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## Numerical simulations of oceanic oxygen cycling in the FAMOUS Earth-System model: FAMOUS-ES, version 1.0

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**Abstract.** Addition and validation of an oxygen cycle to the ocean component of the FAMOUS climate model are described. At the surface, FAMOUS overestimates northern hemisphere oxygen concentrations whereas, at depth, the southern hemisphere values are too low. Surface validation is carried out with respect to HadGEM2-ES where, although good agreement is generally found, discrepancies are mainly attributed to disagreement in surface temperature structure between the models. The disagreement between the models at depth in the Southern Hemisphere is attributed to a combination of excessive surface productivity in FAMOUS' equatorial waters (and its concomitant effect on remineralisation at depth) and its reduced overturning circulation compared to HadGEM2-ES. For the Atlantic basin FAMOUS has a circulation strength of  $12.7 \pm 0.4$  Sv compared to  $15.0 \pm 0.9$  for HadGEM2-ES. Global- and basin-scale decomposition of meridional overturning circulation, oxygen concentration and apparent oxygen utilisation (AOU) – a measure of the departure from equilibrium with the atmosphere – allows specific features of the climatology to be assigned to particular basins. For example, the global signal in overestimation of low-latitude Northern Hemisphere oxygen at intermediate depths is attributed to the Pacific. In addition, the inclusion of the AOU analysis enables explanation of oxygen-deficient deep water in the Southern Hemisphere which is not seen in the Northern Hemisphere.

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