Resolution-induced emergence of intrinsic low-frequency variability in the global ocean: AMOC, SST, SSH

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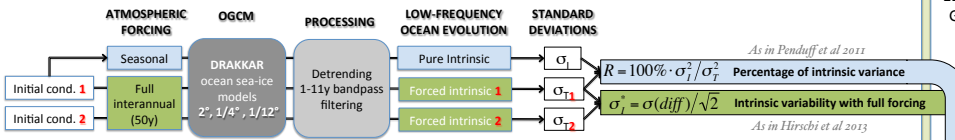
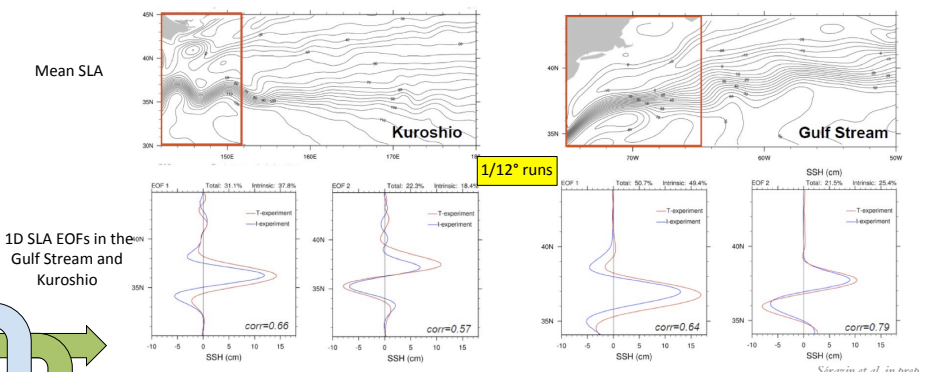
ABSTRACT

Future ocean-atmosphere coupled models used for climate studies and projections will include eddying rather than laminar oceans. Based on seasonally- and interannually-forced global ocean/sea—ice simulations, this study shows that **increasing resolution from 2◦ to 1/4◦ and to 1/12◦ leads to the emergence of a strong, intermittent, intrinsic (nonlinearly-driven), low-frequency (interannual-to-multidecadal) oceanic variability**. We discuss the link between this low-frequency intrinsic variability and the **chaotic character** of the ocean circulation in the interannually- forced eddying regime. We will particularly focus on the Atlantic Meridional Overturning Circulation, Sea-Surface Height and Temperature, whose variability is being monitored, and whose direct forcing by the atmosphere is partly questioned by our results. The chaotic character of the intrinsic AMOC and SST low-frequency variabilities may, in turn, **impact the atmosphere and the climate in future coupled simulations.**

PAIRS OF SIMULATIONS [1 HINDCAST + 1 CLIMATOLOGICAL RUN] AT 2°, 1/4°, 1/12°



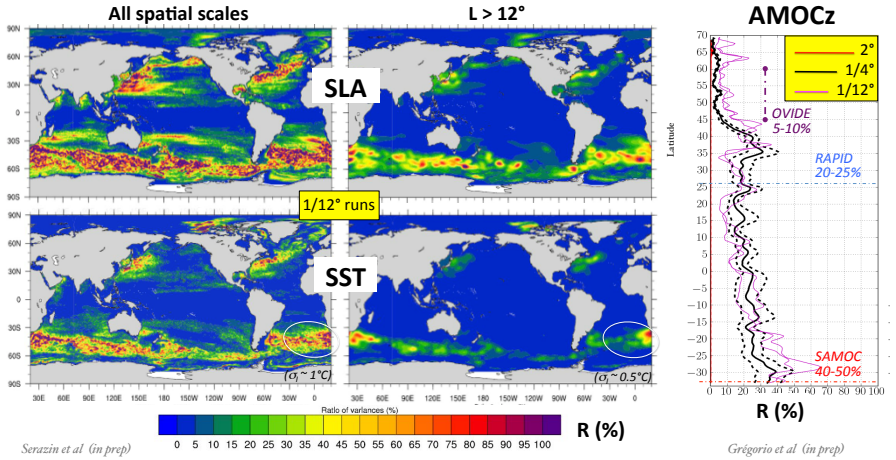
SPATIAL VARIABILITY PATTERNS ARE SET BY OCEANIC NONLINEARITIES



Sérazin et al, in prep (also see Taguchi et al 2007, Pierini et al 2013)

SSH VARIAB. REMAINS CHAOTIC WITH LOW-FREQ FORCING *(not shown)*

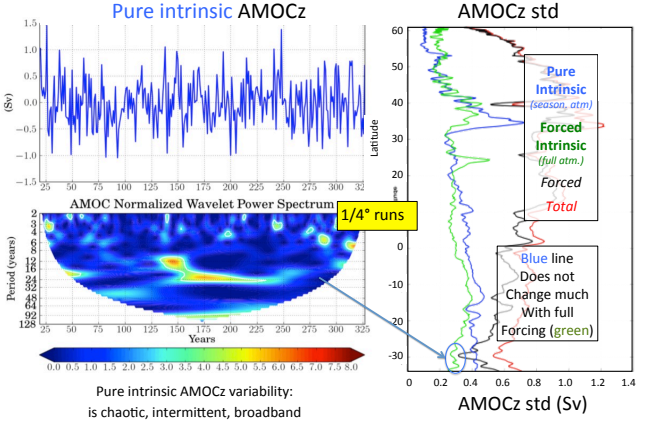
PERCENTAGE R OF INTRINSIC INTERANNUAL VARIANCE (1 < T < 11 years)



Serazin et al (in prep)

Grégorio et al (in prep)

AMOCz VARIAB. REMAINS CHAOTIC WITH LOW-FREQ FORCING



Pure intrinsic AMOCz variability: is chaotic, intermittent, broadband

Grégorio et al (in prep)

TAKE-HOME MESSAGES

Forced OGCMs:

No eddies : 1-11 year variability is *forced* (largely deterministic)

Eddies (1/4° or 1/12°) : 1-11 year variability is *partly intrinsic and chaotic*, with substantial large-scale imprints in SST and MOC

Coupled AOGCMs:

No eddies (AR5) : 1-11year intrinsic variability mostly at low-latitudes (El Niño)

Eddies (AR6) : *might* feed chaotic interannual SST/ MOC variability.

Impact on atmosphere?

Impact on climate?

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