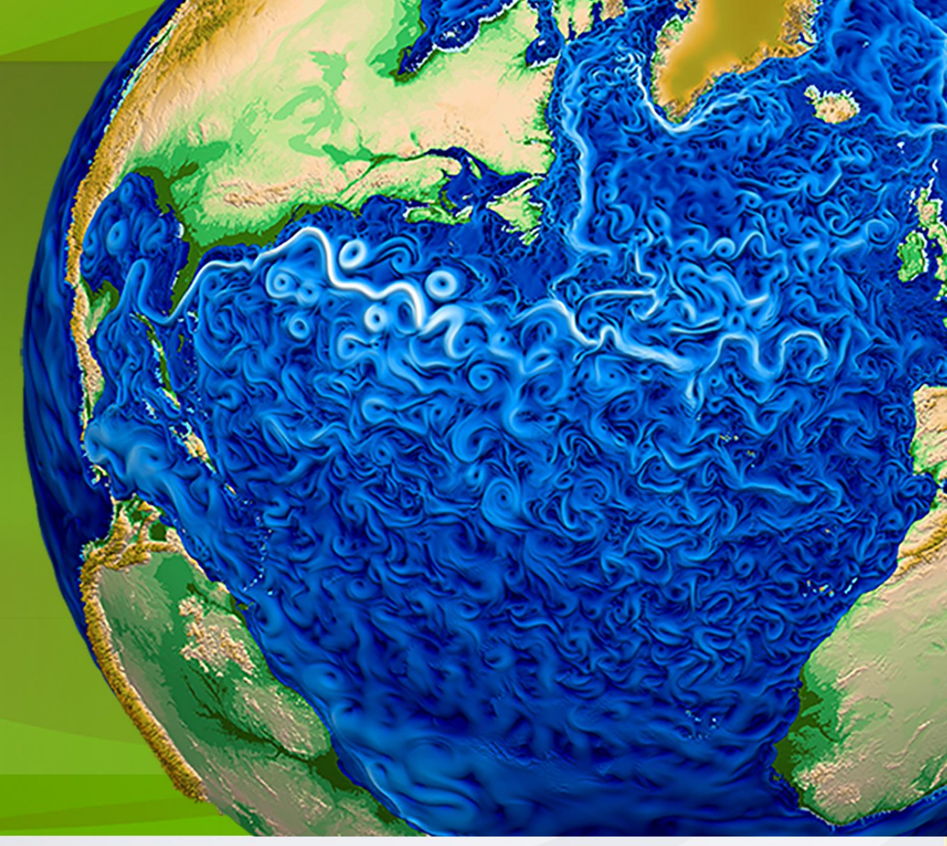
R: Issues with the Hydrologic Cycle in the ACME v0.3 Model



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Objective

We examined characteristics of the global water cycle in the ACME v0.3 model in Atmospheric Model Intercomparison Project (AMIP) simulations spanning the years 1980-2005. We compared low- and high-resolution simulations and evaluated the model against observational datasets and other CMIP5 models.

Here, we highlight some major biases found in the atmospheric water cycle of the ACME v0.3 model. We plan to track how these biases change with future versions of the model.

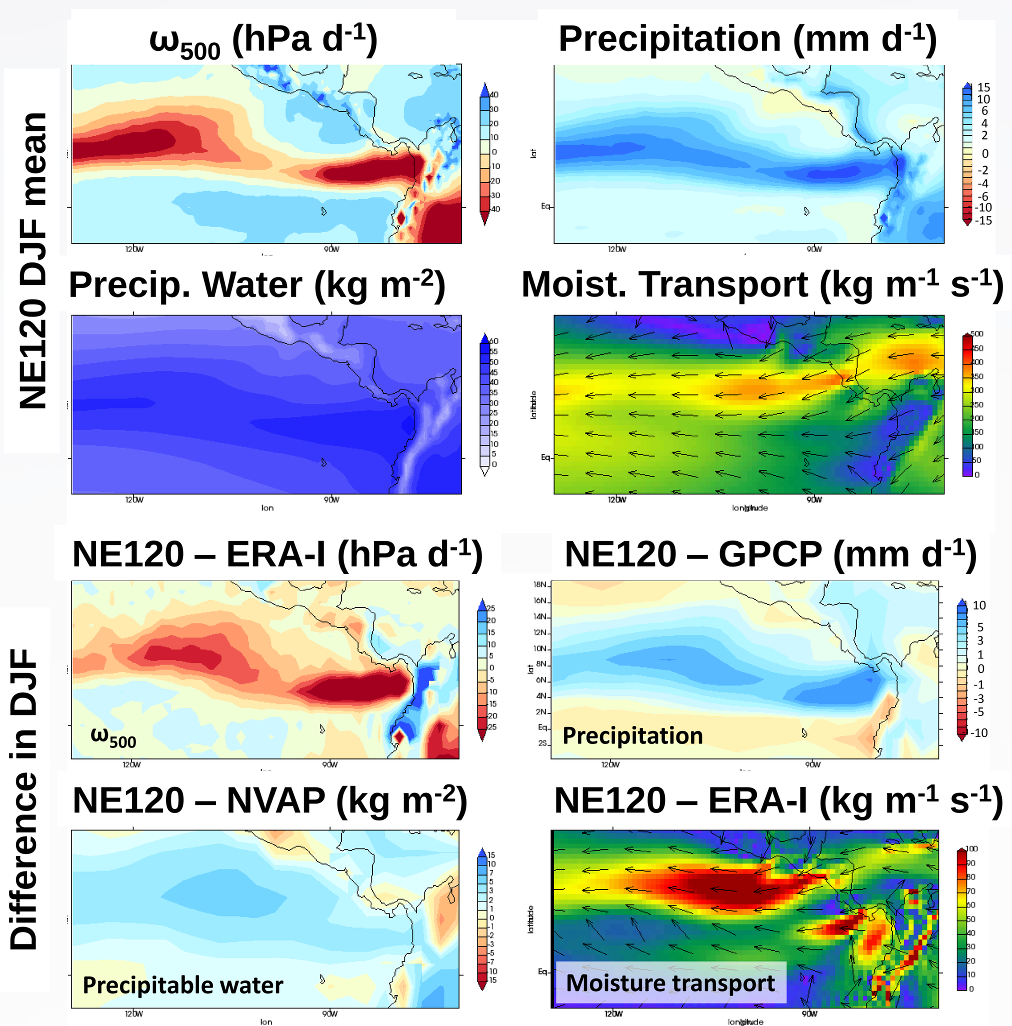
Regional Biases

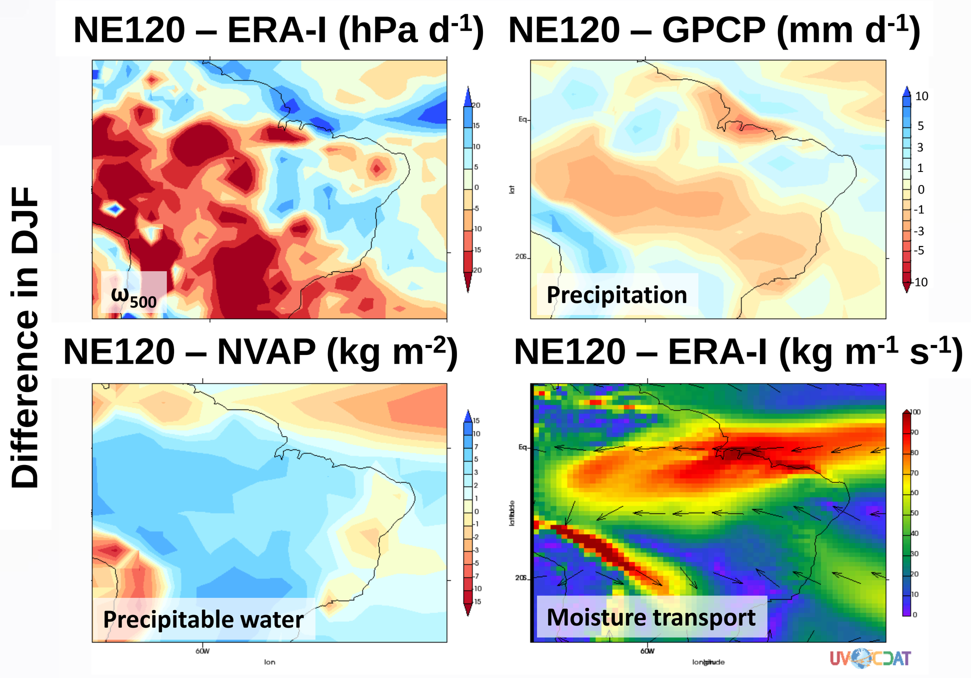
Eastern ITCZ is too rainy

There is too much precipitation over the eastern ITCZ

Where it's too rainy, the precipitable water is also higher

Source of moisture is likely transport over the Panama isthmus





Amazon is too dry

Despite more moisture transport and more precipitable water in some seasons, there is not enough precipitation over the southern Amazon

Lack of precipitation is likely due to local physics and dynamics

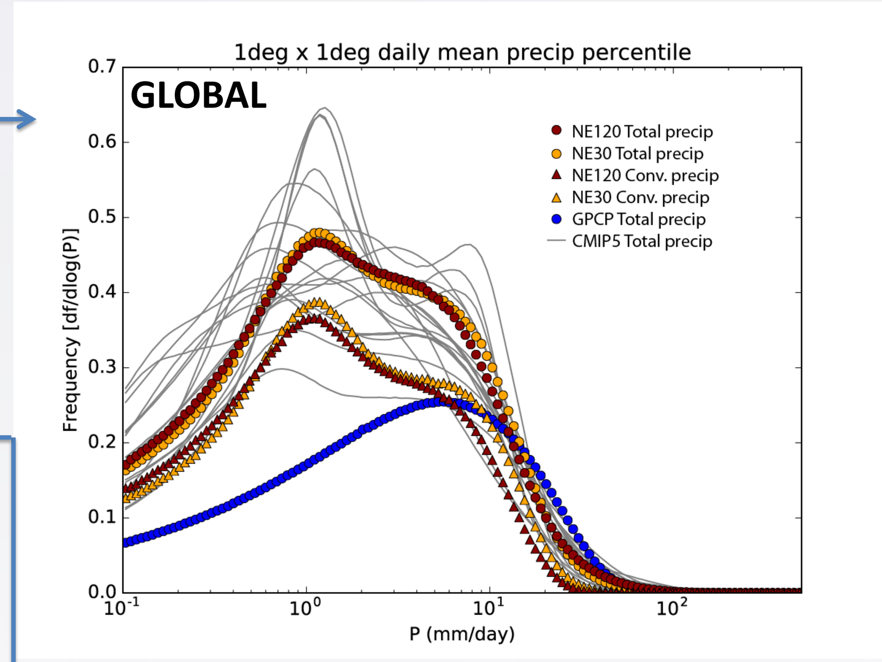
Mystery: despite lower precipitation rates, evaporation rates are higher than observational estimates.

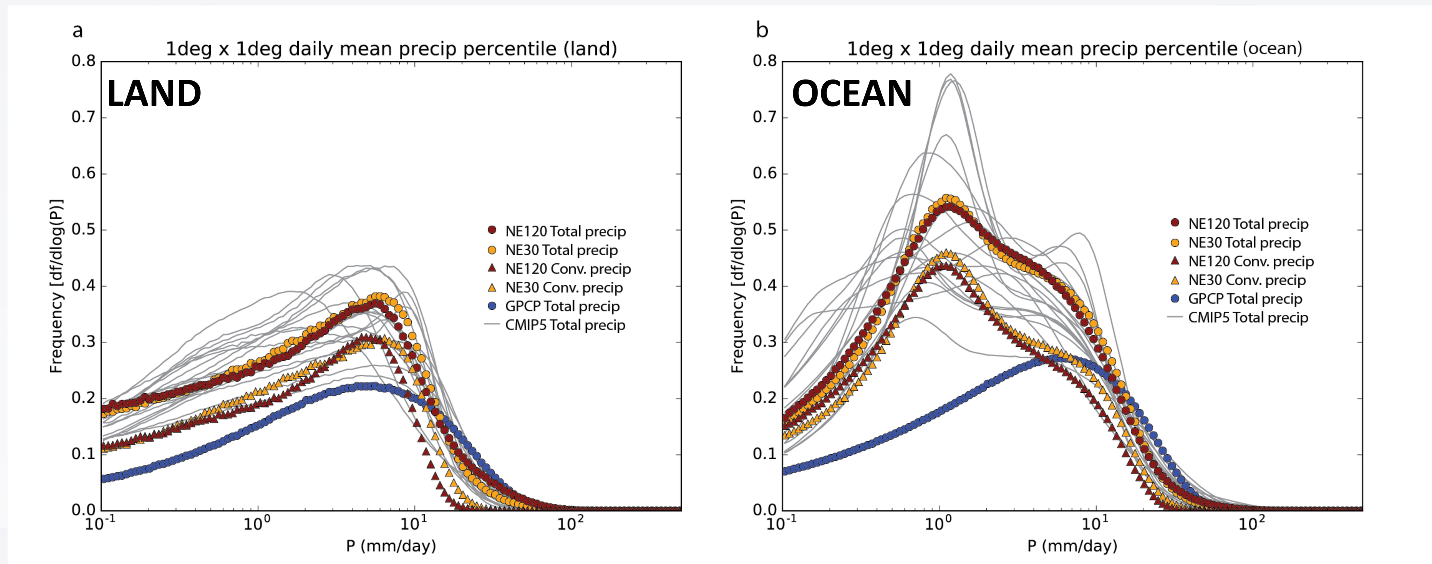
The Model Drizzles Too Much

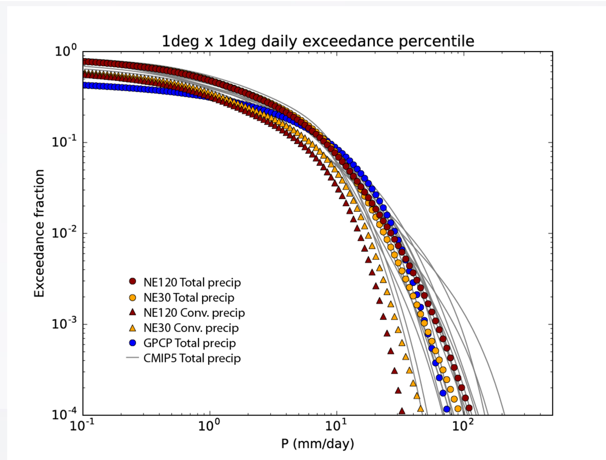
Globally, the model drizzles too frequently, mainly because of the convective precipitation scheme. A similar 'too drizzly' state is shared by other CMIP5 models.

Too frequent drizzle is a problem over oceans, not over land.

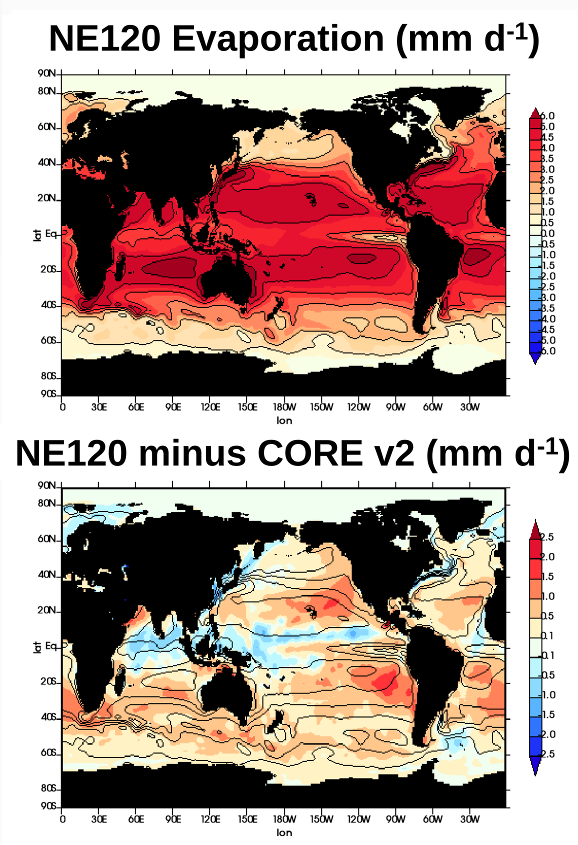
The frequency of extreme precipitation (> 20 mm d^{-1}) increases with higher resolution, most of it due to an increase in large-scale precipitation.







Biases in Oceanic Evaporation



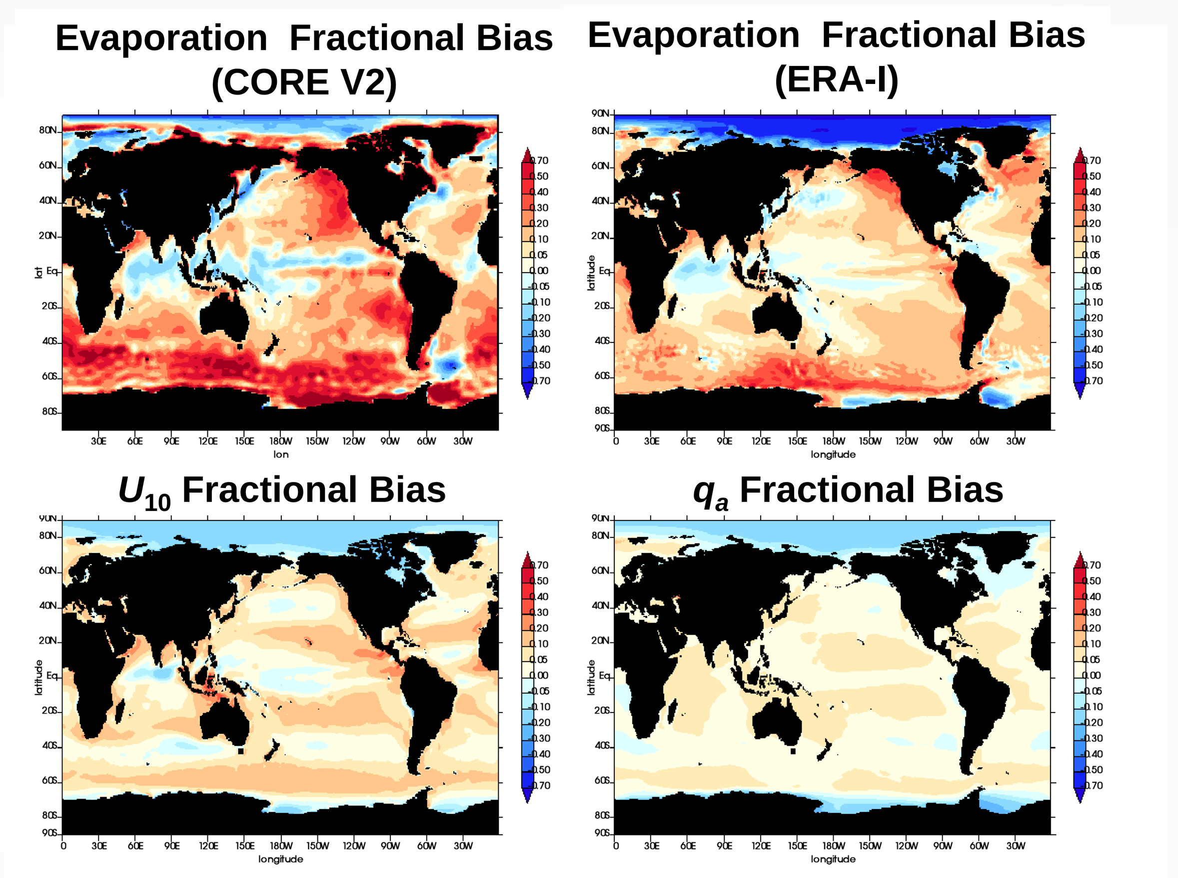
Over the subtropics, the evaporation bias can be as large as 40% of the mean evaporation rate.

So what is the cause of the bias (the wind speed? Surface humidity?)

$$E = C\rho U_{10}(q_s(SST) - q_a)$$

Evaporation; Transfer coefficient; Air density; 10-m wind speed; Saturation vapor mixing ratio, given SST; Vapor mixing ratio at 10-m

The surface wind speed bias can explain up to 10% of the bias, but surprisingly, q_a bias is small.



References and more information

Diagnostics are written in Python/UVCDAT and is available on github at: https://gist.github.com/crterai/2512109b1be07d2ee480

You can find an overview of the diagnostics on confluence by searching for 'Tier 1b metrics Water cycle diagnostics'

More details about the model evaluation of the v0.3 model can be found in our paper in prep:

Terai, C. R. et al., (2016) The Atmospheric Hydrologic Cycle in the ACME v0.3 Model, in preparation.

If you have questions and I am not by my poster, I should be around looking at the other posters.

ACME Accelerated Climate Modeling for Energy

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