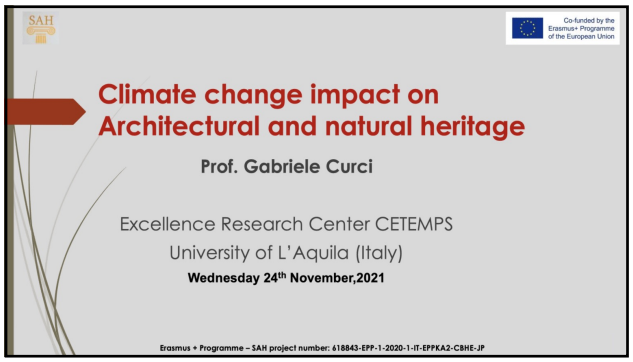
2.5 Climate Change Impact on Architectural and Natural Heritage Prof, Gabriele Curci



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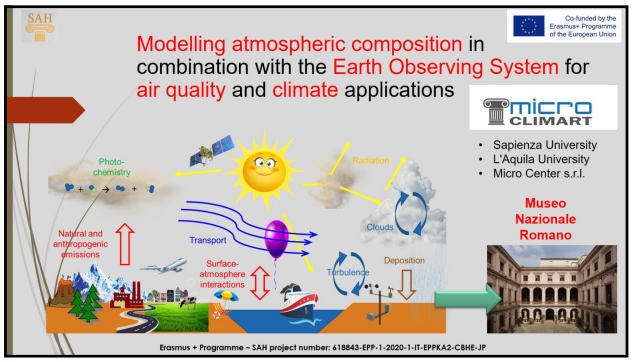

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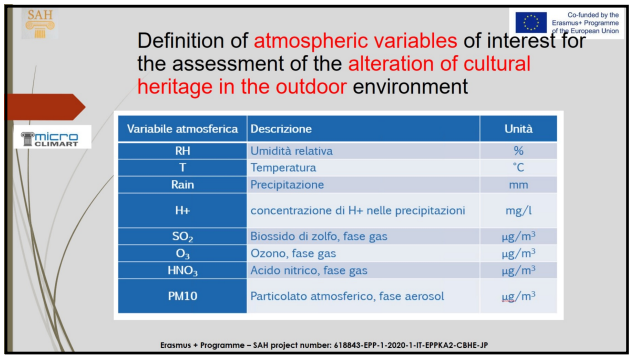
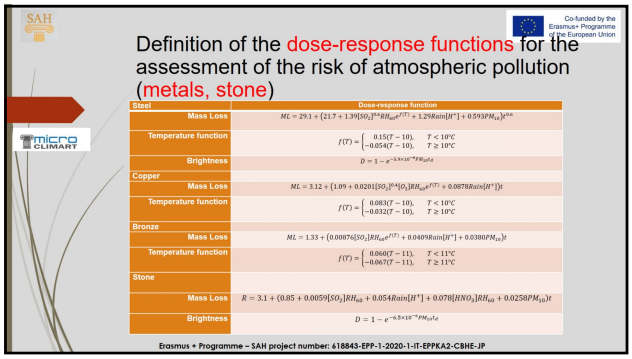


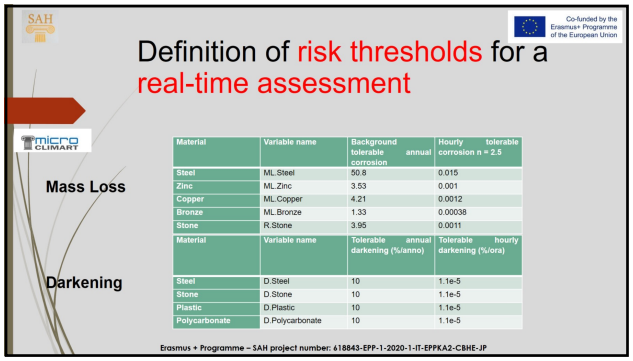
Variabile atmosferica	Descrizione	Unità
RH	Umidità relativa	%
T	Temperatura	°C
Rain	Precipitazione	mm
H+	concentrazione di H+ nelle precipitazioni	mg/l
SO_2	Biossido di zolfo, fase gas	$\mu g/m^3$
O_3	Ozono, fase gas	$\mu g/m^3$
HNO_3	Acido nitrico, fase gas	$\mu g/m^3$
PM10	Particolato atmosferico, fase aerosol	$\mu g/m^3$

3



Steel	Dose-response function
Mass Loss	$ML = 29.1 + (21.7 + 1.39[SO_2]^{0.6}RH_{60}e^{f(T)} + 1.29Rain[H^+] + 0.593PM_{10})t^{0.65}$
Temperature function	$f(T) = \begin{cases} 0.15(T-10), & T < 10°C \\ -0.054(T-10), & T \geq 10°C \end{cases}$
Brightness	$D = 1 - e^{-4.9\times10^{-4}PM_{10}t}$
Copper	
Mass Loss	$ML = 3.12 + (1.09 + 0.0201[SO_2][O_3])^{0.6}RH_{60}e^{f(T)} + 0.0878Rain[H^+])t$
Temperature function	$f(T) = \begin{cases} 0.083(T-10), & T < 10°C \\ -0.032(T-10), & T \geq 10°C \end{cases}$
Bronze	
Mass Loss	$ML = 1.33 + (0.00876[SO_2]RH_{60}e^{f(T)} + 0.0409Rain[H^+] + 0.0380PM_{10})t$
Temperature function	$f(T) = \begin{cases} 0.060(T-11), & T < 11°C \\ -0.067(T-11), & T \geq 11°C \end{cases}$
Stone	
Mass Loss	$R = 3.1 + (0.85 + 0.0059[SO_2]RH_{60} + 0.054Rain[H^+] + 0.078[HNO_3]RH_{60} + 0.0258PM_{10})t$
Brightness	$D = 1 - e^{-6.5\times10^{-4}PM_{10}t}$

4



Material	Variable name	Background tolerable annual corrosion	Hourly tolerable corrosion n = 2.5
Steel	ML.Steel	50.8	0.015
Zinc	ML.Zinc	3.53	0.001
Copper	ML.Copper	4.21	0.0012
Bronze	ML.Bronze	1.33	0.00038
Stone	R.Stone	3.95	0.0011
Material	**Variable name**	**Tolerable annual darkening (%/anno)**	**Tolerable hourly darkening (%/ora)**
Steel	D.Steel	10	1.1e-5
Stone	D.Stone	10	1.1e-5
Plastic	D.Plastic	10	1.1e-5
Polycarbonate	D.Polycarbonate	10	1.1e-5

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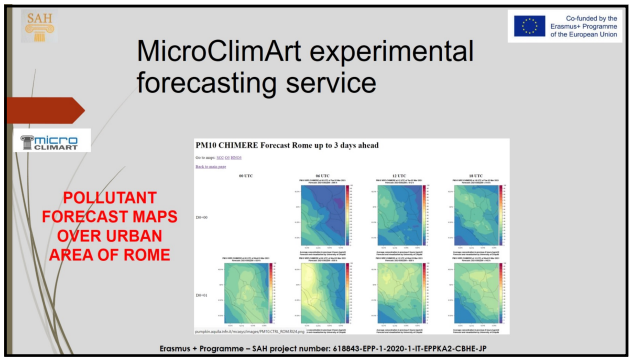

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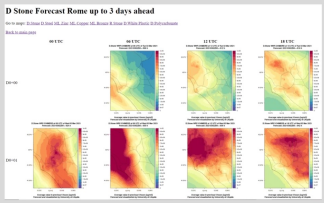
MicroClimArt experimental forecasting service

CULTURAL HERITAGE RISK MAPS



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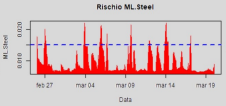
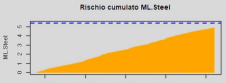
Continuous risk monitoring: example of steel corrosion

Hourly risk time series over places of interest



Risk threshold

Cumulated risk



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