Work Package IV

Integrated Margin-Exchange Product

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Task IV.1 Water budget and circulation
Historical current data have been analysed and are ready for comparison with physical models; such comparison has indeed commenced. A strategy for model validation has been developed (UCG). Current meter data analysis (historic and measured) is proceeding satisfactorily except for the previously reported delay in obtaining data from MORENA.

A historic hydrographic data set has been assembled for the north-eastern Atlantic Ocean (NIOZ-b) with emphasis on the European ocean margin. An initial descriptive water mass analysis has been prepared. Three manuscripts on the deep, intermediate, and central water masses are being revised. A first analysis of the seasonally varying water mass structure and geostrophic flow in the OMEX II-II research area has been developed and was presented at the Mid-Term OMEX II-II Workshop in Plymouth, UK, April 1999.

This formally completes the deliverables for **Task IV.1** to 24 months. In addition, CTD data from the August 1998 cruises (*CD114*, RV *Professor Shtokman*) were sent to BODC.

Discussions of the physical regime took place at the physics workshop (November 1998, previously reported) and at the Mid-Term OMEX II-II Workshop in April 1999 and are synthesised in the WP IV executive summary.

The IST 3-D ocean circulation model has been used to estimate input and output fluxes for an OMEX "box", *e.g.*, for August 1994.

For the future, it is planned to use IH meridional sections of density to force the model in order to obtain a more accurate slope current. Once the model is calibrated net fluxes across box boundaries will be computed.

Final definition of an 'OMEX box' to constrain the budgeting remains in abeyance and is intended to be the subject of a meeting of physical oceanographers and modellers. When the "box" is defined, it is intended to meet to draw together the various observations in terms of a budget.

Task IV.2 Carbon sources, cycling and fates
Task IV.2, led by ULB-b, was the focus of the Mid-Term OMEX II-II Workshop in Plymouth, UK, 25-27 April 1999. The workshop sessions were arranged to cover the carbon cycle elements in the task description. Thus:

Task IV.2 *carbon cycle element*	*Workshop session, title*	
Inputs	1	distribution, inputs and exports …
Lateral advection and exchange, filament transport	4	horizontal and vertical transport
Air-sea exchange	(1), 6	
Production, phytoplankton, pigments, DOC	2	phytoplankton production: new,…
Bacteria, zooplankton	3	heterotrophic losses, respiration, …
Particulates, vertical flux	4	
Modelling pelagic cycling, pelagic-benthic coupling	6	modelling requirements, integration..
Near-bed turbulence, benthic cycling and burial	5	benthic fluxes and burial of C and N

Reports of each session were obtained, have now been assembled at ULB, and are embodied in the WP IV executive summary in parallel with this management report.

It is proposed to have further communication and integration work for grazing (in conjunction with Primary Production). There should be collaboration and discussion with modellers regarding dissolved organic matter and data for calibration (*e.g.*, WP I) and validation (*e.g.*, WP II).

With the completion of data processing and as data analysis progresses, understanding of the dynamics of inorganic carbon in the OMEX region has been refined. ULg, SINTEF, IST, NIOO and RISØ have discussed modelling aspects of the sub-surface pCO_2 distribution and air-sea exchange of CO_2; there are plans for computation and integration of exchange of CO_2 across the air-sea interface, to determine if the OMEX box is a net sink or source of atmospheric CO_2.

Deliverables prior to month 24 (intercalibrations, conclusions about the practical applications of techniques) are generally subsumed in the intercalibrations of **Task IV.3**. An intercalibration of primary and new production, and ^{32}P assimilation, remains to be performed.

Task IV.3 Nutrients, trophodynamics and fertility
Nutrient intercalibrations as previously reported show satisfactory results apart from ammonium. Dissolved inorganic nutrients (nitrate, nitrite, ammonium, phosphate and silicate) were analysed at the laboratory of IEO-La Coruña from samples frozen on board during the August 1998 RV *Professor Shtokman* cruise. Analytical procedures at IEO Coruña have been tested regularly in QUASIMEME intercomparisons. Parallel samples were collected and sent frozen to IIM for the determination of dissolved nutrients and intercalibration.

There remains a need to resolve uncertainty between methods of primary production determination. An intercalibration exercise has been organised to take place in Plymouth, UK during July 1999.

Intercalibration between DOC methodologies continues in a global context as described in the WP IV executive summary.

IEO are processing samples from the RV *Professor Shtokman* August 1998 cruise to provide rates of excretion of DON. During the cruise, IEO also performed experiments in collaboration with UVigo and UOviedo to determine the effect of mesozooplankton grazing on DON and DOC production, and collected samples for intercalibrations of DOC/DON concentrations; DON concentrations derived from the DON production rate measurement using ^{15}N will be compared with DON concentrations measured by IIM and PML.

PML-c have also done an intercalibration of bacterial activity with UAL-a by comparing the uptake of ^{3}H leucine at 2 stations.

To summarise, the intercalibrations have been constrained by the ship-time available, but maximum opportunity has been taken; in particular the WP I and II cruises in August 1998 are now enabling progress regarding pigments, primary / new production, nutrient uptake, grazing and bacterial activity.

Regarding other deliverables up to month 24: primary production data have been supplied by PML-c to NSS - collaboration is continuing to produce algorithms for remote sensing of primary production; estimates have been made of the use of nutrients therein; there is now believed to be a robust understanding of the relationship between *f*-ratio and ambient nitrate concentration – there is an algorithm applicable to the OMEX region to obtain estimates of new production from satellite remote sensing; photosynthetic characteristics of phytoplankton assemblages have been determined.

Task IV.4 Particle dynamics, scavenging and trapping
This aspect of integration has been pursued especially at a WP III meeting and in the "particles and vertical particle movement" session before and during the Mid-Term Workshop in April 1999. The

specific 24-month deliverables (quantifications from sedimentological analyses) have been met by the WP III partners and GEOMAR have characterised bottom boundary layer processes in discussion at the above meetings. *In situ* pump data, and data on vertical fluxes and sediment mineralization rates are being analysed; these topics should be studied in the next six months.

Task IV.5 Sensitivity of upwelling systems to environmental changes
This task is only scheduled from month 31. However, it was raised at the Mid-Term Workshop (Plymouth, UK, April 1999). Means to perform the analyses of the past records are in place, but a dialogue needs to be established between UCamb and OMEX modellers to facilitate scenario modelling.

Task IV.6 Integrated margin exchange model
Since the meeting of OMEX II-II modellers at month 18, considerable progress has been made in dialogue between modelling groups, and modelling was again the subject of a specific session at the Mid-Term Workshop, April 1999.

IST and SINTEF have implemented nesting; the IST nested model is also available for SINTEF. Lagrangian tracking has been coupled with the hydrodynamic model and biochemistry has been coupled with the particle-tracking. The system of coupled models has been run for summer months, *e.g.*, August 1994. Historical currents processed by UCG have been compared with corresponding IST model outputs. In general, flow directions agree, but modelled currents are consistently much stronger; there are possible reasons which are being investigated.

The first deliverables (at 24 months) are comparison of larger-scale and Lagrangian pelagic ecological models and an improved benthic model. These comparisons are in progress as NIOO investigate parametrisations for various taxonomic groups and simplifications appropriate to longer-term integrations. The benthic model has been improved for benthic-pelagic coupling, diagenetic processes, integration routines and ready use.

For the future, IST will compare results with available data to have an idea of the accuracy of the model. This includes the use of historical current meter statistics in collaboration with UCG and ECMWF atmospheric data for 1994; there are several observations for that period. After such validation, estimates of material export by filaments can be undertaken.

In order to validate the IST turbulence closure, UCW-b will make available FLY profiles of temperature, kinetic energy and turbulent viscosity as well as atmospheric forcing for comparison with corresponding 1-D and 3-D profiles.

NIOO will implement a complex ecosystem model, that will be calibrated against the data gathered in the Lagrangian experiment (WP I). Sensitivity and Monte Carlo analysis will then form the basis for reducing the model complexity such that it can be used in the 3-D hydrodynamical model.

Other plans for validation and application were discussed at the modelling workshop (November 1998) and the Mid-Term OMEX II-II Workshop (Plymouth, UK, April 1999) as reported in the accompanying WP IV executive summary.

Task IV.7 Coordination of WP IV
Following the physics and modelling workshops convened by UCG and POL at month 18, the main work has been in preparing for the Mid-Term Workshop in April 1999, instigating discussion of integrating aspects there, and now gathering the results of the parallel sessions which address WP IV tasks, especially **IV.2** regarding carbon cycling and **IV.6** “integrated model”.