UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE
Office of System Architecture and Engineering
SSMC1, Fifth Floor, Silver Spring, MD 20901

4 August 2023

MEMORANDUM FOR: Ed Grigsby, NESDIS/SAE
Irene Parker, NESDIS/DAAS
Tim Walsh, NESDIS/LEO
Pam Sullivan, NESDIS/GEO
Elsayed Talaat, NESDIS/SWO

FROM: Mike Bonadonna, SAT Chair, NESDIS/SAE
Frank W. Gallagher, III, SAT Co-Chair, NWS/OBS

BONADONNA.MICHAEL.FRANK.1025314758 Digitally signed by BONADONNA.MICHAEL.FRANK.1025314758 Date: 2023.08.04 14:31:34 -04'00'

GALLAGHER.FRANK.WOOLSEY.1264444663 Digitally signed by GALLAGHER.FRANK.WOOLSEY.1264444663 Date: 2023.08.04 13:58:57 -04'00'

SUBJECT: Assessment of Solution-Agnostic Observational Needs for Air Quality Monitoring and Forecasting

1. Scope:
This memo provides background information and recommendations and guidance for solution-agnostic observational needs for Air Quality.

2. Background:
NESDIS has to regularly assess the user mission needs for environmental observations. This is important in order to (1) remain cognizant with the evolution of these needs and to (2) better plan for the next-generation architecture, and in particular, the space-based architecture. To achieve this goal, these needs have to be collected from a broad community, in a solution-agnostic fashion, in order to provide a reference for multiple observing systems solutions that will be able (1) to meet these needs now and in the future, (2) to look at innovative ways to meet all needs cost-effectively, and (3) to potentially fill or reduce existing observation gaps. It is important to note that these needs are expressed from a relatively wide community of observational users, but it is important to highlight they do not constitute requirements for NOAA. An internal NOAA process exists to define observational requirements. This effort is one part of the overall NESDIS user engagement process.

Air quality monitoring and forecasting is important due to the substantial documented impacts of poor air quality on human health and its detrimental impacts on various ecosystems. The SAT subcommittee on atmospheric composition (see List of Contributors) focused on several application areas where satellite data is a main source of observational data. A panel of expert reviewers (see List of Contributors) reviewed the needs, attributes, and their priorities, following which observational needs for these applications were briefed to the SAT where representatives from academia, the private

sector, NASA, DoD, and NOAA Cooperative Institutes were participating. There were also several representatives from all NOAA Line Offices, including representatives from the NESDIS flight programs, who ultimately will be charged with developing the components of the space architecture (LEO, GEO, SWO). The OSAAP/TPIO (Technology, Planning and Integration for Observation) team has the responsibility of stewarding and updating the Consolidated Observational User Requirements List (COURL). All participants were given opportunities to provide comments and feedback on the observational needs.

It is the purpose of this memo, compiled by the SAT subcommittee on atmospheric composition and reviewed by the Government-only Core-SAT team, is to document and establish the needs for air quality monitoring and forecasting by assessing the users' needs from many sources. It is important to note that the information captured is in geophysical space which is consistent with the international standard established by the WMO (e.g., the OSCAR database). This means that what is captured here is the information content needed for the observations. It does not mean that the user systems will assimilate those products. This exercise captured user needs in a solution-agnostic fashion.

3. Facts and Findings:
    a. Facts
        (1) Atmospheric chemistry species were selected from a subset of chemical species which are included in state-of-the-art global atmospheric chemical transport models, such as the Real-time Air Quality Modeling System (RAQMS).
        (2) Components of air pollution, such as ozone and fine particulate matter, can impact cardiovascular and respiratory health, and lead to premature death.
        (3) Poor visibility from dust and wildfire smoke can impact ground and air transportation.
        (4) Air quality forecasts are used to understand the impacts of air quality regulations and the long-range transport of pollutants along with their resulting health and environmental outcomes.
        (5) The NWS has provided forecast guidance for surface air quality over the United States since 2004, as mandated by Congress under provisions of the Energy Policy Act of 2002 and by a Memorandum of Agreement between NOAA and the US EPA, updated most recently in 2021.
        (6) Air quality monitoring tracks the efficacy of various environmental public laws, including the Clean Air Act (1970), the subsequent 1990 Clean Air Act Amendments, the Clear Air Interstate Rule (2006), and the Cross-State Pollution Rule (2011).
    b. Findings
        (1) The SAT developed a list of solution-agnostic air quality observational needs and assembled them into several tables. The tables summarize those observational needs and were determined as part of the overall NESDIS user engagement process that consisted of deliberations with

non-NOAA experts, established expert groups, published documentation, and NOAA Line Office experts. The list was consolidated, reviewed, and approved by the Government-only Core-SAT committee.

4. Recommendation:

The SAT recommends that NOAA use the following solution-agnostic air quality observational needs, as shown in the tables below as an input to the establishment of the NOAA observational requirements for atmospheric composition needs. These tables include variable names, attributes' ranges of these variables, as well as associated prioritizations. These recommendations should be considered as part of the planning and development of next-generation space architecture and product development.

Table Descriptions

Table 1. Describes the list of variables needed for the air quality monitoring and forecasting applications, why they are important for the application, and whether they are already identified as an existing variable in the TPIO databases (e.g., COURL).

Table 2. Identifies geophysical variable priorities for the air quality monitoring and forecasting application as reviewed by the Core-SAT using the inputs from the subcommittee for atmospheric composition as an input. The recommendations from other user needs activities (TPIO, NASA-NOAA, XORWG, etc.) were considered, and included by OSAAP/TPIO as appropriate.

Table 3. Shows the variable performance ranges for the air quality monitoring and forecasting application, as determined by the Core-SAT. These data are based on the input from the subcommittee for atmospheric composition as well as input from the OSAAP Analysis Team, and other sources, as mentioned previously. The data ranges, shown as triplets, are defined as "minimally useful or Threshold," "Expected [performance in the 2030-time frame]," and "Maximum Effective." The current geophysical variable performance ranges are also listed.

Table 4. Includes air quality monitoring and forecasting application attribute priorities, per variable, including horizontal and vertical resolution, temporal resolution, error standard deviation, and data latency. This table was provided by the OSAAP/TPIO Team based on "differential attribute change per unit time" in the vertical and horizontal dimensions. Current attribute weights, per geophysical variable, are listed.

Conclusions:

This is the first comprehensive catalog of observational needs for the air quality monitoring and forecasting application that has been collected by NOAA. This observational needs list is designed to consolidate the set of needs, defined in a way that helps the design and evaluation of the next-generation space architecture, but also to

serve as a reference for all those interested in these needs in the near future. As stated previously, the collection of user needs was developed and reviewed by a variety of different sources that included representatives from the OSAAP/TPIO, the LEO and GEO programs, and representatives from the NOAA Line Offices and Centers (OAR/CSL, OAR/GML, OAR/ARL, NWS/EMC, NESDIS/STAR, OAR/CPO), NASA, DoD, and academia. The final determination of the list of user needs and attributes was assembled and confirmed by the Core-SAT. The collection of observational user needs is part of the on-going user engagement process and should be refreshed regularly in order to maintain an up-to-date list of users' observational needs.

Table 1. Air Quality Variable Needs: Table 1 is a list of the variables needed by the air quality monitoring and forecasting application, the importance of these variables, and a notation about the variable status in the TPIO databases.

Geophysical Variable	Variable Importance	TPIO Database (Existing/ New)
O_3 – Ozone	Ozone is a regulated pollutant formed in the atmosphere harmful to human health, agriculture, and the environment	E
CH_4 – Methane	Tracer for chemical releases relevant to air quality	E
CO_2 – Carbon Dioxide	Co-pollutant that provides constraint on emissions of other pollutants	E
HNO_3 - Nitric Acid	Tracer for chemical processes relevant to air quality	E
N_2O_5 – Dinitrogen Pentoxide	Tracer for chemical processes relevant to air quality	N
H_2O_2 – Hydrogen Peroxide	Tracer for chemical processes relevant to air quality	N
HCl – Hydrogen Chloride	Tracer for chemical releases relevant to air quality	N
$ClONO_2$ – Chlorine Nitrate	Tracer for chemical processes relevant to air quality	N
OClO – Chlorine Dioxide	Tracer for chemical processes relevant to air quality	N
HNO_4 – Peroxynitric Acid	Tracer for chemical processes relevant to air quality	N
HOCl – Hypochlorous Acid	Tracer for chemical processes relevant to air quality	N
BrCl – Bromine Chloride	Tracer for chemical processes relevant to air quality	N
Cl_2 – Chlorine	Tracer for chemical releases relevant to air quality	N
CH_2O – Formaldehyde	Tracer for chemical processes relevant to air quality	N
$C_2H_3O_3NO_2$ (PAN) – Peroxyacetyl Nitrate	Tracer for chemical processes relevant to air quality	N
$C_4H_5O_3NO_2$ (MPAN) – Peroxymthacryloyl Nitrate	Tracer for chemical processes relevant to air quality	N
SO_2 – Sulfur Dioxide	Tracer for chemical releases relevant to air quality; regulated pollutant	E
NH_3 – Ammonia	Tracer for chemical releases relevant to air quality	N
$(CH_3)2S$ (DMS) – Dimethyl Sulfide	Tracer for chemical releases relevant to air quality	N
C_2H_6 – Ethane	Tracer for chemical releases relevant to air quality	N
CH_3Br – Bromomethane	Tracer for chemical releases relevant to air quality	N
CH_3CHO – Ethanal	Tracer for chemical processes relevant to air quality	N
CH_3CH_2OOH – Ethyl Hydroperoxide	Tracer for chemical processes relevant to air quality	N
C_3H_6O – Acetone	Tracer for chemical releases relevant to air quality	N
$C_2H_2O_2$ – Glyoxal	Tracer for chemical processes relevant to air quality	N
C3H4O2 – Methylglyoxal	Tracer for chemical processes relevant to air quality	N

Geophysical Variable	Variable Importance	TPIO Database (Existing/ New)
C2H2 – Acetylene	Tracer for chemical releases relevant to air quality	N
C2H4 – Ethylene	Tracer for chemical releases relevant to air quality	N
C5H8 – Isoprene	Tracer for chemical releases relevant to air quality	N
C3H8 – Propane	Tracer for chemical releases relevant to air quality	N
CH3OH – Methanol	Tracer for chemical releases relevant to air quality	N
C4H6O – Methacrolein	Tracer for chemical processes relevant to air quality	N
NO3 – Nitrate	Tracer for chemical processes relevant to air quality	N
NO2 – Nitrogen Dioxide	Tracer for chemical releases relevant to air quality; regulated pollutant	E
NO – Nitrogen Oxide	Tracer for chemical releases relevant to air quality; regulated pollutant	N
CH3OOH – Methyl Hydroperoxide	Tracer for chemical processes relevant to air quality	N
CO – Carbon Monoxide	Tracer for chemical releases relevant to air quality; regulated pollutant	E
HBr – Hydrogen Bromide	Tracer for chemical processes relevant to air quality	N
BrO – Bromine Monoxide	Tracer for chemical processes relevant to air quality	N
BrONO2 – Bromine Nitrate	Tracer for chemical processes relevant to air quality	N
HOBr – Hypobromous Acid	Tracer for chemical processes relevant to air quality	N
ClO - Chlorine Monoxide	Tracer for chemical processes relevant to air quality	N
Fire detection	Identifies hazardous conditions for life and property	E
Fire size	Identifies hazardous conditions for life and property	E
Fire Radiative Power	Identifies hazardous conditions for life and property	E
UV Aerosol Optical Depth	Proxy for fine particulate matter	E
Visible Aerosol Optical Depth	Proxy for fine particulate matter	E
Aerosol Layer Height	Informs fine particulate vertical distribution	E
Aerosol Single Scattering Albedo	Proxy for fine particulate composition	E
Aerosol Refractive Index	Proxy for fine particulate composition	E
Aerosol Particle Size	Impact of fine particulates on health	E
Aerosol Particle Shape	Proxy for radiative impacts of fine particulates	E
Speciated PM2.5	Informs fine particulate composition	N
Total PM2.5	Regulated amount of fine particulate, which is harmful to human health and impacts visibility	N
Speciated PM10	Informs particulate composition	N

Geophysical Variable	Variable Importance	TPIO Database (Existing/ New)
Total PM10	Regulated amount of coarse particulate, which impacts visibility	N
Volcanic Ash	Informs hazardous conditions for aviation	E

Table 2. Geophysical Variable Priorities for Air Quality Monitoring and Forecasting: This table includes the list of the geophysical information and their prioritization, based on a scale from 0 (non-important) to 1 (critically important), needed for air quality monitoring and forecasting as determined by the Systems performance Assessment team (SAT). This list was consolidated using a multitude of sources and follows the variables definition and units used in the Advanced Systems Performance Evaluation tool for NOAA (ASPEN) tool.

Geophysical Variable	Short Name	Units	Priority
O3 – Ozone	O3	ppmv	1.0
CH4 – Methane	CH4	ppbv	1.0
CO2 – Carbon Dioxide	CO2	ppmv	0.5
HNO3 - Nitric Acid	HNO3	ppbv	0.8
N2O5 – Dinitrogen Pentoxide	N2O5	pptv	0.8
H2O2 – Hydrogen Peroxide	H2O2	ppbv	1.0
HCl – Hydrogen Chloride	HCl	ppbv	0.1*
ClONO2 – Chlorine Nitrate	ClONO2	ppbv	0.3*
OClO – Chlorine Dioxide	OClO	pptv	0.1*
HNO4 – Peroxynitric Acid	HNO4	ppbv	0.8
HOCl – Hypochlorous Acid	HOCl	ppbv	0.1*
BrCl – Bromine Chloride	BrCl	pptv	0.1*
Cl2 – Chlorine	Cl2	pptv	0.1*
CH2O – Formaldehyde	CH2O	ppbv	1.0
C2H3O3NO2 (PAN) – Peroxyacetyl Nitrate	C2H3O3NO2	pptv	0.8
C4H5O3NO2 (MPAN) – Peroxymthacryloyl Nitrate	C4H5O3NO2	pptv	0.8
SO2 – Sulfur Dioxide	SO2	ppbv	1.0
NH3 – Ammonia	NH3	ppbv	1.0
(CH3)2S (DMS) – Dimethyl Sulfide	(CH3)2S	ppbv	1.0
C2H6 – Ethane	C2H6	ppbv	1.0
CH3Br – Bromomethane	CH3Br	pptv	0.1*
CH3CHO – Ethanal	CH3CHO	ppbv	0.8
CH3CH2OOH – Ethyl Hydroperoxide	CH3CH2OOH	ppbv	0.5

Geophysical Variable	Short Name	Units	Priority
C3H6O – Acetone	C3H6O	pptv	0.8
C2H2O2 – Glyoxal	C2H2O2	ppbv	0.8
C3H4O2 – Methylglyoxal	C3H4O2	ppbv	0.8
C2H2 – Acetylene	C2H2	ppbv	0.8
C2H4 – Ethylene	C2H4	ppbv	0.8
C5H8 – Isoprene	C5H8	ppbv	1.0
C3H8 – Propane	C3H8	ppbv	0.8
CH3OH – Methanol	CH3OH	ppbv	0.5
C4H6O – Methacrolein	C4H6O	ppbv	0.8
NO3 – Nitrate	NO3	ppbv	0.8
NO2 – Nitrogen Dioxide	NO2	ppbv	1.0
NO – Nitrogen Oxide	NO	ppbv	1.0
CH3OOH – Methyl Hydroperoxide	CH3OOH	ppbv	0.8
CO – Carbon Monoxide	CO	ppmv	1.0
HBr – Hydrogen Bromide	HBr	pptv	0.1*
BrO – Bromine Monoxide	BrO	pptv	0.1*
BrONO2 – Bromine Nitrate	BrONO2	pptv	0.1*
HOBr – Hypobromous Acid	HOBr	pptv	0.1*
ClO - Chlorine Monoxide	ClO	pptv	0.1*
Fire detection	Fire Detection	K	1.0
Fire size	Fire Size	m	1.0
Fire Radiative Power	Fire Radiative Power	MW	1.0
UV Aerosol Optical Depth	AOD, UV	unitless	0.8
Visible Aerosol Optical Depth	AOD, Vis	unitless	1.0
Aerosol Layer Height	Aerosol Height	km	1.0
Aerosol Single Scattering Albedo	Aerosol Albedo	unitless	0.8
Aerosol Refractive Index	Aerosol Scattering	unitless	0.8
Aerosol Particle Size	Aerosol Size	microns	0.8
Aerosol Particle Shape	Aerosol Shape	unitless	0.3
Speciated PM2.5	Speciated PM2.5	ug/m3	1.0

Geophysical Variable	Short Name	Units	Priority
Total PM2.5	Total PM2.5	ug/m3	1.0
Speciated PM10	Speciated PM10	ug/m3	1.0
Total PM10	Total PM10	ug/m3	1.0
Volcanic Ash	Volcanic Ash	mg/m3	0.9

*The Cly and Bry families of compounds are most relevant for marine boundary layer ozone.

Table 3. Air Quality Monitoring and Forecasting Observational Need Attribute Performance Ranges: List of observational needs of the current systems for air quality monitoring and forecasting in NOAA. These needs are expressed in terms of ranges between minimally useful (Threshold), expected level of performance in 2030 (Expected) and the maximum effective usefulness level beyond which there is no incentive to improve performance (Maximum Effective) and are expressed as [Threshold, Expected, Maximum Effective]. The attributes include the following:

- Geographic Coverage: The geographic region needed for observations.
- Horizontal resolution: The ground projected instantaneous field of view.
- Temporal refresh: Time between observations at a location, i.e, time to observe the geographic coverage region.
- Data Latency: Time from 'image taken' to full relay of data to a ground station.
- Vertical Resolution (when appropriate): The average vertical distance between observations in degrees of freedom.
- Precision: Error standard deviation under clear/cloudy conditions and over land/ocean.
- Accuracy: Mean absolute non-random error.
- Validity Range: The low and high values that can be observed.
- Long term stability of the measurement: Long term changes in precision (noise).
- Robustness: The number of sources needed to make the observation.
- Continuity: Period in years for which the observations are required.

Geophysical Variable	Geophysical Variable Units	Geographic Coverage (dimensionless)	Horizontal Resolution (km)	Temporal Refresh (h)	Data Latency (h)	Vertical Resolution (dof)	Precision: Clear/ Cloudy, Land/ Ocean (%)	Accuracy (%)	Validity Range (Same Units as Variable)	Long- term Stability (%)	Robustness (unitless)	Continuity (yr)
O3 – Ozone	ppmv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1**, 5***, 120]	[30,5,1]	0.001+[10, 5, 1]	[0.001- 15]	[10, 2, 1]%/Decade	[2, 3, 6]	1 year
CH4 – Methane	ppbv	Network, CONUS, Global	[50, 5, 0.1]	[24, 12, 0.1]	[3, 1, 0.25]	[1, 5, 120]	[40, 20, 10] %	[40, 10, 5] %	[1.5-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CO2 – Carbon Dioxide	ppmv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 10] %	[40, 10, 5] %	[250-2000]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
HNO3 - Nitric Acid	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 1]	[1, 5, 120]	[40, 20, 5] %	0.1+[40, 10, 5] %	[0.1-30]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
N2O5 – Dinitrogen Pentoxide	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 0.1]	[3, 1, 0.25]	[1, 5, 120]	[40, 20, 5] %	1+[40, 10, 5] %	[1-1000]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
H2O2 – Hydrogen Peroxide	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 0.5]	[3, 1, 0.25]	[1, 5, 120]	[40, 20, 5] %]	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
HCl – Hydrogen Chloride	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5]	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year

Geophysical Variable	Geophysical Variable Units	Geographic Coverage (dimensionless)	Horizontal Resolution (km)	Temporal Refresh (h)	Data Latency (h)	Vertical Resolution (dof)	Precision: Clear/ Cloudy, Land/ Ocean (%)	Accuracy (%)	Validity Range (Same Units as Variable)	Long- term Stability (%)	Robustness (unitless)	Continuity (yr)
ClONO2 – Chlorine Nitrate	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
OClO – Chlorine Dioxide	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.1+[40, 10, 5] %	[0.1-5]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
HNO4 – Peroxynitric Acid	ppbv	Network, CONUS, Global	[50, 5, 0.1]	[24, 12, 0.1]	[3, 1, 0.1]	[1, 5, 120]	[40, 20, 5] %	0.1+[40, 10, 5] %	[0.1-100]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
HOCl – Hypochlorous Acid	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-50]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
BrCl – Bromine Chloride	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.01+[40, 10, 5] %	[0.01-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Cl2 – Chlorine	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1.0+[40, 10, 5] %	[1.0-20,000]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CH2O – Formaldehyde	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.1+[40, 10, 5] %	[0.1-40]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C2H3O3NO2 (PAN) – Peroxyacetyl Nitrate	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	10.0+[40, 10, 5] %	[10.0-10,000]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C4H5O3NO2 (MPAN) – Peroxymthacryloyl Nitrate	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1.0+[40, 10, 5] %	[1.0-1,000]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
SO2 – Sulfur Dioxide	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5]	[0.001-1,000]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
NH3 – Ammonia	ppbv	Network, CONUS, Global	[10, 3, 1]	[24, 6, 0.5]	[3, 1, 0.5]	[1**,5***,120]	[40, 20, 5] %	0.01+[40, 10, 5] %	[0.01-100]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
(CH3)2S (DMS) – Dimethyl Sulfide	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C2H6 – Ethane	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-50]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CH3Br – Bromomethane	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 10, 5] %	[40, 20, 5] %	[1-20]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CH3CHO – Ethanal	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CH3CH2OOH – Ethyl Hydroperoxide	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-5]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year

Geophysical Variable	Geophysical Variable Units	Geographic Coverage (dimensionless)	Horizontal Resolution (km)	Temporal Refresh (h)	Data Latency (h)	Vertical Resolution (dof)	Precision: Clear/ Cloudy, Land/ Ocean (%)	Accuracy (%)	Validity Range (Same Units as Variable)	Long- term Stability (%)	Robustness (unitless)	Continuity (yr)
C3H6O – Acetone	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1.0+[40, 10, 5] %	[1.0-1000]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C2H2O2 – Glyoxal	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C3H4O2 – Methylglyoxal	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C2H2 – Acetylene	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-20]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C2H4 – Ethylene	ppbv	Network, CONUS, Global	[50, 5, 0.1]	[24, 12, 0.1]	[3, 1, 0.1]	[1, 5, 120]	[40, 20, 5] %	0.01+[40, 10, 5] %	[0.01-100]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C5H8 – Isoprene	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 0.5]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.01+[40, 10, 5] %	[0.01-100]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C3H8 – Propane	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.1+[40, 10, 5] %	[0.1-100]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CH3OH – Methanol	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.01+[40, 10, 5] %	[0.010-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
C4H6O – Methacrolein	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
NO3 – Nitrate	ppbv	Network, CONUS, Global	[50, 5, 0.1]	[24, 12, 0.1]	[3, 1, 0.1]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
NO2 – Nitrogen Dioxide	ppbv	Network, CONUS, Global	[50, 5, 0.1]	[24, 12, 0.1]	[3, 1, 0.1]	[1, 5, 120]	[40, 20, 5] %	0.1+[40, 10, 5] %	[0.1-100]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
NO – Nitrogen Oxide	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-100]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CH3OOH – Methyl Hydroperoxide	ppbv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.001+[40, 10, 5] %	[0.001-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
CO – Carbon Monoxide	ppmv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	0.05+[40, 10, 5] %	[0.05-10]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
HBr – Hydrogen Bromide	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1+[40, 10, 5] %	[1-50]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
BrO – Bromine Monoxide	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1+[40, 10, 5] %	[1-50]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
BrONO2 – Bromine Nitrate	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1+[40, 10, 5] %	[1-50]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year

Geophysical Variable	Geophysical Variable Units	Geographic Coverage (dimensionless)	Horizontal Resolution (km)	Temporal Refresh (h)	Data Latency (h)	Vertical Resolution (dof)	Precision: Clear/ Cloudy, Land/ Ocean (%)	Accuracy (%)	Validity Range (Same Units as Variable)	Long- term Stability (%)	Robustness (unitless)	Continuity (yr)
HOBr – Hypobromous Acid	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1+[40, 10, 5] %	[1-50]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
ClO - Chlorine Monoxide	pptv	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[1, 5, 120]	[40, 20, 5] %	1+[40, 10, 5] %	[1-50]	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Fire detection	K	Network, CONUS, Global	[4, 2, 0.1]	[720, 10, 1] min	[60, 10, 1]	1	NA	[40, 20, 5] %	200 - 1600	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Fire size	m	Network, CONUS, Global	[4, 2, 0.1]	[720, 10, 1] min	[60, 10, 1]	1	NA	20+[40, 20, 5] %	20 - 4000	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Fire Radiative Power	MW	Network, CONUS, Global	[4, 2, 0.1]	[720, 10, 1] min	[60, 10, 1]	1	[40, 20, 5] %	0.05+[40, 20, 5] %	0 - 100,000	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
UV Aerosol Optical Depth	unitless	Network, CONUS, Global	[50, 5, 1]	[1440, 60, 5] min	[180, 30, 5] min	[1, 5, 120]	[20, 10, 1] %	0.001+[10, 5, 1] %	0 - 50	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Visible Aerosol Optical Depth	unitless	Network, CONUS, Global	[50, 5, 1]	[1440, 60, 5] min	[180, 30, 5] min	[1, 5, 120]	[20, 10, 1] %	0.001+[10, 5, 1] %	0 - 50	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Aerosol Layer Height	km	Network, CONUS, Global	[50, 5, 1]	[24, 12, 1]	[3, 1, 0.5]	[5, 60, 120]	[20, 10, 1] %	0.05+[10, 5, 1] %	0 - 60	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Aerosol Single Scattering Albedo	unitless	Network, CONUS, Global	[10, 2, 0.1]	[24, 12, 1]	[3, 1, 0.5	[1,5,120]	[40, 20, 5] %	[40, 20, 5] %	0 - 1	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Aerosol Refractive Index	unitless	Network, CONUS, Global	[10, 2, 0.1]	[24, 12, 1]	[3, 1, 0.5]	[1,5,120]	NA	NA	0.0001-2	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Aerosol Particle Size****	microns	Network, CONUS, Global	[10, 2, 0.1]	[24, 12, 1]	[3, 1, 0.5]	[1,5,120]	[40, 20, 5] %	[40, 20, 5] %	0 - 100	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Aerosol Particle Shape	unitless	Network, CONUS, Global	[10, 2, 0.1]	[24, 12, 1]	[3, 1, 0.5]	[1,5,120]	NA	NA	NA	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Speciated PM2.5	ug/m3	Network, CONUS, Global	[10, 2, 0.1]	[1440, 60, 5] min	[180, 30, 5] min	[1,5,120]	[40, 20, 5] %	[40, 20, 5] %	0 - 1000	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Total PM2.5	ug/m3	Network, CONUS, Global	[10, 2, 0.1]	[1440, 60, 5] min	[180, 30, 5] min	[1,5,120]	[40, 20, 5] %	[40, 20, 5] %	0 - 1000	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Speciated PM10	ug/m3	Network, CONUS, Global	[10, 2, 0.1]	[1440, 60, 5] min	[180, 30, 5] min	[1,5,120]	[40, 20, 10] %	[40, 20, 10] %	0 - 1000	[5, 2, 1] %/Decade	[2, 3, 6]	1 year
Total PM10	ug/m3	Network, CONUS, Global	[10, 2, 0.1]	[1440, 60, 5] min	[180, 30, 5] min	[1,5,120]	[40, 20, 10] %	[40, 20, 10] %	0 - 1000	[5, 2, 1] %/Decade	[2, 3, 6]	1 year

Geophysical Variable	Geophysical Variable Units	Geographic Coverage (dimensionless)	Horizontal Resolution (km)	Temporal Refresh (h)	Data Latency (h)	Vertical Resolution (dof)	Precision: Clear/ Cloudy, Land/ Ocean (%)	Accuracy (%)	Validity Range (Same Units as Variable)	Long- term Stability (%)	Robustness (unitless)	Continuity (yr)
Volcanic Ash	mg/m3	Network, CONUS, Global	[4, 2, 1]	[720, 10, 1] min	[60, 10, 1] min	[1,5,120]	[40, 20, 5] %	0.01+[40, 20, 5]	0.01-1000	[5, 2, 1] %/Decade	[2, 3, 6]	1 year

**surface or column
***mostly in troposphere
**** Satellites typically only classify coarse and fine mode aerosols using Angstrom exponent/size parameter

Table 4. Air Quality Monitoring and Forecasting Observational Need Attribute Priority: List of the air quality monitoring and forecasting variables as prioritized in Table 1. This table contains the relative importance of the attributes for each of the variables. This provides engineers and designers of sensors and constellations the ability to assess where emphasis should be put when performing trade studies. For each row (variable), the weights between 0 (no importance) and 1 (highest importance) is assigned to the individual attributes described in the columns. NA indicates not applicable.

Geophysical Variable	Images	Geographic Coverage	Horizontal Resolution	Temporal Refresh	Data Latency	Vertical Resolution	Precision: Clear/Cloudy, Land/Ocean	Accuracy	Validity Range	Long-term Stability	Robustness	Continuity
O3 – Ozone	1	1	1	1	1	1	0.8	1	1	0.8	0.8	0.8
CH4 – Methane	1	1	1	1	0.8	1	1	1	1	1	0.5	0.5
CO2 – Carbon Dioxide	1	1	1	0.8	0.5	1	0.8	0.8	1	1	0.5	0.5
HNO3 - Nitric Acid	1	1	1	0.8	0.8	1	1	1	1	1	0.5	0.5
N2O5 – Dinitrogen Pentoxide	1	1	1	1	1	1	1	1	1	1	0.5	0.5
H2O2 – Hydrogen Peroxide	1	1	1	1	1	1	1	1	1	1	0.5	0.5
HCl – Hydrogen Chloride	0.5	1	1	0.5	0.5	1	1	1	1	1	0.5	0.5
ClONO2 – Chlorine Nitrate	0.5	1	1	0.5	0.5	1	1	1	1	1	0.3	0.3
OClO – Chlorine Dioxide	0.5	0.8	1	0.5	0.5	1	1	1	1	1	0.3	0.3
HNO4 – Peroxynitric Acid	1	1	1	0.8	0.8	1	0.8	1	1	1	0.3	0.3
HOCl – Hypochlorous Acid	0.5	1	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
BrCl – Bromine Chloride	0.5	0.8	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
Cl2 – Chlorine	0.5	0.8	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
CH2O – Formaldehyde	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
C2H3O3NO2 (PAN) – Peroxyacetyl Nitrate	1	1	1	0.8	0.8	1	0.8	1	1	1	0.5	0.5

Geophysical Variable	Images	Geographic Coverage	Horizontal Resolution	Temporal Refresh	Data Latency	Vertical Resolution	Precision: Clear/Cloudy, Land/Ocean	Accuracy	Validity Range	Long-term Stability	Robustness	Continuity
C4H5O3NO2 (MPAN) – Peroxymthacryloyl Nitrate	1	1	1	0.8	0.8	1	0.8	1	1	1	0.3	0.3
SO2 – Sulfur Dioxide	1	1	1	1	1	1	0.8	1	1	1	0.8	0.8
NH3 – Ammonia	1	1	1	1	1	1	0.8	1	1	1	0.8	0.8
(CH3)2S (DMS) – Dimethyl Sulfide	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
C2H6 – Ethane	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
CH3Br – Bromomethane	0.5	1	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
CH3CHO – Ethanal	1	1	1	1	1	1	0.8	1	1	1	0.3	0.3
CH3CH2OOH – Ethyl Hydroperoxide	1	1	1	1	1	1	0.8	1	1	1	0.3	0.3
C3H6O – Acetone	1	1	1	0.8	0.8	1	0.8	1	1	1	0.5	0.5
C2H2O2 – Glyoxal	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
C3H4O2 – Methylglyoxal	1	1	1	1	1	1	0.8	1	1	1	0.3	0.3
C2H2 – Acetylene	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
C2H4 – Ethylene	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
C5H8 – Isoprene	1	1	1	1	1	1	0.8	1	1	1	0.8	0.8
C3H8 – Propane	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
CH3OH – Methanol	1	1	1	1	1	1	0.8	1	1	1	0.3	0.3
C4H6O – Methacrolein	1	1	1	1	1	1	0.8	1	1	1	0.3	0.3
NO3 – Nitrate	1	1	1	1	1	1	0.8	1	1	1	0.5	0.5
NO2 – Nitrogen Dioxide	1	1	1	1	1	1	0.8	1	1	1	1	1
NO – Nitrogen Oxide	1	1	1	1	1	1	0.8	1	1	1	1	1
CH3OOH – Methyl Hydroperoxide	1	1	1	1	1	1	0.8	1	1	1	0.3	0.3
CO – Carbon Monoxide	1	1	1	1	1	1	0.8	1	1	1	0.8	0.8
HBr – Hydrogen Bromide	0.5	1	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3

Geophysical Variable	Images	Geographic Coverage	Horizontal Resolution	Temporal Refresh	Data Latency	Vertical Resolution	Precision: Clear/Cloudy, Land/Ocean	Accuracy	Validity Range	Long-term Stability	Robustness	Continuity
BrO – Bromine Monoxide	0.5	0.8	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
BrONO2 – Bromine Nitrate	0.5	1	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
HOBr – Hypobromous Acid	0.5	0.8	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
ClO - Chlorine Monoxide	0.5	0.8	1	0.5	0.5	1	0.8	1	1	1	0.3	0.3
Fire detection	1	1	1	1	1	NA	NA	1	1	1	1	1
Fire size	1	1	1	1	1	NA	NA	1	1	1	1	1
Fire Radiative Power	0.8	1	1	1	1	NA	0.8	1	1	1	1	1
UV Aerosol Optical Depth	1	1	1	1	1	1	0.8	1	1	1	1	1
Visible Aerosol Optical Depth	1	1	1	1	1	1	0.8	1	1	1	1	1
Aerosol Layer Height	1	1	1	1	1	1	0.8	1	1	1	0.8	0.8
Aerosol Single Scattering Albedo	0.2	1	1	0.5	0.5	1	0.8	1	1	1	0.5	0.5
Aerosol Refractive Index	0.2	1	1	0.5	0.5	1	1	1	1	1	0.3	0.3
Aerosol Particle Size	0.2	1	1	0.7	0.7	1	0.8	1	1	1	0.3	0.3
Aerosol Particle Shape	0.2	1	1	0.5	0.5	1	1	1	1	1	0.3	0.3
Speciated PM2.5	1	1	1	1	1	1	0.8	1	1	1	0.8	0.8
Total PM2.5	1	1	1	1	1	1	0.8	1	1	1	1	1
Speciated PM10	1	1	1	1	1	1	1	1	1	1	0.8	0.8
Total PM10	1	1	1	1	1	1	1	1	1	1	1	1
Volcanic Ash	1	1	1	1	1	1	0.8	1	1	1	1	1

Sources of Air Quality Monitoring and Forecasting Observational Needs:

The Core-SAT team, composed of federal employees from NOAA (including representatives from the NWS, NOAA OSAAP Analysis Team, and the NOAA LEO and GEO Programs), reviewed the air quality monitoring and forecasting observational needs by assessing the users' needs as developed by the SAT air quality subgroup, but also with the findings from other sources including:

- "A Value Assessment of an Atmospheric Composition Capability on the NOAA Next-Generation Geostationary and Extended Orbits (GEO-XO) Missions." DOI: https://doi.org/10.25923/1s4s-t405, https://repository.library.noaa.gov/view/noaa/27224
- "Chemical data assimilation estimates of continental U.S. ozone and nitrogen budgets during the Intercontinental Chemical Transport Experiment–North America." DOI: https://doi.org/10.1029/2006JD007722
- "A revised linear ozone photochemistry parameterization for use in transport and general circulation models: multi-annual simulations." DOI: https://doi.org/10.5194/acp-7-2183-2007
- "Tropospheric chemistry in the Integrated Forecasting System of ECMWF." https://doi.org/10.5194/gmd-8-975-2015
- Community of Practice, product baseline, and user value chain coordination through the User Engagement Council
- "Global Atmospheric Composition Needs from Future Ultraviolet–Visible–Near-Infrared (UV–Vis–NIR) NOAA Satellite Instruments" https://journals.ametsoc.org/view/journals/bams/104/3/BAMS-D-22-0266.1.xml

All these user needs were incorporated into this document, using a prioritized, vetted list of variables, with an agreed upon format (e.g., choice of units, etc.). This will allow for a better understanding of the overall needs for the air quality monitoring and forecasting application, a streamlining of the process to collect observational needs, and minimizing the outreach to users. The requirements' ranges, and their associated priorities, will also serve as an input to the ASPEN tool, which is used to assess potential future architecture solutions and their abilities to meet users' needs.

Important note: This memo was developed by the Subcommittee and approved after deliberations and discussions among the core-SAT, which consist of federal employees only. These recommendations were made following extensive scientific fact-finding, review of the scientific literature, and SAT discussions with scientific experts and others knowledgeable in the field.

List of Contributors to Observational Needs

Subcommittee for Atmospheric Composition:

Stacy Bunin (Riverside Technology, Inc. supporting NESDIS/STAR)
Lawrence Flynn (NESDIS/STAR)
Gregory Frost (OAR/CSL)
Shobha Kondragunta (NESDIS/STAR)
Monika Kopacz (OAR/CPO)
R. Bradley Pierce (University of Wisconsin)

Review Panel:

Ivanka Stajner (NWS/EMC)
Barry Baker (OAR/ARL)
Daniel Tong (George Mason University)
Arlyn Andrews (OAR/GML)
Lori Bruhwiler (OAR/GML)
Andrew Jacobson (CIRES at OAR/GML)
Irina Petropavlovskikh (CIRES at OAR/GML)
Karen Rosenlof (OAR/CSL), and
Sean Davis (OAR/CSL)

List of Acronyms

Abbreviation	Definition
ARL	Air Resources Laboratory
ASPEN	Advanced Systems Performance Evaluation tool for NOAA
BAMS	Bulletin of the American Meteorological Society
COURL	Consolidated Observational Users Requirements List
CPO	Climate Program Office
CSL	Chemical Sciences Laboratory
DAAS	Deputy Assistant Administrator for Systems
DoD	Department of Defense
ECMWF	European Centre for Medium-Range Weather Forecasts
EMC	Environmental Monitoring Center
EPA	[U.S.] Environmental Protection Agency
GEO	Geosynchronous Earth Orbit
GeoXO	Geostationary Extended Observations (Previously GEO-XO)
GML	Global Monitoring Laboratory
IR	Infrared
LEO	Low Earth Orbit
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OAR	Office of Oceanic and Atmospheric Research
OBS	NWS Office of Observations
OSAAP	Office of System Architecture and Advanced Planning (NOAA/NESDIS)
OSCAR	Observing Systems Capability Analysis and Review tool
RAQMS	Real-time Air Quality Modeling System
SAT	System performance Assessment Team
STAR	Center for Satellite Applications and Research
SWO	Space Weather Office
TPIO	Technology, Planning and Integration for Observation
UV	Ultraviolet
Vis	Visible
WMO	World Meteorological Organization
XORWG	GeoXO Requirements Working Group