Impact of a mixed ocean layer and the diurnal cycle on convective aggregation

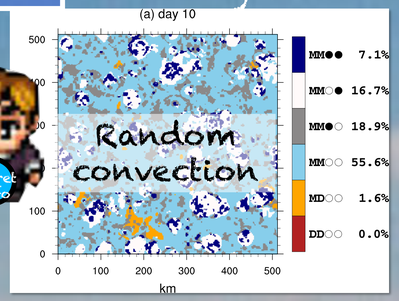
Adrian Tompkins (Tompkins@ictp.it) and Addisu Semie (University of Addis Ababa, Ethiopia)

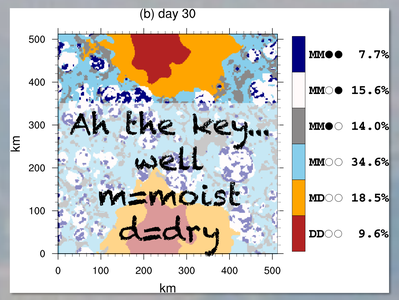
Domain 512² km, Δx=2km don't tell anyone

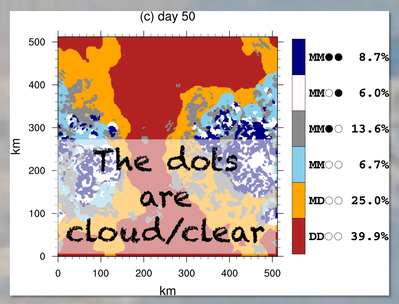
secret info

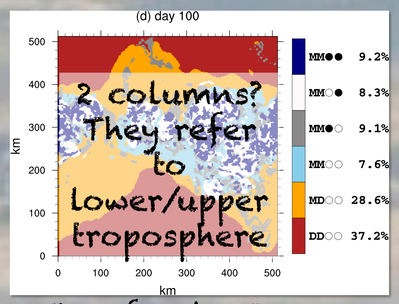
Time

thick mixed ocean layer



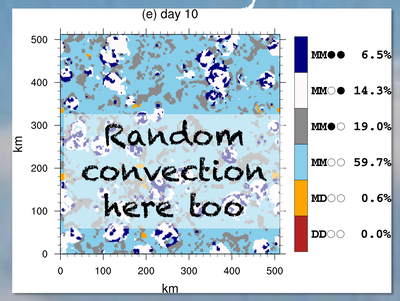


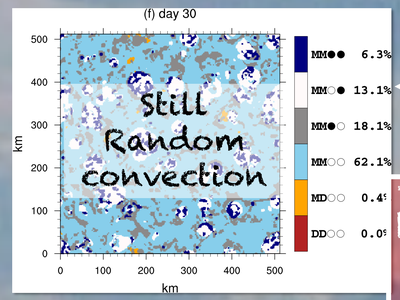


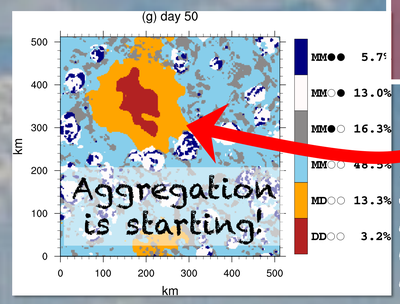


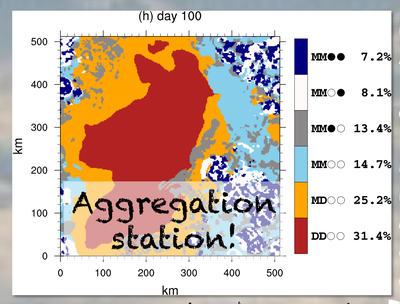
When fixed SSTs or a thick mixed ocean layer is used, the organization starts after 20-25 days

thin mixed ocean layer









Pop a thin (1m) mixed ocean layer underneath and things take a lot longer to get going. See also the OLR plot lower right. But why? Follow #3

No SST drift! Catch my drift?

This red blob is a bone dry patch, it is a sign of convection self-aggregation starting...

... wait long enough and convection ends up in a single cluster...

it has... (cue echo) AGGREGATED...

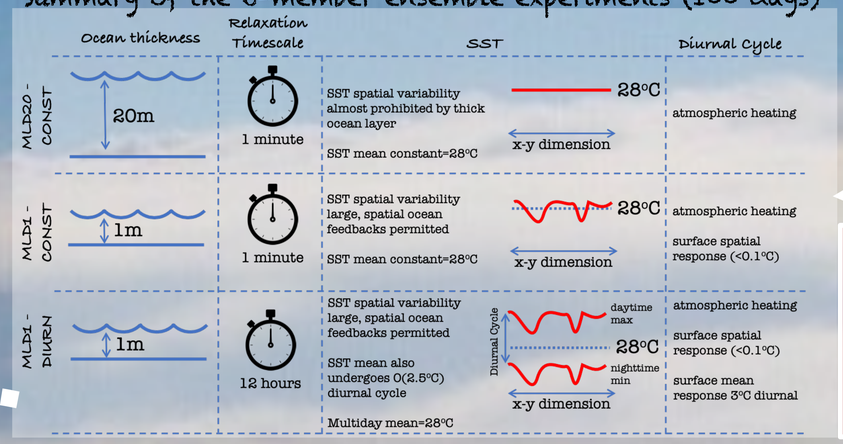
woo hoo, So what?

Well it could be important for climate, aggregated states are much drier!

I'm already zoning out

Let's aggregate!!! (COVID compliantly)

Summary of the 6-member ensemble experiments (100 days)

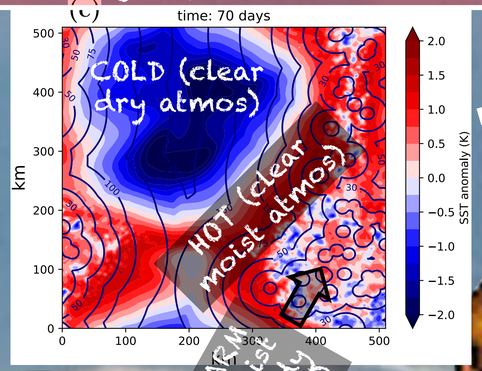


Follow my Avatar!!!

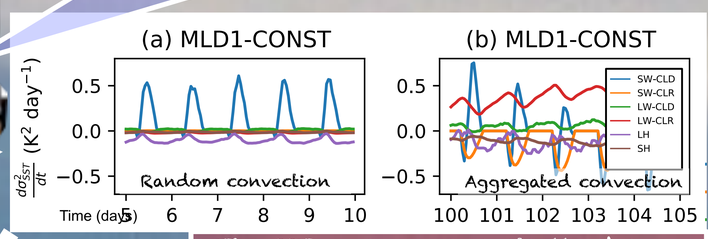
I'm relaxed! (adaptively)

We devised a cool new method to allow spatial sea surface temperature (SST) variability and a mean SST diurnal cycle in a slab ocean, while eliminating all SST drift. Correct, no drift!!! The trick is to use an *adaptive* target SST in a relaxation scheme.

Well first let's look at SST - after aggregation it is divided into 3 clear zones. Note how the convection likes to bunch up to the edges of the hot zones.



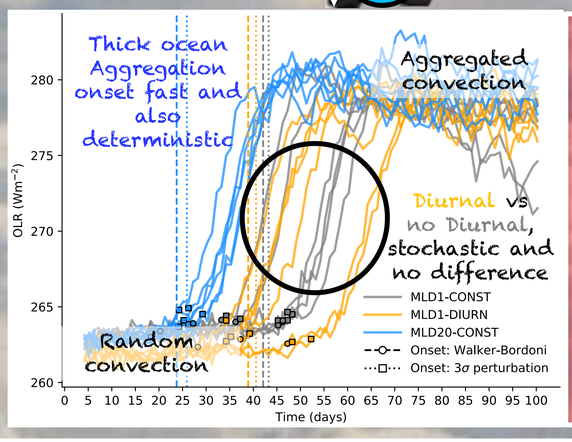
I'm not (SW-cloud) forcing you to stay



This feels more eternal than diurnal

The SST variance is initially driven by shortwave (SW)-cloud forcing, and damped by latent heat (LH) fluxes. The thin ocean increases fluxes far from convection and reduces them nearby, delaying aggregation onset...

In the paper, we use artificial intelligence (best kind!) to show this is predominately via thermodynamic effects (stability and Δq) not wind.



We almost forgot! What about adding the *mean* diurnal cycle?

Well it's a bit boring really as it didn't have any additional impact on aggregation speed (look left!)

There are two subtle mechanisms at play involving SST variance and cloud spacing/cold pools, but they are minor and partially cancel, oh well.

Note the highly variable stochastic onset when it is slow, no space here to discuss that... but...

What! Still here? ...you want to know more?
Yes? Really? Then check out our 2021 paper in JAMES,
https://doi.org/10.1029/2020MS002186

The Abdus Salam International Centre for Theoretical Physics