The St. Louis Ozone Garden Project:

Providing a National Model for Creating an Awareness of the Detrimental Effects of Air Pollution on Vegetation

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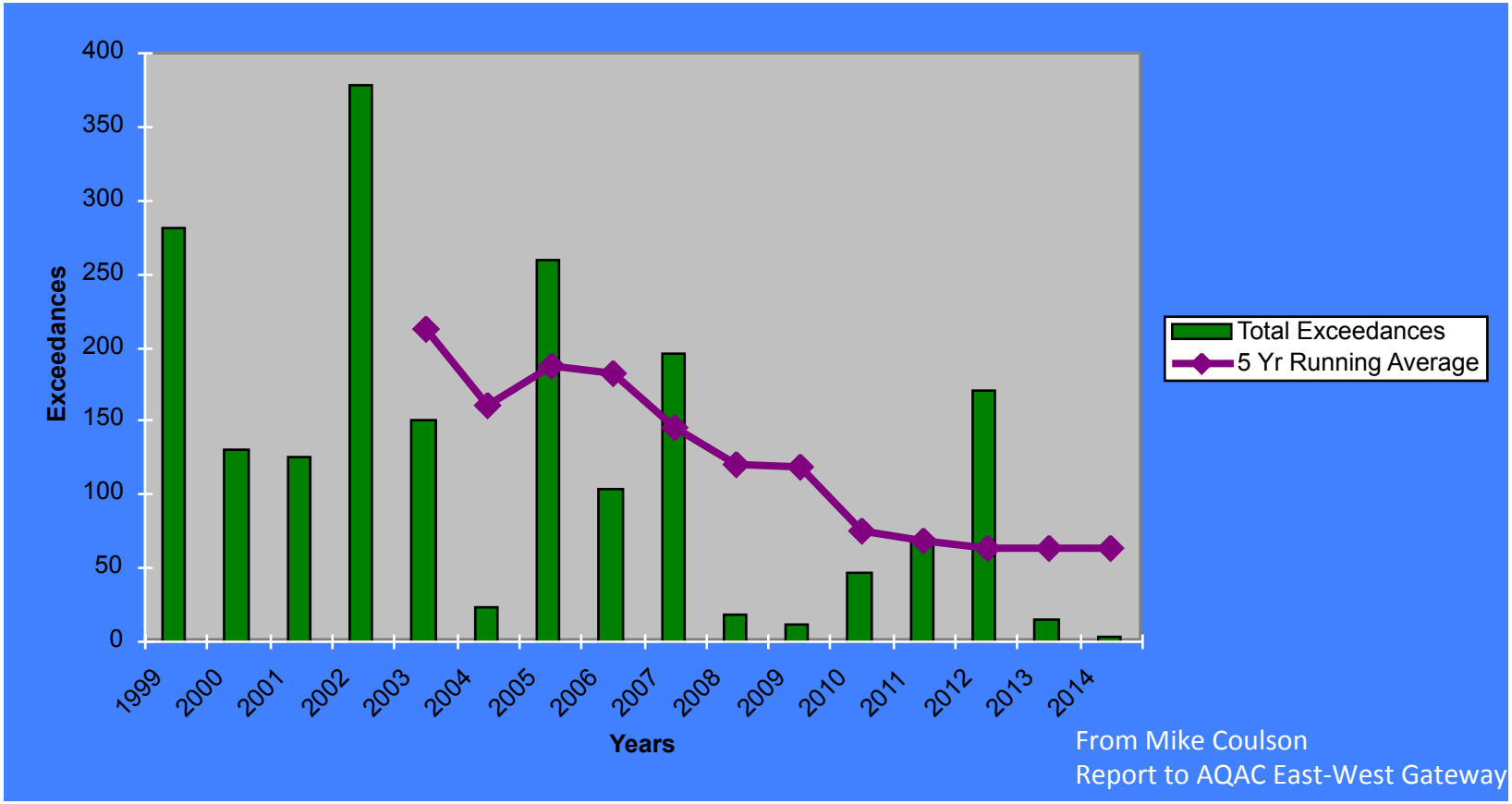
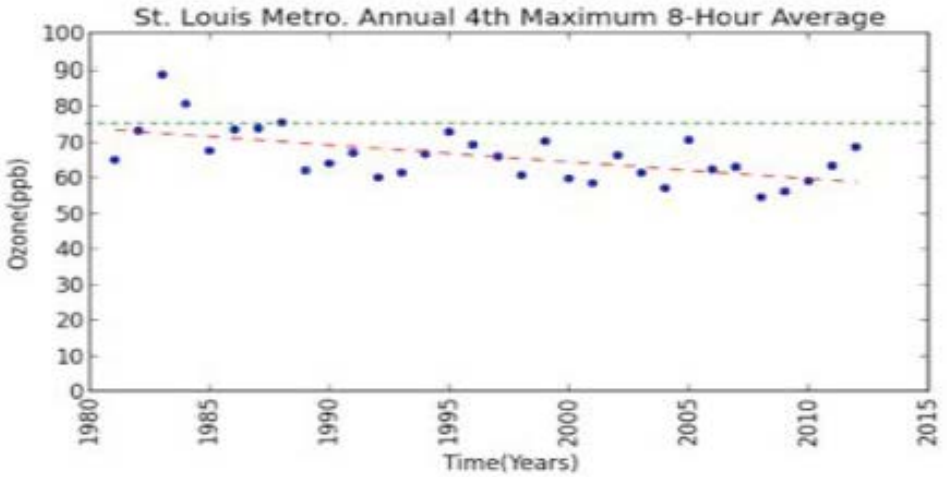
St. Louis Area Monitoring Agencies Meeting
Saint Louis University
St. Louis MO
May 17, 2016

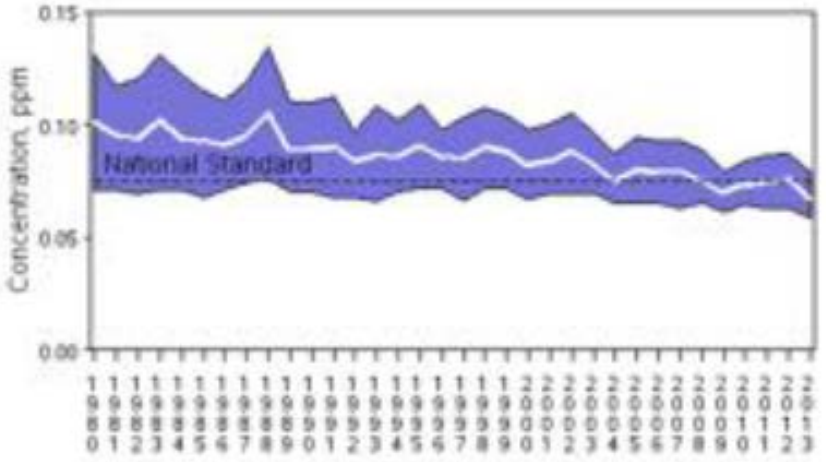
Long-term Trend in Ozone Exceedances of 8-hour standard shows marked improvement in St. Louis



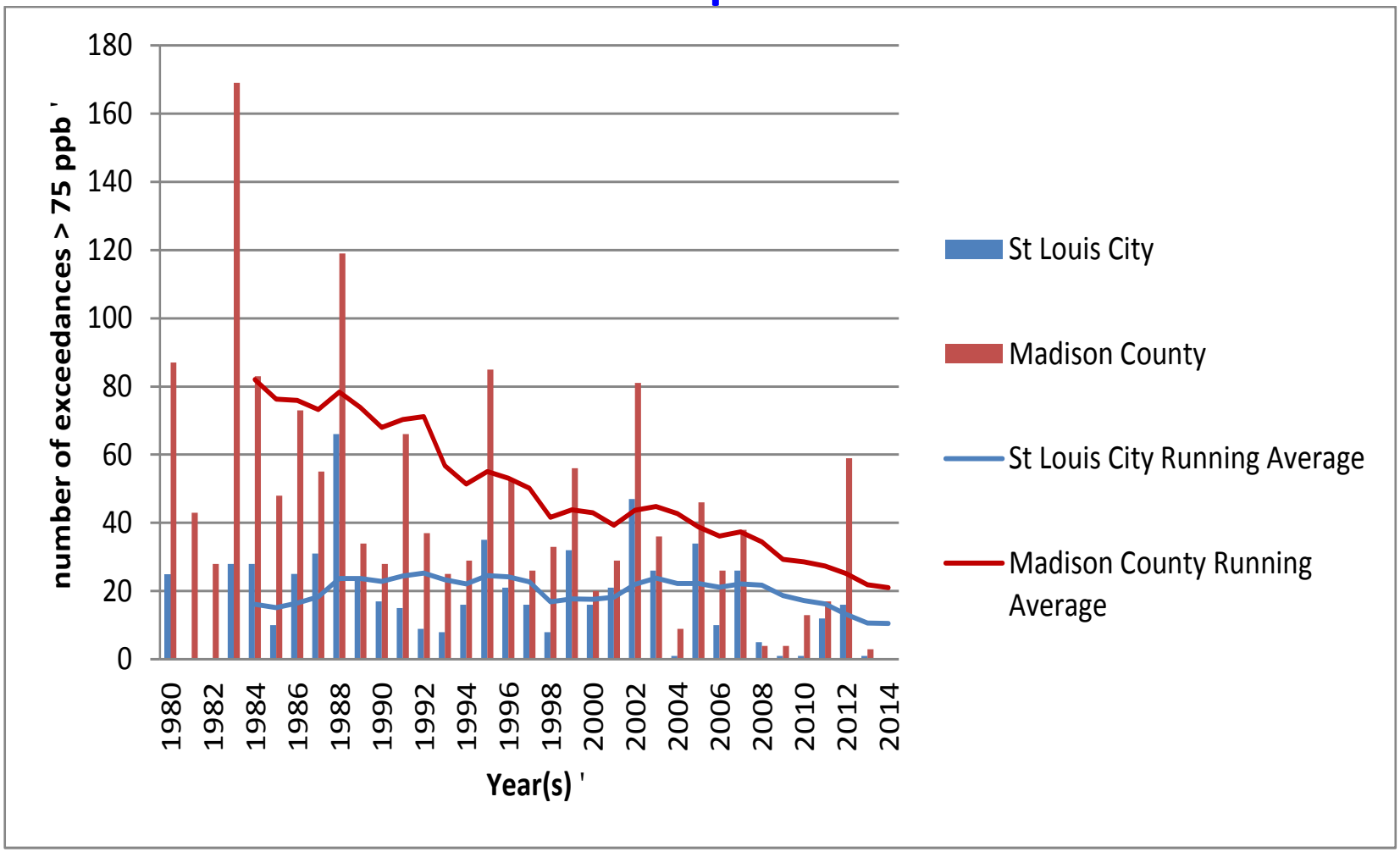
1999-2014 Exceedances
2008 8-Hour Ozone Standard

Long-Term Trend in St. Louis Mirrors National-level Improvements



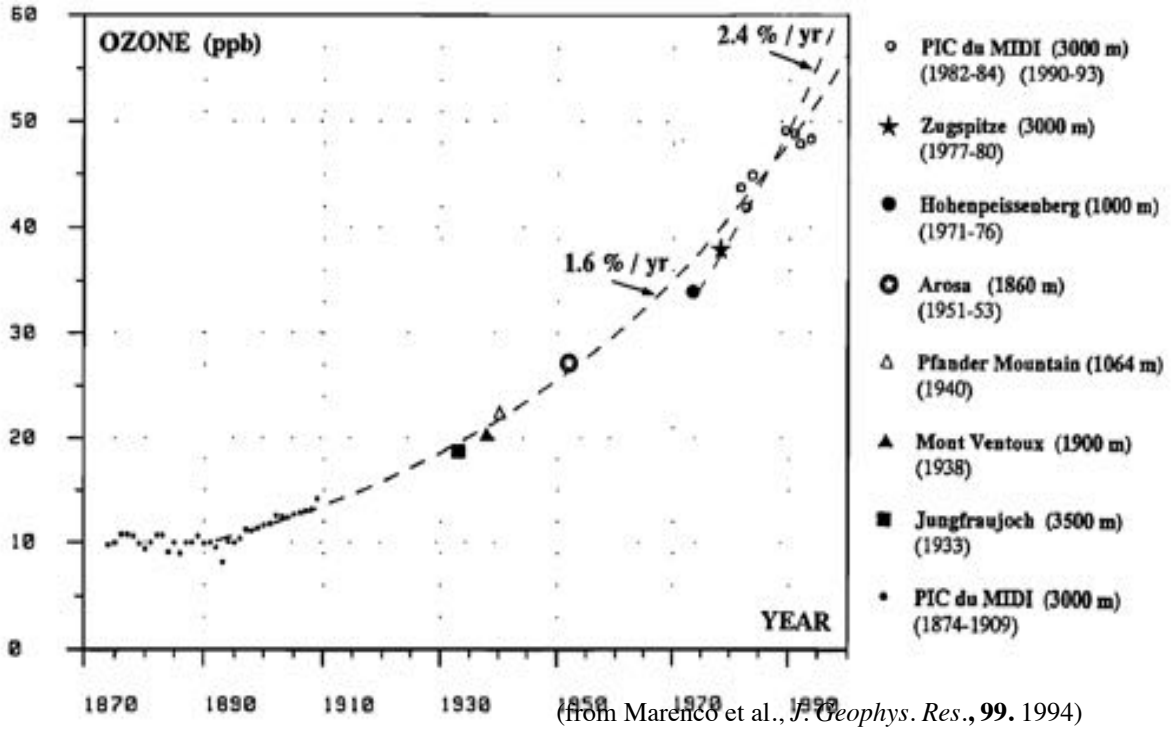


Analysis of AQS Dataset Going Back to 1980
Also Shows Improvement



The Ozone Paradox:
Background O_3 Concentrations are Increasing

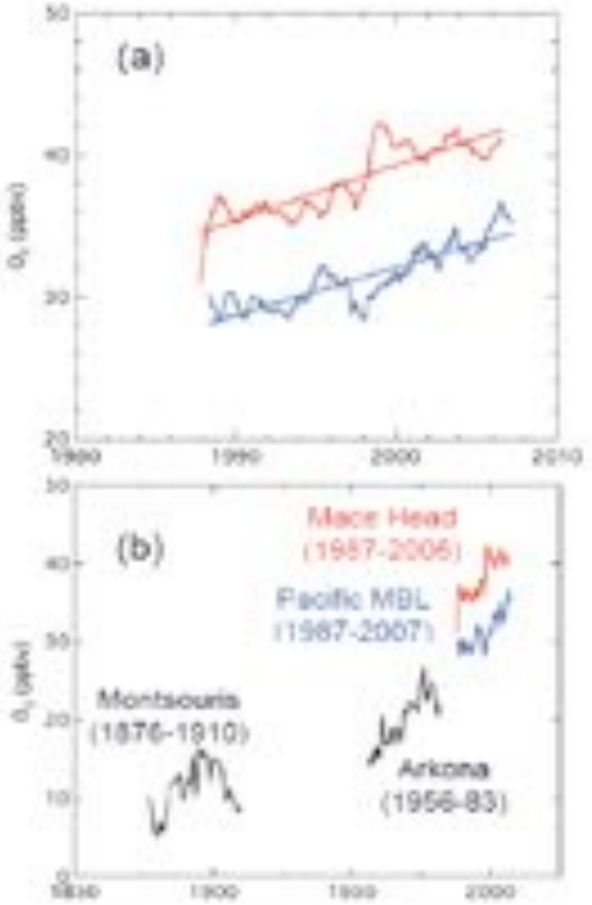
Analyses Conducted in 1980s and 1990s Confirm Hypothesis that Tropospheric Ozone Has Increased during 20th Century



(from Marenco et al., *J. Geophys. Res.*, **99.** 1994)

Figure 5. Ozone evolution in the free atmosphere over western Europe, from measurements at the Pic du Midi and in various European stations at high altitudes (see text).

Background Ozone Concentrations Still Increasing into Beginning of 21st Century

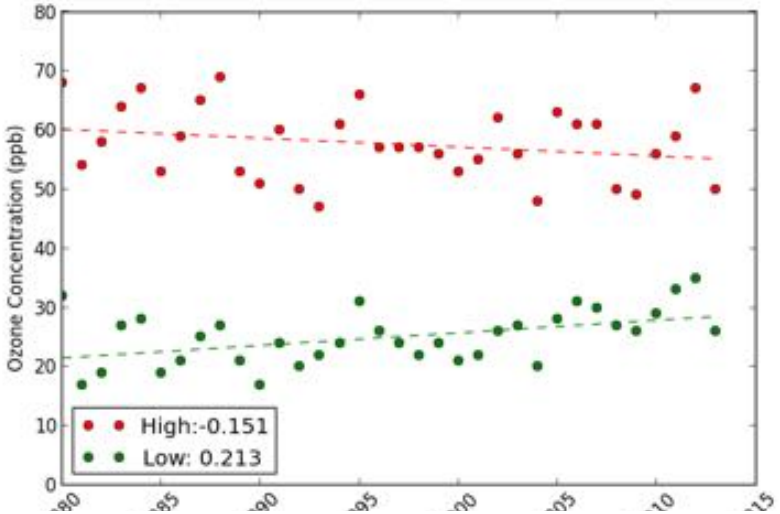


Mace Head (Ireland)

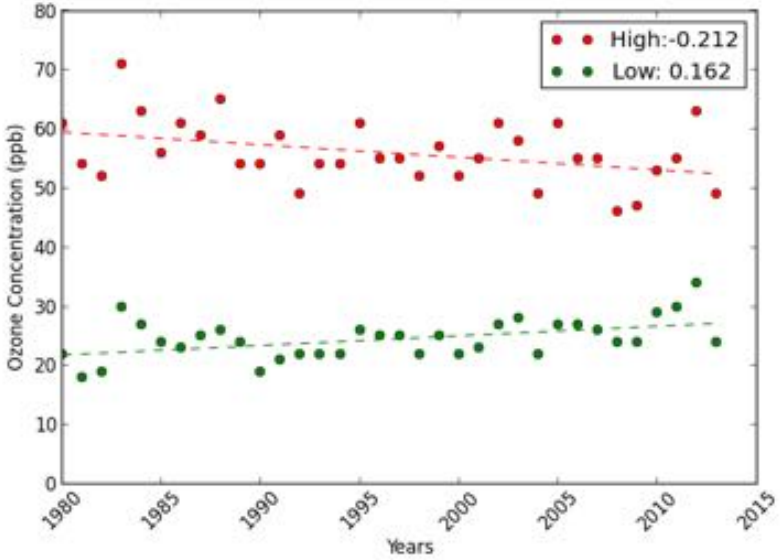
Pacific Coast (US)

(From Cooper et al., *Nature*, **463**, 2010)

Rank-Ordered Trends for MO and IL Sites Separately



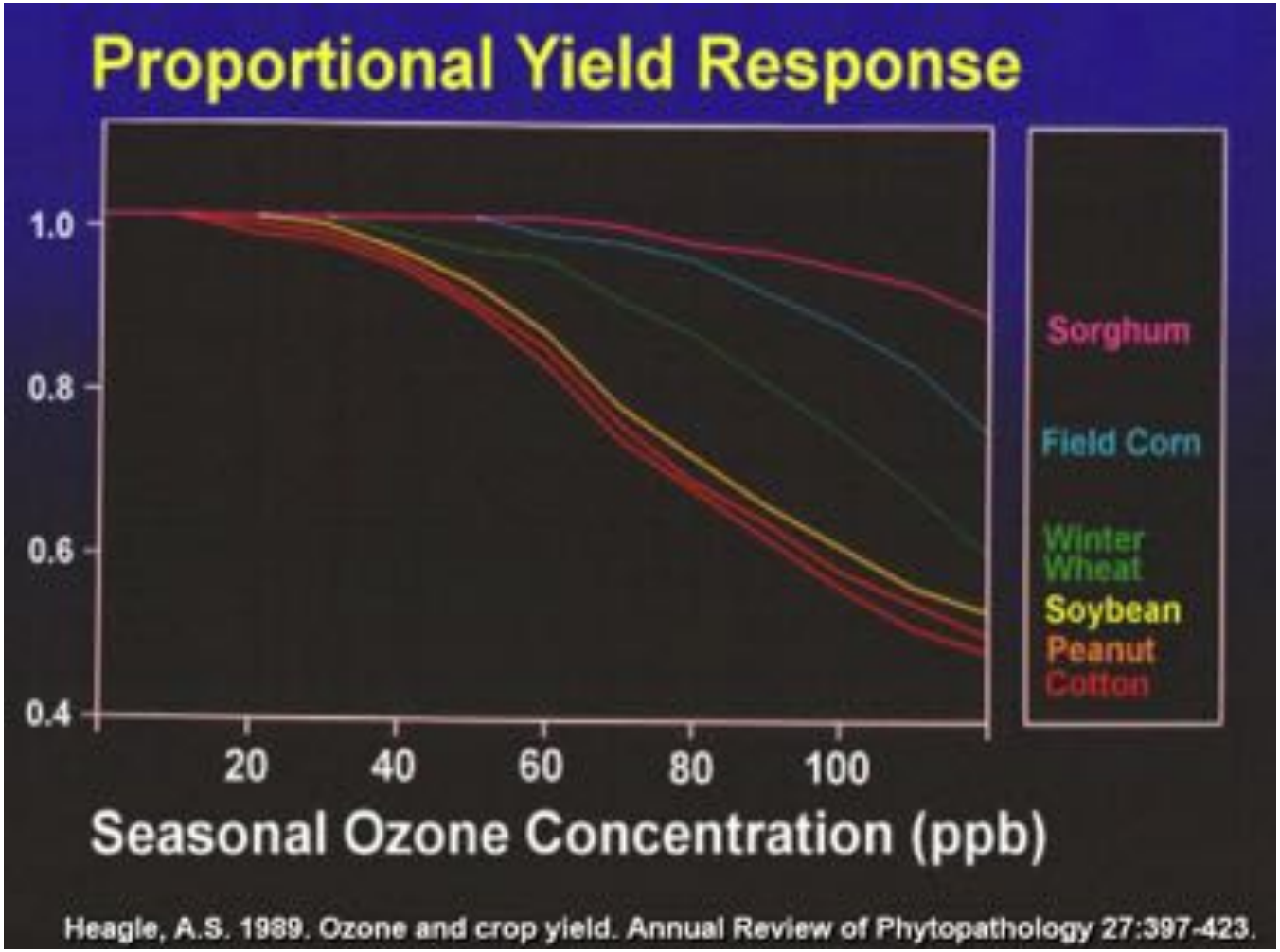
Missouri



Illinois

National Crop Loss Assessment Network (NCLAN) Conducted Studies in the 1980s to Assess Impact of Ozone on Crops

Many crops show decreased yield ~40 ppb



Observable Differences Between Early and Late in the Growing Season

Young Milkweed Leaves

17 June 2014

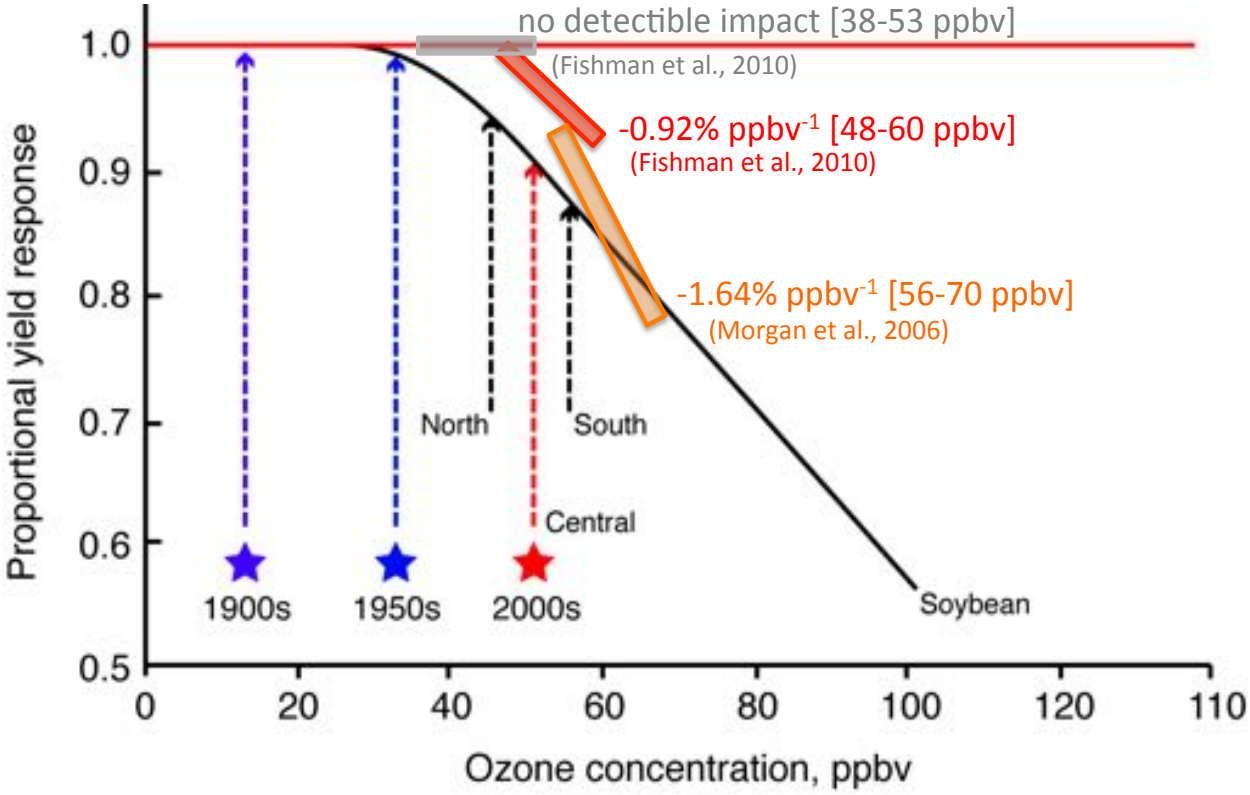
20 August 2014

Observable Differences Between Ozone-Sensitive and Ozone-Tolerant Cultivars

Snap Beans

Soybean Cultivars Late in the Season
(9 Sept. 2014)

Ozone Garden Provides a Simple Visual Demonstration of How Increasing Background O_3 Damages the Biosphere



Three New Ozone Garden Sites in St Louis Area in 2016

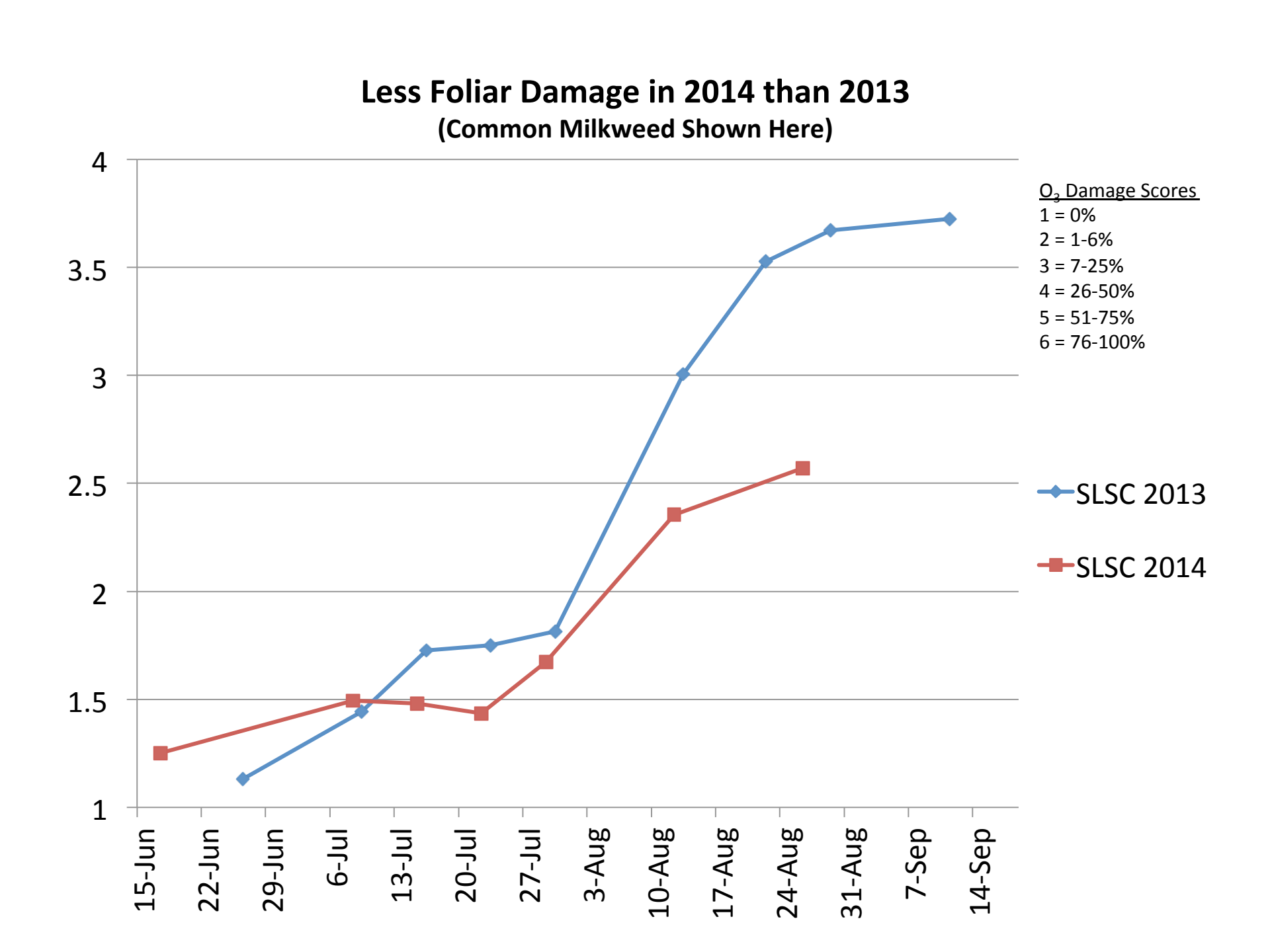
-Saint Louis Science Center will be moved to new GROW display
-Missouri Botanical Gardens
-Granite City IL

St. Louis Science Center's GROW Exhibit

The St. Louis Science Center's permanent exhibit "GROW" will include more that 40 exhibits incorporating chemistry, economics, life sciences, culture and technology. It is expected to open in summer 2016.

Ozone Garden at Missouri Botanical Gardens

Granite City Public Library


Less Foliar Damage in 2014 than 2013
(Common Milkweed Shown Here)
4
3.5
3
2.5
2
1.5
1
15-Jun
22-Jun
29-Jun
6-Jul
13-Jul
20-Jul
27-Jul
3-Aug
10-Aug
17-Aug
24-Aug
31-Aug
7-Sep
14-Sep
O2 Damage Scores
1 = 0%
2 = 1-6%
3 = 7-25%
4 = 26-50%
5 = 51-75%
6 = 76-100%
SLSC 2013
SLSC 2014

MIDWEST CLEAN AIR STEWARDSHIP: BUILDING UPON THE ST. LOUIS OZONE GARDENS

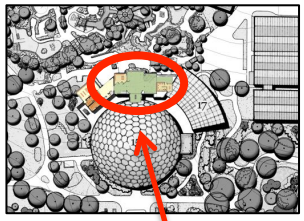
Funded by EPA's Environmental Education Program, SLU will partner with the Missouri Botanical Garden in 2016-2017:

"We are moving the Ozone Garden indoors to teach students all year round about the impact of ozone pollution on the biosphere"

~ 48"

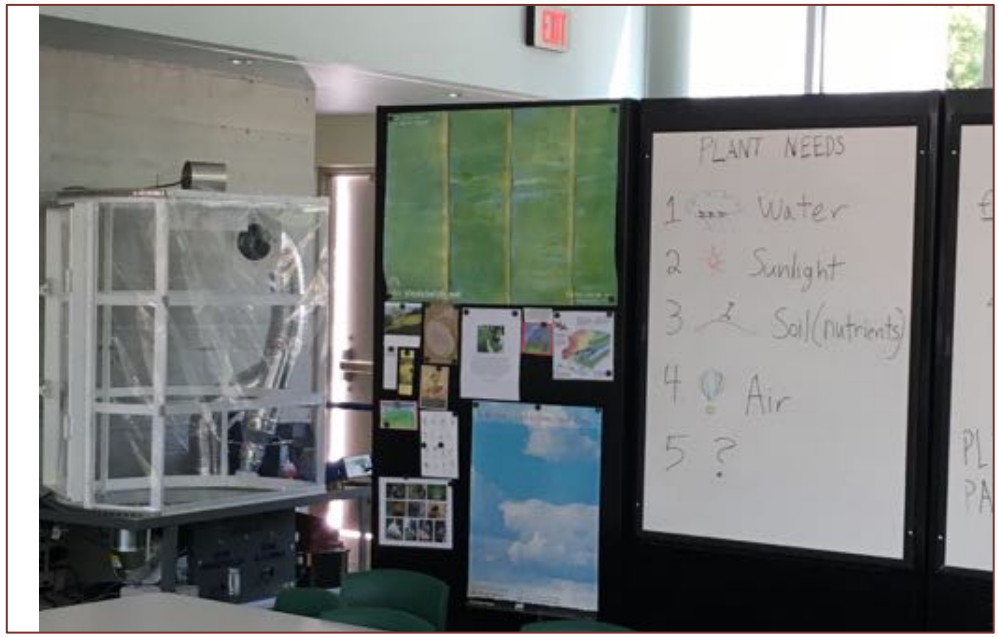
Example of ozone chamber that will be constructed

Artist's rendering of new PlantLab



The PlantLab will be located next to and accessible from the Climatron

In Spring 2016, the Missouri Botanical Garden will open a new publically accessible venue specifically designed as an energizing, creative hub for hands-on plant science, investigation, and conservation – the PlantLab. The 1,100-square foot, greenhouse-like facility will serve as a year-round experiential learning space for people of all ages, backgrounds, and abilities, which include youth and family audiences, scout troops, and school groups to adult learners, teachers, professional groups, and community organizations. When not in use as a class/course venue, general audiences can tour the PlantLab to see the behind-the-scenes plant science work of the Garden and is located adjacent to the iconic Climatron®



First Ozone Chamber Placed at Missouri Botanical Gardens "PlantLab" Educational Facility – May 2016

Close up of ozone generation and ventilation system for chamber

Future IPCC Scenarios Suggest Tropospheric O_3 will Increase by 25%