Grassland dynamics and the driving factors based on net primary productivity in Qinghai province, China

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Eight equations

1 Equations and parameters on CASA model

\[ APAR(x,t) = PAR(x,t) \times FPAR(x,t) \]  \hfill (1)

\[ \varepsilon(x,t) = T_x(x,t) \times W_x(x,t) \times \varepsilon_{max} \]  \hfill (2)

where \( PAR(x,t) \) stands for the total solar radiation of pixel \( x \) in \( t \) time (MJ m\(^{-2}\)); \( FPAR \) represents the fraction of absorbed \( PAR \) of pixel \( x \) in \( t \) time; \( T_x \) and \( W_x \) stand for the effects from the temperature stress and the moisture stress, respectively; \( \varepsilon_{max} \) is the maximum LUE, which is set as 0.115~0.326 across different grassland types (gC/MJ) [1].

\( PAR \) was calculated using the following formula[2]:

\[ PAR = \frac{1}{50} \times (D_0 + D_1 L + D_2 E + D_3 V) (a + b S) \]  \hfill (3)

where \( D_0, D_1, D_2, D_3, a \) and \( b \) stand for constants; \( L \) represents the latitude; \( E \) represents elevation (m); \( V \) is the monthly vapor pressure (pa); and \( S \) stands for the proportion of sunshine duration (\%).

\( FPAR \) can be calculated as follows [3]:

\[ FPAR = a \times NDVI + b \]  \hfill (4)

where \( a = 1.1638 \) and \( b = -0.1426 \) are empirical parameters.

\( T_x \) is calculated as follows:

\[ T_x(x,t) = T_1(x,t) \times T_2(x,t) \]  \hfill (5)

\[ T_1(x,t) = 0.8 + 0.2 \times T_{opt}(x) - 0.0005 \times \left( T_{opt}(x) \right)^2 \]  \hfill (6)

\[ T_2(x,t) = \frac{1.184}{1 + \exp \left( 0.2 \times T_{opt}(x) - 10 - T(x,t) \right)} \times \frac{1}{1 + \exp \left( 0.3 \times \left[ - T_{opt}(x) - 10 - T(x,t) \right] \right)} \]  \hfill (7)

\( T_{opt} \) is the monthly air temperature as the AGB comes up to the peak; \( T_1(x,t) \) and \( T_2(x,t) \) are the temperature stress coefficients, which reflect the reduction in light-use efficiency caused by a temperature factor (Potter et al., 1993).

\( W_x(x,t) \) stands for monthly water deficit [4], which is determined based on the monthly values of actual evapotranspiration \( E(x,t) \) and potential evapotranspiration \( E_p(x,t) \), indicating that the reduction in light-use efficiency caused by a moisture factor.
\[ W_p(x,t) = 0.5 + 0.5 \frac{E(x,t)}{E_p(x,t)} \]  

(8)

where \( E(x,t) \) (mm) and \( E_p(x,t) \) (mm) are calculated according to the model of regional actual evapotranspiration and the approach of complementary relationship between actual evapotranspiration and potential evapotranspiration [5,6].

References


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