

Space Weather Needs and Existing Activities at ESOC

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Presentation to Space Weather
Workshop
ESTEC, 18/12/2002

Summary

- Space Weather Needs at ESOC
- Existing activities
- Future developments



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Space Weather Related Needs at ESOC

- Accurate orbit predictions
- Re-entry predictions
- Space debris predictions applications
- Spacecraft orbital lifetime predictions for future missions
- Spacecraft radio link disturbances predictions
- Monitoring the endangering of spacecraft by direct impact with solar emitted electrical charged particles.



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Plan

- Short-term solar & geomagnetic activity indices prediction
- Long-term solar & geomagnetic activity indices prediction
- Ionosphere monitoring & prediction



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Short-term solar geomagnetic predictions

- Prediction tool, PDFLAP, was developed in 1990 by BGS under ESOC contract.
- Since 1992, predictions over 27-days, including $\pm 3\sigma$, are automatically generated every day. These are used:
 - in the automatic routine orbit determination process
 - for other missions, according to the needs
 - re-entry analysis
 - space debris applications
- Automatic retrieval of latest observed F10.7 and Ap indices values



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Short-term solar geomagnetic predictions, cont'd

- Latest extension of the tool will incorporate E10.7 proxy and it has been developed by BGS under ESOC contract in 2001/2002.
- The new version is under testing, but agreement have been already made to get E10.7 data.



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Long-term solar geomagnetic predictions

- Prediction tool, SOLMAG, was developed in 1988 by BGS under ESOC contract.
- Since 1988, predictions over years, including $\pm 3\sigma$, are regularly generated every month. These are used:
 - in the long-term orbit predictions
 - spacecraft orbital lifetime studies
 - space debris applications
- Several users in ESOC can access the tool and generate the own predictions according to the needs.



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Long-term solar geomagnetic predictions, cont'd

- Monthly update of the input files, the smoothed mean sunspot number and Ap index.
- Predictions can be made available to external users.



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Other related activities

- Study contract with UCL, London, in 1998 produced a reference database of thermospheric winds. The tool was tested in the operational environment. The effects of winds on the orbits predictions are negligible.
- Several studies with BGS to correlate the variability of the geomagnetic activity with the determined drag coefficient for ERS-1, ERS-2 and recently ENVISAT.



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ESOC Ionosphere Monitoring Facility

- The ESOC Ionosphere Monitoring Facility (IONMON) has been developed by J. Feltens at ESOC in order to use dual-frequency GPS data, that are collected from the International GPS Service (IGS) global ground station network, to produce ionosphere products on routine basis, Ref. SWWT Meeting, ESOC, 5 July 2001.
- Since satellite signals are affected by ionosphere in dependency on the frequency, GPS dual-frequency offers a unique opportunity to observe directly the electron content along the signal path and to establish ionospheric electron density models.



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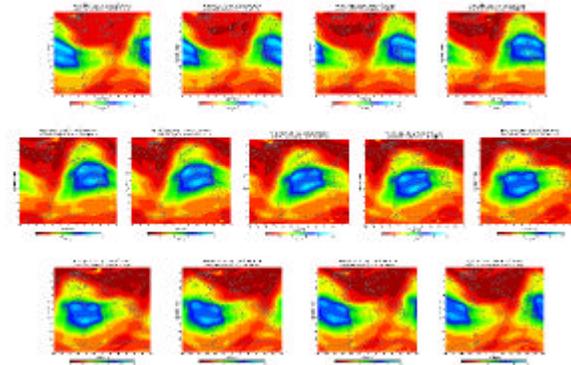
ESOC Ionosphere Monitoring Facility, cont'd

- The IONMON is part of routine IGS activities, run on ESOC's GPS Tracking Data and Analysis Facility (GPS TDAF).
- The products, TEC values in a grid format, are/will be used in routine orbit determination for several ESA missions (ERS-2, Envisat, Rosetta, etc).



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The ESOC TEC maps of 8 December 2002.



ESOC Ionosphere Predicting Facility

- To IONMON belongs also the Ionosphere predicting facility.
- The principle is based on polynominal fit to identical grid points over the previous days and then by evaluating the polynominal for the day to be predicted.
- Prediction usually covers two days ahead (RMS of prediction about 5-10 TEC units).



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Future developments

- As part of planned extensions (IONMON-2), the ionosphere prediction tool will be extend.
- As another application, IONMON will be used to support scintillation and signal corruption analysis for s/c-to-gs link problems (Cluster-2) and to predict possible risks.



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