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Recent drying of the Fertile Crescent: natural or externally forced?

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There has been a reduction in observed precipitation over the greater Mediterranean region since the middle of the 20th Century. Recent studies suggest that while anthropogenic forcing has already begun to assert itself in recent decades, the preponderance of the winter drying trend is attributable to the large natural multidecadal variability of the North Atlantic Oscillation (NAO), while over the eastern Mediterranean, the anthropogenic, or forced drying signal is more clearly evident. This forced drying is projected to increase during the 21st Century according to the newest global climate models and this aridification would present significant challenges for a region that is already water-stressed. Although the Fertile Crescent is historically known for its agricultural prosperity, the severity and persistence of the recent multiyear drought in Syria, directly prior to the 2011 uprising there, leads us to ask whether this is evidence of emerging global warming influence. This drought exacerbated existing water insecurity, resulting in an agricultural collapse and a mass migration of rural drought refugees to the urban areas in Syria's west. This migration followed the previous influx of Iragi refugees and combined with strong natural population growth to place a severe strain on resources. Here we examine observations of precipitation and temperature, both gridded and stations, along with simulations and projections from the newest global climate models, to estimate the forced contribution to the recent Syrian drought, and assess the uncertainty in future drying according to the models. We find that this region has experienced a long-term downward trend in precipitation, and a concomitant increase in temperature, serving to further dry the soil, and in surface pressure. We find that the shift in the distributions of three-year running means of surface pressure and precipitation due to the forcing make severe events such as the recent Syrian drought several times more likely. Next we examine the moisture budget in the models and compare with the ground truth of atmospheric reanalyses to determine the relative contributions from the mean flow and the transient eddies. We find that the mean and transient patterns of moisture budget change over the eastern Mediterranean under forcing resemble the patterns of the NAO-induced moisture budget anomaly, but that over the greater Mediterranean there are distinct differences. Under forced moisture budget change, as noted in a recent study, the mean flow serves to strongly dry the greater Mediterranean, with a smaller contribution from the transients. For the eastern Mediterranean however, the transients oppose the drying by the mean flow, under climate change and under a positive phase of the NAO. These results suggest that anthropogenically forced drying of the Fertile Crescent may already be underway, primarily through a poleward shift in the mean flow, and represent a step forward toward a better understanding of the mechanisms associated with eastern Mediterranean hydroclimate change and variability and how they compare.