

## Environment Induced Satellite Anomalies: Status at ESA

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## Context

- Spacecraft Anomaly: Unexpected behaviour of space systems that are an annoyance or potentially harmful.
- Most anomalies are not of environmental origin.
- Many environment induced anomalies can be avoided by proper design at reasonable cost but there will likely always will be some due to technology change and engineering staff turnover.



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## Experience built at ESA

Some Major Environment-Induced Problems happened in the 80's, e.g.: Marecs-A, B, ECS, Meteosat 1-3.

- Now space craft initial life-time expectation is usually exceeded.
- Currently: ~10 ESA spacecraft are supported by ESA operation centres and only minor problems are encountered.

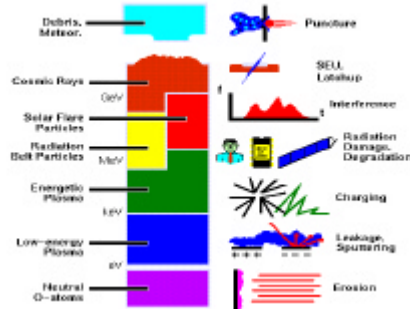


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## Examples of Space Environments and Effects

Example of Space Environment components

Example of Effects



## Examples of Problems with ESA SC

- ECS, MARECSA anomalies (plasma).
- Design corrected after long analysis
- Meteosat 3 (high energy electrons).
- Design corrected after long analysis
- SOHO SEU on all electronics (GCR and SCR).
- Quickly identified, level not as planned but not harmful.
- XMM background (~200 keV- 3 MeV protons).
- Reduced performance and could be improved via predictions.



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## Summary of the Status

- Current knowledge is insufficient to get 100% reliability wrt to environment effects.
- Space environment monitors (or accurate models) help in rapid diagnosis.
- Low energy particle effects are likely impossible to unambiguously identify without onboard sensors.
- S/C anomalies data and design information are difficult to access to.
- Operation teams are poorly aware of plasma and radiation environment effects.
- Observation missions have a strong interest in continuous monitoring of source of interferences and even predictions.



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### Future plans

- Increase use of Space Environment Monitors (cf Nieminen's talk)
- S/C anomaly database (SAAPS) will be made operational (cf <http://www.irfl.lu.se/saaps/>)
- On-line space environment data system (SEDAT, SAAPS, Space Weather System).
- On-line anomaly analysis and forecast system (SAAPS, Space weather system).



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### Conclusion

- Case for spacecraft community benefiting from continuous monitoring of space environment for anomaly analysis/avoidance is clear.
- Can be performed to a large extent with hitchhikers.
- Would also benefit from full blown space weather system.
- Hitchhikers are likely mandatory for effects related to low energy radiations (1. keV to 10 MeV).
- Tools for anomaly report and analysis are needed.
- Getting data from commercial spacecraft would be useful but is difficult.
- Education of users on space weather is also needed in this application area.



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