Soil CO_2 emission doubles depending on soil type in New Zealand dairy grassland

[a] Yulin Liu, [a,b] Jingjing Zhang, [c] Martin K.-F. Bader, [a] Sebastian Leuzinger

[a] School of Science, Auckland University of Technology, Auckland 1010, New Zealand,
[b] Plant & Food Research, Auckland 1025, New Zealand,
[c] Department of Forestry and Wood Technology, Linnaeus University, P G Vejdes väg, 35195 Växjö, Sweden

Background

- Soil respiration (R_s), the CO_2 flux from soil to atmosphere, is the second-largest carbon flux between the land and the atmosphere (1,2).
- The high grassland coverage and CO_2 emission rates can contribute greatly to the atmospheric CO_2 pool in New Zealand.
- It is important to investigate the relationships between R_s and its driving factors and quantify the impact of environmental factors on seasonality of R_s.

Methods

- This study is conducted at four dairy grassland across New Zealand with distinct soil types of Ultic (U), Organic/Gley (OG), Pumice (Pu) and Pallic (Pa) individually.
- Soil respiration rates are measured using the closed static chamber method (3) along with other variables (e.g., soil temperature and moisture)
- Generalised Additive Model (GAM) was used to model R_s using a range of predictors to allow smoothing of the continuous variables.

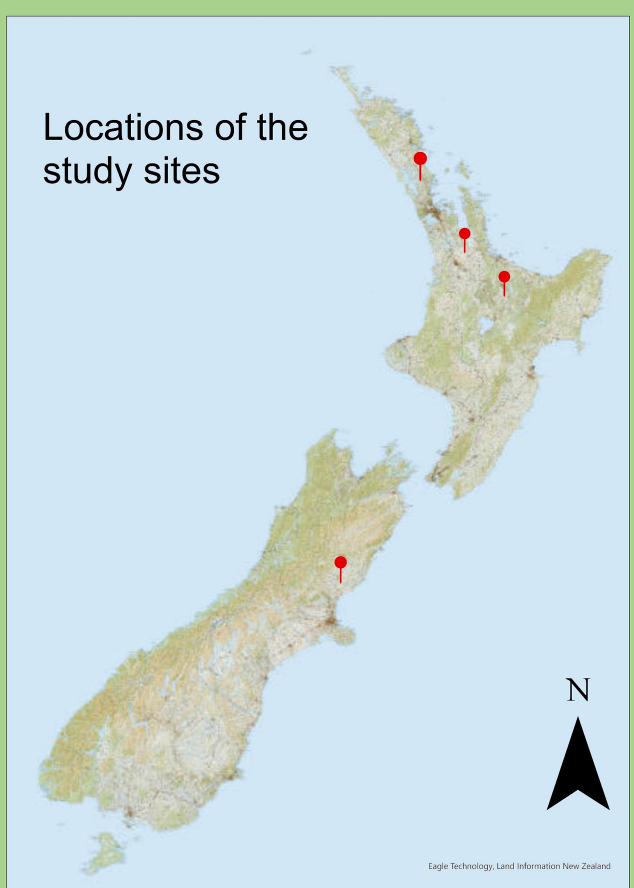

Figure 1: Map of study sites

Figure 2: Soil respiration measuring gears

Results

- Soil respiration in New Zealand dairy grassland was higher than that of global temperate grasslands.
- Soil temperature (T_s) and soil water content (SWC) influence R_s (Fig. 5).
- Seasons and soil types differentiate the magnitude and trend of this influence (Fig. 3, 4, 6).
- T_s drives overall and summer R_s, while SWC drives winter R_s

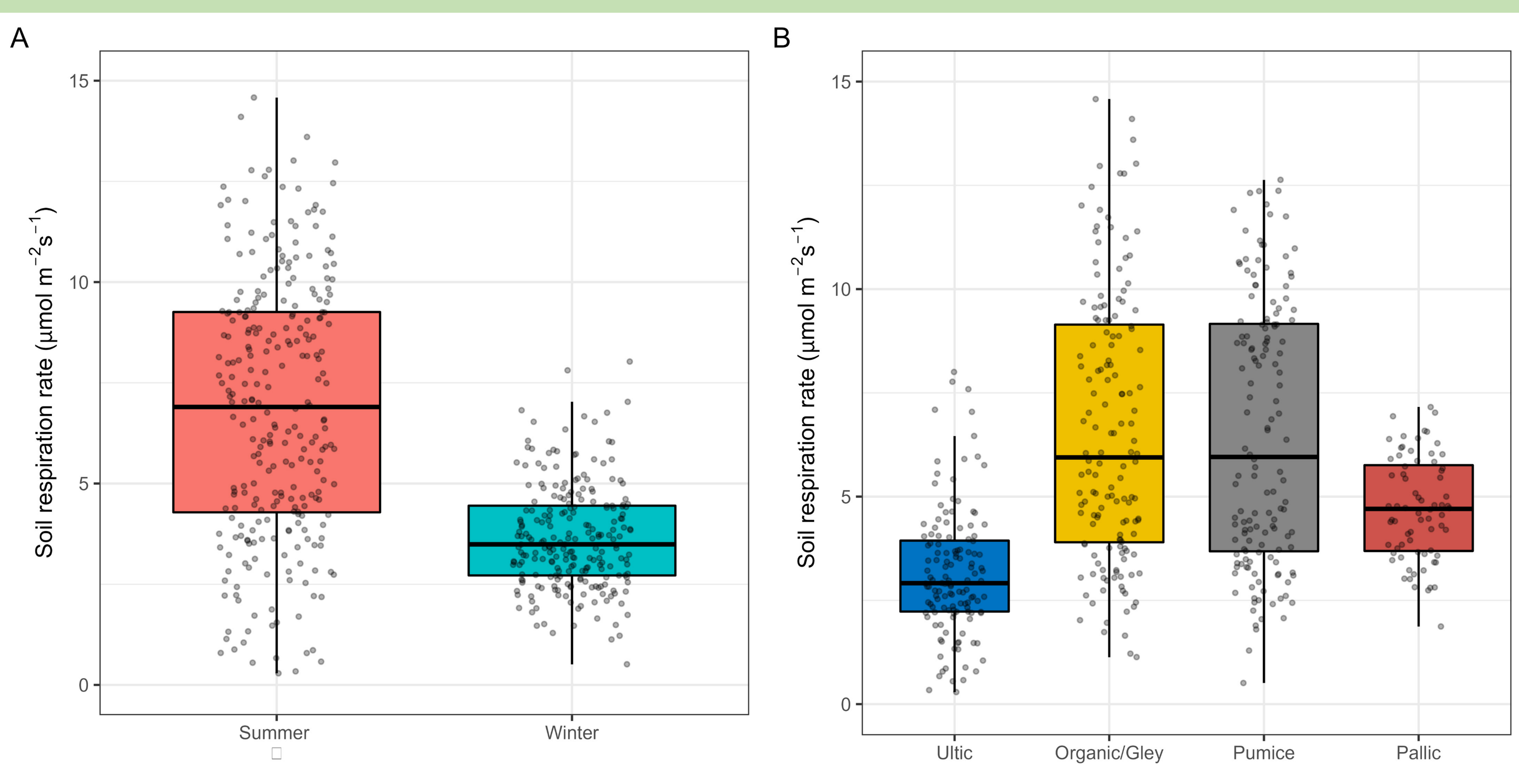

Figure 3: Soil respiration rates categorised by seasons (A), sites/soil types (B)

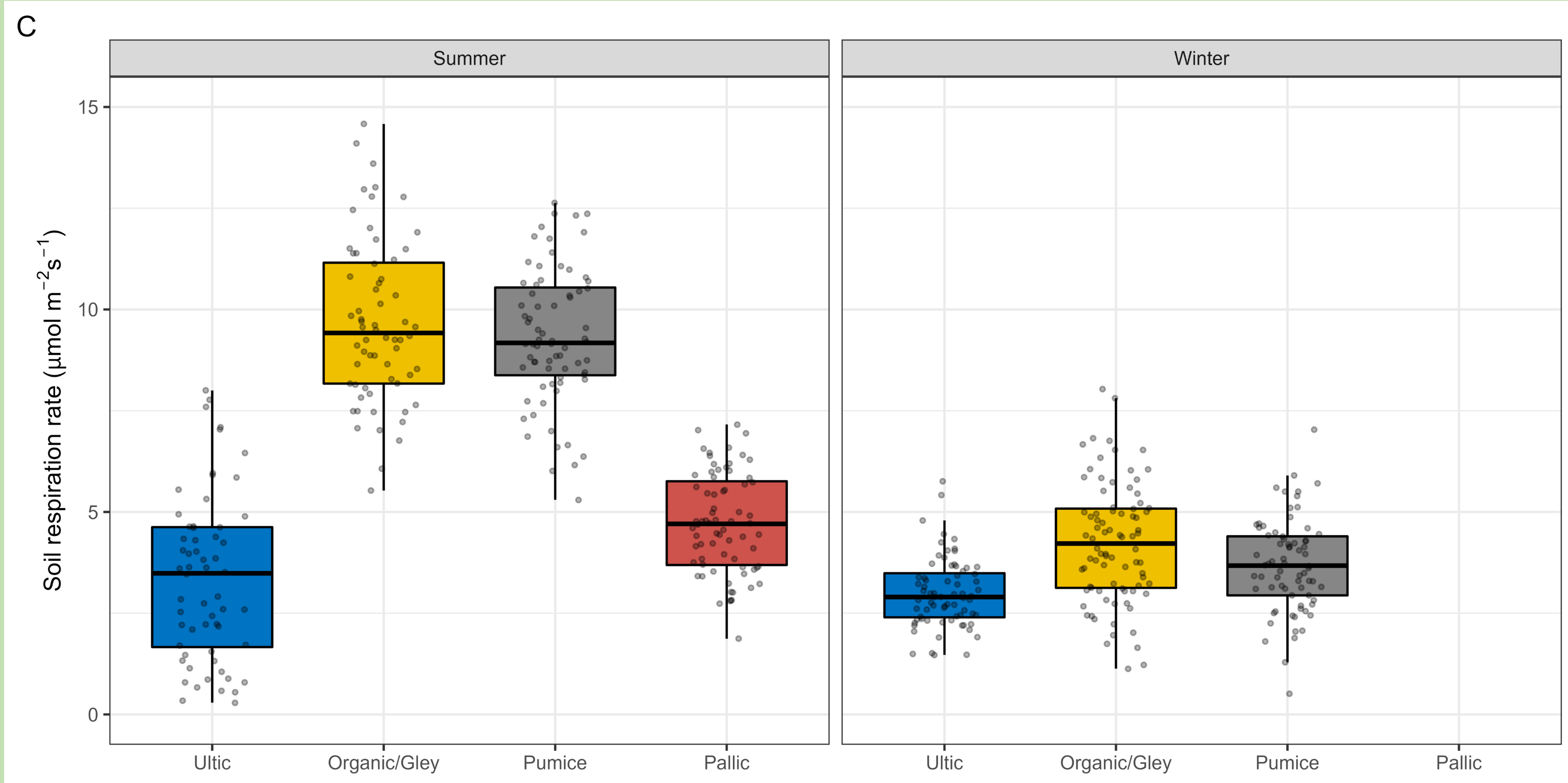

Figure 4: Soil respiration rates categorised by soil types in summer (left) and winter (right)

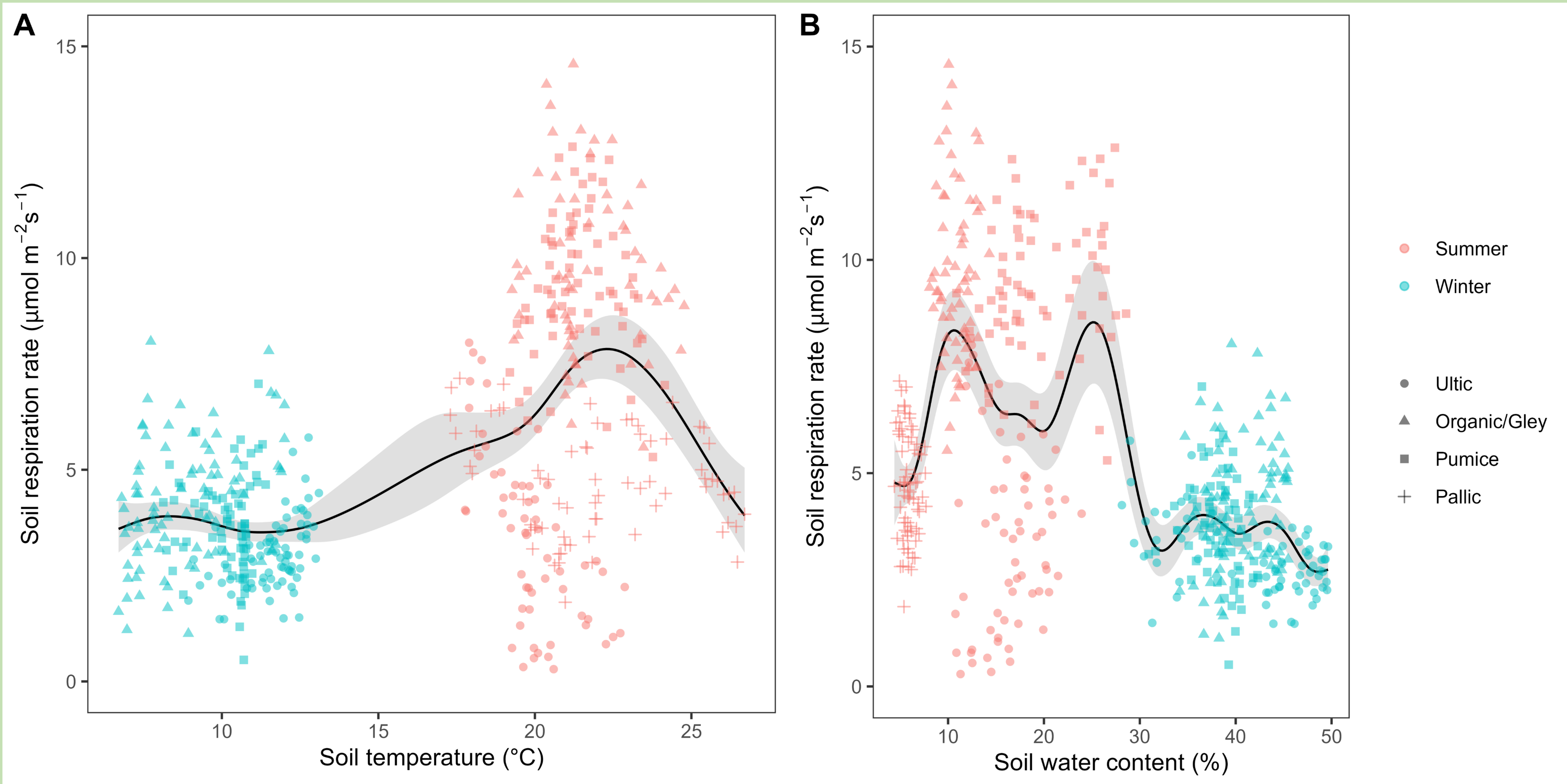

Figure 5: Soil respiration's relationships with soil temperature (A) and soil water content (B)

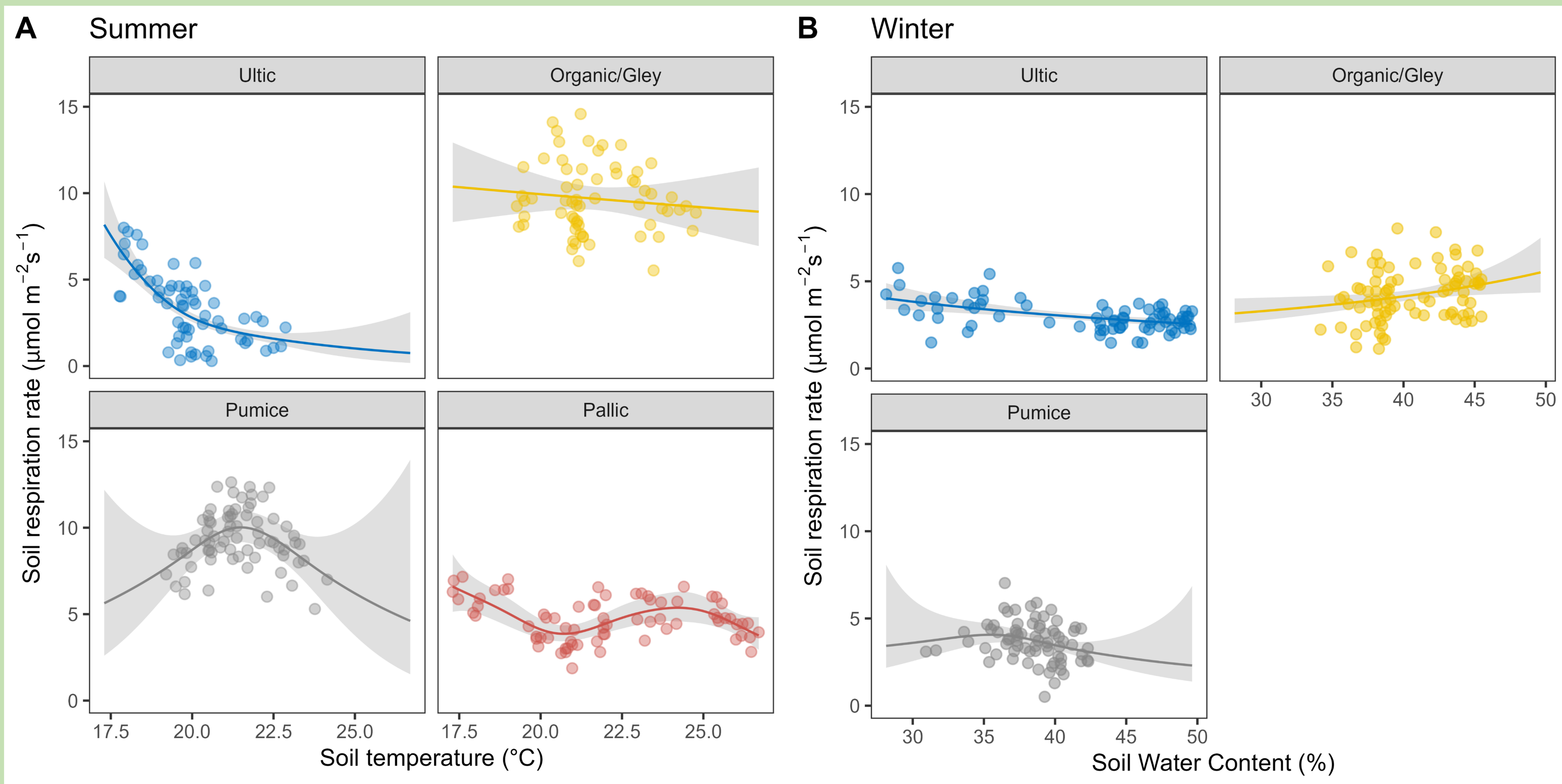

Figure 6: Different model-based trends of soil respiration among sites in both seasons.

Conclusion

- Both autotrophic respiration and heterotrophic respiration are stimulated with temperature increase when soil moisture is not a limiting factor.
- Soil types determine the soil organic content, water holding capacity and soil gas diffusion, thus affecting the soil respiration.

References

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