Editorial
South African Air Quality Information System (SAAQIS) mobile application tool: bringing real time state of air quality to South Africans

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http://dx.doi.org/10.17159/2410-972X/2018/v28n1a1

In terms of Section 24 of the Constitution, as well as the National Environmental Air Quality Act (AQA, 2004), government is charged with the role to ensure that South Africans are breathing air that is not harmful to their health and wellbeing. Several spheres of government monitor the state of air quality across the country at over 130 fully automated air quality monitoring stations (Figure 1). These stations monitor a range of pollutants including ozone (O_3), particulate matter (both PM_{10} and $PM_{2.5}$), carbon monoxide (CO), sulphur dioxide (SO_2), and oxides of nitrogen (nitrogen dioxide NO_2, and nitric acid NO), lead (Pb), hydrogen sulphide (H_2S), black carbon (elementary carbon) and meteorological parameters. The stations form the National Ambient Air Quality Monitoring Network (NAAQMN) and are located in areas with the highest density of people in order to measure human exposure to air pollution. The stations provide critical information to assess compliance with ambient air quality standards and to assess the impact of intervention strategies aimed at addressing air pollution. In addition, data from these monitoring stations also provide valuable information regarding the state of ambient air quality to which the citizens of the Republic are exposed.

South Africans have a right to ambient air quality monitoring information monitored at all of the stations commissioned by government. This information is disseminated through the South African Air Quality Information System (SAAQIS), a partnership between the Department of Environmental Affairs (DEA) and the South African Weather Service (SAWS). SAAQIS is a 'one-stop-shop' for all air quality information, from monitoring to legislation, as well as notices, guidelines and contact information of air quality officials in different jurisdictions across the country. The SAAQIS has recently been upgraded to the second generation system that was launched in October 2017 during the Annual Air Quality Governance Lekgotla. At the centre of the SAAQIS is the ambient air quality monitoring module which provides the public with REAL TIME information on the state of air quality. This information is available on the SAAQIS website (https://saaqis.environment.gov.za) and the mobile application called SAAQIS on both Android and IOS platforms. To date, over 60 stations are reporting LIVE air quality to the SAAQIS. It is envisaged that all operational stations will be available online by the end of 2018.

Ambient pollutant measurements are complex for the general public, specifically issues such as how measured pollutant concentrations translate to the quality of air and associated health effects. DEA has development a country-specific Air Quality Index (AQI) in line with best international practices in order to simplify the reporting of air quality to the general public. Once sanctioned, this AQI will be the official manner by which air quality will be presented to the public. The AQI is derived from six (i.e. PM_{10}, $PM_{2.5}$, CO, O_3, SO_2 and NO_2) criteria pollutants, for good air quality (scale 1) to hazardous (10) based on National Ambient Air Quality Standards (NAAQS). The index has five bands indicating 'Low', 'Moderate', 'High' and 'Very High' and 'Hazardous' levels of air pollution. These bands are further divided into a ten-point scale to provide greater gradation of air pollution levels. The 'Low' bands indicate air pollution levels where it is unlikely that anyone will suffer any adverse effects of short-term exposure, including people with lung or heart conditions who may be more susceptible to the effects of air pollution. The 'Moderate' band represents levels of air pollutants at which there are likely to be minor effects for susceptible people only. Values for the 'High' bands are associated with significant effects in susceptible people. At 'Very High' levels of air pollution even healthy individuals may experience adverse effects of short-term exposure. The 'Hazardous' levels will trigger health warnings of emergency conditions as the entire population will likely be affected by serious health effects.

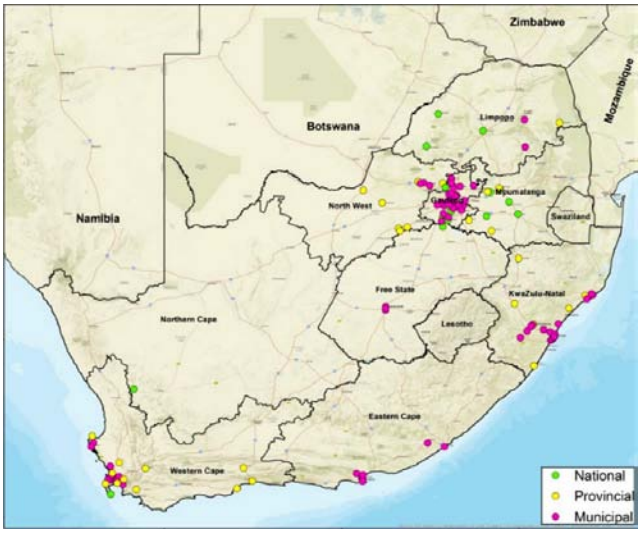

Figure 1: *National Ambient Air Quality Monitoring Network (NAAQMN) of South Africa. Green- national stations managed by the South African Weather Service (SAWS), yellow – provincial stations and magenta – district/metropolitan stations. (Map drawn in-house)*

The reported AQI is derived from the maximum of the pollutant-specific sub-index and associated health effects statements. This means that for each hour, the ambient pollutant concentrations are averaged, and assigned, according to the 10 bands for each pollutant to define the sub-indexes. The maximum of these sub-

indexes is then assigned to the respective hour as the AQI for each station. Because the AQI is defined for each hour, the index is intended to offer information for protection from those pollutants that have short-term health effects (acute effects) such as sulphur dioxide, oxide of nitrogen and ozone. Once the AQI is made available to the public, the AQI will also provide guidance and messages to be included when ambient air quality information is reported on several communication platforms such as the SAAQIS application, television, radio and the Internet.

Figures 2 to 5 show state of air quality in South Africa as of 24 May 2018 from 13h55 to 16h30 from the SAAQIS application screenshots. Users are able to display the AQI, actual pollutant measurements and meteorological data for each monitoring station. The default display is based on LIVE data averaged on the hour. The AQI display is also accompanied by emoticons which are colour-coded to the AQI of that hour (a pleasant green face when the air quality good, and an orange/red/purple sad face when the air quality is unhealthy) as shown in Figure 2.

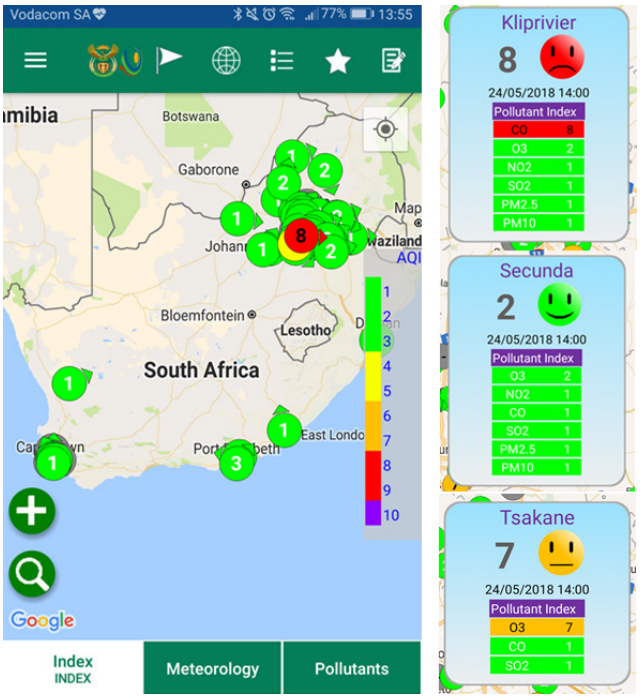

Figure 2: *Mobile device screenshot of SAAQIS application showing the state of air in South Africa as of 24 May 2018 at 13h55. Each monitoring station is represented by a circle colour-coded to the AQI of that station for that hour (greyed circles are stations that are not online at that moment).*

By clicking on a station, the application displays more information about that station, pollutants monitored, time series plots of pollutants and meteorological parameters (Figure 3). Time series plots can be presented over a day or two for any parameter as shown for SO_2 at Secunda. The SAAQIS application not only provides information on the state of air quality, but also educational information on pollutants, what the pollutants are, typical pollutant sources and associated health effects. This educational tool will further be enhanced on the SAAQIS website to support primary educational programmes and information for the general public.

Data presented in the SAAQIS application and website are quality controlled using default data management algorithms in SAAQIS

Figure 3: *Time series plot and general information about pollutants. For this display it is general information about SO_2 and SO_2 measured on 23 May 2018 at Secunda.*

to remove suspicious data spikes before display. All changes to data are noted in the database for verification by data specialists during additional data verification processes that are undertaken by ambient station managers before publishing monthly reports.

The SAAQIS application also includes these additional tools:

- Option for a user to customise display settings, select/unselect favourite stations and share information from the application (Figure 4).
- Ability for users to analyse data and generate a range of reports as shown on the right-hand side menu of Figure 4.

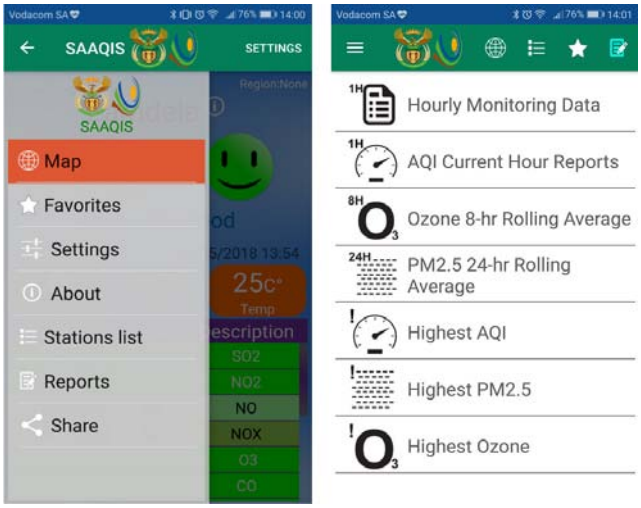

Figure 4: *SAAQIS Application menu of tools for data analyses and application customisation.*

While the SAAQIS application and website are currently displaying only government-owned monitoring stations, there are engagements with private network owners to provide their information into the system too. In addition, there are new initiatives underway to resuscitate non-operational government-owned ambient monitoring stations. By the end of 2018, more stations will be reporting to the SAAQIS, thereby improving coverage and access of information on the state of air quality to the general public. DEA is also undertaking roadshows with university students to educate them on SAAQIS application, air quality tools and how the country is disseminating air quality information to the public. During these roadshows, DEA is also inviting students to design visionary concepts on how the SAAQIS application can further be enhanced to meet community needs.