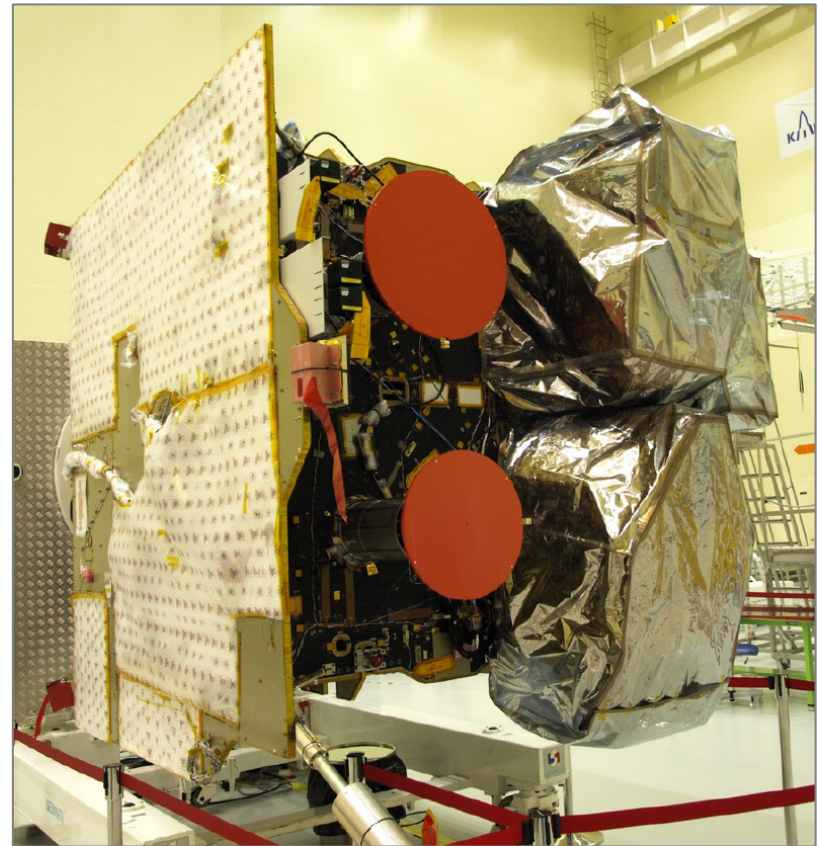# Determining optimal conditions for meso-scale AMV

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## Current status of KMA AMV

Korea plans to launch our first meteorological imager
   at April THIS YEAR (Wish us luck!!)

It has four IR and one VIS channel
   : central wavelengths are almost
     same with MTSAT

We've developed AMV algorithm with MTSAT data
   :   results are comparable to GTS AMVs
       (in accuracy and impact to forecast)
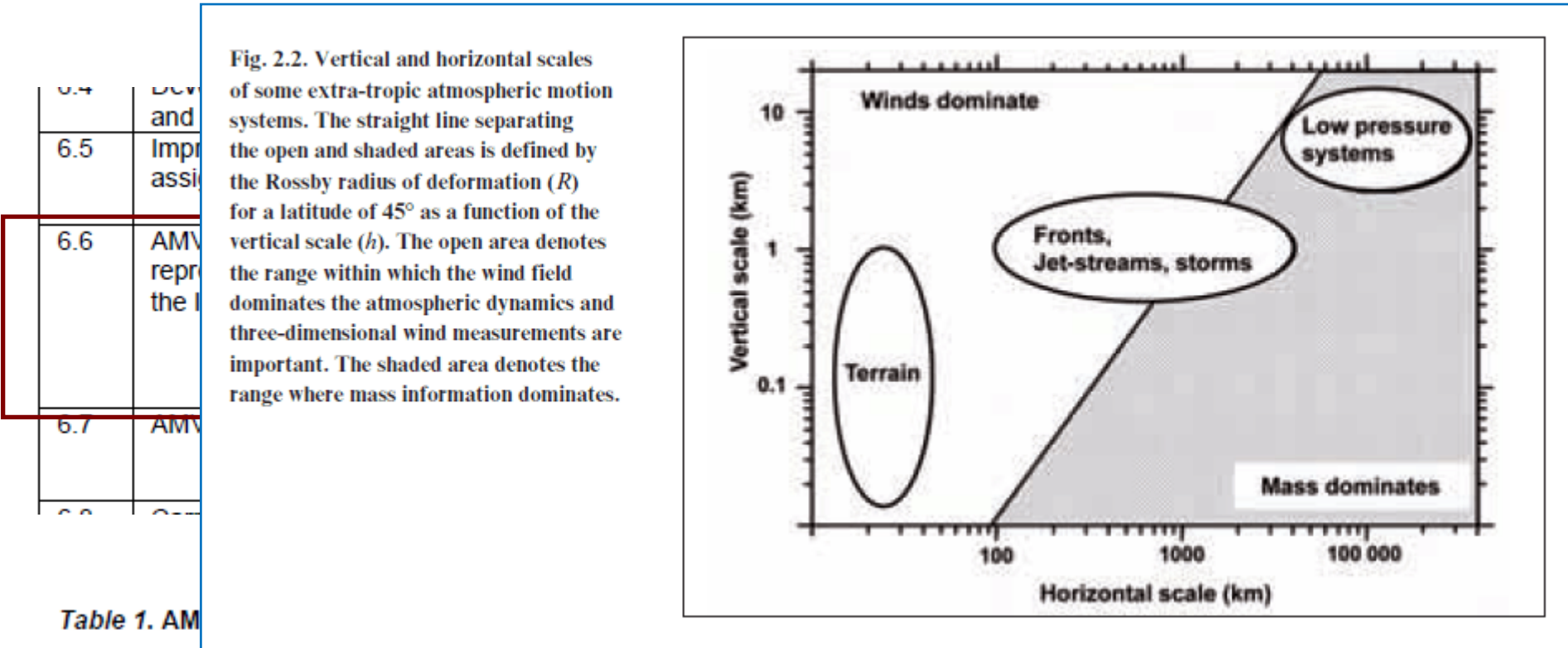
# Attempts to observe smaller scale winds



Fig. 2.2. Vertical and horizontal scales of some extra-tropic atmospheric motion systems. The straight line separating the open and shaded areas is defined by the Rossby radius of deformation ($R$) for a latitude of 45° as a function of the vertical scale ($h$). The open area denotes the range within which the wind field dominates the atmospheric dynamics and three-dimensional wind measurements are important. The shaded area denotes the range where mass information dominates.

Table 1. AM

Genkova, proceedings of 9th IWW workshop

| AMV Producer | EUMESAT | CIMSS/NESDIS | Brazil | JMA | KMA |
|---|---|---|---|---|---|
| Steps subsequence | target, track, height assign. | target, height assign., track | target, track, height assign. | target, track, height assign | target, track, height assign. |
| Target box | 24x24 pix | 15x15 pix | 32x32 pix | 32x32 pix | 32x32 pix |
| Search box | 80x80 pix | 21x37 pix | 50x50 pix | 64x64 pix | 64x64 pix |
| Target | no threshold | 7 bright units | no threshold | no threshold | 5 Kelvin |

~72 km    ~60 km    ~128 km

## What controls SCALE of AMV ?

1. time interval of images
   - 15 minutes
   - 30 minutes

2. horizontal resolution of image
   - 4 km ( IR channels )
   - 1 km ( HR-Visible channel )

3. target size
   - 128 to 16 km

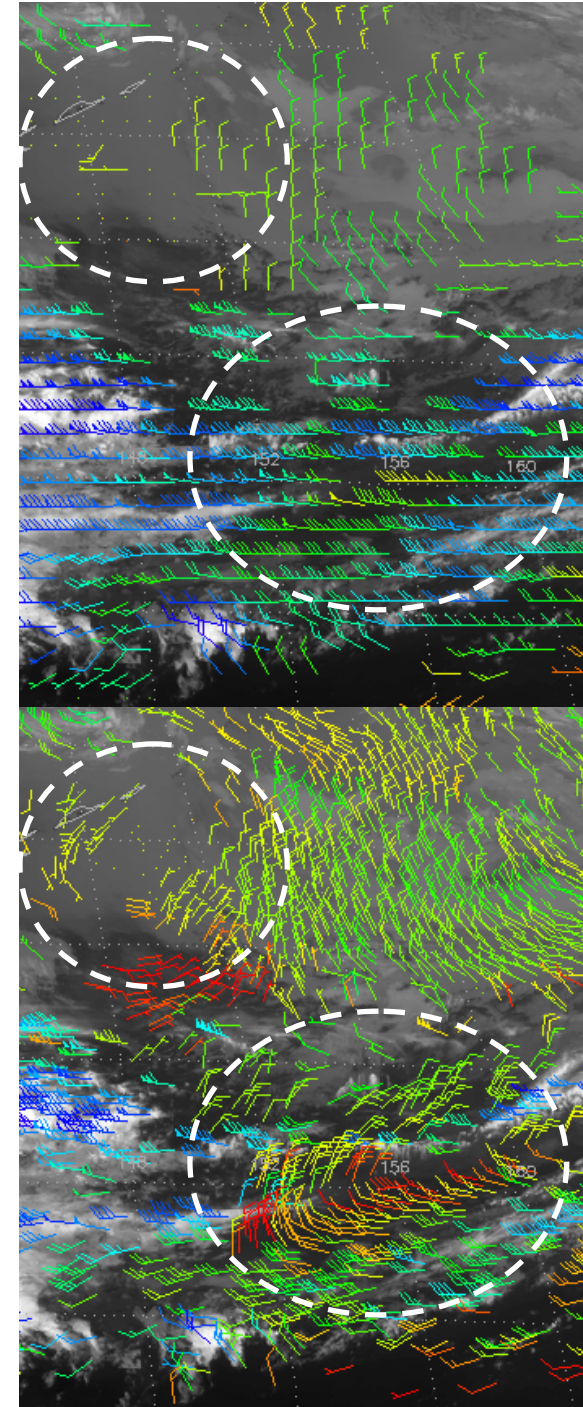4. scale of NWP
   - larger than 35 km (UM/KMA)

Genkova, proceedings of 9th IWW

Table 1. AMV retrieval schemes specifics

| AMV Producer | EUMESAT | CIMSS/NESDIS | Brazil | JMA | KMA |
|---|---|---|---|---|---|
| Steps subsequence | ~72 km | ~60 km | ~128 km | | |
| Target box | 24x24 pix | 15x15 pix | 32x32 pix | 32x32 pix | 32x32 pix |
| Search box | 80x80 pix | 21x37 pix | 50x50 pix | 64x64 pix | 64x64 pix |
| Target | no threshold | 7 bright_units | no threshold | no threshold | 5 Kelvin |

size of TARGET:

128

km ?

# reducing Target Size
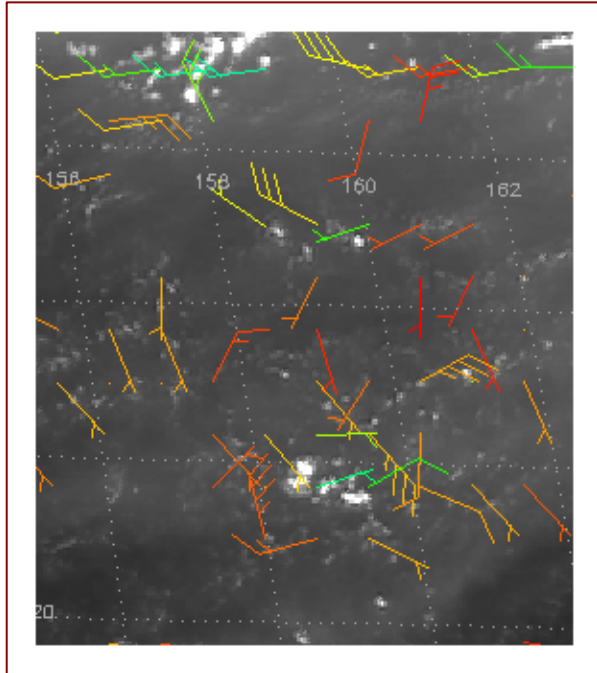


Image1  Image2

**size of target:  64 × 64  km²**
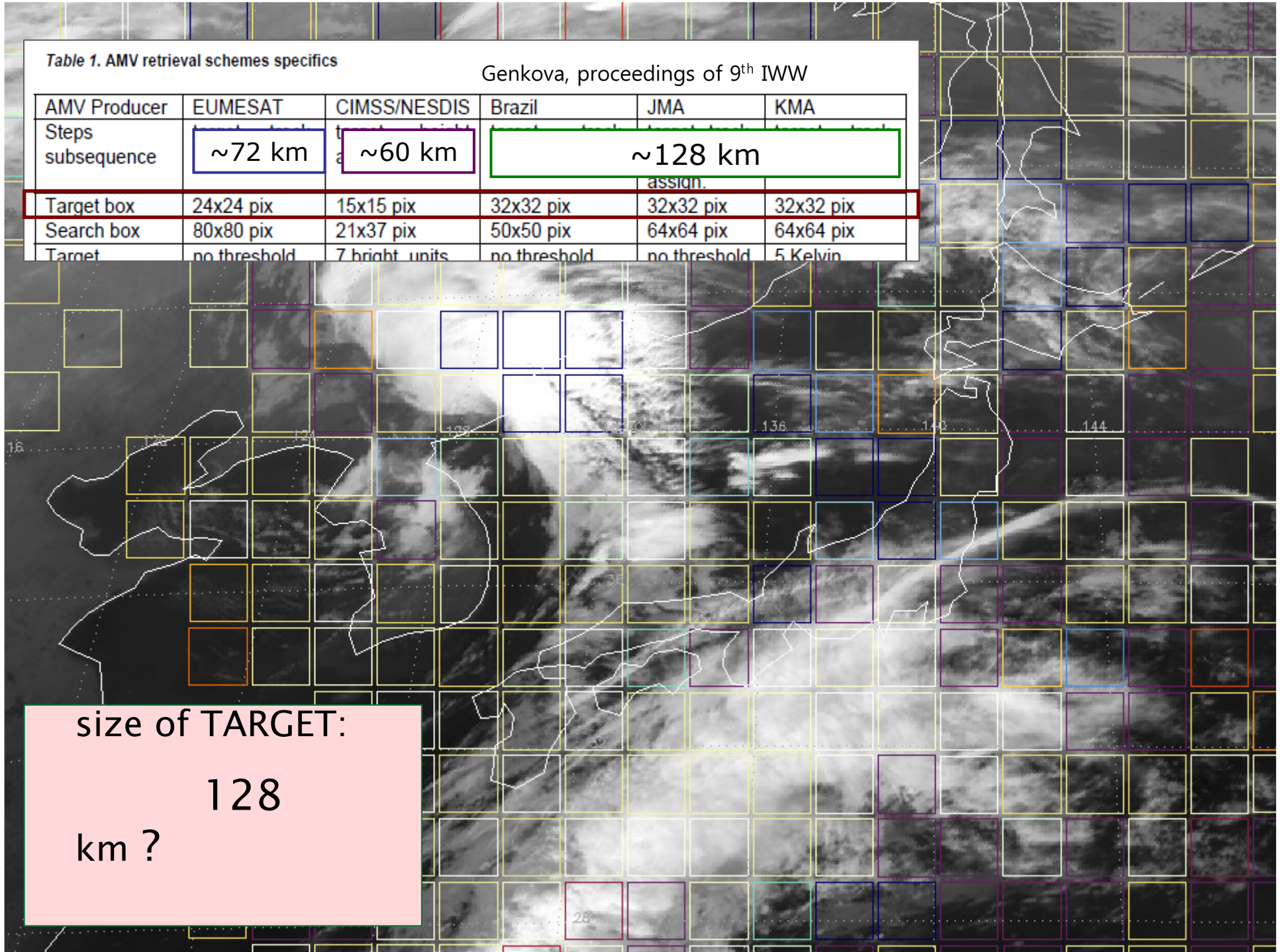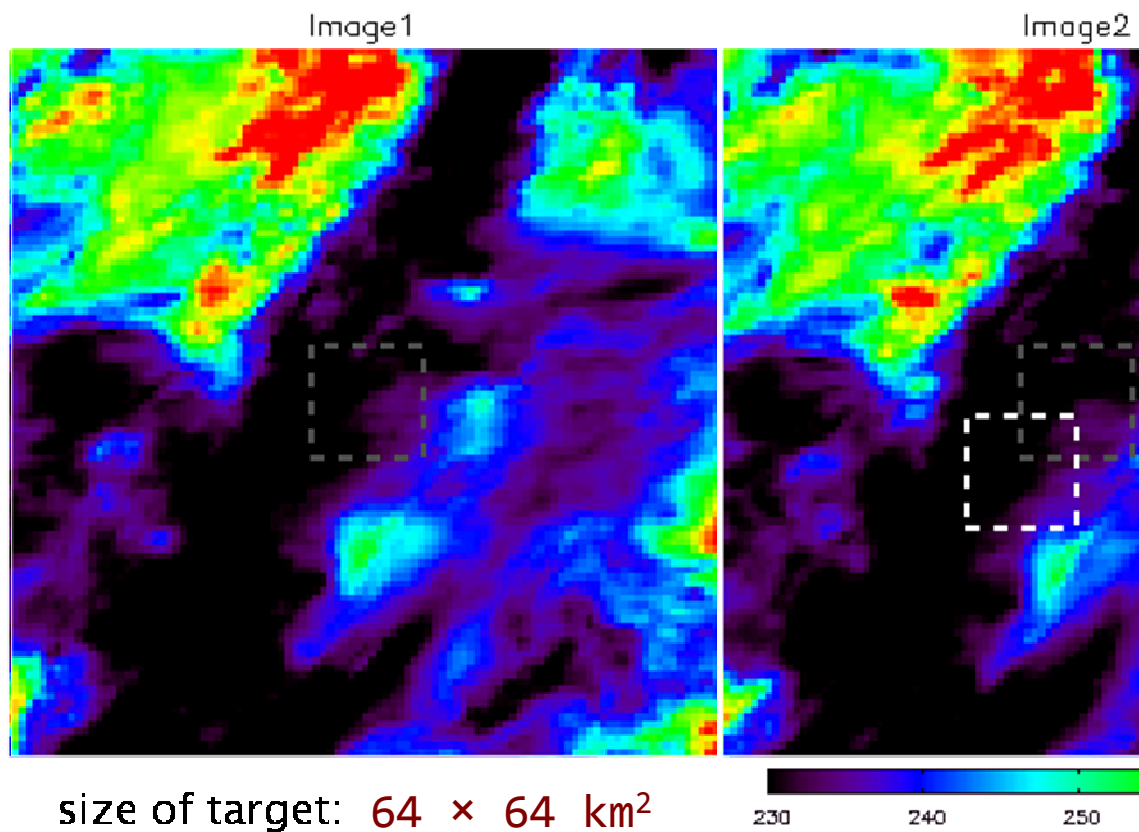
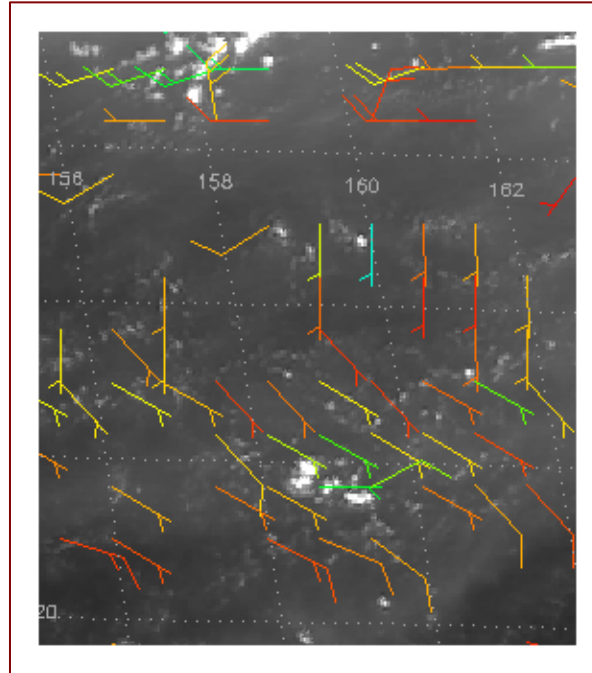128 × 128  km²
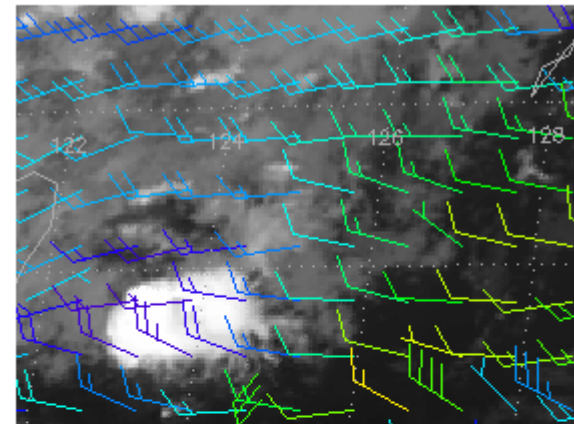
64 × 64  km²
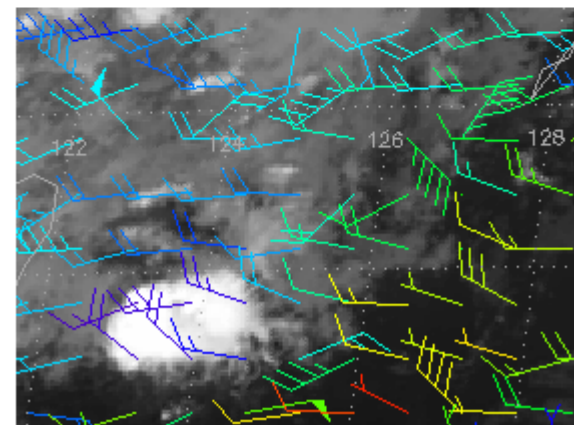
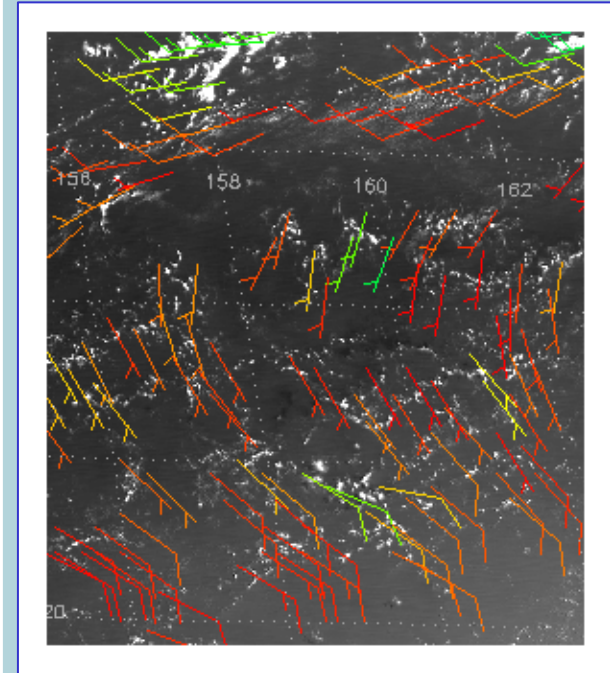solution : Time Interval between images ?

30 minutes

15 minutes

15 minutes

IRW-channel : res.=4 km

HRV-channel : res.=1 km

| time interval | Wind speed *corresponding* one pixel displacement |
|---|---|
| 30 min. | 2.2 ms⁻¹ |
| 15 min. | 4.4 ms⁻¹ |

| time interval | Wind speed *corresponding* one pixel displacement |
|---|---|
| 30 min. | 0.6 ms⁻¹ |
| 15 min. | 1.1 ms⁻¹ |

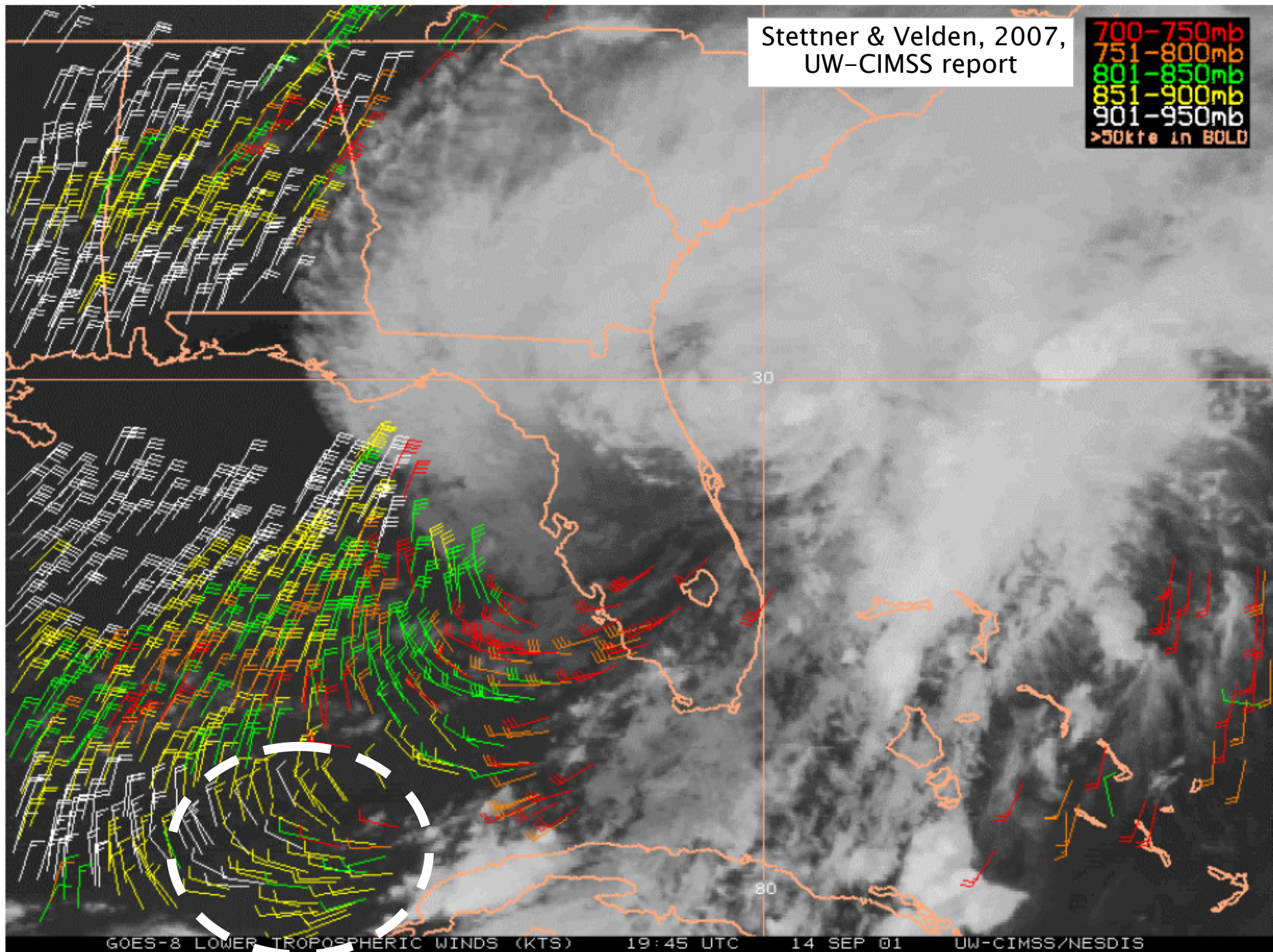solution : Sub-pixel determination of target displacement ?
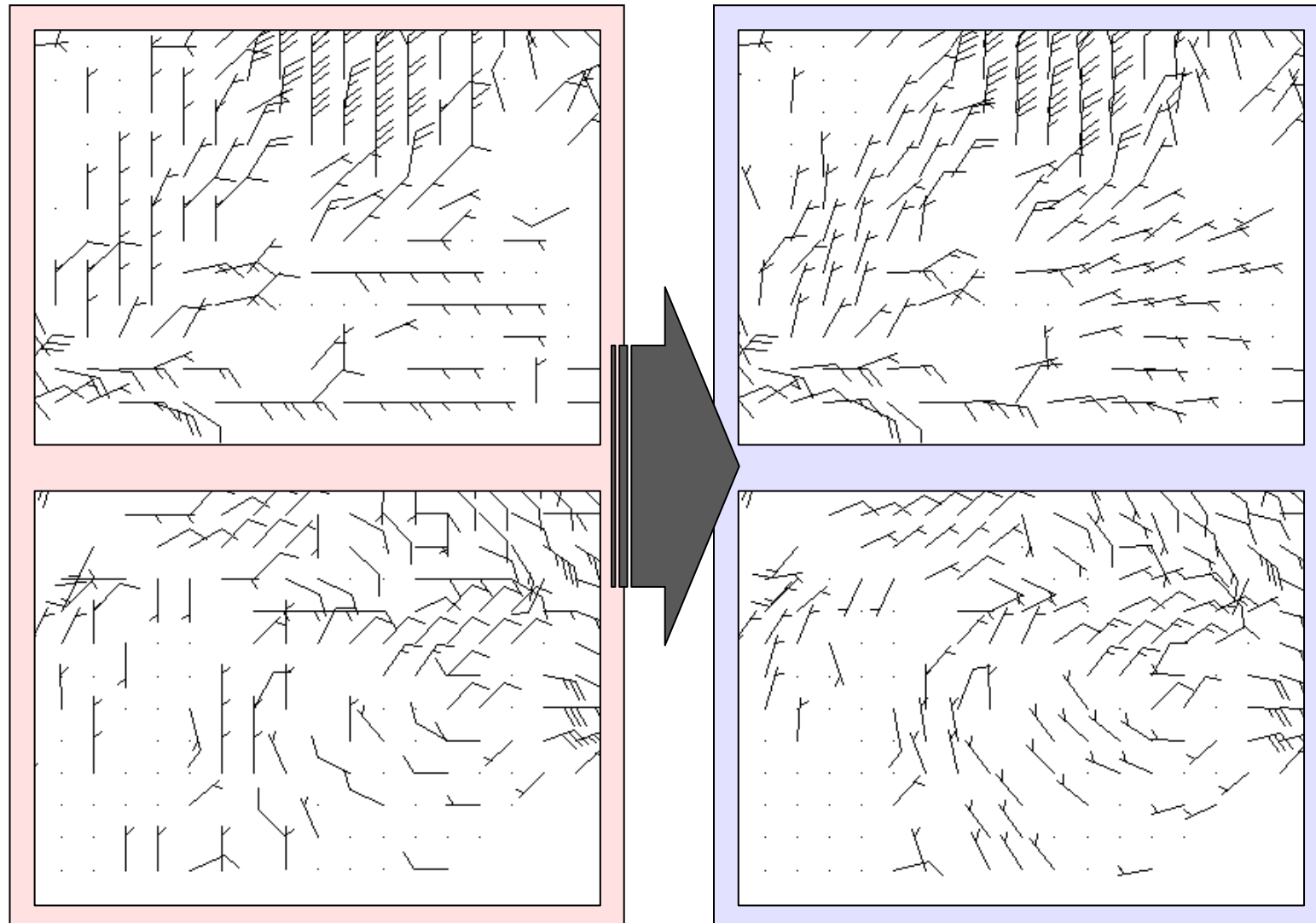
*Figure 3:* Lower troposphere rapid scan AMVs around Tropical Storm Gabrielle, 14 September, 2001.

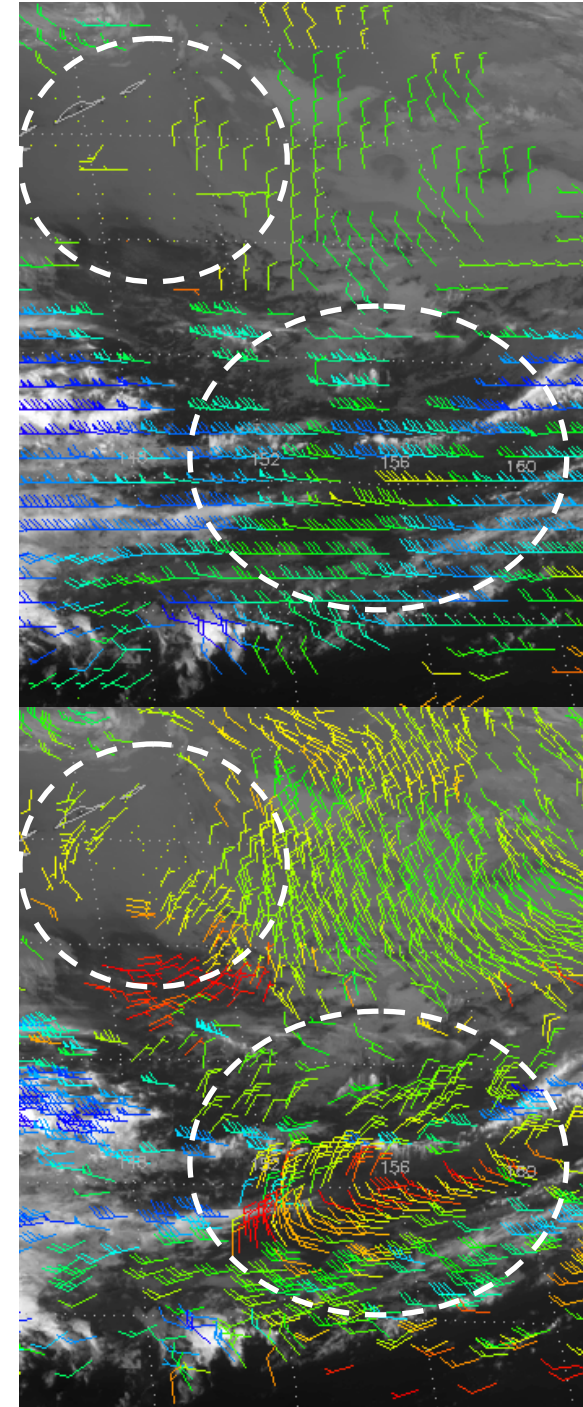What controls SCALE of AMV ?

*assuming we can ignore the effects of*

  2. horizontal resolution of image

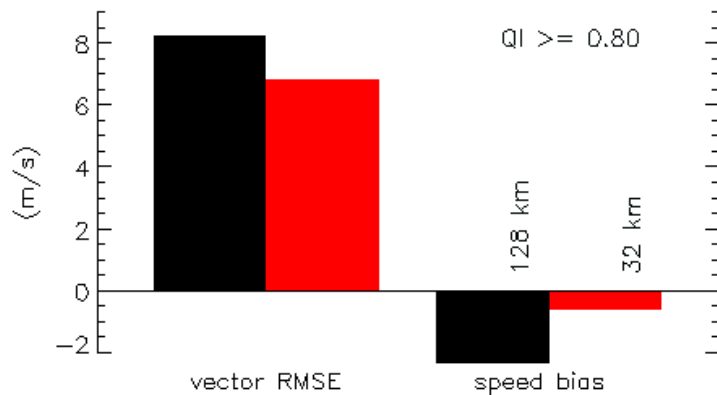  4. scale of NWP

*can we determine the OPTIMAL*

3. target size

     – 128 to 16 km

*for GIVEN*

1. time interval of images
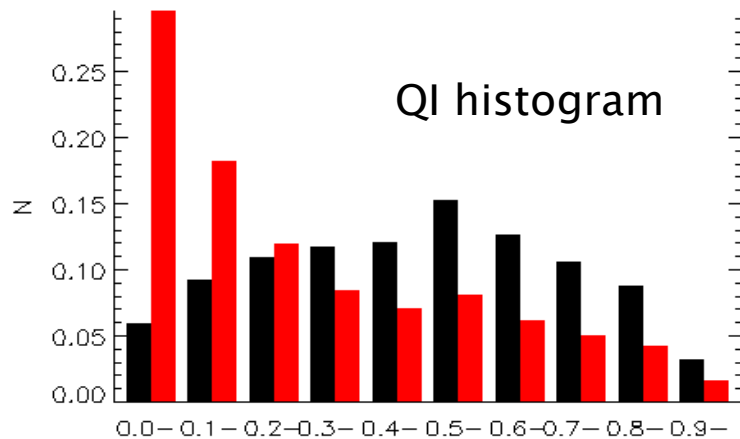
     – 15 minutes

     – 30 minutes

*determining* OPTIMAL target size

*for given* time interval of images

QI >= 0.80

⟨m/s⟩

vector RMSE    speed bias

128 km    32 km

QI histogram

N

0.0— 0.1— 0.2—0.3— 0.4— 0.5— 0.6—0.7—0.8— 0.9—

ACCURACY (to Rawinsonde)
  data : IRW (10.8μm)  AMV
  period : 17 Oct – 10 Nov 2009
  filters :
      horizontal dist < 150 km
      vertical dist < 25 hPa
      quality >= 0.8
      speed diff. < 30 m/s
      dir. diff. < 90 degree

QI (Quality Indicator) Histogram

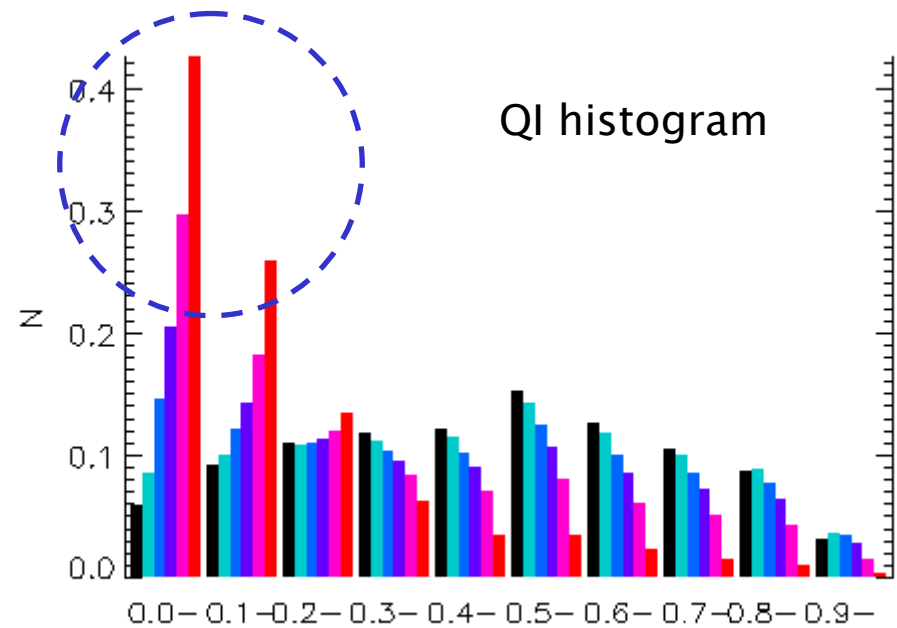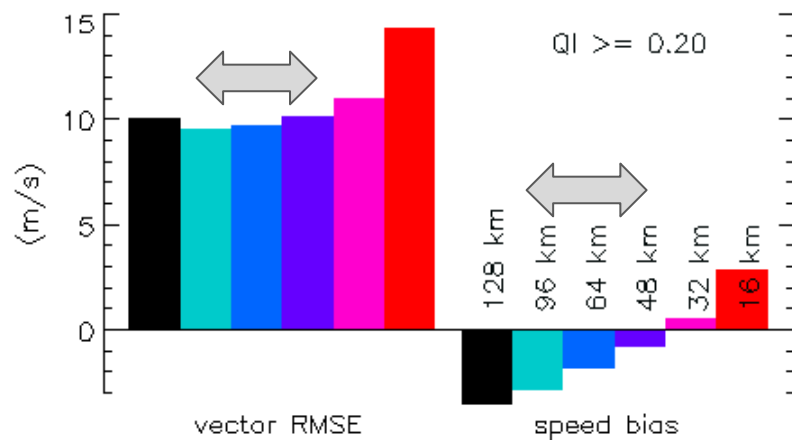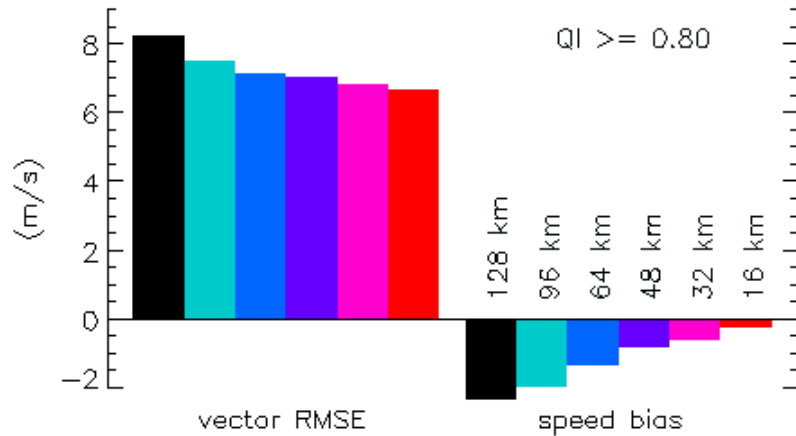  period : (same)
  filter : (none)

  x-axis : QI
  y-axis : number density

must consider
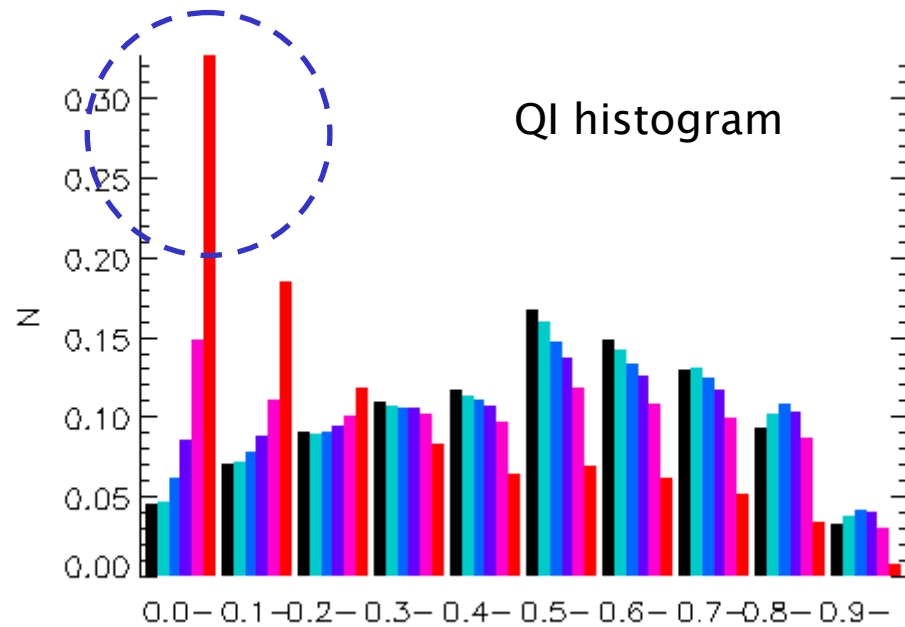not only ACCURACY
**also QUALITY**

168    172
target: 128 km
interval: 30 min.

168    172
target: 32 km
interval: 30 min.
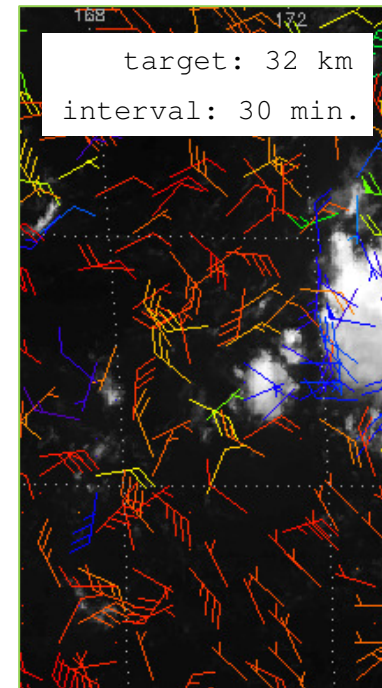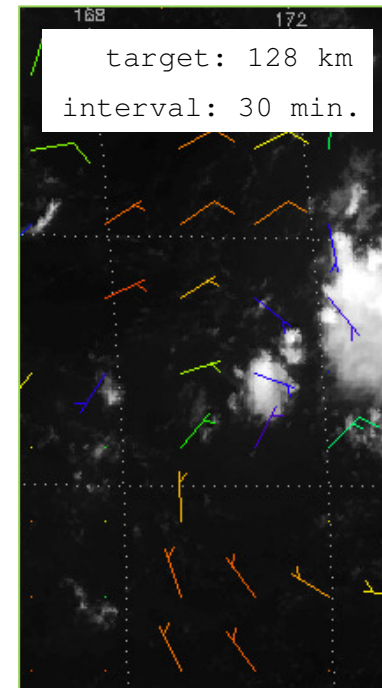
time interval of images: 30 minutes



QI >= 0.80

QI >= 0.20

QI histogram

time interval of images: 15 minutes

17oct-10nov 2009
IRW (10.8µm)  AMV

|  | 30 min. | 15 min. |
|---|---|---|
| IRW (4 km) | 96~48 km | 32 km |
| HRV (1 km) | 64 km | 64~32 km |

QI histogram
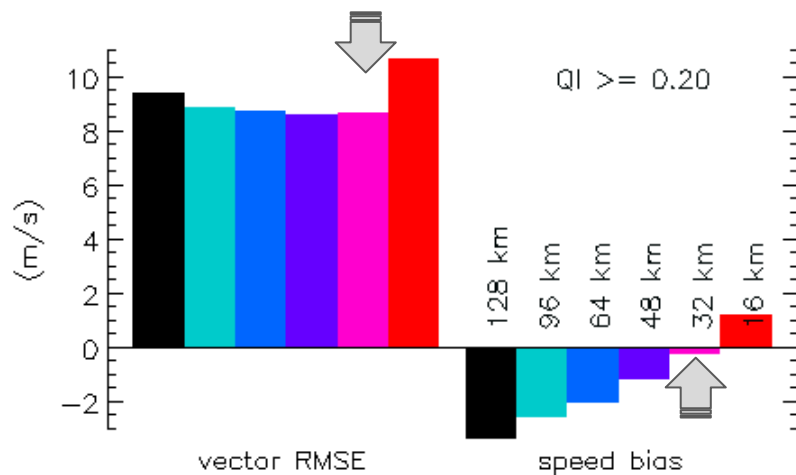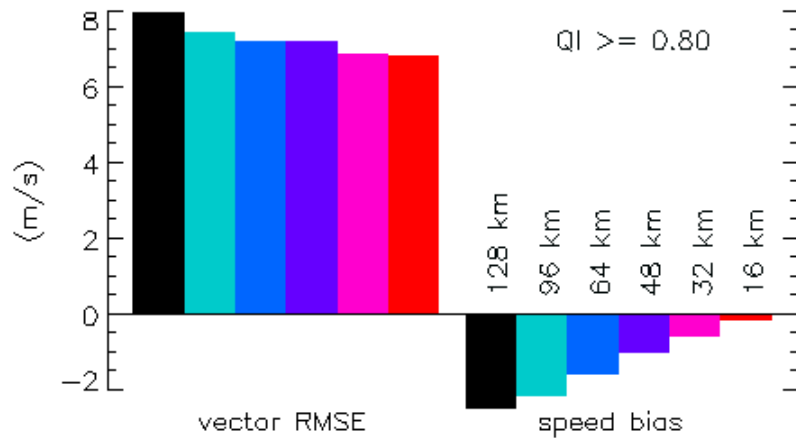
## CONCLUSION

◆ reducing Target Size

⇒ more tracking errors

◆ shorter time interval between images

⇒ precision problem

◆ sub-pixel determination

of target displacement

|              | 30 min.    | 15 min.    |
| ------------ | ---------- | ---------- |
| IRW (4 km)   | 96~48 km   | 32 km      |
| HRV (1 km)   | 64 km      | 64~32 km   |

– Optimal target size varies with time interval of images

– It is determined mainly by time interval, not image resolution

– For AMV whose time scale is more than 15 minutes

  target size is a matter of PHYSICAL scale of cloud deformation

  NOT the number of pixels within target

## DISCUSSION

◆ Rapid scan AMV

– optimal target must be smaller than 30 km

– for that scale, 4km resolution image might be a problem

(1) precision can be poorer than tens of m/s

(2) number of pixels is too few (in sense of corr. calculation)

– optimum can be determined also by dynamic range of cloud

◆ After the MTSAT-1R will be changed to rapid scan mode …