NOAA Western Region Computer Programs and Problems NWS WRCP - NO. 36

SOARING FORECAST PROGRAM

Salt Lake City, Utah
March 1986
(Revised)

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Weather Service

PREFACE

This Western Region publication series is considered as a subset of our Technical Memorandum series. This series will be devoted exclusively to the exchange of information on and documentation of computer programs and related subjects. This series was initiated because it did not seem appropriate to publish computer program papers as Technical Memoranda; yet, we wanted to share this type of information with all Western Region forecasters in a systematic way. Another reason was our concern that in the developing AFOS-era there will be unnecessary and wasteful duplication of effort in writing computer programs in National Weather Service (NWS). Documentation and exchange of ideas and programs envisioned in this series hopefully will reduce such duplication. We also believe that by publishing the programming work of our forecasters, we will stimulate others to use these programs or develop their own programs to take advantage of the computing capabilities AFOS makes available.

We solicit computer-oriented papers and computer programs from forecasters for us to publish in this series. Simple and short programs should not be prejudged as unsuitable.

The great potential of the AFOS-era is strongly related to local computer facilities permitting meteorologists to practice in a more scientific environment. It is our hope that this new series will help in developing this potential into reality.

NOAA WESTERN REGION COMPUTER PROGRAMS AND PROBLEMS NWS WRCP

1 Standardized Format for Computer Series. REVISED January 1984. (PB85 109668)
2 AFOS Crop and Soil Information Report Programs. Ken Mielke, July 1979. (PB85 110419)
3 Decoder for Significant Level Transmissions of Raobs. John A. Jannuzzi, August 1979. (PB85 109676)
4 Precipitable Water Estimate. Elizabeth Morse, October 1979.
5 Utah Recreational Temperature Program. Kenneth M. Labas, November 1979.
6 Normal Maximum/Minimum Temperature Program for Montana, Kenneth Mielke, December 1979. (PB85 112878)
7 Plotting of Ocean Wave Energy Spectral Data. John R. Zimmerman, December 1979. (PB85 112860)
8 Raob Plot and Analysis Routines. John A. Jannuzzi, January 1980.
9 The SWAB Program. Morris S. Webb, Jr., April 1980. (PB80-196041)
10 Flash-Flood Procedure. Donald P. Laurine and Ralph C. Hatch, April 1980. (PB80-298658)
11 Program to Forecast Probability of Summer Stratus in Seattle Using the Durst Objective Method. John R. Zimmerman, May 1980.
12 Probability of Sequences of Wet and Dry Days. Hazen H. Bedke, June 1980. (PB80-223340)
13 Automated Montana Hourly Weather Roundup. Joe L. Johnston, July 1980. (PB81-102576)
14 Lightning Activity Levels. Mark A. Mollner, July 1980. (PB81-108300)
15 Two Fortran Applications of Wind-Driven Ekman Water Transport Theory: Upwelling Index and Storm Tide. Kent S. Short, July 1980. (PB81-102568)
16 AFOS System Local Data Base Save and Rebuild Procedures or A Master Doomsday Program. Brian W. Finke, July 1980. (PB81-108342)
17 AFOS/RDOS Translator Subroutine. Morris S. Webb, Jr., August 1980. (PB81-108334)
18 AFOS Graphics Creation from Fortran. Alexander E. MacDonald, August 1980. (PB81-205304)
19 DATAKEYØ Repair Program. Paul D. Tolleson, August 1980. (PB81-102543)
20 Contiguous File Transfer from the DPCM to the DCM. Paul D. Tolleson, September 1980. (PB81-128035)
21 Freezing Level Program. Kenneth B. Mielke, September 1980. (PB81-128043)
22 Radar Boresighting Verification Program. Thomas E. Adler, November 1980. (PPB81-182677)
23 Accessing the AFOS Data Base. Matthew Peroutka, January 1981.(PB81-190266)
24 AFOS Work Processor. Morris S. Webb, Jr., February 1981. (PB81-210007)
25 Automated Weather Log for Terminal Forecasting. John A. Jannuzzi, February 1981. (PB81-210999)
26 Program to Computer Downwind Concentrations from a Toxic Spill. John R. Zimmerman, February 1981. (PB81-205296)
27 Animation of AFOS Graphics. Joe Wakefield and Jim Fors, April 1981. (PB85 109833)
28 AFOS Interactive Graphics. Jim Fors, Don Laurine, and Sandy MacDonald, April 1981(PB85 110401)
29 Computer Programs for Aviation Forecast Transmission. Kenneth B. Mielke and Matthew R. Peroutka, May 1981.(PB85 110518)
30 AFOS Product Collective Program. Morris S. Webb, Jr., September 1981. (PB85 109841)
31 Graphic Display of FOUS Output. Stephen D. Steenrod, September 1981. (PB85 109817)
32 Automation of Hourly Aviation Observation Calculations. W. Paul Duval, October 1981. (PB85 109650)
33 Mesoscale Objective Analysis. Andrew J. Spry and Jeffrey L. Anderson, December 1981. (PB85 109825)
34 Orographic Snowfall Rate Model for Alta, Utah. Steven K. Todd and Glenn E. Rasch, December 1981. (PB85 109874)
35 F-6 Monthly Climatic Summary Program for AFOS. Peter G. Mueller, May 1982. (PB85 109858)

NOAA Western Region Computer Programs and Problems NWS WRCP NO. 36

SOARING FORECAST PROGRAM

David S. Toronto
National Weather Service Office
Eureka, California

and

Glenn R. Lussky
Scientific Services Division WRH
Salt Lake City, Utah

March 1986
(Revised)

UNITED STATES
DEPARTMENT OF COMMERCE
Malcolm Baldrige, Secretary

National Oceanic and
Atmospheric Administration
John V. Byrne, Administrator

National Weather
Service
Richard E. Hallgren, Director

This technical publication has been reviewed and is approved for publication by Scientific Services Division, Western Region.

Glenn E. Rasch

Glenn E. Rasch, Chief
Scientific Services Division
Western Region Headquarters
Salt Lake City, Utah

CONTENTS

SOARING FORECAST PROGRAM

David S. Toronto
National Weather Service Office, Eureka, California

and

Glenn R. Lussky
Scientific Services Division, WRH

I. GENERAL INFORMATION

A. Summary

Soaring is becoming an increasingly popular sport in many regions of the United States, particularly in the Western Region where the atmospheric conditions tend to be very favorable for soaring during much of the warm season. Because of the importance of the vertical temperature structure and wind conditions with regard to soaring, program SR was written as an aid for the participant. This program is a revised version of the original program named SOAR written by David S. Toronto in July 1982. The program has been made universal so that any location may run it without requiring program changes and recompilation. The data input in the run line was also changed so that it now uses switches to identify the raob station, the node of the raob station, the soaring site station and the forecast maximum temperature at the soaring site. The program reads both the mandatory and the significant levels of the raob data from the AFOS MAN and SGL files, and attempts to read the maximum temperature for the soaring station from the AFOS CCF file if no temperature switch is inserted in the run line.

B. Environment

The program is written in Data General FORTRAN IV and is designed to be run in the background of AFOS.

C. References

1. Higgins, Harry C., 1963: "The Thermal Index", Soaring Magazine, Vol. 27 No. 1, pp. 8-11.

2. Lindsay, Chas. V.: "Forecasting Thermal Conditions for Soaring", WSFO Washington, D.C.

3. Peroutka, Matthew, 1981: "Accessing the AFOS Data Base", Western Region CP No. 23.

II. APPLICATION

A. Program Description

The purpose of this program is to develop a timely and accurate set of thermal indices and other related data using the 12Z upper-air data and the maximum temperature forecast for the station being used. This information may then be distributed to soaring pilots and other users.

The program performs two basic functions:

First, the program retrieves upper level data from the mandatory and significant level data files, using the subroutines in AFREAD.LB. Data retrieval is terminated at 400 mb or the first level above 400 mb. If no temperature switch is included in the run line, the program will also try to read the coded cities forecast (CCF) file.

Second, the program processes the data into several indices and other useful parameters. The indices are obtained by checking at each level the difference between the actual sounding temperature and the temperature of the forecast surface maximum cooled adiabatically to that level. Also calculated is the height of each level in feet so that indices at certain heights may be obtained. The indices computed are:

1. The Thermal Index at 5,000 feet. The difference between the two referenced temperatures at five-thousand feet.
2. The Thermal Index at 10,000 feet. The difference between the two referenced temperatures at ten-thousand feet.
3. Height of The -3 Index. Height where actual temperature is less by three than the temperature along the dry adiabat.
4. Top of the Lift. Height at which the two temperatures are the same.

Other calculated parameters are:

1. First Usable Lift. Actual temperature at 4,000-feet AGL adiabatically warmed to the surface.
2. Max Lift. (Calculated using Top of Lift).

Note: Experience has shown that these are only estimated values and that individual analysis and experience in modifying the values will often improve the numbers shown. These data are only guidance.

Equations used:

1. Temperature at a given level:

$$T = Y(J) + \frac{Y(J+1) - Y(J)}{X(J)^{.288} - X(J+1)^{.288}} * (X(J)^{.288} - X(J+1)^{.288})$$

where Y(J) and Y(J+1) are the temperatures at levels J and J+1
X(J) and X(J+1) are the pressures at levels J and J+1
J=1 is the surface level; J=2 is the next given level; etc.

This equation interpolates the temperatures between Y(J), X(J), and Y(J+1), X(J+1) and takes into account the change of the spacing between pressure levels on the pseudo-adiabatic chart using the .288 power. Using this equation the temperature may be evaluated at any point along the sounding.

2. Temperature along a given dry adiabat:

$$T1 = T * \frac{PX}{X(1)}^{.288}$$

where X(1) is the surface pressure, T is the maximum temperature, and PX is the pressure at some given level.

3. Height of pressure levels in meters:

$$H = 5570 - 14.6281(PX) + 0.00997083(PX)^2 + 4.65217(10^{-6})(PX)^3 - 9.49604(10^{-10})(PX)^4$$

where PX is the pressure at a given level in mb.

This equation was derived using the pseudo-adiabatic chart and takes into account the change in spacing of the pressure levels and the change in spacing of the height levels. The equation is centered on 500 mb (5570 m); thus, the program subtracts 500 from the current pressure before evaluating the height and adds 500 after the computation is complete.

4. For calculating max lift:

$$IFPS = 200 + 0.0485(H4-3000)$$

where H4 is the top of the lift minus the station elevation above sea level.

This equation was derived using a graphic representation of the relationship between the top of the lift and maximum lift. (See Reference No. 2).

B. Program Requirements:

In order to store the program output in your data base, you must have the product CCCSRGXXX in DATAKEYO or on your wish list. CCC is the WSFO code and XXX is your station code.

III. OPERATING INSTRUCTIONS

Program Execution:

1. RUN:SR CCC/C XXX/R BBB/S FFF/T

Where

XXX is the raob station code which you want to use,
CCC is the node of the raob station,
BBB is the station for which the soaring forecast is being made,
and FFF is the maximum high temperature expected at the forecast site.

Notes:

a) The raob station (XXX) and raob station node (CCC) switches must be included in the run line. The program uses the mandatory and significant level data from the raob station as read from AFOS.

b) The forecast station code (BBB) must be included in the run line if the program operator wishes to use the CCF file to find the maximum temperature forecast at the station. The program will find the station in the CCF file of either the operating station's node or the raob station's node, if they are different.

c) If the node of the soaring site is different than the operating station's node and the raob station's node, or if the soaring site is not listed in the CCF file of these nodes, the temperature switch (FFF/T) is required. If the CCF file is used, be sure that the first temperature listed in it is the maximum temperature forecast (i.e., the forecast on the midnight shift), since the program automatically keys on that number. If the afternoon CCF has already been issued, the operator can always bypass the file by using the temperature switch.

2. Examples shown as run from WRH:

RUN:SR SLC/R SLC/S SLC/C

This command line would read the mandatory and significant level raob data from SLC and would then read the maximum temperature from the CCF file for soaring station SLC. See output in Figure 1.

RUN:SR ELY/R CDC/S RNO/C

This command lines uses the Ely raob data (whose node is RNO) to calculate a soaring forecast for Cedar City. It will read the maximum temperature from the SLCCCFSLC file only if run from a site whose node is SLC. See output in Figure 2.

3. If run from an ADM, an alert will flash when a graphic is stored.

Error conditions -

ADM messages: An alert will flash with one of the following messages:

SOAR ABORTED! ERROR CONDITION - CMD NEEDS /T

This occurs when the program could not find the soaring site in the CCF files of either the operating station's node or the raob station's node.

SOAR ABORTED! ERROR CONDITION - MAN RD ERROR
SGL RD ERROR
CCF RD ERROR

These messages occur when the program has trouble reading the mandatory, significant level, or coded cities forecast files.

SOARING FORECAST PROGRAM

PART A: PROGRAM INFORMATION AND INSTALLATION PROCEDURE

PROGRAM NAME: SR REVISION NO.: 2.00

PURPOSE: This program calculates the thermal indices and related data for the sport of soaring.

PROGRAM INFORMATION:

Development Programmers:		Maintenance Programmer:
David S. Toronto		Glenn R. Lussky
Glenn R. Lussky		
Location: WRH/SSD		Location: WRH/SSD
Phone: FTS 588-5131		Phone: FTS 588-5131
Language: FORTRAN IV		
Save File Creation Dates	-	2/21/86
Running Time: 1 Minute		
Disk Space: Program Files	-	50 RDOS Blocks

PROGRAM REQUIREMENTS:

Program Files:

Name:	Comments:
SR.SV	Put on DPØ or link to DPØ

AFOS PRODUCTS:

ID	Action	Comments:
CCCSRGXXX	Stored	Output Default
CCCCCFCCC	Read	
CCCMANRRR	Read	
CCCSGLRRR	Read	

LOAD LINE:

```
RLDR SR PROD AFREAD.LB UTIL.LB BG.LB FORT.LB AFOSE.LB
```

PROGRAM INSTALLATION:

1. Put SR.SV on DPØ or put on another directory and link to DPØ.

2. Ensure that your site specific CCCSRGXXX is in your AFOS data base.

SOARING FORECAST PROGRAM

PART B: PROGRAM EXECUTION AND ERROR CONDITIONS

PROGRAM NAME: SR REVISION NO. 2.00

PROGRAM EXECUTION:

1. RUN:SR CCC/C XXX/R BBB/S FFF/T

Where

XXX is the raob station code which you want to use,
CCC is the node of the raob station,
BBB is the station for which the soaring forecast is being made,
FFF is the maximum high temperature expected at the forecast site.

Notes:

a) The raob station (XXX) and raob station node (CCC) switches must be included in the run line. The program uses the mandatory and significant level data from the raob station as read from AFOS.

b) The forecast station code (BBB) must be included in the run line if the program operator wishes to use the CCF file to find the maximum temperature forecast at the station. The program will find the station in the CCF file of either the operating station's node or the raob station's node, if they are different.

c) If the node of the soaring site is different that the operating station's node and the raob station's node, or if the soaring site is not listed in the CCF file of these nodes, the temperature switch (FFF/T) is required. If the CCF file is used, be sure that th first temperature listed in it is the maximum temperature forecast, since the program automatically keys on that number.

2. Examples:

RUN:SR SLC/R SLC/S SLC/C

This command line would read the mandatory and significant level raob data from SLC and would then read the maximum temperature from the CCF file for soaring station SLC.

RUN:SR ELY/R CDC/S RNO/C

This command line uses the ELY raob data (whose node is RNO) to calculate a soaring forecast for Cedar City. It will read the maximum temperature from the SLCCCFSLC file only if run from a site whose node is SLC.

3. If run from an ADM, an alert will flash when a graphic is stored.

Error conditions -

ADM messages: An alert will flash with one of the following messages:

SOAR ABORTED! ERROR CONDITION - CMD NEEDS /T
This occurs when the program could not find the soaring in the CCF files of either the operating station's node or the raob station's node.

SOAR ABORTED! ERROR CONDITION - MAN RD ERROR
SGL RD ERROR
CCF RD ERROR
These messages occur when the program has trouble reading the mandatory, significant level, or coded cities forecast files.

```
SLCSRGWRH
WOUS00 KSLC

        SOARING FORECAST FOR SLC          DATE... 3/14/1986...12Z

THERMAL INDEX....MINUS SIGN INDICATES INSTABILITY
                 5000 FT ASL..... -6.0
                10000 FT ASL.....  0.0
HEIGHT OF THE -3 INDEX.....  7400 FT ASL
TOP OF THE LIFT.....  9900 FT ASL
SLC  MAX TEMPERATURE..... 46 DEGREES F
FIRST USABLE LIFT..... 42 DEGREES F
MAX LIFT..... 322 FT/MIN
UPPER LEVEL WINDS
                 5000 FT ASL..... 105 DEGREES AT 03 KNOTS
                10000 FT ASL..... 260 DEGREES AT 05 KNOTS

IT IS EMPHASIZED...THIS SOARING INFORMATION IS VALID ONLY FOR THE
RAOB SITE AREA AND FREQUENTLY WILL NOT APPLY TO OTHER AREAS
IN THE STATE.
```

Figure 1.

```
SLCSRGWRH
WOUS00 KSLC

        SOARING FORECAST FOR CDC          DATE... 3/14/1986...12Z

THERMAL INDEX....MINUS SIGN INDICATES INSTABILITY
                 5000 FT ASL.....-10.5
                10000 FT ASL..... -6.0
HEIGHT OF THE -3 INDEX..... 13600 FT ASL
TOP OF THE LIFT..... 16900 FT ASL
CDC  MAX TEMPERATURE..... 46 DEGREES F
FIRST USABLE LIFT..... 35 DEGREES F
MAX LIFT..... 563 FT/MIN
UPPER LEVEL WINDS
                 5000 FT ASL..... /// DEGREES AT // KNOTS
                10000 FT ASL..... 015 DEGREES AT 15 KNOTS


IT IS EMPHASIZED...THIS SOARING INFORMATION IS VALID ONLY FOR THE
RAOB SITE AREA AND FREQUENTLY WILL NOT APPLY TO OTHER AREAS
IN THE STATE.
```

Figure 2.

NOAA Computer Programs and Problems NWS WR (continued)

36 Soaring Forecast Program. D. S. Toronto and G. R. Lussky, Revised March 1986.
37 Program to Work Up Climatic Summary Weather Service Forms (F-6, F-52). Peter G. Mueller, August 1982. (PB85 109866)
38 The Hovmoller Diagram. Pamela A. Hudadoff, September 1982. (PB85 112159)
39 850-Millibar Charts Derived from Surface Data. Jeffrey L. Anderson, December 1982. (PB85 112175)
40 AFOS Vector Graphic to Grid Point Program. James R. Fors, December 1982. (PB85 109544)
41 A Pilot Briefing Program for the Background Partition. Kenneth B. Mielke and Joe L. Johnston, March 1983. (PB85 109551)
42 AEV Local Verification for Aviation, Precipitation, and Temperature Programs: AV, REl, TEM. Lawrence B. Dunn, Revised May 1985. (PB85 210342/AS)
43 OBLOG. Nancy Larsen, December 1983. (PB85 109528)
44 Communications Software for Olympics Micromation Computer System. Glen Sampson, June 1984. (PB85109510)
45 PLOTFILE Appender. Wendy L. Wolf, July 1984. (PB85 109502)
46 Spectral Wave Data Analysis (Non-directional). Lawrence Dunn, August 1984. (PB85 109577)
47 Isentropic Objective Analysis. Jeffrey L. Anderson, August 1984. (PB85 112167)
48 Hurricane Plotting Program. Paul D. Tolleson, October 1984. (PB85 121432)
49 Hemispheric Spectral Wave Analysis (Waves 0 to 7). Mary F. Milkovich, August 1985.
50 AOS Graphic to Grid Point Conversion and Departure from Normal Programs. Jeffrey L. Anderson and Mark A. Mathewson, August 1985.
51 Sunrise/Sunset and Moonrise/Moonset. Glenn R. Lussky, January 1986 (revised).
52 Objective Contour Analysis Using the Surface of Least Bending (Spline Analysis). Les Colin, November 1985.
53 DATACOL - AFOSPLOT Program. Donald P. Laurine and Timothy K. Helble, February 1986.

NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

The National Oceanic and Atmospheric Administration was established as part of the Department of Commerce on October 3, 1970. The mission responsibilities of NOAA are to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

The major components of NOAA regularly produce various types of scientific and technical information in the following kinds of publications:

PROFESSIONAL PAPERS — Important definitive research results, major techniques, and special investigations.

CONTRACT AND GRANT REPORTS — Reports prepared by contractors or grantees under NOAA sponsorship.

ATLAS — Presentation of analyzed data generally in the form of maps showing distribution of rainfall, chemical and physical conditions of oceans and atmosphere, distribution of fishes and marine mammals, ionospheric conditions, etc.

TECHNICAL SERVICE PUBLICATIONS — Reports containing data, observations, instructions, etc. A partial listing includes data serials; prediction and outlook periodicals; technical manuals, training papers, planning reports, and information serials; and miscellaneous technical publications.

TECHNICAL REPORTS — Journal quality with extensive details, mathematical developments, or data listings.

TECHNICAL MEMORANDUMS — Reports of preliminary, partial, or negative research or technology results, interim instructions, and the like.

Information on availability of NOAA publications can be obtained from:

ENVIRONMENTAL SCIENCE INFORMATION CENTER (D822)
ENVIRONMENTAL DATA AND INFORMATION SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

6009 Executive Boulevard
Rockville, MD 20852