VOC Composition and OH Reactivity Observed Over Long Beach, California

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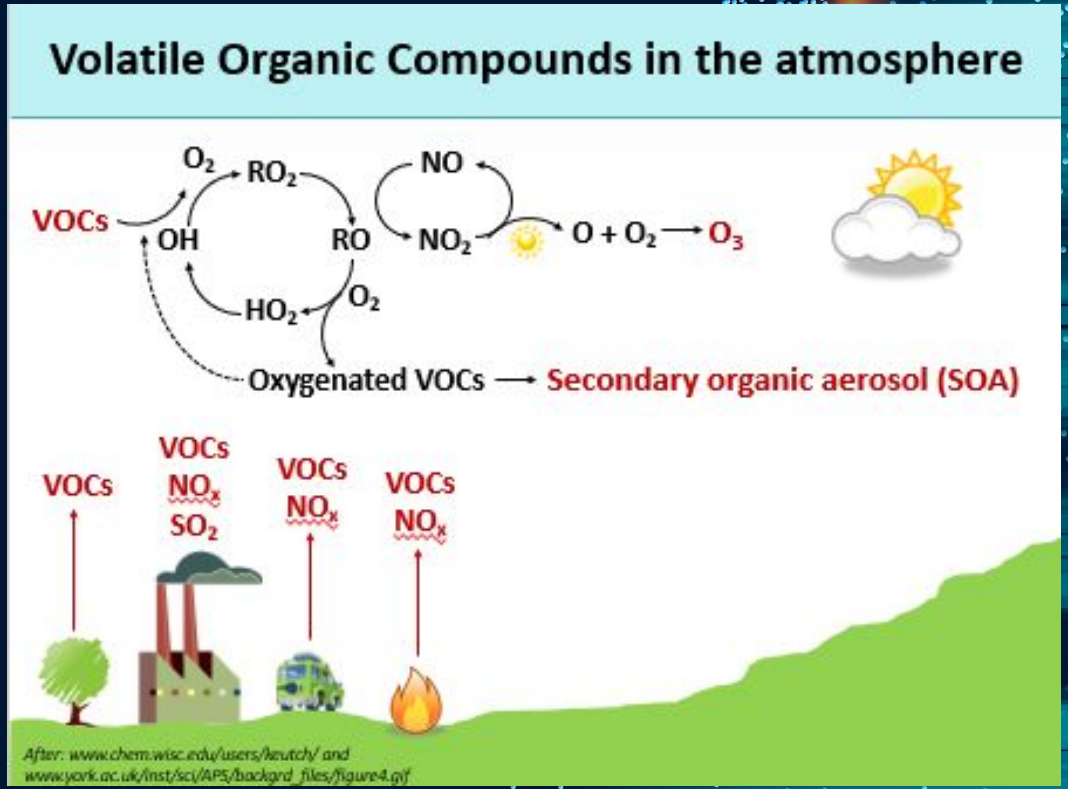
Volatile Organic Compounds (VOCs)

- VOCs are released into the air and react with other compounds which can create ozone
- Ozone in the troposphere can cause negative health effects such as
  - increased risk of respiratory infections
  - reproductive issues
  - Cancer risk



(Chem.wisc.edu)

Platform

DC-8 (retired in 2024)

Methods

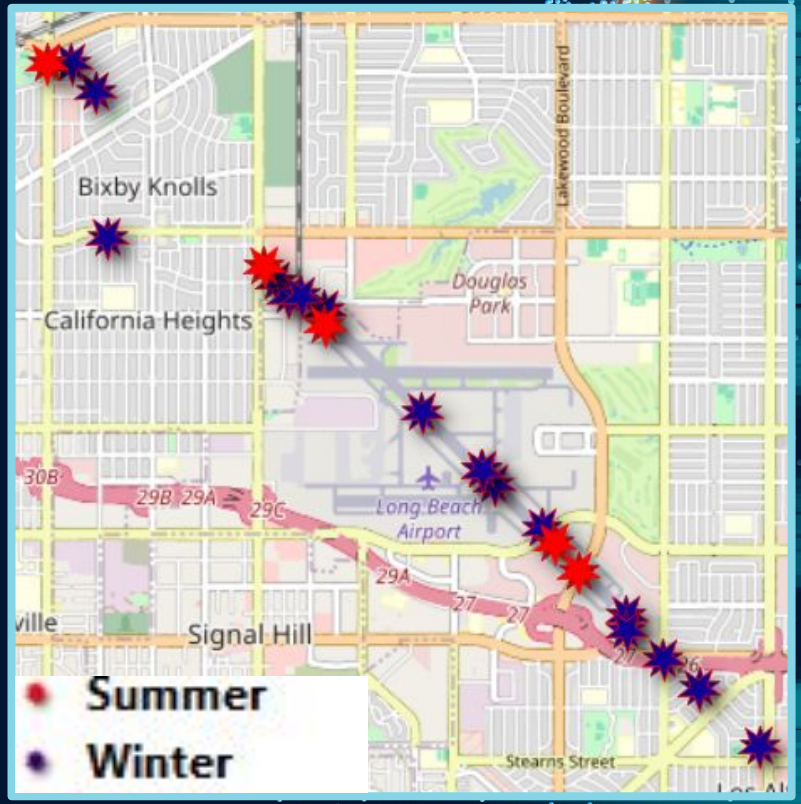
WAS Instrument (DC-8)

WAS “Snake”

Credit: Sam Hall, Rebecca Hornbrook

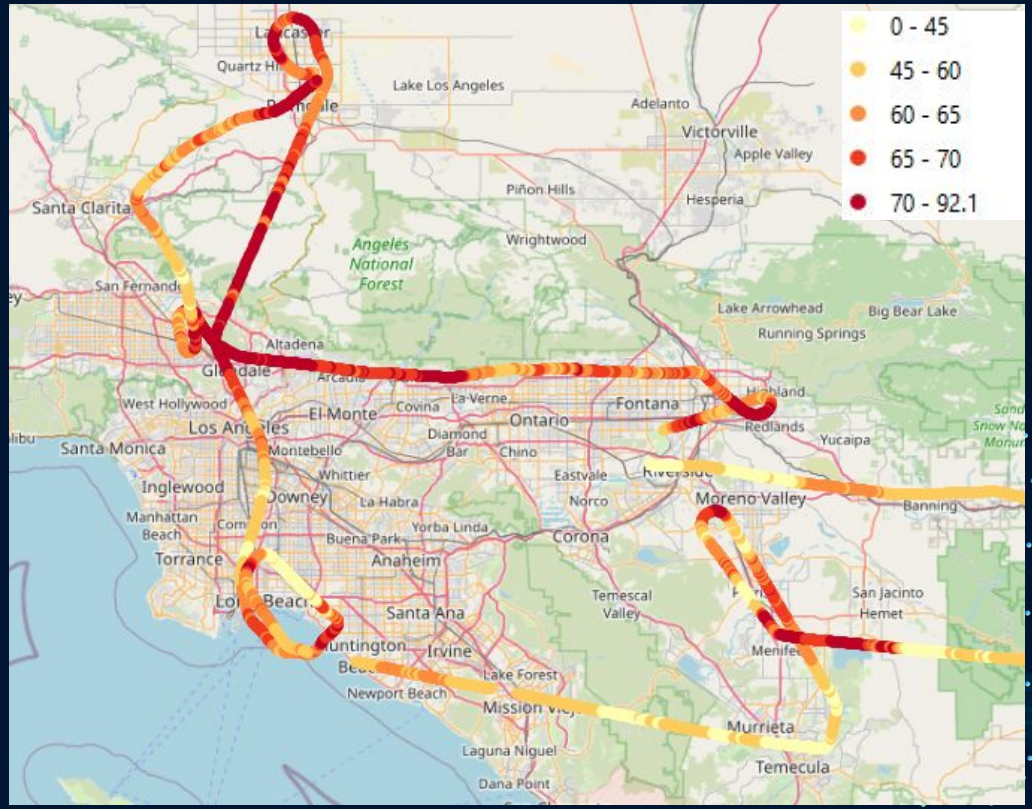
Area Of Interest

- Summer and Winter
- Long Beach area
- Within the boundary layer
- Missed Approaches
- 22 data points
- QGIS



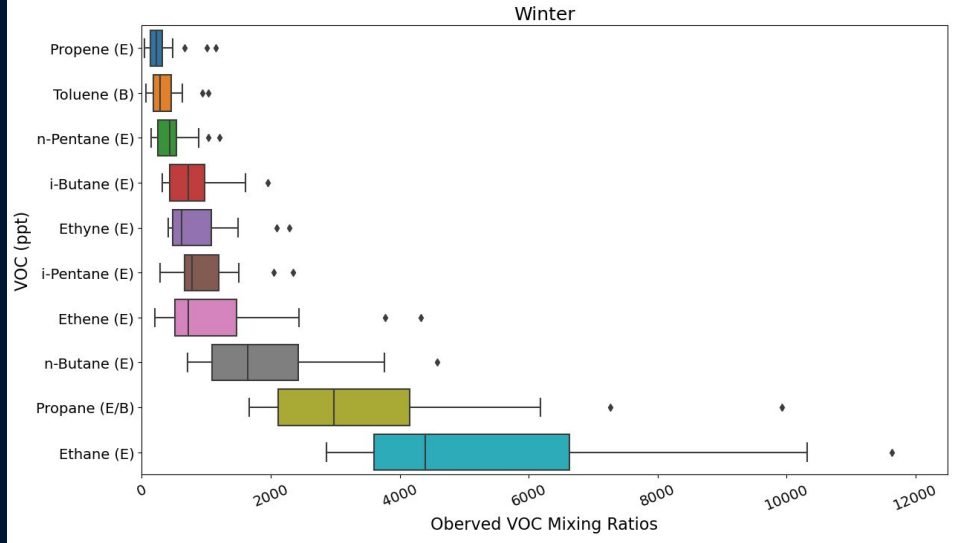
Why Long Beach?

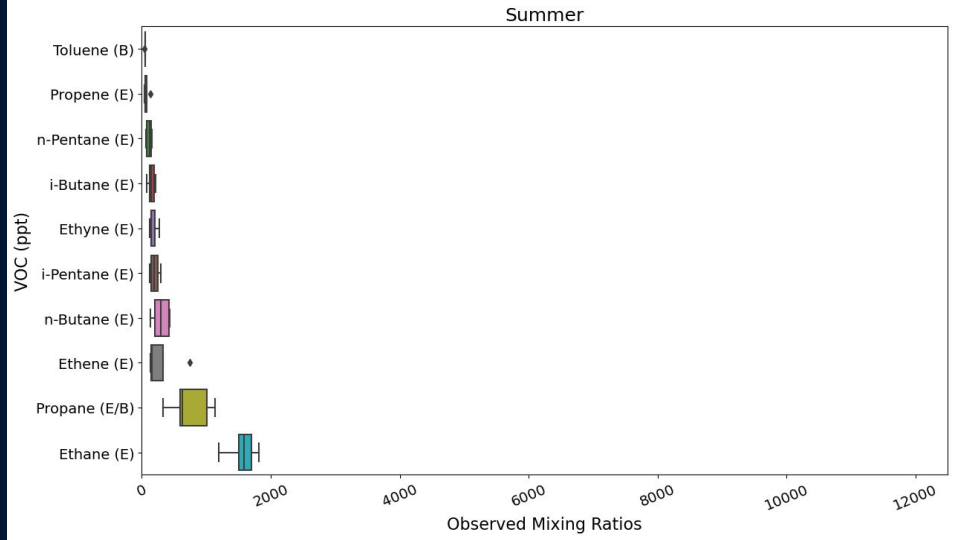
Summer 2022 Observed O3 emissions



Summer VS Winter VOC Composition

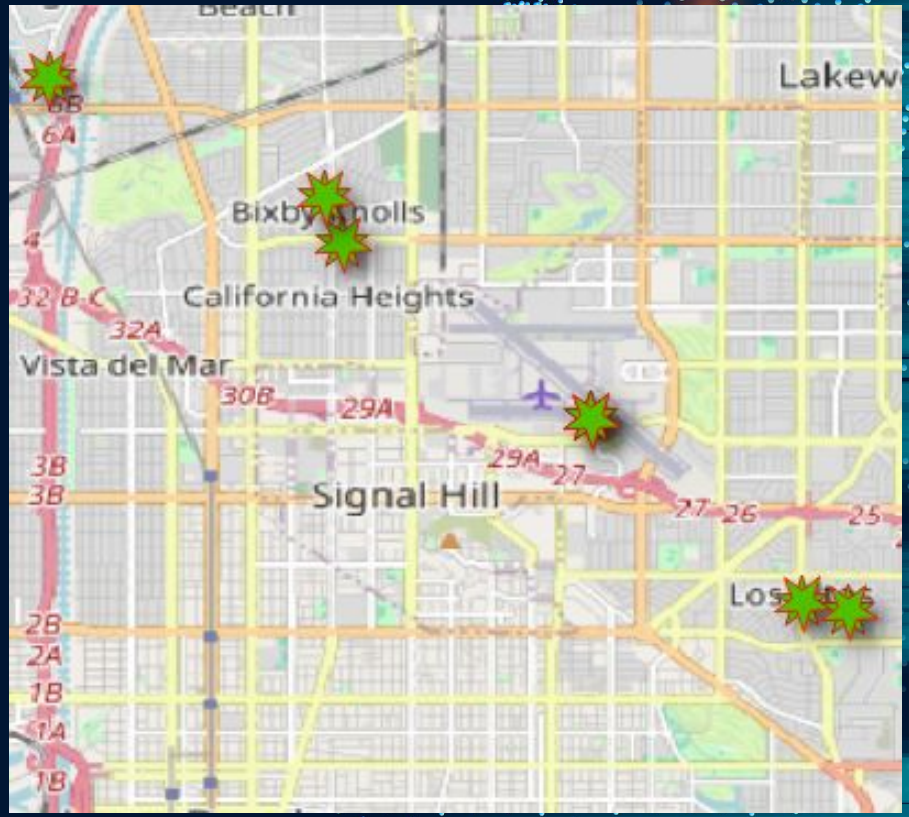
- ~50 VOCs were studied
- Overall higher VOC concentrations in the Winter
  - Less Sunlight
  - Less water vapor
  - Lower Temperature (Reacts Slower)
  - Lower Boundary layer





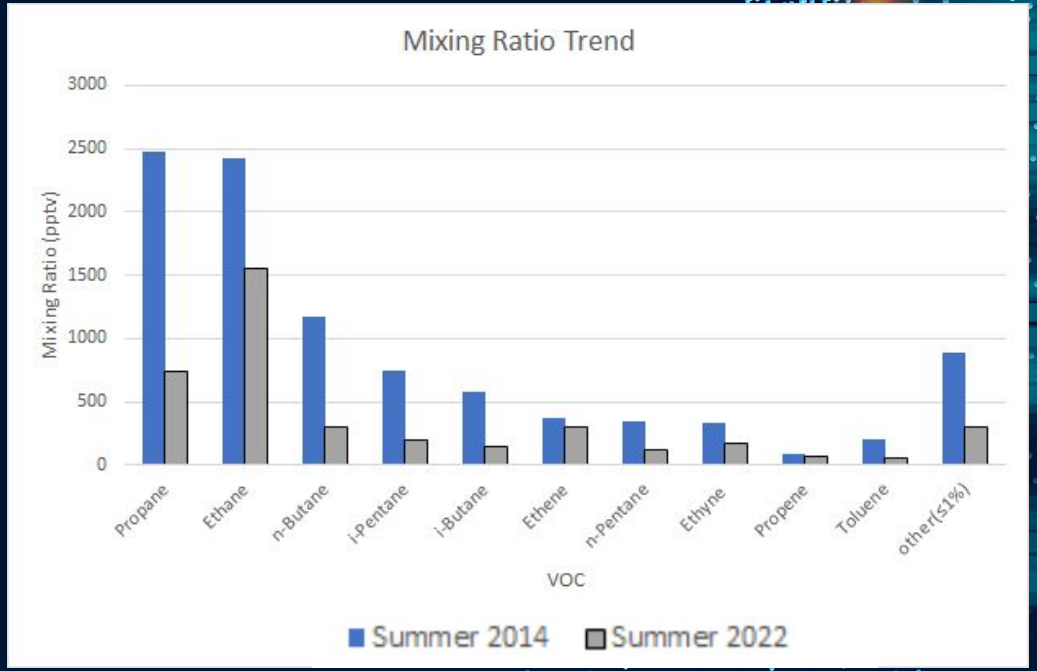
Summer 2014 flight data

- About the same amount of points as summer 2022
- Missed approach
- Within the boundary layer
- QGIS



Total Mixing Ratios

- All mixing ratios for the VOCs decreased
- Propane decreased by a factor of 3.3
- Where Ethane only decreased by a factor of 1.5
- n-Butane decreased the most by a factor of about 4
- Something changed between 2014 and 2022
- **The total mixing ratios decreased by a factor of about 2.5**



Have concentrations really changed over time?

1. Any larger datasets indicating overall changes in VOC emissions?

Unable to look into this due to time constraints

2. Time of day?

2014: 16:00 UTC
2022 - 15:00 UTC

3. Boundary Layer Height?

Date and time did not indicate this

4. COVID-19?

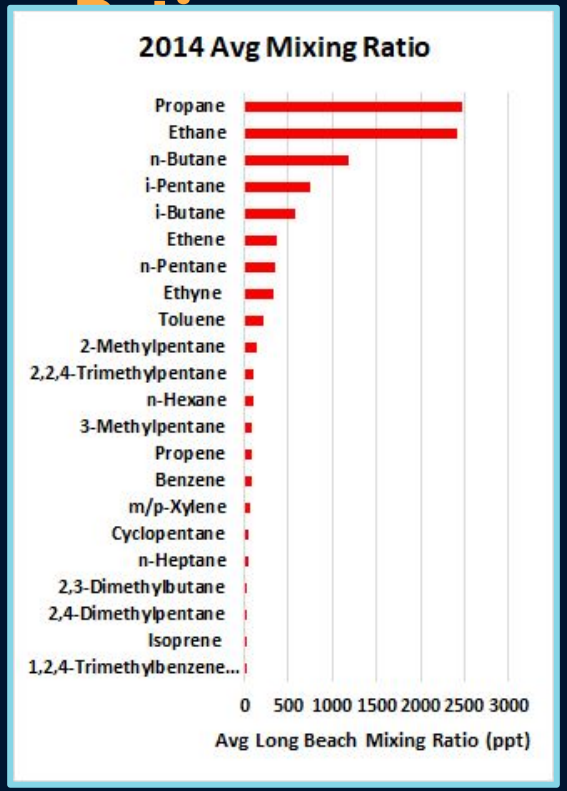
Would need to investigate other datasets

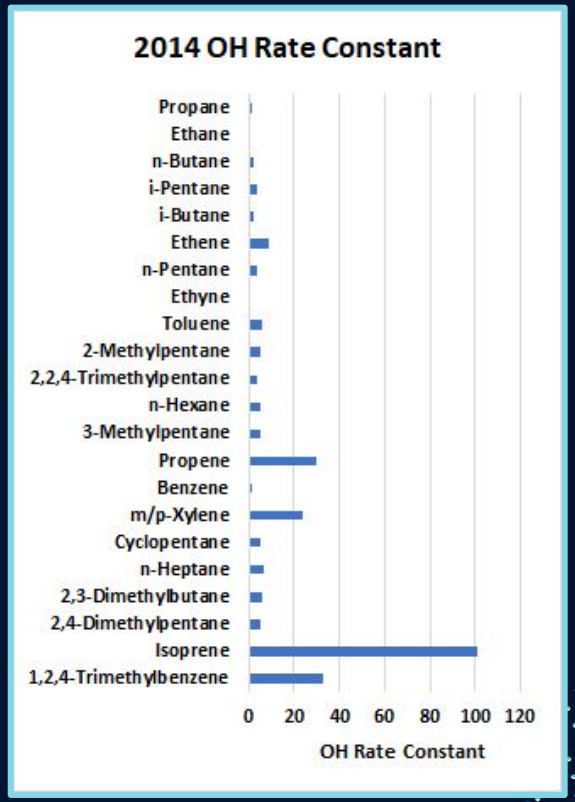
5. Wind direction?

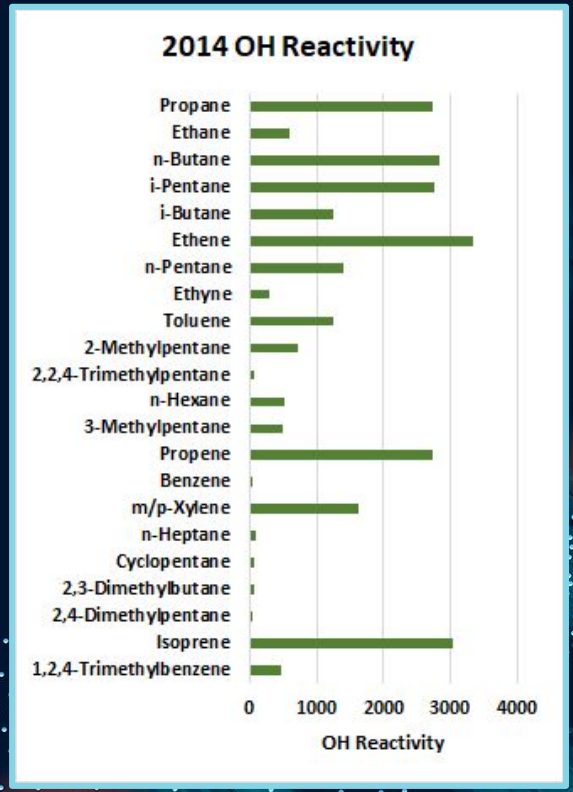
2014: ~ NW
2022: ~ SE

(ppt) (cm^3 molec^{-1} s^{-1}) (s^{-1})

Avg Mixing Ratio X OH Rate Constant = OH Reactivity







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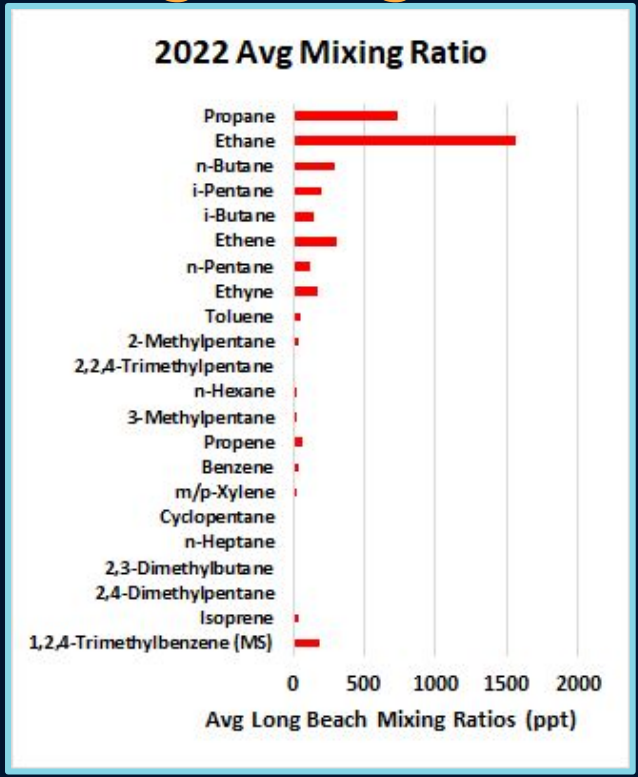
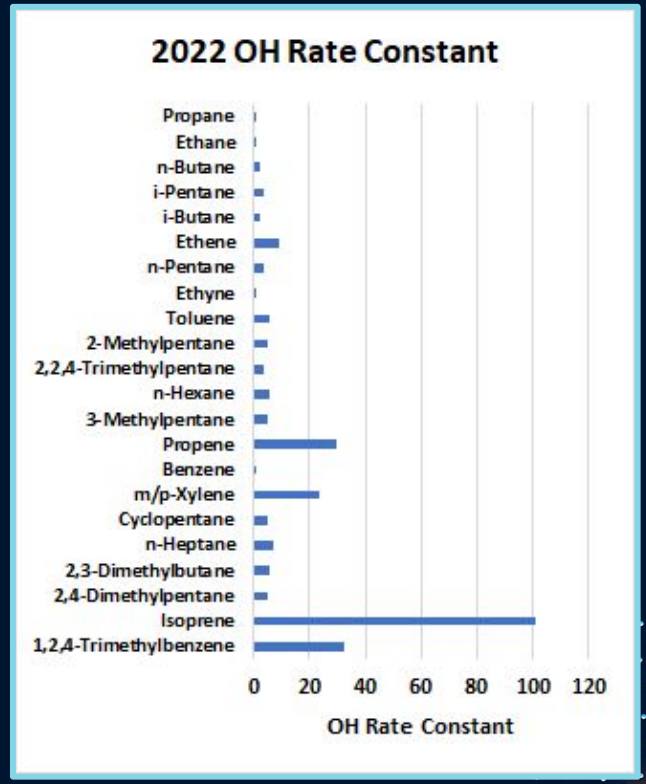
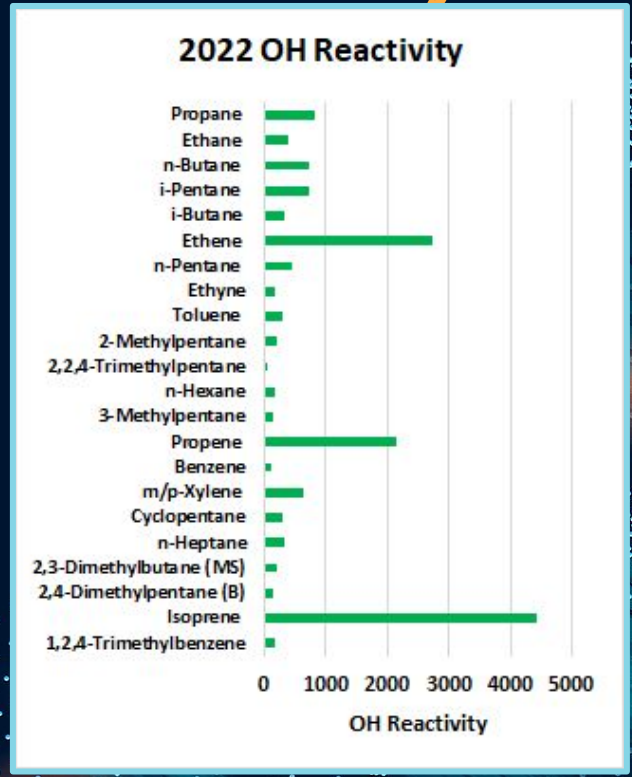


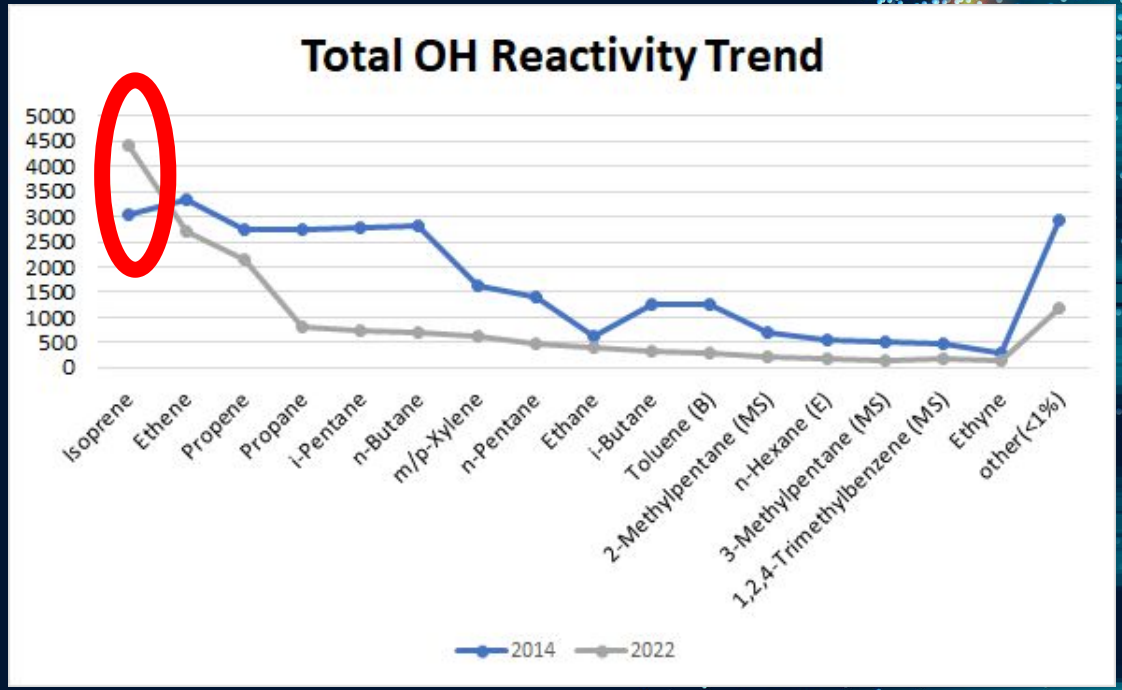




Comparing Trend of Mixing Ratios and OH Reactivity 2014 vs 2022

Total OH Reactivity

- Downward trend for everything except Isoprene
- Increased isoprene could be caused by:
  - Increased temperature
  - More vegetation
  - More overall stress on vegetation
- Accounted for about 30% of reactivity



Conclusions

- Overall decrease in the average VOC concentrations observed in summers of 2014 to 2022
  - Possible cause: wind direction
  - Other possible causes: COVID-19, temperature, regulation changes, etc..
- Isoprene accounted for ~30% of OH reactivity in summer 2022 and ~11% in summer 2014
  - Indications of more reactive VOCs, like isoprene and ethene for example, are dominating in recent years

Future Work

- Study every year from summer 2014 to summer 2022 to see if the trend of increased isoprene that was shown in this study is true.
- Extend study area to include most of the LA basin or other missed approach regions

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