Sensitivity tests of Meiliangwan (MLW) site (DOY 229-238, 2010)

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◆Outline

- **1.Comparison of different spin up days.**
- **2.Comparison of different eddy diffusion coefficient (ke).**
- **3.Comparison of different light extinction coefficient (η).**

- **1.Comparison of different spin up days.**

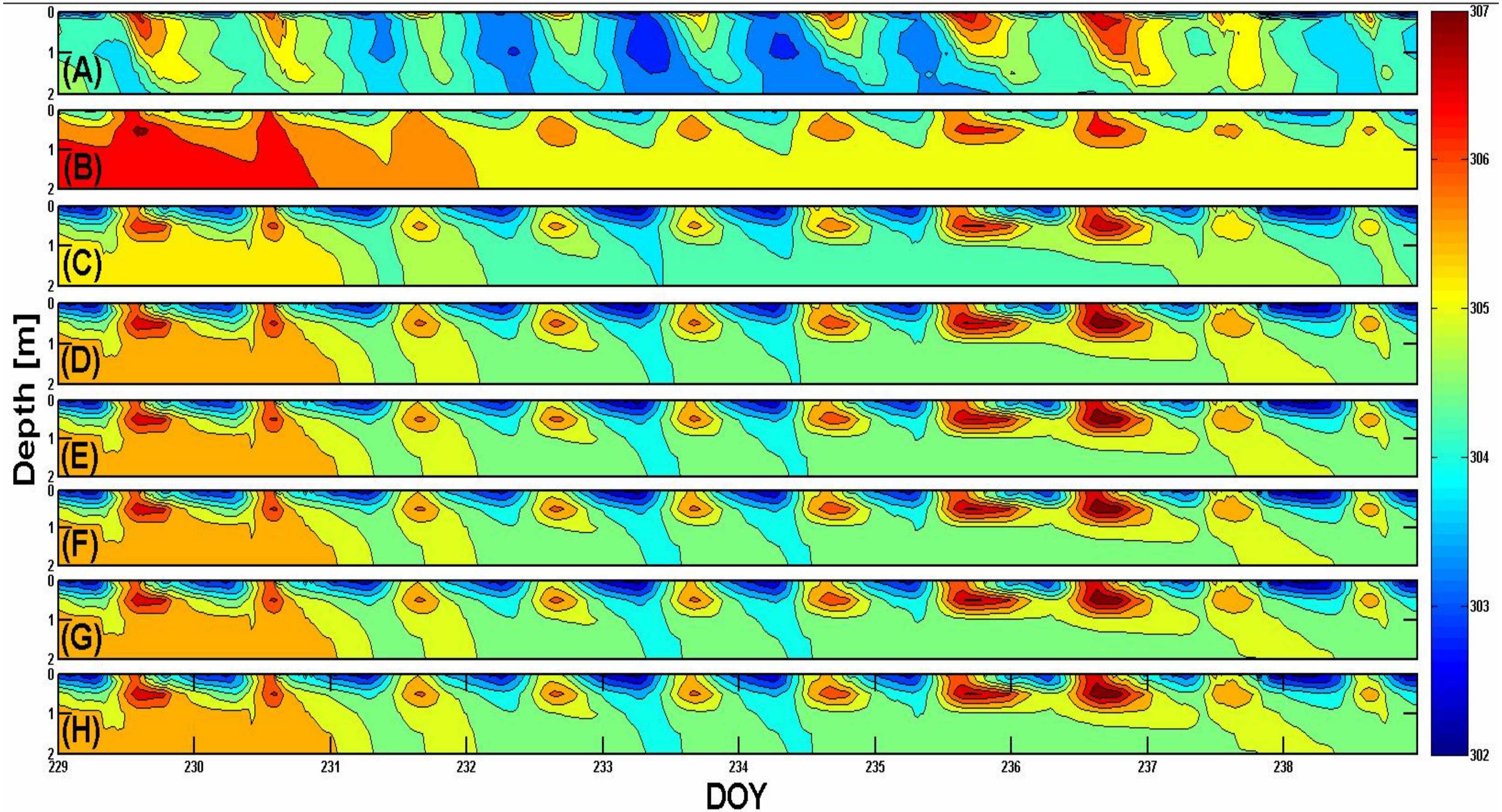

Fig.1 Temperature comparison for DOY 229-238,2010

(A): obs; (B): without spin up; (C): spin up 50 days; (D): spin up 100 days;

(E): spin up 150 days; (F): spin up 200 days; (G): spin up 250 days; (H): spin up 300 days;

Yale

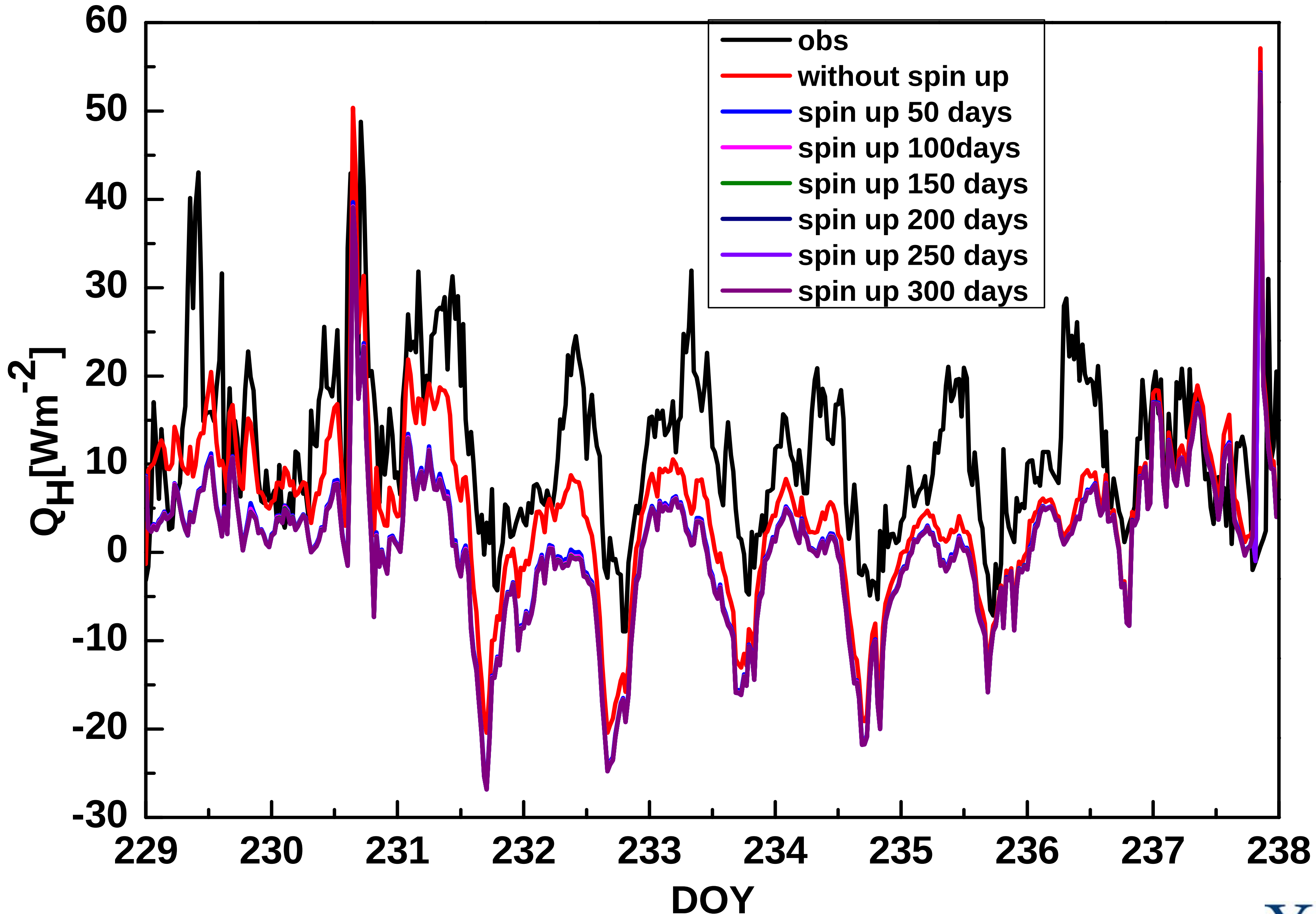

Fig.2 Sensible heat flux comparison for DOY 229-238,2010

Table 1 Initial value and observation of T_lake temperature

T_lake	1	2	3	4	5	6	7	8	9	10
Initial value	305.2	305.6	305.8	306.1	306.3	306.5	306.7	306.8	306.8	306.9
observation	304.5	304.5	304.5	304.4	304.4	304.5	304.7	304.8	304.8	304.8

$$Q_H = \rho_{atm} C_P \frac{T_S - \theta_{atm}}{r_{ah}}$$

$$C_P = 4.188 \times 10^3$$

$$\rho_{atm} = \frac{P - 0.378e}{rT}$$

Ts

$$\theta_{atm} = T\left(\frac{P_{00}}{P}\right)^{0.286}$$

$$rah = \frac{1}{\theta_{2m} \times u^*}$$

$$\frac{dT}{dt} = \frac{d}{dz}\left[(k_m + k_e)\frac{dT}{dz}\right] + \frac{1}{C}\frac{ds}{dz}$$

$$k_m = \frac{tkwat}{c_P \rho} = 1.43 \times 10^{-7} (m^2/s)$$

$$S = (1-\beta) k^* e^{-z_a \eta}$$

$$k_e = \frac{k \cdot u^* \cdot d \cdot e^{-k_s \cdot d}}{P_0 \cdot (1 + 37ri^2)}$$

$$\beta = 1 - e^{-z_a \eta}$$

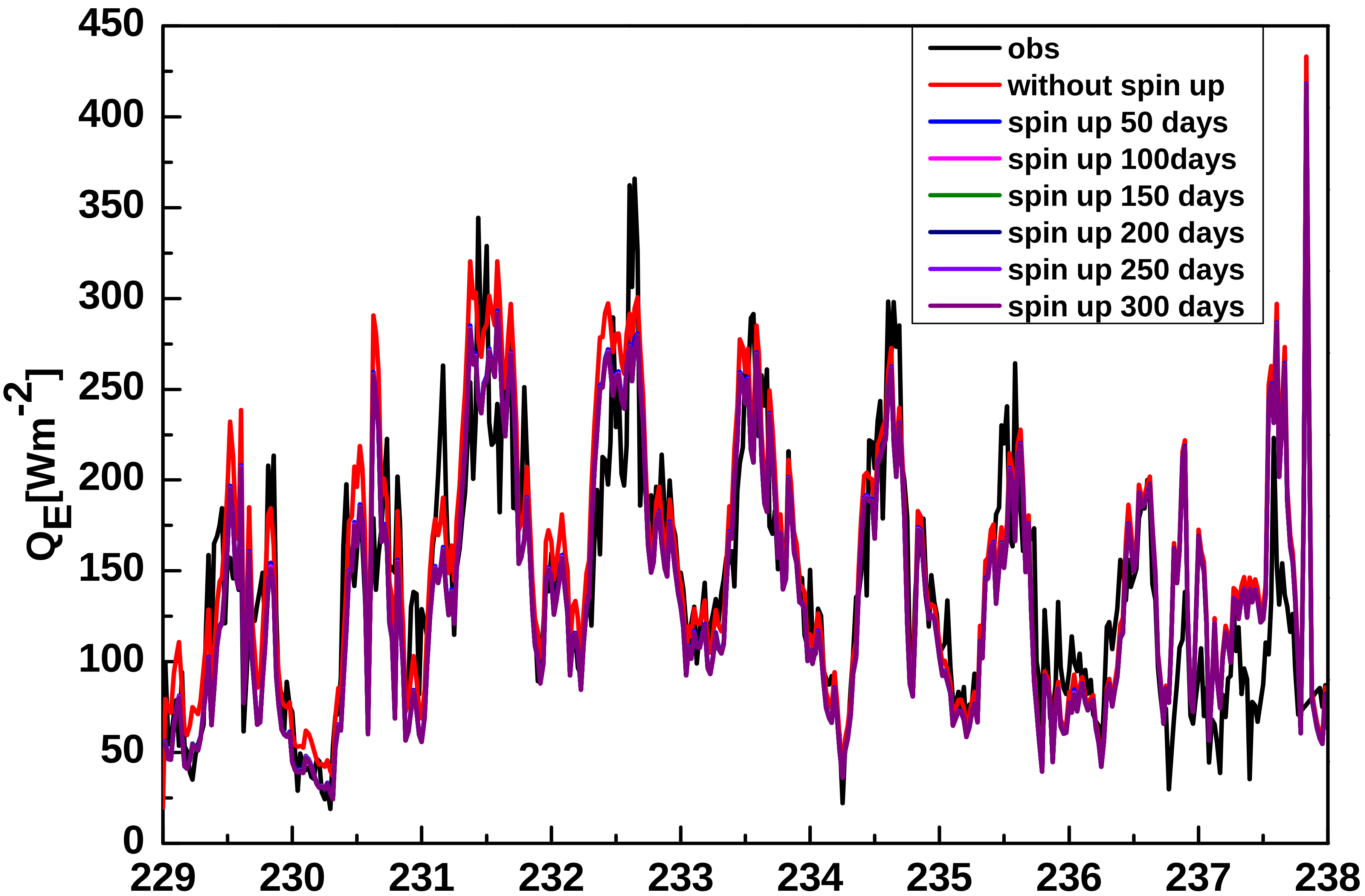

Fig.3 Latent heat flux comparison for DOY 229-238,2010

$$Q_E = \lambda \rho_{atm} \frac{q_g - q_{atm}}{r_{aw}}$$

λ:蒸发（升华）的潜热量，取决于湖表温度

$$raw = \frac{1}{q_{2m} \times u^*}$$

$$\rho_{atm} = \frac{P - 0.378e}{rT}$$

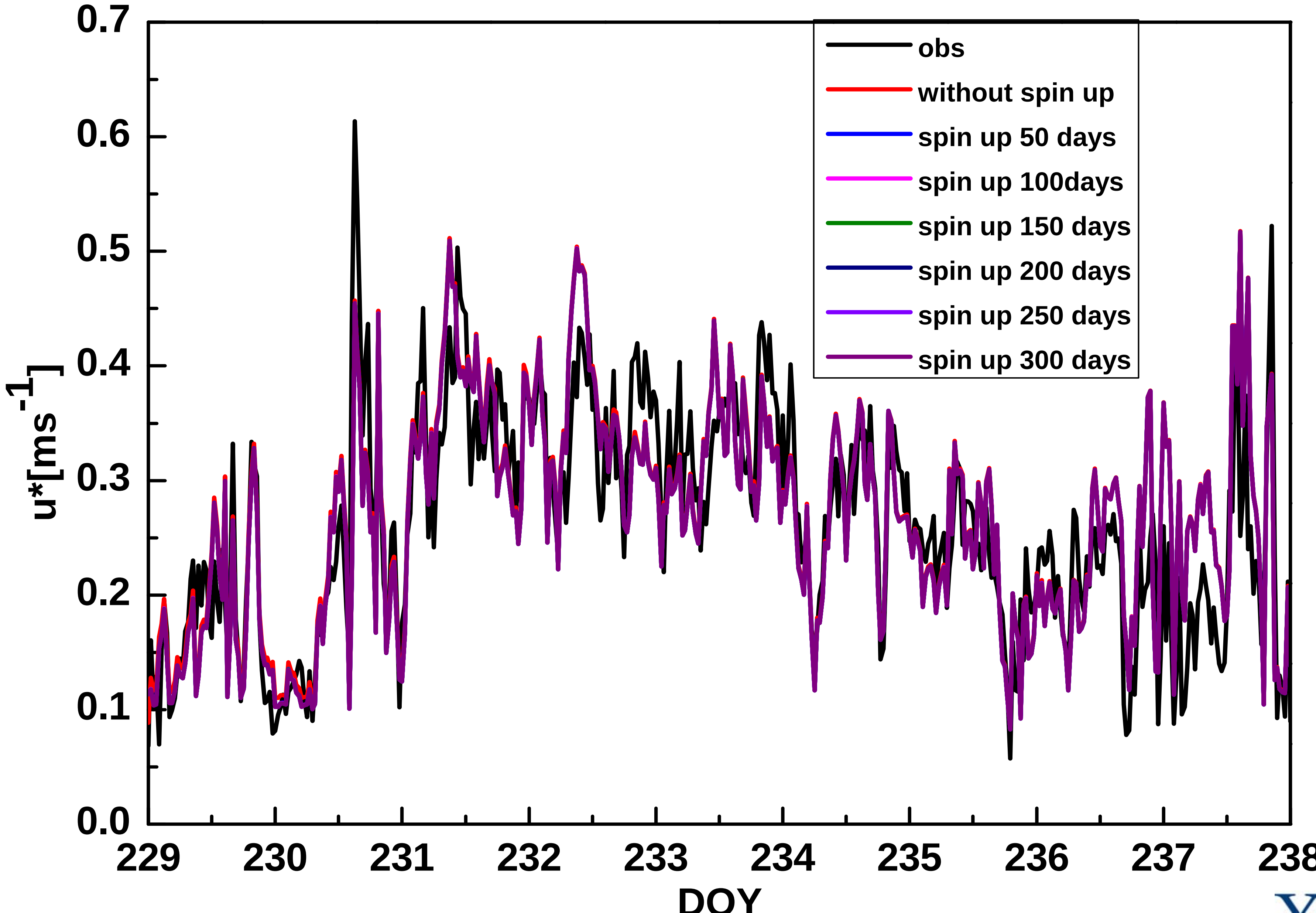

Fig.4 Friction velocity comparison for DOY 229-238,2010

- 1. To lake body temperature, the simulation of spin up more than 150 days matched most closely with the observations, but the simulation became stable by spinning up 300 days, if spin up more than 300 days, the magnitude gap was less than 0.0001.
- 2. To both sensible heat flux and latent heat flux, the simulation without spin up was better as a result of the initial value of lake water temperature was higher than observation.

- **2.Comparison of different eddy diffusion coefficient (ke).**

Table2 Sensitivity experiment on eddy diffusion coefficient

	default	Case a	Case b	Case c	Case d
Ke	0.02	0.005	0.012	0.1	0.2

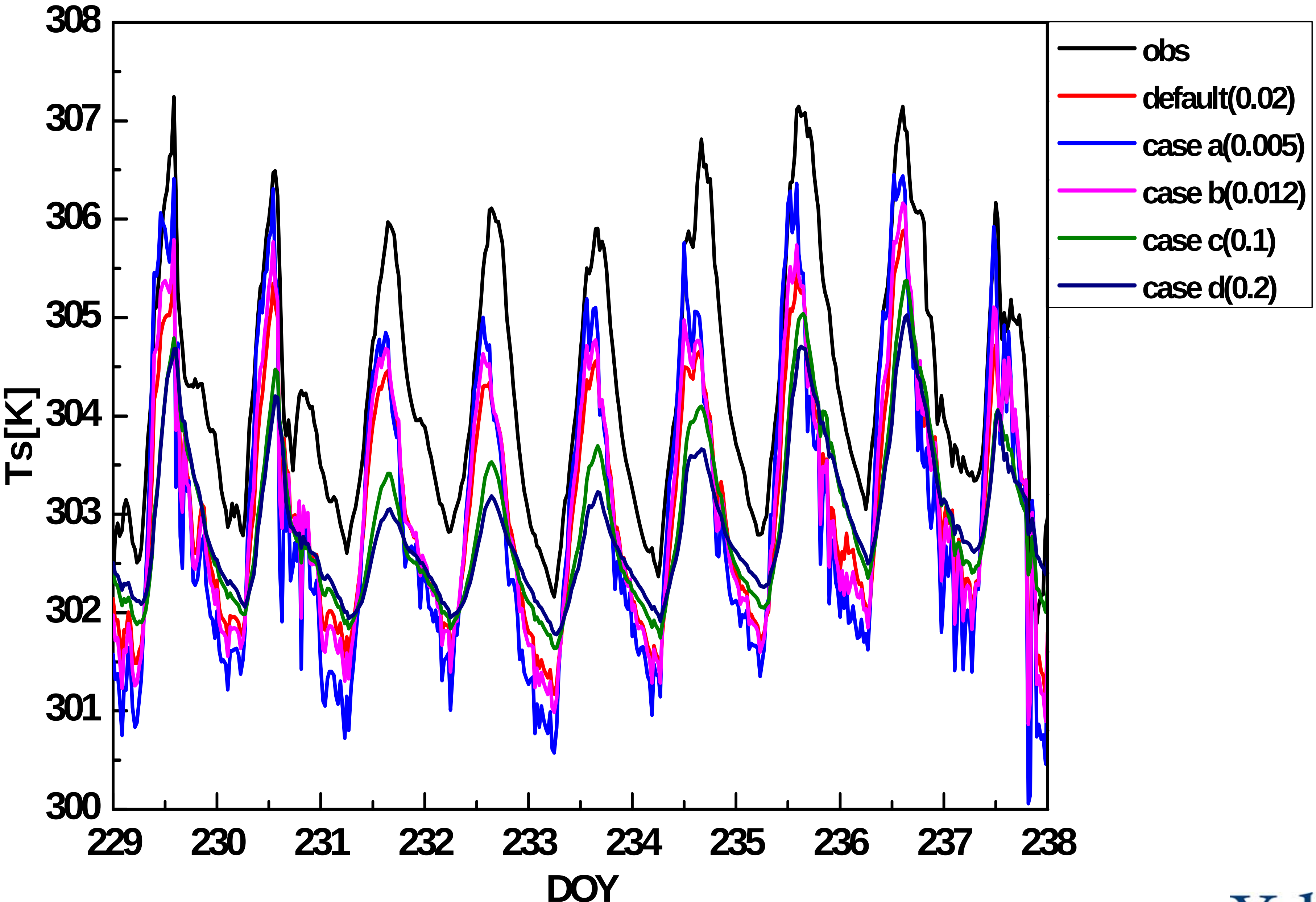

Fig.5 Surface Temperature

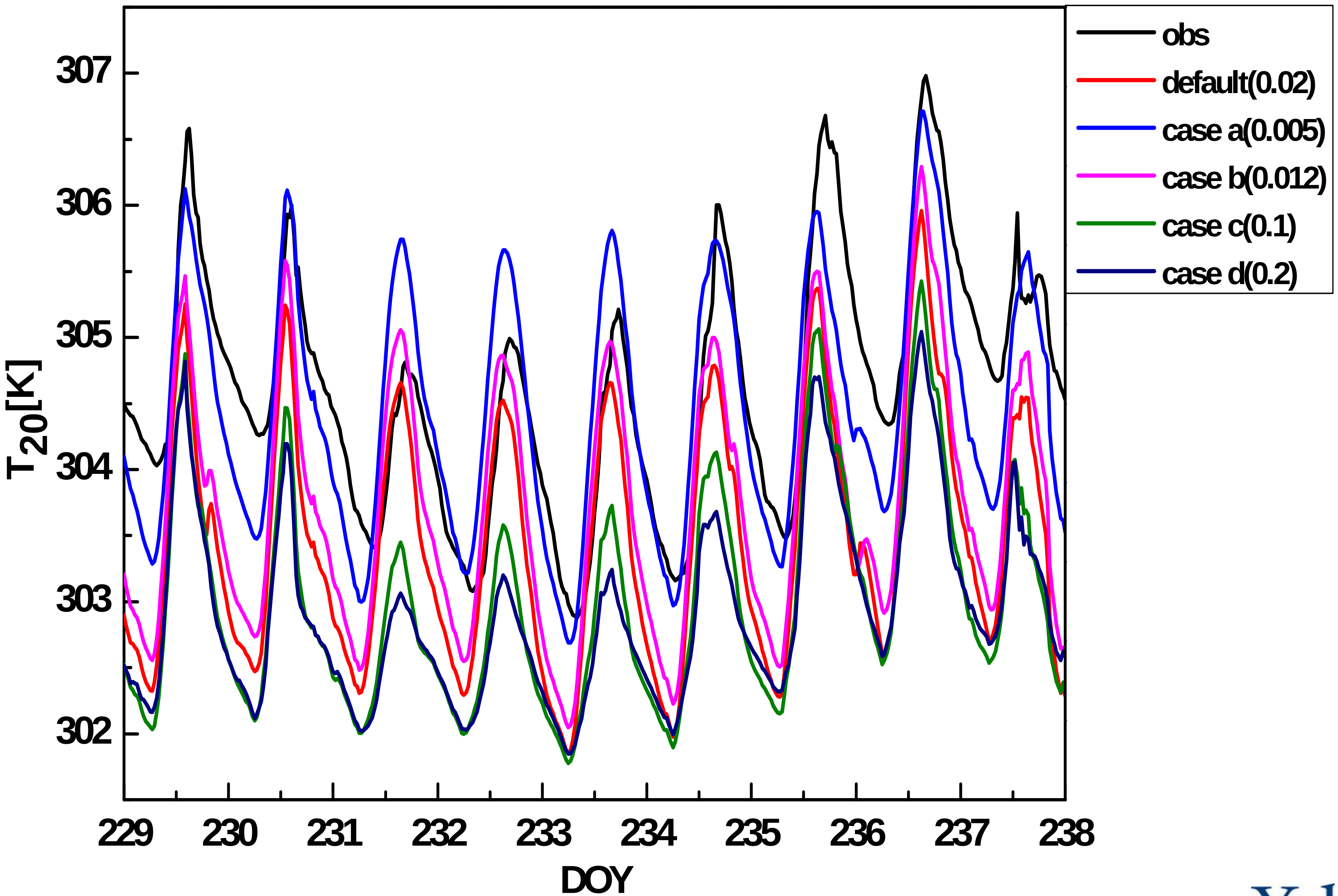

Fig.6 T_lake at 20 cm

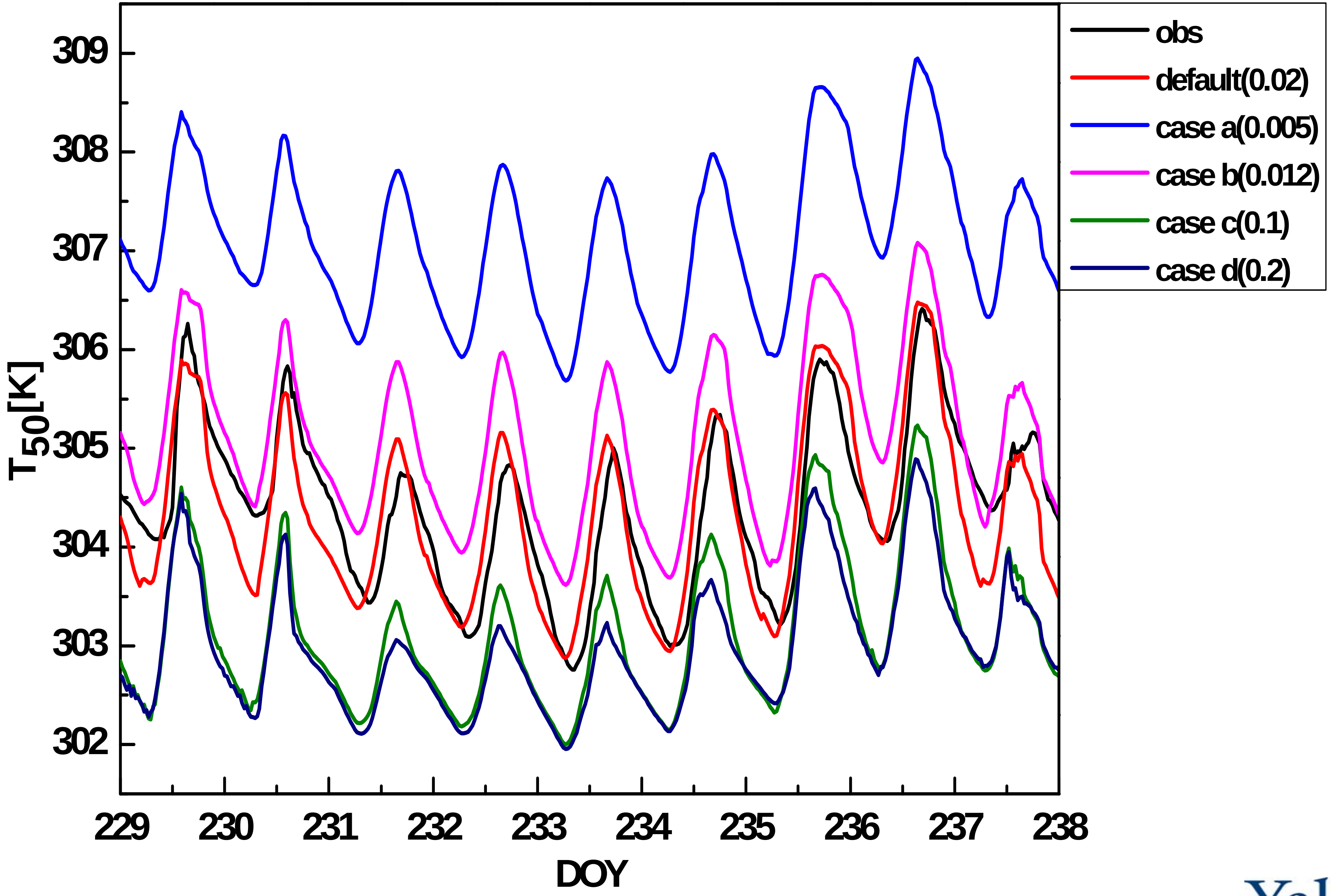

Fig.7 T_lake at 50 cm

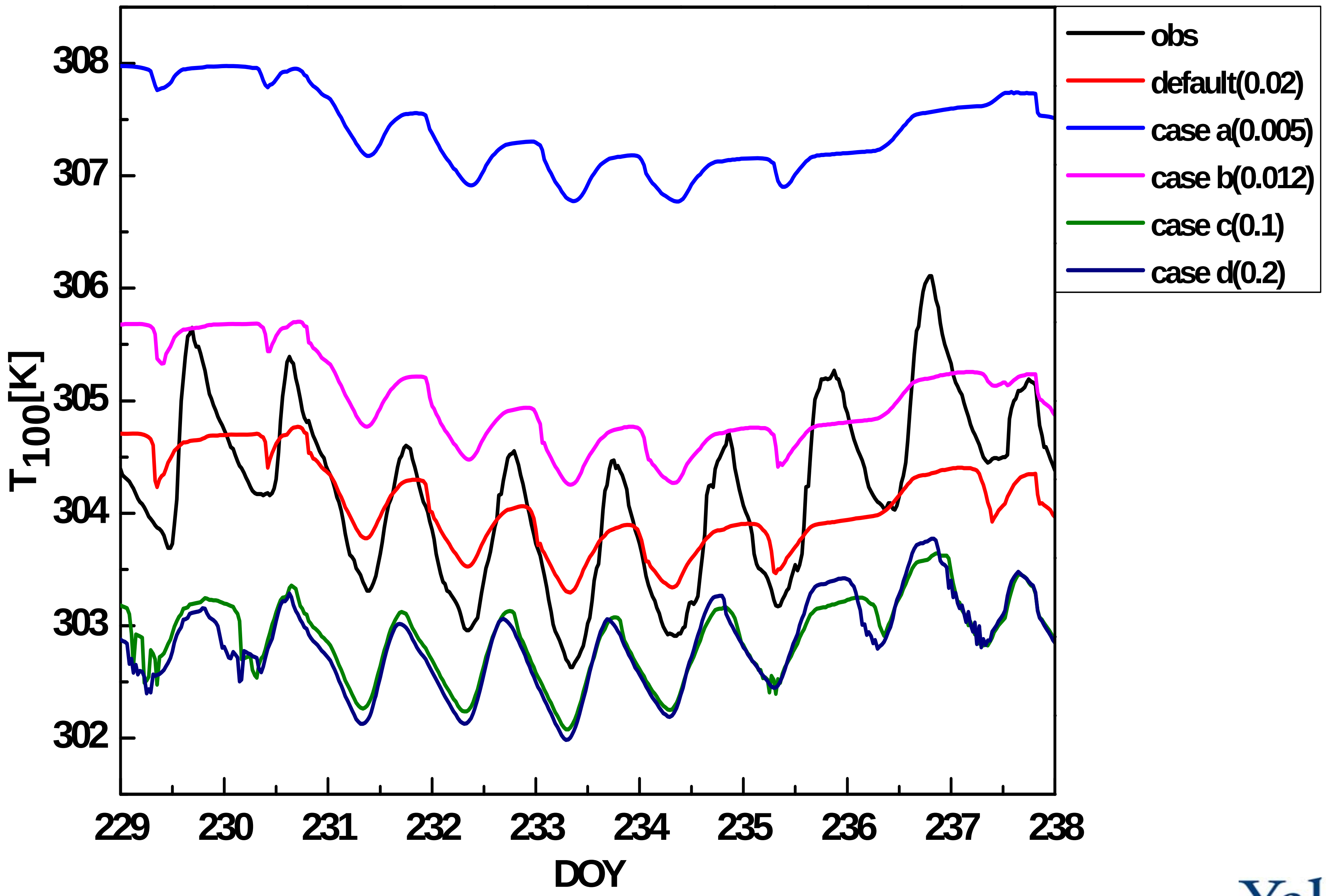

Fig.8 T_lake at 100 cm

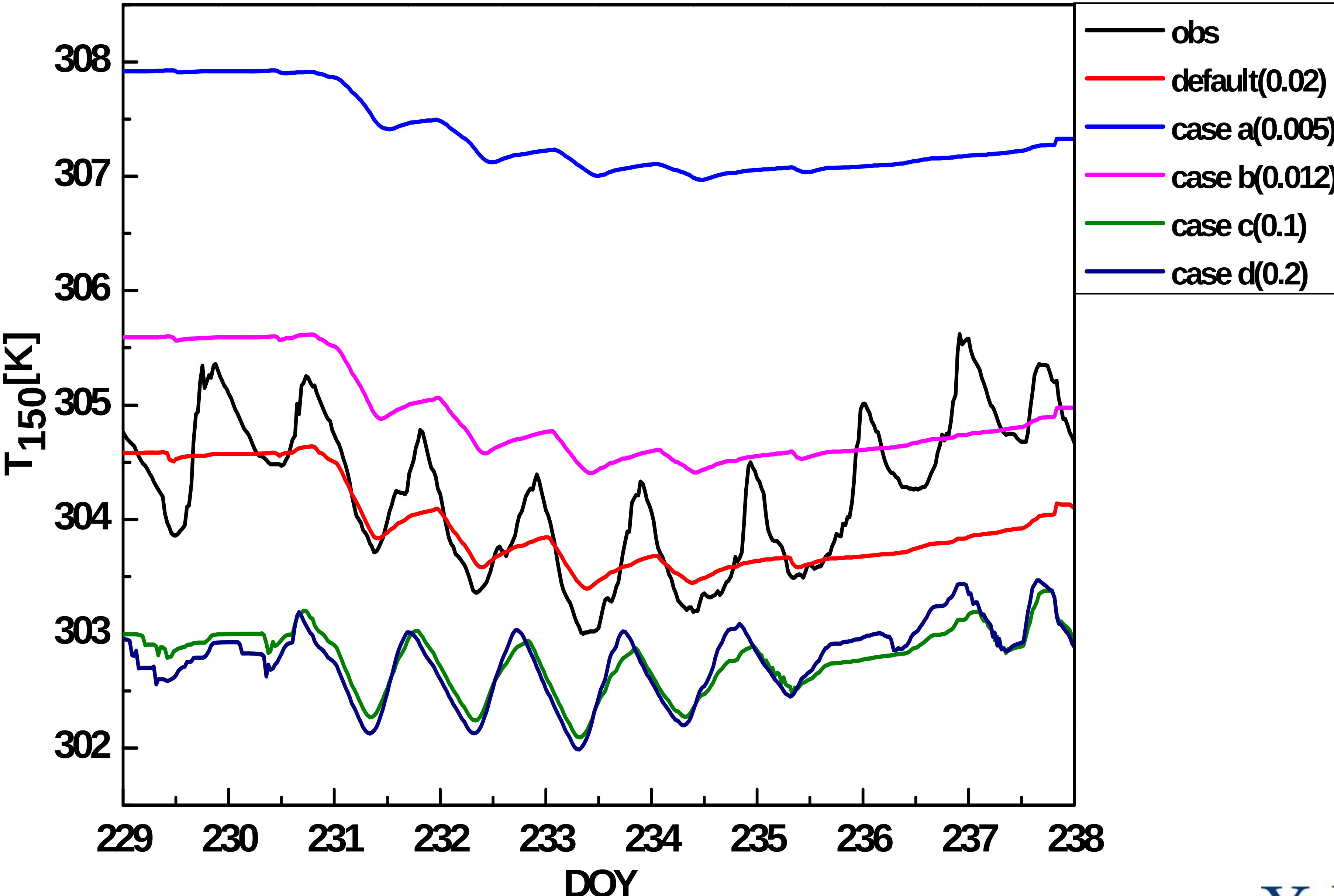

Fig.9 T_lake at 150 cm

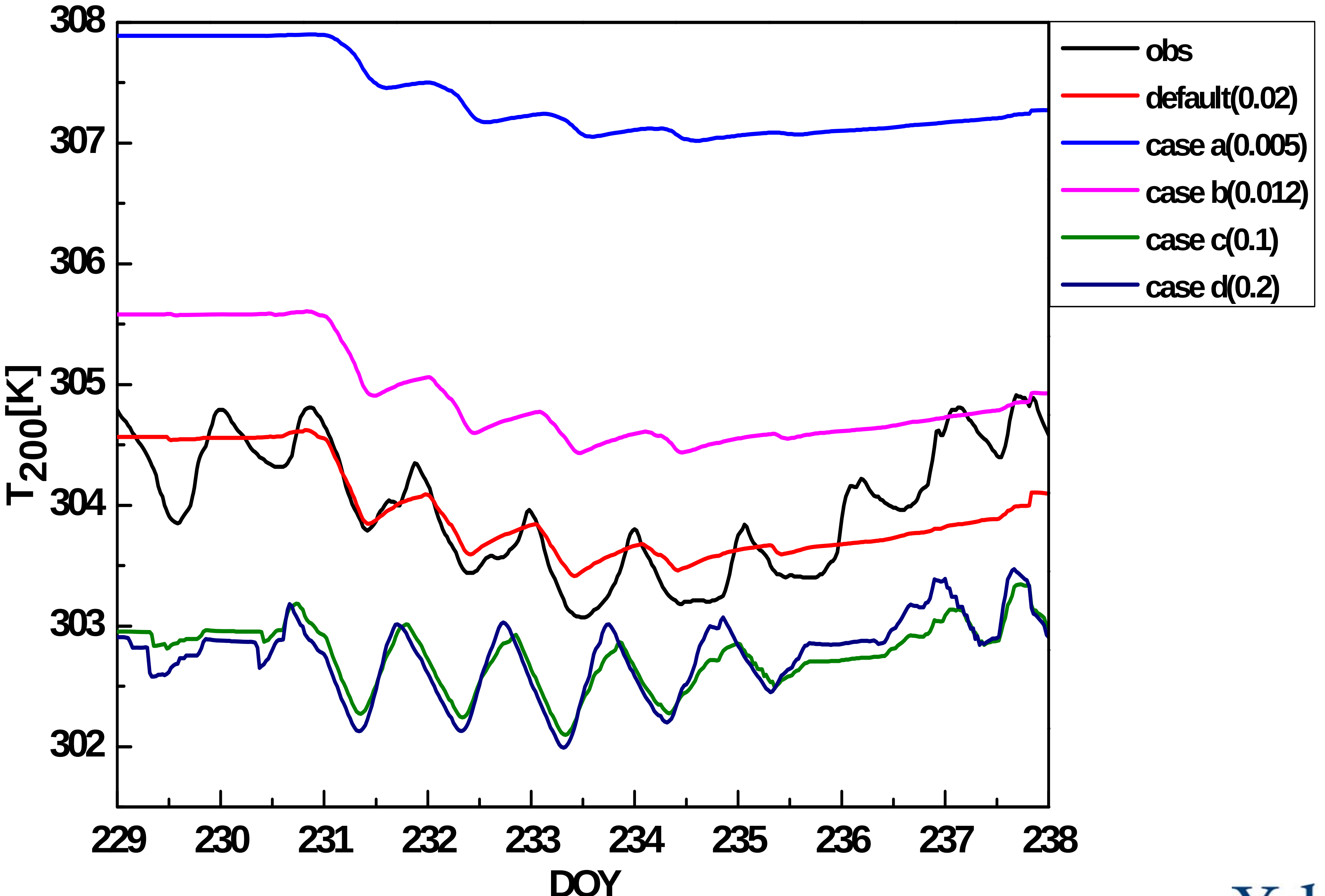

Fig.10 T_lake at 200 cm

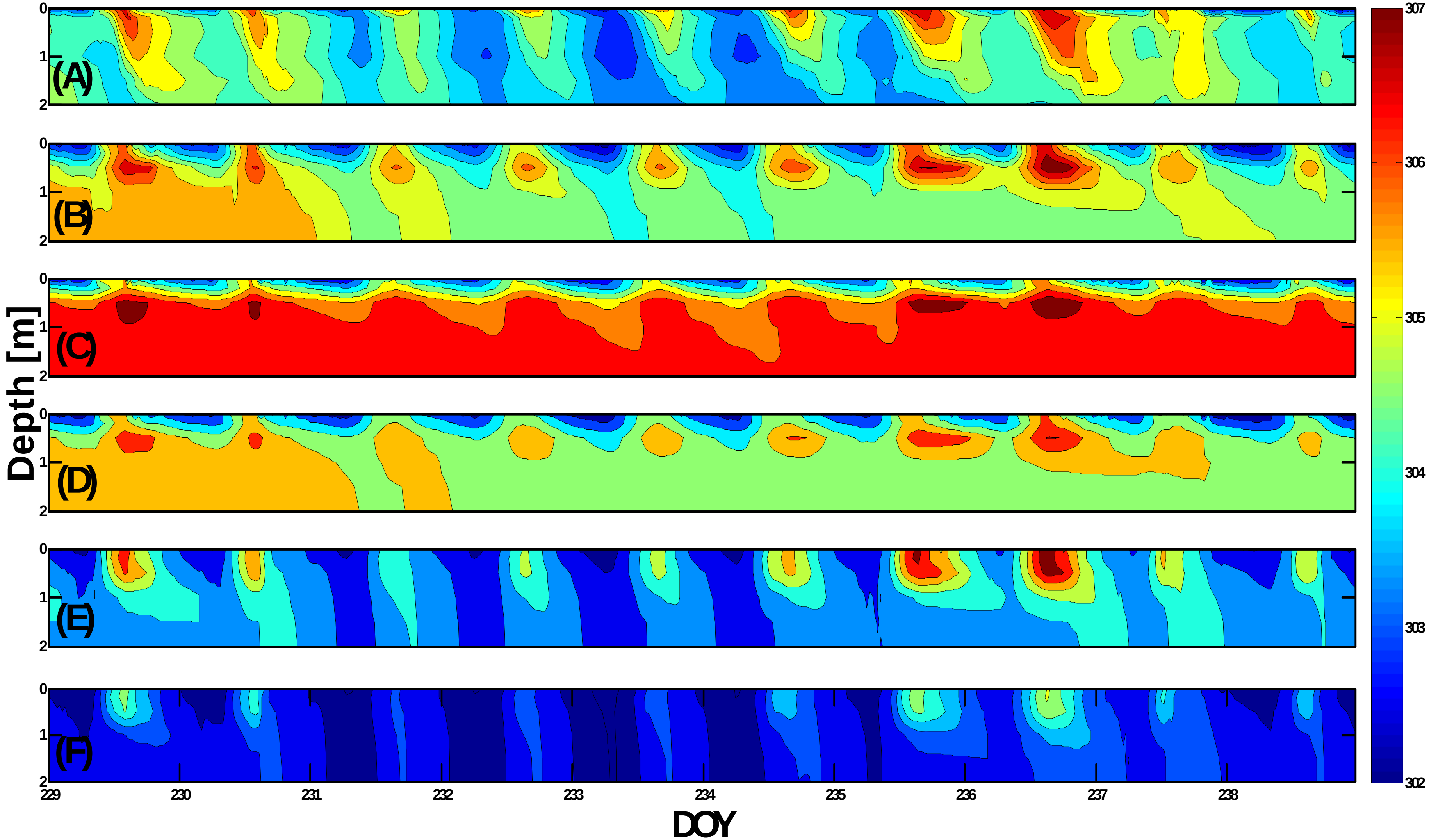

Fig.11 Temperature comparison for DOY 229-238, 2010.(ke)

(A): obs; (B): default(0.02); (C): case a(0.005);

(D): case b(0.012); (E): case c(0.1);(F):case d(0.2).

- 1.During the daytime, the smaller the eddy diffusion coefficient, the better the simulation; During the nighttime, the bigger the eddy diffusion coefficient, the better the simulation; In the later tests, we can set for day and night different eddy diffusion coefficient.
- 2.With the increasing of eddy diffusion coefficient, the diurnal variation of the surface temperature decreased, the lake interpass temperature gradient was also reduced.
- 3.The deeper part of the lake, the smaller the lake temperature of diurnal variation.

- **3.Comparison of different light extinction coefficient (η).**

Table3 Sensitivity experiment on light extinction coefficient

	default	Case a	Case b	Case c	Case d
η	5	0.2	2.5	7.5	10

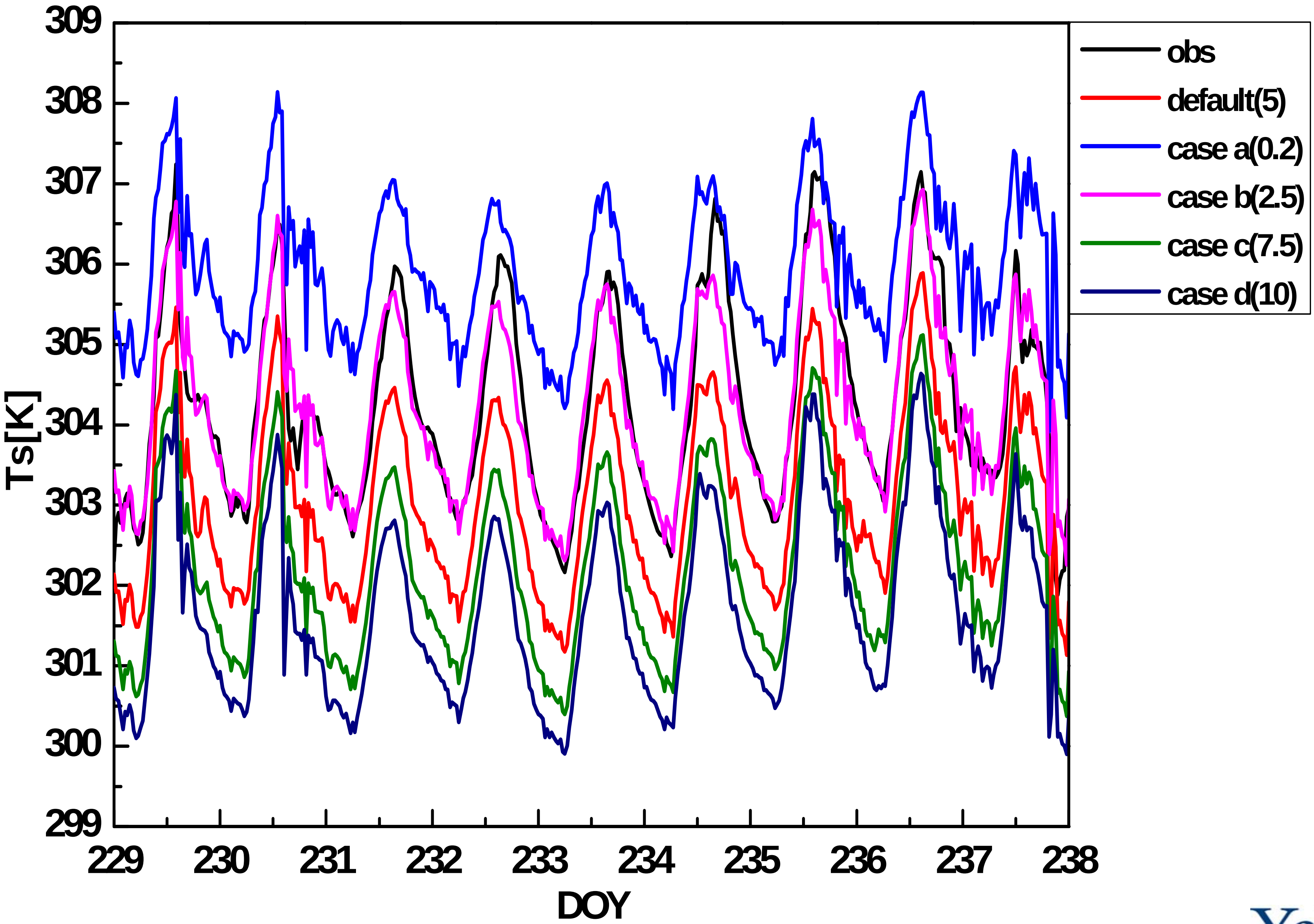

Fig.12 Surface Temperature

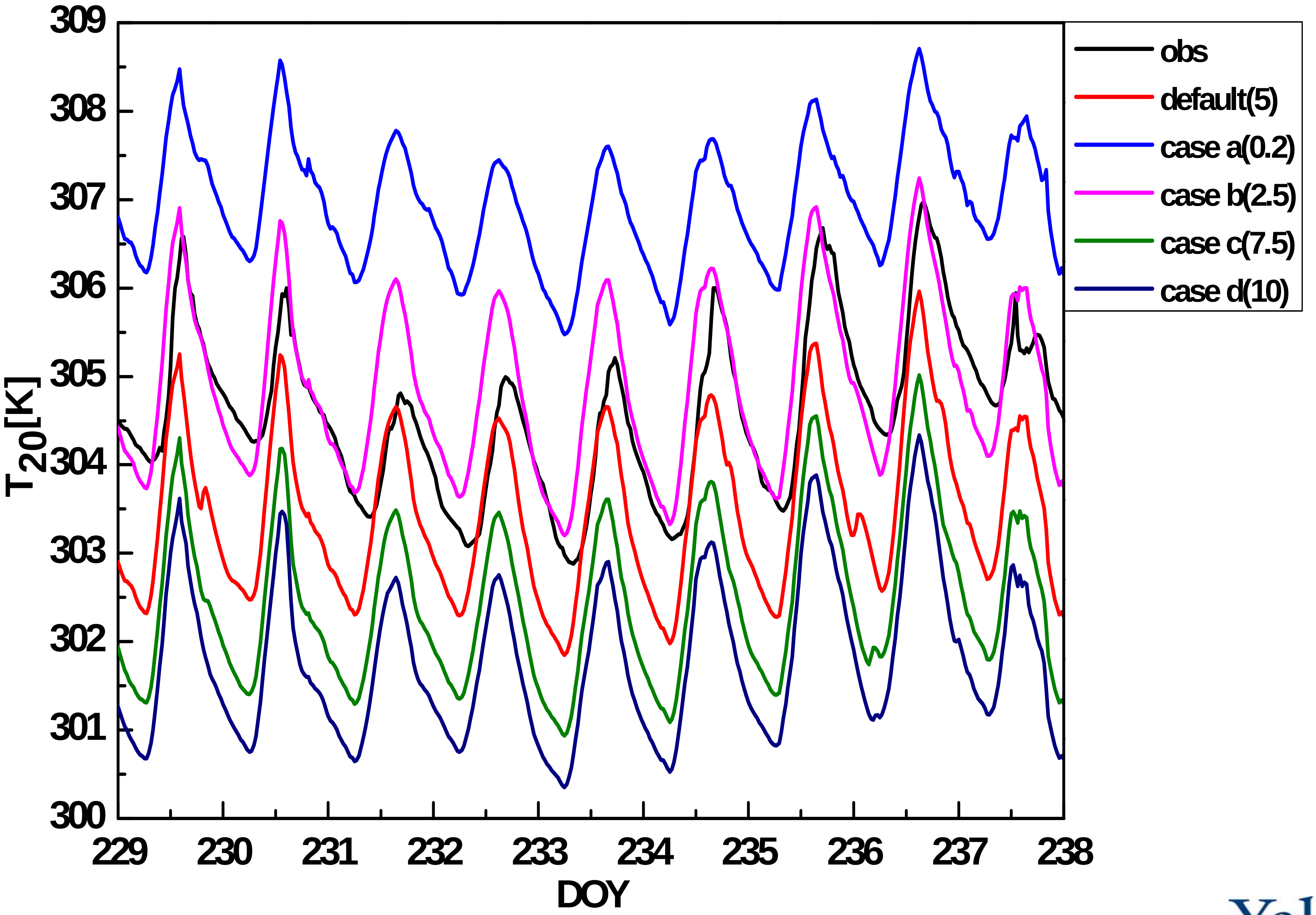

Fig.13 T_lake at 20 cm

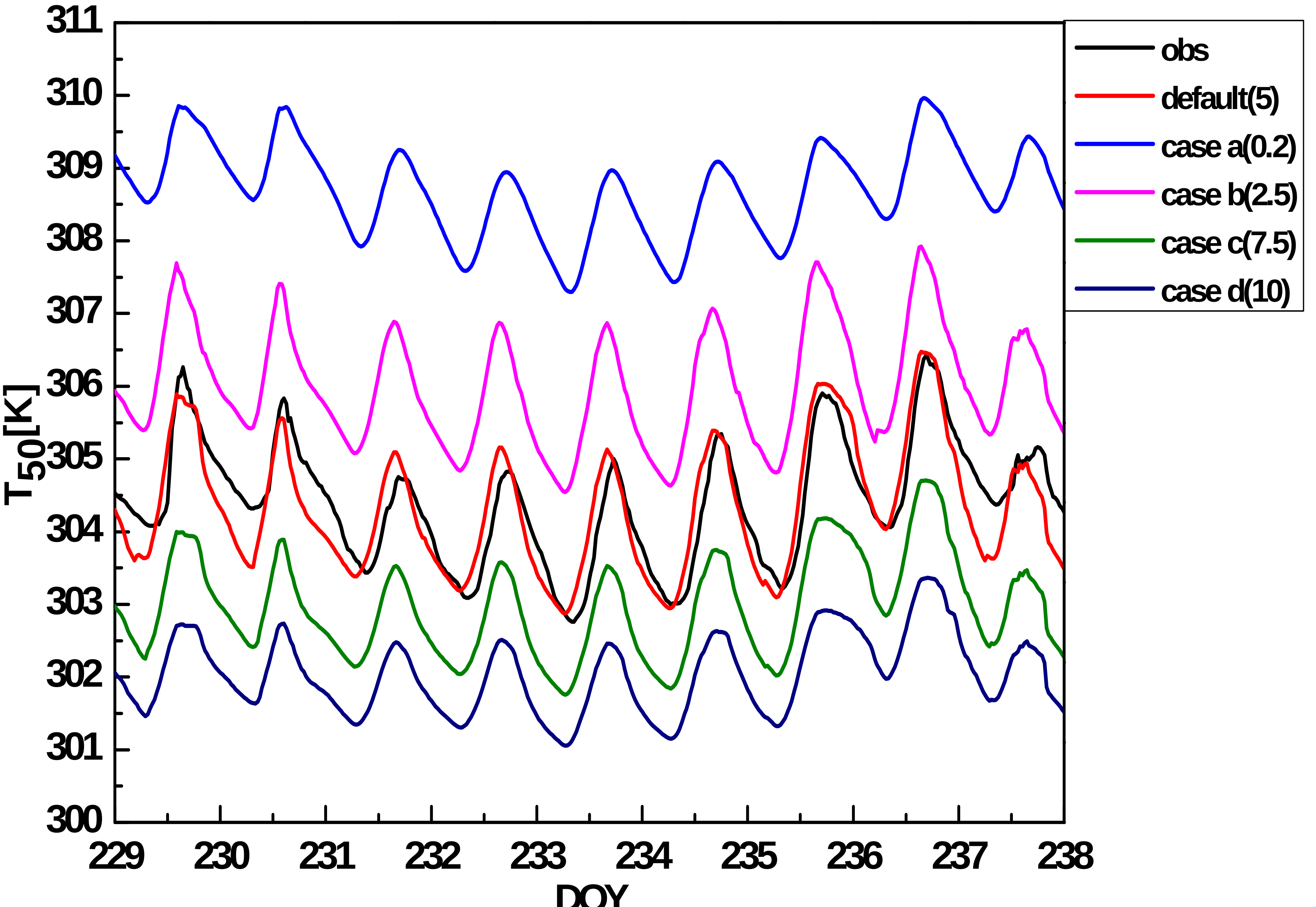

Fig.14 T_lake at 50 cm

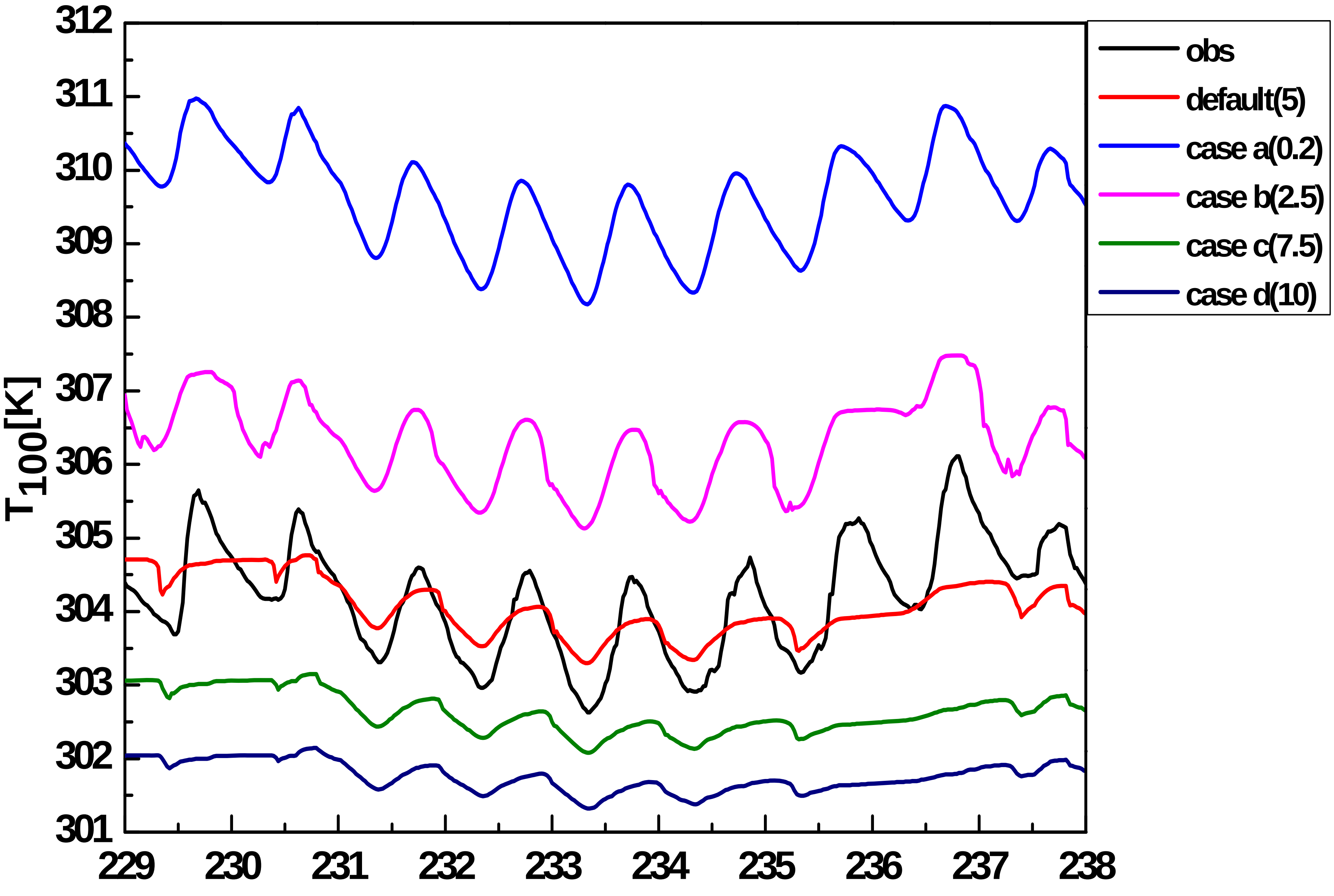

Fig.15 T_lake at 100 cm

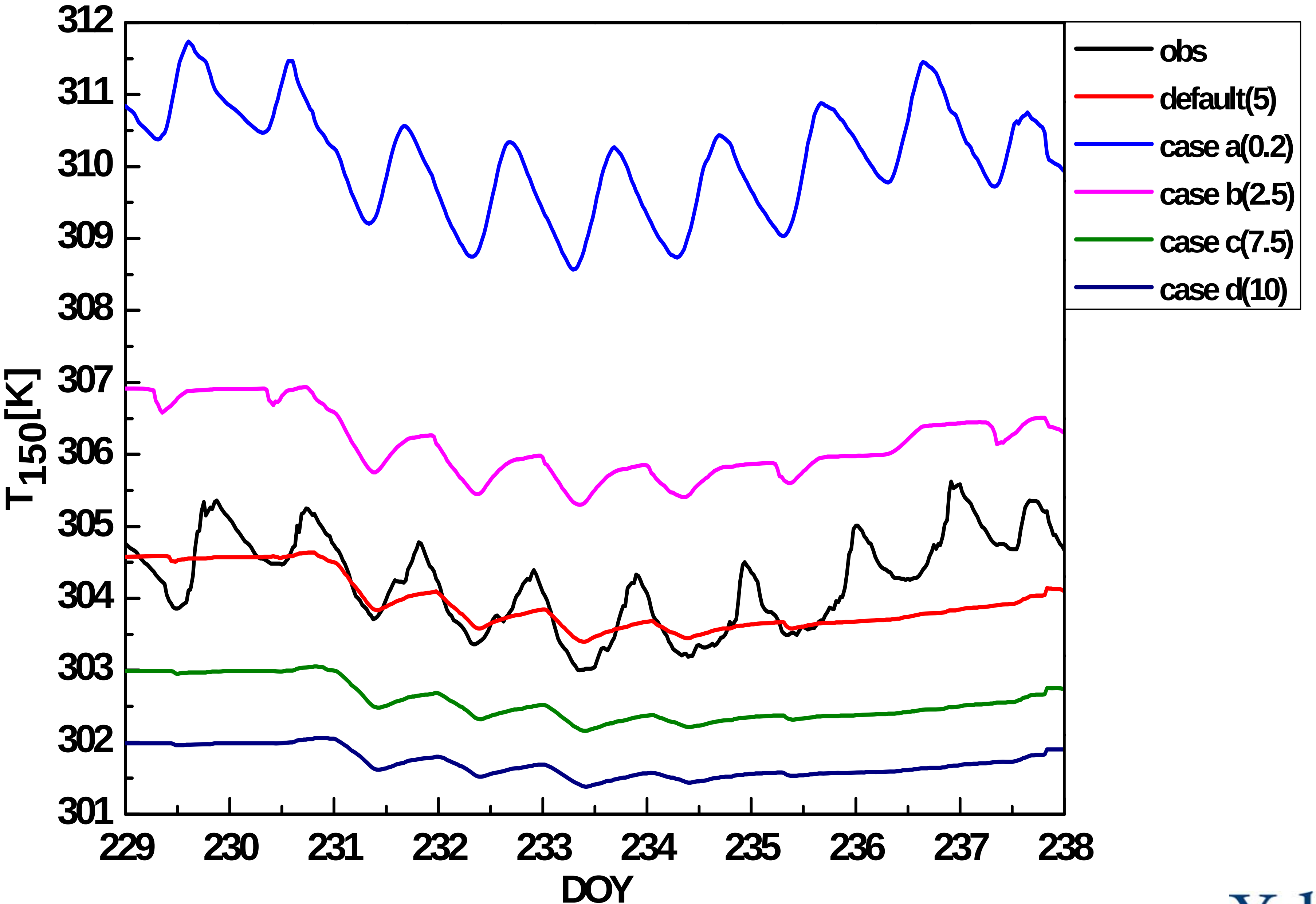

Fig.16 T_lake at 150 cm

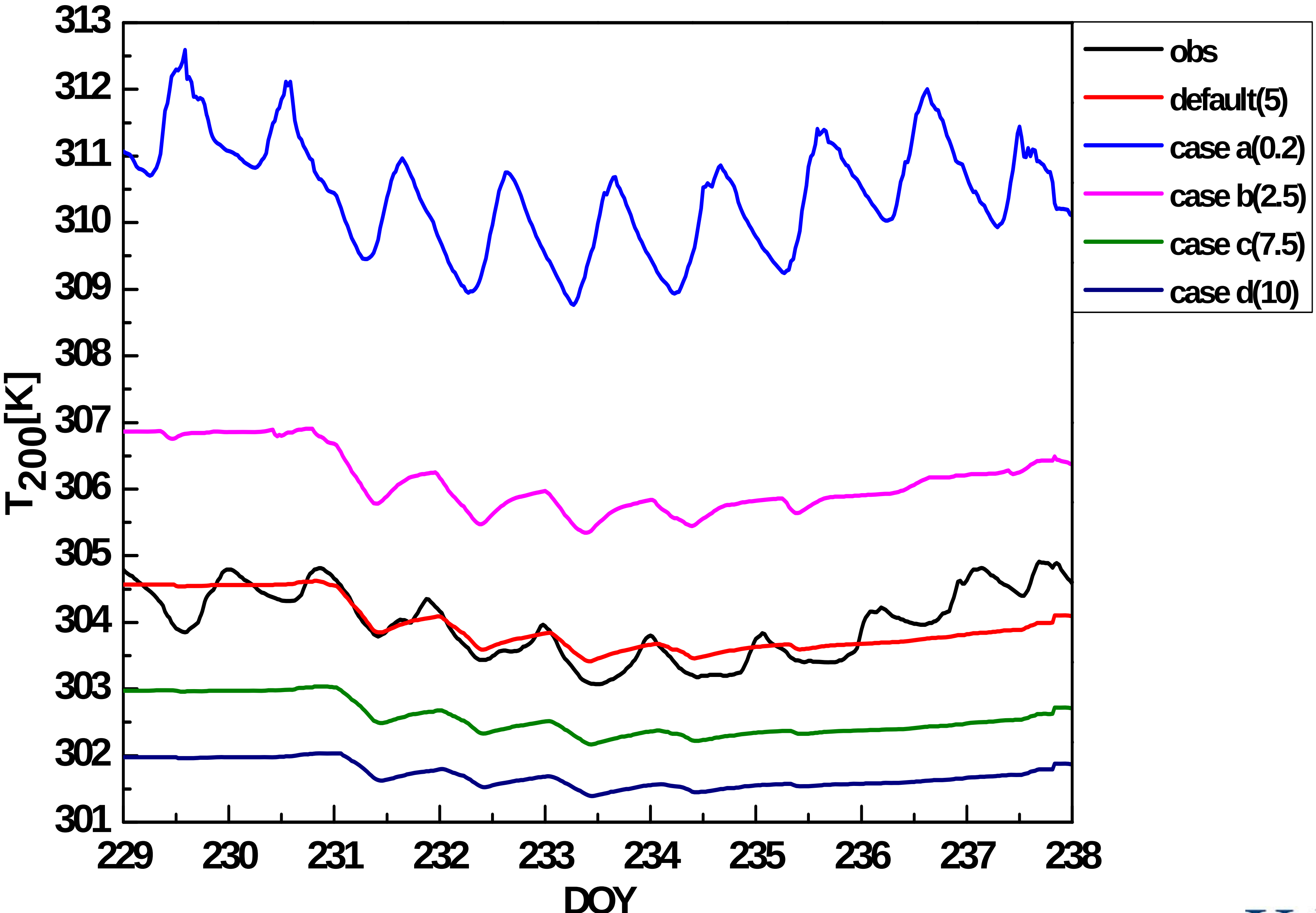

Fig.17 T_lake at 200 cm

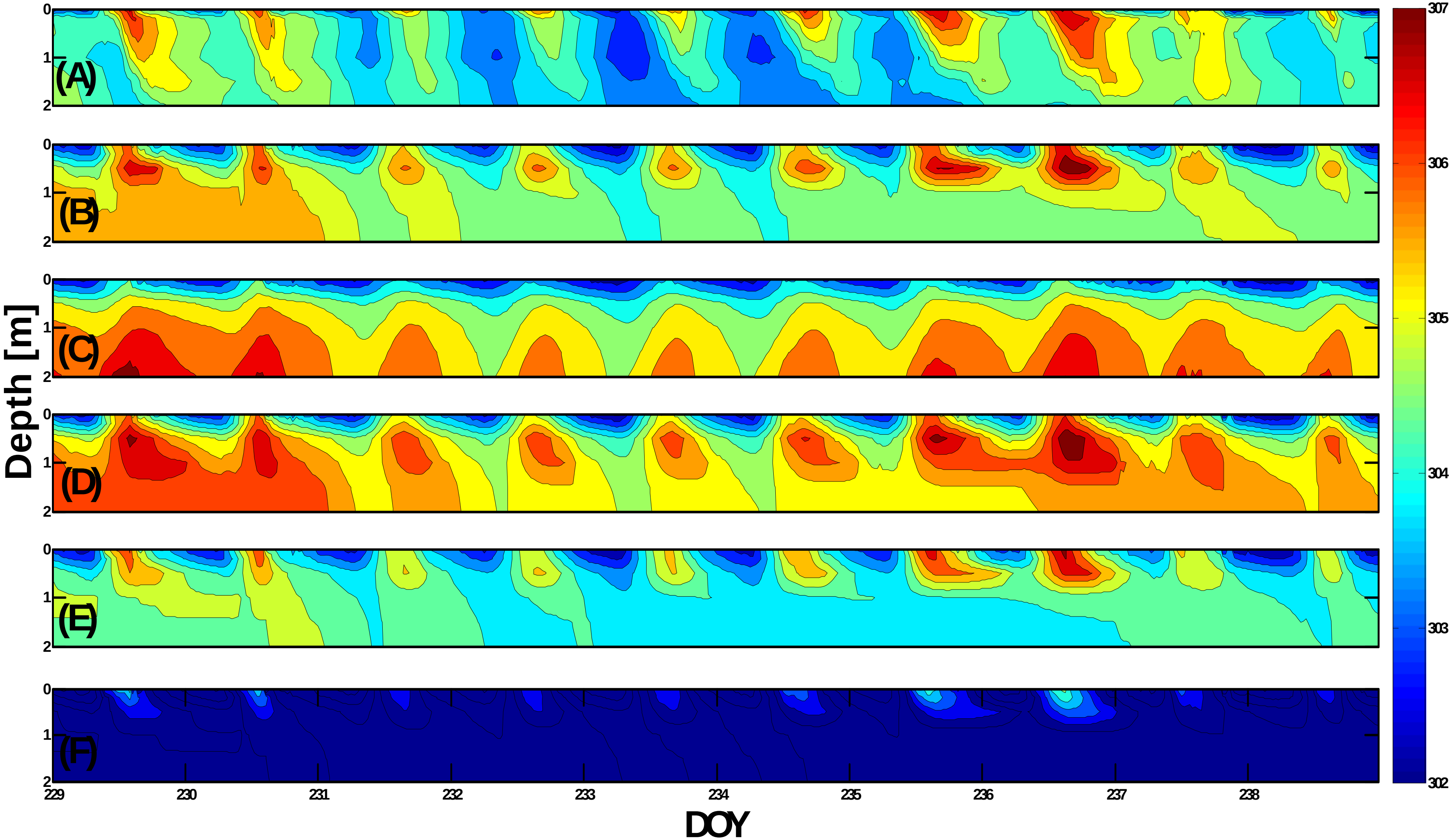

Fig.18 Temperature comparison for DOY 229-238, 2010.(η)

(A): obs; (B): default(5); (C): case a(0.2);

(D): case b(2.5); (E): case c(7.5);(F):case d(10).

Yale

- 1.The simulation of both surface temperature and temperature at 20 cm deep was well when the light extinction coefficient set as 2.5.
- 2.When the lake temperature was deeper than 50 cm, the simulation was better when the light extinction coefficient was 5.
- 3.With the increase of the depth, changing the same amount of the light extinction coefficient, the smaller the light extinction coefficient, the larger the range of lake temperature, the diurnal temperature variation was more obviously.

Thank You