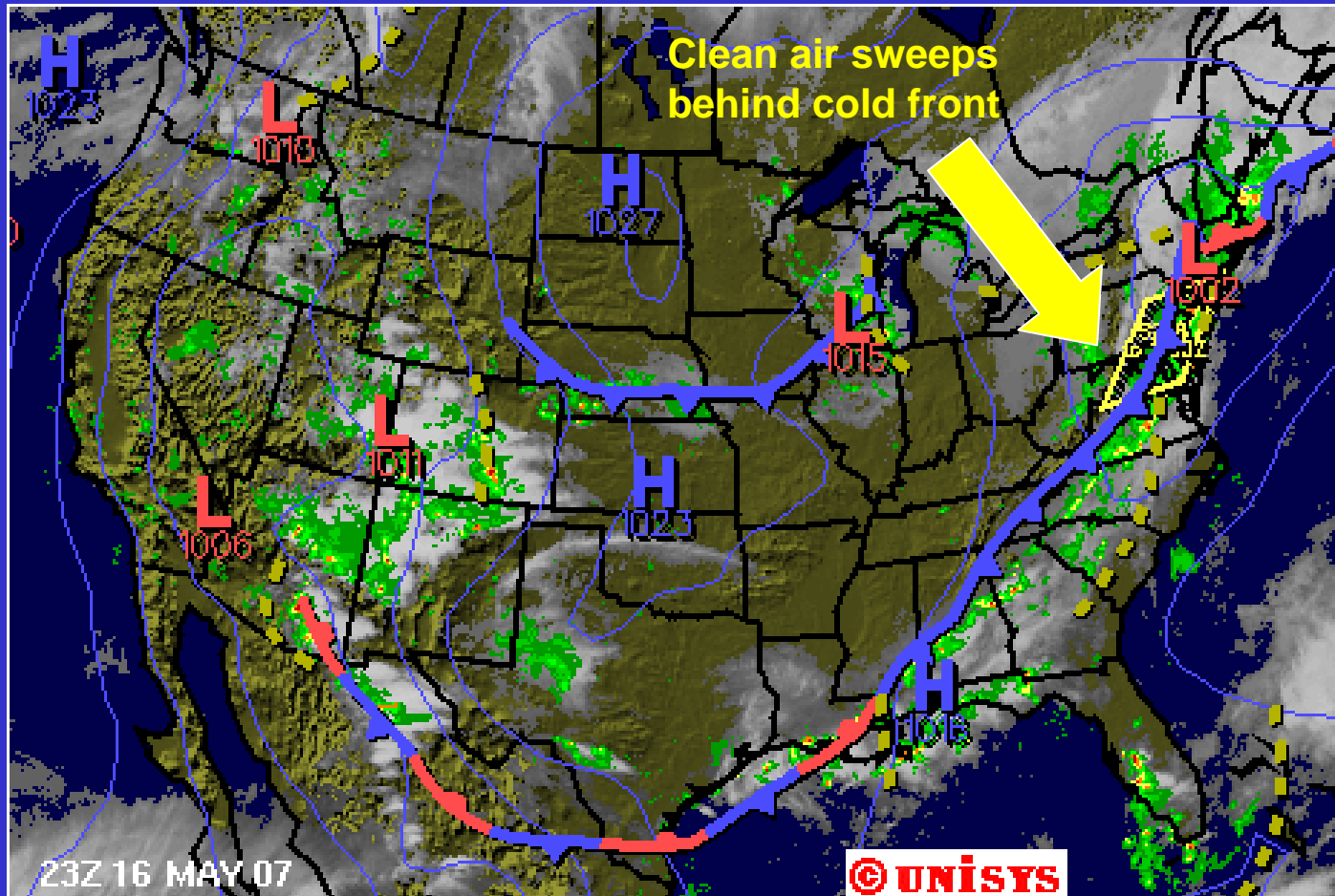


# IMPORTANCE OF MID-LATITUDES CYCLONES IN AIR POLLUTION METEOROLOGY

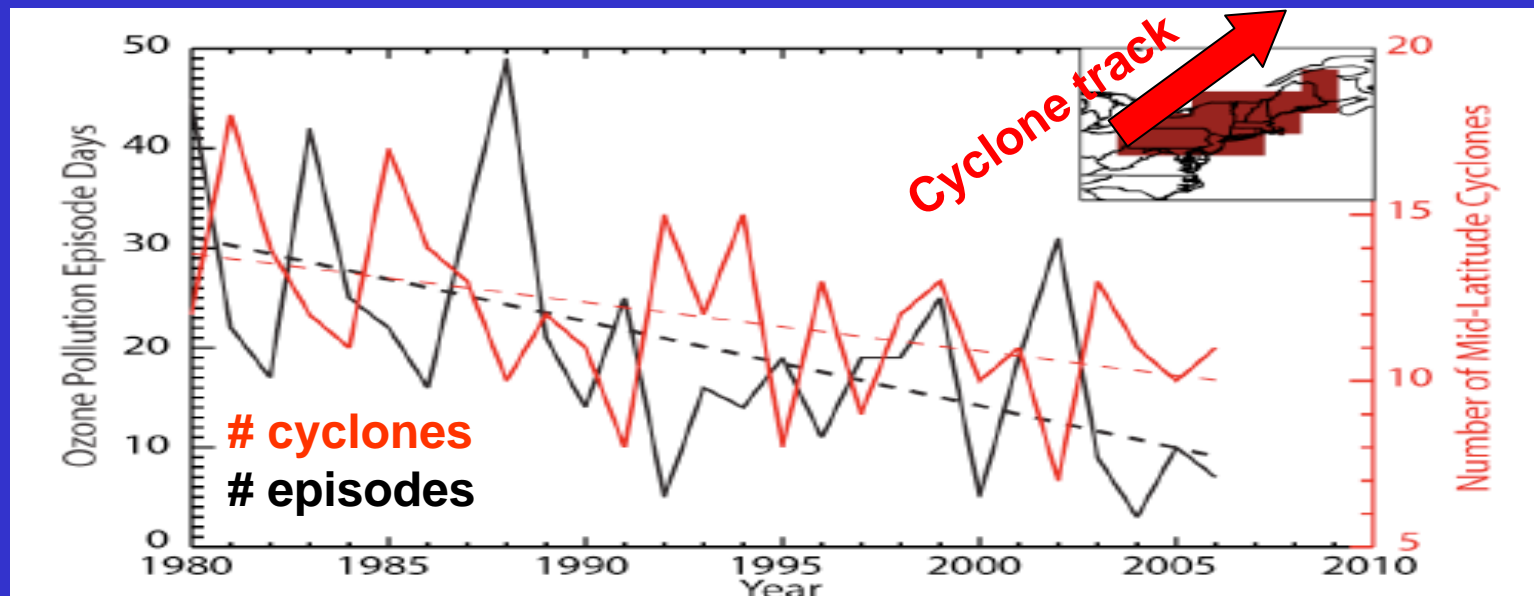
Cold fronts from mid-latitude cyclones are the principal ventilation process for U.S. Midwest/Northeast, western Europe, China



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.

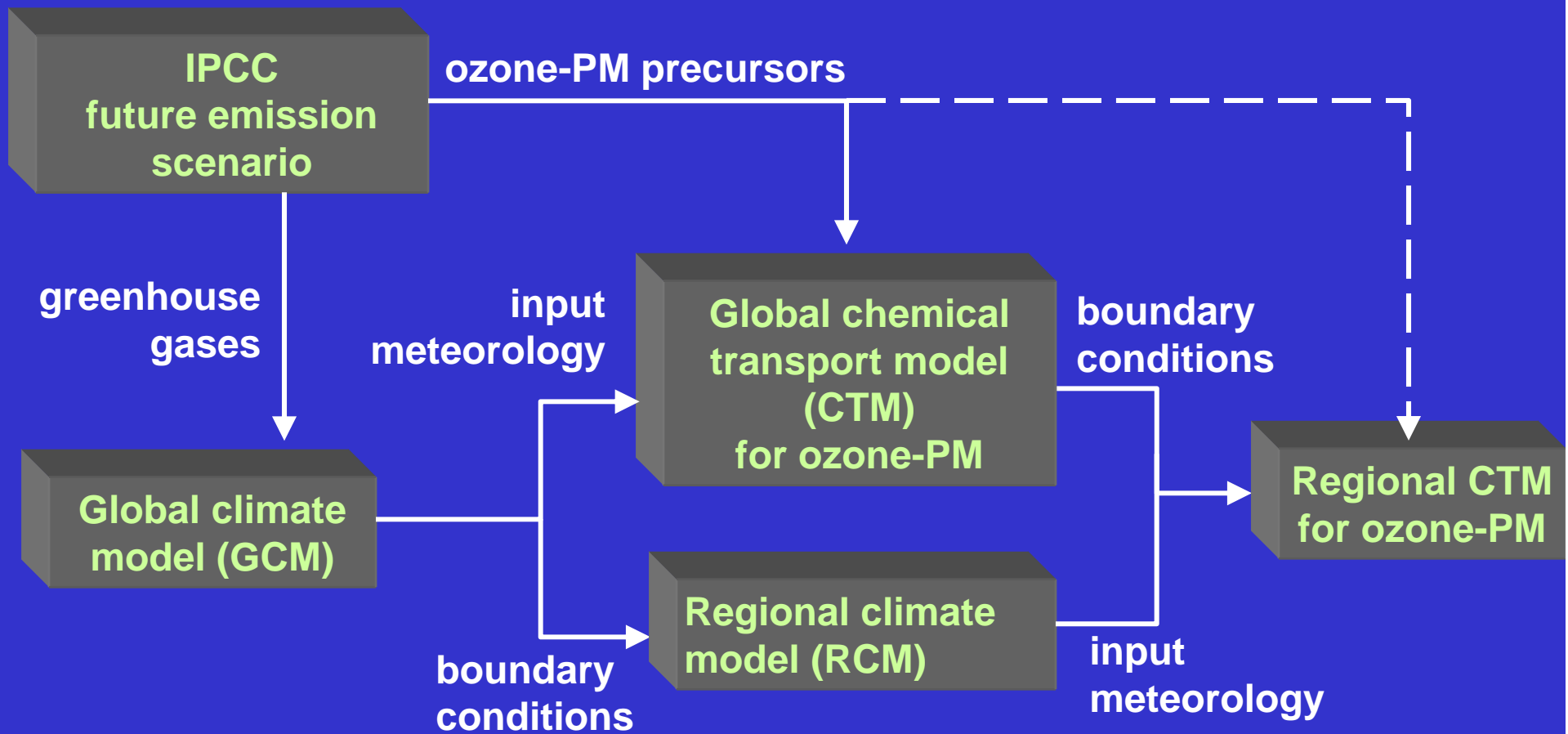
# pollution episode days ( $O_3 > 80$  ppb) and # cyclones tracking across SE Canada  
in summer 1980-2006 observations



- 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

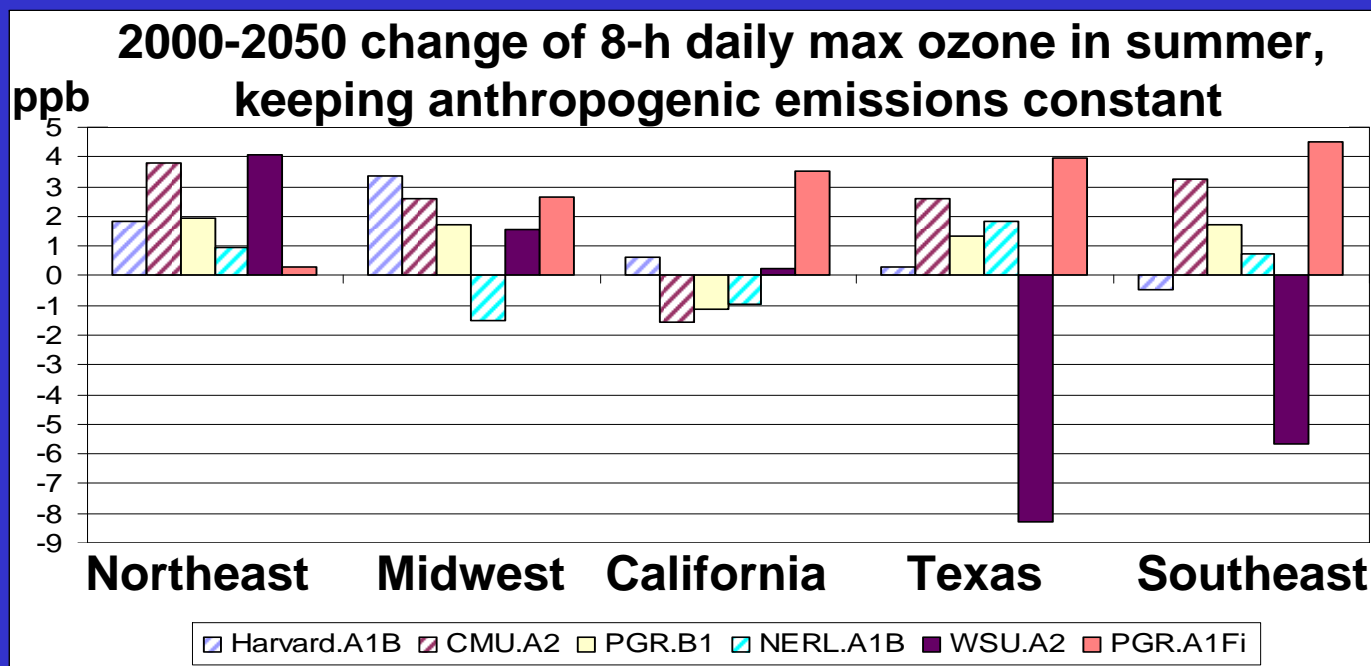
Several EPA-funded projects



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

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

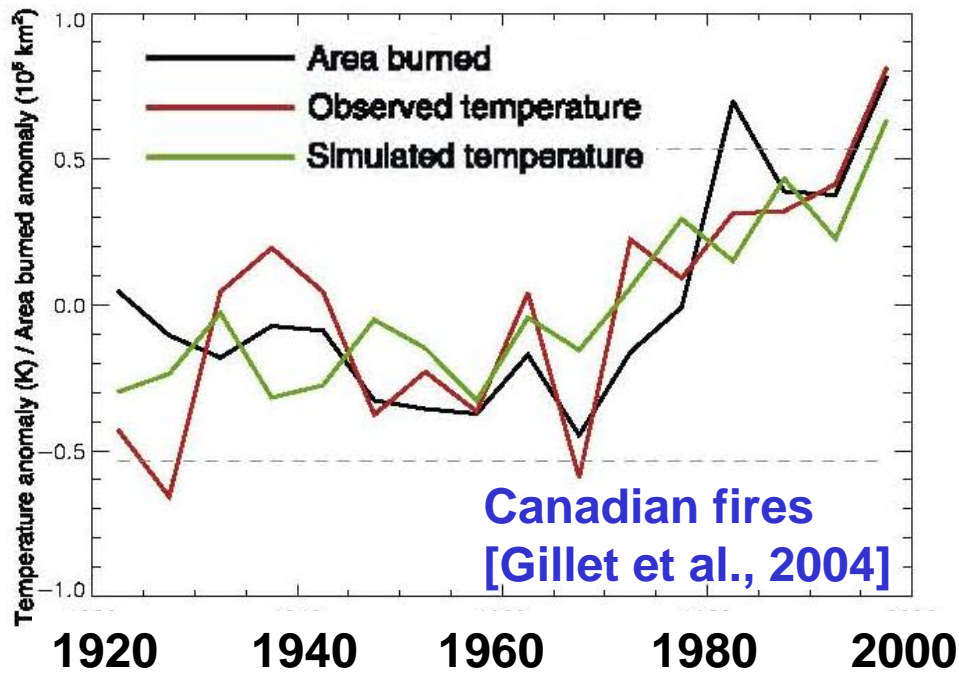
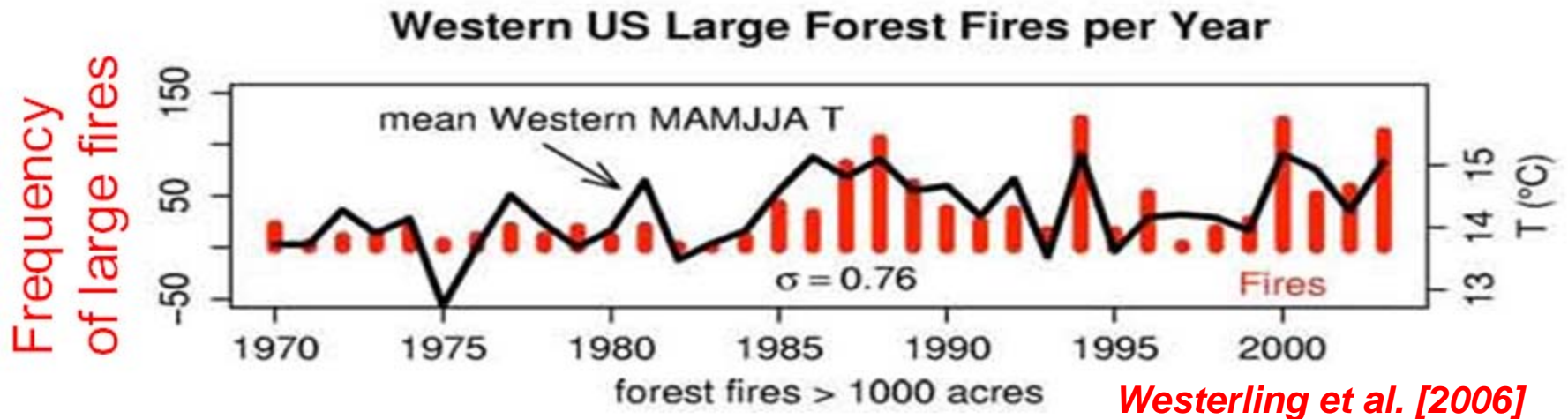
Results from six EPA-funded coupled GCM-CTM simulations



*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 PM<sub>2.5</sub> 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<sub>2.5</sub> 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**