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CLIMATE INFORMATION UNIT
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SWS Contract Report 386

ASSESSMENT OF NEED FOR REAL-TIME CLIMATE DATA AND INFORMATION IN THE UPPER MIDWEST

by
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1. Introduction

Operation of the North Central Regional Climate Center (NCRCC) during the last 4 years led to the conclusion that a real-time climate data and information system would be extremely valuable to a wide variety of users in the Midwest. Studies of agribusiness users (Lamb et al., 1984); advice from NCRCC private sector group; interactions with State Climatologists; and our experience with the Illinois real-time data system (CLASS) provided the impetus to assess regional interest. The staff of the North Central Regional Climate Center (NCRCC) has further described such a system by presentations at professional meetings. In the past year, assessment of regional interest and potential users were accomplished largely by conducting workshops in 11 cities of the Midwest. We invited 20 to 25 individuals from the private sector and state government to each workshop to ascertain their need of, interest in, and perceived value of a real-time weather/climate data acquisition and dissemination system. The envisioned system would rely on daily data from a network of stations in the 12 North Central states. Those invited were affiliated with some weather- or climate-sensitive business or agency, where decisions were made from time to time which were, at least in part, dependent upon past, present, or future weather/climate conditions. Timely, and dense data that we envision, are not currently available. The proposed density of stations (about 50 per state) is exceeded by the number of NWS Cooperative stations, but these data are not available until 2 to 3 months after the fact. Real-time data are only available from the NWS First Order stations, and FAA airports (total of about 10 to 15 per state). These data are available from several private data/information providers for a fee.

2. Workshop format

At the workshops, we described a proposed regional system for development. At the onset, we suggested that initial funding for the development would be sought from some outside source, but that continued support (after the first year) would have to originate from user fees.

Data would originate from various sources. Data would be obtained from NWS First Order and FAA stations in each of the states, and additional daily data would be collected from the Midwest Agricultural Weather Service Center at West Lafayette IN. Some of the states in the region have data collected from automatic weather stations which would be incorporated into the system, if available. These are data which for the most part, are not avialable in near real-time. Finally, about 50 NWS observers per state would call their daily observations to a central computer (location yet to be determined) on a daily basis.

The system's computer would generate several hundred "products" (tables, maps, narratives, and graphs) each day. These would be availble, on demand, to authorized users by means of a terminal and modem. Experience in Illinois suggests that sufficient users will be attracted to the system, once established, and that fees sufficient to support the system would be acceptable to the users.

Workshops were held in Milwaukee WI, Chicago IL, St. Louis MO, Indianapolis IN, East Lansing MI, Ames IA, Minneapolis MN, Fargo ND, Lincoln NE, Kansas City KS, and Peoria IL from July 1985 through February 1986 (attendees given in Appendix A). By contacting the State Climatologists, members of the NC-94 committee, and persons from private business with whom we have worked 1n the

past, we compiled a list of about 25 individuals in and around each major city. These persons worked in weather- and climate-related businesses or agencies. The invitees included representatives from public utilities, environmental consulting companies, farm managers, farmers, radio and TV weathercasters, commodity trading companies, county extension agents, university researchers and a newspaper farm editor.

Each of the invitees were initially phoned to invite them to attend a workshop. The purpose of the workshop was explained to them over the phone. This initial contact was followed by a letter to each person detailing the agenda of the future workshop. It also contained a questionnaire (shown in Appendix B) which requested information concerning their need for weather and climate data and Information; how current such data should be; how those data were used in their operations; and how much they valued such data and information. The questionnaires were returned at the workshop, or mailed to us after the meeting. If no response was received within about 2 weeks, a followup letter (with another copy of the questionnaire) was sent. The results from the questionnaires are presented elsewhere in this report.

Each workshop was convened for about 2 hours, with an average attendance of 12. All attendees were affiliated with organizations whose operation is at least somewhat weather- and climate-related, i.e., decisions must at times be made which are dependent upon current conditions, or the aggregate conditions current to the present. We initially briefed the group on the general concept of a real-time regional climate data service, showed some possible products of such a system, and then discussed the cost and a possible fee structure. The meetings were informal and the ensuing round-table discussions proved to be a good format for information transfer. After making general suggestions as to

how such a system could operate, the attendees were invited to comment, particularly as to how their operation could be benefitted by real-time climate information and data from the region. All attendees voiced strong support for a real-time regional climate data and information system.

The proceedings qf each meeting were summarized and mailed to the attendees. The attendees were asked to reply if pertinent comments were missing or mis-stated. Most workshops brought new and different interests to light. We feel confident that our assessment approach was thorough and detected the range of uses and attitudes.

3. Results of the discussions held at the workshops

Summaries of the comments at the workshops to various components of a regional real-time climate data acquisition and dissemination system follow.

The need for daily current climate data was a response at every workshop. There is a great need to be able to access up-to-date climate data. These data could include, (1) accumulated degree days since a given date, (2) total precipitation in the past 3, 7, 10, or 30 days, or since the beginning of the month or growing season, (4) mean temperature for the same intervals of days, (5) deviations from normal, and (6) comparison of the above parameters with values from the recent year and the past.

Data density was an important user consideration, needed to yield meaningful information. Most attendees agreed that temperature observations from between 40 to 80 stations per state or a density of 1 observation per 1,000 square miles, were sufficient for their needs. Except for micro-scale features, this was deemed adequate. However, precipitation data deserve a

greater density. Farmers and farm managers want to discriminate between the moisture in 1 field compared to that of another, requiring a score or more of gages in each Crop Reporting District. Clearly, this density is beyond the capability of a regional data system. However, precipitation obsevations by NWS Cooperative stations currently depict the distribution of precipitation to a scale of about 1 station per 1,000 square miles, a density about 5 or 6 times greater than those available on ay real-time basis today. Although there are instances when even that density is insufficient, a regional system with precipitation osbservation density between 80 and 100 stations per state will satisfy most needs.

Current observations must be available to users of the system as soon as possible after reception and quality control. Quality controlled data should be placed into a time series of data which are retrievable in raw form, prior to the time that maps, tables and narratives are prepared and ready for dissemination.

Time of product update of the regional system should be completed early in the day, preferrably sufficiently early so that updating 1s complete before 0700. This is important for some of the commercial users, e.g., commodity traders, who wish to see the data before the time that the markets open. For other users, the time of update may not be critical. Since most NWS Cooperative observers now take their observations at about 0700, an update time of 0700 would mean that the most recent data to be able to include in the update would be midnight observations from that morning. By beginning the update after reception of the 0700 observations, updated products are not available until late morning. A possible solution to this problem may be to update 3 times per day, e.g., (1) ca. 0400 (to include the most recent observations for

early morning considerations), (2) ca. 1000 (to update with the greatest number of timely observations), and (3) at ca. 2000 (to include those observations taken between 1600 and 1900.

Desired products of a regional system should include both raw observed and derived products, including temperature and precipitation for each observing site, degree days, means, accumulations and deviations from normal and from last year for the above. Because of the wide variety of users, and the differences in their needs and desires, deviations for some variables, such as precipitation and solar radiation, should be presented in both absolute and percent values. Products should be given in tabular form (for station data), and mapped format (for temporally similar data). Products should be presented in a wide variety of formats and units to satisfy the greatest number of potential users.

Costs of a regional system should be derived from users. The workshop attendees suggested that the fee schedule be scaled so that individual farmers be able to obtain data for a minimal amount. Commercial users, on the other hand, who use the data from the regional system to generate products which they, in turn, sell to their subscribers should be charged a greater fee. A possible solution to this problem is to establish a base annual fee, which is scaled according to the user category,(further discussion of this point in the discussion of the questionnaire below), and an additional fee which is a function of either (1) the connect-time, or (2) the number of products requested.

Presentation of anomalous data should be given in both absolute differences from normal, and for some parameters such as precipitation and solar radiation, as percent of normal. This is particularly important for precipi-

tation data. Different users may desire the information for inclusion in decision-making equations which require the data in specific units. A regional system should present the data in a wide variety of units to satisfy most of the needs of the users.

All derived products (e.g., degree days) must contain a definition as to how they were calculated. This is particularly important when several methods of calculation are possible (e.g., growing degree days).

Quality control of the data is paramount. Although these data will not be of the quality maintained by the National Climatic Data Center, they should be screened as received to ensure that maximum temperatures are equal to or greater than minima, and that the temperature at the time of observation is consistent with the maximum and minimum value. As time permits and need demands, spatial comparisons can be made to "flag" data that are outside some pre-established limit (e.g., temperature at station A more than 3 standard deviations greater than that at station B, 25 km distant). In addition, there should be no missing data. Estimates need to be made for all data if they appear spurious or are missing.

Data should be presented for specific sites, perhaps also averaged for given areas. Site specificity, however, is most important, since many users input the data into models, for which site specific data are needed. This comment was made for both observations and forecasts. In general, these groups felt that site specific data were more useful than areally averaged.

Climate districts used in a regional system should conform to the USDA Crop Reporting Districts, or they should be able to be aggregated into the standard districts. This comment arose because some State Climate Centers

have chosen to divide the state into more than the standard 9 climate districts. Although the attendees agreed that the 9 districts were too large to show necessary small scale features of some parameters, they suggested that the smaller districts should be so constructed to aggregate to the NWS districts.

Exposure of all observing sites must be described for the system. This is necessary because different states have (or will) install state-operated networks for specific purposes, which may demand instrument location and exposure to differ from that suggested by NWS. For example, anemometers may be installed within a crop canopy, changing with the time of season. Although these data may be distributed by the regional system, their height must be given. Some suggested that wind observations be "adjusted" to a common height, in addition to presenting the raw observations. It was also suggested that observations be adjusted, if possible, to coincide with a common time of observation, to reduce any bias which may accumulate from different times of observation.

Forecast information should be presented with given probability levels. One should remember that the attendees were an experienced group, i.e., they were chosen by NCRCC staff and State Climatologists because these people were knowledgable in climate data and information, and in many cases, had helped the climatologists prepare data in a more useful format to suit their particular needs. Probabilities are often needed, when inputing forecast data into decision-making models.

Marketing of such a system is very important. Although we sense a strong support of a system, based on the use of the Illinois CLASS, the system must

be properly advertised so that potential users are made aware of its existence. The experience vested in the NCRCC and State Climate Center personnel throughout the region is more than able to create a credible and complete real-time data and information acquisition and dissemination system. More often than not, however, scientists are not sensitive to the best methods for attracting interested users to the system. This point was strongly made by more than 1 of the consultants in attendence at the workshops.

Data from stations outside the North Central region will be of interest to some users. Experience with the Illinois CLASS system shows that farmers in Illinois often use the system to determine the rainfall or soil moisture in parts of the state other than their own. They measure their own conditions, but because many of them hedge their own production by means of the commodities market, they are concerned with climatic conditions of other areas that produce the same crops. For most row crop farmers, climate data from the North Central region is sufficient to show the environment is the corn and bean area. However, specialized producers in some areas of the region would best be served by showing data from states outside the region. In some states of the region, for example, cherries, apples and peaches are grown. Competition for those crops is found in states outside the North Central region, therefore climate information from these states will be of interest to North Central fruit growers.

4. Results of the questionnaire survey

Ninety-five questionnaires, or about 81% of those attending the workshops, were returned to the NCRCC after all the workshops were completed. Attendees were asked to categorize themselves according to business activity,

and results are shown in Table 1. About 200 persons were contacted and invited to the workshops, and about half that number attended, not an unexpected response. We did have a rather small attendance in some categories. Most of the attendees were related either to agricultural activities or to governmental agencies.

A questionnaire (see Appendix B) had been prepared and distributed to the attendees well before each workshop. The results of the questionnaire responses follow.

The first question asked attendees to rate (1: highest, 5: lowest) the need of each of the 10 items in their business activity, and also to specify the minimum spatial resolution of the data which would satisfy their needs (Table 2).

Table 1. Number of Workshop Attendees by Business Activity Category.

CATEGORY	NUMBER
Fertilizer Company	14
Seed Producer	8
Municipal Government	5
County Government	14
State Government	13
Federal Government	12
Radio	6
Television	7
Newspaper	1
Gas or Electric utility	3
Consulting Firm	5
Insurance (Crop-Hail)	2
Water Resources	1

Table 2. Frequency of responses (number of cases) to "Please indicate the climate parameters which would be helpful to the operation of your business activity, and the area for which the data should be representative." Sums vary because all respondents did not respond to each question.

PARAMETER	1	2	3	4	5	Minimum Site	Spatial Specific/District	Resolution AVR.	Desired /State Avg.
Daily updated temperature	37	6	4	5	8	51	36		21
Last 7 days temperature	23	8	10	7	5	33	34		24
Mean temperature last month	21	11	10	3	7	32	36		22
Mean grow season temperature	21	6	9	4	10	29	31		20
Total growing degree days since 1 May	29	7	5	6	5	36	35		23
Daily update precipitation	39	7	5	6	5	36	35		23
Last 7 days precipitation	28	11	5	9	3	44	38		24
Total precipitation last month	31	11	9	3	3	43	35		26
Total grow season precipitation	28	8	8	4	4	39	35		24
Current Palmer Drought Index	1	8	7	9	1	8	21	31	17

Of the 10 parameters listed, little difference in response frequency is apparent, other than to comment that about half responding to each parameter indicated that the given parameter was very importent in their business decisions. Site specific data are desired in most of the categories shown in Table 2, particularly when referring to precipitation data. Even temperature data are often desired at the site level, as opposed to district or larger, averages. It is therefore recommended that site specific data be available for all parameters possible, with district and state means also provided.

The second question asked the attendee's interest for additional products they specifically would need. The responses are shown in Table 3. The greatest interest was in the 5-day forecasts, the 10-day forecasts, and soil moisture information. The interest in the remaining parameters was either mild or of much interest, except for predicted crop yield for areas other than the

Table 3. Degree of Interest in Additional Products

PRODUCT	LEVEL OF INTEREST NONE	MILD	MUCH
30- and 90-Day Outlooks	8	34	26
Predicted Crop Yield for United States	16	20	29
Predicted Crop Yield for Other Than U.S.	20	23	21
1-5 Day Temperature and Precipitation Forecast	8	16	44
6-10 Day Temperature and Precipitation Forecast	10	17	41
Soil Moisture Information	3	21	48
Frost Depth Information	11	28	25
Snow Cover	6	26	31

United States, which displayed about equal interest in all 3 categories.

The third question asked: "Relative to the density of observing stations available on this regional system, in general, how many stations per state would be necessary for these data to be helpful to you?" The responses are given in Table 4.

Discussions of the above topic at the workshop were very informative and are discussed elsewhere in this report. Briefly, attendees desired between 40 and 80 sites per state reporting temperature, and from 80 to 100 sites per state reporting precipitation.

Table 4. Preferred Data Density, Per State Expressed in Percent.

1 to 5 Stations Per State	3
6 to 10 Stations Per State	7
11 to 19 Stations Per State	23
20 to 29 Stations Per State	18
30 or More Stations Per State	49

The next two questions asked the attendees for their thoughts concerning fees for a regional climate data system. Responses are shown in Table 5.

The last question requested information about the users' climate data needs; specifically: If the weather and climate data and information were available to you, in what ways might you use them (please check all that apply)?. The results are shown in Table 6.

Table 5. Responses (percent) to suggested fee schedules for the system.

Flat fee for all users	21%
Lower fee for individuals than for company users:	72%
No opinion	7%

Based on your experience, and perceived value of the data and information described herein, which of the following annual rates is most appropriate?

more than $1,000	8%
$500 to 999	21%
$300 to 499	19%
$200 to 299	19%
$100 to 199	33%

First, note that the use of weather/climate data and information is perceived to be more useful in planning than operational decisions, and more useful for general information than for systematic use. The former may be directly related to the latter, i.e., there are not many systematic methods available and in use which accept weather/climate data and information as independent variables. Moreover, most individuals still integrate weather/climate data and information into their decision-making by means of subjective techniques which may vary from time to time, and cannot be quantitatively explained, a conclusion reached in a workshop we held to determine

Table 6. Degree to which various parameters could be used by the attendees.

	PLANNING ACTIVITIES		OPERATIONAL DECISIONS	
	GENERAL INFO	SYSTEMATIC USE	GENERAL INFO	SYSTEMATIC USE
Crop and variety choice	12	0	6	0
Cultivation practices	13	2	6	1
Planting/harvesting date choice	14	1	9	2
Planting density	10	2	6	3
Fertilizer applications	8	1	5	2
Pesticide applications	14	1	11	2
Irrigation scheduling	8	2	3	1
Livestock numbers	3	0	1	1
Investment/borrowing decisions	3	0	4	0
Project decisions	4	0	7	0
Personnel deployment	3	0	7	0
Marketing decisions	7	1	6	2
Insurance decisions	1	0	0	0
Information dissemination	11	0	13	1
Consulting activities	10	3	11	3
Management decisions	14	1	14	1
Sales activities	1	0	1	0
Purchasing	1	0	1	0
TOTALS	137	14	111	19

the present and potential uses of climate information by the private agricultural sector (Lamb et al., 1984).

The above analysis was completed for each category of attendees with 5 or more persons responding; consultants, fertilizer companies, seed producers, media representatives, and each level of government. Though there are some differences in responses, these can be predicted based on experience. For example, the media representatives (all weather broadcasters of radio and television) had no interest in the information shown in Table 6. Their only concern is the reporting of the current state of the atmospheric environment and weather forecasts.

5. Conclusions

The workshops largely confirmed several expected conclusions, but brought to light a number of unexpected findings. The presence of a regional system for real-time weather and climate data acquisition and for dissemination was strongly supported by all attendees. This might be expected since the audience was invited because they had needs for such data, and these products are not currently available, either in real time or at the needed station density.

Funding mechanisms for the potential system were suggested at the workshops. We briefed the attendees that funding for planning and development of the system would be sought from some outside source. Continuing maintenance costs would have to be borne by user fees, the amount and structure of such fee schedules yet to be determined. This suggestion was acceptable to the attendees, and their projected commitment to a regional data and information system is given below in the discussion of fee structure and magnitude.

Temperature data should be available from 40 to 80 stations per state, and precipitation data should be available from 80 to 100 stations per state. More are desireable. These data should be partially quality controlled as received, to ensure reasonable values (e.g., maximum temperature equal to or greater than the minimum etc.).

All secondary parameters (those which are calculated from primary parameters such as degree days) should have their calculation methods appear with the products.

Updated products should be available as early each day as possible, preferably before 0700CST, to accomodate most of potential users.

Data and information should be presented in as many different ways as users request, e.g., precipitation anomalies should be given in absolute units as well as percent deviation. Data should be presented for specific sites, in addition to district and state aggregate values. Some models which the users may employ require data in a specific form. A wide variety of units should be available so that the user can tailor the information to his/her specific need.

The fee for the service should be scaled, i.e., least expensive for the individual user, and more expensive for the corporate user, particularly those who use products of the system to provide added value products and for resale to their subscribers. Annual fee recommendations were most common in the $100 to $199 range. Discussion with users suggests that this reflects the fees of other existing data sets.

The responses to the questionnaire were most helpful in specifying products that should be included in a regional system, and how those data should be presented. In addition, the concept of a fee schedule appears to be appreciated by a vast majority of the potential users, and their perception of a reasonable value is focussed on the range of a few hundred dollars per year, scaled according to user type.

The limited range of interests exhibited among the invitees should not be interpretted to mean that these data are of interest only to this limited group. Indeed, the invitations were only made to this group, and others of similar interest, because they were known to need such data, and were knowledgeable about climatological data and information. The invitees were a biased group, but were of particular value because the group could evaluate each of many potential products, and discuss, from experience, the value of each in assisting them in their decision making process.

6. Achnowledgements

Scheduling and arranging the workshops, and collating lists of possible attendees required much coordination, and assistance from colleagues. We are indebted to Stanley A. Changnon, Jr. for his assistance in designing the format and suggesting key persons in various cities. The key persons contributed much of their own time to make the workshops a success, and include Ms. Gail Martell, E. F. Hutton, Milwaukee; Ms. Doris Sincox, Continental Grain, Chicago; Mr. William Nelson, Doane Publishing, St. Louis; Mr. Lynn Murray, Stokley-Van Camp, Indianapolis; Drs. Stuart Gage and J. D. Carlson, Michigan State University, East Lansing; Mr. Ronald McAdoo, Federal Crop Insurance Corp., Kansas City; Dr. Thomas Thompson, University of Nebraska, Lincoln; Dr.

Richard Felch, Prior Lake MN; Dr. Lynn Rose, North Dakota Weather Modification Board, Bismarck; and Mr. Dale Clary, Greene Farm Management Service, Peoria, and Chair of the 1986 meeting of the Illinois Society of Farm Managers and Rural Appraisers. These persons identified potential attendees, and in most cases, hosted the workshops. The Milwaukee workshop was hosted by Mr. Sandy Hamm, Agri-Data Network, Milwaukee; that in Indianapolis by Mr. Roger Stevens, Indiana Division of Agriculture; and that in Minneapolis by Mr. John McEndree and Mr. John Cawhorn, Cargill Inc. The following State Climatologists also helped identify potential attendees: Dr. L. Dean Bark (Kansas), Dr. Douglas Clark (Wisconsin), Dr. Wayne Decker (Missouri), Dr. John Enz, (North Dakota), Mr. Earl Kuehnast (Minnesota), Dr. James Newman (Indiana), Dr. Fred Nurnberger (Michigan), and Mr. Paul Waite, (Iowa).

We enjoyed considerable assistance in the development of the questionnaire from Drs. Eugene Haas, Barbara Farhar Pilgrim and William Easterling. Our thanks to those who completed and submitted the questionnaires for analysis (listed in Appendix A). Conclusions are only possible because of their efforts.

7. References

Lamb, P. J., S. T. Sonka, and S. A. Changnon, Jr. 1984: The present and potential use of climate information by the United States private agricultural sector. Final report to NSF ATM 81-16615. Illinois State Water Survey Contract Report 344, Champaign. 138p.

Appendix A. List of attendees at the various workshops.

MILWAUKEE, WISCONSIN 8 July 1985

Mr. Robert Bjorklund, Farm Editor, Wisconsin State Journal, P.O. Box 8058, Madison, WI 53708
Mr. Vince Condella, WITI-TV, 9001 N. Greenbay Rd., Milwaukee, WI 53217
Dr. Doug Clark, 1225 W. Dayton St, Univ. of Wisconsin, Madison WI 53706
Mr. Vern Doughtery, 500 Riverview Ave., Waukesha, WI 53188
Ms. Gail Martell, EF Hutton, 770 N. Jefferson St., Milwaukee, WI 53202
Mr. Sandy Hamm, Agri-Data Network, 330 E. Kilbourn Ave., Milwaukee, WI 53202
Mr. George Kent, Milwaukee Electric Tool Corp, 13135 W. Lisbon Rd., Brookfield, WI 53005
Mr. Paul Joseph, WTMJ-TV, Milwaukee, WI 53202

CHICAGO, ILLINOIS 12 July 1985

Mr. Lloyd Lindstrom, Crop-Hail Insurance Actuarial Ass'n., 209 W. Jackson Blvd., Chicago, Il 60604
Mr. Steve Heverly, Crop-Hail Insurance Actuarial Ass'n., 209 W. Jackson, Chicago, Il 60604
Mr. R. J. Feltes, REFC0, 135 S. LaSalle, Chicago, Il 60603
Mr. Gary Schmidt, Crop-Hail Insurance Actuarial Ass'n., 209 W. Jackson, Chicago, Il 60604
Mr. Hugh Ulrich, Stotler & Co., 141 W. Jackson, Suite 1600, Chicago, Il 60604
Mr. Steve Freed, Dean, Witter, Reynolds, 150 S. Wacker, Suite 200, Chicago, Il 60606
Ms. Doris Sincox, Continental Grain, 141 W. Jackson, Suite 1950, Chicago, Il 60604
Mr. Dan Brophy, LINNC0, 141 W. Jackson Blvd., Suite 2040, Chicago, Il 60604

SAINT LOUIS. MISSOURI 26 August 1985

Mr. Michael Squire, KM0X-TV, 1 Memorial Dr., St. Louis 63102
Mr. Robert Richards, KSDK-TV, 1000 Market St., St. Louis, M0 63101
Mr. Ronald Yaros, KTVI Berthold, St. Louis, M0 63110
Mr. Armand Jaccheo, Weather Corp of America, 5 American Industrial Dr., St. Louis, M0 63043
Mr. Richard Hoormann, St. Charles Extension Center, R.R. 2, Box 225 C, St. Charles, M0 63303
Mr. Michael Menne (MC 602), Union Electric Co., P.O. Box 149, St. Louis, M0 63166
Mr. William Nelson, Doane Publishing Co., 11701 Borman Dr., Suite 100, St. Louis, M0 63146
Mr. Robert Hamilton, MIC, National Weather Service Forecast Office, 4100 Mexico Rd, St. Charles, M0 63301
Dr. Vernon Jones, Dept. of Atmos. Science, Univ. of Missouri, 701 Hill St., Columbia, M0 65211

Mr. Dennis Bouse, Union Electric Co., P.O. Box 149, St. Louis, MO 63166
Mr. Edward Wulf, Union Electric Co., P.O. Box 149, St. Louis, MO 63166
Mr. Lee Schuldt, Union Electric Co, P.O. Box 149, St. Louis, MO 63166
Mr. James L. Butery, U.S. Army Corps of Engineers, 210 Tucker Blvd., North, St. Louis, Mo 63101
Mr. Merritt Padgett, Missouri Crop & Livestock Reporting Service, USDA/SRS, 555 Vandiver Dr., Columbia, MO 65211
Mr. Robert Bellinghausen, Missouri Crop & Livestock Reporting Service, USDA/SRS, Columbia, MO 65211
Mr. Christopher Eklund, Doane Publishing Co., 11701 Borman Dr., Suite 100, St. Louis, Mo 63146

INDIANAPOLIS. INDIANA 9 September 1985

Mr. John T. Curran, National Weather Service Forecast Office, Indianapolis International Airport, P. 0. Box 51526, Indianapolis IN 46251
Mr. Paul Queck, Indiana Prairie Farmer, P. 0. Box 41281, Indianapolis IN 46241
Dr. James E. Newman, Agronomy Dept. Purdue Univ., West Lafayette IN 47907
Mr. Terry Strueh, Agriculture Admin., Purdue Univ., West Lafayette IN 47907
Mr. Roger Stevens, Indiana Div. of Agriculture, 1 N. Capitol, Suite 700 Indianapolis IN 46204
Mr. Robert Palmer, Pioneer Hybrid International Inc., 100 W. Jefferson, Tipton IN 46072
Mr. Paul Rodgers Pioneer Hybrid International Inc., 100 W. Jefferson, Tipton IN 46072

EAST LANSING. MICHIGAN 10 September 1985

Mr. Charles Cooper, C.E.S., Horticultural Agriculture, 412 Erie St., Jackson MI 49202
Mr. Fred Henningsen, C.E.S., Courthouse Annes, P. 0. Box 278, Centerville MI 49032
Mr. Jay R. Harman, Dept. of Geography, Michigan State Univ., East Lansing MI 48909
Mr. Michael R. Weber, Consumers Power Co., Jackson MI
Mr. Phil Schwallier, C.E.S., 836 Fuller, Grand Rapids MI 49503
Dr. Fred Nurenberger, State Climatologist, MDA, P. 0. Box 30017, Lansing MI 48909
Mr. Graeme D. Murphy, Dept. of Agriculture, Michigan State Univ., East Lansing MI 48909
Dr. Stuart H. Gage, Entomology Dept., Michigan State Univ., East Lansing MI 48909
Dr. Jon Bartholic, Dept. of Resource Development, Michigan State Univ., East Lansing MI 48909
Mr. Robert Craig, Michigan Farm Bureau, P. 0. Box 30960, Lansing MI 48909
Mr. Donald Fedewa, Michigan Crop Reporting Service, Federal Bldg., P. 0. Box 2008, Lansing MI 48901
Mr. John McMurray, Commercial Weather Services, 2107 Davison Rd.,

Flint MI 48506

AMES, IOWA 4 October 1985

Dr. Richard Carlson, 303 Curtiss Hall, Iowa State Univ., Ames IA 50011
Dr. Elwynn Taylor, Agronomy Extension, Iowa State Univ., Ames IA 50011
Mr. Harvey E. Thompson, R. R. 2, Ames IA 50010
Mr. Garren Benson, 117 Agronomy Bldg., Iowa State Univ., Ames IA 50011
Mr. Alan Lockmann, Story County Extension, 220 H Ave., Box 118, Nevada IA 50201
Dr. Howard Hill, National Climate Program Office, Rockwall Bldg., Room 108, Code CP, 11430 Rockville Pike, Rockville MD 20852
Dr. Robert Shaw, Meteorology-Climatology, 303 Curtiss Hall, Iowa State Univ., Ames IA 50011
Mr. Wayne Ellingson, Agri-Pro, R. R.l 2 New Highway, 30 East, Ames IA 50010
Mr. Douglas Yarger, P. 0. Box 65537, Suite 400, 1400 50th St., Des Moines IA 50265
Mr. Thomas Ruttgers, Hertz Farm Mgt. Inc., Box 500, Nevada IA 50201
Mr. Duane M Skow, IA Crop Reporting Service, Room 833, Federal Bldg., 210 Walnut, Des Moines IA 50309

KANSAS CITY, MISSOURI 18 October 1985

Mr. Alan Walter, Crop Hail Insurance Actuarial Ass'n., Room 501, 8400 W. 110 St., Overland Park KS 66210
Mr. Ronald McAdoo, Federal Crop Insurance Corp., P. 0. Box 293, Kansas City M0 64141
Mr. David Salmon, Global Weather Services Div., Commodity News Services Inc., P. 0. Box 6053, Leawood KS 66206
Mr. Carl Welling, Farmers National Co., P. 0. Box 547, Shawnee Mission KS 66201
Prof. Wayne L. Decker, Dept. of Atmospheric Sciences, 701 Hitt St., Univ. of Missouri, Columbia M0 65201
Prof. L. Dean Bark, Dept. of Physics, Cardwell Hall, Kansas State Univ., Manhattan KS 66506
Dr. Clarence Sakomoto, 600 Cheery St., Federal Bldg., Columbia M0
Mr. Robert Kinsinger, FMC Corp., 2001 Danbury Ct., Manhattan KS 66502
Mr. Dudley Alexander, Boatman First National Bank, P. 0. Box 38, Kansas City M0 64483

LINCOLN. NEBRASKA 12 November 1985

About 25 users of the Nebraska AGNET system attended this meeting chaired by Prof. Thomas Thompson.

MINNEAPOLIS. MINNESOTA 12 December 1985

Mr. Earl Kuehnast, Minnesota Dept. of Natural Resources, Univ. of Minnesota, 279 North Hall, St. Paul MN 55108

Mr. Dean Braatz, North Central River Forecast Center, 6301 34th Ave., South, Minneapolis MN 55450
Mr. Pat Neuman, National Weather Service, 6301 34th Ave., South, Minneapolis MN 55450
Mr. Michael McEndree, Cargill Corp., 2301 Crosby Rd., Wayzata MN 55390
Mr. John Cawhorn, Cargill Corp., 2301 Crosby Rd., Wayzata MN 55390
Mr. Michael Fairborne, WCC0-TV, 625 2nd Ave., South, Minneapolis MN
Prof Donald Baker, Borlaug Hall, S331, 1991 Buford Circle, Univ. of Minnesota, St. Paul MN 55108
Mr. Greg Spoden, Borlaug Hall, S333, 1991 Buford Circle, Univ. Of Minnesota, St. Paul MN 55108
Mr. Dennis Feltgen, KSTP-TV, 3415 University Ave., Minneapolis MN 55114
Dr. Richard E. Felch, 3531 Willow Beach Trail, Prior Lake MN 55372
Mr. James Zandlo, Minnesota Dept. of Natural Resources, Univ. of Minnesota, 279 North Hall, St. Paul MN 55108
Mr. Franz Westermeier, 15659 Pilar Rd., North, Scandia MN 55073
Dr. Ken Bauer, R*Scan Corp., Room 220A, Box 35, 511 11th Ave., South, Minneapolis MN 55415
Mr. David G. Green, International Multifoods, Multifoods Tower, Box 2942, Minneapolis MN 55402
Mr. David Floyd, Kavouras Inc., 6301 34th Ave., South, Minneapolis MN 55450
Mr. Bill Schlueter, Kavouras Inc., 6301 34th Ave., South, Minneapoli MN 55450
Mr. Joe Harroun, Cargill Corp., 2301 Crosby Rd., Wayzata MN 55390
Mr. Ed Olson, Control Data Corp., Minneapolis MN
Dr. Tom Carroll, Airborne Snow Survey Program, National Weather Service, 6301 34th Ave., South, Minneapolis MN 55450

FARGO, NORTH DAKOTA 13 December 1985

Mr. Donald Stoltz, MIC, National Weather Service, P. 0. Box 1016, Bismarck ND 58502
Mr. Jay Larsen, Soil Science Dept., Walsten Hall, North Dakota State Univ., Fargo ND 58105
Mr. John Wheeler, WDAY-TV, 301 8th Street, South, Fargo ND 58102
Mr. Gordon Rudolph, Minndak Farmers Cooperative, RR 1, Box 10, Wahpeton ND 58075
Mr. Herb Monson, MIC, National Weather Service WS0, Box 8250, Fargo ND 58250
Mr. Robert F. Carver, Crop & Livestock Reporting Service, Box 3166, Fargo ND 58108
Mr. Lynn Rose, North Dakota Weather Modification Board, P.O. Box 1833, Bismarck ND 58505
Prof. Harvey J. Hirning, Extension Agr. Engineer, Agricultural Engineering Bldg. North Dakota State Univ., Fargo ND 58105
Mr. Mark Anfinrud, Stauffer Seeds, 826 7th Ave., East, West Fargo ND 58078
Dr. Richard Watkins, American Crystal Sugar Co., 101 North 3rd, Moorhead MN 56560
Mr. Edward Lloyd, Agvise Inc., Box 510, Northwood ND 58267
Mr. Vincent B Reed, G. G. County WRD, Grand Forks ND
Mr. C. W. Ekness, Grand Forks County Water Resource Dist., R. R. 1, Grand Forks ND
*Mr. William Guy, 2920 Manitoba Lane, Bismarck ND 58501
*Ms. Joyce Byerly, Box 686, Watford City ND 58854
*Mr. Ray Hutton, Oslo MN 56744

*Mr. Jacob Gust, 814 Del ores Dr., West Fargo ND 58078
*Mr. Jerome Spaeth, 418 Mason Ave., Bismarck, ND 58501
*Mr. Richard Backes, Glenburn ND 58740
*Mr. William Lardy, 920 13th Ave., West, Dickinson ND 58601

*Member, ND State Water Conservation Commission

Peoria, Illinois 13 February 1986

About 100 attendees to the 1986 annual meeting of the Illinois Society of Farm Managers and Rural Appraisers were briefed on the potential of a regional real-time climate data system. Questionnaires were distributed.

Individuals-at-Large who completed the Questionnaire

Mr. Kenneth Christie, Sparks Commodities, P. 0. Box 17339, 889 Ridge Lake Blvd. Memphis TN 38187-0339
Mr. James Jessen, Field Research Representative, Stauffer Chemical Co., Box 1383, Glendiro MT 59330
Mr. Bruce Krantz, Urban Forester, Fertilize Rx,4936-2 Woodfield Ct. Nashotah WI
Mr. Richard Stuff, Climate Assessment Technology, Inc., 11550 Fuqua St. Suite 525, Houston TX 77034
Mr. Dennis Klitzke, P. 0. Box 141, Lyndon Station WI 53944
Mr. Russell Yanke, R. R. 1, Skyview Dr., Loganville WI 53943
Dr. James McQuigg, McQuigg Consultants, 316 Tiger Lane, Columbia M0 65203

Appendix B. Questionnaire submitted to all attendees.

Questionnaire to Assess Climate Products that should be Available on a Regional Climate Data and Information System to make the Data and Information Useful to Your Business

To help the North Central Regional Climate Center design a climate data and Information system that would be helpful to the operation of your business, please respond to the following questions. Please be assured that you acquire no obligation from your responses. Please bring the completed questionnaire to the seminar, or send 1t to Wayne M. Wendland, Director, North Central Regional Climate Center, Illinois State Water Survey, 2204 Griffith Dr., Champaign IL 61820. Thank you.

1. **Please indicate the climate parameters given on the following matrix which would be helpful to the operation of your business activity, and the area for which the data should be representative, i.e., what 1s the minimum resolution you require? Please indicate your interest 1n each item from 1 (greatest interest) to 5 (least interest).**

Indicate Your Interest in these Products rrom 1 (highest) to b (lowest) 1234 or 5	MINIMUM SPATIAL RESOLUTION DESIRED (Check all that apply) STATION	DISTRICT	STATE
TEMPERATURE DATA			
• Daily updated temperature			
• Last 7 days mean temperature			
• Mean temperature for last month			
• Mean growing season temperature			
• Total growing degree days since May 1			
• Other (PLEASE SPECIFY)_____			
• Other (PLEASE SPECIFY)_____			
PRECIPITATION/STORM DATA			
• Daily updated precipitation data			
• Last 7 days total precipitation			
• Total growing season precipitation			
• Total precipitation for last month			
• Current Palmer Drought Index			
• Other (PLEASE SPECIFY)_____			
• Other (PLEASE SPECIFY)_____			

2. In addition to the parameters listed 1n question 1, 1n which of the following parameters would you be interested, and to what degree are they important to you?

PARAMETER	NO INTEREST	MILD INTFREST	MUCH INTEREST
	(please check one)		
30- and 90-day temperature and precipitation outlook			
predicted crop yield for U.S.			
predicted crop yield for various areas of world			
1 to 5 day outlooks of temperature and precipitation			
6 to 10 day outlooks of temperature and precipitation			
soil moisture information			

3. Relative to the density of observing stations available on this regional system, in general how many stations per state would be necessary for these data to be helpful to you?
   a. 1 to 5 stations per state
   b. 6 to 10 stations per state
   c. 11 to 19 stations per state
   d. ?0 to ?9 stations per state
   e. 30 or more stations per state
   f. other density;_____

4. If such a system came into being, its maintenance would be supported by user fees, probably consisting of an annual subscription plus a t1me-of-use cost. If you were to participate 1n such a system, which of the

following methods would you prefer? (please check one)

a. flat fee for all users
b. an individual fee lower than that assessed of companies, particularly companies who further distribute Information received from this system.
c. other (please specify)_____

_____

5. Based on your experience, and your perceived value of the data and Information described herein, which of the following annual rates is most appropriate?

a. more than $3,000 per year
b. $500 to $999
c. $300 to $499
d. $?00 to $?99
e. $300 to $199
f. other:_____

_____

6. With which of the following economic sectors are you most closely associated (please check all that apply)?

a. fertilizer company
b. seed producer
c. municipal government
d. county government
e. state government
f. federal government
g. radio
h. television
i. newspaper
j. gas or electric utility
k. consulting firm
l. travel business
m. insurance
n. water resources
o. self-employed
p. other (please specify):_____

7. With which of the following professions are you most closely associated (please check all that apply)?

a. farmer
b. farm manager
c. county extension agent.
d. researcher
e. broker
f. banker
g. engineer
h. rates manager
i. clerical

j. plant manager
k. other (please specify):_____

8. If the weather and climate data and Information were available to you, in what ways might you use them (please check all that apply)?

	Planning Activities		Operational Decisions	
	General Info	Systematic Use	General Info	Systematic Use
Crop and variety choice				
Cultivation practices				
Planting and harvesting date choice				
Planting density				
Fertilizer applications				
Pesticide applications				
Irrigation scheduling				
Livestock numbers				
Investment/borrowing decisions				
Project decisions				
Personnel deployment				
Marketingdecisions				
Insurance decisions				
Information dissemination				
Consulting activities				
Management decisions				
Sales activities				
Purchasing				
Other (please specify)_____				
Other (please specify)_____				
Other (please specify)_____				

Your answers will be kept confidential. However if you prefer to remain anonymous, do not complete the remaining entries. We want you contribution, regardless of whether you identify yourself or not. Thank you for your consideration.

Name (optional):_____

Title:_____

Organization:_____

Address:_____

_____

_____

Phone: (_____)_____