National Aeronautics and Space Administration

Spatially constrained retrievals for Earth-facing imaging spectroscopy

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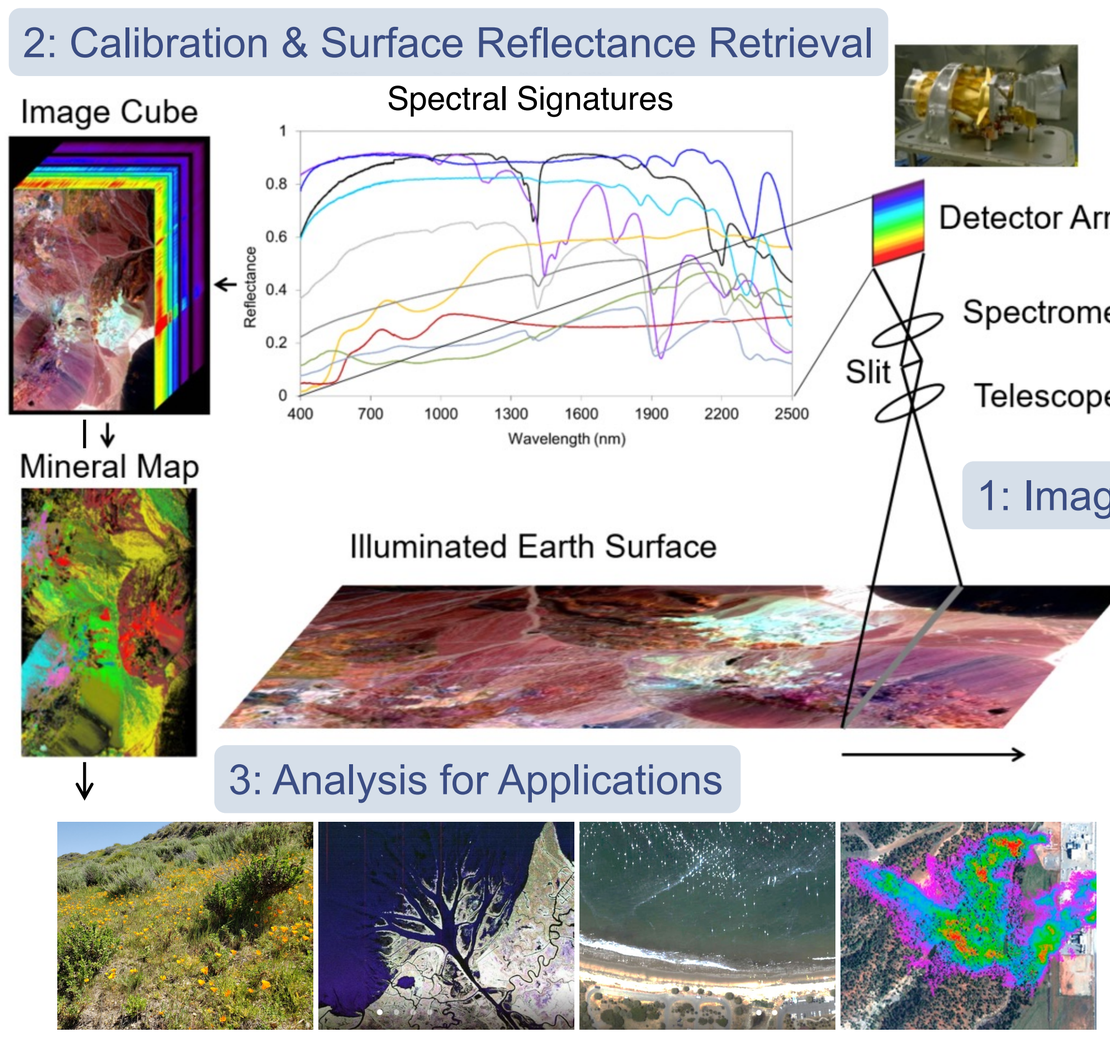
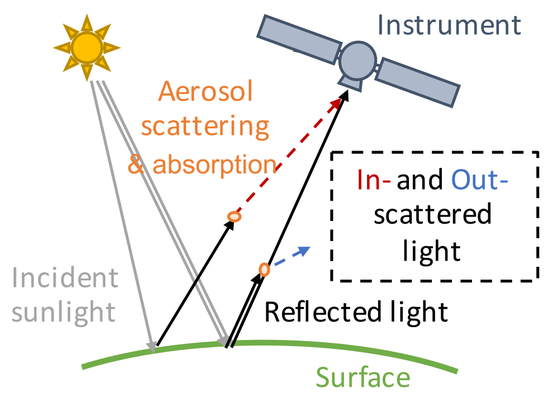
Imaging Spectroscopy Overview

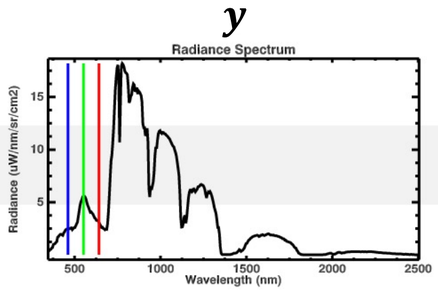


Joint Retrieval of Atmospheric and Surface Parameters

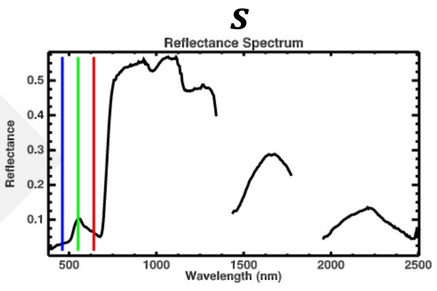


Current algorithms ignore spatial information and retrieve surface reflectance on a pixel-by-pixel basis
→ This is slow and leads to inaccurate retrievals

Radiance at sensor $\boldsymbol{y}$



Retrieved surface reflectance $\boldsymbol{s}$



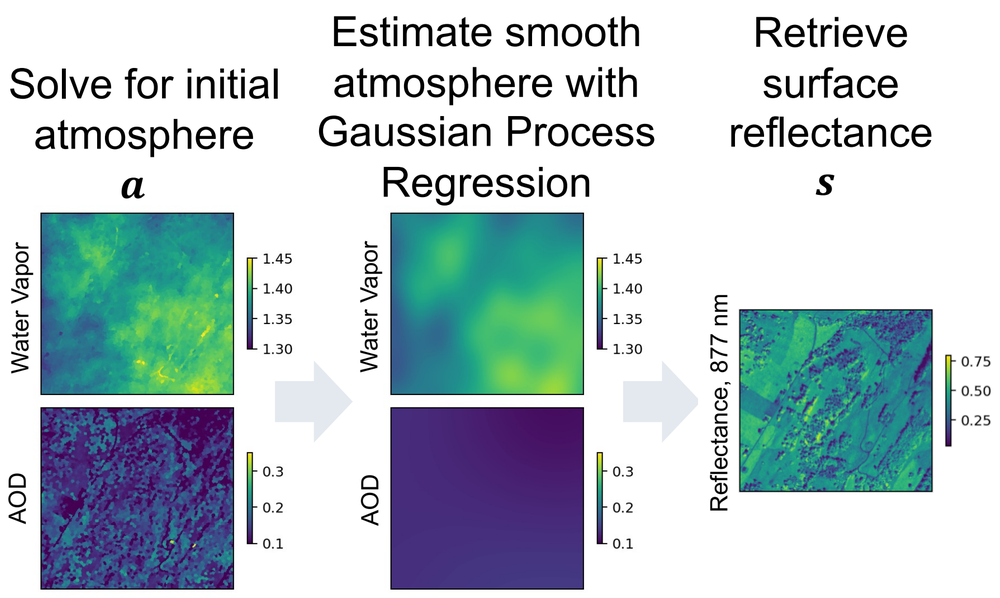
Retrieved atmospheric parameters

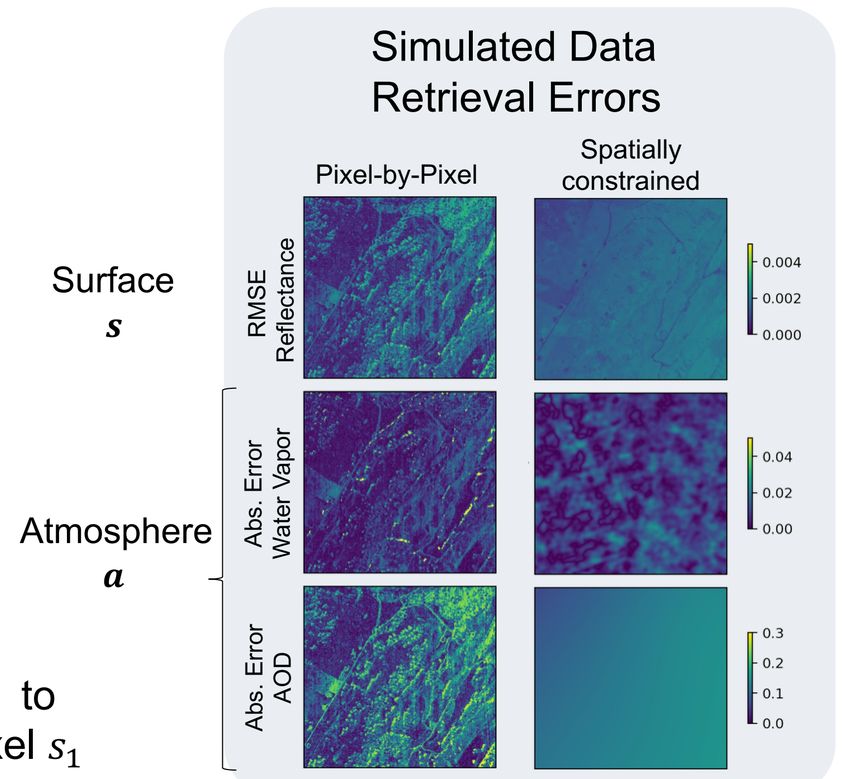
$\boldsymbol{a}$

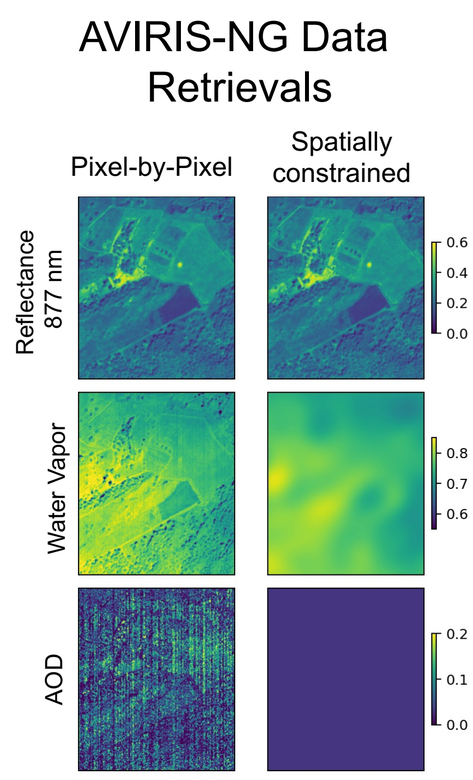
- Water vapor
- Aerosol optical depth

Maximum *A Priori* Estimation (Optimal Estimation)

Proposed Method: Constrain atmospheric parameters to be spatially smooth

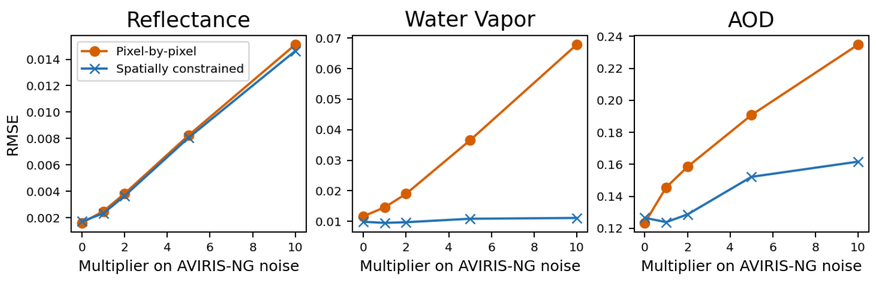






This method is mathematically equivalent to a **full spatio-spectral inversion**, using **belief propagation** to calculate the marginal distribution $p(s_1 | y_1, \ldots y_n)$ at pixel s_1 given all measurements y

Simulated Data Retrieval Error across Noise Levels



Conclusion

Proposed method reduces surface-based biases and is more resilient to increased sensor noise, improving the retrieval across surface types

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Publications:

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