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Comparison of the Revised Air Quality Index with the PSI and AQI indices

Wan-Li Cheng [a,*], Yu-Song Chen [a], Junfeng Zhang [b], T.J. Lyons [c], Joy-Lynn Pai [d], Shiang-Hung Chang [a]

[a] *Dept of Environmental Science and Engineering, Tunghai University, Taichung 407, Taiwan ROC*
[b] *Division of Environmental and Occupational Health, University of Medicine and Dentistry of New Jersey, NJ 08854, USA*
[c] *Environmental Science, Murdoch University, Murdoch, WA 6150, Australia*
[d] *Sunway Environmental Technology Co., Ltd., Taipei 104, Taiwan ROC*

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Abstract

Air pollution indices are commonly used to indicate the level of severity of air pollution to the public. The Pollution Standards Index (PSI) was initially established in response to a dramatic increase in the number of people suffering respiratory irritation due to the deteriorating air quality. The PSI was subsequently revised and implemented by the USEPA in 1999, and became known as the Air Quality Index (AQI) that includes data relating to particle suspension, $PM_{2.5}$, and a selective options of either 8-hour or 1-hour ozone concentration during increased O_3 periods. Yet, the costs of launching a network of $PM_{2.5}$ monitoring stations are prohibitively high for many countries to implement the AQI from the PSI system in the foreseeable future. Therefore, the purpose of this research is to discuss the optimal method of assessing air quality using the latest developed Revised AQI (RAQI), a system that serves as an alternative to the PSI and AQI systems. The feasibility, effectiveness, and the differences between RAQI, AQI, and PSI in their applications to several air pollution conditions are also studied in this research.

The results show that southern Taiwan's suspended particulates have significantly greater impact on $PM_{2.5}/PM_{10}$ ratios than in central and northern metropolitan areas, and that the ratios are higher in Taiwan as a whole compared to many other countries. We also found that the RAQI shows more significant results compared to the PSI and AQI as it has a wider coverage of the range of pollutant concentration levels.
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Keywords: Revised air quality index (RAQI); Air quality index (AQI); Pollutant standards index (PSI)

1. Introduction

After decades of industrialization, air pollution has become a major environmental issue for both developed and developing countries. Poor air quality has both acute and chronic effects on human health (Yang et al., 2004, Afroz et al., 2003). In 1976 the U.S. EPAa,b established a Pollutant Standards Index (PSI) which rated air quality from 0–500, with 100 equal to the National Ambient Air Quality Standards (NAAQS). The PSI is calculated for every pollutant with a NAAQS, but the only level reported for a given time and location is for the pollutant most exceeding its standard. PSI descriptors such as

* Corresponding author.
E-mail address: wlcheng@thu.edu.tw (W.-L. Cheng).

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"good" or "unhealthy" aim to convey this level's health implications. The EPA uses a PSI>100 from the daily measurement of each monitoring station to predict future air quality conditions. The daily PSI is determined by the highest value of one of the five main air pollutants: particulate material (PM_{10}), ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO), and nitrogen dioxide (NO_2). The PSI does not indicate exposure to many other pollutants, some of which may be dangerous for people with respiratory problems (Qian et al., 2004, Radojevic and Hassan, 1999).

The PSI was revised, renamed to the Air Quality Index (AQI), and subsequently implemented in 1999 by the USEPA. The new system includes breakpoints for ozone (O_3), a sub-index of 8-hour average O_3 concentrations, and a new sub-index for fine particulate matter ($PM_{2.5}$). However, even though AQI has completely replaced PSI in the United States, a greater part of the world still could not adopt the AQI system, mainly because the lack of $PM_{2.5}$ measurement capability. For instance, monitoring of $PM_{2.5}$ necessitates installation of expensive instruments to establish nationwide networks of monitoring stations, and the costs are prohibitively high for most countries to afford. The transition to the full implementation of the AQI system, hence, will not be completed in the foreseeable future, even in the newly industrialized countries such as South Korea and Taiwan. Furthermore, the AQI may not be directly applicable to a new region, as Wang (1999) manifested that modification of AQI's $PM_{2.5}$ standard index (65 μg/m^3) to a new recommended level of 75 μg/m^3 would be appropriate for the Taiwan area.

This study has assessed the newly developed Revised Air Quality Index (RAQI) as well as the AQI and PSI for the north, central, and south metropolitan areas of Taiwan (Fig. 1). This paper aims to evaluate the five sub-index pollutants and identify an optimal index that can provide the public with the information needed to understand the daily air quality situation. The air quality data covers 6 years from 1997–2002. Breakpoint concentrations have been defined by the EPA on the basis of National Ambient Air Quality Standards

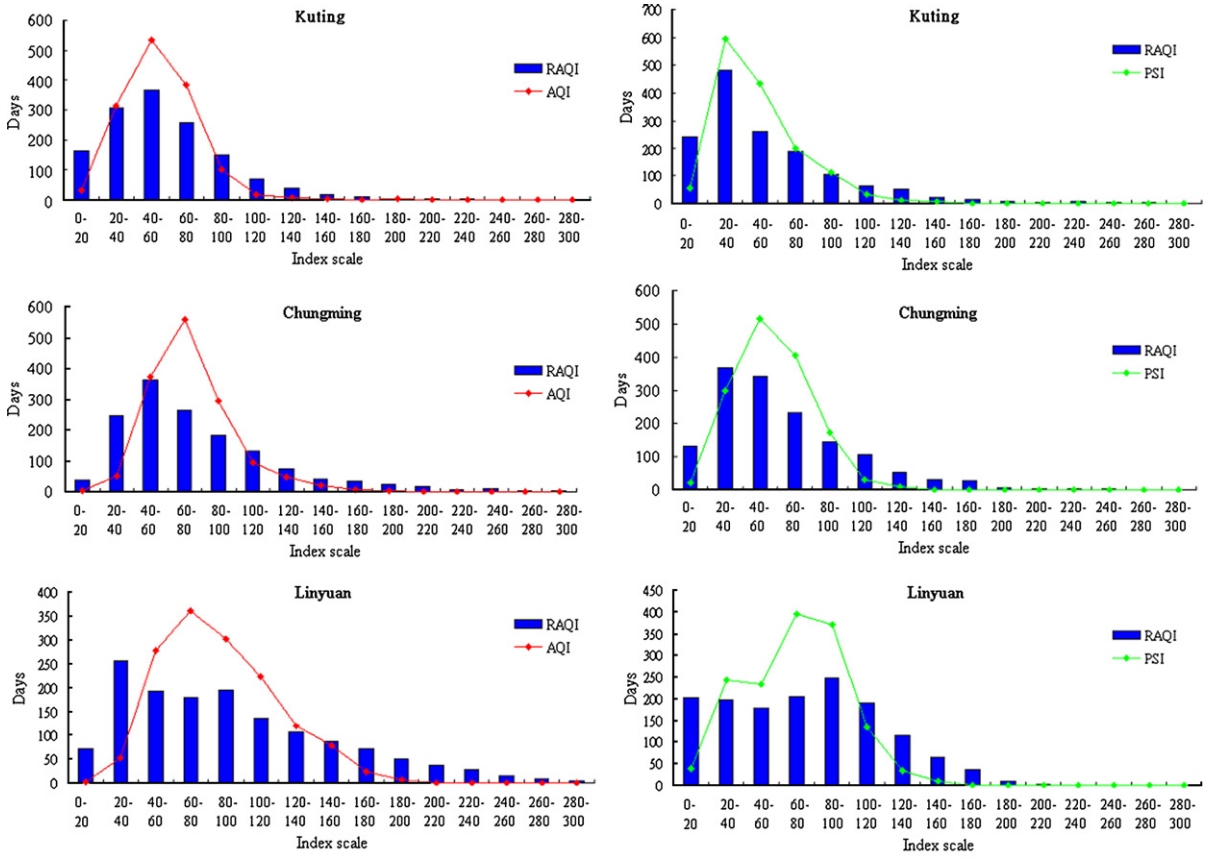

Fig. 1. Daily distribution of AQI, PSI and RAQI at Kuting, Chungming, and Linyuan monitoring stations.

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