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**2014**

Canada

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**T.S. James[1], J.A. Henton[2], L.J. Leonard[3], A. Darlington[4], D.L. Forbes[5], M. Craymer[6]**

[1]Geological Survey of Canada, Pacific Division, Sidney, British Columbia
[2]Canadian Geodetic Survey, Sidney, British Columbia
[3]School of Earth and Ocean Sciences, University of Victoria, Victoria, British Columbia
[4]Environment Canada, Toronto, Ontario
[5]Geological Survey of Canada, Atlantic Division, Dartmouth, Nova Scotia
[6]Canadian Geodetic Survey, Ottawa, Ontario

## 2014



doi:10.4095/295574

This publication is available for free download through GEOSCAN (http://geoscan.nrcan.gc.ca/).

**Recommended citation**
James, T.S., Henton, J.A., Leonard, L.J., Darlington, A., Forbes, D.L., and Craymer, M., 2014. Relative Sea-level Projections in Canada and the Adjacent Mainland United States; Geological Survey of Canada, Open File 7737, 72 p. doi:10.4095/295574

Publications in this series have not been edited; they are released as submitted by the author.

Cover photo: Coastline at Tuktoyaktuk, Northwest Territories, by G.K. Manson, Geological Survey of Canada, Aug. 14, 2004

**Abstract.** Relative sea-level projections are provided for 59 locations in Canada and 10 in the adjacent mainland United States through the 21st century, relative to 1986-2005. The projections are based on the Representative Concentration Pathway (RCP) scenarios of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5). They include contributions from the thermal expansion of the ocean (steric effect), land ice melting and discharge, and anthropogenic influences. The global mean sea-level projection for RCP8.5, the largest emissions scenario, at 2100 is 74 cm (5%-95% range is 54 to 98 cm). Global Positioning System (GPS) measurements of vertical land motion are incorporated into the relative sea-level projections. In the regions presented here, vertical land motion, largely arising from glacial isostatic adjustment, plays a prominent role in determining projected relative sea-level change. On the east coast, crustal subsidence, combined with dynamic oceanographic changes, generates relative sea-level projections that are similar to or larger than the global mean projections in large parts of Atlantic Canada and New England. On the west coast, most relative sea-level projections are smaller than the global means, although some sites in Washington State and southern British Columbia feature relative sea-level projections similar to the global values. The largest variation in projected relative sea-level rise occurs in northern Canada, owing to the very large spatial differences in present-day crustal uplift due to glacial isostatic adjustment. Here, projected relative sea-level at 2100 varies from around 1 m of sea-level fall (median values) where land is rising quickly on Hudson Bay, while it reaches about 70 cm of sea-level rise on the Beaufort coast where the land is subsiding. A scenario featuring partial collapse of a portion of the West Antarctic Ice Sheet provides an additional 65 cm of sea-level rise to RCP8.5, and may be appropriate to consider when tolerance to the risk of sea-level rise is low. The relative sea-level projections given here only provide a trajectory through this century, but the IPCC AR5 projects continued global sea-level rise in coming centuries. As understanding improves of the various components of sea-level rise, it will be necessary to update, on an occasional basis, the relative sea-level projections and re-evaluate the implications for infrastructure, habitat, and marine navigation.

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## 1. Introduction

One of the most significant consequences of climate change is sea-level rise (Stern, 2007; IPCC, 2013). Globally, sea level is projected to rise by tens of centimetres, and possibly more than a metre, by the year 2100 (IPCC, 2007; 2013; Meehl et al., 2007; Church et al., 2013a). Sea-level rise increases the vulnerability to storm surges, causing coastal flooding, and may increase the amount of coastal erosion. Thus, projections of the magnitude of sea-level change are important for forecasting risk to populations, for planning infrastructure maintenance and development, and for habitat management (e.g., Nicholls et al., 2011).

Relative sea-level changes are the changes in sea level that are observed or experienced relative to the solid surface of the Earth. Relative sea-level change differs from absolute sea-level change, which is the change in sea level relative to the centre of the Earth. Global sea-level projections are reported as absolute sea-level change, but locally coastal planners are concerned with relative sea-level change. Both coastal infrastructure and coastal ecosystems are sensitive to changes in local relative sea level, which depends on vertical land motion. Land uplift can offset global sea-level rise, leading to reduced rise or even fall of relative sea level; on the other hand, land subsidence adds to absolute sea-level rise and increases relative sea-level rise.

In Canada there are substantial spatial variations in vertical land motion which lead to substantial spatial differences in observed past and present-day relative sea-level change and projected future relative sea-level change. Across much of the Canadian landmass, glacial isostatic adjustment (GIA), also known as postglacial rebound (PGR) (e.g., Walcott, 1972; Clague et al., 1982), is an important, and often predominant, source of vertical crustal motion and relative sea-level change. GIA is the delayed response of the Earth to the surface loading and unloading caused by the advance and retreat of a continental ice sheet during the last ice age. Other sources of vertical crustal motion arise from soft-sediment compaction and dewatering and from accumulation of crustal strain near active faults.

The range of global sea-level projections is large (e.g., Milne et al., 2009). The range arises in large part because different assumptions about future carbon emissions into the atmosphere lead to different projections of global sea-level rise. Projections of global sea-level rise have contributions from thermal expansion of the ocean (often termed the steric effect) and surface melting and ice discharge from mountain glaciers and ice caps and from the large Greenland and Antarctic ice sheets. As well, there are smaller contributions to sea-level change from groundwater withdrawal and from water impoundment by dams. There remains substantial scientific uncertainty regarding the possibility of rapid collapse of portions of the West Antarctic ice sheet, which, if it were to occur, would further contribute to the projections of sea-level rise (IPCC, 2013; Church et al., 2013a).

Relative sea-level change is projected for 59 locations in the Canadian provinces and territories of Nova Scotia, Newfoundland and Labrador, New Brunswick, Prince Edward Island, Québec, Ontario, Manitoba, British Columbia, Nunavut, and the Northwest Territories, and 10 locations in the American states of Maine, Massachusetts and Washington (Fig. 1). This report builds and extends on preliminary projections of relative sea-level change at a limited number of sites in northern Canada (James et al., 2011) based in the IPCC AR4 (IPCC, 2007; Meehl et al., 2007). Here, the projections are based on the 5th Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC, 2013; Church et al., 2013a). The projections incorporate vertical crustal motion measured by Global Positioning System (GPS) instruments. In most cases the GPS sites are located close to identified communities. Projections are provided from 2007 to 2100, and are relative to the time range 1986-2005.

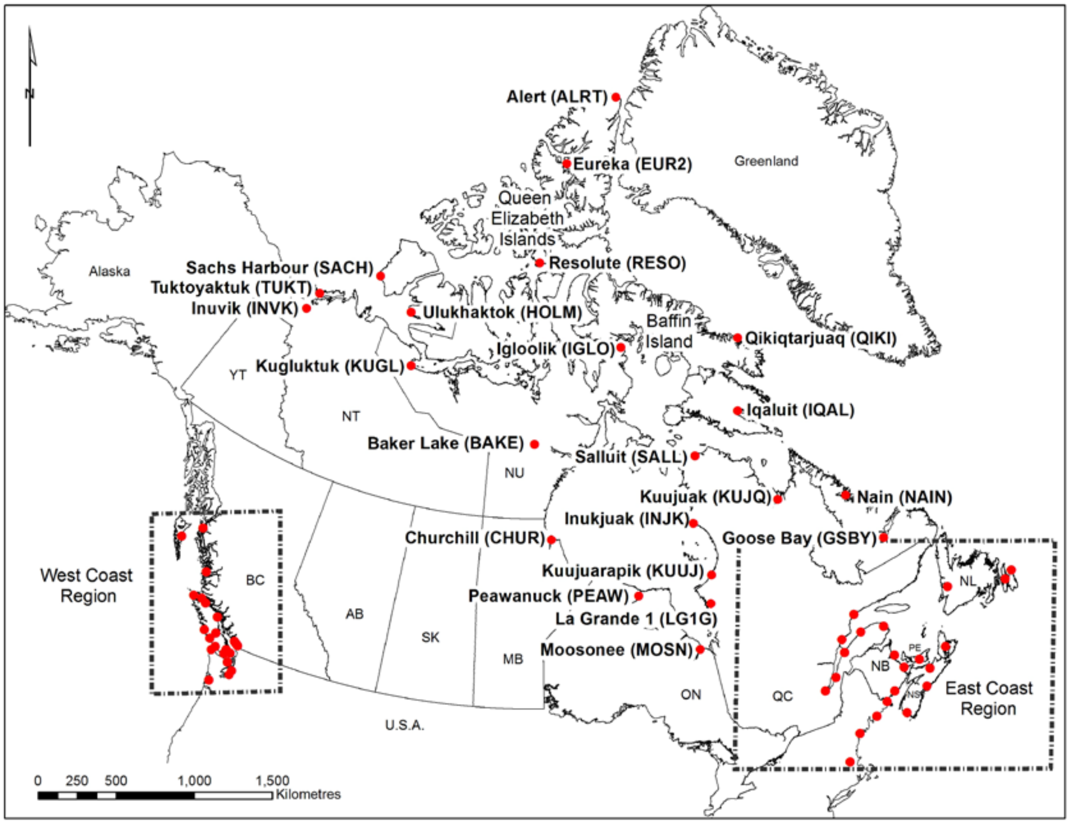


**Figure 1a**. Map of Canada, showing sites for which sea-level projections are provided (red dots) and indicating the extent of the East and West Coast Regions (rectangles, see Fig. 1b and 1c). Site names and GPS station abbreviations (in brackets) are given for the North Coast Region.

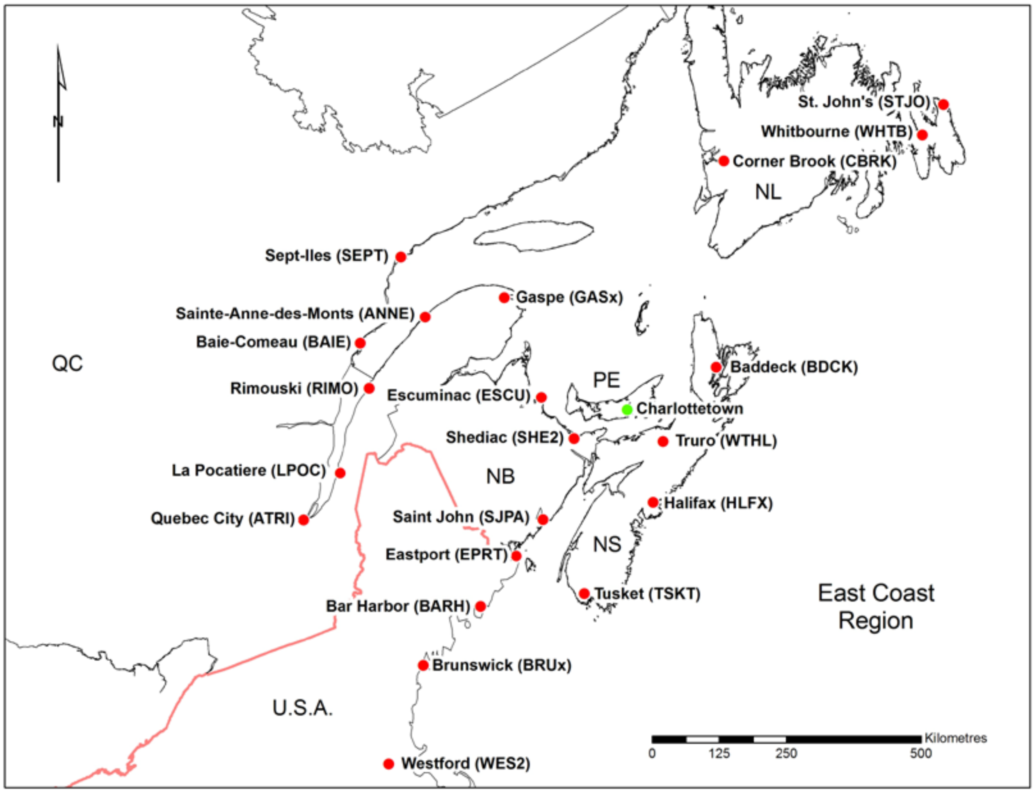


**Figure 1b**. Map of the East Coast Region, showing locations for which sea-level projections are provided (red dots). GPS site names are given in brackets. Charlottetown, PE (green dot), does not have a GPS station and its vertical velocity is estimated from nearby GPS sites (Appendix A).

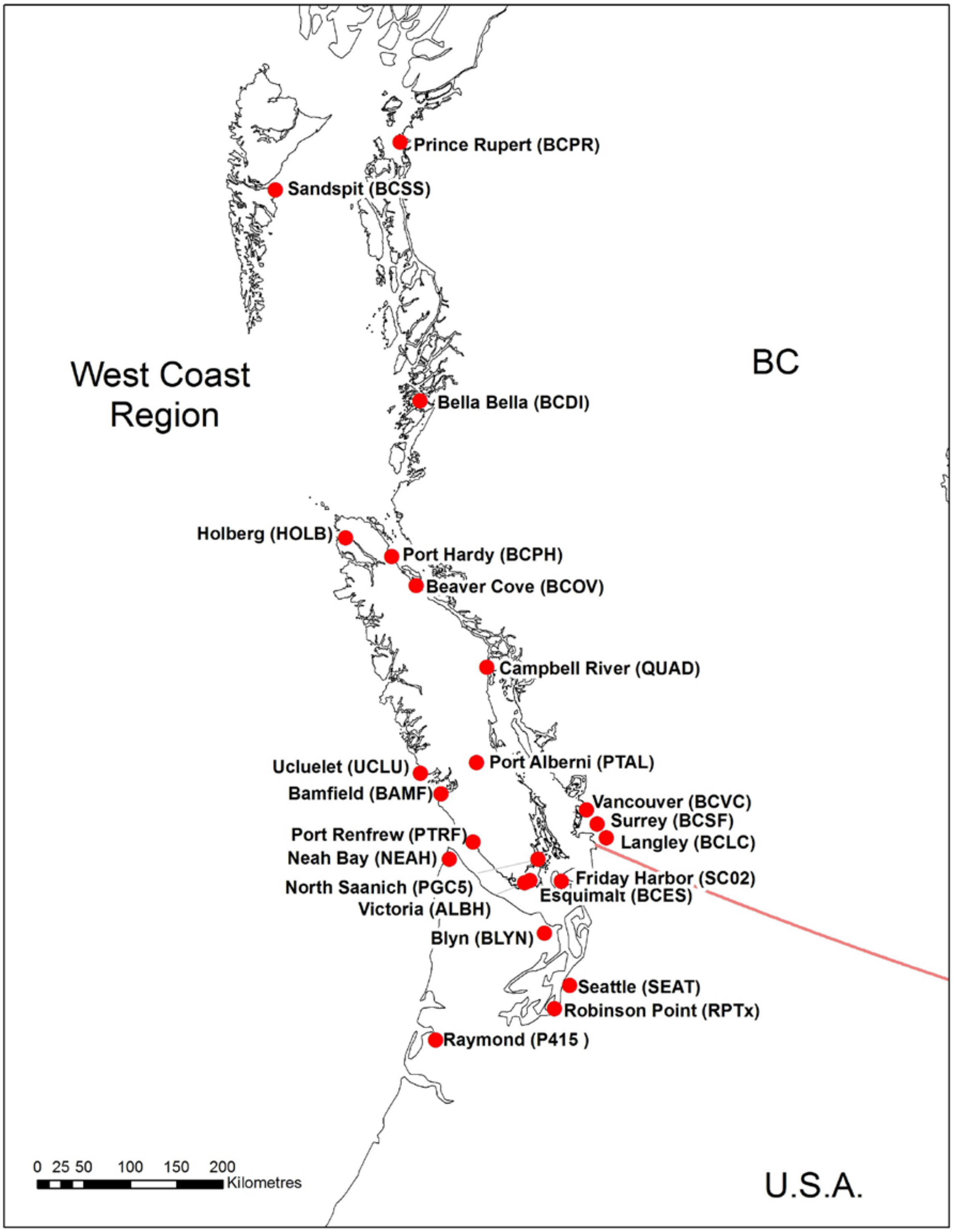


**Figure 1c.** Map of the West Coast Region, showing sites for which sea-level projections are provided. GPS site names are given in brackets.

## 2. Contributions to Sea-Level Change

Global, or absolute, sea level is projected to rise throughout this century due to thermal expansion of the oceans (the steric effect) and surface melting and ice discharge to the oceans of land ice (mountain glaciers and ice caps and the large Greenland and Antarctic ice sheets) (e.g., Milne et al., 2009). Smaller contributions to sea-level change are also expected from groundwater withdrawal and from damming of rivers and streams.

Relative sea-level is the sea-level change relative to the Earth's solid surface. The projected relative sea-level change at a coastal site depends on a number of factors in addition to the projected global sea-level change. Local vertical motion of the ground, spatial variations in the redistribution of glacial meltwater in the global oceans, and regional changes to sea-level due to dynamic oceanographic effects will all contribute to spatially variable relative sea-level change. In the following, the various factors that contribute to a relative sea-level projection are described in more detail.

### *2.1 Scenarios of Global Sea-level Rise*

The global sea-level rise projections employed here are based on the Representative Concentration Pathways (RCP) scenarios (Moss et al., 2010) prepared for the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC): RCP2.6, RCP4.5, RCP6, and RCP8.5. The scenarios are termed Representative Concentration Pathways to emphasize that they are representative of a much larger group of emissions scenarios and that they feature a pathway of greenhouse gas concentration through the 21st century. The RCP scenarios provide four clearly differentiated greenhouse gas concentration pathways. In the RCP nomenclature, the number in each scenario name corresponds to the net radiative forcing (in W $m^{-2}$) at 2100, where the net radiative forcing is the difference between the amount of energy that enters the Earth's atmosphere and the amount that is radiated away from the Earth. The RCP scenarios represent a fundamentally different approach to examining climate futures than was taken in the development of previous (SRES) scenarios (Nakicenovic and Swart, 2000) used in the IPCC 4th Assessment Report. Nonetheless there are similarities between some RCP and SRES scenarios with respect to median temperature increase by 2100, as summarized in Table 1.

**Table 1.** Comparison between SRES and RCP Scenarios

| RCP Scenario | (Equivalent) SRES Scenario[1] |
|---|---|
| RCP2.6 | None |
| RCP4.5 | SRES B1 |
| RCP6 | SRES B2 |
| RCP8.5 | SRES A1FI |

[1]SRES scenario that has equivalent median temperature increase by 2100 (Rogelj et al., 2012).

RCP2.6 has the smallest amount of radiative forcing and does not have an equivalent SRES scenario. It features a rise to a peak radiative forcing of 3 W $m^{-2}$ around mid-century and then a decline to 2.6 W $m^{-2}$ by the end of the century, due to assumed active mitigation of greenhouse gas emissions. RCP2.6 is also known as RCP3-PD, where PD represents Peak and Decline. The IPCC AR5 Summary for Policymakers (IPCC, 2013) reports

> "Global mean sea level rise for 2081-2100 relative to 1986-2005 will *likely* be in the ranges of 0.26 to 0.55 m for RCP2.6, 0.32 to 0.63 m for RCP4.5, 0.33 to 0.63 m for

RCP6.0, and 0.45 to 0.82 for RCP8.5 (*medium confidence*). For RCP8.5, the rise by the year 2100 is 0.52 to 0.98 m,…"

Global sea level is projected to rise over the next century, but the projected magnitude of this rise depends on greenhouse gas concentrations (Figure 2). The median global sea-level rise at 2100, relative to 1986-2005, is 43 cm for RCP2.6 and 73 cm for RCP8.5, i.e., the projected sea-level rise of the maximum RCP scenario is 1.7 times larger than the minimum RCP scenario. Projected global sea-level rise at 2100 is summarized in Table 2.

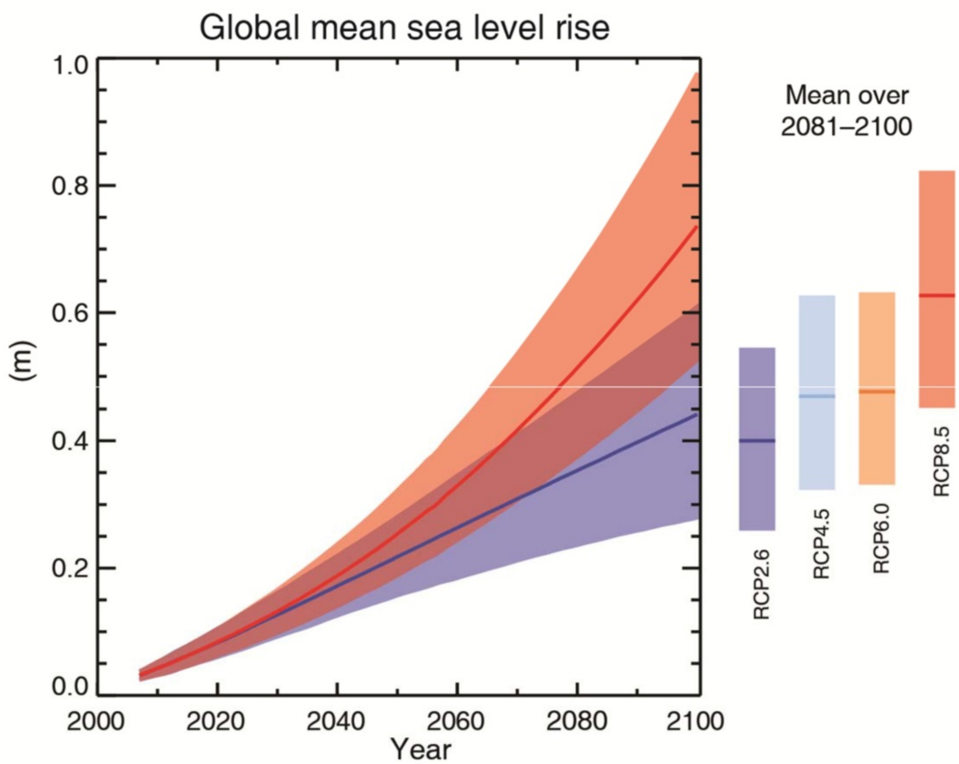


**Figure 2.** Projected sea-level rise over the 21st century relative to 1986-2005 for RCP2.6 and RCP8.5 (Figure SPM.9, IPCC, 2013). The lines indicate the median projection and the shading indicates the assessed likely range. The projected mean sea-level rise for 2081-2100 is given on the right for all four RCP scenarios.

**Table 2.** Projected Global Sea-level Rise[1] (Church et al., 2013a: Table 13.5)

| | RCP2.6 | RCP4.5 | RCP6.0 | RCP8.5 |
|---|---|---|---|---|
| Global mean sea level rise by 2081–2100 | 0.40 [0.26 to 0.55] | 0.47 [0.32 to 0.63] | 0.48 [0.33 to 0.63] | 0.63 [0.45 to 0.82] |
| Global Sea-level Rise by 2100[1] | 0.44 [0.28 to 0.61] | 0.53 [0.36 to 0.71] | 0.55 [0.38 to 0.73] | 0.74 [0.52 to 0.98] |

[1]Numbers are the median value and the 5% to 95% confidence range of sea-level rise relative to 1986-2005.

Semi-empirical sea-level projections assume simple relationships between global atmospheric temperatures (or heat flux) and global sea-level rise (Rahmstorf, 2007). These methods were developed to address concerns with process-based models. They deliver larger amounts of sea-level rise by 2100, for example, Vermeer and Rahmstorf (2009) predict 75-190 cm and Jevrejeva et al. (2010) predict 60-160 cm. Advances in process-based understanding, combined with the very large variability of the semi-empirical results, led the AR5 to assign *low confidence* to their predictions (Church et al., 2013a; IPCC, 2013) and they are not considered further in this report.

### *2.2 Individual Contributions to Global Sea-level Rise*

Global sea-level rise has contributions from a variety of components. Generally ordered from the largest to smallest, the components are thermal expansion of the upper layer of the ocean (the thermo-steric effect, frequently abbreviated to the steric effect), mountain glaciers and ice caps, the Greenland and Antarctic ice sheets, and land water storage (Fig. 3). The land ice contribution to sea-level change has components from melting and from direct discharge of outlet glaciers into the oceans.

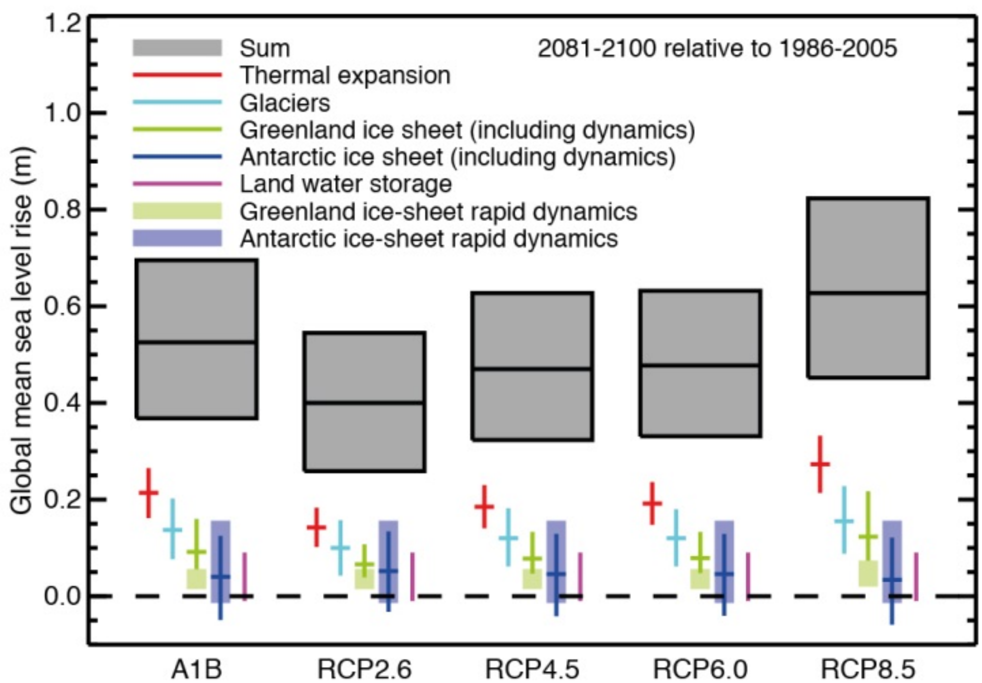


**Figure 3.** Individual contributors (coloured crosses) and total projected global sea-level rise (grey rectangles, giving median and 5% and 95% ranges) in 2081-2100 relative to 1986-2005 (Figure 13.10; Church et al., 2013a)

An important factor in projections of global sea level is the stability of the West Antarctic Ice Sheet (Church et al., 2013a). The potential for collapse of the West Antarctic Ice Sheet remains poorly constrained. The AR5 Summary for Policymakers (IPCC, 2013) reports:

> "Based on current understanding, only the collapse of marine-based sectors of the Antarctic ice sheet, if initiated, could cause global mean sea level to rise substantially above the *likely* range during the 21st century. However, there is *medium confidence* that

> this additional contribution would not exceed several tenths of a metre of sea level rise during the 21st century."

Church et al. (2013a) cite four sources for the amount of sea-level rise that might be produced from a marine ice-sheet instability of the West Antarctic ice sheet: Bindschadler et al. (2013), Katsman et al. (2011), National Research Council (2012), and Pfeffer et al. (2008), with upper-end estimates of 693, 490, 785, and 615 mm of additional sea-level rise, respectively. The mean upper-end estimate is 646 mm. To evaluate the effect of collapse of the West Antarctic Ice Sheet, an additional scenario was generated in which the RCP8.5 scenario is augmented by an additional 65 cm of sea-level rise assumed to be sourced from the West Antarctic ice sheet. The timing of such a contribution is unconstrained, and only the amount of projected relative sea-level at 2100 is given, rather than a time evolution through the century. The additional scenario was developed for this report and is called RCP8.5+W.Ant.

### *2.3 Meltwater Redistribution and Elastic Crustal Response*

Meltwater from glaciers, ice caps and ice sheets is not distributed uniformly throughout the world's oceans (Farrell and Clark, 1976; Mitrovica et al., 2001; 2011). As an ice sheet melts, it exerts a reduced gravitational pull on the surrounding ocean water, causing the nearby ocean surface to fall. The reduced load also causes the solid surface of the Earth to respond elastically such that, under and adjacent to a shrinking ice sheet, the land rises relative to the ocean. The effects are displayed in Figure 4, which shows sea-level change over the global oceans for sources of sea-level rise originating from Antarctica, Greenland, and mountain glaciers and ice caps. In each panel, the source is assumed to provide one millimetre per year of average global sea-level rise. Close to a source of sea-level rise, sea-level will fall. At greater distances the sea-level rise is smaller than the global average. At even larger distances, sea-level rise is slightly higher than the global average.

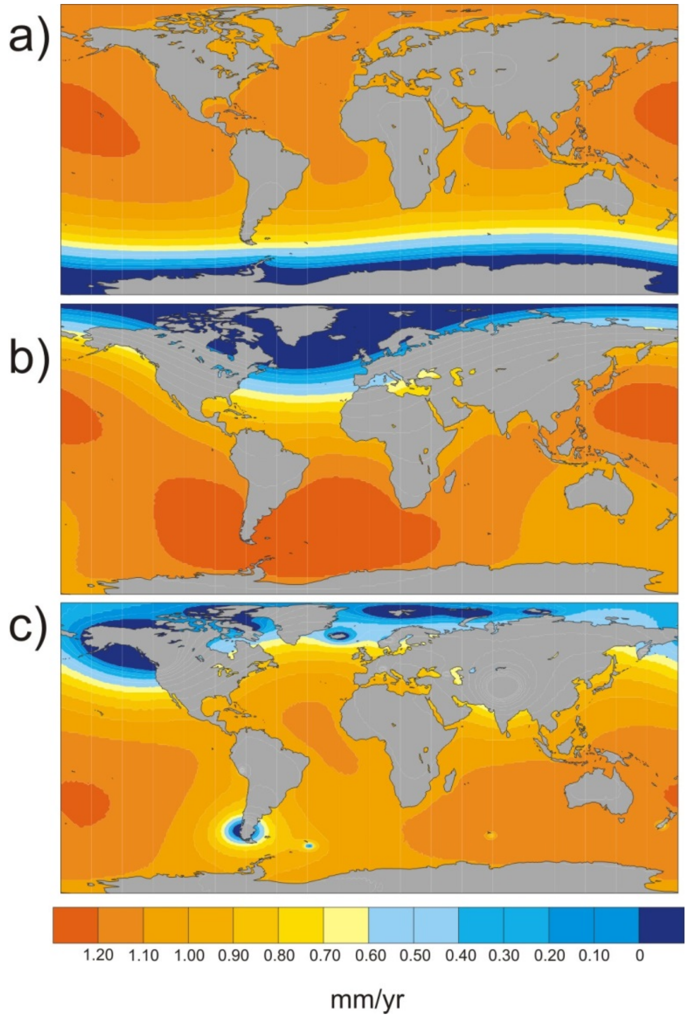


**Figure 4.** The amount of sea-level rise, in millimetres per year, for an assumed 1 mm/yr contribution to global sea level rise from (a) Antarctica, (b) Greenland, and (c) mountain glaciers and ice caps. Figure reprinted by permission from Macmillan Publishers Ltd: Nature, Mitrovica et al., 2001, copyright 2001.

The sea-level response at a particular coastal site, caused by its unique location relative to sources of ice mass loss around the world, is sometimes termed its "sea-level fingerprint". Sea-level fingerprinting can be very significant for sites close to meltwater sources. Canada hosts significant volumes of mountain glaciers and ice caps in the west and north. On a global scale, much of Canada is relatively close to the Greenland ice sheet, which is an important source of meltwater. Western Canada is also influenced by the rapidly wasting mountain glaciers and ice fields of the Coast Mountains and the coastline bordering the Gulf of Alaska. Thus, for Canadian localities it is particularly important that sea level projections incorporate the spatially-varying effects of present-day ice mass changes.

### *2.4 Vertical Land Motion and Glacial Isostatic Adjustment*

It is important to account for the effect of local vertical land motion in generating projections of relative sea-level. Land uplift will reduce the amount of sea-level rise experienced at a site, and, if large enough, will cause sea level to fall. Conversely, land subsidence will add to the amount of relative sea-level rise. Global Positioning System (GPS) observations provide measurements of present-day vertical motion. The GPS monuments are designed to be stable, and are frequently fixed to bedrock. Positions and velocities are expressed in a reference frame that is defined relative to the centre of the Earth.  GPS stations across Canada, and internationally, have been in continuous operation since the early 1990's.  With the addition of more GPS sites over time, they now provide spatially coherent information on vertical land motion (Fig. 5).

Across much of Canada, the surface is uplifting or subsiding due to the delayed effects of the last continental glaciation (Fig. 5).  During the last ice age, ice sheets loaded the surface of the Earth. Beneath the ice sheets, within the interior of the Earth, hot mantle rock flowed downward and outward, and the surface of the Earth sank.  At the periphery of the ice sheet, and immediately adjacent to it, the land rose in response to mantle material flowing outward from under the ice sheets. After deglaciation, the process was reversed.  The land started to rise where it had been depressed under the ice sheets.  Outside the region of former glaciation, peripheral regions began to subside.  The process is called glacial isostatic adjustment (GIA), or postglacial rebound (PGR).  It is still occurring because the Earth's mantle behaves like an extremely slow-flowing, viscous fluid and it has a "memory" of the removal of the ice sheets.  Hudson Bay and much of the Canadian Arctic Archipelago are rising due to GIA, while parts of the southern Prairie provinces, the region south of the Great Lakes, the Beaufort coast of Yukon and Northwest Territories, and parts of Atlantic Canada are sinking (Fig. 5).

In western and northern Canada and adjacent regions, recent and present-day ice mass changes also generate significant crustal motion.  This effect is especially strong in Alaska and Greenland, where large uplift rates have been measured.  On western Vancouver Island, coastal British Columbia, active tectonics generates vertical crustal motion due to the slow buildup of crustal strain.  On the western margin of Canada (western Vancouver Island and Haida Gwaii), a megathrust or large thrust earthquake could cause sudden crustal subsidence of tens of centimetres, possibly reaching a metre or more, and causing rapid sea-level rise.  This effect is not included in the projections presented here.

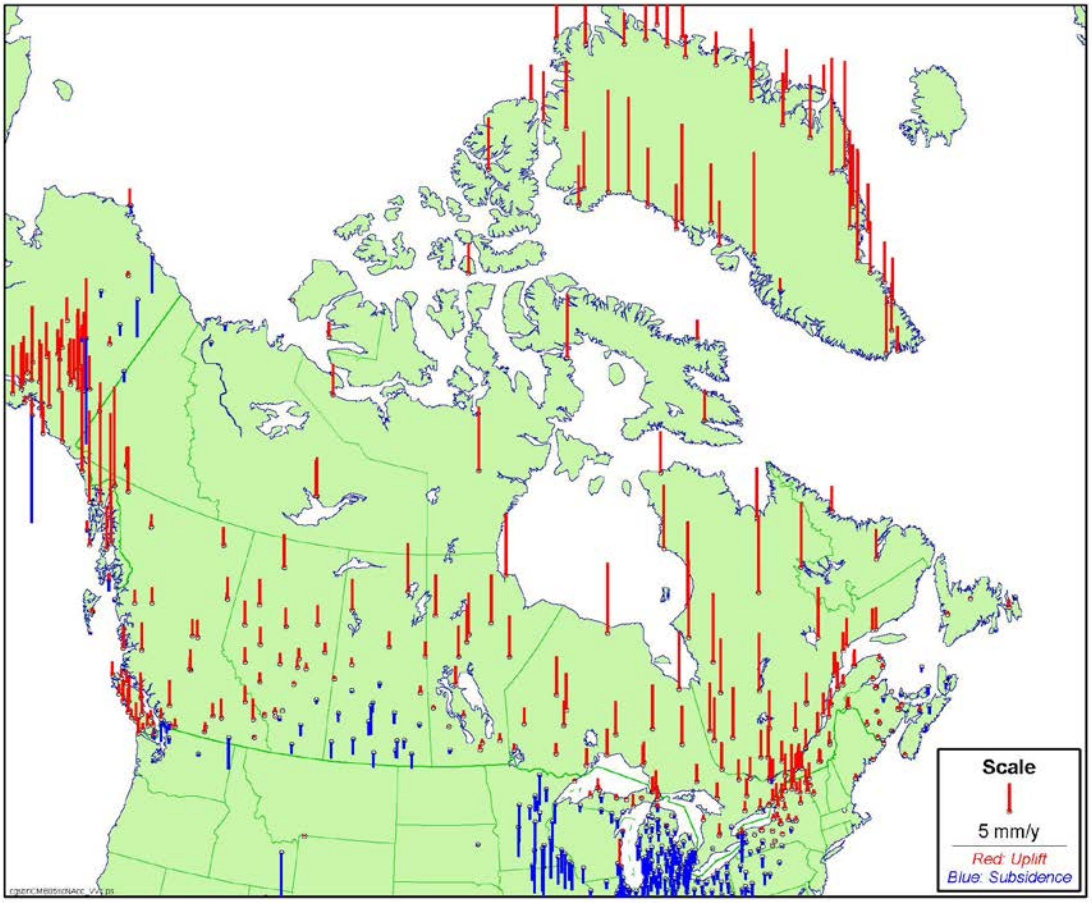


**Figure 5.** GPS-derived vertical crustal motion for Canada and surrounding regions (Craymer et al., 2011).

For this study, GPS observations were processed using the NRCan Precise Positioning (PPP) software (Kouba and Héroux, 2001) for the time period 1994 (or time of GPS station inception) to the end of 2013. Details of the time series analysis, determination of uncertainty, and adjustments required to use the GPS-derived uplift rates for sea-level projections are given in Appendices A and B.

### *2.5 Regional Oceanographic Effects*

Global ocean currents generate "dynamic" sea-surface topography of more than 1 metre in amplitude. Changes to the currents can lead to changes in the sea-surface topography and hence to changes to local relative sea level. The average global steric (thermal expansion) and dynamic sea-level changes were computed from a large number of models for the RCP scenarios (Yin, 2012). A robust feature of the dynamic sea-level changes, which was also observed with the previous generation of models (e.g., Yin et al., 2010), is that sea-level rise due to diminution of the Gulf Stream is predicted for northeastern North America in the coming century and may reach nearly 20 cm at some localities.

### *2.6 Land Water Storage*

Groundwater extraction causes global mean sea-level to rise because water that is extracted from the ground enters the hydrological cycle and returns to the oceans. Reservoir impoundment, generated by construction of dams, prevents water from returning to the oceans and causes global sea-level to fall. The combined effects of anthropogenic intervention have been estimated to amount to -1 to +9 cm of sea-level rise by 2081–2100 relative to 1986–2005 (Church et al., 2013a). This is a relatively small contribution to the total projected global sea-level rise.

## 3. Projections of Sea-level Change

### *3.1 Projections through the 21st Century*

In this report, sea-level projections are provided from 2007 to 2100 for RCP2.6, RCP4.5, and RCP8.5. (RCP6.0 is an intermediate projection and its time evolution is not provided, although its 2081-2100 mean is provided.) As well, RCP8.5 was augmented by an additional 65 cm fingerprinted contribution from West Antarctica (in this report the scenario is termed RCP8.5+W.Ant.) and its projection at the year 2100 is shown in figures. Finally, the mean projections at 2081-2100 relative to 1986-2005 are shown for all four RCPs with their error ranges to indicate the spread (uncertainty) associated with each RCP. Tables and figures of the relative sea-level projections for all locations are given in Appendix C.

The projections provided here were derived from digital files of projections of regional sea-level change that accompanied the release of the AR5 (Church et al., 2013b). The regional projections incorporate the various individual contributions (thermal expansion, land ice, groundwater mining, and reservoir impoundment) and the various regional effects, such as dynamic oceanographic changes and sea-level fingerprinting, discussed above. In the AR5 projections, the average of the predictions of two global GIA models was employed to determine the vertical crustal motion contribution to relative sea-level change (ICE-5G (Peltier, 2004) and the Australian National University (ANU) model (Lambeck et al., 1998 and subsequent improvements)) (Church et al., 2013b).

The GIA model average used in the AR5 projections provides the general global pattern of vertical crustal motion due to GIA, but the models differ significantly in some localities, such as Hudson Bay. Here we directly employ GPS uplift rates derived from data analysis complete to the end of 2013, as described in section 2.4 and Appendices A and B, to generate site-specific projections of relative sea-level change. The vertical motion component (derived from the mean of the GIA models) was removed from the IPCC AR5 regional sea-level projections and the difference was spatially extrapolated and interpolated to study locations. The GPS-derived vertical crustal motion contribution to projected sea-level change, as described in Appendix B, was then added to the AR5 values to obtain the final site-specific sea-level projections.

Vertical crustal motion exerts a fundamental control on projected relative sea-level change. As shown in Figure 6, four representative locations, having vertical crustal motion ranging from -1 mm/yr (Halifax, NS, sinking) to 15 mm/yr (La Grande 1, QC, rising rapidly), feature relative sea-level projections that range from nearly 1 m of sea-level rise by 2100 (Halifax, for RCP8.5) to slightly more than 1 m of sea-level fall (La Grande 1, RCP2.6). Intermediate amounts of crustal uplift generate intermediate projections of relative sea-level change, as illustrated for Vancouver, BC, and Nain, NL. The RCP8.5+W.Ant scenario provides much larger amounts of projected sea-level rise.

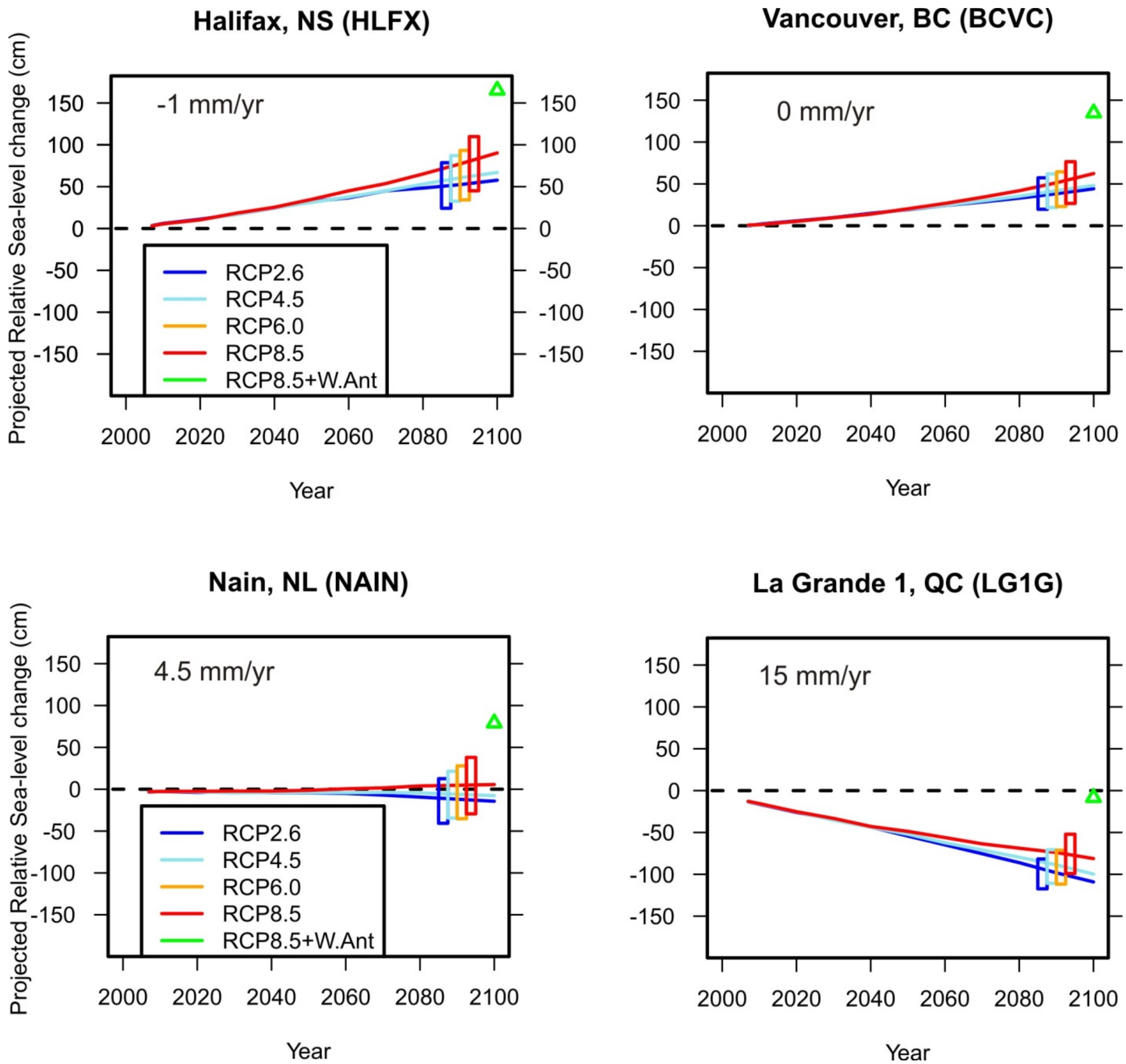


**Figure 6.** Projected relative sea-level change, based on the IPCC AR5 (Church et al., 2013a, b) and utilizing vertical crustal motion (as indicated in each panel) derived from GPS observations (Appendix A). Rectangles show the range of mean projected sea-level change for 2081-2100 relative to 1986-2005, indicating the uncertainty, or scatter, arising from computing the average of model outputs of many different climate centres and including the uncertainty in the vertical crustal motion. The green triangle is the projection of a scenario based on rapid collapse of a portion of the West Antarctic ice sheet, providing an additional 65 cm of global sea-level rise to RCP8.5.

A few sites in the High Arctic are also strongly affected by the elastic crustal response to projected near-by ice mass change (see section 2.3, Meltwater Redistribution and Elastic Crustal Response). The projected decreases in ice mass of the Greenland ice sheet and the glaciers and ice caps of the Canadian High Arctic cause crustal uplift, which subtracts from projected sea-level rise. The effect is strongest at Alert, NU (Fig. 7), which features projected sea-level fall (for RCP8.5) nearly as large as at La Grande 1 (Fig. 6), even though Alert is presently rising at less than half the speed of La Grande 1.   At this location, the elastic crustal response is sufficiently large that RCP8.5 gives the largest amount of projected relative sea-level fall, even though it provides the largest amount of global sea-level rise.  Close to a significant source of meltwater, uncertainties in projected ice-mass change contribute significantly to the uncertainties in projected sea-level change through the influence of the elastic crustal response.  This effect is the source of the large uncertainties in the sea-level projection at Alert.

Other sites that are strongly influenced by near-by and regional projected ice mass change include Eureka, Qikitarjuaq, Resolute, and Iqaluit, all in Nunavut.  On the west coast, sites are affected by projected glacier mass loss of the Coast Mountains and the Gulf of Alaska region, which reduces the amount of projected sea-level rise, although the effect is not as pronounced as in the High Arctic.

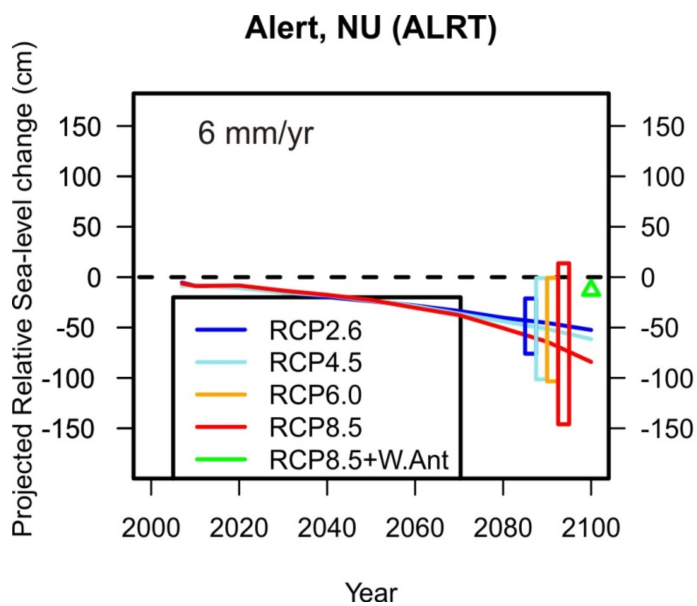


**Figure 7.** Projected relative sea-level change at Alert, NU.  Scenarios and symbols are similar to Figure 6.

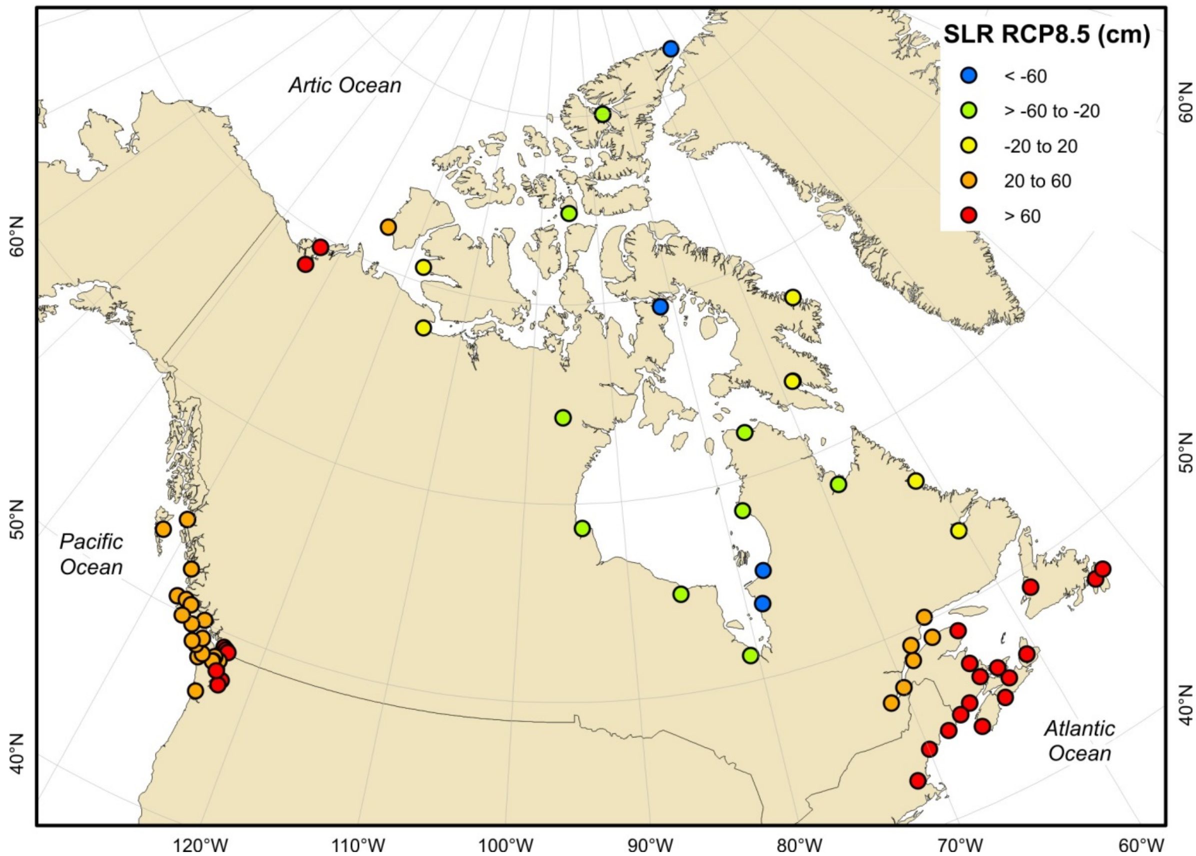


**Figure 8.** Projected median relative sea-level change by 2100, relative to 1986-2005, for RCP8.5. Location names are given in Figure 1.

Projections are shown in map view for RCP8.5 at 2100 (Fig. 8). (Tables and figures of the projections for all locations are given in Appendix C.) The influence of vertical land motion dominates the projections. Large parts of the East Coast Region, the Beaufort coastline, and the southern part of the West Coast Region, which are sinking or have negligible vertical motions, exhibit the largest amount of projected sea-level rise. At the other extreme, rapidly rising Hudson Bay and the central Canadian Arctic Archipelago exhibit pronounced amounts of projected sea-level fall. As mentioned above, High Arctic locations, especially Alert, are also sensitive to present-day ice mass changes and this reduces projections of relative sea-level rise and may result in relative sea-level fall. Other locations, having intermediate amounts of vertical land motion, and not being subject to prominent near-by ice mass change, have intermediate amounts of projected sea-level change.

Projections for all 69 localities for the mean projection for 2081-2100 relative to 1986-2005 are also summarized in Fig. 9 for RCP8.5. For this scenario, global mean sea-level is projected to rise by 63 cm (45 cm to 82 cm is the 5% to 95% model range). The projections are similar to those shown in Fig. 8 and exhibit the same geographical patterns. The larger uncertainties in projected sea-level change of sites close to prominent amounts of ice-mass change are evident. In the East Coast Region, a number of localities in the Atlantic Canada and New England are sinking or have very small uplift rates and the projected relative sea-level change is slightly larger or similar to the global mean. A dynamic oceanographic contribution larger than 10 cm contributes to projected relative sea-level rise. In the Gulf of St. Lawrence, where crustal uplift rates reach a few millimetres per year, projected relative sea-level at Sept-Îles (SEPT) is nearly 40 cm lower than the global mean.

In the West Coast Region, crustal motions at most sites are near-zero or feature a small amount of uplift. This factor, combined with the elastic crustal response to ice-mass changes of the Coast Mountains and Gulf of Alaska and a negligible contribution from dynamic oceanographic changes, lead to projected sea-level change that is smaller than the global average at all locations except Seattle (SEAT) and Robinson Point (RPTx, near Tacoma), both in Washington State.

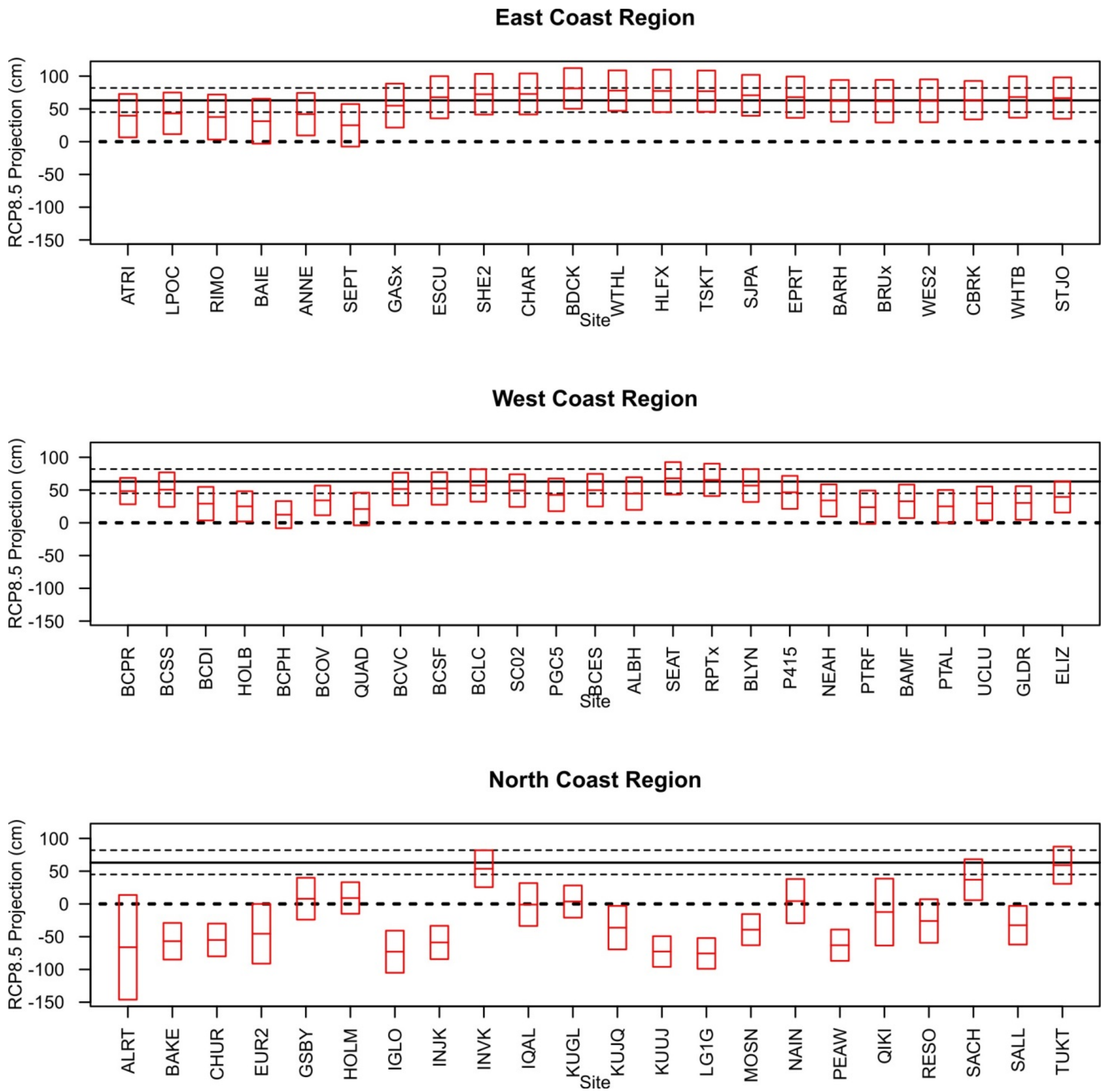


**Figure 9.** Projected median relative sea-level change (red rectangles, median and range) for the mean of 2081-2100, relative to 1986-2005, for RCP8.5. For comparison, the global mean projected sea-level change (solid black line) and 90%-confidence interval (short-dashed black lines, 5% to 95%) are given for RCP8.5.

The North Coast Region features the largest amounts of present-day crustal uplift and largest amounts of projected relative sea-level fall. Of the three regions, the North Coast Region has the largest differences from location to location in projected sea-level change.  Only Tuktoyaktuk (TUKT), Inuvik (INVK), and Sachs Harbour (SACH), all in the Northwest Territories, are projected to experience relative sea-level rise at, or close to, the global mean.

### *3.2 Sea-level Projections Beyond 2100*

Global sea-level rise is projected to continue beyond 2100 (Fig. 10; IPCC, 2013; Church et al., 2013a).  The projections are based on carbon dioxide ($CO_2$) concentrations at 2100.   Estimates of projected global sea-level rise to 2500 range from less than a metre for low scenarios (including RCP2.6), 1-2 m for medium scenarios (including RCP4.5) and several metres for high scenarios (including RCP6.0 and RCP8.5).

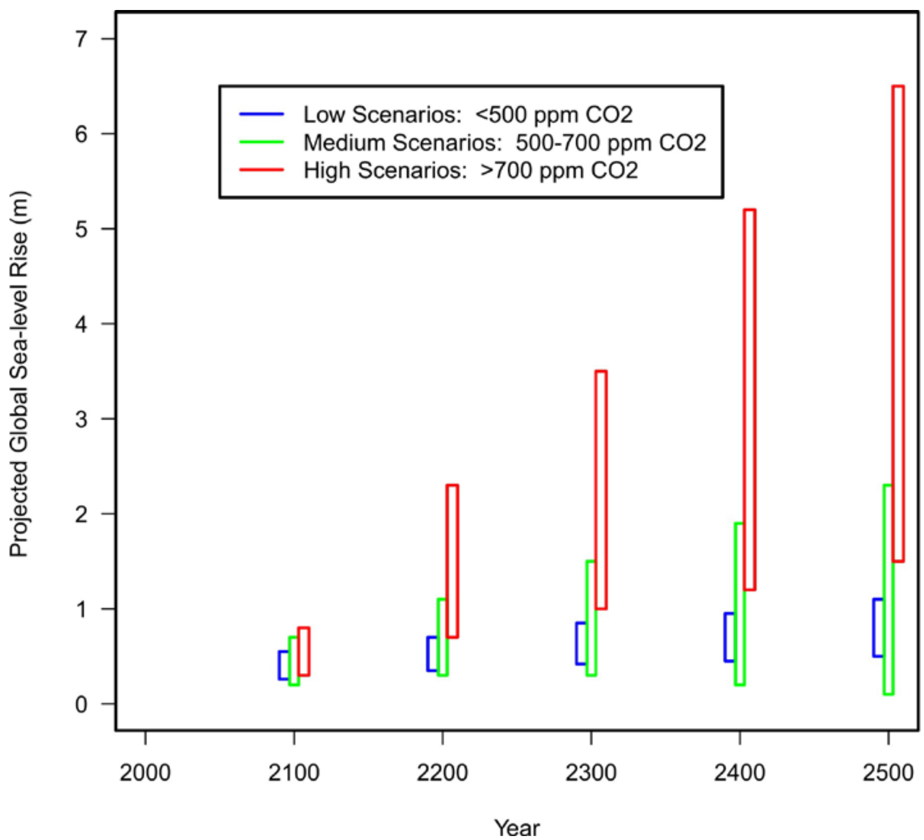


**Figure 10.**  Projected global sea-level rise from 2100 to 2500, based on carbon dioxide concentrations at 2100. Values are presented for “Total sea level” in Figure 13.13 of Church et al., 2013a (p. 1188 of that report).  The IPCC figure provides a further breakdown of contributions to total sea level from thermal expansion, glaciers and ice caps, and the Greenland and Antarctic ice sheets.

As with projections through the current century, the amount of projected global sea-level rise beyond 2100 is highly dependent on future atmospheric concentrations of carbon dioxide.  The general patterns of projected relative sea-level change in Canada will be similar to historical sea-level and to sea-level projections in the current century – locations that are rising quickly will experience reduced sea-level rise, or sea-level fall, depending on the rate of land uplift and on the amount of global sea-level rise.  On the other hand, locations that are presently sinking will experience relative sea-level rise larger than the global value.  In Canada, portions of Atlantic Canada, the Beaufort coastline, and the Fraser Lowland are most susceptible to relative sea-level rise larger than the global mean.  Other regions of Canada, such as most of the west coast and the Quebec coastline bounding the St. Lawrence estuary, will experience relative sea-level rise that will be smaller than the global mean, but potentially still significant. Some locations that are currently experiencing sea-level fall may undergo a transition to sea-level rise. In any event, many localities in Canada may need to prepare for several metres of sea-level rise in coming centuries.

## 4. Discussion

### *4.1 Assessing the Sea-level Scenarios*

In recent years, various expert panels and summary reports have made different choices about how to present projected global sea-level rise, with some reports providing a range, others focussing on an expected peak amount of global sea-level rise, and yet others providing a number of discrete choices of possible future sea-level rise. The different choices reflect scientific uncertainty but are also indicative of differing goals of the summary reports. The recent IPCC AR5 (IPCC, 2013) provides a snapshot of current scientific knowledge of the various contributions to sea-level rise and gives a basis for evaluating the possible range of future sea-level change.

Global sea-level rise scenarios were developed for the United States National Climate Assessment by the U.S. National Oceanic and Atmospheric Administration (NOAA) (Parris et al., 2012). The scenarios were intended to be utilized in the context of tolerance to risk of sea-level rise, with low sea-level rise scenarios implying a high tolerance to risk, and the highest scenario implying very low or no tolerance to risk. Parris et al. (2012) indicate that the NOAA scenarios are to be used "to consider multiple future conditions and devise multiple response options" to "initiate actions that may reduce future impacts". Thus, they did not assign specific probabilities or likelihoods to individual scenarios. Parris et al. (2012) emphasize that no scenario is to be used in isolation.

The relative sea-level projections generated here are based on the 5$^{th}$ Assessment Report of the IPCC (IPCC, 2013; Church et al., 2013a). RCP 8.5 incorporates the upper end of the likely range of the RCP scenarios, and therefore may be of particular relevance to management and planning in coastal areas. In cases where tolerance to the risk of sea-level rise is very low, it may be appropriate to consider larger amounts of global sea-level rise, such as that given by the RCP8.5+W.Ant scenario. Noting that the IPCC AR5 assessment is based on the published scientific and technical literature available up to 15 March 2013 (for Working Group I of the IPCC), it would also be important to review post-AR5 scientific literature on projected sea-level change.

In many locations in northern Canada, the issue is not relative sea-level rise, but relative sea-level fall. Rather than the issues of inundation and flooding that accompany sea-level rise, the potential issues are ones of navigation hazards brought about by reduced depth-under-keel of vessels, and the reduced usefulness of coastal infrastructure brought about by lower water levels. The latter suggests that projected lower water levels should be incorporated into the design life-cycle of coastal infrastructure where appropriate. Both sea-level fall and sea-level rise will bring about changes to coastal habitats. For most locations, RCP8.5, which is the scenario giving the largest amount of global sea-level rise, provides the largest projection of relative sea-level rise (or smallest amount of relative sea-level fall), but Alert, NU, differs in that RCP8.5 gives the largest amount of relative sea-level fall because of the enhanced crustal uplift brought about by local and regional decreases in ice thickness.

Because of the varying risks posed by relative sea-level change (flooding, coastal erosion, navigation hazards, impacts on coastal infrastructure of projected falling sea-level as well as rising sea-level, and habitat change), and because of the varying tolerance to risk of different activities, it is recommended that all the scenarios be consulted and recent (post-AR5) scientific literature on sea-level change be reviewed. This will enable an assessment of the probable range of projected relative sea-level change, assist in determining the tolerance to risk of sea-level change (e.g., Parris et al., 2012), and contribute to a robust evaluation of its potential impacts.

### *4.2 Future Improvements to Sea-level Projections*

Anticipated increases in the understanding of various components of the climate system suggest that revisions to the sea-level projections presented here will be needed on a regular basis. Projections of the mass balance of glaciers, ice caps, and ice sheets are an important source of uncertainty. In particular, the future stability of the West Antarctic ice sheet is uncertain. Improvements in understanding its probable evolution could lead to revisions in the process-based projections of global sea level and reduce the present ambiguity in choosing a plausible upper limit of global sea-level rise.

Nevertheless, the first-order spatial variability brought about because of vertical land motion and meltwater redistribution has been captured in the projections presented here and the spatial patterns (e.g., larger amounts of projected sea-level rise in parts of the Maritime provinces, smaller amounts across much of northern Canada) will be present in future projections. A continuing source of uncertainty in sea-level projections (and other components of the climate system) that can be expected to persist is the different emissions scenarios that reflect different degrees of mitigation of atmospheric emissions in the 21$^{st}$ century.

The sea-level allowance is the elevation change that is needed to ensure that the frequency of flooding at some time in the future will be the same as the present-day frequency of flooding (Hunter, 2012; Hunter et al., 2013; Zhai et al., 2013). It is derived from the statistical properties (frequency and magnitude) of flooding caused by large storms and from projections of changes to mean relative sea-level. Recently, allowances based on the IPCC AR5 projections, including the vertical motion from the mean of two glacial isostatic adjustment models, have been generated (Zhai et al., 2014a). The projections of mean relative sea-level change provided here could form the basis for deriving revised sea-level allowances across Canada that incorporate GPS-measured vertical crustal motion. One such effort is in progress for Atlantic Canada (Zhai et al., 2014b).

## 5. Summary and Conclusions

Relative sea-level projections are provided for 69 locations across coastal Canada and the adjacent mainland United States, based on the IPCC AR5 (IPCC, 2013; Church et al., 2013a,b) and utilizing GPS measurements of vertical crustal motion. The sea-level projections show substantial variability, which arises in large part due to differences in vertical crustal motion arising primarily from glacial isostatic adjustment. The effect is sufficiently prominent that projected sea-level change by 2100 (relative to 1986-2005) ranges from nearly 1 m of sea-level rise at localities in the Maritimes and the Beaufort coastline, which are sinking, to around 1 m of sea-level fall at some localities on Hudson Bay, which are rising rapidly. The elastic crustal response to projected ice-mass changes (section 2.3) and dynamic oceanographic changes (section 2.5) also make important contributions to projected relative sea-level change.

An additional scenario, featuring partial collapse of a portion of the West Antarctic Ice Sheet, provides a further 65 cm of sea-level rise added to RCP8.5. It may be appropriate to consider in instances where the tolerance to the risk of sea-level rise is very low. An increase in process-based understanding of ice-sheet dynamics is needed to better assess probable upper limits of sea-level rise. The IPCC AR5 assessment is based on the published scientific and technical literature available up to 15 March 2013 (for Working Group I of the IPCC). It is recommended that post-AR5 scientific literature on projected sea-level change be reviewed when considering the results presented here.

Over longer time frames, global sea-level is expected to continue to rise (Fig. 10; Church et al., 2013a). Thus, the site-specific relative sea-level projections presented here provide a trajectory of sea-level change over the coming century, but sea-level change will not stop at the end of the century. Future improvements and revisions to the relative sea-level projections presented here are anticipated. It will be necessary to update sea-level projections on an occasional basis and re-evaluate the implications for infrastructure, habitat, and navigation.

**Acknowledgments.**

We acknowledge support from the Climate Change Impacts and Adaptation Division, Earth Sciences Sector (ESS), NRCan. We gratefully acknowledge the advice and encouragement provided by Don Lemmen. Mark Carson is gratefully acknowledged for assistance with IPCC AR5 data files. The AR5 sea level projections were obtained from the Integrated Climate Data Center at the University of Hamburg and downloaded from https://icdc.zmaw.de/ar5_slr.html?&L=1). We thank John Hunter for providing advice on the IPCC AR5 regional sea-level projections. We thank the Canadian Crustal Deformation Service for support for GPS data analysis. Matthew Lagasse and Danial Mariampillai assisted with figures and tables. This is an output of the ESS Climate Change Geoscience Program.

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## Appendix A. GPS-Derived Vertical Crustal Motion

*GPS Time Series Analysis.* GPS instruments are operated continuously at 55 sites considered in this study. Thirteen Canadian Base Network (CBN) sites are also included. CBN sites have a very stable monument and are occupied on a campaign-measurement basis for a few days every few years. Representative time series of a continuous (ALBH, Victoria, BC) and a CBN site (LG1G, La Grande 1, QC) are shown in Figure A1. The analysis of the vertical time series at the 55 continuous sites follows the methods of Mazzotti et al. (2011). It includes a simultaneous least-squares solution for an assumed constant slope (uplift rate), annual and semi-annual sinusoidal terms, and offsets as required by changes to instrumentation or local site relocation. A spectral index was computed to obtain a scaled uncertainty for the uplift rate (Williams, 2003). The time series analysis for the thirteen CBN sites (5 in the East Coast Region and 8 in the North Coast Region) determined a linear trend but did not derive annual or semi-annual terms, owing to the relative sparsity of the time series. As well, the spectral index was not derived. The uncertainty on the vertical rate for CBN sites was taken to be the formal error of the regression. Finally, ±0.2 mm/yr and ±0.5 mm/yr were added in quadrature to the uncertainties thus derived to generate the final uncertainties. This accounts for uncertainties in the scale and translation of the International Terrestrial Reference Frame (ITRF) (Wu et al., 2011) (Tables A1, A2, A3).

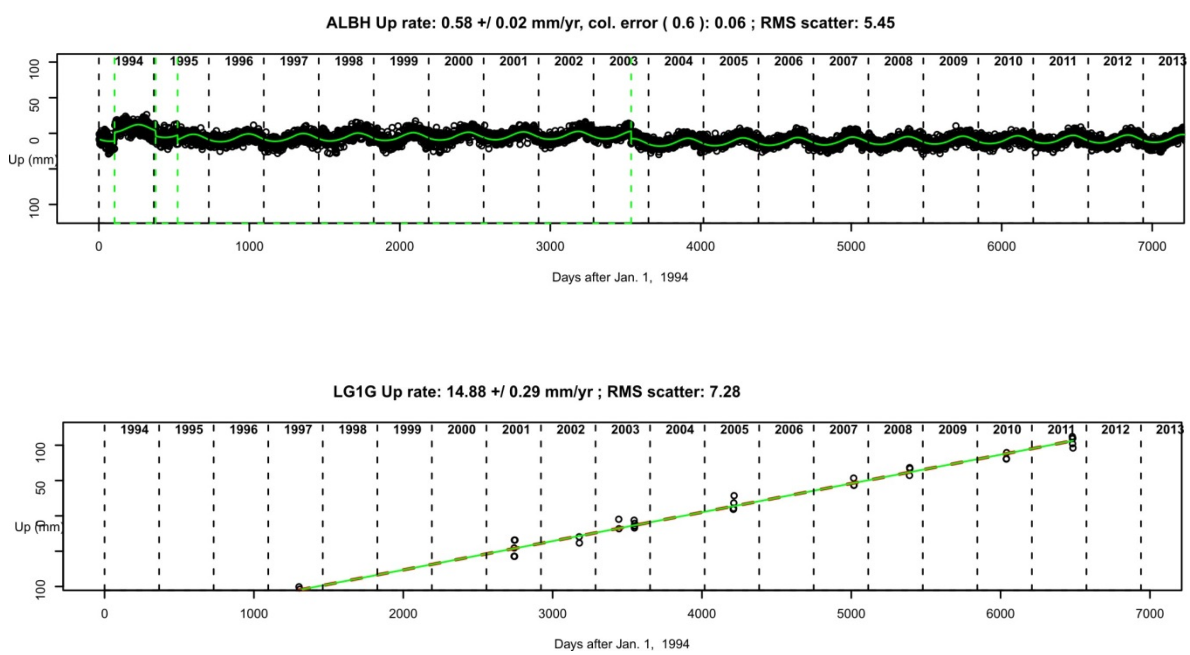



**Figure A1.** Examples of GPS time series from a continuous site (ALBH, Albert Head, near Victoria, BC) and a Canadian Base Network site (LG1G, La Grande 1, QC). ALBH has a small vertical velocity of about 0.6 mm/yr, while LG1G is near a centre of postglacial uplift and is rising at nearly 15 mm/yr. Vertical green lines in the ALBH time series indicate times at which a vertical offset, arising from instrumentation and other site changes, is introduced into the linear regression.

A few GPS time series required special treatment. For three continuous locations, the time series of closely located sites were concatenated to produce a longer time series: GASP and GAS2 were concatenated to generate GASx (Gaspé, QC), RPT1 and RPT5 were concatenated to produce RPTx (Robinson Point, WA), and BRU1 and BRU5 were concatenated to produce BRUx (Brunswick, ME). The BLYN (Blynn, WA) time series shows increased scatter after mid-2011. Data from mid-

2011 to the end of 2013 were removed before carrying out a time series analysis to determine the uplift rate. A large earthquake offshore Haida Gwaii occurred in October, 2012 (James et al., 2013) and caused a large vertical offset at the GPS instrument installed at Sandspit (BCSS). Following the earthquake, the site has been subject to substantial motions due to postseismic relaxation (Nykolaishen et al., 2014), which are expected to decrease to background levels in a few years. Data from the time of the earthquake onwards was removed before carrying out a time series analysis to determine the background tectonic uplift rate at BCSS.

The Québec City (ATRI) time series exhibits an unexplained excursion in the vertical component in 2004 and in the horizontal components in 2011, but the vertical component regression tracks the observations adequately. The inferred uplift rate of 3.21 ± 0.75 mm/yr also agrees with the uplift rate measured at a nearby CBN site, LAVE, of 3.57 ± 0.66 mm/yr. (LAVE had 6 occupations spanning 1994 to 2010.) Further investigation of the ATRI time series may be warranted, but for present purposes the uplift rate determined from the entire time series has been utilized.

Charlottetown, PE, does not have a GPS site. Its vertical velocity was estimated from the uplift rates of 3 near-by sites. On Prince Edward Island, the CBN sites of CVAR and BLFD have uplift rates of -1.85 and -0.80 mm/yr, respectively, while Shediac, NB (SHE2) is moving at -0.86 mm/yr. The mean and standard deviation of the 3 sites gives an estimated uplift rate at Charlottetown of -1.17 ± 0.57 mm/yr. As with other sites, ±0.2 mm/yr and ±0.5 mm/yr were added in quadrature for uncertainties in the scale and translation of the International Terrestrial Reference Frame (ITRF) (Wu et al., 2011) to give a final uncertainty of ±0.80 mm/yr.

The observed vertical velocities include a contribution from the elastic crustal response to present-day ice mass changes. Calculations of sea-level change due to projected ice-mass changes include the elastic crustal response. To avoid double-counting a portion of the elastic crustal response, the elastic crustal response due to present-day glacial and ice sheet change was computed to correct the GPS vertical rates (Tables A1, A2, A3).

**Table A1.** GPS Station Characteristics and Uplift Rates for the East Coast Region

| Location for which sea-level projections is provided | GPS Station | Lat | Long | Station type[1] | Uplift[2] (mm/yr) | Uncertainty[3] (mm/yr) | Correction for present day ice-mass change[4] (mm/yr) | Length (Years) |
|---|---|---|---|---|---|---|---|---|
| Québec City, QC | ATRI | 46.847 | -71.261 | Continuous | 3.21 | 0.75 | -0.31 | 12.8 |
| La Pocatière, QC | LPOC | 47.341 | -70.008 | Continuous | 2.68 | 0.55 | -0.32 | 17.6 |
| Rimouski, QC | RIMO | 48.444 | -68.521 | Continuous | 3.21 | 0.56 | -0.33 | 9.2 |
| Baie-Comeau, QC | BAIE | 49.186 | -68.264 | Continuous | 3.95 | 0.55 | -0.35 | 12.1 |
| Sainte-Anne-des-Monts, QC | ANNE | 49.128 | -66.495 | Continuous | 2.58 | 0.56 | -0.35 | 7.9 |
| Sept-Îles, QC | SEPT | 50.205 | -66.387 | Continuous | 4.56 | 0.56 | -0.36 | 8.2 |
| Gaspé, QC | GASx | 48.829 | -64.487 | Continuous | 1.13 | 0.59 | -0.33 | 5.7 |
| Escuminac, NB | ESCU | 47.073 | -64.799 | Continuous | -0.36 | 0.55 | -0.30 | 9.1 |
| Shediac, NB | SHE2 | 46.221 | -64.552 | Continuous | -0.86 | 0.58 | -0.29 | 6.9 |
| Charlottetown, PE | - | 46.223 | -63.117 | See text | -1.17 | 0.80 | -0.28 | - |
| Baddeck, NS | BDCK | 46.1135 | -60.7754 | CBN | -1.82 | 0.57 | -0.28 | 16.6 |
| Truro, NS | WTHL | 45.4873 | -62.7329 | CBN | -1.42 | 0.61 | -0.27 | 15.7 |
| Halifax, NS | HLFX | 44.683 | -63.611 | Continuous | -1.00 | 0.55 | -0.26 | 11.9 |
| Tusket, NS | TSKT | 43.8699 | -65.9631 | CBN | -1.19 | 0.63 | -0.25 | 9.1 |
| Saint John, NB | SJPA | 45.258 | -66.064 | Continuous | -0.52 | 0.56 | -0.27 | 8.3 |
| Eastport, ME | EPRT | 44.909 | -66.992 | Continuous | -0.20 | 0.56 | -0.28 | 13.3 |
| Bar Harbor, ME | BARH | 44.4 | -68.22 | Continuous | 0.51 | 0.54 | -0.26 | 15.2 |
| Brunswick, ME | BRUx | 43.89 | -69.95 | Continuous | 0.65 | 0.55 | -0.25 | 17.5 |
| Westford, MA | WES2 | 42.61 | -71.49 | Continuous | 0.50 | 0.54 | -0.24 | 18.0 |
| Corner Brook, NL | CBRK | 48.944 | -57.9497 | CBN | -0.05 | 0.61 | -0.32 | 12.9 |
| Whitbourne, NL | WHTB | 47.4089 | -53.5391 | CBN | -0.40 | 1.01 | -0.29 | 5.1 |
| St. Johns, NL | STJO | 47.595 | -52.678 | Continuous | -0.13 | 0.54 | -0.29 | 20.0 |

[1] Continuous: permanent GPS stations; CBN: Canadian Base Network stations, which are occupied periodically. Charlottetown uplift rate determined from near-by GPS sites; see text for description.
[2] Uplift rates are relative to the centre of the Earth, as expressed in ITRF2005.
[3] Uncertainties are calculated as the geometric sum of the uncertainty in regression of the GPS time series, a reference frame scale factor uncertainty of ±0.2 mm/yr, and a reference frame translation uncertainty of ±0.5 mm/yr (Wu et al., 2011).
[4] The elastic crustal response due to present-day ice mass change was calculated at each GPS site to correct the observed GPS uplift rates before making sea-level projections.

**Table A2.** GPS Station Characteristics and Uplift Rates for the West Coast Region

| Location for which sea-level projections is provided | GPS Station | Lat | Long | Station type[1] | Uplift[2] (mm/yr) | Uncertainty[3] (mm/yr) | Correction for present day ice-mass change[4] (mm/yr) | Length (Years) |
|---|---|---|---|---|---|---|---|---|
| Prince Rupert, BC | BCPR | 54.2768 | -130.4346 | Continuous | -0.07 | 0.58 | -1.34 | 9.1 |
| Sandspit, BC | BCSS | 53.2536 | -131.8071 | Continuous | 0.08 | 0.62 | -0.91 | 7.6 |
| Bella Bella, BC | BCDI | 52.158 | -128.1105 | Continuous | 2.61 | 0.65 | -1.30 | 4.1 |
| Holberg, BC | HOLB | 50.6404 | -128.135 | Continuous | 2.95 | 0.55 | -1.12 | 19.0 |
| Port Hardy, BC | BCPH | 50.6856 | -127.3754 | Continuous | 4.09 | 0.57 | -1.11 | 8.0 |
| Beaver Cove, BC | BCOV | 50.5443 | -126.8426 | Continuous | 1.95 | 0.55 | -1.22 | 13.2 |
| Campbell River, BC | QUAD | 50.1325 | -125.3308 | Continuous | 3.74 | 0.57 | -1.23 | 7.9 |
| Vancouver, BC | BCVC | 49.2758 | -123.0893 | Continuous | 0.00 | 0.56 | -1.06 | 11.1 |
| Surrey, BC | BCSF | 49.1921 | -122.8601 | Continuous | -0.15 | 0.55 | -1.02 | 11.1 |
| Langley, BC | BCLC | 49.1038 | -122.6574 | Continuous | -0.74 | 0.55 | -0.97 | 11.1 |
| Friday Harbor, WA | SC02 | 48.546 | -123.008 | Continuous | 0.06 | 0.55 | -0.82 | 12.1 |
| North Saanich, BC | PGC5 | 48.6485 | -123.4511 | Continuous | 0.88 | 0.55 | -0.85 | 15.6 |
| Esquimalt, BC | BCES | 48.4293 | -123.4287 | Continuous | -0.01 | 0.55 | -0.78 | 9.1 |
| Victoria, BC | ALBH | 48.3898 | -123.4875 | Continuous | 0.58 | 0.54 | -0.77 | 20.0 |
| Seattle, WA | SEAT | 47.645 | -122.309 | Continuous | -2.33 | 0.58 | -0.61 | 18.0 |
| Robinson Point, WA | RPTx | 47.388 | -122.375 | Continuous | -2.06 | 0.55 | -0.58 | 18.2 |
| Blyn, WA | BLYN | 48.02 | -122.93 | Continuous | -0.96 | 0.60 | -0.67 | 10.1 |
| Raymond, WA | P415 | 46.656 | -123.73 | Continuous | 0.13 | 0.57 | -0.50 | 8.7 |
| Neah Bay, WA | NEAH | 48.2979 | -124.6249 | Continuous | 1.65 | 0.57 | -0.71 | 18.0 |
| Port Renfrew, BC | PTRF | 48.5443 | -124.4131 | Continuous | 3.05 | 0.64 | -0.80 | 6.6 |
| Bamfield, BC | BAMF | 48.8353 | -125.1351 | Continuous | 2.01 | 0.56 | -0.89 | 11.7 |
| Port Alberni, BC | PTAL | 49.2563 | -124.861 | Continuous | 3.17 | 0.54 | -1.11 | 11.6 |
| Ucluelet, BC | UCLU | 48.9256 | -125.5416 | Continuous | 2.34 | 0.55 | -0.88 | 19.7 |
| Gold River, BC | GLDR | 49.6815 | -126.1273 | Continuous | 2.66 | 0.63 | -1.31 | 4.7 |
| Zeballos, BC | ELIZ | 49.8731 | -127.1227 | Continuous | 1.35 | 0.55 | -1.15 | 12.0 |

[1] Continuous: permanent GPS stations.
[2] Uplift rates are relative to the centre of the Earth, as expressed in ITRF2005.
[3] Uncertainties are calculated as the geometric sum of the uncertainty in regression of the GPS time series, a reference frame scale factor uncertainty of ±0.2 mm/yr, and a reference frame translation uncertainty of ±0.5 mm/yr (Wu et al., 2011).
[4] The elastic crustal response due to present-day ice mass change was calculated at each GPS site to correct the observed GPS uplift rates before making sea-level projections.

**Table A3.** GPS Station Characteristics and Uplift Rates for the North Coast Region

| Location for which sea-level projections is provided | GPS Station | Lat | Long | Station type[1] | Uplift[2] (mm/yr) | Uncertainty[3] (mm/yr) | Correction for present day ice-mass change[4] (mm/yr) | Length (Years) |
|---|---|---|---|---|---|---|---|---|
| Alert, NU | ALRT | 82.4943 | -62.3405 | Continuous | 5.99 | 0.57 | -2.10 | 11.5 |
| Baker Lake, NU | BAKE | 64.31782 | -96.00234 | Continuous | 11.33 | 0.59 | -0.61 | 12.0 |
| Churchill, MB | CHUR | 58.75908 | -94.08873 | Continuous | 11.59 | 0.55 | -0.50 | 17.5 |
| Eureka, NU | EUR2 | 79.9889 | -85.9376 | Continuous | 7.94 | 0.58 | -2.63 | 7.7 |
| Goose Bay, NL | GSBY | 53.296 | -60.538 | CBN | 5.07 | 0.60 | -0.42 | 14.8 |
| Ulukhaktok, NT | HOLM | 70.7363 | -117.761 | Continuous | 3.11 | 0.56 | -0.65 | 12.3 |
| Igloolik, NU | IGLO | 69.3761 | -81.8102 | CBN | 11.28 | 0.67 | -0.99 | 10.0 |
| Inukjuak, QC | INJK | 58.458 | -78.106 | CBN | 11.84 | 0.61 | -0.52 | 13.0 |
| Inuvik, NT | INVK | 68.3062 | -133.527 | Continuous | -0.48 | 0.58 | -0.67 | 12.4 |
| Iqaluit, NU | IQAL | 63.756 | -68.5105 | Continuous | 3.97 | 0.65 | -0.79 | 4.3 |
| Kugluktuk, NU | KUGL | 67.8182 | -115.132 | CBN | 3.57 | 0.81 | -0.65 | 10.9 |
| Kuujuak, QC | KUJQ | 58.1109 | -68.4139 | CBN | 8.53 | 0.61 | -0.53 | 14.9 |
| Kuujuarapik, QC | KUUJ | 55.2784 | -77.7454 | Continuous | 14.20 | 0.55 | -0.45 | 11.5 |
| La Grande 1, QC | LG1G | 53.698 | -78.571 | Continuous | 14.88 | 0.61 | -0.41 | 14.2 |
| Moosonee, ON | MOSN | 51.2877 | -80.6127 | CBN | 10.94 | 0.58 | -0.38 | 13.0 |
| Nain, NL | NAIN | 56.537 | -61.6887 | Continuous | 4.49 | 0.58 | -0.51 | 11.0 |
| Peawanuck, ON | PEAW | 55.0133 | -85.4089 | CBN | 13.19 | 0.57 | -0.43 | 13.0 |
| Qikiqtarjuak, NU | QIKI | 67.5593 | -64.0337 | Continuous | 3.69 | 0.55 | -1.75 | 9.4 |
| Resolute, NU | RESO | 74.6908 | -94.8937 | Continuous | 5.55 | 0.55 | -1.05 | 12.4 |
| Sachs Harbour, NT | SACH | 71.9903 | -125.25 | Continuous | 0.99 | 0.87 | -0.64 | 3.0 |
| Salluit, QC | SALL | 62.1881 | -75.669 | CBN | 7.46 | 0.70 | -0.62 | 13.0 |
| Tuktoyaktuk, NT | TUKT | 69.4382 | -132.994 | Continuous | -1.04 | 0.55 | -0.64 | 10.4 |

[1] Continuous: permanent GPS stations; CBN: Canadian Base Network stations, which are occupied periodically.
[2] Uplift rates are relative to the centre of the Earth, as expressed in ITRF2005.
[3] Uncertainties are calculated as the geometric sum of the uncertainty in regression of the GPS time series, a reference frame scale factor uncertainty of ±0.2 mm/yr, and a reference frame translation uncertainty of ±0.5 mm/yr (Wu et al., 2011).
[4] The elastic crustal response due to present-day ice mass change was calculated at each GPS site to correct the observed GPS uplift rates before making sea-level projections.

## Appendix B. Vertical Crustal Motion and Sea-level Change.

To first order, the relative sea-level change due to vertical land motion is simply the negative of vertical land motion. When the land rises, relative sea level drops, and when land falls, relative sea level rises. In detail, however, the change in relative sea level due to the vertical motion arising from GIA is a combination of vertical crustal motion, change in the vertical position of the geoid (a surface of gravitational equipotential), and a spatially-uniform term that is introduced to conserve global water mass. The sea-level equation, as commonly utilized in GIA modelling, is

$$S(\theta,\varphi,t) = C(t) - [U(\theta,\varphi,t) - N(\theta,\varphi,t)] \quad (1)$$

(e.g., Farrell and Clark, 1976; Mitrovica and Milne, 2003), where θ and ϕ are spatial coordinates, *t* is time, *S* is relative sea-level, *U* is vertical crustal displacement, *N* is the vertical position of the geoid, and *C(t)* is introduced to conserve water mass. Typically the magnitude of the geoid change is about one tenth of the vertical crustal motion, but the relative magnitude can be much larger when the vertical motion is small. The conservation of mass term amounts to about -0.3 mm/yr.

To empirically determine the relationship between vertical crustal motion, as would be measured by GPS, and the resulting sea-level change, the vertical velocity and relative sea-change rate was obtained for the ICE-5G GIA model (Peltier, 2004; http://www.atmosp.physics.utoronto.ca/~peltier/data.php) at the 69 study locations. A regression (Fig. A2) reveals that the empirical relationship is

$$S(\theta,\varphi,t) = -0.91U(\theta,\varphi,t) - 0.25 \quad (2)$$

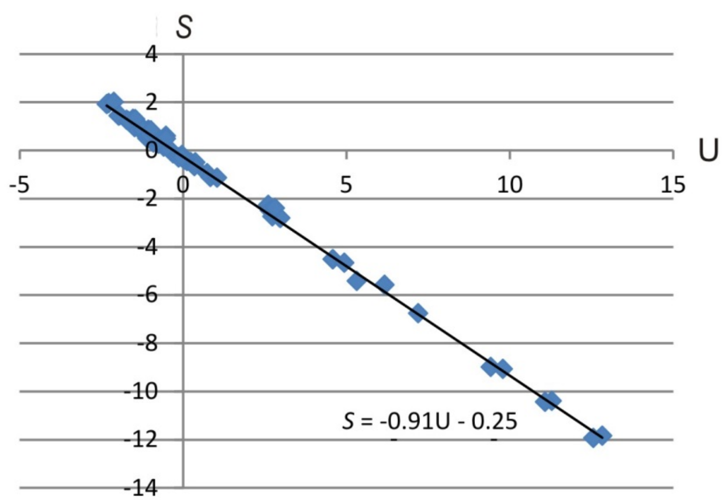



**Figure A2.** Vertical crustal motion (U, mm/yr) plotted against the rate of relative sea-level change (S, mm/yr) derived from the ICE-5G GIA model (Peltier, 2004).

The vertical land motion due to GIA diminishes with time with an exponential decay time estimated to be in the hundreds to thousands of years. Thus, GPS uplift rates are assumed to continue essentially unabated over the rest of this century. After correction for the present-day elastic crustal response to ice mass changes, the GPS vertical rates were converted to sea-level change rates using equation (2). The contribution to projected sea-level change was then determined by multiplying the sea-level change rate due to vertical land motion by the elapsed time (Tables B1, B2, B3).

**Table B1.** Equivalent Sea-level Change Arising from Vertical Crustal Motion for the East Coast Region

| Community for which sea-level projections is provided | GPS Station | Uplift Rate (mm/yr) | Elastic Correction for present-day ice-mass change (mm/yr) | Corrected Uplift rate (mm/yr) | Equivalent rate of change of sea level (mm/yr) | Total sea-level change over 105 years (1995-2100) (cm) |
|---|---|---|---|---|---|---|
| Québec City, QC | ATRI | 3.21 | -0.31 | 2.90 | -2.89 | -30.4 |
| La Pocatière, QC | LPOC | 2.68 | -0.32 | 2.36 | -2.40 | -25.2 |
| Rimouski, QC | RIMO | 3.21 | -0.33 | 2.88 | -2.87 | -30.2 |
| Baie-Comeau, QC | BAIE | 3.95 | -0.35 | 3.60 | -3.52 | -37.0 |
| Sainte-Anne-des Monts, QC | ANNE | 2.58 | -0.35 | 2.23 | -2.28 | -24.0 |
| Sept-Îles, QC | SEPT | 4.56 | -0.36 | 4.20 | -4.07 | -42.7 |
| Gaspé, QC | GASx | 1.13 | -0.33 | 0.80 | -0.98 | -10.3 |
| Escuminac, NB | ESCU | -0.36 | -0.30 | -0.66 | 0.35 | 3.6 |
| Shediac, NB | SHE2 | -0.86 | -0.29 | -1.15 | 0.80 | 8.4 |
| Charlottetown, PE | | -1.17 | -0.28 | -1.45 | 1.07 | 11.3 |
| Baddeck, NS | BDCK | -1.82 | -0.28 | -2.10 | 1.66 | 17.4 |
| Truro, NS | WTHL | -1.42 | -0.27 | -1.69 | 1.29 | 13.6 |
| Halifax, NS | HLFX | -1.00 | -0.26 | -1.26 | 0.90 | 9.4 |
| Tusket, NS | TSKT | -1.19 | -0.25 | -1.44 | 1.06 | 11.1 |
| Saint John, NB | SJPA | -0.52 | -0.27 | -0.79 | 0.47 | 5.0 |
| Eastport, ME | EPRT | -0.20 | -0.28 | -0.48 | 0.18 | 1.9 |
| Bar Harbor, ME | BARH | 0.51 | -0.26 | 0.25 | -0.48 | -5.0 |
| Brunswick, ME | BRUx | 0.65 | -0.25 | 0.40 | -0.61 | -6.4 |
| Westford, MA | WES2 | 0.50 | -0.24 | 0.26 | -0.49 | -5.1 |
| Corner Brook, NL | CBRK | -0.05 | -0.32 | -0.37 | 0.09 | 1.0 |
| Whitbourne, NL | WHTB | -0.40 | -0.29 | -0.69 | 0.38 | 4.0 |
| St. Johns, NL | STJO | -0.13 | -0.29 | -0.42 | 0.13 | 1.4 |

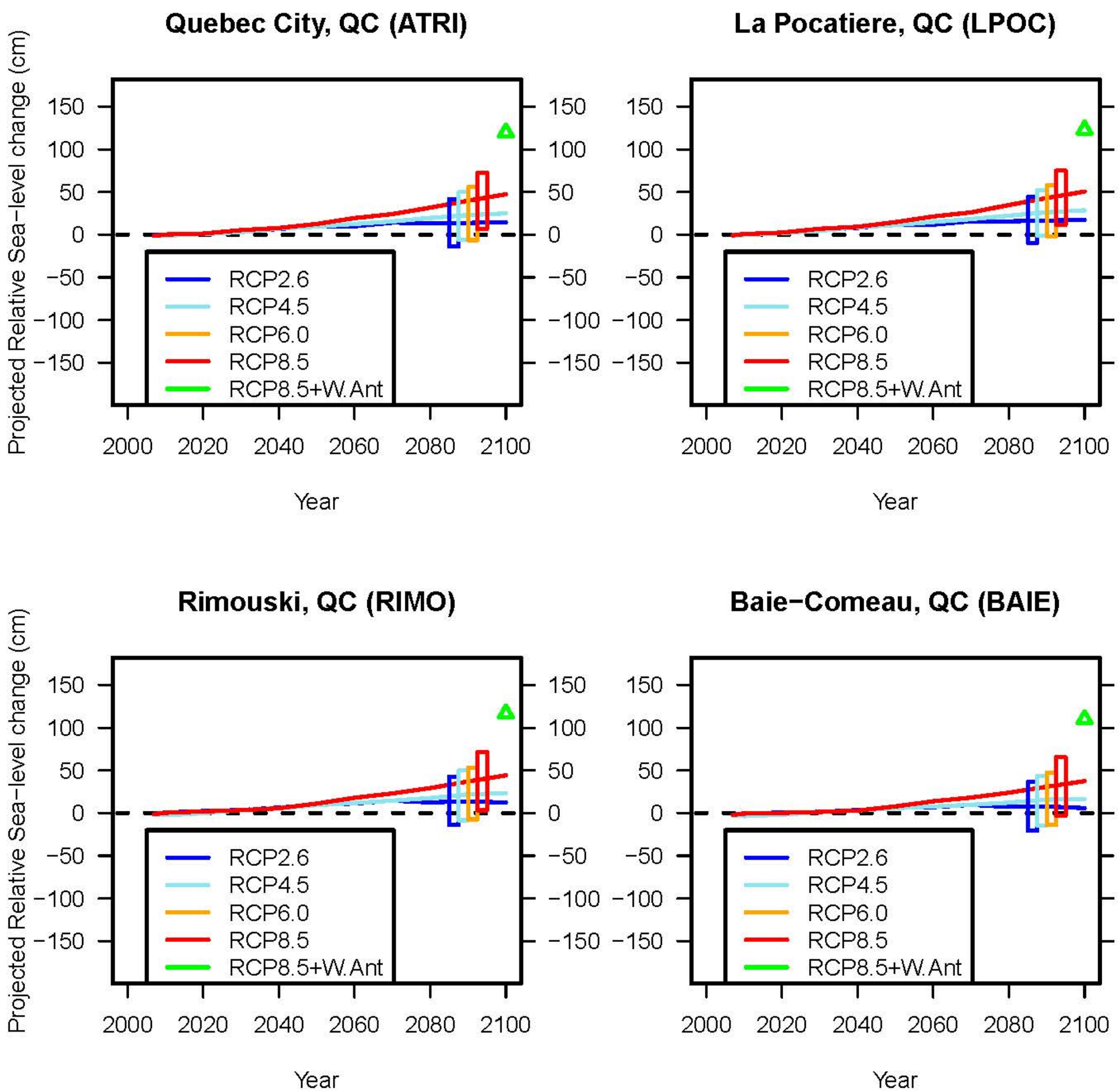
**Table B2.** Equivalent Sea-level Change Arising from Vertical Crustal Motion for the West Coast Region

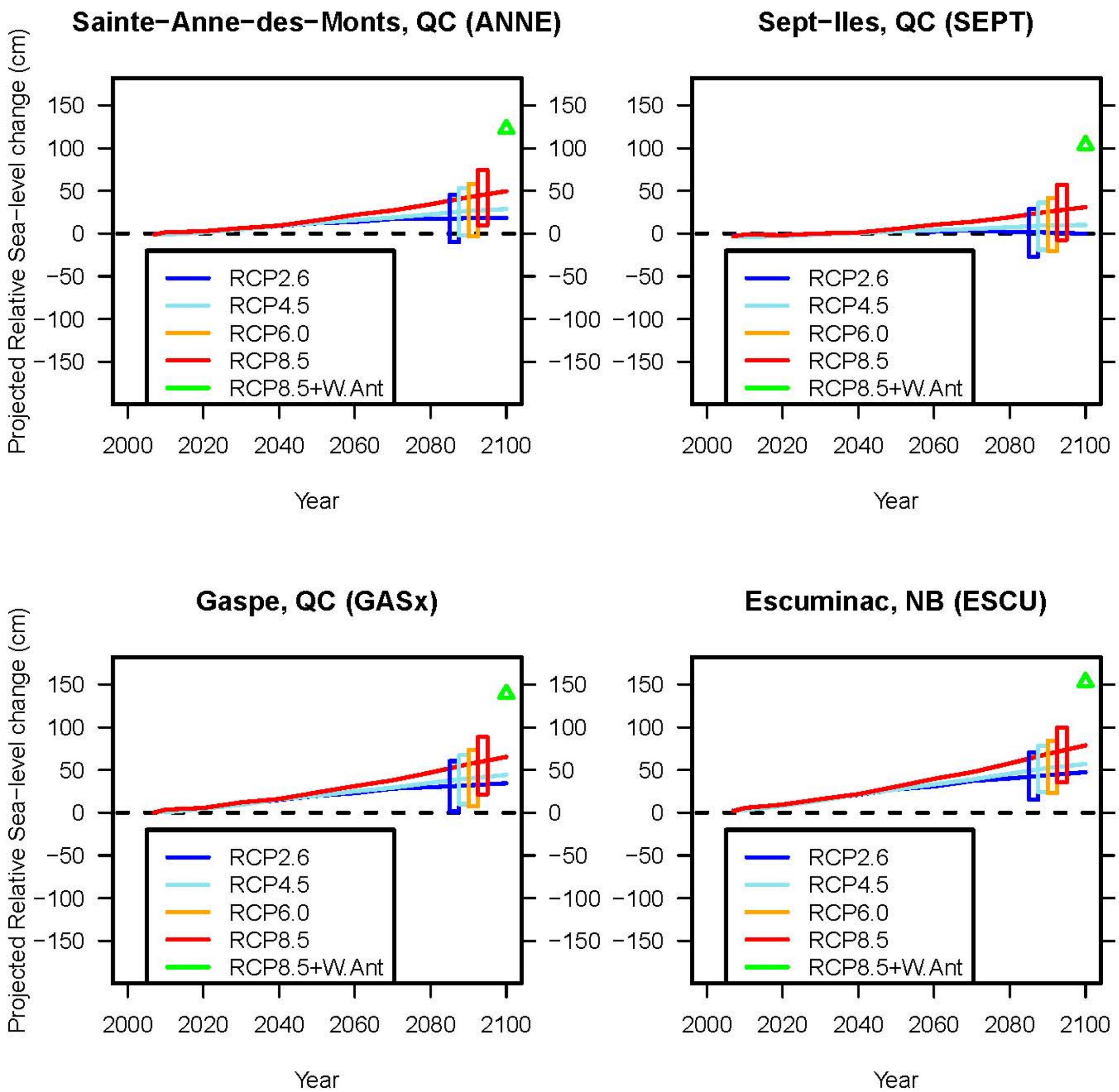
| Community for which sea-level projections is provided | GPS Station | Uplift Rate (mm/yr) | Elastic Correction for present-day ice-mass change (mm/yr) | Corrected Uplift rate (mm/yr) | Equivalent rate of change of sea level (mm/yr) | Total sea-level change over 105 years (1995-2100) (cm) |
|---|---|---|---|---|---|---|
| Prince Rupert, BC | BCPR | -0.07 | -1.34 | -1.41 | 1.03 | 10.9 |
| Sandspit, BC | BCSS | 0.08 | -0.91 | -0.83 | 0.50 | 5.3 |
| Bella Bella, BC | BCDI | 2.61 | -1.30 | 1.31 | -1.44 | -15.2 |
| Holberg, BC | HOLB | 2.95 | -1.12 | 1.83 | -1.91 | -20.1 |
| Port Hardy, BC | BCPH | 4.09 | -1.11 | 2.98 | -2.96 | -31.1 |
| Beaver Cove, BC | BCOV | 1.95 | -1.22 | 0.73 | -0.92 | -9.6 |
| Campbell River, BC | QUAD | 3.74 | -1.23 | 2.51 | -2.53 | -26.6 |
| Vancouver, BC | BCVC | 0.00 | -1.06 | -1.06 | 0.72 | 7.5 |
| Surrey, BC | BCSF | -0.15 | -1.02 | -1.17 | 0.81 | 8.5 |
| Langley, BC | BCLC | -0.74 | -0.97 | -1.71 | 1.31 | 13.8 |
| Friday Harbor, WA | SC02 | 0.06 | -0.82 | -0.76 | 0.44 | 4.6 |
| North Saanich, BC | PGC5 | 0.88 | -0.85 | 0.03 | -0.27 | -2.9 |
| Esquimalt, BC | BCES | -0.01 | -0.78 | -0.79 | 0.47 | 5.0 |
| Victoria, BC | ALBH | 0.58 | -0.77 | -0.19 | -0.08 | -0.8 |
| Seattle, WA | SEAT | -2.33 | -0.61 | -2.94 | 2.42 | 25.5 |
| Robinson Point, WA | RPTx | -2.06 | -0.58 | -2.64 | 2.15 | 22.6 |
| Blyn, WA | BLYN | -0.96 | -0.67 | -1.63 | 1.23 | 12.9 |
| Raymond, WA | P415 | 0.13 | -0.50 | -0.37 | 0.08 | 0.9 |
| Neah Bay, WA | NEAH | 1.65 | -0.71 | 0.94 | -1.11 | -11.6 |
| Port Renfrew, BC | PTRF | 3.05 | -0.80 | 2.25 | -2.29 | -24.1 |
| Bamfield, BC | BAMF | 2.01 | -0.89 | 1.12 | -1.27 | -13.4 |
| Port Alberni, BC | PTAL | 3.17 | -1.11 | 2.06 | -2.12 | -22.3 |
| Ucluelet, BC | UCLU | 2.34 | -0.88 | 1.46 | -1.58 | -16.6 |
| Gold River, BC | GLDR | 2.66 | -1.31 | 1.35 | -1.48 | -15.5 |
| Zeballos, BC | ELIZ | 1.35 | -1.15 | 0.20 | -0.43 | -4.5 |

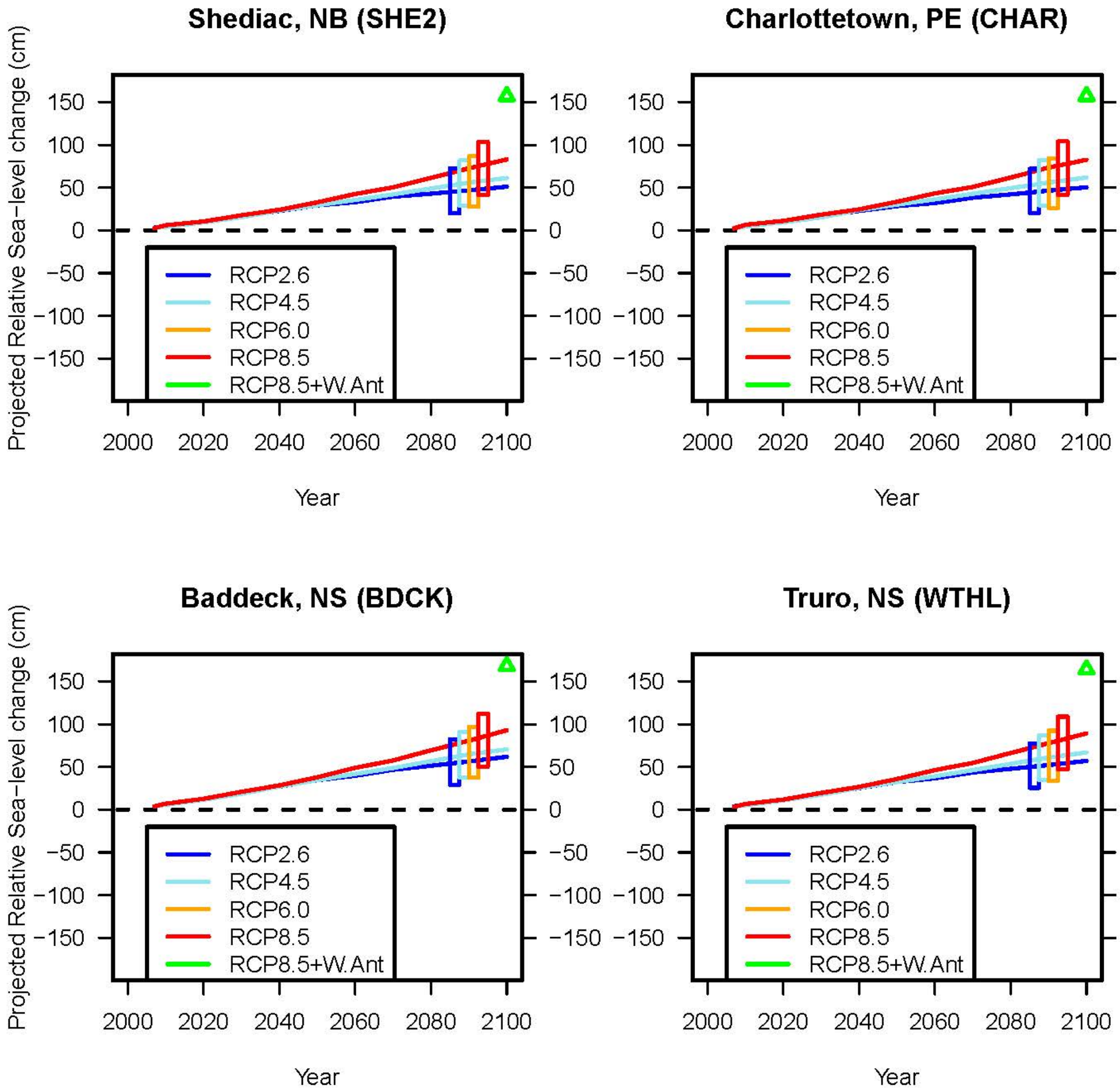
**Table B3.** Equivalent Sea-level Change Arising from Vertical Crustal Motion for the North Coast Region

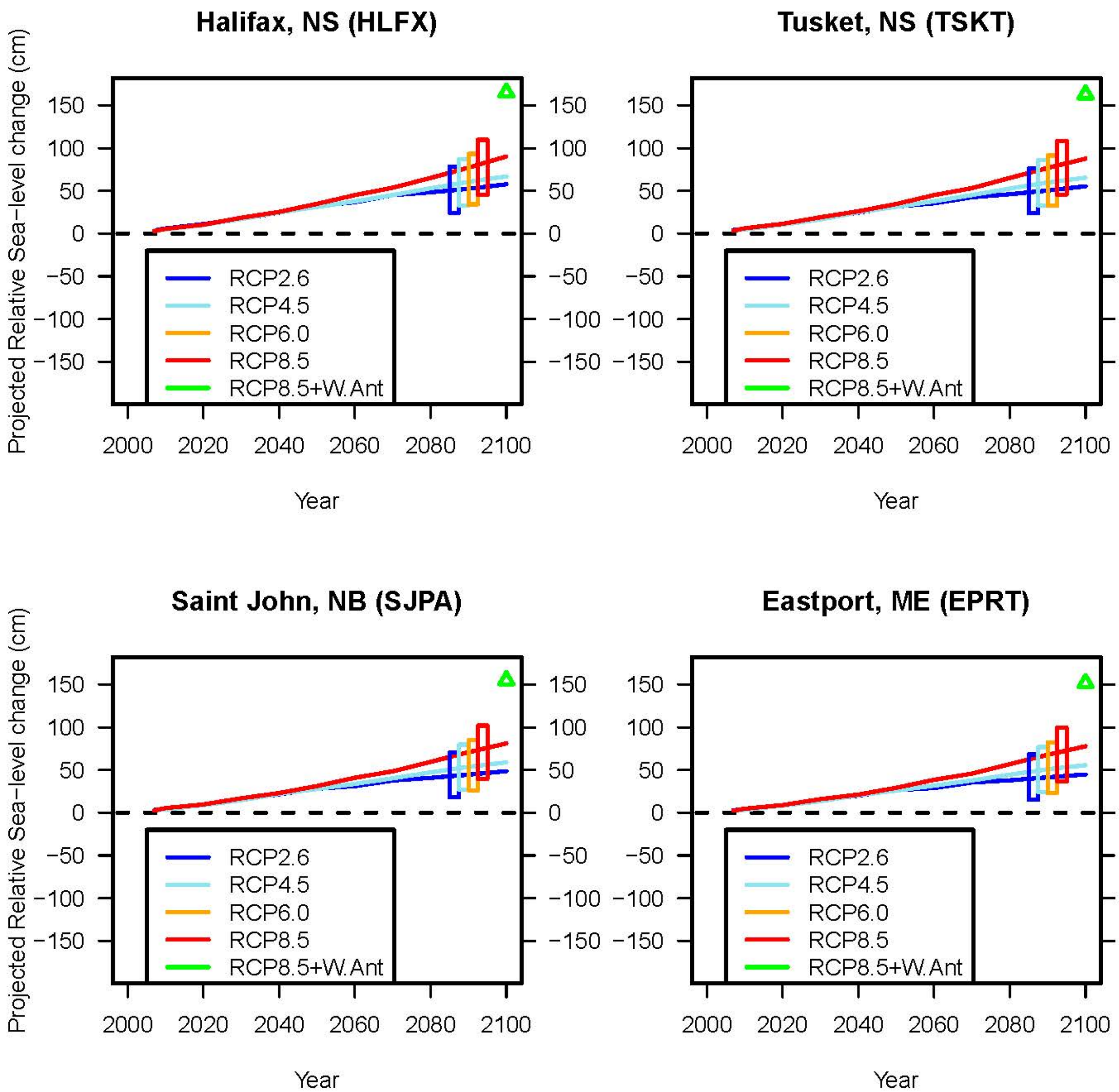
| Community for which sea-level projections is provided | GPS Station | Uplift Rate (mm/yr) | Elastic Correction for present-day ice-mass change (mm/yr) | Corrected Uplift rate (mm/yr) | Equivalent rate of change of sea level (mm/yr) | Total sea-level change over 105 years (1995-2100) (cm) |
|---|---|---|---|---|---|---|
| Alert, NU | ALRT | 5.99 | -2.10 | 3.89 | -3.79 | -39.8 |
| Baker Lake, NU | BAKE | 11.33 | -0.61 | 10.72 | -10.00 | -105.0 |
| Churchill, MB | CHUR | 11.59 | -0.50 | 11.09 | -10.34 | -108.6 |
| Eureka, NU | EUR2 | 7.94 | -2.63 | 5.31 | -5.08 | -53.3 |
| Goose Bay, NL | GSBY | 5.07 | -0.42 | 4.65 | -4.48 | -47.0 |
| Ulukhaktok, NT | HOLM | 3.11 | -0.65 | 2.46 | -2.49 | -26.1 |
| Igloolik, NU | IGLO | 11.28 | -0.99 | 10.29 | -9.61 | -100.9 |
| Inukjuak, QC | INJK | 11.84 | -0.52 | 11.32 | -10.55 | -110.8 |
| Inuvik, NT | INVK | -0.48 | -0.67 | -1.15 | 0.80 | 8.4 |
| Iqaluit, NU | IQAL | 3.97 | -0.79 | 3.18 | -3.15 | -33.0 |
| Kugluktuk, NU | KUGL | 3.57 | -0.65 | 2.92 | -2.91 | -30.6 |
| Kuujjuak, QC | KUJQ | 8.53 | -0.53 | 8.00 | -7.53 | -79.1 |
| Kuujjuarapik, QC | KUUJ | 14.20 | -0.45 | 13.75 | -12.77 | -134.0 |
| La Grande 1, QC | LG1G | 14.88 | -0.41 | 14.47 | -13.42 | -140.9 |
| Moosonee, ON | MOSN | 10.94 | -0.38 | 10.56 | -9.86 | -103.5 |
| Nain, NL | NAIN | 4.49 | -0.51 | 3.98 | -3.87 | -40.7 |
| Peawanuck, ON | PEAW | 13.19 | -0.43 | 12.76 | -11.86 | -124.6 |
| Qikiqtarjuaq, NU | QIKI | 3.69 | -1.75 | 1.94 | -2.01 | -21.1 |
| Resolute, NU | RESO | 5.55 | -1.05 | 4.50 | -4.35 | -45.7 |
| Sachs Harbour, NT | SACH | 0.99 | -0.64 | 0.35 | -0.56 | -5.9 |
| Salluit, QC | SALL | 7.46 | -0.62 | 6.84 | -6.48 | -68.0 |
| Tuktoyaktuk, NT | TUKT | -1.04 | -0.64 | -1.68 | 1.28 | 13.5 |

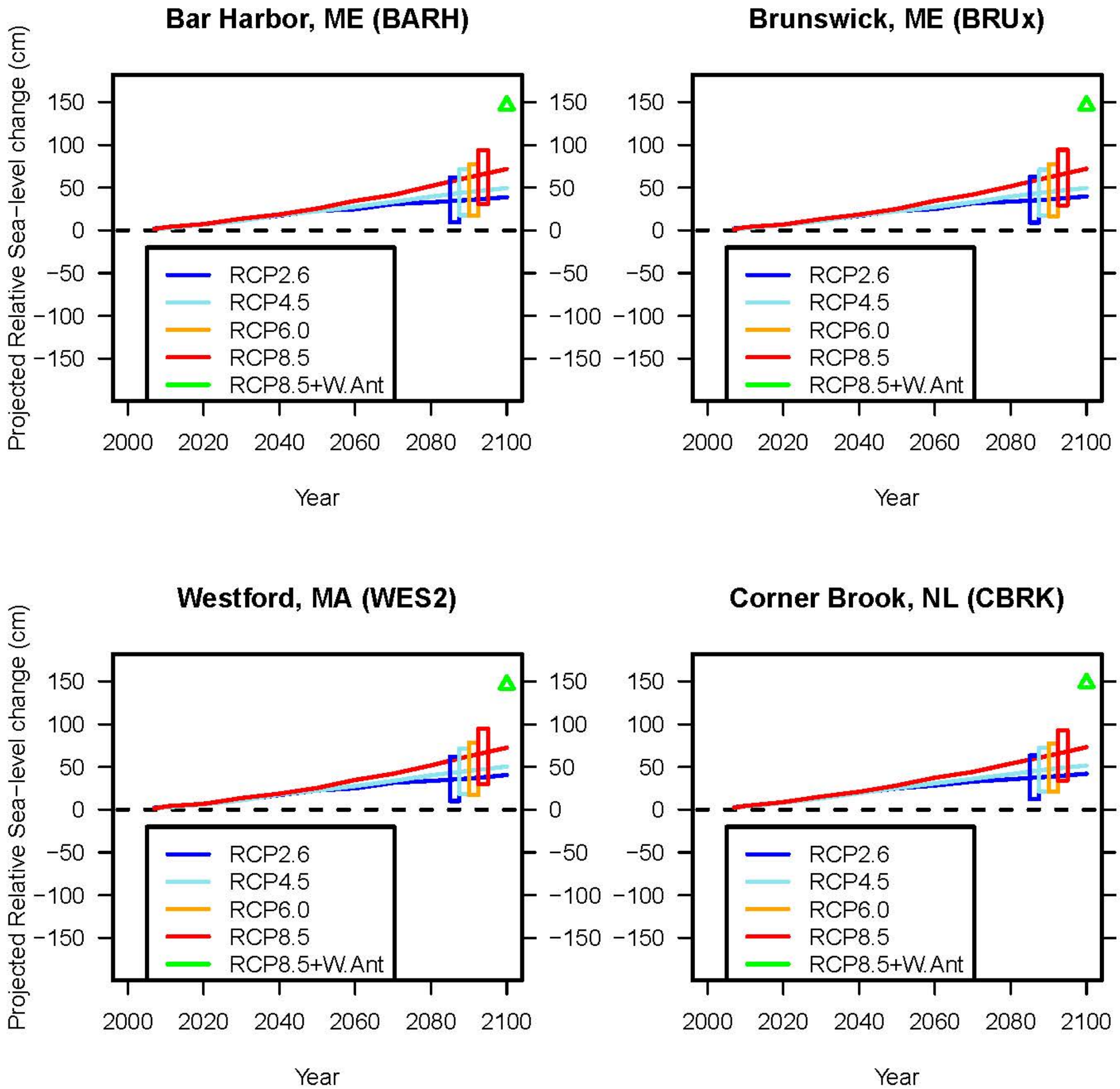
**Appendix C.  Projections of Relative Sea-level Change**




Sainte−Anne−des−Monts, QC (ANNE)
Sept−Iles, QC (SEPT)
Gaspe, QC (GASx)
Escuminac, NB (ESCU)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100


Shediac, NB (SHE2)
Charlottetown, PE (CHAR)
Baddeck, NS (BDCK)
Truro, NS (WTHL)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100


Halifax, NS (HLFX)
Tusket, NS (TSKT)
Saint John, NB (SJPA)
Eastport, ME (EPRT)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant



Bar Harbor, ME (BARH)
Brunswick, ME (BRUx)
Westford, MA (WES2)
Corner Brook, NL (CBRK)
Projected Relative Sea−level change (cm)
Year
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant

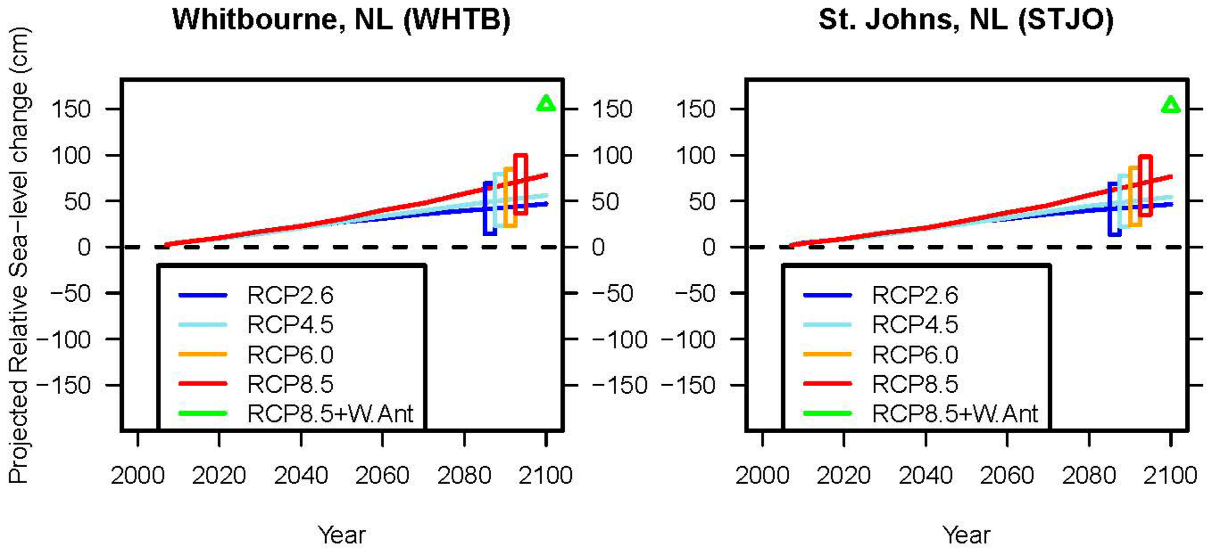
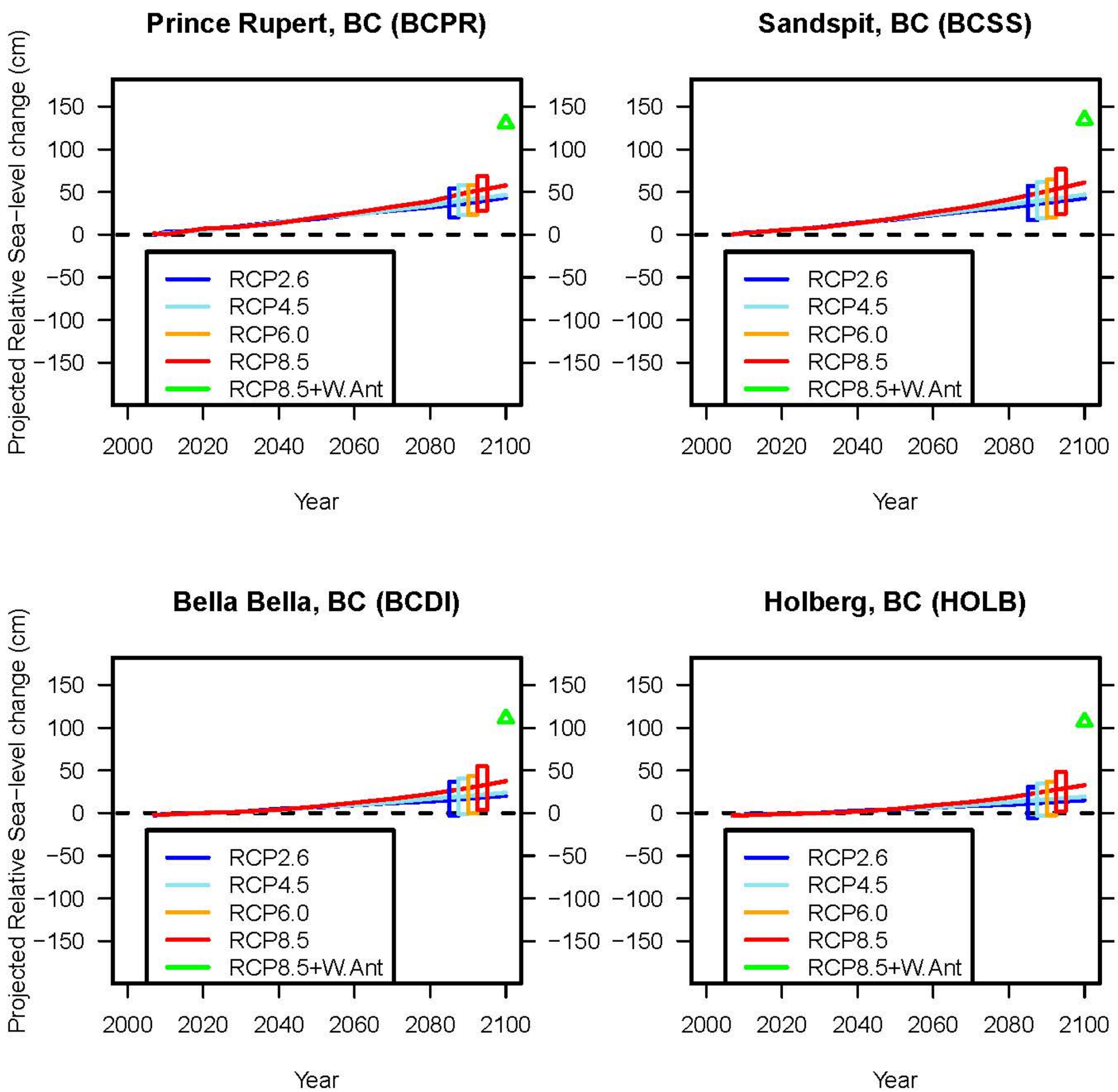
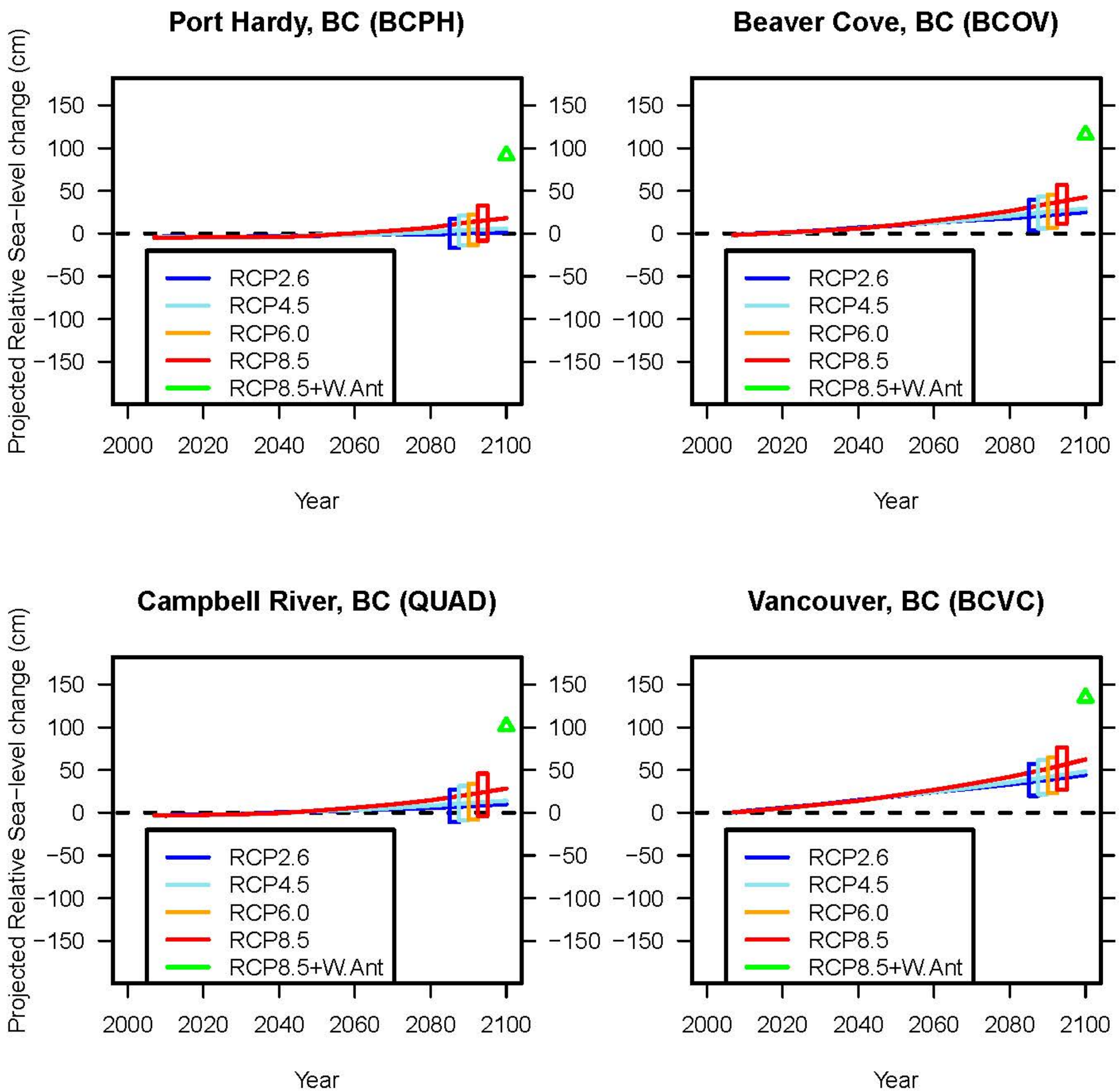
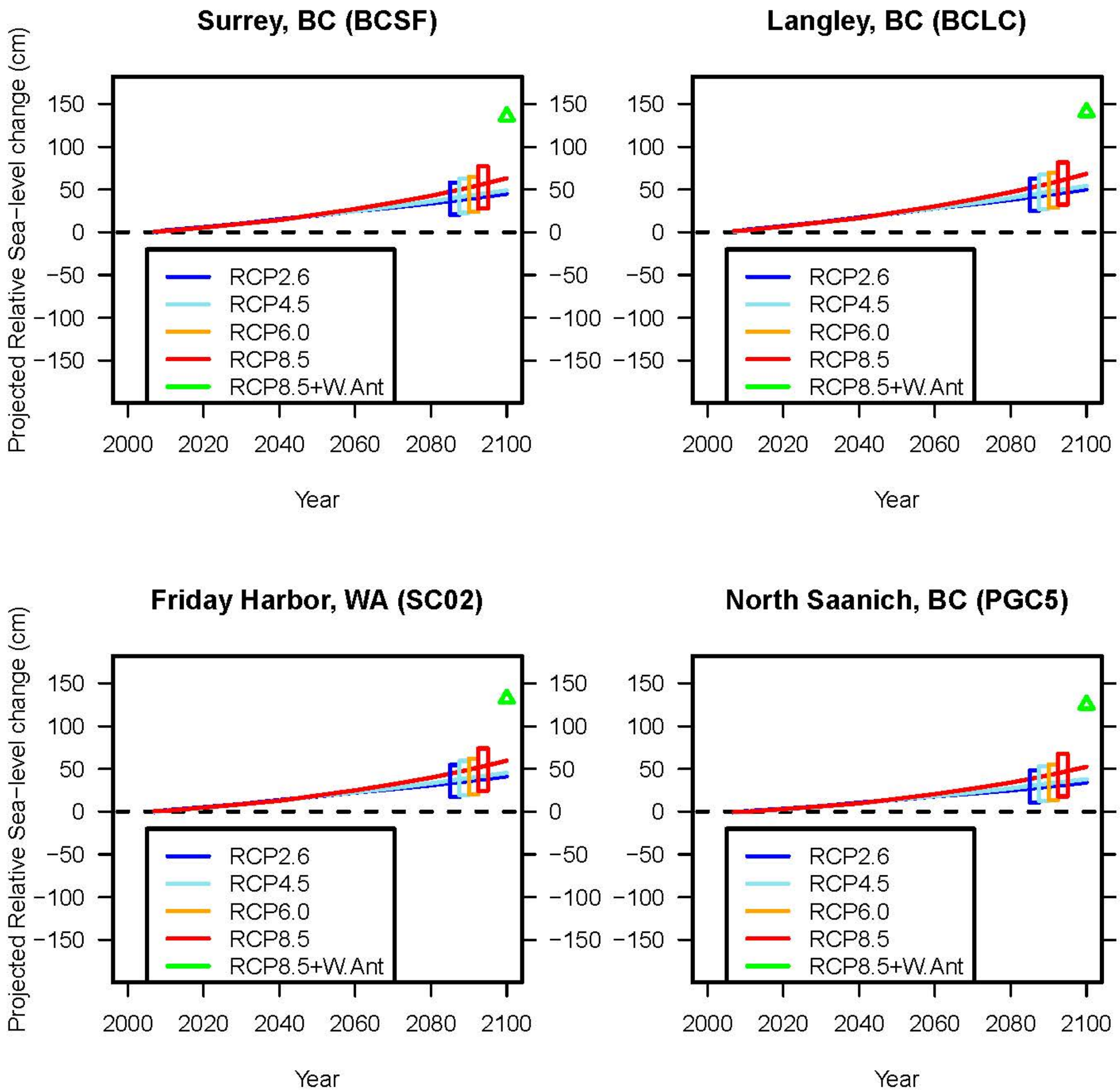
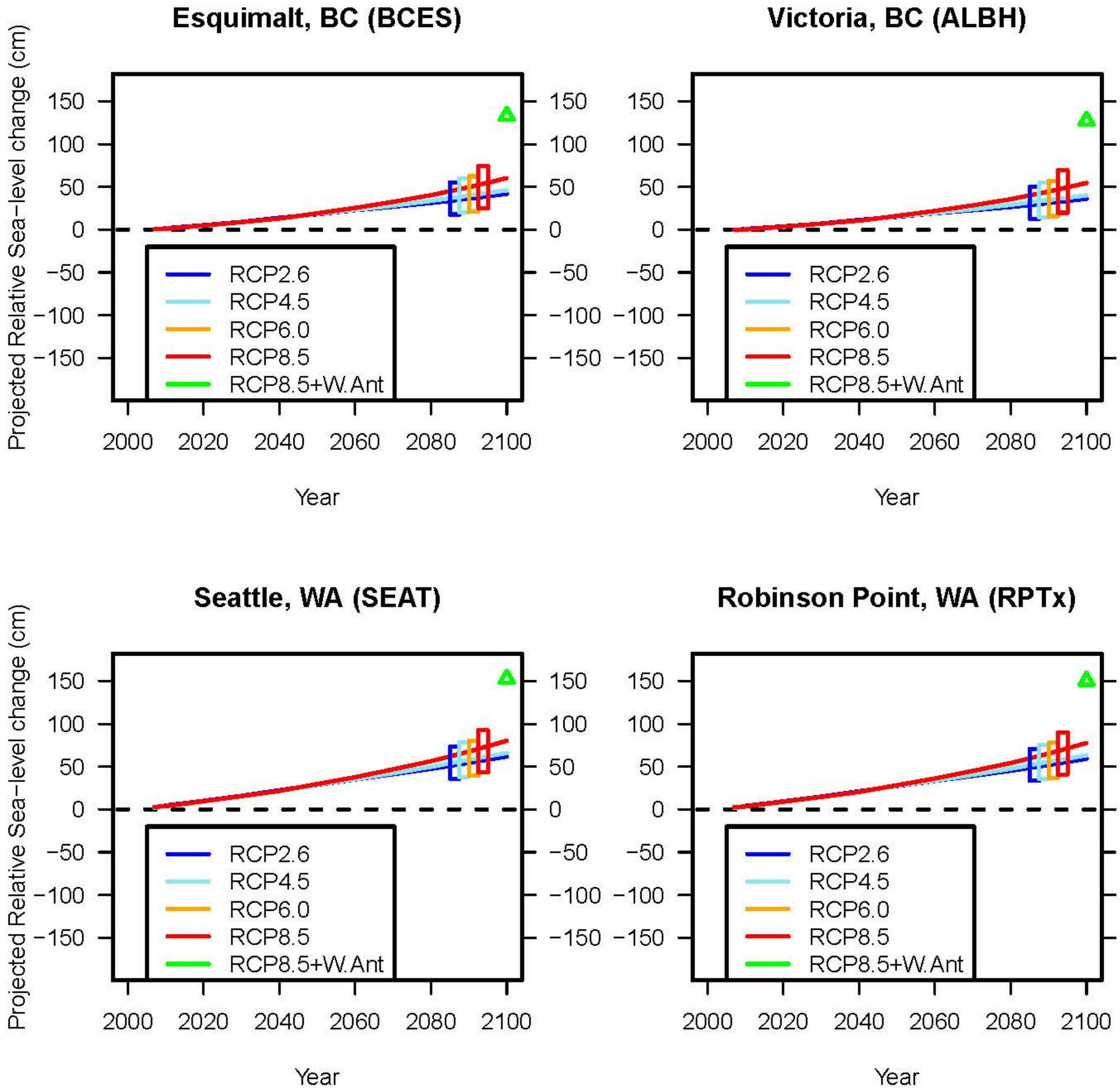


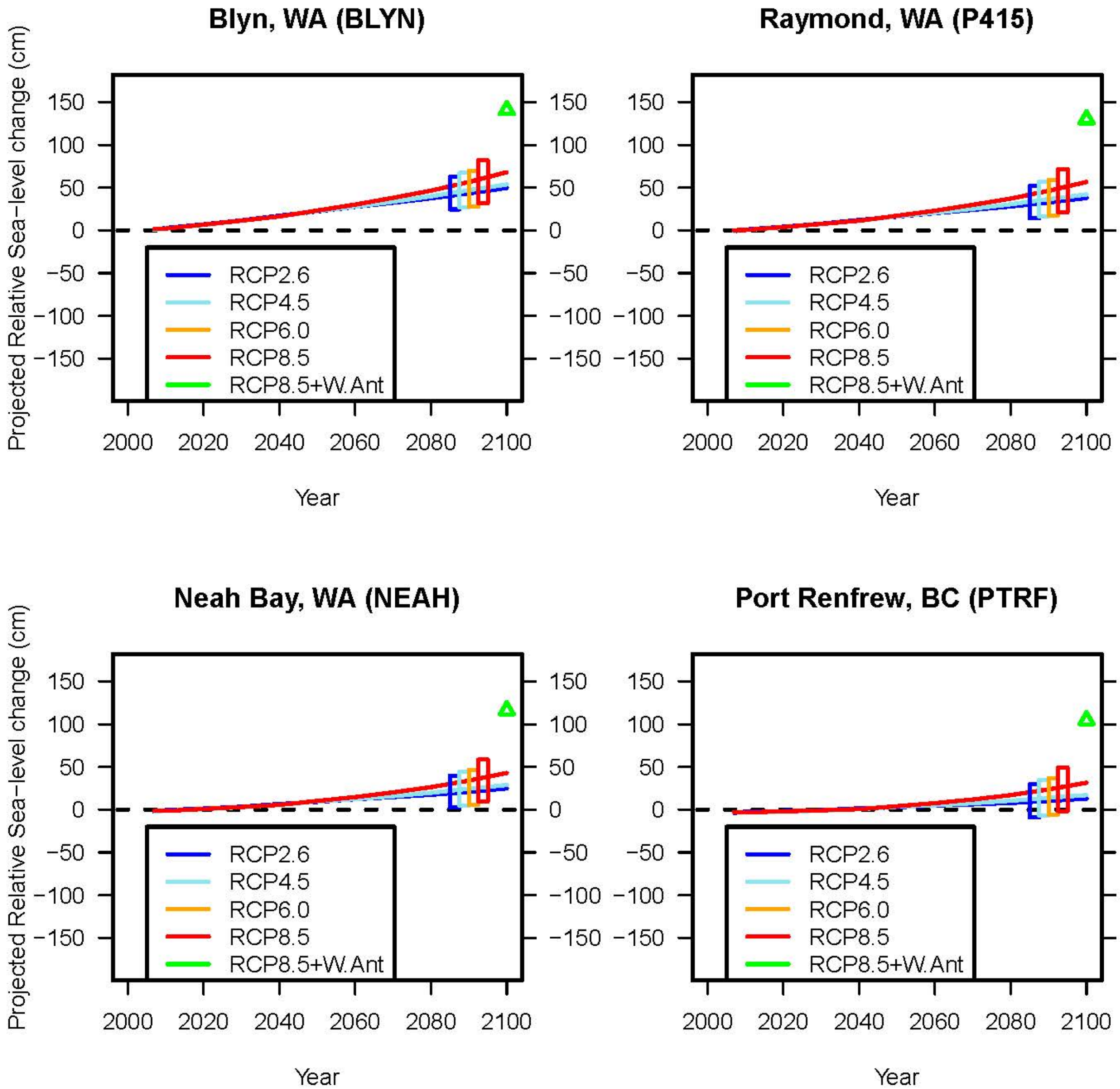

**Figure C1.** Projected relative sea-level change for the East Coast Region, based on the IPCC AR5 (Church et al., 2013a, 2013b) and utilizing vertical crustal motion derived from GPS observations (Appendices A and B). Rectangles show the range of projected sea-level change at 2081-2100 relative to 1986-2005, indicating the uncertainty, or scatter, arising from computing the average of model outputs of many different climate centres and including the uncertainty in the vertical crustal motion. The green triangle is the projection of a scenario based on collapse of a portion of the West Antarctic ice sheet, providing an additional 65 cm of global sea-level rise to RCP8.5.

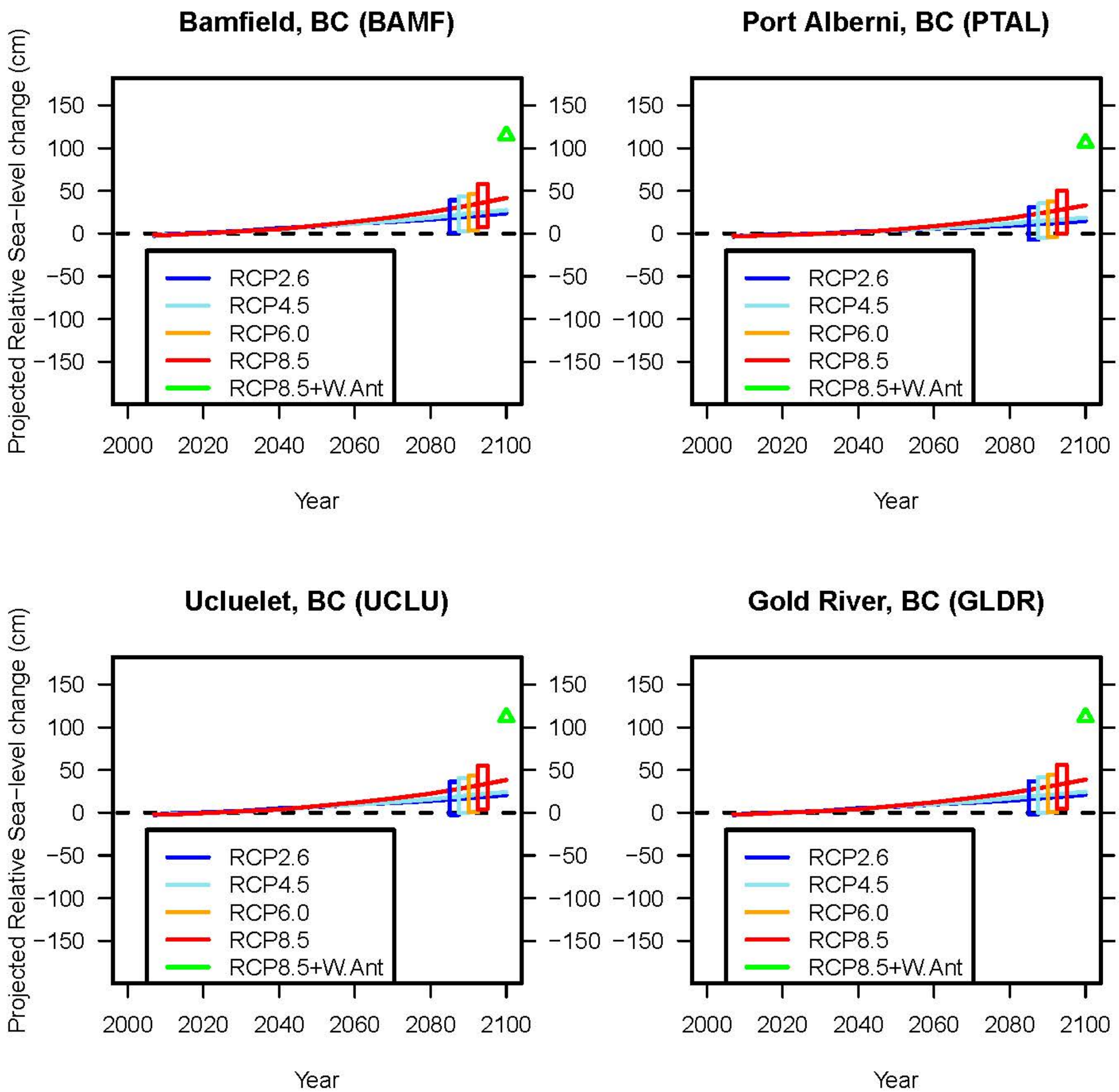

Prince Rupert, BC (BCPR)
Sandspit, BC (BCSS)
Bella Bella, BC (BCDI)
Holberg, BC (HOLB)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100


Port Hardy, BC (BCPH)
Beaver Cove, BC (BCOV)
Campbell River, BC (QUAD)
Vancouver, BC (BCVC)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100


Surrey, BC (BCSF)
Langley, BC (BCLC)
Friday Harbor, WA (SC02)
North Saanich, BC (PGC5)
Projected Relative Sea−level change (cm)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant


Esquimalt, BC (BCES)
Victoria, BC (ALBH)
Seattle, WA (SEAT)
Robinson Point, WA (RPTx)
Projected Relative Sea−level change (cm)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant


Blyn, WA (BLYN)
Raymond, WA (P415)
Neah Bay, WA (NEAH)
Port Renfrew, BC (PTRF)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100


Bamfield, BC (BAMF)
Port Alberni, BC (PTAL)
Ucluelet, BC (UCLU)
Gold River, BC (GLDR)
Projected Relative Sea−level change (cm)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant

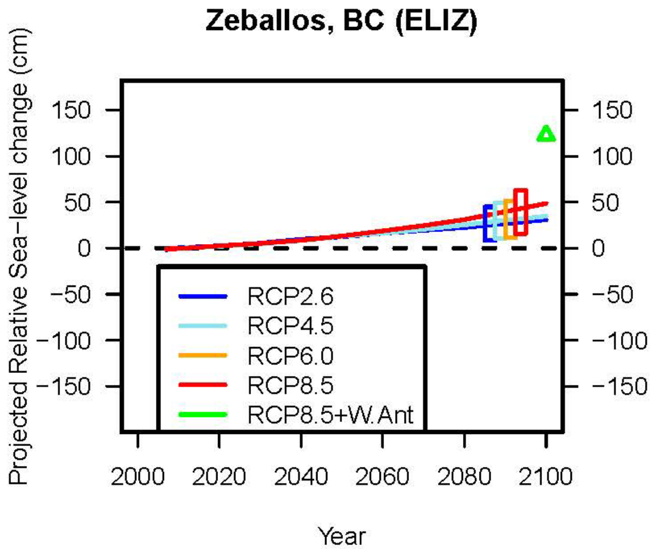
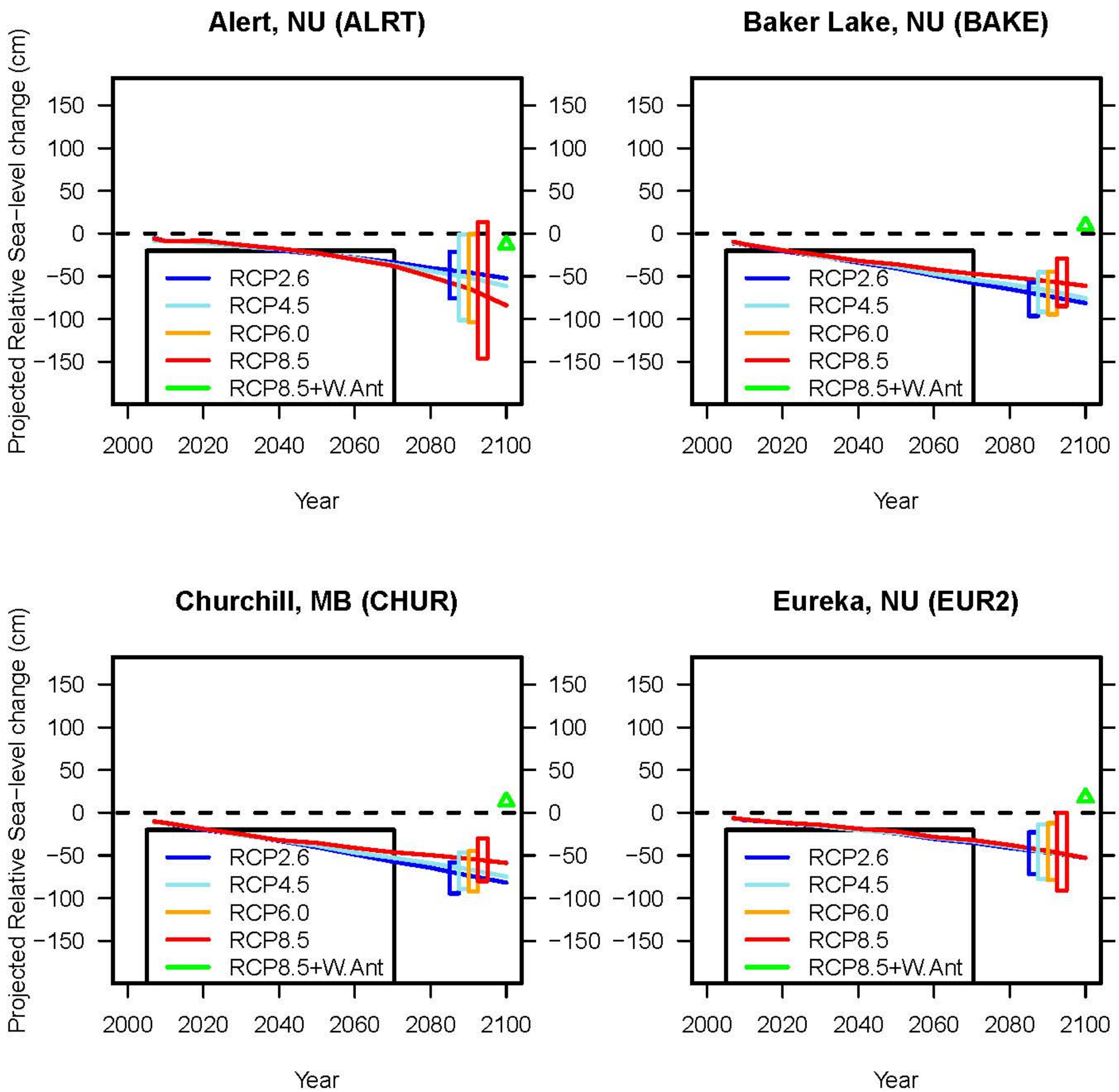
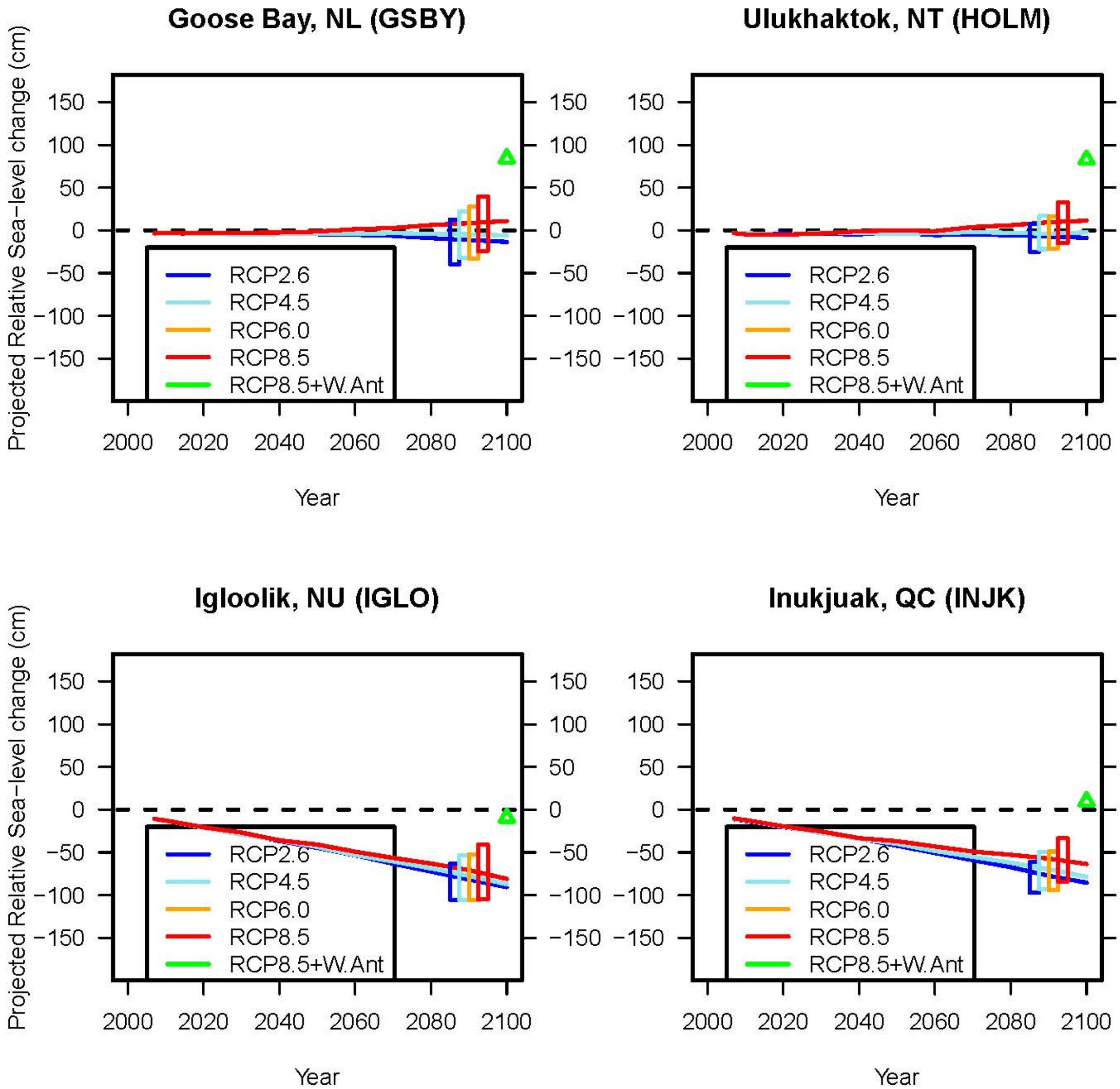
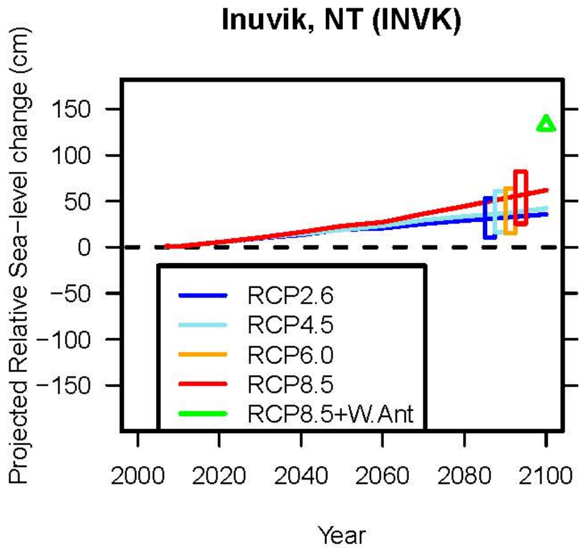
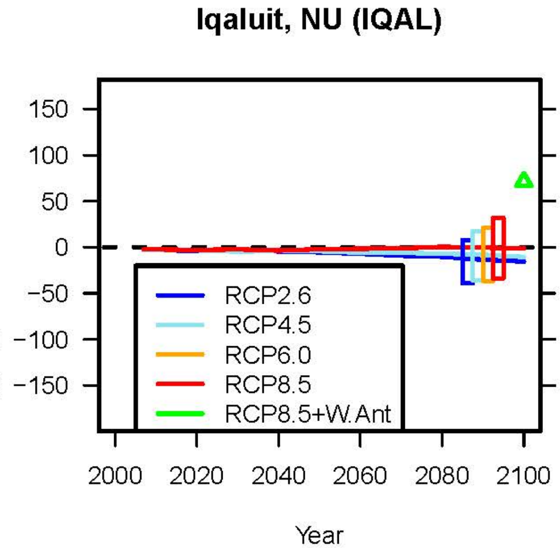


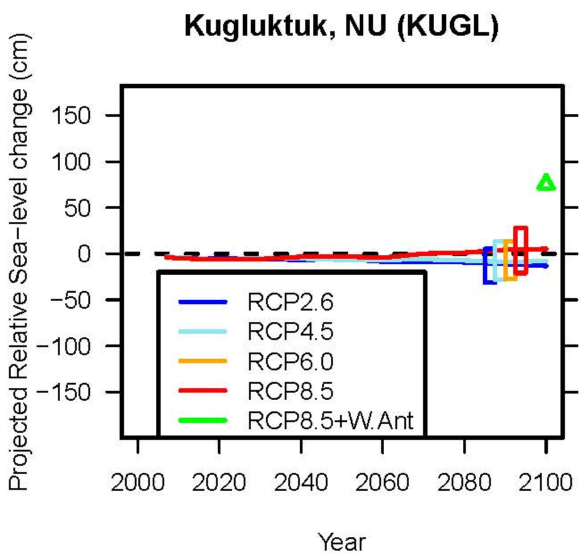

**Figure C2.** Projected relative sea-level change for the West Coast Region, based on the IPCC AR5 (Church et al., 2013a, 2013b) and utilizing vertical crustal motion derived from GPS observations (Appendices A and B). Rectangles show the range of projected sea-level change at 2081-2100 relative to 1986-2005, indicating the uncertainty, or scatter, arising from computing the average of model outputs of many different climate centres and including the uncertainty in the vertical crustal motion. The green triangle is the projection of a scenario based on collapse of a portion of the West Antarctic ice sheet, providing an additional 65 cm of global sea-level rise to RCP8.5.

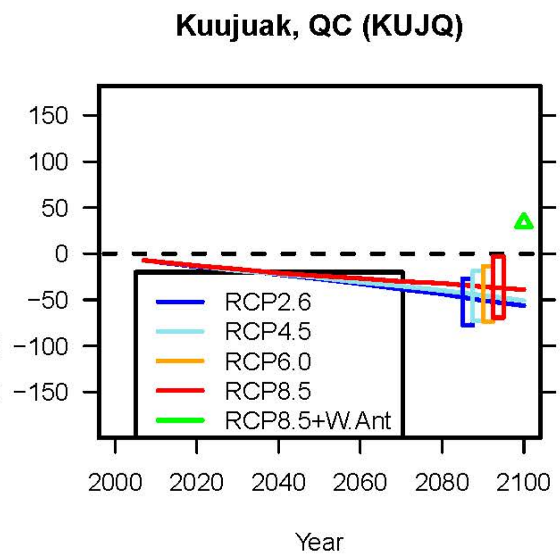

Alert, NU (ALRT)
Baker Lake, NU (BAKE)
Churchill, MB (CHUR)
Eureka, NU (EUR2)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100

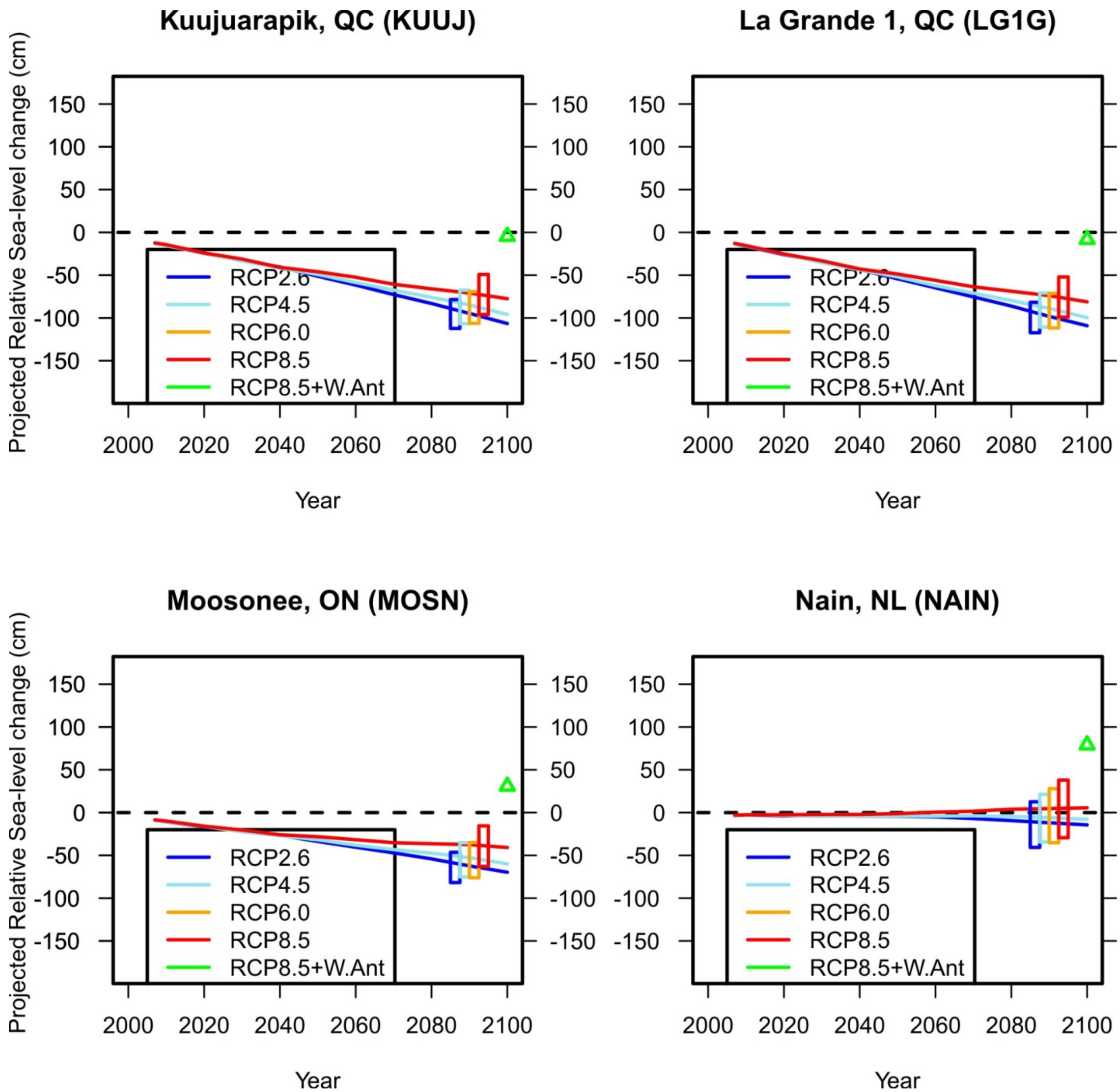

Goose Bay, NL (GSBY)
Ulukhaktok, NT (HOLM)
Igloolik, NU (IGLO)
Inukjuak, QC (INJK)
Projected Relative Sea−level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant


Inuvik, NT (INVK)
Projected Relative Sea-level change (cm)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant

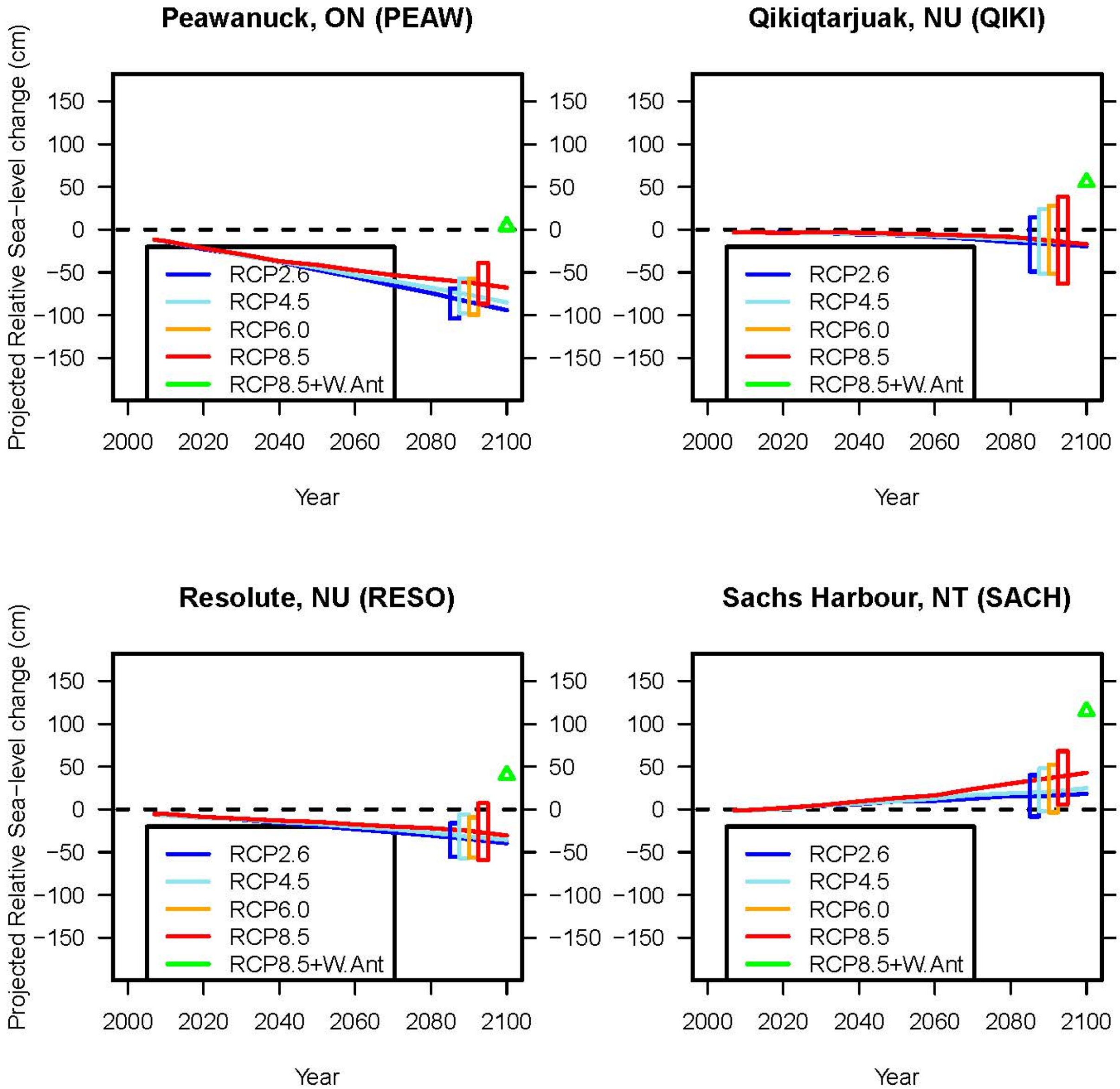

Iqaluit, NU (IQAL)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant


Kugluktuk, NU (KUGL)
Projected Relative Sea-level change (cm)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant


Kuujuak, QC (KUJQ)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant



Kuujuarapik, QC (KUUJ)
La Grande 1, QC (LG1G)
Moosonee, ON (MOSN)
Nain, NL (NAIN)
Projected Relative Sea-level change (cm)
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant


Peawanuck, ON (PEAW)
Qikiqtarjuak, NU (QIKI)
Resolute, NU (RESO)
Sachs Harbour, NT (SACH)
Projected Relative Sea−level change (cm)
150
100
50
0
−50
−100
−150
2000
2020
2040
2060
2080
2100
Year
RCP2.6
RCP4.5
RCP6.0
RCP8.5
RCP8.5+W.Ant

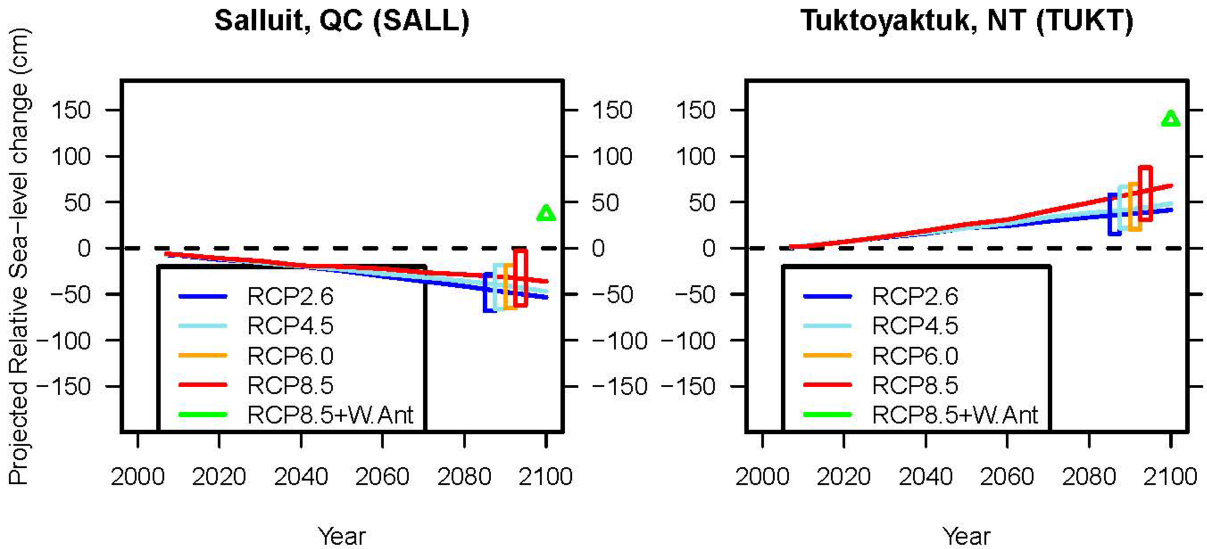



**Figure C3.** Projected relative sea-level change for the North Coast Region, based on the IPCC AR5 (Church et al., 2013a, 2013b) and utilizing vertical crustal motion derived from GPS observations (Appendices A and B). Rectangles show the range of projected sea-level change at 2081-2100 relative to 1986-2005, indicating the uncertainty, or scatter, arising from computing the average of model outputs of many different climate centres and including the uncertainty in the vertical crustal motion. The green triangle is the projection of a scenario based on collapse of a portion of the West Antarctic ice sheet, providing an additional 65 cm of global sea-level rise to RCP8.5.

**Table C1.** Sea-level Projections at 2081-2100 Relative to 1986-2005 for RCP 2.6

| Community for which sea-level projections is provided | GPS Station | Sea-level change (5%) (cm) | Sea-level change (median) (cm) | Sea-level change (95%) (cm) |
|---|---|---|---|---|
| Québec City, QC | ATRI | -14.1 | 13.8 | 41.7 |
| La Pocatière, QC | LPOC | -9.6 | 17.3 | 44.1 |
| Rimouski, QC | RIMO | -14.1 | 14.2 | 42.6 |
| Baie-Comeau, QC | BAIE | -20.6 | 7.9 | 36.3 |
| Sainte-Anne-des-Monts, QC | ANNE | -10.0 | 17.6 | 45.3 |
| Sept-Îles, QC | SEPT | -27.0 | 0.9 | 28.7 |
| Gaspé, QC | GASx | 1.3 | 30.9 | 60.4 |
| Escuminac, NB | ESCU | 15.4 | 42.8 | 70.2 |
| Shediac, NB | SHE2 | 20.1 | 46.3 | 72.5 |
| Charlottetown, PE | | 20.4 | 46.2 | 72.0 |
| Baddeck, NS | BDCK | 29.2 | 55.7 | 82.3 |
| Truro, NS | WTHL | 25.6 | 51.5 | 77.5 |
| Halifax, NS | HLFX | 24.2 | 51.4 | 78.6 |
| Tusket, NS | TSKT | 23.8 | 50.0 | 76.3 |
| Saint John, NB | SJPA | 18.1 | 44.2 | 70.2 |
| Eastport, ME | EPRT | 15.2 | 41.7 | 68.2 |
| Bar Harbor, ME | BARH | 9.3 | 35.6 | 61.9 |
| Brunswick, ME | BRUx | 9.1 | 35.9 | 62.6 |
| Westford, MA | WES2 | 10.1 | 35.9 | 61.8 |
| Corner Brook, NL | CBRK | 12.4 | 37.8 | 63.3 |
| Whitbourne, NL | WHTB | 14.0 | 41.5 | 69.1 |
| St. Johns, NL | STJO | 13.5 | 41.1 | 68.6 |
| Prince Rupert, BC | BCPR | 20.4 | 37.2 | 54.0 |
| Sandspit, BC | BCSS | 17.2 | 37.2 | 57.3 |
| Bella Bella, BC | BCDI | -2.9 | 16.8 | 36.6 |
| Holberg, BC | HOLB | -5.8 | 12.3 | 30.4 |
| Port Hardy, BC | BCPH | -16.7 | 0.2 | 17.1 |
| Beaver Cove, BC | BCOV | 3.6 | 21.4 | 39.2 |
| Campbell River, BC | QUAD | -11.2 | 7.7 | 26.7 |
| Vancouver, BC | BCVC | 19.7 | 38.5 | 57.3 |
| Surrey, BC | BCSF | 20.6 | 39.3 | 58.0 |
| Langley, BC | BCLC | 25.4 | 44.0 | 62.6 |
| Friday Harbor, WA | SC02 | 17.3 | 35.9 | 54.6 |
| North Saanich, BC | PGC5 | 10.6 | 29.3 | 48.1 |
| Esquimalt, BC | BCES | 17.7 | 36.5 | 55.2 |
| Victoria, BC | ALBH | 12.6 | 31.3 | 50.0 |

| | | | | |
|---|---|---|---|---|
| Seattle, WA | SEAT | 36.0 | 54.7 | 73.4 |
| Robinson Point, WA | RPTx | 33.7 | 52.2 | 70.8 |
| Blyn, WA | BLYN | 24.6 | 43.6 | 62.5 |
| Raymond, WA | P415 | 14.2 | 33.0 | 51.8 |
| Neah Bay, WA | NEAH | 2.4 | 21.0 | 39.7 |
| Port Renfrew, BC | PTRF | -9.1 | 10.3 | 29.8 |
| Bamfield, BC | BAMF | 0.5 | 19.8 | 39.1 |
| Port Alberni, BC | PTAL | -7.1 | 11.8 | 30.7 |
| Ucluelet, BC | UCLU | -2.5 | 16.8 | 36.2 |
| Gold River, BC | GLDR | -2.0 | 17.4 | 36.9 |
| Zeballos, BC | ELIZ | 8.4 | 26.7 | 44.9 |
| Alert, NU | ALRT | -76.0 | -48.6 | -21.2 |
| Baker Lake, NU | BAKE | -96.5 | -76.8 | -57.1 |
| Churchill, MB | CHUR | -94.5 | -76.3 | -58.0 |
| Eureka, NU | EUR2 | -71.6 | -47.3 | -22.9 |
| Goose Bay, NL | GSBY | -39.6 | -13.4 | 12.7 |
| Ulukhaktok, NT | HOLM | -25.1 | -8.9 | 7.3 |
| Igloolik, NU | IGLO | -105.6 | -84.4 | -63.3 |
| Inukjuak, QC | INJK | -97.3 | -79.4 | -61.5 |
| Inuvik, NT | INVK | 10.9 | 31.8 | 52.7 |
| Iqaluit, NU | IQAL | -39.2 | -15.7 | 7.9 |
| Kugluktuk, NU | KUGL | -31.4 | -13.1 | 5.2 |
| Kuujuak, QC | KUJQ | -77.6 | -52.4 | -27.2 |
| Kuujuarapik, QC | KUUJ | -112.3 | -95.4 | -78.5 |
| La Grande 1, QC | LG1G | -117.3 | -99.5 | -81.7 |
| Moosonee, ON | MOSN | -81.8 | -64.1 | -46.4 |
| Nain, NL | NAIN | -40.7 | -14.0 | 12.6 |
| Peawanuck, ON | PEAW | -104.0 | -86.3 | -68.6 |
| Qikiqtarjuaq, NU | QIKI | -49.0 | -17.3 | 14.3 |
| Resolute, NU | RESO | -55.6 | -35.9 | -16.2 |
| Sachs Harbour, NT | SACH | -8.3 | 15.8 | 40.0 |
| Salluit, QC | SALL | -68.1 | -48.4 | -28.7 |
| Tuktoyaktuk, NT | TUKT | 15.7 | 36.9 | 58.0 |

**Table C2.** Sea-level Projections at 2081-2100 Relative to 1986-2005 for RCP 4.5

| Community for which sea-level projections is provided | GPS Station | Sea-level change (5%) (cm) | Sea-level change (median) (cm | Sea-level change (95%) (cm) |
|---|---|---|---|---|
| Québec City, QC | ATRI | -6.1 | 21.9 | 49.9 |
| La Pocatière, QC | LPOC | -1.2 | 25.6 | 52.4 |
| Rimouski, QC | RIMO | -8.4 | 20.8 | 49.9 |
| Baie-Comeau, QC | BAIE | -14.5 | 14.5 | 43.5 |
| Sainte-Anne-des-Monts, QC | ANNE | -2.1 | 25.5 | 53.1 |
| Sept-Îles, QC | SEPT | -19.1 | 8.5 | 36.2 |
| Gaspé, QC | GASx | 10.0 | 38.6 | 67.3 |
| Escuminac, NB | ESCU | 23.9 | 51.1 | 78.3 |
| Shediac, NB | SHE2 | 28.9 | 55.4 | 81.8 |
| Charlottetown, PE | | 29.3 | 55.8 | 82.4 |
| Baddeck, NS | BDCK | 37.8 | 64.4 | 91.1 |
| Truro, NS | WTHL | 34.4 | 60.7 | 87.1 |
| Halifax, NS | HLFX | 32.6 | 59.9 | 87.1 |
| Tusket, NS | TSKT | 32.7 | 59.4 | 86.1 |
| Saint John, NB | SJPA | 26.8 | 53.3 | 79.7 |
| Eastport, ME | EPRT | 23.7 | 50.3 | 76.9 |
| Bar Harbor, ME | BARH | 17.8 | 44.6 | 71.3 |
| Brunswick, ME | BRUx | 16.9 | 44.0 | 71.1 |
| Westford, MA | WES2 | 17.9 | 44.9 | 71.9 |
| Corner Brook, NL | CBRK | 21.4 | 47.0 | 72.7 |
| Whitbourne, NL | WHTB | 23.1 | 51.3 | 79.4 |
| St. Johns, NL | STJO | 22.5 | 49.9 | 77.3 |
| Prince Rupert, BC | BCPR | 22.7 | 40.4 | 58.1 |
| Sandspit, BC | BCSS | 19.1 | 40.5 | 61.8 |
| Bella Bella, BC | BCDI | -1.1 | 19.8 | 40.7 |
| Holberg, BC | HOLB | -3.4 | 15.7 | 34.8 |
| Port Hardy, BC | BCPH | -14.0 | 3.7 | 21.4 |
| Beaver Cove, BC | BCOV | 6.1 | 24.8 | 43.6 |
| Campbell River, BC | QUAD | -9.0 | 11.1 | 31.3 |
| Vancouver, BC | BCVC | 21.7 | 41.9 | 62.0 |
| Surrey, BC | BCSF | 22.6 | 42.7 | 62.7 |
| Langley, BC | BCLC | 27.3 | 47.3 | 67.3 |
| Friday Harbor, WA | SC02 | 19.3 | 39.3 | 59.4 |
| North Saanich, BC | PGC5 | 12.6 | 32.8 | 52.9 |
| Esquimalt, BC | BCES | 19.8 | 39.9 | 60.0 |
| Victoria, BC | ALBH | 14.6 | 34.7 | 54.8 |

| | | | | |
|---|---|---|---|---|
| Seattle, WA | SEAT | 37.9 | 58.1 | 78.2 |
| Robinson Point, WA | RPTx | 35.6 | 55.6 | 75.7 |
| Blyn, WA | BLYN | 26.6 | 47.0 | 67.3 |
| Raymond, WA | P415 | 16.1 | 36.5 | 56.8 |
| Neah Bay, WA | NEAH | 4.5 | 24.4 | 44.4 |
| Port Renfrew, BC | PTRF | -6.9 | 13.8 | 34.5 |
| Bamfield, BC | BAMF | 2.6 | 23.1 | 43.6 |
| Port Alberni, BC | PTAL | -4.9 | 15.2 | 35.4 |
| Ucluelet, BC | UCLU | -0.5 | 20.1 | 40.6 |
| Gold River, BC | GLDR | -0.1 | 20.7 | 41.4 |
| Zeballos, BC | ELIZ | 10.6 | 30.0 | 49.4 |
| Alert, NU | ALRT | -101.4 | -51.2 | -1.0 |
| Baker Lake, NU | BAKE | -91.7 | -68.5 | -45.2 |
| Churchill, MB | CHUR | -89.4 | -68.0 | -46.5 |
| Eureka, NU | EUR2 | -77.7 | -45.7 | -13.7 |
| Goose Bay, NL | GSBY | -32.4 | -5.2 | 22.0 |
| Ulukhaktok, NT | HOLM | -22.0 | -2.6 | 16.9 |
| Igloolik, NU | IGLO | -105.5 | -79.3 | -53.1 |
| Inukjuak, QC | INJK | -92.9 | -71.2 | -49.4 |
| Inuvik, NT | INVK | 16.5 | 38.9 | 61.2 |
| Iqaluit, NU | IQAL | -36.0 | -9.2 | 17.5 |
| Kugluktuk, NU | KUGL | -28.1 | -7.4 | 13.3 |
| Kuujuak, QC | KUJQ | -72.9 | -45.9 | -18.8 |
| Kuujuarapik, QC | KUUJ | -106.8 | -87.1 | -67.5 |
| La Grande 1, QC | LG1G | -110.8 | -90.8 | -70.7 |
| Moosonee, ON | MOSN | -75.2 | -55.2 | -35.1 |
| Nain, NL | NAIN | -34.4 | -6.5 | 21.4 |
| Peawanuck, ON | PEAW | -98.0 | -77.6 | -57.2 |
| Qikiqtarjuaq, NU | QIKI | -51.7 | -13.9 | 23.9 |
| Resolute, NU | RESO | -57.0 | -31.6 | -6.2 |
| Sachs Harbour, NT | SACH | -2.4 | 22.7 | 47.9 |
| Salluit, QC | SALL | -65.7 | -42.0 | -18.2 |
| Tuktoyaktuk, NT | TUKT | 21.7 | 44.1 | 66.4 |

**Table C3.** Sea-level Projections at 2081-2100 Relative to 1986-2005 for RCP 6.0

| Community for which sea-level projections is provided | GPS Station | Sea-level change (5%) (cm) | Sea-level change (median) (cm) | Sea-level change (95%) (cm) |
|---|---|---|---|---|
| Québec City, QC | ATRI | -6.4 | 24.7 | 55.9 |
| La Pocatière, QC | LPOC | -1.9 | 28.0 | 57.8 |
| Rimouski, QC | RIMO | -7.4 | 23.0 | 53.3 |
| Baie-Comeau, QC | BAIE | -14.0 | 16.7 | 47.3 |
| Sainte-Anne-des-Monts, QC | ANNE | -3.4 | 27.3 | 58.0 |
| Sept-Îles, QC | SEPT | -20.1 | 10.7 | 41.5 |
| Gaspé, QC | GASx | 7.6 | 40.5 | 73.3 |
| Escuminac, NB | ESCU | 22.7 | 53.4 | 84.1 |
| Shediac, NB | SHE2 | 27.8 | 57.3 | 86.7 |
| Charlottetown, PE | | 26.2 | 55.3 | 84.5 |
| Baddeck, NS | BDCK | 37.6 | 67.3 | 97.1 |
| Truro, NS | WTHL | 33.8 | 63.1 | 92.4 |
| Halifax, NS | HLFX | 34.2 | 63.8 | 93.3 |
| Tusket, NS | TSKT | 32.6 | 62.0 | 91.4 |
| Saint John, NB | SJPA | 26.4 | 55.6 | 84.8 |
| Eastport, ME | EPRT | 23.2 | 52.7 | 82.2 |
| Bar Harbor, ME | BARH | 17.3 | 47.2 | 77.0 |
| Brunswick, ME | BRUx | 16.5 | 46.9 | 77.4 |
| Westford, MA | WES2 | 17.2 | 47.8 | 78.4 |
| Corner Brook, NL | CBRK | 20.9 | 49.1 | 77.3 |
| Whitbourne, NL | WHTB | 23.4 | 54.0 | 84.6 |
| St. Johns, NL | STJO | 24.0 | 54.9 | 85.8 |
| Prince Rupert, BC | BCPR | 23.6 | 40.9 | 58.2 |
| Sandspit, BC | BCSS | 20.4 | 42.5 | 64.5 |
| Bella Bella, BC | BCDI | -0.2 | 21.5 | 43.2 |
| Holberg, BC | HOLB | -2.5 | 17.0 | 36.6 |
| Port Hardy, BC | BCPH | -13.3 | 4.5 | 22.3 |
| Beaver Cove, BC | BCOV | 6.9 | 26.1 | 45.3 |
| Campbell River, BC | QUAD | -8.1 | 12.8 | 33.7 |
| Vancouver, BC | BCVC | 23.0 | 43.7 | 64.4 |
| Surrey, BC | BCSF | 23.9 | 44.5 | 65.0 |
| Langley, BC | BCLC | 28.6 | 49.1 | 69.6 |
| Friday Harbor, WA | SC02 | 20.5 | 41.2 | 61.8 |
| North Saanich, BC | PGC5 | 13.8 | 34.6 | 55.3 |
| Esquimalt, BC | BCES | 21.0 | 41.7 | 62.4 |
| Victoria, BC | ALBH | 15.8 | 36.5 | 57.2 |

| | | | | |
|---|---|---|---|---|
| Seattle, WA | SEAT | 39.3 | 59.9 | 80.5 |
| Robinson Point, WA | RPTx | 37.0 | 57.5 | 78.0 |
| Blyn, WA | BLYN | 27.9 | 48.8 | 69.6 |
| Raymond, WA | P415 | 17.4 | 38.3 | 59.3 |
| Neah Bay, WA | NEAH | 5.7 | 26.1 | 46.5 |
| Port Renfrew, BC | PTRF | -5.7 | 15.6 | 36.9 |
| Bamfield, BC | BAMF | 3.7 | 24.9 | 46.2 |
| Port Alberni, BC | PTAL | -3.9 | 17.0 | 37.9 |
| Ucluelet, BC | UCLU | 0.6 | 22.0 | 43.3 |
| Gold River, BC | GLDR | 0.8 | 22.5 | 44.2 |
| Zeballos, BC | ELIZ | 11.5 | 31.5 | 51.5 |
| Alert, NU | ALRT | -103.4 | -52.1 | -0.7 |
| Baker Lake, NU | BAKE | -94.5 | -69.8 | -45.0 |
| Churchill, MB | CHUR | -91.8 | -68.3 | -44.9 |
| Eureka, NU | EUR2 | -78.7 | -45.5 | -12.3 |
| Goose Bay, NL | GSBY | -32.8 | -2.5 | 27.7 |
| Ulukhaktok, NT | HOLM | -21.3 | -2.6 | 16.1 |
| Igloolik, NU | IGLO | -105.8 | -79.0 | -52.2 |
| Inukjuak, QC | INJK | -94.4 | -71.7 | -49.0 |
| Inuvik, NT | INVK | 15.7 | 39.7 | 63.7 |
| Iqaluit, NU | IQAL | -36.6 | -7.8 | 20.9 |
| Kugluktuk, NU | KUGL | -27.3 | -6.8 | 13.6 |
| Kuujuak, QC | KUJQ | -73.5 | -43.5 | -13.4 |
| Kuujuarapik, QC | KUUJ | -106.3 | -87.8 | -69.3 |
| La Grande 1, QC | LG1G | -111.7 | -91.5 | -71.3 |
| Moosonee, ON | MOSN | -76.1 | -55.5 | -34.9 |
| Nain, NL | NAIN | -35.2 | -3.7 | 27.9 |
| Peawanuck, ON | PEAW | -99.5 | -78.2 | -56.9 |
| Qikiqtarjuaq, NU | QIKI | -51.3 | -11.5 | 28.2 |
| Resolute, NU | RESO | -56.3 | -32.8 | -9.4 |
| Sachs Harbour, NT | SACH | -3.5 | 24.4 | 52.2 |
| Salluit, QC | SALL | -65.4 | -42.0 | -18.7 |
| Tuktoyaktuk, NT | TUKT | 20.6 | 45.1 | 69.6 |

**Table C4.** Sea-level Projections at 2081-2100 Relative to 1986-2005 for RCP 8.5

| Community for which sea-level projections is provided | GPS Station | Sea-level change (5%) (cm) | Sea-level change (median) (cm) | Sea-level change (95%) (cm) |
|---|---|---|---|---|
| Québec City, QC | ATRI | 6.6 | 39.7 | 72.8 |
| La Pocatière, QC | LPOC | 11.5 | 43.2 | 75.0 |
| Rimouski, QC | RIMO | 3.2 | 37.6 | 71.9 |
| Baie-Comeau, QC | BAIE | -3.0 | 31.2 | 65.4 |
| Sainte-Anne-des-Monts, QC | ANNE | 9.5 | 42.0 | 74.4 |
| Sept-Îles, QC | SEPT | -7.5 | 25.0 | 57.4 |
| Gaspé, QC | GASx | 21.5 | 55.0 | 88.6 |
| Escuminac, NB | ESCU | 35.6 | 67.8 | 99.9 |
| Shediac, NB | SHE2 | 41.4 | 72.4 | 103.5 |
| Charlottetown, PE | | 41.5 | 72.8 | 104.1 |
| Baddeck, NS | BDCK | 50.3 | 81.3 | 112.3 |
| Truro, NS | WTHL | 47.1 | 77.9 | 108.8 |
| Halifax, NS | HLFX | 45.1 | 77.4 | 109.8 |
| Tusket, NS | TSKT | 45.7 | 77.1 | 108.6 |
| Saint John, NB | SJPA | 39.6 | 70.8 | 102.0 |
| Eastport, ME | EPRT | 36.4 | 67.9 | 99.4 |
| Bar Harbor, ME | BARH | 30.6 | 62.3 | 94.1 |
| Brunswick, ME | BRUx | 29.3 | 61.8 | 94.3 |
| Westford, MA | WES2 | 29.6 | 62.3 | 95.1 |
| Corner Brook, NL | CBRK | 34.0 | 63.3 | 92.7 |
| Whitbourne, NL | WHTB | 36.6 | 68.1 | 99.6 |
| St. Johns, NL | STJO | 35.0 | 66.5 | 98.1 |
| Prince Rupert, BC | BCPR | 28.3 | 48.4 | 68.6 |
| Sandspit, BC | BCSS | 24.3 | 50.6 | 76.9 |
| Bella Bella, BC | BCDI | 3.6 | 29.2 | 54.8 |
| Holberg, BC | HOLB | 2.1 | 25.1 | 48.2 |
| Port Hardy, BC | BCPH | -8.3 | 12.4 | 33.1 |
| Beaver Cove, BC | BCOV | 11.5 | 34.2 | 56.8 |
| Campbell River, BC | QUAD | -3.9 | 21.0 | 45.9 |
| Vancouver, BC | BCVC | 26.7 | 51.6 | 76.5 |
| Surrey, BC | BCSF | 27.6 | 52.4 | 77.1 |
| Langley, BC | BCLC | 32.3 | 57.0 | 81.7 |
| Friday Harbor, WA | SC02 | 24.3 | 49.2 | 74.0 |
| North Saanich, BC | PGC5 | 17.7 | 42.6 | 67.6 |
| Esquimalt, BC | BCES | 24.9 | 49.8 | 74.7 |
| Victoria, BC | ALBH | 19.7 | 44.6 | 69.5 |

| | | | | |
|---|---|---|---|---|
| Seattle, WA | SEAT | 43.1 | 67.9 | 92.6 |
| Robinson Point, WA | RPTx | 40.8 | 65.5 | 90.3 |
| Blyn, WA | BLYN | 31.8 | 56.8 | 81.9 |
| Raymond, WA | P415 | 21.3 | 46.5 | 71.7 |
| Neah Bay, WA | NEAH | 9.6 | 34.1 | 58.6 |
| Port Renfrew, BC | PTRF | -1.7 | 23.8 | 49.2 |
| Bamfield, BC | BAMF | 7.2 | 32.8 | 58.3 |
| Port Alberni, BC | PTAL | 0.0 | 25.1 | 50.1 |
| Ucluelet, BC | UCLU | 4.0 | 29.7 | 55.4 |
| Gold River, BC | GLDR | 4.6 | 30.3 | 55.9 |
| Zeballos, BC | ELIZ | 15.7 | 39.4 | 63.1 |
| Alert, NU | ALRT | -146.0 | -66.1 | 13.7 |
| Baker Lake, NU | BAKE | -84.9 | -56.9 | -29.0 |
| Churchill, MB | CHUR | -80.0 | -55.0 | -30.0 |
| Eureka, NU | EUR2 | -91.1 | -45.5 | 0.0 |
| Goose Bay, NL | GSBY | -24.0 | 7.9 | 39.9 |
| Ulukhaktok, NT | HOLM | -15.0 | 9.0 | 33.1 |
| Igloolik, NU | IGLO | -105.1 | -72.9 | -40.8 |
| Inukjuak, QC | INJK | -84.2 | -58.8 | -33.4 |
| Inuvik, NT | INVK | 25.6 | 53.7 | 81.9 |
| Iqaluit, NU | IQAL | -33.7 | -1.0 | 31.8 |
| Kugluktuk, NU | KUGL | -20.9 | 3.7 | 28.2 |
| Kuujuak, QC | KUJQ | -69.4 | -36.2 | -3.0 |
| Kuujuarapik, QC | KUUJ | -96.0 | -72.6 | -49.2 |
| La Grande 1, QC | LG1G | -99.0 | -75.6 | -52.1 |
| Moosonee, ON | MOSN | -63.0 | -39.3 | -15.5 |
| Nain, NL | NAIN | -29.4 | 4.3 | 38.0 |
| Peawanuck, ON | PEAW | -86.9 | -63.0 | -39.1 |
| Qikiqtarjuaq, NU | QIKI | -63.5 | -12.4 | 38.6 |
| Resolute, NU | RESO | -59.3 | -26.0 | 7.2 |
| Sachs Harbour, NT | SACH | 5.8 | 37.0 | 68.2 |
| Salluit, QC | SALL | -62.0 | -32.5 | -3.0 |
| Tuktoyaktuk, NT | TUKT | 30.7 | 59.1 | 87.5 |

**Table C5.** Projected Relative Sea-level Change at 2010 and 2100 for RCP2.6

| | RCP 2.6 Projection at 2010[1] | | | RCP 2.6 Projection at 2100[1] | | |
|---|---|---|---|---|---|---|
| **GPS Station** | **Sea-level change (5%) (cm)** | **Sea-level change (median) (cm)** | **Sea-level change (95%) (cm)** | **Sea-level change (5%) (cm)** | **Sea-level change (median) (cm)** | **Sea-level change (95%) (cm)** |
| ATRI | -6.2 | -0.5 | 5.2 | -16.4 | 14.6 | 45.6 |
| LPOC | -4.6 | -0.1 | 4.5 | -10.5 | 17.1 | 44.7 |
| RIMO | -4.1 | 0.6 | 5.2 | -15.0 | 12.3 | 39.6 |
| BAIE | -5.4 | -0.5 | 4.5 | -21.8 | 5.8 | 33.4 |
| ANNE | -4.7 | 0.8 | 6.3 | -9.6 | 18.4 | 46.3 |
| SEPT | -7.3 | -1.9 | 3.5 | -28.5 | -0.2 | 28.0 |
| GASx | -4.1 | 2.7 | 9.4 | 4.5 | 34.4 | 64.3 |
| ESCU | -1.0 | 4.6 | 10.2 | 18.3 | 47.4 | 76.5 |
| SHE2 | 0.2 | 5.3 | 10.3 | 22.4 | 51.1 | 79.8 |
| CHAR | -0.3 | 5.3 | 11.0 | 23.1 | 50.4 | 77.6 |
| BDCK | 2.0 | 6.6 | 11.2 | 31.8 | 61.9 | 92.0 |
| WTHL | 1.4 | 6.1 | 10.8 | 27.6 | 57.1 | 86.5 |
| HLFX | 1.4 | 6.0 | 10.6 | 27.0 | 57.7 | 88.4 |
| TSKT | 0.9 | 5.5 | 10.1 | 25.6 | 55.4 | 85.3 |
| SJPA | -0.2 | 4.6 | 9.5 | 19.6 | 48.6 | 77.6 |
| EPRT | -0.7 | 4.0 | 8.7 | 16.6 | 44.8 | 73.0 |
| BARH | -2.2 | 3.0 | 8.1 | 9.3 | 38.8 | 68.3 |
| BRUx | -2.9 | 3.1 | 9.2 | 8.6 | 39.8 | 71.1 |
| WES2 | -2.9 | 3.1 | 9.1 | 9.2 | 40.5 | 71.9 |
| CBRK | 0.4 | 4.4 | 8.5 | 13.1 | 42.0 | 71.0 |
| WHTB | 0.1 | 4.6 | 9.1 | 14.6 | 46.9 | 79.1 |
| STJO | 0.1 | 4.4 | 8.8 | 15.4 | 46.3 | 77.1 |
| BCPR | -1.8 | 3.2 | 8.3 | 23.1 | 43.5 | 63.9 |
| BCSS | -1.3 | 2.3 | 5.9 | 19.4 | 42.7 | 65.9 |
| BCDI | -5.2 | -0.9 | 3.5 | -2.9 | 20.3 | 43.6 |
| HOLB | -6.2 | -1.7 | 2.7 | -6.5 | 15.0 | 36.6 |
| BCPH | -8.1 | -3.2 | 1.8 | -19.0 | 1.5 | 22.1 |
| BCOV | -4.7 | -0.2 | 4.4 | 3.7 | 25.1 | 46.5 |
| QUAD | -7.0 | -2.7 | 1.6 | -12.5 | 10.1 | 32.8 |
| BCVC | -2.7 | 2.0 | 6.7 | 21.7 | 44.2 | 66.7 |
| BCSF | -2.6 | 2.2 | 6.9 | 22.7 | 45.1 | 67.5 |
| BCLC | -1.9 | 2.9 | 7.7 | 27.9 | 50.2 | 72.5 |
| SC02 | -3.2 | 1.6 | 6.3 | 18.9 | 41.3 | 63.7 |
| PGC5 | -4.1 | 0.5 | 5.1 | 11.5 | 34.0 | 56.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| BCES | -3.0 | 1.6 | 6.3 | 19.4 | 41.9 | 64.4 |
| ALBH | -3.8 | 0.8 | 5.4 | 13.7 | 36.1 | 58.6 |
| SEAT | -0.5 | 4.5 | 9.4 | 39.5 | 61.9 | 84.4 |
| RPTx | -0.9 | 4.0 | 8.9 | 36.9 | 59.2 | 81.6 |
| BLYN | -2.1 | 2.7 | 7.5 | 27.0 | 49.7 | 72.4 |
| P415 | -3.9 | 0.9 | 5.7 | 15.2 | 37.9 | 60.6 |
| NEAH | -5.2 | -0.6 | 4.0 | 2.6 | 24.8 | 47.1 |
| PTRF | -6.9 | -2.4 | 2.1 | -10.1 | 13.0 | 36.2 |
| BAMF | -4.8 | -0.6 | 3.7 | 0.7 | 23.7 | 46.8 |
| PTAL | -6.4 | -2.1 | 2.3 | -7.9 | 14.7 | 37.3 |
| UCLU | -5.1 | -0.9 | 3.2 | -2.5 | 20.6 | 43.6 |
| GLDR | -5.8 | -1.2 | 3.3 | -2.4 | 20.9 | 44.2 |
| ELIZ | -4.3 | 0.3 | 4.9 | 9.0 | 31.0 | 53.0 |
| ALRT | -11.4 | -8.6 | -5.8 | -95.8 | -52.4 | -9.0 |
| BAKE | -14.4 | -13.0 | -11.7 | -104.8 | -81.4 | -58.1 |
| CHUR | -13.9 | -12.6 | -11.3 | -102.2 | -81.9 | -61.5 |
| EUR2 | -15.3 | -8.6 | -1.9 | -82.7 | -52.9 | -23.1 |
| GSBY | -7.6 | -2.9 | 1.8 | -44.2 | -13.5 | 17.3 |
| HOLM | -8.7 | -3.8 | 1.1 | -29.9 | -8.7 | 12.4 |
| IGLO | -16.1 | -12.9 | -9.7 | -119.4 | -90.7 | -62.0 |
| INJK | -14.6 | -13.2 | -11.8 | -101.3 | -85.5 | -69.7 |
| INVK | -4.0 | 1.4 | 6.8 | 12.3 | 35.8 | 59.2 |
| IQAL | -5.8 | -2.8 | 0.2 | -43.0 | -15.5 | 12.0 |
| KUGL | -9.4 | -4.5 | 0.5 | -36.3 | -13.3 | 9.7 |
| KUJQ | -10.4 | -8.7 | -7.0 | -83.9 | -56.4 | -28.9 |
| KUUJ | -16.7 | -15.4 | -14.1 | -116.3 | -106.5 | -96.7 |
| LG1G | -17.9 | -16.4 | -14.9 | -124.3 | -109.1 | -93.8 |
| MOSN | -12.5 | -10.7 | -8.9 | -87.6 | -69.7 | -51.9 |
| NAIN | -7.3 | -2.6 | 2.1 | -45.6 | -14.4 | 16.9 |
| PEAW | -15.3 | -14.0 | -12.7 | -107.3 | -94.2 | -81.1 |
| QIKI | -7.3 | -2.8 | 1.6 | -58.1 | -19.4 | 19.4 |
| RESO | -12.5 | -6.9 | -1.3 | -63.8 | -39.6 | -15.3 |
| SACH | -6.3 | -1.4 | 3.4 | -8.5 | 18.3 | 45.1 |
| SALL | -9.5 | -7.9 | -6.3 | -70.6 | -53.4 | -36.2 |
| TUKT | -3.3 | 2.1 | 7.6 | 17.9 | 41.4 | 64.9 |

[1]Projections are relative to 1986-2005.

**Table C6.** Projected Relative Sea-level Change at 2010 and 2100 for RCP4.5

| | RCP 4.5 Projection at 2010[1] | | | RCP 4.5 Projection at 2100[1] | | |
|---|---|---|---|---|---|---|
| **GPS Station** | **Sea-level change (5%) (cm)** | **Sea-level change (median) (cm)** | **Sea-level change (95%) (cm)** | **Sea-level change (5%) (cm)** | **Sea-level change (median) (cm)** | **Sea-level change (95%) (cm)** |
| ATRI | -5.9 | -1.1 | 3.6 | -6.6 | 24.9 | 56.4 |
| LPOC | -4.7 | -0.6 | 3.4 | -1.7 | 28.5 | 58.8 |
| RIMO | -4.0 | -2.5 | -0.9 | -8.6 | 23.3 | 55.2 |
| BAIE | -5.2 | -3.5 | -1.8 | -15.2 | 16.5 | 48.3 |
| ANNE | -4.3 | -1.3 | 1.6 | -1.9 | 28.7 | 59.3 |
| SEPT | -6.9 | -4.0 | -1.2 | -20.6 | 10.0 | 40.6 |
| GASx | -3.3 | 0.4 | 4.0 | 13.1 | 44.2 | 75.2 |
| ESCU | -0.6 | 3.1 | 6.8 | 26.0 | 57.1 | 88.1 |
| SHE2 | 0.4 | 4.1 | 7.9 | 31.3 | 61.3 | 91.4 |
| CHAR | 0.2 | 4.5 | 8.7 | 31.7 | 61.9 | 92.1 |
| BDCK | 2.0 | 5.7 | 9.5 | 40.2 | 70.6 | 101.1 |
| WTHL | 1.4 | 5.2 | 8.9 | 36.9 | 67.0 | 97.1 |
| HLFX | 0.8 | 5.0 | 9.1 | 35.0 | 66.9 | 98.7 |
| TSKT | 0.9 | 4.9 | 8.8 | 34.8 | 65.4 | 96.0 |
| SJPA | -0.1 | 3.8 | 7.7 | 28.7 | 58.9 | 89.1 |
| EPRT | -0.7 | 3.3 | 7.3 | 25.4 | 55.7 | 86.0 |
| BARH | -1.8 | 2.4 | 6.6 | 19.2 | 49.5 | 79.7 |
| BRUx | -2.3 | 2.4 | 7.1 | 18.8 | 49.6 | 80.4 |
| WES2 | -1.9 | 2.5 | 7.0 | 19.5 | 50.4 | 81.2 |
| CBRK | 0.2 | 3.8 | 7.3 | 22.6 | 51.6 | 80.6 |
| WHTB | -0.2 | 4.3 | 8.8 | 24.1 | 56.0 | 87.8 |
| STJO | -0.1 | 4.0 | 8.1 | 24.3 | 54.4 | 84.6 |
| BCPR | -2.7 | 1.5 | 5.8 | 25.3 | 46.4 | 67.5 |
| BCSS | -2.7 | 1.2 | 5.2 | 22.0 | 46.9 | 71.8 |
| BCDI | -6.0 | -2.0 | 1.9 | -0.6 | 23.9 | 48.5 |
| HOLB | -6.0 | -2.2 | 1.6 | -3.6 | 19.1 | 41.9 |
| BCPH | -7.0 | -3.7 | -0.3 | -15.7 | 5.7 | 27.2 |
| BCOV | -4.3 | -0.7 | 2.9 | 6.8 | 29.2 | 51.6 |
| QUAD | -7.2 | -3.2 | 0.7 | -9.7 | 14.0 | 37.7 |
| BCVC | -2.7 | 1.4 | 5.6 | 24.4 | 48.1 | 71.7 |
| BCSF | -2.6 | 1.5 | 5.7 | 25.4 | 49.0 | 72.5 |
| BCLC | -1.9 | 2.3 | 6.5 | 30.7 | 54.2 | 77.6 |
| SC02 | -3.2 | 1.0 | 5.2 | 21.8 | 45.3 | 68.8 |
| PGC5 | -4.2 | 0.0 | 4.1 | 14.4 | 38.0 | 61.6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| BCES | -3.0 | 1.1 | 5.3 | 22.3 | 45.9 | 69.4 |
| ALBH | -3.9 | 0.3 | 4.4 | 16.6 | 40.1 | 63.7 |
| SEAT | -0.3 | 3.9 | 8.1 | 42.4 | 66.0 | 89.6 |
| RPTx | -0.7 | 3.5 | 7.7 | 39.8 | 63.3 | 86.8 |
| BLYN | -2.0 | 2.2 | 6.4 | 29.9 | 53.7 | 77.5 |
| P415 | -3.8 | 0.5 | 4.8 | 18.2 | 42.0 | 65.7 |
| NEAH | -5.4 | -1.3 | 2.8 | 5.3 | 28.8 | 52.3 |
| PTRF | -7.1 | -2.9 | 1.2 | -7.2 | 17.0 | 41.2 |
| BAMF | -5.4 | -1.3 | 2.7 | 3.6 | 27.5 | 51.4 |
| PTAL | -6.7 | -2.6 | 1.4 | -5.0 | 18.6 | 42.2 |
| UCLU | -5.8 | -1.8 | 2.2 | 0.3 | 24.2 | 48.2 |
| GLDR | -6.0 | -1.9 | 2.2 | 0.1 | 24.5 | 48.8 |
| ELIZ | -4.0 | -0.1 | 3.8 | 11.7 | 34.7 | 57.8 |
| ALRT | -12.5 | -8.1 | -3.6 | -120.8 | -61.5 | -2.2 |
| BAKE | -14.2 | -12.8 | -11.5 | -99.6 | -75.8 | -52.0 |
| CHUR | -13.8 | -12.5 | -11.2 | -95.0 | -74.8 | -54.6 |
| EUR2 | -13.0 | -8.1 | -3.3 | -89.4 | -52.6 | -15.8 |
| GSBY | -6.8 | -2.9 | 1.0 | -36.1 | -5.9 | 24.3 |
| HOLM | -8.2 | -3.3 | 1.6 | -24.7 | -2.3 | 20.1 |
| IGLO | -16.3 | -12.9 | -9.6 | -117.1 | -87.3 | -57.6 |
| INJK | -14.0 | -12.6 | -11.2 | -96.1 | -78.5 | -60.9 |
| INVK | -5.1 | 1.6 | 8.4 | 15.8 | 42.3 | 68.8 |
| IQAL | -4.7 | -2.5 | -0.3 | -40.2 | -10.6 | 19.0 |
| KUGL | -8.4 | -3.8 | 0.9 | -31.4 | -7.9 | 15.6 |
| KUJQ | -10.3 | -8.5 | -6.8 | -79.7 | -50.9 | -22.1 |
| KUUJ | -16.8 | -15.5 | -14.2 | -112.8 | -96.0 | -79.3 |
| LG1G | -17.4 | -16.0 | -14.6 | -118.1 | -99.7 | -81.4 |
| MOSN | -12.0 | -10.6 | -9.2 | -80.4 | -60.0 | -39.7 |
| NAIN | -5.0 | -2.4 | 0.2 | -38.2 | -7.7 | 22.8 |
| PEAW | -15.2 | -13.9 | -12.6 | -101.8 | -85.2 | -68.7 |
| QIKI | -7.1 | -2.5 | 2.1 | -59.9 | -16.5 | 27.0 |
| RESO | -13.0 | -7.1 | -1.2 | -64.3 | -35.6 | -6.9 |
| SACH | -7.4 | -1.2 | 5.1 | -5.2 | 24.9 | 54.9 |
| SALL | -9.0 | -7.4 | -5.8 | -69.2 | -47.0 | -24.8 |
| TUKT | -4.2 | 2.4 | 9.0 | 21.4 | 48.2 | 75.0 |

[1]Projections are relative to 1986-2005.

**Table C7.** Projected Relative Sea-level Change at 2010 and 2100 for RCP8.5

| | RCP 8.5 Projection at 2010[1] | | | RCP 8.5 Projection at 2100[1] | | |
|---|---|---|---|---|---|---|
| GPS Station | Sea-level change (5%) (cm) | Sea-level change (median) (cm) | Sea-level change (95%) (cm) | Sea-level change (5%) (cm) | Sea-level change (median) (cm) | Sea-level change (95%) (cm) |
| ATRI | -5.3 | 0.2 | 5.8 | 7.2 | 47.3 | 87.4 |
| LPOC | -4.5 | 0.7 | 5.8 | 12.2 | 50.5 | 88.7 |
| RIMO | -4.5 | 0.3 | 5.1 | 5.5 | 44.2 | 82.9 |
| BAIE | -5.4 | -0.6 | 4.3 | -1.6 | 37.4 | 76.5 |
| ANNE | -3.2 | 1.5 | 6.3 | 10.6 | 49.6 | 88.6 |
| SEPT | -6.0 | -1.2 | 3.5 | -8.1 | 30.9 | 70.0 |
| GASx | -1.8 | 3.6 | 9.1 | 24.1 | 65.3 | 106.5 |
| ESCU | 1.2 | 5.6 | 10.0 | 38.9 | 78.8 | 118.6 |
| SHE2 | 1.5 | 6.0 | 10.5 | 45.0 | 83.0 | 121.1 |
| CHAR | 2.2 | 6.6 | 11.1 | 45.8 | 82.6 | 119.4 |
| BDCK | 3.2 | 7.0 | 10.7 | 55.0 | 93.0 | 131.0 |
| WTHL | 2.2 | 6.6 | 10.9 | 51.4 | 89.2 | 127.1 |
| HLFX | 0.8 | 5.6 | 10.4 | 51.0 | 90.3 | 129.6 |
| TSKT | 1.4 | 6.2 | 11.1 | 49.3 | 87.8 | 126.2 |
| SJPA | 0.6 | 5.4 | 10.2 | 42.8 | 81.1 | 119.4 |
| EPRT | -0.3 | 4.7 | 9.7 | 39.4 | 77.8 | 116.1 |
| BARH | -1.3 | 3.8 | 8.9 | 33.1 | 71.8 | 110.5 |
| BRUx | -1.7 | 3.8 | 9.3 | 32.0 | 72.1 | 112.3 |
| WES2 | -2.0 | 3.9 | 9.8 | 31.7 | 72.5 | 113.4 |
| CBRK | 0.1 | 4.4 | 8.8 | 37.5 | 73.1 | 108.7 |
| WHTB | 0.1 | 4.6 | 9.1 | 40.7 | 78.2 | 115.6 |
| STJO | -0.2 | 4.0 | 8.2 | 40.0 | 76.5 | 113.0 |
| BCPR | -3.5 | 0.3 | 4.1 | 33.5 | 57.7 | 81.8 |
| BCSS | -3.0 | 1.6 | 6.1 | 28.1 | 61.1 | 94.0 |
| BCDI | -6.2 | -1.7 | 2.9 | 5.4 | 37.4 | 69.4 |
| HOLB | -7.0 | -2.7 | 1.7 | 3.9 | 32.6 | 61.3 |
| BCPH | -9.3 | -5.0 | -0.8 | -7.2 | 18.0 | 43.3 |
| BCOV | -5.8 | -1.4 | 2.9 | 14.4 | 42.5 | 70.5 |
| QUAD | -7.9 | -3.5 | 0.9 | -2.9 | 28.3 | 59.6 |
| BCVC | -3.4 | 1.3 | 5.9 | 31.1 | 62.4 | 93.7 |
| BCSF | -3.3 | 1.4 | 6.1 | 32.1 | 63.2 | 94.3 |
| BCLC | -2.7 | 2.1 | 6.9 | 37.4 | 68.3 | 99.3 |
| SC02 | -3.8 | 0.9 | 5.6 | 28.5 | 59.6 | 90.8 |
| PGC5 | -4.8 | -0.2 | 4.5 | 21.1 | 52.4 | 83.8 |
| BCES | -3.7 | 1.0 | 5.6 | 29.0 | 60.3 | 91.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| ALBH | -4.5 | 0.2 | 4.8 | 23.3 | 54.6 | 85.9 |
| SEAT | -1.2 | 3.8 | 8.8 | 49.3 | 80.3 | 111.2 |
| RPTx | -1.5 | 3.4 | 8.3 | 46.7 | 77.7 | 108.6 |
| BLYN | -2.7 | 2.1 | 6.8 | 36.8 | 68.1 | 99.4 |
| P415 | -4.5 | 0.4 | 5.4 | 25.1 | 56.7 | 88.2 |
| NEAH | -6.1 | -1.5 | 3.0 | 12.2 | 42.9 | 73.6 |
| PTRF | -7.7 | -3.2 | 1.4 | -0.3 | 31.5 | 63.4 |
| BAMF | -6.2 | -1.8 | 2.6 | 9.4 | 41.7 | 73.9 |
| PTAL | -7.4 | -2.9 | 1.5 | 1.5 | 33.0 | 64.5 |
| UCLU | -6.6 | -2.3 | 2.1 | 5.8 | 38.3 | 70.8 |
| GLDR | -6.5 | -1.9 | 2.7 | 6.6 | 38.7 | 70.9 |
| ELIZ | -4.9 | -0.5 | 3.9 | 18.9 | 48.6 | 78.3 |
| ALRT | -15.1 | -8.8 | -2.5 | -185.7 | -84.1 | 17.5 |
| BAKE | -16.2 | -12.5 | -8.9 | -96.6 | -61.2 | -25.7 |
| CHUR | -14.5 | -11.9 | -9.2 | -92.4 | -58.8 | -25.2 |
| EUR2 | -13.4 | -8.0 | -2.6 | -109.9 | -52.9 | 4.0 |
| GSBY | -7.4 | -2.9 | 1.5 | -27.6 | 10.9 | 49.4 |
| HOLM | -11.4 | -4.6 | 2.3 | -18.3 | 11.3 | 41.0 |
| IGLO | -15.6 | -12.8 | -10.0 | -122.6 | -81.1 | -39.7 |
| INJK | -13.5 | -12.1 | -10.7 | -101.5 | -63.6 | -25.6 |
| INVK | -5.3 | 0.9 | 7.2 | 27.6 | 61.9 | 96.2 |
| IQAL | -5.0 | -2.4 | 0.1 | -43.1 | -1.3 | 40.5 |
| KUGL | -12.3 | -5.1 | 2.1 | -25.0 | 5.2 | 35.4 |
| KUJQ | -10.2 | -8.5 | -6.8 | -83.0 | -39.1 | 4.9 |
| KUUJ | -16.5 | -14.4 | -12.4 | -110.5 | -77.5 | -44.5 |
| LG1G | -17.5 | -15.5 | -13.4 | -114.3 | -81.2 | -48.1 |
| MOSN | -12.9 | -9.9 | -6.9 | -72.7 | -40.8 | -9.0 |
| NAIN | -6.8 | -2.6 | 1.5 | -36.7 | 5.6 | 48.0 |
| PEAW | -14.8 | -13.4 | -12.1 | -102.9 | -67.8 | -32.8 |
| QIKI | -7.4 | -3.1 | 1.2 | -80.7 | -17.1 | 46.5 |
| RESO | -10.4 | -5.3 | -0.2 | -72.8 | -30.6 | 11.6 |
| SACH | -7.2 | -1.0 | 5.2 | 5.0 | 42.7 | 80.5 |
| SALL | -8.7 | -7.1 | -5.5 | -75.9 | -36.2 | 3.6 |
| TUKT | -4.2 | 1.7 | 7.7 | 33.2 | 67.9 | 102.5 |

[1]Projections are relative to 1986-2005.