Session: C9 Poster: M153A

Long-term variations of surface and intermediate waters in the southern Indian Ocean along 32S

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Variations of water-properties in surface and intermediate layers at 32S in the southern Indian Ocean were examined using a fifty-year (1960-2010) time-series reproduced by an optimal interpolation from historical hydrographic and Argo data. Salinity in the density of 26.7-27.3-sigma_theta has decreased statistic-significantly over the whole section and the average rate was 0.02 per decade at the maximum (at 26.8-26.9-sigma_theta). Three deoxygenating cores were identified east of 75E: the rate at the most prominent one (26.9-27.0-sigma_theta) exceeded 0.05 ml/L per decade. The pycnostad of Subantarctic Mode Water (SAMW) and the salinity minimum of Antarctic Intermediate Water have shifted toward the lighter layers slightly. The comparisons with the trans-Indian survey in 1936 suggested the tendencies have continued before 1960. Interestingly many cores of the prominent trends were located just offshore of Australia at 26.7-27.0-sigma_theta, in SAMW density range. A spectrum analysis clarified two oscillating components with the time scales of about 40 and 10 years were dominant in the subsurface layers with large variations. Our results are fairly consistent with previous model results: thus, the oceanic reactions in the southern Indian Ocean under the anthropogenic climate change, which were suggested by the model studies, may be verified by hydrographic data.