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An improved sea surface salinity restoring for ocean models

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Common pratice in forced ocean models is to use some form of surface salinity restoring in addition to prescribed freshwater fluxes. This restoring is required because of our imperfect knowledge of atmospheric variables and because of the missing atmospheric feedbacks in forced models. Here, we show that the most commonly used implementation of sea-surface salinity restoring can induce a systematic bias in surface salinity. This bias is due to the possible compensation of the restoring term by other forcing terms in the model salinity equation. It is found that such compensation is responsible for large salinity biases in an eddying Southern Ocean model configuration using an intermediate range piston velocity. In our model, the salinity bias reaches 0.5 psu in the South Eastern Pacific sector of the Southern Ocean. In turn, this salinity bias is associated with too deep winter mixed layers in the Southern Ocean which results in a too strong biogeochemical tracer penetration. A new implementation of surface salinity restoring is proposed and tested. The proposed implementation is based on an additional prognostic equation for a freshwater flux correction. In practice, the new implementation is found to drastically reduce the surface salinity bias and to substantially improve the model winter mixed layer depth in the Southern Ocean. Possible implication for biogeochemical models and global ocean models will be discussed.