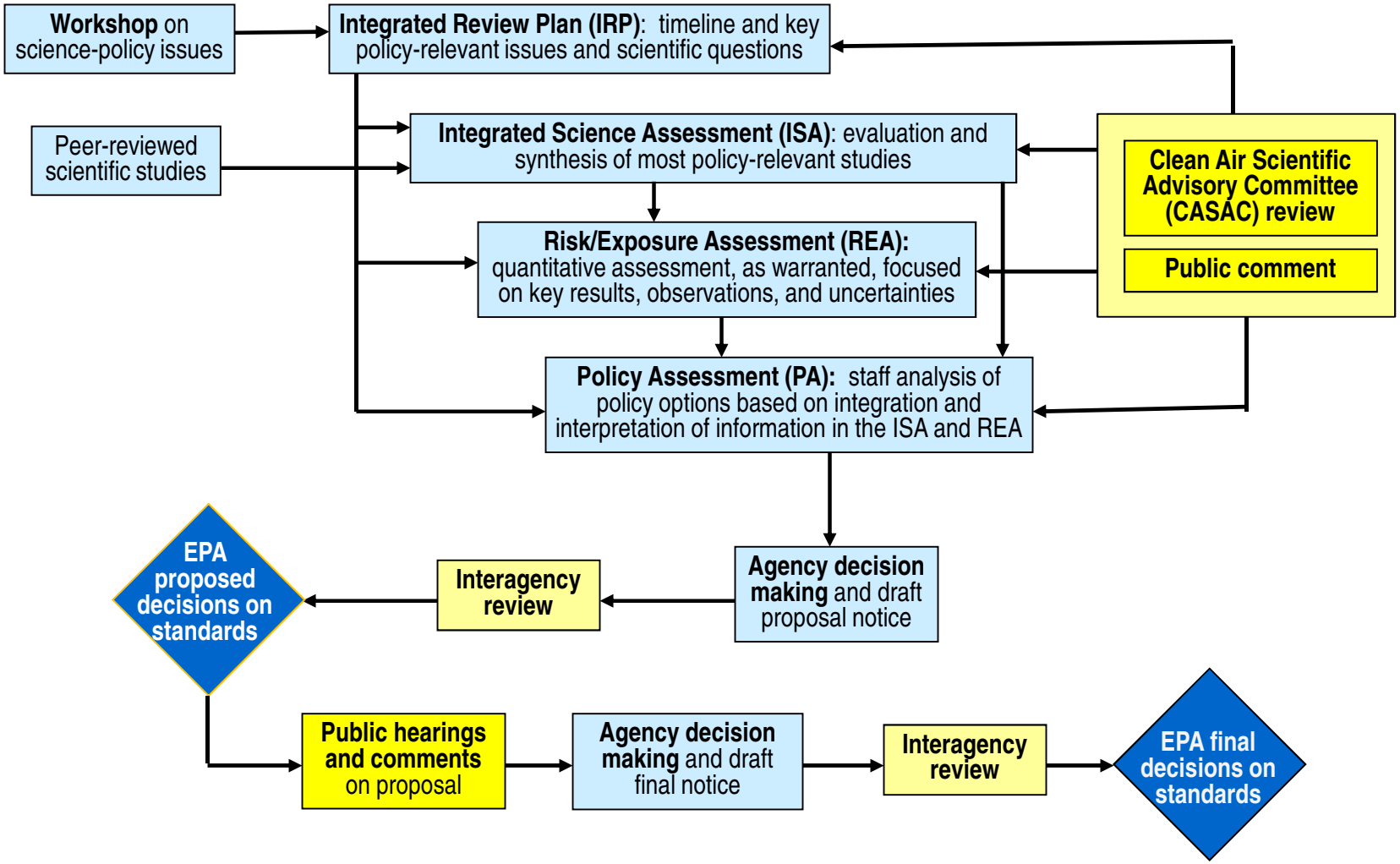
Research on the impact of ozone on crops

Jeffrey D. Herrick

National Center for Environmental Assessment

EPA

NAAQS Review Process



Conclusions from science reviews

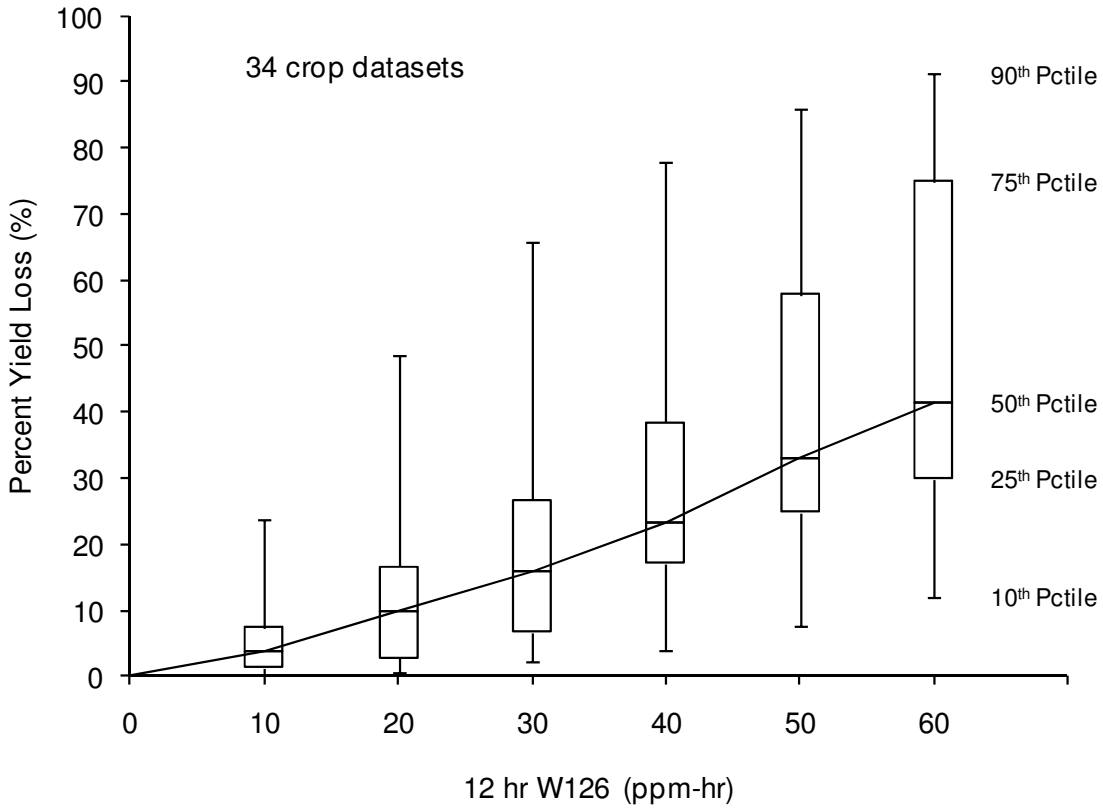
- **2006 Conclusion:** Data published since the 1996 O_3 AQCD strengthen previous conclusions that there is strong evidence that current ambient O_3 concentrations cause decreased yield and/or nutritive quality in a large number of agronomic and forage crops.
- **Conclusion of 2012 draft ISA:** Evidence is sufficient to conclude that there is a causal relationship between O_3 exposure and reduced yield and quality of agricultural crops.

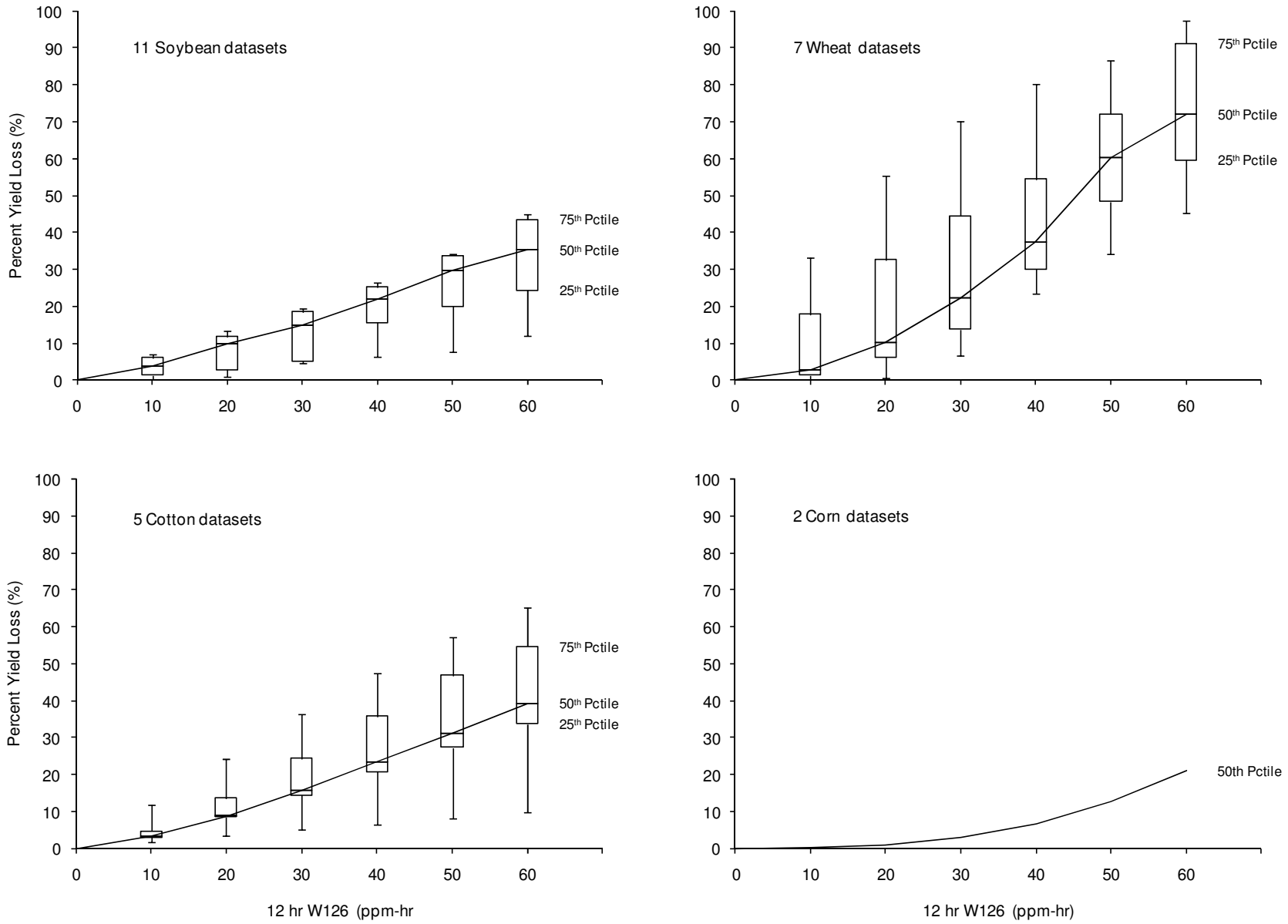
Crops with ozone response functions	Recent crop studies (since 2005)
Barley	Alfalfa
Corn	Bean
Cotton	Oilseed Rape
Kidney Beans	Corn
Lettuce	Cotton
Peanut	Grape
Potato	Mustard
Soybean	Peanut
Tobacco	Rice
Wheat	Soybean
Onion	Wheat
Rice	Strawberry
Oranges	Sugarcane
Grapes	Sweet Potato
Tomatoes	Watermelon
Cantaloupes	

Open Top Chambers


SoyFACE

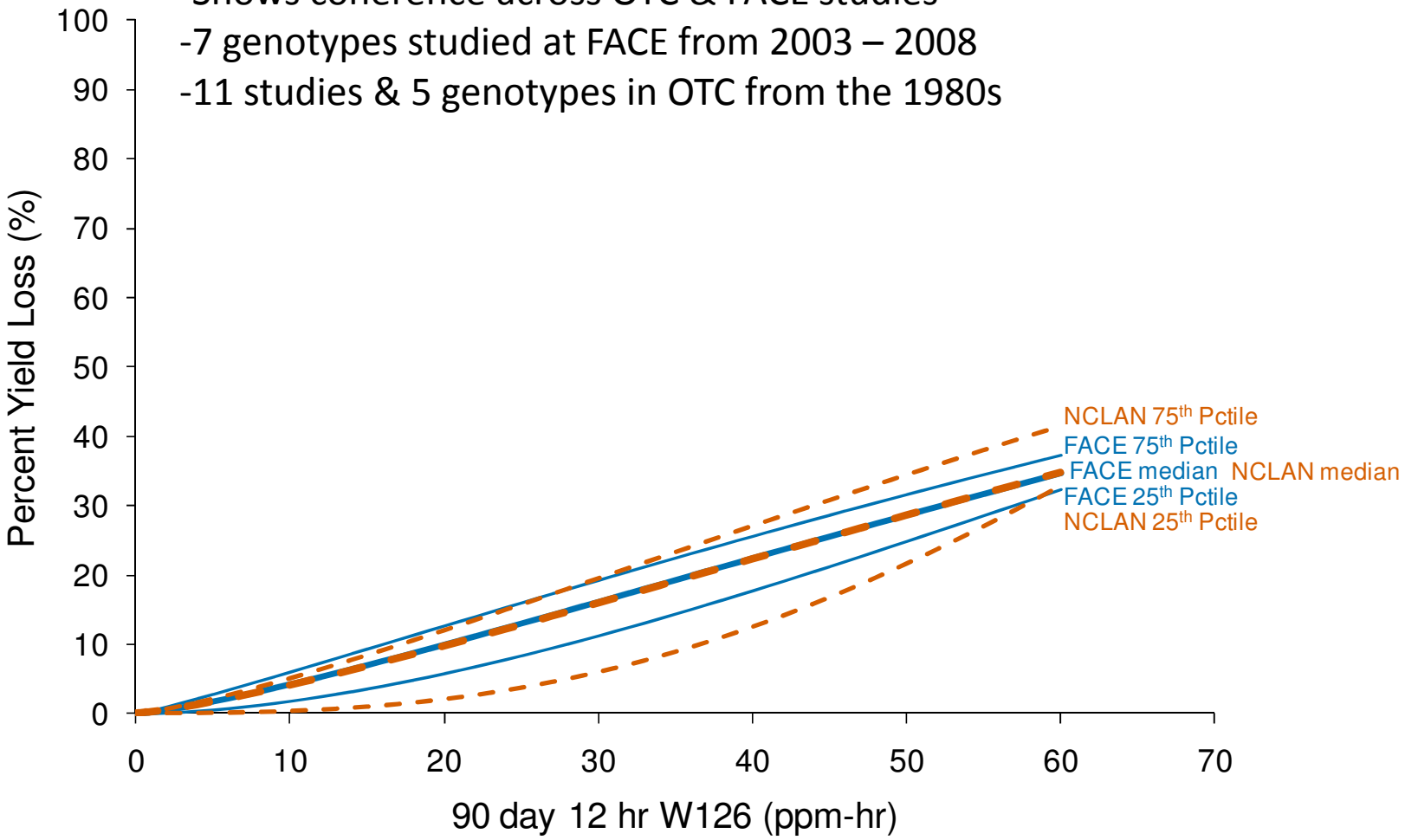
Predicted relative yield loss (12 species)




11 Soybean datasets
7 Wheat datasets
5 Cotton datasets
2 Corn datasets
Percent Yield Loss (%)
12 hr W126 (ppm-hr)
75th Pctile
50th Pctile
25th Pctile
0
10
20
30
40
50
60
70
80
90
100

Soybean across studies

-Shows coherence across OTC & FACE studies
-7 genotypes studied at FACE from 2003 – 2008
-11 studies & 5 genotypes in OTC from the 1980s

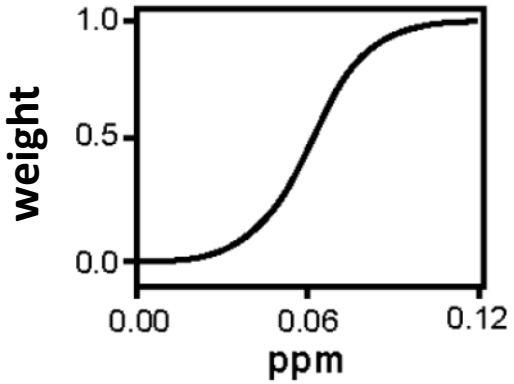


- Supplemental Slides

Understanding the 12-hr W126

Steps in calculating W126 value for a particular site:

1. Measure hourly ozone (O_3) concentrations for each hour within the 12 hour daylight period (8am-8pm).
2. Assign a weight to each hourly value based on concentration: lower concentrations receive less weight than higher concentrations.
3. Sum the 12 weighted hourly values to calculate a daily W126 value.
4. Repeat steps 1-3 for each day within the ozone season and then sum the daily values to calculate the monthly W126 value.
5. Identify the consecutive 3-month period whose monthly W126 values produce the highest total.
6. This total is the seasonal W126 for this site.



Example of weighting over 5-hour period:

Hourly O_3 (ppm)	Weight	W126 (ppm-hrs)
0.03	0.01	0.00
0.05	0.11	0.01
0.06	0.30	0.02
0.08	0.84	0.07
0.10	1.0	0.10
	SUM:	0.20

Daily value =
Sum of values over 12 daylight hours