WP2

Contaminanti nell'ambiente

"Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana

Dipartimento Scienze del Sistema Terra e Tecnologie per l'Ambiente

WP2

Contaminanti nell'ambiente

Task 1	• State of the art
Task 2	• Monitoring
Task 3	• Radionuclides in the environment
Task 4	• The age of contamination
Task 5	• Biogeochemical dynamics of contaminants
Task 6	• Spatial distribution of contaminants: vulnerability and risk map analysis
Task 7	• Contaminants in the atmosphere: dynamics and processes
Task 8	• Contaminants in the atmospheric deposition: quantification and dispersion patterns
Task 9	• Contaminants in the trophic webs and food
Task 10	• Contaminants in the environment and effects of climate change
Task 11	• New generation sensors and observatory nets

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Obiettivi

Obj 1	• Processes
Obj 2	• Pathways
Obj 3	• Kinetics and dynamics
Obj 4	• Biogeochemical cycles of contaminants
Obj 5	• Emerging contaminants
Obj 6	• Sensors

Contaminanti nell'ambiente

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Contaminanti

Contaminanti tradizionali

- Hg, Cd, Zn , Pb, THP, Dioxins and furans, Esachlorobenzene, Polycyclic Aromatic Hydrocarbons, PCB, BTEX

Radionuclidi

Contaminanti Emergenti

- PBDE, TBT e farmaci

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Emerging Contaminants

Substances that have been detected in the environment, but which are currently not included in routine monitoring programmes at EU level and whose fate, behaviour and (eco)toxicological effects are not well understood.

Actually we can count more than 1000 substances (hppt://www.norman-network.net).

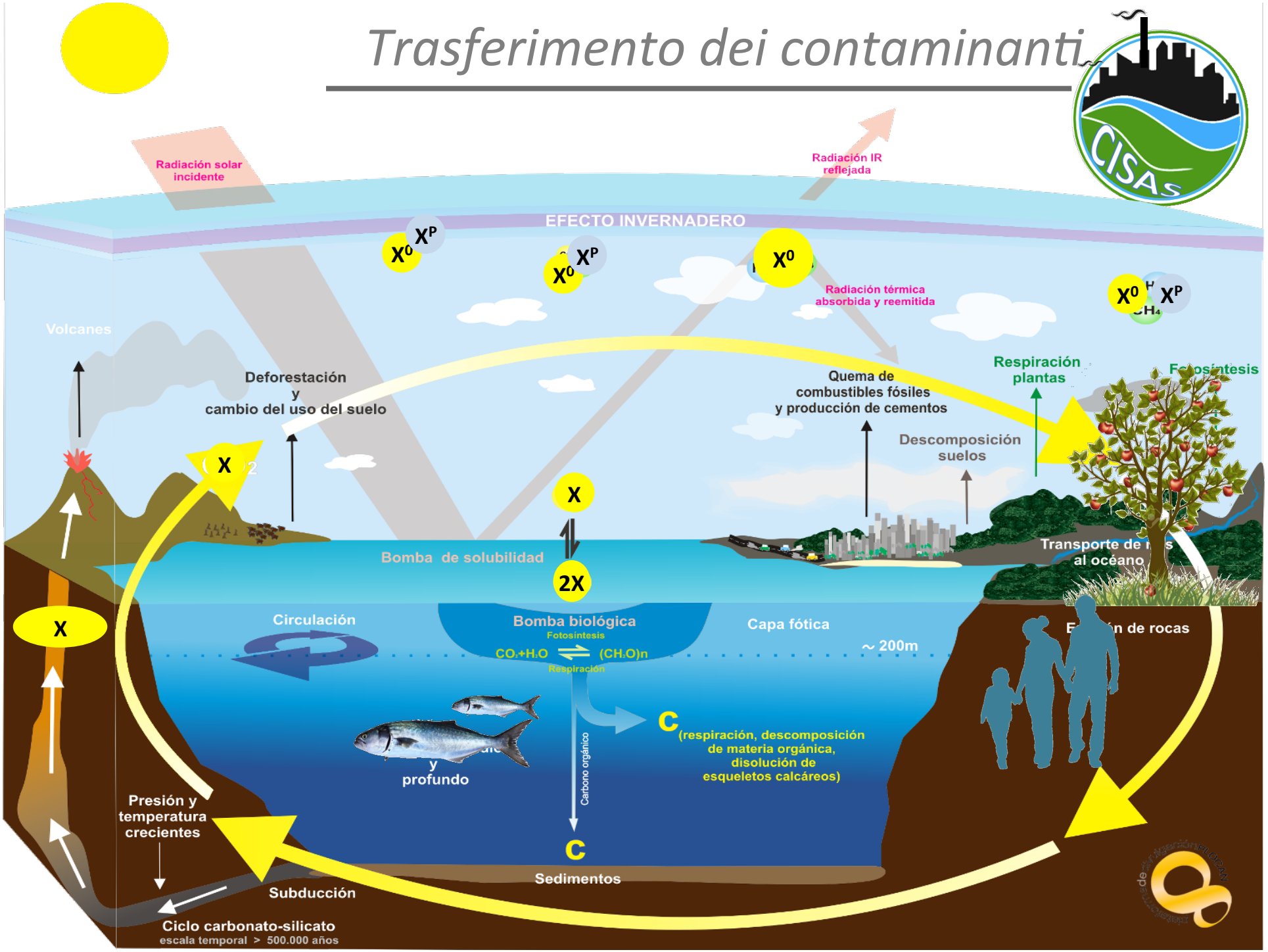
- surfactants
- **flame retardants**
- **pharmaceuticals** and personal care products
- gazoline additives and their degradation products
- biocides
- polar pesticides and their degradation products
- Various proven or suspected endocrine disrupting compounds (EDCs).

Monitored in air, soil, sediment and human breast milk.
Potential health risk to endocrine distruption, neurodevelopment, hepatic and behavioural abnormality and many of them have possible carcinogenic properties.

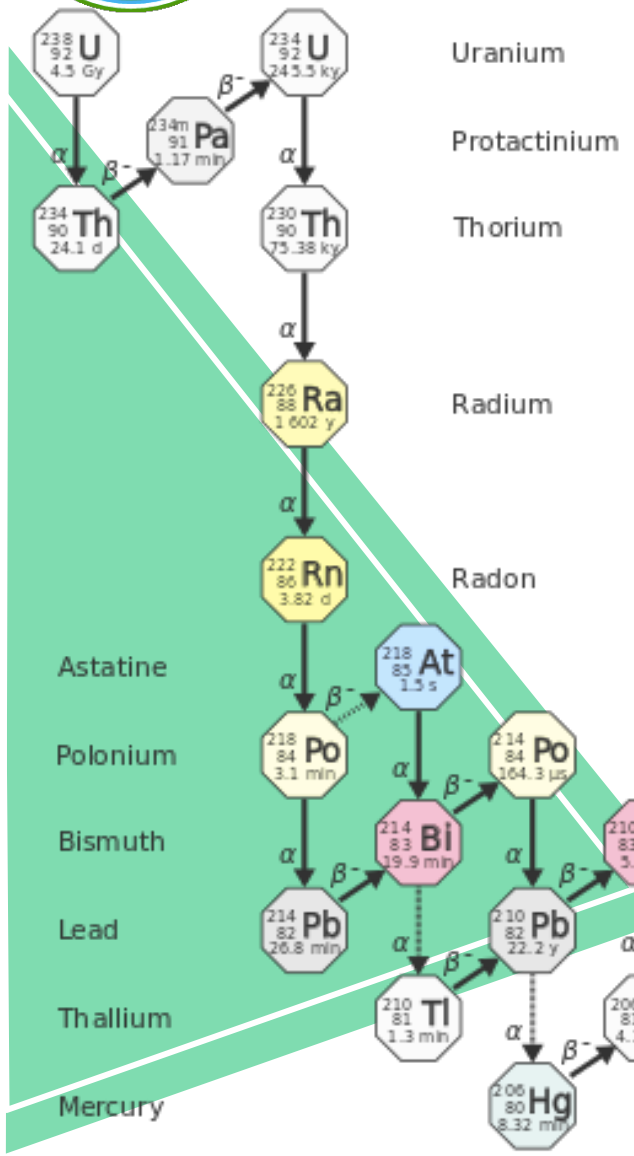
Monitored maily in water and sludge.
Endocrine distrupting chemicals.

Old Flame Retardants	Usage	Regulation
Penta BDE Octa BDE	Use to prevent and minimize fire hazard and or plasticizers	Restrictions on marketing and use (DIRECTVIVE 2003/11/EC) POP substance under Stockholm Convention list (2009).
Deca-BDE	Use to prevent and minimize fire hazard and or plasticizers	Banned in EU in electrical and electronic application since 1 July 2008 (European Court oj Justice, 2008)
New Flame Retardants		
Bis 2,4,6 tribromophenoxyethane (BTBPE) Decabromodiphenylethane (DBDPE) 2-ethylhexyl-2,3,4,5-tertabromobenzoate (TBB)	Replacement of banned formulations of penta, octo and deca-BDEs	Unregulated
Pharmaceutical/Estrogens		
17-Alpha-ethinylestradiol (EE2) 17-Beta-estradiol (E2), Estrone (E1)	Human medicine (contraception, treatment of prostate and breast cancer) and animal farming	Watch List 2015/495/CE
Pharmaceutical/nonsteroidal anti-inflammatory		
Diclorofenac	Human medicine (antirheumatic)	Watch List 2015/495/CE

Trasferimento dei contaminanti



Utilizzo degli isotopi come traccianti geochimici

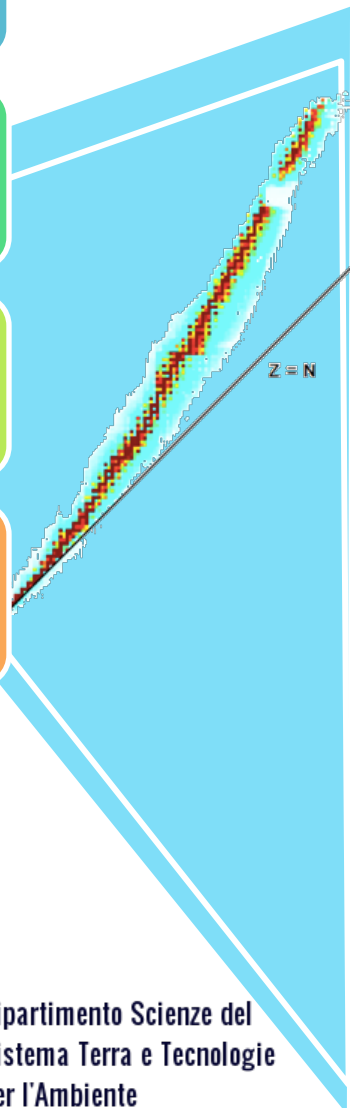


Identification of sources

Process of trasfer and transformation

Identification of pathways of contaminants in the trophic webs and eventually in food

Discrimination of the effects of contaminants transfer through specific diet and crucial advise for the studied human populations.



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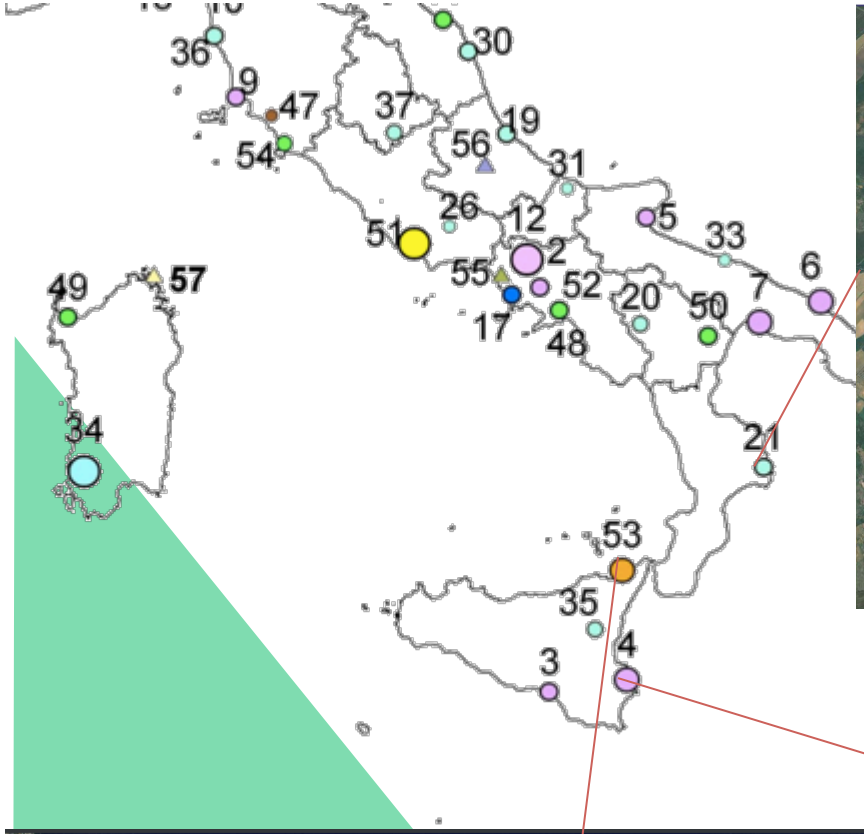
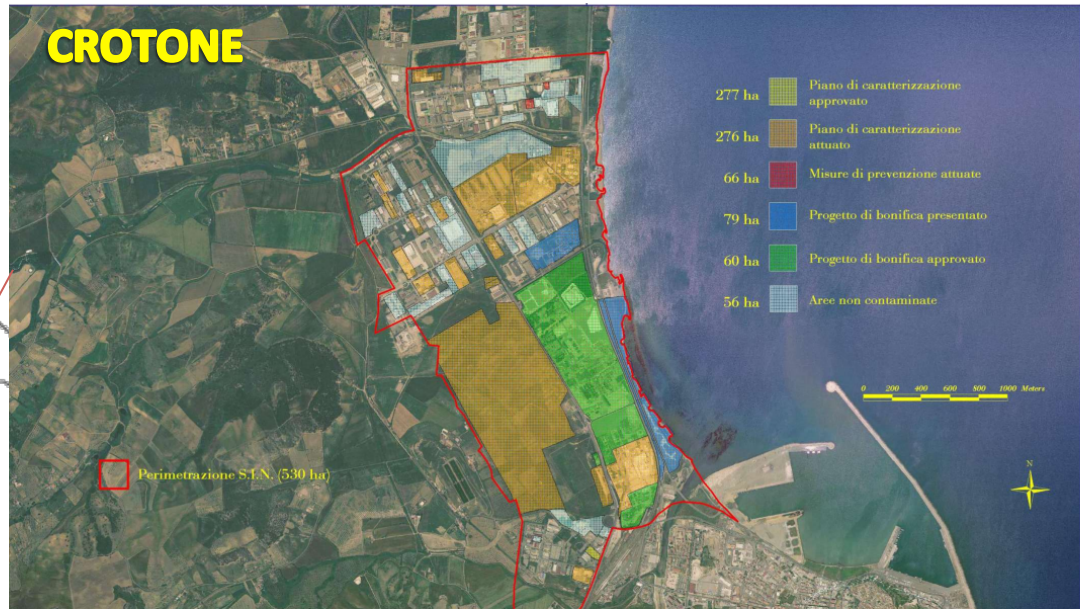
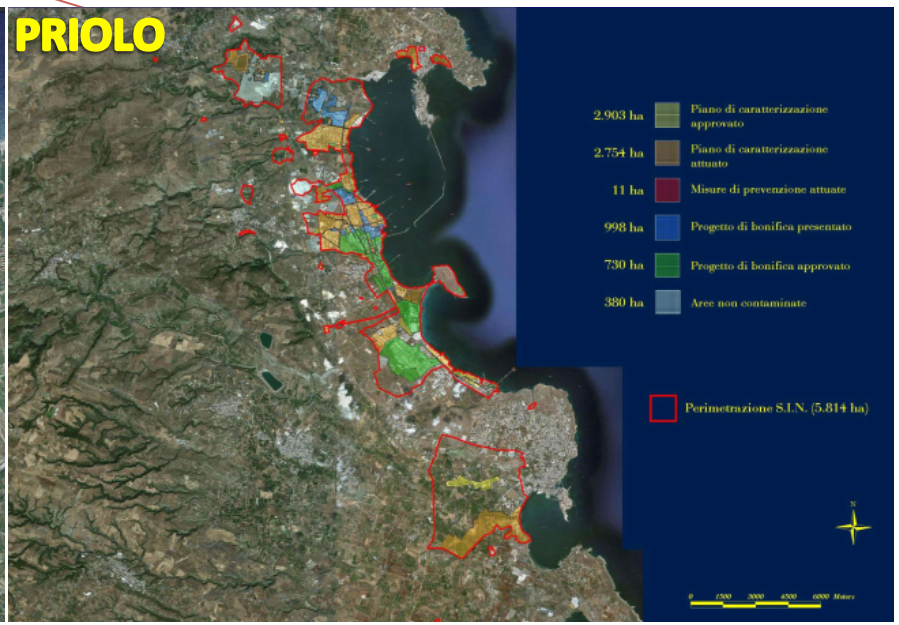




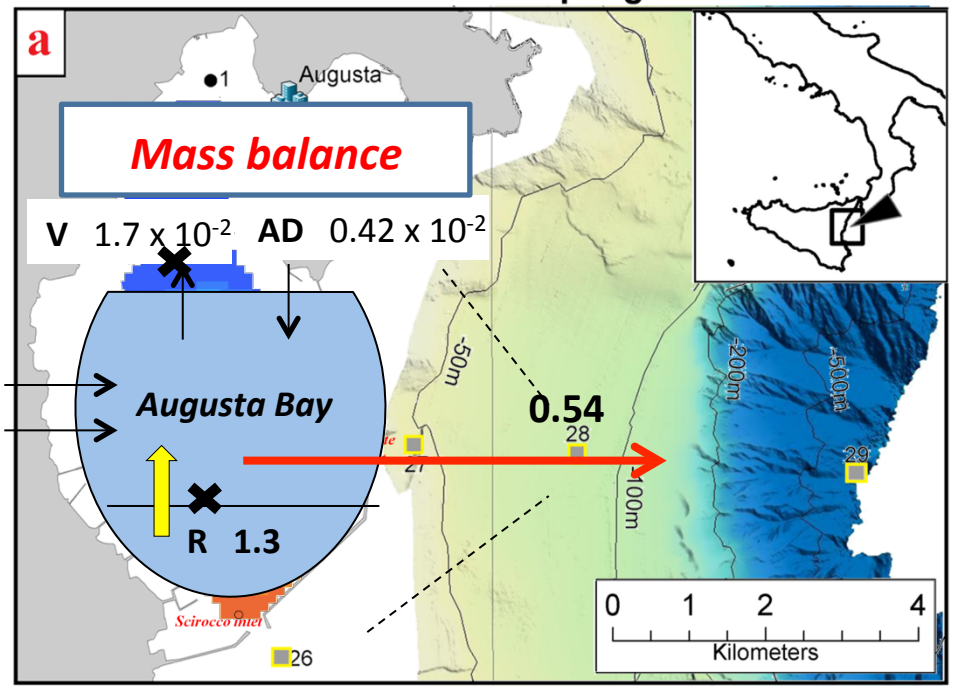
Area di studio



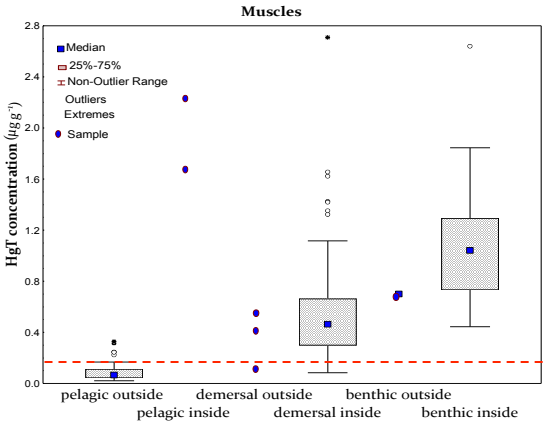
SIN Priolo *Il caso studio della Rada di Augusta*

Unit: *Kmol y^{-1}*

Seawater sampling

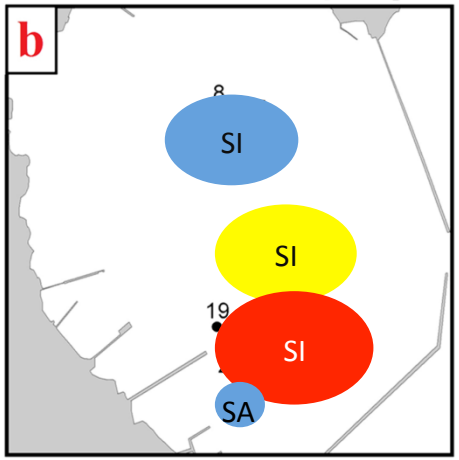


Fish compartment

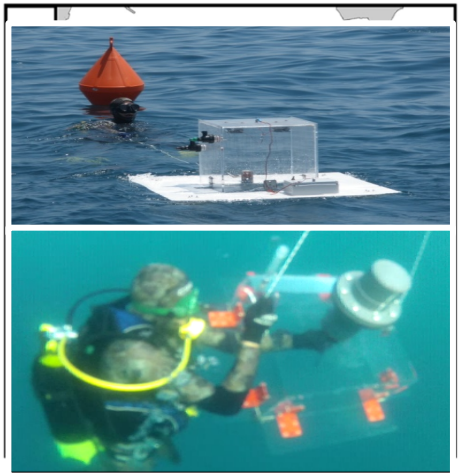


Indici di tossicità (Targhet hazard quotient, Estimated weekly intake)

Sediments sampling



Benthic chamber



THg in sediment *(mg Kg^{-1})*

High: 25

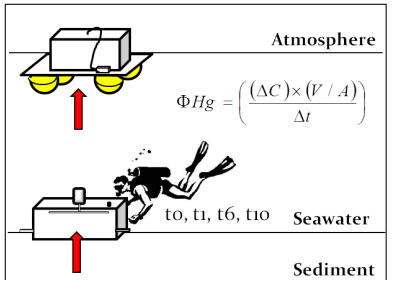
Low: 6.5

Grain size

SA=sandy

SI= silt

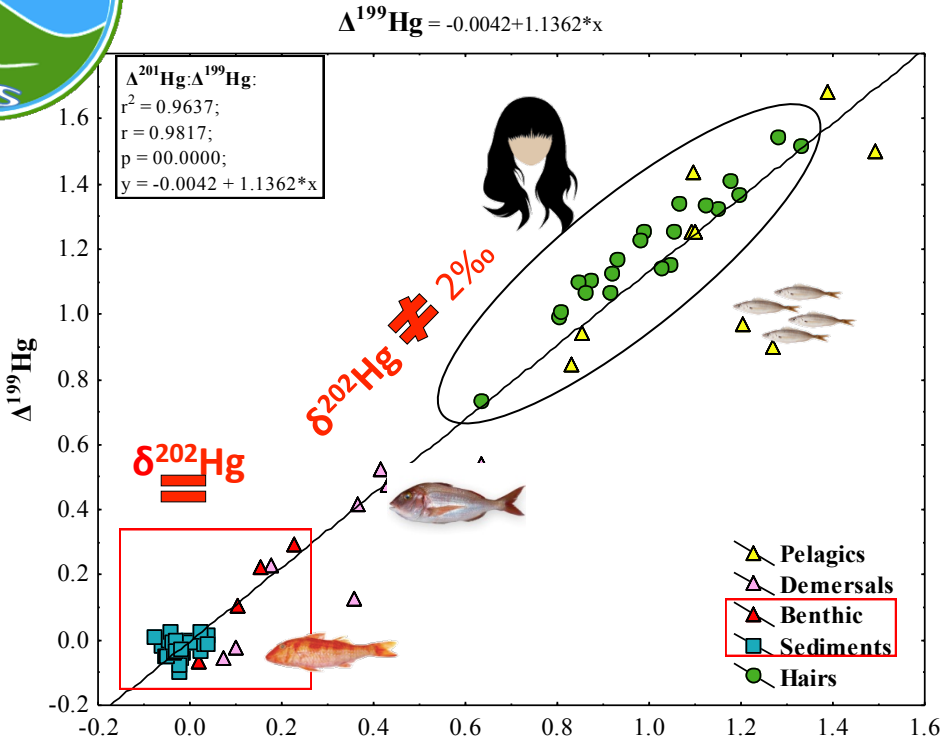
● 2011 ■ 2012

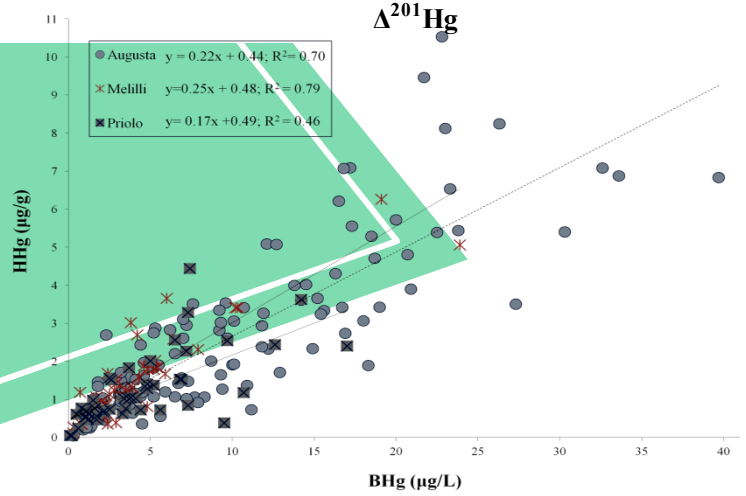


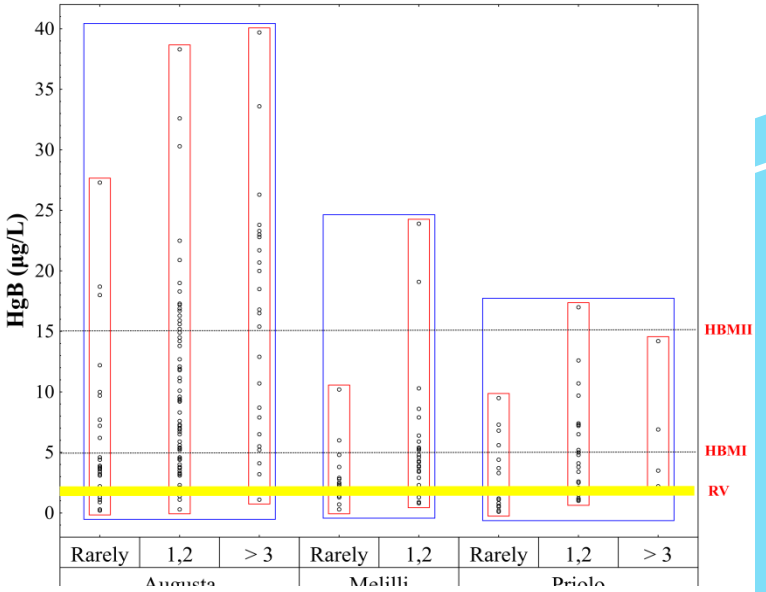
SIN Priolo *Il caso studio della Rada di Augusta*

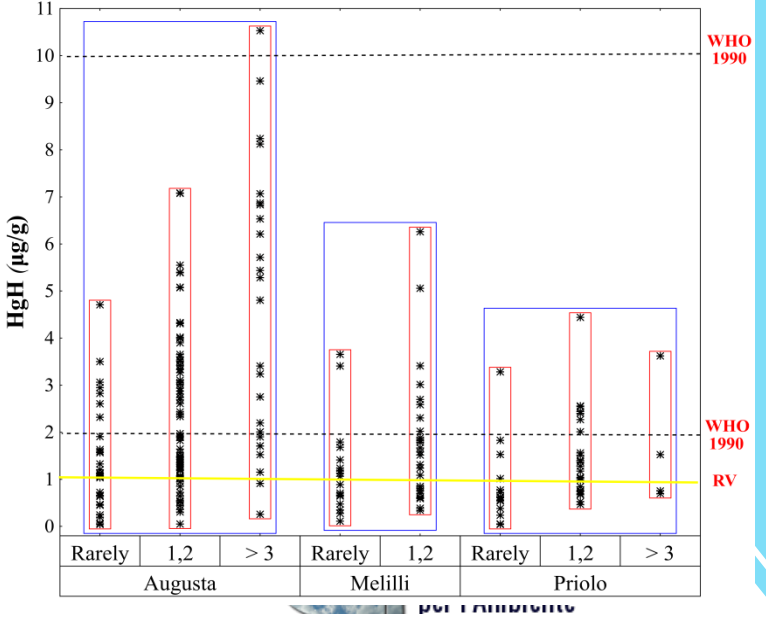
Human biomonitoring

Hg isotopes exploration









SIN Milazzo

- Raffineria di petrolio R.A.M.
- centrale elettrica EDIPOWER
- Centrale Termica Milazzo (ex SONDEL)
- Acciaieria di Giammoro di Pace del Mela
- Cogeneratore
- Profilati in ferro –DUFERDOFIN
- Produzione apparecchiature elettriche (ETS)
- Attività di lavorazione amianto (dismessa)
- impianto per il recupero del piombo dalle batterie esauste
- Diversi depositi di prodotti petroliferi e discariche di rifiuti industriali
- diversi altri opifici minori.

Suoli

- Contaminazione dei suoli da idrocarburi leggeri (C<12) e pesanti (C>12), xilene, organici aromatici, benzene, etilbenzene, toluene, xilene, piombo alchili, mercurio, cromo, cobalto, rame e zinco

Acque di falda

- Metalli pesanti (Al, Mn, Pb, fluoruri,Benzene, Idrocarburi totali, IPA, Alifatici clorurati cancerogeni, Organoalogenati.

- Presenza di notevoli quantità di amianto in un sito industriale dismesso (ex SACELIT)

Studi epidemiologici

Eccessi di cromo, cobalto, rame e zinco nelle urine (CCR dell'Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA)

Analisi dei mortalità e morbosità

ATLANTE D.O.E. SICILIA 2004: MORTALITA' 1995-2000

ATLANTE D.O.E. SICILIA 2004: MORBOSITA' (RICOVERI) 2001-2003

Confermati pure dallo studio per Ricoverati

SIN Crotone

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Produzione acido fosforico

Produzione fertilizzanti complessi azotati e fosfatici, acido nitrico, acido solforico e oleum

Produzione Zinco, acido solforico e cadmio, germanio, indio, solfato di piombo, malte argentifere, e ***scorie metallurgiche***

\+

-impianti per la produzione di prodotti chimici,
-Impianti di incenerimento e trattamento di rifiuti
-centrali per la produzione di energia da biomasse
-numerose industrie alimentari.

Negli anni Novanta le ***scorie cubilot*** *venivano miscelate con sabbia silicea, loppa d'altoforno e catalizzatori, dando vita al conglomerato idraulico catalizzato (**Cic**). prodotto utilizzato per la realizzazione di rilevati, sottofondi stradali, piazzali e manufatti*

Matrice	Parametro
Suolo di riporto	Cadmio
	Zinco
	Arsenico
	Piombo
	Rame
	Mercurio
Suolo argilloso 1-4 m	Cadmio
	Zinco
	Arsenico
	Piombo
Suolo sabbioso max 7,5 m p.c.	Cadmio
	Zinco
	Arsenico
	Piombo
Acqua di falda	Manganese
	Solfati
	Tallio
	Tetracloroetilene
	Tricloroetilene
	Arsenico
	Cadmio
	Nitriti
	Zinco
	Piombo
	Ferro
	Fluoruri
	1,1,2 Tricloroetano
	Mercurio
	Idrocarburi Totali

Studi sul comparto biotico	**La concentrazione dei metalli nei prodotti pescati nell'area di Crotone non sembrerebbe rappresentare una criticità per la sicurezza dei consumatori**
Analisi della mortalità	eccessi di mortalità per epatiti virali e tumori.
Analisi dell'ospedalizzazione	eccessi di ricoverati per tutti i tumori maligni, malattie ischemiche, malattie cerebrovascolari, dell'apparato respiratorio, digerente , urinario ed epatico, nefrite

TASK 2.7 CONTAMINANTS IN THE ATMOSPHERE: DYNAMICS AND PROCESSES

C.N.R. – ISTITUTO SULL'INQUINAMENTO ATMOSFERICO
C. Perrino e collaboratori

COMPOSIZIONE CHIMICA DEL MATERIALE PARTICELLARE SOSPESO IN ATMOSFERA:

Campionamenti giornalieri e/o mensili nei tre siti di interesse

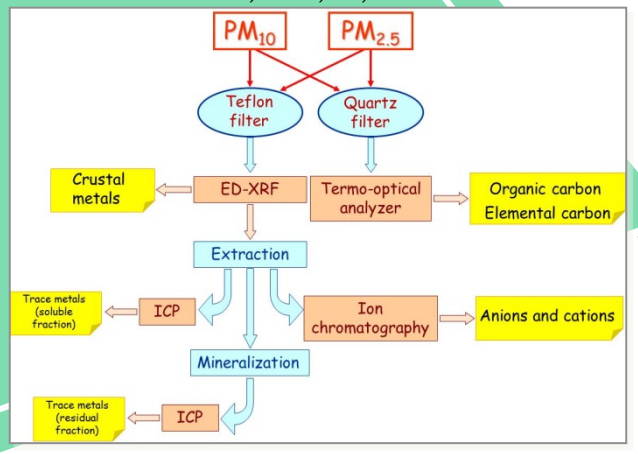
Determinazione della composizione chimica del PM10 e del PM2.5:

- elementi (frazione biodisponibile e residua),
- ioni, carbonio organico, carbonio elementare,
- microinquinanti organici (PCDD, PCDF, PCB, IPA)

CAMPIONAMENTO HV

PCDD PCDF
PCB
IPA
HR GC-MS

ANALISI ELEMENTI, IONI, EC, OC



CAMPIONAMENTO 2.3 m³/h

TASK 2.7 CONTAMINANTS IN THE ATMOSPHERE: DYNAMICS AND PROCESSES

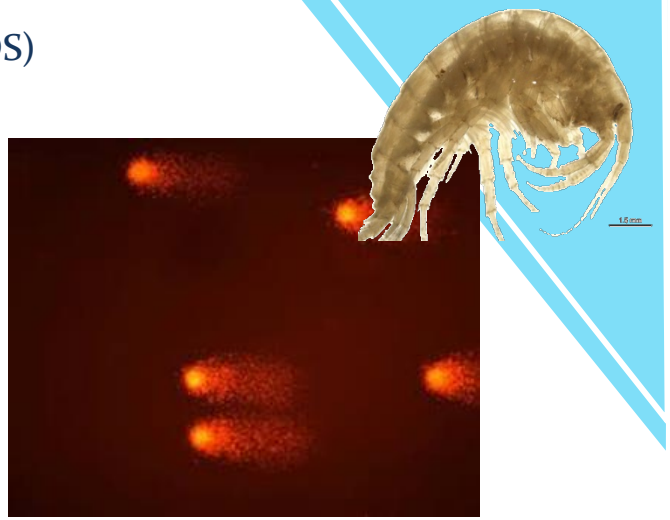
C.N.R. – ISTITUTO SULL'INQUINAMENTO ATMOSFERICO
C. Perrino e collaboratori

EFFETTI *IN VITRO* ED *IN VIVO* DEL MATERIALE PARTICELLARE SOSPESO IN ATMOSFERA

VALUTAZIONE DEI DIVERSI EFFETTI DELLE FRAZIONI ELEMENTARI BIODISPONIBILE E RESIDUA

Test di valutazione *in vitro* del potenziale ossidativo (generazione di ROS) delle polveri atmosferiche campionate nei tre siti di interesse:

- ditiotreitolo (più sensibile alle specie organiche),
- acido ascorbico (più sensibile agli elementi)



Test di valutazione *in vivo* della genotossicità del PM su *Echinogammarus veneris* (anfipode) o su altri animali –modello:

- comet test (elettroforesi su singola cellula)
- comet test + formamido pyrimidine DNA glycosylase (danni di tipo ossidativo)
- bioaccumulo (analisi diretta degli elementi nei tessuti)

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TASK 2.8 CONTAMINANTS IN THE ATMOSPHERIC DEPOSITION: QUANTIFICATION AND DISPERSION PATTERNS (DISTEM)

Gases and particulates emitted by industrial activities are involved in many chemical-physical processes and removed from the atmosphere by wet and dry deposition (rain).

Biomonitoring may be defined as the use of organisms and biomaterials (*biomonitors*) to obtain information on certain characteristics of the atmosphere, as long as they quantitatively reflect their ambient conditions.Various bioaccumulators have been used in trace element air monitoring, such as mosses, lichens, ferns, grass, tree bark and tree rings, leaves and conifers' needles.

Bioindicators

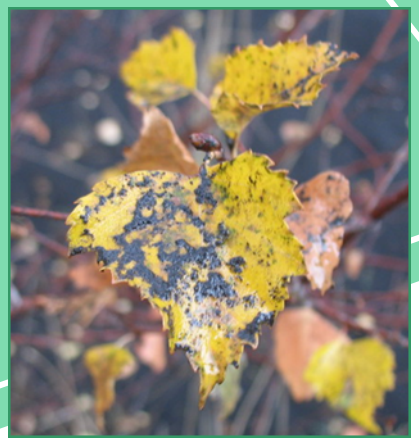
BIOMONITORING

Bioaccumulators

Passive

Active

analysis of leaves



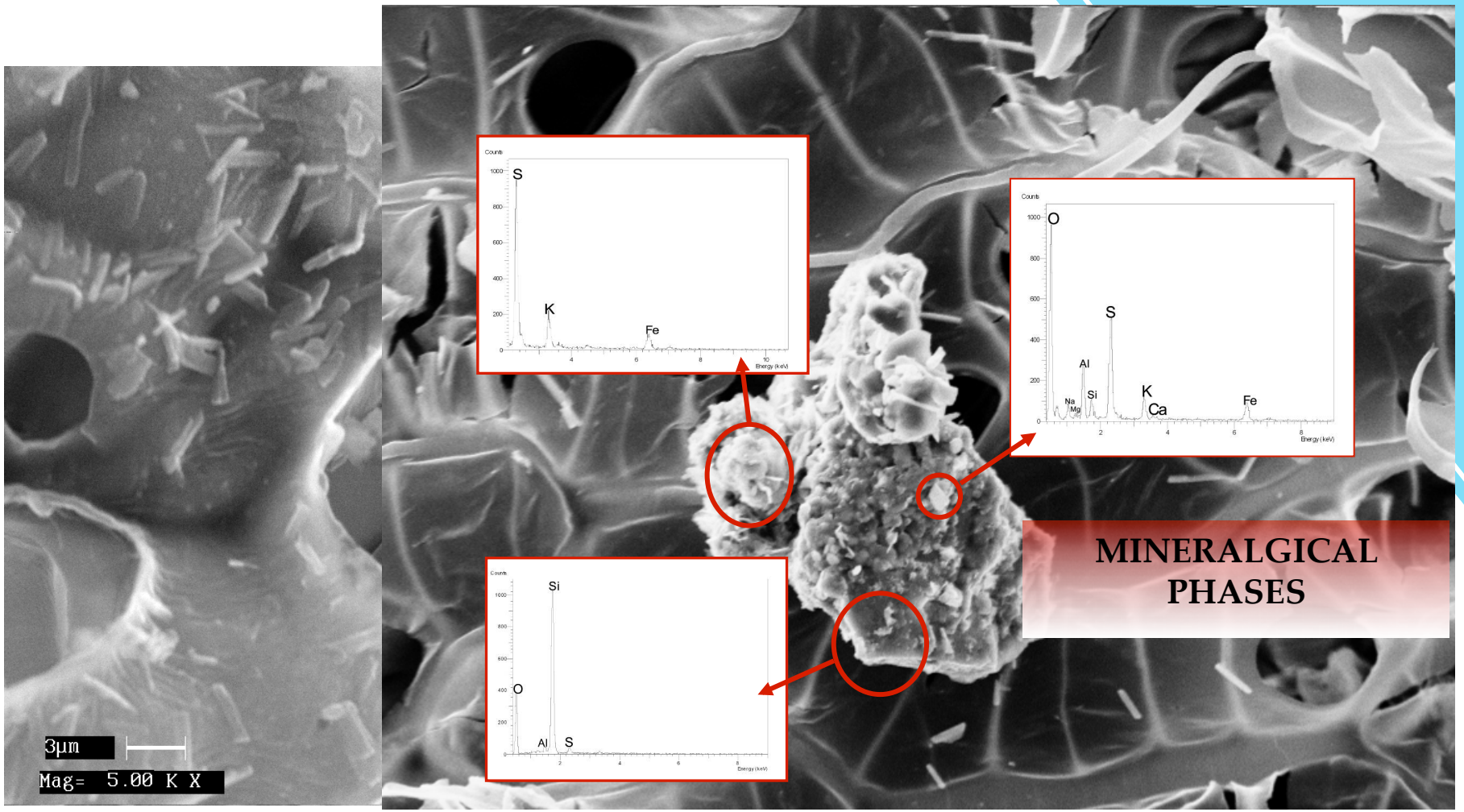
Dendrochemistry

Moss bags

Transplant

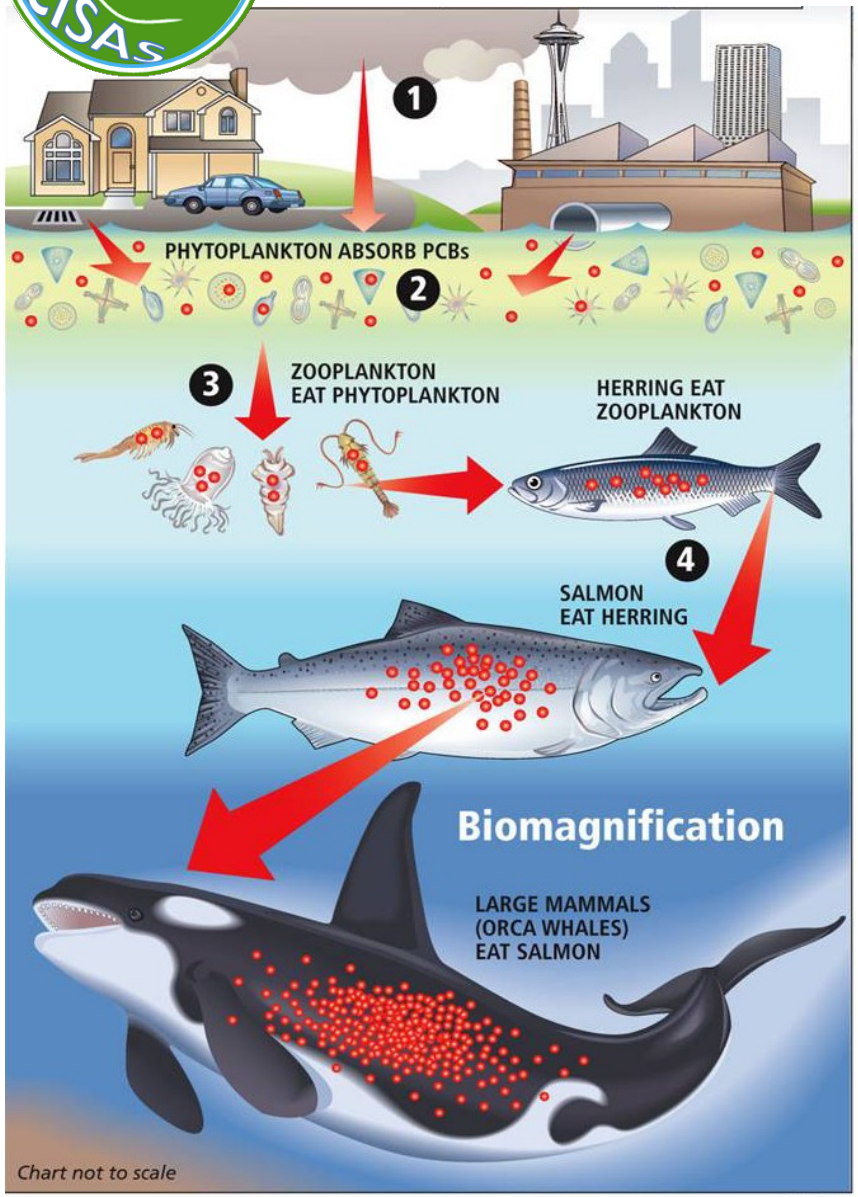
per l'Ambiente

Morphological observation (SEM) and semi-quantitative analysis (EDS spectra)



TASK 2.9 CONTAMINANTS IN THE TROPHIC WEBS AND FOOD

Istituto Zooprofilattico Sperimentale (Palermo)



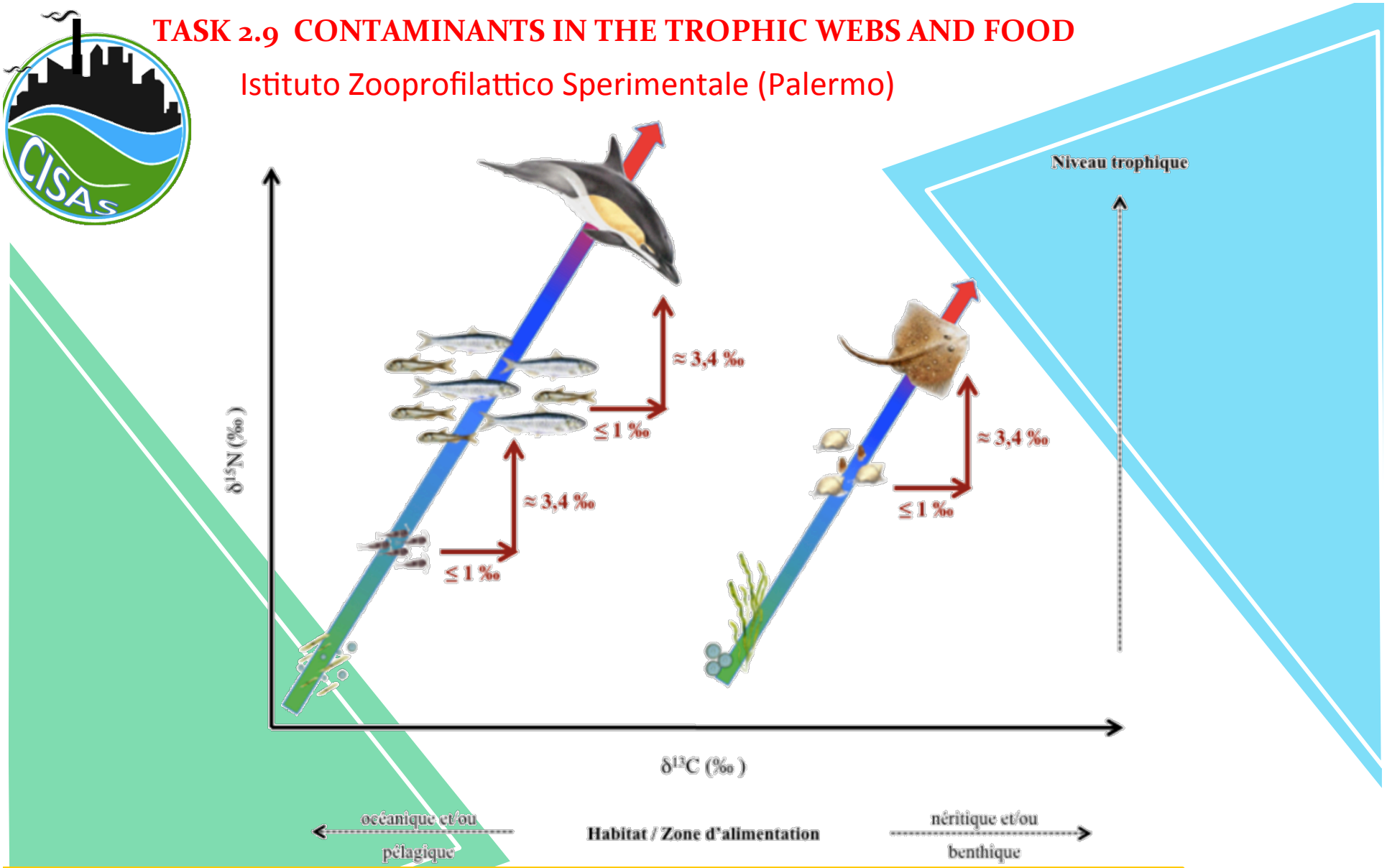
Investigation of a statistically significant number of marine and terrestrial species, covering the complete range of the different trophic webs will in order to verify modes and transfer times of pollutants and NORM from the environment to the consumer stomach.

Metalli pesanti
IPA
Diossine e PCB diossina simili
PCB non diossina simili
Residui di farmaci
Fitofarmaci
NO_X e SO_X
VOC
Composti inorganici del cloro e fluoro
Polveri totali

- **Acqua di abbeverata**
- **Terreni**
- **Tessuto adiposo, muscolo, fegato, rene**
- **Urina**
- **Siero/Plasma**
- **Alimenti di origine animale**
- **Alimenti di origine vegetale**
- **Alimenti per animali**

TASK 2.9 CONTAMINANTS IN THE TROPHIC WEBS AND FOOD

Istituto Zooprofilattico Sperimentale (Palermo)



Isotope tracers (light and heavy isotopes) will provide specific quantitative tools for identifying pathways of contaminants in the trophic webs and eventually in food. Quantitative information will allow an accurate discrimination of the effects of contaminants transfer through specific diet and crucial advise for the studied human populations.

TASK 2.10 CONTAMINANTS IN THE ENVIRONMENT AND EFFECTS OF CLIMATE CHANGE

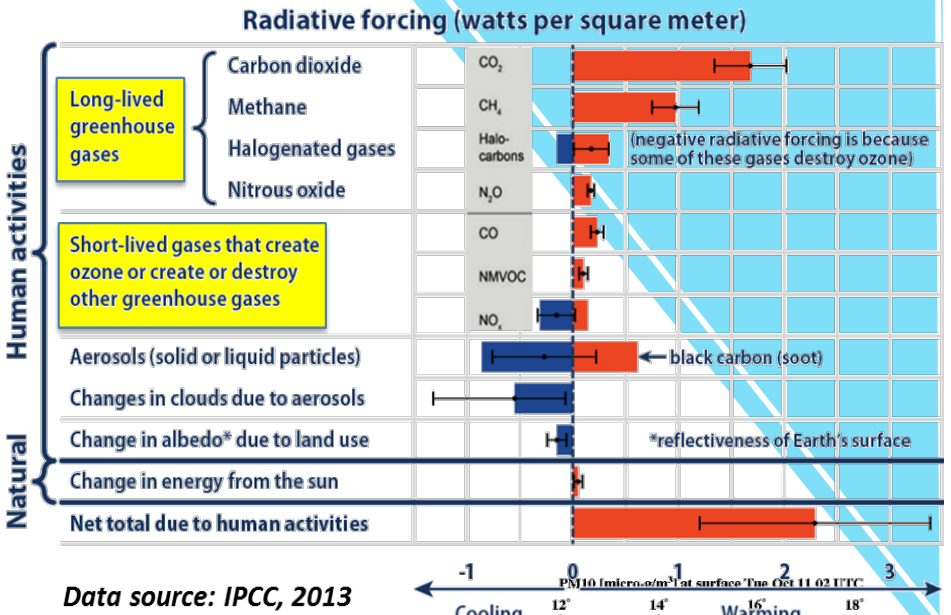
Istituto di Scienze dell'Atmosfera e del Clima ISAC

The Mediterranean Basin is an *Hotspot* for Climate and Environment

Data and methods Observational activities

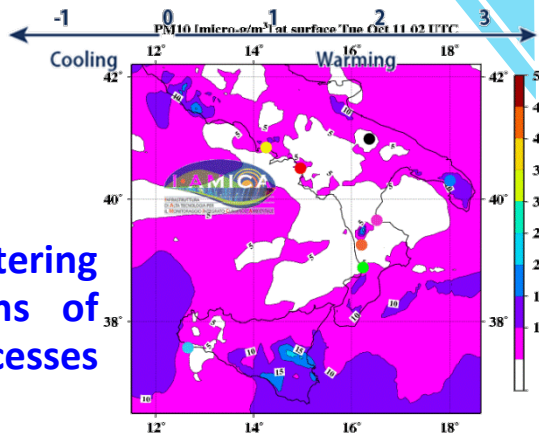
Support a win-win strategy in the fight against contaminants/air pollution and climate change, considered two sides of the same coin: much of the air pollution that damages human health and the environment as result of human activities or due to natural sources contribute to climate change.

Observations of air pollutants and Short and Long Lived Climate Forcers/Pollutants, SLCF/P (e.g. O3, BC, CH4, CO2) at the CNR Climate Observatory of Capo Granitola, the reference Sicily regional station of GAW-WMO program.



Data source: IPCC, 2013

Measurements of O3, CO, NOx, SO2, CO2, CH4, aerosol size distribution, PM10, PM2.5, PM1, scattering and absorption coefficients to identify and tagging the origin and the age of air-masses and related contaminants supporting studies on SLCF/P to the environment also thanks to the use of air quality and regional climate models.



Generation of datasets of anthropogenic and natural climate altering contaminates, reactive trace gases and aerosols and **simulations of atmospheric gases and aerosols formation, diffusion and removal processes on regional scale**.

Climate activities

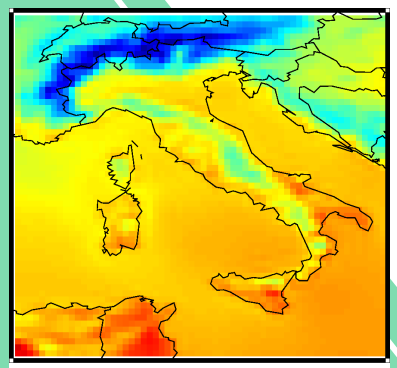
1. **Assessment of the current and future climate conditions in Sicily and in the Mediterranean hot-spot region**

2. **Linkages between climate and air quality/pollution: explore the extent to which the future temperature and precipitation evolution and the climatic extremes will influence contaminants concentration and will impact on ecosystems and human activities**

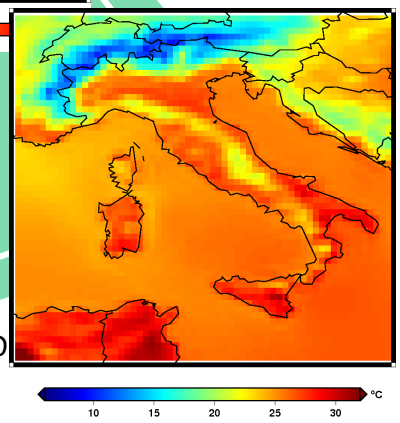
3. **Support future planning and decisions**

Data and methods

Surface Temperature



PRESENT
Mean Summer Temperature <1979-2008>



FUTURE
Mean Summer Temperature <2039-2068>

EC-Earth climate model @ 25 km resolution

- **Observation-based datasets** → picture of the past and present conditions in Sicily and in the Mediterranean region
- **State-of-the-art climate models** → future assessments
- **Downscaling of global and regional climate models** → to make their outputs usable for specific and local studies
- **Descriptive indices for climatic extremes** →e.g., *warm/cold spell duration; annual count of days with precipitation > 10mm or 20 mm; max. length of dry spell combined with max. number of consecutive days with precipitation < 1mm; etc.*

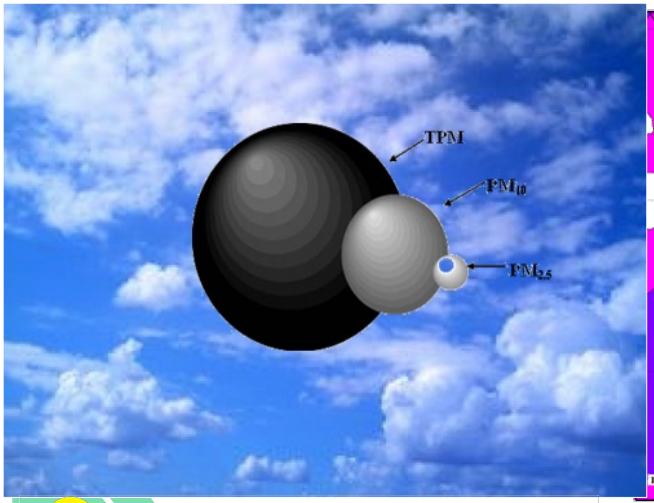
Generate a number of air quality scenarios to provide a comparative analysis depending on technological trends, sector growth or decrease, inertia of the historic data, industry output or the implementation of current or future European regulations in terms of human health.

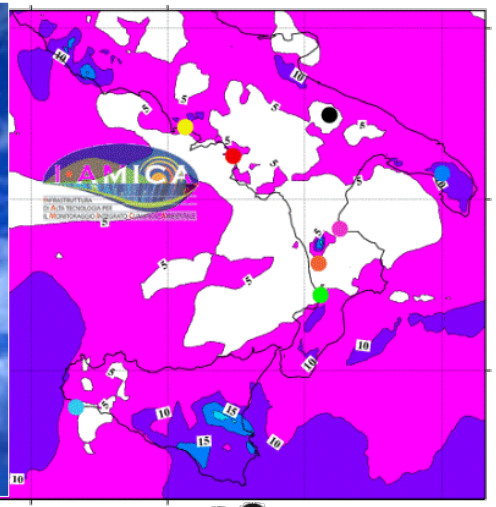
Thus, 2020, 2040 and 2060 emissions will be projected for most of the representative sources in the region of interest

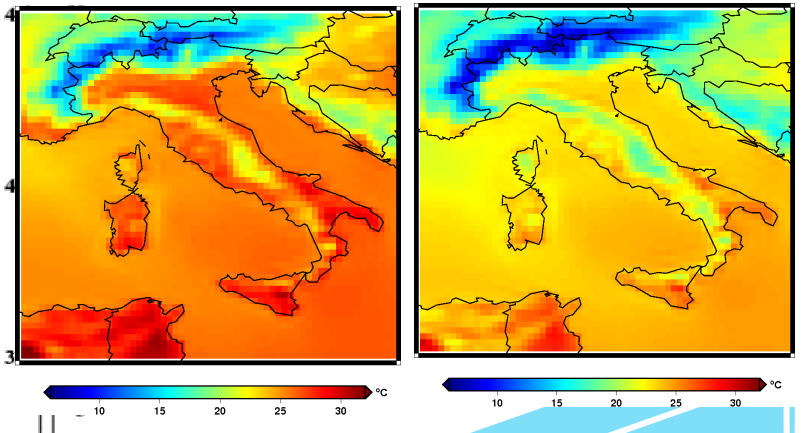
Mesoscale Air Quality Modeling Activities

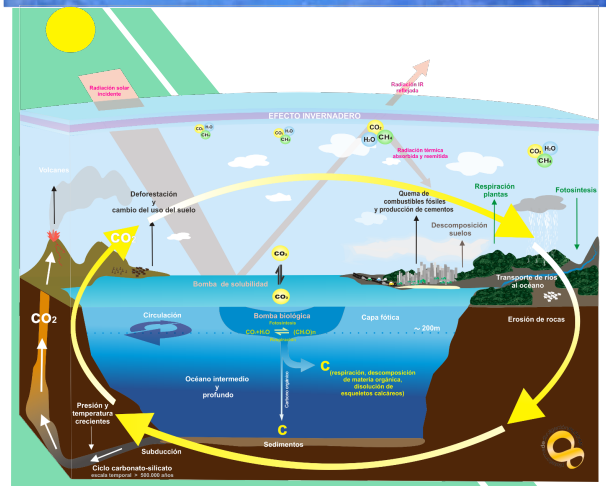
Tunable Sectors in the emissions inventory

a) Combustion in energy and transformation industries
b) Non-industrial combustion plants
c) Combustion in manufacturing industry
d) Production processes
e) Extraction and distribution of fossil fuels and geothermal energy
f) Solvent and other product use
g) Road transport
h) Other mobile sources and machinery
i) Waste treatment and disposal
j) Agriculture
Other sources and sinks

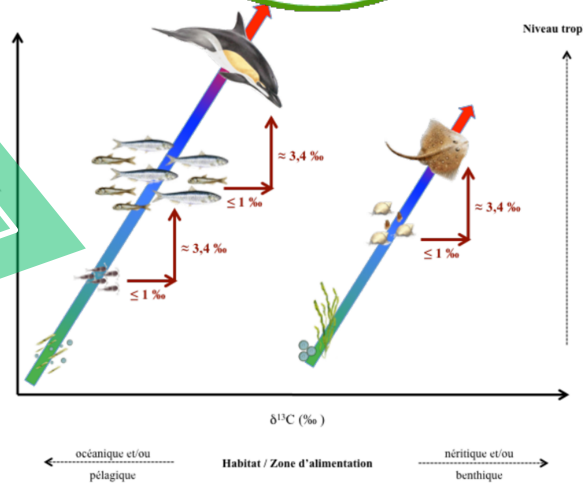

TPM
PM_{10}
$PM_{2.5}$

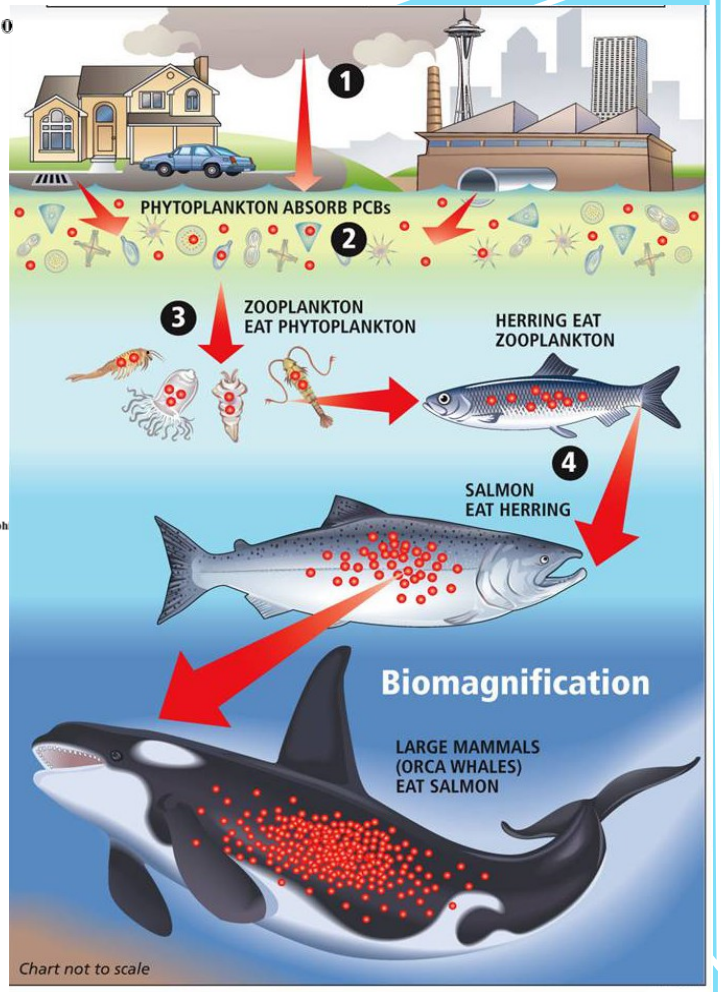

IAMICA


°C
10
15
20
25
30


EFECTO INVERNADERO
Radiación solar incidente
Radiación IR reflejada
Radiación térmica absorbida y reemitida
Volcanes
Deforestación y cambio del uso del suelo
Quema de combustibles fósiles y producción de cementos
Respiración plantas
Fotosíntesis
Descomposición suelos
Bomba de solubilidad
Transporte de ríos al océano
Circulación
Bomba biológica
Capa fótica
~ 200m
Erosión de rocas
Océano intermedio y profundo
Presión y temperatura crecientes
Subducción
Ciclo carbonato-silicato
escala temporal > 500.000 años
Sedimentos
CO_2
CO


CISAs


Niveau troph
≈ 3,4 ‰
≤ 1 ‰
≈ 3,4 ‰
≤ 1 ‰
≈ 3,4 ‰
≤ 1 ‰
δ13C (‰)
océanique et/ou
pélagique
Habitat / Zone d'alimentation
néritique et/ou
benthique


PHYTOPLANKTON ABSORB PCBs
ZOOPLANKTON EAT PHYTOPLANKTON
HERRING EAT ZOOPLANKTON
SALMON EAT HERRING
Biomagnification
LARGE MAMMALS (ORCA WHALES) EAT SALMON
Chart not to scale

Gantt

Dipartimento Scienze del Sistema Terra e Tecnologie per l'Ambiente

Grazie!

"Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana

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