

# Prediction of the VLF signal strength distribution in USA during the great solar eclipse of August 21<sup>st</sup>, 2017

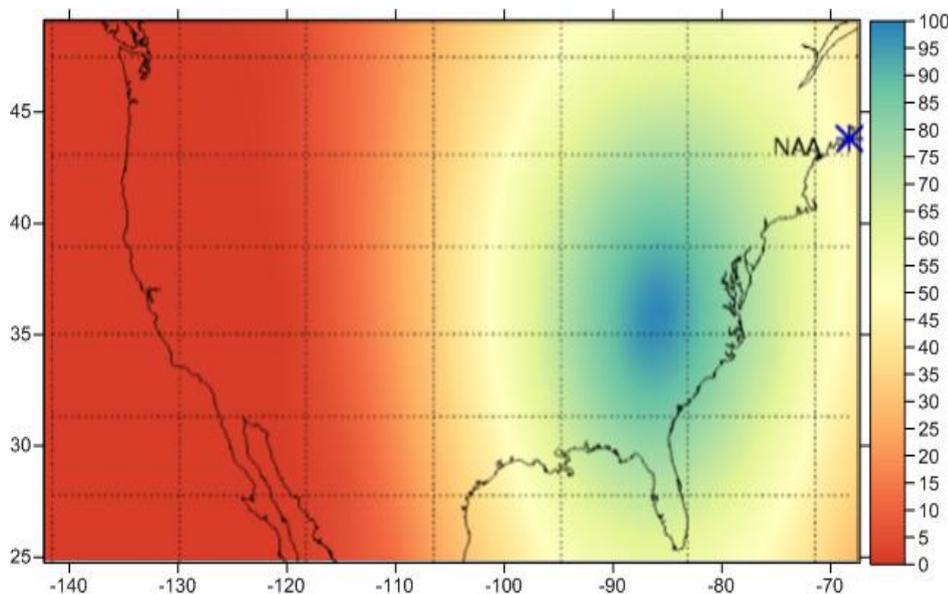
Sujay Pal, Sudipta Sasmal and Sandip K. Chakrabarti

On behalf of Indian Centre for Space Physics Ionospheric research Team

Everyone is looking forward to the upcoming eclipse of 21<sup>st</sup> August, 2017. At Indian Centre for Space Physics (ICSP), we have been monitoring VLF since 2002 and covered a number of eclipses in Indian subcontinent. From our experience, we believe some prediction could be made before the eclipse starts [Ref: 1-5]

Since the total eclipse shadow will move from Oregon to South Carolina, and there will be many transmitters and receivers everywhere, it would be impossible to present the prediction as a function of time from every location. So we concentrated on the signal distribution only at 18:30 UT (2:30 Eastern Standard Time) when the eclipse will have the highest duration of about 2 minutes and 40 seconds. We also concentrated only on the NAA transmitter which may be monitored all over USA. The processes of our calculations are written very well in the references below. We do not repeat them here. However, we wish to point out that the result very much depends on what the space weather is. During August 19<sup>th</sup> -20<sup>th</sup> there were several strong flares, whose effects have to be added also as discussed in our paper on January 2010 eclipse. Although flares are coming at about 5 hours interval, it is entirely possible that the whole even will go normally without a flare. Those who will witness flares partly blocked by the lunar disk would also find important effects as discussed in our paper.

In Figure 1 below we show the obscuration of the sun as seen from the entire USA as calculated in NASA webpage at 18:30 UT.



webpage at 18:30 UT.

Fig. 1: The degree of obscuration at 18:30UT of August 21<sup>st</sup>, 2017. The color bar on the rights the percentage of obscuration of the solar disk by the lunar disk as seen from the respective place.

We now assume that VLF receivers are distributed everywhere and are monitoring NAA. We take the strength of NAA from the literature and found the effects of propagation across the USA in a normal day using LWPC code with 100km as the minimum length scale and putting appropriate ground parameters .

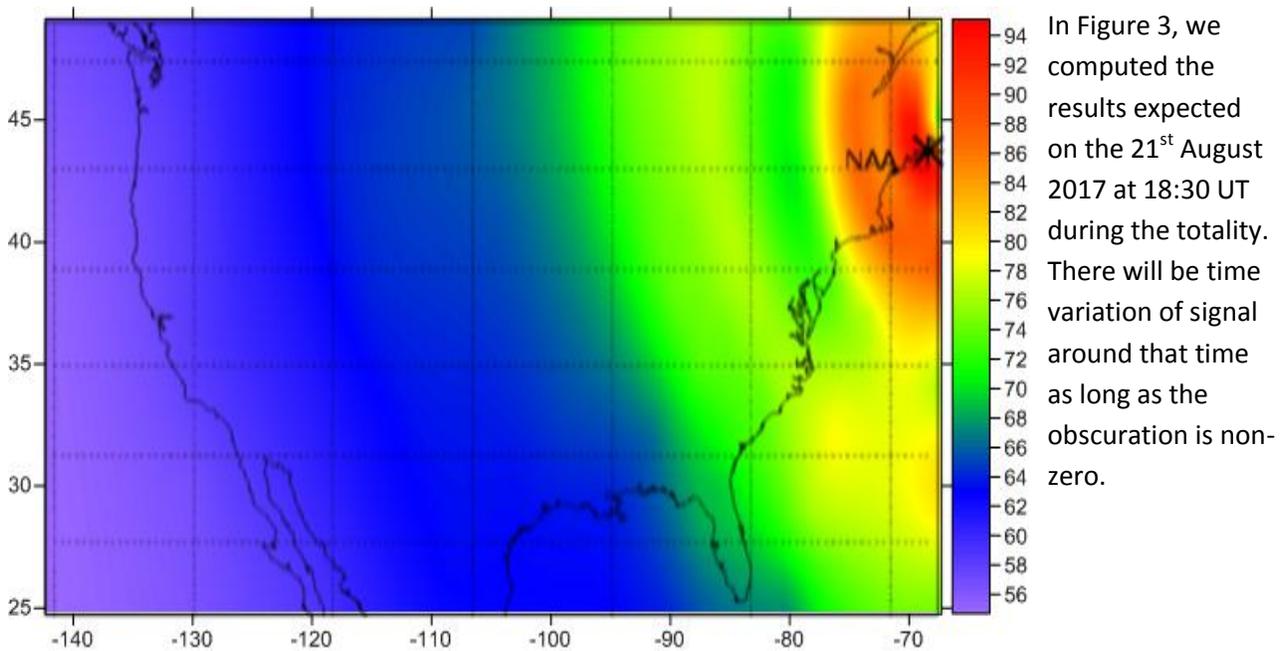
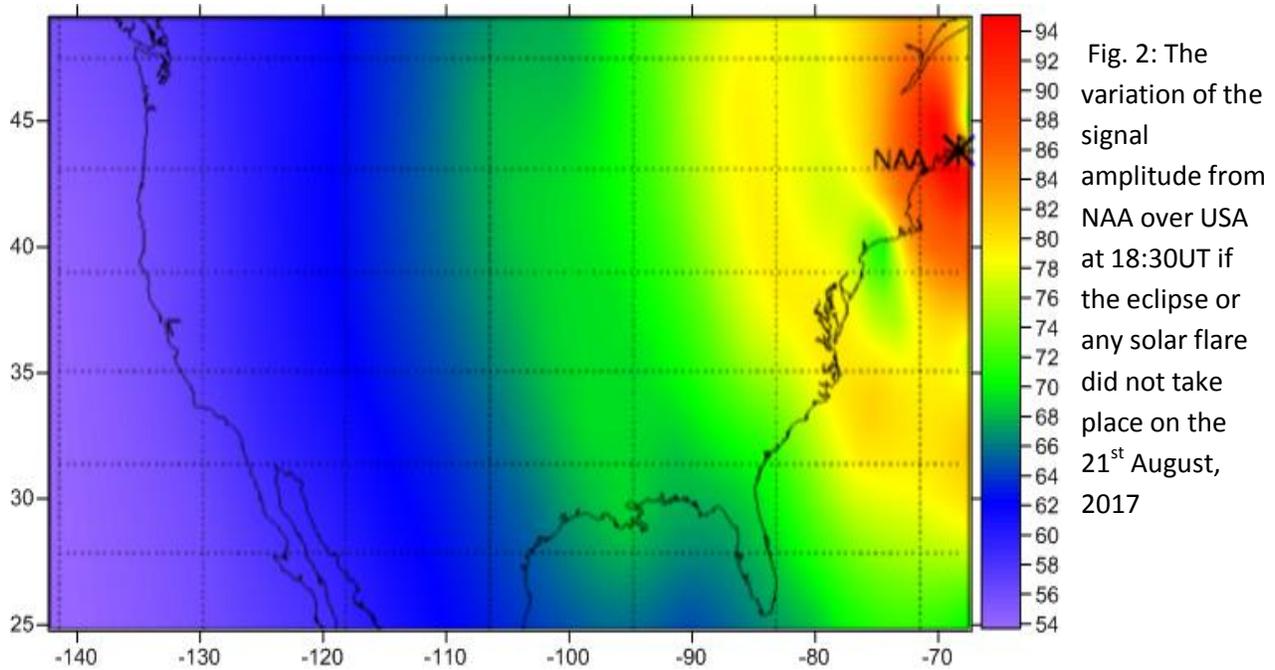


Fig. 3: Spatial variation of the NAA signal amplitude in dB at 18:30UT on 21<sup>st</sup> August , 2017.

In Figure 4, we show the expected deviation in dB if there were no solar flares during the period or it is totally obscured but the lunar disk and do not show up from the limb. Those witnessing partial blocking of the flare by the moon may consult the papers below as to how to interpret the results.

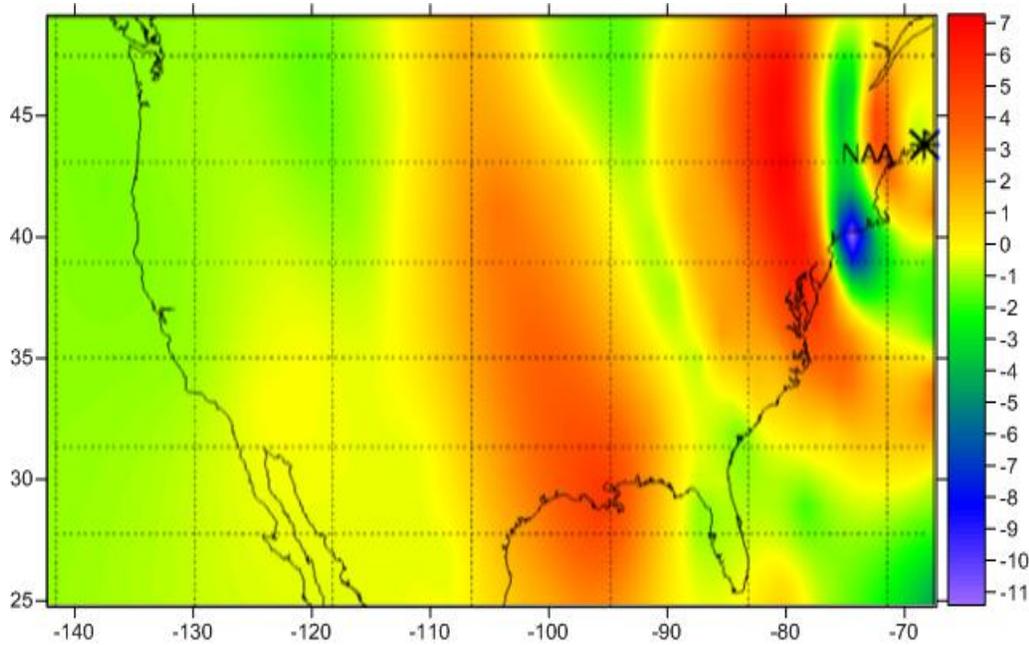


Fig. 4: Spatial variation of VLF signal over USA. We note that signal could be enhanced by as much as 7dB. The signal may be reduced by as much as 11 dB.

It is also to be noted that as discussed in Paper 2 below, the ionosphere at heights of several hundreds of km above (both around NAA latitude as well as the magnetic conjugate point in the southern hemisphere) would have the protons and electron temperatures affected. We do not see any difference in our conclusion over and above what was already wrote in Paper 2 if the fractional changes are taken into account.

We also predict that strong atmospheric gravity waves will be triggered as we have observed in our group during July, 2009 solar eclipse.

Happy monitoring!

Sujay Pal, Sudipta Sasmal, Sandip Chakrabarti on behalf of VLF team of Indian Centre for Space Physics.

## References

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