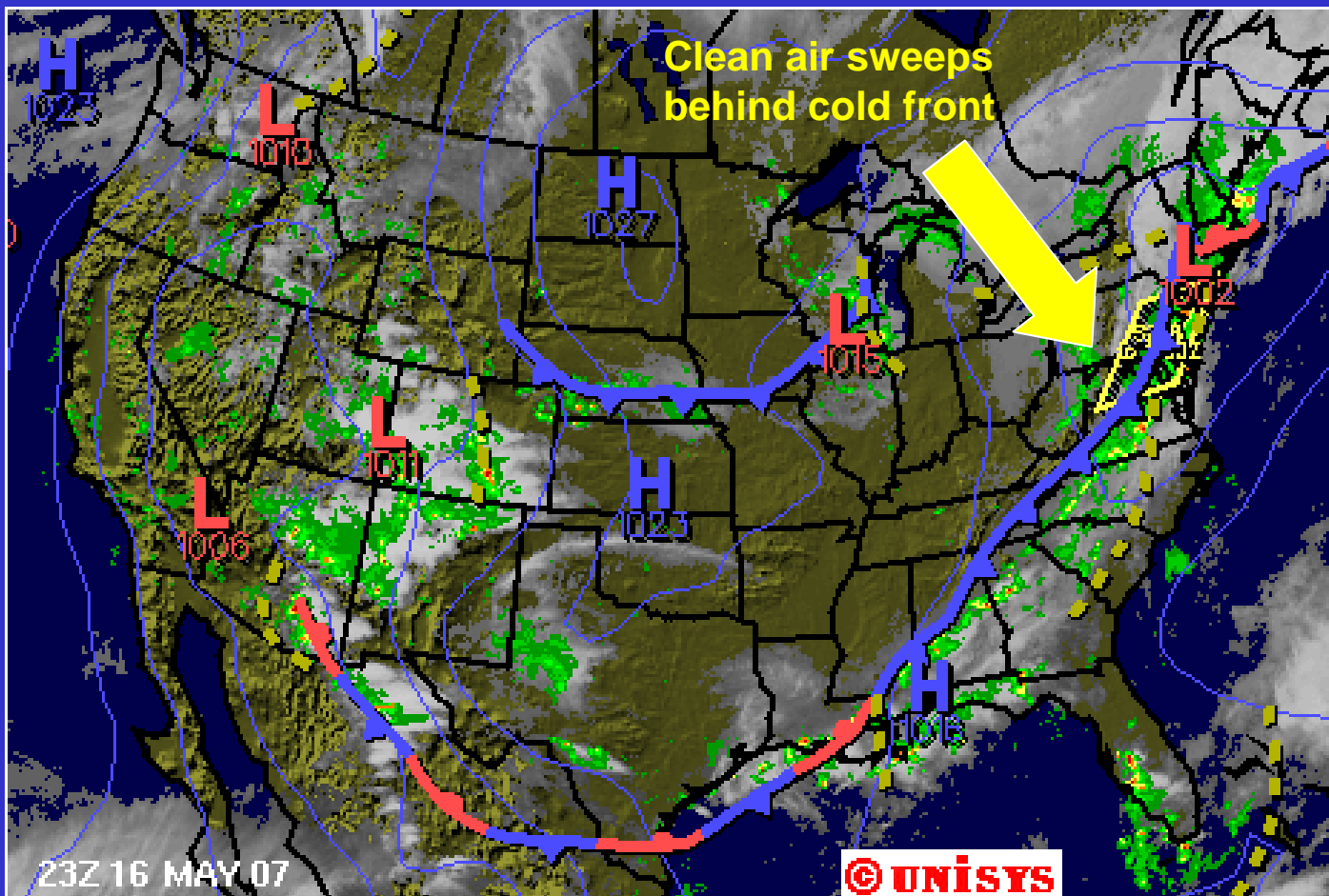


US EPA ARCHIVE DOCUMENT

IMPORTANCE OF MID-LATITUDES CYCLONES IN AIR POLLUTION METEOROLOGY

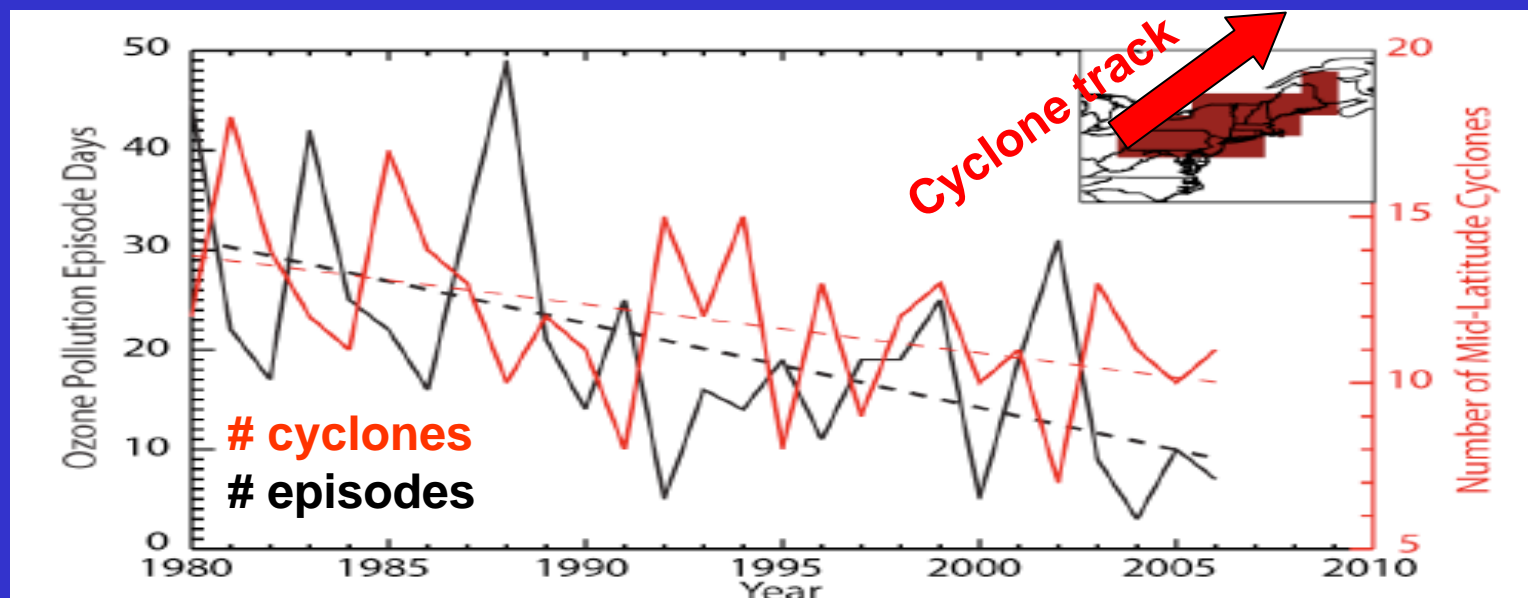
Cold fronts from mid-latitude cyclones are the principal ventilation process for U.S. Midwest/Northeast, western Europe, China



Climate change is expected to decrease the frequency of mid-latitudes cyclones; expect more stagnation events as a result

POLLUTION EPISODES AND MID-LATITUDE CYCLONES IN THE NORTHEAST U.S.

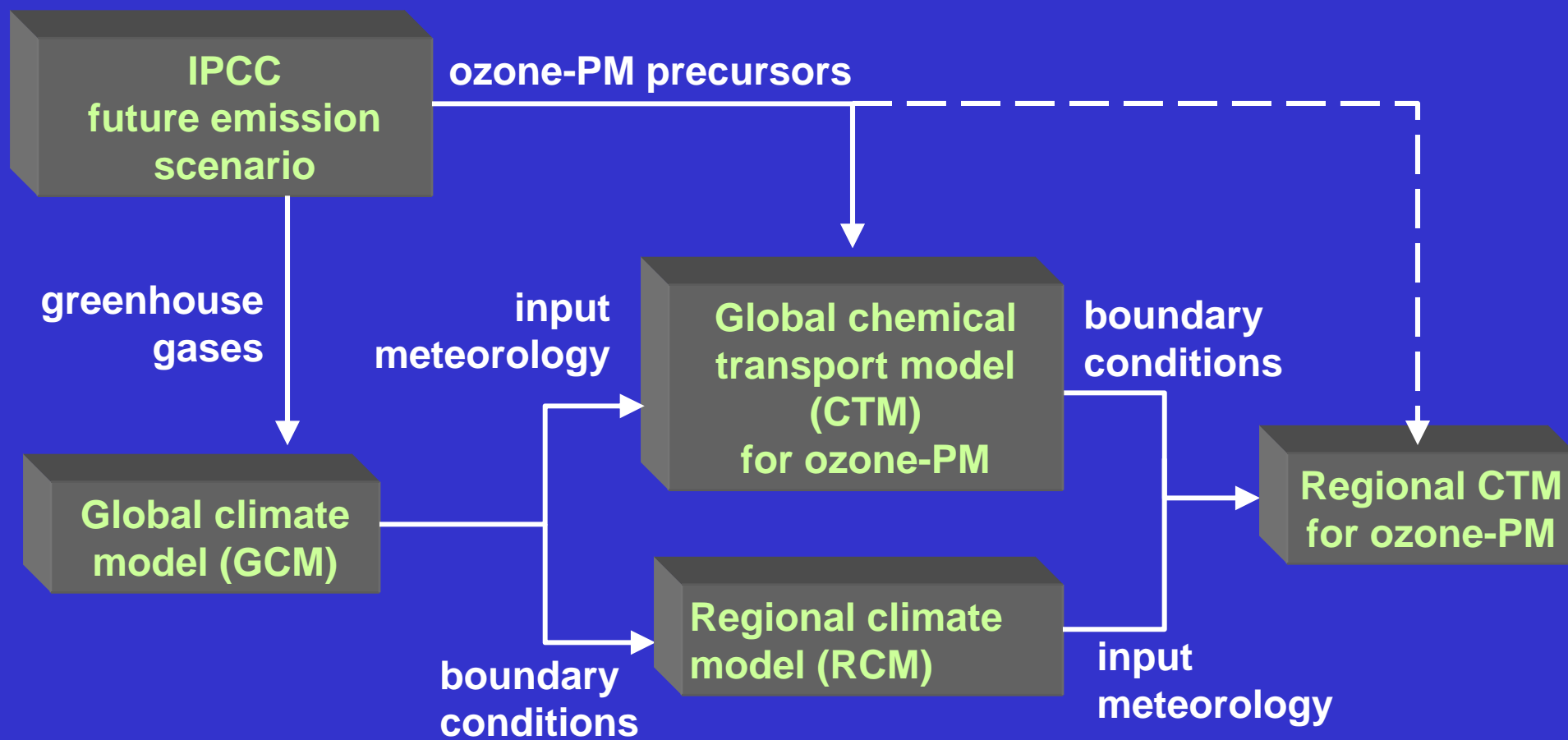
pollution episode days ($O_3 > 80$ ppb) and # cyclones tracking across SE Canada in summer 1980-2006 observations



- Strong correlation; cyclone frequency is predictor of pollution episode frequency
- 1980-2006 decrease in cyclone frequency would imply a corresponding degradation of air quality if emissions had remained constant
- Expected # of 80 ppb exceedance days in Northeast dropped from 30 in 1980 to 10 in 2006, but would have dropped to zero by 2001 in absence of cyclone trend!

COMPREHENSIVE APPROACH FOR INVESTIGATING EFFECT OF CLIMATE CHANGE ON AIR QUALITY

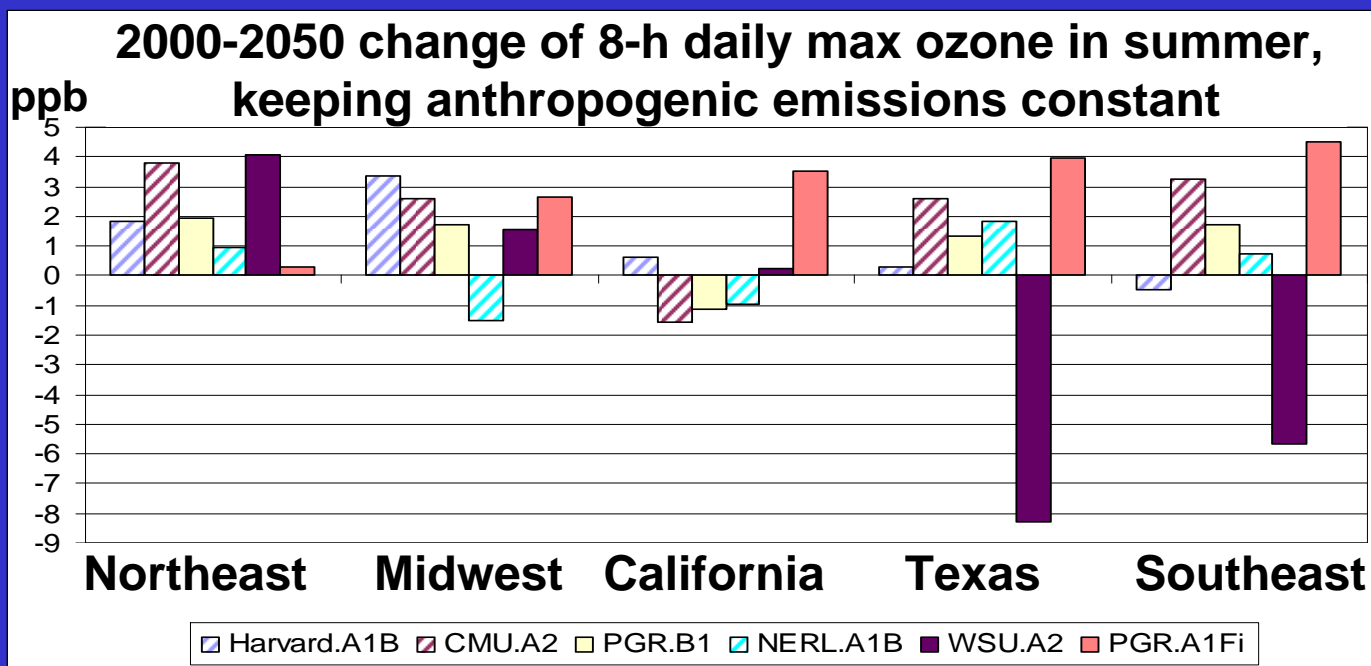
Several EPA-funded projects



Need to run many years to obtain sufficient statistics → expensive!

EFFECT OF CLIMATE CHANGE ON OZONE AIR QUALITY IN THE U.S.

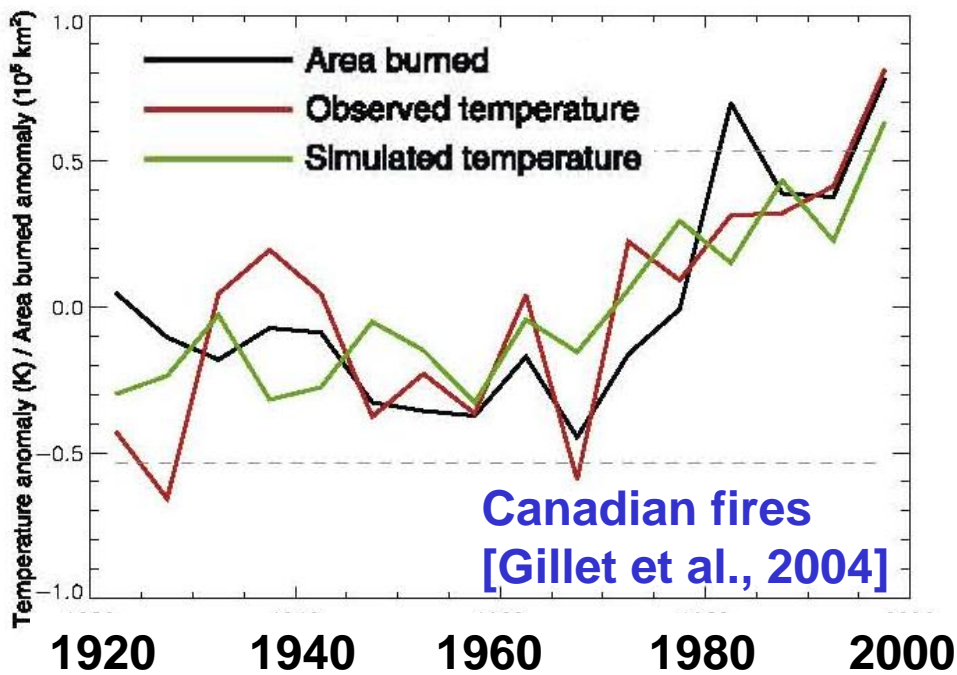
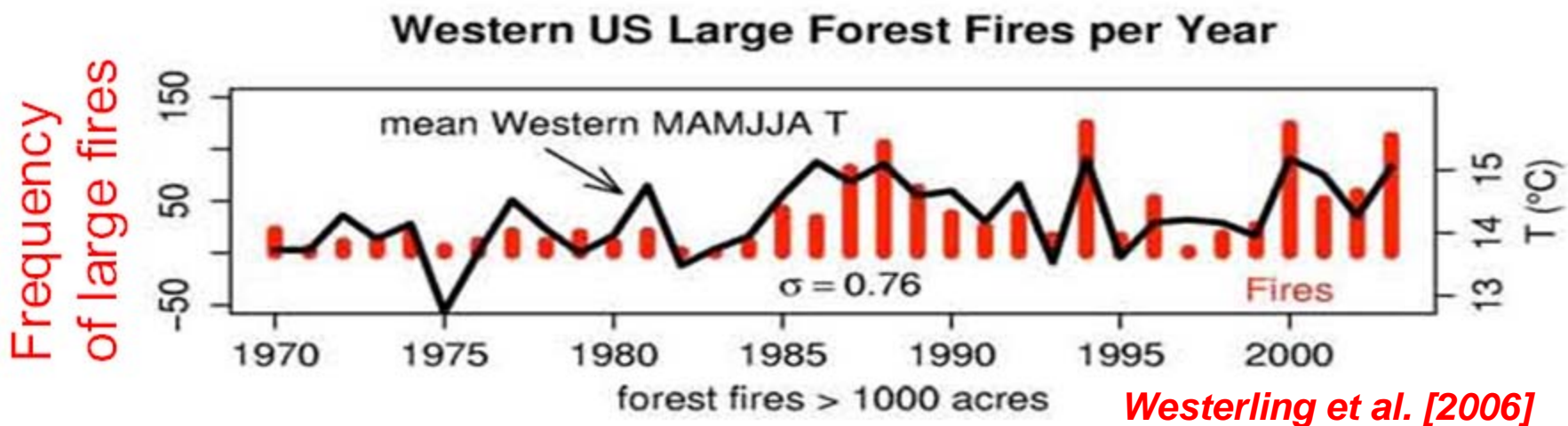
Results from six EPA-funded coupled GCM-CTM simulations



Weaver et al.
[BAMS, submitted]

- Consistent projection of ozone increase in Northeast and Midwest
- Large disagreements for Southeast and California

INCREASING WILDFIRE FREQUENCY IN PAST DECADES



Temperature and drought index can explain 50-60% of interannual variability in fires

Increased fires are projected to increase summer mean $\text{PM}_{2.5}$ concentrations by $0.5 \mu\text{g m}^{-3}$ in the West by 2050.

Spracklen et al. [2008]

SUMMARY OF KNOWLEDGE: EFFECT OF CLIMATE CHANGE ON OZONE AIR QUALITY

- **Climate change is expected to increase surface ozone by 1-10 ppb in most U.S. regions in the coming decades**
- **Effect will be largest in urban environments and during pollution episodes**
- **Northeast and Midwest show consistent increases across models, but there are large disagreements (including in the sign of the effect) for the Southeast and California**
- **This 'climate penalty' for ozone means that stronger emission controls will be needed to meet a given air quality objective.**

SUMMARY OF KNOWLEDGE: EFFECT OF CLIMATE CHANGE ON PM AIR QUALITY

- Climate change may increase or decrease PM_{2.5} by 0.1-1 $\mu\text{g m}^{-3}$ in coming decades – there is large disagreement between models including in the sign of the effect.
- Expect increases in the West from larger and more frequent forest fires