

FIGURE 2.

Sensitivity of the coasts of Canada to sea-level rise

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To accompany GSC Bulletin 505

Scale 1 : 6 750 000
Kilometres

Digital base map from Canadian Hydrographic Service Map M-270.

This figure shows the sensitivity of the coastlines of Canada to an accelerated rise in sea level due to global warming. The increase could amount to 0.65 m by the end of the next century (Houghton et al., 1990). Here, sensitivity means the degree to which a coastline may experience physical changes due to sea-level rise. These could include, for example, erosion, inundation, increased frequency of overtopping and overwashing, beach migration, and coastal dune destabilization. The figure depicts spatial variation of a sensitivity index, a modified version of the coastal vulnerability index of Gornitz (1990), which is obtained by manipulating scores of 1 to 5 attributed to each of seven variables: relief, geology, coastal landform, sea-level tendency, shoreline displacement, tidal range, and wave height. Data were obtained for each of 2899 NTS sheets at a scale of 1:50 000.

Sensitivity Index scores range from 0.8 to 56.7, with a modal value of 4.2. They are grouped into three categories: low (0 - 4.9), moderate (5.0 - 14.9), and high (≥ 15.0). Two major regions of high sensitivity are identified: (1) Maritime Canada (parts of the coasts of Nova Scotia, Prince Edward Island, and New Brunswick) and (2) parts of the Beaufort Sea coast. Small areas of high sensitivity occur in Quebec, Newfoundland, and British Columbia. The scores are not equated with specific effects; they merely indicate in a relative sense the degree of change to be expected. Furthermore, at this scale the data are highly generalized, and there is no accounting for very small areas of high sensitivity (cf. photograph D).

The bulletin describes the potential impacts of sea-level change, using the coastal environments of Owens (1977a) as a framework. The emphasis is on the range of processes which occur today on Canadian coasts and which would be intensified if sea-level rise were to occur.

The present rate of sea-level change is shown at selected tide-gauge stations, one of the seven factors used for calculating the sensitivity index. Accelerated sea-level rise would be superimposed on these existing trends. Photographs A to L illustrate the diversity of Canadian coasts and the wide range of impacts that might be expected.

Produced by Geological Survey of Canada (Atlantic) - Electronic Publishing

COASTAL ENVIRONMENTS OF CANADA

Owens (1977a) classified the coasts of Canada into distinct coastal environments on the basis of 'the physical processes that act on the shoreline and on the geology and relief of the coastal zone'. These environments are used as a framework for discussion in the text.

ATLANTIC COAST

- 1 Labrador and outer Newfoundland
- 2 Western Newfoundland and northern gulf
- 3 St. Lawrence estuary
- 4 Southern Gulf of St. Lawrence
- 5 Atlantic Nova Scotia
- 6 Bay of Fundy
- 7 Sable Island

PACIFIC COAST

- 1 Fraser River Delta
- 2 Queen Charlotte Strait and Strait of Georgia
- 3 Juan de Fuca Strait
- 4 Outer coast
- 5 Queen Charlotte Sound and Hecate Strait
- 6 East Graham Island

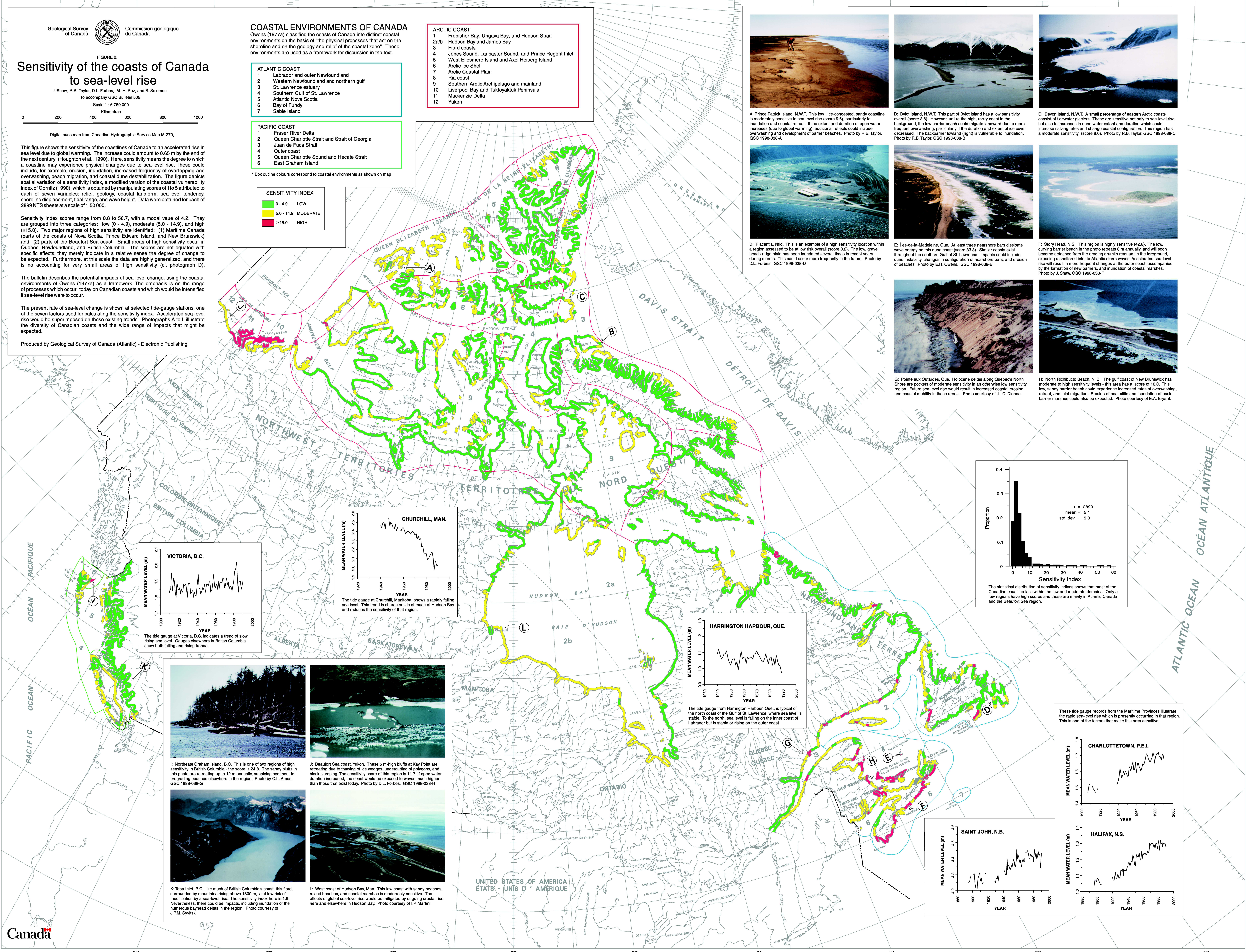
* Box outline colours correspond to coastal environments as shown on map

ARCTIC COAST

- 1 Frobisher Bay, Ungava Bay, and Hudson Strait
- 2a Hudson Bay and James Bay
- 3 Fjord coasts
- 4 Jones Sound, Lancaster Sound, and Prince Regent Inlet
- 5 West Ellesmere Island and Axel Heiberg Island
- 6 Arctic Ice Shelf
- 7 Arctic Coastal Plain
- 8 Ria coast
- 9 Southern Arctic Archipelago and mainland
- 10 Liverpool Bay and Tuktoyaktuk Peninsula
- 11 Mackenzie Delta
- 12 Yukon

SENSITIVITY INDEX

- 0 - 4.9 LOW
- 5.0 - 14.9 MODERATE
- ≥ 15.0 HIGH



A: Prince Patrick Island, N.W.T. This low, ice-congested, sandy coastline is moderately sensitive to sea-level rise (score 9.6), particularly to inundation and coastal retreat. If the extent and duration of open water increases (due to global warming), additional effects could include overwashing and development of barrier beaches. Photo by R.B. Taylor. GSC 1998-038-A



B: Bylot Island, N.W.T. This part of Bylot Island has a low sensitivity overall (score 3.6). However, unlike the high, rocky coast in the background, the low barrier beach could migrate landward due to more frequent overwashing, particularly if the duration and extent of ice cover decreased. The backbarrier lowland (right) is vulnerable to inundation. Photo by R.B. Taylor. GSC 1998-038-B



C: Devon Island, N.W.T. A small percentage of eastern Arctic coasts consist of tidewater glaciers. These are sensitive not only to sea-level rise, but also to increases in open water extent and duration which could increase calving rates and change coastal configuration. This region has a moderate sensitivity (score 6.0). Photo by R.B. Taylor. GSC 1998-038-C



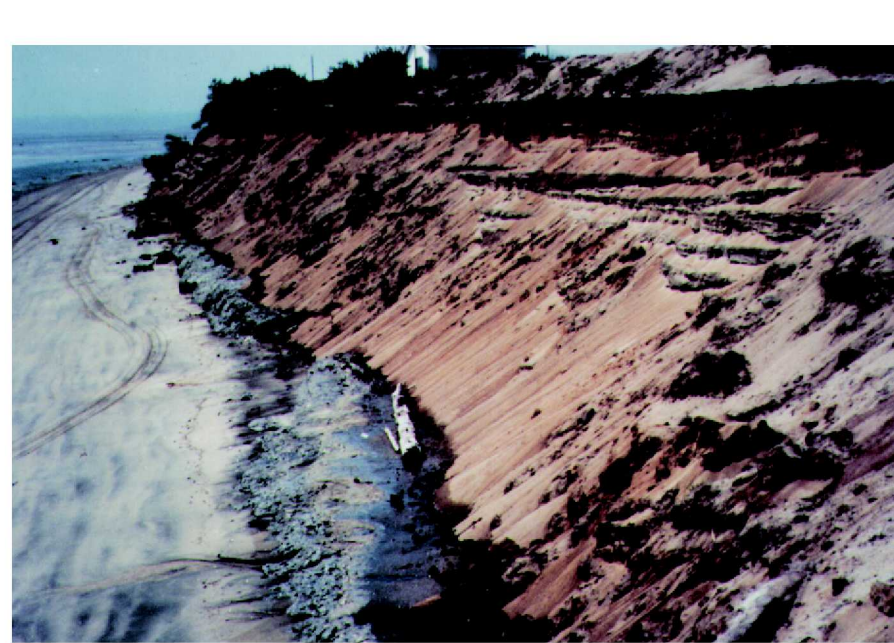
D: Placencia, Nfld. This is an example of a high sensitivity location within a region assessed to be at low risk overall (score 3.2). The low, gravel beach-ridge plain has been inundated several times in recent years during storms. This could occur more frequently in the future. Photo by D.L. Forbes. GSC 1998-038-D



E: Îles-de-la-Madeleine, Que. At least three nearshore bars dissipate wave energy on this dune coast (score 33.8). Similar coasts exist throughout the southern Gulf of St. Lawrence. Impacts could include dune instability, changes in configuration of nearshore bars, and erosion of beaches. Photo by E.H. Owens. GSC 1998-038-E



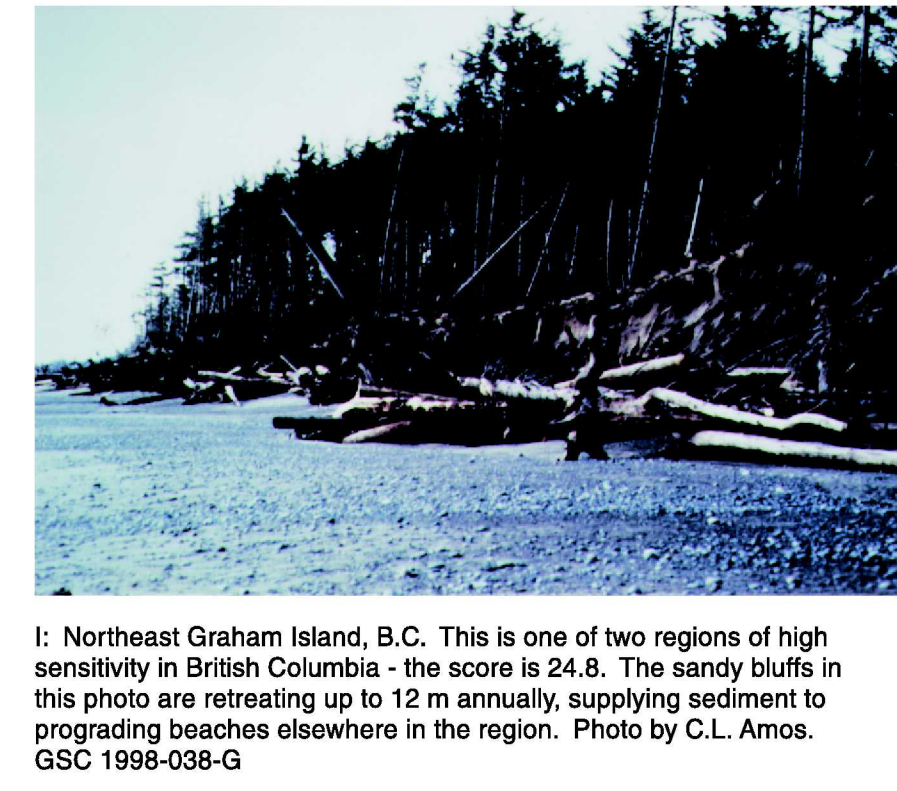
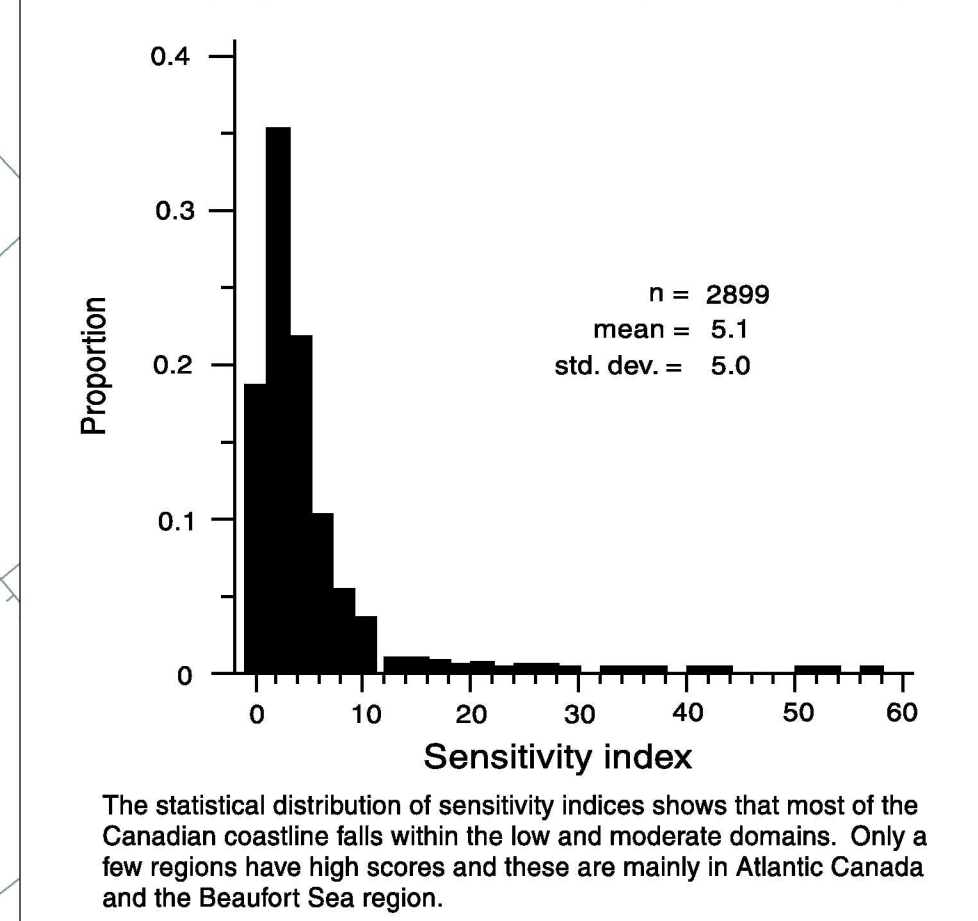
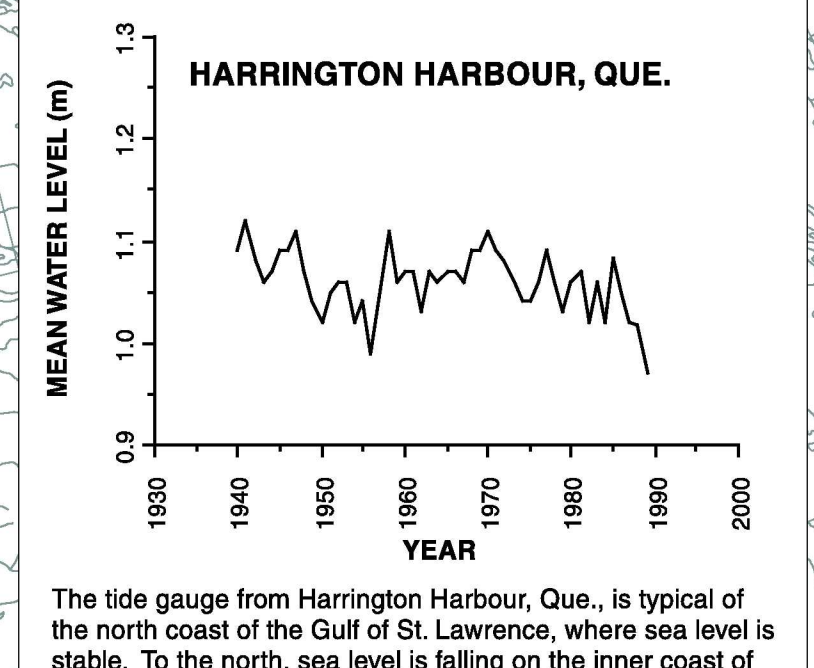
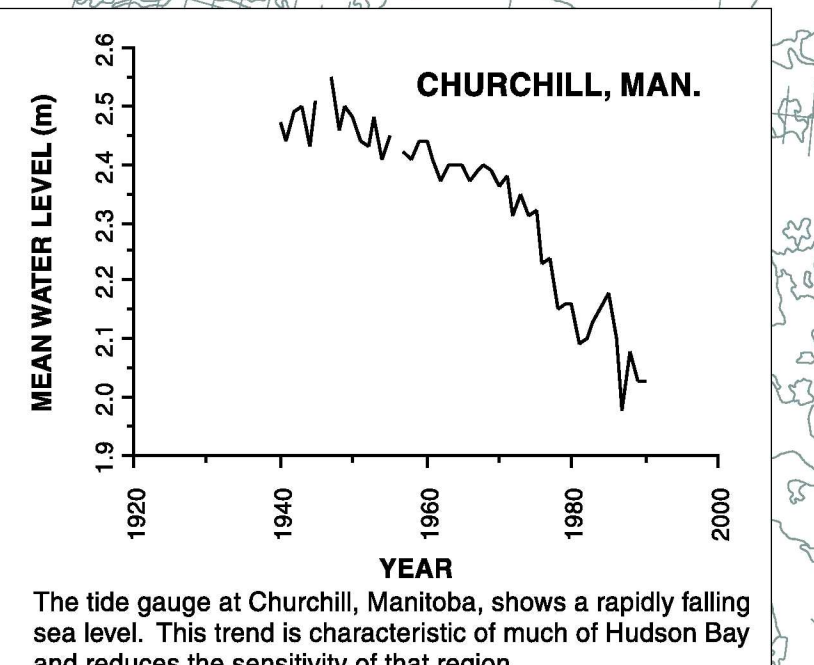
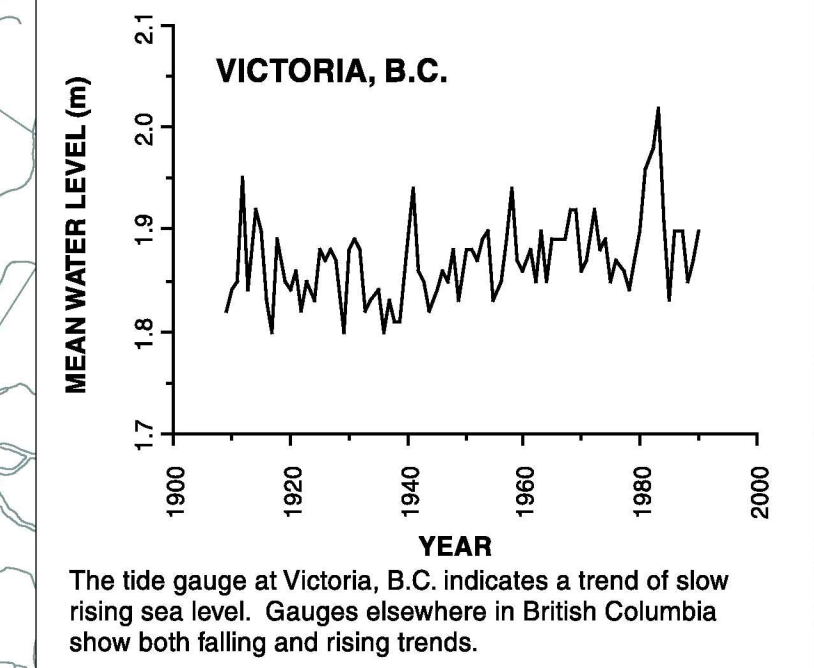
F: Story Head, N.S. This region is highly sensitive (42.8). The low, curving barrier beach in the photo retreats 8 m annually, and will soon become detached from the eroding drumlin remnant in the foreground, exposing a sheltered inlet to Atlantic storm waves. Accelerated sea-level rise will result in more frequent charges at the outer coast, accompanied by the formation of new barriers, and inundation of coastal marshes. Photo by J. Shaw. GSC 1998-038-F



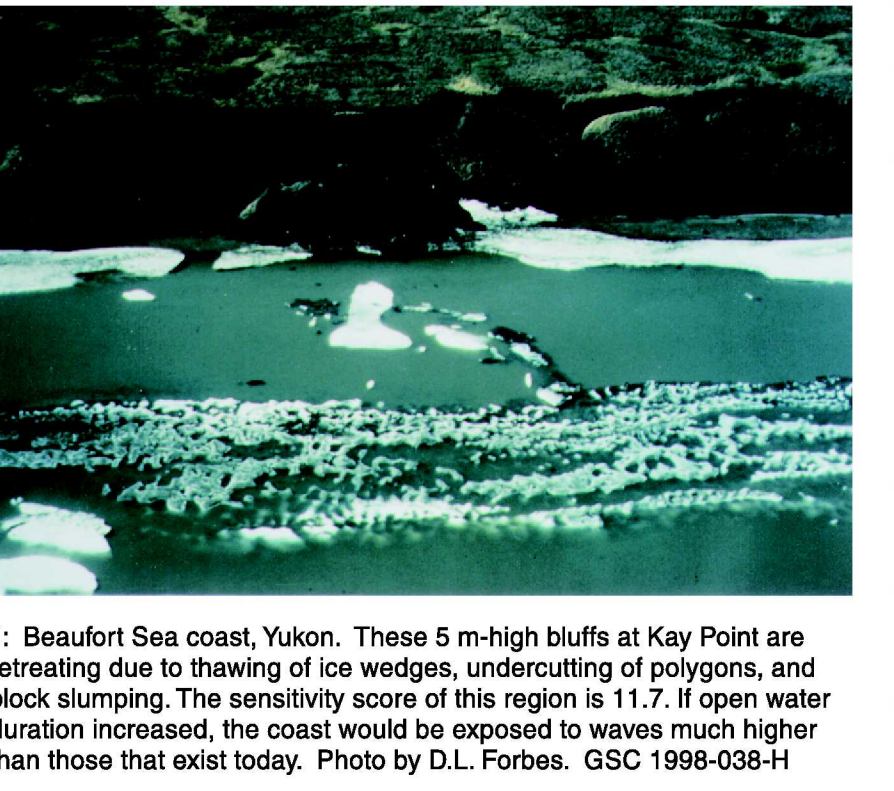
G: Points aux Outardes, Que. Holocene deltas along Quebec's North Shore are pockets of moderate sensitivity in an otherwise low sensitivity region. Future sea-level rise would result in increased coastal erosion and coastal mobility in these areas. Photo courtesy of J.-C. Dionne.



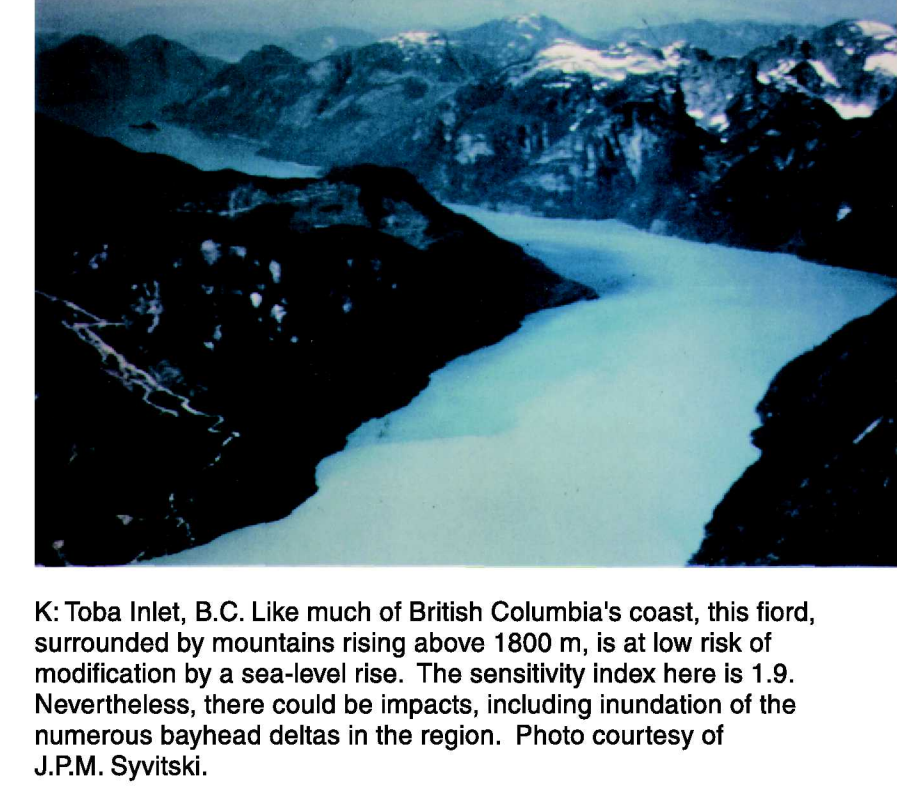
H: North Richibucto Beach, N.B. The gulf coast of New Brunswick has moderate to high sensitivity levels - this area has a score of 16.0. This low, sandy barrier beach could experience increased rates of overwashing, retreat, and inlet migration. Erosion of peat cliffs and inundation of back-barrier marshes could also be expected. Photo courtesy of E.A. Bryant.



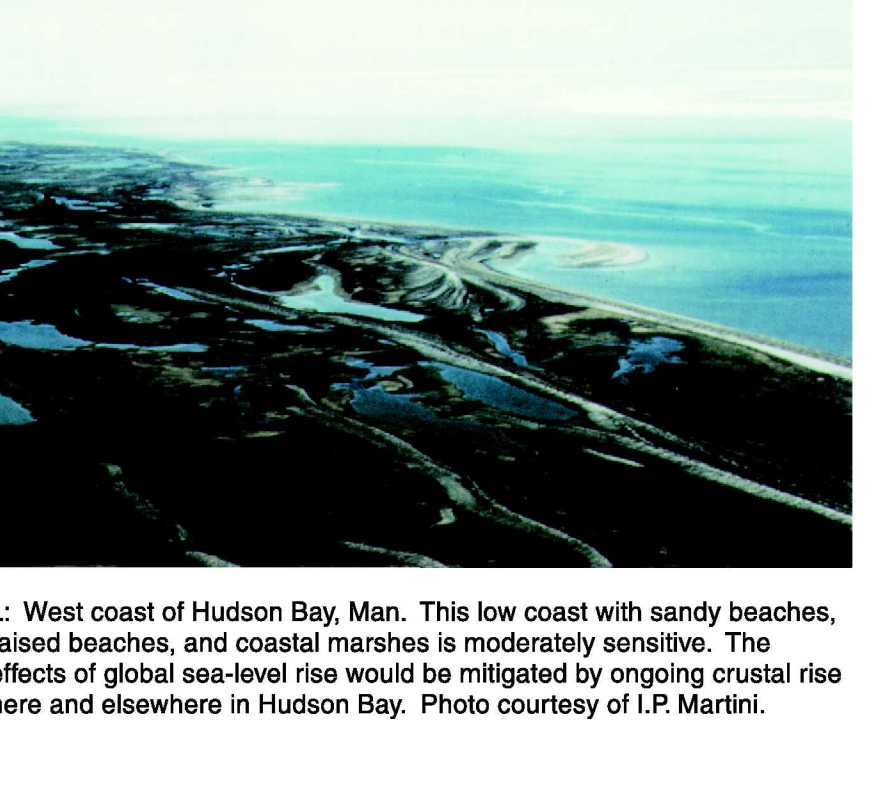
I: Northeast Graham Island, B.C. This is one of two regions of high sensitivity in British Columbia - the score is 24.8. The sandy bluffs in this photo are retreating up to 12 m annually, supplying sediment to prograding beaches elsewhere in the region. Photo by C.L. Amos. GSC 1998-038-G



J: Beaufort Sea coast, Yukon. These 5 m-high bluffs at Kay Point are retreating due to thawing of ice wedges, undercutting of polygons, and block slumping. The sensitivity score of this region is 11.7. If open water duration increased, the coast would be exposed to waves much higher than those that exist today. Photo by D.L. Forbes. GSC 1998-038-H



K: Toba Inlet, B.C. Like much of British Columbia's coast, this fjord, surrounded by mountains rising above 1800 m, is at low risk of modification by a sea-level rise. The sensitivity index here is 1.9. Nevertheless, there could be impacts, including inundation of the numerous bayhead deltas in the region. Photo courtesy of J.P.M. Syvitski.



L: West coast of Hudson Bay, Man. This low coast with sandy beaches, raised beaches, and coastal marshes is moderately sensitive. The effects of global sea-level rise would be mitigated by ongoing crustal rise here and elsewhere in Hudson Bay. Photo courtesy of I.F. Martin.

