Development of an Onboard Doppler LIDAR for Flight Safety

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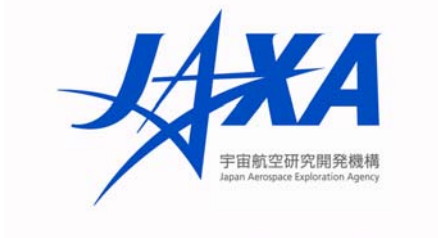

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1NM = 1852 m

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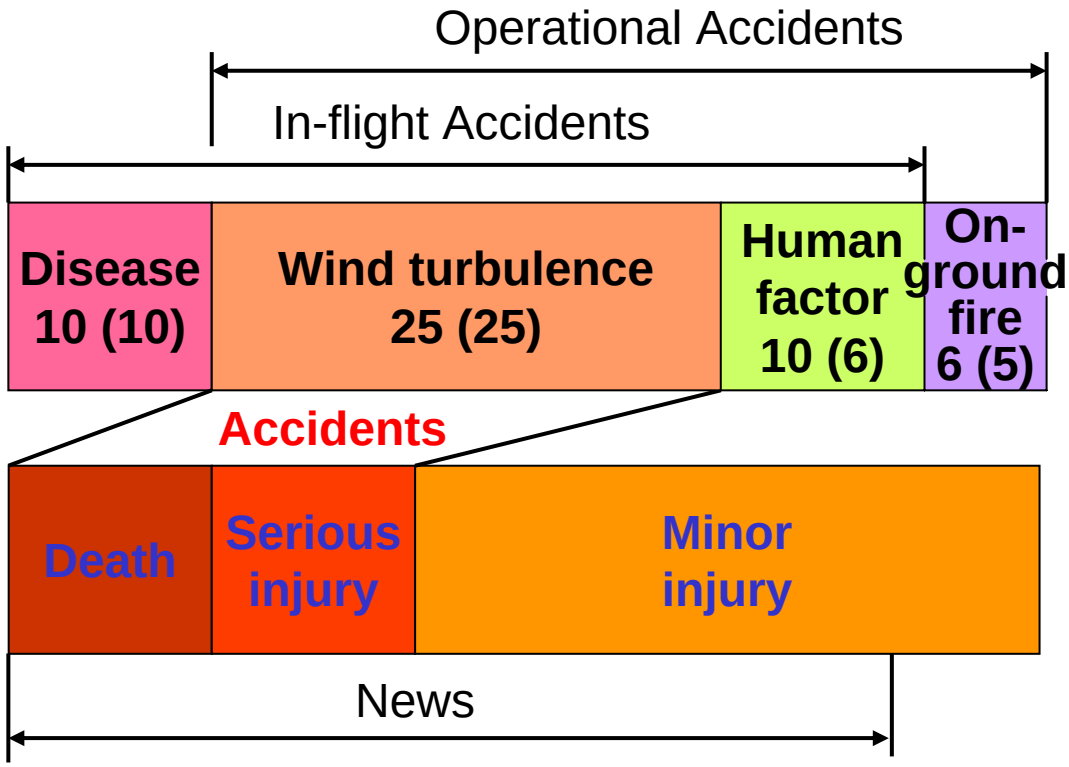
Aviation Accidents

Large civil airplane in Japan (1990～2006)

(Parentheses are the number of personnel accidents)



$$\frac{\text{(25) Turbulence}}{\text{Operational Personnel (36)}} \fallingdotseq 70\%$$

Minor injury ≠ Accident

Frequent

Turbulence Accident Prevention

Prior information

- Weather forecast: Invalid for the small area on enroute
- Weather RADAR: Invalid for the clear air turbulence
- Information from precedence: Invalid for the short time change

Damage reduction

- Seat belt: Difficulty in the cabin service
- Gust alleviation: Invalid for the initial shake
- Interruption of the cabin service: Much time is required
- Evasion flight: Prior reliable information is required

If turbulence is predicted beforehand,
these measures become more effective.

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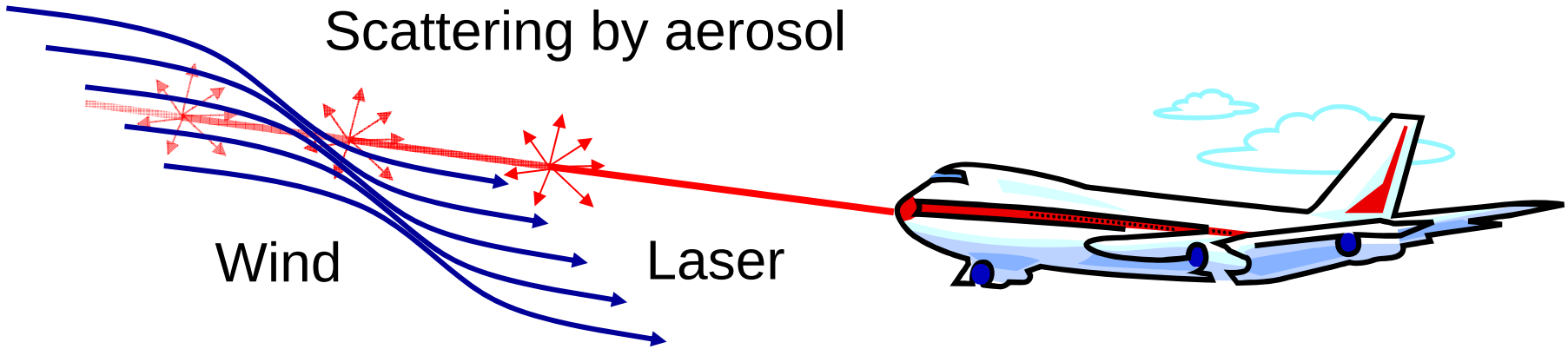
Onboard Doppler LIDAR



LIDAR: Light Detection And Ranging

Overall Concept of the Onboard Wind Measurement LIDAR

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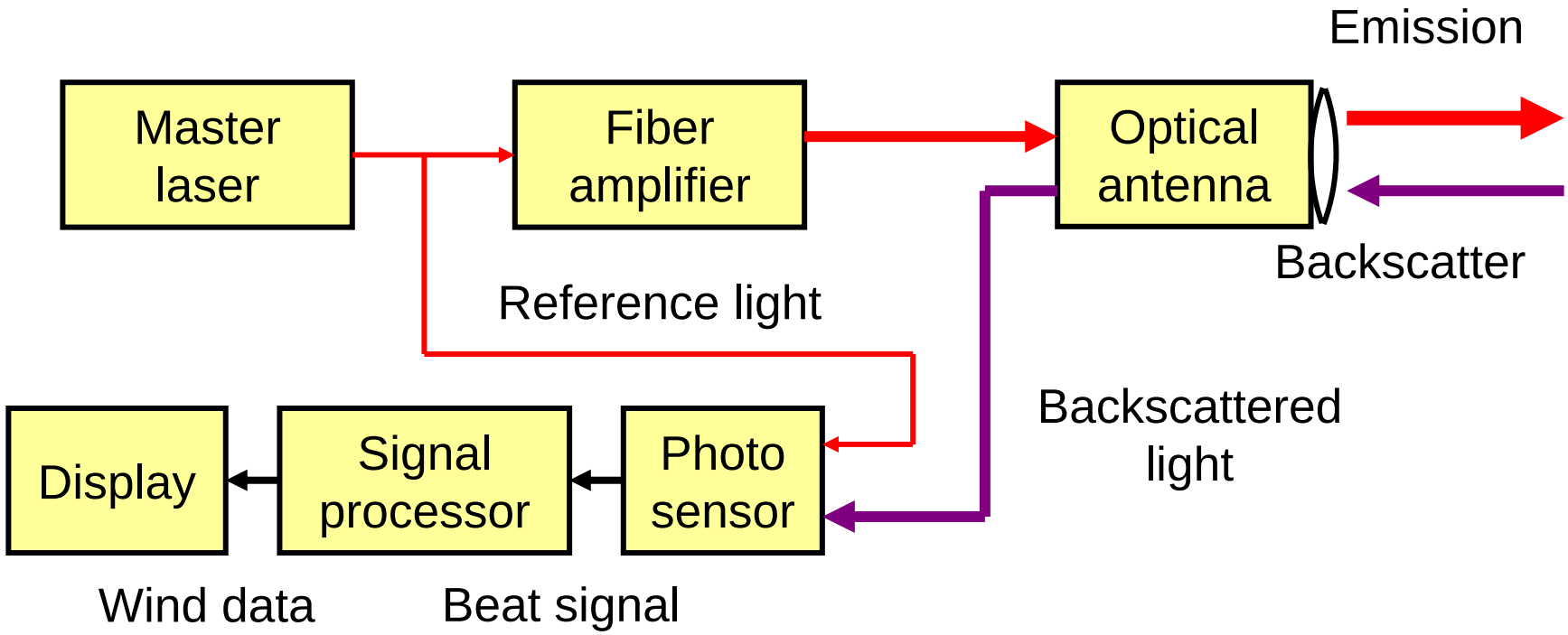
Onboard Doppler LIDAR



Block Diagram of Coherent Doppler LIDAR
Based on Optical Heterodyning Technique

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Adopted Method

Optical fiber amplifier

- Small: Optical devices are small, power-saving and a huge chiller is unnecessary
- High reliability: Dust-proofness and low EM noise
- Flexible layout: Separate installation is possible
- Eye safety: 1.5 μ m is the safest wavelength

Suitable as an onboard system

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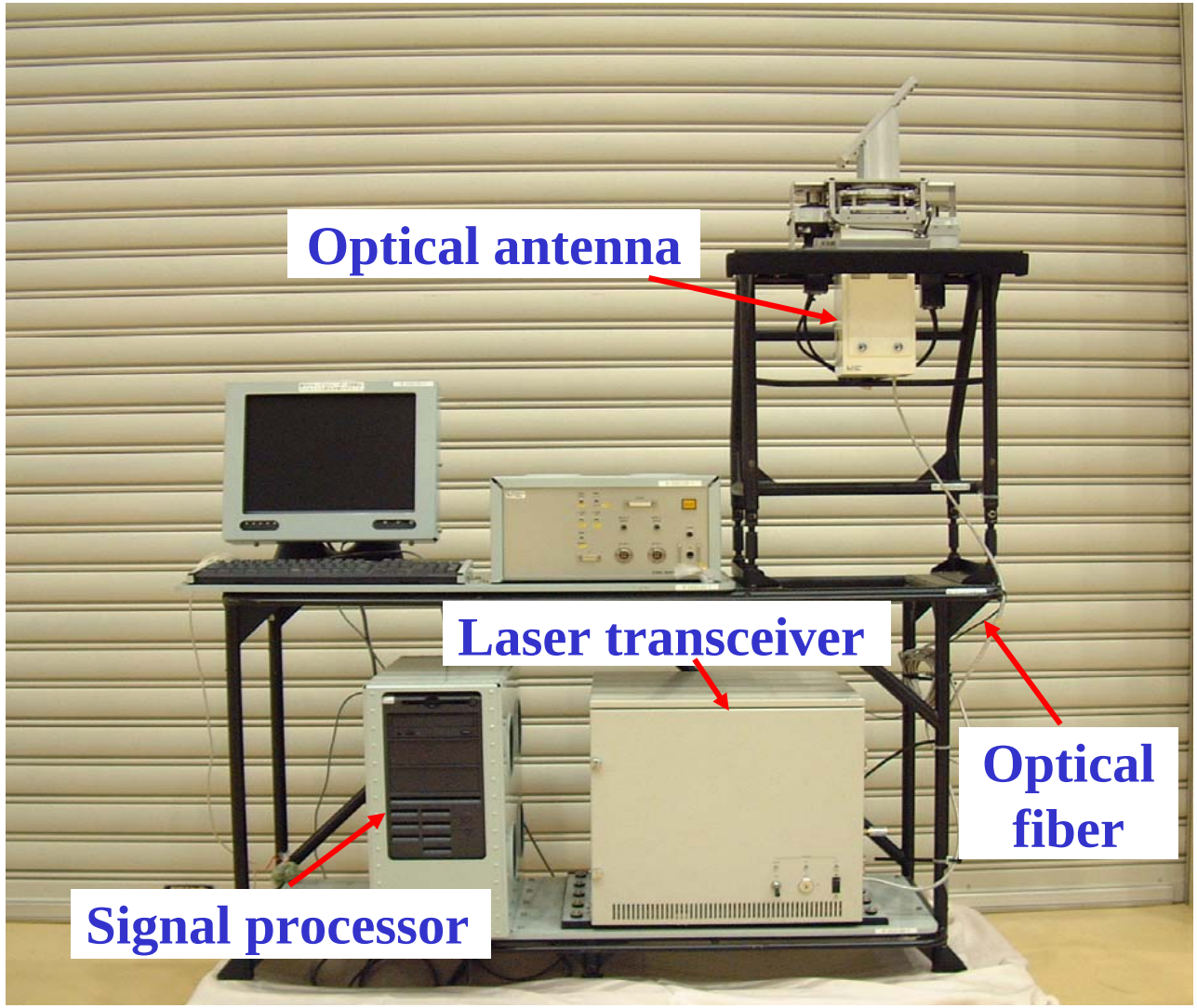
1NM Model

2001



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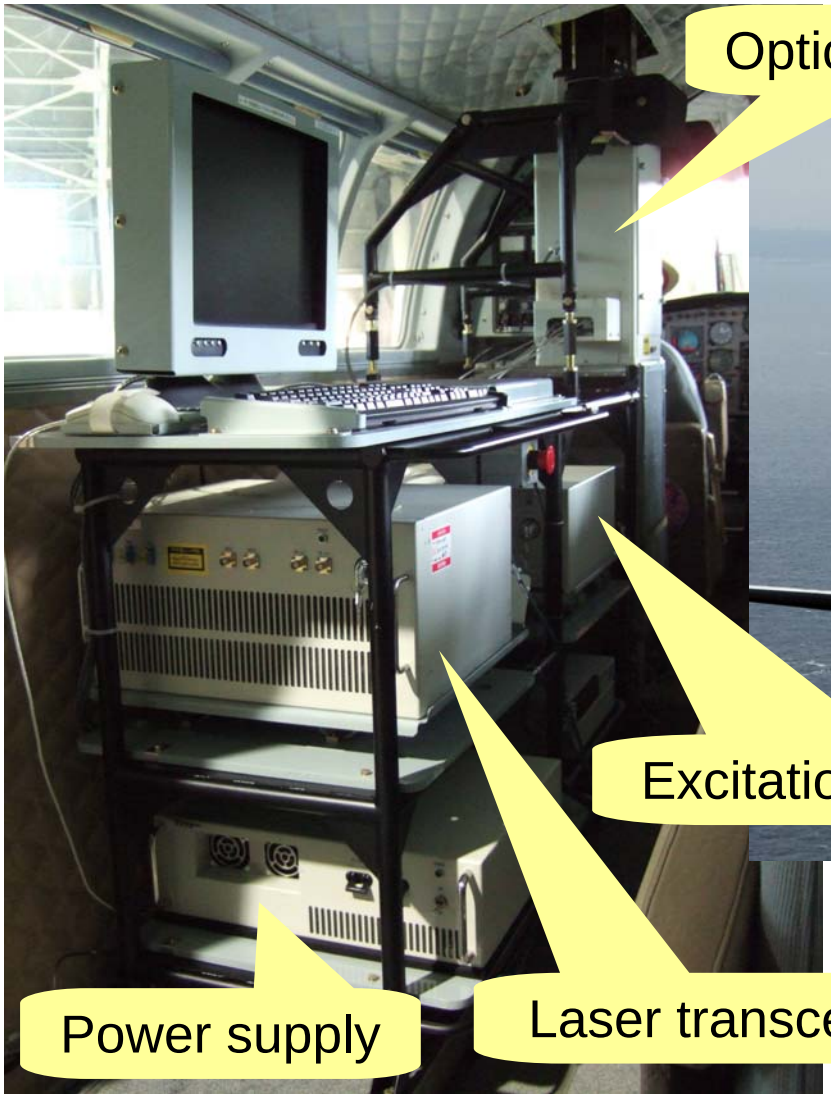
Installation (3NM Model)

2006



Beechcraft Model 65

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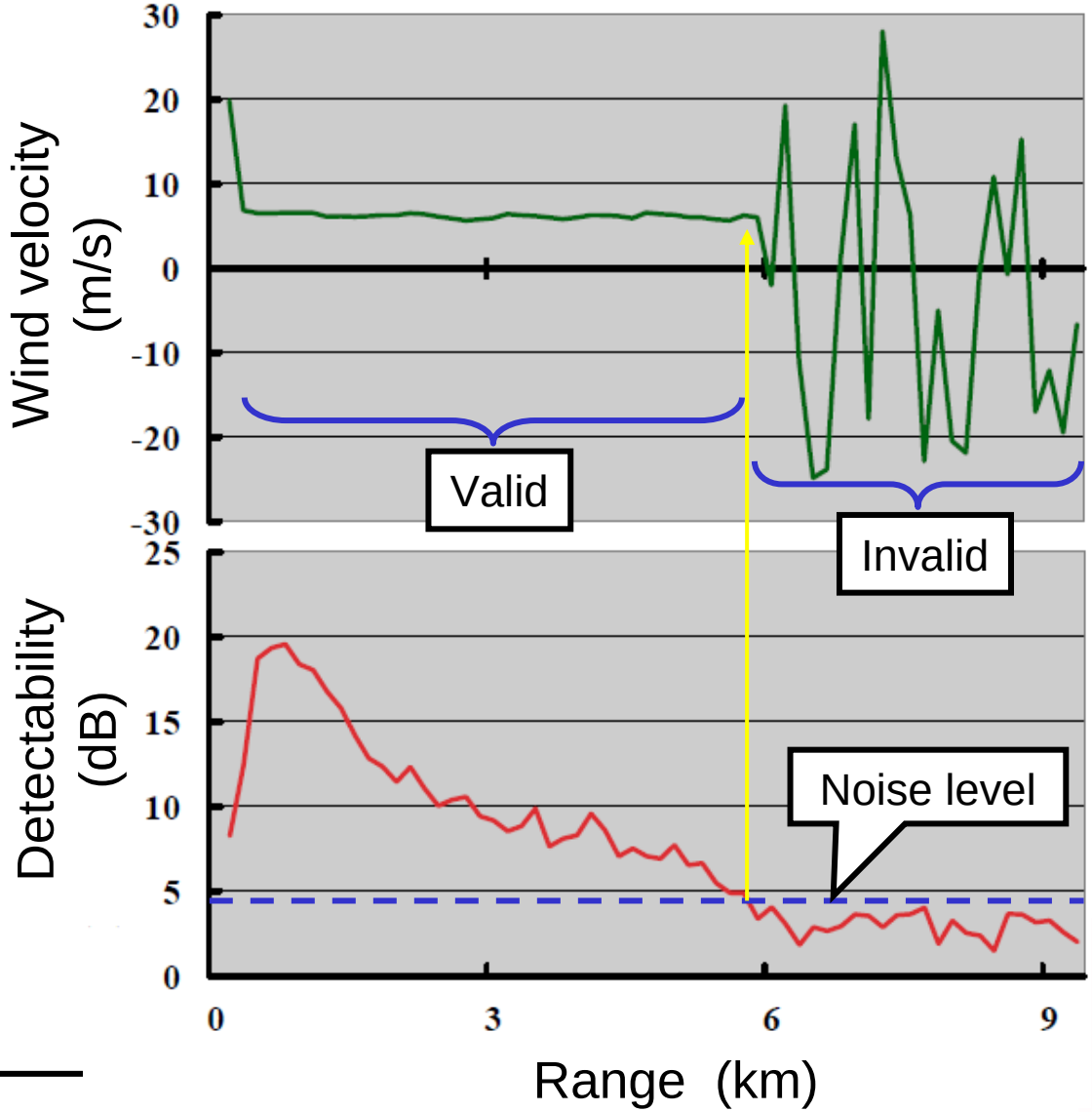
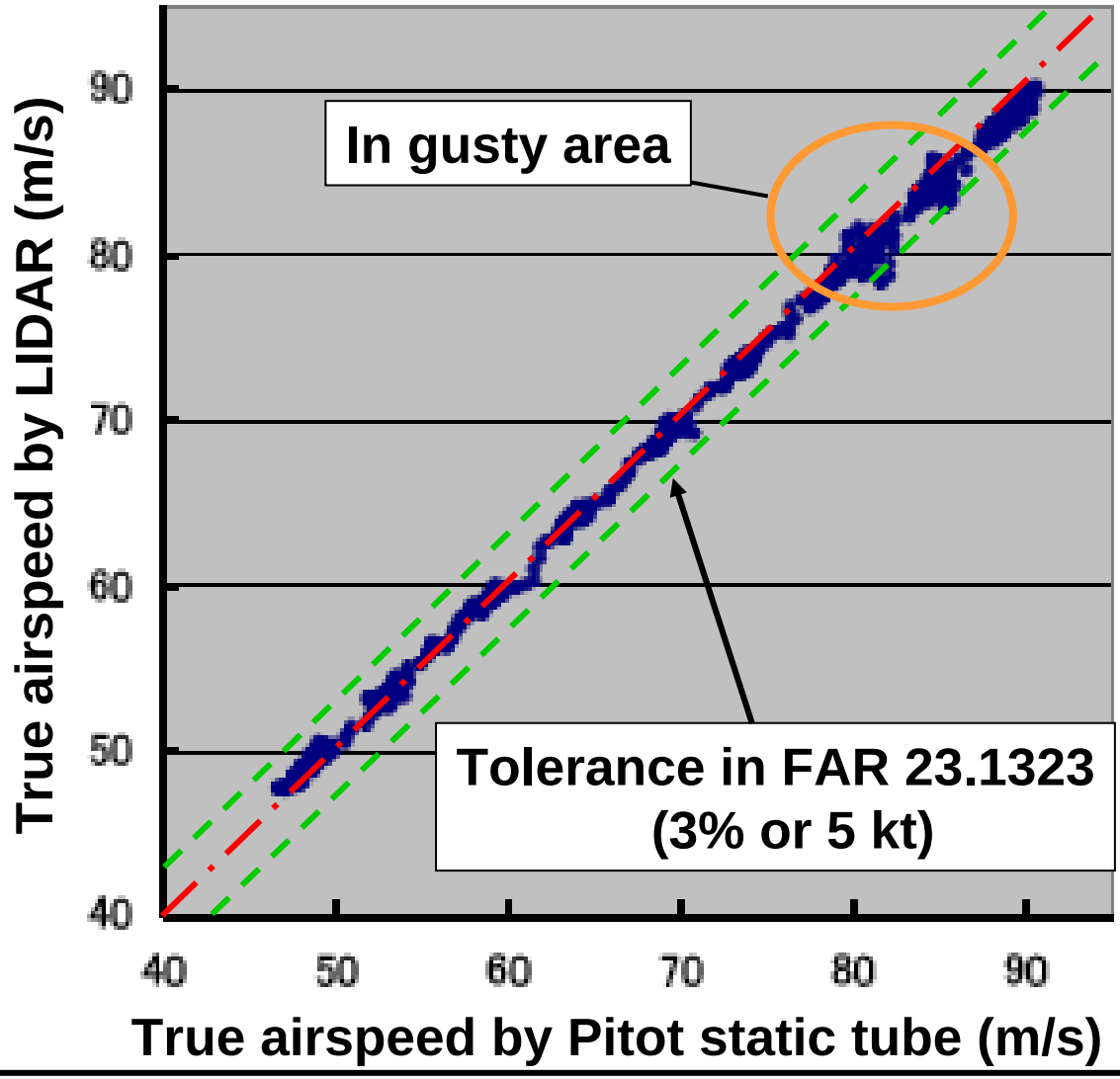
Flight Test Data (3NM Model)



Flight Test Data (3NM Model)



Measured range (m)	Standard deviation (m/s)
450–600	0.63
600–750	0.68
750–900	0.69
900–1050	0.70

Equivalent accuracy to the Pitot tube

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Flight Test Data (3NM Model)

Measured data

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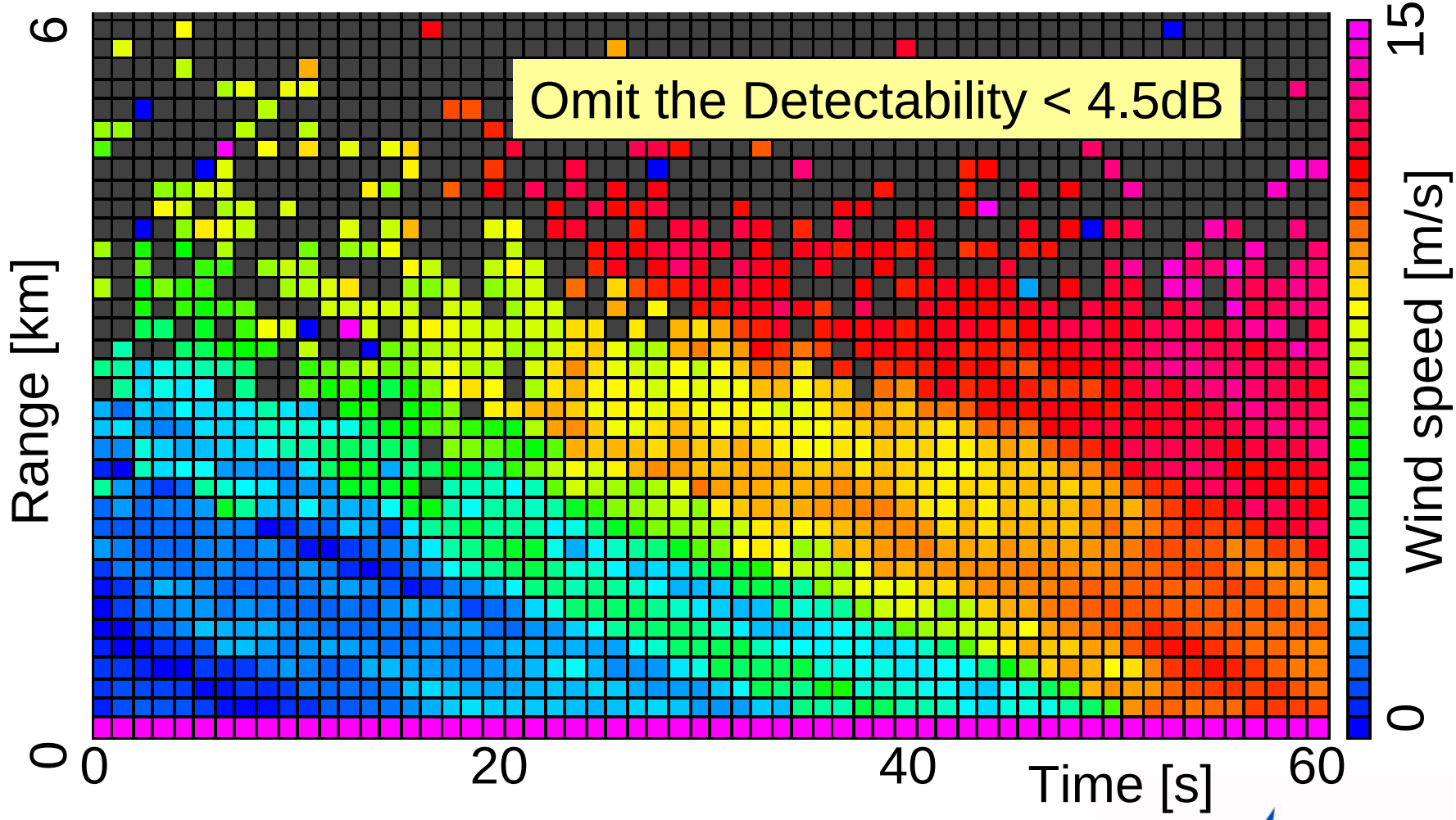
Flight Test Data (3NM Model)



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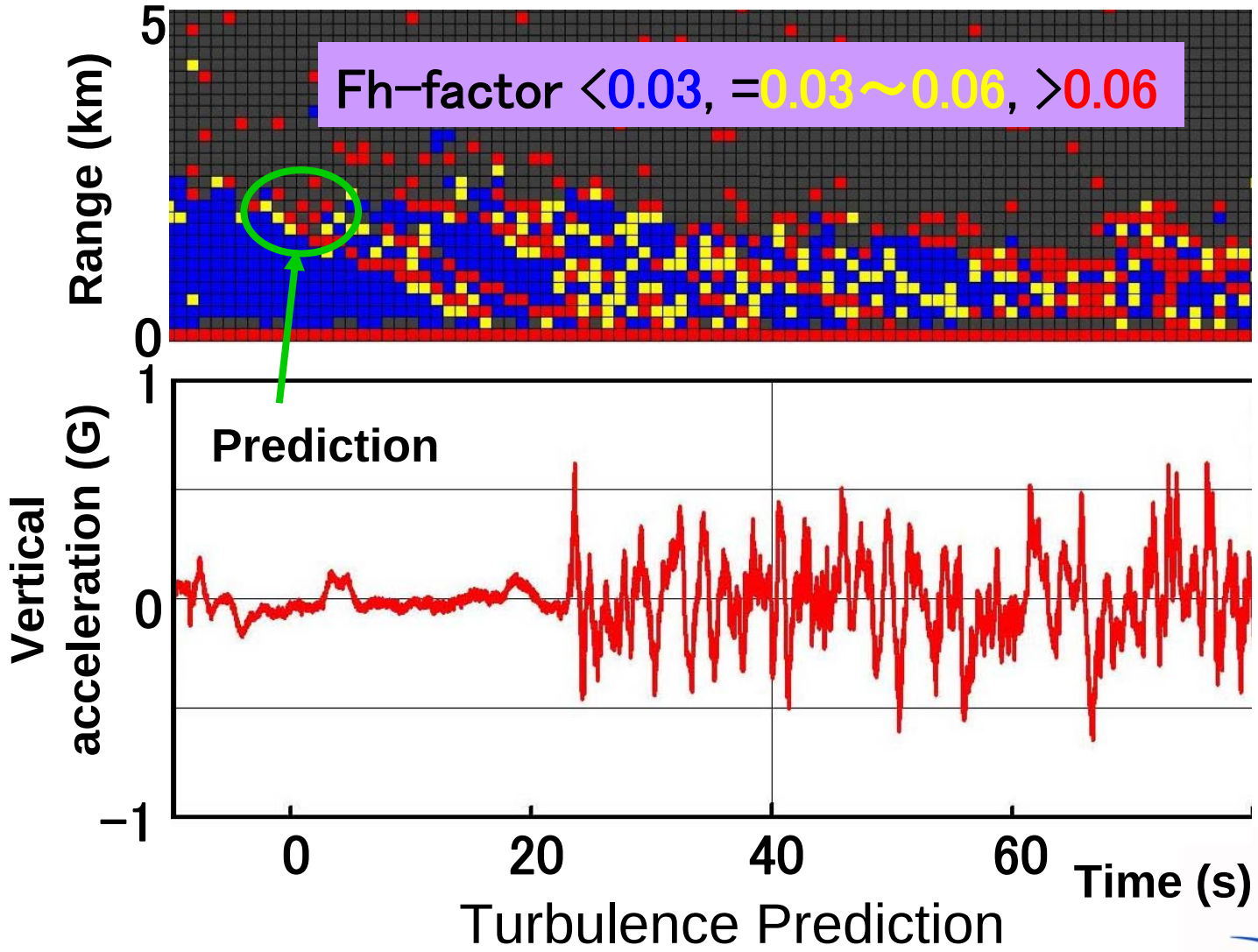
Flight Test Data (3NM Model)



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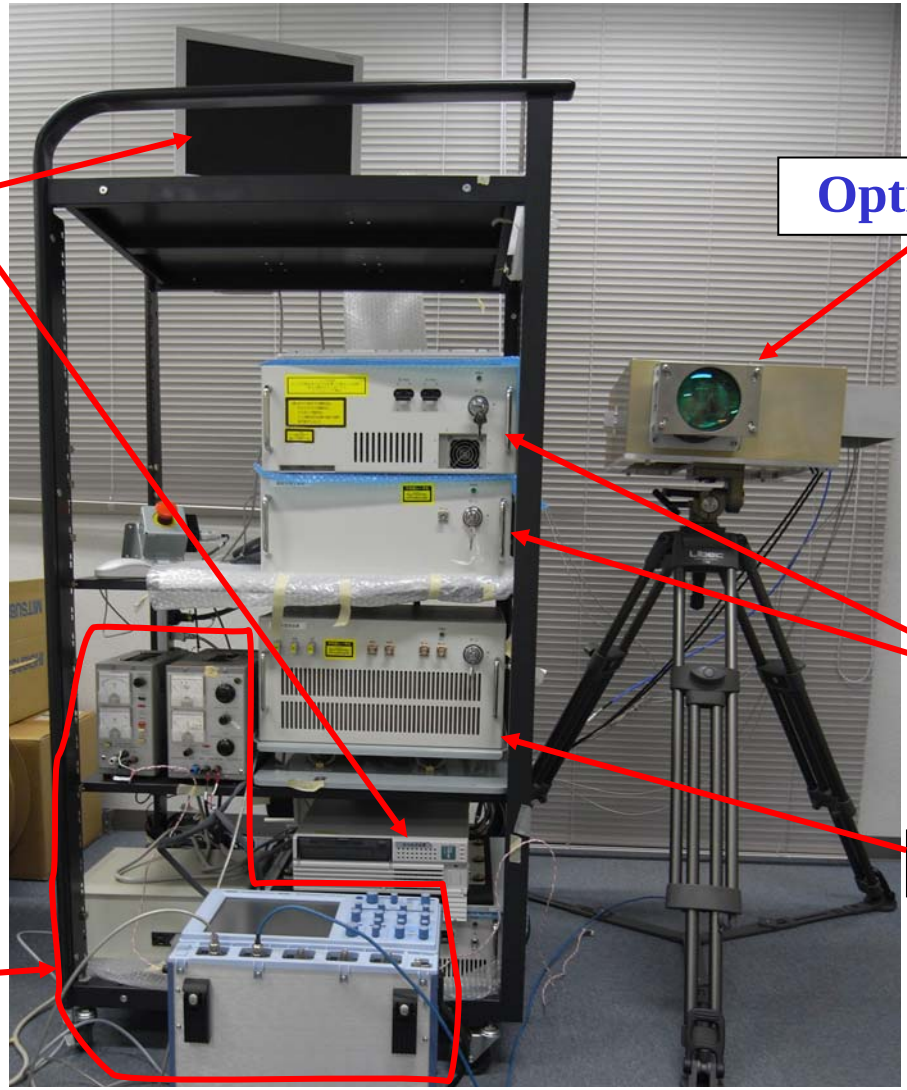
5NM Model

2007



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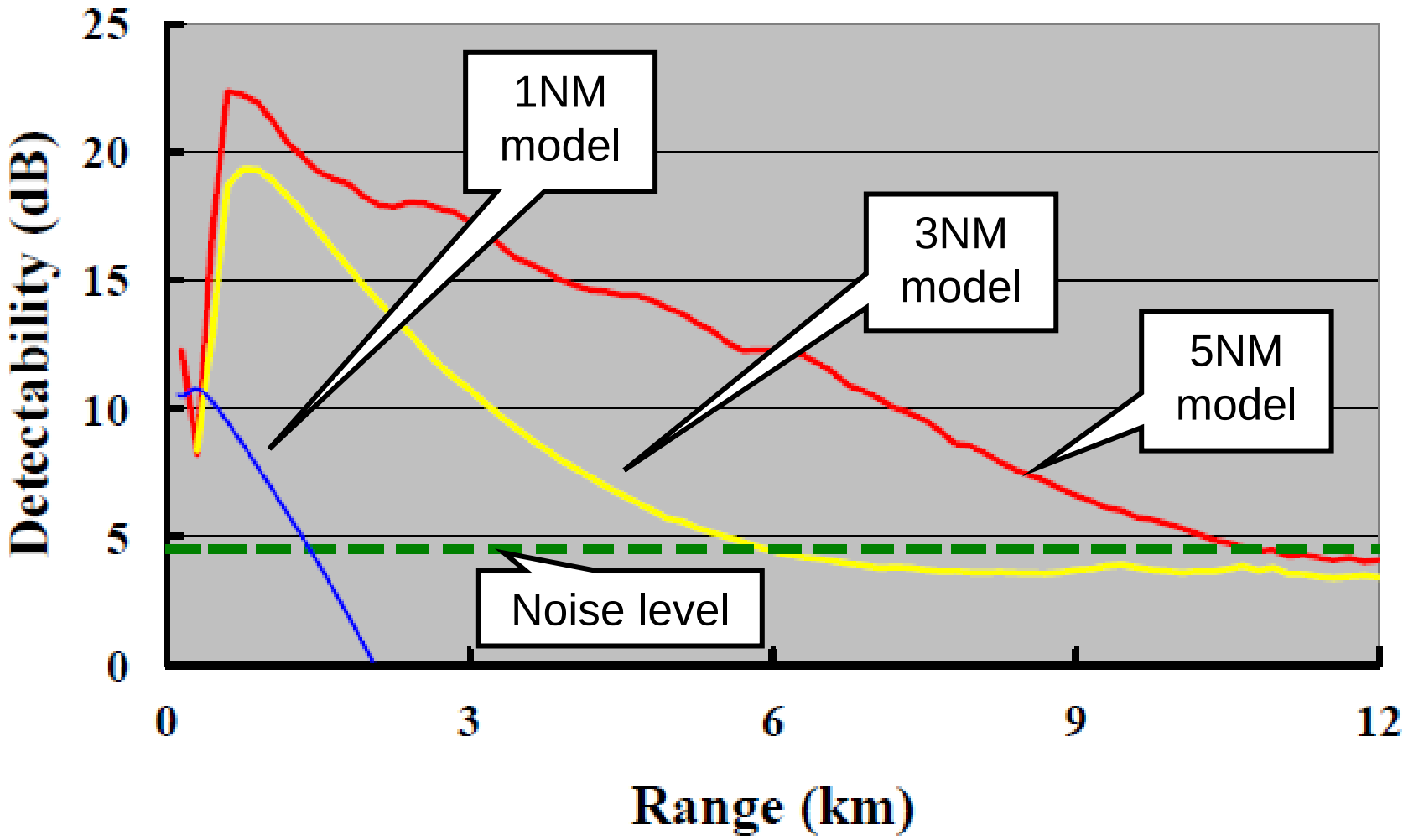
Ground Test Result



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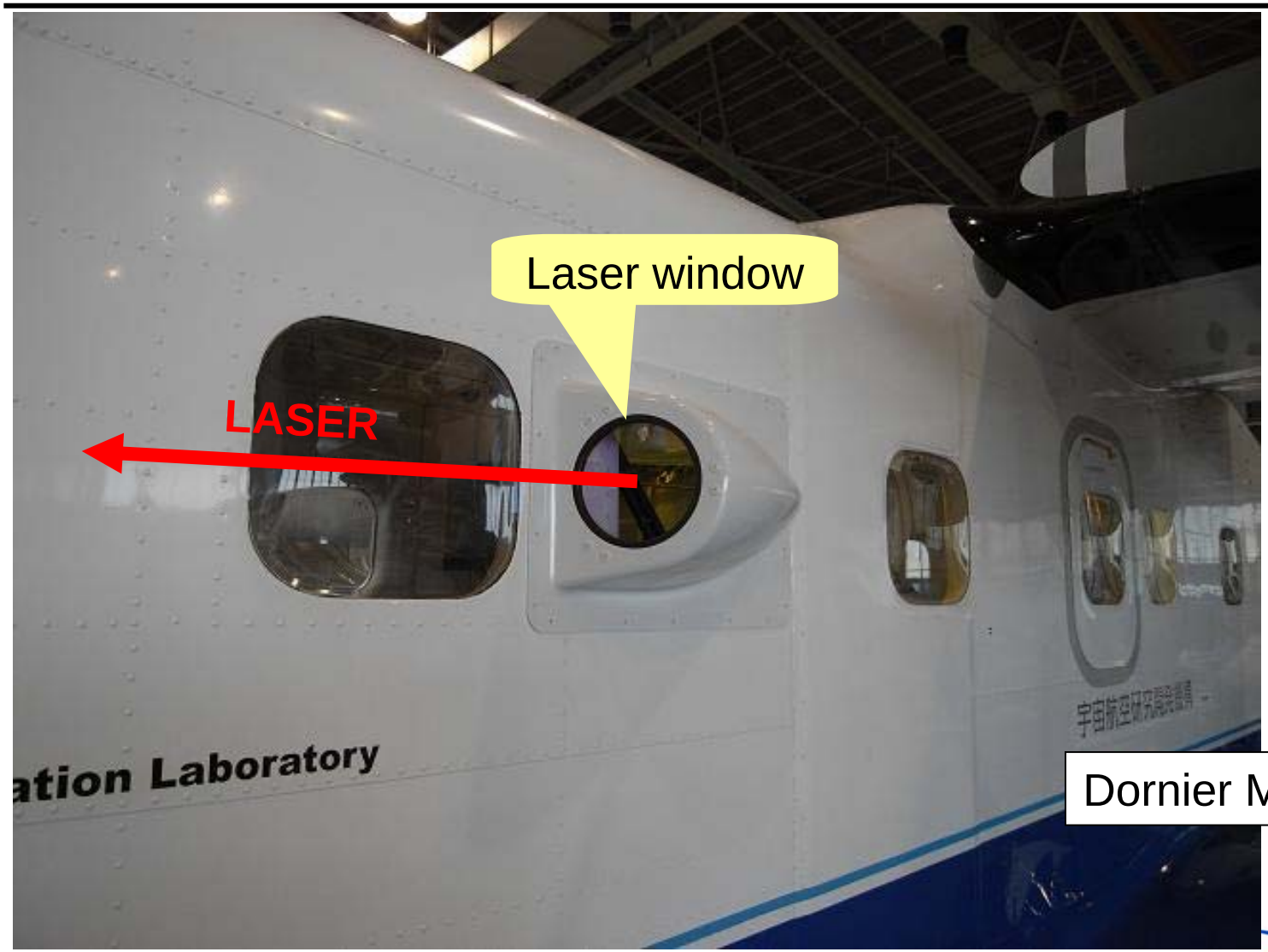
Installation (5NM Model)

2008



Dornier Model 228

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Specifications

	1NM model (2001)	3NM model (2006)	5NM model (2007)
Laser peak power	10 W	90 W	323 W
Laser pulse energy	4.5 μ J	58 μ J	179 μ J
Pulse repetition frequency	50 kHz	4 kHz	4 kHz
Aperture diameter	50 mm	110 mm	110 mm
Power consumption	420 W	306 W	374 W
Weight	105 kg	51 kg	82 kg

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Plans for the Near Future

- Flight demonstration of the 5NM model is planned in March 2009
- Development of a 5NM high altitude model is planned in February 2009
- High altitude demonstration using a jet plane is planned in 2009

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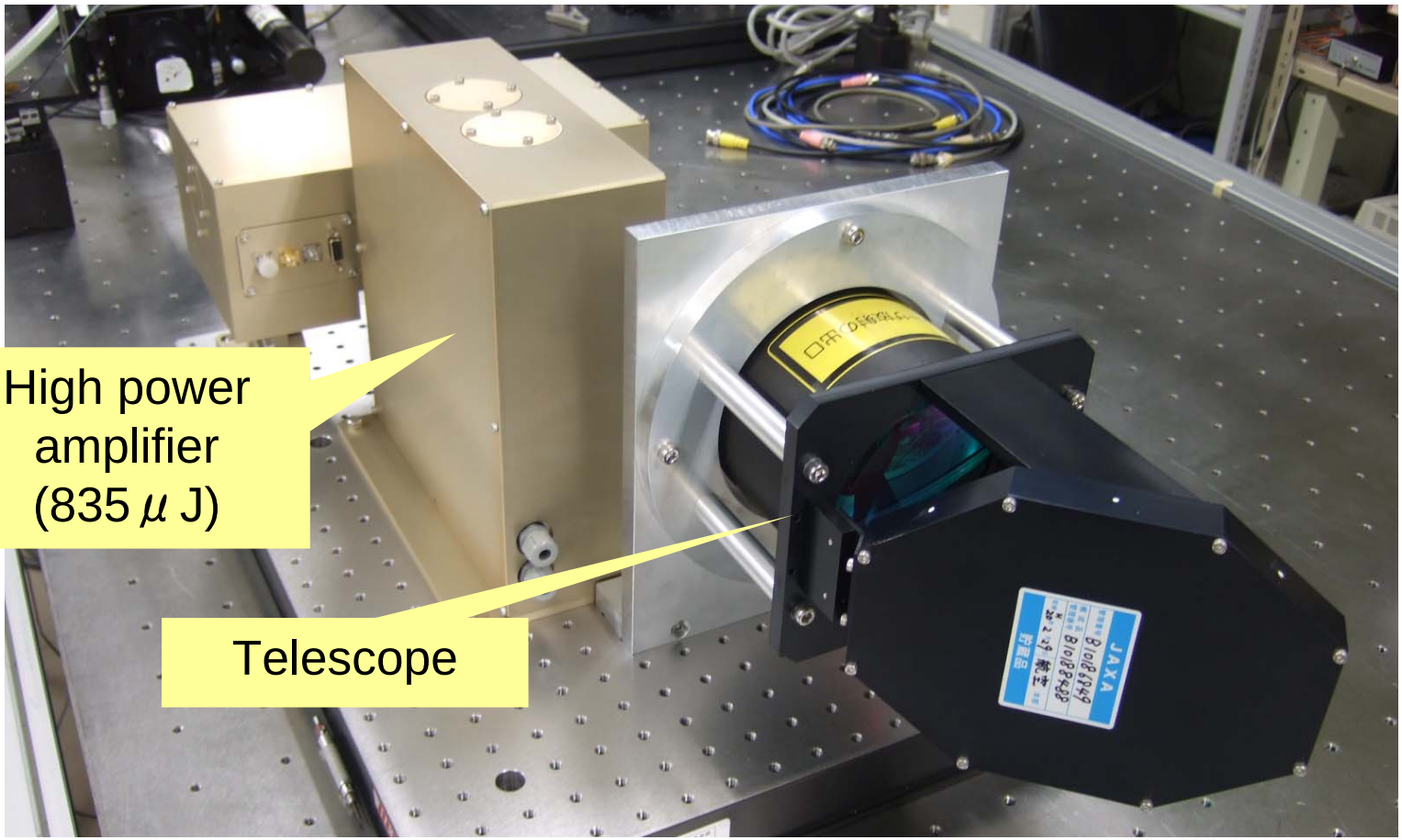
5NM high altitude model

2009



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Summary

- Turbulence accidents are frequent.
- Range of 3NM was demonstrated in flight.
- LIDAR has sufficient accuracy as a sensor.
- Range of 5NM was demonstrated on ground.
- Development of a high altitude model is planned in FY 2008.

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