

Spacecraft Anomaly Analysis and Prediction System – SAAPS



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SAAPS

Spacecraft Anomaly Analysis and Prediction System

- ESA Contract 11974/96/NL/JG(SC):
 - Development of AI Methods in Spacecraft Anomaly Predictions
- Extension of the SPEE study
- Two year project (April 1999 - June 2001)
- Database and software

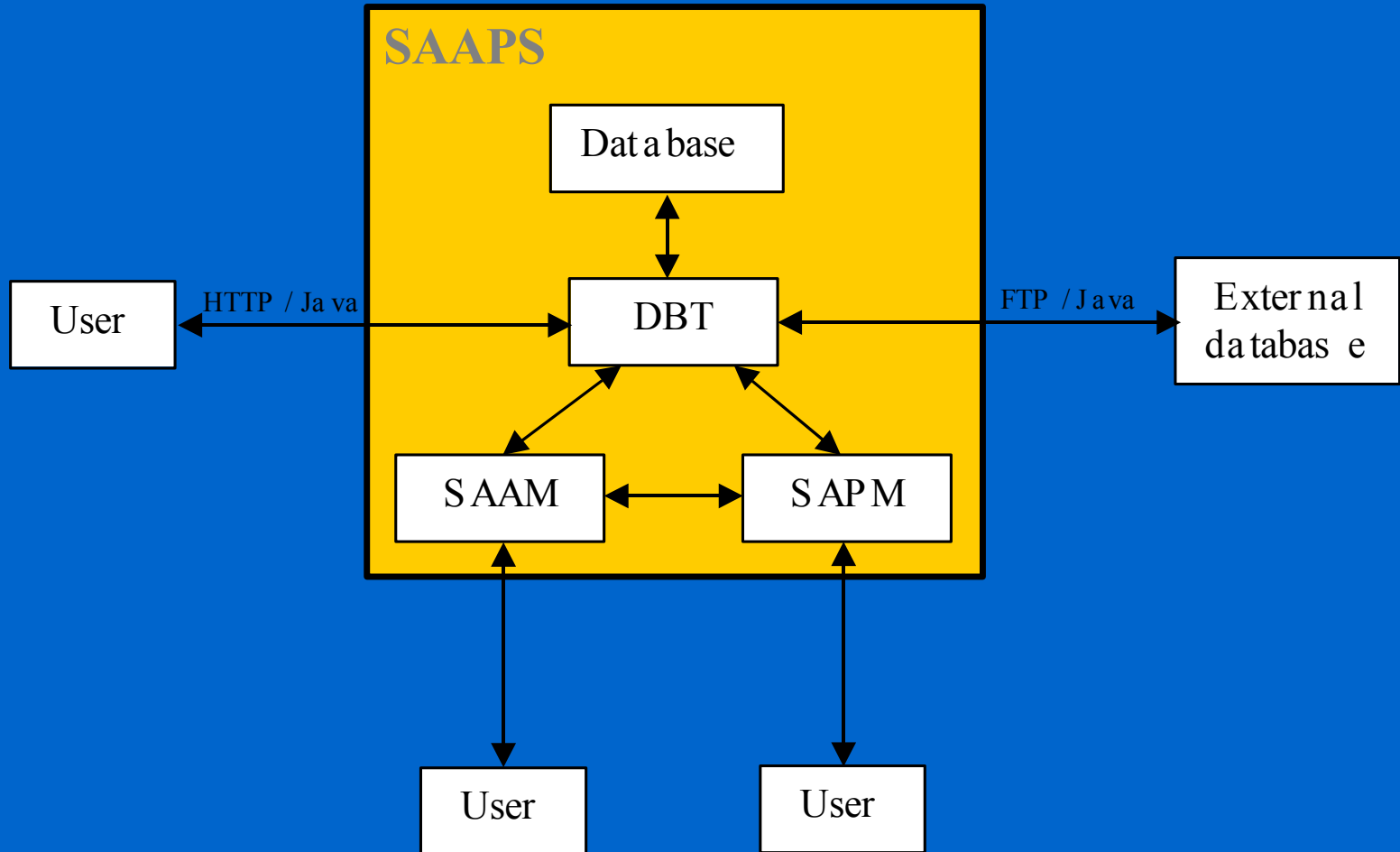
Purpose

Develop tools for the analysis and prediction of spacecraft anomalies.

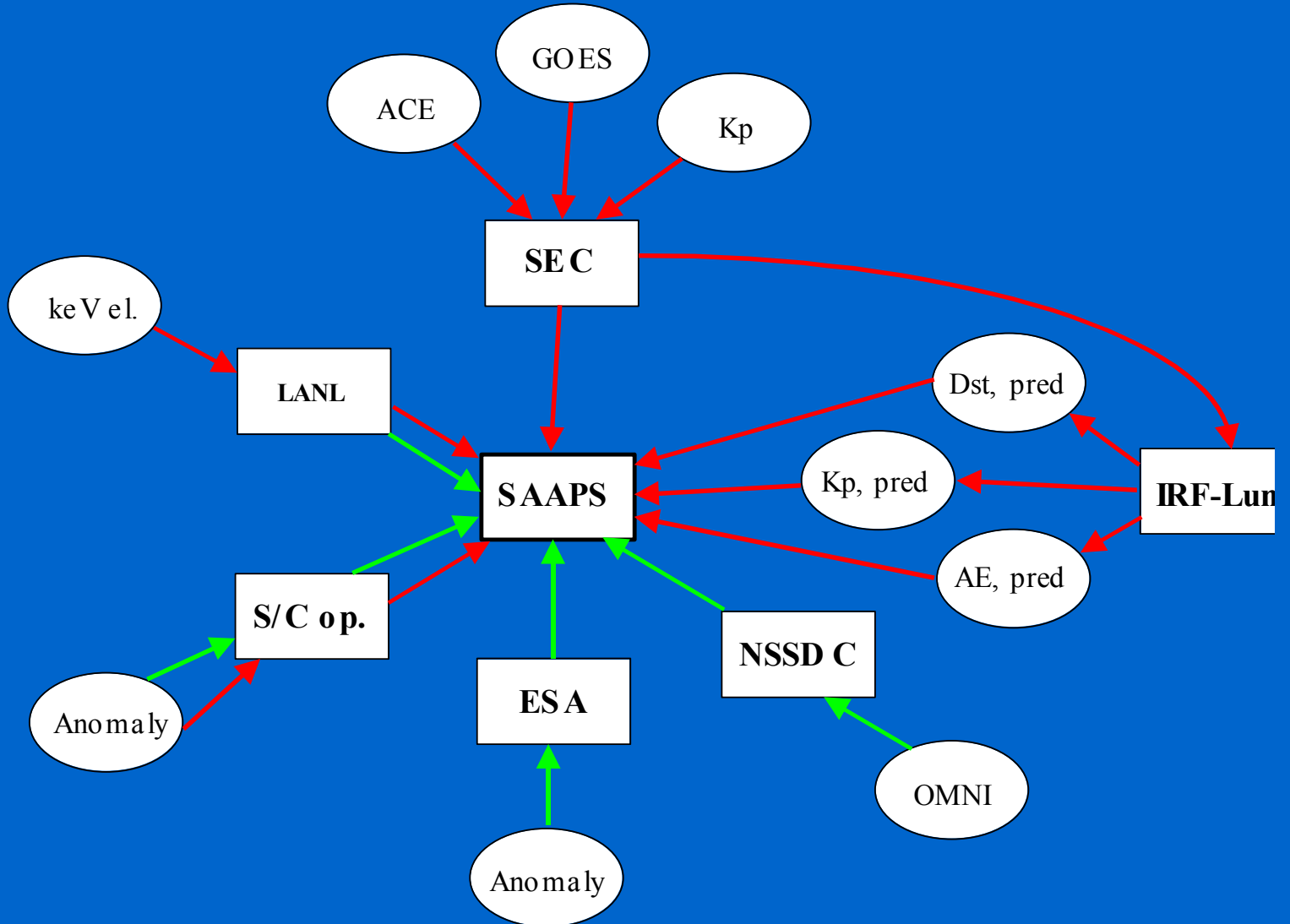
Approach

- Statistical methods for the analysis.
- Artificial intelligence (AI) based models, such as neural networks, for predictions.
- Real time operation.
- Database of space weather data and spacecraft anomalies.

The model



SAAPS Data Sources



SAAM

Spacecraft Anomaly Analysis Module

- Plotting tools
- Statistics
 - Superposed epoch analysis
 - Correlations (linear and entropy based)
 - Cluster analysis
 - Pattern definition and search
- Guidelines
- Estimate best prediction model

Data Plotter

http://sol.lund.irf.se

SEC Alerts SOHO Vel. & Dens. Apple N

Data Plotter

Database objects

- ACEmagDB
- ACEmagHourlyDB
- ACEsweDB
- ACEsweHourlyDB
- AEDB
- DstDB
- GOES08partDB
- GOES08xrayDB
- GOES10partDB
- GOES10xrayDB

Start

2003

10

31

Inspect Latest

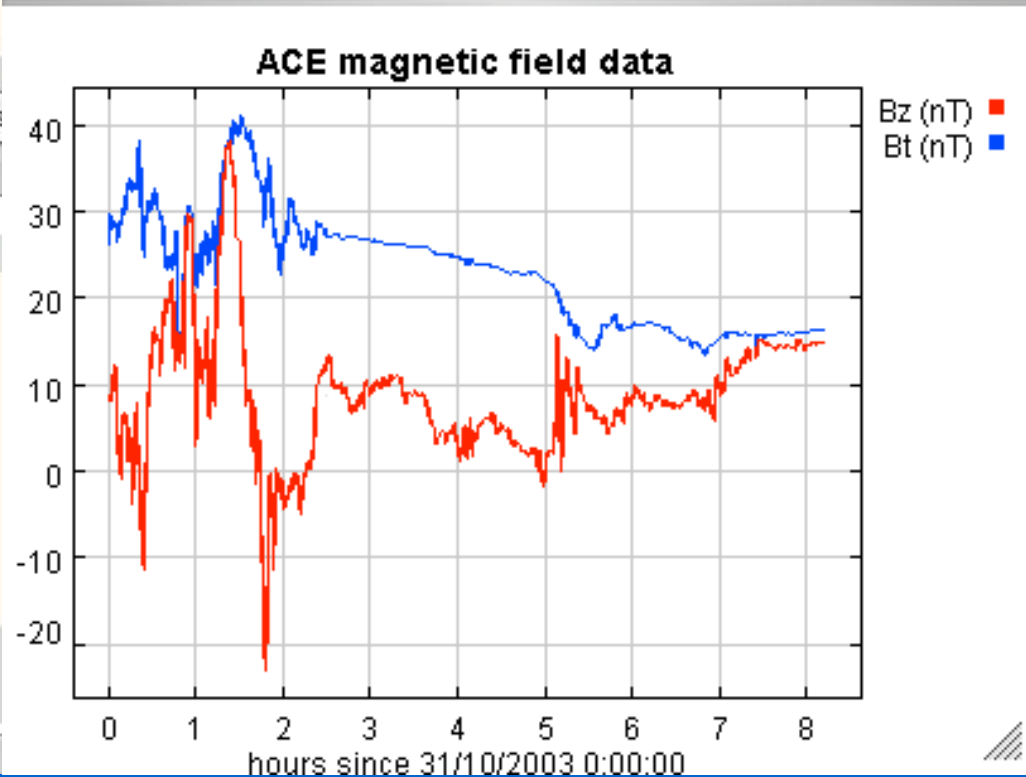
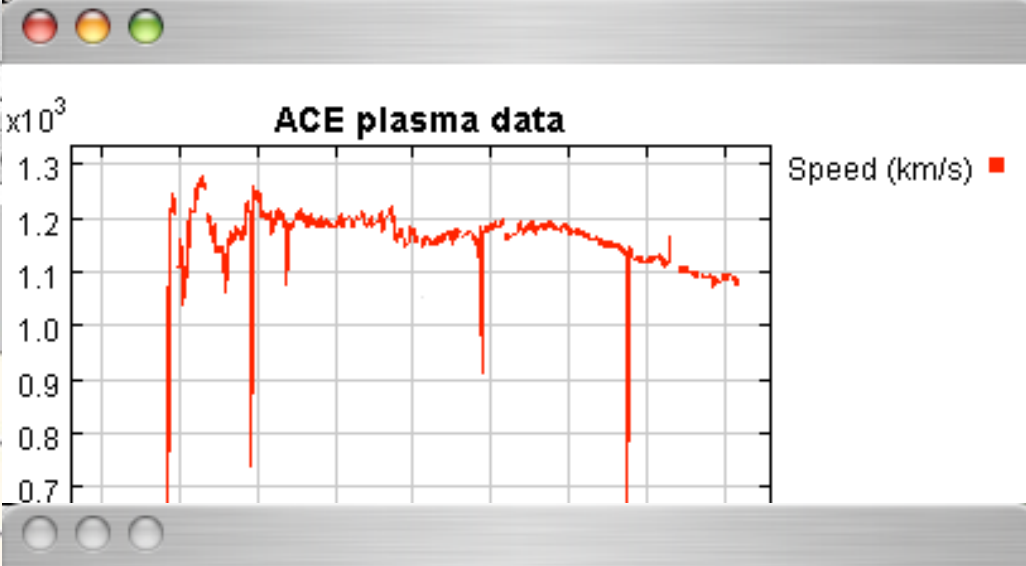
X Axis Data

- Time
- Density
- Speed

Y Axis Data

- Density
- Speed

Plot Help



SAPM

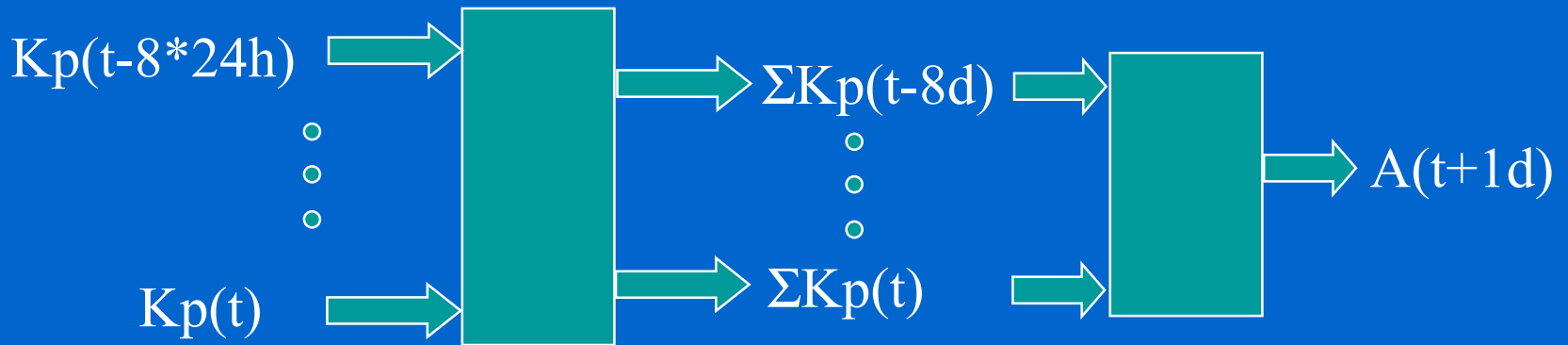
Spacecraft Anomaly Prediction Module

- Neural network based prediction models
- Real time forecast
- Connects to SAAM for analysis
- Anomaly index (?) and/or
- Spacecraft dependent anomaly predictions

Anomaly index?

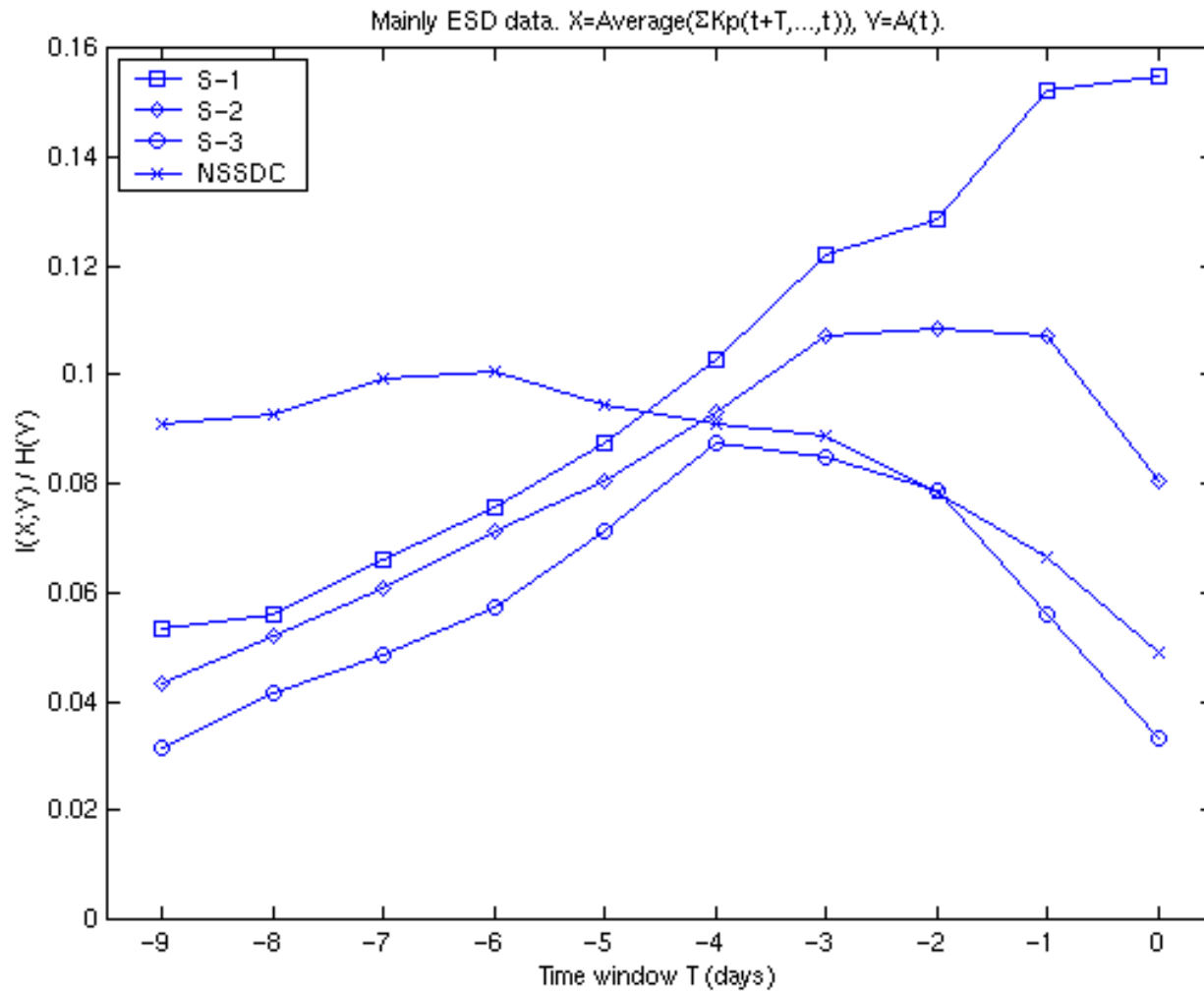
	S1	S2	S3	NSSDC
S1	1.00	0.02	0.03	0.03
S2	0.02	1.00	0.04	0.04
S3	0.02	0.02	1.00	0.11
NSSDC	0.02	0.02	0.10	1.00

ΣK_p based predictions

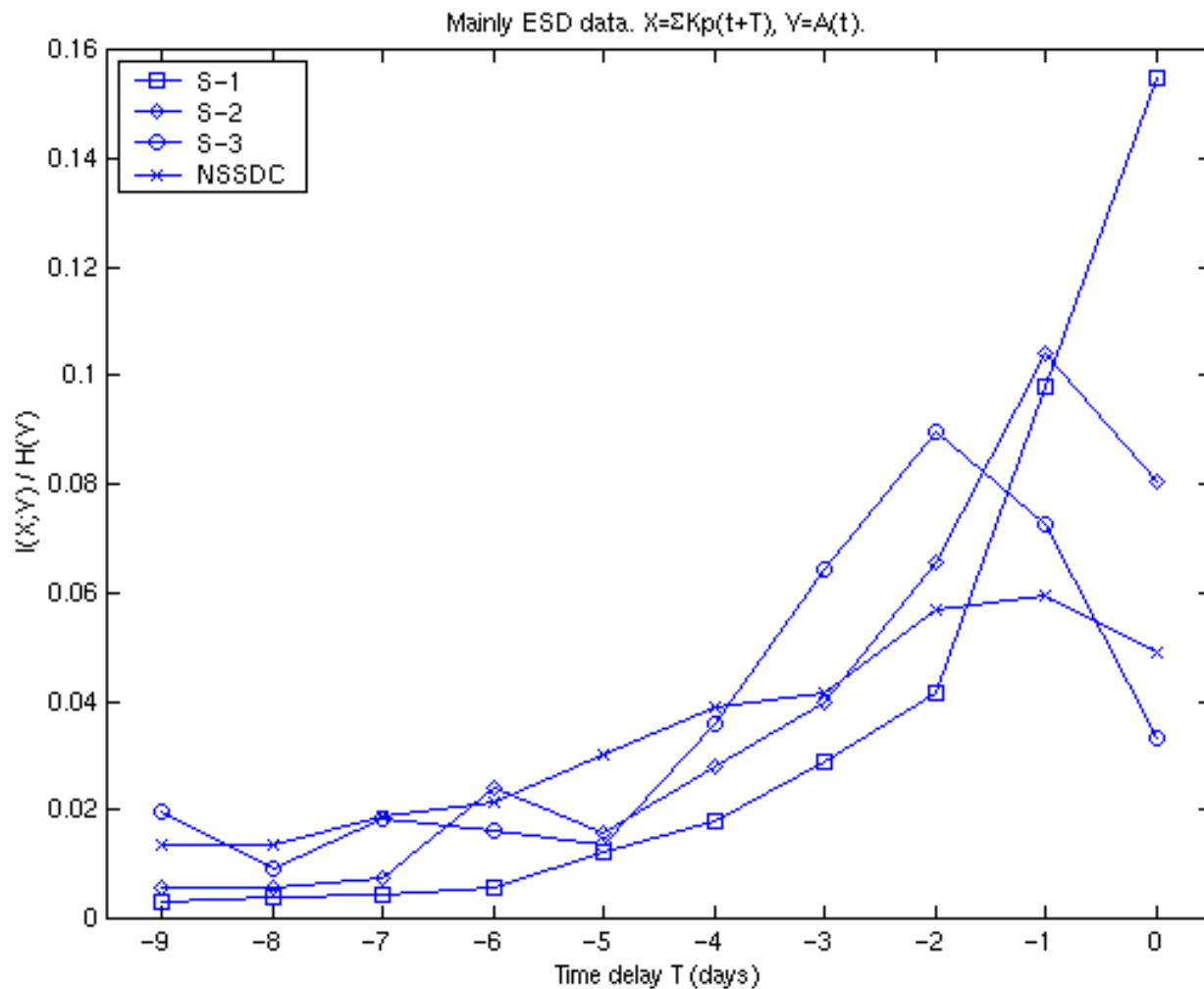


- Satellite specific model (geostationary)
- Fraction of correct classifications is 0.65 on balanced test set

Mutual information between average ΣKp and ESD anomaly data



Mutual information between ΣKp and ESD anomaly data



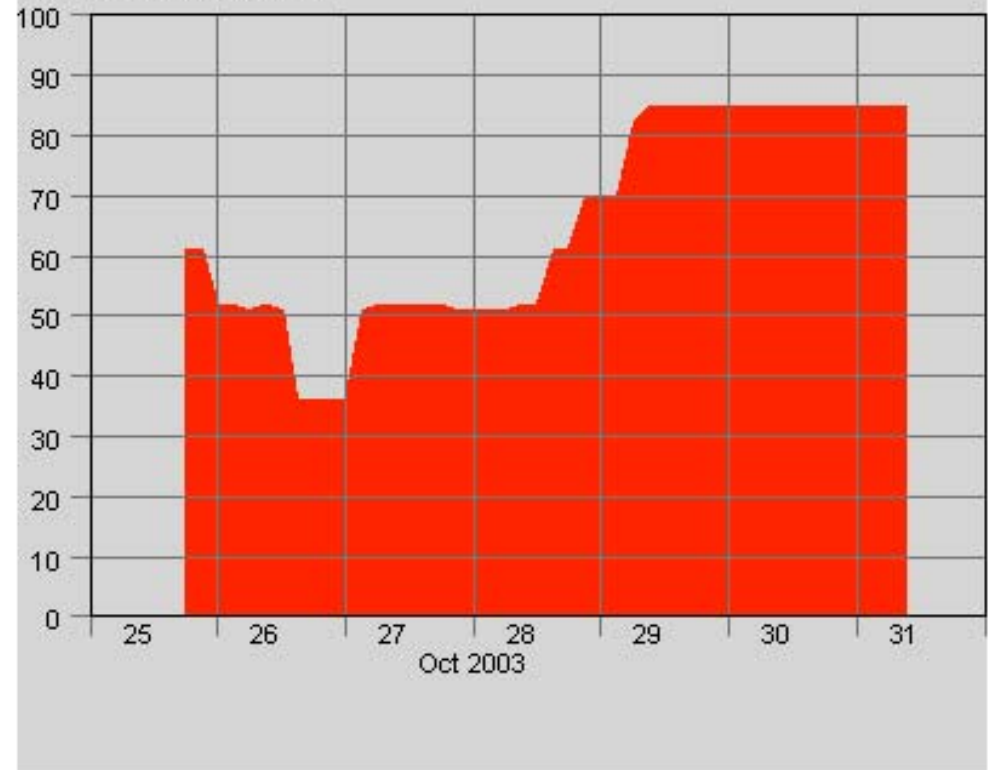
Anomaly Predictions

- Model
- Anom 001
 - Anom 002
 - Anom 003

Model Info ...

Year	2003
Month	10
Day	31

Probability for an anomaly.




Today Plot Help

SAAPS part of RWC-Sweden


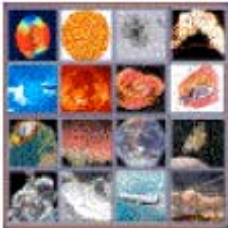
RWC-Sweden

http://www.lund.irf.se/rwc/

SEC Alerts SOHO Vel. & Dens. Apple Netscape.com .Mac Amazon eBay Yahoo! Google News MySQL Conn...umentation




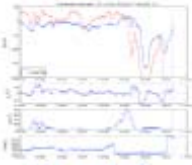
Regional Warning Center Sweden (RWC-Sweden)

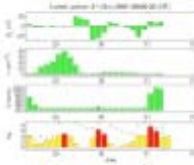



FORECASTS

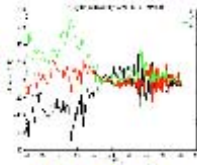
DATA


Lund Space Weather Forecast Service

[More info](#)

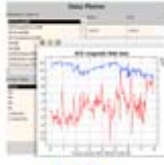
Dst

[More info](#)

Kp

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SAAPS

[HOME](#)

Magnetogram

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Solar-Terrestrial data

[Help](#)

Data plotter

[Help](#)

Issues

- SAAPS Applets
 - communicate over port 2001 => Firewall problems.
 - use of RMI for data access => RMI might be a problem on specific OS.
- SAAPS uses non-standard database engine.

Future

- SAAPS database and models will be merged with the IRF-GIC Pilot Project.
- A standard database engine will be used (MySQL).
- More development on the anomaly prediction models are necessary.

IRF SAAPS Server

<http://www.lund.irf.se/saaps/>

ESTEC SAAPS Server

<http://em450.wm.estec.esa.nl:6668/saaps/>

New ACE data set

- A new ACE data set will soon be released
 - Merged MAG and SWEPAM data
 - 64 second resolution
- <http://www.srl.caltech.edu/ACE/ASC/level2/index.html>

Lund Dst model

www.lund.irf.se/rwc/dst/models/

- Matlab
- Java