ACCORD

ATMOSPHERIC CIRCULATION CLASSIFICATION

AND REGIONAL DOWNSCALING

ENV-4-CT97-0530

Minutes of the final progress meeting

29-30 October 1999

Aristotelian University of Thessaloniki, Greece

SUMMARY OF AGREED ACTION POINTS

- UEA will send out reminders about when and how to submit the final cost statements.

- All groups should submit their final reports to UEA by the end of November, following the guidelines on the web (**http://www.cru.uea.ac.uk/cru/projects/accord/thessal.htm**). *(Please ensure that your report fully covers all work completed during the two year project period.)*

- All groups should reread the project objectives before producing their final report. Particular attention should be paid to writing the concluding section stressing the achievements and scientific advances that have been made and how these relate to the original objectives. When submitting their final report, all groups are asked to tell UEA what are the most important points (relating to their own and other people's work) that should be brought out in the project summary.

- UEA will set up a ftp directory in November, into which groups should copy their report files (ideally these should be in Office 97 format). (*This has been done. The ftp server is* **ftp.cru.uea.ac.uk**, *log in as an anonymous user using your email address as a password, change to the directory /incoming/accord. Please email Clare Goodess with the names of the files you have left in the directory and try to use self-explanatory names, e.g. ueafinal.doc, ueafig1.ps)*

- UEA will edit the reports into a single volume, write a summary, and produce hard copies of the final report for distribution to Brussels (by the end of January 2000 at the latest), and to participants and other people who have attended the project meetings.

- The deadline for preparation of the nine papers for submission to *Climate Research* is the end of February 2000. UEA will circulate details of how to submit these papers and will also arrange for them to be internally reviewed for consistency and cross-references.

- UEA will maintain the project web site for at least a year after the end of the project. The final report will be made available on the web site and the list of publications arising from the project will be updated. It is, therefore, essential that people let UEA know when papers are submitted or published.

MINUTES OF THE FINAL ACCORD PROGRESS MEETING

DEPARTMENT OF METEOROLOGY AND CLIMATOLOGY,

ARISTOTELIAN UNIVERSITY OF THESSALONIKI, 29-30 OCTOBER 1999

LIST OF PARTICIPANTS (see Appendix 1)

AGENDA (see Appendix 2)

All groups were asked to bring copies of the first draft of their final report to the meeting. These were circulated to participants and contain full details of the completed work. Thus these minutes focus on the discussion following each presentation.

No.	Acronym	Partner
01	UEA	Climatic Research Unit, University of East Anglia, UK
02	DMI	Danish Meteorological Institute, Denmark
03	ARPA-SMR	Servizio Meteorologico Regionale, ARPA-Emilia Romagna, Italy
04	CNRS	Laboratoire de Météorologie Dynamique, Centre National de la Recherche Scientifique, France
05	IWS	Institut für Wasserbau, Universität Stuttgart, Germany
06	FTS	Fachhochschule für Technik, Stuttgart, Germany
07	U.BERN	Geographisches Institut, University of Berne, Switzerland
08	UD	University of Derby, UK
09	UT	University of Thessaloniki, Greece
10	VI	Verdustofan Islands, Icelandic Meteorological Office, Iceland
Subcontractors		
	ETH	Eidgenössische Technische Hochschule, Switzerland
	INLN	Institut Non-Lineaire de Nice, France

INTRODUCTORY SESSION AND GENERAL BUSINESS

Panagiotis Maheras welcomed ACCORD to Thessaloniki. Ted Karakostas (Head of the Department of Meteorology and Climatology) also welcomed people, briefly described the work of the department and hoped that the meeting would be successful.

Apologies were received from the following people who could not attend the meeting: Steve Dorling (UEA), Torben Schmith (DMI) and Evi Schuepbach (UB).

The ACCORD project finishes on 30 November 1999. Participants were reminded that final cost statements will be required within one month after the end of the project. UEA will remind people about when and how to submit these statements.

ACCORD REPORTS, PAPERS AND PUBLICATION LISTS

All participants should send their final reports to UEA by the end of November 1999. An ftp directory will be set up at UEA during November – the electronic report files can then be copied into this directory, avoiding the need to email large files. (*This has been done. The ftp server is* **ftp.cru.uea.ac.uk**, *log in as an anonymous user using your email address as a password, change to the directory /incoming/accord. Please email Clare Goodess with the names of the files you have left in the directory and try to use self-explanatory names, e.g. ueafinal.doc, ueafig1.ps)*

Instructions for preparing the report have already been made available on the ACCORD web site (**http://www.cru.uea.ac.uk/cru/projects/accord/thessal.htm**). Groups are urged to use Word 97 wherever possible. *(Please ensure that your report fully covers all work completed during the two year project period.)*

It is important that the end of November deadline is adhered to, giving time for UEA to edit the reports into a single volume, write the summary and get hard copies made and bound. It is essential that the report is received in Brussels by the end of January 2000 (i.e. two months after the end of the project). Hard copies will be sent to Brussels and to all groups, external experts and other people who have attended the project meetings. It was also agreed to make the final report available on the web site which will be maintained by UEA for a year or so after the end of the project.

At the last ACCORD meeting in Bologna (http://www.cru.uea.ac.uk/cru/projects/accord/bologna.pdf) it was agreed to seek a list of proposed titles/authors of papers to submit to *Climate Research* for publication in a single issue. The following nine papers have been suggested:

1. Bárdossy, A., Stehlík, J. and Caspary, H-J. 'Automated optimal fuzzy rule based circulation pattern classification for precipitation and temperature downscaling'

2. Doctor, M., Plaut, G. and Schuepbach, E. 'Atmospheric circulation associated with heavy precipitation events in the southern Alps in Switzerland and comparison with the Alps in southern France'

3. Dorling, S.R. and Cawley, G.C. 'Reproducing and extending subjective weather typing schemes – development of automated methodologies at the local, regional and hemispheric scales'

4. Jónsson, T. '?????'

5. Maheras, P., Patrikas, I., Karacostas, T. and Anagnostopoulou, C. 'Development of daily rainfall scenarios for Greece using a circulation type approach'

6. Plaut, G. 'Intense precipitation over some Alpine subregions, large scale circulation classification, and downscaling'

7. Quadrelli, R., Lazzeri, M., Cacciamani, C. and Tibaldi, S. 'Observed winter Alpine climatology and links with large scale circulation patterns'

8. Reid, P., Jones, P.D., Brown, O., Goodess, C.M. and Davies, T.D. 'Assessments of the reliability of NCEP circulation data and relationships with surface climate data by direct comparisons with station based temperature and precipitation data'

9. Simonnet, E. and Plaut, G. 'Large scale circulation regimes, MSSA, and local climate over some parts of western Europe'

It was agreed that the authors should aim to complete these papers by the end of February 2000. UEA will check whether it is possible to submit all the papers on behalf of ACCORD, or whether they will have to be submitted individually. In either case, UEA will review the papers for consistency and for cross-references (asking some ACCORD participants to act as

internal reviewers). It is important to adhere to the agreed deadline if all the papers are to be published in the same issue of the journal. It was stressed that this single issue should not preclude people from publishing their ACCORD work in other journals.

UEA will remind people of all the report/paper deadlines. The draft minutes of this meeting will be made available on the web site as soon as possible (by 15 November at the latest).

SCIENCE SESSION 1: NCEP DATA AND THE NAO

- ***How reliable are the NCEP data used in ACCORD?***
- ***How do NAO/surface climate relationships vary in time and space?***

UEA progress report presented by Phil Reid
The UEA work has focused on four areas: evaluation of the NCEP Reanalysis data; comparison with observed daily temperature and precipitation data; the influence of the NAO; and, relationships between surface pressure and precipitation/temperature.

Discussion
The decision to compare NAO/climate correlations over the two sub-periods of 1901-1940 and 1959-1997 was fairly arbitrary, though it was noted that running 10-year correlations were also calculated. After about 1940, the NAO correlations tend to be higher than before. We don't know why the influence of the NAO is weaker in the first part of the century. The weakest correlations occur during the period from about 1910 to 1940. Back in the late 19th century the correlations strengthen again (particularly for temperature). A reduction in the influence of the Southern Oscillation in the tropics is also seen at a similar time (i.e. 1910-1940). The UEA work clearly demonstrates that NAO/surface climate relationships show considerable variation in time and space (see question 2 above).

In respect to the first question above, the UEA work indicates that NCEP SLP data are certainly reliable after 1967. The daily temperature data are as reliable as station data over much of Europe (but this cannot be assumed for other regions). Daily precipitation is less reliable, though over the UK the agreement between NCEP and observed data is better than might be expected (there was, however, some debate about this statement given the large differences in rain day amount from box to box). There are highly significant correlations between observed/NCEP precipitation over UK grid boxes and agreement is also reasonable over the Italian grid boxes in winter. In general, the Reanalysis data seem reasonable for frontal precipitation, but less good for convective precipitation.

SCIENCE SESSION 2: FORECASTING/HINDCASTING

- ***How reliable are the forecasts/hindcasts?***
- ***What are the best predictor variables?***
- ***To what extent is non-stationarity a problem?***

UD progress report presented by Rob Wilby
Recent work at UD has focused on the seasonal prediction of UK summer precipitation using North Atlantic SSTs. Daily precipitation occurrence, but not amount, is shown to be

significantly correlated with North Atlantic SST. It is also concluded that there is a difference between statistical and practical significance for forecasting purposes.

Discussion
In response to a question about whether it is possible to derive spatial indicators of the precipitation parameters, Rob said that some of this work had been presented at the Bologna meeting and that there are coherent regions and signals. He stressed the importance of the long memory from SSTs for forecasting purposes. He had looked at wavelets in the precipitation time series and found a few periods with significant oscillations, but these don't persist throughout the record. This will affect the correlation skill over time.

DMI progress report presented by Bennert Machenhauer on behalf of Torben Schmith
The DMI work has focused on the hindcasting of winter precipitation from winter mean circulation and from daily flow indices. Trends in the winter precipitation residuals are due to synoptic activity (i.e. each cyclone) being 'more efficient' and cannot be accounted for by spurious trends in precipitation measurements.

Discussion
It was considered that the results for UK stations (showing an increase in precipitation during winter) are consistent with those obtained by Rob Wilby showing trends towards more rain on wet days in the UK.

It was suggested that the precipitation gauge corrections could be affected by changes in wind speed. It should be possible to explore this using the WASA data set, though it would probably be necessary to look at wind speed on wet days only because mean wind speed hasn't changed much. The reliability of the lower tropospheric humidity measurements used for the gauge corrections was queried. It was suggested that these measurements are probably not very reliable on the time scales considered. Vertical profiles could be examined using Reanalysis data. It was noted that there are plans to re-assimilate the Reanalysis data with respect to this problem. The time series are not, however, long enough to investigate longer term trends. It was noted that there are a few long vapour pressure (2 m) records, for the UK for example, obtained from wet/dry bulb thermometer readings. These records could be examined for trends, but there may be homogeneity problems. Any increase in vapour pressure could simply be because it is getting warmer, but this would still be of interest.

VI progress report presented by Trausti Jónsson
Work at VI (IMO) has focused on: the production and analysis of a daily long-term (1823-1999) pressure data set from Iceland; construction and analysis of a circulation catalogue using Hovmøller circulation parameters; and, investigation of links between these two data sets and Icelandic temperature and sea ice anomalies.

Discussion
Trausti argued that the strong seasonality in SLP (with low values during November-January) lies at the heart of the NAO and needs to be considered in NAO analyses. He noted that the SLP anomalies define slightly different seasons to usual and that the impact of sea ice on Iceland temperatures also needs to be considered. It was suggested that it would be interesting to see whether the SLP seasonal cycle is different in high/low sea ice years.

SCIENCE SESSION 3: LINEAR VS NON-LINEAR VS FUZZY RULE METHODS OF CIRCULATION CLASSIFICATION

- ***Do linear or non-linear or fuzzy rule methods work better?***
- ***Does the "best method" vary with region/classification scheme?***
- ***Can an optimal number of circulation patterns be identified?***

UEA progress report presented by Gavin Cawley
The UEA work has focused on the statistical classification of atmospheric circulation patterns (Lamb weather types, Grosswetterlagen and Dzerdzeevski) using simple linear and more powerful non-linear techniques. For the work undertaken to date on Lamb weather types and Grosswetterlagen, the generalized linear model (GLM) appears to work best. The effects of prior class probability must be considered when assessing the results.

Discussion
Gavin noted that one approach which could be taken when redoing the classifications using upper and lower air data would be to perform a PCA on the three levels (having first normalised the variance of each). This would take advantage of the correlations between the different levels.

He reported that he had tried to produce the Grosswetterlagen classification from the Dzerdzeevski scheme, i.e. to explore relationships between different spatial scales: the very broad picture was obtained but not the detail (i.e. not the correlations on a day-to-day basis).

It was noted that the success of the statistical classifiers is based on how well they reproduce subjective schemes, but there are questions concerning the consistency of the subjective schemes. The Lamb weather types obtained from the statistical classifiers have not been compared with the Jenkinson and Collison classification, but Gavin thought that the GLM seems to produce the original Lamb catalogue better than the Jenkinson and Collison method can.

One observation per day was used for the UEA work, whereas four observations were originally used in the subjective schemes. Gavin noted that they had tried using observations for the preceding n-days. Using observations for the previous 2-3 days does help somewhat with the Lamb weather types.

IWS/FTS progress report presented by Jiri Stehlík, Hans Caspary and Andras Bárdossy
The work by IWS and FTS has focused on temperature and precipitation based optimisation of a stochastic downscaling model which has been developed and tested in Germany and Greece. Work has also focused on evaluating the dependencies of circulation pattern classifications (i.e. are they really the same or different but not independent?) using contingency tables and measures of dependence/independence. Station data for 27 European stations have been used and larger and smaller pressure windows. The results show that using a European classification, rather than the specific classifications for Germany and Greece, seems to make little difference – in each case surface climate patterns which are very different from mean values are obtained for each circulation pattern.

General discussion on Science Session 3
With respect to the third question above, it was concluded that the optimal number of circulation patterns for temperature and precipitation is 12 for Germany and Greece. For

Greece, the same 12 patterns are obtained for temperature and precipitation, whereas different patterns are applicable to temperature and precipitation in Germany.

It is difficult to answer the first question above because no directly comparable results are available. However, the UEA work indicates that linear methods may be somewhat better than non-linear methods for reproducing subjective classification schemes, but not necessarily for downscaling applications.

THE FUTURE
A discussion of how the ACCORD work might be developed in future proposals/projects was led by Trevor Davies. The minutes of this part of the meeting have been distributed to participants by email.

SCIENCE SESSION 4: ALPINE STUDIES

- ***How consistent are the results obtained by the different groups?***
- ***To what extent can regional differences be identified?***
- ***What approaches are most suitable for the study of extreme events?***

ARPA-SMR progress report presented by Marco Lazzeri
Recent work at ARPA-SMR has focused on: investigation of statistical links between precipitation and large-scale circulation indices (e.g. NAO and blocking index); cluster analysis of Alpine precipitation in the PC phase space in order to identify clusters (using the ANAXV software); development of a simple statistical model to downscale Alpine precipitation (using the closest cluster composites); and, improvements in the algorithm for constructing an objective Mediterranean cyclone index. The work on precipitation clusters and their 500 hPa height composites (an example of bottom-up classification) indicates that the best number of PCs to retain is 2 and that the best number of clusters is 3 (based on parameters such as the classifiability index and the Anomaly Correlation Coefficient).

Discussion
It was suggested that the reason for pronounced model biases over the southern Alps in the results from the downscaling model may be related to different station densities in the precipitation data set.

UB progress report presented by Marut Doctor
Recent work at UB has focused on: the identification of circulation clusters (defined using 700 hPa height anomalies (Z')) in the southern Alps in Switzerland; correlations with intense (> 40 mm) and very intense (> 60 mm) precipitation events; and, comparison with clusters/relationships obtained by Guy Plaut in the Alpes Maritimes. A draft paper for submission to *Climate Research* (Doctor, M., Plaut, G. and Schuepbach, E., 'Atmospheric circulation associated with heavy precipitation events in the southern Alps in Switzerland and comparison with the Alps in southeastern France') was circulated. Three clusters have been identified: GASC (Greenland high, which is most important for intense/very intense events), Quadrapole and Ireland Low. The Z' composites are very similar to those obtained for the Alpes Maritimes, as are the circulation-precipitation relationships. However, only a very small increase in the precipitation amount of intense events is observed in the southern Alps, compared with the larger trends in the Alpes Maritimes.

Discussion
In response to a question, Marut explained that the clustering was not stratified by season. In the Ticino region of southern Switzerland, each cluster has a similar frequency in all months, though this is not so for the Alpes Maritimes.

ETH progress report presented by Christoph Frei
The original objective of ETH in ACCORD was to provide a data set of high-resolution (25 km) precipitation analyses for the European Alps. This has been done, through the Mesoscale Alpine Program, and the data have been used by ARPA-SMR, UB and INLN for their ACCORD work.

At the previous ACCORD meeting in Bologna, the potential difficulties in using trend analysis when dealing with extreme events was raised. Christoph has recently written a paper on this topic (Frei, C. and Schär, C., 'Detection probability of trends in rare events: theory and application to heavy precipitation in the Alpine region', *Journal of Climate*, submitted) and presented the major results to the meeting. The major conclusions from this work are: that logistic regression is an appropriate method for the analysis of trends of rare events; that being not significant does not necessarily mean that there is no trend; intense precipitation has increased in Switzerland in autumn and winter; and, trend detectability can be improved by clustering.

Discussion
It was suggested that the precipitation trends in autumn and winter could reflect a snowfall/rainfall distribution problem – what would happen if the data were stratified by temperature? In response, Christoph pointed out that the stations with the strongest trends are in the northeast, i.e. low-level stations with very little snowfall in winter and none in autumn.

It was noted that logistic regression is a good technique, but may miss longer fluctuations, would it be possible to develop a multivariate test? It is also important to know about simultaneous occurrences, e.g. across a river basin. The extent to which it is possible to make conclusions about very rare events (e.g. the 365 day event) from less rare but intense events (e.g. the 30 day event) was questioned. It was acknowledged that this is a difficult statistical issue. It is possible to fit a daily distribution, but this still requires extrapolation.

In response to a question as to what atmospheric circulation patterns might be responsible for the observed trends, Christoph cited a paper by Widmann *et al*. which suggests that there has been a general increase in the intensity of precipitation across all classes, rather than changes in the circulation classes themselves.

INLN progress report presented by Guy Plaut
Recent work at INLN has focused on the identification of mid-latitude weather regimes over the Atlantic sector. The most recurrent Large Scale Circulations (LSCs) are identified using cluster analysis and 700 hPa/500 hPa heights and SLP observations for all winter days. Four clusters are identified for Z700 and five for Z500 and SLP. Relationships with intense precipitation events and warm/cold days have been investigated. It is possible to predict extreme temperature events from the weather regimes, but not extreme precipitation (in this case, the clusters obtained by using only data for days with intense precipitation work better, i.e. they are more discriminatory).

Discussion
It would be interesting to know why the discriminatory power of the LSCs is different for temperature and precipitation. It was stressed that similar patterns are obtained for stations as far apart as Paris and Nice for temperature. It was noted that mesoscale patterns are very important for the distribution of precipitation extremes in the Alpine region, so it is surprising to find such large-scale patterns. What would happen if a higher resolution data set was used to define the clusters, e.g. the ECMWF T106 data set? Guy reported that he hadn't tried using different resolution data, but using a smaller window reduced the discriminatory power.

CNRS progress report presented by Eric Simonnet
Recent work at CNRS has focused on the investigation of large-scale circulation classifications and low-frequency oscillations using multiple singular spectrum analysis (MSSA). Intra-seasonal (where 30 and 70 day oscillations in SLP and 35-70 plus 40-day oscillations in Z700 and Z500 are shown to be important) and inter-annual (where 2.5 and 7.5 year oscillations are shown to be important) variability has been investigated. Inter-annual variability in the LSC regimes has also been explored, together with relationships between the phase of low-frequency oscillations and surface temperature/precipitation.

General discussion on Science Session 4
It was concluded that there seems to be some consistency between the results obtained by different groups working on Alpine regions. In relation to the third question above, work by INLN indicates that for precipitation, it is best to composite the extremes by region, whereas for temperature it is probably possible to go straight to the large-scale patterns. It is not, however, clear whether this would apply to other regions. There are questions concerning the way in which precipitation regions are identified. Would it be better to define coherent precipitation regions first, e.g. using PCA? This might give different/better results for precipitation and it might then be possible to go straight to the large-scale patterns. The need to consider the underlying physics, which may be different for temperature and precipitation, was also noted.

INVITED PRESENTATION
"An operational objective weather type classification for central Europe" presented by Ernst Dittmann, DWD, Germany

Introduction
Motivation for the work:

- applied climatology and hydrology:
  - need to summarise similar cases with characteristic diurnal cycles, e.g. inversions
  - simulation of local climates by:
    - hydrostatic or non-hydrostatic models
    - dispersion modelling
    - estimation of maximum precipitation
- an alternative to Grosswetterlagen

Main differences between Grosswetterlagen and the objective classification (OC):
The OC:

- is daily since 1979 (using 12 UTC data)

- is based on operational numerical weather prediction models and hence repeatable for identical data
- is synoptic in scale, focusing on central Europe
- has 40 classes (with no undefined class)
- may be extended, e.g. into the past using Reanalyses data
- can be applied to forecast situations and other applications
- is a multipurpose classification:
  - technical climatology
  - applied hydrology
  - agrometeorology
  - maps for characteristic weather situations
  - climate monitoring
  - potential refinement of classes

Method

- central Europe (France/Germany) 50 km grid (currently 19x22 grid points)
- criteria (all weighted):
  - 5 advection types:
    - 4 cardinal directions (NE, SE, SW, NW), sector with max. wind directions
    - no predominant direction (XX), if less than two thirds of all wind directions are in one sector
  - anticyclonic (A) or cyclonic (C) airflow (depending on whether the Laplace operator of geopotential height is positive or negative) at two levels:
    - near surface (950 hPa)
    - middle troposphere (500 hPa)
  - dry (D) or humid (W) atmosphere based on precipitable water from grid point values up to the tropopause:
    - values < monthly mean = D
    - values > monthly mean = W
- gives 40 classes (XXAAD to NWCCW)

Results

- frequencies, e.g. July 1979-June 1999:
  - 1st 7 largest classes = >50% of all days, so some very low frequency classes
  - low persistence (e.g. ~78% persist for 1 day)
  - can be forecast up to 72 hours in advance
- published in 'Die Grosswetterlagen Europas' since early 1999
- trajectories, e.g. over 3 days for O_3
- trends, e.g. summer 1980-1999 (decline in A and increase in C at 500 hPa)
- climate maps

Future work

- continuation of series
  - adaptation to new numerical weather prediction models
  - extension into the past
- application to other research areas

Discussion
The OC time series for 1979 onwards can be obtained from Ernst (subject to signing an agreement form). It was noted that the IMO has produced day to day classifications (for 27 classes) for operational forecasting up to 5 days ahead.

Ernst said that he didn't know whether the C and A trends are associated with precipitation trends. It was noted that Schonwiese *et al*. have shown strong positive trends in winter precipitation over Germany during the period 1890-1990, and slower positive trends in summer.

When asked why those particular quadrants for direction were chosen, when the main airflow direction is westerly, Ernst explained that these quadrants were chosen because of the interest in temperature advection. Generally there is advection of warmer air in the southern quadrants and colder air in the northern quadrants.

SCIENCE SESSION 5: MEDITERRANEAN STUDIES

- ***How different are the Eastern and Western Mediterranean?***
- ***What can be concluded about rainfall trends and their possible causes?***

UT progress report presented by Panagiotis Maheras and Ioannis Patrikis
The UT work has focused on: the automatic classification of circulation types over Greece; investigation of the frequencies, variability and trends of the circulation types; the prediction of selected episodes of extreme precipitation events using these circulation types; exploration of the relationship between circulation in the eastern Mediterranean and western and central Europe (using Lamb weather types and Grosswetterlagen respectively); and, analysis of Mediterranean cyclones. During the course of the meeting, the objective classification methodology had been applied to the western Mediterranean and preliminary results were presented.

Discussion
The advantages of comparing classification schemes at the same spatial scale (e.g. Lamb weather types and the automated Greek scheme), rather than comparing schemes at different spatial scales (e.g. the automated Greek scheme with a European scheme) was queried. It was noted that correlation coefficients between the different schemes had also been calculated using lags of 1-3 days, but this made no difference to the results.

UEA progress report presented by Clare Goodess
The UEA work has focused on the exploration of relationships between precipitation at 15 Spanish stations and circulation using: a catalogue of 14 circulation types, the NAO index, and gridded SLP/500 hPa height data. The work confirms the need to consider rain day occurrence (generally increasing) and wet day amount (generally decreasing except in southeast Spain) separately. The number of rain days has increased across Spain, across all circulation types, indicating that the observed changes cannot be explained by changes in circulation alone.

Discussion
It was noted that the circulation types were obtained using the Jenkinson and Collison methodology, thus it would be possible to use the direction and vorticity parameters directly

in a continuous scheme rather than using the discrete circulation types. Clare responded that this raised a general question for ACCORD, was it better to use conventional discrete circulation types (Lamb, Grosswetterlagen etc.) as most groups were doing or to try to use more continuous circulation descriptors? It is easier to understand and conceptualise relationships with surface climate using the conventional, discrete, daily circulation classifications. Also, in most weather generators based on continuous circulation descriptors, the flow parameters are usually divided into a number of equal bins and precipitation parameters calculated for each of these bins, introducing an element of somewhat arbitrary division.

SCIENCE SESSION 6: THE ACCORD PROJECT

- ***To what extent have the project objectives been met?***
- ***How has ACCORD advanced the scientific knowledge?***
- ***What are ACCORD's most important findings?***

Comments on the ACCORD project from one of ACCORD's external experts

Bennert Machenhauer said that he was disappointed that, although connections had been made between different classifications and regions, the underlying physics had not been considered. He had hoped to see clustering of types and identification of the physical reasons for this, and investigation of circulation patterns across all of the European/Atlantic region. It was difficult to see the applications of this classification work. It could be used for downscaling, but he had heard little about this (and nothing about applications to climate models), and for forecasting. The classifications had been applied to investigations of trends in surface climate, but this could be done without using circulation classifications. He stressed the need to look more at the underlying physics. Finally, he noted that progress had been made in simulating circulation dynamics and in reducing systematic errors in regional climate models through the MERCURE and POTENTIAL projects.

Discussion

It was noted that when the ACCORD project was originally submitted, the EC had recommended removing the proposed work with GCM output. ACCORD had accepted this advice and the objectives of the approved proposal were focused on the definition of 'objective classifications'. More generally, ACCORD was intended to be climatological rather than impact-orientated. There is a need for more contact between statistical and dynamical modelling groups but this does not appear to have been fully recognised by the EC in Framework IV. There are differences between the dynamic modellers and other groups. The ACCORD objectives reflect a pragmatic climatological approach and it had never been the intention to focus more on physics than on statistics. The importance of end user needs was stressed. Modellers still cannot provide information on the scales that most users urgently need, so there is still a need for statistical downscaling. This is likely to be the case for the next ten years or so. Even with higher resolution models there is, for example, a need for long time series which can only be provided by statistical downscaling. It was acknowledged that there are some areas relating to the stated project aims in which ACCORD could have done more, such as comparing different schemes and scales, though some questions are very difficult to answer: e.g. how many circulation patterns really exist? Finally, it was noted that it may not be possible to improve understanding of the underlying physics without further improvements in modelling.

Closing discussion on the ACCORD project
All groups are urged to reread the ACCORD objectives before producing revised versions of their final report. In the concluding section it is important to bring out what has been achieved and the scientific advances that have been made. It is also essential to stress the relevance to the project objectives. When submitting their final reports, all groups are asked to tell UEA what are the most important points (relating to their own and other people's work) that should be brought out in the project summary which will be written by UEA.

The ACCORD web site will be maintained for at least a year after the end of the project. The final report will be made available on the web site. The list of publications will be updated. It is therefore important that people let Clare Goodess or Phil Jones know when papers are submitted or published.

Finally, the local organisers and hosts (Panagiotis Maheras, Ted Karacostas, Christina Anagnostopoulou, Ioannis Patrikas and colleagues) were thanked for their excellent organisation of the meeting.

Clare Goodess
5 November 1999
Amended 22 November 1999

APPENDIX 1

List of participants in the final ACCORD progress meeting

Christina Anagnostopoulou, UT, Greece
Andras Bárdossy, IWS, Germany
Carlo Cacciamani, ARPA-SMR, Italy
Hans Caspary, FTS, Germany
Gavin Cawley, UEA, UK
Trevor Davies, UEA, UK
Ernst Dittmann, DWD, Germany
Marut Doctor, UB, Switzerland
Christoph Frei, ETH, Switzerland
Clare Goodess, UEA, UK
Phil Jones, UEA, UK
Trausti Jónsson, IMO, Iceland
Ted Karacostas, UT, Greece
Marco Lazzeri, ARPA-SMR, Italy
Bennert Machenhauer, MPI, Germany
Panagiotis Maheras, UT, Greece
Ioannis Patrikas, UT, Greece
Guy Plaut, INLN, France
Phil Reid, UEA, UK
Eric Simonnet, CNRS, France
Jiri Stehlík, IWS, Germany
Rob Wilby, UD, UK

APPENDIX 2

Agenda of the final ACCORD progress meeting

Agenda for the Final ACCORD Meeting

The meeting consisted of six scientific sessions, together with an introductory session and one invited presentation. Time was also allowed for a discussion of how the project partners might work together after ACCORD. Time for discussion was allocated at the end of each presentation and each Science Session. It was proposed that this discussion should focus on the questions listed at the beginning of each session.

Friday 29 October 1999

0900-0930: Introductory session and general business (UEA)
0930-1000: ACCORD reports, papers and publication lists (UEA)

Science Session 1: NCEP data and the NAO
- ***How reliable are the NCEP data used in ACCORD?***
- ***How do NAO/surface climate relationships vary in time and space?***

1000-1020: UEA progress report (Phil Jones and Phil Reid)

Science Session 2: Forecasting/hindcasting
- ***How reliable are the forecasts/hindcasts?***
- ***What are the best predictor variables?***
- ***To what extent is non-stationarity a problem?***

1050-1120: DMI progress report (to be presented by Bennert Machenhauer on behalf of Torben Schmith)
1120-1150: UD progress report (Rob Wilby)
1150-1220: IMO progress report (Trausti Jónsson)
1220-1230: General discussion on Science Session 2

Science Session 3: Linear vs non-linear vs fuzzy rule methods of circulation classification
- ***Do linear or non-linear or fuzzy rule methods work better?***
- ***Does the "best method" vary with region/classification scheme?***
- ***Can an optimal number of circulation patterns be identified?***

1600-1620: UEA progress report (Gavin Cawley)
1620-1650: IWS progress report (Andras Bárdossy and Jiri Stehlík)
1650-1720: FTS progress report (Hans Caspary)
1720-1730: General discussion on Science Session 3

The Future
1800-1900: After ACCORD? (Trevor Davies)

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Science Session 4: Alpine studies

- ***How consistent are the results obtained by the different groups?***
- ***To what extent can regional differences be identified?***
- ***What approaches are most suitable for the study of extreme events?***

0900-0930: ARPA progress report (Carlo Cacciamani and Marco Lazzeri)
0930-1000: UB progress report (Marut Doctor)
1000-1030: ETH progress report (Christoph Frei)

1100-1130: CNRS progress report (Eric Simonnet)
1130-1200: INLN progress report (Guy Plaut)
1200-1210: General discussion on Science Session 4

Invited Presentation

1210-1230: "An operational objective weather type classification for central Europe" (Ernst Dittmann, DWD, Germany)

Science Session 5: Mediterranean studies

- ***How different are the Eastern and Western Mediterranean?***
- ***What can be concluded about rainfall trends and their possible causes?***

1600-1630: UT progress report (Panagiotis Maheras and colleagues)
1630-1650: UEA progress report (Clare Goodess)
1650-1700: General discussion on Science Session 5

Science Session 6: The ACCORD project

- ***To what extent have the project objectives been met?***
- ***How has ACCORD advanced the scientific knowledge?***
- ***What are ACCORD's most important findings?***

1700-1720: Comments on the ACCORD project from the external expert (Bennert Machenhauer)
1720-1730: Identification of key issues for the final discussion

1800-1900: Final discussion on the ACCORD project