

DEMONSTRATING NAPL COMPOSITIONAL CHANGE OVER THE LIFE CYCLE OF A NAPL PLUME



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INTRODUCTION

Drivers of Compositional Change



LNAPL Drivers and Concerns

Technical Driver (Metric Example)	Concern
LNAPL Composition (NAPL, Dissolved & Vapor Phase Composition)	Explosive Hazards
	Dissolved-Phase Concentration
	Vapor-Phase Concentration
	Direct Contact / Ingestion
LNAPL Saturation (LNAPL Transmissivity)	Mobility (spreads/creates new risk)
	Visible Aesthetics

Regulatory driver: “recover to maximum extent practicable” – States’ interpretations relative to compositional change technologies?

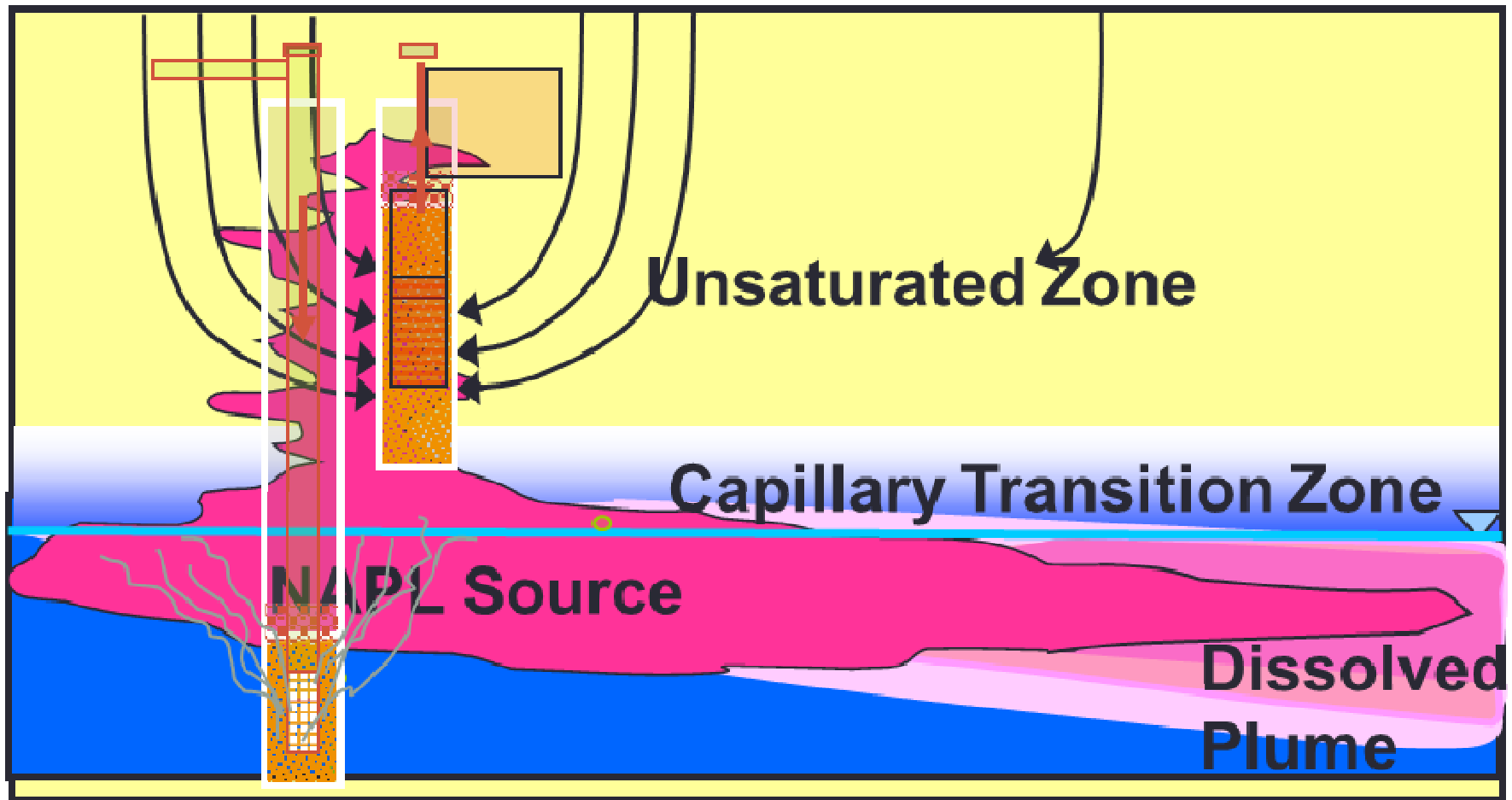


COMPOSITIONAL CHANGE TECHNOLOGIES

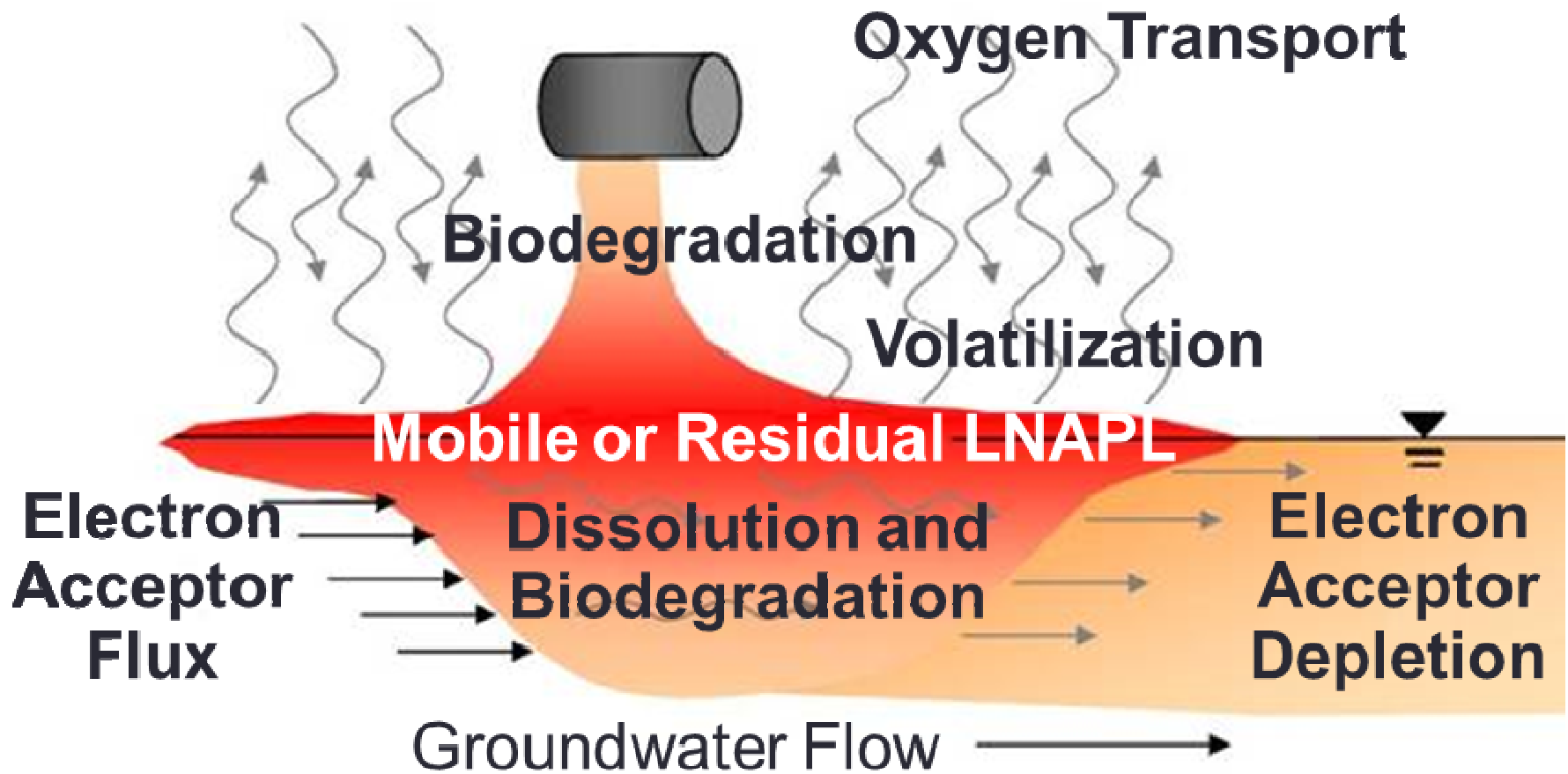
Representative Technologies



Air Sparging / SVE to Achieve NAPL Compositional Change



Natural Source Zone Depletion / Natural Losses to Achieve NAPL Compositional Change



MEASURING COMPOSITIONAL CHANGE



Methods to Measure Compositional Change

NAPL Phase

- Simulated Distillation
- PIANO
- Chromatogram
- Physical Properties

Dissolved Phase

- COC Mass Balance
- COC Ratio Analysis

Vapor Phase

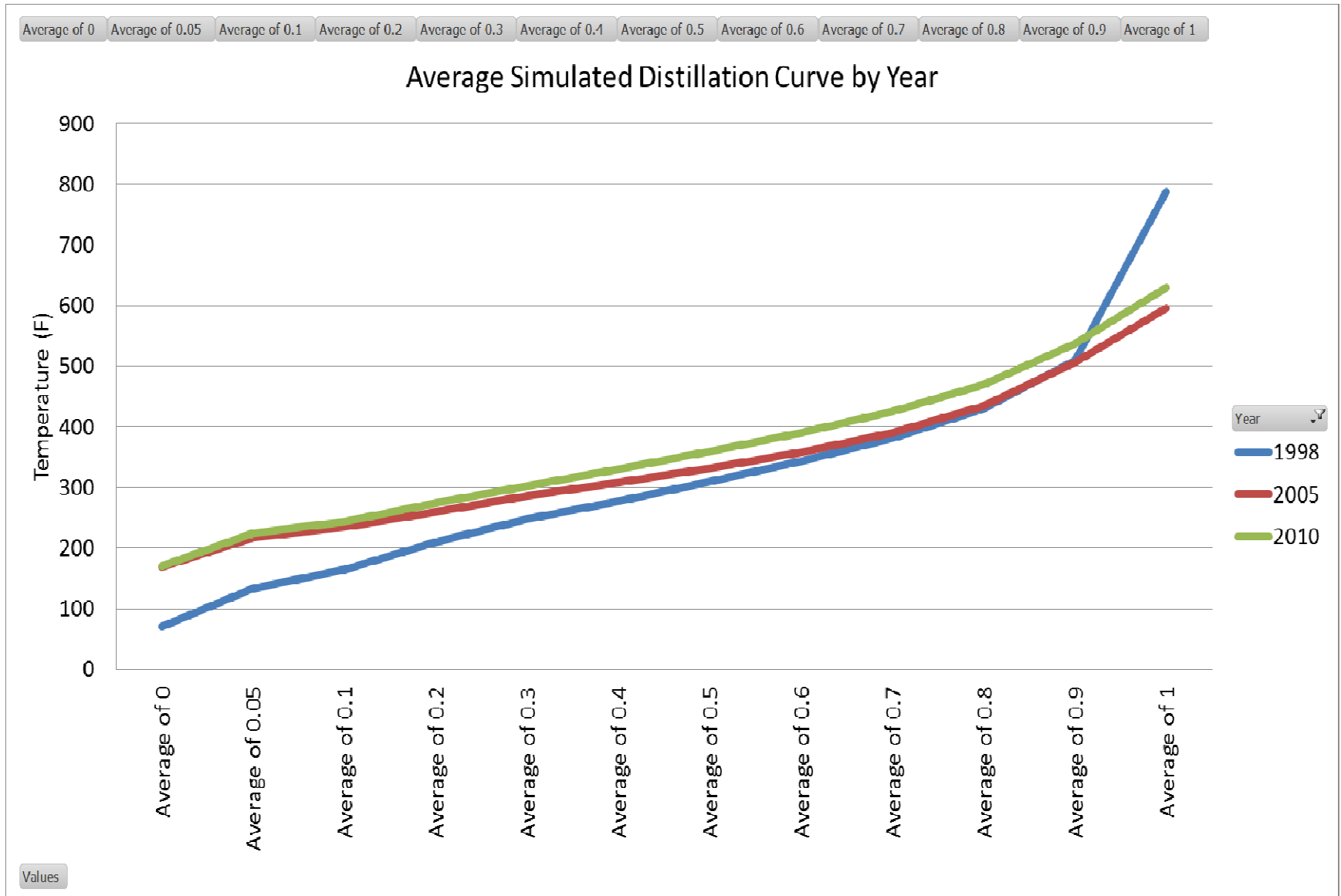
- COC Mass Balance
- COC Ratio Analysis
- Chromatogram
- Natural Losses

NAPL COMPOSITIONAL CHANGE

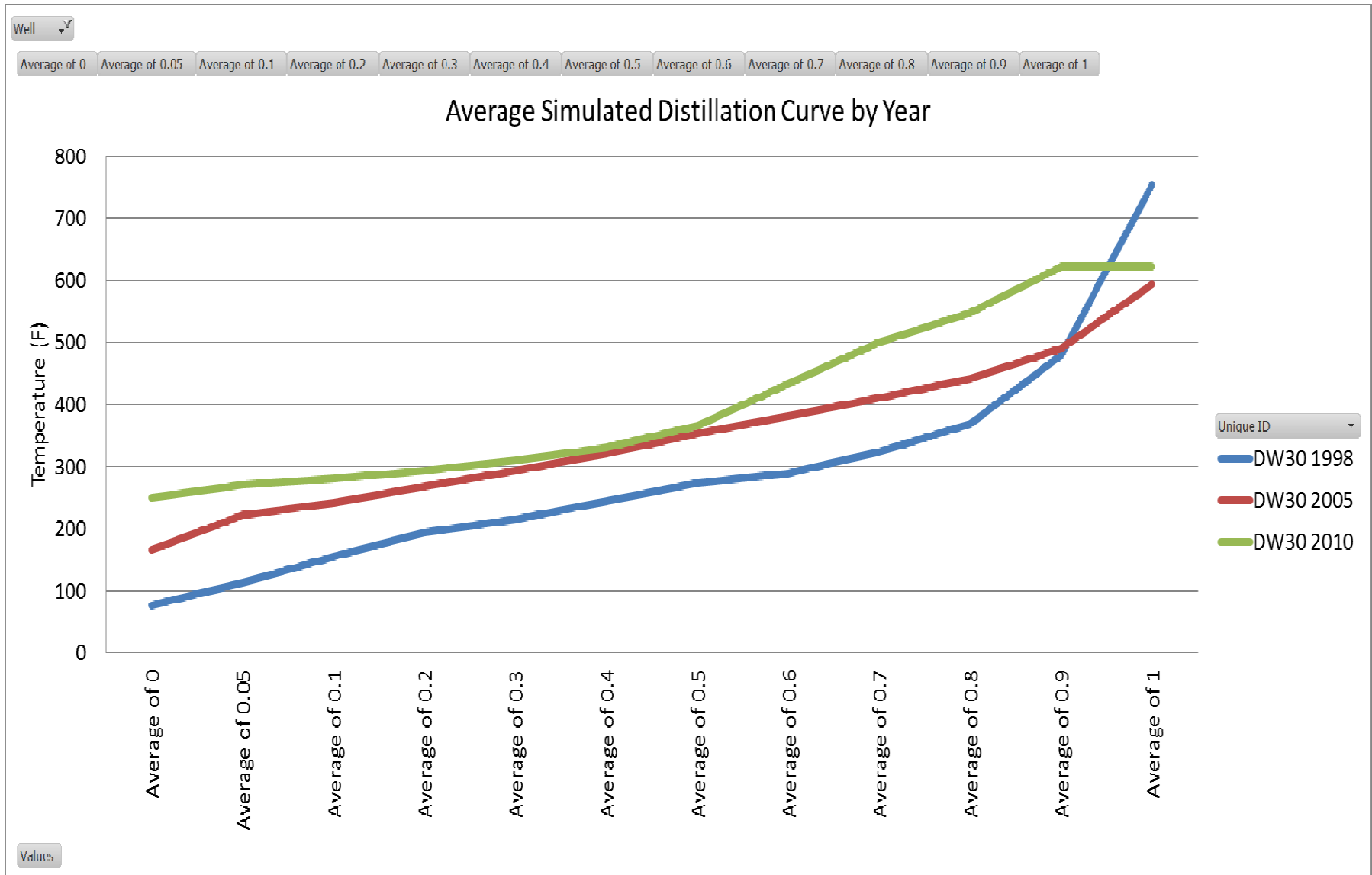
Simulated Distillation Example



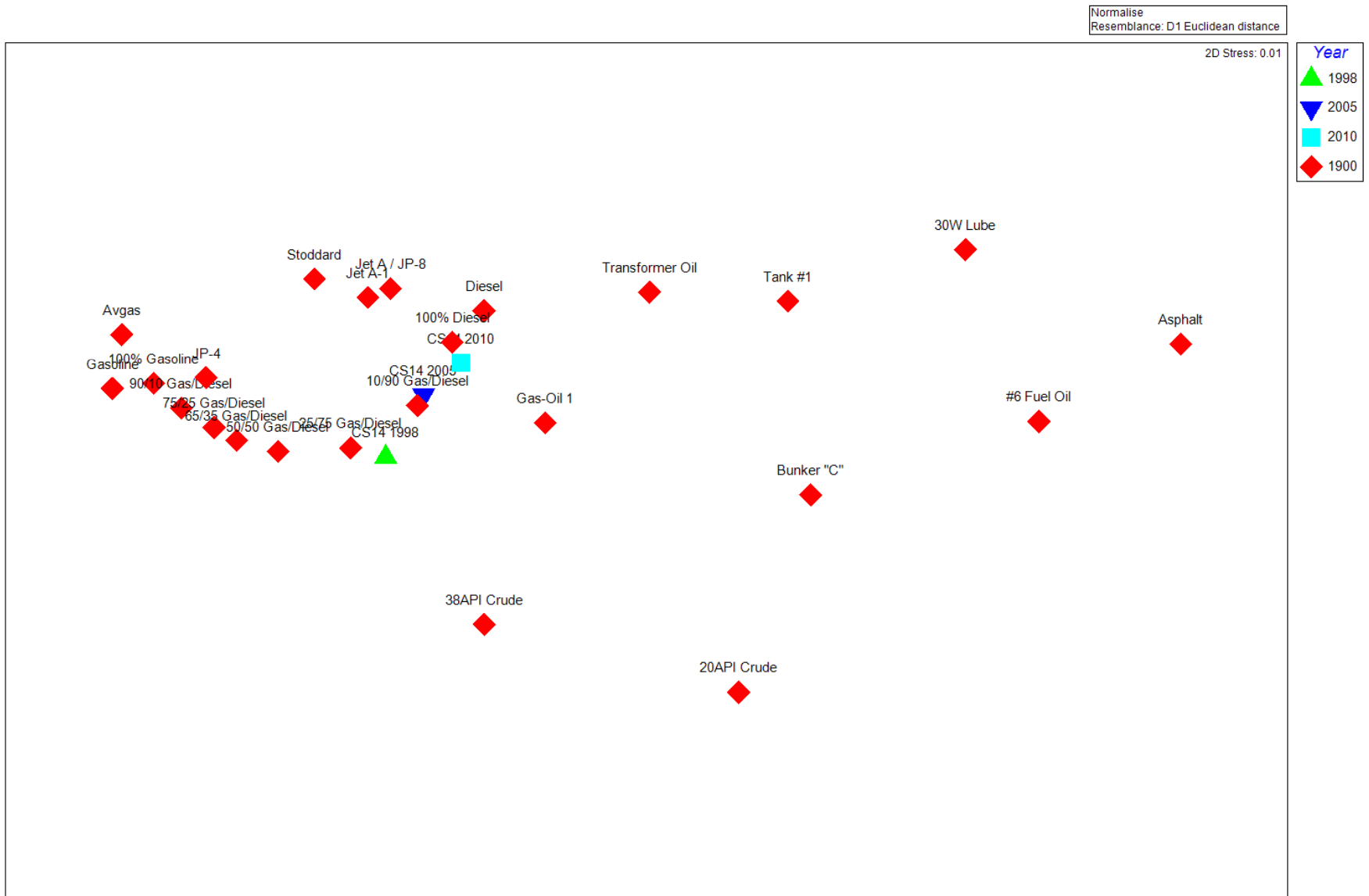
Average Site Wide Simulated Distillation Curves by Year



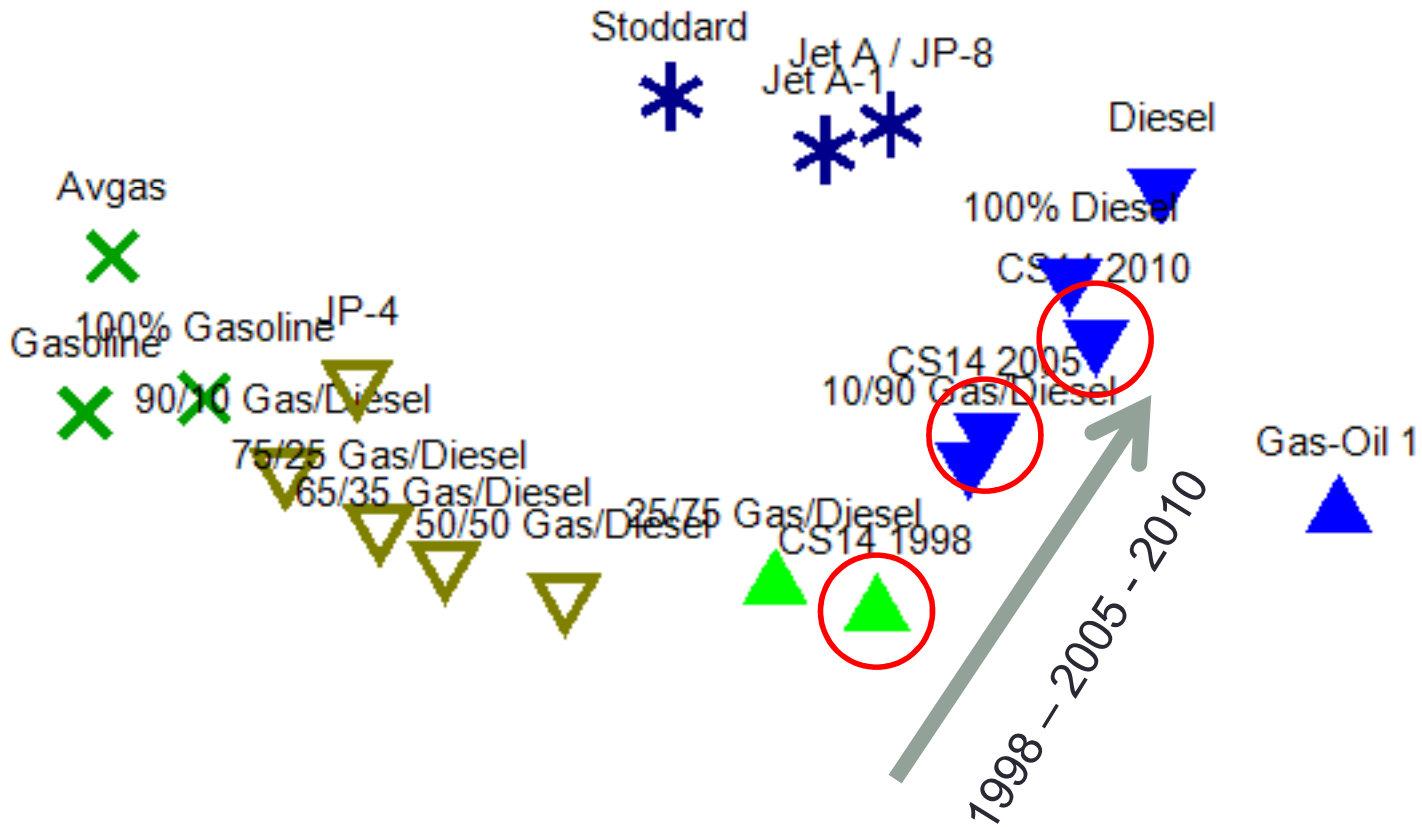
Single Well Simulated Distillation Compositional Change by Year



Single Well Simulated Distillation Compositional Change by Year



Single Well Simulated Distillation Compositional Change by Year



DISSOLVED PHASE COMPOSITIONAL CHANGE

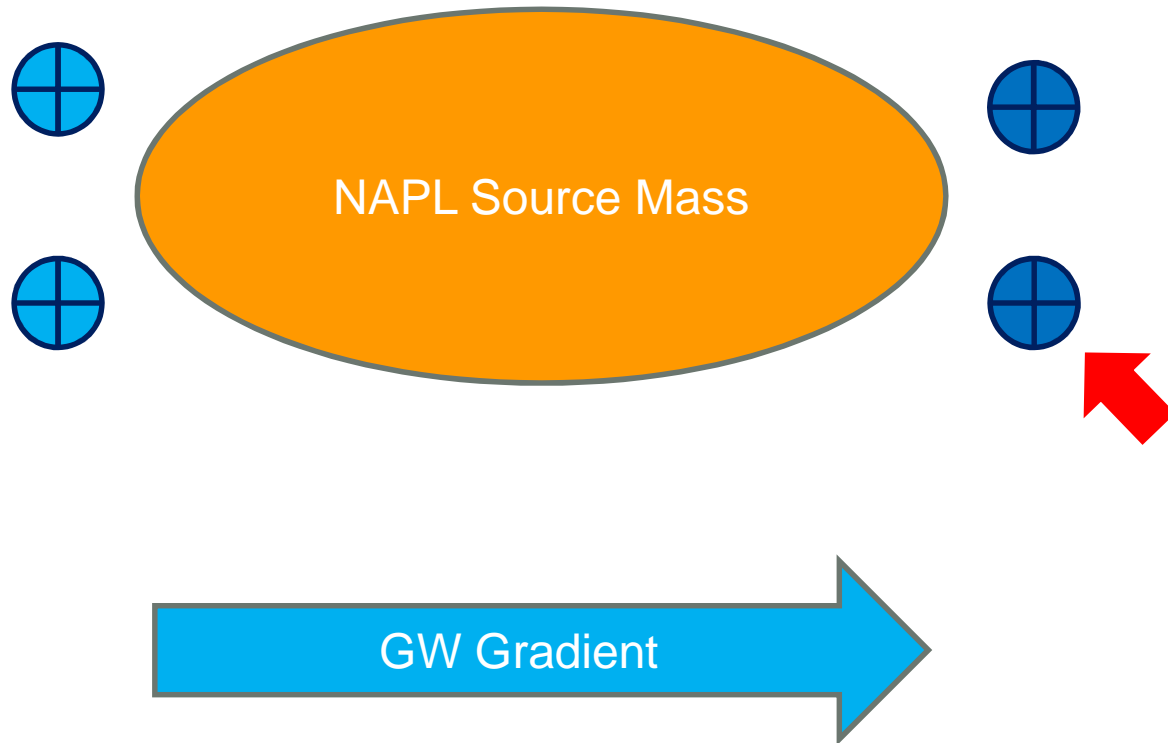
COC Ratio and Mass Balance Example



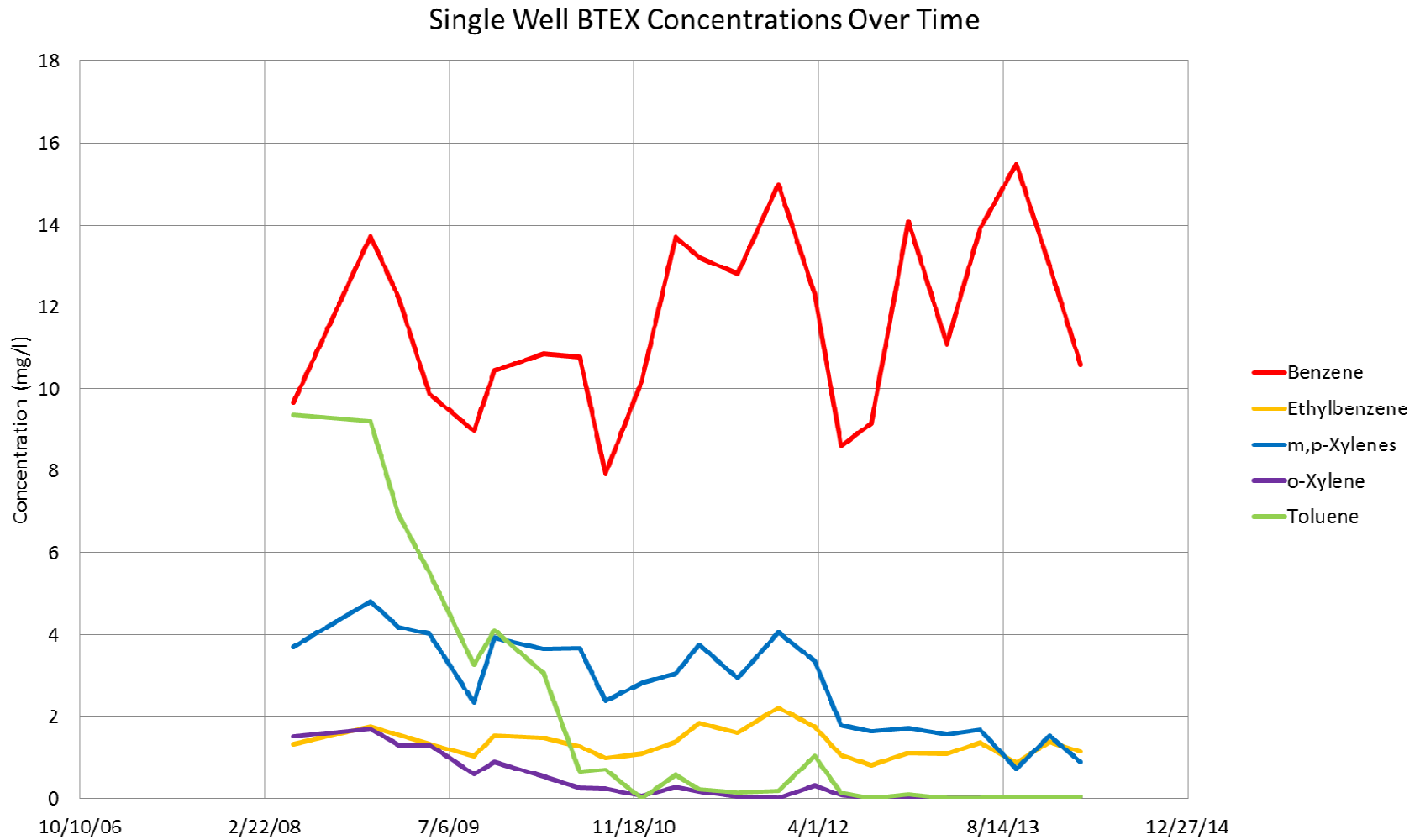
Single Well BTEX Time Series of Compositional Change

Upgradient
NSZD Wells

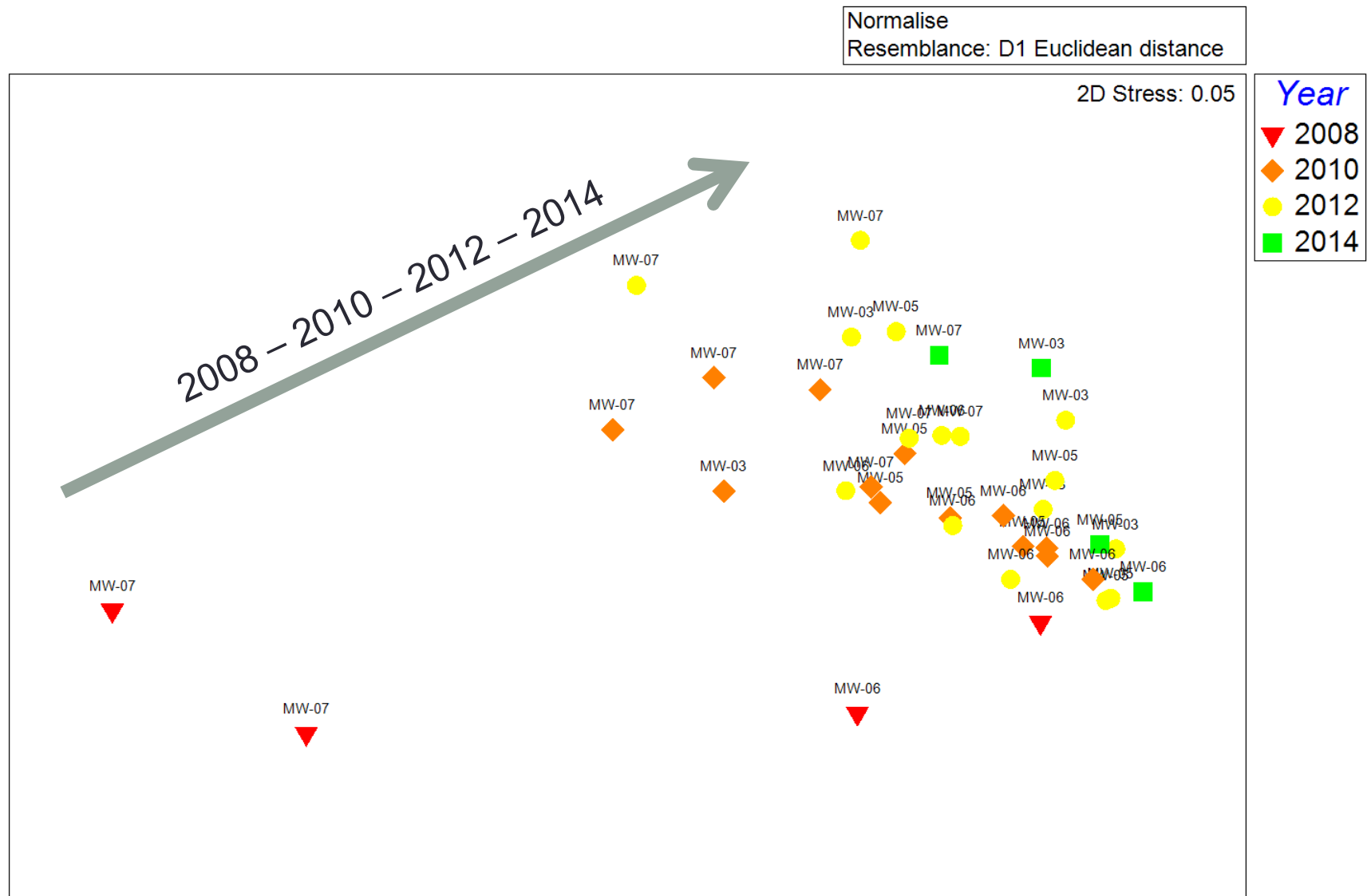
Downgradient
NSZD Wells



Single Well BTEX Time Series of Compositional Change



Site Wide Simultaneous BTEX Compositional Change - NSZD

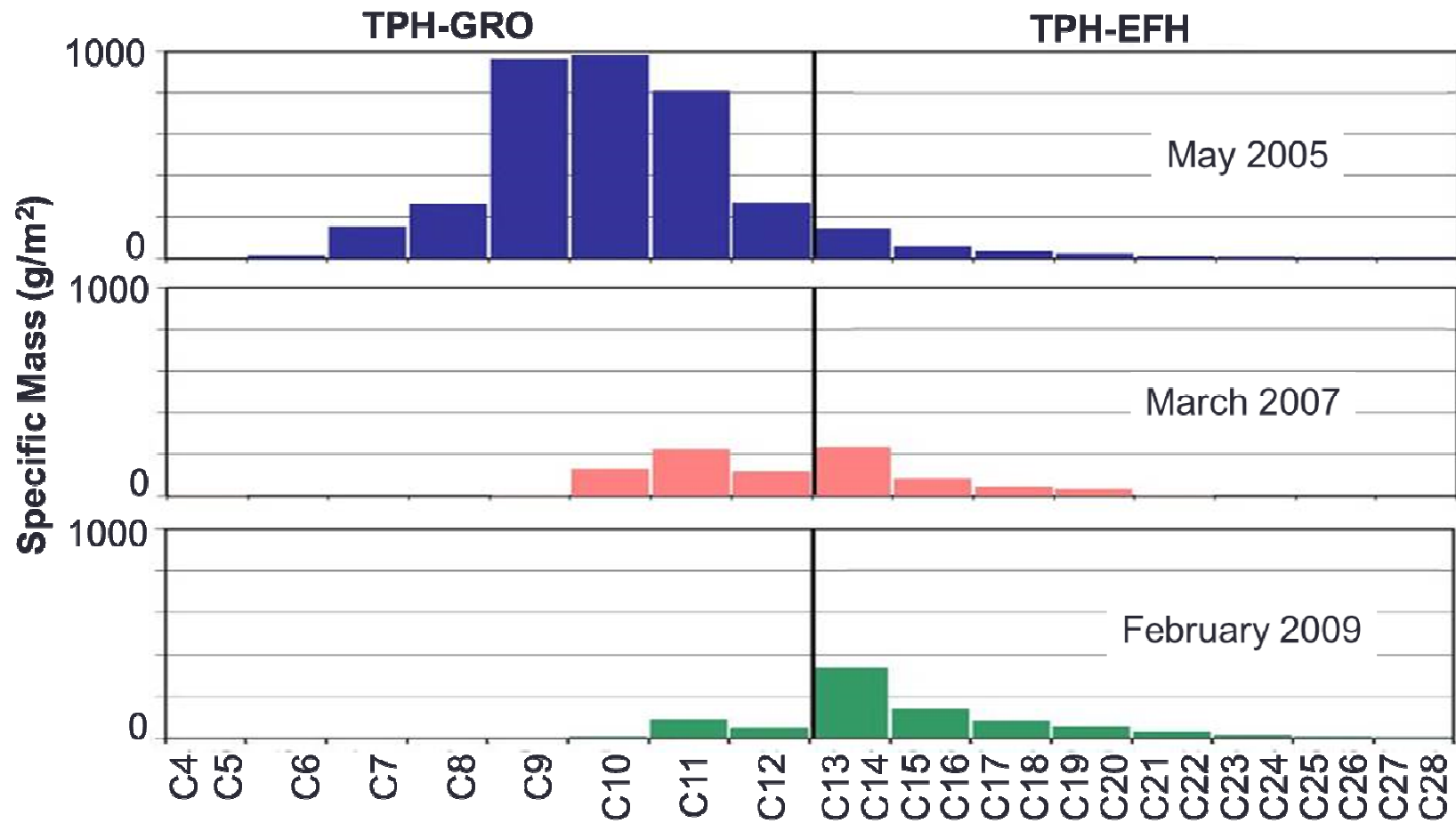


VAPOR PHASE COMPOSITIONAL CHANGE

Volatilization / SVE Example



Soil Vapor Extraction (SVE) – Composition Objective Attainment



Source: ITRC/R. Ahlers, ARCADIS

TPH Carbon Range

Source: ITRC



SUMMARY



Summary

- Comprehensive LNAPL Mgmt Planning Requires Compositional Change Metrics
 - Active Remediation (e.g., SVE, MPE)
 - NSZD
- Compositional Change Measured in Three Phases
 - NAPL Phase
 - Dissolved Phase
 - Vapor Phase
- Use Combinations
 - Time Series Plots
 - X-Y Plots
 - Advanced Numerical Analyses