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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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

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.

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Introduction

Rapid urbanization and industrialization have led to a severe deterioration in the atmospheric environments of major cities[1][2]. 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[3]. 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[4].

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[5][6]. 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[7][8]. 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[9]. 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[10]. 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[11][12].

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.

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

1 Scope

This document facilitates an understanding of the Ubiquitous Public Access (UPA) context information model, as defined in ISO 19154, to establish a UPA-to-Geographic Information (GI) environment. In addition, this document illustrates how the UPA context information model is designed and implemented to provide an air quality information service from a geographic information system (GIS)-based air quality information system. The UPA context information model for air quality information is only a sample of all possible examples to realize the UPA-to-GI that could satisfy the requirements of ISO 19154.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
air pollutant
material emitted into the atmosphere either by human activity or natural processes and adversely affecting humans or the environment

[SOURCE: ISO 18158:2016, 2.1.2.1]

3.2
application
manipulation and processing of data in support of user requirements

[SOURCE: ISO 19101-1, 4.1.1]

3.3
context
aspects or properties of an entity that affect the behaviour or expectations of that entity in any given situation

[SOURCE: ISO 19154:2014, 4.4]

3.4
comprehensive air-quality index
CAI
description of the ambient air qualities based on the health risk of air pollution

EXAMPLE The higher CAI values, the greater the level of air pollution.

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Note 1 to entry: The index aims to make the public easily understand how polluted overall air quality currently is or how polluted it is forecast to become.

3.5
geographic context awareness
application (3.2) or *service* (3.12) behaviour based on the recognition of user's geographic *context* (3.3)

[SOURCE: ISO 19154:2014, 4.7]

3.6
geographic information
information concerning phenomena implicitly or explicitly associated with a location relative to the Earth

[SOURCE: ISO 19101-1, 4.1.18]

3.7
geographic information service
service (3.12) that transforms, manages, or presents geographic information to users

[SOURCE: ISO 19101-1, 4.1.19]

3.8
geographic information system
GIS
information system dealing with information concerning phenomena associated with location relative to the Earth

[SOURCE: ISO 19101-1, 4.1.20]

3.9
interface
named set of *operations* (3.10) that characterize the behaviour of an entity

[SOURCE: ISO 19119:2016, 4.1.8, modified — Note 1 to entry was deleted.]

3.10
operation
specification of a transformation or query that an object may be called to execute

[SOURCE: ISO 19119:2016, 4.1.10, modified — Notes 1 and 2 to entry were deleted.]

3.11
public access
open access to information sources and/or *services* (3.12) by general public users and professional users alike

[SOURCE: ISO 19154:2014, 4.18]

3.12
service
distinct part of the functionality that is provided by an entity through *interfaces* (3.9)

[SOURCE: ISO 19119:2016, 4.1.12]

3.13
ubiquitous public access
UPA
service (3.12) that enables end-users to have easy and interoperable access to specific types of data, irrespective of their location or access device, and that match their interest criteria

EXAMPLE Linked Geodata Service.

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