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The 38 years of the microclimate change dynamics across a cropland-windbreak-desert transition zone in the Ulan Buh Desert, northern China

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The windbreak system is a major component of successful agricultural systems in arid deserts throughout the world. Ulan Buh Desert is one of the eight biggest deserts in China, and the oases there offer residence and cropland for over 90% of the local residents. However, due to climate change and human disturbances, the Ulan Buh Desert continues spreading to the south, bringing more pressure on the windbreak systems there. Meanwhile, the Chinese government put much effort into greening the desert, establishing artificial shrubs to prevent dune movement and soil loss. How microclimate in the cropland-windbreak-desert system responded to human activities and climate change has rarely been studied. In this study, we investigated the microclimate change dynamics across the cropland-windbreak-desert transition zone during the past 38 years. Two 50 m climatological towers, located in the same distance inner and outside a shelterbelt, have continuously monitored climatic factors, including air temperature, soil temperature, relative humidity, precipitation, evaporation, layered wind speeds, etc., and aeolian erosion related factors, such as layered dustfall. The long-time fluctuations of the inside and outside climatic factors have been analyzed, and the global climate change data, local land-use history, as well as the record of afforestation activities implemented by government and local people, were also collected. The results revealed that both the inside and outside windbreak air temperatures and soil temperatures increased during the past 38 years, which agrees with the global warming phenomenon. The inner windbreak air temperature is consistently lower than the outer windbreak areas, and the temperature difference is biggest in summer and smallest in winter. However, the soil temperature difference between the outside and inner windbreak is unstable. In 1995, 2002, and 2004, the dune areas even had lower soil temperature than the inner cropland. The precipitation is 0.5~100.7mm higher in cropland and the evaporation is lower in cropland when comparing to outside dune areas, but their annual variations changed greatly. The wind speed and erosion rate are significantly lower in cropland than desert dune areas, and the seasonal change exhibited a bimodal curve pattern. The results suggest that the cropland-windbreak-desert transition zone responded to global climate change simultaneously. Although the shelterbelt still creates a favorable regional climatic condition for the cropland, the differences

between the inner and outer windbreak areas narrowed during the past 10 years. The aeolian erosion rate reduced significantly in outside windbreak dune areas, which may largely attribute to the artificial Haloxylon ammodendron communities planted at the southeastern margin of the desert.