Geophysical Research Abstracts
Vol. 12, EGU2010-7859, 2010
EGU General Assembly 2010

A transfer operator based numerical investigation of the subpolar gyres in the Southern Ocean

Christian Horenkamp (1), Michael Dellnitz (1), Gary Froyland (2), Kathrin Padberg-Gehle (3,4), and Alex Sen Gupta (5)

(1) Department of Mathematics, University of Paderborn, Germany (horenc@math.upb.de), (2) School of Mathematics and Statistics, The University of New South Wales, Australia, (3) Institue for Transport and Economics, Dresden University of Technology, Germany, (4) Center of Information Services and High Performance Computing (ZIH), Dresden University of Technology, Germany, (5) Centre for Climate Change Research, The University of New South Wales, Australia

The detection and mapping of regions in the ocean that are coherent over an extended period of time is a fundamental problem in many oceanic applications. For instance such regions are important for studying the transport of marine species and for the distribution of nutrients. In this study we demonstrate the efficacy of transfer operators in detecting, mapping, and analysing such structures.

We report on a numerical investigation of three-dimensional circulation in the Southern Ocean over a domain extending from Antarctica to -48 degrees latitude. Our investigation is based upon velocity data simulated by a state-of-the-art 1/4 degree resolution global ocean model. We construct an approximate transfer operator from the velocity data and identify dominant coherent circulation structures from eigenmodes of the transfer operator.

In particular, we focus on the mapping of the Weddell and Ross Gyre for the four seasons spanning December 2003 - November 2004, where we show distinct seasonal differences in both the structure and persistence of the gyres. Additionally, we use the discretised transfer operators to calculate the mean residence time of water within parts of the gyres and to determine pathways of water leaving and entering the gyres.