



Spectral Radiation Diagnostics for Model-Satellite Comparisons

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2023 CESM Workshop



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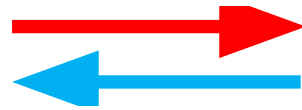
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Model-Observation comparisons go both ways

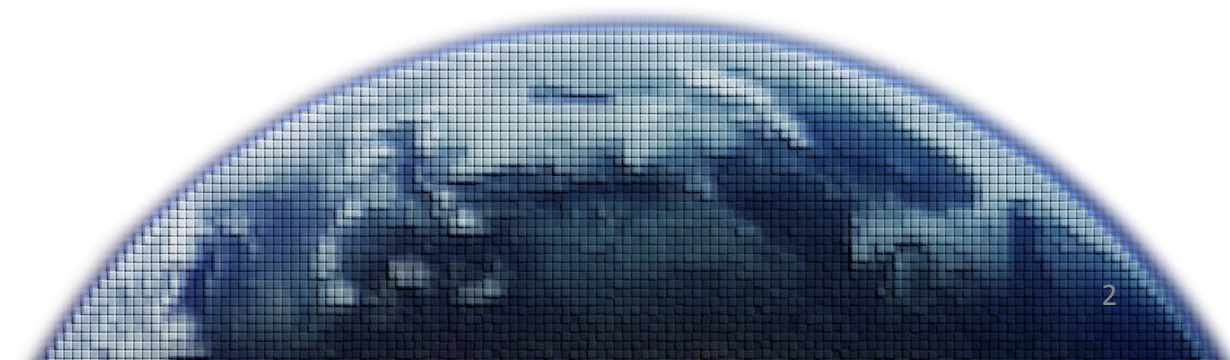
Observations of the
Earth System

Observations
constrain models



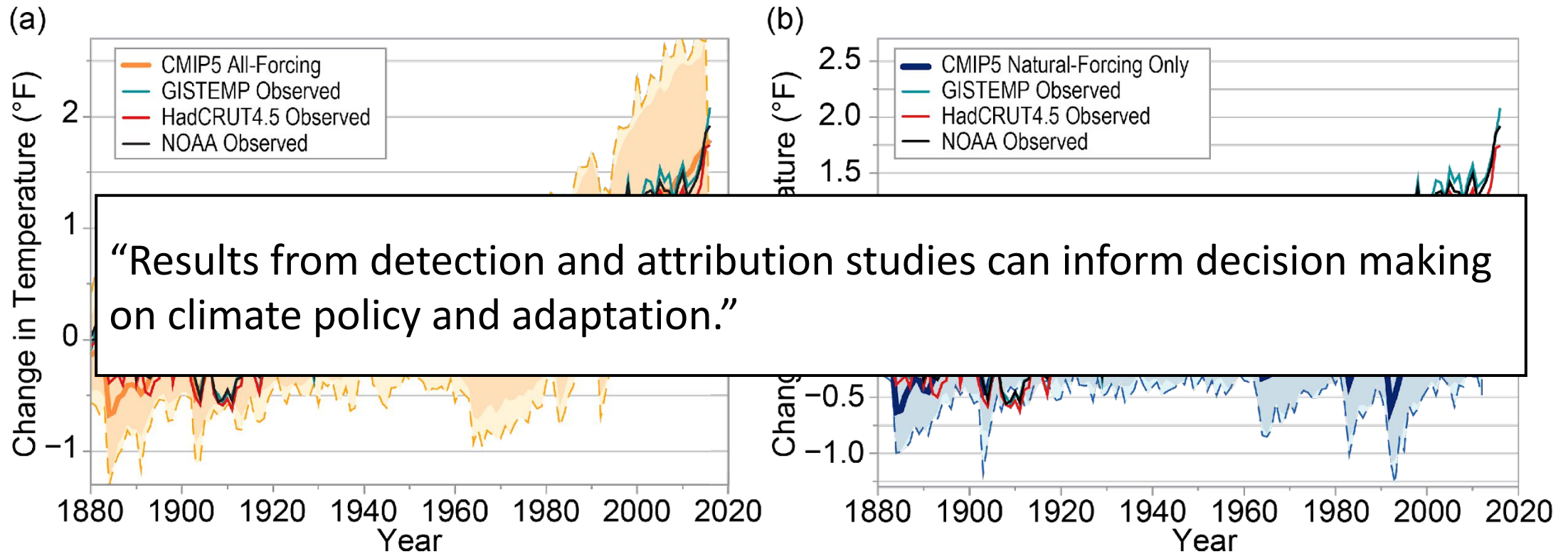
Models inform
observations

Climate Models



Attribution of climate change requires climate model simulations

Global Mean Temperature Change



Satellites are a powerful tool for climate change detection

Time-to-emergence of Arctic Outgoing Longwave Radiation Changes

- Multi-decadal satellite records

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- Climate change detection and attribution can inform decision making on climate policy and adaptation.

- Satellite records provide excellent tools for detecting climate change.

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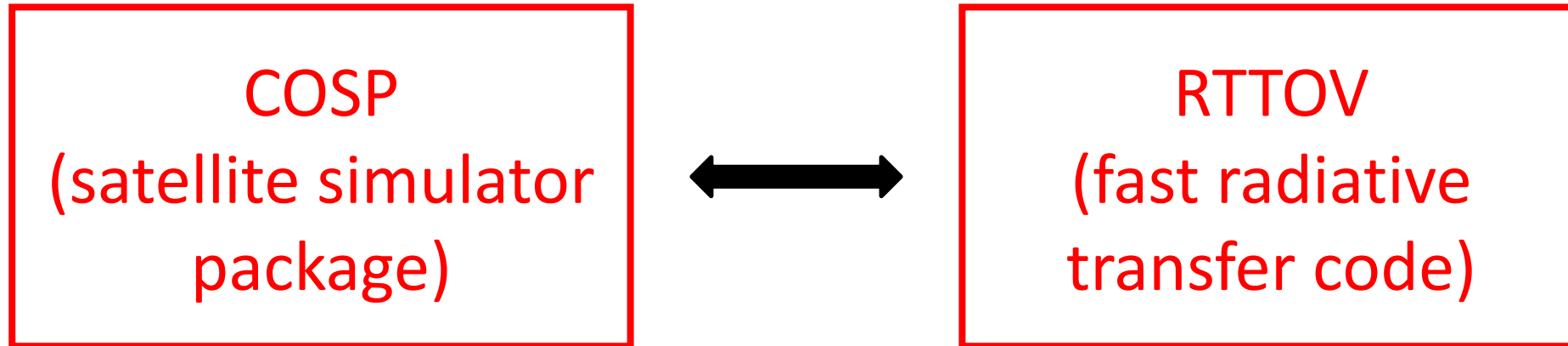
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- But field observations.

- Analogous model output is needed to place observations in the broader context of forced change and internal climate variability.



Online simulation of spectral radiation fields in COSP and RTTOV



- Trusted tool for model-observation and model-model comparisons
- Already used by CESM and several other model development communities

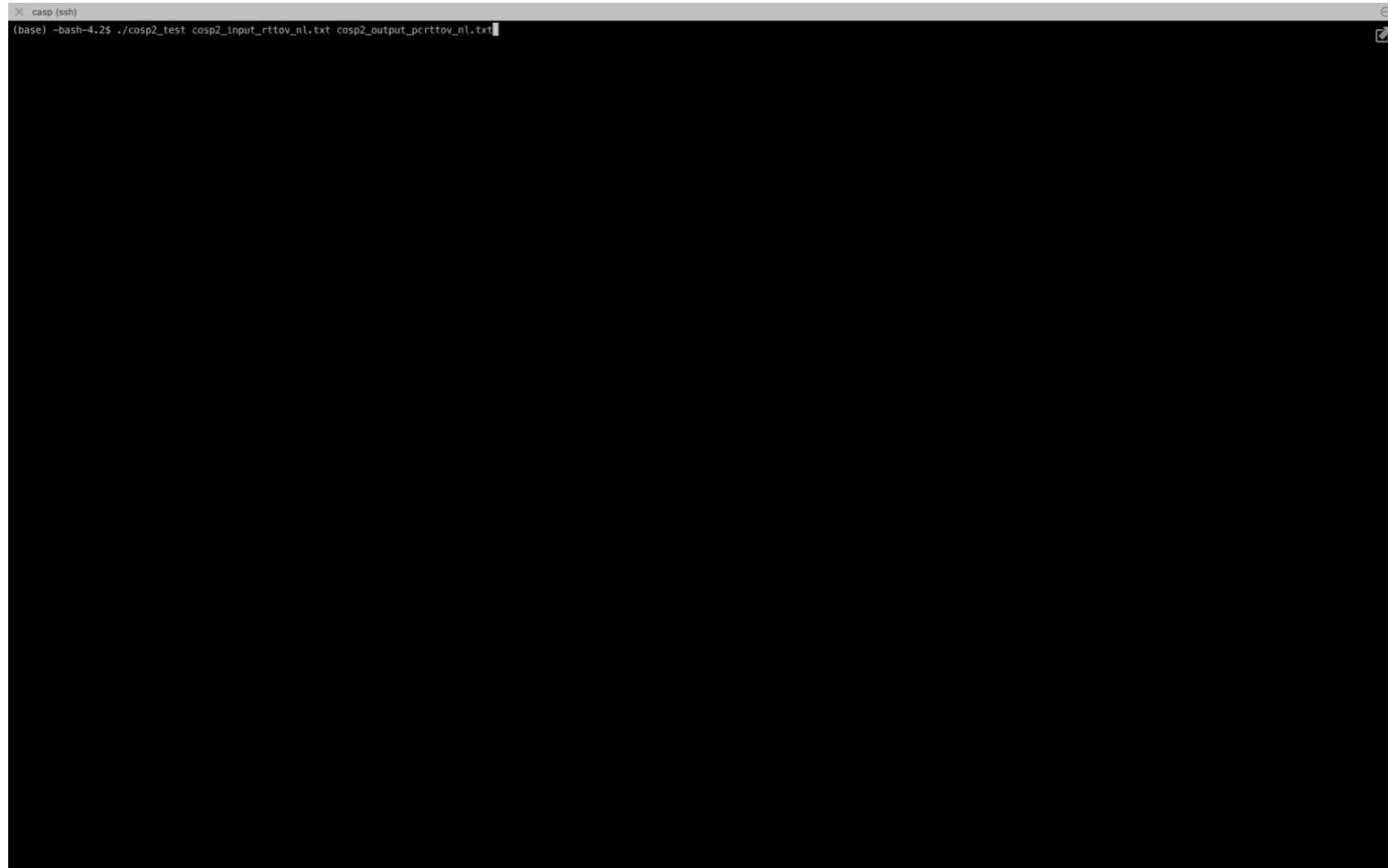
- Fast, accurate simulation of radiance fields
- Radiances are specific to individual instruments

Project Timeline: Initial Simulations complete by the end of 2023

Milestone	Status
Integration of RTTOV v13 into COSP2	Done!
RTTOV functioning in CESM2	In progress, complete by August 2023
Initial simulations in CESM2	Complete by the end of 2023

Simulating spectral fields is computationally efficient

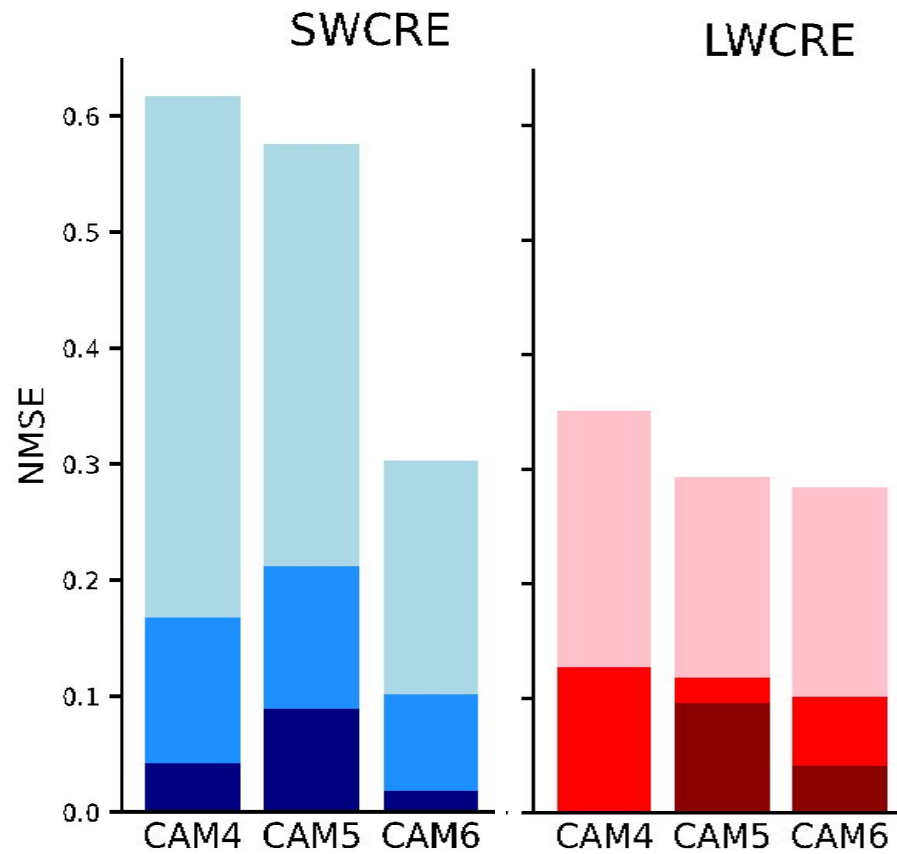
- Like COSP, creating additional model output is computationally efficient.

A terminal window titled 'cosp (ssh)' is shown. The prompt is '(base) -bash-4.2\$'. The command being executed is './cosp2_test cosp2_input_rttov_nl.txt cosp2_output_pcrttov_nl.txt'. The terminal output is currently blank.

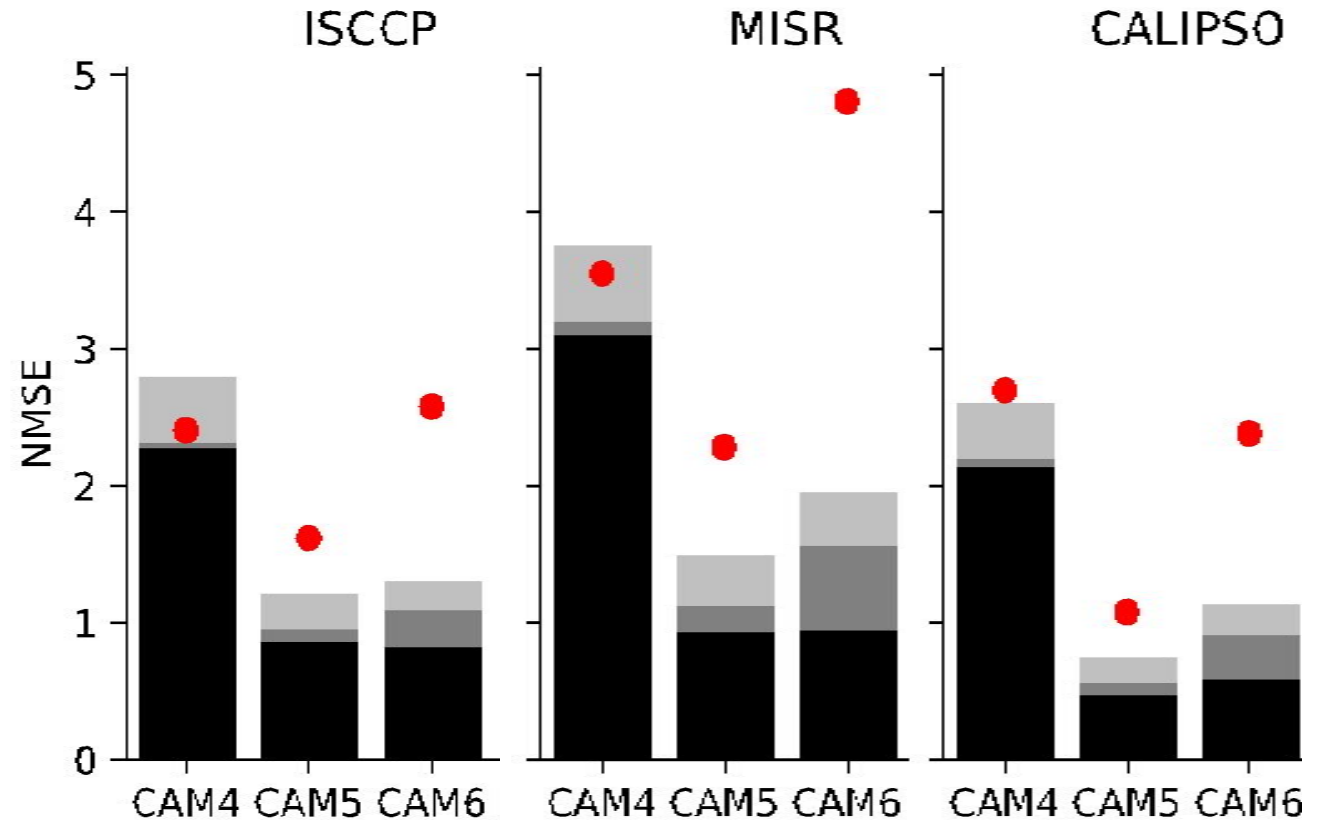
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cosp (ssh)
(base) -bash-4.2$ ./cosp2_test cosp2_input_rttov_nl.txt cosp2_output_pcrttov_nl.txt
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Broadband radiation fields can hide compensating model biases

Model Bias in Cloud Radiative Effect

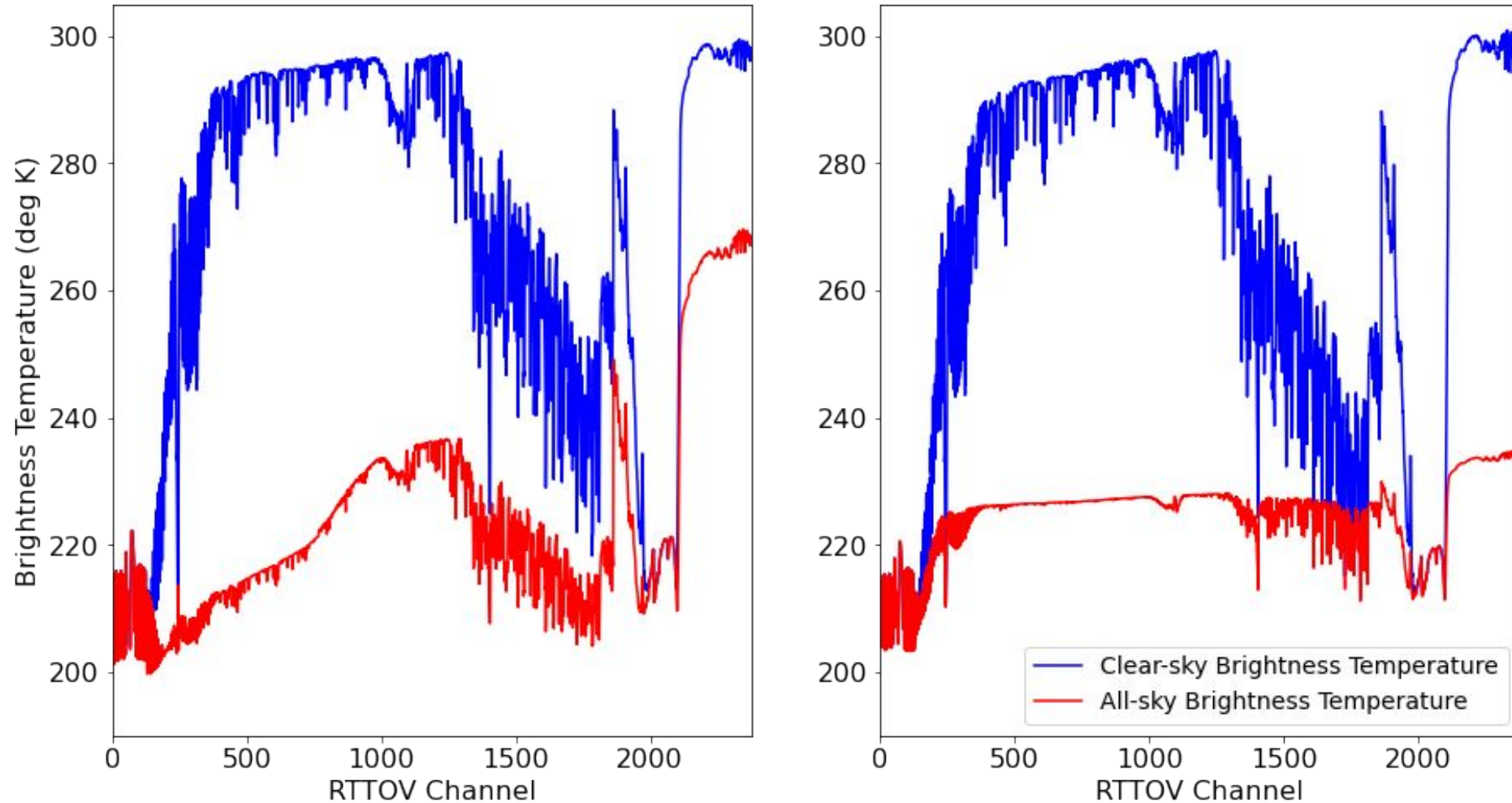


Model Bias in Cloud Fraction



Spectral radiation fields can aid model evaluation and development

Simulated radiances for the AIRS instrument



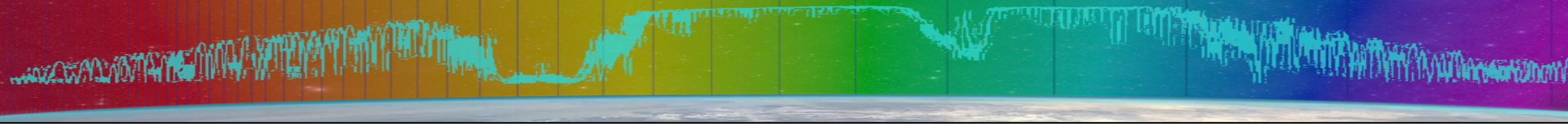
COSP-RTTOV: Spectral Radiation in the Climate Context

What: A computationally-efficient, instrument-specific, radiance simulator in COSP and CESM2.

Why: To enhance the detection and attribution of climate change using spectral satellite records.

When: Initial CESM2 simulations complete by the end of 2023.

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Simulated radiances for
the AIRS instrument

