Abstract View

Volume 15, Issue 12 (December 1985)

Journal of Physical Oceanography
Article: pp. 1721–1732 | Abstract | PDF (838K)

Suction through Broad Oceanic Gaps

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(Manuscript received January 18, 1985, in final form May 31, 1985)

DOI: 10.1175/1520-0485(1985)015<1721:STBOG>2.0.CO;2

ABSTRACT

This paper supplements an earlier article, by Nof and Olson, on the nonlinear flow through broad gaps. In that paper, the steady inviscid transport through a gap located on the left-hand side of a boundary current has been computed. When the gap is located on the right-hand side, instead of the left-hand side, the Nof and Olson solution breaks down because of a singularity at the upstream edge of the gap. The singularity is associated with an infinitely negative pressure resulting from the fact that particles make a “U” turn as they pass through the gap. The present study focuses on these special singular cases.

To avoid the singularity, the use of the integrated *moment of momentum* is adopted because with an appropriate choice of a coordinate system, the contribution of the unknown force (associated with the singularity) to the integrated torque vanishes. This enables one to construct analytical solutions which give the transport through the gap as well as the force associated with the singularity. It is found that a separated current (i.e., a current bounded by a surfacing interface) is always sucked in its entirety into the gap no matter how wide the gap. As in the Nof and Olson study, this result is valid for broad gaps (i.e., gaps whose width is of the order of the deformation radius). For very broad gaps (i.e., much larger than the deformation radius), a perturbation scheme provides an approximate solution which is independent of that derived by the integrated moment of momentum technique. This solution also shows that a separated current is completely sucked into the gap. In view of them solutions, it is concluded that a separated boundary current flowing along a wall with a slides of gaps is always sucked *into the first gap* that it encounters.

Application of this theory to the Unimak Pass, which connects the Gulf of Alaska with the Bering Sea, is considered. Using historical data, it is shown that the locations and positions of the currents located near and at the Pass agree with the model predictions.

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