Christos S. Zerefos

State representative

for climate change, Greece

Side Event

“Climate Change Impacts on Cultural and Natural Heritage: The Day After”

Tuesday 10th of December 2019–12:30 to 14:00

UN Climate Change Conference COP25, Madrid, Spain

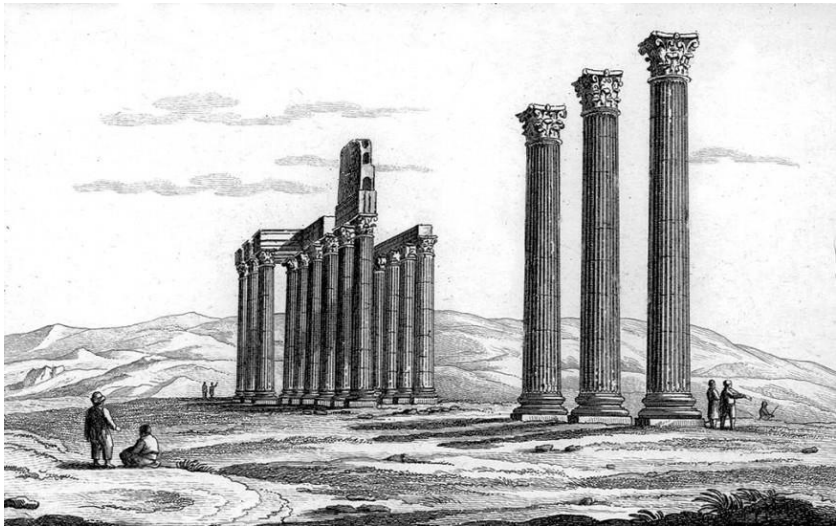
Climate Change & Natural Disasters related to Cultural and natural Heritage

- Cultural and natural heritage are vulnerable to the adverse impacts of natural disasters. Floods, earthquakes, landslides, fires, long-term climate effects, and other natural hazards can cause damage or even total destruction of cultural and natural heritage

- Based on existing trends, it is expected that the number of disasters and their intensity will rise (Meier, Will, and Petzet 2007).

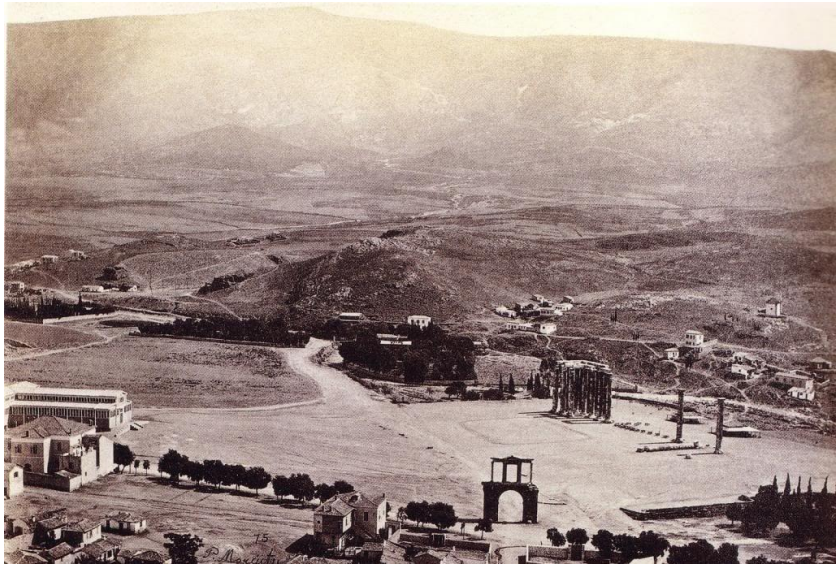
- Climate change will also intensify risks to cultural and natural heritage assets.

Late 18th century

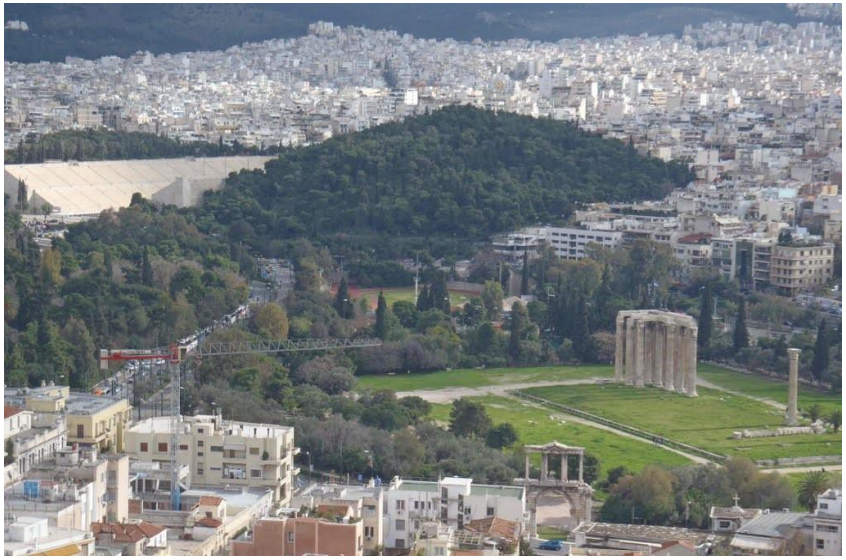


Today

Late 19th century



Today



Detail of a relief on the Arch of Galerius photographed by the German Archaeological Institute in 1924 (left) and in 1984 by the author (right). The affects of acid rain are clear.

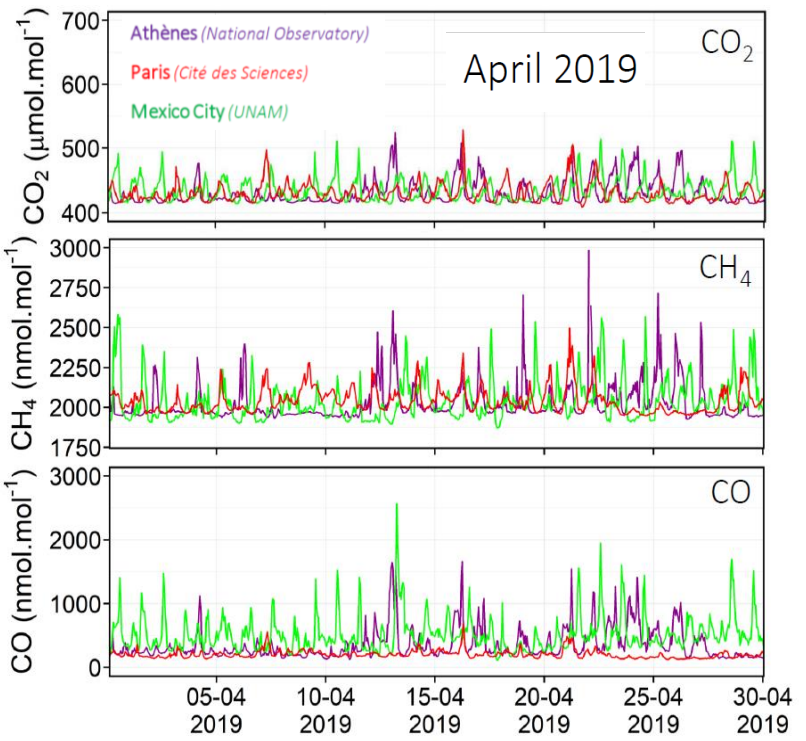
Zerefos, 1984

Imperative need for continuous and specialized monitoring

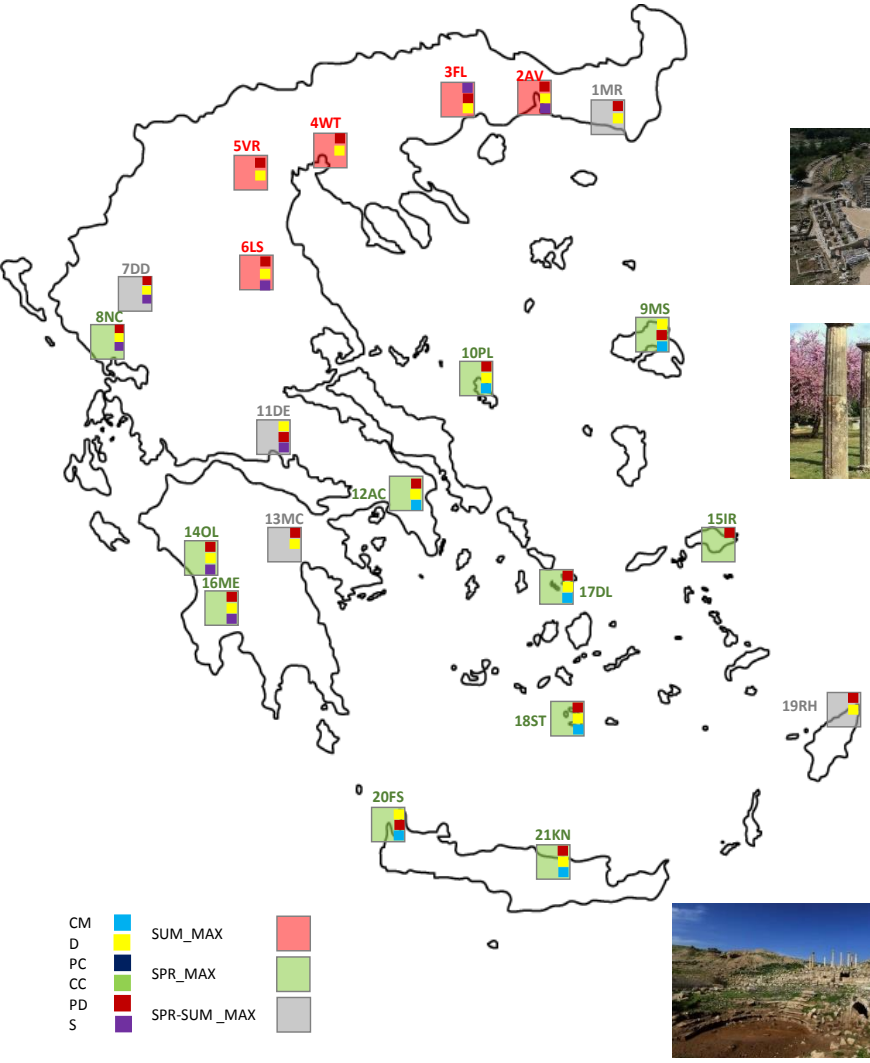
Super-site for Atmospheric Composition Monitoring
View from National Observatory of Athens, Greece

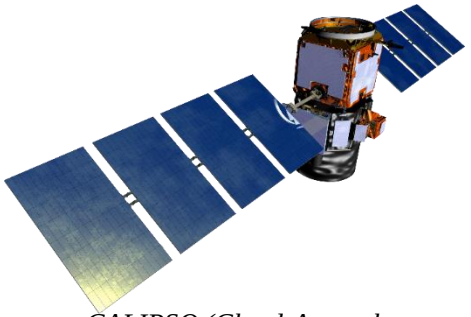
- *Gases and particulate matter pollution*
- *Sampling and chemical analyses for ions, metals, organic and elemental carbon, volatile organic compounds*
- *Non-conventional pollutants (e.g. HNO3, NH3)*
- *Aerosol physical and optical properties*
- *Reactive Oxygen Species – Oxidative Potential*
- *Green House Gases*

To track urban pollution and GHGs at the same time

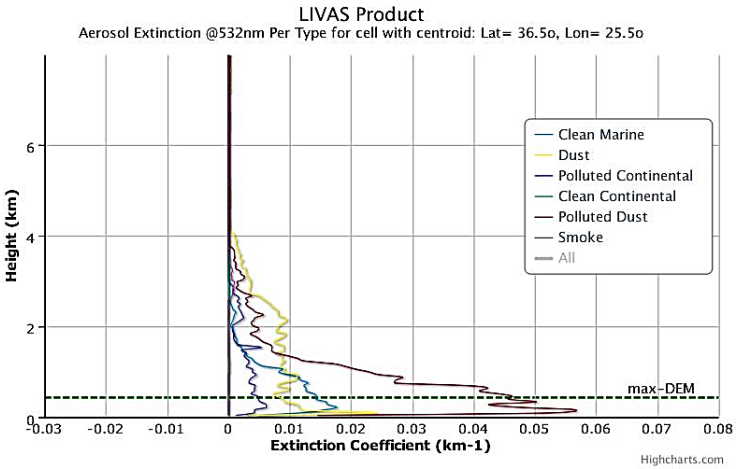


Spatial distribution of antiquities exposed to aerosols, using space – borne remote sensing

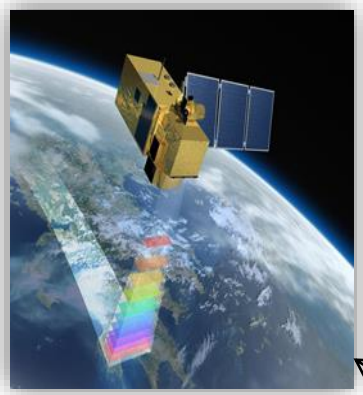




CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation)

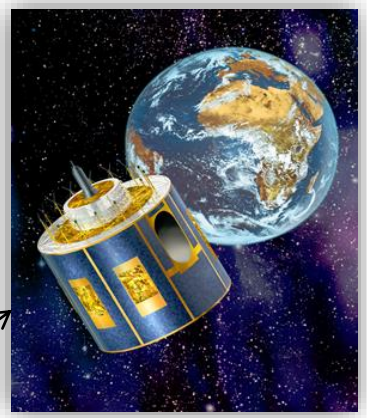


Monitoring Systems for cultural heritage



Satellites Polar Orbit
X-/L-band Station
Sentinel Mirror Site

DATA → ANALYSIS PROCESSING → INFORMATION RESULTS



Satellites Geostationary Orbit
MSG SEVIRI

HELLENIC MirrorSite

Hellenic Mirror Site (Copernicus satellite missions)
http://beyond-eocenter.eu/index.php/web-services/hellenic-mirror-site)

GreekHUB

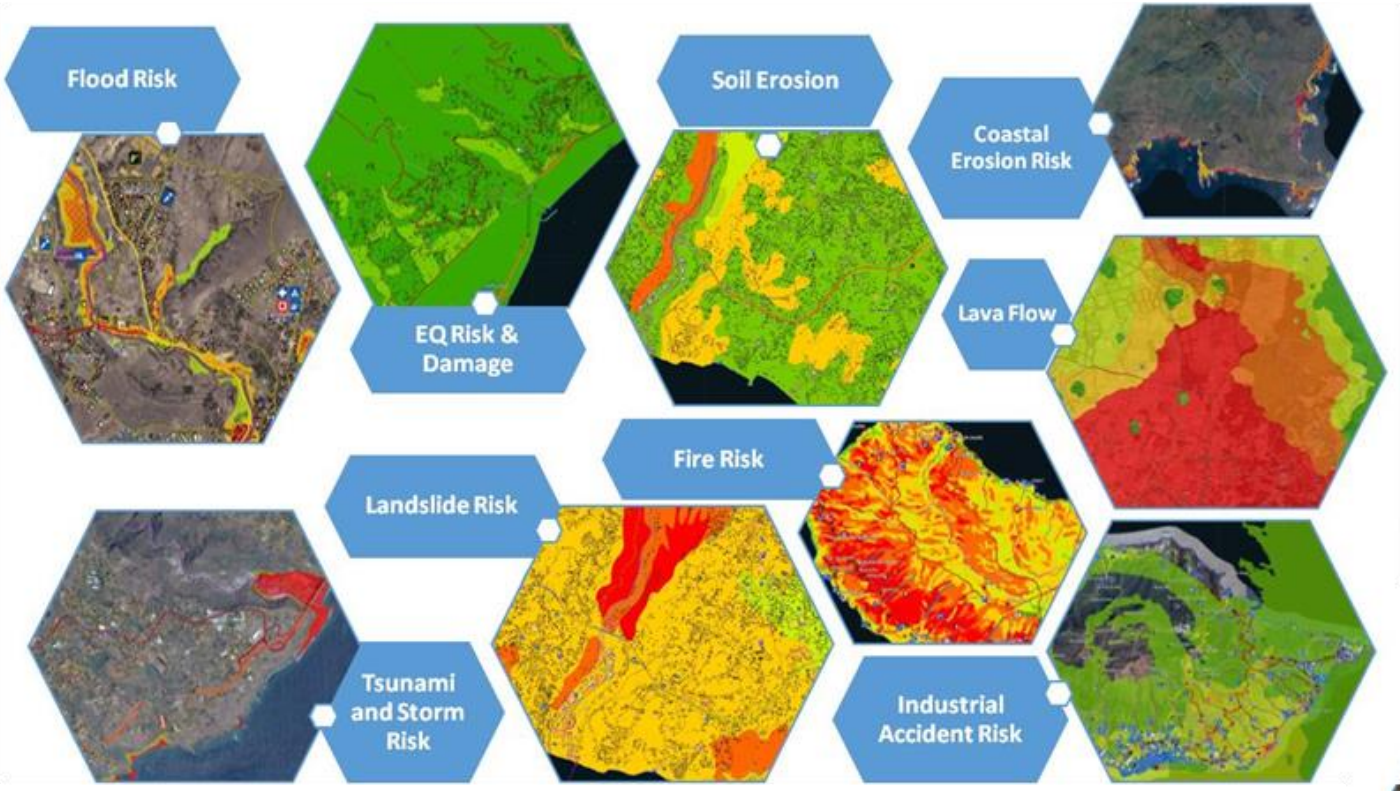
Sentinels GreekHUB (http://beyond-eocenter.eu/index.php/web-services/sentinels-greekhub)

UAV

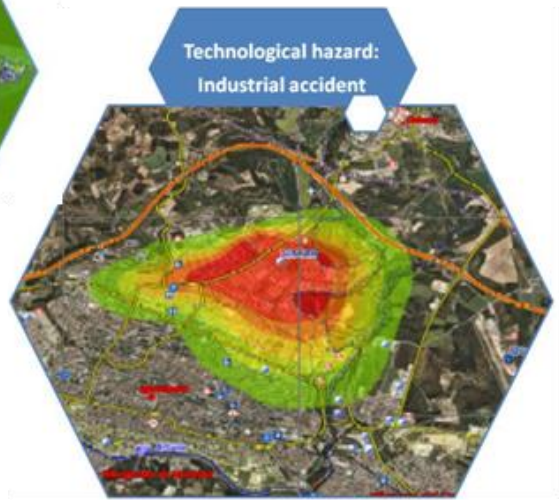
Terrestrial Platforms and Networks

in-situ

Preparedness, Vulnerability and Risk Assessment, Recovery, and **Mitigation** Planning Services **have been delivered** to **> 20 Civil Protection Authorities worldwide**

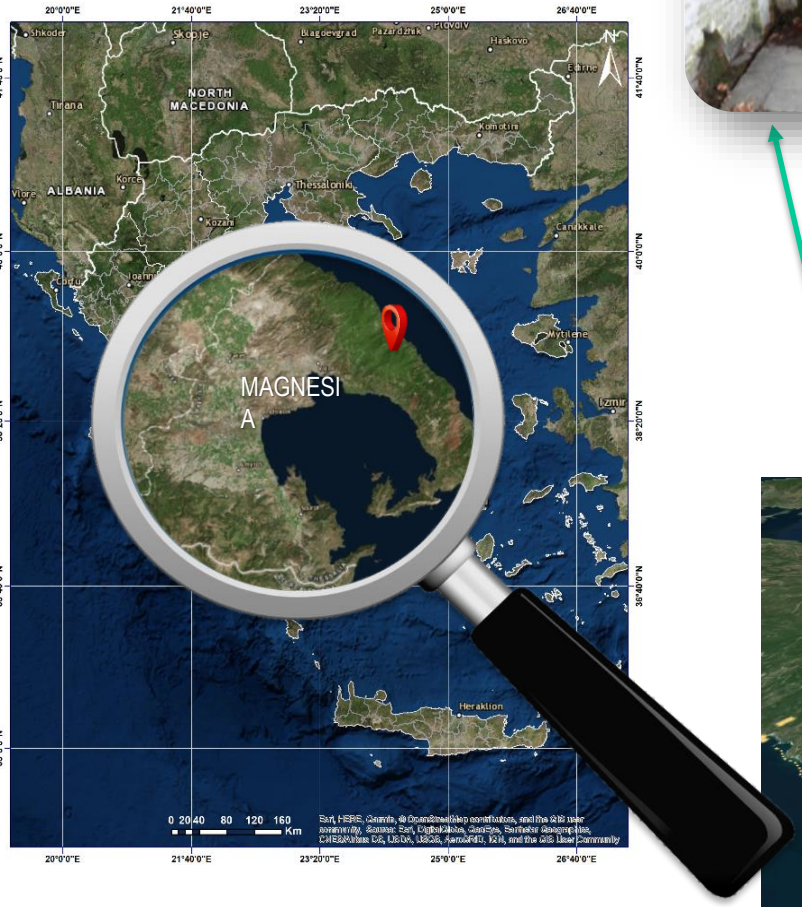


Thousands of Vulnerability, Hazard and Damage Assessment Maps and Reference (Asset) Maps have been delivered in the scale of 1:5000-1:10000 , for a large portfolio of disasters



A vast portfolio of disasters: **fires, floods, draughts, water scarcity, landslides, EQs, volcanic eruption, tsunami, epidemics, industrial accidents, storms/typhoons, etc.**

Example 1
Landslide assessment in Pelion



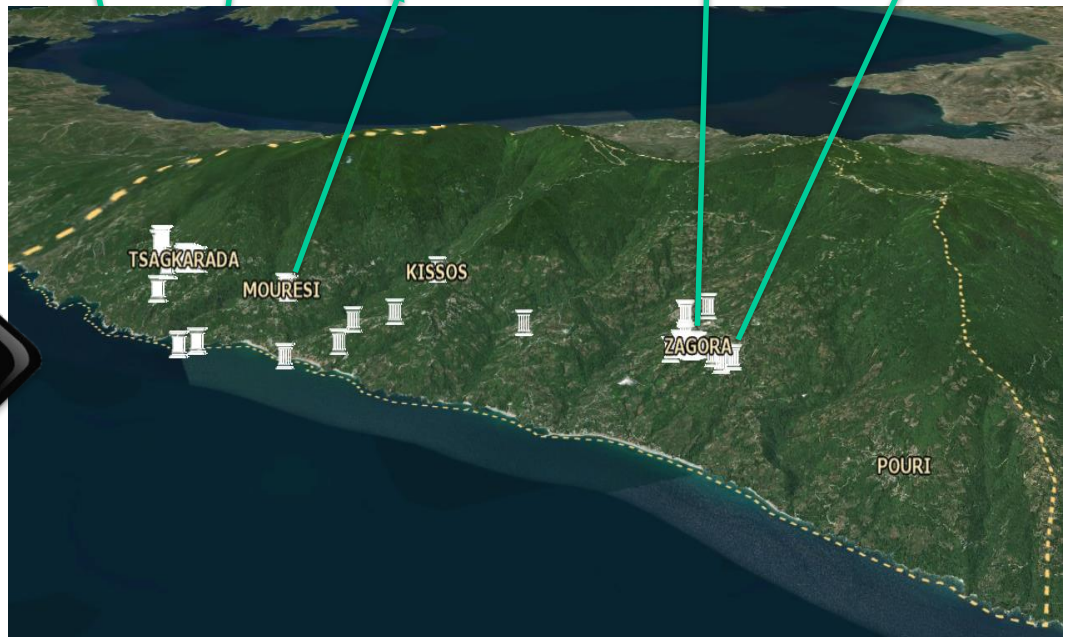
Old fountain is located in the Agia Paraskevi district (Tsagkarada)

Old Kartalio school (Tsagkarada)

Rigas Fereos school (Zagora)

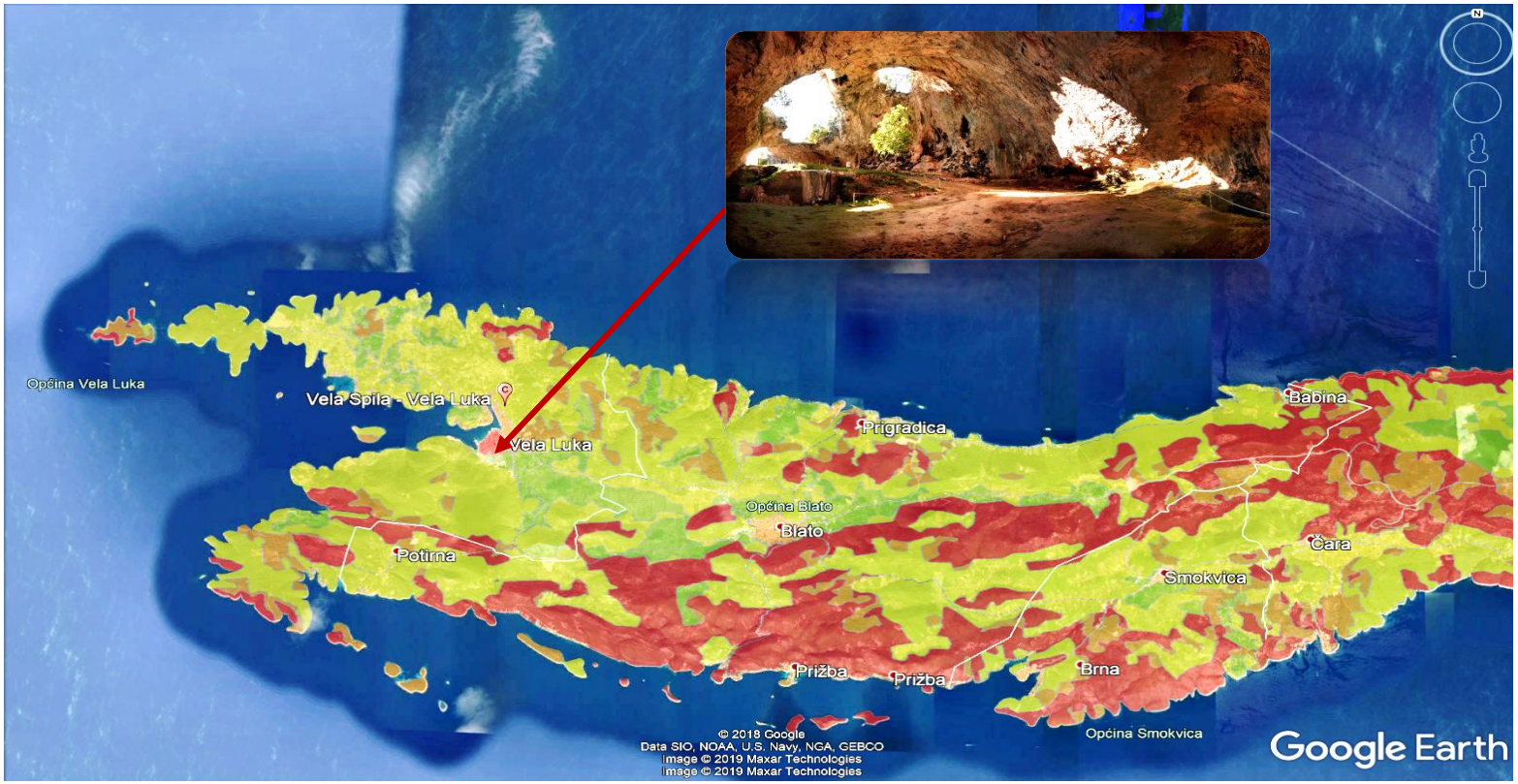
Old church “Agia Triada” (Mouresi)

Neoclassical building of special architectural interest (Zagora)



Example 2

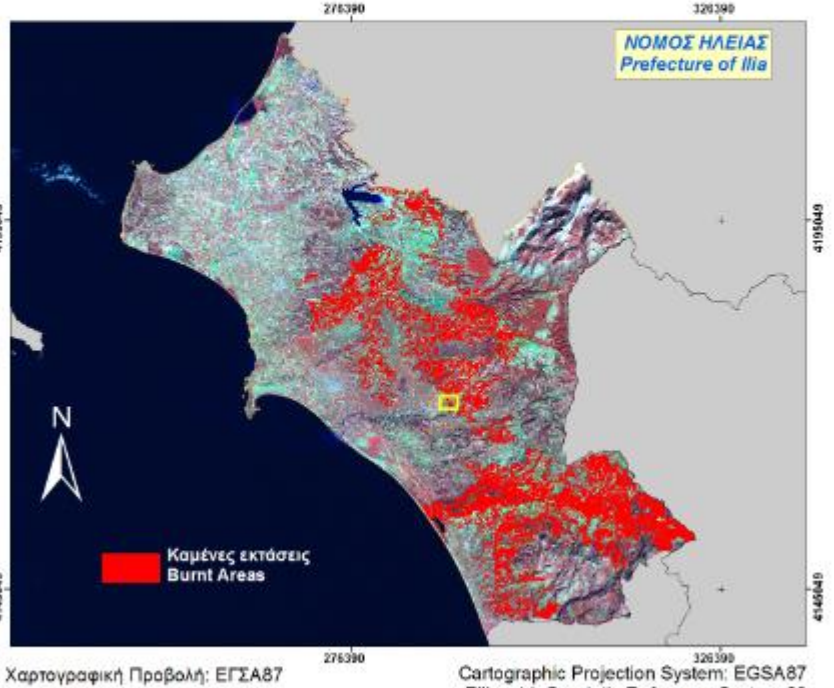
Pre-disaster forest fire risk assessment in Southern Croatia.



Vella luka cave is one of the most important prehistoric archeological monuments in Europe, located on the southern side of Pinski Rat Mountain, 130 m above the cove of Kale in Vela Luka, (Croatia). Excavations and the archaeological investigation of the site lead to the conclusion that the cave has been continuously inhabited from the early Stone Age (about 20 000 bc), and there is evidence of an occasional human presence in the following periods – Iron Age and Copper Age. To this day it has been used by the Greeks, the Romans, the Byzantines and many others.

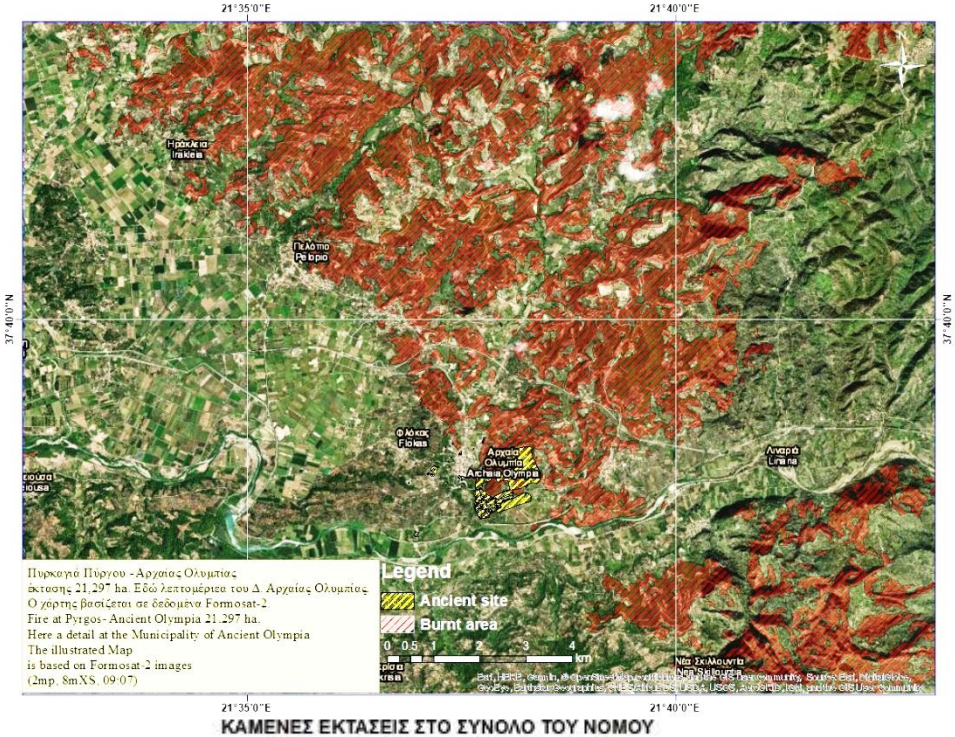
Example 3
Post fire damage assessment of the archeological site in Ancient Olympia (summer 2007)

Αρ. Φύλλου Χάρτη
Sheet No.
BSM GR11.1



Χαρτογραφική Προβολή: ΕΓΣΑ87
Ελλειψοειδές: WGS84
Scale 1:300.000

Cartographic Projection System: EGSA87
Ellipsoid: Geodetic Reference System 80
Landsat-5 TM, 28.09.07



ΚΑΜΕΝΕΣ ΕΚΤΑΣΕΙΣ ΣΤΟ ΣΥΝΟΛΟ ΤΟΥ ΝΟΜΟΥ
Burnt surfaces in the entire Prefecture

Αποτίμηση καταστροφών ανά κατηγορία Κάλυψης Γης κατά CORINE Land Cover 2000 (Burnt area assessment per CORINE Land Cover 2000 class)	Έκταση σε ha (Area in ha)
Δάσος Πλατύφυλλων (Broad-leaved Forest)	258,92
Δάσος Κωνοφόρων (Coniferous Forest)	3.385,92
Μικτό Δάσος (Mixed Forest)	5.418,52
Φυσικοί Βοσκότοποι (Natural Grassland)	1.336,53
Θάμνοι και Χερσότοποι (Moors and Heathland)	0,00
Σκληροφυλλική Βλάστηση (Sclerophyllous Vegetation)	9.483,41
Γεωργικές και Λοιπές εκτάσεις (Agricultural and Other Areas)	25.457,61
Συνολική Έκταση (Total Area)	**45.340,91**

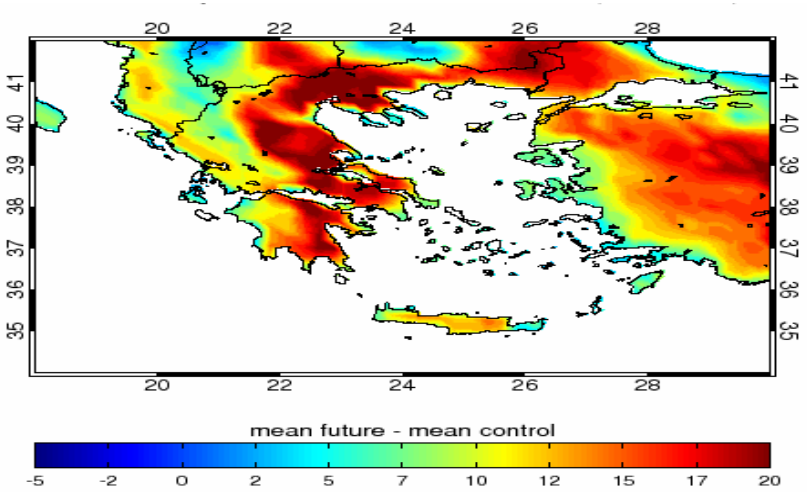
ΝΟΜΟΣ ΗΛΕΙΑΣ
Prefecture of Ilia

Χαρτογράφηση Καμένων Εκτάσεων 2007
με χρήση Δορυφορικών Εικόνων
Επέκταση του προγράμματος RISK-EOS στην Ελλάδα
Burn Scar Mapping in Greece for Year 2007
RISK-EOS, Extention to Greece

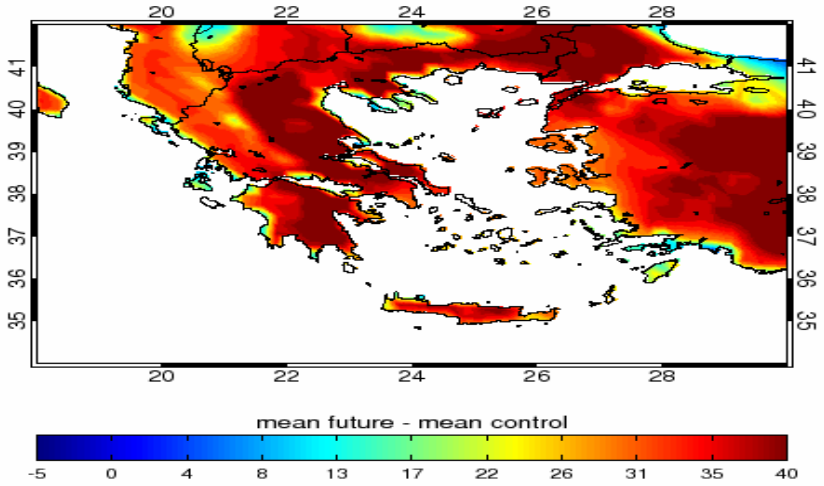
Εθνικό Αστεροσκοπείο Αθηνών
Institute for Space Applications and Remote Sensing
National Observatory of Athens
Ελληνική Δημοκρατία
Υπουργείο Αγροτικής Ανάπτυξης & Τροφίμων
Γενική Διεύθυνση Ανάπτυξης και Προστασίας Δασών και Φυσικού Περιβάλλοντος
Hellenic Ministry of Rural Development and Food
Directorate General for Development and Protection of Forests and Natural Environment

Example 3
Post fire damage assessment of the archeological site in Ancient Olympia (summer 2007)

Number of days with extreme Fire weather Risk



2021-2050 - 1961-1990



2071-2100 - 1961-1990

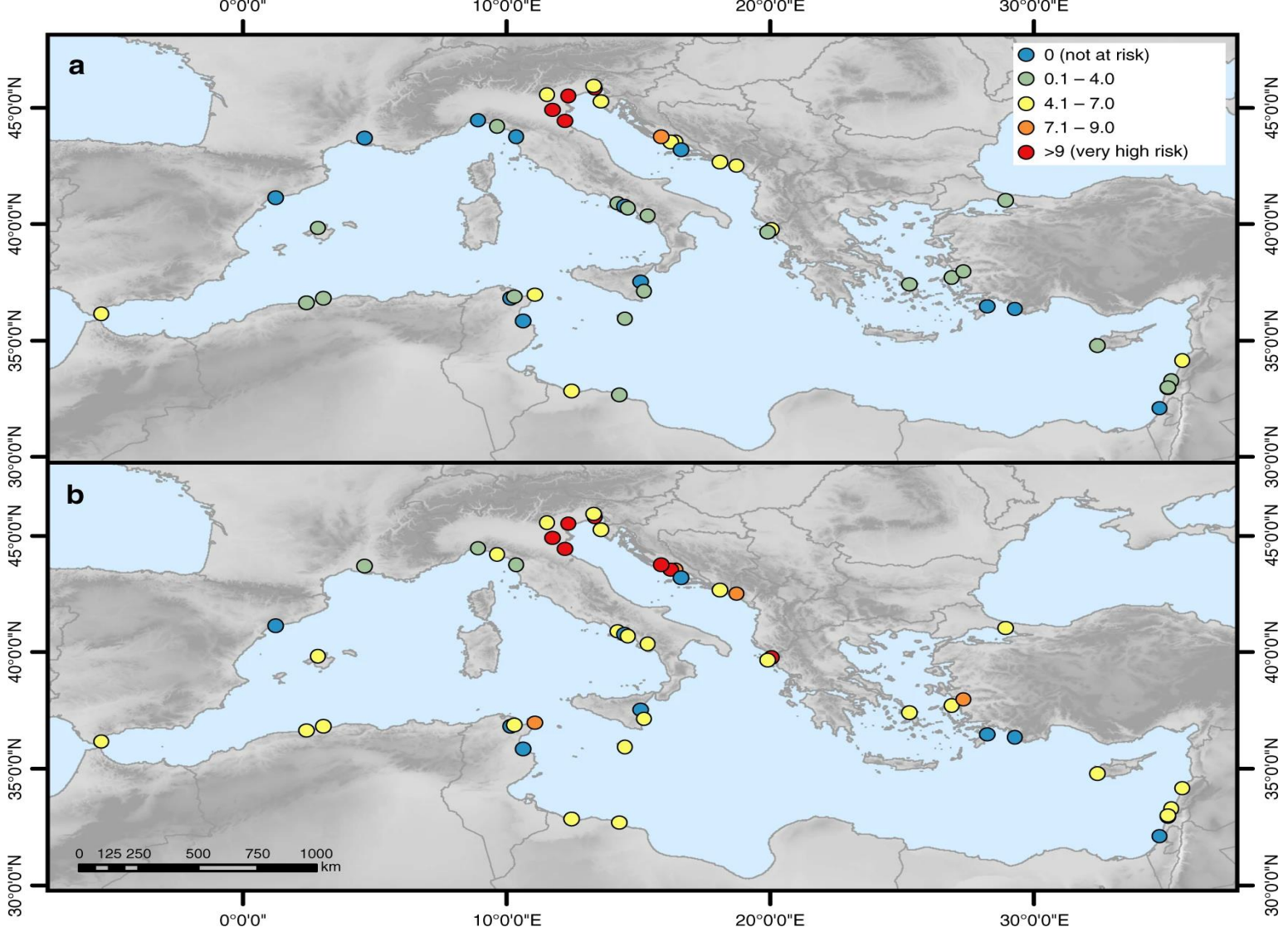
increase of the number of days with extreme fire in Eastern Greece

20 days for the period 2021-2050

40 days for the period 2071-2100

lower increases in Western Greece due to more humid climate

BoG, 2012



Flood risk index at each World Heritage site under current and future conditions. **a In 2000** and **b in 2100** under the high-end sea-level rise scenario (from: Mediterranean UNESCO World Heritage at risk from coastal flooding and erosion due to sea-level rise. Reimann, L., Vafeidis, A.T., Brown, S., Hinkel, J. and Tol R.S.J., Nature Communications 9, Article number: 4161 (2018)

Sea Level Rise

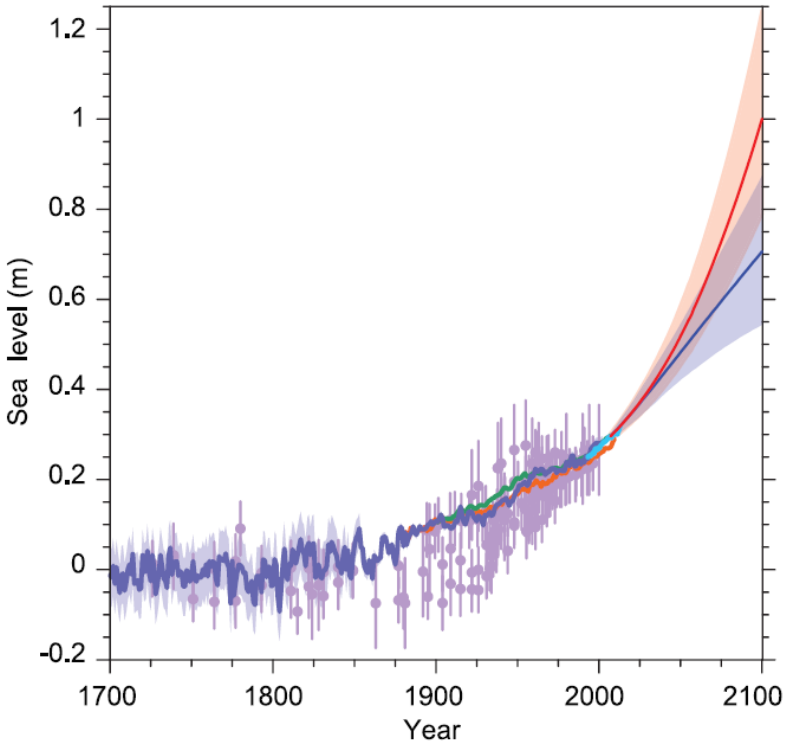
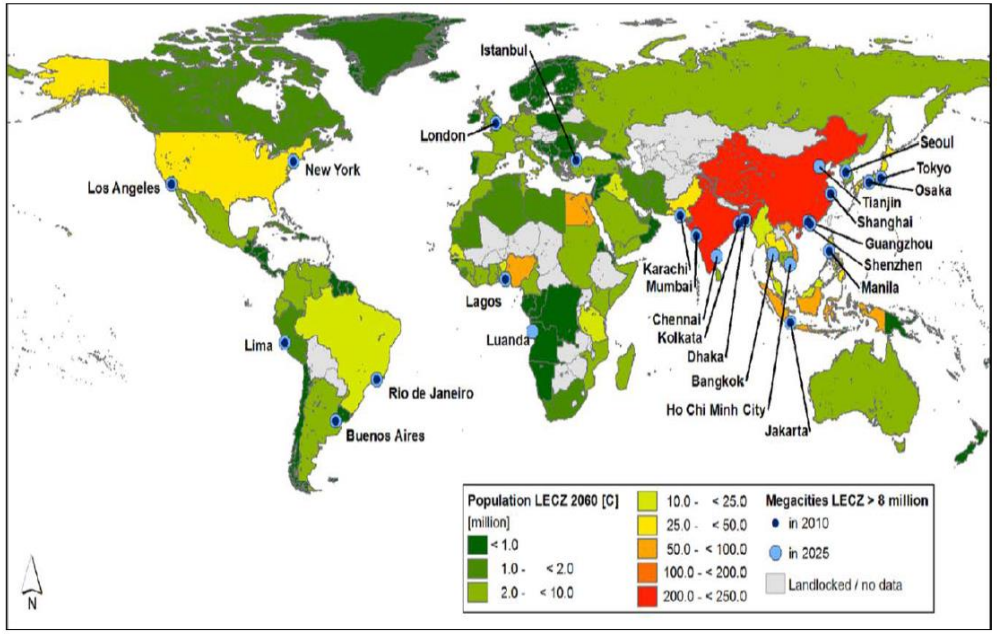


Figure 13.27 | Compilation of paleo sea level data, tide gauge data, altimeter data (from Figure 13.3), and central estimates and *likely* ranges for projections of global mean sea level rise for RCP2.6 (blue) and RCP8.5 (red) scenarios (Section 13.5.1), all relative to pre-industrial values.

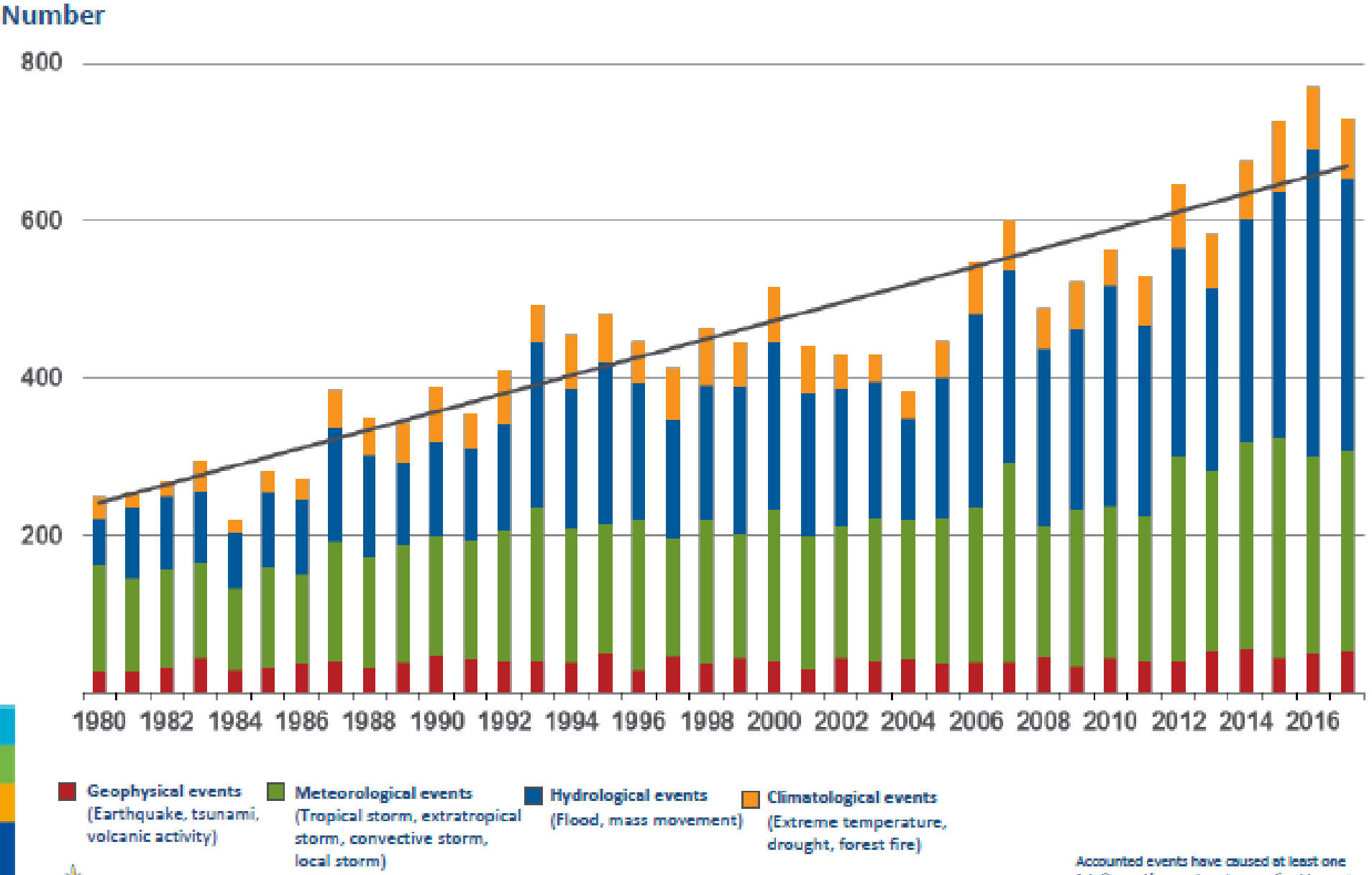
Population in low elevation coastal zones 2060 projections



Source: Neumann, Vafeidis, Zimmermann, Nicholls 2015

WMO OMM

Loss events worldwide 1980 – 2017



WMO OMM

Accounted events have caused at least one fatality and/or produced normalized losses ≥ US$ 100k, 300k, 1m, or 3m (depending on the assigned World Bank income group of the affected country).

Today, 22 June 2019, world experts have convened at the International Conference "**Impacts of Climate Change on Cultural Heritage: Facing the Challenge**" after recognizing that climate change is impacting on all aspects of world cultural heritage and in particular the integrity of monuments and sites of universal value adopted the following actions:

1.Research

The creation of a strategy that furnish better tools for our understanding of the threats as well as a more efficient mitigation of climate change effects. This will include:

Measure 1.1 Improve the quality of information on impacts of climate change on cultural heritage monuments and sites by installing detailed recording and monitoring systems for environmental threats on materials and socio-economic effects in various parts of the world.

Measure 1.2 Creation of a vulnerability index for each one and for groups of monuments and sites including those who might be affected in the future by extreme weather events in a destabilized climate environment applied worldwide.

2.Infrastructure

The creation of a strategy to help mitigation efforts of climate change effects on cultural heritage. This will include:

Measure 2.1 The creation of a repository of good practice for actions, site management and risk management plans for the prevention of climate change impacts, to be used by the relevant services for the protection of cultural heritage.

Measure 2.2 Creating actions that ensure interdisciplinary cooperation in order to investigate and implement methodologies for development of effective sustainable adaptation strategies for the climate derived threats to heritage.

Measure 2.3 Design of increased readiness action programs in Emergencies.

Measure 2.4 Create risk assessment maps for specific threats based on climatic projections.

Measure 2.5 Elaboration, on the appropriate investment programs for the protection against extreme weather events.

3.Education

The formulation of an education policy that will advise educational institutions and other stakeholders on the appropriate content for such programs for the better coordination of education efforts. This will include:

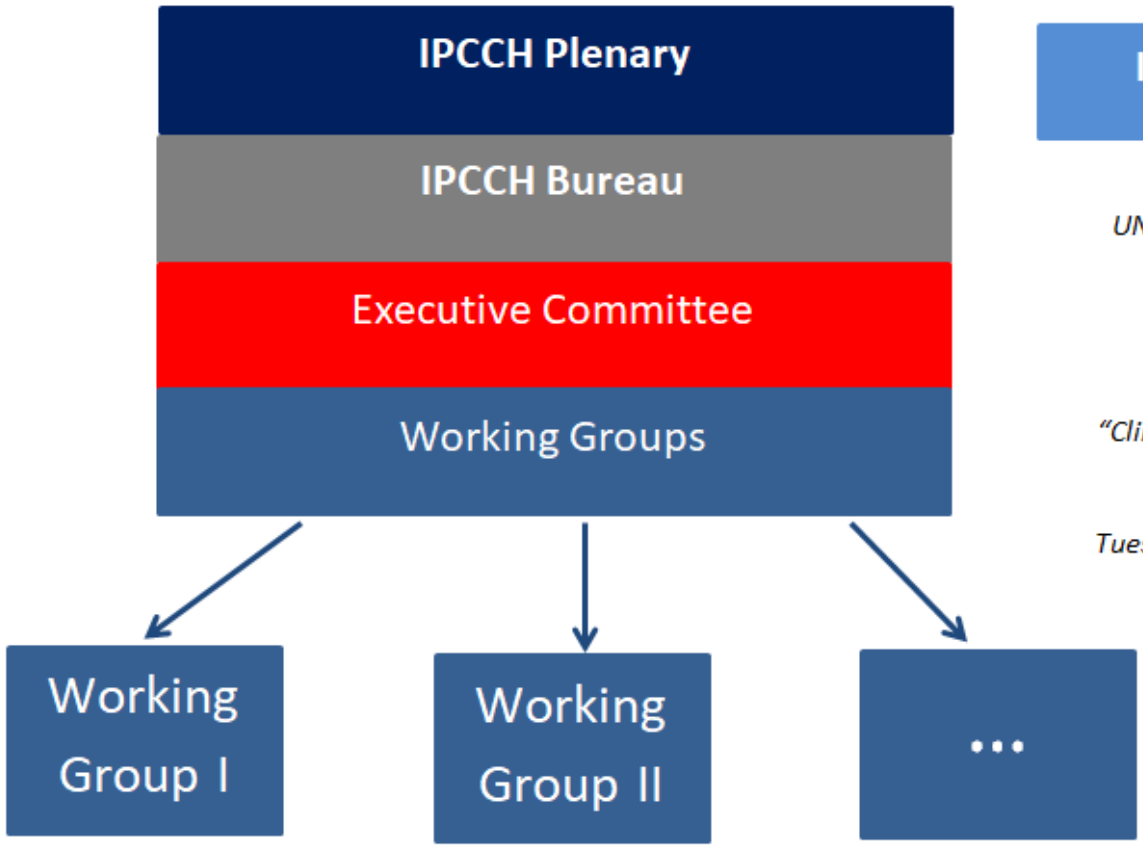
Measure 3.1 Educating children: Integrating into the educational material of primary and secondary education the impacts of climate change on cultural heritage.

Measure 3.2 Educating the public: Informing the public about the effects of climate change on heritage through programs and actions in museums, archaeological sites and schools. Traditional knowledge of indigenous people and local knowledge systems shall be included in the curricula.

Measure 3.3 Training seminars for decision-makers management authorities and services on climate change risk management and prevention.

Proposed Organogramme

for Intergovernmental Panel for Climate Change and Cultural Heritage (IPCCH)*



IPCCH Secretariat

UN Climate Change Conference COP25

Madrid, Spain

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(*) pending on decisions of the Executive Council of WMO and of UNESCO as appropriate