Introduction

Near Vancouver (Canada) at the mouth of the Fraser River a large amount of inter-tidal marshland has been lost at an alarming rate. The marsh is an important part of the Fraser Delta as it supports migratory birds and is part of the coastal protection of the city of Richmond.

Causes for the marsh recession have been extensively investigated, but not conclusively found. This research explored the recession from a new hydro-morphological angle. It was carried out as an MSc project from March 2016 to January 2017 and supported by a joint team from Canada and the Netherlands.

Water level records:
At Point Atkinson between 1984-2016
Wind speed records:
At VYR airport between 1985-2012
Air photo analysis:
Satellite image analysis:
Landsat images made available by the USGS between 1985-2015
Workfield:
In-field GPS elevation measurements and observations
Grain size analysis of the top soil in and near the marsh
Model study:
Delft-3D flow model and a basic model for wave breaking
Expert opinion on ecology:
Literature and meetings in Canada and the Netherlands

Most of the marsh receded between 1985 and 2000 after being stable and/or growing for over 50 years. During the marsh recession the northern tidal channels disappeared and sand swells (sandy bed forms 70-100 m long and 0.2-0.5 m high) migrated shoreward.

Erosion of a terrace at the historic marsh was detected after 3 major storms between 2000-2003. Elevation measurements since 2013 suggest the bank is currently stable with negligible erosion/deposition. The marsh itself has seen little recession since 2000-2005.

More important factors were noted. Sand content within the top soil has increased up to 30% between 2011-2016. Also algae coverage of the marsh and water logging was observed.

Methods were proposed to explain the cause of the marsh recession (see block above). These were evaluated with the results from this research.

Sediment deficit: Although the sediment supply has likely been affected by dredging and the Steveston Jetty, results show no structural loss of sediment from the marsh since dredging commenced as would be expected.

Sea-level rise: Even assuming no deposition the rate of sea-level rise alone was found insufficient to cause a retreat of 22 m/year as observed.

Sand swells: Movement of sand swells is only possibly under strong wave action. Recession had already started before the storms hit after 2000. It is thus unlikely they started the recession.

Conclusions

None of the hypotheses of causes presented above could singularly support the severity and timespan of the recession. Feedback mechanisms were qualitatively supported but were not quantified. An integral approach is required combining the initial causes with the feedback mechanisms to quantify their cumulative effects on the marsh.

More research is required to quantify the tolerance of the marsh plants to the proposed stresses as to better predict the tipping point towards marsh recession. Also the changes in environment (e.g. channels and bed forms) that affect these stresses should be studied further. A pilot study is proposed to study the response of the marsh to a higher elevation, better drainage and protection from waves.