

Supporting Information for

Hot or not? An evaluation of methods for identifying hot moments of nitrous oxide (N₂O) emissions from soils

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Introduction

Here we include data representing additional information about the N₂O flux data (e.g., hot moment thresholds, hot moment contributions to the cumulative annual N₂O flux, and the number of hot moments recorded via each method). All data was obtained from the N₂O flux data collected from the 16 autochambers described in the main text. All methods for analyzing data were described in the Statistical analysis section of the Methods in the main text. All data in the Supplement was collected with our LiCOR N₂O gas analyzer and multiplexer, using methods described in the Methods of the main text. All described methods and all data were collected during May 2022-April 2023.

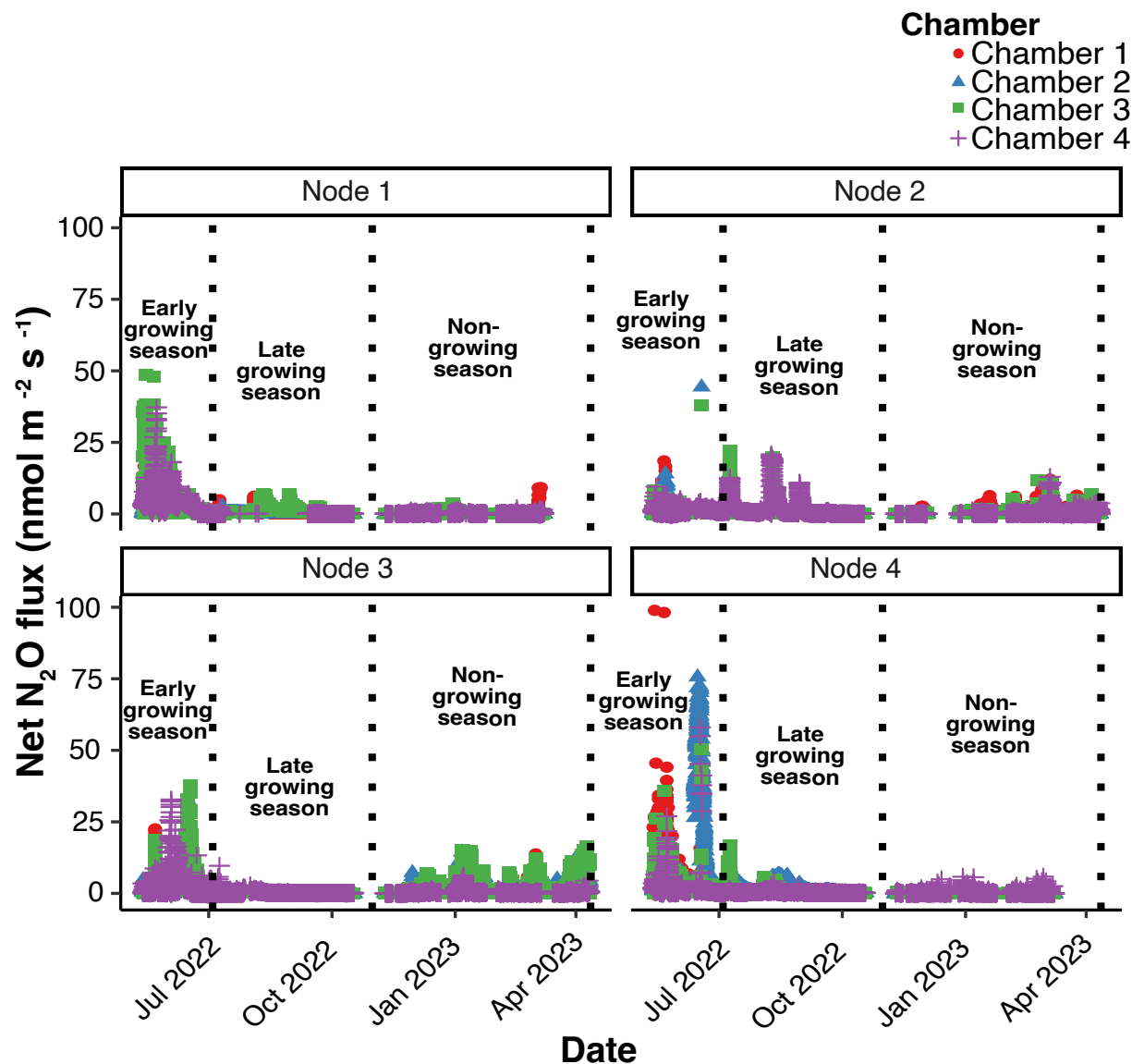


Figure S1. The 16 high spatiotemporal resolution N₂O flux datasets used to compare hot moment identification approaches. Net N₂O fluxes were measured from automated chambers in four areas of a maizefield (termed nodes, shown in separate panels) once hourly from May 2022 to April 2023 (except during harvest) in central Illinois, USA. Each node had four automated chambers (represented by different colors and shapes within each panel), totaling N = 16 automated chambers. We subdivided the dataset into the early growing season, late growing season, and non-growing season based on the seasonally distinct drivers of N₂O hot moments.

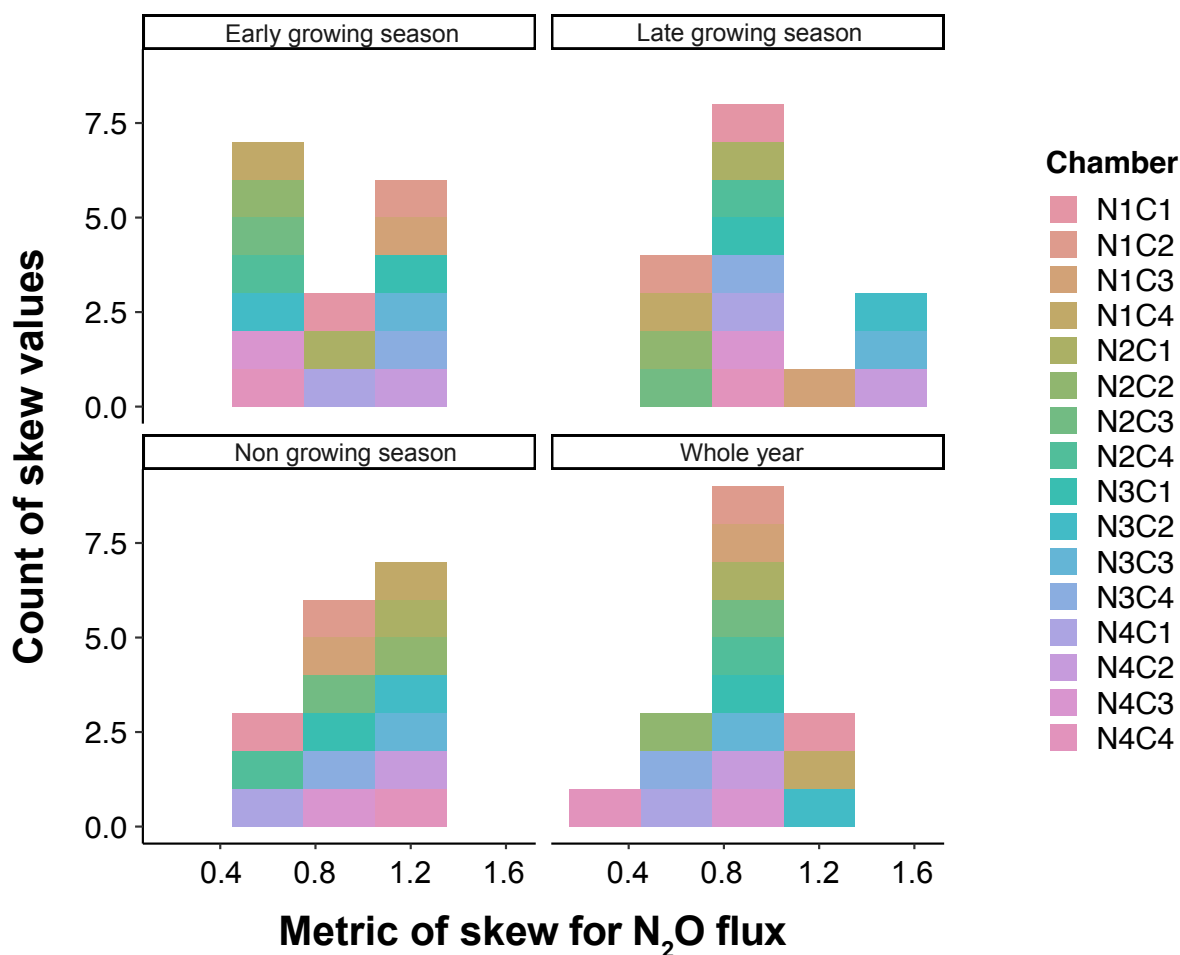


Figure S2. Histogram of Pearson's coefficient of skewness values for each automated chamber's net N₂O flux measurements during either the different time intervals, or across the whole year. The skewness values were calculated using the median with the following equation: $3 \cdot (\text{mean} - \text{median}) / \text{SD}$. Skew values >0 correspond to right-skewed distributions, whereas skew values <0 correspond to left-skewed distributions. In all cases, the net N₂O flux datasets for each automated chamber were right-skewed.

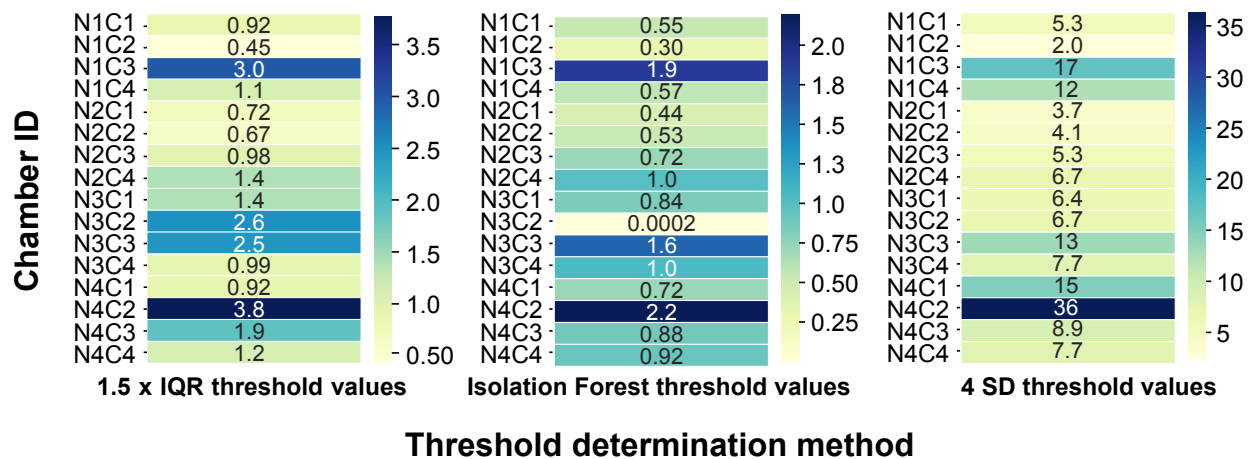
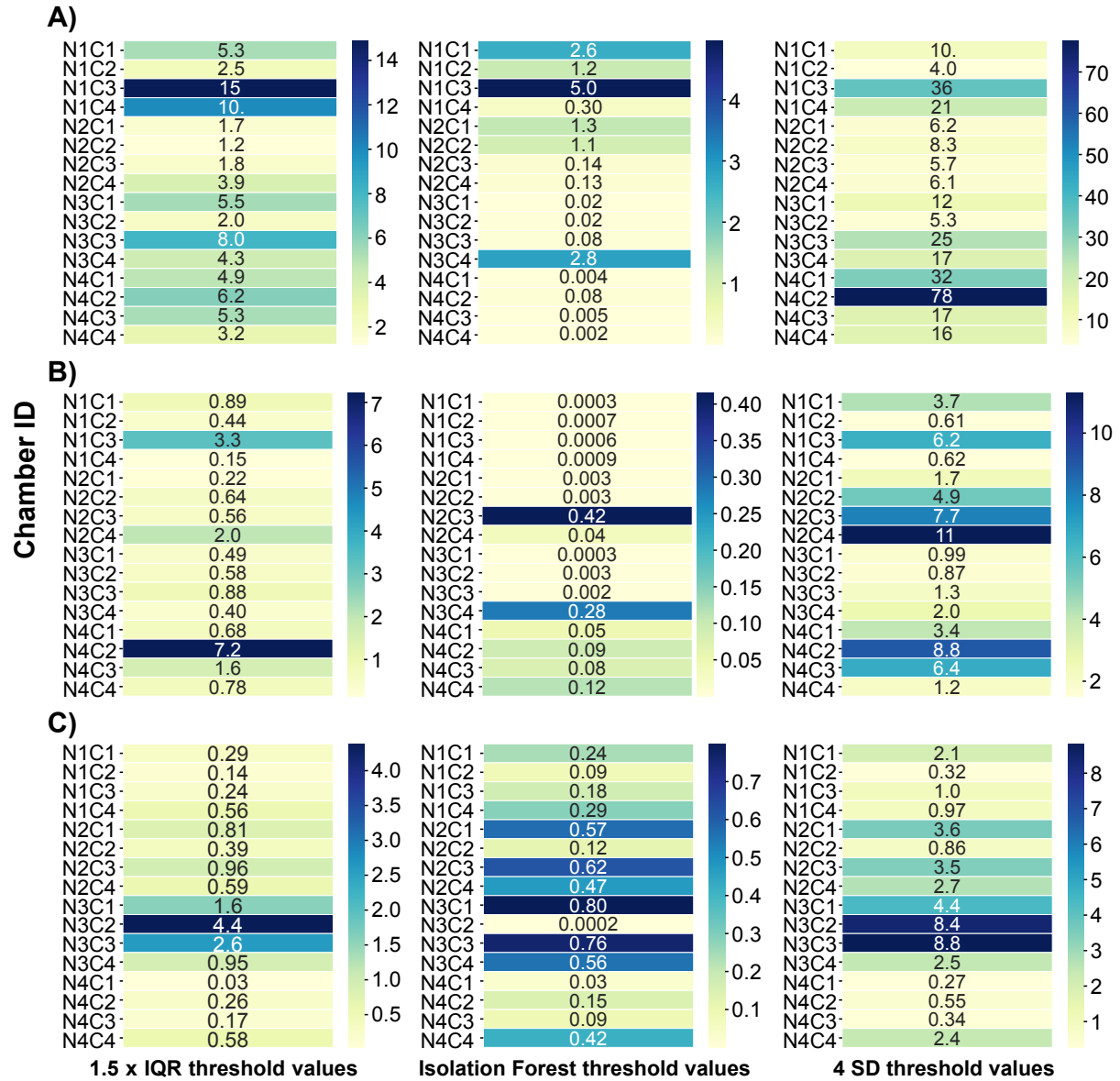


Figure S3. This heat map illustrates the different minimum threshold values for identifying net N₂O fluxes as hot moments using the three threshold determination methods for all 16 automated chambers across the whole year. The units for all values are nmol N₂O m⁻² s⁻¹. Chamber IDs consist of sampling node number (N1-N4) and autochamber number within sampling node (C1-C4). Heat maps for the seasonally subdivided datasets are included in the Supplemental Information (Figure S1).



Threshold determination method

Figure S4. This heat map illustrates the different minimum threshold values for identifying net N₂O fluxes as hot moments using the three threshold determination methods for all 16 automated chambers in each seasonally subdivided time interval. **Panel A** corresponds to the early growing season, **Panel B** corresponds to the late growing season, and **Panel C** corresponds to the nongrowing season. The units for all values are nmol N₂O m⁻² s⁻¹. Chamber IDs consist of sampling node number (N1-N4) and autochamber number within sampling node (C1-C4). The heat map for the whole year dataset is Figure 1 in the main body of the paper, and the means and statistical comparisons among all the thresholds for the different methods and seasons are summarized in Table 1 in the main body of the paper.

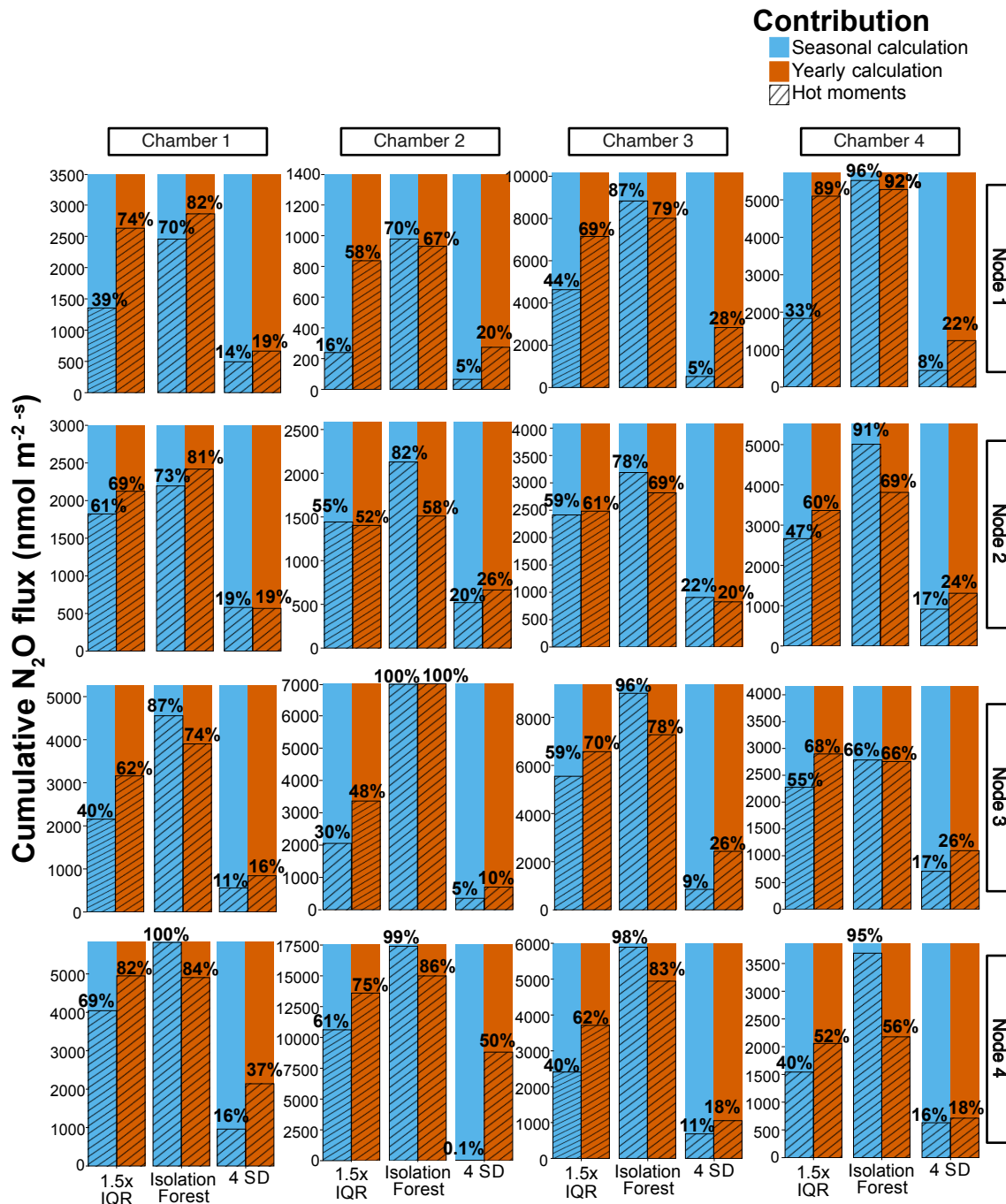


Figure S5. Hot moment contributions to the cumulative N₂O flux for each automated chamber over the whole sampling period (May 2022-April 2023), determined using either the whole year threshold (brown bars), or the sum of all the seasonally subdivided hot moment contributions (blue bars). For each automated chamber (each panel in the figure), the blue bars were calculated by summing up all hot moment fluxes from each season (determined using the hot moment threshold for each chamber for each season) and then dividing that value by the cumulative annual flux for each chamber. Likewise, the red bars were calculated by summing the hot moment fluxes using the whole year threshold and then dividing that value by the cumulative annual flux for each chamber. Flux values greater than or equal to the threshold value were considered part of a hot moment. The percentage values written inside each colored bar portion corresponds to the percentage of the N₂O flux for each season that was attributed to hot moments of N₂O.

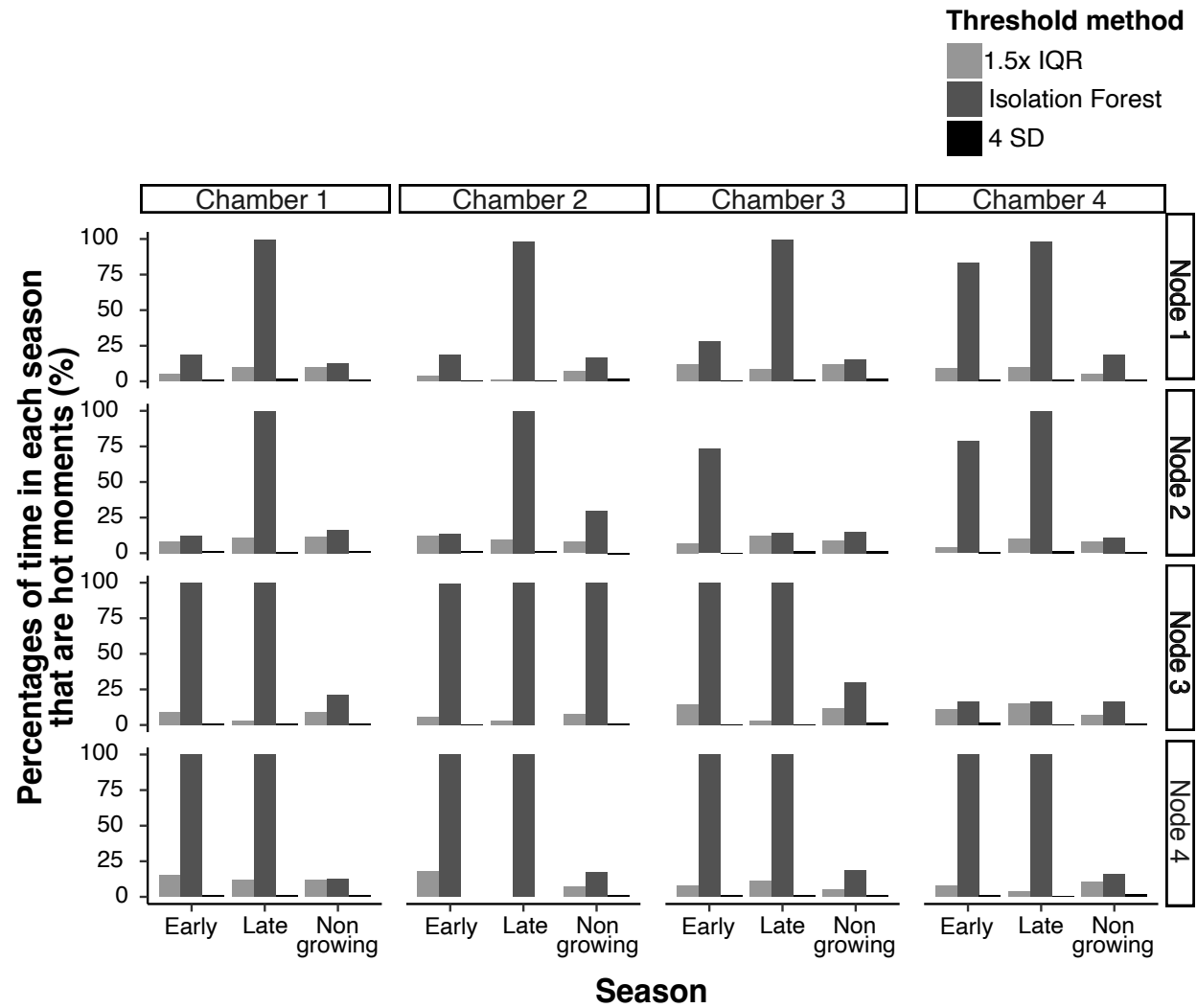


Figure S6. The percentages of time attributed to hot moments for each threshold determination method in each season by autochamber (N = 16). Bar colors indicate different threshold determination methods.

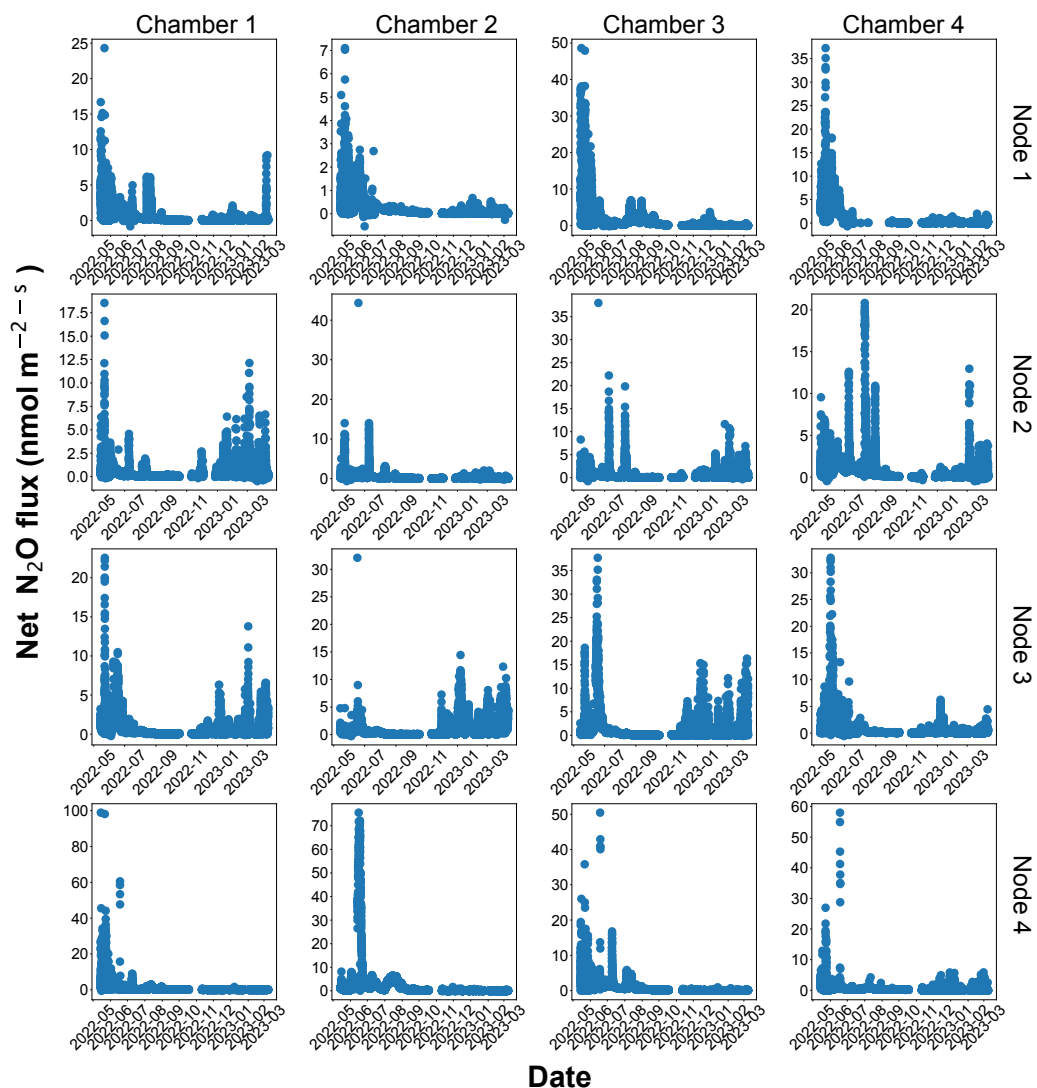


Figure S7. Net N₂O fluxes measured once per hour across the whole sampling year for each automated chamber. Each blue circle corresponds to an hourly N₂O flux measurement. Measurements were conducted from May 2022 to April 2023 with data gaps due to either gas flux sampling instrument error or instrument removal from the field for agricultural management activities.