

Atmospheric Moisture Transport observed by Spaceborne Microwave Scatterometer and Radiometer

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Understanding of the hydrologic balance over the ocean has been hampered by the lack of data. Direct measurements of precipitation (P) and evaporation (E) are extremely sparse and, historically, large-scale hydrologic forcing (P-E) on the ocean was equated to the divergence of moisture transport integrated through the depth of the atmosphere, based on conservation principles and the assumption that the change of moisture storage in the atmosphere is negligible. The computation of the vertically integrated moisture transport, however, requires vertical profiles of humidity and wind vector which come traditionally from serological (rawinsonde) data which are also sparse over the ocean.

Vertically integrated moisture transport can be formulated as the product of the integrated water vapor and an equivalent velocity which, by definition, is the depth-averaged velocity weighted by the humidity. Spaceborne microwave radiometers and scatterometers are providing measurements of integrated water vapor and surface wind vector over global oceans; these measurements could be used to estimate the moisture transport and surface hydrologic forcing if the equivalent velocity is related to the surface wind vector. Using the Level III Atmospheric Data from the European Center for Medium Range Weather Forecast which were derived from the assimilation of conventional data into the numerical weather prediction model and the global atmospheric circulation statistics of the Geophysical Fluid Dynamic Laboratory, which were compiled by objective interpolation of rawinsonde data, the equivalent velocity was computed and found to be in closest agreement with wind velocity at 850mb, near the top of the atmospheric boundary layer. A semi-empirical model was constructed to estimate the equivalent wind from surface wind vector, accounting for boundary layer shear and thermal wind (wind shear caused by baroclinicity). The errors associated with this model are quantified in terms of geographical location and season. The divergence of integrated moisture transport computed with the model, using satellite observed integrated water vapor and surface wind vector was compared with precipitation and evaporation estimated over tropical ocean.