1) BACKGROUND

Marine ecological & biogeochemical time series are a vital source of information about the functioning of the ocean. Sustained ship-based observations allow us to:

• observe processes such as ocean warming, circulation, eutrophication and deoxygenation;
• understand key ecological processes and how the marine environment is being affected by climate change;
• differentiate between natural & anthropogenic changes in marine ecosystems.

However, significant advances in regional and global ocean ecosystem science can be gained by combining data from individual time series.

5) METHODOLOGY

With the help of contributing organizations from around the world, IGMETs has compiled data from ~300 ship-based marine ecological time series, along with ~100 estuarine sites (Fig. 2).

Building on concepts developed during more than 15 years of time series work (Fig. 1) the IGMETs global assessment uses an expanded set of the variables originally applied by ICES working groups to the North Atlantic. In situ biogeochemical measurements and plankton data are combined with satellite observations of sea surface temperature and chlorophyll, which provide a broader regional and global context and add layers of information about changing conditions and ecosystems.

Location of the sampling rate, magnitude and direction of changes occurring within different regions and time windows (from 5 to 30 years) helps us to:

• see where change is happening most rapidly;
• explore connections between variables and ocean basins, and with long-term natural and anthropogenic climate drivers.
• resolve variability from long-term change.

3) GLOBAL ANALYSIS

IGMETs goals include the creation of a report based on Joint Time Series Analysis to identify and interpret temporal and spatial patterns of key ocean parameters on a global scale.

The report will contain chapters on the Arctic, Atlantic, Pacific, Indian, and Southern Oceans, with separate sub-chapters for the North and South Atlantic and Pacific, as well as a unifying Global chapter.

The North Pacific consists of a large central Oceanic Region surrounded by a number of Boundary Currents and Marginal Seas [1], it also includes the North Pacific Subarctic Gyre, the largest ecosystem on Earth [2].

8) VARIABILITY vs. LONG TERM CHANGE

During the 30-year focus period (1983-2012) about 74% of the total surface area of the North Pacific underwent overall warming (Fig. 4A) whereas 26% underwent overall cooling. Most of the warming occurred during the first 20 years (1983-2003) in the western and central North Pacific. During the last 10 years (2003-2012) about 58% of North Pacific surface water underwent overall cooling and 42% overall warming (Fig. 4B). Cooling occurred primarily in the eastern North Pacific (including the Alaska Gyre and California Current) and in the Kuroshio Current (Fig 3A).

The last 5 years of the focus period (2008-2012) saw further breakdown in the established spatial pattern accompanied by greater extremes of variability in SST (Fig 4A) and CHL (Fig. 4B), with warming along the North American west coast and in the central North Pacific.

The onset of these changes (including the initial cooling of the Kuroshio Current) coincides with the abrupt shift from the intense El Niño of 1997 to the La Niña of 1998. Annual PDO State of the North Pacific Ocean reports also confirm that the waters of the eastern North Pacific were cooler than average between 2008 and 2011 due to a Pacific-wide weather pattern associated with La Niña conditions [3].

REFERENCES