*GBC* editors,

Please find enclosed, via electronic submission, a manuscript for your consideration as an article entitled ‘Remotely sensing river greenhouse gas exchange velocity using the SWOT satellite’.

In the past two decades, it has been well established that inland waters contribute substantially to the global carbon cycle as net emitters of carbon dioxide (CO2). While substantial progress has been made in modeling dissolved CO2 concentrations in rivers at the global scale, relatively less progress has been made modeling the rate of this emission (the ‘gas exchange velocity’ or k600) at the global scale. This is arguably due to a lack of direct river hydraulic measurements at the global scale.

We address this gap in knowledge by building an algorithm to infer the gas exchange velocity from soon-to-be-available river hydraulics measurements via the NASA/CNES/UKSA/CSA Surface Water and Ocean Topography (SWOT) satellite. SWOT will measure every large river on Earth multiple times a month (and in some dases daily) and provide a novel, high-temporal resolution dataset of direct river hydraulics measurements. We name the algorithm BIKER, or the ‘Bayesian Inference of the K600 Exchange Rate’ algorithm.

First, we develop a novel physical model that explains 70% of variation in gas exchange velocity in SWOT-observable rivers. We then leverage this model, plus over a decade of scholarship inferring river discharge from SWOT observations, to infer the gas exchange velocity solely from SWOT data. We validate BIKER on 47 rivers’ simulated SWOT data (as SWOT has not yet launched) and find strong inference of the rivers’ temporal trends in gas exchange velocity (median correlation coefficient of 0.91) and reasonable estimates of gas exchange magnitude (given the uncalibrated experimental setup- median normalized root-mean-square-error of 37%).

With SWOT set to launch in late 2022, these findings strongly suggest that BIKER will be useful in 1) elucidating spatiotemporal trends in gas exchange velocity at the global scale as never before possible, and 2) in improving existing river CO2 models via better representation of gas exchange velocity temporality. All told, BIKER has broad implications for better constraining the global river carbon cycle and thus we believe *GBC* be the ideal outlet for this publication.

The authors of this study all approve of this submission, and there are no conflicts of interest. Thank you for your consideration of this article, and if there are any questions regarding our methods or findings, please do not hesitate to contact corresponding author Craig Brinkerhoff (cbrinkerhoff@umass.edu).

On behalf of all authors,

Craig Brinkerhoff

April 5th, 2022