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UTAH WINTER FINE PARTICULATE STUDY: A STATISTICAL OVERVIEW

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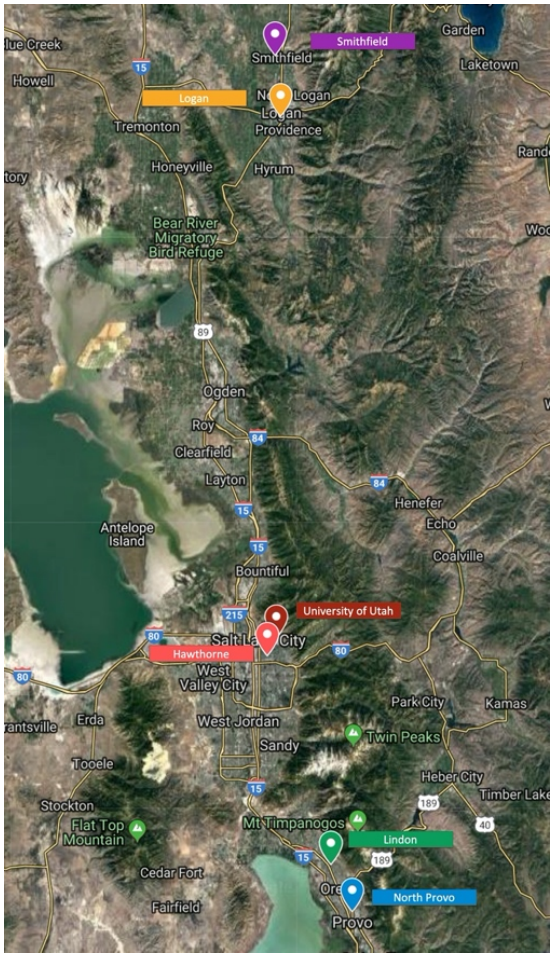
Introduction: The Utah Winter Fine Particulate Study (UWFPS) was a field campaign that took place across Northern Utah from December 2016 to February 2017. The goal of the study was to provide a suite of measurements to gain further understanding of the key meteorological and chemical relationships that occur during severe winter-time pollution events. The study consisted of six different ground sites, and a Twin-Otter research aircraft equipped with chemical analyzers that targeted polluted layers. The ground sites were: University of Utah (UU), Hawthorne (HW), Logan (L4), Smithfield (SM), Lindon (LN), North Provo (NP).



Motivation: The focus of this research project was to analyze and compile the observations from the UWFPS. Research goals included:

- Creating a comprehensive dataset of all UWFPS data
- Identify missing data
- Create a summary of the instruments used for each site
- Explore linear Pearson correlations of all obtained measurements
- Determine the significance of correlations

Methodology: Data was primarily obtained on the UWFPS data website in ICARTT ASCII format. Missing measurements were requested from the PI responsible for each instrument. For this project aircraft and remote sensing data are not included, as vertical variations exist. To account for resolution differences between instruments, all values were averaged hourly for comparison. Upon completion of a comprehensive dataset, Pearson correlation coefficients were calculated for every variable present in the dataset on a per-site basis with a p-value of 0.01 to test for statistical significance. To represent this information correlation matrices were created to visually display the entire dataset for each site. This was primarily done to quickly identify potential relationships of interest for future study.

Results: Conclusions were drawn primarily from the Logan/Cache Valley site and University of Utah site. A common trend was the expected anti-correlation between NO_x and O_3 for each site. The strongest anti-correlation was at the University of Utah site, with an R value of -0.81.

Salt Lake Valley

- Lack of strong correlation between nanoparticles and PM2.5 suggests primary emissions and not new particle formation at the surface
- Strong $PM_{2.5}$ correlation to pNH_4
- Strong pK correlation to $PM_{2.5}$ signify wood smoke

Logan/Cache Valley

- Smithfield site overall showed weaker correlations than Logan site
- Logan showed very strong PM - nitrogen ion correlations

Legend:

Coloring

- Warm colors indicate positive correlations
- Cool colors indicate negative correlations

Values

- R^2 values are annotated within ovals
- Crosses indicate insignificant correlations ($p < 0.01$)
- Empty circles indicate no overlap between datasets

Shape

- Stretch indicates stronger correlations
- Positively sloped ovals are positively correlated
- Negatively sloped ovals are negatively correlated

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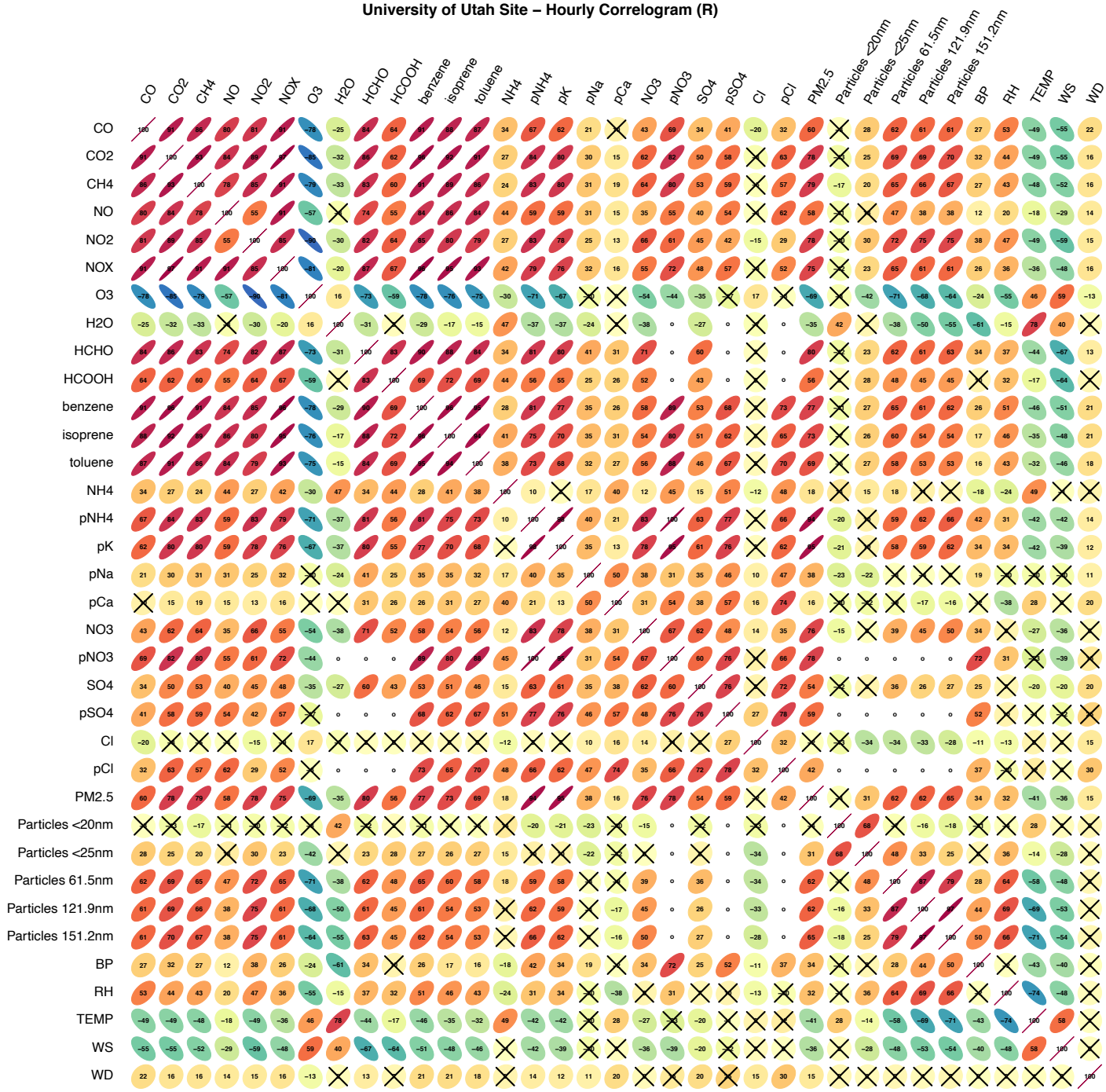
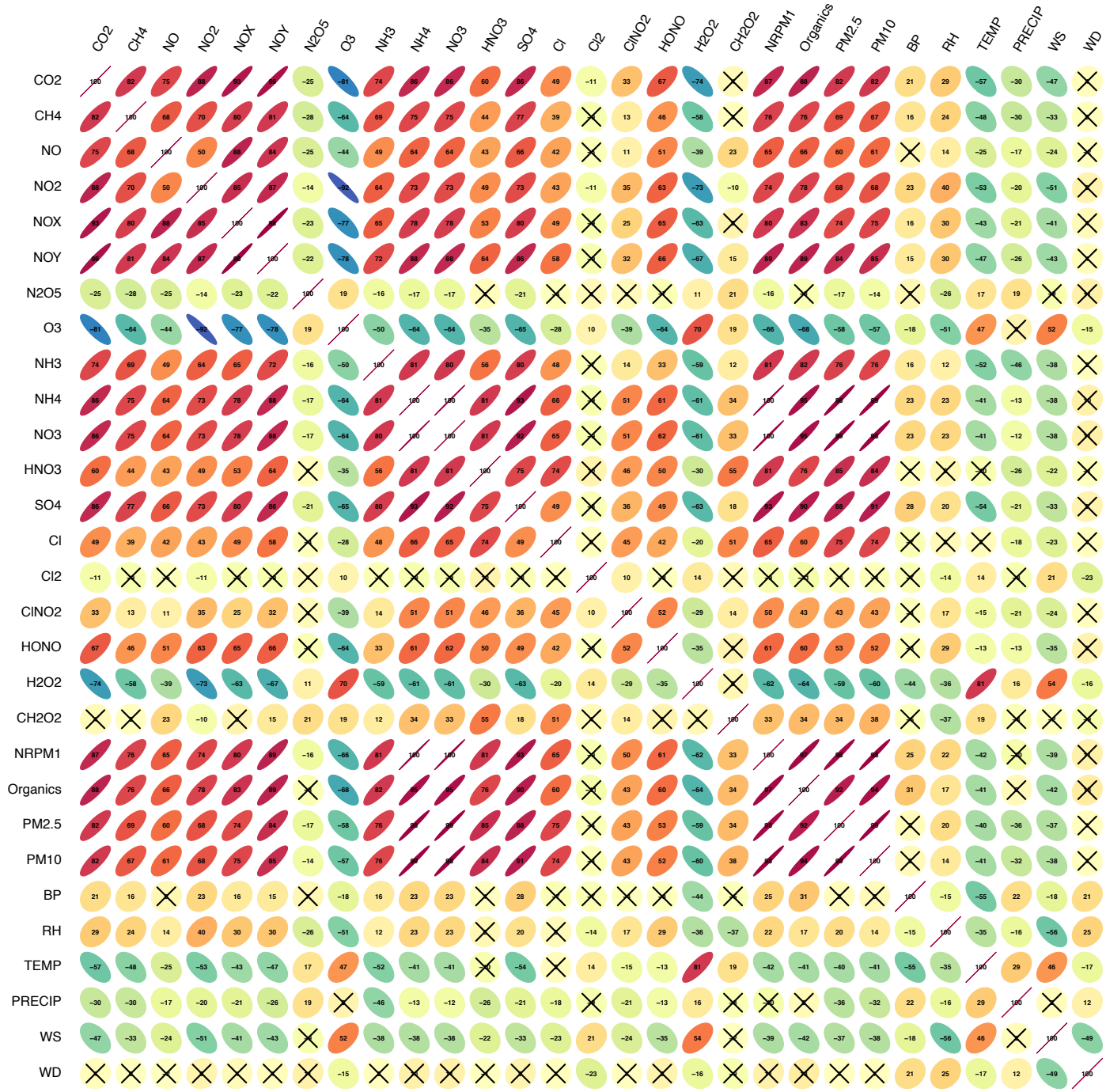
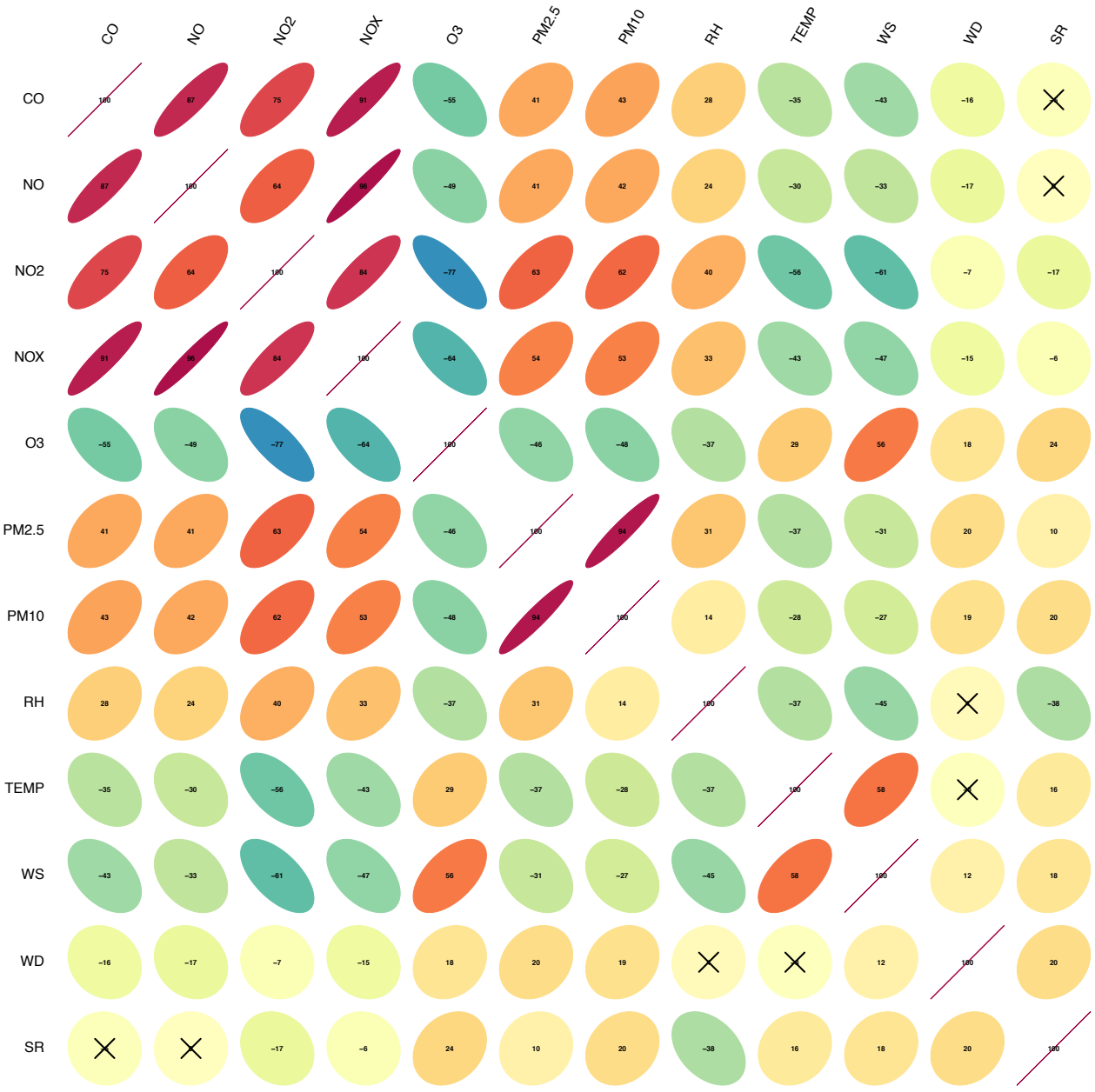

University of Utah Site – Hourly Correlogram (R)
CO
CO2
CH4
NO
NO2
NOX
O3
H2O
HCHO
HCOOH
benzene
isoprene
toluene
NH4
pNH4
pK
pNa
pCa
NO3
pNO3
SO4
pSO4
Cl
pCl
PM2.5
Particles <20nm
Particles <25nm
Particles 61.5nm
Particles 121.9nm
Particles 151.2nm
BP
RH
TEMP
WS
WD

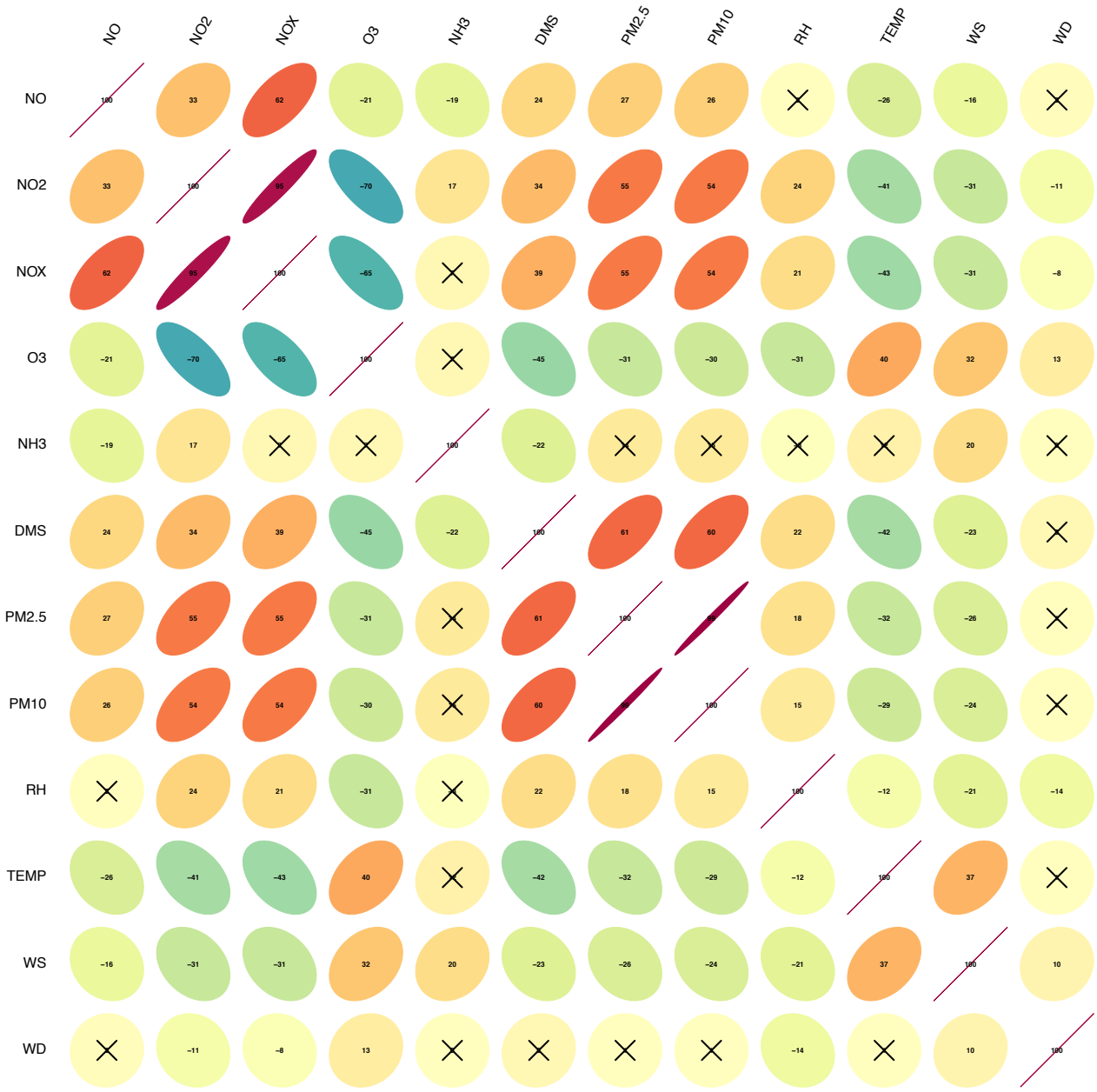
Logan/Cache Valley Site – Hourly Correlogram (R)



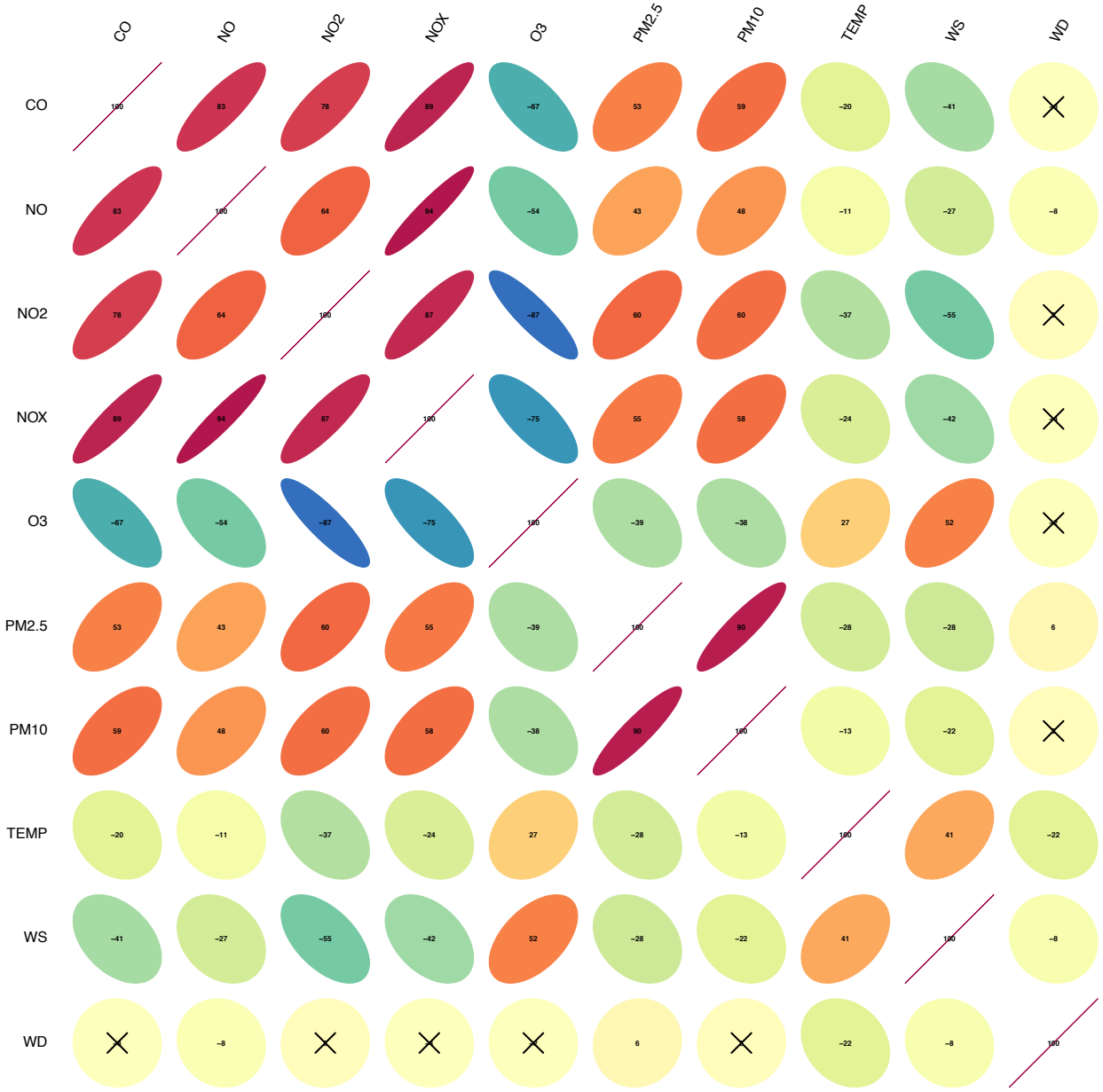
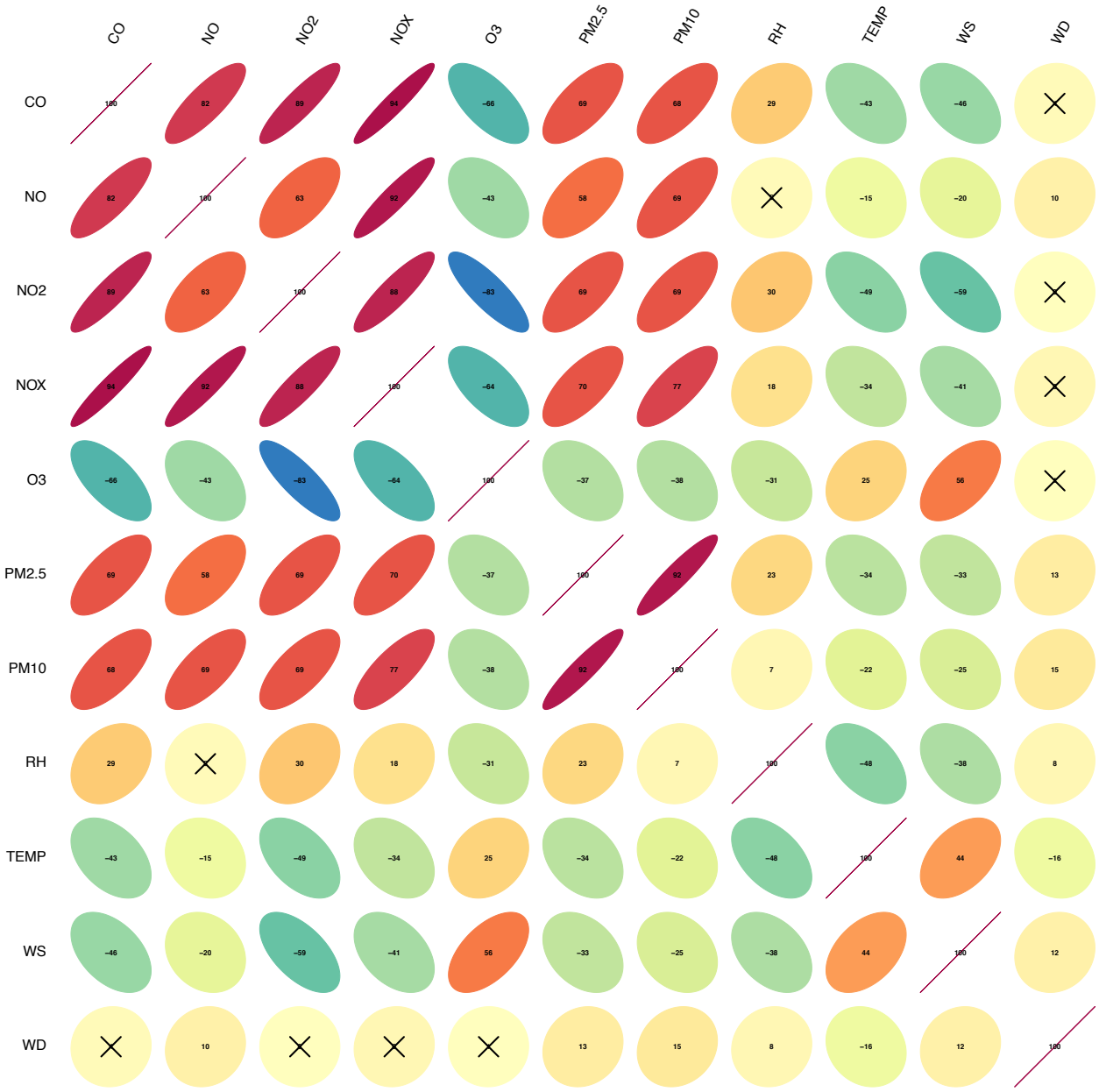
Hawthorne Site – Hourly Correlogram (R)



Smithfield Site – Hourly Correlogram (R)



North Provo Site – Hourly Correlogram (R)



Lindon Site – Hourly Correlogram (R)