European Cooperation in the field of Scientific and Technical Research - COST -

Secretariat

Brussels, 5 December 2006

COST 306/06

MEMORANDUM OF UNDERSTANDING

Subject : Memorandum of Understanding (MoU) for the implementation of a European Concerted Research Action designated as COST Action ES0601: Advances in Homogenisation Methods of Climate Series: An Integrated Approach (HOME)

Delegations will find attached the Memorandum of Understanding for COST Action ES0601 as approved by the COST Committee of Senior Officials (CSO) at its 166th meeting on 20/21 November 2006.

MEMORANDUM OF UNDERSTANDING
FOR THE IMPLEMENTATION OF A EUROPEAN CONCERTED RESEARCH ACTION
DESIGNATED AS

COST ACTION ES0601

Advances in Homogenisation Methods of Climate Series: An Integrated Approach
(HOME)

The Signatories to this 'Memorandum of Understanding', declaring their common intention to participate in the concerted Action referred to above and described in the Technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 299/06 ‘Rules and Procedures for Implementing COST Actions' the contents of which the Signatories are fully aware of.

2. The main objective of the Action is to achieve a general method for homogenising climate and environmental datasets.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at 6 million EUR in 2006 prices.

4. The Memorandum of Understanding will take effect on being signed by at least five Signatories.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of the document referred to in Point 1 above.

COST ACTION ES0601

Advances in Homogenisation Methods of Climate Series: An Integrated Approach (HOME)

A. ABSTRACT AND KEYWORDS

Long instrumental climate records are the basis of climate research. However, these series are usually affected by inhomogeneities (artificial shifts), due to changes in the measurement conditions (relocations, instrumentation and others). As the artificial shifts often have the same magnitude as the climate signal, such as long-term variations, trends or cycles, a direct analysis of the raw data series can lead to wrong conclusions about climate change. In order to deal with this crucial problem many statistical homogenisation procedures have been developed for detection and correction of these inhomogeneities. At present only a limited number of publications intercompare some common methods and their impact on the climate record. The large number of different methods could be seen as a weakness in the science and is a challenge for the climatological community to address. There is therefore a need for a coordinated European initiative in order to produce standard methods designed to facilitate such comparisons and promote the most efficient methods of homogenisation. The Action's main objective is to achieve a general method for homogenising climate and environmental datasets. The method will be derived from the most adapted statistical procedures for detection and correction of varying parameters at different space and time scales.

Keywords : Homogenisation, Climate Change, Statistics

B. BACKGROUND

Monitoring and analysis of our climate has become more and more important since it has been found that most of the temperature change we have seen over the last fifty years has been induced by the anthropogenic increase of greenhouse gases in the atmosphere (IPCC, 2001). Extreme climatic events continue to affect millions of people around the world and are likely to change in the future.

To study this phenomenon, many long instrumental climate records are available and can provide useful information in climate research. These datasets are essential since they are the basis of the description of the past climate, for detection and attribution of climate change at a regional scale and the validation of climate models which predict our future climate. However the prediction of our climate and the mechanisms that control the evolution of extreme events is still largely not understood and can only be understood with an accurate record of the past climate.

The homogeneity of these long instrumental data series (up to 300 years in some cases) has been studied since there became an interest in describing long-term variations in climate. A homogeneous climate time series is defined as one where variations are caused only by variations in weather and climate (Conrad and Pollack, 1950). But in most cases, these series are altered by changes in the measurement conditions, such as evolution of the instrumentation, relocation of the measurement site, modification of the surroundings, instrumental inaccuracies, poor installation, and observational and calculation rules. In many cases, these changes are not recorded in the archives, which are often incomplete. These modifications manifest themselves as a shift in the mean and/or variance that can be sudden (break point or change point), or gradual. These changes will be called inhomogeneities in the following. Moreover spurious observations are frequent. As the artificial shifts often have the same magnitude as the climate signal, such as long-term variations, trends or cycles, a direct analysis of the raw data series might lead to wrong conclusions about climate evolution. This is clearly stated in a recent WMO publication (Aguilar et *al.*, 2003): "all of these inhomogeneities can bias a time series and lead to misinterpretation of the studied climate. It is important, therefore, to remove the inhomogeneities or at least to determine the error they may cause".

These problems are not anecdotic. During the constitution of the HISTALP precipitation dataset (Auer *et al.*, 2005), "on average one break could be detected every 23rd year in a series of 136 years in length". 192 precipitation series were studied, and none of them could be considered free of inhomogeneities. For other elements, e.g. sunshine duration the homogeneous subinterval on average even may be shorter (Auer et al., 2006). Della-Marta *et al.* (2004) show that on average, each of the 99 annual temperature records in Australia's high quality dataset required 5 to 6 adjustments throughout the 100 year record. Thus the detection and the correction of these aberrations are absolutely necessary before any reliable climate study can be based on these instrumental series.

A homogenisation method is a procedure that allows the detection and removal of possible effects of artificial changes in the measuring conditions. Good reviews of such methods can be found in Peterson *et al.* (1998) and in the proceedings of the homogeneity seminars held in Budapest by the Hungarian Met. Office with support of the WMO (Hungarian Meteorological service, 1997,2001,2003).

The problem at hand is tackled in two steps, detection of the inhomogeneities and correction of the series. Several methods have been developed for the homogenisation of climate data. Most of these rely on the "relative homogeneity principle" (Conrad and Pollack, 1950): since a climate signal is mostly undetermined and non-stationary, it has to be removed as far as possible to reveal outliers or changes in measurement conditions. The principle of detection of inhomogeneities is based on the assumption that the comparison by means of a difference (or ratio for cumulative parameters such as rainfall or sunshine duration) between the data at the tested station and a reference series, usually assumed to be homogeneous, is fairly constant in time, up to the inhomogeneity to be detected. The detection procedures rely on a variety of methods, from visual inspection of the series to objective statistical procedures, such as Student's test, likelihood ratio test, Bayesian procedures, non-parametric rank tests, non-parametric kernel smoothers, penalised likelihood procedures, CART algorithms, etc. A detailed review of these procedures is provided in the "history of the proposal".

Once detection is performed, correction factors are estimated, again by means of various methods, usually relying on a computed reference series (supposed homogeneous). Here again, a comparison of the impacts of various correction methods has never been achieved. Another problem is the so-called urban effect when studying temperature series. The effect of urbanization of the surroundings of the observatories has to be investigated further, since greenhouse skeptics continue to argue that a significant portion of the observed warming is only an urban effect (Hansen *et al.* 2000).

Regarding that most methods are intended for the treatment of annual to monthly time series, correcting *daily* datasets is a very difficult – but necessary – task: the most dramatic climate impacts on human societies are caused by extreme events. To study these, high quality *daily* data are required, for computation of various indices (see ECA&D project's web site, http://eca.knmi.nl/, for a various collection of climate indices) or calculation of return levels. The most promising methods seem to rely on the characterization of changes of the entire distribution function based on overlap data between observing systems (Trewin and Trevitt 1996, Della-Marta and Wanner, 2006). But the development of such approaches is recent, and needs to be supported further.

The large number of different methods used in the homogenisation of climate datasets could be seen as a weakness in the science and is a challenge for the climatological community to address. Many methods exist, from many authors who have applied them to many kinds of datasets. There is therefore a need for a coordinated European initiative in order to produce standard methods designed to facilitate such comparisons and promote the most efficient methods of homogenisation. Thus the motivations for such an Action are:

- Homogenisation methods will always be needed and used for a wide range of climate research and for assessing climate change.
- There is no common method to create a reference series. It is undesirable that so many different procedures are available.
- There is a need for developing criteria for comparing homogenisation procedures.
- Practical homogenisation guidance is required.

The aim of the intercomparison of existing homogenisation procedures is to provide objective criteria for choosing a standard homogenisation method, so that in the future homogenised data from various datasets can be compared directly with more confidence.

But besides the statistical problems this COST action will allow experienced climatologists and young scientists to share valuable scientific results, so that the general rules of homogenisation and their applicability are documented. Many practical problems still remain:

- How correlated must data series be to ensure that the relative homogeneity principle can be used? The very high number of undisturbed series found in some studies is sometimes due to poor correlation of the series!
- Should precipitation series be corrected on a monthly, seasonal or annual basis?
- How can the problem of close (in time) change-points be handled?
- What should be done when the interpretation of metadata and the results of statistical detection procedures do not match?

Those results will be valuably transferred to other EU funded projects using observed climate records: ECA&D (http://eca.knmi.nl/), ENSEMBLES, FORALPS, or other proposed projects such as CIRCE (work package 1) and MACE (work packages 4 and 5). There are also links with WMO efforts like ETCCDI (Expert Team on Climate Change Detection and Indices), DARE (Data Rescue) or CLIPS.

By improving the reliability of daily data, the Action will have a more accurate description of European climate variability. This will allow the scientific community to better understand current and future climate extremes. Many of these extremes are associated with hazardous situations and they have significant impacts on many socio-economic issues and activities, such as health, agriculture, forest management, energy production, offshore activities, coastal and port management, energy use, tourism, civil protection/insurance and many others.There is also a great need of reliable data for model calibration and validation purposes: climate models, but also satellite estimates, phenological models (see COST 725), forest models, calibration of proxy data models (tree rings, isotopic models…) and other environmental models.

Since many European institutions and even individual scientists have developed their own homogenisation methods, COST is an ideal platform for the exchange of experiences, harmonisation of approaches and the development of joint methods. COST is the most appropriate mechanism for the achievement of the objectives, and finally this COST Action aims at increasing the use of homogenisation methods in Europe.

C. OBJECTIVES AND BENEFITS

C.1 Objectives

The main objective of the Action is to achieve a general method for homogenising climate and environmental datasets. The method will be an improved synthesis of the most effective statistical procedures for detection and correction of Essential Climate Variables at different space and time scales.

The main objective will be accomplished through fulfilling the following secondary objectives:

- Provide practical rules for the implementation of homogenisation.
- Provide tools for comparison and evaluation of different methods.
- Analyse the strengths and weaknesses of the methods for different applications.
- Provide methods for evaluating uncertainties resulting from homogenisation.
- Provide an evaluation of specific artificial changes, such as the impact of urban effect on temperature series for example.

This will be applicable to commonly observed datasets (temperature, precipitation, air-pressure, vapour-pressure, sunshine duration…) as well as upper-air observations (radiosonde data), data provided by numerical weather forecast models, reanalysis data and climate proxy data.

C.2 Benefits

The release of the resulting homogenisation method will enable a degree of standardisation of homogenisation procedures in Europe. Users who have based their applications on the recommended method(s) could refer to the thorough tests performed in this Action; also the results of climate studies based on homogenised series could be easily compared and crosschecked with studies using the same method. It is expected that in many cases it would no longer be necessary for scientists to develop their own homogenisation method. On the other hand, the availability of the results of this Action could stimulate further research on detection and correction methods, and allow climatologists to investigate methods used in other fields, thus contributing to improvements in the methods.

In summary the Action will provide a standard reference method for detection and correction and will constitute a significant advance in daily data homogenisation and statistical methods.

All this will result in an increased confidence in European (and global) assessments of mean and extreme Climate Change.

D. SCIENTIFIC PROGRAMME

The scientific programme consists of the following activities:

- Inventory of existing detection and correction methods;
- Compilation of a benchmark dataset to be used across the Action;
- Selection, comparison and evaluation of existing detection methods (including those not traditionally used in the climate field);
- Selection, comparison and evaluation of existing correction methods;
- Documentation of practical recommendations;
- Selection, comparison and evaluation of existing correction methods for daily data;
- Presentation and release of the new common method.

D.1. Inventory of existing homogenisation methods and benchmark dataset preparation

During the first phase, an inventory of homogenisation methods and their practical applications will be realized. The detection procedure might be classified in likelihood ratio tests, penalized likelihood, bayesian procedures or others. Non-parametric procedures will consist in rank statistics, local contrast statistics, local linear smoothing. The degree of subjectivity of each technique will be assessed. Special emphasis will be given to detection procedures used in other research fields (for example: econometrics, chemistry, biology) that might be of interest for climate applications.

Methods for constitution of reference series will be listed (e.g. weighted averages, interpolation methods). Correction methods will be separated in reference-based methods and methods that do not require reference series. The applications of each method will be listed: type of parameter (instrumental, upper-air, additive, cumulative).

The results of this inventory will be compiled in a report that includes the properties mentioned above and suitable applications. Such an overview will be a good orientation for developers and users of homogenisation methods.

In parallel the benchmark dataset to be employed for the testing of the selected methods will be set up. Homogenisation is all about data correctness. A very important step is the selection of the dataset to which the different homogenisation procedures will be submitted and, therefore, evaluated. First, a set of random simulated series will be designed and computed. These series will be used to test the statistical properties of the detection procedures (see D.3). Surrogate data generation techniques will also be used. Second, participants will be requested to provide real series with complete metadata (as far as possible), for case studies covering the most used meteorological variables (for example: temperature, precipitation, pressure, sunshine duration).

Tasks:

1- Survey groups or individuals using homogenisation techniques. List currently used techniques together with their strengths and weaknesses. This will be achieved through a questionnaire; and personal contact with recognised experts, an evaluation of results will be presented.
2- Comprehensively search the literature: climate Journals, grey literature and Proceedings, non-climate sources.
3- Classification of the methods according to: statistical nature (parametric, non-parametric, etc…), data requirements (direct, absolute, relative), time scope (annual, monthly, daily).
4- Compilation of the Benchmark Dataset: catalogue of expected inhomogeneity situations, list of suitable real datasets, selection of real datasets, creation of simulated time series reproducing expected problems.

5- Submission to the consortium of a report listing the procedures to be tested: detection methods, reference series methods, correction methods, daily data methods. Release of the Benchmark Dataset.

D.2. Comparison and evaluation of existing detection methods

An objective experiment design will be conceived. The existing detection procedures will be submitted to a benchmark that will test their statistical properties (level, power, robustness).

The significance level of the procedures is the probability of false detection.

The power of a procedure is defined as the probability of detecting true inhomogeneities. Studying the power of the procedures is a challenging task, since many parameters have an influence: amplitude of the inhomogeneities, but also position in the series, configuration, close change-points, etc. Special emphasis will be put on the detection of multiple inhomogeneities.

Robustness: statistical procedures usually rely on statistical assumptions. The robustness is the ability of a procedure to perform well even when some of the required assumptions are not fulfilled. For example, many procedures rely on the normality assumption of the comparison series, what happens when the real distribution is skewed? The following properties will be investigated: robustness to non-normality, robustness to non-independence, robustness to outliers.

Practical cases defined in D.2 will be used to verify the performances of the detection procedures on real datasets. The main problem is to determine whether reference series of multiple comparisons give equivalent results.

Tasks:

6 Creation of software to test the different methods: adaptation of existing software, creation of new software if necessary, implementation of evaluation tools (statistical or graphical).
7 Test runs over the benchmark-dataset: real series, simulated time series.
8 Evaluation of test results: performance over real Series (comparison with metadata, spatial coherency), performance over simulated time series (in terms of level, power, robustness). Ranking of the detection methods: partial rankings (accounting for different Climate Variables, network densities, etc), overall ranking.
9 Redaction of practical recommendations for detection.
10 Dissemination of the results: uploading to website, scientific paper in refereed journal.

D.3 Comparison and evaluation of correction methods for annual to monthly data

An objective experiment design will be conceived. The existing correction procedures will be submitted to the benchmark dataset designed in D.1 to test their ability to correct various inhomogeneities. Simulated and real datasets will be used to inter-compare the different correction methods.

The uncertainties resulting from homogenisation methods will be evaluated, as well as their impact on climate trend calculation.

The impact of homogenisation on spatial variability of the series will be studied. The impact of urban effect will be analysed as well. Two questions may arise: how does homogenisation affect the urban effect in a series, and how does urban effect influence homogenisation?

Tasks:

11 Selection of software to produce reference series: adaptation of existing software, creation of new software, selection/creation of evaluation tools.
12 Generation of reference series over the benchmark dataset
13 Application of correction procedures
14 Evaluation and ranking of correction procedures.
15 Redaction of practical recommendations for correction.
16 Dissemination of the results: uploading to the website, scientific paper in refereed journal.

D.4 Methods for homogenisation of daily data.

As indicated in the previous sections, daily data – due to the special difficulties involved on its treatment – will require a dedicated activity, which will perform specific activities to benefit from existing research to derive a new homogenisation method.

Tasks:

17 Evaluation of the results of D.1: selection of methods to be considered.
18 Considerations over detection methods: should any detection be performed using daily data?
19 Creation of software to test the different methods: adaptation of existing software, creation of new software, selection/creation of evaluation tools (statistical, graphical).
20 Testing over the Benchmark Dataset of existing correction methods/strategies: interpolation of monthly factors, distribution-oriented methods, approaches based on two-phase regression.
21 Development of a new correction method: evaluation of tests results, determination of strengths and weaknesses of the existing methods, theoretical definition of the new method, implementation: software suite, handbooks, testing, debugging, etc.
22 Dissemination of the new method: upload to the Action's web site the software suite and handbooks, scientific paper in refereed journal, dissemination in meetings, preparation of pre-formatted seminars for future dissemination.

D.5 Presentation and release of the new common method

According to the results of D.2, D.3 and D.4, a selection of recommended procedures will be made. It is probable that each procedure has its advantages and disadvantages, and these may also depend on the type of environmental variable assessed. Therefore the most useful features of various methods might be combined into a new and more effective Method. This COST action, bringing together trained climatologists and statisticians will result in fruitful discussion on how statistical procedures should be performed, and respond to practical questions such as: which minimum correlation (or distance) between the series has to be attained for an efficient homogenisation? Shall the Action trust metadata or statistics? Can the Action homogenise monthly rainfall? Can the Action homogenise an element between fixed limits such as cloudiness? Can the Action handle parameters such as number of rainy days?

The selected procedures will be implemented by providing the computer programs and a manual based on the results of activities D.2 and D.3 will be released. The final version will be released to the public according to the Dissemination Plan.

Tasks:

23 Method determination: evaluation of the results and practical recommendations derived from previous work (D.2, D.3), recommended method(s) description.
24 Creation of a software suite: programming, testing, documentation.

25 Evaluation of the Method: intensive testing with Benchmark and additional dataset.
26 Dissemination of the New Method: upload to the Action's web Site the software suite and handbooks, scientific Paper in a refereed journal.

D.6 Comments

The Action is conscious of the fact that the COST Committee provides funding for coordination and missions only.

But the Action feels that releasing only recommendations would be useless to a large extent, if corresponding computer programs are not provided. This is why the Action proposes to develop software within the Action. Software development will be required essentially for coding the final recommended Method, since testing the numerous various procedures will be realized mainly by participants using their own software – that is one reason why coordination through COST is so important.

E. ORGANISATION

E.1 Working Groups

A dedicated preparatory phase will be implemented during the first year and will help to identify and prioritise the various activities and needs in different European countries. During this first phase, WG 1 will be established and provide first an inventory of homogenisation methods and their practical applications, and define in parallel the Benchmark Dataset (tasks 1 to 5). Much of the compilation work will be conducted using participants' networks, open literature, internet, e-mail and questionnaires.

When those tasks are completed, WG1 will disband and be followed by the constitution of four Working Groups:

- WG2 will study statistical properties of the detection procedures listed in the WG1 report and test the procedures on the Benchmark Datasets released by WG1 (tasks 6 to 10).

- WG3 will compare procedures for reference series constitution, correction methods and study the impacts and uncertainties of homogenisation, according to the procedures listed in the WG1 report and the Benchmark Dataset released by WG1 (tasks 11 to 16).

- WG4 will evaluate existing and emerging procedures for daily data processing according to the procedures listed in the WG1 report and the Benchmark Dataset released by WG1 (tasks 17 to 20).

A synthesis provided by experts involved in WG2 and 3 will allow the new common Method to be defined. WG5 will provide the practical implementation of the new method and the redaction of practical recommendations (tasks 21 to 26). The Method will be released to the public by providing the computer programs and a manual based on the results of WG5 according to the Dissemination Plan. The final version will be presented and released to the public according to the Dissemination Plan. The Method for daily values will be implemented in WG4, rather independently from WG2, 3, 4.

E.2 Interactions between Working Groups

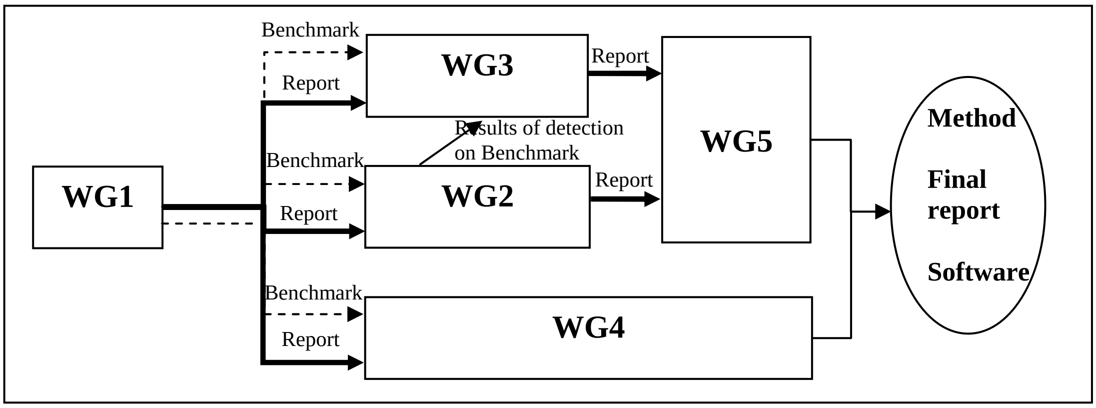

Figure 1: Main interactions between WGs of "*AD HOC*" Action

E.3 Interactions with other projects

Interactions with related projects (e.g. FORALPS, CIRCE, MACE, GCOS AOPC/OOPC, ENSEMBLES, GPCP, ACRE, MED CLIVAR) will be established. For example, Work package 1 of CIRCE and work package 4 of MACE plan to deliver high quality environmental datasets and would really profit by this COST Action. This will be coordinated by inviting experts from these projects to the workshops of this Action or by sending scientists of this Action to workshops of other projects whenever possible.

It is to be emphasized that several scientists interested by this COST Action will participate to those projects. For example, the Action plans to include raw datasets produced by CIRCE, EMULATE or FORALPS in the Benchmark Dataset.

Short Term Scientific Missions (STSMs) and other relevant instruments will be actively used for building networks and coordinating the efforts for achieving and disseminating the expected results.

E.4 Workshops organization, Short Term Scientific Missions

Four workshops will be held within the Action according to the Timetable (Section F), during which the Working Groups will present their results and discuss them with scientists not involved in the Action. Individual publications, oral and poster presentations at suitable conferences (mainly in Europe), and short-term scientific missions (as far as necessary and possible) will be undertaken.

- Kick off meeting: project Overview, Working Groups Creation, start of Activities: first WG1 meeting.
- Workshop-1: submission to the consortium of the Benchmark Dataset and the list of methods to be tested. Discussion of activities of Year-2 for WG2, 3 and 4.
- Workshop-2: intensive discussion about detection and correction methods leading to the definitive adoption of the Action's recommended Method, discussion of activities for Year-3, start of WG5.
- Workshop-3: intensive Evaluation of the Action Method, intensive evaluation of the Action daily data Method, discussion about activities for the 4th year.
- Final Meeting: evaluation of results, evaluation of dissemination actions, final report preparation.

Short Term Scientific Missions (STSMs) and other relevant instruments will be actively used for building networks and coordinating the efforts for achieving and disseminating the expected results. For example, very few scientists (no more than four) are involved in Europe in the development of methods for daily values, and STSMs will be privileged within WG4.

A website for this Action will be established as soon as possible after the first MC-meeting. It will be used for communication within the Action, the presentation of the scientific background and the results and to promote the Action to various scientific and user communities.

F. TIMETABLE

The overall duration of the Action is four years. A period of four years is required because of the inter-comparisons of the various methods for different parameters at different time scales and in multi-disciplinary applications is a major undertaking since:

- The preparation of the datasets (both practical and simulated time series) for many applications is time consuming and needs to be jointly performed by various institutions.
- For additional validation a number of climate series with metadata have to be prepared.
- After the programming and testing, results of the new selected method(s) need to be distributed to the user community for final evaluation.
- Many of the activities in this field are scattered and of diverse nature, being undertaken at various NHMSs, Research Centres and Universities in Europe.
-

A kick off meeting will be organized for a detailed planning and organization purposes. Workshops with invited experts will be held each year of the Action, and a final workshop will be organised to agree on conclusions for the final report with external experts.

The overall time plan for the main phases will be as follows:

- Phase 1: Planning, operational arrangements, establishment of WG1 and inventory activities (year 1).
- Phase 2: Main scientific work to be conducted by WG2, 3 and 4 (years 2, 3, 4).
- Phase 3: Final testing and recommendations with emphasis on reports and final publications (year 4, WG4 and 5).

The planned time table along with an indication of the tasks to be fulfilled is given in figure 2.

(i) Year	WG1	WG2	WG3	WG4	WG5
1	START: KICK OFF MEETING.				
	1,2,3,4 5				
	WORKSHOP				
2		6,7,8	11,12,13,14	17,18 19,20	
	WORKSHOP				
3		6,7,8 9,10	11,12,13,14 15,16	19,20 21,22	23,24
	(ii) WORKSHOP				
4				21,22	23,24,25,26
	FINAL MEETING				
	FINAL REPORT. END				

Figure 2: planned time table and WG tasks for "*AD HOC*" Action

During the first year, the Management Committee will supervise the establishment of WGs based on a survey of methods, applications and activities to be considered within the Action.

The participants would specify their contribution and goals through the Expression of Commitment scheme developed by the Technical Committee. Five WGs (including one inventory WG) will be established broadly developing the research areas described in Section D. It is to be noticed that WG1 should last only during Year 1.

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: Austria (ZAMG, IMG), Bulgaria (NMIH), Croatia (DHMZ), Czech Republic (CHMI, University of Brno), Finland (FMI), France (MF), Germany (DWD, University of Bonn), Hungary (HMS), Ireland (Met Èireann), Italy (CNR, Milan University), Netherlands (KNMI), Norway (DNMI), Slovenia (EARS), Switzerland (METEOSWISS, University of Bern), Spain (University of Rovira I Virgili, University of Zaragoza), United Kingdom (Met office, CRU). Portugal (IM), Poland (IMWM), Romania (NMA), Serbia (RHMZ Srbije) also showed recently an interest for this action.

According to these involvements and other expressed interests for the Action, it is expected that 16 COST member countries would participate in this Action.

On the basis of national estimates provided by the representatives of these countries the economic dimension of the activities to be carried out under the Action has been estimated, in 2006 prices, at roughly 6 million Euros.

This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

The results of the Action are of specific interest especially to climatologists and environmental researchers.

Homogenisation has also an influence on specific financial markets, since weather derivatives frequently rely on homogenised data (or data that should be homogenised).

The dissemination phase is crucial, and will be performed by:

- a mailing list. Already created, this list is used to inform the potential participants of the Action (costh@meteo.fr). 57 subscribers have already registered.

- A web-site continuously updated during the Action including reports on the progress of the Action and selected results. The Action is waiting for the COST Committee final decision to buy a domain name, such as “homogenisation.org”.

- Scientific conferences, proceedings and individual publications in scientific journals.

- The language used for the software development is still to be discussed within the Action, but it will have to be freely available. For example, the “R” language is widely used by statisticians and its use is developing in the environmental community. It offers great capabilities for statistical computing and graphics and is freely available on WINDOWS, LINUX or UNIX. SCILAB, a free version of MATLAB could also be a good choice.

- Information will be provided to the World Meteorological Organisation (WMO) concerning the availability of the tools developed by the Action in order to achieve a global impact.

- Training sessions will be organized. The “Ecole Nationale de la Météorologie” in Toulouse (France) already organizes a training session on homogenisation every year, for Météo-France staff and foreign participants (from Morocco and Libya recently).

After the end of the Action, the website will become static, and will allow free access to the information (final report) and the software developed during the Action.

Special emphasis will be put to knowledge transfer to non-member states by means of training sessions.