



Monitoring the Response to Geomagnetic Storms Using GPS Total Electron Content Measurements

Mariangel Fedrizzi and Eurico Rodrigues de Paula

Instituto Nacional de Pesquisas Espaciais

São José dos Campos, SP, Brasil

Richard B. Langley

Department of Geodesy and Geomatics Engineering

University of New Brunswick

Fredericton, N.B., Canada

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Geodetic Research Laboratory • Department of Geodesy and Geomatics Engineering • University of New Brunswick



Overview



Objectives

Methodology

Results

Conclusions

Future work



Objectives



- Total electron content (TEC) determination from GPS data using the University of New Brunswick (UNB) Ionospheric Modelling Technique.
- RBMC Brazilian GPS network and global network of IGS stations
- Ionospheric response to the March 31, 2001 geomagnetic storm and comparison with quiet days (e.g. 15 and 16 March 2001).



Methodology



- UNB Ionospheric Modelling Technique.
- Observation equation:

$$I(t) = M(e) [a_0(t) + a_1(t) dl + a_2(t) df] + b_r + b^s$$

$I(t)$	L1-L2 ionospheric measurement,
$M(e)$	elevation angle mapping function,
$[a_0(t) + a_1(t) dl + a_2(t) df]$	spatial linear approximation of TEC,
$b_r + b^s$	satellite-receiver differential delays.

- Single layer ionospheric model computed for each station.



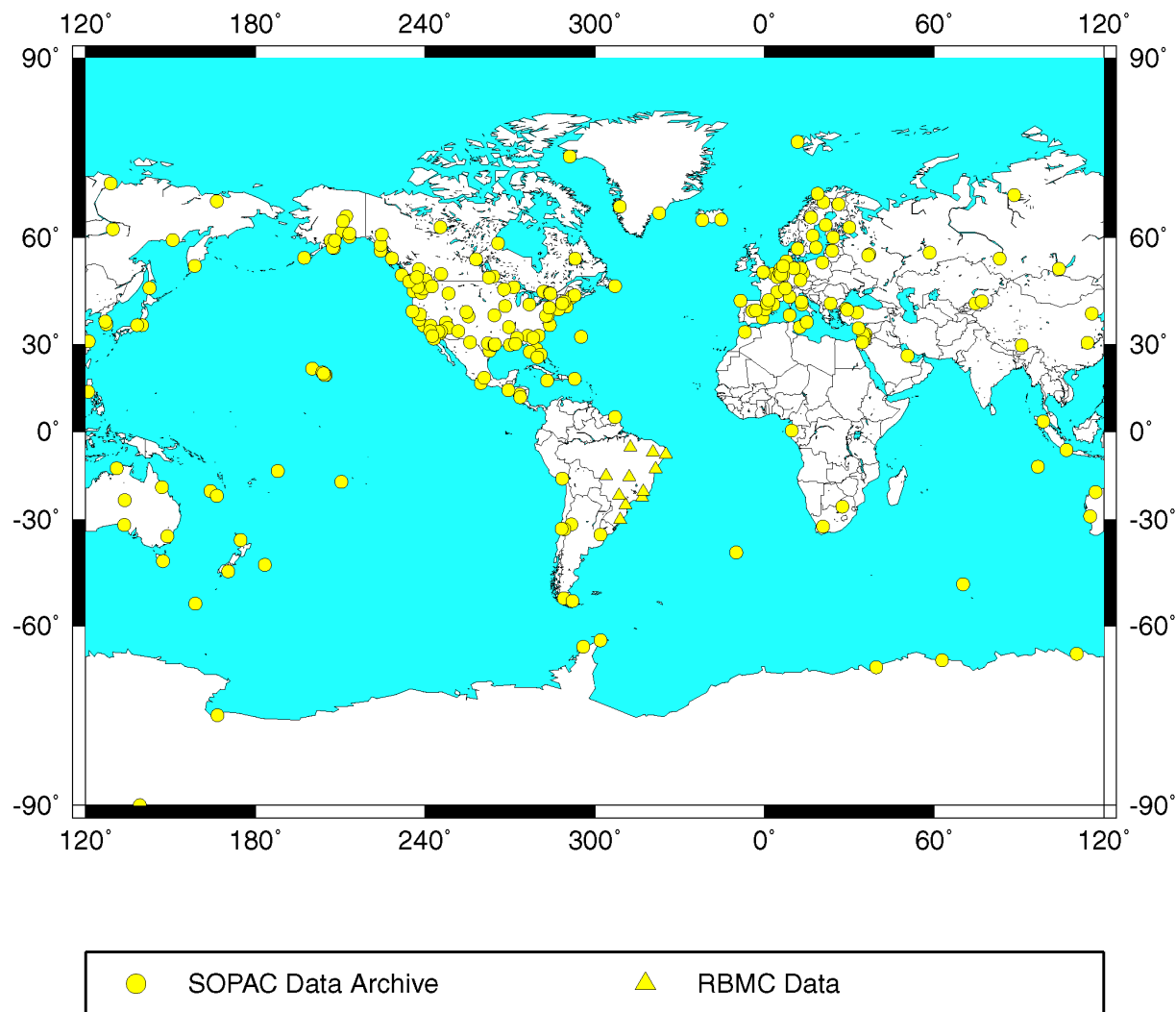
Methodology (cont.)



- Solar-geomagnetic reference frame.
- 5-degree grid spacing maps.
- TEC at each grid node computed using the 4 closest stations.
- Komjathy A., Langley R. B. (1996), *The Proceedings of the National Technical Meeting of the Institute of Navigation*, pp. 615-624.
- Komjathy, A. (1997), *Technical Report No. 188*, University of New Brunswick.
- Fedrizzi et al. (2001), *The Proceedings of ION GPS 2001*, pp. 2468-2475.



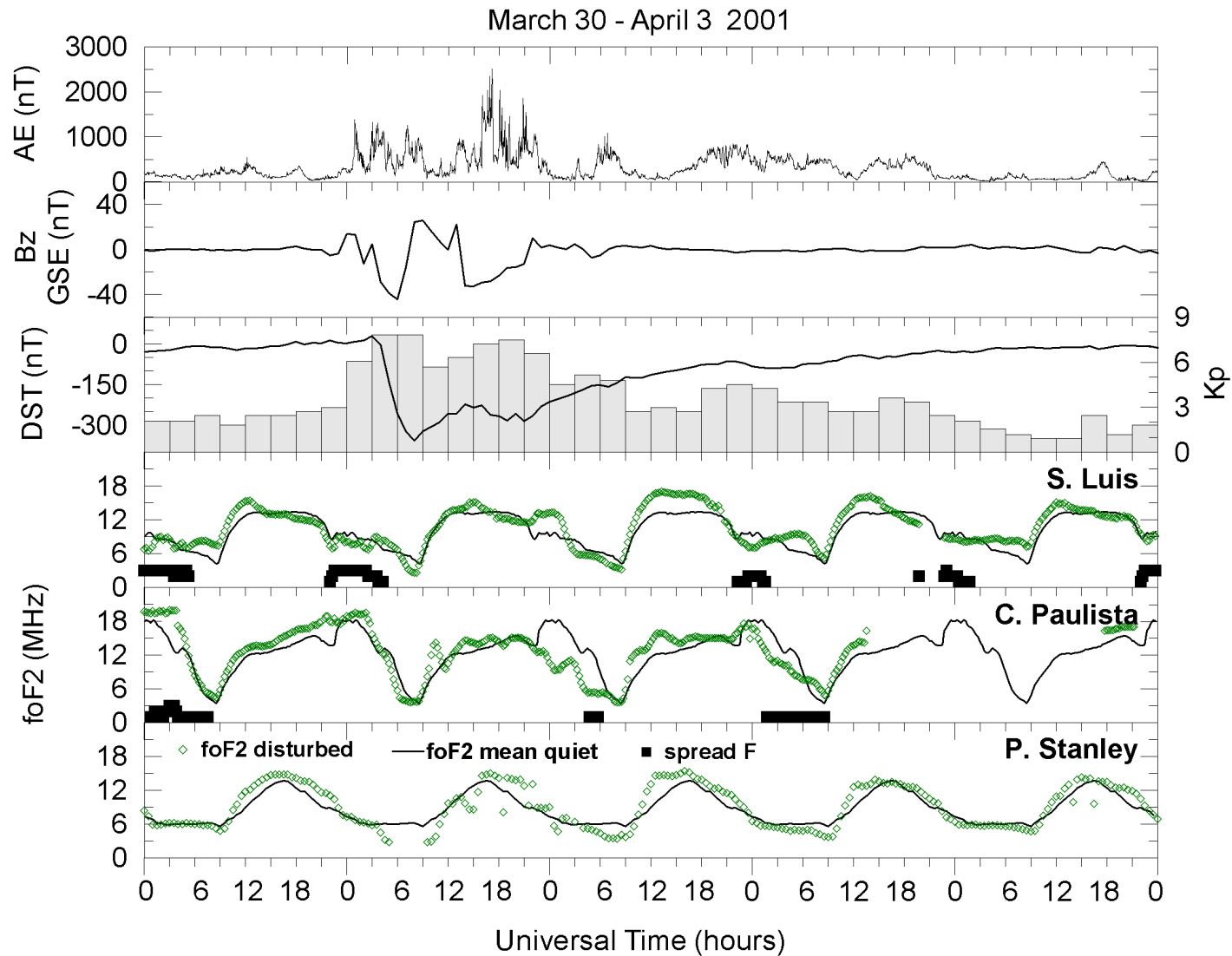
Stations



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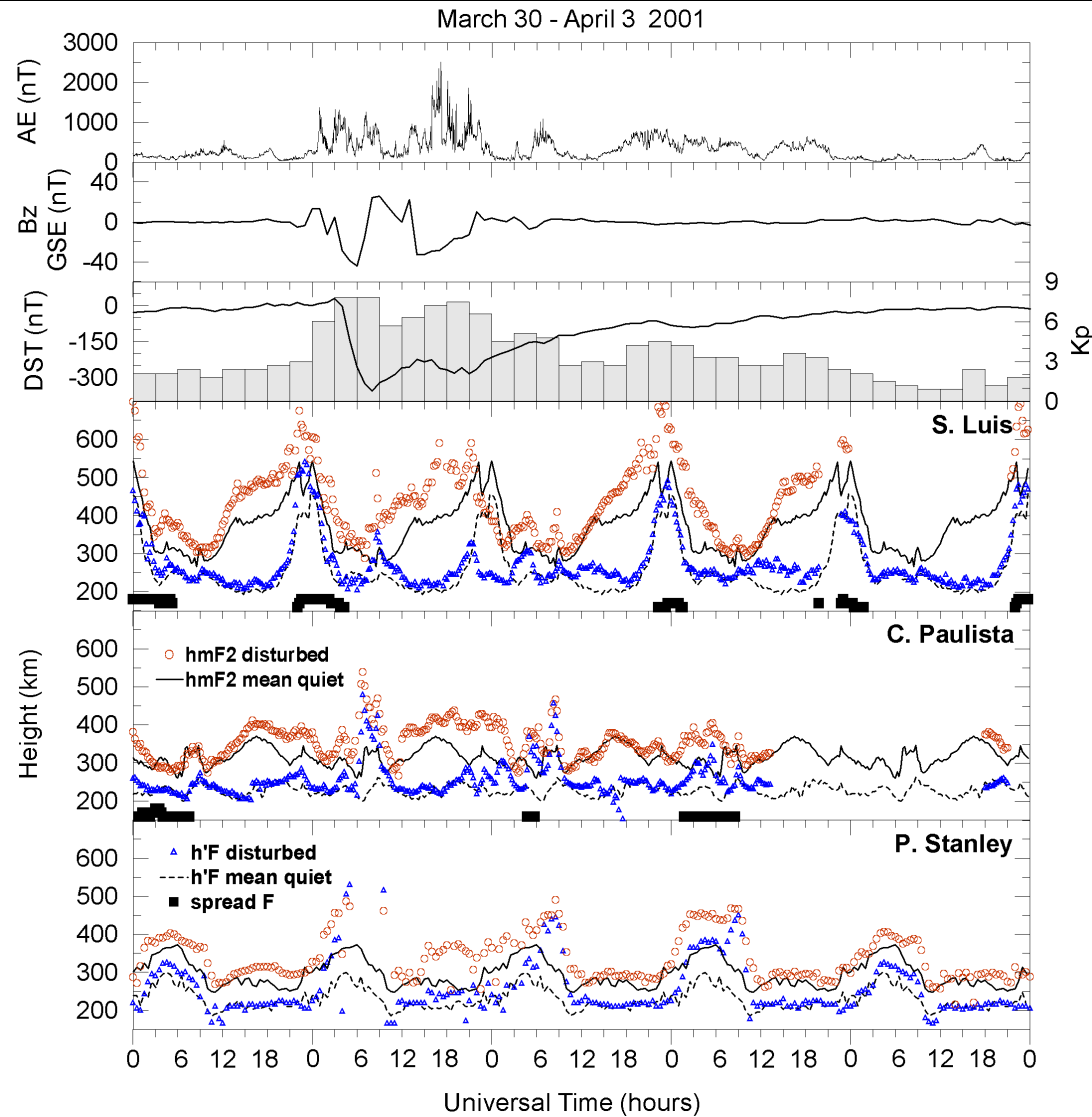
Ionospheric Indices - South American Sector



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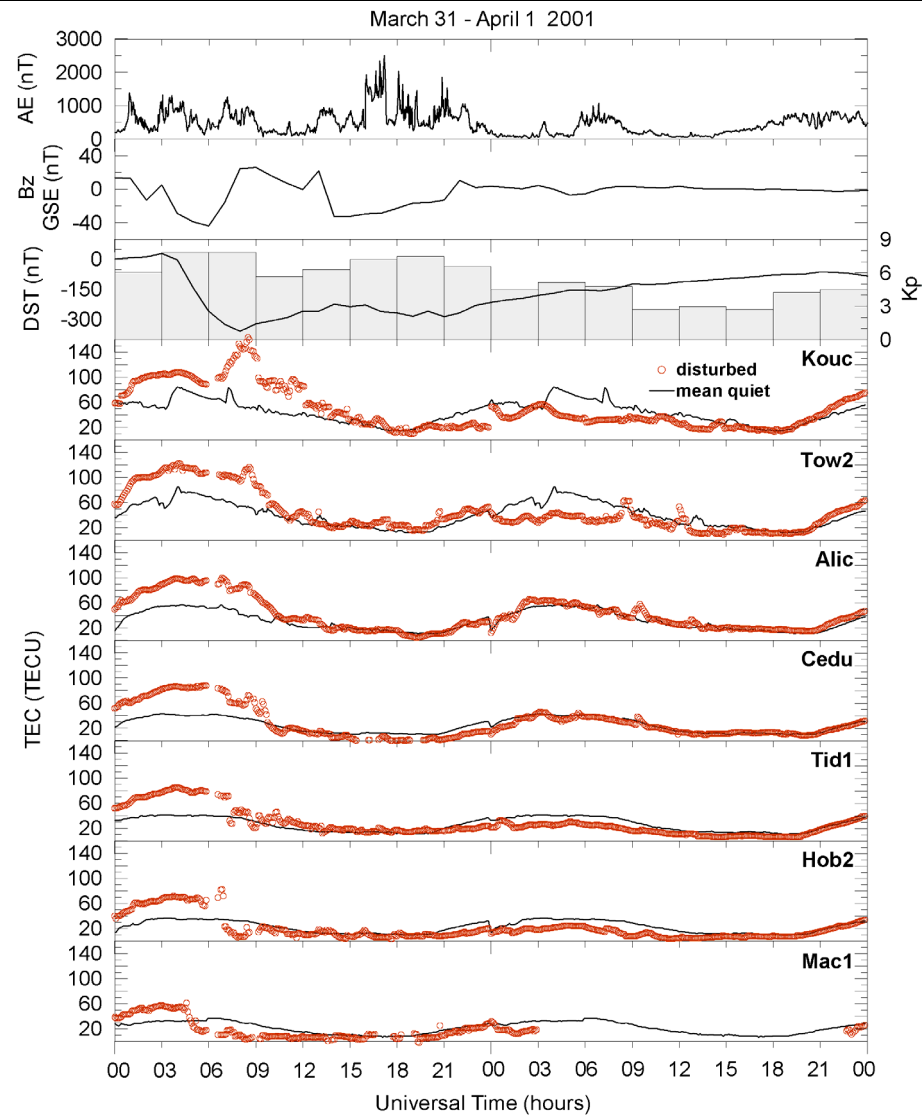
Ionospheric Indices - South American Sector



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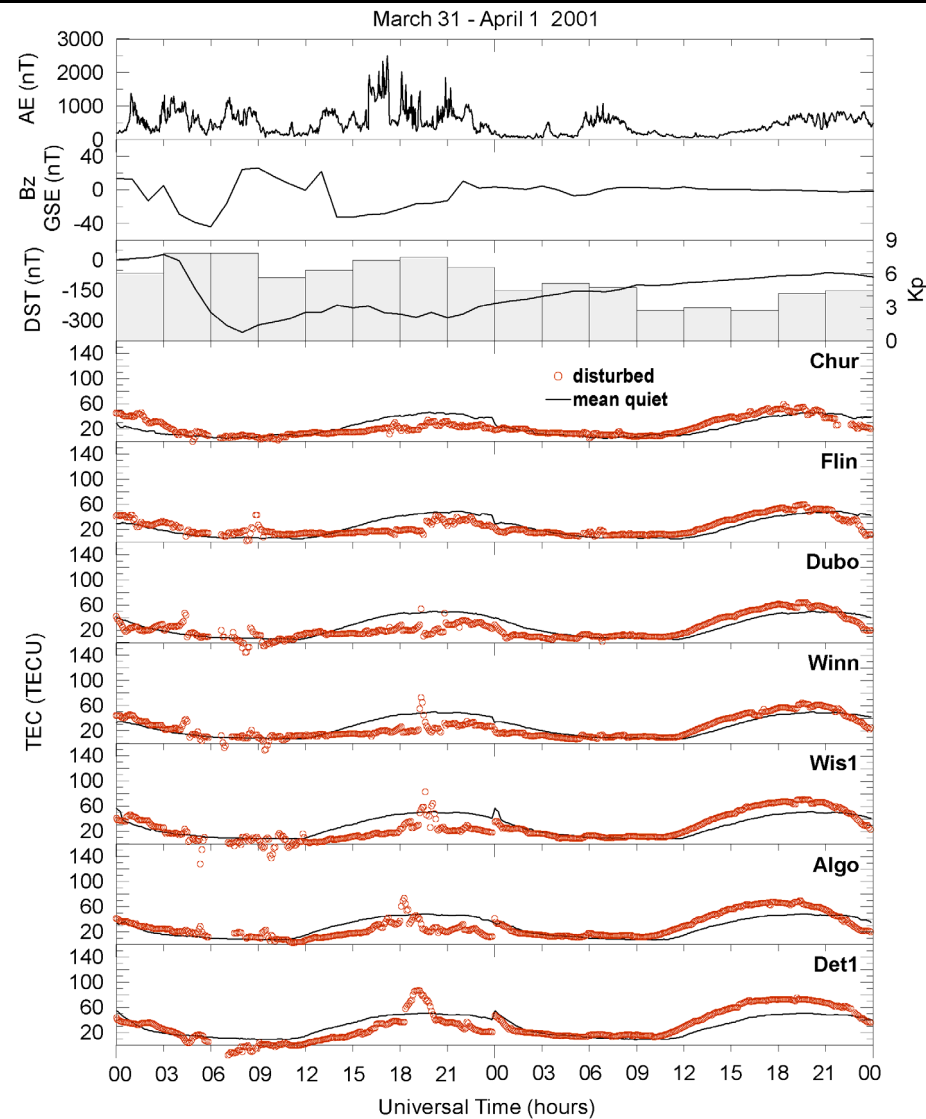
TEC - Australian Sector



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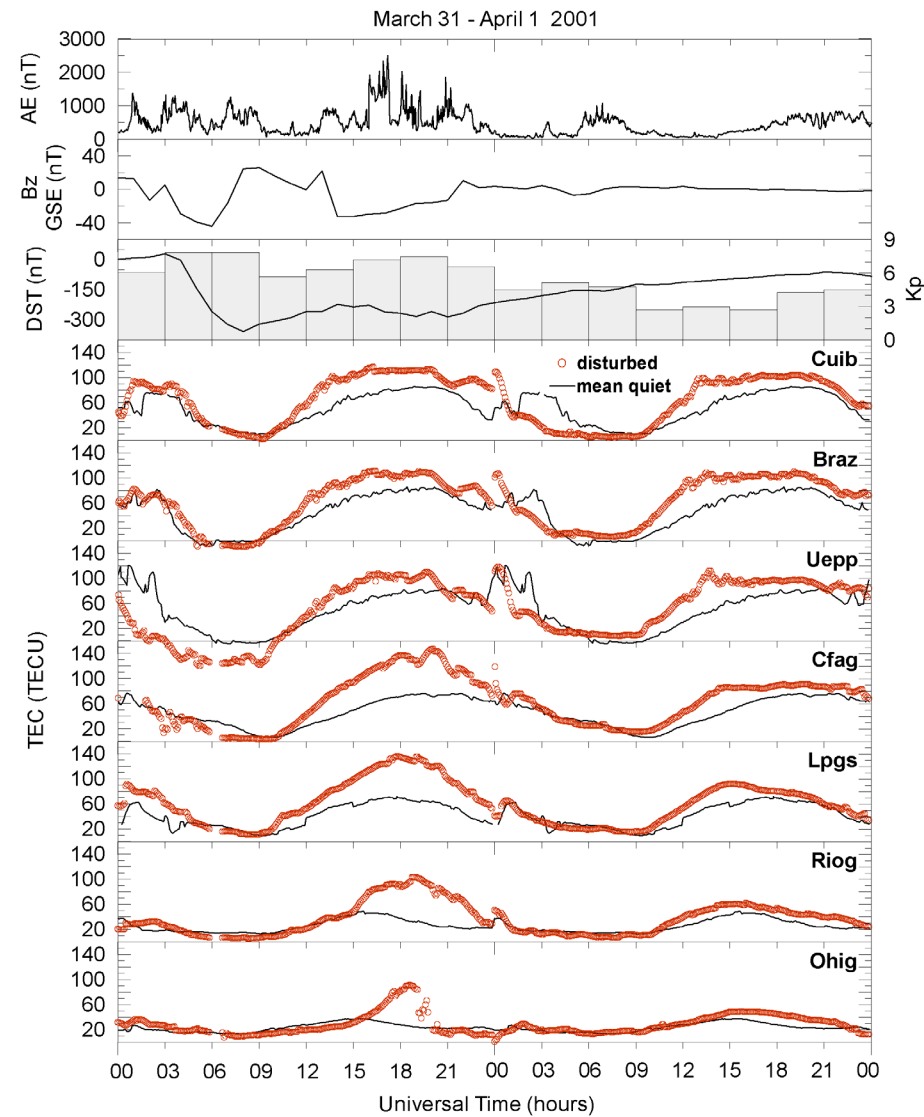
TEC - North American Sector



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TEC - South American Sector



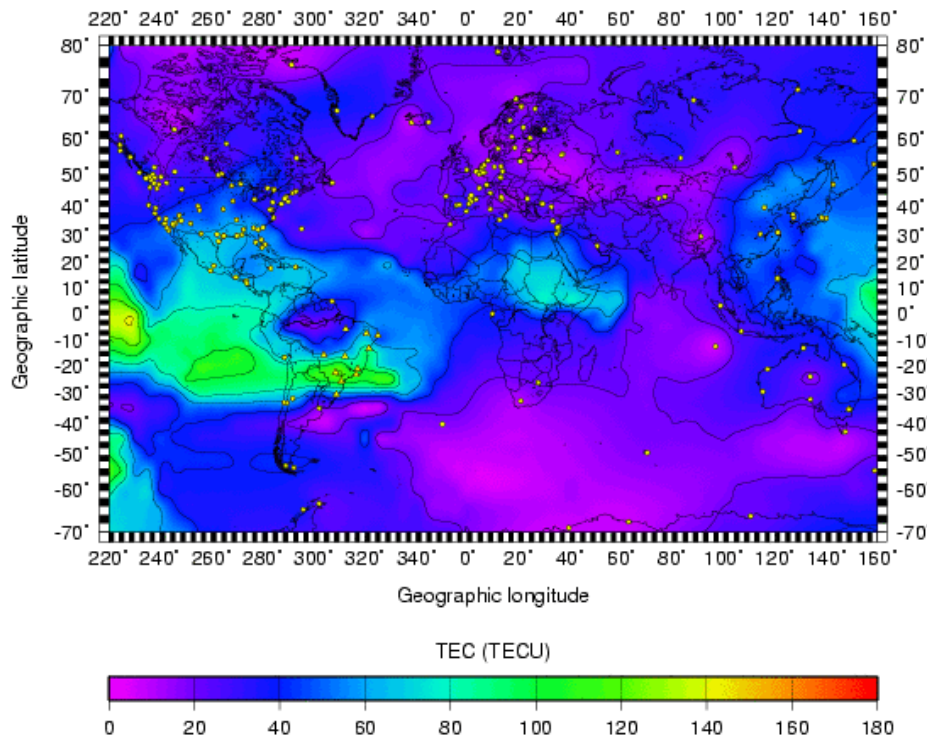
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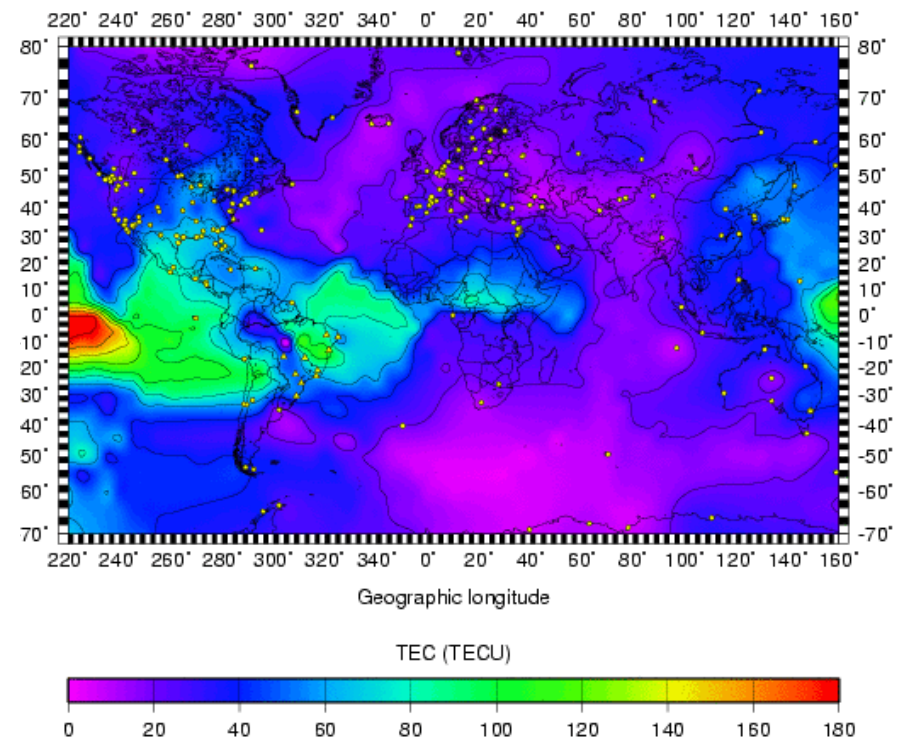
Global TEC Maps for Two Quiet Days



Day 074, 2001 - 00:00 UT



Day 075, 2001 - 00:00 UT



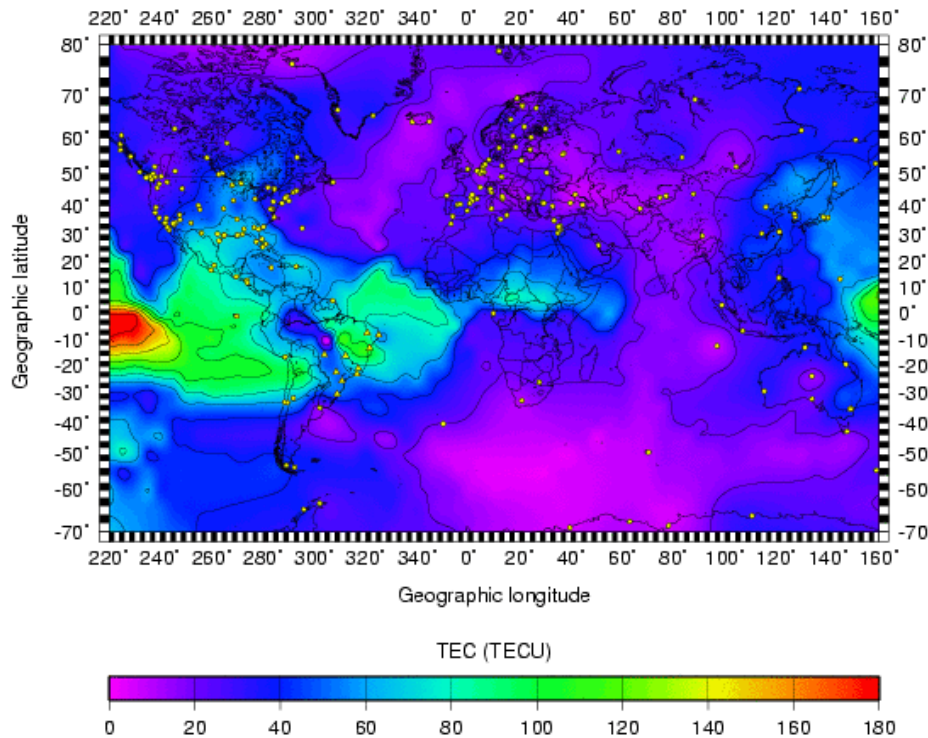
RBL/IUGG
3 July 03



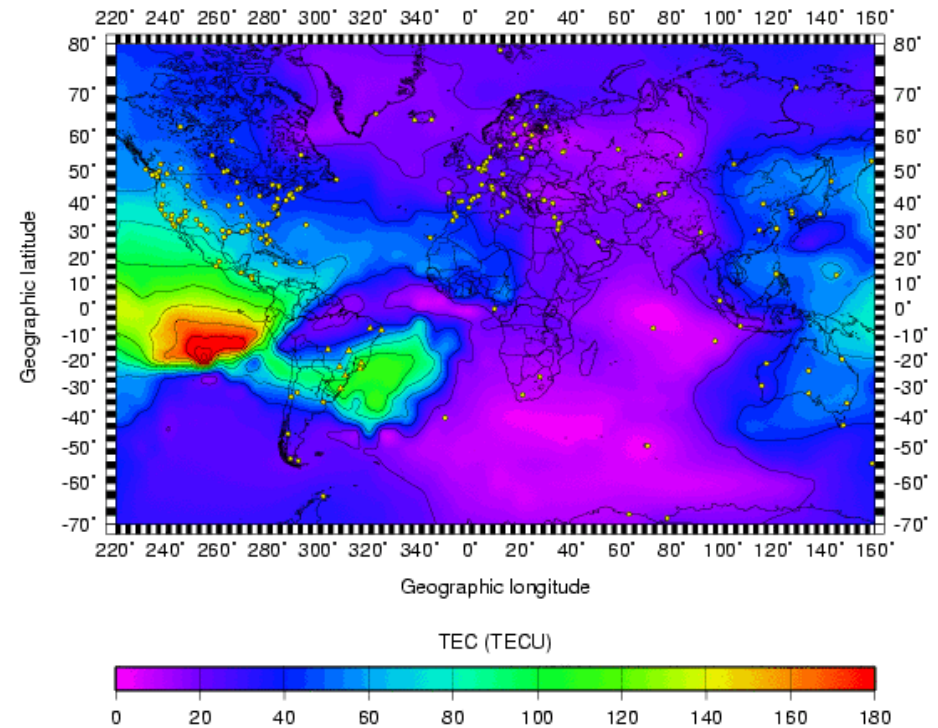
Global TEC Maps for Quiet and Storm Days



Day 075, 2001 - 00:00 UT



Day 090, 2001 - 00:00 UT



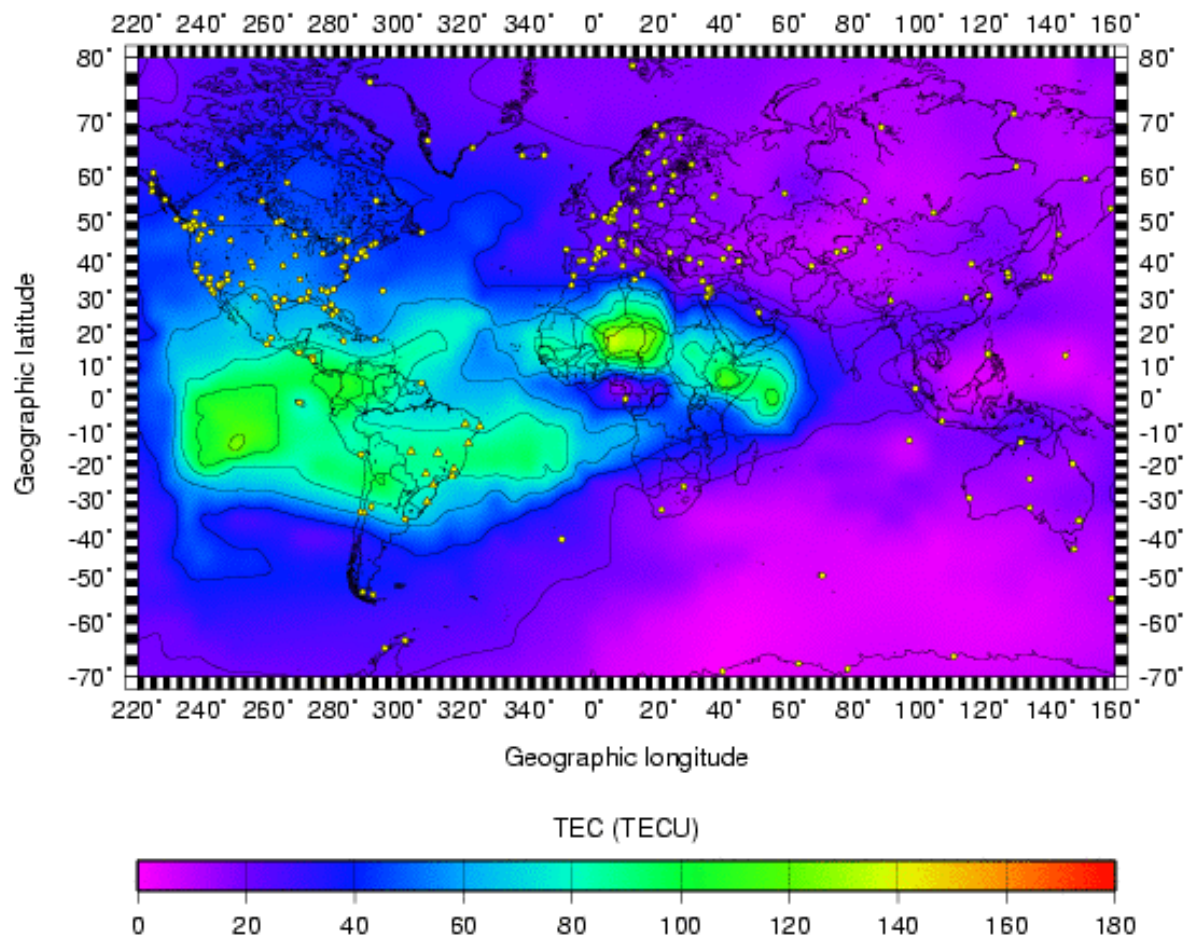
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16 March 2001 - 19:15 UT



Day 075, 2001 - 19:15 UT



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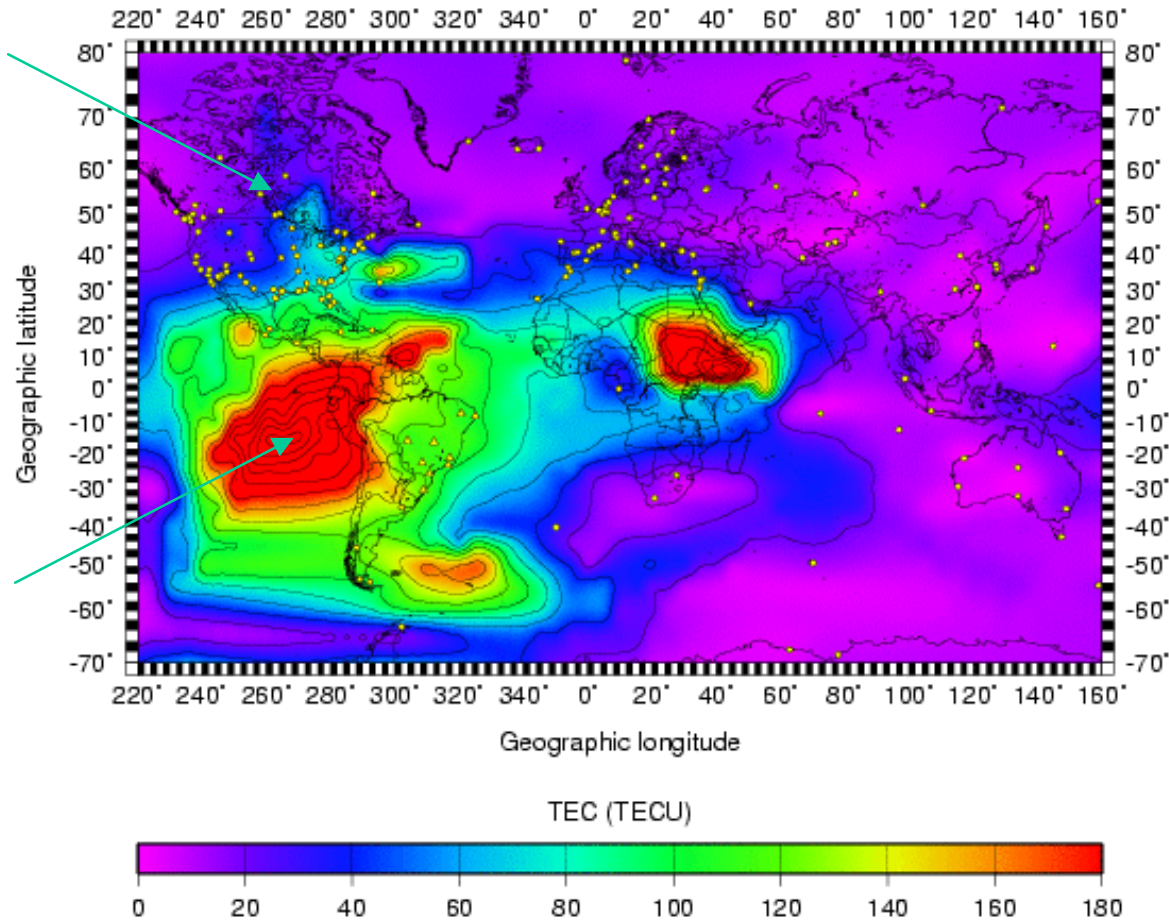
31 March 2001 - 19:15 UT



Day 090, 2001 - 19:15 UT

Ionization
“tongue”

Enhanced
TEC



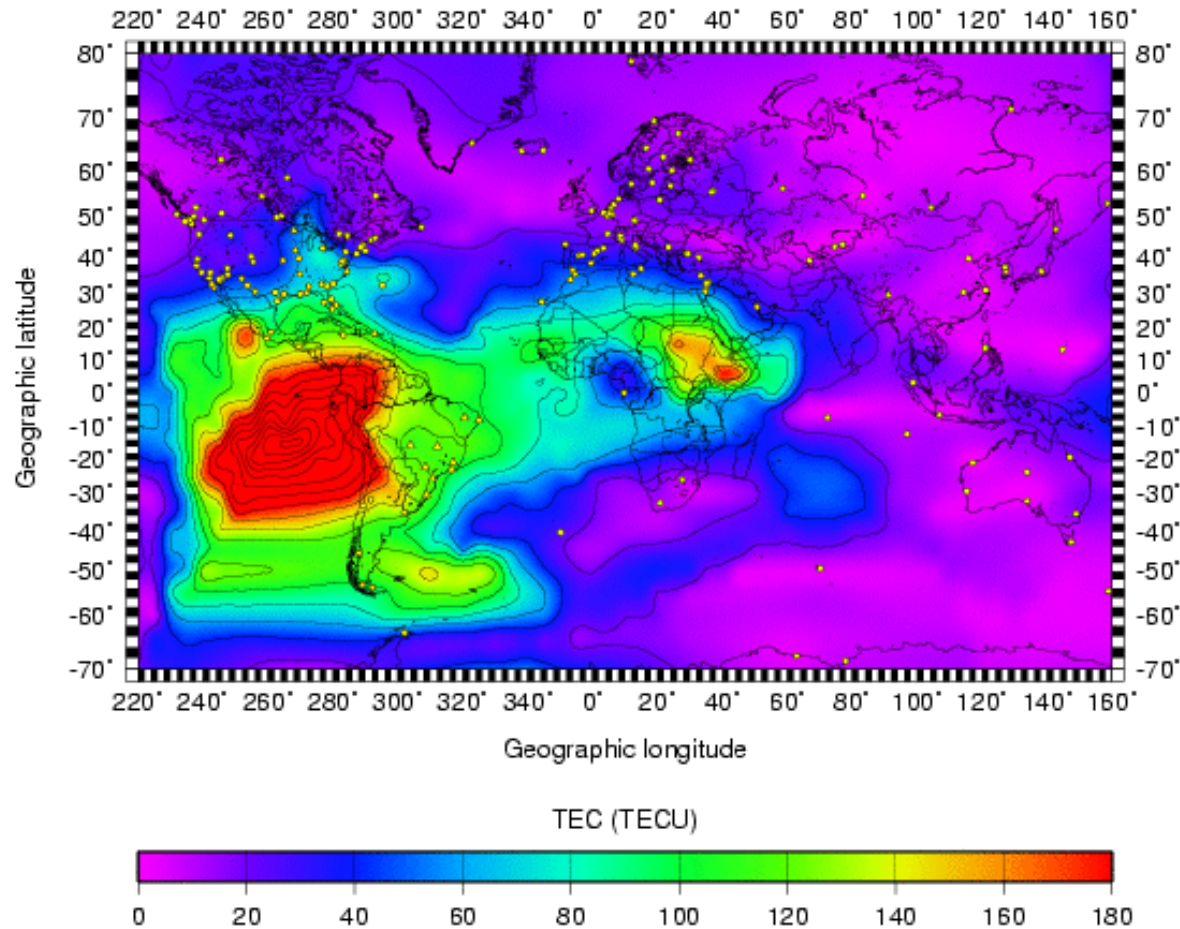
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31 March 2001 - 19:35 UT



Day 090, 2001 - 19:30 UT



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Conclusions



- Effects of the prompt penetration electric field were observed in the first UT hours of the storm and probably over South American sector, causing increasing TEC over the equatorial anomaly peaks.
- Possibility of disturbance dynamo electric field effects.



Future Work



- Analysis of additional storms.
- Improvements to the UNB Ionospheric Modelling Technique.



Thanks



- Dr. Phil Wilkinson, IPS Radio and Space Services
(Australian digisonde data)
- SPIDR (Port Stanley digisonde data)
- CDAWeb (Interplanetary magnetic field data)
- NOAA NGDC Solar Terrestrial Physics Division
- World Data Center for Geomagnetism, Kyoto (AE data)
- IBGE - Brazil (Brazilian GPS data)
- SOPAC (GPS data)
- And anyone else who may have been missed!