

11. Calculation Of Sea Surface Temperature

11.1 Estimated Equation By Split-Window Method

As a calculation algorithm for Sea surface Temperature of OCTS, Split-Window method is applied. This method is a simple statistical method and is widely applied to the calculation of sea surface temperature using NOAA/AVHRR or MOS-1/VTIR data. Hereunder, equation for calculation of sea surface temperature by Split-Widow method is stated.

The following regression equations are applied for the calculation of sea surface temperature based on the combination with thermal infrared band of ADEOS/OCTS;

$$Ts = c_0 + c_1T_{11} + c_2(T_{11} - T_{12}) + c_3(T_{11} - T_{10}) + c_4(T_{11} - T_{12})(m - 1) + c_5(T_{11} - T_{10})(m - 1) \quad (11.1-1)$$

Where

$$m = 1 / \cos \theta$$

T_s : Sea surface temperature

c : Regression coefficients

T_{xx} : Observation brightness temperature of band XX of level 1B

θ : Zenith angle of satellite

(Band 1 value is used as representative band)

Regression coefficients of each regression equation $c_0 - c_5$ values are stored in database. These values are as follows.

c_0	c_1	c_2	c_3	c_4	c_5
-0.4256	1.001	2.2690	-0.1545	0.7140	-0.05751

The unit for thermal infrared region data of Level 1B is radiance brightness, however, Split-Window method requires observation brightness radiance brightness temperature. The following equation is used for brightness to temperature conversion.

$$L = \int L_\lambda d_\lambda = \int R_0(\lambda) \varepsilon(\lambda) 2c^2 h / \lambda^5 / (\exp(ch / (\lambda kT)) - 1) d\lambda \quad (11.1-2)$$

$\varepsilon(\lambda)$: emissivity (assumed as 1)

c : velocity of light

h : Plank's constant

k : Boltzman's constant

R_0 : spectrum characteristics of each band

satisfies $\int R_0(\lambda) d\lambda = \Delta\lambda$ (band width)

By this equation, temperature and brightness of each band is corresponded to one by one; however, table is provided to reduce calculation time.

By performing these operations to each pixel, sea surface temperature is calculated for each pixel.

11.2 Calculation Of Level 2QF

For sea surface temperature, QF of the following items are calculated for each pixel.

- Cloud
- Sea surface effect
- Emission angle
- Land / Ocean
- QC
- Out of scan

This kind of quality information is calculated by the following methods.

(1) Cloud

Cloud flag is placed for items that satisfy more than one following conditions.

The saturation flag of Band1 == "ON"

[The surface temperature (Meteorological Agency objective analysis data)]

[The brightness temperature of band11] > X1

$$L_T(\text{Band8}) / \{F_0(865) * t(865, \theta) * t_0(865, \theta_0)\} > X2$$

$$t(865, \theta) = \exp\{-(0.5 \cos \theta_R + \cos \theta_Z + \cos \theta_X) / \cos \theta\}$$

$$t_0(865, \theta_0) = \exp\{-(0.5 \cos \theta_{R0} + \cos \theta_{Z0} + \cos \theta_{X0}) / \cos \theta_0\}$$

$$\theta_R, \theta_Z, \theta_X : \text{constant}$$

$L_T(\text{Band1})$ substitute for $L_T(\text{Band8})$

C1*[The brightness temperature of band10]

+ C2*[The brightness temperature of band11]

+ C3*[The brightness temperature of band12] > X3

C4*[The brightness temperature of band10]

+ C5*[The brightness temperature of band11]

+ C6*[The brightness temperature of band12] > X4

C7*[The brightness temperature of band10]

+ C8*[The brightness temperature of band11]

+ C9*[The brightness temperature of band12] > X5

(Band8 L_T) > X6 && (The brightness temperature of band11) > X7

Coefficients of each equation C1 - C9, X1 - X7 values are stored in database. These values are as follows.

C1	C2	C3	C4	C5	C6	C7	C8	C9
0	-1	1	1	-1	0	-1	1	0

X1	X2	X3	X4	X5	X6	X7
20	0.016	0.5	-1.5	3.0	0.0025	0.5

(2) Sea surface effect

Combined vector value of velocity is ≤ 4 [m/sec], a flag is placed.

(3) Emission angle

In order to prepare for howl of swirling motions on the surface and elements of ripples, flag area is reserved.

(4) Land / Ocean

DCW is used for determination of land / ocean and a flag is placed when it is ocean.

(5) QC

Pathfinder Dataset is used for determining QC flag. If sea surface temperature calculated for level 2 is not Pathfinder value ± 10 [K], a flag is placed.

(6) Out of scan

When band 6,7 and 8 data is not all there, a flag is placed and masking is performed.