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The monuments of the UNESCO List under threat in the 21rst century: the Project "MONUNESCO-PARIS" (2012-2013)

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The banks of the River Seine in Paris are inscribed on the UNESCO List of the World Cultural Heritage since 1991 because they are studded with a succession of masterpieces such as Notre- Dame Cathedral, Sainte Chapelle, Louvre, Place de la Concorde, Tour Eiffel, and with prestigious museums: Louvre, Orsay, Quai Branly, Petit Palais... Unfortunately, these banks are crossed by the Pompidou urban motorway, an important and continuous source of atmospheric pollution. The aim of the Project is to evaluate the evolution of the weathering of limestone, glass and stained glass in the centre of Paris in the 21rst century by crossing Climate and Pollution Models with Dose-Response Functions (DRF) for limestone, glass and stained glass and with Climatology of Salt Transitions for limestone.

A Lutetian limestone (« Courville Stone ») has been used for the construction and the restoration of the most important monuments (Notre-Dame, Louvre...) and haussmannian buildings in Paris. It has a fine grain, a medium porosity (19%) and contains 90% of CaO. The modern glass of windows and large contemporaneous façades has a Si-Ca-Na composition, it is chemically inert, has a low thermal inertia, a flat surface, no open porosity and no surface roughness, therefore it is very durable. The glass of stained glass windows has a Si-Ca-K composition and it is low durable.

Using different climate and pollution scenarios of the 21rst century, the project will evaluate different schemes of material degradations: (i) - Recession of limestone surface; (ii) - Soiling of limestone surface; (iii) - Soiling of modern glass; (iv) - Leaching of ancient stained glass windows; (v) - Deterioration of limestone by salts.

The British Hadley Models, the French Météo- France Arpège-Aladin Models and the ENSEMBLES Approach will be crossed with DRF and Climatology of Salts Transitions.

An in-the-field inventory (stock at risk) of the surface occupied on the façades by each kind of material (stone, rendering, metal, glass, stained glass...) will be performed. A mapping of the future degradations will be achieved by means of the Aladin-Climat Model (12 x12 km) and Surfex system (1 x 1 km) of Météo-France. The aspect and the state of weathering of the monuments will allow predicting their attractivity and thus the impact on their attendance, which means on cultural and mass tourism in Paris. This assessment will allow to anticipate or to delay the restoration campaigns for the monumental façades.

This prestigious part of Paris will be a model for the entire city for the planning of these maintenance campaigns and for estimating their cost, because the results obtained in the centre of Paris will be transposable to all the haussmannian façades, that are made of the same limestone and the same window glass than those studied in the frame of this project, to the large façades in glass of the contemporaneous buildings and to the ancient stained glass windows of the Parisian churches.