International Union of Pure and Applied Chemistry
A member of the International Council of Scientific Unions

Division VI "Chemistry and the Environment" (DCE)
President: Nicola Senesi

REPORT on Activities 2009 and Expectations 2010

I. HIGHLIGHTS

I.1 Terms of Reference

Through its internationally recognized membership and project teams, the Division of Chemistry and the Environment (DCE) will provide unbiased and timely authoritative reviews on the behavior of chemical compounds in the environment and food. The DCE will undertake both fundamental and applied evaluations that contribute to solving environmental problems and enhancing the quality of environment and food on a global scale.

I.2. People

The new Division Committee (DC) is currently (biennium 2010-2011) comprised of 27 members: 10 TM's, 6 AM's, and 10 NR's and 1 PM, and includes representatives of 25 countries. Each region of the globe is well represented, with the exception of Latin America. The DC includes 8 women and representatives from scientifically emerging countries.
The work of the Division Committee is assisted by the efforts of four sub-committees, which help identify new priority project areas, stimulate proposals, recruit potential project leaders, and facilitate external communication encompassing the broad areas of environmental and food chemistry:
- Biophysical-Chemical Processes in Environmental Systems (Chair: Prof. Nicola Senesi)
- Chemistry of Environmental Compartments (Chair: Dr. Hemda Garelick)
- Crop Protection Chemistry (Chair: Dr. Ken Racke)
- Food Chemistry (Chair: Dr. Patrick Dysseler)

I.3. Projects

Projects sponsored by the DCE generally are comprised in three broad categories.
First, the expertise within the DCE subcommittees is used to coordinate and develop state-of-the-art **authoritative reviews** of a particular area of environmental chemistry, which are generally published in book form. To this end, the Division has a long-standing working partnership with Wiley Press with two book series currently in production, the one on "Analytical and Physical-Chemistry of Environmental Systems" and the other on "Physical-Chemical Processes in Environmental Systems", both edited by former and actual DCE members. Top international experts are recruited to contribute the chapters of each volume in the Series. Eleven volumes have been published so far in the former Series, and one volume in the latter one. In the new series "Physical-Chemical Processes in Environmental Systems", one volume is currently in production by the Publisher Wiley with expected publication in August 2009, and another one is currently in advanced state of preparation, both as part of specific DCE projects, and a third one will be submitted in the course of the year 2009 to the DCE as

a project proposal. One added benefit of this cooperative approach with Wiley is that book royalties are credited back to the DCE so that it may sponsor additional projects in the series.
Second, **technical evaluations**, which are traditional IUPAC projects that focus on critical assessment and development of specific recommendations for an area of environmental or food chemistry so as to assist and influence research, regulatory approach, and public policy. Primary areas of emphasis include definitions, methodologies, and regulations.
Third, **outreach** activities, which help move IUPAC project outcomes outside the small circle of specialists and into the broader scientific and regulatory arena, with a strong emphasis on technology transfer to developing countries. In addition to standard IUPAC sponsorship of relevant chemistry conferences, DCE has made strong efforts to actively plan and organize both international congresses and regional workshops that are designed not only to bring together leading scientists and regulators to exchange and debate their latest findings, but also to highlight key IUPAC projects and project outcomes. Multiple and high levels of IUPAC involvement are maintained, from the organizing and scientific committees to individual lectures highlighting IUPAC projects.
At the moment there are **29** active projects, including **10** that are interdivisionally sponsored and **1** sponsored also by the PC (see below IV. Tabular Material). Most of the projects are demonstrating good progress, although some of these have asked for formal extensions. An additional **4** project proposals are under review with funding decisions expected in the Division meeting to be held during the IUPAC GA to be held in August in Glasgow.

I.4. 42nd IUPAC Congress, 3-7 August 2009, SECC, Glasgow

The DCE has organized a two half-days Symposium held within the Congress, with the title "Analytical and Risk Considerations for Emerging Environmental Issues. The Convener, the Scientific Committee of the Symposium and 7 of the invited lecturers were TMs and AMs of DCE. The International Union of Soil Sciences (IUSS) has collaborated in the organization. The sessions were well attended by an average of 100 participants who were actively involved in lively discussions and proposals.

I.5. Interdivisional Cooperation

Within IUPAC, DCE shares **5** interdivisional projects with Divisions I, III, IV, V, and VII. A representative of DCE is present in the Subcommittee on Green Chemistry of Division III (now proposed as an Interdivisional Committee), CCE, ICTNS, COCI, CODEX, PAC.
In particular, an action has been started by the Presidents of Divisions I, III, V and VI to form an Interdivisional Committee on Green Chemistry (IDCGC). The action has received due consideration by the IUPAC EC, and the discussion on the format of the new body.
We are planning to strengthen and expand the interdivisional collaboration by sharing support of more projects and conferences of mutual interest.

I.6. External Collaboration

The DCE is maintaining hystorically strong collaboration with a number of external bodies including several CODEX committees, FAO, International Standard Organization (ISO), Intergovernmental Forum on Chemical Safety (IFCS), and ICSU Scientific Committee on Problems of the Environment (SCOPE). DCE has recently moved to increase collaboration with he WHO International Program on Chemical Safety (IPCS), Association of Official Analytical Chemists (AOAC), International Organization for Chemistry in Development (IOCD), and International Union of Soil Sciences (IUSS).

I.7. Budget (as of 31 March 2010)

For the 2010-2011 biennium the Division was granted $68,000 total budget (the same amount as in the previous biennium). Of this, up to 30% is expected to be spent on operations, and up to 70% will be allocated for funding new projects. So far, no budget has been yet committed. In addition to the biennial Divisional budget, we will promote specially attractive wide projects to apply for supplemental funding from the IUPAC Project Committee and matching funds from external organizations. Finally, book royalties will be granted to the Division for new project development by Wiley based on the ongoing book contracts. A residue of $2,264 book royalties is remaining available from the biennium 2008-2009.

II. OVERALL REPORT

II.1. REPORT ON DIVISIONAL ACTIVITIES

Some relevant current and planned project activities of DCE in the biennium 2008-2009 are provided below in relation to several of the long-range goals established by IUPAC. This list should provide insight into the project areas of greatest involvement for the Division.

2.1 IUPAC will provide leadership as a worldwide scientific organization that objectively addresses global issues involving the chemical sciences.

• ***Establishment of guidelines for the validation of qualitative and semi-quantitative (screening) methods by collaborative trial: a harmonized protocol*** (2005-024-2-600, continued as 2006-027-1-600)*. **On-going, Project deadline Dec 2009**.

• ***Evaluation of Food and Feed Safety Implications of Altered Residues of Pesticides Applied on Transgenic Crops*** (2006-015-3-600). **On-going, Project deadline Dec 2010**. Production of a sustainable global food supply has for the past 60 years relied upon a combination of cultural, biological, and chemical pest management tools. The recent introduction of transgenic crops containing genetic modifications for pest resistance or pesticide tolerance across millions of hectares of agricultural land has raised worldwide interests and significant differences of views between countries as relates to potential environmental and human health impacts. This active project will provide unbiased and authoritative international views to these areas of concern based on scientific assessment methodology, and provide an opportunity for IUPAC to take an important leadership role in promoting the importance of chemistry in applied molecular biology. This project is a follow-up project of a previous one emphasizing environmental impacts, and was initiated during 2007 to address primarily human health aspects.

• ***Air Pollution Models in Environmental Management and Assessment*** (2003-058-1-600). **Completed-Waiting for Final report**. The Division has had a historical strength related to atmospheric chemistry and air pollution considerations. Air pollution models are powerful and necessary tools in environmental management programs and predictions. The aim of this project is to describe the methodology behind application of mathematical models in various assessments of air pollution impacts. The outcome of the project will be a technical guidance book describing key approaches and providing guidelines for avoiding incomplete or even incorrect answers when models are applied.

2.2 IUPAC will facilitate the advancement of research in the chemical sciences through the tools that it provides for international standardization and scientific discussion.

• ***Critical review of available methods to predict VOC emission potentials for pesticide formulations*** (2006-011-1-600). **On-going, Project deadline June 2008**.

• ***Extraction and fractionation methods for risk assessment related to trace metals, metalloids and hazardous organic compounds in terrestrial enviro***nments (2006-039-2-600). **On-going, Project deadline Feb 2009**.

• ***Combination of Chemical Analytical Measurements and Remote Sensing Techniques for Coastal Water Monitoring***. (2006-049-2-600). **On-going, Project deadline June 2010**. The objectives of this project are to record the state of the art in remote sensing techniques and methods used for marine environment monitoring, and to assess the potential combination of remote sensing data with in situ and laboratory monitoring. Case studies based on the Eastern Mediterranean and Black Sea regions will be developed.

• ***What are Dietary Fibres?*** (2007-017-1-000). **On-going, Project deadline July 2009**. During the past several years the Division has been reinvigorating activities related to food chemistry and has launched several new projects. The "dietary fibres" project will characterize the nature of dietary fibres and how they are altered as a result of food processing, and plans to offer a clear set of internationally accepted definitions.

• ***Wiley-IUPAC Book series "Physical-Chemical Processes in the Soil Environment"*** The first and second volumes have been produced by the end of 2007 and 2009, respectively, based on the projects *"Biophysical-Chemical Processes of Heavy Metals and Metalloids in Soil Environments"* (2004-003-2-600) and *"Biophysical-Chemical Processes Involving Natural Nonliving Organic Matter in Environmental Systems"* (2006-014-1-600). A third volume titled *"Biophysical-chemical processes of anthropogenic organic compounds in environmental systems*" (based on project 2008-001-1-600) has been approved and is now in advanced state of preparation with a **deadline 31 Dec 2010**. The highest academic standards are being maintained also in this volume through the careful selection of the chapter authors and thorough review and editing procedures.

• ***Development of a pesticide ecological risk assessment and training module*** (2008-011-2-600). **On-going, Project deadline April 2012**.

• ***Waste: problems and solutions for our planet or what to do with the things we throw away*** (2008-039-2-600). **On-going, Project deadline June 2011**.

• ***Guidance for substance-related environmental monitoring strategies regarding soil and surface water*** (2009-048-1-600). **On-going, Project deadline June 2012**.

2.3 IUPAC will assist chemistry-related industry in its contribution to sustainable development, wealth creation, and improvement in the quality of life.

• ***Soils contaminated with explosives – environmental risk assessment and evaluation of state-of-art treatment processes***. (2007-026-2-600). **On-going, Project deadline October 2010.**

• ***Global availability of Information on agrochemicals***. (2008-041-1-600). **On-going, Project deadline April 2012.**

DCE will maintain an interest in the Green Chemistry area, and strengthen its contribution through the proposed institution of an Interdivisional (Divs. I, III, V, VI) Committee.

2.4 IUPAC will foster communication among individual chemists and scientific organizations, with special emphasis on the needs of chemists in developing countries.

• ***Environmental Risk Assessments for the Registration of Pesticides used in Rice Paddy Fields*** (2006-044-2-600). **On-going, Project deadline April 2009**. Risk assessment involves integration of chemical exposure information with effects data to determine the likelihood of adverse effects. Scientists and regulatory authorities in developing regions increasingly wish to rely on this advanced approach in order to make informed risk management decisions related to the use of pesticides, and IUPAC is developing guidance on application of these principles within the agricultural context and level of information available in these countries. The "simplified methods" project addresses a critical gap that now exists between the highly sophisticated and resource-intensive approaches to risk assessment practiced in some developed countries with the unreliable or non-scientific consideration of exposure and risk that plagues many developing countries. A project team consisting of leading government, industry, and academic modellers and risk assessment experts has been assembled to make rapid progress. In particular, the "pesticides in rice" project aims to develop a specific framework for assessment of pesticides for use in this highly important crop.

• The ***IUPAC International Symposium on Mycotoxins and Phycotoxins*** has been hosted for more than 30 years. Although much scientific and public attention is directed at chemistry and human exposure aspects of synthetic chemicals in food, natural toxins are far more prevalent and potentially impactful for the majority of the world's population. IUPAC has had a longstanding interest in mycotoxins and phycotoxins, and this symposium will be the next in a series that has become the premiere forum for exchange of research results and methodologies related to these important naturally occurring toxins. The traditional strength of IUPAC as related to the chemistry aspects of these biotoxins has been an important factor in the success of this series. The XII Symposium was held in Istanbul, Turkey during May 2007. The XIII IUPAC International Symposium on Mycotoxins and Phycotoxins is in preparation for 2010. These symposia typically attract more than 300 participants from 40+ countries.

• ***IUPAC Regional Crop Protection Chemistry Workshops*.** During the past 20 years the Division has sponsored a series of regional workshops focused on broadening the adoption of harmonized, international approaches to crop protection chemistry research and regulation in developing countries. The workshops create a forum where IUPAC project outcomes as well as recommendations from other international bodies can be discussed and applied within the context of local environmental problem areas. Following successful sessions in China, Thailand, Taiwan, Brazil, Korea, Costa Rica and China, the 8th workshop was held in Brazil in 2009 as part of the project "*Crop Protection Chemistry in Latin America: Environment, Safety, and Regulation- 3rd International Workshop*" (2007-057-1-600). **On-going, Project deadline Dec 2010**. The Workshop has brought together the diverse regional stakeholders in crop protection chemistry from the research and regulatory communities.

• ***Lecturers on Environmental Chemistry Topics.*** The Division is more and more active in identification of important conferences for IUPAC sponsorship and planning for involvement of IUPAC Lecturers. The objectives for involving the IUPAC Lecturers are to publicize relevant findings of recently completed IUPAC Projects and to recruit new project proposals and task group members from scientifically emerging regions.
The *International Symposium of Molecular Environmental Soil Science at the Interfaces of the Earth's Critical Zone (ISMESS 2009),* hold in Hangzhou, China, October 10-14, 2009 has been supported for two IUPAC lecturers (one from USA and one from UK) by the IUPAC-Program Conferences in New Directions in Chemistry upon endorsement of DCE.

• The ***IUPAC International Congress of Pesticide/Crop Protection Chemistry*** has been hosted for more than 40 years. The 11th IUPAC International Congress of Pesticide Chemistry was held during August 2006 in Kobe, Japan, and it was co-organized with the Pesticide Science Society of Japan (PSSJ). More than 1100 chemists from 52 countries participated in the Congress, which was organized around the theme "Evolution for Crop Protection, Public Health, and Environmental Safety". The core of the scientific program consisted of welcoming speeches on behalf of PSSJ and IUPAC, 5 keynote addresses, more than 100 invited lectures, and nearly 600 posters. The Congress included an outreach program to consumer groups and the media which drew nearly 400 additional, non-chemist participants. Two strong bids for future Congress locations were received, and the Division recently agreed to organize the 12th IUPAC International Congress of Pesticide Chemistry for July 2010 in Melbourne, Australia in cooperation with the Royal Australian Chemical Institute.

• The ***42nd IUPAC Congress, 3-7 August 2009, in Glasgow***. DCE has organized a two half-days Symposium within the Congress, with the title "Analytical and Risk Considerations for Emerging Environmental Issues". The Convener, the Scientific Committee of the Symposium and 7 of the invited lecturers are TMs and AMs of DCE. The sessions were well attended by an average of 100 participants who were actively involved in lively discussions and proposals.

• ***Regional drinking water quality assessment in the Near East (Palestinian Authority, Jordan, Israel)-An overview and perspective*** (2008-003-3-600). **On-going, Project deadline Dec 2010**.

2.5 IUPAC will utilize its global perspective and network to contribute to the enhancement of chemistry education, the career development of young chemical scientists, and the public appreciation of chemistry.

The Division is actively involved in finding ways to contributing to the *International Year of Chemistry* (IYC) celebrations. In particular, the Division President is a member of WCLM San Juan Organizing Committee.
However, DCE has not had a strong direct role in chemical education but in its sponsorship of international symposia, congresses and workshops (see above and below) there is an emphasis on providing avenues to support young scientists and materials that are useful in educating, publicising and promoting particular areas of chemistry. DCE will maintain a permanent representative in the CCE.

2.6 IUPAC will broaden its national membership base and will seek the maximum feasible diversity in membership of IUPAC bodies in terms of geography, gender, and age.

DCE maintains a broad membership base through the organization of its core activities through four advisory panels (the subcommittees), which have wide geographical (about 40 countries including several scientific emerging ones), gender (14 women), and age distributions, and include, besides the TMs, AMs and NRs, a range of interested active scientists without official titles.

III. OVERALL STRATEGY . FUTURE OPPORTUNITIES, ISSUES AND DIRECTIONS

To remain effective and maintain relevance, the Division will need to pay attention to both current strengths and weaknesses of the IUPAC approach, and seek a way forward that takes advantage of the opportunities while avoiding looming threats.

• **Strengths –** Global audience; international, rather than a national/regional, viewpoint and approach; good productivity; important issues for society; credibility; networks (individuals, institutions, cross disciplines); possibility for projects to garner external funding; wide breadth (scholarly, applied, workshops/symposia); subcommittees contributing bring new issues, projects and people to IUPAC.

• **Weaknesses –** Token in-house funding; reliance on enthusiasm and availability of volunteers; high dependence on single individuals (i.e. task group leader); length for project performance and completion; lack of recognition for individual efforts; low impact/visibility for PAC.

• **Opportunities –** Increase credibility through higher impact projects (planning and outputs); increase input from developing countries; more emphasis on food chemistry (functional foods); increase partnerships with other international organizations; seek more interdivisional projects; make better use of electronic media (web, email); attract funding from multiple sources to make more viable projects.

• **Threats –** Loss of relevance; losing intellectual property to collaborating organizations; having Division direction driven by randomly submitted project proposals; having lead on key areas taken by other organizations; slowness in addressing key issues of interest and project areas; not reaching the intended audience; conflicts of interest in funding decisions; inability to define and measure success.

The Division Committee recently took the first steps toward development of a long-range Division activities plan in alignment with the IUPAC long-range goals. Key future areas of interest for the Division in its operations are listed briefly below, and these are expected to be the subject of intense discussions during the next DCE meeting to be held during the GA in Glasgow in August 2009.

• Maintenance of a diverse membership and participation in Divisional activities –
It will be important for the health of the Division to continue to maintain diversity of representation for areas of disciplinary emphasis, affiliation, geographic origin, age, and gender. This need for diversity also applies to the activities of Division sub-committees and project task groups. There is in particular a need to increase participation in Divisional programs from Latin American, Middle Eastern, and African countries. There is also a tendency for an under-representation of IUPAC contributors from the industrial sector, and greater efforts are needed to ensure adequate participation of industry chemists.

• Selection of new members – A large amount of DC energy has been devoted to the biennial election process for covering eight (over ten) TM positions, which terminate with the biennium 2008-2009, for the 2010-2011 biennium. The election process is now completed for the 2010-2011 biennium according to deadlines indicated by IUPAC. A roster of 10 TMs, 6 AMs, 10 NRs and 1 PM has been provided in

due time to IUPAC Secretariat and approved by the Bureau. However, the 2-year term of TM, AM and NR seem too short to allow significant contributions.

• Continued generation of project proposals – A continued flow of high quality project proposals is critical to the future effective contributions of the Division. A good number of new proposals have been received for consideration during the current biennium, and most of them approved, with several still in review. In addition, although conference proposals come from many quarters, project proposals primarily originate from those with some familiarity with IUPAC. Today's chemists face many choices for project involvement at the national and regional levels. The Division needs to find creative ways to continue to identify relevant new project topics and solicit proposals from interested and enthusiastic chemists willing to lead and serve in IUPAC task groups.

• Timely completion of ongoing projects – About 30 active projects are now supported by the Division, and the Division collects regular progress reports so as to allow monitoring of project progress. It is important that IUPAC projects are completed within a reasonable time so as to produce relevant and useful findings. Decisions to accelerate (e.g., top-up funding) or abandon several of the older, slower-moving projects will be needed in near future.

• Continued ramp-up of food chemistry activities – One immediate outcome of the long-range planning exercise involves a continuing effort to reinvigorate the area of food chemistry. A new subcommittee is charting a renewed direction that brings to bear the traditional strengths of the Union with contemporary issues and problems related to food chemistry. As a result, food chemistry activities are increasing following a lull of several years, and three active projects on food chemistry are now active and well in progress.

Despite its overall integrated approach, the Division will also operate sectorially to address customer needs:

• **Protection objectives** - (which are partly the basis for the DCE subcommittees) including air, water, soil and food with (integrated) risk assessments and management options. Collaboration with external bodies and other IUPAC Divisions, for example Division VII for human risks, will be essential to deal authoritatively with such issues.

• **Scientific approaches to study processes,** the advancement of methodology, the concepts of chemical safety and chemical hazards, with a focus on environmental fate, food and environmental analytical chemistry, modelling environmental processes. Also to implement these issues authoritatively, collaboration with external bodies and other IUPAC Divisions, for example the Division of Analytical Chemistry, will be essential.

• **Chemicals groupings**, including bulk and fine chemicals, agrochemicals (of continuing high relevance), pharmaceuticals and veterinary drugs, natural toxicants (to expand from mycotoxins), biochemicals and the chemical safety of genetically modified organisms (environment and food). The combined efforts in conjunction with external bodies and pertinent IUPAC Divisions will surely strengthen these activities.

IV. TABULAR MATERIAL

SUMMARY OF ON-GOING PROJECTS

1999-041-1-600 - Bioavailability of xenobiotics in the soil environment (completed in 2009)
2001-023-1-600 - Agrochemical spray drift: Assessment and mitigation (nearing completion)
2001-039-1-600 - Pest management for small-acreage crops: a cooperative global approach (nearing completion)
2003-013-1-600 - Crop protection chemistry in Latin America: Harmonized approaches for environmental assessment and regulation (ongoing)
2003-058-1-600 - Air pollution models in environmental management and assessment (ongoing)
2005-024-2-600 - Establishment of guidelines for the validation of qualitative and semi-quantitative (screening) methods by collaborative trial: a harmonized protocol* (continued as 2006-027-1-600) (ongoing)
2006-011-1-600 - Critical review of available methods to predict VOC emission potentials for pesticide formulations (ongoing)
2006-014-1-600 - Biophysico-chemical processes involving natural nonliving organic matter in environmental systems, Vol. 3 of Wiley-IUPAC book series “Physical-Chemical Processes in the Soil Environment” (completed)
2006-015-3-600 - Evaluation of food and feed safety implications of (altered) residues of pesticides applied on transgenic (GM) crops (ongoing)
2006-039-2-600 - Extraction and fractionation methods for risk assessment related to trace metals, metalloids and hazardous organic compounds in terrestrial environments* (ongoing)
2006-044-2-600 - Environmental risk assessments for the registration of pesticides used in rice paddy fields (ongoing)
2006-049-2-600 - Combination of chemical analytical measurements and remote sensing techniques for coastal water monitoring. The cases of Eastern Mediterranean and Black Sea (ongoing)
2007-017-1-600 - What are dietary fibres?* (ongoing)
2007-026-2-600 – Soils contaminated with explosives – environmental risk assessment and evaluation of state-of-art treatment processes (ongoing)
2007-057-1-600 - Crop protection chemistry I Latin America: environment, safety, and regulation-3rd International Workshop (ongoing)
2008-001-1-600 – Biophysical-chemical processes of anthropogenic organic compounds in environmental systems - Vol. 3 of Wiley-IUPAC book series “Physical-Chemical Processes in the Soil Environment” (ongoing)
2008-003-3-600 – Regional drinking water quality assessment in the Near East (Palestinian Authority, Jordan, Israel)-An overview and perspective.(ongoing)**
2008-011-2-600 – Development of a pesticide ecological risk assessment and training module (ongoing)
2008-039-2-600 – Waste: problems and solutions for our planet or what to do with the things we throw away.
2008-041-1-600 – Global availability of Information on agrochemicals (ongoing)
2009-048-1-600 - Guidance for substance-related environmental monitoring strategies regarding soil and surface water (ongoing)

PROPOSED PROJECTS (UNDER REVIEW)

2009-007-1-600 – Evaluation of measurement methods and QA/QC for PCDD/F, PCB and PAHs in environmental matrices (air quality, soil, sediments and wastes) used in estimation of global pollution.*
2009-010-1-600 – Requirements for proficiency testing on environmental sampling. *
2010-013-1-600 – Critical review of methods to assess volatility of pesticides with respect to estimating and minimizing human exposure
2010-014-1-600 – Chemistry information international: Planning phase
2010-016-1-600 – Ecological risk assessment harmonized guidance for Brazil and Uruguay
2010-017-1-600 – Development of guidance to promote consistent and transparent pesticide ecological risk assessment in China
2010-018-1-600 – Quantitative review of pesticide environmental fate parameters and their relationship with soil and climate conditions
2010-020-1-600 – IUPAC International Award for Advances in Harmonized Apporaches to crop Protection Chemistry

* Interdivisional project
** Also supported by Project Committee

LIST OF RECENT PUBLICATIONS

Technical Reports and Recommendations
Garelick, H. "Remediation technologies for the removal of arsenic from water and wastewater." *Rev. Environ. Contam. Toxicol.* (**2008**).
Kleter, G.A., et al.. "Altered pesticide use on transgenic crops and the associated general impact from an environmental perspective." *Pest Manag. Sci.* (**2008**).
Kördel , W.; Egli, H.; Klein, M.; "Transport of pesticides via macropores." *Pure Appl. Chem.* (**2008**).

Books
Senesi, N.; King, B.S.; Huang, P.M. *Biophysico-Chemical Processes Involving Natural and Nonliving Organic Matter in Environmental Systems.* John Wiley and Sons, New York (**2009**) 876 pages.
Ohkawa, H.; Miyagawa, H.; Lee, P.W. *Pesticide Chemistry: Crop Protection, Public Health, Environmental Safety*. Wiley-VCH, Berlin (**2008**).
Senesi, N. and Wilkinson K.J. *Biophysical Chemistry of Fractal Structures and Processes in the Environment.* John Wiley and Sons, Chichester (**2008**) 323 pages.
Stephenson, G.; Solomon, K.; Carazo, E. *Pesticides in the Environment*. University of Costa Rica Press, San Jose (**2008**).
Violante, A.; Huang, P.M.; Gadd, G.M. *Biophysico-Chemical Processes of Metals and Metalloids in Soil Environments.* John Wiley and Sons, New York (**2008**) 658 pages.
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