

## Improvement of Chl-a Modeling Accuracy in the Nakdong River, Korea Considering Multiple Algal Groups

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### Summary of key findings

The purpose of this study is to determine the optimal method to improve chl-a concentration prediction accuracy of the water quality models in the river. The Nakdong River, South Korea has been receiving much attention due to intensive in-stream weir construction and dredging. However, consistent inflow of nutrient from tributaries that carry urban wastewater have caused serious algal blooms in the river. To develop management strategies, it was necessary to construct accurate modelling system especially for algal activities. It was found that multiple algal groups must be considered for accurate chl-a prediction throughout the river when a combination of hydrodynamic and water quality model such as EFDC (Environmental Fluid Dynamics Code).

### Background and relevance

During the several centuries, the industrial revolution, humankind's activities have caused strong alterations in the structure and function of their environment [1]. The eutrophication in freshwater is one of the serious environmental problems worldwide. While urbanization and industrialization have been carried, pollutants that contain the nutrient have been introduced in the Nakdong River, the second largest river in South Korea. Since the construction of the Nakdong river barrier in 1997, detention period was prolonged and eutrophication problem has been aggravated in the Nakdong river area. Also, due to the 4 major rivers restoration project in Korea, 8 new instream weirs had been constructed and 0.4 billion cubic meter of sediment was dredged to increase the storage and flood control capacity [2, 3]. Since the 4 major rivers restoration project, the water velocity decreased and the stratification has been observed during the summer in the river. Because of those effects, there is a growing concern about the deteriorating water quality due to increased algal blooms [4]. Consequentially it is necessary to develop management strategies of water quality in the Nakdong River. Water quality models can be used effectively to predict future conditions of the water bodies, and thus, to support the water quality management related decision making processes [5, 6]. In the Nakdong River basin, the characteristics of chlorophyll-a (Chl-a) concentration, an indicator of algal biomass, vary in different localities. Generally, algae growth is closely related with the intensity of solar radiation, water temperature, nutrient conditions and existence of predators. This study was performed to predict seasonal and regional dynamic characteristic of water quality in the Nakdong River, and to identify methods for management of water quality including algae control.

### Results

#### 1. The study Site

The 525 km Nakdong River is the longest river in the South Korea, and has the second largest basin area (23,384 km<sup>2</sup>) in the country. The Nakdong River has been an important source of drinking, industrial and agricultural water in the vicinity of the areas along the river, including Busan and Daegu, the Korea's second and third largest city. In this study, a 334km long river section between from the Andong Dam to the Nakdong Estuarian Dam was selected as a study site of this study.

#### 2. Analysis of water quality data in study area.

Water quality data were collected from 61 governmental monitoring stations. The limiting factors of algae growth in different locations are analysed including water temperature, nutrients concentrations and light intensity.

### 3. Methods

The three dimensional hydrodynamic and water quality model, EFDC(The Environmental Fluid Dynamic Code) was used in this study. Eight different stations were selected for intensive analysis comparing field data and modeling results.

According to the comparison, it was found that limiting factors of algal growth are different dependent on location or pollution level of the station.

### 4. Results

According to the analysis results of monitoring data, the algal growth limiting factor is water temperature in the upper region of the Nakdong River, nutrients in the midstream and light intensity in the lower reaches of a river. And through trial and error, the optimal number of algal species were determined to improve the algae prediction accuracy.

### Discussion

While there could be many factors affecting algal growth in the river, their growth characteristics were found to be different dependent on the nutrient condition or pollution level. While, water temperature seems to be the major factor for algal growth in the relatively clean upper stream areas, winter bloom became dominant in the relatively polluted downstream area. This fact indicates that multiple algal groups must be considered when modeling the large river including the Nakdong River, Korea. This study will present water quality analysis and modeling results of the study site.

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