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THE AUTOMATED GENERATION OF PRECIPITATION PHRASES FOR THE INTERACTIVE COMPUTER WORDED FORECAST

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1. INTRODUCTION

The Techniques Development Laboratory (TDL) has been experimenting with the preparation of worded weather forecasts by computer for over 20 years (Glahn, 1970, 1979; Bermowitz, Heffernan, and Glahn, 1980; Bermowitz and Miller 1984). Interpretation of direct numerical model output by statistical techniques provides a database of Model Output Statistics (MOS) forecasts for those weather elements normally contained in the public weather forecast. The database is analyzed by computer and text forecasts are automatically produced. Similar experiments have been conducted in Sweden (Lonnqvist, 1973) and Canada (Verret, 1990).

In support of the National Weather Service modernization, TDL has made extensive revisions and enhancements to an interactive version of the computer worded forecast known as the Interactive Computer Worded Forecast (ICWF). The aim of the ICWF is to provide forecasters with the mechanism for efficiently preparing the suite of forecast products normally issued by a National Weather Service Weather Forecast Office (WFO). With the ICWF, forecasters are able to interact with the database and modify guidance as needed prior to submitting the database for text formatting.

With previous versions of the ICWF, the forecaster was presented with raw MOS guidance for modification. If the forecaster wanted to change the precipitation type specified in the zone forecast (for which there is no direct MOS guidance), MOS probabilities of freezing and frozen precipitation, the MOS best category forecast of precipitation type, and possibly MOS temperature forecasts would have to be modified. The amount of interaction required was cumbersome and the results unpredictable. In addition, with the exception of temperature guidance, MOS forecasts are valid at either 6-h intervals or for 6-h periods. As a result, the temporal resolution in the worded forecasts was rather coarse.

With the current version of the ICWF, forecasters interact directly with a "best guess" forecast of precipitation types and intensities at 3-h intervals derived from MOS guidance. Interaction with the forecast data is more efficient and more directly coupled with the worded output. The formatters have been rewritten to accommodate the increased temporal resolution in the forecast database and to provide the ability to format a variety of alphanumeric and text products in addition to the public forecast. This office note describes the new precipitation phrase formatting routines for the public weather forecast.

2. THE WEATHER ELEMENT DATABASE

The forecast weather elements are stored in a three-dimensional array for processing by the text formatters. The first dimension is time. The initial time (forecast projection zero) corresponds to the model run from which the forecast guidance was produced (either 0000 UTC or 1200 UTC). There are 73

hours of forecast guidance starting at projection zero. Forecasters are not required to interact with every hour of data. The interactive interface for the ICWF displays data at 3-h intervals for interaction.

The second dimension of the array represents the various sensible weather elements. The ICWF forecast database contains 23 weather elements. The third dimension represents the geographic location within the forecast area. Location can take the form of gridpoints, zones within the forecast area, combined zones, and stations. Forecasts at stations are interpolated to gridpoints resulting in the gridpoint database. The database for forecast zones is the result of averaging data for gridpoints within that zone. Zones can be combined when the forecast weather from one zone to another is similar. Thus the database for combined zones is the result of averaging data for zones with similar weather.

Much of the database is devoted to precipitation (16 of the 23 weather elements are related to precipitation). There may be as many as three types of precipitation forecast at any time projection, plus thunderstorms. Each precipitation type has an accompanying probability qualifier and intensity descriptor to provide additional information about the precipitation event. Thunderstorms also have an intensity descriptor to describe weather conditions associated with the thunderstorm such as strong winds, hail, heavy downpours, and lightning.

Initialization of the database prior to forecaster interaction can be based on MOS guidance or from the forecast prepared by the previous shift. It is important that the initialization be as accurate as possible to minimize the need and time required for forecaster editing and modification.

If the initialization is to be made from MOS guidance, a series of decision trees is employed to specify an explicit weather type, probability qualifier, and intensity descriptor at each forecast projection. The decision trees are necessary since MOS guidance does not directly specify the explicit weather types. For example, explicit weather types result from an analysis of MOS probabilities of freezing, frozen, and liquid precipitation; the MOS best category forecast of precipitation type; MOS probabilities of rain, rain showers, and drizzle; and MOS 3-h temperature and dewpoint forecasts. The initialization of precipitation intensities results from an analysis of MOS quantitative precipitation forecasts (QPF06 and QPF12). In a similar fashion, probability qualifiers for explicit weather, thunderstorms, and severe thunderstorms are obtained from an analysis of MOS probability of precipitation forecasts (POP06 and POP12) and MOS thunderstorm and severe thunderstorm probabilities.

3. AUTOMATED FORMATTING

The objective in developing the formatting routines for the public forecast was to provide for a great deal of flexibility in the construction of phrases with respect to precipitation types, changes in precipitation types, the timing of events, and the ability to describe the same event in more than one way. The highest priority in the construction of phrases is to accurately represent the forecast data. In addition, the phrases must satisfy the structural and grammatical requirements of the English language and conform to Weather Service standards for the composition of public weather forecasts.

In order to accomplish these objectives, the precipitation phrase is viewed as a structure consisting of several predefined parts. To illustrate, consider the following definitions:

Precipitation phrase - That section of the weather forecast that pertains to precipitation. A precipitation phrase consists of one or more sentences describing precipitation type, intensity, probability, beginning and/or ending times, the time of change from one precipitation type to another etc. The precipitation phrase may also include references to snow accumulations, thunderstorms, and obstructions to vision.

Phrase parts - A precipitation phrase is the sum of its parts. Each part is a partial phrase describing a single aspect of the precipitation event. Examples of precipitation phrase parts include precipitation type, precipitation intensity, precipitation probability, the starting time of precipitation, etc.

Partial phrases - Each precipitation phrase part can take on one of a number of partial phrases depending upon the circumstances of the precipitation event. For example, some of the possible partial phrases for the phrase part precipitation type are snow showers, drizzle, sleet, rain, etc.

Phrase structure - A particular ordering of the phrase parts (including punctuation) which form a phrase. The precipitation phrase builder constructs a phrase by piecing together a series of phrase parts according to the dictates of the phrase structure. To illustrate, consider the following simplified example:

```
[ Probability ]          [ Type ]         [ Occurtime ].

   A CHANCE OF            RAIN            THIS AFTERNOON
   A SLIGHT CHANCE OF     SNOW            THIS EVENING
   OCCASIONAL             SLEET           AFTER MIDNIGHT
        .                   .                  .
        .                   .                  .
        .                   .                  .
```

[Probability], [Type], and [Occurtime] are phrase parts. Some possible partial phrases are listed below the corresponding phrase parts. The phrase builder analyzes the database to select the appropriate partial phrase for each phrase part, and then, according to a set of predefined rules, constructs the precipitation phrase from its parts. Using the above example, the final precipitation phrase might read "A SLIGHT CHANCE OF SNOW AFTER MIDNIGHT."

There are a number of possible combinations and orderings of phrase parts (phrase structures) depending on the nature of the situation and the degree of detail desired in the phrase. However, nearly all situations can be satisfactorily described by relatively few phrase structures.

Thus, the first task in designing the phrase builder was to identify the number and types of phrases that the formatter should be capable of producing, and then, set forth definitions of the phrase structures necessary to build each particular phrase type.

Three general classes of phrase structures were identified: simple, complex, and thunderstorm. In general, simple precipitation phrases are used when there is no change in the phase of precipitation (e.g., rain to snow), and thunderstorms are not expected to occur during the forecast period. Complex precipitation phrases apply when precipitation changes phase or when multiple precipitation types occur during the forecast period. Thunderstorm phrase structures are used whenever thunderstorms are forecast to occur. See Appendix I for a complete description of the phrase structures.

Most phrase parts are common to all phrase structures (e.g., precipitation type, precipitation intensity, precipitation probability, and various beginning times, ending times, and times of occurrence). What differs between phrase structures is the ordering of the phrase parts within the structure, the number of times the phrase part appears in the structure, connecting phrase parts, and punctuation. An advantage of building phrases from phrase parts is that only a limited vocabulary is required because of the ability to order the parts in multiple ways. See Appendix I for a listing of the various phrase structures. Appendix II provides a description of the phrase parts and Appendix III gives an example of the construction of a phrase from phrase parts.

4. SELECTING THE APPROPRIATE PHRASE STRUCTURE

Analyzing the database in order to identify the appropriate phrase structure is a complex task. There can be as many as three different types of precipitation at each time projection. Each type of precipitation may have a different probability and intensity, and the probability and intensity may change from one time projection to the next. Thunderstorms can occur with or without precipitation and with a different intensity descriptor from that of precipitation.

Since a specific number of phrase structures have been defined, the database must be analyzed to determine whether the precipitation and thunderstorm data during the forecast period "fits" one of the phrase structures. If no match is found, the phrase must nevertheless be constructed. In each class of phrase structures, at least one is general enough to guarantee that a phrase will be built.

Before a phrase structure is selected to describe the precipitation event, the forecast data is examined to determine which class of phrase structures applies--simple, complex, or thunderstorm. After the appropriate class of phrase structures has been identified, certain attributes of the precipitation event must be determined in order to select a specific phrase structure. The forecast data are examined relative to a set of thresholds to determine the temporal characteristics of the precipitation event and if there are any changes in probability or discontinuities of the precipitation event. See Appendix V for a list of the thresholds used in the selection of the appropriate phrase structure.

In addition, the forecast data are examined to provide information to the formatting routines concerning specific aspects of phrase construction. This information includes:

- if more than one precipitation type is forecast to occur, the probability of each precipitation type is evaluated relative to the probability of

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the others. This information controls the use of phrases such as "RAIN POSSIBLY MIXED WITH SNOW" vs. "RAIN MIXED WITH SNOW" or "RAIN WITH A CHANCE OF A THUNDERSTORM" vs. "RAIN AND THUNDERSTORMS."

- whether to use "AND" or "OR" as a connecting word (e.g., RAIN AND SNOW vs. RAIN OR SNOW).

- whether precipitation should be formatted as "DEVELOPING," "ENDING," or "TAPERING OFF TO."

The desired level of detail also affects the selection of the appropriate phrase structure. Under detail level 1, the full suite of simple, complex and thunderstorm phrase structures may be used. Phrases are fully descriptive providing for the details of intraperiod changes in the phase of precipitation and specific times relating to the precipitation event. Various temporal combinations of thunderstorms with rain, rain showers, or drizzle may be formatted (e.g., RAIN THIS MORNING...THUNDERSTORMS LIKELY THIS AFTERNOON).

Under detail level 2, only four phrase structures may be used (two simple and two thunderstorm). Intraperiod changes in the phase of precipitation and temporal combinations of thunderstorms with rain, rain showers, or drizzle are not formatted. For example, the phrase "RAIN CHANGING TO SNOW AROUND NOON" under detail level 1, would be "RAIN AND SNOW" under detail level 2. Similarly, the phrase "RAIN THIS MORNING...THUNDERSTORMS LIKELY THIS AFTERNOON" under detail level 1 would be "RAIN AND THUNDERSTORMS" under detail level 2. Intensity descriptors are only used for thunderstorms.

A more complete description of the process for selecting specific phrase structures is described in Appendix IV.

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APPENDIX I

Precipitation Phrases

Precipitation phrases consist of six simple phrase structures (no change of phase and no thunderstorms), twelve complex phrase structures (change of phase), and ten thunderstorm phrase structures. Each phrase structure was designed to describe a particular weather situation and consists of a series of phrase parts ordered in a predefined way. The phrase parts describe the precipitation type, intensity, and probability as well as various times relating to the precipitation event (beginning, ending, occur, and change). There are also a number of connecting and punctuation phrase parts. For a listing of the phrase parts see Appendix II.

There are two detail levels for the precipitation phrases. Under detail level 1, the entire set of 28 phrase structures is used. Changes of phase, specific times relating to the precipitation event, and precipitation intensities are explicitly mentioned. The full suite of thunderstorm phrase structures allows for the formatting of various temporal combinations of thunderstorms with another precipitation type (e.g., RAIN THIS MORNING...THUNDERSTORMS THIS AFTERNOON). Under detail level 2, only four of the 28 phrase structures are used. Changes of phase are not mentioned, event times and intensities are treated in a more general fashion (or not mentioned at all), and temporal combinations of thunderstorms with another precipitation type are not formatted.

Simple Precipitation Phrases:

In general, simple precipitation phrases are those used when there are no changes in phase during the precipitation event (e.g., rain to snow) and no thunderstorms in the forecast. For detail level 1, all six simple precipitation phrase structures are used. For detail level 2, only simple precipitation phrase structures 4 and 6 are used.

1. This phrase structure generally applies to situations where the probability of precipitation is likely or greater and the precipitation begins and/or ends during the forecast period.

    Examples:

    a) .TODAY...OCCASIONAL RAIN DEVELOPING THIS MORNING.
    b) .TODAY...SNOW LIKELY THIS AFTERNOON.

2. This phrase structure is called the discontinuous phrase structure and is used in cases where precipitation is discontinuous during the forecast period.

    Example:

    a) .TODAY...RAIN LIKELY EARLY THIS MORNING. OCCASIONAL RAIN SHOWERS LATE THIS AFTERNOON.

3. This phrase structure is called the change of probability phrase struc-
ture and is used in situations where there is a change of probability
from chance (slight chance, chance) to categorical (likely, occasional,
unqualified) or vice versa during the forecast period.

Example:

a) .TODAY...A SLIGHT CHANCE OF SNOW LATE THIS MORNING AND EARLY THIS
AFTERNOON...THEN SNOW LIKELY LATE THIS AFTERNOON.

4. This phrase structure is the most general and widely used phrase struc-
ture. This structure accommodates all cases not covered by specific time
requirements, probability requirements, or precipitation changes. This
phrase structure is one of the four phrase structures used for detail
level 2.

Examples:

a) .TUESDAY...OCCASIONAL RAIN.
b) .TONIGHT...A SLIGHT CHANCE OF SNOW.
c) .TODAY...OCCASIONAL SNOW FLURRIES THIS AFTERNOON.

5. This phrase structure handles specific cases where rain tapers off to
drizzle or snow tapers off to snow flurries or snow showers. A categori-
cal probability (likely, occasional, or unqualified) must occur for each
type of precipitation.

Examples:

a) .TODAY...SNOW TAPERING OFF TO SNOW FLURRIES EARLY THIS AFTERNOON.
b) .TODAY...RAIN TAPERING OFF TO DRIZZLE BY EVENING RUSH HOUR.

6. This phrase structure handles specific cases where two or three types of
precipitation of the same phase occur simultaneously (e.g., SNOW AND SNOW
SHOWERS, RAIN AND DRIZZLE). RAIN AND RAIN SHOWERS will not be formatted
together, rather, the most frequent occurrence will be formatted. This
phrase structure is one of the four phrase structures used for detail
level 2. Most change of phase situations (complex) are formatted by this
phrase structure with detail level 2.

Example:

a) .TODAY...RAIN AND DRIZZLE LIKELY LATE THIS MORNING AND EARLY THIS
AFTERNOON.

Complex Precipitation Phrases:

In general, complex precipitation phrase structures are those used to
describe precipitation events in which precipitation changes phase (e.g., rain
to snow) during the event. Complex phrase structures are used only with an
overall probability of likely or greater. If a change of phase is specified
with a chance or slight chance probability, the discontinuous (simple phrase
structure 2) or change of probability (simple phrase structure 3) simple
phrase structures is used.

Complex phrase structures are used only with detail level 1. For detail level 2, all complex situations are funneled to simple phrase structures 4 or 6. For example, the phrase "RAIN CHANGING TO SNOW LATE THIS MORNING" under detail level 1 would be "RAIN AND SNOW" under detail level 2.

1. This phrase structure is used to describe cases where precipitation type X mixes with then changes to precipitation type Y.

   Examples:

   a) .TUESDAY...SNOW LIKELY...POSSIBLY MIXING WITH AND CHANGING TO RAIN BY MID-AFTERNOON.
   b) .TONIGHT...RAIN MIXING WITH SNOW EARLY THIS EVENING AND CHANGING TO ALL SNOW AROUND MIDNIGHT.

2. This phrase structure is used to describe cases where precipitation type X changes to precipitation type Y.

   Example:

   a) .TODAY...RAIN CHANGING TO FREEZING RAIN AND SLEET EARLY THIS AFTERNOON.

3. This phrase structure is used to describe cases where there is a mixture of precipitation throughout the event.

   Examples:

   a) .TODAY...OCCASIONAL RAIN AND SNOW...POSSIBLY MIXED WITH SLEET DEVELOPING EARLY THIS MORNING.
   b) .TONIGHT...A MIXTURE OF RAIN, SNOW, AND SLEET DEVELOPING AROUND MIDNIGHT.

4. This phrase structure is used in cases where precipitation type X begins and then becomes mixed with precipitation type Y.

   Example:

   a) .TODAY...SNOW POSSIBLY BECOMING MIXED WITH SLEET AND FREEZING RAIN AROUND NOON.

5. This phrase structure is used in cases where precipitation type X begins as a brief period of precipitation type Y.

   Examples:

   a) .TONIGHT...OCCASIONAL RAIN...POSSIBLY BEGINNING AS A BRIEF PERIOD OF SNOW.
   b) .TODAY...RAIN...BEGINNING AS A BRIEF PERIOD OF FREEZING RAIN LATE THIS MORNING AND ENDING LATE THIS AFTERNOON.

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6. This phrase structure is used in cases where precipitation type X begins as a brief period of mixed precipitation types X and Y.

   Example:

   a) .TODAY...RAIN LIKELY...POSSIBLY BEGINNING AS A BRIEF PERIOD OF MIXED RAIN AND SLEET.

7. This phrase structure is used in cases where precipitation type X changes to precipitation type Y before ending.

   Example:

   a) .TODAY...SNOW LIKELY...POSSIBLY CHANGING TO SLEET AND FREEZING RAIN BEFORE ENDING LATE THIS AFTERNOON.

8. This phrase structure is used in situations where precipitation X ends as a mixture of precipitation X and Y.

   Example:

   a) .TONIGHT...OCCASIONAL RAIN...ENDING AS A MIXTURE OF RAIN AND SLEET.

9. This phrase structure handles cases where a mixture of precipitation types becomes all one precipitation type.

   Example:

   a) .TUESDAY...A MIXTURE OF RAIN, SNOW, AND SLEET DEVELOPING AROUND MORNING RUSH HOUR BECOMING ALL SNOW BEFORE NOON AND ENDING LATE IN THE AFTERNOON.

10. This phrase structure handles cases where precipitation type X changes to precipitation type Y, which then changes to precipitation type Z.

   Examples:

   a) .TODAY...RAIN CHANGING TO SNOW AROUND MID-MORNING THEN TAPERING OFF TO SNOW FLURRIES BEFORE ENDING LATE THIS AFTERNOON.
   b) .TODAY...SNOW CHANGING TO RAIN AROUND MID-MORNING THEN CHANGING BACK TO SNOW BEFORE ENDING LATE THIS AFTERNOON.
   c) .TODAY...OCCASIONAL SLEET AND FREEZING RAIN CHANGING TO RAIN LATE THIS MORNING THEN CHANGING TO SNOW EARLY THIS AFTERNOON.

11. This phrase structure handles cases where precipitation type X is the dominant precipitation type during the forecast period and precipitation type Y mixes with precipitation type X for a portion of the forecast period.

   Example:

   a) .FRIDAY...SNOW LIKELY...POSSIBLY MIXED WITH RAIN LATE IN THE MORNING AND EARLY IN THE AFTERNOON.

12. This phrase structure handles cases where precipitation type X mixes with precipitation type Y which then changes to precipitation type Z.

Examples:

a) .TODAY...RAIN LIKELY...MIXING WITH SLEET AROUND NOON AND CHANGING TO SNOW LATE THIS AFTERNOON.
b) .TODAY...RAIN LIKELY...MIXING WITH SLEET AROUND NOON AND CHANGING TO SNOW BEFORE ENDING LATE THIS AFTERNOON.

Thunderstorm Phrases:

Thunderstorms precipitation phrases are used in situations where thunderstorms are forecast to occur either alone or with rain, drizzle, or rain showers. Currently, thunderstorms are not formatted with frozen or freezing precipitation. Under detail level 1, all 10 thunderstorm phrase structures can be used. Under detail level 2, all thunderstorm cases are funneled to thunderstorm phrase structures 1 or 2. The full suite of thunderstorm phrase structures used with detail level 1 provides for the formatting of various temporal combinations of thunderstorms with rain, drizzle, or rain showers. Thunderstorm phrase structures 1 and 2 used with detail level 2 will only format thunderstorms and rain, rain showers, and drizzle as occurring at the same time.

1. This phrase structure is used when rain, drizzle, or rain showers and thunderstorms are forecast to occur during essentially the same projections. The probability of thunderstorms will be set equal to the probability of the rain, drizzle, or rain showers if both are categorical or chance. Otherwise, the set probabilities will be used. This phrase structure is one of the two thunderstorm phrase structures used with detail level 2.

Examples:

a) .TODAY...RAIN SHOWERS AND THUNDERSTORMS LIKELY.
b) .TODAY...RAIN LIKELY WITH A SLIGHT CHANCE OF THUNDERSTORMS.

2. This phrase structure applies when only thunderstorms are forecast to occur. This structure is one of the two thunderstorm phrase structures used with detail level 2.

Example:

a) .TODAY...A CHANCE OF THUNDERSTORMS IN THE AFTERNOON.

3. This phrase structure is used when rain, drizzle, or rain showers and thunderstorms are forecast to occur together, but with intraperiod discontinuities in probability and/or precipitation type.

Example:

a) .TODAY...RAIN AND THUNDERSTORMS LIKELY THIS MORNING. A CHANCE OF RAIN SHOWERS AND THUNDERSTORMS THIS AFTERNOON.

4. This phrase structure is used in cases where rain, drizzle, or rain showers and thunderstorms are forecast to occur during the first part of the period, and only thunderstorms are forecast to occur during the second part of the period.

   Example:

   a)   .TONIGHT...A CHANCE OF RAIN SHOWERS AND THUNDERSTORMS EARLY TONIGHT. THUNDERSTORMS LIKELY TOWARDS MORNING.

5. This phrase structure is used in cases where thunderstorms are forecast to occur during the first part of the forecast period and rain, drizzle, or rain showers, and thunderstorms are forecast to occur during the second part of the forecast period.

   Example:

   a)   .TONIGHT...OCCASIONAL THUNDERSTORMS THIS EVENING AND EARLY TONIGHT. RAIN LIKELY WITH A CHANCE OF THUNDERSTORMS LATE TONIGHT.

6. This phrase structure applies when rain, drizzle, or rain showers are forecast to occur during the first part of the forecast period, and thunderstorms are forecast to occur during the second part of the forecast period.

   Example:

   a)   .TODAY...RAIN LIKELY THIS MORNING. A CHANCE OF THUNDERSTORMS THIS AFTERNOON.

7. This phrase structure applies when thunderstorms are forecast to occur during the first part of the forecast period, and rain, drizzle, or rain showers are forecast to occur during the second part of the forecast period.

   Example:

   a)   .TONIGHT...A CHANCE OF THUNDERSTORMS EARLY THIS EVENING. OCCASIONAL DRIZZLE FROM LATE THIS EVENING ON.

8. This phrase structure applies in situations where only thunderstorms are forecast to occur and there is a discontinuity in the occurrence and/or a change in the probability of occurrence of thunderstorms during the forecast period.

   Example:

   a)   .TODAY...A SLIGHT CHANCE OF THUNDERSTORMS EARLY THIS MORNING. THUNDERSTORMS LIKELY LATE THIS AFTERNOON.

9. This phrase structure is used when rain, drizzle, or rain showers with thunderstorms are forecast to occur during the first part of the forecast period, and only rain, drizzle, or rain showers are forecast to occur during the second part of the forecast period.

    Example:

    a) .TONIGHT...RAIN LIKELY WITH A CHANCE OF THUNDERSTORMS EARLY THIS EVENING. OCCASIONAL DRIZZLE FROM LATE THIS EVENING ON.

10. This phrase structure is used when rain, drizzle, or rain showers are forecast to occur during the first part of the forecast period, and rain, drizzle, or rain showers with thunderstorms are forecast to occur during the second part of the forecast period.

    Example:

    a) .TODAY...A CHANCE OF RAIN SHOWERS EARLY THIS AFTERNOON. RAIN SHOWERS AND THUNDERSTORMS LIKELY LATE THIS AFTERNOON.

Phrase Parts

Precipitation phrase parts consist primarily of a precipitation type, a probability qualifier, an intensity descriptor, various times related to the precipitation event, and connecting/punctuation phrase parts. All phrase structures are built from the same set of phrase parts. The difference between phrase structures is the ordering of the phrase parts, the number of times a phrase part appears in the phrase structure, and connecting/punctuation phrase parts included in the phrase structure.

<u>Probability qualifiers</u>:

<u>conventional</u>	<u>areal coverage</u>
SLIGHT CHANCE	WIDELY SCATTERED (ISOLATED)
CHANCE	SCATTERED
LIKELY	
OCCASIONAL	

<u>in-line</u>
A(N) XX PERCENT CHANCE OF

The user has the option of specifying the type of probability qualifiers to appear in the precipitation phrase. Conventional probability qualifiers are used by default. If areal coverage qualifiers are specified, widely scattered or isolated is used instead of slight chance, and scattered is used instead of chance. If in-line qualifiers are specified, the probability of precipitation in percent is directly specified in the precipitation phrase where appropriate. In cases where in-line qualifiers are not appropriate (most complex and thunderstorm phrase structures), conventional qualifiers are used.

<u>Precipitation type</u>:

RAIN	SNOW	FREEZING RAIN
RAIN SHOWERS	SNOW SHOWERS	FREEZING DRIZZLE
DRIZZLE	SNOW FLURRIES	
SPRINKLES	SLEET	

<u>Precipitation intensity descriptors</u>:

LIGHT
HEAVY AT TIMES

<u>Thunderstorm descriptors</u>:

THUNDERSTORMS	A THUNDERSTORM
SOME THUNDERSTORMS MAY BE SEVERE	HAIL
SOME THUNDERSTORMS MAY CONTAIN	LARGE HAIL
DAMAGING WINDS	STRONG GUSTY WINDS
HEAVY DOWNPOURS	

Time descriptors:

Each point in time (a forecast projection) and any period of time from any
one forecast projection to any other forecast projection within a forecast
period has a time descriptor associated with it. The user has the option of
assigning time descriptors for each point in time and each period of time. A
sample list of time descriptors appears below.

        EARLY THIS (IN THE) MORNING
        THIS (IN THE) MORNING
        THROUGH MID-AFTERNOON
        AROUND MID-MORNING
        LATE THIS (IN THE) MORNING
        LATE THIS (IN THE) MORNING AND EARLY THIS (IN THE) AFTERNOON
        FROM MID-MORNING ON
        AROUND NOON
        EARLY THIS (IN THE) AFTERNOON
        THIS (IN THE) AFTERNOON
        AROUND MID-AFTERNOON
        LATE THIS (IN THE) AFTERNOON
        EARLY THIS (IN THE) EVENING
        THIS (IN THE) EVENING
        BEFORE MIDNIGHT
        THROUGH LATE TONIGHT (THROUGH MOST OF THE NIGHT)
        FROM LATE THIS (IN THE) EVENING THROUGH MUCH OF (THE NIGHT) TONIGHT
        FROM LATE EVENING ON
        AROUND MIDNIGHT
        AFTER MIDNIGHT
        LATE (AT NIGHT) TONIGHT
        TOWARD MORNING

Connecting and punctuation phrase parts:

        POSSIBLY   A MIXTURE OF
        AND   MIXED WITH
        WITH   MIXING WITH
        OR   CHANGING TO
        MAY   CHANGING BACK TO
        THEN   CHANGING TO ALL
        AS   PRECIPITATION
        BEFORE   BECOMING ALL
        ENDING   ...
        BEGINNING   .
        DEVELOPING   ,
        TAPERING OFF TO
        ESPECIALLY
        MAINLY
        BE

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APPENDIX III

Example: Building a Phrase from Its Parts

Listed below is an ordering of phrase parts for the most general simple
precipitation phrase structure (see Appendix I, simple phrase structure 4)
and the partial phrases selected for each phrase part by the formatting
routine based upon the forecast database.

Phrase part	Selected partial phrase
1. [probability qualifier]	OCCASIONAL
2. [light intensity descriptor]	
3. [precipitation type 1]	SNOW
4. [connector - mixed with]	
5. [connector - possibly mixed with]	POSSIBLY MIXED WITH
6. [precipitation type 2]	SLEET
7. [likely probability qualifier]	
8. [time descriptor]	THIS AFTERNOON
9. [punctuation ...]	...
10. [heavy intensity descriptor]	HEAVY AT TIMES
11. [punctuation .]	.

Forecast precipitation types, probabilities and intensities

Time (GMT)	12	15	18	21	00
Precipitation type 1				S	S
Probability 1				O	O
Intensity 1				+	+
Precipitation type 2				IP	IP
Probability 2				C	C
Intensity 2				+	+

The precipitation data listed at a forecast projection applies to the 3-h
period ending at that projection.

In order to build the phrase, the database is first searched for the proba-
bility qualifier for precipitation type 1. In this example, the probability
qualifier is "OCCASIONAL." Since the probability qualifier is not "LIKELY,"
phrase part 7 will not be used.

The database is next searched for an intensity for precipitation type 1.
Since the intensity is heavy (+), phrase part 2 (the LIGHT intensity
descriptor) will not be used and the intensity descriptor will be "HEAVY AT
TIMES." Since phrase part 10 is being used, the connecting/punctuation phrase
part 9 (...) will also be used.

Next the database is searched for a second precipitation type and its
associated probability. The second precipitation type is sleet and its
probability is chance. Since the probability of sleet is chance and the
probability of snow is categorical, connecting/punctuation phrase part 5 will
be used (POSSIBLY MIXED WITH) and phrase part 4 will not be used. Phrase part
6 becomes "SLEET."

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Finally, since the precipitation is forecast to occur during the 6-h period ending at 0000 GMT, the time descriptor for phrase part 8 is THIS AFTERNOON. The connecting/punctuation phrase part 11 is then added and the process is complete.

When the phrase parts are put together in the order specified, the precipitation phrase reads:

OCCASIONAL SNOW POSSIBLY MIXED WITH SLEET THIS AFTERNOON...HEAVY AT TIMES.

APPENDIX IV

Selecting the Appropriate Phrase Structure

There are three classes of phrase structures, complex, thunderstorm, and simple. In general, complex phrase structures describe precipitation events in which there is a change of phase of precipitation. Thunderstorm phrase structures are used in situations where thunderstorms are forecast to occur, and simple phrase structures are used in all other cases.

Once the appropriate class of phrase structures has been determined, a fitting process is used to select a specific phrase structure, with the most unique phrases fitted first. Note that the same phrase structure may be used to construct different phrases with similar attributes. For example, simple phrase structure 6 is used to construct a phrase with multiple types of precipitation and is used in complex precipitation cases and simple precipitation cases. Refer to Appendix I for a list and description of the precipitation phrase structures.

The phrase structure selection process for complex precipitation cases is described below. This description is intended as a general explanation rather than as a complete description.

1. If the detail level is 2 and the precipitation changes state or a mixture of precipitation types of different state occurs, format precipitation X and/or precipitation Y.
   (simple precipitation phrase structure 4 or 6)

Steps 2 through 17 apply to detail level 1:

2. Are there more than two changes of state of precipitation? If so, format the three dominant precipitation types during the forecast period.
   (simple precipitation phrase structure 6)

3. Does the probability change from chance to categorical or vice-versa at or about the same time a change of state occurs? If so, format a change of probability.
   (simple precipitation phrase structure 3)

4. Does a change of precipitation type occur within a precipitation state (e.g., rain to drizzle) at or about the same time a change of state of a second precipitation type occurs? If so, format a change of precipitation type.
   (simple precipitation phrase structure 5)

5. Does precipitation change state shortly after starting? If so, format precipitation X beginning as a brief period of precipitation Y.
   (complex precipitation phrase structure 5)

6. Does precipitation change state briefly before ending? If so, format precipitation X ending as a brief period of precipitation Y.
   (complex precipitation phrase structure 7)

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7. Does precipitation start briefly as a mixture? If so, format precipitation X beginning as a mixture of precipitation X and Y.
    (complex precipitation phrase structure 6)

8. Does precipitation end briefly as a mixture? If so, format precipitation X ending as a mixture of precipitation X and Y.
    (complex precipitation phrase structure 8)

9. Does a mixture of the same two or three precipitation types occur throughout the event? If so, format mixed precipitation.
    (complex precipitation phrase structure 3)

10. Does precipitation mix with a different state, and then change to another different state? If so, format precipitation X mixing with precipitation Y, then changing to precipitation Z.
    (complex precipitation phrase structure 12)

11. Does precipitation mix with a different state and then completely change to that state? If so, format precipitation X mixing with and changing to precipitation Y.
    (complex precipitation phrase structure 1)

12. Does a mixture of precipitation become all one state? If so, format mixed precipitation X and Y becoming all precipitation X or Y.
    (complex precipitation phrase structure 9)

13. Is there a change of state? If so, format precipitation X changing to precipitation Y.
    (complex precipitation phrase structure 2)

14. Are there two changes of state? If so, format precipitation X changing to precipitation Y, then changing to precipitation Z.
    (complex precipitation phrase structure 10)

15. Does another state mix with precipitation? If so, format precipitation X mixing with precipitation Y.
    (complex precipitation phrase structure 4)

16. Does another state mix with precipitation only during part of the event? If so, format precipitation X mixed with precipitation Y part of the time.
    (complex precipitation phrase structure 11)

17. If a phrase has not yet been selected, format up to three precipitation states (the most dominant states during the forecast period).
    (simple precipitation phrase structure 6)

The complex precipitation cases require the most involved search and analysis of the forecast database. Thunderstorm cases also require extensive analysis of the database. The thunderstorm phrase structures are dedicated to describing the occurrence of thunderstorms with or without a precipitation type in various temporal combinations. Many of the thunderstorm phrase structures divide the forecast period into two parts to describe the temporal combination of thunderstorms and a precipitation type. Currently only the precipitation types rain, rain showers, or drizzle may be formatted with

thunderstorms (e.g., .TODAY...SHOWERS AND THUNDERSTORMS LIKELY). Future plans allow for the formatting of freezing or frozen precipitation with thunderstorms.

The selection process for thunderstorm phrase structures is described below. This description is intended as a general explanation rather than a complete description.

1. If the detail level is 2 and thunderstorms are forecast to occur with another precipitation type, format: Precipitation and thunderstorms. (thunderstorm phrase structure 1)

2. If the detail level is 1 or 2 and thunderstorms are forecast to occur without another precipitation type, format: Thunderstorms. (thunderstorm phrase structure 2)

All of the following apply only to detail level 1.

3. Are thunderstorms alone forecast to occur during the forecast period but the event is forecast to be discontinuous and/or the probability of thunderstorms is forecast to be chance (categorical) during the first part of the event and categorical (chance) during the second part of the event? If so, format: Thunderstorms. Thunderstorms. (thunderstorm phrase structure 8)

4. Are a precipitation type and thunderstorms forecast to occur throughout the forecast period but with a chance probability (chance or slight chance) in one part of the forecast period and a categorical probability (likely, occasional, or definite) in the other part of the forecast period? If so, format: Precipitation and thunderstorms. Precipitation and thunderstorms. (thunderstorm phrase structure 3)

5. Are a precipitation type and thunderstorms forecast to occur during the first part of the forecast period and a precipitation type alone forecast to occur during the second part of the forecast period? If so, format: Precipitation and thunderstorms. Precipitation. (thunderstorm phrase structure 9)

6. Are a precipitation type and thunderstorms forecast to occur during the first part of the forecast period and thunderstorms alone forecast to occur during the second part of the forecast period? If so, format: Precipitation and thunderstorms. Thunderstorms. (thunderstorm phrase structure 4)

7. Is a precipitation type alone forecast to occur during the first part of the forecast period and a precipitation type and thunderstorms forecast to occur during the second part of the forecast period? If so, format: Precipitation. Precipitation and thunderstorms. (thunderstorm phrase structure 10)

8. Are thunderstorms alone forecast to occur during the first part of the forecast period and a precipitation type and thunderstorms forecast to occur during the second part of the forecast period? If so, format: Thunderstorms. Precipitation and thunderstorms.
    (thunderstorm phrase structure 5)

9. Is a precipitation type alone forecast to occur during the first part of the forecast period and thunderstorms alone forecast to occur during the second part of the forecast period? If so, format: Precipitation. Thunderstorms.
    (thunderstorm phrase structure 6)

10. Are thunderstorms alone forecast to occur during the first part of the forecast period and a precipitation type alone forecast to occur during the second part of the forecast period? If so, format: Thunderstorms. Precipitation.
    (thunderstorm phrase structure 7)

Precipitation events that have not been determined to be complex or thunderstorm cases must be simple cases. There are six simple phrase structures. The selection process for the simple precipitation cases follows.

1. Does the precipitation stop and then start again to create two distinct precipitation events? Format two precipitation events within one period.
    (simple precipitation phrase structure 2)

2. Does the probability change from chance to categorical or vice-versa? If so, format a change of probability.
    (simple precipitation phrase structure 3)

3. Does a change of precipitation type occur (e.g., rain changing to drizzle)? If so, format a change of precipitation type.
    (simple precipitation phrase structure 5)

4. Does more than one change of precipitation type occur? If so, format up to three precipitation types (the most dominant precipitation types during the forecast period).
    (simple precipitation phrase structure 6)

5. Does precipitation with a categorical probability start or end? If so, format precipitation with a starting and/or ending time.
    (simple precipitation phrase structure 1)

6. If a phrase has not yet been constructed, format a general precipitation phrase.
    (simple precipitation phrase structure 4)

The selection of the appropriate phrase structure is followed by the construction of the phrase. Each phrase structure has a subroutine dedicated exclusively to producing the specific phrase.

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Control Constants (Thresholds) for Constructing
the Precipitation Phrases

Control constants are thresholds which guide the generation of the text phrases by the ICWF formatting routines. The thresholds are integer values which are read in from a file during the initialization of the ICWF. The threshold file is adjustable by the user so that each WFO may tailor the thresholds to best describe their local climatology.

General thresholds (used as criteria in more than one routine).

LP(1) - Maximum number of hours of precipitation free time allowed at the beginning of a forecast period so that precipitation will specifically be mentioned as "DEVELOPING" (otherwise precipitation will be considered to start at the beginning of the forecast period).
Default value = 3.

LP(2) - Maximum number of hours of precipitation free time allowed at end of a forecast period before precipitation will specifically be mentioned as "ENDING" (otherwise the period will just end with precipitation).
Default value = 3.

LP(3) - Minimum number of hours of precipitation free time required between two episodes of precipitation during a forecast period in order for two distinct episodes of precipitation to be formatted. If there are less than LP(3) hours of precipitation free time between two episodes of precipitation, then the precipitation event will be considered to be continuous.
Default value = 3.

LP(4) - Minimum consecutive number of hours of precipitation with a chance or slight chance probability during a precipitation event which also has a categorical probability for at least 3 hours, to qualify the precipitation event for a change of probability phrase.
Default value = 6.

LP(5) - Minimum number of hours that a first precipitation type must occur in conjunction with a second precipitation type in order to format a change of precipitation phrase, otherwise the second precipitation type will usually be formatted for the entire precipitation event.
Default value = 3.

LP(6) - Minimum number of hours that a second precipitation type must occur in conjunction with a first precipitation type in order to format a change of precipitation type, otherwise the first precipitation type will usually be formatted for the entire precipitation event.
Default value = 3.

LP(7) - Maximum number of hours (large time difference) between the start
(or end) of a first and second precipitation type for both precip-
itation types to be formatted as occurring during the same time
period. Both the start and end of the second precipitation type may
be compared to the start and end of the first precipitation type.
At most, a large time difference (LP(7)) and a small time difference
(LP(8)) may occur for both precipitation types to be considered as
occurring during the same time period.
Default value = 3.

LP(8) - Maximum number of hours (small time difference) between the start
(or end) of a first and second precipitation type for both precip-
itation types to be formatted as occurring during the same time
period. Both the start and end of the second precipitation type may
be compared to the start and end of the first precipitation type.
At most, a large time difference (LP(7)) and a small time difference
(LP(8)) may occur for both precipitation types to be considered as
occurring during the same time period.
Default value = 1.

LP(9) - Maximum number of hours (large time difference) between the start
(or end) of a second and third precipitation type for both precip-
itation types to be formatted as occurring during the same time
period. Both the start and end of the third precipitation type may
be compared to the start and end of the second precipitation type.
At most, a large time difference (LP(9)) and a small time difference
(LP(10)) may occur for both precipitation types to be considered as
occurring during the same time period.
Default value = 3.

LP(10)- Maximum number of hours (small time difference) between the start
(or end) of a second and third precipitation type for both precip-
itation types to be formatted as occurring during the same time
period. Both the start and end of the third precipitation type may
be compared to the start and end of the second precipitation type.
At most, a large time difference (LP(9)) and a small time difference
(LP(10)) may occur for both precipitation types to be considered as
occurring during the same time period.
Default value = 1.

Simple precipitation phrase thresholds.

LP(11)- Minimum length of forecast period in hours in order to use simple
precipitation phrase structure 1 (see Appendix I for description of
the precipitation phrase structures).
Default value = 6.

LP(12)- Minimum number of hours of precipitation required to use simple
precipitation phrase structure 1.
Default value = 6.

LP(13)- Minimum length of forecast period in hours in order to use simple
precipitation phrase structure 2.
Default value = 7.

LP(14)- Minimum length of forecast period in hours in order to use simple precipitation phrase structure 3.
Default value = 7.

LP(15)- Minimum number of hours of precipitation required to use simple precipitation phrase structure 3.
Default value = 7.

LP(16)- Minimum length of forecast period in hours in order to use simple precipitation phrase structure 5.
Default value = 6.

LP(17)- Minimum number of hours of precipitation required to use simple precipitation phrase structure 5.
Default value = 6.

Thunderstorm phrase thresholds.

LP(18)- Minimum length of forecast period in hours in order to use thunderstorm phrase structures 3 or 8 which apply for discontinuous precipitation events.
Default value = 7.

LP(19)- Minimum length of forecast period in hours in order to use thunderstorm phrase structure 4, 5, 6, 7, 9, or 10.
Default value = 6.

LP(20)- Minimum number of hours of precipitation required in order to use thunderstorm phrase structure 4, 5, 6, 7, 9, or 10.
Default value = 6.

LP(21)- Minimum length of forecast period in hours in order to use thunderstorm phrase structures 3 or 8 which apply for changes of probability from chance or slight chance to likely occasional or definite.
Default value = 7.

LP(22)- Minimum number of hours of precipitation required in order to use thunderstorm phrase structures 3 or 8 which apply for changes of probability from chance or slight chance to likely occasional or definite.
Default value = 7.

LP(23)- Minimum length of forecast period in hours and the minimum number of hours of precipitation required in order to use thunderstorm phrase structure 4.
Default value = 7.

LP(24)- Minimum number of hours required in which thunderstorms occur with no other precipitation type in order to use thunderstorm phrase structure 4.
Default value = 4.

LP(25)- Minimum number of hours required in which precipitation occurs without thunderstorms in order to use thunderstorm phrase structure 4.
Default value = 4.

LP(26)- Minimum length of forecast period in hours and the minimum number of hours of precipitation required in order to use thunderstorm phrase structure 5.
Default value 7.

LP(27)- Minimum number of hours required in which thunderstorms occur with no other precipitation type in order to use thunderstorm phrase structure 5.
Default value = 4.

LP(28)- Minimum number of hours required in which precipitation occurs without thunderstorms in order to use thunderstorm phrase structure 5.
Default value = 4.

LP(29)- Minimum length of forecast period in hours and the minimum number of hours of precipitation required in order to use thunderstorm phrase structure 6.
Default value = 7.

LP(30)- Minimum number of hours required in which precipitation occurs without thunderstorms in order to use thunderstorm phrase structure 6.
Default value = 4.

LP(31)- Minimum number of hours required in which thunderstorms occur with no other precipitation type in order to use thunderstorm phrase structure 6.
Default value = 4.

LP(32)- Minimum length of forecast period in hours and the minimum number of hours of precipitation required in order to use thunderstorm phrase structure 7.
Default value = 7.

LP(33)- Minimum number of hours required in which precipitation occurs without thunderstorms in order to use thunderstorm phrase structure 7.
Default value = 4.

LP(34)- Minimum number of hours required in which thunderstorms occur with no other precipitation type in order to use thunderstorm phrase structure 7.
Default value = 4.

LP(35)- Minimum length of forecast period in hours and the minimum number of hours of precipitation required in order to use thunderstorm phrase structure 9.
Default value = 7.

LP(36)- Minimum number of hours required in which precipitation occurs without thunderstorms in order to use thunderstorm phrase structure 9.
Default value = 4.

LP(37)- Minimum length of forecast period in hours and the minimum number of hours of precipitation required in order to select thunderstorm phrase structure 10.
Default value = 7.

LP(38)- Minimum number of hours required in which precipitation occurs without thunderstorms in order to use thunderstorm phrase structure 10.
Default value = 4.

LP(39)- Maximum number of hours difference (small difference) between the starting and ending times of a precipitation type and thunderstorms in order to consider them as occurring at the same time. LP(39) is constrained to be between 0 and 2 hours.
Default value = 2.

LP(40)- Maximum number of hours of overlap in the occurrence of a precipitation type and thunderstorms in order for the precipitation and thunderstorms to be considered as two separate episodes: one of thunderstorms and one of precipitation with no thunderstorms. This threshold is needed in thunderstorm phrase structure 6 and thunderstorm phrase structure 7.
Default value = 3.

Complex precipitation phrase thresholds (note precipitation X and precipitation Y indicate different states of precipitation e.g., rain and snow).

LP(41)- Minimum length of forecast period in hours in order to use complex precipitation phrase structure 1.
Default value = 7.

LP(42)- Minimum number of hours of precipitation required in order to use complex precipitation phrase structure 1.
Default value = 7.

LP(43)- Minimum length of forecast period in hours in order to use complex precipitation phrase structure 5.
Default value = 6.

LP(44)- Minimum number of hours of precipitation required in order to use complex precipitation phrase structure 5.
Default value = 6.

LP(45)- Maximum number of hours at the beginning of the forecast period that precipitation X occurs before changing to precipitation Y in order to use complex precipitation phrase structure 5.
Default value = 3.

LP(46)- Minimum length of forecast period in hours in order to use complex precipitation phrase structure 6.
Default value = 6.

LP(47)- Minimum number of hours of precipitation required to use complex precipitation phrase structure 6.
Default value = 6.

LP(48)- Maximum number of hours at the beginning of the forecast period during which precipitation X and precipitation Y are mixed in order to use complex precipitation phrase structure 6.
Default value = 3.

LP(49)- Minimum length of forecast period in hours in order to use complex precipitation phrase structure 7.
Default value = 6.

LP(50)- Minimum number of hours of precipitation required in order to use complex precipitation phrase structure 7.
Default value = 6.

LP(51)- Maximum number of hours at the end of the forecast period during which precipitation Y occurs after changing from precipitation X in order to use complex precipitation phrase structure 7.
Default value = 3.

LP(52)- Minimum length of forecast period in hours in order to use complex precipitation phrase structure 8.
Default value = 6.

LP(53)- Minimum number of hours of precipitation required in order to use complex precipitation phrase structure 8.
Default value = 6.

LP(54)- Maximum number of hours at the end of the forecast period during which precipitation X and precipitation Y are mixed in order to use complex precipitation phrase structure 8.
Default value = 3.

LP(55)- Maximum number of hours during which precipitation type 2 can occur and not be formatted as mixed precipitation with precipitation type 1. This case applies in situations where precipitation type 2 was (becomes) the dominant precipitation type (i.e., precipitation type 1) before (after) a change of state. If precipitation type 2 does not meet the time requirement imposed by LP(55), it is ignored since it is also mentioned as the dominant precipitation. Used in complex precipitation phrase structure 2.
Default value = 3.

LP(56)- Maximum number of hours during which precipitation type 2 can occur and not be formatted as mixed precipitation with precipitation type 1. This case applies in situations where precipitation type 2 was (becomes) the dominant precipitation type (i.e., precipitation type 1) before (after) a change of state. If precipitation type 2 does not meet the time requirement imposed by LP(56), it is ignored since it is also mentioned as the dominant precipitation. Used in complex precipitation phrase structure 5.
Default value = 3.

LP(57)- Maximum number of hours during which precipitation type 2 can occur and not be formatted as mixed precipitation with precipitation type 1. This case applies in situations where precipitation type 2 was (becomes) the dominant precipitation type (i.e., precipitation type 1) before (after) a change of state. If precipitation type 2 does not meet the time requirement imposed by LP(57), it is ignored since it is also mentioned as the dominant precipitation. Used in complex precipitation phrase structure 7.
Default value = 3.

LP(58)- Maximum number of hours from the ending time of precipitation type 2 (which is mixed precipitation with precipitation type 1) to the ending time of precipitation type 1 in order to use complex precipitation phrase structure 1.
Default value = 3.

LP(59)- Maximum number of hours from the starting time of precipitation type 1 to the starting time of precipitation type 2 (mixed with precipitation type 1) in order to use complex precipitation phrase structure 1.
Default value = 3.

LP(60)- Maximum number of hours allowed after a change of state with a chance probability to use the phrase "precipitation X POSSIBLY CHANGING TO precipitation Y change time." If the chance probability occurs for longer than LP(60) hours, then the phrase "precipitation X time1...THEN A CHANCE OF precipitation Y time2" will be formatted. Used in several phrases.
Default value = 3.

LP(61)- Minimum twelve hour Probability of Precipitation that will insert the phrase "PROBABILITY OF PRECIPITATION" into the forecast for the period.
Default value = 20.