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ANTHROPOGENIC CO_2 IN THE SOUTHERN OCEAN : COMPARING DATA-BASED METHODS AND OCEAN MODEL SIMULATION ALONG 30°E

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The Southern Ocean, where various water masses are formed (mode, intermediate, deep and bottom waters), has a high potential to absorb anthropogenic CO_2. However, most data-based and model estimates indicate low inventories of anthropogenic carbon (Cant) south of 50°S. In order to investigate this paradox, we estimated the distribution of Cant at the Indian-Atlantic boundary (WOCE I6 line) based on observations collected in 1996 (CIVA2 cruise). In the Subtropical/Subantarctic region (30-50°S), the formation and spreading of mode and intermediate waters result in a deep penetration of Cant around 40°S (down to 1500m). Below the thermocline, uncontaminated cores of North Atlantic Deep Water overlies Antarctic Bottom Water (AABW) where low Cant concentrations are detected. The distribution of Cant we obtained in the mid-latitude region compares well with previous data-based and model estimates. South of the Polar Front (50°S), we estimated significant Cant concentrations in Circumpolar Deep Water (>10 µmol/kg) and AABW (20-25 µmol/kg). Higher concentrations are detected along the continental shelf in AABW presumably formed on the eastern side of the section (e.g. Prydz Bay) compared to AABW of Weddell Sea origin. It is noted that, although transient tracers are not used in the back-calculation technique employed here, the distribution of Cant is remarkably well correlated with CFCs. We re-evaluated the inventory of Cant for the Southern Ocean and found higher values south of 50°S in the Antarctic zone (60-80 mol/m^2) than north of 50°S in the Subtropical/Subantarctic zone (40-60 mol/m^2). Our results confirm the role of Antarctic deep and bottom water formation as a sink for anthropogenic CO2. Inventories deduced from an ocean-carbon model (OPA-PISCES) forced with NCEP reanalysis over the period 1948-2003 are compared with data-based estimates. A relatively good agreement is obtained at mid-latitudes (30-50 mol/m^2), whereas model-based Cant inventories at high latitudes are much lower (<20 mol/m^2).