

An Inverse-Forward Model for Salt Budgets in Glacier Bay, Alaska

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1 Introduction

Box model, both forward and inverse, is a simple but efficient way to establish a first order understanding of the oceanic system (Guan and Huang, 2008; Stommel, 1961).

2 Model Setup

2.1 Governing Equations

The circulation of a Glacier Bay is regulated by several external forcing and constrains: fresh-water input, vertical density distribution, wind, tide, and topographic constrains. Topographic constrains include (1) a relatively shallow sill towards the fjord entrance and (2) a relatively narrow channel compared to the length of the fjord. The first constrain conserves the total volume of the fjord;

Volume conservation:

$$0 = F_i + \sum Q_{in} + \sum Q_{out} + \sum W_{in} + \sum W_{out} \quad (1)$$

Salt budgets:

$$\frac{d}{dt}S = \sum Q_{in}S_{in} + \sum Q_{out}S_{out} + \sum W_{in}S_{in} + \sum W_{out}S_{out} \quad (2)$$

References

- Guan, Y. P. and Huang, R. X. (2008). Stommels box model of thermohaline circulation revisited the role of mechanical energy supporting mixing and the wind-driven gyration. *Journal of Physical Oceanography*, 38(4):909–917.
- Stommel, H. (1961). Thermohaline convection with two stable regimes of flow. *Tellus*, 13(2):224–230.