Climate Extremes and Global Crop Production

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Climate variability and associated climate extremes (e.g., droughts, floods and heat waves) are major drivers of year-to-year variations in crop yield worldwide and hence important natural hazards in agriculture. As the intensity, frequency and length of some climate extremes have changed due to anthropogenic climate change (Kamae et al., 2014, *Geophys. Res. Lett.*, doi:10.1002/2014GL061062), it is required to improve our understanding on the impacts of climate extremes on crop production to aid the development and social implementation of adaptation technologies.

In this talk, we first overview some climate-yield relationships found in earlier work and then present new results derived from data analysis using global data sets of crop yields and climate indices. Twenty-seven temperature and precipitation indices, which are recommended by the Expert Term on Climate Change Detection and Indices (ETCCDI, http://etccdi.pacificclimate.org/index.shtml) and represent moderate climate extremes, were calculated using daily maximum and minim temperature and precipitation data obtained from a new retrospective meteorological forcing data set S14FD (Iizumi et al., in review). Yield anomalies of major crops (maize, rice, wheat and soybean) that indicate departures from normal yield were computed using the global data set of historical yields (Iizumi et al., 2014, *Glob. Ecol. Biogeogr.*, doi:10.1111/geb.12120). Results of correlation analysis for 1983-2008 showed that, although many extreme indices have the significant correlation with yield anomalies in some regions of the world, growing season mean temperature and precipitation are more powerful to explain yield anomalies. Our findings suggest that more sophisticated sector-specific climate indices than those used in climate science communities are necessary to adequately capture the agricultural impacts of climate extremes. As discussed in the Expert Team on Sector-specific Climate Indices (ET-SCI, see Alexander (2016, *Weather Clim. Extr.*, doi:10.1016/j.wace.2015.10.007)), the development of such indices is of priority to improve our capability in monitoring, early warning and forecasting the impacts of climate extremes on agriculture.

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