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Climate change related hazard for maize cropping in the Po valley of Italy

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We quantify the potential fallout of prospective climate change upon crop yield hazard of maize (Zea mays L.) for a relevant case study area in the Po valley of Northern Italy. Po valley (ca. 70.000 km2) displays up to 45% of farming areas, and cereal production amongst the highest Europe wide (ca. 8.83 ton/ha, 1999-2007), and transient and prospective climate warming put at stake crop production and food security therein. Here, we simulate maize production by way of i) a properly developed hydrological/crop yield model and ii) with a reference literature model, set up and validated by way of meteo and crop yield data during 2001-2010, obtaining acceptable results. Weather drivers of the crop models are temperature, precipitation, solar radiation and CO_2. We then investigate i) crop failure (i.e. significant decrease of crop yield), and ii) water consumption (i.e. excessive use of water for irrigation) under prospective climate change scenarios (until 2050) as depicted by global circulation models (GCMs) included within IPCC panel (e.g. storyline A1B, A2, B2), properly downscaled, and by a local scenario LOC, obtained by projecting recently observed local climate trends (1975-2010). We simulate crop yield under different irrigation scenarios (including no irrigation, or rainfed cropping), and evaluate respective crop yield, and water consumption. Under the worst, more likely future scenarios of increasing temperature and decreasing precipitation, crop failure hazard increases and water use increases, due to increased evapotranspiration, higher irrigation demand, and lower final yield. Increase of CO_2, albeit possibly increasing water use efficiency, seems to affect little water use and yield. Possible increase of precipitation as projected by some GCMs may partly make up for the increase of temperature, especially under a no, or little irrigation scenario, and slightlty decrease crop failure hazard. We also test potential adpatation strategies, including anticipated sowing date, and irrigation on demand, giving some potential for increase of crop yield. Uncertainty in future precipitation carries the greatest bearing upon the variability of scenarios projecting maize yield and water use. Our results deliver suggestions as to how i) evaluate crop failure hazard under modified climate, ii) assess the amount of water required to cultivate maize or other crops, iii) benchmark objectively adaptation strategies for agricultural systems with an eye on least water consumption.

Keywords: crop modeling; climate change hazard; water use; food security.