ECOPOTENTIAL: Improving future ecosystem benefits through Earth Observations

Starting date: 1st of June 2015, Duration: 4 years

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ECOPOTENTIAL Partners

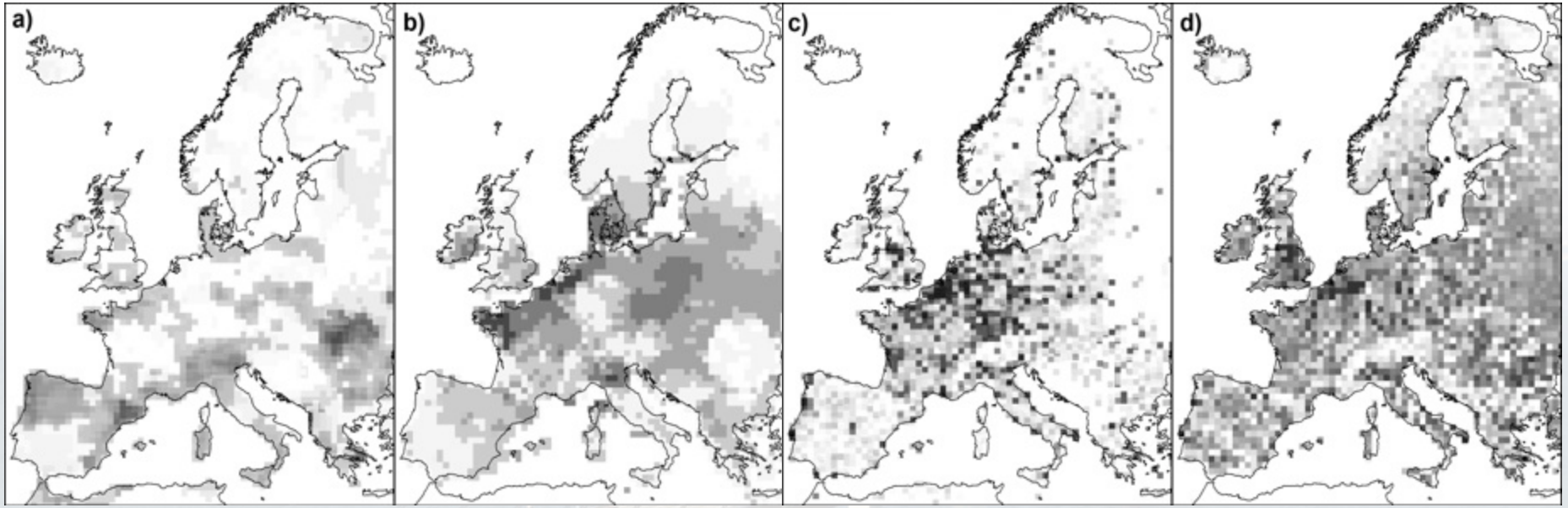
CONSIGLIO NAZIONALE DELLE RICERCHE	IT
UNIVERSITA DEL SALENTO	IT
ACCADEMIA EUROPEA PER LA RICERCA APPLICATA ED IL PERFEZIONAMENTO PROFESSIONALE BOLZANO (ACCADEMIA EUROPEA BOLZANO)	IT
AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	ES
HELMHOLTZ-ZENTRUM FUER UMWELTFORSCHUNG GMBH - UFZ	DE
Karlsruher Institut fuer Technologie	DE
UNIVERSITAET BAYREUTH	DE
DEUTSCHES ZENTRUM FUER LUFT - UND RAUMFAHRT EV	DE
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE	FR
UNIVERSITY OF LEEDS	UK
ENVIRONMENT SYSTEMS LIMITED	UK
UNIVERSITATEA DIN BUCURESTI	RO
ICETA - Instituto de Ciências e Tecnologias Agrárias e Agro-Alimentares	PT
INSTITUTO SUPERIOR TECNICO	PT
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	EL
FOUNDATION FOR RESEARCH AND TECHNOLOGY HELLAS	EL
ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE	CH
BEN-GURION UNIVERSITY OF THE NEGEV	IL
ISRAEL NATURE AND NATIONAL PARKS PROTECTION AUTHORITY ISRAEL NATURE AND PARKS AUTHORITY INPA	IL
PSI Hydrobiological Institute - Ohrid	MK
COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH	ZA
Istituto Superiore per la Protezione e la Ricerca Ambientale	IT
POLITECNICO DI MILANO	IT
CENTRO DE INVESTIGACION ECOLOGICA YAPLICACIONES FORESTALES	ES
UNIVERSITAT AUTONOMA DE BARCELONA	ES
UNIVERSIDAD DE GRANADA	ES
UMWELTBUNDESAMT GMBH	AT
UNIVERSITAET POTSDAM	DE
MUSEUM FUR NATURKUNDE - LEIBNIZ-INSTITUT FUR EVOLUTIONS- UND BIODIVERSITATSFORSCHUNG AN DER HUMBOLDT-UNIVERSITAT ZU BERLIN	DE
FONDATION TOUR DU VALAT	FR
STICHTING DELTARES	NL
ARATOS ANONYMOS ETERIA ANAPTYXIS, PARAGOGIS & EMPORIAS PROIONTON PLIROFORIKIS & IPSILIS TECHNOLOGIAS (Aratos Technologies S.A.)	EL
STARLAB BARCELONA SL	ES
MARTIN-LUTHER-UNIVERSITAET HALLE-WITTENBERG	DE
STICHTING KONINKLIJK NEDERLANDS INSTITUUT VOOR ZEEONDERZOEK (NIOZ)	NL
KLAIPEDOS UNIVERSITETAS	LT
UNIVERSITE PAUL SABATIER TOULOUSE III	FR
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION -UNESCO	FR
LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE	UK
UNIVERSITETET I BERGEN	NO
TERRADUE UK LTD	UK
UNITED NATIONS ENVIRONMENT PROGRAMME	KE
UNIVERSITY OF NEW SOUTH WALES	AU
EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZURICH	CH
AGENCIA DE MEDIO AMBIENTE Y AGUA DE ANDALUCIA	ES
UNIVERSITE DE BRETAGNE OCCIDENTALE	FR
UNIVERSITE' DE GENEVE	CH

47 partners

total budget of 15,993,931 Euro

The old emerging concept of Macrosystems Ecology

Pressures and Responses

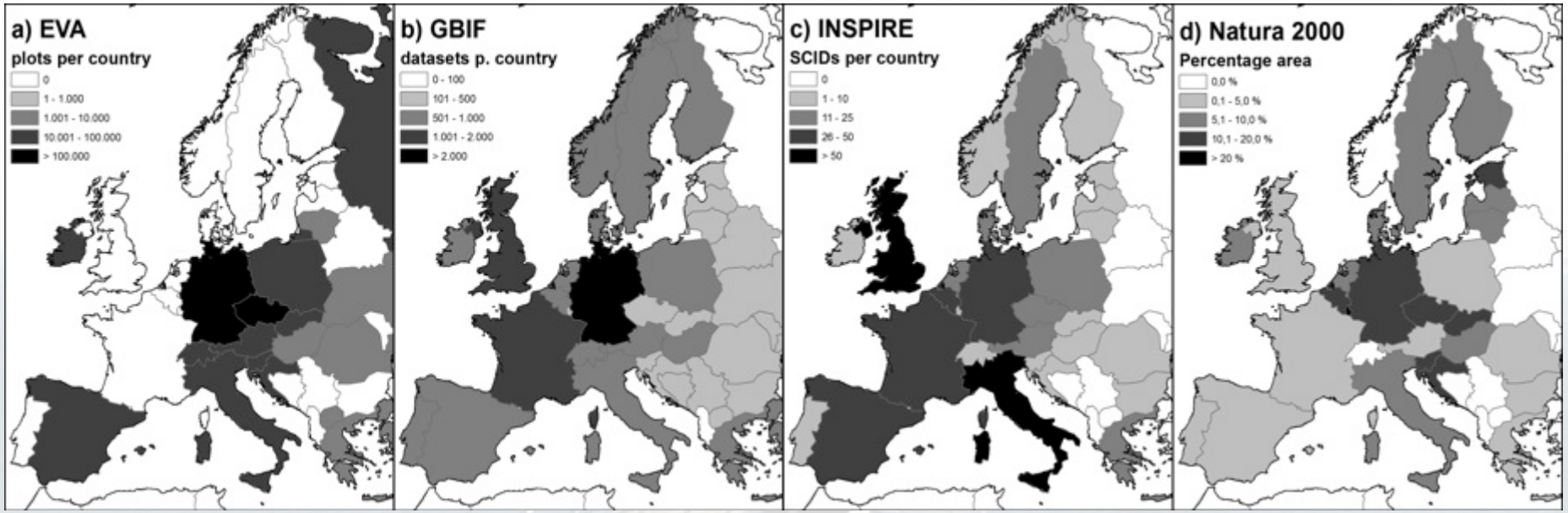


Climate Change | Pollution | Land Cover Change | Biodiversity Response

- Continental-scale drivers of biodiversity change.
- Rapid and large-scale responses are problematic for monitoring and policy.
- Priority areas must be defined.

Beierkuhnlein, Jaeschke, Provenzale in prep.

Examples for "Big Data" in Ecology and Biogeography



EVA GBIF INSPIRE Natura 2000

- Increasingly geo-information, biodiversity data, ecological traits etc. are made available in data bases.
- Spatial cover of earth observation data is increasing rapidly.

Beierkuhnlein, Jaeschke, Provenzale in prep.

Focus on Protected Areas

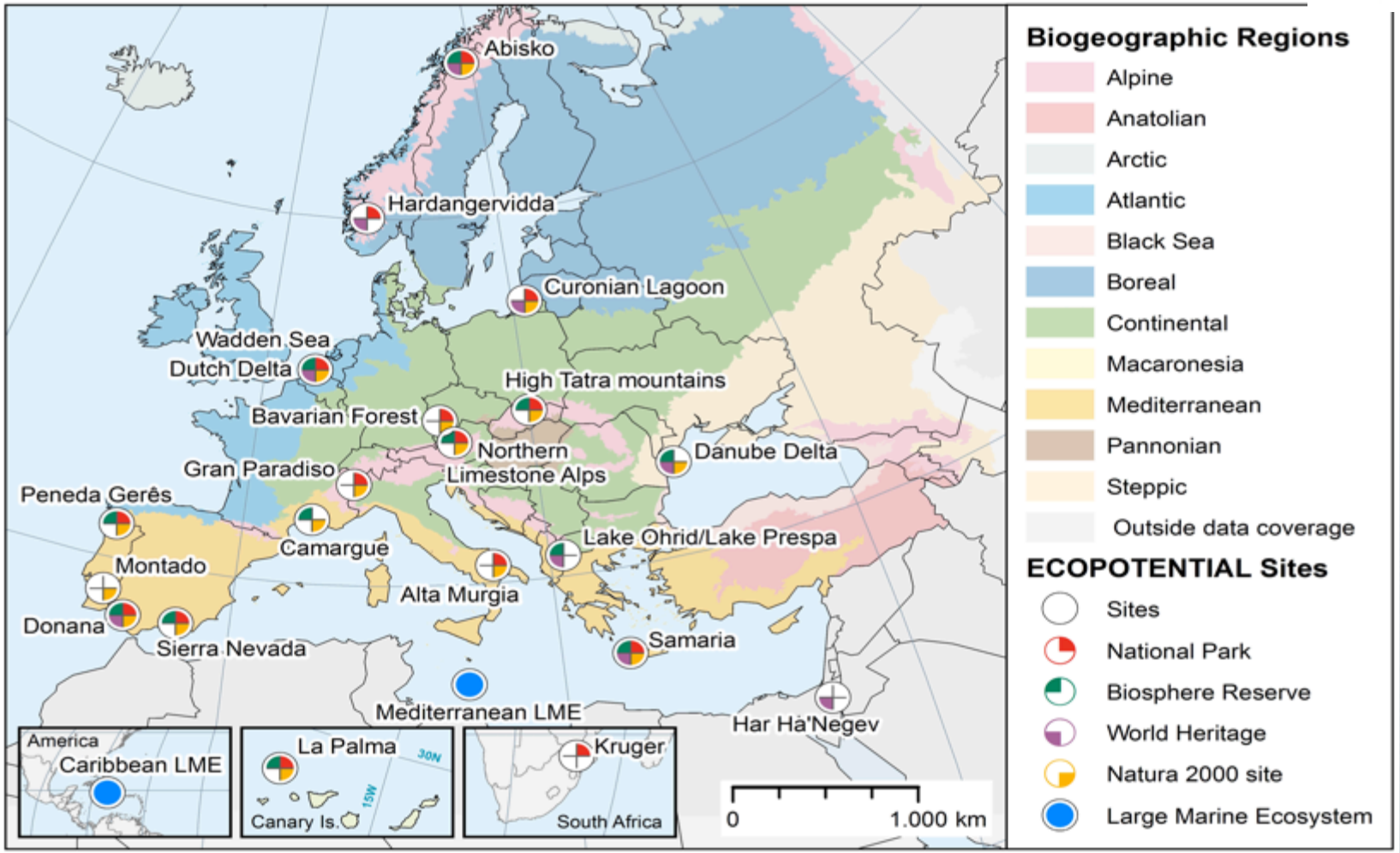
ECOPOTENTIAL sites cover terrestrial **protected areas** over:

- spatial gradients in Europe
- climatic gradients in Europe
- biogeographical regions in Europe
- major ecosystem types
- and one outlayer ecosystems of iconic importance (Kruger NP, SA) for cross-continental implementation

In addition **two Large Marine Ecosystems** are included:

- Mediterranean Sea
- Carribean Sea

Location and protection status of the Protected Areas in ECOPOTENTIAL and European biogeographic regions



Mountain Ecosystems

Gran Paradiso,
Italian Alps

Foto C Beierkuhnlein

Mountain Ecosystems

Abisko, Scandes, Sweden

Foto C Beierkuhnlein

Elevational Range and climatic conditions for the Protected Areas (PA) representing mountain ecosystems in ECOPOTENTIAL

Pilot Sites	Country	Elevation Range [m]	Annual Temperature median [°C] (Worldclim)	Spatial Temperature range [°C] (Worldclim)	Annual Precipitation [mm/yr] (Worldclim)
Mountain Ecosystems					
Gran Paradiso	Italy	750 - 4000	0.1	-6.7 - 9	921 - 2337
Northern Limestone Alps	Austria	500 - 1963	4.6	0.3 - 7.8	972 - 1570
Peneda-Gerês	Portugal	100 - 1545	10.6	7.7 - 14.9	1135 - 1705
Sierra Nevada	Spain	860 - 3482	10.1	1.4 - 17	280 - 1308
Bayerischer Wald	Germany	600 - 1453	5.1	2.6 - 6.7	895 - 1349
Lakes Ohrid/Prespa	Former Yugoslav Republic of Macedonia	693 - 2288	9.4	2.2 - 11.7	722 - 1108
High Tatra Mts.	Poland/Slovakia	700 - 2655	2.7	-2.6 - 5.9	698 - 1760
Hardangervidda	Norway	500 - 1933	-1.3	-3 - 4.1	929 - 2124
Abisko	Sweden	341 - 1191	-0.7	-4.6 - 0.4	387 - 612
La Palma Island	Spain	0 - 2426	16	8.6 - 20.4	307 - 598

Arid / Semiarid Ecosystems

Negev Desert, Israel

Foto C Beierkuhnlein

Arid / Semiarid Ecosystems

Kruger,
South Africa

Foto Hansm auf wikivoyage shared

Elevational Range and climatic conditions for the Protected Areas (PA) in ECOPOTENTIAL (based on Worldclim)

Pilot Sites	Elevation Range [m]	Annual Temperature median [°C] (Worldclim)	Spatial Temperature range [°C] (Worldclim)	Annual Precipitation [mm/yr] (Worldclim)
Water-limited Ecosystems				
Har HaNegev	300 - 800	17.8	16 - 21	69 - 188
Samaria	0 - 2454	12.1	6 - 19.2	679 - 1052
Murgia Alta	300 - 679	13.1	12.1 - 14.6	519 - 647
Montado	0 - 400	16.5	12.5 - 17.6	462 - 1023
Kruger Natl. Park	140 - 462	22.4	19.7 - 24.7	403 - 935

Coastal Ecosystems

Danube Delta, Romania

Foto Elena Pleskevich Wikimedia Commons

Coastal Ecosystems

Camargue, France

bruno monginoux / www.photo-paysage.com

Pilot Sites	Country	Elevation Range [m]	Annual Temperature median [°C] (Worldclim)	Spatial Temperature range [°C] (Worldclim)	Annual Precipitation [mm/yr] (Worldclim)
Coastal and Marine Ecosystems					
Wadden Sea and Dutch Delta	The Netherlands	-15 - 2	8.8	8.1 - 10.1	739 - 827
Camargue	France	-2 - 5	14.2	14 - 14.3	622 - 726
Donana	Spain	0 - 50	17.9	17.7 - 18.1	518 - 554
Danube Delta	Romania	0 - 13	11.5	11.1 - 11.8	311 - 462
Curonian Lagoon	Lithuania	-5 - 60	7.2	7 - 7.4	725 - 754
LME1:Caribbean	transnational	-7,500 - 0			
LME2: Mediterranean	transnational	-5,267 - 0			

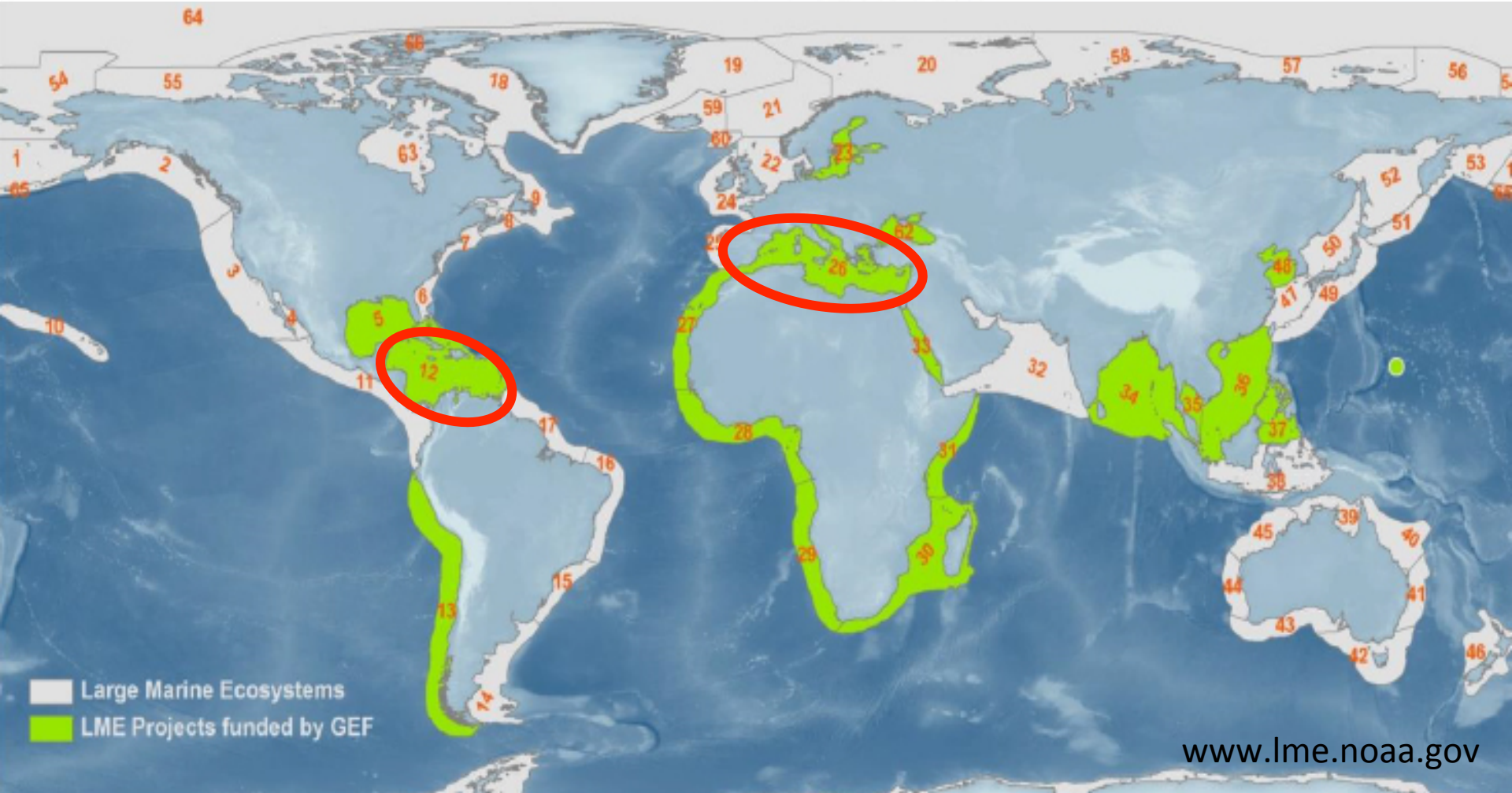
Elevational Range and climatic conditions for the Protected Areas (PA) in ECOPOTENTIAL (based on Worldclim)

Large Marine Ecosystems

Two UNESCO LMEs are included.

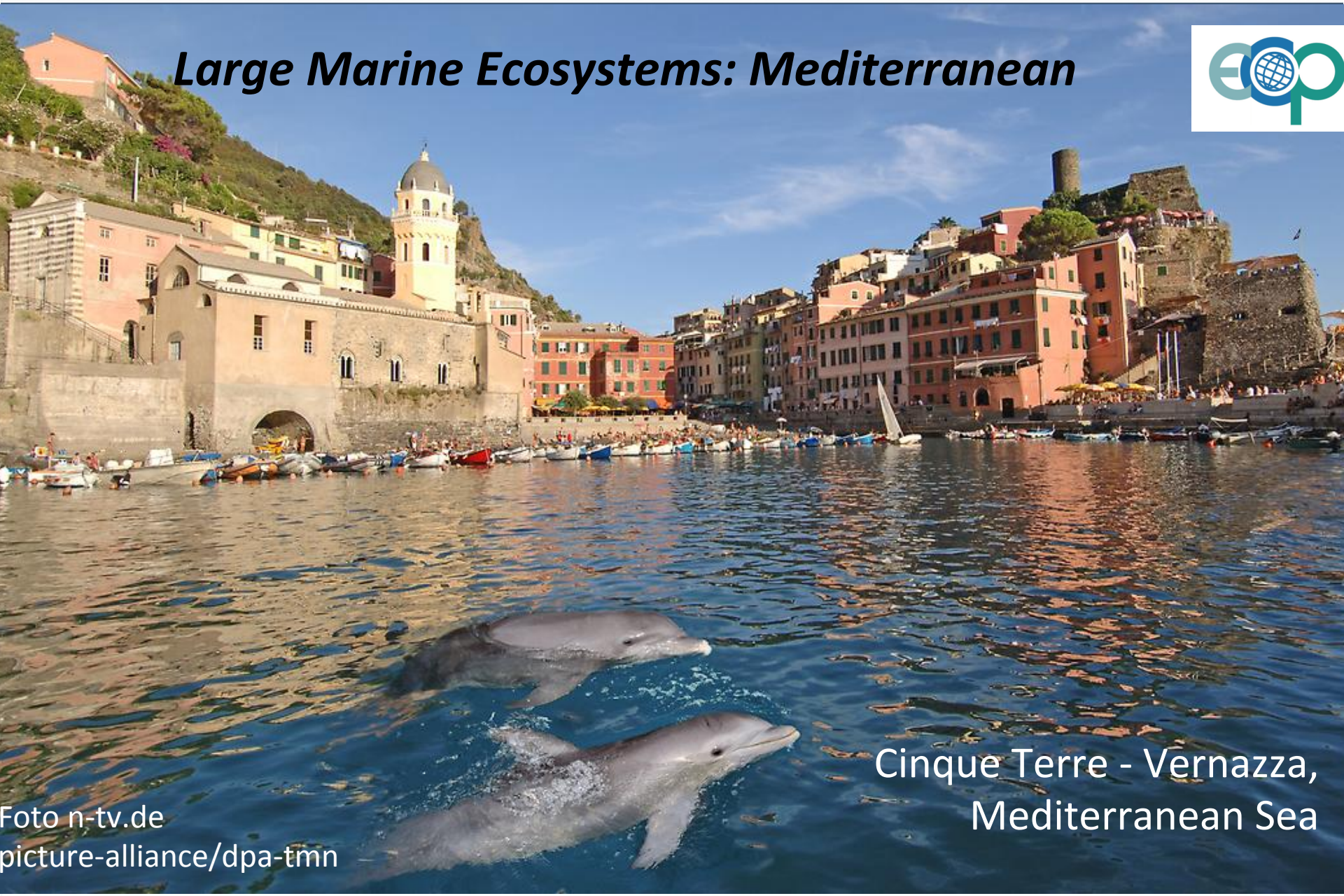
Intergovernmental Oceanographic Commission

United Nations Educational, Scientific and Cultural Organization



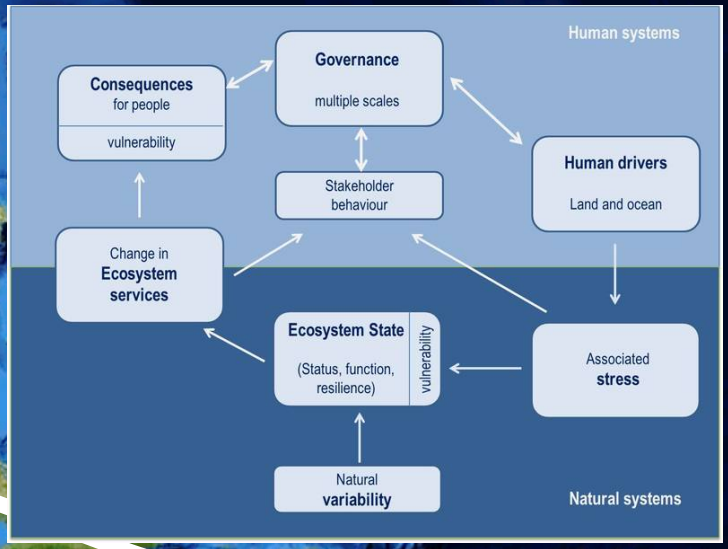
www.lme.noaa.gov

Large Marine Ecosystems: Mediterranean



Cinque Terre - Vernazza,
Mediterranean Sea

Foto n-tv.de
picture-alliance/dpa-tmn



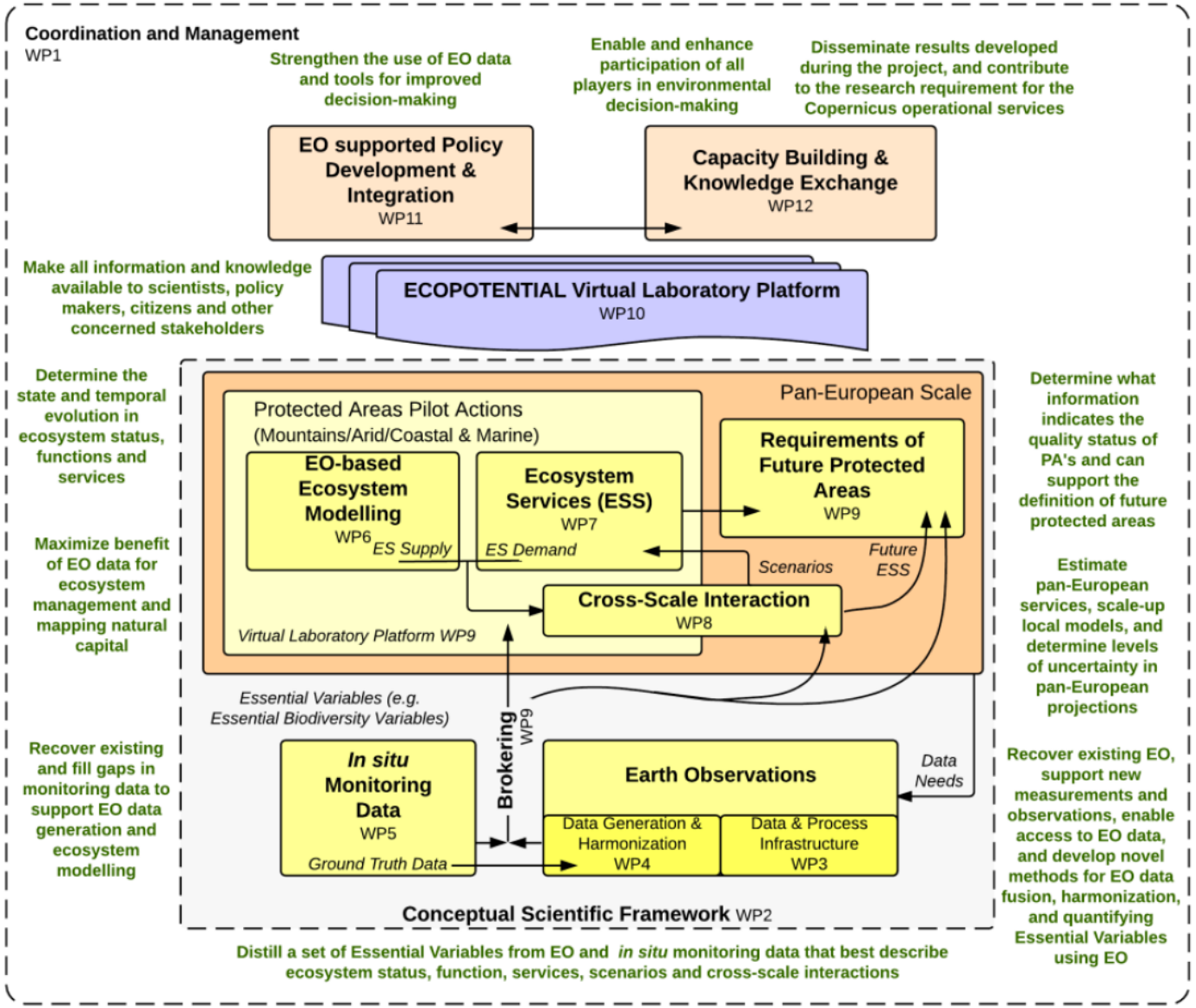
Large Marine Ecosystems

LME Caribbean Sea

Gran Paradiso (CNR)	Land use changes; climate change; natural system modifications; human disturbance.	Nutrition; materials from plants; water; mediation of flows and flood protection; maintenance of physical and biological conditions; gene pool protection; climate regulation; scientific, educational, heritage, cultural, aesthetic values.
Sierra Nevada (UGR)	Climate change; biogeochemical cycle changes; land use changes.	Water; feeding; landscape; geological materials; genetic pool; recreational activities; traditional knowledge; dampening of perturbations; water cycle regulation.
High Tatra (UNEP)	Mass tourism and tourism and sports infrastructure; human settlements (private housing); air pollution; environmental damages caused by historic mismanagement of land.	Surface water; water flow maintenance; flood protection; genetic materials from all biota; wood fuel; mass stabilisation and control of erosion rates; pollination and seed dispersal; soil formation and composition; climate regulation; wild plants and animals; scientific, educational, heritage, cultural, aesthetic values.
Samaria (FORTH)	Overgrazing and uncontrolled fires; poaching and uncontrolled abstraction of endemic species of flora; massive touristic flow.	Water; cultivated crops; reared animals; wild animals; mass stabilisation and control of erosion rates; pollination and seed dispersal; nursery populations and habitats; decomposition and fixing processes; experiential use of plants, animals and land-/seascapes; cultural benefits.
Danube Delta (UBC)	Fisheries; hunting; tourism; eutrophication; water transport.	Local climate and water flow regulation; water purification; nutrient and erosion regulation; pollination; energy (biomass); fodder; livestock; fibre; timber; wood; fisheries; aquaculture; wild foods; biochemicals/ medicine; freshwater; tourism; knowledge systems; religious and spiritual services; cultural/natural heritage.

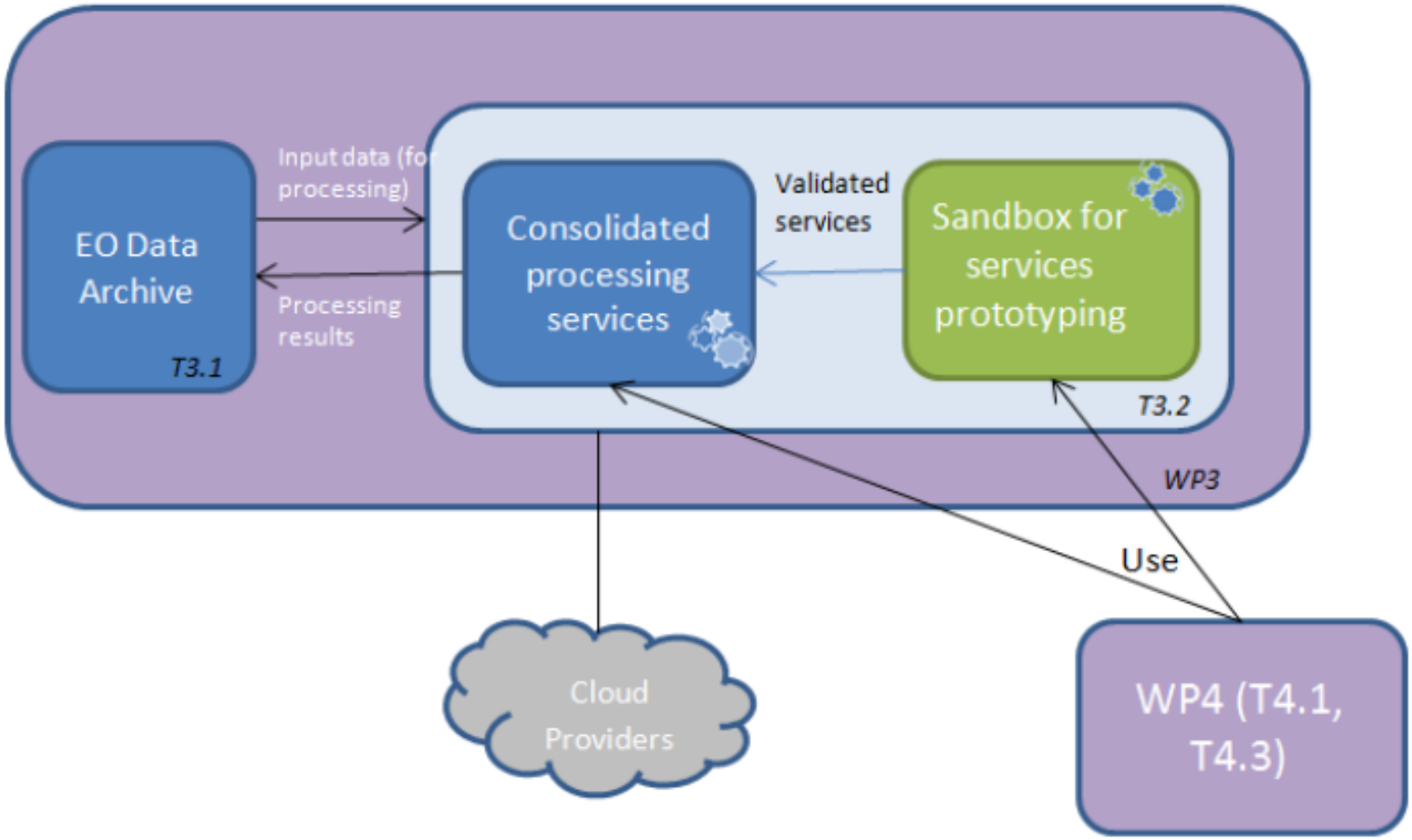
ECOPOTENTIAL: Ecosystem Services

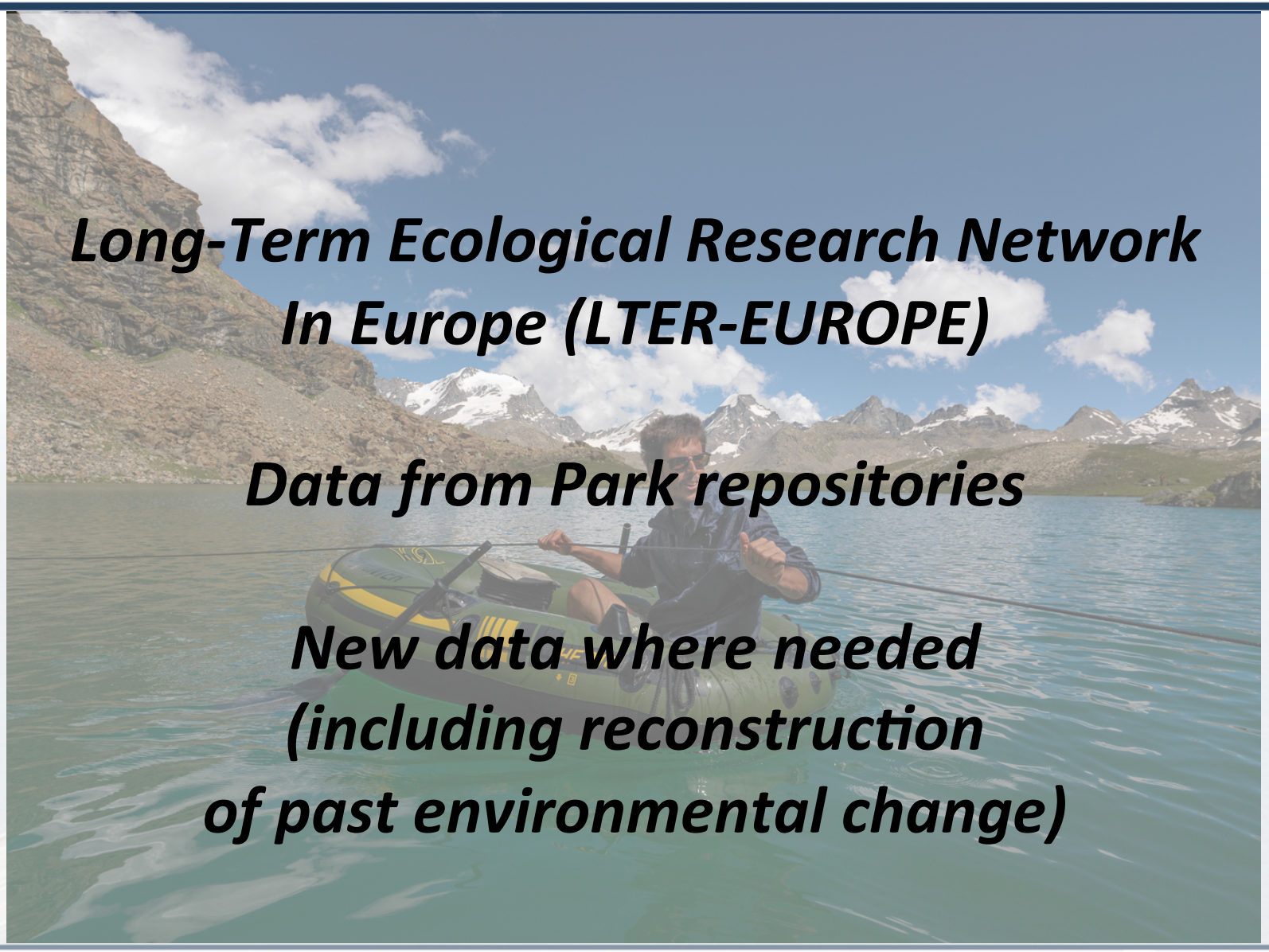
Mutual relation-ships between work packages (arrows), scale of validity (PA / Europe), and relevant issues (green).



	Pre-services		Provisioning services					Regulatory services					
Satellite/ Sensors	NDVI/GI/WBI, PSRI, SAVI, EVI	LCCS change maps	Food	Raw material	Climate regul. / C Storage	Air quality regul.	Erosion prevention	Waste water treatment	Storm and flood prevention	Wind storm protection	Mass flow protection	Maintenance of soil fertility	Biological control (pest control)
TerraSAR-X	-	-	+	+	+	X	+	X	+	X	+	X	X
Sentinel-1 A	-	-	+	+	+	X	+	X	+	X	-	-	-
Sentinel-1 B	-	-	+	+	+	X	+	X	+	X	-	-	-
Sentinel-2 A	+	+	+	+	X	X	+	X	X	X	+	X	+
Sentinel-2 B	+	+	+	+	X	X	+	X	X	X	+	X	+
Sentinel-3 A	+	+	X	+	-	+	+	X	X	X	-	-	-
Sentinel-3 B	+	+	X	+	-	+	+	X	X	X	-	-	-
Pleiades 1A	-	X	+	+	+	X	X	+	X	+	+	+	+
Pleiades 1B	-	X	+	+	+	X	X	+	X	+	+	+	+
SeaWiFS	-	-	X	X	X	X	X	+	+	X	X	X	X
SEVIRI	-	-	X	X	X	+	X	X	X	X	X	X	X
NOAA-AVHRR	-	-	+	+	+	+	+	+	+	X	X	X	X
Terra/Aqua MODIS	+	+	+	+	+	+	-	+	+	+	-	+	+
Terra MISR	-	-	X	+	X	X	X	X	X	X	X	X	X
Envisat AATSR	+	+	+	+	+								
Envisat MERIS	+	+	+		+	+							
Envisat ASAR		+											
Envisat GOMOS?						+							
Envisat DORIS													
ERS SAR	+	+											
ERS-2 GOME						+							
ERS ATSR/M													
ERS-2 ATSR-2	+												
SMOS MIRAS					+							+	
Cryosat SIRAL													
Landsat MSS	+	+	+	+	X	X	+	X	X	X	+	X	+
Landsat TM	+	+	+	+	X	X	+	X	X	X	+	X	+
Landsat ETM+	+	+	+	+	X	+	+	+	X	+	+	+	+
Landsat OLI & TIRS	+	+	+	+	X	+	+	+	X	+	+	+	+
Sentinel 2	+	+	+	+	X	+	+	+	X	+	+	+	+
ASTER	-	-	X	+	+	X	-	-	-	-	-	+	-
IRS LISS-III	-	-	X	X	+	X	X	X	+	X	X	X	X
SPOT 1-5	+	+	+	-	-	X	-	+	-	-	+	+	-
SPOT VGT	+	-	+	+	X	X	X	X	X	X	X	X	X
RapidEye	-	-	-	+	+	-	+	-	+	-	-	-	+
IKONOS	-	-	+	+	+	X	X	+	X	+	+	+	+

Share Remote Sensing information





Long-Term Ecological Research Network In Europe (LTER-EUROPE)

Data from Park repositories

New data where needed (including reconstruction of past environmental change)

ECOPOTENTIAL: Essential Variables

Essential Biodiversity Variables	Essential Climate Variables	Essential Ocean Variables	Essential Water Variables	Essential Social and Environmental Variables
Species Composition	Precipitation	Sea Surface Temperature	Runoff/streamflow/ river discharge	Population density
Functional groups traits	Temperature	Ocean acidification	Lakes/ reservoir levels	Resource use and management
Ecosystem extent & structure	Irradiance	Zooplankton composition	Glaciers front	Natural-areas accessibility

ECOPOTENTIAL thus aims to **develop widely applicable monitoring indicators for ecosystem status and trends, biodiversity change and ecosystem services** (including their socio-economic demand), creating a unified EV framework. This necessitates extending the already developed concepts of EBVs, ECVs etc. and include indicators that capture the major dimensions of ecosystem services supply and demand. Such indicators include,

A suite of remote-sensing and *in-situ* observation data will also be used to develop and define Essential Ecological and Environmental Protection Descriptors (EEPD) and the indicators of the current quality status in the PAs to be studied. To these indicators belong requirements such as: level of (bio)diversity (as being relevant for e.g. the description of the Good Environmental Status (GES) as used in the Marine Strategy Framework Directive (MSFD)), level of protection of key-species, improvement in numbers of (certain) species, habitat diversity, (minimal) size of the area, connectivity with other (protected) areas, and habitat quality. In particular, the parameters "habitat diversity", "size of the area" and "connectivity with other areas" will be mainly determined through EO data.

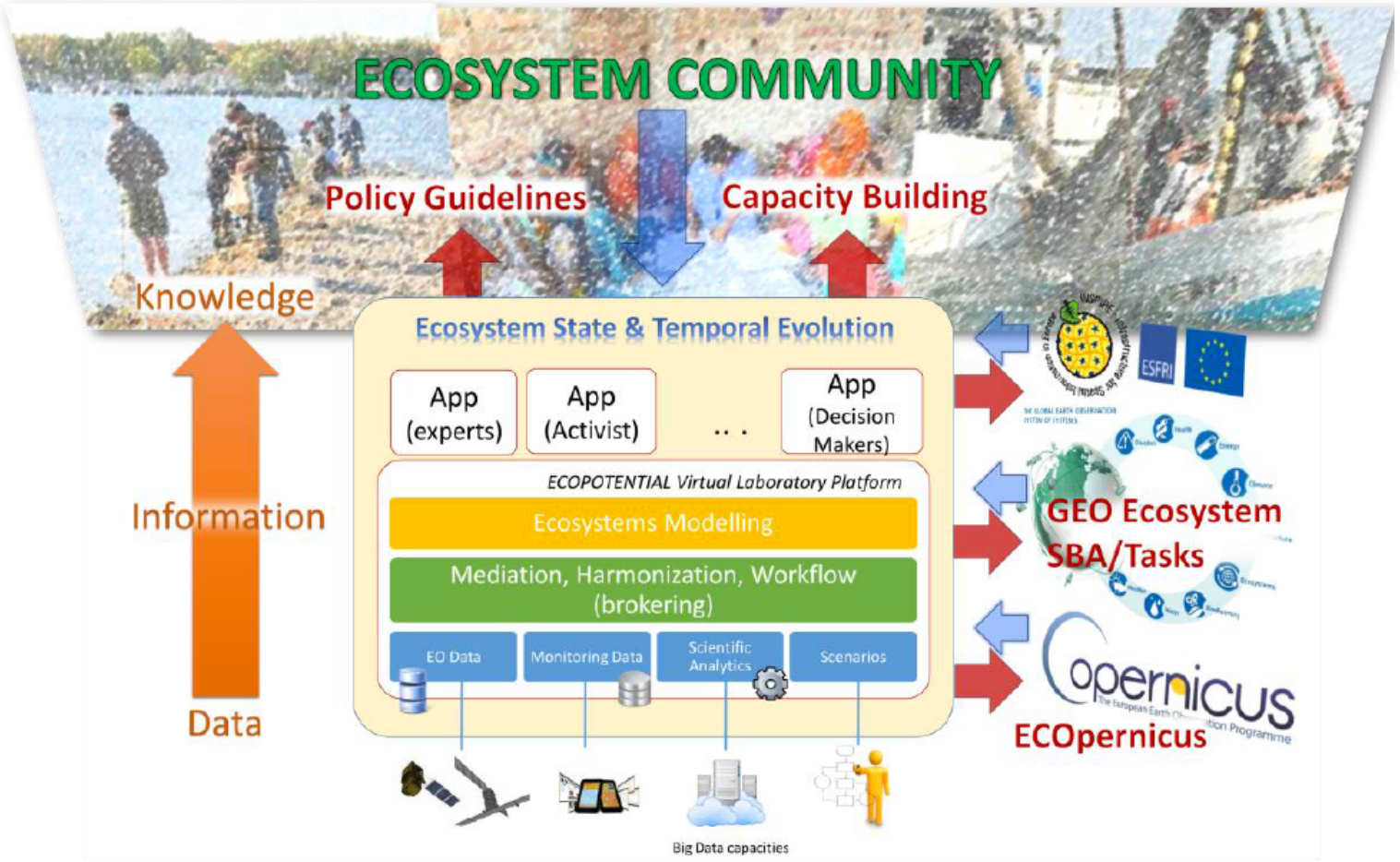
ECOPOTENTIAL will develop models coping with Essential Variables and able to incorporate Remote Sensing and in-situ information

Empirical (correlative) models
Process-based models
Models for ecosystem services

Earth Observation data will be assimilated into widely used process-based ecosystem modelling tools

Define the requirements of future protected areas

ECOPOTENTIAL Virtual Laboratory



Provide strong European support to GEO and GEOSS

Policy and Capacity Building

Develop policy options based on knowledge from EO and in-situ data and modelling results (UNEP, UNESCO)

Capacity building at all levels

Create a GEO Ecosystem Community of Practice

Science training schools for young researchers

Organize public events (eg, European Parliament)

	Linked R&I activities, Projects and other initiatives
WP2	GEO BON, GOOS, BIO_SOS, MS.MONICA, NEON, BUFFER, Mapping Ocean Wealth, SESYNC Mapping Ocean Acidification Human Hotspots, PANACHE, VALMER.
WP3	GEO-WOW, GEOSS Ecosystem SBA, GISC.
WP4	BIO_SOS, MS.MONINA, TELEIOS, GeoViQua, THESEUS, MERMAID, REDDAF, ESA EOLib, GMES, EARSeL, EU BON, GEONETCast, Europe-Africa Marine EO-net , AGRICAB, OGC, EGU, ISO, VENμS, ConnectinGEO.
WP5	LTER-Europe, ILTER, LifeWatch, EU BON, GBIF, ETC-BD, EEA, OBIS, GOOS, IODE, EU BON, EnvEurope, EMODNET, SeaDataNet, GEOSS, GEO BON, INSPIRE, ENVRI, EUDAT, EVA, GLOCHAMORE, GLORIA, CLRTAP, IUCN, Future Earth.
WP6	PESERA, DESIRE, DeSurvey, EcoRiver, TempQsim, ICReW, myOcean.eu, COBIOS.
WP7	CLEANSEA, OPERA, MOUNTLAND, BESAFE, DANK, DG ENV, European Environmental Agency, SoilTrEC, Climate KIC – GreenInfra, JNCC, EU BON, GEO BON, Mapping Ocean Wealth, SESYNC Mapping Ocean Acidification Human Hotspots, IPBES, Ecosystem Services Partnership, MAES-working group.
WP8	EU BON, SCALES, CMIP5, CORDEX, myOcean.eu, CoCoNet, ExeER, CZEN, ECRA, Future Earth, Belmont Forum.
WP9	LifeWatch, MARS, ESF COST EMBOS, MarBEF+, MarCOM+, Vectors, EuroMarine, BIOC3.
WP10	GEO BON WG8 (Data Integration and Interoperability), INSPIRE, ESFRI, NSF Earth Cube, RDA (Research Data Alliance) Brokering IG, Belmont Forum CRA on e-Infrastructure and Data Management, GEOWOW, RECODE, IASON, EO-POWER, BYTE, SeaDataNet II, ODIP, OGC Earth System Science DWG, enviroGRIDS, PEGASO, UNEP Live.
WP11	Carpathian Network of PAs, Alpine Network of PAs, Mediterranean Lagoons Network, OSPAR, COCONET, IPBES, IUCN, Future Earth, IPCC.
WP12	La Palma Science School, EVA - The European Vegetation Archive, LifeWatch, European Citizen Science Association, Mediterranean Lagoons Network, Alpine Network of Pas, Carpathian Network on Pas, IUCN, COBWEB.

BIG DATA
BIG ECOLOGY

Outlook

With ECOPOTENTIAL, European research on protected areas, ecosystem services, biodiversity loss, and earth observation is entering a new dimension in terms of spatial scales and big data.

- knowledge acquired and methods developed in ECOPOTENTIAL will be transferred to and applied in other protected areas;
- trends in protected areas and their contribution to the delivery of ecosystem services will be detected;
- perspectives for novel protected areas will be identified
- Back to the future: ecosystems as networks of biogeodynamical processes

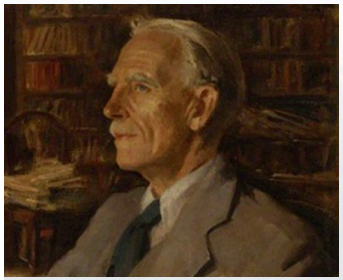
Back to the future

Arthur Tansley (1935), who briefly but substantively defined the ecosystem to be the integrated biotic–abiotic complex:

> the whole *system* (in the sense of physics), including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome – the habitat factors in the widest sense.

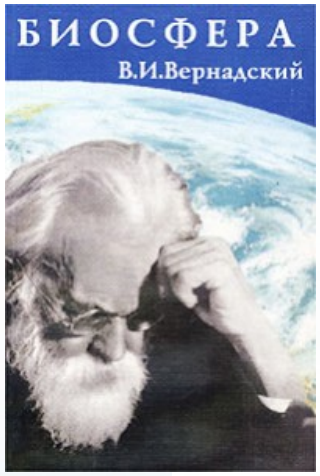
Significantly, as if to emphasize what he meant by 'the whole system', Tansley (1935) added:

> Though (as biologists) the organisms may claim our primary interest, when we are trying to think fundamentally we cannot separate them from their special environment, with which they form *one physical system* (italics ours).

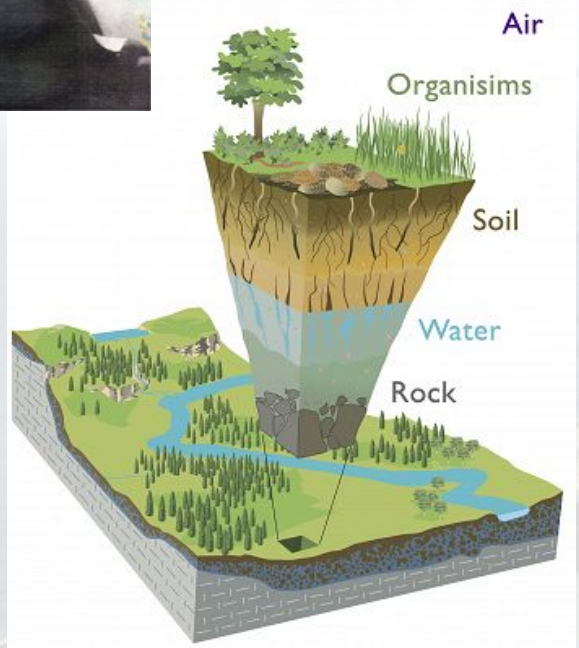


Ecosystems as complex adaptive systems

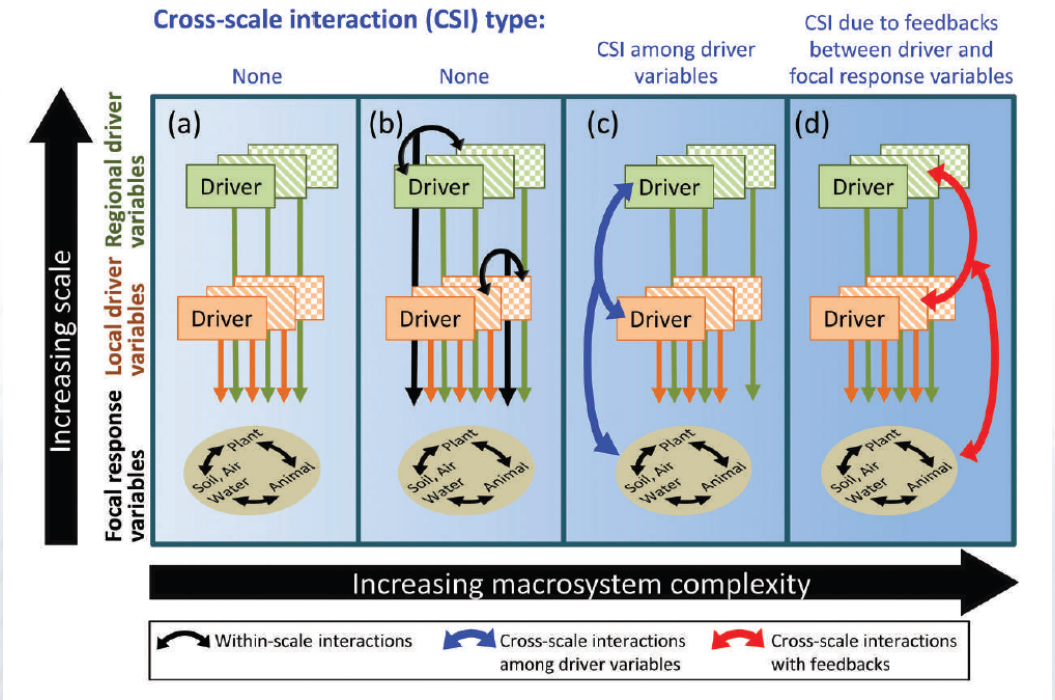
Old and new concepts and ideas



Biogeodynamical processes



Biogeodynamical processes: the **Earth's Critical Zone**



Cross-scale interactions

Soranno et al. Frontiers Ecol. Env. 2014
Rietkerk et al., Ecological Complexity 2011

A European way to Macrosystems Ecology and cross-scale interactions


Thank you for your attention