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**HYDROGRAPHY, COASTAL WATER CIRCULATION AND  
CLASSIFICATION OF SRI LANKAN LAGOONS.**

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**ABSTRACT****HYDROGRAPHY, COASTAL WATER CIRCULATION AND  
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Large daily temperature variations and intermittent hypersalinity are features typical for shallow tropical and subtropical lagoons. We investigate these effects in relation to water exchange, based on data from three lagoons on the west coast of Sri Lanka: Negombo, Puttalam and Chilaw Lagoons.

Negombo Lagoon has an estuarine character with low but variable salinities. The lagoon is strongly choked with respect to the semidiurnal tide, because of a narrow and shallow inlet. Data from Negombo Lagoon includes both a one-year series of monthly hydrographical surveys (salinity and temperature) and a longer campaign, comprising high-resolution salinity, temperature and sea level data from various sites. Simultaneous series of high-resolution meteorological data from a weather mast, covering long and short-wave radiation and data for calculation of turbulent heat fluxes were also obtained. Water exchange with the ocean was studied in relation to heat and freshwater input. The channel flux is a key factor. Salinity stratification, which promotes the exchange of properties, appears regularly. We found a difference in exchange between neap and spring but the difference was smaller than expected. The diurnal tide, which is more prominent during neap, promotes stratification, because of lower tidal velocities. Longer periods of in and outflow, in addition promotes more efficient frontal mixing. The diurnal temperature range is extreme (up to 8°C), but the mean temperature is only 0.5-1

°C higher than that of the ocean. Estimates of heat exchange with the ocean and observations of surplus temperature of the lagoon indicate a net heat flux through the sea surface of 10-20  $\text{Wm}^{-2}$  only, for the period investigated. Observations and calculations based on weather mast data gave higher net flux, probably due to underestimate of the latent heat flux at low winds.

Measurements from the Puttalam Lagoon include monthly hydrographic surveys for a period of 2.5 years and high resolution salinity and sea level data from several sites, including current measurements at the inlet, Kalpity Narrows for a four month period. The Puttalam Lagoon is almost ten times larger and more open than the Negombo Lagoon. Because of poor water exchange and depths of 1-2 m only, the seasonal salinity variations become very large. In its inner parts, the salinities may reach 50-60 because of evaporation whereas the rain periods may lower the salinities to between 20 and 30. The residence times are between 40-100 days for exchange with the ocean but might be even longer. Water exchange within the lagoon takes place primarily during periods of slack water, when tidal mixing is weak and a gravitational circulation can be established. During periods of weak or non-existent horizontal gradients active estuarine circulation is uncommon and water exchange is slower, as indicated in our study. It means that frequent shifts from normal to hypersaline conditions bring down the long-term water exchange. The lagoon seems not to attain a steady state but the salinity continues to increase until the next rain season appears. In fact, it is possible that the salinity may increase indefinitely.

Chilaw Lagoon is smaller than the other lagoons and more restricted. It has two long and narrow entrances, of which one is intermittently closed. It was investigated with tide gauges and salinity-temperature sensors at three sites during 1998. The lagoon is strongly affected by freshwater discharge during floods, when the sea level may rise high above the ocean level.

The salinity of all three lagoons is sensitive to human impact. Changes in freshwater input caused by irrigation or damming, may result in large salinity variations and be crucial to marine life. In Puttalam Lagoon the salinity may have increased by 5-10 psu since the 1960's and it is now well above the oceanic mean, because of a lower river discharge. Also Negombo Lagoon may be affected by reduced discharge. However, all lagoons are also influenced by normal climatic variations, where immediate changes in salinity due to heavy rainfall may reach several psu and the diurnal temperature variability due to sea surface heat flux is 3-5 °C.