The rapid developing convection detection at CMA

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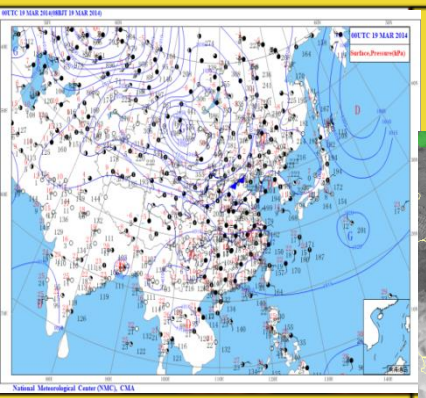
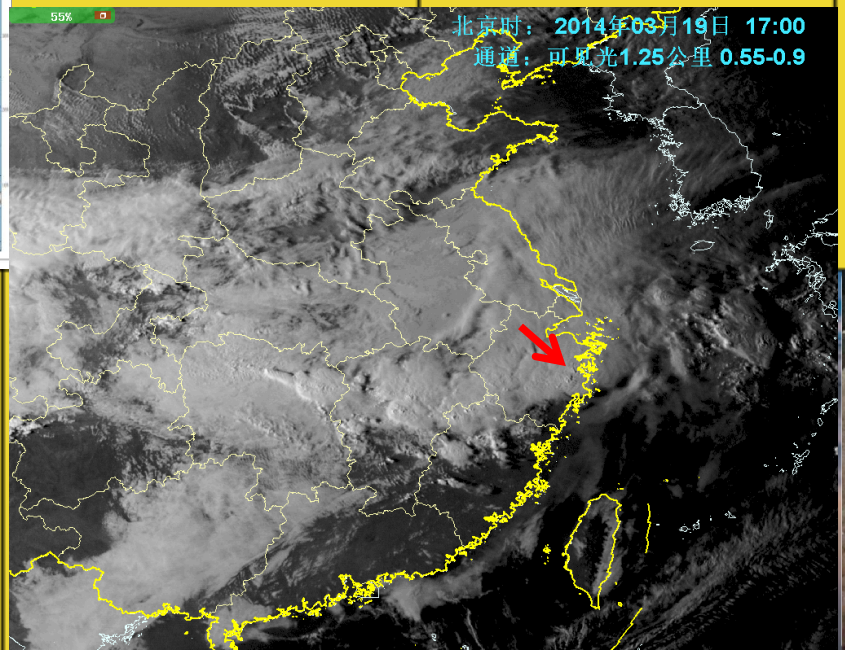
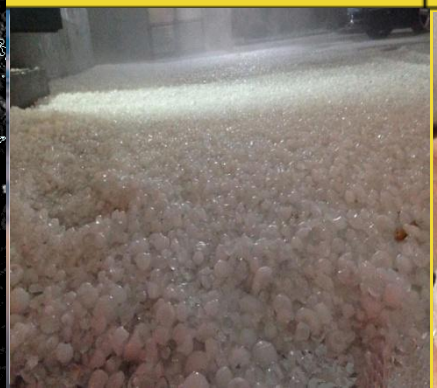
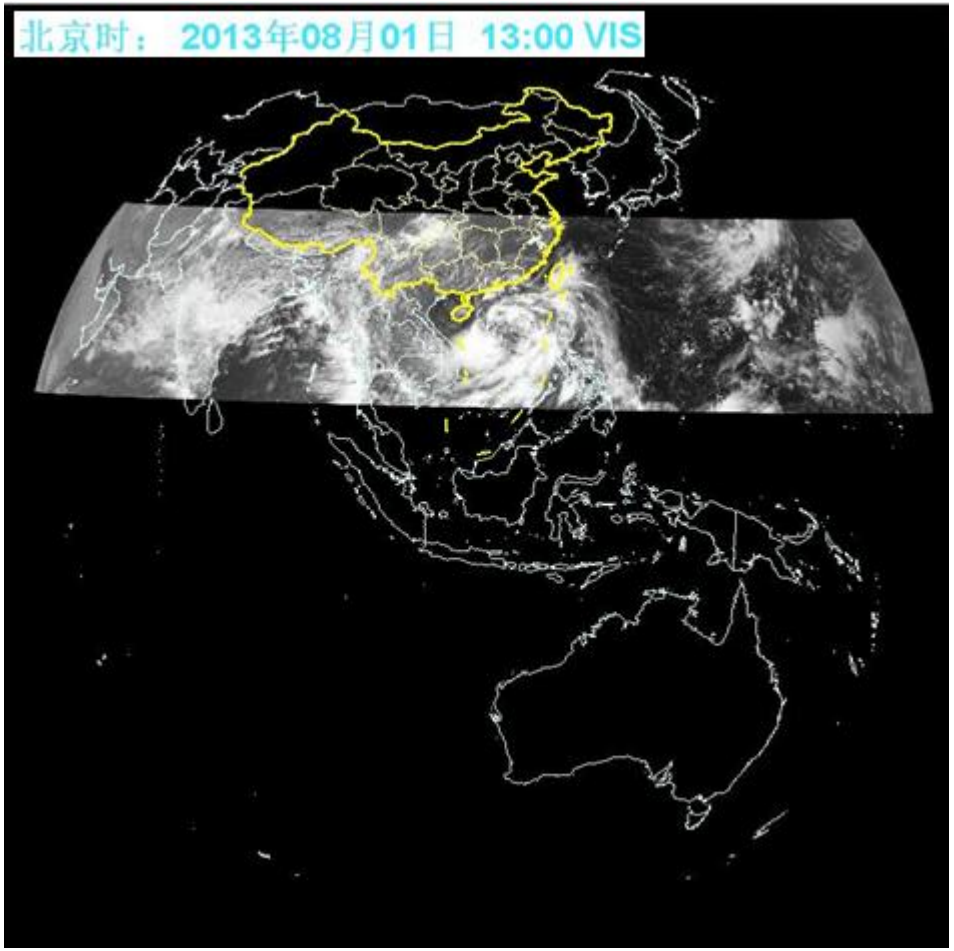






Overview

- Besides cloud image, i.e. gray scale and RGB image, we have no any operational convection detection product. But algorithms are on going test:
  - ✓ Particle Filter method to track multi cell targets
  - ✓ Rapid developing convection (RDC) algorithm to detect cloud top cooling rate
- Since Aug. 2011, the FY-2 rapid scan observation began to provide 6 min satellite imagery of interest region. It becomes operational use in 2012.
- The RDC detection plan set in 2012, and first version is test in 2013.
- RDC plan for FY-4 start in 2013, on going……

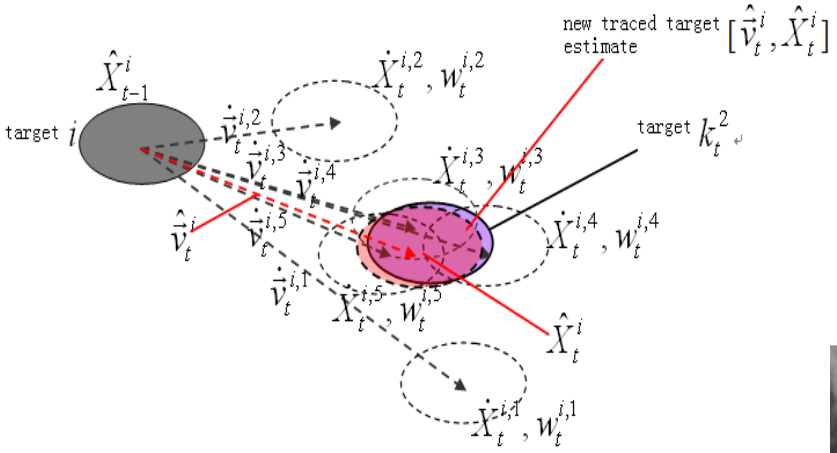


FY-2 rapid scan observation

Case dependent, 23 times in 2013, focus on typhoon and very severe weather.

Particle Filter method to track multi cloud targets

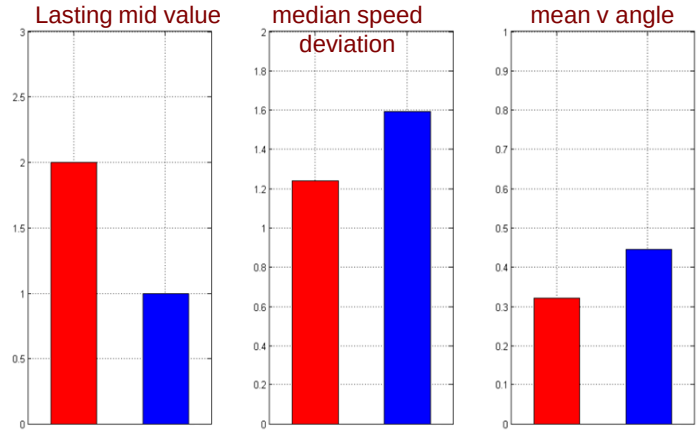
Status definition $S_t^{i,j} = [\vec{v}_t^{i,j}, X_t^{i,j}]$ (Velocity and position)



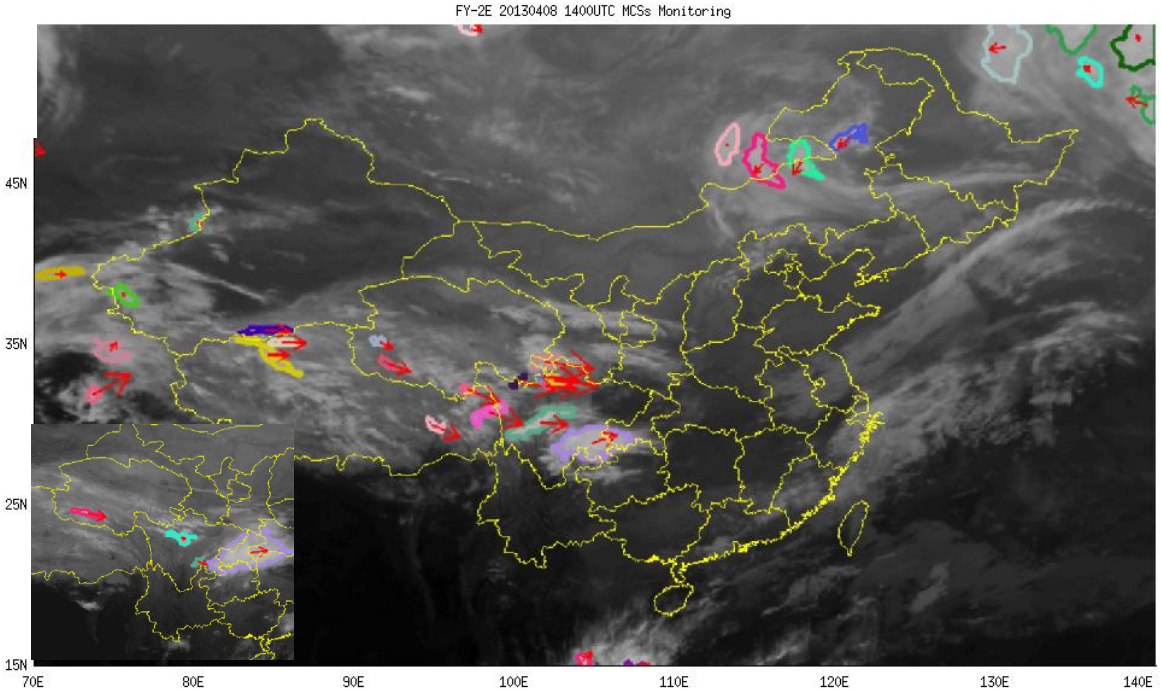
New particle estimation: $S_{t+1}=S_t+\delta$

- Particles produced by random
- Particle update according to:
  - Overlap area>0.5
  - Particles overlap percentage >60%

Compare to overlap trace method



Red:PF, Blue: overlap



RDC from FY-2 rapid scan observation

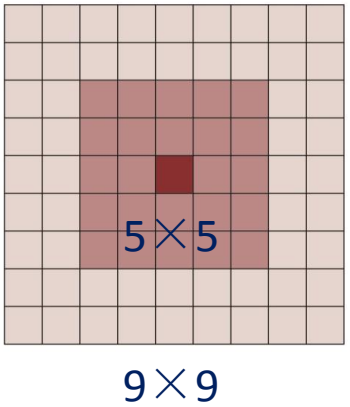
Motivation

Early detection of rapid developing convection and nowcast their evolution

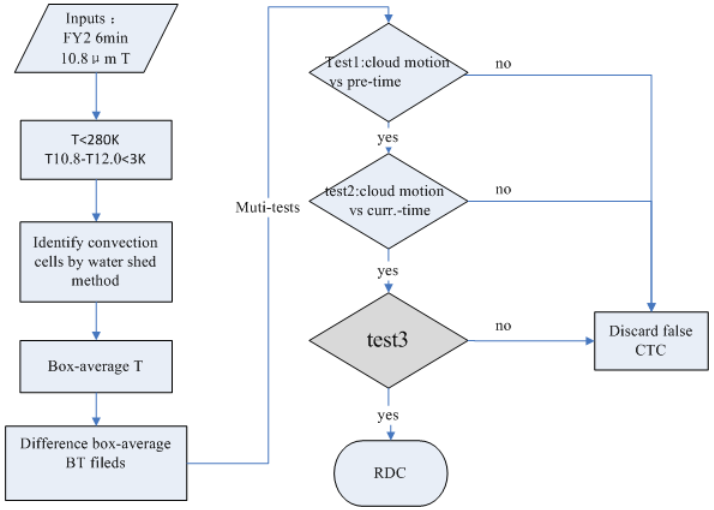
Method

Detect rapid cloud top cooling rate use 10.8μm Tb by Box-averaged method (Sieglaff et al., 2010), but test these parameters:

- CTC< -2.0 K/6min
- 10.8μm-12.0μm
- 10.8μm-6.9μm



Channel	Bands (μm)	Used
VIS	0.55-0.90	
IR1	10.3-11.3	√
IR2	11.5 - 12.5	√
WV	6.3-7.6	√
IR4	3.5 -4.0	



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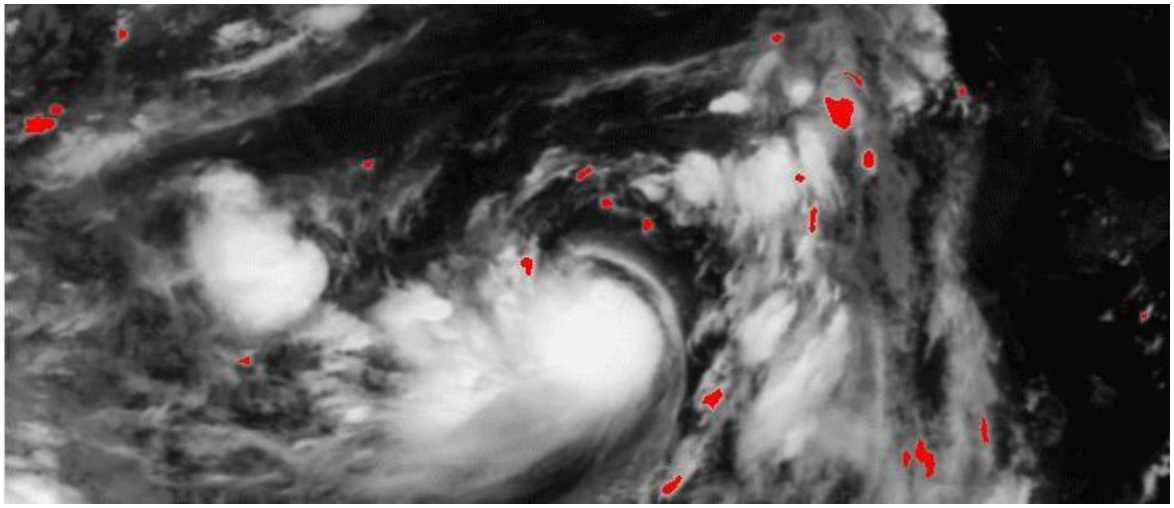
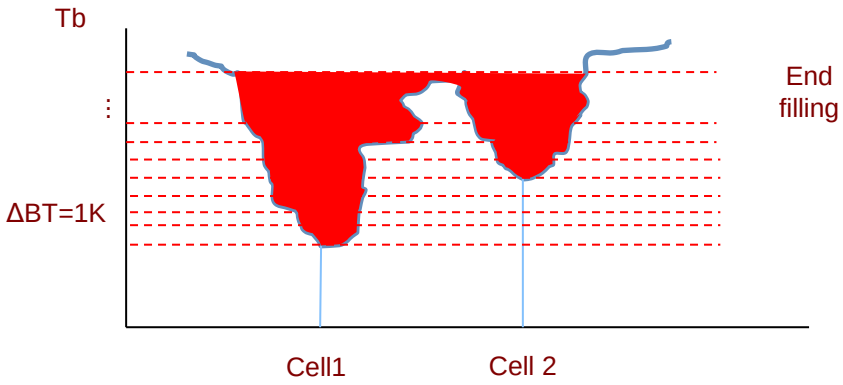
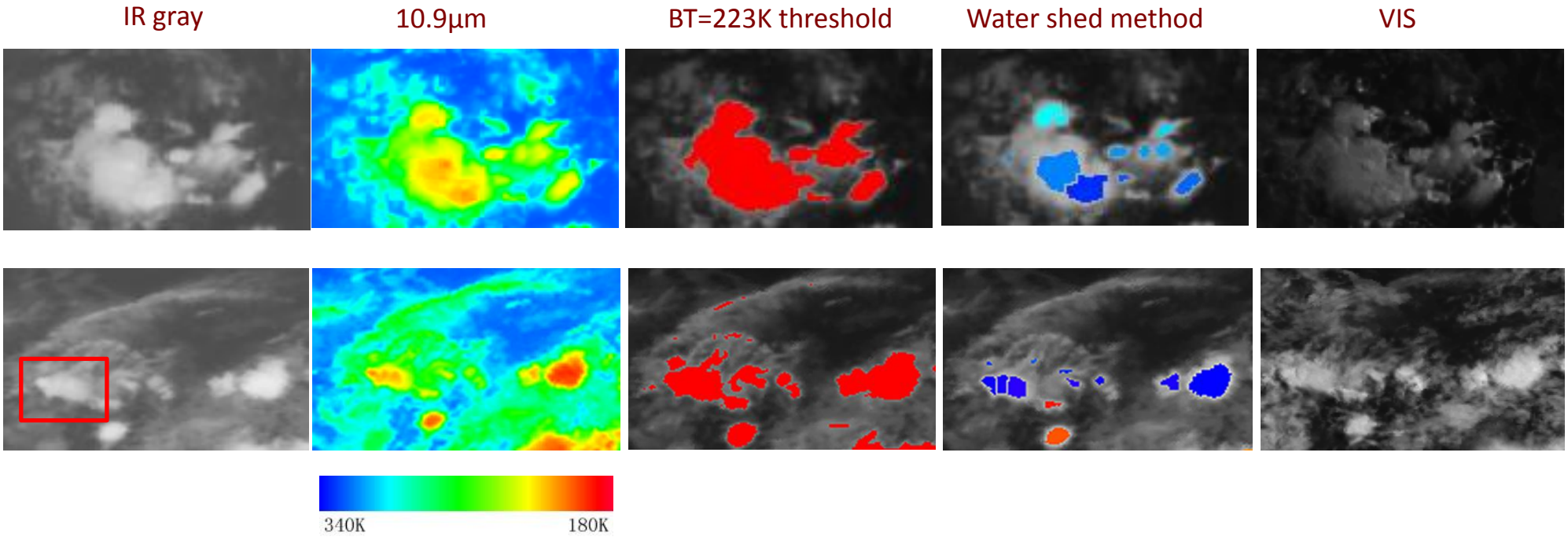


Use water shed method to identify convection cloud clusters



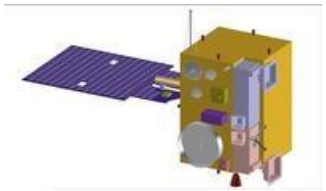


The FY-4 Advanced Geosynchronous Radiation Imager

FY-4 AGRI

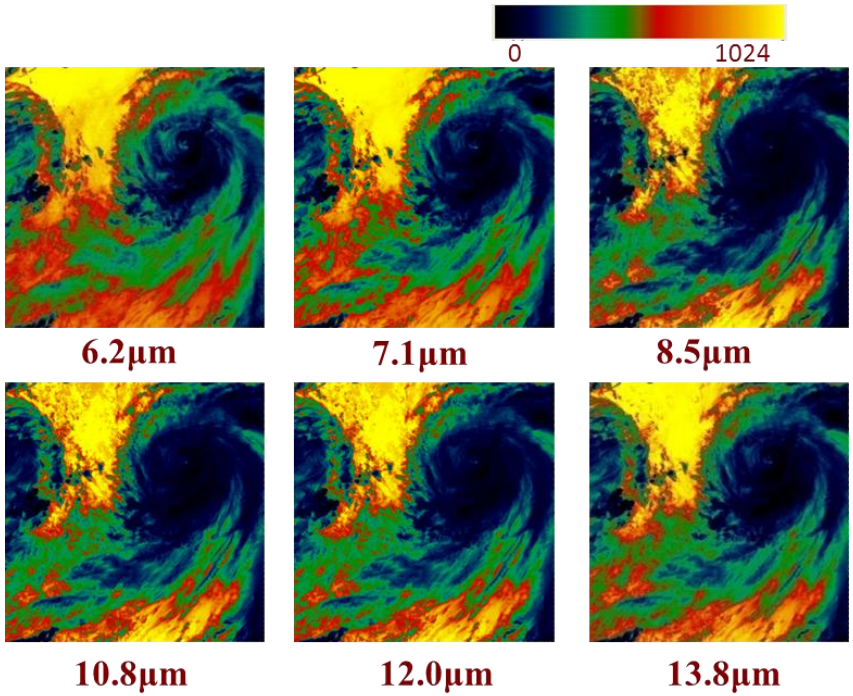
Channel	Band (*μm*)	Spatial Resolution (Km)	Application
Visible & Near-Infrared	0.45～0.49	1	Aerosol
	0.55～0.75	0.5～1	Fog,Clound
	0.75～0.90	1	Vegetation
Short-wave Infrared	1.36～1.39	2	Cirrus
	1.58～1.64	2	Cloud,Snow
	2.1～2.35	2～4	Cirrus,Aerosol
Mid-wave Infrared	3.5～4.0(high)	2	Fire
	3.5～4.0(low)	4	Land surface
Water Vapor	5.8～6.7	4	WV
	6.9～7.3	4	WV
Long-wave Infrared	8.0～9.0	4	WV,Clound
	10.3～11.3	4	SST
	11.5～12.5	4	SST
	13.2～13.8	4	Clound,WV

↑ RDC use



Observation	Time interval
Full disc	15min
Region 3000×3000 Km	3-5min

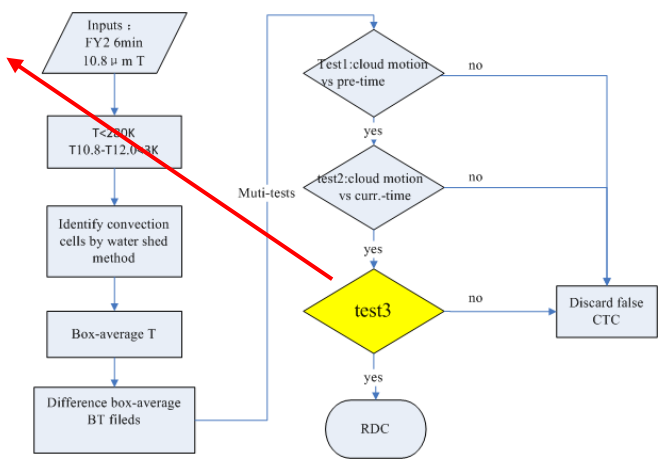
FY-4 program delay to 2016!

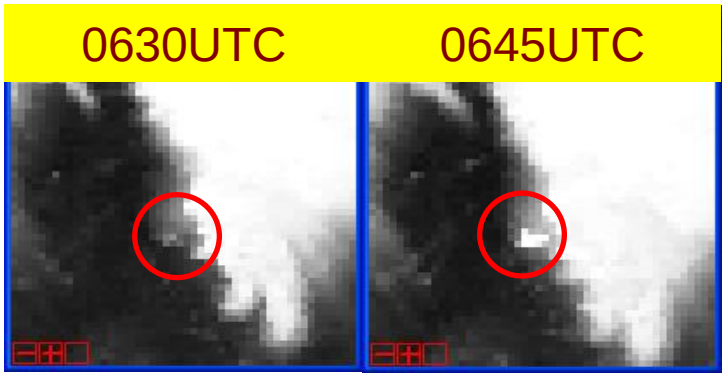


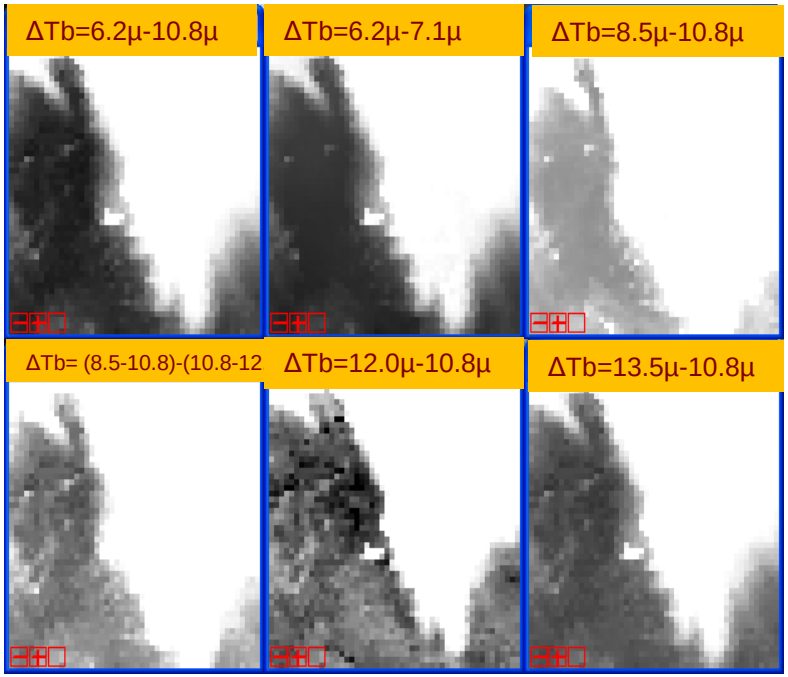
RDC multi-channel tests for FY-4

Method

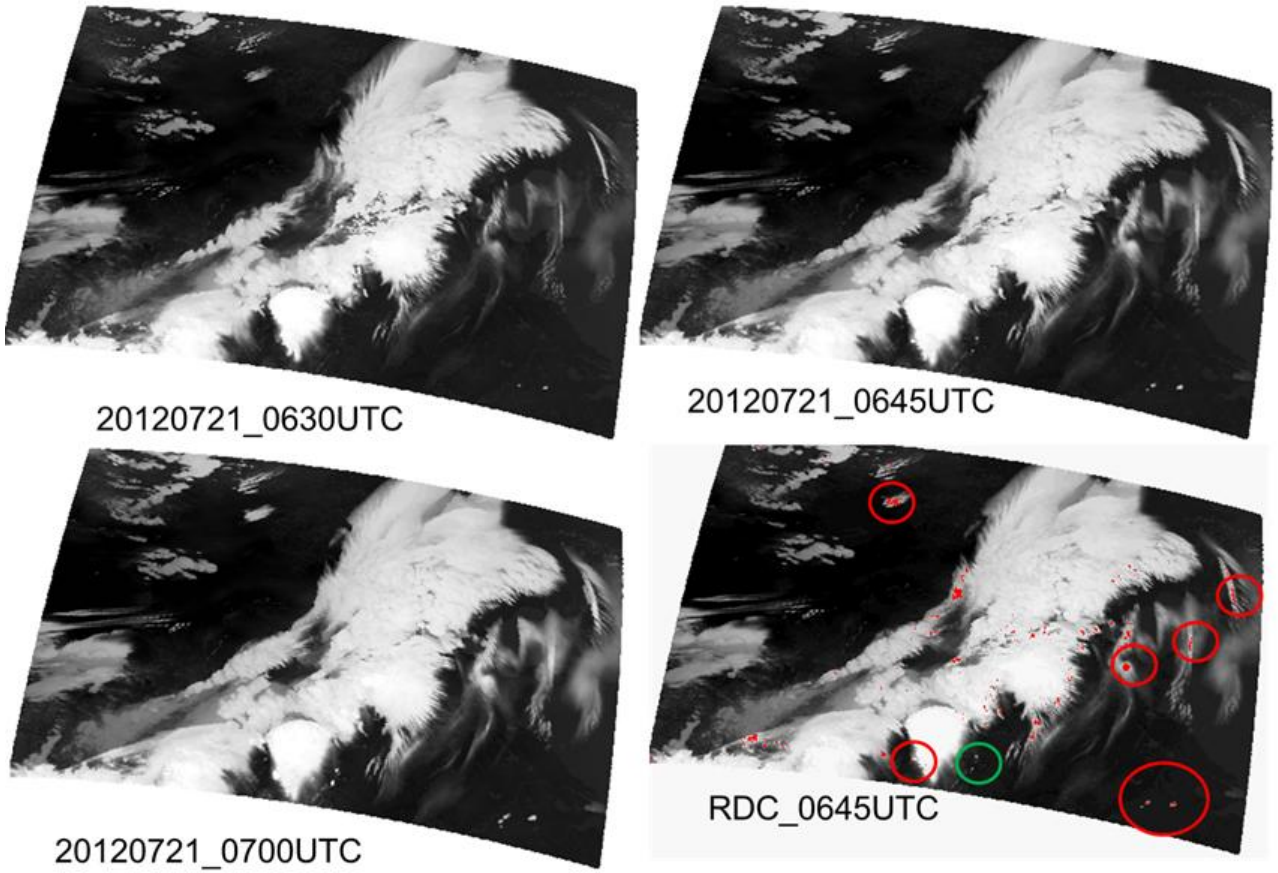
- Detect rapid cloud top cooling rate use 10.8μm Tb. Box-averaged method (Sieglaff et al., 2010)
- Same as FY-2 RDC, but use muti-channel tests. Multi-channel tests with reference of MB06 (Mecikalski and Bedka,2006) and GOES-R CI ATBD:
  - ✓ ΔBT=6.2μ-10.8μ
  - ✓ ΔBT=6.2μ-7.1μ
  - ✓ ΔBT=8.5μ-10.8μ
  - ✓ ΔBT= (8.5μ-10.8μ)-(10.8μ-12.0μ)
  - ✓ ΔBT=12.0μ-10.8μ
  - ✓ ΔBT=13.5μ-10.8μ







Case



- Case: Beijing 721 storm
- Data: WRF model + FY-4 RTM to simulate AGRI 9-14 channel BT

Beijing severe Storm on 21 Jul 2012

Summary and next steps

Summary

- CMA has developed the RDC algorithm to detect active convection cloud clusters, include convective initiation and mature convection, on geo-image.
- The CMA RDC product is testing using FY-2 6-min rapid scan imagery data, and is improved to apply to FY-4 satellite by introduce more channel information.

Next steps

- Surface radar validation
- Critical test thresholds tuning, base on large sample statistics, i.e. considering seasonal variation and regional deference

Thank you for your attention!