How well climate models simulate ENSO? How well do we know ENSO?

Yann Planton*†[1], Peter Gleckler[2], Eric Guilyardi[3,4], Jiwoo Lee[2], Michael Mcphaden[1], and Andrew Wittenberg[5]

[1]NOAA Pacific Marine Environmental Laboratory [Seattle] – 7600 Sand Point Way NE Seattle, WA 98115, United States

[2]Lawrence Livermore National Laboratory – 7000 East Avenue • Livermore, CA 94550, United States

[3]Laboratoire dÓcéanographie et du Climat : Expérimentations et Approches Numériques – Sorbonne Universite : UM71, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique : UMR7159, Museum National d'Histoire Naturelle : USM402, Institut de Recherche pour le Développement, École normale supérieure - Paris, Université Paris sciences et lettres, Université de Versailles Saint-Quentin-en-Yvelines, Commissariat à l'énergie atomique et aux énergies alternatives, Ecole Polytechnique, Centre National d´tudes Spatiales [Toulouse], Sorbonne Universite, Centre National de la Recherche Scientifique : $\mathrm{FR}_6 36, Université de Paris$:

$FR_6 36, Centre National d tudes Spatiales[Toulouse], Centre National d tudes Spatiales[Toulouse] - -case100 - 4place Ju$

[4]NCAS-Climate – Reading, United Kingdom

[5]NOAA Geophysical Fluid Dynamics Laboratory – Princeton University, Forrestal Campus, 201 Forrestal Road, Princeton, NJ 08540-6649, United States

Abstract

The El Niño-Southern Oscillation (ENSO) is the most energetic climate phenomenon at interannual timescales; decadal modulation of its characteristics is both a major source and consequence of tropical Pacific decadal variability. ENSO influences the global atmospheric circulation, causing droughts and floods, modulating the tropical cyclone activity, and altering marine and terrestrial ecosystems. While it has become clearer that ENSO-driven precipitation variations will intensify with the future increase of greenhouse gases in the atmosphere, model biases still contribute to uncertainties regarding the amplitude of these changes, and in possible changes to the dynamics of ENS. It is therefore important to evaluate ENSO in state-of-the-art climate models and in observational datasets, in order to improve them. The International CLIVAR Pacific Region Panel has led the development of a community-wide synthesis to evaluate how well climate models simulate ENSO. We have applied this package to historical simulations from CMIP6, and to a variety of observational datasets. The results underscore the continuing need to improve climate models, in particular the representation of the background cold tongue SST and the amplitude of ENSO. They also highlight a wide diversity of ENSO representations in different observational datasets, especially for ENSO feedbacks. This work demonstrates the importance of choosing the right observational datasets for the right applications when evaluating and developing climate models. Our ongoing work aims to develop a consensus on which reference datasets to use for each metric, and how to best characterize uncertainties arising from observational limitations and sampling variability.

*Speaker

†Corresponding author: yann.planton@noaa.gov

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