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IMPACT OF EXTREME CLIMATE ON THE CARBON BALANCE OF STEPPE ECOSYSTEMS WITH DIFFERENT LAND-USE REGIMES

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We present the first results of our direct chamber measurements of CO_2 fluxes (NEE, Reco) in steppe ecosystems of the «Zauralskaya Steppe» site of Eurasian Carbon Polygon (Republic of Bashkortostan) in 2025, during the hydrothermally abnormal vegetation season. Our aim was to assess the seasonal carbon balance of 4 ecosystems under conditions of a spring-shifted precipitation maximum and enhanced summer water stress: the natural steppe, post-agrogenic fallow, forb-dominated pasture, and *Artemisia* pasture. These ecosystems were found to function as net sources of CO_2. The cumulative carbon emission from April to September amounted to 284.4 gC m^{-2} in the natural steppe, 60.1 gC m^{-2} in the forb-dominated pasture, 66.0 gC m^{-2} in the *Artemisia* pasture, and 85.0 gC m^{-2} in the fallow. The largest daytime CO_2 uptake (NEE) was observed in June at the forb-dominated pasture (−187 mgC m^{-2} h^{-1}) and fallow (−171.6 mgC $m^{-2}h^{-1}$), but this sink potential was offset by high ecosystem respiration, with Reco peaking at 387.3 mgC $m^{-2}h^{-1}$ at the fallow. The main drivers of the seasonal net emission balance were the earlier start of snowmelt (29 March), the shift of the NDVI peak to late May, and the subsequent water stress (92 days with VPD > 1.5 kPa), which suppressed photosynthesis, while maintaining high respiratory fluxes. The results of our research indicate that, under the hydrothermal conditions of 2025, a shift of the phenological window of active vegetation and enhanced respiration made the steppe ecosystems of the Trans-Urals a persistent CO_2 source, regardless of their land-use type.

Keywords: steppe ecosystems, pastures, carbon balance, CO_2 flux, net ecosystem exchange, NEE, ecosystem respiration, Reco, vapor pressure deficit, VPD, post-agrogenic fallow, Southern Ural region.
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