Chapter 10

Conclusions and Recommendations

The present report represents the first comprehensive effort to model the tidal circulations found in Glacier Bay, Alaska. As was put forth in the introductory chapters, Glacier Bay is a location of great interest and importance and it is my hope that this report is a substantial contribution to the physical understanding of this area.

The open-source model ADCIRC was adopted due to its relative ease of use and reasonable level of online and user-community support. The flexibility of ADCIRC, in particular with regards to model output, means that a great number of questions can be asked and answered with the model. As was shown, information on elevation, water velocity, and particle paths can be easily obtained.

To sum up key results, it was found that tidal elevations steadily increase with up-bay distance. Regarding velocity, contour maps of root-mean-square tidal speed revealed very strong spatial gradients. In the lower bay regions, speeds on the order of 2 - 3 m s^{-1} were observed while, in up-bay regions, speeds fully two orders of magnitude less were observed. Computed particle paths showed a similar behavior. In up bay regions, the observed tidal excursions were very slight, on the order of 1 km. In the vicinity of Sitakaday Narrows, on the other hand, it was found that particles would move in excess of 20 km during spring tide conditions.

Numerous localized features of interest were found through careful study of the numerical results. For example, complex clusters of eddies were found in Sitakaday Narrows and in other locations throughout the bay. Additionally, an interesting 'barrier' connecting Points Gustavus and Adolphus was found by considering numerical drifter experiments in the vicinity of the bay mouth.

It was found that the effects of freshwater input were substantial in the vicinity of the bay mouth. Upon inclusion of freshwater input, computed drifter tracks were altered substantially, and drifters were flushed out of the bay.

10.1 Future Work

There are several important extensions to this work that should be carried out in the future. These include:

1. First of all, the study of the effects of freshwater input on the barotropic tide should be refined. Regression equations based upon watershed classification by flow regime, and not geographic proximity, should be pursued. Additionally, analysis of glacial volumetric change should be carried out, as this will be a significant addition to the freshwater budget.

2. Second, studies of contaminant / tracer transport can easily be carried out. This is a current feature of the ADCIRC model. These studies will show how an initial distribution of some material of interest is advected and dispersed due to the tidal motion.

3. Third, and most importantly, the modeling effort needs to be extended to three dimensions. This will allow for the resolution of vertical stratification and the quantification of vertical mixing. This comes at the penalty of increased computational cost, however. Therefore, it will be necessary to reduce the horizontal resolution of the domain. Nevertheless, this is by far the most important step to be taken to further advance our understanding of present and future conditions in the bay.

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