SUSTAINABLE FOOD AND AGRICULTURE

Runoff and climate change

Agricultural runoff in the San Joaquin Valley is significantly affected by changes in precipitation, temperature, and atmospheric CO_2 concentration.

THE SOIL AND WATER ASSESSMENT TOOL (SWAT) watershed model was used to assess the impact of climate change on sediment, nitrate, phosphorus and pesticide (diazinon and chlorpyrifos) runoff in the San Joaquin watershed in California (Figure 1).

This study used modeling techniques that include variations of CO_2, temperature, and precipitation to quantify these responses. Precipitation had a greater impact on agricultural runoff compared to changes in either CO_2 concentration or temperature.

Increase of precipitation by ±10% and ±20% generally changed agricultural runoff proportionally.

Solely increasing CO_2 concentration resulted in an increase in nitrate, phosphorus, and chlorpyrifos yield by 4.2, 7.8, and 6.4%, respectively, and a decrease in sediment and diazinon yield by 6.3 and 5.3%, respectively, in comparison to the present-day reference scenario.

Only increasing temperature reduced yields of all agricultural runoff components.

The results suggest that agricultural runoff in the San Joaquin watershed is sensitive to precipitation, temperature, and CO_2 concentration changes. The results generated from this study are valuable as a tool for guiding water resource managers and those required to comply with legislation for water quality guidelines to make appropriate decisions on land management and/or measures for environmental protection.

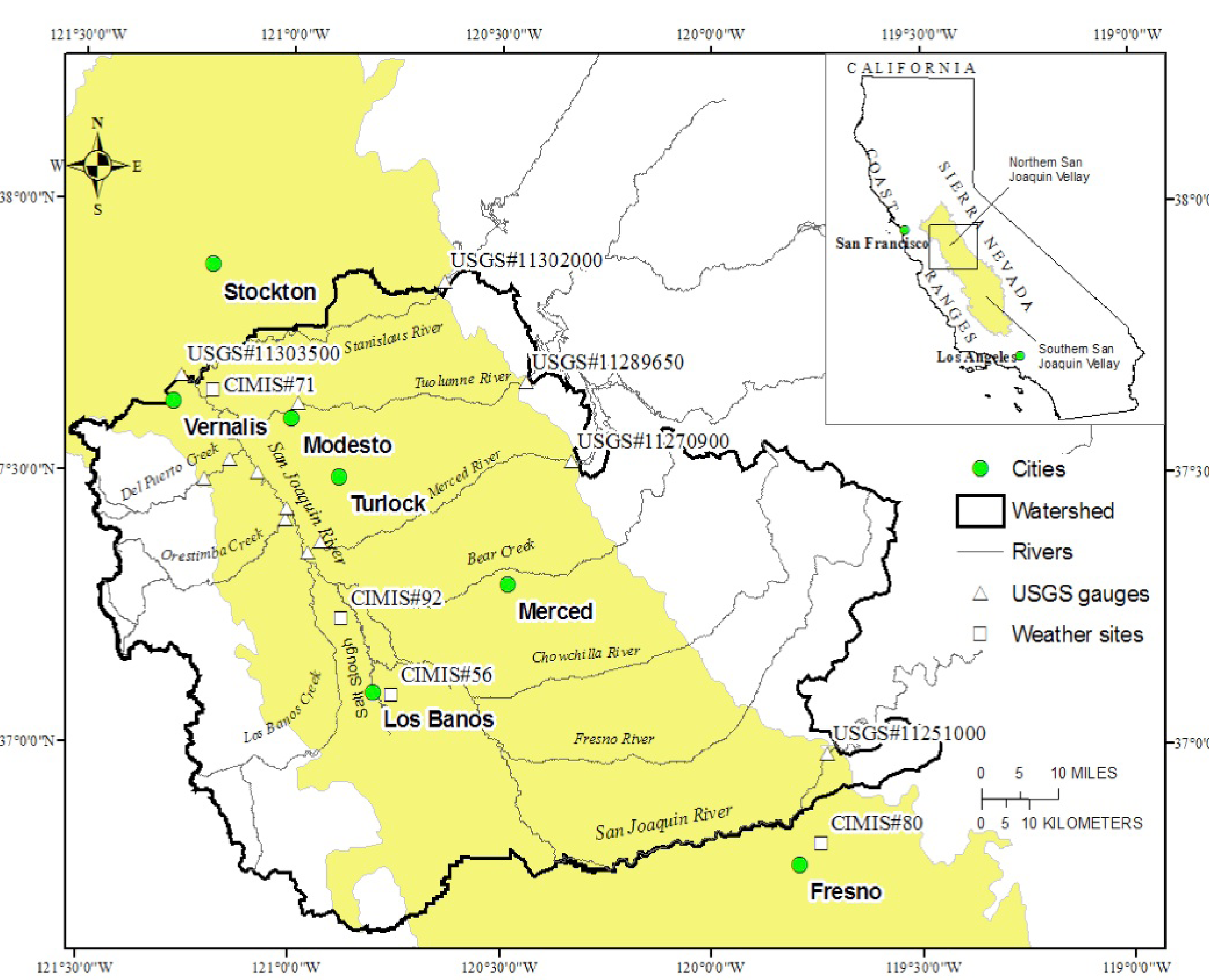

Figure 1. Study area of the northern San Joaquin Valley Watershed

	Reference	Temperature change (°C)	Precipitation changes (%)				
			0	10	20	−10	−20
Water yield (%)	1493.62 mm	0	x	10.1	22.3	−9.9	−19.2
Sediment (%)	6.09×10^8 kg	0	x	11.5	28	−10.7	−20.8
Nitrate (%)	12,550 kg	0	x	13.2	40.2	−11.9	−21.9
Phosphorus (%)	209,174 kg	0	x	11.6	33.1	−10.7	−20.9
Diazinon (%)	75.96 kg	0	x	9.9	20.4	−9.3	−18.6
Chlorpyrifos (%)	41.57 kg	0	x	13.1	27.5	−11.6	−31.9
Water yield (%)	1493.62 mm	1.1	−2.0	7.86	20.0	−11.9	−21.1
Sediment (%)	6.09×10^8 kg	1.1	−2.1	9.3	25.6	−12.5	−22.3
Nitrate (%)	12,550 kg	1.1	−6.1	6.4	30.8	−16.9	−27.2
Phosphorus (%)	209,174 kg	1.1	−2.5	8.7	29.5	−12.9	−22.7
Diazinon (%)	75.96 kg	1.1	−0.8	9.3	19.9	−10.4	−19.4
Chlorpyrifos (%)	41.57 kg	1.1	−0.4*	12.1	26.4	−13.2	−23.3
Water yield (%)	1493.62 mm	6.4	−9.2	0.14*	11.3	−17.9	−26.4
Sediment (%)	6.09×10^8 kg	6.4	−9.3	0.9*	15.3	−18.4	−27.4
Nitrate (%)	12,550 kg	6.4	−18.3	−8.7	9.3	−27	−36.7
Phosphorus (%)	209,174 kg	6.4	−15.3	−6.2	8.3	−23.3	−31.4
Diazinon (%)	75.96 kg	6.4	−4.6	4.6	14.2	−13.3	−21.9
Chlorpyrifos (%)	41.57 kg	6.4	−4.9	6.7	19.4	−15.3	−26.5

	Reference	CO_2 only	CO_2 + 6.4 °C	CO_2 + 20% P
Water yield (%)	1493.62 mm	23.8	24.4	51.8
Sediment (%)	6.09×10^8 kg	−6.3	−2.2	24.5
Nitrate (%)	12,550 kg	4.2	8.7	37.2
Phosphorus (%)	209,174 kg	7.8	1.5*	40.3
Diazinon (%)	75.96 kg	−5.3	−0.4*	16.8
Chlorpyrifos (%)	41.57 kg	6.4	9.8	39.6

*Differences between the reference and climate change scenarios are not significant at $\alpha = 0.05$.

Table 1. Results from the climate change simulations

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