Abstract View

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Modeling the Seasonal Cycle of the Upper Ocean

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ABSTRACT

The parameterization of the turbulence used in one-dimensional oceanic mixed layer models is briefly reviewed, focusing on the long-term response of these models. Particular attention is directed towards the parameterization of turbulent dissipation. A general parameterized form is proposed that provides a useful guideline to devise new parameterizations and to compare existing ones. Different models of the classical Niiler–Kraus type are first tested by simulating four years (1969–72) of the upper ocean evolution at Ocean Station Papa. In the results, distinction is made between the errors inherent in the model and those due to changes in the upper ocean heat content not explained by the surface heat fluxes. It appears that, after a needed empirical calibration, all models systematically overestimate the sea surface temperature (SST) in summer and underestimate it during fall. In absolute value, the maximum error on the monthly-mean predicted SST reaches about 1 K. In an attempt to reduce this error, a new model, CMO, is presented. It includes a novel parameterization of the turbulent dissipation in which the rotation and stability effects are explicitly taken into account. Garwood's closure technique is used. The CMO is calibrated independently of the observations to be simulated. A four-year simulation at Station P shows that the error in the CMO-predicted SST reaches a maximum of only 0.5 K. However, the remaining error keeps an annual cycle similar to that observed with the other models. The obtained enhancement and the persistent error are analyzed.