RESEARCH MOORED ARRAY FOR AFRICAN-ASIAN-AUSTRALIAN MONSOON ANALYSIS AND PREDICTION (RAMA)

Background: The Indian Ocean (I0) is characterized by a spectrum of phenomena that spans intra-seasonal to multi-decadal timescales and has important implications for climate. Quantitative understanding of these phenomena, and how they interact with one another, are however, undermined though by a sparseness of data. Data limitations also constrain the ability to develop, initialize, and validate coupled ocean- atmosphere forecast models for monsoon prediction. Recognizing the need for continuous and systematic observational data from the Indian Ocean with adequate spatial spread, the international G00S program and the CLIVAR component of the World Climate Research Program (WRCP) established an Indian Ocean P (IOP) in 2004 to design and guide the implementation of a basin-scale integrated Indian Ocean Observing System (IndOOS) for climate research and forecasting.

IndOOS is a multi-platform long-term observing system which consist of surface mooring array, ARGO floats, surface drifting buoys, tide gauges, Voluntary Observing Ship (VOS)-based XBT/XCTD sections and satellite measurements. The system is designed to provide high frequency near-real time climate-related observations, serving the needs of climate research, forecasting and services. Satellite Remote Sensing provides maps of surface variables such as temperature, sea surface height, sea surface winds, sea surface salinity and ocean colour, as well as several meteorological input parameters for estimating air-sea momentum, heat and freshwater fluxes.

The main platform for insitu observations in the tropical 0 is the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction ("RAMA") which is similar to the TAO/TRITON array in the pacific and PIRATA array in the Atlantic Ocean. The RAMA Array consists of a total of 46 moorings, of which 38 are ATLAS/TRITON-type surface moorings. Eight of these surface moorings are surface flux reference sites, with enhanced flux and subsurface ocean measurements. The surface mooring system can measure temperature and salinity profiles from the surface down to 500 m depth as well as the surface meteorological variables, and the observed data are transmitted in real-time via ARGOS satellites. In addition to these surface buoys, there are four sub-surface ADCP moorings along the equator and one near the coast of Java to observe the current profiles in the upper ocean, and three deep current-meter moorings with ADCPs in the central and eastern Equatorial regions. Out of the 46 moorings, 3 moorings are in the Bay of Bengal since 2009.

In order to recover the moorings for servicing and to deploy new ones at the same place ensuring continuous time series measurements, a multi-institutional cruise under the aegis of INCOIS was launched on the 12th February 2016 on board the Indian Research Vessel Sagar Kanya. The cruise, currently under way, also would carry out the servicing of the three Tsunami and 4 OMNI buoys in the area. Once the RAMA and OMNI buoys are redeployed, continuous data sets are expected over the next one year, which will eventually benefit both operational services (assimilate the data into the Ocean Models) and the studies aimed at understanding of the ocean dynamics of the Bay of Bengal.

Alignment of the programme with the Science Plan of IIOE-2: As has been highlighted in the HOE-2 Science Plan, existing field activities in the Indian Ocean encompass only a small fraction of the basin, with national programs often targeting restricted geographical regions and the coastal zone. A particular focus of IIOE-2 has therefore been suggested as promoting an international effort to provide improved geographical coverage of the Indian Ocean, both coastal and open ocean areas. This can be facilitated by increasing the use of satellite data and by remote instrumentation such as oceanographic

moorings, drifters etc. Although widely supported internationally, the RAMA mooring system has only been partially implemented, primarily due to piracy threats and non-availability of suitable ocean-going vessels. The Science Plan as well as the Implementation Strategy for I1OE-2 stress on the l1OE-2 activities as affording an ideal opportunity to complete the RAMA array and also to motivate the deployment of 4 additional biogeochemical and ecological sensors. The data collected by RAMA will greatly enhance the ability of scientists to understand climatic events and predict monsoon events. Climatic and oceanic events in the Indian Ocean affect weather and climate throughout the rest of the world (such as El Niño, hurricanes etc.), so RAMA will support weather forecasting and climate research worldwide.

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