APPENDIX F. SATELLITE – BASED AIR QUALITY OBSERVING SYSTEMS[1]

Instrument	Satellite Platform[4]	Lead Agency	Initiated	Measurement Parameters[2]	Orbit & Horizontal Resolution	Location of Information and/or Data
OLS (Operational Linescan System)	DMSP satellites	DOD	1962?	Identify fires and smoke plumes	Polar Imagery only	http://www.af.mil/factsheets/factsheet.asp?fsID=94
BUV (Backscatter Ultraviolet Spectrometer)	Nimbus 4	NASA	1970-1980	O3, CO2, SO2	Sun synchronous	http://nssdc.gsfc.nasa.gov/database/MasterCatalog?sc=1970-025A
SBUV (Solar Backscatter Ultraviolet Spectrometer)	Nimbus 7	NASA	1978-1993	O3, SO2	Polar	http://jwocky.gsfc.nasa.gov/n7toms/nimbus7tech.html
TOMS (Total Ozone Mapping Spectrometer)	Nimbus 7 Meteor 3 Earth-Probe	NASA	1978-1993 1991-1994 1996-2005	O3, SO2, Aerosols	Polar ~100km^2	http://toms.gsfc.nasa.gov/fltmodel/spacecr.html
LIMS (Limb Infrared Monitor of the Stratosphere)	Nimbus 7	NASA	1978-1979	O3, HNO3, NO2,	Polar	http://toms.gsfc.nasa.gov/n7toms/nimbus7tech.html
ATMOS (Atmospheric Trace Molecule Spectroscopy)	Spacelab 3 ATLAS -- 1,2,3	NASA	1985, 1992, 1993, 1994	O3, CFCl3, CF2Cl2, ClONO2, HCl, HF, CO, CH4, HCN, HNO3, NO, NO2, N2O, N2O5, Aerosols		http://remus.jpl.nasa.gov/atmos/sl3.html
CLAES (Cryogenic Limb Array Etalon Spectrometer)	UARS	NASA	1991-1993	O3, CFCl3, CF2Cl2 ClONO2, CH4, HNO3, NO, NO2, N2O, N2O5, Aerosols		http://umpgal.gsfc.nasa.gov/
HALOE (Halogen Occultation Experiment)	UARS	NASA	1991-2005	O3, HCl, HF, CH4, NO, NO2, Aerosols		http://umpgal.gsfc.nasa.gov/
ISAMS (Improved Stratospheric and Mesospheric Sounder)	UARS	NASA	1991-1992	O3, CO, CH4, NO2, N2O, N2O5, Aerosols		http://umpgal.gsfc.nasa.gov/
MLS (Microwave Limb Sounder)	UARS	NASA	1991-1999	O3, ClO, CH3CN, HNO3, SO2		http://umpgal.gsfc.nasa.gov/
GOES Imager (Geostationary Operational Environmental Satellites)	GOES-10 GOES-12	NOAA	1994	Fire products for WF_ABBA (imagery) and GASP (aerosol optical depth)	Geostationary 4x4 km^2	http://www.nesdis.noaa.gov/sat-products.html
GOES Sounder (Geostationary Operational Environmental Satellites)	GOES-10 GOES-12	NOAA	1994	Total column O3	Geostationary	http://cimss.ssec.wisc.edu/goes/data.html
AVHRR[3] (Advanced Very High Resolution Radiometer)	NOAA-15 NOAA-16 NOAA-17 NOAA-18	NOAA	1998	Aerosol optical depth, particle size information and vegetation/drought index products related to air quality through fires	Polar ~1x1 km^2	http://noaasis.noaa.gov/NOAASIS/ml/avhrr.html
SBUV/2[3] (Solar Backscattered Ultraviolet Radiometer Model 2)	NOAA-16 NOAA-17 NOAA-18	NOAA	2000	Total and profile O3 from surface to top of atmosphere in ~5 km thick Umkehr layers	Polar	http://www.ozonelayer.noaa.gov/action/sbuv2.htm

APPENDIX F. SATELLITE – BASED AIR QUALITY OBSERVING SYSTEMS[1] (continued)

MOPITT (Measurement of Pollution in the Troposphere)	EOS Terra	NASA	1999	CO, CH4	Polar 22 x 22 km^2	http://www.eos.ucar.edu/mopitt/
MISR (Multi-angle Imaging SpectroRadiomenter)	EOS Terra	NASA	1999	Aerosol properties and plume height information near the vicinity of fires	Polar ~1x1 km^2	http://www-misr.jpl.nasa.gov/mission/introduction/welcome.html
MODIS (Moderate Resolution Imaging Spectroradiometer)	EOS Terra EOS Aqua[5]	NASA	1999 2002	O3, Aerosol optical depth, particle size information, fine particle fraction, and forest fires	Polar ~1x1 km^2	http://modarch.gsfc.nasa.gov/index.php
AIRS (Atmospheric Infrared Sounder)	EOS Aqua[5]	NASA	2002	Total column ozone, surface temperature, temperature and moisture vertical profiles, (plus under development are CO and CO2 total column, O3 vertical distribution, and CH4 distribution)	Polar 50km	http://airs.jpl.nasa.gov/
HIRDLS (High Resolution Dynamics Limb Sounder)	EOS Aura[5]	NASA	2004	O3, CFC11, CFC12, ClONO2, CH4, HNO3, NO2, N2O5, Aerosols	Polar	http://aura.gsfc.nasa.gov/index.html http://www.nasa.gov/mission_pages/aura/spacecraft/index.html
MLS (Microwave Limb Sounder)	EOS Aura[5]	NASA	2004	O3, BrO, ClO, HOCl, HCl, CO, HCN, CH3CN, HNO3, N2O, OH, HO2	Polar	http://aura.gsfc.nasa.gov/index.html http://www.nasa.gov/mission_pages/aura/spacecraft/index.html
OMI (Ozone Monitoring Instrument)	EOS Aura[5]	NASA	2004	O3, BrO, OClO, HCHO, NO2, SO2 and aerosols	Polar 48 x 48 km^2	http://aura.gsfc.nasa.gov/index.html http://www.nasa.gov/mission_pages/aura/spacecraft/index.html
TES (Total Emission Spectrometer)	EOS Aura[5]	NASA	2004	O3, CO, CH4, HNO3	Polar 26 x 42 km^2	http://aura.gsfc.nasa.gov/index.html http://www.nasa.gov/mission_pages/aura/spacecraft/index.html
CALIPSO (Cloud-Aerosol Lidar & Infrared Pathfinder Satellite Observations)	CALIPSO[5]	NASA	2005	Aerosol optical depth, backscatter, extinction	Polar 0.3 x 0.3 km^2	http://www-calipso.larc.nasa.gov/about/
OMPS (Ozone Mapping and Profiling Suite)	NPOESS - Preparatory Project	NOAA	To be launched 2010	Total column and vertical profile ozone data	Polar	http://www.ipo.noaa.gov/index.php?pg=proj
VIIRS (Visible Infrared Imaging Radiometer Suite)	NPOESS - Preparatory Project	NOAA	To be launched 2010	Aerosol optical depth	Polar	http://www.ipo.noaa.gov/index.php?pg=proj
Orbiting Carbon Observatory	OCO[5]	NASA	2009 (failed)	CO2	Polar	http://oco.jpl.nasa.gov/
APS & TIM (Aerosol Polarimetry Sensor & Total Irradiance Monitor)	Glory	NASA	2009 (planned)	Black carbon soot, other aerosols, total solar irradiance, cloud images	Sun- synchronous, circular, Low Earth Orbit	http://glory.gsfc.nasa.gov/

APPENDIX F. SATELLITE – BASED AIR QUALITY OBSERVING SYSTEMS[1] (continued)

SCIAMACHY (Scanning Imaging Absorption Spectrometer for Atmospheric Chartography)	Envisat	ESA	2002	Total column for O3, NO2, BrO, OClO, SO2, HCHO, aerosols	Polar 60 x 30 km^2	http://envisat.esa.int/instruments/sciamachy/
GOME & GOME-2 (Global Ozone Monitoring Experiment)	ERS-2 MetOp-A	ESA	1995 2006	Total column for O3, NO2, BrO, SO2, HCHO, aerosols	Polar 40 x 40 km^2	http://earth.esa.int/ers/gome/ http://www.esa.int/esaLP/SEMTTEG23IE_LPmetop_0.html
IASI (Infrared Atmospheric Sounding Interferometer)	MetOp-A	ESA	2006	O3, CO, CH4,	Polar 50 x 50 km^2	http://smsc.cnes.fr/IASI/index.htm

Footnotes:

1. Some instrument systems listed (e.g., UARS/HALOE) are oriented primarily to stratospheric measurements and may have limited application to the troposphere.
2. Note that many of the satellite instruments also have the capability to measure temperature, H_2O and other parameters.
3. NOAA satellites as early as 1978 have carried AVHRR, and as early as 1985 have carried BUV/2
4. CALIPSO -- Cloud-Aerosol Lidar & Infrared Pathfinder Satellite Observations
   DMSP -- Defense Meteorological Satellite Program
   EOS -- Earth Observing System
   ESA -- European Space Agency
   GOES -- Geostationary Operational Environmental Satellites
   NASA -- National Aeronautics and Space Administration
   NOAA -- National Oceanic and Atmospheric Administration
   NPOESS -- National Polar-orbiting Operational Environmental Satellite System
   OCO -- Orbiting Carbon Observatory
   UARS -- Upper Atmosphere Research Satellite
5. This satellite is part of the A-Train group of satellites. It will involve for the first time satellites flying in a formation that crosses the equator one satellite at a time, a few minutes apart, at around 1:30 pm local time. The A-Train is made up of Aqua, Aura, CALIPSO, and will include Glory in 2009; it also includes CloudSat (2005) – data on the structure of ice and water clouds, and PARASOL (2004) – data on the directional characteristics and polarization of light reflected by the Earth and atmosphere, including aerosol optical depth. Together their overlapping science instruments will give a comprehensive picture of Earth weather and climate.