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Catalogue of Environmental Satellites

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INTRODUCTION

Since the first environmental satellite, TIROS-1, was launched by the United States on April 1, 1960, the proliferation of satellites has been increasing dramatically. Their usefulness to weather forecasting has been demonstrated and are now a requirement in all forecast functions. These satellites serve as observers of the atmosphere and also communicators of meteorological data. The large number of environmental satellites that have been put into orbit by many countries have produced a world wide coverage of the atmosphere. Because of the large number of satellites involved, from time to time, a cataloguing of them is required in order to maximize their effectiveness and plan for the future. Such a catalogue, distinguishing between geostationary and polar orbiting satellites, has been prepared and is presented in this technical note. The span of time covered in the catalogue is from April 1, 1980 to August 1982. Available projections of future satellite programs have also been included.

ENVIRONMENTAL SATELLITE CATALOGUE

Figure 1 presents in schematic form the chronological evolution of polar orbiting and geostationary environmental satellites. Polar orbiting satellites presently used in the Atmospheric Environment Service forecast program are the NOAA-6 and NOAA-7. Geostationary satellites used are the GOES-4 (located at 135°W) and the GOES-5 (located at 75°E). The satellite providing coverage from 135°W longitude is commonly called GOES-W, where "W" is acronymic for west. Similarly, the satellite located at 75°E is called GOES-E.

The geostationary satellite providing coverage from 135°W longitude is highly important to the weather forecast operations at the Pacific Weather Centre (PWC). Figure 2 shows the area viewed by GOES-W.

The replacement of GOES-3 by GOES-4 in March 1981 was a significant improvement. GOES-3 with a Visible Infrared Spin Scanner Radiometre (VISSR) provided images in the visible and 11.5 micrometre infra-red. GOES-4 however, is equipped with a VISSR Atmospheric Sounder (VAS) which can provide multispectral imaging from 12 infra-red channels. Ultimately this should provide vertical sounding information of temperature and water vapour content. GOES-4 currently provides the PWC

with visible, 11.5 micrometre, and 6.7 micrometre images. The images from the 6.7 micrometre atmospheric water vapour absorption channel supply valuable information about the distribution of upper troposphere water vapour.

Appendix A (Polar Orbiting Satellites) and Appendix B (Geostationary Satellites) supplement the information provided in Figure 1 by detailing the description of the satellites' purpose, length of operation, country of origin, and any other relevant information. Appendix C provides definitions for the satellite acronyms used in this note.

SUMMARY REMARKS

Although the first environmental satellite was launched in 1960, the operational forecast use of these satellites did not begin until 1967 with ESSA II. The catalogue provided in this technical note shows the growth in the number and type of satellites as well as the number of countries providing these non-terrestrial observing platforms.

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Figure 1 Environmental satellites from the first in April 1960 to the present (August 1982) and projected future satellites through 1990.

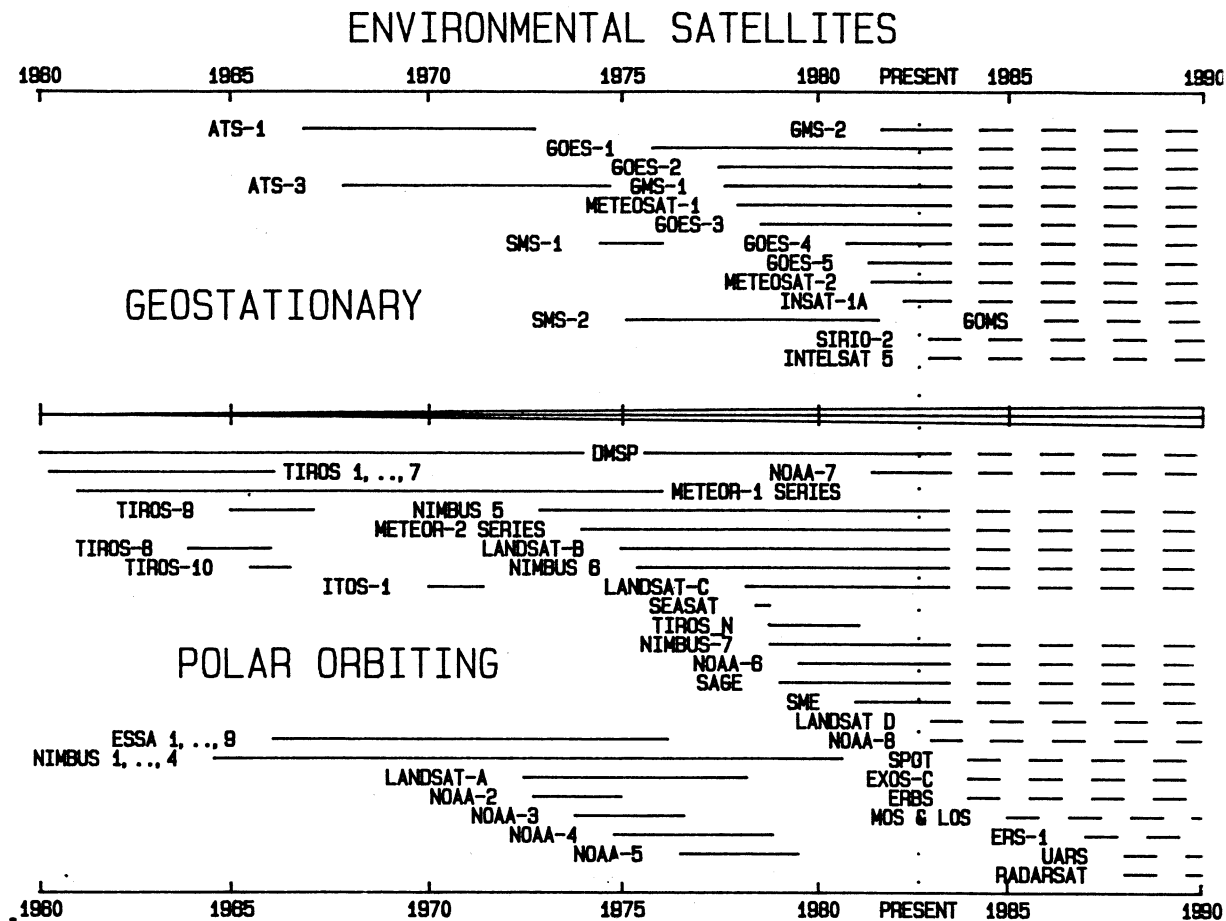
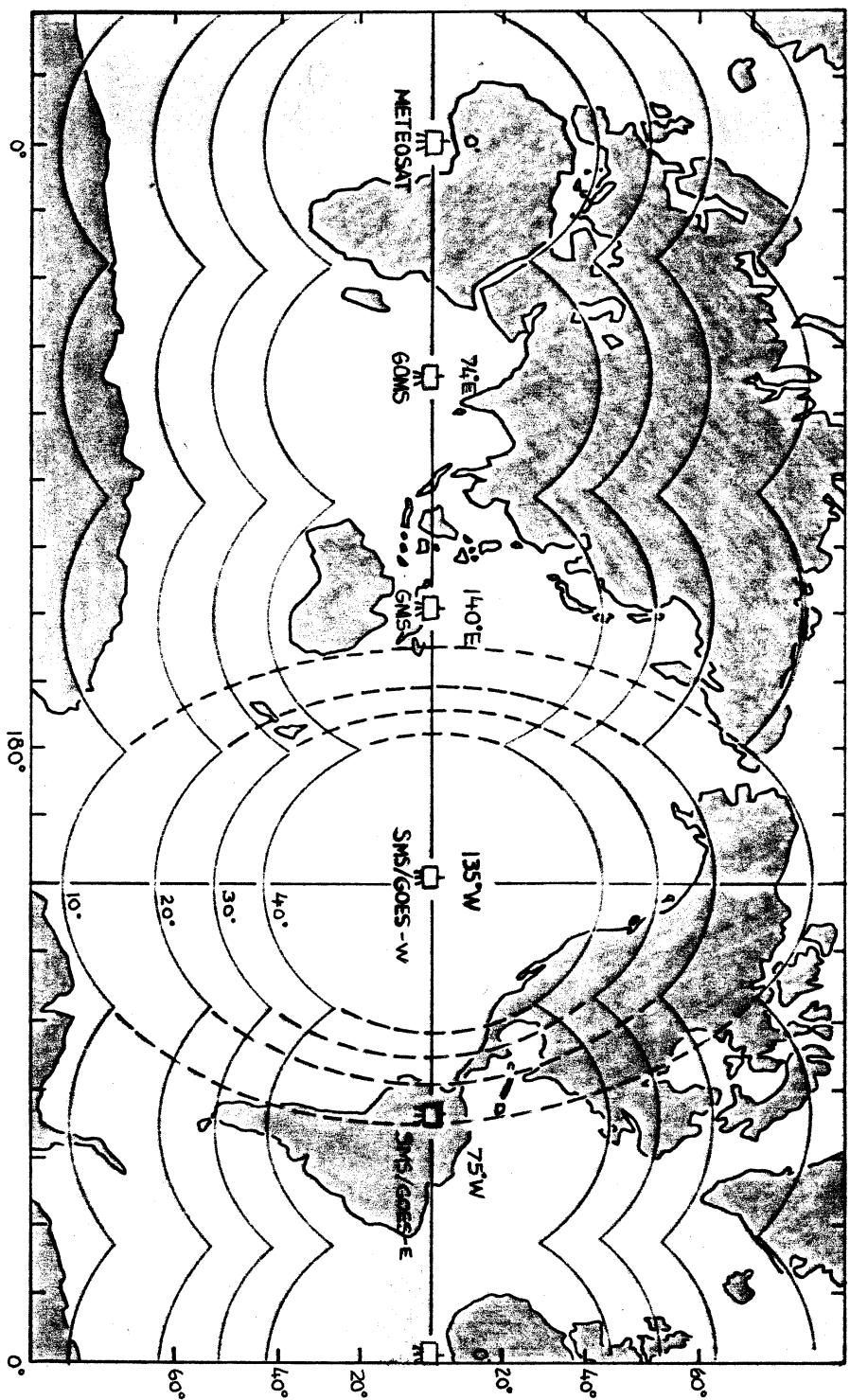


FIGURE 2.

GLOBAL COVERAGE BY WORLD METEOROLOGICAL GEOSTATIONARY SATELLITES



APPENDIX A

POLAR ORBITING ENVIRONMENTAL SATELLITES

<u>SATELLITE</u>	<u>PURPOSE</u>	<u>OPERATION</u>	<u>COUNTRY</u>	<u>REMARKS</u>
TIROS-1,2,...,7	R	04/60, 02/66	U.S.A.	First weather satellites providing cloud cover photography.
TIROS-8	R	12/63, 01/66	U.S.A.	First ATP satellite.
ARIEL-2	R	1964,?	U.S./U.K.	Carried experiments to study dust and ozone.
NIMBUS-1,...,4	R	08/64, 09/80	NASA, U.S.A.	Testing of instruments and sensors now in regular use: APT, AVCS, and HRR.
TIROS-9	R	01/65, 02/67	U.S.A.	First TIROS satellite in sun-synchronous orbits.
TIROS-10	O	07/65, 07/66	U.S.A.	
ESSA-1,2,...,9	O	02/66, 03/76	U.S.A.	First operational satellites and last APT satellites. Carried AVCS cameras.
METEOR-1 series	O	60's, mid 70's	U.S.S.R.	IR and VIS imagery.
DMSP	R	-, -	U.S. Air Force	IR and VIS imagery, VIS imagery by moonlight at night, IR temperature sounder. Data transmissions in cipher.
ITOS-1	R/O	01/70, 06/71	U.S.A.	Second generation TIROS prototype.
NOAA-1 (ITOS-A)	O	12/70, 08/71	NOAA, U.S.A.	First NOAA funded ITOS satellite.
LANDSAT-A	R	07/72, 02/78	U.S.A.	High resolution (80 m) images of earth's surface using MSS.
NOAA-2 (ITOS-D)	O	10/72, 01/75	NOAA, U.S.A.	First operational satellite to carry all scanning radiometers.
NIMBUS-5	R	12/72, -	NASA	
GEOS-3	R	?	NASA, U.S.A.	Carried early version of SEASAT altimeter.
NOAA-3 (ITOS-F)	O	11/73, 08/76	NOAA, U.S.A.	First operational satellite broadcasting VTPR data.
METEOR-2 series	R/O	mid 70's	U.S.S.R.	IR and VIS images and simple IR temperature sounder. Low resolution versions are broadcast.
NOAA-4 (ITOS-G)	O	11/74, 11/78	NOAA, U.S.A.	Includes VTPR.
LANDSAT-B	R	01/75, -	U.S.A.	
NIMBUS-6	R	06/75, -	NASA	
NOAA-5 (ITOS-E2)	O	07/76, 07/79	NOAA, U.S.A.	
LANDSAT-C	R	03/78, -	U.S.A.	First Landsat with IR capability.
SEASAT	R	06/78, 10/78		Microwave techniques of measuring the ocean surface using SMMR. Electrical failure.
TIROS-N	R/O	10/78, 02/81	U.S.A.	First of third generation of polar orbiting satellites.
NIMBUS-7	R	10/78, -	NASA	Carried eight different experimental instruments including CZCS.
HCMM (AEM-A)	R	1978, 09/80	NASA, U.S.A.	Used to test methods of soil moisture measurement and snow mapping.
NOAA-6	O	06/79, -	NOAA, U.S.A.	First NOAA funded TIROS-N system satellite. Carries A/VHRR.
SAGE	R	02/79, -	NASA, U.S.A.	Measures profiles of aerosol, ozone, and nitrogen-dioxide in stratosphere.
NOAA-7	O	08/81	NOAA, U.S.A.	NOAA's primary polar orbiting satellite. Carries A/VHRR.
UOSAT-1	R	10/81, -	Britain	Britain's first amateur satellite.

APPENDIX A (cont.)

<u>SATELLITE</u>	<u>PURPOSE</u>	<u>OPERATION</u>	<u>COUNTRY</u>	<u>REMARKS</u>
SME	R	10/81, -	NASA, U.S.A.	Measures minor constituents and temperature in upper stratosphere and lower mesosphere.
LANDSAT-D	O	01/83	NOAA, U.S.A.	Will implement TM operations as well as MSS.
NOAA-8 (ATN)	O	1983	NOAA, U.S.A.	More instruments and power. Radiation fluxes, ozone, and improved microwave sounding.
SPOT	O	1984	France	20-10 m resolution imagery of earth's surface.
EXOS-C	R	1984	Japan	Research of minor constituents.
ERBS	R	1984	NASA, U.S.A.	Research of short/long wave radiation. Includes SAGE-II for aerosol and ozone.
MOS and LOS	R/O	1985	Japan	Monitors water content, sea surface temperature and colour, sea ice and IR, VIS imagery.
ERS-1	O	1987	E.S.A.	Ocean monitoring satellite. Payload includes SAR.
UARS	R	1988	NASA, U.S.A.	Comprehensive investigation of composition, dynamics, and energetics of atmosphere.
RADARSAT	O	1988	Canada	Principle payload is SAR. Monitors ice and oceans.

APPENDIX B

GEOSTATIONARY ENVIRONMENTAL SATELLITES

<u>SATELLITE</u>	<u>PURPOSE</u>	<u>OPERATION</u>	<u>COUNTRY</u>	<u>REMARKS</u>
ATS-1	R/O	12/66, 10/72	U.S.A.	First geostationary satellite with cloud cameras.
ATS-3	R/O	11/67, 9/74	U.S.A.	
SMS-1	R/O	6/74, 1/81	U.S.A.	Prototype for GOES. First geostationary satellite to be boosted up and out of orbit to alleviate cluttering at the geostationary altitude.
SMS-2	R/O	2/75, 8/81	U.S.A.	Prototype for GOES.
GOES-1	0, 127°E	10/75, -	NOAA, U.S.A.	IR and VIS imagery. First NOAA geostationary satellite.
GOES-2	0, 107°W	06/77, -	NOAA, U.S.A.	Full disc images every 30 minutes.
GMS-1	0, 140°E	07/77, -	Japan	Full disk images every 3 hours or less.
METEOSAT-1	0, 0°E	11/77, -	E.S.A.	
GOES-3	0, 90°W	06/78, -	NOAA, U.S.A.	
GOES-4	0, 135°W	09/80, -	NOAA, U.S.A.	First geostationary satellite to carry VISSR atmospheric sounder (VAS) for temperature and humidity.
GOES-5	0, 75°W	05/81, -	NOAA, U.S.A.	Also carries VAS.
METEOSAT-2	0, 0°E	06/81, -	E.S.A.	Similar imagery to GOES. Includes water vapour distribution in upper troposphere.
GMS-2 (HIMAWARI)	0, 140°E	09/81, -	NASDA, Japan	GMS-1 remains a spare.
INSAT-1A	0, 74°E	04/82, -	India	IR, VIS imagery, telecommunication and television.
GOMS	0, 70°E	?	U.S.S.R.	Promised, but not yet launched.
SIRIO-2	0, ?	1982	E.S.A.	Carries the MDD system for collecting and distributing meteorological messages between regional and national centres.
INTELSAT V	0, ?	1982	International	Used with other satellites for 2-way data transmission between ships and weather centres.
GMS-3	0, 140°E	1984	Japan	

APPENDIX C

SATELLITE ACRONYMS

APT	- Automatic Picture Transmission
ATN	- Advanced TIROS-N
ATS	- Applications Technology Satellites
AVCS	- Advanced Vidicon Camera System
A/VHRR	- Advanced Very High Resolution Radiometer
CZCS	- Coastal Zone Colour Scanner
DMSP	- Defence Meteorological Satellite Program
ERBS	- Earth Radiation Budget Satellite
E.S.A.	- European Space Agency
GEOS-3	- Geodynamics Experimental Ocean Satellite (Polar Orbitting)
GMS	- Geostationary Meteorological Satellite
GOES	- Geostationary Operational Environmental Satellite
GOMS	- Geostationary Operational Meteorological Satellite
HCMM	- Heat Capacity Mapping Mission
HRR	- High Resolution Radiometer
INSAT	- Indian National Satellite
ITOS	- Improved TIROS Operational Satellite
METEOSAT	- Meteorological Satellite (European)
MOS	- Marine Observation Satellite
MSS	- Multispectral Scanner System
NOAA	- National Oceanic and Atmospheric Administration
O	- Operational
R	- Research
SAGE	- Stratospheric Aerosol and Gas Experiment
SAR	- Synthetic Aperture Radar
SME	- Solar Mesosphere Explorer
SMMR	- Scanning Multichannel Microwave Radiometer
SMS	- Stationary Meteorological Satellite
TIROS	- Television Infrared Observational Satellite
TM	- Thematic Mapper
UARS	- Upper Atmosphere Research Satellite
VISSR	- Visible Infrared Spin-Scanner Radiometer
VTPR	- Vertical Temperature Profile Recorder