

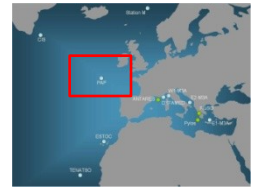
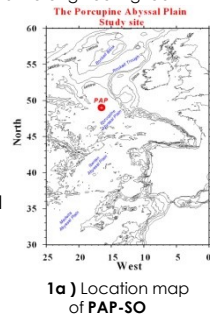
The Porcupine Abyssal Plain open ocean observatory (PAP): Variations and trends from the Northeast Atlantic fixed-point time-series

R.S. Lampitt^{1a}, K.E. Larkin^{1a}, S.E. Hartman^{1a}, M. Pagnani^{1b}, J. Campbell^{1c}, A. Gkrizalis^{1a}, Z. Jiang^{1a}, C. Pebody^{1a}, H. Ruhl^{1a}, A. Gooday^{1a}, B.J. Bett^{1a}, D.S.M. Billeft^{1a}, P. Provost^{1d}, R. McLachlan^{1d}, J. Turton^{1e}, S. Lankester^{1e}

¹ National Oceanography Centre, Waterfront Campus, European Way, Southampton, SO14 3ZH., U.K. ^a Ocean Biogeochemistry and Ecosystems Research Group ^b British Oceanographic Data Centre ^c Underwater Systems Laboratory ^d Sensors and Moorings team ^e Met Office marine engineering team

Introduction and International Context

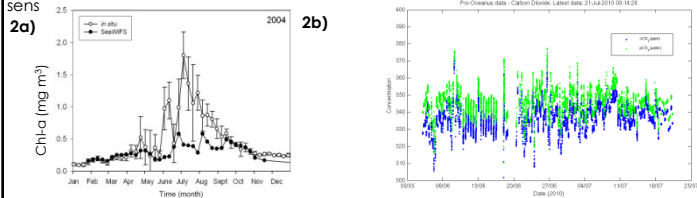
The Porcupine Abyssal Plain fixed-point sustained observatory (PAP-SO) is situated in the sub-polar Northeast Atlantic (49°N, 16.5°W) in a water depth of 4800m and at a location which is as remote as possible from the complexities of the continental slope and the mid-Atlantic ridge. It is the **longest running open ocean time-series observatory in Europe** and one of the longest in the world. Over the past 20 years it has produced high resolution *in situ* time-series data of **climatically and environmentally relevant variables** from the entire **water column and the seafloor** beneath. The PAP site is one of the 9 core observatories in the **EuroSITES** network (1b) (funded 2008-2011) and is also an international **OceanSITES** time-series reference station. (www.oceansites.org). Over 225 peer-reviewed papers have been published on the PAP-SO since 1975 including a recent special issue in **Deep Sea Research**.



1b) PAP-SO: A key ocean observatory in the EuroSITES network (www.eurosites.info)

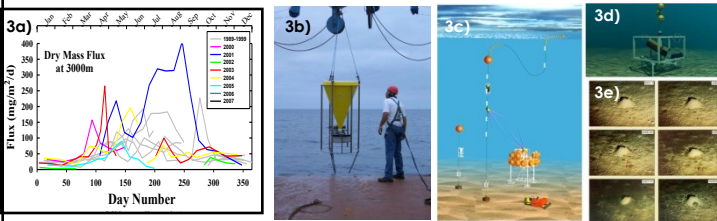
Multidisciplinary time-series : surface to seafloor

Upper Ocean: Since 2002, a multidisciplinary set of sensors on a full-depth mooring have produced high resolution *in situ* time-series dataset of climatically and environmentally relevant ocean variables from the euphotic zone. These include sub-surface (~ 30 m depth) measurements of **temperature, salinity, chlorophyll-a fluorescence, nitrate and pCO₂**. Recent enhancements to the mixed layer variables include O₂ and PAR (Irradiance), and an water sampler at 30 m on the sens



2a) Comparison of Chl-a concentrations at the PAP-SO during 2004 derived from *in situ* (fluorometer at 30m) and remote sensing (SeaWiFS). Evidence that satellite underestimates Chl-a at this NE Atlantic site as a result of a deep chlorophyll maximum.
2b) pCO₂ dataset from June 1st 2010 deployment. Data from 7 ocean (physical and biogeochemical) and 5 atmospheric variables are also available in near real-time.

Mesopelagic: Particle flux samples have been collected for over 20 years at the PAP site using a sediment trap at 3000m depth (see 3a, b below).



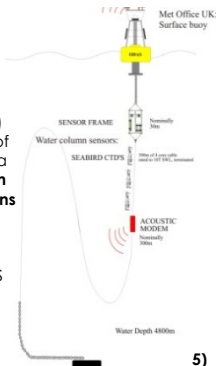
3a) 1989 – 2007 time-series of Particle flux (dry mass). Clear inter-annual and seasonal variation; 3b) Sediment trap deployment at PAP 3c) MODOO lander design: Acoustic telemetry communication to PAP mooring; 3d) Bathysnap camera system (schematic); 3e) Phytodetrital flux time-series from Bathysnap camera

Seafloor: Over 20 years of sampling the abyssal seafloor (4800 m) at PAP has revealed that **benthic ecosystems and geochemistry** are intimately linked with ocean surface processes through **variations in POC flux quantity and/or quality** arriving on the seafloor. All components (and size classes) of the benthic ecosystem communities show a response to benthic-pelagic coupling. Since the 1980's an autonomous time-lapse camera system, **Bathysnap**, has been used taking 8 hourly still images.

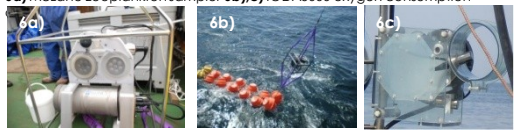
Open Access to Data in near real-time: PAP-SO ocean and atmospheric data are sent in near real-time from the upper 1000m through Iridium telemetry to **NOC, Southampton acting as the PAP and EuroSITES Data Assembly Centre**. Data are available through the EuroSITES website (www.eurosites.info) and CORIOLIS ftp site (<http://ftp.iftremer.fr/iftremer/oceansites>). Physical datasets (temperature and salinity) are sent to the Global Telecommunication System (GTS).

Beyond state-of-the-art

The PAP-SO is leading Europe **beyond the current state-of-the-art** in open ocean observation. In 2010 a **collaboration between NERC and the Met Office UK** led to a redesigned infrastructure (deployed June 1st 2010) and the first simultaneous monitoring of *in situ* meteorological and ocean data at the PAP-SO. As a **European platform** PAP has been used for **science missions** and the development and testing of novel sensors. These include the **IODA6000 for *in situ* oxygen consumption** (developed by EuroSITES partner CNRS: University of Marseille ; LMGM). NOC, S lead the R&D for enhancing long-term capabilities of a **meso-zooplankton sampler**



5) (above) 2010: PAP Mooring design with ODAS surface buoy, full depth mooring line and MODOO lander system (+ acoustic telemetry) 6 (below) 6a) McLane zooplankton sampler 6b) c) IODA6000 oxygen consumption



Policy and Outputs

The PAP-SO is located in **international waters** but in **proximity to 4 member state EEZ's** (see Figure 7). The PAP-SO time-series datasets from the open ocean North Atlantic are invaluable as an **early-warning system** for European shelf and coastal waters at a regional level. PAP-SO scientists regularly **inform Government Policy** on strategic points e.g. marine processes and climate, marine habitats and species (bio-diversity in the deep-sea), open ocean productivity, ocean governance, geo-engineering and ocean fertilisation. Regular advice is provided to the **Royal Society**, Department of Environment, Food and Rural Affairs (**DEFRA**) **UN International Seabed Authority** and the **European Commission** (EC).



7) Location of PAP mooring site and 200 nautical mile limits, as measured from each States' baselines. (courtesy of Alan Evans, UNCLOS group, NOC Southampton, UK).

Outputs include reports for DEFRA (e.g. Charting Progress 2, MCCIP reports) and over 225 peer-reviewed publications including a **Special Issue of Deep-Sea Research II**

www.noc.soton.ac.uk/pap  www.eurosites.info/pap

Coordinated by: National Oceanography Centre, Southampton (Ocean Biogeochemistry and Ecosystems Group)
Principal Scientists: Richard Lampitt and David Billeft

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