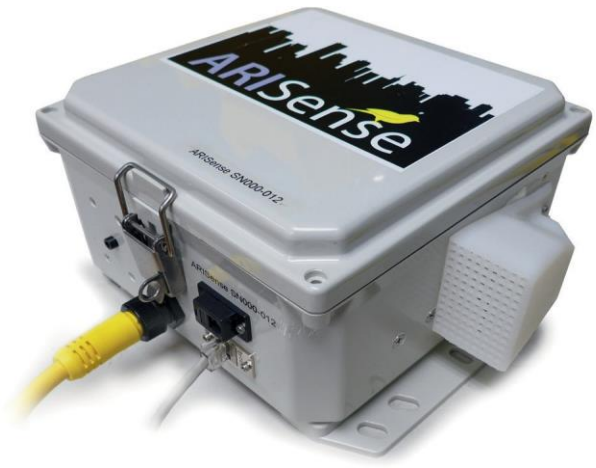
AERODYNE RESEARCH, Inc.

ARISense

Model No. 100

Low-cost air quality sensor system

Designed for gas and particle pollutant measurements to better understand atmospheric chemistry and environmental public health.



https://arisense.io/

APPLICATIONS

- Distributed sensing solutions capable of 10 to 100 times the spatial and temporal resolution of typical air quality monitoring (AQM) networks
- Urban AQ monitoring
- Point source characterization
- Near-field combustion
- Exposure assessment
- Community engagement and education
- Indoor air quality
- Security / Emergency response

ADVANTAGES

- Transparent data handling protocols
- Honest assessment of sensor measurement uncertainties
- Thorough laboratory and in-field calibrations
- Modular, lightweight, flexible design
- Real-time multi-pollutant characterization including both gas phase and particulate matter concentrations
- Adaptable power and networking configurations based on desired deployment scheme
- Rugged weather-proof enclosure with versatile mounting options

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ARISense

Particle Size Range:	$0.38 \leq d_p \leq 17$ µm (across 16 size bins)
Gas Measurements:	Electrochemical measurements of [NO, NO_2, O_x (O_3 + NO_2),CO] Non-dispersive infrared (NDIR) measurement of CO_2
Size/Weight:	8.59” L x 5.11” D x 8.59” H, 5 lbs 21.8 cm x 13 cm x 21.8 cm, 2.3 kg

Fast | Realtime | Raw Data

Data recorded by each ARISense node is stored on an internal flash drive at user-defined data acquisition rates (5-60s). The high time-resolution of ARISense measurements provides a near-instantaneous look at changing pollutant concentrations, leading to a clearer picture of local point source impacts that may disproportionately impact air quality.

Internet-Enabled

ARISense systems are configured to allow users to push real-time data to the cloud where sensor outputs can be visualized by the general public and downloaded by users and researchers. Opening up the ARISense database to the communities in which the systems are deployed allows individuals to connect their personal observations with changes in pollutant concentrations in their immediate vicinity. See https://arisense.io/.

Fully-integrated Low-cost AQ Sensor System

Integration of peripheral sensors for measurement of environmental and meteorological parameters (relative humidity, temperature, solar intensity, barometric pressure, ambient noise, wind speed & direction) provides additional context for interpreting/understanding sensor response and improving source attribution.

Comparison of ARISense performance metrics to other published results utilizing integrated multi-pollutant systems comprised of Alphasense electrochemical sensors

Studies	Temporal Resolution (min)	$N_{data\ pnts}$	Slope	r^2	RMSE (ppb)	MAE (ppb)	MBE (ppb)
CO SENSOR							
Jiao et al., 2016[1]	60	2640-2664[#]	< 0.001	0.63-0.68	NR	NR	NR
Castell et al., 2017[2]	15	6912[#]	NR	0.36	170.99	NR	-147.21
Zimmerman et al., 2017[3]	15	3936[#]	0.86	0.91	NR	38	0.1
This Work[4] (CO-B4)	**5**	**21533**	**0.94**	**0.88**	**32.9**	**24.8**	**-10.4**
NO SENSOR							
Jiao et al., 2016	60	2640-2664[#]	0.883-0.892	0.77-0.87	NR	NR	NR
Castell et al., 2017	15	6912[#]	NR	0.74	16.35	NR	-0.54
This Work (NO-B4)	**5**	**25356**	**0.94**	**0.84**	**4.52**	**2.83**	**0.97**
NO2 SENSOR							
Jiao et al., 2016	60	2640-2664[#]	NR	0.02-0.10	NR	NR	NR
Castell et al., 2017	15	6912[#]	NR	0.24	30.27	NR	13.30
Zimmerman et al., 2017	15	2304[#]	0.64	0.67	NR	3.48	-0.4
This Work (NO2-B43F)	**5**	**25489**	**0.81**	**0.69**	**4.56**	**3.45**	**1.20**
Ox SENSOR							
Jiao et al., 2016	60	2640-2664[#]	NR	0.15-0.20	NR	NR	NR
Castell et al., 2017	15	6912[#]	NR	0.29	22.20	NR	6.76
Zimmerman et al., 2017[*]	15	3648[#]	0.82	0.86	NR	3.36	-0.14
This Work (Ox-B421)[++]	**5**	**25006**	**0.47**	**0.39**	**9.71**	**7.34**	**0.78**

NR = not reported in manuscript
[#]N calculated assuming 100% duty cycle over specified days of co-location for each study
[1]Results obtained from 2 AQMesh integrated sensor systems (Gen. 3) deployed in Decatur, Georgia US
[2]Statistical metrics correspond to average of 24 co-located AQMesh systems deployed in Kirkeveien, Norway
[3]Average test results from 19 Real-time Affordable Multi-Pollutant (RAMP) systems co-located in Pittsburgh, Pennsylvania US
[4]Single ARISense system deployed in Dorchester, Massachusetts US
[*]Ox-B431 sensor

[++] Note that all current versions of ARISense system have integrated the Ox-B431 sensor in place of the Ox-B421 shown above. This new version of the Ox sensor provides improved HDMR-performance in ambient test cases resulting in RMSE values < 5 ppb (5-min average data).

For additional details regarding the performance metrics presented above, please see:
Cross, E. S., Williams, L. R., Lewis, D. K., Magoon, G. R., Onasch, T. B., Kaminsky, M. L., Worsnop, D. R., and Jayne, J. T.: Use of electrochemical sensors for measurement of air pollution: correcting interference response and validating measurements, Atmos. Meas. Tech., 10, 3575-3588, https://doi.org/10.5194/amt-10-3575-2017, 2017.
https://www.atmos-meas-tech.net/10/3575/2017/amt-10-3575-2017.pdf