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Validation of a High Resolution Modelling System for Tides in the Canadian Arctic Archipelago

by

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Abstract

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The tidal prediction system for the Canadian Arctic Archipelago developed by Dunphy et al. (2005) and Hannah et al. (2008) has been improved. The improvements include extension of the mesh south to include Frobisher Bay and southern Baffin Island, increased resolution in narrow channels such as Hell Gate, Cardigan Channel, and Penny Strait, and inclusion of the very narrow Bellot Strait. A detailed comparison with Hannah et al. (2008) shows that Baffin Bay is the most-improved region, and M2 is the most-improved constituent: the average *rms* error over all constituents is reduced by 3 cm, while the average *rms* error for M2 across all regions is reduced by 2 cm. Averaged over the entire model domain the *rms* error of the tidal constituents is about 17 cm for M2 and about (4, 7, 6, 3) cm for (N2, S2, K1, O1). The large M2 error is dominated by the errors in Frobisher Bay, where the M2 tidal amplitude is very large.

Résumé

Collins, A. K., C. G. Hannah, D. Greenberg. 2011. Validation of a High Resolution Modelling System for Tides in the Canadian Arctic Archipelago. Can. Tech. Rep. Hydrogr. Ocean Sci. **273**: vi + 72 pp.

Le système de prédiction des marées pour l'archipel arctique canadien développé par Dunphy et al. (2005), et Hannah et al. (2008) a été amélioré. Les améliorations portent sur l'extension de la grille du modèle vers le sud incluant ainsi la baie de Frosbisher et le sud de l'île Baffin, une résolution plus fine pour les canaux étroits comme la porte Hell, le canal Cardigan et le détroit Penny, et enfin linclusion du très étroit détroit Bellot. Une comparaison détaillée avec les travaux d'Hannah et al. (2008) montre que la baie de Baffin est la région qui bénéficie des plus grandes améliorations, et où la constituante de la marée M2 est la mieux résolue. En effet l'erreur *rms* moyenne des toutes les constituantes de la marée est réduite d'environ 3 cm, alors que l'erreur *rms* moyenne de la constituante M2 seule dans toutes les régions est réduite d'environ 2 cm. L'erreur *rms* des constituantes de la marée moyennée sur la totalité du domaine modélisé est d'environ 17 cm pour M2, et d'environ 4 cm, 7 cm, 6 cm et 3 cm pour les constituantes N2, S2, K1 et O1, respectivement. L'erreur *rms* importante de la constituante M2 est expliquée par les erreurs significatives modélisées dans la baie de Frosbisher, où l'amplitude de la marée de la constituante M2 est très importante.

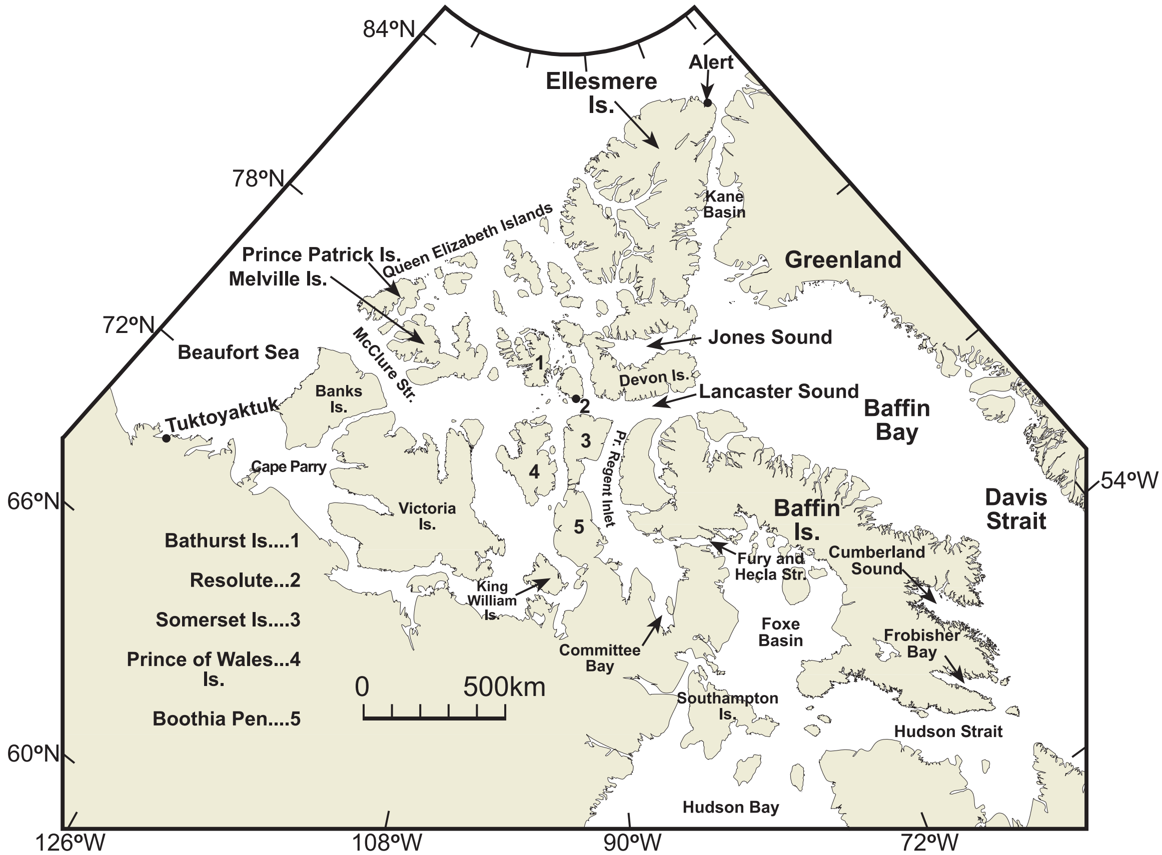


Figure 1: The Arctic Archipelago.

1 Introduction

A tidal prediction system for the five major constituents (M2, N2, S2, K1, O1) has been developed for the Canadian Arctic Archipelago (CAA) and Baffin Bay (Figure 1 and 2). The goals of this study were to improve modelled currents in areas with strong currents, and to add critical inlets and passages that were omitted in previous studies (Hannah et al. (2008) and Dunphy et al. (2005)).

To achieve these goals the model mesh was extended to the south to include Frobisher Bay and southern Baffin Island, the model resolution was increased in narrow channels such as Hell Gate, Cardigan Channel, and Penny Strait, and the mesh was modified to include Bellot Strait, a narrow channel in the central Archipelago. In addition a new numerical model was adopted.

The model used is the Toulouse Unstructured Grid Ocean Model (Pairaud et al., 2008), or T-UGOm, a successor to MOG2D. A key feature of T-UGOm is automatic time step refinement in areas of high resolution, which allows one to use especially high resolution in regions of particular interest. For example, the very narrow Bellot Strait (order 1 km wide) requires a grid spacing of at least 500 m and a correspondingly small time step. The automatic time step refinement makes it possible to include Bellot Strait without making the model simulations prohibitively expensive.

The model solutions were subject to an extensive comparison with archived tide gauge

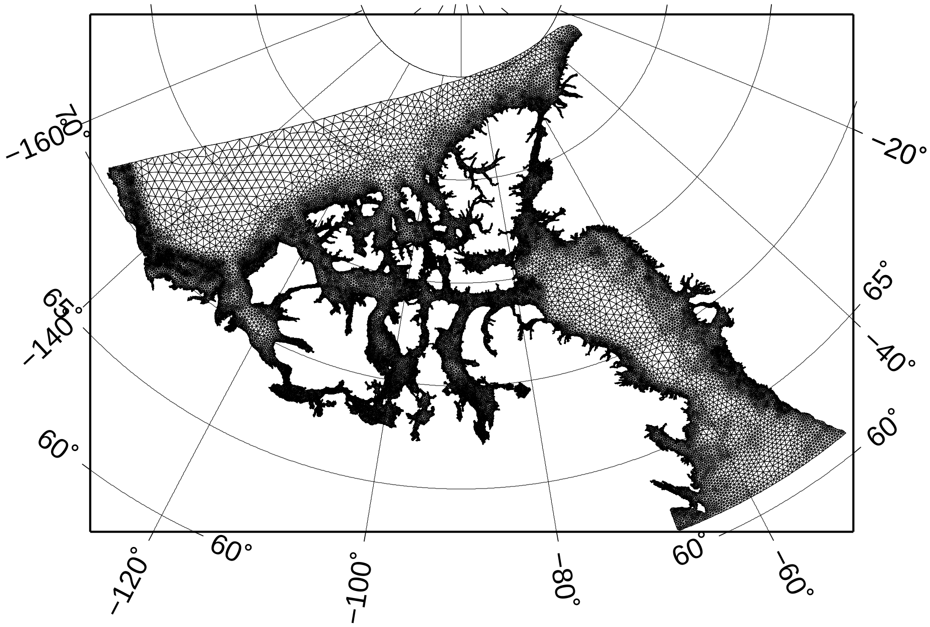


Figure 2: The mesh used for the Canadian Arctic Archipelago tidal model. It contains 48615 nodes and 81698 elements. The model has three open boundaries: Arctic, Northern Labrador Sea, and Fury and Hecla Strait (southwest of 65N, 80W).

data following the methods established in Dunphy et al. (2005) and Hannah et al. (2008). As a basic error analysis, for each constituent the model-data misfit for 109 coastal tide gauge stations and offshore pressure gauges is reported; eight of these stations are new additions to the dataset to cover the expanded domain. The differences between tidal predictions made using the modelled tides and the observed constituents are used to evaluate the magnitude of the errors related to tidal prediction. Finally the model currents are evaluated against observations in the central CAA. Thirteen additional current meters are added to the comparison in this study.

In addition to a complete error analysis and comparison with observations, the region-by-region error analysis is presented for four different versions of friction due to sea ice before the optimal case is chosen and justified. The primary improvements of this study compared to Hannah et al. (2008) are the reduction of errors in the Baffin Bay region and in most regions for the M2 constituents.

The report consists of a description of the modelling system and error metrics in Section 2. The data sets are surveyed in Section 3, tidal elevation and current results are presented and evaluated in Sections 4 and 5, respectively, and Section 6 contains conclusions.

2 Methods

This modelling effort was undertaken to improve the Hannah et al. (2008) solutions by improving the resolution of narrow passageways such as Hell Gate (the channel at the eastern end of Jones Sound) and Fury and Hecla Strait, and expanding the model domain to include Frobisher Bay and Bellot Strait (the narrow channel separating Somerset Island from the Boothia Peninsula). The southern boundary of the domain used by Dunphy et al. (2005) and Hannah et al. (2008) lays just north of Frobisher Bay, excluding it, while Bellot Strait was not resolved in earlier meshes due to model constraints. The strategy for accomplishing these goals was to adopt a new model. The Toulouse Unstructured Grid Ocean Model (T-UGOm) was used because the adaptive time stepping capability allowed for much finer grid resolution in key areas without an enormous increase in computation time.

2.1 The Toulouse Unstructured Grid Model

T-UGOm (Pairaud et al., 2008) is a finite element model derived from MOG2D (Carrère and Lyard, 2003) and developed to extend model resolution range at a reasonable computational cost. The main advantages offered by the unstructured mesh are accurate representation of complex coastlines and bathymetry, and a variable resolution grid.

T-UGOm is being actively developed. Its planned capabilities include multiple modes of computation, from 2D barotropic to full nonlinear 3D baroclinic with different triangular grid structures and vertical representations. In additional to the flexible grid structure of triangular models, T-UGOm employs automatic splitting (reduction) of time steps in local areas where stability measures indicate it is warranted.

In this study the model is run in 2D barotropic shallow-water mode, solving the generalized wave equation with a finite-element discretization. It is used with P1-P1 nodal structure (velocities and elevations are coincident on the vertices of the triangular elements). The conservative horizontal momentum equations are finite-element and the vertical momentum equations are finite-difference (Lyard et al., 2006). The model is forced at the lateral boundaries by specified tidal elevations and the friction includes the effects of both bottom drag and surface drag due to sea ice (Section 2.3).

2.2 The mesh

The mesh is a finite element mesh of triangles with 46815 nodes and 81698 elements (Figure 2), almost three times the number of nodes used in Hannah et al. (2008). The mesh has high resolution near the coast (less than 1 km), and lower resolution in the open ocean (40 km). The coastline has been resolved carefully, such that only the narrowest fjords are not resolved. There are twice as many nodes across Fury and Hecla Strait and Hell Gate as in Hannah et al. (2008), and Bellot Strait has been added with 0.5 km resolution. The mesh was extended at the southern boundary from 63.5N to 61N, and now includes Frobisher Bay.

Digital bathymetry data were obtained from the Canadian Hydrographic Service (CHS; Herman Varma, personal communication) and cross-referenced to available CHS charts. The digital data included multibeam from ships, the International Bathymetric Chart of the Arctic Ocean (IBCAO), and CHS digitized field sheets.

2.3 Model configuration

Open Boundary Conditions

The model is forced by elevations along the open boundaries, which are compiled from a combination of the FES2004 global solutions (Lyard et al., 2006) and the boundary conditions from Dunphy et al. (2005) which were computed by assimilating tide gauge data with the model interior. The final set of elevation boundary conditions used for this study were selected based on a series of trials using different combinations of these sources. The final selection was based on the error analysis done for each trial. The first trial used exclusively global solutions at all three of the open boundaries (Arctic, Northern Labrador Sea, and Fury and Hecla Strait, see Figures 1 and 2) for all five tidal constituents. Results from this trial were poor in the south, so in a second trial the boundary elevations at Fury and Hecla Strait were replaced with the smoothed versions of the elevations and phases from Dunphy et al. (2005). In a third trial, M2 elevations were increased by 2 cm at the Northern Labrador Sea boundary. In a fourth trial, O1 and K1 at Northern Labrador Sea were replaced with values from Dupont et al. (2002), while the semi-diurnal constituents were left as global solutions. The final set of boundaries is as follows:

- Arctic boundary: all constituents = solutions from FES2004;
- Fury and Hecla Strait boundary: all constituents = smoothed version of Dunphy et al. (2005) solutions;
- Northern Labrador Sea boundary: M2 = FES2004 + 2 cm elevation, N2 and S2 = FES2004, O1 and K1 = Dupont et al. (2002).

Friction

Following Dupont et al. (2002) and Dunphy et al. (2005) we combine the bottom drag and the surface drag due to sea ice into a single friction parameter. This is possible because we are using TUGOm as a 2D model and the bottom and surface friction enter the equations as a single parameter. The surface drag is parameterized based on observed sea ice concentration fields.

The spatially variable quadratic friction coefficient (C_D) is based on the sum of the fractional sea ice coverage (C_{Dsurf}) and the constant bottom friction coefficient (C_{Dbot}):

$$C_D = C_{Dbot} + C_{Dsurf}. \tag{1}$$

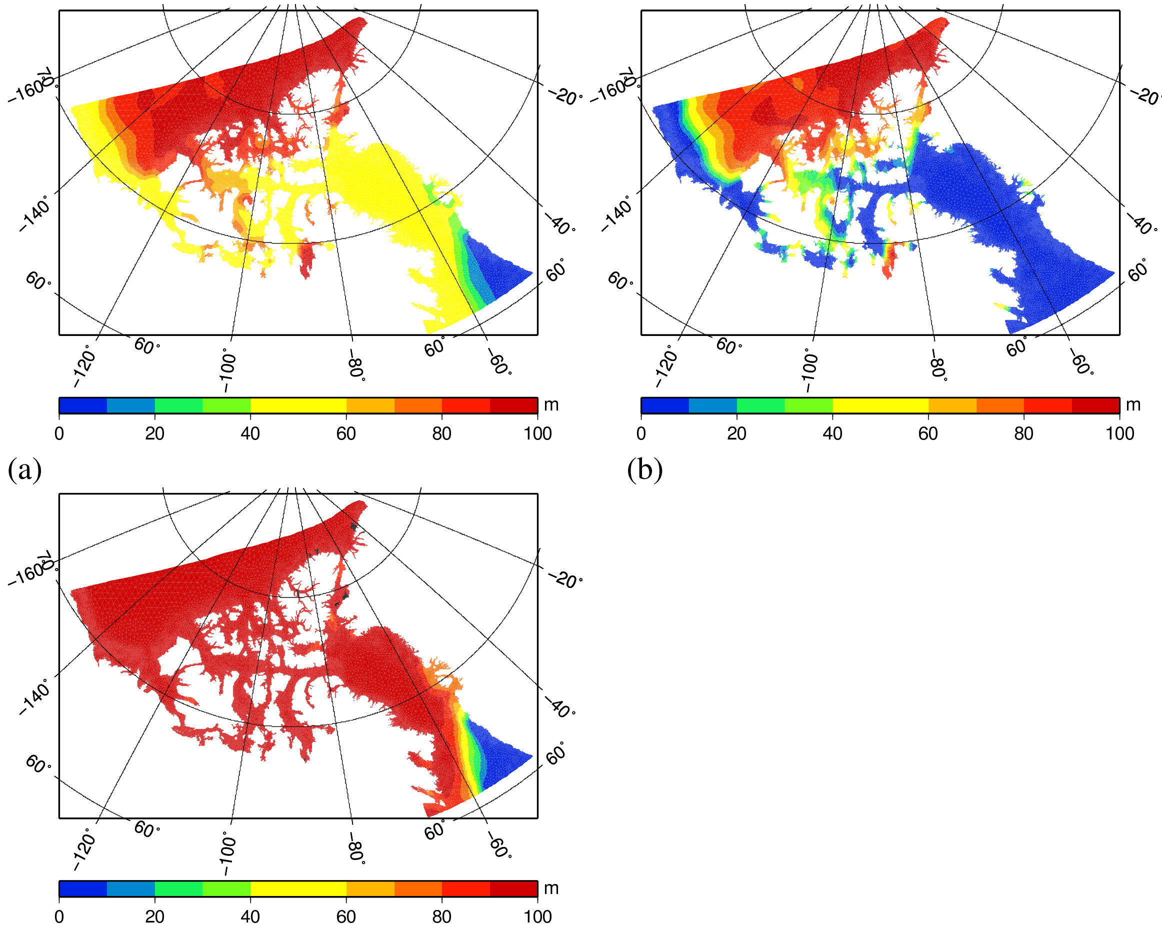
where, $C_{Dbot} = 2.5 \times 10^{-3}$ following Dupont et al. (2002) and Dunphy et al. (2005), and C_{Dsurf} is computed as

$$C_{Dsurf} = C_{Dice} \max(0, 2(A - 1/2)) \tag{2}$$

where $C_{Dice} = 1.8 \times 10^{-2}$ (Tang and Fissel, 1991) and A is the fractional sea ice coverage at the node of interest. C_{Dsurf} is zero for $A < 1/2$ and ramps linearly to its maximum value at $A = 1$.

In this report four scenarios with different surface friction and ice cover combinations are presented. C_{Dbot} remains constant at 2.5×10^{-3} for all four cases. The scenarios are as follows:

1. Base: Ice cover, A, is the mean of September and January (Figure 3a), and surface friction, C_{Dsurf}, is defined by Eq. 2. The total friction coefficient for this scenario is shown in Figure 4a.



(a) (b) (c)

Figure 3: Fractional ice coverage field for (a) average of September 1989 and January 1990, (b) September 1989, (c) January 1990.

2. Ice friction halved: C_{Dsurf} is one half of the values defined in the Base scenario. The total friction coefficient for this scenario is shown in Figure 4b.

3. September ice: C_{Dsurf} is computed following Eq. 2 where A, the ice cover field, is defined by September 1989 data (Figure 3b).

4. January ice: C_{Dsurf} is computed following Eq. 2 where A, the ice cover field, is defined by January 1990 data (Figure 3c).

In Section 4 a region-by-region error analysis for these four cases is presented and the best one is chosen as the final case, for which the full error analysis is presented.

Time Step

The model was ramped up for two days, then run for 29 days with a timestep of 124.21 seconds and a subtimestep of 13.80 seconds.

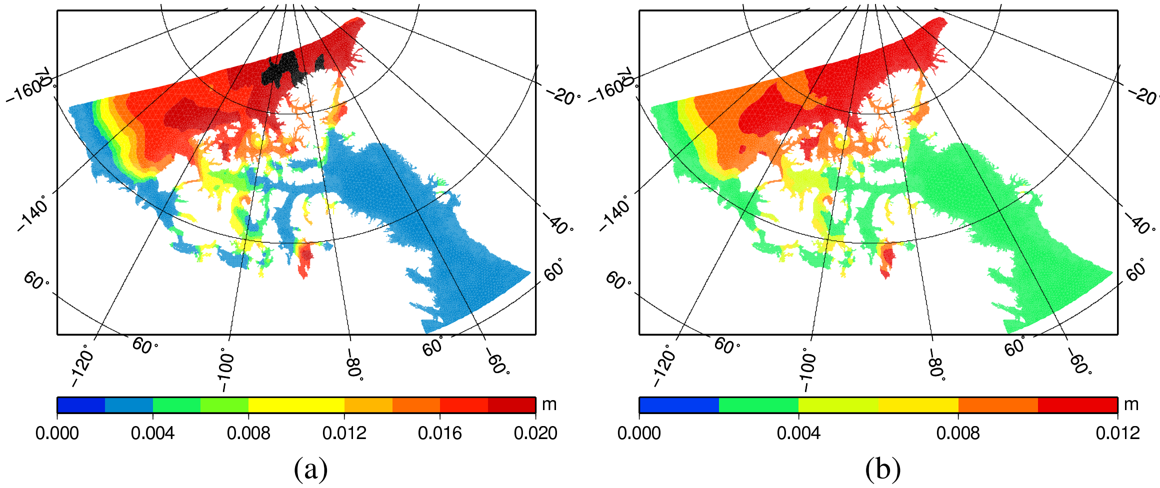


Figure 4: (a) Coefficient of friction due to bottom and ice friction (b) Coefficient of friction due to bottom and ice friction with ice friction divided by 2. Note different scales.

2.4 Error metrics

The model-data comparison described in this section follows the methods of Hannah et al. (2008) closely.

There are large variations in the amplitudes and phases of the tides in the Archipelago. For example, the M2 ranges from a few centimeters in the west along the Arctic shelf to over 1 m in the eastern areas, and up to 3 m in Frobisher Bay. Since error statistics in areas of large tides are not likely relevant in areas of small tides, the Archipelago was divided into eight regions (Table 1, Figure 5) for the purpose of reporting statistics. The eighth region is new for this study, and covers Frobisher Bay and the SW Baffin Island. A few of the tide gauges have been redistributed among the regions in order to better represent tidal dynamics in each region. The map of the old regions is presented for comparison purposes (Figure 5a). Four stations from Arctic North have been shifted to the Baffin Bay region, and two stations have been moved from Arctic Southeast to Baffin Bay. These changes reflect the M2 tidal amplitudes, which match the range of Baffin Bay more closely. The distribution of tide gauge stations within regions are shown in more detail in Appendix B (Figures 19-26).

The first error metric was designed to measure how well each constituent was modelled. At each station (for each constituent) the error is defined as the magnitude of the observed constituent minus the modelled constituent evaluated in the complex plane:

$$\text{Error1} = |A_o e^{\phi_o} - A_m e^{\phi_m}| \tag{3}$$

where A_o, ϕ_o are the observed amplitude and phase and A_m, ϕ_m are the modelled values. This combines both amplitude and phase error into a single error measure. To evaluate the solutions for one constituent over broader areas the root-mean-square (*rms*) values over multiple stations were calculated. A normalized version of this error was calculated by dividing by the observed amplitude ($\text{Error1}/A_o$). Regional averages (*rms*) of this normalized error were also calculated.

The second error metric was designed to measure the quality of tidal predictions made using the tidal solutions. At each station, tidal predictions for one year were made using

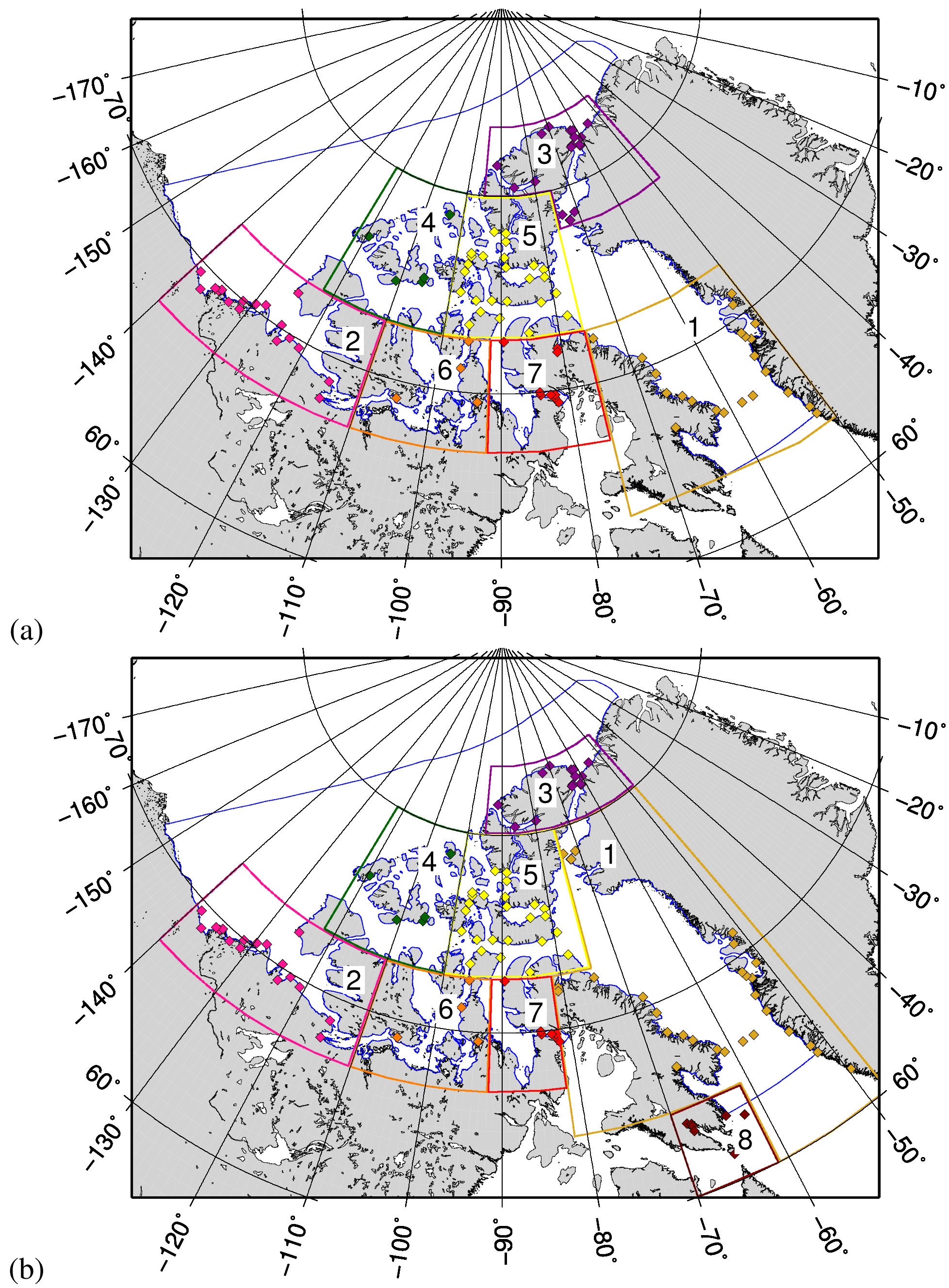


Figure 5: Maps of the Arctic Archipelago showing the locations of the model boundaries (blue lines) and the tide/pressure gauge distribution (diamonds). The boxes labelled 1-7 in panel (a) and 1-8 in panel (b) are subregions for which statistics are calculated for the old mesh and new mesh, respectively. The subregion names are given in Table 1.

Number	Region
1	Baffin Bay
2	Arctic West : Amundsen Gulf and Victoria Island
3	Arctic North : Ellesmere Island and Nares Strait
4	Arctic Northwest : Prince Patrick Island, Melville Island and Amund Ringnes Island
5	Arctic Central : Barrow Strait, Lancaster Sound and Jones Sound
6	Arctic South Central : M'Clintock Channel and Somerset Island
7	Arctic Southeast : Baffin Island North
8	Frobisher Bay

Table 1: The names of the regions in Figure 5 used to provide summary statistics

the observed and modelled constituents. The prediction error was defined as

$$\text{Error2} = rms(T_{obs} - T_{mod}) \tag{4}$$

where T_{obs} and T_{mod} were the elevation time series constructed from the observed and modelled constituents. A relative error was also computed where the prediction error was scaled by the size of the observed time series:

$$\text{Relative Error2} = \frac{rms(T_{obs} - T_{mod})}{rms(T_{obs})} \tag{5}$$

The tidal synthesis was done using `T_PREDIC` which is part of the `T_TIDE` package (Pawlowicz et al., 2002).

The prediction error comparison was done for three cases. In the first, called 5 *vs.* 5, the tidal synthesis for both the observed and modelled tides was done using the five tidal constituents (M2,N2,S2,K1,O1). In the second, called 5 *vs. all*, the observed time series was constructed using all the available constituents. The first is a measure of how well the five constituents were modelled, the second is a measure of the expected error relative to the complete tidal spectrum. The third case, 5 *vs. signal*, was applied to data that was available as a water level time series. In this case, a time series was constructed from the model solution using `T_PREDIC` of the same duration and start date as the observed time series. The prediction error metric (4) was then applied using the constructed time series and the observed signal (with the mean removed). Thus 5 *vs. signal* measures how large the error is between the modelled and measured water levels.

3 Data Sources

CHS tide gauge data

Tidal constituents were extracted from the Canadian Hydrographic Service 'Blue Book' database maintained by Integrated Science Data Management (ISDM, Ottawa, Canada: `http://www.meds-sdmm.dfo-mpo.gc.ca/isdm-gdsi/index-eng.html`). A subset from this database consisting of 153 stations located in the Arctic Archipelago

Station Name	Station ID	Date	Duration
Barrow Strait (1)	B1489	Aug 2003- Aug 2004	358 days
Barrow Strait (2)	B1491	Aug 2003- Aug 2004	359 days
Resolute	B1492	Aug 2003- Jul 2004	353 days
Alert	M3765	Dec 2002- Jul 2004	589 days
Holman	M6380	Dec 2003- Jul 2004	589 days
Tuktoyaktuk	M6485	Aug 2003- Jul 2004	341 days

Table 2: Additional tide/pressure gauge data used for model validation.

and surrounding area were selected as potential candidates. This list was examined for stations that were located within the model domain and with records 29 days and longer, such that the five main constituents would be resolved. Most stations in unresolved inlets and fjords were removed. These criteria resulted in 96 acceptable stations, seven more than were used in Hannah et al. (2008).

The locations of the tide gauges can be found using the tables in Appendix A to identify the station ID as an index to the maps in Appendix B.

Stations 01430, 01465, 01485, 02490, 02410, and 02518 (Table 13) were potential candidates to be included in this modelling study, but they were rejected based on inconsistent data. There is a relatively high tide gauge density in the Baffin Bay region, and so the M2 tidal amplitudes are well-known in that region. The aforementioned gauges were inconsistent with the expected tidal amplitudes and therefore were rejected.

Greenland tide gauge data

The Greenland tide gauge data were extracted from the Danish tidal office report (Farvandsvæsenet, 2000). There were 24 stations in this set, with unknown record lengths and no data for the N2 constituent (which suggests that the record lengths were short). After eliminating stations outside the mesh and one that was duplicated in the CHS database, this set was reduced to 13 acceptable stations, one more than was used in Hannah et al. (2008).

Additional tide and pressure gauge data

Tide and pressure gauge data were obtained from recent field programs (Table 2). From ISDM we obtained data from Alert, Holman and Tuktoyaktuk, three of the ‘Arctic Tide Gauges’ (H. Melling (IOS), S. Prinsenberg (BIO), R. Solvison (CHS, Central and Arctic)). From Hamilton et al. (2008) we obtained pressure gauge data at two locations in Barrow Strait and one near Resolute (Table 2) from ongoing PERD and NOAA funded programs. The tidal constituents were calculated from the time series using `T_TIDE` (Pawlowicz et al., 2002) to resolve the five main constituents. It is worth noting that the record length for these stations is considerably longer than most of the CHS records. The locations of the measurements can be found using the Station IDs from Table 2 and the maps in Appendix B.

Mooring Description	Longitude	Latitude	Duration
South side shallow (SP1)	-91.0502	74.0834	349 days
South side deep (SP2)	-91.0329	74.0818	349 days
South-Central Strait (SP3)	-90.8511	74.1955	349 days
Central Barrow Strait (SP4)	-90.7210	74.3205	348 days
North Barrow Strait (SP5)	-90.4249	74.5366	349 days
Lancaster Sound East (JS1)	-81.1667	74.0917	62 days
Lancaster Sound West (JS2)	-82.2167	74.1233	62 days
Wellington Channel East (JS3)	-93.0083	75.2650	79 days
Wellington Channel West (JS4)	-92.8500	75.2633	96 days
Peel Sound West (JS5)	-96.0000	73.6933	32 days
Peel Sound East (JS6)	-96.6167	73.6933	29 days
Penny Strait East (JS7)	-96.9000	76.6333	>365 days
Penny Strait West (JS8)	-97.4167	76.6000	>365 days
Danish Strait (JS9)	-100.7670	77.8333	30 days
Austin Channel (JS10)	-102.6330	75.3833	>365 days
Hellgate and Cardigan Strait (HM1)	-90.4700	76.5300	>365 days
Hellgate and Cardigan Strait (HM2)	-89.7600	76.5700	>365 days
Hellgate and Cardigan Strait (HM3)	-90.3800	76.5400	>365 days

Table 3: ADCP and current meter data collected in the Central Arctic.

Central Arctic current meter data

For evaluation of the tidal currents in the Central Arctic Archipelago, ADCP data were obtained for the Barrow Strait section from Pettipas et al. (2006) and for Hell Gate and Cardigan Strait from Humfrey Melling (IOS, pers. comm., 2006). Current meter data for other locations in the Central Archipelago was obtained from Stronach et al. (1987).

The station IDs in Table 3 can be used to find the station locations in Figure 16. The time series were vertically averaged and then analyzed with `T_TIDE` (Pawlowicz et al., 2002) for comparison with the model.

4 Results

Regional summaries of Error 1 for four different versions of the friction due to the sea ice coverage are presented in Figures 6 and 7. The figures show *rms* errors for each constituent and region, with Frobisher Bay results presented separately (Figure 8) due to the large tidal amplitude in that region. The four scenarios are defined in Section 2.

Reducing the surface friction drag coefficient has only a small effect on the errors (Figures 6, 7, 8), with largest error differences being ∼25% in M2 at the North and South Central regions. Using summer ice cover also had only minor impact on most errors relative to the "Base" error; the largest change was a (∼40%) increase in the M2 error in the South Central region. Running the model with winter ice cover did not consistently increase or

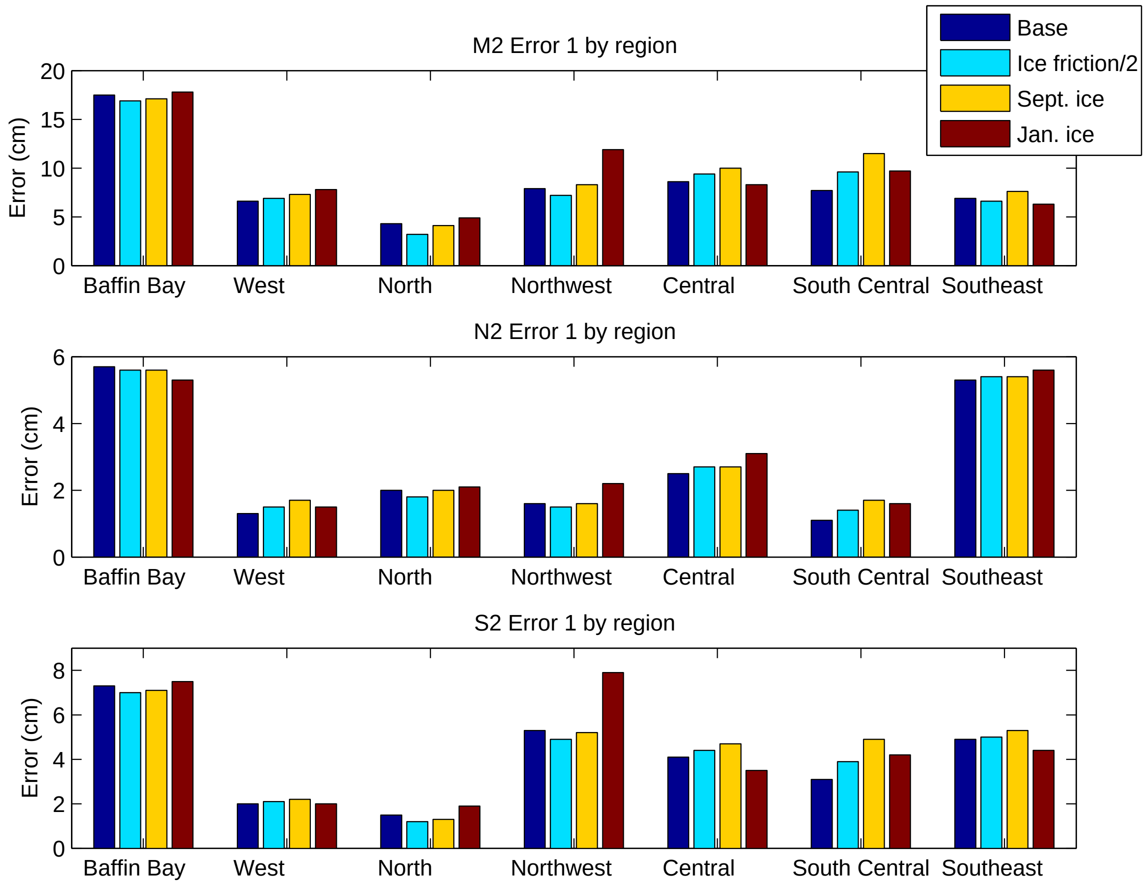


Figure 6: M2, N2, and S2 rms errors for Regions 1-7 for the four friction cases.

decrease error, but there were a few instances when the winter ice error was much higher than the other errors, most notably in the Arctic Southeast region for the K1 and O1 constituents. We note that the large diurnal tides in Boothia Bay (to the east of the Boothia Peninsula) in the Arctic Southeast region suggest that the system is nearly resonant and therefore likely very sensitive to small changes in friction and ice cover. If this is correct then there should be substantial differences between the summer and winter tides. A closer examination of the tide gauge records for the region reveal that most are less than 32 days long, and although no date is given for the observations, one can assume that such a short record would have been obtained during the ice-free conditions of summer. Therefore, for this report we assume that the large errors produced by the January ice scenario do not represent poor model performance, but rather represent important seasonal changes that are not represented by the observations. Further work is required to obtain a better understanding of the tides in Arctic Southeast region.

Since there are no consistent improvements to the Base case in any of the three alternative friction cases, we choose to use the Base case as the model configuration. The rest of the results presented in this report are for the Base friction case.

The amplitude and phase errors and the combined error metric (3) are tabulated for each constituent for each station in Appendix B. The tables are organized by region. Regional averages for amplitude, error, and relative error are reported in the tables; however, given the large variability in tidal phase in each of the regions, it does not make sense to

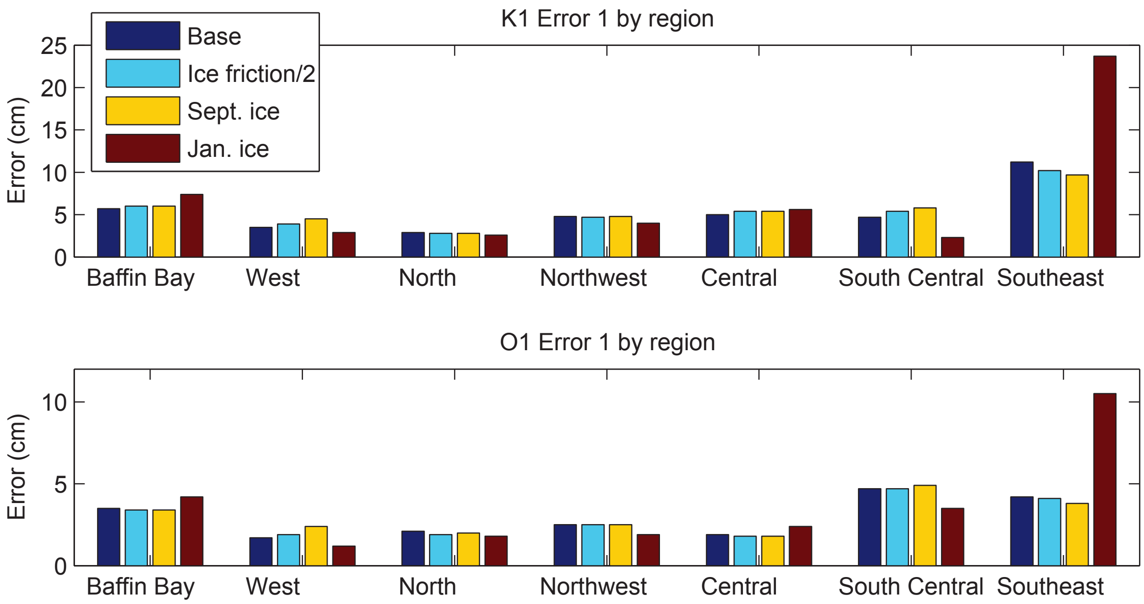


Figure 7: O1 and K1 rms errors for Regions 1-7 for the four friction cases.

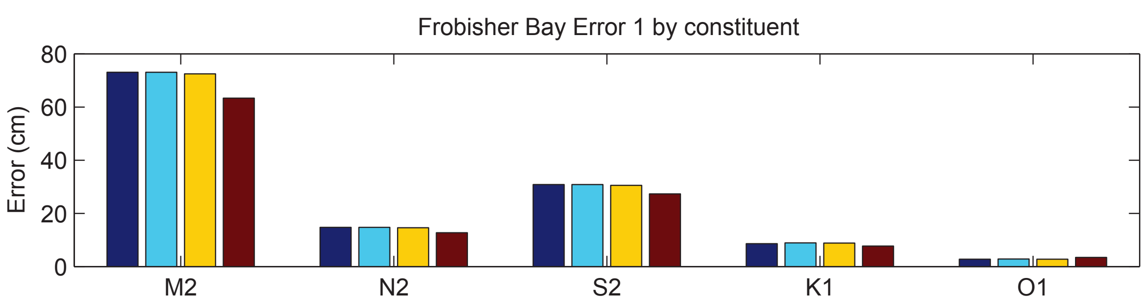


Figure 8: Frobisher Bay rms errors by constituent for the four friction cases. The legend is the same as for Figure 7.

Region	M2 (cm)	N2 (cm)	S2 (cm)	K1 (cm)	O1 (cm)
Baffin Bay	17.5	5.7	7.3	5.7	3.5
Arctic West	6.6	1.3	2.0	3.5	1.7
Arctic North	4.3	2.0	1.4	2.9	2.1
Arctic Northwest	8.2	1.6	5.4	4.8	2.5
Arctic Central	8.7	2.6	4.2	5.0	1.9
Arctic South Central	8.0	1.1	3.1	4.7	4.7
Arctic Southeast	6.6	5.3	4.9	11.2	4.2
Frobisher Bay	73.2	14.7	30.8	8.6	2.7

Table 4: Regional comparison of errors, as defined by Error 1 (Equation 3), for each constituent. The regions are defined in Table 1 and Figure 5b.

Region	M2 (cm)	N2 (cm)	S2 (cm)	K1 (cm)	O1 (cm)
Baffin Bay	12.9	4.6	6.0	6.2	3.7
Arctic West	6.6	1.3	2.0	3.5	1.7
Arctic North	16.8	4.4	6.4	3.4	2.2
Arctic Northwest	8.2	1.6	5.4	4.8	2.5
Arctic Central	8.7	2.6	4.2	5.0	1.9
Arctic South Central	8.0	1.1	3.1	4.7	4.7
Arctic Southeast	6.3	5.0	4.7	9.9	4.0

Table 5: Regional comparison using Error 1 for each constituent using Hannah et al. (2008) regions. The regions are defined in Figure 5a.

compute regional averages for phase.

The regional summaries of the error metric are presented in Table 4. Frobisher Bay has the largest errors and the largest amplitude tide. The M2 tide in Frobisher Bay exceeds 300 cm, so the 73.2 cm error is only about 20% of the total amplitude in that region. Across all regions the M2 errors are larger than the other constituents, ranging from 4 to 73 cm, because the M2 tide has the largest amplitude. The O1 tide has the smallest errors, ranging from 1.7 to 4.7 cm. The error for K1 is especially large in the Arctic Southeast where the near-resonant tide reaches more than 70 cm.

Summaries for the regions as they are defined in Hannah et al. (2008) have also been computed (Table 5) and are compared to results from that study (Table 6). Baffin Bay shows the most dramatic improvement, with error of the semi-diurnal constituents reduced by up to 6 cm. M2 errors are decreased in most regions, with several regions showing between 3 and 7 cm reductions. The diurnal errors stayed mainly the same with the exception of the Arctic South Central and Southeast regions, where errors increased slightly.

A small analysis was done to test the effect of observation record length on the error estimates by computing the error statistics using only those records longer than 45 days. Most errors did not change significantly. The biggest changes (and reductions in error) were seen for the M2 constituent in regions such as Frobisher Bay, Arctic Southeast and

Region	**M2 (cm)**	**N2 (cm)**	**S2 (cm)**	**K1 (cm)**	**O1 (cm)**
Baffin Bay	16.3	10.3	12.6	6.9	2.6
Arctic West	13.7	1.8	3.4	3.8	1.9
Arctic North	14.7	4.0	6.4	3.7	2.3
Arctic Northwest	7.4	1.5	3.9	4.8	2.2
Arctic Central	11.8	2.1	5.3	5.2	2.0
Arctic South Central	7.6	1.0	2.4	3.4	2.4
Arctic Southeast	11.4	4.9	5.7	8.5	3.7

Table 6: Regional comparison using Error 1 for each constituent for the regions and solutions reported by Hannah et al. (2008). This allows for the direct comparison of these old solutions with the new solutions (Table 5).

Region	5 *vs.* 5		5 *vs. all*	
	cm	norm	cm	norm
Baffin Bay	16.8	0.351	18.2	0.362
Arctic West	5.7	0.554	9.0	0.728
Arctic North	6.6	0.510	8.3	0.538
Arctic Northwest	8.0	0.406	8.9	0.435
Arctic Central	8.1	0.207	11.2	0.264
Arctic South Central	7.7	0.997	9.0	0.964
Arctic Southeast	10.9	0.187	18.5	0.297
Frobisher Bay	57.5	0.249	61.2	0.265

Table 7: Regional prediction error (using the Error2 metric). The normalized error (norm) is the *rms* regional value of the station by station normalized error.

Arctic Northwest, where more than half of the records were removed by the 45 day restriction. Given that so many records are shorter than 45 days and that we wanted to maintain broad spatial coverage, we chose to report the error statistics and analysis using all records 29 days.

Maps of amplitude and phase for the five modelled constituents after running the model for 29 days are shown in Figures 4-13. Note that the phase is not labelled on these figures, and that the colour scale is adjusted from figure to figure. The semi-diurnal tides all show an amphidromic system in Baffin Bay and maximum amplitude in Frobisher Bay. The two diurnal tides are generally small and reach a maximum in Boothia Bay.

In order to illustrate the spatial patterns of the errors for M2 and K1, the amplitude errors at each station are plotted using shaded symbols in Figures 14 and 15. The model appears to be under-predicting both M2 and K1 more often than over-predicting.

The overall quality of the solutions for predicting the tides was estimated using the prediction errors defined by Eq. 4-5 in Section 2. The station-by-station prediction errors are tabulated in Appendix C and regional averages are given in Table 7. For the Greenland stations, the results for 5 *vs.* 5 and 5 *vs. all* are identical because only four constituents were available (M2, S2, K1, O1).

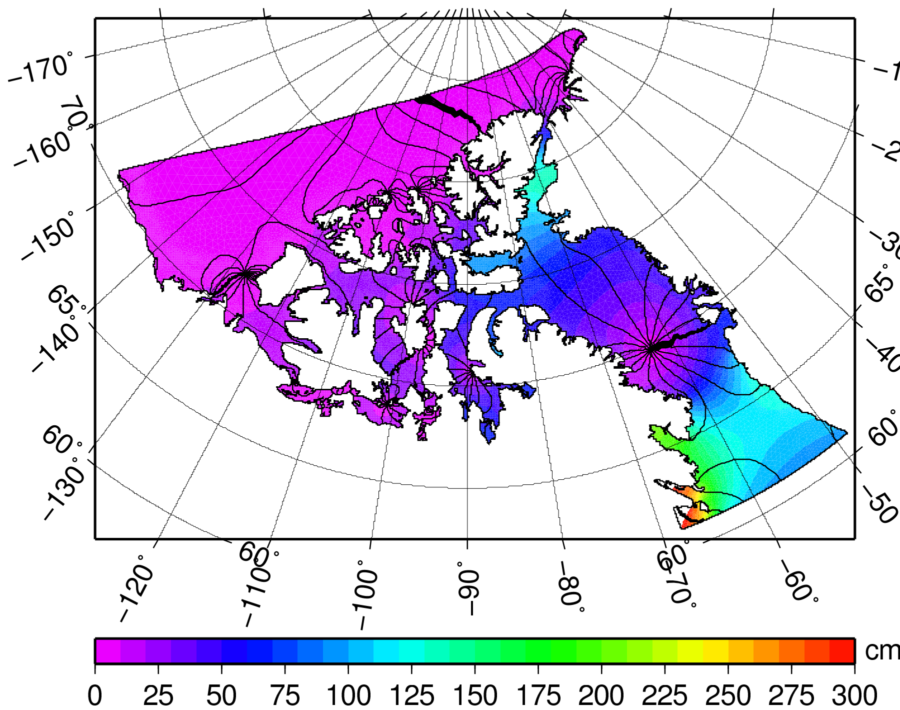


Figure 9: The M2 elevation solution.

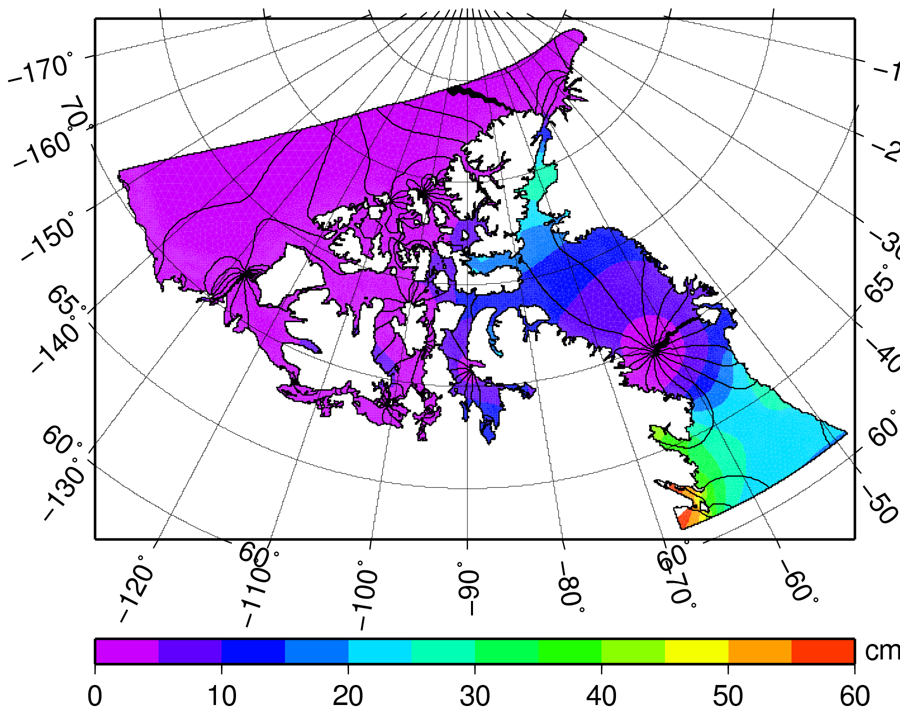


Figure 10: The N2 elevation solution.

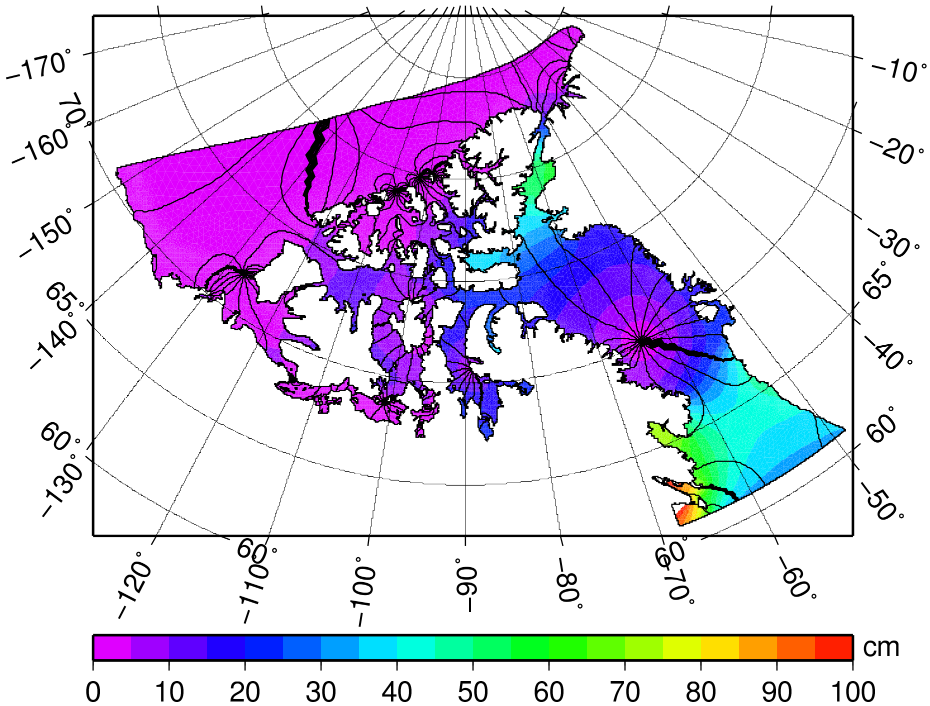


Figure 11: The S2 elevation solution.

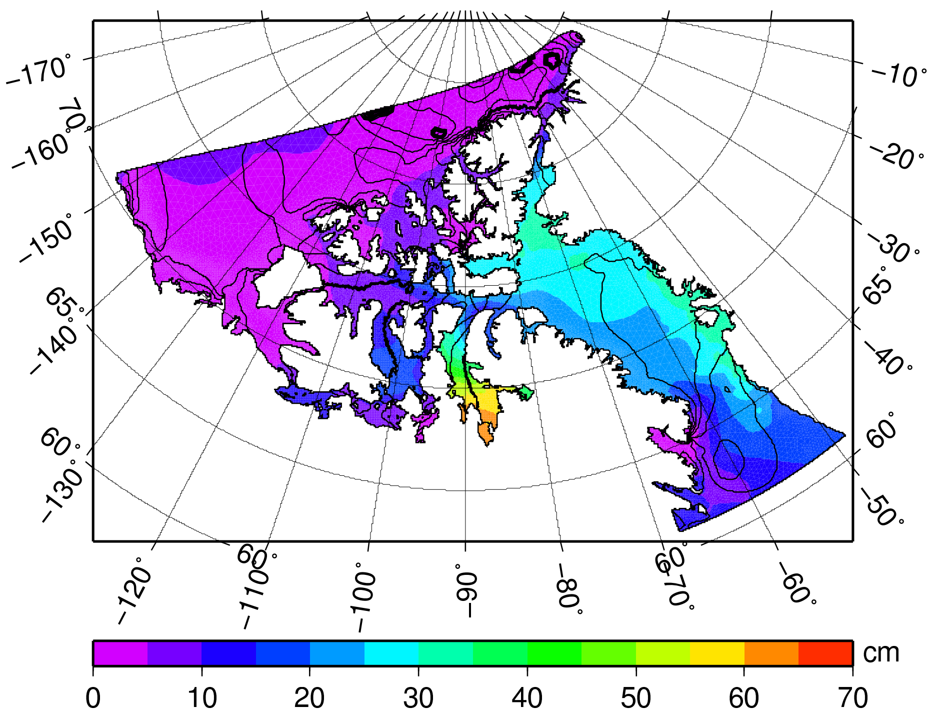


Figure 12: The K1 elevation solution.

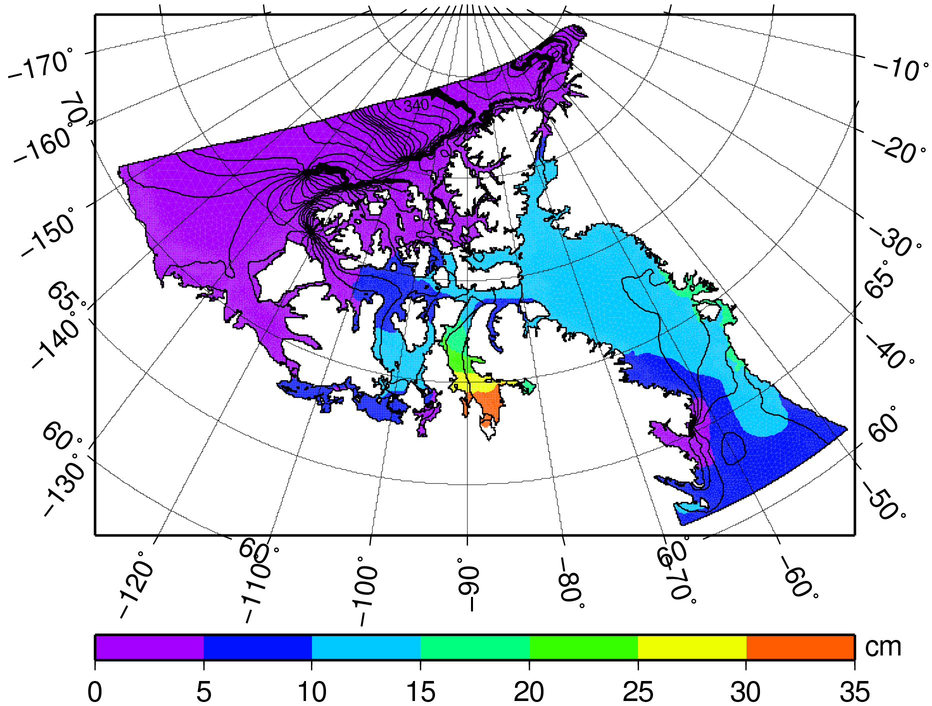


Figure 13: The O1 elevation solution.

The 5 *vs.* 5 errors are in the range 6-58 cm and the 5 *vs. all* errors are slightly larger at 8-61 cm. With one exception, none of the errors increase by more than 4 cm, indicating that the five tidal constituents include most of the tidal variability. The exception is the 7 cm jump in the Arctic Southeast error which suggests that some important tidal constituents were not modelled. Closer inspection of the tide gauge data in that region reveals that the MM and NO1 constituents contribute a significant percentage to the total signal. However, the contribution is inconsistent across the stations in the region, ranging from 0 to 19%. Further analysis or data collection would be required to assess whether the MM and N01 signals are real tides or other variability aliased onto the tidal frequencies in short records.

The two regions with the highest quality simulations are the Arctic Central region (Barrow Strait), the Arctic Southeast region, and Frobisher Bay. In all three cases the normalized error for 5 *vs. all* is about 0.3. The normalized error is near 1 for the Arctic South Central, and greater than 0.5 in the Arctic West and North. However, the normalized errors do not exceed 1, indicating that using the model is better than using nothing.

The prediction errors for the additional stations are tabulated in Table 8. The 5 *vs. all* errors are in the 4-18 cm range and consistent with the regional analysis. The prediction error relative to the entire sea level (or pressure) signal ranges from about 1-10 cm larger than when compared to the tides. The exception is M6485 (Tuktoyaktuk) where there is clearly a large non-tidal signal.

Padman and Erofeeva (2004) (referred to here as ‘PE’) report on a tidal model of the entire Arctic Ocean with 5 km resolution that includes good solutions in the Archipelago; the results provide an opportunity for a model inter-comparison. For a rough comparison of the PE solutions with the results from this study (‘Arctic9’), regional errors have been computed using approximately the same stations as Padman and Erofeeva (2004) for two

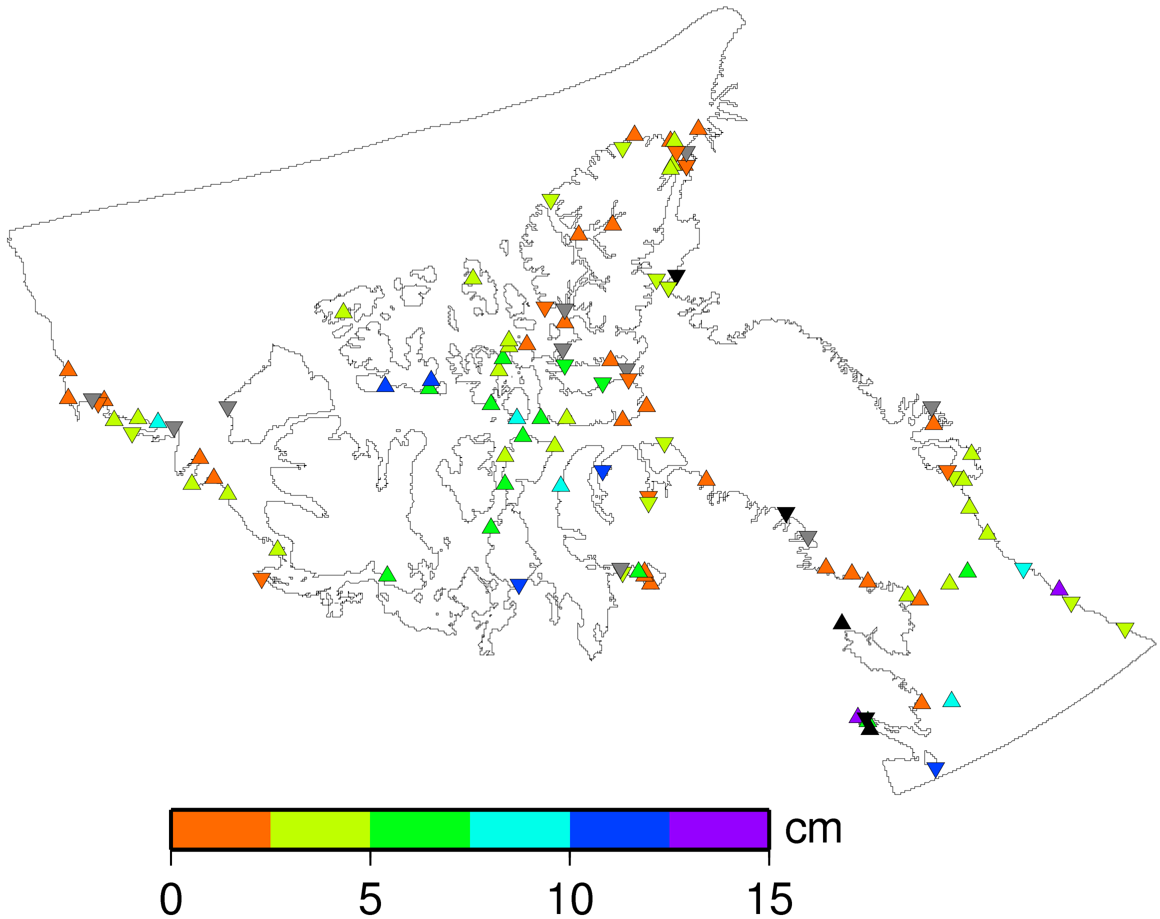


Figure 14: M2 amplitude error for the tide gauge stations. A triangle pointing upward indicates that the observed amplitude exceeds the modelled value (under-prediction) and a downward pointing triangle indicates that the modelled amplitude exceeds the observed one (over-prediction). The triangles do not show the phase error. Stations with errors in excess of 15 cm are shown in black.

Station	5 *vs. all*(cm)	*rms*(all) (cm)	5 *vs. signal*(cm)	*rms*(signal) (cm)
M3765	7.5	19.0	12.1	21.3
M6380	11.4	17.0	15.3	19.8
M6485	4.3	8.6	21.5	22.7
B1489	18.3	50.6	28.6	55.2
B1491	12.5	56.5	13.6	56.8
B1492	10.2	40.0	12.1	40.5

Table 8: Prediction Errors for the additional stations: 5 *vs. all* is defined in Section 2.4; *rms*(all) is the *rms* amplitude of the observed tidal time series (reconstructed from the constituents); 5 *vs. signal* is the *rms* error found when using the modelled tides to predict the observed pressure signal (tides plus everything else) with the mean removed; *rms*(signal) is the *rms* amplitude of the observed signal.

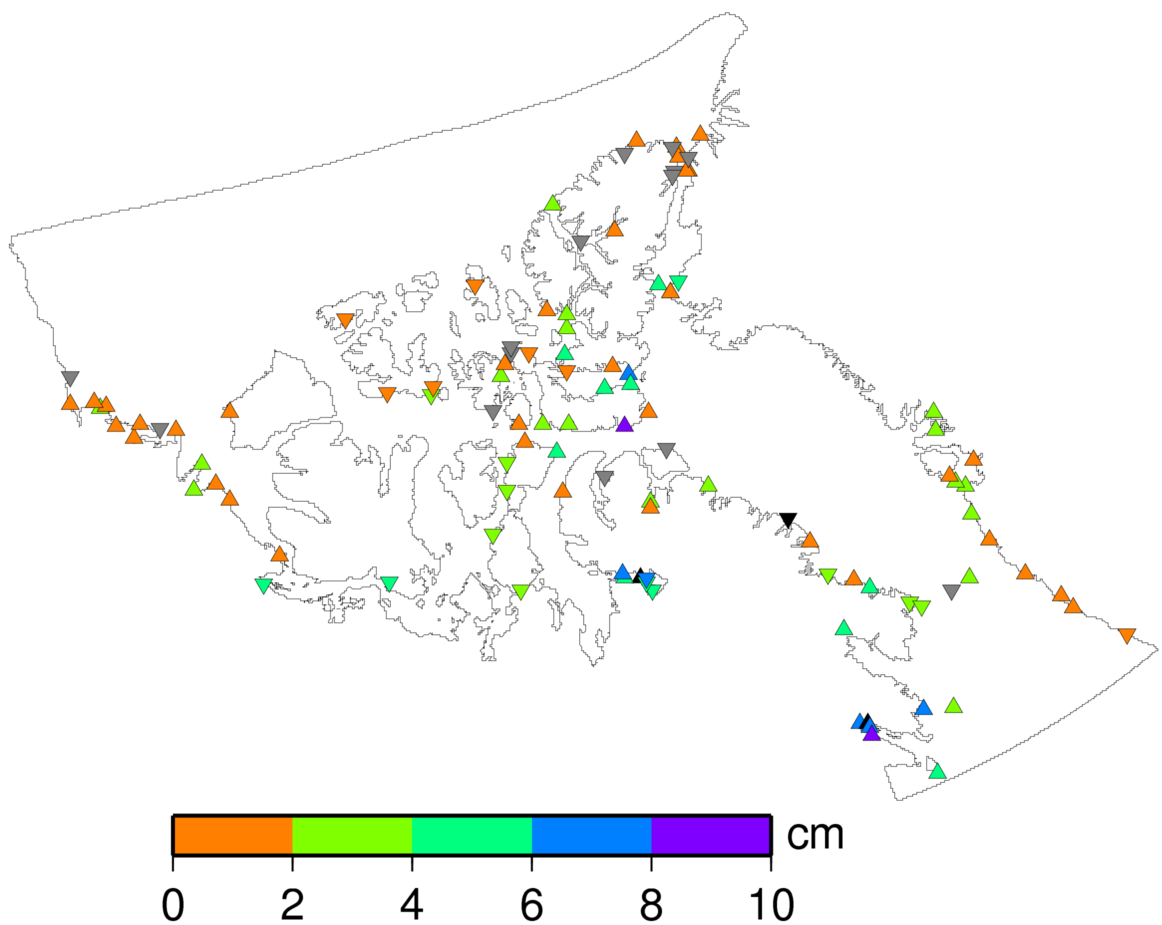


Figure 15: K1 amplitude error for the tide gauge stations. A triangle pointing upward indicates that the observed amplitude exceeds the modelled value (under-prediction) and a downward pointing triangle indicates that the modelled amplitude exceeds the observed one (over-prediction). The triangles do not show the phase error. Stations with errors in excess of 10 cm are shown in black.

Constituent	AODTM	AOTIM	Arctic9
Baffin Bay			
M2	14.5	11.8	16.1
N2	NA	NA	4.1
S2	6.5	2.5	6.5
K1	7.6	2.9	3.4
O1	2.6	1.7	2.3
Nares Strait			
M2	4.2	3.5	3.2
N2	NA	NA	1.6
S2	2.2	1.9	1.1
K1	1.6	1.1	1.6
O1	0.7	0.3	1.3

Table 9: Comparison of the errors in our Arctic9 solutions with the model of Padman and Erofeeva (2004) (who did not compute an N2 component). AODTM is the dynamics only model of Padman and Erofeeva (2004) and AOTIM is the assimilation model. The errors for Arctic9 were assessed using stations that corresponded visually to those shown on the map in Padman and Erofeeva (2004). The error metric used is that of Padman and Erofeeva (2004) which is $1/\sqrt{2}$ smaller than the peak error of Error1 (3) as tabulated in Appendix D.

of the PE regions: Baffin Bay (PE region 6) and Nares Strait (PE region 7). The identification of common locations was not precise; it was based on a visual inspection of the PE map and the Arctic9 map. The stations (and errors) used from Arctic9 results are listed in Appendix D.

The comparison is shown in Table 9. The AODTM solutions of Padman and Erofeeva (2004) were computed using a tidal model and the best PE boundary conditions at the edges of the Arctic Ocean. The solutions reported here ('Arctic9') are generally as good or better than the AODTM solutions, with the exceptions being M2 in Baffin Bay and O1 in Nares Strait. The AOTIM solutions are an assimilation that combines the AODTM solution with corrections in the model interior related to the model-data misfit. Since the Arctic9 modelling study does not include data assimilation, it is not surprising that the Arctic9 solutions are generally a little worse than the AOTIM solutions.

The station errors listed in Appendix D show that Arctic9 errors are dominated by large errors at few locations. A more careful evaluation of which stations were used by Padman and Erofeeva (2004) may indicate locations where the Arctic9 model is performing particularly badly or where the observations are incorrect.

5 Tidal Currents in the Central Region

For the comparison with the modelled currents, which are depth-averaged currents, we have done some averaging of the observations in the vertical. For the Barrow Strait data-set (Figure 16, SP1,SP3,SP4,SP5), the ADCP data were depth-integrated below 10 m; data above 10 m were rejected following RDI's standard echo intensity quality criteria. The records at SP1 and SP2 were merged (called SP1 in this section) to provide coverage over the entire water column at that location. For the current meter data reported in Stronach et al. (1987) only locations with data at two or more depths were considered and approximate vertical averages were computed. The tidal currents in Cardigan Strait and Hell Gate were taken from analysis in the middle of the water column as the tidal shear is weak away from the bottom boundary (Melling, pers. comm. 2006).

The comparison of the observed and modelled tidal ellipse parameters for M2 and K1 are tabulated in Tables 10 and 11; the other constituents are generally small. Overall, the amplitude of the M2 major axis is reasonably well modelled and the amplitude of K1 is less well modelled with only the SP stations agreeing with observations (Figure 17). The major axes of the M2 and K1 currents are particularly well modelled at SP1, SP3, SP4, and SP5 where the ADCP provided good coverage of the water column. The largest systematic error for both constituents is the under prediction of the currents at HM1, HM2, and HM3 (Figure 17).

There are many strange features in the currents comparison. For example, the M2 agreement is good at JS1 and poor at JS2 even though the sites are close together; the observed M2 currents change from 3.8 cms^{-1} at JS1 to 0.5 cms^{-1} at JS2 whereas the model reports the same currents at both. Notice also that the observed K1 currents change from 0.8 cms^{-1} at JS1 to 38 cms^{-1} at JS2 whereas the model reports 6-7 cms^{-1} at both. Perhaps there are internal tides at JS1 and JS2 and the tidal transport is not well represented by the few current meters in the vertical. There are lots of large differences in the phases at various location for which we have not attempted explanation. Sorting out the model-data discrepancies is a subject for future work.

Overall the best agreement between the observed and modeled currents is at the SP sites where there are long records with good coverage of the water column. This raises the possibility that some of the model-data mismatch is due to (at least in part) the following: 1) important seasonal changes in the tidal currents; and 2) important vertical structure in the tidal currents that is not resolved by two or three current meters in the vertical. As such, improved simulation of the tidal currents will likely require a three dimensional model which accounts for vertical stratification and horizontal density gradients.

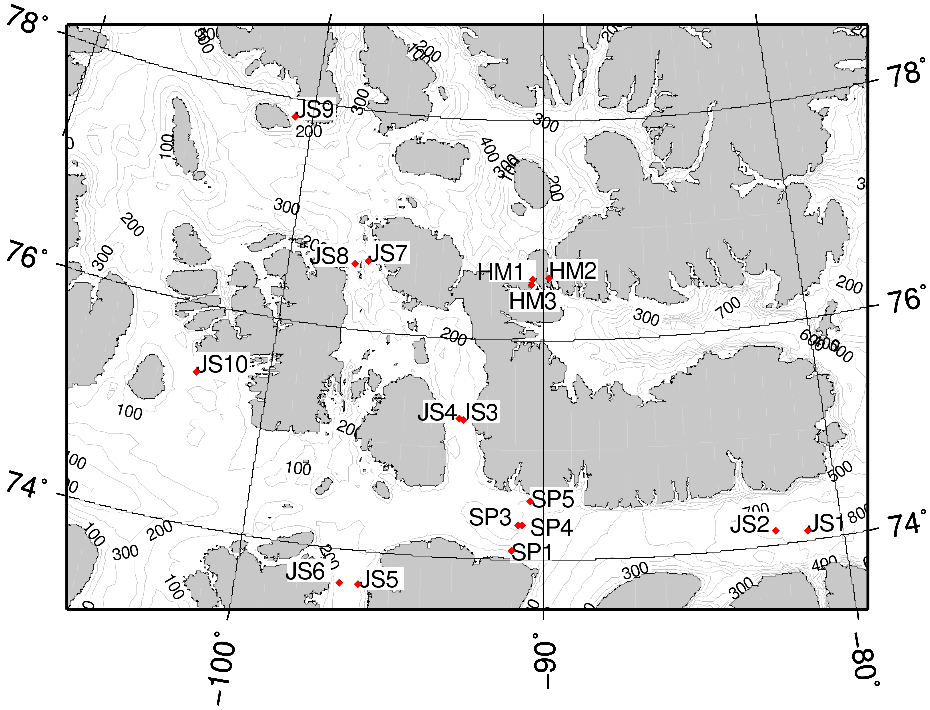


Figure 16: Map showing the locations of the ADCP moorings.

Stat #	Major (cms^{-1})		Eccentricity		Inclination (^{o}true)		Phase (GMT)	
	obs	mod	obs	mod	obs	mod	obs	mod
SP1	8.9	8.3	-0.079	-0.011	167.3	159.3	303.5	206.9
SP3	8.9	8.8	-0.168	-0.035	172.8	176.2	288.5	212.0
SP4	9.8	8.9	-0.137	-0.060	167.0	178.0	270.9	211.9
SP5	9.3	8.5	0.013	-0.298	160.8	17.1	84.4	357.9
JS1	3.8	3.2	-0.065	0.040	10.7	177.9	90.8	99.8
JS2	0.5	3.2	-0.428	-0.077	97.6	1.5	16.0	289.9
JS3	1.8	6.9	-0.540	-0.000	12.5	100.2	349.1	193.0
JS4	1.8	7.3	-0.335	-0.029	173.9	99.1	203.9	192.7
JS5	5.7	7.3	0.064	0.057	91.6	81.1	153.7	85.6
JS6	7.1	6.1	0.070	0.095	90.8	89.0	252.7	97.4
JS7	20.2	19.5	-0.196	-0.046	31.2	132.3	261.9	259.9
JS8	13.8	15.8	-0.195	-0.033	160.4	113.2	97.0	249.9
JS9	9.2	9.8	0.151	-0.090	148.0	122.2	87.7	244.2
JS10	5.2	4.4	-0.506	-0.129	12.5	151.6	107.1	314.6
HM1	62.4	53.9	0.029	0.099	114.8	78.4	270.3	29.4
HM2	88.0	55.7	0.049	-0.110	105.3	102.2	270.1	205.9
HM3	66.8	61.2	0.004	-0.008	115.6	108.4	270.0	187.7

Table 10: Model-data velocity comparison for M2.

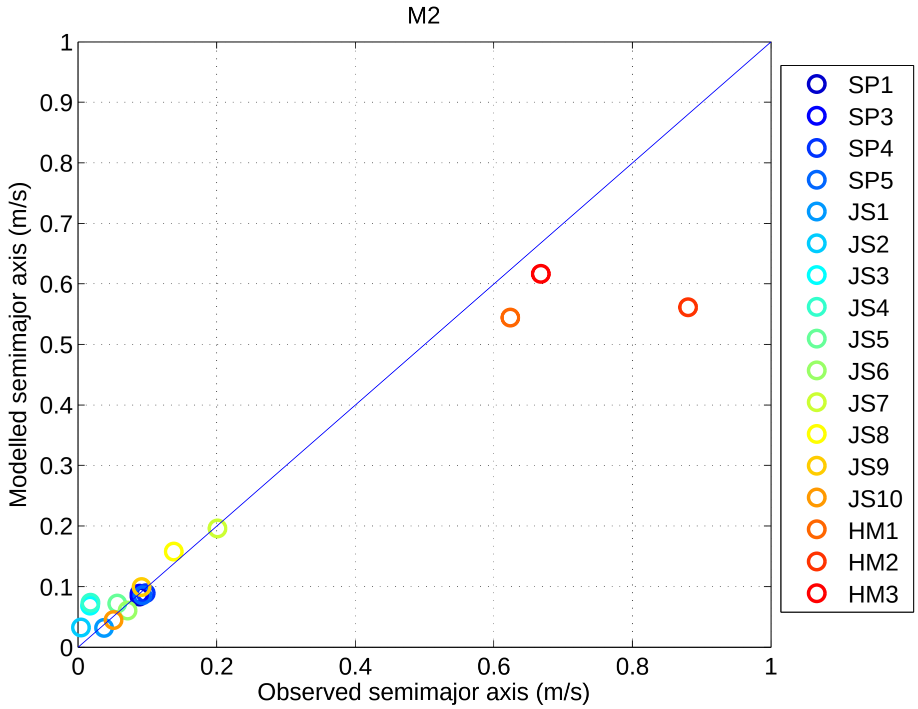
Stat #	Major (cms^{-1})		Eccentricity		Inclination (^{o} true)		Phase (GMT)	
	obs	mod	obs	mod	obs	mod	obs	mod
SP1	9.0	10.5	0.237	0.057	160.5	157.2	222.1	324.9
SP3	11.8	11.7	-0.044	-0.049	163.0	170.2	257.6	349.7
SP4	12.2	11.8	-0.206	-0.090	167.4	169.3	121.6	350.1
SP5	10.2	9.7	0.059	0.057	158.5	156.9	262.6	306.0
JS1	0.8	6.0	0.207	0.019	104.4	178.5	132.4	286.1
JS2	37.0	6.8	0.004	0.033	164.1	0.2	90.2	110.1
JS3	9.0	10.5	-0.088	-0.076	109.3	99.0	87.5	352.7
JS4	9.6	11.0	-0.036	-0.092	110.6	96.2	88.9	351.9
JS5	0.5	4.2	0.037	0.002	97.0	80.9	195.5	103.5
JS6	1.8	4.0	0.065	-0.001	108.8	93.7	123.0	109.0
JS7	5.6	16.0	-0.194	0.047	17.5	129.9	8.5	19.3
JS8	8.2	10.9	-0.370	0.075	99.4	112.7	275.7	10.6
JS9	4.4	2.3	0.102	-0.105	159.3	117.6	96.8	350.9
JS10	2.8	5.7	-0.426	0.023	175.7	154.6	85.6	56.9
HM1	34.6	33.2	0.026	0.009	119.1	103.5	92.9	293.3
HM2	55.0	34.5	0.059	0.004	112.7	104.0	103.2	293.6
HM3	56.8	39.9	0.036	-0.014	115.5	107.5	93.0	297.7

Table 11: Model-data velocity comparison for K1.

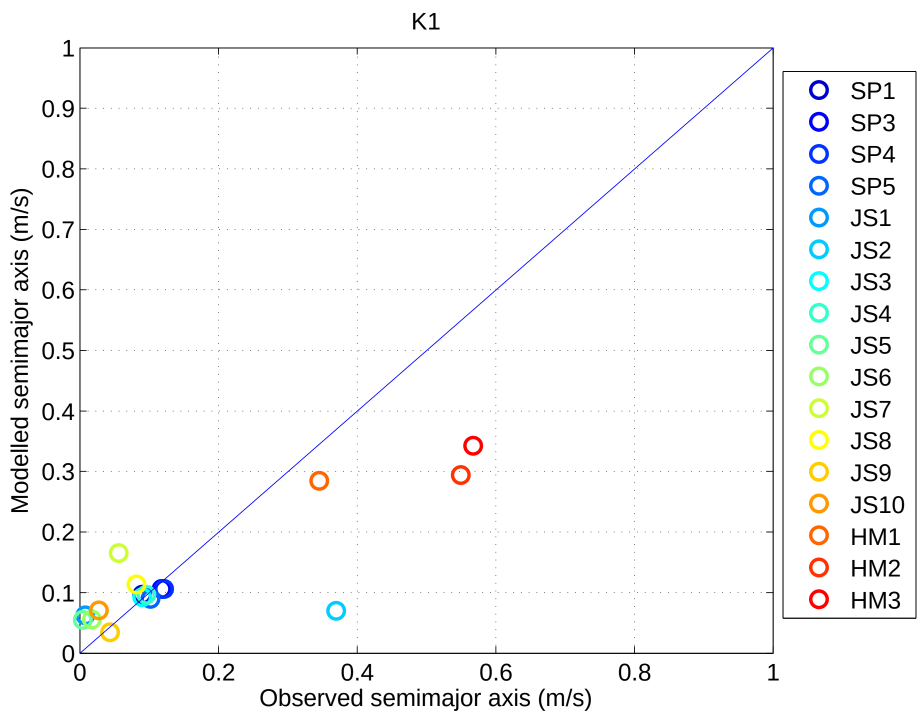
Bellot Strait is a narrow (1 km) tidal channel that is only marginally resolved in the model grid (500 m mesh spacing). In addition there are no current meter observations in the strait to use for validation. An anecdotal validation of the modelled currents in the strait was provided in October 2008 when the CCG vessel Louis S. St. Laurent was in the strait recovering current meters. Tidal current predictions at two locations were provided to the captain as part of the operation planning process. The solid line in Figure 18 is the prediction for a location at the eastern end of the strait and the dashed line is for a location close to the middle of the strait. The predictions were assessed during mooring operations at the eastern end of the strait on the first day and then used to plan the operation in the middle of the strait the next day. After the operations the captain reported that the timing (phase) of the predictions was very good but that the currents were under-estimated (especially for the location inside the strait). An important feature of the prediction is the mixed diurnal semi-diurnal nature of the tide and that at the time of the operations the currents were more diurnal than semi-diurnal in nature. Unfortunately a quantitative validation is not possible because only one of the two moorings was recovered and no useful data was obtained from that mooring. The qualitative validation suggests that the tidal current predictions can be useful.

6 Conclusions

A tidal prediction system for the Canadian Arctic Archipelago has been completed for the five major constituents (M2, N2, S2, K1, O1) using the Toulouse Unstructured Grid Ocean Model (T-UGOm). The study improves on the results of Dunphy et al. (2005) and Hannah et al. (2008). An extended, higher resolution mesh was used; boundary conditions are a



(a)



(b)

Figure 17: Comparison of the modelled and observed semi-major axis for the (a) M2 and (b) K1 currents.

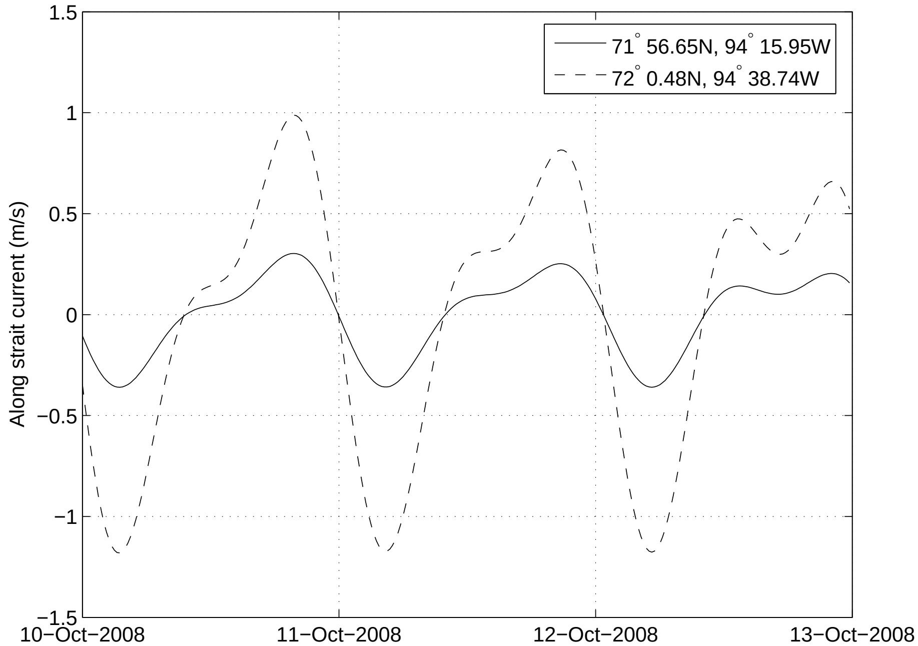


Figure 18: Tidal current prediction in Bellot Strait.

combination of Dunphy et al. (2005) solutions and FES2004 global solutions (Lyard et al., 2006).

The sensitivity of the model solutions to the surface friction due to sea ice showed that the regional tidal height validation statistics where relatively insensitive to the details of the parameterization. The exceptions to this were the diurnal constituents in the South Central and Southeast regions where the validation is worse when the winter sea ice cover is used. The enhanced diurnal tides in Boothia Bay are likely very sensitive to the details of the friction and the observations in the area are probably restricted to the summer.

The *rms* error of the tidal constituents when averaged over the eight regions is about 17 cm for M2 and about (4, 7, 6, 3) cm for (N2, S2, K1, O1). The semi-diurnal regional-average errors are increased by the large errors in Frobisher Bay, where tidal range is large.

A comparison of the model solutions to those of Hannah et al. (2008) shows that Baffin Bay is the most-improved region, and M2 is the most-improved constituent: the average *rms* error over all constituents is reduced by 3 cm, while the average *rms* error for M2 across all regions is reduced by 2 cm.

The Arctic South Central and Southeast regions were not well-modelled for the diurnal tidal constituents, and in fact the *rms* errors increased in this study from Hannah et al. (2008). It is thought that the assimilation procedure followed in the latter study played a major role in getting better results in that region. The near-resonant diurnal tide in Boothia Bay makes these regions difficult to model accurately. The region's sensitivity to winter ice cover leads to the conclusion that the area is quite sensitive to friction, and perhaps the observations in the region are summer-biased.

A possible source of error in the Arctic South Central region is the poor resolution of the Finlayson Islands west of Cambridge Bay. These islands appear as a shallow shoal rather than islands; this could account for the overestimate of diurnal tides in this region. This is a region that will require further attention in subsequent studies.

Observation record length was shown to have some impact on the error analysis. However, the results are difficult to interpret. The biggest changes are in the regions where restricting the analysis to records 45 days long or longer results in removing half or more of the records (relative to a 29 day criteria). The error analysis is then based on only a handful of records. In order to maintain the spatial coverage the final error analysis uses all records 29 days or longer. Data quality and quantity is an ongoing issue for validating tidal models in the Canadian Arctic.

The comparison between the modeled and observed currents shows reasonable agreement when the observations cover most of the water column and are for long periods of time (close to a year). The comparisons with current from shorter records with less coverage in the vertical exhibits many strange features that are difficult to interpret. It is likely that some of the model-data mismatch is due to important seasonal changes in the tidal currents and important vertical structure in the tidal currents. Addressing these issues in a modeling context will require a three dimensional model which accounts for vertical stratification and horizontal density gradients.

The reported application of the model currents to a Canadian Coast Guard operation in Bellot Strait shows that the modeled currents can be useful. However, site specific validation needs to be done to make sure that the model captures those features of the tidal currents that are important to the operation.

Acknowledgments
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Appendix

A Stations

Table 12: The stations selected for model comparison including the MEDS code and record length (in days). For the Greenland data, the station number has a G prefix and the record length is unknown.

Station Name	Station Number	Record Length
DAVIS STRAIT	64000	1 X 398
DAVIS STRAIT	64005	1 X 399
DAVIS STRAIT	64010	1 X 395
RENSSELAER BAY	3710	1 X 44
THANK GOD HARBOUR	3735	1 X 44
NEWMAN BAY GREENLAND	3740	1 X 42
CAPE BRYANT	3755	1 X 44
ALERT	3765	1 X 362
CAPE LIVERPOOL	3902	1 X 52
NOVA ZEMBLA ISLAND	3916	1 X 53
CAPE CHRISTIAN	3941	1 X 54
AULITIVING ISLAND	3948	1 X 49
BROUGHTON ISLAND	3980	1 X 44
IGLOOLIK	5295	1 X 105
CAPE COCKBURN	5428	1 X 61
RESOLUTE	5560	1 X 364
MCBEAN ISLAND	5920	1 X 52
OTRICK ISLAND	6090	1 X 58
TASMANIA ISLAND	6110	1 X 56
SPENCE BAY	6150	1 X 112
CAMBRIDGE BAY	6240	1 X 331
COPPERMINE	6290	1 X 290
PEARCE POINT	6340	1 X 69
CAPE PARRY	6360	1 X 363
SACHS HARBOUR	6424	1 X 174
BAILLIE IS (S. SPIT)	6443	1 X 58
ATKINSON POINT	6476	1 X 59
TUKTOYAKTUK	6485	1 X 333
RAE ISLAND	6492	1 X 57
HOOPER ISLAND	6495	1 X 49
GARRY ISLAND	6498	3 X 56

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Station Name	**Station Number**	**Record Length**
HERSCHEL ISLAND	6525	1 X 50
CAPE SKOGN NWT	6560	1 X 61
GRISE FIORD NWT	6570	1 X 62
BAY OF WOE	6580	1 X 43
HELL GATE	6584	1 X 43
BERE BAY	6588	1 X 45
NORWEGIAN BAY	6595	1 X 142
CAPE SOUTHWEST	6598	1 X 42
HYPERITE POINT	6605	1 X 42
DISRAELI FIORD	6730	1 X 78
NORAH ISLAND	6781	1 X 43
Rae Point Melville I	6835	1 X 366
ISACHSEN	6910	1 X 29
MOULD BAY	6955	1 X 29
Aasiatt-Egedesminde	G01	N/A
ILulissat-Jacobshavn	G09	N/A
Kronprinsens-Ejland	G14	N/A
Maniitsoq-Sukkertoppen	G16	N/A
Qaamarujuk	G24	N/A
Qeqertarsuaq-Godhavn	G26	N/A
Rifkol	G28	N/A
Sisimiut-Holsteinsborg	G29	N/A
Uummannaq	G31	N/A
GODTHAAB	3575	4 X 29
FOULKE FIORD	3690	2 X 29
CAPE LUPTON GREENLAND	3736	1 X 33
CAPE SHERIDAN	3780	5 X 29
LINCOLN BAY	3782	1 X 35
ST.PATRICK BAY	3788	1 X 35
DISCOVERY HARBOUR	3790	1 X 29
PIM ISLAND	3840	1 X 29
CAPE HOOPER	3960	1 X 29
KIVITOO	3970	1 X 29
CAPE DYER	3995	1 X 29
CLEARWATER FIORD	4040	1 X 29
BOUVERIE ISLAND	5305	1 X 29
SEVIGNY POINT	5310	1 X 31
BONNE ISLAND	5315	1 X 32
PURFUR COVE	5330	1 X 32

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Station Name	**Station Number**	**Record Length**
BAFFIN	5332	1 X 32
DUNDAS HARBOUR	5430	1 X 29
BEECHY ISLAND	5510	1 X 29
MAXWELL BAY	5530	1 X 32
CAPE CAPEL	5600	1 X 31
WINTER HARBOUR	5645	1 X 29
KOLUKTOO BAY	5790	1 X 29
MILNE INLET (HEAD)	5791	1 X 29
ARCTIC BAY	5865	1 X 29
PORT LEOPOLD	5905	1 X 29
CUNNINGHAM INLET	5910	1 X 37
WADSWORTH ISLAND	6080	1 X 59
BERNARD HARBOUR	6310	1 X 29
TYSOE POINT	6338	1 X 36
PAULATUK	6350	1 X 29
KRUBLUYAK POINT	6457	1 X 46
CAPE DALHOUSIE	6472	1 X 29
SHINGLE BAY	6505	1 X 36
KING EDWARD POINT	6556	1 X 30
BELCHER POINT	6557	1 X 31
ICEBERG POINT	6660	1 X 29
GREELY FIORD	6670	1 X 29
KLEYBOLT PENINSULA	6704	1 X 29
CAPE ALDRICH	6735	1 X 29
AIRSTRIP POINT	6765	1 X 29
HYDE PARKER ISLAND	6770	1 X 39
NORTHUMBERLAND SOUND	6780	1 X 29
BYAM CHANNEL(Z3)	6834	1 X 38
Foulke-Havn	G08	N/A
Kangerluarsoruseq-Faering	G11	N/A
Thank-God-Havn	G30	N/A
FROBISHER	4140	1 X 337
LEWIS BAY	4135	1 X 29
FROBISHER S FARTHEST	4120	1 X 29
RESOR ISLAND	4100	1 X 29
ACADIA COVE	4170	1 X 63
BREVOORT HARBOUR	4070	1 X 29
HEJKA DRILL SITE	44081	1 X 71
Paamiut-Frederikshab	G23	N/A

Table 13: The stations not used for model comparison including the MEDS code and record length (in days).

Station Name	Station Number	Record Length
EKALUGARSUIT	3515	1 X 29
NORTH STAR BAY	3670	1 X 24
WRANGEL BAY	3785	1 X 17
CAPE DEFOSSE	3800	1 X 24
CLYDE RIVER	3940	1 X 98
AULATSIVIK PT.	4031	1 X 27
IMIGEN ISLAND	4045	1 X 15
LAKE HARBOUR	4205	1 X 362
PORT BURWELL	4265	1 X 29
KOKSOAK R. WEST ENT.	4295	1 X 29
FORT CHIMO	4298	1 X 26
LEAF BASIN	4315	1 X 29
HOPES ADVANCE BAY	4325	2 X 29
AGVIK ISLAND	4335	1 X 29
PIKIYULIK ISLAND	4340	1 X 29
KOARTAC	4379	1 X 113
CAPE WILSON 3	5230	1 X 55
CAPE WILSON 1	5231	1 X 18
CAPE WILSON 2	5232	1 X 46
ROCHE BAY	5252	1 X 48
HALL BEACH	5275	1 X 338
ENTRANCE ISLAND	5350	1 X 28
NEEDLE COVE	5358	1 X 35
LONGSTAFF BLUFF #1	5385	1 X 32
RIGBY BAY	5490	2 X 15
RADSTOCK BAY	5500	1 X 15
HAMILTON ISLAND	5615	1 X 15
PISIKTARFIK ISLAND	5795	1 X 15
STRATHCONA SOUND	5860	1 X 15
FORT ROSS	5930	1 X 15
CROWN PRINCE FREDERICK	5970	1 X 27
FALSE STRAIT	6100	1 X 15
FRANKLIN BAY	6367	1 X 21
BAILLIE ISLAND	6442	1 X 21
LIVERPOOL BAY	6455	1 X 23

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Station Name	**Station Number**	**Record Length**
ESKIMO LAKES STN 1C	6461	1 X 17
ESKIMO LAKES STN 2B	6462	1 X 19
PELLY ISLAND	6497	1 X 20
KAY POINT YUKON.	6515	1 X 25
SURPRISE FIORD	6600	1 X 18
EUREKA	6640	1 X 15
TANQUARY CAMP	6680	1 X 29
LITTLE CORNWALLIS IS.	6757	1 X 27
BYAM CHANNEL(LP)	6833	1 X 15
Ammassalik	G02	N/A
Danmarkshavn	G04	N/A
Danmarks-0	G05	N/A
Finsch-Oer	G07	N/A
Kangilinnguit-Gronnedal	G12	N/A
Mestersvig	G17	N/A
Nanortalik	G18	N/A
Narsaq	G19	N/A
Nuuk-Godthab	G22	N/A
Qaqortoq-Julianehab	G25	N/A
Uunarteq-Kap-Tobin	G33	N/A
NAIN LABRADOR	01430	1 X 320
HEBRON	01465	1 X 358
BROWNELL POINT	01485	1 X 359
BAIE JOHAN-BEETZ	02490	1 X 29
HEATH POINT	02410	1 X 29
KEGASHKA	02518	1 X 32

B Complete station by station comparisons

B.1 Baffin Bay

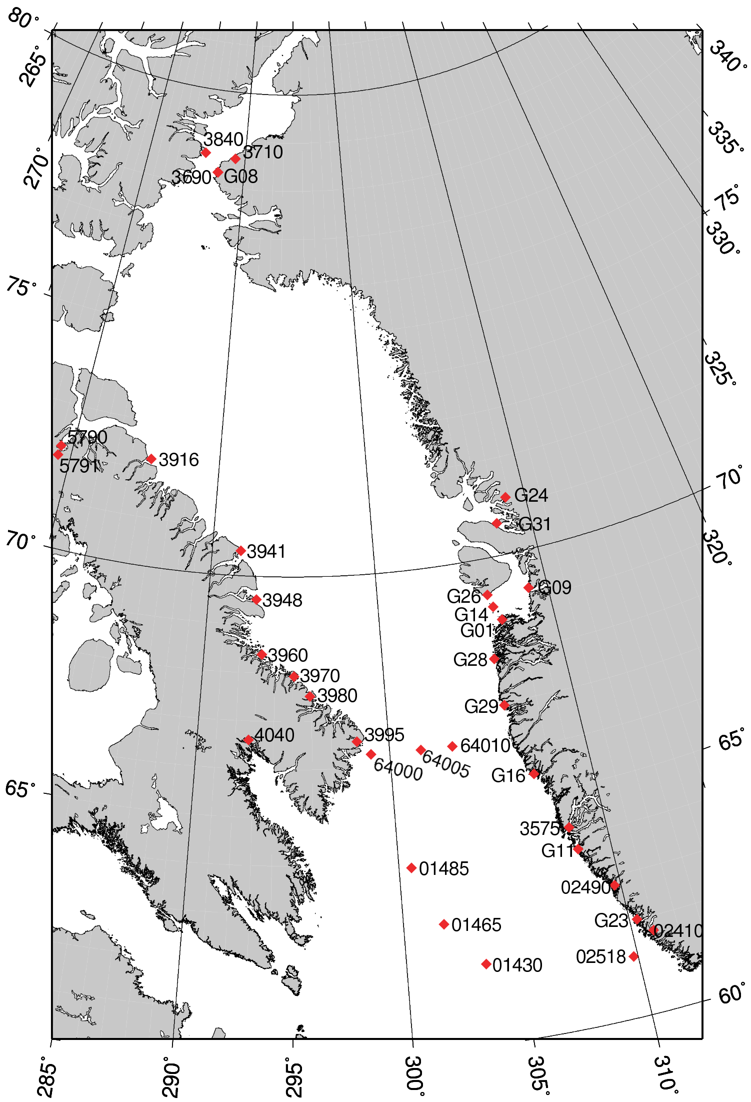

Figure 19: Baffin Bay

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
G01	66.7	-9.0	63.0	-6.3	3.7	-2.7	4.8	0.072
G09	66.7	-2.0	63.4	-2.0	3.3	-0.0	3.3	0.050
G11	116.5	-70.0	119.1	-72.5	-2.6	2.4	5.6	0.048

G14	57.0	-13.0	60.6	-5.9	-3.6	-7.2	8.2	0.144
G16	124.7	-58.9	132.9	-62.1	-8.2	3.1	10.8	0.087
G24	45.6	40.0	45.7	39.2	-0.1	0.8	0.6	0.014
G26	59.5	-6.0	60.6	-3.8	-1.1	-2.2	2.6	0.043
G28	78.0	-38.0	75.0	-14.9	3.0	-23.2	30.9	0.396
G29	117.1	-44.0	113.9	-40.7	3.2	-3.3	7.4	0.064
G31	46.5	35.0	45.8	38.7	0.7	-3.7	3.1	0.067
3575	138.0	-68.1	123.5	-70.7	14.5	2.7	15.8	0.114
3916	44.8	138.3	43.4	134.4	1.4	3.9	3.3	0.074
3941	11.0	151.3	27.4	145.1	-16.4	6.2	16.6	1.505
3948	18.7	-156.5	19.4	-170.6	-0.7	14.1	4.7	0.253
3960	20.4	-122.1	19.4	-133.5	1.0	11.4	4.1	0.200
3970	24.6	-106.1	23.7	-114.1	0.9	8.0	3.5	0.142
3980	30.4	-106.1	28.9	-109.4	1.5	3.4	2.3	0.075
3995	83.5	-87.1	80.8	-97.3	2.7	10.2	14.9	0.178
4040	226.7	-66.1	205.5	-74.7	21.2	8.7	38.9	0.171
64000	89.9	-88.2	88.4	-88.7	1.5	0.5	1.7	0.019
64005	90.2	-67.1	86.3	-67.3	3.9	0.2	3.9	0.043
64010	98.9	-58.0	93.2	-58.2	5.7	0.2	5.7	0.058
5790	57.3	139.9	58.5	133.3	-1.2	6.6	6.7	0.118
5791	55.6	132.5	58.5	133.4	-2.9	-0.9	3.0	0.054
3840	116.7	113.9	121.2	116.0	-4.5	-2.1	6.2	0.053
3710	102.7	93.9	129.2	111.9	-26.5	-18.0	44.7	0.435
G08	110.9	117.0	115.8	110.1	-4.9	6.8	14.4	0.130
3690	110.9	82.9	115.8	110.1	-4.9	-27.1	53.4	0.481
G23	102.7	-83.0	106.1	-78.7	-3.4	-4.4	8.7	0.084
Mean	79.7	–	80.2	–	-0.5	-0.2	11.4	0.2
Absolute	–	–	–	–	5.1	6.3	–	–
RMS	91.4	90.5	90.8	93.4	8.1	9.2	17.5	0.330

Table 14: Baffin Bay - M2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
G01	N/A	N/A	12.6	-27.4	N/A	N/A	N/A	N/A
G09	N/A	N/A	12.6	-23.1	N/A	N/A	N/A	N/A
G11	N/A	N/A	24.8	-95.9	N/A	N/A	N/A	N/A
G14	N/A	N/A	12.1	-27.0	N/A	N/A	N/A	N/A
G16	N/A	N/A	27.5	-85.4	N/A	N/A	N/A	N/A
G24	N/A	N/A	9.4	18.8	N/A	N/A	N/A	N/A
G26	N/A	N/A	12.1	-25.0	N/A	N/A	N/A	N/A
G28	N/A	N/A	15.0	-36.7	N/A	N/A	N/A	N/A
G29	N/A	N/A	23.3	-63.6	N/A	N/A	N/A	N/A

G31	N/A	N/A	9.5	18.4	N/A	N/A	N/A	N/A
3575	28.3	-90.7	25.7	-94.2	2.6	3.5	3.1	0.109
3916	10.9	114.3	9.3	108.3	1.6	5.9	1.9	0.173
3941	2.4	132.6	6.1	117.9	-3.7	14.7	3.9	1.613
3948	6.5	174.9	4.3	156.4	2.2	18.4	2.8	0.430
3960	3.0	-157.2	3.9	-168.2	-0.9	10.9	1.1	0.367
3970	4.5	-158.2	4.6	-146.1	-0.1	-12.2	1.0	0.213
3980	5.1	-130.2	5.6	-139.9	-0.5	9.7	1.0	0.198
3995	12.8	-129.2	16.2	-123.7	-3.4	-5.5	3.7	0.287
4040	36.5	-81.2	41.1	-100.7	-4.6	19.5	13.9	0.380
64000	18.4	-113.8	17.8	-114.8	0.6	1.0	0.7	0.037
64005	18.3	-91.5	17.3	-91.9	1.0	0.4	1.0	0.053
64010	20.1	-81.6	18.8	-82.0	1.3	0.4	1.3	0.065
5790	12.8	103.2	12.3	107.2	0.5	-4.0	1.0	0.080
5791	9.7	85.0	12.3	107.3	-2.6	-22.3	5.0	0.510
3840	26.2	99.2	24.4	91.7	1.8	7.4	3.8	0.143
3710	21.3	63.8	26.0	87.8	-4.7	-24.1	10.9	0.510
G08	N/A	N/A	23.4	85.9	N/A	N/A	N/A	N/A
3690	20.4	54.8	23.3	85.8	-2.9	-31.1	12.1	0.591
G23	N/A	N/A	22.1	-101.6	N/A	N/A	N/A	N/A
Mean	15.1	–	16.3	–	-0.7	-0.4	4.0	0.3
Absolute	–	–	–	–	2.1	11.2	–	–
RMS	17.8	114.3	18.4	96.7	2.5	14.3	5.7	0.496

Table 14 continued: Baffin Bay - N2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
G01	25.8	25.0	24.5	24.8	1.3	0.2	1.3	0.052
G09	27.4	30.0	24.6	28.8	2.8	1.2	2.8	0.102
G11	40.0	-34.0	42.2	-36.2	-2.2	2.2	2.7	0.068
G14	27.0	25.0	23.6	25.2	3.4	-0.2	3.4	0.125
G16	44.7	-25.3	47.6	-26.4	-2.9	1.1	3.1	0.069
G24	17.0	62.0	16.7	66.7	0.3	-4.7	1.4	0.083
G26	24.6	31.0	23.6	27.3	1.0	3.7	1.9	0.075
G28	32.0	-8.0	28.3	17.0	3.7	-25.0	13.6	0.424
G29	45.1	-8.0	42.1	-6.3	3.0	-1.7	3.2	0.071
G31	18.1	61.0	16.7	66.2	1.4	-5.2	2.1	0.116
3575	56.6	-30.0	43.8	-34.5	12.8	4.5	13.4	0.237
3916	15.1	-176.6	13.7	175.9	1.4	7.5	2.3	0.153
3941	3.4	-165.1	7.7	-170.1	-4.3	5.0	4.3	1.270
3948	6.7	-90.5	6.2	-110.3	0.5	19.8	2.3	0.339
3960	5.7	-60.0	7.7	-74.6	-2.0	14.6	2.7	0.465

3970	10.9	-54.0	9.9	-61.5	1.0	7.5	1.7	0.153
3980	12.8	-60.0	11.9	-59.4	0.9	-0.6	0.9	0.074
3995	24.6	-41.0	30.0	-54.4	-5.4	13.4	8.3	0.337
4040	81.3	-23.0	74.8	-33.5	6.5	10.5	15.6	0.192
64000	33.9	-45.5	32.7	-47.2	1.2	1.7	1.6	0.046
64005	34.9	-27.3	32.4	-28.7	2.5	1.4	2.7	0.076
64010	38.2	-19.8	34.9	-21.1	3.3	1.3	3.4	0.090
5790	20.4	-176.0	19.5	175.1	0.9	8.9	3.2	0.158
5791	23.4	-178.9	19.5	175.1	3.9	6.0	4.5	0.193
3840	48.1	148.0	47.9	156.0	0.2	-8.0	6.7	0.139
3710	45.4	132.0	51.8	151.2	-6.4	-19.2	17.4	0.383
G08	46.3	150.0	45.3	149.0	1.0	1.0	1.3	0.028
3690	46.3	125.0	45.3	148.9	1.0	-23.9	19.0	0.410
G23	37.0	-43.0	38.0	-42.4	-1.0	-0.6	1.1	0.028
Mean	30.8	–	29.8	–	1.0	0.8	5.1	0.2
Absolute	–	–	–	–	2.7	6.9	–	–
RMS	35.2	90.6	33.8	95.1	3.7	10.0	7.3	0.314

Table 14 continued: Baffin Bay - S2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
G01	35.5	-151.9	32.5	-150.7	3.0	-1.2	3.1	0.087
G09	34.1	-139.9	33.1	-148.9	1.0	9.0	5.4	0.158
G11	18.2	170.1	18.2	167.2	0.0	2.9	0.9	0.051
G14	35.0	-146.9	32.0	-149.7	3.0	2.8	3.4	0.098
G16	21.0	165.7	20.6	156.2	0.4	9.5	3.5	0.165
G24	36.5	-160.9	33.4	-134.0	3.1	-26.8	16.5	0.452
G26	31.7	-145.9	31.4	-148.9	0.3	3.0	1.7	0.053
G28	36.0	-154.9	32.4	-160.4	3.6	5.5	4.9	0.135
G29	33.5	179.1	33.2	175.6	0.3	3.5	2.1	0.062
G31	35.5	-124.9	33.4	-134.3	2.1	9.4	6.0	0.170
3575	20.1	174.1	18.2	166.5	1.9	7.6	3.2	0.158
3916	26.3	-108.0	23.8	-120.1	2.5	12.0	5.8	0.220
3941	10.5	-104.0	24.1	-116.3	-13.6	12.3	14.0	1.338
3948	22.7	-99.2	22.4	-114.7	0.3	15.5	6.1	0.268
3960	18.8	-108.8	21.8	-115.1	-3.0	6.3	3.7	0.197
3970	21.3	-110.8	20.4	-116.9	0.9	6.1	2.4	0.113
3980	24.6	-110.8	20.4	-117.2	4.2	6.4	4.9	0.200
3995	10.9	-103.8	14.1	-104.7	-3.2	0.9	3.2	0.291
4040	8.2	99.2	3.2	140.7	5.0	-41.6	6.2	0.753
64000	6.2	-80.4	9.9	-115.2	-3.7	34.8	6.0	0.960
64005	16.3	-155.6	16.5	-159.3	-0.2	3.7	1.1	0.067

64010	23.8	-149.7	20.9	-159.9	2.9	10.2	4.9	0.207
5790	25.6	-111.8	23.6	-117.6	2.0	5.8	3.2	0.125
5791	25.3	-114.3	23.6	-117.6	1.7	3.3	2.2	0.087
3840	34.4	-106.8	28.5	-110.7	5.9	3.9	6.3	0.183
3710	25.9	-106.8	30.3	-105.8	-4.4	-1.0	4.4	0.171
G08	32.0	-99.9	31.2	-109.1	0.8	9.3	5.2	0.162
3690	32.0	-112.8	31.2	-109.2	0.8	-3.7	2.2	0.068
G23	15.1	160.1	17.1	164.1	-2.0	-4.0	2.3	0.151
Mean	24.7	–	24.2	–	0.5	3.6	4.6	0.2
Absolute	–	–	–	–	2.6	9.0	–	–
RMS	26.3	132.5	25.4	136.6	3.7	13.1	5.7	0.377

Table 14 continued: Baffin Bay - K1 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
G01	10.6	-178.2	15.2	174.4	-4.6	7.4	4.8	0.457
G09	11.6	178.8	15.4	176.0	-3.8	2.8	3.8	0.332
G11	9.7	141.8	9.7	137.6	-0.0	4.3	0.7	0.075
G14	12.0	166.8	14.9	175.3	-2.9	-8.5	3.6	0.296
G16	10.1	126.9	10.3	130.2	-0.2	-3.3	0.6	0.060
G24	8.9	-170.2	15.4	-170.1	-6.5	-0.1	6.5	0.732
G26	12.8	177.8	14.7	176.1	-1.9	1.7	1.9	0.150
G28	9.0	148.8	15.3	165.4	-6.3	-16.6	7.2	0.796
G29	12.7	139.8	15.7	142.5	-3.0	-2.7	3.0	0.239
G31	11.9	-165.2	15.4	-170.3	-3.5	5.1	3.7	0.313
3575	10.3	132.8	9.7	137.2	0.6	-4.4	0.9	0.092
3916	9.3	-149.5	10.3	-153.0	-1.0	3.5	1.1	0.121
3941	3.4	-153.9	10.7	-150.1	-7.3	-3.8	7.3	2.144
3948	7.3	-146.9	9.8	-148.7	-2.5	1.8	2.6	0.350
3960	12.4	-162.2	9.5	-150.0	2.9	-12.2	3.7	0.296
3970	6.0	-159.2	8.9	-152.4	-2.9	-6.8	3.0	0.504
3980	8.2	178.8	8.9	-153.2	-0.7	-28.1	4.2	0.513
3995	2.7	-172.2	5.9	-142.0	-3.2	-30.2	3.8	1.413
4040	2.7	114.8	2.2	95.8	0.5	19.0	1.0	0.357
64000	1.3	-172.6	4.1	-155.8	-2.8	-16.8	2.9	2.197
64005	7.3	147.7	8.2	162.7	-0.9	-15.0	2.2	0.302
64010	10.1	159.2	10.7	165.4	-0.6	-6.2	1.3	0.126
5790	8.2	-150.3	10.3	-149.3	-2.1	-1.0	2.1	0.259
5791	7.5	-158.6	10.3	-149.2	-2.8	-9.3	3.2	0.422
3840	13.1	-161.3	13.2	-148.4	-0.1	-13.0	3.0	0.226
3710	12.8	-149.2	13.8	-143.4	-1.0	-5.8	1.7	0.130

G08	12.4	-142.2	14.3	-146.2	-1.9	4.0	2.1	0.168
3690	12.4	-154.2	14.3	-146.2	-1.9	-8.0	2.6	0.213
G23	9.6	117.8	9.2	136.7	0.4	-18.8	3.1	0.323
Mean	9.2	–	11.2	–	-2.1	-5.6	3.0	0.5
Absolute	–	–	–	–	2.4	9.0	–	–
RMS	9.8	155.4	11.8	152.8	3.0	11.8	3.5	0.711

Table 14 continued: Baffin Bay - O1 Results

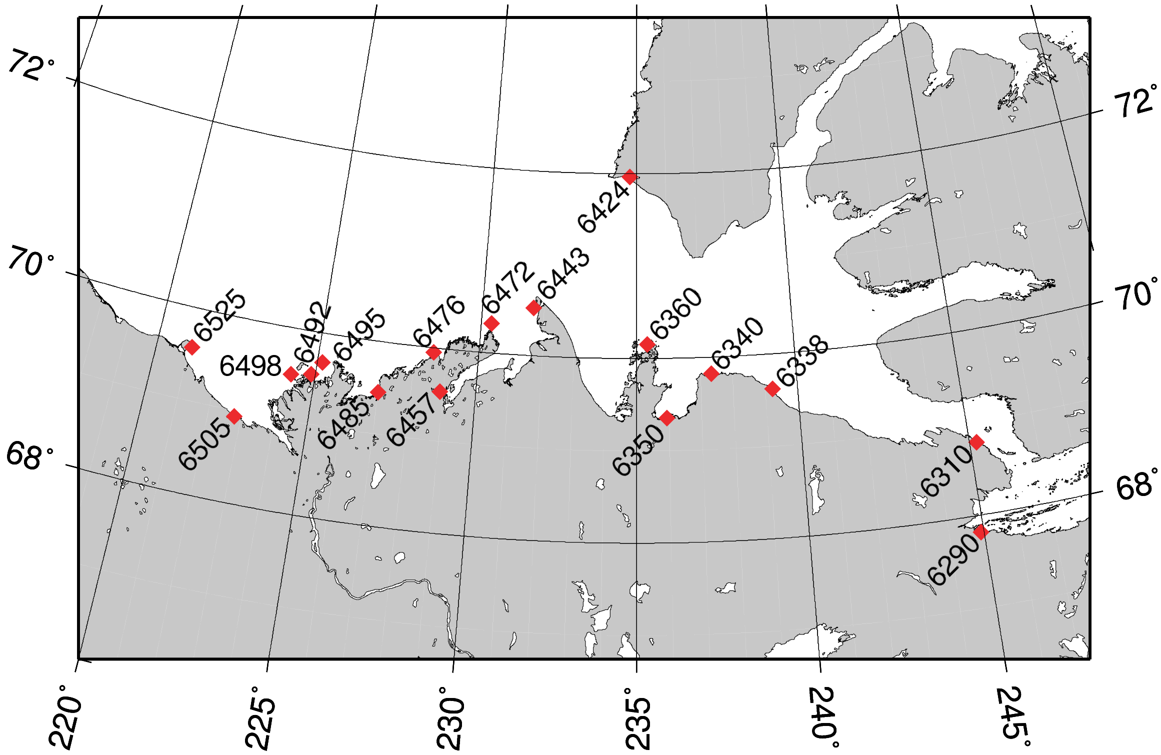

Figure 20: Arctic West

B.2 Arctic West

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
6290	1.6	-18.0	3.7	-105.7	-2.1	87.6	4.0	2.473
6310	17.3	80.9	13.2	86.6	4.1	-5.7	4.4	0.254
6338	17.3	45.4	14.2	70.0	3.1	-24.6	7.4	0.426
6340	13.2	48.0	12.4	65.7	0.8	-17.7	4.0	0.305
6350	16.4	48.9	13.0	64.4	3.4	-15.5	5.2	0.319
6360	11.9	40.0	10.0	48.5	1.9	-8.5	2.5	0.212
6424	4.6	134.3	4.8	107.7	-0.2	26.6	2.2	0.471
6443	8.1	14.2	8.5	23.9	-0.4	-9.7	1.5	0.180
6457	31.7	91.3	36.2	57.3	-4.5	33.9	20.3	0.640
6472	21.8	-36.8	13.4	-19.6	8.4	-17.2	9.8	0.451
6476	12.8	-88.9	9.6	-65.7	3.2	-23.2	5.5	0.429
6485	12.1	-55.6	9.2	-74.6	2.9	19.0	4.5	0.376
6492	3.9	-58.6	5.7	-72.4	-1.8	13.8	2.2	0.555
6495	6.7	-101.2	6.0	-74.5	0.7	-26.7	3.0	0.449

6498	5.2	-80.4	5.8	-65.4	-0.6	-15.0	1.5	0.297
6505	10.2	-89.3	8.0	-77.9	2.2	-11.4	2.8	0.278
6525	7.9	-100.4	5.9	-80.8	2.0	-19.7	3.1	0.388
Mean	11.9	–	10.6	–	1.4	-0.8	4.9	0.5
Absolute	–	–	–	–	2.5	22.1	–	–
RMS	14.0	73.7	12.8	71.9	3.2	28.4	6.6	0.712

Table 15: Arctic West - M2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
6290	0.3	-71.9	0.8	-152.2	-0.5	80.4	0.9	2.836
6310	2.7	46.1	3.0	61.6	-0.3	-15.6	0.8	0.313
6338	2.8	4.7	3.2	43.8	-0.4	-39.1	2.0	0.729
6340	2.4	-21.5	2.8	39.6	-0.4	-61.1	2.7	1.110
6350	3.0	13.5	2.9	38.3	0.1	-24.8	1.3	0.425
6360	2.7	8.5	2.3	22.4	0.4	-13.9	0.7	0.274
6424	0.8	107.6	1.1	80.8	-0.3	26.8	0.5	0.662
6443	1.4	8.1	1.8	-6.3	-0.4	14.4	0.6	0.417
6457	4.5	27.5	6.7	39.6	-2.2	-12.1	2.5	0.547
6472	3.5	-74.1	2.7	-45.9	0.8	-28.2	1.7	0.486
6476	2.1	-86.1	2.0	-90.1	0.1	4.0	0.2	0.090
6485	1.9	-82.2	1.9	-97.2	0.0	15.0	0.5	0.260
6492	0.3	18.4	1.2	-93.8	-0.9	112.2	1.4	4.506
6495	0.3	-109.8	1.3	-96.2	-1.0	-13.7	1.0	3.235
6498	1.0	-54.1	1.2	-87.2	-0.2	33.1	0.7	0.673
6505	1.7	-51.8	1.7	-100.0	0.0	48.2	1.4	0.816
6525	1.1	-127.4	1.3	-103.5	-0.2	-23.9	0.5	0.467
Mean	1.9	–	2.2	–	-0.3	6.0	1.1	1.0
Absolute	–	–	–	–	0.5	33.3	–	–
RMS	2.2	66.1	2.6	79.2	0.7	43.2	1.3	1.600

Table 15 continued: Arctic West - N2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
6290	0.6	47.7	0.7	-59.8	-0.1	107.5	1.1	1.808
6310	6.0	143.0	4.7	134.2	1.3	8.8	1.6	0.262
6338	6.4	105.5	4.7	116.5	1.7	-11.0	2.0	0.313
6340	3.5	93.7	4.0	111.6	-0.5	-17.9	1.3	0.369
6350	4.8	106.0	4.3	110.1	0.5	-4.1	0.6	0.131
6360	3.4	85.0	3.2	92.6	0.2	-7.6	0.5	0.138

6424	1.1	-166.4	1.3	157.8	-0.2	35.8	0.8	0.710
6443	2.4	63.7	2.7	65.6	-0.3	-1.9	0.3	0.142
6457	8.6	153.3	11.5	119.2	-2.9	34.1	6.5	0.756
6472	6.4	18.4	4.6	27.9	1.8	-9.5	2.0	0.317
6476	5.1	-30.7	3.9	-17.6	1.2	-13.1	1.6	0.313
6485	4.8	-7.0	4.0	-28.0	0.8	21.0	1.8	0.369
6492	2.5	-9.5	2.6	-31.7	-0.1	22.2	1.0	0.395
6495	3.3	-39.0	2.7	-32.6	0.6	-6.4	0.7	0.208
6498	2.4	-37.2	2.6	-26.4	-0.2	-10.8	0.5	0.205
6505	4.5	-30.4	3.4	-39.4	1.1	9.0	1.2	0.273
6525	3.2	-54.0	2.4	-41.9	0.8	-12.1	1.0	0.303
Mean	4.1	–	3.7	–	0.3	8.5	1.4	0.4
Absolute	–	–	–	–	0.8	19.6	–	–
RMS	4.5	85.6	4.3	83.9	1.1	30.8	2.0	0.566

Table 15 continued: Arctic West - S2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
6290	7.8	-135.2	12.8	165.7	-5.0	59.2	11.0	1.416
6310	8.5	133.3	7.1	127.1	1.4	6.1	1.7	0.195
6338	5.5	137.8	4.1	121.6	1.4	16.2	1.9	0.350
6340	5.2	137.8	3.8	119.2	1.4	18.6	2.0	0.383
6350	6.4	124.3	3.9	118.9	2.5	5.4	2.6	0.401
6360	5.5	115.0	3.5	108.8	2.0	6.2	2.1	0.376
6424	4.0	150.8	2.7	136.0	1.3	14.8	1.5	0.382
6443	2.1	132.0	1.2	105.2	0.9	26.8	1.2	0.549
6457	1.5	-126.8	1.1	150.0	0.4	83.2	1.8	1.179
6472	0.7	-155.0	1.0	137.1	-0.3	67.9	1.0	1.420
6476	2.8	122.9	2.1	140.6	0.7	-17.7	1.0	0.374
6485	3.1	165.6	2.7	132.5	0.4	33.1	1.7	0.546
6492	7.0	-179.4	3.0	118.9	4.0	61.7	6.2	0.882
6495	2.9	148.2	2.9	120.2	0.0	28.0	1.4	0.480
6498	3.2	134.3	3.1	113.9	0.1	20.5	1.1	0.353
6505	3.5	147.7	3.2	100.3	0.3	47.4	2.7	0.776
6525	2.8	137.8	2.9	101.3	-0.1	36.5	1.8	0.644
Mean	4.3	–	3.6	–	0.7	30.2	2.5	0.6
Absolute	–	–	–	–	1.3	32.3	–	–
RMS	4.8	141.1	4.5	125.7	1.9	39.6	3.5	0.730

Table 15 continued: Arctic West - K1 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
6290	2.3	129.1	5.8	90.6	-3.5	38.6	4.3	1.862
6310	3.9	141.6	1.7	132.6	2.2	9.0	2.2	0.566
6338	3.1	155.8	2.5	153.5	0.6	2.3	0.6	0.191
6340	3.2	140.9	2.5	153.9	0.7	-13.0	1.0	0.302
6350	3.0	149.5	2.5	153.7	0.5	-4.2	0.5	0.174
6360	3.3	147.0	2.3	150.2	1.0	-3.2	1.0	0.304
6424	2.6	-177.5	2.3	163.1	0.3	19.4	0.9	0.337
6443	1.7	177.2	1.4	161.5	0.3	15.7	0.5	0.302
6457	1.9	-116.5	1.8	-176.3	0.1	59.8	1.8	0.973
6472	2.0	-154.5	1.5	162.7	0.5	42.8	1.4	0.680
6476	2.7	168.6	1.8	158.0	0.9	10.6	1.0	0.353
6485	2.4	-172.7	2.0	153.9	0.4	33.4	1.3	0.550
6492	3.3	179.8	2.1	146.9	1.2	32.9	1.9	0.582
6495	2.5	160.3	2.0	147.3	0.5	13.0	0.7	0.277
6498	2.1	161.5	2.1	144.3	-0.0	17.3	0.6	0.304
6505	4.8	147.7	2.2	133.2	2.6	14.5	2.7	0.559
6525	3.2	157.2	2.1	132.5	1.1	24.7	1.6	0.491
Mean	2.8	–	2.3	–	0.5	18.4	1.4	0.5
Absolute	–	–	–	–	1.0	20.8	–	–
RMS	2.9	156.1	2.5	149.0	1.3	25.9	1.7	0.648

Table 15 continued: Arctic West - O1 Results

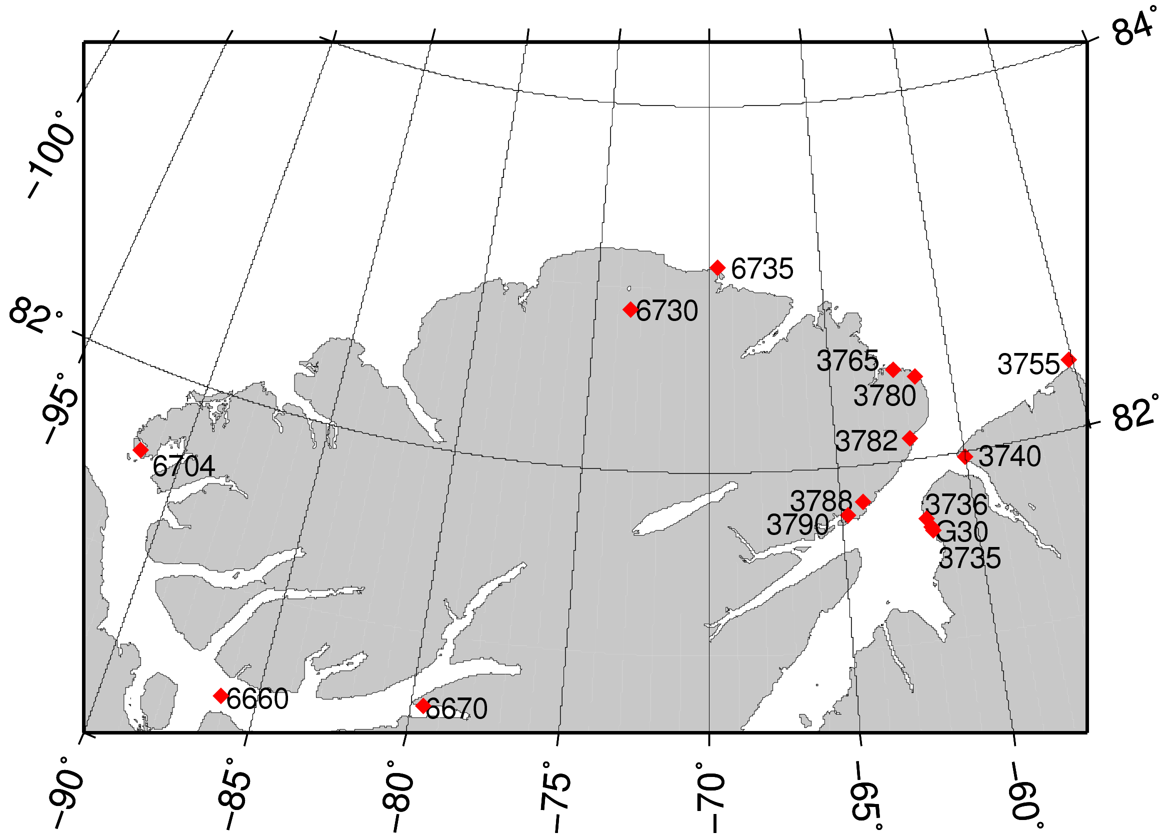

Figure 21: Arctic North

B.3 Arctic North

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
G30	54.9	115.0	57.1	119.8	-2.2	-4.9	5.2	0.095
3735	54.8	111.9	57.1	119.8	-2.3	-7.9	8.0	0.146
3736	55.5	114.9	55.4	119.4	0.1	-4.5	4.3	0.078
3740	38.3	118.2	38.8	120.5	-0.5	-2.2	1.6	0.042
3755	12.8	123.9	12.7	125.7	0.1	-1.7	0.4	0.032
3765	20.9	64.9	18.6	65.5	2.3	-0.6	2.3	0.109
3780	24.3	65.9	21.3	71.7	3.0	-5.7	3.8	0.154
3782	37.9	101.5	39.8	104.9	-1.9	-3.4	3.0	0.078
3788	58.2	106.7	55.7	109.3	2.5	-2.5	3.6	0.061
3790	59.7	103.9	56.9	109.5	2.8	-5.5	6.3	0.105
6660	4.5	-101.8	3.1	-52.3	1.4	-49.5	3.4	0.762
6670	5.1	-86.8	3.4	-52.8	1.7	-33.9	3.0	0.580

6704	1.2	116.5	5.5	-36.3	-4.3	152.8	6.6	5.497
6730	3.7	14.5	7.5	4.8	-3.8	9.7	3.9	1.050
6735	11.5	9.9	9.5	14.9	2.0	-4.9	2.2	0.191
Mean	29.6	–	29.5	–	0.1	2.3	3.8	0.6
Absolute	–	–	–	–	2.0	19.3	–	–
RMS	36.8	97.0	36.7	91.2	2.4	42.6	4.3	1.469

Table 16: Arctic North - M2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
G30	N/A	N/A	11.7	94.4	N/A	N/A	N/A	N/A
3735	10.6	85.8	11.7	94.4	-1.1	-8.6	2.0	0.190
3736	8.5	81.1	11.4	94.0	-2.9	-12.9	3.6	0.429
3740	5.6	91.8	8.1	94.2	-2.5	-2.4	2.5	0.455
3755	2.4	109.8	2.9	92.2	-0.5	17.5	0.9	0.394
3765	3.4	43.9	4.3	42.6	-0.9	1.3	0.9	0.255
3780	4.2	38.8	4.8	47.8	-0.6	-9.0	0.9	0.215
3782	5.8	65.3	8.3	79.6	-2.5	-14.3	3.1	0.531
3788	9.7	74.1	11.5	84.3	-1.8	-10.3	2.6	0.265
3790	11.5	78.8	11.7	84.5	-0.2	-5.8	1.2	0.103
6660	1.4	-125.6	1.0	-49.0	0.4	-76.6	1.5	1.099
6670	2.4	-107.9	1.1	-49.4	1.3	-58.5	2.1	0.854
6704	0.4	123.5	1.4	-51.8	-1.0	175.3	1.8	4.454
6730	0.6	-53.4	2.2	-5.2	-1.6	-48.2	1.8	3.083
6735	1.8	-25.8	2.5	2.4	-0.7	-28.2	1.2	0.684
Mean	4.9	–	6.3	–	-1.0	-5.8	1.9	0.9
Absolute	–	–	–	–	1.3	33.5	–	–
RMS	6.1	84.5	7.6	71.3	1.5	56.1	2.0	1.531

Table 16 continued: Arctic North - N2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
G30	25.3	156.0	24.8	159.6	0.5	-3.6	1.7	0.065
3735	25.2	153.0	24.8	159.6	0.4	-6.6	2.9	0.116
3736	24.3	155.7	24.2	159.3	0.1	-3.6	1.5	0.063
3740	16.1	162.4	17.4	160.2	-1.3	2.2	1.5	0.092
3755	7.0	167.0	6.6	162.6	0.4	4.4	0.6	0.091
3765	10.1	114.4	8.6	114.0	1.5	0.4	1.5	0.150
3780	11.5	114.0	9.7	118.6	1.8	-4.6	2.0	0.173
3782	18.2	147.0	17.7	146.6	0.5	0.4	0.5	0.027

3788	24.0	148.4	24.2	150.3	-0.2	-1.9	0.8	0.035
3790	N/A	N/A	24.7	150.5	N/A	N/A	N/A	N/A
6660	0.2	-128.3	0.5	118.9	-0.3	112.8	0.6	3.158
6670	1.5	117.4	0.6	118.8	0.9	-1.4	0.9	0.629
6704	2.6	4.6	1.3	30.7	1.3	-26.1	1.5	0.594
6730	2.2	58.9	3.3	64.5	-1.1	-5.6	1.1	0.515
6735	4.8	64.0	4.1	72.2	0.7	-8.2	0.9	0.191
Mean	12.4	–	12.8	–	0.4	4.2	1.3	0.4
Absolute	–	–	–	–	0.8	13.0	–	–
RMS	15.5	129.2	16.1	131.9	0.9	31.2	1.4	0.891

Table 16 continued: Arctic North - S2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
G30	12.2	-51.9	11.8	-68.8	0.4	16.9	3.5	0.291
3735	12.1	-53.8	11.8	-68.8	0.3	14.9	3.1	0.258
3736	12.2	-56.7	11.5	-67.9	0.7	11.1	2.4	0.197
3740	9.6	-38.6	9.8	-54.3	-0.2	15.7	2.7	0.277
3755	9.7	-13.8	8.3	-22.3	1.4	8.5	2.0	0.201
3765	4.7	2.8	4.8	-7.6	-0.1	10.4	0.9	0.185
3780	4.8	-0.8	4.3	-8.1	0.5	7.3	0.8	0.162
3782	6.5	-52.7	6.3	-61.1	0.2	8.4	1.0	0.147
3788	8.3	-65.0	8.5	-77.5	-0.2	12.4	1.8	0.220
3790	8.5	-73.8	8.7	-78.3	-0.2	4.5	0.7	0.083
6660	5.5	35.5	5.6	98.8	-0.1	-63.3	5.8	1.062
6670	6.2	101.5	5.7	98.8	0.5	2.7	0.5	0.087
6704	8.0	64.9	5.7	99.9	2.3	-35.0	4.7	0.582
6730	2.9	27.9	3.7	-39.6	-0.8	67.5	3.7	1.275
6735	5.1	21.2	4.5	-16.0	0.6	37.2	3.1	0.612
Mean	7.8	–	7.4	–	0.3	7.9	2.4	0.4
Absolute	–	–	–	–	0.6	21.1	–	–
RMS	8.3	51.6	7.9	65.8	0.8	28.9	2.9	0.511

Table 16 continued: Arctic North - K1 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
G30	4.6	-89.2	4.6	-114.7	0.0	25.5	2.0	0.441
3735	4.5	-91.2	4.6	-114.7	-0.1	23.4	1.8	0.411
3736	4.3	-89.1	4.4	-114.1	-0.1	24.9	1.9	0.438
3740	3.7	-78.0	3.4	-100.4	0.3	22.3	1.4	0.380
3755	4.2	-38.2	2.5	-58.9	1.7	20.6	2.1	0.490
3765	2.6	-17.1	1.0	-12.4	1.6	-4.7	1.6	0.606
3780	2.7	-19.2	0.7	-5.6	2.0	-13.6	2.0	0.734
3782	2.1	-74.9	2.0	-118.5	0.1	43.6	1.5	0.723
3788	3.0	-94.0	3.3	-130.0	-0.3	36.0	2.0	0.661
3790	2.7	-96.2	3.4	-130.4	-0.7	34.1	1.9	0.719
6660	2.7	-2.7	2.1	53.8	0.6	-56.5	2.3	0.860
6670	5.0	38.7	2.1	53.8	2.9	-15.1	3.0	0.606
6704	2.1	-53.6	2.2	54.9	-0.1	-108.5	3.5	1.647
6730	1.3	8.6	1.0	-47.5	0.3	56.1	1.1	0.865
6735	3.3	-9.3	1.3	-22.1	2.0	12.8	2.1	0.629
Mean	3.3	–	2.6	–	0.7	6.7	2.0	0.7
Absolute	–	–	–	–	0.9	33.2	–	–
RMS	3.4	63.6	2.9	86.6	1.2	41.5	2.1	0.743

Table 16 continued: Arctic North - O1 Results

B.4 Arctic Northwest

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5645	36.8	-104.1	25.0	-96.0	11.8	-8.1	12.6	0.342
6834	30.4	-112.1	23.7	-110.1	6.7	-1.9	6.8	0.223
6835	32.1	-123.5	21.6	-119.7	10.5	-3.8	10.6	0.331
6910	8.8	-102.1	5.9	-108.1	2.9	6.0	3.0	0.345
6955	14.6	-83.1	12.0	-79.5	2.6	-3.6	2.8	0.189
Mean	24.5	–	17.6	–	6.9	-2.3	7.1	0.3
Absolute	–	–	–	–	6.9	4.7	–	–
RMS	26.8	105.8	19.1	103.6	7.9	5.1	8.2	0.293

Table 17: Arctic Northwest - M2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5645	5.1	-142.9	4.0	-122.5	1.1	-20.4	1.9	0.378
6834	4.2	-126.4	3.8	-137.4	0.4	11.0	0.9	0.203
6835	5.9	-155.2	3.4	-146.5	2.5	-8.7	2.6	0.441
6910	2.1	-133.9	0.9	-115.2	1.2	-18.7	1.3	0.609
6955	2.4	-104.9	2.0	-100.8	0.4	-4.1	0.4	0.163
Mean	3.9	–	2.8	–	1.1	-8.2	1.4	0.4
Absolute	–	–	–	–	1.1	12.6	–	–
RMS	4.2	133.7	3.1	125.5	1.4	14.0	1.6	0.394

Table 17 continued: Arctic Northwest - N2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5645	21.6	-55.0	11.4	-47.1	10.2	-7.9	10.5	0.485
6834	11.3	-64.6	10.3	-62.2	1.0	-2.4	1.1	0.101
6835	14.5	-69.1	9.0	-72.9	5.5	3.8	5.5	0.380
6910	2.4	-56.0	1.3	-73.6	1.1	17.6	1.2	0.518
6955	7.0	-36.0	5.2	-29.2	1.8	-6.8	2.0	0.281
Mean	11.4	–	7.4	–	3.9	0.8	4.1	0.4
Absolute	–	–	–	–	3.9	7.7	–	–
RMS	13.1	57.3	8.3	59.4	5.3	9.4	5.4	0.384

Table 17 continued: Arctic Northwest - S2 Results

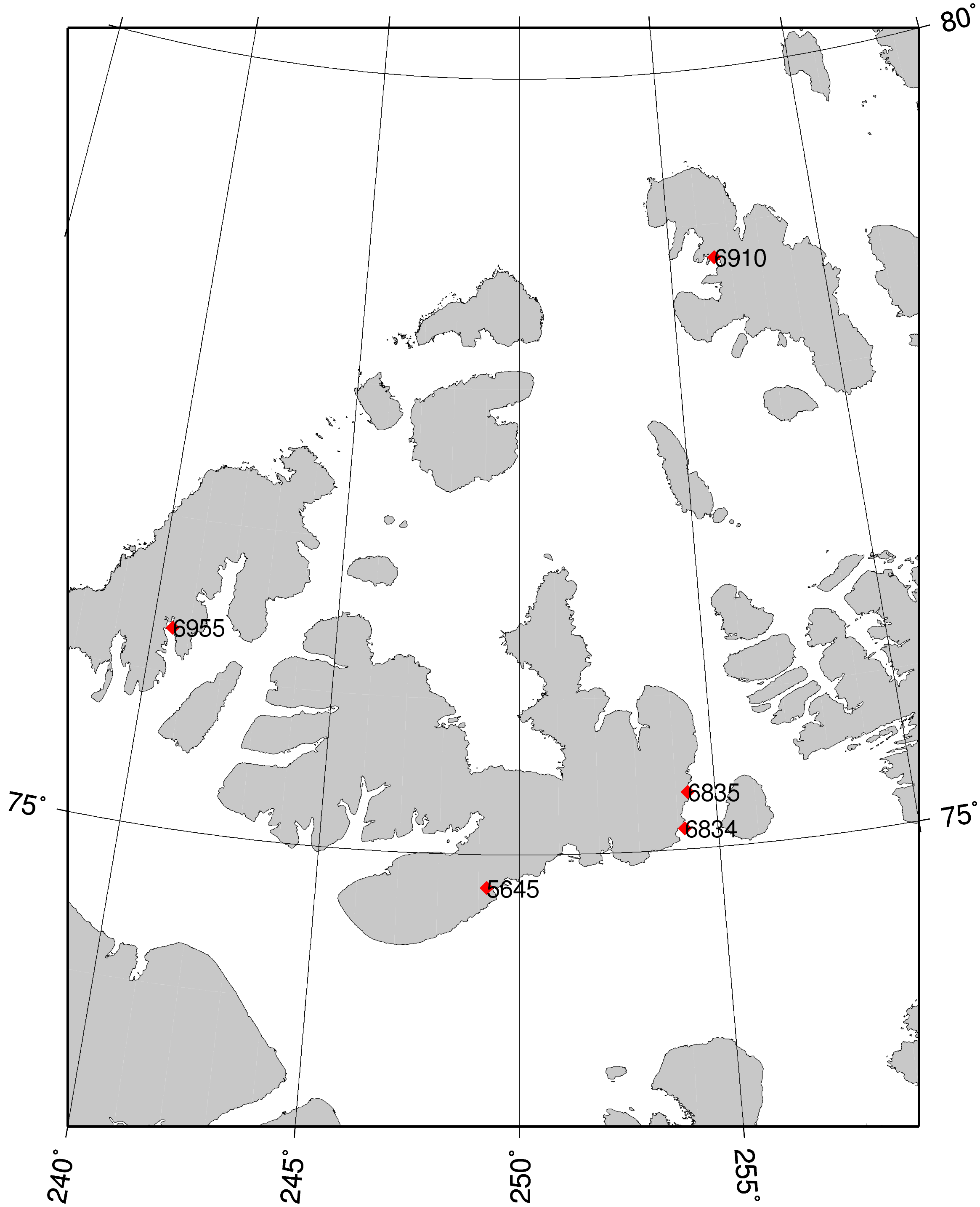

Figure 22: Arctic Northwest

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5645	6.7	18.3	8.6	12.2	-1.9	6.1	2.1	0.313
6834	7.2	-18.0	10.0	0.6	-2.8	-18.6	3.9	0.545
6835	6.9	5.0	8.8	-0.9	-1.9	5.9	2.0	0.297
6910	4.8	43.3	6.1	41.1	-1.3	2.2	1.3	0.281
6955	3.9	-132.7	5.5	50.9	-1.6	176.4	9.4	2.413
Mean	5.9	–	7.8	–	-1.9	34.4	3.8	0.8
Absolute	–	–	–	–	1.9	41.9	–	–
RMS	6.0	63.5	8.0	29.7	2.0	79.4	4.8	1.130

Table 17 continued: Arctic Northwest - K1 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5645	3.0	-119.4	4.9	-69.8	-1.9	-49.6	3.7	1.235
6834	5.6	-53.1	6.2	-75.4	-0.6	22.3	2.4	0.420
6835	3.5	-103.4	5.4	-79.6	-1.9	-23.8	2.6	0.743
6910	2.1	-14.4	2.4	-26.5	-0.3	12.1	0.6	0.268
6955	0.9	139.6	1.3	-29.6	-0.4	169.2	2.2	2.418
Mean	3.0	–	4.0	–	-1.0	26.0	2.3	1.0
Absolute	–	–	–	–	1.0	55.4	–	–
RMS	3.4	97.4	4.4	60.8	1.2	80.4	2.5	1.279

Table 17 continued: Arctic Northwest - O1 Results

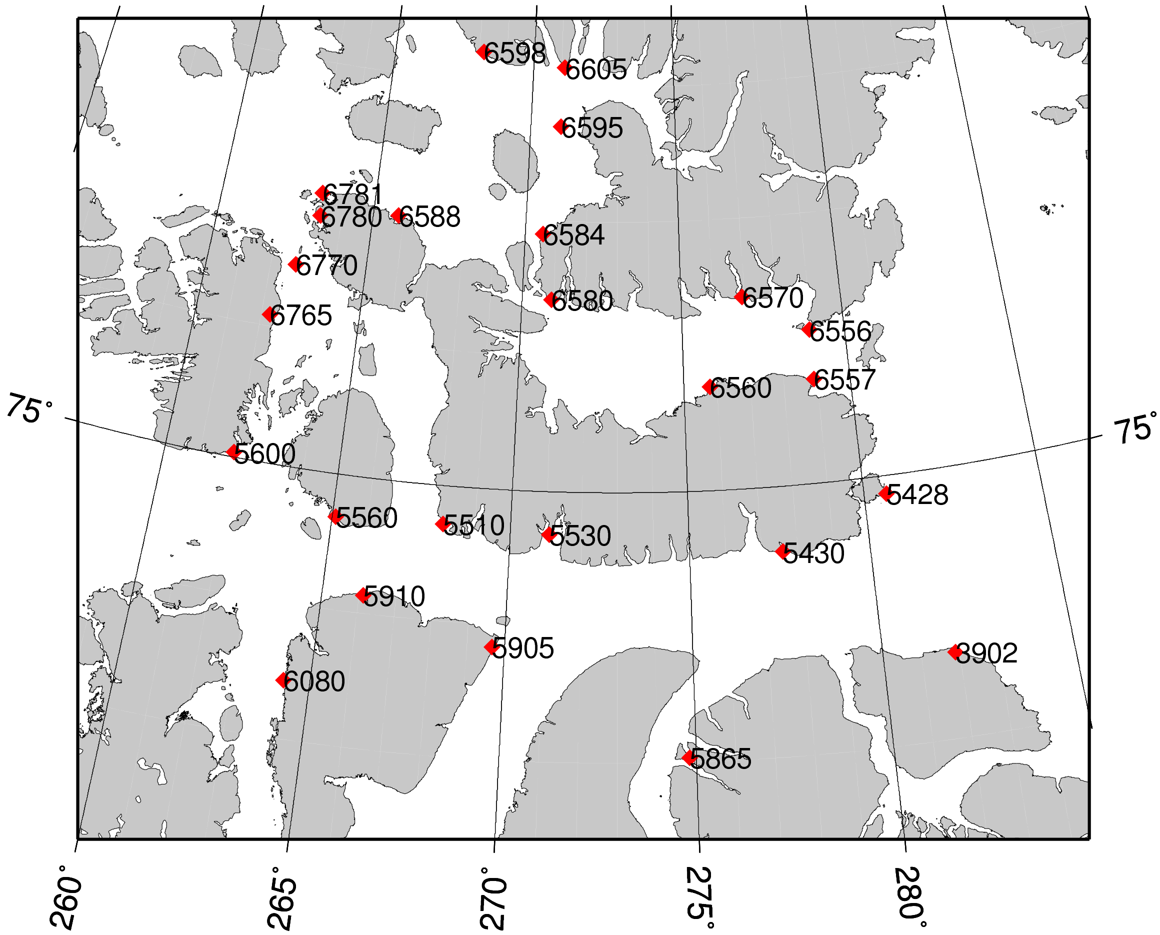

Figure 23: Arctic Central

B.5 Arctic Central

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
3902	53.9	135.9	56.8	132.8	-2.9	3.1	4.2	0.078
5428	69.0	134.6	66.8	131.9	2.2	2.7	3.9	0.056
5430	66.4	137.9	65.6	135.5	0.8	2.5	3.0	0.044
5510	60.9	170.9	54.9	160.8	6.0	10.1	11.8	0.194
5530	67.5	172.4	62.8	149.1	4.7	23.3	26.7	0.395
5560	46.3	178.6	37.3	174.0	9.0	4.6	9.6	0.207
5600	36.8	-160.7	31.1	-164.4	5.7	3.7	6.1	0.166
5865	61.2	147.9	73.3	138.7	-12.1	9.2	16.2	0.265
5905	60.9	151.9	57.0	149.2	3.9	2.7	4.8	0.078
5910	43.6	162.6	36.7	150.1	6.9	12.5	11.1	0.255
6080	22.9	152.0	18.3	148.0	4.6	4.0	4.8	0.210
6556	89.4	129.9	90.1	129.1	-0.7	0.8	1.5	0.017

6557	84.7	132.7	85.8	132.0	-1.1	0.7	1.5	0.018
6560	88.4	135.9	95.1	134.1	-6.7	1.9	7.3	0.083
6570	96.3	132.5	94.4	130.9	1.9	1.6	3.3	0.035
6580	82.3	142.4	89.2	139.8	-6.9	2.6	7.9	0.096
6584	42.3	165.2	42.4	158.1	-0.1	7.1	5.2	0.124
6588	23.8	165.4	22.8	155.8	1.0	9.6	4.0	0.168
6595	35.1	169.1	34.9	164.9	0.2	4.2	2.6	0.073
6598	28.1	176.4	29.6	172.5	-1.5	3.9	2.5	0.089
6605	33.7	173.1	34.3	168.6	-0.6	4.5	2.7	0.081
6765	37.7	-174.1	32.8	170.8	4.9	15.1	10.4	0.277
6770	32.2	-168.9	26.1	177.1	6.1	14.0	9.4	0.291
6780	20.1	-166.1	16.7	-174.3	3.4	8.2	4.3	0.213
6781	18.6	-160.3	15.3	178.8	3.3	20.9	7.0	0.374
Mean	52.1	–	50.8	–	1.3	6.9	6.9	0.2
Absolute	–	–	–	–	3.9	6.9	–	–
RMS	57.1	156.7	56.9	153.7	4.9	9.2	8.7	0.189

Table 18: Arctic Central - M2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
3902	12.2	110.6	11.9	106.7	0.3	3.9	0.9	0.072
5428	13.1	106.0	13.8	106.4	-0.7	-0.4	0.7	0.052
5430	13.5	102.6	13.4	109.4	0.1	-6.8	1.6	0.119
5510	13.1	138.6	10.6	134.0	2.5	4.7	2.7	0.204
5530	8.1	126.9	12.4	122.7	-4.3	4.3	4.3	0.535
5560	8.4	149.6	7.1	146.1	1.3	3.5	1.4	0.162
5600	7.6	174.6	5.7	166.2	1.9	8.4	2.1	0.280
5865	14.6	116.2	14.9	111.8	-0.3	4.4	1.2	0.079
5905	12.8	116.6	11.2	122.4	1.6	-5.8	2.0	0.157
5910	5.5	137.3	7.1	121.4	-1.6	16.0	2.4	0.434
6080	3.6	119.3	3.4	120.9	0.2	-1.6	0.2	0.054
6556	20.0	97.9	18.3	103.6	1.7	-5.7	2.5	0.127
6557	16.7	107.5	17.5	106.5	-0.8	1.1	0.9	0.051
6560	18.7	101.7	19.3	108.3	-0.6	-6.6	2.3	0.122
6570	16.4	98.0	19.2	105.3	-2.8	-7.3	3.6	0.217
6580	18.8	128.0	18.0	113.5	0.8	14.6	4.7	0.252
6584	9.6	149.9	7.8	126.2	1.8	23.7	4.0	0.416
6588	5.6	149.2	4.0	118.6	1.6	30.6	3.0	0.532
6595	7.9	149.3	6.2	131.6	1.7	17.8	2.8	0.349
6598	6.5	161.0	5.2	138.8	1.3	22.3	2.6	0.401
6605	7.7	157.8	6.0	135.1	1.7	22.8	3.2	0.411
6765	7.0	169.6	5.8	139.5	1.2	30.1	3.5	0.503
6770	6.9	150.4	4.5	145.8	2.4	4.6	2.5	0.360
6780	3.9	175.6	2.5	153.4	1.4	22.3	1.8	0.471
6781	3.9	162.9	2.3	143.3	1.6	19.7	1.9	0.492
Mean	10.5	–	9.9	–	0.6	8.8	2.3	0.3
Absolute	–	–	–	–	1.4	11.5	–	–
RMS	11.6	136.6	11.3	126.6	1.7	14.8	2.6	0.321

Table 18 continued: Arctic Central - N2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
3902	19.4	-176.9	19.2	174.7	0.2	8.4	2.8	0.146
5428	26.0	-178.1	23.5	173.5	2.5	8.4	4.4	0.169
5430	26.2	180.0	23.1	178.1	3.1	1.9	3.3	0.124
5510	21.0	-142.0	20.8	-154.8	0.2	12.8	4.7	0.222
5530	25.6	-140.1	23.0	-166.5	2.6	26.4	11.4	0.445
5560	19.1	-129.6	14.6	-139.9	4.5	10.3	5.4	0.282
5600	15.6	-112.2	12.6	-117.4	3.0	5.2	3.2	0.208
5865	21.9	-160.0	26.0	-177.3	-4.1	17.3	8.3	0.378
5905	19.5	-151.0	21.0	-164.9	-1.5	13.9	5.1	0.263
5910	16.5	-150.7	14.1	-161.8	2.4	11.1	3.8	0.230
6080	8.9	-151.1	7.9	-163.1	1.0	12.0	2.0	0.228
6556	34.6	170.2	33.5	169.9	1.1	0.3	1.2	0.034
6557	32.4	175.0	31.7	173.3	0.7	1.7	1.2	0.037
6560	36.7	173.4	35.9	175.4	0.8	-2.0	1.5	0.040
6570	37.7	177.5	35.4	171.8	2.3	5.7	4.3	0.115
6580	33.2	-175.0	34.6	-179.7	-1.4	4.7	3.1	0.094
6584	17.1	-159.4	18.1	-162.9	-1.0	3.5	1.5	0.086
6588	9.1	-163.4	10.8	-166.8	-1.7	3.4	1.8	0.197
6595	14.5	-157.7	15.6	-157.3	-1.1	-0.4	1.1	0.074
6598	11.2	-151.1	13.2	-150.7	-2.0	-0.4	2.0	0.182
6605	13.7	-153.4	15.4	-153.7	-1.7	0.3	1.7	0.125
6765	14.9	-134.0	13.8	-146.9	1.1	12.9	3.4	0.229
6770	11.0	-119.9	10.8	-144.1	0.2	24.2	4.6	0.416
6780	7.0	-135.0	6.8	-143.2	0.2	8.2	1.0	0.144
6781	4.6	-116.4	6.6	-151.4	-2.0	35.0	3.8	0.834
Mean	19.9	–	19.5	–	0.4	9.0	3.5	0.2
Absolute	–	–	–	–	1.7	9.2	–	–
RMS	22.0	154.6	21.5	161.4	2.0	12.7	4.2	0.270

Table 18 continued: Arctic Central - S2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
3902	21.6	-105.7	22.1	-116.6	-0.5	10.9	4.2	0.193
5428	30.1	-97.2	28.2	-106.3	1.9	9.1	5.0	0.166
5430	34.1	-91.8	25.0	-96.1	9.1	4.3	9.4	0.276
5510	27.4	-24.8	25.0	-41.3	2.4	16.5	7.9	0.288
5530	28.1	-40.0	25.8	-61.0	2.3	21.0	10.1	0.359
5560	19.5	-21.2	19.0	-26.6	0.5	5.4	1.9	0.097
5600	16.2	-6.2	16.3	-15.6	-0.1	9.4	2.7	0.164
5865	15.8	-79.8	16.3	-103.5	-0.5	23.7	6.6	0.419
5905	27.4	-53.8	22.2	-60.5	5.2	6.7	5.9	0.216
5910	10.6	-39.3	10.1	-45.0	0.5	5.8	1.2	0.109
6080	8.7	-12.8	11.3	-12.2	-2.6	-0.6	2.6	0.294
6556	35.8	-99.6	29.5	-106.8	6.3	7.2	7.5	0.210
6557	33.4	-103.3	28.3	-107.4	5.1	4.1	5.6	0.167
6560	32.0	-100.9	27.8	-105.1	4.2	4.2	4.8	0.149
6570	30.8	-94.8	29.3	-105.6	1.5	10.8	5.9	0.190
6580	23.3	-83.8	24.8	-95.9	-1.5	12.2	5.3	0.228
6584	8.6	-35.8	4.0	-46.8	4.6	11.0	4.7	0.549
6588	5.4	37.8	6.8	49.4	-1.4	-11.6	1.9	0.349
6595	6.3	-19.7	3.1	8.8	3.2	-28.5	3.8	0.610
6598	5.6	-2.9	3.6	18.9	2.0	-21.7	2.6	0.463
6605	5.7	-12.5	3.1	13.1	2.6	-25.5	3.2	0.561
6765	10.9	-13.8	8.7	-18.9	2.2	5.1	2.4	0.221
6770	10.2	6.6	9.7	1.3	0.5	5.4	1.1	0.104
6780	9.4	11.2	9.9	23.3	-0.5	-12.1	2.1	0.225
6781	8.3	29.5	9.0	31.7	-0.7	-2.1	0.8	0.096
Mean	18.6	–	16.8	–	1.8	2.8	4.4	0.3
Absolute	–	–	–	–	2.5	11.0	–	–
RMS	21.4	61.3	19.2	68.9	3.3	13.3	5.0	0.306

Table 18 continued: Arctic Central - K1 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
3902	7.8	-147.1	9.8	-147.6	-2.0	0.5	2.0	0.257
5428	12.7	-143.1	13.6	-142.7	-0.9	-0.3	0.9	0.068
5430	10.8	-134.4	12.8	-131.2	-2.0	-3.2	2.1	0.191
5510	14.9	-106.3	15.0	-88.5	-0.1	-17.8	4.6	0.311
5530	16.3	-96.2	15.0	-103.5	1.3	7.3	2.4	0.145
5560	10.9	-82.0	12.1	-79.4	-1.2	-2.6	1.3	0.121
5600	8.1	-78.4	10.4	-73.6	-2.3	-4.8	2.4	0.298
5865	8.2	-120.3	8.3	-127.5	-0.1	7.2	1.0	0.126
5905	13.5	-112.3	13.5	-102.4	-0.0	-9.9	2.3	0.173
5910	8.7	-106.7	8.2	-91.1	0.5	-15.6	2.4	0.270
6080	7.2	-95.2	8.8	-74.0	-1.6	-21.2	3.4	0.467
6556	12.8	-136.7	13.9	-143.8	-1.1	7.1	2.0	0.157
6557	11.7	-140.9	13.4	-144.0	-1.7	3.1	1.8	0.156
6560	11.1	-138.5	13.3	-142.0	-2.2	3.5	2.3	0.205
6570	12.8	-141.0	13.9	-142.8	-1.1	1.8	1.2	0.090
6580	8.6	-132.8	11.3	-135.6	-2.7	2.7	2.7	0.319
6584	4.1	-80.3	2.8	-86.8	1.3	6.5	1.3	0.324
6588	2.8	-27.6	3.1	-23.5	-0.3	-4.1	0.4	0.137
6595	3.1	-63.2	2.2	-60.0	0.9	-3.2	0.9	0.291
6598	2.9	-54.7	2.2	-50.6	0.7	-4.1	0.7	0.235
6605	2.8	-59.0	2.1	-57.6	0.7	-1.4	0.7	0.237
6765	5.7	-75.3	5.9	-82.1	-0.2	6.8	0.7	0.123
6770	6.5	-62.5	5.8	-63.5	0.7	1.0	0.7	0.104
6780	4.5	-50.3	5.1	-42.3	-0.6	-8.0	0.9	0.207
6781	4.7	-35.7	4.5	-36.1	0.2	0.4	0.2	0.046
Mean	8.5	–	9.1	–	-0.6	-1.9	1.6	0.2
Absolute	–	–	–	–	1.0	5.8	–	–
RMS	9.4	103.4	10.1	102.4	1.3	7.8	1.9	0.224

Table 18 continued: Arctic Central - O1 Results

B.6 Arctic South Central

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
6090	15.9	103.4	9.8	117.2	6.1	-13.8	6.8	0.425
6110	23.4	53.8	18.3	35.4	5.1	18.4	8.4	0.357
6150	6.1	100.0	16.3	111.2	-10.2	-11.2	10.4	1.706
6240	14.7	178.9	9.5	170.2	5.2	8.6	5.5	0.374
Mean	15.0	–	13.5	–	1.5	0.5	7.8	0.7
Absolute	–	–	–	–	6.6	13.0	–	–
RMS	16.2	117.9	14.0	118.7	7.0	13.5	8.0	0.916

Table 19: Arctic South Central - M2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
6090	2.1	71.3	1.6	98.1	0.5	-26.8	1.0	0.474
6110	3.3	12.2	3.0	-2.8	0.3	15.1	0.9	0.266
6150	1.2	65.2	2.6	75.8	-1.4	-10.6	1.5	1.209
6240	2.7	140.7	1.5	137.1	1.2	3.5	1.2	0.431
Mean	2.3	–	2.2	–	0.1	-4.7	1.1	0.6
Absolute	–	–	–	–	0.9	14.0	–	–
RMS	2.5	85.6	2.3	92.5	1.0	16.4	1.1	0.697

Table 19 continued: Arctic South Central - N2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
6090	7.2	167.2	5.3	170.7	1.9	-3.5	2.0	0.276
6110	9.3	126.1	7.0	102.2	2.3	23.9	4.0	0.435
6150	2.4	158.4	5.7	-173.9	-3.3	-27.7	3.7	1.545
6240	5.5	-121.2	3.4	-129.7	2.1	8.5	2.2	0.401
Mean	6.1	–	5.3	–	0.8	0.3	3.0	0.7
Absolute	–	–	–	–	2.4	15.9	–	–
RMS	6.6	144.6	5.5	147.2	2.4	18.9	3.1	0.839

Table 19 continued: Arctic South Central - S2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative

6090	9.9	-0.4	13.6	-7.3	-3.7	6.9	4.0	0.403
6110	10.2	11.3	13.7	6.6	-3.5	4.7	3.7	0.359
6150	2.1	137.2	6.0	60.4	-3.9	76.8	5.9	2.824
6240	5.1	128.9	9.3	104.8	-4.2	24.0	5.1	0.992
Mean	6.8	–	10.7	–	-3.8	28.1	4.7	1.1
Absolute	–	–	–	–	3.8	28.1	–	–
RMS	7.6	94.3	11.1	60.7	3.9	40.4	4.7	1.521

Table 19 continued: Arctic South Central - K1 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
6090	7.6	-93.2	10.3	-70.5	-2.7	-22.7	4.4	0.577
6110	7.4	-91.2	10.5	-62.0	-3.1	-29.3	5.4	0.732
6150	1.6	30.4	4.6	-9.3	-3.0	39.7	3.5	2.180
6240	3.6	-13.8	7.7	19.4	-4.1	-33.2	5.1	1.416
Mean	5.0	–	8.3	–	-3.2	-11.4	4.6	1.2
Absolute	–	–	–	–	3.2	31.2	–	–
RMS	5.7	67.3	8.6	48.2	3.3	31.8	4.7	1.381

Table 19 continued: Arctic South Central - O1 Results

B.7 Arctic Southeast

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
5295	65.6	0.0	65.1	3.9	0.5	-3.9	4.5	0.068
5305	68.3	4.8	66.7	1.7	1.6	3.1	4.0	0.059
5310	64.2	8.0	64.1	2.3	0.1	5.7	6.4	0.100
5315	61.4	-14.3	56.4	-16.5	5.0	2.3	5.5	0.090
5330	49.3	-20.1	51.9	-26.2	-2.6	6.1	6.0	0.121
5332	47.9	-20.9	48.4	-24.4	-0.5	3.5	3.0	0.062
5920	52.5	163.5	44.2	152.5	8.3	11.0	12.4	0.237
Mean	58.5	–	56.7	–	1.8	4.0	6.0	0.1
Absolute	–	–	–	–	2.6	5.1	–	–
RMS	59.0	63.1	57.3	59.5	3.8	5.8	6.6	0.120

Table 20: Arctic Southeast - M2 Results

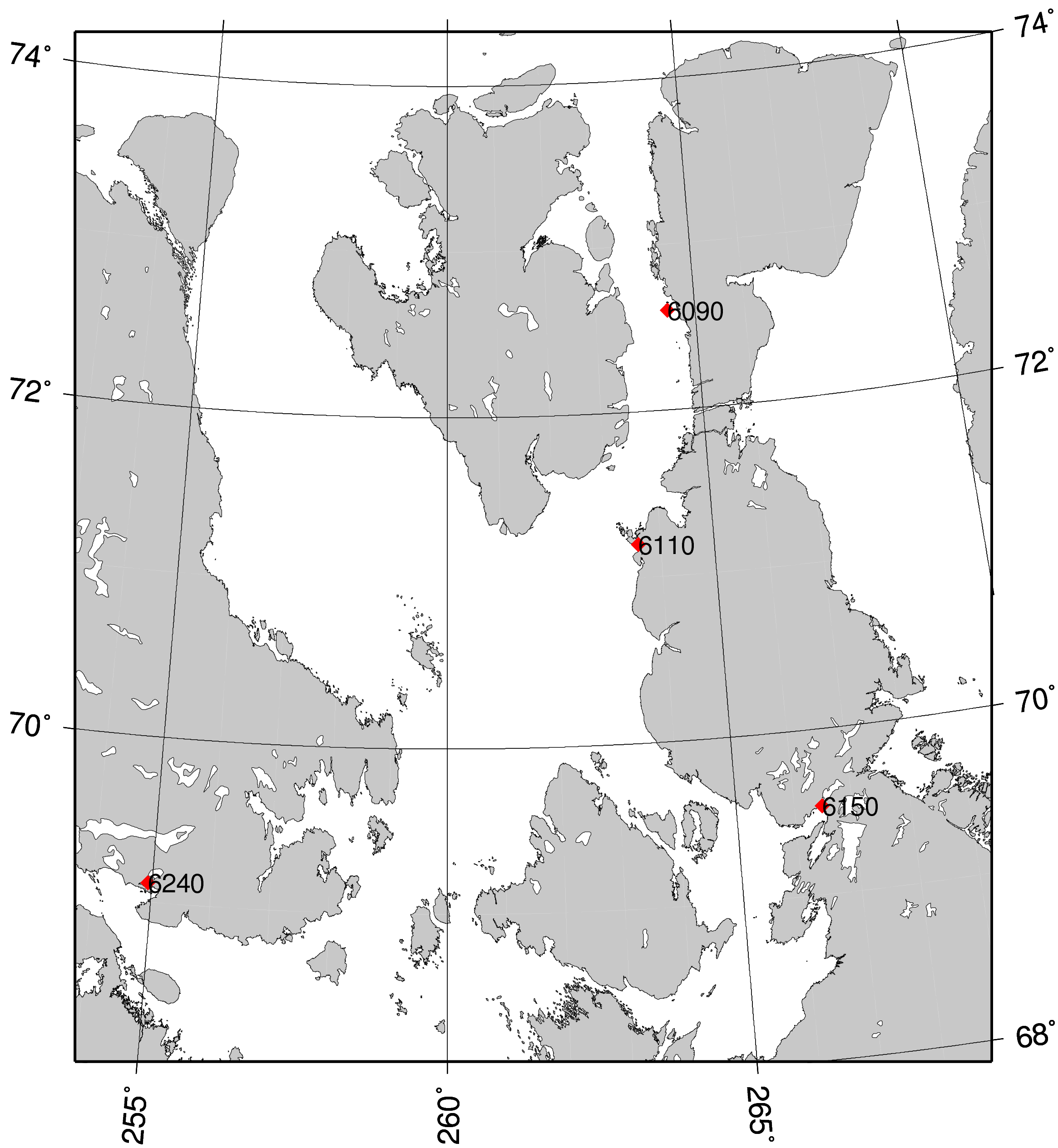

Figure 24: Arctic South Central

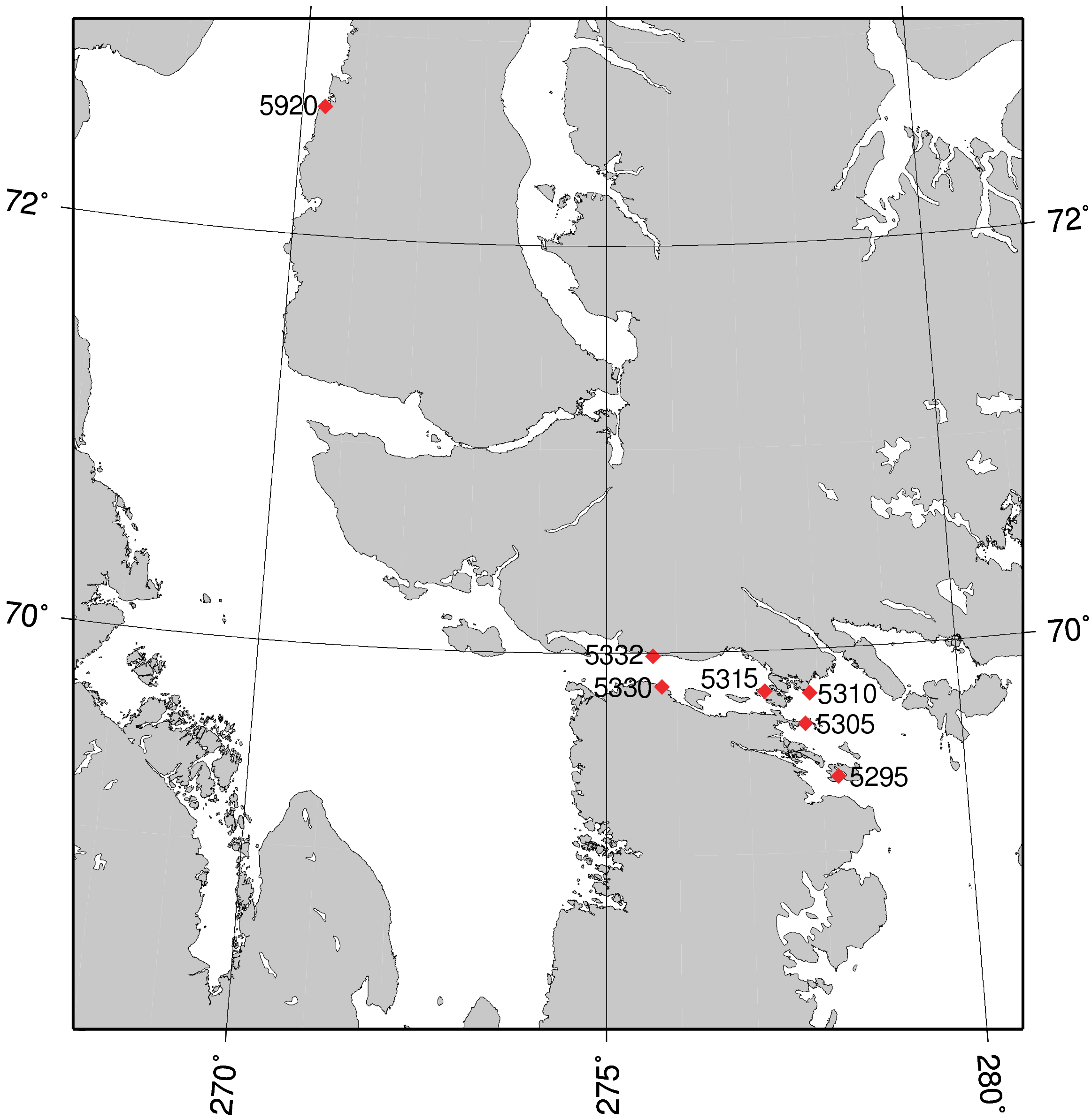

Figure 25: Arctic Southeast

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5295	9.8	-40.1	10.0	-39.4	-0.2	-0.7	0.2	0.021
5305	15.6	-39.6	10.3	-41.8	5.3	2.3	5.3	0.339
5310	10.9	-15.9	10.1	-43.0	0.8	27.1	5.0	0.456
5315	8.9	-11.2	10.7	-52.8	-1.8	41.6	7.1	0.803
5330	16.7	-68.0	10.3	-58.0	6.4	-10.0	6.8	0.405
5332	16.8	-54.7	10.0	-57.1	6.8	2.4	6.9	0.408
5920	9.0	131.4	8.3	124.8	0.7	6.6	1.2	0.138
Mean	12.5	–	9.9	–	2.6	9.9	4.6	0.4
Absolute	–	–	–	–	3.1	13.0	–	–
RMS	13.0	63.7	10.0	65.6	4.1	19.4	5.3	0.434

Table 20 continued: Arctic Southeast - N2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5295	23.0	57.5	23.9	58.3	-0.9	-0.8	1.0	0.043
5305	23.0	52.1	24.1	55.3	-1.1	-3.2	1.7	0.074
5310	21.8	68.5	23.0	55.6	-1.2	12.9	5.2	0.237
5315	21.5	56.8	20.3	33.0	1.2	23.8	8.7	0.405
5330	15.1	28.0	19.0	22.6	-3.9	5.4	4.2	0.279
5332	21.0	16.3	17.7	23.5	3.3	-7.2	4.1	0.196
5920	18.5	-143.4	16.5	-159.2	2.0	15.8	5.2	0.281
Mean	20.6	–	20.7	–	-0.1	6.7	4.3	0.2
Absolute	–	–	–	–	1.9	9.9	–	–
RMS	20.7	71.3	20.8	72.7	2.2	12.4	4.9	0.246

Table 20 continued: Arctic Southeast - S2 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5295	34.1	48.3	38.7	36.2	-4.6	12.1	8.9	0.262
5305	34.8	18.3	39.9	31.6	-5.1	-13.3	10.1	0.289
5310	30.6	35.5	37.0	30.2	-6.4	5.3	7.1	0.231
5315	65.4	13.6	52.4	18.6	13.0	-5.0	13.9	0.213
5330	61.4	2.7	56.8	14.9	4.6	-12.2	13.4	0.217
5332	61.6	-0.4	54.5	14.2	7.1	-14.6	16.4	0.266
5920	21.5	-9.6	21.0	-11.2	0.5	1.6	0.8	0.038
Mean	44.2	–	42.9	–	1.3	-3.7	10.1	0.2
Absolute	–	–	–	–	5.9	9.2	–	–
RMS	47.2	24.5	44.5	24.3	6.8	10.3	11.2	0.230

Table 20 continued: Arctic Southeast - K1 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
5295	16.4	-21.6	16.6	-10.1	-0.2	-11.5	3.3	0.202
5305	15.9	-28.8	17.0	-16.7	-1.1	-12.1	3.7	0.230
5310	15.6	-29.3	15.1	-18.0	0.5	-11.2	3.0	0.195
5315	27.0	-49.7	26.1	-34.9	0.9	-14.8	6.9	0.255
5330	29.3	-35.3	29.3	-38.9	-0.0	3.6	1.9	0.064
5332	28.9	-52.8	27.9	-40.3	1.0	-12.5	6.3	0.217
5920	13.6	-70.7	13.6	-64.5	0.0	-6.2	1.5	0.109
Mean	21.0	–	20.8	–	0.1	-9.2	3.8	0.2
Absolute	–	–	–	–	0.5	10.3	–	–
RMS	22.0	44.2	21.7	36.3	0.7	10.9	4.2	0.193

Table 20 continued: Arctic Southeast - O1 Results

B.8 Frobisher Bay

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
4140	345.2	-22.0	331.0	-25.8	14.2	3.9	26.9	0.078
4135	293.8	-16.0	326.5	-26.1	-32.7	10.1	63.8	0.217
4120	329.5	3.4	322.0	-26.4	7.5	29.8	167.6	0.509
4100	334.3	-18.1	309.2	-26.5	25.1	8.4	53.5	0.160
4170	228.8	-11.2	240.1	-11.1	-11.3	-0.0	11.3	0.049
4070	180.7	-58.1	179.2	-62.2	1.5	4.1	13.0	0.072
44081	159.1	-43.6	150.4	-57.3	8.7	13.7	37.9	0.238

Mean	267.3	–	265.5	–	1.9	10.0	53.4	0.2
Absolute	–	–	–	–	14.4	10.0	–	–
RMS	276.7	30.4	274.6	37.8	17.6	13.5	73.2	0.240

Table 21: Frobisher Bay - M2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
4140	67.7	-53.1	65.0	-56.6	2.7	3.4	4.8	0.071
4135	72.2	-45.1	64.1	-56.8	8.1	11.7	16.1	0.222
4120	54.0	-29.2	63.3	-57.0	-9.3	27.8	29.6	0.548
4100	66.4	-49.2	60.8	-57.4	5.6	8.2	10.7	0.161
4170	46.5	-42.8	47.1	-44.3	-0.6	1.5	1.3	0.029
4070	34.7	-85.2	36.0	-89.3	-1.3	4.1	2.8	0.082
44081	38.1	-61.3	30.9	-84.3	7.2	23.0	15.5	0.406
Mean	54.2	–	52.4	–	1.8	11.4	11.5	0.2
Absolute	–	–	–	–	5.0	11.4	–	–
RMS	56.0	54.8	54.1	65.5	5.9	14.8	14.7	0.281

Table 21 continued: Frobisher Bay - N2 Results

Stat #	**Observed**		**Modelled**		**Error**		**Complex Error**	
	cm	deg	cm	deg	cm	deg	cm	relative
4140	117.4	28.8	108.8	21.6	8.6	7.2	16.6	0.141
4135	109.7	37.0	107.2	21.3	2.5	15.7	29.7	0.271
4120	110.4	57.1	105.5	21.1	4.9	36.0	67.0	0.607
4100	118.8	32.0	101.0	20.7	17.8	11.3	28.0	0.236
4170	71.9	39.6	73.7	37.6	-1.8	2.0	3.1	0.043
4070	64.0	-15.0	61.9	-19.9	2.1	4.9	5.8	0.090
44081	52.4	-2.2	51.2	-17.0	1.2	14.8	13.4	0.255
Mean	92.1	–	87.0	–	5.0	13.1	23.4	0.2
Absolute	–	–	–	–	5.5	13.1	–	–
RMS	95.7	34.4	89.9	23.6	7.8	16.8	30.8	0.291

Table 21 continued: Frobisher Bay - S2 Results

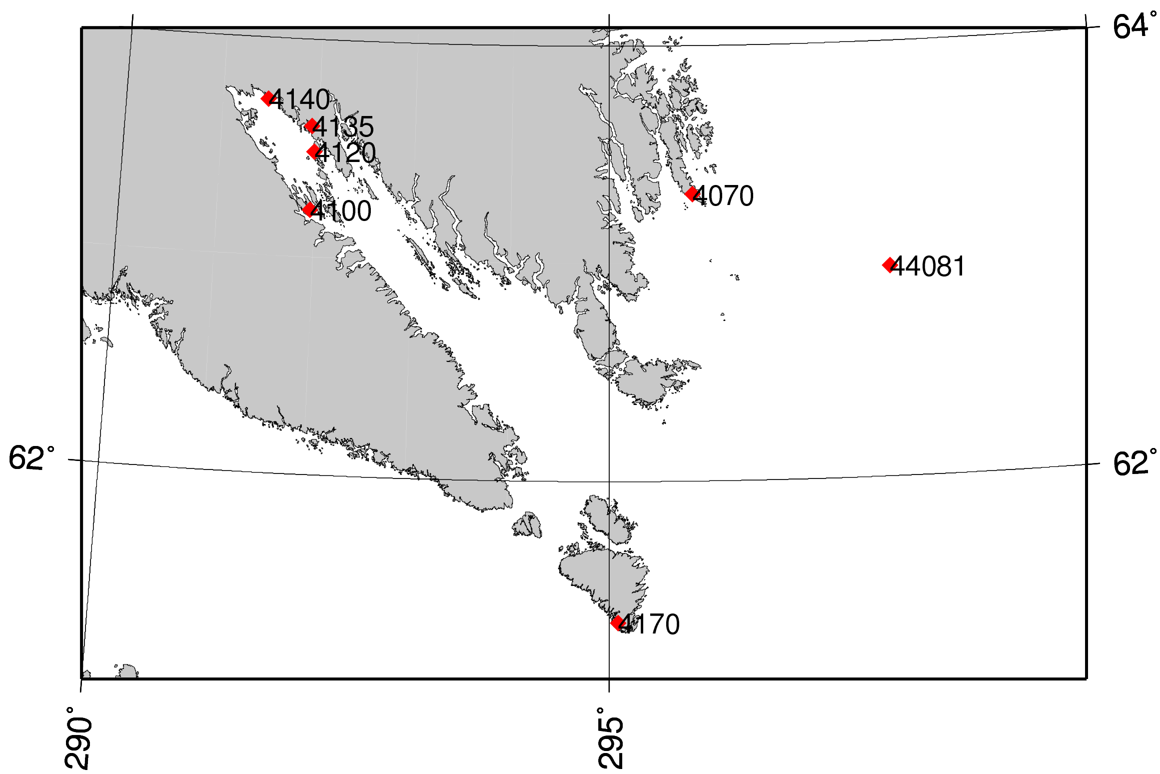

Figure 26: Frobisher Bay

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
4140	18.4	160.7	10.7	166.6	7.7	-5.9	7.8	0.426
4135	21.6	-173.7	10.7	166.5	10.9	19.8	12.1	0.560
4120	18.0	175.8	10.6	166.3	7.4	9.5	7.7	0.429
4100	20.1	171.2	10.5	166.1	9.6	5.1	9.7	0.480
4170	16.2	161.0	10.5	153.7	5.7	7.2	5.9	0.367
4070	17.0	124.2	9.6	140.6	7.4	-16.4	8.2	0.484
44081	11.9	158.4	8.6	-166.1	3.3	-35.5	7.0	0.589
Mean	17.6	–	10.2	–	7.4	-2.3	8.4	0.5
Absolute	–	–	–	–	7.4	14.2	–	–
RMS	17.8	161.5	10.2	161.1	7.8	17.4	8.6	0.482

Table 21 continued: Frobisher Bay - K1 Results

Stat #	Observed		Modelled		Error		Complex Error	
	cm	deg	cm	deg	cm	deg	cm	relative
4140	11.4	124.3	8.7	122.0	2.7	2.2	2.7	0.240
4135	9.7	110.9	8.7	121.9	1.0	-11.0	2.0	0.210
4120	8.6	131.7	8.6	121.8	-0.0	9.9	1.5	0.172
4100	9.4	118.8	8.6	121.6	0.8	-2.8	1.0	0.102
4170	9.5	119.0	9.9	132.7	-0.4	-13.7	2.3	0.247
4070	9.7	84.8	5.1	93.4	4.6	-8.7	4.7	0.483
44081	7.2	119.0	5.3	143.1	1.9	-24.1	3.2	0.445
Mean	9.4	–	7.8	–	1.5	-6.9	2.5	0.3
Absolute	–	–	–	–	1.6	10.3	–	–
RMS	9.4	116.3	8.0	123.2	2.2	12.4	2.7	0.301

Table 21 continued: Frobisher Bay - O1 Results

C Prediction errors

In this section we tabulate the expected prediction error at each station. The prediction error is reported using the 5 vs 5 and 5 vs All method reported in Table 7 in Section 4. In the tables that follow the first column (Stat #) is the station number used in Appendices A and B; the second column (# Cons.) is the number of constituents reported at that station; the third column (MaxTide) is the maximum possible tidal height from the observations (the sum of all the amplitudes); the last column (Diff) is the difference between the prediction error for 5 vs All and that for 5 vs 5 and is a measure of how important the additional constituents are.

C.1 Baffin Bay

Stat #	# Cons.	MaxTide	5 vs 5		5 vs All		Diff
			cm	norm	cm	norm	
G01	4	138.6	10.4	0.182	10.4	0.182	0.0
G09	4	139.8	10.6	0.185	10.6	0.185	0.0
G11	4	184.4	18.2	0.206	18.2	0.206	0.0
G14	4	131.0	11.1	0.215	11.1	0.215	0.0
G16	4	200.5	21.2	0.223	21.2	0.223	0.0
G24	4	108.0	14.3	0.327	14.3	0.327	0.0
G26	4	128.6	9.0	0.174	9.0	0.174	0.0
G28	4	155.0	26.8	0.410	26.8	0.410	0.0
G29	4	208.4	17.6	0.190	17.6	0.190	0.0
G31	4	112.0	8.8	0.198	8.8	0.198	0.0
3575	9	279.4	15.0	0.138	19.1	0.174	4.1
3916	31	130.2	5.2	0.132	9.0	0.223	3.7
3941	31	48.3	16.7	1.465	17.4	1.408	0.7
3948	31	81.8	6.3	0.281	8.6	0.373	2.4
3960	9	68.4	5.1	0.233	6.7	0.300	1.6
3970	9	80.3	3.9	0.159	6.9	0.272	3.0
3980	9	94.1	6.0	0.202	8.7	0.286	2.7
3995	9	147.8	12.9	0.205	14.0	0.222	1.2
4040	7	381.5	31.7	0.183	35.5	0.205	3.9
64000	69	206.6	5.0	0.072	10.4	0.148	5.4
64005	69	214.4	3.8	0.054	10.3	0.143	6.4
64010	69	245.7	6.0	0.076	12.4	0.156	6.3
5790	10	141.5	6.0	0.125	9.4	0.195	3.4
5791	10	139.2	5.9	0.125	9.5	0.199	3.6
3840	10	269.4	8.5	0.090	15.3	0.159	6.7
3710	7	229.0	35.0	0.419	36.6	0.435	1.6
G08	4	201.6	20.0	0.226	20.0	0.226	0.0
3690	8	246.5	41.0	0.458	42.7	0.472	1.6

G23	4	164.4	17.0	0.217	17.0	0.217	0.0
RMS	–	–	16.8	0.351	18.2	0.362	–

Table 22: Baffin Bay Prediction error

C.2 Arctic West

Stat #	# Cons.	MaxTide	5 vs 5		5 vs All		Diff
			cm	norm	cm	norm	
6290	39	21.4	8.9	1.512	9.3	1.436	0.4
6310	9	44.7	3.9	0.264	4.6	0.309	0.7
6338	25	42.5	5.8	0.413	6.8	0.470	1.0
6340	25	39.9	3.9	0.360	5.9	0.509	2.1
6350	9	37.8	4.3	0.321	4.6	0.345	0.4
6360	48	51.7	2.5	0.248	9.4	0.694	6.9
6424	41	21.1	2.1	0.435	3.6	0.636	1.5
6443	28	29.4	1.4	0.227	7.4	0.764	5.9
6457	28	69.6	15.3	0.652	16.1	0.671	0.8
6472	28	56.1	7.3	0.447	10.3	0.578	3.0
6476	28	41.1	4.2	0.408	8.2	0.659	4.0
6485	40	49.6	3.8	0.390	9.9	0.742	6.1
6492	28	34.7	5.0	0.779	8.6	0.907	3.7
6495	27	32.6	2.5	0.426	7.4	0.808	4.8
6498	28	18.7	1.5	0.313	2.0	0.394	0.5
6505	29	60.9	3.6	0.400	16.9	0.898	13.3
6525	27	32.2	2.9	0.421	7.2	0.759	4.3
RMS	–	–	5.7	0.554	9.0	0.728	–

Table 23: Arctic West Prediction error

C.3 Arctic North

Stat #	# Cons.	MaxTide	5 vs 5		5 vs All		Diff
			cm	norm	cm	norm	
G30	4	97.0	9.6	0.218	9.6	0.218	0.0
3735	8	118.7	6.7	0.151	8.8	0.196	2.1
3736	27	136.0	4.7	0.105	9.5	0.212	4.9
3740	29	97.9	3.2	0.104	7.7	0.245	4.5
3755	8	41.8	2.2	0.170	3.5	0.263	1.3
3765	48	63.4	2.4	0.141	6.0	0.336	3.6
3780	11	53.5	3.4	0.174	4.2	0.211	0.8
3782	27	92.6	3.3	0.108	6.8	0.220	3.5
3788	27	134.6	3.7	0.081	8.8	0.191	5.1
3790	9	101.7	18.2	0.417	19.8	0.447	1.6
6660	10	17.6	5.2	0.951	5.4	0.954	0.2
6670	10	26.9	3.4	0.491	4.7	0.610	1.3
6704	10	24.2	6.4	1.039	7.7	1.027	1.3
6730	28	15.0	4.2	1.097	4.4	1.084	0.3
6735	11	30.7	3.2	0.329	3.6	0.361	0.4
RMS	–	–	6.6	0.510	8.3	0.538	–

Table 24: Arctic North Prediction error

C.4 Arctic Northwest

Stat #	# Cons.	MaxTide	5 vs 5		5 vs All		Diff
			cm	norm	cm	norm	
5645	10	82.8	12.0	0.389	12.8	0.410	0.8
6834	28	89.8	5.9	0.245	8.2	0.331	2.3
6835	52	88.5	9.0	0.346	10.2	0.388	1.3
6910	9	22.9	2.7	0.354	2.9	0.382	0.3
6955	9	31.2	7.2	0.607	7.3	0.610	0.1
RMS	–	–	8.0	0.406	8.9	0.435	–

Table 25: Arctic Northwest Prediction error

C.5 Arctic Central

Stat #	**# Cons.**	**MaxTide**	**5 vs 5**		**5 vs All**		**Diff**
			cm	norm	cm	norm	
3902	31	157.5	4.9	0.111	10.5	0.230	5.5
5428	33	185.3	5.5	0.095	10.8	0.185	5.3
5430	9	170.0	7.6	0.132	12.0	0.207	4.4
5510	8	150.9	11.2	0.218	12.7	0.245	1.5
5530	28	196.8	22.1	0.392	25.0	0.435	2.9
5560	18	138.9	8.0	0.204	12.2	0.302	4.2
5600	25	104.0	5.7	0.181	8.2	0.256	2.5
5865	9	134.6	13.8	0.282	14.8	0.302	1.1
5905	18	158.1	6.8	0.134	9.6	0.188	2.8
5910	27	129.5	8.7	0.252	14.2	0.391	5.5
6080	27	65.5	4.8	0.246	5.8	0.296	1.0
6556	31	233.5	6.0	0.080	13.0	0.173	7.1
6557	33	222.5	4.4	0.063	12.0	0.170	7.6
6560	31	238.9	6.7	0.092	14.1	0.190	7.3
6570	31	233.7	6.3	0.081	12.7	0.161	6.4
6580	27	200.7	8.0	0.121	12.3	0.182	4.2
6584	27	99.4	5.9	0.175	7.5	0.219	1.6
6588	23	57.3	4.0	0.210	4.8	0.253	0.9
6595	27	80.9	3.9	0.141	5.5	0.194	1.5
6598	27	67.9	3.5	0.155	4.9	0.217	1.4
6605	27	79.1	3.9	0.147	5.5	0.205	1.6
6765	10	90.0	8.4	0.275	9.9	0.320	1.5
6770	27	83.4	7.6	0.292	8.7	0.330	1.1
6780	11	52.1	3.7	0.220	4.6	0.266	0.8
6781	20	48.7	5.8	0.376	6.3	0.403	0.5
RMS	–	–	8.1	0.207	11.2	0.264	–

Table 26: Arctic Central Prediction error

C.6 Arctic South Central

Stat #	# Cons.	MaxTide	5 vs 5		5 vs All		Diff
			cm	norm	cm	norm	
6090	27	57.1	6.6	0.430	7.4	0.473	0.8
6110	27	67.2	8.1	0.402	8.8	0.431	0.7
6150	27	22.3	9.3	1.825	9.6	1.678	0.4
6240	48	57.9	6.6	0.548	9.9	0.701	3.3
RMS	–	–	7.7	0.997	9.0	0.964	–

Table 27: Arctic South Central Prediction error

C.7 Arctic Southeast

Stat #	# Cons.	MaxTide	5 vs 5		5 vs All		Diff
			cm	norm	cm	norm	
5295	27	183.3	7.5	0.133	12.3	0.214	4.7
5305	25	199.3	9.0	0.153	13.8	0.231	4.8
5310	31	194.3	8.7	0.161	14.0	0.253	5.3
5315	26	252.9	14.1	0.207	22.1	0.314	8.0
5330	25	252.0	11.9	0.193	29.4	0.438	17.5
5332	26	231.4	13.8	0.223	19.3	0.306	5.6
5920	27	138.1	9.7	0.221	11.7	0.264	2.0
RMS	–	–	10.9	0.187	18.5	0.297	–

Table 28: Arctic Southeast Prediction error

D Errors at Padman and Erofeeva (2004) locations

Padman and Erofeeva (2004) report on a tidal model of the Arctic Ocean that includes good solutions in the Archipelago. Their solutions were computed on a model domain that covered the entire Arctic Ocean at 5 km resolution and using an assimilation scheme.

The Arctic9 solutions have been evaluated at several locations modelled by Padman and Erofeeva (2004) for a rough comparison of the two solutions. Results were compared for two regions for which several common stations could be found: Baffin Bay (their region 6) and Nares Strait (their region 7). The identification of common locations was not precise; it was done by a visual inspection of each model's associated station maps. Twelve common locations were identified in Baffin Bay (for M2) out of a total of nineteen reported by Padman and Erofeeva (2004). Nine common locations were identified in Nares Strait. While the station lists may not be identical, we think they suffice for a rough comparison of the errors based on similar region partitioning.

Tables 29 and 30 list Arctic9 errors at the stations identified (extracted from the tables in Appendix B). The comparison with the regional statistics of Padman and Erofeeva (2004) are reported in Section 4. It is worth noting that the regional errors are dominated by large errors at a few stations.

Note that our error metric is the difference in the tidal phasors and represents a peak error. The errors reported by Padman and Erofeeva (2004) are the rms error which is the peak error divided by $\sqrt{2}$.

Stat #	M2 cm	N2 cm	S2 cm	K1 cm	O1 cm
G09	3.3	N/A	2.8	5.4	3.2
3995	14.9	3.7	8.3	2.9	3
G16	10.8	N/A	3.1	3.4	0.8
G28	30.9	N/A	13.6	5	6.7
3970	3.5	1	1.7	2.6	2.2
3902	4.3	0.9	2.9	4	0.9
5428	3.9	0.7	4.4	4.7	0.5
6557	1.6	0.9	1.2	5.3	0.8
6556	1.5	2.5	1.2	7.5	1.4
3840	6.2	3.7	6.8	6.5	4
3710	44.7	10.9	17.5	4.1	2.4
3690	53.3	12.1	19.1	2.2	2.7
RMS	22.8	5.8	9.2	4.8	3.2

Table 29: Errors at Padman and Erofeeva (2004) stations in Baffin Bay (their region 6).

Stat #	M2	N2	S2	K1	O1
	cm	cm	cm	cm	cm
3755	0.4	0.9	0.6	2.6	3.4
3765	2.3	0.8	1.6	1.1	4
3782	2.8	3	0.5	1.6	3.4
3788	3.6	2.5	0.9	2.4	2.7
3790	6.3	1.2	N/A	1.2	3.1
G30	5.1	N/A	1.7	4.1	2.6
3735	7.9	2	3	3.7	2.8
3736	4.3	3.6	1.6	3	2.8
3740	1.5	2.5	1.4	3.1	3.3
RMS	4.4	2.3	1.6	2.7	3.2

Table 30: Errors at Padman and Erofeeva (2004) stations in Nares Strait (their region 7).