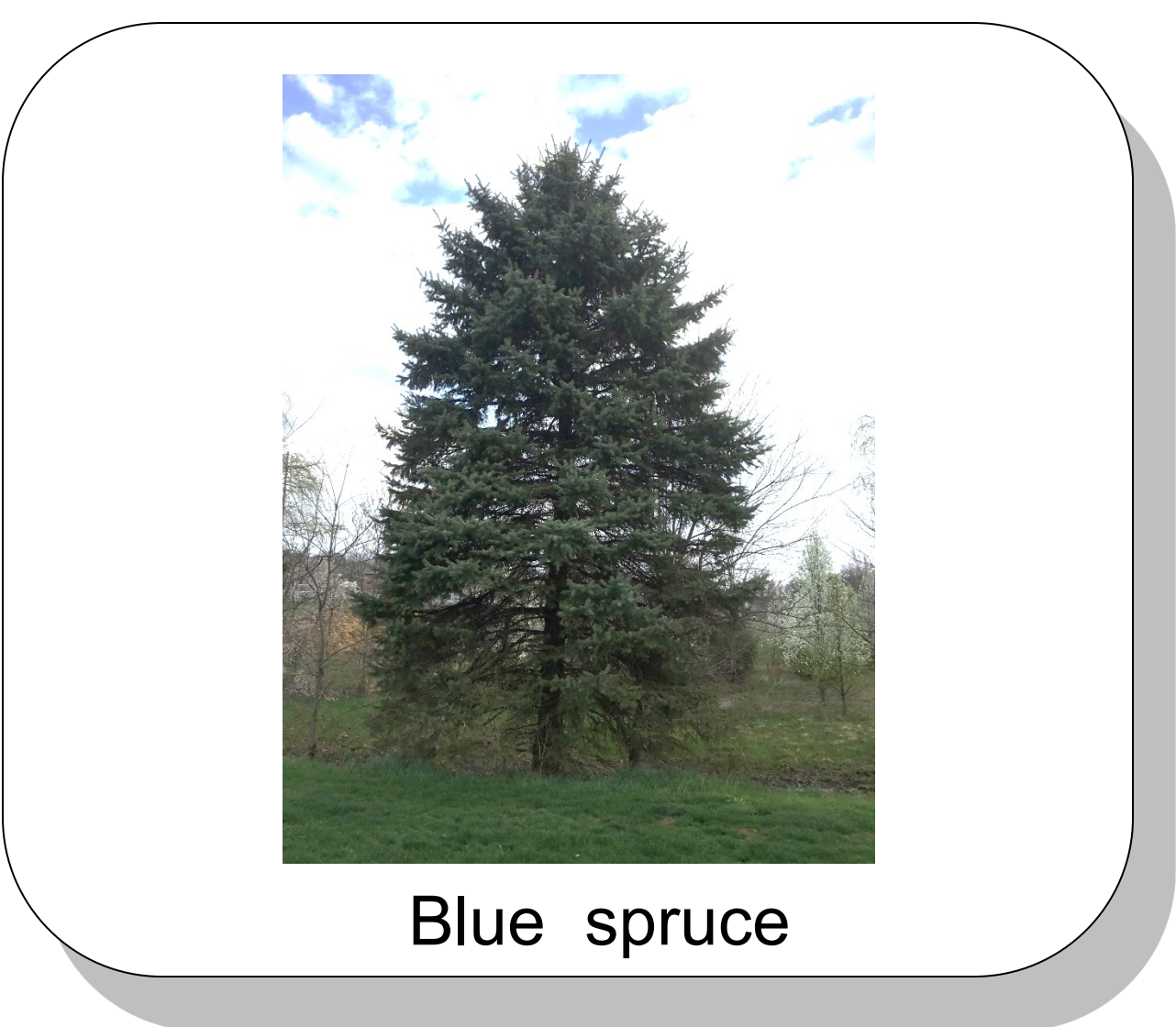


# Intra-Tree Spruce Volatiles Using Automated Headspace GC/MS

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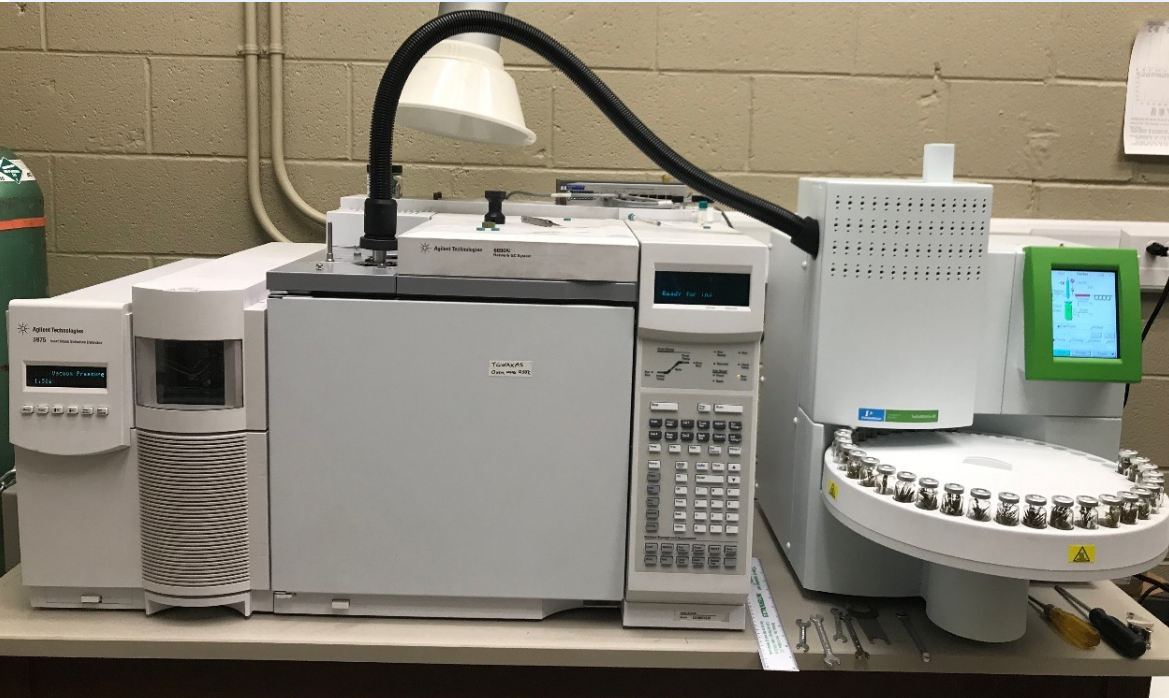


## Introduction

Terpenoids are highly volatile compounds that can be used to distinguish differences between tree species. Gas chromatography is a widely used technique for analyzing volatile compounds. Prior experiments in our lab explored differences in terpenoid profiles both between tree species and between different trees with a species. This experiment explores differences in terpenoid profiles within the same tree based on needle morphology and varying levels of sun exposure. Additionally, the general timeline of how quickly these changes in terpenoid emissions occur was assessed; whether differences in terpenoids in relation to sun exposure were a developmental change that occurred over a longer period of time or were more of a rapid change occurring throughout a 24-hour period.

## Methods

- General Method:
- Spruce trees selected for this study were on or around the campus of Eastern Mennonite University.
  - Samples were collected by cutting two inches off of the ends of branches.
  - Samples were placed in vials, sealed, and loaded into the HS/GC/MS.
  - Data were analyzed using Principal Component Analysis.



Headspace autosampler/  
gas chromatograph/  
mass spectrometer



Sample vial

### Experiment 1:

- Spruce branches were taken from blue and Norway spruce. The results were used to confirm previous experiments.

### Experiment 2:

- Spruce branches were taken from the inner and outer portions of the Norway spruce. Differences in morphologies were recorded.



### Experiment 3:

- Samples were taken of the Norway spruce at 3 hour intervals starting at 7 am and going to 12 am.

## Results

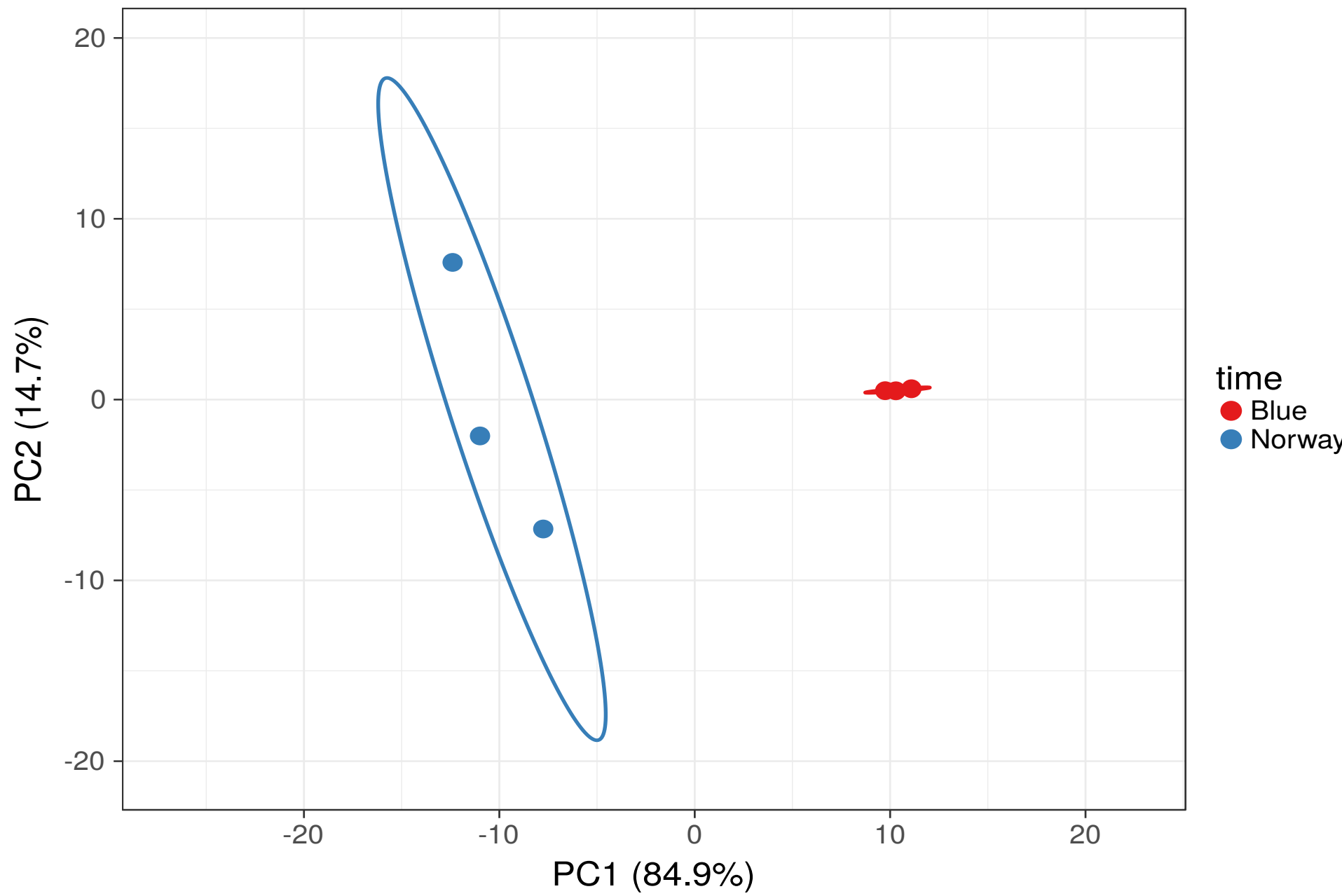


Figure 1. PCA of Blue and Norway spruce to confirm previous study (circles = 95% CI).

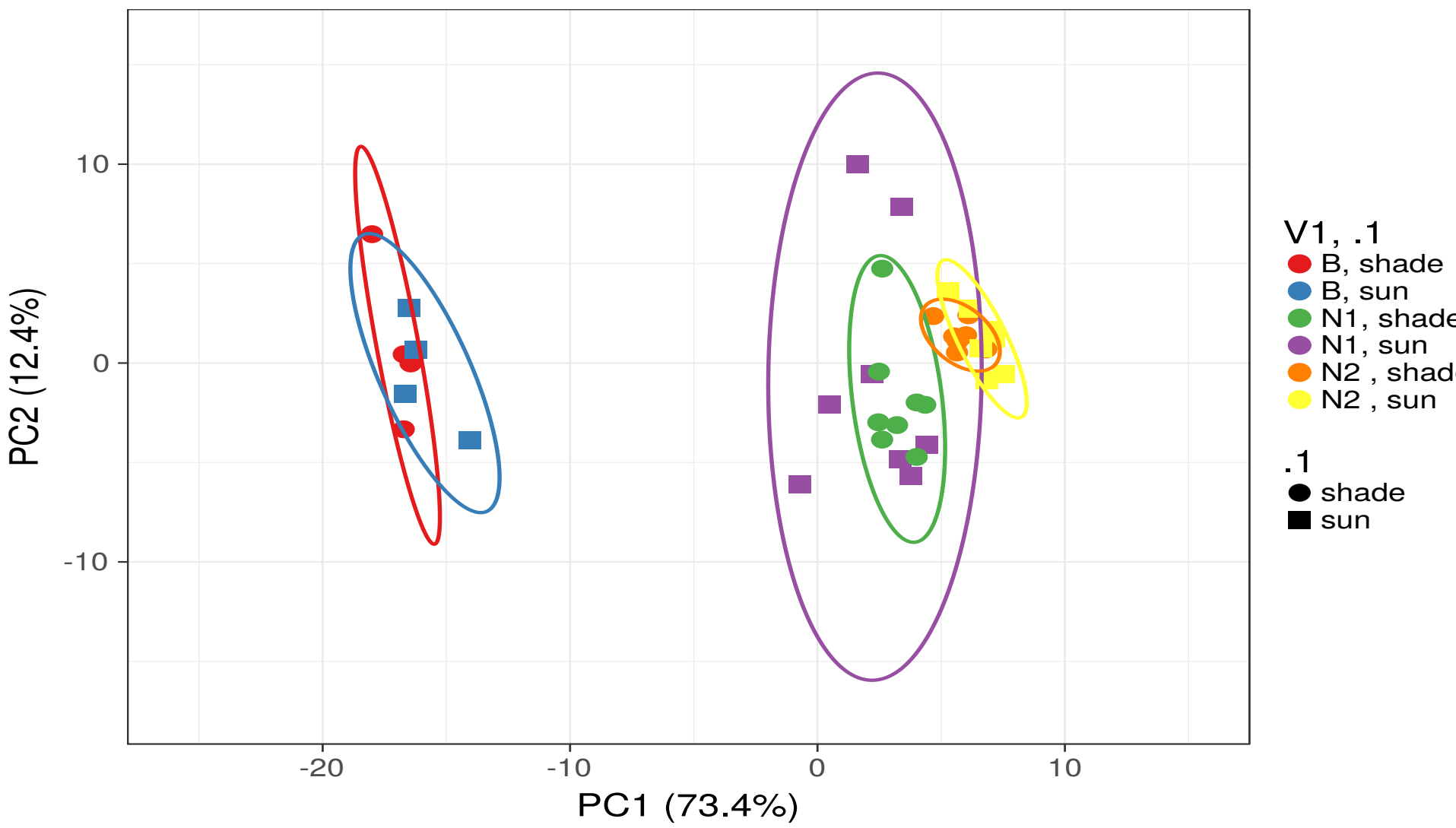


Figure 2. PCA of blue and Norway with changes in light exposure.

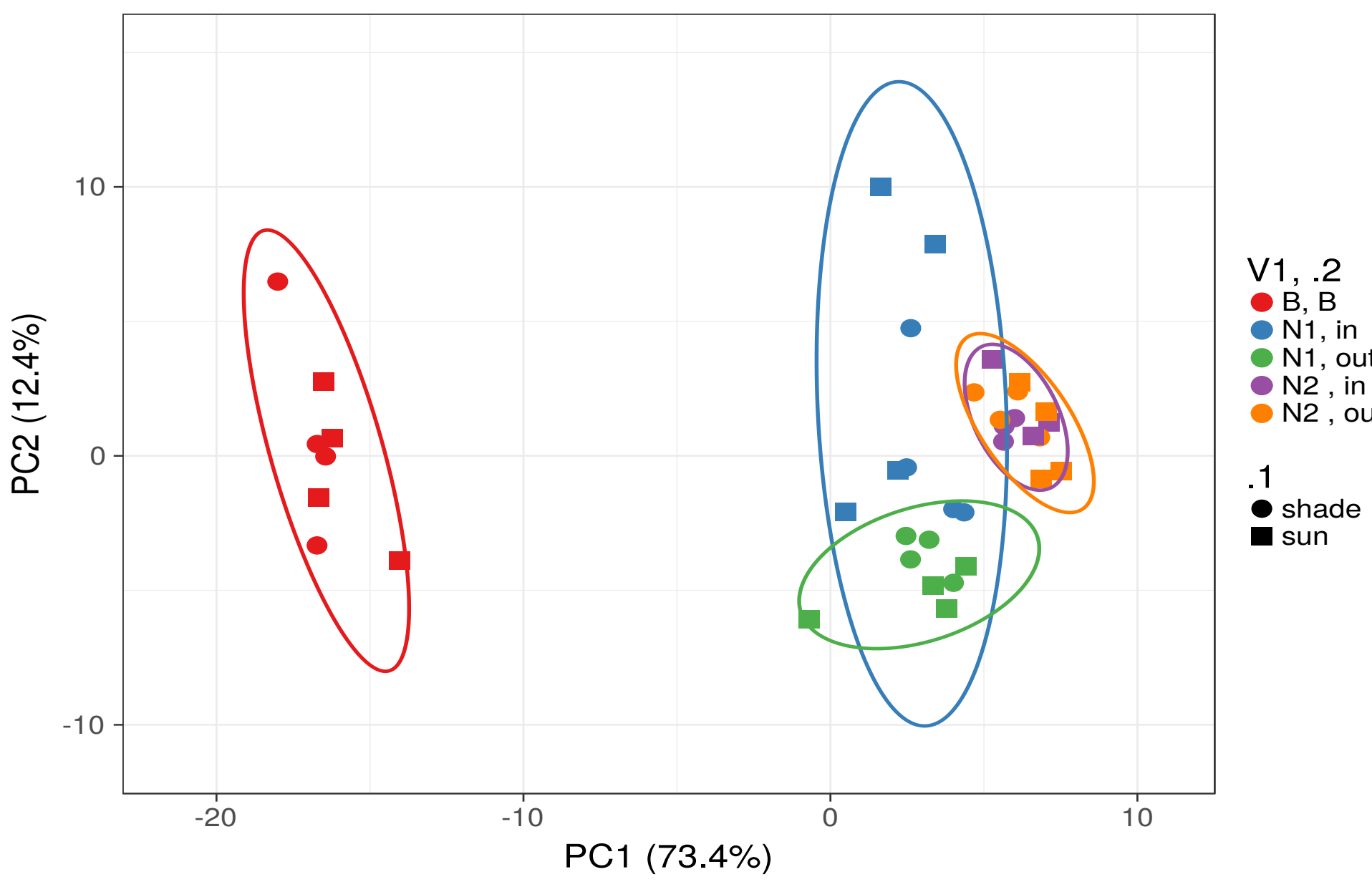


Figure 3. PCA of blue and Norway with changes in morphology.

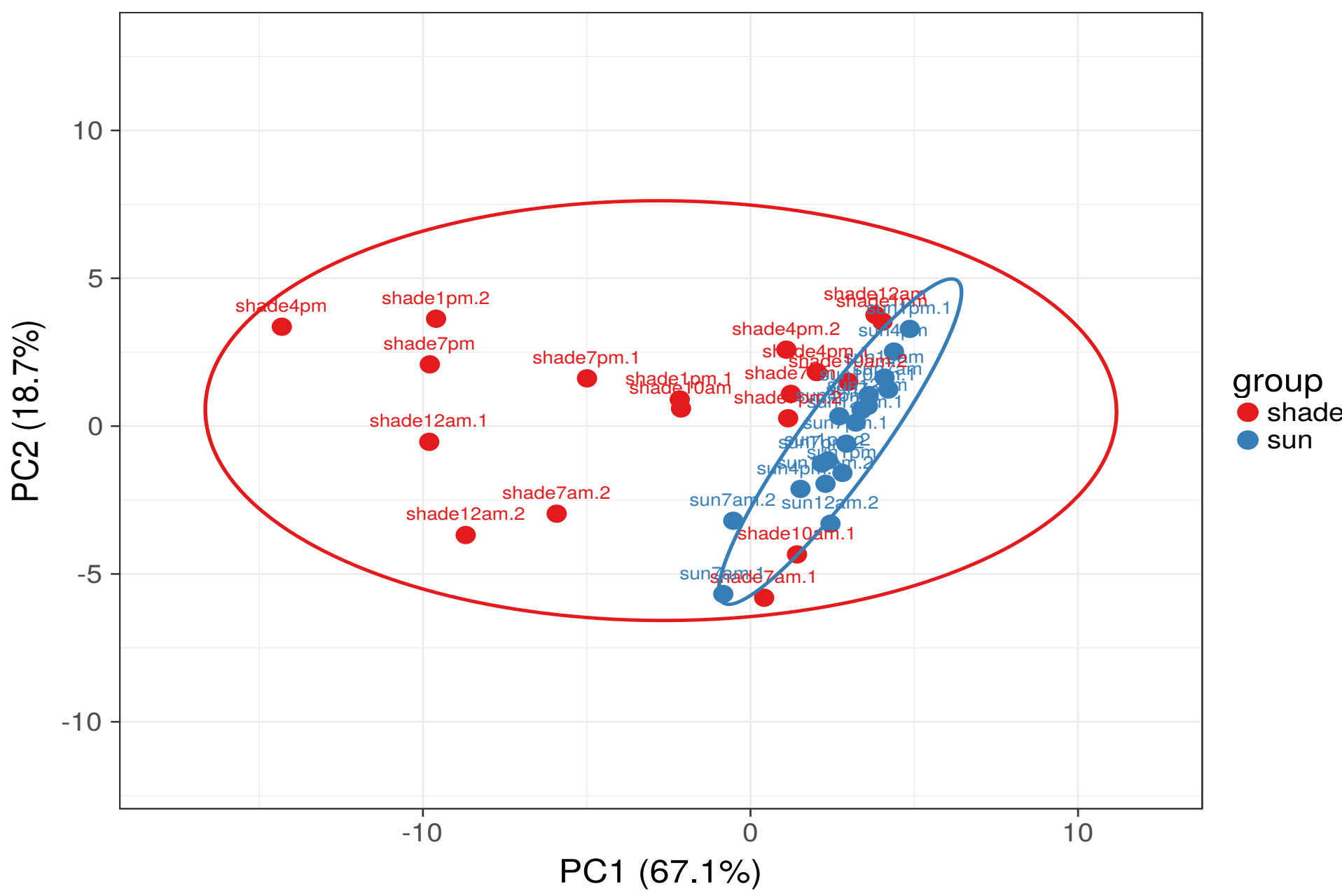


Figure 4. PCA of Norway with changes in time and sun exposure.

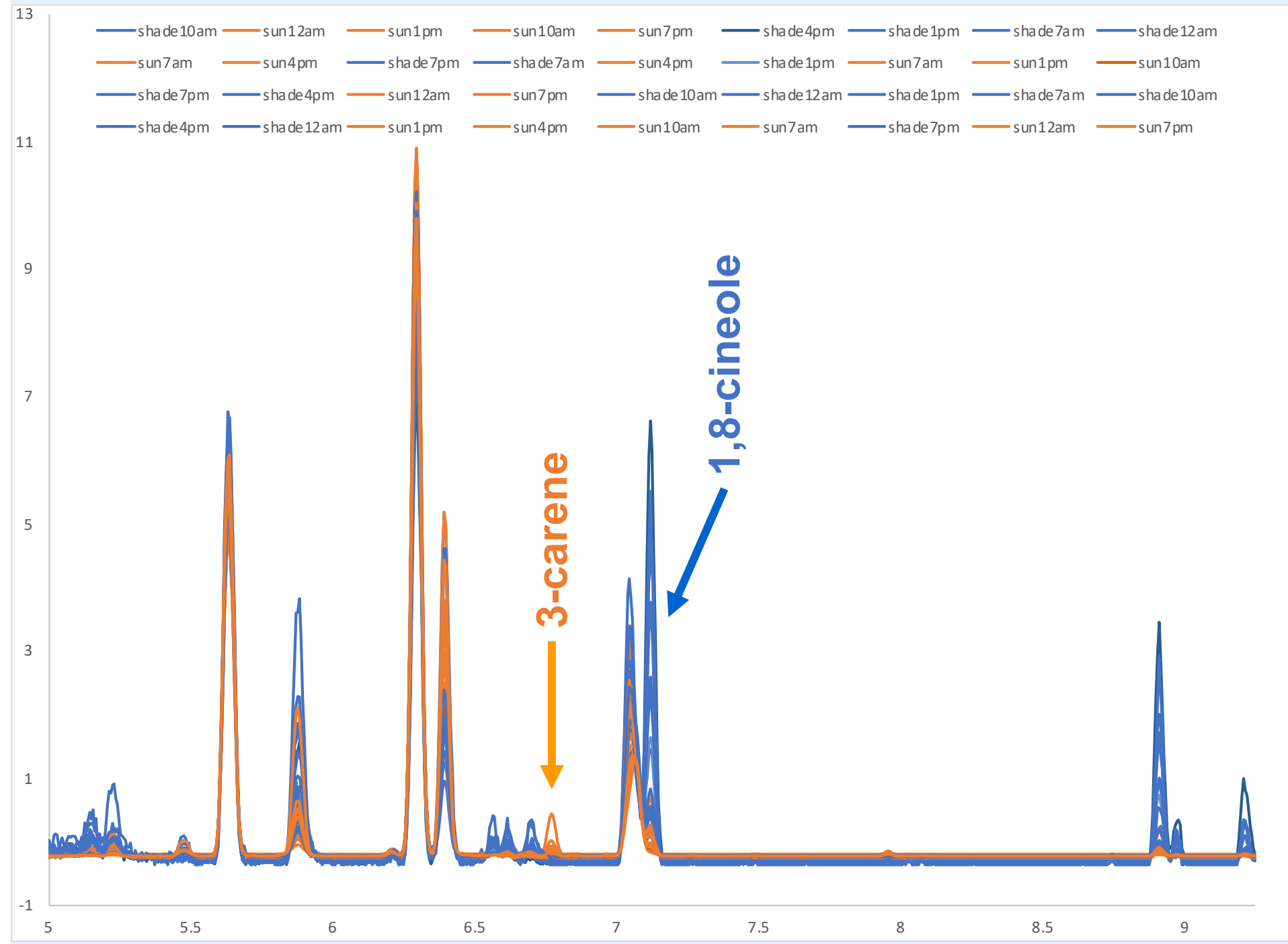


Figure 5. Traces of Norway spruce with changes in time and sun exposure (standardized). Orange peaks = sun, while blue peaks = shade.

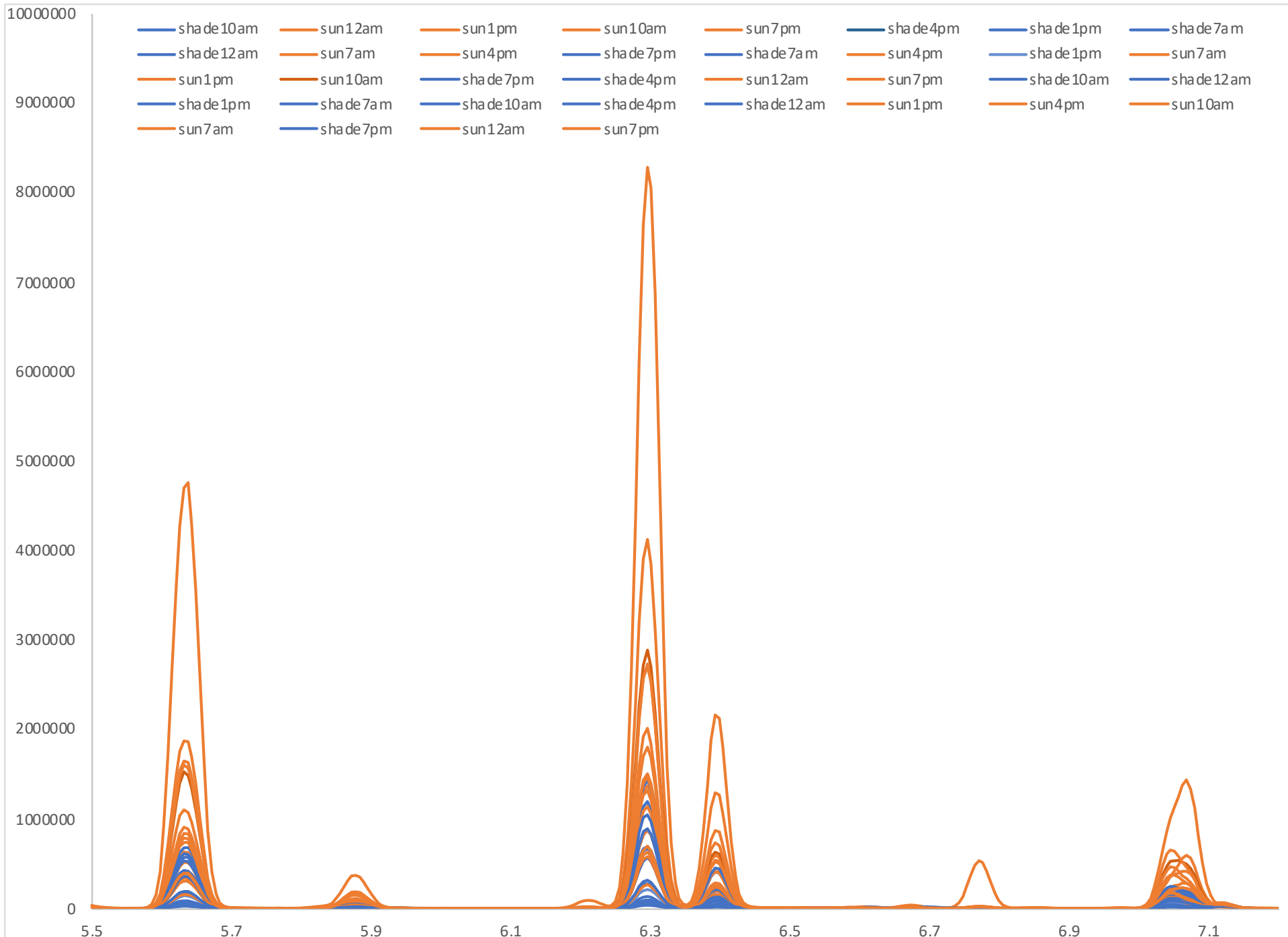


Figure 6. Trace of Norway with changes in time and sun exposure (unstandardized).

## Conclusions

- The first experiment confirmed the findings from prior experiments.
- While not a large difference, there were changes in terpenoids and morphology from branches taken from the outside portion of the tree compared to the inside portion.
- The changes in terpenoids in relation to sun exposure, appear to occur slowly and do not dramatically change within one day.
- There was an increase in almost all terpenoids in the branches taken from the sunny side of the tree.
- There were a number of compounds (1,8-cineole, camphor, and several other unidentified monoterpenes) whose levels remained unchanged with sun exposure.
- 3-carene was only detected in samples from the sunny sides of the trees.

## References

Raber, A. G., Peachey-Stoner, R. J., Cessna, S. G., & Siderhurst, M. S. (2021). Headspace GC-MS analysis of differences in intra-and interspecific Terpene profiles of *Picea pungens* Engelm. and *P. abies* (L.) Karst. *Phytochemistry*, 181, 112541.