

Satellite Anomaly Information System (SIAS) for Identifying The Satellite Operation Disturbance

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Outline of Talk

- Introduction to LAPAN
- Satellite Development Programs in LAPAN
- Space Weather Research in LAPAN
- Satellite Anomaly Information System (SIAS)

A Brief Introduction of LAPAN

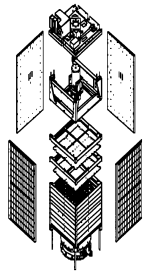


LAPAN stands for **L**embaga **P**enerbangan
Antariksa **N**asional (National Institute of
Aeronautics and Space)



LAPAN

- Indonesian government space agency
- It was established on November 27, 1964
- Responsible for long-term civilian and military aerospace research
 - ✓ Astronomy & Astrophysics
 - ✓ Atmospheric study
 - ✓ Rocket & Satellite
 - ✓ Space Weather
 - ✓ Weather & Climate
 - ✓ Space – and Ground – based Tech



SATELLITE DEVELOPMENT PROGRAMS



S
P
A
C
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C
R
A
F
T



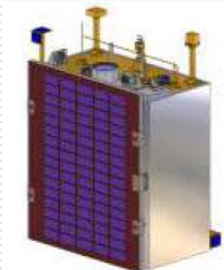
- Satellite Gen. I (LAPTUB/-A1)



- Launch LPN-A1
- CDR, PDR LAPAN-A2



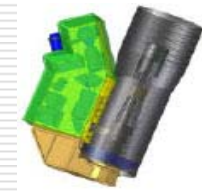
- Procurement & Component Test of LAPAN-A2



- Flight Model LAPAN-A2
- CDR LPN-B1



- Launch of LAPAN-A2
- Components proc. & Test of LPN-B1



- Comp. proc. LAPAN-B1

2006

2007

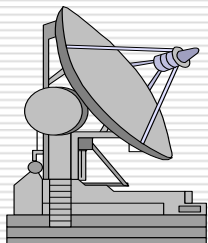
2008

2009

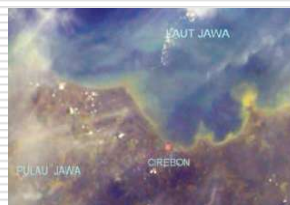
2010

G
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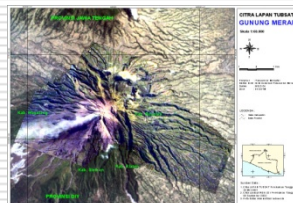
- LEOP & IOT LAPTUB/-A1 Preparation



- LEOP, IOT & Operation of LAPAN-A1



- Enhancement process of LPN-A1 Satellite Data



- LEOP & IOT LAPAN-A2 Preparation



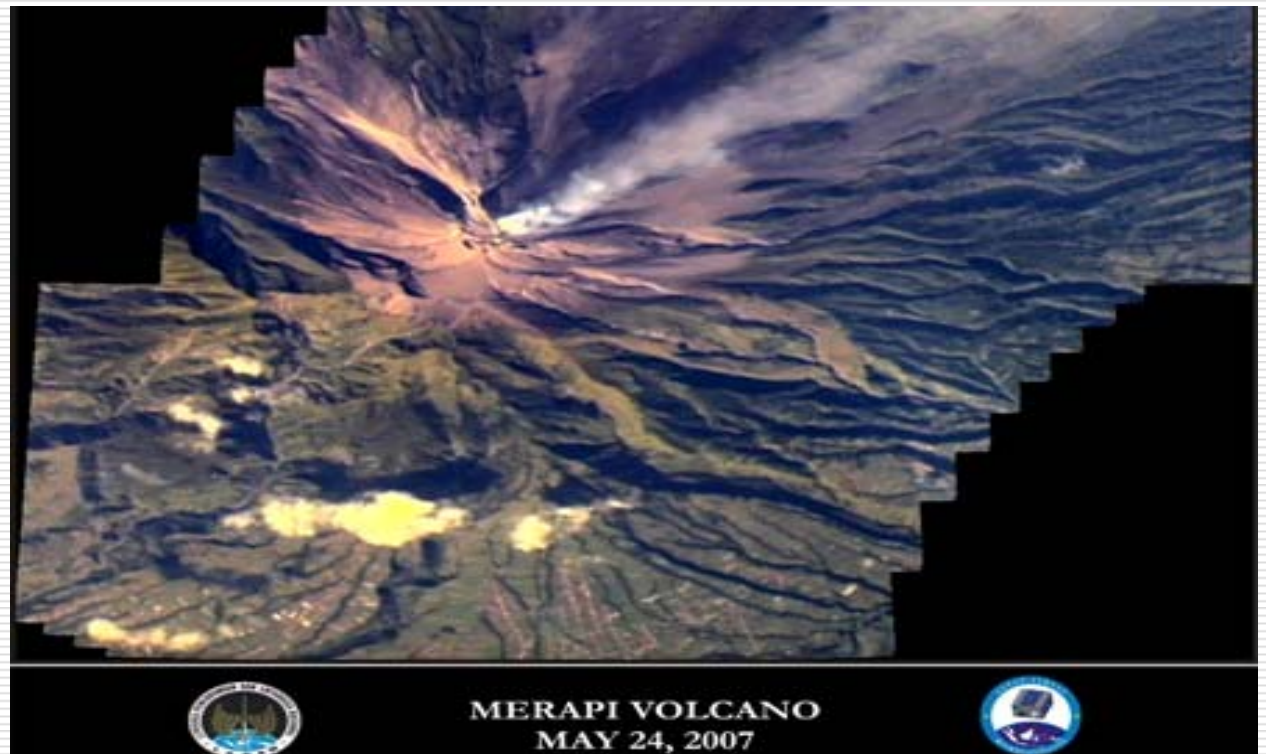
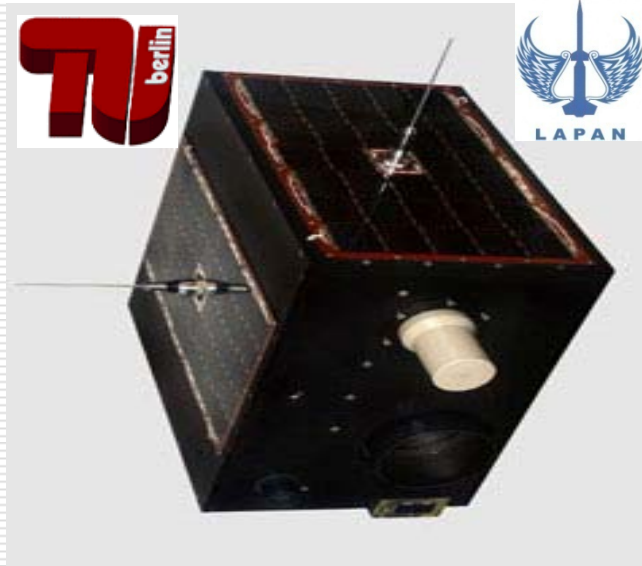
- LEOP, IOT & Operation of LAPAN-A2

Micro-satellite development for earth observation.

LAPAN-TUBSAT micro-satellite.

LAPAN TUBSAT is the first Indonesian micro satellite made by Indonesia through LAPAN in cooperation with Technische Universität (TU) Berlin, Germany.

Dimension approx 45 cm (l) x 45 cm (w) x 27 cm (h)
Weight nearly 57 kg. Polar LEO orbit at 630 km altitude, inclination at $97,6^{\circ}$.

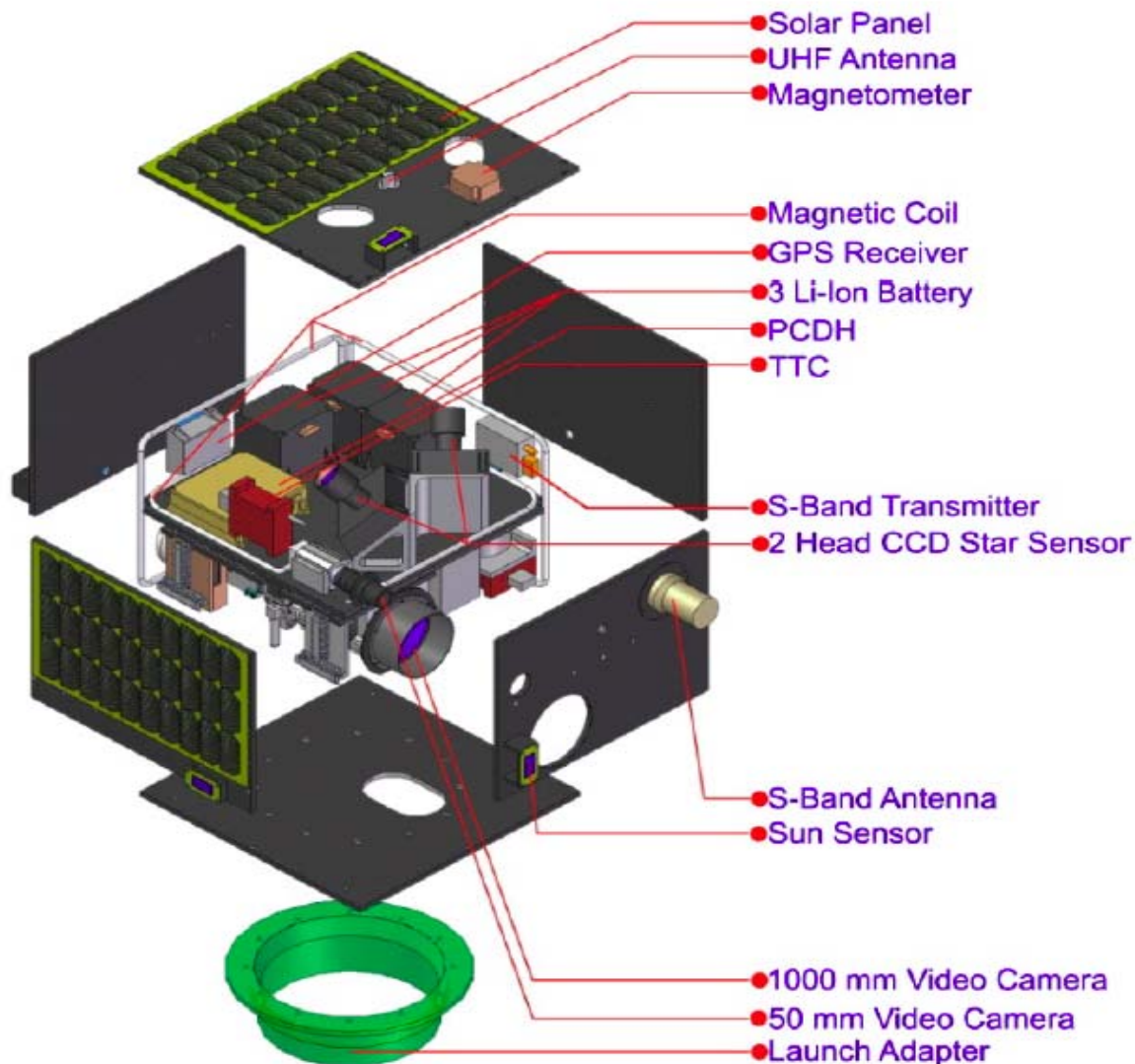


Exactly on 9.23 morning at
January 10th, 2007, PSLV C7
Lifted-off



MERAPI VOLCANO
MAY 24, 2007

LAPAN's next micro-satellite : Twin Satellites: LAPAN-A2 & LAPAN-ORARI



LAPAN-A2 and LAPAN-ORARI satellites developed based on the space proven LAPAN-TUBSAT satellite bus;

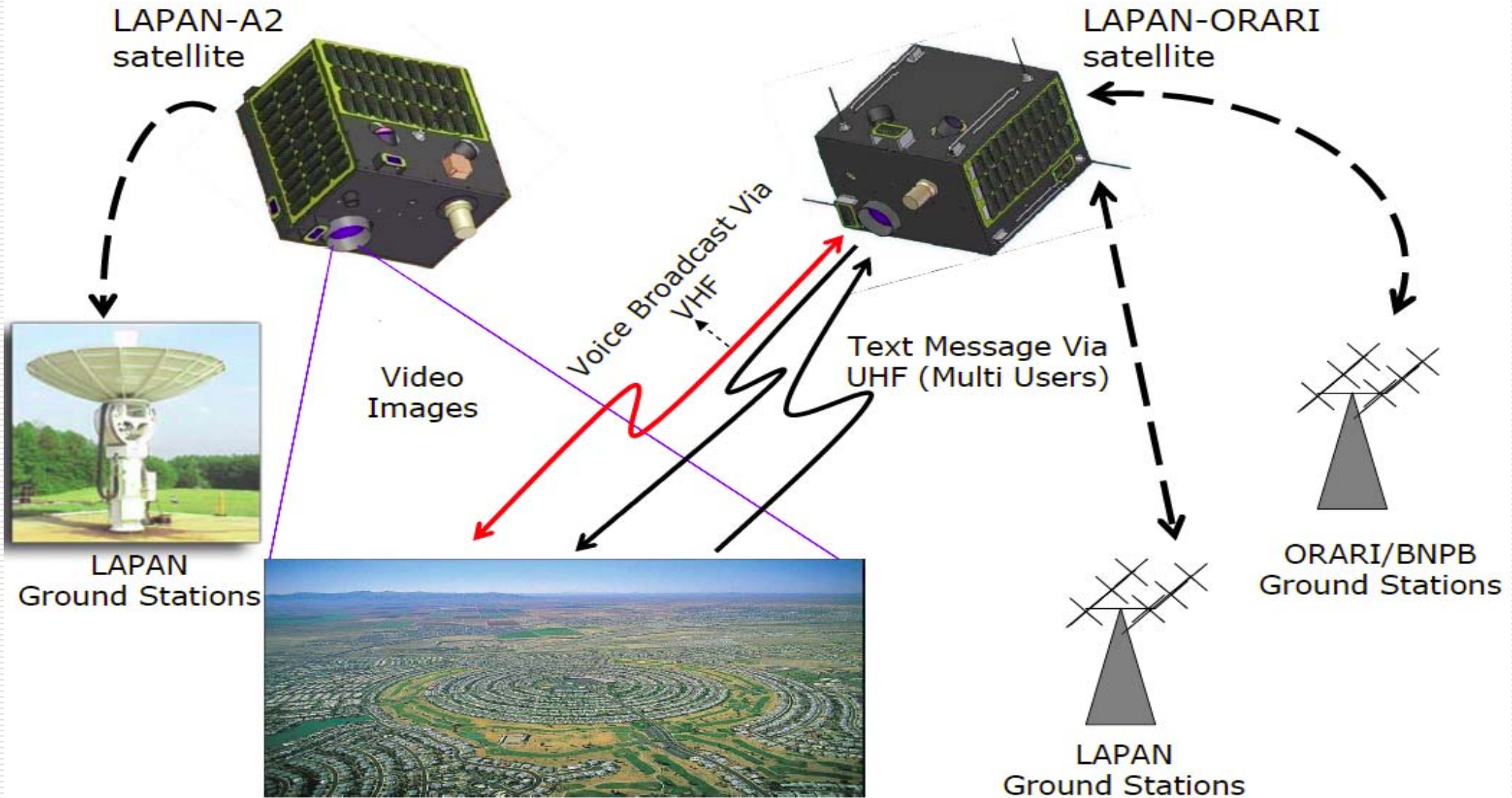
Both LAPAN-A2 and LAPAN-ORARI satellites are developed using same satellite bus and structure (twin satellites), with individual and complementary mission payloads.

LAPAN-A2 satellite payload:
HDTV color video camera;

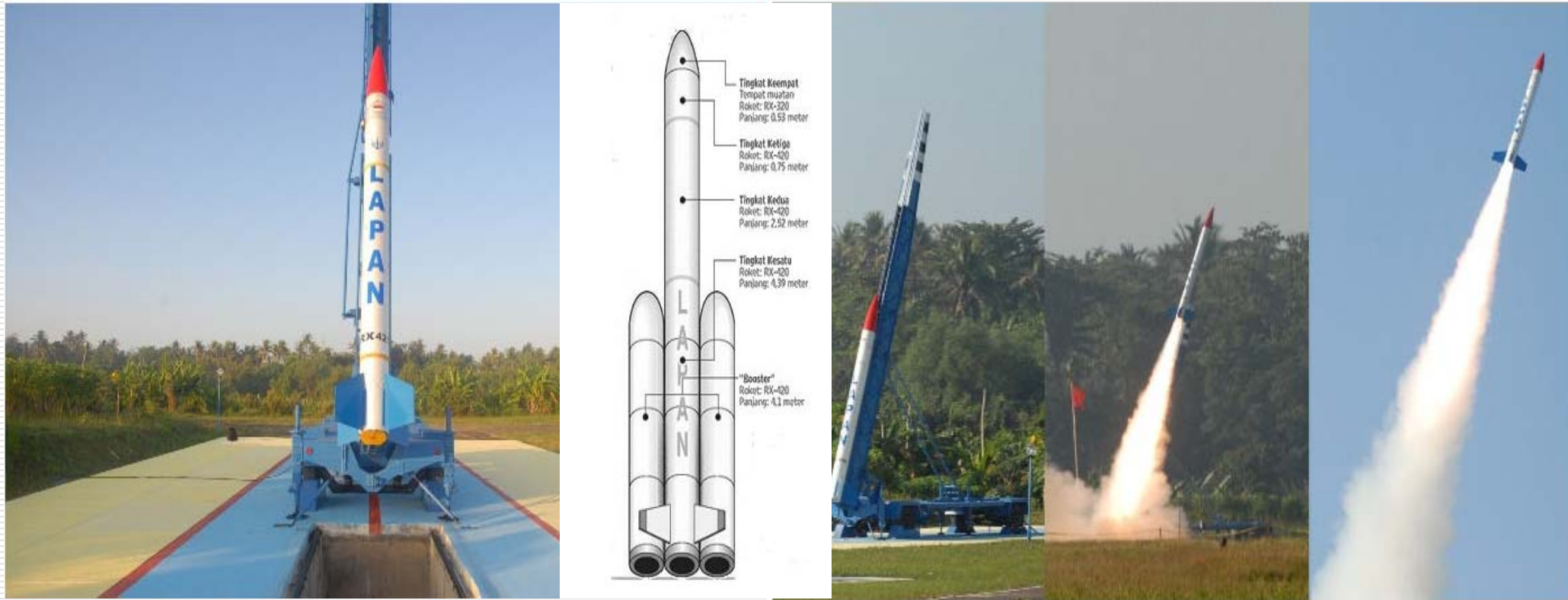
LAPAN-ORARI satellite payload:

1. 3-band multi-spectral imager
2. Amateur radio communication
 - Automatic Position Relay System (APRS);
 - Analog voice repeater.

Integrated Disaster Mitigation Monitoring with LAPAN Equatorial Orbit Satellites



Launcher Program

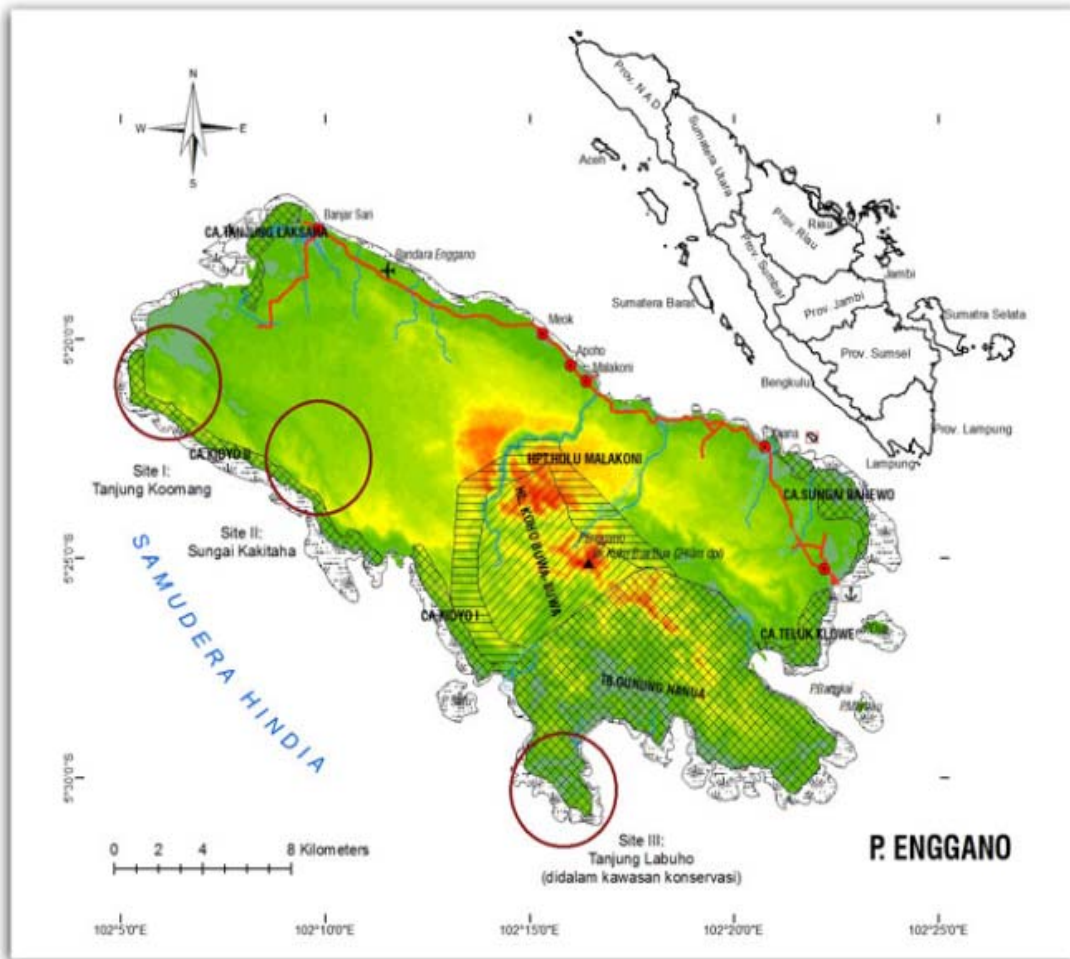


Roket Pengorbit Satelit (RPS) or Satellite Orbiting Rocket consists of four stages, namely the three-stage RX 420 and the RX-320 level. RX-420 plan will be the booster (rocket booster) RPS. It is expected to fly in 2014.

Launch Pad Development Program

ENGGANO

BIAK

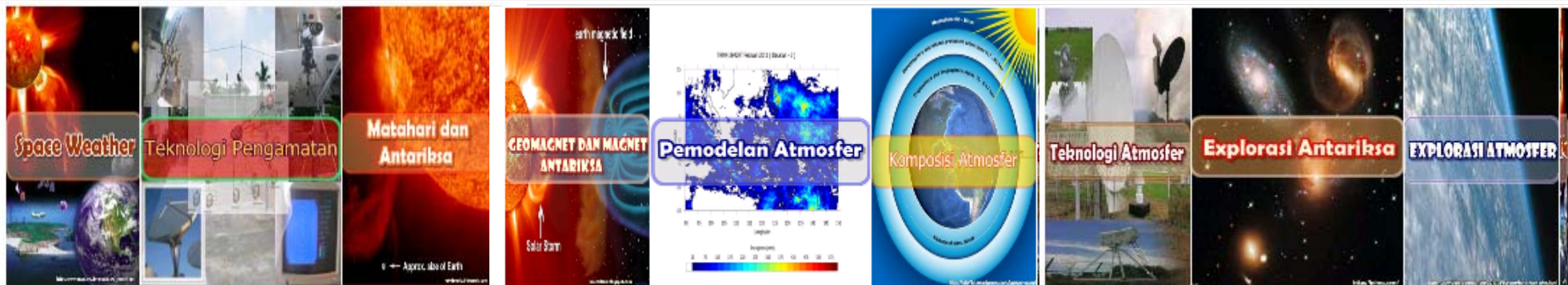


LEMBAGA PENERBANGAN DAN ANTARIKSA NASIONAL
DEPUTI BIDANG SAINS PENGKAJIAN
DAN INFORMASI KEDIRGANTARAAN

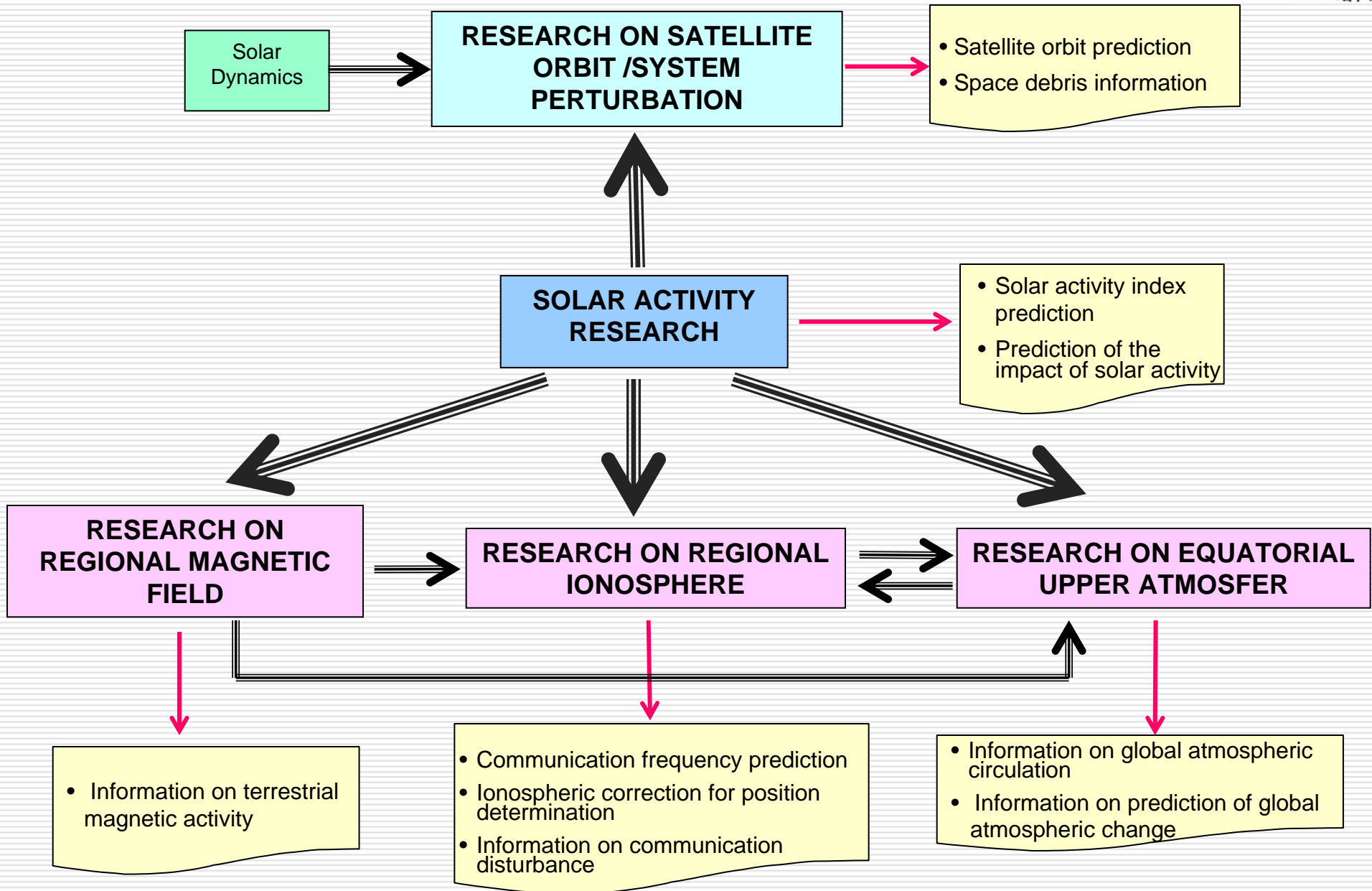
HOME
WEBMAIL
WEBMASTER



Space Weather Program

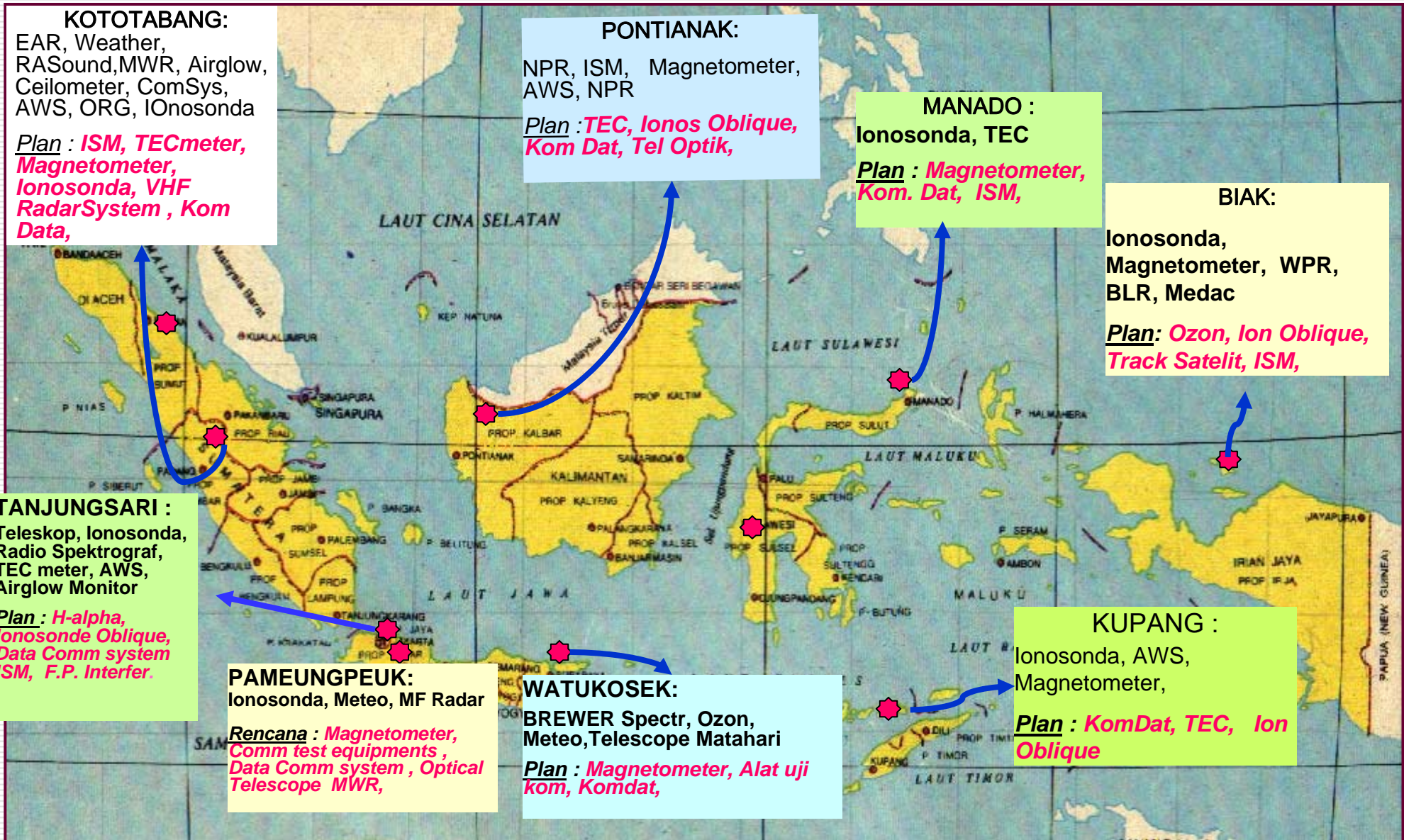


INTEGRATION of SW PROGRAMS



INSTRUMENTATION NETWORK

(SOLAR & SPACE DYNAMICS AND ATMOSPHERIC OBSERVATION)



FACILITIES



H-ALPHA
SUNSP

Solar observation using Optical Teles
SPD Tanjungsiari and Watukose



FLUXGATE
MAGNETOMETER



PERALATAN IONOSON
DAN HASIL REKAM



OBSERVASI SATELIT PEMERIKSAAN DATA TEC/NUMBER

EQUATORIAL ATMOSPHERIC RADAR

Observations of *Total Electron Content (TEC)* at Bandung, Tanjungsari, Pameungpeuk, Biak, Pontianak, Manado and Kupang stations.

ANTENNA MF RADAR
SPD PONTIANAK

KOTOTABANG OBSERVATORY



Tanjungsari
stations



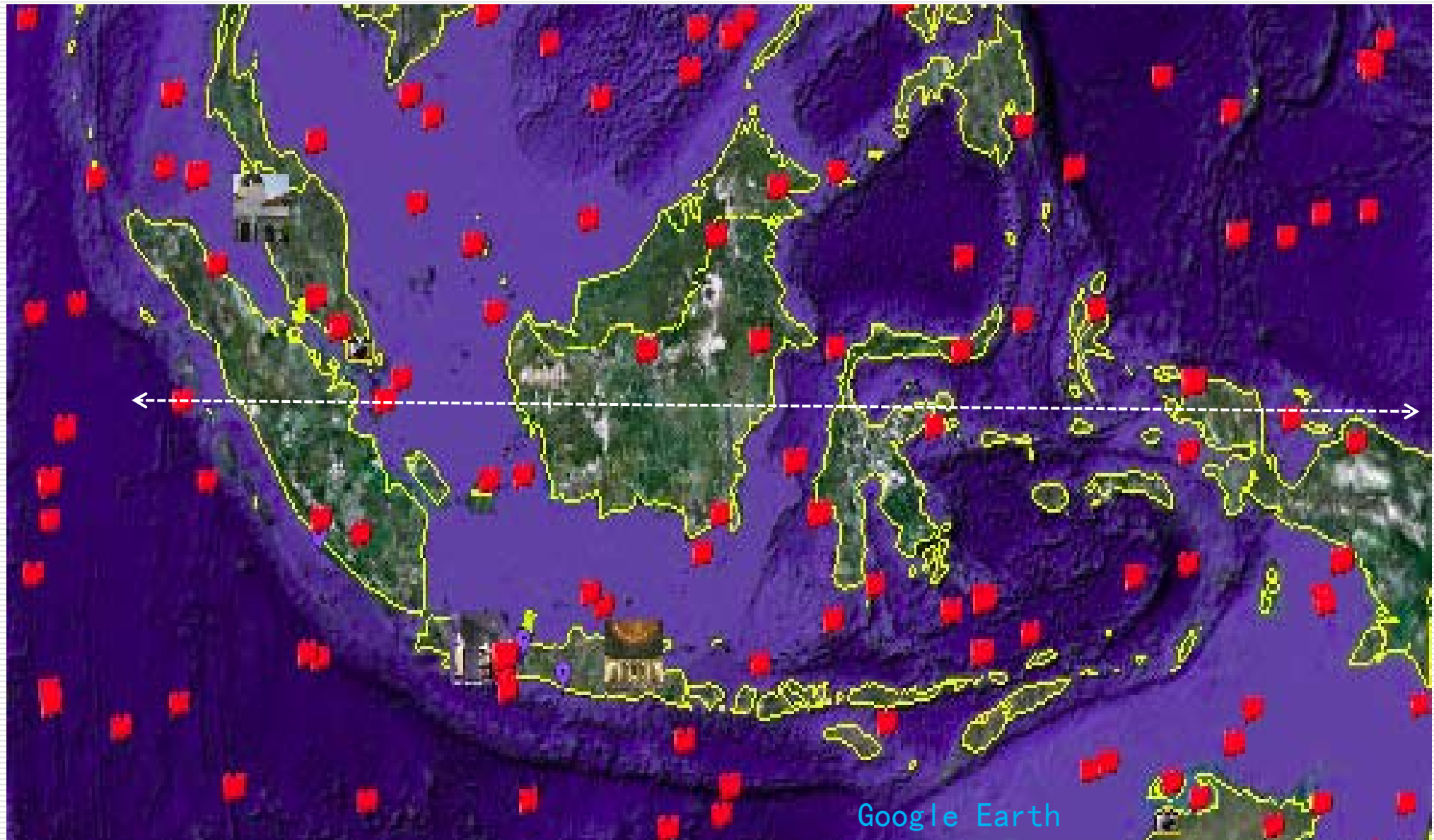
BALOON LAUNCHING
OZON MONITORING



SOLAR TELESCOPE



Space Debris Monitoring



Space Debris Monitoring (cont.)

PECAHAN ROKET CZ-3A RRC

PENEMUAN
Lokasi : Kebun Karet, Desa Bukit Harapan IV, Kecamatan Ketahun, Kabupaten Bengkulu Utara.
 Koordinat: 3°16'3.3" LS, 101°54'3.8" BT di ketinggian 40 meter dpl
Penemu : A. Budi Mashudi, petani setempat
Waktu penemuan : 14 Oktober 2003 pagi. Sore hari sebelumnya, 13 Oktober 2003 terdengar ledakan di arah barat laut yang menimbulkan getaran seperti gempa.
Pelapor ke LAPAN : Sdr. Zaki, wartawan "Rakyat Bengkulu" (17 Oktober 2003)
Analisis Orbit : Peneliti Matahari dan Antariksa LAPAN

HASIL ANALISIS ORBIT



Objek benda jatuh: Pecahan roket CZ-3 (Chang Cheng/Long March 3) milik RRC
Nomor katalog benda antariksa: 23416. **Kode internasional**: 1994-080B. **Peluncuran**: 16:23:00 WIB
Orbit sebelum jatuh: inklinasi 27,4°, ketinggian 136 – 853 km.
Fungsi Roket: meluncurkan satelit komunikasi DHF-3.
Perkiraan radar ukuran asal sebelum pecah: 23,9 m².
Perkiraan jatuh oleh Space Control Center: 13 Oktober 2003, antara pukul 16:23 (Arahan jatuh) dan 16:36 WIB
Dari analisis orbit disimpulkan benda tersebut jatuh di Bengkulu pada 13 Oktober 2003

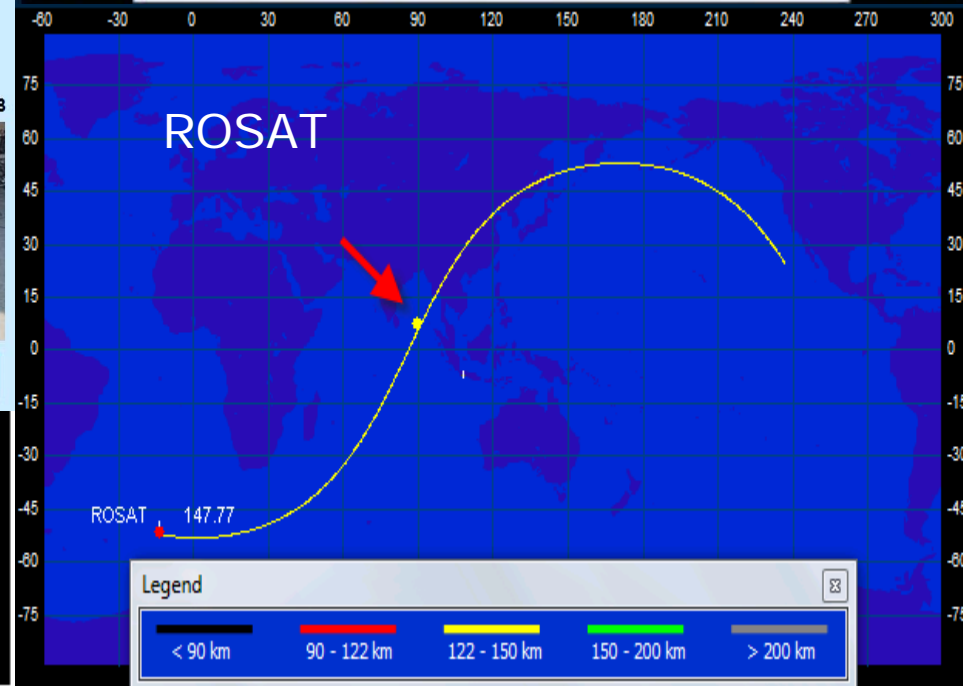
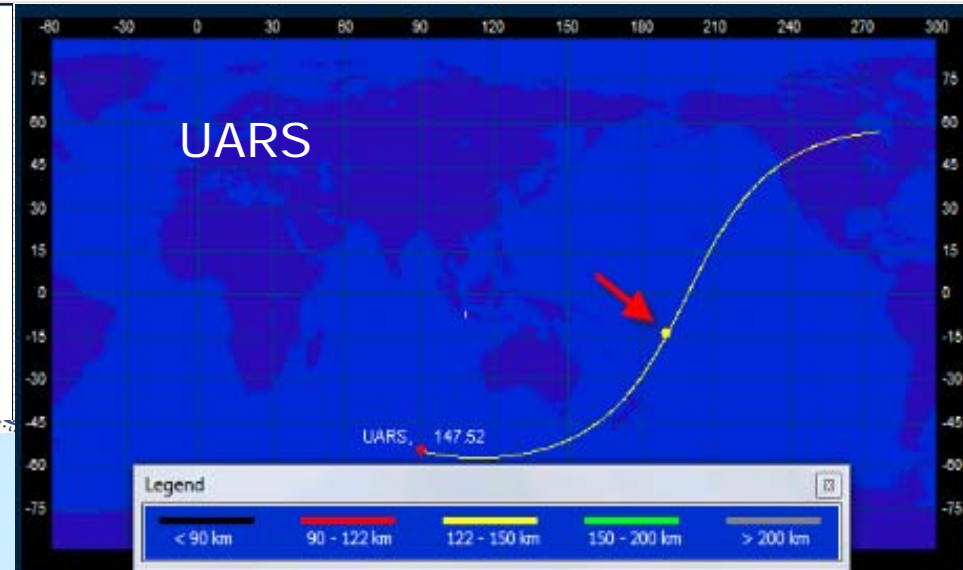
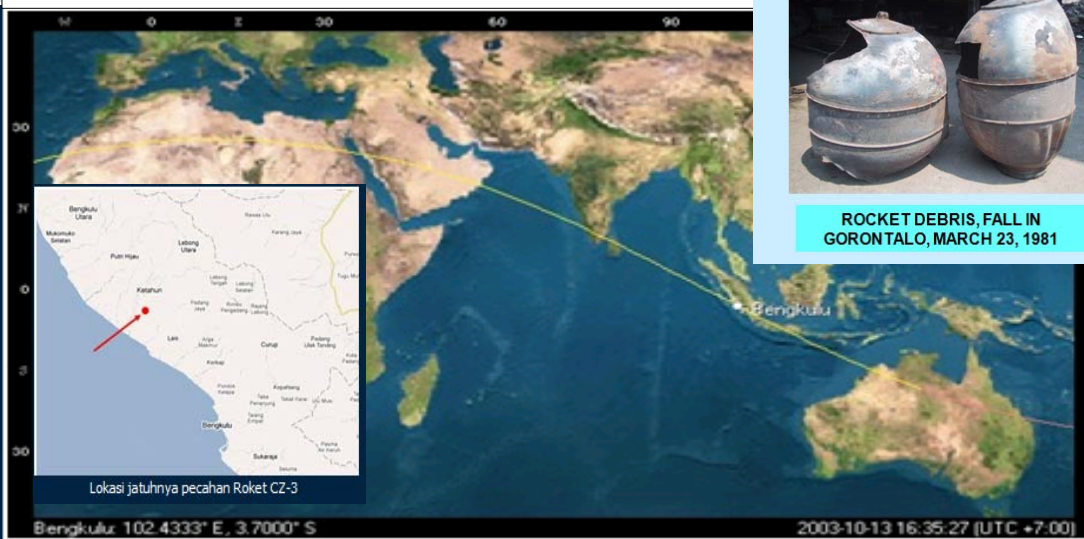
Informasi ini dibuat oleh Pusat Pemantauan Sains Antariksa, Lembaga Penelitian dan Diklat, Institut Teknologi Sepuluh Nopember, Bandung 40173, Indonesia



SATELLITE DEBRIS, FALL IN BENGKULU OCT. 13, 2003, 16:36 WIB



ROCKET DEBRIS, FALL IN GORONTALO, MARCH 23, 1981



Space Asset Protection

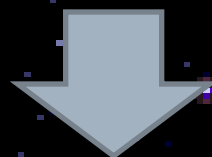
A Question for Us...



If there's something wrong with your S/C and you couldn't access data for several weeks or months.



S/C was in good condition
(launched and operated)

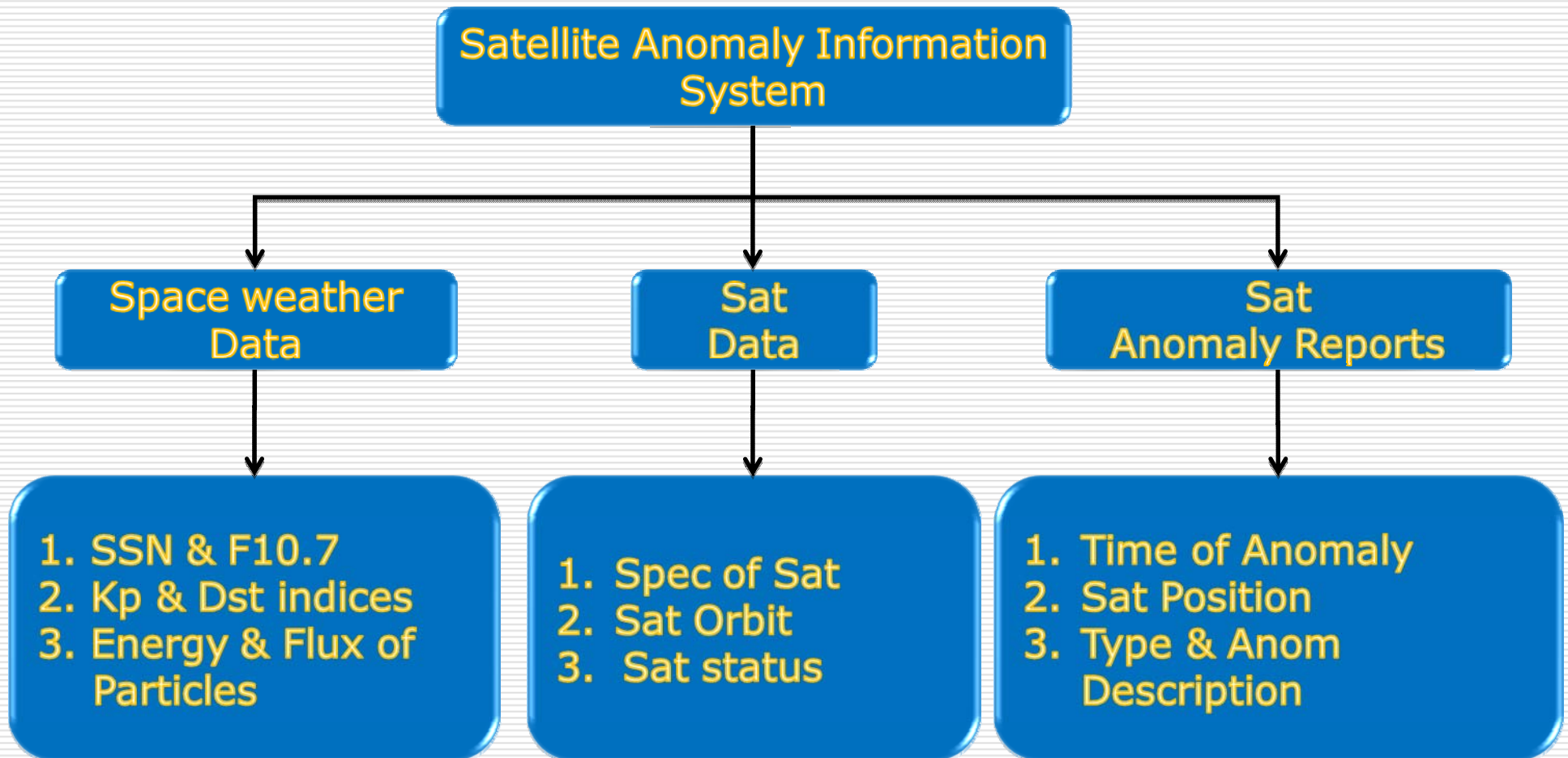


Don't you want to know what happened with S/C?

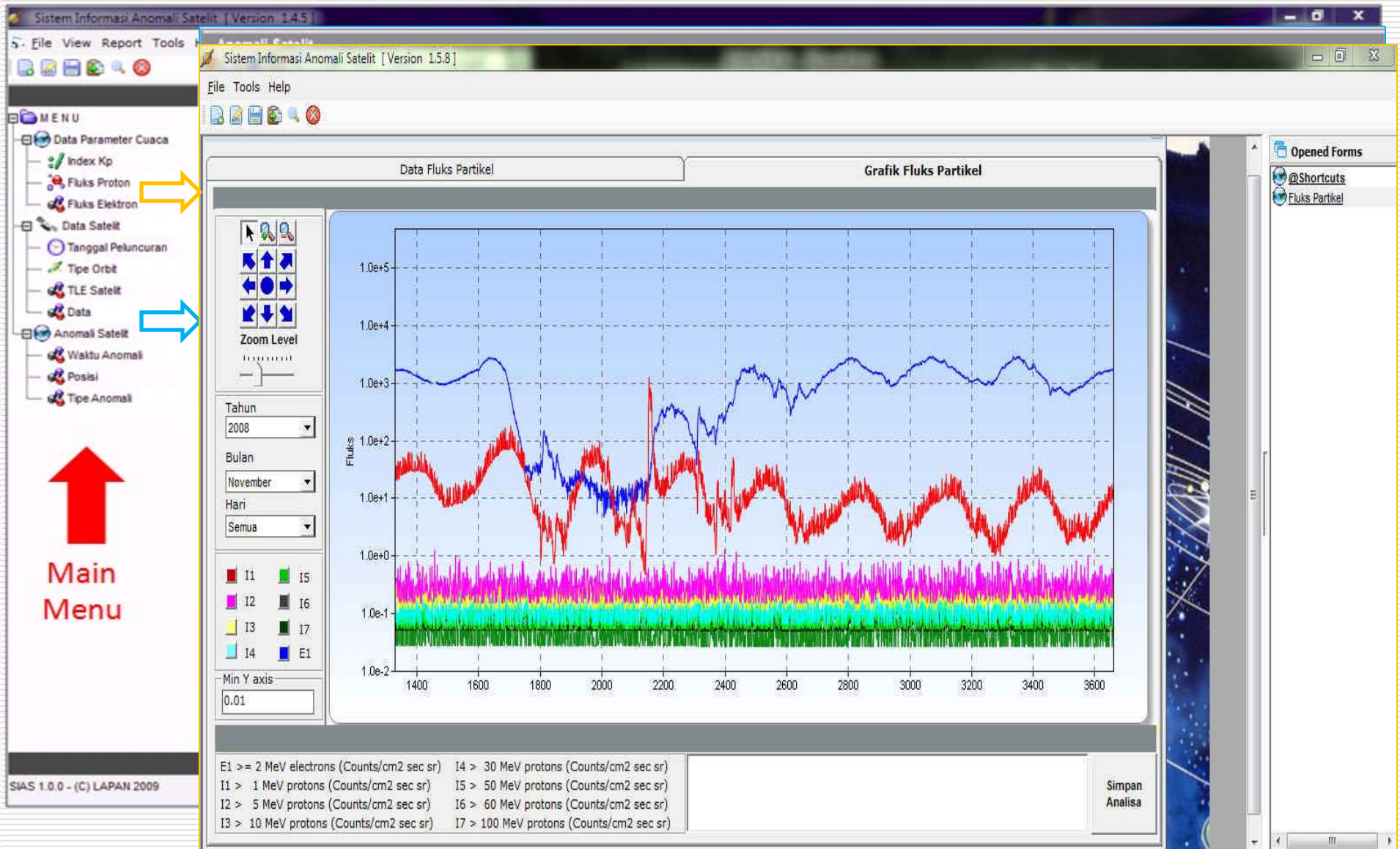
Then What will you do ?

What do we need?

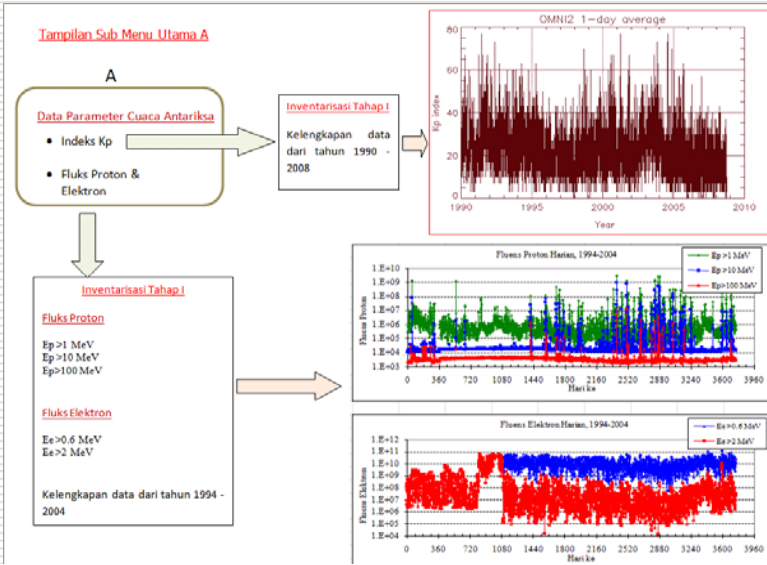
Satellite Anomaly Information System (SIAS)



Satellite Anomaly Information System (SIAS)



SIAS TOOLS



Data Satelit

- Tanggal Peluncuran, Akhir beroperasi (bagi satelit yg telah tidak beroperasi [g])
- Tipe Orbit (based on altitude)
 - LEO
 - GEO
- TLE Satelit
 - Recently (data)
 - Plot Ketinggian, Inklinsi, bujur Sat selama beroperasi

Inventarisasi Tahap I

Kelengkapan data peluncuran satelit dari tahun 1981 - 2000 meliputi satelit-satelit pada ketinggian Leo dan GSO.

Contoh Data TLE terbaru Satelit Anik E2 (27 Okt 2008)

ANIK E2

```

1 21222Z 91026A 08298.56731085 -.00000055 +00000.0 +10000
2 21222Z 005.1910 072.7702 0009283 198.6849 161.3516 00.99130
    
```

Contoh Data Orbit Satelit

Nama Satelit	Negara	Peluncuran	Decay	Orbit	
				Periode (Menit)	Inklinsi (deg)
Anik E2	Kanada	4-4-1991	-	1452.74	5.04
Amara 2	USA	29-5-1991	-	1454.4	6.91
Landas 5	USA	1-3-1984	-	98.82	98.14
Clementine	Perancis	3-12-1999	-	96.94	98.18
Solar A	Jepang	30-8-1991	12-9-2005	87.67	31.29
STEP 2	USA	19-5-1994	-	98.07	81.95
TELSTAR 402	USA	9-9-1994	14-11-2004	106.03	7.08
TOMS EP	USA	2-7-1996	-	99.16	98.07
HOTBIRD 2	Europa	21-11-1996	-	1436.05	0.04
EARLY BIRD	USA	24-12-1997	27-7-2000	87.25	97.2
INTESAT 801	ITSO	1-3-1997	-	1436.12	0.04
IRIDIUM 5	USA	5-5-1997	-	100.4	86.39
IRIDIUM 11	USA	19-12-1998	-	98.97	86.52
IRIDIUM 27	USA	14-9-1997	1-2-2002	87.38	86.58
IRIDIUM 42	USA	8-12-1997	-	100.4	86.39
SSTLEWIS	USA	23-8-1997	28-8-1997	87.07	97.54
GALAXY 4	USA	25-6-1993	-	1436.01	8.88
GFO	USA	10-2-1998	-	100.59	108.06
GOES 9	USA	23-5-1995	-	1457.5	4.61
TEKREERS	USA	18-5-1999	-	94.5	97.26
HST	USA	24-4-1990	-	95.97	28.47
IMAGE	USA	25-3-2000	-	85.92	91.73
GALAXY 8	USA	8-12-1997	-	1444.39	5.52
ECHOSTARS	USA	23-9-1999	-	1436.06	0.03

Masukan: Tren anomali Orbit satelit

Jumlah: 180 Bulan: Semua

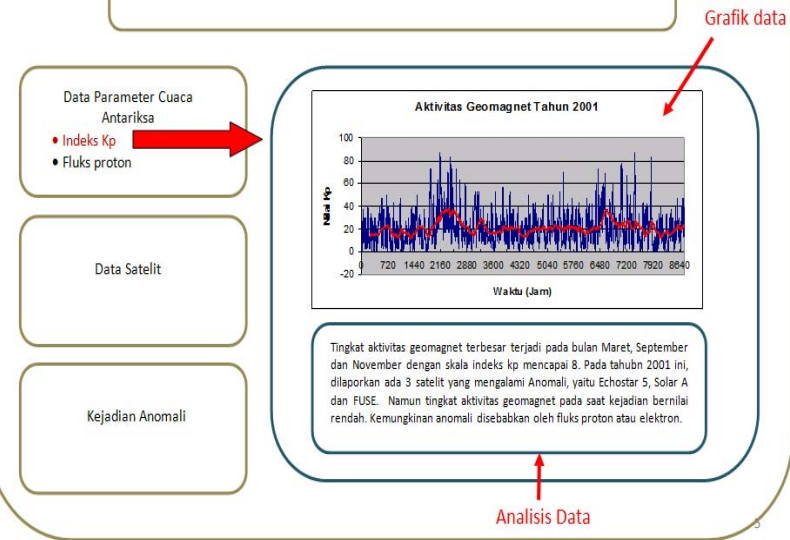
ADATE	STIMEL	ATYPE	ADIAG	ACOMMENT
1/27/1982	2252	PC	ESD	1 SWITCHING PARAMETER
2/1/1982		UNK	UNK	[MESH] Solar Array Drive Rotation Difficulty (SYSTEM: E
2/1/1982		UNK	UNK	[MESH] Altitude Control Subsystem & Elec Pwr Sys ESD
2/2/1982	0308	PC	ESD	1 SWITCHING PARAMETER
2/4/1982	0025	PC	ESD	2 SWITCHING PARAMETERS
2/4/1982	0100	PC	ESD	1 SWITCHING PARAMETER
2/4/1982	0137	PC	ESD	1 SWITCHING PARAMETER
2/4/1982	0215	PC	ESD	1 SWITCHING PARAMETER
2/4/1982	0324	PC	ESD	1 SWITCHING PARAMETER
2/4/1982	0601	PC	ESD	1 SWITCHING PARAMETER
2/4/1982	2148	PC	ESD	2 SWITCHING PARAMETERS
2/4/1982	2201	PC	ESD	1 SWITCHING PARAMETER

Tipe distribusi: Bulanan Waktu lokal

Diagnosis anomali: Semua RFI ESD ECEMP SEU UNK SDC

Bikin report

Sistem Informasi Gangguan Operasional Satelit



Kejadian Anomali

- Waktu Anomali
- Posisi (tinggi, lintang, bujur, inklinsi) saat anomali terjadi
- Tipe Anomali
 - Penyebab
 - Dampak
 - Deskripsi anomali

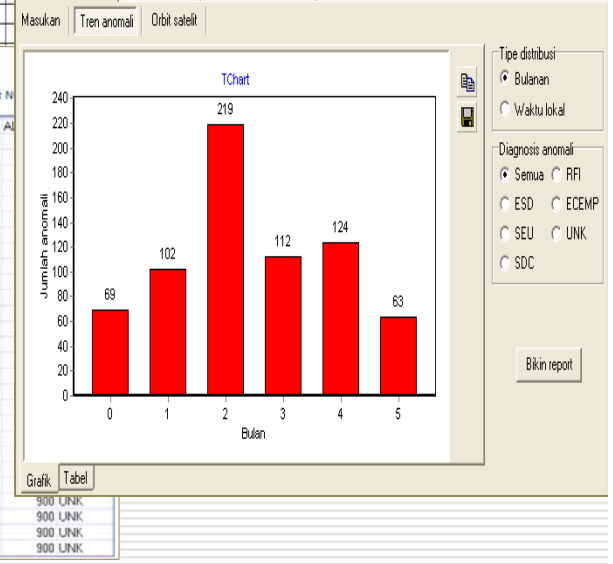
Inventarisasi Tahap I

Kelengkapan data anomali satelit dari tahun 1966-1992 meliputi satelit-satelit pada ketinggian LEO dan GSO.

NOAA 11 Anomaly

Contoh Data Anomali Satelit NOAA

BIRD	ADATE	LAT	LON	AL
NOAA-09	3/1/1989	0	0	0
NOAA-09	3/12/1989	0	0	0
NOAA-09	1/15/1990	0	0	0
NOAA-10	#####	0	0	0
NOAA-10	3/10/1989	0	0	0
NOAA-10	3/14/1989	0	0	0
NOAA-10	5/22/1989	51	27	
NOAA-10	10/1/1989	74	166	
NOAA-10	4/17/1990	75	170	
NOAA-11	9/27/1988	26	50	
NOAA-11	1/27/1989	48	281	
NOAA-11	3/7/1989	48	83	
NOAA-11	3/14/1989	0	0	
NOAA-11	3/16/1989	0	0	
NOAA-11	4/13/1989	53	128	
NOAA-11	6/13/1989	43	92	
NOAA-11	8/7/1989	52	130	
NOAA-11	9/5/1989	54	175	
NOAA-11	9/19/1989	2	78	
NOAA-11	9/27/1989	0	310	
NOAA-11	10/1/1989	0	0	
NOAA-11	1/15/1990	81	15	
NOAA-11	5/25/1990	53	158	
NOAA-11	7/19/1990	10	128	
NOAA-11	7/20/1990	43	126	
NOAA-11	7/28/1990	56	69	
NOAA-11	7/30/1990	60	46	



SIAS Application

LAPAN TUBSAT satellite experienced charging for the first time on September 7, 2007 that caused satellite operation disrupted for several days.

```

### LAPAN SERVER #####
9/7/2007 00:20:50 PCDH high level command : Radio Acknowledge OK
[ 0xB5 0xAB 0xEE 0x0A 0xFF 0xFF 0xFF 0xFF 0x00 0xEE 0xEE 0xEE 0xEE ]

PCU Telemetry

Switch Register           :          00111010 00000000 00010000 01000111
Status Fuse/TTC          :          01000111 00000011
System Time               :          1400458s = 16d 5h 0min 58sec

Solar Panel +X            :          14.5V    156mA
Solar Panel -X            :          14.5V     77mA
Solar Panel -Y            :          14.5V   666mA
Solar Panel -Z            :          14.5V   140mA
Sun Sensor +Y             :                   32mA
Sun Sensor +Z             :                   16mA

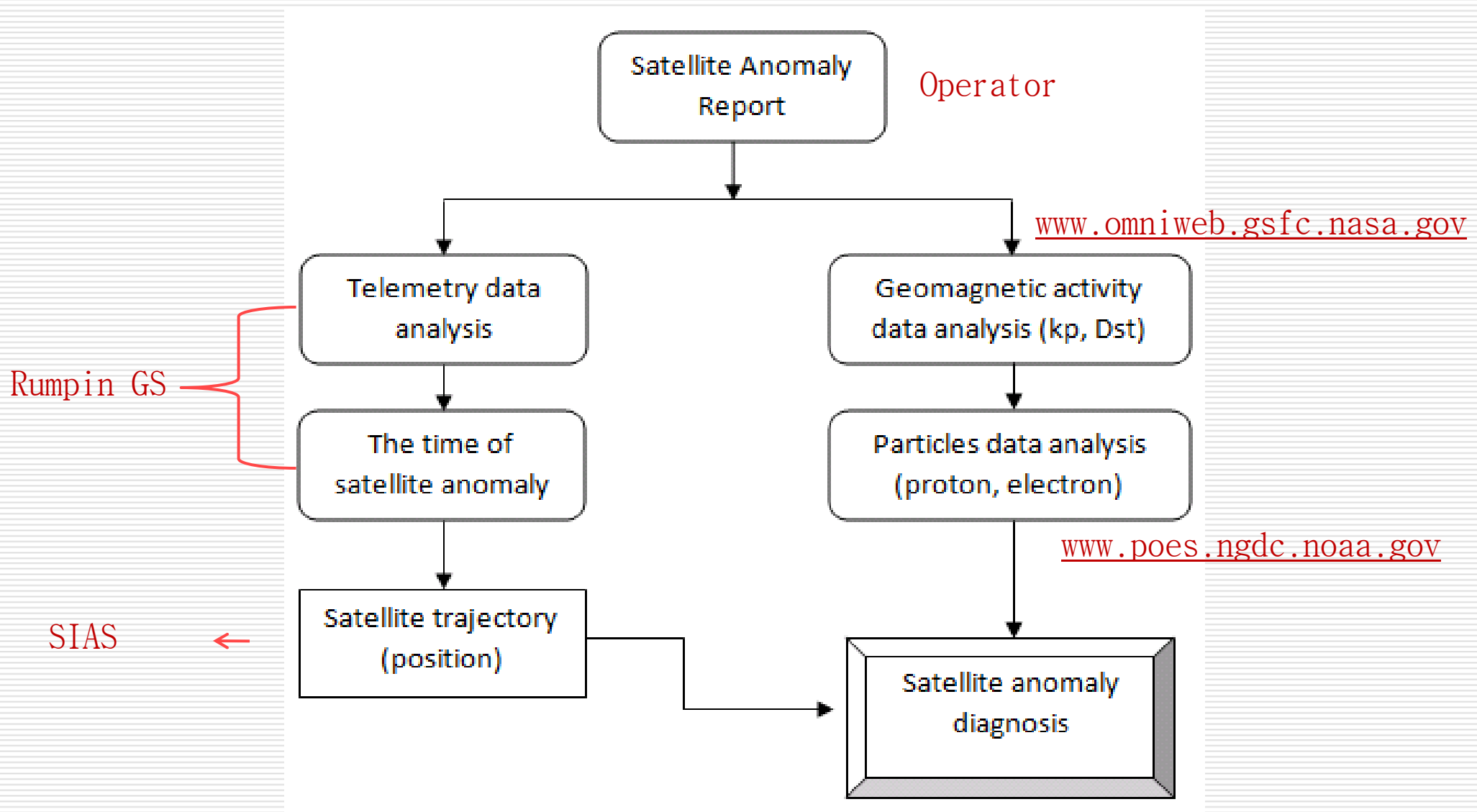
Main Power Bus           :          14.21V    598mA

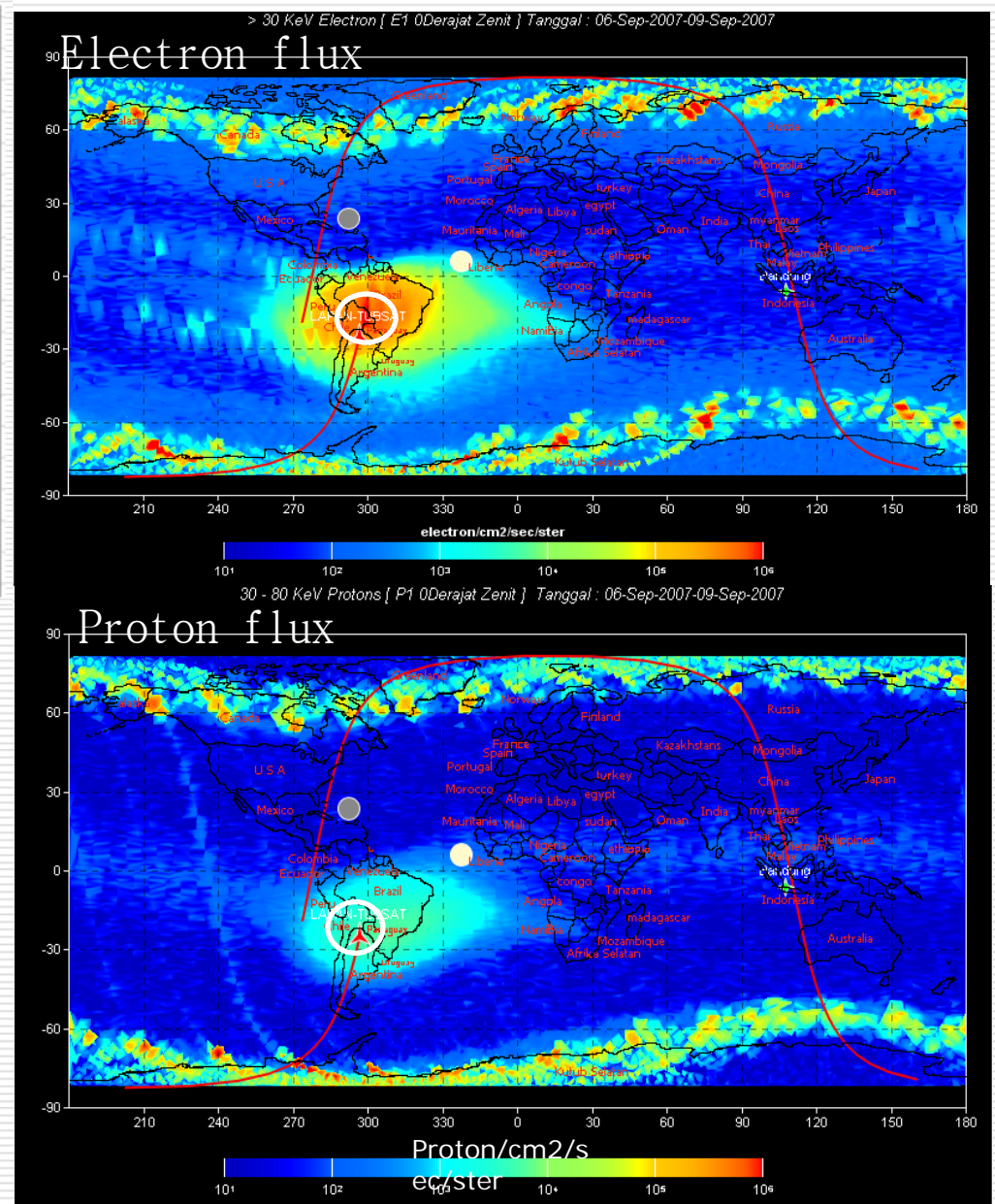
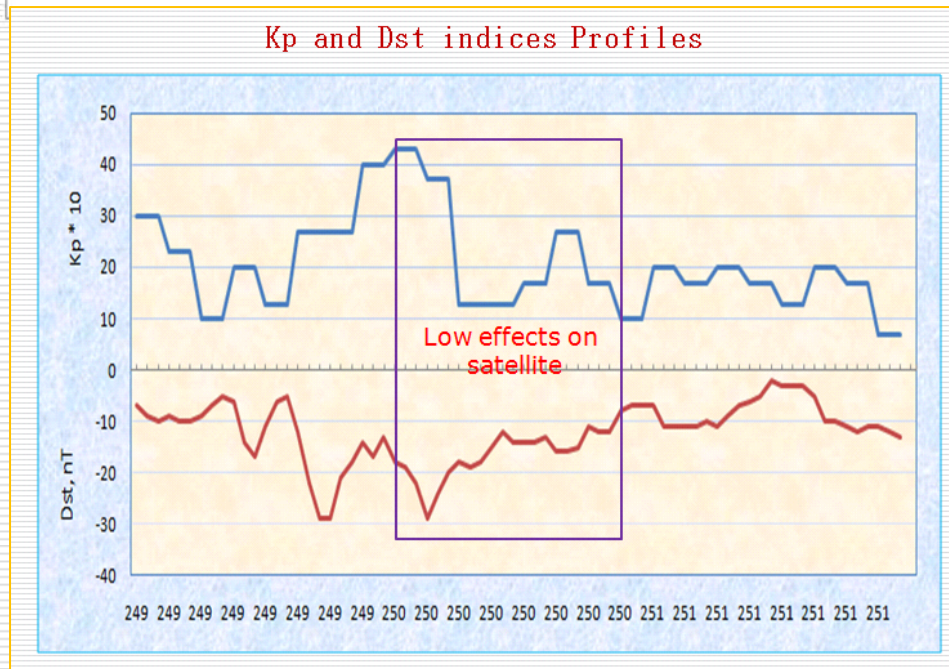
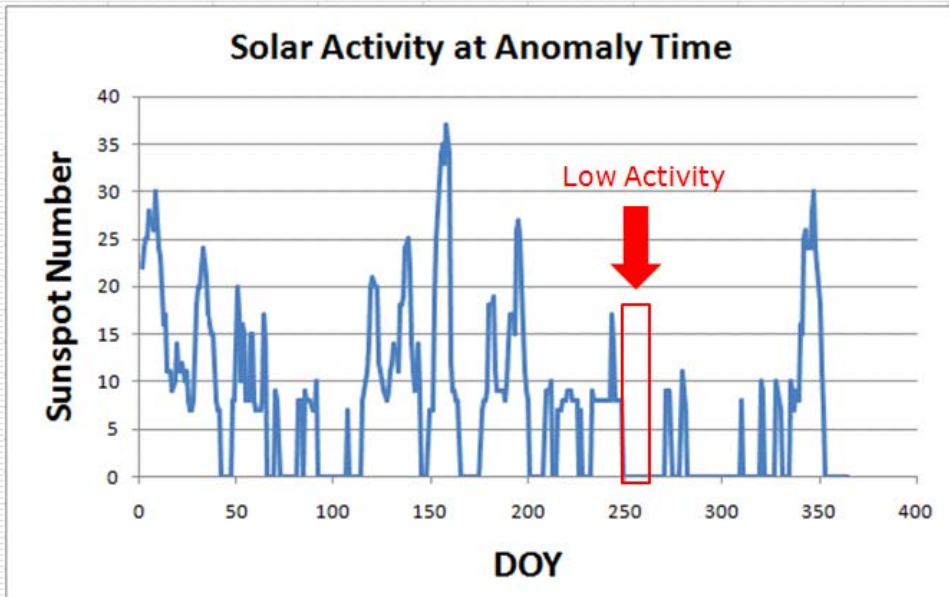
Voltage 29V/12V/-5V      :          26.42V    0.03V   -4.95V
Current TTC1/TTC2        :          62mA     60mA
Current Gyros/Wheels     :          359mA   108mA
Current Coils/STS        :           5mA    12mA
Current Stepper+Cam/S-Band :          20mA    22mA

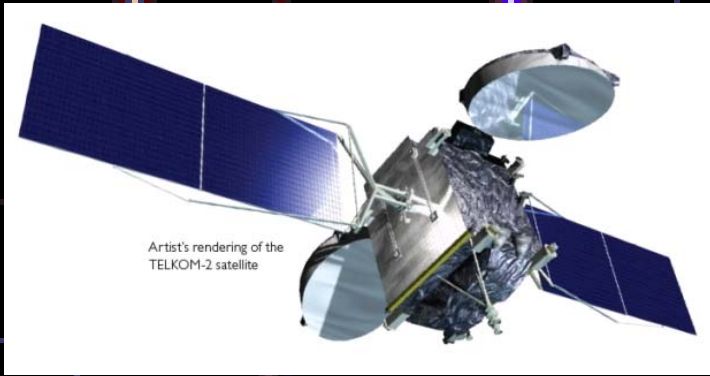
Temp PCDH CPU/Housing/DCDC :          14ΦC    12ΦC    18ΦC
Temp Battery/Middle Plate :          13.8ΦC   7.4ΦC
Temp +X/-X                :           8.4ΦC   8.4ΦC
Temp +Y/-Y                :          -0.9ΦC  22.1ΦC
Temp +Z/-Z                :           5.5ΦC  10.9ΦC
Temp S-Band               :           6.5ΦC

Target Current Coil X/Y/Z :          -0mA    -0mA    -0mA
    
```

Charging Analysis Scheme







Artist's rendering of the
TELKOM-2 satellite

Indonesia as a developing country has many communication satellites such as Palapa, Garuda and Telkom. In the future, We are going to launch many satellites in LEO for remote sensing missions and also for communication.

In the interest of anticipating and reducing of damages on Indonesian satellites due to space weather phenomena, it's important to have such a kind of information system that can give an early warning related to satellite problems in space





LAPAN

LEMBAGA PENERBANGAN DAN ANTARIKSA NASIONAL

LAPAN Polar Satellite

Thank You

LAPAN Equatorial Satellite

