AERODROME METEOROLOGICAL OBSERVATION AND FORECAST STUDY GROUP (AMOFSG)

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Agenda Item 5: Observing and forecasting at the aerodrome and in the terminal area
5.2: Forecasts

TRIAL TREND – IMPROVING LANDING FORECASTS IN THE NETHERLANDS

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SUMMARY

At the Royal Netherlands Meteorological Institute (KNMI) it is felt that the current format of the TREND has shortcomings during changeable weather. Under these circumstances, the TREND may alternate continuously and therefore become demanding to the forecaster and confusing to the user. These drawbacks are especially pronounced when reports (METAR, SPECI and local routine and special reports) are generated by automated systems. In this paper these shortcomings are underlined with the use of a one year dataset of local routine and special reports of four Dutch airports. An adjustment to the TREND format is proposed, in order to make the TREND clearer and more efficient. It is suggested to replace the change indicator TEMPO with two indicators: a state indicator PREV (describing the prevailing meteorological conditions) and a change indicator TEMPO (describing the temporary fluctuations). KNMI plans to test this adjustment on the local routine and special reports for the airports EHRD, EHGG and EHBK and intends to start a one year trial period in fall 2011. Prior to the test period a user consultation on the need for TREND in local routine and special reports will be carried out in the Netherlands..

1. INTRODUCTION

1.1 The Royal Netherlands Meteorological Institute (KNMI) is responsible for the issuance of meteorological reports for the four major civil airports in the Netherlands: Amsterdam Airport

Schiphol (EHAM), Rotterdam The Hague Airport (EHRD), Groningen Airport Eelde (EHGG) and Maastricht Aachen Airport (EHBK).

1.2 For these airports, a routine Meteorological Aerodrome Report (METAR) is issued every 30 minutes (H+25 and H+55) and distributed internationally. Simultaneously, a weather report for local use at the airport is generated (local routine report or ACTUAL). The ACTUAL will be overruled by an intermediate report (local special report or SPECIAL) if significant changes occur.

1.3 The meteorological reports for EHAM are created by a human observer at the airport. The reports for EHGG and EHBK are generated by an automated system (indicated with the prefix 'AUTO'). Until October 2010, all EHRD reports have been created by a human observer. From October 2010 until March 2011 day time reports have been made by an observer, night time reports by an automated system. As of March 2011 all reports for EHRD are generated by an automated system.

1.4 A forecaster located at KNMI in De Bilt is responsible for adding landing forecasts (TRENDs) with a period of validity of 2 hours. On request of the Netherlands CAA, TRENDs are added to all reports during opening hours of the airports (EHAM and EHRD 24 h per day, EHGG and EHBK from ± 5.30 LT until 23.00 LT).

1.5 At KNMI it is felt that the current TREND format has some shortcomings, especially in circumstances with changeable meteorological conditions (e.g. showers, gusts, banking fog). In these situations, the number of intermediate (SPECIAL) reports increases significantly. With every new SPECIAL, the forecaster has to issue a new TREND. In the current format, the TREND only depicts the upcoming changes *with respect to* the actual state mentioned in the report. As a result, the TREND may change completely between consecutive reports, although the overall meteorological circumstances remain constant (e.g. clear skies with intermittent showers). This is not only demanding to the forecaster, but may also be confusing to the user: 'Has the forecast changed, or only the actual observations?'.

1.6 A small study group at KNMI has performed a survey to investigate a possible improvement of the TREND with the working name 'Trial TREND'. The results of this investigation are discussed in this report.

2. DATA SET STATISTICS

2.1 Use has been made of the local reports ((AUTO) ACTUALs and (AUTO) SPECIALs) of EHAM, EHRD, EHGG and EHBK, issued during 2010. These are all arrival reports made for the landing runway in use and available on ATIS. EHAM also has a separate report for departure, which has not been taken into account, as this report is not accompanied by a TREND. EHAM reports also differ from the reports for the other airports as they may contain information for up to 2 runways. For the second runway, only wind changes will invoke a SPECIAL. A TREND is added for the main arrival runway only.

2.2 For EHGG, reports made during August 2010 are lacking in the database, for the other airports only a few days (3 at EHAM, 9 at EHBK and EHRD) are missing.

2.3 General statistics

2.3.1 Table 1 shows the number of local reports issued during 2010. Several subdivisions have been made to show the differences in frequency of the reports during daytime, summer and winter. For a comparison between airports, it is best to investigate daytime reports (approx. 5.30 LT – 23.00 LT).

During daytime, all airports are accompanied by TRENDs. Besides this, during daytime, EHRD has had a human observer throughout 2010.

EHAM compared with EHRD

2.3.2 During daytime, EHAM has about twice as many SPECIALs as EHRD. This difference is mainly caused by runway changes. EHAM has six runways, while EHRD has only one. At EHAM almost 50 per cent of the SPECIALs are caused by a runway change, while at EHRD this is only the case in less than 5 per cent of the SPECIALs. Besides this, a small number of SPECIALs at EHAM is caused by variations on the second runway. Both kind of SPECIALs do not require a new TREND. Taking these differences into account, the number of SPECIALs is on average comparable for the two airports.

2.3.3 Winter has more SPECIALs than summer: for EHAM about 50 per cent more, for EHRD about 300 per cent. For EHAM this difference is caused by the fact that poor conditions occur more often in winter. The large difference for EHRD is mainly caused by the transition from observer to automated system in October 2010 (see Section 2.1.4).

EHGG compared with EHBK

2.3.4 EHGG has two runways, but reports are only issued for the major runway. EHBK has only one runway. For both airports, all reports are generated by an automated system. The total number of reports is about the same. Note that for EHGG August is missing, causing slightly lower values in summer. The number of ACTUALs is about the same as the number of SPECIALs, so on average there has been one SPECIAL on every ACTUAL. In reality, in 50 per cent of the time no intermediate reports have been generated. In 10 per cent of the time more than four intermediate reports have been issued between two ACTUALs, in 1 per cent of the cases even six or more. In winter, about twice as many SPECIALs have been issued compared to summer.

Table 1. Total numbers of SPECIALs and ACTUALs over 2010.

Daytime[1] 2010	EHAM	EHRD	EHGG	EHBK
Total # of ACTUALs	12276	12121	10617	12111
# ACTUALs with TREND	12276	12121	10617	12111
Total # of SPECIALs	5505	2738	11738	12986
# SPECIALs with TREND	5505	2738	10757	12986

Summer[2] 2010	EHAM	EHRD	EHGG	EHBK
Total # of ACTUALs	8604	8530	6963	8547
# ACTUALs with TREND	8604	8530	4779	6049
Total # of SPECIALs	2911	1385	5537	6317
# SPECIALs with TREND	2911	1385	3621	4748

Winter[2] 2010	EHAM	EHRD	EHGG	EHBK
Total # of ACTUALs	8734	8566	8565	8569
# ACTUALs with TREND	8734	8566	5838	6062
Total # of SPECIALs	3816	3826	11520	11025
# SPECIALs with TREND	3816	3826	8117	8238

2010	EHAM	EHRD	EHGG	EHBK
Total # of ACTUALs	17338	17096	15528	17116
# ACTUALs with TREND	17338	17096	10617	12111
Total # of SPECIALs	6727	5211	17057	17342
# SPECIALs with TREND	6727	5211	11738	12986

[1] Daytime: during opening hours of EHGG and EHBK, approx. 5.30 LT – 23.00 LT.
[2] Summer: April – September. Winter: January – March and October-December.

Human observers compared with automated systems

2.3.5 Compared to EHRD (and EHAM, if runway changes are omitted), the number of SPECIALs during daytime at EHGG and EHBK is four times as large. This huge difference is to some extent caused by some (by now partly solved) bugs in the automated systems, but can mainly be attributed to the nature of the automated systems. For example, automated systems strictly adhere to regulations: they will issue a SPECIAL every time a threshold is reached or crossed (this will be discussed in more detail in Section 3.2). Another property of automated systems is their inability to combine several phenomena at the same time. In showery conditions, they may first issue a SPECIAL for precipitation, several moments later for visibility and again some moments later for the clouds. An observer will probably merge these observations in one single report.

Transition from observer to automated system at EHRD

2.3.6 The difference between a human observer and an automated system is also illustrated by the totals of EHRD. From October 2010, nighttime reports for EHRD are no longer created by a human observer, but generated by an automated system. This is reflected in the number of SPECIALs, as can be seen in Table 1. During daytime and summer (and also during the first three winter months, not shown in Table 1), EHRD has about half the number of SPECIALs of EHAM. In winter however, the total number

of SPECIALs becomes almost equal to the number at EHAM. When only nighttime SPECIALs from October until December are counted, EHRD even has three times as much SPECIALs compared to EHAM (not shown in Table 1).

2.4 **Occurrence of TREND indicators**

2.4.1 A TREND always starts with a change indicator (TEMPO or BECMG) or the codeword NOSIG. Table 2 summarizes the occurrence of these indicators over 2010. As mentioned in Section 2.1, airports are best compared by their daytime totals.

Table 2. Occurrence of TREND indicators.

	ACTUALs daytime[1] 2010				SPECIALs daytime[1] 2010			
	EHAM	EHRD	EHGG	EHBK	EHAM	EHRD	EHGG	EHBK
Amount with TREND	12276	12121	9746	10790	5505	2738	10757	11565
NOSIG	73%	72%	63%	67%	53%	36%	32%	35%
Only BECMG	10%	11%	13%	9%	17%	25%	21%	17%
TEMPO (w/wo BECMG)	16%	16%	25%	24%	30%	39%	47%	48%

	ACTUALs winter[2] 2010				SPECIALs winter[2] 2010			
	EHAM	EHRD	EHGG	EHBK	EHAM	EHRD	EHGG	EHBK
Amount with TREND	8734	8566	5838	6062	3816	3826	8117	8238
NOSIG	65%	61%	50%	57%	44%	32%	25%	27%
Only BECMG	14%	16%	17%	11%	22%	24%	23%	17%
TEMPO (w/wo BECMG)	21%	23%	33%	32%	34%	43%	52%	56%

	ACTUALs summer[2] 2010				SPECIALs summer[2] 2010			
	EHAM	EHRD	EHGG	EHBK	EHAM	EHRD	EHGG	EHBK
Amount with TREND	8604	8530	4779	6049	2911	1385	3621	4748
NOSIG	79%	77%	77%	75%	59%	42%	45%	49%
Only BECMG	8%	9%	9%	8%	14%	24%	21%	17%
TEMPO (w/wo BECMG)	13%	14%	14%	17%	27%	34%	34%	33%

	ACTUALs 2010				SPECIALs 2010			
	EHAM	EHRD	EHGG	EHBK	EHAM	EHRD	EHGG	EHBK
Amount with TREND	17338	17096	10617	12111	6727	5211	11738	12986
NOSIG	72%	69%	62%	66%	50%	35%	32%	35%
Only BECMG	11%	13%	13%	10%	19%	24%	22%	17%
TEMPO (w/wo BECMG)	17%	19%	25%	24%	31%	41%	47%	48%

NOSIG

2.4.2 In winter, for 50-60 per cent of the ACTUALs no significant change is to be expected (NOSIG). In summer this percentage is 60-70 per cent. For SPECIALs, these percentages are of course

lower, ranging from 25 per cent in winter, up to 50 per cent in summer. EHAM has even higher percentages of SPECIALs with a NOSIG TREND, caused by runway changes during peak hours. But runway changes are not the only reason for SPECIALs during 'NOSIG' weather. By local agreement, some other variables can also invoke SPECIALs, without passing TREND thresholds. For example: temperature variations, pressure changes and wind variations at low speeds.

BECMG

2.4.3 In about 10-15 per cent of the ACTUALs and about 20 per cent of the SPECIALs only the time indicator BECMG has been used. In these cases, the weather may change abruptly or gradually, but reaches or passes a threshold in one direction only. During winter, the time indicator BECMG has been used more often (about twice as much), as conditions are more often below limits.

TEMPO

2.4.4 The change indicator TEMPO has been used (possibly in combination with a BECMG group) for 15-25 per cent of the daytime ACTUALs and 40-50 per cent of the daytime SPECIALs. During summer, TEMPO only occurs in 15 per cent of the ACTUALs and 35 per cent of the SPECIALs. Many of these TEMPO groups describe showery conditions. In winter the occurrence is 25-30 per cent and 45-55 per cent respectively. As mentioned in Section 2.1, in winter, periods of poor conditions occur more often, are more prolonged and conditions are often worse than in summer (dense fog, low ceilings, low visibilities in snow). In snow, conditions may fluctuate strongly. But also in very poor, almost stable conditions TEMPO groups are frequently used (Section 3.1). As conditions become poorer, the intervals between thresholds become smaller and thresholds are more likely to be reached or passed.

2.5 Length of TRENDs

2.5.1 Figure 1 shows the distribution of the length of all TRENDs (ACTUALs and SPECIALs combined). More than 50 per cent of the issued TRENDs consist of only 5 characters: NOSIG. 75 per cent of the TRENDs are shorter than 13 characters. Only 1 per cent of the TRENDs is longer than 40 characters. The longest TREND of 2010 consists of 85 characters and has been issued on November 11 for EHGG:

SPECIAL EHGG 111803Z 20023KT 160V230 3600 -SHRA SCT007
BKN009 BKN010 07/07 Q0981

TEMPO 20030G42KT 2500 RA SHRA BKN012 FEW025CB
BECMG FM1900 24015G25KT 9999 NSW SCT040=

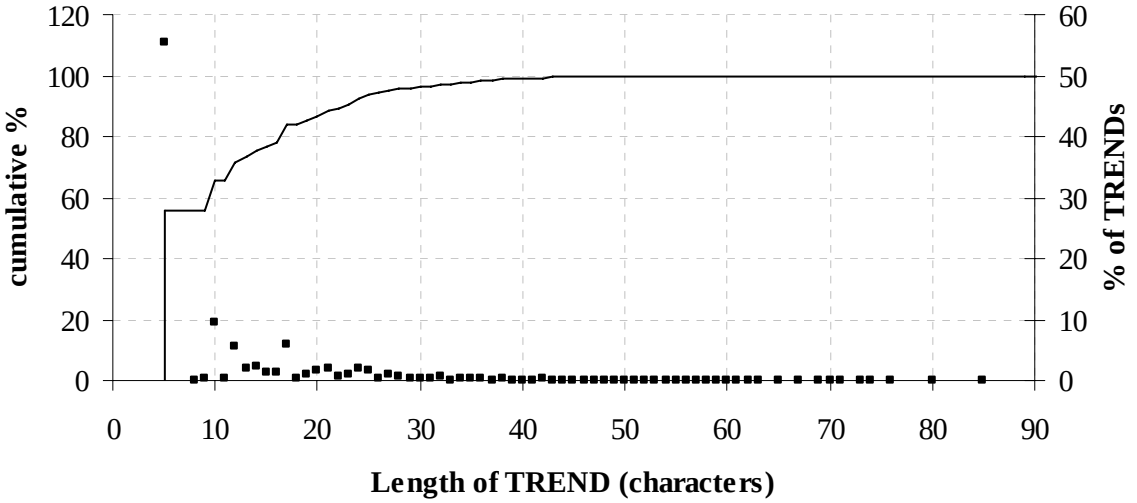

Figure 1. Percentage of TRENDs with a certain length (dots) and cumulative percentage of TRENDs shorter or equal to a certain length (line).

3. TRENDS FOR VARIOUS METEOROLOGICAL CIRCUMSTANCES

3.1 In the previous Section, the general statistics of TRENDs have been investigated. This Section deals with the contents of the TREND. The behavior of the TREND under various meteorological regimes will be investigated.

3.2 Steady conditions

3.2.1 In general, in steady conditions the number of intermediate reports is low. Some SPECIALs may occur due to runway changes (especially at EHAM during peak hours). The TREND consists of 'NOSIG' and both the forecaster and the users only have to pay minor attention to the reports. They only have to perform a quick check whether the conditions are still within the expected limits.

3.2.2 With automated systems however, stable conditions will sometimes cause a large number of SPECIALs. If conditions vary slightly around a significant threshold, these systems strictly adhere to regulations and issue SPECIALs. Each of these reports requires a suitable TREND.

For example, reports for EHGG on November 19:

ACTUAL EHGG 190855Z 09002KT 2900 BR OVC013 05/05 Q1013
TEMPO 3500=

SPECIAL EHGG 190903Z 12002KT 3100 BR OVC011 05/05 Q1013
TEMPO 2500=

SPECIAL EHGG 190910Z 12003KT 2900 BR OVC010 05/05 Q1013

TEMPO 3500=

SPECIAL EHGG 190917Z 11004KT 3000 BR SCT010 BKN014 05/05 Q1013
TEMPO 2500=

3.2.3 This is an inconvenient situation for the forecaster and does not show the almost stationary conditions to the user. In this particular situation, the forecaster did not issue the TRENDs as presented above. He only issued 'NOSIG', which is of course understandable, as it is NOSIG weather. It is however not strictly in accordance with regulations.

3.2.4 A human observer is able to account for insignificant fluctuations and will only issue a SPECIAL if conditions really change. He would probably have issued the ACTUAL only:

ACTUAL EHGG 190855Z 09002KT 3000 BR OVC013 05/05 Q1013
NOSIG=

or, if he expects the visibility to be mainly below 3000 m:

ACTUAL EHGG 190855Z 09002KT 2500 BR OVC013 05/05 Q1013
NOSIG=

3.3 **Gradually changing conditions**

3.3.1 When meteorological conditions are expected to change in such a way that significant thresholds are reached or passed in one direction only, the forecaster will issue a TREND containing the change indicator BECMG. Each time a threshold is reached or passed, an intermediate report will be generated. The TREND will only be adjusted when the expected change has been completed, or when the forecast has changed. e.g. November 16:

ACTUAL EHGG 160925Z 24002KT 2400 BR BKN047 01/01 Q1022
BECMG 9999 NSW=

SPECIAL EHGG 160935Z 20003KT 3900 BR OVC047 02/02 Q1022
BECMG 9999 NSW=

ACTUAL EHGG 160955Z 22002KT 4800 BR OVC049 04/04 Q1022
BECMG 9999 NSW=

SPECIAL EHGG 161003Z 17002KT 6000 OVC048 04/04 Q1022
BECMG 9999=

SPECIAL EHGG 161013Z 18002KT 7000 FEW049 06/06 Q1022
BECMG 9999=

ACTUAL EHGG 161025Z 16002KT 7000 NCD 06/06 Q1022
BECMG 9999=

SPECIAL EHGG 161042Z 20002KT 9999 BKN048 07/07 Q1022
NOSIG=

3.4 **Fluctuating conditions**

3.4.1 When changes to the meteorological conditions are expected to be only temporary, the forecaster will issue a TREND containing the change indicator TEMPO. Each time a threshold is reached or passed, an intermediate report will be generated. Often the TREND has to be adjusted, as the TREND has to describe changes with respect to the observed values. This is especially inconvenient in highly fluctuating conditions, for example during isolated heavy thunderstorms or strong wind gusts. For a forecaster, these are demanding conditions: he has to monitor rapidly changing observations, keep his forecasts up to date and give accurate advice to his customers. In the current situation, he also has to rewrite the TREND over and over again, even if the overall weather conditions do not change. When conditions are good, he has to write a TREND for the poorer conditions. When the conditions become poor as expected, he has to rewrite the TREND to forecast the better conditions. This is not only time consuming to the forecaster, it may also confuse users. For example, August 4 on EHRD:

ACTUAL EHRD 040755Z 24 20012KT 150V230 9999 -SHRA SCT013 BKN015 18/15 Q1007
TEMPO 6000 FEW015CB =

SPECIAL EHRD 040803Z 20014KT 160V230 7000 -SHRA SCT013 BKN015 18/14 Q1007
TEMPO 9999 FEW015CB=

SPECIAL EHRD 040811Z 20011KT 170V240 9999 SCT014 BKN016 17/15 Q1007
TEMPO 6000 -SHRA FEW015CB=

SPECIAL EHRD 040815Z 20011KT 170V230 6000 -SHRA FEW015CB BKN017 17/15 Q1007
TEMPO 9999 NSW=

ACTUAL EHRD 040825Z 20014KT 170V230 9999 -SHRA FEW014 BKN024 17/15 Q1007
TEMPO 6000 FEW015CB=

ACTUAL EHRD 040855Z 20015KT 170V230 9999 FEW013 BKN020 17/15 Q1006
TEMPO 6000 -SHRA FEW015CB=

3.4.2 The TREND ‘TEMPO 9999 NSW’ is strictly not correct, but it is common practice. TEMPO means by definition that the change ‘lasts for a period of less than one hour in each instance and in the aggregate covers less than half of the forecast period during which the fluctuations are expected to occur’ (WMO-306). In this particular case, the definition of TEMPO only holds for the showers, not for the (longer) periods in between. As an alternative, the forecaster often issues ‘BECMG 9999 NSW’. Again this is common practice, but not entirely correct, as part of the information (the ongoing intermittent showers) is lost.

3.4.3 Note that also the cloud group is not entirely correct. According to regulations, all cloud bases should be mentioned: ‘in the case of significant changes of the clouds, all cloud groups, including any significant layer(s) or masses not expected to change, shall be given.’(WMO-306). The shown notation is however commonly used as it enhances the readability of the TREND.

As a second example, on October 23 the following reports were issued at EHBK:

ACTUAL EHBK 231655Z 22019KT 9999 BKN014 OVC016 07/05 Q1003
TEMPO 22018G28KT 7000 SHRA BKN015 SCT020CB=

SPECIAL EHBK 231708Z 21019KT 180V250 9999 BKN014 OVC017 07/05 Q1003
TEMPO 22018G28KT 7000 SHRA BKN015 SCT020CB=

SPECIAL EHBK 231718Z 21018KT 9999 -DZ OVC015 08/05 Q1003
TEMPO 22018G28KT 7000 SHRA BKN014 SCT020CB=

ACTUAL EHBK 231725Z 21022G27KT 9999 -DZ SCT014 OVC016 07/05 Q1003
TEMPO 6000 SHRA BKN014 SCT020CB=

SPECIAL EHBK 231725Z 21017G27KT 9999 DZ BKN013 OVC016 07/05 Q1003
TEMPO 6000 SHRA BKN016 SCT020CB=

3.4.4 When gusts appear in the observations (1725Z), the wind group in the TREND has to be changed. In this case it is left out of the TREND completely, which is of course not entirely correct. But again, as in the previous example, each of the possible alternatives (e.g. BECMG 21020KT, or TEMPO 21020KT) is not completely correct as well.

3.4.5 Also note that the cloud forecast changes in the consecutive TRENDs as a response to slight changes in the automated reports. This is an example of a situation where small fluctuations around a significant threshold may generate many additional SPECIALs (see Section 3.1).

4. TRIAL TREND

4.1 Outline

4.1.1 From the previous Sections it has become clear that TRENDs with a TEMPO group:

- are used in almost 50 per cent of the AUTO SPECIALs,
- often yield (unnecessary) extra work to the forecaster,
- may show a ‘jumpy’ and confusing picture to the user and
- may even be unsuitable to contain all the necessary information in specific cases.

4.1.2 To evade these inconvenient effects, KNMI proposes to replace the ambiguous TEMPO group with two groups: 1) a group that represents the prevailing meteorological conditions during the period of validity of the TREND (2 hours) and 2) a second group that indicates the significant changes. The group stating the prevailing conditions starts with a state indicator. In this study the codeword PREV has been used. The PREV group is followed by a group with the change indicator TEMPO. Both groups contain the same parameters. An example of the changes that have to be made to the code technical descriptions (e.g. WMO-306, FM 15-XIV METAR) can be found in the appendix.

4.1.3 The NOSIG and BECMG groups do not show these inconvenient effects and remain unchanged in the proposed Trial TREND format.

4.2 **Trial TREND example – fluctuating conditions**

4.2.1 The different TRENDs accompanying the reports shown in Section 3.1 (steady case) can be replaced with one Trial TREND:

PREV 2500 TEMPO 3500=

The different TRENDs accompanying the reports shown in Section 3.3 (showery case) can be replaced with one Trial TREND:

PREV 9999 BKN020 TEMPO 6000 –SHRA FEW015CB BKN018=

The different TRENDs accompanying the reports shown in Section 3.3 (showery case with gusts) can be replaced with one Trial TREND:

PREV 22017KT 9999 NSW BKN020 TEMPO 22018G28KT 7000 SHRA BKN014 SCT020CB=

4.2.2 In this case, the PREV group contains the weather group NSW. On first sight, this seems inconsistent. NSW is not used to describe the actual weather, but only to describe upcoming changes. NSW appears in the change groups TEMPO and BECMG when all actual weather phenomena are expected to end within the next two hours. One has to bear in mind that when the shower eventually occurs in the report, the TEMPO group describes the actual weather. The PREV group then becomes the group describing the expected changes. So in fact, the PREV group is also a kind of change group.

In the previous example (showery case of Section 3.3) NSW is not necessary in the PREV group as a light shower does not need to be cancelled.

These Trial TRENDs are longer than the original TRENDs but can be maintained during the entire period, whereas the original TRENDs have to be adjusted repeatedly.

4.3 **Trial TREND example – gradually changing conditions**

4.3.1 A TREND with only a BECMG group does not change in the new format: the TRENDs shown in Section 3.2 remain unchanged. It is of course possible to issue a TREND with a PREV, a TEMPO and a BECMG group at the same time. The BECMG group may interact with the PREV group, by changing the conditions that are stated in the PREV group.

On January 2, the groups do not interact:

ACTUAL EHBK 021225Z 22012KT 9999 OVC010 M01/M03 Q1016

Current TREND: BECMG 7000 TEMPO BKN008
Trial TREND: PREV BKN012 TEMPO BKN008 BECMG 7000

On December 23, however, the BECMG group changes the PREV group:

SPECIAL EHGG 230556Z 03015KT 360V060 7000 BKN006 OVC007 M00/M00 Q1004

Current TREND: TEMPO 4000 -SN BECMG 8000
Trial TREND: PREV 6000 NSW TEMPO 4000 –SN BECMG 8000

On October 12 the BECMG group also changes the PREV group (original TREND adjusted for example):

SPECIAL EHGG 122011Z 25001KT 4400 BR NCD 06/06 Q1019

Current TREND: BECMG 2000 TEMPO FM2100 1200 BCFG
Trial TREND: PREV 4500 BR BECMG 2000 TEMPO FM2100 1200 BCFG

5. DISCUSSION

5.1 Length of the TREND

5.1.1 The current proposal increases the length of TRENDs that contain a TEMPO group. With some restrictions, the increase in size can be kept to a minimum:

- A maximum of one PREV group in the TREND
- No time indication (e.g. FM1200) allowed in the PREV group
- A maximum of one weather group (e.g. –RA) in the PREV group.

Theoretically, this could still lead to a PREV group of 60-70 characters (incl. spaces), e.g.:

PREV 25025G35KT 7000 –SHRAGS FEW008 SCT012 BKN015 FEW020CB

In practice however, the PREV group will consist of approximately 9 (e.g. PREV 4000) up to 35 characters (e.g. PREV 20025KT 9999 –RA SCT012 BKN020).

The longest TREND mentioned in Section 2.3 of 85 characters would become about 114 characters with the new Trial TREND:

PREV 20020KT 4000 –RA BKN012
TEMPO 20030G42KT 2500 RA SHRA BKN008 FEW025CB
BECMG FM1900 24015G25KT 9999 NSW SCT040=

KNMI has not been able to find any international regulations on the maximum length of a TREND. At KNMI, the computer systems are able to process TRENDs consisting of more than 200 characters. It is currently under investigation whether the systems of our users have any restrictions on this point.

5.2 Name of state indicator

5.2.1 The TRIAL TREND uses a new indicator. At KNMI, this is not a problem, as the TREND is processed as a free format string. Unfortunately, from a short survey performed by code- and communication specialists at KNMI it has come clear that this adjustment in the TREND code cannot be implemented internationally as such. Many systems will not recognize the new indicator. Beside this general implementation problem, some systems might have extra difficulties with a four-character

indicator, like PREV. A five-character indicator might be a safer choice (like PREVG or PREVL). This has to be decided upon.

5.3 Potential drawbacks of Trial TREND

5.3.1 The length of the Trial TREND can be longer than the current TREND and thus increasing the length of the ATIS broadcast. In general, the Trial TREND will provide a more consistent forecast for users. However, one could argue that a longer Trial TREND in itself could be less clear to the users.

5.3.2 The use of BECMG in combination with a TEMP or PREV group in the Trial TREND may result in a forecast that is less clear or confusing to the user.

5.4 Testing the Trial TREND

5.4.1 KNMI proposes to test the Trial TREND with the local reports AUTO ACTUAL and AUTO SPECIAL for EHRD, EHBK and EHGG. A change in this code only needs a local agreement with the users (e.g. Air Traffic Control, airport operators and pilots) and permission of the National Supervisory Authority.

5.4.2 Testing this way, might yield extra workload for the forecaster. The METAR requires a TREND with the regular format, while a Trial TREND has to be added to the ACTUAL and SPECIAL. On the other hand, KNMI expects that the workload caused by the unexpected intermediate SPECIALs will decrease substantially as the Trial TREND does not need to be adjusted as often.

5.4.3 At KNMI, the implementation of the Trial TREND does not require any adjustments to the production systems as the TREND field is a free format string that will be processed regardless the contents. The ATIS/CCIS systems of ATC however, have to be adjusted to be able to process the indicator PREV.

5.5 The actual use of TREND in (AUTO) ACTUAL and (AUTO) SPECIAL

5.5.1 Based on the comments of the ad hoc working group 4 of ICAO AMOFSG and internal discussions within KNMI the question arose if there is a real need for a TREND in (AUTO) ACTUAL and (AUTO) SPECIAL reports.

5.5.2 The TREND in (AUTO) ACTUAL and (AUTO) SPECIAL is only available for users via the ATIS broadcast. This VHF broadcast is only available in a smaller area around the airport[1]. The TREND in (AUTO) ACTUAL and (AUTO) SPECIAL is available for ATC via CCIS as well.

5.5.3 Feed back from users (pilots) during a safety assessment AUTO METAR Rotterdam indicated that pilots in general listen to the ATIS broadcast only once in the landing process.

5.5.4 The TREND in (AUTO) METAR is available via the OPMET databank, the aviation website of KNMI, Teletext and VOLMET[2]. Note that the broadcast of (AUTO) METAR via VOLMET has a much broader range then the ATIS broadcast at an airport.

[1] Will this change in future with D-ATIS ?
[2] Only the METAR of EHAM and the AUTO METAR of EHRD are available on VOLMET.

5.5.5 At the moment the current usage of the TREND in (AUTO) ACTUAL and (AUTO) SPECIAL is not clear. KNMI will initiate a user consultation on the user requirements for the TREND in (AUTO) ACTUAL and (AUTO) SPECIAL. At this moment KNMI identifies as current users the pilots landing at the airport and ATC.

The outcome of the user consultation aims to address the following questions:

— Is there a need for pilots to add a TREND to the (AUTO) ACTUAL and (AUTO) SPECIAL given that a TREND is available in the half hourly (AUTO) METAR ?

— Is there a need for ATC to add a TREND to the (AUTO) ACTUAL and (AUTO) SPECIAL given that a TREND is available in the half hourly (AUTO) METAR.

— If the outcome is that there is a need for ATC only then the question will be to investigate whether this information can be provided in another format or by another product.

6. CONCLUSIONS

6.1 Based on the local reports of EHAM, EHRD, EHGG and EHBK over 2010, it can be concluded that the proposed Trial TREND improves the clarity of the landing forecasts and may considerably lower the workload of the forecaster. This is especially true for automated reports, since the Trial TREND is able to combine the fluctuations in the reports into one consistent forecast.

6.2 The proposal consists of replacing the change indicator TEMPO by a combination of a state indicator (e.g. PREV) and a change indicator TEMPO. As long as the general conditions do not change, the TREND does not have to be adjusted, regardless the number of SPECIALs.

6.3 Before testing the Trial TREND KNMI will conduct a user consultation to identify the need for a TREND in the (AUTO) ACTUAL and (AUTO) SPECIAL product. If the outcome of this consultation confirms the need of a TREND in (AUTO) ACTUAL and (AUTO) SPECIAL then KNMI will start a Trial TREND test period.

6.4 The Trial TREND will be tested locally, using the AUTO ACTUALs and AUTO SPECIALs of EHRD, EHBK and EHGG.

6.5 Some issues still require further research. Issues concerning local implementation are currently dealt with. An international survey has to be conducted on the benefits and drawbacks of the new TREND. Also the technical issues concerning international implementation need to be addressed, like the length of TREND, length of the new indicator and the recognition of the new indicator by the systems.

7. WAY FORWARD

7.1 In order to proceed with the trial and the possible implementation of the new TREND format, the following steps have to be taken:

— User consultation on the need of TREND in (AUTO) ACTUAL and (AUTO) SPECIAL (July/August 2011)

— Preparing CCIS/ATIS systems of ATC (July 2011)

— Revision of documents on procedures at KNMI (July/August 2011)

— Notify regulator, NSA, ATC and users and publish AIC (August/September 2011)

— Start of trial period for the duration of one year (4 seasons), with intermediate evaluations every 3 months (September 2011 – September 2012)

— Consultation with international partners / survey on international implementation

— (November 2012 – August 2013)

— Final evaluation and decisions on local/international implementation (November 2013).

— Action by the AMOFSG

7.2 The AMOFSG is invited to:

a) note the contents of this paper; and

b) consider appropriate follow-up actions.

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Appendix A to Study Note Trial TREND – Improving landing forecasts in The Netherlands

Questions and remarks by ad hoc WG/4 of ICAO AMOFSG/8 on KNMI Proposal Trial TREND
Date March 12, 2011
Version 1.1 Containing KNMI responses

1. What is the definition of PREV? The technical specification on the PREV is needed.

A description of the state indicator PREV has been added to WMO Manual No.306, section 'FM 15-XIV METAR'. The original document and the proposed changes can be found in the appendices.

From 'Trial TREND changes to WMO-No.306 version 20110312.doc':

> 'A group with change indicator TEMPO shall be preceded by a group with the state indicator PREV. The PREV group describes the prevailing meteorological conditions, which are subject to the temporary fluctuations mentioned in the TEMPO group (for example: PREV 9000 TEMPO 6000).'

'ICAO Annex 3' and 'Technical Regulations Basic Documents No. 2 Volume II - WMO-No. 49' have to be extended as well, e.g. table A3-3:

Table A3-3. Use of change indicators in trend forecasts

~~Change~~ indicator	Time indicator and period	Meaning	
NOSIG	–	No significant changes are forecast	
BECMG	FM$n_1n_1n_1n_1$ TL$n_2n_2n_2n_2$	The change is forecast to	Commence at $n_1n_1n_1n_1$ UTC and be completed by $n_2n_2n_2n_2$ UTC
	TLnnnn		Commence at the beginning of the trend forecast period and be completed by nnnn UTC
	FMnnnn		Commence at nnnn UTC and be completed by the end of the trend forecast period
	ATnnnn		Occur at nnnn UTC (specified time)
	–		(a) Commence at the beginning of the trend forecast period and be completed by the end of the trend forecast period; *or* (b) The time is uncertain
PREV	-	Prevailing meteorological state, subject to temporary fluctuations.	
TEMPO	FM$n_1n_1n_1n_1$ TL$n_2n_2n_2n_2$	Temporary fluctuations are forecast to	Commence at $n_1n_1n_1n_1$ UTC and cease by $n_2n_2n_2n_2$ UTC
	TLnnnn		Commence at the beginning of the trend forecast period and cease by nnnn UTC
	FMnnnn		Commence at nnnn UTC and cease by the end of the trend forecast period
	–		Commence at the beginning of the trend forecast period and cease by the end of the trend forecast period

Note: the mentioned documents contain specifications on (AUTO) METAR only. The proposed changes should also be implemented in specifications on local routine reports and local special reports (called (AUTO) ACTUAL and (AUTO) SPECIAL at KNMI).

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2. PREV may be suitable for the stable conditions with small fluctuations around a significant threshold, but not for tremendously fluctuating conditions such as strong convective activity in (sub-) tropical regions. One of my colleagues tried to do the Trial TREND as a research using PREV, which seemed to be very hard to apply the PREV to our TSRA case particularly because of the rapid change of wind and visibility, please find attached ' METAR examples of ZGGG in May'.

The heavy thunderstorms in the example are hard to capture in a TREND. To me this seems mainly to be caused by the unpredictability of the weather phenomena. With both the proposed and the current format it is difficult to generate a reliable 2-hour forecast for this situation. In the attached example, the moderate thunderstorms with rather poor conditions are forecasted well in advance. The heavy thunderstorms with very poor conditions are not well forecasted or only half an hour in advance.

I am not very familiar with tropical meteorology, but the following examples may be suited for tropical thunderstorms:

PREV 13005KT 9999 NSW BKN040 TEMPO VRB10G20KT 2500 TSRA SCT025CB BKN030

or, when a really heavy isolated storm is expected to pass the field:

PREV 13005KT 9999 NSW BKN040 TEMPO FM1500 VRB20G60KT 1000 +TSRA BKN012 SCT025CB BKN030

or, if an extended complex is passing over:

PREV 20010KT 2500 SHRA SCT030CB BKN040 TEMPO VRB20G50KT 1000 +TSRA SCT025CB BKN030

We are convinced that the proposed Trial TREND is also suitable for highly variable conditions. The benefits will especially be felt if intermediate reports have to be generated (SPECIs / local special reports). Highly fluctuating conditions may be very demanding to the forecaster: he has to monitor rapidly changing observations, keep his forecasts up to date and give accurate advice to his customers. With the current TREND format, he also has to rewrite the TREND over and over, even if his insights do not change. When the conditions are good, he has to write a TREND for the poorer conditions. When the conditions become poor as expected, he has to rewrite the TREND to forecast the better conditions. This is not only time consuming to the forecaster, it may also confuse users. With the Trial TREND, the forecaster only has to address the TREND if his insights change or the *overall* weather conditions change.

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3. In 4.2.4, The BECMG group may also interact with the new PREV group, by changing the conditions that are stated in the PREV group.

9 February 2009:

Current format:

METAR EHAM 092325Z 11016KT 5000 -RASN FEW004 BKN006 BKN012 02/01 Q0986

TEMPO 4000 BKN004 BECMG 8000=

Trial TREND:

PREV 5000 FEW004 BKN006 TEMPO 4000 BKN004 BECMG 8000=

As a result, three visibility values appearing simultaneously in Trial TREND and will be quite difficult to understand for users, and even mislead users.

In the current format, there are also three visibility values. The user has to extract the current value from the METAR and read the possible deviations from the TREND. We even think that the Trial TREND will be less difficult to understand, as it does not change as long as the overall conditions do not change. With the current TREND format, the next METAR may be:

METAR EHAM 092355Z 11015KT 4000 –RASN… TEMPO 5000 BECMG 8000=

The TREND has changed, although the overall forecast remains the same. With the Trial TREND, the previous TREND remains valid and the user does not have to consider whether the forecast has changed, or only the TREND.

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4. Reduce the accuracy of the TREND as a result of cancelling the time indicator FM (See *5. Discussion : As a result, no time indication (e.g. FM1200*)).

We should have been more specific: cancelling the time indicator only applies to the PREV group. The TEMPO and BECMG groups can still be followed by a time indicator. The second Section of 5.1 has been rephrased as follows:

‘With some restrictions, the increase in size can be kept to a minimum:

- A maximum of one PREV group in the TREND
- No time indication (e.g. FM1200) allowed in the PREV group
- A maximum of one weather group (e.g. –RA) in the PREV group.

---

5. We wish to point out that whilst Annex 3 does not preclude States from appending TRENDs to local reports and local specials, the phraseology (use of 'or') suggests that TRENDs might not be required for all types of weather reports:

6.3.3 A TREND forecast shall consist of a concise statement of the expected significant changes in the meteorological conditions at that aerodrome to be appended to a local routine or local special report, or a METAR or SPECI. The period of validity of a TREND forecast shall be 2 hours from the time of the report which forms part of the landing forecast.

Perhaps you could consider the issues associated with workload etc if you only provided a TREND for METARs. Alternatively should the Annex be rationalised so that TRENDS for local reports/special and METAR/SPECI were representative of the same area and therefore had the same information (app 2.2.3, note refers).

In the Netherlands, it is a request of the Dutch CAA that TRENDs are issued for METARs as well as for local routine and local special reports during opening hours of the airports. In our opinion, the amount of new TRENDs becomes unnecessarily high in meteorological circumstances that are already very demanding to the forecaster. Moreover, the changing TRENDs may be confusing to the user and even be inaccurate (Section 3). The Trial TREND has to address these issues and provide a more accurate and stable TREND, which only changes when the forecast changes.
The issue of the area of coverage of the reports is currently being addressed (see AMOFSG/8 Action 8/26).

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6. In most of the examples provided the PREV appears to mirror the existing conditions in the METAR or local report. Is this duplication necessary?

Yes, the actual conditions are either mirrored in the PREV group or in the TEMPO group. When both groups are separated by more than one threshold, it is of course also possible that the observed value is somewhere in between, changing from one group to the other. The benefit of this format is, that you do not have to change the TREND when the actual conditions change.

e.g. the Trial TREND:

PREV 9999 NSW FEW020 TEMPO 4000 SHRA SCT018CB BKN020

may suit the following (imaginary) series of reports:

METAR 030855Z 20002KT 9999 FEW020
METAR 030925Z 20005KT 7000 –SHRA FEW020CB BKN040
METAR 030955Z 20008KT 4500 SHRA FEW018CB BKN030
METAR 031025Z 20008KT 3500 SHRA SCT015CB BKN020
METAR 031055Z 20004KT 8000 –RA FEW018CB BKN025
METAR 031125Z 20002KT 9999 FEW020
METAR 031155Z 20008KT 4000 SHRA SCT020CB BKN030

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7. You appear to propose effectively a 2 hour TAF for every report. Wouldn't users simply refer to the TAF instead, which should always be within existing tolerances? Have there been any discussions with users?
In the UK TRENDs are predominately used by Offshore Helicopter Operators.

In the Netherlands, it is requested by the Dutch CAA that TRENDs are issued for local reports during opening hours of the airports. According to Annex 3 par 6.3.3 the TREND should describe upcoming changes in the next 2 hours:

> 'A TREND forecast shall consist of a concise statement of the expected significant changes in the meteorological conditions at that aerodrome to be appended to a local routine or local special report, or a METAR or SPECI. The period of validity of a TREND forecast shall be 2 hours from the time of the report which forms part of the landing forecast.'

From this section it may be concluded that a TREND is in fact a 2-hour TAF. Due to the frequent updates, the TREND provides a more accurate forecast than the TAF and gives more clarity on PROB30/PROB40 groups in the TAF. TRENDs are especially valuable to VFR-pilots who want to know whether it is safe or not to perform a local flight or a flight between regional airports. For example:

Based on the next TAF and local report, a pilot cannot decide whether it is possible to perform a flight or not.

TAF EHBK 2000/2106 25010KT 6000 NSC
PROB30 TEMPO 2000/2012 0800 BCFG
BECMG 2010/2013 CAVOK

ACTUAL EHBK 24008KT 7000 NSC

The TREND provides more information. When this ACTUAL is accompanied by the Trial TREND PREV 6000 NSW TEMPO 0800 BCFG it is clear that conditions at the airport are still very poor from time to time. A VFR-pilot will probably decide to postpone his flight. However, when this ACTUAL is accompanied by the TREND NOSIG, visibility is not expected to become below VFR-limits (5000 m) in the next two hours.

---

8. There is a concern that this could make the process of generating a 2 hour TAF longer than the existing process for TRENDs.

Using the new format, it is to be expected that one TREND on its own may take a little more time to generate. Not because of the forecast period, this remains 2 hours, but because of the extra PREV group the forecaster may have to compose and write down. The amount of TRENDs however, is expected to be smaller, so total production time will be less. This time-saving effect is especially valuable in critical meteorological circumstances, when forecasters are already very busy monitoring observations, updating forecasts and advising customers. This assumption will of course be evaluated during the local trial period in The Netherlands.

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9. In general messages will be longer than at present. Is this consistent with the ICAO desire to make messages succinct?

The Trial TRENDs may be somewhat less succinct, but more clear and practical in daily use.

An imaginary case: a showery day in polar airmass. In general conditions are good, but from time to time moderate showers pass over.

METAR 20010KT 9999 SCT030	TEMPO 4000 SHRA SCT020CB BKN030
METAR 20012KT 9999 –SHRA BKN030	TEMPO 4000 SHRA SCT020CB BKN030
METAR 20015KT 4000 SHRA SCT020CB BKN030	TEMPO 9999 NSW SCT030
METAR 20015KT 7000 –SHRA FEW020CB BKN030	TEMPO 4000 SHRA SCT030 TEMPO 9999
METAR 20010KT 9999 FEW020CB BKN030	TEMPO 4000 SHRA TEMPO SCT030
METAR 20010KT 9999 SCT030	TEMPO 4000 SHRA SCT020CB BKN030

With the current format, many different TRENDs are necessary. With the Trial TREND, one TREND can cover the entire period:

PREV 9999 SCT030 TEMPO 4000 SHRA SCT020CB BKN030

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10. On page 3, in section 3.2, you say "TRENDs with a BECMG group need somewhat more attention of the forecaster as they often yield intermediate SPECIALs". I don't understand this. Are you saying that a BECMG group results in more local special reports? If so, could you please explain to me the connection between BECMG and local special reports.

The mentioned section is not correctly formulated and should be rephrased. The intermediate SPECIALs are of course not the result of the BECMG group itself, but are caused by the changing conditions, which are forecasted in the BECMG group. The same applies to the next section about the TEMPO group (by mistake also numbered 3.2). The message we wanted to deliver in this section is that, under more or less linearly changing conditions, the TREND (with a BECMG group) does not change often. Only when the forecasted condition has been reached or the opinion of the forecaster changes, the TREND changes.
If the changes are only temporary, the TRENDs (with a TEMPO group) become ‘jumpy’. Although the general meteorological circumstances during the next hours do not change (e.g. nice weather with isolated showers), the TRENDs may change continuously. With the Trial TREND, the fluctuating conditions can be captured in one TREND that remains valid as long as the general circumstances (nice weather with isolated showers) do not change.

Appendix 1: Trial TREND changes to WMO-No.306 version 20110312.doc
Appendix 2: WMO-N0.306 (2010) FM 15-XIV METAR.pdf
Appendix 3: METAR examples of ZGGG in May_Guangzhou.doc

Appendix 1 Code technical description of Trial TREND of appendix A of AMOFSG/9 Study Note Trial TREND – Improving landing forecasts in The Netherlands – June 2011

Code technical description of Trial TREND

Excerpt from Manual WMO-No. 306 FM 15-XIV METAR (version 2010) with modifications (highlighted)

pag. 1 A-25
code form:

TTTT(T) or NOSIG	TTGGgg	ddd ff Gf$_m$f$_m$	KMH or KT or MPH	VVVV or CAVOK	w'w' or NSW	N$_s$N$_s$N$_s$h$_s$h$_s$h$_s$ of VVh$_s$h$_s$h$_s$ of NSC

blz 1 A-25 - note (3)
Old:
The code form includes a section containing the trend forecast identified either by a change indicator (TTTTT =BECMG or TEMPO as the case may be), or by the code word NOSIG.
New:
The code form includes a section containing the trend forecast identified by an indicator TTTT(T):

- the change indicator BECMG, or
- the state indicator PREV in combination with the change indicator TEMPO, or
- the codeword NOSIG.

15.14.2
Old:
When a change, required to be indicated in accordance with the governing criteria for significant changes, is expected for one or several of the observed elements — wind, horizontal visibility, present weather, clouds or vertical visibility — one of the following change indicators shall be used for TTTTT: BECMG or TEMPO.
New:
When a change, required to be indicated in accordance with the governing criteria for significant changes, is expected for one or several of the observed elements — wind, horizontal visibility, present weather, clouds or vertical visibility — one of the following indicators shall be used for TTTT(T): the change indicator BECMG, or the state indicator PREV together with the change indicator TEMPO.

15.14.3
Old:
The time group GGgg, preceded without a space by one of the letter indicators TT = FM (from), TL (until) or AT (at), shall be used as appropriate, to indicate the beginning (FM) or the end (TL) of a forecast change, or the time (AT) at which specific forecast condition(s) is (are) expected.
New:
The time group GGgg, preceded without a space by one of the letter indicators TT = FM (from), TL (until) or AT (at), shall be used as appropriate, to indicate the beginning (FM) or the end (TL) of a forecast change, or the time (AT) at which specific forecast condition(s) is (are) expected. The time group shall only be used following a change indicator (BECMG or TEMPO), not in combination with the state indicator PREV.

15.14.7
Old:
The change indicator TEMPO shall be used to describe expected temporary fluctuations to meteorological conditions which reach or pass specified threshold criteria and last for a period of less than one hour in each instance and in the aggregate cover less than half of the forecast period during which the fluctuations are expected to occur.
New:
The change indicator TEMPO shall be used to describe expected temporary fluctuations to meteorological conditions which reach or pass specified threshold criteria and last for a period of less than one hour in each instance and in the aggregate cover less than half of the forecast period during which the fluctuations are expected to occur. A group with change indicator TEMPO shall be preceded by a group with the state indicator PREV. The PREV group describes the prevailing meteorological conditions, which are subject to the temporary fluctuations mentioned in the TEMPO group (for example: PREV 9000 TEMPO 6000).

15.14.10
Old:
Following the change groups TTTTT TTGGgg, only the group(s) referring to the element(s) which is (are) forecast to change significantly shall be included. However, in the case of significant changes of the clouds, all cloud groups, including any significant layer(s) or masses not expected to change, shall be given.
New:
Following the state and/or change groups TTTT(T) (TTGGgg), only the group(s) referring to the element(s) which is (are) forecast to change significantly shall be included. However, in the case of significant changes of the clouds, all cloud groups, including any significant layer(s) or masses not expected to change, shall be given.

FM 15–XIV METAR **Aerodrome routine meteorological report (with or without trend forecast)**

FM 16–XIV SPECI **Aerodrome special meteorological report (with or without trend forecast)**

C O D E F O R M :

METAR or **SPECI** **COR** CCCC YYGGgg**Z** **NIL** **AUTO** dddff**G**$f_m f_m$ {**KMH** or **KT** or **MPS**} $d_n d_n d_n$**V**$d_x d_x d_x$

{VVVV or VVVV**NDV** or **CAVOK**} $V_N V_N V_N V_N D_v$ {**R**$D_R D_R$/$V_R V_R V_R V_R$i or **R**$D_R D_R$/$V_R V_R V_R V_R$**V**$V_R V_R V_R V_R$i} w´w´ {$N_s N_s N_s h_s h_s h_s$ or **VV**$h_s h_s h_s$ or **NSC** or **NCD**}

T´T´/T´$_d$T´$_d$ **Q**$P_H P_H P_H P_H$ **RE**w´w´ {**WS R**$D_R D_R$ or **WS ALL RWY**} (**W**$T_s T_s$**/S**S´) (**R**$D_R D_R$/$E_R C_R e_R e_R$**B**$_R B_R$)

{(TTTTT or **NOSIG**)} TTGGgg dddff**G**$f_m f_m$ {**KMH** or **KT** or **MPS**} {VVVV or **CAVOK**} {w´w´ or **NSW**} {$N_s N_s N_s h_s h_s h_s$ or **VV**$h_s h_s h_s$ or **NSC**}

(**RMK** .....)

Notes:

(1) METAR is the name of the code for an aerodrome routine meteorological report. SPECI is the name of the code for an aerodrome special meteorological report. A METAR report and a SPECI report may have a trend forecast appended.

(2) The groups contain a non-uniform number of characters. When an element or phenomenon does not occur, the corresponding group, or the extension of a group, is omitted from a particular report. Detailed instructions are given for each group in the following Regulations. The groups enclosed in brackets are used in accordance with regional or national decisions. Groups may have to be repeated in accordance with the detailed instructions for each group. The code words COR and NIL shall be used, as appropriate, for corrected and missing reports, respectively.

(3) The code form includes a section containing the trend forecast identified either by a change indicator (TTTTT = BECMG or TEMPO as the case may be), or by the code word NOSIG.

(4) The governing criteria for issuing SPECI reports are specified in publication WMO-No. 49 – *Technical Regulations* [C.3.1].

Appendix 2: WMO-N0.306 (2010) FM 15-XIV METAR

R E G U L A T I O N S :

15.1 **General**

15.1.1 The code name **METAR** or **SPECI** shall be included at the beginning of each individual report.

15.1.2 When a deterioration of one weather element is accompanied by an improvement in another element (for example, lowering of clouds and an improvement in visibility), a single SPECI report shall be issued.

15.2 **Group** CCCC

The identification of the reporting station in each individual report shall be indicated by means of the ICAO location indicator.

15.3 **Group** YYGGgg**Z**

15.3.1 The day of the month and the time of observation in hours and minutes UTC followed, without a space, by the letter indicator **Z** shall be included in each individual METAR report.

15.3.2 This group shall be included in each individual SPECI report. In SPECI reports, this group shall indicate the time of occurrence of the change(s) which justified the issue of the report.

15.4 **Code word AUTO**

The optional code word **AUTO** shall be inserted before the wind group when a report contains fully automated observations without human intervention. The ICAO requirement is that all of the specified elements shall be reported. However, if any element cannot be observed, the group in which it would have been encoded shall be replaced by the appropriate number of solidi. The number of solidi depends on the number of symbolic letters for the specific group which is not able to be reported; i.e. four for the visibility group, two for the present weather group and three or six for the cloud group, as appropriate.

15.5 **Groups** $ddd ff \mathbf{G} f_m f_m \left\{ \begin{array}{l} \textbf{KMH} \text{ or} \\ \textbf{KT} \text{ or} \\ \textbf{MPS} \end{array} \right\} d_n d_n d_n \mathbf{V} d_x d_x d_x$

15.5.1 The mean true direction in degrees rounded off to the nearest 10 degrees from which the wind is blowing and the mean speed of the wind over the 10-minute period immediately preceding the observation shall be reported for dddff followed, without a space, by one of the abbreviations **KMH**, **KT** or **MPS**, to specify the unit used for reporting wind speed. Values of wind direction less than 100° shall be preceded by 0 and a wind from true north shall be reported as 360. Values of wind speed less than 10 units shall be preceded by 0. However, when the 10-minute period includes a marked discontinuity in the wind characteristics, only data after the discontinuity shall be used for obtaining mean wind speed and maximum gust values, and mean wind direction and variations of the wind direction, hence the time interval in these circumstances shall be correspondingly reduced.

Notes:

(1) **KMH**, **KT** and **MPS** are the standard ICAO abbreviations for kilometres per hour, knots and metres per second, respectively.

(2) The unit of wind speed used is determined by national decision. However, the primary unit prescribed in ICAO Annex 5 for wind speed is the kilometre per hour (KMH), with the knot (KT) permitted for use as a non-SI alternative unit until a termination date is decided.

(3) A marked discontinuity occurs when there is an abrupt and sustained change in wind direction of 30° or more, with a wind speed of 20 km h^{-1} (10 kt) or more before or after the change, or a change in wind speed of 20 km h^{-1} (10 kt) or more, lasting at least two minutes.

15.5.2 In the case of variable wind direction, ddd shall be encoded as VRB when the mean wind speed is less than 3 knots (2 m s^{-1} or 6 km h^{-1}). A variable wind at higher speeds shall be reported only when the variation of wind direction is 180° or more or when it is impossible to determine a single wind direction, for example when a thunderstorm passes over the aerodrome.

15.5.3 If, during the 10-minute period preceding the observation, the total variation in wind direction is 60° or more but less than 180° and the mean wind speed is 3 knots (2 m s^{-1} or 6 km h^{-1}) or more, the observed two extreme directions between which the wind has varied shall be given for $d_nd_nd_n$**V**$d_xd_xd_x$ in clockwise order. Otherwise this group shall not be included.

15.5.4 "Calm" shall be coded as 00000 followed immediately, without a space, by one of the abbreviations **KMH**, **KT** or **MPS** to specify the unit, used normally for reporting wind.

15.5.5 If, during the 10-minute period preceding the observation, the maximum wind gust speed exceeds the mean speed by 10 knots (5 m s^{-1} or 20 km h^{-1}) or more, this maximum speed shall be reported as **G**f_mf_m immediately after dddff, followed immediately, without a space, by one of the abbreviations **KMH**, **KT** or **MPS** to specify the units used for reporting wind speed. Otherwise the element **G**f_mf_m shall not be included.

Note: It is recommended that the wind measuring systems should be such that peak gusts should represent a three-second average.

15.5.6 For wind speeds of 100 units or greater, the exact number of wind speed units shall be given in lieu of the two-figure code ff or f_mf_m. When the wind speed is 100 knots or more (50 m s^{-1} or 200 km h^{-1}), the groups ff and f_mf_m shall be preceded by the letter indicator P and reported as P99 **KT** (P49 **MPS** or P199 **KMH**).

Note: There is no aeronautical requirement to report surface wind speeds of 200 km h^{-1} (100 kt) or more; however, provision has been made for reporting wind speeds up to 399 km h^{-1} (199 kt) for non-aeronautical purposes, as necessary.

15.6 **Groups** VVVV VVVV**NDV** $V_NV_NV_NV_ND_v$

Note: The coding of visibility is based on the use of the metre and kilometre, in accordance with the units specified in ICAO Annex 5.

15.6.1 The group VVVV shall be used to report prevailing visibility. When the horizontal visibility is not the same in different directions and when the visibility is fluctuating rapidly and the prevailing visibility cannot be determined, the group VVVV shall be used to report the lowest visibility. When visibility sensors are used and they are sited in such a manner that no directional variations can be given, the abbreviation **NDV** shall be appended to visibility reported.

15.6.2 ***Directional variation in visibility*** $V_NV_NV_NV_ND_v$

When the horizontal visibility is not the same in different directions and when the minimum visibility is different from the prevailing visibility, and less than 1 500 metres or less than 50% of the prevailing visibility, and less than 5000 metres, the group $V_NV_NV_NV_ND_v$ shall also be used to report the minimum visibility and its general direction in relation to the aerodrome indicated by reference to one of the eight points of the compass. If the minimum visibility is observed in more than one direction, the D_v shall represent the most operationally significant direction.

Appendix 2: WMO-N0.306 (2010) FM 15-XIV METAR

15.6.3 Visibility shall be reported using the following reporting steps:

(*a*) Up to 800 metres rounded down to the nearest 50 metres;

(*b*) Between 800 and 5 000 metres rounded down to the nearest 100 metres;

(*c*) Between 5 000 metres up to 9 999 metres rounded down to the nearest 1 000 metres;

(*d*) With 9999 indicating 10 km and above.

15.6.4 ***Code word* CAVOK**

Regulation 15.10 shall apply.

15.7 **Groups** $\begin{cases} \mathbf{R}D_RD_R/V_RV_RV_RV_Ri \\ \text{or} \\ \mathbf{R}D_RD_R/V_RV_RV_RV_R\mathbf{V}V_RV_RV_RV_Ri \end{cases}$

Note: The coding of runway visual range is based on the use of the metre in accordance with the unit specified in ICAO Annex 5.

15.7.1 During periods when either the horizontal visibility reported in the group VVVV or the runway visual range for one or more runways available for landing is observed to be less than 1 500 metres, one or more groups under Regulation 15.7 shall be included in the report. The letter indicator **R** followed immediately, without a space, by the runway designator D_RD_R shall always precede the RVR reports.

15.7.2 The groups shall be repeated to report runway visual range values for each runway, up to a maximum of four, which is available for landing and for which runway visual range is determined.

15.7.3 ***Runway designator*** D_RD_R

The designator of each runway for which runway visual range is reported shall be indicated by D_RD_R. Parallel runways should be distinguished by appending to D_RD_R letters L, C or R indicating the left, central or right parallel runway, respectively. The letter(s) shall be appended to D_RD_R as necessary in accordance with the standard practice for runway designation, as laid down by ICAO in Annex 14 — Aerodromes, Volume I — Aerodrome design and operations, paragraphs 5.2.2.4 and 5.2.2.5.

15.7.4 ***Mean value and tendency of runway visual range over the 10-minute period immediately preceding the observation*** $V_RV_RV_RV_Ri$

15.7.4.1 The runway visual range values to be reported shall be representative of the touchdown zone of the active landing runway(s) up to a maximum of four.

15.7.4.2 The mean value of the runway visual range over the 10-minute period immediately preceding the observation shall be reported for $V_RV_RV_RV_R$. However, when the 10-minute period includes a marked discontinuity in the RVR (for example, sudden advection of fog, rapid onset or cessation of an obscuring snow shower), only data after the discontinuity shall be used for obtaining mean RVR values and variations thereof, hence the time interval in these circumstances shall be correspondingly reduced.

Notes:

(1) See Regulation 15.7.5.

(2) Any observed value which does not fit the reporting scale in use should be rounded down to the nearest lower step in the scale.

(3) A marked discontinuity occurs when there is an abrupt and sustained change in runway visual range, lasting at least two minutes, consistent with the issuance of selected special reports given in *Technical Regulation* [C.3.1.] 4.3.3.

15.7.4.3 If the runway visual range values during the 10-minute period preceding the observation show a distinct upward or downward tendency such that the mean during the first five minutes varies by 100 metres or more from the mean during the second five minutes of the period, this shall be indicated by i = U for upward and i = D for downward tendency of runway visual range values. When no distinct change in runway visual range is observed, i = N shall be used. When it is not possible to determine the tendency, i shall be omitted.

15.7.5 ***Significant variations of runway visual range*** **R**$D_RD_R/V_RV_RV_RV_R$**V**$V_RV_RV_RV_R$i

When the RVR at a runway varies significantly and when during the 10-minute period preceding the nominal observation time the one-minute mean extreme values assessed vary from the mean value by more than 50 metres or more than 20% of the mean value, whichever is greater, the one-minute mean minimum and the one-minute mean maximum values shall be given in that order in the form **R**$D_RD_R/V_RV_RV_RV_R$**V**$V_RV_RV_RV_R$i instead of the 10-minute mean. Extreme RVR values shall be reported in accordance with Regulation 15.7.6 and the tendency shall be indicated in accordance with Regulation 15.7.4.3.

15.7.6 ***Extreme values of runway visual range***

When actual RVR values are outside the measuring range of the observing system in use, the following procedure shall apply:

(*a*) When the RVR, to be reported in accordance with the *Technical Regulations*, is greater than the maximum value which can be assessed with the system in use, the group $V_RV_RV_RV_R$ shall be preceded by the letter indicator P (**P**$V_RV_RV_RV_R$) in which $V_RV_RV_RV_R$ is the highest value which can be assessed. When the RVR is assessed to be more than 2 000 metres, it shall be reported as P2000;

(*b*) When the RVR is below the minimum value which can be assessed with the system in use, the group $V_RV_RV_RV_R$ shall be preceded by the letter indicator M (**M**$V_RV_RV_RV_R$) in which $V_RV_RV_RV_R$ is the lowest value which can be assessed. When the RVR is assessed to be less than 50 metres, it shall be reported as M0050.

15.8 **Group** w′w′

15.8.1 One or more groups w′w′, but not more than three, shall be used to report all present weather phenomena observed at or near the aerodrome and of significance to aeronautical operations in accordance with Code table 4678.

Appropriate intensity indicators and letter abbreviations (Code table 4678) shall be combined in groups of two to nine characters to indicate present weather phenomena.

15.8.2 If the observed present weather cannot be reported by use of Code table 4678, the group w′w′ shall be omitted from the report.

15.8.3 The w′w′ groups shall be ordered as follows:

(*a*) First, if appropriate, the qualifier for intensity *or* for proximity, followed without a space by;

(*b*) If appropriate, the abbreviation for the descriptor followed without a space by;

(*c*) The abbreviation for the observed weather phenomenon or combinations thereof.

15.8.4 Intensity shall be indicated only with precipitation, precipitation associated with showers and/or thunderstorms, duststorm or sandstorm. If the intensity of the phenomena reported in the group is either light or heavy, this shall be indicated by the appropriate sign (see Code table 4678 and specially Note (5)). No indicator shall be included in the group when the intensity of the reported phenomenon is moderate.

15.8.5 The intensity of present weather phenomena reported in the group w′w′ shall be determined by the intensity at the time of observation.

15.8.6 If more than one significant weather phenomenon is observed, separate w′w′ groups shall be included in the report in accordance with Code table 4678. However, if more than one form of precipitation is observed, the appropriate letter abbreviations shall be combined in a single group with the dominant type of precipitation being reported first. In such a single group, the intensity shall refer to the total precipitation and be reported with one or no indicator as appropriate.

When an automatic observing system is used and when the type of the precipitation cannot be identified by this system, the abbreviation **UP** shall be used for precipitation. The abbreviation **UP** may be combined, as necessary, with the following characteristics of present weather: **FZ**, **SH** and **TS**.

15.8.7 The qualifier **SH** shall be used to indicate precipitation of the shower type. When associated with the indicator VC, the type and intensity of precipitation shall not be specified.

Note: Showers are produced by convective clouds. They are characterized by their abrupt beginning and end and by the generally rapid and sometimes great variations in the intensity of the precipitation. Drops and solid particles falling in a shower are generally larger than those falling in non-showery precipitation. Between showers, openings may be observed unless stratiform clouds fill the intervals between the cumuliform clouds.

15.8.8 The qualifier **TS** shall be used whenever thunder is heard or lightning is detected at the aerodrome within the 10-minute period preceding the time of observation. When appropriate, **TS** shall be followed immediately, without a space, by relevant letter abbreviations to indicate any precipitation observed. The letter abbreviation **TS** on its own shall be used when thunder is heard or lightning detected at the aerodrome but no precipitation observed.

Note: A thunderstorm shall be regarded as being at the aerodrome from the time thunder is first heard, whether or not lightning is seen or precipitation is observed at the aerodrome. A thunderstorm shall be regarded as having ceased or being no longer at the aerodrome at the time thunder is last heard, and the cessation is confirmed if thunder is not heard for 10 minutes after this time.

15.8.9 The qualifier **FZ** shall be used only to indicate supercooled water droplets or supercooled precipitation.

Notes:

(1) Any fog consisting predominantly of water droplets at temperatures below 0°C shall be reported as freezing fog (FZFG) whether it is depositing rime ice or not.

(2) Whether or not the supercooled precipitation is of the shower type shall not be specified.

15.8.10 The qualifier **VC** shall be used to indicate the following significant weather phenomena observed in the vicinity of the aerodrome: TS, DS, SS, FG, FC, SH, PO, BLDU, BLSA, BLSN and VA. Regulations referring to the combination of VC and FG are given in Regulation 15.8.17.

Notes:

(1) Such weather phenomena should be reported with the qualifier VC only when observed between approximately 8 km and 16 km from the aerodrome reference point.

(2) See Regulation 15.8.7.

15.8.11 The letter abbreviation **GR** shall be used to report hail only when the diameter of the largest hailstones observed is 5 mm or more. The letter abbreviation **GS** shall be used to report small hail (diameter of the hailstones less than 5 mm) and/or snow pellets.

15.8.12 The letter abbreviation **IC** shall be used to indicate the phenomenon ice crystals (diamond dust). For w′w′ = **IC** to be reported, the visibility shall be reduced by this phenomenon to 5 000 metres or less.

15.8.13 The letter abbreviations **FU**, **HZ**, **DU** and **SA** (except **DRSA**) shall be used only when the obstruction to vision consists predominantly of lithometeors and the visibility is reduced by the reported phenomenon to 5 000 metres or less.

15.8.14 The letter abbreviation **BR** shall be used when the obstruction to vision consists of water droplets or ice crystals. For w′w′= **BR** to be reported, the visibility reported in the group VVVV shall be at least 1 000 metres but not more than 5 000 metres.

15.8.15 The letter abbreviation **FG** shall be used when the obstruction to vision consists of water droplets or ice crystals (fog or ice fog). For w′w′= **FG** to be reported without the qualifiers **MI**, **BC** or **VC**, the visibility reported in the group VVVV shall be less than 1 000 metres.

15.8.16 For w′w′= **MIFG** to be reported, the visibility at two metres above ground level shall be 1 000 metres or more and the apparent visibility in the fog layer shall be less than 1 000 metres.

15.8.17 The letter abbreviation **VCFG** shall be used to report any type of fog observed in the vicinity of the aerodrome.

15.8.18 The letter abbreviation **BCFG** shall be used to report fog patches and the letter abbreviation **PRFG** to report fog covering part of the aerodrome; the apparent visibility in the fog patch or bank shall be less than 1 000 metres, the fog extending to at least two metres above ground level.

Note: BCFG should be used only when the visibility in parts of the aerodrome is 1 000 metres or more although, when the fog is close to the observing point, the minimum visibility reported by $V_NV_NV_NV_ND_V$ will be less than 1 000 metres.

15.8.19 The letter abbreviation **SQ** shall be used to report squalls when a sudden increase in wind speed is observed of at least 16 knots (32 km h^{-1}, 8 m s^{-1}), the speed rising to 22 knots (44 km h^{-1}, 11 m s^{-1}) or more and lasting for at least one minute.

15.8.20 Regulation 15.10 shall apply.

15.9 **Group** $N_sN_sN_sh_sh_sh_s$ or **VV**$h_sh_sh_s$ or **NSC** or **NCD**

15.9.1 ***Cloud amount and cloud height*** $N_sN_sN_sh_sh_sh_s$

15.9.1.1 Cloud amount, cloud type and height of cloud base shall be reported to describe the clouds of operational significance, i.e. clouds with the height of base below 1500 meters (5000 ft) or below the highest minimum sector altitude, whichever is greater, or cumulonimbus or towering cumulus at any height. The cloud amount $N_sN_sN_s$ shall be reported as few (1 to 2 oktas), scattered (3 to 4 oktas), broken (5 to 7 oktas) or overcast (8 oktas), using the three-letter abbreviations FEW, SCT, BKN and OVC followed, without a space, by the height of the base of the cloud layer (mass) $h_sh_sh_s$. If there are no clouds below 1 500 m (5 000 ft) or below the highest minimum sector altitude, whichever is greater, no cumulonimbus and no towering cumulus and no restriction on vertical visibility, and the abbreviations **CAVOK** is not appropriate, then the abbreviation **NSC** shall be used. When an automatic observing system is used and no clouds are detected by that system, the abbreviation **NCD** shall be used.

15.9.1.2 The amount of each cloud layer (mass) shall be determined as if no other clouds were existing.

15.9.1.3 The cloud group shall be repeated to report different layers or masses of cloud. The number of groups shall not exceed three, except that significant convective clouds, when observed, shall always be reported.

Note: The following clouds shall be reported as significant convective clouds:

(*a*) Cumulonimbus cloud (CB);

(*b*) Cumulus congestus of great vertical extent (TCU). The contraction TCU, taken from the term "towering cumulus", is an ICAO abbreviation used in aeronautical meteorology to describe this cloud.

15.9.1.4 The selection of layers or masses of cloud to be reported shall be made in accordance with the following criteria:

1st group:	the lowest individual layer (mass) of any amount, to be reported as FEW, SCT, BKN or OVC;
2nd group:	the next individual layer (mass) covering more than two oktas, to be reported as SCT, BKN or OVC;
3rd group:	the next higher individual layer (mass) covering more than four oktas, to be reported as BKN or OVC;
Additional groups:	significant convective clouds (CB or TCU) when observed and not already reported in one of the three groups above.

The order of reporting the groups shall be from lower to higher levels.

15.9.1.5 The height of cloud base shall be reported in steps of 30 m (100 ft) up to 3 000 m (10 000 ft). Any observed value which does not fit the reporting scale in use shall be rounded down to the nearest lower step in the scale.

Note: See Note (2) to Regulation 15.7.4.2.

15.9.1.6 When cumulonimbus clouds or towering cumulus clouds are detected by the automatic observing system and the cloud amount and the height of cloud base cannot be observed, the cloud amount and the height of cloud base should be replaced by //////.

15.9.1.7 Types of cloud other than significant convective clouds shall not be identified. Significant convective clouds, when observed, shall be identified by appending the letter abbreviations CB (cumulonimbus) or TCU (cumulus congestus of great vertical extent), as appropriate, to the cloud group without a space. When an automatic observing system is used and the cloud type cannot be observed by that system, the cloud type in each cloud group shall be replaced by ///.

Note: When an individual layer (mass) of cloud is composed of cumulonimbus and towering cumulus clouds with a common cloud base, the type of cloud should be reported as cumulonimbus only and the amount of clouds shall be encoded as the sum of the CB and TCU amounts.

15.9.2 Vertical visibility **VV**$h_s h_s h_s$

When the sky is obscured and information on vertical visibility is available, the group **VV**$h_s h_s h_s$ shall be reported, where $h_s h_s h_s$ is the vertical visibility in units of 30 metres (hundreds of feet). When information on vertical visibility is not available, the group shall read **VV**///.

Notes:

(1) The vertical visibility is defined as the vertical visual range into an obscuring medium.

(2) See Note (2) to Regulation 15.7.4.2.

15.9.3 Regulation 15.10 shall apply.

15.10 Code word CAVOK

The code word **CAVOK** shall be included in place of the groups under Regulations 15.6, 15.8 and 15.9, when the following conditions occur simultaneously at the time of observation:

(*a*) Visibility reported in the group VVVV is 10 km or more and criteria for inclusion of the group $V_NV_NV_NV_ND_V$ are not met;

(*b*) No cloud below 1 500 metres (5 000 ft) or below the highest minimum sector altitude, whichever is greater, and no cumulonimbus and no towering cumulus;

(*c*) No significant weather phenomena (see Code table 4678).

Note: Highest minimum sector altitude is defined in ICAO PANS–OPS, Part 1 – *Definitions*, as the lowest altitude which may be used under emergency conditions which will provide a minimum clearance of 300 metres (1 000 ft) above all objects located in an area contained within a sector of a circle of 46 km (25 nautical miles) radius centred on a radio aid to navigation.

15.11 **Group** $T'T'/T'_dT'_d$

15.11.1 The observed air temperature and dew-point temperature rounded to the nearest whole degree Celsius shall be given for $T'T'/T'_dT'_d$. Observed values involving 0.5°C shall be rounded up to the next higher Celsius degree.

15.11.2 Rounded whole degree values of air temperature and dew-point temperature of –9°C to +9°C shall be preceded by 0; for example, +9°C shall be reported as 09.

15.11.3 Temperatures below 0°C shall be immediately preceded by M, that is minus; for example, –9°C shall be reported as M09 and –0.5°C shall be reported as M00.

15.12 **Group** **Q**$P_HP_HP_HP_H$

15.12.1 The observed QNH value rounded down to the nearest whole hectopascal shall be given for $P_HP_HP_HP_H$ preceded, without a space, by the letter indicator **Q**.

15.12.2 If the value of QNH is less than 1000 hPa, it shall be preceded by 0; for example, QNH 995.6 shall be reported as Q0995.

Notes:

(1) When the first digit following the letter indicator Q is either 0 or 1, the QNH value is reported in the unit hectopascal (hPa).

(2) The unit prescribed by ICAO Annex 5 for pressure is the hectopascal.

15.13 **Supplementary information – groups**

REw′w′ { **WS R**D_RD_R / or / **WS ALL RWY** } **(W**T_sT_s**/S**S′**)** **(R**D_RD_R/$E_RC_Re_Re_RB_RB_R$**)**

15.13.1 For international dissemination, the section on supplementary information shall be used only to report recent weather phenomena of operational significance, available information on wind shear in the lower layers and, subject to regional air navigation agreement, sea-surface temperature and state of the sea, and also subject to regional air navigation agreement, the state of the runway.

15.13.2 ***Recent weather phenomena of operational significance*** **RE**w′w′

15.13.2.1 Up to three groups of information on recent weather shall be given by the indicator letters **RE** followed, without a space, by the appropriate abbreviations, in accordance with Regulation 15.8 (but no intensity of the recent weather phenomena shall be indicated) if the following weather phenomena were observed during the period since the last routine report, or last hour, whichever is shorter, but not at the time of observation:

- Freezing precipitation;
- Moderate or heavy drizzle, rain or snow;
- Moderate or heavy: ice pellets, hail, small hail and/or snow pellets;
- Blowing snow;
- Sandstorm or duststorm;
- Thunderstorm;
- Funnel cloud(s) (tornado or water-spout);
- Volcanic ash.

When an automatic observing system is used and when the type of the precipitation cannot be identified by this system, the abbreviation **REUP** shall be used for recent precipitation. It may be combined with the characteristics of the present weather in accordance with Regulation 15.8.6.

15.13.3 ***Wind shear in the lower layers*** **WS R**D_RD_R or **WS ALL RWY**

Information on the existence of wind shear along the take-off path or approach path between one runway level and 500 metres (1 600 ft) significant to aircraft operations shall be reported whenever available and if local circumstances so warrant, using the group set **WS R**D_RD_R repeated as necessary. If the wind shear along the take-off path or approach path is affecting all runways in the airport, **WS ALL RWY** shall be used.

Note: Concerning runway designator D_RD_R, Regulation 15.7.3 applies.

15.13.4 Supplementary information other than specified by Regulations 15.13.2 and 15.13.3 shall be added only in accordance with regional decision.

15.13.5 Sea-surface temperature and the state of the sea (**W**T_ST_S**/S**S′**)**

15.13.5.1 The sea-surface temperature shall, by regional agreement, be reported according to the regional ICAO Regulation 15.11. The state of the sea shall be reported in accordance with Code table 3700.

15.13.6 State of the runway (**R**D_RD_R/$E_RC_Re_Re_RB_RB_R$)

15.13.6.1 Subject to regional air navigation agreement, information on the state of the runway provided by the appropriate airport authority shall be included. The runway deposits E_R, the extent of runway contamination C_R, the depth of deposit e_Re_R and the friction coefficient/braking action B_RB_R shall be indicated in accordance with code tables 0919, 0519, 1079 and 0366, respectively. The state of the runway group shall be replaced by the abbreviation SNOCLO when the aerodrome is closed due to extreme deposit of snow. If contaminations on a single runway or on all runways at an aerodrome have ceased to exist, this should be reported by replacing the last six digits of the group by CLRD//.

Note: Concerning runway designator D_RD_R, Regulation 15.7.3 applies. Additional code figures 88 and 99 are reported in accordance with the European Air Navigation Plan, FASID, Part III-AOP, Attachment A.

15.14 Trend forecasts

Note: The governing criteria for issuing trend forecasts are specified in publication WMO-No. 49 – *Technical Regulations* [C.3.1].

15.14.1 When included in METAR or SPECI reports, the trend forecasts shall be in coded form.

15.14.2 When a change, required to be indicated in accordance with the governing criteria for significant changes, is expected for one or several of the observed elements — wind, horizontal visibility, present weather, clouds or vertical visibility — one of the following change indicators shall be used for TTTTT: **BECMG** or **TEMPO**.

Note: Where possible, values corresponding to the local operating minima should be selected to indicate changes.

15.14.3 The time group GGgg, preceded without a space by one of the letter indicators TT = FM (from), TL (until) or AT (at), shall be used as appropriate, to indicate the beginning (FM) or the end (TL) of a forecast change, or the time (AT) at which specific forecast condition(s) is (are) expected.

15.14.4 The change indicator **BECMG** shall be used to describe expected changes to meteorological conditions which reach or pass specified threshold criteria at either a regular or irregular rate.

15.14.5 Changes in meteorological conditions which reach or pass specified threshold criteria for trend forecasts shall be indicated as follows:

(*a*) When the change is forecast to begin and end wholly within the trend forecast period: by the change indicator BECMG followed by the letter indicators FM and TL respectively with their associated time groups, to indicate the beginning and end of the change (for example, for a trend forecast period from 1000 to 1200 UTC in the form: **BECMG** FM1030 TL1130);

(*b*) When the change is forecast to occur from the beginning of the trend forecast period and be completed before the end of that period: by the change indicator BECMG followed only by the letter indicator TL and its associated time group (the letter indicator FM and its associated time group being omitted), to indicate the end of the change (for example: **BECMG** TL1100);

(*c*) When the change is forecast to begin during the trend forecast period and be completed at the end of that period: by the change indicator BECMG followed only by the letter indicator FM and its associated time group (the letter indicator TL and its associated time group being omitted), to indicate the beginning of the change (for example: **BECMG** FM1100);

(*d*) When it is possible to specify a time for the change to occur during the trend forecast period: by the change indicator BECMG followed by the letter indicator AT and its associated time group, to indicate the time of the change (for example: **BECMG** AT1100);

(*e*) When changes are forecast to take place at midnight UTC, the time shall be indicated:

(i) By 0000 when associated with FM and AT;

(ii) By 2400 when associated with TL.

15.14.6 When the change is forecast to commence at the beginning of the trend forecast period and be completed by the end of that period, or when the change is forecast to occur within the trend forecast period but the time of the change is uncertain (possibly shortly after the beginning of the trend forecast period, or midway or near the end of that period), the change shall be indicated by only the change indicator **BECMG** (letter indicator(s) FM and TL or AT and associated time group(s) being omitted).

15.14.7 The change indicator **TEMPO** shall be used to describe expected temporary fluctuations to meteorological conditions which reach or pass specified threshold criteria and last for a period of less than one hour in each instance and in the aggregate cover less than half of the forecast period during which the fluctuations are expected to occur.

15.14.8 Periods of temporary fluctuations to meteorological conditions which reach or pass specified threshold criteria shall be indicated as follows:

(*a*) When the period of temporary fluctuations is forecast to begin and end wholly within the trend forecast period: by the change indicator **TEMPO** followed by the letter indicators FM and TL respectively with their associated time groups, to indicate the beginning and end of the fluctuations (for example, for a trend forecast period from 1000 to 1200 UTC in the form: **TEMPO** FM1030 TL1130);

(*b*) When the period of temporary fluctuations is forecast to occur from the beginning of the trend forecast period but cease before the end of that period: by the change indicator **TEMPO** followed only by the letter indicator TL and its associated time group (the letter indicator FM and its associated time group being omitted), to indicate the cessation of the fluctuations (for example: **TEMPO** TL1130);

(*c*) When the period of temporary fluctuations is forecast to begin during the trend forecast period and cease by the end of that period: by the change indicator **TEMPO** followed only by the letter indicator FM and its associated time group (the letter indicator TL and its associated time group being omitted), to indicate the beginning of the fluctuation (for example: **TEMPO** FM1030).

15.14.9 When the period of temporary fluctuations to meteorological conditions is forecast to occur from the beginning of the trend forecast period and cease by the end of that period, the temporary fluctuations shall be indicated by only the change indicator TEMPO (letter indicators FM and TL and associated time groups being omitted).

15.14.10 Following the change groups TTTTT TTGGgg, only the group(s) referring to the element(s) which is (are) forecast to change significantly shall be included. However, in the case of significant changes of the clouds, all cloud groups, including any significant layer(s) or masses not expected to change, shall be given.

15.14.11 Regulation 15.5.6 shall apply.

15.14.12 Inclusion of significant forecast weather w'w', using the appropriate abbreviations in accordance with Regulation 15.8, shall be restricted to indicate:

(1) the onset, cessation or change in intensity of the following weather phenomena:
- Freezing precipitation;
- Moderate or heavy precipitation (including showers);
- Duststorm;
- Sandstorm;
- Thunderstorm (with precipitation)

(2) the onset or cessation of the following weather phenomena:
- Freezing fog;
- Ice crystals;
- Low drifting dust, sand or snow;
- Blowing dust, sand or snow;
- Thunderstorm (without precipitation);
- Squall;
- Funnel cloud (tornado or waterspout).

15.14.13 To indicate the end of significant weather phenomena w′w′, the abbreviation **NSW** (Nil Significant Weather) shall replace the group w′w′.

15.14.14 When no cloud below 1500 metres (5000 ft) or the highest minimum sector altitude, whichever is greater, and no cumulonimbus and no towering cumulus are forecast, and **CAVOK** is not appropriate, the abbreviation **NSC** shall be used.

15.14.15 When none of the elements listed in Regulation 15.14.2 is expected to change significantly as to require a change to be indicated, this shall be indicated by the code word **NOSIG**. **NOSIG** (no significant change) shall be used to indicate meteorological conditions which do not reach or pass specified threshold criteria.

15.15 **Group** (**RMK** .....)

The indicator **RMK** denotes the beginning of a section containing information included by national decision which shall not be disseminated internationally.

Appendix 3 METAR of ZGGG Guangzhou of appendix A of AMOFSG/9 Study Note Trial TREND – Improving landing forecasts in The Netherlands – June 2011

METAR of ZGGG on 6/5/2010

METAR ZGGG 060000Z 15002MPS 120V220 4000 BR SCT011 OVC026 27/25 Q1007 NOSIG=
METAR ZGGG 060030Z 14003MPS 4000 BR SCT011 OVC026 28/25 Q1007 NOSIG=
METAR ZGGG 060030Z 14003MPS 4000 BR SCT011 OVC026 28/25 Q1007 NOSIG=
METAR ZGGG 060100Z 16003MPS 4500 BR SCT013 OVC026 28/25 Q1007 NOSIG=
METAR ZGGG 060130Z 16003MPS 5000 BR SCT015 OVC026 28/25 Q1007 NOSIG=
METAR ZGGG 060200Z 17004MPS 5000 BR BKN026 29/25 Q1007 NOSIG=
METAR ZGGG 060230Z 17005MPS 7000 SCT015 BKN040 30/26 Q1006 NOSIG=

METAR ZGGG 060300Z 17005MPS 8000 SCT016 BKN046 30/26 Q1006 NOSIG=
METAR ZGGG 060330Z 17005MPS 8000 SCT016 BKN046 30/25 Q1006 NOSIG=
METAR ZGGG 060400Z 20006MPS 8000 FEW026CB BKN026 30/25 Q1006 TEMPO VRB06G13MPS 1600 TSRA SCT008 SCT025CB BKN030=
METAR ZGGG 060430Z 21006MPS 4500 -TSRA BR FEW026CB BKN026 29/25 Q1005 TEMPO VRB06G13MPS 1600 TSRA SCT008 SCT025CB BKN030=
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METAR ZGGG 061530Z 04006MPS 2500 TSRA BR SCT010 BKN023CB SCT023 27/25 Q1006 TEMPO VRB10G17MPS 0500 +TSRA BKN030CB SCT030=

METAR ZGGG 061600Z 06006MPS 030V120 1000 R02R/1100U R02L/P2000 +TSRA BR SCT010 BKN023CB SCT023 25/24 Q1005 TEMPO -TSRA SCT030CB BKN030=
METAR ZGGG 061630Z 05007G12MPS 020V080 1000 R02R/0900V1200D R02L/0800V0900N +TSRA BR SCT006 BKN023CB SCT023 23/23 Q1006 NOSIG=
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METAR of ZGGG on 14/5/2010

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METAR ZGGG 140200Z 08002MPS 4000 BR SCT016 BKN026 27/24 Q1010 NOSIG=

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METAR of ZGGG on 22/5/2010

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