Study of relationship of time intervals and target box sizes for rapid-scan Atmospheric Motion Vector computation

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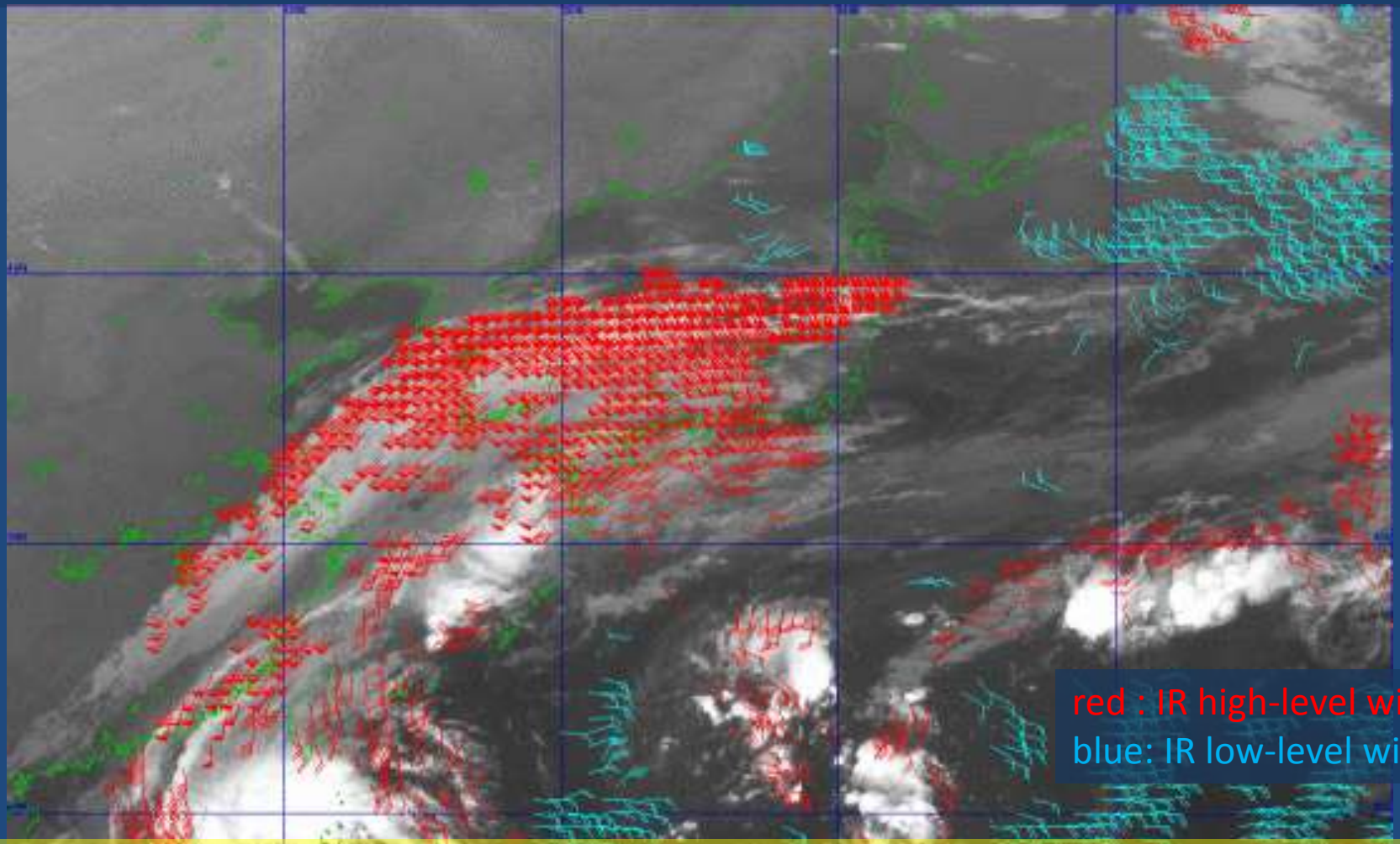
Motivation of this study

1. Fine spatial and time resolution of AMV product is needed for NWP assimilation.

2. JMA/MSC plans to produce AMV with high time and fine space resolution from the Japanese follow-on satellite Himawari-8.

3. For generating high-resolution AMV from Himawari-8, Relationship of target box size (correspond to space scale of meteorological phenomena) and time intervals of imagery (correspond to time scale) should be studied.

Introduction to Atmospheric Motion Vector

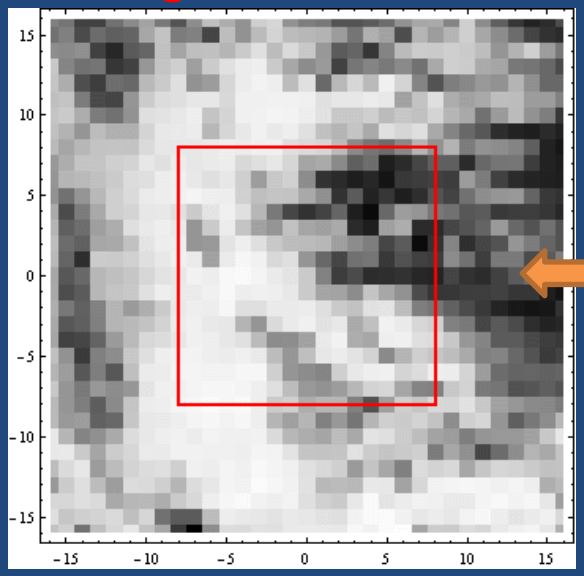


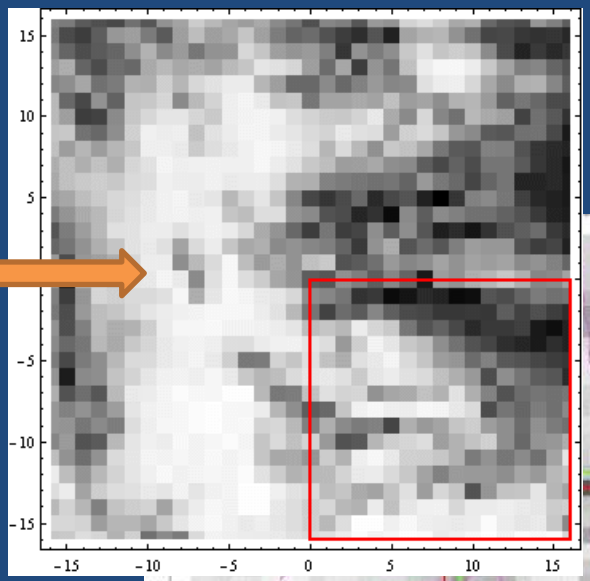
- ***Atmospheric Motion Vector products is derived from successive satellite imagery***
- ***Wind vectors are routinely utilized for NWP assimilation***

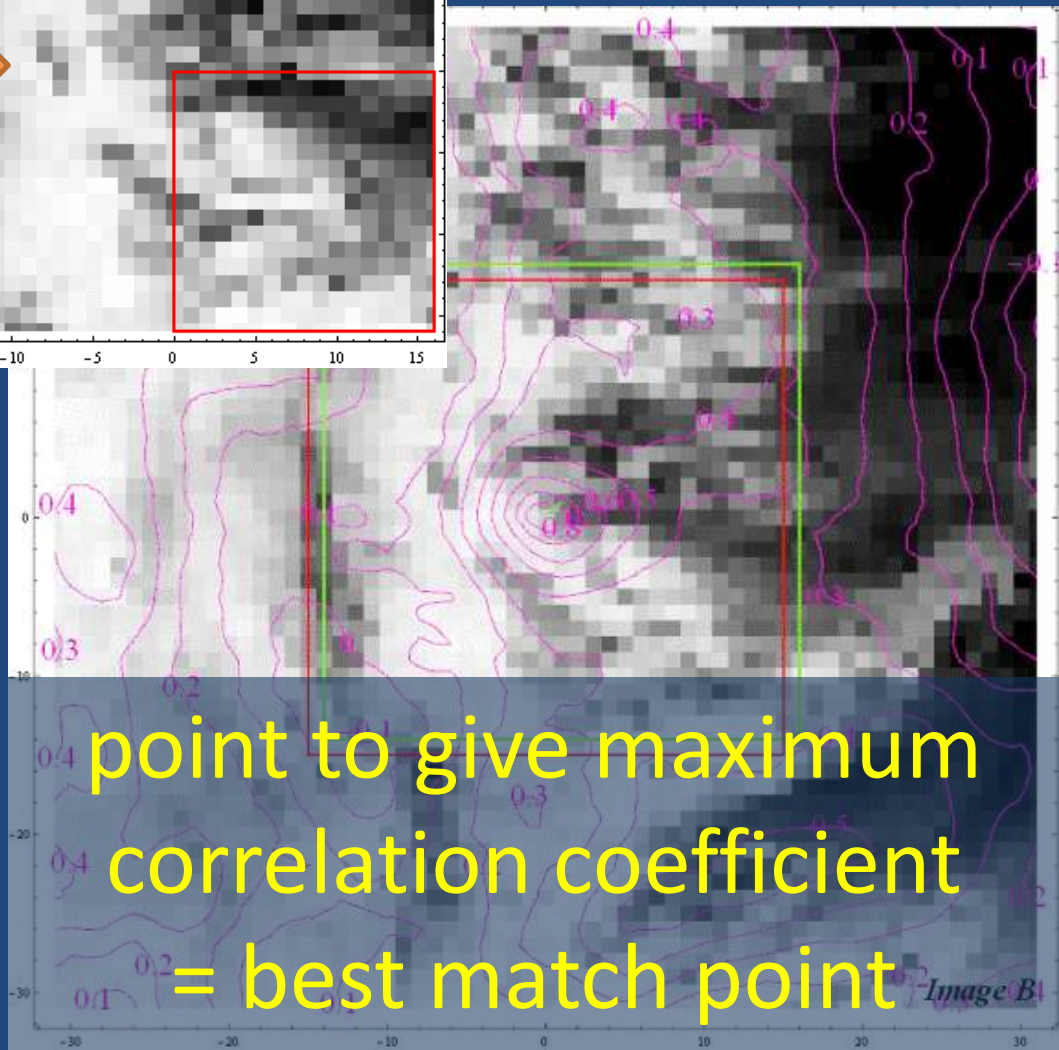
Tracking cloud by Pattern Matching

targeted feature

searching







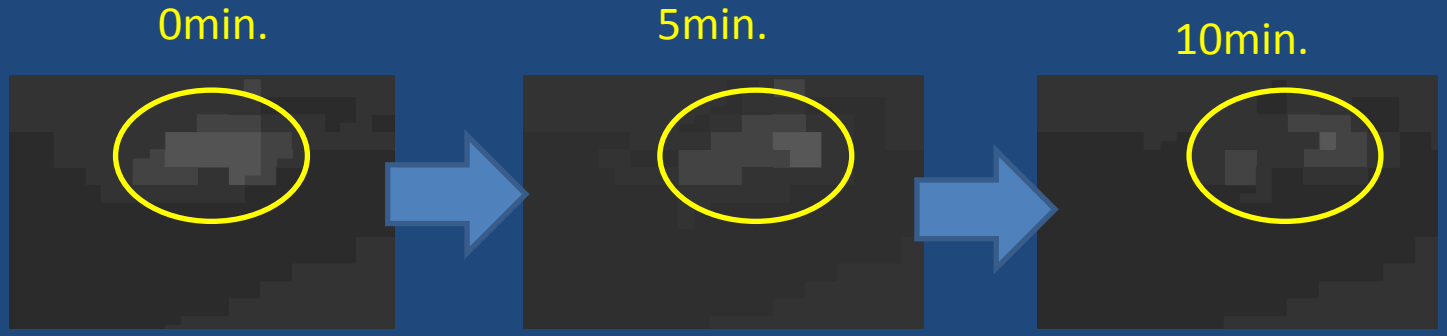
Method to find the most similar pattern from follow-throw image

Cross-correlation is similarity of a pair of "pattern"

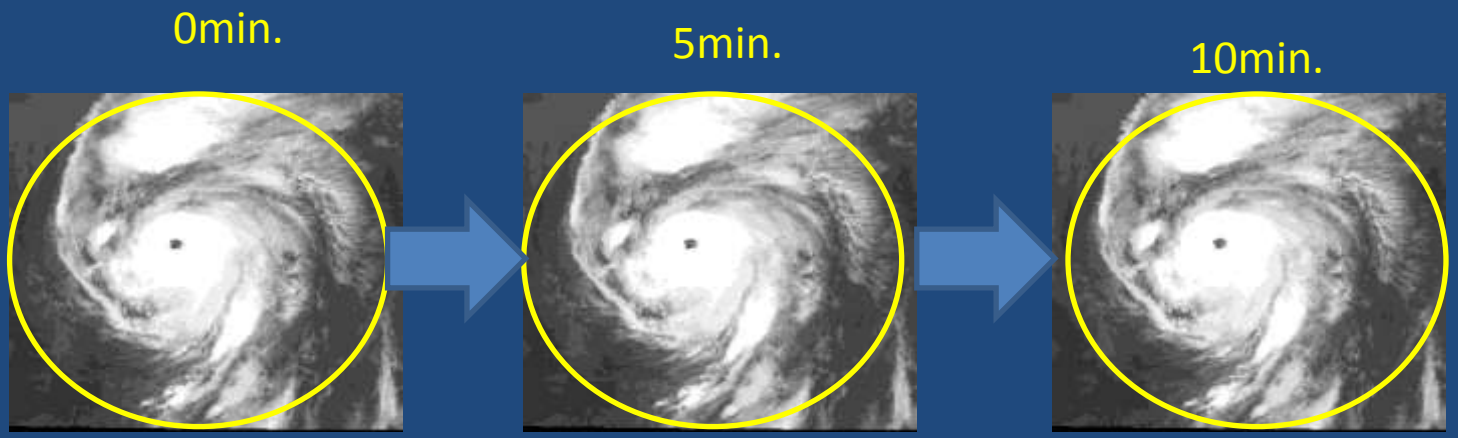
point to give maximum correlation coefficient = best match point

Difficulty of using small target box size

Feature of small scale phenomena vanishes in a short time



Feature of large scale phenomena is consistent for long period



lifetime of cloud feature is correlating with its size

Difficulty of using small target box size

Cloud system deforms as time goes by

Appropriate “target size” determined if
“observation intervals” determined, and vice-versa

Study of Relationship b/w Box Size and Time Interval using MTSAT Rapid Scan Images

Method to evaluate the relationship:

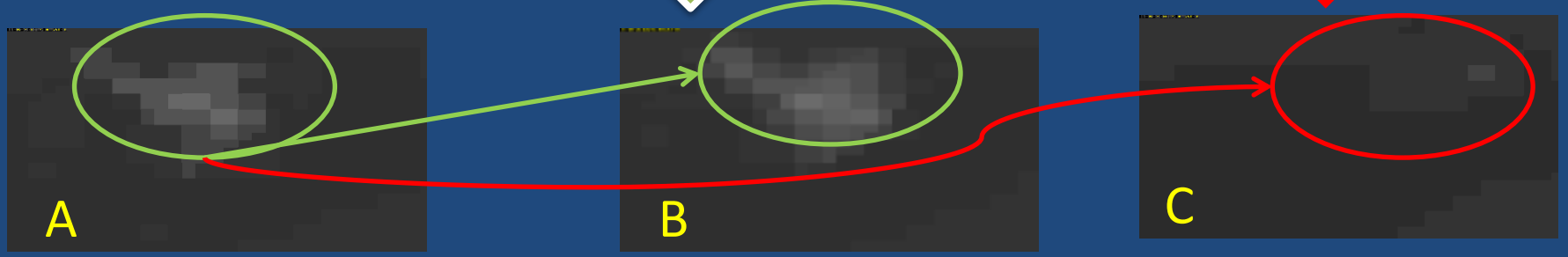
- Two satellite images of different observation times prepared
- Cross-correlation between cloud features in boxes of the two images computed to evaluate the lifetime of cloud system

Experimental Design

Rapid-scan MTSAT-1R image : September 2011 (daytime only)
Target box size: 5,7,9,11,13,15,17,19,21,23,25,27,29,31 and 33 pix
Time interval of imagery : 5,10,15,20,25 and 30 minutes

Highly correlated to A and trackable

Less correlated to A difficult to be tracked



Relationships of target size and time intervals of satellite imagery for cloud tracking

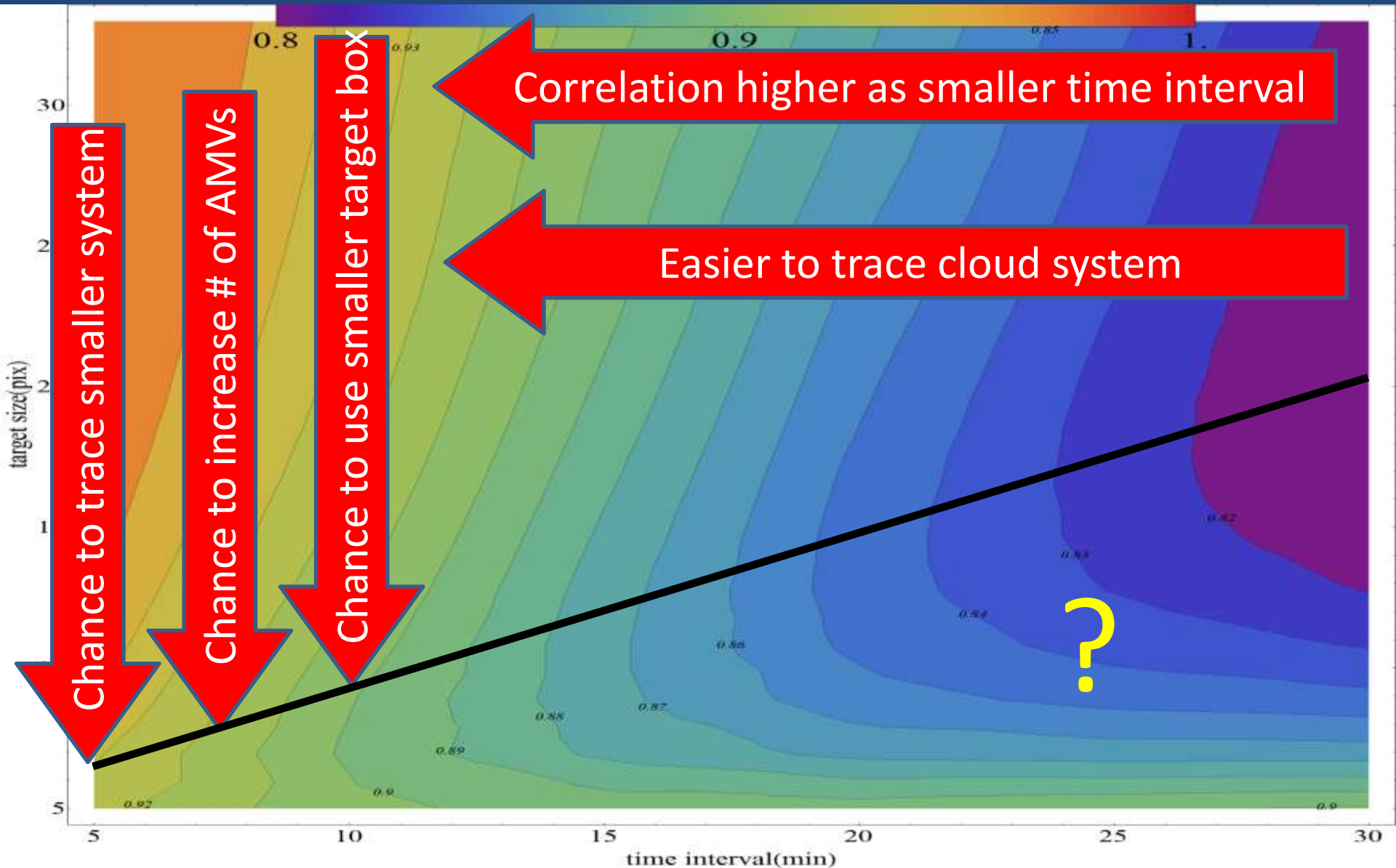
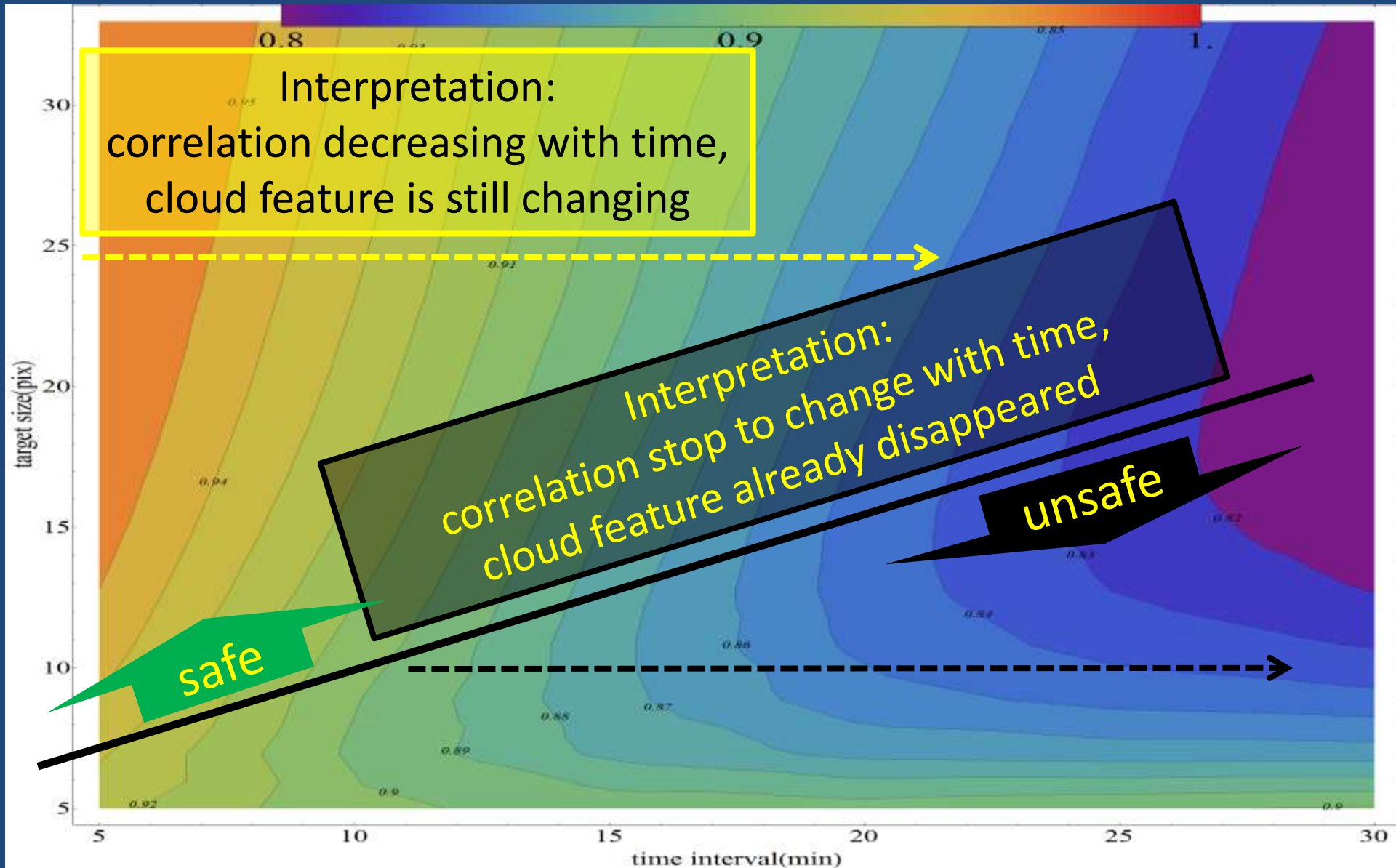
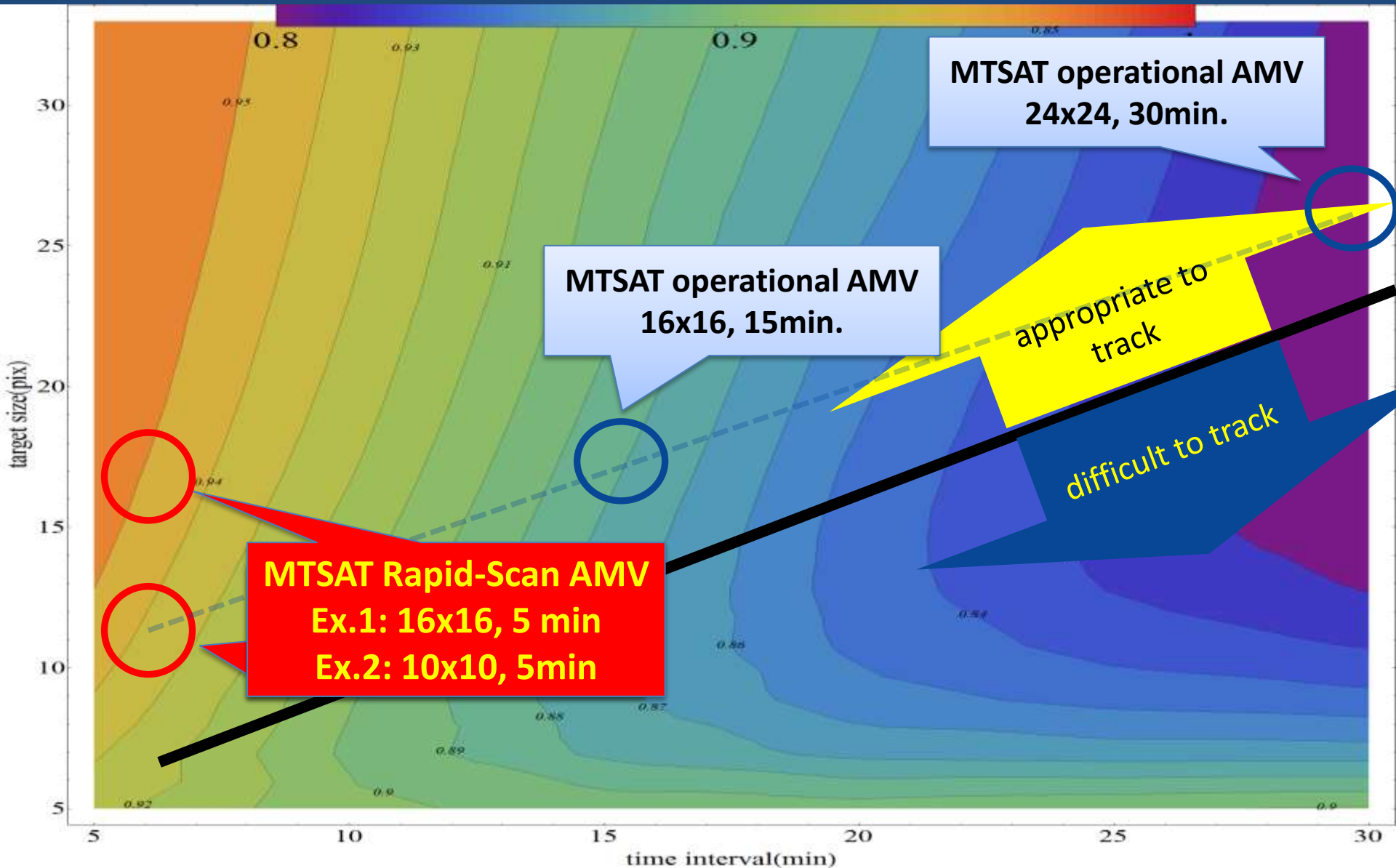
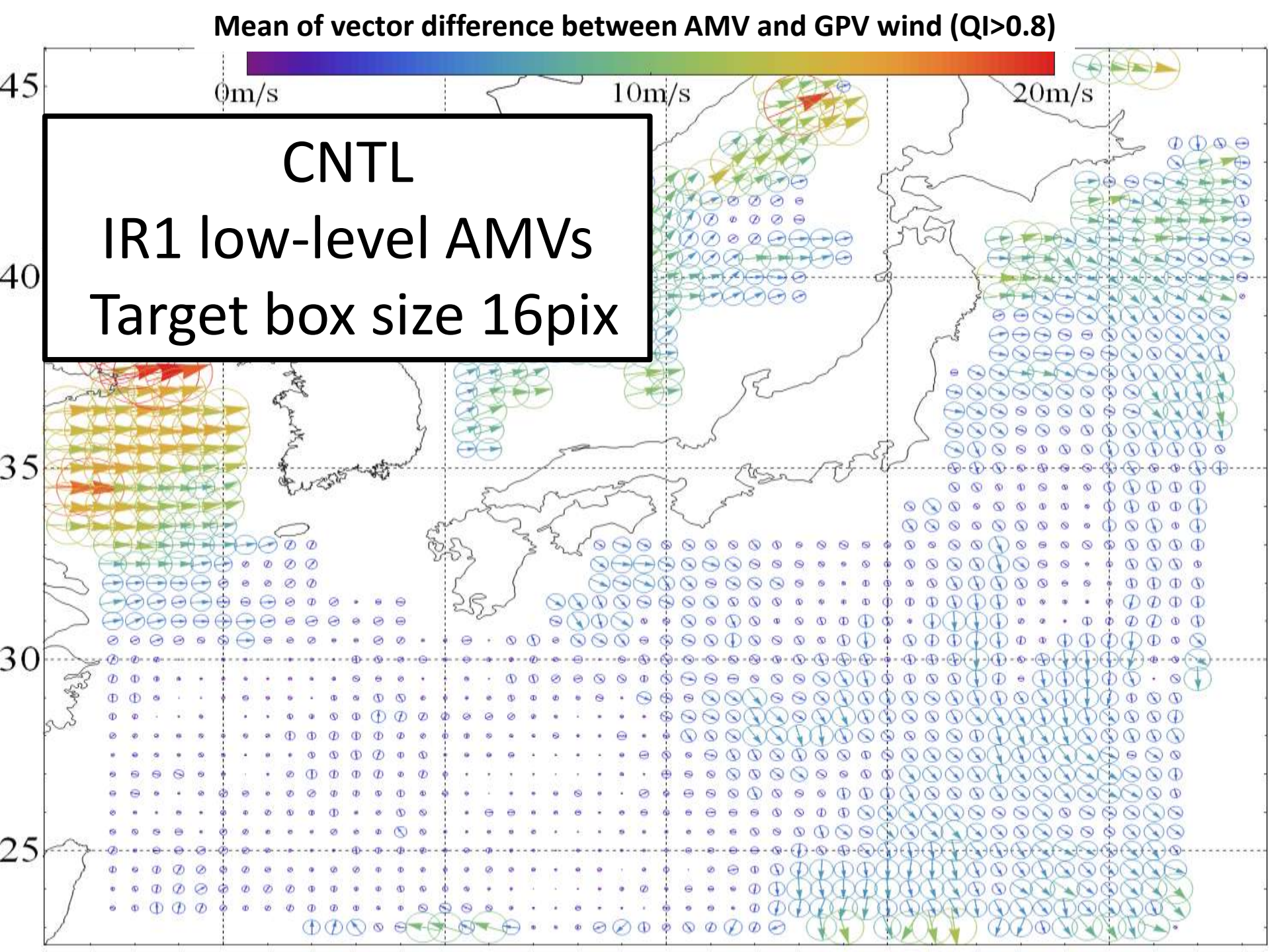


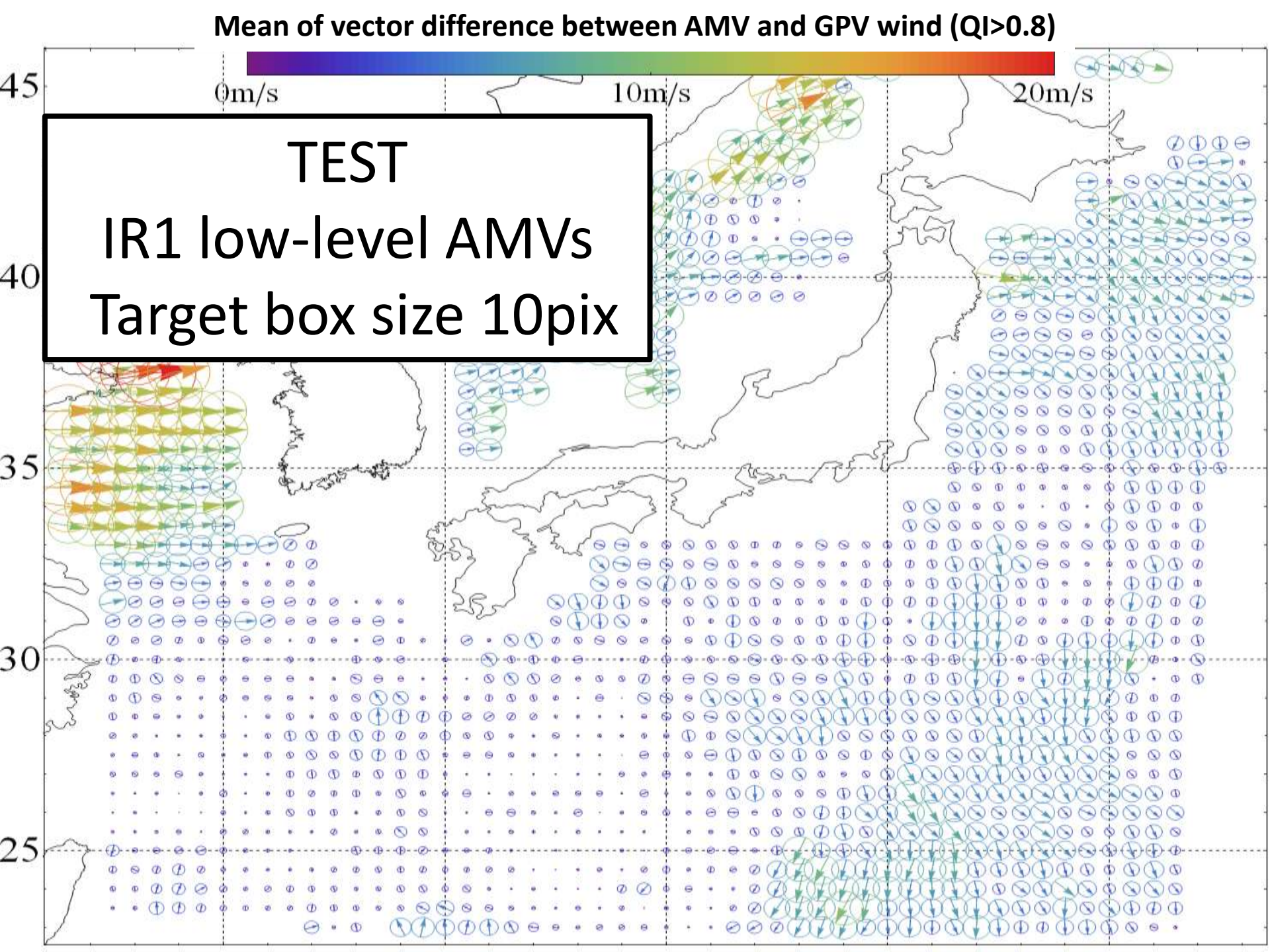
table of mean of maximum correlation computed from many pairs of target Box sizes and time intervals



Experiment to resize target box size for MTSAT-1R rapid-scan AMV



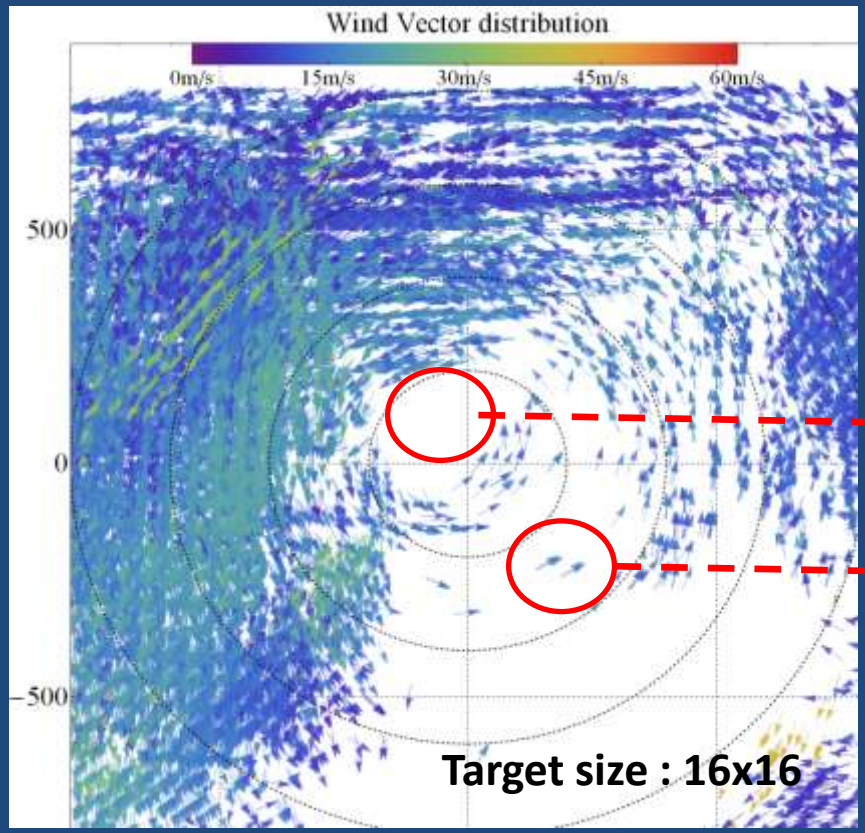

Mean of vector difference between AMV and GPV wind (QI>0.8)
0m/s
10m/s
20m/s
45
40
35
30
25
CNTL
IR1 low-level AMVs
Target box size 16pix

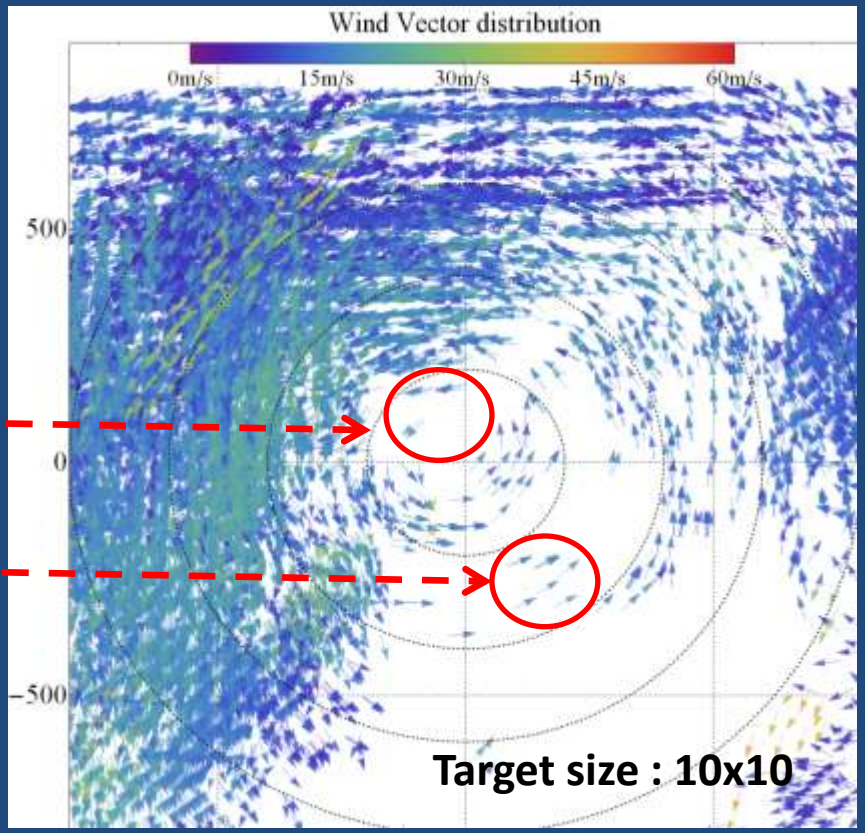

Mean of vector difference between AMV and GPV wind (QI>0.8)
0m/s
10m/s
20m/s
45
40
35
30
25
TEST
IR1 low-level AMVs
Target box size 10pix

Rapid-Scan AMVs around Typhoon

Enlargement of data coverage near typhoon center
by using small target box size
even without optimal target alignment

Accumulated AMVs(Qi > 0.8) around center of typhoon “ROKE”
From 9 Sep 2011 to 24 Sep 2011





Summary

1. JMA/MSC is developing rapid-scan high resolution AMV for Japanese follow-on satellite “Himawari-8”.

2. Rapid-scan high-resolution AMV needs appropriate a pair of observation interval and target box size.

3. “cloud tracking limit” achieved from relationships of “maximum correlation coefficient”, “time interval” and “target box size” by using 90 pairs of different sizes and different intervals using MTSAT-1R rapid-scan IR imagery.

4. Comparison experiment using target box sizes 10x10 and 16x16 was examined for checking a part of cloud tracking limit”. As a result, AMVs from 10x10 target box size show comparable quality from 16x16. this result also suggests that resizing target box size from 16x16 to 10x10 can increase number of AMV without debasement of quality.