

Inferring Middle- and High-Level Cloud Feedbacks Using A-Train Observations



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Background

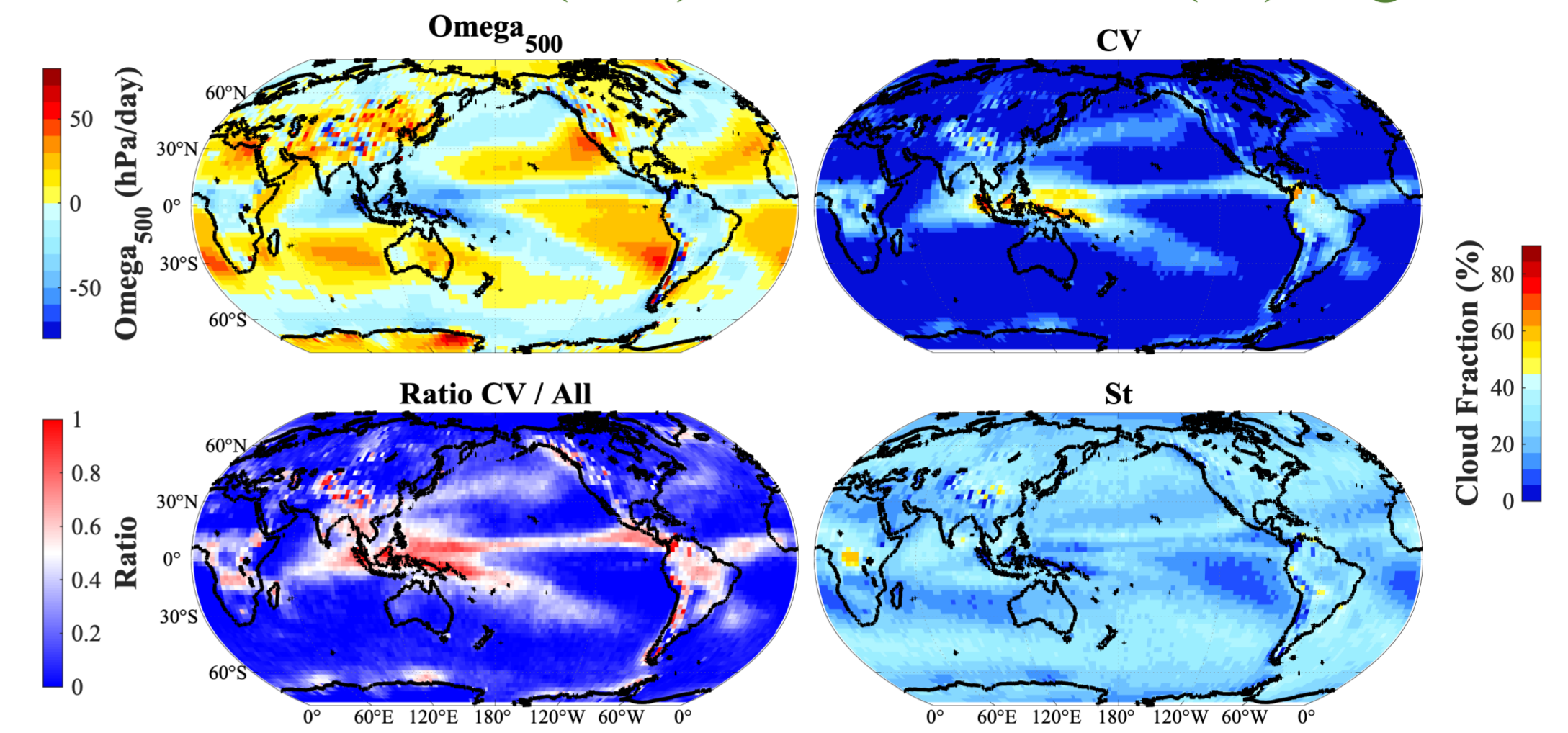
A recent assessment indicates that the best estimate of high-cloud feedback is relatively large and solely relies on climate model estimates. In addition, the sign of stratiform (St) and convective (CV) high clouds is opposite.

→ Need to faithfully characterize each cloud type to be able to evaluate them in climate models.

→ How do changes in these cloud type properties affect cloud feedbacks?

Method

We use a simple threshold on vertical velocity at 500 hPa (Ω_{500}) to discriminate convective (CV) and stratiform (St) high-level clouds.

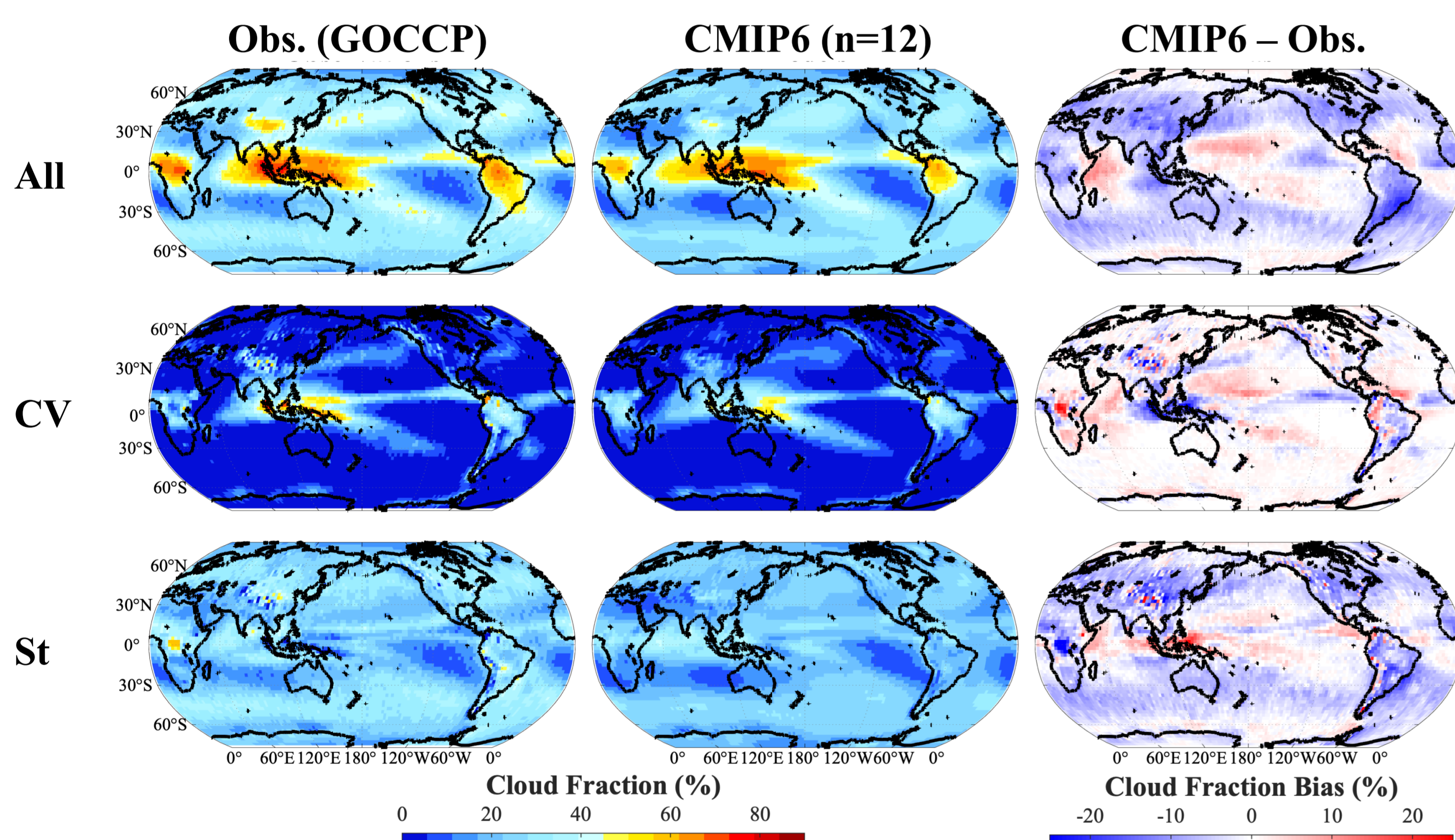


High-level Cloud Fraction

While getting correct cloud patterns, CMIP6 models:

- underestimate CV high-level clouds in the warm pool and along the ITCZ (middle row)

- underestimate St high-level clouds outside the tropics (bottom row)

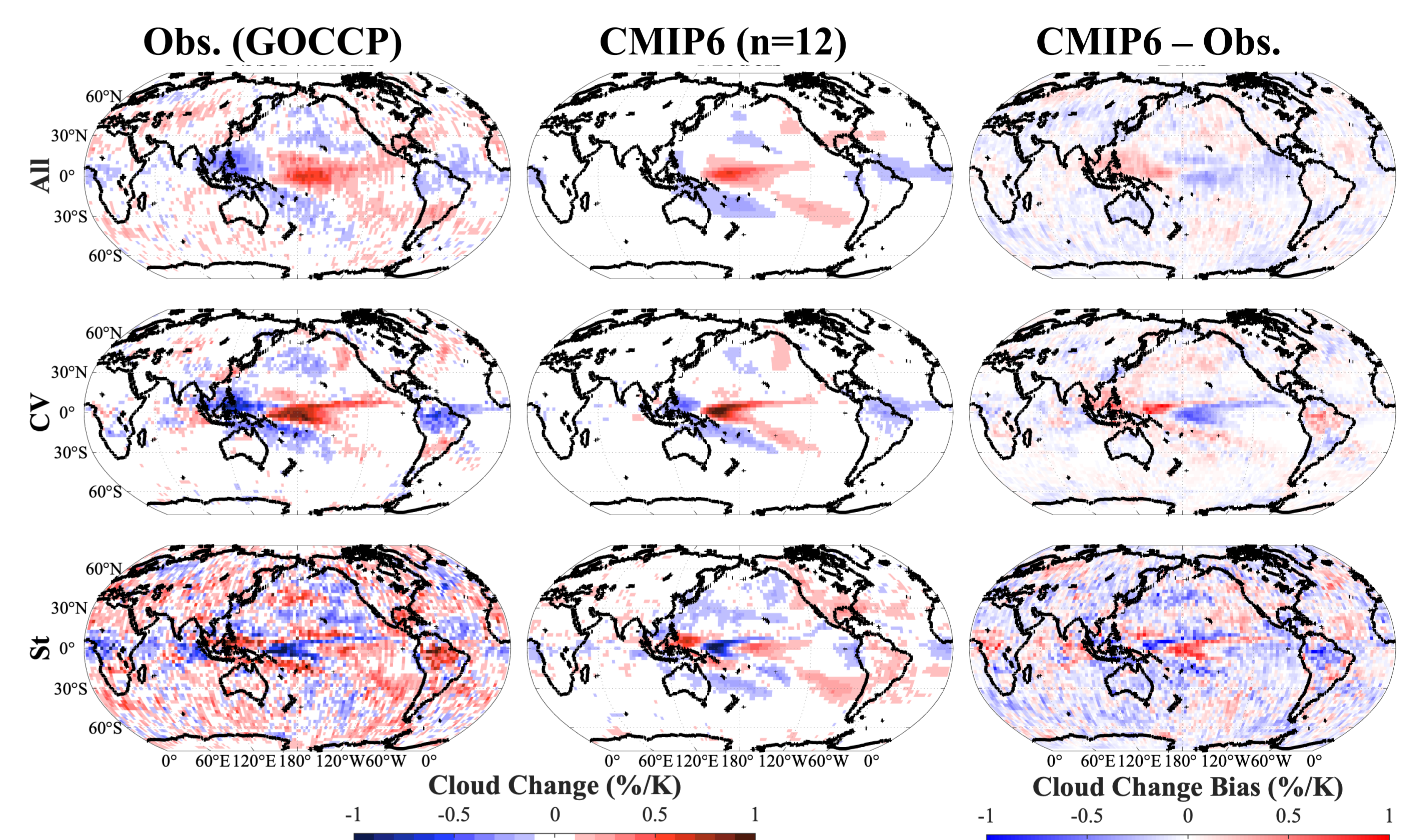


Cloud Change per Unit of Warming

The cloud change per unit of warming (interannual cloud change as a function of global mean surface temperature) is also qualitatively well reproduced. However, CMIP6 models:

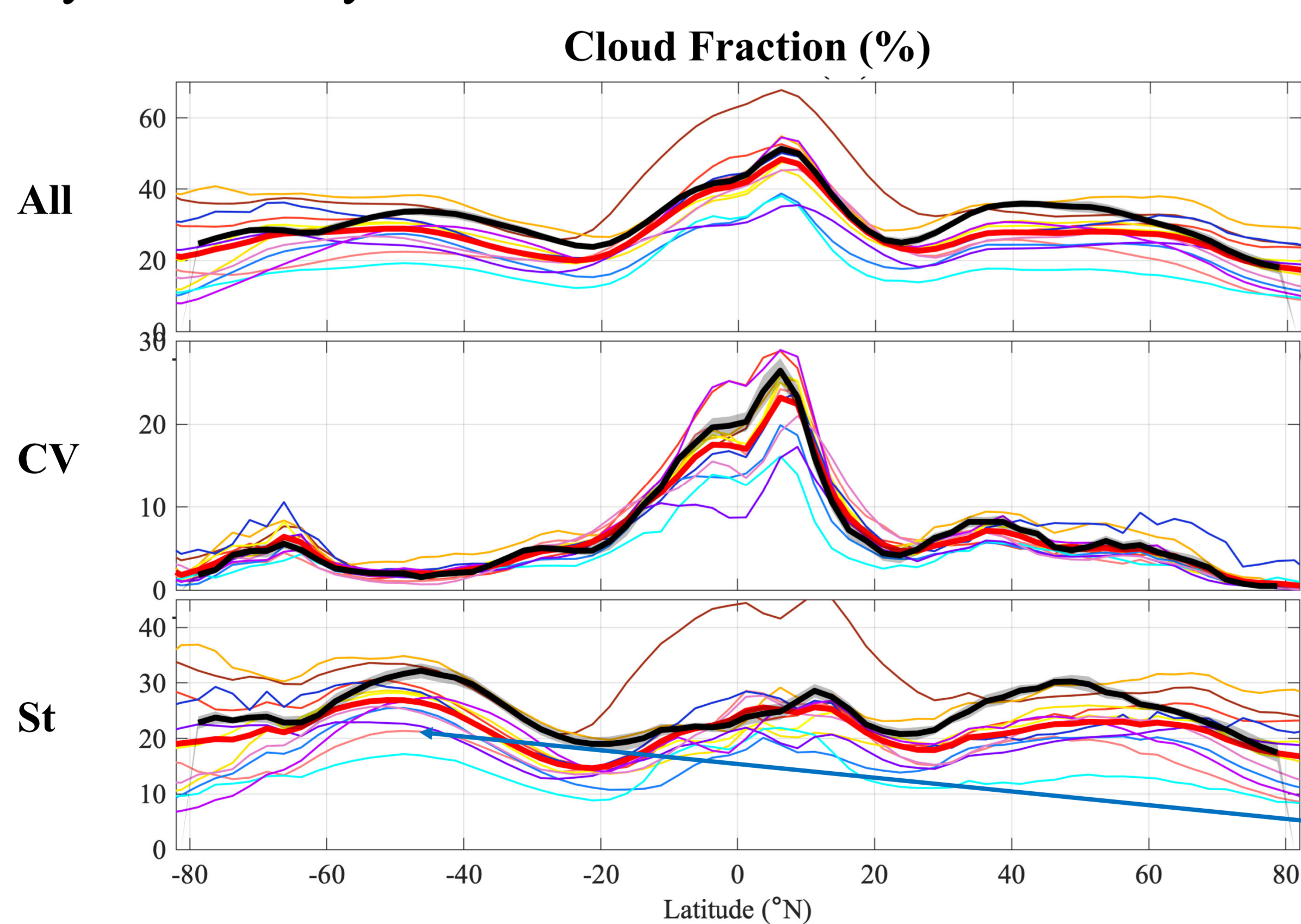
- underestimate the CV increase in the western pacific

- underestimate the St increase outside the tropics

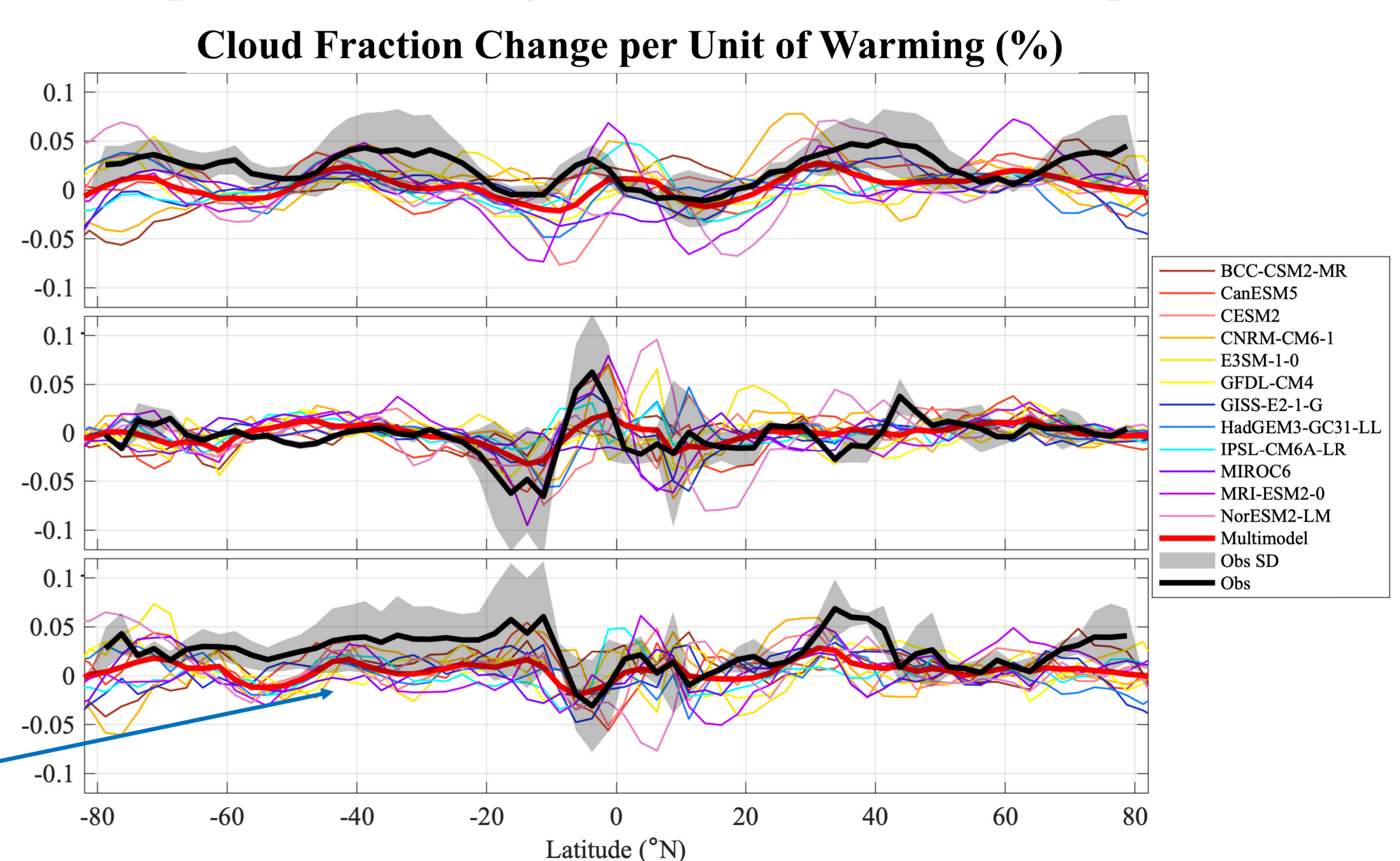


Most models underestimate CV clouds in the tropics and systematically underestimate midlatitude St clouds.

While it is difficult to connect CMIP6 CV biases with their cloud change biases, the CMIP6 St underestimate seems to be related to the lack of positive St change at midlatitudes (bottom plots).



Coincident underestimate



Next

In the next part of the project, we will analyze what environmental factors drive the variability of St and CV and infer their cloud feedback assuming different scenarios of environmental factor future changes to provide constraints for model assessment.

Acknowledgements

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