

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 for the biennium 2010-2011 (until 30 April 2011)

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) currently (biennium 2010-2011) comprises 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 three volumes in the latter one. In the new series “Physical-Chemical Processes in Environmental Systems”, the third volume has been published in March 2011 by the Publisher Wiley, and the proposal for a fourth one is currently in advanced state of preparation to be submitted in 2011

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 **19** active projects, including **3** 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 **7** project proposals are under review with funding decisions expected in the Division meeting to be held during the IUPAC GA to be held in July-August in Puerto Rico.

I.4. 43rd IUPAC Congress, 1-5 August 2011, Puerto Rico

The DCE is organizing two Symposia at the Puerto Rico Congress, with the titles “Advanced Physico-Chemical Techniques to Solve Environmental Science Challenges” and “Sustainability of Water Quality”. The Conveners, several Scientific Committee Members of the Symposia and several invited lecturers are TMs, AMs and NRsof DCE.

I.5. Interdivisional Cooperation

Within IUPAC, DCE shares **3** interdivisional projects with other IUPAC Divisions. A representative of DCE is present in the Subcommittee on Green Chemistry of Division III, CCE, ICTNS, COCI, CODEX, PAC.

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 historically 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 the 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, 32.2% of the budget has been committed, but all the remaining amount will be shortly committed to fund projects in review and to support participation at the two Symposia organized by the Division at the Puerto Rico IUPAC Congress.

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.

- *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.

- *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 2012.** 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.

- *Quantitative review and analysis of pesticide sorption and its effects on degradation in relation to soil and climate* (2010-018-2-600). **On-going, Project deadline Dec 2013.**

- *Global framework for implementing consistent ecological risk assessment of pesticides for sustainable agriculture* (2010-056-1-600). **On-going, Project deadline Dec 2013.**

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 environments*** (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 2011.** 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.
- ***Wiley-IUPAC Book series “Biophysico-Chemical Processes in Environmental Systems”*** The first, second and third volumes have been published by the end of 2007, 2009 and March 2011, respectively, based on the projects “*Biophysico-Chemical Processes of Heavy Metals and Metalloids in Soil Environments*” (2004-003-2-600), “*Biophysico-Chemical Processes Involving Natural Nonliving Organic Matter in Environmental Systems*” (2006-014-1-600) and “*Biophysico-chemical Processes of Anthropogenic Organic Compounds in Environmental Systems*” (2008-001-600). The Project Proposal for a fourth volume on Nanoparticles in the Environment is in course of preparation. The highest academic standards will be 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). **Completed.**
- ***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). **Completed.**
- ***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) Panel.

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. 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). **Completed.** 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 *IUPAC International Congress of Pesticide/Crop Protection Chemistry* has been hosted for more than 40 years. The 12th IUPAC International Congress of Pesticide Chemistry was held in July 2010 in Melbourne, Australia in cooperation with the Royal Australian Chemical Institute.
- *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 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.

- *IUPAC International Award for Advances in Harmonized Approaches to crop Protection Chemistry* (2010-020-1-600) **On-going, Project deadline Dec 2011.**

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

- 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)
- 2007-026-2-600 – Soils contaminated with explosives – environmental risk assessment and evaluation of state-of-art treatment processes (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)
2008-041-1-600 – Global availability of Information on agrochemicals (ongoing)
2009-010-2- Harmonized protocol for the proficiency testing of sampling of environmental matrices*
2009-048-1-600 - Guidance for substance-related environmental monitoring strategies regarding soil and surface water (ongoing)
2010-018-2-600 – Quantitative review and analysis of pesticide sorption and its effects on degradation in relation to soil and climate (ongoing)
2010-020-1-600 – IUPAC International Award for Advances in Harmonized Approaches to crop Protection Chemistry (ongoing)
2010-056-1-600 – Global framework for implementing consistent ecological risk assessment of pesticides for sustainable agriculture (ongoing)

PROPOSED PROJECTS (UNDER REVIEW)

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
2010-028-3-600 – Management of maritime pollutants in shipping and commercial ports based on relevant physical and biogeochemical environmental parameters
2010-060-1-600 – A support team for enhancing, maintaining and ensuring the future of the pesticides properties database (PPDB)
2010-063-200-600-500-050-024 – Open geochemical database*
2011-001-2-600 – Crop protection through the ages
2011-005-1-600 – Water sustainability and quality symposium

* 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

Xing, B.S.; Senesi, N.; Huang, P.M. “*Biophysico-chemical Processes of Anthropogenic Organic Compounds in Environmental Systems*”. John Wiley and Sons, Hoboken, NJ (2011) 572 pages.

Senesi, N.; King, B.S.; Huang, P.M. *Biophysico-Chemical Processes Involving Natural and Nonliving Organic Matter in Environmental Systems*. John Wiley and Sons, Hoboken, NJ (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.

Xing, BS; Senesi, N.; Huang, P.M.

.