



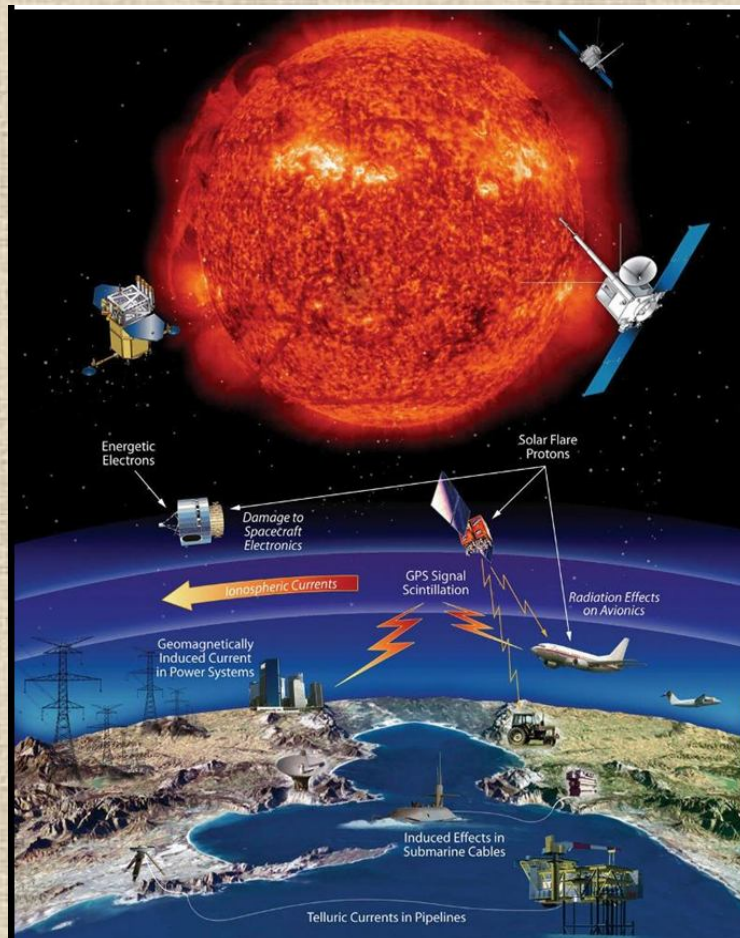
Space Weather Program in Indonesia: Needs and Uses

T. Djamaluddin

LAPAN

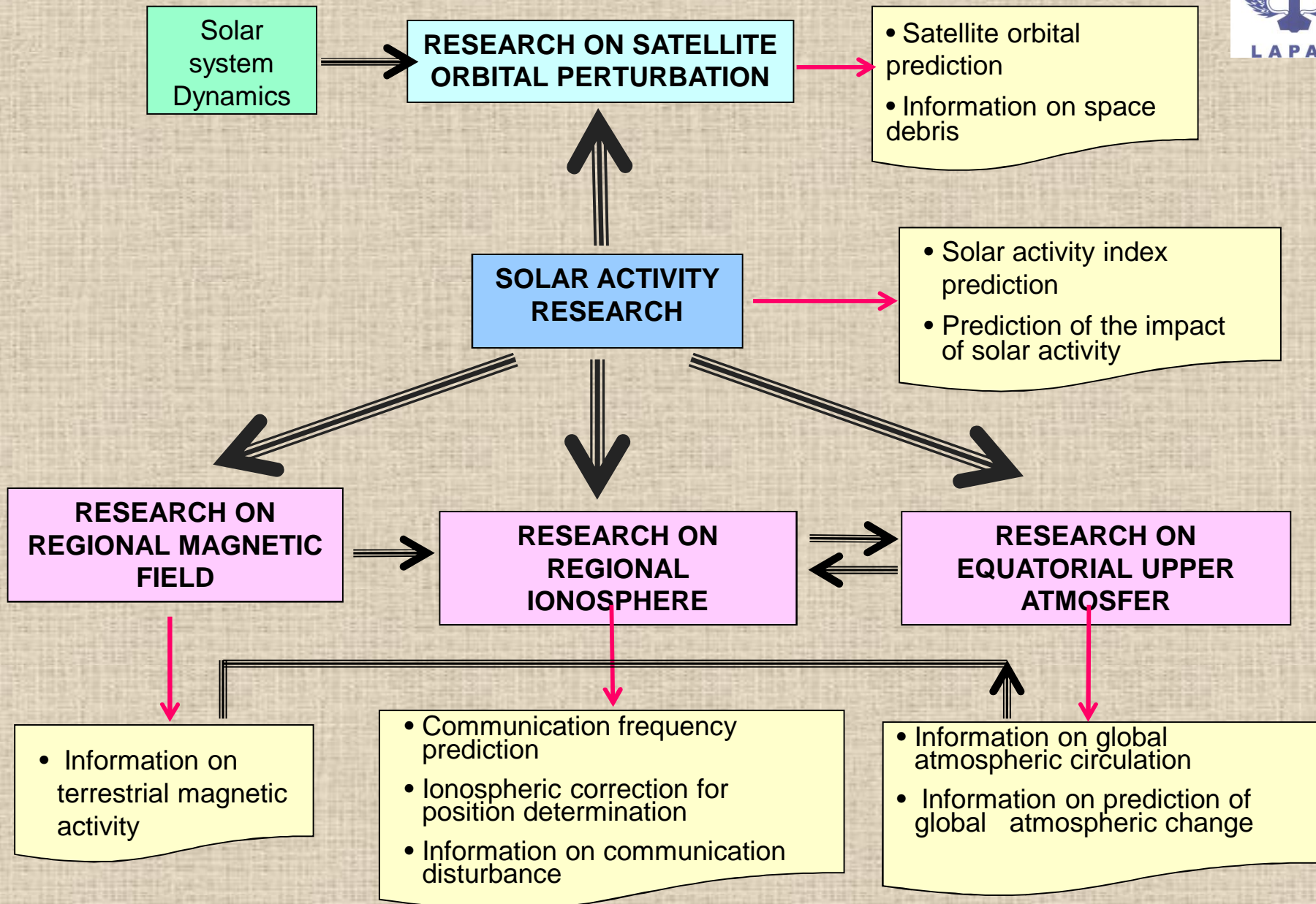
(National Institute of Aeronautics and Space)

SPACE WEATHER

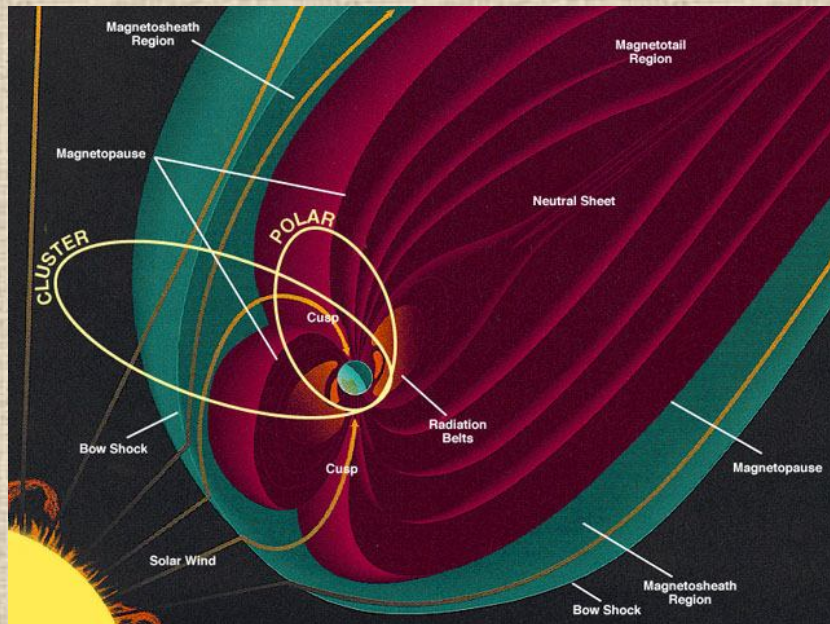


Conditions on the Sun and in the solar wind, magnetosphere, ionosphere and thermosphere that can influence the performance and reliability of **space-borne and ground-based technological systems** and can endanger human life or health.

PROGRAMME INTEGRATION



What is Space Climate and Weather?



- Climate and weather of space environment (space between satellite orbit to the sun)
- Mainly caused by solar activity (energetic particles and radiation burst)
- It can be identified also in geomagnetic variation and total electron content of ionosphere

Analogical phenomena on Earth

- **Solar wind** (*solar particles ejected to space environment*)
- **Magnetic storm and ionospheric storm** (*sudden magnetic or ionospheric variation*)
- **Meteor shower/storm** (*comet origin dust entering Earth atmosphere*),
- **"Space climate": active/quiet solar period every ~ 11 years**

We need
space weather Information
we have
put our facilities in space



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Need of space applications in Indonesia:

Extensive and diverse maritime continent geography of Indonesia;

Growing need of space technology utilization and application for national development:

- + Telecommunication (first domestic satellite telecommunication system in operation in 1976 – **The third countries uses satellite communication**);
- + Earth observation (natural resources, rural and infrastructure development, land use, environment, weather, climate and others);
- + Navigation;
- + Defense and security;
- + Disaster mitigation and relief;
- + Health;
- + Education;
- + Others;



Requirement on utilization of progressive space technology, industry and its application for sustainable development of national prosperity and resilience;



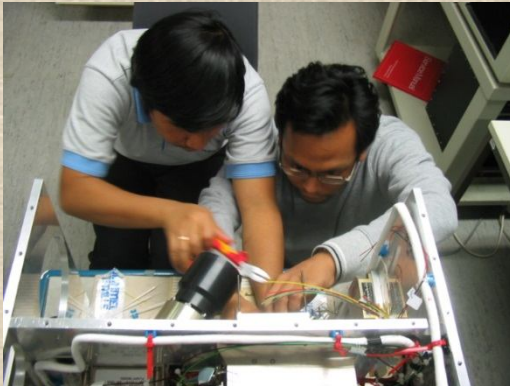
National Institute of Aeronautics and Space - LAPAN

Earth Observation (EO) small/micro-satellite program by developing country.

Case: Indonesia (LAPAN).

EO Satellite Program

Development of Capability



Focus on knowledge, skill and experience on integration, test, launch and operation.

Development of Mission and Technology



Focus on space application.

Design-to-cost EO satellite

Ext. performance EO satellite

Known and proven EO mission

Dedicated and new EO mission

—————>: Steps taken. Development of human resources on satellite technology.

Status of LAPAN-TUBSAT Micro-Satellite

**Transfer of Knowledge, Skill and Experience on Micro-satellite
Development from TU Berlin to LAPAN.**

Acceleration of Indonesian satellite development capacity.





National Institute of Aeronautics and Space - LAPAN

LAPAN-TUBSAT micro-satellite.



Transfer of knowledge, skill and experience on micro-satellite technology development from Technische Universität Berlin, Germany to LAPAN.

Dimension approx 45 cm (l) x 45 cm (w) x 27 cm (h) Weight nearly 57 kg.

Interactive 3-axis attitude control;
Star Sensor for satellite attitude determination;

CCD color video camera on 1,000 mm cassegrain lens provide 5 m ground resolution and 3.5 km swath;
CCD color video camera on 50 mm lens provide 81 km swath and 200 m resolution; Application for earth observation surveillance, e.g. natural resources, environment and disaster management, as well as store-and-forward data communication.

Polar LEO orbit at 630 km altitude, inclination at $97,6^{\circ}$.
Launched as auxiliary payload on ISRO PSLV-C7 Cartosat-2 and SRE mission at SDSC SHAR, India, on 10 January 2007.



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Satellite Utilization in Indonesia

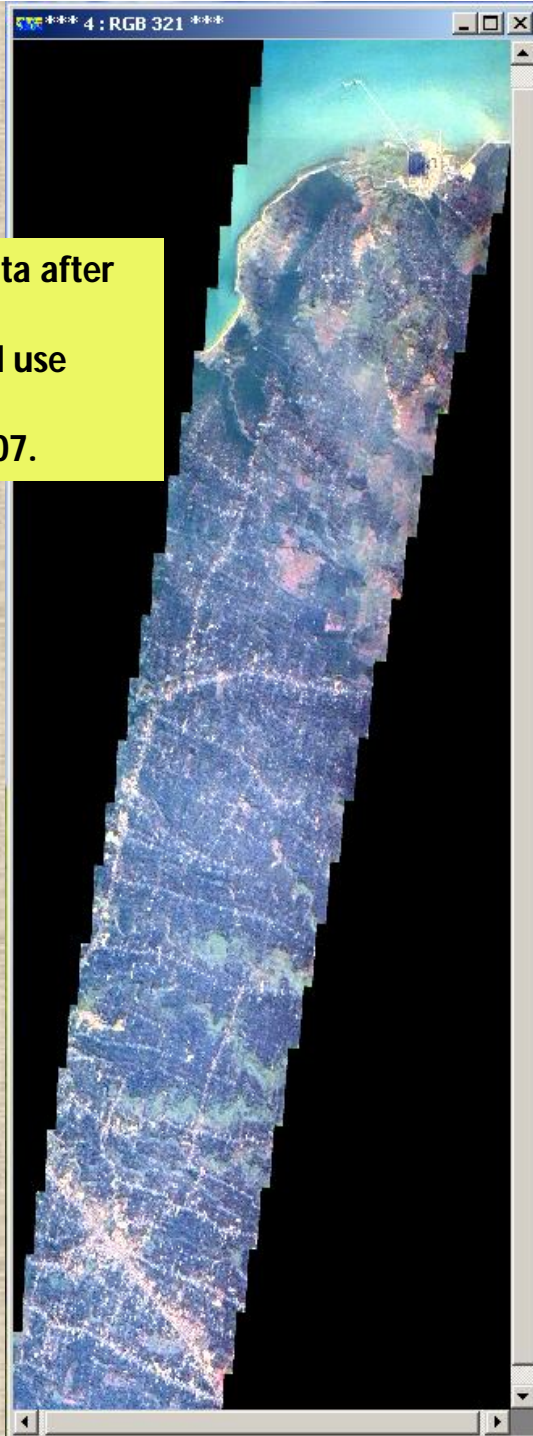
**Soekarno-Hatta Airport
Cengkareng, Banten
LAPAN-TUBSAT image**



A video stitch image frame generated from video data recording. The resulting is an RGB composite color photo image of the location observed by the video streaming data. The image frame clearly show urban land use from spatial resolution and color separation. Some sea water attributes could also be observed.



LAPAN-TUBSAT data after application of unsupervised land use classification. Jepara, 11 July 2007.





National Institute of Aeronautics and Space - LAPAN

LAPAN-TUBSAT satellite operational organization and management.

Primary Issues:

- ▶ Satellite health;
- ▶ Payload health;
- ▶ Orbit status;
- ▶ TTC operation;
- ▶ Payload data acquisition;
- ▶ Payload data handling & distribution.

Satellite operation analysis and evaluation.

Ground segment:

- + Ground station operation;
- + Data acquisition;
- + Data utilization management;
- + Satellite operation management;
- + Satellite health management;
- + Tracking parameters;
- + TTC function;
- + Orbit analysis.

Space segment:

- + Bus system operation and health;
- + Payload operation and health;
- + Power supply operation and health;
- + Orbit parameters;
- + Communication parameters;
- + Satellite Tx ERP;
- + TTC performance;
- + Satellite attitude management

System operation function:

- + Human resources development;
- + Operation plan and scheduling;
- + EO data acquisition, archive & catalog;
- + EO data evaluation & processing;
- + EO data promotion & services;
- + Organization & procedures;
- + Legal and RF coordination;
- + Evaluation & assessment of operation;
- + Technical & operational documentation.

Now we preparing new microsatellite
LAPAN-A2 and LAPAN A-3

Initiation of Satellite Development and Integration in Indonesia.

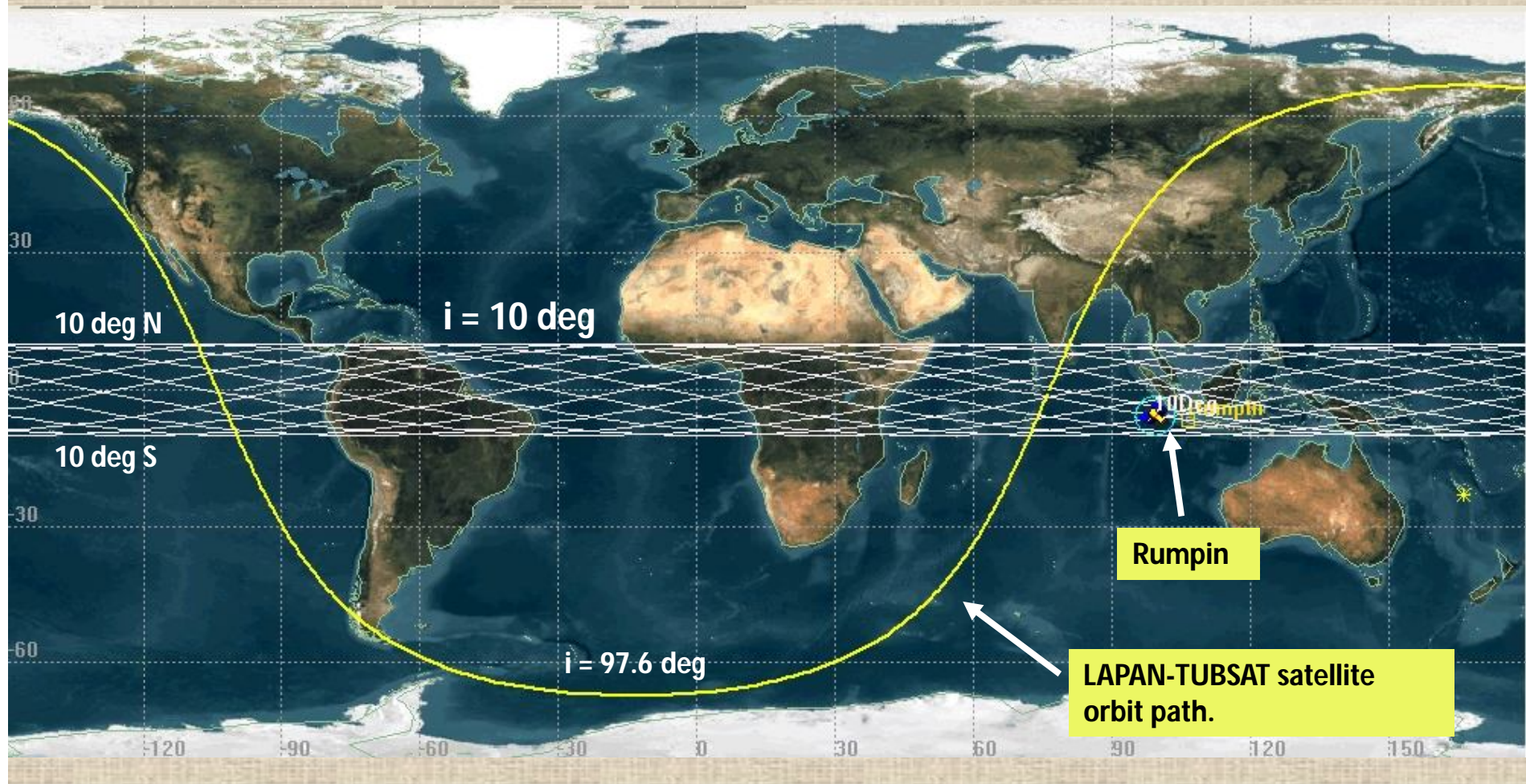




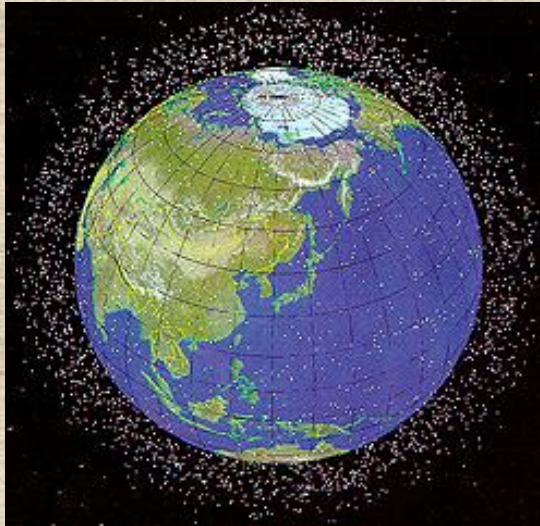
National Institute of Aeronautics and Space – LAPAN
Indonesia

Developing an Equatorial Earth Observation Satellite System

World coverage of one satellite in near-equatorial LEO at 10° inclination, h ~ 650 km.



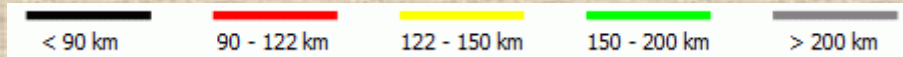
Space debris: dilemma of space technology



Pemantauan benda jatuh antariksa



Sejak 1 jam yang lalu hingga 1 jam ke depan sebanyak 1 benda antariksa melintasi Indonesia dengan ketinggian kurang dari 200 km. Pada umumnya suatu benda dikatakan jatuh jika ketinggiannya mencapai 122 km.
Last update: 2011-06-01 08:06:51 WIB

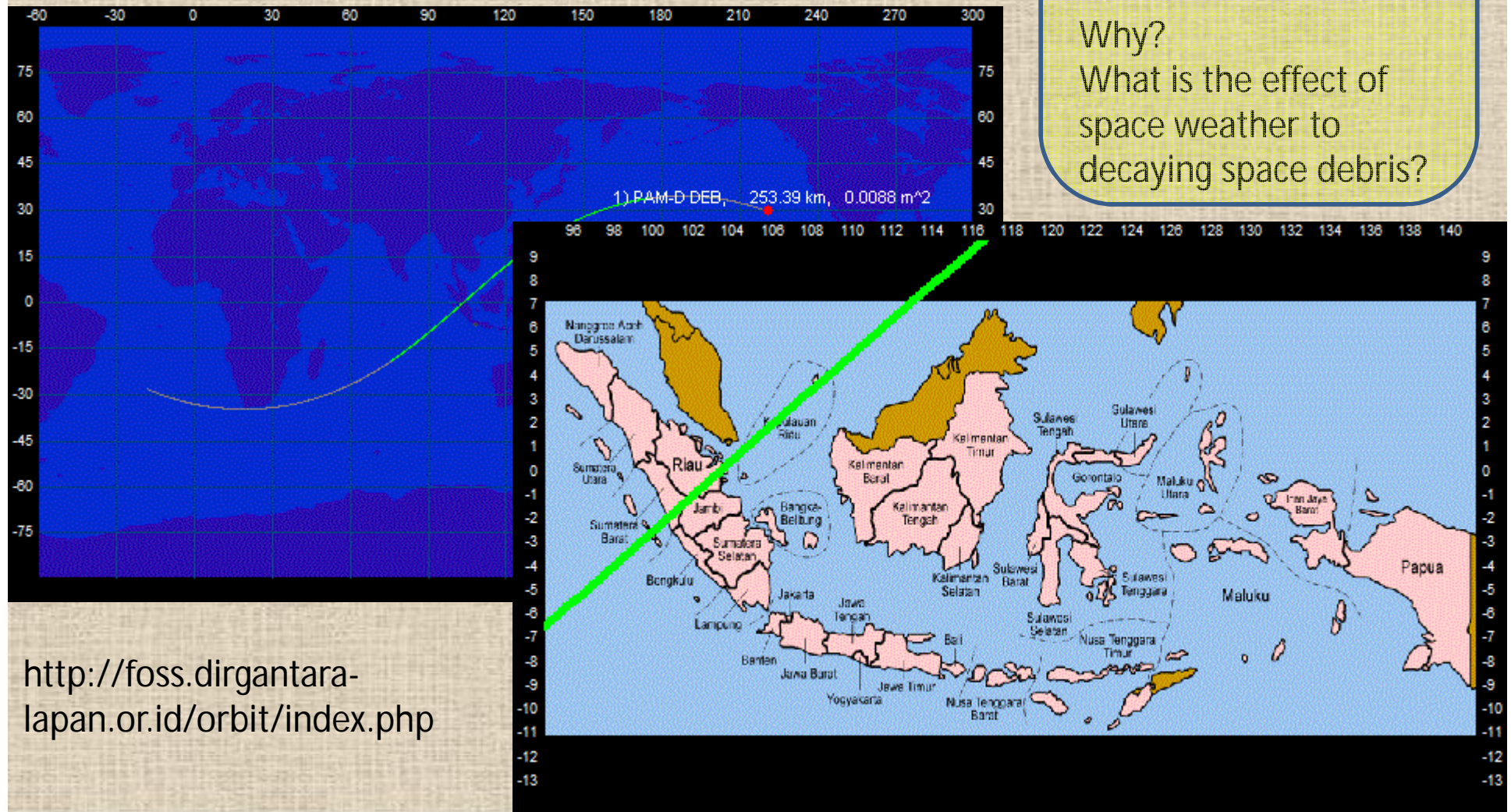


Realtime monitoring of space debris passing Indonesia.

Trying to detect decaying space debris.

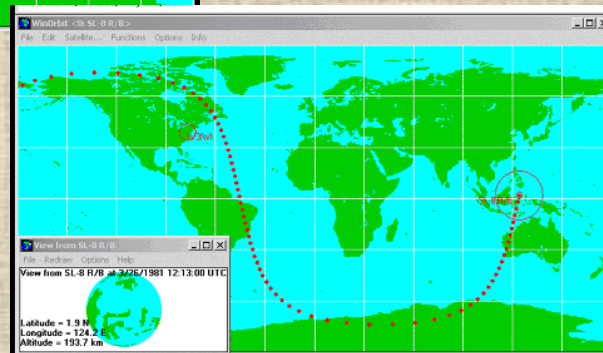
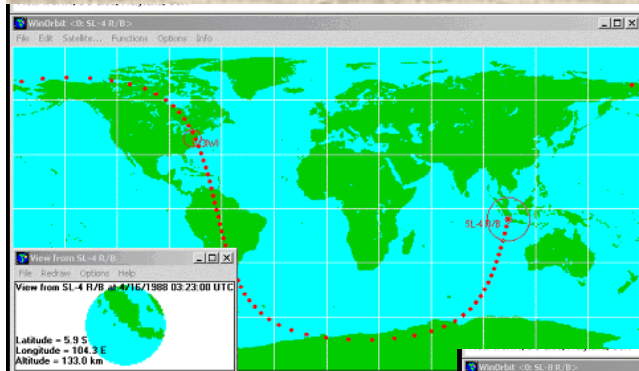
Why?

What is the effect of space weather to decaying space debris?



<http://foss.dirgantara-lapan.or.id/orbit/index.php>

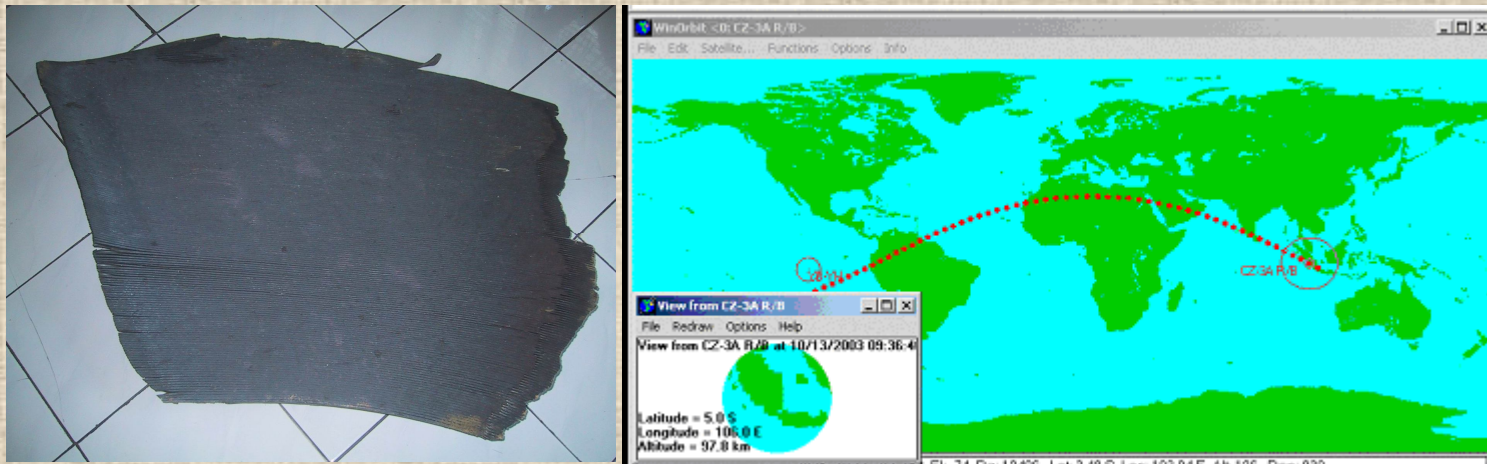
Decayed Space Objects



Falling space object in Gorontalo is part of rocket motor of Cosmos-3M/Space Launcher 8 (SL-8)/11K65M belong to Russia, fallen at 12:13 UTC (20:13 WITa) on 26 March 1981

Falling space object in Lampung is part of rocket motor of Soyuz A-2/Space Launcher 4 (SL-4)/11A511U belong to Russia, fallen at 03:24 UTC (10:24 WIB) on 16 April 1988

Decayed Space Objects



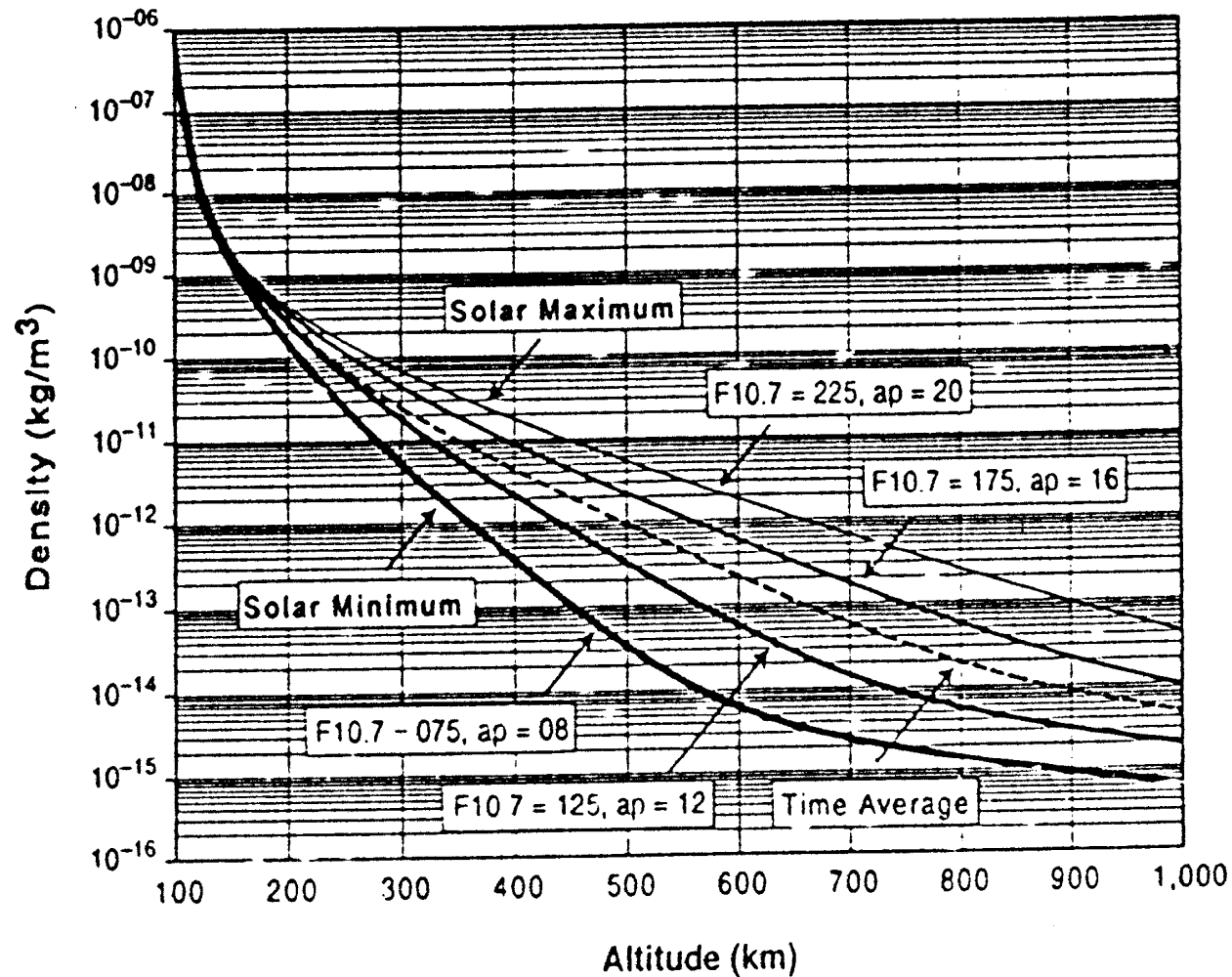
Part of CZ-3 (Chang Cheng/Long March 3) of PR of China
Catalog: 23416. Code: 1994-080B. Launched on 29 November
1994

Size : ~ 60 cm x 80 cm

Orbit of decayed estimated by Space Control Center : 13 October 2003,
between 16:23 (South on Arab) – 16.37 (West Java).

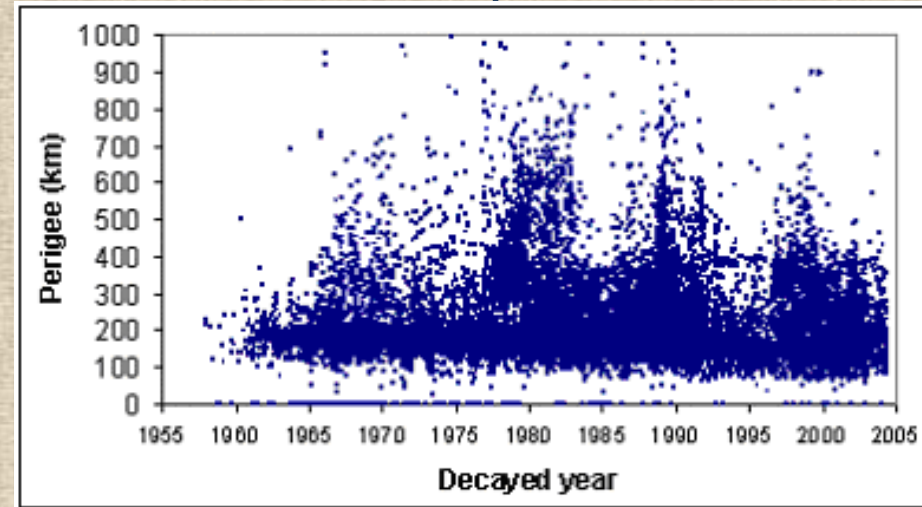
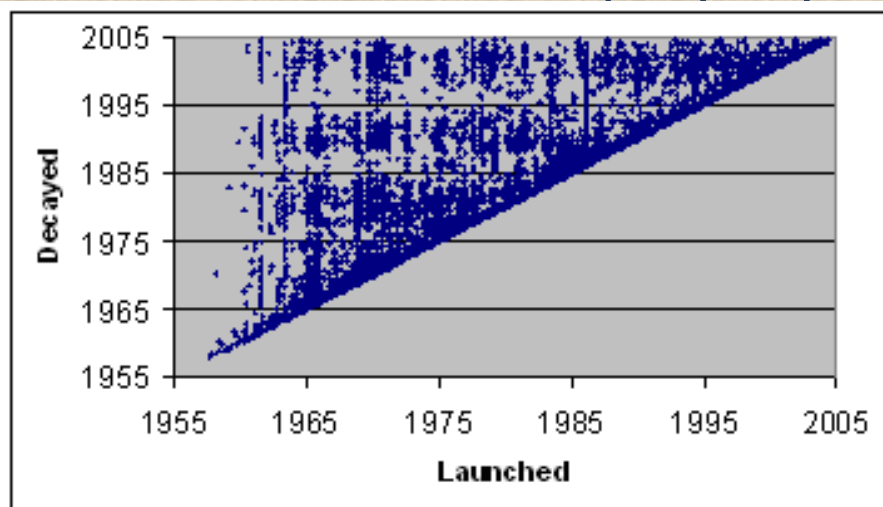
Orbital analysis : fallen on Bengkulu on 13 October 2003 at ~16.36
(West Indonesia Time)

Space Weather affecting atmospheric density, thus effecting satellite orbit



Space Environment Monitoring

- ~ 20.000 Earth orbiting objects have been cataloged. Decayed objects enhance during solar active.
- All of decaying objects orbit are passing equator. Indonesia with long equator region has higher risk from falling space debris.
- We monitor decaying objects for disaster mitigation.



We need
to know space weather
so we
make observation
and
make analysis and prediction

SPACE WEATHER

Research and Observation:

- Solar Activity
- Geomagnetism and Magnetosphere
- Ionosphere

INSTRUMENTATION NETWORK

SOLAR, SPACE DYNAMICS, DAN ATMOSPHERE OBSERVATION

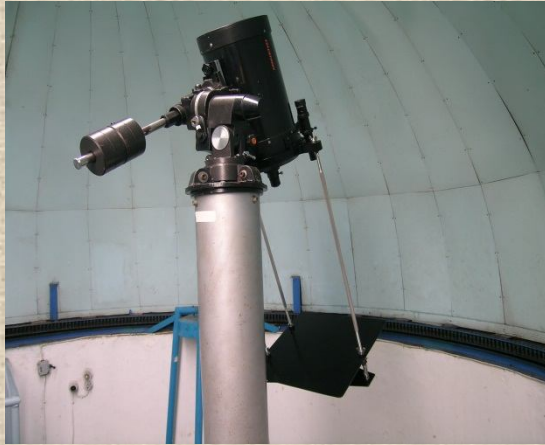


SOLAR ACTIVITY

- **Long term solar activity prediction and the identification of the nature and mechanisms of flares, CMEs, etc.**
- **Preliminary model and the prediction of the impact of solar activity to the Earth (Sun-Earth connection), including the impact on ionosphere, geomagnetic field and climate parameters**
- **Ground based solar observation**

TELESCOPES

**CELESTRON 8 INCH FOR
SUNSPOT SKETCH**



**Refractor VIXEN 10,5 CM
and Coronado Ca K**



**Refractor CELESTRON NEXSTAR
8 INCH for solar observation**



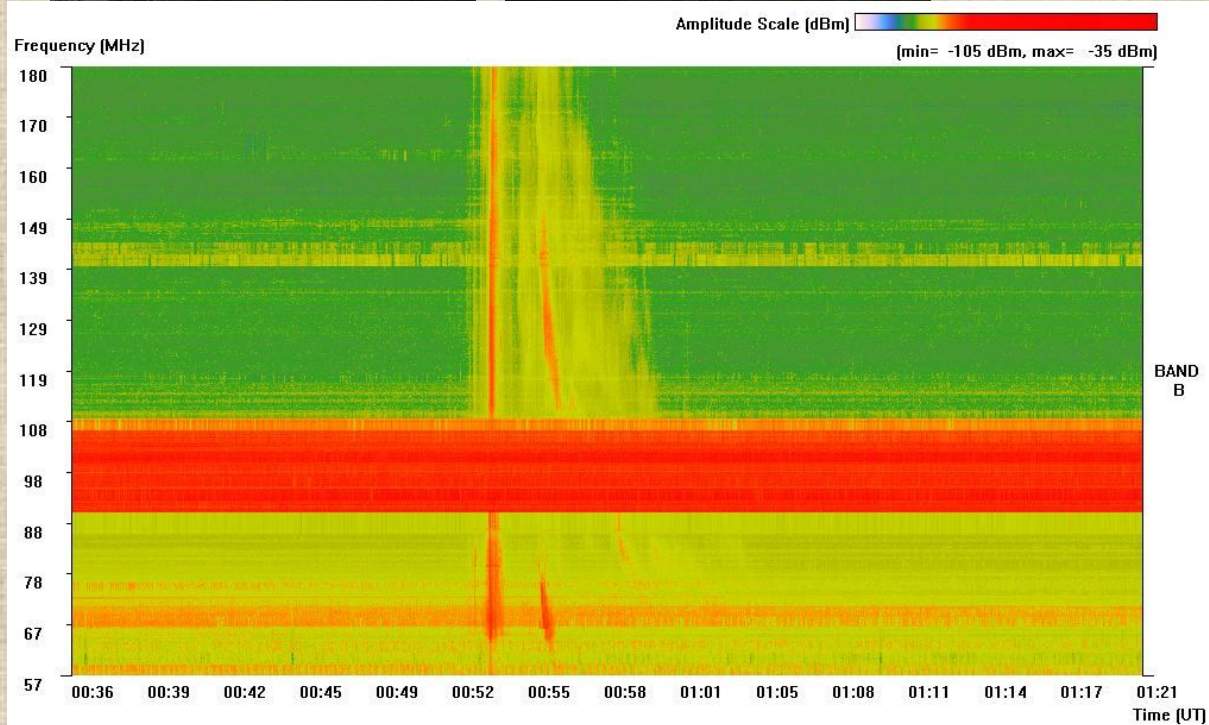
OBSERVATION OBJECTS:

- **SUNSPOT**
- **FLARE**
- **PROMINENCE** ----→ **H α filter**
- **CHROMOSPHERE** -→ **Ca filter**



SOLAR RADIO
SPECTROGRAPH -
SN 4000

RADIO SPECTRUM :
18 MHz – 1.8 GHz
OPERATING NOW:
56 MHz – 1.8 GHz



12 June, 2010

Solar Radio Burst
on 12 June 2010



Informasi Pengamatan Cuaca Antariksa

Lembaga Penerbangan dan Antariksa Nasional

- Home
- Aktivitas Matahari
- Dampak Aktivitas Matahari
- Karakteristik Matahari
- Siklus Matahari
- Pengamatan Matahari (Live)

Links

- > NOAA
- > Spaceweather
- > IPS
- > SOHO
- > Exploratorium
- > Boscha ITB
- > SIDC
- > SWPC
- > NICT
- > ESA
- > SolarCycle24
- > ISES

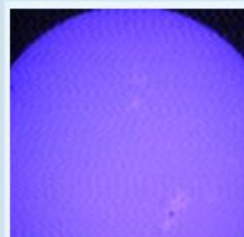
Counter

Hit counter:
9147
 Users online:

Pengamatan Matahari



Teleskop H alpha

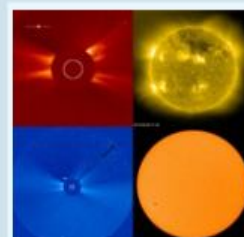
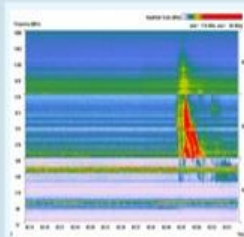
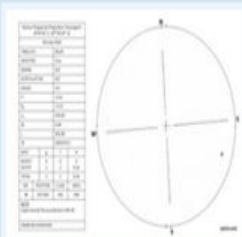


Teleskop Cak



Teleskop White Light

Pengamatan Sunspot



Informasi dan Berita

Cuaca Antariksa

24 November 2010

Cuaca antariksa menggambarkan kondisi di antariksa yang meliputi kondisi pada matahari, angin surya, magnetosfer, ionosfer, dan termosfer.

GEOMAGNETISM AND MAGNETOSPHERE

- **Development of regional magnetic field modelling**
- **Geomagnetic activity prediction and its impact**
- **Geomagnetic activity prediction model and study on coupling of lithosphere - atmosphere- thermosphere – ionosphere**
- **Information on geomagnetic disturbance (micropulse, k index) and information on characteristics of geomagnetic periodicity**

FLUXGATE MAGNETOMETER

LOCATION :

- BIAK
- PONTIANAK
- TANJUNGSARI
- KOTOTABANG
- PARE-PARE
- KUPANG
- MENADO

COLLABORATION UNDER PROJECT
MAGDAS (MAGNETIC DATA AQUISITION
SYSTEM → Kyushu univ)

- RESOLUTION 1 SEC
- NEAR REAL TIME → SYSTEM GPRS

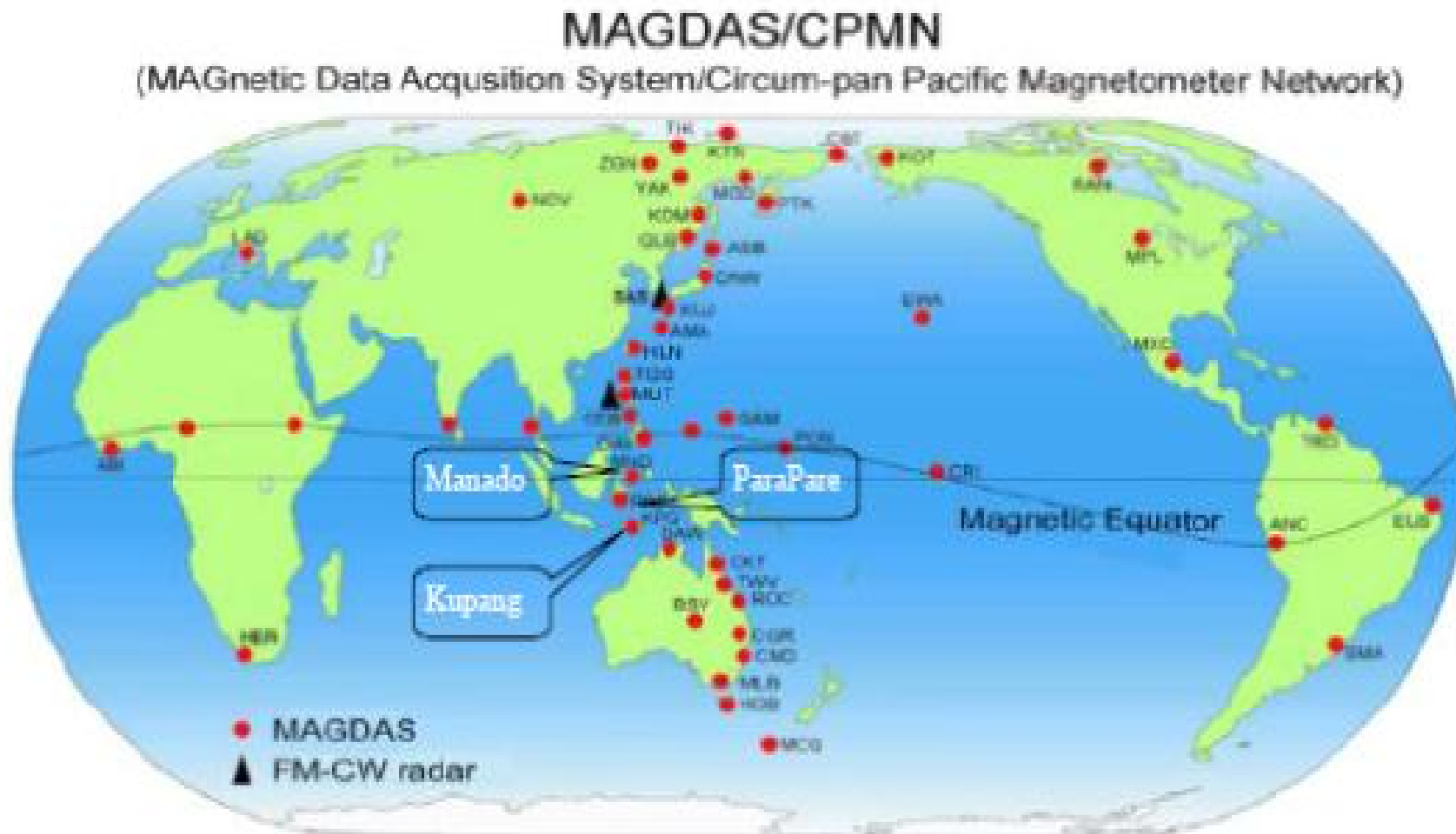


OBJECT OBSERVATION

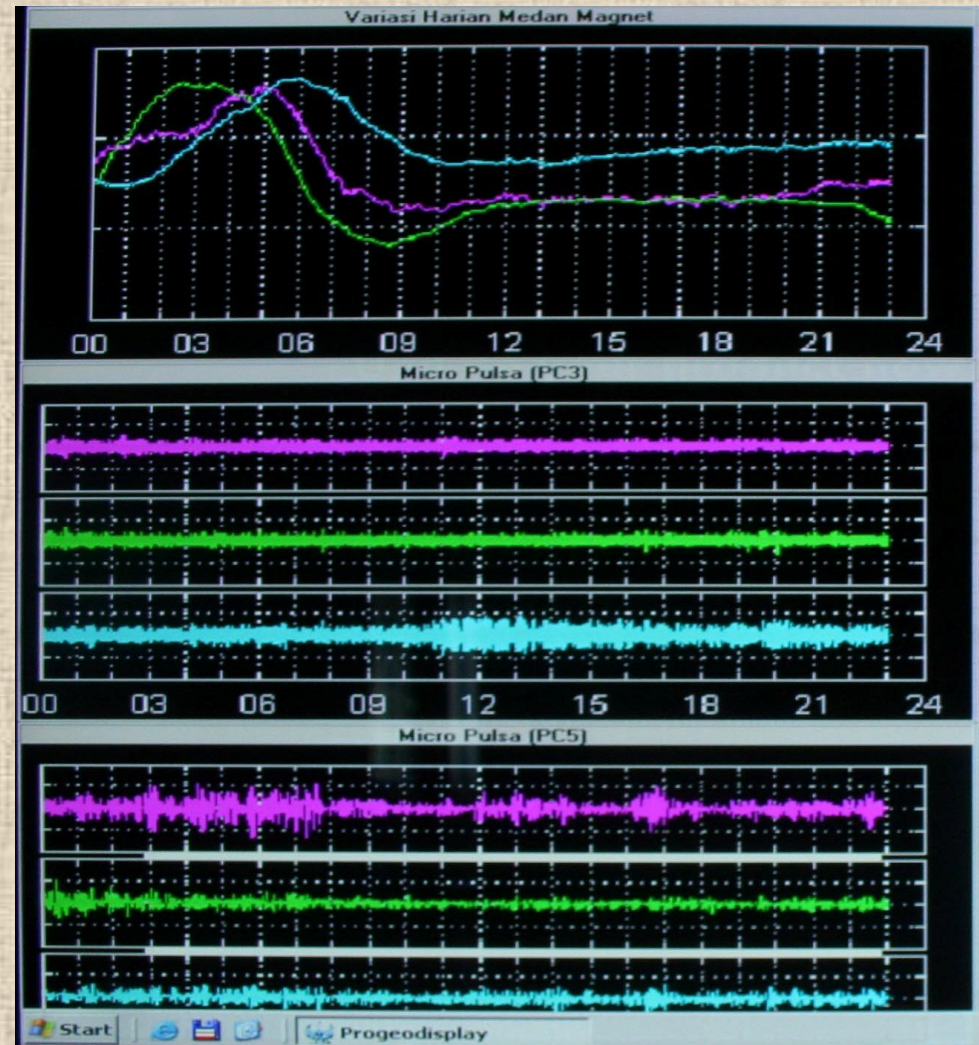
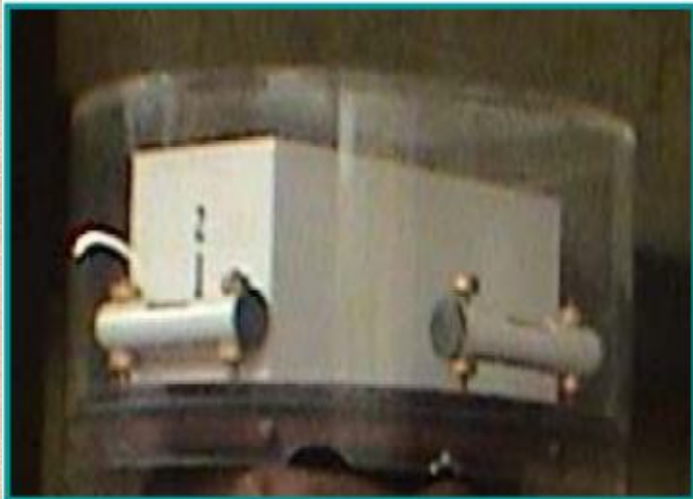
- Magnetic field
component : D, H, Z
- Pi 2, Pi 3
- Pc 3, Pc 4, Pc 5

MAGDAS Network in Indonesia

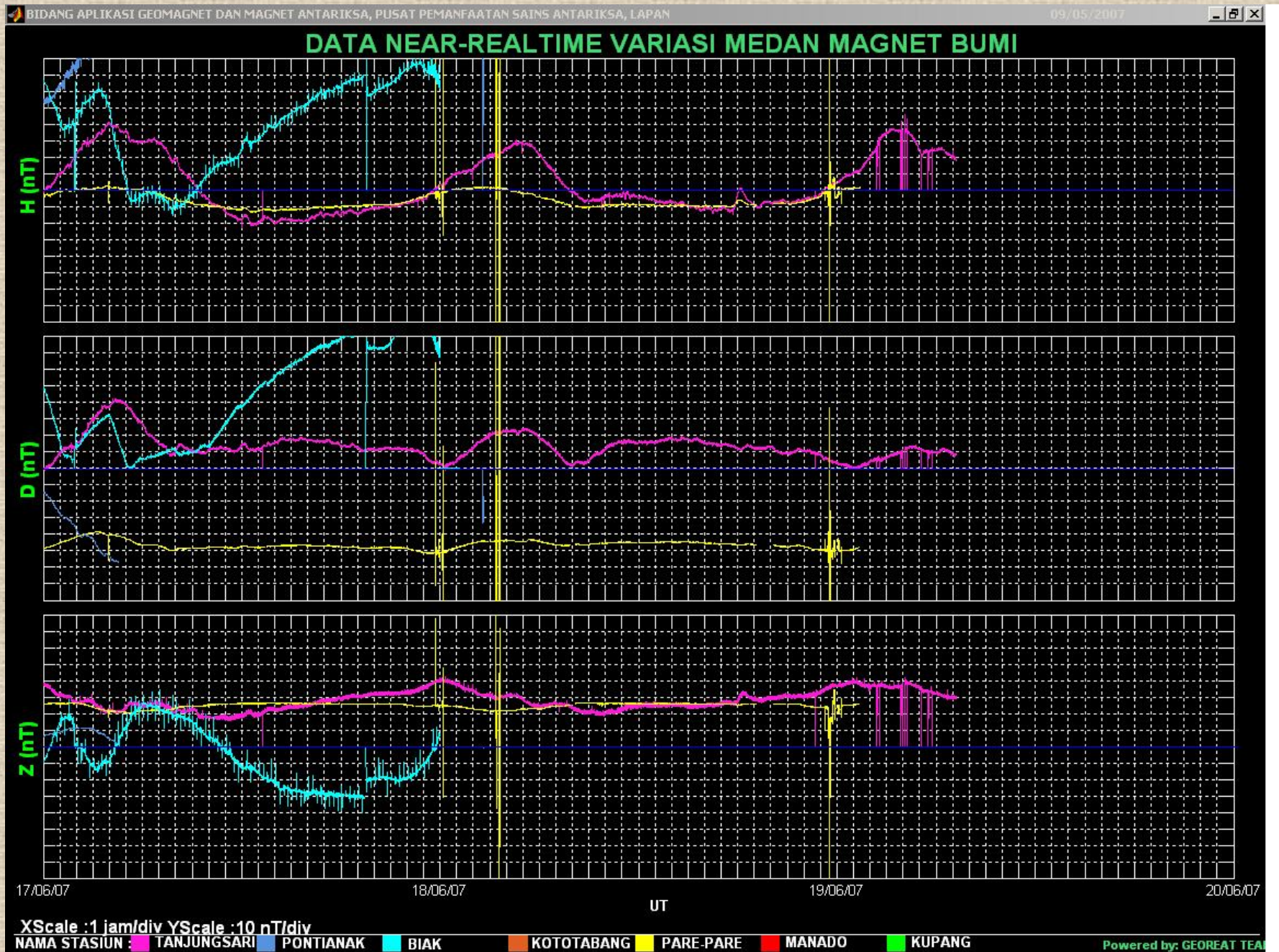
(Magnetic Data Acquisition System)



Biak, Pontianak, Sumedang, Kototabang
Manado, Parepare, Kupang



Geomagnetic Near Real Time Data



REGIONAL IONOSPHERE

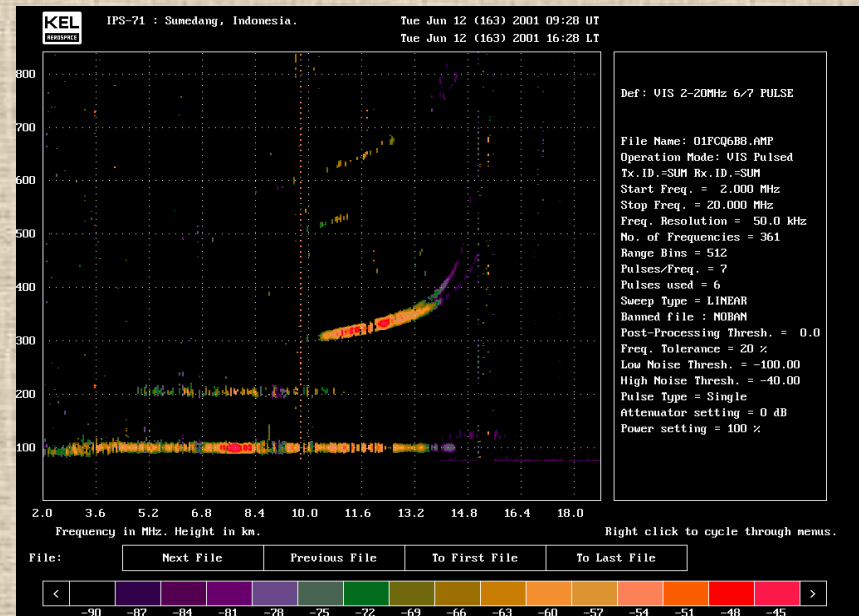
- **Ionospheric disturbances on satellite communication and position determination (scintillation, tec, integration on disturbances due to solar and geomagnetic activity)**
- **Model and method on ionospheric parameter prediction of Indonesian regional ionosphere**
- **Study on equatorial (Indonesia) scintillation and regional total electron content (TEC) modelling**
- **High frequency (HF) communication prediction service, prediction and real time radio frequency management system**

RESEARCH ON EQUATORIAL UPPER ATMOSPHERE

- **Study on seasonal variability of waves and waves interaction**
- **Modelling of regional dynamical upper atmosphere over indonesia (gravity wave, disturbance propagation, neutral wind, periodicity analysis on atmosphere)**
- **Spectrum of troposphere -thermosphere - ionosphere over indonesian equatorial region**

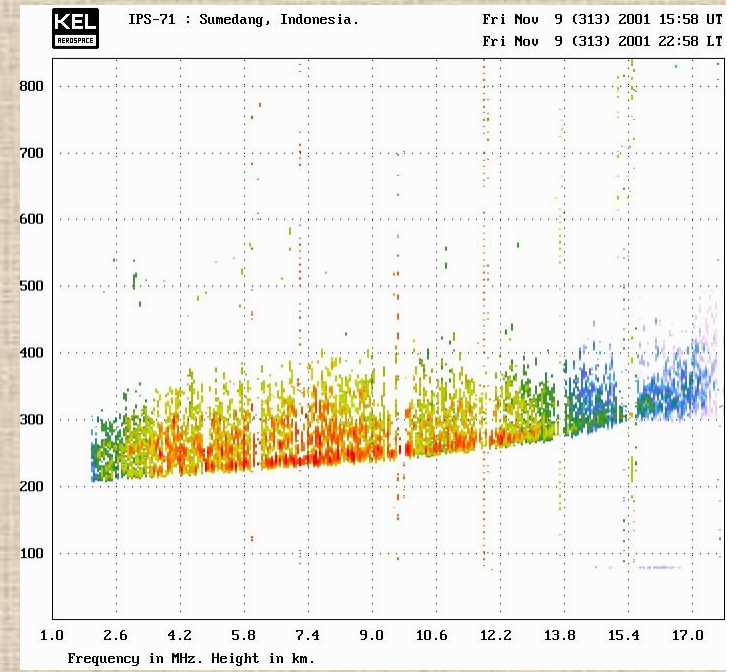
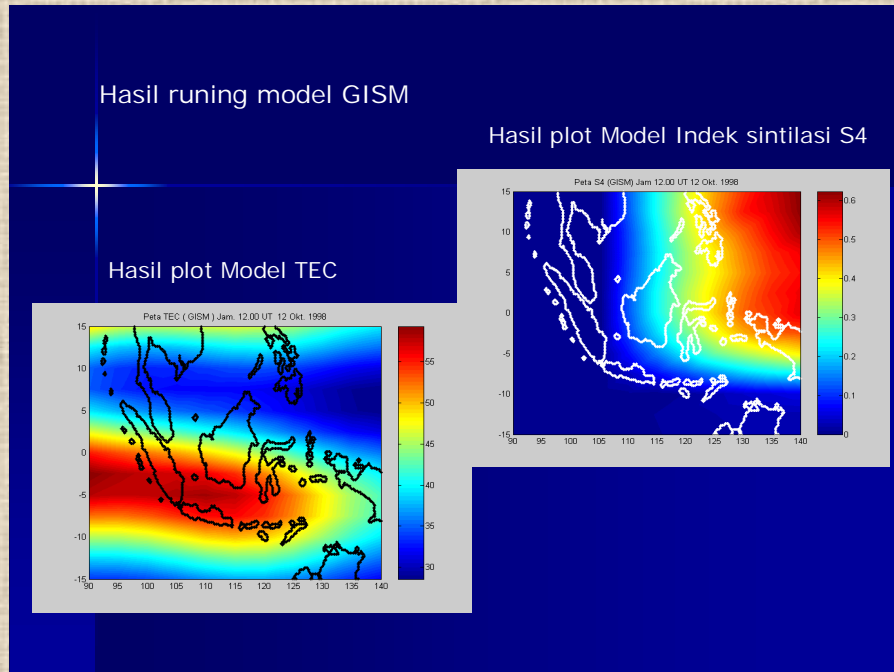
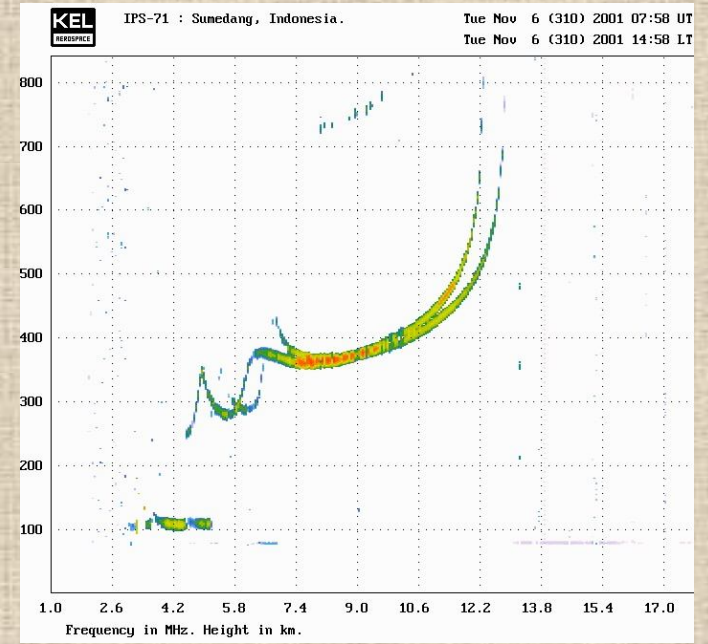
IONOSONDE

- IPS -51
Pameungpeuk, Menado
- IPS - 71
Tanjungsari
- CADI
Biak, Pontianak
- FMCW (NICT, Japan)
Kototabang



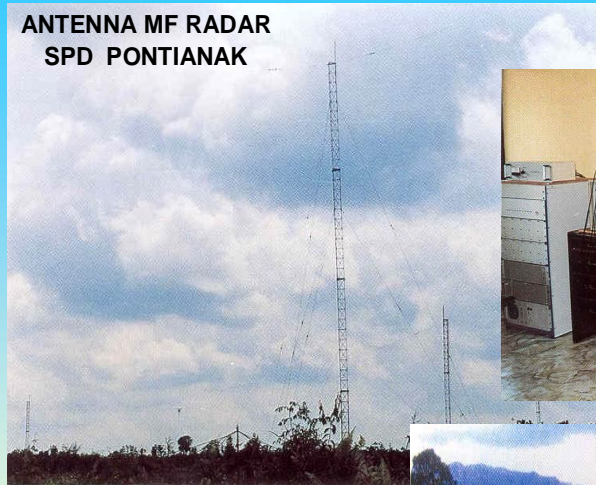
PREDICTION :

- LUF, MUF --→ software ASAPs (Advanced Stand Alone Prediction System → version under windows, 2004)
 - input : - Indonesia regional ionospheric index (calculated from global ionospheric index)
 - latitude, longitude, month etc
- Skip zone -→ software GWPS 2004 (Ground Wave Prediction System)

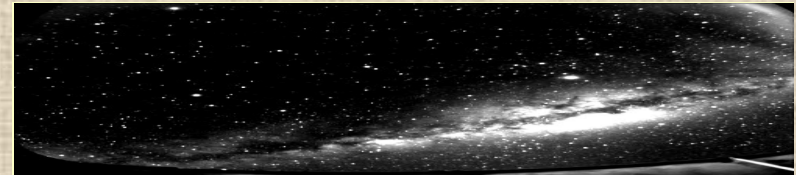
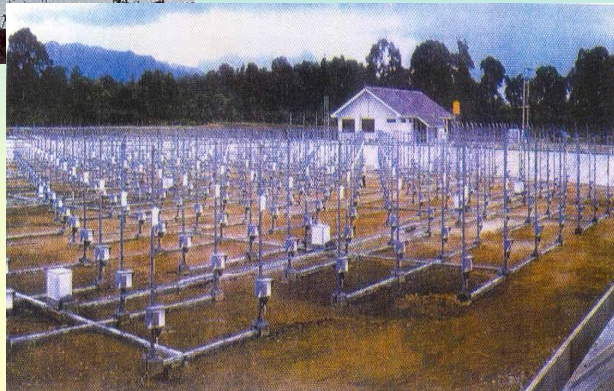
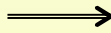


OBSERVATION AND STUDY OF EQUATORIAL MIDDLE AND UPPER ATMOSPHERE

ANTENNA MF RADAR
SPD PONTIANAK



ANTENNA EAR
SPD KOTOTABANG

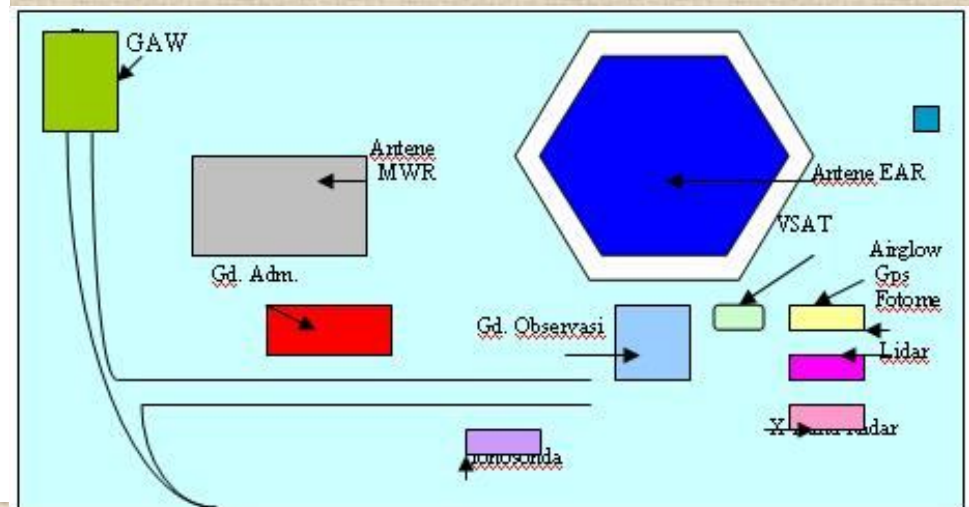
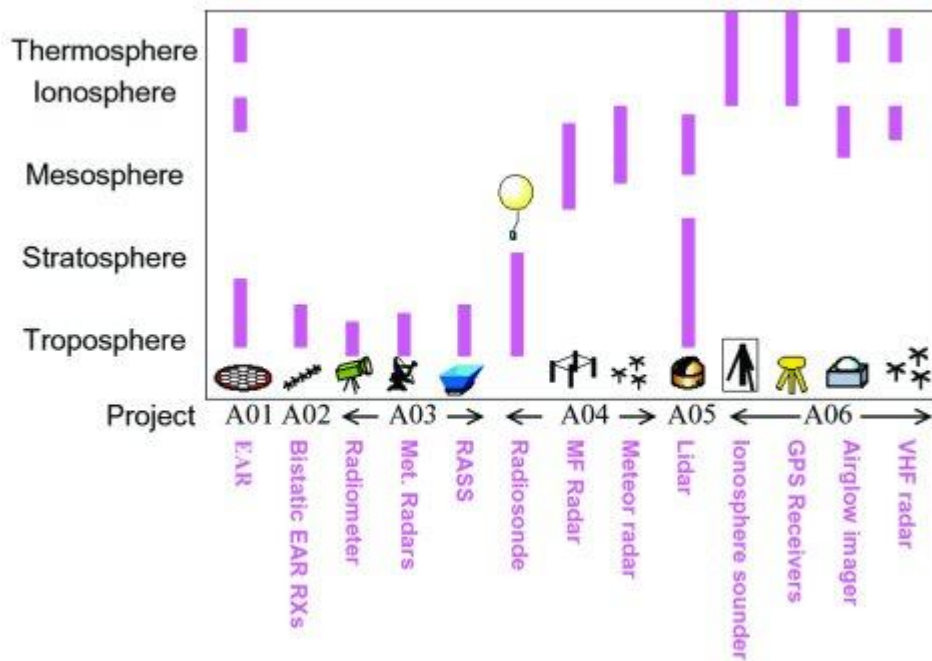


Airglow observations at
Tanjung Sari dan Kototabang

Observations of middle and upper Atmosphere
dynamics at Pontianak dan Kototabang

Ground Based Atmospheric Radar Observation

at Ketatobana, Sumatera



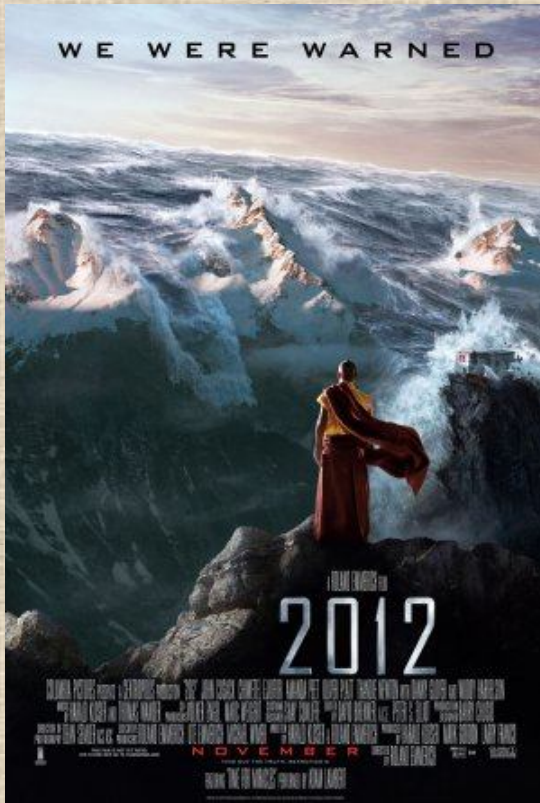
Control Room Space Weather and Earth Weather



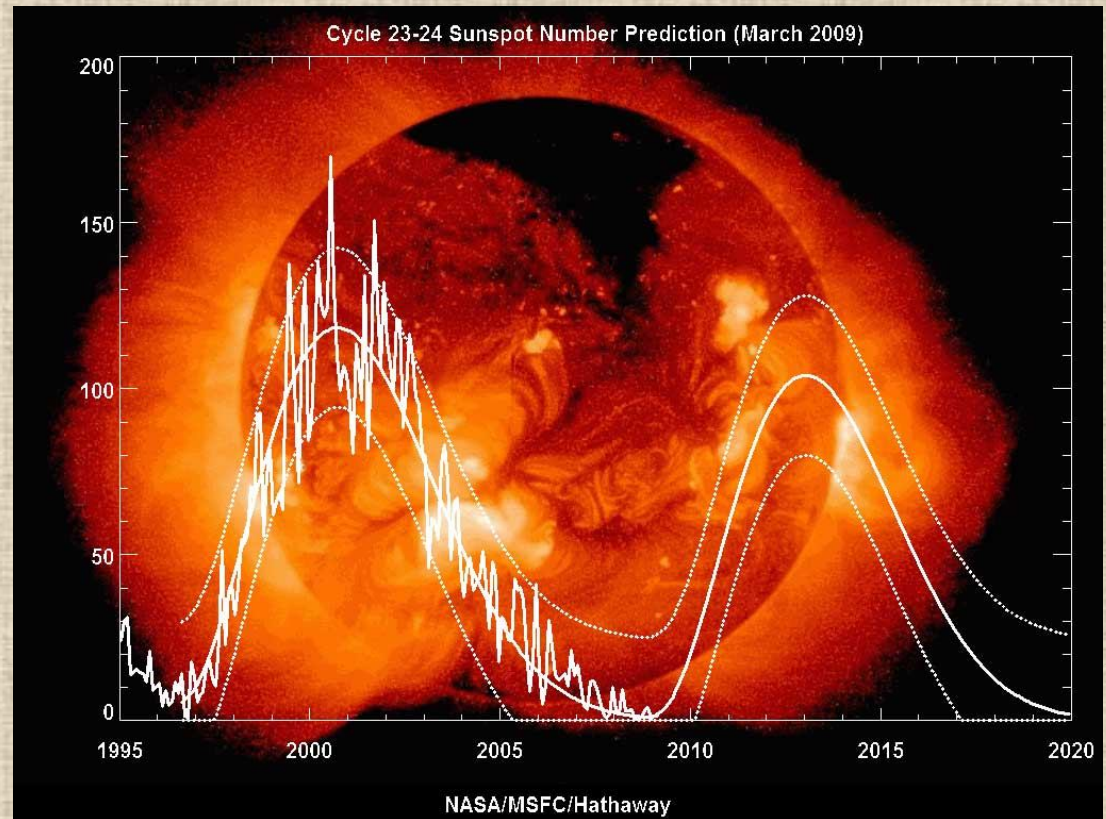
People should know
what space weather is
and its impact.

People on Earth surface are safe,
because we are protected
by magnetosphere
and atmosphere

Pseudoscience vs Science



VS



Public Outreach

