

Measuring the Emissions Impacts of Ozone Action Programs

Integrating Air Quality and
Transportation Planning Workshop
Using Outreach to Improve Air Quality

NARC Workshop – February 24, 2004

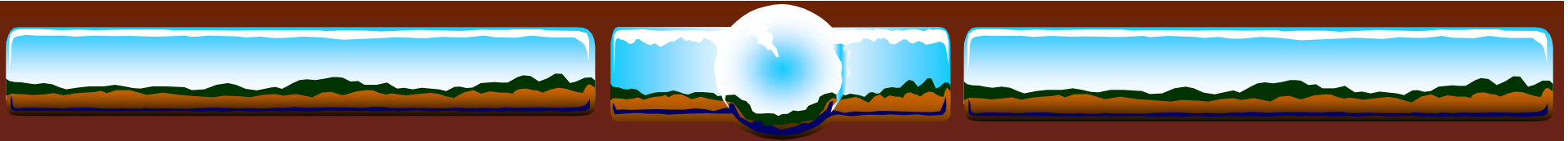
Eric N. Schreffler, ESTC



NARC

Building Regional Communities

NATIONAL ASSOCIATION OF REGIONAL COUNCILS



INTRODUCTION

How do you measure the actual impact of public education programs?

How do you get beyond awareness and recall?

What about episodic versus seasonal programs?



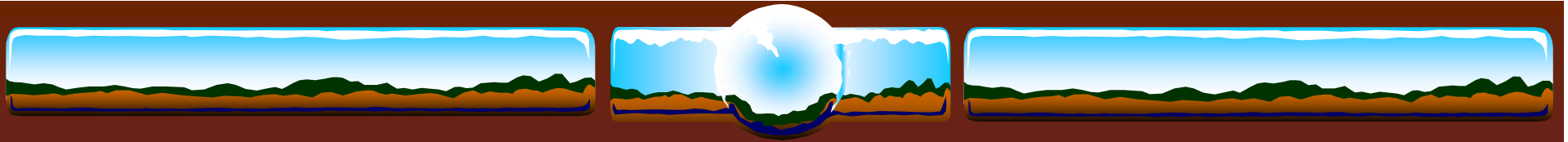
TOPICS

1. General Evaluation Issues
2. Ozone Action Quantification Method
3. Voluntary TDM Program Evaluation
4. General Guidance and Tools



Evaluation Issues

- ❖ Projections rely on intended outcome, not planning strategies
- ❖ Methods used to project results differ from those used to measure impacts
- ❖ Surveys focus on awareness, not behavior
- ❖ Too many assumptions...not empirical



Public Education Programs

- ❖ Most common are ozone alert or seasonal clean air programs
- ❖ Often under control of public information
- ❖ Rely on mass media and outreach
- ❖ Use marketing and advertising specialists
- ❖ Little experience with impact quantification



Public Education Programs

So, how do you make leap from marketing and education...



to travel behavior and trip reduction...



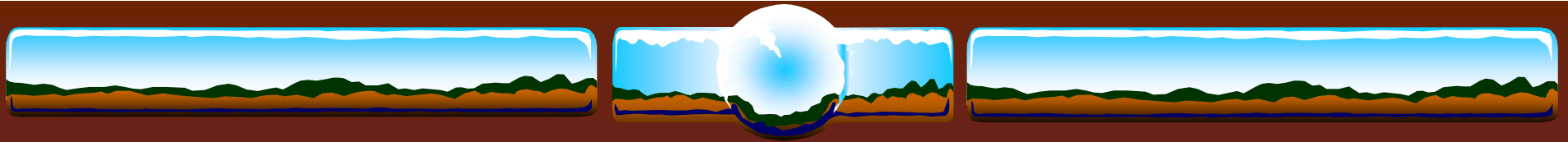
to emission reduction?





Why Evaluate?

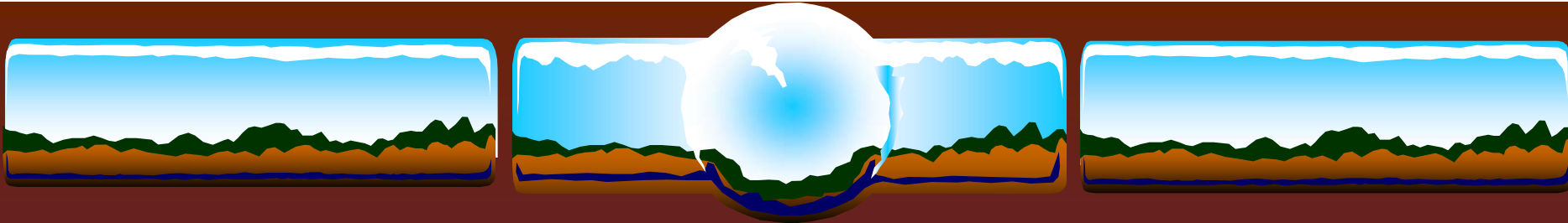
- ❖ Quantify actual emission reductions for SIP credit
- ❖ Satisfy measurement requirements in Early Action Compacts
- ❖ Evaluate cost effectiveness of program
- ❖ Measure travel behavior changes
- ❖ Document impacts for CMAQ reporting
- ❖ Help demonstrate conformity
- ❖ Provide decision-makers with feedback on results



Range of Evaluation Approaches

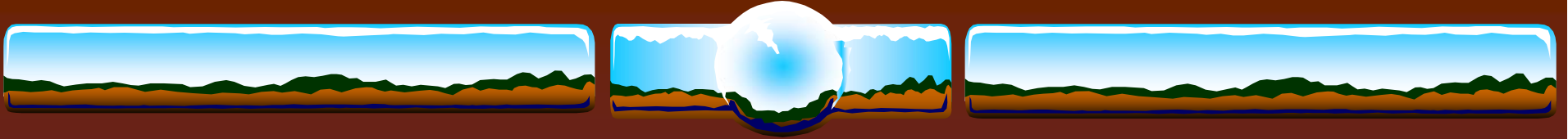
Depends on program objectives and funder expectations:

- ❖ track awareness of program
- ❖ measure recall of message and call to action
- ❖ evaluate “precursors” to behavior change
- ❖ assess stated preferences
- ❖ estimate travel behavior change
- ❖ convert travel behavior to emission reductions



EPIODIC PROGRAM

Spare the Air Programs in
Sacramento and San Francisco



ARB/EPA METHOD

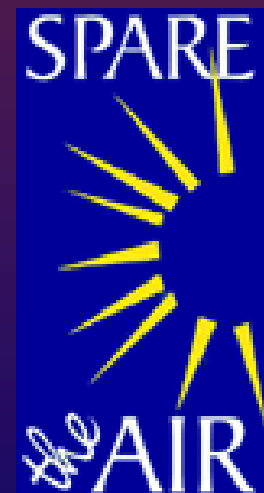
“A Method to Measure the Travel and Emissions Impacts of Ozone Action Public Education Programs”

- ❖ developed in Sacramento
- ❖ implemented in SF Bay Area



Research Sponsors

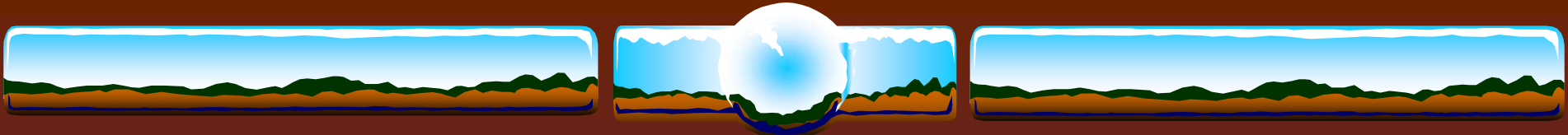
- ❖ California Air Resources Board
- ❖ US Environmental Protection Agency
- ❖ Federal Highway Administration
- ❖ Sacramento Metro AQMD
- ❖ Bay Area AQMD
- ❖ San Joaquin Valley AQMD





Research Objectives

- ❖ Method to Quantify Trip and Emission Reductions
- ❖ Method for Episodic Education Programs
- ❖ Affordable for Use by Air Districts
- ❖ Accurate and Rigorous
- ❖ Develop Correction Factors to Adjust Survey Findings
- ❖ Acceptable to EPA for SIP Credit

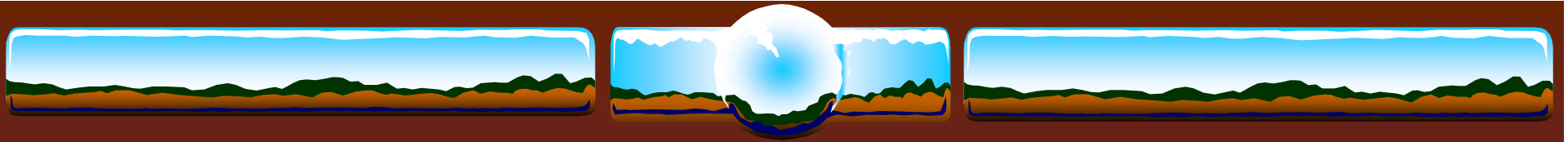


Research Definitions

STA = Spare the Air

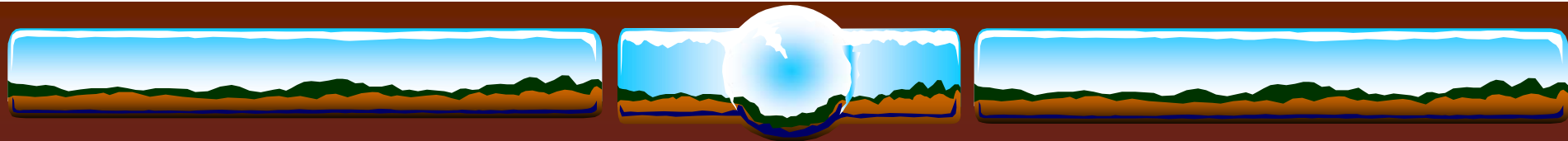
Reducer = Driver who purposely reduces trips because of STA

Non-Reducer = Driver who did not respond to STA message



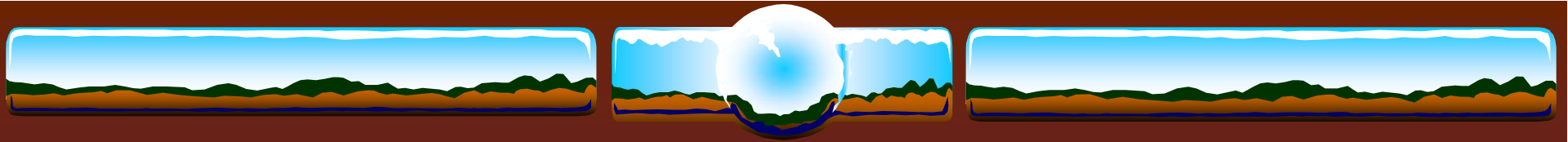
Research Design

- ❖ Track Behavior of Reducers and Control Group
- ❖ Compare STA Behavior to Other Days
- ❖ Compare Reducer Behavior to Non-reducers
- ❖ Develop Estimate of Actual Trip Reduction
- ❖ Compare Actual to Reported Trip Reduction
- ❖ Produce Correction Factor for Over-reporting of Trip Reduction



What Do You Need to Know?

1. Proportion of drivers who reduce travel
2. Self-reported number of trips reduced
3. Proportion of work and non-work trips
4. Knowledge of ozone message
5. Average trip lengths
6. Regional emission factors



Key Comparisons

Travel behavior (trips) of respondents who “purposely reduced” trip on STA days versus non-STA days (Treatment)

and

Travel behavior of all drivers on STA days versus non-STA days (Control)



Sacramento Surveys

- ❖ Developed “Reducer” and “Standard” surveys
- ❖ Fielded surveys evening after STA alert
- ❖ Followed-up on Non-STA day
- ❖ Surveyed Summer of 1999 and 2000 in Sacramento
- ❖ Called almost 4,000 people
- ❖ Resulted in 134 Reducers and 177 Non-reducers with paired surveys

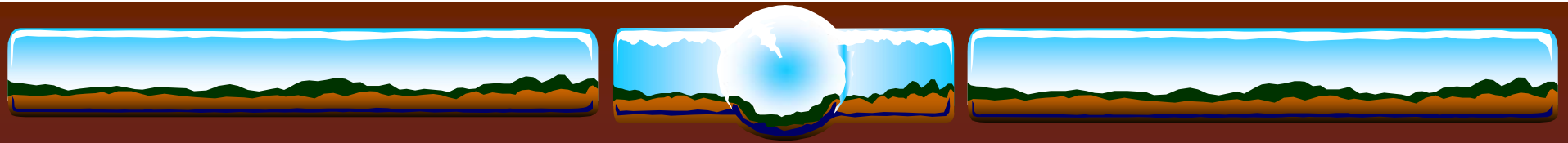


Net Average Trip Reduction

Reducers made *0.4478* fewer trips on STA days as compared to Non-STA days

Control group made *0.6497* MORE trips on STA days

Net average trip reduction = $0.4478 - (-0.6497)$
= ***1.0975*** trips reduced by "reducers"



Self-Reported Trip Reduction

Summary question about how many trips reducers eliminated equaled:

2.2 fewer trips



Correction Factor

$$\text{Correction Factor} = \frac{\text{Net Measured Average Trip Reduction}}{\text{Average Self-Reported Trip Reduction}}$$

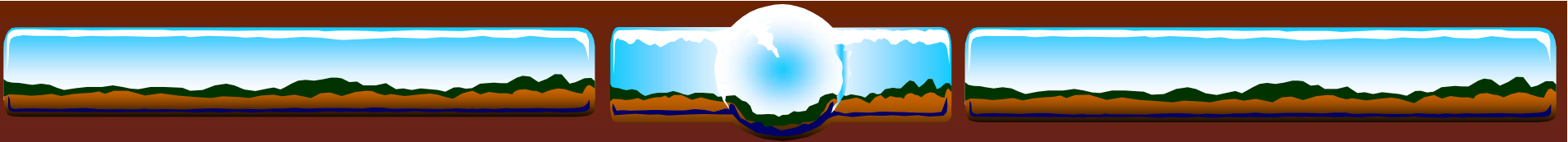
$$\text{Correction Factor} = \frac{1.0975}{2.2} = 0.50$$

So, people actually reduce 1/2 of a trip for every reported trip reduced



Summary of ARB Method

1. Ask if they purposely reduced driving
2. Ask how many trips they reduced
3. Ask what kind of trips they reduced
4. Ask if they knew it was an ozone action day
5. Apply correction factor to reported reduction
6. Apply reduction to population of reducers
7. Apply VMT and emission factors



Recommended Method

Step 1 - Modify Survey and Sample Size

- ✓ Add questions for % of reducers, reported trip reduction, and type of trip reduced
- ✓ Sample size of about 1,000 to get acceptable range of error for estimate

Step 2 – Field Survey right after STA Day



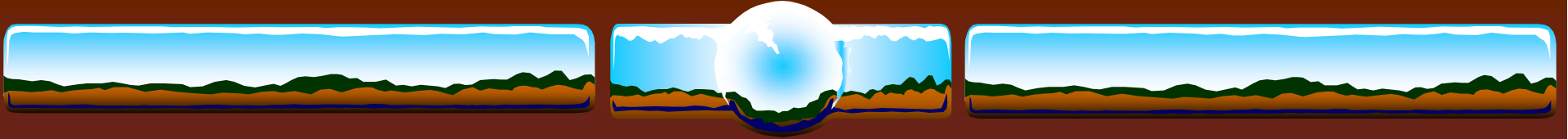
Survey Topics

1. Did you purposely increase or decrease the amount of driving you did today?
 - 2a. How many trips did you decrease?
 - 2b. How did you decrease each trip?
 - 2c. What kind of trip did you decrease?
 - 2d. Why did you reduce the trip?
3. Are you aware of Spare the Air or AQ ads?



Survey Tips

- ❖ Need random sample of drivers
- ❖ Utilize RDD telephone survey
- ❖ Avoid self-selection – e.g., alert recipients
- ❖ Sample size depends on “incidence” and trips reduced
- ❖ Don’t ask leading questions
- ❖ Ask about campaign awareness at end
- ❖ Be aware of survey biases



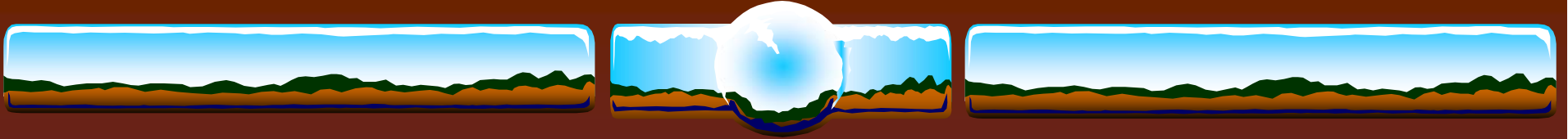
Recommended Method

Step 3 – Tabulate Results

- ✓ Proportion of reducers
- ✓ Reported average number of trips reduced
- ✓ Type of trip reduced (work vs. non-work)

Step 4 – Estimate Total Reducers

- ✓ Apply proportion of reducers to driving population (equal to RDD sample)



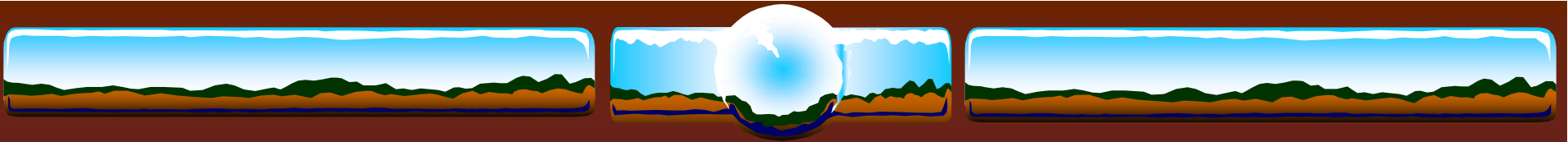
Recommended Method

Step 5 – Estimate Average Trip Reduction

- ✓ Derive self-reported trip reduction from survey

Step 6 – Apply Correction Factor

- ✓ Multiply correction factor (0.5) to average self-reported trip reduction from Step 5



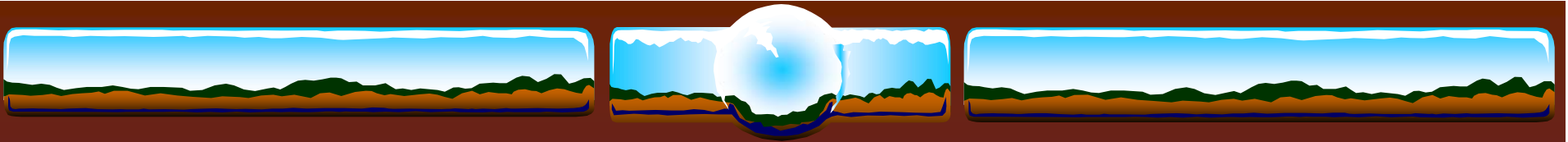
Recommended Method

Step 7 – Estimate Total Trip Reduction

- ✓ Multiply adjusted trip reduction (Step 6) by total reducers (Step 4)

Step 8 – Determine Proportion of Work and Non-Work Trips Reduced

- ✓ Apply proportions of work and non-work trips reduced to adjusted total trip reduction



Recommended Method

Step 9 – Estimate VMT Reduction

- ✓ Multiply trips reduced by type (Step 8) by average trip length by type (work and non-work)

Step 10 – Estimate Emission Reduction

- ✓ Apply emission factors to total trip (by type) and VMT reduction



Summary of Method

- ❖ Run measurement plan by USEPA
- ❖ Add three revised question strings to regional follow-up survey
- ❖ Adjust and readjust sample size
- ❖ Apply correction factor to self-reported trip reduction
- ❖ Calculate emission reductions



Preliminary Impact Findings

- ❖ About 5% of drivers reduce trips for STA
- ❖ They report reducing 2.2 trips
- ❖ They actually reduce 1.1 trips
- ❖ They eliminate or postpone trips
- ❖ They reduce non-work trips
- ❖ Reduced 0.35 tons/day NO_x; 0.37 tons/day ROG and 0.06 tons/day PM₁₀



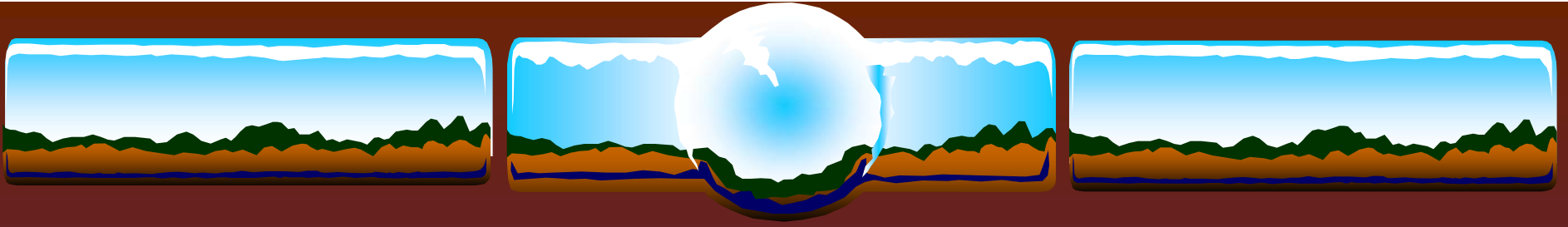
Multivariate Analysis Findings

- ❖ Those working at employer sites that give air quality alerts about 1.6 x more likely to be reducers
- ❖ Women about 1.6 x more likely to be reducers than men
- ❖ Those with larger families (3 or more children) about $\frac{1}{4}$ as likely to be reducers



Suggested Use of Results

- ❖ Emission factors are getting smaller
- ❖ Better to also track proportion of reducers and average trips reduced
- ❖ Report total number of drivers affected
- ❖ Monitor changes in these indicators over time
- ❖ Modify program accordingly to influence these
- ❖ Calculate cost effectiveness (\$/driver, \$/trip, \$/mile or \$/pound of pollution (\leq \$10/lb.))



VOLUNTARY TDM PROGRAM

Framework for Cooperation to
Reduce Traffic Congestion and
Improve Air Quality

Atlanta, Georgia



ATLANTA TDM Evaluation

- ❖ Georgia seeking SIP credit for all voluntary TDM trip reduction programs in Atlanta (VMEP)
- ❖ 1.5% of emission target or 4.28 tpd of NO_x and 6.51 tpd of VOC in 2003
- ❖ Equates to 4.4 million miles of travel
- ❖ 90% from CAC participating employees (132,645)
- ❖ 10% from collateral influence of campaign (14,739)



ATLANTA TDM Framework

- ❖ Clean Air Campaign/Private – employer outreach
- ❖ Clean Air Campaign/Public - state worksites
- ❖ Media Campaign – public education
- ❖ Support from Framework Partners
 - ✓ regional rideshare program
 - ✓ network of TMAs – transit pass discounts
 - ✓ vanpool program
 - ✓ cash for commuters incentive



TDM Evaluation

- ❖ State funds large-scale evaluation for VMEP SIP
- ❖ Performed by Center for Transportation and the Environment
- ❖ Assisted by advisory group and consultants
- ❖ Annual regional survey
- ❖ Annual evaluation of partner programs
- ❖ 2003 test of emission impacts toward attainment; 2004 refinement being implemented



Evaluation Plan

Annual “bottom-up” evaluation of partner programs

- ❖ count placements into new alternative modes
- ❖ avoid double counting
- ❖ sum by mode, not partner = 0.73 ton of NO_x; 0.84 VOC

Annual “top-down” evaluation of regional impacts

- ❖ are commuters and others shifting modes?
- ❖ developed “switcher” survey to find mode switchers



Evaluation Issues

- ❖ SIP forecast backed into target impact
- ❖ Assumes every “participant” reduced a trip every day
- ❖ Did not account for occupancy or part-time use
- ❖ Did not account for prior mode or access mode



Refinements for 2004

- ❖ Annual survey of regional travelers will be repeated
- ❖ Will account for all mode switching (net impact)
- ❖ Will try to directly link switch to influence of media campaign and/or TDM programs
- ❖ Georgia DNR-EPD will decide what to report to EPA

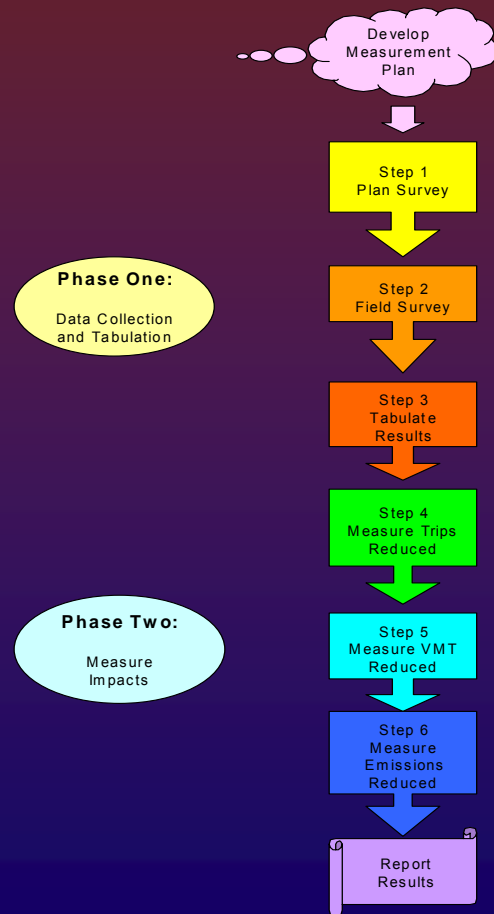
www.tdmframework.org



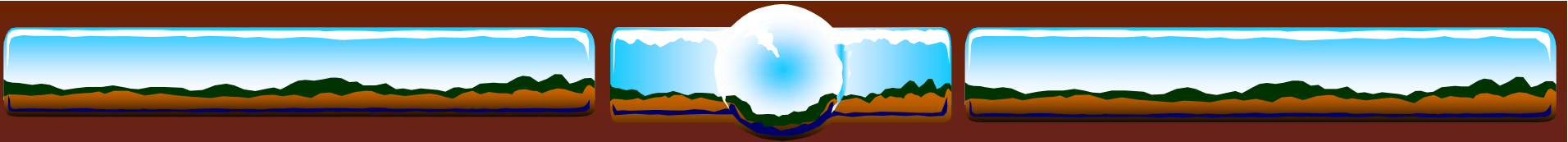
General Guidance

- ❖ Think through forecasting and measurement issues when designing program
- ❖ Maintain consistency in approach/methods
- ❖ Develop measurement plan – get help first time
- ❖ Don't just do it for SIP or Early Action Compact
- ❖ Minimize assumptions and borrowed factors
- ❖ Minimize self-reporting bias

Guidance Document



- ❖ Developed Guidance Manual for Air Districts
- ❖ Reasons for Evaluating Program
- ❖ Steps for Using Method
- ❖ Tips on Planning Evaluation
- ❖ Case Study from Bay Area
- ❖ Sample Survey from Bay Area



Additional ARB Tools

Quantification Method for Ozone Action Programs

www.arb.ca.gov/research/abstracts/98-318.htm

Automated Methods to Find the Cost Effectiveness of
Funding Air Quality Projects

Determining the Cost Effectiveness of Employer TDM
Programs

www.arb.ca.gov/planning/tsaq/eval/htm