FAQ:
Transport of Radioactive Contaminants in and around Cape Cod Bay

Findings of a WHOI Sea Grant-funded study by WHOI scientists into the circulation patterns around Cape Cod Bay were published Dec. 4, 2024 in the Journal of Physical Oceanography. The paper, "**Model-based study of near-surface transport in and around Cape Cod Bay, its seasonal variability and response to wind**" by Margaret Gregory, Irina I. Rypina, Sachiko Yoshida, and Alison M. Macdonald, provides insight into what the travel times and pathways of radioactive wastewater would be if released into the Bay from the Pilgrim Nuclear Power Station (PNPS).

Key Points

The study was designed to shed light on the possible fate of 1.1 million gallons of radioactive wastewater from the Pilgrim Nuclear Power Station, which the plant's owner, Holtec, has proposed to release into Cape Cod Bay. The study's aim is to gain a better understanding of plume transport and spreading pathways, and their associated time scales.

- Over the month following the release, the probability of plume waters coming close to the inner- Bay shoreline, including coastal waters of Dennis, Wellfleet, and Provincetown, is high.
- The probability of a plume leaving the Bay without coming close to the shoreline within the bay is low.
- When some portion of a plume leaves the Bay, it passes north of Provincetown and then flows southward along the outer Cape.
- The spreading of a plume depends on the timing of a release.
- In winter and fall the probability of wastewater leaving the Bay without first coming close to the inner-Bay shoreline is virtually zero, and it is slightly larger (but still low) in spring and summer.
- Seasonal differences can be linked to wind conditions that affect oceanic circulation in and around the Bay throughout the year.

Read the full press release:

SEAGRANT.WHOI.EDU/CC-BAY-PATHWAYS-STUDY-FINDINGS/

Funded by WHOI Sea Grant

WHOI Sea Grant funds research research projects that address coastal issues in and around Massachusetts.

ABOUT WOODS HOLE OCEANOGRAPHIC INSTITUTION SEA GRANT

Based at Woods Hole Oceanographic Institution, the Sea Grant program encourages environmental stewardship, long-term economic development, and responsible use of the nation's coastal and ocean resources. The program supports research and education, and an extension program in collaboration with the Cape Cod Cooperative Extension. It is part of the NOAA-funded National Sea Grant College Program, a network of 34 individual programs located in each of the coastal and Great Lakes states.

What was the focus of the study?

Because of active tourism and aquaculture sites located along the inner shoreline of Cape Cod Bay, the paper focuses on investigating whether the plume water will spread towards the shoreline within the Bay or will leave the Bay without coming close to the inner-Bay shoreline.

How was the work conducted?

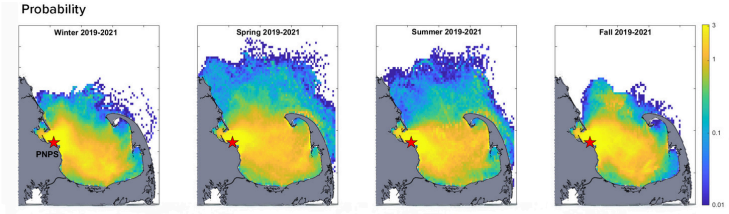
The study's authors, led by WHOI physical oceanographer Irina Rypina, used a NOAA state-of-the-art, high-resolution ocean circulation model to study transport by oceanic currents near Cape Cod Bay. The research focused on the near-surface (<2m) transport of wastewater released from Pilgrim, how it varies seasonally, and the role of wind as the driving force behind the spread of the plume. The model output was validated using observational data from 20 drifters passing through the study area between 2019 and 2021 as part of a NOAA Fisheries study.

Will this study help us draw conclusions about the health and safety impacts of releasing wastewater for humans and animals in Cape Cod Bay and surrounding waters?

This study, alone, is not able to draw conclusions about the health and safety impacts of a release of radioactive wastewater from Pilgrim. The study is a critical first step to evaluating the spread of wastewater releases based on known ocean currents and transport pathways, but these pathways do not tell us the fate of the many different radionuclides that we know are present or their ultimate fate in the marine ecosystem, which depends on their individual chemistries in the ocean.

Where would the wastewater go if it were released into Cape Cod Bay?

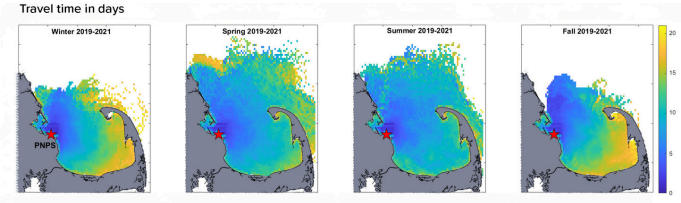
The model results suggest it is unlikely that the bulk of plume waters will leave the Bay in less than a month. More likely, most of the released material will stay in the Bay for longer than a month, coming close to the coastlines, including coastal areas offshore of Dennis, Wellfleet, and Provincetown. If the release were to happen in the spring and summer, a small portion of a plume might leave the Bay in less than a month's time, passing north of Provincetown and then flowing southward along the outer Cape.



Maps showing most likely pathways for waters released at PNPS during different seasons. Color shows probability in percent (on logarithmic scale) that a virtual water parcel released off PNPS (red star) will pass through a given location. Yellow indicates prominent spreading pathways. Dark blue denotes areas that are not typically reached by a plume. White denotes areas that are never reached by a plume.

Does the research indicate when the wastewater would leave Cape Cod Bay?

The model cannot tell us how long it will take for water that reached the shoreline to eventually leave the Bay. In the model, the Bay is divided into a grid with 700-meter squares, and every 6 hours a value for ocean currents is estimated for each grid cell. Any variations in the ocean currents that happen closer than 700 m from the coast are not resolved by the model. As a result, when the model tracks virtual water parcels across the Bay, parcels can sometimes enter grid cells that lie entirely on land. When this happens, the model will stop tracking the parcels. A different model would be needed to answer questions about when the plume would eventually leave the Bay.



Maps showing the average time it takes in days for a virtual water parcel released off PNPS to reach a given location.

Why do the transport pathways vary by season?

These seasonal changes can be linked to different wind conditions that affect the oceanic circulation in and around the Bay.

How much of the release water would mix below the surface current and possibly take alternative pathway(s)?

This project focused on near-surface transport only; questions related to 3-D circulation and transport will be addressed in future research.