

*International Civil Aviation Organization*

**INFORMATION PAPER**



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Working Group (MET/R WG/15)**

Bangkok, Thailand 07 April – 10 April 2026

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**Agenda Item 3: Collaboration between MET and ATM stakeholders**

**AN EVALUATION METHOD FOR THE QUALITY AND INFLUENCE OF LOW-LEVEL  
WIND SHEAR WARNINGS BASED ON ATM OPERATIONS IN CHINA**

(Presented by China)

**SUMMARY**

This paper introduces an evaluation method for the quality and influence of low-level wind shear warnings based on actual ATM operations in China mainland. This method takes into account human factors and attempts to minimize their influence, which conducting an evaluation in a relatively objective manner.

**1. INTRODUCTION**

1.1 Low-level wind shear is regarded as an invisible killer, which has a serious effect on aviation flight and has caused many air accidents in the world. An accurate, effective and early warning of low-level wind shear not only gets pilots ready for dangerous weather and reduce the flight risks, but also even helps aircraft avoid risks actively.

1.2 It is important and necessary to propose a method to evaluate the accuracy and influence of low-level wind shear warnings based on ATM operations in China, which could reflect the real effect of weather warnings on aviation flight actually.

**2. DISCUSSION**

2.1 Low-level wind shear and related weather warnings have a great influence on aviation flight operations in China. When dangerous weather occurred or weather warnings issued by MET, some of the pilots will choose to take off or land according to the original plan, while others will change the established flight procedures which are regarded as abnormal take-offs and landings.

2.2 All abnormal take-offs and landings related to low-level wind shear could be divided into two situations. One is disrupting arrival or departure procedures passively due to suffering wind shear, which will be recorded in aircraft and pilot reports (PIREPs). The other is aborting flight

procedures actively on account of receiving weather warnings from MET or reports from former aircraft. Which means:

$$Total = N + A + PIREPs \tag{1}$$

where *Total* means the number of scheduled flights during the periods of hazardous weather and weather warnings, *N* means the number of normal take-off and landing events, *A* means the number of flights aborting flight procedures actively, *PIREPs* means the number of flights disrupting arrival or departure procedures passively due to suffering wind shear.

2.3 In order to analyse the influence of low-level wind shear warnings on ATM operations quantitatively, we would like to use *I* to evaluate which could be expressed as:

$$I = \frac{A}{Total} \tag{2}$$

This index reflects the level of trust that aviation meteorological users have in weather warnings and helps us to assess the influence of low-level wind shear warnings on actual aviation flight operations. The higher the value is, the more trusted users are in the warnings, and the greater influence the warnings have on flight operations.

2.4 In order to evaluate the quality of low-level wind shear warnings more accurately, we divide the issued warnings into three kinds based on ATM operations which are called “red warning”, “white warning” and “gray warning” (**Appendix A, Table.1**). During the warning period, if fewer than half of the scheduled flights are in normal and no aircraft reports suffering wind shear, this warning will be regarded as a “gray warning” which is not included in the assessment. If more than half of the scheduled flights are in normal and no aircraft reports suffering wind shear, this warning will be regarded as a “white warning” which means the warning information is false. If any aircraft reports encountering wind shear during the warning period, we regard this warning as a “red warning” which means the warning information is correct.

2.5 On this basis, we proposed four index to evaluate the quality of low-level wind shear warnings, which are hit rate, false rate, miss rate and confidence rate. They could be calculated separately using the following formulas:

$$Hit\ Rate = \frac{R}{ALL} \tag{3}$$

$$False\ Rate = \frac{W}{ALL} \tag{4}$$

$$Confidence\ Rate = \frac{ALL-G}{ALL} \tag{5}$$

$$Miss\ Rate = \frac{M}{PIREPs} \tag{6}$$

where *ALL* means the total number of issued warnings, *R* means the number of “red warnings”, *W* means the number of “white warnings”, *G* means the number of “gray warnings” and *M* means the number of low-level wind shear events without warning. The higher the confidence rate is, the more reliable and persuasive the hit rate and the false rate are.

2.6 According to the method, we evaluated the quality and influence of low-level wind shear warnings in Lanzhou Zhongchuan International Airport (ZLLL) from 2004 to 2024 (**Appendix A, Fig.1**). We could see that the hit rate has raised from 30.8% in 2019 to 90.4% in 2024, and the users’ trust has been increasing gradually at that airport.

### 3. ACTION BY THE MEETING

3.1 The meeting is invited to note the information contained in this paper.

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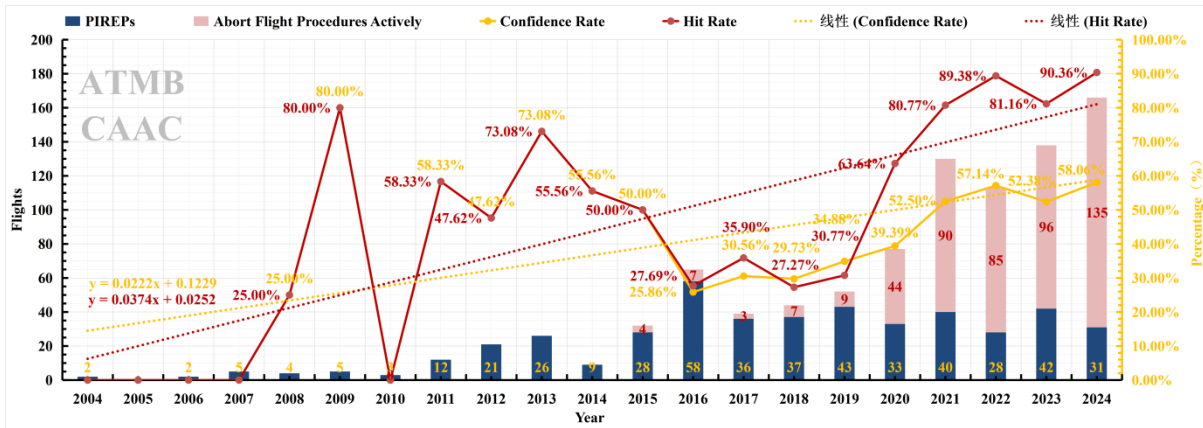
MET/R WG/15  
APPENDIX A to IP/12  
(Revision 1)

**APPENDIX A**

**Table.1 Classification of Low-level Wind Shear Warnings based on ATM operations**

Types of Warnings	Criteria	Meaning
Gray	$A/Total > 0.5$ and $PIREPs = 0$	Not to Be Evaluated
White	$A/Total \leq 0.5$ and $PIREPs = 0$	False Information
Red	$PIREPs \neq 0$	Correct Information

The **Total** means the number of scheduled flights during the periods of hazardous weather and weather warnings; **A** means the number of flights aborting flight procedures actively; **PIREPs** means the number of flights disrupting arrival or departure procedures passively due to suffering wind shear.



**Fig.1 Interannual variation of flights influenced by low-level wind shear and the quality of weather warnings at ZLLL**