

HERACLES

HERitage Resilience Against CLimate Events on Site

A holistic EO technology approach for improving resilience of CH assets: the **HERACLES project**



SEC DRS11-2015: Disaster Resilience & Climate Change topic 3: Mitigating the impacts of climate change and natural hazards on **cultural heritage sites**, structures and artefacts

The integrity of monuments, historical centers and archaeological landscapes is nowadays increasingly threatened by **the climatic change, the extreme meteorological phenomena and the natural hazards**.

The Cultural Heritage monuments are exceptionally vulnerable to these threads while any loss or deterioration of these outstanding assets would negatively impact local and national communities, due to their **cultural importance** as a source of information on the past and a **symbol of identity**, as well as for **their socio-economic value**



the CONSORTIUM



- The Project received funding from the *European Union's Horizon 2020 research and innovation programme* under Grant Agreement No 700395
- Funding: 6.564.313,75 Euro
- Starting date: May 1°, 2016



Advisory Board & SSH/Ethical Board
(local and national Decision & Policy makers, UNESCO Chairs, ICOMOS, restorers, local civil protection, social experts etc...)

the SITES

Archaeological site



Living area

Greece, Heraklion : Minoan Palace of Knossos, centre of the first civilization of the Mediterranean basin, namely the Minoan civilization and is in the tentative UNESCO list.

The Sea Fortress of "Koules" symbolises all monuments facing the risk of hazards from climatic change, such as significant impact from the sea, (sea level rising, increasing intensity of extreme weather phenomena combined with the air and land associated hazards, increased salinity accelerating corrosion and deterioration of materials and structures, etc)



Living town

Italy, Gubbio wants to represent all the historical monumental towns in Italy and in Europe, that were conceived and built in the past following criteria when the climate conditions were very different from nowadays and that suffers at present the effects of climate changes, that would endanger their safeguard, particularly the hydrogeological risk (heavy rains , flood, landslides).



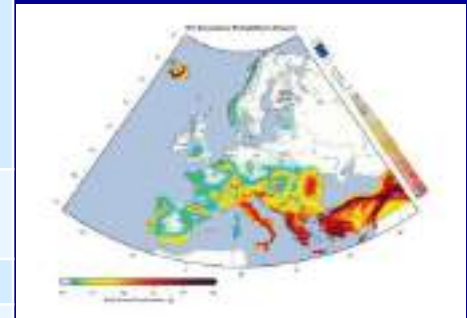
Hazard list in the HERACLES CH sites

Rainfall erosivity



Climate parameters	Climate change risk
Atmospheric moisture change	Flooding (sea, river)
	Intense rainfall
	Changes in water table levels
	Changes in soil chemistry
	Ground water changes
	Changes in humidity cycles
	Increase in time of wetness
Temperature	Sea salt chlorides Diurnal, seasonal, extreme events (heat waves, snow loading) Changes in freeze-thaw and ice storms, and increase in wet frost
Sea level rises	Coastal flooding Sea water incursion
Wind	Wind-driven rain Wind-transported salt Wind-driven sand Winds, gusts and changes in direction
Desertification	Drought Heat waves Fall in water table
Climate and pollution acting together	pH precipitation Changes in deposition of pollutants
Climate and biological effects	Spread of existing and new species of insects Increase in mould growth Changes in lichen colonies on buildings Decline of original materials

Seismic risk





CURRENT CH RISK MANAGEMENT IN GREECE/HERAKLION AND ITALY/GUBBIO:

Based first on the end-users requirements and on our investigations and surveys on site, one of the key elements necessary for the effective implementation and exploitation of a platform is represented by the:

- **Monitoring/Earth Observation technologies** for the wide area surveillance not only of the single CH asset/monument but also of the surrounding territory.

This study was the object of the HERACLES deliverable D1.2 – public (currently under evaluation by the EC)



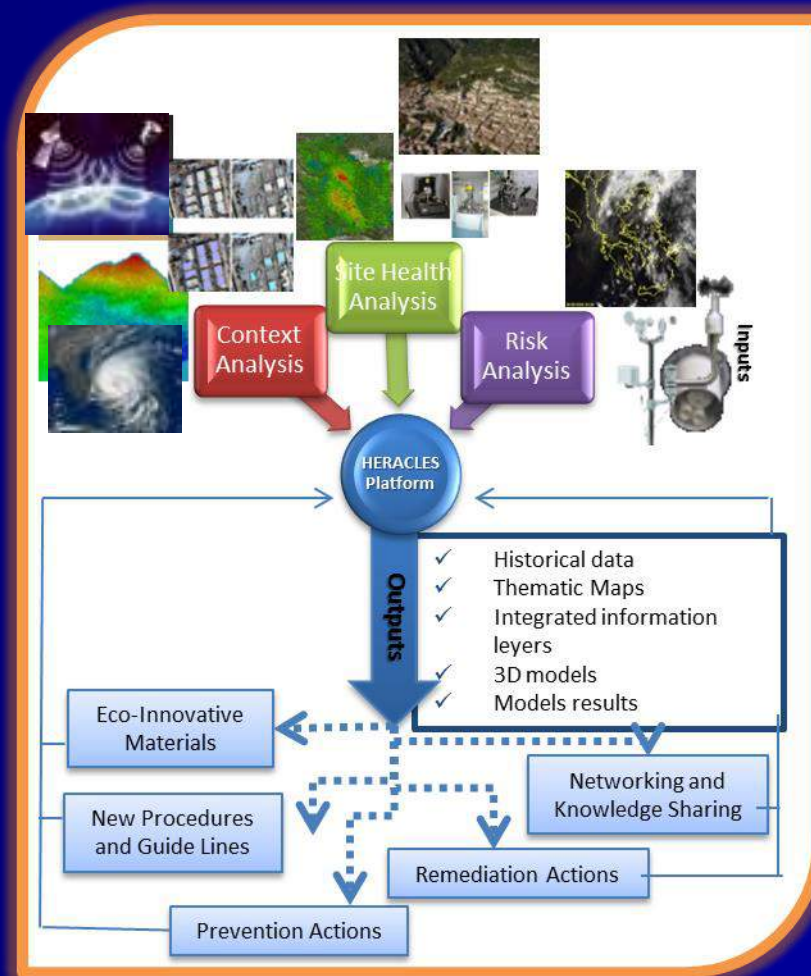
HERACLES platform concept

There is the **NEED OF NEW TOOLS** for **IMPROVING THE CURRENT CH MAINTENANCE**:

HERACLES PLATFORM DEVELOPMENT



HERACLES platform
Multirisks → multisource data



Flexible, general applicability

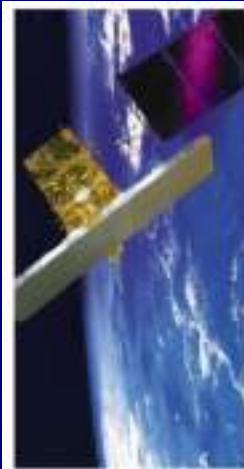


..... some examples

**Realization of geo-information layers:
specific informations for
specific domains**



**other in-situ sensing and
monitoring systems**



COSMO-SkyMed
COMMERCIAL OPERATOR



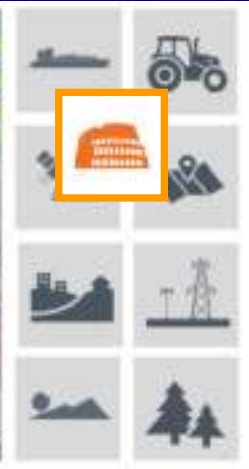
DATA PORT
SERVICES



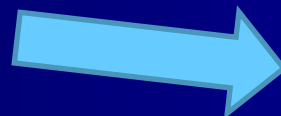
SATELLITE DATA &
AERIAL SURVEY



MAPPING &
MONITORING



GEO-INFORMATION
SOLUTIONS



**Useful information for
preventive
maintenance/conservation**



..... some examples monitoring of a structure

Interferometric analysis

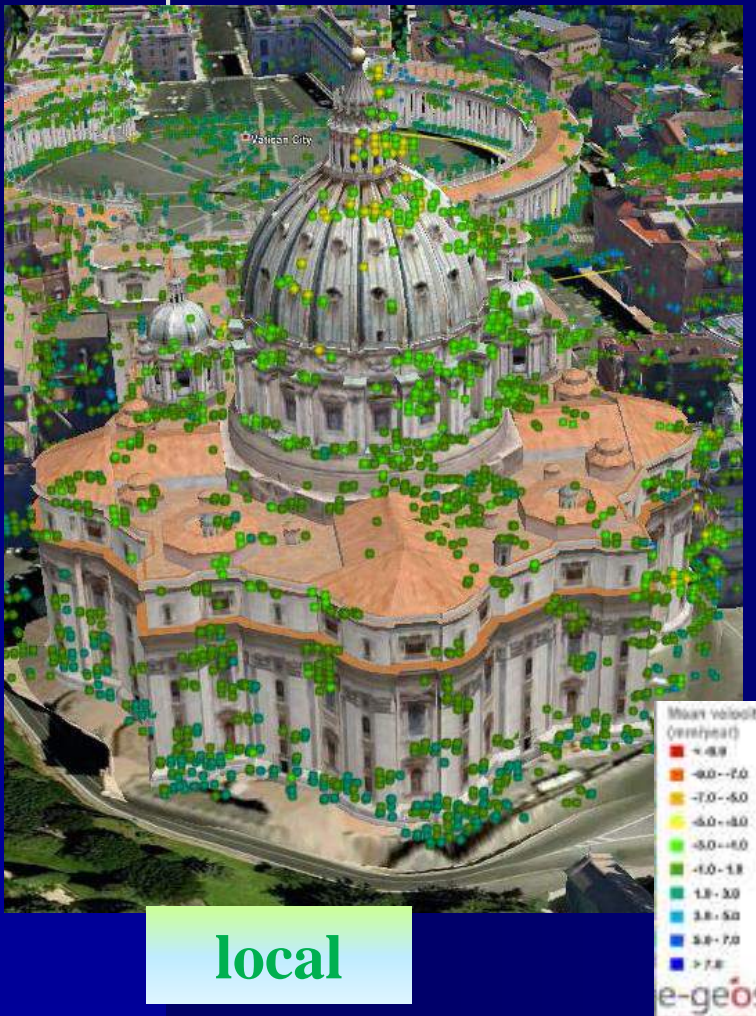
Interferometric service based on PSP-IFSAR technique, using the data from the **COSMO-SkyMed satellite constellation** (X-band SAR allows the detection of movements of building structure parts).

Historical and updated data will be analysed for studying the evolution of the site and highlighten potential problems in terms of structure deformation.

To recover the maximum info for a site, ascending and descending passes are analysed to observe the structures from different point of views.

Monthly updates will guarantee an effective monitoring of the area.

Here, an example showing the detail level that the PSP-IFSAR technique, X-band SAR, can provide for a building like San Pietro, Rome (**deformation evaluation**).



local



..... **some examples** monitoring of structures in an area

Main archeological area of Rome CSK PSP-IFSAR analysis (Jan. 2010 – May 2012)

**Map of
displacements
in time**



Credits: **Copernicus**, **CNR-DPC-INGV**, **ESA-ASI**

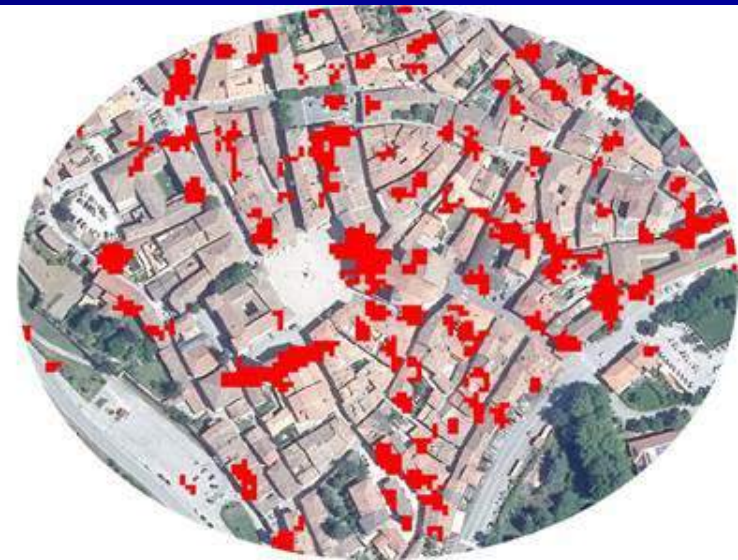


..... some examples

SAR coherence comparison before and after an event



e-geos
an europa.eu initiative



NORCIA: damages to buildings derived from SAR data – **Damage Proxy Map**



CURRENT AND FUTURE COPERNICUS ROLE FOR CH

- Enable the continuous monitoring of surrounding area of CH sites, through Sentinel data & products: a priority list of sites, e.g. a subset of the UNESCO ones, can be derived. This context analysis, continuously updated, could help in detecting potential risk related to natural and anthropic hazards, by means of specific products, as change detection analysis (optical data) and deformation analysis (SAR data)
- Selection of Copernicus Contributing missions able to provide other value-added information for the CH monitoring (e.g. CosmoSkymed data for structure deformation monitoring) and plan their operational usage for the monitoring of a set of high-risk CH sites.

These activities could be part of a new, dedicated Copernicus Service or a dedicated new line of an existing Copernicus Service (e.g. Land)



A vulnerable heritage at risk to preserve !

HERACLES test beds: Italy + Greece hold 69 UNESCO world heritage sites (tangibles)



Thanks for your kind attention !

