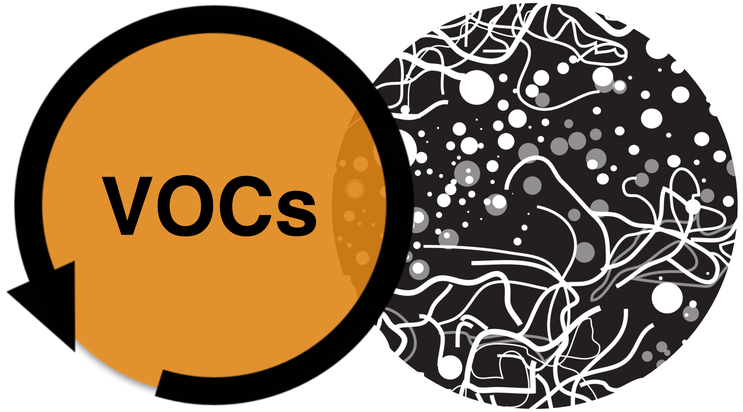
# Microbial Volatile Organic Compounds

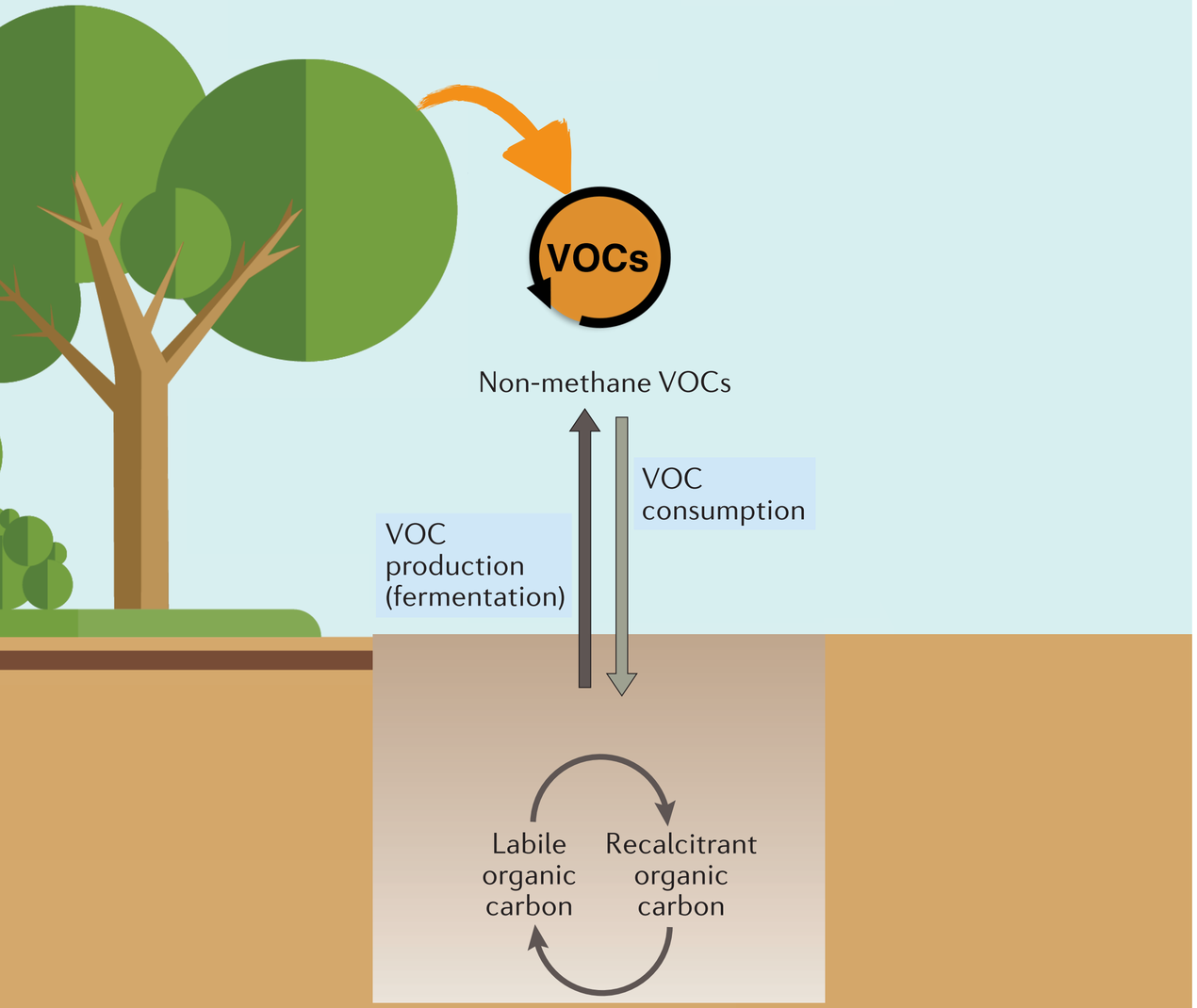
## important but overlooked in microbial systems studies




**Laura Meredith**, Malak Tfaily, Parker Geffre, Kelsey Graves, Kristina Riemer, Linnea Honeker | University of Arizona

Jordan Krechmer | Aerodyne Research, Inc.

# Volatile organic compounds (VOCs) are produced and consumed by microbes,




**Peñuelas** et al., (2014) Plant, Cell & Environment
**Fierer** (2017) Nature Reviews Microbiology

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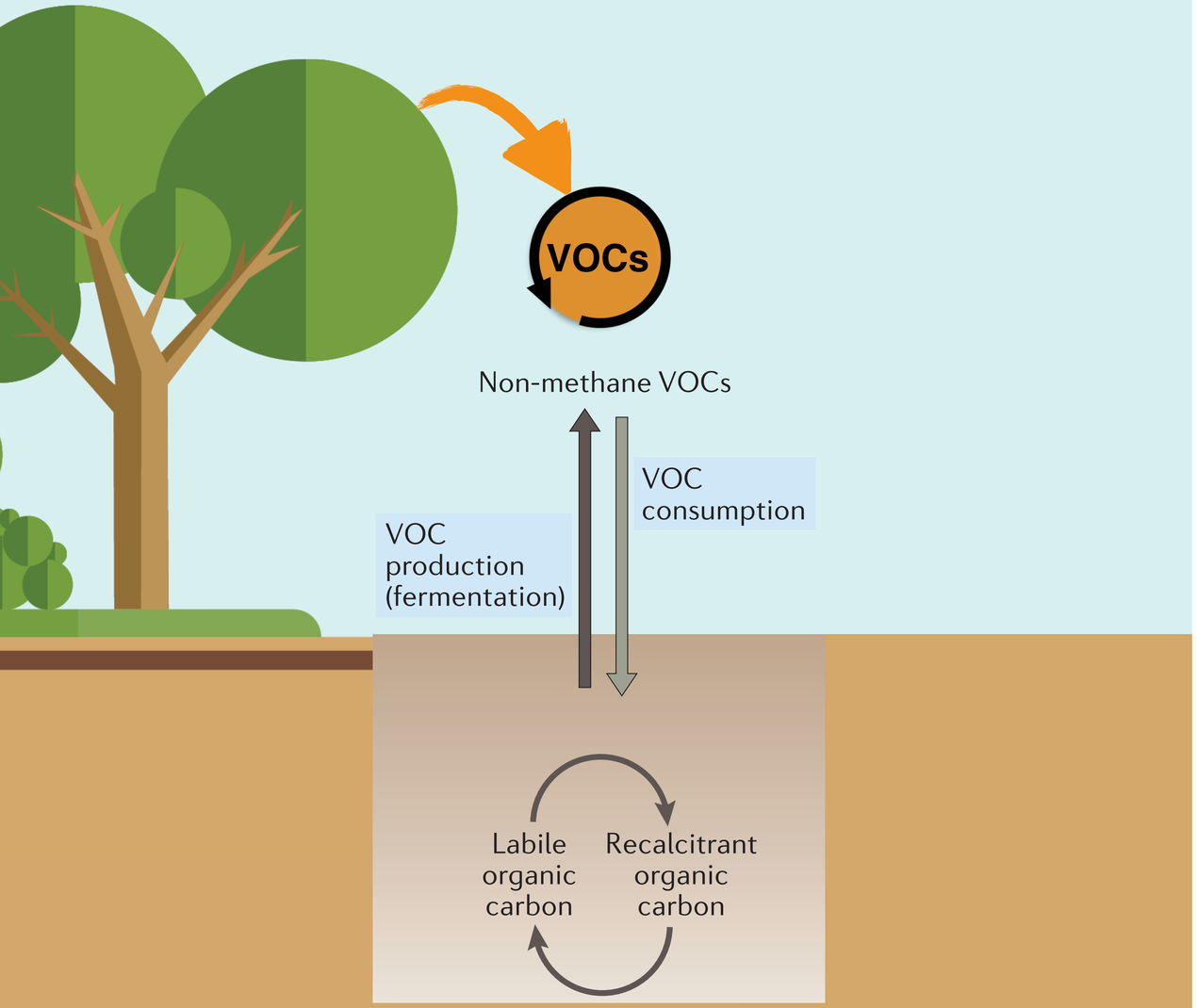


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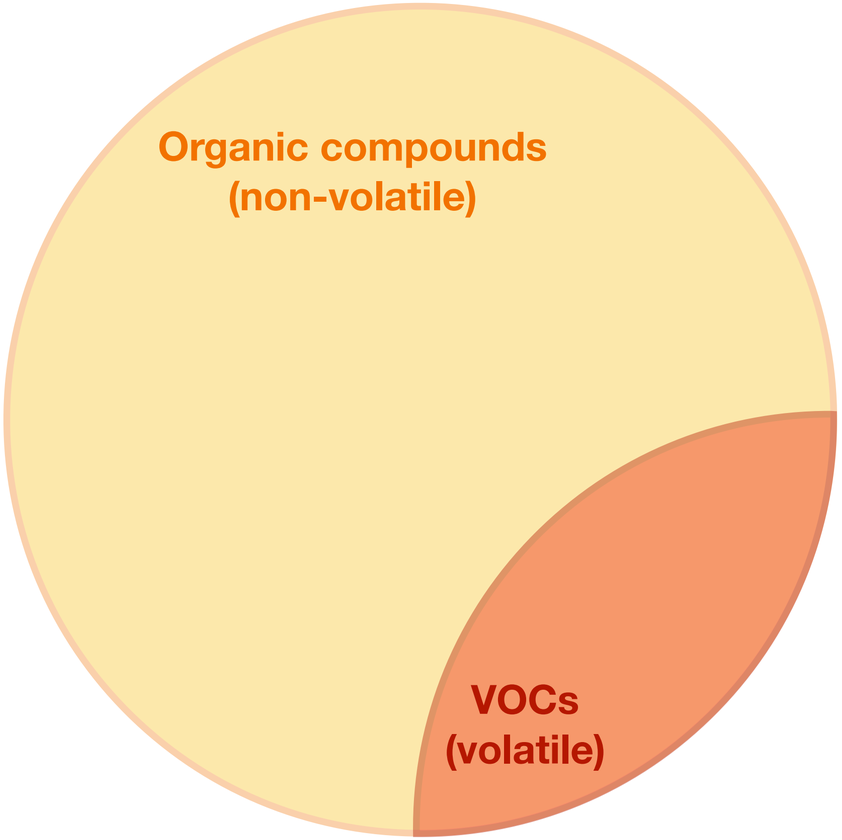
# yet metabolomics studies commonly overlook volatile metabolites




Malak Tfaily

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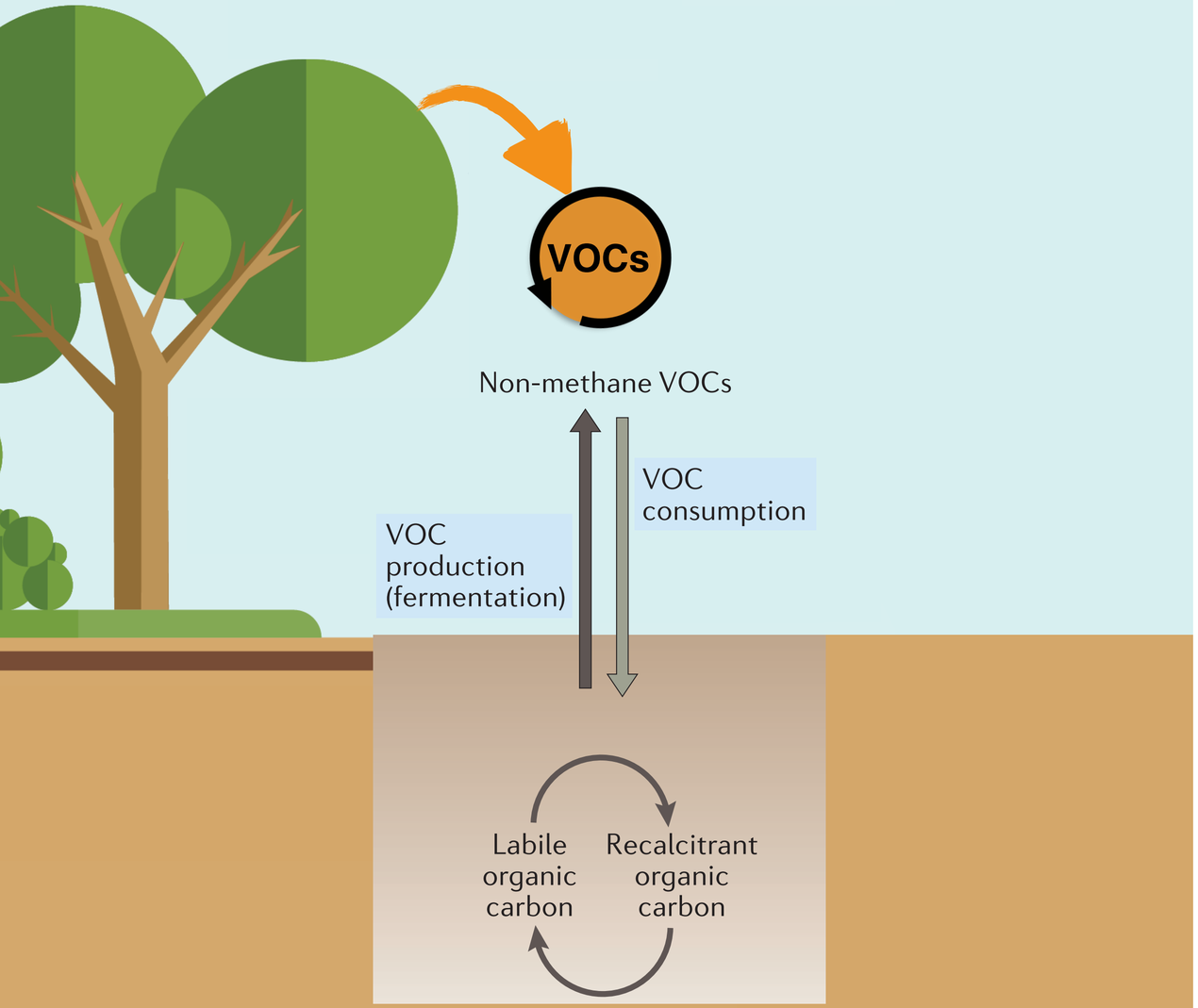


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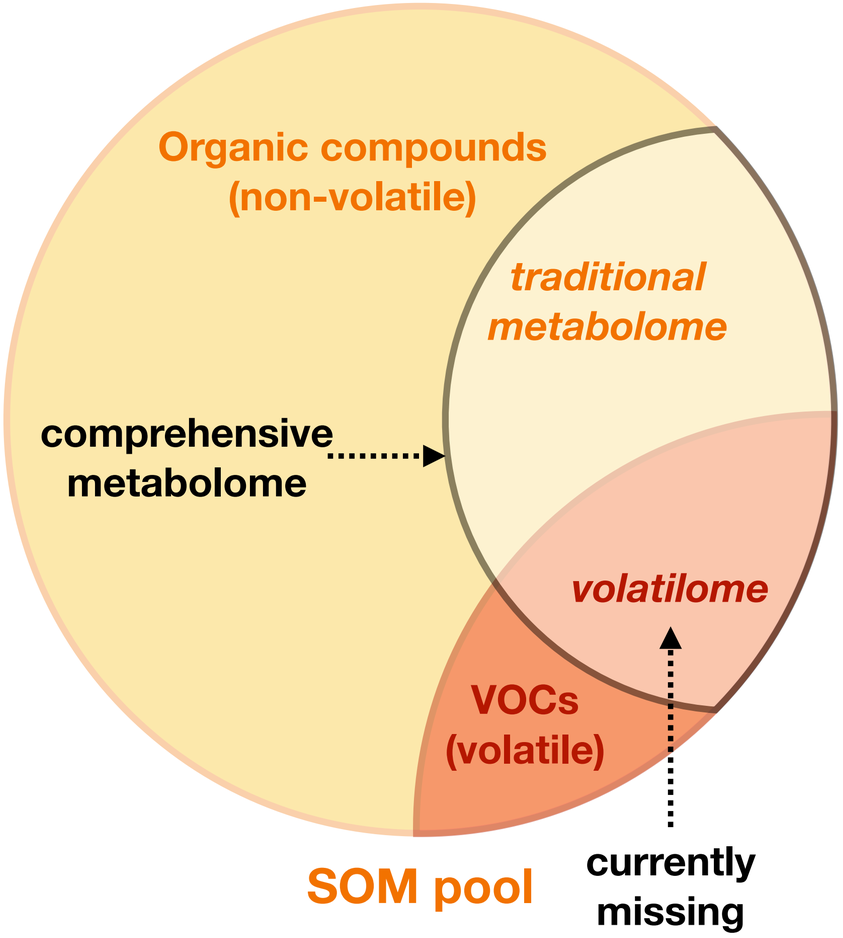


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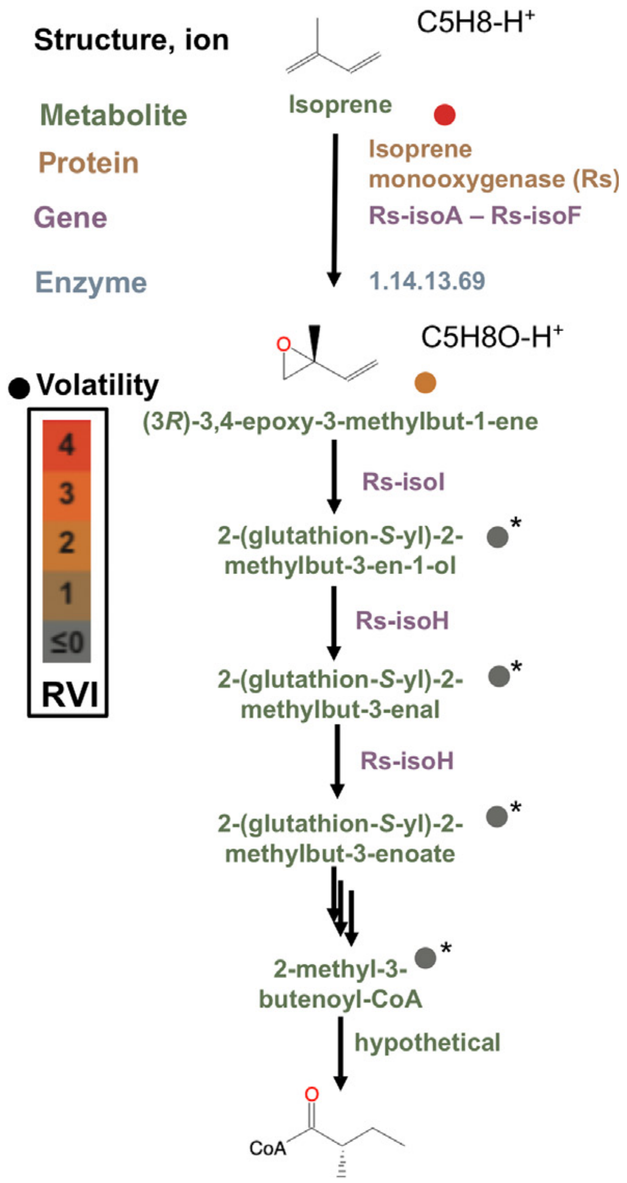
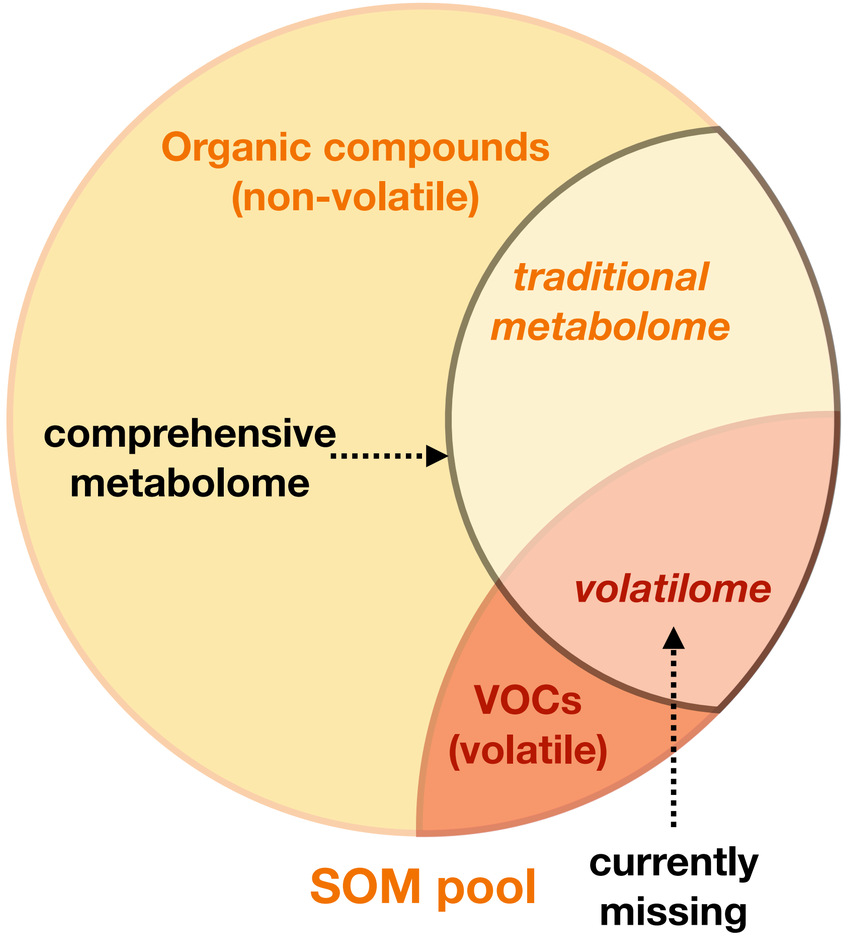
# Estimating metabolite volatility along pathways may explain observational gaps,

ISOPRENE DEGRADATION




Malak Tfaily

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# Estimating metabolite volatility along pathways may explain observational gaps, and motivate more complete integration of -omics data to study microbial systems

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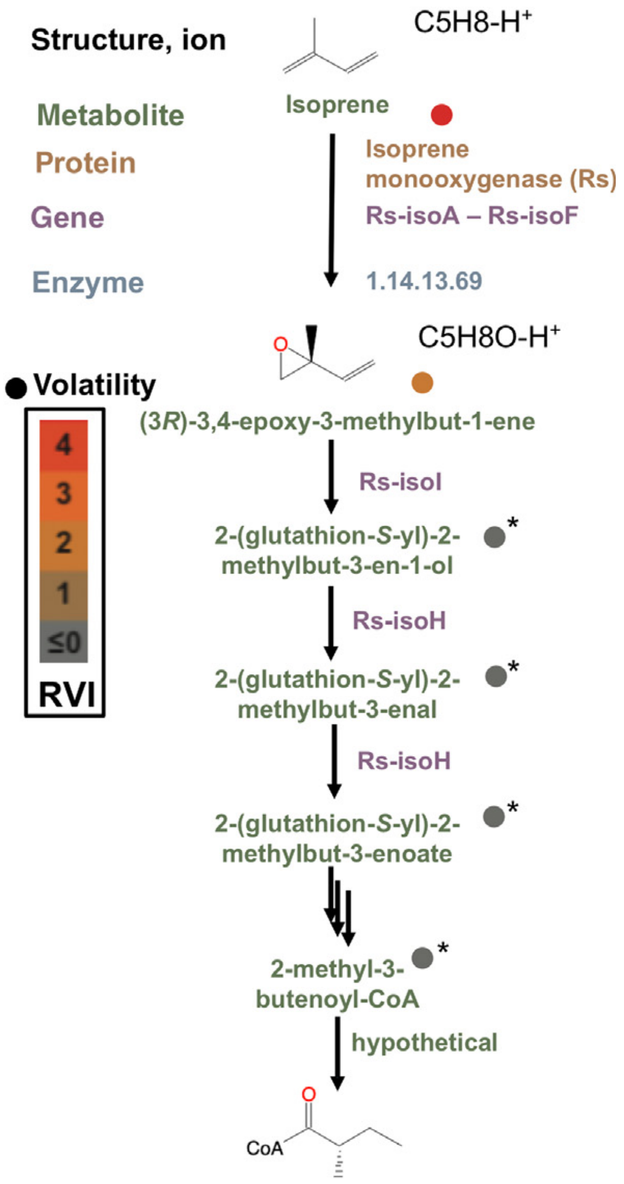


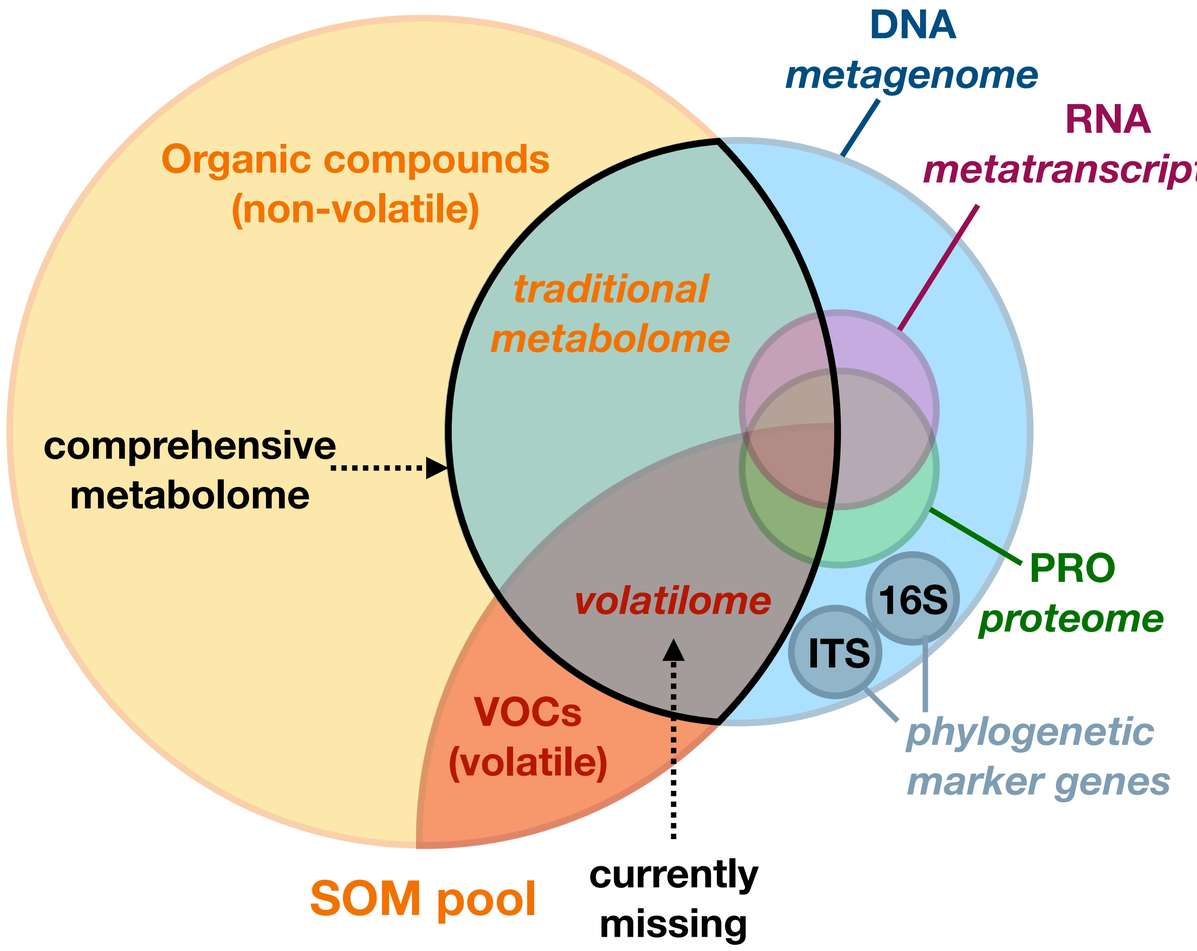


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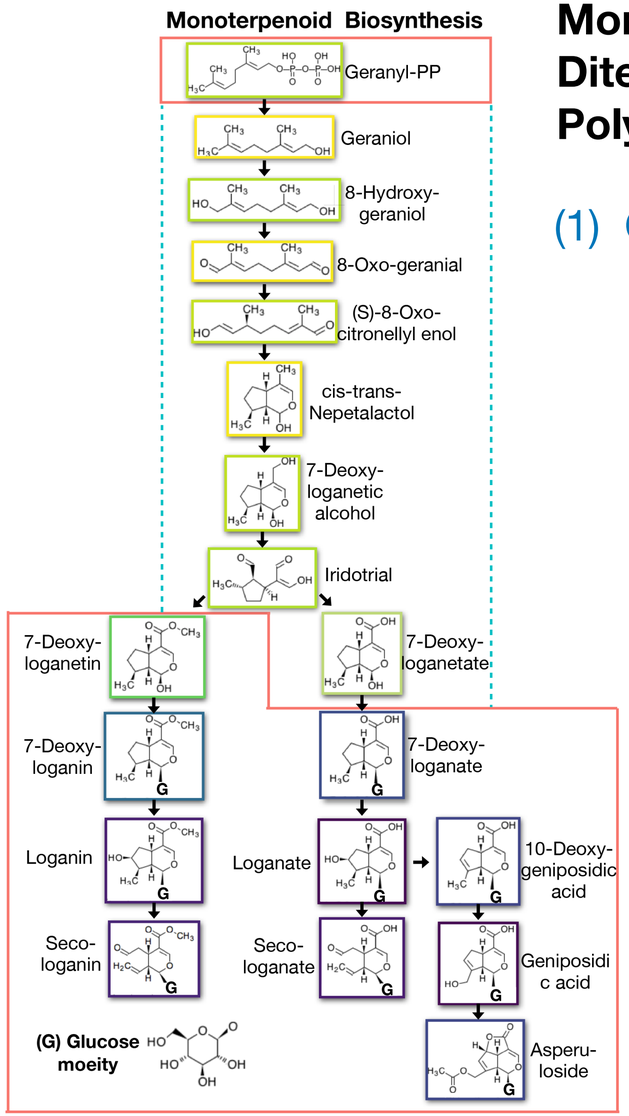
# Do current metabolic approaches underrepresent volatile metabolites?

hypothesis: compounds with higher volatility will be disproportionally undetected




**Monoterpenoid Biosynthesis**
**Diterpenoid Biosynthesis**
**Polycyclic Aromatic Hydrocarbon Degradation**

(1) Considered 3 pathways containing VOCs

Linnea Honeker

Jordan Krechmer

Kelsey Graves

**Honeker** et al., (2021)
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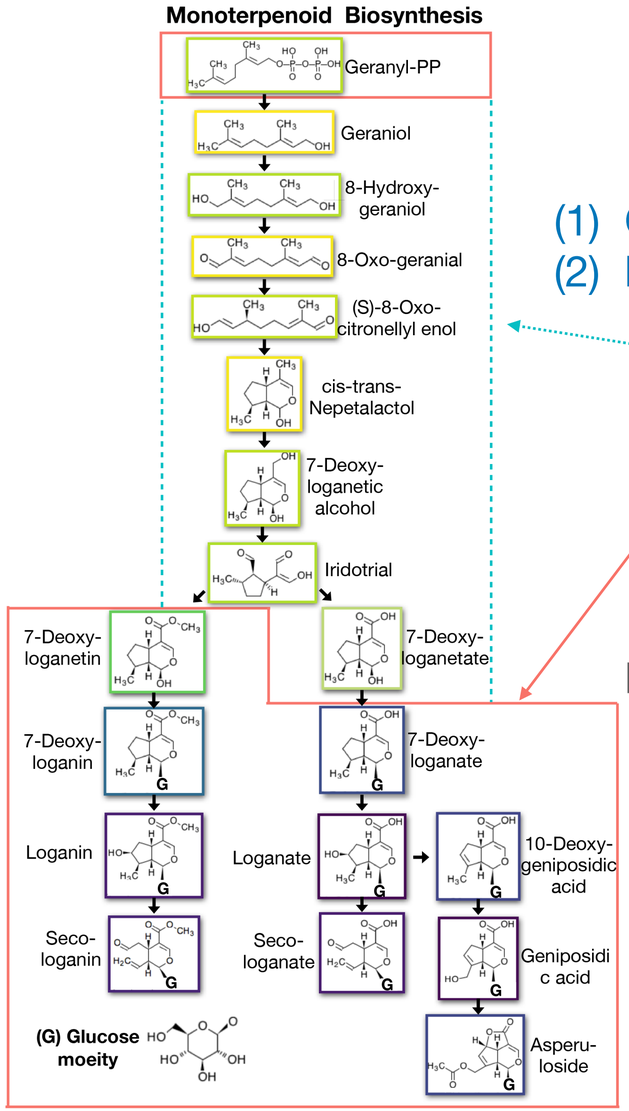


(1) Considered 3 pathways containing VOCs
(2) Metabolite detected in peat metabolome?

Detected

Not-detected

NMR: nuclear magnetic resonance;
GC-EI-MS: gas chromatography electron-ionization MS;
FT-ICR-MS: fourier-transform ion cyclotron resonance MS.

Linnea Honeker

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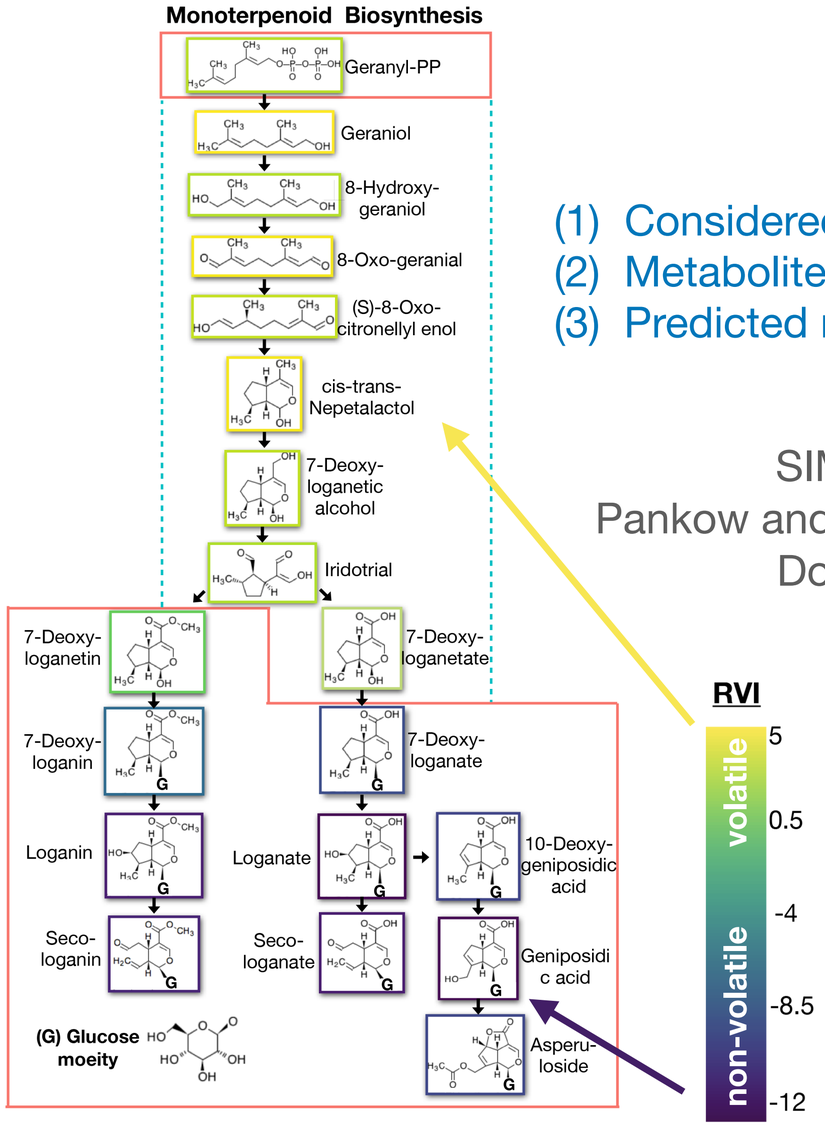


(1) Considered 3 pathways containing VOCs
(2) Metabolite detected in peat metabolome?
(3) Predicted metabolite volatility.

SIMPOL.1 method & gas phase partitioning
Pankow and Asher (2008) *Atmospheric Chemistry and Physics*
Donahue et al. (2006) *Environ. Sci. Technol.*




**Relative Volatility Index**
$\log_{10}$(mass vapor pressure)


Linnea Honeker


Jordan Krechmer


Kelsey Graves

**Honeker** et al., (2021)
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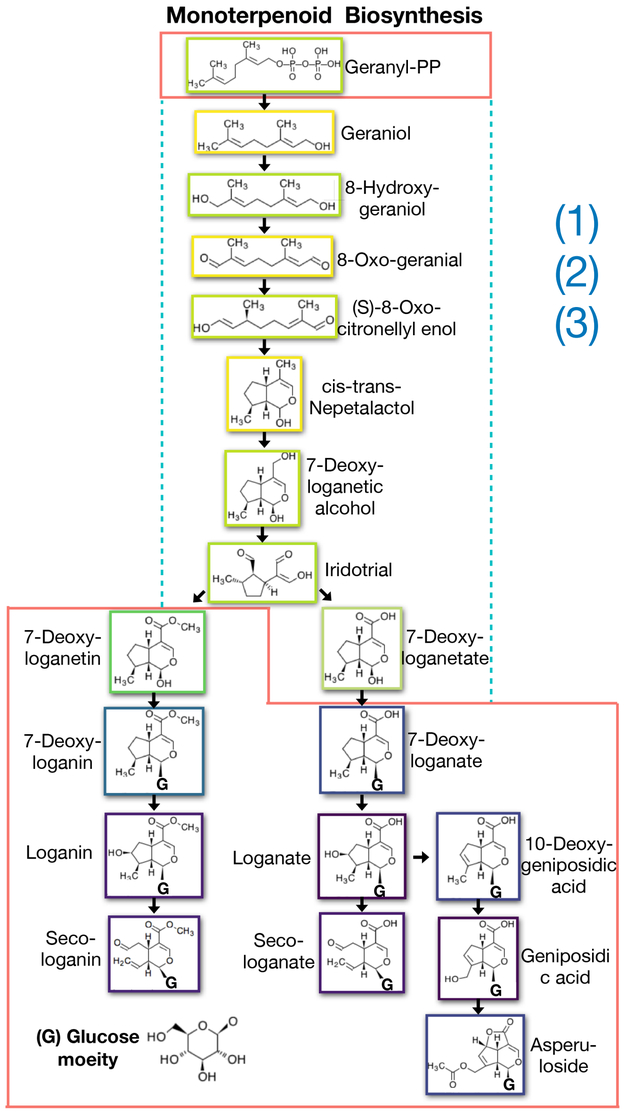
# Do current metabolic approaches underrepresent volatile metabolites?

We find evidence that compounds with higher volatility are disproportionally undetected

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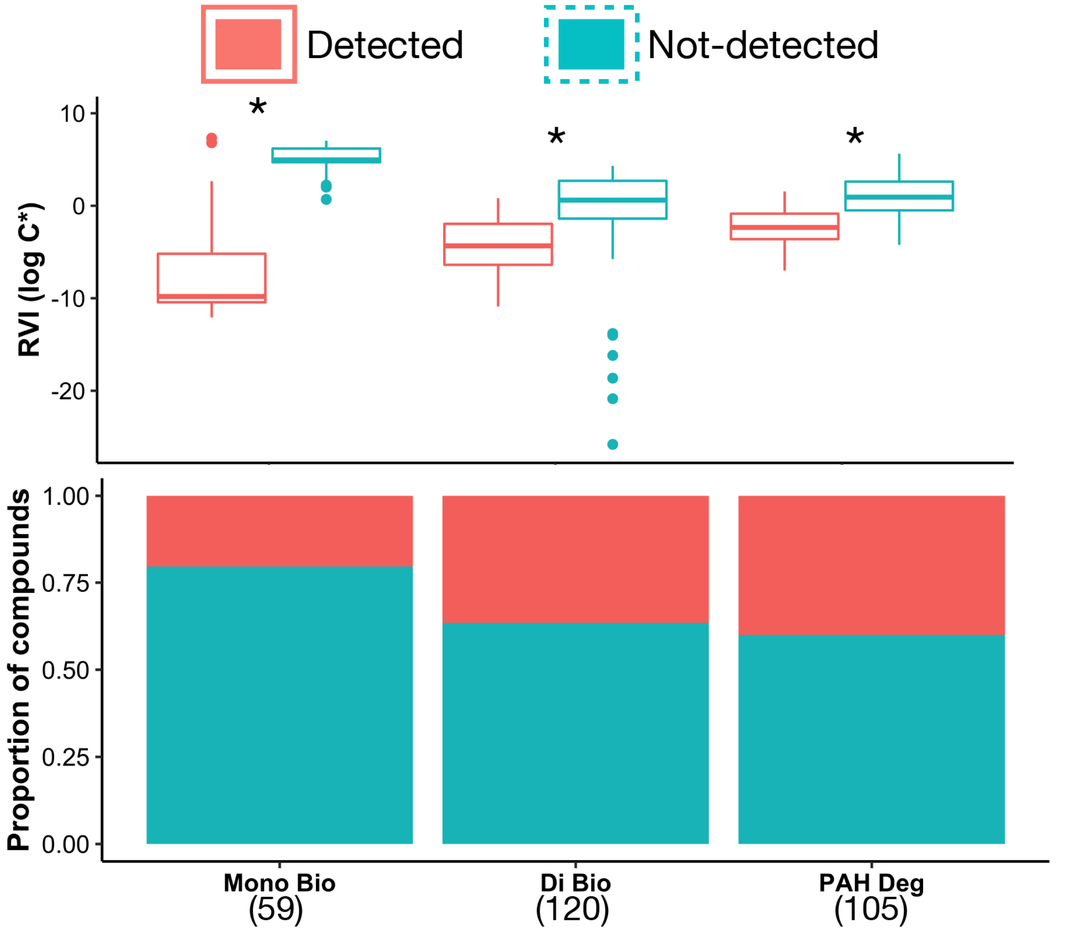
**Relative Volatility Index**
$\log_{10}$(mass vapor pressure)




**Honeker** et al., (2021)
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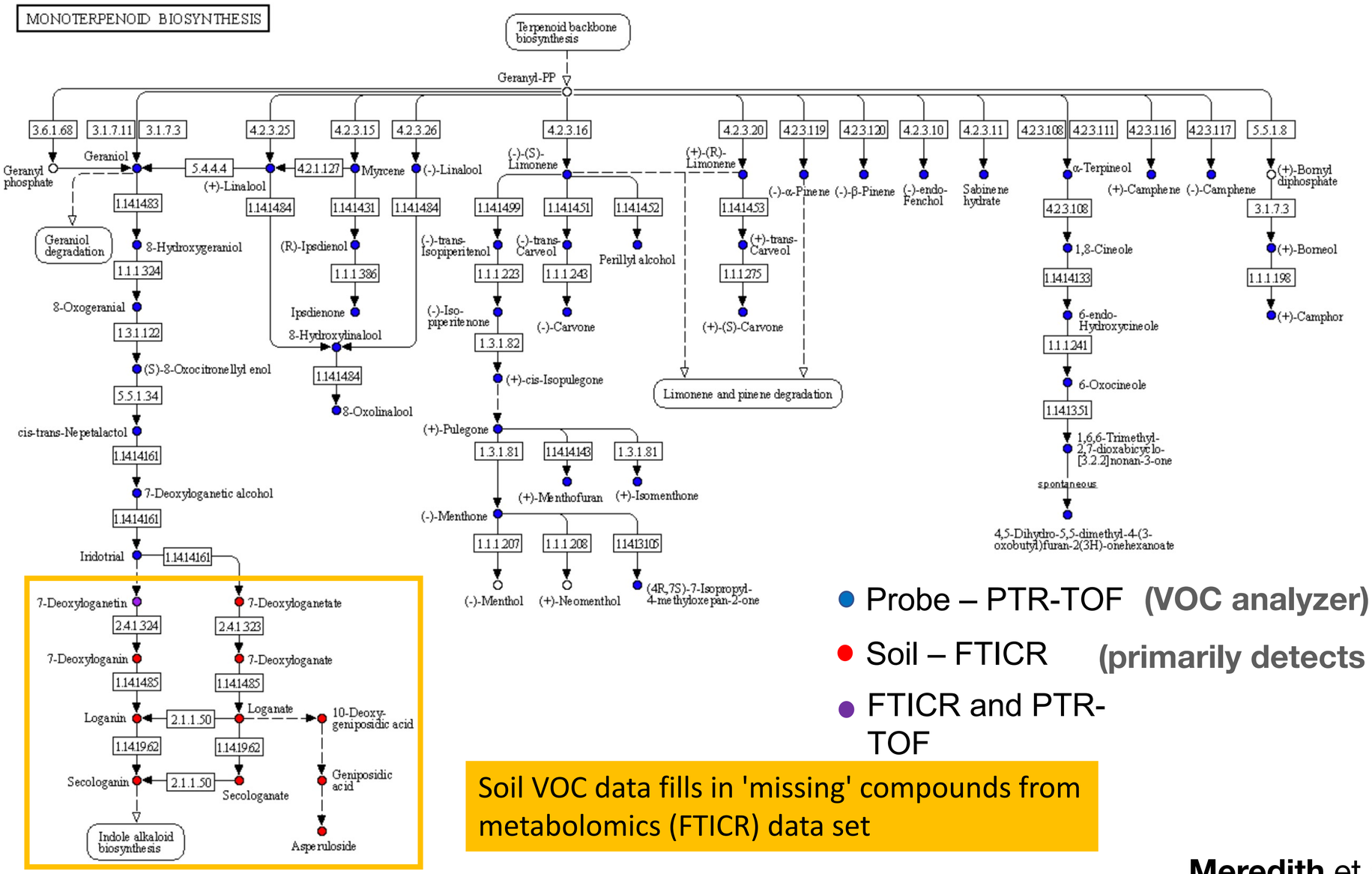
# Compounds with higher volatility are disproportionally undetected

Potential to fill in ‘missing’ compounds with VOC measurement methods



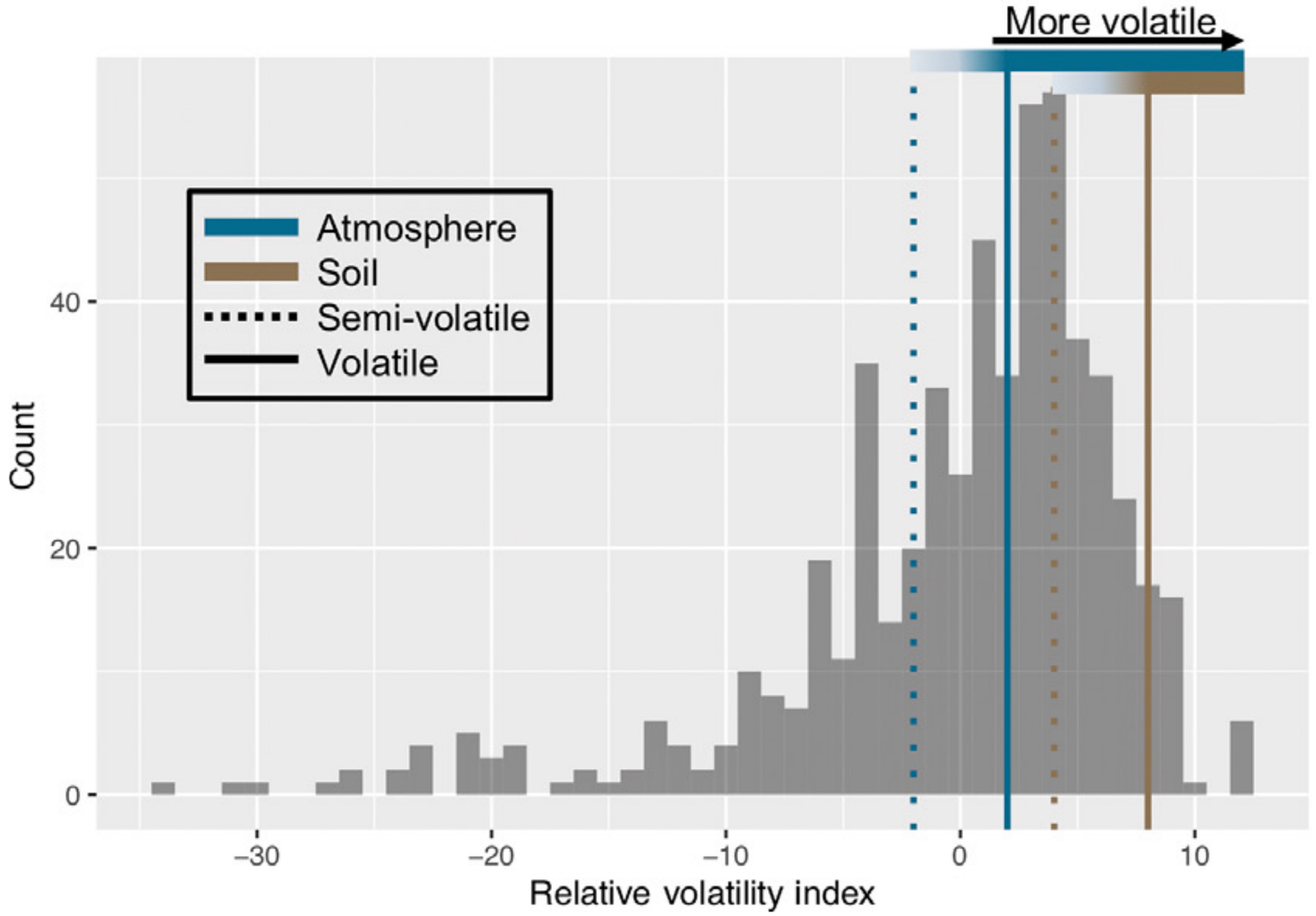

- Probe – PTR-TOF **(VOC analyzer)**
- Soil – FTICR **(primarily detects non-volatile compounds)**
- FTICR and PTR-TOF

Soil VOC data fills in 'missing' compounds from metabolomics (FTICR) data set

**Meredith** et al., unpublished data

# Compounds with higher volatility are disproportionally undetected

A significant number of metabolites may be volatile in soil…




but thresholds for partitioning to gas phase in soil are uncertain.

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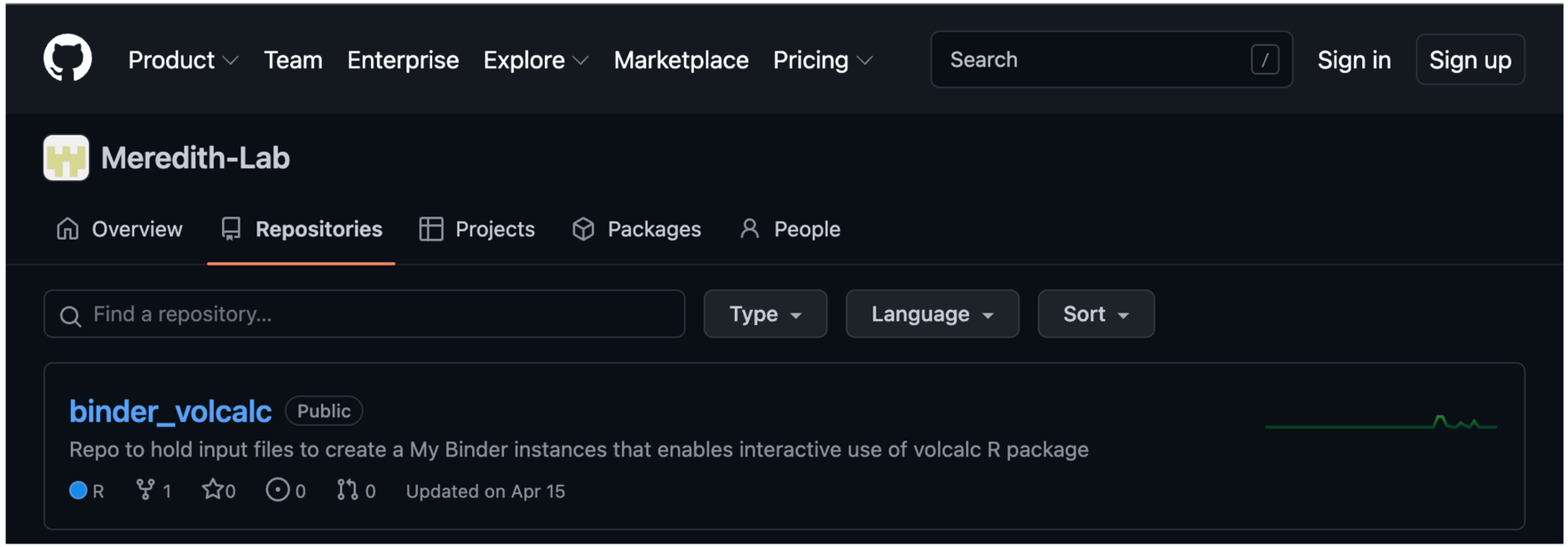
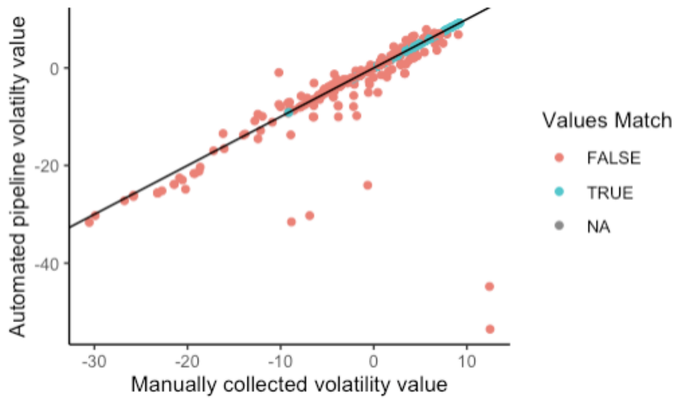
# Volatility prediction pipeline for metabolomics studies

Predict presence of volatile metabolites in biological systems





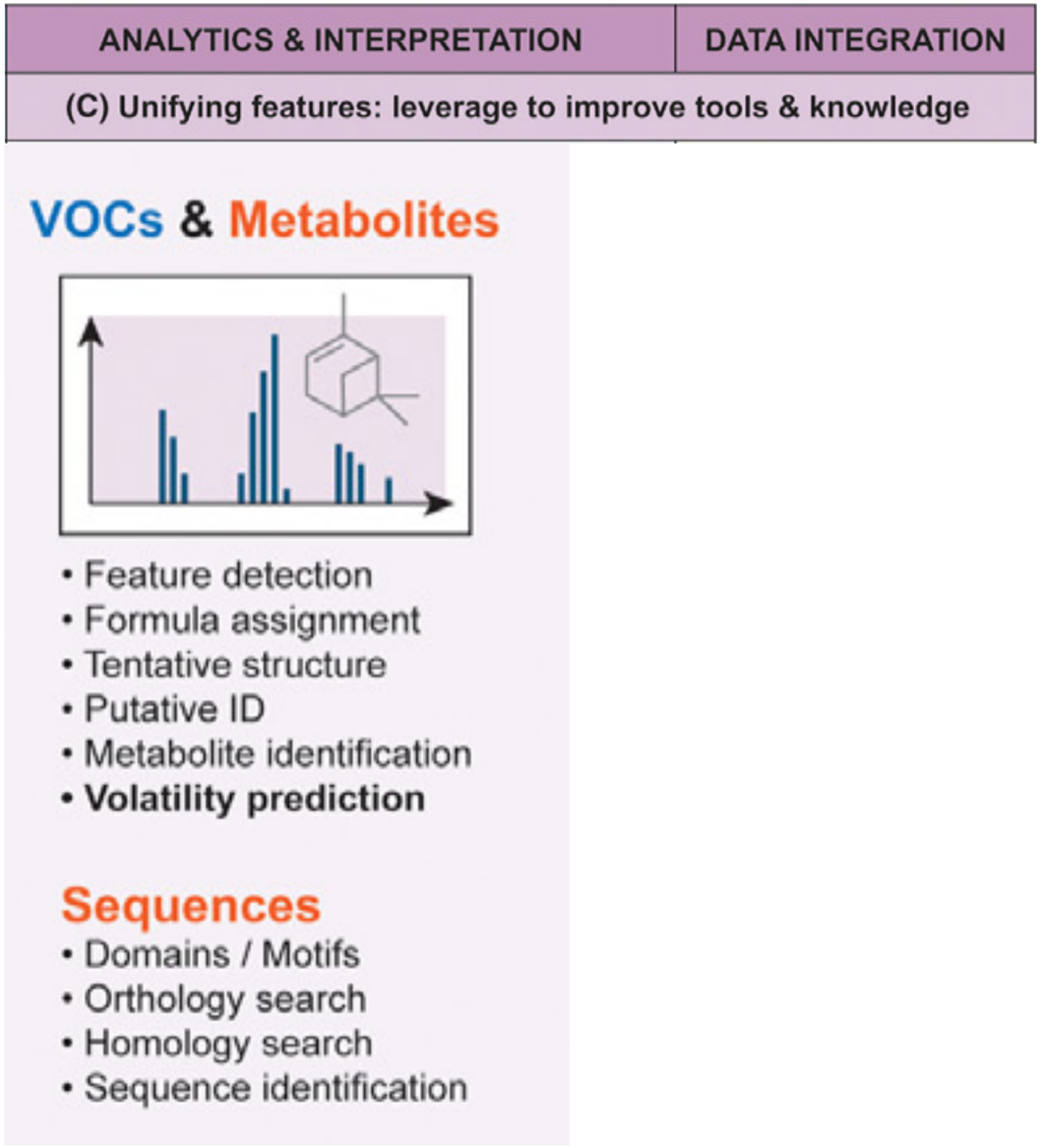

Kristina Riemer

Parker Geffre

**Meredith** et al., in prep

# Vision: leverage unifying and contrasting features of volatilomics and multi-omics

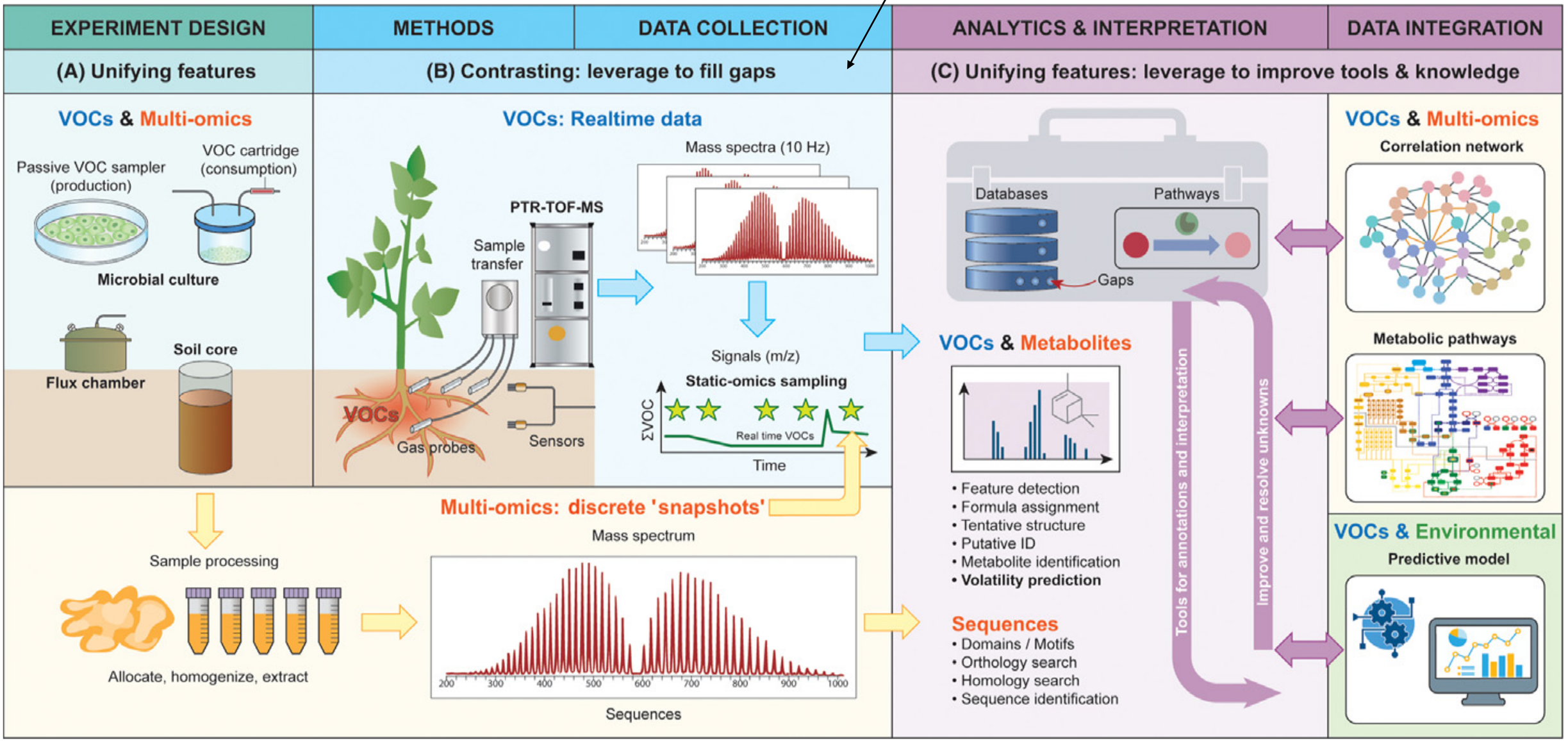
Build on areas of common strength




**Meredith** and **Tfaily** (2022) Trends in Microbiology

# Vision: leverage unifying and contrasting features of volatilomics and multi-omics

Build on areas of common strength and leverage contrasts to fill gaps




**Roscioli and Meredith** (2021) Scientific Reports

**Meredith** and **Tfaily** (2022) Trends in Microbiology

# Thank you!

Postdoc Position Available!
Please, get in touch if interested!

Signals in the Soil #2034192
CAREER #2045332

**Laura Meredith**
laurameredith@arizona.edu
@DrLauraMeredith