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The Environmental Physics Group

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Editorial

This is the second Bulletin of the Environmental Physics Group. Due to problems beyond our control (indeed, beyond our understanding!), the first Bulletin was formatted in a rather strange way. We hope that this issue will reach you in a more attractive format.

We want to extend to you again an invitation to submit letters or articles for publication in the Bulletin. Please consider writing to us or submitting an article for the Personal View or the new Research Notes sections, or under any other category that you like -- ideas for meetings, relevant information, indeed anything relevant that might interest other members of the Group. We think that the best way to make the Bulletin more useful to its readers is to first make it more attractive and more interesting. To do this, we need help from the members. If you want to contribute, please contact one of the editors at the address given at the back of this Bulletin. The deadline for submission of contributions for the next Bulletin is 15 October 1996.

A new feature of this issue is the section Research Notes. We intend that this be a regular column, providing a forum for environmental physicists to air their views on whatever aspects of their research they would like to share. To start the ball rolling, the first contribution was provided by David Pearson; but to sustain this column, we need contributions from members.

As usual, this Bulletin is also available on the WorldWide Web, at the following URL: http://www.nerc-aesc.ac.uk/~chwp/Htmls/epg_top.html.

Ranjeet Sokhi, David Pearson (editors).

The views expressed in this editorial are those of the editors, and do not necessarily reflect those of the Institute of Physics or of the Environmental Physics Group.

Research Notes


Global maps of physical quantities, as measured by orbiting instruments, are quite common. For example, behind the PC on which I am typing this, there is a poster showing the diurnal variability of land-surface temperature, variability of sea-level over a two-year period, an index that is correlated with the density of vegetation, and others. However, it appears not to be widely appreciated how hard it is, in many cases, to derive quantitative estimates of phenomena at the Earth’s surface, given measurements at the top of the atmosphere (TOA). My intention in this article is to illustrate the difficulties involved in a particular estimation problem, that of solar energy input to land surfaces.

Bull. EPG 2, No. 2, 1996.

Research Notes

Our problem, then, is to estimate the solar radiative flux density absorbed at the Earth’s surface, with spatial and temporal resolution over large areas, given measurements of the reflected solar radiation at TOA. This is of value to climatologists who need to know the input of energy at the lower boundary of the atmosphere. It is also of value when resolved spectrally, enabling an estimation of photosynthetic activity, and hence plant biological activity more generally, evapotranspiration, and so on. In the discussion that follows, I will neglect the complications of sampling, and consider only the physics of the problem. I will also ignore spectral resolution for brevity.

A first, naïve train of thought might run as follows. We need to measure reflected flux density, so we can determine the absorbed flux density by conservation of energy (since we know how bright the sun is). So we need to orbit a downward-looking radiometer that will measure the reflected intensity over some finite footprint determined by the optics of the radiometer and its height above the ground.

Of course, this strawman method is too simple. The method contains faulty assumptions: (i) that we automatically know the incident solar flux density at the surface; (ii) that the signal at TOA automatically tells us the reflected intensity at the surface; and (iii) that the intensity of light reflected in a certain direction (upwards) automatically tells us the total reflected flux density, i.e. the exitance. Assumption (i) is incorrect because the atmosphere has a large effect on the downwelling sunlight. Assumption (ii) is incorrect because the reflected signal is also strongly perturbed by the atmosphere. Assumption (iii) is wrong because the reflectance of complex surfaces is anisotropic, and naïve integration of a constant intensity over a hemispherical solid angle is unlikely to provide a good estimate of the true exitance. The rest of this article discusses ways of fixing these assumptions.

The Atmosphere.

To simplify the discussion still further, I assume that the atmosphere is free of clouds — this restricts the geographic and temporal applicability, but is sufficient for the present discussion. Further, it is adequate for most purposes to consider that the atmosphere is a slab, and that the Earth is an infinite flat plane beneath it. Finally, I assume horizontal homogeneity, i.e. the problem is 1-dimensional. This does not imply isotropy — intensity fields can be highly directional.

Bull. EPG 2, No. 2, 1996.
Figure 1 shows that the scattering of light by the atmosphere leads to a 'contamination' by the atmosphere of the light detected by the sensor, and to a similar effect on the downwelling light at the surface. These effects can be understood qualitatively with the aid of radiative transfer theory. In slab geometry, this theory (or numerical applications of it) leads to directional reflectances and transmittances for the atmosphere. If $I^{\pm}_{\text{ROA}}(\theta, \phi)$ is the intensity of light incident on the top of the atmosphere in spherical polar coordinates, $I^{\pm}_{\text{ROA}}(\theta, \phi)$ is the downwelling intensity at the bottom of the atmosphere, and $T^{\pm}(\theta', \phi'; \theta, \phi)$ is the bidirectional atmospheric transmission function, then by the definition of the latter, we have:

$$I^{\pm}_{\text{ROA}}(\theta, \phi) = \int_{0}^{\pi} \int_{0}^{2\pi} T^{\pm}(\theta', \phi'; \theta, \phi) I^{\pm}_{\text{ROA}}(\theta', \phi') \sin \theta' \sin \phi' \cos \phi' \, \, \phi' \, \, \theta' \, \, d\theta' \, \, d\phi'. \quad (1)$$

This is a linear integral transform, which is easier to write (and read) using an operator formalism:

$$I^{\pm}_{\text{ROA}} = \hat{T}^{\pm} I^{\pm}_{\text{ROA}}. \quad (2)$$

Similarly:

$$I^{\mp}_{\text{ROA}} = \hat{R}^{\pm} I^{\mp}_{\text{ROA}}, \quad (3)$$

where $\hat{R}^{\pm}$ is the reflection operator for light incident on the top of the atmosphere. If light is also incident on the bottom of the atmosphere with intensity $I^{\mp}_{\text{ROA}}$, these two equations generalize to:

$$I^{\pm}_{\text{ROA}} = \hat{T}^{\pm} I^{\mp}_{\text{ROA}} + \hat{R}^{\pm} I^{\pm}_{\text{ROA}}, \quad (4)$$

$$I^{\mp}_{\text{ROA}} = \hat{R}^{\pm} I^{\mp}_{\text{ROA}} + \hat{T}^{\pm} I^{\pm}_{\text{ROA}}. \quad (5)$$

Note that the reflectances of the atmosphere are different for light incident at the top and bottom, and similarly with the transmittances. We can think of $I^{\pm}_{\text{ROA}}$ and $I^{\mp}_{\text{ROA}}$ as outputs to the atmosphere, and $I^{\pm}_{\text{THO}}$ and $I^{\mp}_{\text{ROA}}$ as inputs. Thus we have a means of understanding the interaction of the incident sunlight and of the light reflected from the ground with the atmosphere.

The Ground.

Complex surfaces have anisotropic reflectances as a result of geometric effects. For example, most terrestrial (and solid planetary) surfaces exhibit the so-called hot-spot effect, which is an augmentation of the reflected intensity in the direction of backscatter. In astronomy, this is known as the opposition effect, indicating that the intensity of light reflected from a solid planetary surface is high at opposition, i.e. when the planet and the Sun are approximately 180° apart. The cause of the effect is simple. A complex surface composed of many small components (such as a soil or vegetation) contains the shadows of those objects; when the observer is looking from the same direction as the source of light, those shadows are hidden by the objects that cast them, so the scene appears bright.

The transfer function relating incident to reflected intensity at a surface is the bidirectional reflectance distribution function (BRDF). This, like the transmittance and reflectance functions of the atmosphere, is a function of two directions, i.e. of four variables. A linear integral transform is used again, so we can use an operator notation, denoting the BRDF by $\hat{\Phi}$:

$$\hat{\Phi} = [I - \hat{\Phi} \hat{B}]^{-1} \hat{\Phi} \hat{B}, \quad (7)$$

$$I_{\text{ROA}} = \hat{T} \hat{B} \hat{I}_{\text{ROA}}, \quad (8)$$

and equation (6) gives $I^{\pm}_{\text{ROA}}$. These equations can be understood by expanding the term $[I - \hat{\Phi} \hat{B}]^{-1}$ in a binomial series, to give terms that represent successive multiple reflections between the atmosphere and the ground. Thus if we know the BRDF of the surface and the optical properties of the atmosphere, we can determine the incident and exitant intensities at the surface, then integrate them over the hemisphere to obtain the incident and exitant flux densities, thus solving our problem.

However, if we could do this, we would not need an orbiting sensor! The real problem is that $I_{\text{ROA}}$ is measured for a single direction, and $I^{\pm}_{\text{THO}}$ is known exactly, but the optical...
properties of the ground and of the atmosphere are unknown. Everyday experience tells us that the appearance of the sky can change considerably even in the absence of clouds; this is due to changes in the amount of water vapour in the atmosphere, and to variations in the type and concentration of suspended aerosol particles. The colour and brightness of an area of land can also change; so it would be a poor approximation to assume fixed, standard optical properties.

Therefore we need some model of the optical properties of the land and the atmosphere (such as in Fig. 2), and to adjust the parameters in those models to reproduce the observed TOA intensity. Unfortunately, we only have one measurement at each point on the surface, but generally a host of parameters in the models of the atmosphere and land. Thus it is necessary to make assumptions, such as using a standard atmosphere, or to use a priori information on the type of surface, such as that it is coniferous forest, or unvegetated desert, or wheatfield. The type of surface can often be estimated by its reflectance spectrum. Another approach is to take measurements on the ground as the sensor passes overhead — spectral measurements of the solar disc can be used to estimate the column-integrated amount of water vapour, and the size-distribution of aerosol particles, which information can be used in a radiative transfer calculation. However, this provides information that is regionally applicable at a certain time, but is not global.

In the future, this problem will be partly addressed by the launch of sensors that observe the Earth from several different directions simultaneously, or nearly so. This will allow a better characterization of the BRDF and of the optics of the atmosphere. A sensor of intermediate complexity is already in orbit; the ATSR-2 looks at the surface from two different directions, about two minutes apart. This has other advantages, such as the possibility of using stereocopy to determine the heights of the tops of clouds. Other possibilities include the synergistic use of several sensors, including non-optical (e.g. radar, thermal infrared) sensors.

Further Reading.


For further information contact: Dr. David Pearson, Environmental Systems Science Centre (ESSC), PO Box 227, University of Reading, Reading RG6 6AA, UK. Tel: (01734) 318741, fax: (01734) 753865, email: dwpmail@nrcx.essc.ac.uk, internet:

http://www.nerc-essc.ac.uk/~dwp/Home.html

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**Research Notes**

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**Environmental Physics Group AGM, 1996.**

The AGM was held at the annual Congress (see below). Ian Colbeck and Peter Hodgson were elected to the Committee.

Peter Hodgson graduated in Physics and Applied Physics from Nottingham University in 1986. He then spent three years at the British Telecom Research Laboratories, developing optical communication systems, before returning to academia to study for an M.Sc. in Optoelectronics and Laser Devices at Heriot-Watt University. He remained in the Physics department at Heriot-Watt to complete his Ph.D. in 1994, investigating the photoacoustic technique for the detection of oil in water. Since then, he has been employed in the Instrument Section of the Institute of Hydrology, where he has responsibility for the development of new hydrological instrumentation, particularly in water quality.

Ian Colbeck was awarded his B.Sc. at Queen Mary College, London, his M.Sc. at Oxford University and his Ph.D. at Lancaster University. Previously employed as a Research Associate in the Department of Environmental Sciences, University of Lancaster and as a Higher Scientific Officer for the British Antarctic Survey, he is now Senior Lecturer and Director of the Institute for Environmental Research, Department of Biological and Chemical Sciences, University of Essex. His research interests are photochemical oxidants, atmospheric modelling, fractal properties of aerosols, studies of the optical properties of aerosols, aerosol shape, industrial applications of aerosols, processing of nanoparticles, materials, urban air quality. His teaching experience includes the setting up of a new multidisciplinary Masters course “Environment: science and society” which introduces students to both the physical and social dimensions of major environmental problems, and to the way in which those dimensions interact. Further information can be found on:

http://www.essex.ac.uk/bcs/aerosol.html

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**The Institute of Physics Annual Congress, 1996.**

Report on the Congress.

This three day meeting took place at the Telford International Centre from 23 to 25 April 1996. The Environmental Physics Group held a one day meeting, as part of the larger affair, on 24 April. The EPG’s meeting, titled *Physics and the Environment: Processes and Applications*, was attended by about forty participants. It was one of fifteen physics meetings
Summaries of Talks Presented to the EPG at the Congress.

Processes of atmospheric dispersion.
F.B. Smith, Imperial College Centre for Environmental Technology, 48 Prince's Gardens, South Kensington, London SW7 2PE.

Airborne pollutants have most frequently been emitted into the lower atmosphere where the profiles of wind, temperature and humidity are often complex and variable in time and space. The relative proximity of the underlying surface usually means that the airflow is turbulent with scales of motion spanning an enormous range from millimetres to kilometres in the vertical, and to thousands of kilometres in the horizontal. At short ranges, out to several tens of kilometres, vertical dispersion is governed by turbulence generated by the tumbling action of the airflow over the surface (e.g. by wind shear) and by any thermally-generated motions whenever the surface is warmer than the air above.

Large clouds, frontal zones and high mountains can often be important in dispersing pollutants through a much greater depth of the atmosphere. With deep polluted layers the variation of wind speed, and particularly wind direction, coupled with subsequent vertical mixing, can lead to a marked broadening of the pollutant-concentration field at ground level where the effects of the pollution can be felt on the environment.

This paper provides a summary of these various processes and outlines how air-pollution meteorologists attempt to model them to provide guidance for those concerned with concentration and deposition patterns.

L.P. Simmons, Department of Soil Science, University of Reading, Whiteknights, P.O. Box 233, Reading RG6 6DW.

Water flow from the soil to the atmosphere via plants is an important component of evaporation from land surfaces. This paper discusses some of the approaches that have been used to model the flow of water through the soil/plant system. The paper concludes by demonstrating the application of a soil/vegetation/atmosphere transport model which incorporates a plant water uptake element to investigate the factors controlling evaporation from sparsely vegetated land where there can be important interactions between evaporation from leaves and direct evaporation from the soil surface.

The paper starts by reviewing early attempts to describe the availability of soil water to plants in terms of upper and lower limits of soil water suction, and the development of theories based on the assumption that water flows from the bulk soil to the site of evaporation within the leaf along gradients in water potential. The nature of the water pathway from bulk soil to leaf is discussed with reference to the sites of greatest hydraulic resistance to water flow. Progress towards evaluating the relative magnitudes of the hydraulic resistances in the bulk soil, at the root/soil interface and at various locations in the plant will be discussed.

Recent research has cast doubt on the extent to which simple hydraulic models based on water flow along gradients in water potential can be applied to model transpiration. One of the areas of key concern is how stomata respond to soil drying, and the extent to which stomatal closure, and hence transpiration, is controlled by hormonal signalling triggered by direct sensing of soil water status by roots.

The final section gives one example of how a model of water flow through the soil and plant has been incorporated into a more comprehensive model of transfer processes in the soil-plant-atmosphere system that has been applied to study the impact of crop management practices on the partitioning of evaporation from sparsely vegetated land between plant and soil surfaces.
Transport processes in soils: applying soil physics to some environmental problems.
P.B. Leeds-Harrison, School of Agriculture, Food and Environment, Cranfield University, Silsoe, Bedfordshire MK45 4DT.

Soil physical processes produce the soil environment for maintaining the ecosystem for plant and animal life. The system is dynamic and soil physical conditions result from the conditions at the boundaries and the transport coefficients that determine the rates of movement.

Soils are complex composite bodies with soil air and soil water occupying the space between soil particles. The arrangement of the particles forms a network of interconnecting pores in which the soil air and water can move and reside. The soil water is held by means of surface tension forces in soil pores and adsorption forces on the solid surface. The dryer the soil the greater the force, and in wet soils surface tension forces dominate. There is convective movement of energy and matter in moving fluids in soil pores, while concentration and thermal gradients produce diffusive components. Physical theories of transport of matter and energy do not consider the composite nature of soils but assume transport processes to take place in a continuum, using transport coefficients of the composite system. The boundary conditions determine the patterns of flow.

The applications of soil physics to environmental problems are illustrated in three examples that have become important in recent years:

1. The first example concerns the conservation of wildlife species and the physical conditions required to maintain the correct soil environment for their survival. The physical conditions can be modelled over long time spans, so giving a link between the observed plant community today and the past conditions that gave rise to them. This work gives guidance on appropriate soil-water management to encourage a given species.

2. The second example concerns the minimisation of pollution by leaching from landfill sites that are lined with engineered clays of very low permeability. The time scale for landfill to stabilise is many tens of years so that leachate migration from the fill is a potential problem. Using hydrodynamic dispersion theory for solute movement in soils, it can be demonstrated that, perhaps contrary to first expectations, a high water table around the site can minimise this leakage.

3. The third example concerns the movement of pesticides to surface and groundwaters. In simple sands, the movement of pesticide to groundwater has been described well by the transport theories used in classical continuum soil physics. However, complications arise in aggregated soils that often make these theories inappropriate. In these cases the scale of observation becomes important. At the aggregate scale continuum physics may be appropriate, and at a much larger scale in a fractured aggregated material continuum physics may also be applied but with different properties to those of the basic soil fabric. The intermediate scale, however, is often met when the continuum approach cannot be used, and current research in soil physics is aimed at extending our theoretical knowledge to deal with this non-continuum situation. This has inevitably raised difficulties in matching descriptions of the geometry of the complex pore space to the simple boundary condition approaches previously used.

Bull. EPG 2, No. 2, 1996.

The development of a high resolution model of the global ocean.
D.J. Webb, James Rennell Division, Southampton Oceanography Centre, Empress Dock, Southampton, SO14 3ZH.

Most of our knowledge of the ocean is based on measurements from ships, with additional data in recent years coming from current-meter arrays, drifting buoys and satellite measurements of the ocean surface. Such data are very expensive to collect, and given the size of the ocean it means that, relative to the total problem, the data are often sparse in both space and time.

The ocean, though, is a classical physical system satisfying equations that conserve mass, momentum, heat and salt. We can thus learn more about the ocean by solving these using analytic and numerical methods. In the past analytic methods have been very successful in explaining some of the large scale features of the ocean but, because of the small scale of many key oceanic features, the best descriptions of the large scale ocean circulation require numerical models.

In this talk, the structure of OCCAM, the UK high resolution global ocean model, is described. Recent developments to the model include a better representation of the ocean surface, an improved equation of state and the use of a high order advection scheme. Developments under way include a new method for representing ocean bottom topography and a better representation of the overflows from one ocean basin to another.

The talk will also include early results from the model showing the large scale ocean circulation, the eddy field and the transports of fresh water and heat. The latter is important in studies of the ocean's role in climate and climate change.

Modelling and Managing the Aquatic Environment.
R.A. Falconer, Department of Civil and Environmental Engineering, University of Bradford, Bradford, West Yorkshire, BD7 1DP.

In recent years there has been a growing public concern and an increased awareness of pollution problems. This concern has led to engineers and scientists being increasingly involved in undertaking environmental impact assessment studies for such potential contamination sources as: (i) sewage discharges of both domestic and industrial waste; (ii) sewage sludge discharges at sea; (iii) cooling water discharges from power stations and fertilizer plants etc.; (iv) toxic and radio-active waste discharges from chemical plants and power stations etc.; (v) intensive crop farming on land, leading to increased use of fertilisers, and fish farming in coastal and estuarine waters, leading to increased nutrient and pesticide loadings; and (vi) poor flushing of coastal and estuarine basin developments.

In assisting engineers and scientists in evaluating the hydro-ecological impact of potential coastal pollution sources, such as those outlined above, scaled physical models sited in large hydraulics laboratories have historically been used. However, physical models have a number of restrictions, including (i) scaling and distortion, (ii) cost, (iii) inflexibility, (iv) not being transportable, and (v) not adaptable. Hence, engineers and scientists have increasingly turned to numerical hydraulic, water quality and sediment transport models for such studies. Although numerical models have a number of advantages over physical models, they also have their disadvantages. Apart from requiring a high level of technical expertise — not always...
readily available to many organisations — numerical models are used to solve a set of governing differential equations. However, the true solution of the flow, water quality constituent and sediment transport fluxes in coastal waters depends upon how accurately the solution of these equations, and the equations themselves, reflect the actual physical conditions in the coastal basin. In numerically modelling flow, water quality constituents and sediment transport processes in coastal waters there are still a number of uncertainties involved, including for example: (i) the fluid mechanics, e.g. turbulence; (ii) the physical processes, e.g. erosion and deposition of cohesive sediments; (iii) the chemical and biological processes relating to the various water quality constituents, e.g. decay rates for nitrates; (iv) the numerical methods, e.g. the treatment of mathematical discontinuities or high concentration gradients near sea outlets; and (v) the inclusion of interpreted boundary conditions, e.g. bathymetry, currents, water levels and bed roughness lengths.

The Environmental Hydraulics Research Group at the University of Bradford has been involved in a number of research contracts relating to the development and application of numerical models to site specific coastal and estuarine studies, as well as refining models by comparison with laboratory based tidal flow and flushing hydraulic models. The research projects outlined in the presentation are taken from:

1. Development and comparison of various types of nested models for flow in a model rectangular harbour, with an idealised geometry, bathymetry and tidal input conditions. The results showed that the numerical treatment of the acceleration terms was critical in modelling the tide-induced circulation and, in particular, that non-dynamically linked models can lead to erroneous flow field predictions.

2. A comparison of the use of a complex turbulence model for predicting tide-induced circulation as compared with a much simpler model of the mixing length type. The results showed that the complex turbulence model did not significantly improve the velocity distribution as compared with tide-induced velocity distributions measured in a laboratory model and in the lee of Ratrarry Island, Australia. However, the results did show a marked difference in the predicted turbulent diffusion coefficients — an important component in water quality and sediment transport modelling.

3. A study undertaken to improve the numerical representation of the complex hydrodynamic processes of flooding and drying, with the objective being to develop an algorithm that would generate little or no disturbances on the removal or inclusion of wet or dry grid cells respectively in the domain. Various schemes have been tested against idealised basins and field data for Poole Harbour, Dorset, with a new scheme being more accurate and robust than others reported in the literature.

4. A comparison has been undertaken of 38 numerical schemes for treating the transport process in the pollutant and sediment transport equations. Emphasis has been focused on finding a computationally efficient, robust and accurate scheme which can readily be applied to coastal waters where flooding and drying are often extensive in UK waters, e.g. the Severn Estuary. Apart from applying and testing the schemes for idealised test cases, various schemes have been compared against field data for tidal current distributions from Bridlington long sea outfall and nitrate and BOD predictions from riverside and sewage outfall inputs to Poole Harbour, Dorset.

5. A practical study application of the use of a two-dimensional model for predicting the optimal location of a long sea sewage effluent outfall off the Whitby coast, in North Yorkshire. The results of an earlier study using a relatively coarse grid suggested that a 900m outfall would be sufficient for meeting the EC Bathing Water Directive. However, when re-modelled using a much finer grid, this site was shown to be highly inappropriate due to the prediction of a complex eddy structure along the coastline.

Natural and man-made earthquakes: Why? Where? How can we use them? P. Styles, Department of Earth Sciences, Jane Hurman Laboratory, University of Liverpool, Brownlow Street, Liverpool L69 3BX.

Every day about a dozen earthquakes of magnitude 4 and over are detected by networks of seismometers distributed over the globe. Every year or so a magnitude 6 or 7 event such as Kobe or Northridge associated with considerable damage will be reported; and about once every decade a great earthquake, like Alaska, 1964, or Chile, 1960, of more than magnitude 8 will occur. These events are not randomly distributed on the globe but lie in well-defined zones marking the edges of the tectonic plates that are the loci of most of the current seismic and volcanic activity. In the last thirty years we have learnt a great deal about the geological processes that create new oceans in regions like the Red Sea and the recycling of old earth materials in the deep trenches like those which fringe the Pacific Ocean, from studies of their earthquakes. More recently seismologists have used the seismic waves that are generated from the larger quakes to probe the interior of the Earth and, in addition to defining the major layering features such as crust, mantle and core, can now produce tomographic images of the more subtle variations in velocity and elastic properties within the earth.

However, in addition to these tectonic earthquakes, thousands of smaller events which can only be detected instrumentally occur every day, and many of these are induced seismic events. These are generated by human agencies, often during extraction of mineral resources or sometimes associated with changes in the fluid regimes beneath human-made lakes and reservoirs. During the decades from 1980 to 1990, about 50% of UK's earthquakes were probably associated with deep coal mining and the subsequent subsidence. In fact anywhere where geological instability or rock-failure is happening, e.g. landslides, avalanches, will be associated with the release of acoustic/seismic energy, albeit often at very high frequencies and very low amplitudes. It is only recently that it has been appreciated that, instead of attempting to ignore these man-made earthquakes as unwanted nuisances, it is possible to use these events to glimpse the nature of stress changes being initiated by the human agency and to detect and locate the creation, nature and propagation of new fracture damage and even to control the possible hydrogeological consequences of this. This microseismic imaging technology has tremendous potential for understanding the stability and long-term hydrological integrity of underground excavations, tunnels and hazardous waste repositories.
Research Funding News

New NERC Structures and Procedures for Research Programmes.

The reorganisation of the Research Councils in response to the 1993 White Paper, Realising our Potential, resulted in the transfer of all programmes relating to atmospheric science to NERC. In addition, a new funding model is expected to be fully operational from 1 April 1997. NERC-funded programmes and activities will fall under four modes:

- Core Strategic
- Infrastructure
- Non-thematic
- Thematic

Core strategic funding is typically long-term underpinning aimed at maintaining expertise in key areas of the environmental sciences, determined by the NERC Council. Infrastructure funding will provide essential support, equipment, services and facilities for the NERC community — this includes access to the Central Laser Facility at the Rutherford Appleton Laboratory. Non-thematic funding corresponds to the old NERC Responsive Mode. This will foster excellence by supporting curiosity-driven research, training and technology development in areas selected by applicants. Funds for competition is likely to be very strong. Thematic funding will encourage excellence and contribute to known research and development, within selected themes. This information was taken from NERC’s website, Atmospheric Chemistry, April 1996.

MAST III.

The European Commission has released a second call for proposals under the Marine Sciences and Technologies (MAST) Programme. Area A covers marine science, marine systems research and extreme marine environments. Area B covers marine research, coastal and shelf seas research and coastal engineering and natural defences. Area C covers marine technology, generic technologies and advanced systems. The closing date for receipt of proposals is 15 October 1996 for all areas apart from B1.2 (Structure and Dynamics of Shelf Ecosystems), which has a closing date of 15 January 1997. An information pack is available from CEC DG XI, MAST III/RTD, (SDME 7/0), Square de Meeus B, B-1050 Brussels. Fax: 0032 2 296 3024.

Many European funding opportunities...

...can be found on DG XI’s WWW site

http://www.cec.eu.int/comm/dg11/dg11acsae.html

Watch out for a significant new announcement of opportunity from DG XII (Science, Research and Development) under the Environment and Climate Programme on 17 September 1996.

Meetings, Conferences, Events

Visit to Alcan Recycling, Warrington, Cheshire.

Date of visit: Friday 27 September 1996.
Time of Visit: 3pm to 5pm.

Alcan Recycling’s dedicated aluminium can recycling plant, the first of its kind in Europe, was opened in Warrington, Cheshire, in November 1991. The plant produces ingots from used beverage cans; these ingots subsequently being rolled into sheet at another mill and then supplied to can makers to be made into cans again. With a capacity of over 60,000 tonnes each year, there is enough capacity to recycle all the aluminium cans collected in the UK for the foreseeable future. Alcan’s capital investment in the plant alone amounted to some £28 million, of which some £5 million was used to install state of the art emission abatement equipment to minimise the impact on the environment.

To take part in this visit please fill in the form on page 24 of the Bulletin.


The Summit will aim to provide an opportunity for ecologists to interact with engineers, economists, modelers, habitat restorers, health professionals, policy makers and members of other professions in order to explore areas of common concern and avenues for collaboration.

For further information contact: Ecological Summit 96 Conference Secretariat, Elsevier Science Ltd, The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, UK. Tel: (01865) 843643, Fax: (01865) 843958, email: g.spear@elsevier.co.uk, internet: http://info.dfh.dk/ecosum96/welcome.html.

Royal Society of Chemistry Symposium on Air Pollution in the United Kingdom, 23 September 1996, Lancaster University, UK.

For further information contact: Professor Nick Hewitt, Institute of Environmental and Biological Sciences, Lancaster University, Lancaster LA1 4YQ, UK. Tel: (01524) 593931, fax: (01524) 593985, email: n.hewitt@lancaster.ac.uk.
Meetings, Conferences, Events


For further information contact: Liz Kerr, Conference Secretariat, Wessex Institute of Technology, Ashurst Lodge, Ashurst, Southampton SO4 7AA, UK.
Tel: (01703) 292223, fax: (01703) 292853, email: cmi1@ib.r1.ac.uk.


This biennial symposium is the most important meeting in gas kinetics. In recent years atmospheric chemistry, homogeneous and heterogeneous, has featured prominently and, it is anticipated, will do so again. The scientific programme will be built around the following topics:

- Unimolecular reactions: dynamics, kinetics and theory;
- Bimolecular reactions: dynamics, kinetics and theory;
- Complex and non-linear processes;
- Atmospheric chemistry;
- Reactions in condensed phases;
- Measurement techniques.

Enquiries to: Miss Elaine Goodrich, 14th International Symposium on Gas Kinetics, School of Chemistry, University of Leeds, Leeds LS2 9JT, or email GazKinetics@chem.leeds.ac.uk.

Further information is available from http://www.chem.leeds.ac.uk/conferences/kinetics96.html.

British Association Annual Festival of Science, 8–13 September 1996, University of Birmingham.

Various sessions include Natural Hazards, Making International Environment Agreements Effective, Environmental Engineering, plus debates, field visits, dinners, and so on. For more information, contact Major Events Department, British Association, 23 Savile Row, London W1X 2NB. Tel: (0171) 973 3500, fax: (0171) 973 3051.

Books, Reports and Publications.

Earth Observation Quarterly.

EOQ is distributed free of charge to all readers who wish to be informed on the evolution of various elements of ESA's Earth Observation Programme. For a free subscription, write to: ESA Publications Division, 'Earth Observation Quarterly', ESTEC, Keplerlaan 1, 2200 AG Noordwijk, The Netherlands. Fax: +31 71 565 5433.


Abstract: "A workshop on soil moisture was held to identify the scientific requirements of the atmospheric, hydrologic, and ecologic disciplines for soil moisture observations. These
discussions are summarized and recommendations are made on promising avenues for research to further the knowledge of soil moisture, particularly the spatial and temporal evolution of the coupled moisture and temperature states. Appendices provided for the nonspecialist—provide overviews of ground-based measurement techniques, microwave remote sensing, long-term soil moisture observations in the US and Canada, soil water and solute transport equations, and a glossary of technical terms."

Available from NASA Centre for Aerospace Information, 800 Eleridge Landing Road, Lanthicum Heights, MD 21090-2934.


Available from OECD, 2 rue André-Pascal, 75775 Paris Cedex 16, France. Tel: +33 1 45 24 82 00, Fax: +33 1 45 24 81 76. Price: US$86.


Even bigger than the first Assessment, at around 2,000 pages and 10,000 references, in three volumes with three executive summaries. Working Group I reports on scientific understanding of climate change, emphasizing anthropogenic effects, in a paperback volume at £22.95 or hardback at £65. Working Group II reports on environmental and socio-economic impacts of climate change, possible response scenarios and management, at £24.95 and £55. Working Group III's technical assessment of information related to economic and social implications of climate change is £19.95 and £55.

These volumes are available in August from booksellers, or direct from Cambridge University Press, The Edinburgh Building, Direct Selling Dept., Shaftesbury Road, Cambridge, CB2 2RU. Phone (01223) 325588.

"Is Muck Brass?"

This question is posed in a leaflet published to draw attention to the Government's White Paper on sustainable management, Making Waste Work, ISBN 0-10-130402-1. It costs £16 from HMSO Publications Centre, PO Box 276, London SW8 5DY. Telephone orders: (0171) 873 9090. General enquiries: (0171) 873 0011.

A 16-page summary of the White Paper is available free from the Department of the Environment, Publications Despatch Centre, Blackhorse Road, London SE9 0TT. Fax (0181) 964 0099. Please quote reference number 95 EP 130.

(You won't be surprised that the answer to the question is, "Yes, Muck is brass.")

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Airborne Particulate Matter in the United Kingdom: Third Report of the Quality of Urban Air Review Group, May 1996 (prepared at the request of the Department of the Environment.)

Excerpt from the Executive Summary: "Airborne particulate matter is a very diverse material in terms of its physical and chemical properties and there are many sources which contribute to atmospheric concentrations. This report reviews knowledge of the sources, chemical composition and physical properties and concentrations of airborne particles and examines the implications for control of particulate matter in UK urban air." ISBN 0-9520771-3-2, available from the University of Birmingham, Institute of Public and Environmental Health, School of Chemistry, Edgbaston, Birmingham B15 2TT.

Molecular Collisions in the Atmosphere.

This 120-page booklet is available free of charge to the scientific community. This should provide a good introduction to the field for those workers outside it, or a useful update for those more directly involved. The following topics are covered:

- Pressure-broadened lineshapes for atmospheric gases;
- Solvation of hydrogen halides on ice surfaces;
- Vibrational and rotational relaxation processes for atmospheric gases;
- Atmospheric modelling;
- Earth observation.

Edited by A. Earnest, J. Hutter, C.F. Roche, published by the Collaborative Computational Project on Heavy Particle Dynamics (CCP6) of the EPSRC. Available free, but subject to availability, from C. Roche, at the following email address: c.f.roche@durham.ac.uk

Your email should contain your name and full postal address, in a format that can be transferred to an address label. Further information is available at:

http://www.dur.ac.uk/~dchlee/booklet_content.html

Note that "-dchlee" contains the numeral 1, not the letter l.

Urban Air Quality Teaching Pack.

Produced by the Atmospheric Research and Information Centre, Dept. of Environmental and Geographical Sciences, Manchester Metropolitan University, Chester Street, Manchester M1 5GD. Tel: (0161) 247 1592, fax: (0161) 247 6332. For teachers and lecturers in geography, environmental and other sciences. Cost: £10.
News and Information

Convention on Desertification.

The Convention on Desertification now has an interim secretariat. A dossier and other guidance material are available from the UNEP office: fax +41 22 9799030.

British Soil-Water Physics Group.

Lester Simmons at the Department of Soil Science, University of Reading, aided by Glyn Benceaugh at the Scottish Crop Research Institute, Dundee, is taking over as the Coordinator of the British Soil-Water Physics Group. This Group was formed in 1980 by Edward Youngs, then at Rothamsted Experimental Station and John Bell at the Institute of Hydrology in an attempt to bring together workers from various disciplines concerned with soil-water physics. Since the opening meeting in Rothamsted in 23 September 1980, the Group has met about twice a year for discussion meetings, workshops and the occasional field visit. The meetings are planned to be informal, and are organised by the scientist who elects to host the meeting. The next meeting is being arranged for early 1997 as a joint meeting with the British Hydrological Society on "Preferential Flow in Hydrological Systems" at Imperial College. Anyone new wishing to be put on the mailing list is invited to get in touch (email communication preferred) with Lester Simmons, Department of Soil Science, University of Reading, Whiteknights, PO Box 233, Reading RG6 6DW. Tel: (01734) 316557; fax: (01734) 316660, email: assimms@reading.ac.uk.

1997: The Year of Engineering Achievement.

For more information, please contact Dr. Mary Harris, YES, 10 Mallinders Street, London WC2E 3ER. Tel: (071) 240 7891; fax: (0171) 240 7517.

Inquiry into the Natural Environment Research Council.

N.B. The deadline for this has passed, but it may still be of interest.

A press release from the House of Commons Science and Technology Committee states that: "The Science and Technology Committee has decided that the second of its inquiries into the Research Councils will examine the Natural Environment Research Council (NERC). This will be a brief inquiry into the broad issues facing the Research Council in the next five years. The Committee is expected to address:

- the current review of the NERC research portfolio;
- the extent to which environmental research is best approached on an international basis;
- the funding available to NERC from sources (including government sources) other than the science budget;
- the funding of major items of equipment.

Other topics may also emerge in the course of the inquiry. Written submissions should be sent to Eve Samson, Clerk of the Committee, 7 Millbank, London SW1P 3JA by 21 June 1996."

Mailing list: Human Dimensions of Global Environmental Change.

The purpose of this electronic forum is to facilitate discussions on the 'human dimensions' of environmental change. The list is unmoderated, i.e. not refereed and open to anyone who has access to email. Subscription is by sending email to majorworld@icesin.org , the message part of the email should read subscribe hdegc. An automatic response will be sent back to you via email, telling you more about the list, how to contribute, how to unsubscribe, and so on.
Do You Know About The Data Protection Act?

If you store personal data on a computer, it is very likely that you must register with the Data Protection Registrar (if you have not already done so). Personal data means almost any information about any number of individuals. Registration costs £75 for three years, and the Office of the Data Protection Registrar has a record of prosecuting non-compliers. Fines can be large!

For more information, write to The Office of the Data Protection Registrar, Wycliffe House, Water Lane, Wimborne, Dorset BH21 6BQ, or phone (01202) 545700, or email data@wycliffe.demon.co.uk or browse


Internet Sites of Interest.

Here is a selection of some useful addresses, or URLs (Uniform Resource Locators).

- International Space University:
  http://www.isunet.edu/

- Space Shuttle Earth Observation Photography:
  http://ersaf.jsc.nasa.gov/sm5.html

- NASA JSC Imagery Services:
  http://images.jsc.nasa.gov/html/home.htm

- Earth Resources Observation System Data Center Distributed Active Archive Center:
  http://edcwww.cr.usgs.gov/landdaac/landdaac.html

- EMITS --- ESA Electronic Mail Invitation to Tender System:
  http://edms.esrin.esa.int/emits/login

- HAPEX-Sahel Information System:
  http://www.orstom.fr/hapex/

- FIFE (First ISLSCP [International Satellite Land-Surface Climatology Project] Field Experiment) Information System:
  http://www.versar.com/fife/fifehome.html

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Internet Sites/EPG Committee

- IPCC (Intergovernmental Panel on Climate Change):
  http://www.unep.ch/ipcc/ipcc-0.html
  and
  http://www.wmo.ch/

- Journal — Global Change Biology:
  http://www.blacksci.co.uk/products/journals/gcb.htm

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Form.

Alcan's Recycling Plant, Warrington
I wish to visit Alcan on 27 September 1996. Please send me more details.

Name: __________________________________________
Address: _________________________________________
Telephone: ________________________________________
Email: ____________________________________________

Please return this form by 18 September 1996 to: Alexandra Wilson, Research and Development,
Ove Arup and Partners, 13 Fitzroy Street, London W1P 6BQ.

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