Short-lived atmospheric trace gases in polar ice cores:

motivation, recent developments, and future needs

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Goals

Document the range of natural variability in atmospheric trace gases in order to:

1. Quantitatively assess man's impact on atmospheric composition and reactivity
2. Investigate the relationship between atmospheric composition and climate change
3. Infer changes in global/hemispheric biogeochemistry

Examples of short-lived trace gases

ethane (and other light hydrocarbons)

- fossil fuels, biomass burning

carbonyl sulfide (COS)

- terrestrial carbon uptake (GPP)

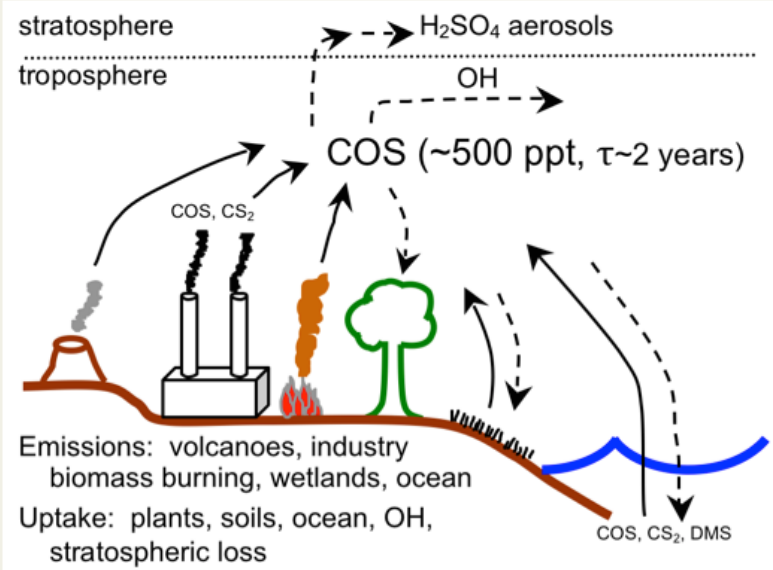
methyl chloride, methyl bromide

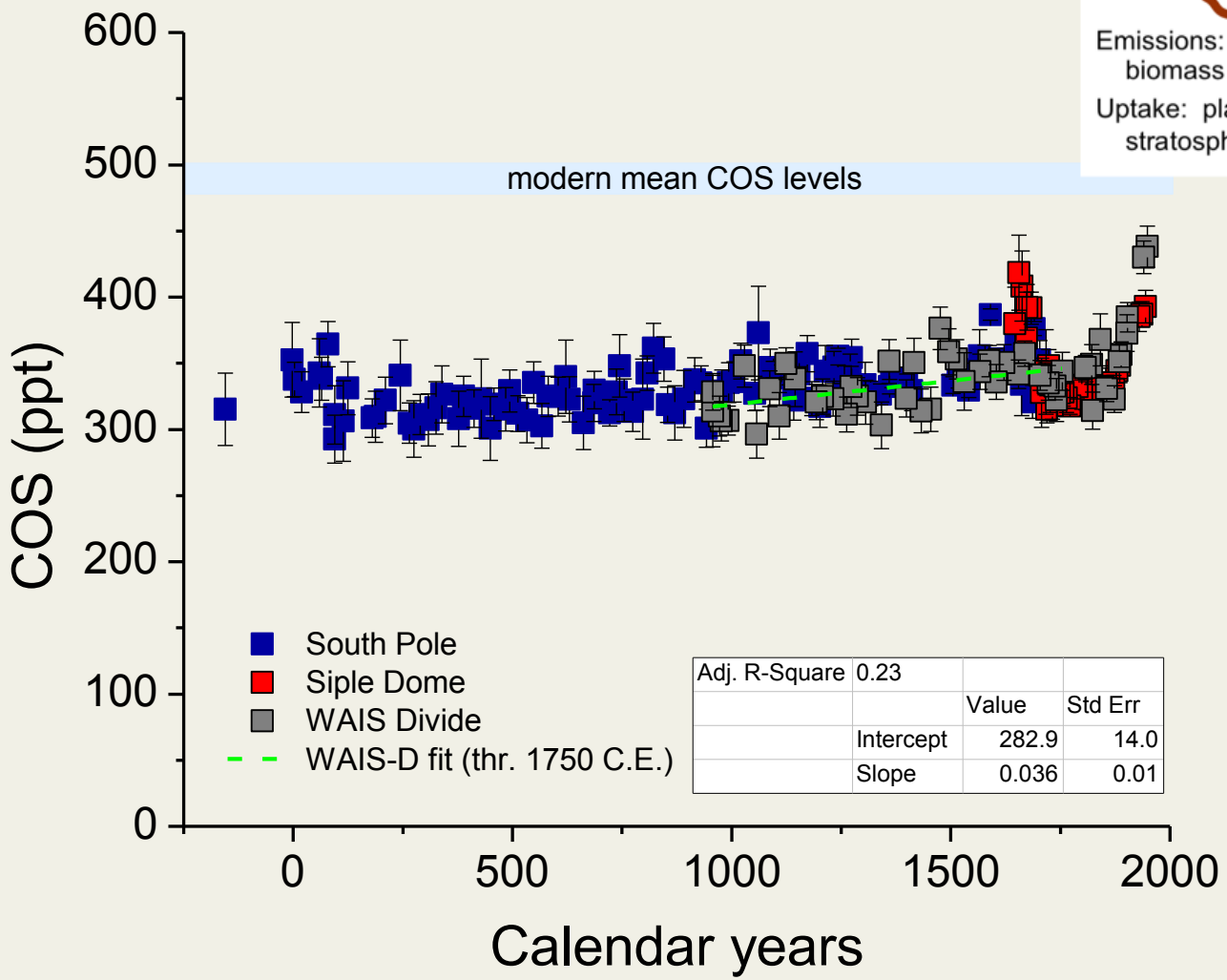
- tropical plants/ocean, biomass burning

acetylene, acetonitrile

- biomass burning

Carbonyl sulfide in Antarctic ice



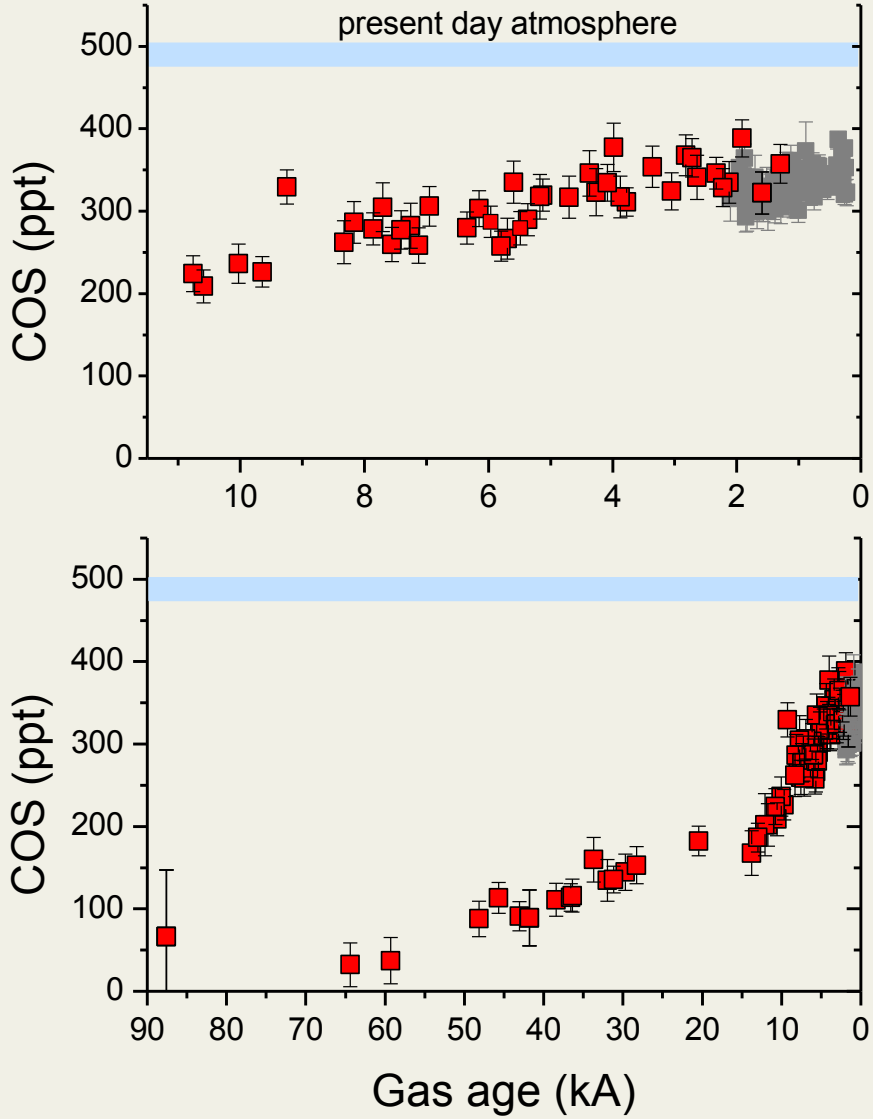


COS in Taylor dome and South Pole ice cores

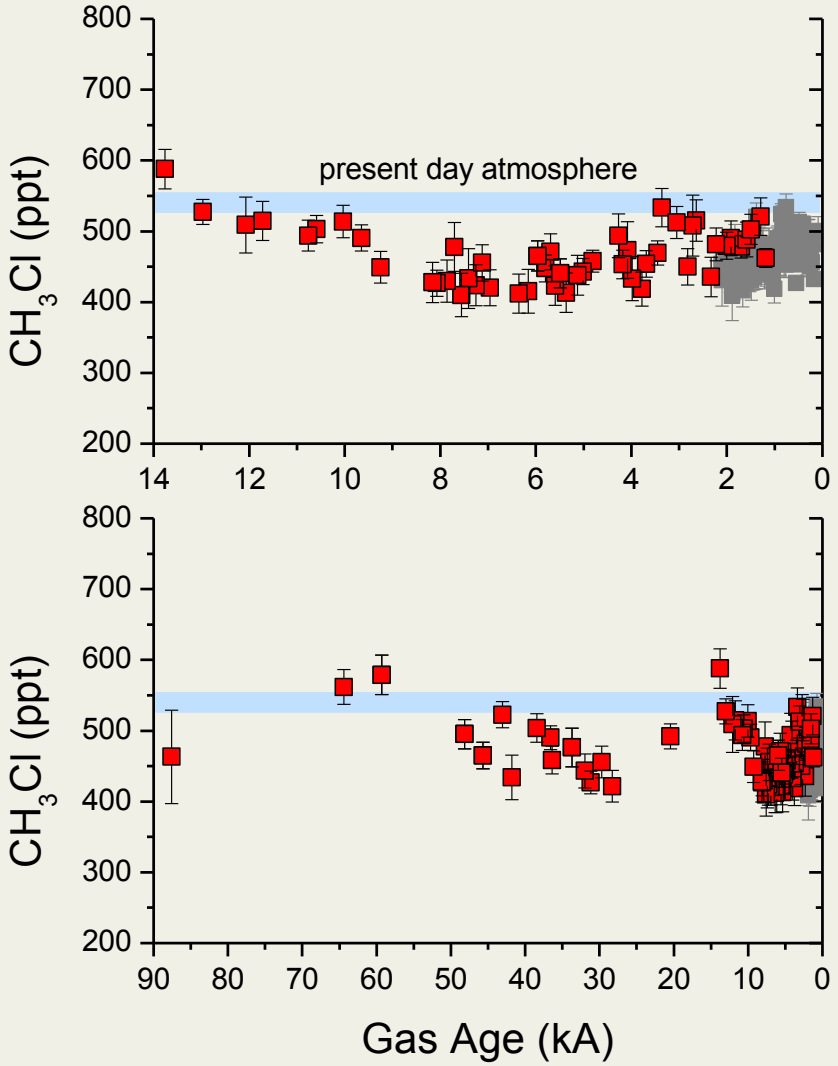
Atmospheric history vs chemical loss?

T-dependent hydrolysis?

Lifetime 5-10kyrs, longer?



Methyl chloride at Taylor Dome and South Pole



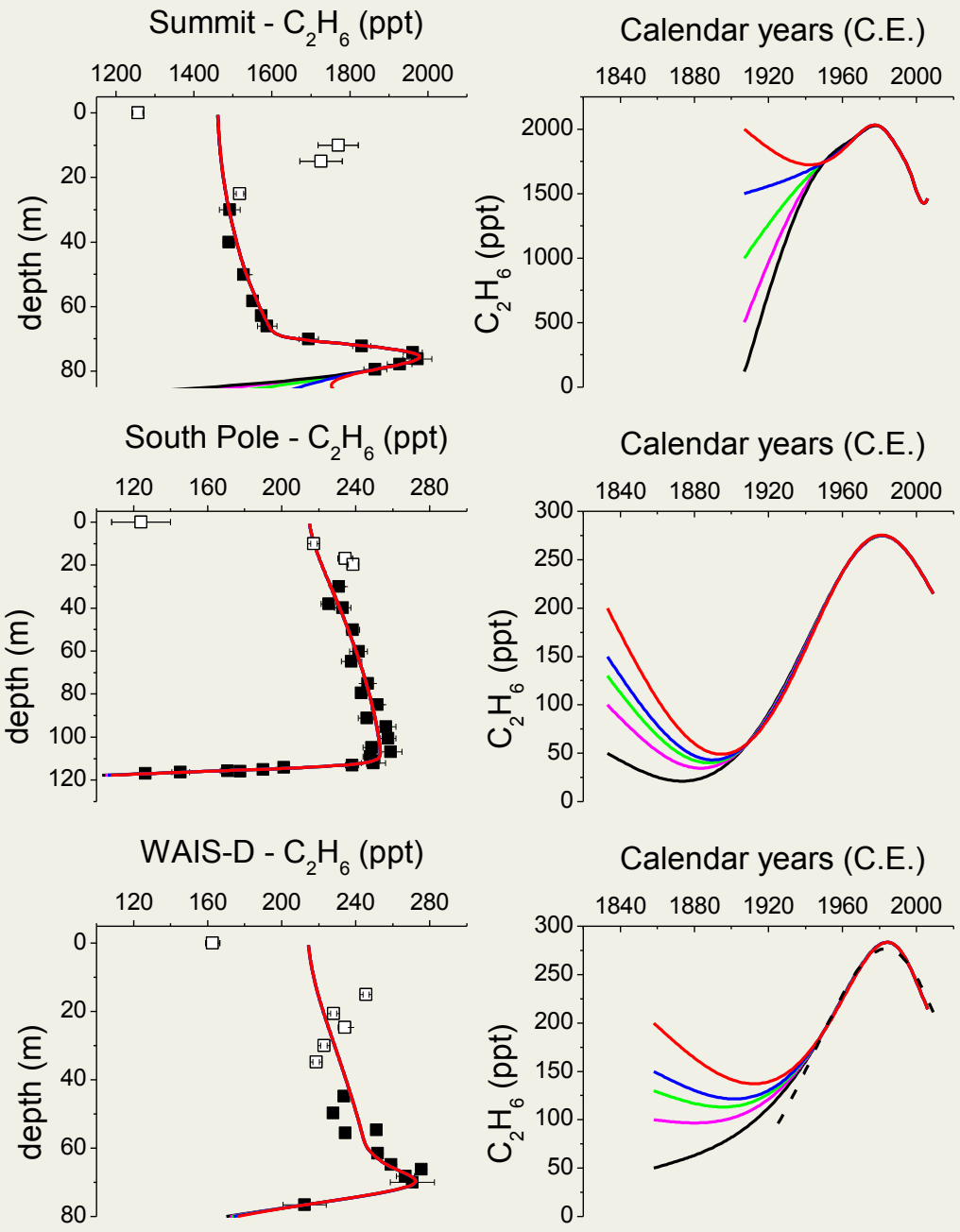
Ethane in polar firn air

bipolar increase

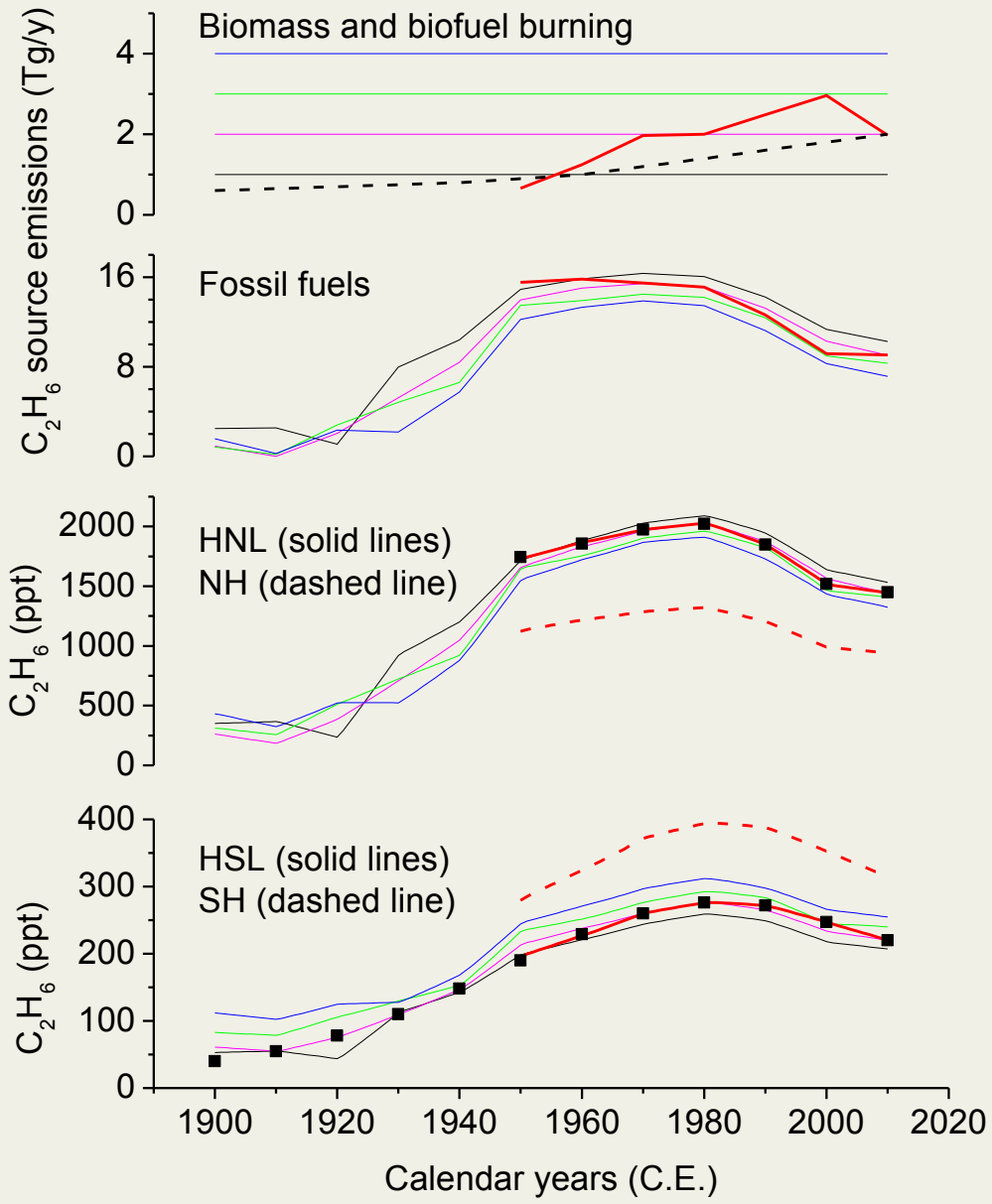
mid-century roll-over

N-hemisphere driven

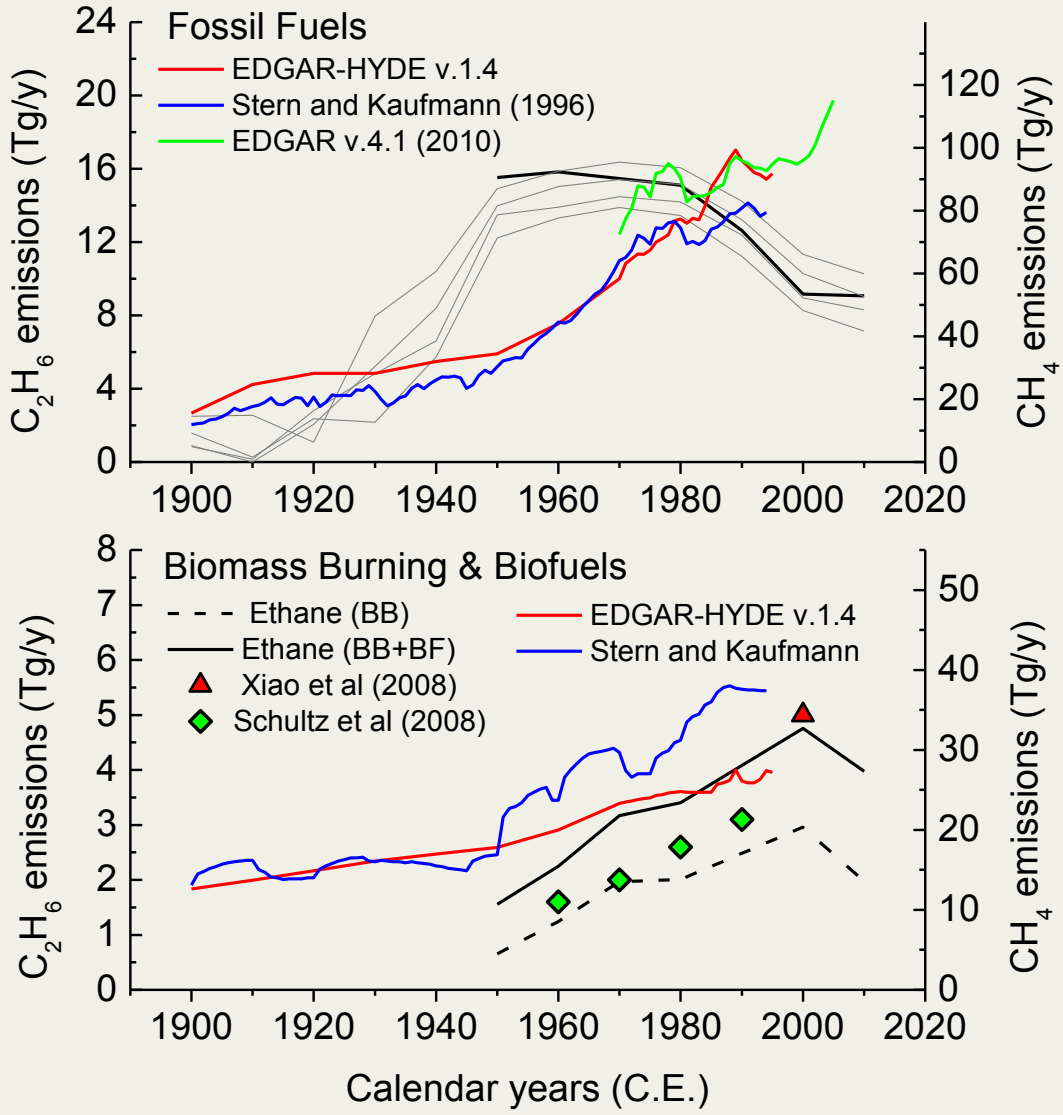
fossil fuel emissions



Firn air/model derived ethane emissions histories



Ethane-based methane emissions histories



Ice core site selection

- sites removed from coastal input to minimize impurities
- range of surface temperatures/accumulation rates to validate atmospheric histories
- consider sample thermal history

  ideal site – cold surface temperature, thick ice sheet, low dust load

  but, narrow firn air age distribution (high accumulation)

  → South Pole…
- bipolar records are needed