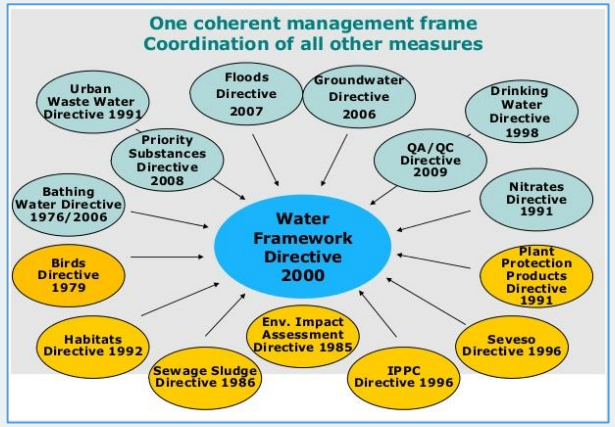
Post spill monitoring: the data we already have and the new data we need

Brett Lyons

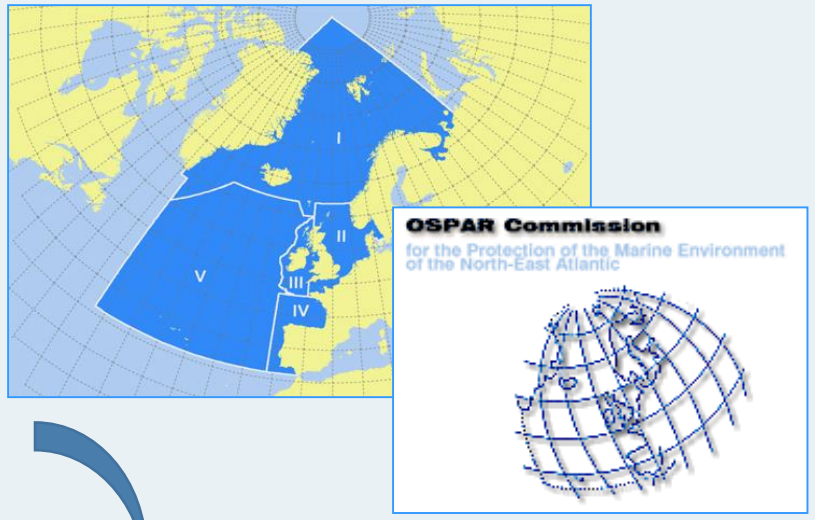
(Cefas)

Policy Drivers: Marine monitoring providing source of baseline data

Water Framework Directive (WFD)



OSPAR Convention



Marine monitoring

Natural Resources Wales

marinescotland science

Centre for Environment Fisheries & Aquaculture Science

SEPA Scottish Environment Protection Agency

Environment Agency

DOE Department of the Environment www.doeni.gov.uk

JNCC Joint Nature Conservation Committee

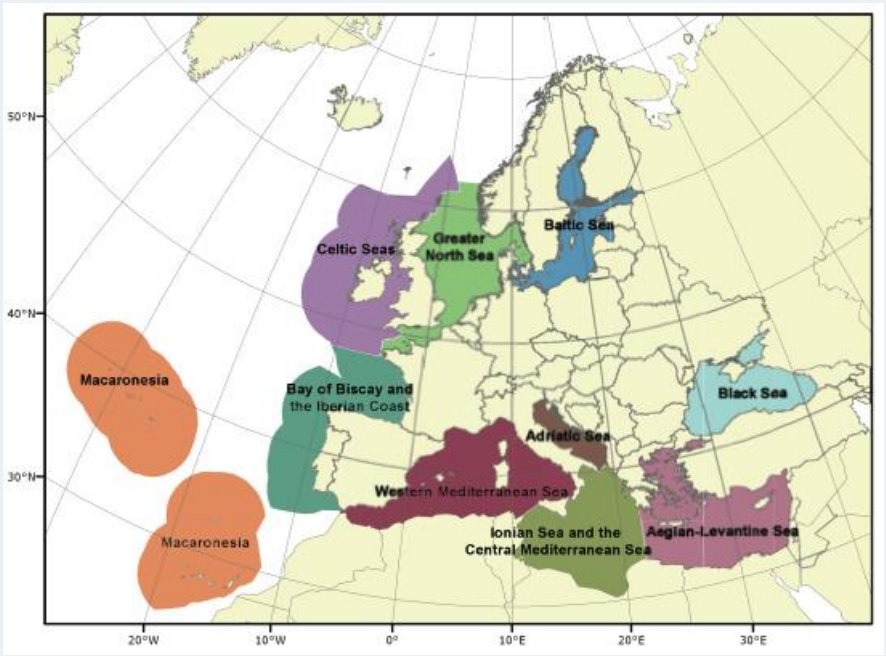
NATURAL ENGLAND

Marine Strategy Framework Directive (MSFD)

Marine Strategy Framework Directive

To put in place measures to achieve Good Environmental Status in Europe's seas by 2020

- Ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and;
- Use of the marine environment is sustainable - safeguarding the potential for uses and activities by current and future generations.



11 Descriptors of Good Environmental Status (GES)

No.	Descriptor
1	Biological diversity
2	Non-indigenous species
3	Commercial fish & shellfish
4	Food webs
5	Eutrophication
6	Seafloor integrity
7	Hydrographical conditions
8	Contaminants
9	Contaminants in seafood
10	Litter
11	Energy, incl. underwater noise

The organisation of marine monitoring in the UK

Twice yearly alternately chaired by the Marine Directors from the Department of Environment, Food and Rural Affairs (Defra) and Marine Scotland.

Marine Science Co-ordination Committee (MSCC)

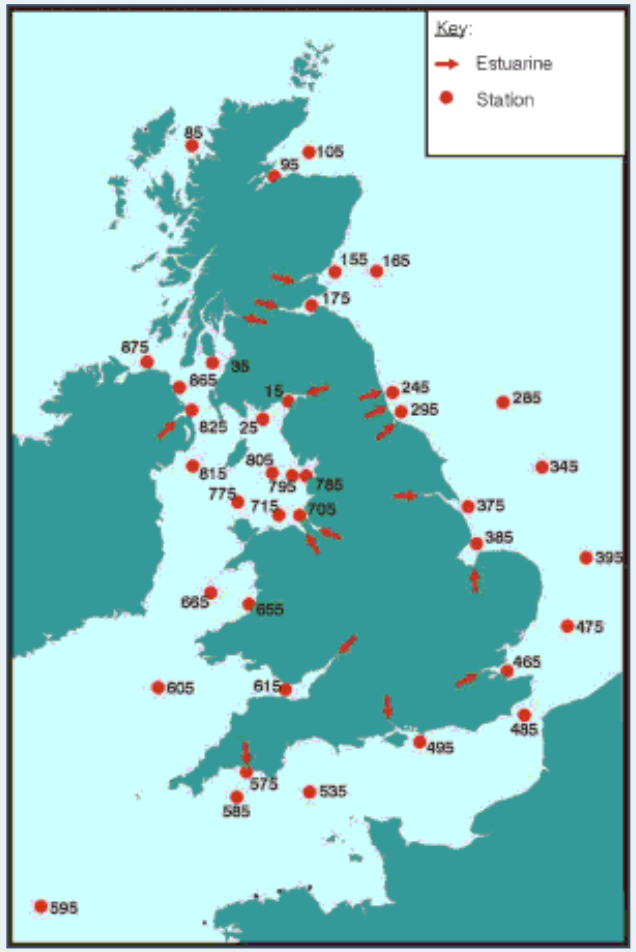
Multiple Gov. departments and organisations with interests in the blue space (UKHO, Met Office, BIS, Crown Estate etc)

UK Marine Monitoring and Assessment Strategy Evidence Groups (UKMMAS)

- Clean and Safe Seas Evidence Group (CSSEG)
- Productive Seas Evidence Group (PSEG)
- Healthy and Biologically Diverse Seas Evidence Group (HBSEG)
- Ocean Processes Evidence Group (OPEG)

Clean Seas Environmental Monitoring Programme (CSEMP)

- OSPAR/MSFD focused spatial and temporal programme (status & trend)
- Applying internationally recommended biological and chemical techniques with approved **QA/QC** (developed by ICES/OSPAR)
- Integrated monitoring focusing on water, sediment and biota
  - Analytical chemistry (metals, PAHs, PCB, PBDEs, Dioxins)
  - Ecotoxicology (limited geographically and mainly historical)
  - Biomarkers (linked to metals and pollution by PAHs/PCBs)
  - Fish/shellfish disease (general and pollutant specific health markers)
  - Benthic ecology (better data available elsewhere!)
- **Supports critical mass and capacity in relation to the UK's marine chemical contaminants knowledge base and scientific expertise**



Easy access to CSEMP baseline data : MERMAN database

British Oceanograph
Data Centre
NATURAL ENVIRONMENT RESEARCH CC

Site map | search BODC
My account | Register | Log in
rtners | Products | Help and hints

Data management
UK
MERMAN
- Project overview
- BODC's role
- Partnerships
- Project specific
- Assessments and data
- Other links

Marine
databa

MERMAN holds U
Convention (OSI
European Comm
EMODNET.

To find out more

- Project ov
- BODC's r
- Partnersh
- Project sp
- Assessme
  how to access these and other data held within MERMAN.
- Other links — Links to relevant pages

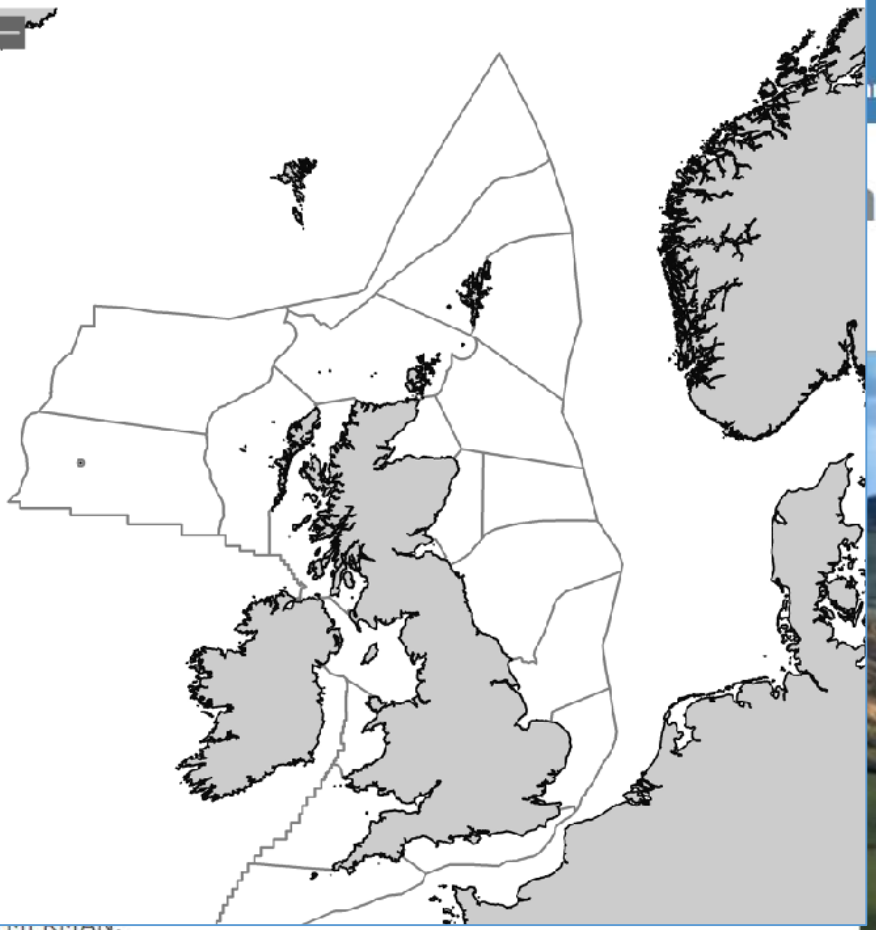
t National

CSEMP assessment using data extracted from MERMAN on 1 September 2014

Select a media
Measurement types
Measurements
Go to national area
Go to region

Station information
Name :
Code :
Longitude :
Latitude :
Agency :

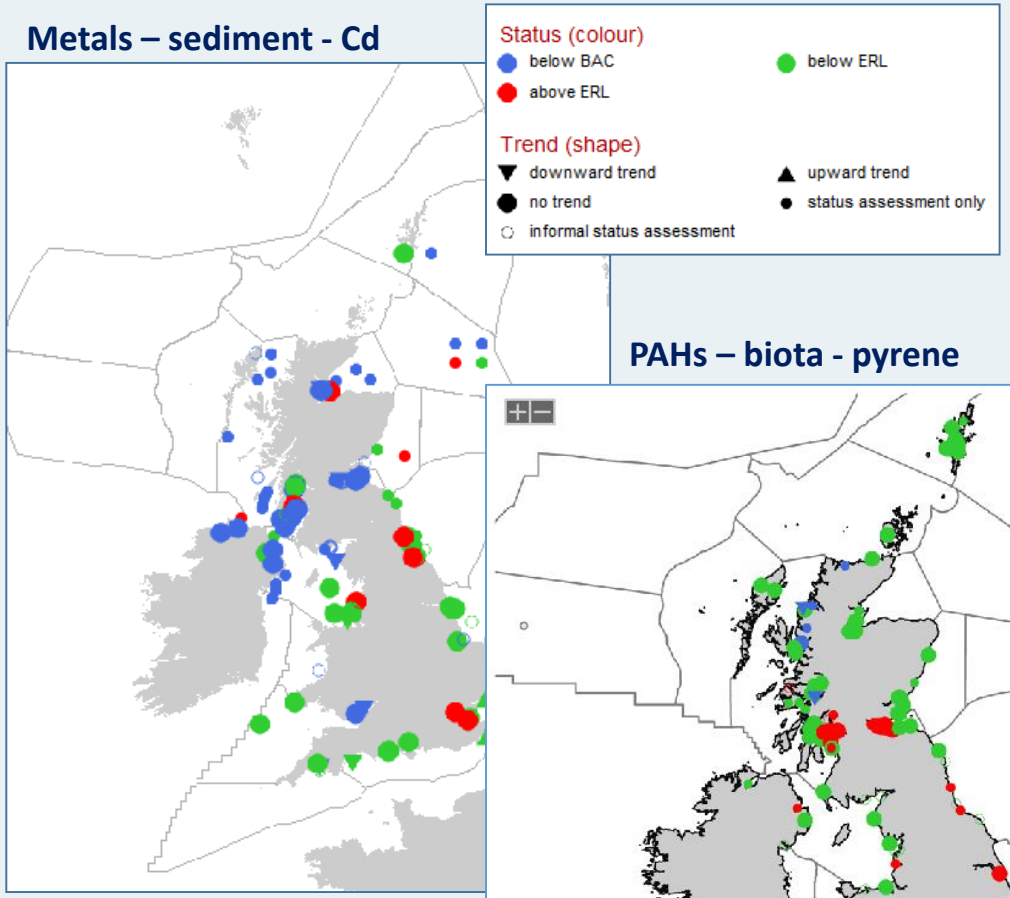
Access to data
Contact : Data Manager
merman@bodc.ac.uk



Jurassic Coastline, West Dorset ©

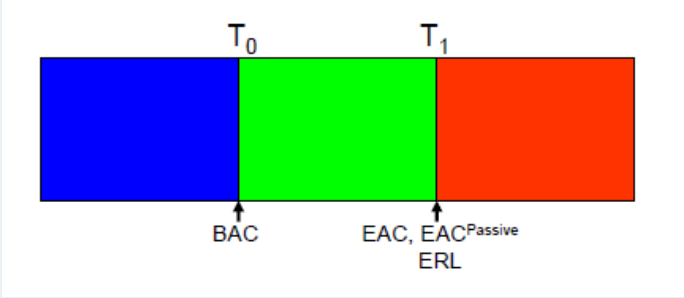
Easy access to CSEMP baseline data : MERMAN database

Metals – sediment - Cd



PAHs – biota - pyrene

- The Marine Environment Monitoring and Assessment National database (**MERMAN**)
- Holds all CSEMP data (high level QA/QC)
- Assessment tools based on international standards (e.g. sediment quality guidelines)
- Temporal data 20+ years
- Potential to have data available in the event of a spill
- *Limited spatial scale and set of contaminants measured*



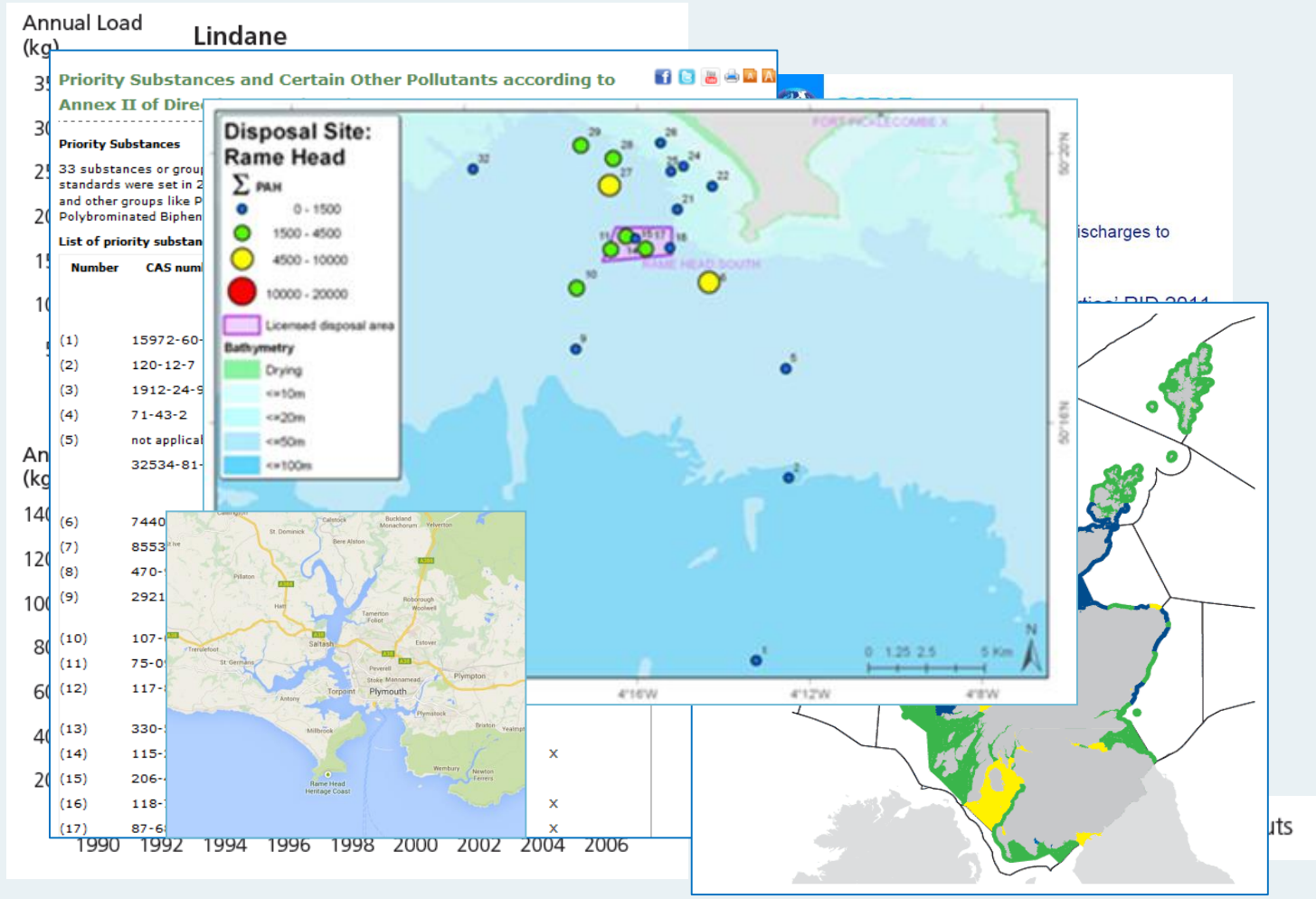
Centre for Environment Fisheries & Aquaculture Science

http://www.bodc.ac.uk/projects/uk/merman/

Cefas

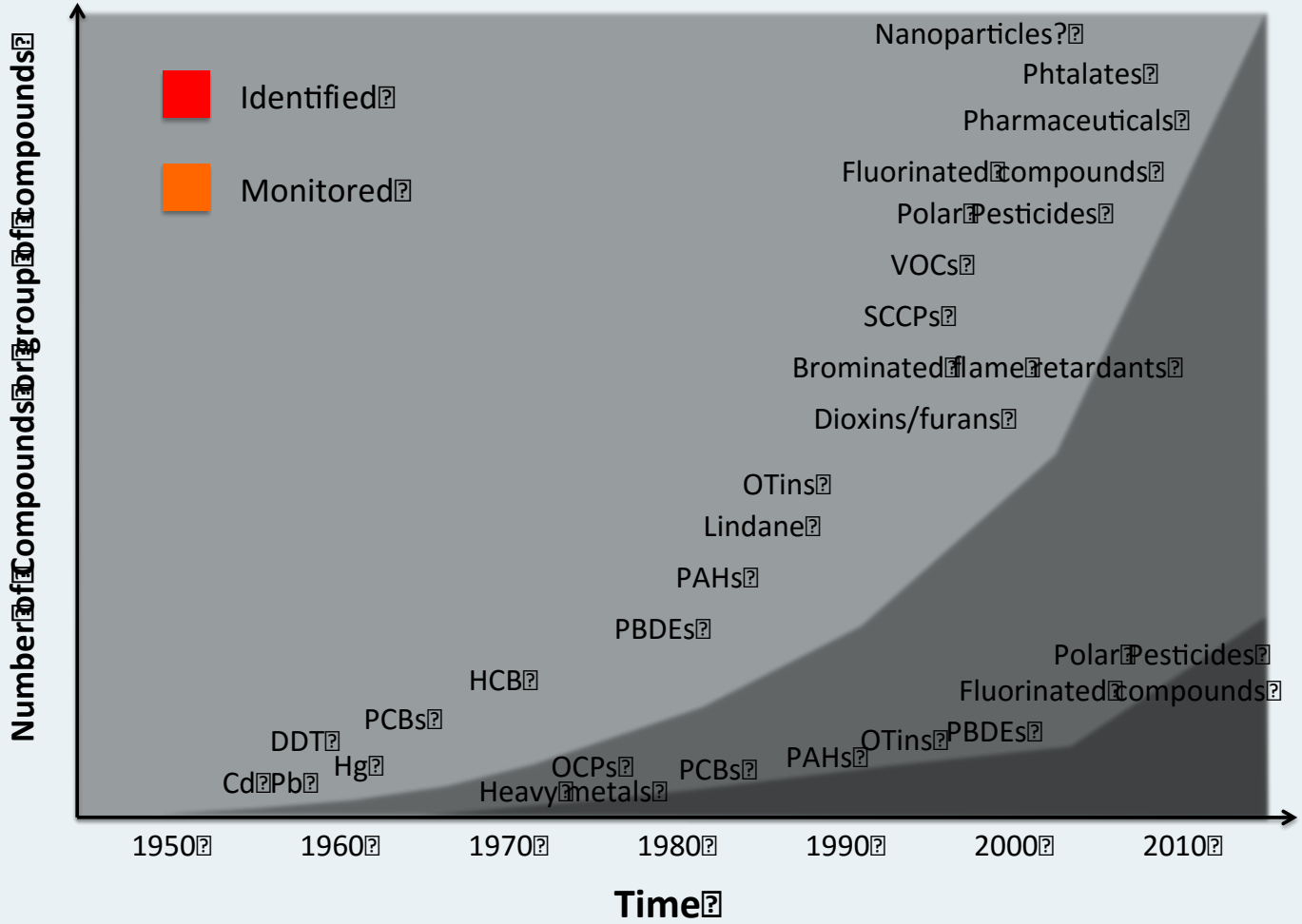
Other potential sources of chemical contaminant data currently available

- OSPAR Riverine Inputs and Direct Discharges – RID
- WFD Priority pollutants
  - 33 core priority substances (plant protection products, biocides, metals and other groups like PAH and PBDEs).
  - EA Chemical screen programme (GCMS scan) > 1000 chemicals (high LOD)
- Information from Dredge disposal site monitoring
- Other ad-hoc (e.g. commercial licencing consent, environmental Impact assessment data) and R&D information may be available.

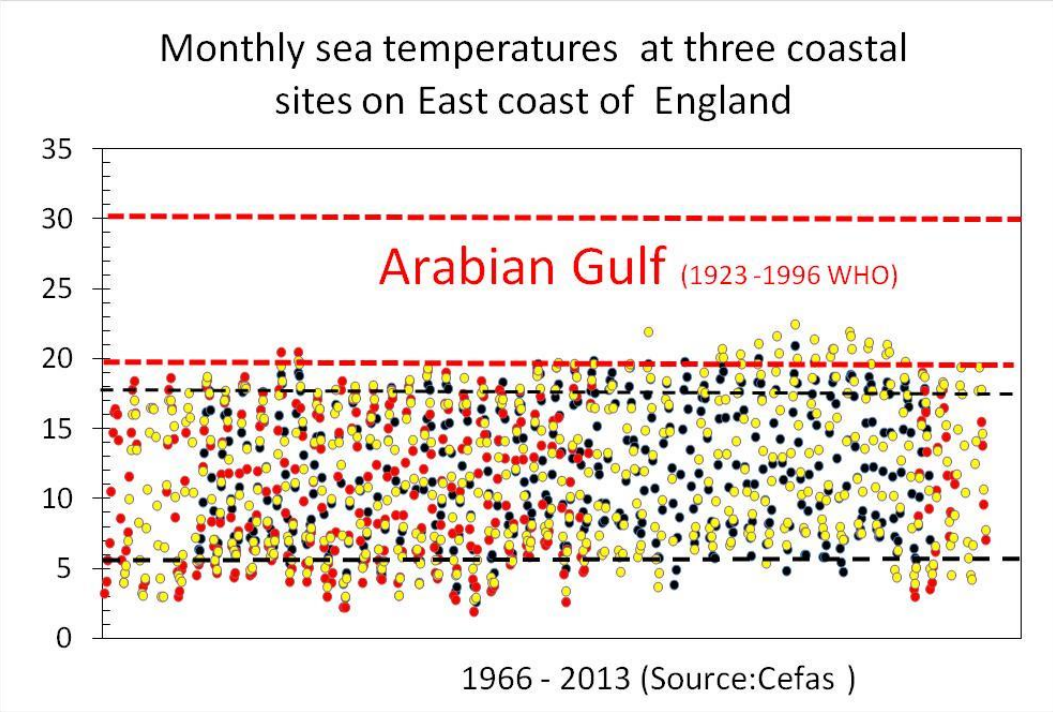


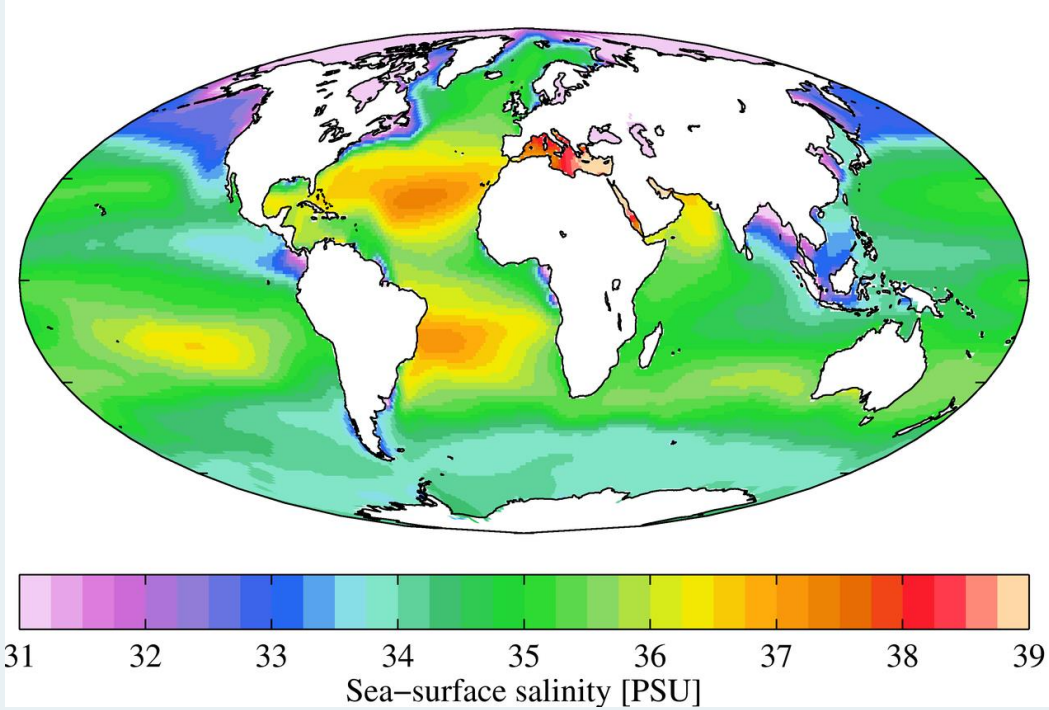
What about HNS: Why relying on routine monitoring is never going to be enough

- Too many chemicals currently manufactured and shipped to have baseline data for all
- 2009: CAS registry = 50 million chemicals…. By 2011 60 million chemicals registered!
- Understanding fate and effects of spills is difficult as the data available for marine systems is often limited (e.g. toxicity & fate)
- Need to consider that not all marine systems are the same (vary widely in relation to temperature, salinity etc.)



The importance of environmental factors

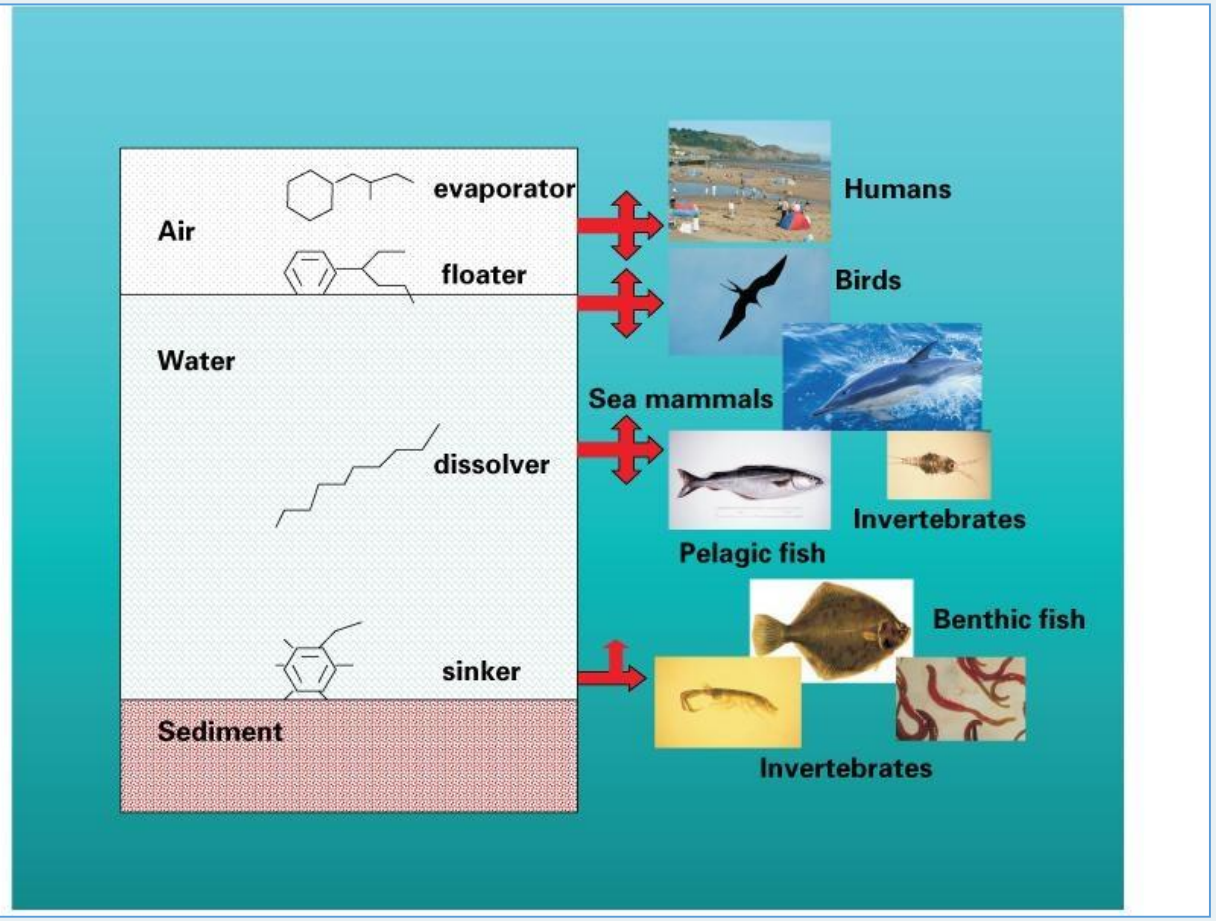




Depth, Suspended sediment, Light

The importance of chemical properties

- Fate and effects of HNS spills less well recognised than those involving oil pollution
- Most oils float and are immiscible with water
- HNS chemicals exhibit a far greater range of properties that determine where they end up in the environment and what effect they have
- Need to consider things such as density, solubility and volatility
- ~50% by tonnage **evaporators** and **floaters**
- Often scarcity of data, little if any in relation to impacts on marine animals (e.g. most toxicological information on freshwater animals)
- Understanding properties allow us to tailor post spill responses



Prioritisation process to rank main HNS: risks & knowledge gaps

- Although rare spills do occur
  - *Levoli Sun*: 1000 tonnes styrene
  - MSC *Napoli*: >1600 tonnes of IMO classified dangerous goods
- *ARCOPOL identified 23 substances as a priority based on frequency of transport, occurrence of previous incidents, behaviour in seawater and toxicity
- Weight-of –evidence approaches
  - Volumes HNS transported around our coasts and incidents reported
  - HNS physico-chemical properties
  - Toxicities to marine organisms
- HNS: moderate to high toxicity, bioaccumulation potential, persistent and carcinogenic = **high risk!**

Marine Pollution Bulletin 64 (2012) 1085–1095

Priority list of HNS in EU Atlantic waters.

HNS	GESAMP Classification				Carcinogenic effects[b]	Previous incident	Physico-chemical properties[c]	Trafficranking[d]
	Bioaccumulation	Biodegradation[a]	Acute toxicity	Chronic toxicity				
Benzene	1	R	2	–	C	Bow Eagle	E	3
Styrene monomer	3	R	3	–	C	Ievoli Sun	FE	8
Xylenes	3	NR	3	0	NC	Cason	FE	7
Cyclohexane	3	NR	3	–	NC	Bow Eagle	E	14
Toluene	2							
Nonene (all isomers)	4							
Aniline	0							
Acrylonitrile	2							
Nitrobenzene	1							
Isononanol	3							
Alkyl (C5–C8, C9) benzenes	4							
Nonylphenol poly(4–12) ethoxylates	4							
Octane (all isomers)	5							
1-Nonanol (Nonyl alcohol)	3							
Butyl acrylate (all isomers)	2							
Di (2-ethylhexyl) adipate	2							
Trichloroethylene	2							
Hexane (all isomers)	3							
Heptane (all isomers)	4							
1-Dodecanol	2							
Cresols (all isomers)	2							
Decanoic acid	4							
Perchloroethylene	2							

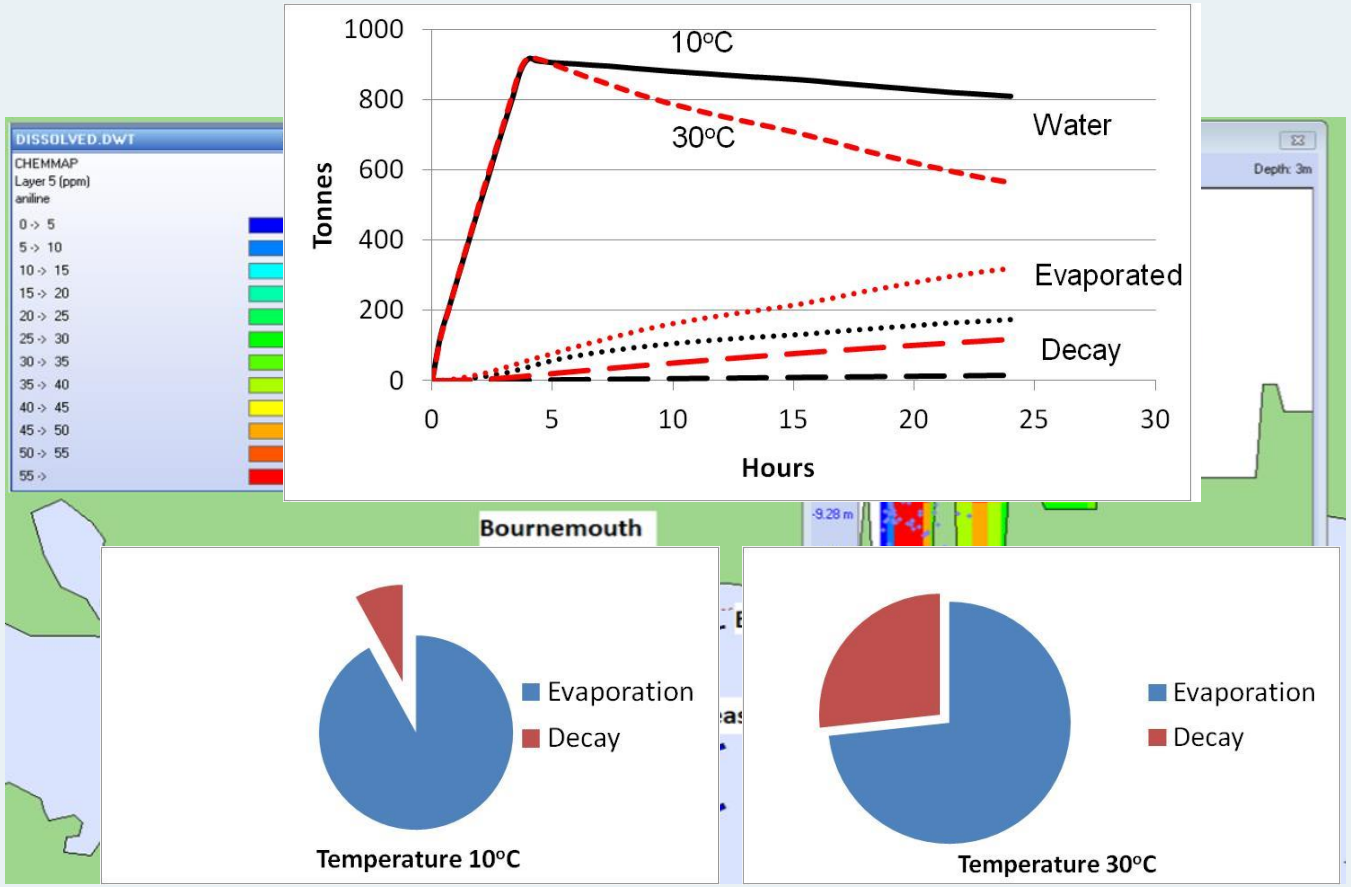
Table SM-1. Priority list of the Top 20 HNS for European Waters for the RAMOCS project based upon the revised GESAMP hazard profile system. The alternative list is adjusted to account for volatilization.

Ranking	HNS	HNS (Alternative)
1	Styrene monomer	Sulfuric acid
2	Xylene	Phosphoric acid
3	Sodium hydroxide	Styrene monomer
4	Sulfuric acid	Phenol
5	Ammonia	Sodium hydroxide
6	Phosphoric acid	Ammonia
7	Phenol	Methanol
8	Methanol	Xylene
9	Benzene	Aniline
10	Palm oil	Benzene

*The ARCOPOL – The Atlantic Regions' Coastal Pollution Response Project
Neuparth et al., Marine Pollution Bulletin 62 (2011) 21-28

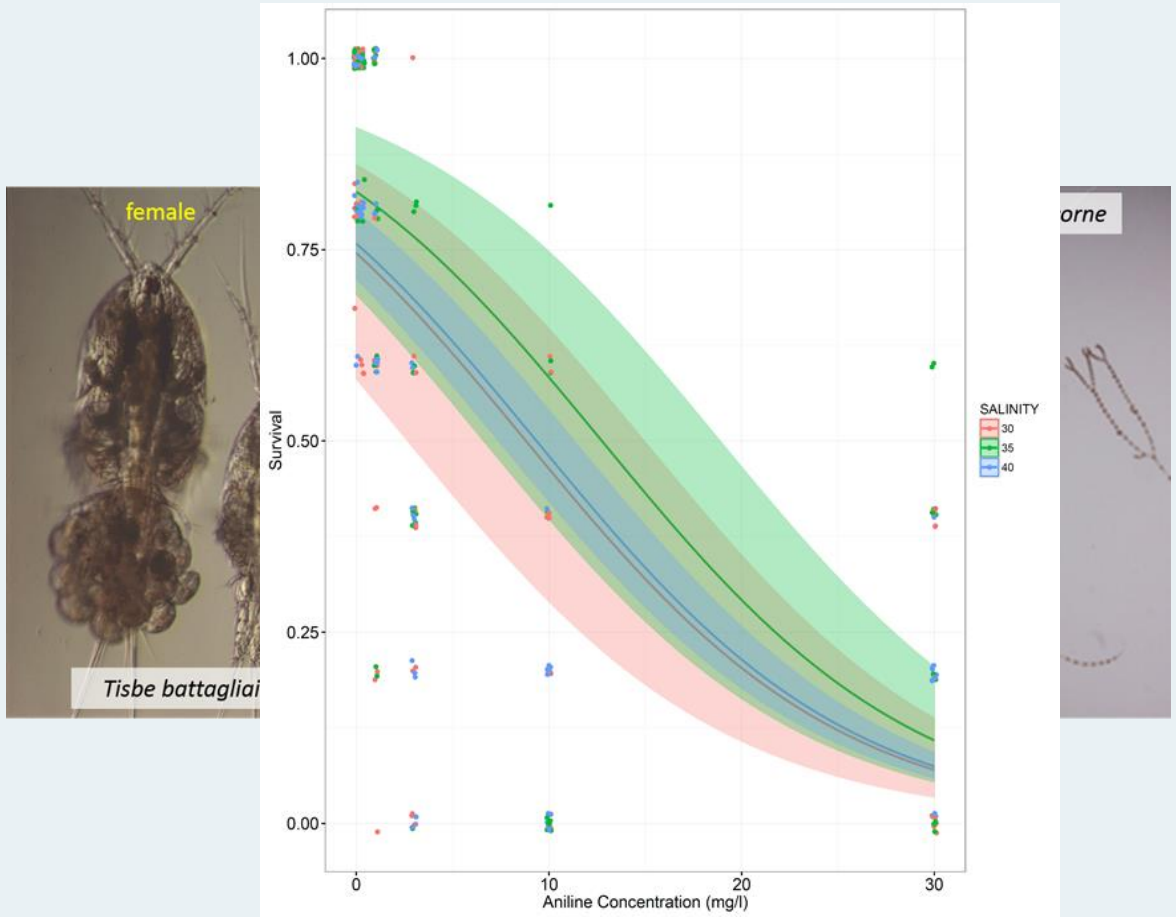
New data we need: HNS fate

- ITOPF funded project looked at 6 priority HNS identified by ARCOPOL project.
- CHEMMAP model used to look at dispersion and fate (nearshore) with different environmental variables (‰ and ˚C).
- Example Aniline (floater/dissolver, 4 hrs 1000 tonne release) a temp change 10 -30 ˚C significant effect on overall fate.
- After 24hrs
  - Evaporation fraction increased from 16% to 29%.
  - Degradation > from 1% to 12% total tonnage.
  - Seabed water conc. showed a commensurate change from a 4 day time weighted mean of 4.36 mg l-1at 10˚C to 2.82 mg l-1 at 30˚C.



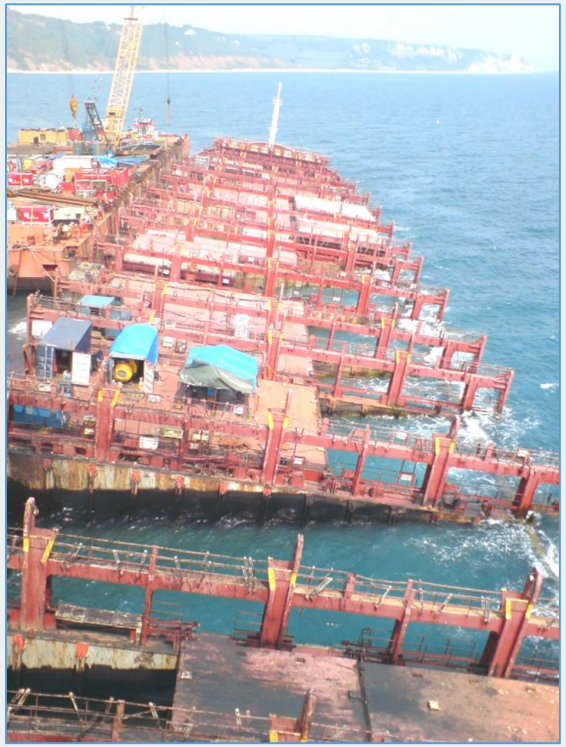
New data we need: HNS toxicity (lab studies)

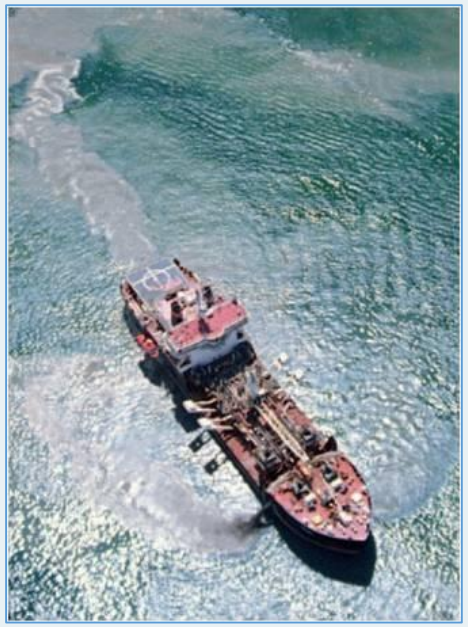
- Range of toxicity test species
- Aniline, butyl acrylate and zinc sulphate
- Range of environmental conditions: 20 to 40 ‰ and 10 – 30˚C
- In most cases, higher toxicity with increasing temperature and lower toxicity with increasing salinity.
- HNS spills more impact in summer in temperate regions and in lower salinity coastal or estuarine areas (these are also likely regions of higher marine traffic)

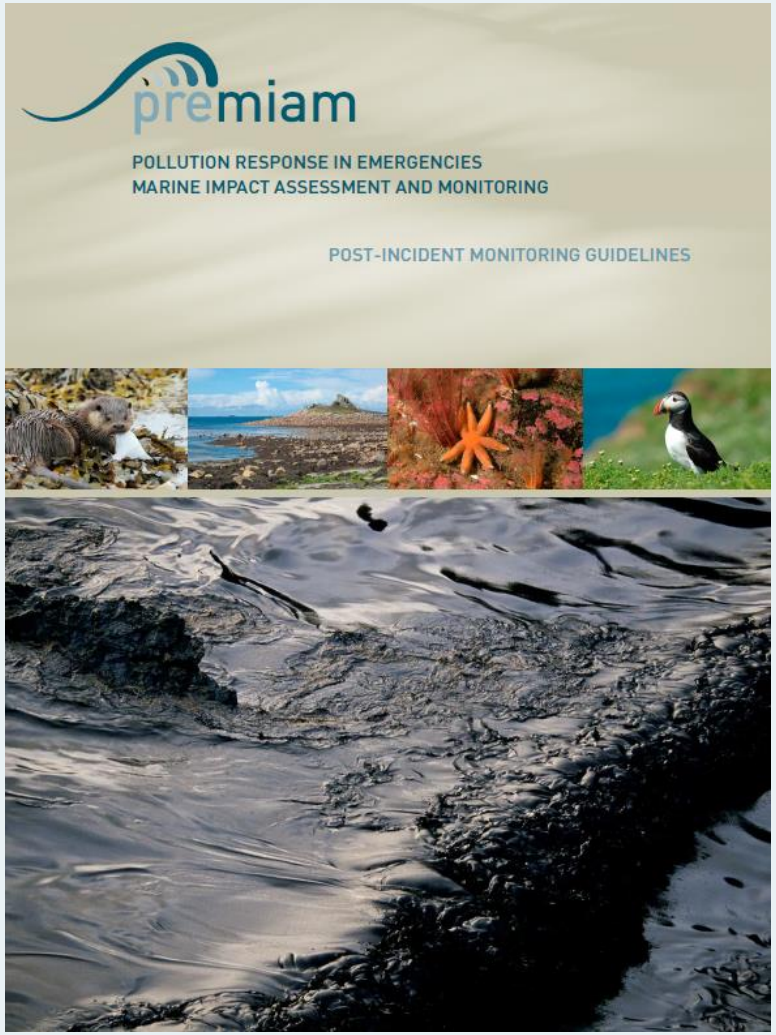


Summary

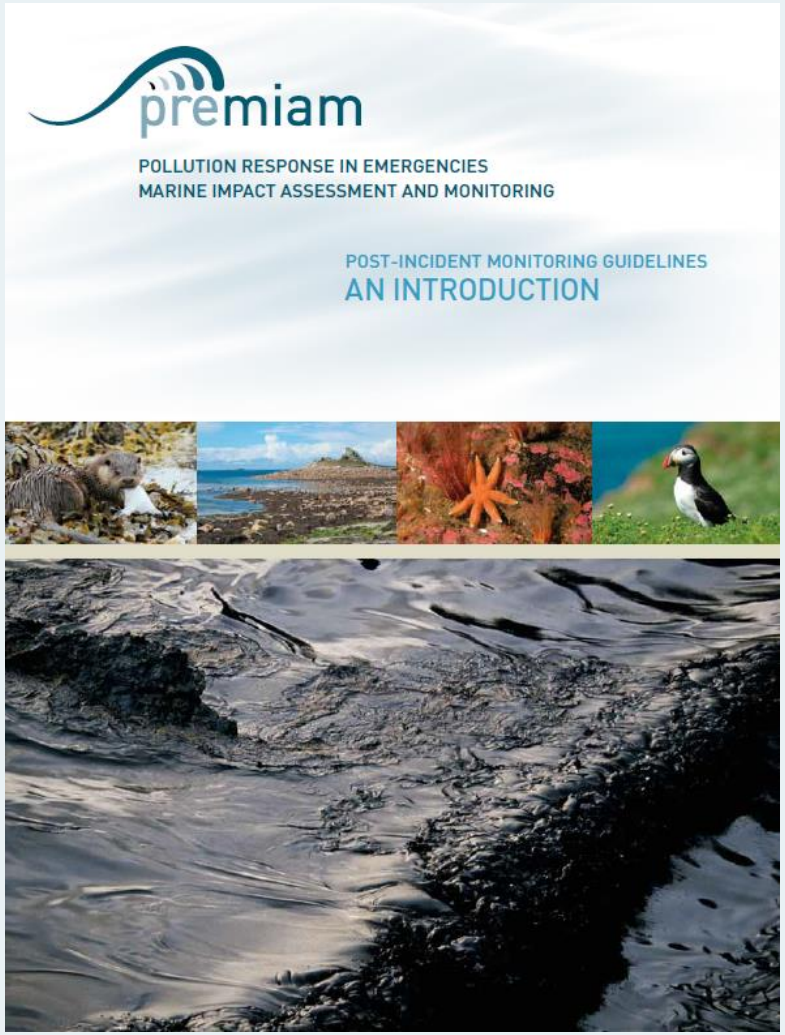
- Routine monitoring driven by MSFD, OSPAR, WFD provides some potential baseline data
- Likely that for an oil based spill baseline data would be available and fate/effects reasonably understood
- HNS spill likely to have less baseline data available
- Risk based reviews underway to provide a better understanding of fate and effects
- Clear environmental conditions big factor in overall impact
- More research required to understand some of the fundamental issues relating to HNS marine spills






premiam
POLLUTION RESPONSE IN EMERGENCIES
MARINE IMPACT ASSESSMENT AND MONITORING
POST-INCIDENT MONITORING GUIDELINES

Thank you


premiam
POLLUTION RESPONSE IN EMERGENCIES
MARINE IMPACT ASSESSMENT AND MONITORING
POST-INCIDENT MONITORING GUIDELINES
AN INTRODUCTION