—— The Thirteenth Meeting of the Meteorological Requirements Working Group (MET/R WG/13) ——

THE DEVELOPMENTS OF DETECTION, WARNING AND SERVICE OF LOW-LEVEL WIND SHEAR AND TURBULENCE

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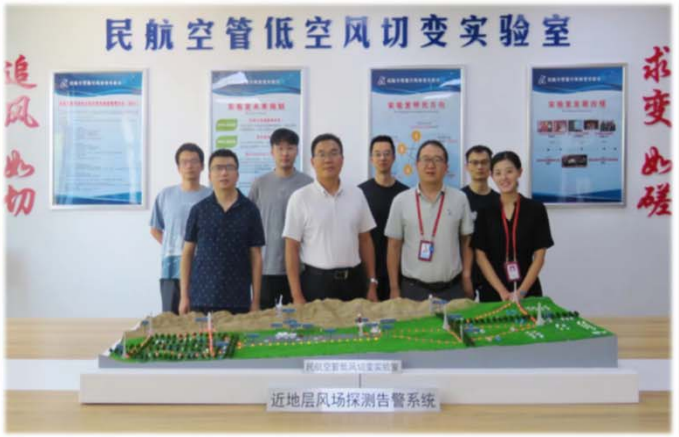
Contents

- Invisible killers
- Small scale and change rapidly
- Real-time detection and observation from ground-based equipment
- High cost and complexity of purchase, installation and maintain of advanced equipments

1.Introduction

- Strongly support and vigorously promotion from the ATMB of CAAC
- Greatly further developments of the advanced detection equipment construction and application, such as Doppler weather Radar and LIDAR.
- Research and development of system and platform for MET and ATM operation have made a fast progress
- Quality of aviation weather products and service has shown a significant improvement



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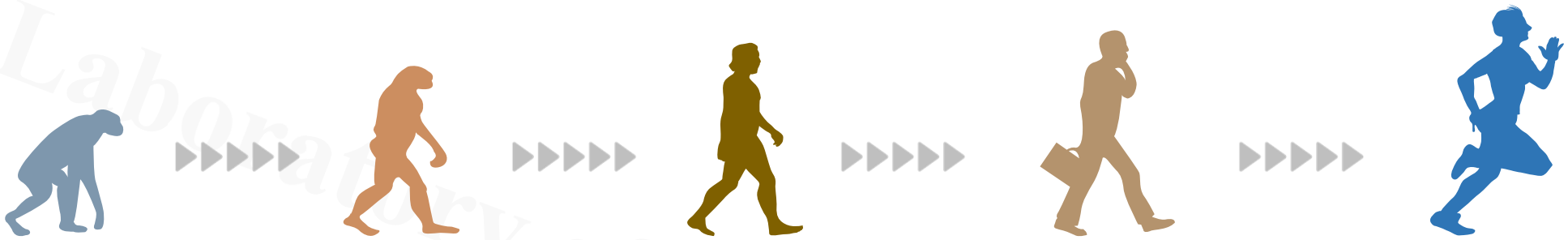
2.Ground-Based Detection Network



AWOS
Runway

- √ Sensitive, Rapid
- √ High Temporal Resolution(3s)
- × Single Point Detection
- × On the Ground

DWR
Convective Storms

- √ Wide Detection Range(400km)
- × Only Wet Wind Shear

WPR
Vertical Wind Field

- √ Vertical Wind Profile
- × Blind in Low Level(100m/600m)
- × Single Point Detection
- × Poor Real-time Performance

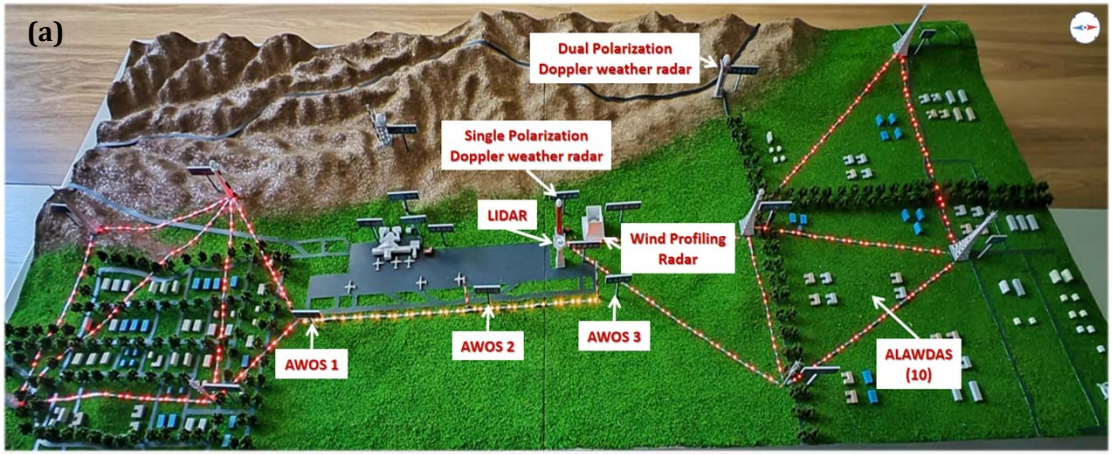
ALAWDAS
Low-level Wind Field

- √ Sensitive, Rapid
- √ High Temporal Resolution(3s)
- √ Network Detection
- × Limited Detection Range
- × Better Performance in Horizontal Wind Shear

LIDAR
Glide Path

- √ Wide Detection Range (10-14km，3-4km)
- √ High Temporal and Spatial resolution (50-200m、30s-1min)
- × Attenuation in rainy, fog, sand and dust day

2.Ground-Based Detection Network



□ **GPS**: 36.52°N, 103.62°E □ **Altitude**: 1947.2m □ **Climate**: Arid and semi-arid □ **Runway**: single(18/36, 4.0km, 45m)

□ **Location**: · Northeast of the Tibetan Plateau · Intersection of the Tibetan Plateau and Loess Plateau

□ **Terrain**: · Southeast of the Qinwangchuan alluvial–diluvial basin; · Surrounded by 3000m height mountains;
· North higher and south lower; · North and east direction is flat and open;
· Southwest and northwest direction is a ladder - Shaped trench beam topography, high mountain

Fig.2.1 Integrated Ground-Based Detection Network
(a) ZLLL; (b) ZBAD

- **Lanzhou Zhongchuan International Airport(ZLLL) and Daxing International Airport(ZBAD) have both constructed a comprehensive detection network in China mainland and put into operations for several years.**
- **Doppler LIDAR is being used at 15 civil airports including feeder airports in China mainland at least.**
- **2 busy airports have made a plan to construct for operation in addition.**

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3.1 Terminal Display Interface

Fig.3.1 AWOS

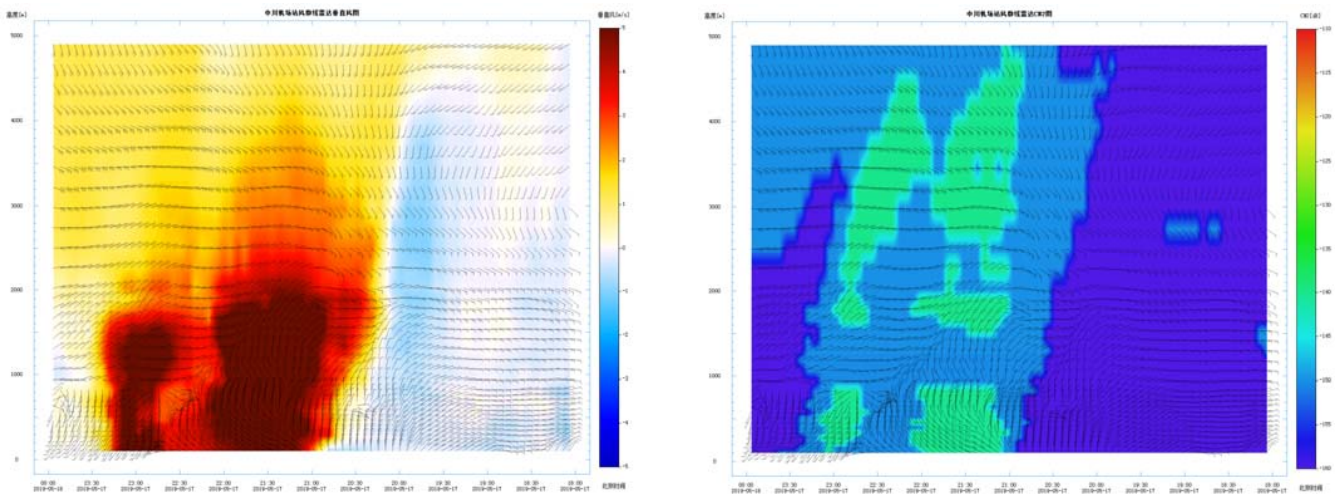


Fig.3.2 WPR

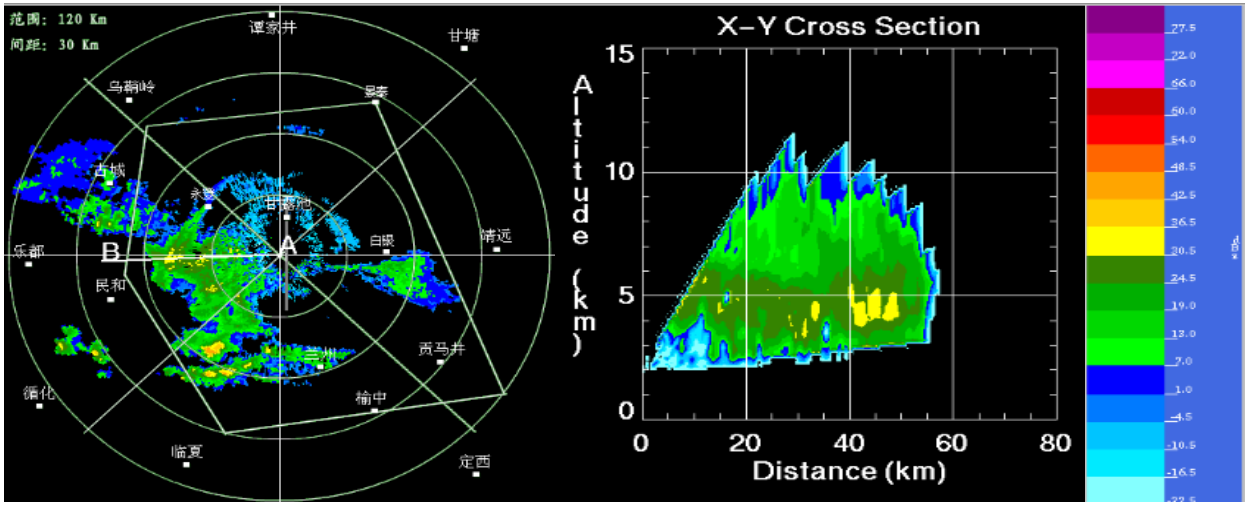


Fig.3.3 DWR

Fig.3.4 LIDAR

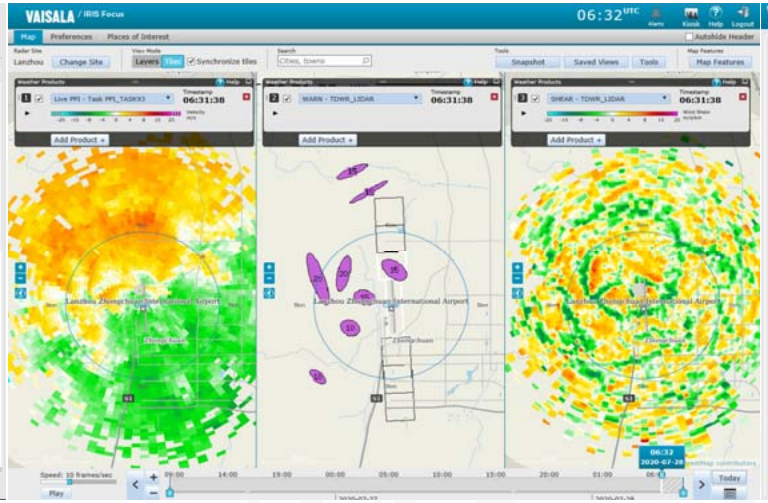
3.2 Terminal Display Interface - LIDAR

Interface for Engineer(LEOSPHERE)

Operate the LIDAR, Perform Sweeping Scheme

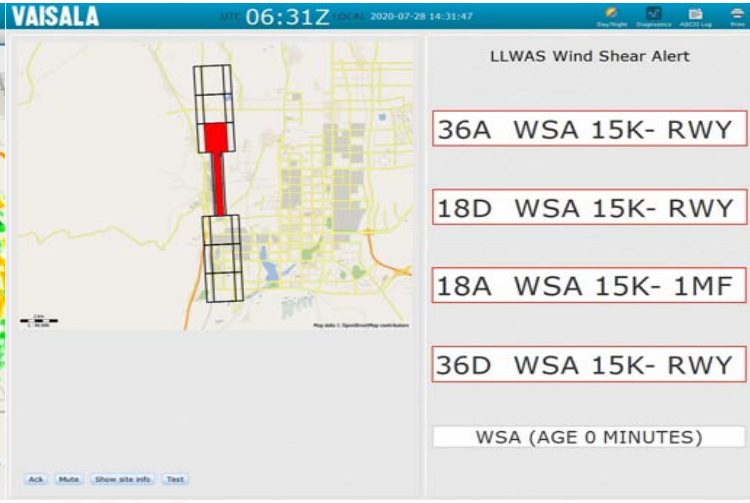
Interface for Forecasters(IRIS)

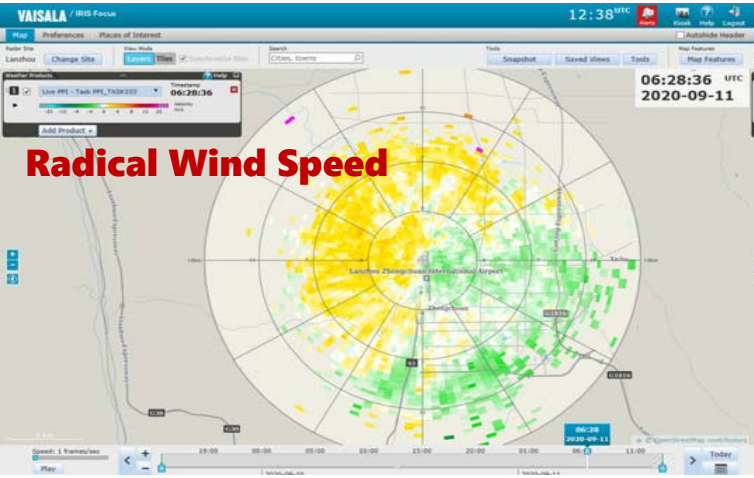
Radial Wind Speed, SHEAR and WARN products

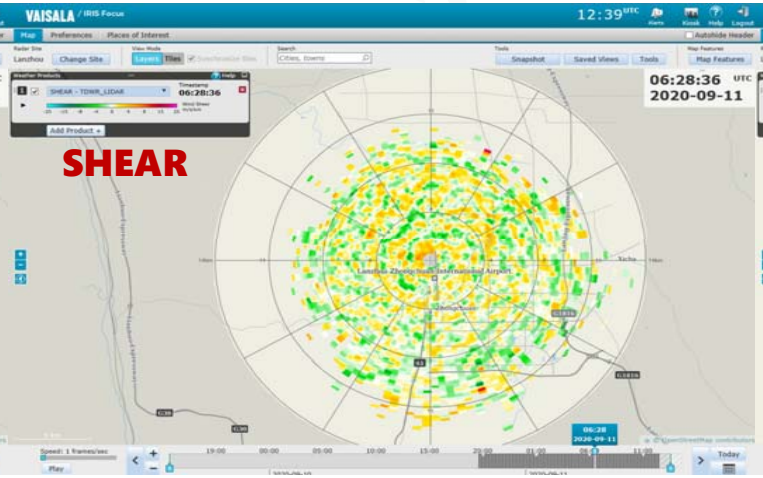


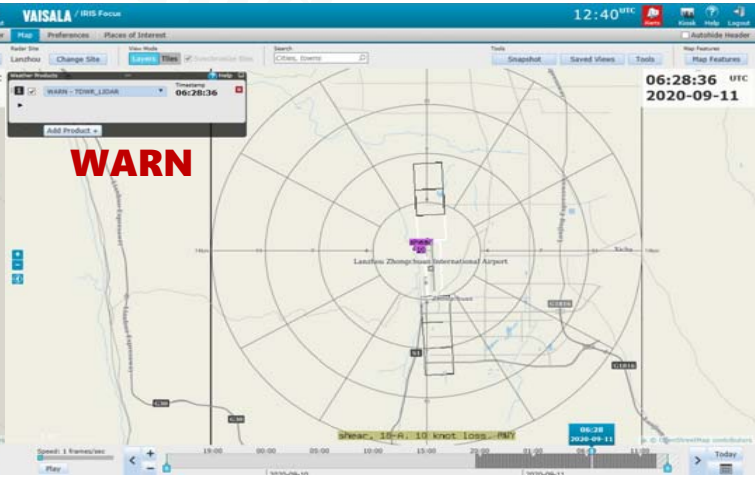
Interface for ATC (Avimet)

ALERT generated by Avimet









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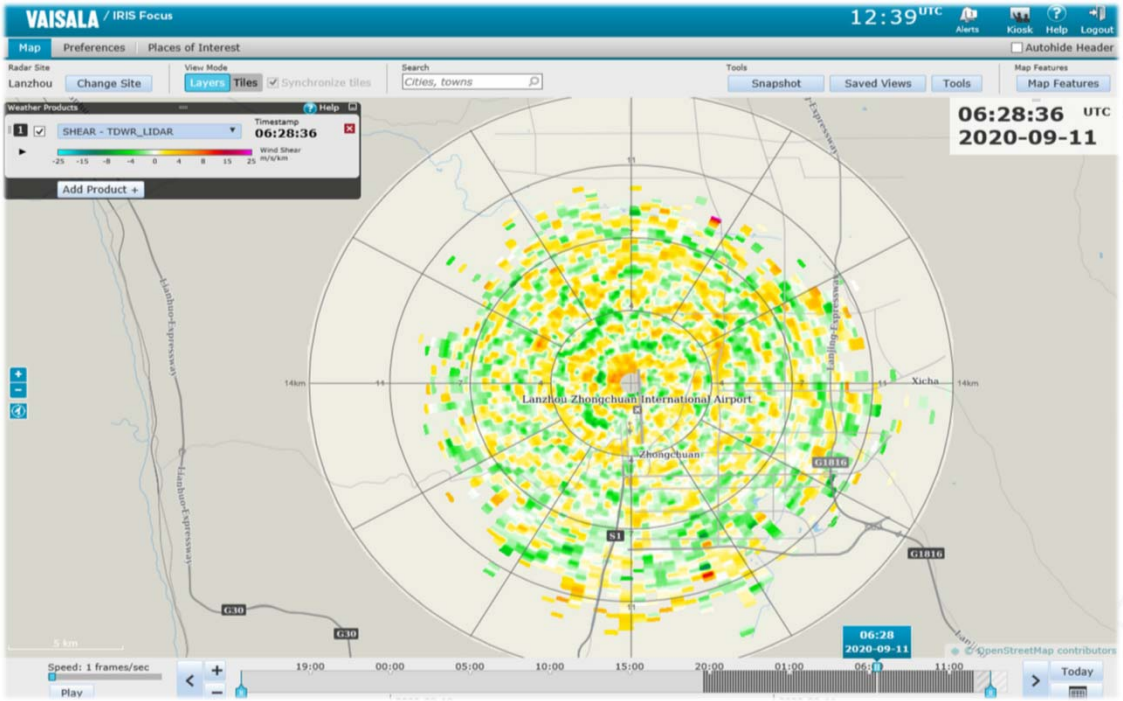
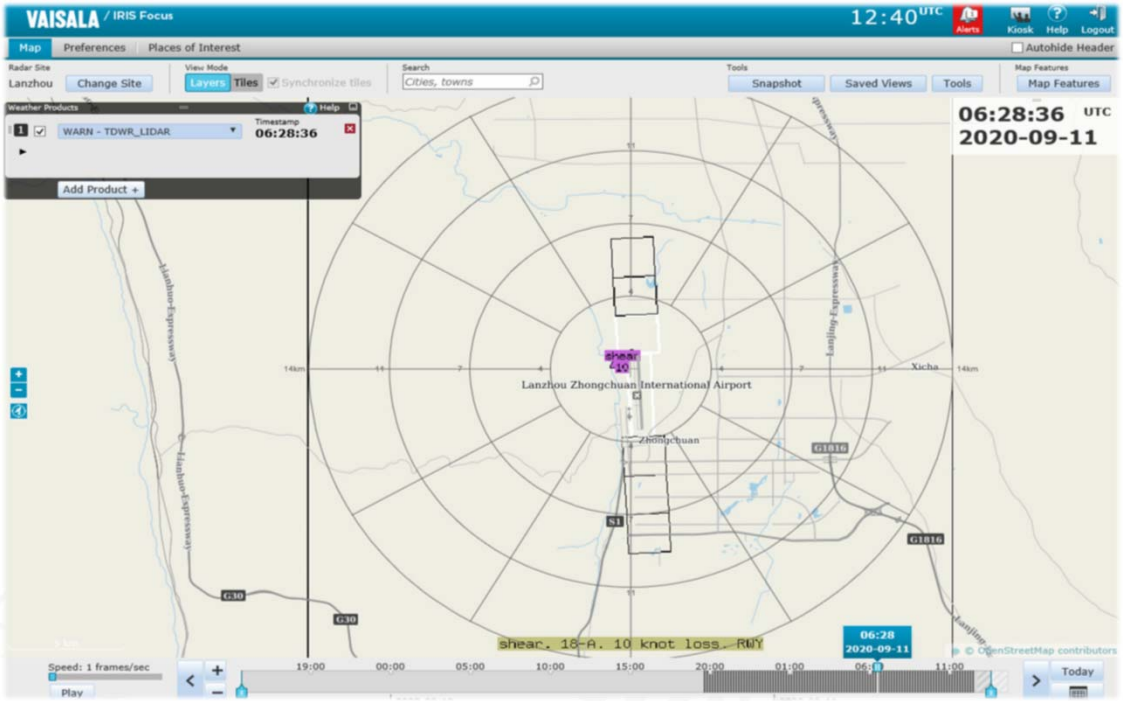




SHEAR(OPTIONAL PRODUCT)

SHEAR detects wind shear in the atmosphere, allowing the detection of microbursts, gust fronts, mesocyclones, cold fronts and atmospheric waves. We can calculate radical, azimuthal, elevation and conbined shears.

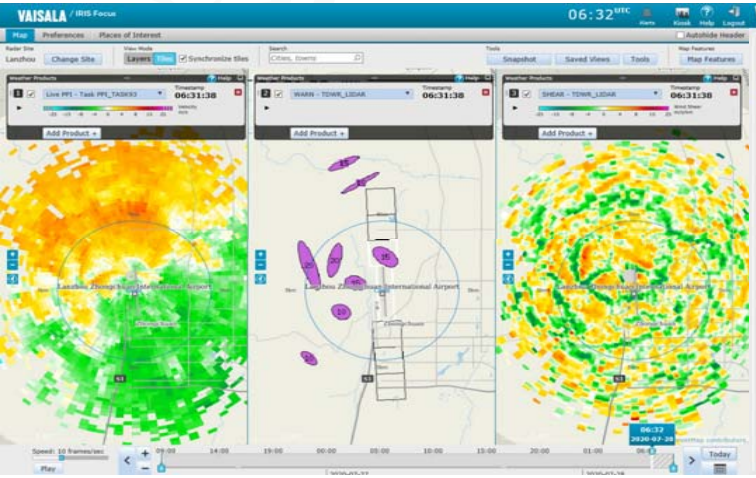
WARN(BASE PRODUCT)

WARN is an automatic warning and centroid plotting, which can be set for protected areas and user-selectable warning criteria. Output is a warning message and a situation overlay showing the centroid locations of storm features.

3.2 Terminal Display Interface - LIDAR

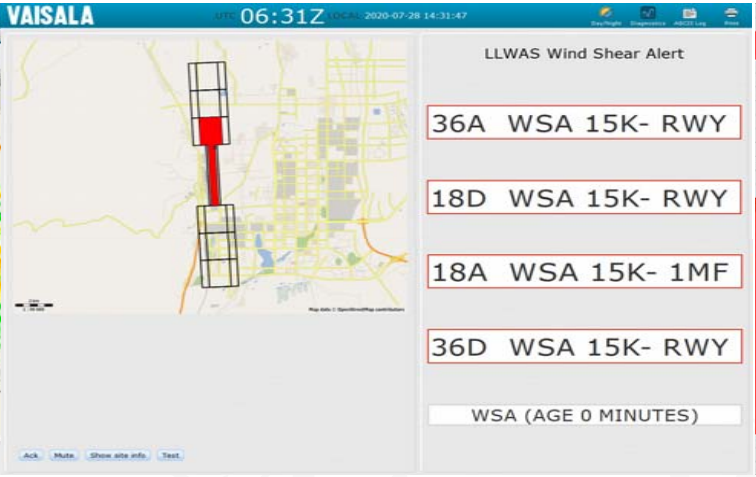
Interface for Forecasters(IRIS)

Radial Wind Speed, SHEAR and WARN products



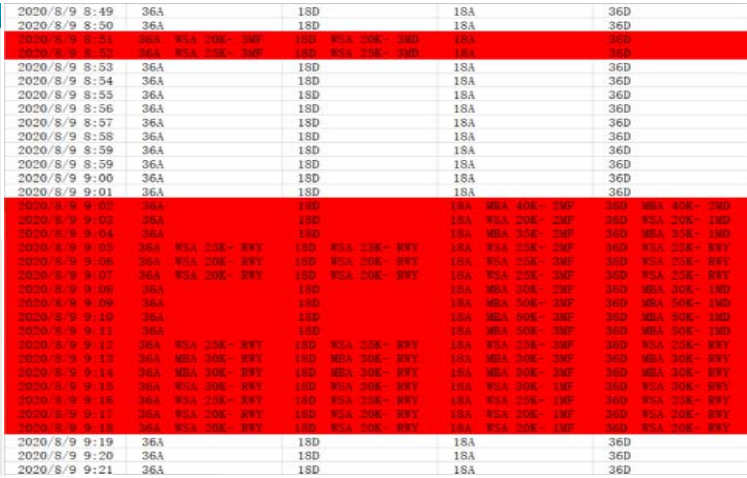
Interface for ATC (Avimet)

ALERT generated by Avimet



ALERT Log

TDWR Style



	WARN	ALERT
Process	IRIS Analysis SHEAR→IRIS Analysis WARN →IRIS Focus	IRIS Analysis SHEAR→IRIS Analysis WARN →IRIS Analysis TDWR→Avimet
Protect Areas	can set	can not set
Thresholds/Criteria	can change	can not change
Types	many	one
Display on the Screen	many kinds at the same time	one
Occurance Position	the detection zones of LIDAR	the protect zones(3nm)
Message Format	TDWR/IRIS	TDWR

3.3 Comprehensive Alarm System

3.3 Comprehensive Alarm System

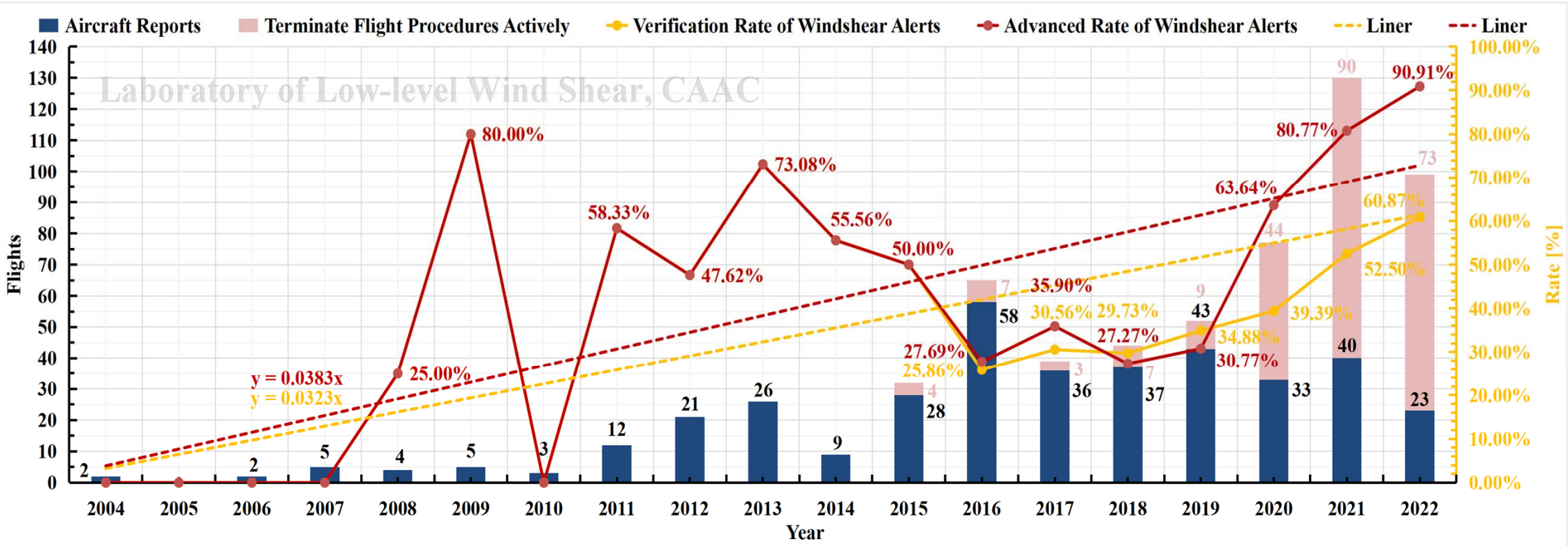


Fig.3.1 Interannual variation of flights influenced by the disturbance in low-level wind field and windshear alerts quality

- **Low-level wind shear detection rate has increased from 27.7% to 90.9% during 2018 to 2022 at ZLLL.**
- **Be of great support to MET work and ATC operation decision.**

Contents

4.1 Low-level Wind Shear Information

PIREPs

regarded as reflection of real events

received through ATC

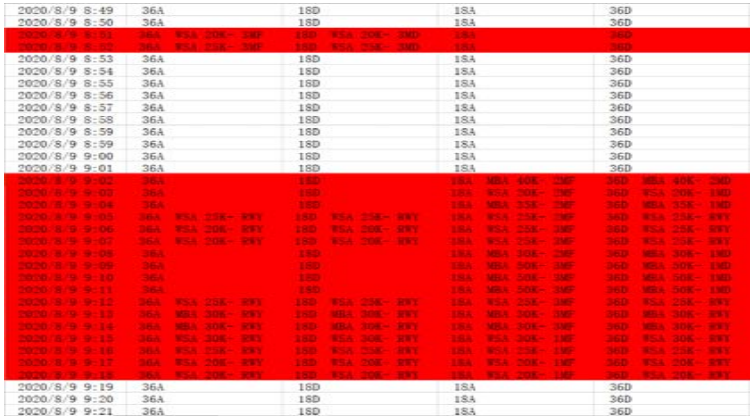
话音方式航空器空中报告表

报告时间（北京时间）	2023年08月22日 17时49分
报告单位	塔台
航班号	机型 A320
出现时间（北京时间）	22日 17时44分
强度危险天气类型	风切变 未知强度
位置	距36号跑道入口5公里
高度（飞行高度层）	2300米
对航班影响	中止进近 复飞
记录单位	甘肃空管分局气象台预报室

Alert

no timing advance information

issued by alarm systems



Warning

timing advance information

issued by MET department(human)

兰州中川机场风切变警报

兰州机场气象台

警报发布序号：02

发布时间：2023-05-12 15:22（北京时）

预计05月12日15:23-15:43，兰州中川机场全跑道及延长线0-500米有轻度风切变，请提醒机组注意。（预报员已于15:22电话通知塔进区，注意看综显）

4.2 Aviation Weather Service Procedures

Step1: Existance

Yes

Step2: Intensity

Step3: Issue Warning

Step4: Monitor & Amend

Step5: Issue or Cancel

No

Determine

1.Obervation: a roller-shaped cloud base, fallstreak, CB
2.AWOS:abrupt wind speed change on the runway
3.ALAWDAS:low-level wind field, warning
4.TDWR:mesocyclone, gust fronts, downburst, strong wind, convergence and divergence, etc
5.WPR:strong vertial wind speed(non-precipitation), CN2, downward momentum transportation, low-level jets, ect
6.LIDAR:strong radial wind speed, shear and warning

Determine the intensity of low-level wind shear according to the critical table.

Issue the windshear warnings, including location, height, intensity and last time of the prospective wind shear. ATC will send the message into the ATIS or D-ATIS.

Monitor weather, according to the weather conditions and aircraft reports to adjust or amend the warnings.

4.2 Aviation Weather Service Procedures

Table. 4.1 Criteria for the intensity of low-level windshear in Lanzhou Zhongchuan International Airport

Intensity	Alerts	Height	Weather System	Cloud	Wind Speed Difference	Vertical Wind Speed	WARN in LIDAR	Impact
Low	Blue	Below 500	Turbulence Downward momentum Low-level jets Weak cold fronts	Cumulus Cumulonimbus	< 9m/s	< 1.8m/s	**≥25K**	Slight change in track and airspeed
Medium	Yellow	Below 373	Strong cold fronts Convective storm Gust fronts	Fallstreak	9m/s~17m/s	1.8m/s~3.6m/s	**≥35K**	Handle great difficulty
High	Red	Below 100	Thunderstorm Downbust Squall line	Roller-shaped cloud base	≥17m/s	≥3.6m/s	**≥50K**	Lose control

Notes: 1. The criteria is based on the international standard from ICAO, and consideration of the characteristics of low-level windshear in Lanzhou Zhongchuan International Airport.
2. The intensity of low-level windshear and the level of windshear alerts is determined by forcasters' comprehensive judgement.

Thank you!

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