



AFFECTS space weather tools and services

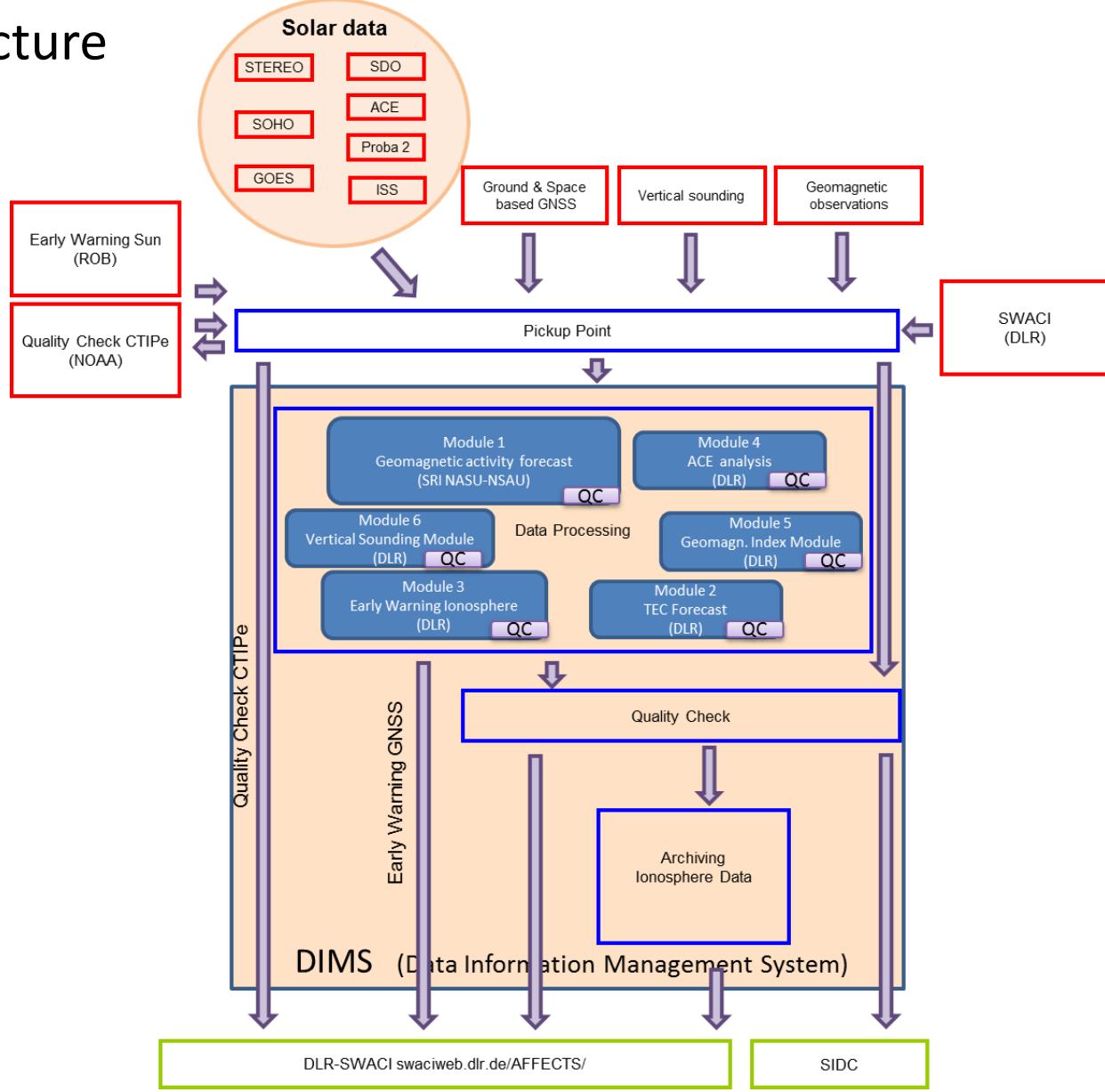
Forecast System Ionosphere

Presentation by Jens Berdermann





System architecture overview





Input data

Solar Wind Data

- ACE data

Ground & Spaced based GNSS

- TEC maps

Vertical Sounding

- SAO Files

Geomagnetic Observation

- indices

Early Warning

- Early Warning Message Sun

CTIPe

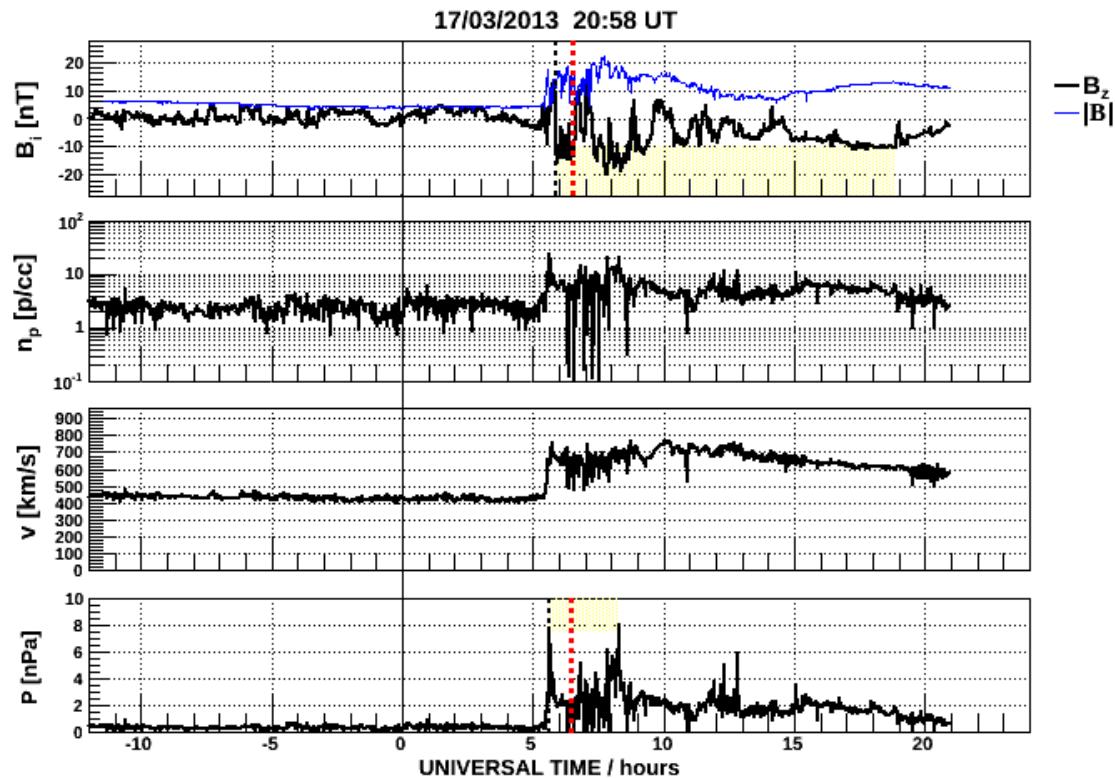
- TEC maps





ACE Analysis

- Processor developed at DLR
- Used for Pre-analysis and correlation studies on ACE measurements and storm onset definition
- Input: ACE data (NOAA-ESWDS)
- Output: data file, plot



DLR

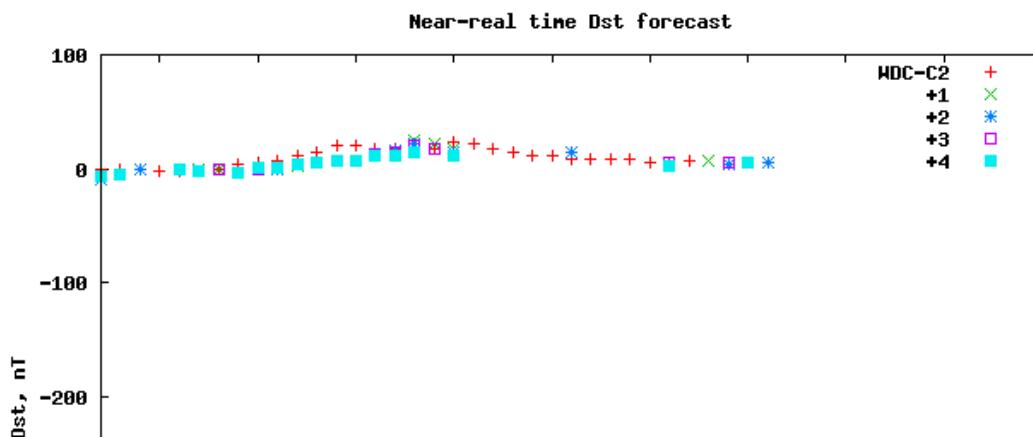




Geomagnetic activity forecast

- Processor developed at SRI NASU-NSAU
- Predicts the geomagnetic index Dst up to 4 hours in advance, storm onset definition
- Input: ACE data and previous Dst values
- Output: Dst forecast data file

HOY	HTND	YYYY	MM	DD	DOY	HH	Dst [nT]	FC+01H [nT]	FC+02H [nT]	FC+03H [nT]	FC+04H [nT]
653	476	2013	1	28	28	4	-15.	-13.	-15.	-12.	-13.
654	475	2013	1	28	28	5	-17.	-16.	-14.	9999.	-12.
655	474	2013	1	28	28	6	-17.	-17.	-16.	-15.	-15.
656	473	2013	1	28	28	7	-19.	-15.	-17.	-15.	-14.



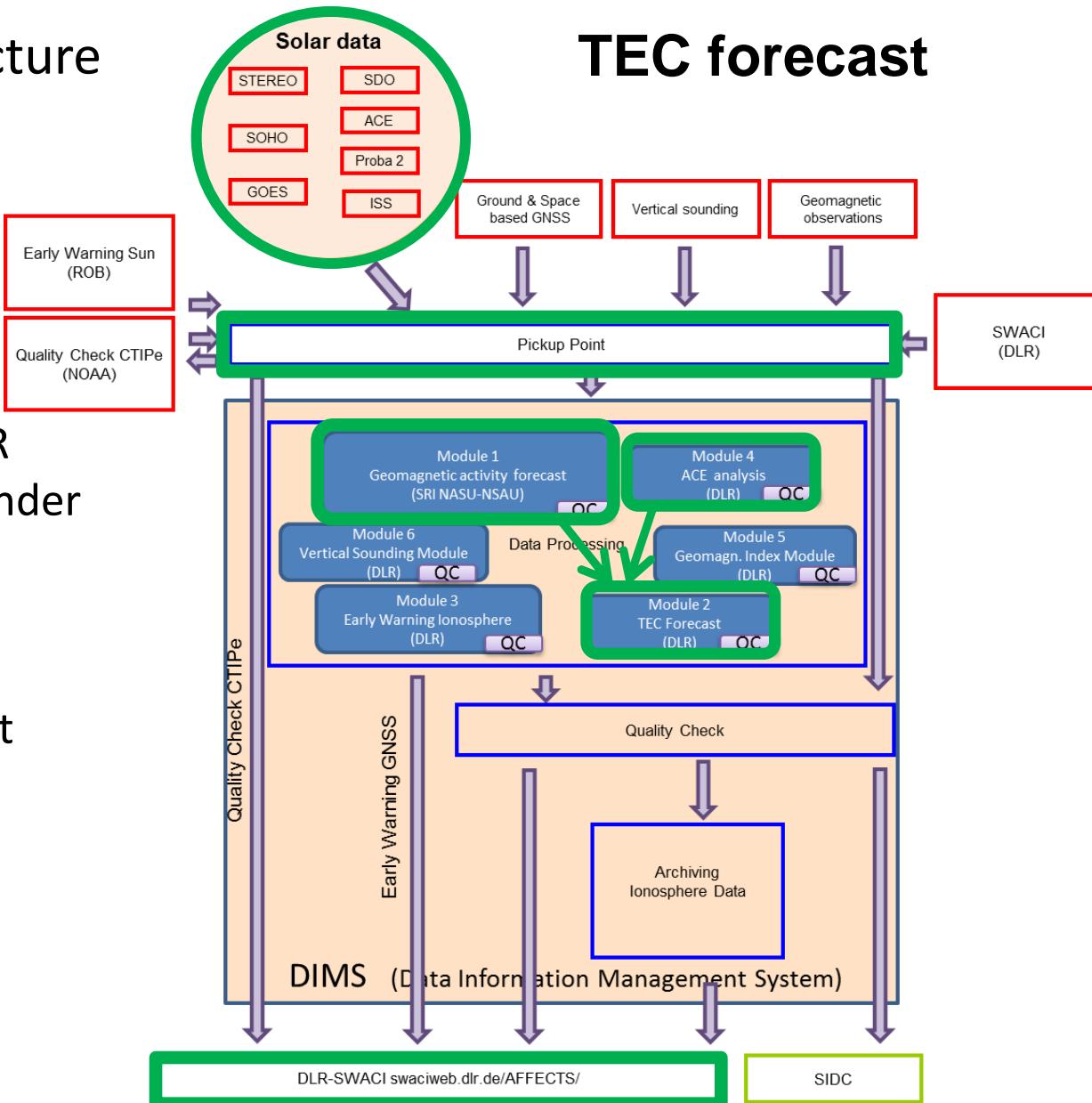
System architecture overview

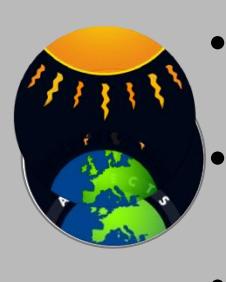


- Processor developed at DLR
- Predicts TEC over Europe under perturbed conditions (24 hours in advance)
- Input: ACE data
Geomagnetic forecast
TEC maps
- Output: TEC forecast maps

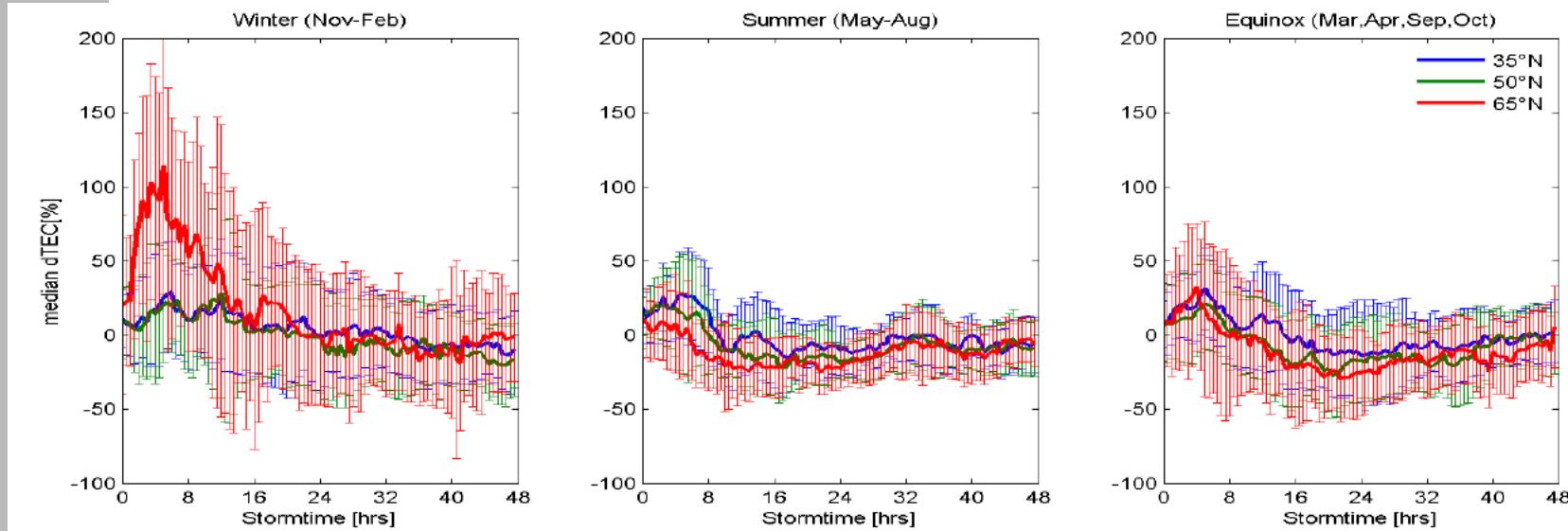


TEC forecast

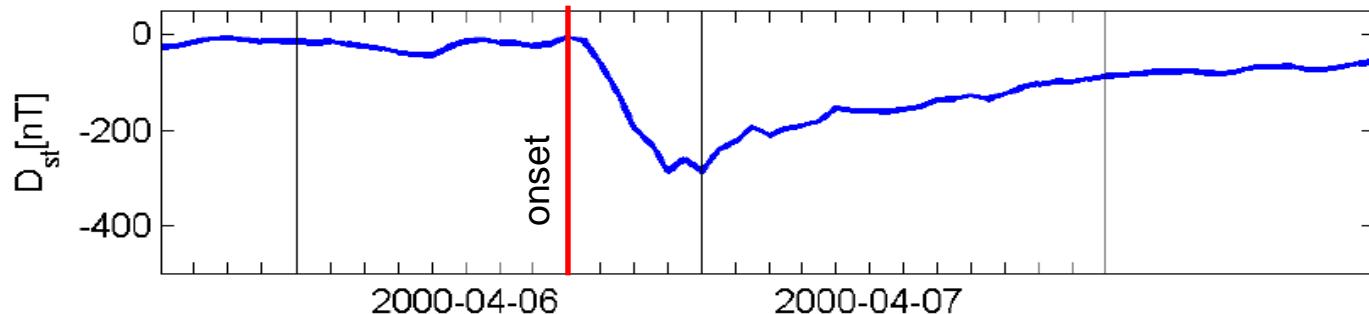




- 67 geomagnetic storms over europe in the periode 1995-2009 analysed
- Superposition of median differential TEC values for storms of defined subsamples depending on season, storm time and latitude
- Parametrization of a mean storm behaviour within the subsamples



Example for defining the storm onset via the forecasted Dst index.



TEC Forecast

60 min

120 min

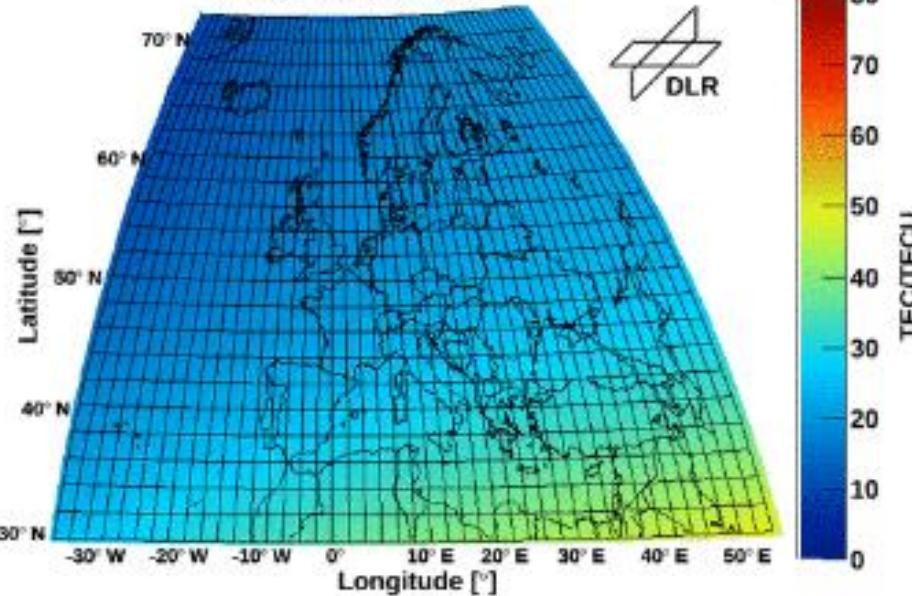
360 min

720 min

1440 min

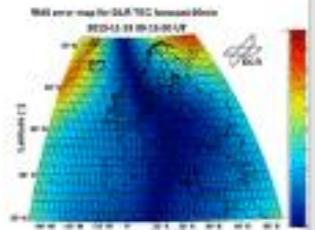
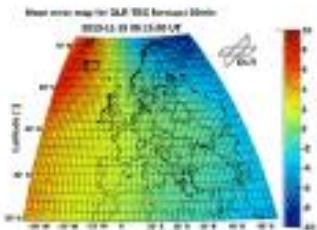
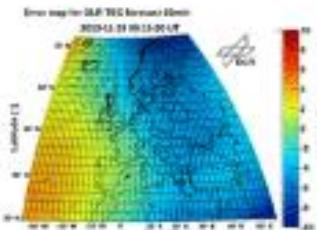
DLR TEC forecast 60min

2013-11-19 10:15:00 UT



Link to current DAT-file, please click here: [DAT](#)

DLR TEC Error views





TEC Forecast

60 min

120 min

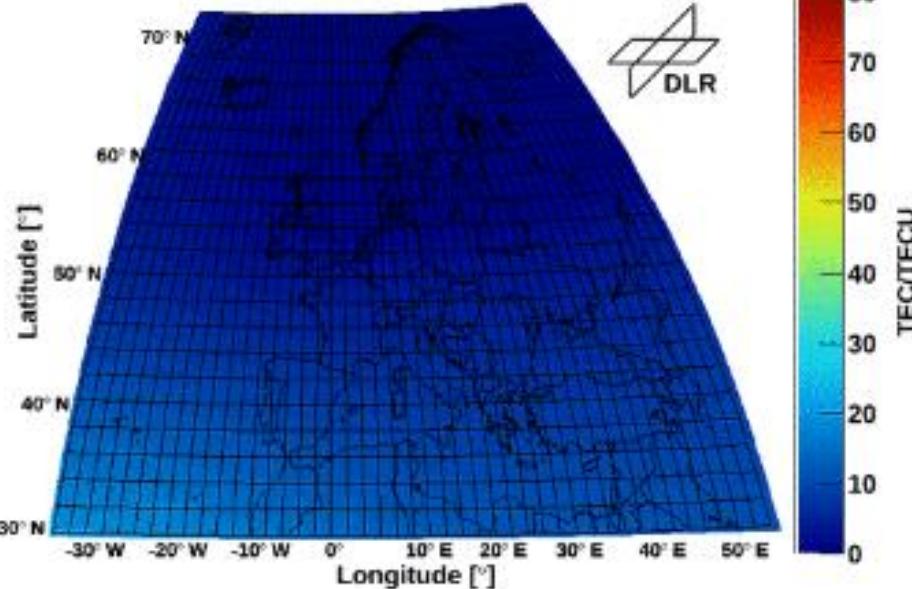
360 min

720 min

1440 min

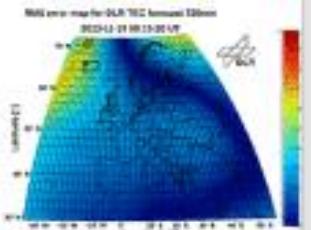
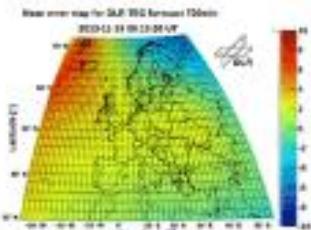
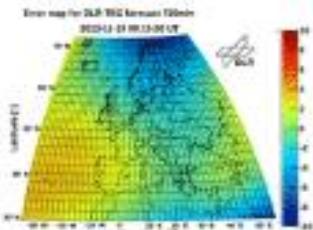
DLR TEC forecast 720min

2013-11-19 21:15:00 UT



Link to current DAT-file, please click here: [DAT](#)

DLR TEC Error views



Early Warning Message

- Processor developed at DLR
- Generates an early warning message primarily directed to users of GNSS systems
- Input: Solar alerts disseminated by ROB (UGOE)
- Output: Warning mail, Webpage update



Von: affects@dlr.de
An: knut.stanley.jacobsen@kartverket.no; satref@kartverket.no; Yngvild.linnea.andal@kartverket.no
Cc: Krafft, Christian; Jakowski, Norbert
Betreff: CME arrival alert

Nachricht EWI.html (2 KB) EWI.xml (1 KB)

Dear customer,

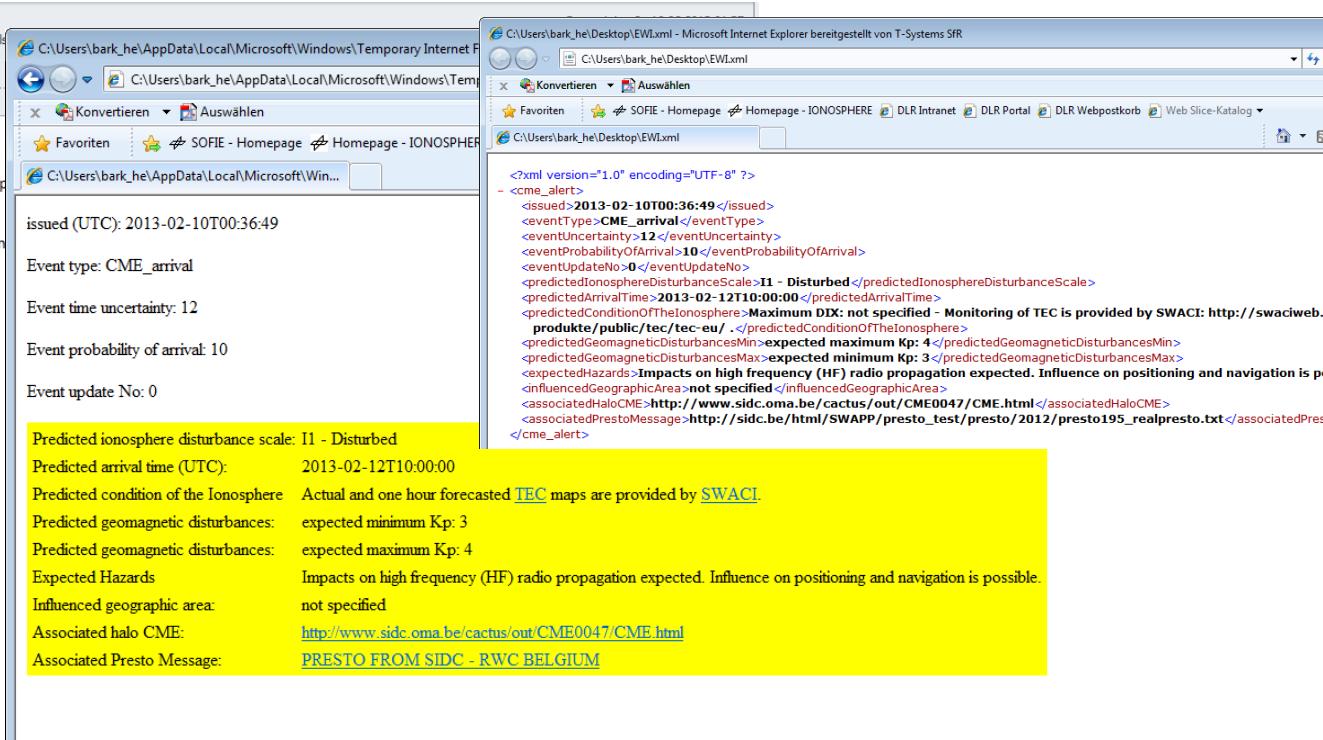
An incoming space weather event is announced. Associated ionospheric perturbations are expected. Please read the attached note (EWI.html) for detailed information.

Please find further information about acronyms and scientific formulation in the attached note.

With kind regards
Your IMPC Team

Ionospheric Monitoring and Prediction Center
Deutsches Zentrum für Luft- und Raumfahrt e.V.
in the Helmholtz-Association
German Aerospace Center

phone: +49 3981 480 106
fax: +49 3981 480 123



```
<?xml version="1.0" encoding="UTF-8"?>
<cme_alert>
<issued>2013-02-10T00:36:49</issued>
<eventType>CME_arrival</eventType>
<eventUncertainty>12</eventUncertainty>
<eventProbabilityOfArrival>10</eventProbabilityOfArrival>
<eventUpdateNo>0</eventUpdateNo>
<predictedIonosphereDisturbanceScale>II - Disturbed</predictedIonosphereDisturbanceScale>
<predictedArrivalTime>2013-02-12T10:00:00</predictedArrivalTime>
<predictedConditionOfTheIonosphere>Maximum DIX: not specified - Monitoring of TEC is provided by SWACI: http://swaci.be/produkte/public/tec/tec-eu/ </predictedConditionOfTheIonosphere>
<predictedGeomagneticDisturbancesMin>expected maximum Kp: 4</predictedGeomagneticDisturbancesMin>
<predictedGeomagneticDisturbancesMax>expected minimum Kp: 3</predictedGeomagneticDisturbancesMax>
<expectedHazards>Impacts on high frequency (HF) radio propagation expected. Influence on positioning and navigation is possible</expectedHazards>
<influencedGeographicArea>not specified</influencedGeographicArea>
<associatedHaloCME>http://www.sidc.oma.be/cactus/out/CME0047/CME.html</associatedHaloCME>
<associatedPrestoMessage>http://sidc.be/html/SWAPP/presto_test/presto_2012/presto195_realpresto.txt</associatedPrestoMessage>
<cme_alert>
```

Predicted ionosphere disturbance scale: II - Disturbed

Predicted arrival time (UTC): 2013-02-12T10:00:00

Predicted condition of the Ionosphere: Actual and one hour forecasted [TEC](#) maps are provided by [SWACI](#).

Predicted geomagnetic disturbances: expected minimum Kp: 3

Predicted geomagnetic disturbances: expected maximum Kp: 4

Expected Hazards: Impacts on high frequency (HF) radio propagation expected. Influence on positioning and navigation is possible.

Influenced geographic area: not specified

Associated halo CME: <http://www.sidc.oma.be/cactus/out/CME0047/CME.html>

Associated Presto Message: http://sidc.be/html/SWAPP/presto_test/presto_2012/presto195_realpresto.txt

Automated check system for FSI products.



The system allows to detect missing products at the earliest possible time and informs the corresponding colleagues for maintenance via email.

Warning:

You got this automatically generated message because the following products on swacweb.dlr.de are outdated or not available:

Product	Status	Delay	Maximal Delay
Total Electron Content (TEC)	304: Ok	31 minutes 07 seconds	20 minutes 00 seconds
One Hour TEC Forecast	304: Ok	31 minutes 00 seconds	20 minutes 00 seconds
TEC Error	304: Ok	31 minutes 01 seconds	20 minutes 00 seconds
TEC Forecast Quality	304: Ok	31 minutes 01 seconds	20 minutes 00 seconds
TEC Median - 27 days	304: Ok	31 minutes 07 seconds	20 minutes 00 seconds
Model Total Electron Content (TEC)	304: Ok	31 minutes 10 seconds	20 minutes 00 seconds
TEC Gradient - Latitude	304: Ok	31 minutes 04 seconds	20 minutes 00 seconds
TEC Gradient - Longitude	304: Ok	31 minutes 04 seconds	20 minutes 00 seconds
TEC Rate	304: Ok	31 minutes 15 seconds	20 minutes 00 seconds

Please note:

This message was sent to the following receivers:

- Martin.Kriegel@dlr.de

Last Check: 2013-11-18 14:28:01 (UTC)		
Product Group	Product	Last Modified (UTC)
TEC Personnel	Total Electron Content (TEC) - 24h	2013-11-18 14:28:01
TEC Personnel	TEC Error	2013-11-18 14:28:01
TEC Personnel	TEC Forecast Quality	2013-11-18 14:28:01
TEC Personnel	TEC Forecast Quality (24h)	2013-11-18 14:28:01
TEC Personnel	TEC Median (24h)	2013-11-18 14:28:01
TEC Personnel	Model Total Electron Content (TEC)	2013-11-18 14:28:01
TEC Personnel	TEC Gradient - Latitude	2013-11-18 14:28:01
TEC Personnel	TEC Gradient - Longitude	2013-11-18 14:28:01
TEC Personnel	TEC Rate	2013-11-18 14:28:01
TEC Personnel	Total Electron Content (TEC) - 24h (24h)	2013-11-18 14:28:01
TEC Personnel	TEC Forecast Quality (24h) (24h)	2013-11-18 14:28:01
TEC Personnel	TEC Forecast Quality (24h) (24h) (24h)	2013-11-18 14:28:01
TEC Personnel	TEC Median (24h) (24h)	2013-11-18 14:28:01
TEC Personnel	Model Total Electron Content (TEC) (24h)	2013-11-18 14:28:01
TEC Personnel	TEC Gradient - Latitude (24h)	2013-11-18 14:28:01
TEC Personnel	TEC Gradient - Longitude (24h)	2013-11-18 14:28:01
TEC Personnel	TEC Rate (24h)	2013-11-18 14:28:01
ACM	ACM	2013-11-18 14:28:01
ACM	ACM (24h)	2013-11-18 14:28:01
Vertical Sounding	Vertical Sounding	2013-11-18 14:28:01
Vertical Sounding	Vertical Sounding (24h)	2013-11-18 14:28:01
Vertical Sounding	Vertical Sounding (24h) (24h)	2013-11-18 14:28:01
Vertical Sounding	Vertical Sounding (24h) (24h) (24h)	2013-11-18 14:28:01
Geosynchronous	Geosynchronous Satellite Orbit Determination	2013-11-18 14:28:01
Geosynchronous	Geosynchronous Satellite Orbit Determination (24h)	2013-11-18 14:28:01

Continued:

[View All Products](#)
[View All Services](#)





Thanks for your attention!

Contact:

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Institute of Communication and Navigation**

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The research leading to these results has received funding from the European Commission's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n° 263506 (AFFECTS project, www.affects-fp7.eu).

