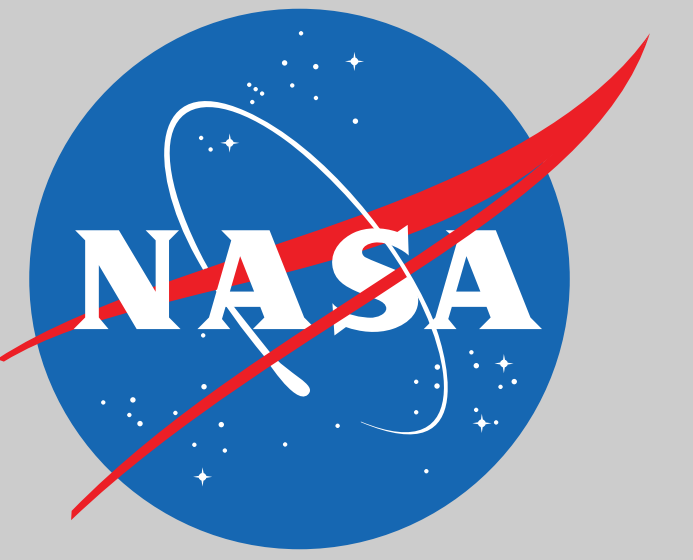


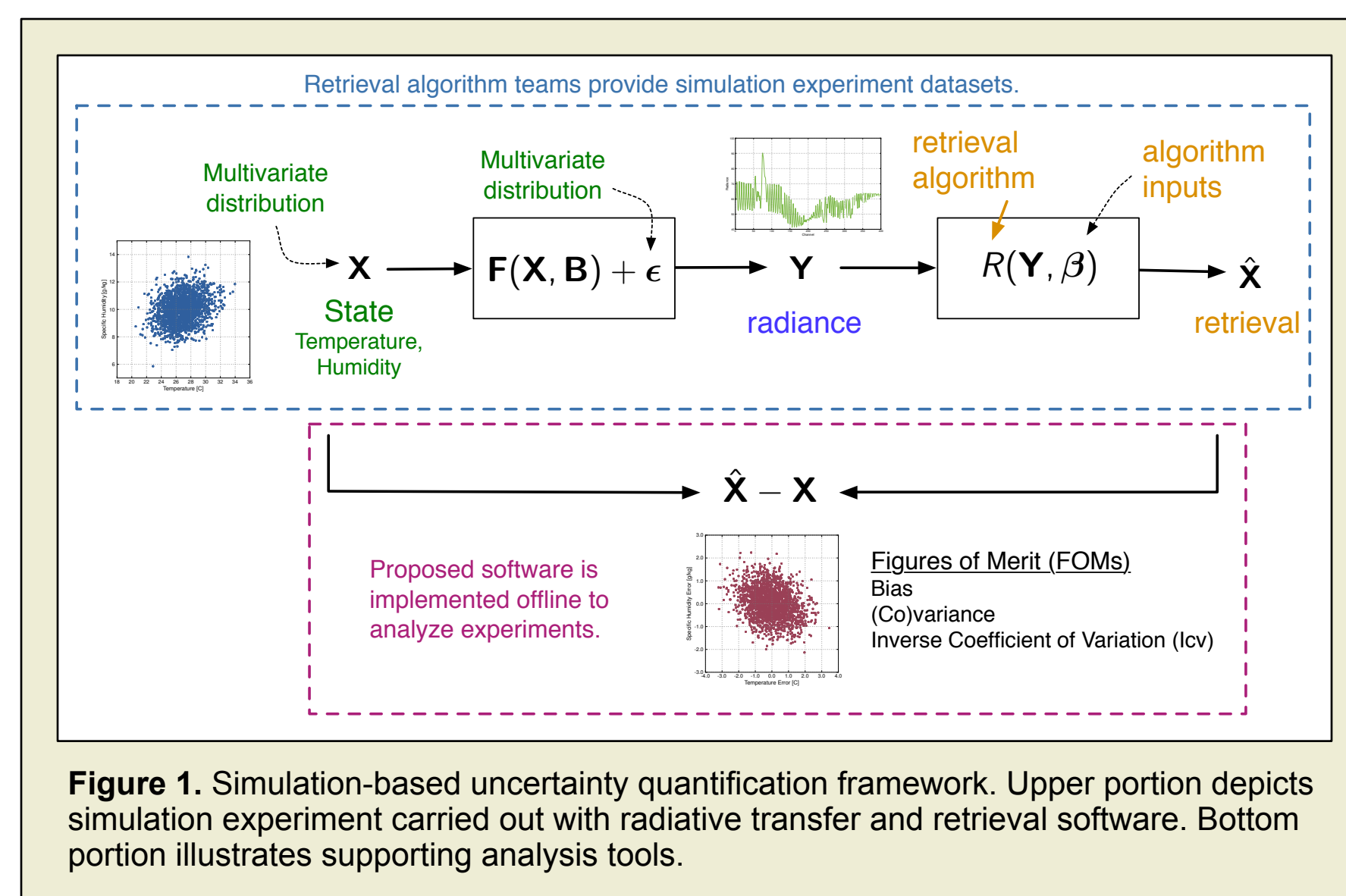
Simulation-Based Uncertainty Quantification for Level 2 Retrievals: Tools and Applications

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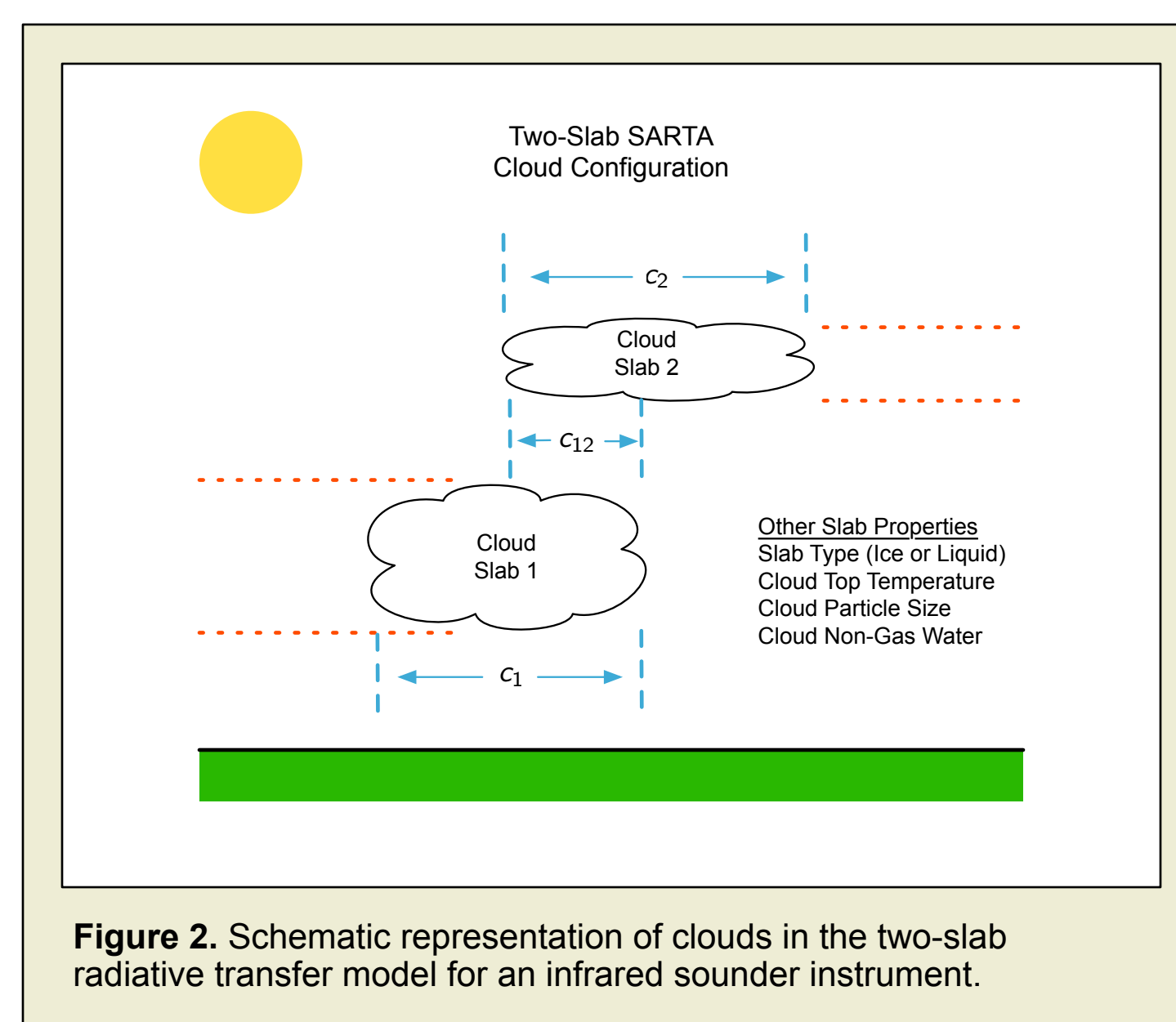


Simulation-Based Uncertainty Quantification

- **Objective:** Develop statistical methods and analysis software to facilitate uncertainty quantification (UQ) for Level 2 atmospheric remote sensing data products produced by operational retrieval algorithms.
- Monte Carlo simulation of the observing system (Fig. 1) provides a general setting for UQ and investigation of sources of uncertainty on the retrieval error distribution.

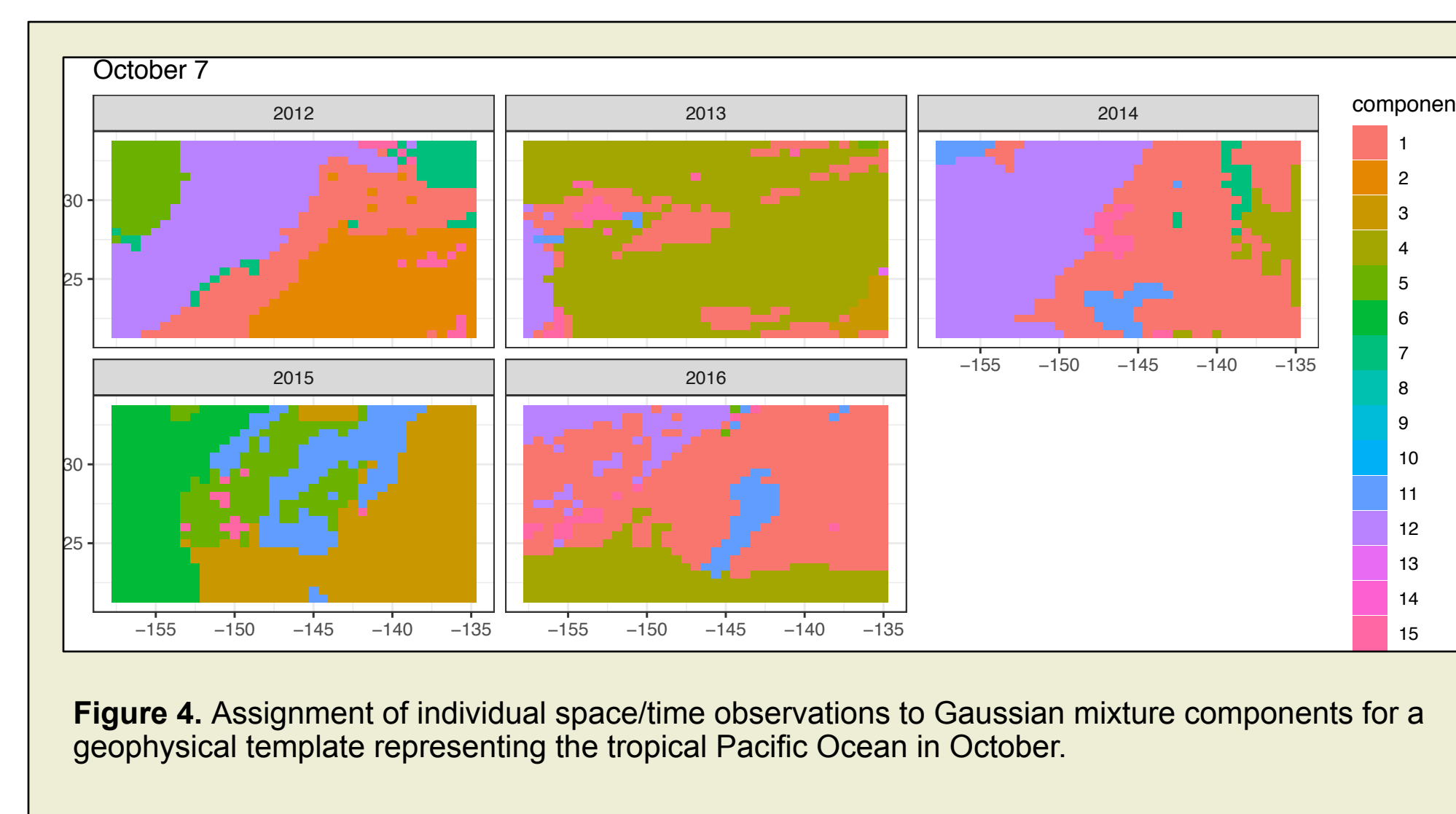
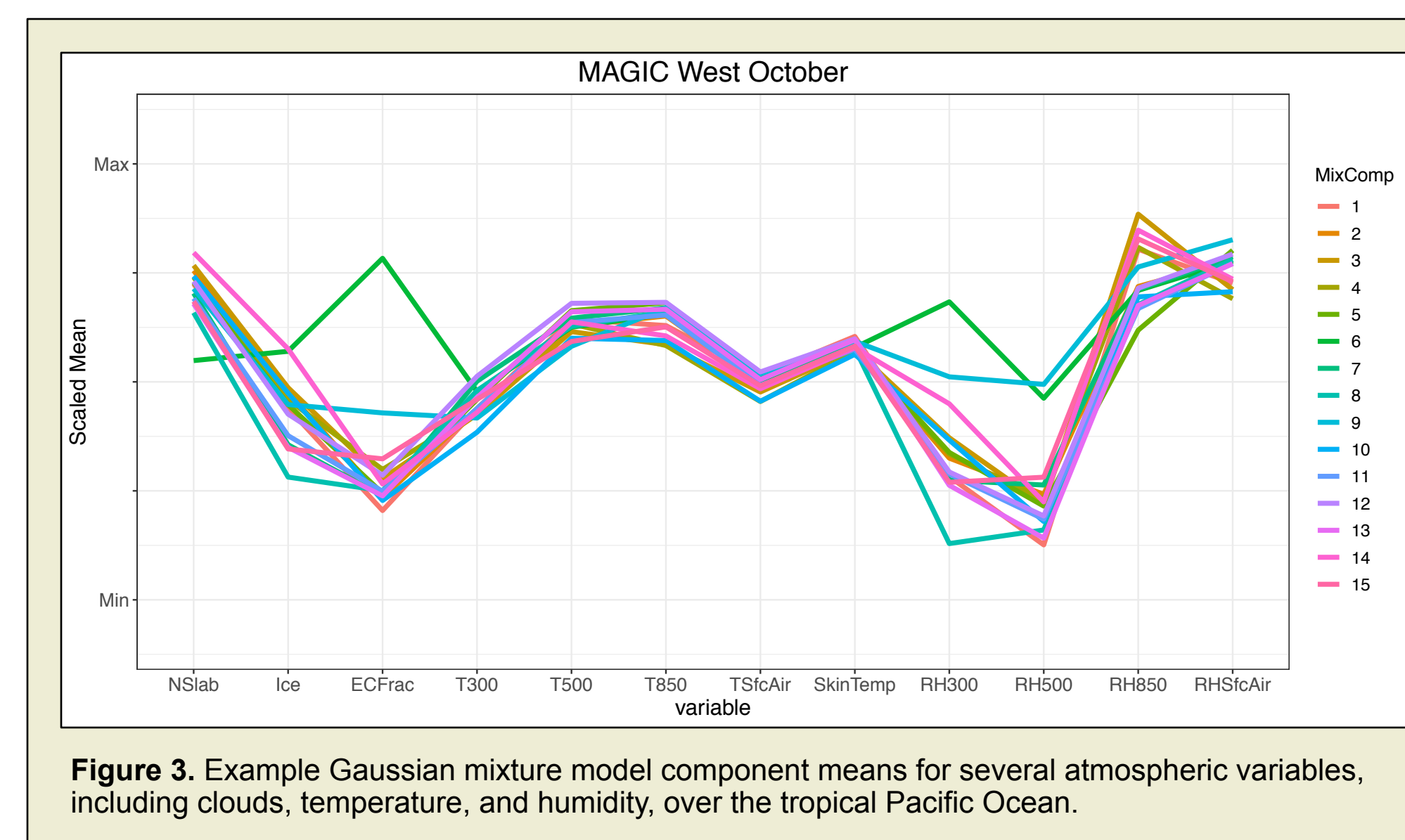


- Experiments require a realistic forward model (Fig. 2), which need not match a physical model incorporated in the retrieval.



Statistical Tools

- Framework is based on a probabilistic representation of the input state vector X .
- Quantile transformation enforces physical constraints for individual state variables
- Flexible multivariate model uses Gaussian mixture modeling (Fig. 3).
- Experiment is executed for a *geophysical template*, a specific set of atmospheric and observing conditions defined by region and season (Fig. 4).



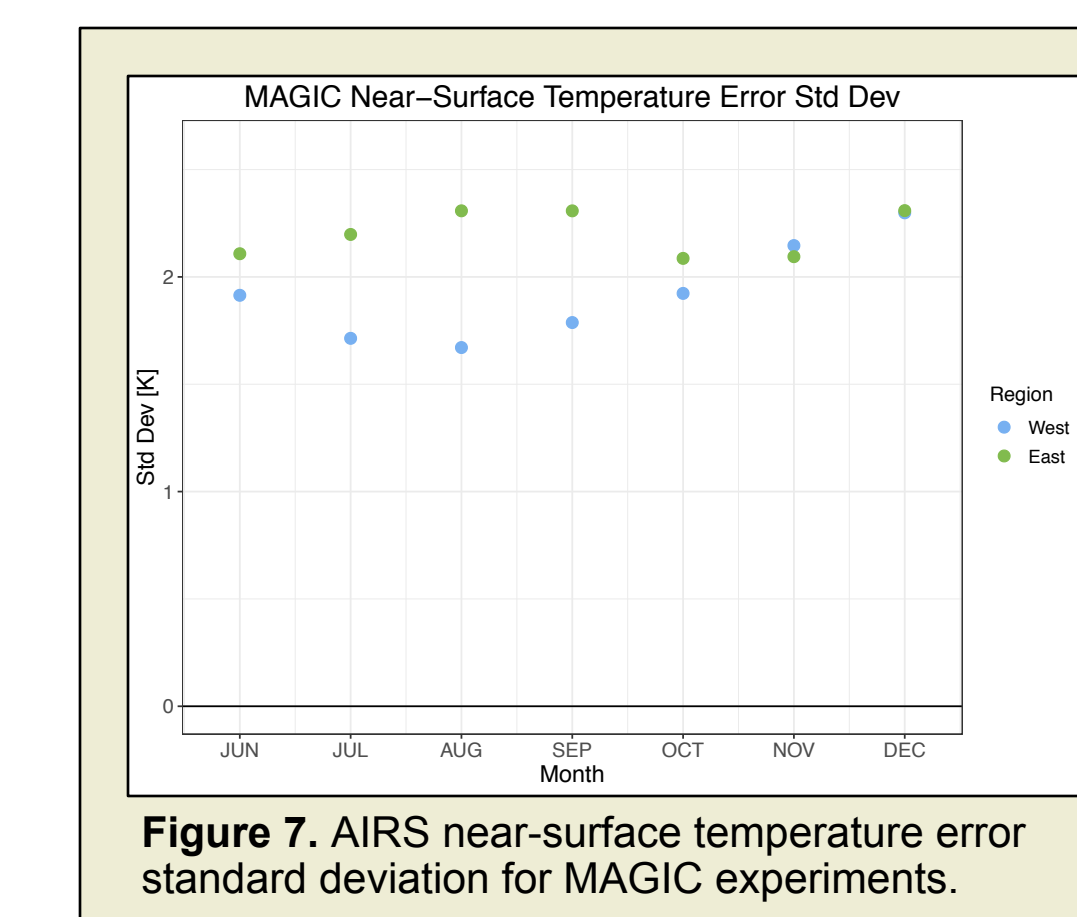
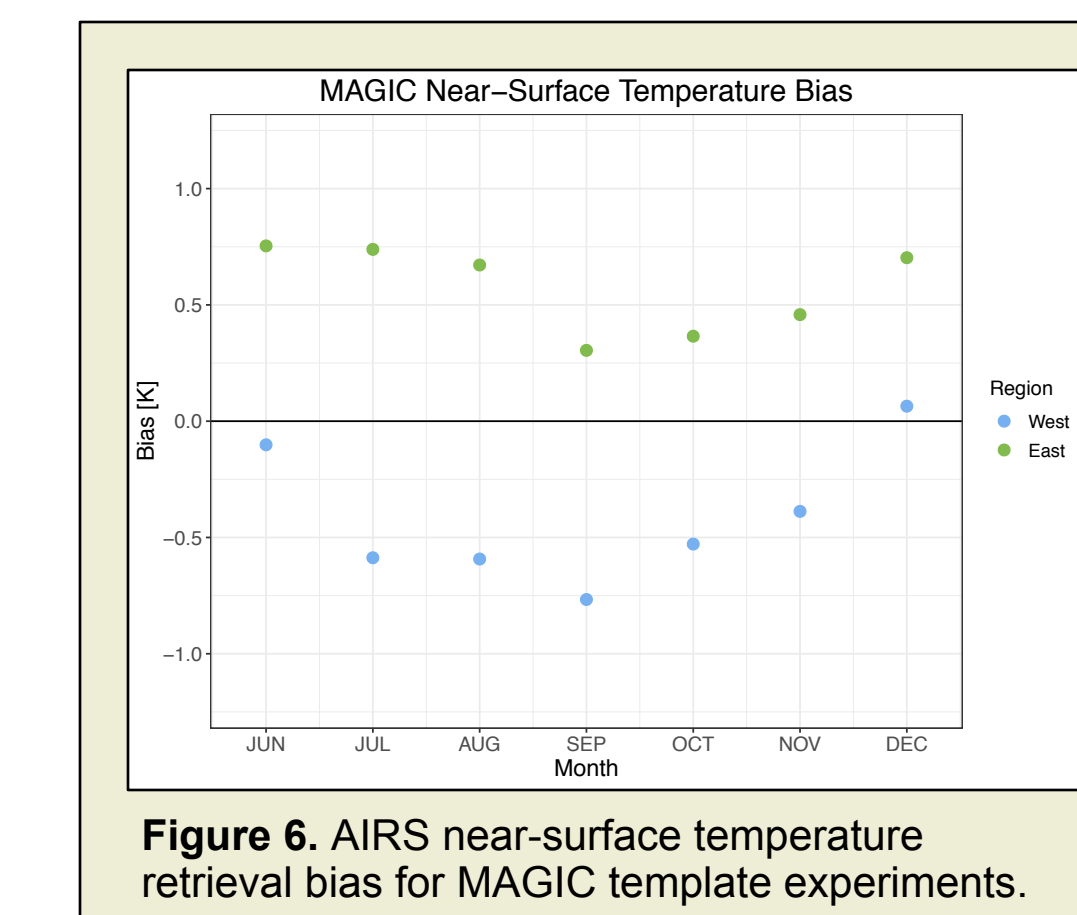
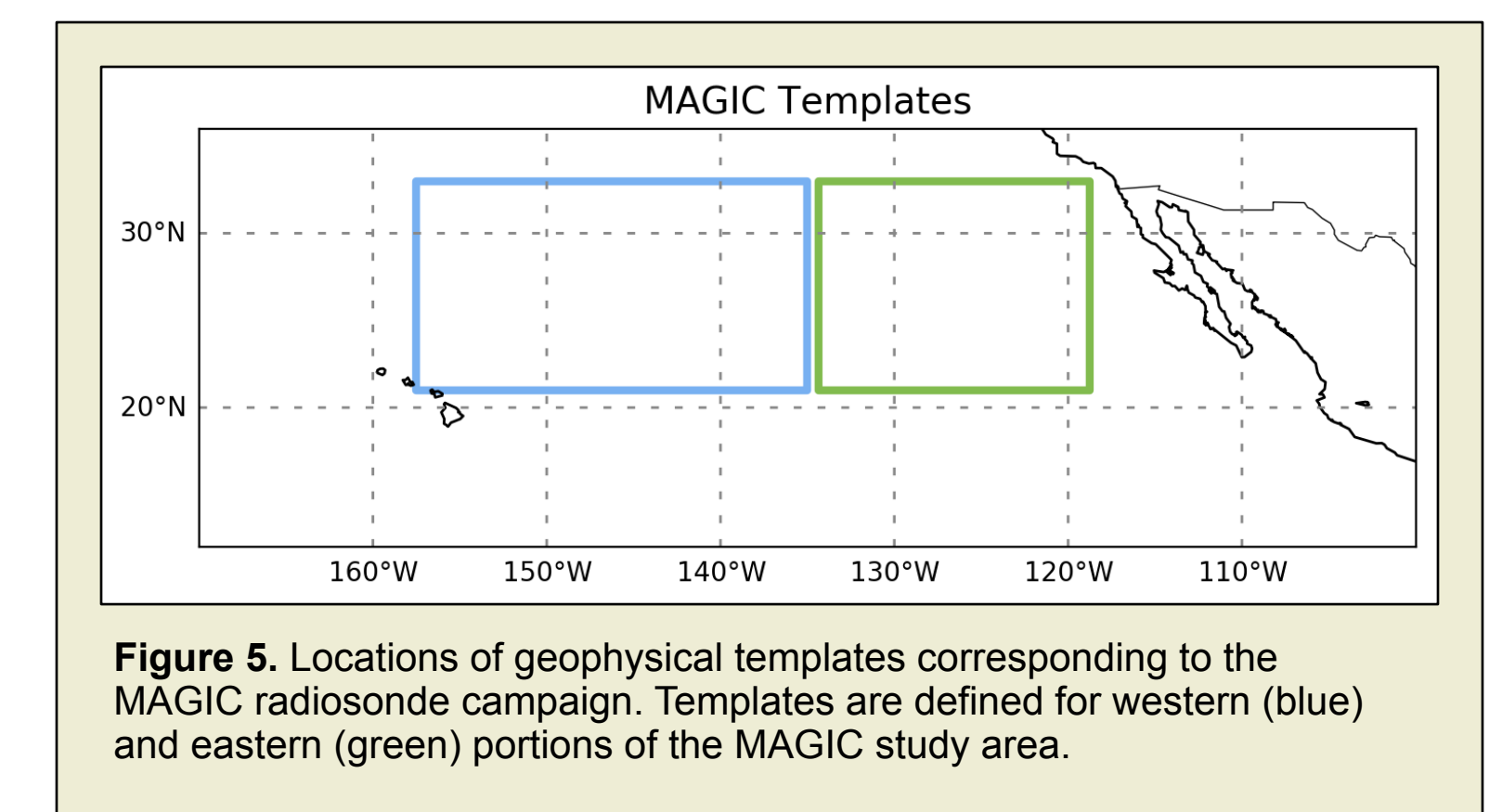
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AIRS Implementation

- Simulation framework implemented for Atmospheric Infrared Sounder (AIRS) retrieval of temperature, humidity, and clouds.



- **Objective:** Execute simulation experiments for the subtropical eastern Pacific, coincident with the MAGIC validation campaign (Fig. 5).
- Different regional cloud regimes impact retrieval error properties (Fig. 6-7).
- Experiments complement data fusion activities.

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