On-line services for the use of Remote Sensing data

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Key ECOPOTENTIAL results of interest to GEO

https://vlab.geodab.org/

Selected models and other model supportive workflows were transformed into operational online data services and integrated into the ECOPOTENTIAL Virtual Laboratory (VLAB).

Services may be utilized either stand-alone or as workflow components to generate input for further models or decision support chains.

Key messages

- Automated execution of models or modules by the users is enabled by the VLAB.

- Users may input existing or new data and activate the online services.

- Products can be downloaded in commonly used formats.

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WaterMasks & LAST-EBD

Generate inundation maps with Sentinel-2/ Landsat data

Applied to Doñana (Spain), Camargue (France).

inundated
non-inundated
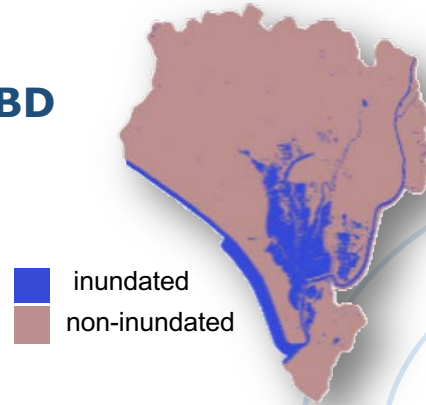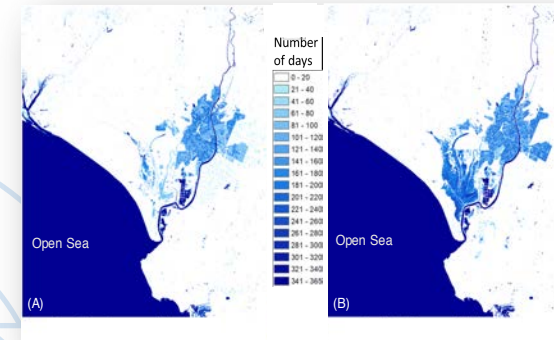
Speckle Removal

Improved speckle suppression of SAR images to be used as input data

Applied to Doñana (Spain).

HydroMap & LAST-EBD

Estimate hydroperiod (length of time an area remains flooded)

Applied to Doñana (Spain), Camargue (France).

Support the assessment of the hydrological cycle

Number of days
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
101 - 120
121 - 140
141 - 160
161 - 180
181 - 200
201 - 220
221 - 240
241 - 260
261 - 280
281 - 300
301 - 320
321 - 340
341 - 365

Open Sea

(A)　(B)

WiMMed

Calculate aquifer recharge & surface runoff

Applied to Sierra Nevada (Spain).

WiMMed

Evapotranspiration
Precipitation
Meteorological model
Interception model
Infiltration
Snowmelt model
Percolation
Hillslope routing model water, sediment & substances
Baseflow model
River routing model
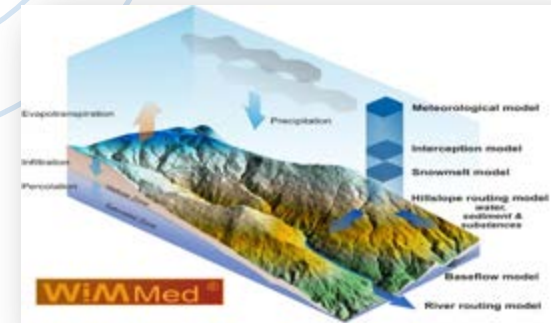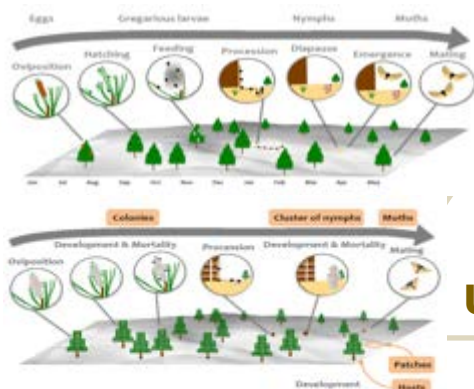
INSTAR

Estimate population dynamics of *Thaumetopoea pityocampa* forest pest.

Applied to Sierra Nevada (Spain).

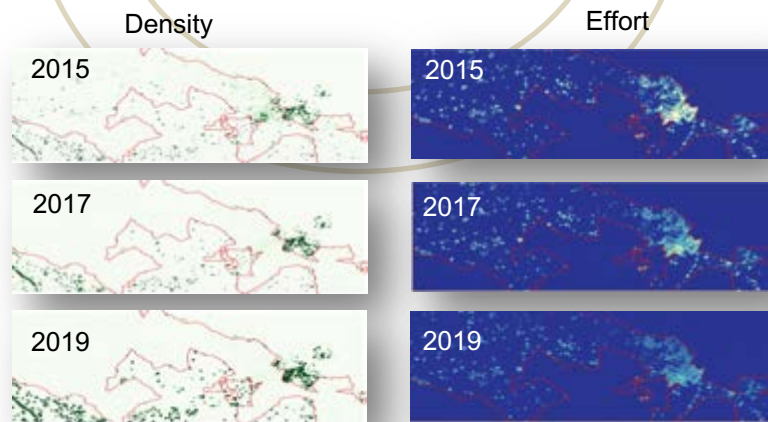**Understanding dynamics of species distribution: human activities in support of nature**

IP 5km

Habitat suitability
- Non prediction
- Overlap
- Only CLI
- Only EFAs

COINS

Calculate optimal spatiotemporal COntrol of INvasive Species (tested for *Ailanthus Altissima* species).

Applied to Murgia Alta (Italy)

Density

2015	2015
2017	2017
2019	2019

Effort

IRIS-SDM & EO-SDM

Predict habitat suitability & test the applicability of established species distribution models.
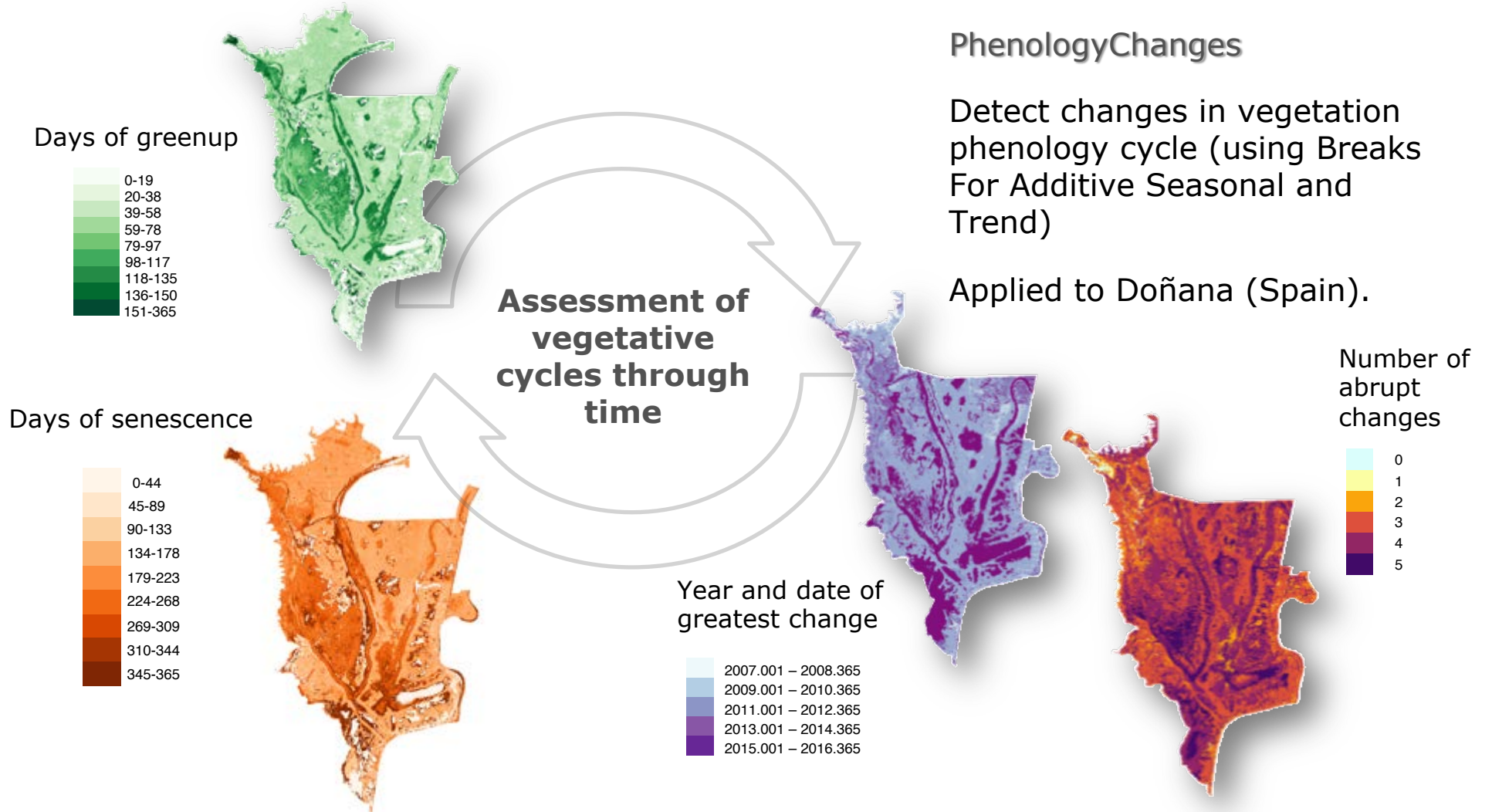
Applied to and Peneda-Gerês (Portugal) and Gran Paradiso (Italy).

PhenologyMetrics

Calculate phenology metrics based on the phenex R package

- Greenup
- Senescence
- Peak

Applied to Doñana (Spain).

Days of greenup

	0-19
	20-38
	39-58
	59-78
	79-97
	98-117
	118-135
	136-150
	151-365

Days of senescence

	0-44
	45-89
	90-133
	134-178
	179-223
	224-268
	269-309
	310-344
	345-365

Assessment of vegetative cycles through time

PhenologyChanges

Detect changes in vegetation phenology cycle (using Breaks For Additive Seasonal and Trend)

Applied to Doñana (Spain).

Number of abrupt changes

	0
	1
	2
	3
	4
	5

Year and date of greatest change

	2007.001 – 2008.365
	2009.001 – 2010.365
	2011.001 – 2012.365
	2013.001 – 2014.365
	2015.001 – 2016.365

LandMetrics

Calculate landscape fragmentation metrics (FRAGSTATS)

- Percentage of landscape

- Total class area

- Patch density

- Mean patch size

- Shape index distribution

- Effective mesh size

- Area-weighted mean patch fractal dimension
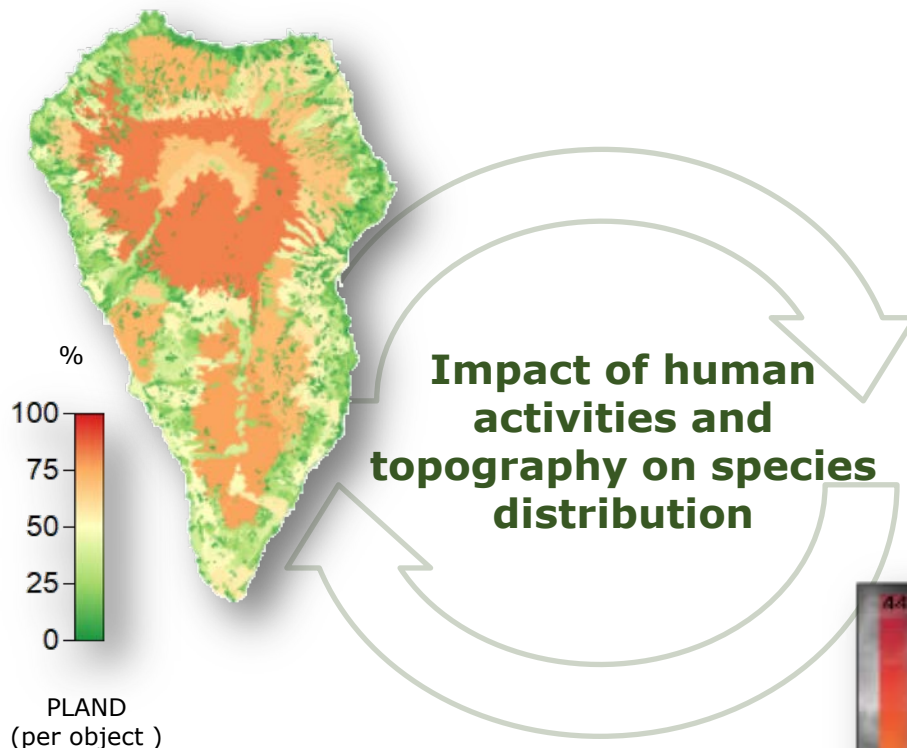
Applied to Sierra Nevada (Spain), Samaria (Greece), Montado (Portugal), Lake Prespa (FYROM), La Palma (Spain), Curonian Lagoon (Lithuania).

%

100
75
50
25
0

PLAND
(per object)

Impact of human activities and topography on species distribution

MountainMetapop

Impact of landscape topography on species distribution

Applied to Gran Paradiso (Italy).
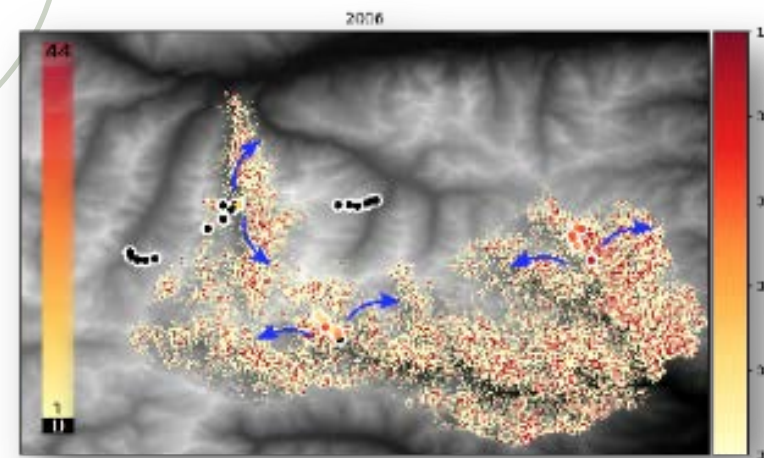
GEO flagships and initiatives of interest for ECOPOTENTIAL and vice versa

✓ **GEO Biodiversity Observation Network (GEO BON**)

INSTAR, IRIS SDM, EO-SDM and COINS outcomes may be used to support understanding dynamics of species distribution.

Annual hydroperiod provided by HydroMap and LAST-EBD module is also a critical ecological parameter that shapes aquatic plants' and animals' distribution and determines available habitat for many of the living organisms.

✓ **GEO Global Agricultural Monitoring (GEOGLAM)**

PhenologyMetrics and PhenologyChanges may be used to assess changes in the phenological cycle of plant species.

Monitoring of abrupt changes among vegetation cycles is an indicator of the primary production of an area.

✓ **Global Forest Observation Initiative (GFOI)**

PhenologyMetrics, PhenologyChanges and LandMetrics provide information that may be used to i) assess the impact of seasonal and inter-annual climate variations on forests, ii) support mapping of vegetation disturbances, and iii) recognize patterns which represent the reaction of the biomes to external factors, such as human intervention or extreme events (e.g. fire)

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✓ **Contribution to European Group on Earth Observations – EuroGEO (former EuroGEOSS)**

All services may be used to support the EuroGEO activities by providing EO based useful information.

Services have been already applied for validation to various protected areas across Europe (e.g. Alta Murgia, Donana, Camargue, Gran Paradiso, Sierra Nevada, etc.)

✓ **Contribution to GEO Global Ecosystem Initiative (GEO ECO)**

All services may be used to support monitoring of ecosystem state functioning and services at various scales; an overarching goal of the GEO-ECO Initiative.

As an instance, satellite-derived inundation maps (Watermasks) offer an efficient solution for monitoring the spatial and temporal variability of the hydrological cycle of wetlands.

✓ **Contribution to GEO Land Degradation Neutrality Initiative (GEO LDN)**

LandMetrics, WaterMasks and HydroMap may contribute to the assessment of Land degradation component and the calculation of the SDG15.3.1 indicator "Proportion of land that is degraded over total land area".

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Ways of interaction with GEO (GEOSS)

Inputs - Outputs

Model name	Output	User inputs	EO data	Free Sources for EO data
INSTAR	number of pine processionary moths, percentage of infected pines, average biomass of pines	Wimmed-produced maps of temperature	Digital Elevation Model (DEM), Pines location (using LiDAR data), Land cover (LC) map	LC: Copernicus Land Monitoring Service (CLMS) (100m), CORINE LC, DEM: CLMS (EU-DEM v1.0 & v1.1)
COINS	Habitat suitability map, effort allocation for species control & population density under control	Model parameters (species parameters e.g. growth & diffusion, budget constraint etc.), Initial density species map, Area boundary	LCCS LC map	LC: CLMS (100m), CORINE LC
EO-SDM	Species-specific habitat suitability maps & model uncertainty	Species occurrences, Model parameters	DEM, NDVI-based Land Surface Temperature	NDVI: CLMS (300m, 1km), DEM: CLMS (EU-DEM v1.0 & v1.1)
IRIS-SDM	Spatially-explicit predictions for the current distribution of the target species	Species occurrence data, Set of parameter values for running the model	Spectral Vegetation Indices (EVI), Land Surface Temperature (LST) & Albedo to calculate Ecosystem Functional Attributes	LST: CLMS (hourly, 10-day), NASA MODIS, AVHRR (DLR), EUMETSAT (10-day), Albedo: CLMS (1 km), EUMETSAT (daily)
WiMMed	Accumulated surface runoff and aquifer recharge	Meteorology data, soil properties maps, vegetation cover (veg. max storage capacity, transpiration capacity)	DEM, vegetation canopy fraction calculated using NDVI & LAI	LAI (till present): CLMS (1km, 300m), NASA MODIS (500m), NDVI: CLMS (1km, 300m), DEM: CLMS (EU-DEM v1.0 & v1.1)
MountainMetapop	Average presence of species	Specific parameter values of focus species	DEM	DEM: CLMS (EU-DEM v1.0 & v1.1)

Model name	Outputs	Inputs: Free Sources for EO data (examples, as GEO has many more data sources ~2M to select from)
INSTAR	number of pine processionary moths, percentage of infected pines, average biomass of pines	LC: Copernicus Land Monitoring Service (CLMS) (100m), CORINE LC, DEM: CLMS (EU-DEM v1.0 & v1.1)
COINS	Habitat suitability map, effort allocation for species control & population density under control	LC: CLMS (100m), CORINE LC
EO-SDM	Species-specific habitat suitability maps & model uncertainty	NDVI: CLMS (300m, 1km), DEM: CLMS (EU-DEM v1.0 & v1.1)
IRIS-SDM	Spatially-explicit predictions for the current distribution of the target species	LST: CLMS (hourly, 10-day), NASA MODIS, EUMETSAT (10-day), Albedo
WiMMed	Accumulated surface runoff and recharge	(EU-DEM v1.0 & v1.1)
MountainMetapop	Average presence of species	DEM: CLMS (EU-DEM v1.0 & v1.1)

Most of the services work better at higher resolutions than the one you can get from the Copernicus layers. E.g. CORINE doesn't work very well at PA's scale.

Module name	Contribution	Alternative products
WaterMasks/ LAST-EBD module	Capacity to automatically generate 20m - 30m inundation maps in real time (Sentinel-2/1, Landsat), BUT may use VHR data also	Water Seasonality: CLMS (300m, 1km), Water Surface Water Explorer
HydroMap/ LAST-EBD module	Capacity to automatically generate 20m - 30m hydroperiod maps in real time (Sentinel-2/1, Landsat - time resolution up to 3 day), BUT may use VHR data also	Water Seasonality: CLMS (300m, 1km), Water Surface Water Explorer
PhenologyMetrics	NDVI/ EVI products can be used as inputs from various spaceborne sensors in an easy to self-initiate service	NASA MODIS/ AVHRR EVI or NDVI (1981-2014, yearly, 5.6 km, global), SPOT-VGT and PROBA-V (1999-2016, yearly, 1km, Europe – by CREAF), free open access: Phenex algorithm, Timesat software
PhenologyChanges	NDVI/ EVI products can be used as inputs from various spaceborne sensors in an easy to self-initiate service	Bfast algorithm
LandMetrics	Land cover and habitat self-initiate service	Commercial software Fragstats

Services offered exploit higher resolutions than the one you can get from the Copernicus layers. I.e. They provide a better service at PA's scale.

- Couplings with advancing technologies – i.e. Open Data Cubes (Swiss /Greek)

- Data Cube's integration with the VLAB platform

- Ingestion of multi-source data to Data Cubes and provision of analysis ready data

- Incorporation of the ECOPOTENTIAL services/ modules/ algorithms to the Open Data Cube Infrastructure

- Generation of maps per location and provision of structured time series maps in the GEOSS portal

Dice ...   ... Stack ...   ... and Use
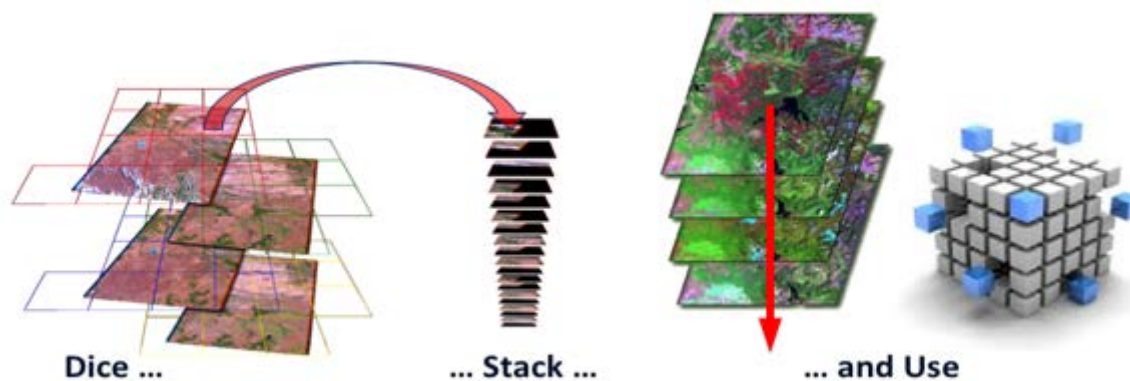
- Repository for Essential Variables at global scale (similar to the _Living Greece-Wales_ repository)
- Improved query in the GEOSS web portal (?)

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With a smile and a vision

Thank you
for your attention

At your disposal
for questions/ clarifications

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