THESIS SUMMARY

Climate change is mainly caused by human-induced GHG emissions and halogenated gases, leading to irreversible losses in ecosystems, hampered efforts to achieve Sustainable Development Goals, and negative effects on human health. Hungary's adoption of environmental policies has had positive effects on CO_2, CH_4, and N_2O emissions. The Economic growth in the country has led to environmental improvement, but agricultural systems need a plan to reduce GHGs.

Reliable quantification of GHG emissions from agricultural soils essential for development of plans to mitigate GHG emissions. However, GHG emissions vary due to variables in environmental conditions, crop management, and measurement procedures. Studies must therefore be conducted to understand causes of spatio-temporal variation and reduce GHG emissions. The goal of our study was to measure N_2O and CO_2 emissions in winter wheat in a typical farming setting and to determine the relationship between the emissions with SWC and soil temperature.

A field experiment was conducted at Kartal from February 2021 to December 2022. 24 PVC collars of 20 cm diameter were inserted into the soil in the field sown with winter wheat, leaving a height of 4 cm above the soil surface for the flux measurements. $NaNO_3$ was applied to collars at a rate of 185 kg/ha, with collars 5, 6, 7, 8, 21, 22, 23 and 24 covered with foil and did not receive the fertilizer. Li-Cor Smart Gas Analyzer was used to measure the fluxes weekly at noon. An Eddy Covariance (EC) station measured environmental variables. The Pearson correlation coefficient was used to measure the correlation between fluxes and environmental variables ($\alpha = 0.05$).

We observed varying connections between the emissions and the environmental factors under study (SWC and soil temperature). For both the covered and treated collars, we found a positive but insignificant connection between N2O emission and soil temperature. For the covered collars, there was an insignificant negative correlation between N2O and SWC, but a significant negative correlation for the treated collars. We expected a positive association based on previous research. This inconsistency is most likely related to the weather extremes characterized by high temperatures experienced during the study. We also found a significant positive correlation between CO2 and soil temperature in both the covered and treated collars, as well as a positive but insignificant relationship between CO2 fluxes and SWC in both types of collars. The field experiment's findings therefore demonstrated the intricacy of N_2O and CO_2 emissions and the

substantial roles that the studied environmental factors played in determining the emissions. When designing management plans to lower N_2O and CO_2 emissions from agricultural soils, as well as for modelling studies and GHG inventories, these correlations might be a useful resource.

During the course of our study, we noted that environmental and management factors interact to determine how much N and C are present in soils. While measurement factors do not have a direct impact on N_2O and CO_2 emissions, they may impact on the accuracy (and uncertainty) of measured data, which is crucial for validation. With regards to our study, the SWC and temperature data measured by the Li-COR seemed erroneous and we had to resort to data recorded by the Eddy Covariance tower.

However, the general consensus on how major environmental variables (namely SWC and soil temperature) correlate with N_2O and CO_2 emissions seems to vary with the soil types and weather conditions during the course of study as shown by our findings. For example, we observed negative correlations between N_2O emissions and SWC for both the covered and treated collars, yet we anticipated enhanced N_2O emissions with increase in SWC in line with literature. This could be linked to very dry conditions experienced during the study period. It is therefore suggested to consider such weather extremities in determining and modelling N_2O emissions from agricultural soils.

The depth of measurement of both SWC and soil temperature is crucial for drawing conclusions about the correlations between the variables (SWC and soil temperature) and emissions. For instance, unlike Lou et al. (2003) who measured SWC at 10 cm and found a negative correlation between SWC and soil CO_2 flux, we measured SWC at 30 cm depth and observed a positive association between the two variables. Thus, it is recommended that the depth of measuring SWC in such research be standardized.

It is may also be feasible to carry out a study on the effects of environmental and management factors on the ratio of N_2O and N emissions resulting from nitrate fertilization, which may vary depending on the type of soil and climate. Another aspect that has not been fully addressed and that can be further researched is the impact of soil pH, site elevation, and air pressure on N_2O and CO_2 emissions. Additionally, it is recommended to do more research to discover how the entire soil profile would react to warming and to quantify emissions from the various soil profiles**.**