Drought impacts to water footprints and virtual water transfers of the Central Valley of California

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The Central Valley of California is one of the most productive agricultural locations in the world, made possible by a complex and vast irrigation system. Beginning in 2012, California endured one of the worst droughts in its history. Local impacts of the drought have been evaluated, but it is not yet well understood how the drought reverberated through the global food system. Here, we quantify drought impacts to the water footprint (WF) of agricultural production and virtual water transfers (VWT) of the Central Valley of California. To do this, we utilize high spatial, temporal, and water source resolution datasets and a crop model from pre-drought conditions (2011) through three years of exceptional drought (2012--2014). Despite a 6.5% reduction in crop production over the course of the drought, the WF of agricultural production in the Central Valley increased by 1.3%. This was due to greater crop water requirements from higher temperatures and a shift to more water-intensive orchard and vine crops. The groundwater WF increased from 5.93 km3 in 2011 to 11.64 km3 in 2014, predominantly in the Tulare Basin. During the drought, transfers of food commodities declined by 1.3%. However, total VWT increased by 4.2% (0.57 km3), driven by an increase in groundwater VWT (3.31 km3), offsetting declines in green and surface VWT. During the drought, local and global consumers doubled their reliance on the already overexploited Central Valley Aquifer. These results indicate that drought may strengthen the telecoupling between unsustainable groundwater withdrawals and distant consumers of groundwater-intensive agricultural commodities.

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