ICP Materials

Activities and results 2014-2015



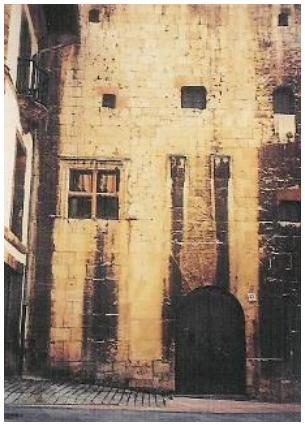

Aims of the programme

- Quantify effects of corrosion and soiling (dose-response functions)
- Describe and evaluate long-term changes in corrosion and soiling (trends)
- Apply results for mapping areas with increased risk of corrosion and soiling
- Calculation of cost of damage caused by corrosion and soiling

- Focus on multi-pollutants but taking into account confounding factors including climate effects

”Corrosion”

”Soiling”



Introduction

- The thirtieth meeting of the ICP Materials Task Force was held in Stockholm from 23 to 25 April 2014 with 18 participants from 10 countries.
- In 2014, the following reports are expected (WI 1.1.12):
  - Report No 75, Environmental data report, October 2011 to November 2012.
    - Finished, published on ICP Materials home page
  - Report No 76, Trends in pollution, corrosion and soiling 1987–2012.Report No 76 Trends in pollution, corrosion and soiling 1987-2012
    - Draft version
  - Update of mapping manual chapter 4
    - Final draft for commenting, informal document No 8 to this meeting.
- In 2014, the 2014-2015 exposure for trend analysis is expected to start
    - Estonia and Finland have joined the program (again!)
    - Slovakia has joined the program!

WGE and common workplan items discussed at ICP Materials task force (WI 1.1.10)

- Priorities of monitoring (reporting of environmental data)
  - Add PM10 as an optional parameter
  - Change status of sulphate in precipitation from mandatory to optional
  - Change status of nitrate in precipitation from mandatory to optional
- EECCA countries and co-operation with programmes/activities outside the ECE region
  - Russia is included in the programme and participated in the meeting and has declared its willingness to be active in involvning other EECCA countries
  - A representative from the standardisation group ISO TC 156 Corrosion of metals and alloys informed about an upcoming new work item proposal on a technical specification of mapping procedures
  - A representative from the standardisation group CEN TC 346 on cultural heritage conservation informed about current activities

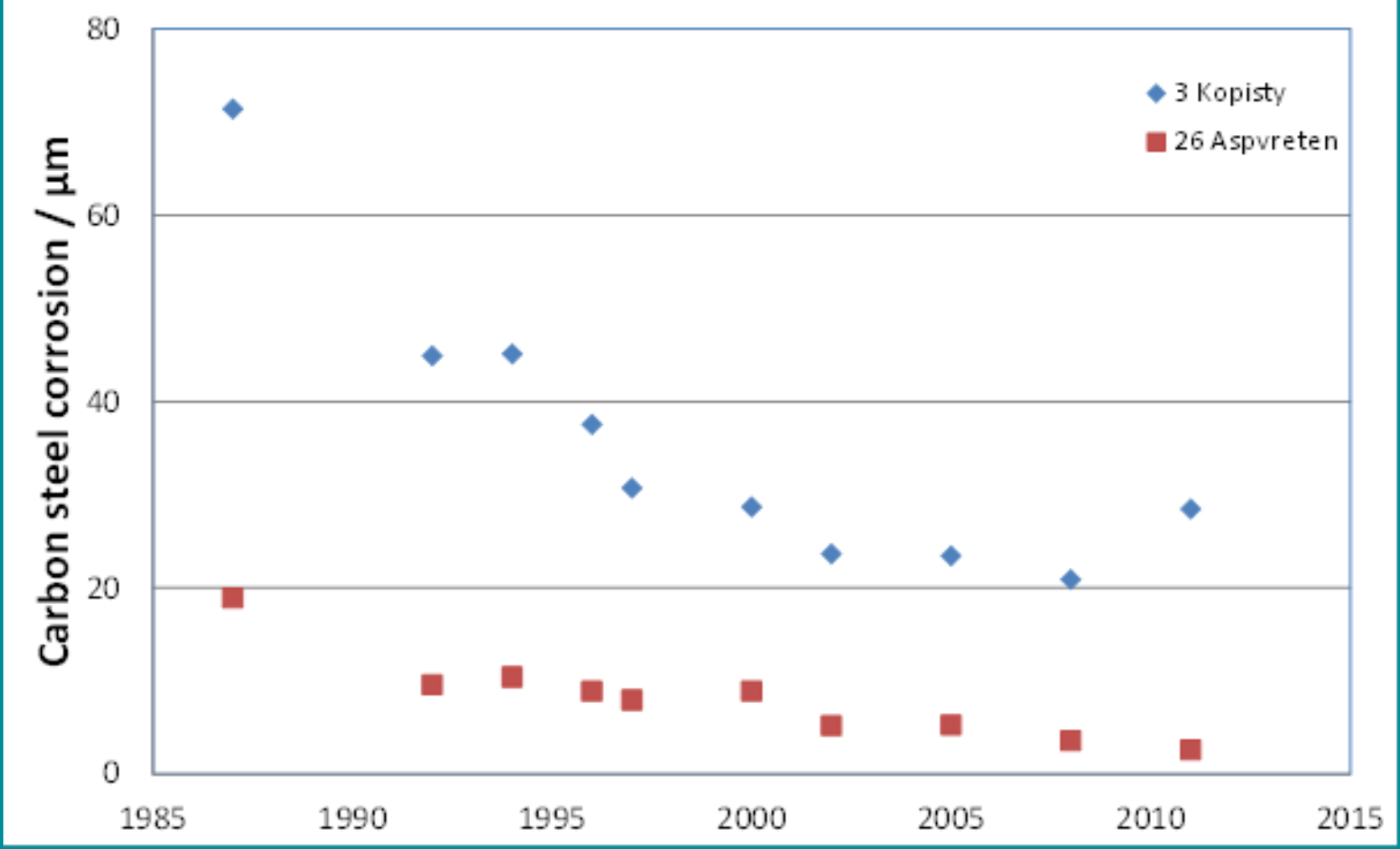
ICP Materials Report No 76: Policy relevant questions related to the trends in pollution, corrosion and soiling 1987-2012 (WI 1.1.12)

- What improvements in corrosion and soiling of materials and cultural heritage can be observed?
- Considering the improvements, are there still differences in corrosion and soiling between polluted and non-polluted areas?
- What are the main pollutants responsible for corrosion and soiling of materials and can the most recent dose-response functions predict corrosion and soiling in the current multi-pollutant situation?
- Will climate change decrease or increase the risk of corrosion and soiling due to pollution?
- What errors, if any, are introduced by using EMEP (50 km x 50 km) data for predicting corrosion?

What improvements in corrosion and soiling of materials and cultural heritage can be observed?

- Corrosion has descreased substantially to around 50% of the original values measured in 1987. In recent years, however, the improvements in corrosion and soiling are minor.

- For real cultural heritage objects made of metals the decreases are instantaneous, responding rapidly to decreasing pollution levels. For stone materials, however, there is a substantial time lag, 20 years or more, before improvements can be seen.



Carbon steel corrosion (µm) after one year of exposure at two selected sites in the ICP Materials network, one in the Czech Republic (Kopisty) and one in Sweden (Aspvreten).

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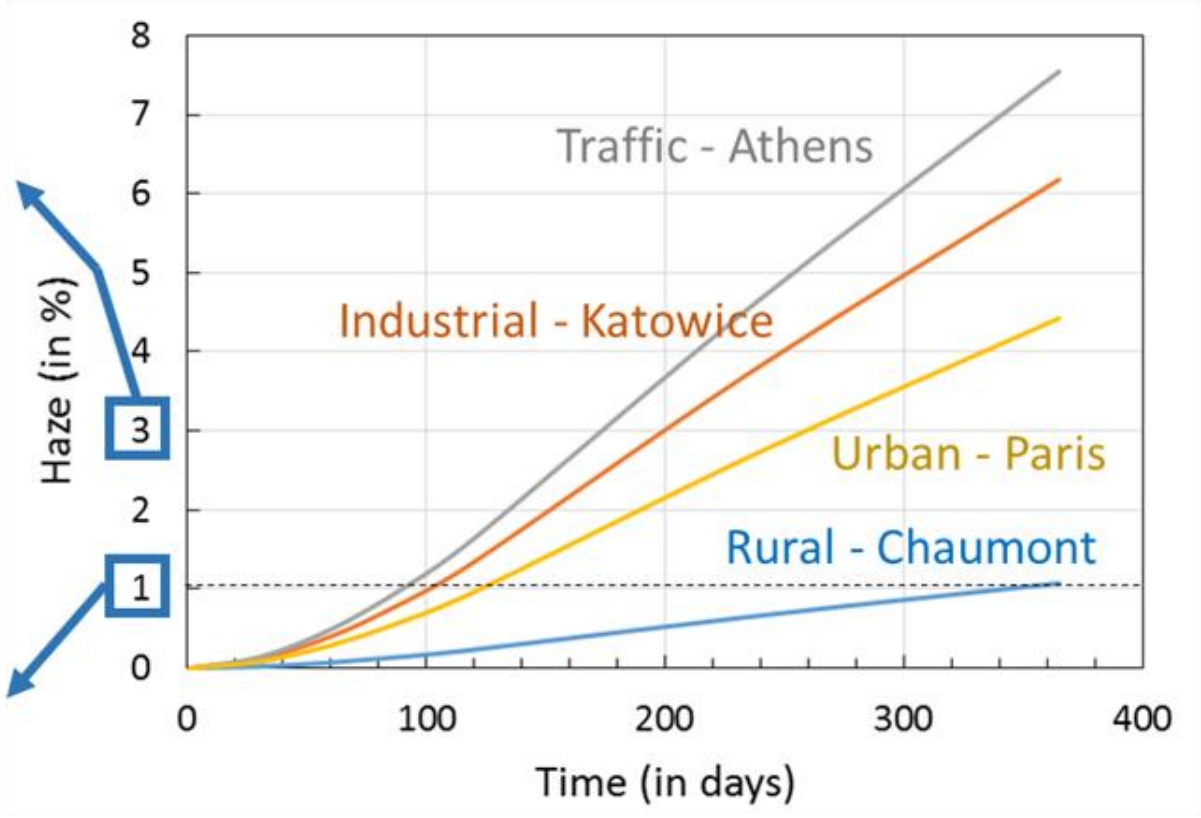
Considering the improvements, are there still differences in corrosion and soiling between polluted and non-polluted areas?

- The differences between polluted and non-polluted areas are not as high as in the 1980s' but are still significant. At the most polluted sites 2020 targets are exceeded

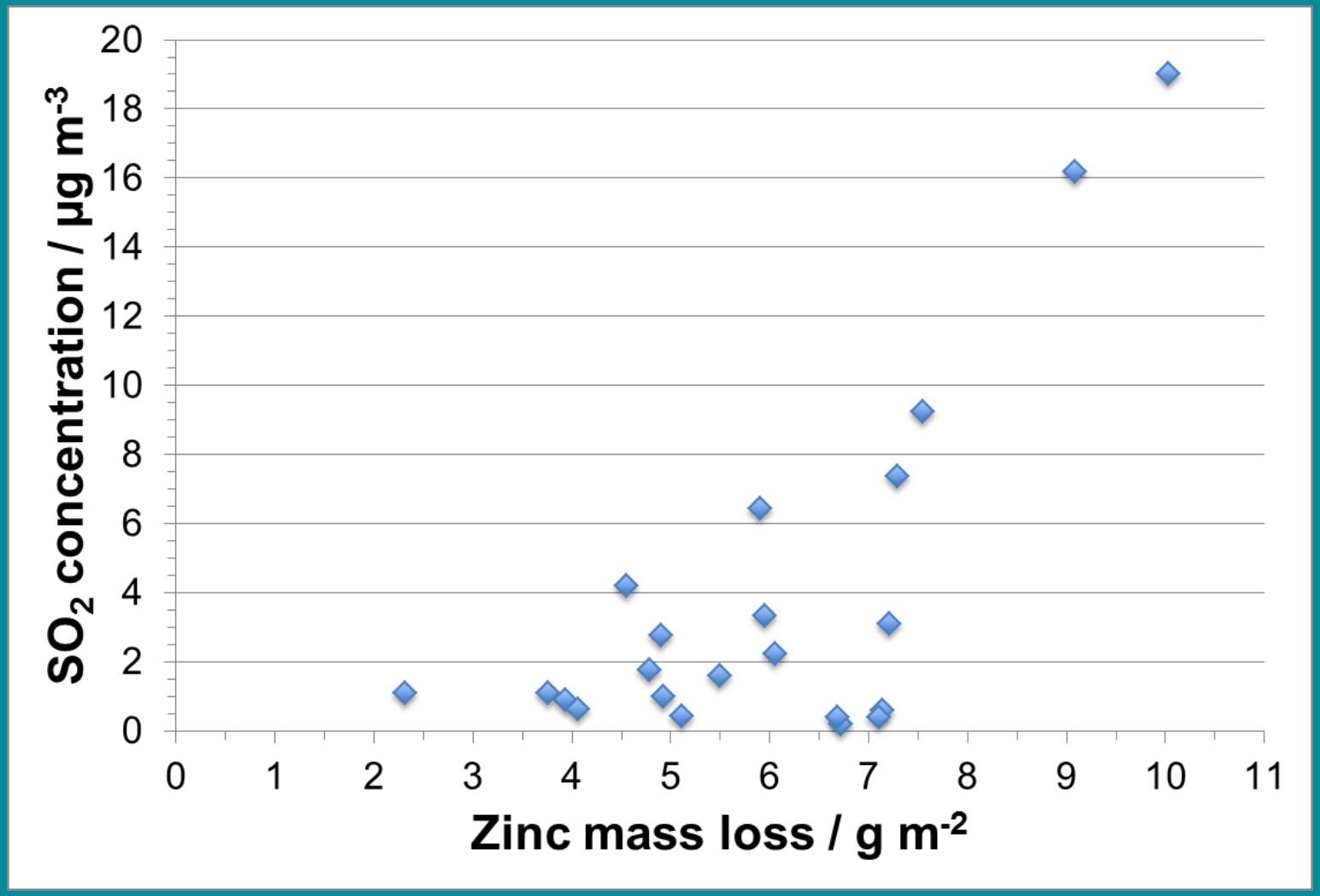


Based on a tentative target value for Haze of 1%, leading to visual nuisance detected by the human eye, exceedance is reached after 90 days (traffic site), 110 days (industrial), 130 days (urban) and one year (rural).

What are the main pollutants responsible for corrosion and soiling of materials and can the most recent dose-response functions predict corrosion and soiling in the current multi-pollutant situation?

- For corrosion, sulphur dioxide is still the main pollutant while wet acid deposition has no longer a high contribution. Other pollutants of importance in the multi-pollutant situation are particulate matter and nitric acid. The multi-pollutant functions can be improved. This is especially true for limestone where natural processes such as dissolution in neutral rainwater and freeze-thaw cycles now are relatively more important. For metals, the main confounding factor is chloride deposition.

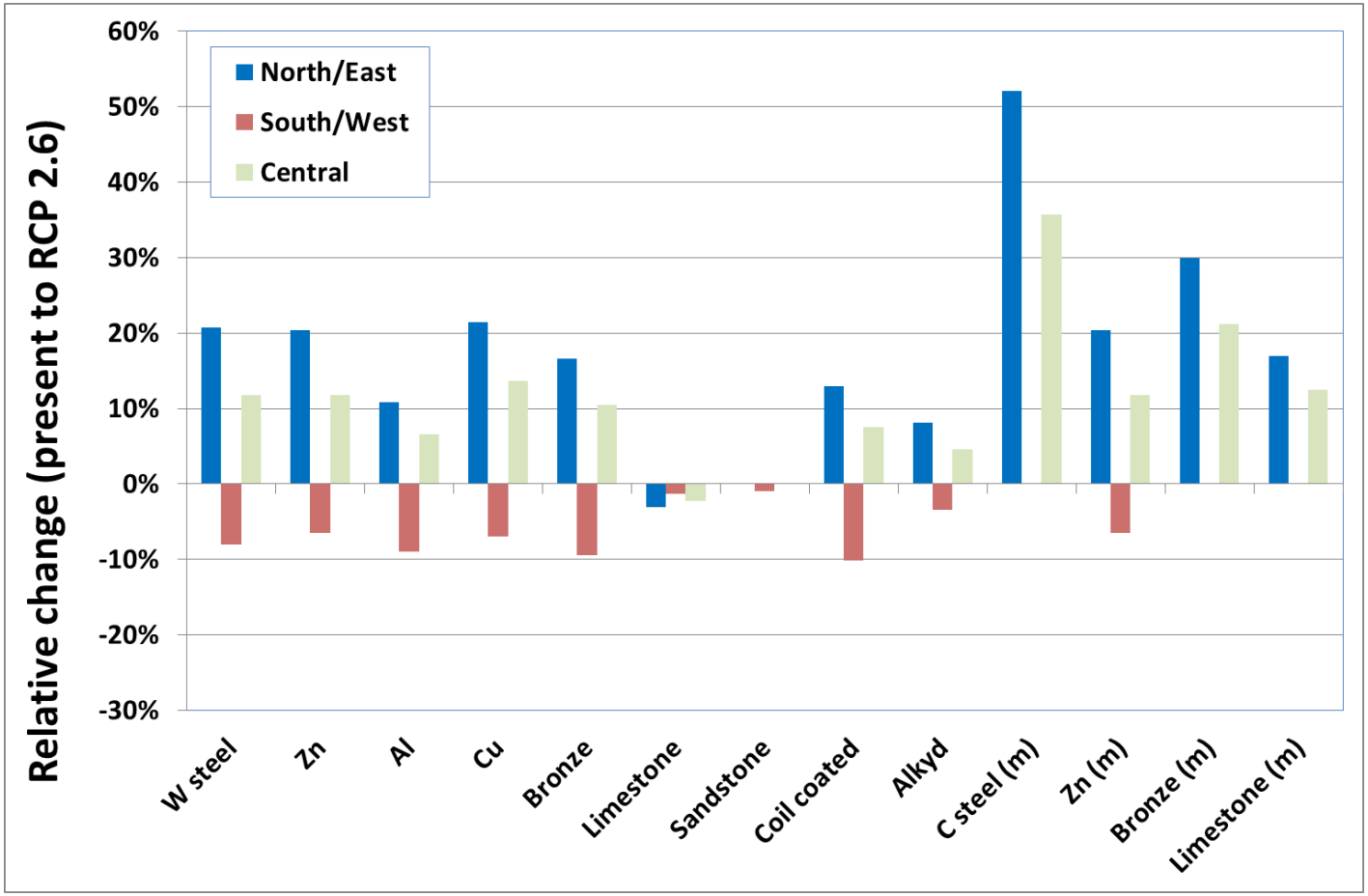
- For soiling, particulate matter together with sulphur dioxide and nitrogen dioxide are the main pollutant included in recently developed dose-response functions.



Zinc corrosion (2011-2012) relates to SO_2, especially at higher levels. At lower levels, other pollutants are also important

Will climate change decrease or increase the risk of corrosion and soiling due to pollution?

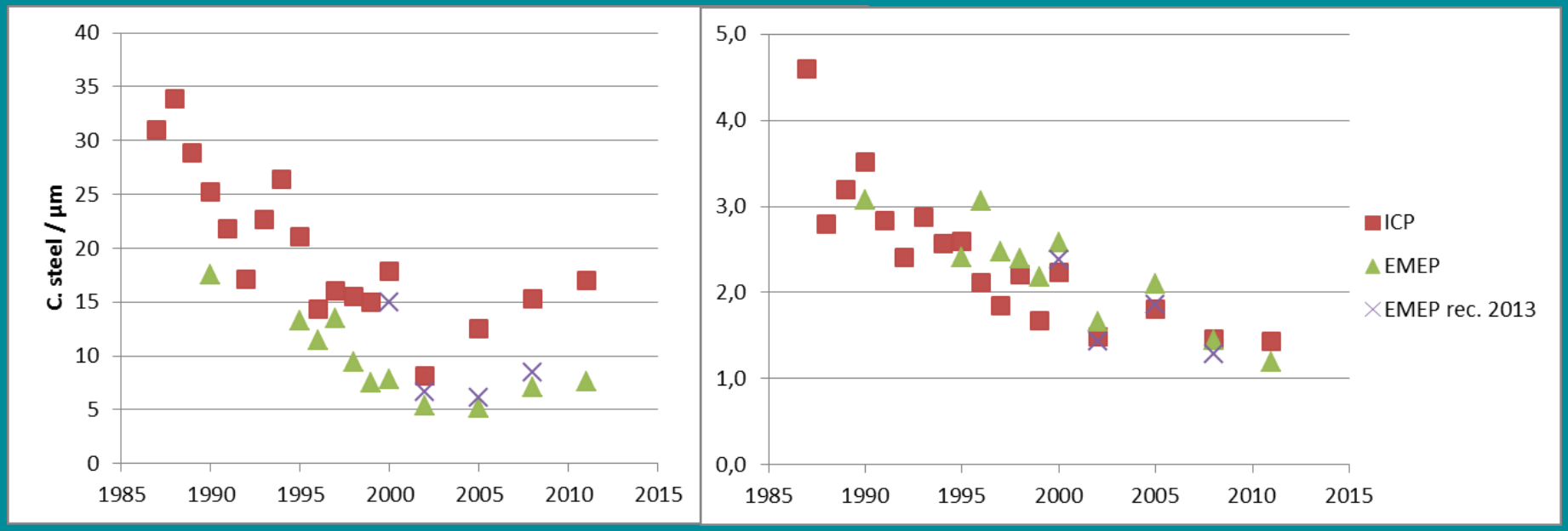
- Depending on the area, climate change can either increase or decrease the risk of corrosion. The risk is increased in North/East and Central Europe while it is decreased in South/West Europe. The magnitude of the risk depends on the chosen scenario.



The IPCC fifth assessment report defines Representative Concentration Pathways (RPCs) and RPC 2.6 is a mitigation scenario leading to a very low forcing level. Calculated relative changes are based on dose-response functions in the Mapping Manual where (m) indicates multi-pollutant functions.

What errors, if any, are introduced by using EMEP (50 km x 50 km) data for predicting corrosion?

- For polluted sites (SO_2) the use of EMEP data can result in a 50% underprediction of corrosion.
- For low polluted sites the use of EMEP data, as opposed to data measured at the site, do not result in significant errors.



Calculated carbon steel corrosion based on the sulphur dioxide part of the dose-response function for two selected sites, one in the Czech Republic (Kopisty, left) and one in Sweden (Aspvreten, right).

Activities targeted towards cultural heritage at UNESCO sites

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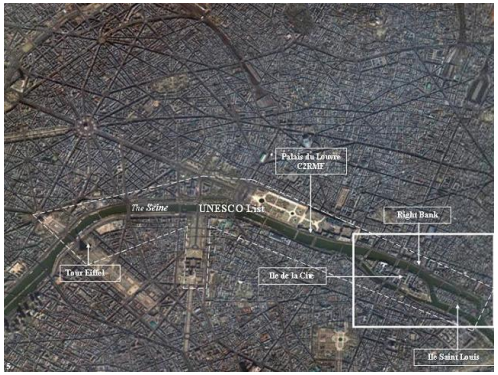
Pilot study on inventory and condition of stock of materials at risk at UNESCO cultural heritage sites

Greece, Athens
The Parthenon



France, Paris
The Facades in the Centre of City

Czech Republic, Prague
The Klementinum

Germany, Berlin Neues Museum

UK, City of Bath Royal Crescent

Further development of activities targeted towards cultural heritage at UNESCO sites

Collection, processing and elaboration of information from literature data on anthropogenic activities that could determine the levels of pollutants affecting the studied UNESCO sites.

Elaboration of maps of atmospheric pollution;

Elaboration of corrosion maps in an adequate area around the site;

Individuation of the major contributors of air pollution-related problems at the studied UNESCO sites;

Propose measures to be adopted to improve air quality at UNESCO sites and to prolong the maintenance intervals for restoration works.

Call for data proposed by ICP Materials

Cultural sites included in the UNESCO World Heritage List can serve as well-known indicators for the individuation of areas with increased risk of corrosion due to atmospheric pollution and for the economic evaluation of the damage caused by air pollution.

The purpose of the call would be:

To disseminate the experience gained during the "Pilot study on inventory and condition of stock of materials at risk at UNESCO cultural heritage sites";

To identify UNESCO sites at risk in individual countries;

To raise the interest in the work of ICP Materials.

Call for data proposed by ICP Materials
Draft template

- Site information
- Characterisation of the cultural heritage
- Concentration of atmospheric pollution
- Climate
- Additional information

Site information		
Country		
State, province or region		
Name of the site		According to the UNESCO World Heritage List
Short description		Short text describing site.
Denomination of the artistic/cultural realization to which the following data relates		Please, specify whether the reported information relates to the entire UNESCO site or individual building/monument (for example, Historic Centre of Florence, Italy or Cathedral of Santa Maria del Fiore).

Characterization of the cultural heritage		
Total surface of building(s)/monument(s), m2		Please, report all available/estimated data. The amounts of different materials may be reported as total amount (m2), percentage (%) or simply as yes/no
Limestone / marble		
Sandstone		
Render / Mortar / Plaster		
Brick		
Copper		
Bronze		
Wood		
Painted surfaces		
Glass		
Others		

Concentrations of atmospheric pollutants		
Year		Please, report all available data. Year: the year to which the data relate (possibly the most recent year). Location of measurement station: Geographic latitude and longitude of the measurement station (possibly the monitoring station nearest to the site). Alternatively, indicate the source of the data (eg. EMEP model results). All data expressed as annual averages.
Location of measurement station		
SO2, µg/m3		
NO2, µg/m3		
O3, µg/m3		
PM10, µg/m3		

Meteoclimatic parameters		
Year		Please, report all available data. Year: the year to which the data relate (possibly the most recent year). Location of measurement station: Geographic latitude and longitude of the measurement station (possibly the monitoring station nearest to the site). Alternatively, indicate the source of the data (eg. EMEP model results). All data expressed as annual averages.
Location of measurement station		
Temperature, °C		
Relative humidity, %		
Amount of rain, mm/year		
pH of precipitations		

Additional information		
Environment		Short description of the surrounding environment (eg urban, traffic, rural)
State of conservation/preservation		Please provide available information. Relevant documents can be attached as separated files to this template.
Conservation approaches		
Life cycle of maintenance/restoration		
Cost of maintenance/restoration		

Draft brochure on activities targeted towards cultural heritage at UNESCO sites

Welcome to ICP Materials 31st meeting!

April 22-24, 2015

Kjeller, Norway

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