surface; flow past a cavity in a surface; a vortex wake behind a bluff body; such a wake interacting with a surface; a wake from a streamlined body such as an airfoil, and its interaction with a surface; a wall jet, and such a jet interacting with a surface. The various geometric and dynamic parameters governing the flow and sound fields will be detailed, and discussion will be presented in terms of them. The flow and sound fields involved will be described by means of visualization studies and quantitative measurements.

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FLUID DYNAMICS OF THE MONSOONS

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In its simplest form, the atmospheric circulation in the tropics can be thought of as axi-symmetric convection of a rotating fluid forced by a spatially varying heat flux applied at its lower boundary, since most of the incident solar radiation is absorbed at the surface of the earth. This convective cell is characterized by a narrow zone of ascending fluid located over the region of maximum heating and a broad zone of descending fluid elsewhere. There is flow towards the rising limb i.e. convergence at the lower levels and divergence aloft. Due to the rotation, however, the predominant horizontal component of the wind is parallel (rather than normal) to the zone of ascent and blows in opposite directions on either side of it. This zone of ascent, associated with high cyclonic (i.e. same sign as the rotation) vorticity and convergence at the lower levels is delineated in our moist atmosphere as a narrow band of convective clouds stretching almost continuously around the globe at low latitudes and is called the intertropical convergence zone (ITCZ).

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The location of the ITCZ changes in response to the seasonal variation in the latitude of incidence of maximum solar radiation. This implies a seasonal reversal of the winds in the region over which the ITCZ sweeps in its seasonal migration.

This seasonal reversal is called the monsoon. The onset of the monsoon, the fluctuations within a season and its withdrawl are thus manifestations of the changes in location and intensity of the ITCZ.

In the determination of the structure, dynamics of the steady state ITCZ as well as its temporal variations, interactions between three-scales play a crucial role. These are

(i) large-scale of the ITCZ (few thousand kms in longitudinal extent)

(ii) scale of the synoptic vortices generated in it $\sim$ few hundred kms

(iii) scale of the cumulus cloud $\sim$ few kms.

Organization on each scale occurs as a result of an instability of the larger scale and intensification involves co-operative interactions between two or more scales through another set of instabilities. Hence the temporal response to the time-dependent boundary condition is highly complex with the scales characteristic of these instabilities superposed on the seasonal scale. An understanding of the physics of these instabilities and scale interactions is a pre-requisite for the development of a model capable of predicting the vagaries of the monsoon.

STUDY ON VORTEX BY FLOW VISUALIZATION

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1.0 INTRODUCTION

In former days, turbulent flows were considered to have random velocity fluctuations owing to superposed "eddies" in the flow of different scale and of different strength. Nowadays, turbulent shear flows are considered to have velocity fluctuations, not perfectly random but of some kind of regularity, owing to "vortices" of large scale, in other words, tubulent shear flows have "coherent structures". In the discription, the definition of "eddy" and "vortex" is not clear, but it is doubtless that the concept of eddy or vortex "in a flow", not stationary as a whole, is based on the Lagrangian stand point, while what appears from the Eulerian standpoint is velocity fluctuations. As Navier-Stokes equations stand on the Eulerian view point, what we need is velocity fluctuation, not vortex. However, it seems that we are not satisfied only with velocity fluctuations. The reason is presumably due to the fact that the concept of velocity fluctuation is not so intuitive as the concept of eddy or vortex. The concept of eddy or vortex is intuitive and seems to be so clear that the definition is not necessary. Thus, we have no clear definition of eddy or vortex in fluid mechanics. Nevertheless, the concept of a vortex is frequently used and appears to be useful. This is the reason why we study the characteristics of a vortex or vortices which are not known clearly so far.

In this paper described are the characteristics of vortices studied by our colleague, such as Karman vortex street, vortices in the flow around a circular cylinder and vortex rings.