

## ALESSANDRA BONAZZA

### CURRICULUM VITAE

**Coordinator of the Research Team "Impacts on Environment, Cultural Heritage and Human Health" at the Institute of Atmospheric Sciences and Climate, National Research Council, Italy  
PhD Earth Sciences, Professor of "Environmental impact on materials, deterioration and ageing" at the University of Bologna**

#### **Short Biography**

Senior researcher at the Institute of Atmospheric Sciences and Climate ISAC - CNR (Italy), where I am Responsible for the Unit "Impacts on Environment, Cultural Heritage and Human Health".

PhD in Earth Sciences applied to cultural heritage protection, I am Professor of "Environmental impact on materials, deterioration and ageing" at the University of Bologna and Member of the PhD Board of Earth and Marine Sciences (EMAS) of the University of Ferrara (Italy). I supervises postgraduated and PhD theses.

Since 2011 I participate as invited lecturer at the Doctoral Course organized by the Council of Europe and the European University Centre for Cultural Heritage on "Impact of Climate Change on Cultural Heritage".

Since 2014 I coordinate the International Summer School ENVIMAT "Environment-Material interaction. Preventive Conservation of monuments and archaeological sites in the Mediterranean Basin".

I have been invited as visiting Professor in different international research entities, such as School of Energy and Environment of City University of Hong Kong, Geosciences et Environment Cergy of the University of Cergy-Pontoise, Universidad Autonoma de Campeche (Mexico), University of Science and Technology Beijing (China). My academic background is geology, though I have worked in the field of heritage science for my entire career moving from building material characterization to evaluation of pollution and climate impact on monuments and archaeological sites. I am particularly interested in resilience and adaptation of cultural heritage to climate changes and environmental compatibility and durability of materials in restoration.

#### **POSITIONS HELD**

- 2019 – present **Coordinator of Research Team** "Impacts on environment, cultural heritage and human health" at CNR-ISAC.
- 2016 – 2019 **Coordinator of Research Team** "Natural, environmental and anthropic risks of Cultural Heritage" at CNR-ISAC.
- 2019 – present **CNR-ISAC responsible** for the Agreement between Opificio delle Pietre Dure and CNR-ISAC.
- 2015 - 2019 **CNR-ISAC responsible** for the Memorandum of Understanding between Specialized Analysis Institute – University of Panama and CNR-ISAC.
- 2014-present **CNR-ISAC responsible for Consorzio Cultura & Innovazione**, Progetto Polo di Innovazione Beni Culturali della Regione Calabria, Italy.
- 2014-present **Responsible for the laboratory "Material-Atmosphere Interaction"** at CNR-ISAC, Lamezia Terme unit, Italy
- 2014 - 2018 **CNR-ISAC responsible** for the Memorandum of Understanding between Water Centre for the Humid Tropics of Latin America and the Caribbean (CATHALAC) di Panama (Repubblica di Panama) University of Panama and CNR-ISAC.
- 2014-present **Member of the PhD Board** Earth and Marine Sciences of the **University of Ferrara** in collaboration **with Universidad de Cadiz**.
- 2013-present **Responsible for the laboratory of Optical Microscopy** at CNR-ISAC, unit of Bologna, Italy.
- 2013-present **CNR-ISAC responsible** for the Agreement between Dipartimento di Scienze e Ingegneria della Materia, dell'Ambiente ed Urbanistica of Università Politecnica delle Marche and CNR-ISAC.

- 2013-2019 **CNR-ISAC responsible** for the Memorandum of Understanding between Patronato Panama' Viejo (Repubblica di Panama) and CNR-ISAC.
- 2013-2019 **CNR-ISAC responsible** for the Agreement between Dipartimento di Chimica, Materiali e Ingegneria Chimica "Giulio Natta" and CNR-ISAC.
- 2011-present **CNR-ISAC responsible** for the Agreement between Facoltà di Scienze Matematiche, Fisiche e Naturali dell'Università degli Studi di Ferrara and CNR-ISAC.
- 2011-present Working Group Member of UNI **Ambiente** (GL4) – Ente Nazionale Italiano di Unificazione.

### **RESEARCH PROJECTS PARTICIPATION AND ROLE**

- 2021 – present CNR-ISAC **Principal Investigator** of EU Project ERASMUS + Cultural Heritage Protection in Climate Change online, ChePiCC online".
- 2021 – present CNR-ISAC **Principal Investigator** of EU Project EC H2020-MSCA-RISE-2020 "Sustainable COnservation and REstoration of built cultural heritage, SCORE".
- 2020 – present **Project Coordinator** of Interreg Central Europe Project "STRENGhtening resilience of Cultural Heritage at risk in a changing environment through proactive transnational cooperation – STRENCH".
- 2019 – present CNR-ISAC **Principal Investigator** of EU Project EC H2020-MSCA-RISE-2019 "TEchnological Consortium TO develop sustainAbility of underwater Cultural heritage, TECTONIC".
- 2019 CNR-ISAC **Principal Investigator** of the Project funded by SENACYT "Innovación y tecnología en la conservación de monumentos y sitios patrimoniales en ambientes tropicales húmedos: retos y perspectivas".
- 2018 – 2020 CNR-ISAC **Principal Investigator** of the Project funded by the Council for Public Education of México "Red de estudios interdisciplinarios sobre medio ambiente y conservación del patrimonio mexicano. Escenarios de riesgo para el patrimonio en México: causas ambientales involucradas en su deterioro y estrategias de conservación."
- 2017 – 2020 **Project Coordinator** of Interreg Central Europe Project "Risk assessment and sustainable protection of Cultural Heritage in changing environment, ProteCHt2save".
- 2016 – 2018 **Project Coordinator** of the Project funded by European Commission Directorate-General for Education and Culture "Study on Safeguarding Cultural Heritage from Natural and Man-Made Disasters (contr. EAC-2016-0248).
- 2014-2017 CNR-ISAC **Principal Investigator** of the Project funded by JPI Cultural Heritage "Effectiveness of methods against rising damp in buildings: European practice and perspective (EMERISDA)".
- 2014-2016 CNR-ISAC (Bologna unit) **Principal Investigator** of the Project Accordo Bilaterale di Cooperazione Scientifica CNR-PAS Italia-Polonia "Transport and deposition of particulate matter in historic buildings".
- 2014-2015 CNR-ISAC **Principal Investigator** of the Project Accordo Bilaterale di Cooperazione Scientifica CNR-CNRST (Marocco) "Atmospheric pollution impact on Moroccan architectural cultural heritage".
- 2014-2015 CNR-ISAC **Principal Investigator** of the Project funded by Regione Calabria POR CALABRIA FESR 2007/2013 "Sistemi e tecnologie per il MONitoraggio di Aree culturali in ambiente subacqueo e terrestre (SIMONA)".
- 2014-2015 CNR-ISAC **Principal Investigator** of the Project funded by Regione Calabria POR CALABRIA FESR 2007/2013 "PROtection TEchnology for Cultural Heritage (NANOPROTECH)".

- 2013-presente CNR-ISAC **Principal Investigator** of the Project funded by Ministero dei Beni e delle Attività Culturali e del Turismo “Valutazione dell’impatto del traffico veicolare sul patrimonio culturale: esposizione presso il Museo di S. Marco, Firenze”.
- 2013-2014 CNR-ISAC **Principal Investigator** of the Project funded by Opera di Santa Maria del Fiore “Porta del Paradiso. Progetto di monitoraggio durante l’esposizione”.
- 2011-2014 CNR-ISAC **Principal Investigator** of the EU Project 7FP “System for Digitisation and Diagnosis in ART Applications (SYDDARTA)”.
- 2011-2014 CNR-ISAC (Bologna unit) **Principal Investigator** of the EU 7FP Project “Nano-systems for the conservation of immovable and moveable polymaterial Cultural Heritage in a changing environment (NANOMATCH)”.
- 2008-2011 CNR-ISAC (Bologna unit) **Principal Investigator** of the EU 7FP Project “*Technologies and tools to prioritize Assessment and diagnosis of air pollution impact on immovable and movable Cultural Heritage (TeACH)*”.
- 2008-2009 **Participation** at the Project funded by Opera della Primaziale Pisana “Monitoraggio delle cause ambientali di degrado per la messa a punto dei protocolli di manutenzione”.
- 2007-2013 **Participation** at the EC Project “Planning, Urban Management and Heritage (PUMAH)” People Marie Curie Actions. International Research Staff Exchange Scheme, 7FP.
- 2006-2008 **Participation** at the Project funded by Opera della Primaziale Pisana “Indagini diagnostiche finalizzate alla identificazione delle cause di degrado degli affreschi del Camposanto Monumentale di Pisa”.
- 2005-2006 **Project Coordinator** of the Project funded by Comune di Ancona “Caratterizzazione del degrado del Museo della Città di Ancona”.
- 2005-2006 **Participation** at the Project funded by Heritage Malta “Environmental Monitoring at Hagar Qim and Mnajdra Temples” (Tender CT 2592/04).
- 2005 - 2006 **Participation** at Progetto PRIN 2005 “Indagine microstrutturale sul calcestruzzo armato di infrastrutture degradate per aggressione ambientale”.
- 2004-2007 **Participation** at the EC 6FP Project “Global climate change impact on built heritage and cultural landscapes (NOAH’S ARK)” (contr. SSPI-CT-2003-501837).
- 2004-2005 **Participation** at the Project funded by Ministero per i Beni e le Attività Culturali e dall’Istituto Centrale per il Restauro “Studio sperimentale per la caratterizzazione del danno connesso all’annerimento e all’azione di organismi biodeteriogeni per i beni di interesse storico-artistico esposti all’aperto”.
- 2003-2005 **Participation** at the EC INCO-MED Project “Project on high compatibility technologies and systems for conservation and documentation of masonry works in archaeological sites in the Mediterranean Area (PRODOMEA)” (contr. ICA3-CT-2002-10021).
- 2003-2004 **Participation** at the Progetto Battistero “Studio dell’impatto ambientale nel centro urbano di Firenze”.
- 2003 **Project Coordinator** of the Project funded by Centro Europeo Conservazione del Patrimonio Architettonico (Venezia) “Surface deposit identification on building materials of Iranian cultural heritage”.
- 2003 **Project Coordinator** of the Project funded by Istituto per i Beni Ambientali e Culturali (IBACN) della Regione Emilia Romagna “Caratterizzazione del degrado della loggia del Castello di Montechiarugolo”.

- 2001-2003 **Participation** at the EC 5FP Project “Carbon content and origin of damage layers in European Monuments (CAMEL)” (contr. EVK4-CT-2000-0029).
- 2002-2003 **Participation** at the Project funded by Consorzio Venezia Nuova “Analisi sui materiali a supporto dell’identificazione dei fenomeni di degrado, nell’ambito dell’indagine propedeutica alla progettazione degli interventi presso l’Arsenale di Venezia”.
- 2001 **Participation** at the Project funded by Comune di Bologna “Diagnostica del degrado del quadriloggiato inferiore del Palazzo dell’Archiginnasio”.

### RELEVANT TEACHING ACTIVITIES

- 2019- present **Professor** of “Environmental impact on materials, deterioration and ageing – 1 Environmental Impact and Damage Processes of Cultural Heritage”. Second Cycle Degree/Two years Master “Science for the conservation –Restoration of cultural heritage”. **University of Bologna**. A.A. 2019/2020, A.A. 2020/2021.
- 2011- 2019 **Professor** of “Environmental impact on materials, deterioration and ageing – 2 preventive conservation”. Second Cycle Degree/Two years Master “Science for the conservation – Restoration of cultural heritage”. University of Bologna. A.A. 2011/2012, A.A. 2012/2013, A.A. 2013/2014; A.A. 2014/2015; A.A. 2015/2016; A.A. 2016/2017; A.A. 2017/2018; A.A. 2018/2019.
- May 2021 Professor of “Climate change and pollution impact on cultural heritage” and “Exploring Copernicus programme for safeguarding cultural heritage at risk”. Master in “Space missions science, design and applications”. **University of Bologna**. A.A. 2020 -2021
- Feb 2019 **Professor** of “Pollution impact on cultural heritage: impact assessment and strategies for preventive conservation” at the course “Preventive conservation, handling and transport of artworks”. Opificio delle Dure di Firenze, supported by **MiBACT**, Italy.
- Sept 2018 **Teaching** “Climate change impact on cultural heritage” at the course Kulturgüterschutz 2017/2020 (Tutela dei Beni Culturali 2017/2020). **Universität für Weiterbildung Krems Department für Bauen und Umwelt**.
- Mar-Jun 2017 **Professor** at the course “UNESCO/Monaco Funds-in-Trust Project Capacity-Building and Awareness-Raising for the Preservation, Conservation, Visibility and Sustainable Management of the Archaeological Site of Shoroon Bumbagar of Mount Maikhan (Mongolia)” supported by **UNESCO** Office in Beijing.

### RELEVANT PUBLICATIONS

- Bonazza A.**, Sardella A., Kaiser A., Cacciotti R., De Nuntiis P., Hanus C., Maxwell I., Drdäcký T., Drdäcký M., 2021. Safeguarding cultural heritage from climate change related hydrometeorological hazards in Central Europe. *International Journal of Disaster Risk reduction*, 63, 102455, ISSN 2212-4209, <https://doi.org/10.1016/j.ijdr.2021.102455>.
- Cacciotti R., Kaiser A., Sardella A., De Nuntiis O., Drdacky M., Hanus, C., **Bonazza, A.** 2021. Climate change-induced disasters and cultural heritage: Optimizing management strategies in Central Europe. *Climate Risk Management*. Vol. 32, 100301. ISSN 2212-0963. DOI: <https://doi.org/10.1016/j.crm.2021.100301>.
- Ricca M., Urzi C., Rovella N., Sardella A., **Bonazza A.**, Ruffolo S. A., De Leo F., Randazzo L., Arcudi A., La Russa M. F. 2020. Multidisciplinary approach to characterize archaeological materials and status of conservation of the Roman Thermae of Reggio Calabria site (Calabria, South Italy). Special Issue "Analytical Methodologies Applied to the Study of Cultural Heritage Surface". *Section Environmental and Sustainable Science and Technology. Applied Sciences*, 10, 5106. doi:10.3390/app10155106.
- Ricca M., Alexandrakis G., **Bonazza A.**, Bruno F., Davide Petriaggi B., Elkin D., Lagudi A., Nicolas S., Novák M., Papatheodorou G., Prieto J., Ricci M., Vasilijevic A., La Russa M. F., 2020. A Sustainable Approach for the

Management and Valorization of Underwater Cultural Heritage: New Perspectives from the TECTONIC Project. Sustainability, 12, 50000, doi:10.3390/su12125000.

Sardella A., Palazzi E., von Hardenberg J, Del Grande C., De Nuntiis P., Sabbioni C., **Bonazza A.** 2020. Risk mapping for the sustainable protection of cultural heritage in extreme changing environments. Special Issue Assessing the Impact of Climate Change on Urban Cultural Heritage. Atmosphere 10(15), 5106. DOI: <https://doi.org/10.3390/atmos1070700>

Fermo P., Comite V., Ciantelli C., Sardella A., **Bonazza A.** 2020. A multi-analytical approach to study the chemical composition of total suspended particulate matter (TSP) to assess the impact on urban monumental heritage in Florence. Science of the Total Environment. Vol. 740, 140055. DOI: <https://doi.org/10.1016/j.scitotenv.2020.140055>

Sesana E., Gagno A.S., **Bonazza A.**, Hughes J.J. 2020. An integrated approach for assessing the vulnerability of World Heritage Sites to climate change impacts. Journal of Cultural Heritage, 41, 211-224. DOI:10.1016/j.culher.2019.06.013.

García-Florentino, C., Maguregui, M., Ciantelli, C., Sardella, A., **Bonazza, A.**, Queralt, I., Carrero, J.A., Natali, C., Morillas, H., Madariaga, J.M., Arana, G., 2020. Deciphering past and present atmospheric metal pollution of urban environments: The role of black crusts formed on historical constructions. Journal of cleaner Production, vol 243, DOI: 10.1016/j.jclepro.2019.118594

Ciantelli C., Sardella A., Pecchioni E., Favoni O., **Bonazza A.**, 2020. Herodian Machaerus Fortress (Jordan): investigation of mortars belonging to the hydraulic constructions. International Journal of Architectural Heritage. 14(5), 645-657. <https://doi.org/10.1080/15583058.2018.1558312>.

**Bonazza A.**, De Nuntiis P., Sardella A., Ciantelli C., Palazzi E., Hardenberg J. 2020. ProteCHt2save - Risk assessment and sustainable protection of Cultural Heritage in changing environment. Convegno Internazionale di Studi "Monitoraggio e manutenzione nelle aree archeologiche. Cambiamenti climatici, dissesto idrogeologico, degrado chimico-ambientale". Ed. L'Erma di Bretschneider, collana Bibliotheca Archaeologica, Volume 24. 2020. ISBN: 9788891319470.

Vidorni G., Sardella A., De Nuntiis P., Volpi F., Dinoi A., Contini D., Comite V., Vaccaro C., Fermo P., **Bonazza A.** 2019. Air pollution impact on carbonate building stones in Italian urban sites. The European Physical Journal Plus. 134: 439. DOI: 10.1140/epjp/i2019-12943-0.

Lamhasni T., El-Marjaoui H., El Bakkali A., Ait Lyazidi S., Haddad M., Ben-Ncer A., Benyaich F., **Bonazza A.**, Tahri M., 2019. Air pollution impact on architectural heritage of Morocco: Combination of synchronous fluorescence and ATR-FTIR spectroscopies for the analyses of black crusts deposits. Chemosphere 225, 517-523. doi:10.1016/j.chemosphere.2019.03.109.

Sardella A., De Nuntiis P., **Bonazza A.**, 2018. Efficiency evaluation of treatments against rising damp by scale models and test in situ. Journal of Cultural Heritage, Special Issue ModihMA 2018, 31S, S30-S37.

**Bonazza A.**, Maxwell I., Drdácky M., Vintzileou E., Hanus C, Ciantelli C., De Nuntiis P., Oikonomopoulou E., Nikolopoulou V., Pospíšil S., Sabbioni C., Strasser P. 2018 "Safeguarding Cultural Heritage from Natural and Man-Made Disasters A comparative analysis of risk management in the EU", © European Union, 2018, ISBN 978-92-79-73945-3, DOI:10.2766/224310, (catalogue) NC-05-17-059-EN-N, 207 pp.

Pepi S., Sardella A.; **Bonazza, A.**, Vaccaro C., 2018. Geochemical caper fingerprints as a tool for geographical origin identification". Environmental Geochemistry and Health, 1-19, <https://doi.org/10.1007/s10653-017-0063-y>.

Ciantelli, C., Palazzi E., Von Hardenberg J., Vaccaro C., Tittarelli F., **Bonazza A.**, 2018. How can climate change affect the UNESCO cultural heritage sites in Panama? Geosciences (Switzerland) 8, <https://doi.org/10.3390/geosciences8080296>

**Bonazza A.**, Vidorni G., Natali I., Giosuè C., Tittarelli F. 2017. Durability assessment to environmental impact of nano-structured consolidants on Carrara marble by field exposure tests. Science of the Total Environment, 575, 23-32. DOI: 10.1016/j.scitotenv.2016.10.004.

**Bonazza A.** 2017. Kuwait Oil Fires (1991): Searching for Long-range Deposits on Heritage. Book Title Air Pollution Episodes, Edited by P. Brimblecombe, Book Series Air Pollution Reviews, Pages: 175-189, Book DOI: <https://doi.org/10.1142/q0098>. ISBN-13: 978-1786343406.

**Bonazza A.**, De Nuntiis P., Mandrioli P., Sabbioni C., “*Aerosol impact on cultural heritage: deterioration processes and strategies for preventive conservation*” In: Atmospheric Aerosols, Life Cycles and Effects on Air Quality and Climate (Tomasi C., Fuzzi S., Kokhanovsky A. Eds.). Wiley-VCH, Berlin, 11, 645-670, (ISBN:978-3-527-33645-6), 2016.

**Bonazza, A.**, Sabbioni C. 2016. Composition and chemistry of crusts on stone. Urban Pollution and changes to materials and building surfaces. Brimblecombe P.(ed.). Air Pollution Reviews – Vol. 5. Imperial College Press, 103-126.

**Bonazza A.**, Natali C., Ghedini N., Vaccaro C., Sabbioni C., 2015. Oxalate Patinas on Stone Monuments in the Venetian Lagoon: Characterization and Origin, International Journal of Architectural Heritage, Volume 9, Issue 5, 542-552, DOI 10.1080/15583058.2013.837546.

Furtado F., **Bonazza A.**, 2015. Mudandas no Clima e Patrimônio Cultural Costruido. Libro Mudandas Climaticas e Resiliencia de Cidades, pp. 135-144. ISBN 978-85-69110-00-2.

Ruffolo S.A., Comite V., La Russa M.F., Belfiore C.M., Barca D., **Bonazza A.**, Crisci G.M., Pezzino A., Sabbioni, C., 2015. An analysis of the black crusts from the Seville Cathedral: A challenge to deepen the understanding of the relationships among microstructure, microchemical features and pollution sources. Science of the Total Environment, 502, 157-166. DOI: 10.1016/j.scitotenv.2014.09.023.

Barca D., Comite V., Belfiore C.M., **Bonazza A.**, La Russa M.F., Ruffolo S.A., Crisci G.M., Pezzino A., Sabbioni, C., 2014. Impact of air pollution in deterioration of carbonate building materials in Italian urban environments. Applied Geochemistry, 48, 122-131. DOI: 10.1016/j.apgeochem.2014.07.002

Ozga I. Ghedini N. Giosue C. Sabbioni C. Tittarelli, F., **Bonazza A.**, 2014. Assessment of air pollutant sources in the deposit on monuments by multivariate analysis. Science of the Total Environment, 490, 776-784.

La Russa M.F., Belfiore C.M., Comite V., Barca, D., **Bonazza A.**, Ruffolo S.A., Crisci G.M., Pezzino A., 2013. Geochemical study of black crusts as a diagnostic tool in cultural heritage. Applied Physics A: Materials Science and Processing, 113 (4), 1151-1162. DOI 10.1007/s00339-013-7912-z

**Bonazza A.**, Ciantelli C., Sardella A., Pecchioni E., Favoni O., Natali I., Sabbioni C., 2013. Characterization of hydraulic mortars from archeological complexes in Petra. Periodico di Mineralogia, 82 (2), 459-475. DOI: 10.2451/2013PM0027.

La Russa M.F., Belfiore C.M., Comite V., Barca, D., **Bonazza A.**, Ruffolo S.A., Crisci G.M., Pezzino A., 2013. Geochemical study of black crusts as a diagnostic tool in cultural heritage. Applied Physics A: Materials Science and Processing, 113 (4), 1151-1162.

Belfiore C.M., Barca D., **Bonazza A.**, Comite V., La Russa M.F., Pezzino A., Ruffolo S.A., Sabbioni C., 2013. Application of spectrometric analysis to the identification of pollution sources causing cultural heritage damage. Environmental Science and Pollution Research, 20 (12), 8848-8859.

Ozga I., **Bonazza A.**, Ait Lyazidi S., Haddad M., Ben-Nerc A., Ghedini N., Sabbioni C., 2013. Pollution impact on the ancient ramparts of the Moroccan city Salé. Journal of Cultural Heritage, special issue, S25–S33.

Gomez-Bolea, A., Llop E., Arino X., Saiz-Jimenez C., **Bonazza A.**, Messina P., Sabbioni C., 2012. Mapping the impact of climate change on biomass accumulation on stone. Journal of Cultural Heritage 13, 254-258.

Ozga I., **Bonazza A.**, Bernardi E., Tittarelli F., Favoni O., Ghedini N., Morselli L., Sabbioni C., 2011. Diagnosis of surface damage induced by air pollution on 20th-century concrete buildings. Atmospheric Environment, 45, 4986-4995.

- Nava S., Becherini F., Bernardi A., **Bonazza A.**, Chiari M., García-Orellana I., Lucarelli F., Ludwig N., Migliori A., Sabbioni C., Udisti R., Valli G., Vecchi R., 2010. An integrated approach to assess air pollution threats to cultural heritage in a semi-confined environment: The case study of Michelozzo's Courtyard in Florence (Italy). *Science of the Total Environment*, 408,1403-1413 .
- Bonazza A.**, Sabbioni C., Messina P., Guaraldi C., De Nuntiis P., 2009. Climate change impact: mapping thermal stress on Carrara marble in Europe. *Science of the Total Environment*, 407, 4506-4512.
- Bonazza A.**, Messina P., Sabbioni C., Grossi C. M., Brimblecombe P. 2009. Mapping the impact of climate change on surface recession of carbonate buildings in Europe. *Science of the Total Environment* 407, 2039-2050.
- Grossi C. M., **Bonazza A.**, Brimblecombe P., Harris I., Sabbioni C. 2008. Predicting twenty-first century recession of architectural limestone in European cities. *Environmental Geology* 56, 455-461
- Tittarelli F., Moriconi G., **Bonazza A.**, 2008. Atmospheric deterioration of cement plaster in a building exposed to a urban environment. *Journal of Cultural Heritage* 9, 203-206
- Bonazza A.**, Brimblecombe P., Grossi C., M., Sabbioni C., 2007. Carbon in black crusts from the Tower of London. *Environmental Science and Technology* 41, 4199-4204
- Bonazza A.**, Sabbioni C., Ghedini N., Hermosin H., Jurado V., Gonzalez J. M., Saiz-Jimenez C. 2007. Did smoke from the Kuwait oil well fires affected archaeological sites and monuments of Iranian cultural heritage? *Environmental Science and Technology* 41, 2378-2386
- Bonazza A.**, Sabbioni C., Ghedini N., Gobbi G., 2007. Blackening as major atmospheric pollution effect on monuments. *Pollution atmosphérique*, 55-62
- Sabbioni C., Ghedini N., **Bonazza A.**, Favoni O., 2007. Atmospheric pollution effects on hydraulic mortars. *Pollution atmosphérique*, 7-12
- Ghedini N., Sabbioni C., **Bonazza A.**, Gobbi G., 2006. Chemical-Thermal quantitative methodology for carbon speciation in damage layers on building surfaces. *Environmental Science and Technology* 40, 939-944
- Bonazza A.**, Sabbioni C., Ghedini N., 2005. Quantitative data on carbon fractions in interpretation of black crusts and soiling on European built heritage. *Atmospheric Environment* 39, 2607-2618
- Sabbioni C., Ghedini N., **Bonazza A.**, 2003. Organic anions in damage layers on monuments and buildings. *Atmospheric Environment* 37, 1261-1269.
- Sabbioni C., **Bonazza A.**, Zappia G., 2002. Damage on hydraulic mortars: the Venice Arsenal. *Journal of Cultural Heritage* 3, 83-88