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www.elsevier.com/locate/csr

PII: S0278-4343(17)30403-X
DOI: https://doi.org/10.1016/j.csr.2018.04.006
Reference: CSR3752

To appear in: *Continental Shelf Research*

Received date: 4 August 2017
Revised date: 9 April 2018
Accepted date: 11 April 2018

Cite this article as: Hwa Chien, Yao-Zhao Zhong, Kang-Hung Yang and Hao-Yuan Cheng, Diurnal variability of CO_2 flux at coastal zone of Taiwan based on eddy covariance observation, *Continental Shelf Research,* https://doi.org/10.1016/j.csr.2018.04.006

Diurnal variability of CO_2 flux at coastal zone of Taiwan based on eddy covariance observation

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Abstract

In this study, we employed shore-based eddy covariance systems for a continuous measurement of the coastal CO_2 flux near the northwestern coast of Taiwan from 2011 to 2015. To ensure the validity of the analysis, the data was selected and filtered with a footprint model and an empirical mode decomposition method. The results indicate that the nearshore air–sea and air–land CO_2 fluxes exhibited a significant diurnal variability and a substantial day–night difference. The net air–sea CO_2 flux was −1.75±0.98 μmol-C m^{-2} s^{-1}, whereas the net air–land CO_2 flux was 0.54±7.35 μmol-C m^{-2} s^{-1}, which indicated that in northwestern Taiwan, the coastal water acts as a sink of atmospheric CO_2 but the coastal land acts as a source. The Random Forest Method was applied to hierarchize the influence of Chl-a, SST, DO, pH and U_{10} on air-sea CO_2 fluxes. The result suggests that the strength of the diurnal air-sea CO_2 flux is strongly influenced by the local wind speed.

Keywords coastal zone; CO_2 flux; eddy covariance method; footprint; diurnal variation; carbon sink.

1. Introduction

Since the industrial revolution, the CO_2 concentration in the atmosphere has increased by 41%, and its growth rate is increasing (IPCC, 2013); by inducing global climate changes, CO_2 is causing the greatest environmental crisis ever encountered by