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Research paper

Performance of ecosystem water utilization in Inner Mongolia temperate pasturage

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A R T I C l E I N F O

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A B S T R A C T

Describing spatial deviations in pasturage ecosystem water-utilization performance (ewup) would help our knowledge of how pasturage ecosystems' water responds to weather change. Nevertheless, complete knowledge of the spatial deviations of ewup in Inner Mongolia's temperate pasturage is yet to be get. We have analyzed the spatial patterns of ANPP and ewup along with a rainfall rise in the pasturage. The ANPP advanced exponentially with rising mean annual evapotranspiration (MAE). The ewup grew linearly by growing mean annual precipitation (MAP).

Introduction

Aboveground net primary productivity (ANPP) that is a key feature of vegetation ecosystems, and combines various factors of ecosystem structure and functioning in its amount (Paruelo et al., 1999). Evapotranspiration (ET) is a powerful predictor of ANPP patterns across large areas (Webb et al., 1983). Ecosystem water-utilization performance, the ratio of ANPP to ET, delivers an impact necessary measurement for assessing the ANPP response to shifts in ET. Investigating the spatial deviations in ewup is a good to predict the impacts of temperature differences on vegetation productivity. China maintains the second-largest region of pasturage in the world. The pasturage is about forty percent of the country (Fan et al., 2008). Temperate pasturage is the major pasturage kind. It has great importance for global weather modification analysis and the production of livestock (Hu et al., 2007). Some investigators (Bai et al., 2008; Hu et al., 2010) have desired for improving our performance knowledge of the spatial pattern of precipitation use efficiency along with a precipitation rise in Chinese temperate pasturage, but a complete knowledge of the spatial pattern of ewup along the precipitation rise is yet to be reached. In comparison with PUE, the ewup supplies more sense to the ecological structure and operational in the pasturages.

In this investigation, we have studied the spatial deviations in ANPP and ewup , with a precipitation rise in the pasturage of Inner Mongolia that contains most of the Chinese temperate pasturage. This investigation tries for addressing the following analysis questions: (1) What is the condition of the ET-ANPP connection in the pasture? (2) What is the spatial pattern of ewup with the precipitation rise?

Methodologies

Case study

The investigation has been performed in the Inner Mongolia Autonomous Region (IMAR) in northern China. The IMAR has 78.8 million hectares of natural pasturage, which is reported 66 percent of the whole site. Inner Mongolia's temperate pasturage belongs to the arid and semiarid areas which rainfall the main weather element is restricting plant growing. From east to west, mean annual precipitation (MAP) in the area reduces from 500 to 100 mm. The soil changes from chernozems, chestnut, and meadow soil to calcic brown and desert soils from the wet northeast to the dry southwest with the rise. The investigation site is the major area of temperate pasturage in China. The vegetation shifts progress from field steppe in the east to generic steppe in the center and desert steppe in the west by reducing rainfall.

Measurements of aboveground net primary productivity

In this investigation, ANPP has been calculated as the maximum aboveground biomass in the growing seasons. This is a famous approach to evaluating pasturage ANPP. We have gathered ANPP data on a whole of fifty-seven zonal areas that have been fenced for preventing grazing. 2 resources have been utilized: (1) long period of time observances. In this database, a whole of fourteen locations has been chosen from this database resource. (2) Literature. A whole of forty-three locations has been chosen from this resource.

Weather elements

Zhou and Zhang (1995, 1996) presented a model of yearly ET. The model presents a method to estimate yearly ET on the basis of yearly precipitation (P) and radiation dryness index (RDI):

$$EI = \frac{P \times RDI \times (1 + RDI + RDI^2)}{(1 + RDI) \times (1 + RDI^2)}$$

Where ET demonstrates the yearly evapotranspiration, P shows the yearly precipitation, the yearly radiation dryness index is shown by RDI, and RDI is as the following formulation:

$$RDI = 0.629 + 0.237 \times PER - 0.00313 \times PER^2$$

$$PER = BT \times \frac{58.93}{P}$$

$$BT = \sum MMV12$$

Where the radiation dryness index is demonstrated by RDI, PER belongs to the yearly potential evapotranspiration ratio, BT is yearly temperature, P shows yearly rainfall, and MMT is the monthly average temperate (if MMT > 30°C, then MMT = 30°C; if MMT < 0°C, then MMT = 0°C). We obtained yearly precipitation, yearly average temperature, and monthly average temperature, and interpolated the location-special weather data.

Results

The temperate pasturage ANPP in Inner Mongolia grew exponentially by growing average yearly evapotranspiration (MAE) (ANPP = 15.61e0.01MAE, R2 = 0.59, $p < 0.001$), indicating an growing ewup by growing MAE by the precipitation rise as demonstrated in Fig. 1. Utilizing long period of time observance database, we had studied the spatial deviations in ewup in the driest years (ewup dry, estimation from lowest precipitation and related ANPP) and the moistest years (ewup wet, estimation from highest precipitation and corresponding ANPP). With the precipitation rise, ewup dry and ewup wet whole tended for increasing by MAP ($p < 0.001$) as shown in Fig. 2.

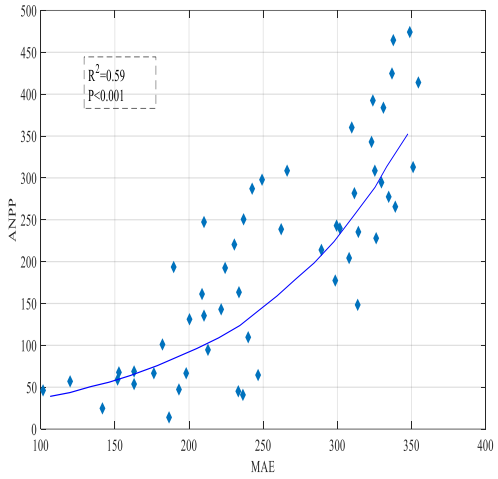

Fig. 1. Spatial relation among aboveground net primary productivity and MAE

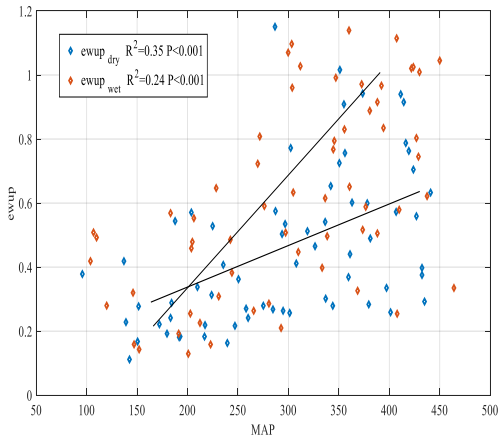

Fig. 2. Spatial relation among MAP and $ewup_{dry}$ and $ewup_{wet}$

Conclusion

Our investigation demonstrated that ANPP advanced exponentially by growing MAE, and the ewup improved linearly by growing MAP with a precipitation rise in Inner Mongolia temperate pasturage. There has been no consistent spatial ewup with precipitation rise.

Conflict of interest

The authors declare that they have no conflict of interest.

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