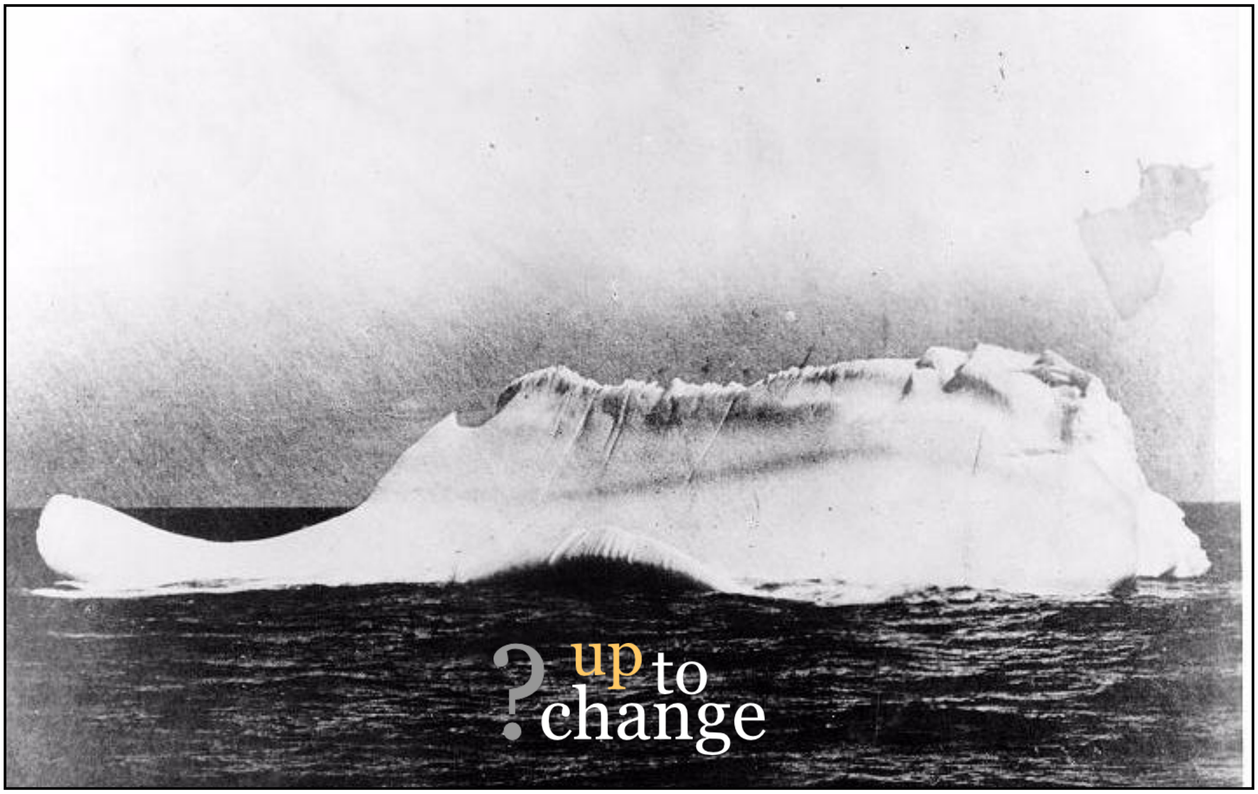


# An Iceberg Tracking and Drift Prediction System

Prepared for: Anchor Modeling classes
Prepared by: Lars Rönnbäck

Up To Change
Karlbergsvägen 67
113 35 Stockholm
Sweden
sales@uptochange.com

# EXECUTIVE SUMMARY

## Objective

To track and predict the movements of icebergs in order to avoid collisions with vessels traveling on or below the oceanic surface, and allow for better route planning in the presence of icebergs.

## Goals

Hourly track the position of every iceberg larger than 1 square mile and accurately predict their positions in 1, 3, 5, 10, 15, and 30 days. Areas free from icebergs are also reasonably well predicted up to half a year in advance. This data should be made freely available on the Internet.

## Solution

Thanks to the commoditization of GPS transmitters these are now cheap enough to be dropped onto the edges of the glaciers and ice shelves that produce icebergs. Once an iceberg is formed by breaking off a fixed body of ice and become freely floating in the open water it will already be tagged with several transmitters. Such an event can be immediately noticed and the origin exactly determined.

Provided that the transmitters have been spread out evenly, it is also possible to approximate the initial size of the iceberg by the number of moving transmitters and their positions. The position of a tagged iceberg will thereafter be recorded on an hourly basis.

Twice a day the sizes and positions of the icebergs are fed into an oceanic drift prediction model that utilizes the local hydrodynamic properties of the area to estimate where an iceberg will be in 1, 3, 5, 10, 15, and 30 days from now. The reliability of the estimates vary depending on the conditions, such as wind, temperature, salinity, air pressure, and currents. Generally the margin of error is also larger the farther into the future the prediction lies, preventing predictions for longer than a month in advance.

Negative predictions, where icebergs will not be found, can be made with higher reliability and farther into the future. For example, if no icebergs have broken loose it is extremely unlikely that one will be found outside of Hawaii in the next six months.

## Challenges

In order for the predictions to be accurate the input data to the model must be well measured. While the initial size can be determined well enough through the number of transmitters icebergs tend to melt over time. The melting rate can, however, be approximated given the air and water temperatures. Once a day a new size is calculated using this rate. The calculated size may come to deviate significantly from the actual size, which is why whenever possible sizes are verified through other means. This is usually done through satellite imagery, but sometimes through radiometry made by vessels in the vicinity of an iceberg.

Icebergs also break apart. If the transmitters on an iceberg suddenly start to drift apart we can conclude that it is either because of a split or that some transmitters fell off. The latter is easy to rule out, since transmitters sink when not attached and the signal is lost shortly thereafter. In the case of a split, the new icebergs are tracked similarly to original one.

Quite often icebergs refreeze by sticking to the seabed. This is detected by the fact that the iceberg stops moving for a longer period of time. If it starts moving again we say that the iceberg thawed.

Rarely icebergs may become completely submerged. In this case the iceberg is considered lost, as no signals are received from the transmitters. A last known position are kept for the lost icebergs. Lost icebergs almost always resurface at some point in time though, which is detected by the reception of the signals again.

## Next Generation

Once technology has matured the system intends to evolve into the area of iceberg management. Vessels equipped for the purpose will alter the trajectory of icebergs moving in undesirable directions.