# A data delivery system for IMOS, the Australian Integrated Marine Observing System

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The Integrated Marine Observing System (IMOS, www.imos.org.au), a $150m 7-year project (2007-2013) is a distributed set of equipment and data-information services which, among many applications, collectively contribute to meeting the needs of marine climate research in Australia. The observing system provides data in the open oceans around Australia out to a few thousand kilometres as well as the coastal oceans through 11 facilities which effectively observe and measure the 4-dimensional ocean variability, and the physical and biological response of coastal and shelf seas around Australia. Through a national science rationale IMOS is organized as four regional nodes (Western Australia – WAIMOS, South Australian – SAIMOS, New South Wales – NSWIMOS and Great Barrier Reef Ocean Observing System – GBROOS) surrounded by an oceanic node (Blue Water and Climate). Operationally IMOS is organized as 11 facilities (Argo Australia, Ships of Opportunity, Southern Ocean Automated Time Series Observations, Australian National Facility for Ocean Gliders, Autonomous Underwater Vehicle Facility, Australian National Mooring Network, Australian Coastal Ocean Radar Network, Australian Acoustic Tagging and Monitoring System, Facility for Automated Intelligent Monitoring of Marine Systems, eMarine Information Infrastructure and Satellite Remote Sensing, Figure 1) delivering data. IMOS data is freely available to the public.


**Figure 1: IMOS Nodes and Facilities**

Marine data and information are the main products of IMOS and data management is therefore a central element to the project's success. The eMarine Information Infrastructure (eMII) facility of IMOS provides a single integrative framework for data and information management that will allow discovery and access of the data by scientists, managers and the public. The initial strategy has focused on defining specific data streams and developing end-to-end protocols, standards and systems to join the related observing systems into a unified data storage and access framework.

IMOS data streams can be categorized in four ways: gridded data from satellites and HF radar systems; time series data from moorings, Argo floats, gliders and ships of opportunity; image data from Autonomous Underwater Vehicles; biological data from continuous plankton recorders and acoustic tagging. The first two provide real-time and delayed-mode data sets whereas the latter are delayed-mode delivery only.

The IMOS data management infrastructure employs OGC standards wherever possible. The main components of the system are: OPeNDAP/THREDDS servers hosting CF-compliant NetCDF, HDF or GeoTIFF data; the open-source GeoNetwork (http://geonetwork-opensource.org/) Metadata Entry and Search Tool (MEST) for metadata cataloguing; SensorML, which provides standard models and an XML encoding for describing sensors and measurement processes; the open-source DataTurbine (www.dataturbine.org), data streaming middleware providing the foundation for reliable data acquisition and instrument management services; a web portal (the IMOS Ocean Portal, http://imos.aodn.org.au ) using the open-source ZK Ajax framework (www.zkoss.org) and the OpenLayers geospatial framework (http://openlayers.org/) incorporating access to Web Services.

IMOS data utilises the Australian Research Collaboration Service (ARCS) Data Fabric (http://www.arcs.org.au/products-services/data-services/arcs-data-fabric-start-here ). A distributed network of OPeNDAP/THREDDS servers around Australia forms the primary data storage (Figure 2). This complements the regional nodal structure of IMOS and allows rapid access to data by the local research community. Each local server also supports the GeoNetwork catalog with, wherever possible, automatic harvesting of metadata from the OPeNDAP/THREDDS system. An IMOS NetCDF standard ensures that all necessary metadata to comply with ISO 19115 can be automatically extracted from the NetCDF files. Automation of metadata creation from non-NetCDF datasets is also being investigated. A master GeoNetwork catalog at the University of Tasmania routinely harvests new metadata records from the regional catalogs to maintain a central registry.

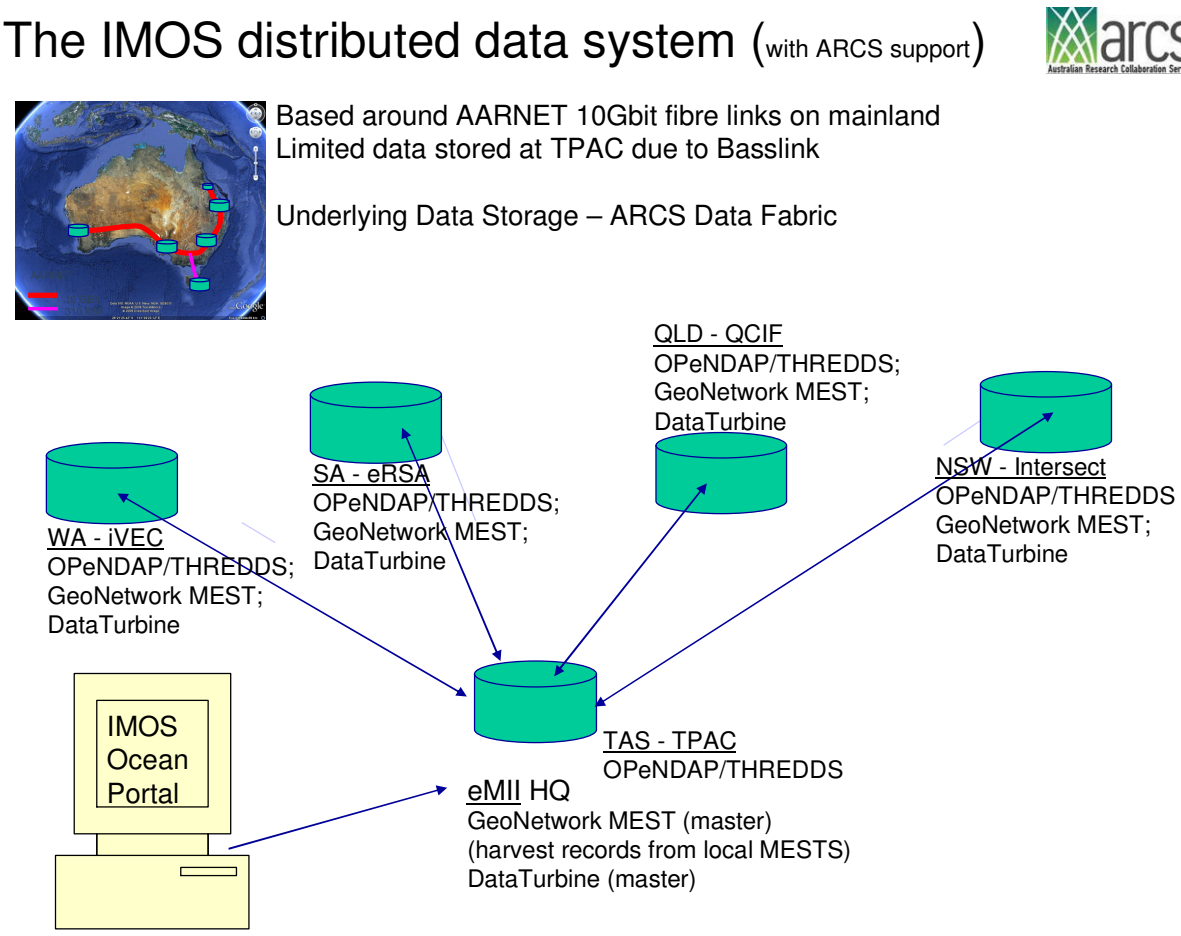


**Figure 2: The IMOS distributed data centre**

Data storage and retrieval in IMOS is designed to be interoperable with other national and international programs. Thus, it will be possible to integrate data from sources outside IMOS into IMOS data products, and IMOS data will also be exported to international programs such as Argo (argo.jcommops.org) and Oceansites (www.oceansites.org). Also, most of the real-time data of physical parameters will be exported to the Global Telecommunications System.