Data Substitution for WRAP

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Support Tasks for State Planning

- Identify IMPROVE sites within WRAP states that have moved since baseline period (2000-2004)
- Perform data substitution
Sites That Have Moved

- WRAP IMPROVE sites that have moved:
  - Sycamore Canyon, AZ (SYCA1 > SYCA2) with no overlap, 2015
  - Zion NP, UT (ZION1 > ZICA1) with 1.5 year overlap, 2003-04
  - Haleakala NP, HI (HALE1 > HACR2) with overlap, 2007-2011
  - Tuxedni Wilderness, AK (TUXE1 > KPBO1) with no overlap and incomplete 2015
Sycamore Canyon, AZ
SYCA1 → SYCA2

- Site moved < 3 km in Oct 2015
- Daily and annual timelines suggest these two sites can be treated as one
- * The annual 2015 data for SYCA shown in the top graph is based on a combination of both sites for that year
Sycamore Canyon, AZ
Sycamore Canyon, AZ
Site moved across the inlet late in 2015

Daily and annual timelines suggest there may be more impact from OC, Soil, CM and Sea Salt at KPBO1

* The annual 2017 KPBO1 data shown in the top graph is missing 55 days of Soil and CM
Other Sites ThatMoved

Haleakala National Park

Annual Average IMPROVE Mass by Species
HALE1 and HACR1

Zion National Park

Annual Average IMPROVE Mass by Species
ZION1 and ZICA2

* indicates partial year
RHR Data Completeness Requirements

- Individual samples must contain all species required for the calculation of light extinction (ammonium sulfate, ammonium nitrate, POM, EC, soil, coarse mass, and sea salt)
- Calendar seasons must contain at least 50% of all possible daily samples
- Calendar years must contain at least 75% of all possible daily samples
- Calendar years must not contain more than 10 consecutive missing daily samples
- The 5-year baseline and each 5-year progress period averages must contain at least 3 complete years of data
Sites Not Meeting Completeness Requirements
Data Substitution

- **Data substitutions were not recommended for** sites missing more than 50% of all sample days or have no candidate donor site with reasonable correlations
- All missing data were substituted to make year complete to avoid undue bias
- Exceptions:
  - Kenai Peninsula – 55 days of coarse mass & soil
  - Mount Baldy – 6 days coarse mass & soil
  - Point Reyes – 4 of 5 years complete, no good donor
Compared mass data between donor and recipient sites over 5-year periods, centered around missing year:
- 2006-10 for sites with incomplete data for 2008
- 2009-13 for sites with incomplete data for 2011
- 2013-17 for sites with incomplete data for 2013-17

Used Kendall-Theil statistics to compare mass data from recipient and donor sites
- Annual and combined calendar quarters
- Sites within 200 km of each other
- Geographical and airshed differences taken into consideration

Summary of data substitution methods from the Baseline period:
- [http://vista.cira.colostate.edu/docs/wrap/Monitoring/TSS%20WRAP%20Data%20Substitution%20Methods%20June%20202011.doc](http://vista.cira.colostate.edu/docs/wrap/Monitoring/TSS%20WRAP%20Data%20Substitution%20Methods%20June%20202011.doc)
Ammonium Sulfate Comparison

SIAN1 (Recipient) vs. TONT1 (Donor)

AmmSO4
- Slope: 0.83, 0.77, 0.82, 0.78, 0.81
- Intercept: -0.01, 0.01, -0.01, 0.03, -0.06
- r^2: 0.90, 0.84, 0.87, 0.86, 0.88

AmmNO3
- Slope: 0.81, 0.87, 0.86, 0.72, 0.76
- Intercept: -0.02, -0.01, 0.00, 0.00, 0.01
- r^2: 0.66, 0.80, 0.62, 0.83, 0.46

EC
- Slope: 0.76, 0.72, 0.73, 0.71, 0.68
- Intercept: 0.03, 0.04, 0.02, 0.04, 0.06
- r^2: 0.04, 0.34, 0.04, 0.05, 0.05

OC
- Slope: 0.78, 0.66, 0.66, 0.84, 0.80
- Intercept: 0.15, 0.19, 0.17, 0.14, 0.18
- r^2: 0.04, 0.25, 0.06, 0.12, 0.08

SOIL
- Slope: 0.73, 0.72, 0.71, 0.58, 0.73
- Intercept: -0.01, 0.04, 0.01, 0.04, 0.00
- r^2: 0.72, 0.74, 0.61, 0.54, 0.83

CM
- Slope: 0.61, 0.56, 0.59, 0.45, 0.59
- Intercept: 0.24, 0.02, 0.83, 1.14, 0.43
- r^2: 0.65, 0.52, 0.61, 0.60, 0.84

SeaSalt
- Slope: 0.65, 0.59, 0.71, 0.55, 0.48
- Intercept: 0.00, 0.00, 0.00, 0.01, -0.01
- r^2: 0.87, 0.92, 0.87, 0.90, 0.11
Donor Site Selection

- Tonto chosen due to strong AmmSO$_4$ correlations and generally equal or better correlations among other species
- Sierra Ancha was used as donor site for Tonto during the baseline period (2000-2004)
## Selected Sites and Years

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Final Steps

- ARS provided memo containing methods discussion and donor-recipient statistics
- Following input from States, final donor sites were selected
- Data substitutions performed based on the donor-recipient regression statistics
- Data provided to Scott Copeland for review and to apply RHR2 and MID metrics
- Final data provided to CIRA and uploaded to TSS ver.2 website [http://views.cira.colostate.edu/tssv2/](http://views.cira.colostate.edu/tssv2/)