

2.5 Climate Change Impact on Architectural and Natural Heritage

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Climate change impact on Architectural and natural heritage

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Modelling atmospheric composition in combination with the Earth Observing System for air quality and climate applications

micro CLIMART

- Sapienza University
- L'Aquila University
- Micro Center s.r.l.

Museo Nazionale Romano

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Definition of atmospheric variables of interest for the assessment of the alteration of cultural heritage in the outdoor environment

Variable 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	µg/m ³
O ₃	Ozono, fase gas	µg/m ³
HNO ₃	Acido nitrico, fase gas	µg/m ³
PM10	Particolato atmosferico, fase aerosol	µg/m ³

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Definition of the dose-response functions for the assessment of the risk of atmospheric pollution (metals, stone)

Material	Variable	Dose-response function
Steel	Mass Loss	$ML = 29.1 + [21.7 + 1.39[SO_2]^{0.77} + 1.29[Rain]^{0.77} + 0.519[PM_{10}]^{0.77}]e^{0.00074[SO_2]^{0.77} + 0.00099[Rain]^{0.77} + 0.0380[PM_{10}]^{0.77}}$
	Temperature function	$f(T) = \begin{cases} 0.15(T - 10), & T < 10^\circ C \\ -0.05(T - 10), & T \geq 10^\circ C \end{cases}$
	Brightness	$D = 1 - e^{-0.5 \times 10^{-5} PM_{10}}$
Copper	Mass Loss	$ML = 3.12 + (1.09 + 0.020[SO_2]^{0.77} + 0.04099[Rain]^{0.77} + 0.0878[PM_{10}]^{0.77})e^{0.00074[SO_2]^{0.77} + 0.00099[Rain]^{0.77} + 0.0380[PM_{10}]^{0.77}}$
	Temperature function	$f(T) = \begin{cases} 0.083(T - 10), & T < 10^\circ C \\ -0.032(T - 10), & T \geq 10^\circ C \end{cases}$
	Brightness	$D = 1 - e^{-0.5 \times 10^{-5} PM_{10}}$
Bronze	Mass Loss	$ML = 1.33 + (0.0074[SO_2]^{0.77} + 0.04099[Rain]^{0.77} + 0.0380[PM_{10}]^{0.77})e^{0.00074[SO_2]^{0.77} + 0.00099[Rain]^{0.77} + 0.0380[PM_{10}]^{0.77}}$
	Temperature function	$f(T) = \begin{cases} 0.060(T - 11), & T < 11^\circ C \\ -0.067(T - 11), & T \geq 11^\circ C \end{cases}$
	Brightness	$D = 1 - e^{-0.5 \times 10^{-5} PM_{10}}$
Stone	Mass Loss	$R = 3.1 + (0.05 + 0.005[SO_2]^{0.77} + 0.054[Rain]^{0.77} + 0.070[HNO_3]^{0.77} + 0.0258[PM_{10}]^{0.77})e^{0.00074[SO_2]^{0.77} + 0.00099[Rain]^{0.77} + 0.0380[PM_{10}]^{0.77}}$
	Temperature function	$f(T) = \begin{cases} 0.060(T - 11), & T < 11^\circ C \\ -0.067(T - 11), & T \geq 11^\circ C \end{cases}$
	Brightness	$D = 1 - e^{-0.5 \times 10^{-5} PM_{10}}$

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Definition of risk thresholds for a real-time assessment

Material	Variable name	Background tolerable corrosion	Hourly tolerable corrosion n = 2.5
Mass Loss	Steel	ML Steel	0.015
	Zinc	ML Zinc	0.001
	Copper	ML Copper	0.0012
	Bronze	ML Bronze	0.00038
	Stone	R Stone	0.0011
Darkening	Steel	D Steel	1.1e-5
	Stone	D Stone	1.1e-5
	Plastic	D Plastic	1.1e-5
	Polycarbonate	D Polycarbonate	1.1e-5

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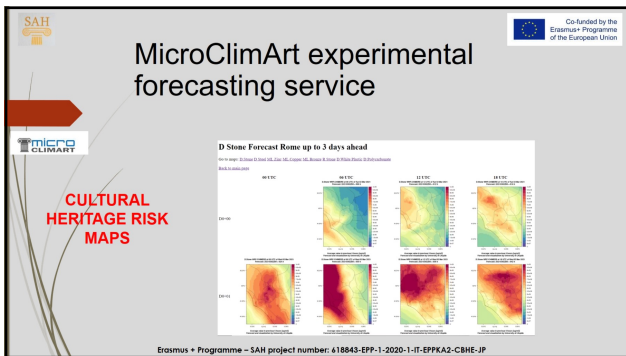
MicroClimArt experimental forecasting service

PM10 CHIMERE Forecast Rome up to 3 days ahead

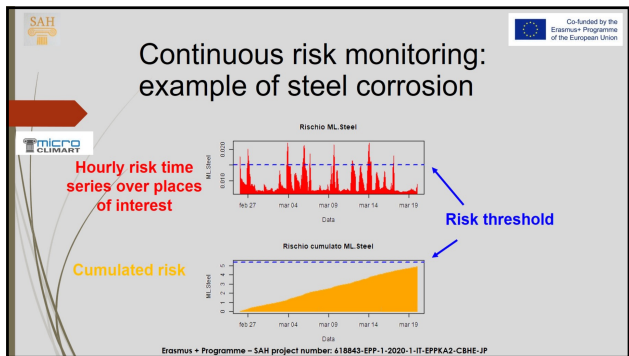
POLLUTANT FORECAST MAPS OVER URBAN AREA OF ROME

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