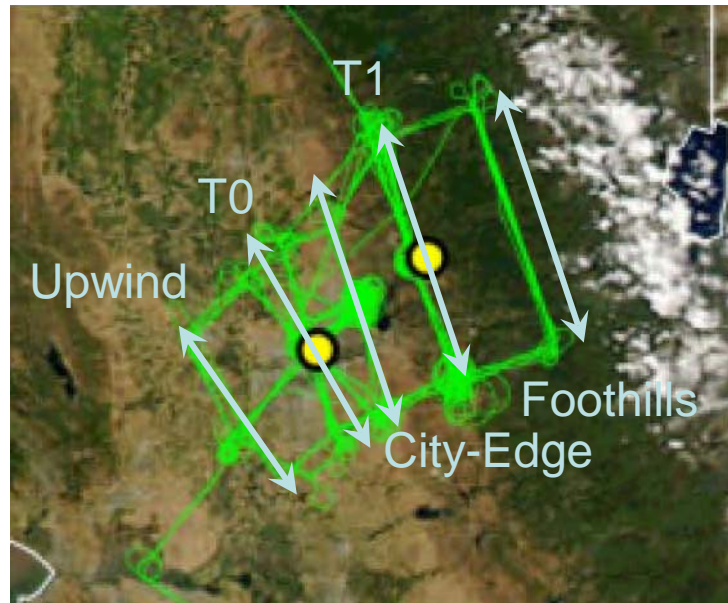


# A-B Interactions from G-1 data in CARES

Whereby the presence of **A** enhances the conversion of **B VOCs** to Aerosol

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13 flights with SW winds, 56 transects of SAC plume from T0 to Foothills



**A-B** Interaction found by Setyan et al using CARES data from T1

Also by Shilling et al using G-1 data with winds from SW and NW

**We are working with CARES data in ways that are the same and ways that are different.**

Ari Setyan et al., Characterization of submicron particles influenced by mixed biogenic and anthropogenic emissions using high-resolution aerosol mass spectrometry: results from CARES, ACP, 2012

John Shilling et al, Enhanced SOA formation from mixed anthropogenic and biogenic emissions during the CARES campaign, ACP, 2013

# Why do we need **A-B** interactions? Why do we care?

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## Why Needed?

Most models predict too little SOA and not enough modern carbon

There are reasonable processes whereby presence of **A** promotes SOA formation from **B**

- Effect of **A** on oxidant levels, including **NO<sub>3</sub>**
- Low vs. high **NO<sub>x</sub>** oxidation pathways for **B VOCs**
- Effects of **A acids** on aerosol phase chemistry
- Organo sulfates and nitrates from **A S** and **N**
- **A** effects on aqueous phase pathways
- Increased partitioning of **B-VOC** to aerosol because of **A-aerosol volume**

## Why Care?

**Biogenic VOCs** >> **Anthropogenic VOCs**

A way for **anthropogenic aerosols** to have a disproportionate influence on climate

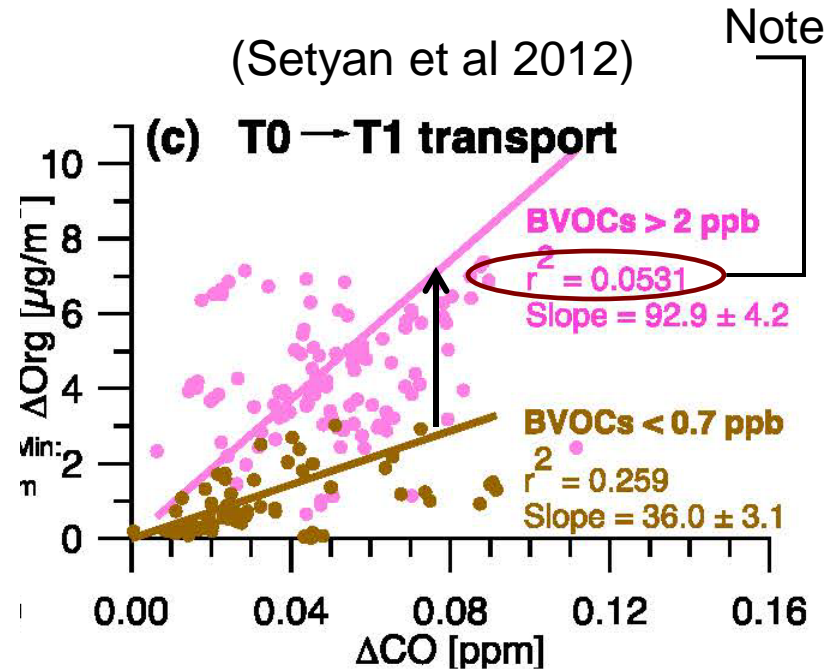
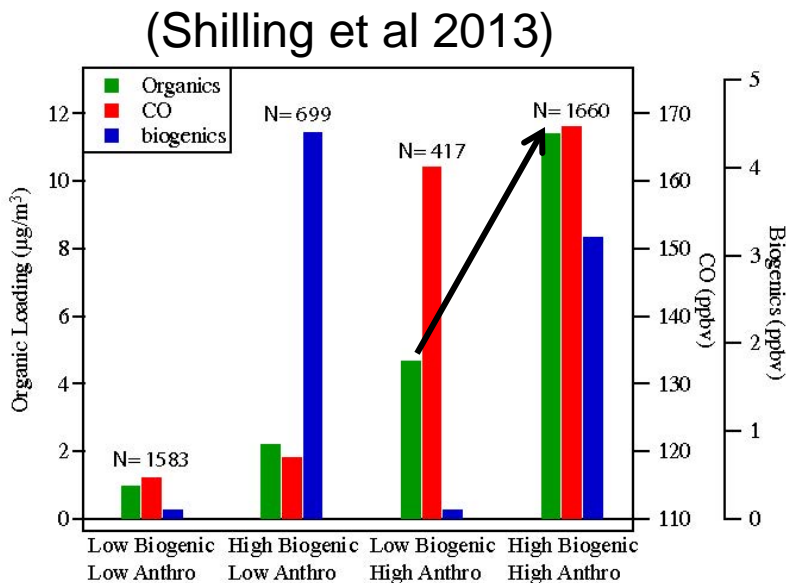
# What is **A** and What is **B**?

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- **A** is a tracer of Anthropogenic emissions
  - It's source should be co-located with **A VOCs** that form **A SOA**
  - CO is a good choice. Long lifetime. Used to normalize for dilution
- **B** is a tracer of Biogenic emissions
  - It's source should be co-located with **B VOCs** that form **B SOA**
  - $^{14}\text{C}$  in an aerosol would be a great choice – but ~ 2 hours for sample
  - We are stuck with what we can measure:
    - Isoprene, MVK+MACR, terpenes (often below LOD)
  - We used MVK+MACR
- Lifetime ~ 4 hours at  $\text{OH} = 3 \times 10^6$ 
  - Barely adequate to address SOA formation between T0 and T1

# What Was Found in CARES?

- SOA increase with **A**
- SOA increases slightly with **B**
- SOA increase a lot when both **A** and **B** are present  
i.e., synergism



Arrows indicate the increase in SOA at ~ constant **A**, due to increasing **B**

# Three Methods to Look for A-B Interactions

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1. On each transect, correlation of OA with CO, MVK+MACR, isoprene, O<sub>3</sub>, A×B, Bi-linear models i.e. OA vs. CO & MVK+MACR  
Correlations between explanatory variables i.e., CO vs. MVK+MACR



2. Define plume perturbations on a transect: 90<sup>th</sup>% - 10<sup>th</sup>% =  $\Delta$ OA,  $\Delta$ CO, etc  
Correlations amongst  $\Delta$ 's on 56 transects

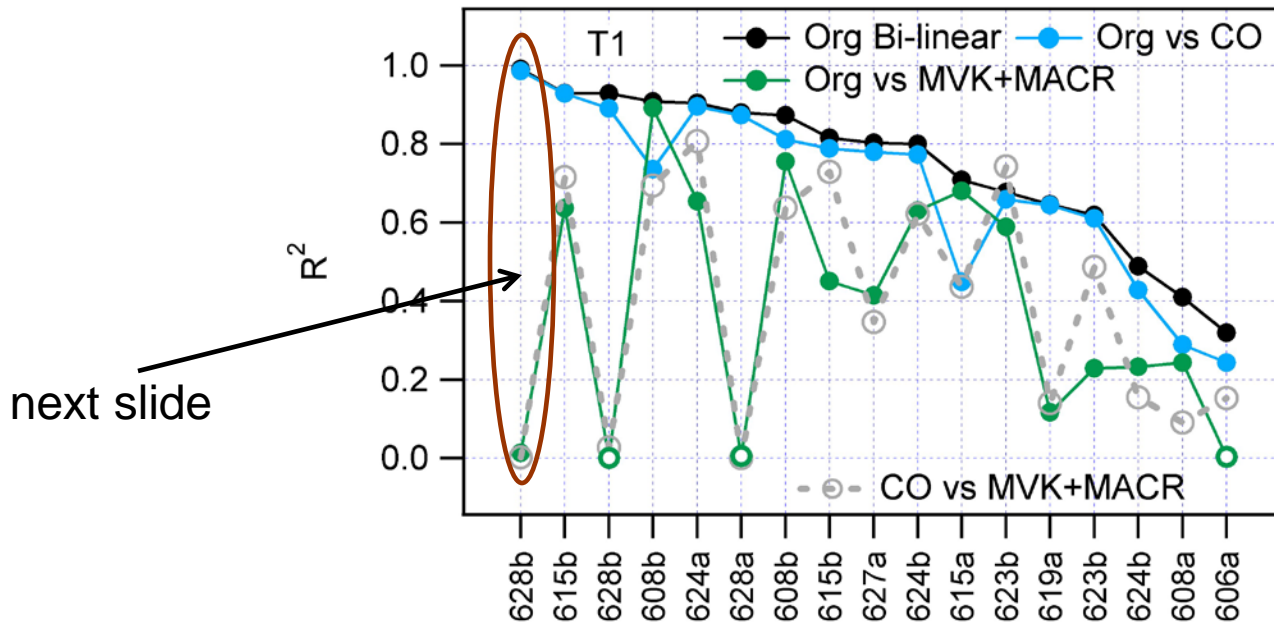


3. Parse transect  $\Delta$ 's into subsets with high  $\Delta$ CO and quartiles of  $\Delta$ MVK+MACR



# R<sup>2</sup> for 4 Regressions on T1 Transect

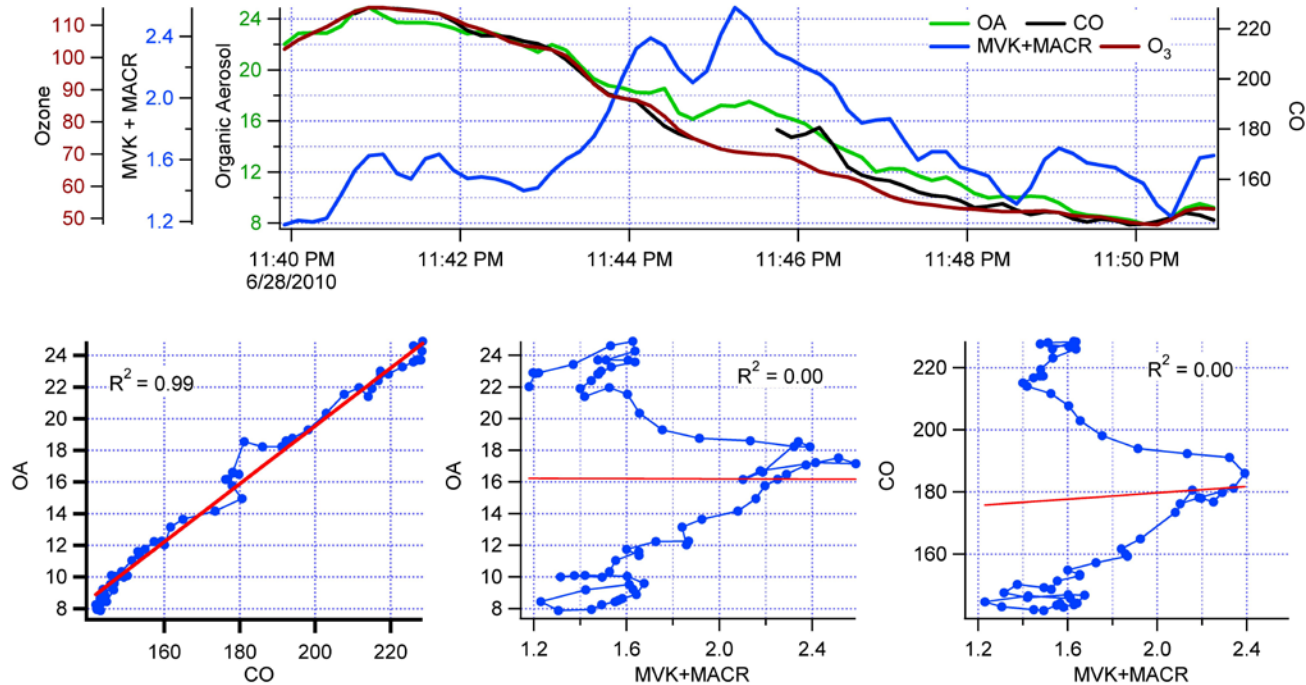
## Method 1



**A** and **B** explanatory variables can be highly correlated (gray symbols)  
 $r(\text{OA vs. MVK+MACR}) \sim r(\text{CO vs. MVK+MACR})$

The bivariate correlation of OA with **MVK+MACR** is usually spurious

# Transect over T1 on flight 628a



Almost perfect correlation between **OA**, **CO**, and **O<sub>3</sub>**

No correlation between **OA** and **MVK+MACR**

**A** and **B** variables independent

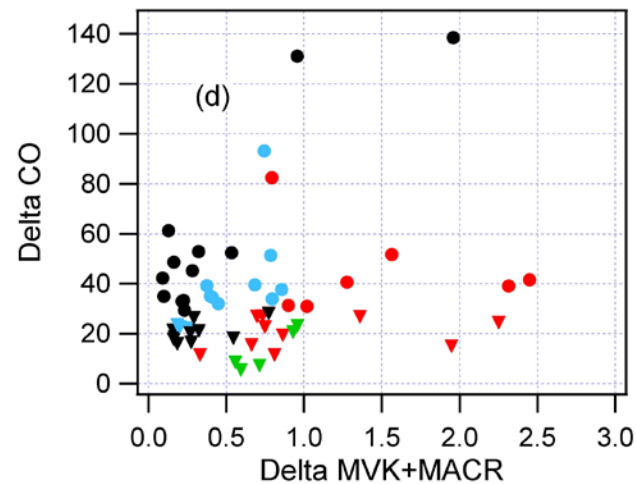
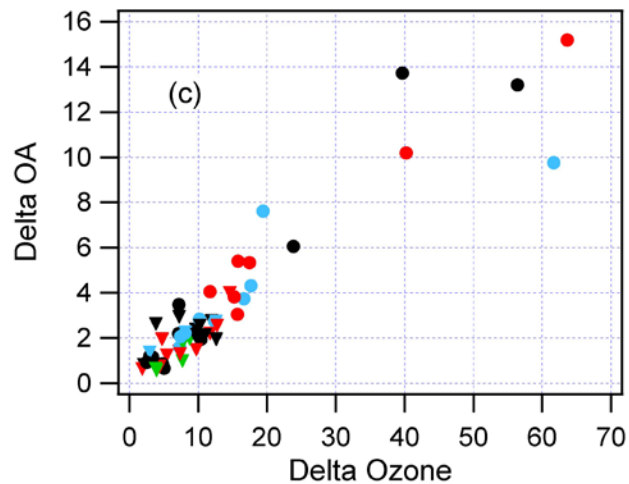
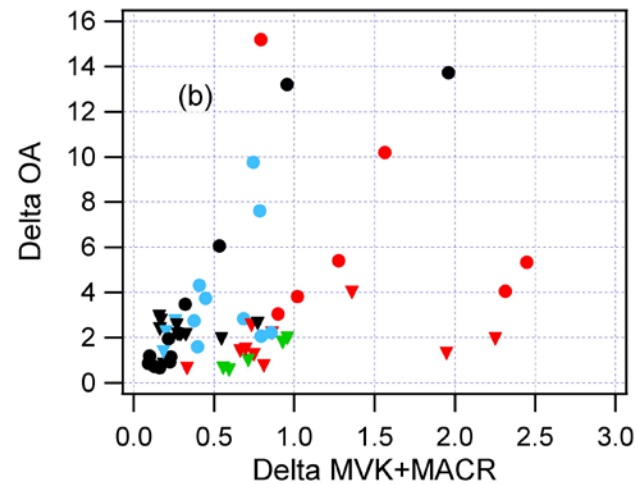
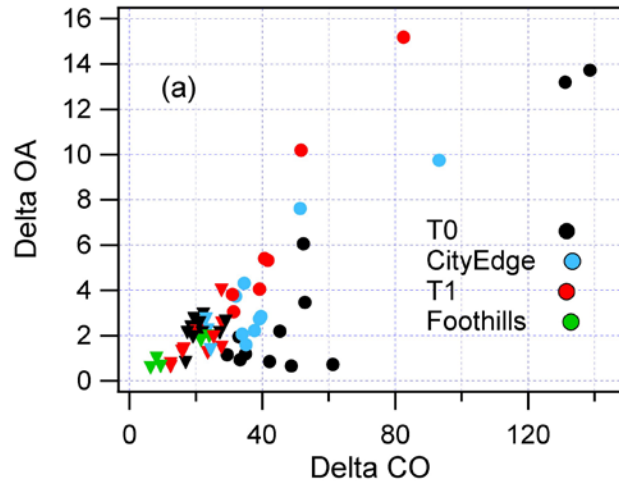
Plumes have long auto-correlation distances

Most statistical tests are useless.



# Relations amongst transects for $\Delta$ variables

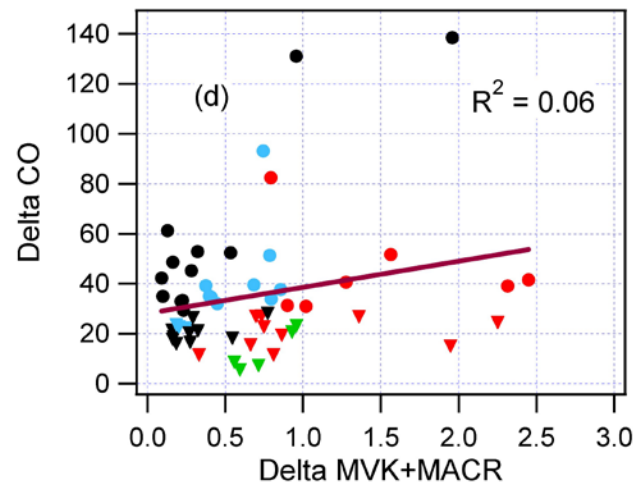
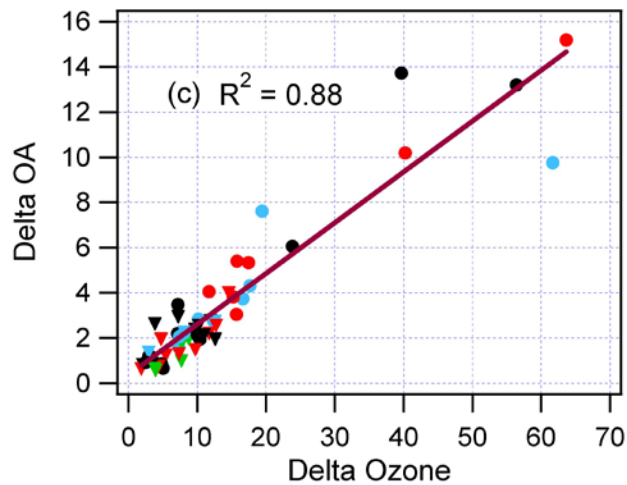
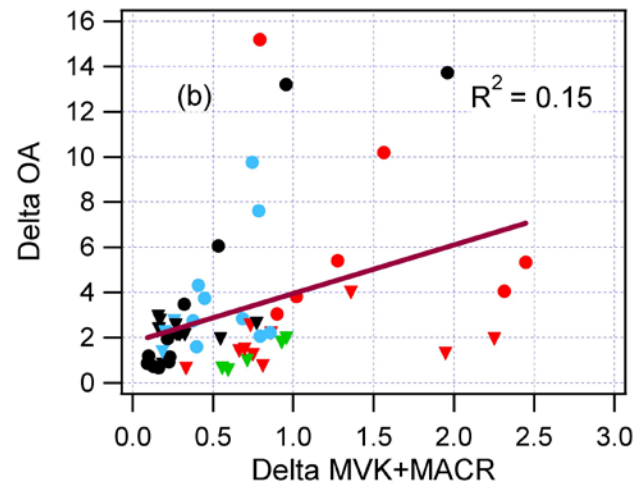
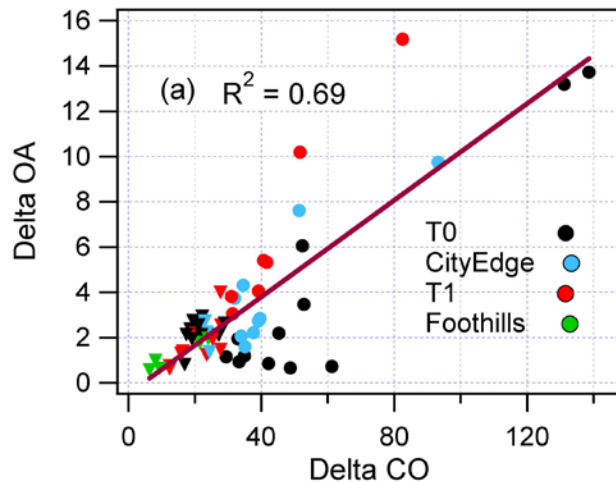
## Method 2





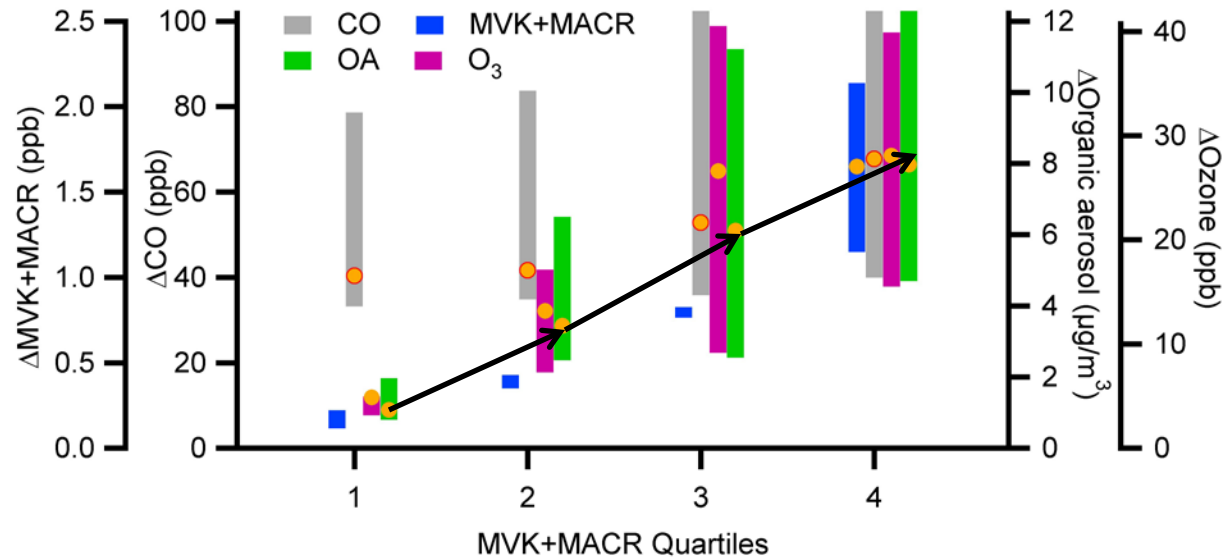
# Relations amongst transects for $\Delta$ variables

## Method 2



# Effect of Biogenics on High CO Transects

## Method 3



Graph shows averages and inter-quartiles ranges for 4 levels of  $\Delta$ MVK+MACR

- OA increases with MVK+MACR (and  $O_3$ ), CO ~ Constant  
At low CO, only trend of OA is with  $O_3$



- This satisfies requirement for an A-B effect
- But previous graph showed that the trends come from data with almost no correlation



# Thank you

## Impressionist

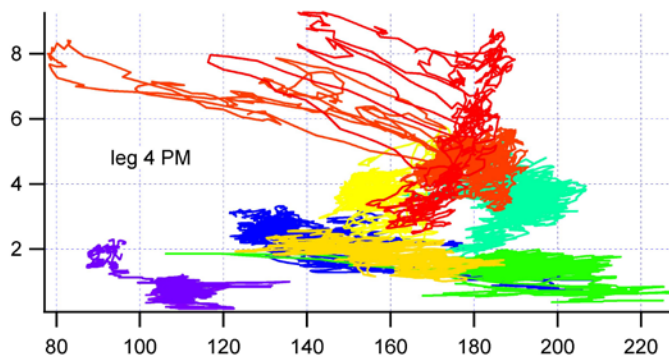


## Post Impressionist



## Actual Atmospheric Data from Igor

### Abstract



### Abstract Expressionism

