PRELIMINARY REPORT

The Widespread Tornado Outbreak of April 3-4, 1974

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

CONTENTS

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Introduction

Because of the magnitude, both in terms of geography and the number and intensity of the tornado occurrences, this report, of necessity, will be very preliminary and tentative in nature. As of April 23, 1974, definitive data on storm tracks and times along with supporting input from the NWS regions, are still incomplete. Follow-up field visits are still being pursued. Our goal is to have most of the necessary information by May 1 with a draft report ready for internal review in about six weeks. This is later than the reporting date requested when the Survey Team was established, but it is believed that the great extent of the outbreak makes this additional time necessary.

The basis for this report has been derived mainly from the results of the NOAA Natural Disaster Survey Team's visit to the five states hardest hit by the tornadoes. The team consisted of the following members:

Dr. Edward S. Epstein, Associate Administrator for Environmental Monitoring and Prediction

Gerald A. Petersen, Director of Meteorological and Hydrological Services

Herbert Lieb, Public Affairs

Vince Oliver and James Purdom, NESS

Phil Dales, NWS

Most of the team arrived at Birmingham on April 5 and by April 12 had covered the most severely damaged areas in Alabama, Tennessee, Kentucky, Indiana, and Ohio. In addition, the NWS regional headquarters teams who had arrived on the scene within six to twelve hours after the tornadoes, provided debriefings on the results of their surveys within Georgia, Alabama, Tennessee, Kentucky, Indiana, and Ohio. Personnel from offices in Missouri, Illinois, Michigan, West Virginia, Virginia, and North Carolina also will be contributing material on the tornadoes affecting their respective states. On the basis of the initial survey and reports, segments of the survey team are now visiting additional sites in Tennessee and Illinois.

General Description

In the view of Fujita of the University of Chicago and Pearson of the National Severe Storm Forecast Center, this outbreak was a once in a century event that far exceeded the 1965 Palm Sunday tornadoes in terms of numbers, length of tracks, total area affected, deaths, and damage. Although we cannot be absolutely certain at this time, somewhere between 75 and 85 tornadoes occurred within the area generally encompassed by a line from Chicago southward almost to the Gulf of Mexico and eastward to the Appalachians. There is little question that several of these tornadoes were among the most severe ever observed.

Initial Red Cross information indicates the following overall statistical data:

328	Deaths
6,142	Injuries (1,183 hospitalized)
13,458	Dwellings destroyed or with major damage
8,390	Dwellings with minor damage
3,000	Mobile homes destroyed or with major damage
6,867	Farm buildings destroyed or with major damage
1,427	Small businesses destroyed or with major damage
27,590	Total families suffering loss

Newspaper accounts place the value of property lost at 540 million dollars. The most concentrated physical damage was sustained in the city of Xenia, Ohio. However, several rural communities (e.g., Guin, Alabama, Brandenburg, Kentucky, Monticello, Indiana) suffered comparable losses on a lesser scale because of their smaller size. Deaths were reported in the following eleven states:

Alabama	- 86
Kentucky	- 77
Tennessee	- 50
Indiana	- 49
Ohio	- 35
Georgia	- 17
North Carolina	- 7
Michigan	- 3
Virginia	- 2
Illinois	- 1
West Virginia	- 1

Loss of life could have been much greater especially in the case of Xenia where several schools were severely damaged. If the storms had come through during school hours, as many as 1,000 of the 5,000 students who attend the schools damaged or destroyed by the tornado in Xenia might have lost their lives. At Monticello, Indiana, a tornado passed directly through the business district in the late afternoon killing two people. However, many of the stores are closed on Wednesday afternoons. Thus, the downtown area was not nearly as busy as it normally is and, once again, loss of life was

limited through good fortune. In many other cases, it was also evident that the late afternoon and early evening timing of the tornadoes permitted exposure to the dissemination of warnings through radio and television as well as direct observation by the people.

The Warning System

The NOAA team plans on evaluating the total warning system extending from the National Weather Service production stage to the public response stage at the community level in its full report. In this discussion, a brief overview that touches on production, dissemination, and public response will be given.

Production. For the most part, the NWS portion of the warning system performed remarkably well under the most trying of conditions. In a condensed chronological order, the sequence of events began on Tuesday, April 2, when the Director of the National Severe Storms Forecast Center alerted all Central Region offices with radars to the likelihood of a serious outbreak the following day. This word was also passed to the Regional Warning Coordination Center at Ft. Worth where the same message was moved out to Southern Region field offices. The early morning severe weather outlook of April 3 outlined the area where practically all tornadoes eventually occurred along with the statement that "scattered", as opposed to the more normal "few", tornadoes were expected. The SELS unit issued a total of 30 tornado watches between 3:50 a.m. CDT on April 3, and 6:15 p.m. CDT on April 4, although most of the killer storms occurred on Wednesday, the third. Countless severe thunderstorm and tornado warnings were issued by the Weather Service Forecast and Weather Service Offices over almost the same period of time. As far as can be determined, practically all of the tornadoes occurred in valid watch areas but not all occurrences were covered by actual warnings.

A substantial problem seemed to be the difficulty experienced in trying to keep up with the numbers of watches and warnings, some of which overlapped one another at times. This was compounded by the fact that the tornadoes moved at speeds of as much as 50 to 60 knots. The value of our network and local warning radars in handling the forecast problem cannot possibly be emphasized enough. A large fraction of the warnings issued were based on the form of the radar echo, rather than visual sightings. Thus, the radars were absolutely essential to issuing timely, early warnings, as well as in tracking visually recognized destructive cells. As a corollary, emergency power is a must item, especially at all radar sites. The Covington WSR-57 was out of action for three hours. Fortunately, most of the worst of the tornadoes had already occurred by this time, and some backup was available from Wright-Patterson AFB. The Huntsville local warning radar was able to operate continuously only because emergency power was available and power surges due to the storms were damped out. At Louisville, although power was not lost, the many surges did make the radar inoperative from time to time; only exceptional performance by the electronic technician, changing parts and recalibrating at frequent intervals, kept the radar performance at a reasonable level. In addition, the Lexington WSO was

without power from 7:38 p.m. CDT, April 3, to 2:44 a.m. CDT, April 4. This included the period when storms were active in the Lexington area. A mobile city police unit manned by the police relayed reports from the WSO beginning at 8:30 p.m. CDT but the Office had to rely mainly on FTS and intermittent use of NAWAS while WSFO Louisville prepared and issued the formal warnings.

Satellite information available at the Kansas City and Suitland SFSS was used to good advantage in identifying areas of potentially severe and on-going severe weather. The Kansas City SFSS staff closely coordinated its efforts with those of the NSSFC and the RWCC, while both SFSSs communicated directly with field offices. An analysis is being performed to relate the ATS images, the radar data, and the severe weather occurrences to illustrate the extent to which these complement one another. The satellite information did contribute to the warning system in the present situation. In the future, with operational GOES systems, there is great promise of very substantial benefits to warning capabilities with the anticipated higher quality satellite imagery.

Special mention of the outstanding performance on the part of the WSFO and WSO staffs involved should be made. They did a wonderful job with many of the personnel staying on the job throughout the whole period of occurrences.

Dissemination. The most important element in the dissemination process was the active participation on the part of television and radio. As far as could be determined, most stations did not hesitate to interrupt normal programming with warnings as they were received. There were several examples of TV stations who did extremely well. Although not without exception, those TV and radio stations with NOAA Weather Wire Service did the best job of all. Those visited praised the value of having this service. Even in the case of the stations relying on the wire services, we noted that they transmitted the warnings as received. It was not possible to determine how timely the wire services were but, in at least one case, the delay was eight minutes.

Clearly the relation of time of day to the listening habits of the public has a strong influence on the rate at which warning information diffuses. Longer warning times are particularly important during times when fewer people can be reached directly by radio or TV, to permit the message to spread by word-of-mouth, as it indeed does.

The most outstanding example of performance by a radio station took place at Brandenburg, Kentucky, where the station was located two or three miles upstream in the path of the tornado. The announcer of this small FM station observed the tornado coming and continued to broadcast a warning until the station was literally destroyed. The only thing left standing was the woman's bathroom which does say something about a possible place to look for shelter.

As another part of the dissemination problem, those stations with hours of operation limited to a schedule (e.g., sunrise to sunset) should be made aware of the fact that in emergencies they are permitted by FCC rules to continue on the air. In addition, the Emergency Broadcast System needs attention to take advantage of its potential role.

In our press briefings, the question of VHF/FM came up again and again. It is the NOAA team's view that this capability, along with tone alert receivers in all schools, hospitals, and in local government facilities, would be an important asset to our ability to provide rapid and effective dissemination. Again, emergency power in all offices with this means of transmission would be a necessity in the event of power failure. This also applies to the provision of "all clear" messages when all other means of communication might be out.

The question of watches and warnings was repeatedly raised in the states not usually exposed to frequent tornadoes. In the small rural community of Guin, Alabama, however, not one person was interviewed who was unable to distinguish between the two. This suggests that frequency of occurrence along with continual education does overcome the difficulty of distinguishing between a watch and a warning. We simply must do more in educating the public and must provide the media with an appropriate explanation as the events occur. In our final report we will deal directly with this question of how warning messages should be phrased. At this time, we recommend no change.

Public Response. This is the biggest variable in the complex chain reaching from production to action. Larger cities with active Civil Defense efforts seem to do very well although the question of more sirens was raised many times.

The NOAA team emphasized the importance of preparedness at all our press briefings. As was the case in Alabama, people took decisive action by getting into basements, storm cellars, or inner parts of houses. They opened windows and doors and called neighbors. At other locations, in less tornado-prone areas, some people knew what actions to take while many did not. Although the school system in Xenia had a disaster plan, they had never conducted a tornado drill. It is our view that all officials with public responsibilities should be aware of the proper actions to be taken. Tornadoes are perhaps as likely as fires in public buildings. Education and movement of preparedness planning down to the smaller communities within the Nation presents a larger problem. The challenge is there for NOAA as well as for other agencies such as the DCPA. In our report, we will be addressing this aspect and the total system in detail.

We know from specific incidents that have been related to us, that the NOAA warning system helped in saving hundreds of lives. Were it not for the timely warnings by the Weather Service, the total loss of lives on April 3-4, might have been several thousand.

Tentative Findings and Recommendations

Our tentative findings and recommendations are summarized in this section. In general, we do not foresee any major changes in them, although they will be expanded in the report as added supportive material becomes available.

Findings. In general, the team has determined that:

1. NMC products gave accurate and timely forecasts of a major large scale storm development 36 hours in advance.

2. NSSFC gave widespread notice a day in advance to get ready for a major storm day. Radar and raob preparedness was emphasized.

3. SFSS gave 24-hour notice to NESS Operations to go to storm day routine. Pictures from ATS-3 were available at 30-minute intervals from 5:59 a.m. CDT until 1:49 p.m. CDT at which time pictures at about 13-minute intervals until 6:24 CDT were obtained. There was insufficient illumination to continue operations over the outbreak area after this time.

4. The early morning NSSFC "AC" outlook very accurately outlined the area in which storms occurred.

5. Tornado watch "boxes" were prepared and disseminated prior to nearly all the days tornadoes. Some confusion resulted, both in our field offices and with the media, due to the large number of boxes, some of which overlapped in time and space. Radar plots of existing storms appear to be the presently most used tool in preparing tornado watch boxes.

6. Network and local warning radars were absolutely essential to the success of our tornado warning program. In the press briefings, there were many questions about improvements in existing, as well as concerns about expansions in local warning radar coverage. Offices without radars or radar remotes were at a terrible disadvantage in trying to track and forecast the storms.

7. The lack of direct broadcast capability via VHF-FM in most of the area affected limited the effectiveness of the warning dissemination. This also received frequent attention from the media and the NWS offices visited.

8. The lack of emergency power was very evident in the case of the Covington radar and in keeping local warning radars operating under the stress of power surges.

9. Although NWWS (and RAWARC) stood up very well under the strain, there are far too many radio and TV stations without this service. We did note routine data being hauled on NWWS in a few cases when it may have been better to place total priority upon warnings and statements. Also,

there were some problems in relaying information from one state to another via NWWS. In addition, there is no question that our torn paper tape manual operation should be replaced by AFOS which will enhance our capability to respond as quickly as technology allows to severe weather situations as well as to streamline our whole communications system.

10. The preparedness activities on the part of state and local officials in Alabama and Tennessee were very effective, whereas, in the more northern states with less frequent tornado occurrences, there were many locations without any effective disaster plans at all.

11. The overall performance of the plans and equipment and the people of the Weather Service was superb. In a number of cases particular commendations should be issued.

Recommendations: As a result of the findings, the following items deserve the utmost attention and support.

1. Expand VHF as quickly as possible. Its usefulness in rapid and efficient transmission of warning messages especially to local officials, schools, hospitals, etc., within thickly populated areas would significantly enhance our ability to disseminate information.

2. Acceleration of the radar program is a must item. In our view, local warning radars provide the most effective tool available for detecting and forecasting the movement of storms at the office level. At a minimum, every WSO with county warning responsibility should have a radar remoting device. Visual imagery is an essential factor in being able to handle severe weather situations.

3. Emergency power at all offices with county warning responsibility is an important item. This is particularly so for those offices with radar capability.

4. AFOS must be implemented as quickly as possible if we are to obtain improvements in our ability to be as responsive to disasters as technology permits.

5. Community preparedness activities in cooperation with other Federal, State, and local government agencies should be expanded right now. Ad additional specialist at all WSFOs will go a long ways toward helping in preparedness planning and education, as well as in other areas such as the development of improved spotter networks.

6. The newly developed tornado detectors also should receive attention. In our view, these devices could provide another source of valuable information upon which to base severe thunderstorm and tornado warnings.

7. A techniques development staff located at NSSFC, as we have at NHC, will aid greatly in determining new ways and new applications of the data to be derived from radars, satellites, and other conventional sources.

8. With the planned May launch of GOES, twice-per-hour high resolution imagery will become available. All WSFOs, especially in severe weather areas, should have the capability to receive this data. The ATS-3 data contributed to the handling of this outbreak and we fully expect GOES data to be even more valuable in detecting and tracking severe weather events.