Spontaneous low-frequency variability of the eddying ocean circulation: an OGCM study.

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Idealized studies have shown that the nonlinear ocean circulation may spontaneously generate 1-10 year variability under constant/seasonal atmospheric forcing; this chaotic phenomenon gets stronger with increasing Reynolds number and affects the horizontal circulation. Whether mesoscale turbulence directly feeds this low-frequency variability (e.g. Berloff et al 2007, Arbic et al. 2012) and/or favors random transitions between the oceanic system's multiple stable states (e.g. Hazeleger and Drijfhout 2000, Dijkstra and Ghil 2005) is still under debate.
Several primitive-equation global ocean simulations are being investigated to study the imprints of this intrinsic variability on observed climate-relevant quantities (sea-surface height/ temperature, meridional overturning circulation, etc). Intrinsic variance is negligeable in laminar IPCC-like (~2°) ocean models but becomes important when oceanic eddies are simulated ; in strong eddy-active regions, most low-frequency variance is produced intrinsically with secondary influence of the low-frequency atmospheric variability. Intrinsic variability features are depicted globally, and in more detail in the Gulf Stream area and in the ACC (patterns, spatio-temporal scales, variables concerned). These results suggest that eddying ocean models used in future climate predictions may yield a more chaotic variability, possibly impacting the overlying atmosphere; these results call for the investigation of nonlinear sources of intrinsic variability in "realistic" ocean simulations.