THE ROYAL SOCIETY OF CHEMISTRY

ENVIRONMENTAL CHEMISTRY GROUP

RS

Bulletin

A new discovery in this work was that an additional oestrogen was detected in bile from effluent-exposed fish, namely 17β-dihydroequilenin (DHQ) (Figure 2). DHQ had not been previously recognised as an environmental oestrogen and its source, as well as its potency as a feminising agent in fish, is now being currently investigated.

Are there other endocrine disrupting chemicals present in WwTWs effluents?

We are confident that we have identified all the major oestrogen receptor-active contaminants in WwTWs effluents that are likely to contribute to the feminisation of fish. However, sex changes in fish and other vertebrates are mediated by other sex hormones in addition to oestrogens notably androgens and these effects are signalled via specific receptors. Thus, disruptions in sexual development can potentially occur via either the oestrogen receptor(s) or the androgen receptor(s). Therefore, we have also attempted to identify bioavailable (anti-)androgen receptor-active contaminants in effluents that could contribute to endocrine disruption and feminisation of fish. Based on our work with oestrogens, we collected bile from fish that had been caged below a WwTWs effluent and analysed the bile extracts for anti-(androgenic) activity using a recombinant yeast androgen receptor screen (YAS). The receptor activity of total and HPLC fractionated bile extracts from these fish were compared with fish held in tap water.

The anti-androgenic activity of effluent-exposed fish was 28-fold higher than that from reference fish. In contrast, the oestrogenic activity was 12-fold higher in bile from effluent-exposed fish compared with bile in reference fish. This work suggests that a number of other bioavailable androgen antagonists are present in effluents from WwTWs, and their presence in bile of exposed fish has opened up a new dimension in this work. Anti-androgens can induce similar feminising effects as oestrogens. We are currently trying to identify these chemicals and to establish their relative contribution to the feminised responses in fish. The recent survey of 50 effluents from WwTWs, mentioned above, found that most contained anti-androgenic activity, emphasising the potential significance of the finding of anti-androgens in the environment.

A variety of other biologically active pharmaceuticals including analgesics, antidepressants, lipid lowering drugs, antibiotics, anti-cancer agents, caffeine and musks are present in wastewater effluents of many countries including the UK, and their impact on organisms living in the aquatic environment has not been established. The research from this project illustrates that bile acts as an excellent tissue for concentrating chemicals in effluents, and that combining biological screening with high quality analytical chemistry is a highly successful approach for identifying chemicals with endocrine disrupting activity, an approach that could equally be applied to chemicals with other modes of action in organisms.

References

Desbrow, C., Routledge, E.J., Brighty, G.C., Sumpter, J.P., and Waldock, M. (1998). Identification of estrogenic chemicals in STW effluent. Environmental. Science and Technology 32: 1549-1558.

Gibson, R., Tyler, C.R and E.M. Hill (2005). An analytical methodology for the identification of estrogenic contaminants in fish bile. Journal of Chromatography. In press.

Jobling, S., Nolan, M., Tyler, C.R., Brighty, G., and Sumpter, J.P. (1998). Widespread Sexual Disruption in Wild Fish. Environmental Science and Technology 32: 2498 - 2506.

Thorpe, K., Hetheridge, M.J., Hutchinson, T.H., Scholze, M., Sumpter, J.P., and Tyler, C.R. (2003). Relative potencies and combination effects of steroidal oestrogens in fish. Environmental Science and Technology 37: 1142-1149.

FIRS (Ferric Iron Remediation and Stabilisation)

Groundwater is dissociated at the electrodes (via the reactions shown in Figure 1), producing an acid front (due to excess H

The iron in this barrier is derived from the cast iron sacrificial anode, and the treated sediment itself. The acid front acid-washes the soil, while the precipitated iron band provides an impermeable barrier to contaminant migration, and, together with the pH gradient, provides a chemical trap for a range of inorganic, organic and radioactive contaminants remobilised from the treated soil. Essentially, in contaminated soils, the system remobilises contaminants and concentrates them on to the solid iron barrier, which can then be excavated. Alternatively, the precipitated iron band itself can be used as a reactive (i.e. sorptive) barrier for waste spillages and contaminated shallow groundwaters.

The system mimics natural mineralisation processes, where internal electric fields present in rock and soil bodies can generate multiple bands of ironstone via precipitation of iron oxides and hydroxides. In the FIRS technique, these iron-rich bands are grown over timescales of 3 - 400 hours, and consist of a series of amorphous (or micro-

The FIRS technology is also capable of significantly reducing contaminant concentrations in treated soil, and can also improve the mechanical properties of soils (contaminated or otherwise) for civil engineering purposes, via iron cementation and/or strategic electro-osmotic dewatering or rewatering.

The FIRS system has significantly lower energy requirements than commercial electrokinetic remediation techniques, uses low cost sacrificial (scrap iron) electrodes, and does not involve the use of potentially toxic conditioning solutions. The technique is applicable to small sites, as well as to larger areas of contaminated land, and the flexibility provided by the use of multiple, low cost electrodes, means that contaminated land could be sequentially treated with a series of electrode arrays (wired to car batteries or a similar current source), placed to avoid (or work around) site infra-structure, where the distance between individual electrodes does not exceed a few metres.

Following a successful scaling-up, the system could be operated in combination with, or as an alternative to, existing land remediation technologies, although laboratory data indicate that it will probably best be applied as a low-energy, non-selective, preliminary contaminant reduction/containment technique (particularly in cleaning up more localised hot-spots of contamination) before the application (if necessary) of more specialist (and expensive) techniques.

Note: The technique and ideas described here are the subject of a patent application filed in September 2002 by the Universities of Sussex and Brighton.

Part of this work was completed under funding provided by EPSRC (grant number GR/S27924/01).

References

1 Virkutyte, J.; Sillanpaa, M.; Latostenmaa, P. (2002). Electrokinetic soil remediation a critical overview. Sci. Tot. Env. 289, 97-121.

2 Acar, Y. B.; Alshawabkeh, A. N. (1993). Principles of electro-kinetic remediation. Environ. Sci. Technol. 27 (13), 2638-2647.

3 Mulligan, C. N.; Yong, R. N.; Gibbs, B. F. (2001). Remediation technologies for metal-contaminated soils and groundwater: an evaluation. Eng. Geol. 60, 193-207.

4 Cundy, A. B.; Hopkinson, L. Electrokinetic iron pan generation in unconsolidated sediments: implications for contaminated land remediation and soil engineering. Applied Geo-chemistry in press.

5 Hopkinson, L.; Cundy, A. B. (2003). FIRS (Ferric Iron Remediation and Stabilisation): A novel electrokinetic technique for soil remediation and engineering. CL:AIRE Research Bulletin RB2, May 2003. Available at http://www.claire.co.uk/html/clairepubs.html http://www.claire.co.uk/html/RB2Web.pdf

catchments) as well as an association with manufacturing (Torino is the home of FIAT). Notably, the mercury content in soil from the Glasgow park was more than three times higher than that in any other city and over 26 times the level in Aveiro.[2] Further useful information was gained from application of chemometric procedures to the data set. For example, rotated principle components analysis allowed differentiation between the so called urban metals (copper, lead and zinc) and other analytes.[3]

Assessing inter-laboratory comparability

A research project that involves the collection of several hundred soil samples, their transport across Europe, and analysis in different laboratories requires the definition and implementation of adequate QC/QA procedures. Few urban soil certified reference materials exist for use in method validation and so partners prepared a suite of project-specific reference soils, one from each city. These were exchange and analysed to assess comparability of the results obtained in different countries. Despite the fact that different laboratories used different analytical methods (e.g. microwave vs. reflux digestion, FAAS vs. ICPOES analysis) and some determinations were carried out by laboratories not specialising in analytical chemistry, agreement between results for heavy metal analysis was generally good with few analytes showing overall variability of > 15%. An example of the results obtained is shown in Figure 1.

The URBSOIL DST

Interfacing science with wider social, economic and policy issues is both challenging and topical.[4] The URBSOIL DST, development of which is being led by Professor Andrew Hursthouse and colleagues at the University of Paisley, incorporates databases, a data handling and display tool and an electronic conferencing resource based on e-Delphi. Its purpose is not risk assessment, as in, for example, the UK CLEA model, but to facilitate consultation and integrate information on soil into urban decision making processes. The concept is as follows. When a planning decision is to be made, information is solicited from a wide a range of stakeholders . As well as scientific experts, these will include local special interest groups, legislators, environmental authorities and other interested parties. The information obtained is collated and disseminated, anonymously, back to the stakeholders who then have the option to refine their input in a subsequent round of information gathering. The process is iterated until consensus is achieved (or areas of non-consensus become clearly defined) thus guiding the planner towards an optimal solution. Recent tests on the prototype DST, to support a hypothetical planning decision on placement of a city farm in Glasgow, indicated that reproducible results could be obtained.

Continuing developments

In addition to further refinement and testing of the DST, current research within URBSOIL is focused on soil obtained from different types of urban land surface (roadsides, riverbanks etc) and on more specialised investigations such as the measurement of polycyclic aromatic hydrocarbons; heavy metal fractionation using the BCR sequential extraction protocol, and column leaching experiments to assess the mobilisation of metals under reducing conditions. Information on the URBSOIL project can be obtained at http://URBSOIL.paisley.ac.uk/

Acknowledgements

The URBSOIL project is supported by the EU FP5, Energy, Environment and Sustainable Development Program under contract EVK4-CT-2001-00053. The authors gratefully acknowledge the contribution of all members of the URBSOIL team to the contents of this article.

References

1 P. Bullock and P. J. Gregory, Soils: a neglected resource in urban areas , In P. Bullock and P. J. Gregory (eds.), Soils in the Urban Environment, Blackwell, Oxford, 1991.

2 S. A. Rodrigues et al., Comparative assessment of total mercury concentration in soil samples from parks in six European cities (submitted).

3 L. Madrid et al., Potentially toxic metals in urban soils of six European cities: a pilot study on selected parks (submitted).

4 M. Sharpe, Weighing the evidence: prospects for evidence-based policy-making , J. Environ. Monit., 2004, 6, 114N-117N.

[Ultramafic Rock: The class of rock which crystallizes from silicate minerals at the highest temperatures is sometimes referred to as ultramafic rock. It includes peridotite and komatiite. It is in the highest temperature range of the Bowen reaction series].

Department of Pure and Applied Chemistry, University of Strathclyde, Glasgow

The UK•s Health Protection Agency

In 2003, George Kowalczyk was transferred from the Department of Health to the newly-formed Health Protection Agency (HPA). In this article, George, a stalwart of the RSC s OETG, describes the multifarious roles of this new organisation.

What is the HPA?

Although I came from the Department of Health, my new HPA associates some 2,700 in total were assembled from over 80 different other organisations. Needless to say, even after a year together we are still establishing our working relationships and our public profile. So, what is the HPA, and what does it do?

The Health Protection Agency is a new national organisation for England and Wales, which was established on 1st April 2003. It is dedicated to protecting people s health and reducing the health impact of:

Infectious diseases
Chemical hazards
Radiation hazards.

The HPA brings together the expertise of health and scientific professionals working in public health, communicable disease, emergency planning, infection control, chemical and radiation hazards. This expertise was previously located in a number of organisations which have now been incorporated into the HPA, and they include:

The Public Health Laboratory Service (PHLS), including the Communicable Disease Surveillance Centre and Central Public Health Laboratory at Colindale.
The Centre for Applied Microbiology and Research (CAMR) at Porton Down.
The National Focus for Chemical Incidents in Cardiff and the four Regional Service Provider Units that support the management of chemical incidents e.g. the Chemical Incidents Response Service (CIRS) based at Guys Hospital, London.
The National Poisons Information Service (NPIS).
NHS and Department of Health public health staff responsible for infectious disease control, emergency planning, and other protection support.

The HPA currently works in partnership with the National Radiological Protection Board. (NRPB), which is expected to become incorporated into the HPA later in 2004.

What does the HPA do?

Provides impartial authoritative information and advice to professionals and the public, and independent advice to the Government on public health protection policies and programmes.
Delivers services and supports the NHS and other organisations to protect people s health from infectious diseases, chemical hazards, poisons, and radiation hazards.
Monitors and responds to new threats to public health, and provide a rapid response to health protection emergencies, including the deliberate release of poisons, chemicals, or microbiological substances.
Seeks to improve knowledge about health protection through research, development, education and training.

What is HPA•s role with regard to chemical hazards?

The Agency has six main Divisions, three of which have roles in provision of advice on chemical hazards and assisting in the response to chemical incidents. The relevant parts of the HPA dealing with toxicological issues are:

Chemical Hazards and Poisons Division (DCHaP)
Emergency Response Division (ERD)
Local and Regional Services (LARS).

Chemical Hazards and Poisons Division (DCHaP)

The Chemical Hazards and Poisons Division of the Health Protection Agency provides comprehensive expert advice and support for chemical incidents across England and Wales. Such potential health threats might involve chemical fires, chemical contamination of the environment, or the deliberate or accidental release of chemicals and poisons. It provides information and support to the NHS and health professionals on toxicology and is developing a national programme for the surveillance of chemical hazards and their health effects, along with a national poisons information databases, and a database of laboratories.

DCHaP also provides advice on a wide range of issues including:

Personal protective equipment
D

a multi-agency approach to dealing with abandoned waste mercury to reduce the chances of such incidents re-occurring.

Ammonia spill

A spill by a workman working on a refrigeration unit on the roof of a large department store in Wilmslow, led to ammonia entering the store s air conditioning system and spreading throughout the building. Eleven people were affected and transported to hospitals in the locality. The local HPA and DCHaP were alerted and provided advice to A&E staff about the need to decontaminate casualties before admission (A&E units in the past have become contaminated and needed to be shut down after receiving chemical casualties) and on the needs for monitoring and possible longer term surveillance.

IPPC applications

IPPC (Integrated Pollution Prevention and Control) is a regulatory system to ensure that industry adopts an integrated approach to pollution control to achieve a high level of protection for the environment and human health. Operators of new of proposed installations must apply for a permit from the Regulator (either the Environment Agency or the Local Authority) and part of the process involves consultation with nominated health organisations, principally NHS Primary Care Trusts (PCTs). The HPA, through its specialists in DCHaP and LARS has drafted guidance for NHS to respond to consultation process and in many cases has conducted the IPPC assessment on behalf of the PCTs.

The addition of landfill sites to the IPPC process has placed an additional burden on the NHS, and since its inception in April 2003, the HPA has responded to over 400 applications, and the workload is expected to increase during 2004.

Further information

Further information about the HPA can be found on the its web site on www.hpa.org.uk, and in particular for ECG and OETG members on the Chemical Hazards and Poisons section of this site.

Additionally, information on deliberate release of chemical agents may be found on the DH web site (www.dh.gov.uk)

News of the RSC•s Environment, Sustainability and Energy Forum

The Environment, Sustainability and Energy Forum (ESEF) had a busy year in 2004, expanding our portfolio of activities, key initiatives and projects. As reported in previous bulletins, ESEF s interest are wide-ranging and we are developing our activities under three key initiatives:

Sustainable Energy
G

pharmaceuticals, manufacturers and specialised equipment. The meeting was very timely and complemented the publication of the technology road-map from QUILL (Queen s University Ionic Liquids Laboratory) on the future of ionic liquids.

A major piece of work which will outline the priority areas for chemistry and the chemical sciences in the context of energy is nearing completion. The expert group, coordinated under the auspices of ESEF, is near to finalising the report which looks across the energy distribution system and all major energy sources and highlights where chemistry and chemists will play a critical role in achieving major breakthroughs. The document will be made available in early 2005.

The Forum is also developing activities with other RSC Fora; we organised a workshop on November 15th in London on Materials for Sustainable Chemical Technologies with the RSC s Material Chemistry Forum. The workshop aimed to bring together materials chemists working on different sustainable energy technologies. The key points to arise from this workshop included the lack of materials chemists in the UK who apply their research to sustainable energy technologies and the need for more funding to support academic research as its moves from lab-based research into technology development. To download the presentations from this event, visit http://www.rsc.org/science/esef.htm.

ESEF also organised a workshop on Nanotechnology in Land and Natural Water Remediation on December 6th in London in association with FIRSTFARADAY and CL:AIRE. The emerging fields of nanoscience and nanoengineering provide new and novel tools for environmental technologies. This workshop focused on the application of nanoscience in land and natural water remediation and brought together those working in this field to assess current progress and discuss opportunities for future developments. Many participants agreed that the potential benefits of nanoscience in environmental technologies were tremendous with considerable increased efficiency in, for example, the remediation of contaminated sites and groundwater. However, many noted the potential environment, health and safety impacts associated with the introduction of nanoparticles into the environment by means of environmental technologies. They called for more research to understand how these nanoparticles

could potentially impact the natural balance of human health, animal and plant ecosystems. To access the presentations from this workshop visit http://www.rsc.org/science/esef.htm.

In relation to green chemistry, ESEF is organising an international conference Catalysis and Biocatalysis in Green Chemistry in December 2005 in Cambridge which is attracting attention from an international audience. Confirmed speakers include Paul Anastas, Green Chemistry Institute, ACS; Alfons Baiker, ETH, Switzerland; John Frost, Michigan State University; Klavs Jensen, MIT; Shu Kobayashi, University of Tokyo; Isao Noda, The Proctor and Gamble Company, USA; John Pierce, Dupont and Roger Sheldon, Delft University of Technology, The Netherlands. This conference will provide a strategic response to the recommendations in the International Assessment of UK Chemistry Research and the follow-on Benign and Sustainable Chemical Technologies report which recommends providing a forum to bring various catalysis communities together. This conference is supported by the RSC s journal Green Chemistry, the ACS Green Chemistry Institute and IChemE. For more details click on http://www.rsc.org/lap/confs/green.htm.

In addition to organising focussed workshops and events, ESEF is also becoming very active in developing RSC

Total column and tropospheric column of O_3, NO_2, SO_2, HCHO, H_2O & BrO
Vertical Profiles of O_3
Cloud cover, top height and cloud optical thickness, aerosol optical thickness.

Figure 3 shows the current state of the art from the SCIAMACHY instrument on Envisat for NO_2 measurements. The data in Figure 3 illustrate that urban pollution sources can be identified from space, but shows the relative paucity of data from current low earth orbit satellites. The satellite will next revisit Birmingham in six days time at 10.00am in the morning.

A new scientific imperative is emerging to understand atmospheric processes, their development and evolution, and their effects on air quality and human health. It is argued that the chemistry and dynamics of trace gases and pollutants in the troposphere and lower atmosphere are highly significant factors in determining long-term trends in air quality. Key issues emerge on local, regional and global scales. Geostationary observations of atmospheric composition offer a totally new approach to the scientific study of atmospheric composition and pollution monitoring, through its capability to provide comprehensive data sets of atmospheric trace constituents with high temporal and spatial resolution on scales ranging from local to continental.

(This article is based on a presentation by Dr Monks at the ECG symposium Environmental chemistry from space held in London in March 2004).

Web link: Techniques for determining tropospheric composition http://troposat.iup.uni-heidelberg.de/AT2/PIs/TG_3/Monks.htm

CASIX and CO_2 air-sea fluxes

and the Met Office ocean modelling team with international links and direct Space Agency support.

The primary goal of CASIX is to quantify accurately the global air-sea fluxes of CO_2, other gases (CH_4, DMS etc.), and particles. Sea surface properties are acquired by remote sensing at CASIX. This information is used to derive air-sea interactions and CO_2 fluxes.

CO_2 air-sea fluxes The flux of CO_2 is the major component of the oceanic contribution to the global carbon cycle. The air-sea fluxes of CO_2 are driven by physical, chemical and biological processes, often separated in time and space. The solubility and ecological conversion of CO_2 into the ocean is a rapid process (time scale of a few days), but the re-equilibration (time scale ~100 days) may be displaced several hundred kilometres from the sink because of ocean circulation.

High-resolution 3D circulation models with coupled biological processes (carbon cycle) are needed to compute CO_2 fluxes over ocean basins and shelf seas. With a severe paucity of CO_2

scales and sub-seasonal (monthly) time scales. Both terrestrial and marine sinks for anthropogenic CO_2 vary greatly from year to year[8] and are changing substantially on decadal time scales. As part of the post-Kyoto carbon accounting, changes in these natural sinks must be tracked and if possible predicted. Terrestrial carbon sinks at the continental scale can be tracked, but the results are reliable only if the intervening oceanic sinks are constrained independently.[9] Thus, improved estimates of oceanic fluxes will lead to better estimates of the land-atmosphere components of the global carbon cycle. On decadal to centennial scales, substantial changes in both marine and terrestrial components of the carbon cycle are expected in response to global climate change. Current predictions range from the modest to near-catastrophic.[10] It is likely, in a warming Earth, that the land sink will become a source within 20 years. In the marine realm, we expect that increasing CO_2 concentrations, temperatures and an intensifying hydrological cycle will affect ocean circulation, ventilation and ecosystem structure. Currently we have little knowledge of the impact of these changes on the capacity of the oceans to take up atmospheric CO_2, and no methods to monitor the extent of their occurrence now or in the future. EO data, combined with models and in situ observations offer the best prospects of a quantitative solution.

Currently, our knowledge of air-sea CO_2 fluxes is based on models,[11] atmospheric measurements of CO_2 and O_2/N_2 ratios[12] or climatologies compiled from decades of sea-surface observations.[13] None of these techniques provides the space and time resolutions needed to constrain calculations of sources or sinks on an annual and regional basis.

Estimating air-sea gas fluxes at regional, sub-seasonal resolution and global coverage, requires calculation at the appropriate resolution by a Fickian flux equation.[14, 15]

$$\text{Flux} = - K S [p_{atm} \{1 + \Delta\} - p_{oce}]$$

Where K is the transfer velocity, S is the solubility of the gas in the upper ocean, p_{atm} and p_{oce} are the partial pressures of the gas in the lower atmosphere and upper ocean respectively; Δ is a modification of the standard Fickian equation to incorporate small but important anomalies.[14,16] Each term in the flux equation relates to diverse strands of science that must be integrated to achieve the primary objective.

Most of the errors in computed CO_2 fluxes arise from uncertainties for the coefficients K and p_{oce}, and their determination is the highest priority. K is the primary rate constant and depends on turbulent and molecular transport near the surface of the ocean. The partial pressure (or fugacity) of the dissolved gas, p_{oce}, varies on the scale of ocean gyres and seasonally, but also at shorter space and time scales. This is due to mesoscale biophysical dynamics, and creates a difficult sampling problem. EO data will play a major role in estimating fluxes. EO data of surface roughness are the key to estimating K accurately with high resolution, while EO colour and SST will be used to interpolate the sparse measurements of CO_2 in the upper ocean. Estimating CO_2 fluxes globally requires continuous data, which ships and buoys alone cannot provide. EO data are the only global sources of data, and these are exploited by CASIX in concert with in situ data and models. One approach uses EO and in situ data to derive improved parameterisations of the air-sea gas fluxes, including analysis of the importance of processes not presently considered in predictions of future oceanic carbon uptake. These include the complex cycling of carbon in the shelf seas, the impact of white-capping, and the role of surface films in inhibiting air-sea gas exchange. A second approach is developing methods for data assimilation of carbon and ecosystem variables into 3-D ocean circulation models, using EO colour data to interpolate the oceanic ecosystem between sparse in situ measurements. This will provide coherent, self-consistent and time evolving maps of the pCO_2 distributions, and using the improved CASIX parameterisations, accurate maps of air-sea fluxes of CO_2.

The different processes of carbon uptake in shelf seas and the open ocean are handled in separate models, with careful attention to the links between these at the shelf edge. CASIX will use the new models and archived EO data to produce a 10-year climatology of air-sea gas fluxes, primarily CO_2, over the North Atlantic and where possible the globe. Analysis of these and comparison with climatologies derived from a less comprehensive approach, will provide the knowledge needed to parameterise gas fluxes more robustly in global climate models. Finally, remote sensing of atmospheric concentrations of CO_2 are now available from SCIAMACHY on Envisat and CASIX will both utilise and evaluate these measurements.

The scientific structure of CASIX

Figure 1 shows the scientific elements of CASIX and their interconnections, which defines the scientific work programme.

Element 1 (E1) is concerned with improving the parameterisation of air-sea exchange of materials, primarily CO_2, in relation to the physical state of the sea surface. Hitherto, only wind speed and SST have been used as drivers, but the impact of other factors such as the wind stress, sea state, wave breaking and surface films can now be quantified using EO data. A fundamental scientific study

D models, we will produce new climatologies, combining modelled pCO_2 with the improved air-sea exchange parameterisations from Element 1. Finally we will analyse the relationships between the observed fluxes and other climate indicators such as ENSO and NAO.

Table 1 summarises the scientific elements of CASIX, involvement of the CASIX team, the main tasks to be performed and their principal deliverables. The table shows the interactions between several partners are needed within each science element as well as across the whole span of CASIX. This highlights the importance of establishing CASIX, since without it, the necessary collaborative research projects are unlikely to emerge. The management challenge is to ensure that CASIX fosters the fully integrated research that is needed to tackle the pressing problem of CO_2 fluxes and global budgets.

All science elements and sub-projects are making substantial progress and accomplished new developments in the first year of CASIX. Element 1 has produced new algorithms for the gas exchange coefficients using EO data of wind and waves and Element 2 has developed preliminary bio-optical algorithms for ocean biological properties that work in open ocean and shelf seas; validated, tested analyses will be released soon. Element 4 has produced the first new CO_2 flux climatology for the global oceans, combining historical pCO_2 data and new satellite remotely sensed data for wind and waves.

References

1 Aiken, J, Moore, G. & Holligan, P. 1992. Remote sensing of ocean biology in relation to global climate change. J. Phycology28, 579-590

2 Lefevre, N., Moore, G., Aiken, J., Watson, A., Cooper, D. and Ling, R. 1998. Variability of pCO2 in the tropical Atlantic, J. Geophys. Res. 103, 5623-34.

3 Lefevre, N., Aiken, J. et al. 2002. Observations of pCO2 in the coastal upwelling off Chile: spatial, temporal extrapolation using satellite data. J. Geophys. Res. Oceans,107 (C6): art. no. 3055

4 Kettle, A.J., Rhee, T.S., von Hobe,

Inherent Optical Properties
JGOFS
Joint Global Ocean Flux Study
LISST
Laser
In-Situ Scattering and Transmissometry
MERIS
MEdium Resolution Imaging Specrometer
MODIS
Moderate Resolution Imaging Spectro-radiometer
MODIS-A
Moderate Resolution Imaging Spectroradiometer - Aqua
NAO
North Atlantic Oscillation
NASA-AMT
National Aeronautics and Space Administration - Atlantic Meridional Transect
NPZD
Nutrient - Phytoplankton - Zooplankton - Detritus
OCTET
Ocean Carbon Transport, Exchanges and Transformations
SAR
Synthetic Aperture Radar
SCIAMACHY
SCanning Imaging Absorption SpectroMeter for Atmospheric CHartographY
SeaWiFS
Sea-viewing Wide Field-of-view Sensor
SOLAS
Surface Ocean-Lower Atmosphere Study
SPM
Suspended Particulate Material
SSH
Sea Surface
SSS
Sea Surface Salinity
SST
Sea Surface Temperature
TOPEX
TOPography EXperiment for Ocean Circulation

JIM AIKEN,
Director of CASIX, NICK HARDMAN-MOUNTFORD and the CASIX team

(This article is based on a presentation by Professor Aiken at the ECG symposium Environmental chemistry from space held in London in March 2004).

Web links

CASIX: http://www.nerc.ac.uk/funding/earthobs/coex/casix.shtml

The Global Carbon Cycle: A Test of Our Knowledge of Earth as a System , P. Falkowski et al, Science, 2000, 290, 291-296 http://www.globalcarbonproject.org/PRODUCTS/pre%20project%20products/Falkowski2000.pdf

European Association for Chemical and Molecular Sciences

The new European Association for Chemical and Molecular Sciences, EuCheMS, will take over the role and responsibilities of the former Federation of European Chemical Societies (FECS) in 2005. The RSC is the largest member society of EuCheMS and will hold the Secretariat. Sean McWhinnie from the RSC reports.

At the 2004 Federation of European Chemical Societies (FECS) General Assembly meeting in Romania, the member societies approved an amended constitution and a new name. The European Association for Chemical and Molecular Sciences (EuCheMS) is a non-profit-making organisation. Its object is to promote co-operation in Europe between those non-profit-making scientific and technical societies in the field of chemistry whose membership consists largely of individual qualified chemical and molecular scientists and whose interests include the science and/or practice of chemistry. In the coming months, EuCheMS will become an Association Internationale Sans But Lucratif (not-for-profit organisation) in Belgium.

The most vital aspect of the future strategy of EuCheMS is political impact. With the new enlarged EU, it is even more important that EuCheMS provides a focus for discussion on chemical and molecular science issues in order to influence EU government and politicians on developments in European research. To do this, EuCheMS needs to obtain financial support. Under its new constitution, EuCheMS will be better able to enter into partnership with other science groups. The chemical and molecular sciences community needs to readjust in order to operate on equal terms with other science groups and to be welcomed as a partner in joint initiatives. EuCheMS is ready to take the lead. To succeed, EuCheMS must be visible to the decision makers, to other science groups and to its member societies and their members. EuCheMS aims to provide added value to the member societies in order to ensure their involvement in developing the new strategy.

Professor Giovanni Natile from the Italian Chemical Society will take over as President of EuCheMS from Professor GÆbor NÆray-Szabó of the Hungarian Chemical Society at the beginning of 2005.

EuCheMS, like FECS, promotes educational, professional and ethical matters, including the designation European Chemist (EurChem). Scientific meetings, sponsored events and development of initiatives in specific areas are carried out by Divisions and Working Parties.

The former FECS Division for Chemistry and the Environment will continue to operate under the new constitution. The Division s main activities are centred on the arrangement of conferences, especially the Annual International Conferences on Chemistry and the Environment. However, in 2006 the Division will contribute to European Chemistry Congress which will take place in Budapest from 27th to 31st August 2006.

The Division also has a number of sub-committees which have their own activities and organise specialist meetings. These sub-committees are: Soil Chemistry; Cultural Heritage Chemistry; Environmental Chemistry Education; Green Chemistry; Atmospheric Chemistry; and Water Chemistry.

The current chairman of the Division is Philippe Garrigues from France, and John Holder from Centre for Environmental Research and Technology T

interest. It should also make a good reference work for someone on the periphery, or for a library. The first part of the book comprises twelve chapters on the principles of atmospheric science. The initial chapters set the scene, dealing with the evolution of the atmosphere (Wayne), the structure of the atmosphere and atmospheric energy (Coe and Webb), the Earth s climates (Lockwood), biogeochemical cycles and residence lifetimes (Shallcross, Wang and Dimmer) and sources of pollution (Jackson). Pollution is, as it should be, a recurring topic throughout the book.

Then come five more detailed chapters on tropospheric photochemistry (Monks), stratospheric chemistry and transport (Mackenzie), tropospheric aqueous phase chemistry (Brimblecombe) and on atmospheric particulate matter and aerosols (Baltensperger, Nyeki and Kalberer). The first section concludes with chapters on meteorological aspects: atmospheric dispersion and air pollution meteorology (Carruthers), synoptic scale meteorology (Parker) and wet and dry deposition (Hall). The text is copiously supported with clear diagrams and well set-out equations. It is nice to see a willingness to repeat chemical equations to avoid constant thumbing back and forth when trying to follow the argument over several pages. There are a few oddities such as the CLAW hypothesis and the QG theory and potential vorticity (PV) which are discussed at length but for which definitions are either not given or are hard to find.

The second part of the book is concerned with problems, tools and applications. It opens with three chapters on air pollution: on global (Jain and Hayhoe), regional (Halsall) and urban scales (Fenger). Two chapters follow on monitoring techniques (Robinson) and emission inventories (Hutchinson). There are then modelling chapters for each end of the scale pollutant dispersion (Vawda) and climate (Lahoz). The book concludes with two chapters on management: critical levels and critical loads (de Vries and Posch) and air quality management (Fisher). An effort is made throughout to break away from the European bias and consider problems in other regions. However the final management chapter is confined just to the UK, although summer smog episodes in south-eastern England almost always involve the whole of north-western Europe. Since the UK is a party to the CRTAP convention and adheres to EU directives, some mention of the EU directives and the CAFÉ initiatives would have been welcome, together with the role of the EEA and the interaction with EMEP.

The level of approach is reasonably uniform throughout and each chapter would provide a good start for a new research student. Each is self-contained with its own references and in some cases has a conclusion. Although the first chapter leaves the reader 300M years before the present, there are in fact references up to the year 2000.

So why the fuss about a handbook? In what is essentially a reference work, an excellent index, and cross referencing within chapters is needed to be able to find things easily, particularly in areas with which one is less familiar. The book has a nice contents list but a poor index; so, much of the book is inaccessible to all but those who know the areas well. For example, you won t find the ozone hole or summer smog or the QG theory or potential vorticity, even though they are dealt with at length in the text or the weekend or titration effects or the CLRTAP, which perhaps ought to have been both discussed and mentioned. Initials and chemical formulae are eschewed, which is crippling in a field where they are common. Surely abbreviations and acronyms, such as IPCC, EMEP, NOx, AOT40 and POPs, are part of the language of the field now they are mentioned as such in the text. And if one insists on avoiding them in the index, then perhaps a comprehensive glossary would have helped, provided it was correlated with the index. As well as the omissions, it is hard to discern the philosophy behind the index: some section heads are included, some aren t; some items are included for one chapter but not for another. So following up ozone chemistry for example will take you to the nice discussion in chapter 14 but not to the definitive accous eas.043Nisth khtin 9T*khtRuJTmor another. Five ac7 fo1

wheD0.01W5wded itcorrel thads are0eychapte

the references to the subjects mentioned essential where there is no internal cross-referencing. Having had to do such indexing myself, I realise that it costs a lot of effort but it is essential to provide access for the potential users.

And what of the serious omission? Well apart from a brief section in chapter 14, there is nothing about regional and synoptic scale modelling. Chemical Transport Models (CTM) attempt to encapsulate our knowledge and understanding of the behaviour of trace substances in the atmosphere, and they provide the basis for the appreciation and regulation of tropospheric air pollution. But here we learn nothing about distinctions between Lagrangian and Eulerian models, and their uses in interpreting data, or their support through the EMEP and RAINS models for the EU directives on ozone, NOx, VOC and other pollutants. And there is no discussion of the problems of such models the science and skill needed to construct spatial and temporal emission estimates; the parameterisation of turbulence and the necessary simplifications of the chemistry schemes. Nor is there any mention of the gradual progress in incorporating observations from disparate sources into model calculations on these scales which, many

inventory shows a substantial decrease from 1970-2000 and this is mostly associated with a decrease in coal use. But PM resulting from road transport is becoming relatively more important especially since particulate iron concentrations seem to be high, and inhaled iron has been linked to cellular oxidative stress. In both the UK and Europe the decrease in PM now seems to have declined, but it is not clear if this is associated with climate factors or due to some other reason.

In the final paper of the first session, Peter Woods (NPL) spoke on The European Network of National Air Quality Reference Laboratories (AQUILA) (http://ies.jrc.cec.eu.int/Units/eh/Projects/Aquila/). EC Directive 96/62/EC on Ambient Air Assessment requires member states to nominate National Reference Laboratories (NRL) to conduct quality assurance and quality control checks of both analytical methods and those who carry out the analyses.

Meeting report

Third annual AIRNET conference

The 3rd, and final, AIRNET Annual Conference was held at the Movenpick Hotel, Prague, Czech Republic from 21st - 23rd October 2004, and was attended by approximately 150 delegates.

AIRNET is a thematic network project initiated to develop a European-wide framework for air pollution and health research. AIRNET collects, interprets and disseminates data from individual (EU funded) projects, in order to strengthen the relationship between science and policy and to draw policy-relevant recommendations from air pollution and health research. AIRNET started in 2002 and is funded until the end of 2004. The first two years have focused on the collection and interpretation of air pollution and health data. The main aim of the 2004 AIRNET Conference was on communication between EU research and policy. The following topics were discussed:

Role of EU research in policy development for air pollution and health.
AIRNET and WHO reports on air pollution and health.
Air pollution and health in Central and Eastern Europe views from science and policy.
Air pollution and health issues and problems specific to European regions (North, West, Central/East, South).

Details of AIRNET conferences plus reports of various working parties may be seen at the AIRNET web site: http://airnet.iras.uu.nl/

Recent books on the environment and on toxicology at the RSC library

The following books and monographs on environmental topics, toxicology, and health and safety have been acquired by the Royal Society of Chemistry library, Burlington House, during the period July to December 2004.

Agricultural Applications in Green Chemistry
(ACS Symposium Series No. 887)
Nelson, W.M. (Ed), ACS, Washington, 2004 ISBN/ISSN: 0841238286

Chemical Sciences in Changing Times: Visions, Challenges and Solutions
Vol. II (4th International Conference of the Chemical Societies of the South-east European Countries, Belgrade July 18-21 2004)
Serbian Chemical Society, Belgrade, 2004 ISBN/ISSN: 8671320200

COSHH in Practice: Skin Management
2nd edition
Packham, C.L; Packham, H.E., Croner, Kingston, 2004 ISBN/ISSN: 1855246813

1,1-Difluoroethane (JFC-152a)
(Joint Assessment of Commodity Chemicals No. 45)
European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC), Brussels, 2004

1,1,1,3,3-Pentafluoropropane (HFC-245fa)
(Joint Assessment of Commodity Chemicals No. 44)
European Centre for Ecotoxicology and Toxicology of Chemicals (ECETOC), Brussels, 2004

Water Quality Assessments in the Mississippi Delta: Regional Solutions, National Scope
(ACS Symposium Series No. 877)

THE ROYAL SOCIETY OF CHEMISTRY ENVIRONMENTAL CHEMISTRY GROUP

Bulletin

CORRECTION

Forthcoming symposium

Pharmaceuticals in the Environment: Fate, Effects and Regulation

Tuesday, 1st March 2005

Venue: The Society of Chemical Industry, 14/15 Belgrave Square, London

Organised by the SCI BioActive Sciences group in association with JPAG, RSC and SETAC-UK

Conference Aims

There is an increasing awareness of the presence and effects of pharmaceuticals in the environment particularly in watercourses. Pharmaceuticals are present from veterinary and human use. This meeting, which is aimed at regulators, industry and academics, will address recent regulatory advances, and include talks on current research into the fate of pharmaceuticals in the environment and their potential impacts on environmental and human health.

Programme

Tuesday, 1st March 2005

09.15 Registration and coffee
09.55 Introduction
10.00 Usage and input routes of pharmaceuticals into the environment
Emma Pemberton, Environment Agency, UK
10.35 Environmental legislation for human and veterinary pharmaceuticals in Europe
Alex Tait, Veterinary Medicines Directorate, UK
11.10 Fate of pharmaceuticals in the environment
Alistair Boxall, University of York/ Central Science Laboratory, UK
11.45 Occurrence of human pharmaceuticals in the UK aquatic environment
Kevin Thomas, CEFAS, UK
12.20 Lunch and Poster Exhibition
13.40 Challenges in exposure modelling for pharmaceuticals
Kathrin Fenner, EAWAG, Switzerland
14.15 Impacts of clinical and non-clinical usage of antibiotics and biocides on environmental reservoirs and mobility of resistance genes
Liz Wellington, University of Warwick, UK
14.50 Tea break
15.10 Ecotoxicity testing of human pharmaceuticals: principles and practicalities
Tim Williams, AstraZeneca, UK
15.45 Indirect effects of pharmaceuticals on consumers
Len Levy, IEH Leicester, UK
16.20 Closing remarks
16.30 Close of meeting

REGISTRATION FORM

To register, please fill in your details below and send with the appropriate remittance to:
Katherine Simpson, Society of Chemical Industry, 14/15 Belgrave Square, London, SW1X 8PS, UK
Tel: +44 (0) 20 7598 1566,
FAX: +44 (0) 20 7235 7743,
E-mail: katherine.simpson@soci.org

Pharmaceuticals in the Environment: Fate, Effects and Regulation
Tuesday 1 March 2005, SCI, 14/15 Belgrave Square, London, SW1X 8PS, UK

Name: .....

Affiliation: .....

Address: .....

.....

Special requirements: dietary/access/other .....

Please register me for the above conference

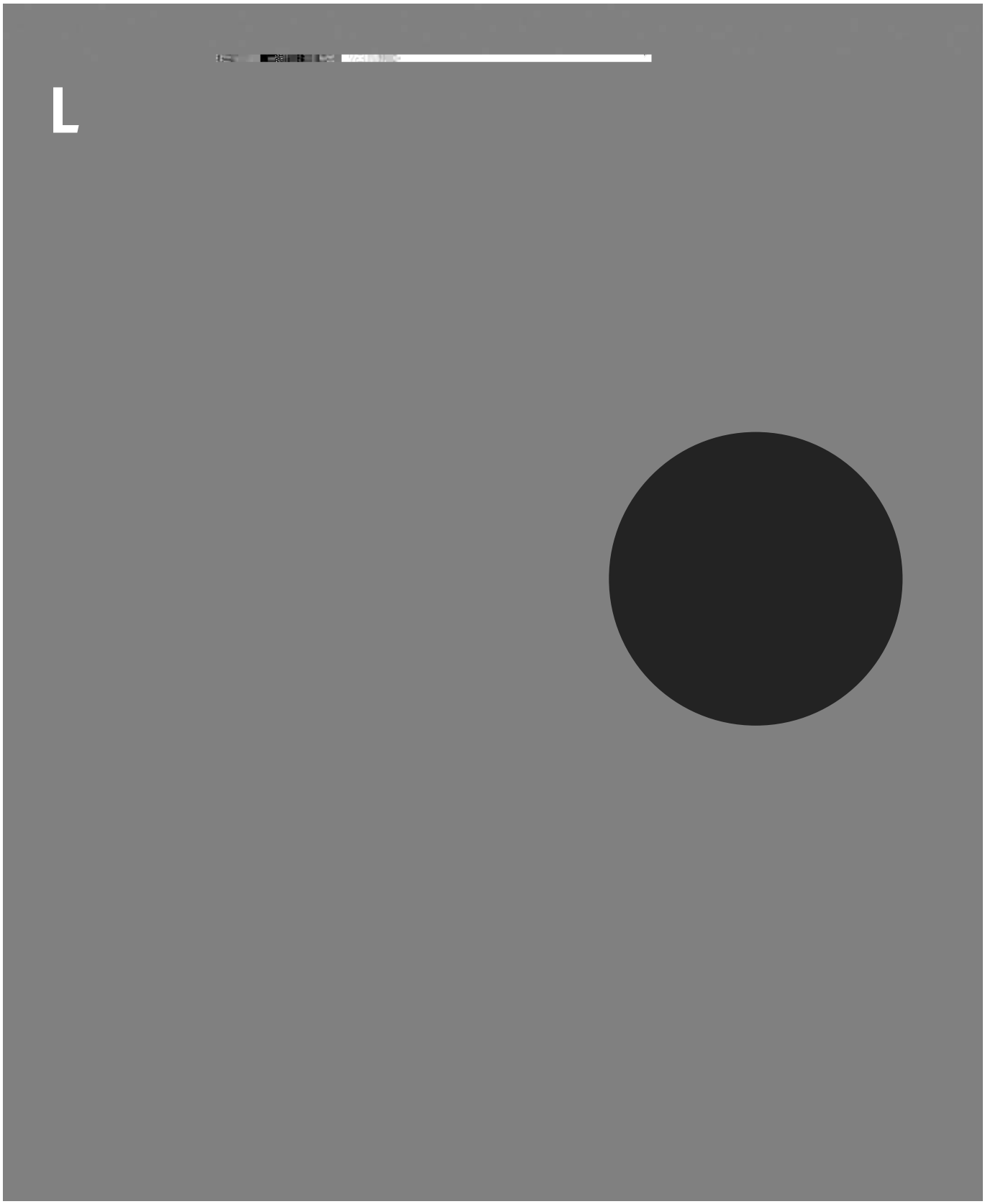
Signature .....Date .....

PLEASE NOTE THAT UNSIGNED FORMS CANNOT BE ACCEPTED

FEE: Includes refreshments as stated in the programme.
Non-members: £140 ❑ Member of SCI/JPAG/RSC/SETAC: £100 ❑ Retired member of SCI: £35 ❑
Non-member students: £35 ❑ Student member of SCI: £25 ❑

Register online at www.soci.org

Scientific Organisers: Alistair Boxall, University of York/CSL; Mark Cronin, Liverpool John Moores University; Roger Reeve, Sunderland University



This issue of the ECG Bulletin was printed by SurePrint, Haywards Heath, West Sussex RH16 3NG Tel: 01444 456673