

COPERNICUS: “NUOVA” BASE INFORMATIVA

Prof. A. Taramelli

COPERNICUS: LO SGUARDO DELL'EUROPA

SULLA TERRA

«Copernicus offre gratuitamente una quantità di dati senza precedenti, fornirà nuovi servizi operativi e stimolerà nuove partnership pubbliche private

Elżbieta Bieńkowska

Commissario europeo responsabile per il Mercato interno, l'industria, l'imprenditoria e le PMI

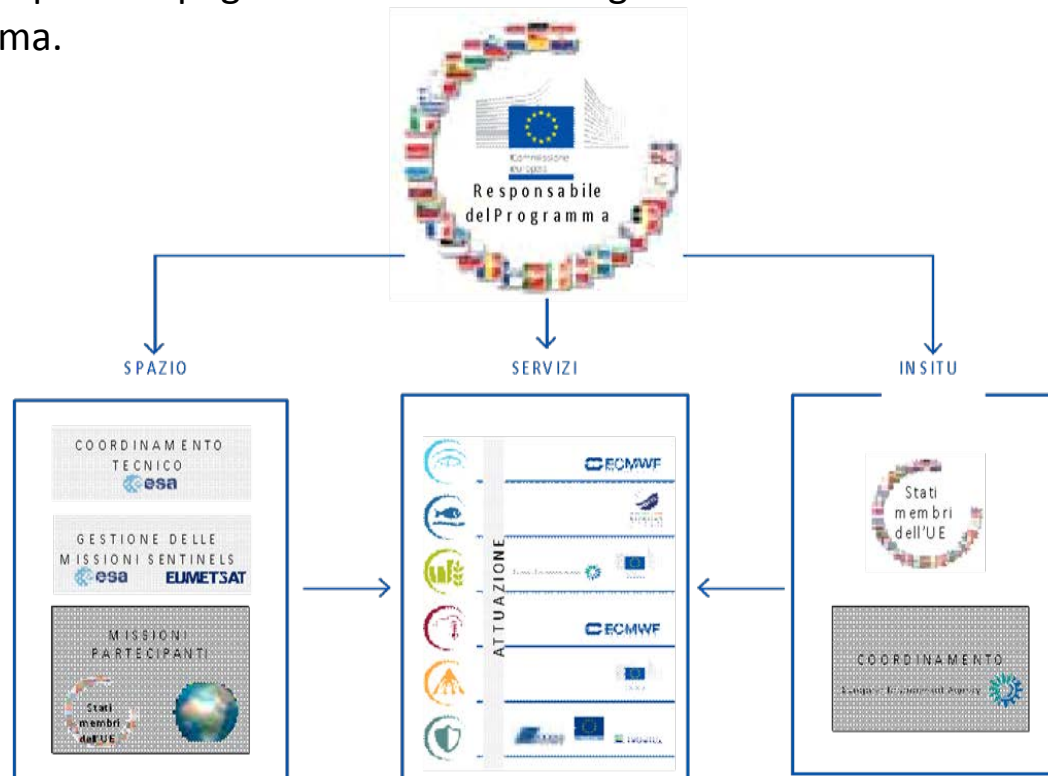
1. Come possiamo gestire al meglio il nostro **uso e consumo delle risorse naturali** della Terra e proteggere l'ambiente per il bene delle generazioni future?
1. Come possiamo **garantire la sicurezza**, la protezione e la qualità della vita dei milioni di futuri abitanti delle nostre città e regioni e **reagire adeguatamente alle catastrofi e alle crisi**?
1. Come possiamo comprendere meglio le **cause e le conseguenze del cambiamento climatico**, predisponendo opportune misure di mitigazione e di adattamento?

... La Governance ed il processo Copernicus: dai dati all'informazione...

In collaborazione con gli Stati membri dell'Unione europea, la Commissione europea sovrintende e coordina il programma e assicura che rimanga orientato ai bisogni degli utenti.

La Commissione persegue tali obiettivi con il concorso degli Stati Membri attraverso il Comitato e le loro rappresentanze delle Comunità degli utenti, intermedi e finali attraverso lo User Forum.

La Commissione ha il compito di definire e sviluppare la visione politica del programma e di mettere a punto gli elementi per il corretto e adeguato funzionamento del sistema ed insieme al Parlamento e al Consiglio è responsabile per l'impegno finanziario a lungo termine che assicura le basi per la sostenibilità del programma.



4 Satellite data Access Points:

2 managed by ESA:

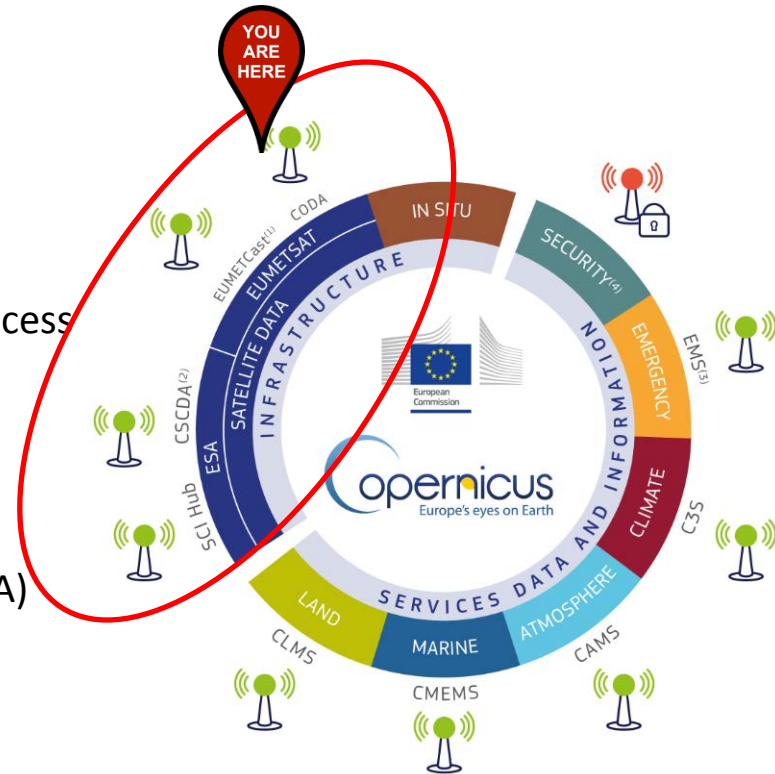
Open Access Hub

Copernicus Space Component Data Access
(CSCDA)

2 managed by EUMETSAT

EUMETCast

Copernicus Online Data Access (CODA)



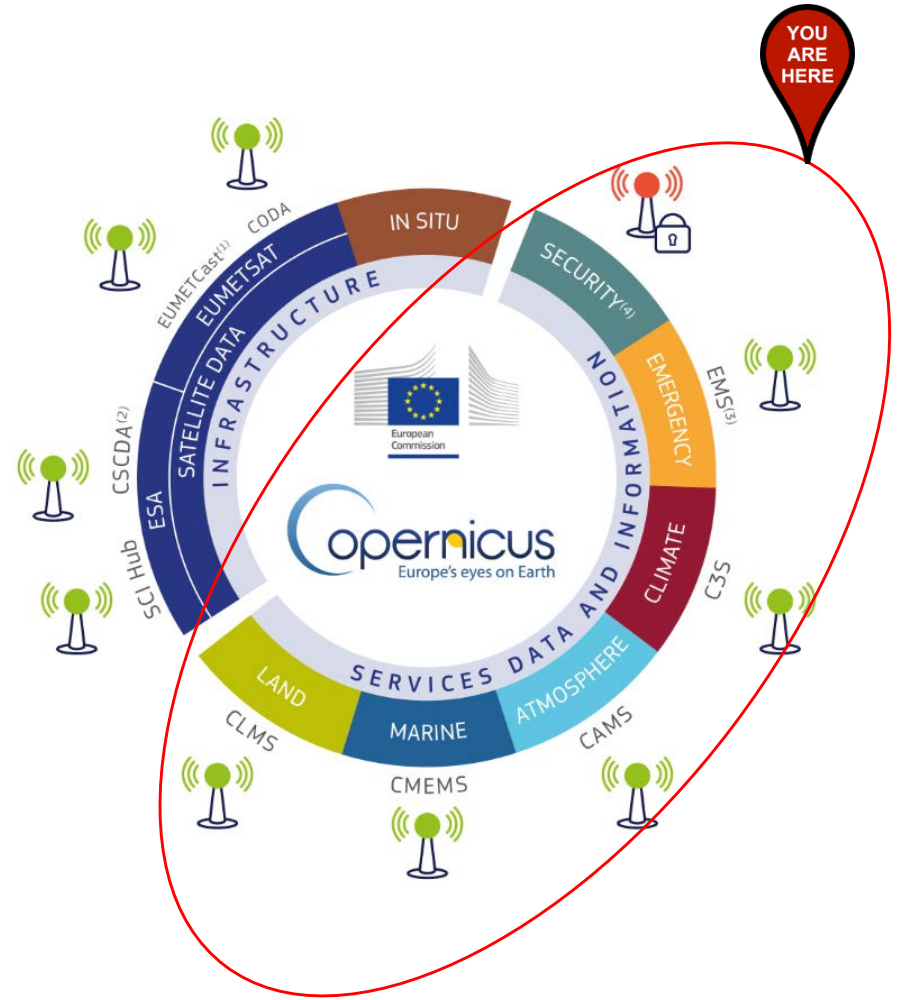
• 6 Thematic Copernicus Services

• 5 are under Full, free and open access:

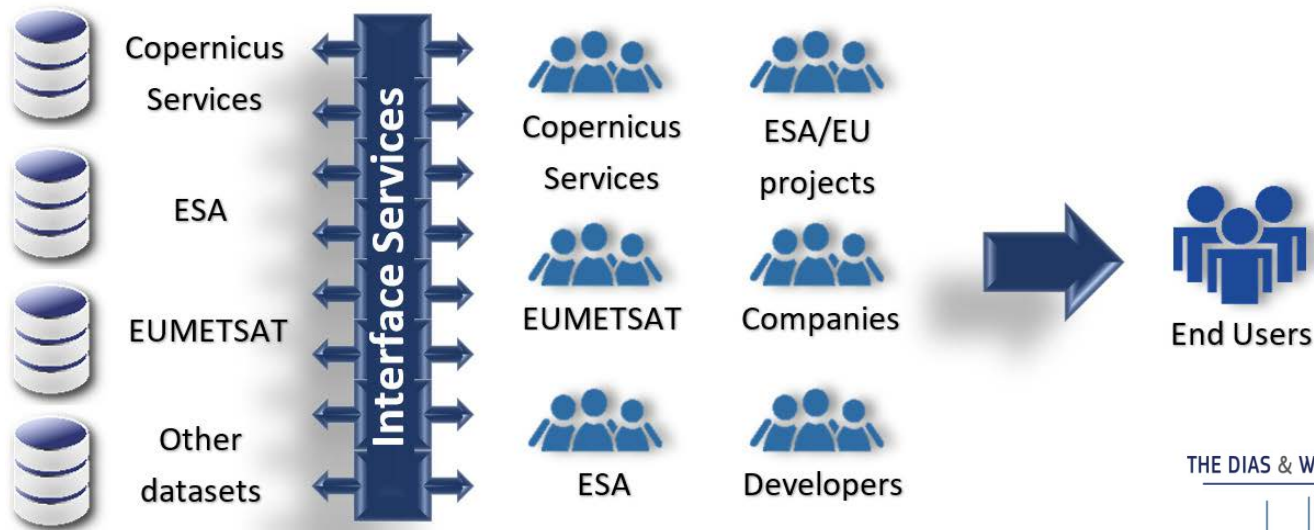
- Land 
- Marine 
- Atmosphere 
- Climate 
- Emergency 

• 1 has restricted access

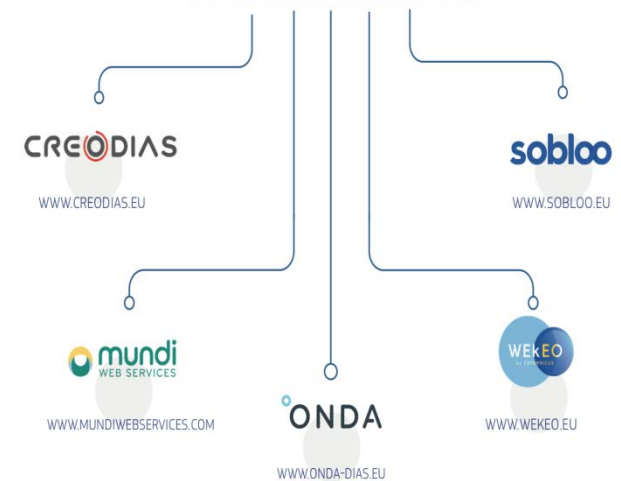
- Security 



DIAS: A game changer for accessing and processing Copernicus data and information ...

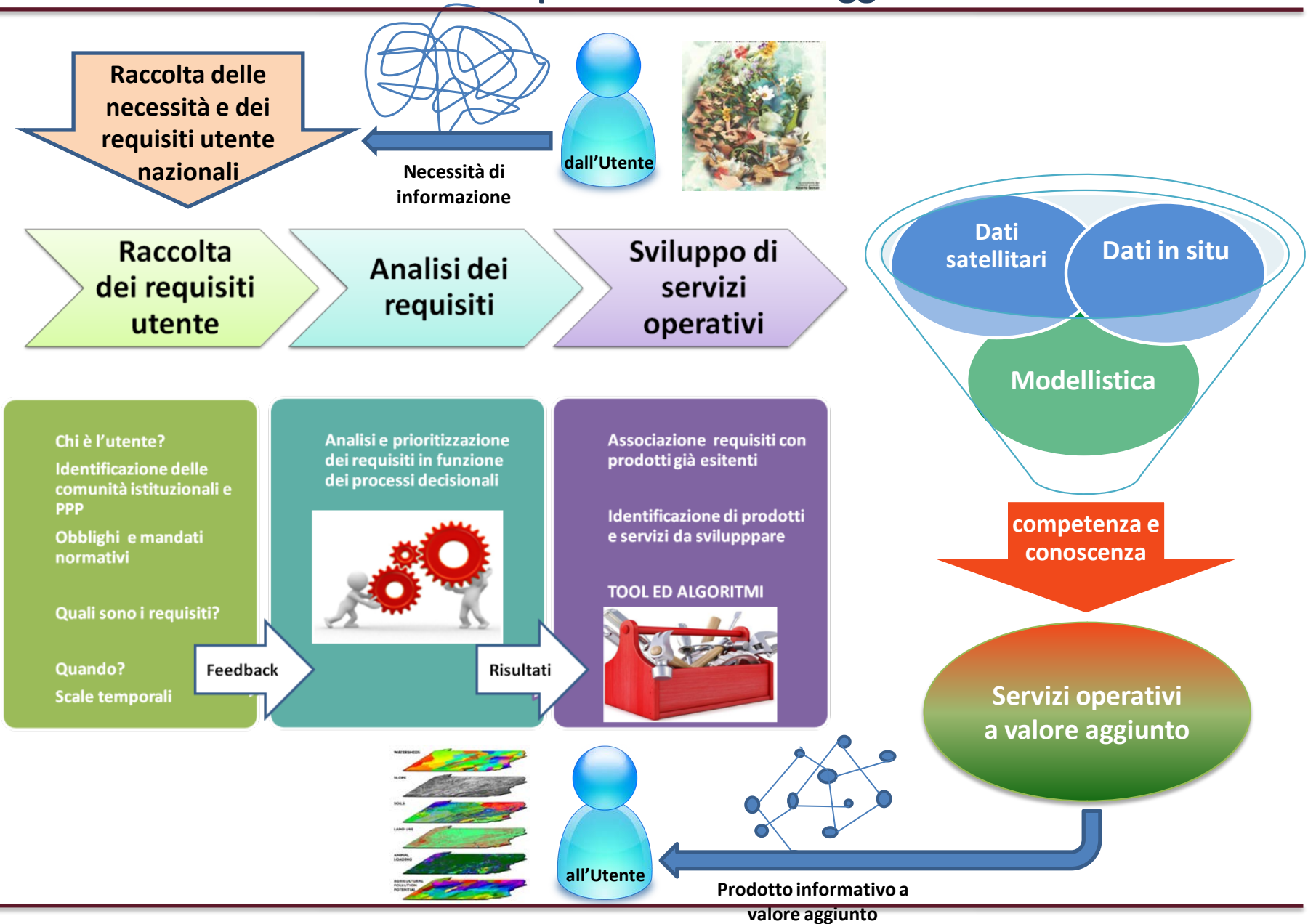


THE DIAS & WHERE TO REACH THEM



- 'Creodias – <http://www.creodias.eu>' : Creotech (PL) with cloud provider CloudFerro (PL)
- 'ONDA – <http://www.onda-dias.eu>' : Serco (IT) with cloud provider OVH (FR)
- 'SOBLOO – <http://www.sobloo.eu>' : Airbus (FR) with cloud provider Orange (FR)
- 'Mundiwebservices – www.mundiwebservices.com' : ATOS (FR) with cloud provider T-Systems (DE)
- 'WeKEO – <http://wekeo.eu>' : EUMETSAT, with Mercator Ocean and ECMWF

... dai fabbisogni degli Utenti alla realizzazione di Servizi operativi a valore aggiunto ...





Copernicus e Politiche Ambientali

IDENTIFICAZIONE E ANALISI DEI PROSSIMI SERVIZI DI ECOSISTEMA

- Fornitura di servizi di unità
- Identificazione proxy
 - quantificazione dei servizi

1. COSTE
2. AGRICOLTURA
3. INFRASTRUTTURE VERDI



RICERCA E POLITICHE

PIANIFICAZIONE E GESTIONE DEL TERRITORIO

- Governance adattativa
- Co-gestione
- Aree naturali protette
- Comunicazione e educazione

a) COSTE

Discriminating among transitional zones of tidal landscapes, vegetation cover types and the variety of coastal habitats is mandatory for the conservation and sustainable use of protected coastal areas. The requirements of European consolidated policies and the recent launch of new ones, have given new impetus for the integration of knowledge in coastal habitat mapping.

POLICY FRAMEWORK

- Integrated Coastal Zone Management
- Marine Strategy Framework Directive
- Birds Directive
- Habitat Directive
- Maritime Spatial Planning
- EU Adaptation Strategy
- Floods Directive

INFORMATION NEEDS

a reinforced habitat mapping for supporting the following activities:

- conservation & biodiversity
- sustainable use
- management
- planning
- risk recovery and prevention
- assessment of ecosystem services

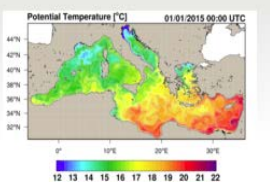


Il supporto del Copernicus Marine Environment Monitoring Service (CMEMS) alla Marine Strategy Framework Directive (MSFD)

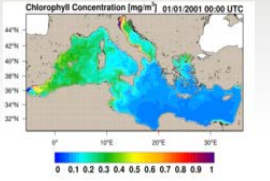


I prodotti CMEMS sono stati ampiamente utilizzati a supporto della valutazione iniziale della direttiva quadro sulla strategia marina (2012), mentre **sono stati utilizzati solo parzialmente nel 2° ciclo di reporting (2018), poiché i programmi di monitoraggio si concentrano principalmente sulle aree costiere.**

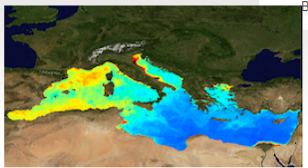
MEDITERRANEAN SEA PHYSICS REANALYSIS
Metadata provided by CMEMS
Credits: E.U. Copernicus Marine Service Information



MEDITERRANEAN SEA BIOGEOCHEMISTRY REANALYSIS
Metadata provided by CMEMS
Credits: E.U. Copernicus Marine Service Information



MEDITERRANEAN SEA MONTHLY AND 8-DAYS REPROCESSED SURFACE CHLOROPHYLL CONCENTRATION FROM MULTI SATELLITE OBSERVATIONS + SEAWIFS DAILY CLIMATOLOGY
Metadata provided by CMEMS
Credits: E.U. Copernicus Marine Service Information



I prodotti satellitari e di modellazione CMEMS

MSFD Initial Assessment (Year 2012)

Physical features

- Water temperature
- Salinity
- Current velocity
- Upwelling
- Mixing characteristics
- Residence time

Nutrient and organic matter enrichment

- Nutrients
- Chlorophyll a

MSFD II cycle reporting (Year 2018)

Physical features

- Water temperature
- Salinity
- Current velocity
- Upwelling
- Mixing characteristics
- Residence time

Nutrient and organic matter enrichment

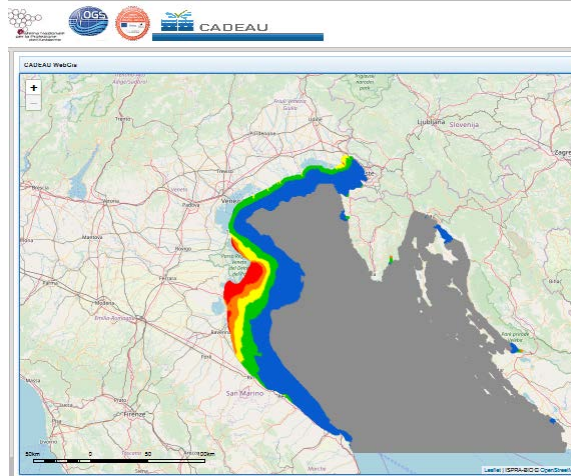
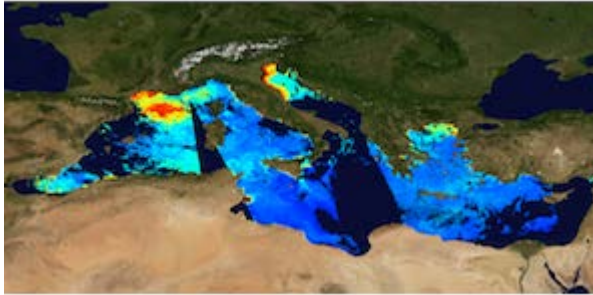
- Nutrients (in situ monitoring focused on land-based sources)
- Chlorophyll a

(A broad scale description of physical features is not required)



Il supporto del Copernicus Marine Environment Monitoring Service (CMEMS) alla Marine Strategy Framework Directive (MSFD)

CADEAU è un servizio di downstream derivato dal CMEMS a scala di Adriatico settentrionale con lo scopo di supportare l'attuazione delle direttive Comunitarie. Cadeau ambisce a supportare non solo alla MSFD ma anche ad altre direttive e politiche relative all'ambiente marino-costiero (Direttiva Quadro sulle acque, Direttiva sulle acque di balneazione, Politica Comune sulla Pesca).



**Risoluzione aumentata
(da ~4km a ~700m
Assimilazione dati in situ)**



- MSFD (2008/56/EC) and WFD (2000/60/EC)**
- ✓ Nutrienti
 - ✓ Chlorofilla "a"
 - ✓ Ossigeno
 - ✓ Temperatura
 - ✓ Salinità
 - ✓ TRIX

- Direttiva acque di balneazione (2006/07/EC) e Acquacultura (Politiche EU, es. Blue Growth, Politica Comune sulla Pesca)**
- ✓ Indici di impatto potenziale di contaminazione batterica delle acque di balneazione e di miticoltura

POLICY FRAMEWORK AND MAPPING NEEDS

A deep understanding on crop dynamics and on the effect the agronomic practices exert on these could improve the efficient use of resources (water, energy, etc.), while contributing to preserve biodiversity, reduce pollutants emissions, and foster carbon storage .

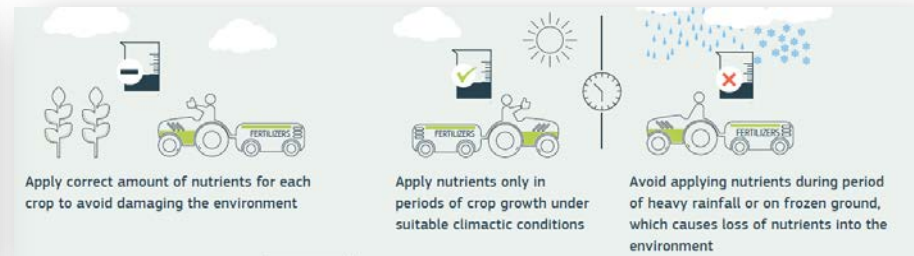
Nitrogen, used for fertilization, is a vital nutrient that helps plants and crops grow, but high concentrations are harmful to people and nature: excess nitrogen from agricultural sources is one of the main causes of water pollution in Europe.

POLICY FRAMEWORK

- Common Agriculture Policy
- Nitrates Directive
- EU Adaptation Strategy

INFORMATION NEEDS

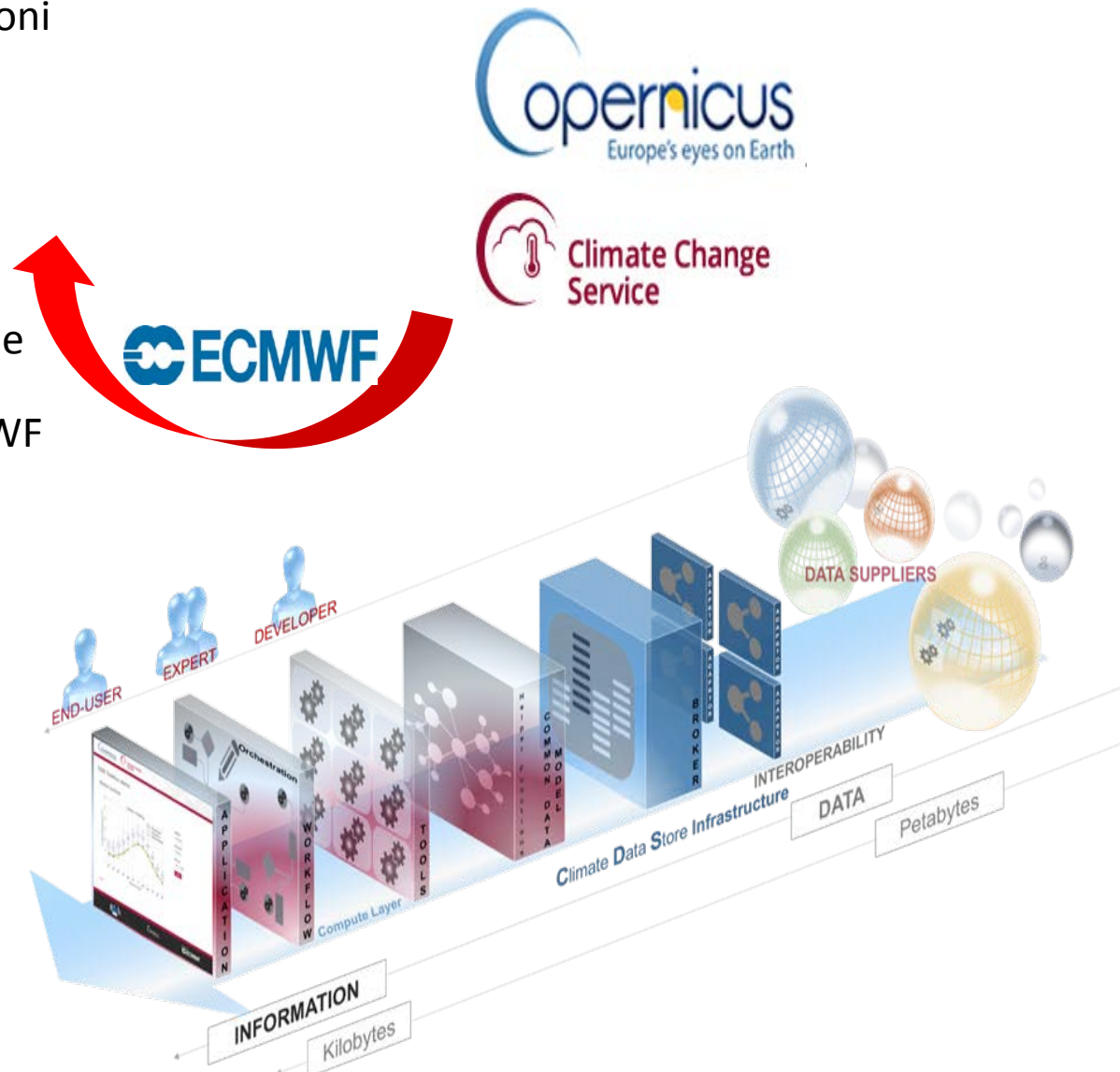
- conservation
- sustainable and efficient use of resources
- management & planning
- assessment of ecosystem services
- reduce pollutions
- forecast air quality



I Servizi atmosfera - Climate Change Copernicus

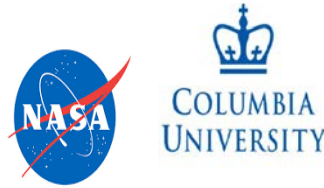
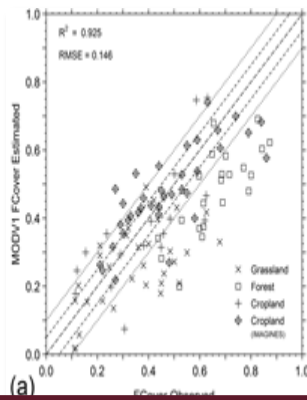
Fornisce autorevoli informazioni sul clima passato, presente e futuro, nonché strumenti per consentire la mitigazione dei cambiamenti climatici e le strategie di adattamento da parte dei responsabili politici e delle imprese. C3S è implementato da ECMWF per conto della Commissione Europea

Il Climate Data Store - CDS è un punto di riferimento per informazioni sul clima: passato, presente e futuro. Offre un facile accesso a una vasta gamma di dataset climatici tramite un catalogo ricercabile.





Interazione
tra utenti



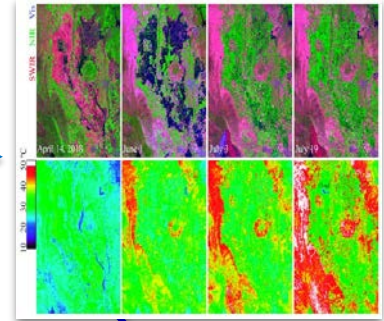
Fonti di
emissione
urbane ed
agricole



Modellistica
atmosferica



Telerilevamento
satellitare e
assimilazione dati



Valutazione
dell'impatto
sulla salute

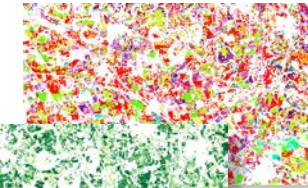




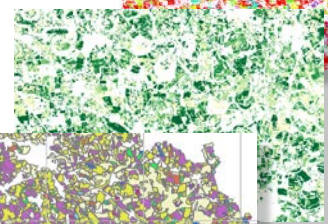
Fenologia della vegetazione

From Earth Observation products it is possible to map:

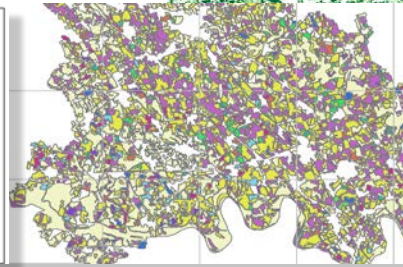
crop types
vegetation phenology



Start of Growing Season



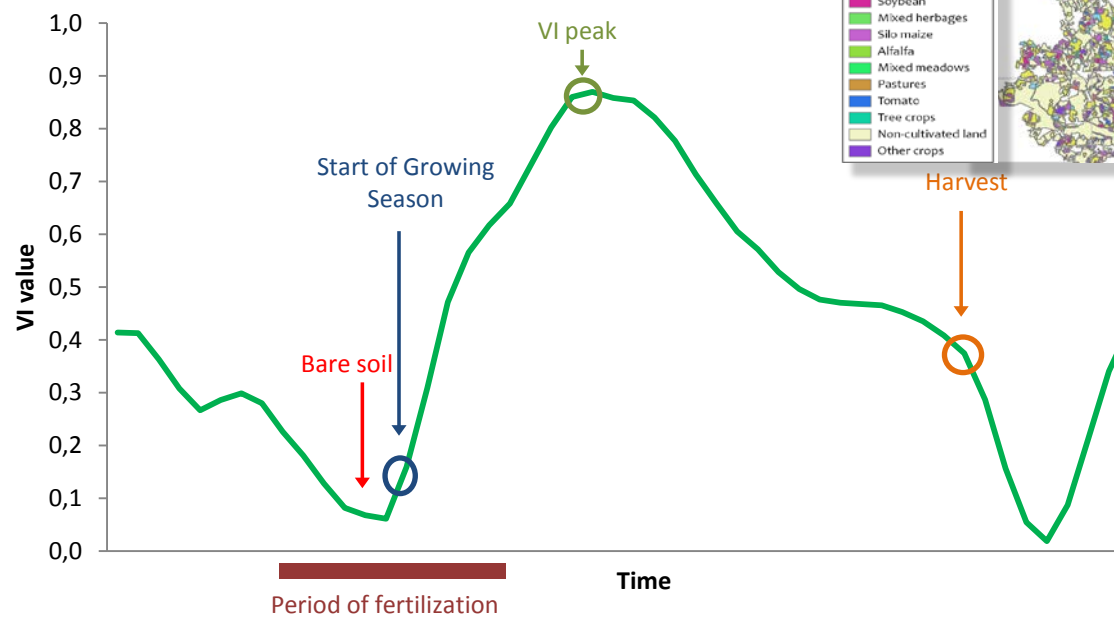
Maximum NDVI



Crop type mapping

- Legend**
- Winter cereals
 - Rice
 - Maize
 - Soybean
 - Mixed herbage
 - Silo maize
 - Alfalfa
 - Mixed meadows
 - Pastures
 - Tomato
 - Tree crops
 - Non-cultivated land
 - Other crops

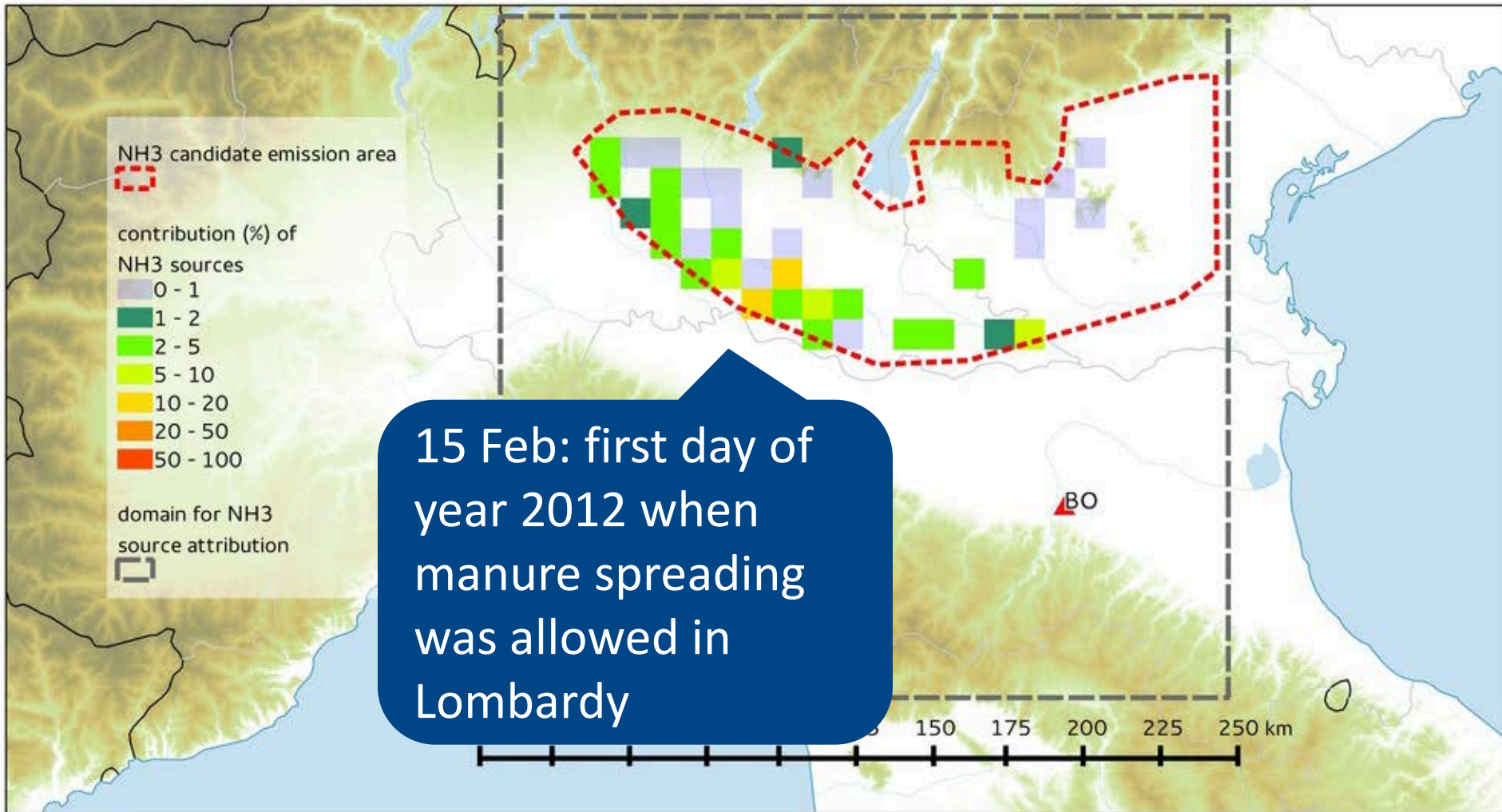
Crops phenology



Support nitrogen cycle from agriculture analysis
integrating optical, SAR and hyperspectral data



SOURCE ATTRIBUTION: AMMONIUM IONS





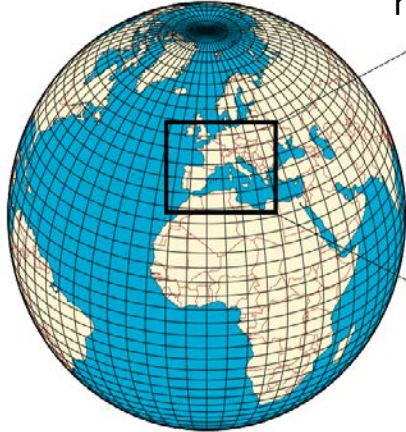
Il modello nazionale di qualità dell'aria

Il Downscaling del Copernicus Atmosphere Monitoring Service

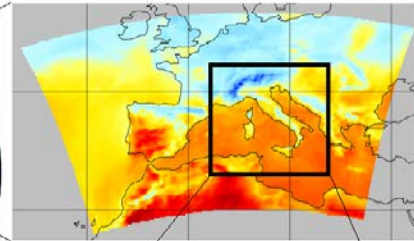
Tre scale geografiche considerate: Globale, continentale e nazionale

Scala globale

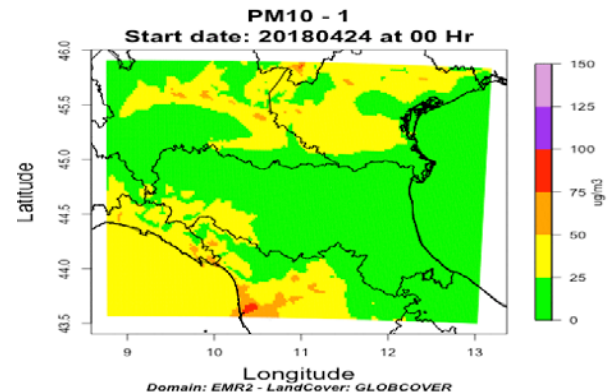
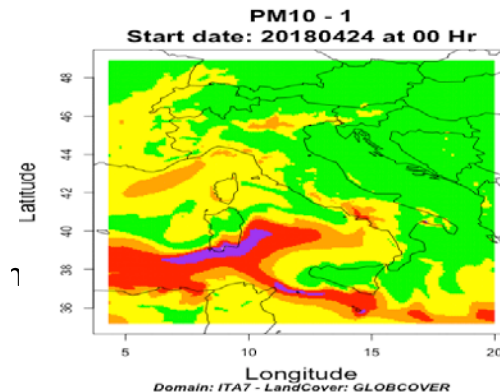
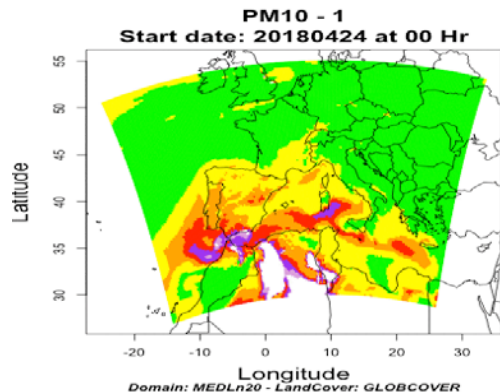
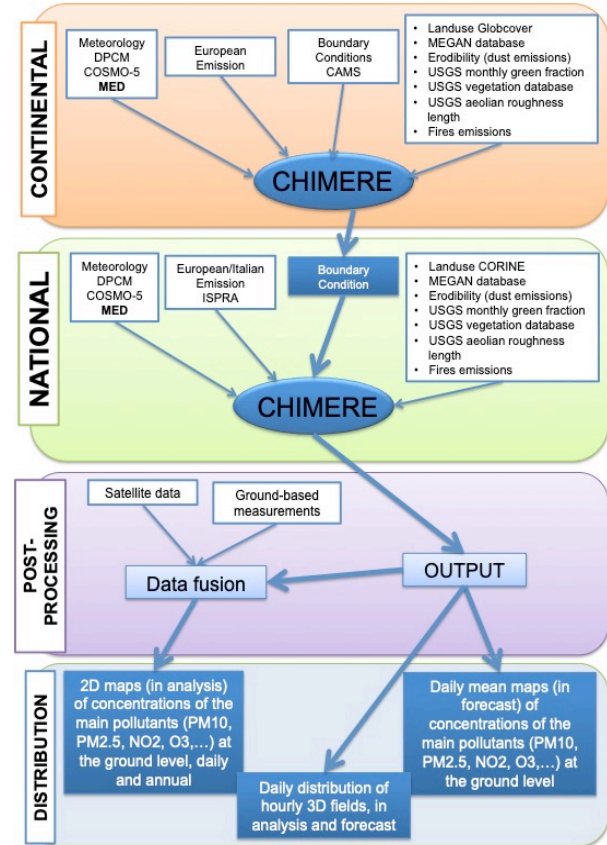
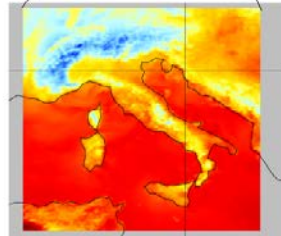
Resoluzione: 40 km



Scala continentale
horizontal resolution: 20 km



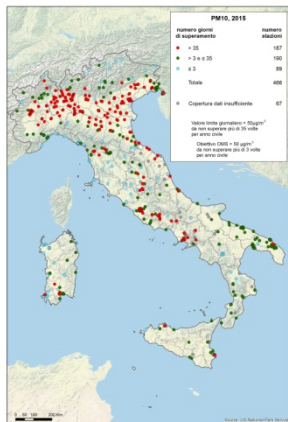
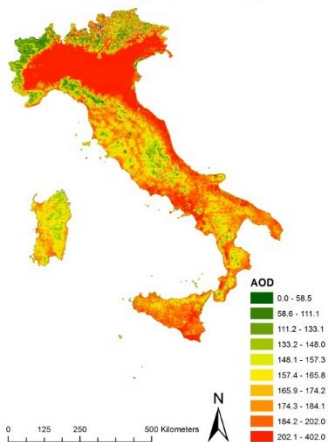
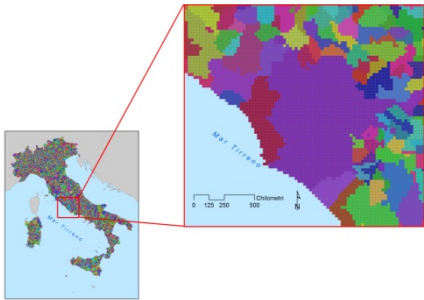
Scala nazionale
Resoluzione: 1 km



Valutazione annuale/stagionale e di scenario

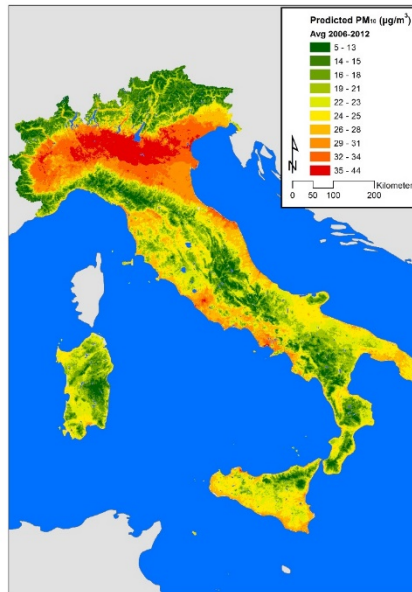
INPUT

- Dati delle reti di monitoraggio
- Variabili di land use
- Dati di osservazione dallo spazio (AOD)
- Variabili emissive



METODO

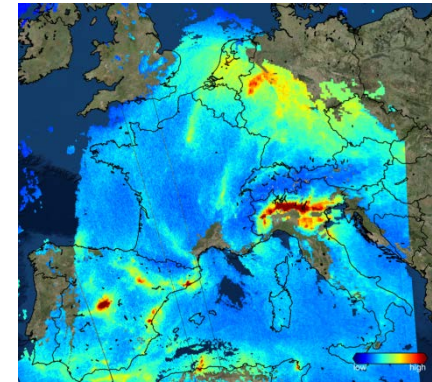
Sviluppo di modelli empirici ad alta risoluzione spaziale e temporale



Collaborazione con DIP
EPIDEMIOLOGIA SSNR
LAZIO

OUTPUT

Miglioramento delle stime con l'uso di dati Sentinel 3 e 5p



Estensione ai gas e al PM 2.5 di quanto già fatto per il PM10 con dati NASA

Servizio preoperativo di rianalisi annuale/stagionale

C) INFRASTRUTTURE VERDI

POLICY FRAMEWORK AND MAPPING NEEDS

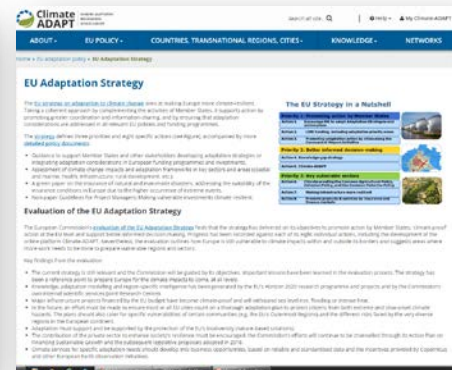
The green vegetation and its features enable to perform several assessments such as those related to the ecosystem services supply, those dealing with the effectiveness of protection and conservation strategy and those related to the adaptive and recovery capacity of vegetation in space and time.

POLICY FRAMEWORK

- Millennium Ecosystem Assessment
- EU Adaptation Strategy
- Strategy on Green Infrastructure

INFORMATION NEEDS

- conservation
- sustainable use
- connectivity
- management & planning
- assessment of ecosystem services



C) INFRASTRUTTURE VERDI

FCOVER: FRACTION OF GREEN VEGETATION COVER

FCOVER DEFINITION:

A continuous variable corresponding to the green vegetation fraction covering a unit ground area as seen from the nadir direction. It depends on the canopy structural attributes (leaf area index, leaf angle distribution, and clumping) and does not depend on the geometry of illumination.

Forcing source/driver of change: short a/o long term natural processes & anthropic pressures and actions

EO Data input: optical

Other data: cartography

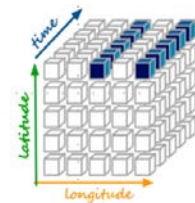
Technique: Principal component analysis, Linear Spectral Mixing Analysis, Land dataset validation, Multitemporal analysis

Product output: global Fcover map

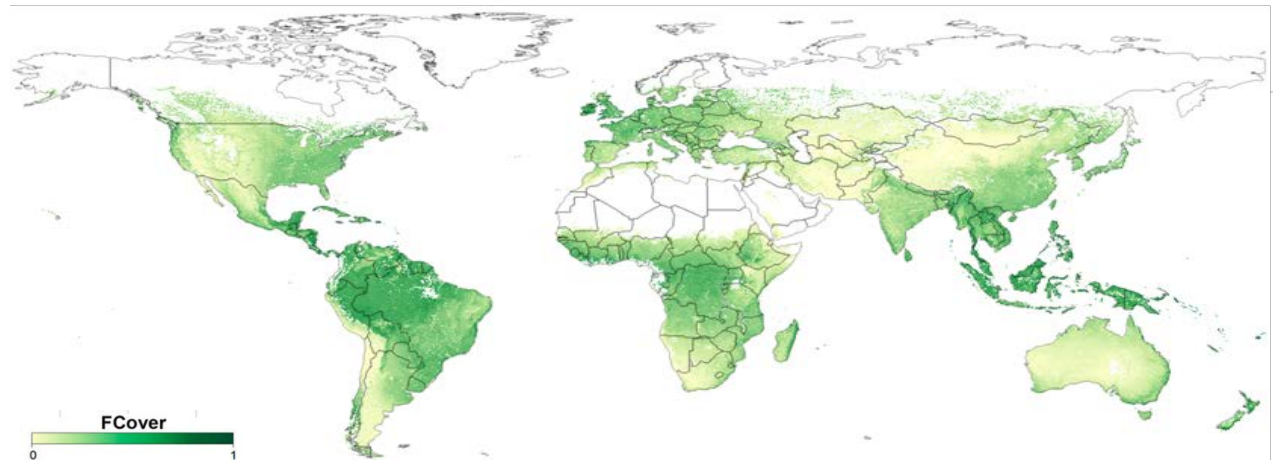
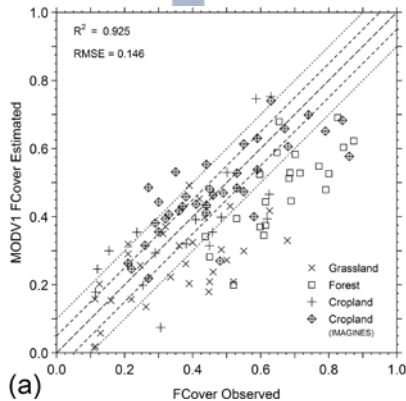


Article
Global MODIS Fraction of Green Vegetation Cover for Monitoring Abrupt and Gradual Vegetation Changes

Federico Filippini ¹, Emiliana Valentini ^{1,*}, Alessandra Nguyen Xuan ¹, Carlos A. Guerra ^{2,3}, Florian Wolf ^{2,3}, Martin Andrzzejak ^{2,3} and Andrea Taramelli ^{1,4}



Multitemporal analysis

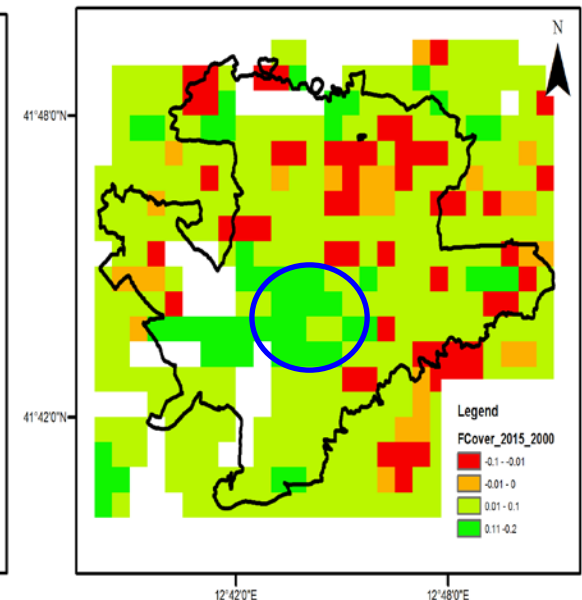
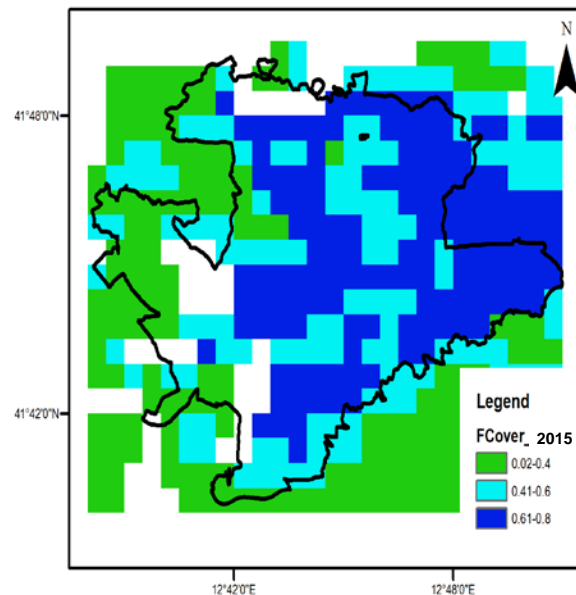
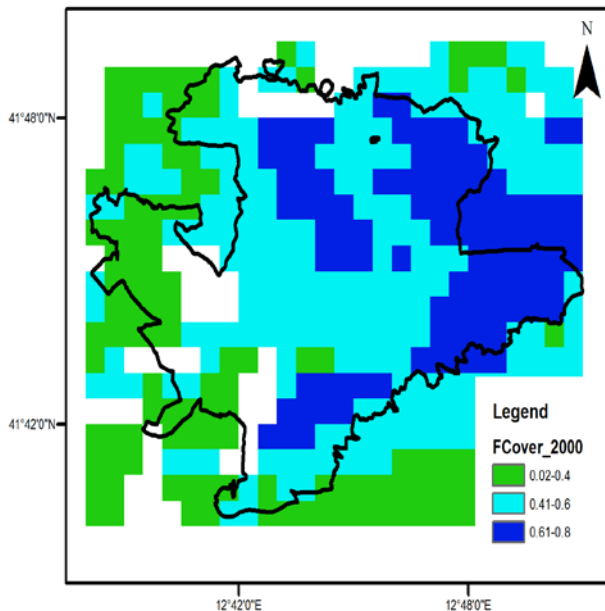


Average of global FCover product (value ranges 0-0,8)

C) INFRASTRUTTURE VERDI

FCOVER & SOIL PROTECTION ECOSYSTEM SERVICE THROUGH THE TIME

- According to CICES (Common International Classification of Ecosystem Services) the vegetation cover is listed among the ecosystems delivering Regulation and Maintenance ecosystem services.
- Change in Fcover and thus in soil protection can be assessed interannually and infrannually



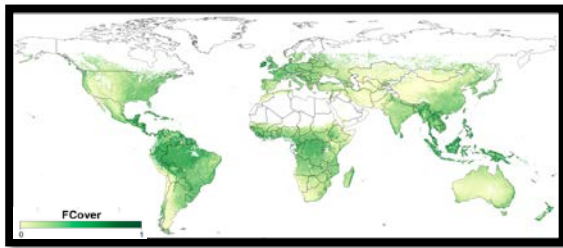
Higher FCover values are related to a higher soil protection capacity, but it's worth to notice that this capacity is related also to other drivers like precipitation (intensity and patterns), land management (agricultural, natural), plant functional types, or extreme events

C) INFRASTRUTTURE VERDI

FCOVER AS PROXY FOR CARBON STORAGE POTENTIAL

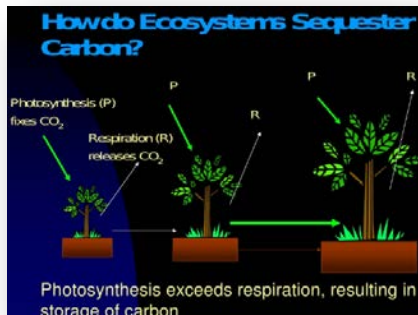
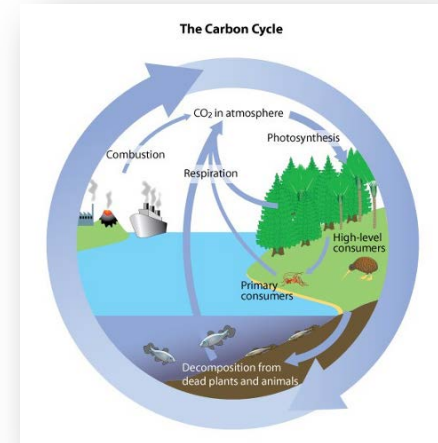
Carbon stocks in vegetation have a key role in the climate system

Trees and other vegetation are the planet's carbon storage closet – absorbing and releasing carbon dioxide and other greenhouse gases in an ongoing cycle. But just how big is that potential?



Fcover

Tree cover density
(Copernicus Land Service)



HIGH CARBON STOCK (MATURE FOREST)		UNDEVELOPED LANDS (YOUNGER FOREST)			
High Density Forest (HDF)	Medium Density Forest (MDF)	Low Density Forest (LDF)	Young Regenerating Forest (YRF)	Scrub (S)	Cleared / Open Land (OL)
High Density Forest (HDF)	Medium Density Forest (MDF)	Low Density Forest (LDF)	Young Regenerating Forest (YRF)	Scrub (S)	Cleared / Open Land (OL)
Renewable forest or advanced secondary forest close to primary condition	Renewable forest but more disturbed than HDF	Appears to be renewable forest but highly disturbed and recovering	Mixity young to growth forest, but with occasional patches of older forest within the stratum	Recently cleared areas, some woody regrowth and grass-like ground cover	Very recently cleared land with mostly grass or crops, few woody plants

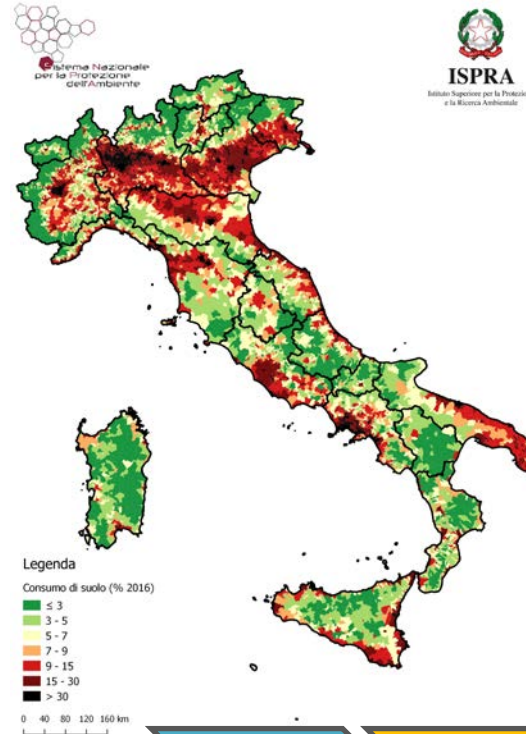



Classificazione della copertura del suolo

Cartografia tematica coerente con la direttiva 2007/2/CE, con il sistema di classificazione dei prodotti Copernicus High Resolution Layers (HRL) e con i prodotti Corine Land Cover di seconda generazione, progettando quindi un sistema di monitoraggio rapidamente aggiornabile

Monitoraggio del consumo di suolo

Sistema di monitoraggio del consumo di suolo rapidamente aggiornabile per le principali classi (aree artificiali impermeabilizzate, aree artificiali non impermeabilizzate) con una frequenza almeno annuale


1. Superfici abiotiche non vegetate

- 1.1 Superfici artificiali
- 1.2 Superfici naturali



2. Superfici biotiche vegetate

- 2.1 Vegetazione legnosa
 - 2.1.1 Latifoglie
 - 2.1.2 Conifere
- 2.2. Vegetazione erbacea
 - 2.2.1 Vegetazione erbacea permanente
 - 2.2.2 Vegetazione erbacea periodica



3. Superfici idriche

- 3.1 Acqua liquida
- 3.2 Acqua solida



Prodotti Corine Land Cover di seconda generazione

- **Hyperspectral Imaging Mission Concepts** - ESA-ESRIN ITT AO/1-8579/16/I-Sbo
- **The support of the ASI-ISPRA pre-operational National services Air Quality and Habitat Mapping is gratefully acknowledged**
- **ECOPOTENTIAL** - “Improving future ecosystem benefits through earth observations”, grant agreement No 641762, H2020 - www.ecopotential-project.eu
- **COPERNICUS USER UPTAKE LOT 2 2017 (ISPRA Infosession available at <http://workshop.copernicus.eu/>)**
- **CLARA** - “Climate forecast enabled knowledge service”, grant agreement No 730482, H2020 – www.clara-project.eu
- **GREEN** – ECHO/SUB/2016/740172/PREV18 - www.green-infrastructures.eu

... Thanks for your attention! ...

A. Taramelli, M. Deserti, E. Valentini, A. Nguyen Xuan,
S. Geraldini, E. Schiavon, N. Bonora, A., Tornato, M. Munafò. I. Marinosci, L. Congedo,
A. Bruschi, C. Siilvestri, M. Stortini

