Intraseasonal surface salinity variability and the MJO in a climate model

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Background and Motivation:

- Surface and upper ocean salinity are significantly modulated by the MJO, but **inconsistencies** were reported even in a **qualitative** respect about the relative role of ocean dynamics vs. E-P (e.g., Matthews et al. 2010; Grunseich et al. 2013; Guan et al. 2014);
- The current **salinity observational** coverage, together with a lack of high-quality 3D **ocean current** observations, is **not sufficient** for a **quantitative** description about salinity/freshwater budgets related to the MJO;

Supports from CVP&MAPP/CPO/NOAA and NASA OSST are acknowledged
Two major modifications relative to the operational CFSv2:

1) The SAS atmospheric convection scheme $\rightarrow$ RAS
2) Near the ocean surface, 10-meter vertical resolution $\rightarrow$ 1-meter

- Improved simulations of the MJO, barrier layer distribution/thickness, intraseasonal SST/SSS variance…….
Simulations of intraseasonal salinity variability

- The adoption of 1-m vertical oceanic resolution significantly improves the simulations of the intraseasonal SSS variance.

- CFSm501 realistically captured the composite MJO lifecycle of intraseasonal SSS anomalies.
Upper ocean salinity budget analysis

\[
\frac{\partial S_a}{\partial t} = \frac{1}{h} S_0 (E - P) - \mathbf{v}_a \cdot \nabla S_a - \frac{1}{h} \nabla \cdot \int_{-h}^{0} \mathbf{v} S \, dz - \frac{1}{h} (S_a - S_{-h}) \left( \frac{dh}{dt} + w_{-h} \right) - \frac{1}{h} F_{-h}
\]

(Cronin and McPhaden 1998)

Except some occasional events/periods, the mixed layer salinity tendency is closed by E-P flux and advection terms.

There is a strong regional dependency about the role of E-P flux vs. ocean dynamics in the intraseasonal SSS anomalies.
Summary

- The usage of the RAS convection scheme improves the MJO significantly;

- The adoption of 1-m vertical oceanic resolution improves the simulations of climatological BL distribution/thickness and intraseasonal SSS;

- Salinity budget analysis suggests a strong regional dependency about the role of E-P flux vs. ocean dynamics in the intraseasonal SSS anomalies.