A – Context

The study "Monitoring the quantity of water flowing through the upper Mekong basin under natural (unimpeded) conditions by Basist and Williams from Eyes on Earth (hereafter "the EoE study") is an innovative and important effort to understand a longstanding issue of interest to the Lower Mekong Basin Countries – what level of influence or control does China’s cascade of large hydropower projects on Lancang River have on flow conditions in the Lower Mekong River.

In recent years, both droughts and floods in the Mekong Basin have been blamed on the regulatory control exerted by the large Lancang projects. However, with China reluctant to fully share data on the upper Lancang River and the operations of its cascade it has been difficult to establish a conclusive answer to this problem.

There have been a number of important studies of Chiang Saen flow observation data and modelling studies that have been undertaken². These studies are predominately based on hydrological modelling assessments that input temperature and rainfall data and make best-estimate assumptions about how reservoirs are operated. These studies produce the following conclusions:

1. During typical post-dam operations, reservoirs of the Lancang cascade exploit their capacity to regulate flows to store wet season flows for release during the dry season. Downstream this manifests as a reduction in wet season flows and an increase in dry season flows. This has become evident in the observed hydrograph at Chiang Saen from 2012

2. During years of known dam filling, there have been significant reductions in downstream flow levels which are generally considered a function of the reservoir filling.

3. Based on long-term observed data at Chiang Saen (1960 – 1990) the active storages of the 11 reservoirs in the Lancang cascade can withhold:
   - 34 – 36% of average wet season flow (June – Nov)
   - 62 – 65% of wet season (June – Nov) flow during driest year on record
   - 17% of wet season (June – Nov) flow during the wettest year on record

4. If the impacts of filling for the newer reservoirs (x5) in the Lancang cascade are considered, the above % control on wet season flows during average, wet and dry years would increase 2 to 5 percentage points.

5. During the dry season, capacity for regulation of the Mekong flows by the Lancang cascade increases significantly, because the Lancang constitutes a much larger share of Mekong flows during the dry season. This is most pronounced in March – May, where

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¹ Director General, Principal Associate Economist, Associate Water Resources Specialist
simulations predict that the Lancang cascade has the capacity to increasing flows by up to +160%.

6. Downstream of Chiang Saen, the capacity for Lancang regulation to alter wet season flows decreases as the flow contribution from large, wet, left-bank tributaries progressively dominates the hydrograph.

B – Conclusions from the technical report and web-feature

On 10th April 2020, Eyes on Earth (EoE) published a technical report that uses remotely-sensed microwave data to develop a land surface wetness index which is then coupled to a simple regression model to estimate changes in water levels at Chiang Saen station (northern Thailand). The surface wetness model is then used to back-cast "natural flow conditions" in the Lancang River (i.e. those unimpeded by the Lancang cascade) and then these ‘natural conditions’ are compared to observed flow at the Chiang Saen gauge.

The main conclusions from the EoE Study are:

Conclusion 1. Flow from the Lancang to the Lower Mekong began to diverge from "natural" conditions in 2012 – the time when the Nouzhadu dam began commissioning.

Conclusion 2. The change in the flow regime entering the Lower Mekong can be characterised by two shifts:
   - a decrease in wet season flows and an increase in dry season flows (as the cascade of 11 Lancang reservoirs store wet season flows for release in the dry season), which the authors associate with typical operations of the hydroelectric dams for energy production.
   - A more irregular signal of rapid fluctuations in water levels in both wet and dry seasons (1992-1995, 2002, 2009, 2010 and 2015), which the authors associate with filling and/or inauguration of the turbines for Manwan, Dachshaoshan, Jinhong and Xiaowan dams respectively.

Conclusion 3. During 2019, the Lancang catchment experienced above average rainfall and, consequently, "the severe lack of water in the Lower Mekong during the wet season of 2019 is largely influenced by the restriction of water flowing from the upper Mekong during that time."

The EoE study then draws some modest geopolitical conclusions from these findings:

Conclusion 4. Erratic releases in some years are speculated as an act of showmanship by dam operators to impress China’s elite with the power of the hydroelectric facilities.

Conclusion 5. “Cooperation between China and the Lower Mekong Countries to stimulate the natural flow cycle of the Mekong could have improved the low flow conditions experienced downstream in the summer of 2019.”

Conclusion 6. “if the wetness index is used as a guide to stimulate natural flow, then all communities along the Mekong basin could benefit from maintaining the integrity of the Mekong River”.

On 13th April 2020, the Stimson Centre released a new feature on their website which draws a starker set of conclusions on the controlling role and motivations of China in causing the 2019

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drought. The feature is primarily based on the EoE Study and cites collaboration with the EoE Study authors, but also appears to extend beyond the study. The Stimson feature repeats some of the findings from the EoE Study, and points to a number of other technical findings:

Conclusion 7. “The increasing frequency of drought in the Lower Basin tracks closely to the way China restricts water during the dry season”.

Conclusion 8. “For six months in 2019, China’s dams held back so much water that they entirely prevented the annual monsoon-driven rise in river level at Chiang Saen.”

Conclusion 9. “the amount of rainfall and snowmelt in China was enough to keep the water levels in much of the Lower Mekong Countries above average between April 2019 and March 2020 if China’s dams were not restricting that water”.

Conclusion 10. The EoE study concludes that China’s Lancang dams restricted more water in their reservoirs than they released to downstream over the last three decades.

The Stimson feature then draws a number of geopolitical hypotheses regarding China’s political motivations for making these decisions:

Conclusion 11. “not one drop shared”: China’s national government considers water a sovereign commodity which should not be shared with downstream countries, without first utilising the water or making downstream countries pay for it.

Conclusion 12. Water hoarding by China’s hydropower elite: China’s water elite are utilising the Lancang cascade to hoard water should these projects be called on for national electricity production.

Conclusion 13. Water hoarding in response to climate change: the increasing rate of melt in the Himalaya glaciers sees China utilising the Lancang cascade reservoirs to capture runoff and store for years for future electricity production, or even inter-basin diversion to the Yangtze River system.

Conclusion 14. False solidarity with downstream neighbours: Official messaging from the Chinese government does not reflect the actual situation. The government regularly portrays a situation of solidarity where China and the LMB countries are suffering together, and makes highly public releases of water which are presented as benevolent decisions to share water with its downstream neighbours – for example in March 2016 – when the EoE Study confirms that in some years China is not suffering from the same drought conditions and hoarding water from the Lower Mekong, often withholding water when it is abundant in the Lancang but scarce in the Lower Mekong Basin.

Based on these findings the Stimson feature then draws some transboundary water management conclusions:

Conclusion 15. The EoE Study unmask the real situation of flow control in the Lancang cascade and provides an opportunity for downstream countries and the MRC to engage with China and collectively improve how the Lancang cascade is being managed.

Conclusion 16. In relation to the 2019 Drought, while the MRC and LMC are jointly conducting an investigation to identify the root cause of the 2019 drought …“the Eyes on Earth study provides clear evidence to lay to rest any doubt toward the role of China’s upstream Mekong dams.”
C – Review of the technical conclusions

C1 – the EoE Study

Transboundary development and impacts from large hydropower development is the dominant regional water governance issue in the Mekong Basin. It was behind the motivations in the 1960s of setting up the Mekong Commission, forms the main tenements of cooperation for the MRC and has been responsible for the largest set of concerns and deliberation by civil-society actors and riparian communities. Arguably the issue achieves such importance because, during a period of significant social and economic change (i.e. the last four decades since the wars of the 1960s-1980s), in a region with large underexploited natural resources, the issue galvanises important trade-offs: local and national; economic growth and livelihoods; environment and development; national sovereignty and regional cooperation; the rise of Chinese influence and the role of the "west".

The EoE Study is an important step forward in the regional discussion on this issue, for two reasons.

First, the study triangulates with a number of other existing analytical and modelling studies that outline the scale of Chinese control on the Lower Mekong flows exerted by the Lancang cascade. Two of its main conclusions (C1 – C2) are entirely consistent with previous modelling efforts. Where the EoE Study adds novelty is in its analysis of the 2019 event.

Second the study proposes an innovative, simple approach to modelling that relies on high resolution, remotely sensed daily data. The strength lies in its simplicity and the potential for near-real time reporting on daily perturbations from a “natural flow” regime. However, while the study is described as "monitoring" analysis, it should be stressed that the effort is a modelling study, albeit a different kind of modelling study to others that have been undertaken for the Mekong. Observed data on soil/land wetness is used as an input to a regression model that links this parameter to observed water levels.

There are some significant limitations in the EoE Study which stress caution when drawing specific stronger conclusions:

1. The report has not, it appears, undergone peer-review, and has only a few citations on existing work on Mekong hydropower development – most from the 2000’s and not from the most recent decade.
2. There are a number of studies in recent years addressing the same topic which are not mentioned with no comparative analysis of the new findings with existing understanding.
3. While the authors show reasonable validation for their results, a number of important questions arise with no attempt to answer them:
   a. Can a simple regression model sufficiently capture the relevant hydrological processes in the Mekong. The EoE study cites that the method has been used for smart-agriculture studies but makes no reference that this approach has been utilised for hydrological analysis.
   b. The model is calibrated on a monthly time-step, whereas most hydrological studies on the influence of hydropower on the Mekong recognise a daily-time step is needed to properly capture dynamics of operational decisions.
   c. There are some issues with the data on hydropower reservoirs, for example in the table of reservoirs (table 1) there is some instances of confusion between active and total storages.
   d. The study relies on a concept of “natural flow” that is based only on 5 years of historical data. This is short and inconsistent with the understanding of the large seasonal and inter-annual variability of the Mekong flow regime.
   e. The modelling outputs are for Chiang Saen station, but some of the conclusions refer to flow conditions much further downstream. Whilst it is reasonable to use Chiang Saen as a proxy for the Lancang, there are a number of left-bank
tributaries downstream of Chiang Saen that make important flow contributions to the Mekong muting the influence of the Upper Mekong basin.

- The EoE study compares a 1-month and 3-month accumulated lag model for their study and confirms that the 3-month lag model gives better results. While there is strong evidence in the literature that a hydrological lag exists, it is unclear why the EoE study considers only 1- or 3-month lags. Other studies found that there is likely a one-year lag associated with the influence of groundwater – i.e. that the accumulated rainfall of the previous year affects this year’s river flow.

The EoE study provides a novel approach to understanding the influence of China’s Lancang cascade on the Lower Mekong System. Efforts to strengthen both the study and its presentation for peer-review would allow it to improve its contribution to understanding of the Mekong system and the role of upstream controls on lower Mekong flows.

C2 – the Stimson web feature

On the technical side, the Web feature provides a number of conclusions which are not substantiated by the EoE study, nor are other sources provided.

Conclusion 8: “For six months in 2019, China’s dams held back so much water that they entirely prevented the annual monsoon-driven rise in river level at Chiang Saen.”

This is a highly significant conclusion but as presented is unsubstantiated. It also does not fit prevailing scientific understanding of the Mekong system. Previous studies suggest that during the wettest year of 1960-1990, all 11 dams in the Lancang cascade would have the capacity to exert ~20% control on wet season flows. It is unclear what is meant by a “large influence” (conclusion 3), but 20% does not constitute prevention of the Monsoon system as suggested by the web feature.

D – Review of the geopolitical conclusions

D1 – the EoE Study

The EoE study makes some important conclusions regarding the utility of the wetness index – subject to the review in Section C, and the recommendation that enhanced cooperation between China and Lower Mekong Basin countries could improve conditions is also valuable for improving flow conditions in the Lower Mekong.

D2 – the Stimson web feature

The Stimson web feature draws some very strong conclusions regarding the role and motivation of China in the 2019 flood. Given the limitations in the background research on the context, simplicity of the method, and lack of comparison with existing studies, it is bit surprising how the EoE Study is used to substantiate such strong conclusions.

On the claim that the EoE Study provides a definitive evidence of China’s role in recent floods or irregular water levels, this is unsubstantiated. At best the study confirms some of the conclusions in the existing evidence base – though, as mentioned, the approach by the EoE team does show promise to make an important near real-time contribution to improve understanding of Lancang cascade operations.

On the claim that the motivations of China are hoarding water for rather capricious and ideological ends is also unsubstantiated by the web feature.
E – Conclusions

The accuracy of the claims by Stimson and the EoE Study are questionable, but they nevertheless address a right and real problem. The wet season flows of 2019 were disastrous and this should prompt more investigations with better analytical methods.

Whilst it is reasonable to assume that China’s Lancang cascade has played a role in the recent drought and low flow events experienced in the Lower Mekong since 2012, and especially 2016 and 2019; it is not reasonable to draw the kinds of geopolitical conclusions that the Stimson Centre has – at least not on the evidence presented. Further, such conclusions when weakly substantiated could have a damaging role on efforts to foster open information sharing and genuine cooperation between China and LMB countries.

Relevant to this analysis, there remains two significant barriers\(^5\) to improved management of hydropower on the Mekong River.

1. The first is a lack of understanding of actual reservoir operations due to poor levels of information sharing and cooperation between countries. On this, the development of an independent approach to assessing and monitoring the daily situation in the river is essential – such as the geospatial approach proposed by the EoE study. However for these efforts to have diplomatic potency they must be based on robust and irrefutable science – which the EoE study is not.

2. The second is need for much improved cooperation between Mekong countries to manage the planning and operations of hydropower projects in the basin – especially the Lancang cascade which dominates the human capacity to control flows. The strong conclusions drawn by Stimson on the motivations and influence of China on flows in the Lower Mekong, unsubstantiated as they are, are not helpful in this regard.

The challenge of regional cooperation remains elusive for the Mekong basin because of the large discrepancies in national power amongst riparian nations. The international development community have an important role to play in balancing geopolitical forces and supporting the effort towards regionally equitable and sustainable utilisation of the basin’s water resources, but such interventions must be unbiased and based on robust scientific evidence.

At present the EoE Study and the Stimson web feature, because of the discrepancy between the veracity of the science and the strength of their conclusions, could be construed as biased and so do not provide the basis needed.

There remains in the Mekong an important, long-standing, strategic need to build a credible, independent information base on which Mekong countries could facilitate discussions and negotiations on the current and future development and conservation of the Mekong basin.

Since the inception of dams on the mainstream of the Lancang (and Mekong), the urgency of our need for clear, transparent and robust evidence only continues to increase.

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\(^5\) There are of course, other barriers not mentioned here, for example: poor notification on the proposal for new hydropower projects; no mandated regulations or consultation mechanisms to allow countries to cooperatively decide on specific projects with transboundary applications.