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MR ANDREW TURNBULL

12 April 1989

GLOBAL CLIMATE

*at top of page 5 para 4*

As requested in Dominic Morris's minute of 13 January I have prepared a paper on Global Climate : Research Priorities and Co-ordination and a separate paper on UK Participation in ERS-2. Copies of both are attached for the Ministerial meeting on 19 April.

2. I am copying this letter and attachments to the Private Secretaries of the Ministers who attended the meeting on 12 January and, as agreed, to the Private Secretaries of the Chief Secretary to the Treasury and the Secretary of State for Defence, and also to Sir Robin Butler.

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JOHN W FAIRCLOUGH  
Chief Scientific Adviser

*Jane Lane*

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GLOBAL CLIMATE: RESEARCH PRIORITIES AND CO-ORDINATION

Note by the Chief Scientific Adviser

SCOPE OF PAPER

This paper focusses on priorities for research into the detection, understanding and prediction of climate change and assessment of its impacts. Research on minimising release of greenhouse gases and adapting to some level of climate change identified in papers Ministers considered in January is listed in Annex 1 but not discussed further at this stage ; priorities for much of this research will need to reflect the growing scientific understanding.

2. The paper has been prepared in a small Working Group which I have chaired comprising the Chief Scientist of the Department of the Environment (DOE), the Director General of the Meteorological Office (MetO), the Chairman of the Natural Environment Research Council (NERC) and the Science and Engineering Research Council (SERC). I have also consulted the Advisory Council on Science and Technology's (ACOST) Global Environment Research Working Group, particularly on research priorities. Their views, which have been endorsed by the Chairman of ACOST, are summarised in paragraphs 26 and 27.

RESEARCH OBJECTIVES AND TIMESCALE FOR ACHIEVING THEM

3. The main aim of research into global climate must be to provide a sound scientific basis for taking policy decisions, both internationally and at home, on actions to lessen man's impact on climate and/or to adapt to future climate change. Progress is of course incremental. We will have a clearer idea of the likely rise in temperature on a global basis before we can predict with any



degree of certainty what is likely to happen at a regional level. Our best estimate of when we will have reasonable certainty, including at a regional level, is the early part of next century, say by the year 2005.

4. It is difficult to see this timeframe being advanced significantly since improved assessment is dependent on outputs of major international data gathering programmes over the next 10 years or so. The scope for advancing these programmes is limited as, even if infinite resources were to be made available, much of the data gathering has to look at annual and seasonal trends over a sufficiently long run of years.

5. This is not to say that no advances can be made with existing information and as new results come to hand. It is therefore useful to look at the information and assessments which will become available over the short, medium and long term as follows:

#### Short term (2 years)

(i) assessments of likely future world climate scenarios from comparative studies using existing models. These will provide the main input to the work of the Intergovernmental Panel on Climate Change (IPCC) subgroup on Scientific Assessment which is chaired by the UK. The activities of this group aim to provide an internationally agreed assessment of the accuracy and reliability currently achievable by the existing models (4 in the US and 1 in the UK), together with an appraisal of the ways in which they need to be improved. A small international core team is being set up at the MetO to pursue this work, with support provided by DOE and the Department of Energy (DEn).

(ii) preliminary assessments of the impacts of climate change on relevant sectors of the economy using predictions obtained from existing models.



### Medium Term (10 years)

(i) more detailed and reliable predictions of climate change. These will evolve as climate modelling techniques develop and the models incorporate better data and a better scientific understanding of critical environmental processes, in particular those related to cloud and ocean feedbacks. The aim is to develop climate modelling to the point where prediction of climate change can be made with a sufficient level of confidence and be sufficiently area-specific to provide a useful input to strategic planning by government and industry. The timescale is largely determined by the need to obtain sufficiently long time-series of ground, sub-sea and satellite based observational data to provide realistic inputs to the models.

### Long Term (more than 10 years)

(i) further improvement of the global climate models by incorporation of data and understanding of processes relating to atmospheric water and its fluxes and ecological and biological observations. Development of better regional and local predictive models.

(ii) further assessment of impacts on a more localised basis as regional models improve.

The aim should be to promote strong international collaboration on research to achieve these outputs.



## ELEMENTS OF RESEARCH PROGRAMME

6. The following main elements feature in global climate research:

(i) development of climate models to predict effects of future emission scenarios on climate at global, regional and local scales;

(ii) development of integrated comprehensive programmes of monitoring of environmental parameters important (a) for detecting climate change signals and (b) for developing and validating climate models; evidence will need to be obtained from past (geological and ice core data) as well as from present sources.

(iii) improving understanding of the key physical, chemical and biological processes important in climate interactions in order to incorporate realistic representations of these processes in predictive models;

(iv) assessment of impacts of predicted climates on human settlement, industry, agriculture and the environment;

Elements (i), (ii) and (iii) are global questions to be pursued on an international basis. Priorities for the UK are best assessed in the context of international effort and our relative strengths in terms of expertise and facilities to contribute to this effort. Whilst research on element (iv) is more directly an issue for individual countries or regions, local effects may well have wider international impacts and will need to be considered on an international basis.



## PRESENT RESEARCH

7. The paper which Ministers considered in January reviewed the range of global climate research and UK participation in international programmes. The UK has been prominent in helping to plan the major international science programmes developed under the umbrella of the World Climate Programme of the World Meteorological Organisation (WMO) and the International Council of Scientific Unions (ICSU). It is also active in planning for the International Geosphere-Biosphere Programme established by ICSU in 1987 and now being developed as a major new initiative in global change research. Details of these and other areas of international research collaboration were contained in paragraphs 6-12 of the paper I submitted in January.

8. There is currently no readily available estimate of current UK spend on global climate research. Spend on research with climate change as its primary purpose may be no more than £10m but a wide range of other research will also have direct relevance. The previous paper took as a broad indication the figure of £29m per annum on global process studies quoted in the report on Global Environment Research which NERC prepared for ACOST. Other sources suggest a lower figure of the order of £19m plus costs of satellite remote sensing (see Annex 2) with a further sum of about £25m (or £160m if nuclear R&D is included) spent by Government on research relevant, if not primarily directed towards, reducing the emission of greenhouse gases or adapting to climate change.

## FUTURE UK RESEARCH CONTRIBUTION

9. Existing and planned UK research overall will maintain a basic national programme on global climate and allow the UK to continue to make a reasonable contribution to international studies of climate change. There are no obvious areas of low priority within the existing programme. There are however some areas where, building on our relative strengths, UK initiatives could lead to



enhancement of the international research effort and, to the limited extent possible, accelerate some aspects of the work.

### Climate Modelling

10. For political and scientific reasons there is a good case for ensuring that at least two independent climate prediction research centres are retained in the world. At present the UK Meteorological Office (MetO) has the only full climate model outside the US. This and the high international standing of the UK's modelling work on atmospheric and ocean processes critical in improving the reliability of climate models, means that the UK has a strong claim to house one of these centres.

11. One option Ministers might consider for the UK to propose as part of an international programme of action would be to expand our present effort on climate modelling and establish a designated Centre for Climate Modelling by extending and developing current MetO activities on climate modelling in close collaboration with the modelling programmes of NERC and the Higher Education Institutions (HEI's). Such a Centre could expect to attract high calibre staff both from within the UK and also from overseas. It would best be based on the MetO where it will benefit from the existing modelling infrastructure of the State Meteorological Service, but the aim should be to develop it into a truly international Centre, working closely with colleagues in Europe in the first instance. Estimated running costs might be of the order of £3 - 4 million per annum in excess of current expenditure. Further enhancement of the Centre would be needed in due course to prepare for and assimilate new forms of satellite observations as they become available towards the end of the century.



## Monitoring

12. The raw material for detecting climate change and for the development of the climate models comes from long-term monitoring of key environmental parameters, with some programmes extending over decades. If the UK is to take an initiative in proposing further international research into global climate we should start by indicating the critical importance of high quality data from such programmes. The problem is that monitoring has often been regarded as 'unexciting science' and, in times of financial stringency, is frequently the first item to be cut or reduced in scale.

13. There is then the question of the organisation of the data collection, archiving and dissemination. Monitoring programmes, particularly the satellite programmes when they come on stream, will generate vast sets of data. It is vital to ensure a methodical and structured approach to the management of this data if comparability and maximum benefit is to be obtained. Clear responsibilities need to be defined at the outset and links established between the various systems holding the data that will be needed for the global climate models. In my view the area of data handling is one that calls for further specific attention in the UK as well as in the wider international context.

14. We also need to ensure an integrated approach to the various satellite projects on earth observation from space. Satellites, with their ability to provide synoptic and repetitive coverage, are now playing an increasing role in global monitoring of all areas (except sub-surface ocean data) needed for climate research. This satellite data comes mainly from the following programmes:

- Operational meteorological satellites which provide basic observations of temperature, humidity and cloud via geostationary and polar orbiting satellites. The MetO contributes to these either on a European collaborative basis



or through bilateral arrangements with the US. It is essential that such arrangements continue so that continuity of this data is maintained.

- The scientific programme of the US National Aeronautics and Space Agency (NASA) for which the UK has over many years provided advanced instrumentation. The Upper Atmospheric Research Satellite (UARS) of NASA due to be launched in 1991 is an example of an advanced mission with a strong scientific input from the UK. This satellite is dedicated to research in the stratosphere, in particular the ozone region.

- The Earth Observation Applications Programme of the European Space Agency (ESA). The UK is already supporting the first Earth Resources Satellite (ERS-1) but has so far withheld support for a follow-on ERS-2 mission. Further downstream in the ESA programme is the European Polar Platform to which the UK is already committed. Towards the end of the century this will join with other Polar Platforms from the US and Japan in contributing greatly increased possibilities for observation of different components of the climate system. The UK has played a significant role in the development of appropriate instrumentation for the European and US Polar Platforms.

15. I would suggest that further consideration should be given to the case for UK support for ERS-2 as the only practical way to provide a continuous series of global ocean measurements for the climate research programme. Data supplied by the ERS satellites on the physical characteristics of the ocean and transfers of water vapour and energy between the ocean surface and the atmosphere are crucial inputs to the World Ocean Circulation Experiment which aims to develop a global ocean circulation model and thus to improve the representation of the critical ocean-atmosphere processes in climate models (see paragraph 17). The UK has already earmarked some resources for this planned six year programme which has been timed to start when ERS-1 data comes on stream. Without ERS-2 the basic data set to develop the model will be incomplete and the



improvement of predictive climate models set back. There are no plans for providing observations from elsewhere which duplicate or diminish the value of the observations to be obtained from ERS-2. The satellite would also ensure the continuity of imaging radar data which is seen as essential in the development of Earth observation as a commercial business. British refusal to participate in ERS-2 would probably be enough to cause the project to fail. The estimated cost to the UK of supporting ERS-2 is estimated at £60 million over the period 1989/90 to 1996/7. A decision on ERS-2 is now unlikely to be taken until the October meeting of the ESA Council but expressions of interest may be sought in June. I attach a more detailed note on this issue and the funding implications.

£ 360m  

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#### Process Studies

16. A critical element in modelling is to understand the nature of various processes which have a strong influence on climate. These include, in order of importance, cloud processes, ocean processes, land surface processes, ice processes, and studies of the sources and sinks of the greenhouse gases. The long endurance research aircraft operated by the MetO enables the UK to participate effectively in and benefit from the wider international climate programmes on cloud processes.

17. The main new initiative on process studies in the early-mid 1990's will be the World Ocean Circulation Experiment (WOCE) which will provide the major input on physical ocean processes. This programme is the result of extensive international discussion and will be implemented by a series of integrated national programmes from over 40 countries. The UK is one of the few nations which has the scientific capability and expertise to make a major contribution. Its strengths are recognised by the location of the WOCE International Planning Office in the UK.



18. In view of the importance of this programme in helping solve some of the major uncertainties on oceans and the climate system and the UK's particular strengths in this field, high priority has already been given to supporting a significant UK contribution to WOCE. The level of involvement the UK has been invited to take by WOCE members represents 10% of the total programme at a cost of around £33m over 7 years from 1989/90, excluding expenditure on space observations. This compares with roughly 45% by the US, 15% by Germany and 10% by France. Funding of £24m (including £15m on shiptime) has already been designated from existing UK resources. The Advisory Board for the Research Councils (ABRC) will be considering bids for a further £9m and for further expenditure on ships that will be needed if the UK is to participate as fully as planned both in the Southern Ocean and North Atlantic sectors of interest. If the UK does not participate to the full 10% level, this will mean that important parts of the North Atlantic, including the Gulf Stream which has such a direct influence on our weather, will be inadequately covered.

19. The scientific community is presently considering the appropriate level of UK participation in further international science programmes important in the longer term, including the International Geosphere-Biosphere Programme, which will be particularly concerned with biological and chemical observations and the Global Energy and Water Cycles Experiment, which is aimed at studying the interactions of energy systems and the hydrological cycle and which is scheduled to begin in the late 1990s to coincide with the Polar Platform era.

#### **Impact Studies**

20. Present climate predictions are available for only a limited number of climate variables and are very unreliable at the regional scale. Some key variables, such as changes in seasonal rainfall, cannot presently be predicted at all. Nevertheless work to date has shown that some valuable progress can be made with current knowledge and can even help identify possible response strategies. There also remains long term work to be done to improve methodology



for translating climate prediction that spans over half a century into economic and social impacts. Priorities identified for further work in this area are:

- To improve the underlying theory of economic impacts of climate change and the development of the most efficient adaptation and prevention strategies. The appropriate focus for this work is the current initiative of the Organisation for Economic Co-operation and Development (OECD) on the economics of climate change, but it will need to draw on a broad base in the UK of economic and social science.
- To consider the implications for UK sea defences and water resources of current estimates of sea level rise. These are amongst the more reliable impact assessments likely to be available in the short term.
- Some scenarios have already shown that natural ecosystems could be amongst the first to show adverse effects of rapid climate change. Careful studies might be conducted with realistic scenarios to identify the critical climate parameters. Similar studies are justified on the effect on crops, on the energy consumption of buildings, and on the effect of climate change on other environmental pollutants.

Expenditure plans for UK contributions to the OECD studies are £0.1m per annum. Current DOE provision on natural ecosystems and effects is £0.32k.

## CO-ORDINATION

### National

21. There are several Government Departments, Research Councils, and HEI's, as well as some industries, with interests in global climate research. At present government funded research is co-ordinated through working contacts and cross-representation on



funding committees. Mechanisms exist within Government for ensuring interdepartmental consultation on briefing for international meetings on climate change, for UK participation in EC programmes, and for co-ordinating inputs to space programmes. The Royal Society as the UK adhering body to the International Council of Scientific Unions, provides mechanisms for co-ordinating UK inputs to the major international non-governmental science programmes such as the World Climate Research Programme and the International Geosphere-Biosphere Programme.

22. Whilst DOE has the lead responsibility on global climate, other Departments will continue to be responsible for carrying forward work on impacts and responses for their relevant sectors of the economy. As global climate becomes more important in the international arena, it will be important to bring together these impact (and possibly response) assessments. I therefore endorse a DOE proposal to form a Climate Impacts Review Group. This Group would act in an analogous fashion to the Stratospheric Ozone Review Group and its work would underpin UK inputs to and parallel the work of the Intergovernmental Panel on Climate Change.

23. Responsibility for the national and international science base programmes on global climate, including process research and long-term variability of important geosphere variables, falls largely to the Research Councils and the MetO. NERC and SERC are discussing co-ordination of their research on the global environment, including the possible establishment of a NERC/SERC Directorate; I think this discussion should be encouraged. The existing MetO/Research Council Climate Committee should, with appropriate revision to its membership and remit, play an important role in co-ordinating the work of the Research Councils with that of the MetO.



24. I propose that oversight of the total "national programme" on global climate research should remain under collective Ministerial control through the existing Cabinet Committee machinery for science and technology. However, if this and the measures outlined above are to be effective, there must be clear allocation of responsibilities to individual Departments and to the Research Councils.

### **International**

25. Formulation and co-ordination of international research programmes has been carried out largely through the International Council of Scientific Unions and World Meteorological Organisation, with some involvement of the United Nations Environment Programme. The practice so far has been for countries to contribute according to their scientific strengths. Whilst this may be appropriate in principle, it has meant that many countries may have benefitted from the work without having made a commensurate commitment themselves. As greater priority is given to global climate research internationally it will be important to ensure that a more systematic approach to sharing of costs and co-ordination of responsibilities is introduced.

### **VIEWS OF ACOST**

26. The ACOST Global Environment Research Working Group, chaired by Sir George Porter, were invited to comment on my recommendations on research priorities. They agree that additional UK effort in modelling, monitoring and process studies could make a useful contribution to greater international effort to improve scientific understanding of climate change. They would place particular emphasis on work to understand the basic and underlying science, including the chemical and biological processes, which they rightly see as critical for the monitoring and modelling functions. They consider it important that there should be continuity in satellite based monitoring programmes and support the case for ERS-2 to bridge any gap between ERS-1 and the Polar Platform.



27. On domestic co-ordination they would prefer the establishment of a Global Environment Research directorate in NERC to act as the lead agency and direct the work on climate modelling and impact studies and to perform the functions I envisaged for a Climate Impact Review Group. To provide scientific advice to this Directorate they propose the formation of a Greenhouse Gases Review Group with common administrative arrangements with the existing Stratospheric Ozone Review Group. On international co-ordination they agree that the UK should press for a fairer distribution of costs (based for example on GNP). They also propose that the UK Climate Model should be opened to EC funding.

## CONCLUSIONS

### Research

28. This paper has attempted to describe the main priority areas in existing research devoted to understanding global climate change and to identify areas where the UK could propose additional effort itself, building on its strengths, as part of an international programme of action.

29. The paper has not attempted to address the funding implications of these proposals, except to indicate that there are no obvious areas of low priority within existing expenditure on related research. In view of the objective of the Ministerial Sub-Committee on Science and Technology to transfer resources to high priority research from areas of low priority, I suggest that the costs of additional research be met if possible from within the total provision for research funding. At the conclusion of last year's Survey the Chief Secretary indicated the areas he would be looking for savings this year. Apart from ERS-2 (if Ministers should decide they wished to give an indication of commitment in June ahead of the anticipated October deadline for decisions) the question of funding can and should be addressed in the forthcoming Public Expenditure Survey (PES).



30. At this stage Ministers are invited to consider whether, if they wish to do more in the field of global climate research, a balanced programme of additional effort should include the following, provided appropriate funding can be identified:

- the development of existing climate modelling capabilities into a Centre for Climate Modelling (paragraph 11);
- participation in and support for a coherent series of meteorological and earth observation satellite projects, including ERS-2 and later on the Polar Platforms (paragraphs 14 and 15);
- full planned participation in WOCE (paragraph 17).

#### Co-ordination

31. Ministers are invited:

- i. to note proposals by the DOE to establish a Climate Impacts Review Group, the consideration presently being given by NERC and SERC to a joint Directorate on Global Environment Research, and the reconstitution of the MetO/Research Councils Climate Committee (paragraphs 22 and 23);
- ii. to endorse the principle of clear division of responsibilities between Departments, with collective Ministerial oversight maintained through the existing Cabinet Committee machinery for science and technology (paragraph 24).



EXAMPLES OF RESEARCH ON RESPONSES TO MINIMISE  
OR ADAPT TO FUTURE CLIMATE CHANGE

Energy

(i) Further examination of technologies for removal of carbon dioxide from flue gases and options for and environmental impacts of disposal of carbon dioxide removed.

(ii) Continuing encouragement of innovation in energy-efficient technology in industrial plant and operations and in buildings.

(iii) Continuing research to establish and develop options for use of non-fossil fuel energy sources: mainly nuclear, renewables.

Transport

(i) Improvements in vehicle design leading to greater fuel efficiency using existing fuels.

(ii) Research to establish and develop alternative fuel options with reduced greenhouse gas emissions.

Agriculture

(i) Quantification of agricultural inputs to the greenhouse effect and development of options for tackling these inputs.

(ii) Adaptation of agricultural practices to future climate change and identification of new opportunities.



### Forestry

- (i) Quantification of the scope for increasing absorption of carbon dioxide by afforestation.
- (ii) Adaptation of forestry and forestry practices to climate change.

### Chlorofluorocarbons

- (i) Continuing research on alternatives to CFC's and halons including assessment of environmental impact of these alternatives.



CLIMATE CHANGE RESEARCH IN THE UK

A rough indication of the breakdowns of present  
spend based on several sources

+ Climate Modelling and Process Studies	£15 million
+ Monitoring	£3 million plus Satellite Observations
+ Impact Assessment	£0.5 million
* Responses	£25 million plus Nuclear R&D (£135 million)

+ Primarily Government funding but includes a small element of  
external funding

\* Government funding only.



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**UK PARTICIPATION IN ERS-2**  
**Note by the Chief Scientific Adviser**

**Issue**

At the meeting on Global Climate on 12 January I was asked to arrange for the question of United Kingdom support for the proposed second European Earth Resources Satellite (ERS-2) to be reconsidered urgently against the UK's other priorities within the European Space Agency's (ESA) Programmes. Since then the Secretary of State for Trade and Industry has offered in his minute of 1 February to give higher priority to the project within his Departmental budget and to provide half the expected £60m costs if other Departments with an interest in Global Climate find the other half.

**Background**

2. The first ESA earth resources satellite (ERS-1) will monitor from its low polar orbit position the physical characteristics of the ocean surface and transfers of water vapour and energy between its surface and the atmosphere. It will also provide data on the extent and characteristics of the ice caps and monitor the land surface. ERS-1 is due for launch late in 1990; its design life is two years but provided it is successfully launched and performs to specification it should continue to provide useful data for about 3 years, ie. until 1994.

3. The UK decision to participate in ERS-1 rested on its contribution to the development of commercial applications of remote sensing data, rather than on its contribution to climate research. This is in line with current objectives of Department of Trade and Industry (DTI) space policy. On that basis a simple repeat mission (ERS-2) was accorded a low priority. However, the increased interest in climate change puts a different perspective



on the proposed ERS-2 mission, certainly for those Departments with a direct interest in the monitoring data it will provide.

#### **The scientific case for ERS-2**

4. In terms of space observations needed for climate change research, the case for ERS-2 ranks second only to maintaining continuity of the basic meteorological observations from geostationary and polar orbiting meteorological satellites.

5. My paper on research priorities sets the scientific case for ERS-2 in context. Briefly it is one of providing continuity of global observations of the oceans and their interactions with the atmosphere between the end of the ERS-1 mission in 1993/94 and the launch of the Polar Platform planned for 1997.

6. Such data will provide a vital input to the major international oceanographic programme, the World Ocean Circulation Experiment (WOCE) during its intensive field phase between 1990 and 1996. The primary goal of WOCE is to obtain a much improved understanding of the general circulation of the oceans and the role they play in controlling and modifying the earth's climate. A better representation of ocean processes in climate models is critical to improving the accuracy of our predictions of future climate change. There are no plans elsewhere to provide the full range of ocean observations that will result from the ERS missions; in particular there are no other satellites capable of measuring sea surface temperature with adequate accuracy during this period.

7. ERS-2 will also provide continuity of data on the extent and characteristics of the polar ice caps and the marginal ice zone, both important components of the climate machine and indicative of change. There will be other benefits from ERS data over and above its contribution to climate change, for example improved forecasts of sea state and ice conditions can be applied to ship routing, global ocean data on winds and waves will be relevant to design and construction of ships and offshore structures, fish



resource management etc, and land data to land use studies and management of natural resources.

#### **Rescheduling ERS-1 and the Polar Platform**

8. We have considered whether it would be possible to extend the life of ERS-1 or to bring forward the Polar Platform. We have concluded that neither option is feasible. In order to provide the information that is required, earth resources satellites travel in a low polar orbit. But in doing so they experience radiation induced degradation of electronic components and solar arrays which limits their life to two or three years. The design of ERS-1 accordingly includes enough fuel for attitude and orbit control and for batteries to provide power for that time. There would be no point in carrying more fuel (quite apart from the payload restrictions this would impose on the number of instruments which could be carried) since with current technology the instruments cannot be made to last longer.

9. The development of suitably hardened components and other techniques to extend satellite life is a major thrust of the national and European Space Agency technology programmes. The Columbus Polar Platform and its payloads hope to take advantage of the success of these programmes and thereby achieve a longer life. However, the relevant development work cannot be completed before 1995 when the instruments have to be delivered for integration to permit a 1997 Polar Platform mission. The new Ariane V launcher needed to lift the Polar Platform with a commercially and operationally useful payload, will also not be ready for operational launches before 1997.

#### **Timing of a decision**

10. If the ERS-2 mission is to be launched in 1994 as planned and continuity maintained with ERS-1, a decision will have to be taken this year. The final decision is likely to be taken at the ESA Council meeting on 18/19 October, when the related question of the



configuration of the Polar Platform is expected to be resolved. A detailed plan for ERS-2 including cost estimates is however expected to be prepared for the Council meeting at the end of June, and member states are likely to be invited at that meeting to indicate their readiness to commit to ERS-2. At present all countries with the exception of the UK and France have confirmed their support in principle for the project. There could be a tactical advantage in relation to an outstanding issue on the Polar Platform (described below) for the UK to announce its position on ERS-2 in June. This would however require Ministers to take a decision ahead of the other research issues on global climate identified in my separate paper, the funding for which can be addressed in the forthcoming Survey in the normal way. Indeed the timing of the decisive Council meeting in mid October may make it difficult in any case to leave this to be resolved in the Survey.

11. The outstanding contentious issue on the Polar Platform is whether it should be based on the British Aerospace (BAe) design, or on the French SPOT technology. Whichever is selected BAe will have prime contractor role, but the UK's commercial objectives will be better realised if the BAe design is chosen; this would have a larger and more flexible capacity to carry commercial payloads and to become the basis of a "for profit" business. The British National Space Centre (BNSC) have argued the point strongly that an early positive indication of our support for ERS-2 could prepare the ground for a decision in favour of the BAe design when the matter is resolved in October. The French can be expected to be thinking along similar lines in relation to advancing the case for using SPOT technology, and failure on our part to indicate our position on ERS-2 in June, if the French do so, could weaken our position on the Polar Platform design.

#### Costs

12. The UK is contributing a 15% share (£70m) to the cost of ERS-1, from the DTI budget, plus £5m from the budget of the Science and Engineering Research Council (SERC) for an experimental Along



Track Scanning Radiometer (ATSR) to collect, inter alia, precision sea surface temperature data. In the absence of final cost estimates from ESA, the DTI's best estimate of the cost of ERS-2 is £325m at current prices. A 15% share of this and provision of an enhanced fully operational ATSR as a national contribution would cost the UK about £60m over the period 1989/90 - 1996/97.

13. If a decision is to be taken in time for an ERS-2 launch in 1994, it is said not to be feasible to re-negotiate the technical roles and funding within ESA or to bring in other countries, for example from the wider WOCE community, who will benefit from the ERS-2 data.

#### Funding

14. The Secretary of State for Trade and Industry has already indicated that if colleagues agree that participation in ERS-2 would make a valuable contribution to climate research he would be prepared to re-order priorities and transfer funds from other programmes to the DTI space budget to meet up to half the costs of participation. On present estimates this would leave a £30m gap in funding.

15. In my view there is still a strong case for DTI, with its responsibility for ESA application satellites, to bear the full costs. Nevertheless there are also some good arguments for sharing the costs between different Departments. Indeed the rationale for the BNSC, whose future is due to be reviewed in July this year, is to act as spokesman and co-ordinator for a number of different Departments with an interest in civil space. Since space is a means to a variety of different ends, it is no surprise that BNSC should have new client Departments over and above those who were contributing to civil space when BNSC was established - DTI, the Department of Education and Science (DES) and the Ministry of Defence (MOD)/ Meteorological Office.



16. If Ministers were to favour sharing the costs, whether by transfers from other Departments to DTI or by different Departments making separate payments, there is no scientific way of suggesting how this might be done. One approach would be to consider which Departments have a policy interest in an improved scientific understanding of global climate change. I would divide these 'beneficiary' Departments into two groups: first the Departments with responsibility for different aspects of the understanding of climate change - the Department of the Environment, the Department of Education and Science (with its responsibility for the Research Councils) and the Ministry of Defence (with its responsibility for the Meteorological Office); and second those Departments who need to know the scale of the problem in order to consider what policies to introduce in response - the Department of Energy, the Department of Transport and the Agriculture Departments. On the basis of present estimates the amounts that are required over the Survey period to make up the shortfall on DTI's offer are:

	1990/91	1991/92	1992/93
£m	5.75	6.25	6.5

Reducing amounts would be required up to 1996/97.

#### Conclusion

17. Ministers are invited -

- i. to say whether they endorse the scientific case as set out in paragraphs 4 - 7 above for the UK to participate in ERS-2 as one element in a package of additional research to improve understanding of global climate;



ii. to consider whether a decision for the UK to participate in the project should be taken in time for a decision to be announced at the ESA Council meeting in June for the reasons set out in paragraphs 10 and 11;

iii. to consider whether, if the UK is to participate in the project, the costs should be borne by DTI or shared between Departments, two groups of beneficiary Departments being suggested in paragraph 16.



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