

Ionospheric effects of the geomagnetic storm and the Solar eclipse observed during March 2015.

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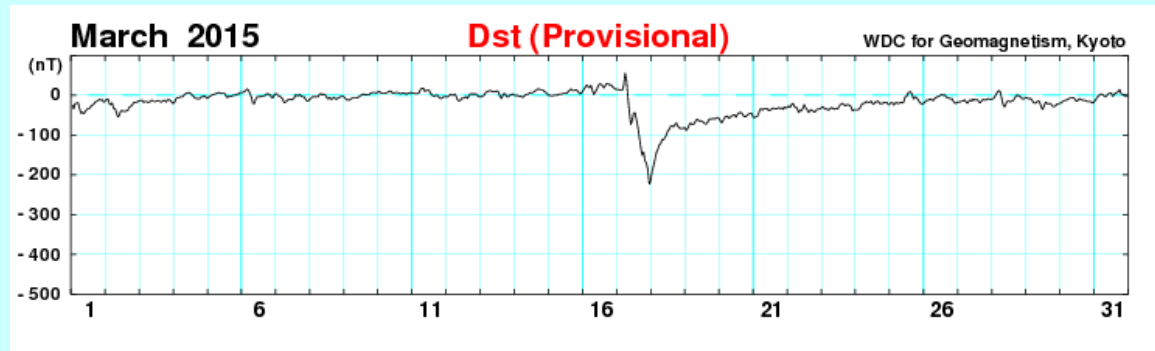
Introduction.

- **Solar activity during Solar cycle 24 is unusually low.**
- **Strongest disturbances was observed during March 2015.**
- **Two significant events strongly disturbed the state of the ionosphere over Central Europe.**
- **Strong geomagnetic storm with Kp – 8 and DST – 223 started 17.3.2015.**
- **During the recovery phase of this storm the second significant event partial Solar eclipse 20.3.2015 strongly affected the state of the ionosphere above Europe.**
- **This paper describe the ionospheric behaviour over Central Europe during this two events as was observed at ionospheric observatory Pruhonice.**

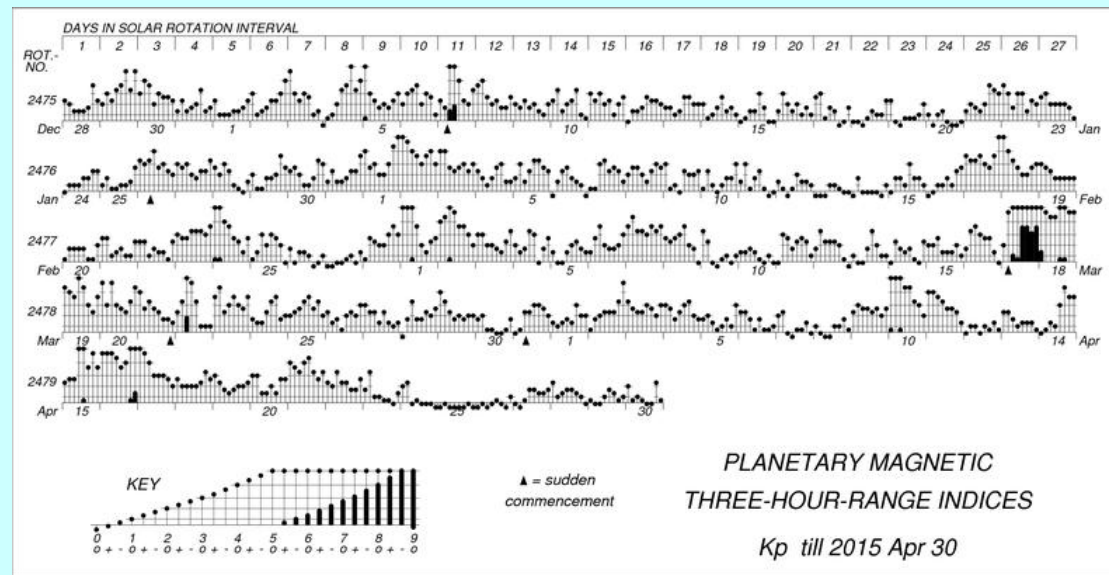
- **Digisonde DPS4 D, installed at the Pruhonice observatory, allow standard ionospheric vertical sounding measurements. Digisonde DPS4 D is also working as Doppler radar and allow ionospheric drift measurements. Ionospheric vertical sounding and drift velocity was measured with standard delay time 15 minutes during geomagnetic storm.**
- **Solar eclipse 20.3.2015 above Pruhonice started 08:36 UT and finished 10:45 UT with magnitude 0.743.**
- **Rapid sequence ionospheric vertical sounding data and drift velocity measurements with delay time 3 minutes was measured during eclipse event. This time resolution allow observation short time changes of the ionosphere during eclipse event.**

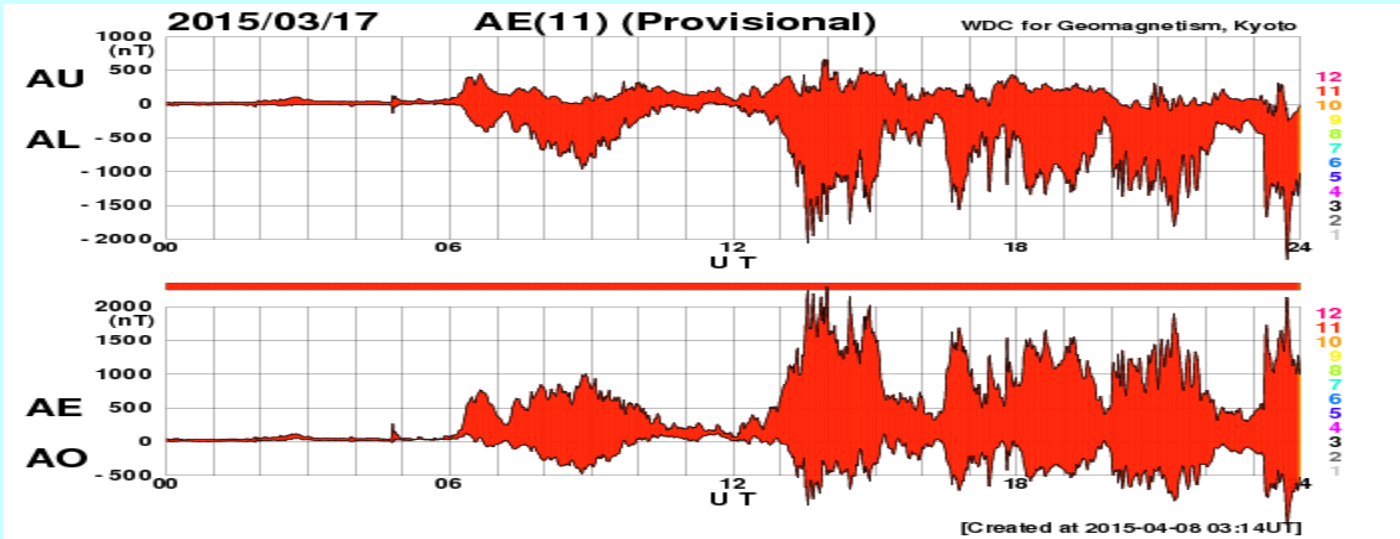
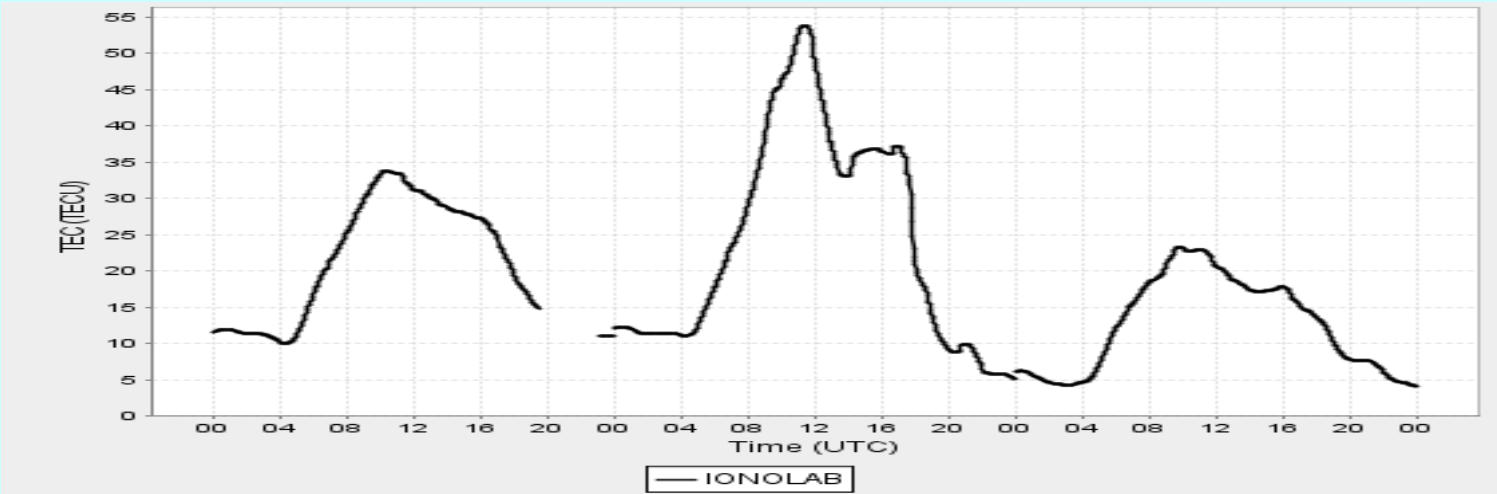
The ionosphere during March 2015 was strongly affected by geomagnetic storm (with Dst index -223) which started 17.3.2015.

- Dst -231

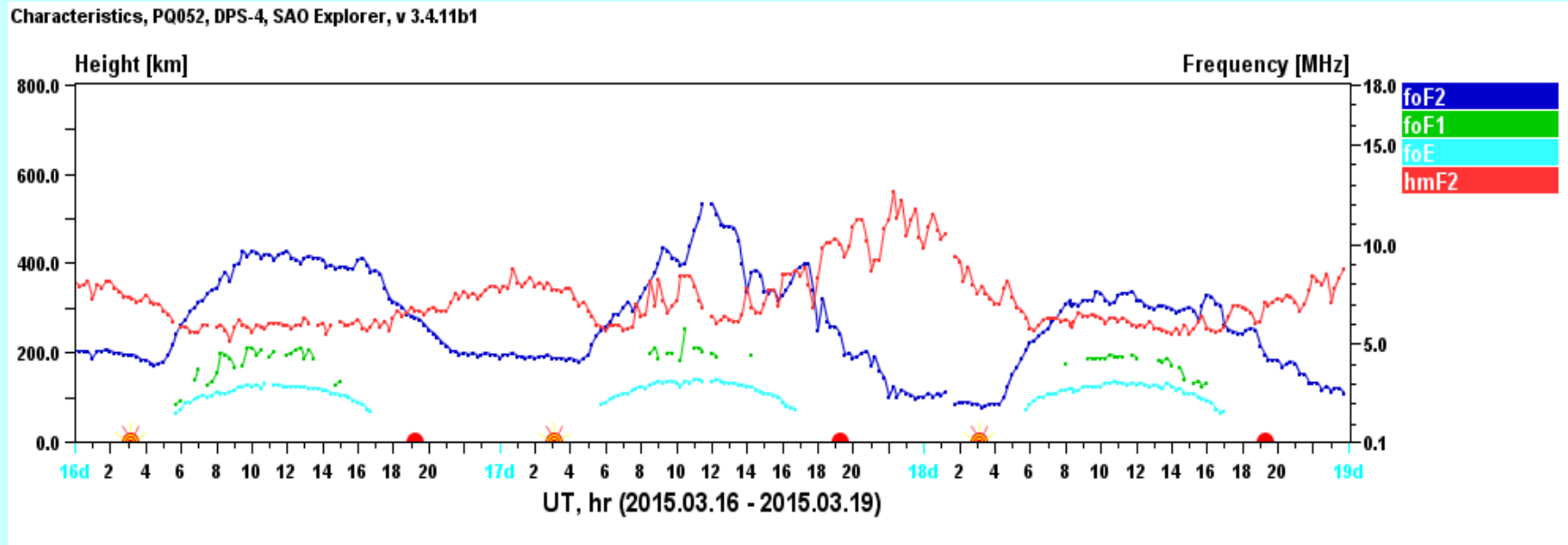


- Kp = 8





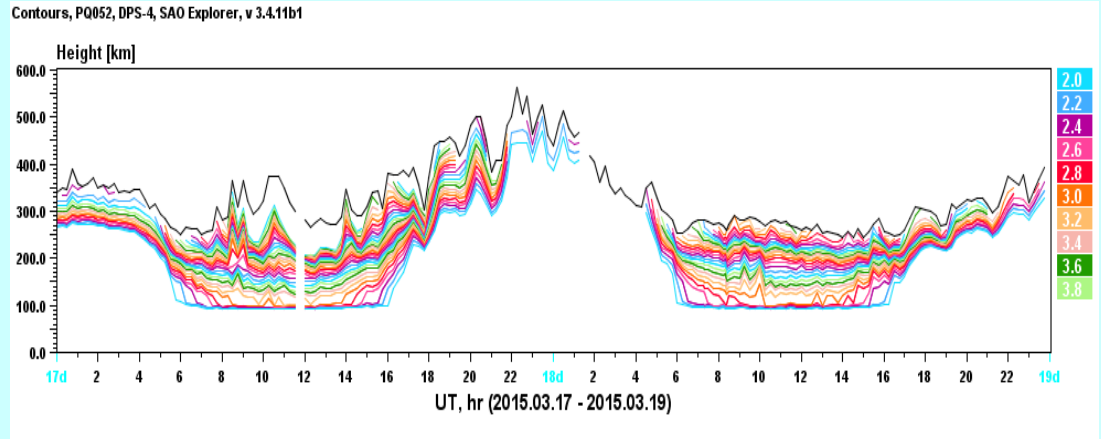
The course of the main ionospheric characteristics, critical frequencies of the layers FoF2, FoF1 and FoE and peak height F2 layer during storm 16 – 18.3.2015.



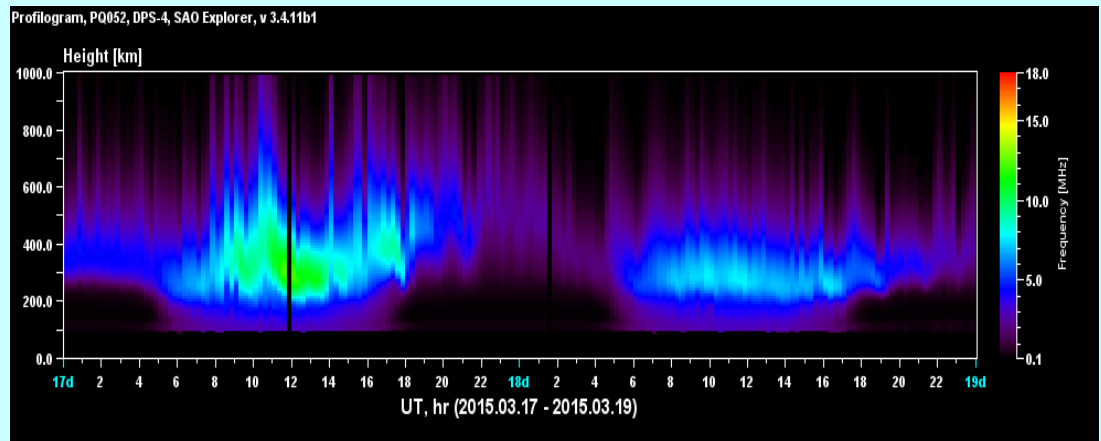
- 16.3.2015 typical quiet day
- 17.3.2015 ionospheric storm started ~ 7 00 UT. Quick changes of the critical frequencies FoF2 and peak height hmF2 of the F2 layer was observed during tho storm. Very high and variable value of hmF2 during night time.
- 18.3.2015 Ionospheric storm finished near sunrise.

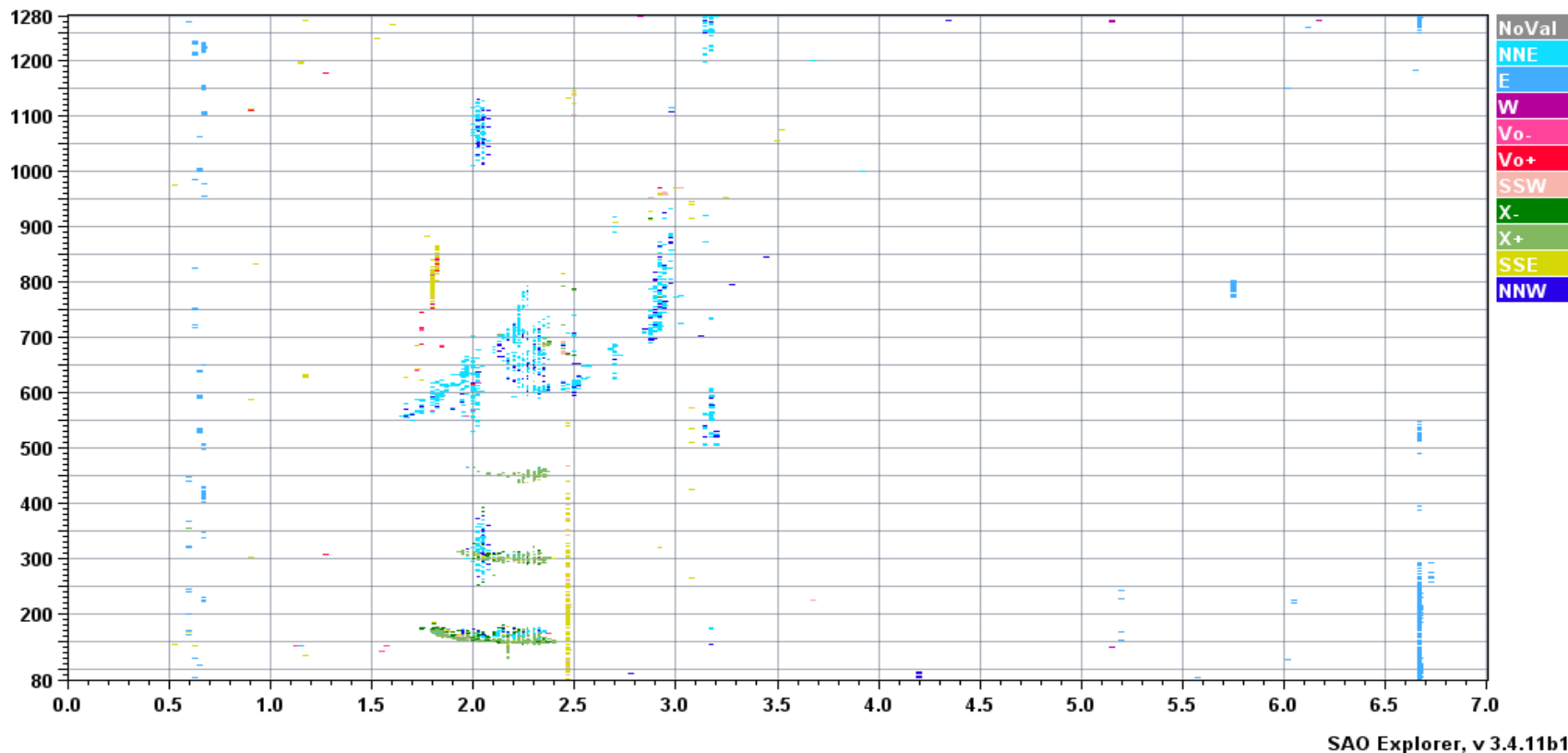
Behaviour of full electron density profiles measured at Pruhonice observatory 17 – 18.3.2015.

- Changes of the isolines of the constant electron concentration during 17 - 18.3.2015.



- Full electron density profiles measured 17 – 18.3.2015.

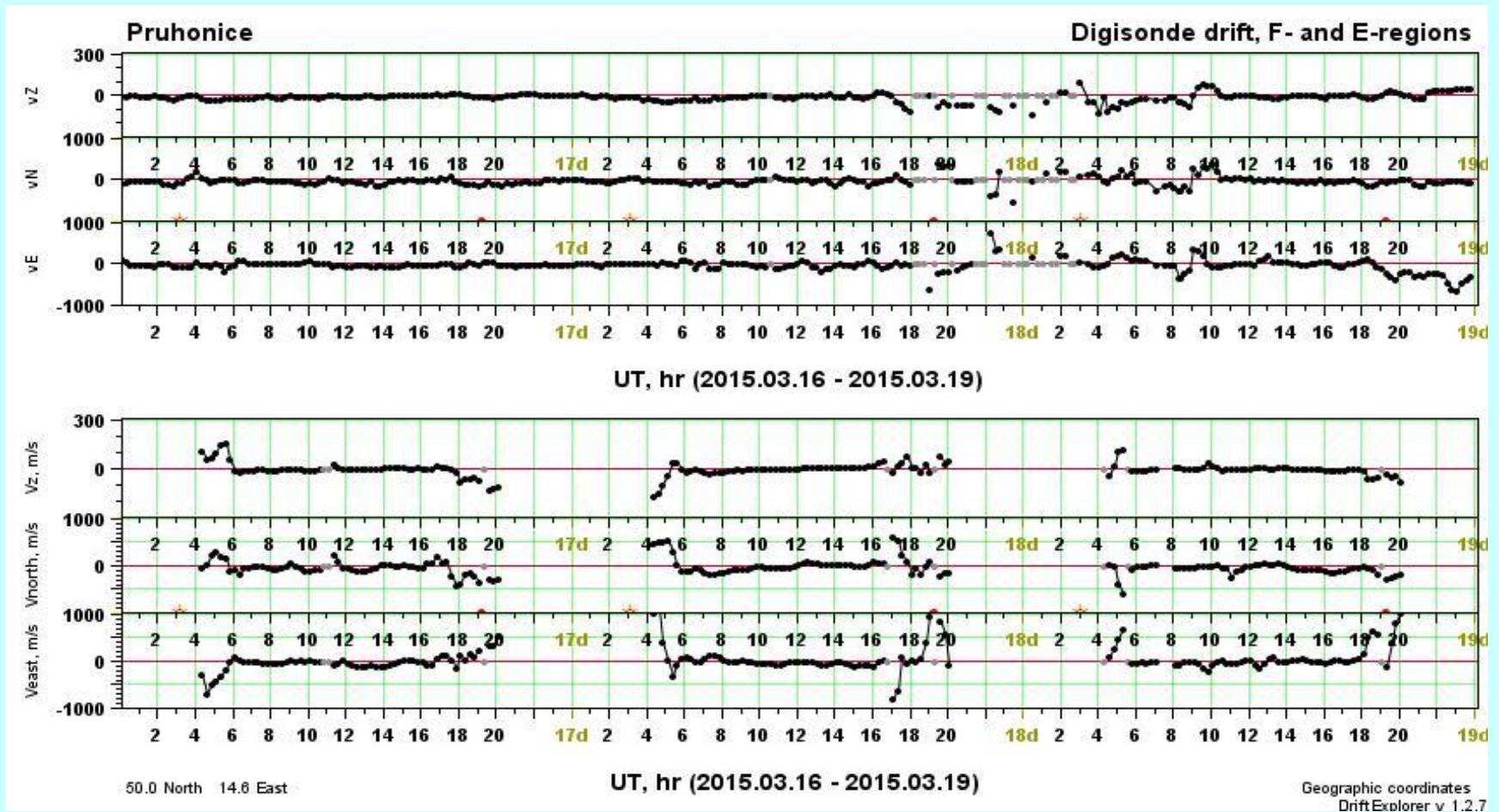




Energetic particles effects observed during the storm.

Ionogram measured 17.3.2015 22 30 UT shows the presence special sporadic Es ionospheric layer at the heights about 150 km. This sporadic layer, called particle Es layer was observed for several hours. Under normal conditions exist only for several tenth minutes near sunrise.

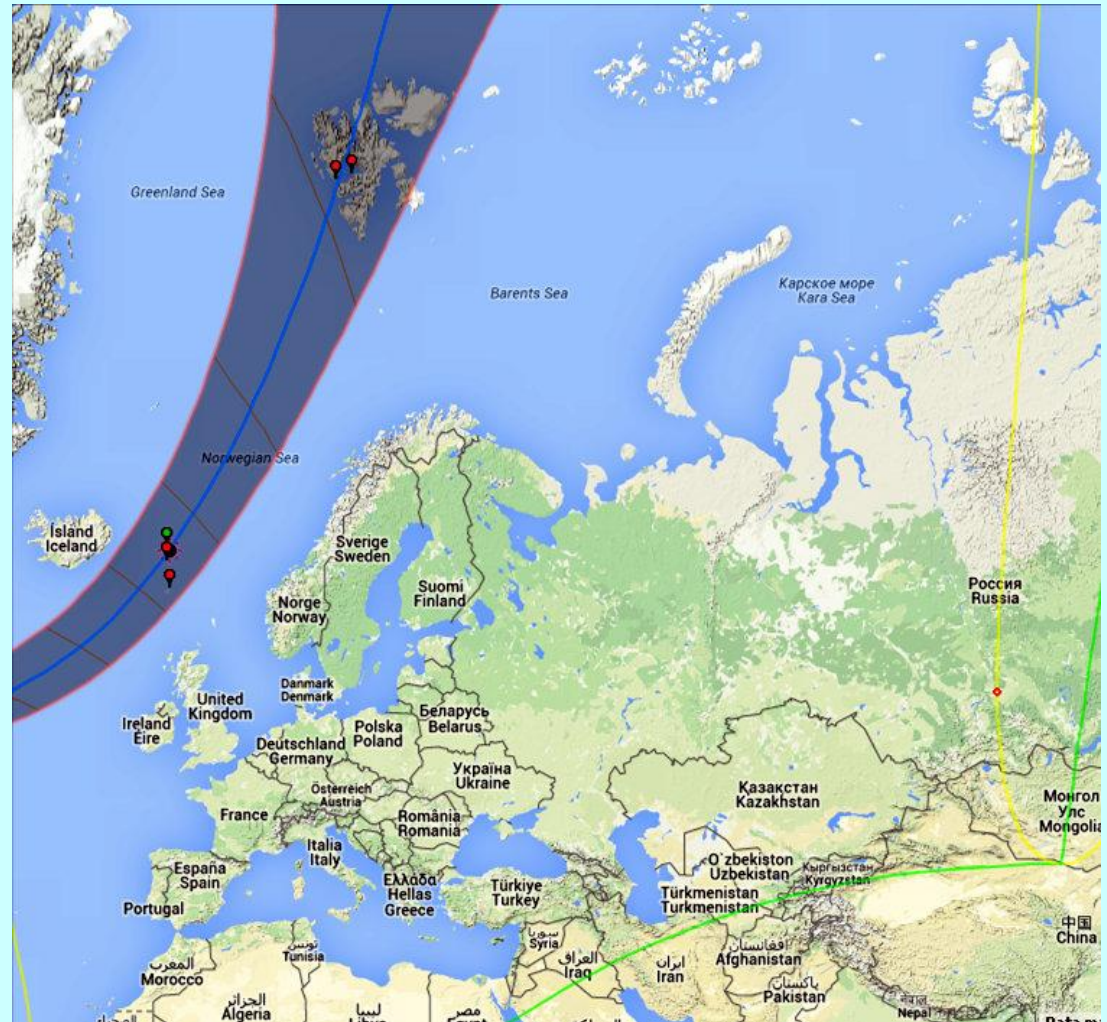
Digisonde E and F region drift velocity during the storm 16 – 18 .3.2015



- The effects of ionospheric storm in ionospheric drifts, strong increasing of the drift velocity in both E and F region, is observed from 16 00 UT 17.3. till the end of the storm.

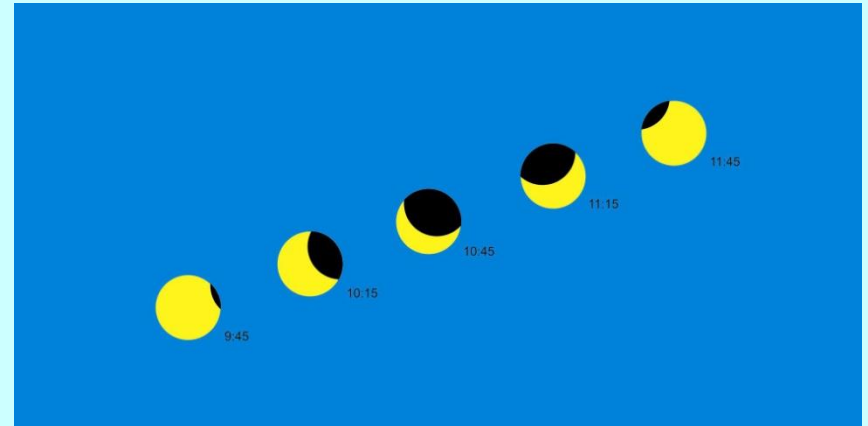
Solar eclipse 20.3.2015.

Total Solar Eclipse in the Faroe Islands and Svalbard (Norway), and a Partial Solar Eclipse in Europe, northern and eastern Asia and northern and western Africa. For the most european location 60 – 90 % of the Solar disc was covered.



Solar eclipse 2015 above Pruhonic.

- Ionospheric rapid sequence vertical sounding data and drift velocity measurements with delay time 3 minutes was measured during eclipse event. This time resolution allow observation short time changes of the inosphere during eclipse event.



Pruhonic observatory:

Start: 8:36 UT

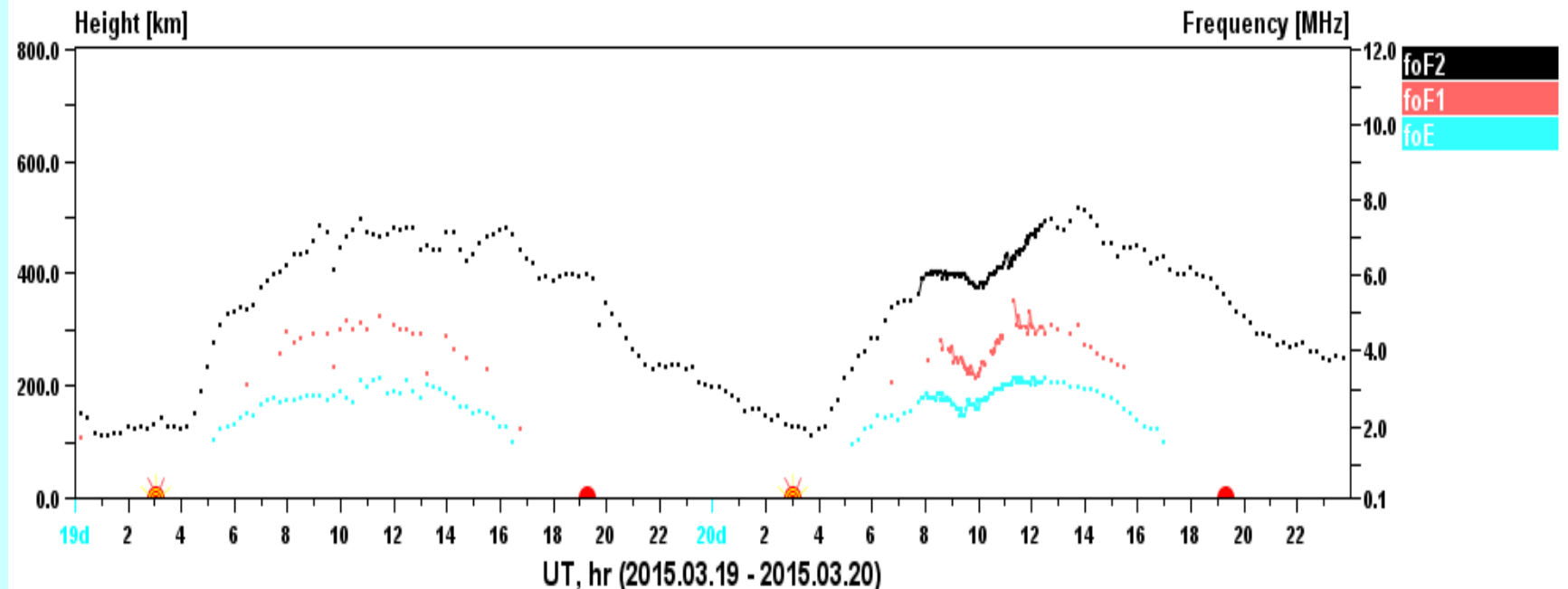
Maximum: 9:45UT

74 %

End: 10:57 UT

The course of the main ionospheric characteristics during 19 – 20.3.2015.

Characteristics, PQ052, DPS-4, SAO Explorer, v 3.4.11b1

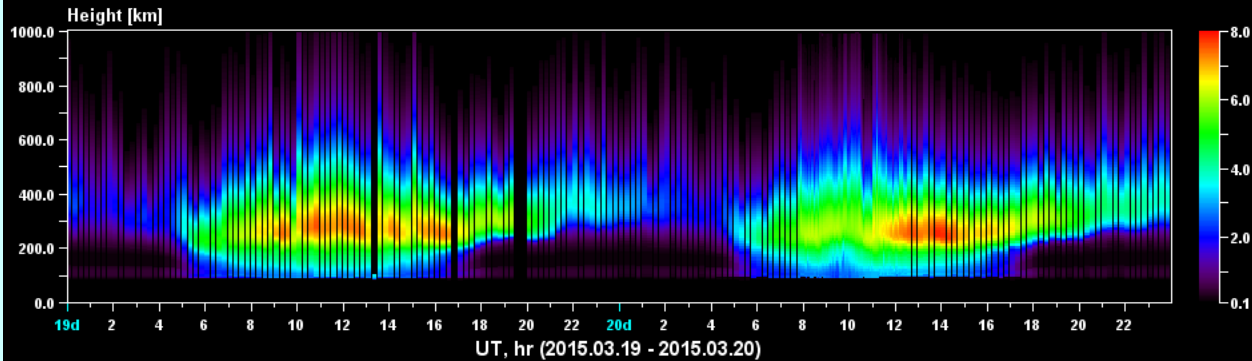


Ionospheric behaviour during the eclipse is affected:

- 1) By changes of Solar zenith angle
- 2) By decreasing of the solar ionizing radiation during eclipse
- 3) By recovery phase of the geomagnetic storm

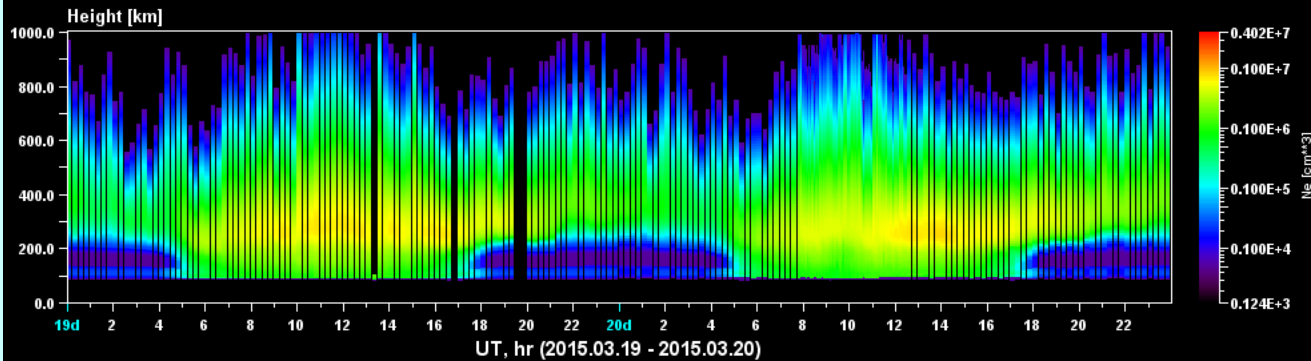
Full electron density profiles measured 19 – 20.3.2015.

Profigram, PQ052, DPS-4, SAO Explorer, v 3.4.11b1



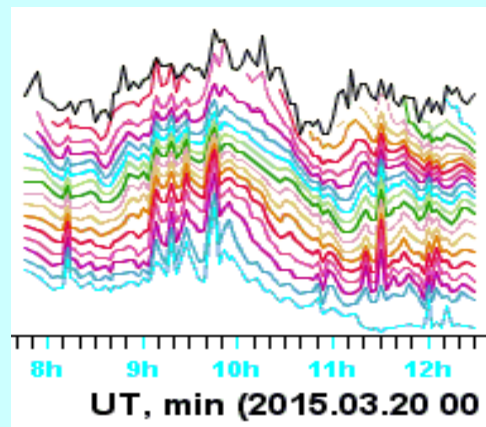
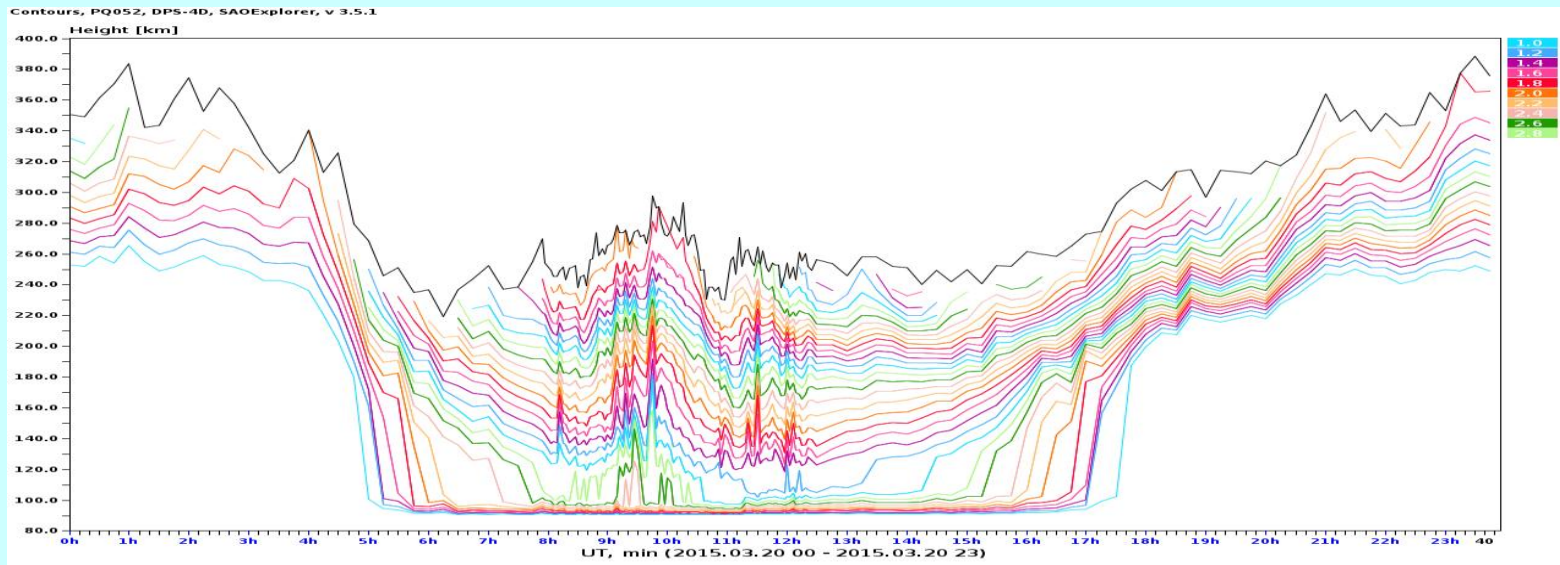
[MHz]

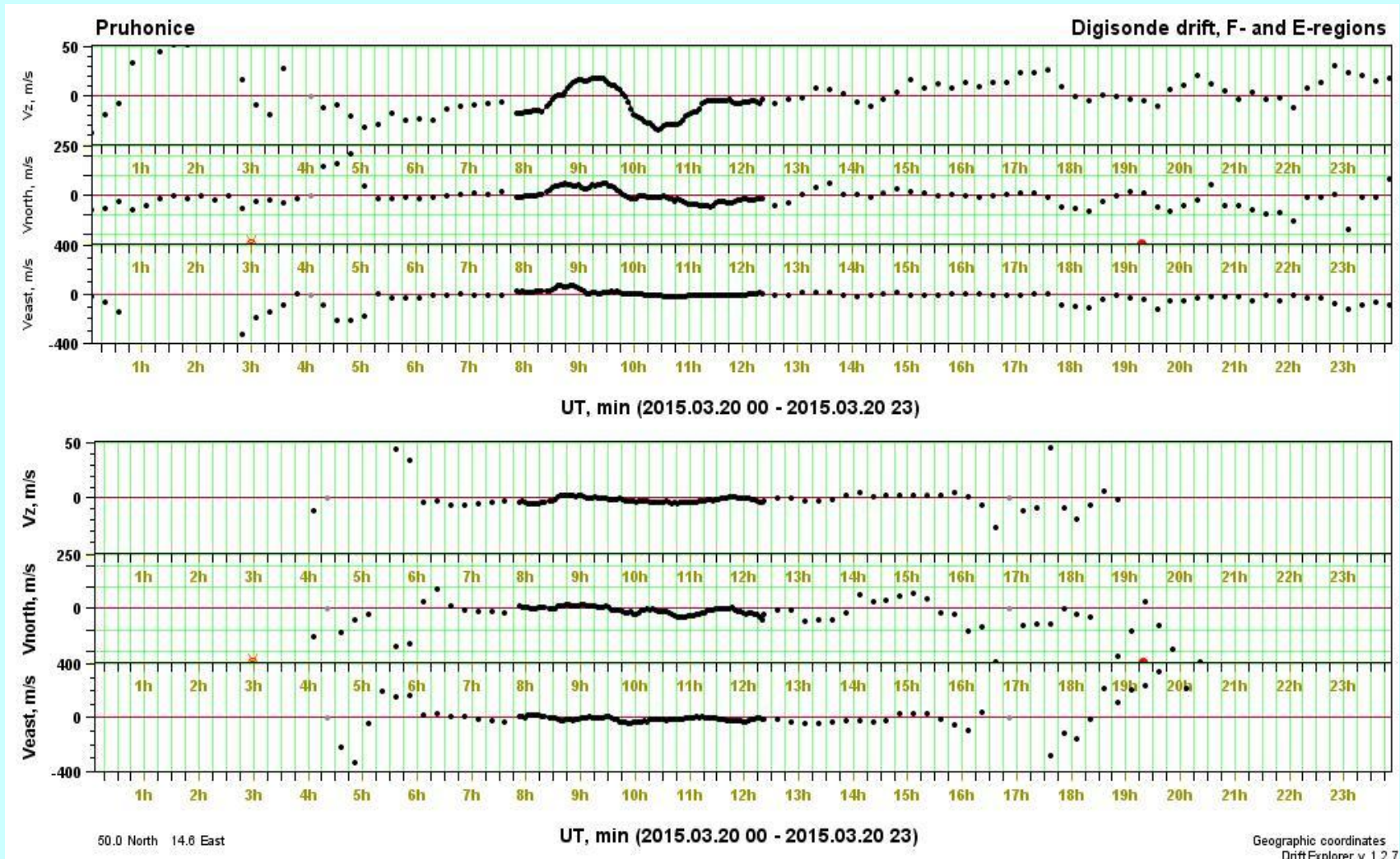
Profigram, PQ052, DPS-4, SAO Explorer, v 3.4.11b1



[Ne]

Changes of the isolines of the constant electron concentration during eclipse 20.3.2015.





Results of rapid sequence digisonde drift measurements in the E and F ionospheric region during the Solar eclipse 2015 with the time resolution 3 min. Main effect of Solar eclipse was observed near peak height of F2 layer.

Thank you for your attention.