



ENDOCRINE DISRUPTING COMPOUNDS IN COASTAL AND SURFACE WATERS IN THE AREA OF THESSALONIKI, NORTHERN GREECE

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What is an endocrine disrupting compound?

An endocrine disrupting chemical (EDC) is an exogenous substance that causes adverse health effects in an intact organism, or its progeny, consequent to changes in endocrine function (EU/WHO/OECD Workshop UK, Dec. 1996)

Substances that are potential EDCs

- Hormones excreted by mammals
 - Natural and synthetic
- Phytoestrogens
- Synthetic EDCs
 - PCBs
 - Alkylphenols (non – ionic surfactants)
 - Phthalates (plasticizers)
 - Organochlorine pesticides
- Pharmaceuticals
- Personal care products

Estrogenic activity

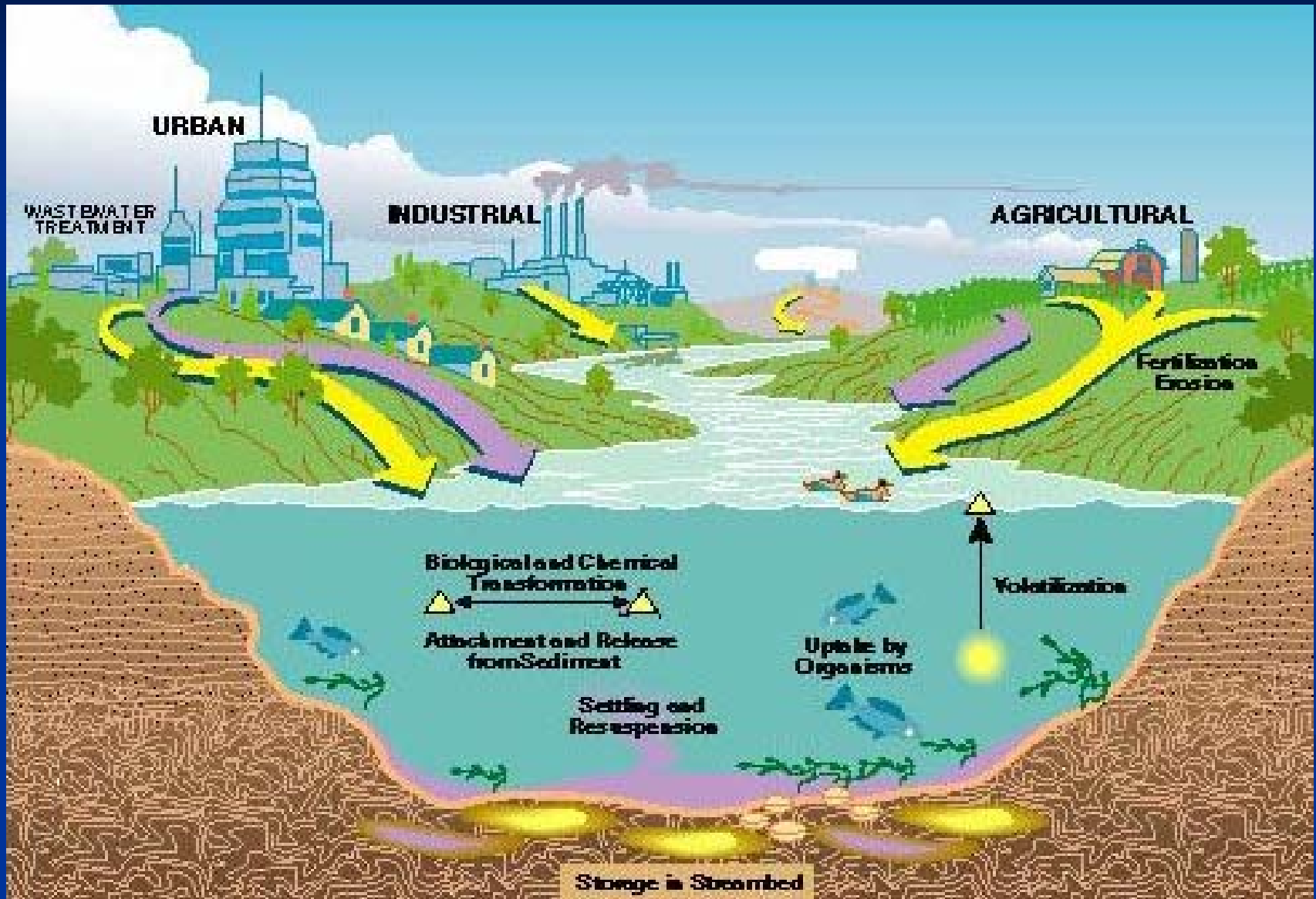
- ❖ Mimick endogenous hormones
- ❖ Antagonize normal, endogenous hormones
- ❖ Alter the pattern of synthesis and metabolism of natural hormones
- ❖ Modify hormone receptor levels.

Impacts:

- Decreased fertility, feminization and hermaphroditism of aquatic organisms
- Increased incidence of cancer and reproductive abnormalities e.g. hypospadias and decreasing sperm counts



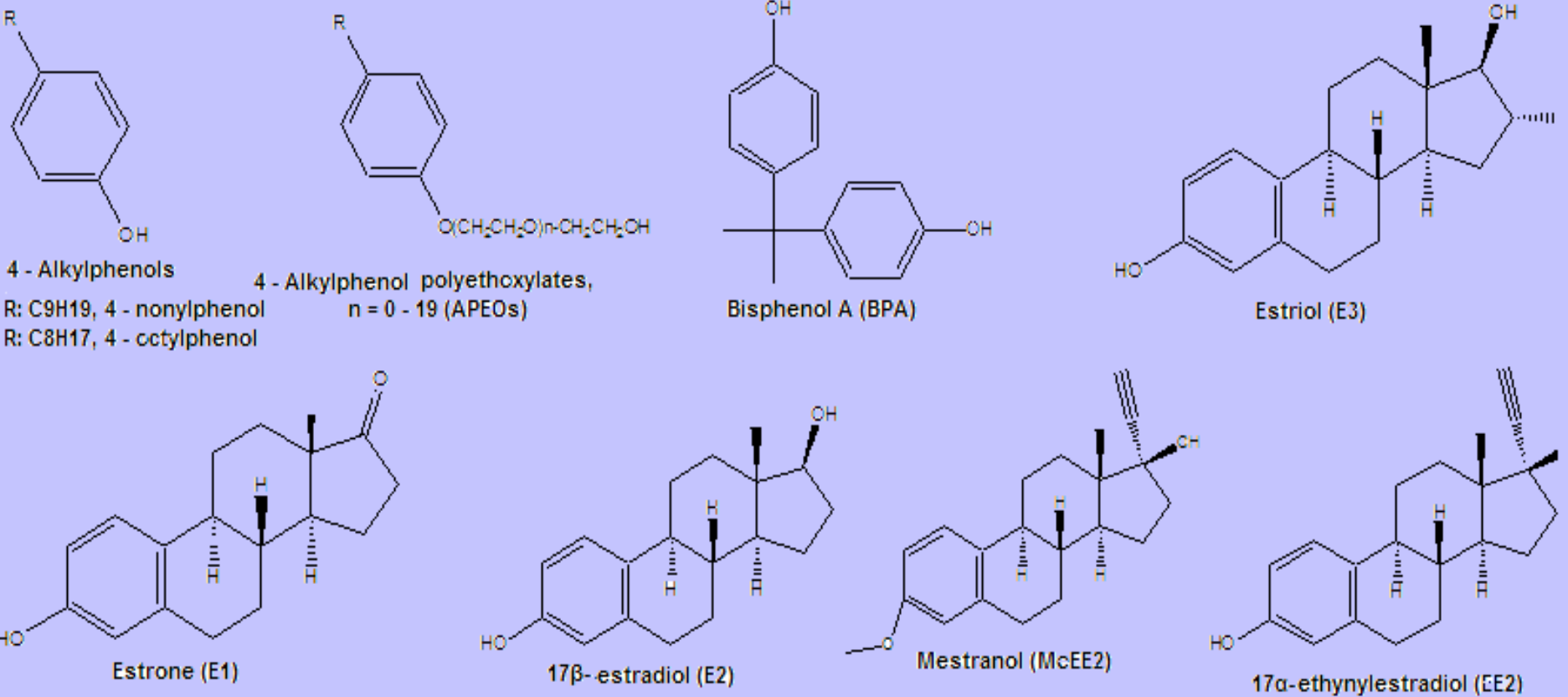
Sources and sinks of EDCs



Object of the study

- Examine the occurrence of selected EDCs in the coastal environment of Thermaikos Gulf, in the area of Thessaloniki, Greece
- Determine possible sources of EDCs in the coastal environment by examining inflowing waters, rivers and canals.

Target Compounds



PHYSICAL PROPERTIES OF THE INVESTIGATED COMPOUNDS

Compound	Molecular Weight	Water Solubility (mg/l, 20°C)	logK _{ow}
Nonylphenol (NP)	220	5.43	4.48
Nonylphenol monoethoxylate (NP1EO)	264	3.02	4.17
Nonylphenol diethoxylate (NP2EO)	308	3.38	4.21
Octylphenol (OP)	206	12.6	4.12
Octylphenol monoethoxylate (OP1EO)	250	8.0	4.10 ^κ
Octylphenol diethoxylate (OP2EO)	294	13.2	4.00 ^κ
Estrone (E1)	270.4	13	3.43
17β-estradiol (E2)	272.4	13	3.94
Estriol (E3)	288.4	13	2.81
17α-ethynylestradiol (EE2)	296.4	4.8	4.15
Mestranol (MeEE2)	310.4	0.3	4.67
Bisphenol A (BPA)	220	120	3.32

Uses

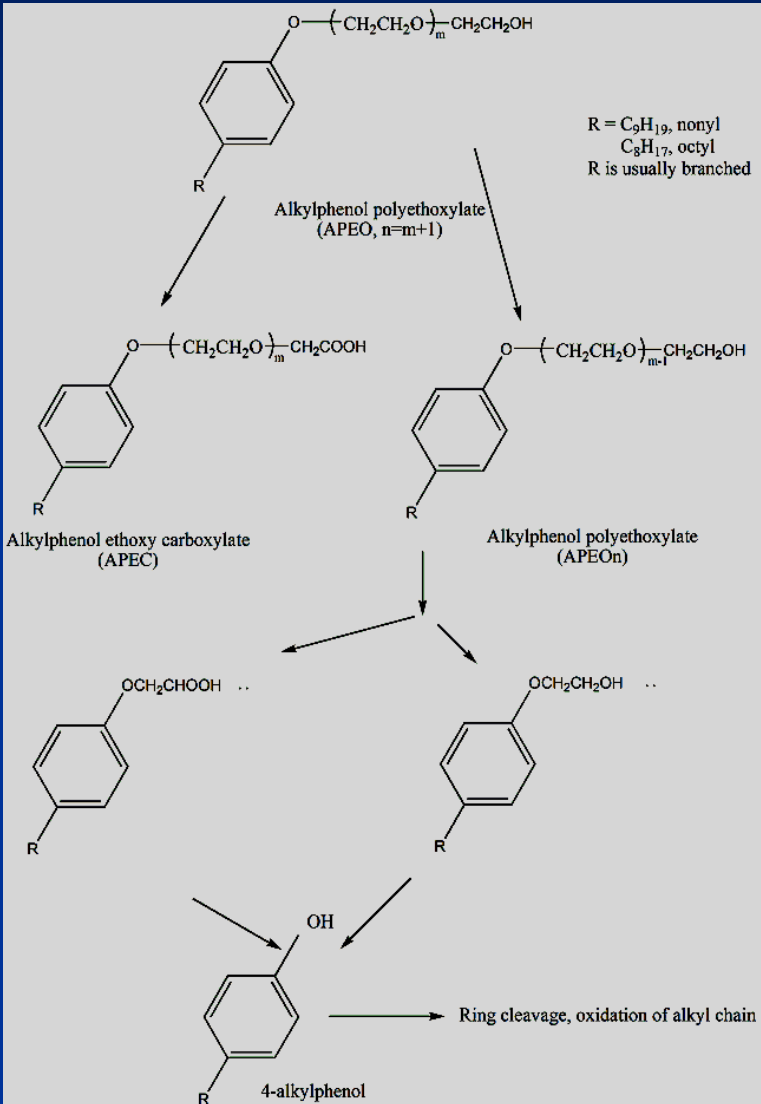
- **APEOs:** (non ionic surfactants) detergents, wetting agents, dispersants. Application in pulp and paper industry, textiles, pesticides, lube oils and fuels, plastics. Most significant compounds: OPEOs, NPEOs.
- **APs:** raw materials for APEOs and in the preparation of phenolic resins, polymers, usage as stabilizers, antioxidants.
- **BPA:** intermediate in the production of polycarbonate and epoxy resins, flame retardants, adhesives, protective coatings, powder paints, building materials, compact disks, optical lenses, thermal paper, developer in dyes.

Human excretion

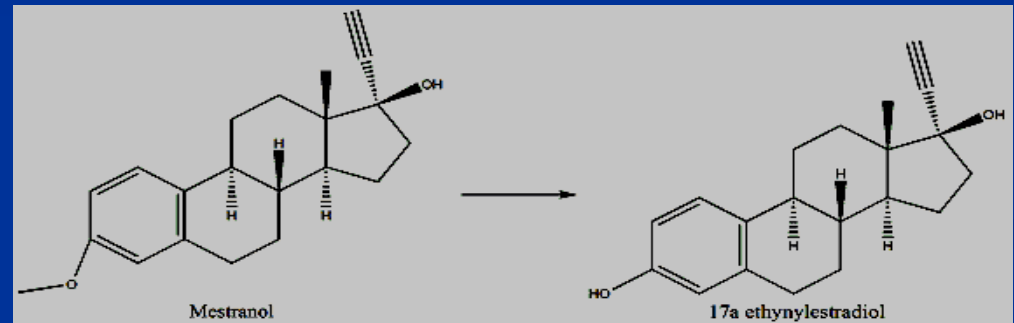
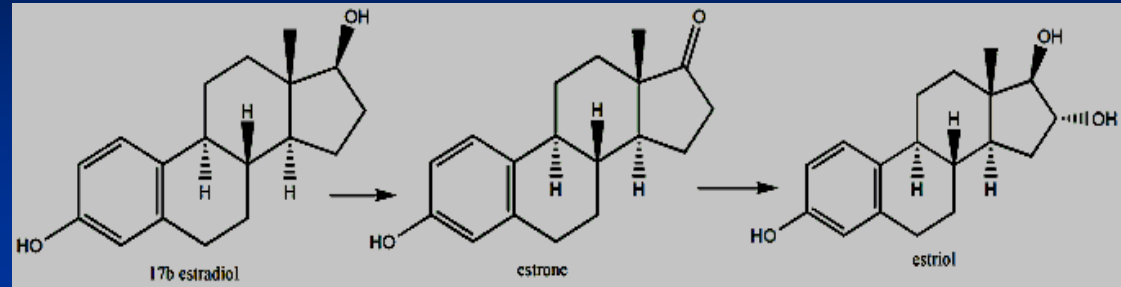
- **Natural estrogens:** Predominantly female hormones, important for the health of reproductive tissues, breast, skin and brain.
- **Synthetic steroids:** Mestranol, 17 α -ethynylestradiol: contraceptives.

Environmental fate

• Degradation of APEOs



• Degradation of steroids



Main processes

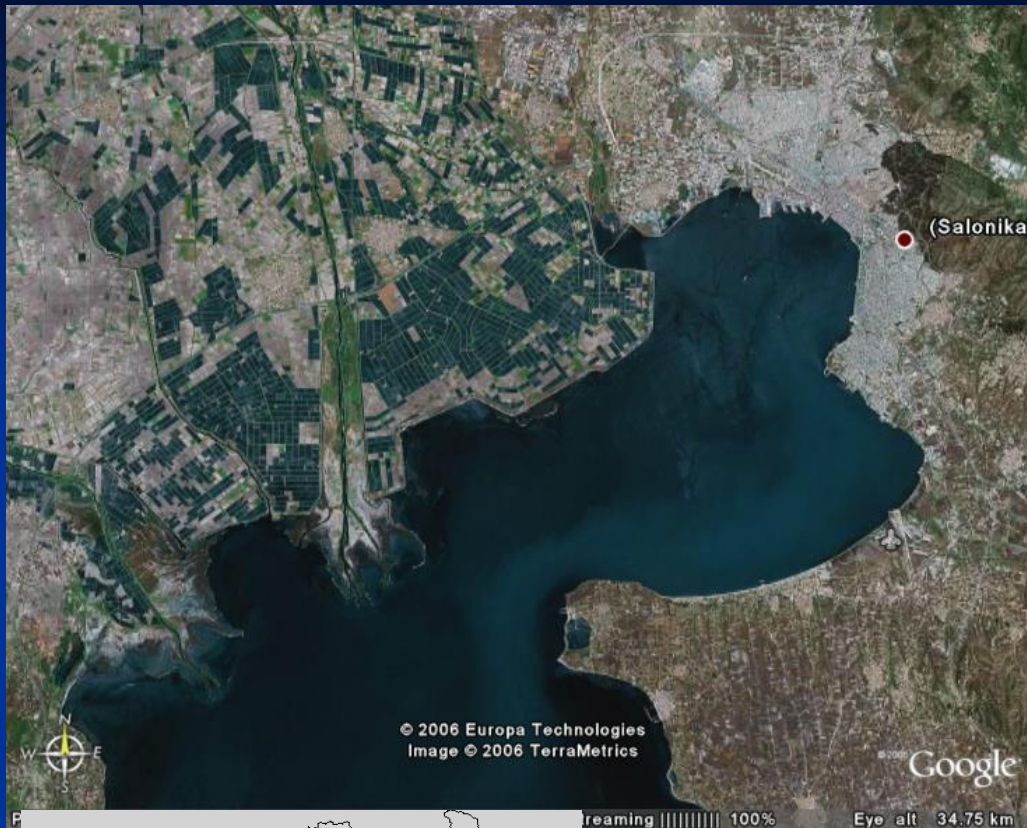
- degradation
- sorption

Legislation

- **Directive 76/769/EEC:** Proposal for the abolition of NPs and NPEOs to those industries that their use can be substituted by other substances.
- **PARCOM Recommendation, 1992:** call for the phase out of NPEOs in domestic cleaning agent by 1995 and in industrial by 2000.
- **793/93/EU Council Regulation:** The use of NPs and their ethoxylated derivatives pose dangers for the environment.
- NP, OP are included in the **Water Framework Directive (WFD) 2000/60/CE** and in the **US EPA priority pollutant list.**
- **Directive 2003/53/EC:** restriction on the sale and use of products that contain more than 0,1% NPEO or NP in Europe from January 2005.

STUDY AREA

Thermaikos Gulf



- Population over 1.200.000
- Industrialized
- Commercial center – harbor
- Fishing activities
- Mussel cultivations
- Offers relaxation



2 SAMPLING CAMPAINGS:

1ST: September 2005 – warm period

2ND: March 2006 – cold period

**EDCs
in marine
environment**

**Water – TSS –
sediments
11 sampling sites**

**Assessment
of quality
of marine
environment**

**EDCs
in inflowing
waters**

**Water and TSS
Rivers, canals,
streams**

**Identification
of
possible
sources**

**EDCs
in
seafood**

**Different species
of
organisms**

**Assessment
of exposure

Biomonitoring**

**Environmental
fate
of EDCs**

**Calculation
 K_D
 K_{OC}**

**Distribution
of EDCs
Sorption,
Degradation**

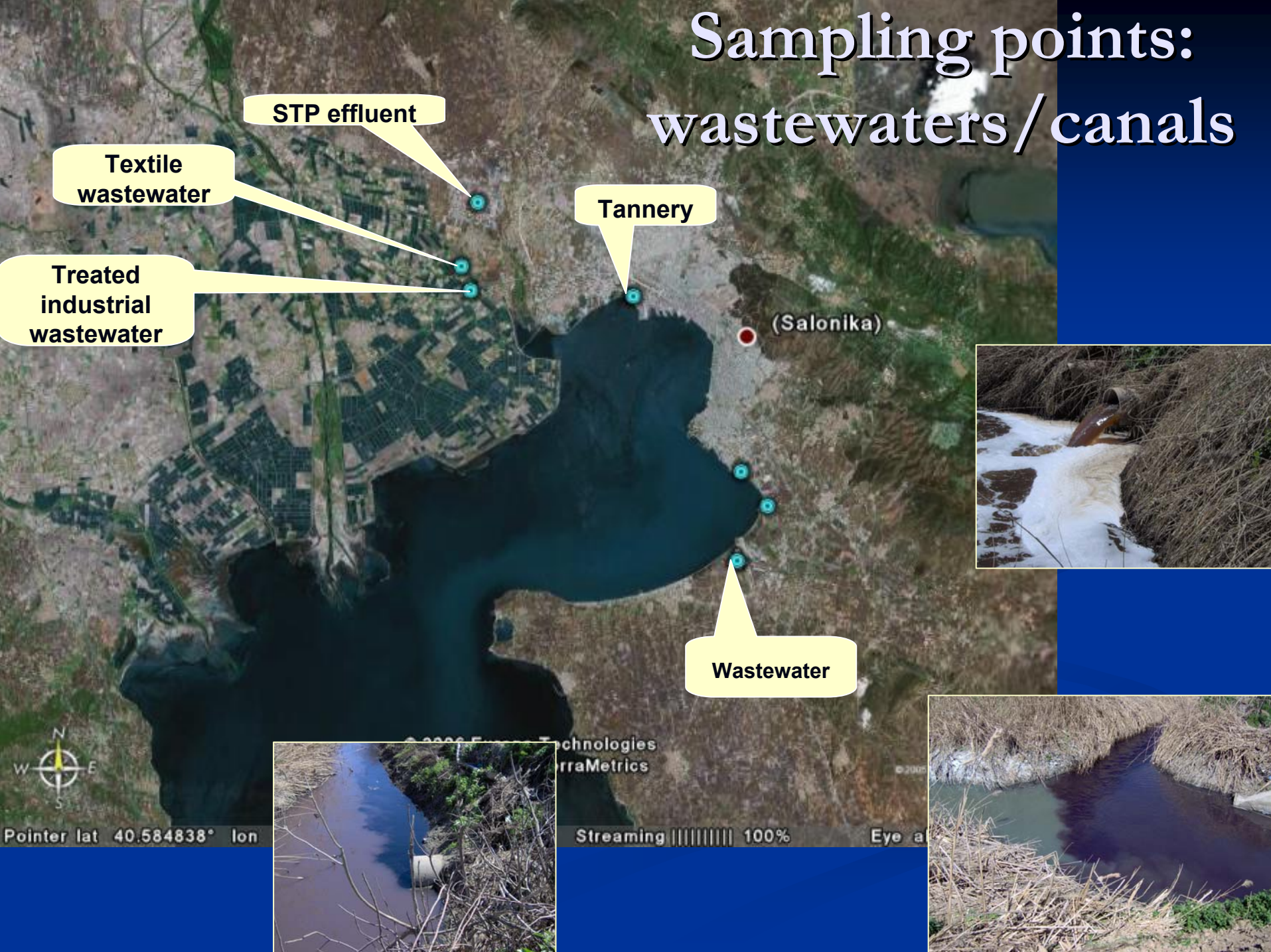
Sampling points – seawater



Sampling points – river water



Sampling points: wastewaters/canals



STP effluent

Textile
wastewater

Treated
industrial
wastewater

Tannery

(Salonika)

Wastewater



Pointer lat 40.584838° lon

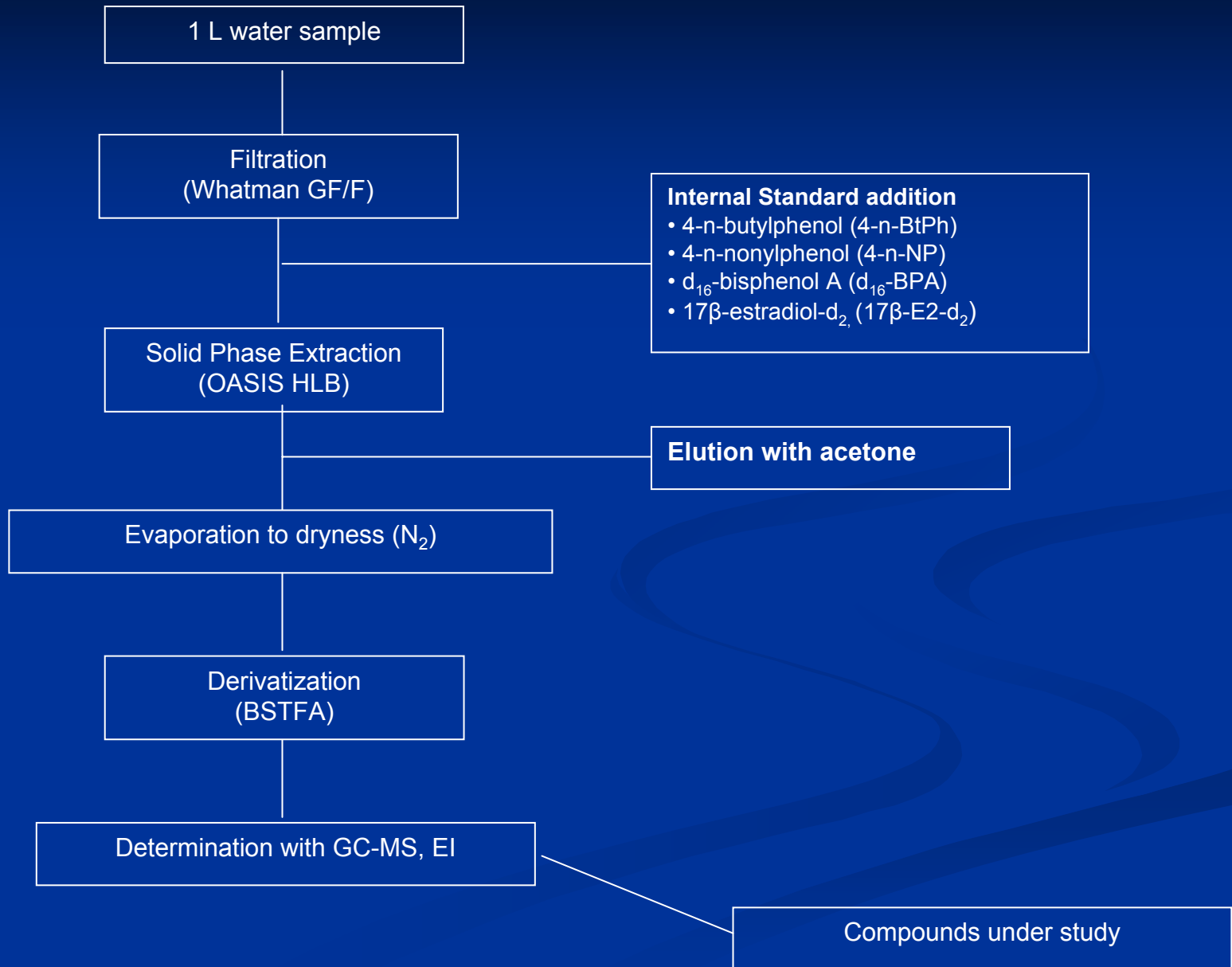
Technologies
TerraMetrics

Streaming ||||| 100%

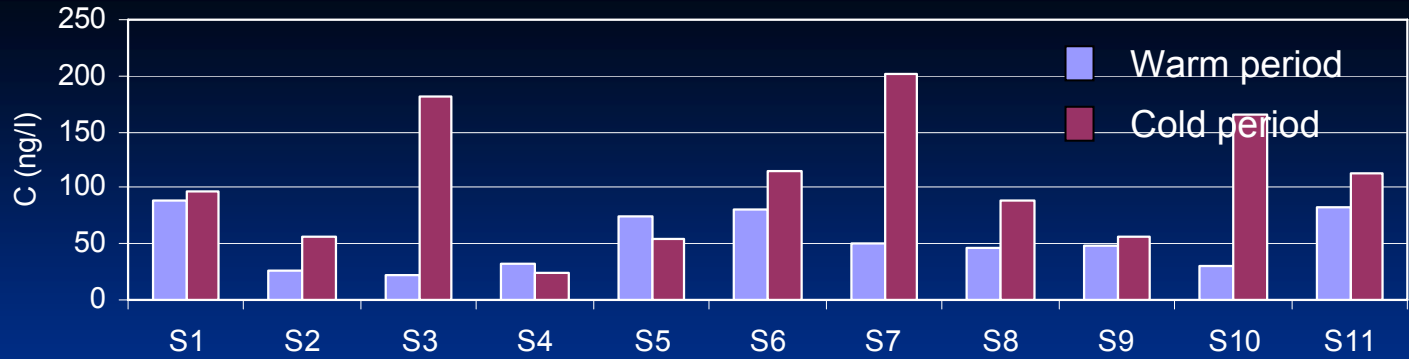
Eye a



ANALYTICAL PROCEDURE



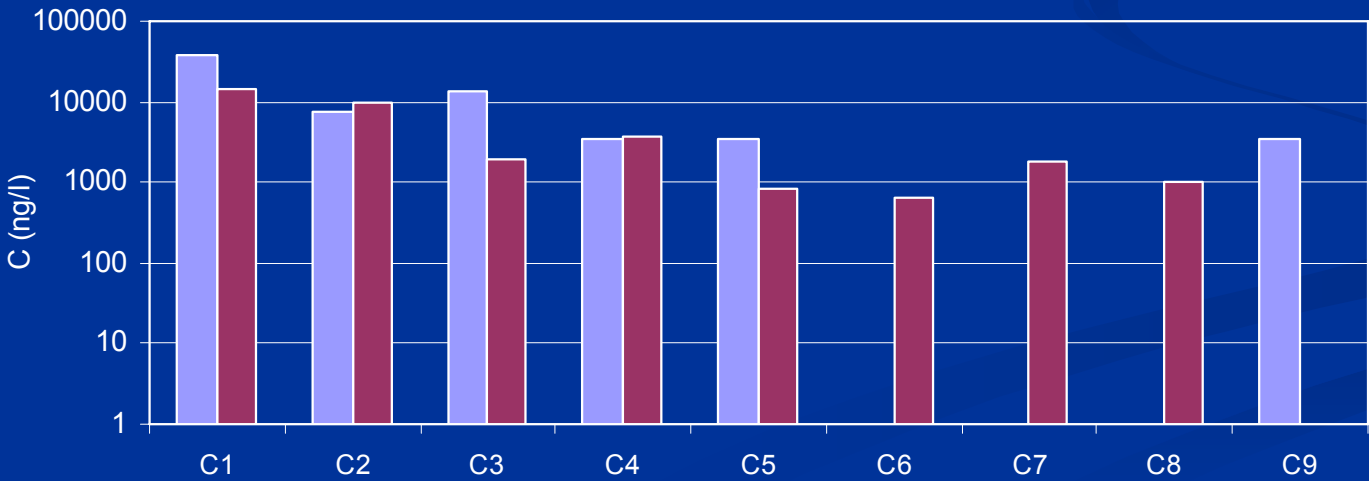
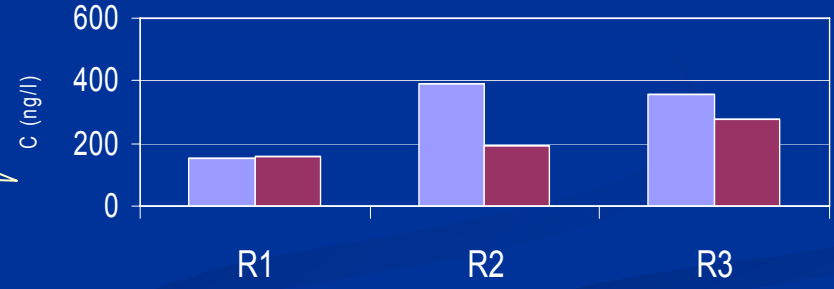
RESULTS



Seawater

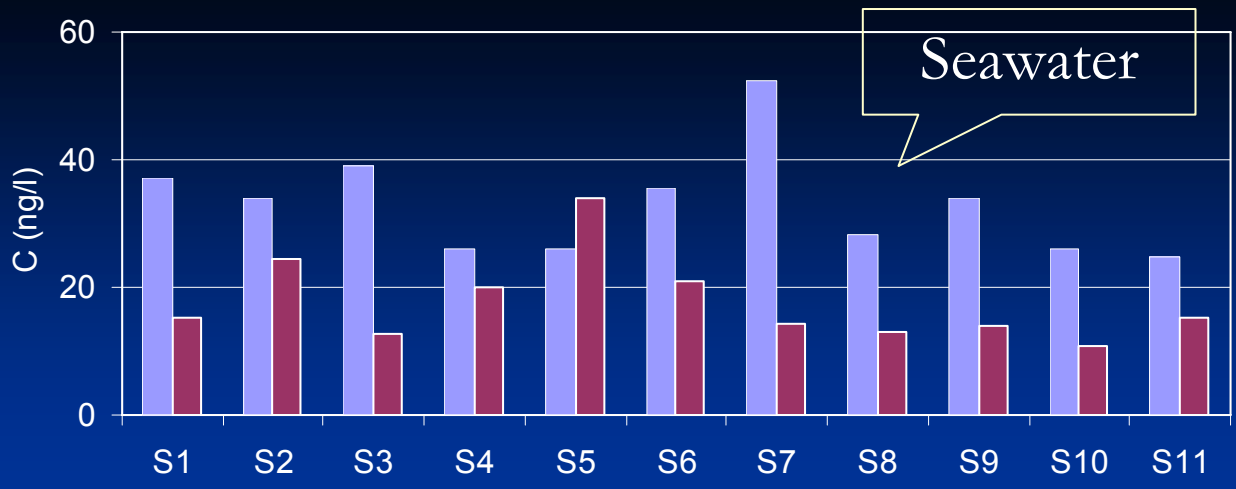
4 - NP

River water

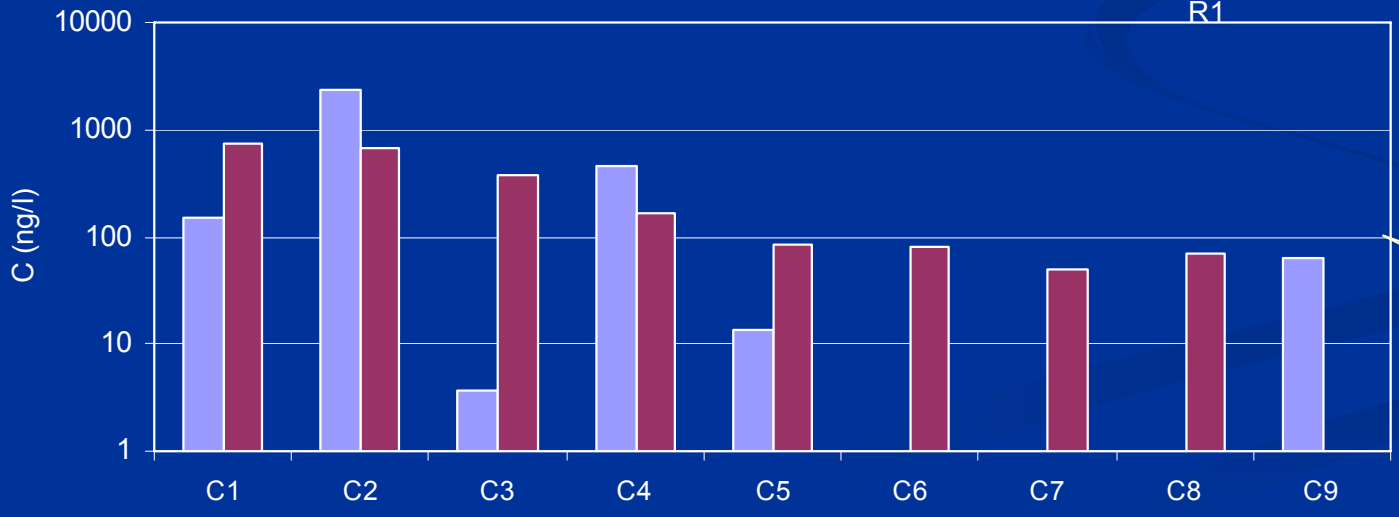
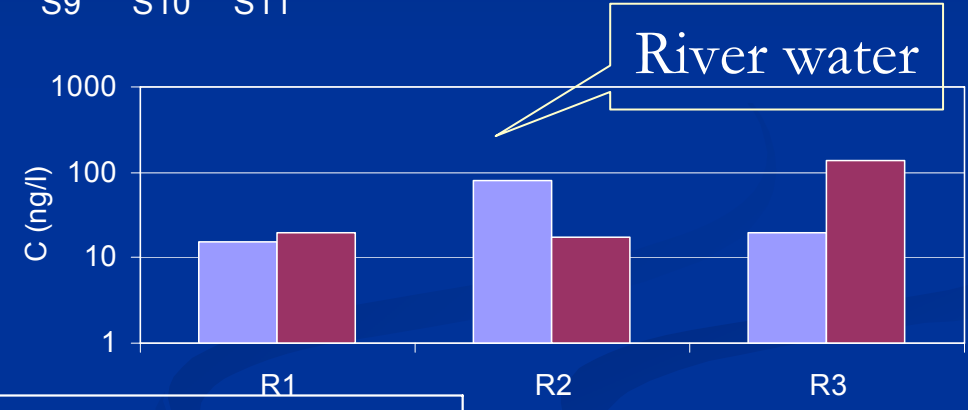


Canal water

BPA



Warm period
Cold period



CONCLUSIONS

- ◆ 4-t-OP, 4 - NP, 4 - NP1EO, 4 - NP2EO, BPA were determined at all water samples for both sampling campaigns.
- ◆ Estrogens were not found at detectable concentrations in water samples.
- ◆ The concentrations of the determined compounds in seawater and river water are at the same range as those reported in the literature.
- ◆ Generally, the compounds show higher concentrations during the cold period. This could be attributed to reduced biodegradation due to decreased water temperature and microbial activity.
- ◆ High concentrations were obtained in canal waters due to wastewater discharges (i.e. STP effluents, tannery and textile effluents).
- ◆ Concentrations of the determined compounds in seawater are lower than inflowing waters. Dilution of the last along with the diffusion and the consequent degradation of the pollutants is a reason for that.

Further research

- Determination of the compounds in suspended particles and sediments.
- Estimation of partition coefficients.
- Effort to locate more sources of the compounds in the coastal environment

**Thank you very much
for your attention**