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COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP
ON INTEGRATED OBSERVING SYSTEMS

ITEM: 4

EXPERT TEAM ON OBSERVATIONAL DATA REQUIREMENTS
AND REDESIGN OF THE GLOBAL OBSERVING SYSTEM

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OXFORD, ENGLAND, 1 – 5 JULY 2002

EUCOS Operational Program

(Submitted by Jim Caughey, EUCOS Programme Manager)

Summary and purpose of Document

Proposals are outlined for further OSEs/OSSEs, technology demonstrations, network studies, etc to better inform the development of the EUCOS operational programme.

ACTION PROPOSED:

The Expert Team Members are invited to comment on the proposals contained in this document especially identifying priority areas.

Reference	Date	Author(s)	Content
EUCOS/SP/100-draft	7 May 2002	Jim Caughey	Original draft version
EUCOS/SP/100-draft 2	9 May 2002	Jim Caughey & Bruce Truscott	Draft version 2, with Technology demonstration section added
EUCOS/SP/100-draft 3	24th May 2002	Jim Caughey & Bruce Truscott	Draft version 3, reflecting comments from the SAT and COSNA SEG

Contents

1. Introduction

1.1 The EUCOS Implementation Programme (1999-2001) provided recommendations for the evolution of EUCOS in the period 2002-2006 (Ref 1). It was envisaged that an on-going Studies Programme would further refine and underpin these conclusions. This document has been developed in response to those requirements. It includes proposals for further OSEs/OSSEs, technology demonstrations, network studies etc, aimed at achieving a better understanding for the ways in which the major components of EUCOS should evolve in the future. The intention is to build upon and extend previous work initiated by EUCOS.

It is the intention to link the proposals outlined here to those in other relevant programmes *e.g*. the COSNA SEG, SRNWP etc. The NAOS initiative seems to be in the process of being re-configured within the US Weather Research Programme. Once the situation is clearer EUCOS will establish appropriate linkages.

1.2 Available funding for these activities is summarised in the Table below. Some comments are appropriate. The figures for 2004-2006 are not yet approved by the EUMETNET Council. They will decide on an annual basis, so, for example, the 2004 figure will be discussed at the September 2002 Council meeting. The Special Projects fund may, in principle, be used to support the Studies Programme but will require specific approval by the Council. A component of this Fund has already been allocated to support a separate EUCOS activity.

EUCOS Studies Programme and Special Project Funding					
(all figures in Euro)	2002	2003	2004	2005	2006
	Approved		*Indicative figures*		
Studies Programme	150 000	150 000	150 000	150 000	150 000
Special Projects Fund	0	200 000	200 000	200 000	200 000
Total	**150 000**	**350 000**	**350 000**	**350 000**	**350 000**

1.3 In the final section some recommendations for the initial work programme are made based on the feedback and interests of the EUCOS Scientific Advisory Team (SAT) and the COSNA SEG.

2. Observing Experiments

2.1 Observing System Experiments (OSEs)

Observing System Experiments assess the impact of existing observations on current NWP systems by removing and/or adding sets of observations from the assimilation process and comparing forecasts. Whole observing systems can be omitted or added or more limited sets over defined geographical areas (Ref. 2). OSEs are usually run for periods of at least one month, preferably using data from several seasons.

Advantages of OSEs are that they are relatively easy to run (compared with OSSEs), and they can be used to assess the impact of real observations under various scenarios. For example, the impact of various observation network configurations can be assessed, and the effect of observation networks on forecasts over downstream areas investigated.

A disadvantage of OSEs is that they can only assess the impact of existing observing systems using existing assimilation techniques.

To investigate whether the results obtained are dependent on the assimilation methods used, all OSEs should ideally be run using several different assimilation schemes.

It is recommended that all the OSEs proposed in Section 2.4 meet the following 'minimum' requirements.

2.1.1 Model and assimilation scheme

An operational, global model should be run at a horizontal and vertical resolution as close to operational as possible. At least one NWP Centre involved in each OSE should run one 5-day forecast per day from the 12UTC analysis since there tends to be more data at this time.

2.1.2 Verification and assessment

To facilitate comparison of results, it is important that verification details are agreed in advance of running the OSEs. Some suggestions are given below.

Objective:

Verify PMSL, height and wind fields over the agreed verification areas, including the North Atlantic and Europe. Verify against radiosonde and surface observations and the 'all data' analyses. It would be worthwhile assessing humidity related parameters (e.g. precipitation and cloud) if appropriate verification data were available.

Subjective:

Carry out subjective verification against observations and satellite imagery (rather than analyses). This would be done by picking out cases of particular interest, such as high precipitation events and deep cyclones, in the European area.

Economic

The economic impact of improved forecasts should be evaluated where possible (Ref. 2).

2.2 Observing System Simulation Experiments (OSSEs)

The aim of Observing System Simulation Experiments is to anticipate the impact on NWP of a future observing system. 'Pseudo-observations', with characteristics similar to those expected from the future observing system, are generated by a numerical model then assimilated into another model and their impact assessed. To represent the fact that real observations contain more information than a numerical model, the model and assimilation scheme used to assess the impact are less sophisticated than the model that generates the observations (Ref. 2).

An advantage of OSSEs is that they attempt to assess the impact of 'new' observations. Disadvantages are that they are complex and expensive to run, and the 'new' observations generated are not independent of NWP and cannot fully replicate the characteristics of real observations. Consequently, OSSEs tend to over-estimate the benefits of a new observing system. As with OSEs, OSSEs can only assess impact using existing assimilation techniques.

As OSSEs are relatively complex and expensive to run, the building an OSSE system is likely to be beyond the scope of EUCOS. Collaboration should be sought with a Centre that has already set up an OSSE system, such as the NASA Goddard Laboratory - their OSSE configuration could be used (Ref. 4).

2.3 Information Content, Sensitivities and Climatology

The regions in which significant weather features, such as cyclones, develop vary on a daily basis. However, for a given forecast range and verification area (such as Europe), it is possible to identify the regions in which the initial condition error is most likely to contribute most to the forecast error. Studies can be performed to identify such 'climatologically sensitive' regions (for example, Ref. 5). Such studies can guide the deployment of observations in sparsely observed areas such as the North Atlantic.

2.4 OSE/OSSE Research proposals

The following proposals are intended to consolidate and extend the work already carried within EUCOS studies. Several OSEs and a single OSSE are proposed. The OSEs will further investigate the role of the current observing network and assess the benefit of extra observations obtained during Special Observing Periods. The OSSE is intended to assess the potential benefit of more profile data over the North Atlantic.

2.4.1. EUCOS-THORpex Research and Predictability Experiment

Aim: To test the ability of NWP schemes to identify synoptically 'sensitive' areas and of EUCOS to quickly 'target' these areas. Explore the utility of new technologies (such as robotic aircraft) that are candidates for operational implementation. Develop methods for targeting ASAP/AMDAR assets. This experiment builds upon the 2001 E-ASAP OSE (Ref. 6) and the 2002 Aerosonde Technology Demonstration (Ref. 7).

Method: Identify the 'sensitive' areas in the North Atlantic/Mediterranean areas on a daily basis and target these for extra observations. Using data from the entire SOP(s), it is suggested that an OSE is run that compares forecasts using the following observation scenarios:

(a) all data, including the data from the targeted observations (the enhanced network)

(b) all data less all the targeted observations (the existing network)

(c) data from the existing network plus data from the targeted aircraft, AMDAR and Robotic (a partially enhanced network)

(d) data from the existing network plus data the targeted ASAPs (a partially enhanced network).

Funding has been sought from the EC GMES FM 5. NOAA has indicated financial support for the targeted observations from robotic aircraft elements.

2.4.2 The Euro-THORpex Research and Predictability Experiment

Background: THORpex plans to organise a SOP which will provide very enhanced observation coverage over the North Atlantic. A variety of observing systems will be used, including some, such as driftsondes and rocketsondes, that have the potential for operational implementation, as well as other systems, such as research aircraft (Ref. 8) that will not be made operational. The THORpex SOP will occur in addition to any SOP supporting proposal 2.4.1. Euro-THORpex will exploit the new idea of a reactive two-way flow of information between observational and NWP systems. Until now this has been one-way from observations into the NWP scheme. This process will become two-way and fully interactive ie “dynamical control”.

In addition Euro-THORpex will address key issues in predictability theory assimilation techniques, NWP processes etc. An ambitious goal will be set to make very significant advances in the accuracy of forecasts from short range to medium range within a period of 5-10 years. Although much wider than observations alone it is felt that EUCOS should be an important element in this initiative.

Aim: To widen and develop EUCOS-THORpex. Assess the impact on NWP forecasts for Europe of the new 'in-situ' observing technologies (such as driftsondes) and exploiting ‘dynamical control’ of observations programmes by NWP systems.

Method: Run an OSE to assess the impact on GNWP. Using data from the entire SOP(s), it is suggested that an OSE is run that compares forecasts using the following observation scenarios:

(a) all data, including all the extra data (the enhanced network)

(b) all data less all the targeted observations (the existing network)

(c) the existing network plus the driftsonde data (a partially enhanced network)

(d) the existing network plus the ASAP data (a partially enhanced network)

(e) the existing network plus data from robotic aircraft (a partially enhanced network).

2.4.3 Increased in-situ profile data over the North Atlantic and Mediterranean

Aim: To guide (and further justify) the development of the EUCOS ASAP programme, which envisages a fleet of 18 ASAP ships by 2006 and 25 ASAP ships by 2010.

Method: Organise and conduct three experiments.

(a) Estimate the impact of an enhanced upstream 'in-situ' profile network by assessing the impact over Europe of the North American radiosonde and wind profiler network. Run an OSE to assess the impact at 48 - 72 hours over Europe. Use periods when the information from the North American network is likely to rapidly advect downstream (e.g.

when there is a strong jet stream across the North Atlantic). The OSE should ideally use at least two one-month periods of data. It is suggested that an OSE is run that compares forecasts using the following observation scenarios:

(i) all data, including all data from the North American network (the existing network)

(ii) all data less data from selected North America stations (the reduced network)

(iii) all data less the entire North American upper air network (the null network).

(b) Following on from the first E-ASAP experiment (Ref. 6), organise a second, more comprehensive ASAP-SOP in the North Atlantic/Mediterranean employing more ships and a more flexible observing programme that may allow the launching of radiosondes on request. Run an OSE to assess the impact of the data from the entire SOP. It is suggested that an OSE is run that compares forecasts using the following observation scenarios:

(i) all data including all extra observations (the enhanced network)

(ii) all data less the additional ASAPs (the existing network)

(iii) all data less all ASAPs (the null network).

(c) Set up and run an OSSE to test the impact of a new set of profile data over the North Atlantic. The OSSE would investigate the optimum deployment, both in density and distribution, of in-situ observations.

2.4.4 Increased AMDAR data

Aim: To guide and further justify the growth in AMDAR data envisaged in EUCOS programme plans, particularly beyond the levels expected in 2004 (see also 2.4.6).

Method: Establish the potential 2006 level of coverage for a limited 2-3 month period by:

(a) generating profiles on ascent and descent at airports more frequently than 3 hourly

(b) if possible, subject to the installation of software on extra aircraft, extend the coverage within the EUCOS area of the sites from where ascent/descent profiles are obtained every 3 hours

(c) extending coverage of the en-route data, especially in the climatologically sensitive areas.

Run an OSE to assess the impact of the extra data on GNWP using several different assimilation schemes to seek justification of the proposed additional spend. It is suggested that an OSE is run using data from the entire SOP and compares forecasts using the following observation scenarios:

(a) all data including all the extra aircraft data (the enhanced network)

(b) all data but excluding the extra data (the existing network)

(c) all data less selected aircraft data (e.g. use only one report in a given lat./long/time box; the reduced network)

(d) all data less all aircraft data from over the Atlantic and Europe (the null network)

2.4.5 Surface data (pressure) over the North Atlantic

Aim: There is little available justification for the current (or a different) level of investment in drifting/moored buoys in the North Atlantic. This infrastructure is likely to be incorporated within a new (optional) integrated EUCOS programme. Guidance is needed as to the appropriate level of future investment.

Method: Organise, in conjunction with EGOS, a significant enhancement in the number of drifting buoys in the area - say an increase by a factor of 2. Target deployment initially on the climatologically sensitive areas. Assess the impact across two winter periods i.e. 02/03 and 03/04. Run an OSE using several one-month periods of data from within the SOP. The OSE could compare the following scenarios:

(a) all data, including all the extra buoy data (the enhanced network)
(b) all data less the extra buoy data provided for the SOP (the existing network)
(c) all data less all the buoy data from the North Atlantic (the null network).

2.4.6 Review the Territorial Upper Air Evolution

Background: The current evolution of the territorial upper air network envisages a reduction from 69 radiosonde sites (19 of which operate with 4 soundings per day) in EUCOS (0) to 46 sites (34 with 4 soundings per day as a target) in EUCOS (1) (Ref. 9). The increase from 19 to 34 operating 4 per day is envisaged as occurring from voluntary commitments by the countries concerned. Soundings from the other 12 sites, which are mainly islands/remote platforms (surprisingly), remain at 2 per day. This seems out of line with conclusions, which were based on an analysis of the impact of the observations taken during the SOP of autumn 1999 (Ref. 10).

Aim: To further test (and refine) the currently envisaged evolution from EUCOS(0) to EUCOS(1) considering especially the recommended frequency of ascents from islands, remote locations, the western coastal fringe and interior continental sites.

Method: Organise a second upper air SOP in which the whole EUCOS (1) network operates at 4 ascents per day. Use the same period as for the AMDAR SOP in Experiment 2.4.4. Conduct an OSE to test and identify the optimum geographical/temporal programme from the GNWP viewpoint. The OSE would use data from the entire SOP and it is suggested that it compares forecasts using the following observation scenarios:

(a) data from the existing sonde network
(b) data from the EUCOS(1) network
(c) data from the enhanced EUCOS(1) network, i.e. with all stations making four soundings per day
(d) data from a modified EUCOS(1) network, e.g. coastal and island stations making four soundings per day, but some continental stations making just two soundings a day.

Each of these scenarios could be repeated but including the extra AMDAR data provided by Experiment 2.4.4.

2.4.7 Evolution of the Surface Territorial Network

Aim: To establish the most cost effective land surface network within the EUCOS area for GNWP and therefore refine the list of surface stations in content of EUCOS (1).

Method: Evaluate various network arrangements reflecting WMO guidance concerning surface measurements for NWP. Conduct an OSE to assess the optimum density of surface reports required for GNWP. The OSE could assess impact using at least two one-month periods of data from different seasons. It is suggested that the OSE compares forecasts using the following observation scenarios:

(a) all data, including all surface reports (existing network)
(b) all data less selected surface reports so that remaining network is uniformly distributed at a prescribed density (reduced network)
(c) all data less all territorial surface reports (null network)

3. Technology Demonstrations

Technology Demonstrations will form another important component of the EUCOS Studies Programme the aim being to demonstrate the technical feasibility of operating existing systems at greater capacity, or entirely new systems. Recent examples include the E-ASAP trial (Ref. 6), and the demonstration of the robotic aircraft technology (Ref. 7).

As the scope of the EUCOS Operational Programme does not include active development of new observing solutions the general approach will be to develop strong collaborative links with other activities and initiatives (such as THORpex and COST). The aim will be to gain knowledge about new observing technologies that may in the near future be ready for operational deployment. If appropriate, EUCOS will arrange specific demonstrations to test whether the new systems can be operated in the manner required by EUCOS. Efforts will focus on the assessment of those, which look most promising, initially including:

3.1 Robotic Aircraft (specifically Aerosonde)

Robotic aircraft have been operated for some years now performing a wide range of activities including the capture of meteorological data. The Aerosonde aircraft can provide measurements of air temperature, humidity, pressure and wind (using two Vaisala RSS901 sensors, one under each wing). Extended flight duration and the development of satellite communication facilities now means that they are becoming capable of providing data from remote, data sensitive regions in a targeted manner.

It is proposed that future demonstrations should be arranged to test further the weaknesses revealed by a previous trial arranged as part of the EUCOS Implementation Programme (March 2002). Tests should focus on aircraft range (horizontal and vertical), reliability and the ability to launch at short notice.

3.2 AMDAR Humidity Sensor

Two potential solutions are being developed, one by UCAR in partnership with NOAA and the FAA and the other by Cambridge University. The UCAR effort is estimated to be at least 18-months ahead although recent reports seem to suggest that it may be faltering due to a reduction in funding by the US (as a direct result of increased spend on national security).

Although UCAR made a first generation sensor (WVSS-1) operational in 1999, this was not considered as operationally viable because of demanding installation and servicing requirements. Instead UCAR have chosen to develop a second-generation (diode laser) solution known as WVSS-II. Whilst development has been slower than expected, it is anticipated that the unit will be certified for the first fleet of aircraft (B-757) during early 2003.

It is proposed that both the UCAR and Cambridge University efforts should be closely monitored through the E-AMDAR Programme. Links to the developers should be formed through which the possibility of obtaining a small number of sensors for trial purposes should be investigated.

3.3 Driftsonde

The Driftsonde has been designed and developed by NCAR’s Atmospheric Technology Division (ATD) in consultation with co-investigators at the Naval Research Laboratory (NRL) and NOAA. It is intended as an observing system that will fill critical gaps in data coverage over data sparse areas with high vertical resolution GPS dropsonde profiles spanning the lower stratosphere and entire troposphere. With an operational payload of 24 dropsondes, (typically released every 6-hours) it has a normal flight duration of approximately 5-6 days.

Like Aerosonde, the Driftsonde should be regarded as an adaptive observing platform, deployed into specific regions when needed, although once launched it simply ascends to between 50-100 hPa and then drifts in the prevailing stratospheric flow. Deployment is planned as part of the THORpex experiment, firstly during 2001-2002 to test the system as a candidate for the major field campaign scheduled for 2003 – 2005.

It is proposed that EUCOS should first investigate the success of the above tests by forming links with those involved and then;

(a) consider whether deployment can be achieved in a manner that satisfies operational requirements;

(b) arrange the deployment of a number of Driftsondes in an operational manner, targeting developing storms over the North Atlantic to demonstrate the units operational viability;

3.4 Tropospheric Aircraft Meteorological DAta Reporting (TAMDAR)

NASA initiated the TAMDAR program in response to a US government mandate to reduce the aviation accident rate by 80% within a decade. TAMDAR is designed as a low cost atmospheric data collection system suitable for installation on small aircraft flying in the lower troposphere that are not AMDAR compatible. Work on the development of the core component of the system, (the TAMDAR atmospheric data sensor) is well advanced. Less progress seems to have been with the development of the communications device that will be coupled to the unit. The TAMDAR sensor will measure and detect winds aloft, temperature, humidity, pressure icing and turbulence although data are not expected to be as accurate as traditional AMDAR measurements.

TAMDAR could potentially supplement AMDAR and radiosonde data by providing lower level 'enroute' observations and profiles over additional, regional airports not covered by larger AMDAR compatible aircraft.

The initial EUCOS aim should be to obtain the results from the NASA trials and gather more information on the device. If this looks promising EUCOS should:

(a) investigate whether there is a European application by assessing the availability of aircraft suitable for TAMDAR installation operating within the EUCOS area;

(b) arrange an independent EUCOS trial/demonstration if this seems appropriate.

3.5 GPS integrated column water vapour

The emerging ground-based Global Position System (GPS) networks offer the potential for an important source of humidity observations over Europe. Estimates of the Integrated Water Vapour (IWV) in the atmosphere from the anomalous delays in the radio signals transmitted from GPS satellites are reported to have an accuracy at least comparable to that of radiosondes. COST action 716 was established with the primary objective of providing an assessment of the networks operational potential on an international scale for exploitation of the ground-based GPS systems to provide real-time observations for NWP and climate applications.

It seems clear that the necessary operational assessment process is being undertaken within COST action 716. EUCOS should not seek to duplicate this work but must instead monitor progress in order to understand the role of GPS humidity data as an element of EUCOS. Through this process, EUCOS should receive the guidance required to decide when this network has reached a stage where European implementation under EUCOS is appropriate. This may require a specific OSE to test the benefit and guide the design of the GPS IWV network.

3.6 Automated VOS

Automated observing systems are currently increasing in popularity amongst some VOS operators despite the difficulties of finding suitable sensor exposure on board ships. However, their use by EUMETNET VOS operators is currently relatively limited and there is no co-ordination mechanism for their deployment or future development.

Two systems have been identified which are operational today:

(a) **AVOS:** Operated by the Canadians and commercially available for purchase or possibly hire;

(b) **Vaisala MILOS:** Operated by the Australians and commercially available. Vaisala have also indicated to the Met Office that they may be willing to lend some units for demonstration purposes.

EUCOS, through the Surface Marine Programme (if established), should:

(a) Assess the performance of each of the available products;

(b) Identify the rationale for increased use of these automated systems on suitable EUCOS VOS ships or possibly European ASAP vessels.

4. Evolution of between the Space and Terrestrial components

4.1 It is important to consider, in as objective a way as possible, the optimal evolutionary relationship between the terrestrial and space components of the integrated (overall) observing system. Major developments in European space capability are scheduled (MSG, Metop, JASON-2 etc.) and there is a need to understand the implications for in-situ networks,

In the longer term the two elements of the composite system should maintain an optimal, complementary balance so that the most appropriate investment is made in space-based and in-situ instruments and techniques.

There is also the need to provide for effective calibration-validation of the space-based equipment. On the time scale out to 2015 the evolution of the space component is relatively clear. It is important to establish how in-situ networks should respond.

4.2 It is proposed to approach this issue jointly with Eumetsat in a co-funded study. Further thought needs to be given to the specific approach to take in this study. Proposals will be developed and distributed to the EUCOS-SAT before work is initiated.

5. EUCOS-Medex Collaboration

5.1 Even in the Mediterranean area the inaccuracy in the initial conditions is considered to be a major source of forecast failure. According to the recommendations formulated by WWRP/SSC for MEDEX, particular attention should be paid in the Mediterranean Project MEDEX to the identification of the sensitive areas where the addition of observations may lead to improved forecasting of Mediterranean cyclogenesis events.

The identification of sensitive areas will be performed by adjoint computations using the ARPEGE/IFS software. In the case of the Mediterranean area, it is expected that diabatic processes will need to be included in the adjoint calculations.

Although there is available a EUCOS' general climatological study of sensitivity areas related to Southern Europe (Marseille & Bouttier, 2000), nothing is known regarding the identification of sensitive areas for the cases of cyclones that produce high impact weather in the Mediterranean. The MEDEX project also favours the case study approach rather than running sensitivity calculations on all kinds of cases. However, no general conclusion may be drawn with individual sensitivity calculations. We therefore propose a mixed climatological and dynamical approach of the Mediterranean cyclogenesis problem.

5.2 In broad outline, we propose a two step approach. The first step uses an automatic tracking algorithm to build significant statistical properties of Mediterranean cyclones out of long re-analyses (such as ERA-40). In the second step, the sensitivities to initial conditions of typical Mediterranean situations of known representativeness will be determined.

It turns out that, as part of FASTEX, that event-based climatological approaches become extremely dangerous when based on operational analyses, instead of large homogeneous data bases of re-analyses, like ERA-15 (or ERA-40).

Similarly, it has also been learned from FASTEX how important it is for sensitivity calculations to be focused on particular systems rather than averaged over too large an area or average by combining situations that correspond to very different background flows or flow regimes.

But the statistical aspects are very important when dealing with methodologies that are ultimately meant to underlie decision-making tools for facing possibly extreme events: this is why it is important to have the largest possible sample in the background.

It is interesting to have both "typical" composite systems of known representativeness such as can be gained from using extended re-analyses and well documented case studies, such as provided by the FASTEX field experiment or, in the case of MEDEX, by the list of selected cases.

The so-called climatological part of this proposal implies adaptation of the Franck Ayrault's automatic tracking algorithm (developed for FASTEX) to the Mediterranean area. At some stage, if this proposal is well received by EUCOS, we will need to choose between using ERA15 or the available years of ERA-40 (more than 15 already).

The new aspects are on the sensitivity calculation. Either we find an acceptable way to compute it on a set of averaged "typical" flow regimes conducive to cyclogenesis or we extract the cases that are closest to the centre of the classes and compute sensitivities on these. In this way, we hope to be able to have both ideas on the "typicalness" of a set of characteristic situations as well as sensitivity maps for various ranges that will be richer in signal than randomly averaged maps.

5.3 It is expected that this work would ultimately lead to good guidance for the development of the EUCOS network in the Mediterranean area and more especially requirements for targeted observations to better predict high impact weather.

6. Tools and Techniques

6.1 The Zurich meeting concerning tools and techniques for network design (especially related to the surface network) will be followed up, as appropriate, by further work within EUCOS. The suggestions, comments and recommendations of the meeting will therefore be evaluated for relevance to EUCOS development and appropriate activities initiated.

6.2 One area that requires consideration in the short term is the EUCOS surface network on land. This is simply defined in EUCOS(O) as the 359 (or so) RBSN stations of the EUCOS Members. An analysis (similar to that performed for the upper air network) to achieve a more balanced and homogeneous set of EUCOS stations will be performed. The overall number and spacing of sites in the EUCOS network will be based on WMO Recommendations and also the OSE outlined in 2.4.7. The final design will also take account of the contributions of EUCOS to GCOS ie the final design should adequately cover the GCOS Surface Network (GSN) sites.

7. Conclusions and Recommendations

The priorities should be based upon answering important questions for the evolution of EUCOS out to 2006 and in building upon previous EUCOS studies and investments. These should take into account the feedback and advice from the COSNA SEG, EUCOS-SAT and available technology, funding and practicalities.

7.1 Available Funding

The EUCOS Operational Programme Decision (Ref 11) states under Annex 1, paragraph VII; “The annual budget for items VI A *(The running of the programme office)* and B *(The EUCOS Studies Programme)* is set at 260,000 Euro.”

Programme Management charges are fixed at 110,000 Euro/year, resulting in an annual Studies Programme budget of 150,000 Euro, subject to Council approval beyond 2003. The available funding is therefore 300,000 Euro for 2003 and 2003. Furthermore it may be possible to allocate some of the Special Projects fund to data gathering, this could be of order 100,000 Euro, making a total of around **400,000 Euro.**

7.2 Proposes Studies

7.2.1 Targeted Observing

Description: On the assumption that the NOAA contribution of 100,000 $ is confirmed, proceed with a more limited study involving ASAP, AMDAR and Robotic Aircraft. The study may also include US Driftsonde flights (if available). Identification of sensitive areas would be carried out by ECMWF or MeteoFrance. Scheduled for February and March 2003, this would be in effect a reduced EUCOS-THORpex study given unavailability of EC Funding.

Partners: Involving those identified in the EC FMV proposal, i.e. ECMWF, SMHI, DMI, Met Office etc.

Costs: It is assumed that collaborators will carry their own costs. The only costs therefore identified here are the extra data costs based on consumables, communications etc.

EUCOS:	150,000 Euro
NOAA:-	100,000 Euro

7.2.2 High Frequency AMDAR Data

Description: ECMWF have demonstrated the positive impact of higher frequency data sampling in GNWP. In addition the CBS Expert Team of the re-deign of the Global Observing System have recommended an OSE to assess the impact of hourly AMDAR profiles in NWP. Finally, a number of EUCOS Members have stated a requirement for higher frequency profiles and indicated that the EUCOS Programme should in the future capture such data.

It is therefore proposed to conduct an OSE in conjunction with the targeted observing OSE described in 7.2.1. However, a three-month period is recommended and would probably be affordable.

Partners: ECMWF, Met Office, Others

Cost: 70,000 Euro

7.2.3 Surface Marine Data

Description: The EUCOS detailed design includes the surface marine component and notes the need to better define the content to inform evolution out to 2006. In parallel a proposal has been developed to set up an Optional Integrated Surface Marine Programme. It is also noted that EUMETSAT have requested ECMWF to conduct a study to identify the requirement for surface pressure/wind measurements in support of satellite observations. Finally, this work would build upon previous data denial experiments by DWD, Met Office etc, suggesting small impacts overall but noting the need for a case study approach and ensuring maximum buoy coverage in sensitive areas.

There is therefore an opportunity to look objectively at the future requirement for surface marine observations both directly in support of GNWP in there own right and to provide an optimal link to the space segment.

Partners: EGOS, EUMETSAT, ECMWF and others.

Cost: 50,000 Euro (assuming EGOS countries voluntarily support enhanced buoy deployments).

Schedule: Initial deployment by the end of 2002. Enhanced network available until spring 2004 – studies conducted on an ongoing basis.

7.2.4 EURO-THORpex / CLIMMET-RISK

EUCOS will link as appropriate to these major proposals being made for funding under EC FM VI. If successful these significant tasks would require additional dedicated resources for the EUCOS Programme Team (funded through the EC).

7.3 Technology Demonstrations

7.3.1 AMDAR Humidity Measurement

Description: These measurements are of potentially high value to NWP. The following EUCOS involvement is recommended.

(a) Prepare a draft report for distribution to Members on the US WVSSII sensor development to date including data quality etc (2002)

(b) Link with the sensor certification process tentatively scheduled for early 2003 and work to look at sensor performance etc.

Partners: UCAR, NOAA, WMO (AMDAR Panel), BF Goodrich Corporation

Cost: (i) 5,000 Euro
(ii) 10,000 Euro

7.3.2 Driftsonde

Description: It is proposed that EUCOS should first investigate the success of the first Driftsonde tests by forming links with those involved and then;

(a) Consider whether deployment can be achieved in a manner that satisfies operational requirements

(b) Arrange the deployment of a number of Driftsondes demonstration in the North Atlantic.

Partners: NCAR, NRL, NOAA and Vaisala

Cost: (i) 5,000 Euro
(ii) 50,000 Euro

7.3.3 TAMDAR

Description: The initial aim should be to obtain the results from the NASA trials (2001/2002) and gather more information on the device. If this looks promising EUCOS should:

(a) investigate whether there is a European application by assessing the availability of aircraft suitable for TAMDAR installation operating within the EUCOS area;

(b) arrange an independent EUCOS trial/demonstration if this seems appropriate.

Partners: NASA, WMO (AMDAR Panel), Optical Detection Systems Inc.

Cost: 5,000 Euro

7.4 EUCOS-MEDEX Collaboration

The Medex Programme is potentially of importance in the better determination of sensitive areas in the Mediterranean and Southern European area generally. If successful it could help to better inform observational priorities in the region. It is felt that it should be supported to a modest degree.

Partners: The Medex Group

Cost: 30,000 Euro

7.5 Space – Terrestrial Components

It is recommended that the Programme Manager approach EUMETSAT with a proposal for a joint study in this area. It is hoped that EUMETSAT may meet most of the cost.

Partners: EUMETSAT

Cost: 20,000 Euro

7.6 Network Studies

Further study should be made of the upper air network, particularly the observational programme. There is also a need to define a EUCOS Surface Network in support of GNWP.

Cost: Within Programme Management costs (work to be carried out by the EUCOS Technical Co-ordinator).

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