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Four decades of field-scale evapotranspiration mapping over the Beqaa valley in Lebanon

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The Beqaa valley in Lebanon currently hosts the highest number of refugees per capita in the world. It is also the major agricultural production area in the country. Groundwater levels in some regions of the valley have decreased by more than 15 meters in the last five years. Water use estimates at the regional and the field scale for this valley are crucial for enhancing resilience and for managing competing sector water demands. In this research, we derive an actual evapotranspiration estimate using a one source energy balance-based algorithm at the field scale for the Beqaa for the period 1984-2017. For this we utilize all available Landsat imagery including Landsat 4, 5, 7, and 8 using local weather data. The pySEBAL energy-balance approach was used to determine the 30-m ET maps over the study area. Analysis of 825 cloud- masked scenes shows that ET over the heavily cultivated valley in the last twenty years has ranged between 1000 to 1300 mm/yr. Annual analysis shows no discernible trend in ET across the valley, but inter-seasonal analysis shows a slightly decreasing trend in winter evapotranspiration and increases in irrigation activities in the dry months of September and October, further impounding the stress on groundwater. This work is the first of its own that makes use of the full range of Landsat products in calculating evapotranspiration over the Beqaa valley. The outcome of this research also offers unique opportunities for estimating past and future trends of groundwater withdrawals. Results can provide insights into the sustainability of irrigated agriculture and the required international interventions in the water sector for enhancing resilience of refugee and local communities.