Introduction

Minas Basin, at the eastern end of the Bay of Fundy in Nova Scotia, Canada, is a large macro-tidal estuary. Strong currents associated with the large tidal range could potentially provide a source of renewable tidal energy, but they also are a fundamental part of the Bay of Fundy ecosystem. Significant extraction of tidal energy could lead to local and far field changes in the tidal regime and sediment dynamics.

We present observations of Total Suspended Matter (TSM) concentrations from ocean colour imagery (MERIS data) in Minas Basin. The mean TSM derived from both summer and winter MERIS data were compared to predictions using the Delft3D model (Lesser, 2004).

Comparison between the magnitude and spatial and temporal patterns of observed and simulated TSM will help to evaluate the appropriate sediment parameters in the model and to understand the observed seasonal variability of sediment in suspension.

Methods

Autocorrelation Analysis

Time series of TSM in 1-km-square pixel boxes throughout the Basin were produced, and temporal autocorrelation analysis has been carried out with those time series.

- The mathematical definition of Variogram V(K) is (Diggle, 1990):

\[
V(k) = \frac{1}{N} \sum (Y(t) - Y(t-k))^2
\]

where, Y(t) is stands for TSM concentration at time t, and k is time lag. Average for a given lag is

\[
\text{V}(k) = \frac{1}{N} \sum \text{V}(k)/N
\]

where, N indicates the number of observations at lag k. \(\text{V}(k)\) was normalized by variance of the time series, \(\sigma^2\).

- Temporal Autocorrelation analysis be used to estimate the dominant time scales of variability in TSM concentration. If \(\text{V}(k)\) small, observations at time \(\pm k\) are similar to observations at time t.

Quantitative Comparison for Map

Comparison using “percent difference” capitalizes on the juxtaposition of the differences by simply evaluating the percent change for each grid cell (Berry, 1999).

\[
RD = \left[ \frac{(\text{map1}_\text{value} - \text{map2}_\text{value})}{\text{map2}_\text{value}} \right] \times 100
\]

Where, \(\text{map1}_\text{value}\) stands for model TSM concentration, \(\text{map2}_\text{value}\) stands for satellite TSM concentration, RD is relative difference.

- Model overestimate: RD > 0
- Model underestimate: RD < 0

Strength of Annual Signal

The strength of the TSM Annual Signal in Minas Basin

In-situ vs. Satellite

Satellite vs. Model

Variability of TSM

Conclusions

- TSM derived from MERIS indicate a strong annual change in the most areas of Minas Basin. Larger TSM are observed in mid-winter (Feb. and Mar.), and smaller TSM characterize mid-summer (Jul. and Aug.).
- The strength of annual signal varies throughout the Basin, with the largest variation occurring in middle of the Minas Basin, and the smaller variations occurring in Cobequid Bay and near Windsor Bay.
- In-situ surficial TSM measurements are higher than satellite observations in Minas Basin.

Future Work

- Compare satellite data with more model output.
- Evaluate the appropriate sediment parameters in the model to produce the appropriate TSM concentration.

References


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