Numerical model predictions of seabed shear stress, sediment mobility, and sediment transport in the Bay of Fundy

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Seabed substrate stability and sediment dynamics are fundamental geoscience knowledge required for developing the tidal energy, and the overall sustainable development in the Bay of Fundy. Waves, tidal currents, and wind-driven and circulation currents were predicted from oceanographic models to assess the wave and current processes for the broader Bay of Fundy. The wave and current outputs were coupled with observed grain size in a sediment transport model (SEDTRANS) to predict the seabed shear stresses, sediment mobility, and sediment transport pattern in the region. Mean tidal current is the highest in the upper bay (>1.2 m/s), reduced to moderate in the central bay (0.5–0.8 m/s) and decreased further in the outer bay (0.2–0.5 m/s). Maximum tidal current occurs in the Minas Channel and is greater than 5 m/s. Mean wave height, in contrast, is the greatest in the outer bay (~1.3 m) and gradually decreases to the northeast in the central and upper bay (<0.5 m). Ocean circulation currents are largely less than 0.3 m/s. Maximum mean shear velocity on the seafloor due to combined effects of waves and currents reaches about 5 cm/s and is predominantly due to tidal current. Comparison between the

Atlantic Geology, 2010, Volume 46, Number 1

model-predicted shear velocity from various processes and the threshold for bedload transport suggests that sediment mobilization is predominantly by tidal current and occurs nearly over the entire Bay of Fundy with maximum values reaching 100% of the time in several areas. Sediment mobilization by waves is generally restricted to small coastal areas. Total sediment transport rate can reach 1–10 kg/m/s under spring tide condition. Net sediment transport averaged over a tidal cycle typically reaches 0.1 kg/m/s, and is dominantly to the top of the bay with local reversals and developments of eddies.