Abstract View

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Accelerating the Convergence to Equilibrium of Ocean-Climate Models

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ABSTRACT

Solutions corresponding to climatic equilibrium are usually obtained from atmospheric general circulation models by extended numerical integration with respect to time. Because the ocean contains a much wider range of time scales the same procedure is not practical for ocean general circulation models. The ocean contains the same high frequency waves as the atmosphere and in addition, has ultra low frequencies associated with slow diffusion of water mass properties below the main thermocline. For the parameter range in which equilibrium solutions exist, a method based on distorted physics partially circumvents this difficulty. The distorted physics compresses the frequency band of the ocean model by slowing down gravity waves and speeding up abyssal processes. The acceleration of abyssal processes is accomplished by decreasing the local heat capacity without altering the transport and mixing of heat. Numerical integration of the distorted-physics ocean model then converges to equilibrium nearly as efficiently as a atmospheric model of comparable spatial resolution. Equilibrium solutions of the distorted- and nondistorted-ocean models are equivalent because the distortion only involves local derivatives with respect to time. A joint ocean–atmosphere model study provides a practical demonstration of the method.