Some EU and US experiences in eutrophication assessment for transitional and coastal waters

http://www.eutro.org

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EU Joint Research Centre
Assessment of Eutrophication in
European Water Policy
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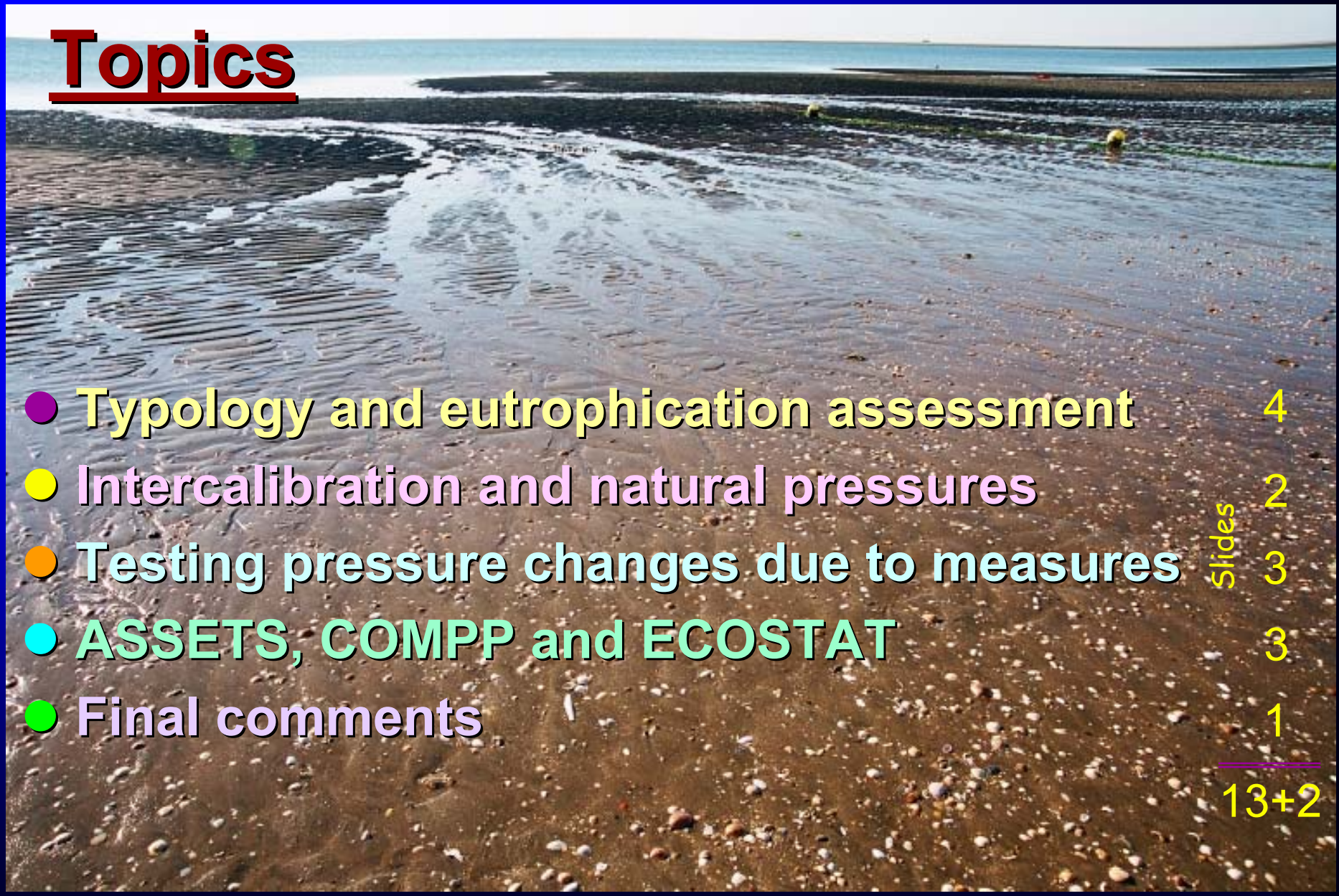
NOAA – U.S.A. http://www.nccos.noaa.gov
IMAR – Portugal http://www.imar.pt

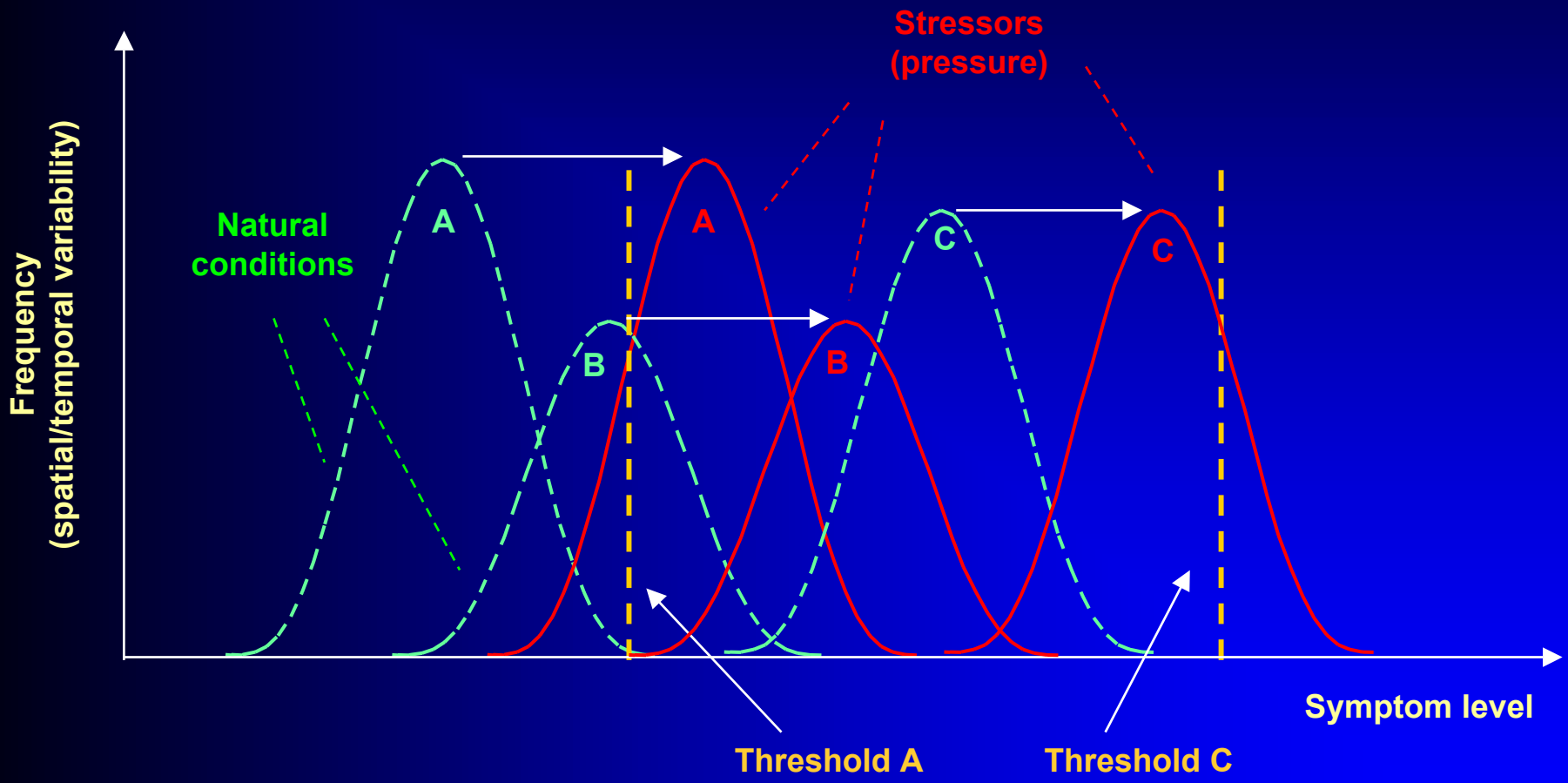
Topics



	Slides
Typology and eutrophication assessment	4
Intercalibration and natural pressures	2
Testing pressure changes due to measures	3
ASSETS, COMPP and ECOSTAT	3
Final comments	1
	13+2

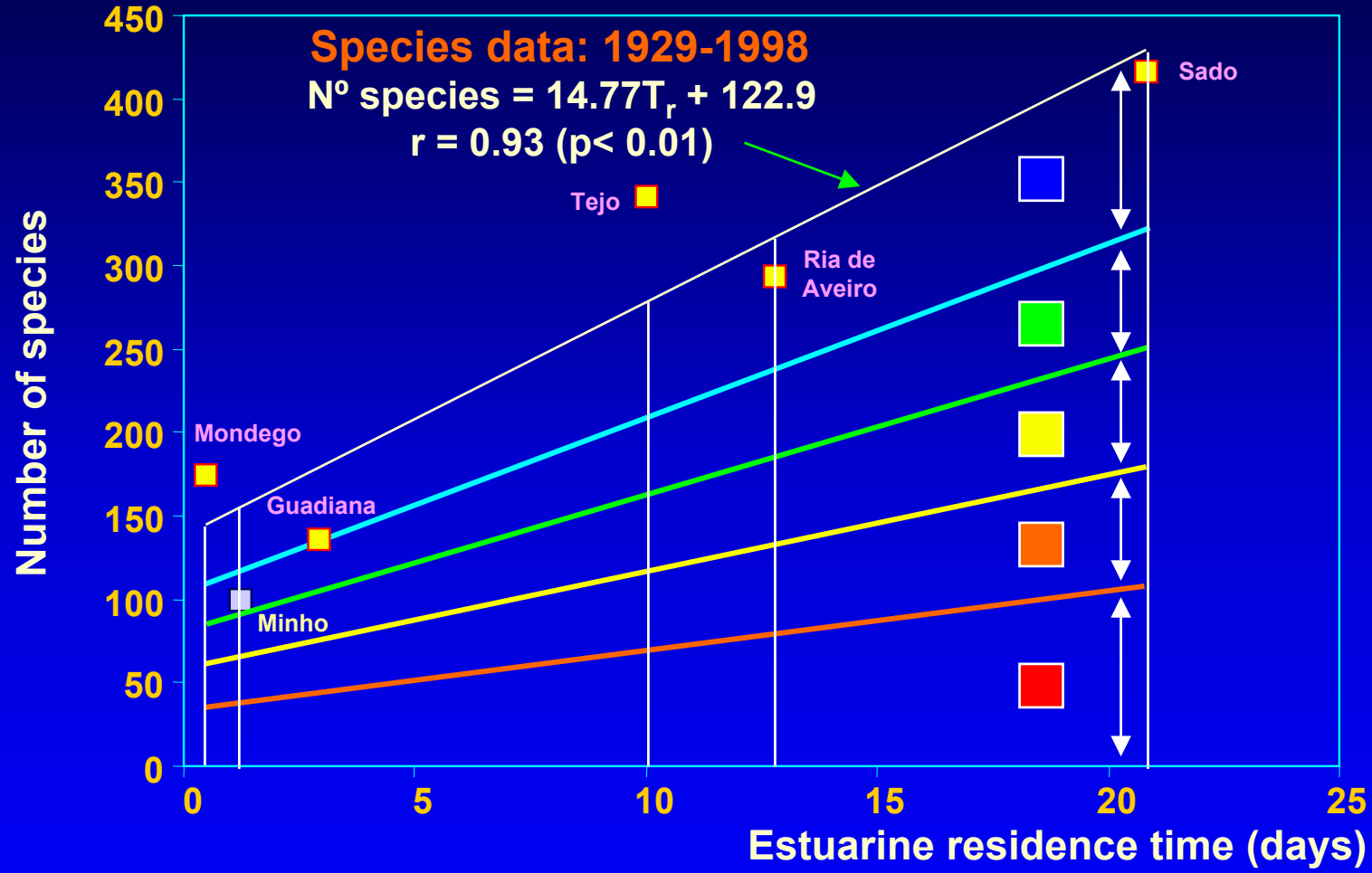
Guadiana estuary, Portugal

Typology reality check
ecosystem reality



Transitional water residence time and species number

A factor in reference conditions for phytoplankton species composition



Ferreira, J.G., Wolff, W.J., Simas, T.C. & Bricker, S.B., 2004. Does biodiversity of estuarine phytoplankton depend on hydrology? Submitted.

Classification issues

NEEA

- Florida Bay: Highly sensitive system is severely impacted when chlorophyll *a* reaches 5 μg L^{-1}, which is considered Low by the NEEA/ASSETS category definition
- Narraguagus Bay: Naturally occurring nuisance and toxic blooms which come into the system from the ocean
- US NW coast: HAB events due to upwelling relaxation occurring offshore, transported into the coastal bays and estuaries

Others

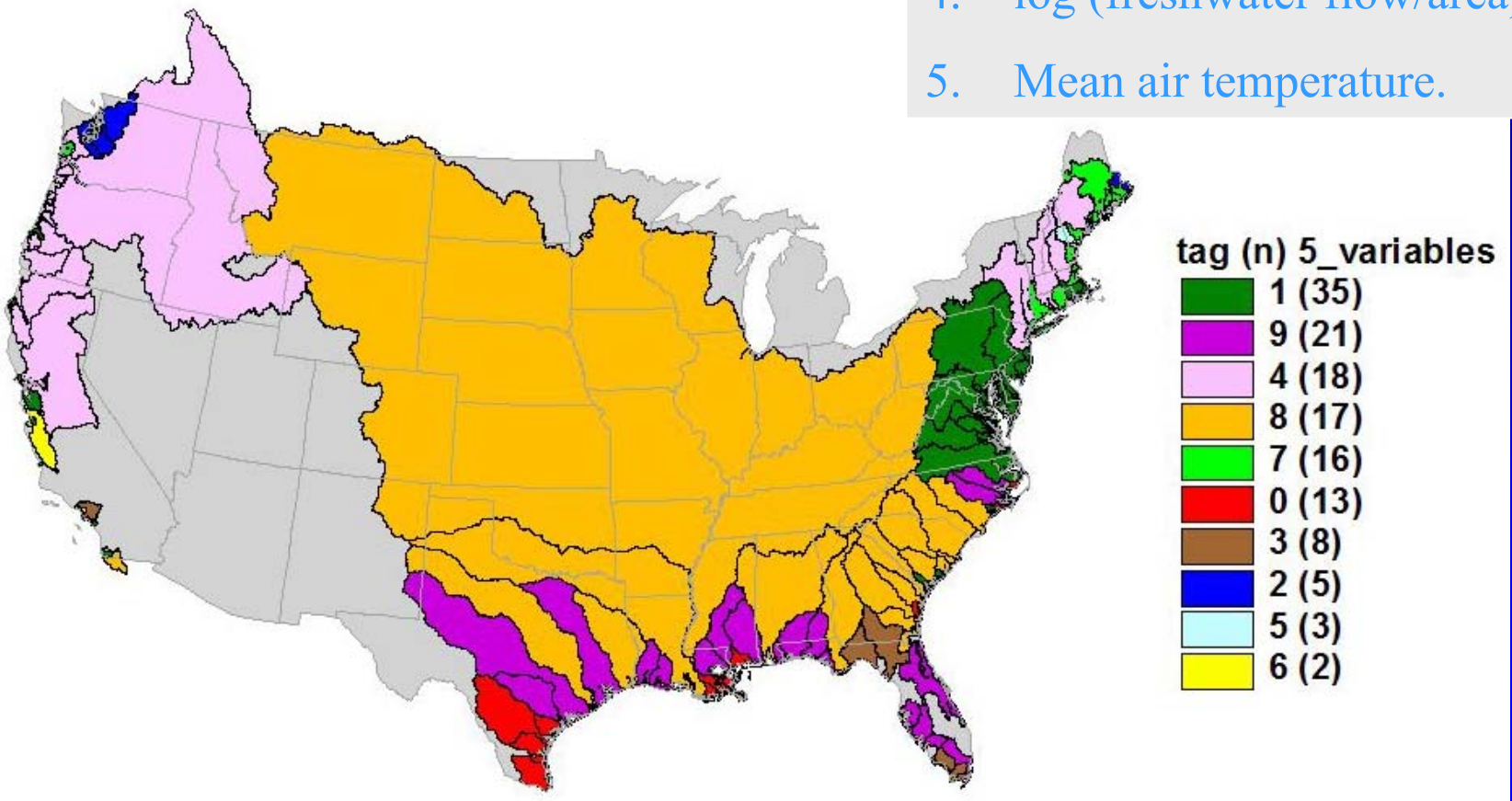
- Similar issues for HAB, e.g. in the EU Western Iberian Atlantic region or the Benguela upwelling
- D.O. thresholds set in absolute terms penalize water bodies with a naturally lower capacity to dissolve O_2, due to higher T and S
- Short residence times or high natural turbidity favour shifts from pelagic to benthic symptoms of eutrophication
- Use of means instead of medians or a percentile based approach may misclassify systems subject to short extreme events

US typology

DISCO – Deluxe Integrated System for Clustering Operations (successor of LOICZView)

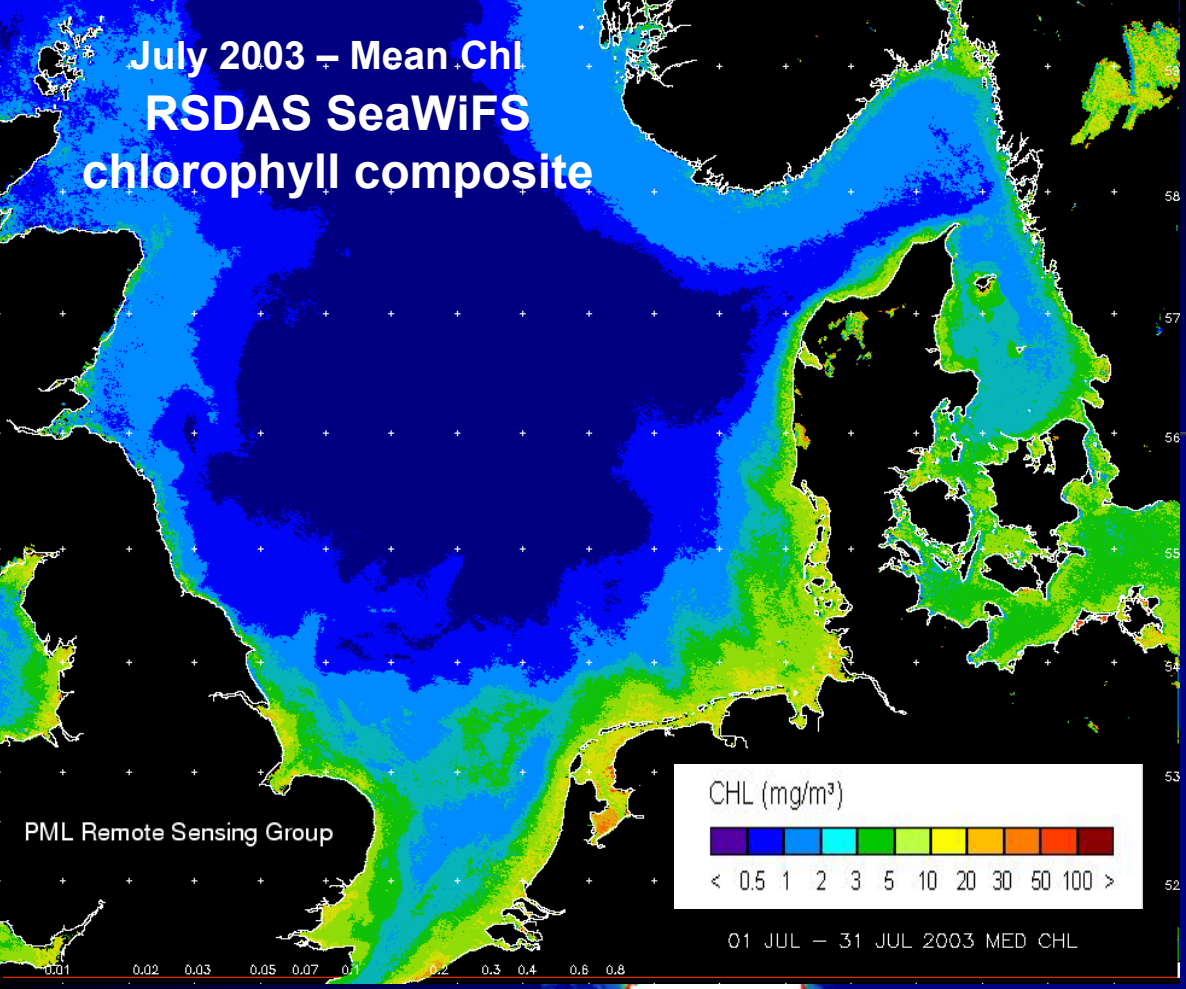
Example: Division into ten types

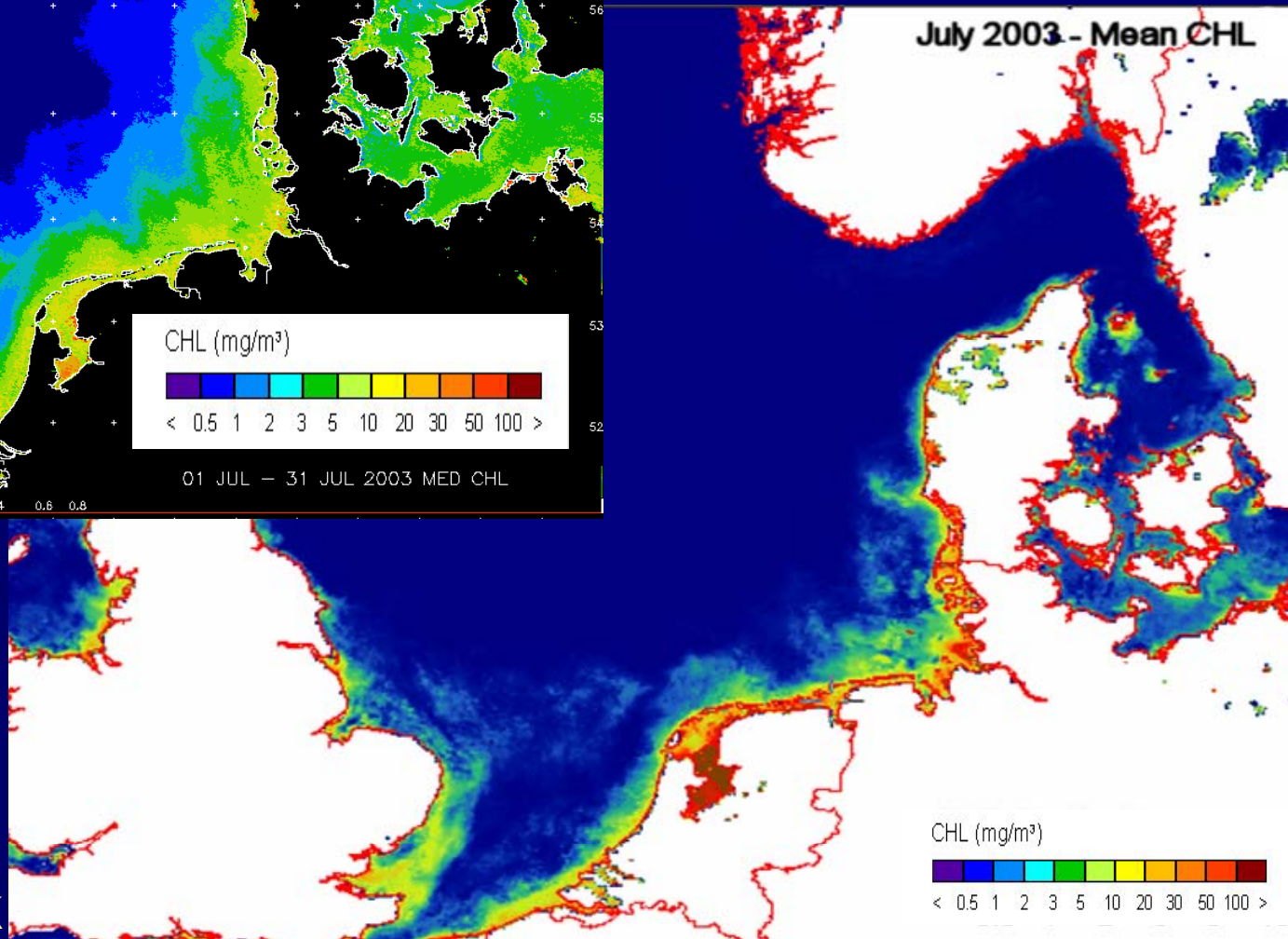
1. Mean depth;
2. Percentage open mouth;
3. Tide height;
4. log (freshwater flow/area);
5. Mean air temperature.



S. V. Smith, R. W. Buddemeier, S. B. Bricker, P. Pacheco, A. Mason, B.A. Maxwell. Estuarine Typology: Perturbations and Eutrophication Responses. ASLO/TOS ORC, February 2004.

Chlorophyll *a* in the North Sea



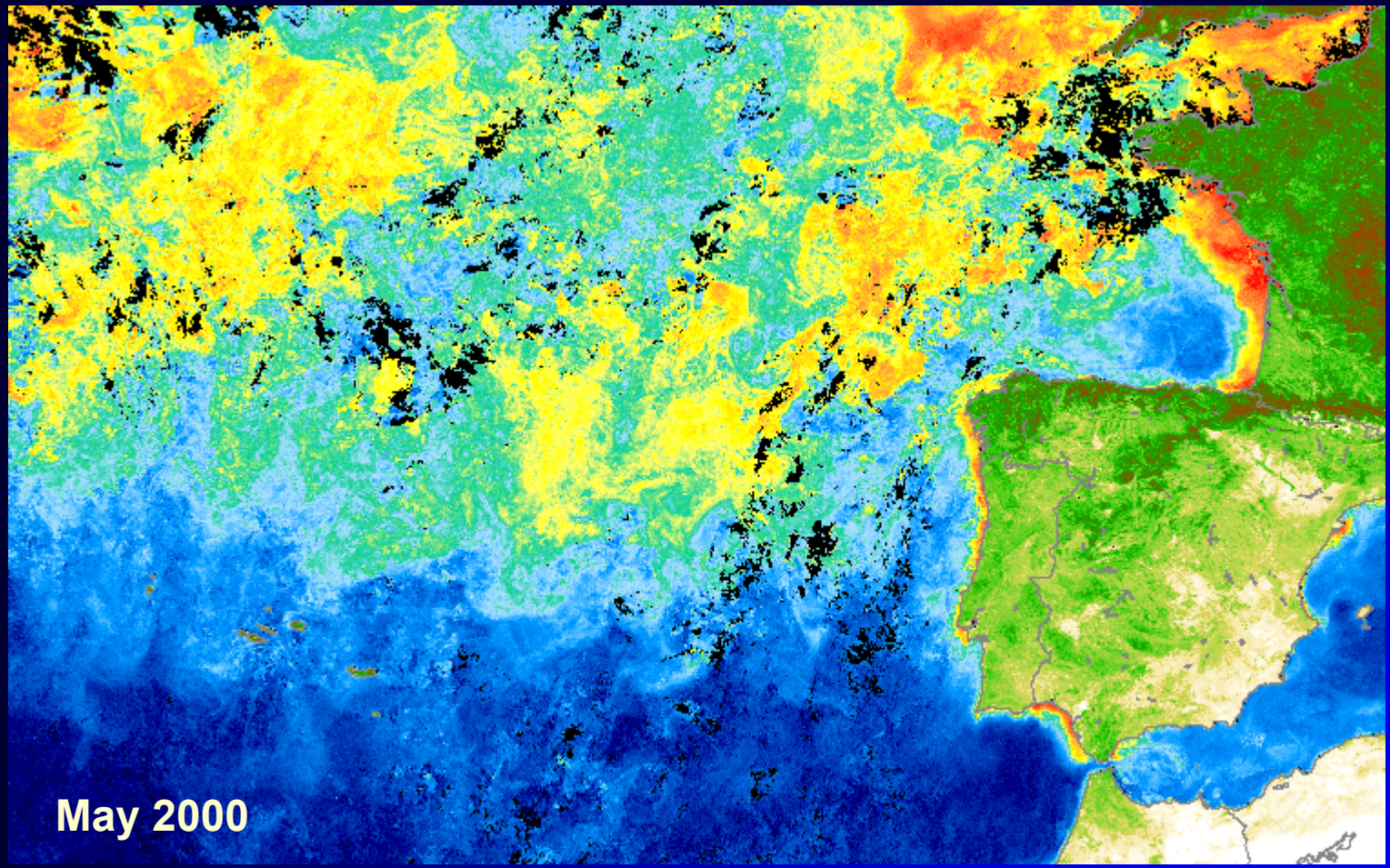


REVAMP algorithm MERIS chlorophyll composite

Courtesy Plymouth Marine Laboratory, UK

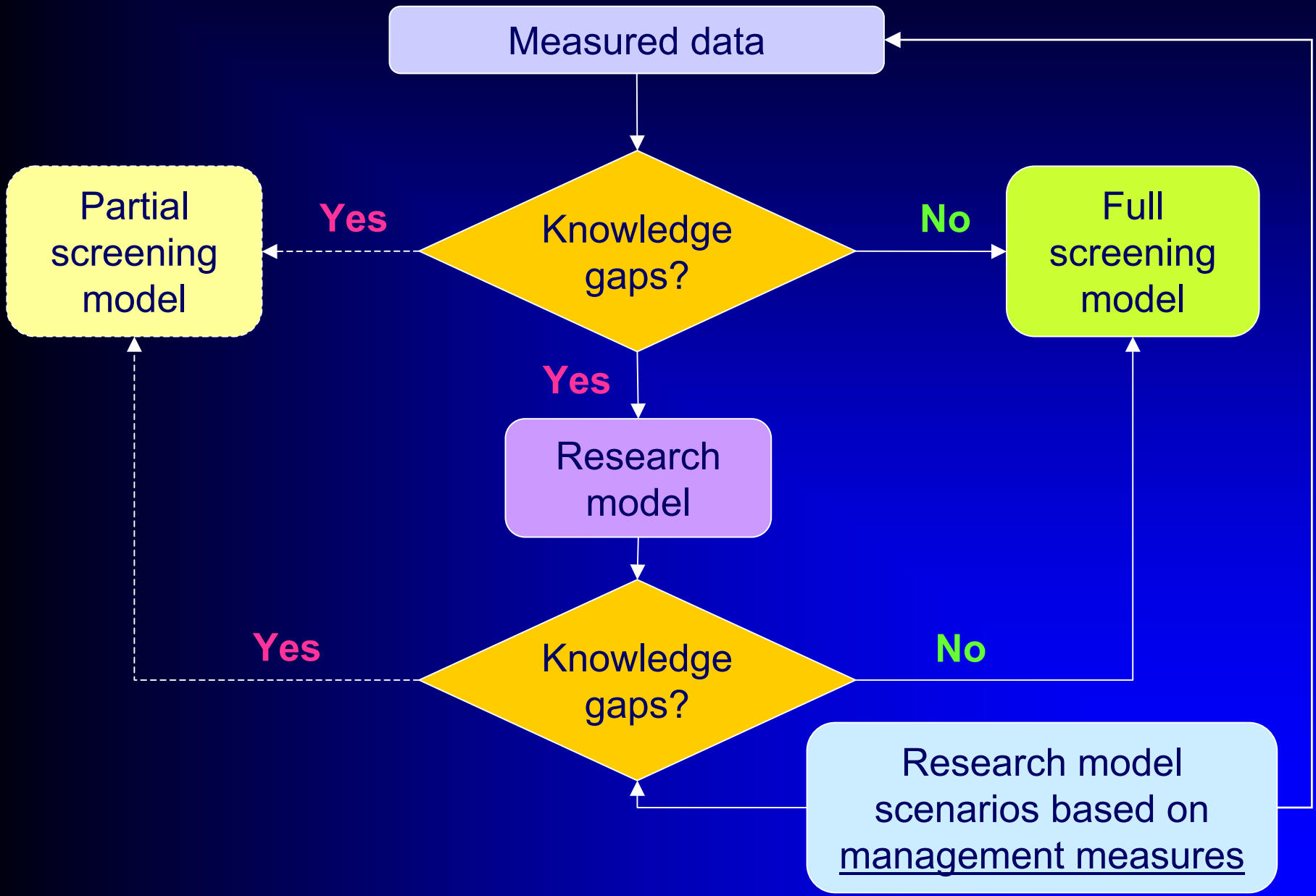
Harmful Algal Bloom(?)

Advection to the coast from offshore fronts



Courtesy Joint Research Centre, Ispra
http://marine.jrc.cec.eu.int/

Relationship between data, research models and screening models

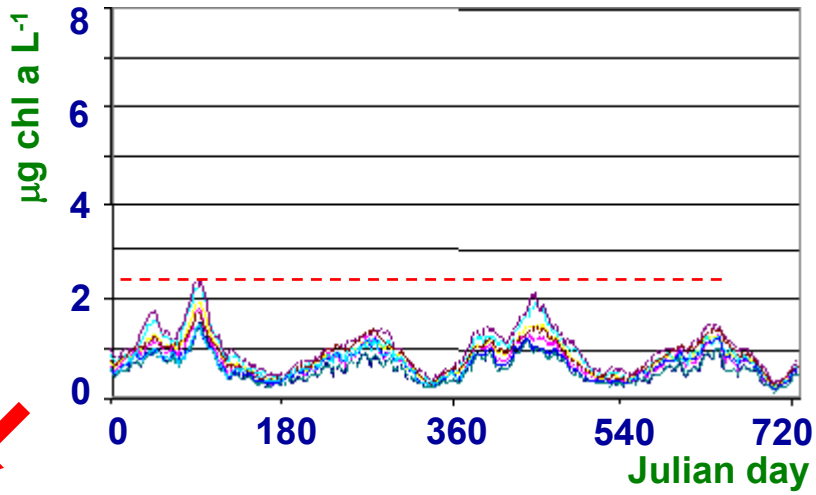


Different pressure scenarios

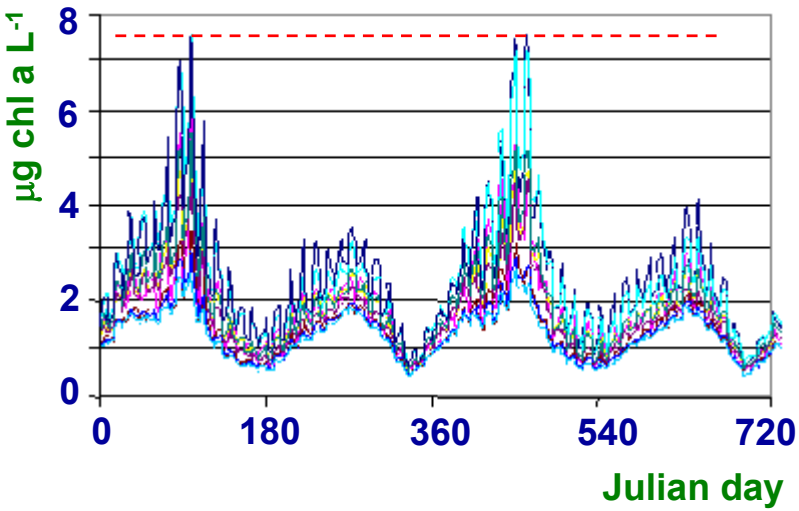
Effluent inputs and top-down control

Effects of land inputs and grazing pressure on phytoplankton in the Ria Formosa. Results from EcoWin2000, with nine boxes

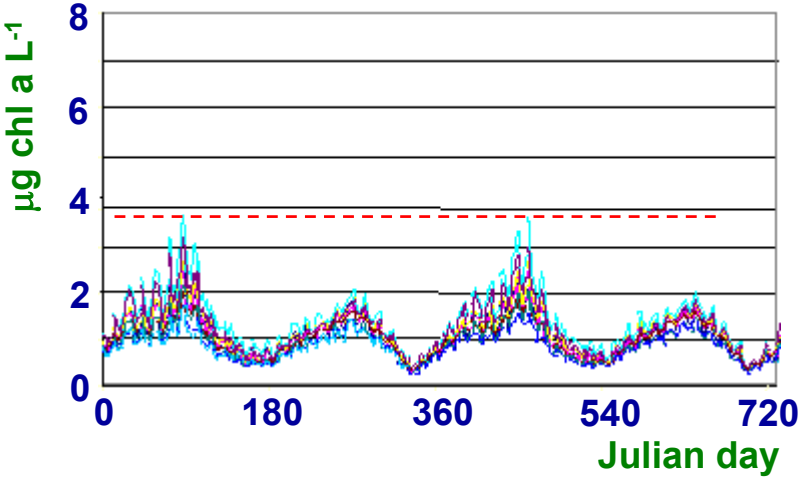
No land inputs, no bivalves



Land inputs, no bivalves



Land inputs and bivalves



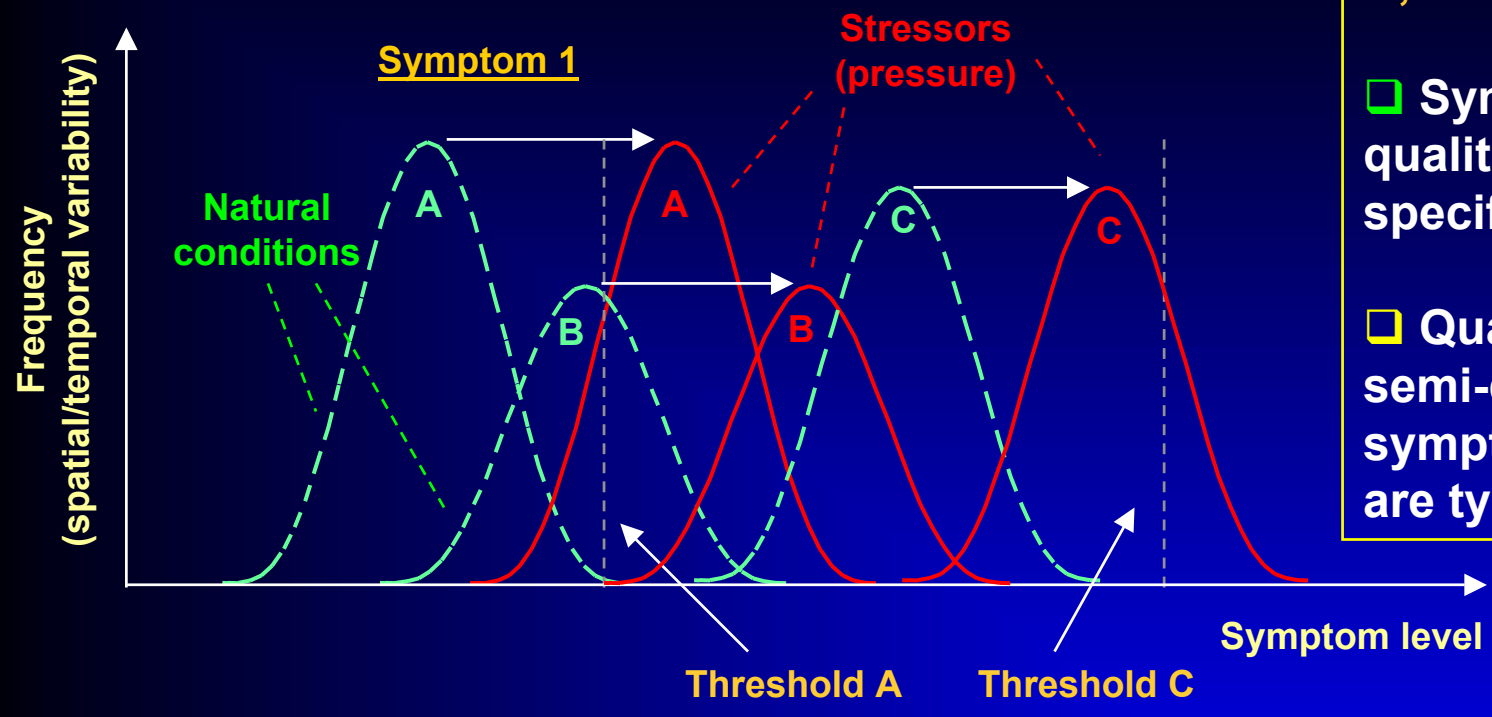
Newton, A., Icely, J.D., Falcão, M., Nobre, A., Nunes, J.P., Ferreira, J.G. & Vale, C., 2003. Evaluation of Eutrophication in the Ria Formosa coastal lagoon, Portugal. Continental Shelf Research, 23, 1945-1961.

Ria Formosa –ASSETS validation & model scenarios

Index	Methods	Parameters	Value	Level of expression	Index
Overall Eutrophic Condition (OEC)	PSM	Chlorophyll *a*	0.25		MODERATE LOW
	Field data	Epiphytes	0.50	0.57 Moderate	
ASSETS OEC: 4		Macroalgae	0.96		
	SSM	Dissolved Oxygen	0		
		Submerged Aquatic Vegetation	0.25	0.25 Low	
		Nuisance and Toxic Blooms	0		
Overall Eutrophic Condition (OEC)	PSM	Chlorophyll *a*	0.25		MODERATE LOW
	Research model	*Epiphytes*	*0.50*	0.58 Moderate	
ASSETS OEC: 4		Macroalgae	1.00		
	SSM	Dissolved Oxygen	0		
		Submerged Aquatic Vegetation	0.25	0.25 Low	
		Nuisance and Toxic Blooms	0	28% lower	
Overall Eutrophic Condition (OEC)	PSM	Chlorophyll *a*	0.25		MODERATE LOW
	Model green scenario	*Epiphytes*	*0.50*	0.42 Moderate	
ASSETS OEC: 4(5)		Macroalgae	0.50		
	SSM	Dissolved Oxygen	0		
		Submerged Aquatic Vegetation	0.25	0.25 Low	
		Nuisance and Toxic Blooms	0		

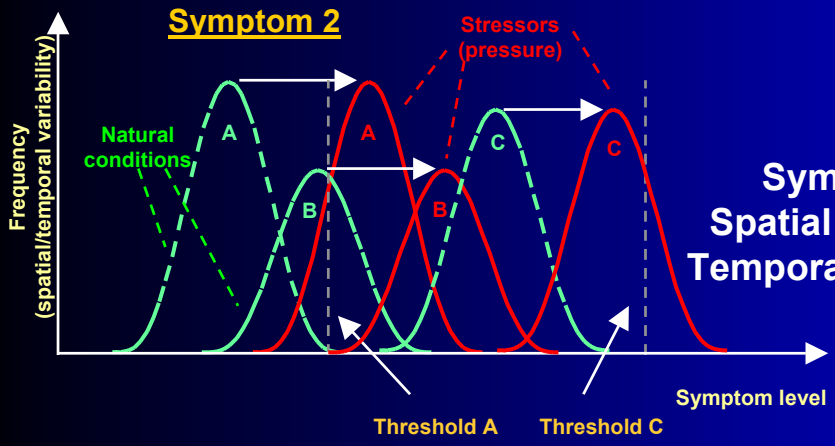
A.M.Nobre, J.G.Ferreira, A.Newton, T.Simas, J.D.Icely & R.Neves, 2004. Managing eutrophication: Integration of field data, ecosystem-scale simulations and screening models. Submitted.

ASSETS multitype approach for OEC



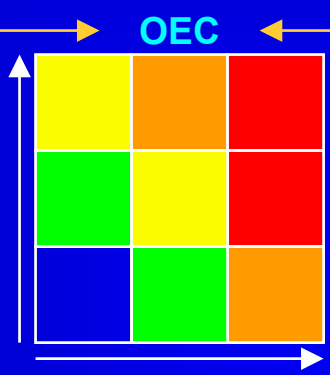
A, B and C are types

- Symptoms may be qualitatively type-specific
- Quantitative or semi-quantitative symptom thresholds are type-specific



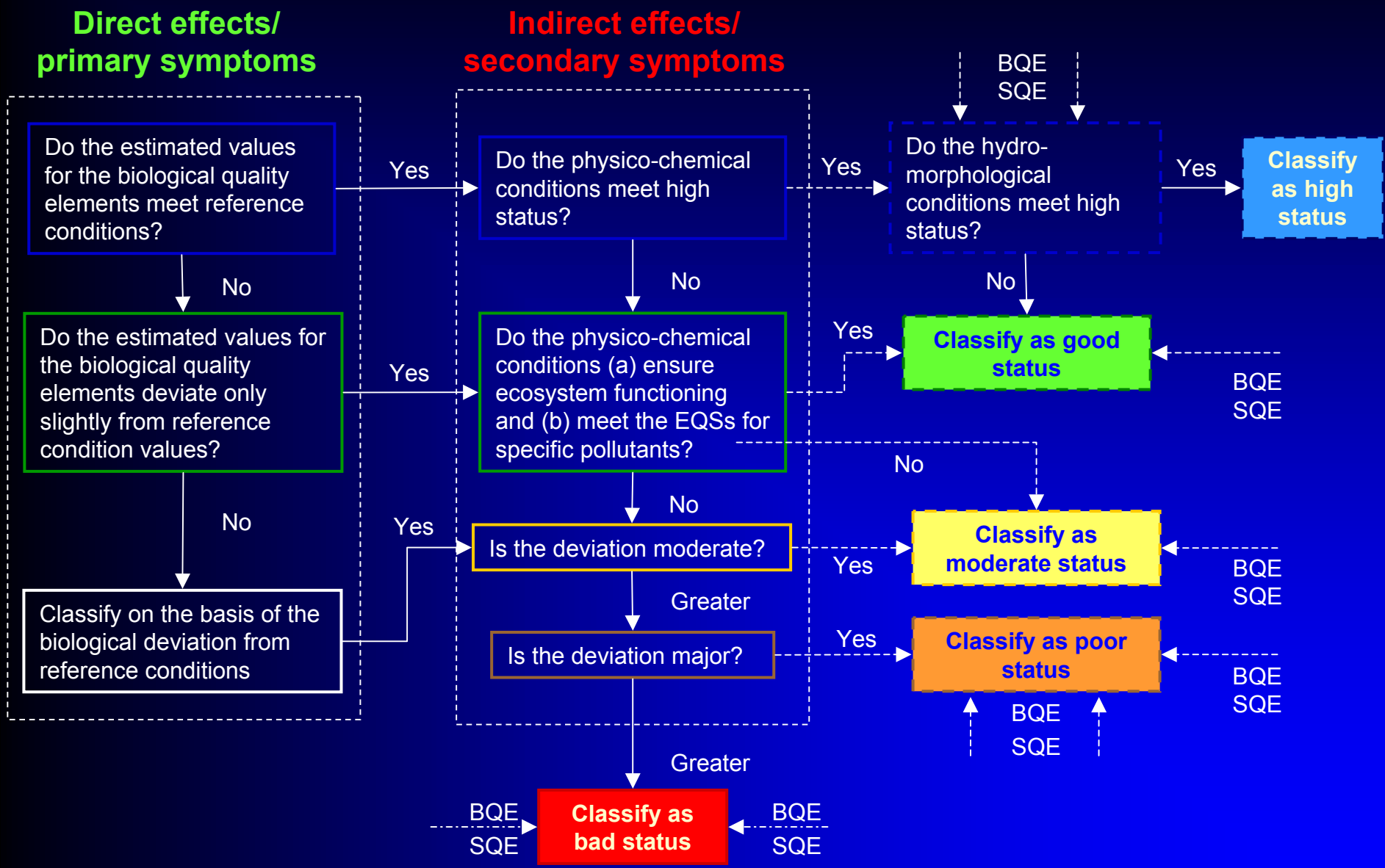
Symptom 2
Spatial weighting
Temporal weighting

Symptom 1
Spatial weighting
Temporal weighting



Normalized scores are as before, but related to type-specific thresholds

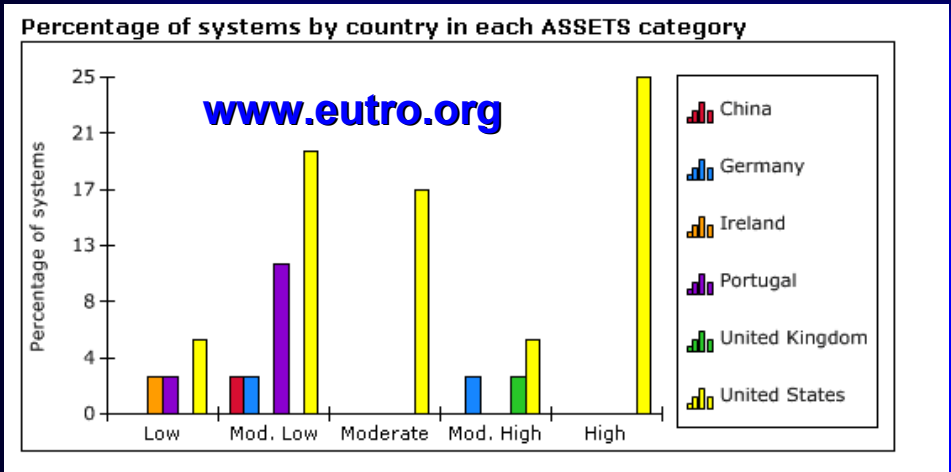
ECOSTAT adapted for eutrophication assessment



Intercalibration between ASSETS and COMPP for the Tagus Estuary, Portugal

Assessment time period		1976-2000	
Method applied		OSPAR COMPP	ASSETS
Causative factors	Discharge Trends	+	2
	Nutrients (N,P, N/P)	+,+,+	1
Direct effects (primary symptoms)	Chlorophyll	+	1
	Nuisance/ toxic species	-/-	0
	Macrophytes	-	0
	SAV	-	0
Indirect effects (secondary symptoms)	Oxygen	-	0.12
	Zoobenthos	-	Not app.
	Fish kills	-	Not app.
	Toxins	-	Not app.
Integration		-,-,-	5,4,4
Overall Classification		NPA	4

U.Brockmann, D.Topcu, U.Claussen, S.B.Bricker, J.G.Ferreira, M.Dowell, T.Raabe & W.Zevenboom, 2004. COMPASS, a proposed eutrophication classification, considering the WFD, based on COMPP and ASSETS. In prep.



Final comments

- Eutrophication assessment must rely on a PSR approach, therefore the distinction between natural and anthropogenic causes is critical, in order to define responses (measures);
- Assessment methods such as NEEA/ASSETS already accommodate natural variability, by accounting for vulnerability and susceptibility, which are indirectly related to typology (e.g. more vulnerable systems naturally have higher symptom expression);
- Research models may be used to explore changes in state (impacts) due to various pressure scenarios for different types, to help define meaningful thresholds;
- Research models and screening models may be combined to test the potential effects of management mesures;
- The EU and US share many common features in their estuaries and coastal zones, but there are also some obvious (and useful) differences. It makes good sense to use harmonized methodologies: The COMPASS group is currently working towards that end by leveraging NEEA/ASSETS and OSPAR/COMPP;
- www.eutro.org is a resource for comparative assessment methods and results, and other eutrophication-related information, for Transitional and Coastal Waters.