



DYFAMED: DYnamique des Flux de mAtière en MEDiterranée

The DYFAMED station is located at 43°25'N, 7°52'E in the north-western sector of the Mediterranean Sea (Ligurian Sea) approximately 45 km south-east of Nice, France, in 2350 m of water, and not very far from the former station J, which was regularly visited in the sixties. The central part of the western basin of the Mediterranean Sea constitutes a homogenous system isolated from direct coastal inputs by rivers but receives significant atmospheric input from deserts of the North Africa and from the industrialized countries bordering the Mediterranean Sea. At this site, the seasonal succession of hydrological conditions induces production systems varying from mesotrophy in spring to oligotrophy in summer and fall. The selected site is of particular interest: (i) the central part of the basin is protected from coastal inputs by the presence of a coastal current, but receives a significant atmospheric input from the deserts of North Africa and from the industrialized countries bordering the Mediterranean Sea; (ii) anthropogenic influence is likely to have a rapid response, since the site is close to industrialized zones; (iii) it is an open-sea site (2350-m depth) close to the Oceanographic Observatory of Villefranche (3-h steam) which in the past has conducted many observations in the Ligurian Sea.

The objectives of the DYFAMED programme are: (1) to study the variations of hydrology and biogeochemistry at the seasonal and interannual scales, (2) to investigate the ecosystem response to atmospheric deposition events and long-term environmental/climate forcing, (3) to investigate and understand the ecological effects of meteorological forcing, especially the transition in community structure from spring mesotrophy to summer oligotrophy and (4) to estimate the air-sea CO₂ exchange.

In the establishment of the IGBP (International Geosphere–Biosphere Programme) and JGOFS (Joint Global Ocean Flux Study), it has been realized that the systematic long-term observation of key biogeochemical parameters is an essential tool for the study of biogeochemical processes at the seasonal and decadal scale, as well as of short-term episodic events that are not easily investigated by "classical" oceanographic cruises. Under the auspices of JGOFS-France / PROOF (then PFO), the French research community implemented in 1987 the time-series program DYFAMED (Dynamics of atmospheric fluxes in the Mediterranean Sea) in the western Mediterranean Sea (Ligurian Sea) with the aim to study the response of the ocean to climate variability and anthropogenic inputs. Systematic monthly cruises were established in 1991 and the DYFAMED time-series measurement of core parameters is now funded independently from specific programs since 1995, giving the final impulse for this long-term study. Like US stations BATS and HOT, DYFAMED has both a physical and biogeochemical focus.

DYFAMED Observatory

The "DYFAMED" site was first equipped in 1986 with sediment trap moorings and visited punctually for hydrological monitoring. Atmospheric deposition survey was at the same time initiated in 1988 at the nearby Cape Ferrat signal station (43°41'N, 7°19'30''E; altitude: 130 m). Since 1991, approximately monthly cruises with interdisciplinary fieldwork, including physical, chemical, biological and sedimentological observations and rate measurements, and a benthic survey have been conducted and most of the JGOFS core parameters acquired. In March 1999, a buoy was deployed with meteorological, optical and biogeochemical sensors. These investigations contribute to the understanding of the oceanic processes, in general, since the Mediterranean Sea can be considered as a model for many open-ocean processes. Those works have contributed to emerging understanding of the response of the ocean to climate variability and impact on the carbon cycle and revision of our knowledge of the functioning of the ocean.

DYFAMED Observatory is maintained mainly by scientists of the Laboratoire d'Océanographie de Villefranche (former *Laboratoire de Physique et Chimie Marines*, Observatoire Océanologique de Villefranche) and of IAEA Marine Environmental Laboratory in Monaco (for sediment trap experiments), and with guest investigators from several French and foreign institutions.

Project Leader: Jean-Claude Marty (marty@obs-vlfr.fr), initiated by Patrick Buat-Ménard (1986-1992); Logistics: Jacques Chiavérini, (chiaverini@obs-vlfr.fr), initiated by Bernard Avril (1991-1993); Cruise organisation: Agnès Stock (stock@obs-vlfr.fr); Data management: Marie-Paule Torre (dm_frjgofs@obs-vlfr.fr)

The DYFAMED time-series station has also been the site for numerous ancillary activities that have increased our knowledge of the biogeochemistry of the Mediterranean Sea:

Short-term and process studies within DYFAMED-JGOFS France programme

In the frame of the France-JGOFS / PROOF programme, a number of multidisciplinary projects were (and are) realized at the DYFAMED site with the aim of studying the seasonal variations (during at least one year) of various processes using chemical and biological approaches. Other multidisciplinary projects were based on the study of a specific process at scales which cannot be achieved through monthly cruises: *DYNAPROC* (P.I.: V. Andersen) Dynamics of rapid processes controlling vertical flux (one month in May 95); *MIGZOO* (P.I.: V. Andersen): Vertical migration of zooplankton; *EIMETO* (P.I.: C. Jeandel): Exchanges between dissolved and particulate matter and transfers; *DYFABAC* (P.I.: A. Bianchi): Deep bacterial activities using hyperbare sampler.

New projects developed after 2002 at the DYFAMED site in the course of the PROOF programme

PECHE (P.I.: V. Andersen): Production et Exportation du Carbone: contrôle par les organismes HÉTérotrophes à petite échelle de temps; *BARMED* (P.I.: C. Jeandel): Processus de synthèse et réactivité de la barytine dans les eaux de surface, dans la zone mésopélagique et à l'interface eau-sédiment; *MELISSA* (P.I.: C. Migon): MEditerranée LImitationS Saisonnières; *ACTION* (P.I.: C. Goyet): Anthropogenic Carbon: Temporal Increase, Observations, Numerization.

The core datasets acquired since the beginning of the time series and links to related projects are available, along with further information on DYFAMED at www.obs-vlfr.fr/sodyf/home.htm.