二維渦流遇阻之流場分析

EFFECT OF BARRIERS ON FLOWS ASSOCIATED WITH A FIXED VORTEX

(黃榮鑑)(鮑咸平) (郭純圖)
Robert R. Hwang, H. P. Pao and T. Y. Kou

Institute of Physics

Academia Sinica

Nankang, Taipei, Taiwan

Effect of mountain barrier on the typhoon vortex is studied theoretically in terms of the understanding of the dynamical events associated with its blocking phenomena. Utlizing a numerical scheme, this paper studies the flow patterns for various angles attack associated with a fixed concentrated vortex in the presence of a two-dimensional barrier. Numerical model is done on an initial-value problem based on the stream-function/vorticity formulation. The general behavior and the feature of flows when interacting with the barrier have found to depend on angle attack, velocity of uniform flow, the circulation and location of vortex. The agreement of flow patterns between the laboratory experiment and the numerical solution is reasonable.

I. Introduction

The importance of topographic effects on the atmospheric flow have led to numerous studies and investigations by many scientists throughout the world in recent years. It has been recognized that mountain ranges have strong interaction with and influence over typhoons. The mountain effect usually manifests itself in the form of floods and disasters for certain areas. In order to reduce human and economic losses resulting from typhoons, it is important to understand the phenomena and mechanism of the blocking effect when a typhoon vortex is in the vicinity of mountain barriers. But the problem of studying the dynamics of a typhoon vortex in the presence of barriers seems to have not been very well investigated. With the strong two dimensional characters assured by its high rotational itensity, typhoon can be treated as a quasi-two-dimensional rotationally constrained fluid and considered as a two-dimensional concentrated vortex. This paper is then to study the flow pattern of a uniform flow associated with a fixed vortex in the presence of a barrier.

The literature on the flow past obstacles is extensive. The survey