Session I – Climate Change and Challenges to Ecological and Economic Sustainability
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Hydrological Changes and Possible Transboundary Impacts in Lancang (Upper Mekong) Mainstream

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Abstract

Ecological and socioeconomic issues in the Greater Mekong Subregion have in recent years attracted increasing regional and global attention. Much of this concern has been centered on construction of a cascade of hydropower dams on the Lancang River (upper Mekong) in southwestern China's Yunnan Province.

The Lancang-Mekong is among the few major rivers in the world developing in a north-south direction, with extremely diverse ecological and socioeconomic environments prevailing along the entire length of the river. The downstream socioeconomic and environmental impacts and interactions resulting from the climate change and human action are extremely complex and cannot be classified simply as positive or negative. Constraints stem from limited academic knowledge, modeling, and assessment technologies; limited (or limited access to) measurement data; and limited cooperation between upstream and downstream countries.

Based on the research of the change and linkage of the eco-hydrological process in Lancang-Mekong Mainstream, the major results of the analysis show the following:

(1) **Runoff change**. Monthly runoff data at three mainstream sites from the 1950s onward and key data of the partially completed 8-dam cascade on the main stream of Lancang river were used to perform a comprehensive analysis of possible transboundary hydrologic effects of dam construction to Lower Mekong river. The major results are: the changes in flows over the Lancang-Mekong river's 4880 km course are exceedingly complex, and the two existing dams on the mainstream of the Lancang river are but one of many factors influencing those flows, not a major factor; significant downstream impacts of the two existing dams are limited in scale to changes in daily flow stages, and are limited geographically to the narrow channel north of Vientiane; over timescales of several days or more, the primary factor in flow changes is climate change; below the Yunjinghong hydrologic station in

Lancang river basin, flow volumes can be as great as 113.7×10^8 m^3, or 15.44% of the average annual total runoff out of China, now are not influenced by the dam construction. These results provide a scientific basis for reasonable assessment of transboundary impact of dam construction on the mainstream of the Lancang river to the lower Mekong River.

(2) **Water Level change.** Based on the records of water levels from 1960 to 2003 at three mainstream sites in the upper Mekong River, a quantitative examination has been undertaken into characteristics of the mainstream water-level process at multiple timescales and its response to cascade development. The major results are: the annual mean, wet period mean, and the mean water levels during the period between March and April (PBMA period) exhibit a significant increasing trend at Jiuzhou and Yunjinghong sites, which are influenced by large-scale factors such as climate change and solar activity; the interdecadal and interannual variations of annual mean, annual maximum, and wet period mean water levels at three sites show similar features during the dam construction period; the interdecadal variations of PBMA period water level show a gradual increase at Gajiu and Yunjinghong sites but a falling trend at Jiuzhou, and these trends confirm that there is some regulation on the flow in the dry season caused by the two existing dams; the downstream effects of the present dams on water levels are very limited at the annual mean and wet season mean levels, not apparent at the monthly and yearly timescales, and relatively significant at daily and hourly timescales.

(3) **Sediment change.** The daily sediment data series spanning 17 years (1987-2003) at the hydrologic stations of Yunjinghong in Lancang mainstream and Chiang Saen in the lower Mekong mainstream, northern Thailand, are analyzed to reveal the possible environmental effects of hydropower cascades of the Lancang River on downstream sedimentation. Monthly mean sediment concentration data of the two stations are compared in-phase and yearly series are analyzed by the method of correlation and regression analysis and causality test. The analysis result shows that, though both of them are located downstream of Manwan and Dachaoshan hydropower stations which are already built-up and in use, the sediment responses of the two stations are different under the regulation of the hydropower stations. Annual series from Yunjinghong station are positively correlated but do not match well with those from Chiang Saen station. In addition, the results of Granger causality test on the time series also suggest that the series of annual maximum monthly mean sediment concentration at the Yunjinghong station may give cause for the ones at Chiang Saen station, while the series of annual minimum monthly mean sediment concentration and annual mean sediment concentration at the Yunjinghong do not evidently give cause for those at the Chiang Saen station. Undoubtedly, this discovery will provide new evidence to assess the impacts of cascades construction in the mainstream of the Lancang River on the variation of downstream sediment and its transboundary effects.