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Report on Operational Analysis of Asian Dust

This paper reports the Operational Analysis of Asian Dust at KMA. KMA has been using the GEO as well as LEO for operation analysis of Asian dust since 2002. BTD is basically used for dust detection due to its availability in nighttime. KMA developed the IODI which is now operationally used and will update BTD method to reduce the uncertainties, such as low sensitivity over ocean, diurnal variation of BTD, and the false signal near northern Chinese continent.

BTD : Brightness temperature difference between IR1 and IR2

IODI : Infrared Optical Depth Index

Operational Analysis of Asian Dust at KMA

KMA has operated various observation systems and numerical model to detect Asian dust at source regions in China and Mongolia and analyze the possibility of the inflow of dust into the Korean Peninsula since 2002. Satellite monitoring of Asian dust is based on the brightness temperature difference (BTD) method, false and true color composite using MTSAT-1R, NOAA, FY-1D and Terra/Aqua.

Operational Analysis using GEO (MTSAT-1R)

- Brightness temperature difference (BTD): using the difference of extinctions between 11㎛ and 12 ㎛ IR channels.
- Infrared Difference Dust Index (IDDI): it was originally developed to process the daily daytime IR images of METEOSAT so that the dust effect component is separated from the total satellite signal (Legrand et al., 2001). To improve the detection of dust, multiple channel threshold method is being used.
- Infrared Optical Depth Index (IODI): It was developed by NIMR, KMA in 2007 to reduce the effect of surface temperature. It uses the ratio of surface temperatures and brightness temperatures. It represents a difference of optical depth between clear and dusty sky. After 1 year operational test in 2007, IODI was updated by considering the temporal and/or spatial difference in NDVI and satellite zenith angle.

Operational Analysis using LEO (NOAA)

- False color composite

Table 1. Specification of Asian dust monitoring products

Satellite	Sensor	Products	Channel	Frequency	Remark
MTSAT-1R	JAMI	BTD	10.3-11.3㎛ (IR1) 11.5-12.5㎛ (IR2)	44/day	
		IDDI	10.3-11.3㎛ (IR1)	44/day	Multiple channel criteria
		IODI	10.3-11.3㎛ (IR1)	44/day	
NOAA-15, 17, 18	AVHRR	BTD	10.3-11.3㎛ (Ch4) 11.5-12.5㎛ (Ch5)	6-9/day	
		False Color Composite	0.58-0.68㎛ (Red) 0.725-1.0㎛ (Green) 10.3-11.3㎛ (Blue)	2-3/day	
FY-1D	MVISR	False Color Composite 1	0.58-0.68㎛ (Red) 0.84-0.89㎛ (Green) 10.3-11.3㎛ (Blue)	2-3/day	
		False Color Composite 2	0.58-0.68㎛ (Red) 0.84-0.89㎛ (Green) 1.58-1.64㎛ (Blue)		
Terra/Aqua	MODIS	True Color Composite	0.62-0.67㎛ (Red) 0.545-0.565㎛ (Green) 0.459-0.479㎛ (Blue)	2-3/day	

Future plan for Operational Analysis using GEO (COMS and/or MTSAT-1R)

KMA have been developed algorithm to detect the Asian dust as a part of CMDPS (COMS Meteorological Data Processing System). The new algorithm introduced the background threshold value of BTD.

1. Brightness temperature difference (BTD): basically, it uses the difference of extinctions between 11㎛ and 12㎛ IR channels.
2. Background threshold value of BTD (BTV): BTV is the threshold value for background of clear sky conditions, which is calculated by fitting the 10 days maximum brightness temperature at a given specific time.
3. Updated BTD is retrieved from the difference between BTD and BTV, which can be expected to reduce the uncertainties of previous BTD method, such as low sensitivity over the ocean and time variation of BTD during the daytime.