Capacity building at the Marine Environment Laboratories (MEL) of the IAEA

INTERNATIONAL ATOMIC ENERGY AGENCY
- DEPARTMENT OF NUCLEAR SCIENCES AND APPLICATIONS
Hartmut Nies
Head of Radiometrics Section

Conference on Developing a Global Strategy for Capacity Building in the Ocean Sciences, Bremen

Early sources of MEL

Albert I, Prince of Monaco (13 November 1848 – 26 June 1922)

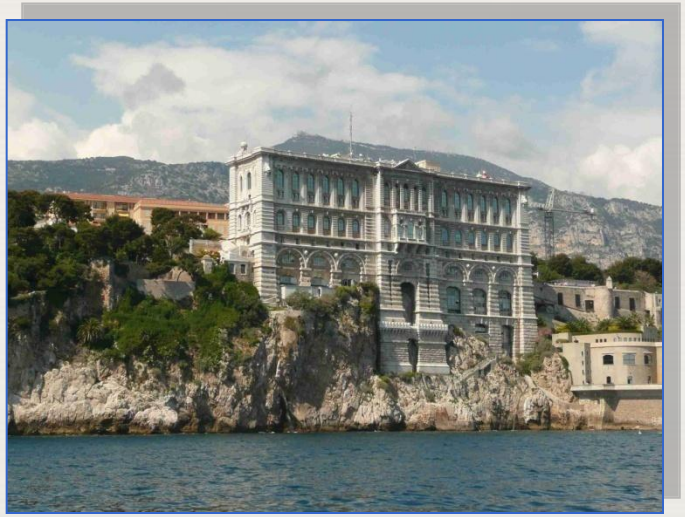
28 Research Cruises of *Prince Albert I* with numerous specimens from marine life brought back to Monaco

1889: Foundation of the

Musée et Institut Océanographique de Monaco

1899 -1910: The Oceanographic Museum was built and inaugurated at 29th March 1910

Monaco became a Centre of Oceanography



„Prince navigateur“

Origin of MEL

- 1961… Global concern about the impacts and fate of radioactive fallout from atmospheric testing of nuclear weapons on the ocean
- Apply & transfer of emergent Nuclear & Isotopic Tracers techniques for understanding and managing the marine environment.
- As UN's only Marine Laboratory, to host partnership programs UN organisation (UNEP, IOC, IMO, FAO…
- IAEA Monaco *Seat Agreement*

10 March 1961: Inauguration of the Marine Laboratory

International Symposium „Isotopes in Hydrology, Marine Eco-system, and Climate Change Studies

on the occasion of the 50th anniversary, 27 March to 1 April 2011

http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=38297

Director General Yukiya Amano:

Since 1 December 2009

Remarks at Reception for Member States at 9 December 2009:

... that my key objective is to address global issues related to nuclear technology, in accordance with the Statute of the IAEA.

- That means working for nuclear non-proliferation, enhancing nuclear safety and security, assisting Member States in meeting their energy needs, responding to concerns about **climate change**, helping to ensure **food security** and **clean water** and improving **health care** through the application of nuclear techniques.
- … My intention is to continue to focus on **technical cooperation** so that we can more effectively meet the needs of Member States, as identified by them.
- In this regard, the priority is **capacity-building** to help countries establish their own expertise in nuclear science and technology.

The <u>only</u> Marine Laboratory in UN System

1961 - Laboratory established in the Oceanographic Museum

1988 -Temporary facilities in the Louis II Football Stadium

1998 - Permanent facilities on the Port of Monaco

MEL's Facilities

Low-level measurement capabilities

Mission Statement of the Marine Environment Laboratories

The Marine Environment Laboratories will provide Member States with

1. *Research & Developments* **for the protection of the marine environment from radioactive substances and from other chemical contaminants**
2. *Applications* **of nuclear & isotopic techniques and solutions for tracking oceanic processes, marine ecosystems and pollution impacts**
3. *Expertise, Training & Reference Materials* **essential for Member States' commitment to a Sustainable Development and Monitoring of their marine environments.**
4. *Strategic partnerships* **with International and other UN ocean agencies (IOC/UNESCO, UNEP, UNDP, IMO) to deliver the UN-WSSD programmes on sustainable development of the ocean.**

Programmatic priorities

- To support IAEA Member States and regional sea Conventions to develop monitoring programmes of marine ecosystems (radionuclides, inorganics and organics) and to assists in Quality Status Assessments (OSPAR, HELCOM, ROPME, Carribbean, ASEAN ...)
- To improve knowledge of the behaviour and fate of pollutants with emphasis on marine biosphere impact and coastal zone
- Production of Marine **Reference Materials** for Quality Management capability in MS and to assure comparability of marine data

Principal areas of NAEL-MEL

- Understanding the Geo-chemical Behaviour of Radioactive Substances in Oceans & Seas (natural and artificial radionuclides)
- Data Base **MARiS** on Marine Radioactivity Concentration Data from all over the World Ocean
- Diagnosing Marine Ecosystems and Pollutions
- Enabling Analytical Excellence
- Building Strategic Partnerships for Reaserch and Sustainability
- Analysing Ocean Carbon and Climate Change Impact on the Ocean
- Research on Ocean Acidification from CO_2 Input and its Impact on Marine Life

Data & knowledge management

- Capacity building through training
- Coordinated Research Programme
- Regional and Interregional Technical Co-operation Programmes
- Collaborations with other UN Agencies and International organizations
- Databases
- Networks e.g. by Collaborating Centres

Short & Long term priorities

- Short term
  - Reinforce exchange of data and expertise in Member States also in terms Quality Assurance/Quality Control
- Long term
  - Collate and harmonise the existing data basis as well as monitoring programmes in Member States by reinforcing networking and collaborations with other UN agencies, national and international organizations.
  - Consider the socio-economic impact of climate change for a sustainable marine environment

Expertise

Marine Radiological Measurements

Marine Radiotracer Studies (oceanography, biogeochemistry, radiochronology)

Marine pollution assessment (trace metals and POPs)

Marine Radioecology

Harmful Algal Blooms (HABs)

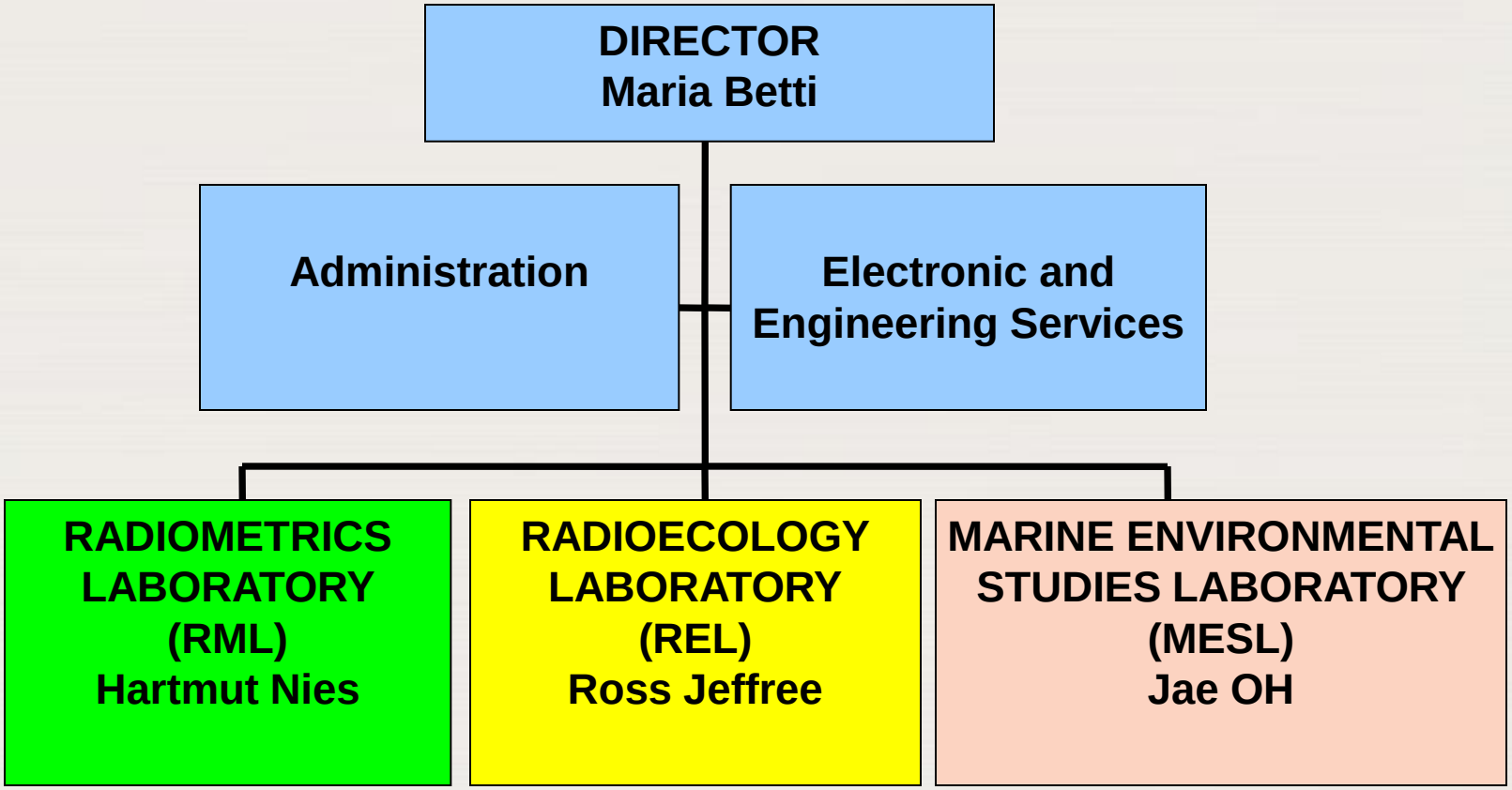
Ocean-climate interactions (carbon cycle, ocean acidification)

Modelling and Remote Sensing

Reference Materials

Training/capacity building

IAEA-MEL ORGANIZATIONAL STRUCTURE



Expertise of MEL's 3 Sections

RML: Radionuclides in the marine environment; Reference Materials; geochronology; ocean tracers; radio-chemistry, u/w detection; modelling; training

REL: Radioecology; biological tracers; carbon export; ecotoxicity; Harmful Algal Blooms (HAB); training

MESL: Organic micropollutants; heavy metals; long-lived radionuclides; RMs; survey & training in UN partnerships (*Extra Budgetary*)

NAEL

TEL: Terrestrial Radioactivity (Laboratory Seibersdorf near Vienna)

[since 1 January 2010]

MARINE Subprograms 2010/2011

H.103 Provision of Reference Products for the marine environment and laboratory performance support

Summary of Reference Materials

Code	Matrix	Origin	Analytes	Status
IAEA-384	Sediment	Fangataufa atoll	Radionuclides	Available
IAEA-414	Fish	Irish & North seas	Radionuclides	Available
IAEA-385	Sediment	Irish Sea	Radionuclides	Available
IAEA-437	Mussel (*Mytilus*)	Mediterranean	Radionuclides	Available
IAEA-418	Sea water	Mediterranean	I-129	Available
IAEA-443	Sea water	Irish Sea	Radionuclides	*On-going*
IAEA-446	Fucus	Baltic Sea	Radionuclides	*On-going*
IAEA-438	Fish	Baltic Sea	Radionuclides	*Pending*
Proficiency Test (PT)	*HELCOM PT* *Arasia PT*	Biota Sediment, biota, water	Radionuclides	*Final report*

Interlaboratory studies and the resulting marine RMs for Trace Metals and MeHg or organic contaminants produced in MESL and distributed through the Analytical Quality Control Services (IAEA, Vienna)

IAEA – Code	Sample Type	Analyte Groups	Year	Availability
IAEA-159	Marine Sediment	Organic Contaminants	2007	Yes
IAEA-158	Marine Sediment	TM & MeHg	2007	Yes
IAEA-436	Tuna Tissue	TM & MeHg	2006	Yes
IAEA-435	Tuna Tissue	Organic Contaminants	2006	Yes
IAEA-433	Marine Sediment	TM & MeHg	2004	Yes
IAEA-432	Mussel Tissue	Organic Contaminants	2003	Yes
IAEA-407	Fish Tissue	TM & MeHg	2003	Yes
IAEA-417	Marine Sediment	Organic Contaminants	2002	Yes
IAEA-406	Fish Tissue	Organic Contaminants	2000	Yes
IAEA-405	Estuarine Sediment	TM & MeHg	2000	Yes

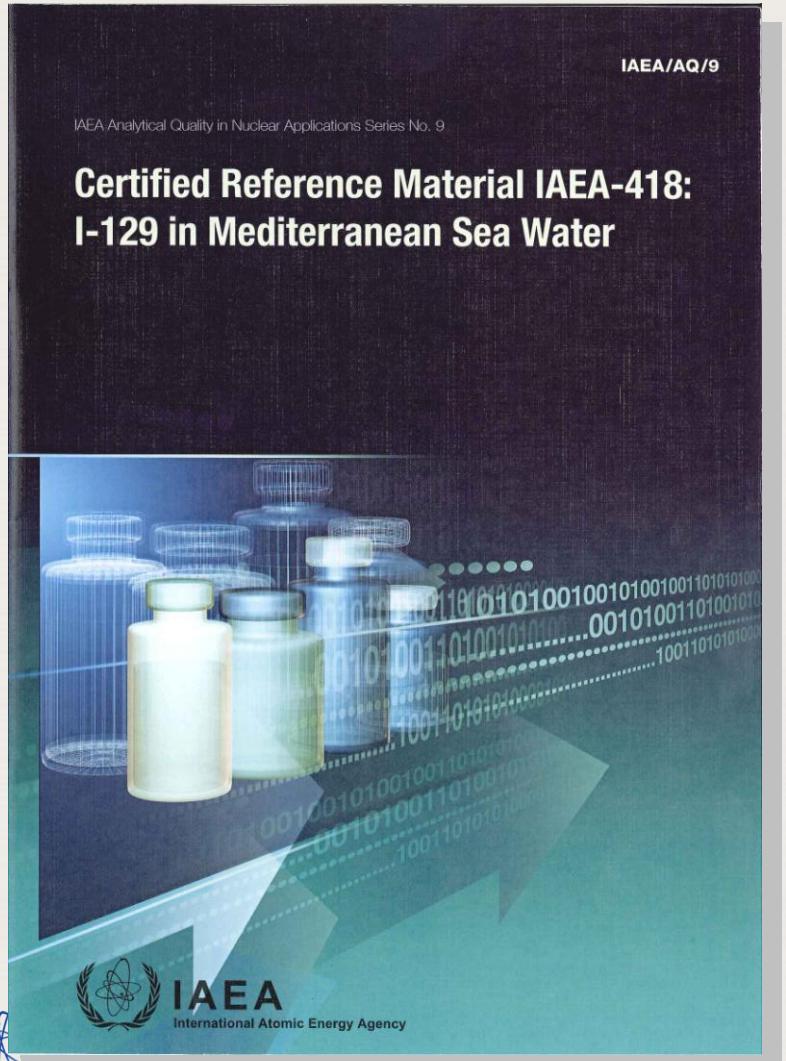
AQCS Activities 2008 – 2010

- Marine Reference Materials produced:
  - IAEA-418 (I-129 in Mediterranean sea water) and IAEA-437 (Radionuclides in Mediterranean Mussel).
- Interlaboratory Comparison Exercises completed:
  - IAEA-443 (Radionuclides in Irish Sea water).
- Interlaboratory Comparison Exercises initiated:
  - One Global exercise in 2010

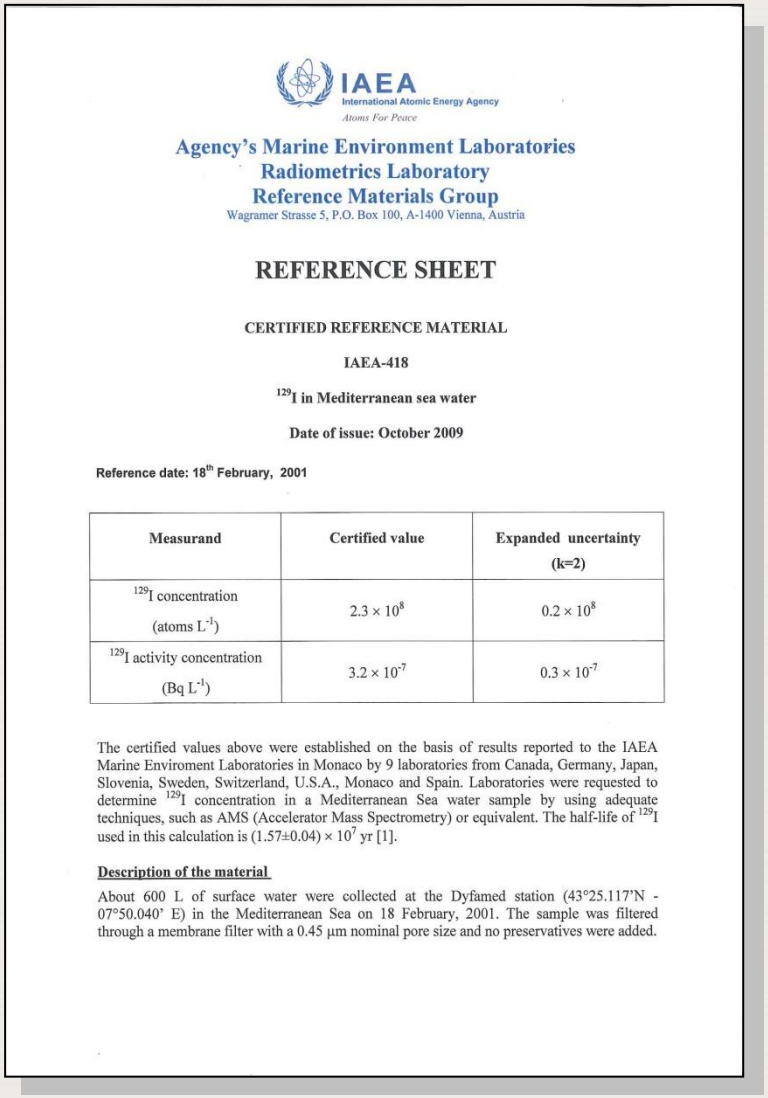
  (IAEA-446, Radionuclides in Baltic Sea *Fucus*).
- Regional Proficiency Test:
  - 3 exercises for ARASIA TC projects in 2008-2009
  - One exercise for CRP gamma spectrometry in 2009

Reference Products for Science and Trade

Report



Reference Sheet



IAEA
International Atomic Energy Agency
Atoms For Peace

Agency's Marine Environment Laboratories
Radiometrics Laboratory
Reference Materials Group
Wagramer Strasse 5, P.O. Box 100, A-1400 Vienna, Austria

REFERENCE SHEET

CERTIFIED REFERENCE MATERIAL

IAEA-418

^{129}I in Mediterranean sea water

Date of issue: October 2009

Reference date: 18th February, 2001

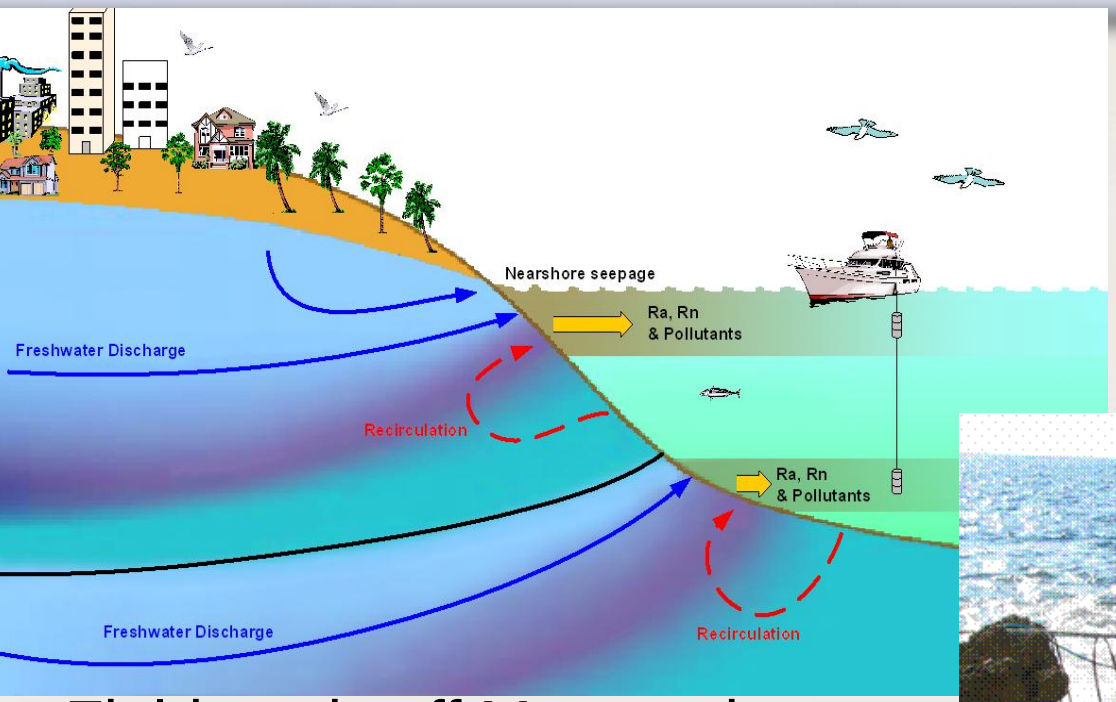
Measurand	Certified value	Expanded uncertainty (k=2)
^{129}I concentration (atoms L^{-1})	2.3×10^{8}	0.2×10^{8}
^{129}I activity concentration (Bq L^{-1})	3.2×10^{-7}	0.3×10^{-7}

The certified values above were established on the basis of results reported to the IAEA Marine Enviroment Laboratories in Monaco by 9 laboratories from Canada, Germany, Japan, Slovenia, Sweden, Switzerland, U.S.A., Monaco and Spain. Laboratories were requested to determine ^{129}I concentration in a Mediterranean Sea water sample by using adequate techniques, such as AMS (Accelerator Mass Spectrometry) or equivalent. The half-life of ^{129}I used in this calculation is $(1.57 \pm 0.04) \times 10^{7}$ yr [1].

Description of the material

About 600 L of surface water were collected at the Dyfamed station (43°25.117'N - 07°50.040' E) in the Mediterranean Sea on 18 February, 2001. The sample was filtered through a membrane filter with a 0.45 µm nominal pore size and no preservatives were added.

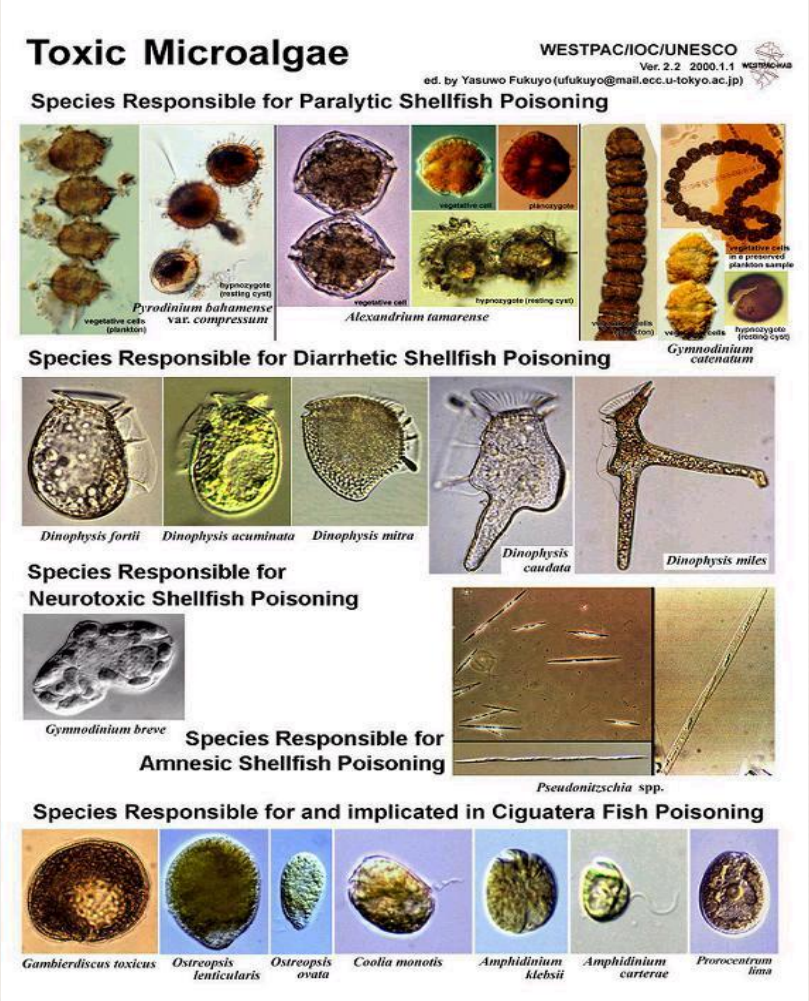
Submarine Groundwater Discharge



- Freshwater resource
- Source of pollution to coastal zones

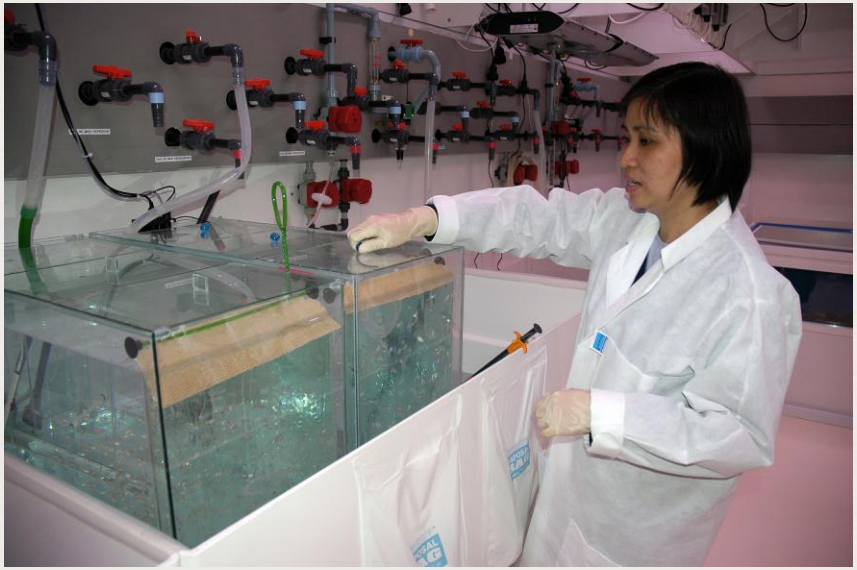
Field study off Monaco in cooperation with: Helmholtz Centre for Environmental Research, Leipzig; AWI Bremerhaven; Hellenic Centre for Marine Research, Greece

HABs are toxic microalgae (phytoplankton 10^4-10^6 / ml)



TC Fellow from Philippines Nuclear Research Institute (PNRI), training in radiotracer techniques for food-chain transfer studies, for national HABs studies at the PNRI IAEA Collaborating Centre

PNRI to produce C-14 labelled saxitoxin



PROGRAM H: ASSESSMENT AND MEASUREMENT OF MARINE AND TERRESTRIAL ENVIRONMENTS

MARINE Subprograms 2010/2011

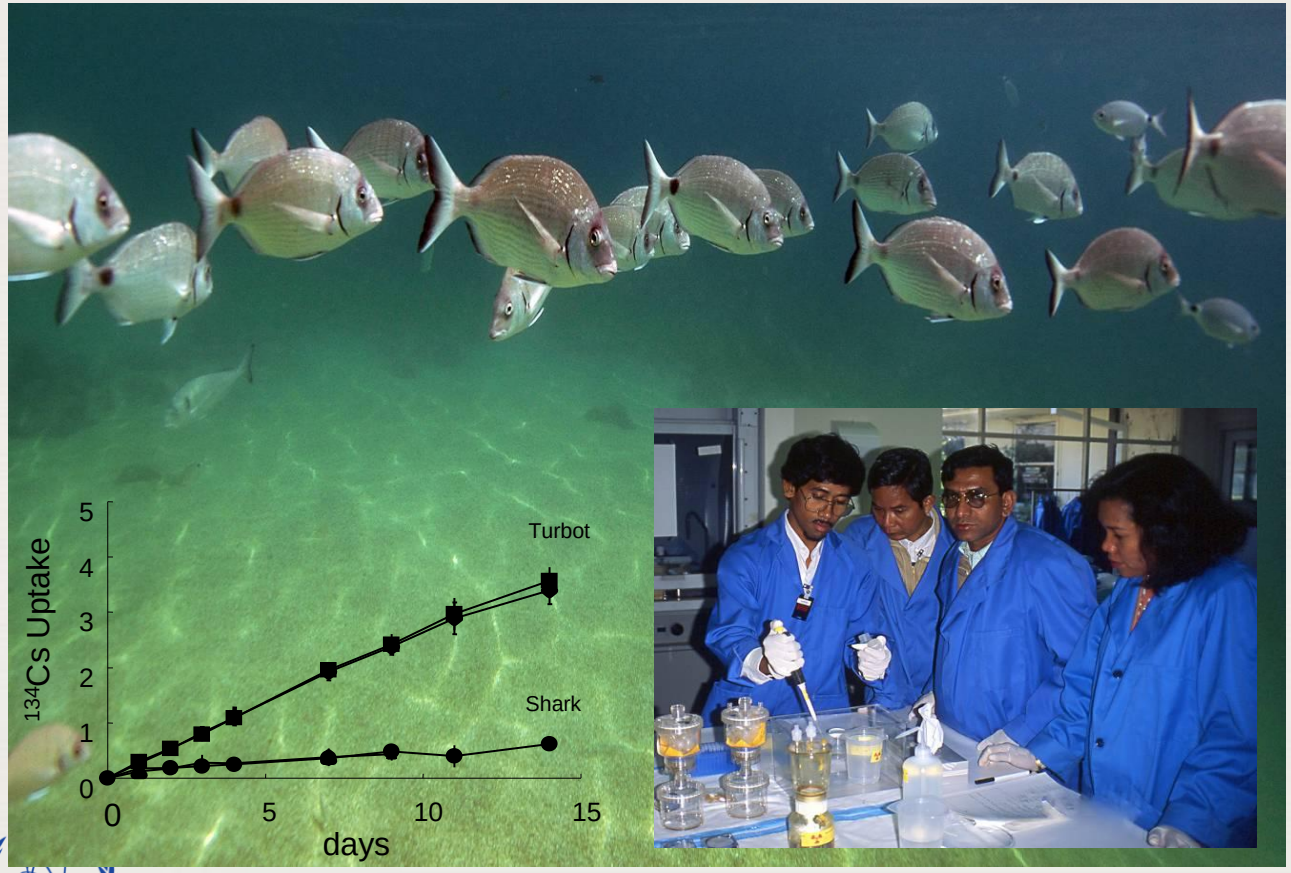
H.203 Radiological techniques for seafood safety

International Atomic Energy Agency
Dept. of Nuclear Sciences and Applications

Marine Environment Laboratories
Monaco

MARINE Subprograms 2010/2011

H.203 Radiological techniques for seafood safety

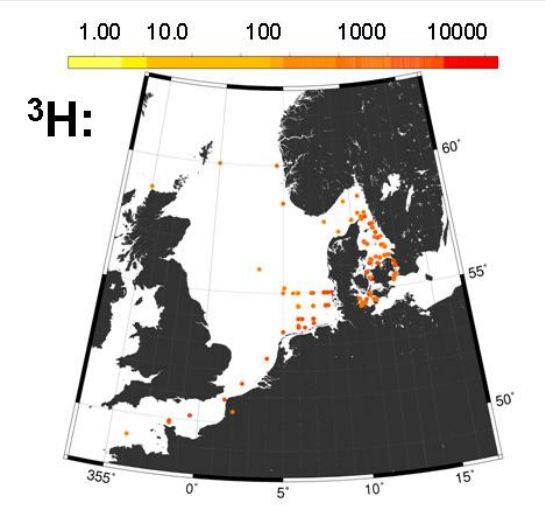


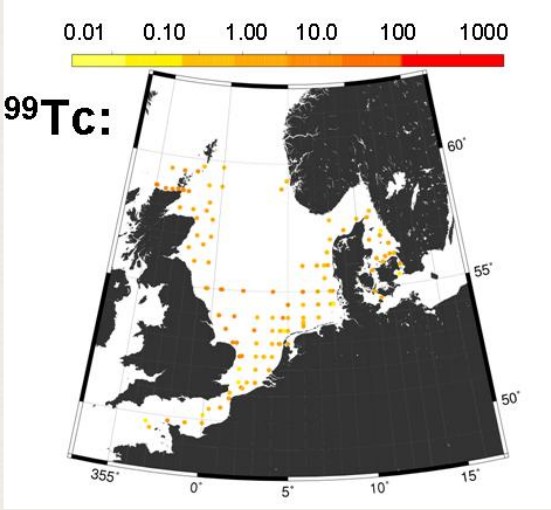
Training IAEA member states in tracer studies of contaminant uptake in Fish

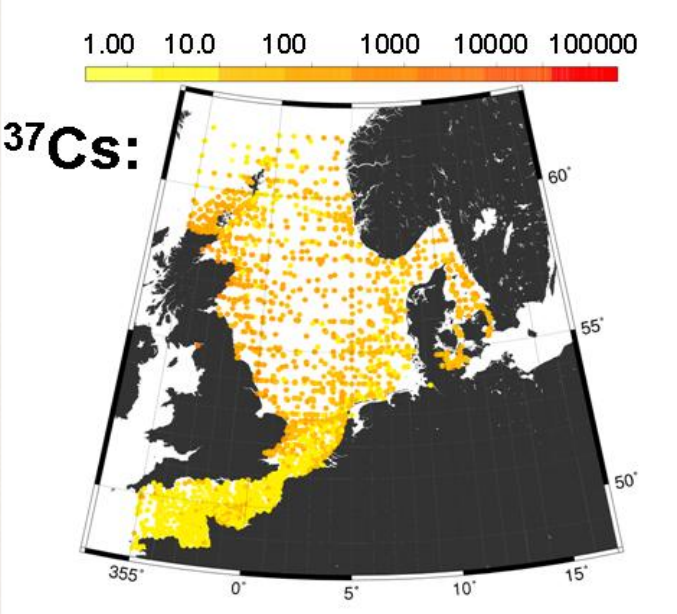
PROGRAM H: ASSESSMENT AND MEASUREMENT OF MARINE AND TERRESTRIAL ENVIRONMENTS

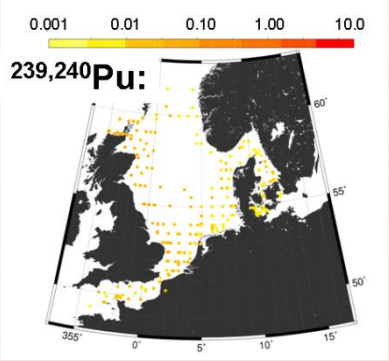
MARINE Subprograms 2010/2011

H.205 Marine Radioactivity Measurements and Assessment









Geographical distribution of radionuclides in a regional sea area

- Data taken from IAEA-MEL **MARiS** Data Base

International Atomic Energy Agency
Dept. of Nuclear Sciences and Applications

Marine Environment Laboratories
Monaco

PROGRAM H: ASSESSMENT AND MEASUREMENT OF MARINE AND TERRESTRIAL ENVIRONMENTS

MARINE Subprograms 2010/2011

H.206 Marine Pollution and impact assessment

MARINE Subprograms 2010/2011

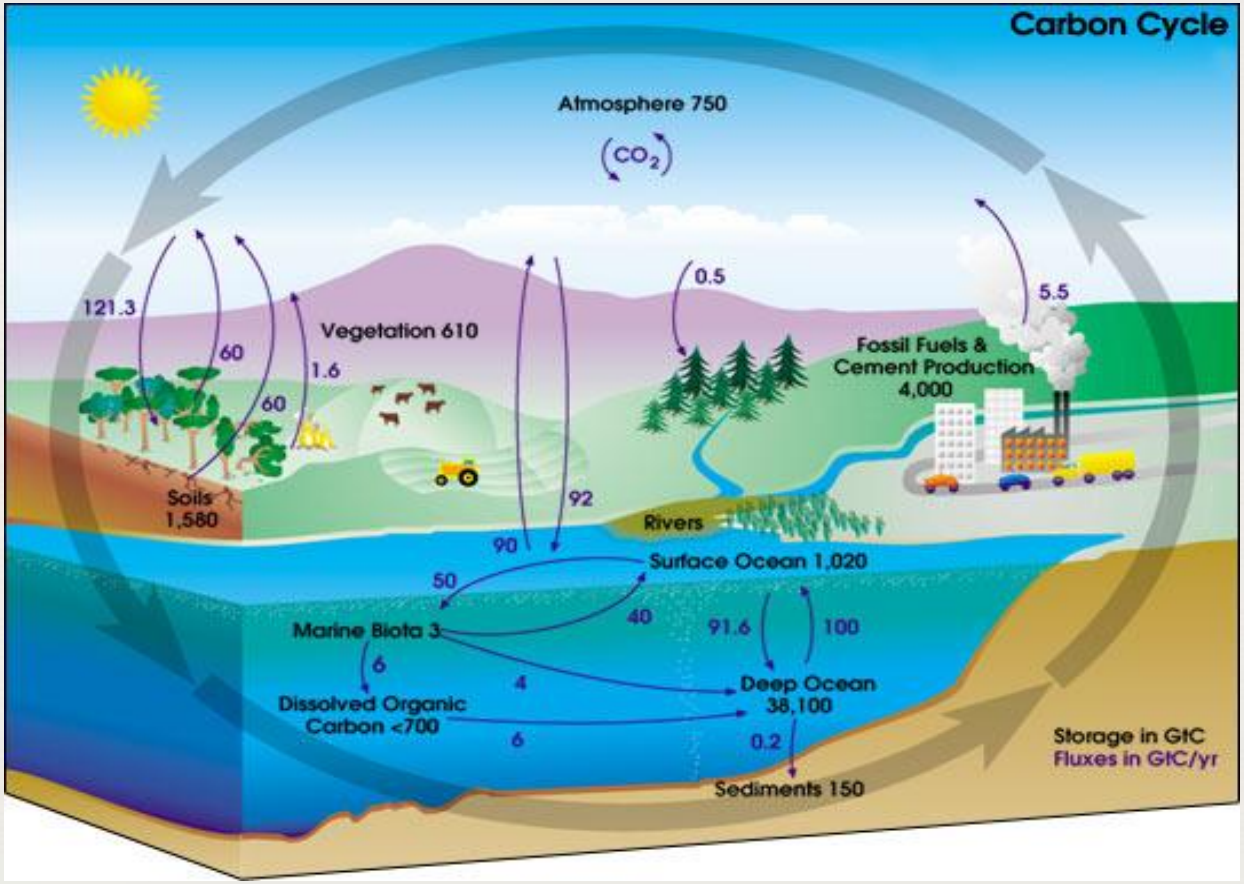
H.302 Monitoring and assessment of Carbon cycling in the Oceans

Selection of Corals

Study of CO_2 and pH influence on the skelaton growth

MARINE Subprograms 2010/2011

H.304 Isotopic tools and models to study climate change

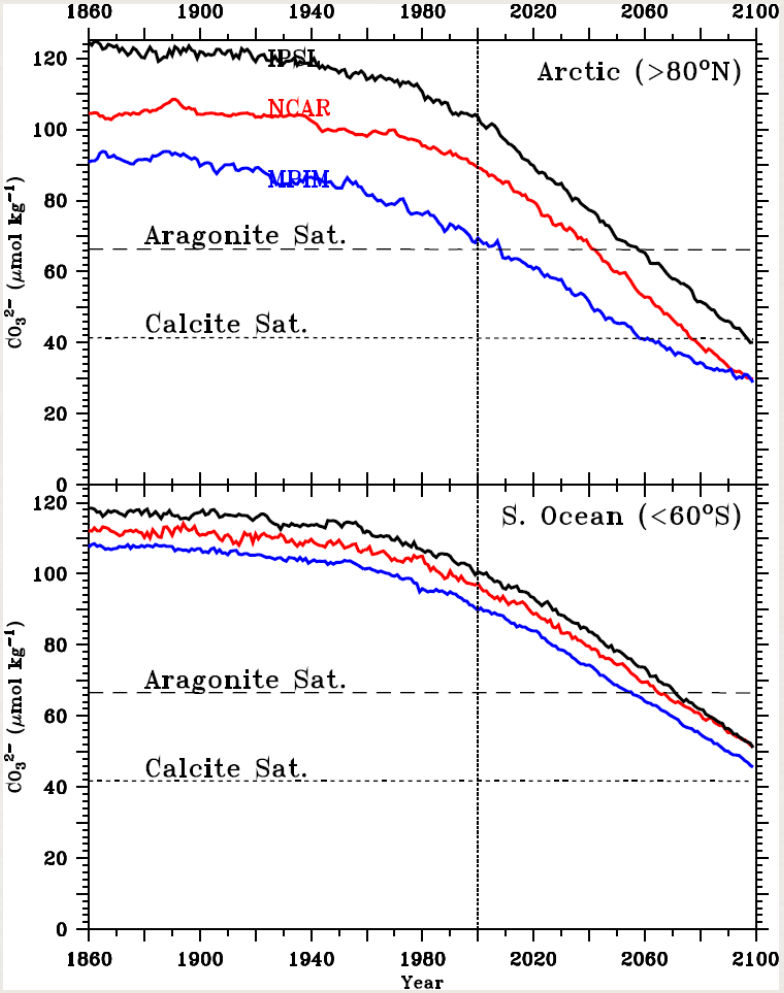


Ocean acidification

- *Ocean in a High CO2 symposium*

  (Monaco, October 6-9 2008)

- Analysis of Arctic Ocean Acidification in 3 coupled climate - carbon cycle models
  - undersaturation occurs first in the Arctic;
  - waters become corrosive to all forms of $CaCO_3$ by the end of the century

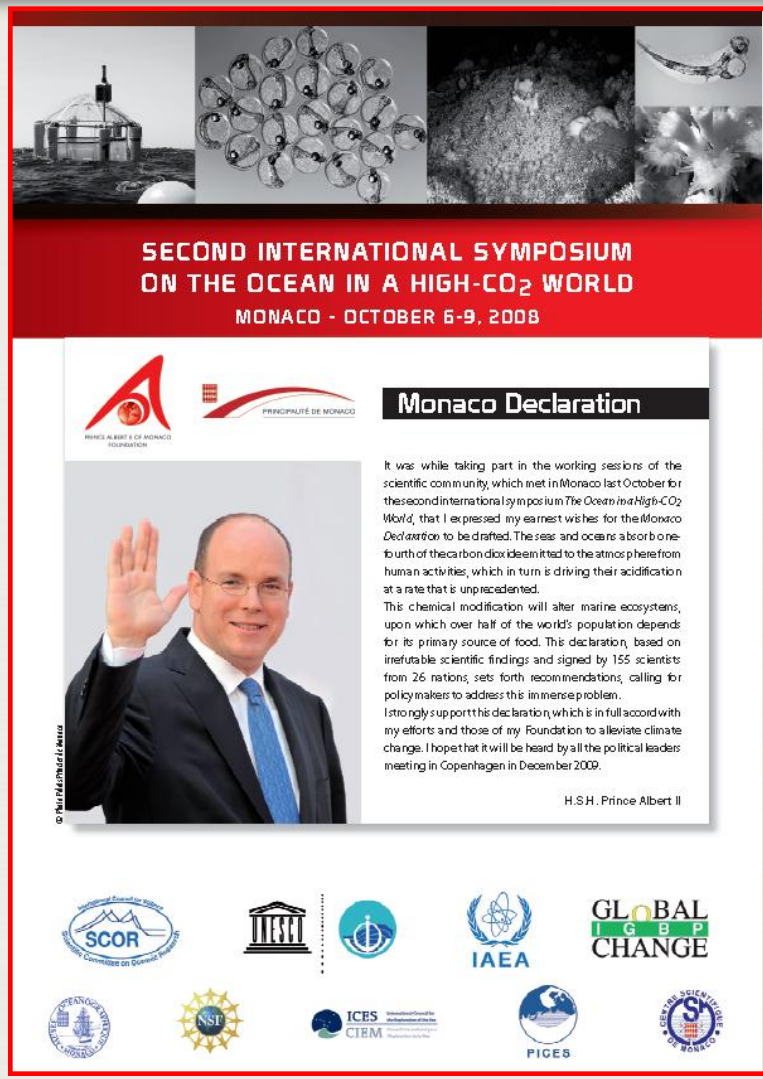


Monaco Declaration urges policymakers to take action on

Ocean acidification:

- is ongoing
- is already detectable
- is accelerating & severe damages are imminent
- will have socio-economic impacts
- is rapid, but recovery will be slow
- can be controlled only by limiting future atmospheric CO_2 levels

→ *Signed by 155 ocean scientists from 26 countries*

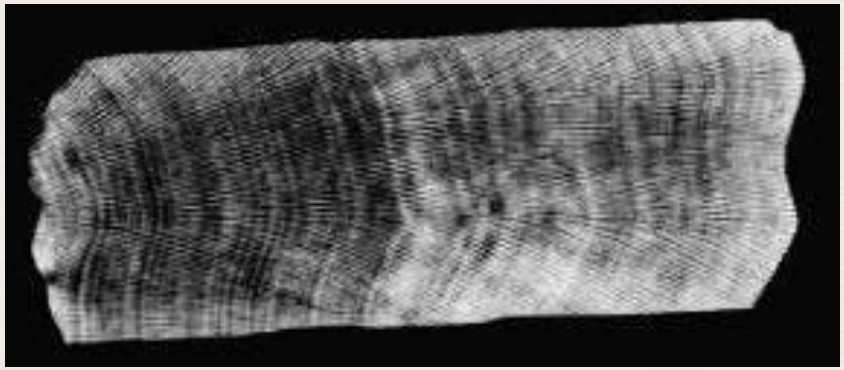


http://www.ocean-acidification.net

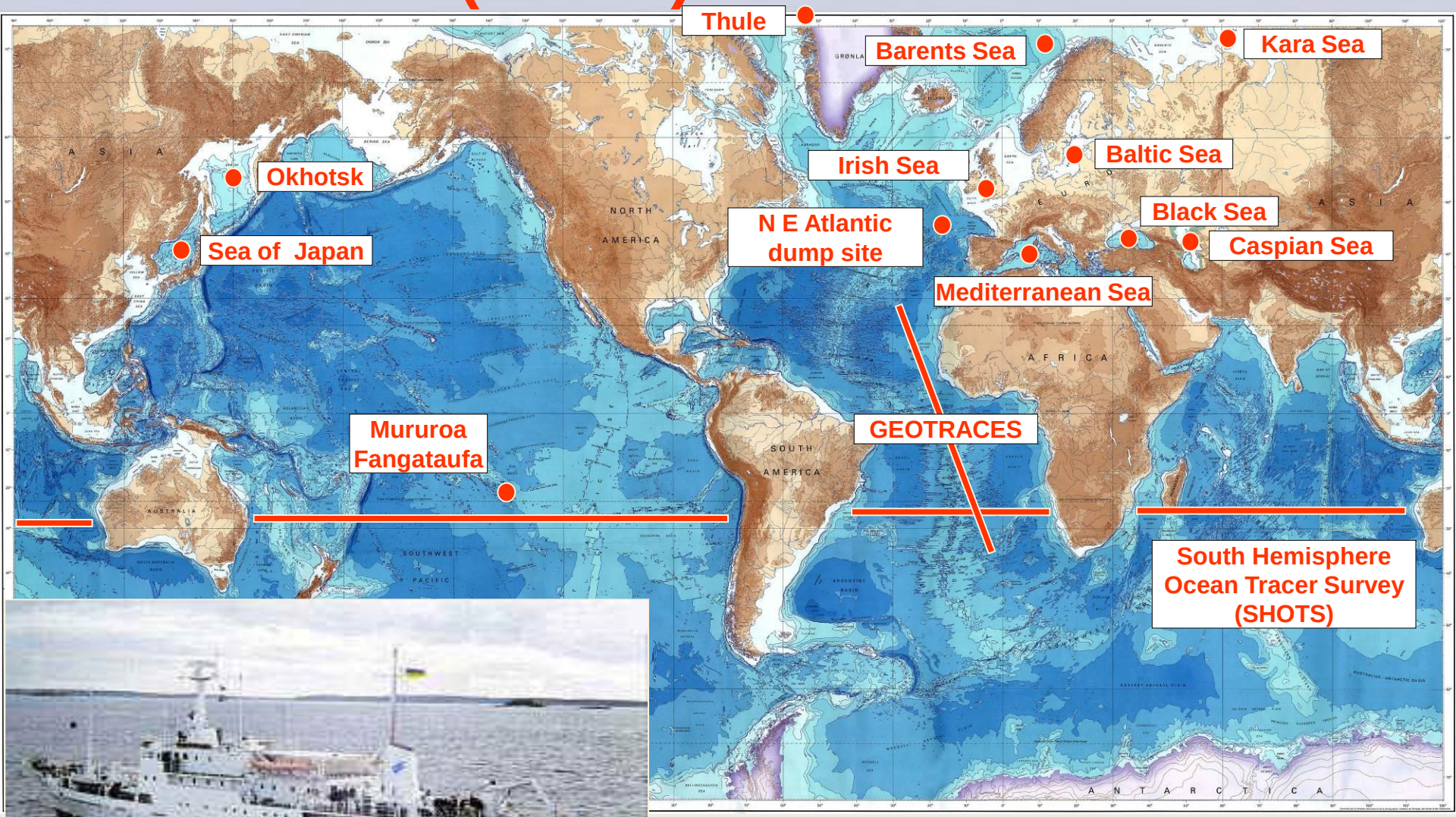
MARINE Subprograms 2010/2011

H.305 Isotopic tracers of climate and environmental change

- CRP El Niño (2004-2010)
  - Laminated peruvian sediments
  - Coral field missions along the equator (Palmyra atoll, Rep. of Palau)

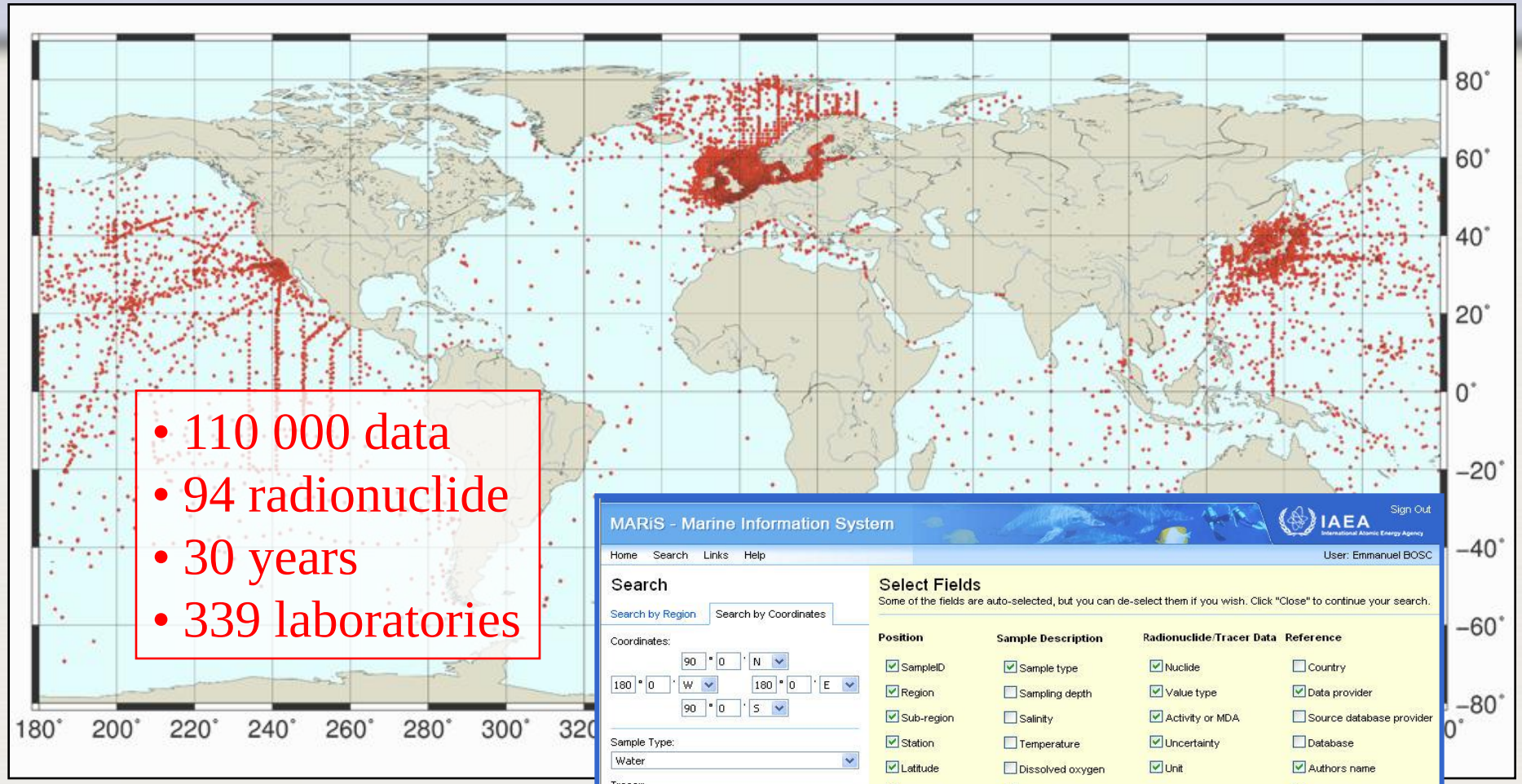


Marine Environmental and Radiological Assessment (MERA)

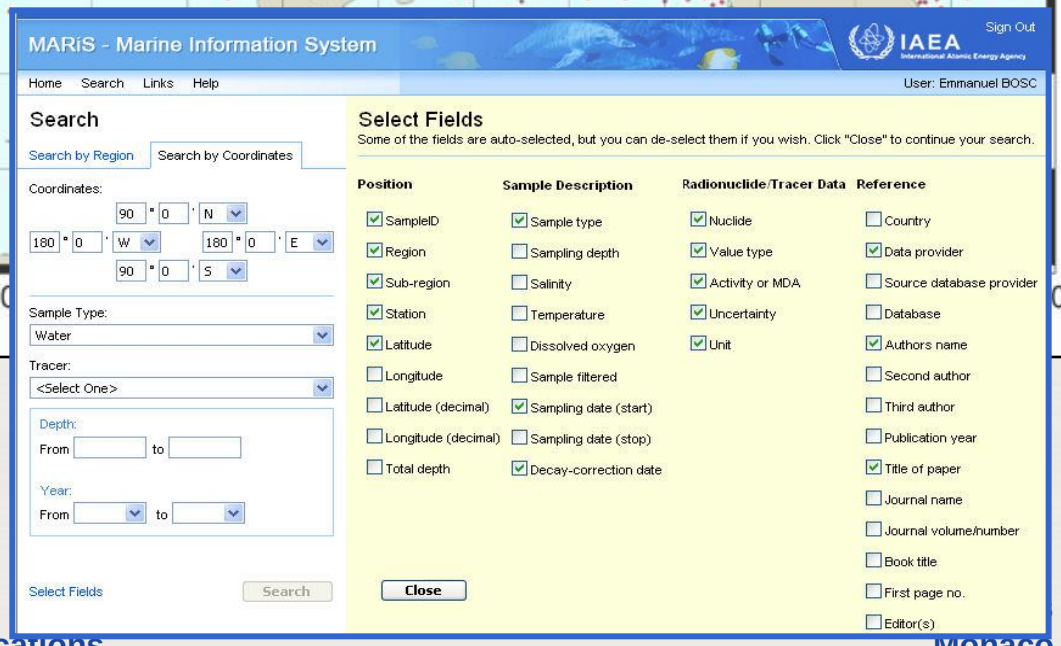


Marine Environment Laboratories
Monaco

On-line access to world-wide marine radioactivity data



- 110 000 data
- 94 radionuclide
- 30 years
- 339 laboratories



http://maris.iaea.org/

Support Capacity Building

- MED POL
  - Regional training courses in Monaco
  - Interlaboratory Comparison Exercises
  - Proficiency tests
  - Expert visits
- ROPME
  - Regional training courses
  - Joint pollution surveys
  - Proficiency tests
  - Expert visits
- TC RAF project (Africa)
  - Regional training courses
  - Procurement of instruments
  - Fellowships
  - Expert visits

Training Courses

- Regional Courses held in Monaco
  - 3 in Nov.-Dec. 2007 (MED POL)
  - 2 in June 2008 (YSLME)
  - 2 in Nov.-Dec. 2008 (MED POL)
  - 2 in 2009 (MED POL)
  - 1 in 2010 NUCLEONICA (together with ITU EC JRC)

- Regional Courses
  - 3 in 2007 (ROPME)
  - 2 in 2008 (ROPME)
  - 1 in 2009 (ROPME)
  - 1 in 2009 (Caspian Sea)
  - 1 in 2010 (ROPME)

YSLME: Yellow Sea Large Marine Ecosystem (China)
ROPME: Regional Organization for the Protection of the Marine Environment (Persian or Arabian Gulf area)

Training Capacity

RADIOMETRICS LABORATORY

Remarks: A group training course in RML requires six months preparation (including purchase of consumables), two weeks for the lab setup and one week for clean-up. Three persons are needed to supervise the trainees in the laboratory and four lecturers for periods between two days to the full length of the course for the theoretical part.

Training Capacity:

- Maximum number of fellows per year: 6 (depending on the length and subject of training the given number may vary; typical length of training should be 6 months)
- Maximum number of training courses per year: 1-2 (3 in 2 years)
- Maximum number of trainees per course: 12
- Training course languages: English and/or French

Training Capacity

Main subjects of training offered:

- Sampling and sample processing
- Radiochemical and radiometric analyses of marine samples (anthropogenic and natural radionuclides)
- Sediment dating
- Marine radioactivity monitoring and assessment
- Radiological assessment
- Modeling of dispersion and transfer of radionuclides
- Tracer applications in oceanography and pollution studies
-

Budgetary requirements:

- Training course (2 weeks, 12 participants): 20 000 € for consumables, 12 000 € for 4 days ship rental for training courses involving sampling at sea
- Fellowships: 1000 €/month bench fees

Training Capacity

RADIOECOLOGY LABORATORY

- Remarks: A group training course in REL requires six months preparation (including purchase of consumables), two weeks for the lab setup and one week for clean-up. Four persons are needed to supervise the trainees in the laboratory and a minimum of two lecturers for the theoretical part.

Training Capacity

- Maximum number of fellows per year: 4 for a 6 months period – max. 2 fellows at the same time - typical length of training should be 6 months
- Maximum number of training courses per year: 1 training, 2-3 weeks long
- Maximum number of trainees per course: 20 (in 2 groups)
- Training course languages: English & French

Training Capacity

Main subjects of training offered:

- Marine Radioecology and Biogeochemical cycling of radionuclides
- Applications to other contaminants and climate change investigations

Budgetary requirements:

- Training course (3 weeks, 20 participants): 15 000 € for consumables and minor equipment
- Fellowships: 1000 €/month bench fees

Training Capacity

MARINE ENVIRONMENTAL STUDIES LABORATORY

Remarks: A group training course in MESL requires four months preparation (including purchase of consumables), two weeks for the lab setup and clean-up. One expert for organic pollutants and two for trace metals are needed to supervise the trainees in the laboratories and a minimum of 2 lecturers for the theoretical part (one for organic pollutants and one for trace metals).

- There is an increasing demand of training course on sampling techniques; these courses would require renting a boat suited to operate equipments like rosette water sampler, multiple sediment corer, box corer, etc. Three experts are needed for sampling training.
- One of MESL's main activities is the analyses of samples issued from extra-budgetary projects. Since the amount of these extra-budgetary-funded samples is not constant, the number of training courses that MESL can carry out per year is variable, the more EB samples to be analyzed, the less number of fellows can be trained.

Training Capacity

- Maximum number of fellows per year: 4 for a 3 months period - max 2 at the same time
- Approximate number of training courses per year: 4 trainings (2 for organic pollutants and for trace metals), 2-3 weeks long
- Maximum number of trainees per course: 6-8 trainees
- Training course languages: English and/or French

Training Capacity

Main subjects of training offered:

- Analytical techniques on trace metals (AAS & ICP-MS), Mercury speciation (Solid AAS & GC-AFS).
- Organotin speciation (GC-FPD & GC-MS).
- Analytical techniques on petroleum hydrocarbons (GC-MS, GC-FID & Spectrofluorometer), Analytical techniques on organochlorine pesticides and PCBs (GC-ECD & GC-MS), Analytical techniques on PBDEs (GC-ECD & GC-MS)

Budgetary requirements:

Monthly training fee for a fellowship: 1500 US$ for trace metals. 2000 US$ for organic pollutants

Thank you very much for your attention!

… and come and co-operate with us.