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Japan Meteorological Agency

Improvement of Low-Level Wind Shear Information of JMA

Japan Meteorological Agency (JMA)

ICAO MET/ATM Seminar (Tokyo, 29 June-1 July 2015)

Current Low-level Windshear Information of JMA

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Wind Shear (WS) affects airplane safety operation

WS Observation in all weather conditions

DRAW (TDWR) detects low-level wind shear in Rainy condition

Doppler Radar for Airport Weather (DRAW, Japanese version of TDWR) (from 1996)

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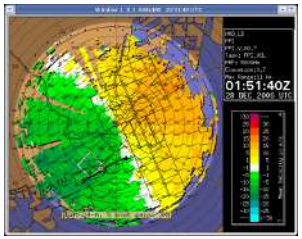
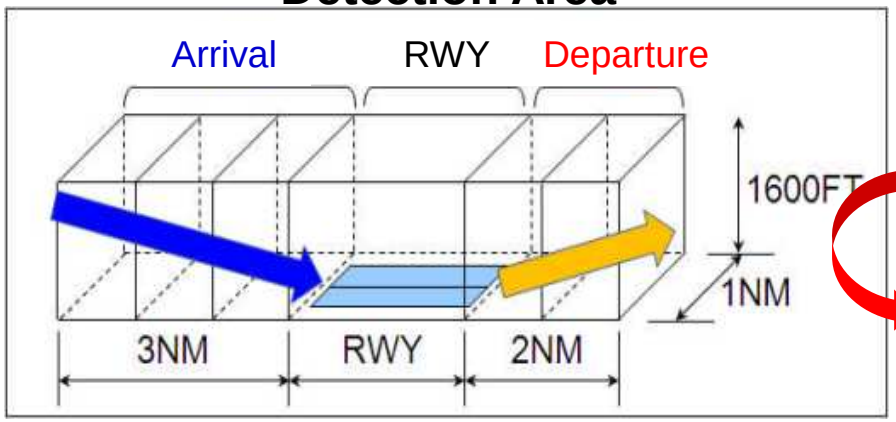


Doppler LIDAR detects low-level wind shear in Sunny or Cloudy condition

Light Detection and Ranging (LIDAR) (from 2008)

Detection Area



TDWR and LIDAR detects Shear Line(SL)and Microburst(MB). Those information are provided as WS Alert and MB Alert.

WS, MB alerts are simple text message, and contents are not enough.

Overview of Wind Shear and Microburst Alert

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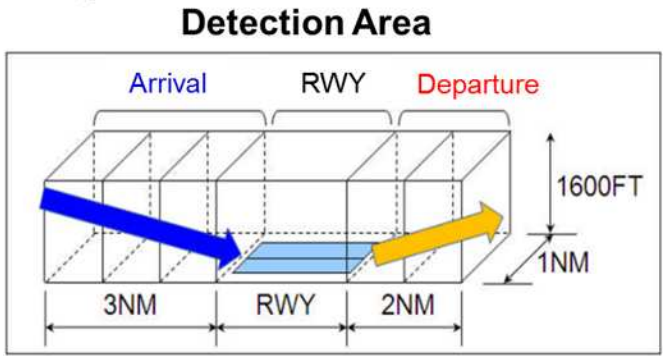
Wind Shear Alert

Over 20 kt Increase or Decrease of Head Wind Component

Microburst Alert

Over 30 kt Decrease of Head Wind Component



(Example)

0837 34LA MBA 39kt- 3nm FNL

- 34LA：34L (RWY)
  - A: ARRIVAL
  - D: DEPARTURE
- 39kt-：39kt (wind speed change)
  - ＋：GAIN
  - －：LOSS
- MBA：MBA (Microburst Alert)
  - WSA (Wind Shear Alert)
- 03nm FNL: 03nm (Position)
  - FNL (Arrival side)
  - DEP (Departure side)
  - RWY (Over Runway)

Collaborative Research with JAXA

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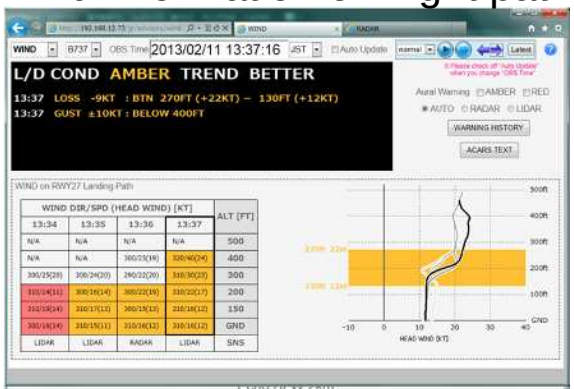
To provide new WS information, JMA started a collaborative research with JAXA (Japan Aerospace Exploration Agency). JAXA developed information providing system, called LOTAS.

LOTAS

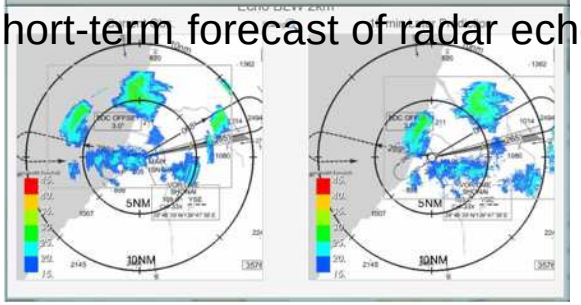
(Low-level Turbulence Advisory System)

Observation by compact RADAR/LIDAR near airport

Wind information on flight path



Short-term forecast of radar echo



Users (Airlines)

New low-level wind information

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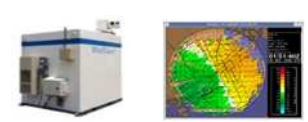
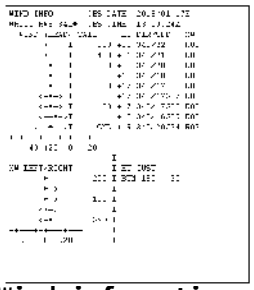
ALWIN

(Airport Low-level Wind InformatioN)



Doppler Lidar
(Narita, Tokyo)



Wind information
for ACARS datalink

JMA
JAXA
Weather information compiler

- Wind info on flight path
- SL, MB info
- Temporal wind change info
- WS detection info

Anemometer

FTP Server

WEB Server

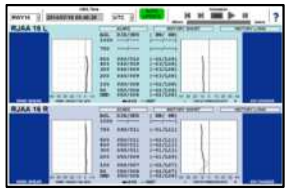
Airline

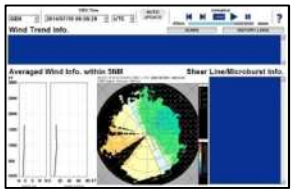
Airplane

ACARS System

Flight crew can check wind condition on flight path in cockpit

Terminal of operation control center





Graphical wind information for operation staff

Based on LOTAS, JMA and JAXA developed a test system with cooperation of JAL and ANA

Display of Flight Path Wind Information

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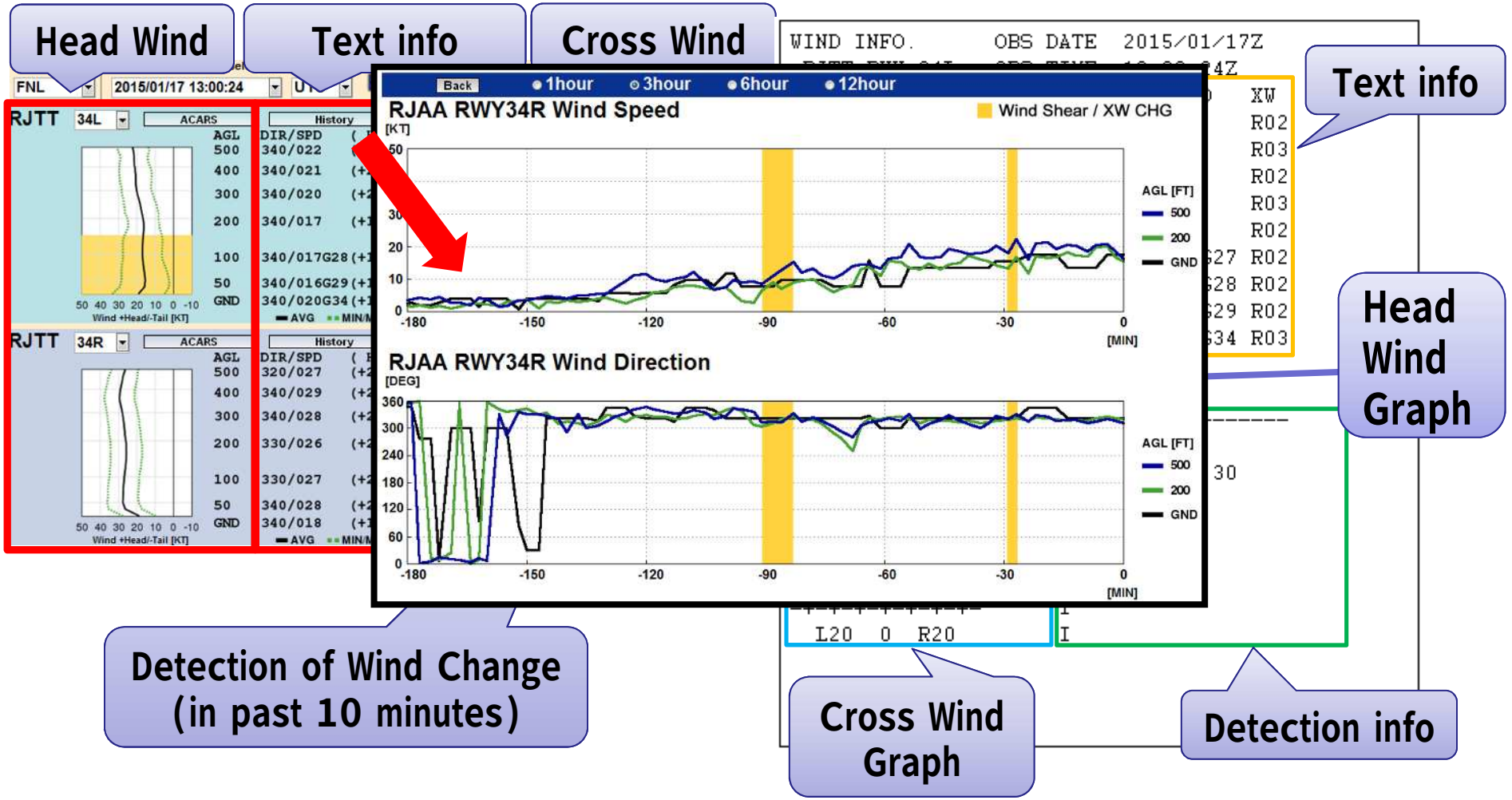
For Operation Staff → For Airplane



Display of Airport Information

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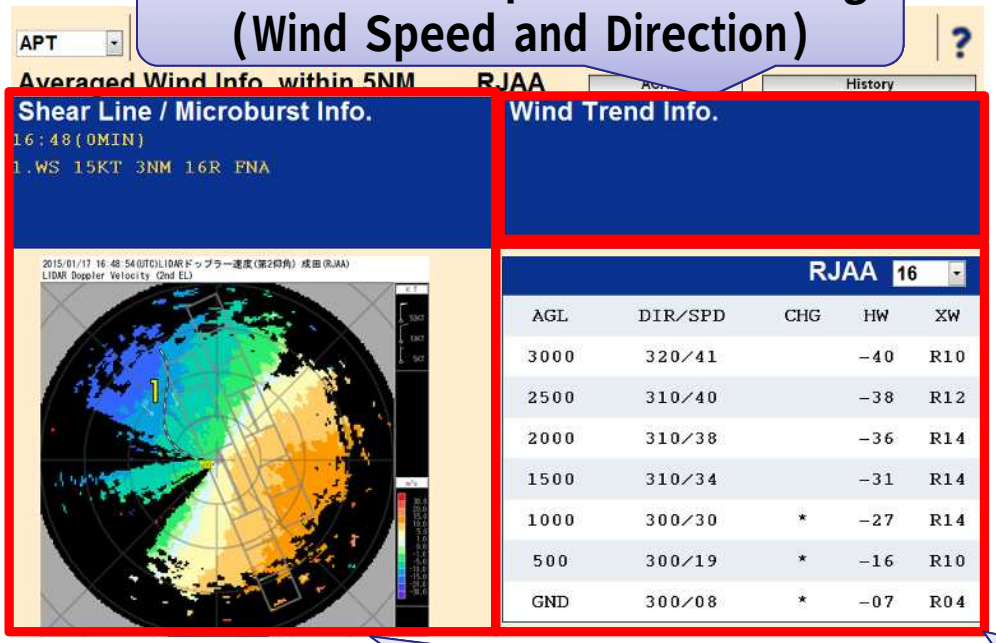
For Operation Staff

For Airplane

Detection of Temporal Wind Change (Wind Speed and Direction)



SL/MB information (position and moving direction)

Wind Vertical Profile

```
WIND INFO.        OBS DATE
*RJAA AIRPORT*    OBS TIME
 AVERAGE WIND WITHIN 5NM FRO   RJAA

AGL   DIR/SPD     CHG
3000  310/39
2500  310/37
2000  300/35
1500  310/32
1000  300/31        *
 500  300/26        *
 GND  300/16        *

WS 5KT OVER A-RWY
```

Detection information

3000	110/02
2500	020V100/03
2000	010/06

2500	VRB03

Vertical Wind Profile
[*]indicating existence of large wind change

Wind variable/wind change is indicated by [VRB]or[V], like METAR

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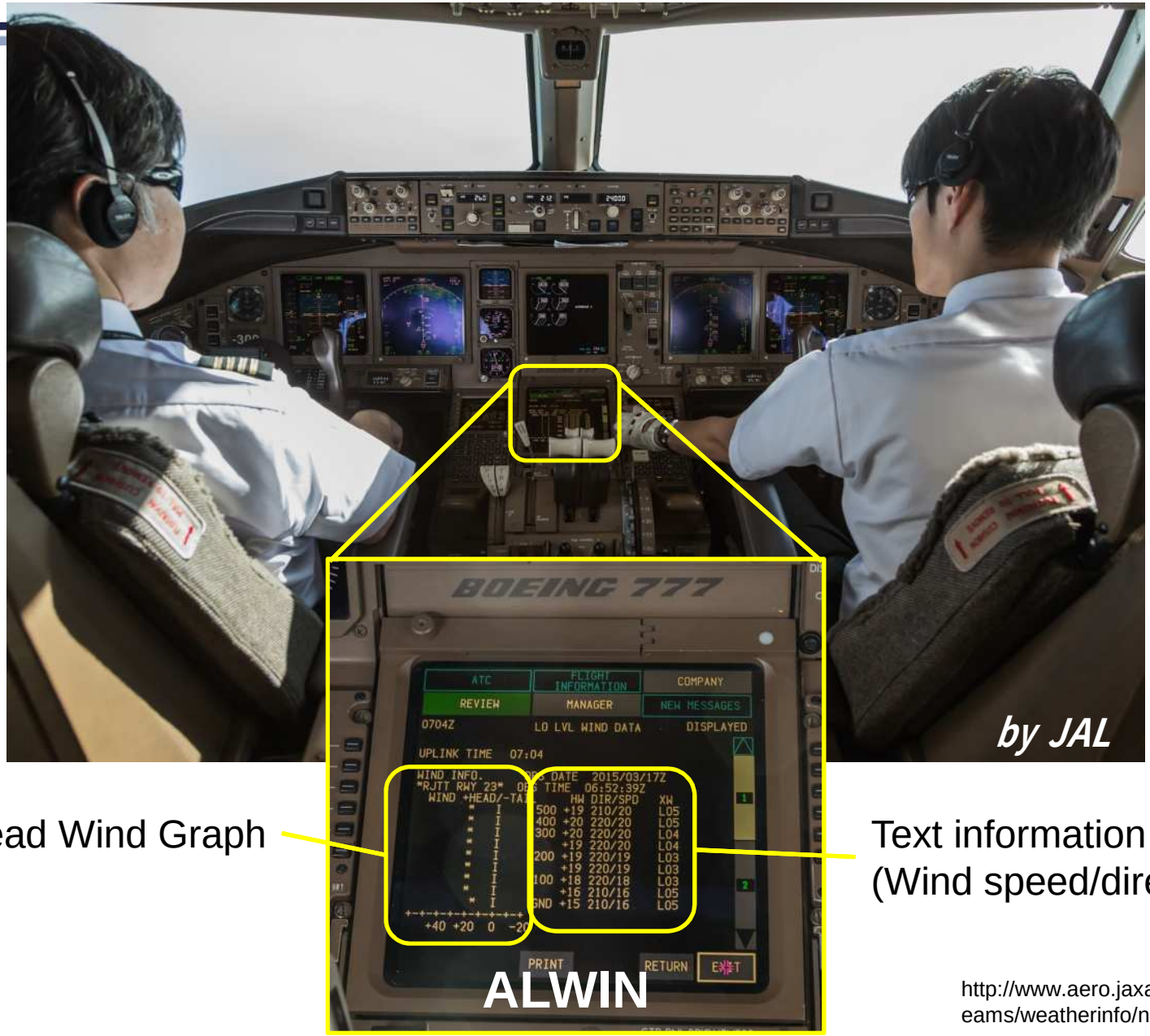

Head Wind Graph

Text information
(Wind speed/direction)

ALWIN

http://www.aero.jaxa.jp/research/star/dreams/weatherinfo/news150401.html

Evaluation of ALWIN by Users

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ALWIN was evaluated by airlines (JAL, ANA) using questionnaire
- Period: from March to April, 2014
- Airport: Narita International Airport (only RWY16R, 16L)
- Target: All landing flight crew and operation staff

Questionnaire for Flight Crew (2 pages)

成田空港 RWY16 進入時の乱気流調査(アンケート案)

※ Go Around された方は、お手数ですが２枚（G/A 時、着陸時）ご記入をお願いします。１枚目と変更の無い箇所は無回答で結構です。

1. ___月 ___日 （ 便）機種-(□767 □777 □737 □787 □320) RWY-(□16L □16R) 着陸時刻-(_____)

2. Target APP SPD = Vref + (_____kt)

3. 高度 500ft 以下の進入着陸を総括しての評価（当てはまる□に印をつけて下さい。）
(1) □風変化（乱れ、シア）の存在に気づかない。
(2) □風変化（乱れ、シア）はあるが通常の注意／操作で対処可能。
(3) □風変化（乱れ、シア）により特別の注意／操作が必要だが進入着陸は継続可能。
(4) □風変化（乱れ、シア）により進入着陸を継続したが場合によっては復行の可能性があった。
(5) □風変化（乱れ、シア）により進入着陸を断念して復行した。
統括評価の理由：

4. LOTAS の実用化に
□実用化を希望せず
コメント：

5. LOTAS の欲しい他

6. LOTAS ACARS 情
有の場合は裏面に

その他コメント（取得したい情報・手段・統括評価に影響した操作（例：Roll Control））：

以下は、Windshear があった時のみご記入下さい。

7. Windshear Warning の有無 □有 (_____ft)□無

8. 以下のチェックボックス(□)で該当箇所に印をつけ、W/S があった場合その速度を記入して下さい。

着陸難易度が高かった高度にチェックをお願いします。

□ GND~100'AGL □ 100~200'AGL □ 200~300'AGL □ 300~400'AGL □ 400~500'

コメント：

Questionnaire for Operation Staff (3 pages)

運航支援者用

2013 年度運航支援者 LOTAS アンケート（RJAA 用）
2 回/名記入

はじめに：
RJAA 用の LOTAS（LOw-level Turbulence Advisory System）を使われた運航支援者の方にアンケートをお願い致します。2014 年 3/1~4/30 までの LOTAS 評価期間中は、2 回/名（評価初期と終了時）の御記入をお願いします。

ご氏名 _____

1. LOTAS を低層風擾乱の状況把握として有効と感じましたか？（全体）
□有効ではなかった □あまり有効ではなかった □やや有効だった □有効だった

2. 各表示・機能の有効性・表示の直感的理解及び使用感について
(1) 表示

表示項目・機能	有効性	直感的理解・使用感	コメント
HEAD WIND グラフ表示	□有効ではなかった □あまり有効ではなかった □やや有効だった □有効だった	□使いにくかった □やや使いにくかった □やや使いやすかった □使いやすかった	
CROSS WIND グラフ表示	□有効ではなかった □あまり有効ではなかった □やや有効だった □有効だった	□使いにくかった □やや使いにくかった □やや使いやすかった □使いやすかった	
風向・風速テキスト表示	□有効ではなかった □あまり有効ではなかった □やや有効だった □有効だった	□使いにくかった □やや使いにくかった □やや使いやすかった □使いやすかった	

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Results of Evaluation of ALWIN

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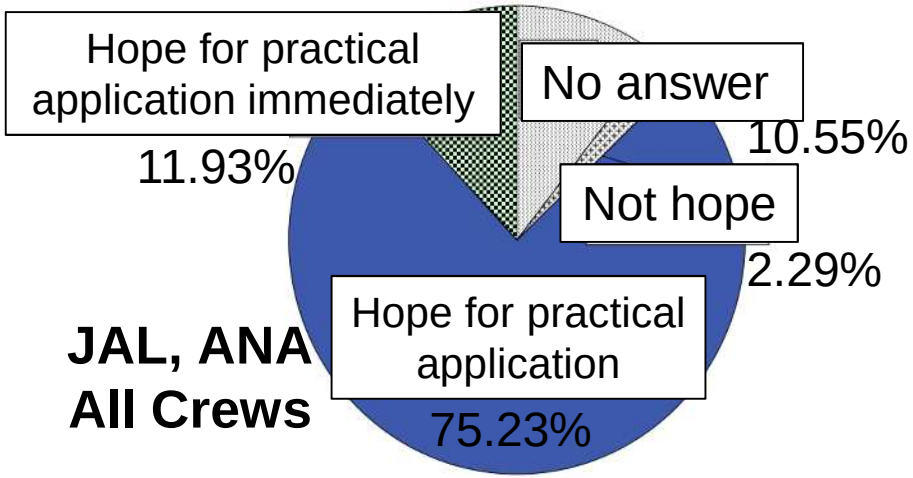
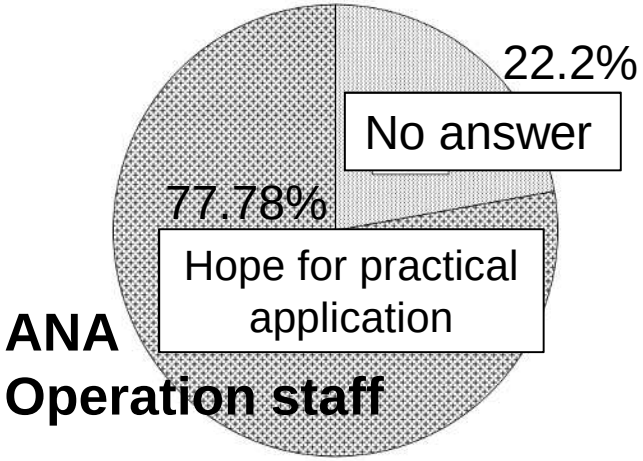
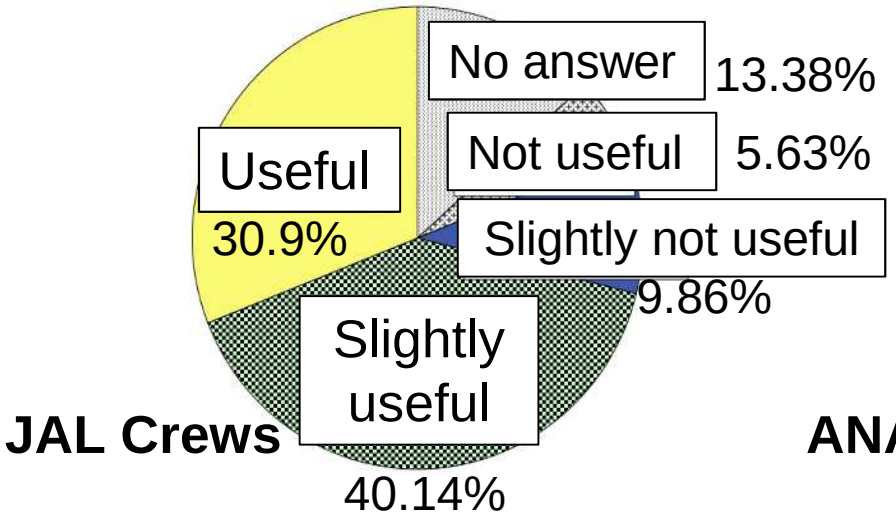
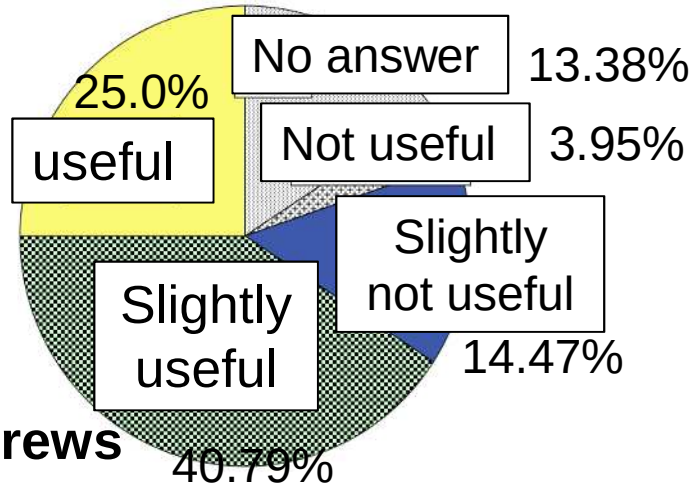
Over 80% of users hopes for operational use





70% of crew thinks the system useful





Users' Comments for ALWIN

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Comments	Possible reasons	Improvement plan
Actual wind did not consist with estimated wind	• Wind changes by time (time between data acquisition and landing)	• Add WS info in the past 10 min to notify details of current weather condition tendency
	• Gust wind • UP / DOWN DRAFT (First prototype ALWIN provided mean wind only)	• Add gust information • Indicate wind variable width in ACARS graph (calculated width is horizontal component only. But there is good relationship between horizontal and vertical wind by isotropy of turbulence)
Can not use in rainy condition	• Laser is attenuated by rain LIDAR: Infrared radiation	• Utilize TDWR data

Accuracy of ALWIN Wind

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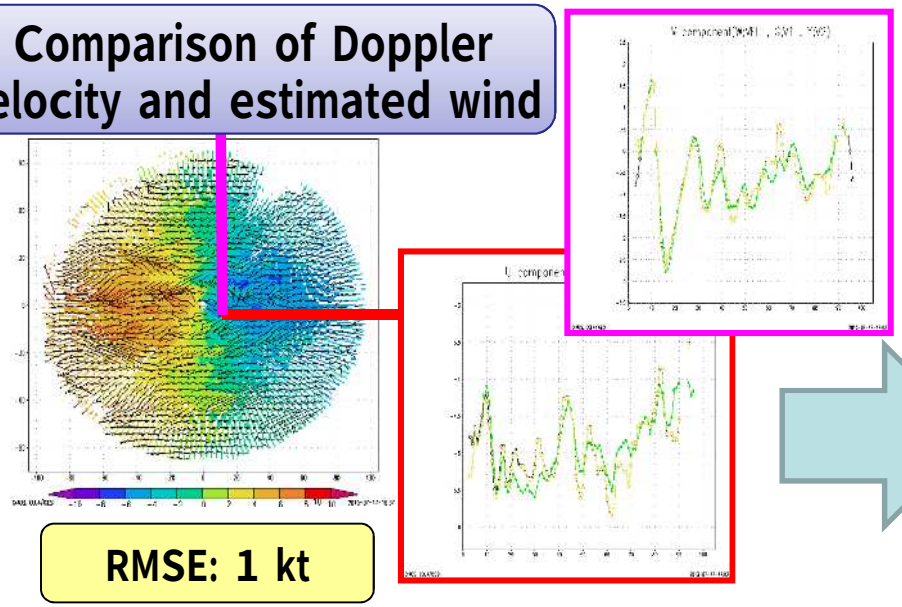
Comparison of Doppler velocity and estimated wind



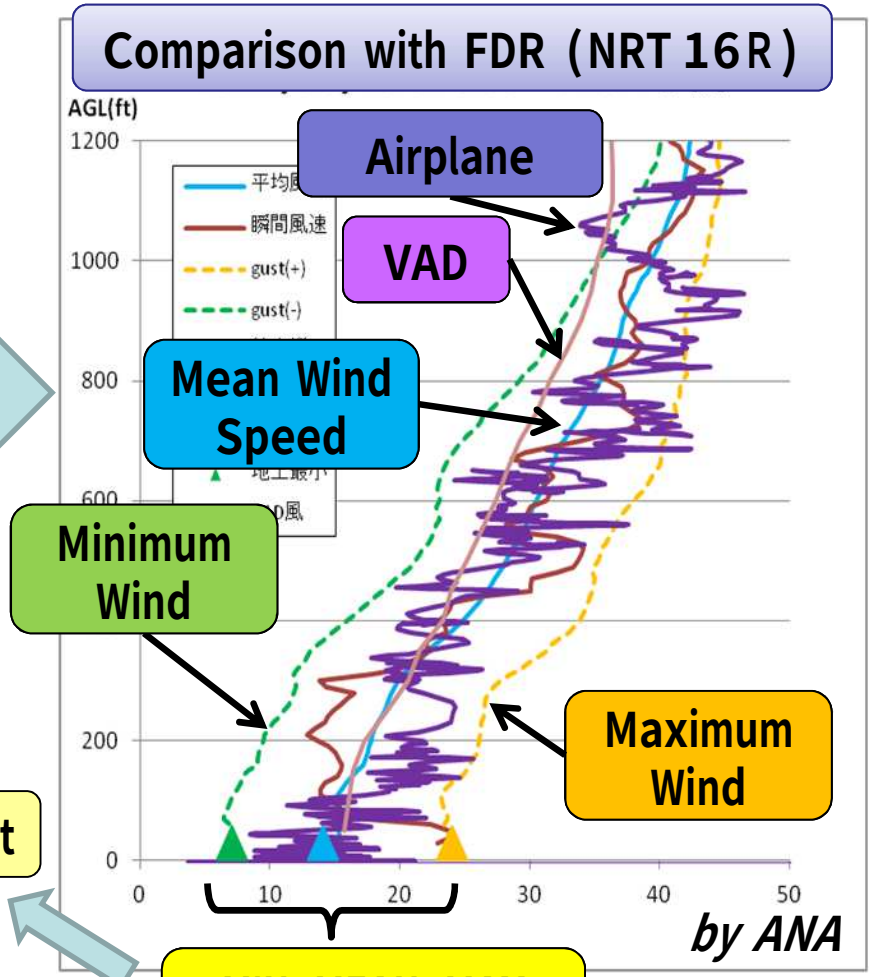
RMSE: 1 kt

Comparison with anemometer

	RMSE
Mean Direction (deg.)	6.48deg
Mean Wind Speed	2.05kt
Max Wind Speed	2.63kt
Min Wind Speed	1.85kt
GUST (MAX－MEAN)	1.61kt

RMSE: 2 - 3 kt

Comparison with FDR (NRT16R)



Airplane

VAD

Mean Wind Speed

Minimum Wind

Maximum Wind

MIN, MEAN, MAX (Anemometer)

Utilization of RADAR

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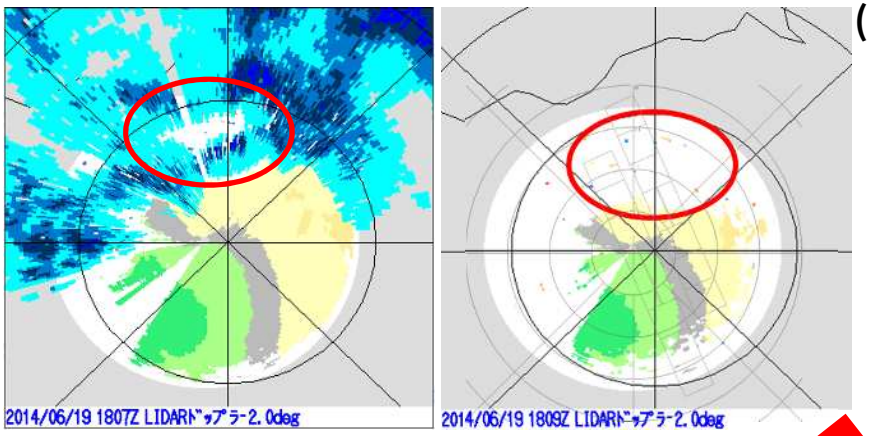
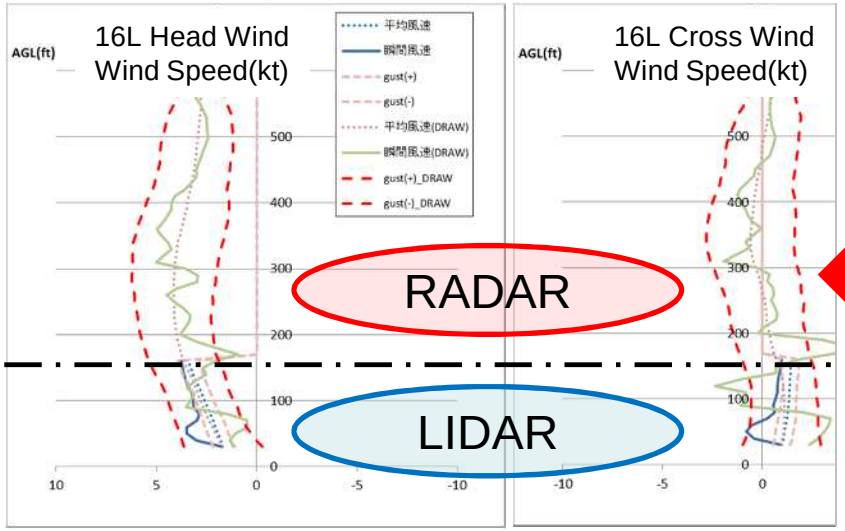
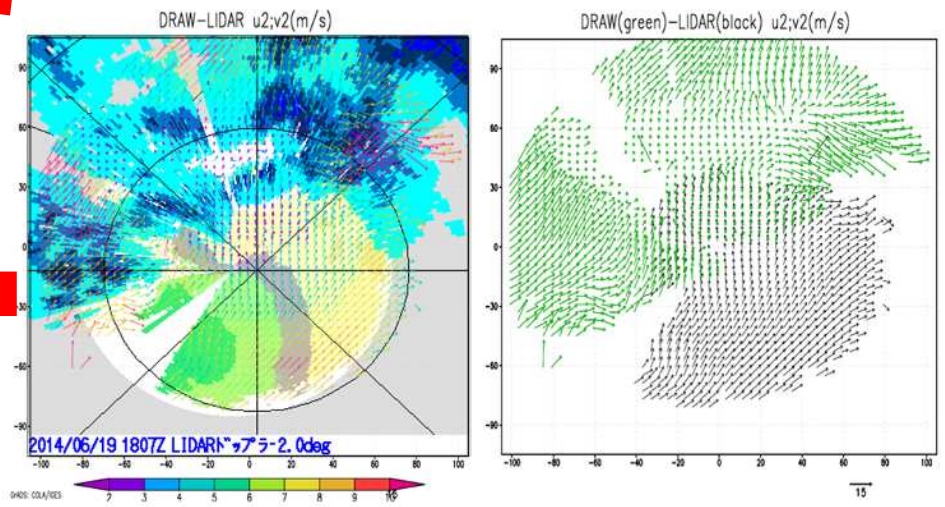


(DRAW: Doppler Radar for Airport Weather)

LIDAR can not observe in rainy weather.
In such conditions, RADAR will become important to provide wind products.
(The new data is not yet adopted in the current test system, but will be tested soon)





GREEN: RADAR
BLACK: LIDAR

Future Plan

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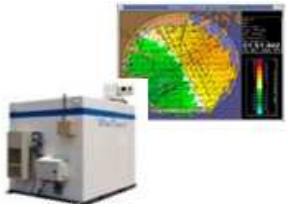
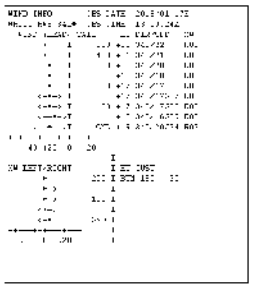
RADAR



LIDAR

HND,NRT,KIX



Wind information for ACARS datalink

Airport Doppler Radar Administration System (ADRAS)

Data transmission System in JMA (ADESS)

Website of Aviation weather information in JMA (MetAir)

Airline

Airplane

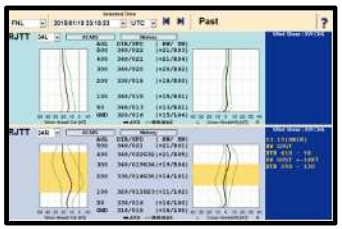
ACARS System

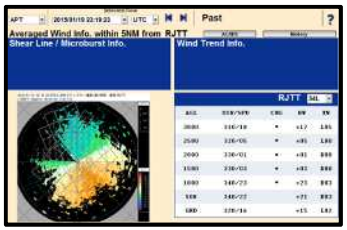
Flight crew can check wind condition on flight path in cockpit

Terminal of operation control center

Real time data of 6 sec intervals (Current test system uses 10 min intervals)

Anemometer





Graphical wind information for operation staff

ALWIN is scheduled to start operation in April 2016

Summary

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- To make more effective windshear information, JMA developed new information with JAXA and Airlines (JAL, ANA)
- New information named ALWIN was provided by test system and the evaluation shows users request its operational use
- ALWIN is to be improved so as to meet requirements of users
- ALWIN is scheduled to start operation in April 2016