

SUPPLEMENTAL FIGURES & TABLES: Species' Sensitivity to Hydrologic Whiplash in The Tree-Ring Record of the High Sierra Nevada

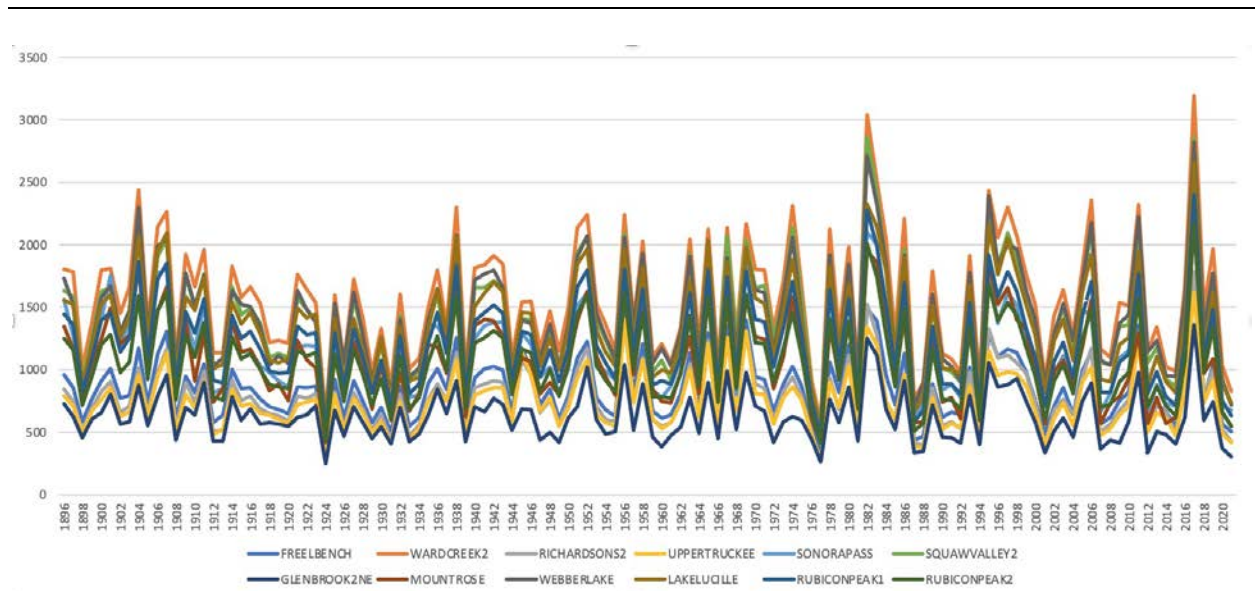


Figure S1. Time series of PRISM water-year precipitation at 12 SWE monitoring stations, 1896-2020. Site names correspond to sites listed at <https://cdec.water.ca.gov/> (accessed on 2 February 2022).

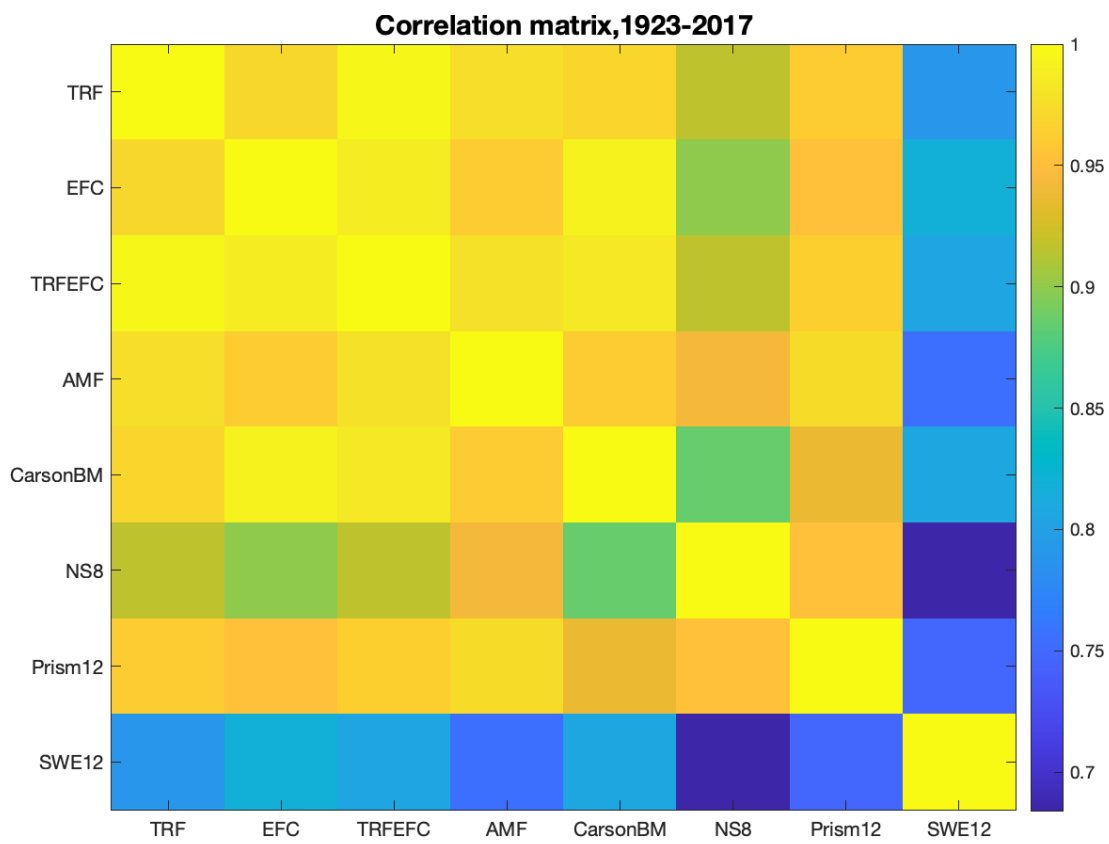


Figure S2. Correlation matrix of annual hydroclimatic series, 1923–2017. Site codes are defined in Table S1.

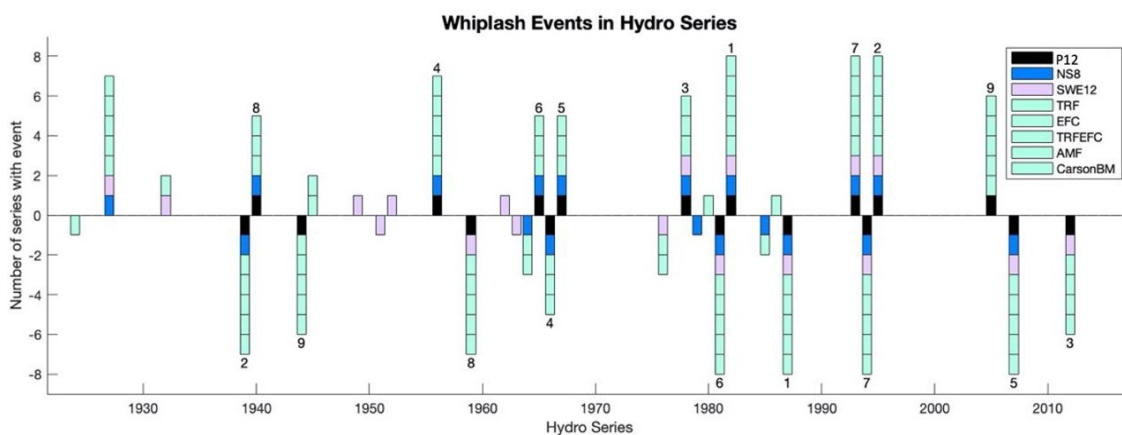


Figure S3. Synchrony of positive whiplash events in alternative annual hydroclimatic series, 1923–2017. The top eight ranked whiplash events in each series are represented in the plot. Numbers indicate the event ranking of P12 events. P12 whiplash events are coded in black, the Northern Sierra 8-Station Precipitation Index (NS8) in blue, the Snow Water Equivalent (SWE12) in light purple, and 5 streamflows (natural flows) in light blue-green. Site codes are defined in Table S1.

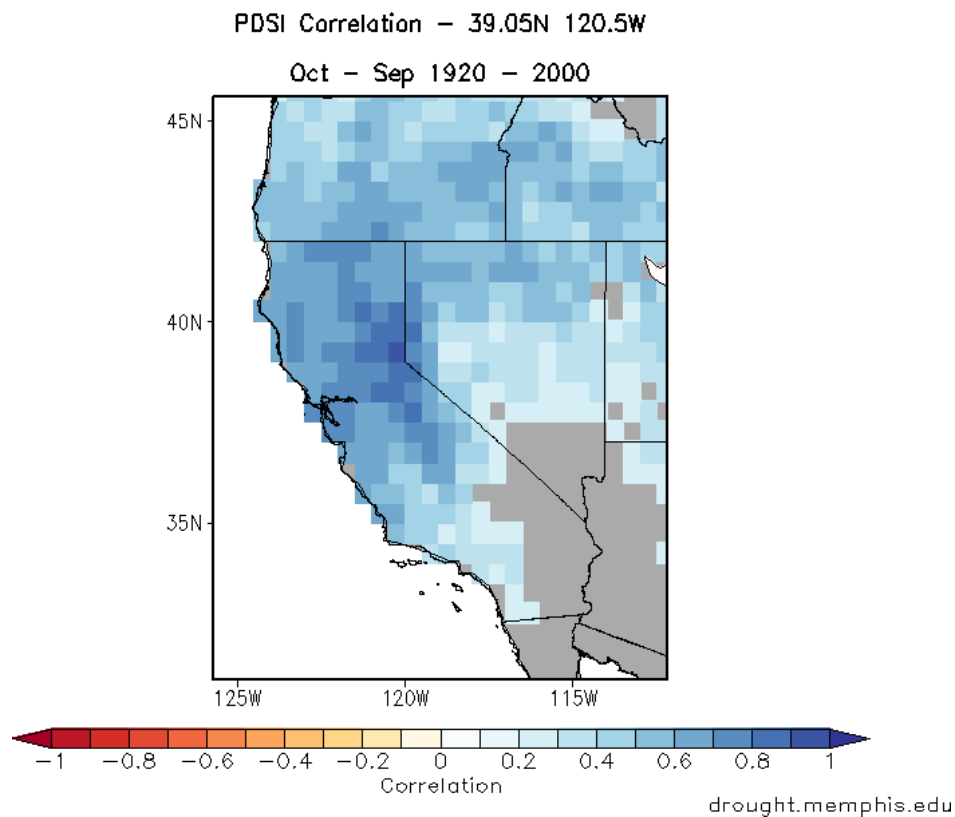


Figure S4. The climate footprint of the Truckee-Carson River Basin is illustrated with the spatial correlation of the instrumental summer (June-July-August) Palmer Drought Severity Index (PDSI) on a 0.5-degree latitude-longitude grid. The correlations are with the point over the basin. Analysis period: 1920-2000. Map generated at <http://drought.memphis.edu/NADA/Correlation.aspx> (accessed on 13 January 2021).

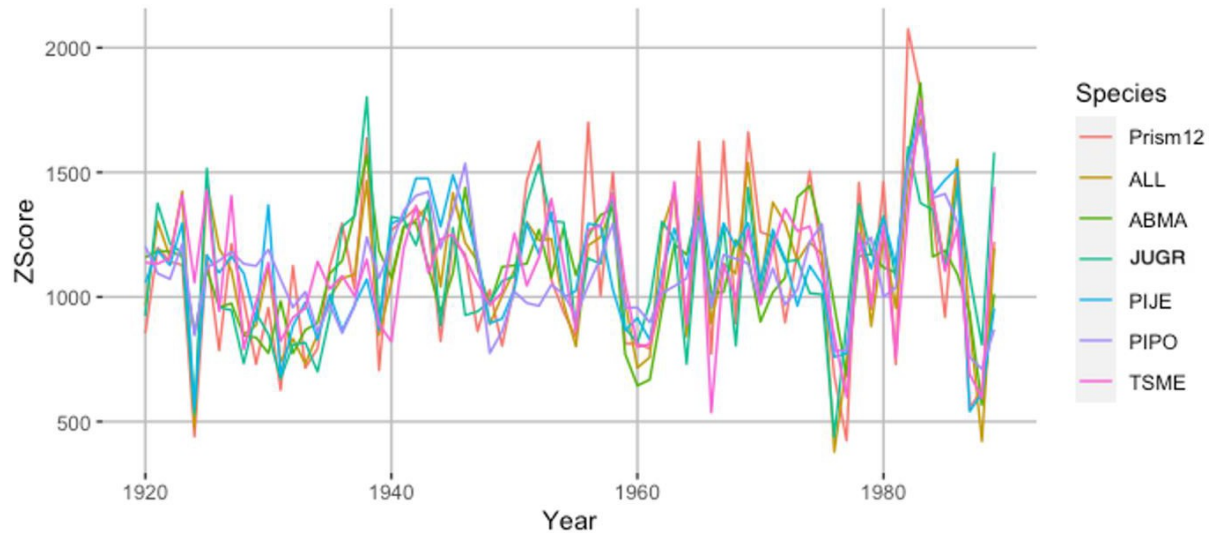


Figure S5. Time series of P12, species-specific reconstructions of P12, and full-network reconstructions of P12.

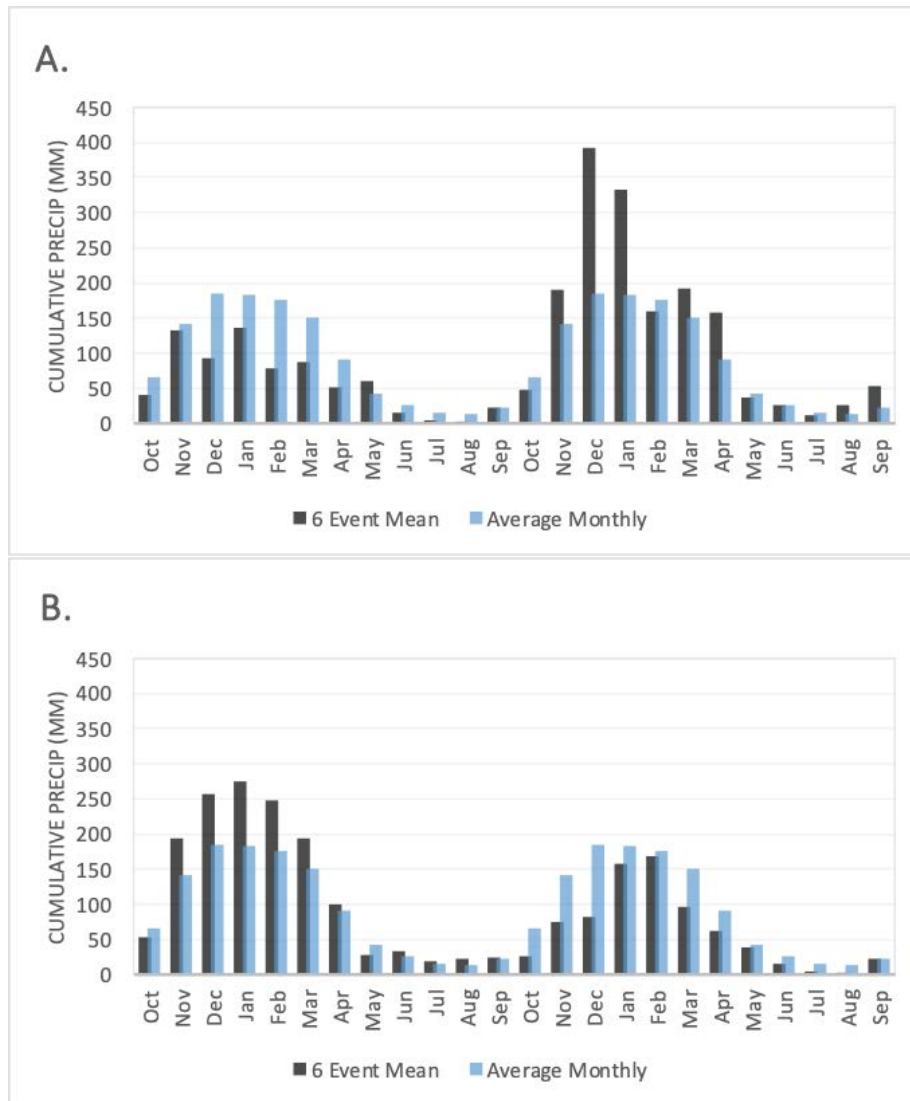


Figure S6. Mean of monthly P12 precipitation in years of whirlash events in P12. **(A)** Positive events. **(B)** Negative events. Blue shows the long-term mean monthly precipitation, which does not vary among frames.

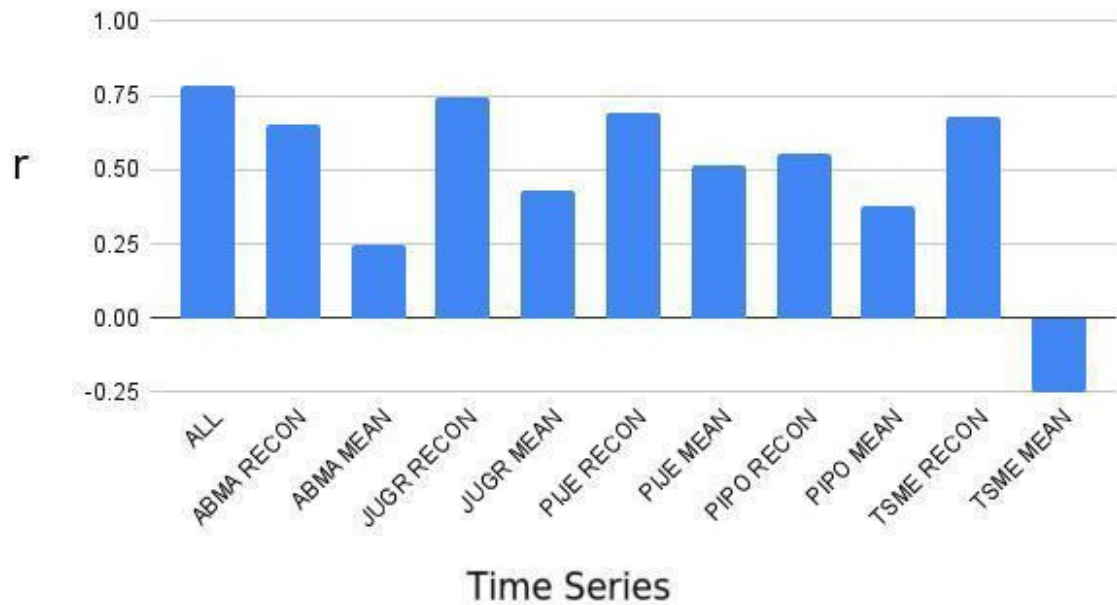


Figure S7. Correlation of annual precipitation (P12) with species-mean chronologies and with full-network (All) and species-specific reconstructions, 1920-1989. For reconstructions, the squared r is equivalent to the regression R-squared of the reconstruction models reported in this paper. For the mean chronologies, squared r is equivalent to the regression R-squared of a simple linear regression model of P12 on the mean of available chronologies (no screening, no lags) of a particular species. Note the negative ($r=-0.25$) correlation for TSME MEAN. A simple linear regression model of P12 on that mean chronology would explain 6.25% (-0.25 squared) of the variance of P12. The model would have a negative regression coefficient, reflecting the tendency for heavy snowpack to be associated with a narrow ring in mountain hemlock in the current year.

Table S1. Key for 8 Hydroclimatic series in/near the Truckee-Carson River Basin. Time series for analyses are annual (average or sum of water year is from October to September), except for SWE12, a measure of April 1st Snow Water Equivalent.

ID	TYPE	UNITS	SOURCE	NAME
TRF	FNF	mcm	CDEC	Truckee River at Farad
EFC	FNF	mcm	CDEC	East Fork Carson River nr Garnerville
TRFEFC	FNF	mcm	CDEC	Sum of Truckee and E Fork Carson
AMF	FNF	mcm	CDEC	American River at Folsom
CARSONBM	FLO	Z-score	USGS	Carson River calibration series (Biondi and Meko 2019)
NS8	PCP	mm	CDEC	Northern Sierra 8-Station Precipitation Index
PRISM12	PCP	mm	PRISM	PRISM precipitation averaged over points for SWE12
SWE12	Snow	%normal	CDEC+	12-station snow-course SWE assembled by us

Table S2. Summary statistics of site-specific reconstructions of P12. Statistics in columns are the same as in Table 2.

Recon	Species Code	Lags Used	R ²	R ² adj	F	pF	REcv	RSME
CA574	ABMA	P1	0.287	0.266	13.294	1.41×10^{-5}	0.261	302.415
CA589	ABMA		0.069	0.055	4.957	2.93×10^{-2}	0.034	345.857
CA691	ABMA		0.267	0.259	33.455	9.95×10^{-8}	0.261	299.090
CA696	ABMA		0.228	0.219	26.838	1.32×10^{-6}	0.209	310.652
CA630	JUGR	N2 P2	0.062	0.024	1.639	1.88×10^{-1}	0.040	350.903
CA631	JUGR	N1	0.018	-0.008	0.679	5.10×10^{-1}	-0.019	361.530
CA632	JUGR	N2	0.184	0.162	8.440	4.94×10^{-4}	0.171	326.115
CA698	JUGR		0.016	0.006	1.516	2.21×10^{-1}	-0.007	350.564
DGS	JUGR		0.419	0.411	56.186	8.86×10^{-11}	0.401	276.270
IVJ	JUGR	N2 P2	0.114	0.079	3.227	2.72×10^{-2}	0.073	345.360
KAIM	JUGR		0.246	0.238	28.765	6.52×10^{-7}	0.238	304.419
CA677	PIJE	N1	0.419	0.405	30.988	7.33×10^{-11}	0.395	272.539
CA678	PIJE		0.282	0.274	34.245	8.39×10^{-8}	0.282	296.951
DLB	PIJE		0.028	0.015	2.179	1.44×10^{-1}	0.008	357.126
IVP	PIJE		0.025	0.012	1.935	1.68×10^{-1}	-0.010	360.491
LEM	PIJE	P1 N1	0.157	0.130	5.880	1.00×10^{-3}	0.129	338.129
LSF	PIJE	P1	0.278	0.263	18.478	1.63×10^{-7}	0.259	311.872
LTV	PIJE		0.028	0.018	2.797	9.77×10^{-2}	0.003	361.876
SSP	PIJE	P1	0.361	0.344	21.174	5.12×10^{-8}	0.335	292.021
CA578	PIPO	P2 N1 N2	0.418	0.382	11.491	4.32×10^{-7}	0.361	281.239
CA583	PIPO	P1 N1	0.083	0.041	1.970	1.27×10^{-1}	0.029	346.681
CA694	PIPO	P1 N1	0.211	0.185	7.938	9.48×10^{-5}	0.155	321.127
CA695	PIPO	P1 N1	0.159	0.130	5.599	1.46×10^{-3}	0.112	329.121
CPRMTR	PIPO	P1 N1	0.175	0.149	6.719	3.68×10^{-4}	0.145	335.146
NOD	PIPO		0.006	-0.007	0.449	5.05×10^{-1}	-0.019	357.991
CA576	TSME	P1 N2 N1	0.430	0.395	12.079	2.25×10^{-7}	0.342	285.386
CA692	TSME	P1 N2	0.469	0.451	26.495	2.26×10^{-12}	0.429	262.994
GPH	TSME	P1 P2	0.211	0.180	6.701	4.56×10^{-4}	0.169	326.904

Table S3. Significance of tracking of whiplash events in P12 by site-specific reconstructions as estimated by hypergeometric test. Sample size ($N_s = 69$) and maximum possible event matches ($M=6$) are the same for all reconstructions. The last two columns list the probability, by chance alone, of Q-or-more successes (events identified) given k draws from the sample.

NAME	SPECIES CODE	Q (POS)	Q (NEG)	K (POS)	K (NEG)	P-VAL (POS)	P-VAL (NEG)
CA574	ABMA	0	2	6	6	4.33×10^{-1}	6.87×10^{-3}
CA589	ABMA	1	1	6	6	8.14×10^{-2}	8.14×10^{-2}
CA691	ABMA	2	2	7	6	1.16×10^{-2}	6.87×10^{-3}
CA696	ABMA	0	3	6	6	4.33×10^{-1}	2.48×10^{-4}
CA630	JUGR	1	2	6	7	8.14×10^{-2}	1.16×10^{-2}
CA631	JUGR	2	1	6	6	6.87×10^{-3}	8.14×10^{-2}
CA632	JUGR	1	2	6	6	8.14×10^{-2}	6.87×10^{-3}
CA698	JUGR	1	1	6	7	8.14×10^{-2}	1.09×10^{-1}
DGS	JUGR	1	2	7	6	1.09×10^{-1}	6.87×10^{-3}
IVJ	JUGR	1	2	6	6	8.14×10^{-2}	6.87×10^{-3}
KAIM	JUGR	1	2	6	6	8.14×10^{-2}	6.87×10^{-3}
CA677	PIJE	2	2	6	6	6.87×10^{-3}	6.87×10^{-3}
CA678	PIJE	0	2	6	6	4.33×10^{-1}	6.87×10^{-3}
DLB	PIJE	0	0	6	6	4.33×10^{-1}	4.33×10^{-1}
IVP	PIJE	0	1	6	6	4.33×10^{-1}	8.14×10^{-3}
LEM	PIJE	1	2	6	6	8.14×10^{-2}	6.87×10^{-3}
LSF	PIJE	2	0	6	6	6.87×10^{-3}	4.33×10^{-1}
LTV	PIJE	0	1	6	6	4.33×10^{-1}	8.14×10^{-2}
SSP	PIJE	1	2	6	6	8.14×10^{-2}	6.87×10^{-3}
CA578	PIPO	2	2	6	6	6.87×10^{-3}	6.87×10^{-3}
CA583	PIPO	1	3	6	6	8.14×10^{-2}	2.48×10^{-4}
CA694	PIPO	1	1	6	6	8.14×10^{-2}	8.14×10^{-2}
CA695	PIPO	1	3	7	7	1.09×10^{-1}	5.63×10^{-4}
CPRMTR	PIPO	0	2	6	6	4.33×10^{-1}	6.87×10^{-3}
NOD	PIPO	0	1	7	6	4.87×10^{-1}	8.14×10^{-2}
CA576	TSME	3	3	6	6	2.48×10^{-4}	2.48×10^{-4}
CA692	TSME	5	1	7	6	5.84×10^{-8}	8.14×10^{-2}
GPH	TSME	2	2	7	6	1.16×10^{-2}	6.87×10^{-3}