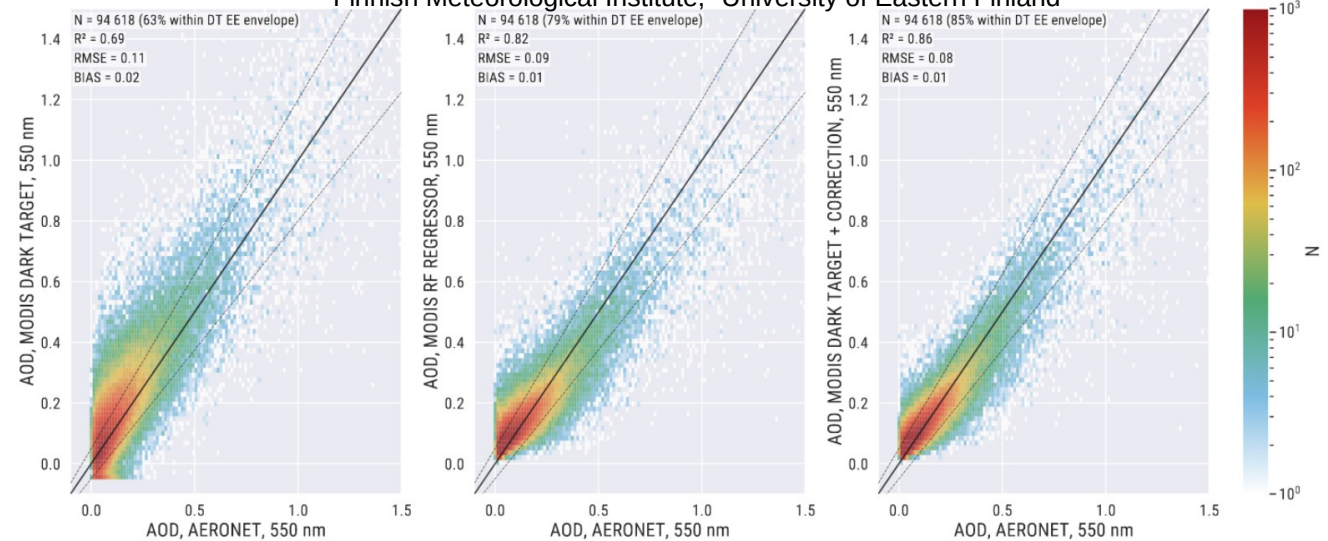
AOD

AE



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