INVERTING TRACER DATA FOR THREE-DIMENSIONAL VELOCITY FIELDS WITH DYNAMICAL CONSTRAINTS

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1. INTRODUCTION

There are two main areas where the ocean is important in climate change. Firstly, it is an active lower boundary to much of the atmosphere, for which it is a major source and/or sink of heat, water vapour and carbon dioxide. Secondly, sea-level changes have a direct affect on the coastal environment.

In order to understand the ocean's role in climate change it is necessary to be able to model the entire depth of the ocean, not just the surface layers. Present day numerical ocean general circulation models (OGCM's) suffer a number of deficiencies:

1. Climatically important quantities such as poleward heat flux are sensitive to the parameterization of unresolved mixing processes. Present estimates of the vertical diffusivity in the ocean vary by almost two orders of magnitude [2].
2. The present ocean velocity climate is not well-known, which makes validation and tuning of OGCM's difficult.

Tracer conservation equations provide a relation between velocity, tracer gradients, mixing coefficients and tracer source/sink terms. Several methods exist for inverting these equations to obtain ocean currents, mixing coefficients and source/sink distributions (if the tracer is not conservative). Additional constraints are provided by the assumptions of geostrophy and continuity. The tracer conservation equations are integrated vertically between two neutral surfaces to improve accuracy, and a geostrophic streamfunction is introduced to reduce the number of unknowns. The resulting equations are discretized,