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Geoscientific Model Development Discussions

Interactive comment on "Quasi-hydrostatic equations for climate models and the study on linear instability" *by* Robert Nigmatulin and Xiulin Xu

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In the context of my original comment, this is an almost predictable back-and-forth discussion. As I implied, in the absence of some actual data to compare against, the mathematical degrees of freedom involved in a fluid dynamics formulation will allow many possibilities for a potential solution.

Geoscientific model development should be geared toward emulating some known physical behavior, otherwise it would be just discussion of the math underlying partial differential equations. Consider the figure below taken from https://doi.org/10.1029/2019JD032362 which collects over 30 model comparisons to a

historical QBO time-series, yet revealing little consilience and limited agreement among the models. The authors of the paper suggest that even though "the number of climate or Earth system models being able to simulate the QBO" .... "However, the quality of the simulation of the QBO has not improved."

What can end this back-and-forth discussion is the mathematical insight leading to a formulation that will allow the QBO time-series to be modeled effectively. Otherwise, in the absence of a real-world context, there is no end in sight.

1. Richter, J. H., Anstey, J. A., Butchart, N., Kawatani, Y., Meehl, G. A., Osprey, S., & Simpson, I. R. (2020). Progress in simulating the quasiâĂŘbiennial oscillation in CMIP models. Journal Geophysical Research: Atmospheres

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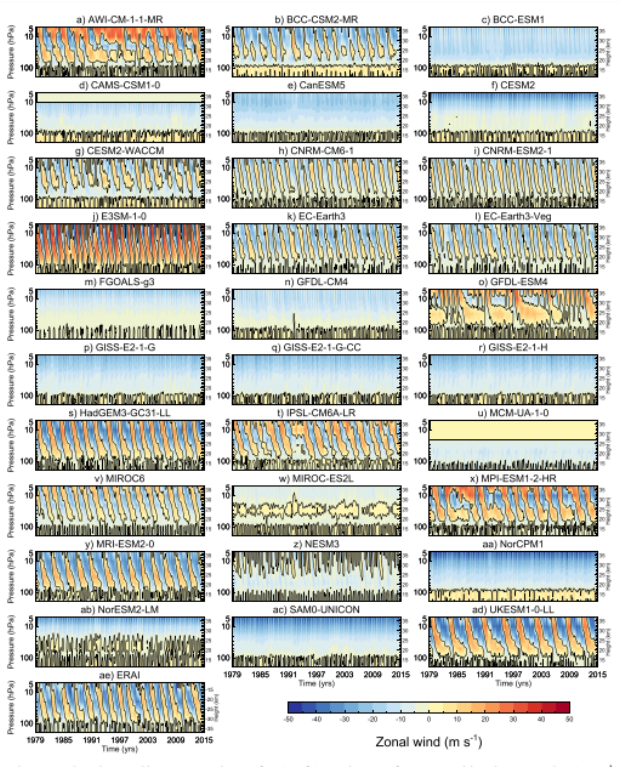
a) AWI-CM-1-1-MR
b) BCC-CSM2-MR
c) BCC-ESM1
d) CAMS-CSM1-0
e) CanESM5
f) CESM2
g) CESM2-WACCM
h) CNRM-CM6-1
i) CNRM-ESM2-1
j) E3SM-1-0
k) EC-Earth3
l) EC-Earth3-Veg
m) FGOALS-g3
n) GFDL-CM4
o) GFDL-ESM4
p) GISS-E2-1-G
q) GISS-E2-1-G-CC
r) GISS-E2-1-H
s) HadGEM3-GC31-LL
t) IPSL-CM6A-LR
u) MCM-UA-1-0
v) MIROC6
w) MIROC-ES2L
x) MPI-ESM1-2-HR
y) MRI-ESM2-0
z) NESM3
aa) NorCPM1
ab) NorESM2-LM
ac) SAM0-UNICON
ad) UKESM1-0-LL
ae) ERAI
Pressure (hPa)
Time (yrs)
Zonal wind (m s^{-1})

Fig. 1.