

APPENDIX L:
TIME SERIES SUMMARY TABLES

Appendix L: Time Series Summary Tables

The time series of the relative source strengths for each source solution (see Appendices J and K) have several reoccurring patterns that are summarized in the tables in this appendix. The patterns identified are: very large single events, random multiple isolated events, discrete changes, seasonal patterns, and overall increasing/decreasing. Except for the discrete changes category, each of these characteristics was quantified. The seasonality and the increasing/decreasing patterns were identified via statistical hypothesis tests described below. The relative source strength patterns are constrained to have a mean of one. Hence, the first two items can be fairly well characterized by absolute criteria, rather than statistical hypothesis tests. The “discrete change” is a subjective assessment of the time series plot.

- Very large event - A time series was flagged as having a “very large event” if the maximum was 20 or more (i.e., if the maximum source strength was 20 times its average strength).
- Multiple events - Multiple events were identified as any time series with a 98th percentile of 5 or more.
- Discrete Source Change - The discrete changes are a subjective indication that time series changed in some manner. (These generally look as if the source strength significantly dropped at some point.) If this source is a major source of sodium, then this is also noted in the tables. (See Section 5.2 for discussion.) A few of these are flagged with question marks where the change is questionable.
- Seasonal - Seasonality was identified by testing for a statistically significant difference among the means for winter (December-February), spring (March-May), summer (June-August), and fall (September-November).
- High Season - If there was significant seasonality, then the season with the highest mean is indicated in the adjoining column.
- Trend - The last column is a test for increasing/decreasing. This was tested by finding the mean concentrations for the first and last half of the sampling period and testing these for a statistically significant difference.

The discrete events or changes indicated in the first three columns of Tables L-1 and L-2 could influence the outcomes of the statistical tests used for the last three columns. Hence, those three should be considered first. Also, the climatic differences of the seasons and years could be the main reason that a source appears seasonal or increasing/decreasing. Hence, the one should not rule out identifying a source just because the time series characteristics do not match expectations. Rather these classifications should only be used to provide additional confirmation for source identification.

Table L-1. Time series summaries for the UMMIX solutions

Site	Source Number	Very Large Event	Multiple Isolated Events	Discrete Source Change	Seasonal	High Season	Increasing/Decreasing
Acadia National Park	1				x	Winter	Increasing
Acadia National Park	2				x	Winter	Decreasing
Acadia National Park	3				x	Summer	Decreasing
Acadia National Park	4				x	Winter	Decreasing
Acadia National Park	5				x	Winter	Decreasing
Acadia National Park	6				x	Summer	
Arendtsville	1		x				Decreasing
Arendtsville	2				x	Winter	
Arendtsville	3						
Arendtsville	4				x	Spring	
Arendtsville	5				x	Summer	
Arendtsville	6				x	Fall	
Boundary Waters Canoe Area	1		x				
Boundary Waters Canoe Area	2		x		x	Winter	
Boundary Waters Canoe Area	3			? (Na)	x	Winter	
Boundary Waters Canoe Area	4				x	Winter	Decreasing
Boundary Waters Canoe Area	5				x	Spring	Increasing
Boundary Waters Canoe Area	6				x	Summer	
Brigantine National Wildlife Refuge	1				x	Spring	Increasing
Brigantine National Wildlife Refuge	2				x	Winter	Decreasing
Brigantine National Wildlife Refuge	3				x	Winter	
Brigantine National Wildlife Refuge	4				x	Summer	
Brigantine National Wildlife Refuge	5				x	Summer	Increasing
Brigantine National Wildlife Refuge	6				x	Winter	Decreasing
Bondville	1		x				
Bondville	2	x	x				
Bondville	3				x	Spring	
Bondville	4						
Bondville	5						
Bondville	6						
Connecticut Hill	1	x					
Connecticut Hill	2				x	Winter	
Connecticut Hill	3		x				
Connecticut Hill	4				x	Spring	
Connecticut Hill	5				x	Spring	
Connecticut Hill	6				x	Summer	

Table L-1. Time series summaries for the UMMIX solutions (continued)

Site	Source Number	Very Large Event	Multiple Isolated Events	Discrete Source Change	Seasonal	High Season	Increasing/Decreasing
Dolly Sods Wilderness Area	1			x (Na)	x	Summer	Decreasing
Dolly Sods Wilderness Area	2		x		x	Winter	Decreasing
Dolly Sods Wilderness Area	3				x	Summer	
Dolly Sods Wilderness Area	4				x	Winter	
Dolly Sods Wilderness Area	5				x	Winter	
Dolly Sods Wilderness Area	6				x	Summer	
Great Smoky Mountains National Park	1			x (Na)	x	Summer	Increasing
Great Smoky Mountains National Park	2				x	Winter	Decreasing
Great Smoky Mountains National Park	3	x			x	Summer	
Great Smoky Mountains National Park	4				x	Spring	Increasing
Great Smoky Mountains National Park	5				x	Summer	
Great Smoky Mountains National Park	6				x	Summer	Decreasing
James River Face Wilderness Area	1			x (Na)	x	Summer	Decreasing
James River Face Wilderness Area	2		x		x	Winter	Decreasing
James River Face Wilderness Area	3				x	Spring	Decreasing
James River Face Wilderness Area	4						Decreasing
James River Face Wilderness Area	5						
James River Face Wilderness Area	6				x	Summer	Increasing
Livonia	1	x	x				
Livonia	2				x	Winter	
Livonia	3						Increasing
Livonia	4				x	Summer	Decreasing
Livonia	5				x	Summer	
Livonia	6				x	Winter	Increasing
Lye Brook Wilderness Area	1						
Lye Brook Wilderness Area	2			?			
Lye Brook Wilderness Area	3	x	x				
Lye Brook Wilderness Area	4				x	Spring	Increasing
Lye Brook Wilderness Area	5				x	Winter	
Lye Brook Wilderness Area	6				x	Summer	
Mammoth Cave National Park	1		x		x	Winter	Decreasing
Mammoth Cave National Park	2			x (Na)	x	Summer	Decreasing
Mammoth Cave National Park	3				x	Winter	Decreasing
Mammoth Cave National Park	4				x	Summer	Increasing
Mammoth Cave National Park	5	x			x	Winter	Decreasing
Mammoth Cave National Park	6				x	Summer	Increasing

Table L-1. Time series summaries for the UMMIX solutions (continued)

Site	Source Number	Very Large Event	Multiple Isolated Events	Discrete Source Change	Seasonal	High Season	Increasing/Decreasing
M.K. Goddard	1		x				
M.K. Goddard	2				x	Summer	
M.K. Goddard	3	x					
M.K. Goddard	4						
M.K. Goddard	5				x	Winter	
M.K. Goddard	6				x	Winter	Increasing
Quaker City	1		x				
Quaker City	2		x		x	Fall	
Quaker City	3		x				
Quaker City	4		x				
Quaker City	5				x	Summer	
Quaker City	6						Increasing
Shenandoah National Park	1			x (Na)	x	Summer	Increasing
Shenandoah National Park	2	x	x				Decreasing
Shenandoah National Park	3				x	Winter	
Shenandoah National Park	4				x	Summer	
Shenandoah National Park	5				x	Summer	
Shenandoah National Park	6				x	Spring	Decreasing
Washington D.C.	1				x	Winter	Decreasing
Washington D.C.	2			x (Na)	x	Summer	Increasing
Washington D.C.	3	x					
Washington D.C.	4	x					Decreasing
Washington D.C.	5				x	Summer	
Washington D.C.	6				x	Winter	

Table L-2. Time series summaries for the PMF solutions

Site	Source Number	Very Large Event	Multiple Isolated Events	Discrete Source Change	Seasonal	High Season	Increasing/Decreasing
Acadia National Park	1				x	Spring	Increasing
Acadia National Park	2				x	Winter	Decreasing
Acadia National Park	3				x	Winter	Increasing
Acadia National Park	4	x			x	Spring	Increasing
Acadia National Park	5				x	Summer	Decreasing
Acadia National Park	6				x	Summer	Decreasing
Acadia National Park	7				x	Winter	
Acadia National Park	8				x	Winter	Decreasing
Acadia National Park	9						Decreasing
Arendtsville	1				x	Summer	Decreasing
Arendtsville	2				x	Fall	
Arendtsville	3				x	Summer	Decreasing
Arendtsville	4				x	Spring	
Arendtsville	5				x	Winter	
Arendtsville	6				x	Winter	Decreasing
Arendtsville	7				x	Fall	Decreasing
Arendtsville	8				x	Summer	
Arendtsville	9				x	Summer	
Boundary Waters Canoe Area	1						
Boundary Waters Canoe Area	2	x			x	Spring	Increasing
Boundary Waters Canoe Area	3				x	Winter	Decreasing
Boundary Waters Canoe Area	4				x	Summer	
Boundary Waters Canoe Area	5						
Boundary Waters Canoe Area	6				x	Spring	Increasing
Boundary Waters Canoe Area	7				x	Spring	Decreasing
Boundary Waters Canoe Area	8				x	Winter	
Boundary Waters Canoe Area	9						Increasing
Brigantine National Wildlife Refuge	1			x	x	Winter	
Brigantine National Wildlife Refuge	2				x	Winter	Decreasing
Brigantine National Wildlife Refuge	3				x	Winter	
Brigantine National Wildlife Refuge	4				x	Winter	Decreasing
Brigantine National Wildlife Refuge	5						Increasing
Brigantine National Wildlife Refuge	6				x	Winter	
Brigantine National Wildlife Refuge	7				x	Summer	Decreasing
Brigantine National Wildlife Refuge	8				x	Winter	
Brigantine National Wildlife Refuge	9				x	Summer	

Table L-2. Time series summaries for the PMF solutions (continued)

Site	Source Number	Very Large Event	Multiple Isolated Events	Discrete Source Change	Seasonal	High Season	Increasing/Decreasing
Bondville	1				x	Fall	
Bondville	2						
Bondville	3				x	Summer	
Bondville	4				x	Spring	
Bondville	5						
Bondville	6				x	Summer	
Bondville	7						Decreasing
Bondville	8		x				
Bondville	9						Decreasing
Connecticut Hill	1				x	Summer	
Connecticut Hill	2						
Connecticut Hill	3				x	Summer	
Connecticut Hill	4				x	Winter	
Connecticut Hill	5				x	Summer	
Connecticut Hill	6						
Connecticut Hill	7				x	Summer	
Connecticut Hill	8				x	Fall	
Connecticut Hill	9				x	Spring	
Dolly Sods Wilderness Area	1				x	Summer	Increasing
Dolly Sods Wilderness Area	2				x	Summer	
Dolly Sods Wilderness Area	3						
Dolly Sods Wilderness Area	4				x	Summer	Decreasing
Dolly Sods Wilderness Area	5				x	Spring	Increasing
Dolly Sods Wilderness Area	6			x (Na)	x	Summer	Decreasing
Dolly Sods Wilderness Area	7				x	Summer	Decreasing
Dolly Sods Wilderness Area	8						
Dolly Sods Wilderness Area	9				x	Summer	Increasing
Great Smoky Mountains National Park	1				x	Summer	Increasing
Great Smoky Mountains National Park	2				x	Summer	
Great Smoky Mountains National Park	3				x	Summer	
Great Smoky Mountains National Park	4						Decreasing
Great Smoky Mountains National Park	5				x	Summer	
Great Smoky Mountains National Park	6				x	Summer	
Great Smoky Mountains National Park	7			x (Na)	x	Summer	Increasing
Great Smoky Mountains National Park	8				x	Spring	
Great Smoky Mountains National Park	9				x	Spring	Increasing

Table L-2. Time series summaries for the PMF solutions (continued)

Site	Source Number	Very Large Event	Multiple Isolated Events	Discrete Source Change	Seasonal	High Season	Increasing/Decreasing
James River Face Wilderness Area	1						Increasing
James River Face Wilderness Area	2				x	Summer	
James River Face Wilderness Area	3			x	x	Winter	Decreasing
James River Face Wilderness Area	4				x	Spring	Decreasing
James River Face Wilderness Area	5				x	Winter	
James River Face Wilderness Area	6						Decreasing
James River Face Wilderness Area	7				x	Winter	Decreasing
James River Face Wilderness Area	8						
James River Face Wilderness Area	9	x					Decreasing
Livonia	1				x	Winter	
Livonia	2				x	Winter	Increasing
Livonia	3				x	Summer	
Livonia	4						
Livonia	5				x	Summer	
Livonia	6				x	Spring	Increasing
Livonia	7				x	Summer	
Livonia	8						
Livonia	9		x				Increasing
Lye Brook Wilderness Area	1				x	Winter	Increasing
Lye Brook Wilderness Area	2				x	Winter	Decreasing
Lye Brook Wilderness Area	3				x	Spring	Increasing
Lye Brook Wilderness Area	4				x	Winter	Increasing
Lye Brook Wilderness Area	5				x	Summer	Increasing
Lye Brook Wilderness Area	6				x	Summer	
Lye Brook Wilderness Area	7	x			x	Spring	Decreasing
Lye Brook Wilderness Area	8						
Lye Brook Wilderness Area	9				x	Spring	Increasing
Mammoth Cave National Park	1				x	Summer	
Mammoth Cave National Park	2				x	Winter	Decreasing
Mammoth Cave National Park	3				x	Winter	
Mammoth Cave National Park	4				x	Spring	Increasing
Mammoth Cave National Park	5				x	Summer	Decreasing
Mammoth Cave National Park	6				x	Spring	
Mammoth Cave National Park	7				x	Winter	Increasing
Mammoth Cave National Park	8				x	Summer	
Mammoth Cave National Park	9			?	x	Winter	Increasing

Table L-2. Time series summaries for the PMF solutions (continued)

Site	Source Number	Very Large Event	Multiple Isolated Events	Discrete Source Change	Seasonal	High Season	Increasing/Decreasing
M.K. Goddard	1						
M.K. Goddard	2				x	Fall	
M.K. Goddard	3						
M.K. Goddard	4				x	Summer	
M.K. Goddard	5				x	Winter	Increasing
M.K. Goddard	6				x	Summer	Increasing
M.K. Goddard	7				x	Summer	
M.K. Goddard	8			x			Increasing
M.K. Goddard	9						
Quaker City	1						Decreasing
Quaker City	2						
Quaker City	3				x	Summer	
Quaker City	4				x	Summer	
Quaker City	5				x	Winter	Increasing
Quaker City	6						
Quaker City	7				x	Winter	
Quaker City	8		x				
Quaker City	9				x	Summer	
Shenandoah National Park	1				x	Summer	
Shenandoah National Park	2			x (Na)	x	Summer	Increasing
Shenandoah National Park	3		x		x	Spring	Increasing
Shenandoah National Park	4				x	Summer	Decreasing
Shenandoah National Park	5				x	Spring	Increasing
Shenandoah National Park	6						Increasing
Shenandoah National Park	7				x	Summer	Decreasing
Shenandoah National Park	8				x	Summer	Increasing
Shenandoah National Park	9				x	Spring	Decreasing
Washington D.C.	1	x	x		x	Winter	Decreasing
Washington D.C.	2				x	Winter	Decreasing
Washington D.C.	3	x			x	Summer	Decreasing
Washington D.C.	4				x	Summer	Decreasing
Washington D.C.	5				x	Fall	
Washington D.C.	6				x	Winter	Increasing
Washington D.C.	7				x	Winter	Decreasing
Washington D.C.	8				x	Summer	Decreasing
Washington D.C.	9				x	Summer	