

# A method of typhoon center estimation using AMSR-E data.

Joint AMSR Science Team Meeting

Sep. 6, 2006

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Japan Aerospace Exploration Agency (JAXA)

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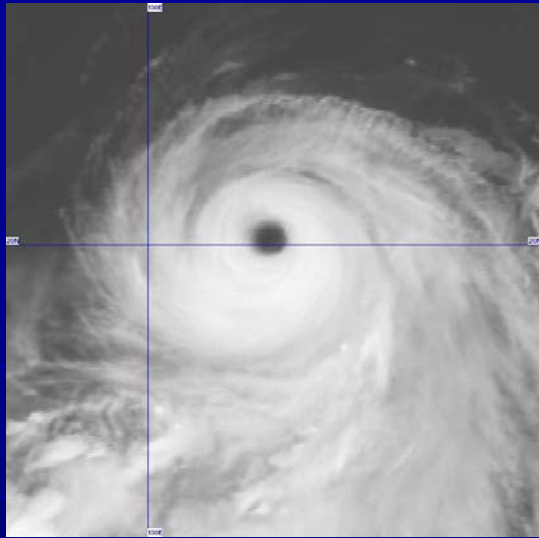
# Contents of the presentation

- About Dvorak technique which is a conventional method to estimate typhoon from satellite imagery.
- About estimation of the center from AMSR-E imagery.
- Accuracy of estimation of the center from AMSR-E imagery.
- Conclusions and acknowledgements.

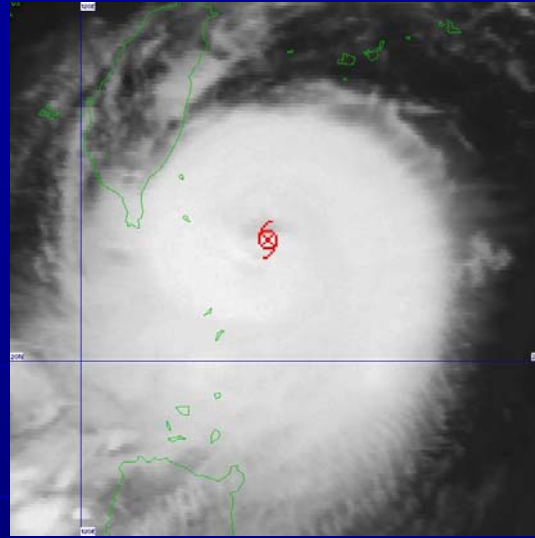
# What is Dvorak technique?

- Use geostationary satellite imagery (Visible and infrared).
- Pattern recognition of the typhoon cloud system.
- It can estimate both the center and typhoon intensity (Today I won't mention typhoon intensity.)

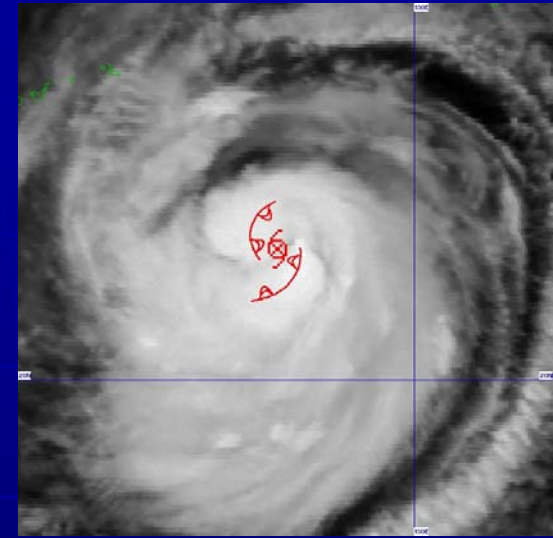
# Typhoon cloud system patterns (infrared image)



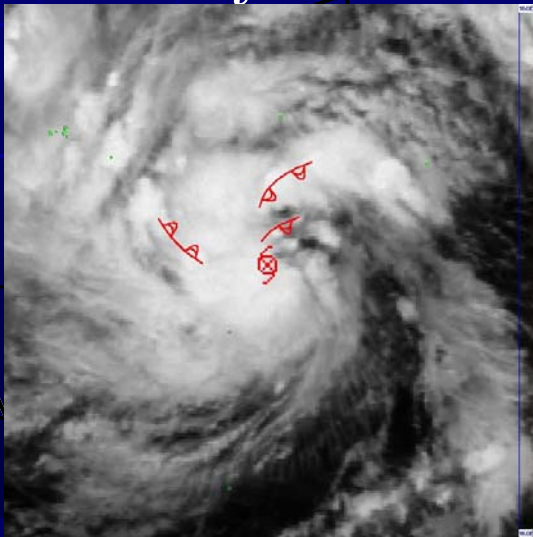
Eye



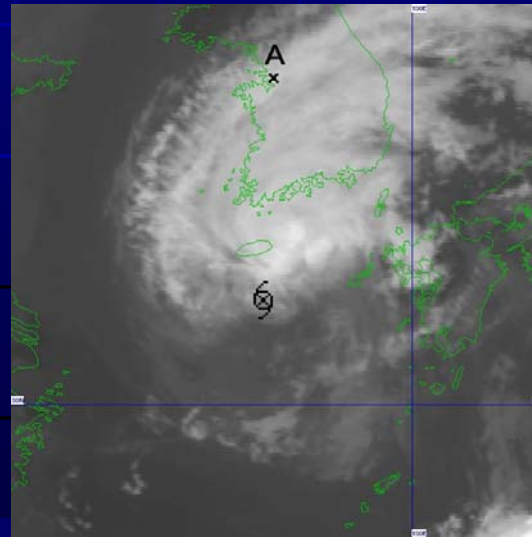
Central Dense Overcast



Cloud Band

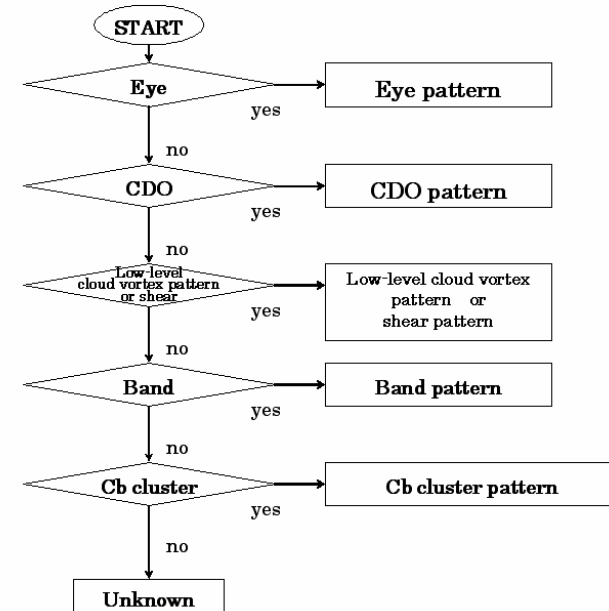


Cb cluster

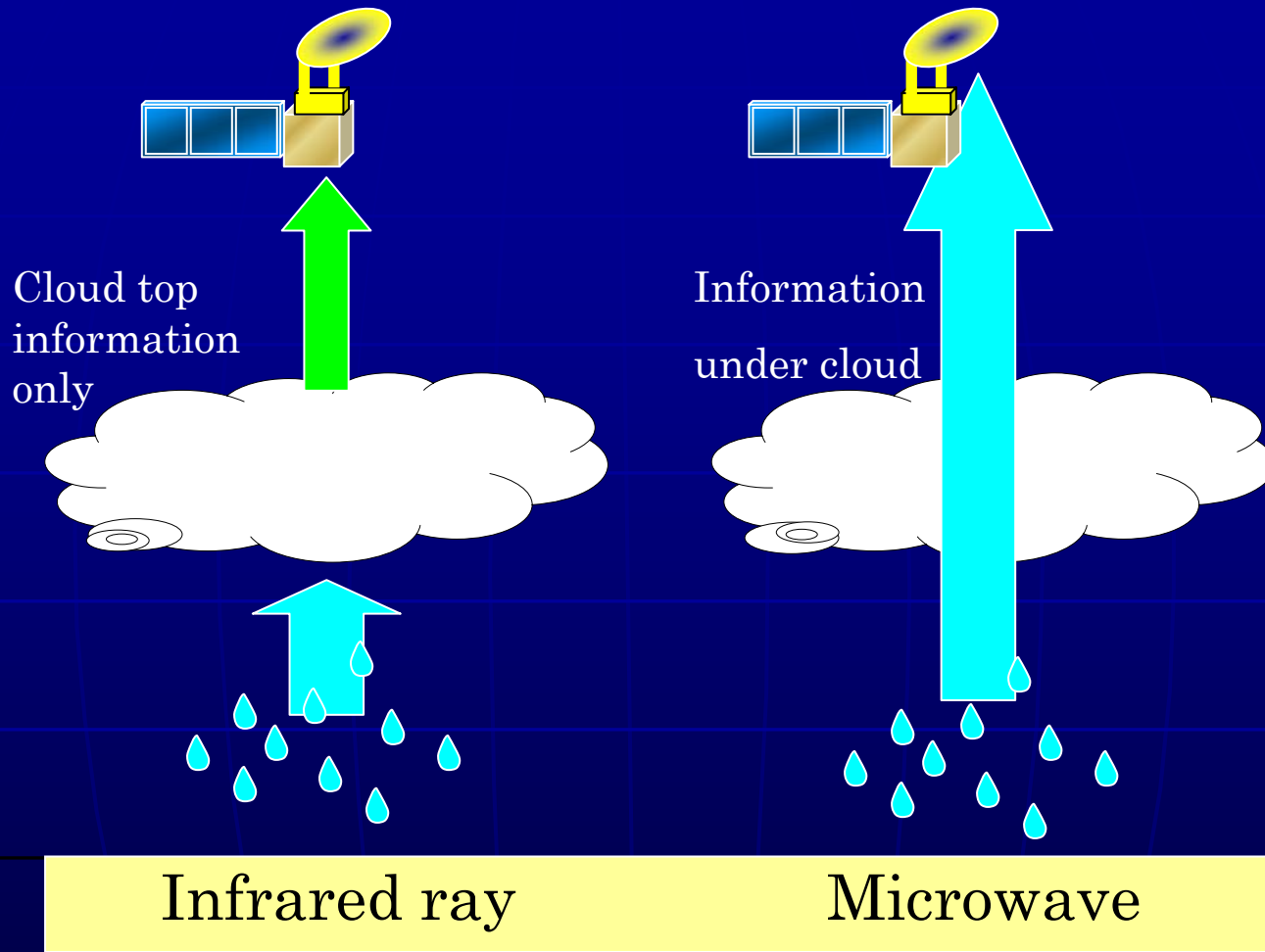


Shear

Flowchart for determination of cloud patterns



# Difference between infrared and microwave imagery.

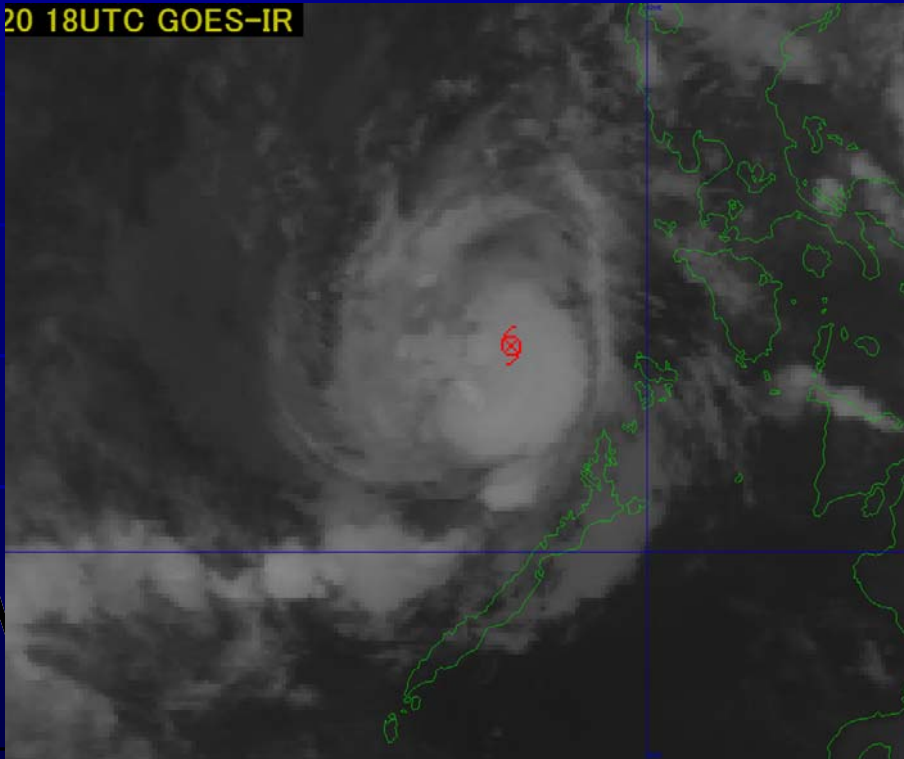


Microwave imagery can show active convective clouds mainly.

An example of AMSR-E estimation is easier than infrared estimation.

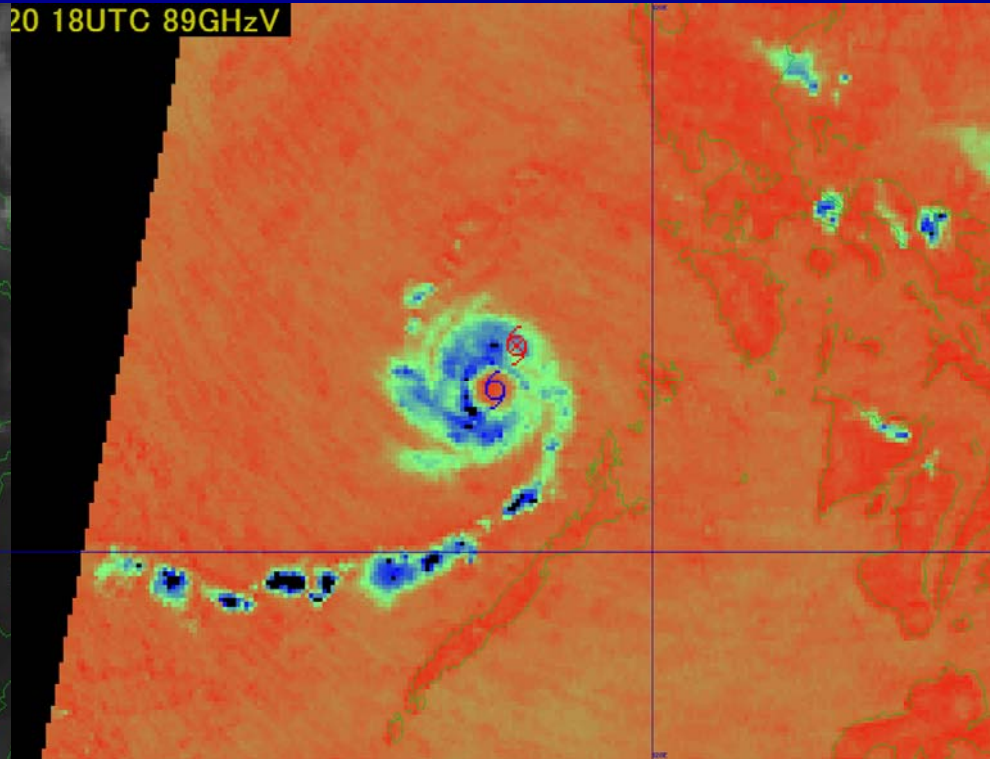
Nov.20, 2004 18UTC Typhoon 0425, Muifa

20 18UTC GOES-IR



GOES-9 Infrared Image

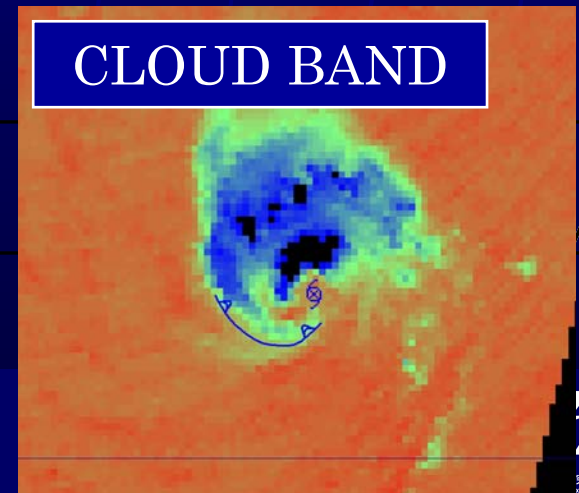
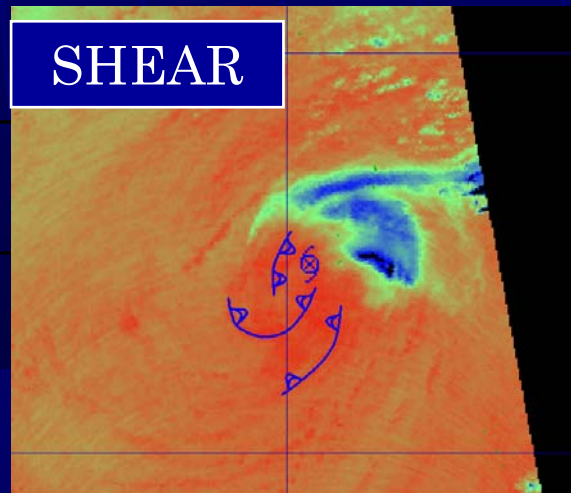
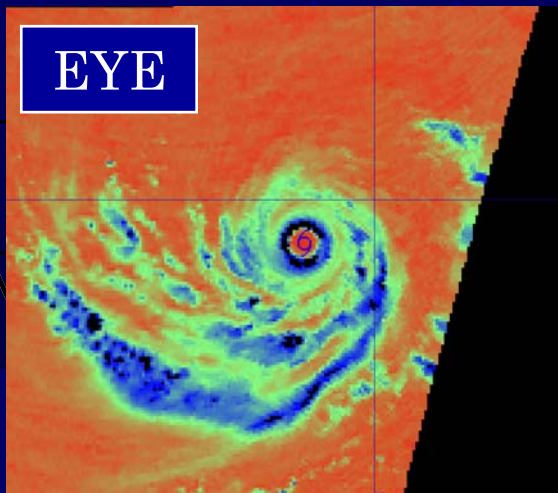
20 18UTC 89GHzV



AMSR-E 89GHz-V Image

# How to estimate the center from AMSR-E imagery

- Use AMSR-E 36GHz-V and 89GHz-V TB imagery
- Like Dvorak technique, fix cloud system pattern from 3 patterns (below images).
- Estimate location of center of typhoon.



# Pattern classification procedure (abstract)

START

## SHEAR pattern

Does it have high brightness temperature (TB) cloud lines which suggest the center in 89GHz Imagery?

or

Does it have high TB cloud lines which suggest the center In 36GHz imagery?

and

In 89GHz imagery (**Precondition**)

Is the center at the position that comes off from the outside of the cloud system of typhoon or the center of the cloud area?

no

## EYE pattern

Is High TB area (center) enclosed with low TB ring in 89GHz imagery?

or

Is Low TB area (center) enclosed with high TB ring in 36GHz imagery?

•You may not completely shut the ring If it is 0.5 times or more.

no

## CLOUD BAND pattern

When not applying to any the above-mentioned, the center is estimated from the shapes of convective clouds.

When it isn't possible to take it even with BAND, the estimation from microwave imagery is abandoned. (unknown)

Have no relation to the patterns for visible and infrared imagery.

Pattern distinction standard is also different from that of visible and infrared method.

How to estimate the center in shear pattern.

In microwave image that became grounds of shear selection, estimate center of typhoon from the curvatures of cloud lines which are expressed at a high TB.

It also refers to the position when 36 GHz imagery has an EYE area with the ring insufficient.

•It is noted that it is not the cloud lines expressed at low TB in 89GHz imagery.

How to estimate the center in EYE pattern

First, estimate the center from 89GHz imagery and refine it from 36 GHz imagery.

The center location is at center of high TB EYE in 89GHz imagery and low TB EYE in 36GHz imagery.

•In EYE pattern, the priority level by estimation from 36GHz imagery is high.

•If the ring is imperfection and identification of EYE is difficult, the center is estimated not at the center of EYE but at the ending point of rolling of the ring.

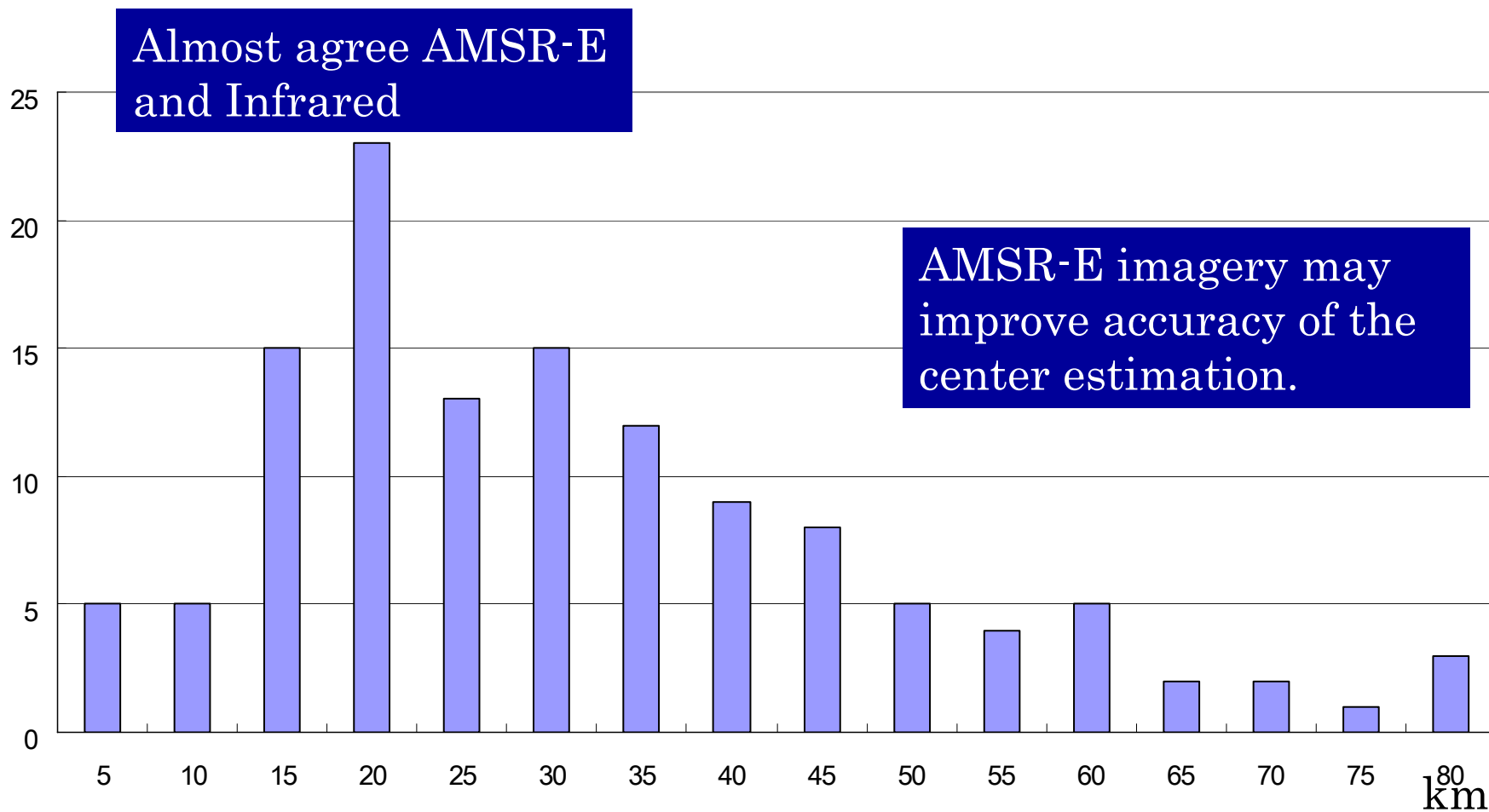


Accuracy of the center estimated from AMSR-E imagery against radar observation.

Year	2004-2005
Number of cases	22
Mean error	12.9 [km]
Standard deviation	7.0 [km]
Max error	28.1 [km]

The center estimated from AMSR-E imagery has almost as accurate as the center observed by radar.

# Histogram of the distance between infrared estimation and AMSR-E estimation.



Year 2004-2005 137cases

# Conclusion

- AMSR-E estimations have almost as accurate as radar observation.
- Some AMSR-E estimations are more accurate than that of infrared estimations.

Complementarily use for microwave and infrared estimation is necessary.

# Acknowledgements

In this research, Mr. Kouji Kato at System Engineering Division, Meteorological Satellite Center advised me and offered some data.

Everyone of Analysis Division, Meteorological Satellite Center also advised and offered the text of Dvorak technique.

I'd like to express special thanks to them very much.

End

# Percentage of typhoon with Eye

Imagery type	Rate of Eye pattern(%)
Infrared	31
AMSR-E	<u>58</u>

Sample year 2004-2005

Infrared image : 2996 cases

AMSR-E image : 382 cases

In this research, more than 50% typhoons are judged to have Eye from AMSR-E images.

# Appearance rate of cloud pattern

Cloud pattern	Number of appearance	Appearance rate(%)
SHEAR	62	16
EYE	221	<u>58</u>
BAND	56	15
unknown	43	11

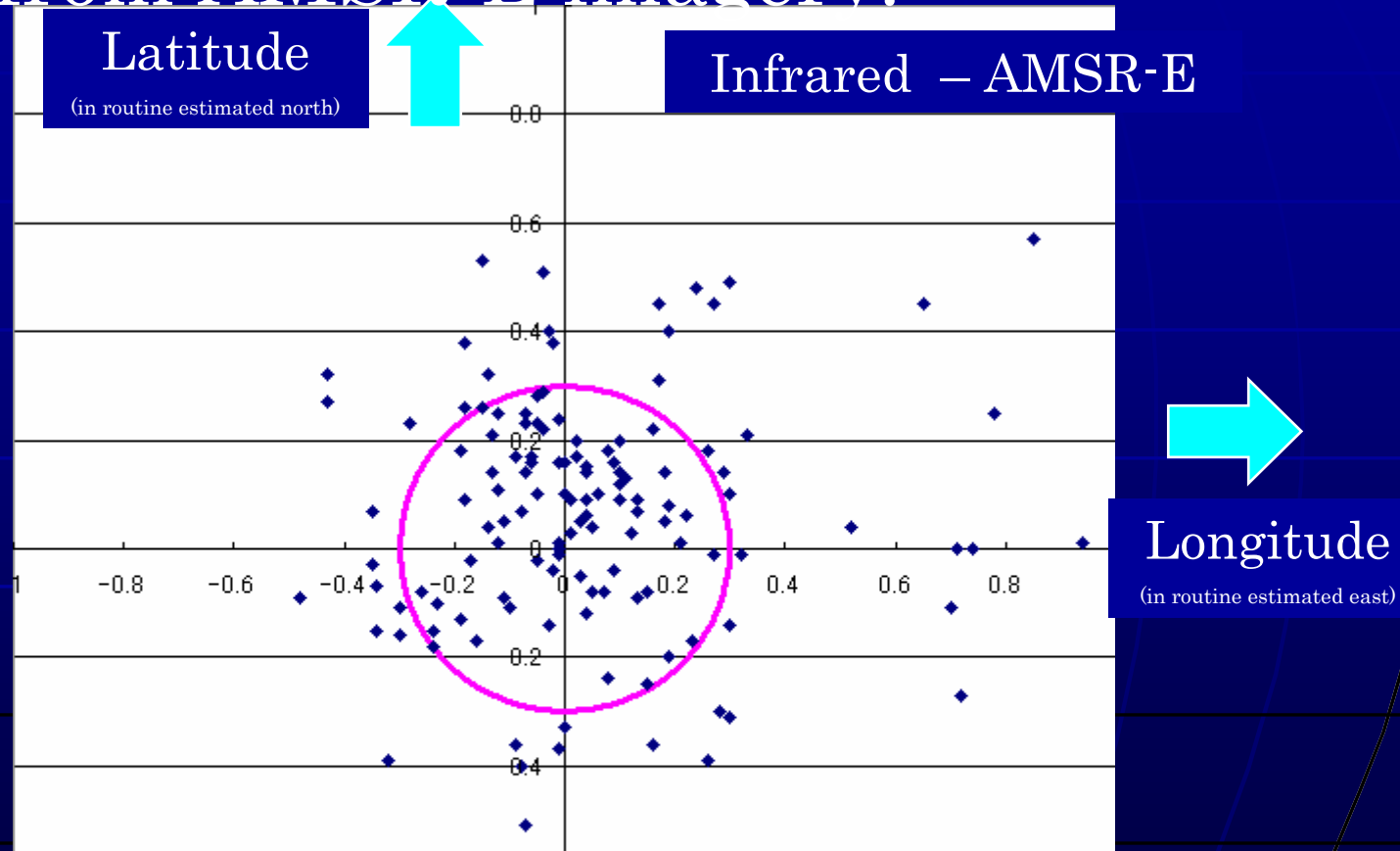
2004-2005

# Appearance rate (infrared image)

Pattern	Number of appearance	Appearance rate(%)
Unknown	17	0.6
Unorganized CB Cluster	75	2.5
Organized CB Cluster	241	8.0
Curved Band	1168	39.0
Shear or LCV	432	14.4
Banding Eye	331	11.0
Indistinct CDO	77	2.6
Distinct CDO	49	1.6
Ragged Eye	428	14.3
Distinct Small Eye	71	2.4
Distinct Large Eye	107	3.6



A scatter plot of the center location difference between estimated from infrared imagery and estimated from AMSR-E imagery.



In most cases difference is less 0.3 deg (106cases) but in 31 cases difference is over 0.3deg.