THE AUTOMATION OF FIELD OPERATIONS AND SERVICES *(AFOS)* WITHIN THE NWS AND ITS IMPACT ON AVIATION METEOROLOGY

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I would like to begin by presenting some details about our future program efforts in AFOS which, once again, stands for the Automation of Field Operations and Services within the National Weather Service, and then discuss aviation forecast products now available and our plans for future aviation products.

Within the National Weather Service (NWS), we have to begin dealing more realistically with the serious problem of expanding and improving our services (adding people is no longer feasible). We must also ensure that we can improve the response time of warnings that we issue within the national airspace system. The solution that we see internally at NWS is AFOS. The AFOS concept involves extensive use of mini-computers, video display, and rapid communications to aid our field personnel in their daily activities. By 1981 we hope to have completed the implementation of a National Distribution Circuit (NDC) connecting all our Weather Service Forecast Offices (WSFO's) and National Centers: The National Meteorological Center (NMC), National Severe Storms Forecast Center (NSSFC), National Hurricane Center (NHC), and the National Climatic Center (NCC), plus State Distribution Centers, (SDC) connecting all lower level stations with their parent WSFO's along the interfacing with the future FAA modernization program. Mini-computers at 200 stations will handle all communications, maintain the station data base, service the forecasters' data requests,

and drive cathode ray tube (CRT) display units. In a typical forecast work station, forecasters will be able to call up weather maps (within a few seconds) and compose messages on a console. Other combinations of graphic and alpha numeric consoles (including about 70 serviced by remote computer) are planned to meet the needs of individual NWS offices.

Some of the predominant characteristics of AFOS are:

.....communications will be consolidated and streamlined

.....the system is modular in structure

.....is not subject to catastrophic failure

.....can be implemented in phases adaptable to changing conditions and requirements

Now, I would like to present some more details on the NDC and SDC. The NDC (Figure 1) will replace existing facsimile (FAX) and teletypewriter circuits within the NWS by an 11,620 mile communication circuit connecting 47 **WSFO's,** three national centers, and a Systems Monitoring and Coordination Center (SMCC) in a closed loop. The NCC in Asheville, North Carolina, and forecast offices in Alaska, Hawaii, and Puerto Rico will be connected by spur nodes on the NDC. The NDC will consist of independent, leased, voice quality, station to station linkages, each operating at 2400 bits per second, full duplex. Circuit protocol will be simple stores and forward with full error checking on data in entry and receipt. All NDC communications will be computer to computer with each NDC link consisting of dual dedicated lines. In the event of failure of both leased lines, the stations involved will reestablish communications automatically via commercial telephone networks. When one of the leased lines comes back into operation, the telephone connections will be terminated. Data can be entered on the NDC at any of the stations and once on the circuit, will move from station to station in both directions

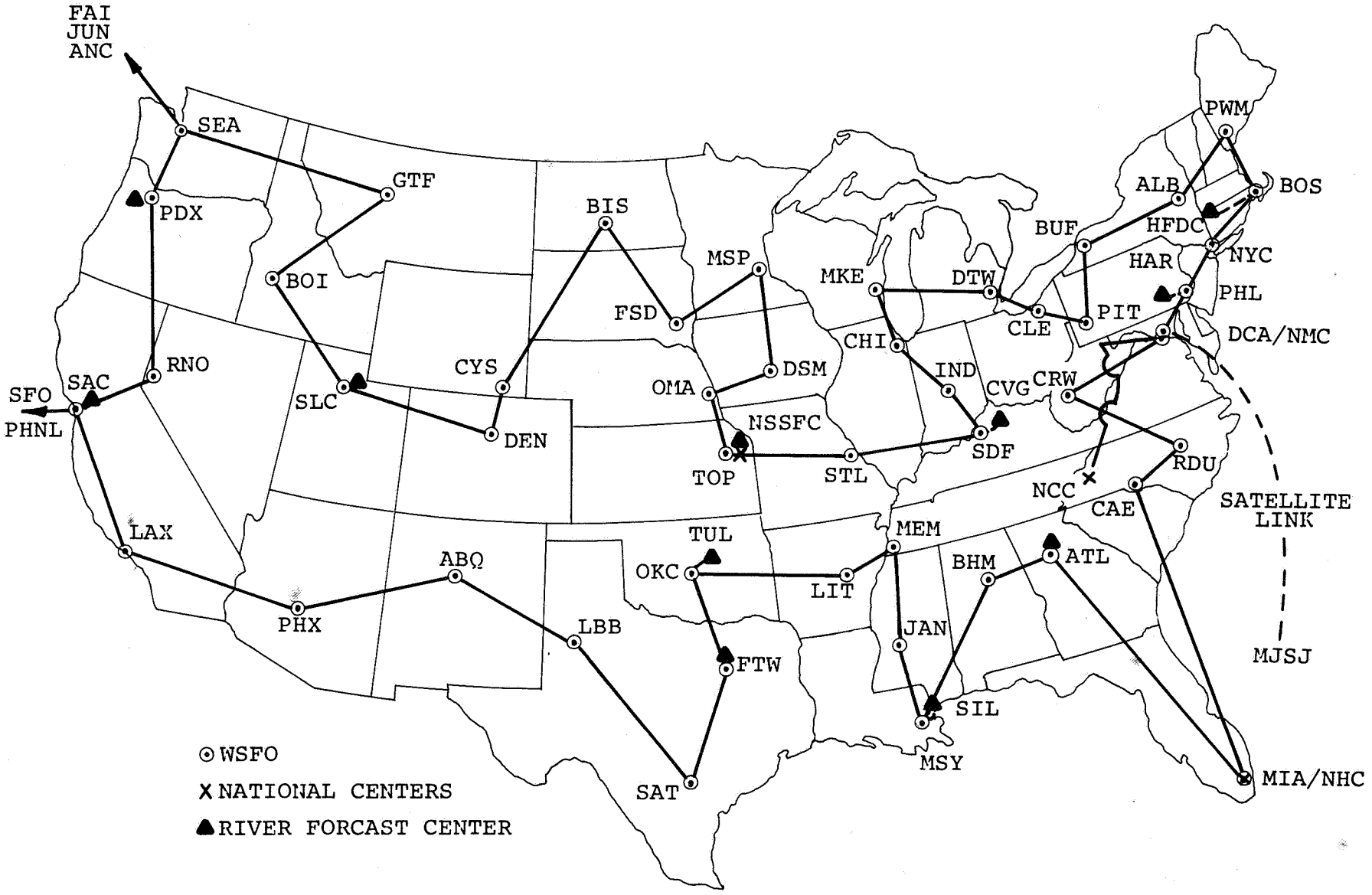


Figure 1 -- AFOS National Distribution Circuit

from the originator. In less than a minute the messages will be received in duplicate by a station on the opposite side of the NDC, whereupon it will be automatically removed from the circuit.

The state distribution circuit (SDC) is our second level of the ***AFOS*** communications system (Figure 2). It will connect from one to nine weather service offices (WSO's) and river forecast centers (RFC's) within each forecast area to the parent WSFO in a star configuration. This will allow each WSFO to exchange messages with the local level. Since the SDC's will be operated at *2400* bits per second, half duplex, many of the software and equipment modules will be common with those required for operation on the NDC. All data collected from meteorological observations (surface, upper air, radar, etc.) within a forecast area will follow local distribution circuits into the WSO and back along its SDC to the WSFO for distribution circuits into the WSO and back along its SDC to the WSFO for distribution on the NDC.

On January 30, 1976, the Department of Commerce signed the contract with Aeronautronic Ford Corporation to develop and install 213 AFOS automated weather stations over a 5-year period. The latest agreement calls for installation of about six field sites per month beginning with Pittsburgh, Pennsylvania, in January 1978 and ending with Hilo, Hawaii, in November 1980, at a total cost of about $35 million. Each WSFO will have two mini-computers, one for communications and storage, the other for on-station data processing and control. The WSO's and RFC's will have one mini-computer each, with storage of 128,000 bytes, equivalent to 64,000 words (16 bits each). AFOS will help the NWS eliminate the following tasks:

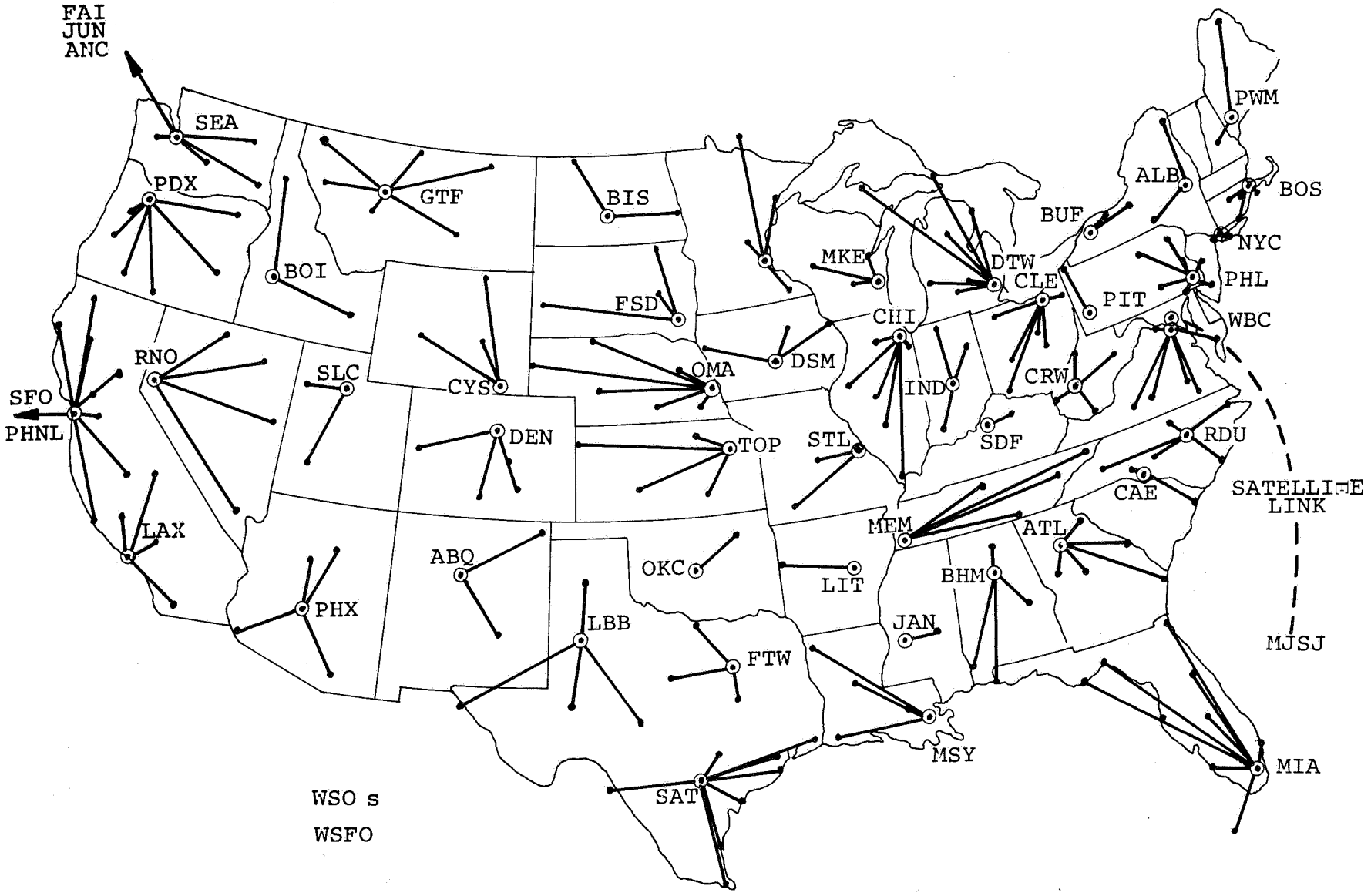
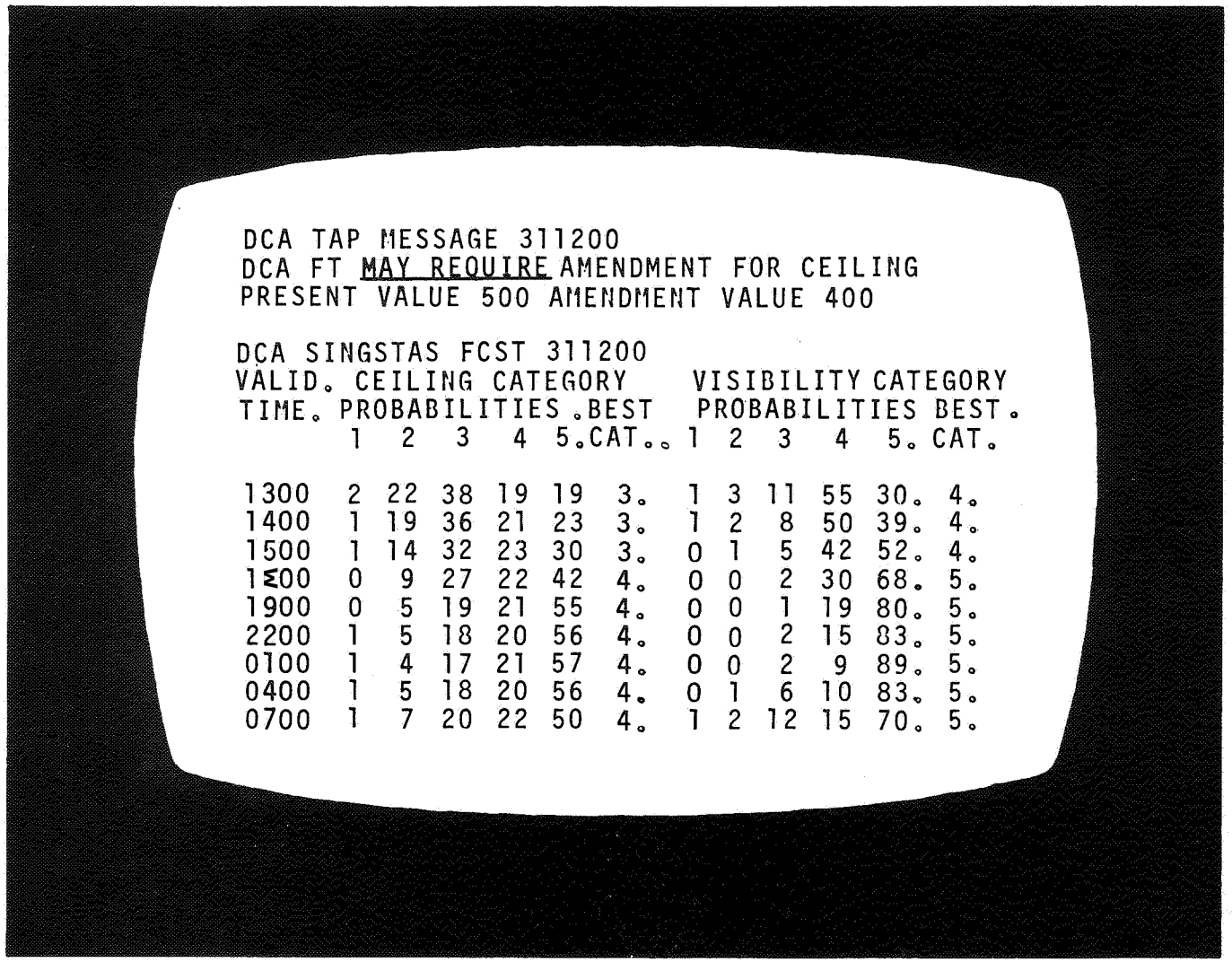


Figure 2 -- State Distribution Circuits (SDC)

tearing teletypewriter paper
posting facsimile charts
plotting local maps
cutting teletype tapes
relaying telephone messages
and telephoning long warning lists

Along with those items, we will be able to prepare more timely warnings. Once a message is prepared, AFOS will automatically transmit it to appropriate users, saving valuable time now lost in dissemination. And, of course, we are working to ensure that AFOS interfaces efficiently with the FAA modernization program. The Observational Program will also be assisted by AFOS's ability to collect observations more rapidly and more frequently, and monitoring the message content automatically for quality and accuracy. Video display systems will be utilized for text editing and message composition by the forecaster. By providing better tools to the forecaster, we will be able to produce more terminal forecasts for airports, river forecasts for more points on the river, more complete agricultural forecasts, more detail in forecasts, more efficient meteorological watches, and more frequent updating of forecasts, watches, and warnings.

To take advantage of AFOS capabilities, the NWS is working toward standardization of all our forecast product formats. One of the first programs we have developed for AFOS, which we feel will aid the aviation community, will be a program we call "Terminal Alert Procedures" (TAP), (See Figure 3). Establishing fixed formats for hourly observations and terminal forecasts will enable the computer to continuously monitor terminal forecasts for validity and alert the forecaster when the forecast needs amending, along with producing objective categorical forecasts as guidance.



DCA TAP MESSAGE 311200
DCA FT MAY REQUIRE AMENDMENT FOR CEILING
PRESENT VALUE 500 AMENDMENT VALUE 400

DCA SINGSTAS FCST 311200

VALID. TIME.	CEILING CATEGORY PROBABILITIES					BEST	VISIBILITY CATEGORY PROBABILITIES					BEST
	1	2	3	4	5.	CAT..	1	2	3	4	5.	CAT.
1300	2	22	38	19	19	3.	1	3	11	55	30.	4.
1400	1	19	36	21	23	3.	1	2	8	50	39.	4.
1500	1	14	32	23	30	3.	0	1	5	42	52.	4.
1600	0	9	27	22	42	4.	0	0	2	30	68.	5.
1900	0	5	19	21	55	4.	0	0	1	19	80.	5.
2200	1	5	18	20	56	4.	0	0	2	15	83.	5.
0100	1	4	17	21	57	4.	0	0	2	9	89.	5.
0400	1	5	18	20	56	4.	0	1	6	10	83.	5.
0700	1	7	20	22	50	4.	1	2	12	15	70.	5.

Figure 3 A TAP (Terminal Alerting Procedure) Message will be Automatically Received when the Present Value of a Meteorological Variable Approaches or Reaches the Amendment Value. Hourly Guidance Forecasts of Ceiling and Visibility for the First Four Hours Followed by Three-Hourly Forecasts will be Included.

After many years of hard work, we have developed a fixed format for pilot reports in the United States. Through a cooperative effort of the FAA, NWS, Department of Defense, and the airlines, we will now be able to sort pilot reports by type (icing, turbulence, sky condition, wind, and temperature) by location and altitude, and use these pilot reports more efficiently in monitoring our en-route forecasts and in-flight advisories. Right now, the NWS is producing a whole series of computer-derived aviation guidance products, using our model output statistics (MOS) approach, in which statistical relationships are determined between the forecast output of numerical weather prediction models (predictors) and observed occurrences of a particular weather element (predictand). Among the products are six category ceiling and visibility forecasts for 233 terminals with projections out to 48 hours from model runs of 00 and 1200 GMT, along with objective cloud cover amounts, in four categories for opaque sky cover in tenths. (See Table 1)

Table 1 Definition of the Categories Used for the Development of Prediction Equations for Ceiling, Visibility, and Cloud Amount

Category	Ceiling (ft.)	Visibility (mi.)	Cloud Amount (Opaque sky cover in tenths)
1	<200	<1/2	0-1
2	200-400	1/2-7/8	2-5
3	500-900	1-2 1/2	6-9
4	1000-2500	3-4	10
5	3000-7500	5-6	
6	>7500	≥7	

Objective freezing level, surface wind, precipitation, and temperature forecasts are also available in projections out to *48* hours. We are testing new satellite-derived products for use in aviation forecasting and briefing, along with more detailed radar charts. Future products being considered are automated route forecasts for any two points in the country, along with wind and temperature aloft forecasts for any location. A whole new series of aviation graphic products, time cross-sections, and work on voice response systems will help improve increasing mass dissemination requirements.

As can be seen, the NWS is working toward the implementation of new hardware to make our internal operation more efficient, along with improved guidance for our forecasters which should lead to more tailored and improved forecasts to aid the aviation community in getting from Point A to Point B more efficiently and safely.