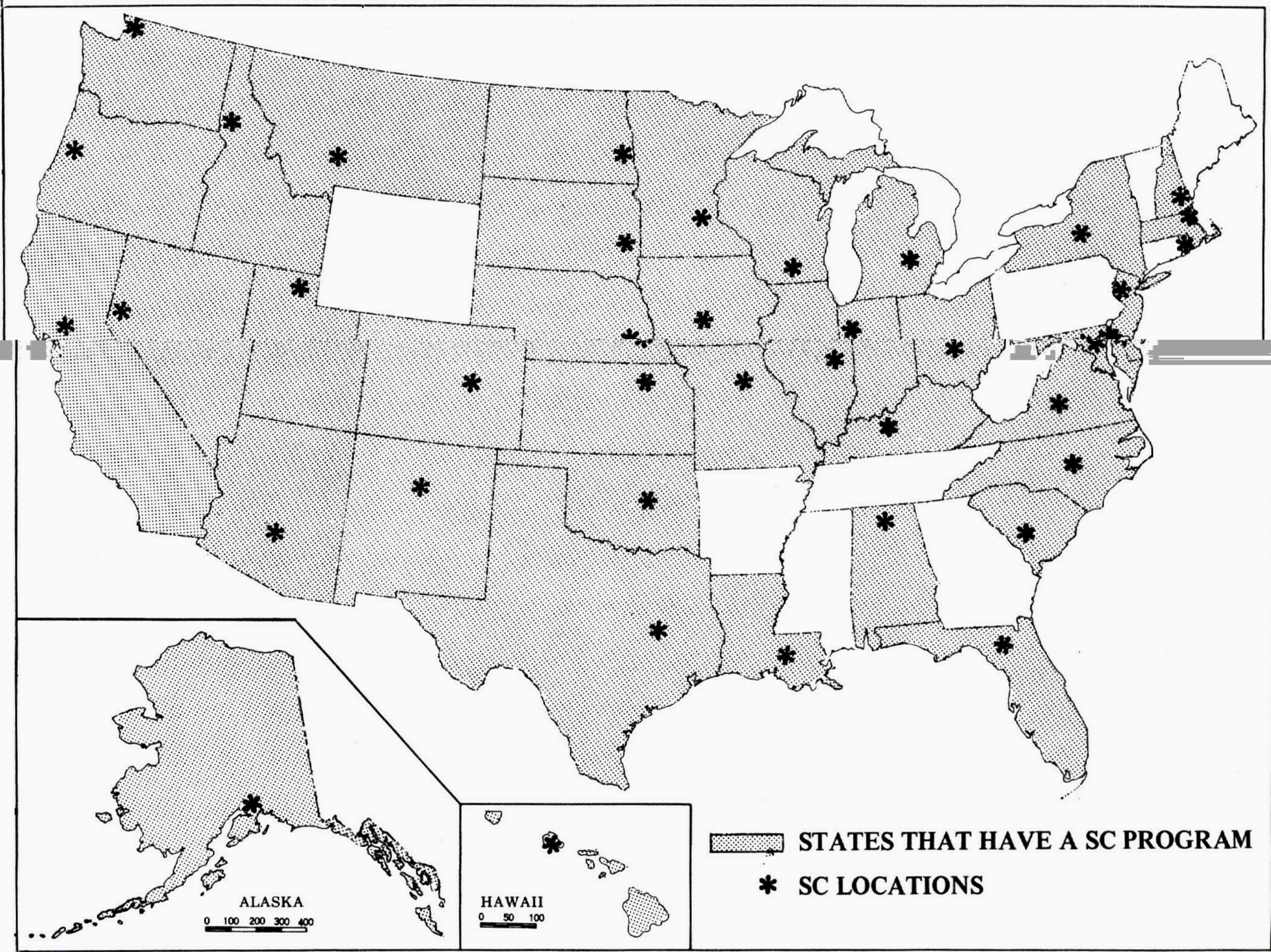
National Oceanic and Atmospheric Administration
Environmental Data and Information Service
National Climatic Center

NEWS LETTER

IN COOPERATION WITH
THE AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS



VOLUME 2 NUMBER 2 SEPTEMBER 1978

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NCC BRIEFS

NCC is pleased to announce that five more States - Alabama, Hawaii, North Carolina, Oregon, and Rhode Island, have recently established SC [redacted]

Two sample publications - Prototype Data Inventory and Station Climatic History - have been assembled at NCC as part of an effort to develop long-term data inventories for the United States and compile climatological time series for selected long-period stations. The purposes of this project are:

1. To determine the existence of recorded meteorological data during the 1800's and to synthesize available station documentation into a single reference source.

2. To create a unique digital data file of long-term climatological data for stations selected on the basis of the availability of adequate documentation regarding location, instrumentation exposure and observing practices.

Our intent is to produce a data inventory for each State and to do a number of individual station summaries. The State inventories will become a digitized information file amenable for computer information retrieval systems. A copy of each publication will be mailed to all SC's. We invite your comment regarding the contents and format of these publications.

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CLIMATIC ATLAS OF ALASKA'S OUTER CONTINENTAL SHELF - EDIS/NCC and the University of Alaska's Arctic Environmental Information and Data Center (AEIDC) have jointly compiled the Climatic Atlas of the Outer Continental Shelf Waters and Coastal Regions of Alaska. The atlas has three volumes: I. The Gulf of Alaska, II. The Bering Sea, and III. The Chukchi and Beaufort Seas covering the area from 50^o - 75^oN, 130^o - 180^oW. It was published in support of NOAA's Outer Continental Shelf Environmental Assessment Program for Alaska, being carried out for the Department of the Interior's Bureau of Land Management.

Each volume describes the climatology of the area and presents data analyses of surface marine and atmospheric parameters which will aid in assessing the risks involved in the construction and operation of energy-related structures in these Alaskan coastal waters. The climate data in each volume are presented in monthly isopleth maps and statistical graphs and tables. Elements included are: clouds, visibility, fog, precipitation, air and sea temperatures, waves, winds, sea-level pressure, and extratropical cyclones. The climatological analyses are based on 600,000 surface marine observations and on two million 3-hourly surface observations for 49 selected coastal stations contained in NCC's digital data base.

As marine data are typically sparse in the near coastal zone - an area of sharp gradients and complex climate - data from land stations were included to develop the best possible climatological picture. Environmental records and publications held by NCC and AEIDC provided supplemental information.

Each volume is 11½" x 11½" and contains 409 to 433 pages. Volumes I and II each contain 228 pages of three-color maps. Each map has an opposing page of graphs for selected marine and coastal stations. For those parameters that apply only to marine areas, such as sea-surface temperatures and wave data, the maps and graphs are on the same page. Volume III has fewer maps, since sea ice makes marine data sparse during winter months. The remaining pages for each volume consist of sections on selected topics such as storm surges, sea ice, weather extremes, tides, bathymetry, and ocean currents.

The atlas is available from the Arctic Environmental Information and Data Center, University of Alaska, 707 A Street, Anchorage, Alaska 99501, for $5 per volume ($15 for all three), plus postage and handling. A limited number of copies of the atlas are available from NCC.

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NCC has published a "Summary of Snyoptic Meteorological Observations (SSMO)" for Valdez and Cape Hinchinbrook, Alaska, and the adjacent marine area. Preparation of this SSMO was initiated for and supported in part by NOAA's Outer Continental Shelf Environmental Assessment Program for Alaska, being carried out for the Department of Interior's Bureau of Land Management; the funding for completion was made possible through the Marine Pilot Program of NOAA's National Oceanographic Data Center.

The monthly and annual statistical tables summarize wind direction and speed, weather occurrences, cloud amounts, ceiling height, visibility, precipitation, dry-bulb temperature, relative humidity, air-sea temperature difference, sea height and period, sea surface temperature, and sea-level pressure.

The data contained in these tables were obtained from Tape Data Family 11 (TDF-11), Marine Surface Observations, and Tape Data Family 14 (TDF-14), Land Surface Observations. Data for Valdez and Cape Hinchinbrook were edited and keyed to magnetic tape for a ten year period: Valdez hourly observations varied from 0800-1600 LST to 0500-2000 LST for the period July 1967 - June 1977; Cape Hinchinbrook observations were three hourly observations from 0100-1900 LST (excluding 1600 LST) for the period July 1964 - June 1974. The marine area in this volume is defined 59°N to Alaska's Coast, 144° - 149°W. The marine data contains weather observations taken aboard vessels of varying registry over the period 1929 - 1977.

A limited number of copies of the SSMO are available from NCC.

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STATUS OF SUBSTATION NETWORKS

	Networks as of Jan. 1, 1978						Networks as of July 1, 1978						Net Changes						Planned Network (a) Not Implemented
	a	ab	b	c	x	Total	a	ab	b	c	x	Total	a	ab	b	c	x	Total	
Eastern Region																			
Connecticut	9	5	38	0	0	52	8	5	38	0	0	51	-1	0	0	0	0	-1	0
Delaware	4	2	2	3	0	11	4	2	2	2	1	11	0	0	0	-1	+1	0	0
Maine	31	14	35	0	0	80	30	14	35	0	0	79	-1	0	0	0	0	-1	9 (5)
Maryland & D.C.	22	8	23	29	0	82	21	8	23	23	7	82	-1	0	0	-6	+7	0	0
Massachusetts	17	14	72	1	0	104	17	14	70	0	0	101	0	0	-2	-1	0	-3	1
New Hampshire	6	17	54	3	0	80	8	18	52	1	0	79	+2	+1	-2	-2	0	-1	1
New Jersey	7	13	62	14	0	96	7	13	61	9	5	95	0	0	-1	-5	+5	-1	0
New York	34	55	211	28	0	328	34	56	222	5	6	323	0	+1	+11	-23	+6	-5	7
North Carolina	45	46	104	19	0	214	45	45	104	11	6	211	0	-1	0	-8	+6	-3	1
Ohio	15	56	172	17	0	260	15	56	173	9	4	257	0	0	+1	-8	+4	-3	1
Pennsylvania	12	68	227	38	0	345	12	71	233	16	4	336	0	+3	+6	-22	+4	-9	8 (1)
Rhode Island	1	3	3	0	0	7	1	3	3	0	0	7	0	0	0	0	0	0	0
South Carolina	24	33	54	22	1	134	24	33	54	21	1	133	0	0	0	-1	0	-1	0
Vermont	6	9	53	5	0	73	6	10	56	0	0	72	0	+1	+3	-5	0	-1	1
Virginia	30	45	129	14	0	218	31	45	127	6	6	215	+1	0	-2	-8	+6	-3	1
West Virginia	18	40	97	6	0	161	18	43	98	2	1	162	0	+3	+1	-4	+1	+1	0
Totals	281	428	1336	199	1	2245	281	436	1351	105	41	2214	0	+8	+15	-94	+40	-31	30 (6)
Southern Region																			
Alabama	34	47	81	3	0	165	33	47	80	3	0	163	-1	0	-1	0	0	-2	1
Arkansas	21	67	135	1	0	224	20	67	136	1	0	224	-1	0	+1	0	0	0	1
Florida	59	40	47	6	0	152	59	40	46	6	0	151	0	0	-1	0	0	-1	3
Georgia	39	48	135	6	0	228	38	48	134	6	0	226	-1	0	-1	0	0	-2	2
Louisiana	28	41	97	3	0	169	28	41	100	3	0	172	0	0	+3	0	0	+3	5 (1)
Mississippi	25	53	108	3	0	189	25	54	108	3	0	190	0	+1	0	0	0	+1	2 (1)
New Mexico	65	72	71	6	0	214	61	75	69	5	0	210	-4	+3	-2	-1	0	-4	49 (21)
Oklahoma	14	95	219	1	0	329	14	95	219	1	0	329	0	0	0	0	0	0	0
Tennessee	42	33	66	1	0	142	42	33	65	1	0	141	0	0	-1	0	0	-1	0
Texas	87	230	533	11	0	861	94	231	527	11	0	863	+7	+1	-6	0	0	+2	49 (36)
Puerto Rico	2	22	69	0	0	93	2	22	69	0	0	93	0	0	0	0	0	0	0
Virgin Islands	0	5	19	3	0	27	0	5	21	3	0	29	0	0	+2	0	0	+2	1
Totals	416	753	1580	44	0	2793	416	758	1574	43	0	2791	0	+5	-6	-1	0	-2	113 (59)
Central Region																			
Colorado	8	130	141	3	0	282	9	128	138	0	1	276	+1	-2	-3	-3	+1	-6	56 (37)
Illinois	32	62	162	0	0	256	32	62	166	0	0	260	0	0	+4	0	0	+4	0
Indiana	23	51	105	20	0	199	25	51	103	12	2	193	+2	0	-2	-8	+2	-6	0
Iowa	10	93	180	1	0	284	10	93	185	0	0	288	0	0	+5	-1	0	+4	0
Kansas	11	105	326	0	0	442	9	106	328	0	0	443	-2	+1	+2	0	0	+1	0
Kentucky	29	46	124	10	0	209	29	46	129	9	0	213	0	0	+5	-1	0	+4	0
Michigan	42	61	159	37	0	299	45	63	157	34	1	300	+3	+2	-2	-3	+1	+1	0
Minnesota	16	111	111	20	0	258	16	111	111	10	2	250	0	0	0	-10	+2	-8	1
Missouri	8	109	194	5	0	316	8	108	190	5	0	311	0	-1	-4	0	0	-5	2
Nebraska	5	113	222	0	0	340	5	113	226	0	0	344	0	0	+4	0	0	+4	2 (1)
North Dakota	1	101	108	1	0	211	1	102	110	0	1	214	0	+1	+2	-1	+1	+3	1
South Dakota	11	98	72	6	0	187	14	93	72	4	1	184	+3	-5	0	-2	+1	-3	8
Wisconsin	4	101	107	8	0	220	4	101	107	6	0	218	0	0	0	-2	0	-2	0
Wyoming	21	111	55	1	0	188	22	110	55	1	0	188	+1	-1	0	0	0	0	44 (36)
Totals	221	1292	2066	112	0	3691	229	1287	2077	81	8	3682	+8	-5	+11	-31	+8	-9	114 (74)
Western Region																			
Arizona	41	111	73	4	0	229	41	115	70	1	1	228	0	+4	-3	-3	+1	-1	40 (9)
California	133	126	429	35	0	723	132	126	425	29	4	716	-1	0	-4	-6	+4	-7	19
Idaho	38	75	64	16	0	193	39	77	61	10	0	187	+1	+2	-3	-6	0	-6	32 (19)
Montana	40	170	161	7	0	378	38	175	160	7	0	380	-2	+5	-1	0	0	+2	23 (8)
Nevada	40	54	18	1	0	113	39	60	13	1	0	113	-1	+6	-5	0	0	0	78 (57)
Oregon	10	155	192	13	0	370	12	156	186	14	1	369	+2	+1	-6	+1	+1	-1	12 (2)
Utah	42	87	66	6	0	201	42	86	66	6	0	200	0	-1	0	0	0	-1	34 (23)
Washington	45	78	132	8	0	263	45	77	130	8	0	260	0	-1	-2	0	0	-3	11 (2)
Totals	389	856	1135	90	0	2470	388	872	1111	76	6	2453	-1	+16	-24	-14	+6	-17	250 (120)
Alaskan Region																			
Alaska	115	35	51	2	0	203	114	36	43	2	0	195	-1	+1	-8	0	0	-8	24
Pacific Region																			
Hawaii	0	32	248	8	0	288	0	32	251	2	0	285	0	0	+3	-6	0	-3	0
Pacific Islands	0	9	1	23	0	33	0	9	1	23	0	33	0	0	0	0	0	0	0
Totals	0	41	249	31	0	321	0	41	252	25	0	318	0	0	+3	-6	0	-3	0
GRAND TOTALS	1422	3405	6417	478	1	11723	1428	3430	6408	332	55	11653	+6	+25	-9	-146	+54	-70	531 (259)

The figures in parenthesis beside the planned (a) network indicate the number of locations approved for that type of substation which cannot be established at this time due to location in an uninhabited or remote area.

Also included in this table are 552 first- and second-order stations with network designations.

Alaska has no definite number of stations in the planned network due to circumstances peculiar to that area.

ENTER AFOS: NEW NATIONAL WEATHER NET NEARS

By Edwin P. Weigel

(Reprint from NOAA Magazine, Volume 8, Number 2, April 1978)

The National Weather Service's revolutionary new data-handling system known as AFOS is now going into place.

AFOS stands for Automation of Field Operations and Services. The installation of minicomputers and TV-type displays at the Pittsburgh Weather Service Forecast Office this spring marks the opening wedge in what will become in three years a nationwide network of more than 200 automated weather offices linked together in an 11,620-mile circuit.

AFOS will do away with the present system of teletypewriters and facsimile machines and the enormous quantities of paper they generate and substitute an all-electronic system in which weather information from the minicomputer systems will be displayed on TV-like screens.

It will free forecasters of much of the drudgery they must perform now and enable them to provide a greatly expanded and accelerated weather service to the nation at no increase in manpower. It will be especially helpful in speeding storm and flood warnings to people making critical, split-second decisions involving lives and property.

No longer will it be necessary for forecasters to spend vast amounts of time tearing off, sorting and posting paper teletypewriter messages and paper maps. A weather map will arrive on station in about 1/40th the time it takes on paper - 15 seconds instead of 10 minutes. Messages will arrive 30 times as fast - 3,000 words per minute instead of 100.

A message will go from one station on the main circuit to the station most remote from it in about 25 seconds, with error checks at an average of 24 places between them.

Installation of the AFOS system is to take place at three levels. The first level consists of the sophisticated automation of the 52 Weather Service Forecast Offices, three National Centers (the National Meteorological Center, the National Hurricane Center, and the National Severe Storms Forecast Center), and 14 River Forecast Centers. The National Centers and Forecast Offices will be linked together by the 11,620-mile National Distribution Circuit - a full-duplex communications line of telephone quality. The River Forecast Centers will be served with high-speed spur circuits.

The second level will be extension of AFOS into each Forecast Office's area of responsibility (generally a State), by automation of about 150 Weather Service Offices, with similar but simpler equipment. Messages between these smaller offices and the Forecast Offices also will move by high-speed communications links, in a "star" configuration.

The third level will be integration into AFOS of the 150 or so remaining Weather Service operational sites, and will be accomplished for the most part by operating them as remote terminals from the computers at the first and second-level stations.

Each of the 52 Forecast Offices will act as the collection point for all weather data acquired within its area. It will store the data locally and pass it on to all other weather offices. Thus the AFOS program contrasts sharply with previous trends in computerized data-handling in that it decentralizes the processing rather than centralizing it. Minicomputers have made this possible.

Each automated station will have at least one minicomputer. The minicomputer will have a built-in memory of 128,000 to 192,000 characters (letters or numbers), plus at least 10 million characters in storage on disks. Data will be available from minicomputer memories instantaneously; from disks in less than a tenth of a second.

Forecasters will have available a tremendous variety of weather maps and messages they can call up within seconds to aid them in preparing forecasts and warnings. To keep the data manageable, the minicomputers will be programmed to pull off the National Distribution Circuit only that data a Forecast Office wants. Information that has outlived its operational usefulness will be automatically purged.

The AFOS system will be enhanced by other automated devices and systems in existence or being developed - such as automatic weather-observing stations, digitized radar, and computer-assisted measurements of the upper air. These linkages will allow fast and frequent observations of changes taking place in the weather.

Russell G. McGrew, chief of the AFOS implementation staff at Weather Service headquarters, says that after the initial installation in May at Pittsburgh, new installations should be initiated at a rate of six to eight a month, until the system is complete, targeted for November, 1980. "We should be fully operational at all sites four to six months after that," he says.

Weather Service officials are well aware that the AFOS system is going to take some getting used to, and have made plans for making the transition as smooth as possible. Already, between 250 and 300 Weather Service personnel have received a preliminary introduction to AFOS at the Experimental Facility at Weather Service headquarters.

"Reactions so far have been very positive," says McGrew. He explains that as the early field installations come on the line, the first three months will "involve a lot of systems checkout, because for the first time we will have a lot of different places tied together, with live data flowing through field communications lines.

"During those first three months, our people will be getting formal training in the use of AFOS equipment but they won't be putting data through the system.

"Then, during the next three months, station personnel will start actually putting data through AFOS, but they will still have available their teletypewriter and facsimile equipment, for certain tasks. Finally, during a third three-month period, we will start pulling the old equipment out of the stations."

Each station, McGrew explains, will have a similar phasing in program, but for the later stations it should last four to six months instead of nine. McGrew explains that training will be provided by four teams of two persons each, who will be dispatched to field stations as installations are made, to impart their knowledge to their colleagues.

"These are Weather Service personnel, most of them with extensive field experience. They have been busy building up the curricula here at headquarters, preparing the workbooks to use when they visit the stations."

Any special hurdles to overcome? "I think the hardest job for our people will be to change the way they think and do the little things. Up until now, it has been sort of a rote process. They move along the walls, looking at certain charts and flipping through them, going through their sequence boards. Now they will have to learn what to do to bring certain messages and images up on the tubes in the sequence they want. It isn't difficult, but the old habits are so ingrained that for some it will be a bit difficult to form new habit patterns."

The planners realize that there has been some uneasiness about being "glued to a chair." Says McGrew: "We have tried to get away from that. At first, one almost got the impression that the forecaster walked in and strapped on his seatbelt and eight hours later got up out of the chair.

"Now we're aiming more toward sharing of the consoles, by jobs. We're also advocating the arrangement of consoles so that group discussions can take place, centered on what is being displayed. We think of it as an island type of philosophy, involving the basic thinking-through of the forecast in a group, followed by dispersal of group members to terminals to prepare the individual forecasts and messages.

"Also, the software programs are being written to allow for periodic relief. We're working toward a scenario that will allow the forecaster to keep only a general eye on the situation on a day that he expects to be relatively uneventful - for reassurance more than anything else. Perhaps he might want to be alerted only if the ceiling drops below 5,000 feet at some upstream station. He can have the computer programmed to let him know that without continuously monitoring the tube. He could be over at another desk reading NOAA Magazine, and merely glance up at a screen from time to time to monitor what's going on. So he wouldn't be tied precisely to the machine, but he would have a means of learning about a significant change."

Will audible alarms be used? "For a real warning situation there's a buzzer that goes off. and there's a flashing red light on the console. We've been urged to go to all kinds of tones and sounds, but we're trying to hold down the variations in audible alarms as much as possible, because if you have too many you tend to muck up the situation and endanger the effectiveness of the prime purpose. We're looking at lights only and blinking messages, that type of thing - devices that will tell the forecaster he should go to the console and review the situation but won't reach out and grab him at the lunch counter only for him to find out it's just a mediocre happening."

McGrew explains that the graphics being provided for AFOS by Ford Aerospace & Communications Corporation are much better than the system installed earlier in the Experimental Facility. "Beyond the actual display quality, they have much more flexibility. In the overlays, for example, the forecaster has independent control over the configuration of the lines - whether they're dashed, dotted, or solid - and he also has separate controls over the intensity. If his overlays begin to look like spaghetti, and he wants to reduce the confusion, he can fade one set of them out, temporarily, and then bring it back without having to recall it. This is one part I think they'll like. Then, too, there's the improved ability to zoom portions of images.

"Suppose you're looking at the total North American chart. Well, you can only plot so many stations on a chart of that scale. Now, when you zoom a certain portion, you have the ability to add more stations after you zoom, and get more data for the area you're interested in, because, as opposed to the previous sytem, you can zoom the chart without zooming the data on it.

"Another factor we've been paying a lot of attention to is helping forecasters review their material in the sequence they personally prefer. Some like to do it one way, others in a different way. With charts and clipboards, a forecaster walks back and forth along the wall, looking first at one, then another, in his own set pattern, or perhaps two or three patterns depending on the situation. With AFOS he can set up the sequence ahead of time - perhaps put today's 500-millibar chart on tube one; overlay yesterday's 500-millibar chart; then overlay something else. Then on tube two he puts all the observations for Missouri; on tube three something else. He can enter that sequence in the computer and give it a name, perhaps his own name. Then tomorrow when he comes in, all he has to do is call it up by that name and the whole operation takes place automatically. It's a sort of macroinstruction for the computer. And he can change it any time he wants to, by merely redefining the sequence of events. Furthermore, he can manage the time intervals - either by "saying" to the computer, proceed to the next step when I strike a key on the keyboard, so that he can hold a given step as long as he likes, or he can instruct it to operate by fixed time intervals. Put this up for 15 seconds, the next step for 20 seconds, and so on.

"Thus each forecaster in a weather office can have his own preferred way of doing things built right into the system."

McGrew says that a major change in the design of the AFOS system has been the addition of a second minicomputer for each Forecast Office. "One of the computers will handle the communications, the so-called front-end computer, and the other will handle all the office operations, the manipulation of data. At the same time the storage capacity has been increased to 128,000 characters in the front end and 129,000 characters in the other processor. And we've increased storage capacity on disks from 10 million to 20 million characters."

Another big change is in backup capability. Initially, it appeared that if the station's one and only minicomputer was shut down, the Forecast Office was out of business, temporarily, and would have to have its computer's memory refreshed by a neighboring office when it came back into operation.

"Now," says McGrew, "we have two levels of backup. For example, if something happens to one of the minicomputers, the other computer can do both jobs. It will be somewhat less responsive, but it can do all of the work. Then, if both computers go out, one of the consoles in the station can receive and transmit data by acting as a remote terminal to the AFOS Systems Monitoring and Coordination Center (SMCC) at Suitland, Md. That's a second level backup operation before you're out of business."

[redacted]

Reprint From

WEATHER & CLIMATE REPORT
Volume 1, Number 7, August 1978
Editors John R. Botzum & Rose Jacobius

THE U. S. NATL. CLIMATE PROGRAM WILL BE ENACTED BY THE 95TH CONGRESS when it returns from the Labor Day recess. A conference committee of members of the Senate and House have worked out their differences on the legislation (H.R.6669), and returned a report to the House but that body was unable to get to the measure because of the press of work necessary to adjourn 17 Aug.

As accepted by the conferees and certain to be accepted by all the members of the Congress, the bill calls for the establishment of a Natl. Climate Program Office by the Secretary of Commerce, while the President (operating through the Office of Science & Technology Policy) will establish a program with a five-year plan. Coordination among the affected federal agencies is required (Depts. of Agriculture, Commerce, Defense, Energy, Interior, State and Transportation; Environmental Protection Agency; Natl. Aeronautics & Space Administration; Council on Environmental Quality; Natl. Science Foundation; and OSTP). The new office at Commerce is due to be set up within 30 days after the bill becomes law; it will be lodged in the office of Asst. Administrator for Research & Development of the Natl. Oceanic & Atmospheric Administration. The office will be "the lead entity responsible for administering the program." Some $50 million is authorized for fiscal year 1979 and $65 [redacted]

The intergovernmental program will involve federal and state "cooperative activities in climate studies and advisory services." The Secretary of Commerce will make annual grants "to any state or group of states, such grants to be made available to public or private educational institutions, to state agencies and to other persons or institutions qualified to conduct climate-related studies or provide climatic related services." These will be 50% federal grants, and will be made in five areas: (1) climate effects on agriculture, water resources, energy need, "and other critical sectors of the economy"; (2) collection and monitoring on a state and regional basis of atmospheric data; (3) advice to regional, state and local governments on climate related issues; (4) information to users within a state on climate and climatic effects; and (5) information to the Secretary of Commerce on the needs of persons within a state for climate-related services, information, and data.

But before a state will be eligible for these grants ($10 million a year would be available beginning in FY 79), a state or group of states will have to adopt "a state climate program," which will include integration of the state program with the federal one, plus the establishment of "an effective mechanism for consultation and coordination with federal and local government officials and users within the state."

The congressional conferees noted that NOAA has already moved to establish a program office (with Edward Epstein in line to run it) and has brought in personnel from other agencies to start implementing the program. On board, or soon to be, are representatives from NASA, Natl. Bureau of Standards, Depts. of Defense and Agriculture, Natl. Center for Atmospheric Research, and the Natl. Science Foundation (a university person will be brought in). A "terribly important" slot to be filled, NOAA Asst. Administrator Ferris Webster said, is that of economist, because NOAA will have responsibility for understanding the social, economic and political impacts of climate. The congressional conferees noted that it is their intent that assessment of climatic impact conducted under the act will include "analyses, studies and recommendations for action concerning (1) the impact of small changes in climate on agriculture, the economy, commerce, technology and other areas of human endeavor; (2) appropriate changes in agriculture, economic, commercial, technological, and other practices to respond to the effects of climate; and (3) appropriate strategies to respond to man-induced changes in global and regional climates."

The conferees also intend that the research program will be "broadly interdisciplinary -- encompassing physical, chemical, biological, geological, and archeological and historical investigations ... The research program should study causes of climatic change including the relationships among the atmosphere, the hydrosphere, and the biosphere, that affect climate. It is hoped these studies would lead to the development of climate models which can be used to predict climate changes." The research program is also intended, the conferees went on, to include activities to "improve the understanding of the social, economic, and political impacts of climate change."

(NOTE: The above bill passed September 6, 1978.)

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