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The 2011 Great Flood in Thailand: Climate Diagnostics and Implications from Climate Change

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ABSTRACT

Severe flooding occurred in Thailand during the 2011 summer season, which resulted in more than 800 deaths and affected 13.6 million people. The unprecedented nature of this flood in the Chao Phraya River Basin (CPRB) was examined and compared with historical flood years. Climate diagnostics were conducted to understand the meteorological conditions and climate forcing that lead to the magnitude and duration of this flood. Neither the monsoon rainfall nor the tropical cyclone frequency anomalies alone were sufficient to cause the 2011 flooding event. Instead, a series of abnormal conditions collectively contributed to the intensity of the 2011 flood: anomalously high rainfall in the pre-monsoon season especially during March; record-high soil moisture content thorough the year; elevated sea level height in the Gulf of Thailand which constrained drainage (Fig. 1(a)-(c)), as well as other water management factors. In the context of climate

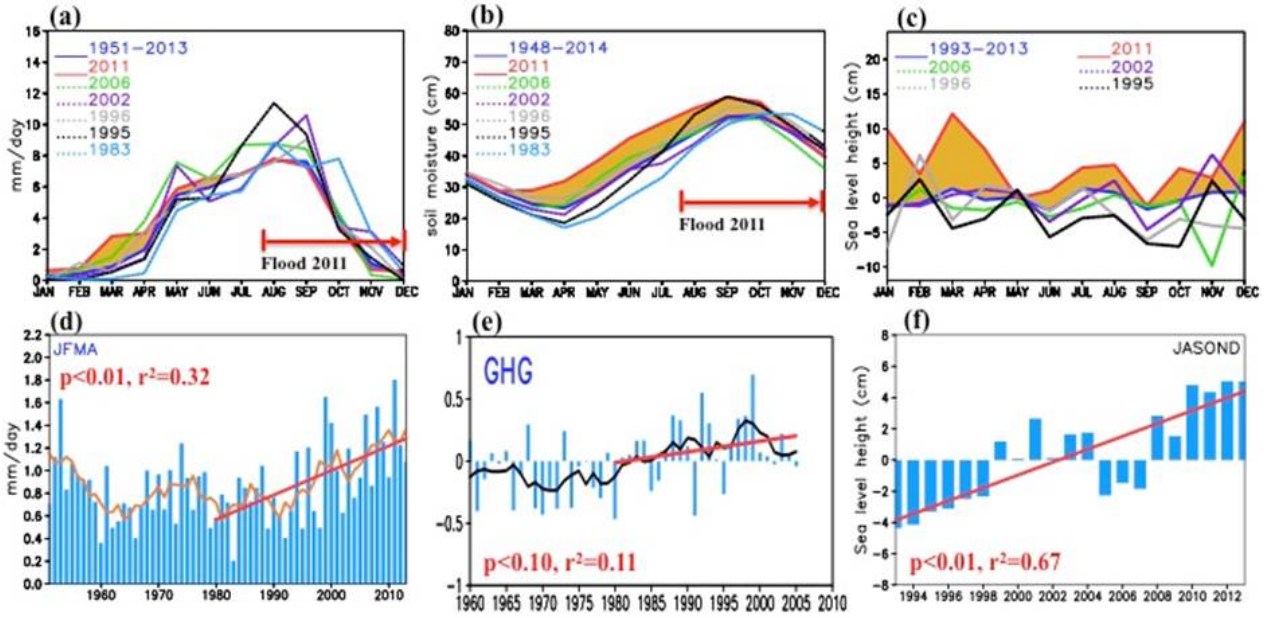

Fig. 1 Monthly distribution of (a) rainfall computed from 1951-2013 for the CPRB, (b) soil moisture content couputed from 1948-2014 for the CPRB, and (c) sea level height computed from 1993-2013 for the Gulf of Thailand overlaid with 6 flood years. The above-normal values in 2011 are indicated by the yellow area. (d) Premonsoon (January-April) rainfall overlaid with the linear trend of the preriod 1980-2013 (red) and the 5-yr moving average (orange) for the CPRB. The linear trend slope is hightly significant with r^2=0.32, p<0.01. (e) Premonsoon rainfall (normalized scales) derived from CMIP5 ensembles of GHG forcing superimposed with the 5-yr moving average (black) and post-1980 linear trend (orange) constructed for the CPRB. The linear trend slope is significant with r^2=0.11, p<0.10. (f) Flood-period sea level height (July-December) overlaid with the linear trend constructed for the Gulf of Thailand. The linear trend slope is highly significant with r^2=0.67, p<0.01.

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change, the substantially increased pre-monsoon rainfall in CPRB after 1980 and the continual sea level rise in the river outlet (Fig. 1(d) and (f)) have both played a role. The rainfall increase is associated with a strengthening of the pre-monsoon northeasterly winds that come from East Asia. Attribution analysis using the Coupled Model Intercomparison Project Phase 5 historical experiments pointed to the anthropogenic greenhouse gases as the main external climate forcing leading to the rainfall increase (Fig. 1(e)). Together, these findings suggest increasing odds for potential flooding similar to the 2011 flood intensity.

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Reference

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