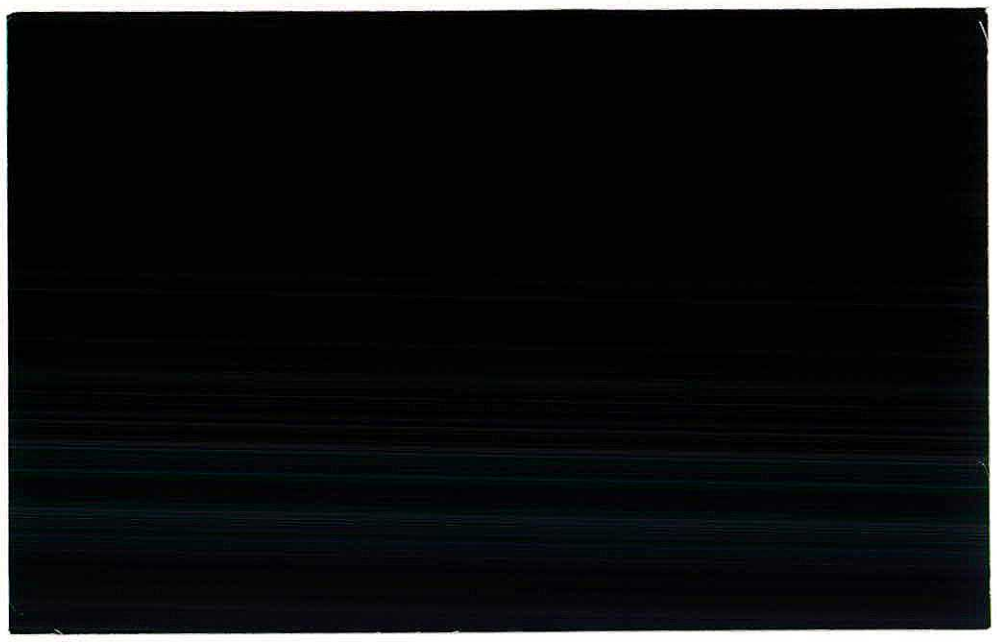


1990/005



**Institute of
Hydrology**



1990/005

(First Draft - prior to revision by INPE)

UK-BRAZILIAN AMAZONIAN CLIMATE PROJECT

(Proposed September 1990 as the 'Anglo-Brazilian Amazonian
Climate Observational Study')

INTERIM REPORT NO. 1 (1 January 1990 - 30 June 1990)

Prepared by

Institute of Hydrology, UK (IH)

Instituto Nacional de Pesquisas Espaciais, Brazil (INPE)

June 1990

CONTENTS

	Page
PROJECT OVERVIEW	1
CONTRACTUAL STATUS AND ITS IMPLICATIONS	
STAFFING ISSUES	9
Bar Charts for Participation in Mission M1	12
ACTIVITY	14
4.1. Equipment Specification and Requisition	14
4.2. Visit to Brazil by Drs Gash and Roberts	21
4.3. Visit to UK by Drs Nobre and Setzer	27
4.4. Brazilian-based Consultant's Report	27
4.5. Planned Activity in Brazil	30
4.5.1. Prior to Mission M1	30
4.5.2. Mission M1: Micrometeorology	31
4.5.3. Mission M1: Climatology	32
4.5.4. Mission M1: Plant Physiology	33
4.5.5. Mission M1: Soil Physics	36
FINANCIAL OVERVIEW	38
CONCLUDING SUMMARY	43
A1 EQUIPMENT SPECIFICATION (as of 30 June 1990)	44
A2 ITINERARY OF DRS GASH, ROBERTS AND CLARKE	48

PROJECT OVERVIEW

1.1. Problems and Recommendations

1.1.1. Delays in the initiation of the project have meant that there has been significant difficulty in requisitioning and taking delivery of equipment in time for shipment to meet the projected 3 September start date for Mission M1. Notwithstanding this, it appears that the vast majority of the hardware and instrumentation required for this Mission will arrive in time to meet the shipping date. There will necessarily have to be subsequent air freight consignments of outstanding equipment, however, and most of the instrumentation will reach Manaus having had very limited testing in the UK prior to dispatch. Additional freight charges will be incurred, and the consequences of the poor preshipment testing cannot be foreseen at this time. (Paragraph 2.1.1. refers).

1.1.2. The change in preferred vehicle manufacturer has generated additional risk regarding the availability of the two vehicles required in Manaus at the beginning of Mission M1. There is also enhanced risk that the four vehicles may not remain serviceable throughout the project as relevant service support is less accessible in Brazil. IH nonetheless welcomes the decision by ODA and the British Embassy, Brasilia to purchase and ship Land Rover vehicles, and finds the level of risk associated with their maintenance and servicing

acceptable. (Paragraph 2.1.3. refers.)

- 1.1.3. In the event that postponement of Mission M1 is essential, IH and INPE strongly recommend that this Mission goes ahead as soon as new arrangements can be made, regardless of the then prevailing weather conditions in Manaus. (Paragraph 2.2.3 refers).
- 1.1.4. IH recommends that the provision of vehicles and their maintenance should be separated in the project budget. (Paragraph 2.3.2. refers).
- 1.1.5. IH recommends the redistribution of UK support summarized in the table in 3.3, and that there is short term splitting of specialist rôles S4, S6 and S7 in Mission M1. (Paragraphs 3.2, 3.3, 3.4 and 3.5 refer).
- 1.1.6. There have been particular problems with the requisition of the climatological equipment, firstly in that this budget line will be over budget by up to £14K, and secondly because some critical components for the satellite data acquisition system cannot be delivered until August 1990. Allowing time for testing and air freighting, such equipment will not become available in Brazil until the second half of Mission M1 at the earliest. Some difficulty in installing and testing this transmitting and receiving hardware may well arise therefore, and the possibility that

protracted delays occur in delivery, testing, shipping and installing this equipment cannot be ruled out. Retiming and enhanced participation on the Service Missions planned for late 1990 and early 1991 could well prove necessary. (Paragraph 4.1.4. refers).

1.1.7. IH recommends that an additional £23K is allocated Line 1.3.1 to allow the purchase of the re-reinforcement for tower sections to meet the safety standards recommended by the manufacturer. (Paragraph 4.1.5. refers).

1.1.8. It is already clear from initial remote sensing surveys that selection of sites P1 and P2 is likely to be a difficult task. Although not planned or yet recommended, there is some possibility that site selection and subsequent negotiations may become an iterative process, and that a second short and well-focussed site selection visit involving both UK and Brazilian counterparts may be required between Missions M1 and M2. (Paragraph 4.2.3. refers).

1.1.9. IH and INPE recommend that Fazenda Dimona be adopted as the primary cleared forest site. (Paragraph 4.2.6. refers).

1.1.10 IH recommends that the level of the per diem paid to Brazilian counterparts as a UK input be raised from 25 to 45 US\$. (Paragraph 4.2.8. refers).

1.1.11. The provision of adequate radio contact between the several Manaus sites is a difficult and unresolved problem. Adequate radio contact cannot be guaranteed during Mission M1. (Paragraph 4.2.9. refers).

1.2. Project Summary

1.2.1. **Background and Objectives**

The possible climatic effects of widescale clearance of tropical forests is a subject of global concern. Predictions of these effects can be made using Global Circulation Models (GCMs), but credible predictions require the models to be calibrated against actual field data and their predictions tested against actual climate measurements. Previous work by the Institute of Hydrology and the Brazilian Institutes, INPA and INPE, has improved the representation of the natural rainforest in GCMs. This project will improve the representation of cleared areas and test the accuracy of the models' climate predictions. Measurements will be made at a cleared forest site near Manaus, in central Amazonia, in a series of field campaigns scheduled to start in September 1990. Comparison of the climates of forest and clearings will be made at three sites across the Amazon basin starting in 1991.

1.2.2. **Progress**

The first six months of the project attention has

concentrated on preparation for the first experimental mission. The design of the experiment and purchasing of the necessary equipment has been substantially completed, although the short lead time of the project means some items will need to be sent late as air freight consignments. A planning visit was made to Brazil during which a site was selected for the cleared forest measurements and the existing forest tower refurbished.

1.2.3. **Conclusion**

Given some reservations about the delivery and importation of the equipment, the project is on schedule to produce the scientific measurements required from the first field mission.

CONTRACTUAL STATUS AND ITS IMPLICATIONS

2.1. Contractual Status

2.1.1. In principle, this consultancy began on 1 January 1990, on the basis of an ODA Letter of Intent dated 27 December 1989 (File Ref. OML 89-91/485/087/002A). In practice, activity was postponed almost immediately at the verbal request of ODA. By 20 February 1990, a level of agreement was reached with the Government of Brazil which was considered sufficient to reinitiate

activity, and ODA issued instructions to proceed to the Institute of Hydrology via telefax (Ref. A51 087/485/003C).

2.1.2. At the time of writing, the formal contract between ODA and NERC under which this project will operate is still under negotiation. The Institute of Hydrology is meanwhile proceeding with project implementation acting under the Terms of Reference (TOR) in the draft contract. These TORs are not the subject of current negotiations.

2.1.3. Although originally the management responsibility of the Institute of Hydrology, the provision of vehicles in support of this project are now being considered in the broader context of all the projects fostered under the Memorandum of Understanding and Land Rover is the preferred supplier. Provision, shipping and importation of the first two vehicles is being managed jointly by the British Embassy, Brasilia and the ODA Latin American, Caribbean and Atlantic Department. Management of the operation and maintenance support for these vehicles remains the responsibility of the Institute of Hydrology, acting through Dr Clarke, their Brazilian-based consultant.

2.1.4. The Subsidiary Agreement to the Memorandum of Understanding between the Governments of Brazil and

Great Britain under which this project will proceed is due for signature in early July 1990, and the project will then carry the necessary legal status to assist equipment importation.

2.2. Implications for Project Timing

2.2.1. The circumstances described in paragraph 2.1.1. delayed the first administrative mission to Brazil by Dr Gash and Dr Roberts to 20 March 1990; and have necessitated a delay in the target shipping date to 12 July 1990, and in the projected start date for mission M1 to 3 September 1990.

2.2.2. The negotiations associated with the provision of vehicles described in paragraph 2.1.3. has been slow, but the best advice available to the Institute of Hydrology suggests that the two vehicles required in Manaus for Mission M1 will be available there by 3 September 1990.

2.2.3. In the event that there is unforeseen delay in the shipment or importation of equipment or vehicles, then some postponement of Mission M1 will become essential. In this event, it is the recommendation of IH and INPE that this Mission should go ahead as soon

as new arrangements can be made, regardless of the then prevailing weather conditions in Manaus.

2.3. Implications for Project Budget

- 2.3.1. The delays referred to in paragraph 2.2.1 are such that it is not possible to maintain the yearly pattern of spend projected in the project proposal. The projected budgets for 1989/90 and 1990/91 have of necessity had to be merged.
- 2.3.2. The change in management responsibility associated with vehicle provision described in paragraph 2.1.3. mean that this aspect of the project requisition has been placed beyond the budgetary control of the Institute of Hydrology. It is recommended that vehicle provision and vehicle maintenance should become separate items in the project budget.
- 2.3.3. The circumstances described in paragraph 2.2.3. could have budgetary impact, but only in the case of extreme delay.

STAFFING ISSUES

- 3.1. UK-based activity in the form of project planning and equipment specification, requisition, testing and packing, is currently proceeding urgently, the several specialist rôles being fulfilled by IH staff selected on a day to day basis as most appropriate and effective.
- 3.2. It is already clear that the relative demands on the staff time of the UK specialists, S1 to S9, requires some small adjustment from that described in the original project proposal - in particular that the necessary proportional contribution of the senior specialists S1, S2 and S3 was significantly underestimated, while the seniority and staff time of the required junior specialists was, if anything, overestimated. Moreover, until the project is firmly established and operational, it is considered wise to increase the proportional participation by UK participants with past experience in the Brazilian Amazon. Accordingly, changes are recommended in paragraph 3.3 in the time allocation by year and specialist. These involve some small carry forward of the staff resource unused in 1989/90 to the current and future years, and retain the overall time allocation by UK specialists as 24 man years in accordance with the Subsidiary Agreement. These changes have neutral impact on the project budget.

3.3. Revised Time Allocation by Year and Specialist (in Man Years)

Specialist	Grade	89/90	90/91	91/92	92/93	93/94	94/95	Totals
S1	G6	0.12	0.30	0.38	0.38	0.38	0.38	1.94
S2	G7	0.11	0.35	0.35	0.20	0.20	0.17	1.38
S3	G7	0.10	0.38	0.38	0.20	0.20	0.17	1.43
S4	HSO	0.12	1.00	1.00	1.00	1.00	0.75	4.87
S5	SSO	0.05	0.00	0.00	0.20	0.20	0.15	0.60
S6	HSO	0.02	1.00	1.00	1.00	1.00	0.75	4.77
S7	HSO	0.05	0.80	0.70	1.00	1.00	0.75	4.20
S8	HSO	0.01	0.70	0.50	0.50	0.50	0.40	2.71
S9	HSO	0.13	0.50	0.50	0.50	0.50	0.00	2.13
TOTAL STAFF TIME:		0.71	5.03	4.81	4.98	4.98	3.52	24.03

3.4. The primary changes implicit in this revised time allocation are as follows. The proportional commitment of specialist S1 (Project Administrator) has been increased, partly by some carry forward of the manpower resource unused in 1989/90 and partly through the lower seniority of specialist S4. The rôles to be fulfilled by Specialist S2 (Micrometeorology/Climatology Co-ordinator) and Specialist S5 (Senior Micro-meteorologist) have been merged for the next two years, and this dual function will be carried out by Dr J H C Gash. Similarly, the proportional commitment of Dr Roberts as Specialist S3 (Plant Physiology/Soil Physics Co-ordinator) has been increased for the next two years at the expense of that of Specialist S7 (Plant Physiologist). The need to propogate the enhanced rôle of specialists S2

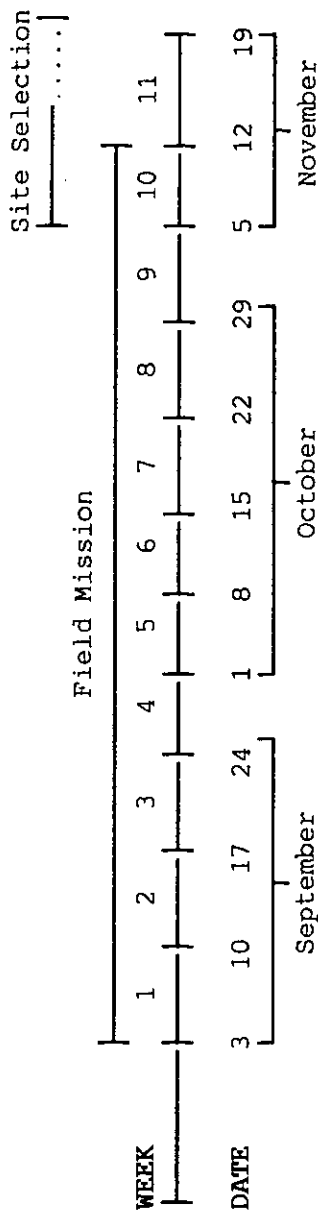
and S3 beyond the first two years will be reviewed after Mission M2.

3.5. The need for relevant UK staff in the field at the start of Mission M1 is such that the rôles of Specialist S4, S6 and S7 will be split at this time, and Mr Matthew McCartney will participate in this Mission, primarily to support the climatology sub-project, but also in partial support of the micrometeorology and plant physiology studies. A similar mechanism to enhance the UK specialist manpower available in the field may also be appropriate in Mission M2.

3.6. The timing of field work by UK participants and those Brazilian participants whose travel will draw on project funds has been defined for Mission M1, assuming a start date of 3 September. Details are given in the bar charts which follow. Additional Brazilian participation is envisaged and partly defined, but detailed planning of the activity of Manaus-based Brazilian participants is still to be specified by Dr Nobre. This will occur in meetings over the next two months.

3.7. Flexibility has been retained in timing of the site selection visits which are projected to occur at the end of the Mission. The precise itinerary is not yet defined since it requires further detailed study of remotely sensed images and maps.

3.8.1. MISSION M1 1990 Planned Field Work: UK Participants



Name	Speciality	Organisation
J Shuttleworth	Co-ordinator	IH
J Gash	Meteorology	IH
J Roberts	Plant Physiology	IH
I Wright	Micrometeorology	IH
H Bastable	Climatology	IH
M McCartney	Climatology	IH
A-L McWilliam	Plant Physiology	IH
R T Clarke	Brazilian Co-ord.	IH
M G Hodnett	Soil Physics	IH
P Rowntree	Meteorological Modelling	Met. O

3.8.2. MISSION M1 1990 Planned Field Work: Brazilian Participants

Name	Speciality	Organisation	Field Mission											Site Selection
			1	2	3	4	5	6	7	8	9	10	11	
WEEK														
DATE	3	10	17	24	1	8	15	22	29	5	12	19		
	September			October					November					
C Nobre	Co-ordinator	INPE	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
CENA Scientist	Chemistry	CENA	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
L Nordemann	Chemistry	INPE	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
Student	Soil Moisture	INPE	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
A Lola Costa	Micrometeorology	UFPA	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
P Rubens	Technician	INPE	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
A N Other	Technician	INPE	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
O Cabral	Plant Physiology	EMBRAPA	To be decided											-----
G Fisch	Micrometeorology	CTA	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
Student	Micrometeorology	INPE	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
Not Supported by ABRACOS														
M Lombardo	Urban Climatology	USP	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
G Martelli	Microclimatology	UFMT	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----
Cleusa	Microclimatology	UFMT	----- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----											-----

(Manaus-based participation to be defined by Dr Nobre in meetings over next two months).

ACTIVITY

Over the reporting period activity has comprised equipment specification and requisition; a visit to Brazil by Dr Gash and Dr Roberts; a visit to the UK by Dr Nobre and Dr Setzer; co-ordination activity by IH's Brazilian-based consultant and detailed planning for Mission M1. These are reported on separately below.

4.1. Equipment Specification and Requisition

The purchasing and delivery of equipment continues apace, in anticipation of shipping to Manaus on 12 July 1990. Contracts have been placed for most, though not yet all major items of capital expenditure. A summary of the status of requisition, delivery and preshipment testing follows, itemized by Budget Line. An up-to-date list of the equipment to be used in the project is given in Appendix 1.

4.1.1. Micrometeorological Equipment (Budget Line 1.1.1.)

All of this equipment is ordered and delivery is expected with sufficient time for some testing prior to shipment.

4.1.2. Plant Physiology Equipment (Budget Line 1.1.2.)

All of this equipment has been ordered and the majority should be delivered in time for shipment. It may be

necessary to include some small items, such as loggers, as part of a subsequent air freight.

4.1.3. Soil Moisture Equipment (Budget Lines 1.1.3. and 1.2.2.)

That portion of this equipment which is required in Manaus during Mission M1 has been ordered, and should be delivered in time for shipment. A significant proportion of the equipment, and in particular all that required by Mission M2 for use at sites P1 and P2, has not been ordered pending its better specification based on field experience in Mission M1.

The neutron probes contain a radioactive source - to simplify their shipment and importation, IH plans to send these to Brazil as a separate air freight consignment.

4.1.4. Climatological Equipment (Budget Line 1.2.1.)

A contract for six automatic weather stations with associated data transmission hardware and receivers has been placed with a nominal delivery date of 30 June 1990. This leaves little time for testing the instrumentation before shipping. It is envisaged that some of the field hardware will be tested and shipped on time, but a significant proportion will necessarily have to form part of a subsequent air freight package.

One significant concern is that the transmitters and receivers which will become necessary for data transmission

via satellite will not become available until August 1990 at the earliest, and will not therefore be available in Brazil for first tests until halfway through Mission M1. This need not seriously impact the main commissioning tests for the climatological equipment since data collection can meanwhile proceed using the field loggers. However, it may well complicate the testing of satellite transmission hardware which is proposed to occur between Missions M1 and M2.

IH recommends that the two receiving stations destined for use in São José dos Campos and Porto Alegre are airfreighted directly to São Paulo when available.

The expenditure against this Budget Line will be in excess of that estimated in the project proposal, due largely to the cost of the AWS systems and associated hardware, which are the major item. Permission to exceed this Budget Line limit was given by ODA via telefax on 16 June 1990.

4.1.5. Forest Towers (Budget Line 1.3.1.)

Martin Thomas Ltd., the company which manufacture these 'Hi-Way' towers, have advised IH that the free standing 45m (24 section) towers proposed for use in this study do not have a sufficient margin of safety without considerable reinforcing of the lower 16 sections. This is despite the fact that one such tower already

exists in Brazil and has stood for the past seven years without any problems.

The requirement to reinforce the two new towers proposed for this study has added considerably to the estimated cost. Martin Thomas have quoted £42K (+ VAT) for the two towers and associated guys. As yet neither of these towers, which are not required for Mission M1, have been ordered. The recommendation of Martin Thomas Ltd is that the existing tall tower should also be reinforced. Such reinforcing would cost an additional £5K (+ VAT)

The short tower required for Mission M1 which does not require reinforcement is ordered (quoted cost is £3K + VAT). It will be delivered to meet the sea freight deadline.

Clearly, the additional cost arising from the need to reinforce tower sections would take this budget line well over the estimated expenditure of £35,000. With the prices as quoted, expenditure within this budget line would need to be £58K. IH therefore requests that the necessary additional funds are released to this budget line so that ordering can proceed.

The new forest towers will be shipped directly to sites P1 and P2 when defined prior to mission M2.

4.1.6. Computers (Budget Line 1.4.1. and others)

Most of the computers have now been purchased or are on order. Three IBM PS2 computers and associated software for use in analysis at IH (Budget Line 1.4.1.) have been delivered. The six laptop computers and associated software (Compaq 286/LTE), to be used for downloading and processing data in the field (Budget Lines 1.1.1., 1.2.1., 1.1.2. and 1.3.1.) are ordered and should be delivered in time for shipment.

The computers to be used as the base stations of the telemetric system have not yet been ordered as there have been problems in defining the correct graphics board, and the board required to interrogate the satellite signal. Uninterruptable power supplies for these computers are also still to be specified and ordered.

4.1.7. Site Facilities (Budget Line 1.3.3.)

An existing IH trailer-mounted diesel generator will be refurbished for shipping to Brazil and this is in hand. A small airconditioned enclosure will be built in the field for housing computers and other sensitive scientific equipment. The air conditioner has been ordered and both it and the generator should be ready for shipment.

4.1.8. Shipping Plans (Budget Line 2.2)

The plans for shipping equipment from the UK to Brazil have been considerably complicated by the urgency of the requisition and the ensuing delays in delivery of certain items, particularly of the climatological equipment. The following shipments are proposed:

F1: Sea Freight (12 July 1990)

That proportion (the majority) of the equipment delivered to meet this date will be sent by sea to Manaus with an estimated arrival date of 20 August 1990.

F2: Air Freight (as soon as possible)

The neutron probes contain a radio-active source and will be airfreighted directly to Manaus as a separate consignment to decouple any possible problems associated with their importation.

F3: Air Freight (late July 1990)

With certain exceptions given below, that portion of the equipment not already sent by sea will be airfreighted directly to Manaus, estimated to arrive mid-August 1990 (see paragraphs 4.1.2. and 4.1.4.).

F4: Air Freight (September 1990, or as equipment available)

The AWS receiving data transmission equipment, and that portion of the data receiving station equipment required in Manaus will be airfreighted directly to Manaus.

F5: Air Freight (September 1990, or as equipment available)

The AWS receiving station hardware required in São José dos Campos and Porto Alegre will be airfreighted directly to São Paulo for onward shipment by road.

The complexity of these shipping arrangements is such that the freighting costs (Budget Line 2.2.) for the 1990/91 financial year are likely to be significantly over budget by an amount provisionally estimated as £6K.

4.2. Visit to Brazil by Drs J H C Gash and J M Roberts

4.2.1. Itinerary

Drs J H C Gash and J M Roberts visited Brazil between 20 March and 11 April 1990. The visit included Brasilia, São José dos Campos, Manaus and Rio de Janeiro. During the visit to São José dos Campos and Manaus they were accompanied by Dr R T Clarke, IH consultant and international co-ordinator to the project. The itinerary is given in detail in Appendix 2.

4.2.2. Brasilia

The visit to Brasilia included contact with Fernanda Basbaum of the British Council and Mark Kent of the British Embassy. Discussions took place on the general progress of the project, details of the operation of the project bank account and on the procurement and servicing arrangements to be made for the project vehicles.

4.2.3. São José dos Campos

A two day meeting was held at INPE. Dr Gylvan Meira Filho opened the meeting with a welcoming address and this was followed by presentations from Drs Gash and Roberts on the history of the project and the planned IH contributions. Presentations on the planned

Brazilian contributions followed, together with a discussion of the timetable. Useful informal discussions on the experimental details were also possible. The location of the two sites to be selected at the east and western edges of the Amazon basin was discussed. The new atlas of clearings in Amazonia prepared by INPE from Landsat imagery was consulted in the search for possible areas where a site might be found. It was clear that finding clearings of the optimum 20 to 30 km diameter, which are also logistically feasible to service, will not be easy.

4.2.3. Manaus - INPA

An initial meeting was held with Dra Nazaré, Vice-Director of INPA, and Dr Franken and Dr de la Rosa. The progress and objectives of the project were discussed and activity during the remainder of the visit planned. Scientists from the University of Amazonas also attended and their involvement in the project was discussed. During the course of the visit it was also possible to go to the agricultural institute, EMBRAPA, which now specialises in agro-forestry. EMBRAPA expressed interest in being involved in the project. Frequent meetings were held with Dra Nazaré whose help and intervention ensured that it was possible to meet all the objectives of this visit to Manaus.

4.2.4. Manaus - Reserva Ducke field site.

The tower erected during the previous project was inspected. With the exception of the wooden platforms and the ropes, the tower appeared to be in good condition. The alignment appeared to be vertical. A selection of diagonal tubes were removed and replaced without difficulty, indicating that the structure was not distorted. During the course of the visit all the guy wires were tightened, new safety and hauling ropes were purchased and fitted, and wood was purchased and cut for a new set of platforms. These were manhandled to the tower, treated with insecticide and preservative, and fitted to the tower. The site building was cleared of most of the rotten timber and other unwanted material and the two sheds left by the American ABLE experiment put into service as store sheds. Some work remains to be done refurbishing the site and the building, and removing the old instrument booms and the thermometer interchange system from the tower. Because of the state of the track, vehicular access to the tower was not possible.

4.2.5. Manaus - city climate site.

INPA arranged visits to two possible locations for the city climate site, namely the old Manaus airfield, now the military airfield, and the National Meteorological Service site. Neither of these sites were thought to be ideal. This problem has subsequently been discussed

with Dr Nobre and a search for a better site will be initiated as soon as is feasible.

4.2.6. Manaus - clearing site

A trip was made to the sites used by the Worldwide Fund for Nature (WWF), which are north of Manaus. The Fazenda Dimona (see Figure 4.1.) was established as being the most suitable location for the project's clearing site. Although it is not perfect as a micrometeorological site, the access is reasonable and the management and terrain appear to be typical of this type of cattle ranch established in forest clearings. Permission to work at this site is being sought through the WWF.

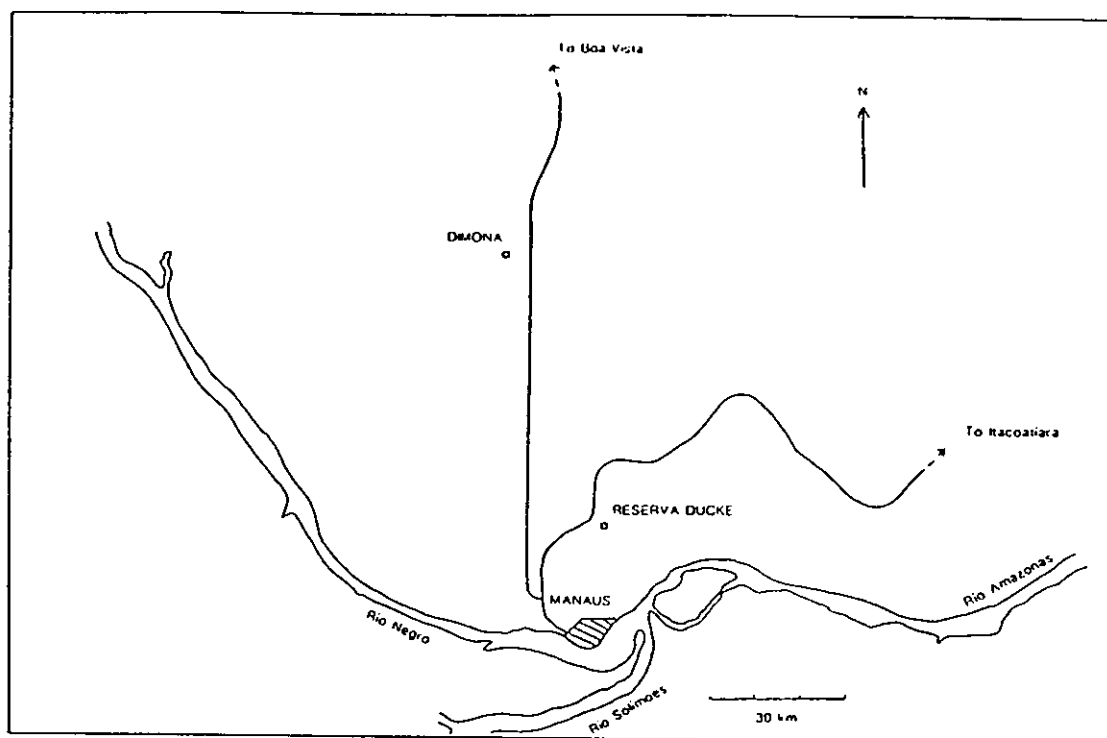
4.2.7. Manaus - vehicles

Mr Mark Kent from the British Embassy, Brasilia, was able to come to Manaus and, as well as visiting the forest site, had meetings with three possible agencies who would be prepared to take on the servicing of the project Land Rovers. Mr Kent also established contact between IH and the British Honorary Consul in Manaus.

4.2.8. Manaus - expenses

A survey of hotel prices in Manaus revealed that the cost for sharing a basic room in a simple two star hotel was the equivalent of US\$45. Although the US\$/Cr\$ rate has subsequently strengthened, it is clear

Figure 4.1



Map showing the location of the Dimona and Reserva Ducke sites

that the US\$25 per diem proposed in the project document for Brazilian participants will be inadequate and that at least US\$45 is required. Bearing in mind the financial difficulties under which Brazilian institutions will now operate, it is IH's opinion that the necessary level of Brazilian participation cannot be guaranteed unless this level of support is provided as a UK input, and IH therefore recommends that funds are released to allow a counterpart per diem at the rate of US\$45.

4.2.9. Manaus - radio communication

Discussions on radio communication between forest sites and Manaus, and between vehicles and sites, were held firstly with Mr Roger Hutchings, Project Leader of the WWF team. WWF experience with radio has not been good. An attempt was made to set up a radio link between the WWF sites and Manaus but it was not successful. Further discussions with Philips, who have a large factory in Manaus, were more optimistic but it was clear that installing radio communication is not straight forward. For a VHF link to be effective, at least one permanent repeater station would need to be installed on the forest tower. Even then, given the problems of reception/transmission beneath the forest canopy, communication might still be difficult. Radio communication will be further investigated during Mission M1, but adequate radio contact cannot be guaranteed for that Mission.

4.3. Visit to UK by Drs Nobre and Setzer

4.3.1. Itinerary

Drs C Nobre and A Setzer visited the UK from 18 May to 26th May, their first three nights being spent in London and the rest near Wallingford, Oxfordshire.

4.3.2. Activities

The visit included delivering lectures at the Royal Meteorological Society all day meeting on 'Tropical Forests and Climate Change' at Imperial College, London (on Saturday 19 May) and their participation in project development meetings in consultation with UK participants at ODA, London (on 21 May), at IH (on 22, 23 and 25 May) and at the Hadley Centre, Bracknell, Berkshire (on 24 May).

4.4. Brazilian-based Consultant's Report

4.4.1. Activities undertaken were as follows:

- (a) Assessment of vehicle availability at Manaus with particular reference to Gurgel, Engesa, Chevrolet and Toyota alternatives (see 'Report to ODA on visits to Brasilia, Manaus and São Paulo: 4-9 February 1990').

(b) Participation, together with Drs Gash and Roberts in visits to INPE, INPA and in restoration of the tower in the forest reserve as described in Section 4.2.

(c) Local activities, at Porto Alegre, have included the following:

Setting up accounts with Lloyds Bank in Porto Alegre in preparation for the transfer of Project funds.

Establishing lines of communication between Lloyds in Porto Alegre and Lloyds in Brasilia. In this context the British manager of Lloyds in Porto Alegre, Mr Peter Craddock, has been most helpful; he was formerly with Lloyds in Manaus and can therefore give us useful introductions to management of the Manaus Branch.

Purchase of air tickets for Drs Nobre and Setzer for their visits to UK in May 1990. Tickets were purchased through a local agent UNESUL; they have been informed broadly of our future travel requirements and the likelihood of this future business should ensure that we get good value in future transactions.

Preparation of 'Travel claim forms' for the travel of Brazilian counterparts. Twelve

copies were sent to Dr Nobre for distribution amongst those participating in the September 1990 Mission.

Preparation of a three-week training course to be held at Porto Alegre for Brazilian counterparts. The course, if it is held, will consist of three components, in remote sensing techniques, analysis of data, and forest hydrology, to be given respectively by Drs Haertel, Clarke and Caicedo. Drs Haertel and Caicedo hold doctoral degrees from Colorado State University. Mr Morrice, the Chargé d'Affaires at the British Embassy, Brasilia, approached Souza Cruz (a Brazilian tobacco company) to persuade them to fund the course; he received a promising response, and further developments are anticipated. Discussions with Brazilian hydrologists and sedimentologists regarding the possibility of using ABRACOS sites to measure sediment removal rates and the effects on them of deforestation.

4.4.2. The following financial aspects are reported:

- (a) On 25 May 1990, the British Council in Brasilia authorised the transfer to Porto Alegre of Cruzeiros to the value of US\$ 5,561.99 (£3,400) for the purchase of air tickets for Drs Nobre and Setzer travelling to the United Kingdom. Initial

shortcomings in the transfer system resulted in the funds not being received until 28 May. The sum received was Cr 422 711.24.

- (b) The total cost of Dr Nobre's and Dr Setzer's tickets was Cr 224 209. The cheques were dated 25 May, but UNESUL agreed not to cash them until funds arrived from Brasilia (see (a) above).
- (c) The balance, after purchase of these tickets, was transferred to a 'curto prazo' account which pays interest. Subsequently the sum of Cr 20000 - the minimum permissible - was transferred to the current account on 13 June to pay a bill of Cr 5993.49 for telephone charges.
- (d) The balance in the 'curto prazo' is approximately Cr 178000 and that in the current account Cr 14000.

4.5. Planned Activity in Brazil (in the forthcoming Reporting Period)

- 4.5.1. Prior to Mission M1, Dr Shuttleworth and Dr Clarke will make a short visit to Manaus from 5-11 August to attend the Hydrology and Water Management of the Amazon Basin Seminar, to hold further planning discussions with Brazilian participants who will also be attending this meeting, and to further develop contacts with Manaus-based collaborators. ODA gave approval to release

funds from the contingency element for Dr Shuttleworth's trip on 7 June 1990.

4.5.2. Mission M1: Micrometeorology The objective of the micrometeorology sub-project during Mission M1 is to establish the field installation in a grazed area of cleared forest, and thereby make measurements of the surface and near-surface micrometeorology, with particular emphasis on evaporative flux and albedo.

The field site clearing is already chosen and permission sought to install the instrumentation. Therefore, construction of the 9m high profile tower and other smaller structures can begin subject to the successful transportation of the equipment from Britain to Brazil and onward to the field site. It is estimated that full deployment of all measurement systems will be achieved by the end of week 6.

Intended instrumentation, enclosed within an electric fence, will comprise:

a 9m profile system measuring temperature, humidity and wind speed at 6 levels and supported on a 'HIWAY' tower, together with soil heat flux and temperature sensors,

A Bowen ratio system for the measurement of temperature and humidity gradients,

a 'HYDRA' for the measurement of latent and sensible heat fluxes,

a standard automatic weather station with DCP data transmission and additional radiation and soil heat flux sensors, and

additional net and reflected short-wave radiometers.

On completion of this field installation, attention during the remaining weeks of Mission M1 will shift towards training counterpart scientists in maintaining the performance of the measurement systems. This will include both hardware maintenance and software development for the analysis and quality control of data.

4.5.3. Mission M1: Climatology The primary objective of the climatology sub-project during Mission M1 is to establish the first three automatic climate stations of the network. These will be in the clearing site at Fazenda Dimona, the forest site at Reserva Ducke and the city site in Manaus. The remaining four stations will also be tested by using them in an operational mode at one of these sites. The necessary procedures for servicing the stations, and downloading and processing the data, will be established. Training will

be given to the personnel who will be operating the stations over the life of the project.

Initial tests of satellite data transmission systems will be made as soon as the necessary hardware reaches Manaus (see paragraph 4.1.4.). Long-term tests will be set in operation to allow the establishment of procedures for rapid fault finding and quality control of the data.

The data from all the stations will ultimately be incorporated into a quality controlled database which is compatible with the requirements of all the users of the data. Establishing these requirements and initiating this database will begin during Mission M1 and develop in the course of subsequent service missions prior to Mission M2.

4.5.4. Mission M1: Plant Physiology The objectives of the plant physiology sub-project during Mission M1 are as follows:

To quantify the biomass and leaf area index for adjacent areas of rainforest and cleared forest laid to pasture.

To provide first measurements of the surface conductances to canopy transpiration for pasture areas and obtain data against which it can be modelled.

To provide an initial investigation of the CO₂ exchange of the vegetation and soil for rainforest and pasture.

To obtain first information on canopy distribution and extinction of radiation within canopies necessary to begin the construction of a physiological model of rainforest canopy transpiration.

Specific studies at the experimental sites during Mission M1 are as follows:-

At the Fazenda Dimona clearing:

Diurnal measurements on selected days of leaf and crop gas exchange in vegetation in appropriate slope elements within cleared pasture areas.

Diurnal measurements on selected days of leaf water status in vegetation in appropriate slope elements within cleared pasture areas.

Measurements of leaf area index, above and below ground dry weight in vegetation in appropriate slope elements within cleared pasture areas.

At an undisturbed rainforest site adjacent to the
Fazenda Dimona clearing:

Measurement of leaf area index in a selected plot
using two independent methods, firstly by using
destructive layered sampling of representatives
from the selected plot, and secondly using
Sunfleck Ceptometers.

At the original undisturbed rainforest site in Reserva
Florestal Ducke:

Diurnal measurements on selected days of CO_2
exchange of forest canopy and soil.

First measurements of the profile of photosynthetically
active radiation throughout the rainforest canopy.

Estimation of LAI using Sunfleck Ceptometers.

4.5.5. Mission M1: Soil Physics The objective of the soil physics sub-project during Mission M1 is to measure soil water content and soil water potential at regular intervals throughout the study period, and to initiate longer term routine measurements. This will provide first indications as to whether there are significant differences between the amount of water abstracted by the forest and the amount abstracted by the pastureland. In addition, it will be possible to determine the depth in the soil profile to which water is abstracted and to gain an understanding of the processes of water movement in Amazonian soils. The methodology to be applied is as follows:

Investigate the soils and topography in the clearing and surrounding forest to determine a sampling strategy to provide representative data. The provisional strategy is to instrument sites in three locations in the clearing and three in the forest, the proposed locations being in a valley bottom, mid-slope and on a ridge top.

Install up to 6 neutron probe access tubes and up to 12 tensiometers at each of the 6 access tube locations.

Carry out a preliminary calibration of the neutron probe and capacitance probe; make measurements of soil hydraulic conductivity using permeameters,

and then maintain regular measurements of soil water content and potential.

The intention is to complete all the installation by week 6, to carry out calibration measurements in weeks 7 and 8. Attention will then focus on training Manaus-based Brazilian collaborators in techniques of data collection and first stage data processing so as to allow long term monitoring between Missions M1 and M2.

FINANCIAL OVERVIEW

- 5.1.1. Paragraph 2.3.1 refers: The Rolling Project Budget given in 5.2. reflects the actual spend in 1989/90 and the major carry forward from that year to 1990/91. The two minor exceptions are that the carry forward in the recurrent elements of Budget Lines 1.3.2., 2.1. and 2.6. has been evenly distributed over the appropriate remaining years, and that some of the unused man power from 1989/90 has been used to supplement the future commitment of specialists S1, S2 and S3 as described in paragraph 3.4.
- 5.1.2. Paragraph 2.3.2. refers: in the Rolling Project Budget, the expenditure for the provision of vehicles has been removed from the managed budget and identified as a separate Budget Line. Figures in brackets are a provisional estimate of £76.
- 5.1.3. Paragraphs 3.2, 3.3 and 3.4 refer: none of the staff management decisions described in these paragraphs have budgetary impact, apart from the minor redistribution in IH staff costs between years described in paragraph 3.4.
- 5.1.4. Paragraphs 3.5, 3.6, 3.7 and 3.8 refer: none of the staff management decisions described in these paragraphs are projected to have budgetary impact.

- 5.1.5. Paragraph 4.1.4. refers: the approved overspend in Budget Line 1.2.1. has been incorporated into the Rolling Project Budget.
- 5.1.6. Paragraph 4.1.5 refers: the recommended increase in Budget Line 1.3.1. has been incorporated into the Rolling Project Budget.
- 5.1.7. Paragraph 4.2.8 refers: the additional expense involved in the recommendation to raise the per diem for Brazilian counterparts from 25 to 45 US\$ has been incorporated into Budget Line 2.3 of the Rolling Project Budget, assuming a conversion rate of £1 = 1.65 US\$.
- 5.1.8. Paragraph 4.5.1 refers: the estimated cost of Dr Shuttleworth's approved additional trip has been included in Budget Line 2.5 of the Rolling Project Budget: Dr Clarke's expenses will be met within the existing budget.
- 5.1.9.. Paragraph 4.1.8. refers: the likely additional freight costs for 1990/91 have been included in Budget Line 2.2. of the Rolling Project Budget.

- 5.1.10. The Rolling Project Budget contains no allowance for the unknown additional cost of shipping vehicles.
- 5.1.11. The estimated IH staff costs in the project proposal were made on the basis of a full economic cost (FEC) which was assumed to rise with inflation at 5 per cent per year. Salary level increases set by UK Treasury in the 1989/90 Financial Year slightly exceeded this assumed rate. The Rolling Project Budget adopts the actual FEC for 1990/91 and then assumes an increase of 5 per cent in each subsequent year.

5.2. ROLLING PROJECT BUDGET (in £K)

CAPITAL COSTS

	Year 1 89/90	Year 2 90/91	Year 3 91/92	Year 4 92/93	Year 5 93/94	Year 6 94/95	Totals
<u>1.1. Hardware associated with Phase 2</u>							
1.1.1. Micrometeorological Equipment	0.5	61.6	18.0	16.0	5.0		101.1
1.1.2. Plant Physiological Equipment		78.8					78.8
1.1.3. Soil Moisture Equipment		13.7					15.0
<u>1.2. Hardware associated with Phase 3</u>							
1.2.1. Climatological Equipment and Receiving Stations		132.0					132.0
1.2.2. Soil Moisture Equipment		45.0					45.0
<u>1.3. Transport and Site Facilities</u>							
1.3.1. Forest Towers		58.0					58.0
1.3.2.A. Transport Facilities		9.0	9.0	9.0	9.0		36.0
B. Transport Facilities		(76.0)					(76.0)
1.3.3. Site Facilities		10.1	7.8				17.9
<u>1.4. UK-based Hardware and Facilities</u>							
1.4.1. Computers		24.0					24.0
<hr/>							
TOTAL CAPITAL:	1.8	432.2	34.8	25.0	14.0		484.8
		(508.2)					(560.8)

6. CONCLUDING SUMMARY

The delay in project initiation and lack of contractual commitments has considerably complicated activity in the first reporting phase of this project, and amplified the difficulties involved. Outstanding risks remain which are referred to in paragraphs 1.1, 1.2, 1.6, 1.8 and 1.11.

Some overspend above original estimates has already arisen in respect of climatological hardware, vehicles and IH travel, and UK wage inflation slightly exceeded the estimated 5% last year. Further overspend is recommended in respect of tower purchase and counterpart travel costs

Notwithstanding the difficulties encountered over the last six months, it is IH's and INPE's opinion that this project can now proceed with the start date for Mission M1 set as 3 September 1990, and that the objectives of this Mission summarized in Section 4.5, will be substantially met.

APPENDIX A1. EQUIPMENT SPECIFICATION (AS OF 30 JUNE 1990)

A.1.1. EQUIPMENT TO BE SHIPPED FOR USE IN MISSION M1.

A.1.1.1. Micrometeorological Equipment (B.L. 1.1.1.)

- 2 Hydras
- 1 Bowen Ratio System
- 8 point profile hardware (includes anemometers and psychrometers)
- 1 Automatic Weather Station and transmitter and logger
- 7 Diffuse radiometer shade rings
- 6 Soil thermometers
- 9 Soil heat flux plates
- 3 Campbell CR10 loggers
- 5 Campbell interfaces and storage modules
- 2 lap top PCs
- 2 Gk Hydra interfaces
- 1 Net radiometer
- 16 pyranometers
- Batteries, computer supplies, solar panels, etc.
- General supplies.

A.1.1.2. Plant Physiological Equipment (B.L. 1.1.2.)

- 2 Portable infrared gas analysers, each with
 - leaf chambers
 - air supply
 - all accessories
- 2 Pressure chamber water potential systems
- 1 Vapour pressure osmometer

- 1 BT porometer
- 1 Lap top PC
- 2 Campbell 21X loggers
- 2 Sunfleck Ceptometers
- 1 Torsion Balance
- 6 Anemometers
- 6 RH Temperature probes
- 1 Weighing Lysimeter system
- 1 leaf area and root length measuring machine
- 20 Silicon cell quantum sensors, with cable
- 2 pneumatic masts
- 1 Vacuum pump
- 1 Turbo molecular pump
- Batteries, computer supplies
- General supplies

Climatological Hardware (B.L. 1.2.1.)

- 5 Automatic Weather Stations and spares
(including loggers)
- 5 Data Transmission Units
- 5 Inverted Kipp Radiometers
- 4 Portable computers
- 3 Receiving stations (including 3 computers)

A.1.1.3. Soil Moisture Equipment (B.L. 1.1.3. and 1.2.2.)

- 2 Neutron probes and accessories
- 100 tensiometers and 10 manometer boards
- 1 lap top PC
- 2 permeameters
- 1 General purpose balance
- 1 Capacitance probe
- 1 prime series oven (150 litres)
- Installation equipment (viz. ball core clamp and
jack; augers, etc.)
- Access tubing
- Miscellaneous tools

Scaffolding Towers (B.L. 1.3.1.)

- 5 tower sections
- Sundry tackle (guy ropes, anchors, etc.)

Transport Facilities (B.L. 1.3.2.A)

- 10 Land Rover tyres

Site Facilities (B.L. 1.3.3.)

- 1 Trailer-mounted Generator
- 1 Air conditioner
- 25 litres Creosote
- 1 Storage Shed

A.1.2. EQUIPMENT TO BE BOUGHT IN BRAZIL (B.L. 2.1.)

Radio communication hardware (to be investigated)

Shed fittings

Lab fittings

Sundry Scientific Supplies and Site Facilities

A.1.3. EQUIPMENT ORDERED FOR USE IN THE UK (B.L. 1.2.1. and
1.4.1.)

4 PS2 computers and associated software

Receiving stations (including 1 computer)

A.1.4. EQUIPMENT STILL TO BE SHIPPED FOR USE IN MISSION M2
(B.L. various)

1 Automatic Weather Station and spares (including
loggers

- 1 Data Transmission Unit

1 Inverted Kipp Radiometer

- 48 tower sections (for 2 towers)

48 reinforcing components (for 3 towers)

2 Sunfleck Ceptometers

Leaf area and root length measuring machine

- Sundry tackle (guy ropes, anchors, etc.)

2 Neutron probes and accessories

Additional Soil Physics Equipment, to be defined

- Sundry Scientific Equipment and Supplies, to
be defined.

APPENDIX A2. ITINERARY OF DRS GASH, ROBERTS AND CLARKE

Tue 20.3.90	Depart London
Wed 21.3.90	Arrive Rio de Janeiro, travel to Brasilia
Thu 22.3.90	Visit British Council and Embassy
Fri 23.3.90	Visit British Embassy
Sat 24.3.90	Travel to São José dos Campos
Sun 25.3.90	Rendezvous with Dr Clarke
Mon 26.3.90	Meeting at INPE
Tue 27.3.90	Meeting at INPE
Wed 28.3.90	Travel to Manaus
Thu 29.3.90 to 9.4.90	In Manaus - see main report
Tue 10.4.90	Gash and Roberts travel to Rio de Janeiro
Wed 11.4.90	Clarke travels to Porto Alegre Gash and Roberts meeting with British Aerospace, then depart for London
Thu 12.4.90	Arrive London.