



**The Scientific and Technical Research Council  
of Turkey**

**Space Technologies Research Institute**

**Environment monitoring capacities and activities in  
TÜBİTAK UZAY and Turkey**

**FP7 SEOCA/TEMPUS CRIST**

Astana, Kazakhstan

**October 24 - 27, 2011**

# Content

- Short history of environmental monitoring
- Capacities for enviromental analysis
- First EO satellite of Turkey
  - RASAT Satellite sub systems
- Needs & future studies for environmental monitoring

# History of Environmental Monitoring in Turkey

- Turkey has international obligations for environmental reporting mainly from UNEP, EU , OECD.
- National Photogrammetry and Remote Sensing Union, (like ISPRS) has established in 1984.
- National environment monitoring project launched at 1999, by Ministry of Environment.

# Capacities for Enviromental Analysis

- Several different National Institutes analyses environmental data
  - Ministries (Environment, Health, Agriculture..)
  - Statistic Institute, TÜBİTAK,
  - Mineral Research & Exploration General Directorate, since 1975 remote sensing unit, giving service with the analysis of Landsat images.

# Researches for Ecological Monitoring

- Determination of the water quality and urbanization analysis of the water basins and hydrodynamic structure and pollution of the Bosphorus by using satellite imagery data, (İTÜ and TÜBİTAK).



- Forecasting Wheat Production Zones in Turkey (DPT/UBITEK).
- Using GIS-based remotely sensed data to develop methods for characterization, classification and mapping of biotope type, a case study: Antalya-Manavgat region (İTÜ and Environment and Forest Ministry Research Project).

# Environmental Monitoring Today

- Good knowhow level in academic studies for monitoring vegetation conditions, and ecological monitoring.
- Expertise in using international satellite data (NOAA, Landsat, Spot Satellite, MODIS data)
- Awareness is raised in all level.
- Increasing need of focused environmental data.

# RASAT: First EO satellite of Turkey

2009

Dnepr launch vehicle operated by International Space Company Kosmotras (ISCK).

2010

Yasny Base of Russia at the Kazakh border

17<sup>th</sup> August, 2011

2011





# RASAT: First satellite designed and built in Turkey



## Technical Specifications

- LEO EO satellite with GSD of 7.5 m
  - Mass: ~95 kg
  - Orbit: ~687 km, SSO
  - 3-axis control
- Optical imaging system
  - 15 m MSI (red, blue, green, NIR)
  - 7.5 m PAN
- UHF/ VHF/ S Band/X Band comms

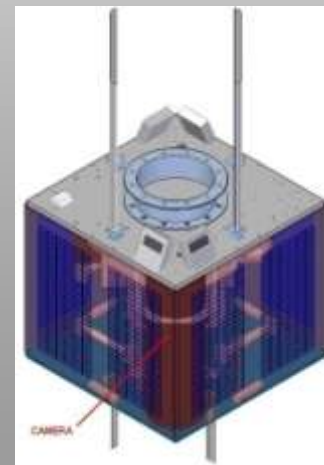
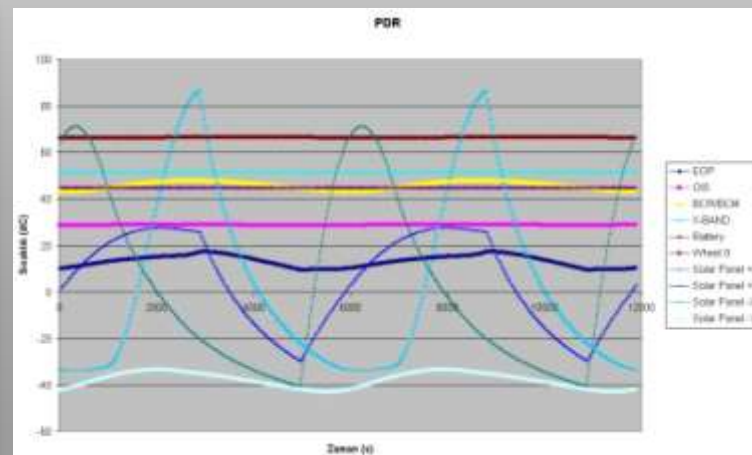
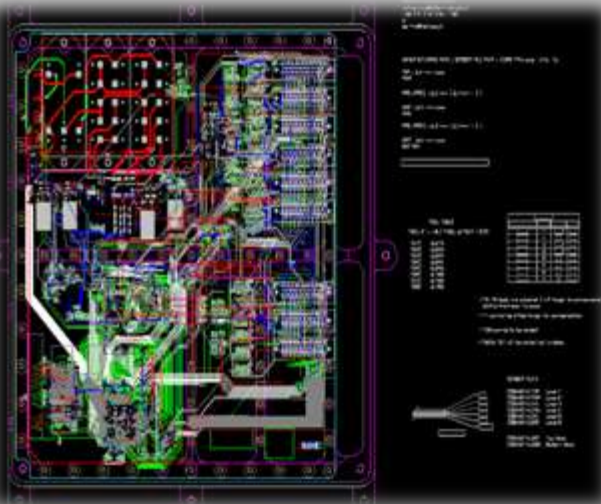
## Objectives

- Accumulate know-how to produce high resolution satellites at low-risk
- Test higher technology products for upcoming satellites in space
- Improve space based capabilities of Turkish space industry



# RASAT Satellite Subsystems

- Flight Computer with Spacewire
- Flight Software
- Ground Station Software, Mission Planning Software
- Image Compression, Encryption and Processing Module
- X-Band Transmitter



# Capabilities – Communication Systems

S Band Transmitter/Receiver & X Band Transmitter

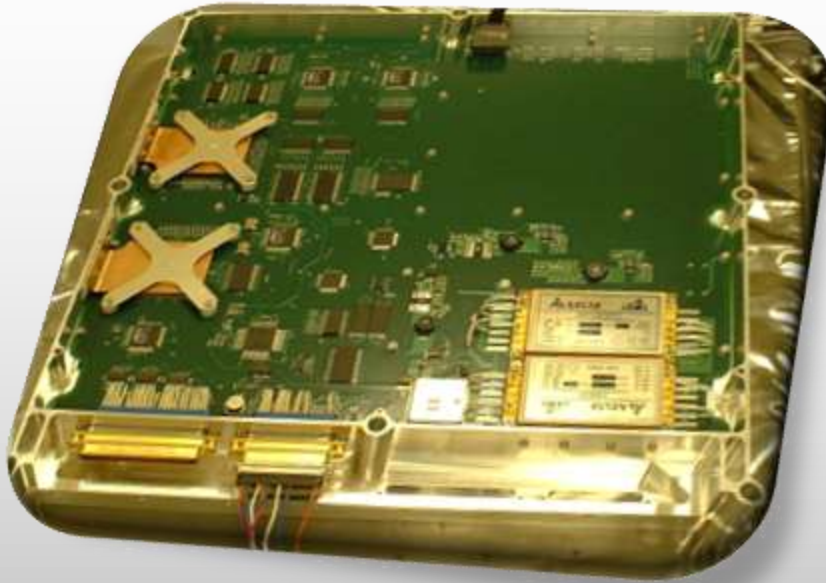
Communication system with 100 Mb/s downlink at 7W output.



On Board  
RASAT!

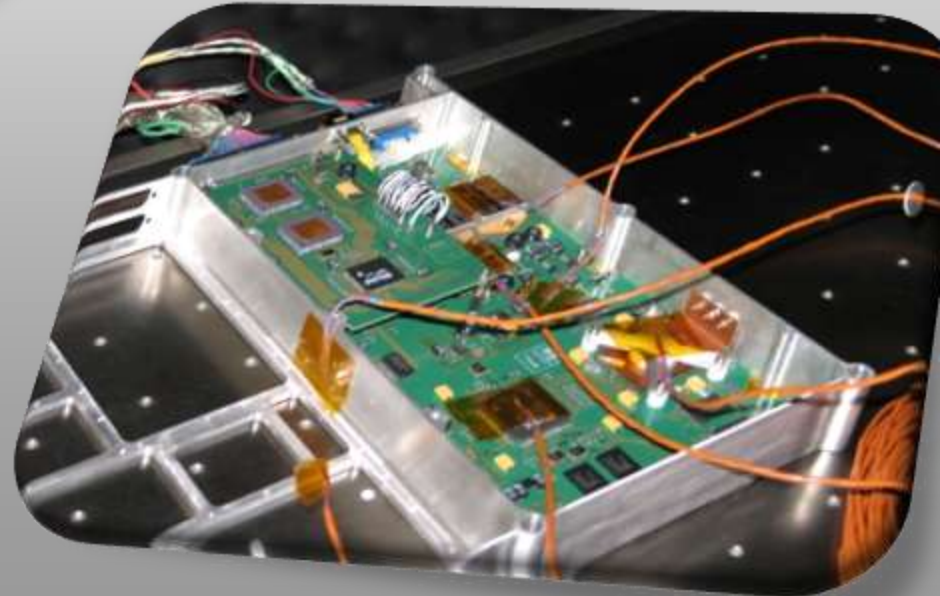


# Capabilities – On Board Image Processing



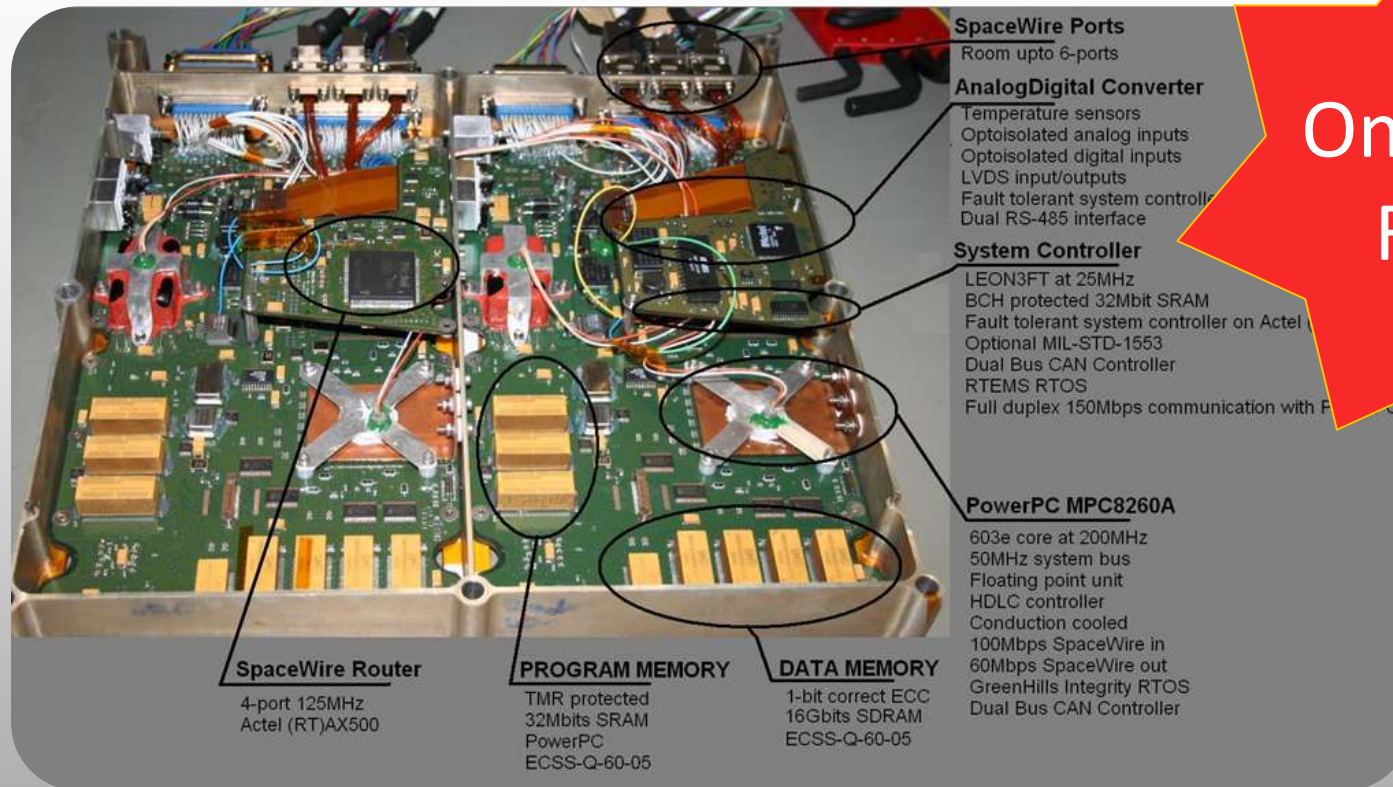
On Board  
RASAT!

GEZGiN-2: New generation image processor capable of high-speed multi-spectral image; compression using the JPEG2000 algorithms with encryption capabilities.





# Capabilities – Flight Computer



On Board  
RASAT!

BiLGE: Flight computer with the capability to utilize Spacewire

# Infrastructure

## Ground Station



- UHF/VHF
- S Band / X Band





# Recent Photos from RASAT



Adıyaman, Turkey, 11.10.2011



Beijing Airport, China, 16.10.2011



# Recent Photos from RASAT



Marsey, France, 12.10.2011



USA, Los Angeles,  
Harbour 12.10.2011

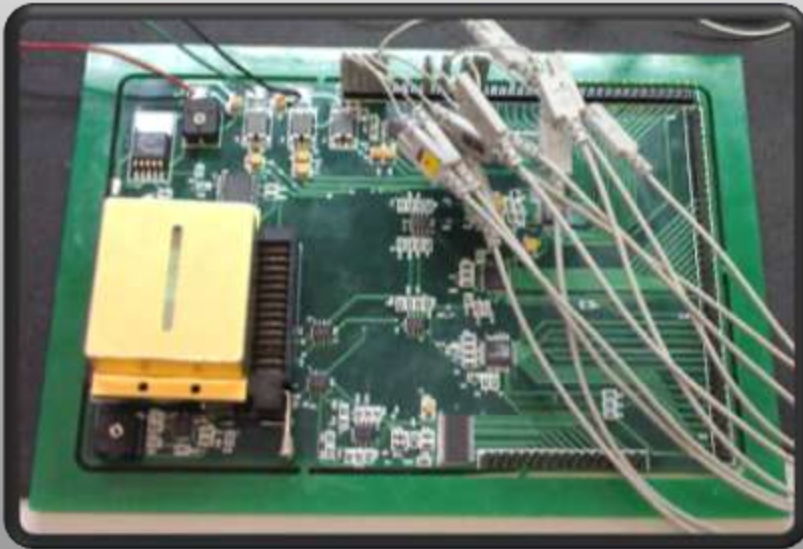


# Need: Imaging Systems for Eco Monitoring

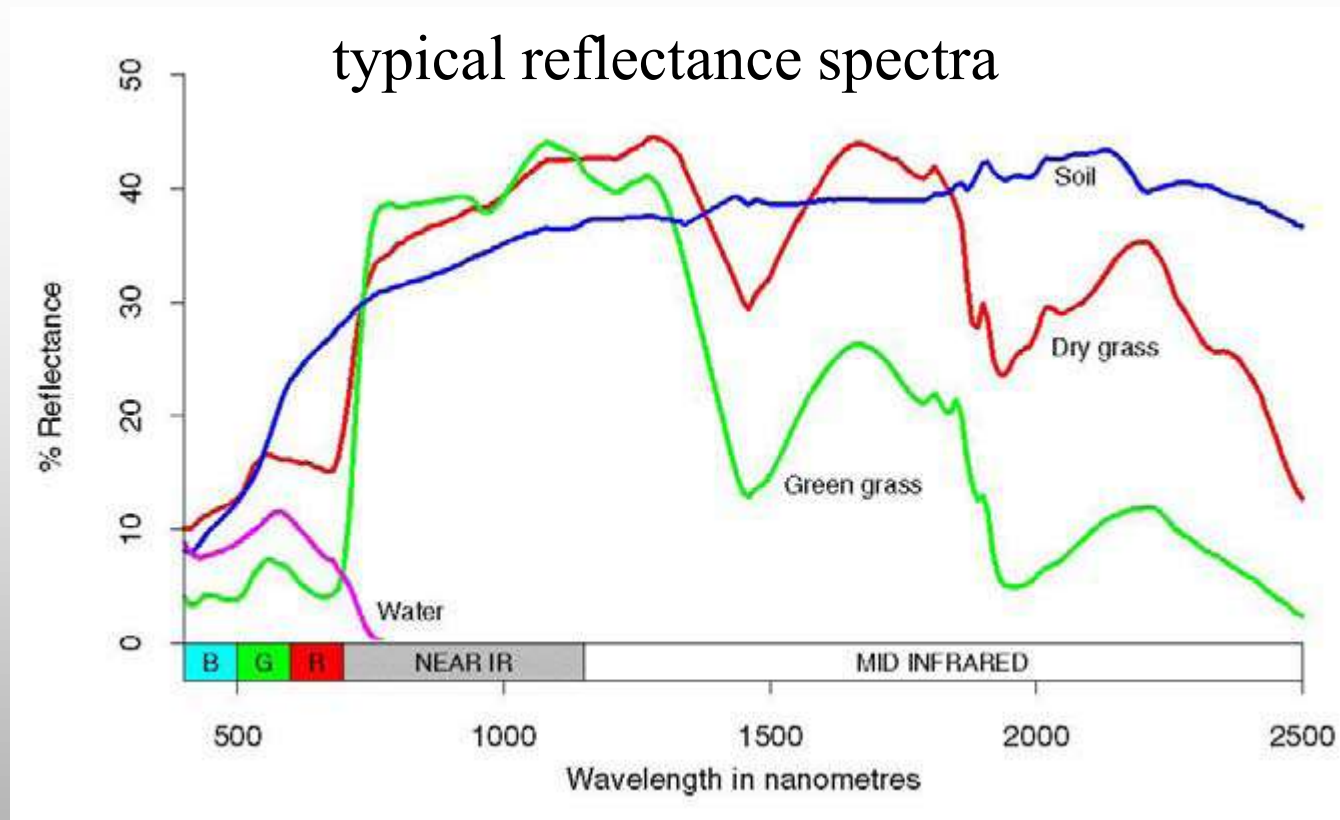
- Monitoring of biodiversity, protection of natural resources require the most recent and correct information.
- There are various ways of obtaining such information.
  - Field survey, traditional aerial photography
  - Challenges: insufficiency of the spectral capability of imagers to differentiate the features of interest or the impossibility of imaging at a very precise time or the insufficiency of ground sampling distance

# Optical Imaging System Capability

High resolution need for environmental monitoring:  
Thermo Electrically Cooled Satellite NIR Camera  
(KUZGUN)



# Need: Imaging Systems for Eco Monitoring



Vegetation has a unique spectral signature that enables it to be distinguished readily from other types of land cover in an optical/near-infrared image.

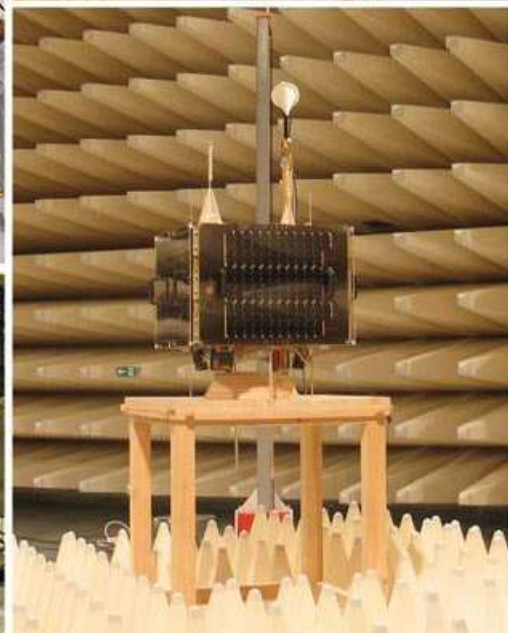
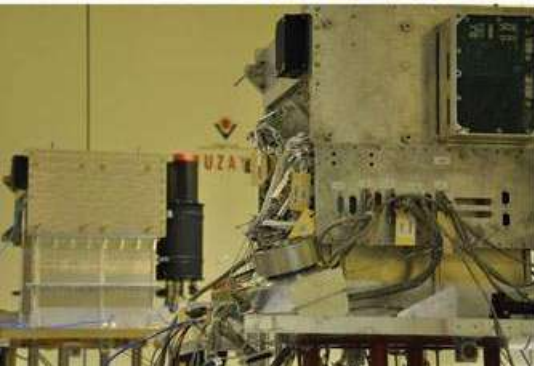
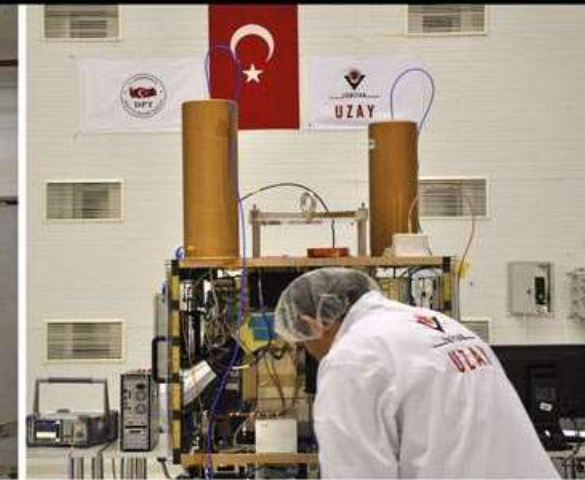
# Need: Imaging Systems for Eco Monitoring

- A short-wave long infrared (SWIR, 800nm-1700nm) band can be used to precisely detect clouds and land areas.
- Moisture is a key indicator of process control and quality in agriculture
- Water is opaque to SWIR illumination, detecting its presence or absence can be useful in gauging crop health and product ripeness or dryness.

# Need: Imaging Systems for Eco Monitoring

- TÜBİTAK UZAY is developing high resolution monitoring capability for environmental and eco-system monitoring
- KUZGUN will gain space heritage in 2012
- Future studies:
  - The development of hyper spectral imaging systems and  $<1\text{m}$  resolution satellite camera.
  - Specializing on environment applications of satellite data





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