Upper Ocean Heat Budget of Western-North Pacific Using Satellite and Ship Observations

Pankajakshan Thadathil* Yasuhiro Sugimori** Masatoshi Akiyama**

Abstract

Surface layer (0-17°C isotherm depth) heat balance of a closed rectangular system (the Kuroshio system) in the North-West Pacific has been examined for a period of 10 days (from 16th to 25th, October, 1991), by considering the residual of net surface heat flux and heat divergence of the system due to horizontal advection. The Kuroshio system has been formulated by taking hydrographic sections (CTD) across the lateral boundaries. Net surface heat flux for the system has been obtained exclusively from satellite observations of surface meteorological parameters using bulk method. Heat divergence in the system is deduced by considering the residual heat advection into/out of the system due to geostrophic currents across the lateral boundaries, derived using method of Wunsch (1978).

Synoptic flux estimates using satellite observations are compared with earlier estimates for this region (in the same season) from in situ data and are found to be reasonable. While the Kuroshio regime shows large net heat loss, towards the south it decreases and have heat surplus. An evaluation of the satellite derived heat fluxes by comparing with flux estimates from in situ observations at ocean weather station-Tango are also found to be comparable. For net satellite derived heat flux varying from 0 to 300w/m^2 the uncertainties are found to be of the order of 50-80w/m^2 . For the same range of flux values the possible uncertainties in ground based climatological estimates are from 40 to 60w/m^{-2}. This increase in uncertainties for satellite derived fluxes are found to be due to remote sensing error. For the Kuroshio system, the net heat flux varies from 0-300w/m^2 with uncertainties varying from 50 to 80w/m^2.

Regarding the heat balance of the Kuroshio box model, the net surface heat flux for the box is -1.4×10^{14}watt. Though there is a general view that Kuroshio act as an effective feeder for the surface heat loss for this region in the present case it is found that for 10-days mean period this is not hapening. Instead of that the system is also losing heat in terms of advection. The horizontal heat divergence due to advection is -0.6×10^{14}watt. During the observation period it is seen that the surface layer (nearly 100m) temperature falls down considerably (of the order of 1°C). It is found that the observed surface heat loss alone is not sufficient to cause the fall in the surface layer temperature of such a large system. The observed horizontal heat divergence is largely caused by the mass imbalance rather than the flow temperature difference at the boundaries.