APPENDIX A: CREATION OF HISTORICAL SALINITY OBSERVATIONS DATABASE

Purpose:

Create a database in MS Access format that contains historical salinity observations information for the stations located in San Francisco Bay and the Sacramento – San Joaquin Delta from October 1921 to June 1971.

Process:

The overall workflow is shown in Figure 1, and individual steps are presented below.

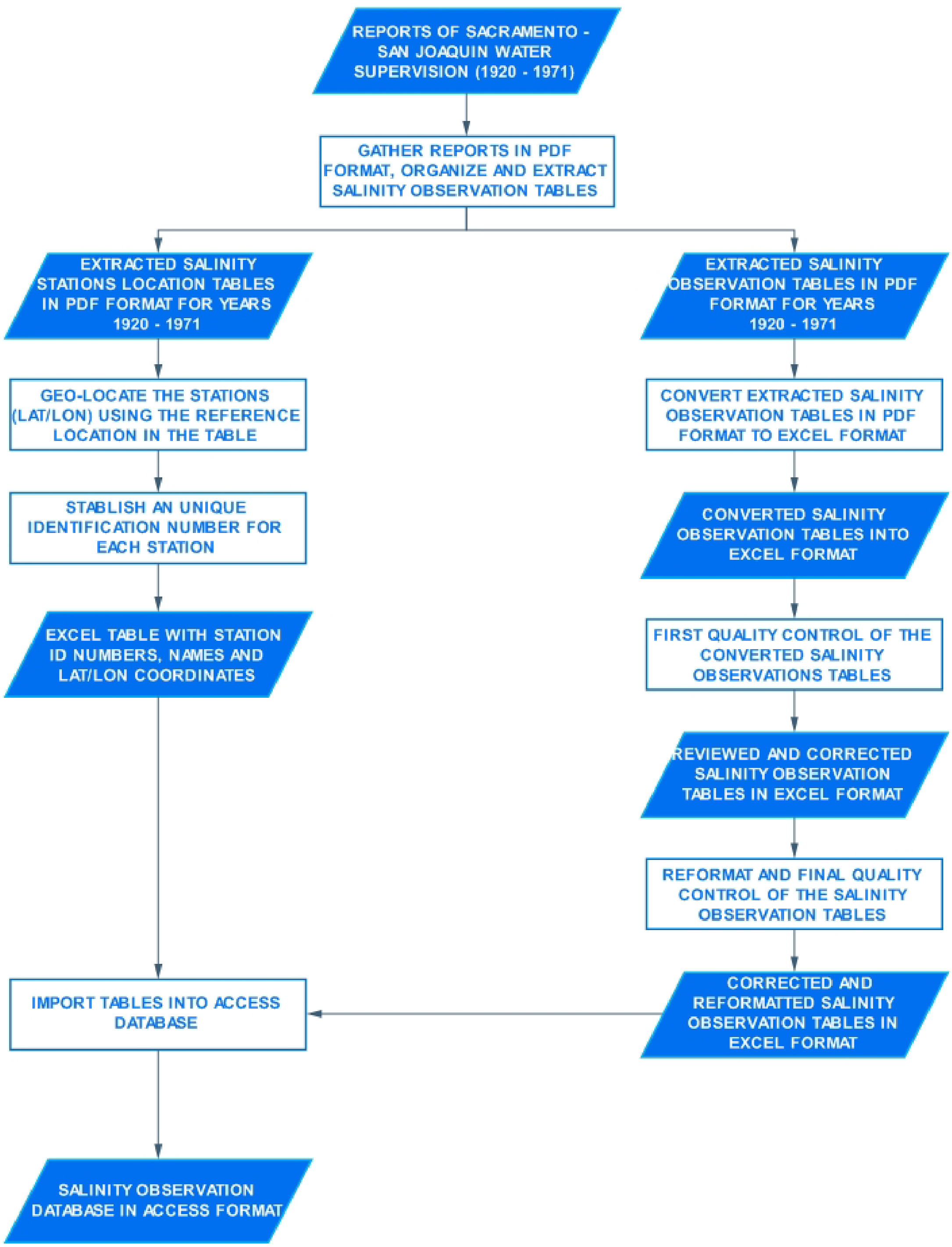
1. Bulletins with historical data were obtained from two sources:

SOURCE	REPORT	YEARS
Department of Water Resource of California website (www.water.ca.gov/waterdatalibrary/docs/historic/)	Bulletin 23	1929–1961
Paul Hutton	Bulletin 27	1920–1931
Paul Hutton	Bulletin 65	1962
Paul Hutton	Bulletin 130	1963–Sept. 1969
Paul Hutton	Bulletin 130	Oct. 1970–Jun. 1971
Department of Water Resource of California website (www.water.ca.gov/waterdatalibrary/docs/historic/)	Bulletin 130	October 1969-Jun. 1970

All the bulletins were scanned documents in PDF format.

2. Tables relating to the salinity observations were extracted from these bulletins. The salinity report tables had 6 different formats (below). The tables were organized by table format for transcription.

WATER SALINITY OBSERVATIONS DATABASE WORKFLOW
(Figure 1)



Format 01

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TABLE 33

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER SAN FRANCISCO BAY, 1920

Samples taken in surface zone usually about two hours after high tide

Month	Station	Salinity in parts of chlorine per 100,000 parts of water — Day of month: 2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	Carquinez Strait															
April	Vallejo Junction[1]					480			420			*240				570
	Benicia[1]					180			530			*120				300
	Martinez[1]					230					30					250
May	Vallejo Junction[1]				150				400			330			*390	
	Benicia[1]				300		400				*420					120
	Martinez[1]					120					150					160
	Carquinez Strait and Suisun Bay															
June	Vallejo Junction[1]	*750				*490				*850			*750			
	Benicia[1]	*450				*410				*500		48)				610
	Martinez[1]					240					420					610
	O. and A. Ferry	5	*4					11	*14			26		37	*71	
	O. and A. Bridge								5	8	11	6	26	34	37	38
	Sacramento River Delta															
	Collinsville	4	5	*4	4	4			*4		4	*5	*5		7	*10
	Emmaton		4	4	†2		*†3	*3		*5	6			3	6	*4
	Three Mile Slough Ferry	4	5	4	*5	*†4		3	7	*4		*5	4	4	*4	3
	San Joaquin River Delta															
	Antioch	*4	*4	*6	*5	*5		3	3	4	*5	6	5	*7	10	
	Sherman Island Ferry	6	6	4	*5	5	5	4	4	4	6	6	*3	5	4	4
	Jersey	5			7		5	†5	*3							
	East Contra Costa Irrigation Company[2]	*2	*2	*2		2				2	*2		2	2	*3	*3
	Carquinez Strait and Suisun Bay															
July	Vallejo Junction[1]	1,200				*1,100				1,400		*1,450				1,500
	Benicia[1]					950					*1,050					1,260
	Martinez[1]		590			920		920			1,030		1,200			1,210
	O. and A. Ferry	74	*79		127			302	*326		324	*418		†434	*507	
	O. and A. Bridge	46	47	49	73	95	93	94	142	157	218	204	314	351	336	†352

Format 02

TABLE 83

SALINITY OBSERVATIONS, SACRAMENTO-SAN JOAQUIN DELTA AND UPPER BAYS

Samples taken by local observers approximately one and one-half hours after high high tide

Salinity expressed in parts of chlorine per 100,000 parts of water

1938

Station	JANUARY: 2	6	10	14	18	22	26	30
San Francisco, San Pablo and Suisun Bays								
Point Orient	1140	940	1200	1380	1260	1180	1280	1140
Point Davis				1020	880	:a 360		610
Bullshead Point	:a 90		:a 160	:ab 430	:a 148	:a 21	:ab 340	190
Bay Point							16	17
O and A Ferry	2	:a 2	9	8	7	2		3
Innisfail Ferry	30	52	42	66	62	78	72	46
Sacramento River Delta								
Collinsville	2	3	2	4	:a 2		3	:d 4
Emmaton		:a 2		2	:a 2	2		1
Sacramento	:a 1	2	1	:ab 1	:a 1	1	:ab 1	:ab 1
San Joaquin River Delta								
Antioch	3	2	2	5	4	3	2	3
Webb Pump	3	5		3	:a 3	:abd 4		:ab 4
Opposite Central Landing	2	:a 1	2	2	:a 1	1	3	1
Dutch Slough	6	4	5	4	7	4	5	5
Rindge Pump	:ad 3		:d 4	:ab 5	:a 5	:a 4	3	3
Rock Slough West of Dam	:a 5	6	6	6	:a 6	6	7	7
Rock Slough East of Dam	:a 3	3	5	4	:a 5	4	5	3
Middle River P.O.			2		:a 4			
Mossdale Bridge	2	3	4	2	3	4	4	5

Format 03

TABLE 138

MISCELLANEOUS SALINITY OBSERVATIONS 1942
SACRAMENTO-SAN JOAQUIN DELTA
Chlorides in parts per 100,000 parts of water

Samples taken by Fontana Farms Company			
		Montezuma Slough	
Date	Sacramento River (1)	Ferry (2)	Meins Landing (3)
1942			
Jan. 14	6	15	26
23	5	18	45
Feb. 6	4	6	
12	4	9	10
24	5	15	16
Mar. 11	4	13	35
Apr. 8	5	9	14
24	5	7	8
May 16	4	6	
June 1	4	6	
29	4	6	
July 6 L.L.W.		7	
18 L.H.	4	10	
25	6	17	
Aug. 6		66	
8		72	
11		92	
21		137	
27 L.L.W.	98		
Sept. 4 L.H.	190	260	
15	171	420	
Oct. 22	85	344	
Nov. 5	39	288	
15	83	293	
18	64	278	
20	10	145	
Dec. 2	8	101	249
8	7		
15	6	179	
29		14	
31	3	14	63

NOTE: Except as noted all samples taken 1½ hours after H.H. tide.
(1) Samples taken at tide gate 1700' west of Collinsville gage.
(2) Samples taken at Roaring River Ferry.
(3) Samples taken at Meins Landing.

TABLE 138

MISCELLANEOUS SALINITY OBSERVATIONS 1943
SACRAMENTO-SAN JOAQUIN DELTA
Chlorides in parts per 100,000 parts of water

Samples taken by Fontana Farms Company			
		Montezuma Slough	
Date	Sacramento River (1)	Ferry (2)	Meins Landing (3)
1943			
Jan. 1	3	14	62
Feb. 1	2	9	11
13	2	9	11
Mar. 1	2	9	11
Apr. 2	3	9	9
May 3	2	4	
20	2	7	
June 2	3	7	
20	2	11	
24	2	12	
July 2	4 LLW	5	
8	6 LLW	6	
18		64	
27	60		
Aug. 1	102		
17	311	320	
23	241	397	427
Sep. 10	340 Est.		
21	220	572	
Oct. 7	151	358	
19	95	277	
Nov. 6	58	428	
20	78	342	
27	74	356	
Dec. 10	23 LLW	35	
10	104	285	364
20	86	301	
23	77	277	
27	109	326	550
30	46 LH		
30	57 HH		
31	49 LH		

NOTE: Except as noted all samples taken 1½ hours after H.H. tide.
(1) Samples taken at tide gate 1700' west of Collinsville gage.
(2) Samples taken at Roaring River Ferry.
(3) Samples taken at Meins Landing.

Format 04

TABLE 133 (CONTINUED)

MISCELLANEOUS SALINITY OBSERVATIONS 1942

Samples taken by City of Antioch												
San Joaquin River at Water Works Wharf												
Chlorides in parts per 100,000 parts of water												
Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2	3	2	3	3	2	1	2	19	100	46		4
6	3	3	3	3	2	1	2	32	85	38	21	4
10	3	2	2	3	2	1	2	40	104	45		5
14	3	2	3	2	2	1	2	76	140	22		5
18	3	3	3	2	2	1	2	116	140	22		5
22	3	3	3	2	1	1	5	85	85	34		5
26	3	3	3	2	2	1	10	104	92	29	5	4
30	2		3	2	1	1	22	174	56	15	4	3

NOTE: All samples taken 2 hours after High tide.

Format 05

TABLE 133 (CONTINUED)

SALINITY OBSERVATIONS SACRAMENTO-SAN JOAQUIN DELTA - 1942
Samples taken by U. S. Bureau of Reclamation (1)
Chlorides in parts per million parts of water

	S. J. River at Garwood Br.	Stockton Ship Channel at Rindge Pump	Mokelumne R. at Central Landing	Sacramento R. opposite Snodgrass Sl.	S.F. Mokelumne near Hog Slough	Sacramento R. at Collinsville	Sacramento at Sacramento	Sacramento at Emmaton	Sacramento at Antioch	False River at Webb Pump	Dutch Slough at Bethel Is. Br.	Rock Sl. East of Dam in Rock Sl.	Sand Mound Sl. north of dam	Stockton Ship channel at lower end of Pt. Stockton Wharves	Middle River at Santa Fe RR Crossing	Sacramento at Freeport Br.	S. J. River at Mossdale Br.
Station No.	59a	59c	59h	59n	59s	59u	70	80	81	82	83	84	85	86	87	88	58
1-5-42	22	30	7.3	7.3	15	14	6.4	11	30	36	55	60	78	87	38	5.5	19
2-4-42	16	15	5.9	1.3	10	11	0.7	5.2	24	31	57	69	96	31	41	0.7	16
3-9-42	25	31	9.0	9.1	26	17	5.3	14	23	29	39	40	59	33	32	8.3	29
4-7-42	37	36	3.9	5.0	5.6	10	4.2	9.8	22	33	36	46	48	46	43	6.1	32
5-6-42	14	15	4.5	3.7	2	8.9	4.5	9.3	13	14	16	24	23	20	15	3.6	15
6-4-42	9.1	11	3.7	4.5	6.9	6.6	3.9	7.3	9.5	9.6	10	11	12	32	11	3.4	9.1
7-3-42	17	16	11	17	3.2	12	8.3		12	13	12	11	12	18	13	7.5	13
8-17-42	100	85	32	30	70	1300	25	110	600	30	43	52	46	120	56	28	90
9-15-42	71	93	42	29		1200	24	110	820	58	78	88	88	84	91	35	68
10-14-42	58	77	23	18		370	15	37	230	56	73	80	81	81	77	17	56
11-12-42	83	76		7.4		290	7.8	25	220	43	60	67	67	92	65	7.8	80
12-7-42				7.5			8.1					82	82				38

(1) Samples not always taken at High Tide.

Format 06

190

TABLE 138 (CONTINUED)

SALINITY OBSERVATIONS SACRAMENTO-SAN JOAQUIN DELTA - 1943
Samples taken by U.S. Bureau of Reclamation (1)
Chlorides in parts per million parts of water

1943	San Joaquin R. at Mossdale Br.	French Camp Slough South of Stockton	Stockton Ship Channel at Burns Cut-off	Rock Slough at Contra Costa Canal Intake	Indian Slough at East Contra Costa I.D. Intake	San Joaquin R. at Brandt Bridge	Rock Slough east of Dam in Rock Slough	Sand Mound Slough at Junction of Rock Slough	Old River at Clifton Ferry	San Joaquin R. at Antioch	Suisun Bay at Benicia	Sacramento River at Collinsville	Sacramento River opposite Snodgrass Slough	Sacramento River at Freeport Bridge	Sacramento River at Sacramento	Mokelumne River at Woodbridge
Station No.	58	59b	59c	59f	59f3	59w	84	85	59b	81	167	59u	59n	88	70	63
January Chlorides	7th 31	2nd 36	7th 35	6th 61	6th 130	7th 30	6th 15	6th 61		6th 25	15th 3200	6th 37	6th 3.9	6th 3.9	6th 7.6	2nd 1.1
February Chlorides		10th 19	10th 15	9th 79	9th 130	10th 12	9th 59	9th 71		9th 21	3rd 25	9th 13	10th 6.4	10th 6.2	10th 4.8	8th 1.7
March Chlorides	8th 7.8	8th 5.8	15th 9.7	5th 52	5th 130	8th 7.4	5th 55	5th 52		5th 23	10th 40	5th 13	6th 4.8	6th 4.9	6th 6.5	4th 1.1
April Chlorides	6th 11	8th 44	8th 13	6th 40	6th 130	8th 12	6th 30	6th 30		6th 15	7th 500	6th 64	6th 4.1	6th 3.5	6th 3.0	5th 1.8
May Chlorides	10th 9.1	10th 27	10th 11	8th 20	25	10th 9.6	8th 15	8th 15		10th 11	12th 53	8th 10	8th 4.3	8th 3.9	8th 3.9	6th 1.2
June Chlorides	2nd 6.2	15th 19	2nd 7.1	4th 19	4th 11	2nd 6.8	4th 26	4th 15		4th 17	3rd 260	4th 61	3rd 4.1	3rd 5.5	3rd 7.8	2nd 1.2
July Chlorides	3rd 71	3rd 20	3rd 50	2nd 27	2nd 27	3rd 67	2nd 26	2nd 27		2nd 41	15th 7800	2nd 33	2nd 14	2nd 20	5th 17	3rd 1.4
August Chlorides	5th 93	5th 41	5th 98	3rd 62	3rd 93	5th 86	3rd 63	3rd 63		3rd 530	7th 9700	3rd 1400	6th 35	6th 31	6th 31	2nd 1.4
September Chlorides	7th 81	7th 68	7th 100	8th 85	8th 100	7th 91	8th 86	8th 91		8th 1700		8th 2800	7th 44	7th 51	7th 46	6th 2.4
October Chlorides	8th 66	8th 100	8th 77	9th 91	9th 90	8th 63	9th 90	9th 88		9th 460		9th 820	9th 18	9th 20	9th 17	8th 2.6
November Chlorides	4th 83	4th 79	4th 78	9th 73	9th 100	4th 78	9th 72	9th 71		9th 130		9th 170	9th 11	9th 7.5	9th 12	4th 1.9
December Chlorides	6th 63	6th 64	6th 69	10th 83	10th 83	6th 53	10th 79	10th 78	6th 60	10th 120		10th 230	10th 8.9	10th 9.2	10th 9.6	6th 2.1

3. The organized scanned PDF salinity observation tables were then digitized in MS Excel. All tables were kept in their original layout in order to make the quality control process easier. Footnote information corresponding to individual stations was retained for future reference. In particular the footnotes record when the sampling occurred at a non-standard time in the tidal cycle.

4. In conjunction with the previous step, the stations were spatially located using the geographic reference tables in the reports. This process resulted in a unique list of stations names and latitude and longitude coordinates. A unique identifier for each station was also assigned in order to create a master table. The result of this process was an MS Excel table containing station ID, station name, latitude and longitude coordinates.

5. Once the salinity observation tables were digitized in MS Excel format a second quality control was performed. Each digitized table was reviewed and compared to original scanned PDF files in order to find and correct digitizing errors and typos.

6. The reviewed and corrected salinity observation tables were reformatted in order to import them into an MS Access database.

7. The MS Access database was designed and created in order to receive all the data contained in the MS Excel tables previously generated (location and salinity observation). The completed dataset contains 94,420 records of salinity observations.

Data Deliverables (all files are in a folder called "Creation of Historical Salinity Database"):

FOLDER	CONTENT
a_original_scanned_pdf	Contains all the scanned report PDF files
b_digitized_files_xls	Contains all the digitized report XLS files
c_station_location	Contains the station locations in KML (Google Earth) and SHP (ArcGIS) format
d_proccesed_files_xls	Contains all the reviewed, corrected and formatted XLS files
e_final_database	Contains the final database in MS Access

Appendix B: Procedures for Cleaning Data and Calculating Isohalines[1]

The process of integrating the historical observed data involved identifying appropriate locations, converting numerical values of salinity to a common set of units, addressing special issues that were highlighted in footnotes in the original data, and performing conversions to represent the values as a daily average salinity. The goal of this appendix is to present the data processing in detail for future records. Toward that end, this appendix is supported by electronic files containing data that are referred to in the text.

- The accompanying file “Table1-historical-raw-data.xlsx” provides the initial raw data for the historical dataset.
- The accompanying files “Table2-cdec-raw-data.xlsx” and “Table3-chipps-raw-data.xlsx” provide the raw CDEC data.
- The accompanying file “Table6-usgs-bay-stations-raw-data.xlsx” provides the raw data for the USGS stations.
- The file “Table7-Wickland-Oil-Pier.csv” provides continuous data from IEP station Wickland Oil Pier to use in tidal adjustment of stations west of the DSM2 boundary.

B.1. Standardization of Equivalent Textual Data

The Bulletin 23 dataset did not have consistent representations of units, footnotes, or station names. We converted the information in each category to a single representation.

B.1.1 Units

The following unit designations in the Bulletin 23 dataset (column SAL_OBS_UNIT) are numerically equivalent to ppm Cl:

1. Chlorides in milligrams per liter
2. Chlorides in parts per million parts of water
3. Chloride in parts per million of water
4. Parts of chloride per million parts of water

Similarly, the following unit designations are equivalent to parts per 100,000 Cl:

1. Chlorides in parts per 100,000 parts of water
2. Parts of chloride per 100,000 parts of water

[1] Note that all citations in this Appendix refer to the References section of the main report

All observations in the dataset were tagged with one of the above unit designations. We converted the values in rows with units in parts per 100,000 Cl to ppm Cl (multiplication by 10). Following this, all units in the historical database were in ppm Cl.

B.1.2 Footnotes

The historical database used footnotes to mark exceptions in the data collection schedule. By correcting spelling errors; trimming leading, trailing, and repeated whitespace; and merging otherwise synonymous footnotes (e.g. “LOW HIGH TIDE” and “TAKEN AT LOW HIGH TIDE”), we obtained an updated, consistent set of each type of footnotes.

Footnote Column	Original Unique Footnotes	Updated Unique Footnotes
SAL_OBS_FNT	292	162
SAL_STAT_FNT	42	37
SAL_VAL_FNT	181	78
SAL_VAL_TTNT	6	5

Section B.10 on Footnote Standardization shows each change that was made.

B.2. Stations

B.2.1 Bulletin 23 dataset

Recall that during the digitization process of the Bulletin 23 dataset, a master list of stations was assembled, and each salinity observation was assigned to one of those master stations. As a final consistency check, the name from the scanned bulletin (SAL_STAT_NAM) was compared with the name of the assigned station (STAT_NAME). The comparison was made by looking at a generalized edit distance[2] between STAT_NAME and SAL_STAT_NAM for each observation. The vast majority of nonzero edit distances are due to spelling and word order differences, abbreviations, etc., but 34 points were removed due to meaningful differences identified in this comparison. Figure B-1 shows the edit distance for each point in the dataset and the points that were removed.

Table B-1 shows the stations in the Bulletin 23 dataset and corresponding three-letter abbreviations. The distance from Golden Gate Bridge (GGB) is an important value assigned to each station that is used during data cleaning, data filling, and calculation of isohaline positions. The distance from GGB that was assigned to each station came directly from the station metadata in the assigned bulletins.

[2] The minimal number of insertions, deletions and substitutions needed to transform one string into another

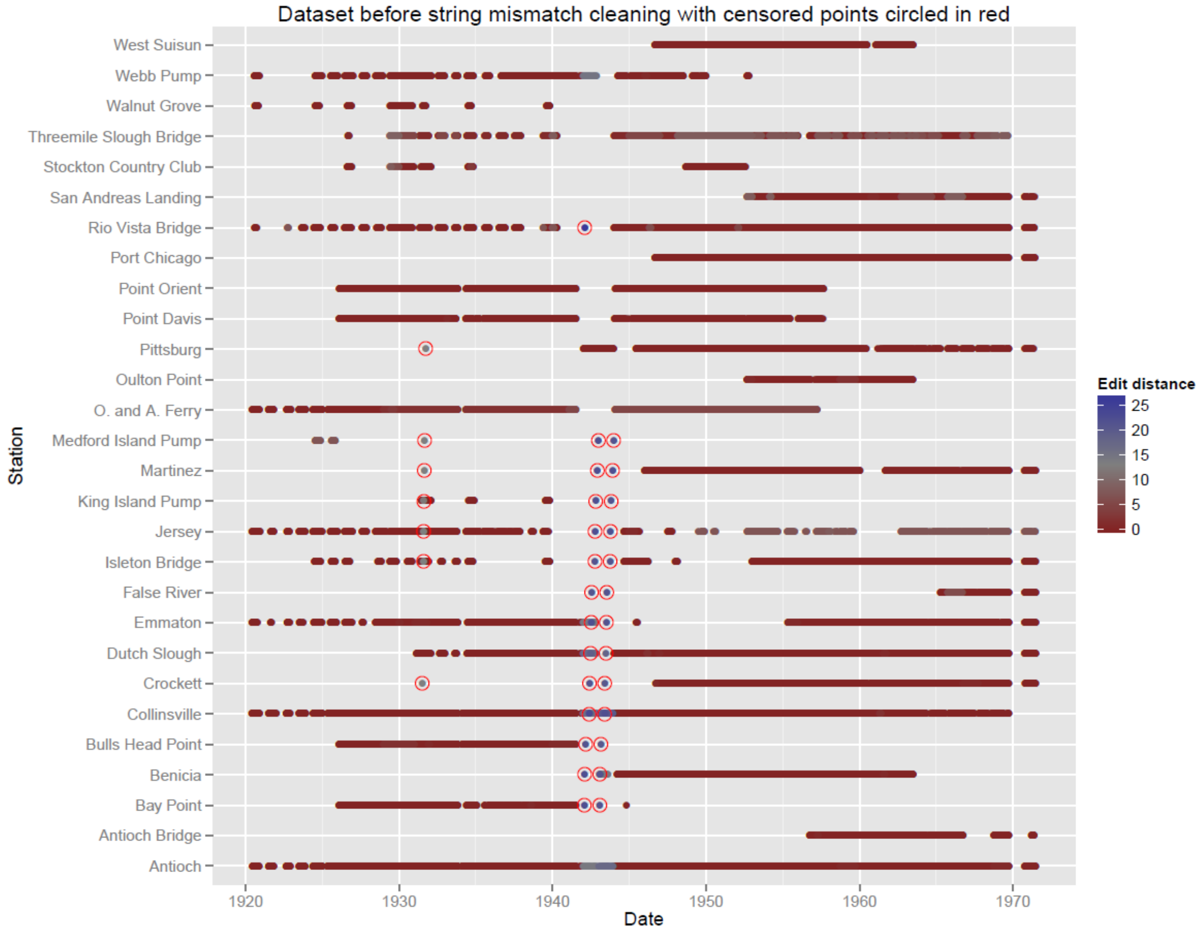


Figure B-1 Edit distance comparison of STAT_NAME and SAL_STAT_NAM.

Table B-1
Historical Dataset Site Information

STAT_ID_TT (Tables A&C)	STAT_NAME (Table A)	Station Code
20120125	Point Orient	PTO
20120124	Point Davis	PTD
20120041	Crockett	CRK
20120011	Benicia	BEN
20120090	Martinez	MRZ
20120017	Bulls Head Point	BHP
20120182	West Suisun	WSN
20120010	Bay Point	BPT
20120128	Port Chicago	PCT
20120112	O. and A. Ferry	OAF
20120123	Pittsburg	PTS
20120040	Collinsville	CLL
20120052	Emmaton	EMM
20120161	Threemile Slough Bridge	TSB
20120134	Rio Vista Bridge	RVB
20120075	Isleton Bridge	ITB
20120177	Walnut Grove	WNG
20120001	Antioch	ANH
20120002	Antioch Bridge	ANB
20120076	Jersey	JER
20120054	False River	FRV
20120118	Oulton Point	OPT
20120144	San Andreas Landing	SAL
20120181	Webb Pump	WBP
20120096	Medford Island Pump	MIP
20120080	King Island Pump	KIP
20120156	Stockton Country Club	SCC
20120156	Stockton	SCT

B.2.2 CDEC dataset

Station identification and location was more straightforward for the modern dataset. Distance from GGB was assigned according to DWR official numbers, based on the river kilometer index (RKI) of each station. There were two exceptions made for the Martinez and Mallard Island stations.

The station labeled as MRZ in the IEP dataset from USBR was tagged with RKI SAC056 and apparently located on the Martinez-Benicia bridge. The actual station history places it on the Shell refinery pier, about 55km from GGB (Eli Ateljevich, personal communication). For comparison, station MRZ in the CDEC dataset is approximately 1 kilometer downstream (RKI SAC054). Due to their spatial proximity and relative data availability, we treat the Martinez stations as one dataset for the purposes of cleaning and filling but use a distance of 54 km or 55 km for calculation of isohaline positions, depending on whether the salinity value was from CDEC or USBR MRZ.

The Mallard Island station has many periods before 1980 without data. Data from the Chipps Island was used to fill these gaps according to the relationship

$$\mathrm{CHP} = 0.36611 * \mathrm{MAL}^{1.104639},$$

and then only this Mallard Island data is used in subsequent analysis (Joey Zhou, personal communication).

Table B-2 shows the set of stations ultimately comprising the CDEC dataset.

Table B-2
CDEC Site Information

Station Code	Station Name
ANH	Antioch
BLP	Blind Point
CLL	Collinsville
EMM	Emmaton
JER	Jersey
MAL	Mallard Island
MRZ	Martinez
PCT	Port Chicago
PTS	Pittsburg
RVB	Rio Vista Bridge
SAL	San Andreas Landing
TSL	Threemile slough
PSP	Point San Pablo
CAR	Carquinez Strait

B.3. PRELIMINARY SCREENING

B.3.1 Bulletin 23

Some observations in the Bulletin 23 dataset had associated footnotes that indicate departure from the station's usual sampling schedule. Only observations with specific footnotes (column SAL_OBS_FNT) were retained. The decision of which footnotes to include involved a tradeoff between data completeness (high inclusivity) and data consistency (low inclusivity). Observations were classified as taken either at high high-tide (HHT) or low high-tide (LHT) based on those footnotes. The following table shows the selected footnotes and their tidal classification.

Table B-3
Footnote Tidal Classifications

Footnote	Observation Tide Classification	Number of Records
(Blank, indicating normal collection)	HHT	61,082
Taken on Following Day	HHT	4,474
Taken on Preceding Day	HHT	862
Low High Tide	LHT	18,475
Low High Tide; Taken Following Day	LHT	1,087

Rows with observed chloride concentrations greater than 30,000 ppm Cl were excluded to eliminate a few extreme outliers. Together, the footnote and chloride concentration criteria shortened the database (all sites, not just those shown in Table B-1) to 85,980 rows from 94,420.

For some of the calculations later in the analysis, it was necessary for each combination of station and date to have a corresponding *unique* salinity observation. Of the 85,980 observations remaining after the footnote restriction above, 3,760 are duplicates by station, date, and footnote. Uniqueness by station, date, and footnote was established by using average values among any duplicates.

For the remaining duplicates by date and station (but with differing footnotes, as ensured by the previous step), the observation with the best footnote is kept and the others discarded according to the priority

$$\text{Blank} > \text{Low High Tide} > \text{Taken on Preceding day} > \text{Taken on Following Day} > \text{Low High Tide; Taken Following Day},$$

leaving 83,720 observations that are unique by date and station.

After the process of selecting the subset of stations we would be using, according to Section B.2.1, we were left with 44,624 observations. To give context to this number, if all 28 of the stations had an observation for every day from October 1, 1921 to June 30, 1971, there would be 508,760 observations, so this dataset has an observation every 11.4 days on average, although the actual frequency and record length varies widely across stations.

B.4. DAYFLOW DATA

Daily net delta outflow (NDO) data from October 1929 – September 2012 were obtained from DAYFLOW (*http://www.water.ca.gov/dayflow/output/Output.cfm*). We were provided additional data to extend this dataset back to October 1921 (Paul Hutton, personal communication).

See accompanying file “Table5-daily-delta-outflow.xlsx” for compiled NDO data.

B.5. CONVERSION OF CHLORIDE CONCENTRATION TO ELECTRICAL CONDUCTIVITY

In the historical dataset, salinity is represented by chloride concentration. In the CDEC dataset, it is represented by electrical conductivity (EC). Chloride concentrations were converted to EC based on the following relationships (Denton, 2013):

$$\mathrm{EC} = f(x) = \begin{cases} -8.5 \times 10^{-5} \cdot x^2 + 3.5 \cdot x + 175, & x > 30 \text{ ppm Cl} \\ 6.67 \cdot x + 80, & x \leq 30 \text{ ppm Cl (San Joaquin River sites)} \\ 12.74 \cdot x + 76.8, & x \leq 30 \text{ ppm Cl (All other sites)} \end{cases},$$

where x is the input chloride concentration in ppm and the resulting EC is in µS/cm. See the first section of the file "Bulletin23_data_cleaning_filling.xlsx" for the Bulletin 23 data after conversion to EC.

B.6. Accounting for Tidal Effects

The observations in the Bulletin 23 dataset were taken either at high-high tide (HHT) or low-high tide (LHT), but the daily CDEC data are daily averages of measurements made every hour. In order to have a set of comparable values over the whole period of record, it is desirable to represent the Bulletin 23 as daily averages. We considered several approaches for doing so; in the following subsections we give descriptions and diagnostics of performance for each approach. The diagnostics are based on the period of overlap between Bulletin 23 and CDEC data from 1964–1971 when both types of data are available and include scatter plots of predicted and observed daily average EC (linear and log scales); histogram and nonparametric density estimates of the tidal correction residuals as well as the root mean square error (RMSE) and mean value of the residuals; and scatter plots of relative error against observed daily EC, delta outflow, and station distance to Golden Gate Bridge.

The first three methods involve different sources of data for powering a least squares estimation of a linear relationship between high tide EC and daily average EC on a log-log scale at each station in the overlapping dataset. The predictions of this relationship during the overlapping period are used to do the performance diagnostics.

B.6.1 Statistical comparison of high tide and daily average values in hourly data (1984–2012)

At each station and for each date in the hourly CDEC dataset, the HHT EC was estimated as the daily maximum, provided there were at least 12 observed hourly values in the day. The LHT EC was estimated as the value occurring 12 hours after the maximum (even if it occurred on the following calendar day).

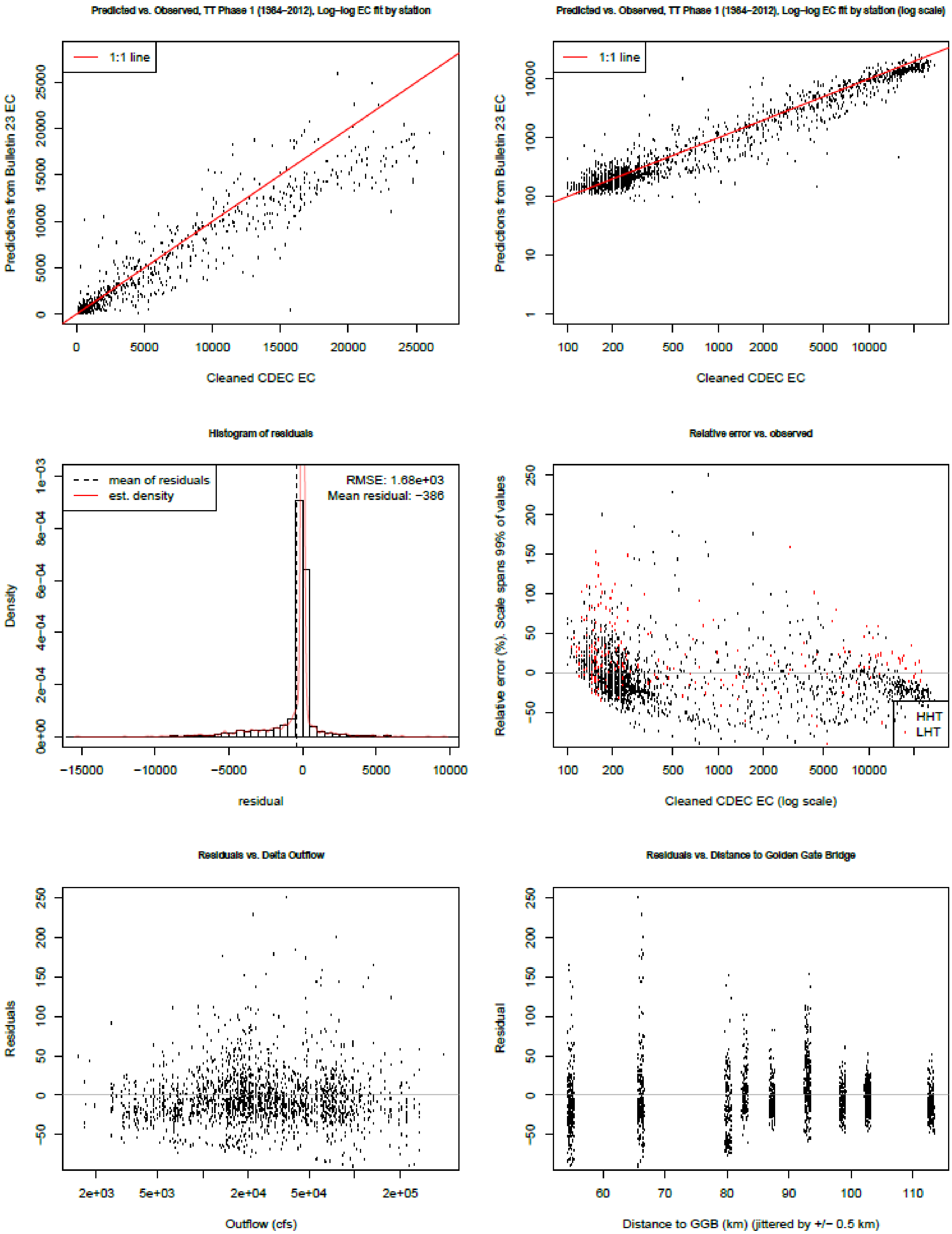


Figure B-2 **Diagnostics of tidal adjustment using statistical estimates derived from modern hourly salinity data (1984-2012)**

B.6.2 Statistical comparison of high tide and daily average in daily data from the overlapping period (1964–1971)

This method is similar to that of Enright and Culberson, 2009. HHT EC and LHT EC are taken directly from the Bulletin 23 observations.

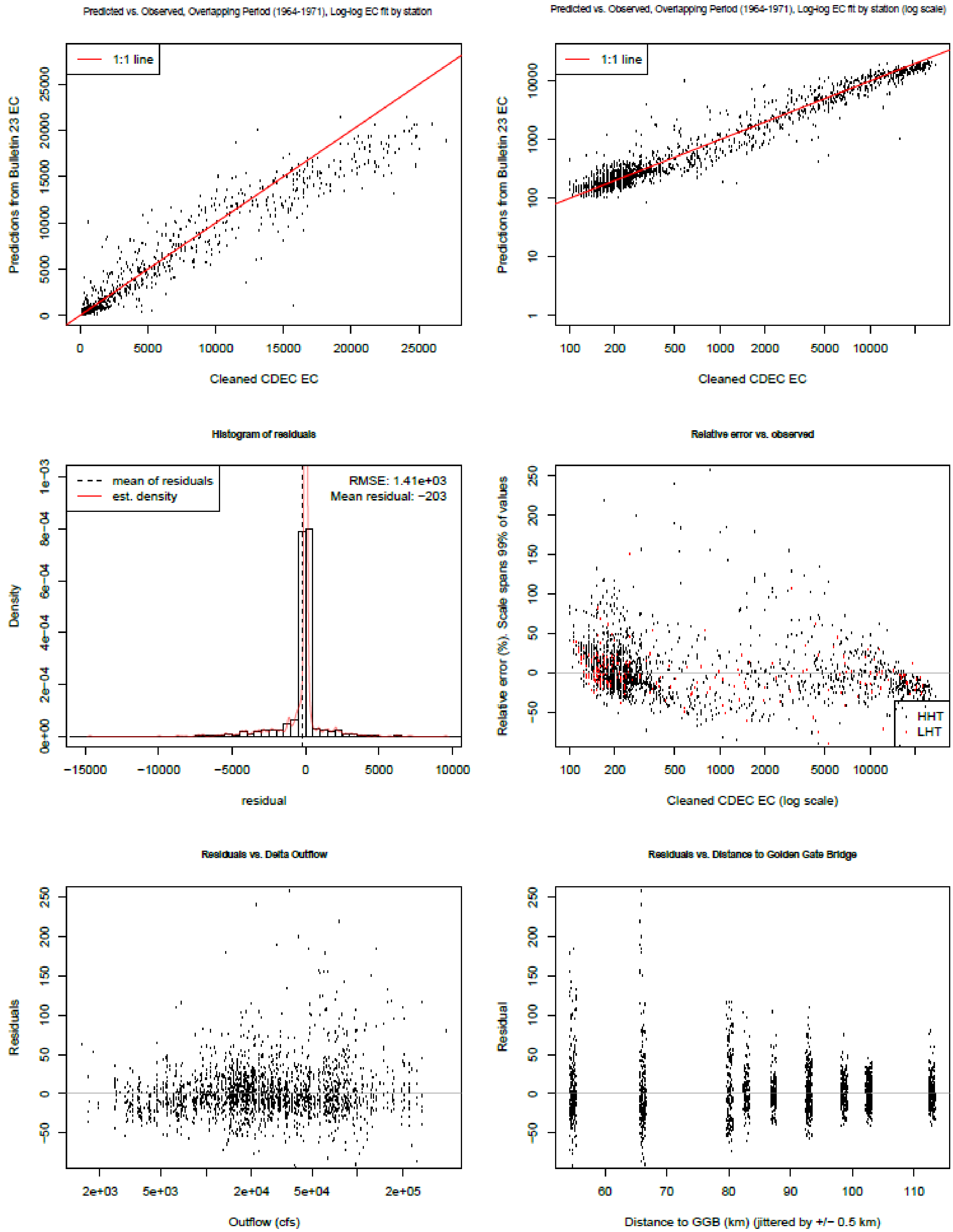


Figure B-3 **Diagnostics for tidal adjustment using statistical estimates from the period of overlap between CDEC and Bulletin 23 datasets**

B.6.3 Statistical comparison of high tide and daily average in DSM2 simulation (1922–1976)

HHT EC is taken as the daily maximum of a Delta Salinity Model 2 (DSM2) simulation. LHT is assumed equal to the daily average value.

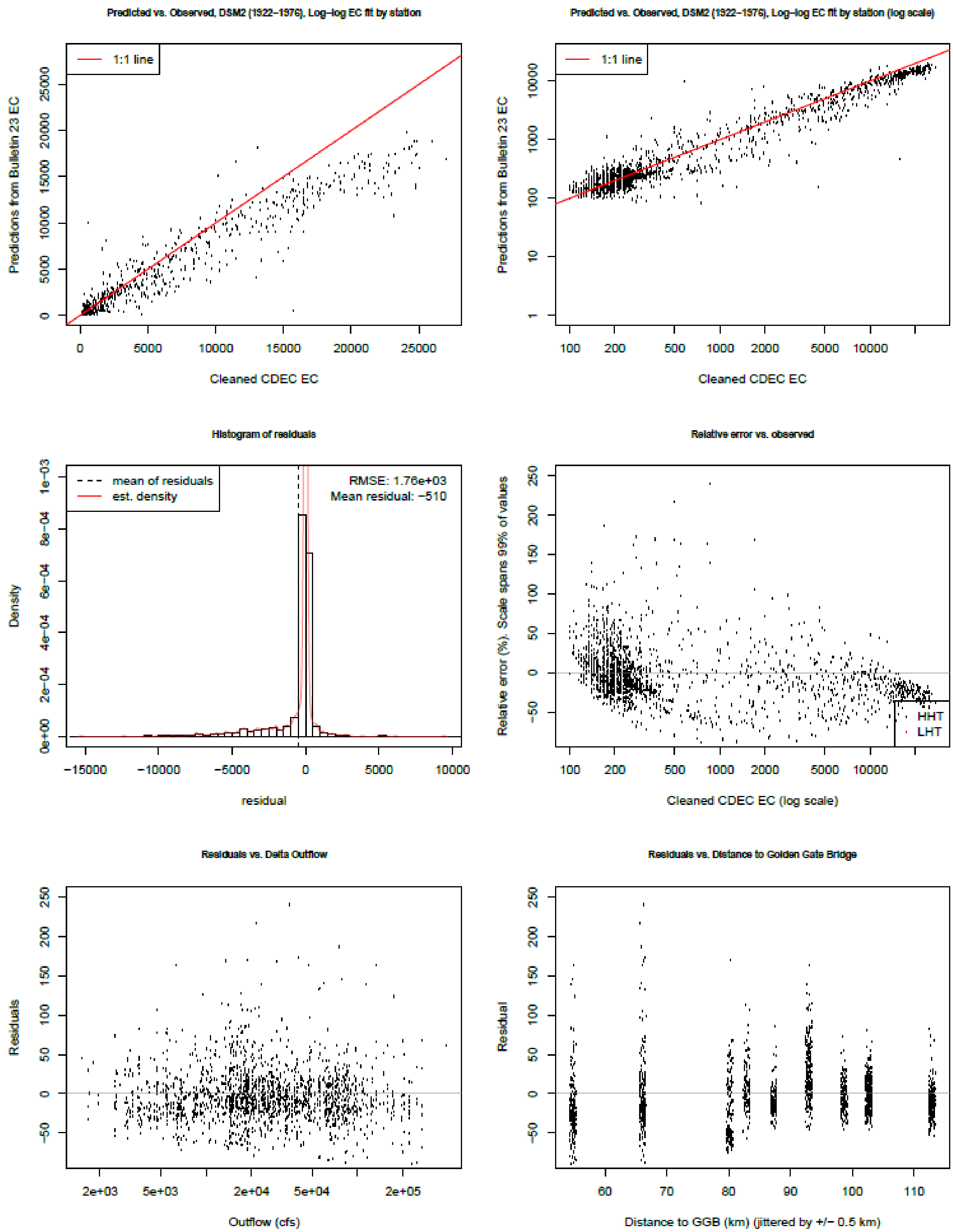


Figure B-4 Diagnostics of tidal adjustment using statistical estimates from DSM2 simulation

B.6.4 Direct use of DSM2 simulation (1922–1976)

This method differs from the previous ones in that there is no statistical fitting involved in the correction. The adjustment from HHT to daily average EC is done directly by multiplying the HHT value by the ratio of daily average EC to daily maximum EC from the DSM2 simulation at the corresponding station on the corresponding day. The LHT value was assumed equal to the daily average value. The diagnostics are still performed on the same period of overlap between the CDEC and Bulletin 23 datasets.

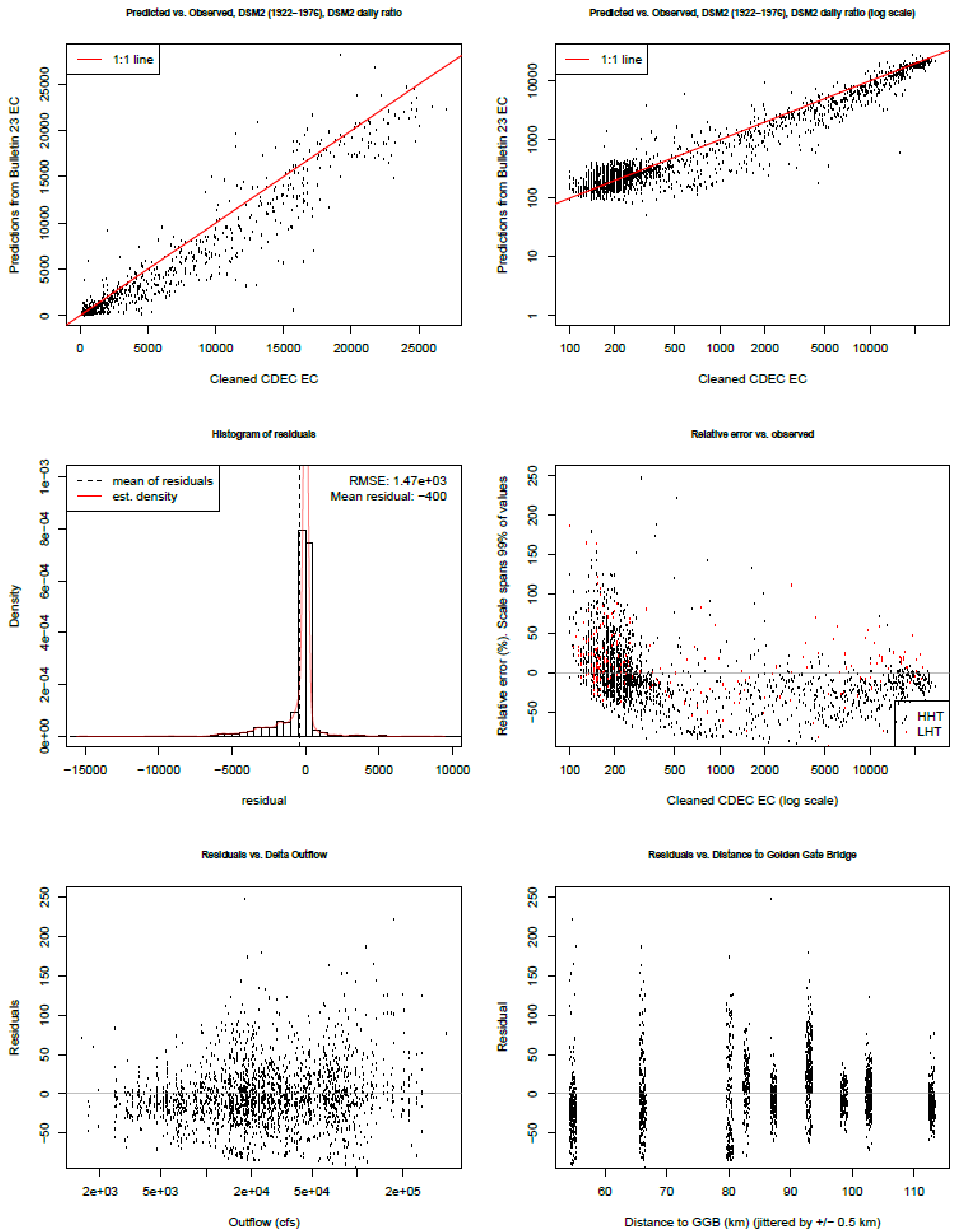


Figure B-5 Diagnostics of tidal adjustment by directly applying DSM2 simulated ratios

B.6.5 Discussion

The main characteristics desired in the assembled performance diagnostics are (1) low RMSE, (2) mean residual near zero, and (3) no egregious patterns of residuals against explanatory or other variables. The method using a statistical fit derived from the overlapping period (B.6.2) tends to generally have the best performance according to these criteria, with the direct use of DSM2 simulation performing nearly as well.

However, we expect that its performance is artificially inflated due to its predictions being based on the same dataset as was used in the performance evaluation. Also, it is hypothesized that the method making direct use of the DSM2 simulation (B.6.4) would have better performance outside of the overlapping period of performance validation because it takes additional historical data as input. Finally, tidal correction of stations without data in both the CDEC and Bulletin 23 datasets is implicit in the DSM2 approach; accounting for tidal effects at such stations using the statistical approach would involve using the estimated model from a nearby station as a proxy. These reasons, together with the performance scores from the direct use of DSM2 not being drastically worse than the winning case lead us to select it as the method for accounting for tidal effects.

B.6.6 Implementation

The DSM2 simulation output consisted of daily maximum and daily average values at several important stations (specific named output settings) and at 1 kilometer intervals east of Martinez. At each Bulletin 23 station, the daily chloride concentration values were matched to a ratio of daily maximum to daily average value from the DSM2 simulation and converted to a daily average equivalent using that ratio. If the Bulletin 23 station corresponded to a named output setting from DSM2, that was used. Otherwise, the closest point on the 1 kilometer grid was used. One exception here is that Bulletin 23 station Benicia corresponded to the named output setting for Martinez in the DSM2 simulation because the Benicia station was almost directly across the river from the Martinez station.

There were three stations west of the DSM2 downstream boundary: Point Orient, Point Davis, and Crockett. Lacking corresponding DSM2 output, these stations were tidally adjusted using the method of (B.6.1), where the hourly data came from two modern datasets: PSP (USGS, 1989–2002) and WIC (IEP, 1986–1998). PSP hourly data was used to adjust Point Orient and WIC was used to adjust Point Davis and Crockett. These hourly data had units of psu, so they were first converted to EC in the same manner described in the main report (Schemel, 2001).

In all cases, LHT values were taken as equal to daily average values. See the second section of “Bulletin23_data_cleaning_filling.xlsx” for the Bulletin 23 data after tidal adjustment.

B.7. Pairwise Data Cleaning

Once the DWR Bulletin grab sample salinity data had been converted to daily average EC a cleaning procedure was performed by comparing daily average EC values at pairs of stations. The underlying conceptual model is that for moderately high salinities, perhaps exceeding 500 to 1,000 µs/cm, where the ocean signal is dominant, there should be a clear west to east gradient of decreasing salinity. Thus, as one moves away from Golden Gate, daily average observed salinity should decrease. If, however, the data at a pair of stations are not consistent with this pattern, i.e., an eastern station has a higher salinity than a western station, the challenge is to determine which of the two salinity values is erroneous, and there is no a priori way of making this determination. To perform this cleaning step, we statistically estimated piecewise-polynomial fits of nearby stations' EC data using least-squares regressions. The procedures for the CDEC and Bulletin 23 datasets were similar, but the more irregular structure of the Bulletin 23 dataset required some additional considerations. We first describe the cleaning procedure used on the CDEC dataset.

B.7.1 CDEC Dataset

Table B-4 shows the pairs of neighboring stations used to compute the piecewise-polynomial least-squares regressions. In this dataset, either one or two pieces were used. If there were two pieces, the piece for the lower salinity regime was always a constant relationship. Otherwise, the piece was a degree 1 or 2 polynomial. The boundary between the pieces and the degree of each polynomial was selected according to the visual structure of the data.

Data points (which correspond to a single date for the two stations involved in a particular regression) outside of two and four standard errors of the regression were noted. Points that had exceeded four standard errors in at least one regression were removed. Points that had exceeded two standard errors in at least two regressions were removed. See accompanying file for plots of the regressions used for cleaning. See "CDEC_data_cleaning.xlsx" for tables of the data before and after the cleaning process. See "CDEC_neighbor_cleaning.pdf" for plots of the regressions used in filling.

B.7.2 Bulletin 23 Dataset

Table B-5 shows the pairs of neighboring stations used to compute the regressions for the Bulletin 23 dataset. Whereas the CDEC pairings were based on using the two closest stations in either direction for each river, the two closest stations in the Bulletin 23 dataset did not necessarily represent the same time periods with their data. For example, Martinez and Bulls Head Point are adjacent, but Martinez has observations strictly after 1945 and Bulls Head Point strictly before 1945, so no regression between them can be computed. The more extensive list of station pairings was intended to enter each data point into regressions for cleaning. Note that some eastern stations (ITB, KIP, MIP, SCC, SCT, WBP, and WNG) are still underrepresented or unrepresented even with these 44 pairings. Stations with very few data points above 1,000 µS/cm were not used in regressions due to concerns with sample size sufficiency.

Due to highly influential observations in some cases, we used a robust form of least squares regression: iteratively re-weighted least squares (IWLS) using an MM estimator (Venables and Ripley, 2002). Furthermore, the models were restricted to be continuous at the breakpoints—only the leftmost piece had an estimated intercept.

As some stations were involved in more than four regressions, only the regressions from (up to) the four closest stations were used (the four stations can vary across different days) to count exceedances of two or four standard errors. Using all available regressions would have meant a significantly lower threshold for rejection compared to the CDEC dataset, where each station was only involved at most four regressions. See the third section of "Bulletin23_data_cleaning_filling.xlsx" for the Bulletin 23 data after cleaning. See "Bulletin23_neighbor_cleaning.pdf" for plots of the regressions used in the cleaning done here.

Table B-4
CDEC station pairing for regression-based cross-checking

x-Axis Station (Downstream)	*y*-Axis Station (Upstream)
PSP	CAR
PSP	MRZ
CAR	MRZ
CAR	PCT
MRZ	PCT
MRZ	MAL
PCT	MAL
PCT	CLL
MAL	CLL
MAL	EMM
CLL	EMM
CLL	RVB
EMM	RVB
PCT	PTS
MAL	PTS
MAL	ANH
PTS	ANH
PTS	BLP
ANH	BLP
ANH	JER
BLP	JER
BLP	TSL
JER	TSL
JER	SAL
TSL	SAL

Table B-5
Bulletin 23 station pairing for regression-based cross-checking

x-Axis Station	*y*-Axis Station
PTO	PTD
PTO	CRK
PTO	BEN
PTO	MRZ
PTO	BHP
PTD	CRK
PTD	BEN
PTD	MRZ
PTD	BHP
CRK	BEN
CRK	MRZ
CRK	PCT
BEN	MRZ
BEN	WSN
MRZ	WSN
MRZ	PCT
BHP	BPT
BHP	OAF
WSN	PCT
WSN	OAF
BPT	OAF
BPT	CLL
BPT	ANH
PCT	OAF
PCT	CLL
PCT	ANH
OAF	CLL
OAF	ANH
OAF	EMM
OAF	JER
CLL	EMM
CLL	TSB
CLL	RVB
ANH	ANB
ANH	JER
ANH	FRV

EMM	TSB
EMM	RVB
ANB	JER
ANB	FRV
TSB	RVB
JER	SAL
FRV	SAL
OPT	SAL

B.8. DATA FILLING

Both datasets were filled with a procedure similar to the cleaning procedure of Bulletin 23 data in Section B.7.2. In the same manner as before, piecewise polynomial regressions were fit between the selected pairs of stations. Then, we attempted to fill each station's missing salinity values with predictions of regressions between the station and its neighbors. When selecting the neighbor to use for predicting a missing value on a particular day, we generally used the closest station in either direction, subject to several restrictions.

If the distances from GGB for the prediction station and the station being filled differed by more than 20 km, no filling was done. As Point Orient is further than 20km from all stations and because the salinity relationship persists better across distance in the relatively saline waters in this region, it was allowed to be filled from stations from up to 25 km away. Additionally, filling regressions with a pseudo-r^2 value of less than 0.75 were not used for filling. The pseudo r^2 value was calculated using linear regression (ordinary least squares) of the predicted values from the robust regression against the observed values of the response value (the upstream station) with prior weights equal to the final weights from the IWLS step. Finally, filling in the upstream to downstream direction (e.g. filling EMM from RVB) was restricted below a minimum EC value. In certain cases, downstream EC could vary across several orders of magnitude for low upstream EC values; put another way, the predictive power of the relationship between the stations was low in these situations. This minimum EC for upstream to downstream filling was determined for each station pair as the largest upstream EC such the slope of the regression line was larger than 5 (uS/cm) / (uS/cm). This slope value was chosen as a tradeoff between accuracy (a lower number would potentially exclude more filling from less predictively powerful regression segments) and completeness (a value that is too low has the potential to overly restrict the whole filling process).

Finally, gaps of up to eight days were filled via linear interpolation within each station's data. See the fourth section of "Bulletin23_data_cleaning_filling.xlsx" for the filled Bulletin 23 data. See "Bulletin23_neighbor_filling.pdf" for plots of the regressions used in neighbor filling.

B.9. ISOHALINE CALCULATIONS

After data filling and cleaning was completed, four sets of daily isohalines were calculated. The four sets are all combinations of dataset (CDEC or Bulletin 23) and river (Sacramento or San Joaquin, where both rivers include stations west of the confluence). Then, monthly isohaline positions are calculated as monthly averages of the daily isohaline positions within each calendar month, unless fewer than 14 days are available for averaging; in that case, the monthly average is left as missing.

The same method was used for all four sets of isohalines, and we now describe the algorithm for calculation. On each day, consider only stations with non-missing salinity values on that day. Then, find all pairs of adjacent stations that bound the isohaline value (e.g. for X2, the value at one station is about 2,640 µS/cm and below 2,640 µS/cm at the next station with data). The bounding stations must be no more than 25 km apart.

If there is only one pair of bounding stations, the isohaline position is uniquely defined by linear interpolation between them. The EC values at the bounding stations are transformed to log scale before interpolation; the distances from GGB are left untransformed.

If there is more than one pair of bounding stations, the isohaline position, I, is defined as a weighted average of the minimum and maximum isohaline positions predicted by the bounding pairs, where each bounding pair defines an isohaline position as above:

$$I = w_m I_m + w_M I_M,$$

where the $0 \leq w \leq 1$ are the weights, the I are the corresponding isohalines positions, and m, M denote minimum and maximum respectively. The weights are functions of the EC values of all stations between the western station of the bounding pair for I_m and the eastern station of the bounding pair for I_M, inclusive, as follows: among these stations, count the number of stations with EC values larger than the isohaline value, and denote that count as n_M. Similarly, denote the number of EC values smaller than the isohaline value as n_m. The idea here is that having $n_M > n_m$ indicates evidence for isohaline to be closer to I_M, and $n_m > n_M$ indicates evidence for the isohaline to be closer to I_m. The weight (w_m or w_M) corresponding to the smaller of n_m or n_M is calculated as, for example, $n_m < n_M$:

$$w_m = \frac{(0.5)^{n_M}}{(0.5)^{n_m} + (0.5)^{n_M}}.$$

If $n_m > n_M$, then w_M is calculated similarly with the roles of the n values swapped. The w value that was calculated this way is determined by $w_m + w_M = 1$. Finally, if the four westernmost stations on a given day have EC values below the target isohaline value and I_m is east of these stations, we assume I_m is erroneous and that the actual isohaline position is west of the available data and leave I undefined for that day.

The point of this calculation is to achieve some robustness in the isohaline calculation, particularly in the noisier daily salinity datasets. We also considered simply using the mean value of all isohaline positions predicted by all bounding pairs, but this proved unresistant to small irregularities in the salinity record. We also considered using simple linear weighting instead of the more complicated counting method described above, but we chose this method because it has the advantage of very strongly associating with I_m or I_M when there is only minimal evidence against it.

Finally, the CDEC and Bulletin 23 isohalines are combined by using the CDEC values when available and the Bulletin 23 values otherwise. See "Table9-isohaline-positions.xlsx" for the daily and monthly isohaline positions.

B.10. Footnote Standardization in Historical Data

Column	From	To
SAL_OBS_FNT	CHLORIDE VALUES COMPUTED FROM CONDUCTIVITY RECORDER READINGS	CHLORIDE VALUES COMPUTED FROM CONDUCTIVITY RECORDER
SAL_OBS_FNT	INDICATES PUMPING PLANT NOT IN OPERATION AT TIME OF SAMPLING	INDICATES PUMPING PLANT NOT IN OPERATION AT TIME OF SAMPLING
SAL_OBS_FNT	INDICATES PUMPING PLANT NOT IN OPERATION AT TIME OF SAMPLING / INDICATES PUMPING PLANT NOT IN OPERATION AT TIME OF SAMPLING	INDICATES PUMPING PLANT NOT IN OPERATION AT TIME OF SAMPLING
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE	LOW HIGH TIDE
SAL_OBS_FNT	TAKEN AT LOW HIGH TIDE	LOW HIGH TIDE
SAL_OBS_FNT	LOW HIGH TIDE; OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME	LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	LOW HIGH TIDE; TAKEN TWO DAYS EARLIER	LOW HIGH TIDE; TAKEN TWO DAYS EARLIER
SAL_OBS_FNT	TAKEN TWO DAYS EARLIER; LOW HIGH TIDE	LOW HIGH TIDE; TAKEN TWO DAYS EARLIER
SAL_OBS_FNT	5OBSERVATION ON NEXT SUCCEEDING DAY	OBSERVATION ON NEXT SUCCEEDING DAY
SAL_OBS_FNT	OBSERVATION ON NEXT SUCCEEDING DAY	OBSERVATION ON NEXT SUCCEEDING DAY
SAL_OBS_FNT	OBSERVATION AFTER LOW TIDE; OBSERVATION ON NEXT SUCCEEDING DAY	OBSERVATION ON NEXT SUCCEEDING DAY; OBSERVATION AFTER LOW TIDE
SAL_OBS_FNT	OBSERVATION ON NEXT SUCCEEDING DAY; OBSERVATION AFTER LOW TIDE	OBSERVATION ON NEXT SUCCEEDING DAY; OBSERVATION AFTER LOW TIDE
SAL_OBS_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER
SAL_OBS_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME, TAKEN TWO DAYS EARLIER	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER
SAL_OBS_FNT	TAKEN TWO DAYS EARLIER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER
SAL_OBS_FNT	PRESUMED; TAKEN AFTER LOW-HIGH TIDE	PRESUMED; TAKEN AFTER LOW HIGH TIDE
SAL_OBS_FNT	PRESUMED; TAKEN AFTER LOW HIGH TIDE	PRESUMED; TAKEN AFTER LOW HIGH TIDE
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW-HIGH TIDE	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW HIGH TIDE
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW HIGH TIDE	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW HIGH TIDE
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW HIGH TIDE; OVER ONE HOUR OFF SCHEDULED TIME	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW HIGH TIDE; OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	STATION LOCATED ABOVE TIDAL ACTION / TAKEN AFTER LOW HIGH TIDE; OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	STATION LOCATED ABOVE TIDAL ACTION / TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON FOLLOWING DAY	STATION LOCATED ABOVE TIDAL ACTION / TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN ON PRECEDING DAY	STATION LOCATED ABOVE TIDAL ACTION / TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN ON PRECEEDING DAY	STATION LOCATED ABOVE TIDAL ACTION / TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEDING DAY	STATION LOCATED ABOVE TIDAL ACTION / TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	STATION LOCATED ABOVE TIDAL ACTION / TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY	STATION LOCATED ABOVE TIDAL ACTION / TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	TAKEN AFTER LOW-HIGH TIDE	TAKEN AFTER LOW HIGH TIDE
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE	TAKEN AFTER LOW HIGH TIDE
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME

Column	From	To
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_OBS_FNT	TAKEN ON FOLLOWING DAY; TAKEN AFTER LOW HIGH TIDE	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_OBS_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	TAKEN ON PRECEEDING DAY; TAKEN AFTER LOW HIGH TIDE	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN AFTER LOW TIDE	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN ON PRECEDING DAY	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY

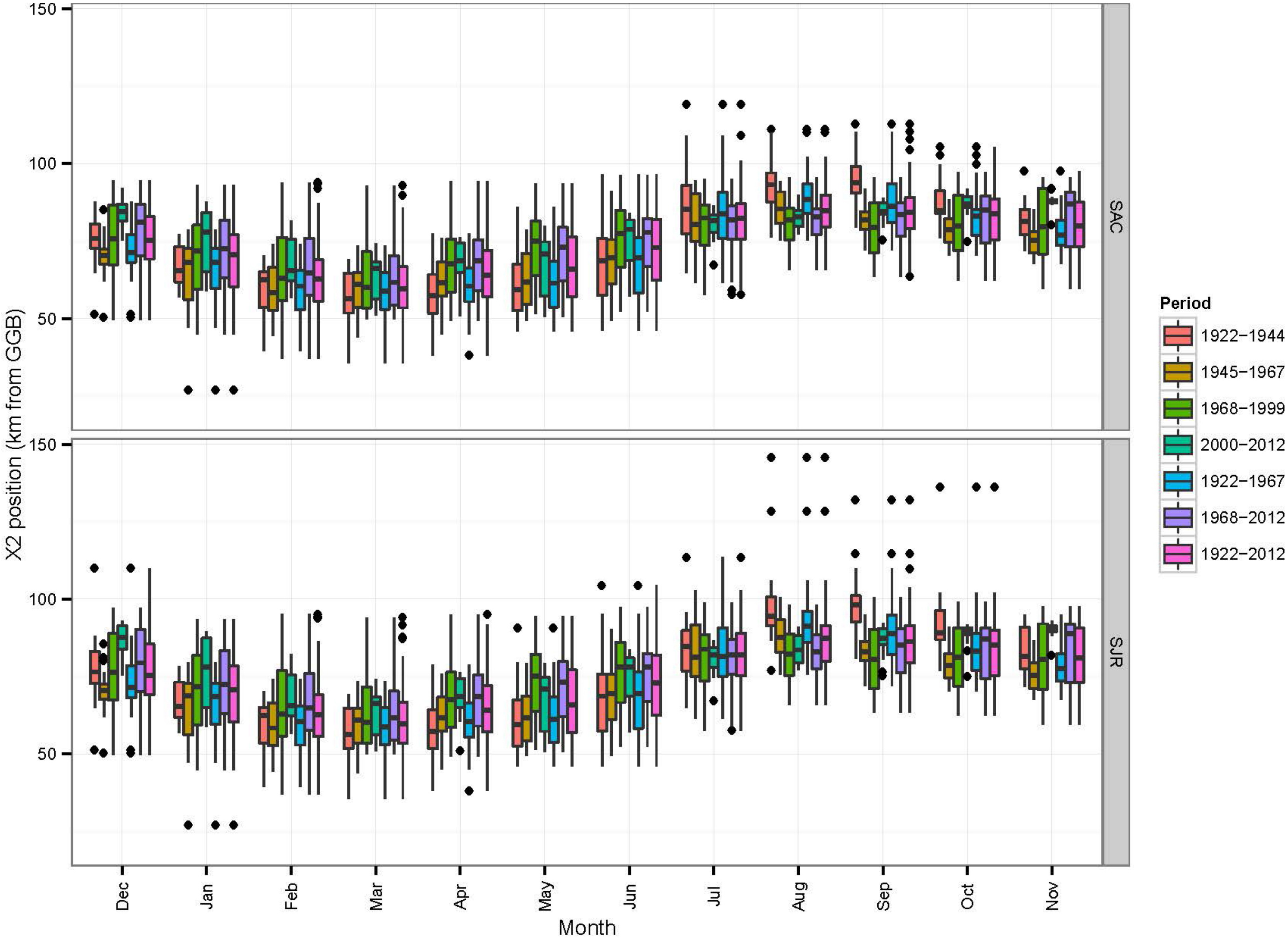
Column	From	To
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN AFTER LOW TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON FOLLOWING DAY	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	PRESUMED; TAKEN ON PRECEDING DAY	TAKEN ON PRECEDING DAY; PRESUMED
SAL_OBS_FNT	TAKEN ON PRECEDING DAY; PRESUMED	TAKEN ON PRECEDING DAY; PRESUMED
SAL_OBS_FNT	TAKEN ON PRECEDING DAY; PRESUMED	TAKEN ON PRECEDING DAY; PRESUMED
SAL_OBS_FNT	TAKEN ON PRECEEDING DAY; PRESUMED	TAKEN ON PRECEDING DAY; PRESUMED
SAL_OBS_FNT	TAKEN ON PRECEDING DAY	TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	TAKEN ON PRECEEDING DAY	TAKEN ON PRECEEDING DAY
SAL_OBS_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN ON PRECEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN ON PRECEEDING DAY; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME, TAKEN TWO DAYS EARLIER	TAKEN OVER ONE HOUR OFF SCHEDULED TIME, TAKEN TWO DAYS EARLIER
SAL_OBS_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER	TAKEN OVER ONE HOUR OFF SCHEDULED TIME, TAKEN TWO DAYS EARLIER
SAL_OBS_FNT	TAKEN FOLLOWING DAY; TAKEN TWO DAYS EARLIER	TAKEN TWO DAYS EARLIER; TAKEN FOLLOWING DAY
SAL_OBS_FNT	TAKEN TWO DAYS EARLIER; TAKEN FOLLOWING DAY	TAKEN TWO DAYS EARLIER; TAKEN FOLLOWING DAY
SAL_OBS_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS LATER	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN TWO DAYS LATER; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_OBS_FNT	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_STAT_FNT	CHLORIDE VALUES COMPUTED FROM CONDUCTIVITY RECORDER	CHLORIDE VALUES COMPUTED FROM CONDUCTIVITY RECORDER
SAL_STAT_FNT	CHLORIDE VALUES COMPUTED FROM CONDUCTIVITY RECORDER READINGS	CHLORIDE VALUES COMPUTED FROM CONDUCTIVITY RECORDER
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE	LOW HIGH TIDE
SAL_VAL_FNT	TAKEN AT LOW HIGH TIDE	LOW HIGH TIDE
SAL_VAL_FNT	LOW HIGH TIDE; OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME

Column	From	To
SAL_VAL_FNT	LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME	LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	LOW HIGH TIDE; TAKEN TWO DAYS EARLIER	LOW HIGH TIDE; TAKEN TWO DAYS EARLIER
SAL_VAL_FNT	TAKEN TWO DAYS EARLIER; LOW HIGH TIDE	LOW HIGH TIDE; TAKEN TWO DAYS EARLIER
SAL_VAL_FNT	5OBSERVATION ON NEXT SUCCEEDING DAY	OBSERVATION ON NEXT SUCCEEDING DAY
SAL_VAL_FNT	OBSERVATION ON NEXT SUCCEEDING DAY	OBSERVATION ON NEXT SUCCEEDING DAY
SAL_VAL_FNT	OBSERVATION AFTER LOW TIDE; OBSERVATION ON NEXT SUCCEEDING DAY	OBSERVATION ON NEXT SUCCEEDING DAY; OBSERVATION AFTER LOW TIDE
SAL_VAL_FNT	OBSERVATION ON NEXT SUCCEEDING DAY; OBSERVATION AFTER LOW TIDE	OBSERVATION ON NEXT SUCCEEDING DAY; OBSERVATION AFTER LOW TIDE
SAL_VAL_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER
SAL_VAL_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME, TAKEN TWO DAYS EARLIER	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER
SAL_VAL_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER
SAL_VAL_FNT	TAKEN TWO DAYS EARLIER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS EARLIER
SAL_VAL_FNT	PRESUMED; TAKEN AFTER LOW-HIGH TIDE	PRESUMED; TAKEN AFTER LOW HIGH TIDE
SAL_VAL_FNT	PRESUMED; TAKEN AFTER LOW HIGH TIDE	PRESUMED; TAKEN AFTER LOW HIGH TIDE
SAL_VAL_FNT	TAKEN AFTER LOW-HIGH TIDE	TAKEN AFTER LOW HIGH TIDE
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE	TAKEN AFTER LOW HIGH TIDE
SAL_VAL_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_VAL_FNT	TAKEN ON FOLLOWING DAY; TAKEN AFTER LOW HIGH TIDE	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON FOLLOWING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN ON PRECEEDING DAY; TAKEN AFTER LOW HIGH TIDE	TAKEN AFTER LOW HIGH TIDE; TAKEN ON PRECEEDING DAY

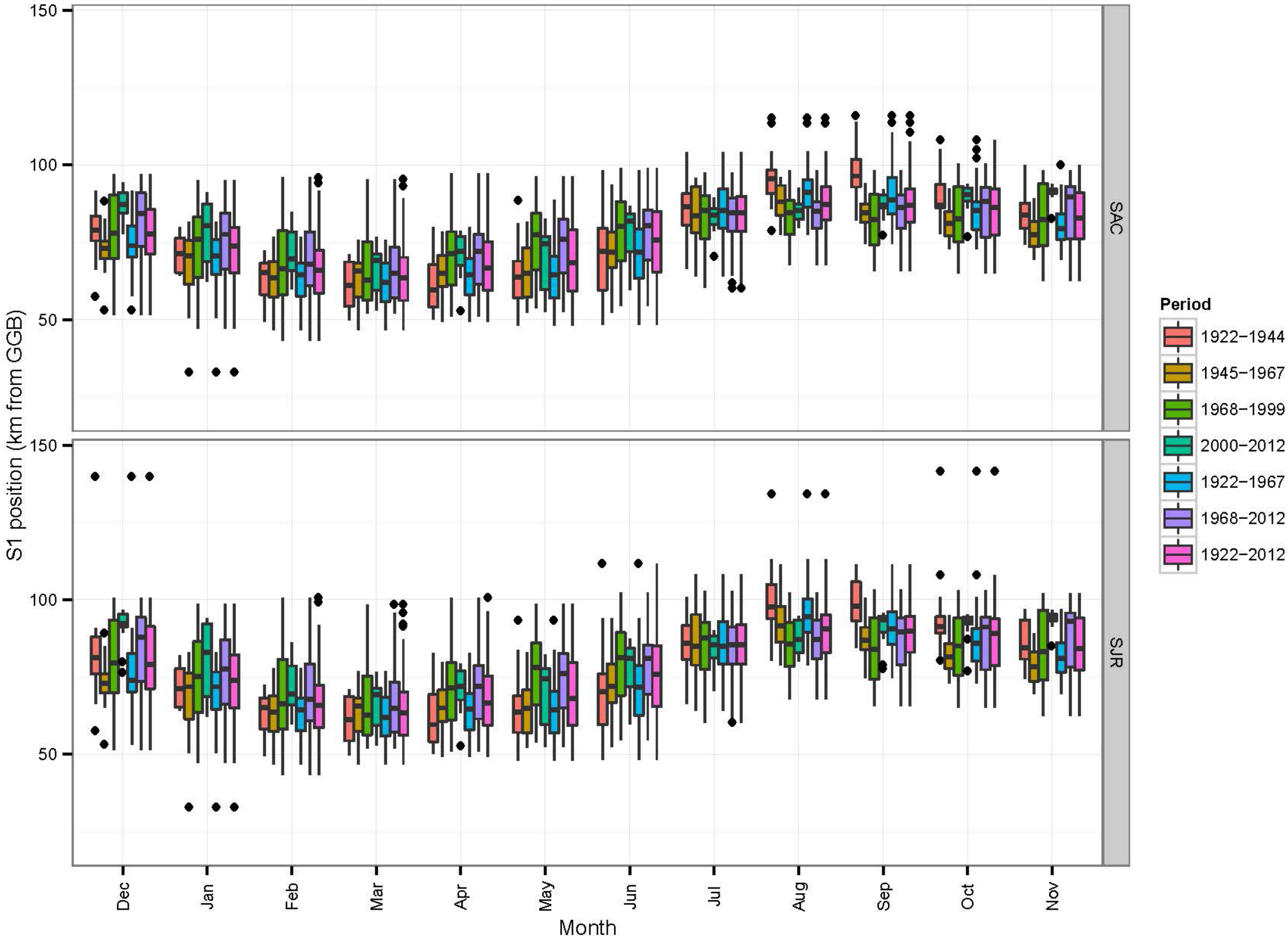
Column	From	To
SAL_VAL_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW HIGH TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW-HIGH TIDE; TAKEN TWO DAYS LATER	TAKEN AFTER LOW HIGH TIDE; TAKEN TWO DAYS LATER
SAL_VAL_FNT	TAKEN AFTER LOW HIGH TIDE; TAKEN TWO DAYS LATER	TAKEN AFTER LOW HIGH TIDE; TAKEN TWO DAYS LATER
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN AFTER LOW TIDE	TAKEN AFTER LOW TIDE; TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN ON PRECEDING DAY	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN AFTER LOW TIDE; TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY	TAKEN AFTER LOW TIDE; TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN FOLLOWING DAY; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN FOLLOWING DAY	TAKEN FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON FOLLOWING DAY	TAKEN ON FOLLOWING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	PRESUMED; TAKEN ON PRECEDING DAY	TAKEN ON PRECEDING DAY; PRESUMED
SAL_VAL_FNT	TAKEN ON PRECEDING DAY; PRESUMED	TAKEN ON PRECEDING DAY; PRESUMED
SAL_VAL_FNT	TAKEN ON PRECEDING DAY; PRESUMED	TAKEN ON PRECEDING DAY; PRESUMED
SAL_VAL_FNT	TAKEN ON PRECEEDING DAY; PRESUMED	TAKEN ON PRECEDING DAY; PRESUMED
SAL_VAL_FNT	TAKEN ON PRECEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN ON PRECEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEDING DAY	TAKEN ON PRECEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN ON PRECEDING DAY	TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN ON PRECEEDING DAY	TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON	TAKEN OVER ONE HOUR OFF SCHEDULED

Column	From	To
	PRECEEDING DAY	TIME; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN ON PRECEEDING DAY; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN ON PRECEEDING DAY; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN ON PRECEEDING DAY
SAL_VAL_FNT	TAKEN FOLLOWING DAY; TAKEN TWO DAYS EARLIER	TAKEN TWO DAYS EARLIER; TAKEN FOLLOWING DAY
SAL_VAL_FNT	TAKEN TWO DAYS EARLIER; TAKEN FOLLOWING DAY	TAKEN TWO DAYS EARLIER; TAKEN FOLLOWING DAY
SAL_VAL_FNT	OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS LATER	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN OVER ONE HOUR OFF SCHEDULED TIME; TAKEN TWO DAYS LATER	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN TWO DAYS LATER; OVER ONE HOUR OFF SCHEDULED TIME	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_FNT	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME	TAKEN TWO DAYS LATER; TAKEN OVER ONE HOUR OFF SCHEDULED TIME
SAL_VAL_TTNT	EST.	ESTIMATED

Appendix C: Supporting Plots for All Isohalines



150
100
50
X2 position (km from GGB)
SAC
SJR
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Month
Period
1922–1944
1945–1967
1968–1999
2000–2012
1922–1967
1968–2012
1922–2012


S1 position (km from GGB)
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SAC
SJR
Dec
Jan
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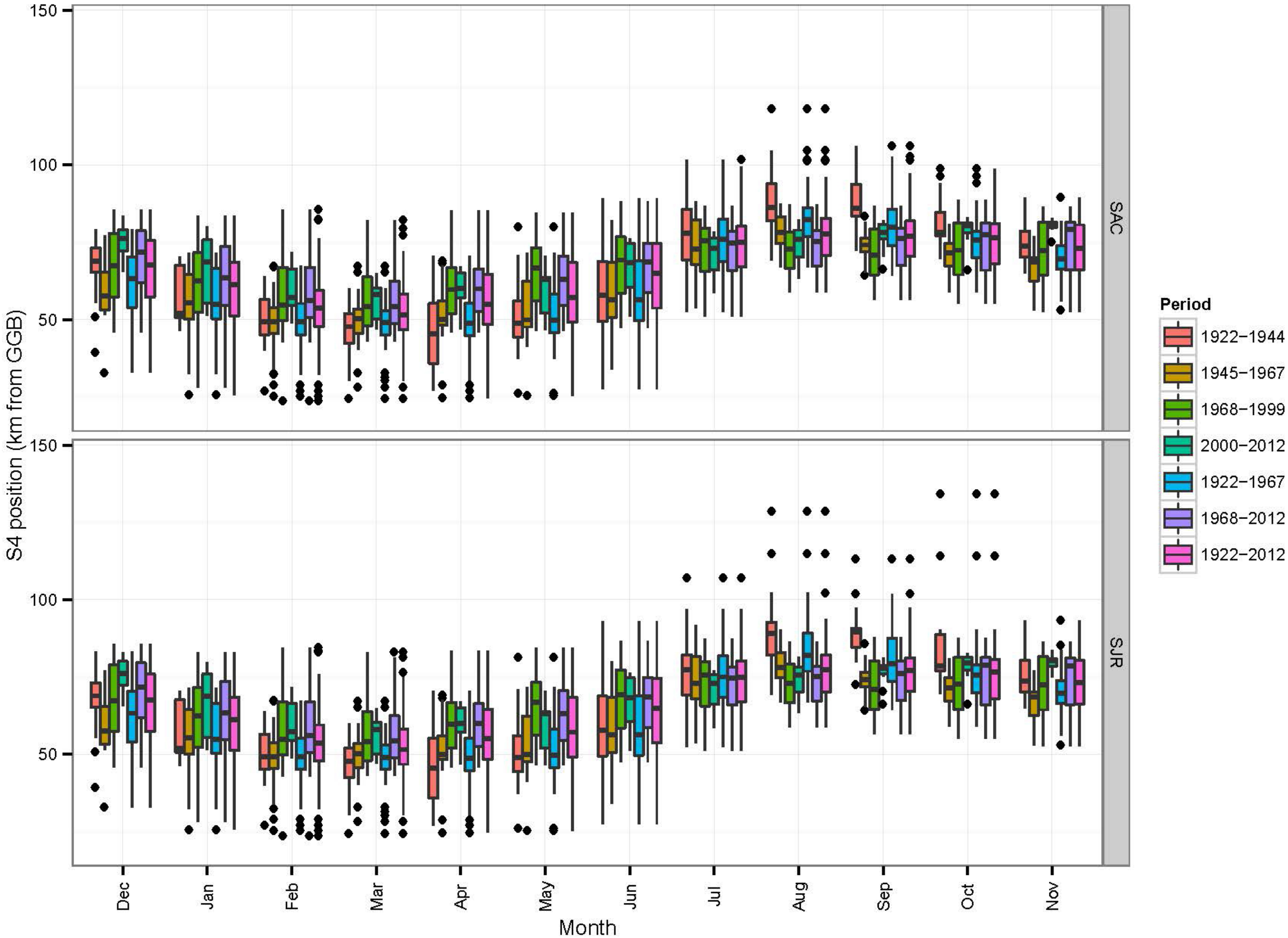
Month
Period
1922–1944
1945–1967
1968–1999
2000–2012
1922–1967
1968–2012
1922–2012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100
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150
100
50
S4 position (km from GGB)
SAC
SJR
Dec
Jan
Feb
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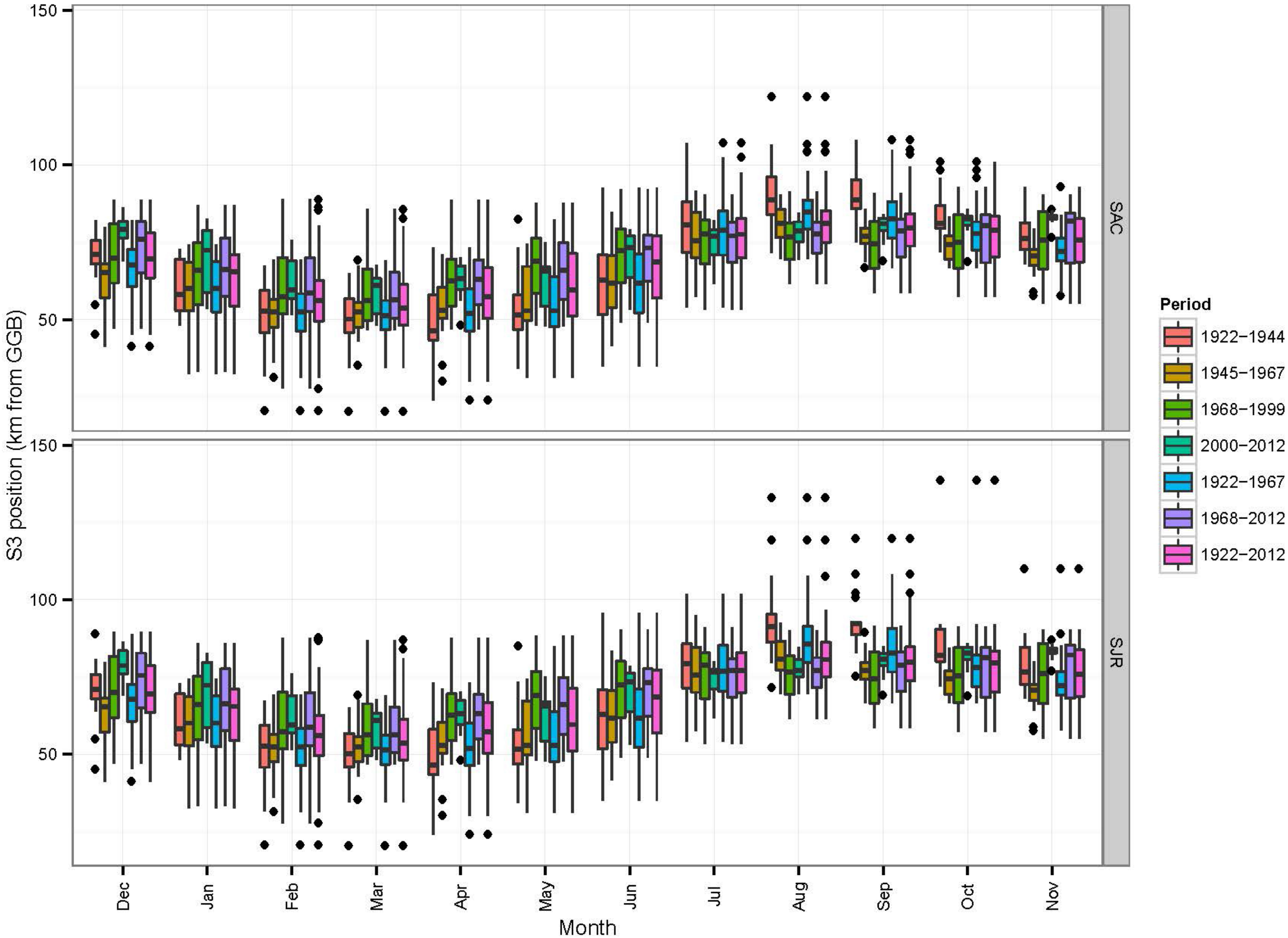
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Month
Period
1922–1944
1945–1967
1968–1999
2000–2012
1922–1967
1968–2012
1922–2012


150
100
50
150
100
50
S3 position (km from GGB)
SAC
SJR
Dec
Jan
Feb
Mar
Apr
May
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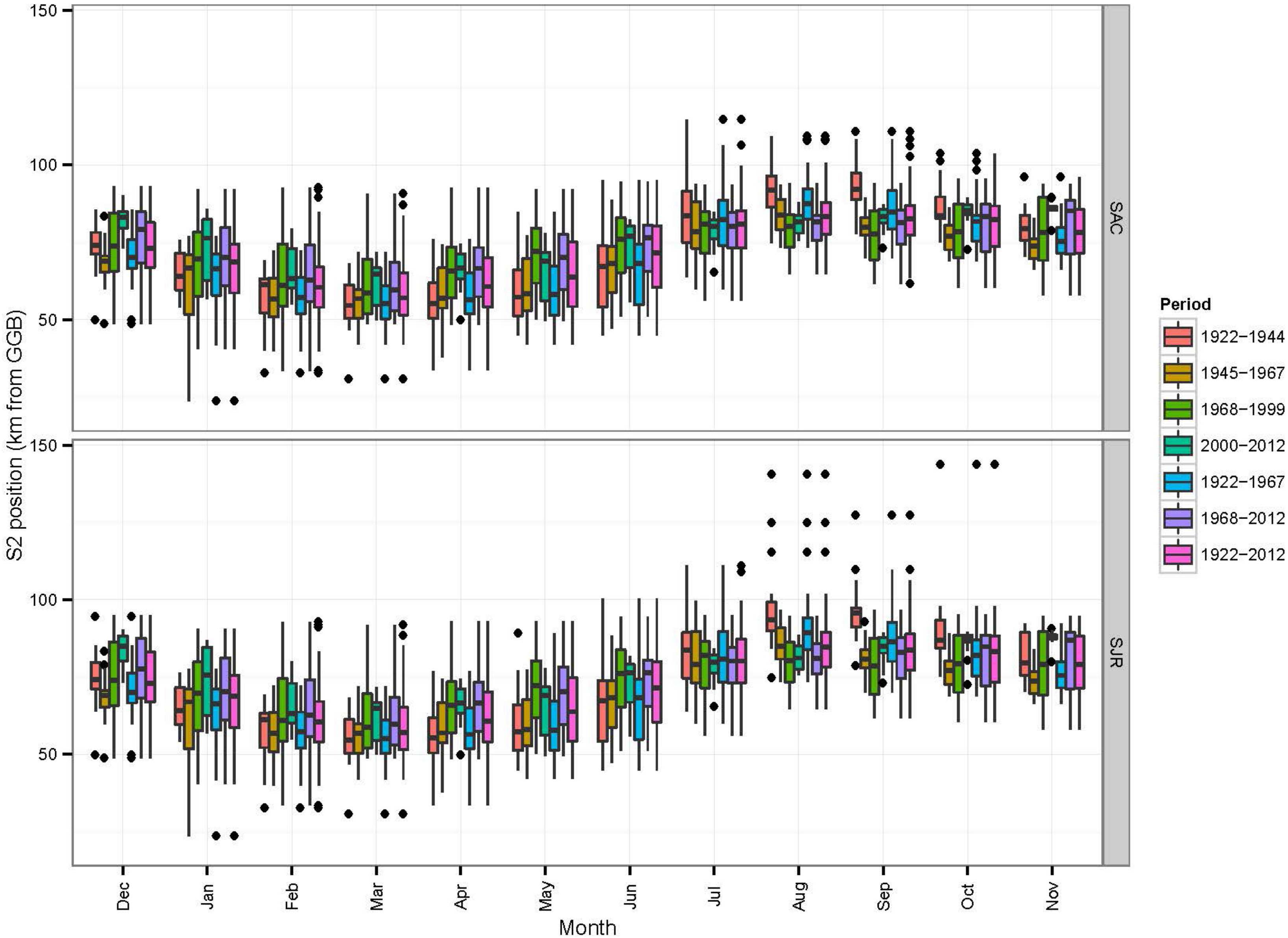
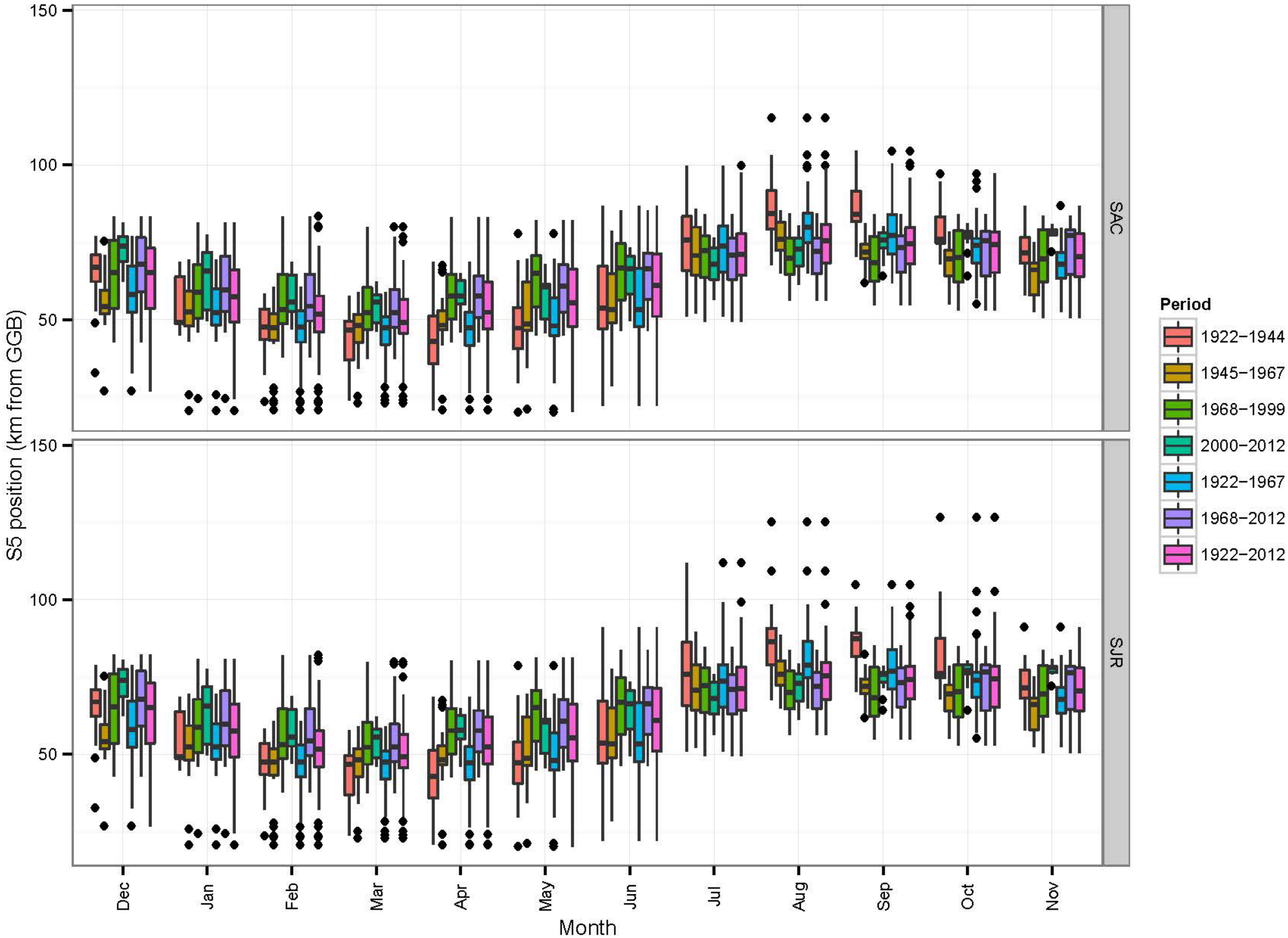
Jul
Aug
Sep
Oct
Nov
Month
Period
1922–1944
1945–1967
1968–1999
2000–2012
1922–1967
1968–2012
1922–2012



S2 position (km from GGB)
150
100
50
SAC
SJR
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Month
Period
1922−1944
1945−1967
1968−1999
2000−2012
1922−1967
1968−2012
1922−2012



S5 position (km from GGB)
150
100
50
SAC
SJR
Dec
Jan
Feb
Mar
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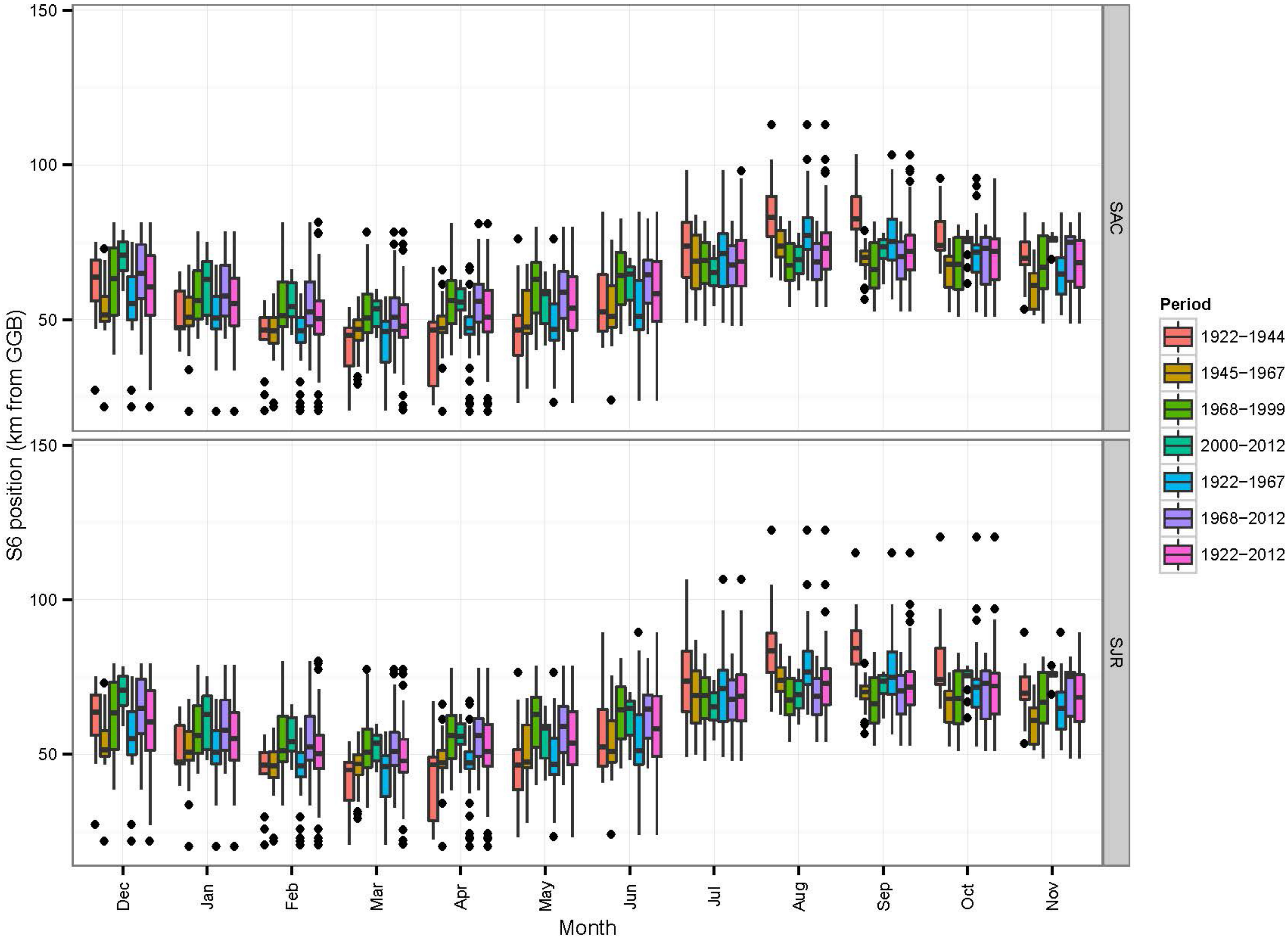
Month
Period
1922–1944
1945–1967
1968–1999
2000–2012
1922–1967
1968–2012
1922–2012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100
50
150
100
50
S6 position (km from GGB)
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SJR
Dec
Jan
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Mar
Apr
May
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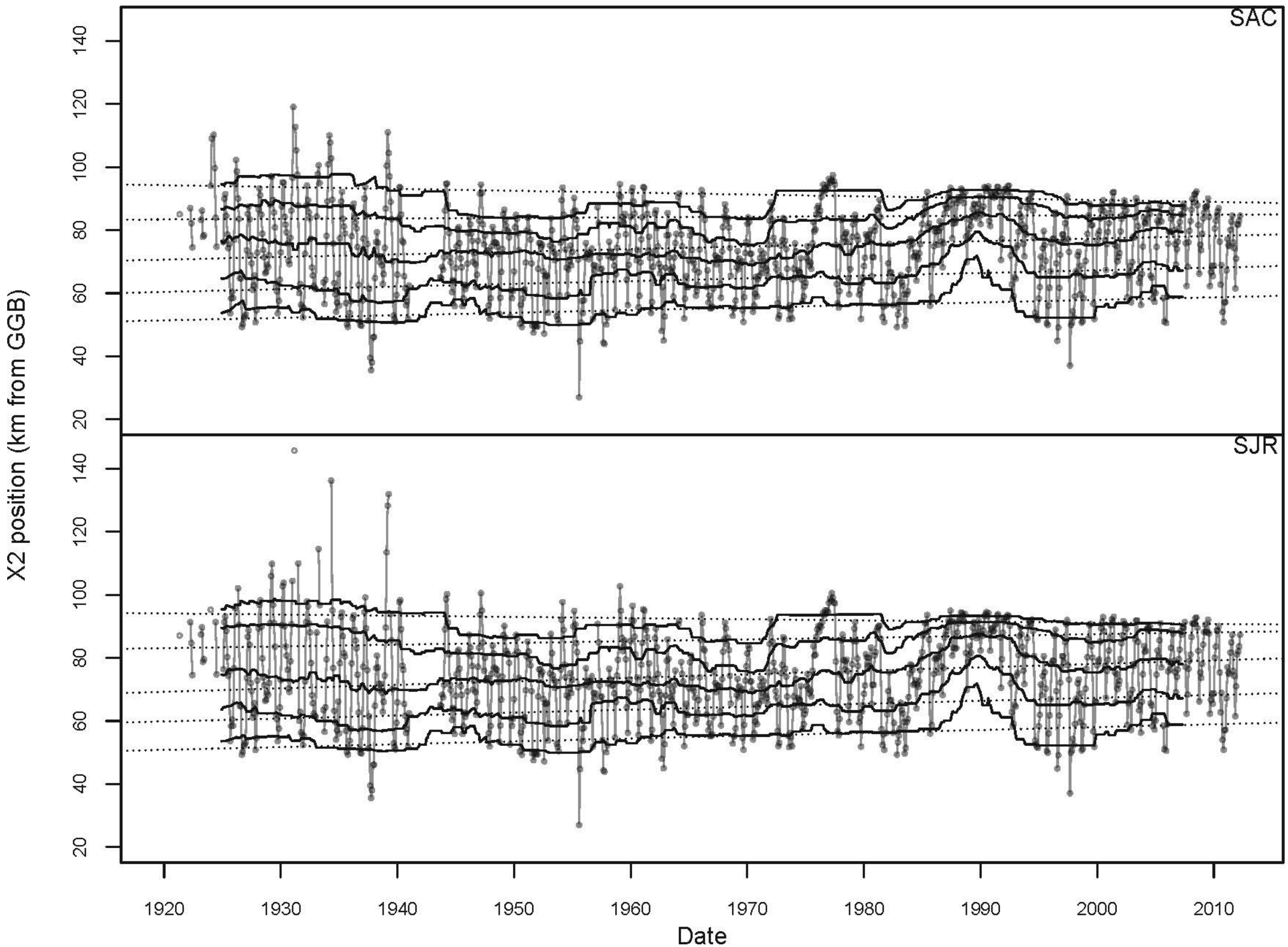
Nov
Month
Period
1922–1944
1945–1967
1968–1999
2000–2012
1922–1967
1968–2012
1922–2012


SAC
SJR
X2 position (km from GGB)
Date
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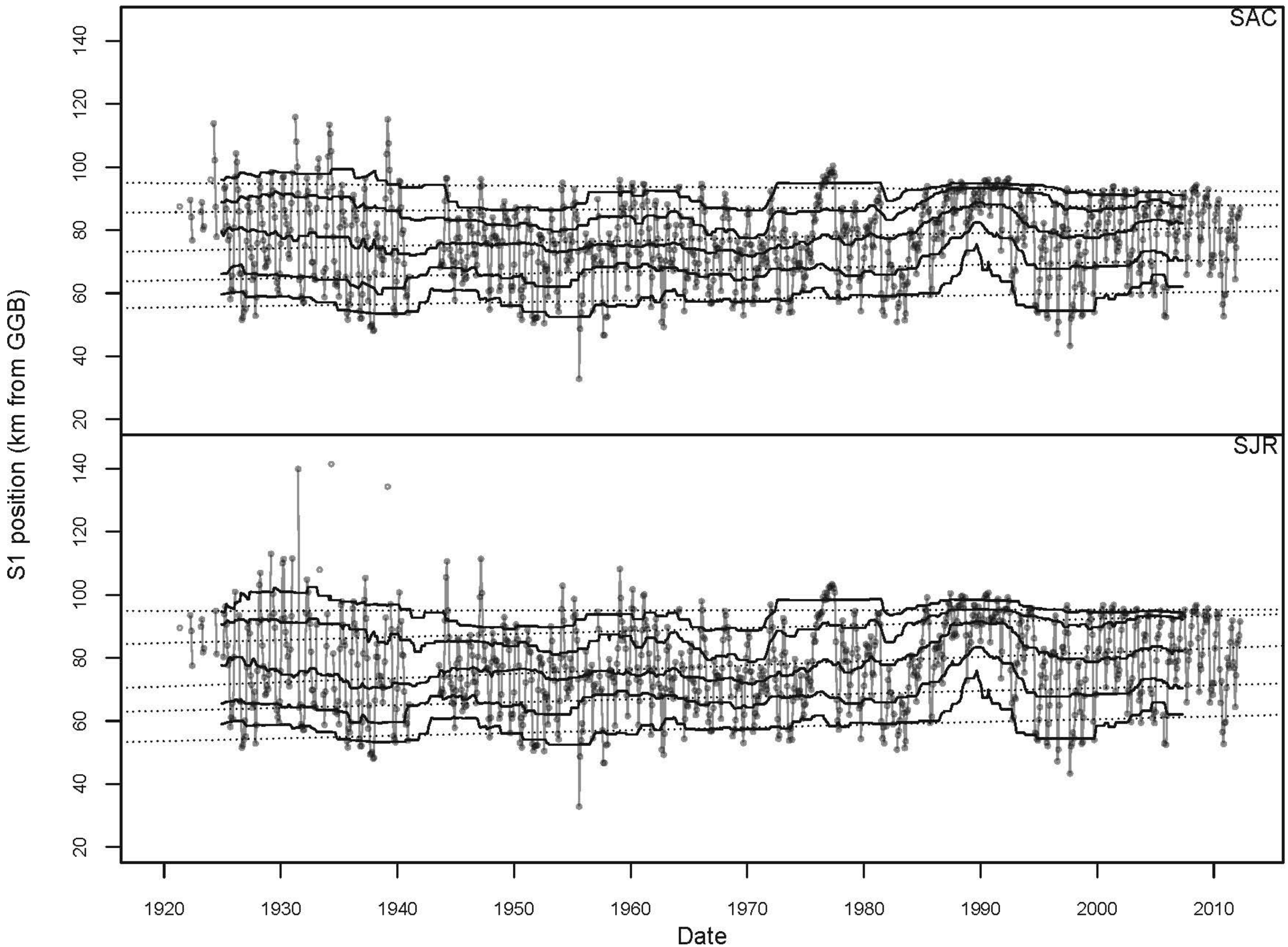
100
120
140
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010



SAC
SJR
S1 position (km from GGB)
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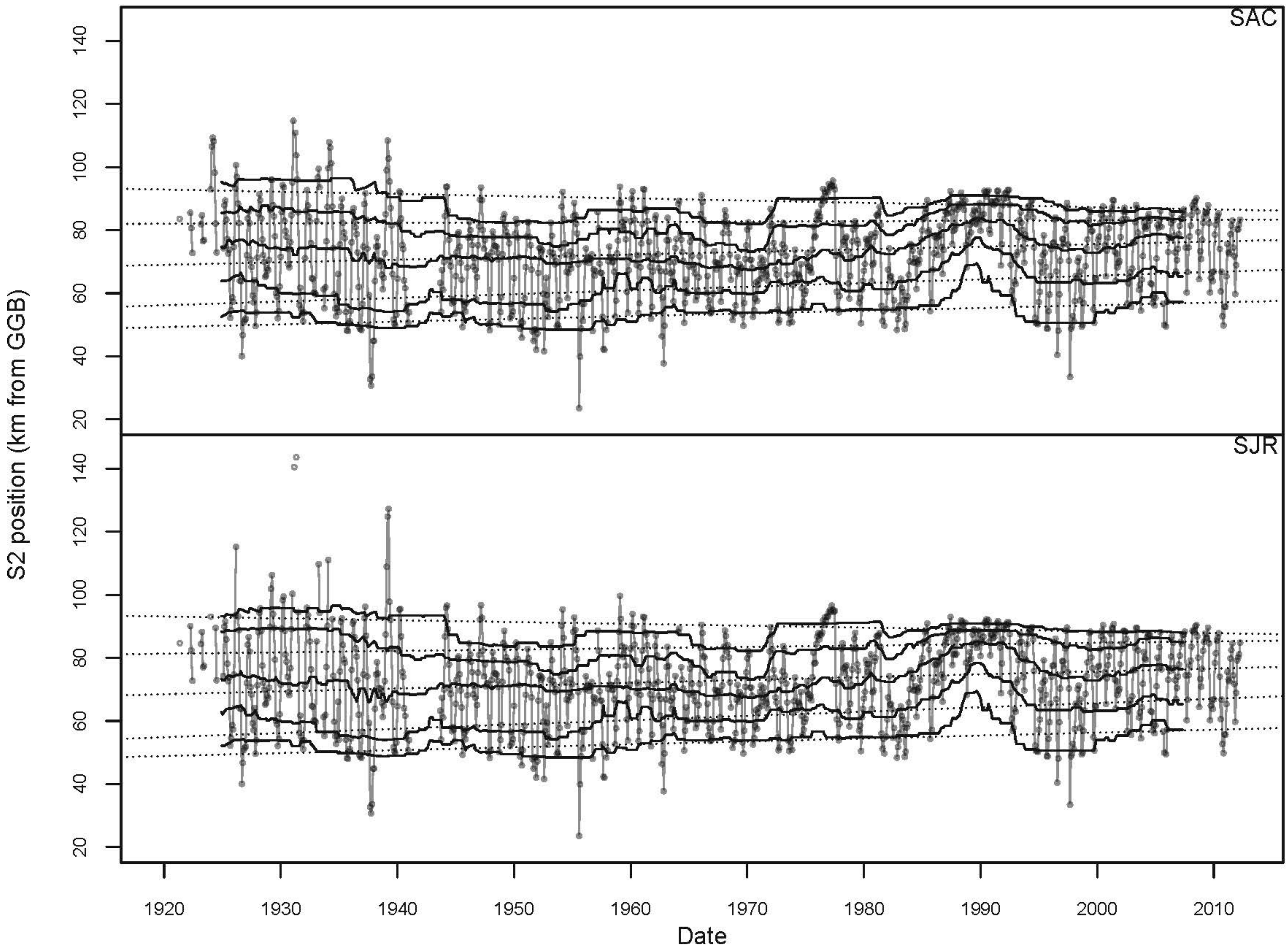
100
120
140
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Date



SAC
SJR
S2 position (km from GGB)
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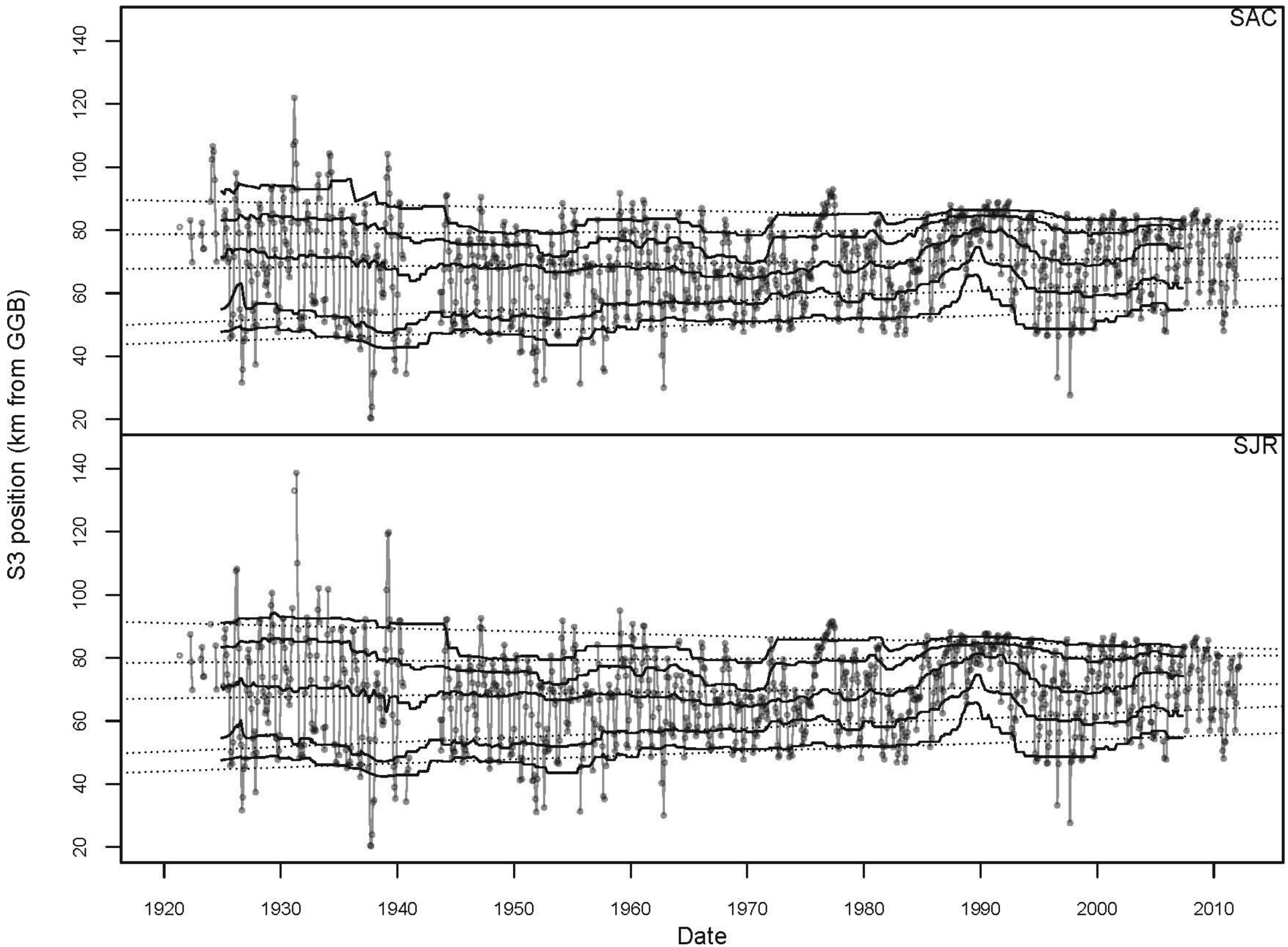
Date


SAC
SJR
S3 position (km from GGB)
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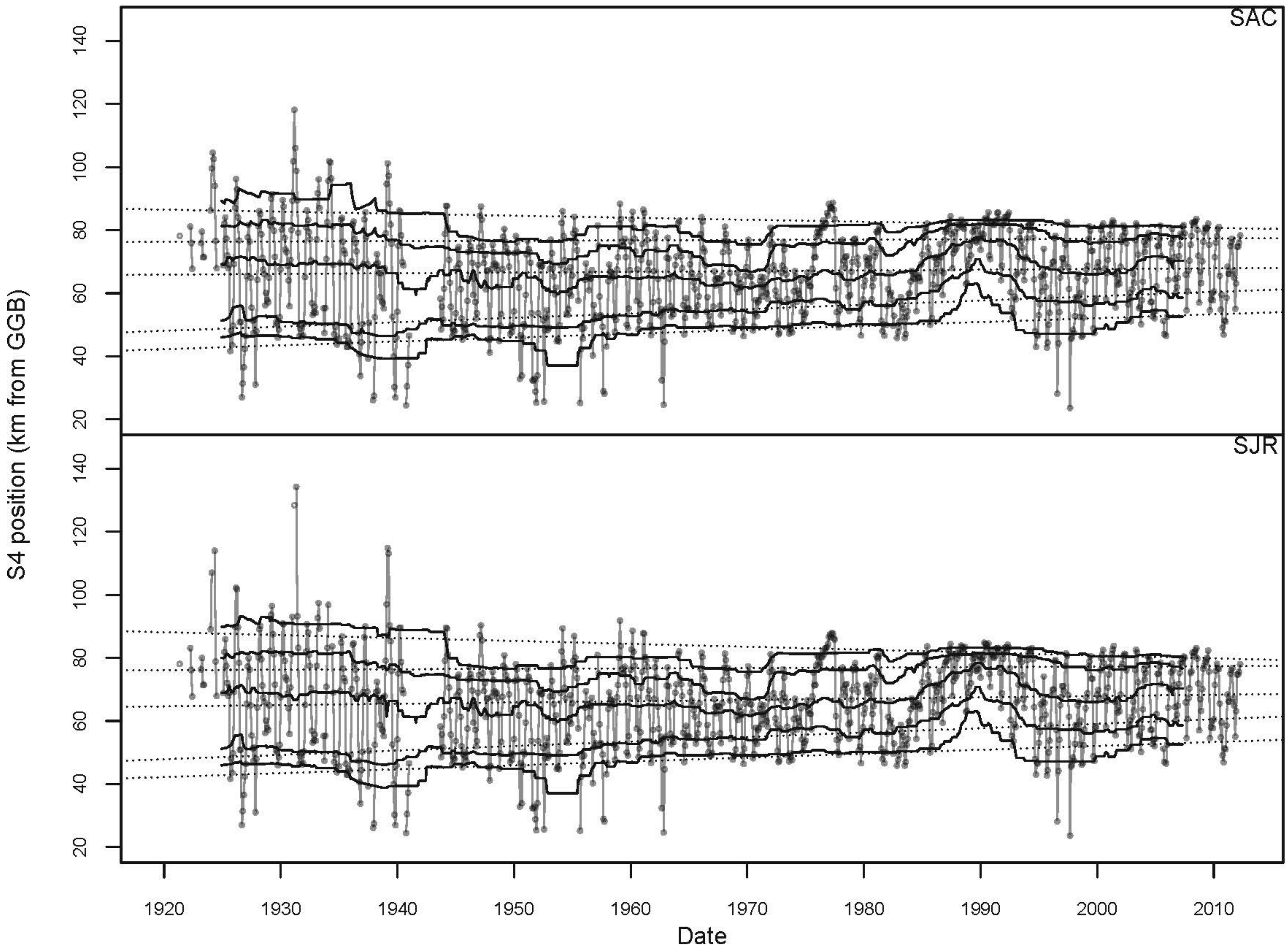
Date


SAC
SJR
S4 position (km from GGB)
140
120
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1920
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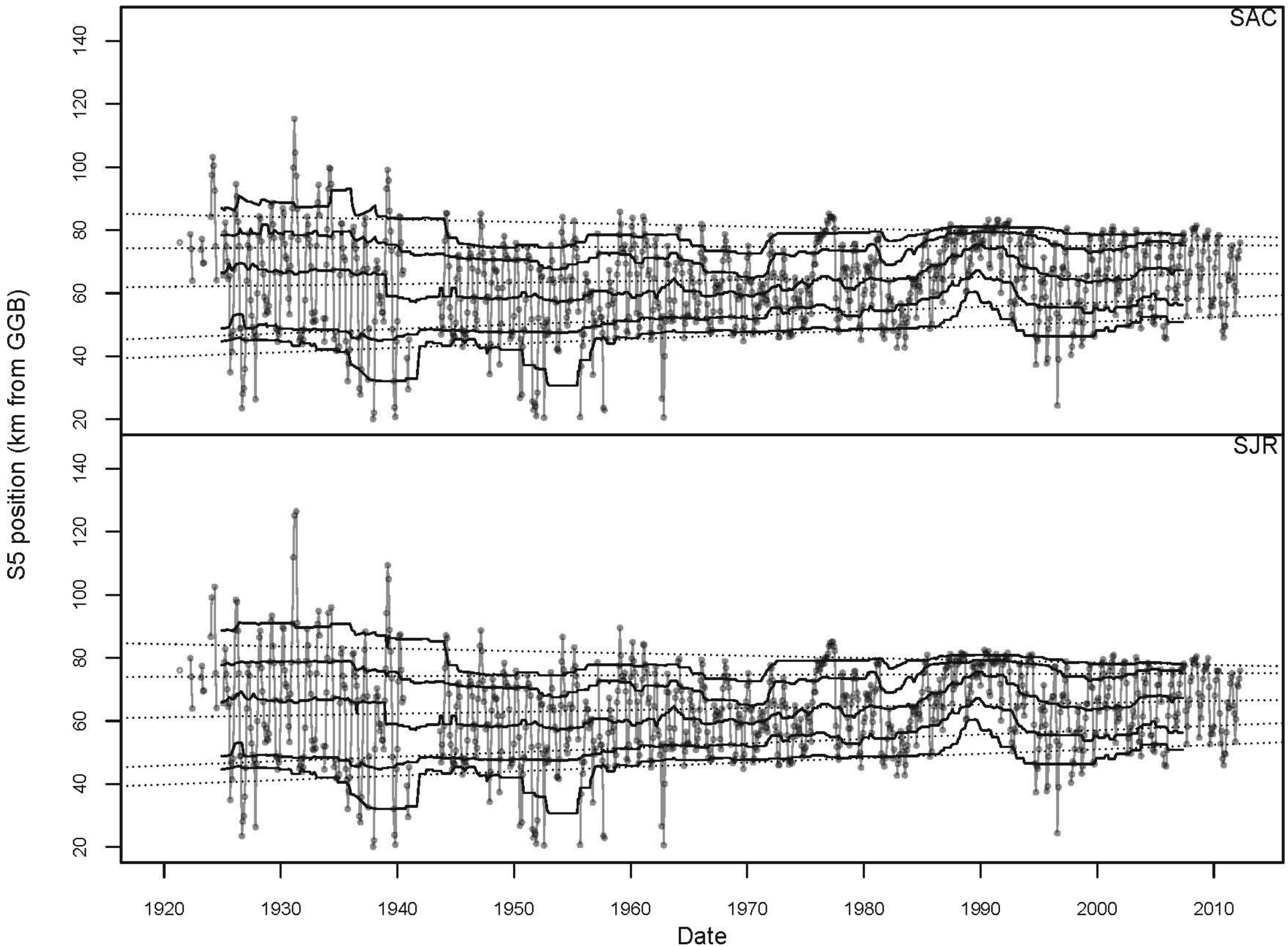
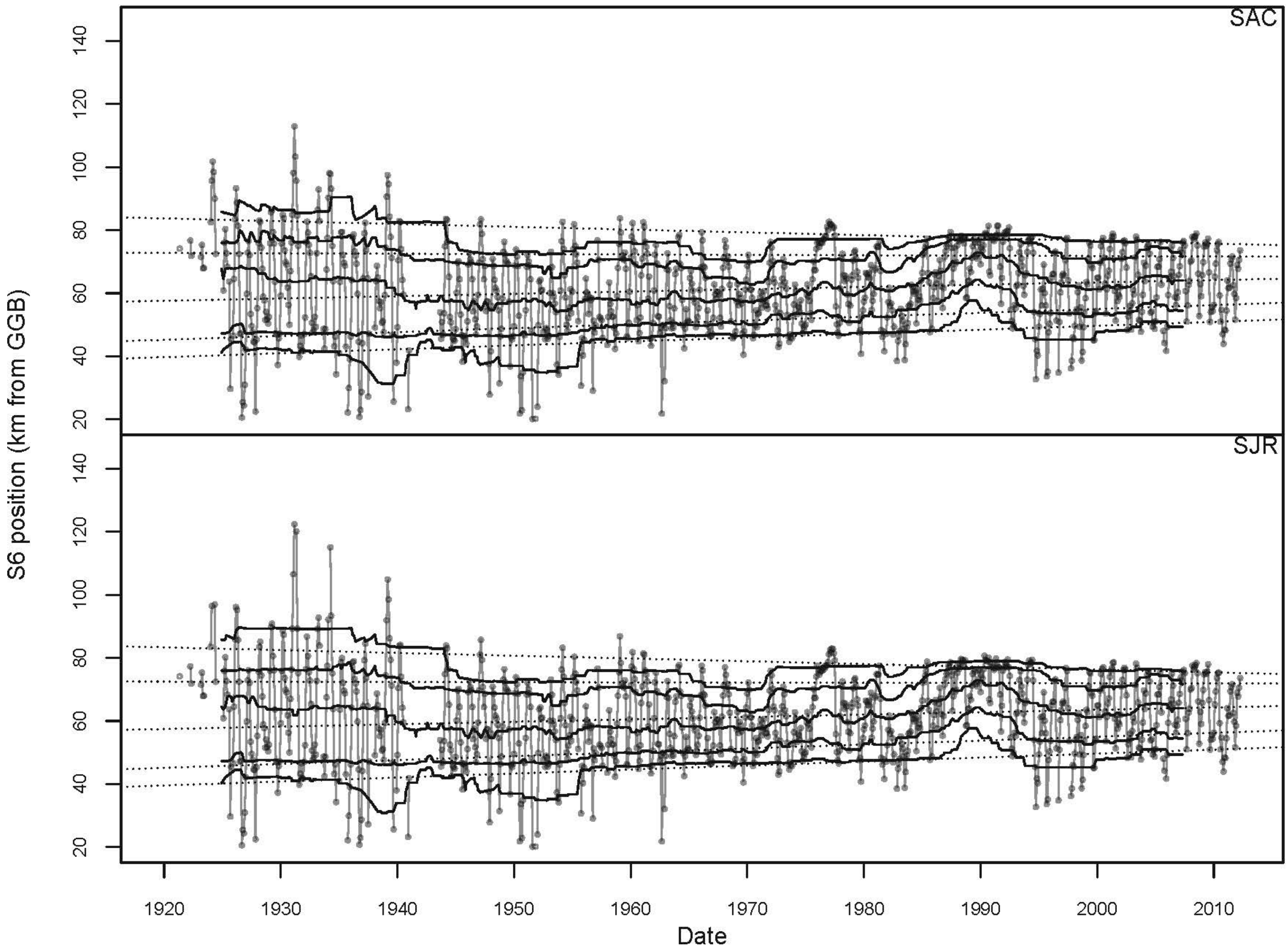
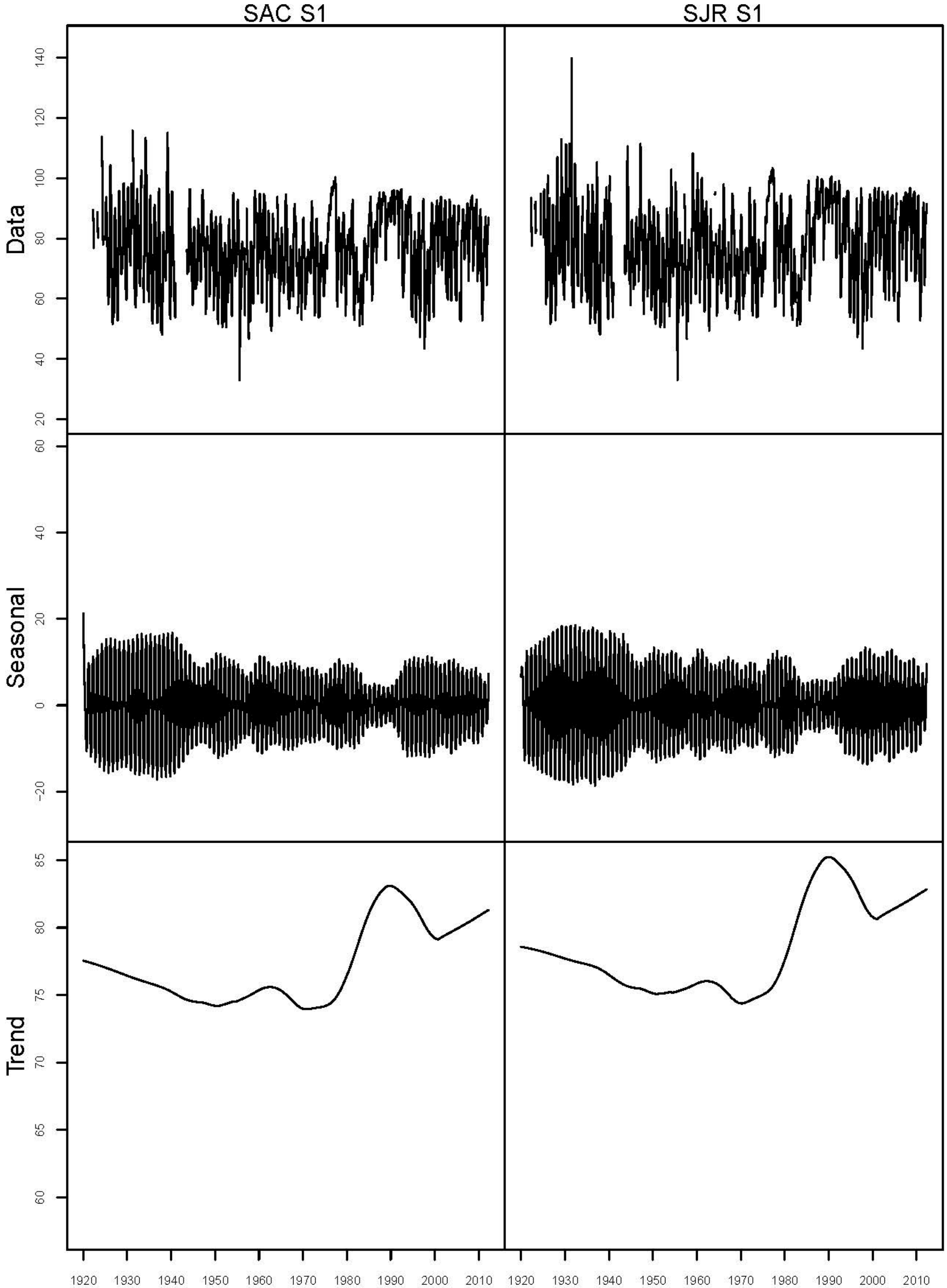
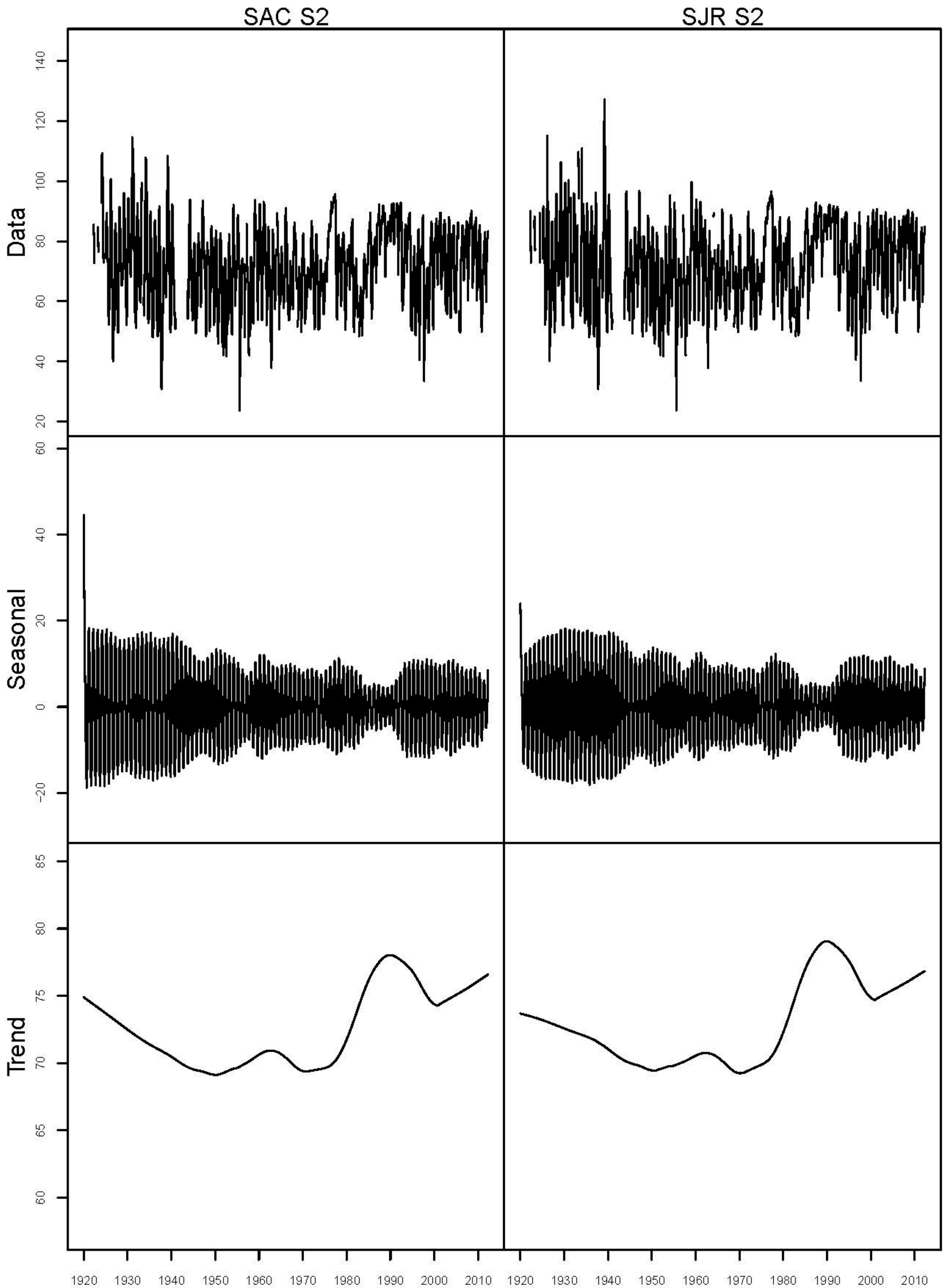
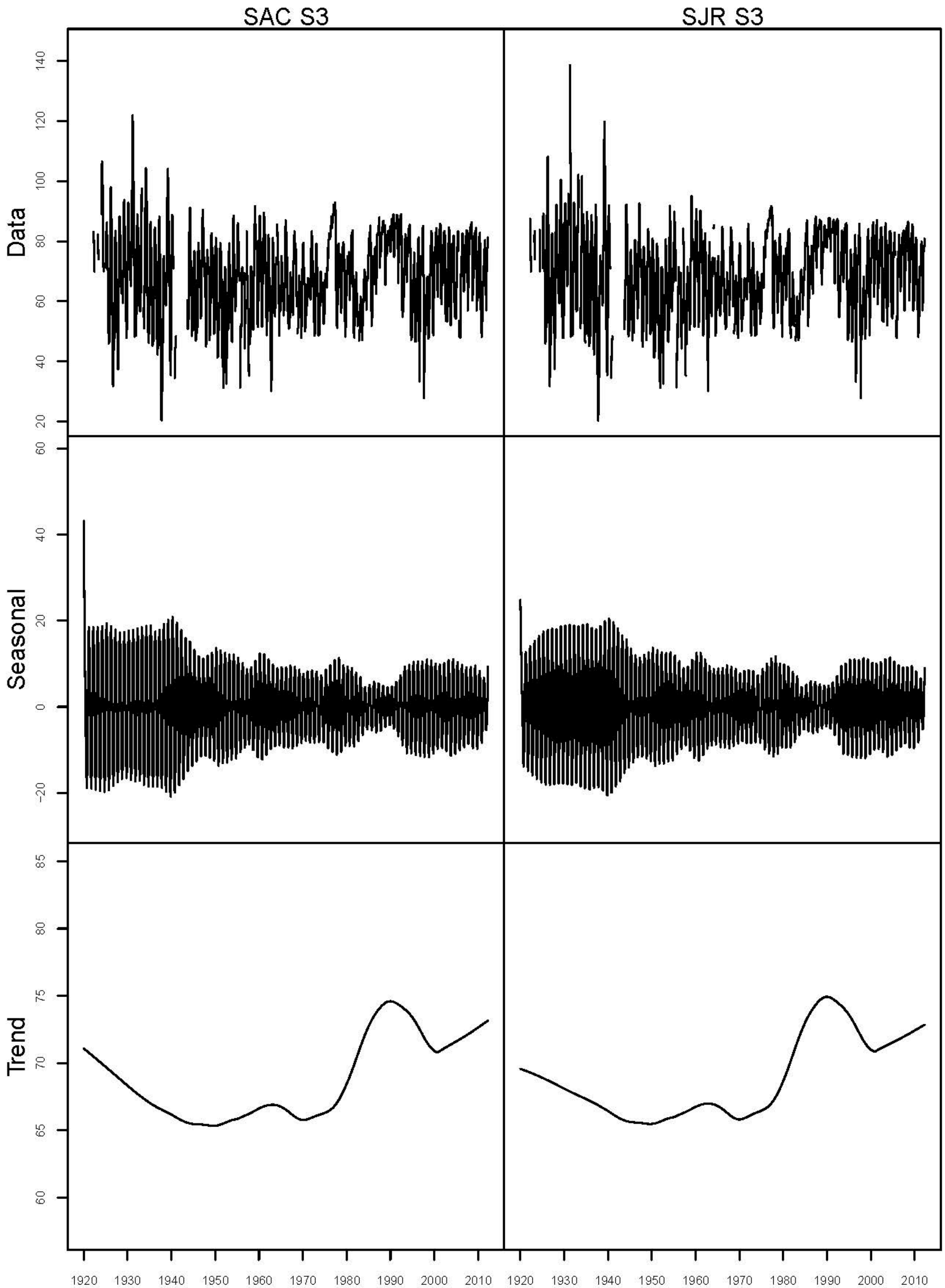
2010
Date

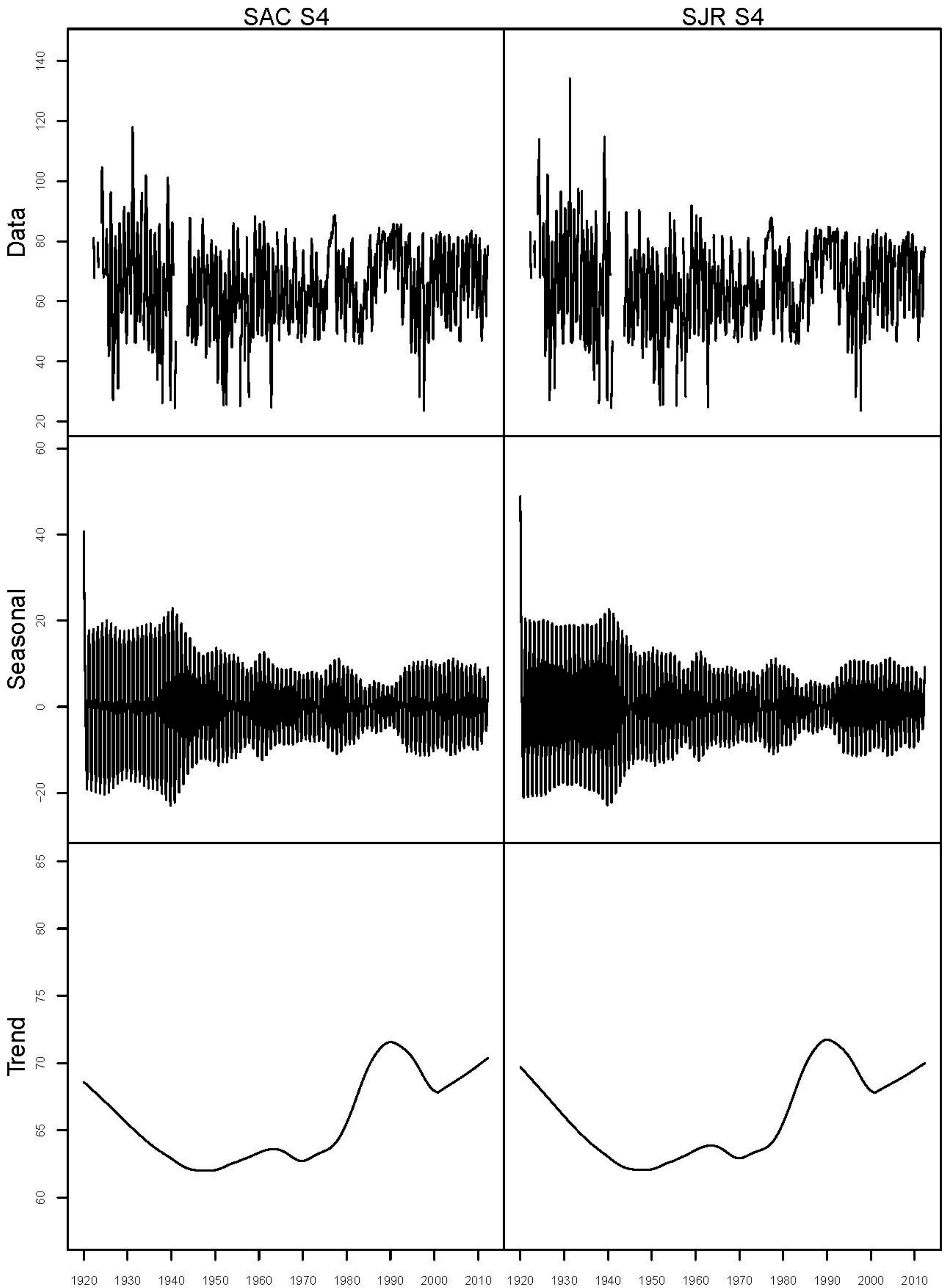

SAC
SJR
S5 position (km from GGB)
20
40
60
80
100
120
140
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Date

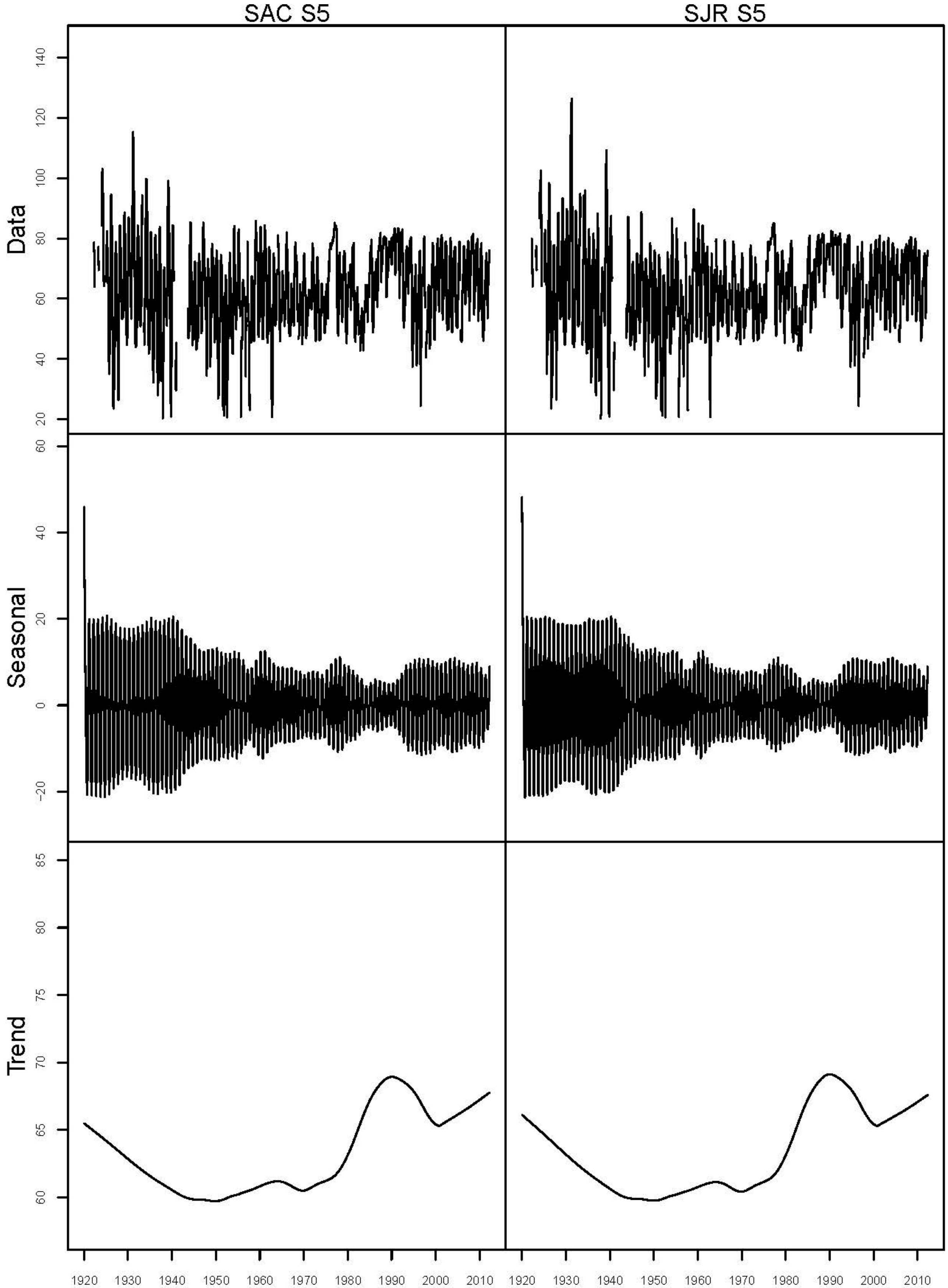

SAC
SJR
S6 position (km from GGB)
20
40
60
80
100
120
140
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Date

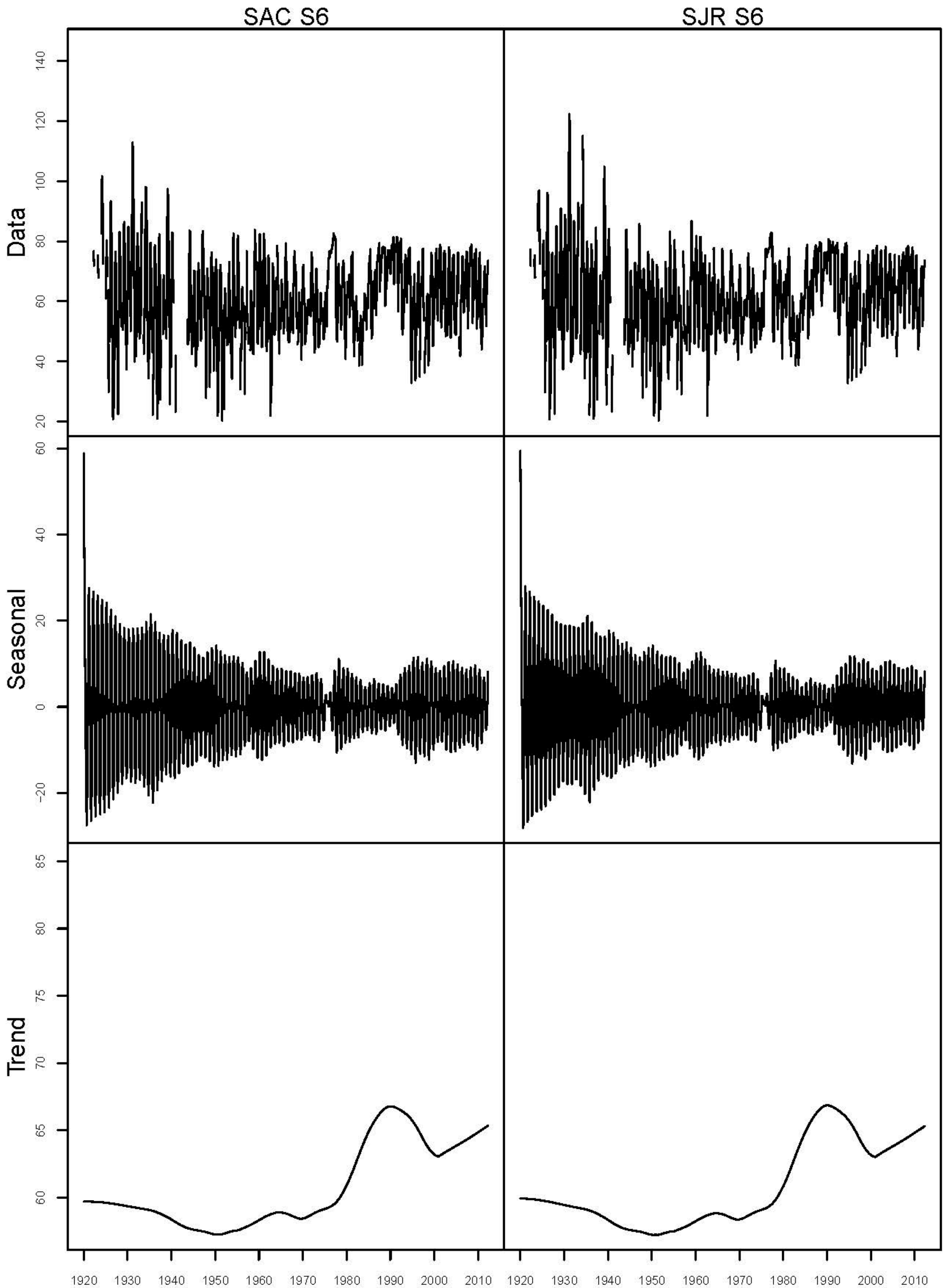

SAC S1
SJR S1
Data
Seasonal
Trend
140
120
100
80
60
40
20
60
40
20
0
-20
85
80
75
70
65
60
1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

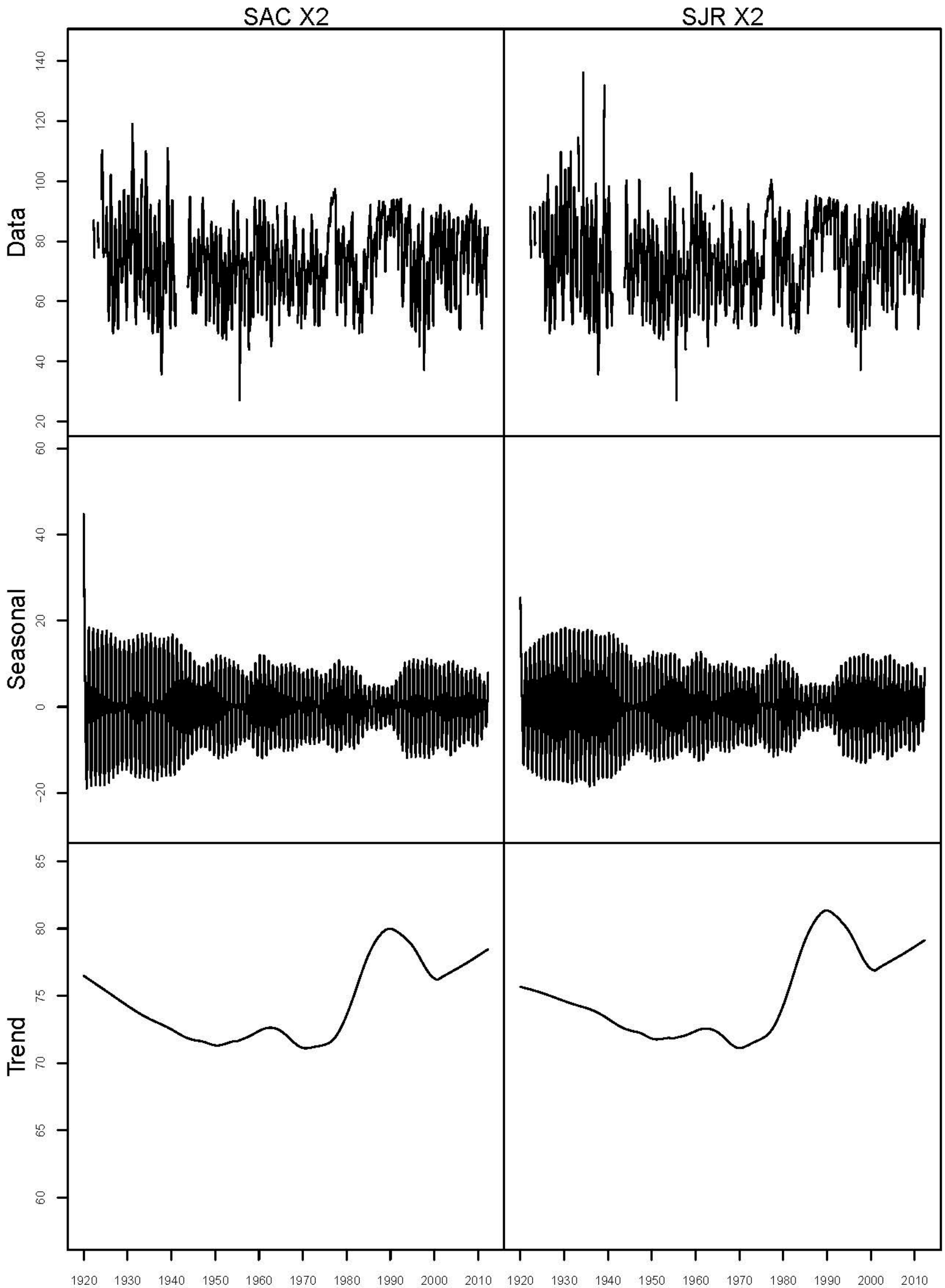

SAC S2
SJR S2
Data
Seasonal
Trend
140
120
100
80
60
40
20
60
40
20
0
-20
85
80
75
70
65
60
1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

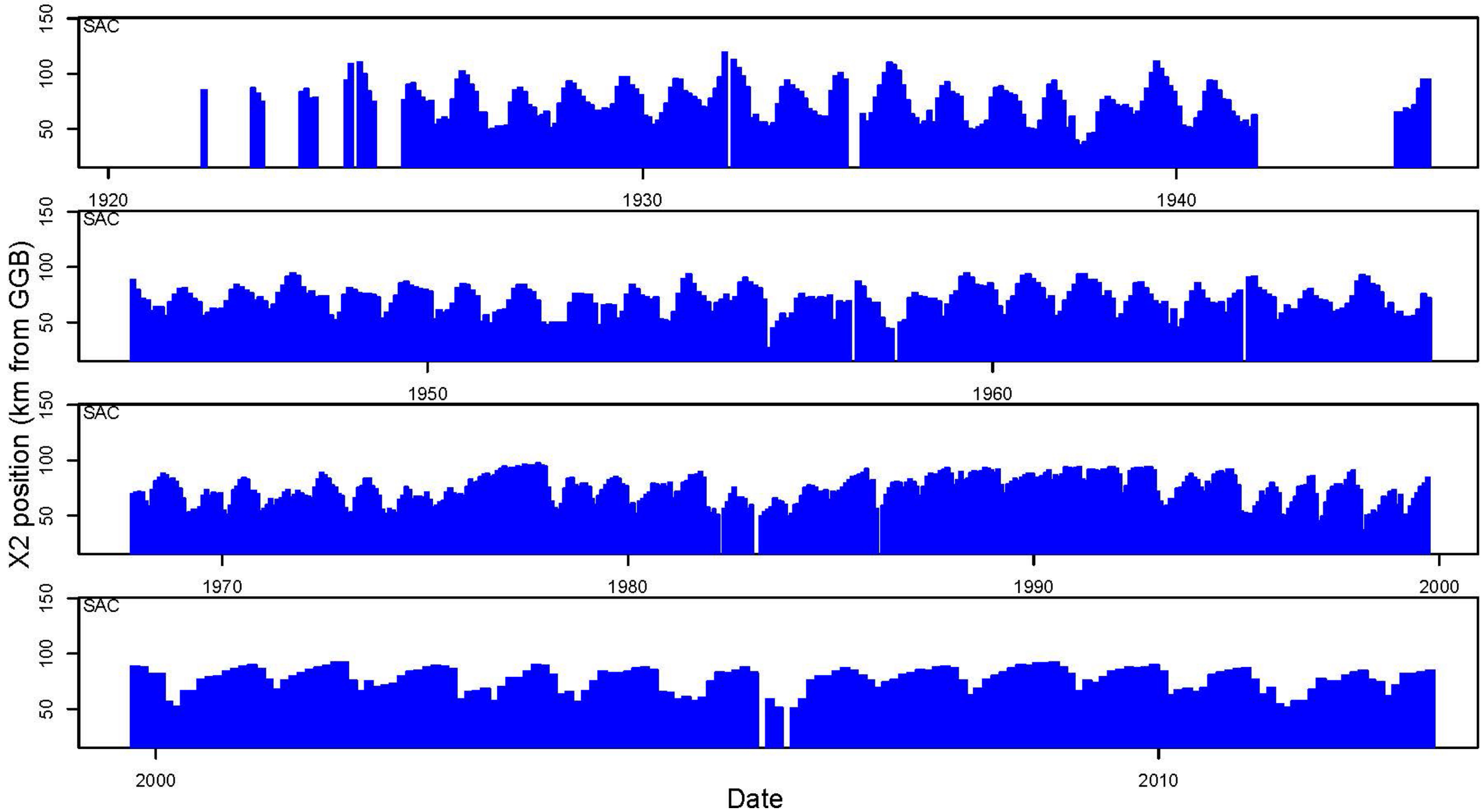

SAC S3
SJR S3
Data
Seasonal
Trend
140
120
100
80
60
40
20
60
40
20
0
-20
85
80
75
70
65
60
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

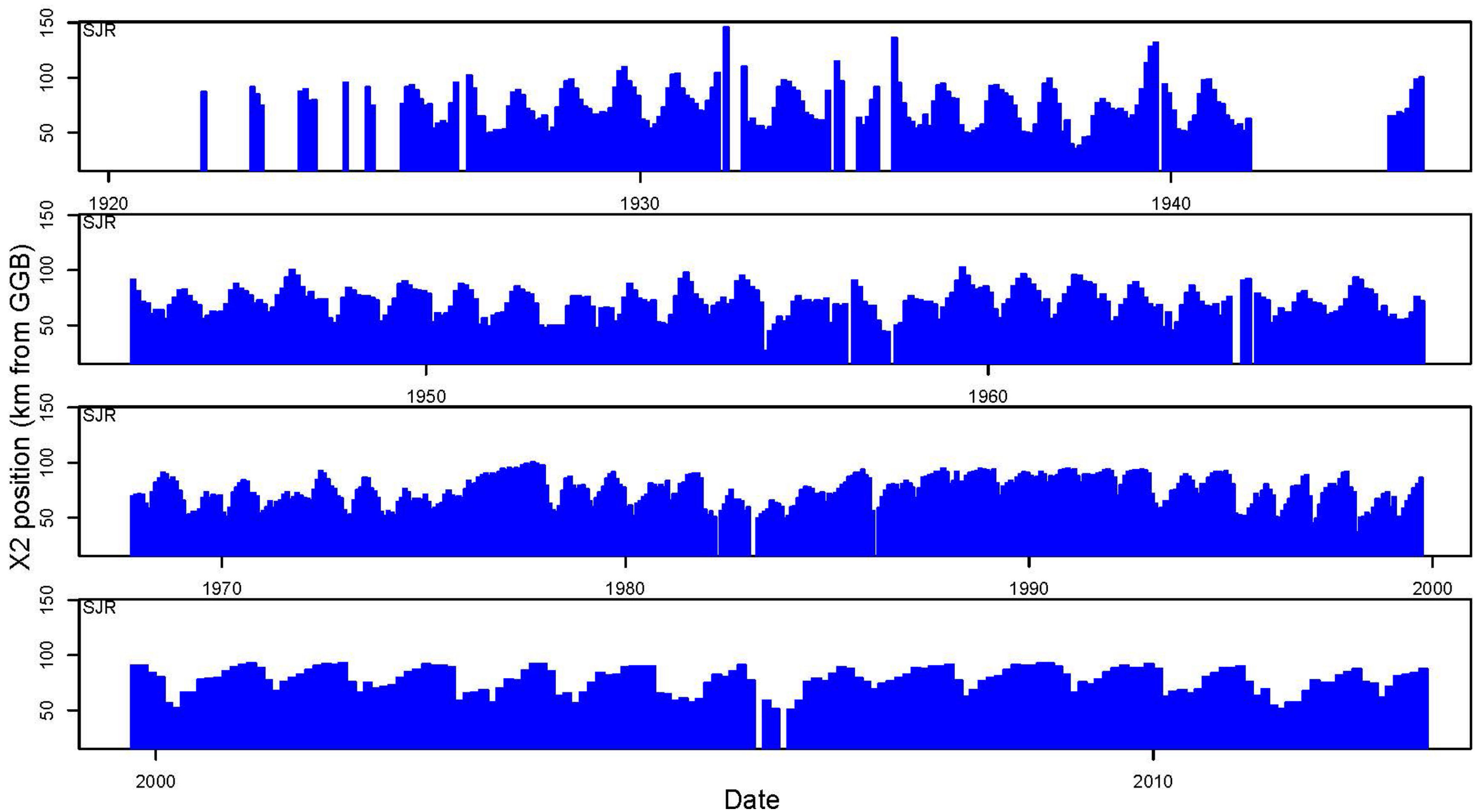

SAC S4
SJR S4
Data
Seasonal
Trend
140
120
100
80
60
40
20
60
40
20
0
-20
85
80
75
70
65
60
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

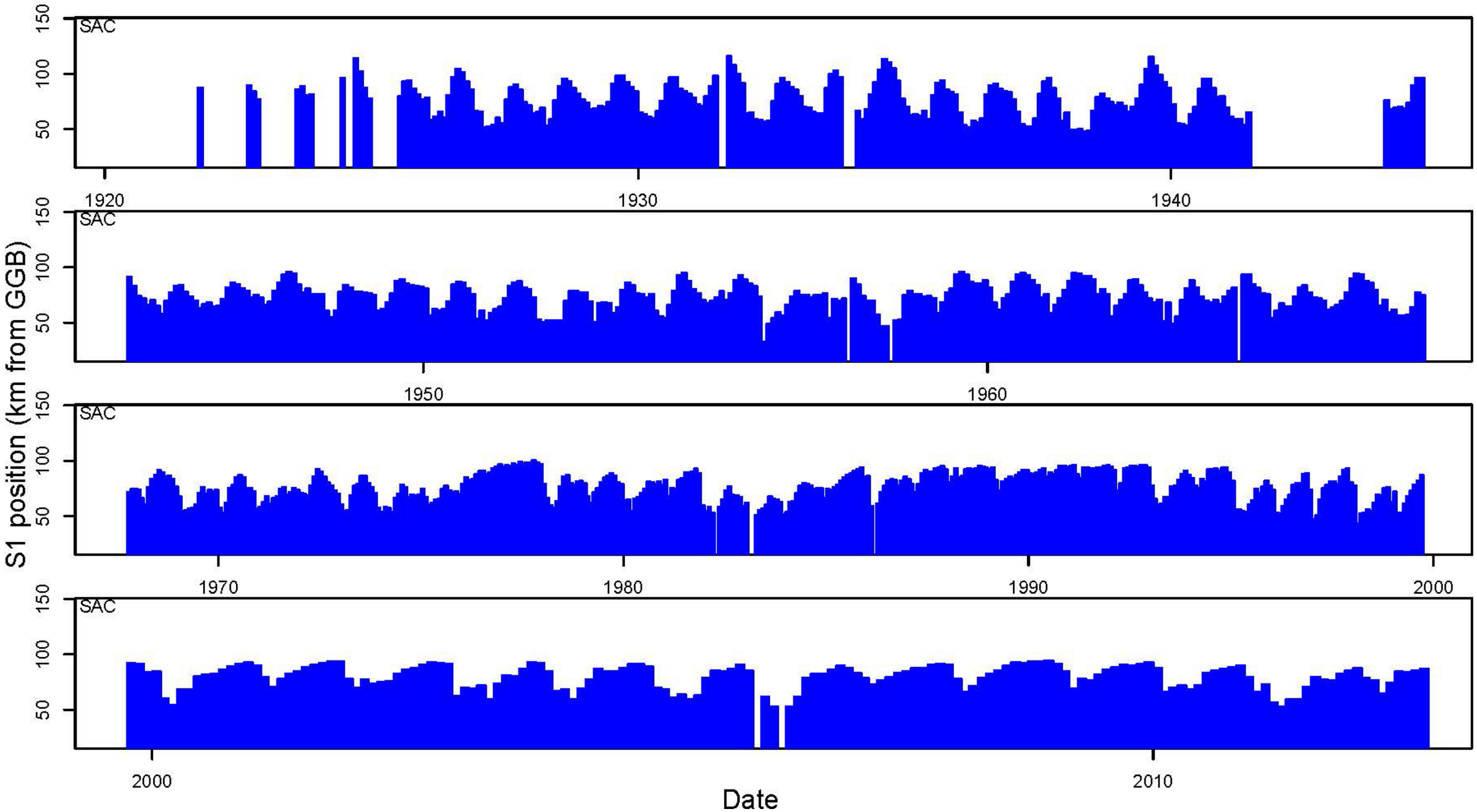

SAC S5
SJR S5
Data
Seasonal
Trend
140
120
100
80
60
40
20
60
40
20
0
-20
85
80
75
70
65
60
1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

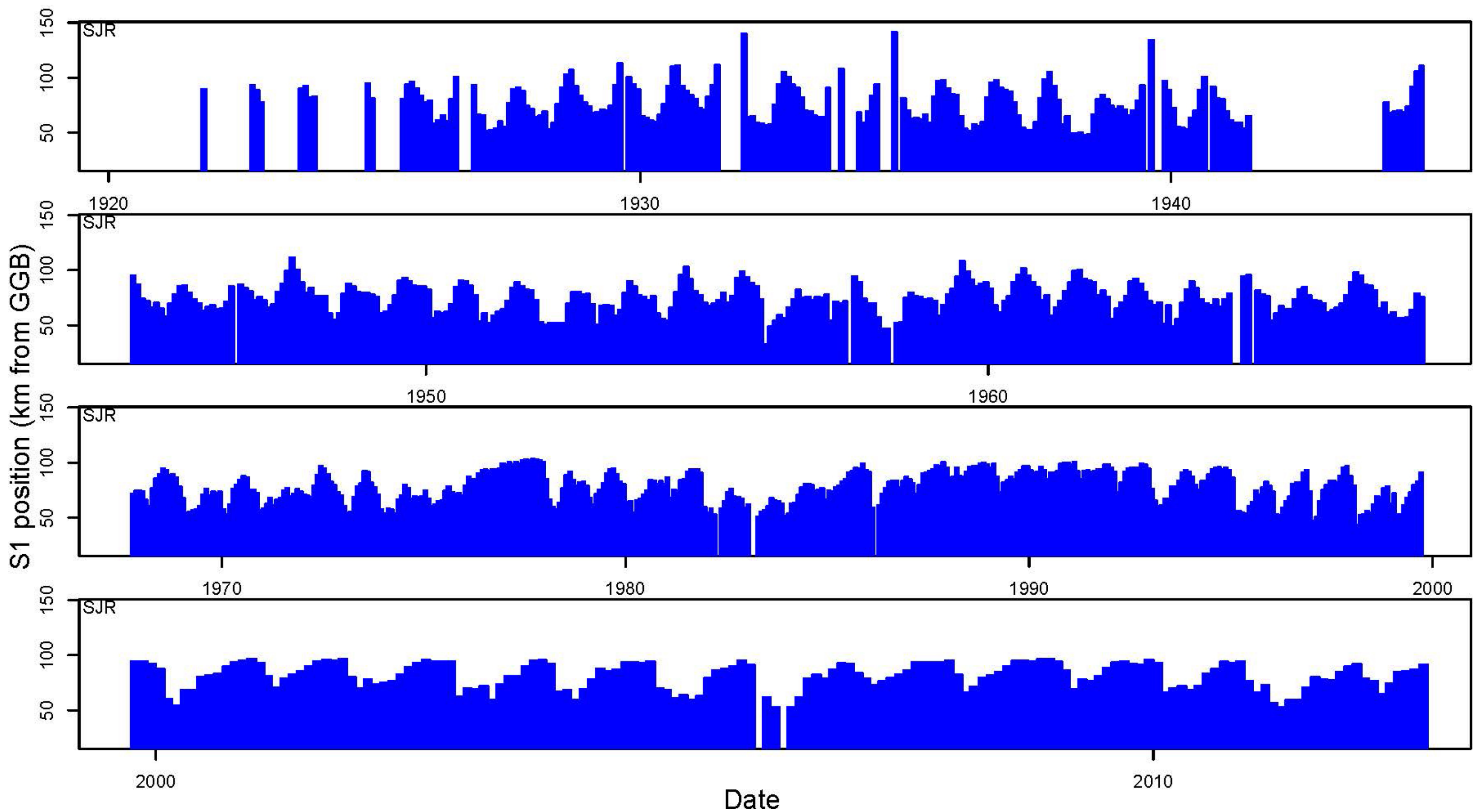

SAC S6
SJR S6
Data
Seasonal
Trend
140
120
100
80
60
40
20
60
40
20
0
-20
85
80
75
70
65
60
1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

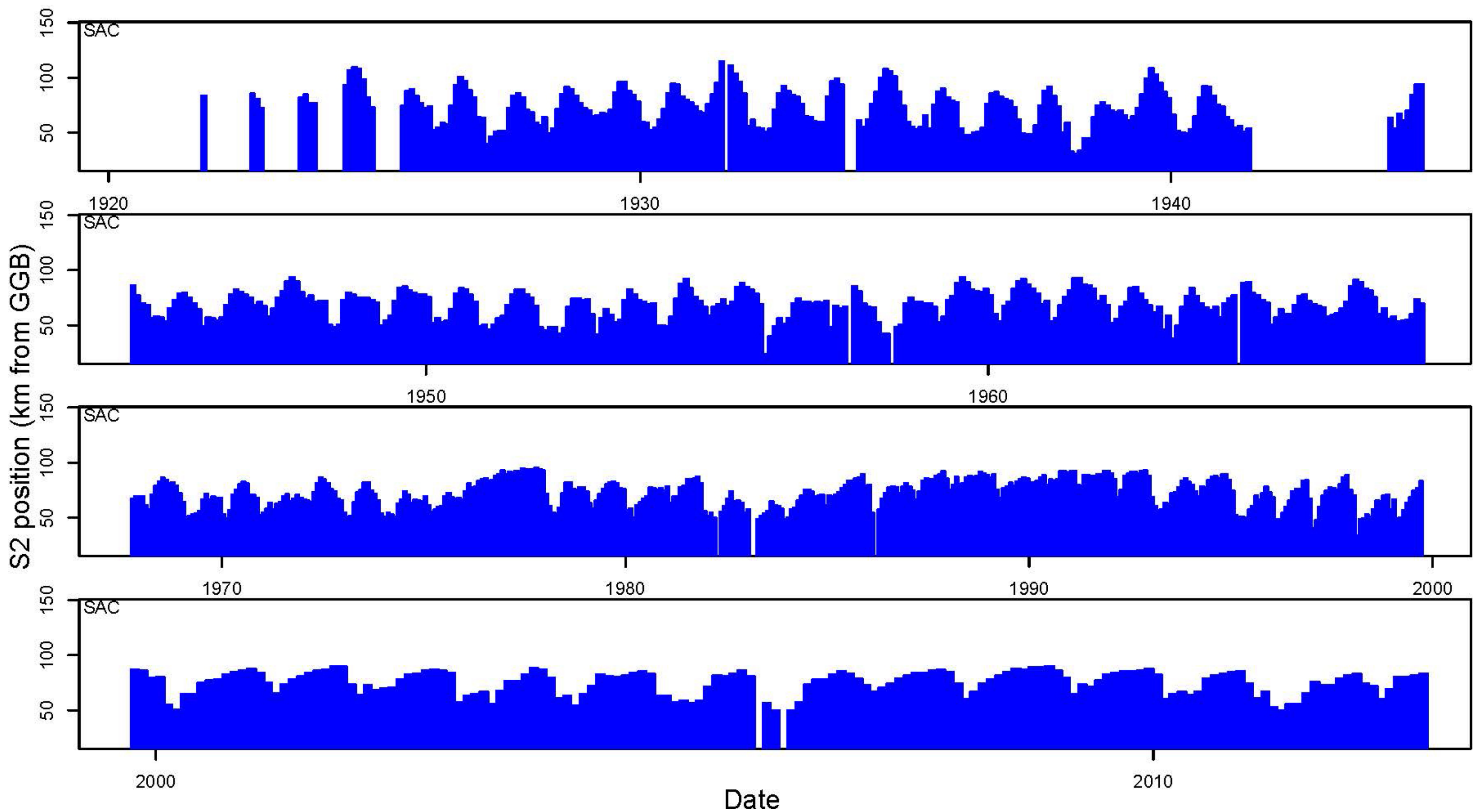

SAC X2
SJR X2
Data
Seasonal
Trend
140
120
100
80
60
40
20
60
40
20
0
-20
85
80
75
70
65
60
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

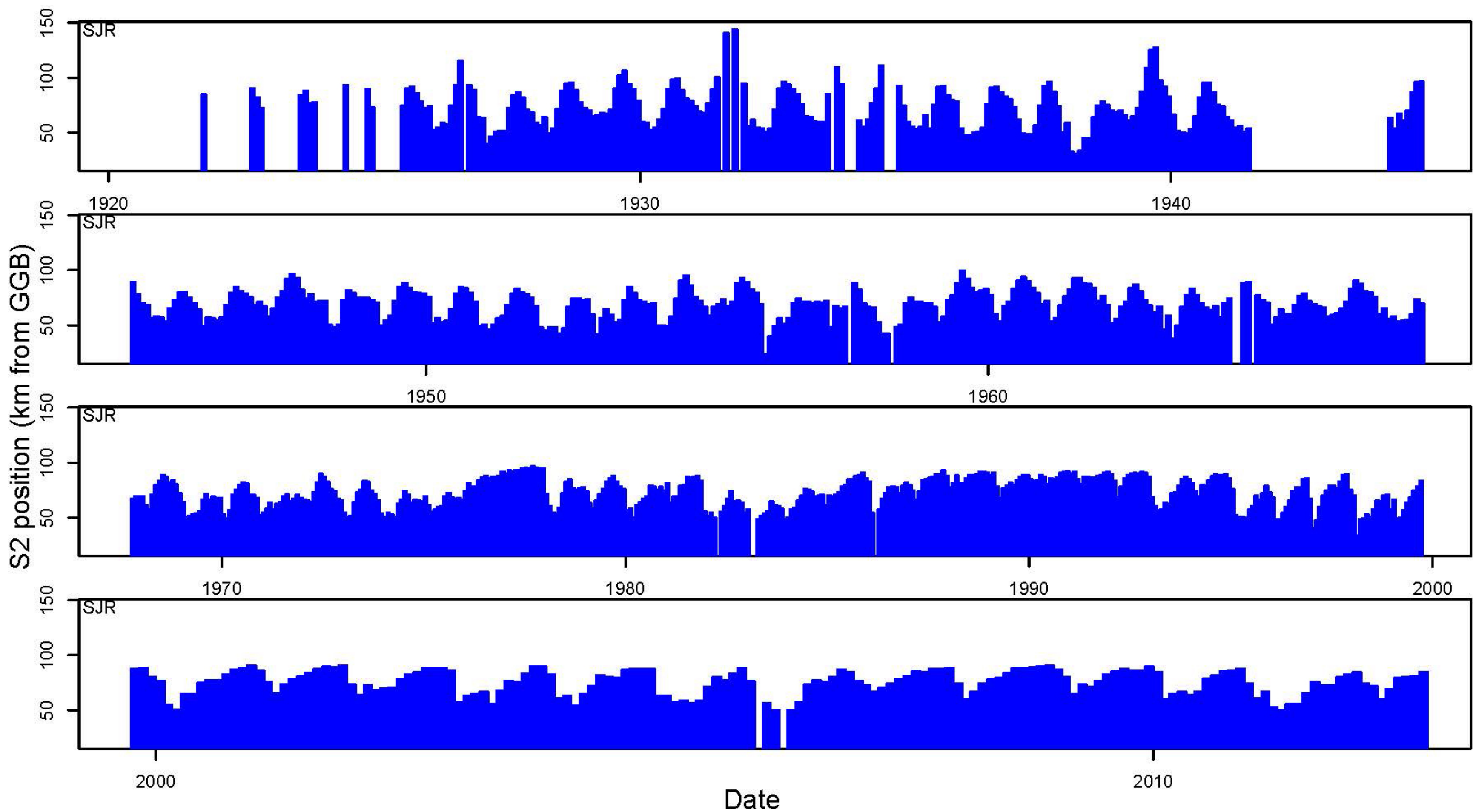

SAC
150
100
50
1920
1930
1940
SAC
1950
1960
SAC
1970
1980
1990
2000
SAC
2000
2010
X2 position (km from GGB)
Date

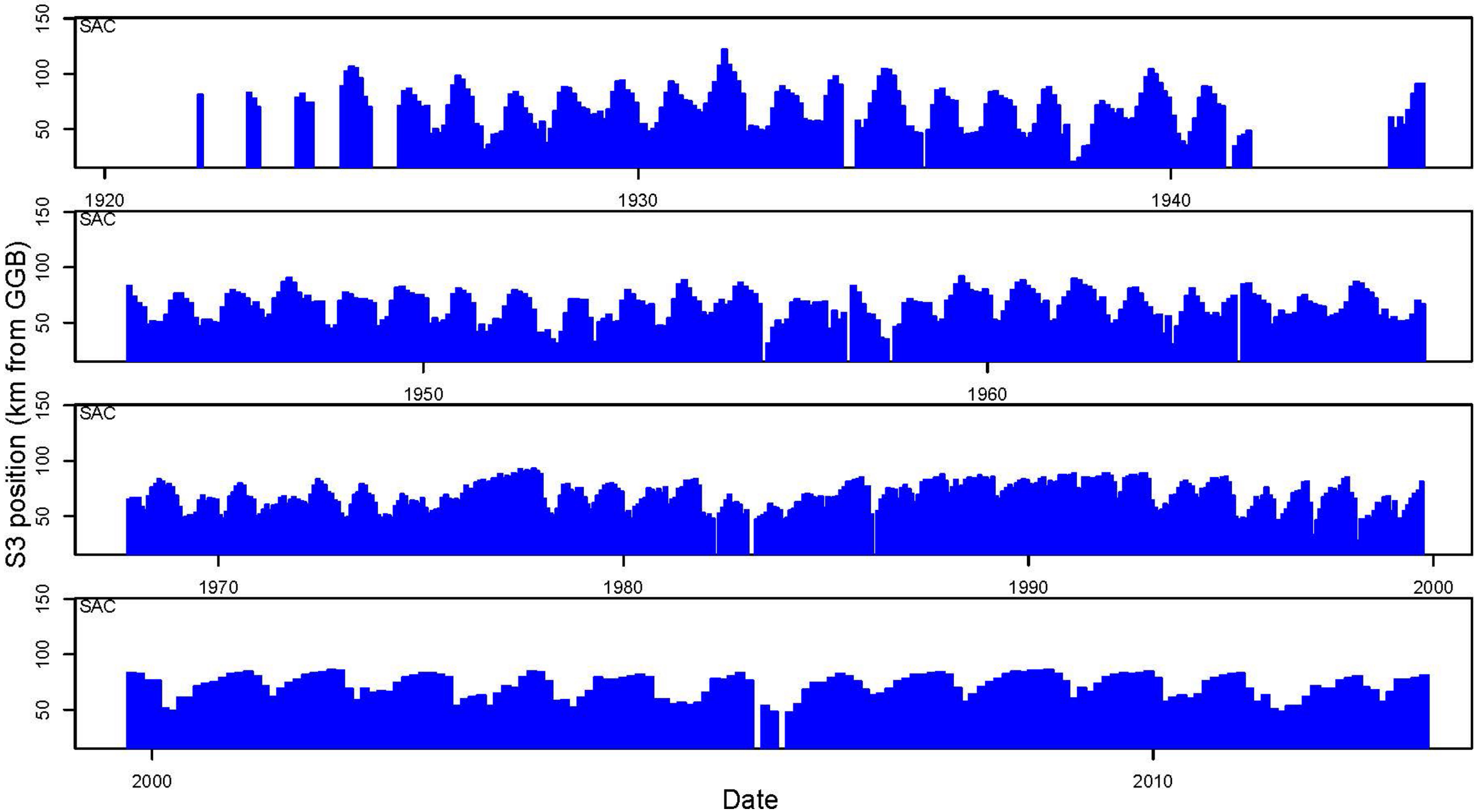

SJR
SJR
SJR
SJR
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
X2 position (km from GGB)
Date

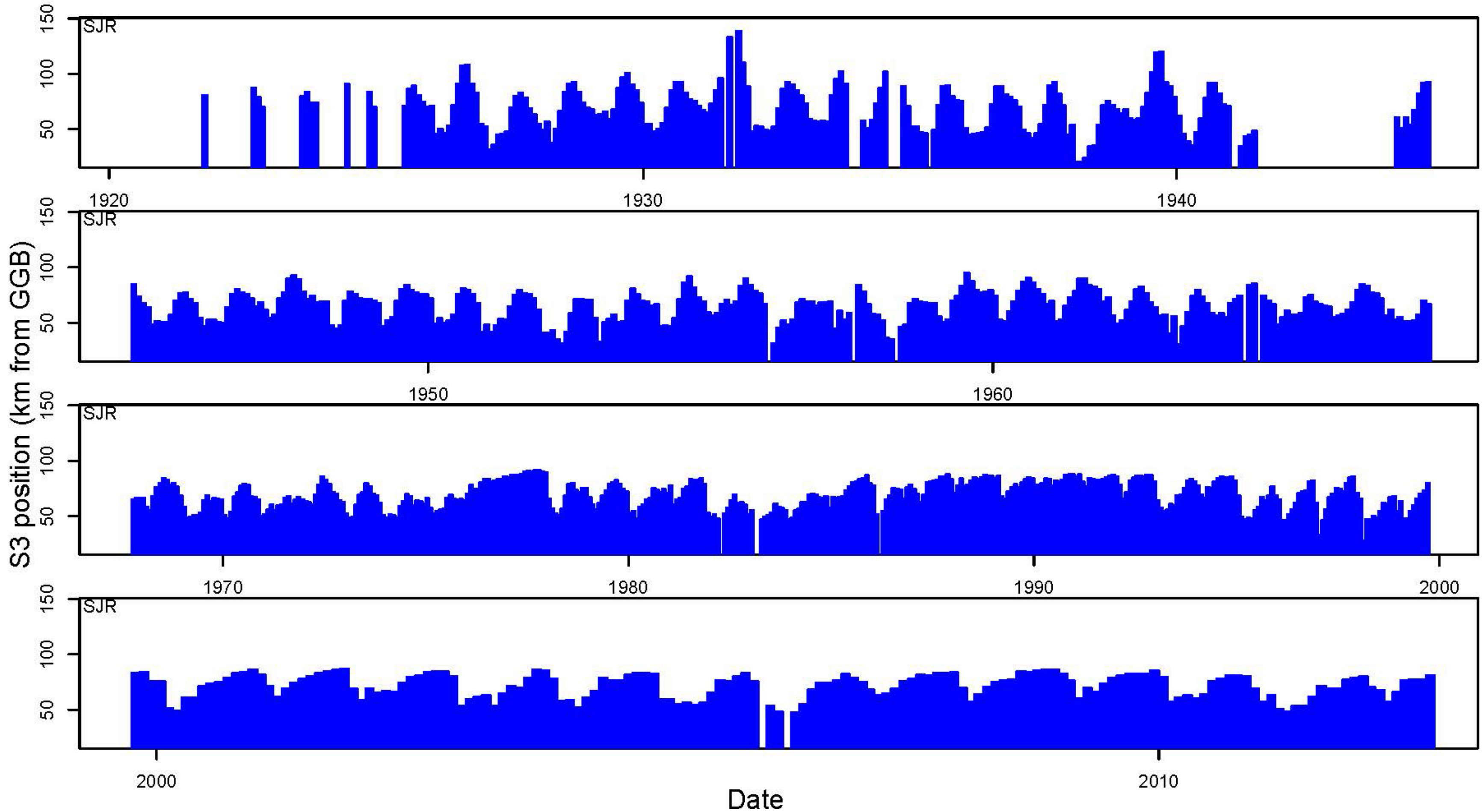

SAC
SAC
SAC
SAC
S1 position (km from GGB)
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Date

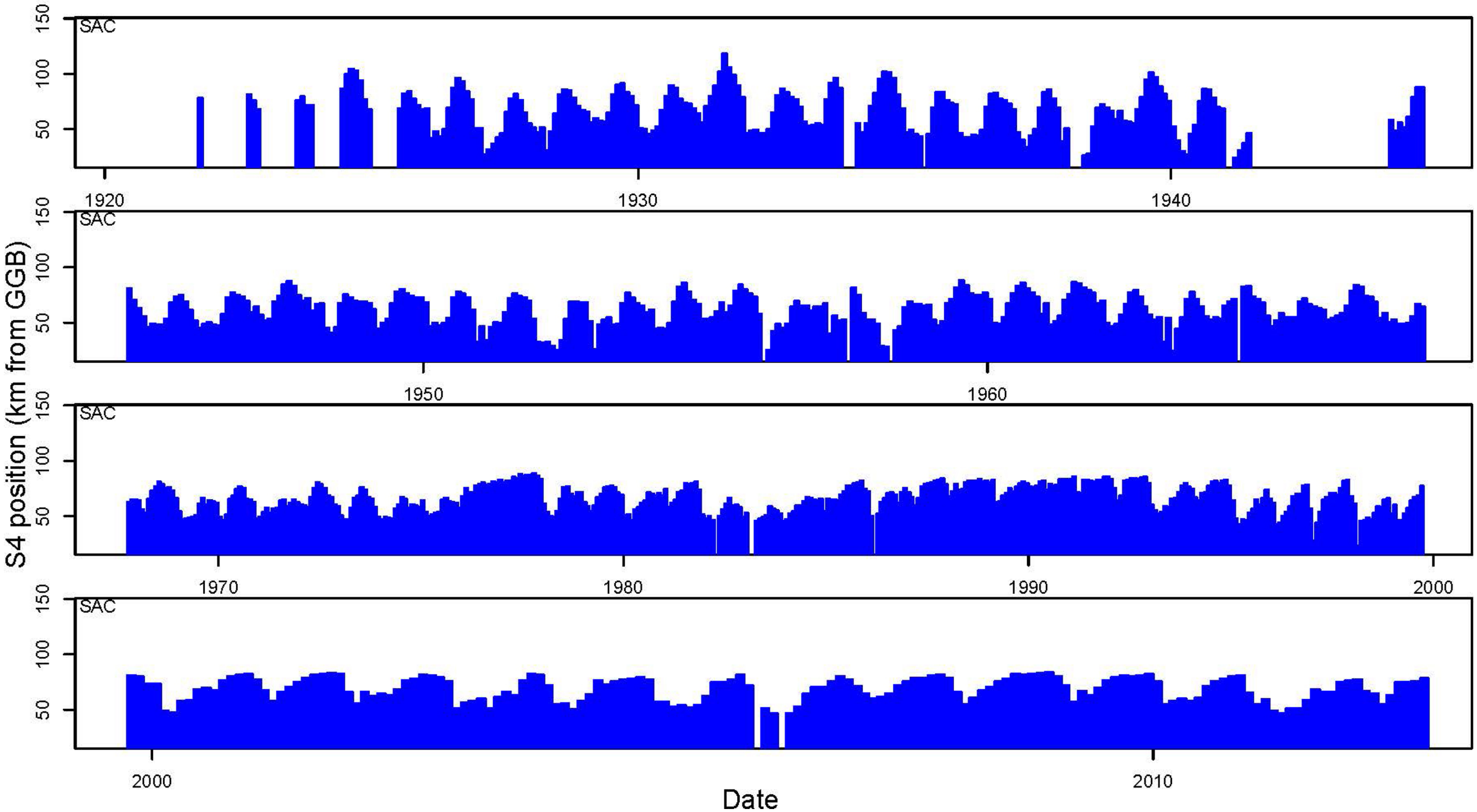

SJR
SJR
SJR
SJR
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
S1 position (km from GGB)
Date

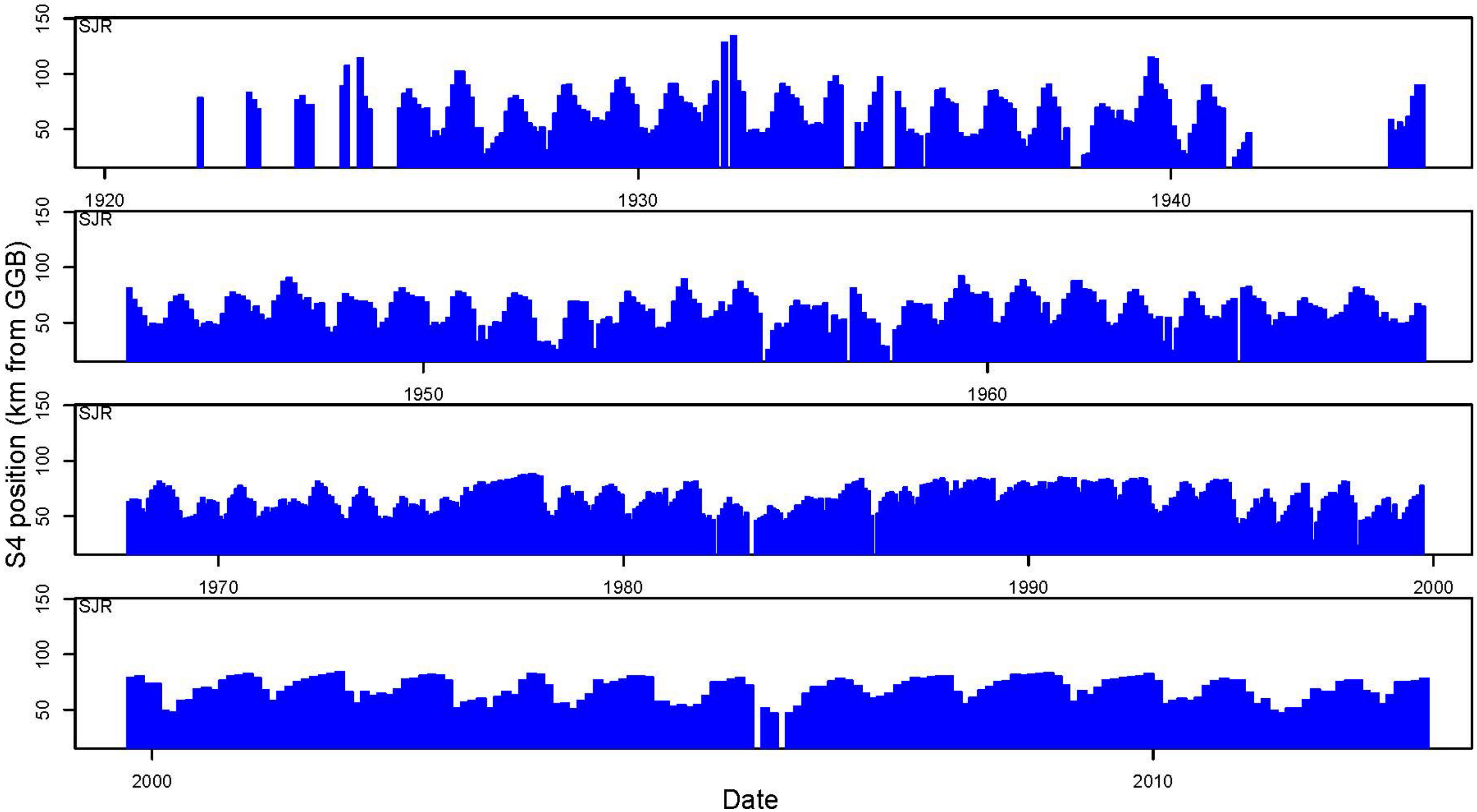

SAC
SAC
SAC
SAC
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
S2 position (km from GGB)
Date

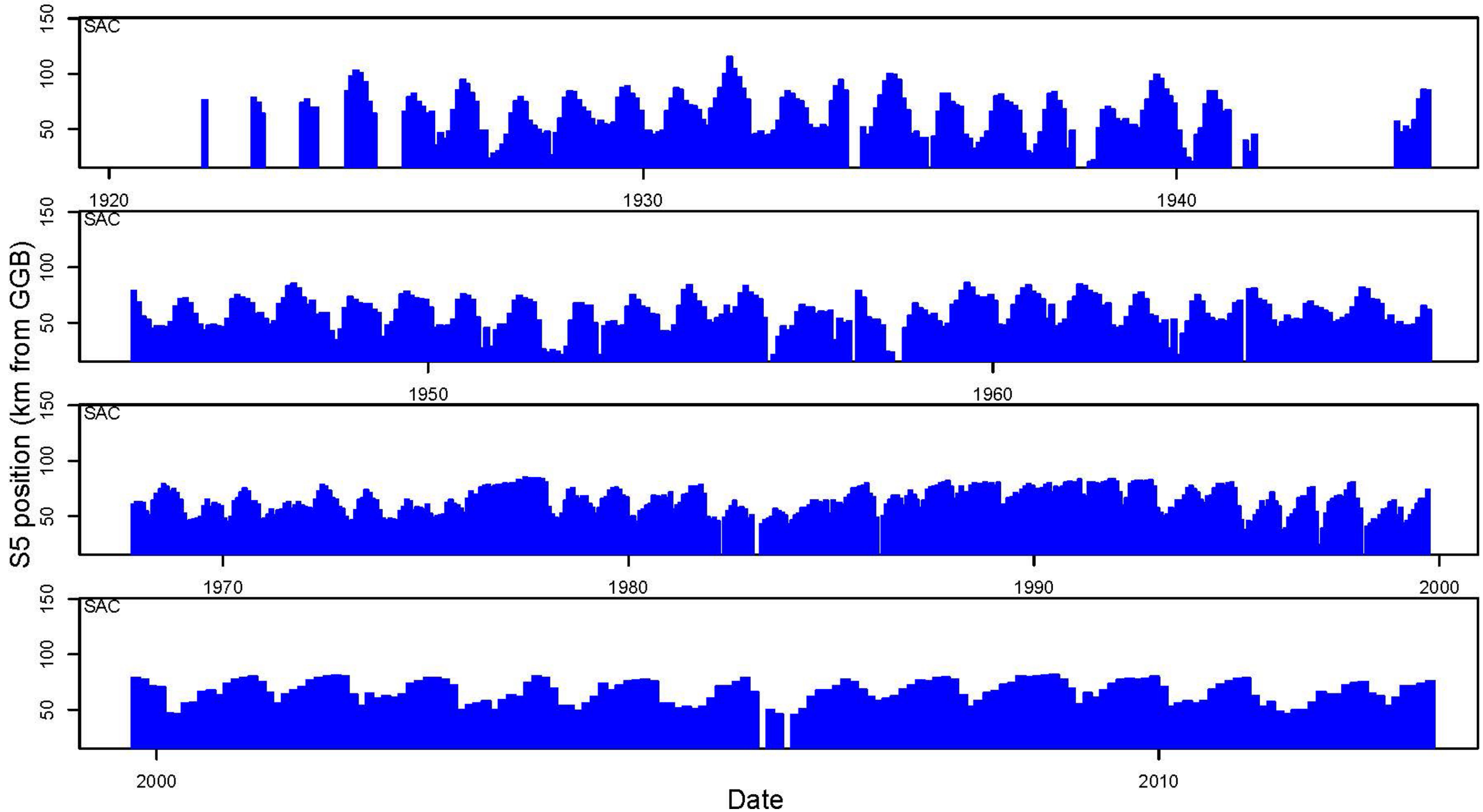

SJR
SJR
SJR
SJR
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
S2 position (km from GGB)
Date

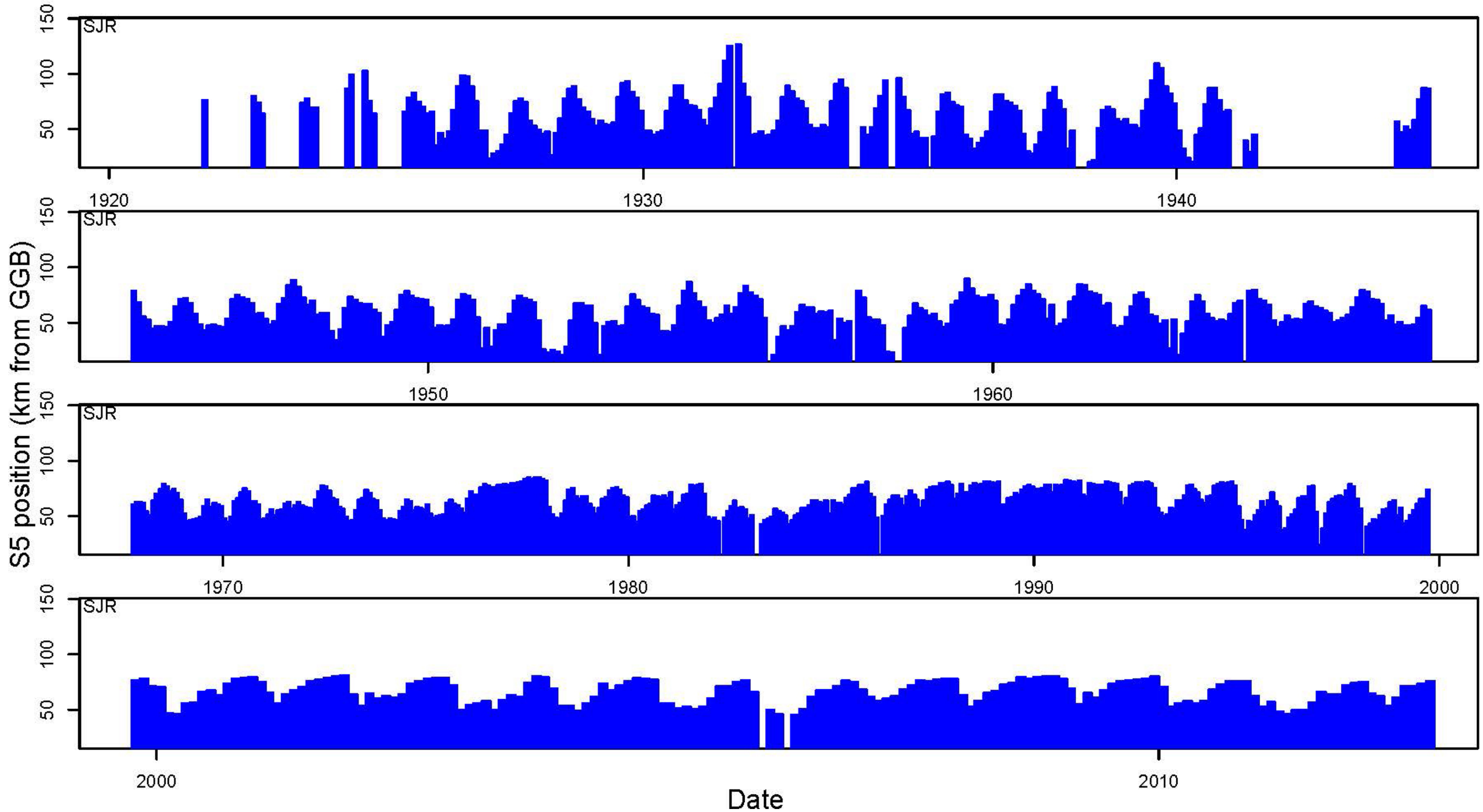

SAC
SAC
SAC
SAC
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
S3 position (km from GGB)
Date

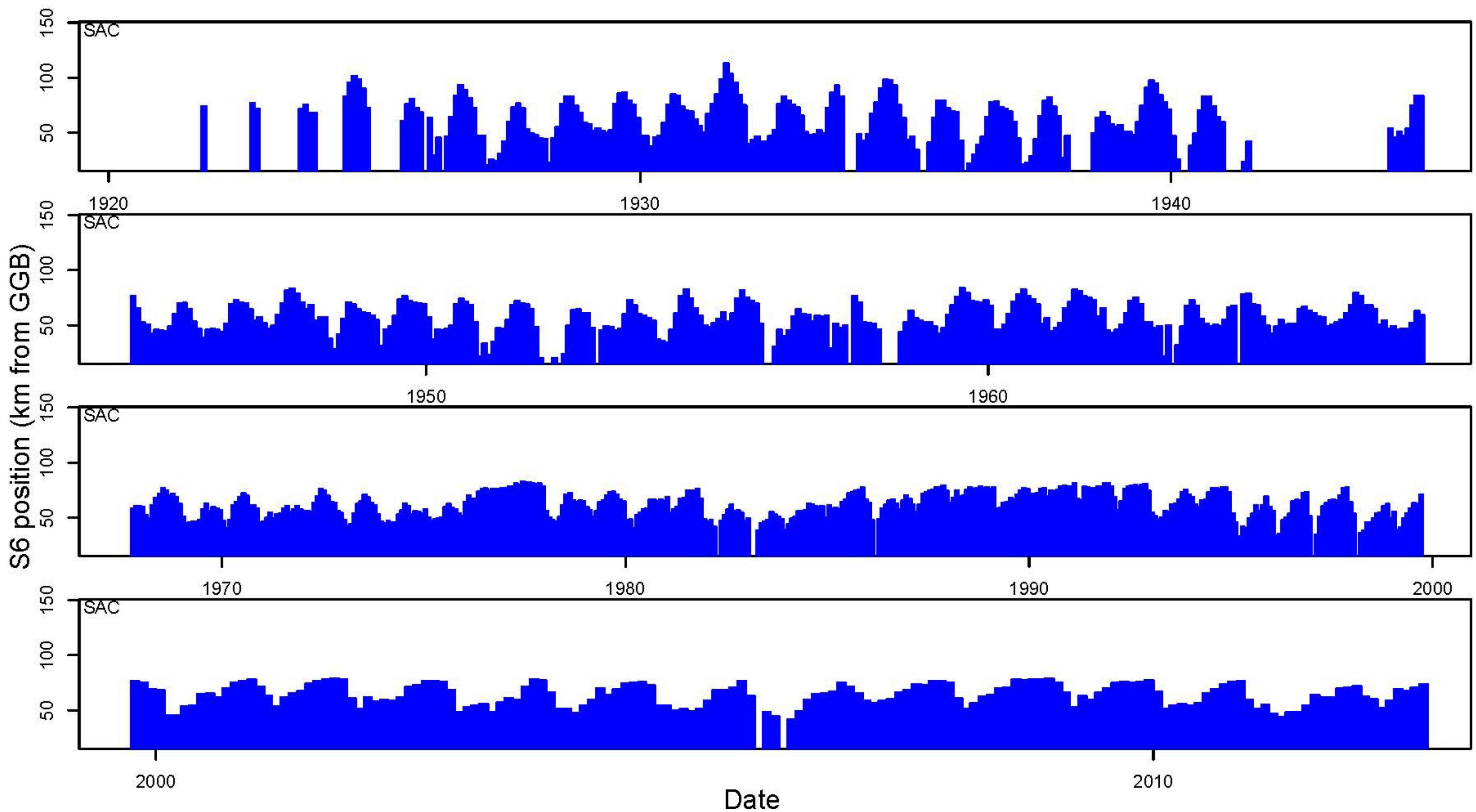

SJR
SJR
SJR
SJR
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
S3 position (km from GGB)
Date

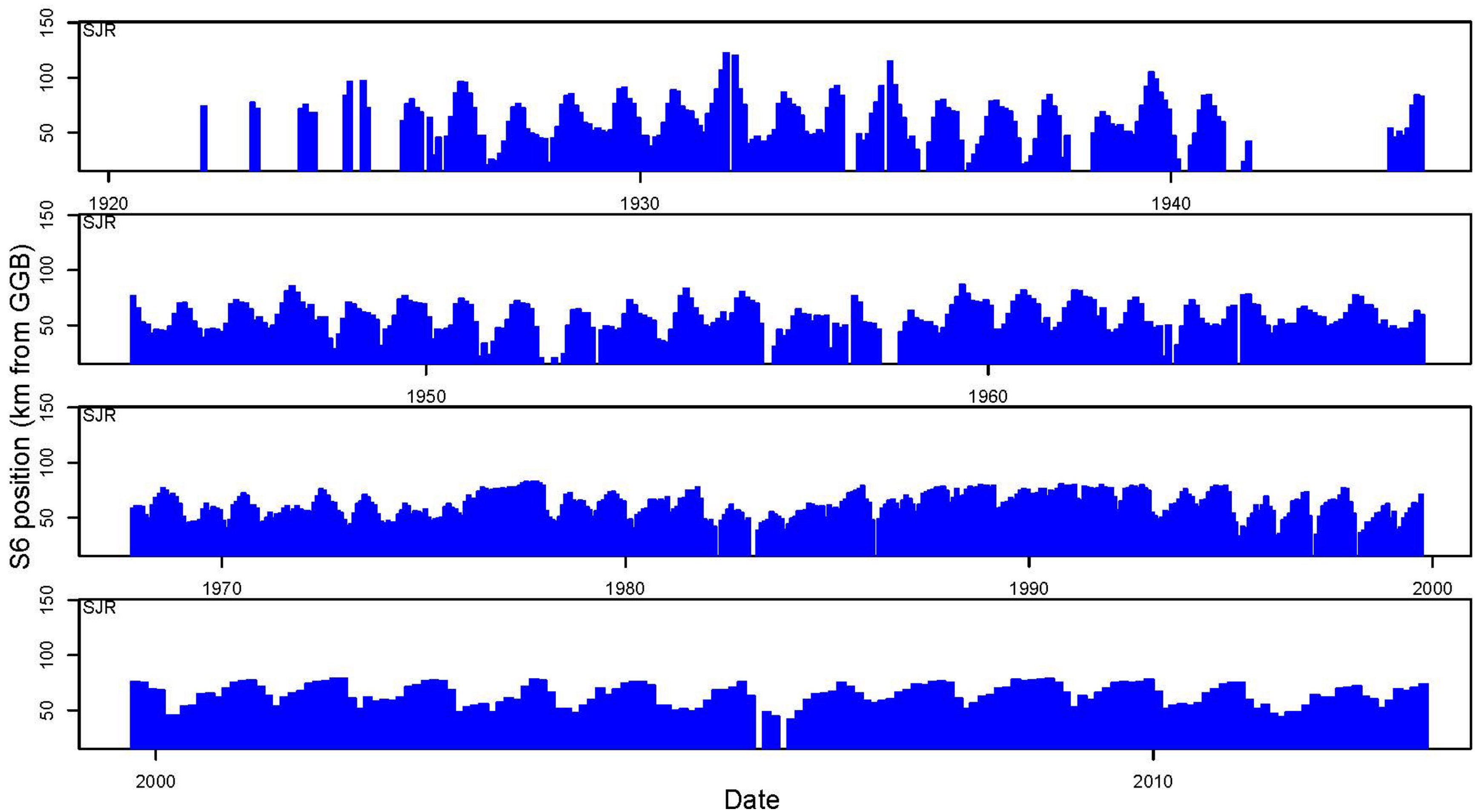

SAC
SAC
SAC
SAC
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
S4 position (km from GGB)
Date

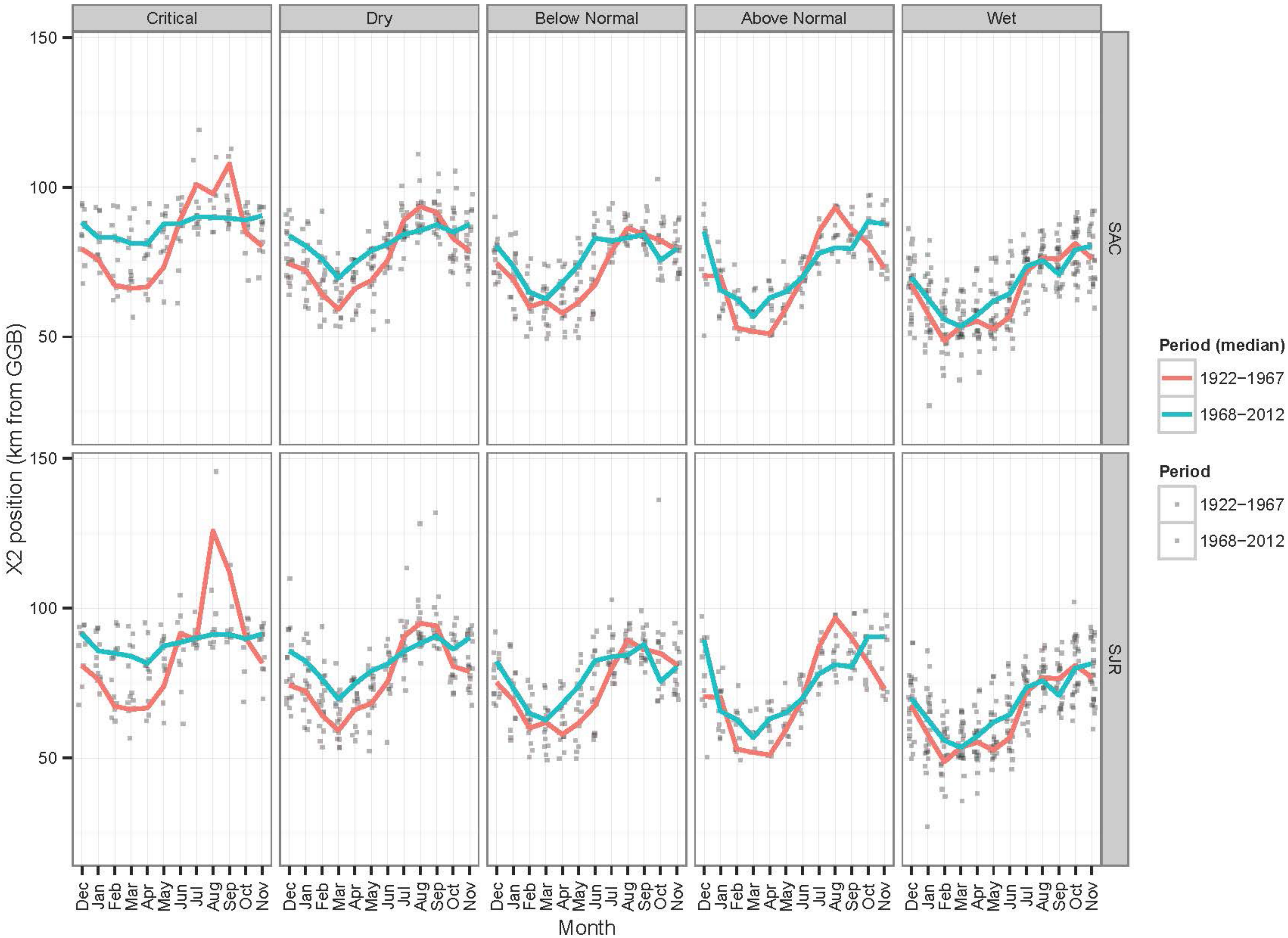

SJR
SJR
SJR
SJR
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2000
2010
S4 position (km from GGB)
Date

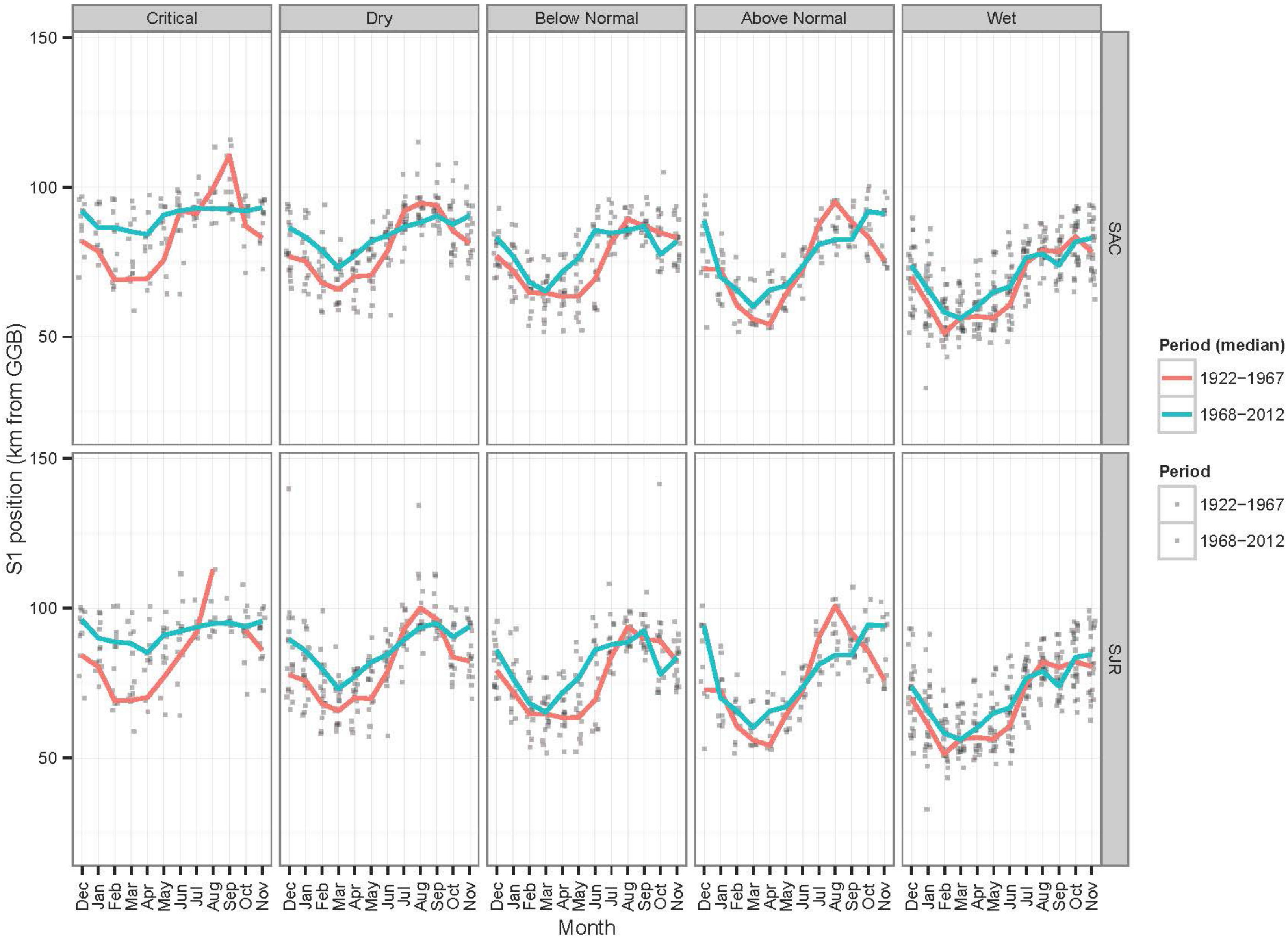

SAC
SAC
SAC
SAC
S5 position (km from GGB)
50
100
150
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Date


SJR
SJR
SJR
SJR
S5 position (km from GGB)
50
100
150
1920
1930
1940
1950
1960
1970
1980
1990
2000
2000
2010
Date

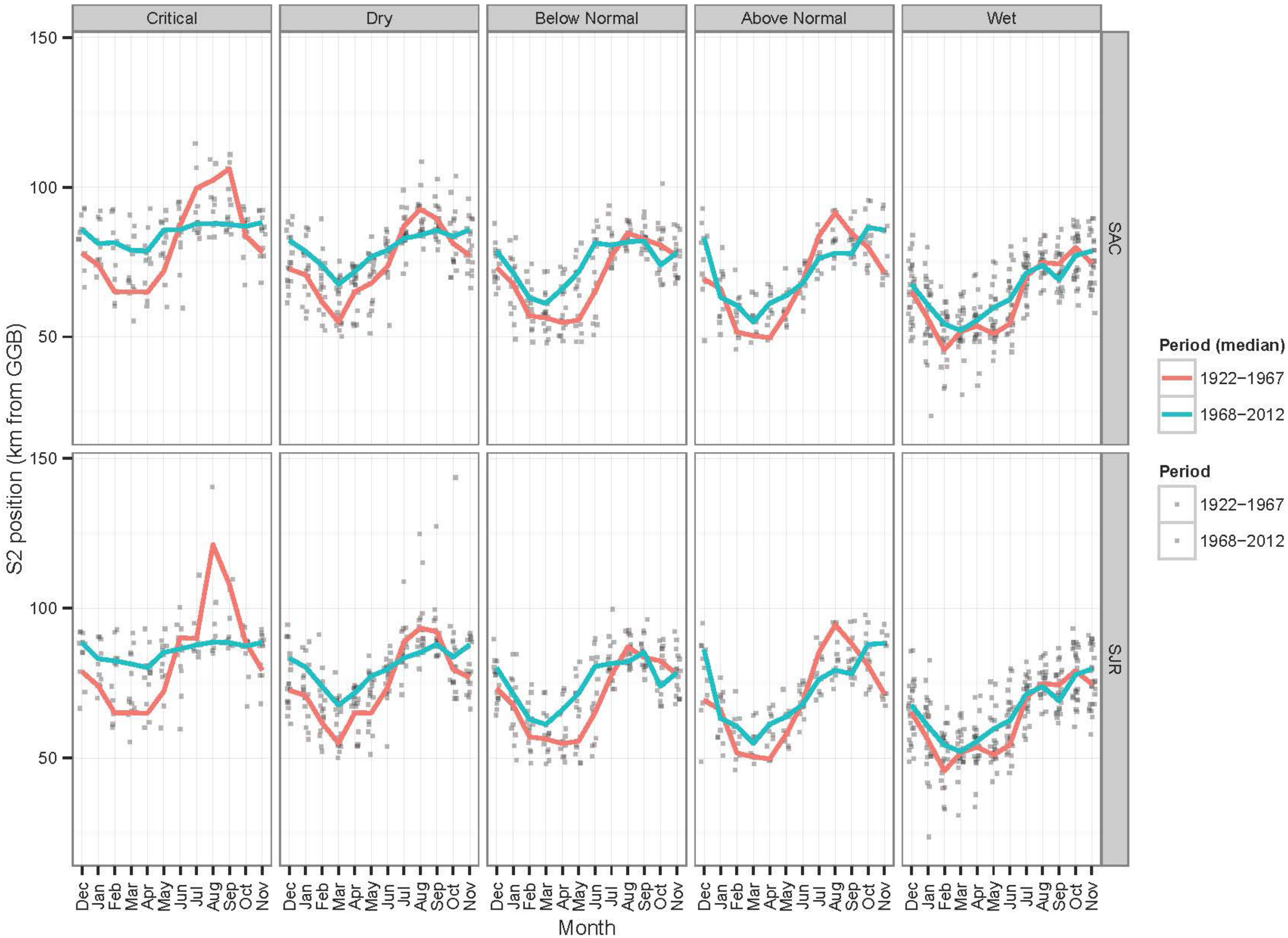

SAC
SAC
SAC
SAC
150
100
50
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
S6 position (km from GGB)
Date

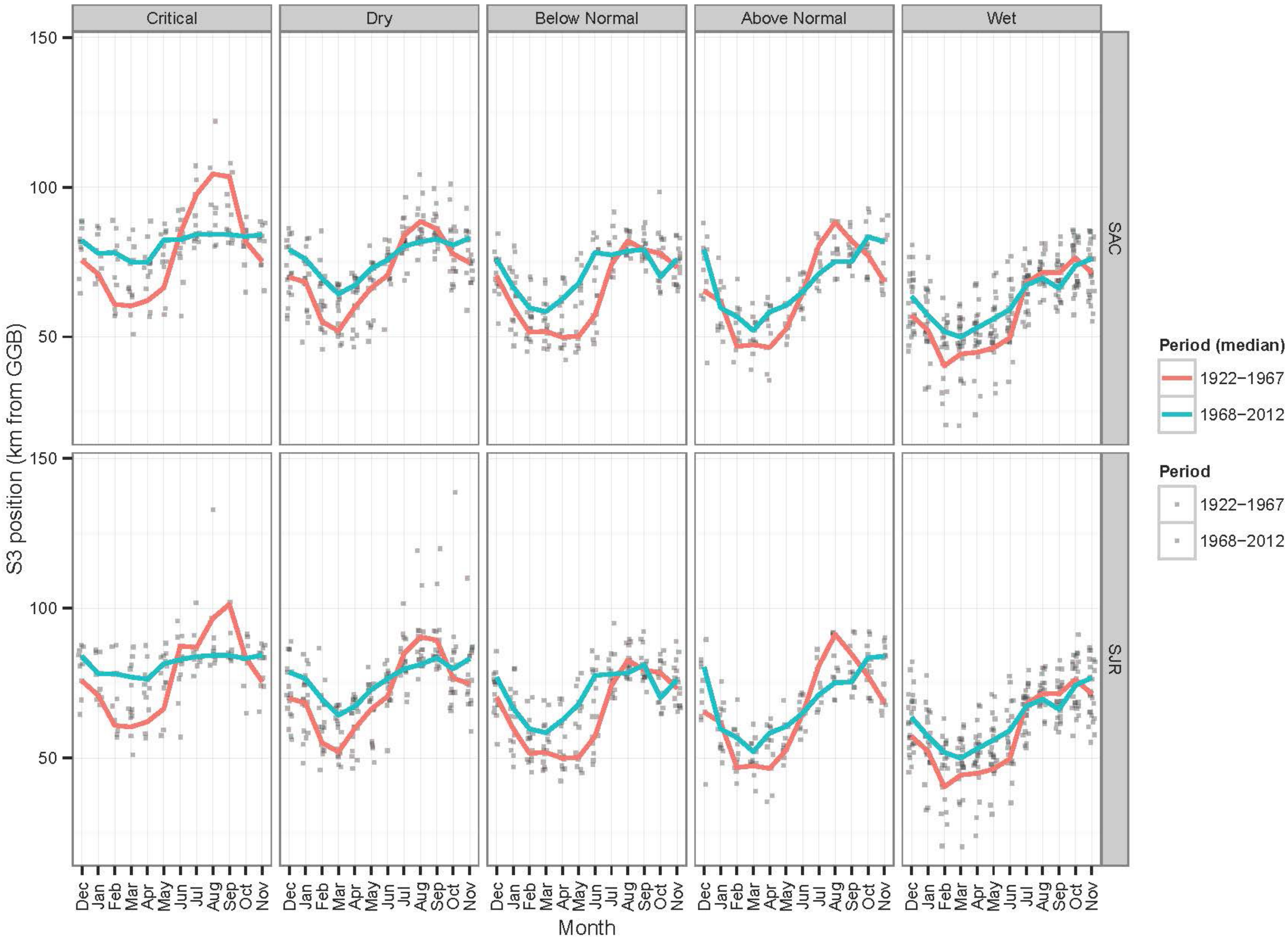

SJR
SJR
SJR
SJR
S6 position (km from GGB)
50
100
150
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Date

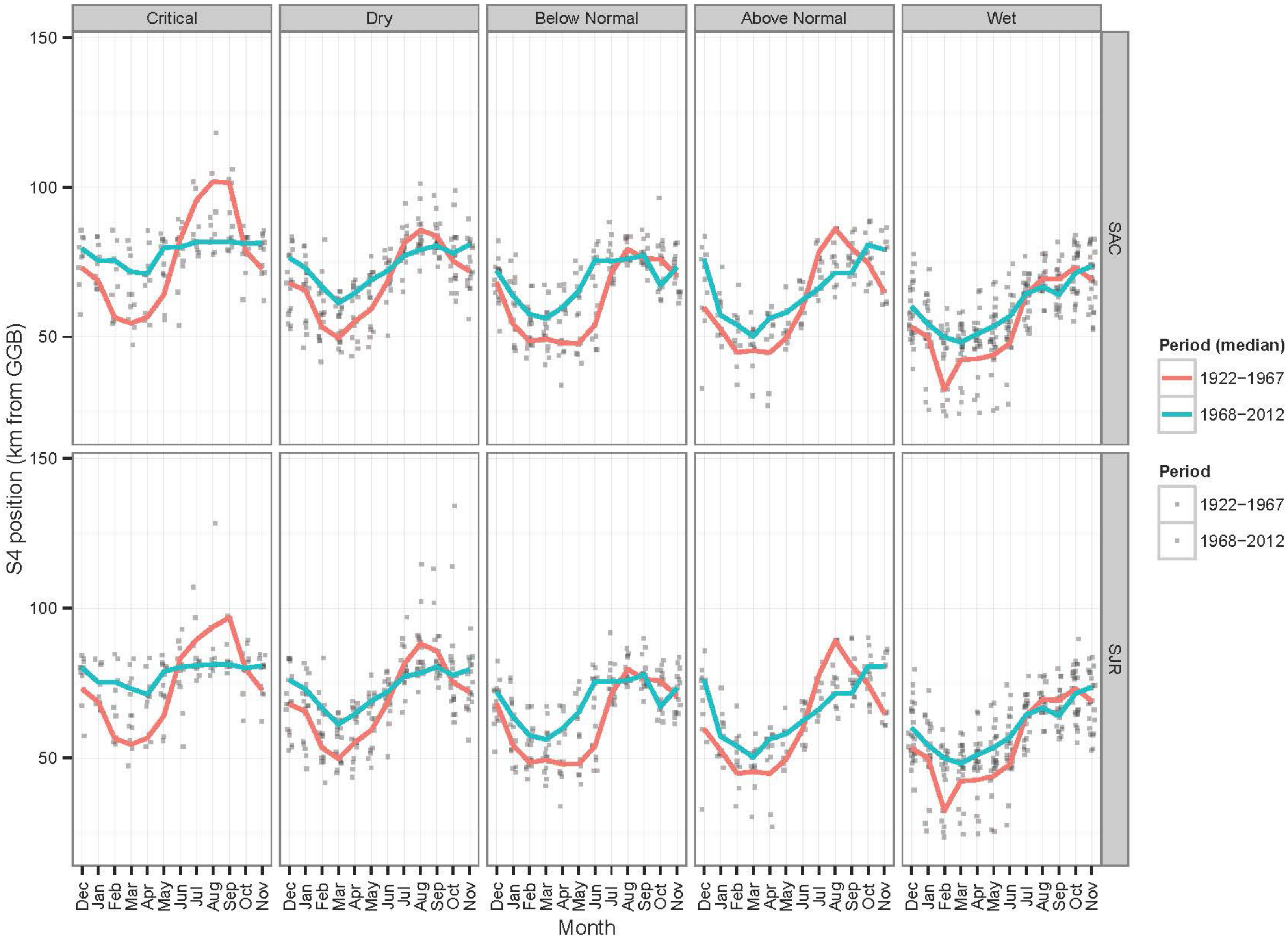

Critical
Dry
Below Normal
Above Normal
Wet
SAC
SJR
X2 position (km from GGB)
150
100
50
Month
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Period (median)
1922−1967
1968−2012
Period
1922−1967
1968−2012

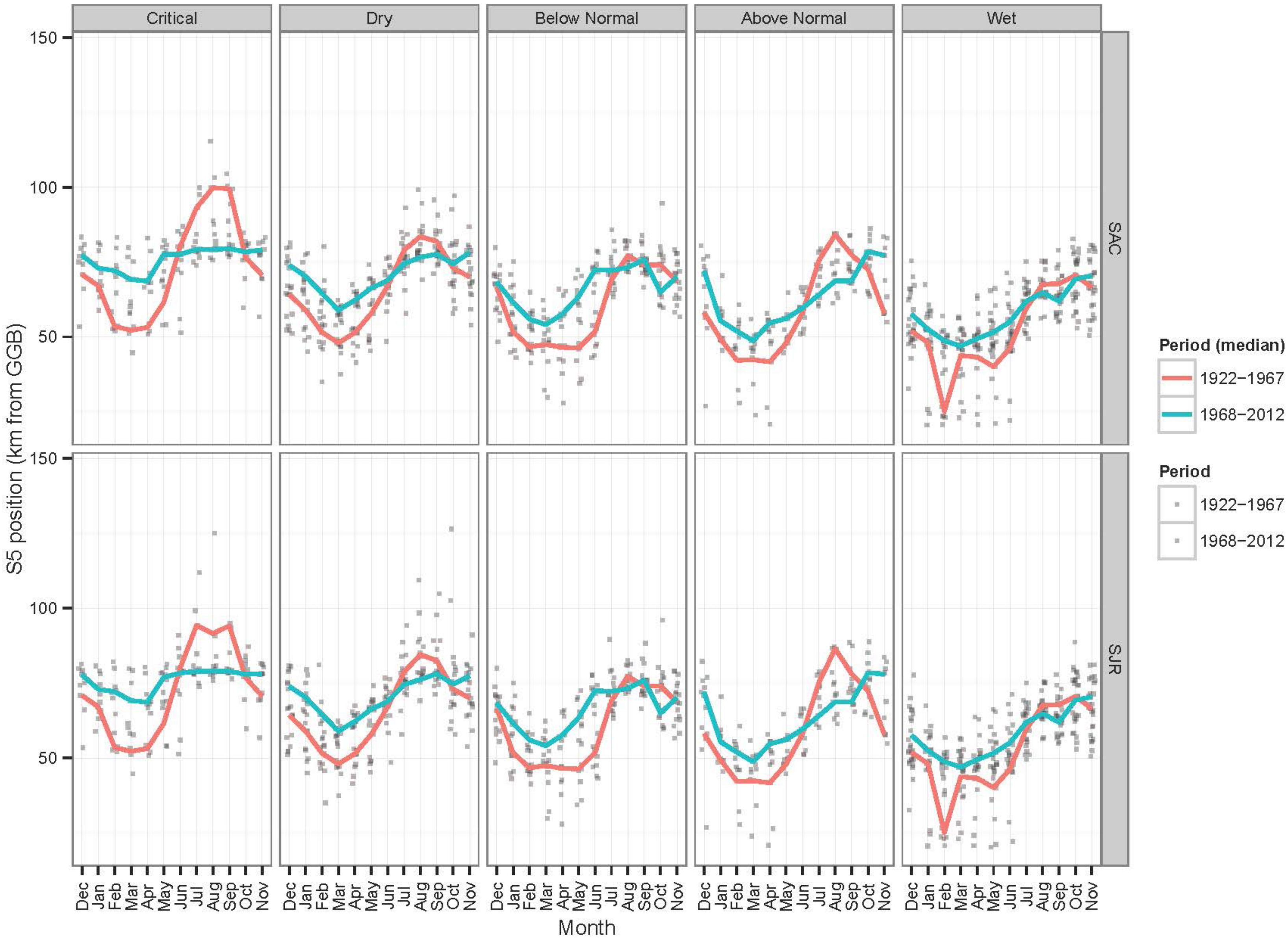


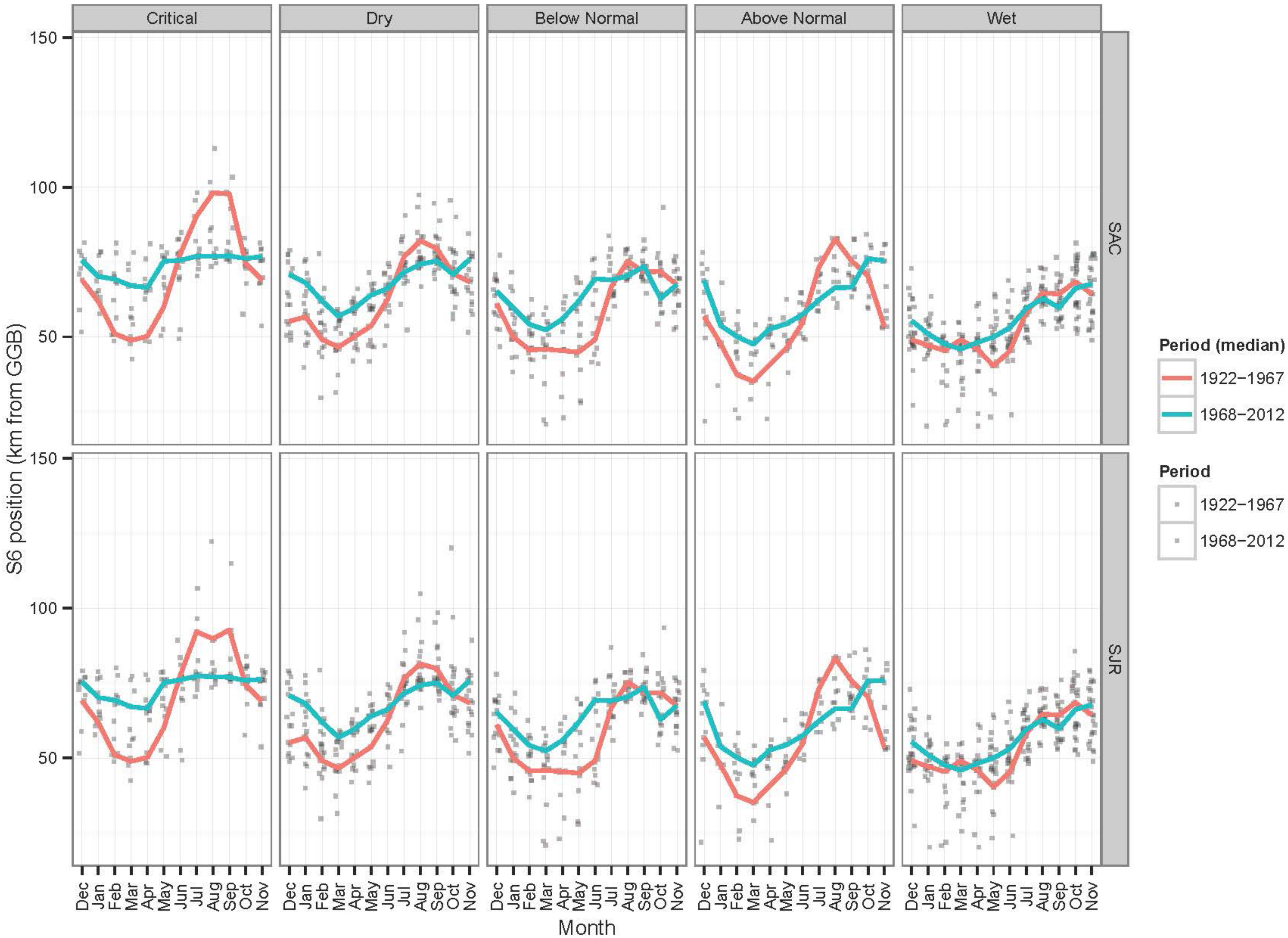
Critical
Dry
Below Normal
Above Normal
Wet
SAC
SJR
150
100
50
S1 position (km from GGB)
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Month
Period (median)
1922−1967
1968−2012
Period
1922−1967
1968−2012


Critical
Dry
Below Normal
Above Normal
Wet
SAC
SJR
150
100
50
S2 position (km from GGB)
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Month
Period (median)
1922–1967
1968–2012
Period
1922–1967
1968–2012


Critical
Dry
Below Normal
Above Normal
Wet
SAC
SJR
S3 position (km from GGB)
150
100
50
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Month
Period (median)
1922−1967
1968−2012
Period
1922−1967
1968−2012


Critical
Dry
Below Normal
Above Normal
Wet
SAC
SJR
S4 position (km from GGB)
150
100
50
Month
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Period (median)
1922−1967
1968−2012
Period
1922−1967
1968−2012


Critical
Dry
Below Normal
Above Normal
Wet
SAC
SJR
S5 position (km from GGB)
150
100
50
Month
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Period (median)
1922–1967
1968–2012
Period
1922–1967
1968–2012


Critical
Dry
Below Normal
Above Normal
Wet
SAC
SJR
S6 position (km from GGB)
150
100
50
Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov
Month
Period (median)
1922–1967
1968–2012
Period
1922–1967
1968–2012

APPENDIX D. STATISTICAL PROCEDURES USED[1]

MANN-KENDALL TEST FOR SEN SLOPE SIGNIFICANCE

The Mann-Kendall test for trend is insensitive to the presence or absence of seasonality. It is a nonparametric test since it does not assume any type of data distribution. Nonetheless, two forms of the test are provided: one that ignores data seasonality (even if it is present) and one that considers data seasonality. In either test, the null hypothesis (H_0) assumes that the trend is zero, and the alternate hypothesis (H_a) is that the trend is either upward or downward. Details of the Mann-Kendall trend test for slope and the seasonal Kendall trend test are shown below.

In general, the Mann-Kendall trend test considering seasonality indicates a larger range for an allowable estimate of trend when seasonality is actually present than the range indicated by the test performed ignoring seasonality.

In the Mann-Kendall trend analysis and Kendall seasonal analysis, the "Sen" slopes are first calculated, ranked, and then assigned the indicator value of +1, -1, or 0 according to the sign of the calculated differences of all possible time-ranked pairs. The Mann-Kendall S statistic is then computed as the number of positive differences minus the number of negative differences. The Kendal test statistic Ts is computed using the S value and its variance $VAR(S)$, such that a positive Ts value means an upward trend and a negative Ts value means a negative trend. Significance of the Kendal test statistic Ts is determined by comparing it against the cumulative normal distribution function $Z_{1-\alpha}$. The median value of the Sen slope is calculated with and without seasonality. Since slopes are calculated over all possible time intervals, it is possible that the test indicates a "non-zero" trend, yet the median slope value equal zero.

[1] All references cited in this section are listed in the main report.

MANN-KENDALL TREND TEST FOR SLOPE

Mann-Kendall Trend Test for Sen Slope Significance – for number of data as small as 10, unless there are many tied (e.g., equal, NDs are treated as tied) values (Gilbert, 1987; p. 208)	
Indicator Function $\mathrm{sgn}(x_j - x_k)$	= 1 if $(x_j - x_k) > 0$ = 0 if $(x_j - x_k) = 0$ = -1 if $(x_j - x_k) < 0$ where $x_1, x_2, ..., x_n$ are the time ordered data (n is the total of data).
Mann-Kendall Statistic, S	$= \sum_{k=1}^{n-1} \sum_{j=k+1}^{n} \mathrm{sgn}(x_j - x_k)$
Variance of S : $VAR(S)$	$= \frac{1}{18}\Big[n(n-1)(2n+5) - \sum_{p=1}^{g} t_p(t_p - 1)(2t_p + 5) - \sum_{q=1}^{h} u_q(u_q - 1)(2u_q + 5)\Big] + \frac{\sum_{p=1}^{g_i} t_{ip}(t_{ip}-1)(t_{ip}-2) \sum_{q=1}^{h_i} u_{iq}(u_{iq}-1)(u_{iq}-2)}{9n_i(n_i-1)(n_i-2)} + \frac{\sum_{p=1}^{g_i} t_{ip}(t_{ip}-1) \sum_{q=1}^{h_i} u_{iq}(u_{iq}-1)}{2n_i(n_i-1)}$ where g is the number of tied groups (equal-valued) in the data set; t_p is the number of tied data in the p-th group; h is the number of sampling times (or time periods) in the data set that contain multiple data; u_q is the number of multiple data in the q-th time period; and n is the number of data values.
Test Statistic, Ts	The Kendal statistic Ts is defined as $= \frac{S - 1}{[VAR(S)]^{1/2}}$ if $S > 0$ $= 0$ if $S = 0$ Ts $= \frac{S + 1}{[VAR(S)]^{1/2}}$ if $S < 0$ where a positive Ts value means an upward trend and a negative Ts value means a negative trend.

Hypothesis Test: H_0 = no trend H_{a1} = upward trend present H_{a2} = downward trend present This is a one-sided test at the α significance level.	The null hypothesis H_0 assumes that there is no trend in the data as a function of time. However, we will check for two alternative hypotheses. These are determined as follows: A1) Reject the null hypothesis H_0 and accept the alternative hypothesis Ha1 for an upward trend if $T_s > 0 \quad and \quad T_s > Z_{1-\alpha}$; A2) Reject the null hypothesis H_0 and accept the alternative hypothesis Ha2 of a downward trend if $T_s < 0 \quad and \quad \lvert T_s \rvert > Z_{1-\alpha}$. The term $Z_{1-\alpha}$ is the cumulative normal distribution function, which can be obtained from Table A1 in Gilbert (1987; p. 254).
Sen's Slope Estimator: Q	Slopes are initially calculated over each possible time period: $Q_{lk} = \frac{X_l - X_k}{t_l - t_k}$, l > k where Xl and Xk are the concentrations measured at time tl and tk. These Qlk individual slopes are ranked, and the median value is used to represent the slope estimator of trend (Gilbert, 1987; p. 227).

WILCOXON RANK SUM TEST

Assumptions in the Wilcoxon Rank-Sum test are generally more reasonable than those in the Student t-test. The Wilcoxon Rank-Sum test assumes that: (1) both data sets contain random values from their respective populations, and (2) in addition to independence within each data set, there is mutual independence between the two sample sets. No assumptions are made about data distribution. The null hypothesis is that the two location means are equal, and the alternative hypothesis is that the two location means are different.

Wilcoxon Rank-Sum Test for Comparison of Means – a one-sided, non-parametric test for comparing the means of two data sets (Gilbert, 1987; p. 247). In this application the two data sets are concentration data from pooled background and a single compliance location.	
Sum of Ranks: W_A, W_B	First pool all of the data from samples A and B, then rank the values from smallest to largest. Sum all of the ranks associated with samples A and B from the pooled sample set, respectively.
n_A, n_B	Number of observations in samples A and B, respectively.
Test Statistic: Z_A	Z_A = $$\frac{\left[W_A - n_A \frac{(m+1)}{2}\right]}{\left\{\frac{n_A n_B}{12}\left[(m+1) - \frac{\sum_{j=1}^{g} t_j (t_j^2 - 1)}{m(m-1)}\right]\right\}^{1/2}}$$ where $m = (n_A + n_B)$, g is the number of tied groups, and t_j is the number of tied data in the j-th group.
Hypothesis Test: H_0 = means are the same H_{a1} = Compliance location has a higher concentration than the Background. H_{a2} = Background location has a higher concentration than the Compliance. This is a one-sided test at the α significance level.	Accept the null hypothesis H_0 of equal means if $Abs[Z_A] < Z_{1-\alpha}$ *accept* H_0. Reject the null hypothesis H_0 of equal means if $Z_A \geq Z_{1-\alpha}$ *reject* H_0 *and accept* H_{a1}, if $Z_A \leq -Z_{1-\alpha}$ *reject* H_0 *and accept* H_{a2}, where $Z_{1-\alpha}$ is the critical Z value given in Table A1 of Gilbert (1987; p. 254).

Appendix E: Mann-Kendall Trend Test and Wilcoxon Rank-Sum Test for All Isohalines

Mann-Kendall Trend Test

S1

Sacramento 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	17	0.39	↔
Jan	16	-0.05	↔
Feb	17	0.02	↔
Mar	17	-0.71	↔
Apr	17	-0.21	↔
May	17	-0.26	↔
Jun	18	-0.85	↔
Jul	20	-0.55	↔
Aug	18	0.06	↔
Sep	20	0.14	↔
Oct	20	0.05	↔
Nov	18	0.17	↔
All	215	-0.55	↓

Sacramento 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	40	-0.19	↓
Jan	39	-0.12	↔
Feb	40	-0.08	↔
Mar	40	0.04	↔
Apr	39	0.15	↔
May	40	0.09	↔
Jun	40	0.01	↔
Jul	42	-0.03	↔
Aug	41	-0.19	↓
Sep	43	-0.41	↓
Oct	43	-0.30	↓
Nov	41	-0.20	↓
All	488	-0.16	↓

Sacramento 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	85	0.12	↑
Jan	83	0.10	↑
Feb	83	0.09	↑
Mar	83	0.07	↑
Apr	82	0.14	↑
May	85	0.13	↑
Jun	85	0.11	↑
Jul	87	-0.04	↔
Aug	86	-0.13	↓
Sep	88	-0.11	↓
Oct	87	0.00	↔
Nov	86	0.11	↑
All	1020	0.05	↑

Sacramento 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.18	↔
Jan	23	-0.12	↔
Feb	23	-0.25	↔
Mar	23	0.03	↔
Apr	22	0.17	↔
May	23	0.38	↔
Jun	22	0.29	↔
Jul	22	0.25	↔
Aug	23	0.10	↔
Sep	23	-0.10	↔
Oct	23	-0.23	↔
Nov	23	-0.14	↔
All	273	0.02	↔

Sacramento 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.49	↔
Jan	32	0.39	↔
Feb	30	-0.06	↔
Mar	30	0.05	↔
Apr	31	0.01	↔
May	32	-0.04	↔
Jun	32	0.00	↔
Jul	32	-0.06	↔
Aug	32	0.06	↔
Sep	32	0.28	↔
Oct	31	0.49	↑
Nov	32	0.62	↑
All	378	0.23	↑

Sacramento 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.38	↑
Jan	44	0.25	↔
Feb	43	0.10	↔
Mar	43	0.04	↔
Apr	43	0.01	↔
May	45	-0.16	↔
Jun	45	-0.08	↔
Jul	45	-0.07	↔
Aug	45	0.06	↔
Sep	45	0.19	↑
Oct	44	0.30	↑
Nov	45	0.38	↑
All	532	0.13	↑

Sacramento 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.47	↔
Jan	12	0.62	↔
Feb	13	0.46	↔
Mar	13	0.53	↔
Apr	12	-0.64	↔
May	13	-0.39	↔
Jun	13	-0.31	↔
Jul	13	-0.22	↔
Aug	13	0.02	↔
Sep	13	-0.22	↔
Oct	13	-0.50	↔
Nov	13	-0.20	↔
All	154	-0.12	↔

San Joaquin 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	17	0.41	↔
Jan	16	-0.02	↔
Feb	17	0.02	↔
Mar	17	-0.71	↔
Apr	17	-0.18	↔
May	17	-0.26	↔
Jun	18	-0.74	↔
Jul	17	-0.23	↔
Aug	13	0.65	↔
Sep	15	0.28	↔
Oct	16	0.27	↔
Nov	17	0.18	↔
All	197	-0.47	↓

San Joaquin 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	40	-0.24	↓
Jan	39	-0.13	↔
Feb	40	-0.08	↔
Mar	40	0.04	↔
Apr	39	0.15	↔
May	39	0.06	↔
Jun	40	0.01	↔
Jul	39	0.08	↔
Aug	35	-0.20	↔
Sep	37	-0.50	↓
Oct	39	-0.36	↓
Nov	40	-0.29	↓
All	467	-0.11	↓

San Joaquin 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	85	0.15	↑
Jan	83	0.12	↑
Feb	83	0.09	↑
Mar	83	0.08	↑
Apr	82	0.14	↑
May	84	0.13	↑
Jun	85	0.10	↔
Jul	84	-0.02	↔
Aug	80	-0.14	↓
Sep	82	-0.11	↓
Oct	84	0.02	↔
Nov	85	0.12	↑
All	1000	0.08	↑

San Joaquin 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.18	↔
Jan	23	-0.12	↔
Feb	23	-0.25	↔
Mar	23	0.03	↔
Apr	22	0.16	↔
May	22	0.20	↔
Jun	22	0.13	↔
Jul	22	0.16	↔
Aug	22	-0.07	↔
Sep	22	-0.26	↔
Oct	23	-0.36	↔
Nov	23	-0.18	↔
All	270	-0.02	↔

San Joaquin 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.61	↔
Jan	32	0.46	↔
Feb	30	-0.05	↔
Mar	30	0.03	↔
Apr	31	0.01	↔
May	32	-0.06	↔
Jun	32	-0.06	↔
Jul	32	-0.14	↔
Aug	32	-0.03	↔
Sep	32	0.21	↔
Oct	32	0.48	↑
Nov	32	0.72	↑
All	379	0.23	↑

San Joaquin 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.46	↑
Jan	44	0.28	↔
Feb	43	0.10	↔
Mar	43	0.03	↔
Apr	43	0.01	↔
May	45	-0.20	↔
Jun	45	-0.11	↔
Jul	45	-0.13	↔
Aug	45	0.04	↔
Sep	45	0.22	↑
Oct	45	0.27	↑
Nov	45	0.42	↑
All	533	0.13	↑

San Joaquin 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.33	↔
Jan	12	1.04	↔
Feb	13	0.48	↔
Mar	13	0.54	↔
Apr	12	-0.64	↔
May	13	-0.47	↔
Jun	13	-0.37	↔
Jul	13	-0.30	↔
Aug	13	-0.09	↔
Sep	13	-0.22	↔
Oct	13	-0.33	↓
Nov	13	-0.33	↓
All	154	-0.17	↔

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Sacramento 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	17	0.29	↔
Jan	15	-0.08	↔
Feb	17	0.02	↔
Mar	17	-0.88	↔
Apr	17	-0.25	↔
May	17	-0.18	↔
Jun	18	-0.75	↔
Jul	20	-0.62	↔
Aug	18	0.11	↔
Sep	20	0.16	↔
Oct	20	0.08	↔
Nov	18	0.24	↔
All	214	-0.59	↓

Sacramento 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	40	-0.20	↓
Jan	38	-0.11	↔
Feb	40	-0.08	↔
Mar	40	0.07	↔
Apr	39	0.12	↔
May	40	0.09	↔
Jun	40	0.01	↔
Jul	42	-0.05	↔
Aug	41	-0.21	↓
Sep	43	-0.44	↓
Oct	43	-0.32	↓
Nov	41	-0.21	↓
All	487	-0.17	↓

Sacramento 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	85	0.13	↑
Jan	82	0.12	↑
Feb	83	0.11	↑
Mar	83	0.11	↑
Apr	82	0.15	↑
May	85	0.15	↑
Jun	85	0.11	↑
Jul	87	-0.05	↔
Aug	86	-0.14	↓
Sep	88	-0.12	↓
Oct	88	-0.01	↔
Nov	86	0.11	↑
All	1020	0.06	↑

Sacramento 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.19	↔
Jan	23	-0.04	↔
Feb	23	-0.11	↔
Mar	23	0.13	↔
Apr	22	0.29	↔
May	23	0.53	↔
Jun	22	0.38	↔
Jul	22	0.21	↔
Aug	23	0.08	↔
Sep	23	-0.17	↔
Oct	23	-0.29	↔
Nov	23	-0.13	↔
All	273	0.05	↔

Sacramento 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.46	↔
Jan	32	0.35	↔
Feb	30	-0.06	↔
Mar	30	0.06	↔
Apr	31	-0.01	↔
May	32	-0.04	↔
Jun	32	-0.05	↔
Jul	32	-0.05	↔
Aug	32	0.05	↔
Sep	32	0.32	↑
Oct	32	0.47	↑
Nov	32	0.62	↑
All	379	0.22	↑

Sacramento 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.36	↑
Jan	44	0.23	↔
Feb	43	0.07	↔
Mar	43	0.04	↔
Apr	43	-0.01	↔
May	45	-0.17	↔
Jun	45	-0.09	↔
Jul	45	-0.05	↔
Aug	45	0.07	↔
Sep	45	0.21	↑
Oct	45	0.28	↑
Nov	45	0.38	↑
All	533	0.13	↑

Sacramento 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.52	↔
Jan	12	0.58	↔
Feb	13	0.36	↔
Mar	13	0.53	↔
Apr	12	-0.62	↔
May	13	-0.11	↔
Jun	13	-0.27	↔
Jul	13	-0.21	↔
Aug	13	0.04	↔
Sep	13	-0.24	↔
Oct	13	-0.42	↔
Nov	13	-0.10	↔
All	154	-0.09	↔

San Joaquin 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	17	0.20	↔
Jan	15	-0.08	↔
Feb	17	0.02	↔
Mar	17	-0.88	↔
Apr	17	-0.25	↔
May	17	-0.18	↔
Jun	18	-0.75	↔
Jul	18	-0.69	↔
Aug	15	0.46	↔
Sep	17	0.42	↔
Oct	18	0.23	↔
Nov	17	0.17	↔
All	203	-0.52	↓

San Joaquin 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	40	-0.21	↓
Jan	38	-0.11	↔
Feb	40	-0.08	↔
Mar	40	0.07	↔
Apr	39	0.12	↔
May	39	0.05	↔
Jun	40	0.01	↔
Jul	40	-0.01	↔
Aug	38	-0.23	↓
Sep	39	-0.49	↓
Oct	41	-0.37	↓
Nov	40	-0.27	↓
All	474	-0.15	↓

San Joaquin 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	85	0.14	↑
Jan	82	0.13	↑
Feb	83	0.11	↑
Mar	83	0.11	↑
Apr	82	0.15	↑
May	84	0.15	↑
Jun	85	0.10	↑
Jul	85	-0.05	↔
Aug	83	-0.15	↓
Sep	84	-0.13	↓
Oct	86	-0.01	↔
Nov	85	0.11	↑
All	1007	0.07	↑

San Joaquin 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.18	↔
Jan	23	-0.04	↔
Feb	23	-0.12	↔
Mar	23	0.12	↔
Apr	22	0.28	↔
May	22	0.37	↔
Jun	22	0.37	↔
Jul	22	0.11	↔
Aug	23	-0.01	↔
Sep	22	-0.23	↔
Oct	23	-0.30	↔
Nov	23	-0.18	↔
All	271	0.01	↔

San Joaquin 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.51	↔
Jan	32	0.38	↔
Feb	30	-0.07	↔
Mar	30	0.06	↔
Apr	31	-0.01	↔
May	32	-0.04	↔
Jun	32	-0.05	↔
Jul	32	-0.09	↔
Aug	32	0.00	↔
Sep	32	0.25	↔
Oct	32	0.43	↑
Nov	32	0.66	↑
All	379	0.21	↑

San Joaquin 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.39	↑
Jan	44	0.23	↔
Feb	43	0.06	↔
Mar	43	0.04	↔
Apr	43	-0.01	↔
May	45	-0.18	↔
Jun	45	-0.10	↔
Jul	45	-0.11	↔
Aug	45	0.04	↔
Sep	45	0.21	↑
Oct	45	0.24	↑
Nov	45	0.38	↑
All	533	0.12	↑

San Joaquin 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.42	↔
Jan	12	0.67	↔
Feb	13	0.35	↔
Mar	13	0.53	↔
Apr	12	-0.63	↔
May	13	-0.11	↔
Jun	13	-0.37	↔
Jul	13	-0.27	↔
Aug	13	0.07	↔
Sep	13	-0.29	↔
Oct	13	-0.37	↓
Nov	13	-0.23	↓
All	154	-0.14	↔

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Sacramento 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	16	0.32	↔
Jan	14	-0.06	↔
Feb	15	0.38	↔
Mar	17	-1.04	↓
Apr	17	-0.25	↔
May	16	-0.42	↔
Jun	18	-1.02	↔
Jul	20	-0.55	↔
Aug	19	0.06	↔
Sep	20	0.16	↔
Oct	20	0.10	↔
Nov	18	0.17	↔
All	210	-0.62	↓

Sacramento 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	39	-0.23	↓
Jan	36	-0.05	↔
Feb	38	-0.03	↔
Mar	40	0.13	↔
Apr	39	0.26	↑
May	39	0.16	↔
Jun	40	0.01	↔
Jul	42	-0.07	↔
Aug	42	-0.26	↓
Sep	43	-0.44	↓
Oct	43	-0.32	↓
Nov	41	-0.22	↓
All	482	-0.17	↓

Sacramento 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	84	0.14	↑
Jan	80	0.13	↑
Feb	81	0.14	↑
Mar	83	0.15	↑
Apr	82	0.20	↑
May	84	0.18	↑
Jun	85	0.12	↑
Jul	87	-0.05	↔
Aug	87	-0.16	↓
Sep	88	-0.13	↓
Oct	88	-0.01	↔
Nov	86	0.11	↑
All	1015	0.06	↑

Sacramento 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.15	↔
Jan	22	0.03	↔
Feb	23	0.00	↔
Mar	23	0.24	↔
Apr	22	0.38	↔
May	23	0.51	↔
Jun	22	0.29	↔
Jul	22	0.19	↔
Aug	23	0.07	↔
Sep	23	-0.18	↔
Oct	23	-0.27	↔
Nov	23	-0.11	↔
All	272	0.08	↔

Sacramento 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.49	↔
Jan	32	0.34	↔
Feb	30	-0.09	↔
Mar	30	0.06	↔
Apr	31	0.01	↔
May	32	-0.03	↔
Jun	32	-0.03	↔
Jul	32	-0.05	↔
Aug	32	0.02	↔
Sep	32	0.30	↔
Oct	32	0.45	↑
Nov	32	0.61	↑
All	379	0.21	↑

Sacramento 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.36	↑
Jan	44	0.22	↔
Feb	43	0.05	↔
Mar	43	0.04	↔
Apr	43	-0.01	↔
May	45	-0.16	↔
Jun	45	-0.08	↔
Jul	45	-0.06	↔
Aug	45	0.07	↔
Sep	45	0.23	↑
Oct	45	0.27	↑
Nov	45	0.37	↑
All	533	0.12	↑

Sacramento 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.48	↔
Jan	12	0.52	↔
Feb	13	0.35	↔
Mar	13	0.46	↔
Apr	12	-0.67	↔
May	13	-0.09	↔
Jun	13	-0.25	↔
Jul	13	-0.22	↔
Aug	13	0.09	↔
Sep	13	-0.21	↔
Oct	13	-0.37	↓
Nov	13	-0.09	↔
All	154	-0.07	↔

San Joaquin 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	16	0.32	↔
Jan	14	-0.06	↔
Feb	15	0.38	↔
Mar	17	-1.04	↓
Apr	17	-0.25	↔
May	16	-0.43	↔
Jun	18	-1.02	↔
Jul	19	-0.67	↔
Aug	17	0.28	↔
Sep	18	0.21	↔
Oct	18	0.16	↔
Nov	18	0.28	↔
All	203	-0.56	↓

San Joaquin 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	39	-0.24	↓
Jan	36	-0.05	↔
Feb	38	-0.03	↔
Mar	40	0.13	↔
Apr	39	0.26	↑
May	39	0.16	↔
Jun	40	0.00	↔
Jul	41	-0.06	↔
Aug	40	-0.27	↓
Sep	41	-0.52	↓
Oct	41	-0.34	↓
Nov	41	-0.26	↓
All	475	-0.15	↓

San Joaquin 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	84	0.15	↑
Jan	80	0.13	↑
Feb	81	0.14	↑
Mar	83	0.15	↑
Apr	82	0.20	↑
May	84	0.18	↑
Jun	85	0.11	↑
Jul	86	-0.06	↔
Aug	85	-0.17	↓
Sep	86	-0.14	↓
Oct	86	-0.01	↔
Nov	86	0.10	↑
All	1008	0.07	↑

San Joaquin 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.15	↔
Jan	22	0.03	↔
Feb	23	0.00	↔
Mar	23	0.24	↔
Apr	22	0.38	↔
May	23	0.51	↔
Jun	22	0.29	↔
Jul	22	0.09	↔
Aug	23	-0.05	↔
Sep	23	-0.22	↔
Oct	23	-0.28	↔
Nov	23	-0.14	↔
All	272	0.06	↔

San Joaquin 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.51	↔
Jan	32	0.35	↔
Feb	30	-0.09	↔
Mar	30	0.06	↔
Apr	31	0.01	↔
May	32	-0.03	↔
Jun	32	-0.03	↔
Jul	32	-0.06	↔
Aug	32	0.01	↔
Sep	32	0.29	↔
Oct	32	0.38	↑
Nov	32	0.62	↑
All	379	0.21	↑

San Joaquin 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.36	↑
Jan	44	0.22	↔
Feb	43	0.04	↔
Mar	43	0.04	↔
Apr	43	-0.01	↔
May	45	-0.16	↔
Jun	45	-0.09	↔
Jul	45	-0.10	↔
Aug	45	0.03	↔
Sep	45	0.22	↑
Oct	45	0.22	↑
Nov	45	0.36	↑
All	533	0.11	↑

San Joaquin 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.39	↔
Jan	12	0.53	↔
Feb	13	0.35	↔
Mar	13	0.46	↔
Apr	12	-0.67	↔
May	13	-0.09	↔
Jun	13	-0.33	↔
Jul	13	-0.25	↔
Aug	13	0.06	↔
Sep	13	-0.26	↔
Oct	13	-0.45	↔
Nov	13	-0.32	↓
All	154	-0.13	↔

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Sacramento 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	16	0.33	↔
Jan	14	-0.13	↔
Feb	15	0.35	↔
Mar	16	-0.71	↔
Apr	15	0.18	↔
May	16	-0.35	↔
Jun	18	-1.12	↔
Jul	19	-0.88	↔
Aug	19	0.01	↔
Sep	20	0.14	↔
Oct	20	0.10	↔
Nov	18	0.18	↔
All	206	-0.55	↓

Sacramento 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	39	-0.23	↓
Jan	36	-0.06	↔
Feb	37	0.01	↔
Mar	39	0.12	↔
Apr	37	0.26	↑
May	39	0.15	↔
Jun	40	-0.01	↔
Jul	41	-0.12	↔
Aug	42	-0.27	↓
Sep	43	-0.46	↓
Oct	43	-0.33	↓
Nov	41	-0.23	↓
All	477	-0.17	↓

Sacramento 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	84	0.14	↑
Jan	80	0.14	↑
Feb	79	0.17	↑
Mar	82	0.14	↑
Apr	80	0.19	↑
May	84	0.18	↑
Jun	85	0.12	↑
Jul	86	-0.07	↔
Aug	87	-0.17	↓
Sep	88	-0.13	↓
Oct	88	-0.01	↔
Nov	86	0.11	↑
All	1009	0.06	↑

Sacramento 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.09	↔
Jan	22	0.04	↔
Feb	22	0.11	↔
Mar	23	0.26	↔
Apr	22	0.43	↑
May	23	0.42	↔
Jun	22	0.38	↔
Jul	22	0.19	↔
Aug	23	0.02	↔
Sep	23	-0.18	↔
Oct	23	-0.28	↔
Nov	23	-0.07	↔
All	271	0.10	↔

Sacramento 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.46	↔
Jan	32	0.33	↔
Feb	29	0.05	↔
Mar	30	0.05	↔
Apr	31	0.00	↔
May	32	-0.02	↔
Jun	32	-0.04	↔
Jul	32	-0.07	↔
Aug	32	0.01	↔
Sep	32	0.29	↔
Oct	32	0.41	↑
Nov	32	0.59	↑
All	378	0.21	↑

Sacramento 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.36	↑
Jan	44	0.20	↔
Feb	42	0.09	↔
Mar	43	0.04	↔
Apr	43	0.00	↔
May	45	-0.15	↔
Jun	45	-0.09	↔
Jul	45	-0.09	↔
Aug	45	0.05	↔
Sep	45	0.24	↑
Oct	45	0.26	↑
Nov	45	0.38	↑
All	532	0.12	↑

Sacramento 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.55	↔
Jan	12	0.51	↔
Feb	13	0.37	↔
Mar	13	0.49	↔
Apr	12	-0.57	↔
May	13	-0.12	↔
Jun	13	-0.27	↔
Jul	13	-0.29	↔
Aug	13	0.13	↔
Sep	13	-0.13	↔
Oct	13	-0.36	↔
Nov	13	-0.02	↔
All	154	-0.06	↔

San Joaquin 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	16	0.28	↔
Jan	14	-0.13	↔
Feb	15	0.35	↔
Mar	16	-0.71	↔
Apr	15	0.18	↔
May	16	-0.35	↔
Jun	18	-1.12	↔
Jul	19	-0.99	↔
Aug	18	0.02	↔
Sep	18	0.24	↔
Oct	20	0.08	↔
Nov	18	0.23	↔
All	203	-0.54	↓

San Joaquin 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	39	-0.23	↓
Jan	36	-0.06	↔
Feb	37	0.01	↔
Mar	39	0.12	↔
Apr	37	0.26	↑
May	39	0.15	↔
Jun	40	-0.01	↔
Jul	41	-0.17	↔
Aug	41	-0.33	↓
Sep	41	-0.52	↓
Oct	43	-0.38	↓
Nov	41	-0.25	↓
All	474	-0.17	↓

San Joaquin 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	84	0.14	↑
Jan	80	0.14	↑
Feb	79	0.17	↑
Mar	82	0.14	↑
Apr	80	0.19	↑
May	84	0.18	↑
Jun	85	0.12	↑
Jul	86	-0.08	↓
Aug	86	-0.18	↓
Sep	86	-0.14	↓
Oct	88	-0.03	↔
Nov	86	0.09	↑
All	1006	0.06	↑

San Joaquin 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.09	↔
Jan	22	0.04	↔
Feb	22	0.11	↔
Mar	23	0.26	↔
Apr	22	0.43	↑
May	23	0.42	↔
Jun	22	0.38	↔
Jul	22	0.16	↔
Aug	23	-0.04	↔
Sep	23	-0.21	↔
Oct	23	-0.31	↔
Nov	23	-0.08	↔
All	271	0.09	↔

San Joaquin 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.45	↔
Jan	32	0.33	↔
Feb	29	0.05	↔
Mar	30	0.04	↔
Apr	31	0.00	↔
May	32	-0.02	↔
Jun	32	-0.09	↔
Jul	32	-0.07	↔
Aug	32	0.01	↔
Sep	32	0.28	↑
Oct	32	0.40	↑
Nov	32	0.56	↑
All	378	0.20	↑

San Joaquin 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.36	↑
Jan	44	0.20	↔
Feb	42	0.09	↔
Mar	43	0.04	↔
Apr	43	0.00	↔
May	45	-0.16	↔
Jun	45	-0.10	↔
Jul	45	-0.11	↔
Aug	45	0.03	↔
Sep	45	0.22	↑
Oct	45	0.22	↑
Nov	45	0.35	↑
All	532	0.11	↑

San Joaquin 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.42	↔
Jan	12	0.47	↔
Feb	13	0.37	↔
Mar	13	0.49	↔
Apr	12	-0.57	↔
May	13	-0.12	↔
Jun	13	-0.25	↔
Jul	13	-0.22	↔
Aug	13	0.10	↔
Sep	13	-0.20	↔
Oct	13	-0.45	↓
Nov	13	-0.36	↓
All	154	-0.11	↔

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Sacramento 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	16	0.30	↔
Jan	14	-0.07	↔
Feb	15	0.39	↔
Mar	15	-0.22	↔
Apr	15	0.15	↔
May	15	-0.30	↔
Jun	18	-1.05	↔
Jul	19	-0.89	↔
Aug	19	0.03	↔
Sep	20	0.13	↔
Oct	20	0.09	↔
Nov	18	0.21	↔
All	204	-0.47	↓

Sacramento 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	39	-0.25	↓
Jan	36	-0.05	↔
Feb	37	0.01	↔
Mar	38	0.11	↔
Apr	36	0.29	↑
May	38	0.13	↔
Jun	40	0.01	↔
Jul	41	-0.15	↔
Aug	42	-0.27	↓
Sep	43	-0.47	↓
Oct	43	-0.37	↓
Nov	41	-0.26	↓
All	474	-0.18	↓

Sacramento 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	84	0.14	↑
Jan	79	0.16	↑
Feb	79	0.19	↑
Mar	81	0.14	↑
Apr	79	0.20	↑
May	83	0.18	↑
Jun	85	0.12	↑
Jul	86	-0.08	↓
Aug	87	-0.17	↓
Sep	88	-0.14	↓
Oct	88	-0.01	↔
Nov	86	0.11	↑
All	1005	0.06	↑

Sacramento 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	0.01	↔
Jan	22	0.05	↔
Feb	22	0.12	↔
Mar	23	0.34	↔
Apr	21	0.47	↑
May	23	0.48	↔
Jun	22	0.27	↔
Jul	22	0.23	↔
Aug	23	0.03	↔
Sep	23	-0.20	↔
Oct	23	-0.37	↔
Nov	23	-0.08	↔
All	270	0.12	↔

Sacramento 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.46	↔
Jan	31	0.41	↑
Feb	29	0.08	↔
Mar	30	0.01	↔
Apr	31	-0.01	↔
May	32	-0.03	↔
Jun	32	-0.08	↔
Jul	32	-0.07	↔
Aug	32	0.00	↔
Sep	32	0.31	↔
Oct	32	0.38	↑
Nov	32	0.60	↑
All	377	0.21	↑

Sacramento 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.37	↑
Jan	43	0.23	↑
Feb	42	0.08	↔
Mar	43	0.02	↔
Apr	43	-0.01	↔
May	45	-0.15	↔
Jun	45	-0.09	↔
Jul	45	-0.11	↔
Aug	45	0.04	↔
Sep	45	0.22	↑
Oct	45	0.24	↑
Nov	45	0.39	↑
All	531	0.11	↑

Sacramento 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.61	↔
Jan	12	0.51	↔
Feb	13	0.37	↔
Mar	13	0.41	↔
Apr	12	-0.53	↔
May	13	-0.11	↔
Jun	13	-0.32	↔
Jul	13	-0.34	↔
Aug	13	0.20	↔
Sep	13	-0.10	↔
Oct	13	-0.38	↔
Nov	13	-0.03	↔
All	154	-0.05	↔

San Joaquin 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	16	0.30	↔
Jan	14	-0.07	↔
Feb	15	0.39	↔
Mar	15	-0.22	↔
Apr	15	0.15	↔
May	15	-0.30	↔
Jun	18	-1.05	↔
Jul	19	-0.89	↔
Aug	18	0.02	↔
Sep	18	0.29	↔
Oct	20	0.05	↔
Nov	18	0.22	↔
All	201	-0.46	↓

San Joaquin 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	39	-0.26	↓
Jan	36	-0.05	↔
Feb	37	0.01	↔
Mar	38	0.11	↔
Apr	36	0.29	↑
May	38	0.13	↔
Jun	40	0.01	↔
Jul	41	-0.18	↔
Aug	41	-0.33	↓
Sep	41	-0.50	↓
Oct	43	-0.40	↓
Nov	41	-0.28	↓
All	471	-0.17	↓

San Joaquin 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	84	0.14	↑
Jan	79	0.16	↑
Feb	79	0.19	↑
Mar	81	0.14	↑
Apr	79	0.20	↑
May	83	0.18	↑
Jun	85	0.12	↑
Jul	86	-0.08	↓
Aug	86	-0.18	↓
Sep	86	-0.14	↓
Oct	88	-0.02	↔
Nov	86	0.10	↑
All	1002	0.07	↑

San Joaquin 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	0.01	↔
Jan	22	0.05	↔
Feb	22	0.12	↔
Mar	23	0.34	↔
Apr	21	0.47	↑
May	23	0.48	↔
Jun	22	0.27	↔
Jul	22	0.15	↔
Aug	23	-0.02	↔
Sep	23	-0.19	↔
Oct	23	-0.37	↔
Nov	23	-0.09	↔
All	270	0.11	↔

San Joaquin 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.45	↔
Jan	31	0.41	↑
Feb	29	0.09	↔
Mar	30	0.01	↔
Apr	31	-0.01	↔
May	32	-0.02	↔
Jun	32	-0.07	↔
Jul	32	-0.04	↔
Aug	32	0.01	↔
Sep	32	0.27	↑
Oct	32	0.40	↑
Nov	32	0.53	↑
All	377	0.20	↑

San Joaquin 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.36	↑
Jan	43	0.22	↑
Feb	42	0.08	↔
Mar	43	0.02	↔
Apr	43	-0.01	↔
May	45	-0.15	↔
Jun	45	-0.09	↔
Jul	45	-0.11	↔
Aug	45	0.03	↔
Sep	45	0.21	↑
Oct	45	0.23	↑
Nov	45	0.35	↑
All	531	0.10	↑

San Joaquin 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.55	↔
Jan	12	0.56	↔
Feb	13	0.37	↔
Mar	13	0.41	↔
Apr	12	-0.53	↔
May	13	-0.11	↔
Jun	13	-0.32	↔
Jul	13	-0.30	↔
Aug	13	0.20	↔
Sep	13	-0.15	↔
Oct	13	-0.38	↓
Nov	13	-0.24	↓
All	154	-0.09	↔

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Sacramento 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	14	0.69	↔
Jan	14	-0.33	↔
Feb	14	0.52	↔
Mar	15	-0.19	↔
Apr	14	0.15	↔
May	15	-0.31	↔
Jun	17	-0.87	↔
Jul	19	-0.96	↔
Aug	19	0.03	↔
Sep	20	0.13	↔
Oct	20	0.08	↔
Nov	17	-0.01	↔
All	198	-0.43	↔

Sacramento 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	37	-0.24	↔
Jan	34	-0.03	↔
Feb	34	0.03	↔
Mar	36	0.15	↔
Apr	35	0.30	↑
May	36	0.25	↔
Jun	39	-0.03	↔
Jul	41	-0.18	↔
Aug	42	-0.30	↓
Sep	43	-0.49	↓
Oct	43	-0.39	↓
Nov	40	-0.29	↓
All	460	-0.17	↓

Sacramento 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	82	0.17	↑
Jan	77	0.16	↑
Feb	76	0.17	↑
Mar	79	0.14	↑
Apr	78	0.21	↑
May	81	0.19	↑
Jun	84	0.12	↑
Jul	86	-0.09	↓
Aug	87	-0.18	↓
Sep	88	-0.15	↓
Oct	88	-0.02	↔
Nov	85	0.11	↑
All	991	0.06	↑

Sacramento 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	0.01	↔
Jan	20	-0.08	↔
Feb	20	0.02	↔
Mar	21	0.30	↔
Apr	21	0.50	↑
May	21	0.55	↔
Jun	22	0.39	↔
Jul	22	0.23	↔
Aug	23	-0.04	↔
Sep	23	-0.22	↔
Oct	23	-0.38	↔
Nov	23	-0.12	↔
All	262	0.10	↔

Sacramento 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.45	↔
Jan	31	0.40	↑
Feb	29	0.07	↔
Mar	30	0.00	↔
Apr	31	0.01	↔
May	32	-0.03	↔
Jun	32	-0.06	↔
Jul	32	-0.06	↔
Aug	32	0.02	↔
Sep	32	0.27	↔
Oct	32	0.40	↑
Nov	32	0.59	↑
All	377	0.21	↑

Sacramento 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.36	↑
Jan	43	0.22	↑
Feb	42	0.07	↔
Mar	43	0.02	↔
Apr	43	0.00	↔
May	45	-0.15	↔
Jun	45	-0.08	↔
Jul	45	-0.12	↔
Aug	45	0.03	↔
Sep	45	0.22	↑
Oct	45	0.24	↑
Nov	45	0.39	↑
All	531	0.11	↑

Sacramento 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.43	↔
Jan	12	0.66	↔
Feb	13	0.46	↔
Mar	13	0.40	↔
Apr	12	-0.43	↔
May	13	-0.15	↔
Jun	13	-0.22	↔
Jul	13	-0.16	↔
Aug	13	0.30	↔
Sep	13	-0.19	↔
Oct	13	-0.38	↔
Nov	13	-0.05	↔
All	154	-0.05	↔

San Joaquin 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	14	0.53	↔
Jan	14	-0.33	↔
Feb	14	0.52	↔
Mar	15	-0.19	↔
Apr	14	0.15	↔
May	15	-0.31	↔
Jun	17	-0.87	↔
Jul	19	-0.88	↔
Aug	18	0.03	↔
Sep	18	0.29	↔
Oct	20	0.05	↔
Nov	17	-0.05	↔
All	195	-0.41	↔

San Joaquin 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	37	-0.26	↓
Jan	34	-0.03	↔
Feb	34	0.03	↔
Mar	36	0.15	↔
Apr	35	0.30	↑
May	36	0.25	↔
Jun	39	-0.03	↔
Jul	41	-0.18	↔
Aug	41	-0.33	↓
Sep	41	-0.51	↓
Oct	43	-0.40	↓
Nov	40	-0.30	↓
All	457	-0.16	↓

San Joaquin 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	82	0.16	↑
Jan	77	0.16	↑
Feb	76	0.17	↑
Mar	79	0.14	↑
Apr	78	0.21	↑
May	81	0.19	↑
Jun	84	0.12	↑
Jul	86	-0.08	↓
Aug	86	-0.18	↓
Sep	86	-0.14	↓
Oct	88	-0.02	↔
Nov	85	0.10	↑
All	988	0.06	↑

San Joaquin 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	0.01	↔
Jan	20	-0.08	↔
Feb	20	0.02	↔
Mar	21	0.30	↔
Apr	21	0.50	↑
May	21	0.55	↔
Jun	22	0.39	↔
Jul	22	0.17	↔
Aug	23	-0.03	↔
Sep	23	-0.24	↔
Oct	23	-0.36	↔
Nov	23	-0.12	↔
All	262	0.10	↔

San Joaquin 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.45	↔
Jan	31	0.39	↑
Feb	29	0.11	↔
Mar	30	0.00	↔
Apr	31	0.01	↔
May	32	-0.02	↔
Jun	32	-0.08	↔
Jul	32	-0.04	↔
Aug	32	0.02	↔
Sep	32	0.28	↔
Oct	32	0.42	↑
Nov	32	0.54	↑
All	377	0.20	↑

San Joaquin 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.34	↑
Jan	43	0.22	↑
Feb	42	0.08	↔
Mar	43	0.02	↔
Apr	43	0.00	↔
May	45	-0.15	↔
Jun	45	-0.09	↔
Jul	45	-0.12	↔
Aug	45	0.03	↔
Sep	45	0.21	↑
Oct	45	0.24	↑
Nov	45	0.35	↑
All	531	0.10	↑

San Joaquin 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.48	↔
Jan	12	0.66	↔
Feb	13	0.47	↔
Mar	13	0.40	↔
Apr	12	-0.43	↔
May	13	-0.15	↔
Jun	13	-0.22	↔
Jul	13	-0.16	↔
Aug	13	0.26	↔
Sep	13	-0.15	↔
Oct	13	-0.42	↓
Nov	13	-0.15	↓
All	154	-0.08	↔

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Sacramento 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	17	0.33	↔
Jan	15	-0.08	↔
Feb	17	0.02	↔
Mar	17	-0.79	↔
Apr	17	-0.27	↔
May	17	-0.17	↔
Jun	18	-0.88	↔
Jul	20	-0.58	↔
Aug	18	0.09	↔
Sep	20	0.18	↔
Oct	20	0.07	↔
Nov	18	0.24	↔
All	214	-0.57	↓

Sacramento 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	40	-0.21	↓
Jan	38	-0.11	↔
Feb	40	-0.08	↔
Mar	40	0.05	↔
Apr	39	0.13	↔
May	40	0.12	↔
Jun	40	0.02	↔
Jul	42	-0.04	↔
Aug	41	-0.20	↓
Sep	43	-0.43	↓
Oct	43	-0.32	↓
Nov	41	-0.21	↓
All	487	-0.16	↓

Sacramento 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	85	0.12	↑
Jan	82	0.12	↑
Feb	83	0.09	↑
Mar	83	0.09	↑
Apr	82	0.14	↑
May	85	0.14	↑
Jun	85	0.11	↑
Jul	87	-0.04	↔
Aug	86	-0.13	↓
Sep	88	-0.12	↓
Oct	88	0.00	↔
Nov	86	0.11	↑
All	1020	0.06	↑

Sacramento 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.19	↔
Jan	23	-0.11	↔
Feb	23	-0.23	↔
Mar	23	0.04	↔
Apr	22	0.16	↔
May	23	0.45	↔
Jun	22	0.40	↔
Jul	22	0.20	↔
Aug	23	0.10	↔
Sep	23	-0.15	↔
Oct	23	-0.28	↔
Nov	23	-0.13	↔
All	273	0.02	↔

Sacramento 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.48	↔
Jan	32	0.36	↔
Feb	30	-0.06	↔
Mar	30	0.04	↔
Apr	31	0.01	↔
May	32	-0.06	↔
Jun	32	-0.03	↔
Jul	32	-0.05	↔
Aug	32	0.05	↔
Sep	32	0.29	↔
Oct	32	0.47	↑
Nov	32	0.62	↑
All	379	0.23	↑

Sacramento 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.37	↑
Jan	44	0.23	↔
Feb	43	0.10	↔
Mar	43	0.04	↔
Apr	43	0.01	↔
May	45	-0.18	↔
Jun	45	-0.08	↔
Jul	45	-0.06	↔
Aug	45	0.06	↔
Sep	45	0.20	↑
Oct	45	0.28	↑
Nov	45	0.37	↑
All	533	0.13	↑

Sacramento 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.50	↔
Jan	12	0.59	↔
Feb	13	0.41	↔
Mar	13	0.52	↔
Apr	12	-0.60	↔
May	13	-0.28	↔
Jun	13	-0.28	↔
Jul	13	-0.21	↔
Aug	13	0.02	↔
Sep	13	-0.23	↔
Oct	13	-0.53	↔
Nov	13	-0.15	↔
All	154	-0.11	↔

San Joaquin 1922-1944

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	17	0.24	↔
Jan	15	-0.08	↔
Feb	17	0.02	↔
Mar	17	-0.79	↔
Apr	17	-0.27	↔
May	17	-0.17	↔
Jun	18	-0.88	↔
Jul	17	-0.30	↔
Aug	14	0.60	↔
Sep	17	0.38	↔
Oct	18	0.30	↔
Nov	17	0.19	↔
All	201	-0.41	↓

San Joaquin 1922-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	40	-0.23	↓
Jan	38	-0.11	↔
Feb	40	-0.08	↔
Mar	40	0.05	↔
Apr	39	0.13	↔
May	39	0.07	↔
Jun	40	0.02	↔
Jul	39	0.07	↔
Aug	37	-0.19	↔
Sep	39	-0.51	↓
Oct	41	-0.37	↓
Nov	40	-0.27	↓
All	472	-0.13	↓

San Joaquin 1922-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	85	0.14	↑
Jan	82	0.13	↑
Feb	83	0.10	↑
Mar	83	0.09	↑
Apr	82	0.15	↑
May	84	0.14	↑
Jun	85	0.10	↔
Jul	84	-0.02	↔
Aug	82	-0.14	↓
Sep	84	-0.13	↓
Oct	86	-0.01	↔
Nov	85	0.11	↑
All	1005	0.07	↑

San Joaquin 1945-1967

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	23	-0.18	↔
Jan	23	-0.08	↔
Feb	23	-0.23	↔
Mar	23	0.04	↔
Apr	22	0.12	↔
May	22	0.28	↔
Jun	22	0.26	↔
Jul	22	0.13	↔
Aug	23	0.00	↔
Sep	22	-0.25	↔
Oct	23	-0.34	↔
Nov	23	-0.18	↔
All	271	-0.03	↔

San Joaquin 1968-1999

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	32	0.53	↔
Jan	32	0.40	↔
Feb	30	-0.06	↔
Mar	30	0.06	↔
Apr	31	0.01	↔
May	32	-0.06	↔
Jun	32	-0.06	↔
Jul	32	-0.12	↔
Aug	32	-0.01	↔
Sep	32	0.25	↔
Oct	32	0.44	↑
Nov	32	0.67	↑
All	379	0.22	↑

San Joaquin 1968-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	45	0.42	↑
Jan	44	0.25	↔
Feb	43	0.10	↔
Mar	43	0.04	↔
Apr	43	0.02	↔
May	45	-0.20	↔
Jun	45	-0.11	↔
Jul	45	-0.12	↔
Aug	45	0.05	↔
Sep	45	0.22	↑
Oct	45	0.25	↑
Nov	45	0.40	↑
All	533	0.12	↑

San Joaquin 2000-2012

Month	Sample Size	Sen's Trend Slope Median (km per year)	Test Decision of MK Test
Dec	13	0.42	↔
Jan	12	0.83	↔
Feb	13	0.41	↔
Mar	13	0.52	↔
Apr	12	-0.61	↔
May	13	-0.28	↔
Jun	13	-0.37	↔
Jul	13	-0.27	↔
Aug	13	-0.04	↔
Sep	13	-0.29	↔
Oct	13	-0.35	↓
Nov	13	-0.29	↓
All	154	-0.17	↔

WILCOXON RANK-SUM TEST

S1

Sacramento 1921-1967 vs. 1986-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↔	↑	↔	↑	↑	↑	↑	↔	↔	↔	↔
Above Normal	↔	↑	↔	↔	↔	↔	↔	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↔	↔	↔	↔	↑	↑	↔	↓	↓	↔	↔

San Joaquin 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↔	↔	↔	N/A	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↔	↓	↔	↔	↑
Below Normal	↑	↔	↔	↑	↔	↑	↑	↑	↔	↔	↔	↔	↔
Above Normal	↔	↑	↔	↔	↔	↔	↔	↔	↓	↓	↓	↑	↔
Wet	↑	↔	↔	↔	↔	↔	↑	↑	↔	↓	↓	↔	↔

S2

Sacramento 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↔	↑	↔	↑	↑	↑	↑	↔	↔	↔	↔
Above Normal	↔	↑	↔	↔	↔	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↔	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔

San Joaquin 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↔	↔	↔	N/A	↓	↔	↔
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Below Normal	↑	↔	↔	↑	↔	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↔	↔	↑	↑	↔	↓	↓	↓	↔	↔
Wet	↑	↔	↔	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔

S3

Sacramento 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↔	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↔	↓	↓	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↔	↔	↔	↔
Above Normal	↔	↑	↔	↔	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↔	↑	↔	↑	↑	↑	↔	↓	↓	↔	↔

San Joaquin 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↔	↔	↔	↓	↓	↔	↔
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↔	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↔	↑	↔	↑	↑	↑	↔	↓	↓	↔	↔

S4

Sacramento 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↔	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↔	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↔	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔

San Joaquin 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↔	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↔
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↔	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔

S5

Sacramento 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↔	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↑	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔

San Joaquin 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↔	↑	↔	↑	↑	↑	↔	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↑	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔

S6

Sacramento 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↔	↔	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↔	↔	↔	↔	↔	↔	↑	↑	↔	↓	↓	↔	↔

San Joaquin 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↑	↑	↑	↑	↑	↑	↔	↓	↔	↔	↔
Above Normal	↔	↑	↔	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Wet	↔	↔	↔	↔	↔	↔	↑	↑	↔	↓	↓	↔	↔

X2

Sacramento 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↑	↔	↔	↓	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↔
Below Normal	↑	↔	↔	↑	↔	↑	↑	↑	↑	↔	↔	↔	↔
Above Normal	↔	↑	↔	↔	↔	↔	↔	↔	↓	↓	↓	↔	↑
Wet	↑	↔	↔	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔

San Joaquin 1921-1967 vs. 1968-2012

Year Type	All	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Critical	↑	↑	↔	↑	↑	↑	↔	↔	↔	N/A	↓	↔	↑
Dry	↑	↑	↑	↑	↑	↑	↑	↔	↓	↓	↓	↔	↑
Below Normal	↑	↔	↔	↑	↔	↑	↑	↑	↔	↔	↔	↔	↔
Above Normal	↔	↑	↔	↔	↔	↔	↔	↔	↓	↓	↓	↔	↔
Wet	↑	↔	↔	↑	↔	↔	↑	↑	↔	↓	↓	↔	↔