Proposal for Interactive Chemistry

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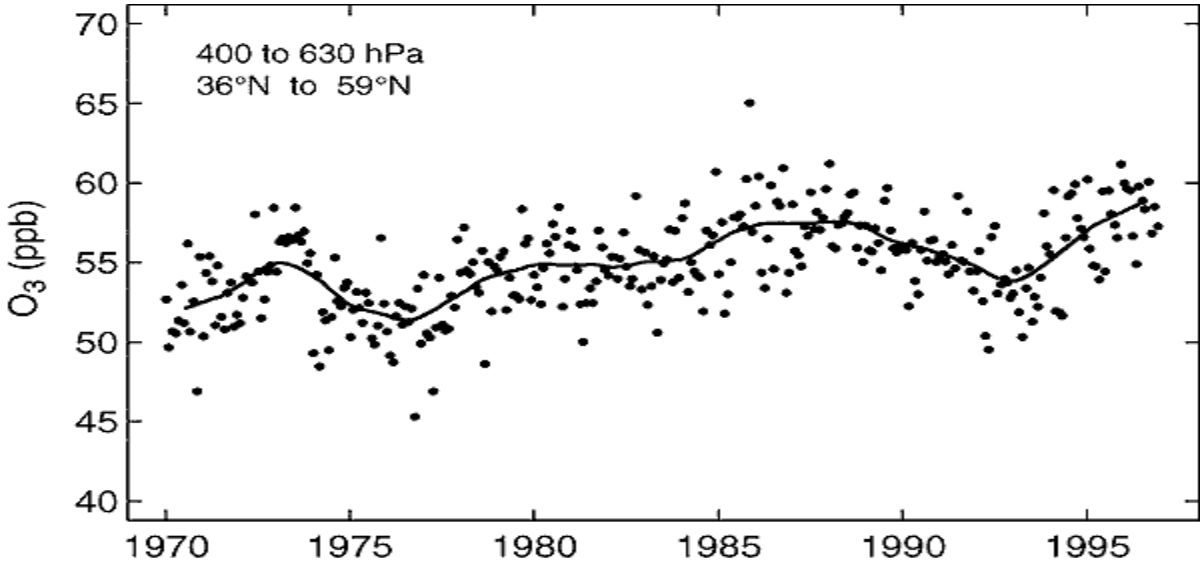
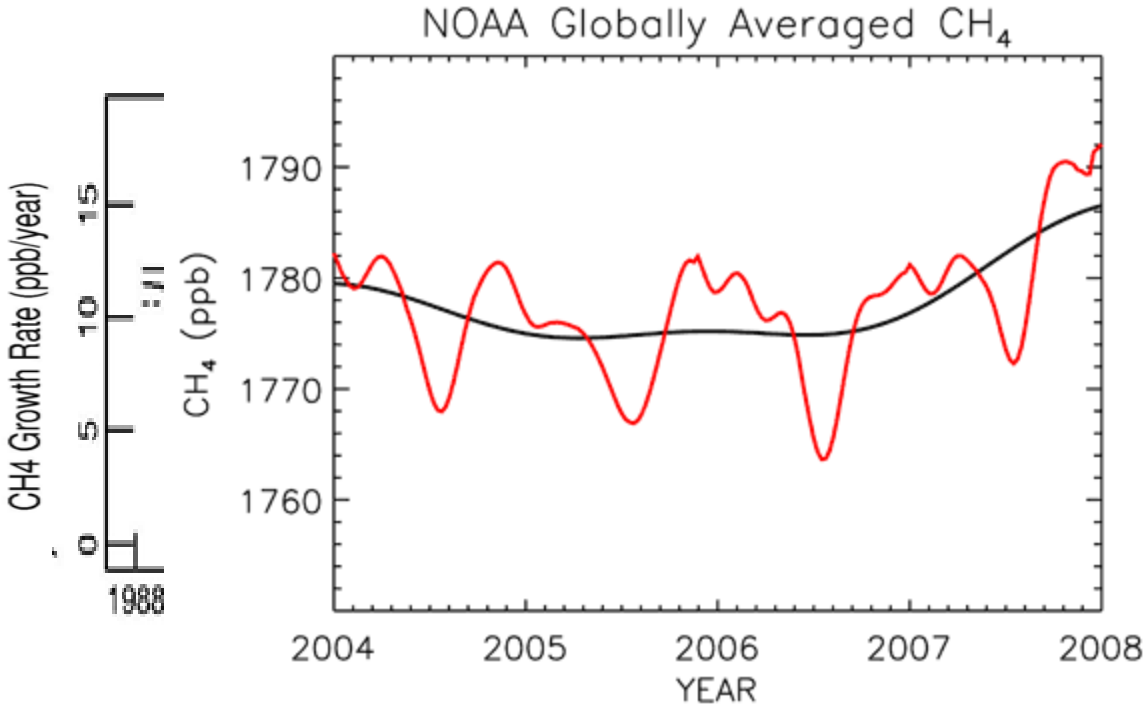


Ozone Variability



Methane Variability

(Tied to the variability of OH)

Hydroxl Radical (OH)

- Most important atmospheric oxidant
- Determines Tropospheric sink of CH4, HFCs
  - CH4 and HFCs: climate variability now and in future is not well defined. Depends on OH.
  - The interactions of CH4-CO-OH are key feedbacks in elevating CH4 RF (by 40%, MP)
  - OH is intimately tied to climate (increase 3-6%/K)
    - Water vapor
    - Lightning
    - Cloudiness, Lightning, Aerosols
    - Stratospheric Ozone Column
    - Tropospheric Ozone Concentration

Methane/Ozone/OH system

- Tropospheric Chemistry
  - To 0^{th} order determined by a few chemical long-lived constituents:
  - CH4, CH3OOH, CH2O, NO, NO2, HNO3, H2O2, O3, CO (possibly N2O5)
  - Short lived non-advected constituents: OH, HO2, CH3OO
- Linearized stratospheric chemistry (LNOZ)
  - Tables for linearized chemical tendencies
  - Tables can shift with evolving CL-y, CH4, and N2O (and H2O if predicted)
  - VERY important in the climate calculations as this will feed back on tropopause!
  - Using a climatology for O3 smears the heating rates over the tropopause region, instead of maintaining a sharp gradient

Value of explicitly including O3/OH/CH4

- To develop and evaluate the climate statistics (interannual, decadal, modes) of the chemistry and carbon cycling .
- If either of these key component of the climate system is dropped from the ensemble runs for AR5, the climate statistics, including the possible covariance (feedbacks) of climate forcing by the different components (stratospheric ozone, tropospheric OH, CO2, vegetation) that operate on decadal scales will simply not be acquired.
- Even given reasonable amounts of computer time, post facto, we will not recover these climate statistics. Although subsequent short-period runs will allow for more detailed ("better physics/chemistry") to examine the causes of these feedbacks.
- (Carbon cycle can also be done after the fact with a few reruns of some ensembles, the key interactive nature is really one way, with the carbon cycle models needing the detailed information from the climate model, but the climate model really only needs the CO2 global mean abundance)

Methane/Ozone/OH system

- Gives a first-order response of atmospheric composition change directly coupled to climate change
- Requires a bare minimum of atmospheric chemistry.
  - The simple model should respond in same manner as more complex models.

Thanks.