NWS-CR-90-35

CRH SSD
OCTOBER 1990

CENTRAL REGION TECHNICAL ATTACHMENT 90-35

PRODUCT UNIFORMITY AT THE MINNEAPOLIS CWSU DURING 1989

Arden Berge
National Weather Service Center Weather Service Unit
Farmington, Minnesota

1. Introduction

The issuance of Center Weather Service Unit (CWSU) products is similar to the issuance of other National Weather Service (NWS) watch and warning products. There needs to be a balance between making sure all situations with the potential for adverse conditions are covered adequately without overforecasting. If they are over used, there is the danger that the aviation community will not react properly when there is a very real danger to the flying public.

Forecast products issued by the CWSU are the Meteorological Impact Statement (MIS) and the Center Weather Advisory (CWA). Both products do not easily lend themselves to objective verification. If you have done a good job as a forecaster and gotten an advisory out and if pilots have taken you seriously, then no one will be flying into severe icing, turbulence, or a thunderstorm. If no one flies through those severe conditions, then there is generally no direct verification of their existence. Even with good radar, satellite, and surface observations, there is still some degree of speculation as to what is really going on at flight level. With sophisticated equipment, such as Doppler radar, coming into use we will be able to lessen this uncertainty to some extent.

One of the goals the National Weather Service, including the CWSU's, strives for is uniformity. By that is meant under similar situations forecasters will issue similar products. This does not imply that National Weather Service is trying to turn forecasters into robots. However, most offices do have a set of guidelines, written or implied, so that when certain conditions are met specific products are to be issued. This uniformity builds a higher public confidence and leads to the public being better prepared and reacting better when adverse weather develops.

The same holds true for the Center Weather Service Units. The FAA and other parts of the aviation community will be better prepared and have a better idea how to react to adverse weather if they are provided a uniform service. There is enough uncertainty in the weather itself that can cause problems for the aviation community without additional uncertainty being added by large differences in the advice being given to the aviation community under similar weather conditions.

2. Measuring the Uniformity of Products

Measuring the uniformity of the advice being given to the aviation community by a CWSU is quite difficult. To make some crude qualitative measurements of the forecaster to forecaster uniformity in the products the Minneapolis (ZMP) CWSU issue, several assumptions have to be made.

The first assumption is that over a long enough period of time all CWSU meteorologists will encounter approximately the same amount of adverse weather requiring the issuance of approximately the same number of Meteorological Impact Statements (MIS) and Center Weather Advisories (CWA). That period of time has

to take into account both the natural variability of weather and also the variability of work schedules which are affected by Regular Days Off (RDO), Administrative Shifts, Sick Leave, Holiday Leave, Annual Leave, and Training. These considerations rule out meaningful comparisons for time periods as short as a week and even a month. It is more necessary to make comparisons over time periods of several months to a full year.

The second assumption is the information available to each forecaster is the same. This sounds like a reasonable assumption to make and to expect to be true. In the case of nationally distributed products such as surface observations and NWS charts it should indeed be true. In the case of information being provided to each forecaster by FAA personnel at an Air Route Traffic Control Center (ARTCC), there may not be the same amount and quality of information getting to each forecaster. The flow of information from the ARTCC personnel may be influenced by the personal rapport a forecaster has with some of the ARTCC staff. The flow of information from the ARTCC personnel may also be influenced by the initiative of the individual forecaster. This may vary from an individual who solicits information even when he/she doesn't really expect to find any adverse conditions, to the individual who takes the approach that as long as no one tells him/her about adverse conditions then nothing must be happening (the see no evil and hear no evil, so everything must be okay approach) even if they suspect something may be going on. Better personal rapport and more initiative may result in one forecaster issuing a greater number of MIS and CWA than the rest of the staff. We have consciously chosen to assume that there are no significant differences between forecasters.

It is also necessary to take note of the way the CWSU is staffed and some generalities of when and how often some of the products are issued. ZMP operates on two daily shifts. The first is from 5:00 a.m. to 1:00 p.m. local and the second is from 1:00 p.m. to 9:00 p.m. local. The main products, as mentioned above, are the MIS and the CWA. The MIS is meant to be a planning product to help the air traffic community make plans for significant weather expected during the next 8-12 hours. In that sense it is a forecast product. If a MIS is called for, there is a need to issue it as soon as possible upon beginning the 5:00 a.m. to 1:00 p.m. shift (early shift) since the last MIS issued was the night before. Also, by the time the early shift is about over and the 1:00 p.m. to 9:00 p.m. shift (late shift) is about to begin, the first MIS is 7-8 hours old and generally can use some "fine tuning." That could be left to the late shift but it is customary at the ZMP CWSU to issue any needed MIS just before the late shift starts so that the oncoming forecaster has time to thoroughly look over the situation before having to issue products. Finally, if the late shift forecaster anticipates significant weather overnight, then he/she generally issues an MIS just before leaving. This is not to imply that these issuances happen everyday. There are quite a few days when no MIS are issued at all and other days when four or five may be issued. However, there are roughly twice as many MIS issued during the early shift as during the late shift (see the last line of Table 1).

The numbers are completely reversed when it comes to the CWA issued by the ZMP CWSU. As its name says, it is an advisory and it is used most frequently to note of the location, intensity, movement, and/or development of thunderstorms during the warm season months over the ARTCC area. During the past five years (which is roughly the length of time the CWSU has been issuing and keeping track of the CWA's) 82 percent of the CWA's have been issued during the months of April through September. Although an exact breakdown of what part of the percentage was for thunderstorms, turbulence, and icing has not been done, by far the greater percentage of the CWA's were to advise of thunderstorms. Along with the seasonal influence of the thunderstorms on the CWA issued at by the ZMP

CWSU, there is also a diurnal influence. Since the greatest number of thunderstorms occur during the afternoon and evening hours, nearly 70 percent of the CWA's are issued during the 1:00 p.m. to 9:00 p.m. shift (see the next to last line of Table 1).

Consequently, in order to compare the numbers of products being issued from one forecaster to the next to see if there is any uniformity in the service to the FAA and the air traffic system, it is necessary to 'normalize' the number of products issued by specific forecasters for the amount of time they are on particular shifts. If he/she works more of the early shifts, there is a high probability he/she will issue proportionally more MIS's and less CWA's.

To come up with a normalized set of numbers to compare all forecasters with, one simply divides the percentage of the total number of products issued by a forecaster for a particular shift type by the percentage of the total number of shifts of that type worked by that forecaster. This is the uniformity number and it takes on the expression

$$U(x) = [P(x)/P(t)] \; / \; [S(x)/S(t)]$$

where P is the product category by shift type; S is the shift category; x is a particular forecaster; t is the total products/shifts.

If the ratio for a particular shift category of the products issued by forecaster x to the total products issued (percent of total) is exactly equal to the ratio of the number of shifts in that category that forecaster x worked to the total number of shifts worked by all forecasters, then U(x) is exactly equal to 1.

U(x) will be greater than one when the P(x)/P(t) is greater than S(x)/S(t) and less than one (but greater than zero) when P(x)/P(t) is less than S(x)/S(t). If one forecaster has a U(x) value much greater than one while another forecaster has a U(x) value significantly less than one, then there is probably something significantly different about the way the two forecasters are approaching and carrying out their duties.

This certainly does not allow one to decide whether one forecaster is right or wrong in the way they are doing things, it only says that there is a strong likelihood that not all of the forecasters are providing the same kind of service to the FAA and the air traffic community.

3. Discussion

Table 2 gives the 'uniformity' numbers for the ZMP CWSU for the year 1989. Before discussing any implications of the numbers, it should be pointed out that forecaster number 5 from WSFO Minneapolis was only at ZMP for 5-6 weeks during late January and February while on a forecaster exchange program with ZMP forecaster number 3. The dashes in the CWA product category for forecaster number 5 are the result of no CWA being issued by this forecaster during the period of his stay. This is not particularly surprising considering the majority of CWA's are not issued during the time of year he was at the CWSU. In fact, due to the shortness of forecaster 5's stay it is probably best not to compare him with the other four forecasters.

The data in Table 2 shows some interesting results. There is a wide difference in the issuance of CWA's between forecasters. The largest difference in the uniformity values occurs between forecasters 1 and 2 with the value for forecaster 1 being roughly a factor of ten greater than for forecaster 2.

Although the difference is not as large between forecaster 2 and either forecasters 3 or 4, the difference is large enough that it appears that forecaster 2 is not providing the same type of service to the FAA and air traffic community. It must be emphasized that there is no way to judge which forecaster is providing the right type of service with this particular method. All that can be said is that there is a difference, and the forecasters should probably work on providing a more uniform service for this particular product.

There is one other interesting result that can be seen in Table 2. Despite the relatively large difference in the uniformity values for the CWA, there is very little difference from one forecaster to the next when it comes to the values for the MIS. This is most likely the result of there being a relatively good office consensus on what conditions an MIS needs to be issued for. As mentioned above, the tendency for MIS to be issued at somewhat regular times during shifts likely also has a tendency to help keep the distribution of MIS more uniform among the staff. For the MIS, the ZMP CWSU appears to have passed this uniformity of service test.

TABLE 1

SUMMARY OF SHIFTS WORKED AND PRODUCTS ISSUED BY ZMP CWSU FOR ALL OF 1989

FCSTR NO., SHIFT AND PRODUCTS		SHIFT CATEGORIES			
		NO. OF SHIFTS WORKED/PRODUCTS ISSUED (% ZMP TOTAL)			
		0500-1300	1300-2100	ADMINSTV	TOTAL OPTNL
1	SHIFTS	44 (12%)	37 (10%)	143 (67%)	81 (11%)
	CWA	12 (28%)	27 (27%)	1 (100%)	40 (28%)
	MIS	50 (12%)	24 (11%)	1 (100%)	75 (12%)
2	SHIFTS	109 (30%)	115 (32%)	12 (6%)	224 (31%)
	CWA	1 (2%)	10 (10%)	-	11 (8%)
	MIS	108 (26%)	62 (28%)	-	170 (27%)
3	SHIFTS	70 (19%)	124 (34%)	23 (11%)	194 (27%)
	CWA	16 (37%)	42 (42%)	-	58 (41%)
	MIS	89 (22%)	70 (32%)	-	159 (25%)
4	SHIFTS	133 (37%)	81 (22%)	28 (13%)	214 (29%)
	CWA	14 (33%)	18 (18%)	-	32 (22%)
	MIS	157 (38%)	58 (26%)	-	215 (34%)
5	SHIFTS	8 (2%)	8 (2%)	8 (4%)	16 (2%)
	CWA	0 (-)	0 (-)	-	0 -
	MIS	8 (2%)	7 (3%)	-	15 (2%)
TOTAL	SHIFTS	364* (50%)	365 (50%)	214 (100%)	729* (100%)
	CWA	43 (30%)	99 (69%)	1 (1%)	143 (100%)
	MIS	412 (65%)	221 (35%)	1 (<1%)	634 (100%)

* One 0500-1300 shift was not worked due to SNOW LEAVE.

Abbreviations: FCSTR is Forecaster; ADMINSTV is Administrative; OPTNL is Operational; CWA is Center Weather Advisory; and MIS is Meteorological Impact Statement.

The percent values in brackets ( ) are percent of the annual total for each shift except for the last three lines across labelled TOTAL vertically. Percentages in these last three lines are the percent of the annual total for all shifts.

TABLE 2

ZMP CWSU PRODUCT UNIFORMITY VALUES FOR 1989

		SHIFT CATEGORIES		
FCSTR	PRODUCT	0500-1300	1300-2100	TOTAL OPRTNL
1	CWA	2.33	2.70	2.55
	MIS	1.00	1.10	1.09
2	CWA	.07	.31	.26
	MIS	.87	.88	.87
3	CWA	1.95	1.24	1.52
	MIS	1.16	.94	.92
4	CWA	.89	.82	.76
	MIS	1.03	1.18	1.17
5	CWA	-	-	-
	MIS	1.00	1.50	1.00

Abbreviations: FCSTR is forecaster; OPRTNL is operational; CWA is Center Weather Advisory; MIS is Meteorological Impact Statement.