

R.D 6323-EN-01

①

Coordination of Mesoscale Meteorological Research
between ASL and European Groups

AD-A233 586

Principal Investigator : Professor R. P. Pearce

Contractor : University of Reading, U.K.

Contract Number : DAJA 45-90-C-0009

THIRD INTERIM REPORT
1st August 1990 - 31st January 1991

Following the Meeting of the European Meteorology Panel at Traben-Trarbach, West Germany, 23rd-27th April 1990, ASL confirmed that the mesoscale model comparison project should go ahead along the lines proposed. Letters were then sent out to five European modelling groups in October inviting their expressions of interest in participating in the project. Some positive responses were received in time for the Panel meeting held at ASL, 3rd-7th December 1990, the report of which is attached. Although responses were not available from U.S. groups at the meeting, it was clear that there would be no difficulty in attracting the interest of the maximum of eight groups which ASL could administer under the project. The meeting therefore drew up a complete plan of action for the project and this is described in detail in the report.

Three other activities were undertaken under the contract during this period:

1. A two-day workshop on the U.S. Army Regional Aerosol Transport Simulation (ARATS) was organised at the Frimley Hall Hotel, Camberley, Surrey, U.K. under the direction of Dr. H. Holt. Extra funding was made available for this workshop and a preliminary report has been submitted to the U.S. Army European Research Office.
2. Support was provided, under the special project heading of the contract, for Dr. C. Jones of the Chemical Defence Establishment, Porton Down, U.K. to visit ASL to carry out dispersion experiments.
3. Professor R.P. Pearce attended the 11th Annual EOSAEL/TWI Conference at ASL, 27th-30th November 1990, and chaired Session IV on Battlefield Scale Models - Tools for solving the problem.

R. P. Pearce

Professor R. P. Pearce
28.01.91

Enc. Report of 18th Meeting of the Mesomet Advisory Panel

USARDCG (UK)

6.1 effort and its linkage to 6.2 is clear. Continued work in this area should be encouraged.

R29. The Panel strongly endorses the IMETS concept with a goal of also incorporating state-of-the-art modelling capabilities, satellite (e.g. TOVS) data and synoptic NWP information.

R30 The Panel urges ASL to consider developing in-house mobile lidar wind and turbulence capability in order to remotely monitor the boundary layer structure over distances of tens of kilometers. Such a capability would provide effective nowcasting and model initialisations as well as effectively compliment existing meteorological monitoring.

R31. The primary evaluation of 6.1 activities should include peer-review publications of ASL investigators and general relevance and linkage to the 6.2 work.

R32. The Panel recommends that ASL provide synoptic-scale analyses and landscape information to the workshop participants, in addition to the WIND data sets. Terrain data on scales larger than the WIND domain are also needed. This information should be in a computer-readable format and well documented.

R33. The Panel recognises the positive contribution that the completion and documentation of the 0900 PST 27 June to 0900 PST 28 June WIND data set will contribute to the ASL mission and to the mesoscale modelling commitment. The Panel strongly urges completion and documentation of the precipitation system (winter) event by July 1, 1991. This is essential for the workshop.

R34. The Panel feels that it would be useful for ASL to carry out a pilot run of the procedures specified for the workshop participants using the Army/Navy model, before these are finalised.

1. INTRODUCTION.

This meeting was called with three purposes, set out by Mr. Morris at the first session:

1. To update the Panel on recent developments at ASL,
2. To plan the Mesomet Modelling Workshop, proposed at the previous(17th) Panel meeting
- and 3. To produce evaluation criteria for the workshop.

The list of attendees is attached as Appendix 1. (apologies for absence were received from Dr. Peter White, Dr. Niels Busch and Dr. Walter Bach, all of whom were prevented from attending because of urgent conflicting commitments.) The agenda, as finally adopted, is attached as Appendix 2.

It was reported that the only Panel-supported event to take place since the last meeting was the ARATS workshop at Camberley, UK, 29-30th October, 1990, organised by Dr. Holt. This was a

successful event, involving 27 participants. The workshop report is being prepared by Dr. Holt and will be distributed to Panel members.

2. DEVELOPMENTS AT ASL SINCE APRIL, 1990.

The Panel were pleased to hear that the Department of Defence had now allocated to ASL responsibility for research and development of boundary-layer meteorology over land. It was assumed that this must necessarily also involve the adjacent oceans round coasts, since sea- and land-breeze effects are often of considerable military significance. The Panel were grateful for the responses to their recommendations made at the previous meeting which they had already received; in particular (R15) that a new Branch Chief was to be appointed to the ARD with mesomet experience as well as management expertise and (R16) that the US Navy model had been adopted by ASL for future development. It was also pleased to learn that every effort was now being made to complete the WIND data base (R23) and that those parts required for the workshop would be available in time for distribution to participants. However the Panel also remains concerned that adequate resources may still not be made available for all the planned 6.1 activities to proceed effectively and this concern is reflected in the following recommendation, which refers also to R18:

R25. The Panel appreciates that laboratories of the DOD are expected to do basic research of their own; complete reliance on outside contractors in basic research is discouraged. We realise that the ASL needs inhouse basic research, but both ASL and the Panel recognise that for a promising basic research programme a "critical mass" is required. The Panel feels that until such time that additional capable, qualified personnel are secured, the interests and needs of the Army are best served by concentrating a great part of the mesometeorological efforts in 6.1 on the frequent testing of an existing mesometeorological model. The research should put the emphasis on improvement of the chosen model, examining its physical bases and improving the physics.

The Panel were much impressed by the determined efforts made over the past six months by the ASL management to coordinate the activities of the 6.1 and 6.2 groups (R21). They feel that these have laid a firm foundation for the basic research program of the 6.1 group not only to provide a continuous input supporting the needs of the 6.2 group, but also to develop new techniques for solving those meteorological problems with which the Army is concerned. Of immediate concern is the development of the US Navy model, and in this connection the following recommendation is made:

R26 The 6.1 group should share the Navy model *in its present form* with the 6.2 group so that they can gain experience working with it, recognising that improvements will subsequently be made.

Further recommendations are made in this general context arising from the up-date presentations made by 6.1 and 6.2 scientists:

R27. The Panel endorses the development of local

meteorological analysis and modelling capabilities using state-of-the-art computing techniques and platforms as recommended by Mr. Meyers.

R28 The Panel concludes that the research on heavy gas dispersion with complex obstacles is a valuable component of the 6.1 effort and its linkage to 6.2 is clear. Continued work in this area should be encouraged.

R29. The Panel strongly endorses the IMETS concept with a goal of also incorporating state-of-the-art modelling capabilities, satellite (e.g. TOVS) data and synoptic NWP information.

R30 The Panel urges ASL to consider developing in-house mobile lidar wind and turbulence capability in order to remotely monitor the boundary layer structure over distances of tens of kilometers. Such a capability would provide effective nowcasting and model initialisations as well as effectively complement existing meteorological monitoring.

R31. The primary evaluation of 6.1 activities should include peer-review publications of ASL investigators and general relevance and linkage to the 6.2 work.

One final point the Panel wishes to make relates to GOPAD and this is included as a comment:

COMMENT. The Panel took notice of the contracting work done under the title of GOPAD. We advise that the present results be peer-reassessed, since the Panel is of the opinion that the selection of predictors is not adequate and work in the past on model output statistics (MOS) and PERFECT PROG has not been taken properly into consideration.

3. PLANS FOR THE 1992 MESOSCALE MODELLING WORKSHOP AT ASL.

Following the Traben-Trabach meeting, ASL agreed formally to go ahead with planning for a mesoscale modelling workshop at ASL in April, 1992 along the general lines proposed at that meeting. The first stage would be to contact modelling groups in the US and Europe asking for expressions of interest. This has already been done for Europe and three groups, the UK Met Office, Dr. Gross's group at Hanover and Dr. Alpert's group at Tel Aviv have written expressing interest in participating. Dr. Gruning of the Riso Laboratory, Denmark has also indicated verbally that they will almost certainly wish to participate; no reply has yet been received from the remaining person contacted, Dr. Andre of CNRM, Toulouse.

The first matter which had to be decided was the size of workshop which could be accommodated at ASL, bearing in mind its demands on space and manpower. It was decided that a limit would have to be set of eight participating groups, three from Europe and five from the U.S. Those to be formally invited in the first instance are

Europe: UK Met Office, Dr. Gross and Riso.

U.S: NCAR/Penn State, NCAR/Arizona (Clark), Yamada,
CSU(RAMS) and Navy/Army (ASL).

The following were agreed as alternates should any of these decline:

Livermore (Leoni), Mascart (France), Bornstein and Nickerson.

The main criterion governing this selection was that as many *different types of state-of the-art models* as possible should be included; also priority was given to non-hydrostatic models in view of their suitability for adaption to modelling smaller- scale phenomena.

Detailed plans for the workshop were then drawn up, essentially based on the framework agreed at Traben-Trarbach. The main new features introduced are the inclusion of a "pilot run" at ASL of the computations to be requested of the participants; and a request to Dr. Alpert to check the accessibility of the WIND data tapes for 27/28 June and estimate the computer time required for the requested runs. Mr. Cionco's efforts in preparing the three tapes and two floppy discs containing this data in time for this meeting were much appreciated. It was also decided to encourage participants to carry out sensitivity tests with their models on a voluntary basis as part of their own model development programmes. They would be invited to present the results at the workshop and write them up for inclusion in the post-workshop proceedings. Pre-workshop proceedings will be prepared by ASL, following consultation with the Panel, using computer results supplied by the participants in a designated format on floppy discs.

It was realised that limiting the number of participants would restrict the value of the workshop to the wider community of mesometeorological modellers. It was therefore agreed that, to offset this, Dr. Pielke would negotiate, on behalf of the Panel, with the American Meteorological Society to publish a monograph (or perhaps more than one) based on the papers presented at the workshop. The results of the sensitivity studies in particular should prove to be of wide interest.

A listing of the tasks to be carried out by the workshop participants, to be included in the formal invitation, was drawn up. This is included in the draft letter attached as Appendix 3. The respective responsibilities of ASL and the Panel were then agreed as follows:

Responsibilities of ASL:

1. Host workshop.
2. Survey U.S. modellers for interest. Identify Prof. Pearce as Panel Chairman and Dr. Pielke as U.S. POC for Panel.
3. Send confirmation letter under Pearce's signature with WIND data, source code (optional) descriptions, commitment to all modellers.
4. Prepare hard copy output from models.
5. Prepare inter-comparison report.
6. Arrange facilities and conference administration.
7. Invite DOD observers (civilian and uniformed) and select individuals (people involved with WIND).

8. ASL review Panel's letter to modellers.
9. Supply elevation feature data and NMC numerical model output for larger synoptic area of California with Phase 1 data by 31 May 1991.
10. Perform pilot run by 1 April 1991.

Responsibilities of Panel:

1. Sponsor and chair workshop.
2. Survey European modellers for interest.
3. Provide WIND data to Alpert (to be sent to him direct from ASL) to test and report results to ASL and Panel prior to distribution of data by ASL to modellers.
4. Send letter of invitation to *all* modellers to include evaluation criteria. Ask for comments, commitment to participate, model description, source code (optional).
5. Distribute funds to European modellers.
6. Organise workshop - agenda, order of speakers, chairmen.
7. Chair workshop and Panel discussion.

These tasks will be carried out according to the timetable attached as Appendix 4.

The following are three recommendations relating to the workshop:

R32. The Panel recommends that ASL provide synoptic-scale analyses and landscape information to the workshop participants, in addition to the WIND data sets. Terrain data on scales larger than the WIND domain are also needed. This information should be in a computer-readable format and well documented.

R33. The Panel recognises the positive contribution that the completion and documentation of the 0900 PST 27 June to 0900 PST 28 June WIND data set will contribute to the ASL mission and to the mesoscale modelling commitment. The Panel strongly urges completion and documentation of the precipitation system (winter) event by July 1, 1991. This is essential for the workshop.

R34. The Panel feels that it would be useful for ASL to carry out a pilot run of the procedures specified for the workshop participants using the Army/Navy model, before these are finalised.

4. WORKSHOP EVALUATION PROCEDURES.

U.S. Army requirements of mesoscale models were set out by Mr. Harris (Appendix 5) and these are incorporated in the choice of outputs listed in the draft letter of invitation to participants (Appendix 3). Assessment of the capabilities of state-of-the-art models to meet these requirements is one of the main purposes of the workshop; others are to determine how existing technology can best be applied to meet the Army's needs and where ASL's basic research can most effectively be directed to contribute to model improvements.

It is to be expected that the various models will exhibit strengths in some aspects and weaknesses in others and none is likely to be superior to the others in all respects. It would not

be appropriate to aim to produce a "league table" of those participating, although a concise table of the strengths and weaknesses of the models in various aspects of their performance, e.g. ability to predict diurnal variations of wind and temperature, radiative fluxes, turbulence, low-level inversions, etc., would be of considerable value, not only to ASL, but also to the whole modelling community. A further aspect of interest to ASL is the adaptability of the various model codes to small computers (e.g. P.C's).

The pre-workshop proceedings will simply contain summaries of the basic results requested on floppy discs, together with a selection of time-series graphs in a format to be determined by consultation between the Panel and ASL (through Mr. Harris). The post-workshop proceedings, also to be produced at ASL, will contain a commentary on these results and, in addition, the papers describing sensitivity studies. This will be edited jointly by Prof. Pearce, Dr. Pielke and Mr. Harris.

4 FUTURE ACTIVITIES OF THE PANEL.

The next meeting of the Panel will take place in Belgium, 9-10 May, 1991 (local arrangements to be made by Prof. Klug). Its main purpose will be to assess reports from ASL and Dr. Alpert on the use of the WIND data, approve the formal invitation letter to be sent to the workshop participants and suggest the most appropriate format for the pre-workshop proceedings. Since this meeting is not included in the Panel contract, additional funds of about 3000 U.S. dollars will be needed to cover the expenses (allowing for some savings from the present meeting at ASL).

The subsequent scheduled meeting of the Panel is in April, 1992 at ASL at the time of the workshop (the precise dates yet to be decided).

APPENDIX 1

LIST OF PARTICIPANTS

1. PANEL MEMBERS

Professor Robert Pearce, University of Reading. UK.
Professor Werner Klug, Technische Hochschule, Darmstadt,
Germany.
Professor Jehuda Neumann, University of Copenhagen, Denmark.
Professor Roger Pielke, C.S.U., Fort Collins, CO.

2. ASL MANAGERS

Mr. Gene Morris, Technical Director.
Dr. James Harris, Acting Chief, Meteorology and Obscuration
Branch.
Dr. Doug Brown, Director, Atmospheric Research Division (ARD)
Dr. Frank Niles, Director, Atmospheric Effects Division (AED)
Dr. Bob Sutherland, Meteorology and Obscuration Branch (ARD)
Dr. Bob Brown, Atmospheric Research Division (ARD)

3. ASL PRESENTERS

Mr. Ron Meyers
Mr. Robert Dumais
Mr. John Elrick
Mr. Robert Northrop
Dr. Teizi Henmi
Mr. Gary McWilliams
Mr. Ron Cionco
Mr. Robert Lee
Mr. Stephen Huntwork
Mr. Robert Flanigan
Dr. Howard Holt

APPENDIX 2

AGENDA

MESOMET ADVISORY PANEL CONFERENCE
HILTON HOTEL, LAS CRUCES
3 - 4 DECEMBER, 1990
U.S. ARMY ATMOSPHERIC SCIENCES LABORATORY
WHITE SANDS MISSILE RANGE, NM
5 - 7 DECEMBER 1990

DAY 1 (MONDAY, 3 DECEMBER 1990)

0900 - 0930	Check In and Introductions	
<u>0930 - 1130:</u>	<u>OPENING SESSION (CHAIR, MR. JAMES E. MORRIS)</u>	
0930 - 0945	Host Briefing and Welcome	Mr. Morris
0945 - 1000	Overview and Objective	Mr. Morris
1000 - 1100	Panel Recommendations from April 30, 1990 Traben Trarbach Conference	Dr. Brown
1100 - 1130	Discussion	ALL
1130 - 1300	LUNCH	
<u>1300 - 1530:</u>	<u>TECHNICAL SESSION 1 (MR. JIM HARRIS)</u>	
1300 - 1400	Portable Tactical Workstation Demonstration at PSL	Mr. Elrick
1400 - 1415	Return to Hilton Hotel	
1415 - 1445	GOPAD Model	Mr. Dumais
1445 - 1515	ARATS Program	Dr. Holt
1515 - 1530	Break	
1530 - 1630	Closed Panel Discussion	Panel Members

DAY 2 (TUESDAY, 4 DECEMBER 1990)

0900 - 1530: TECHNICAL SESSION 2 (CHAIR, Dr. R. A. Pielke)

0900 - 0930	AE Division Overview	Dr. Niles
0930 - 1000	AS Division Overview	Mr. Northrup
1000 - 1030	BREAK	
1030 - 1130	Status of 6.1 Mesoscale Modeling	Mr. Meyers
1130 - 1300	LUNCH	
1300 - 1345	Status of 6.2 Mesoscale Modeling	Dr. Henmi
1345 - 1400	Automated Weather Effects Templating	Mr. McWilliams
1400 - 1430	BREAK	
1430 - 1445	ASL Plans for April 1992 Workshop	Dr. Sutherland
1445 - 1530	Identification of European Models for Evaluation at April 1992 Workshop	Prof. Pearce
	US Models	Dr. Pielke
1530 - 1630	Closed Panel Session	Panel Members

DAY 3 (WEDNESDAY, 5 DECEMBER 1990)

0900 - 1130: TECHNICAL SESSION 2 (CHAIR: DR. R. A. PIELKE)
CONTINUATION

0900 - 1000	Closed Panel Session	Panel
1000 - 1030	BREAK	
1030 - 1130	Workshop to Select Models for Evaluation at April 1992 Workshop	Panel Mr. Morris Dr. Brown Mr. Cionco Dr. Henmi Mr. Harris
1130 - 1230	LUNCH (Sandwiches from NCO Club in 1623 Conference room	
1230 - 1330	IMETS POC/Sea Space Demo bldg 1646	B. Brown S. Huntwork J. Elrick/B. Lee
1300 - 1600:	<u>TECHNICAL SESSION 3 (CHAIR: DR. D. R. BROWN)</u>	
1330 - 1430	Project WIND Data for April 1992 Workshop	Mr. Cionco
1430 - 1500	BREAK	
1500 - 1530	WSMR Meteorological Data Available for Model Evaluation	Dr. Henmi
1530 - 1600	Terrain Elevation Data Available for Model Evaluation	Mr. Flanigan
1600 - 1700	Closed Panel Session	Panel Members
1800 - 1845	Cocktails at Jim & Linda Harris's house (See map)	
1845 - 1900	Travel to La Posta Restaurant	
1900	Dinner at Posta Restaurant Mesilla, New Mexico	

DAY 4 (THURSDAY, 6 DECEMBER 1990)

0900 - 1530: TECHNICAL SESSION 4 (CHAIR: PROFESSOR PEARCE)

0900 - 0930	Evaluation Criteria Used by ASL for Model Evaluation	Mr. Harris
1000 - 1030	BREAK	
1030 - 1130	Evaluation Criteria Proposed by Panel	Panel
1130 - 1300	LUNCH	
1300 - 1330	Workshop to Finalize Plans for April 1992 Workshop to Include Objective, Attendees, and Agenda	Dr. Sutherland
1330 - 1400	Techniques for Model Evaluation	Mr. Meyers
1400 - 1530	Workshop to Develop Objective Evaluation Criteria for April 1992 Workshop	Professor Pearce
1530 - 1630	Closed Panel Session	Panel Members

DAY 5 (FRIDAY, 7 DECEMBER 1990)

0900 - 1100 WRAP-UP SESSION AND FEEDBACK

		Panel Members
		Mr. J. E. Morris
		Dr. D. R. Brown
		Dr. F. E. Niles
1100	Close of Workshop	

APPENDIX 3

DRAFT LETTER TO PROJECT PARTICIPANTS

Dear

Mesoscale Model Comparison Project

Thankyou for indicating your interest in participating in the above project. The purpose of this letter is to provide you with further details of how it is anticipated it will proceed and what we envisage will be required of each participant. You should regard the plans outlined in this letter as provisional to the extent that if participants have suggestions to make which would enhance the value of the project, they will be considered by the mesoscale panel before the plan is finalised.

The following timetable has been agreed: The finalised plan will be distributed requesting formal agreement to participate in May, 1991. The WIND data tapes will be sent out on July 1 and the basic results required at ASL on floppy discs by 31 December, 1991 to be processed for the pre-workshop volume. Model descriptions in the format described below will be required by August 1 also to be included in this volume. Papers describing results of (optional) sensitivity experiments, to be included in a post-workshop volume, will be required by May 31, 1992. (Abstracts by March 31 1992). Here are the details:

Model descriptions.

Participants are requested to describe the capabilities of the current version of their model using the attached framework (an example of a description you completed in 1988 is enclosed). For each category in which a short descriptive paragraph is provided please include references where more details can be obtained. Examples of the material to be included can be found in Pielke (1984, Appendix B).

This material should be forwarded to Mr. Jim Harris, Commander/Director, U.S.Army Atmospheric Sciences Laboratory, ATTN: SLCAS-LR, by August 1, 1991 with a copy to the Workshop Chairman, Professor R.P.Pearce, Department of Meteorology, University of Reading, 2 Earley Gate, Whiteknights, P.O.Box 239, Reading, RG6 2AU, UK.

Model outputs.

The following outputs are required:

a. Hourly values at grid points 5 km apart in the horizontal at the altitude levels

0, 10m, 50m, 500m, 1000m and 5000m

of the variables

V , θ (wind direction), w , T , q (specific humidity), q_l (liquid water), the subgrid turbulent fluxes $\overline{u'w'}$, $\overline{v'w'}$, $\overline{u'v'}$, $\overline{w'T'}$ and $\overline{w'q'}$ as

parameterised and radiative fluxes R_{sd} , R_{su} , R_{lu} , and R_{ld} .

b. Power spectra of V in the N-S and W-E directions. (Spectra of orographic data will be supplied).

c. Output at station locations:

1. Surface stations (0m, screen height, tower levels):
For each of the surface stations time series are required at the corresponding time of all measured quantities, i.e.

V , θ , T , T_d , R_{sd} , $\overline{\theta'^2}$ and precipitation.

2. Upper air stations:

For each of the upper air stations time series are required of all measured quantities at the levels defined, i.e.

V , θ , T , T_d and p .

d. Statistics:

Each of the participants is requested to furnish the following statistical data for all quantities where measured and numbered data exist:

1. Biased and unbiased correlation coefficients r between $\delta\theta_{obs}$ and $\delta\theta_s$, where $\delta\theta(t) = \theta(t) - \theta(0)$, $t = 1, 2, 3, \dots, 24$ hours.

2. Spatial averages of r at each height level.

3. Bias $B = \overline{\delta\theta}_{obs} - \overline{\delta\theta}_s$ where $(\bar{\quad})$ denotes time averaging.

The above output data are required on floppy disks, to be received at ASL by 31 December 1991. Specifications of formats will be provided in due course.

Sensitivity studies.

In view of the large demands on computer resources usually involved in carrying out sensitivity experiments, these are not a specific requirement of those participating in the workshop. However, groups carry out such studies as an integral part of their own model development programmes and it would be of considerable benefit to all participants if the results of these studies were reported and discussed at the workshop. Areas of particular interest to ASL are sensitivity of mesoscale model predictions to

1. initial data coverage and quality,
2. model resolution
3. terrain resolution
4. terrain type (including landscape variations)
5. changes in large-scale forcing of the mesoscale flow.

It would be most helpful to the organisers if you would indicate

at this stage whether you would be able to present a paper (or papers) at the workshop related to any of these topics. We would hope that a collection of such papers, to be published as part of the post-workshop proceedings, would be of considerable value to the wider community of mesoscale modellers.

I look forward to receiving your reaction to this plan, in particular any queries or suggestions.

Yours sincerely,

R.P.Pearce.

U.S.Army Mesomet Advisory Panel Chairman.

MODEL CAPABILITIES

- A. GROUP
- B. EQUATIONS
- C. DIMENSIONALITY
- D. GRID
- E. HORIZONTAL RESOLUTION
- F. VERTICAL RESOLUTION
- G. MODEL DOMAIN
- H. INITIALIZATION
- I. SOLUTION TECHNIQUE
- J. COORDINATE SYSTEM
- K. LATERAL BOUNDARY CONDITIONS
- L. TOP BOUNDARY CONDITIONS
- M. SURFACE BOUNDARY
- N. PARAMETERIZATION OF SUBGRID MIXING
- O. CUMULUS PARAMETERIZATION
- P. RADIATION PARAMETERIZATION
- Q. STABLE PRECIPITATION PARAMETERIZATION
- R. ALGORITHMS TO LINK CODE WITH OTHER MODELS
- S. PHENOMENA STUDIED
- T. COMPUTER USED AND CALCULATION SPEED PER TIME STEP FOR FULLY CONFIGURED MODEL (INCLUDE TIME STEP FOR A HORIZONTAL GRID INTERVAL OF 5km)
- U. REFERENCES

APPENDIX 4

MILESTONES

1. ASL send survey letter to U.S. modelers by 31 Dec 90.
2. Determine Alpert's participation by 14 Dec 90.
3. ASL send WIND mesoscale data to Alpert by 31 Dec 90.
4. Alpert's report by 31 Mar 91.
5. Panel send letter of invitation to modelers by 31 Jan 91.
6. Modelers responses by 1 May 91.
7. Assess Alpert's report, ASL pilot experiment and modelers responses (Panel by 10 May 91 in Europe (Gwent, Belgium); facilities arranged by Professor Klug.
8. Send formal letter and Phase I data by 31 May 91 (ASL).
9. Send Phase II data by 15 Jul 91. (ASL)
10. Modelers send results by 1 Dec 91 (floppy disks).
11. Consult Panel on hard copy format by 31 Jan 92.
12. Sensitivity studies and presentations by 28 Feb 92.
13. ASL prepare hard copy tables and graphs by 31 Mar 92. (Pre-workshop proceedings).
14. Conduct workshop - April 92.
15. ASL Post-workshop proceedings by 31 Aug 92.
16. Distribute proceedings - 30 Sep 92.
17. Negotiate with AMS for monographs (Pielke).

ASL EVALUATION CRITERIA

- **UNIQUE ARMY REQUIREMENTS**
- **QUALITATIVE EVALUATION CRITERIA**
- **QUANTITATIVE EVALUATION CRITERIA**

UNIQUE ARMY REQUIREMENTS

- **MULTISCALE - 200 km X 450 km --> 5 km X 5 km**
- **Variable grid spacing**
 - 10 km --> 1 km --> 100 m horizontal
 - 30 km in vertical
 - high definition in boundary layer
- **Limited data available for initialization**
- **Model must run on fielded Army computers**
- **Fast run time with flexibility to rapidly change to higher grid resolutions**
- **Output parameters**
 - wind speed and direction
 - temperature
 - RH
 - cloud cover
 - precipitation
 - fog/visibility

QUALITATIVE CRITERIA

Model must correctly simulate spatial and temporal evolution of meteorological parameters to include transitional periods:

- **wind speed and direction
 - upslope - onset & magnitude
 - downslope - onset & magnitude
 - drainage - timing & magnitude
 - sea breezes - timing & strength & area coverage
 - land breezes - timing & strength & area coverage**
- **Max temperature - timing & amplitude & proper location**
- **Min temperature - timing & amplitude & proper location**
- **realistic vertical profiles are foremost, then magnitudes**
- **overlay simulated fields onto observed fields**

QUANTITATIVE CRITERIA

- **Simulation vs Observation Horizontal Overlays**
- **Time vs Parameter plots**
- **Height vs Parameter plots (vertical profiles)**
- **Scatter diagrams (simulation vs observed)**
- **Statistical Calculations**
 - root mean square error**
 - standard deviation**
 - correlation coefficient**
 - standard error of simulated values**
 - mean wind direction difference**
 - mean wind speed difference**
 - multivariate randomized block permutation (MRBP)**
- **Rigorous tests of skill in "operational" mode**