

## GLIMPSE OF OCEAN FLOW MEASUREMENT TECHNIQUES

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### Introduction

Accurate measurements of ocean flows are of fundamental interest to Oceanographers and marine engineers. Currents in the ocean is an interesting problem for a number of scientific and practical reasons. Probably the most important of these include study of dispersal of pollutants discharged into the ocean, coastal erosion studies, estimation of hydrodynamic loads required for the design of marine structures such as offshore drilling platforms, pipelines and dock facilities, study of sediment distribution in the ocean and estuaries and study of mesoscale eddies and upwelling which exert widespread influence on the biological productivity, regional climate, and meteorological conditions of the adjacent land.

In the oceans, the scales of motions range from mesoscale to microscale. The spectrum of motions which have this wide range is highly complex. In the following sections, we take a cursory look at the various tools and techniques being employed for such measurements.

### Methods of ocean flow measurements

Ocean flow measurements can be broadly divided into three distinct groups namely; Lagrangian, Eulerian, and Single-probe profiling methods. In the Lagrangian method a synoptic view of currents spreading over large areas is mapped. The Lagrangian method is useful in detecting large circulation routes as well as major ocean gyres. In the Eulerian method, flow of water past a fixed point or specific volume is determined as a function of time using a single instrument or a chain of instruments deployed in a specific site. Current measurements in a Eulerian fashion become important when a detailed study of a particular area of interest is required on a long-term basis. The single-probe profiling method measures the vertical depth dependence of horizontal currents. This method is mainly employed to investigate fine and microstructures in the velocity field. The aforementioned three methods are examined below.

1) Lagrangian method

Various Lagrangian techniques of ocean flow measurements are shown in chart 1. As shown, this method is useful to map surface as well as subsurface currents.

Surface currents	subsurface currents
1. drift bottles and poles.	1. loran or radar tracked parachutete drogues.
2. Aerial photography of fluorescent dyes.	2. satellite-recovered subsurface drifters.
3. Satellite-tracked drifting buoys.	3. Subsurface floats acoustically tracked by ship-borne hydrophones.
4. Remote sensing by H.F.Radar.	4. SOFAR floats remotely tracked by moored hydrophone arrays.
5. Remote sensing by satelite-borne visible and infra-red radiometers.	5. Remote sensing by acoustic travel time differnce between moored transceivers.
6. Remote sensing by satellite altimetry.	6. Remote sensing by acoustic tomography.
	7. Space-time acoustic scintillation analysis.

Chart 1. Lagrangian methods of ocean flow measurements.

It can be observed that a significant improvement has occurred in this method where the technology shifted rapidly from the conceptually simple position measurements of parachute drogues and drift bottles to the sophistication of satellite-tracked drifters, Hf radars, satellite altimetry, satellite imagery and acoustic remote sensing techniques.

2). Eulerian methods

Eulerian current measuring devices may be classified into (i) purely mechanical devices where flow detection and recording are controlled solely by mechanical devices, (ii) electronic current meters using mechanical sensors where flow detection is achieved by mechanical devices whereas acquisition and display/recording are controlled by electronic circuitries, and (iii) Electronic current meters using electronic sensors. These are summarised in chart 2. some of these current meters are direct reading types and others recording types.

### 3). Single-probe profiling methods

This method is used to explore, with good resolution, the vertical distribution of horizontal flows over large depths. Two methods are, basically, used. One method uses free-falling, wire guided, or free-falling/rising probes. The other method uses acoustic Doppler profiling to remotely sense velocity profiles at different depth layers. These are shown in chart 3.

Chart 3.		Single-probe profiling methods
<ol style="list-style-type: none"> <li>1. Slowly sinking float acoustically tracked from a set of hydrophones.</li> <li>2. Depth transmitting, free-falling probe tracked by a single hydrophone's phased array.</li> <li>3. Freely sinking, wire-guided, relative velocity probe.</li> <li>4. Freely sinking and rising boomerang type relative velocity probe.</li> <li>5. Vertically cycling, self-profiling, wire-guided relative velocity probe.</li> <li>6. Untethered and unguided, horizontally drifting, vertically cycling, self-profiling relative velocity probe.</li> <li>7. Freely sinking and rising absolute velocity probe.</li> <li>8. Absolute velocity measuring acoustic Doppler remote profiler.</li> </ol>		
Purely mechanical devices.	Electronic current meters with mechanical sensors of the following types.	Electronic current meters with electronic sensors of the following types.
<ol style="list-style-type: none"> <li>1. Angle measurements of thin-wire-suspended drag.</li> <li>2. Registration of propeller revolution on mechanical counters, or on mechanically driven tin foils.</li> <li>3. Stylus markings of pendulum positions on graduated waxed paper.</li> <li>4. Deflecting wand.</li> </ol>	<ol style="list-style-type: none"> <li>1. Unidirectional impeller.</li> <li>2. Savonius or Roberts type rotor.</li> <li>3. Orthogonally mounted cosine-responding dual-propeller pairs.</li> </ol>	<ol style="list-style-type: none"> <li>1. Electromagnetic.</li> <li>2. Acoustic travel time difference.</li> <li>3. Thermal.</li> <li>4. Laser Doppler.</li> <li>5. Acoustic Doppler.</li> </ol>