COST Office

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Proposal for a new COST Action

COST 733

Harmonisation and Applications of Weather Types Classifications for European Regions

Proposers: Ernst DITTMANN
Deutscher Wetterdienst
P.O.Box 100465
D-63004 Offenbach, Germany
Tel +49 69 8062 2938
Fax +49 69 8062 2993
email : ernst.dittmann@dwd.de

Peter BISSOLLI
Deutscher Wetterdienst
P.O.Box 100465
D-63004 Offenbach, Germany
Tel +49 69 8062 2936
Fax +49 69 8062 2993
email : peter.bissolli@dwd.de

COST National Coordinator: Ms. Ruth Badeberg
PT-DLR
Südstr.125
53175 Bonn
GERMANY
Tel:+49 228 3821357
Fax:+49 228 3821357
ruth.badeberg@dlr.de

TC Meteorology Rapporteur: to be nominated

DRAFT

MEMORANDUM OF UNDERSTANDING

for the implementation of a European Concerted Research Action designated as

COST 733

"HARMONISATION AND APPLICATIONS OF WEATHER TYPES CLASSIFICATIONS FOR EUROPEAN REGIONS"

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 400/01 "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 numerical method for assessing, comparing and classifying typical weather situations in the European regions.

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 € 10 million in 2004 prices.

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

5. The Memorandum of Understanding will remain in force for a period of 5 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 Chapter 6 of the document referred to in Point 1 above.

Technical Annex

COST 733

"HARMONISATION AND APPLICATIONS OF WEATHER TYPES CLASSIFICATIONS FOR EUROPEAN REGIONS"

A. BACKGROUND

Concise descriptions of the actual atmospheric conditions are necessary for many environmental applications. A weather type classification is an algorithmic method which distinguishes between meteorological situations describing them by circulation parameters (e.g. zonality, cyclonality, position of low and high pressure systems etc.) or by local weather elements such as temperature or precipitation. Circulation parameters are often preferred (e.g. Yarnal et al. 2001) since such parameters can be used very easily to relate certain features of the atmospheric circulation with local weather by statistical methods.

Many weather type classifications, covering different scales of space and time, have been used through the years in Europe. Most of them were designed for special applications e.g.:

- storms,
- periods of intense rainfall,
- heat waves and droughts,
- cold spells,
- continuous fog/ low visibility,
- reduced air quality/ surface inversions,
- biometeorological factors (e.g. allergenic risks).

The wide range of applications in climatology, biometeorology, atmospheric physics and chemistry is reflected in various recent publications (see attached list of references).

Weather type classifications for European regions began to be established more than a half century ago (e.g., Baur et al., 1944), some of which have been derived from records over many years. One of the longest series is based on the H.H. Lamb's (1972) method, consisting of daily circulation patterns over the British Isles since 1861. Another one is the daily 'Grosswetterlagen' of Hess & Brezowsky (1952), reprocessed in a 5th edition by Gerstengarbe and Werner (1999), starting from 1881 until today. These classifications were set up as manual subjective classifications.

With the advent of numerical weather analyses, weather type classifications could be based on the automatic evaluation of grid point values (e.g. Groll, 1976; Bénichou, 1985). Some of the weather type classifications have become routine applications, e.g. the objective weather types classification of the German Meteorological Service (Bissolli and Dittmann, 2001).

In the light of the debate on climate change and its impact on ecosystems, weather types classifications gained interest, because a changing circulation structure could be one of the keys for understanding the

changing climate. Recently, S.C. Sheridan (2002) wrote in his paper:

"Synoptic weather-typing, or the classification of weather conditions or patterns into categories, continues to be popular, and numerous methods have been developed over the past century. The recent increased interest in the procedure is attributed to its utility in solving a wide array of applied climatological problems. Concern over the impacts of weather, especially for the purpose of understanding possible implications of climate change, has driven the search for more, and better, weather-typing schemes."

Weather types are indeed used to describe and understand the physical links between atmospheric circulation modes, synoptic features, and surface weather at various scales. Relationships between circulation classification schemes and surface weather variables are used for the downscaling (i.e., transfer to smaller scales) of climate model results.

Appropriate weather types classifications for downscaling have been investigated during the project ACCORD (Atmospheric Circulation Classification and Regional Downscaling; Jones et al., 2000), funded by the European Commission as part of the Environment and Climate Programme of the 4th RTD Framework Programme (1997-1999). ACCORD was followed by another EU project named STARDEX (Statistical and Regional Dynamical Downscaling of Extremes for European Regions, 2002-2005; see http://www.cru.uea.ac.uk/projects/mps for more details), which focuses in particular on an intercomparison of downscaling methods describing scenarios of extreme events. The STARDEX project will end in 2005 and so that this Action will build on its results.

Weather types classifications are also often used in describing and mapping climatic and phenological characteristics. Therefore, links will be established to COST Actions 719 and 725. Long-lived fog episodes as well as icing on structures are often related to specific weather types; consequently, liaisons with COST Actions 722 and 727 will be of mutual interest.

The large number of different methods applied for classification of weather types implies open challenges to the meteorological-climatological communities. Most weather types classifications are:

- adapted to a specific region, and not necessarily easily transferable to another region.
- focused on a specific (environmental) problem, and the spatial and temporal scale are adapted to this purpose.

For these reasons, there is some difficulty in comparing and evaluating the various weather types classifications *per se* as well as the applications using these classifications. There is therefore a need for a coordinated European initiative in order to produce one or a few standard methods designed to facilitate such comparisons. Thus the motivations for such an Action are:

- weather types classifications are still needed and used for a wide range of applications,
- it is undesirable that so many different weather types classifications are available,
- there is no common reference weather types classification for European regions,
- there is a need for developing criteria for comparing weather types classifications.

A common database for the comparison and testing of weather types classifications is necessary. Numerical reanalyses, such as the ERA 40 global data set of ECMWF (European Centre for Medium-Range Weather Forecasts), provide long series of gridded data of consistently assimilated meteorological elements and thus would meet this need.

The aim of the intercomparison of existing classification schemes is to produce a few new schemes of more general applicability. The new method(s) will be open for use by the geosciences community, especially workers in synoptic meteorology, climatology and environmental applications. The method(s) could serve as a kind of standard for future applications, possibly based on an official recommendation of the WMO.

Thus, this COST Action aims at increasing the use of weather types classifications in Europe. A list of possible new applications of the selected method(s) will also be provided to stimulate further application projects on a European level (e.g. STARDEX). On the other hand, the latter can benefit from them by exchange of experiences and the cross-checking of results.

Since many European institutions and even individual scientists have developed their own weather types classification, COST is an ideal platform for the exchange of experiences, harmonisation of approach and the development of joint methods. Additionally, existing networks between National Hydro-Meteorological Services (NHMSs) will foster the activities of this Action in the COST domain of 'Meteorology' and bring coherence to what currently amounts to fragmented national activities. COST is the most appropriate mechanism for the achievement of the objectives.

B. OBJECTIVES AND BENEFITS

B.1 OBJECTIVES

The main objective of the Action is to achieve a general numerical method for assessing, comparing and classifying typical weather situations in European regions. The method will have the following features:

- scalable to any European (sub)region with time scales between 12 h and 3 days and spatial scales of ca. 200 to 2000 km,
- applicable for:
  - . frequency analysis of extreme weather events,
  - . local climate assessment (e.g. fog/snow cover/sunshine duration),
  - . human biometeorology and impacts on ecosystems,
  - . climate monitoring,
  - . assessment of impaired air quality episodes,
  - . medium range weather forecast and climate characteristics of the forecast period (e.g. by mapping of climate parameters related to historic weather types and application to the forecast meteorological situations),
  - . verification of numerical weather forecast models (by checking the forecast weather types),

Secondary objectives are.

- to enhance our knowledge on linkages between the atmospheric circulation, weather, climate, and environmental variables,
- to have an up-to-date overview of existing weather types classification methods,
- to identify suitable criteria/indicators to weather types,

- to identify a set of useful applications of weather types classifications,
- to analyse the strengths and weaknesses of the methods for different applications,
- to establish a (new) scientific cooperation forum in synoptic climatology in Europe,
- to provide tools for comparison and evaluation of different weather types classifications,
- to assess different methodologies for the comparison of weather types classifications.

B.2 BENEFITS

The free release of the resulting classification methods will enable a degree of standardisation of weather type based investigations within Europe. Users who based their applications on one of these recommended methods could refer to the thorough tests performed in this Action; also the results of an application could be easily compared and cross-checked with other applications using the same method.

It is expected that in many cases it would no longer be necessary for scientists to develop their own classification. On the other hand, the availability of the results of this Action could stimulate further research on weather types classifications, thus contributing to a better understanding of the role of the atmospheric circulation in climate change. In summary the Action will

- provide a standard reference classification of weather types,
- reduce the need for the development of individual classifications,
- stimulate further weather types based research leading to better understanding of the relationship between weather situations and response variables

C. SCIENTIFIC PROGRAMME

The scientific programme consists of the following activities:

1. Inventory of existing methods and applications of weather types classifications,
2. Identification of the requirements of applications of weather types classifications,
3. Selection, comparison and evaluation of existing classification methods. For this purpose the recently completed ERA40 data set will be used as it provides a homogeneous test bed for such an evaluation and also a data set of sufficient duration for intercomparison,
4. Design of new weather types classification(s) that can be applied to any region (of a given scale) in Europe for as many purposes as possible, by combining and/or correcting certain features of existing methods,
5. Identification of new methodologies/methods for comparing and assessing weather types classifications,
6. Programming, testing, presentation and release of the new harmonised weather types classification methods.

C.1 Inventory of existing methods and applications

An inventory of existing weather types classification methods and their applications will be carried out through a review of the literature, web pages, project reports and other documentation. The methods will be classified by:

- the type of the method (manual/automatic, subjective/objective, physical/statistical, computation method),
- the atmospheric scale in space and time (local, synoptic, planetary),
- the input data set (surface pressure, geopotential, temperature, humidity, circulation quantities),
- the indicators/features used for characterising the different weather types classification methods,
- the number of discriminated weather types,
- specific limitations (scale, special applications, special area, special weather conditions etc.),
- an heuristic assessment of strengths and weaknesses based on the previous experience of developers and users,
- their implementation as an operational method.

The results of this inventory will be compiled in a report that includes the classification, the properties mentioned above, the topic of application (e.g. downscaling, forecasting, urban air pollution etc.), the application itself and (if possible) an assessment of the usefulness of the weather types classification for this application. Such an overview will also be a good orientation for developers and users of weather types classifications.

Based on a better knowledge of the different methods, one main development will be to identify new or potential domains of applications for such methods. Investigations, which have not used any weather types classifications so far, will be improved by taking such classifications into account. The inventory of such potential applications could be done e.g. on the basis of a literature review, a questionnaire, and the personal scientific expertise of the participants of this Action.

C.2 Identification of the requirements of applications of weather types classifications

The inventory performed in C1 will collect the applications of weather types classifications. The Action will set guidelines for using weather types classifications for different applications and provide information on their various advantages and disadvantages as well as on the limitations inherent in each method for each application. These various aspects are not always known, as some methods are highly empirical.

In this framework, the specific requirements of the applications have to be identified as they will largely determine the design of the new classifications.

C.3 Selection, comparison and evaluation of different methods

After the requirements of each method have been identified, a limited number of classifications will be selected for intercomparison. Only those classifications, which satisfy the main objectives mentioned in Section B should be chosen. Objective and automatic classifications will be preferred since a numerical computation is required for the intercomparison. The classification should in principle be applicable to any region in Europe. The time scale is suggested to be in the range of 12h – 3 days, since the synoptic scale (change of air masses, often related with changes of ground-level weather) is expected to be of particular importance for most applications. In most cases, the synoptic scale is covered by an area of

up to 1.000 km x 1.000 km.

The number of weather types should be large enough to provide the distinctions required by applications, but also small enough to lead to significant results in statistical analyses. The weather types should be easy to interpret. Finally, it is clearly desirable that there are as few limitations as possible on the area, time scales and the variety of weather conditions to which they can usefully be applied.

All selected methods must be transferable to a standard grid point data set in order to have the same data basis for any intercomparison. There is the opportunity to exploit the reanalysis data set ERA40 of the European Centre for Medium Range Weather Forecast (ECMWF). This data set consists of numerical analyses covering more than 40 years, all carried out with the same model at the same spatial resolution. Thus, it is a consistent data set with a sufficiently long period of record for test purposes.

The various classification results will be compared both in a qualitative and quantitative way. For this purpose comparison measures will be defined. The results of the comparison will be assessed with respect to the main objective mentioned in Section B. The numerical comparison might be iterated, if necessary, after adjustments of the classification (e.g. integrating some types into one type, changing the classification criteria, etc.).

C.4 Design of a new weather types classification

It is expected that none of the selected methods will be clearly superior to the other methods. Instead, it is more likely that each method has its advantages and disadvantages, and these may also depend on the type of application. Therefore the most useful features of various methods will be combined into new and more effective classifications. It might also be possible that two or three alternative methods are finally selected for different regions in Europe (e.g., one each for northern, central and southern Europe), but the number of finally selected classifications should be minimised. Depending on the results of the intercomparisons and assessments in C3, the Action may recommend developing new methods for specific applications.

C.5 Realisation, testing, presentation and release of the new common method

The new method(s) selected will be realised by providing the computer programme(s) for gridded data set like the ERA40. The overall performance of the method(s) itself (themselves) will be tested, and also their performance in some of the applications identified in C1.

The final version will be presented and released to the public according to the Dissemination Plan (Section G).

D. ORGANISATION

A dedicated preparatory phase through a broad inventory will be implemented during the first year and will help to identify and prioritise the various activities and needs in different European countries. Much of the compilation work will be conducted using participants' networks, open literature, internet, e-mail and questionnaires. This will be followed by three focussed Working Groups (WG). 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 + first half of year 2);
- 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 5).

During the first year, the Management Committee (MC) 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 for Meteorology. Four WGs (including one inventory WG) will be established broadly developing the research areas described in Section C:

Working Group 1: Existing methods and applications

During the first phase, WG1 will be established and divided into 3 subgroups (A), (B) and (C):

- WG 1A: Inventory of weather types classifications,
- WG 1B: Identification of requirements of the various applications,
- WG 1C: Selection of classification methods and of applications to be used in this Action.

There will be an intense exchange of information between these 3 subgroups during the first phase.

After the inventory phase, the experts from the three subgroups will join WG 2, 3 and 4.

Working Group 2: Implementation and development of weather types classification methods

- Computation of time series of weather type data using the selected methods of WG1C and a defined basic data set (e.g. ERA40) for different European regions,
- Selection of the features from the different selected methods to be combined in a new common method (based on results of WG1 and the recommendations from WG3 and WG4),
- Conception and development of the new method,
- Programming of the new method,
- Computation of time series of the new method in different European regions using the same data set,
- Corrections and updates of the new method (after exchange of results with WG3 and 4),
- Presentation and release of the weather types classification data to the other WGs and the interested scientific community.

Working Group 3: Comparison of selected weather types classifications

- Find or devise statistical tools for an intercomparison of weather types classification methods,
- Statistical comparison/evaluation of available weather type data including the data provided by WG2,
- Assessment of the statistical results,
- Presentation and release of results to the other WGs and the interested scientific community,
- Recommend specifications for a new (common) method (interaction with WG2).

Working Group 4: Testing methods for various applications

- Selection of dedicated applications (using results from WG1),
- Collection/development of application software,
- Performance of the selected applications using available weather type data including those provided by WG2,
- Comparison of the application results with results of former methods,
- Final assessment of the results and uncertainties,
- Presentation and release of results to the other WGs and the interested scientific community.
- Recommend specifications for a new (common) method → WG2

WG2, 3 and 4 start immediately after the inventory phase.

Three workshops will be held within the Action according to the Timetable (Section E) at 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.

Interactions with related projects (e.g. STARDEX, ENSEMBLE, EMULATE) and other COST Actions (719, 722, 725, 727) will be established. This could 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. 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.

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.

E. TIMETABLE

The overall duration of the Action is 5 years. A period of 5 years is required because the intercomparisons of the various methods over different regions, a range of space and time scales and in multi-disciplinary applications is a major undertaking since:

- The preparation of the time series for many applications is time-consuming and needs to be jointly performed by various institutions.
- After the programming and testing, results of the new selected method(s) need to be distributed to

the user community for final evaluation.

- For the formulation of the recommendations input will be gathered from a large multidisciplinary community.
- Many of the activities in this field are scattered and of diverse nature, being undertaken at various NHMSs, research centres and universities in Europe.

Workshops with invited experts will be held after the 1st and the 3rd year of the Action, and a final workshop will be organised to agree on conclusions for the final report with external experts and scientists.

Year	WGIA-C	WG2	WG3	WG4
1	**START, Kickoff meeting**			
	Workshop			
2				
3				
	Workshop			
4				
5				
	Final workshop			
	Final Report			
	End			

F. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest:

Austria	Czech Republic	Estonia	Finland	France	Germany
Greece	Hungary	Italy	Latvia	Lithuania	Norway
Poland	Serbia and Montenegro	Slovenia	Spain	Switzerland	United Kingdom

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 2004 prices, at

roughly Euro 10 million.

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.

G. DISSEMINATION PLAN

The results of the Action are of specific interest especially to synoptic meteorologists, climatologists and environmental researchers. Dissemination of the results will be performed by:

- A web-site continuously updated during the Action including reports on the progress of the Action and selected results,
- Scientific conferences, proceedings and individual publications in scientific journals,
- Providing information to the World Meteorological Organisation (WMO) concerning the availability of the tools developed by the Action in order to achieve a global impact.

After the end of the Action, a static website will permit free access to the information and the software developed during the Action.

COST 733

"HARMONISATION AND APPLICATIONS OF WEATHER TYPES CLASIFICATIONSD FOR EUROPEAN REGIONS"

ADDITIONAL INFORMATION
NOT PART OF THE MOU

History of the proposal: While presenting DWD's method (P. Bissolli, E. Dittmann, 2001) at several scientific conferences, e.g. at ECAM 03 in Rome, interest shown by participants from different countries stimulated the idea for a new COST Action on the harmonisation of weather types classifications; this was first proposed to the COST TC Meteorology at the TC-meeting in Exeter, November 2003. The proposal has been further elaborated at DWD and was distributed to potential participants for discussion. Updated versions of the proposal were presented to the COST TC Meteorology in Langen (April 2004) and Nice (September 2004). The current version of the MoU was prepared during an expert meeting in Langen, 16-17 November 2004.

Proposers:

Ernst DITTMANN
Deutscher Wetterdienst
P.O.Box 100465
D-63004 Offenbach, Germany
Tel +49 69 8062 2938
Fax +49 69 8062 2993 email : ernst.dittmann@dwd.de

Peter BISSOLLI
Deutscher Wetterdienst
P.O.Box 100465
D-63004 Offenbach, Germany
Tel +49 69 8062 2936
Fax +49 69 8062 2993 email : peter.bissolli@dwd.de

List of experts, who have contributed during the drafting of this MoU:

Sylvain JOFFRE
Finnish Meteorological Institute
P.O.Box 503
FIN-00101 Helsinki, Finland
Tel +358 9 19292250
Fax +358 9 19294103 email sylvain.joffre@fmi.fi

Denis L. FITZGERALD
Met Eireann
Glasnevin Hill
Dublin 9, Ireland
Tel +353 1 806 4204
Fax +353 1 806 4247 email denis.fitzgerald@met.ie

Massimo CAPALDO
Centro Nazionale di Meteorologia e Climatologia Aeronautica
Aeroporto di Pratica di Mare
I-00040 Pomezia (RM), Italy
Tel +39 06 91292012
Fax +39 06 91140009 email m.capaldo@meteoam.it

Zbigniew USTRNUL
Institute of Meteorology and Water Management
P. Borowego 14
PL-30215 Krakow, Poland
Tel +48 12 4251900
Fax +48 12 4251929 email zbigniew.ustrnul@imgw.pl

Sylvie JOURDAIN
Météo France, Direction de la Climatologie
42 avenue Coriolis
F-31057 Toulouse Cedex, France
Tel +33 5 61 07 83 84
Fax +33 5 61 07 83 09 email sylvie.jourdain@meteo.fr

Ole Einar TVEITO
Norwegian Meteorological Institute
P.O.Box 43 Blindern, N-0313 Oslo
Norway
Tel +47 22 963260
Fax +47 22 963050 email ole.einar.tveito@met.no

Massimiliano PASQUI
IBIMET-CNR
Via Giovanni Caproni 8
I-50145 Firenze, Italy
Tel +39 055301422
Fax +39 055308910 email m.pasqui@ibimet.cnr.it

Preliminary list of experts interested in this Action:

Ernest RUDEL

Zentralanstalt für Meteorologie und Geodynamik
Hohe Warte 38
A-1190 Vienna, Austria
Tel +43 1 36026 2201
Fax +43 1 36026 72 email ernest.rudel@zamg.ac.at

Radan HUTH
Institute of Atmospheric Physics
Bocni II 1401
CZ-14131 Prag 4, Czech Republic
Tel +420 2 2191 1111
Fax +420 2 2191 1292 email huth@ufa.cas.cz

Jaak JAAGUS
University of Tartu, Institute of Geography
Vanemuise 46
EE-51014 Tartu, Estonia
Tel +372 737 5818
Fax +372 737 5825 email jjaagus@ut.ee

Piia POST
University of Tartu, Institute of Geography
Vanemuise 46
EE-51014 Tartu, Estonia
Tel +372 737 5816
Fax +372 737 5825 email piia@ut.ee

Merike MERILAIN
Estonian Meteorological and Hydrological Institute
Rävala 8
EE-0001 Tallinn, Estonia
Tel +372 646 1563
Fax +372 645 4277 email merike@emhi.ee

Raino HEINO
Finnish Meteorological Institute
P.O.Box 503
FIN-00101 Helsinki, Finland
Tel +358 91 9292 200
Fax +358 91 9292 203 email raino.heino@fmi.fi

Hilppa MYLLYS
P.O.Box 503
Finnish Meteorological Institute
FIN-00101 Helsinki, Finland
Tel +358 91 9292 200

Fax +358 91 9292 203 email hilppa.myllys@fmi.fi

Guy PLAUT
Institut Non Linéaire de Nice du CNRS
1361, route des Lucioles
F-06560 Valbonne, France
Tel +33 4 92 96 73 10
Fax +33 4 93 65 25 17 email guy.plaut@inln.cnrs.fr

Constanta BORONEANT
Institut Non Linéaire de Nice du CNRS
1361, route des Lucioles
F-06560 Valbonne, France
Tel +33 4 92 96 73 10
Fax +33 4 93 65 25 17 email constanta-emilia.boroneant@inln.cnrs.fr

Charles OBLED
Institut National Polytechnique de Grenoble
LTHE BP 53
F-38041 Grenoble Cedex 9, France
Tel +33 4 76 82 50 53
Fax +33 4 76 82 52 86 email charles.obled@hmg.inpg.fr

Sylvie JOURDAIN
Météo France, Direction de la Climatologie
42 avenue Coriolis
F-31057 Toulouse Cedex, France
Tel +33 5 61 07 83 84
Fax +33 5 61 07 83 09 email sylvie.jourdain@meteo.fr

Wolfgang ENKE
Meteo Research
Waltraudstr. 20
D-14532 Stahnsdorf/Kienwerder, Germany
Tel +49 30 838 71134
Fax +49 30 859 939095 email meteo-research@t-online.de

Thomas DEUTSCHLÄNDER
Meteo Research
Waltraudstr. 20
D-14532 Stahnsdorf/Kienwerder, Germany
Tel +49 30 838 71134
Fax +49 30 859 939095 email meteo-research@t-online.de

Friedrich Wilhelm GERSTENGARBE
Potsdam Institute for Climate Impact Research

Telegrafenberg
P.O. Box 601203
D-14412 Potsdam, Germany
Tel +49 331 288 2586
Fax +49 331 288 2510 email gerstengarbe@pik-potsdam.de

Peter WERNER
Potsdam Institute for Climate Impact Research
Telegrafenberg
P.O. Box 601203
D-14412 Potsdam, Germany
Tel +49 331 288 2587
Fax +49 331 288 2510 email werner@pik-potsdam.de

Jucundus JACOBEIT
University of Augsburg, Institute of Geography
Universitätsstraße 10
D-86135 Augsburg, Germany
Tel +49 821 598 2662
Fax +49 821 598 2264 email jucundus.jacobeit@geo.uni-augsburg.de

András BARDOSSY
University of Stuttgart, Institute for Water Engineering
Pfaffenwaldring 61
D-70550 Stuttgart, Germany
Tel +49 711 685 4663
Fax +49 711 685 4681 email andras.bardossy@iws.uni-stuttgart.de

Panagiotis MAHERAS
Aristotle University of Thessaloniki
Department of Meteorology and Climatology, School of Geology
GR-54124 Thessaloniki, Greece
Tel +30 2310 99 8471
Fax +30 2310 99 5392 email maheras@geo.auth.gr

Judit BARTHOLY
Eotvos Lorand University
Department of Meteorology
P.O. Box 32
H-1518 Budapest, Hungary
Tel +36 1372 2945
Fax +36 1372 2904 email bari@ludens.elte.hu

Sandor SZALAI

Hungarian Meteorological Service
P.O. Box 38
H-1525 Budapest, Hungary
Tel +36 1346 4660
Fax +36 1346 4669 email szalai@met.hu

Giampiero MARACCHI
IATA-CNR
Piazzale delle Cascine 18
I-50144 Firenze, Italy
Tel +39 05 535 4895
Fax +39 05 535 0833 email maracchi@sunserver.iata.fi.cnr.it

Massimiliano PASQUI
IBIMET-CNR
Via Giovanni Caproni 8,
I-50145 Firenze, Italy
Tel +39 05 530 1422
Fax +39 05 530 8910 email m.pasqui@ibimet.cnr.it

Teodoro LA ROCCA
CNMCA
Aeroporto "M. de Bernardi" di Pratica di Mare
Via Pratica di Mare
I-00040 Pratica di Mare (Roma), Italy
Tel +39 06 9129 2012
Fax +39 06 9129 2457 email t.larocca@meteoam.it

Luca ONORATO
ARPAL-CMIRL (Met. Centre of Liguria Region)
Piazza della Vittoria 15/c
I-16121 Genova, Italy
Tel +39 01 057633268
Fax +39 01 057633260 email luca.onorato@arpal.org

Lita LIZUMA
Latvian Hydrometeorological Agency
165, Maskavas Str.
LV-1019 Riga, Latvia
Tel +371 714 4390
Fax +371 714 5154 email lita.lizuma@meteo.lv

Arunas BUKANTIS
Vilnius University, Department of Hydrology and Climatology
M.K. Ciurlionio 21/27
LT-03101 Vilnius, Lithuania
Tel +370 5 239 8292
Fax +370 5 239 8292 email arunas.bukantis@gf.vu.lt

John Bjørnar BREMNES
Norwegian Meteorological Institute, Research and Development Division
P.O.Box 43 Blindern
N-0313 Oslo, Norway
Tel + 47 22 96 30 00
Fax + 47 22 96 30 50 email john.bjoernar.bremnes@met.no

Eirik FØRLAND
Norwegian Meteorological Institute, Climatological Division
P.O.Box 43 Blindern
N-0313 Oslo, Norway
Tel + 47 22 96 30 00
Fax + 47 22 96 30 50 email e.forland@met.no

Inger HANSSEN-BAUER
Norwegian Meteorological Institute, Climatological Division
P.O.Box 43 Blindern
N-0313 Oslo, Norway
Tel + 47 22 96 30 00
Fax + 47 22 96 30 50 email i.hanssen-bauer@met.no

Ole Einar TVEITO
Norwegian Meteorological Institute, Climatological Division
P.O.Box 43 Blindern
N-0313 Oslo, Norway
Tel + 47 22 96 30 00
Fax + 47 22 96 30 50 email ole.einar.tveito@met.no

Tadeusz NIEDZWIEDZ
University of Silesia, Faculty of Earth Sciences
Bedzinska 60
PL-41200 Sosnowiec, Poland
Tel +48 32 291 8381
Fax +48 32 291 5865 email niedzwie@ultra.cto.us.edu.pl

Zbigniew USTRNUL

University of Silesia, Institute of Meteorology and Water Management
P. Borowego 14
PL-30215 Krakow, Poland
Tel +48 12 4251900
Fax +48 12 4251929 email zbigniew.ustrnul@imgw.pl

Nedeljko TODOROVIC
Republic Hydrometeorological Service of Serbia
Kneza Viseslava 66, P.O. Box 37
SCG-11030 Belgrade, Serbia and Montenegro
Tel + 381 11 35 37 864
Fax + 381 11 54 53 78 email todor52@yahoo.com

Mojca DOLINAR
Environmental Agency of the Republic of Slovenia
Vojkova 1 b
SLO-1001 Ljubljana, Slovenia
Tel + 386 1 478 4000
Fax + 386 1 478 4054 email mojca.dolinar@rzs-hm.si

Maria Jesus CASADO CALLE
Instituto Nacional de Meteorologia
Leonardo Prieto Castro 8
E-28040 Madrid, Spain
Tel + 34 91 581 98 82
Fax + 34 91 581 98 45 email mjcasado@inm.es

Pere ESTEBAN
University of Barcelona, Group of Climatology
Av. Diagonal 645
E-08028 Barcelona, Spain
Tel +34 402 15 60
Fax +34 411 09 69 email pere_esteban@hotmail.com

Maria Asuncion PASTOR SAAVEDRA
Instituto Nacional de Meteorologia
Leonardo Prieto Castro 8
E-28040 Madrid, Spain
Tel + 34 91 581 98 82
Fax + 34 91 581 98 45 email a.pastor@inm.es

Walter KIRCHHOFER

Meteo Swiss
Krähbühlstraße 58
CH-8044 Zürich, Switzerland
Tel +41 1 256 9355
Fax +41 1 256 9278 email Walter.Kirchhofer@meteoswiss.ch

Claire GOODESS
Climate Research Unit
University of East Anglia
Norwich NR4 7TJD, United Kingdom
Tel +44 1603 592875
Fax +44 1603 507784 email c.goodess@uea.ac.uk

Andrew HARDING
Climate Research Unit
University of East Anglia
Norwich NR4 7TJD, United Kingdom
Tel +44 1603 593161
Fax +44 1603 507784 email andrew.harding@uea.ac.uk

Francisco DOBLAS-REYES
ECMWF
Shinfield Park
Reading, Berkshire RG2 9AX, United Kingdom
Tel + 44 118 949 9000
Fax + 44 118 986 9450 email f.doblas-reyes@ecmwf.int

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