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**Application of ubiquitous public  
access to-geographic information to  
an air quality information service**

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

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## Introduction

Rapid urbanization and industrialization have led to a severe deterioration in the atmospheric environments of major cities<sup>[1][2]</sup>. Air pollutants, which include both naturally occurring and anthropogenic substances, are associated with illness and mortality in humans, and with damage to natural and built environments<sup>[3]</sup>. However, despite the dedicated actions over the past decades of both international and national organizations to decrease major pollutant emissions, urban air quality continues to worsen, affecting residential environments and harming the health of citizens<sup>[4]</sup>.

Information communication technology (ICT) has contributed to addressing the challenges of improving urban air quality. Sensor networks provide a powerful tool for monitoring air quality in real-time through widely dispersed monitoring stations<sup>[5][6]</sup>. Portable air pollution sensors, combined with the Global Navigation Satellite System (GNSS) technology, supplement an existing sensor network with enhanced availability and accessibility for monitoring air quality in near real-time<sup>[7][8]</sup>. Also, spatial data infrastructure (SDI) is established for integrated and interoperable management of air pollutant measurements at national and international levels. For example, INSPIRE, which is the European SDI based upon ISO 19156, defines a framework to access, share, and use air quality data from member countries<sup>[9]</sup>. The air quality information platform is a bridge between the sensor systems and the citizens. Both web- and mobile-based applications, highly coupled to geographic information systems (GIS), enable citizens to easily obtain air quality information services without spatial or temporal limitations.

As public awareness of urban atmospheric problems has risen, air pollution now has become both an environmental and social problem. Citizens are also encouraged to participate in air quality assessment and environmental governance<sup>[10]</sup>. These societal and technical changes require a new paradigm to develop an air quality information system and their services. Different from conventional air quality information systems, citizens are no longer only consumers of air quality information, but rather producers of air quality information. For example, a social media service such as a blog, Twitter, and Facebook are now major communication channels for expressing the concern of citizens about urban air quality issues. Social media technology platforms are now regarded as "social sensors" collecting citizens' perceptions of air quality<sup>[11][12]</sup>.

In this document, an air quality information system was developed, referencing ISO 19154. The ubiquitous public access to geographic information (UPA-to-GI) is a geographic information service for the general public to easily access and produce geographic data or information in a ubiquitous computing environment. In this system, the UPA context information model defined in ISO 19154 is employed to systematically associate air quality data from various information sources (e.g. physical sensor measurements, subjective citizen's opinions, and semantic social media data). The UPA context information model is also used to formulate air quality information services, conforming to the citizen's contextual requests.

This document aims to assist the understating of the UPA context information model and to illustrate its application for air quality information services. In this regard, a proof of concept (POC) study was conducted in Seoul, South Korea. The GIS-based air quality information system was designed and implemented to realize a UPA-based air quality information service. Globally, there are widely different approaches to monitor and report air quality. The UPA-based air quality information service model, described in this document, is a sample of all possible examples. However, the underlying idea and concept for designing and implementing the UPA context information model is still helpful to develop other UPA-based air quality information services, conforming to the unique atmospheric and social environments in each nation.