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Climate determined differences in carbon dioxide fluxes dynamics between two comparable agroecosystems of Central Russia

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Creation of Russian part of Fluxnet - Rusfluxnet, aims to fill the carbon dioxide fluxes data shortage. Because the Central Russia is still one of the less GHG-investigated European areas especially in case of agroecosystem-level carbon dioxide fluxes monitoring by eddy covariance method. For the first time eddy covariance (EC) GHG study has been conducted at two representative agroecosystems of Central Russia belonging to different climate zones (climate and soils), but both with the same land use: the both fields were under barley. The study was carried out in 2013 and supported by RF Government grant No. 11.G34.31.0079.

The first agricultural field located at Precision Farming Experimental Field of the Timiryazev Agricultural University situated in Moscow. It's arable Albeluvisols Umbric have around 1% of SOC, 5.4 pH(KCl) and NPK medium-enhanced contents in sandy loam topsoil. The field was used for barley planting (Hordeum vulgare L., breeding line Mihailovsky). Sowing was in early May 2013 and harvest was in August, 14. The second agricultural field near the Pristen placed at Kursk region of Russia. It's arable Chernozems have around 4% of SOC, 6.5 pH(KCl) and NPK high-enhanced contents in sandy loam topsoil. The field was used for barley planting (Hordeum vulgare L., breeding line Xanadu). Sowing was 25-27 of April and harvest was 14-19 of August.

Instrumental equipments (mainly LI-COR) were the same for both stations. Both towers height was 1.4m. Footprints were considered by fields edges, and were about 55m for Moscow and about 150m for Pristen. Canopy growth and snow melting were taking into account in the model. Surface roughness was neglected. Calculations were done using EddyPro software.

Since Pristen field is 600 km to the South than the Moscow one, higher PAR values were observed for Pristen field. Modal PAR values were 600 and 400 umol m-2 s-1 for Pristen and Moscow fields respectively. Nevertheless temporal pattern of PAR was similar for both fields. Pristen field's soil water content was higher through the growing season due to better chernozem's moisture retention capacity. Amount and dynamics of precipitation and as a result soil water content at studied plots differed distinctly. Moscow field had a higher precipitation values. Diurnal values of net ecosystem exchange (NEE) clearly showed significant interseasonal and interplot differences. Diurnal patterns of NEE were considerably higher in Pristen site with similar to Moscow patterns for all months of growing season, except May due to earlier sowing in Chernozem region. Maximal CO_2 sink were observed during June for both fields and made -6 and -3 g C CO_2 m-2 d-1, for Pristen and Moscow fields, respectively. The Pristen site showed similar sink values and dynamics for May.

Main GPP dynamics driver was different crop development stage: Pristen's barley earlier sowing and longer growing period. Higher GPP values were due to better climate and soil parameters in Pristen (higher PAR, temperature and soil moisture). The number of net sink days for Pristen and Moscow fields were 85 and 67 days, respectively. All cumulative functions for growing season were consistently higher in Pristen than in Moscow: cumulative NEE were -160 g C CO_2 m-2 and -80 g C CO_2 m-2, cumulative Reco were 450 g CCO_2 m-2 and 300 g C CO_2 m-2, cumulative GPP were 610 g C CO_2 m-2 and 380 g C CO_2 m-2, respectively.

As a result, we can conclude that essentially higher GPP values were in Pristen due to its better climate and soil parameters (higher PAR, temperature and soil moisture). General trends for ecosystem's respiration (Reco) and GPP were determined by crop phase. Reco peaks corresponded well to raining periods. Differences in carbon loss can be explained by differences in soil microbial community due to different soil type, what highlights important role of soil in carbon exchange for agroecosystems. Obtained unique for Russian agriculture data will be used for land-use models, environmental assessment, soil organic carbon dynamics prediction and agroecological evaluation.