Space weather activities in Tunisia

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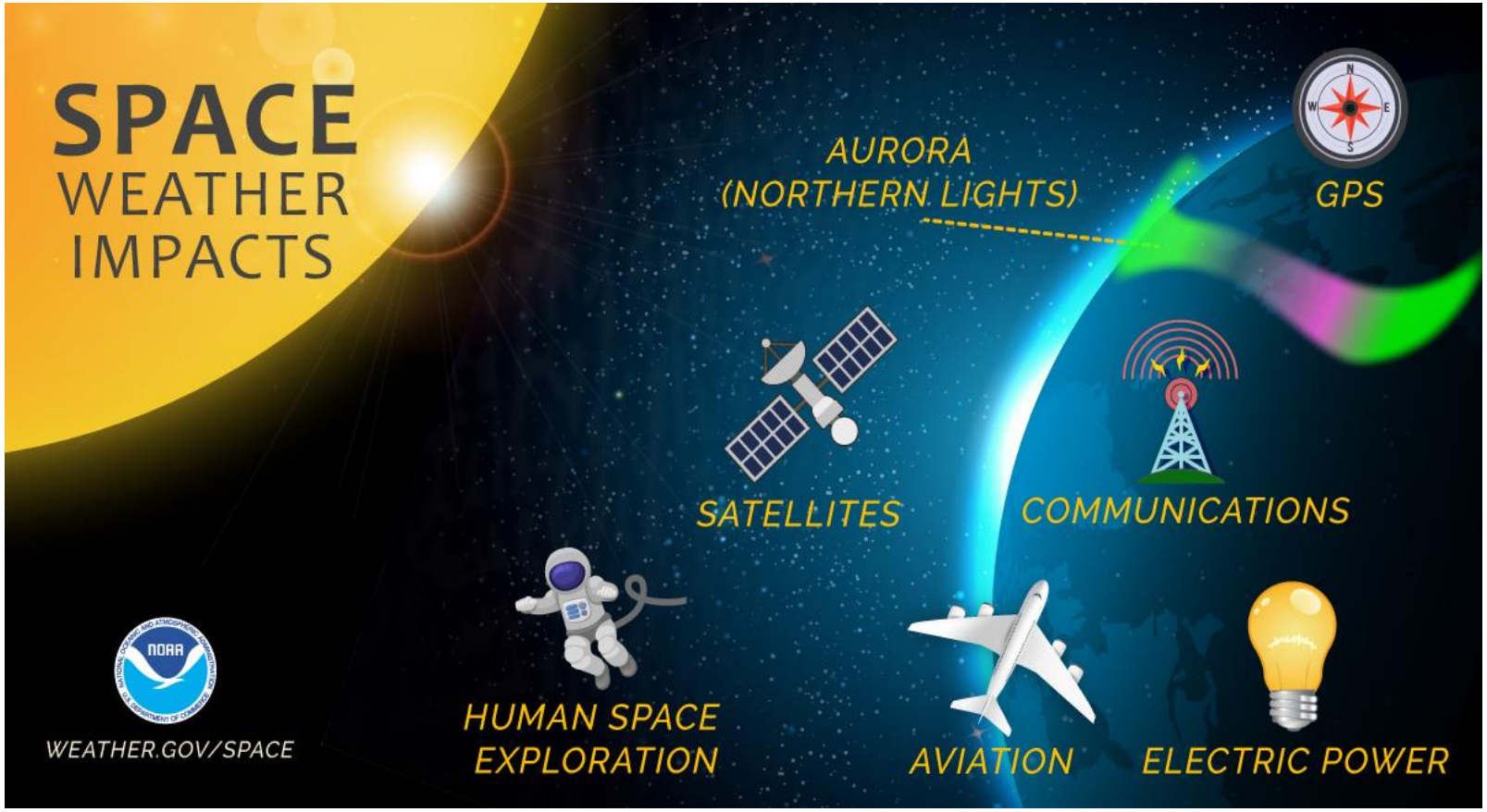
I. VLF-LSAMA: Context of the research

Space weather



UNITED NATIONS
Office for Outer Space Affairs

SPACE4SDGS

BRINGING THE BENEFITS OF SPACE TO HUMANKIND

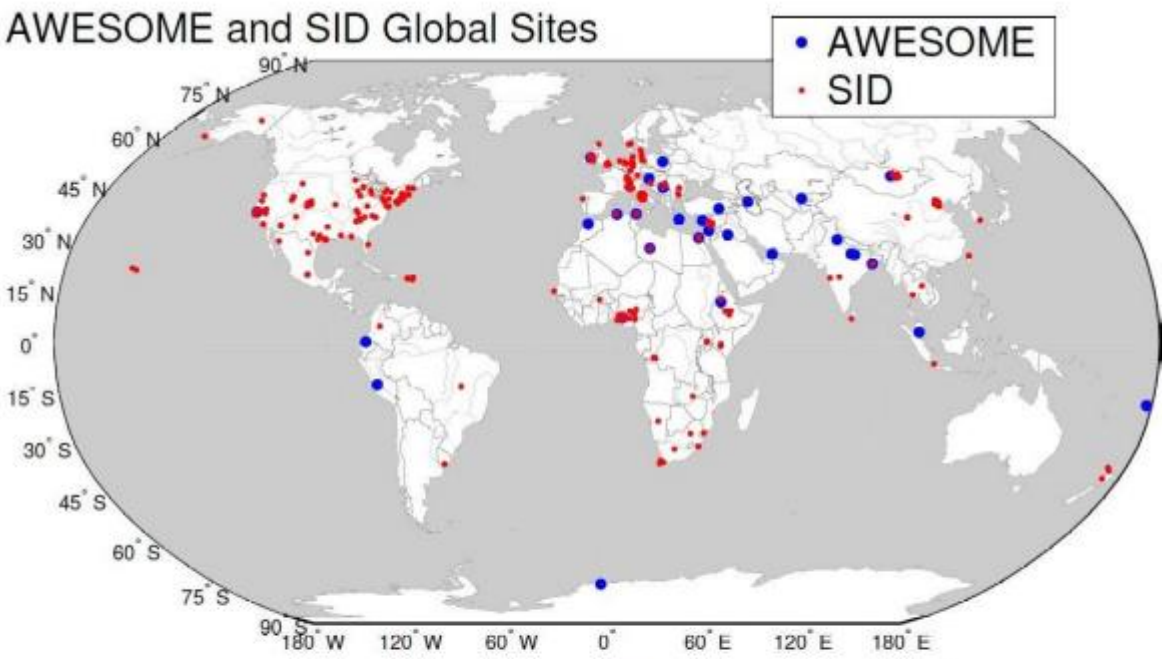
COSPAR
COMMITTEE ON SPACE RESEARCH

INTERNATIONAL SPACE WEATHER INITIATIVE
ISWI

NASA

NOAA

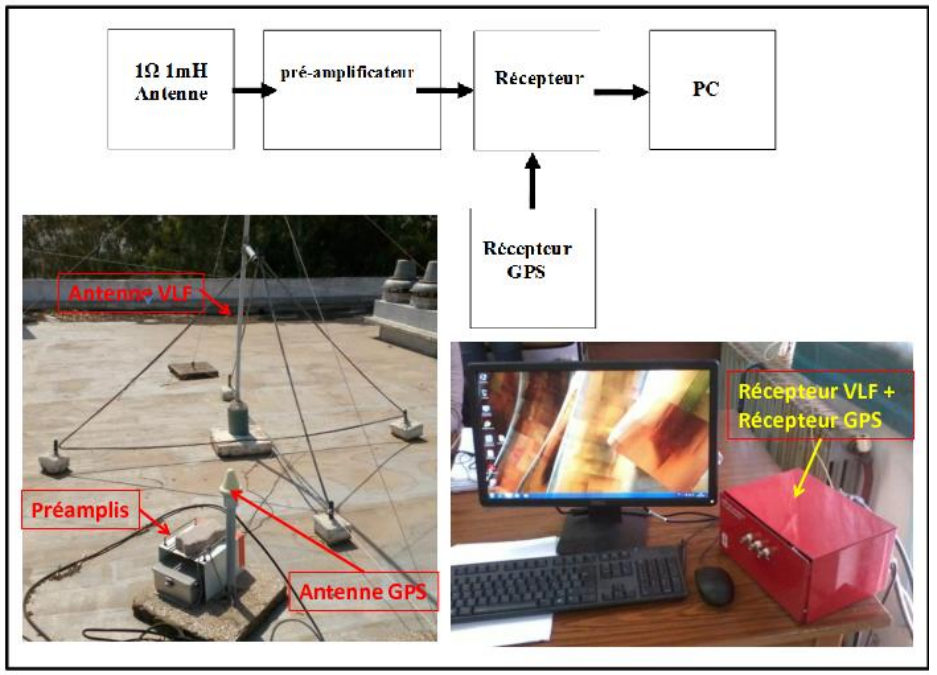
II. ELF/VLF/LF receiving stations (3Hz-50 kHz)



Georgia Institute of Technology

University of Colorado Denver

Stanford University



AWESOME (Atmospheric Weather Electromagnetic System for Observation Modeling and Education)

Acknowledgment :

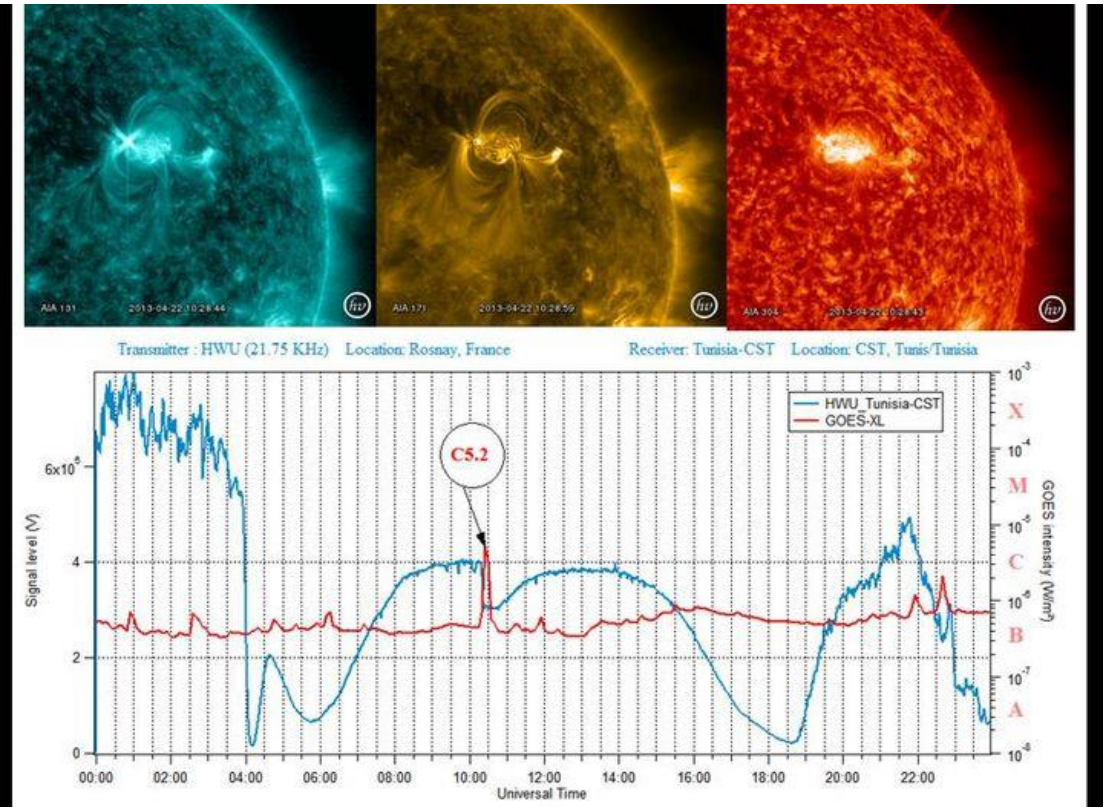
Dr. Morris Cohen

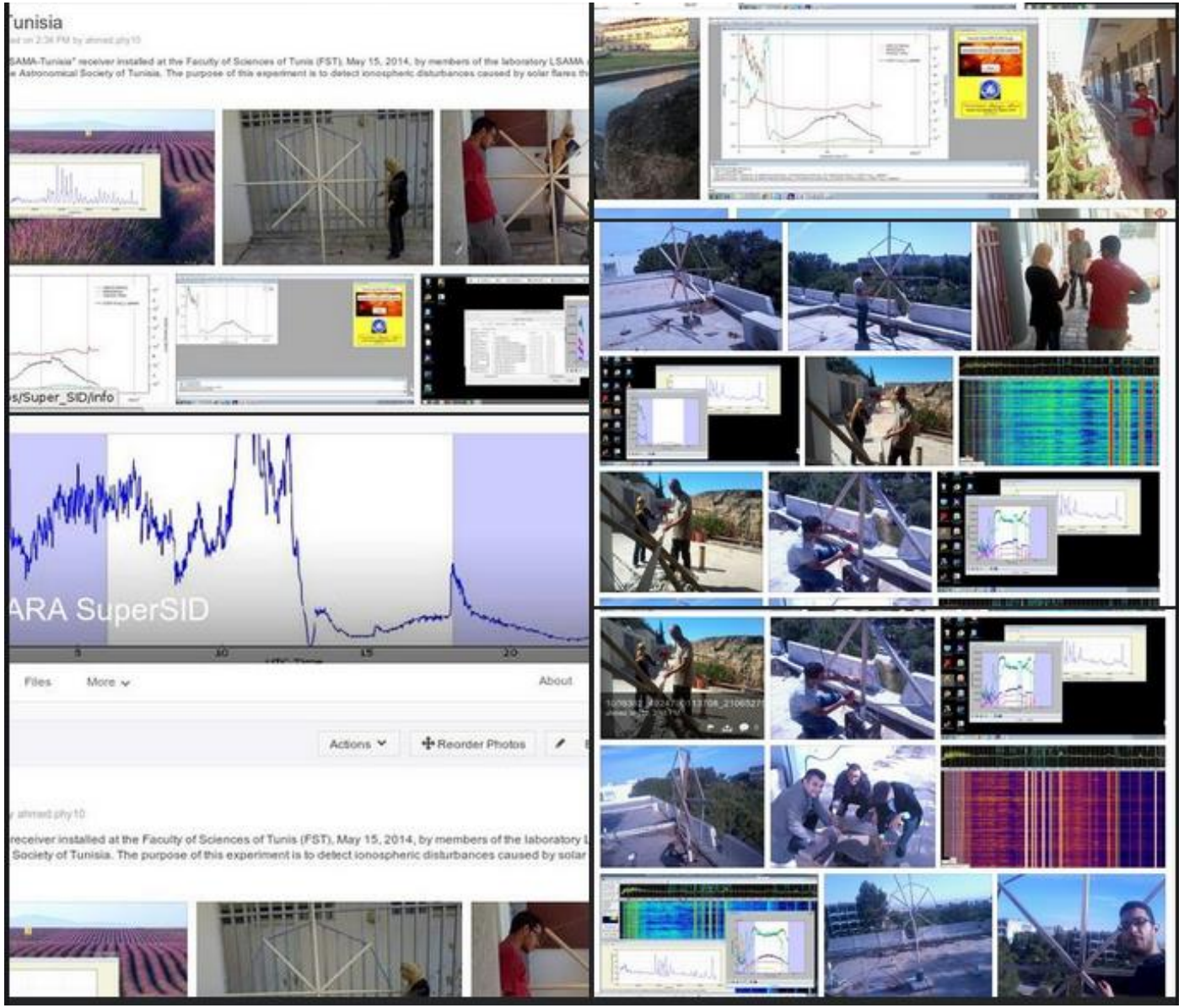
Georgia Institute of Technology

II. ELF/VLF/LF receiving stations (3Hz-50 kHz)

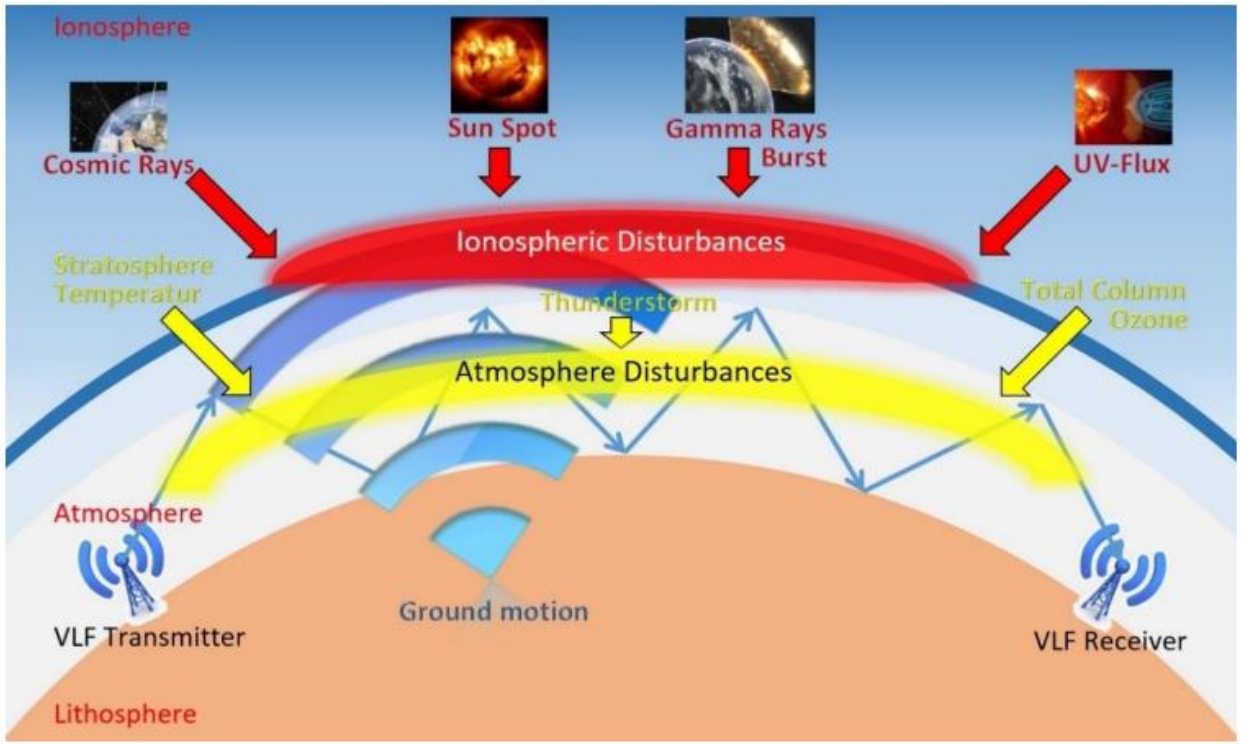
SuperSID instruments

Acknowledgment :
Deborah Scherrer
Stanford University





III. Observations and measurements



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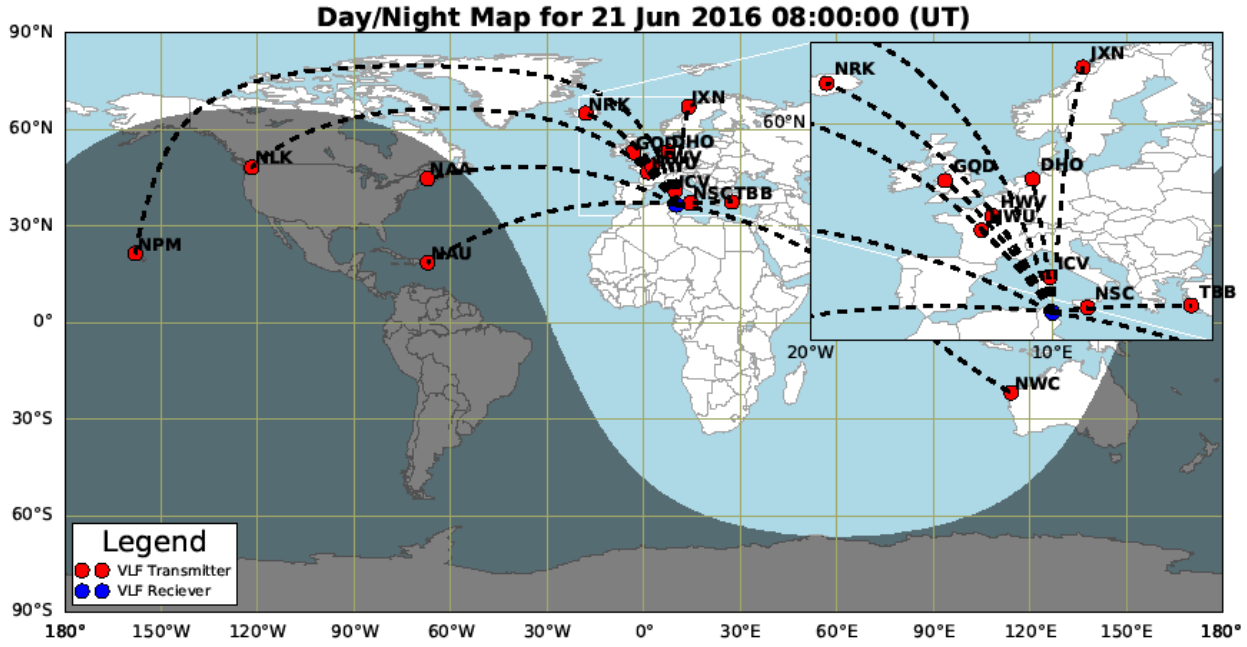

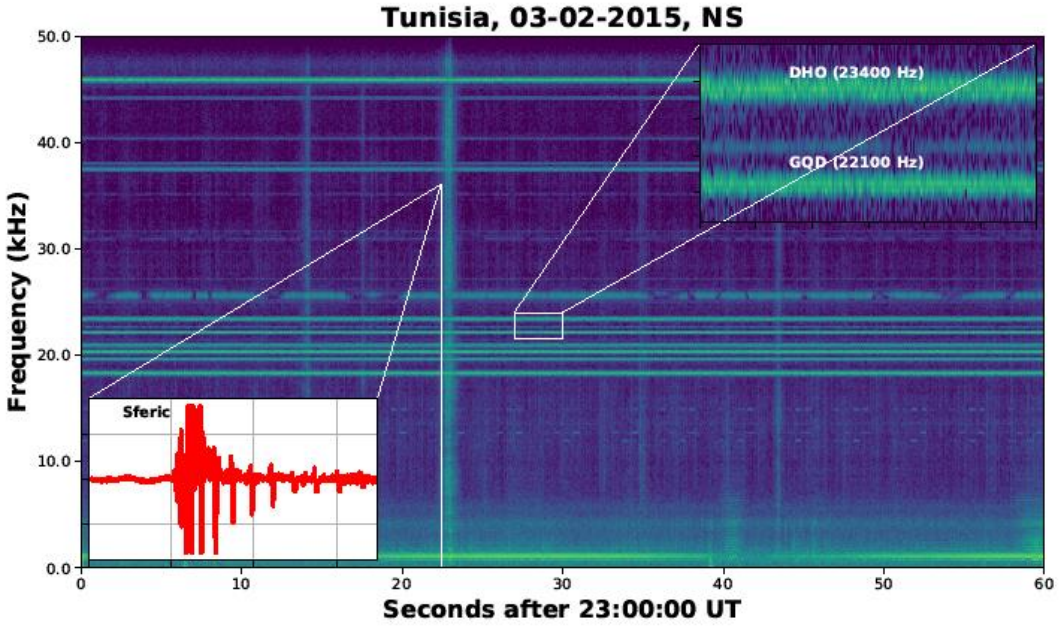

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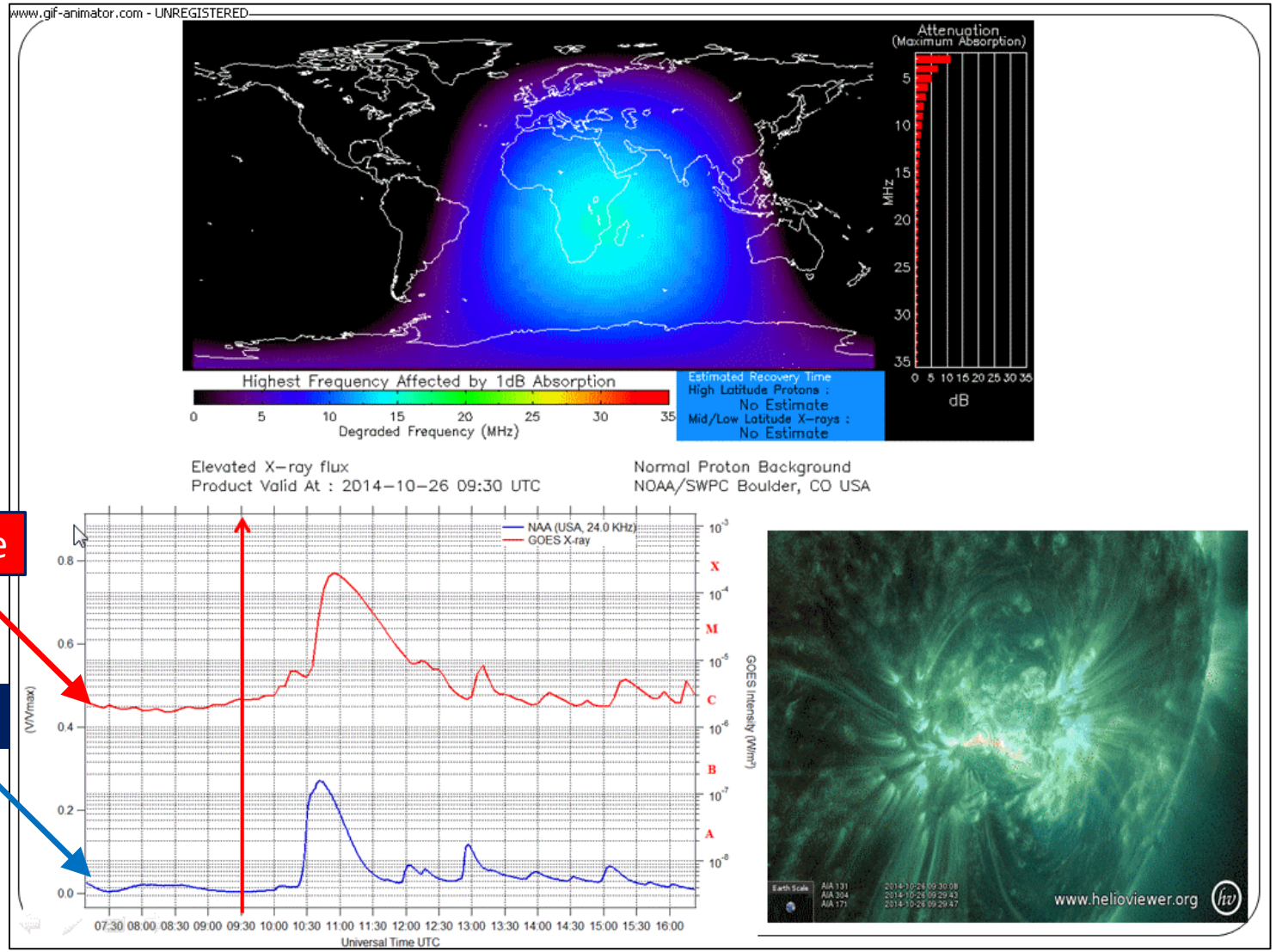
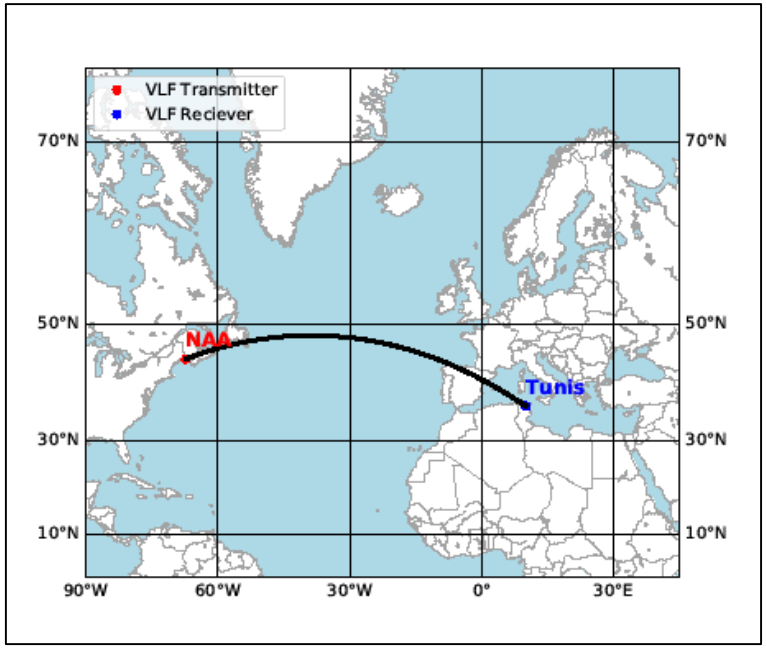
Effect of the solar flare on the terrestrial ionosphere



GOES Satellite

VLF-LSAMA



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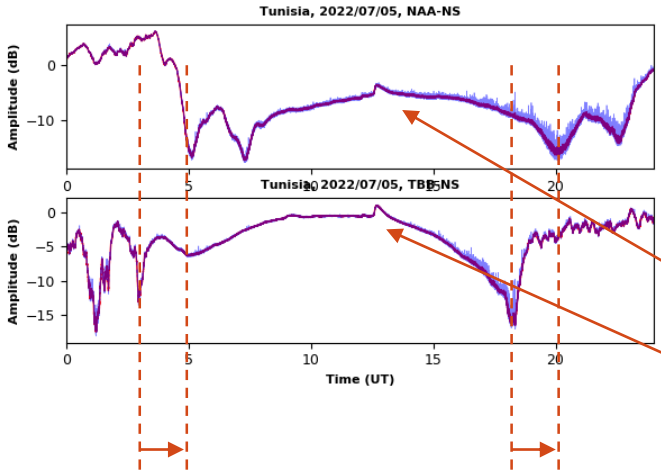
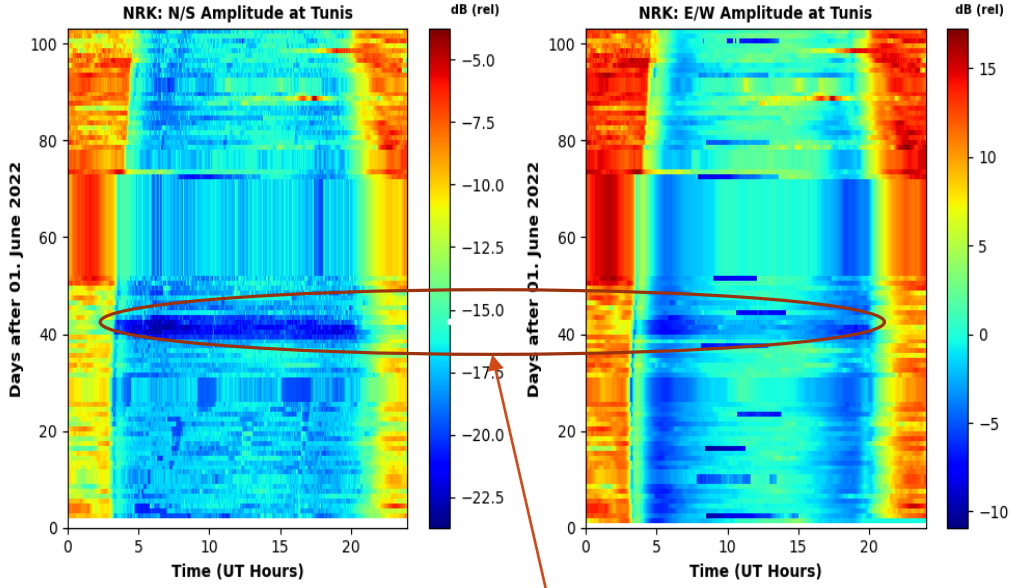
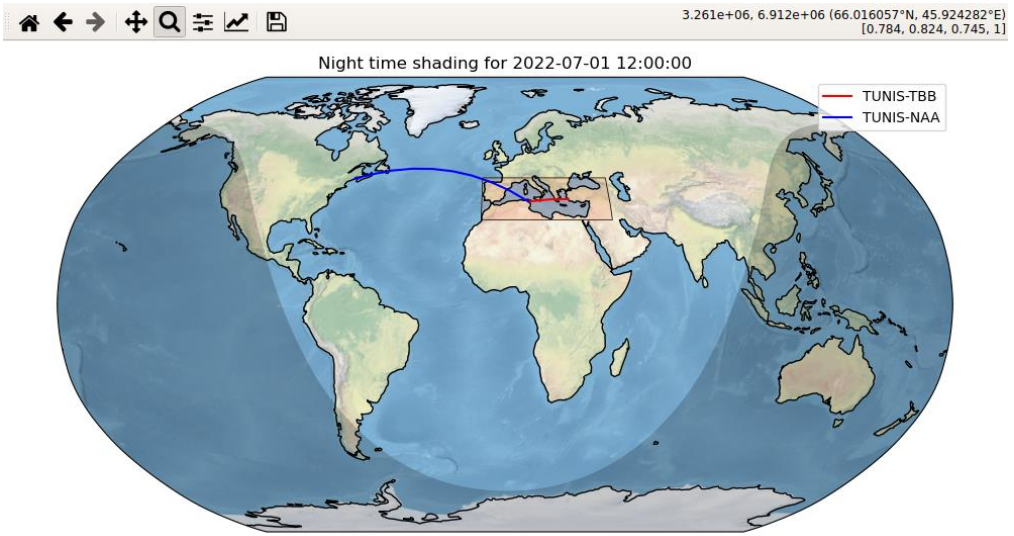
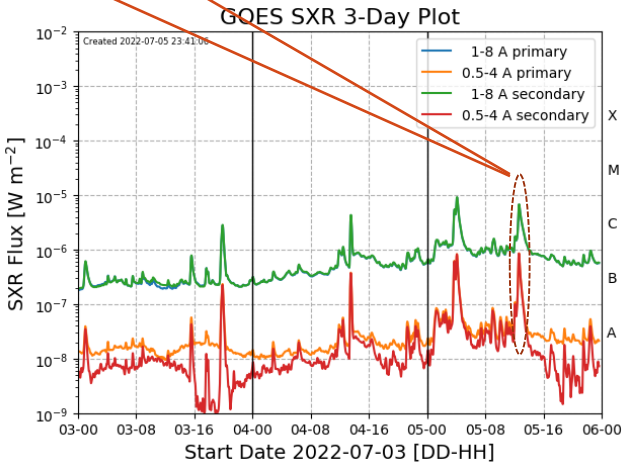
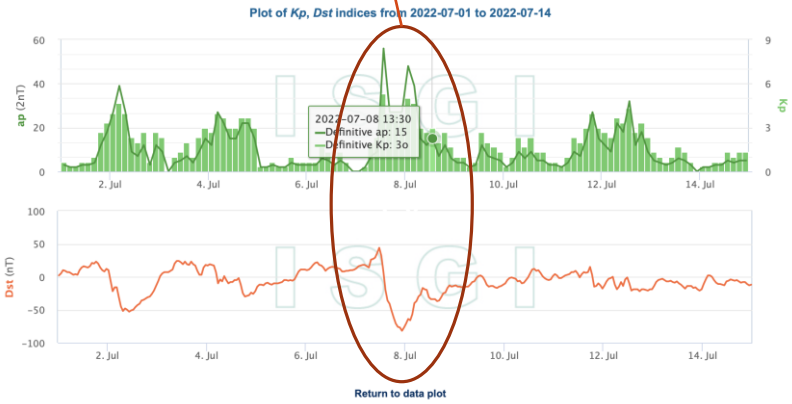






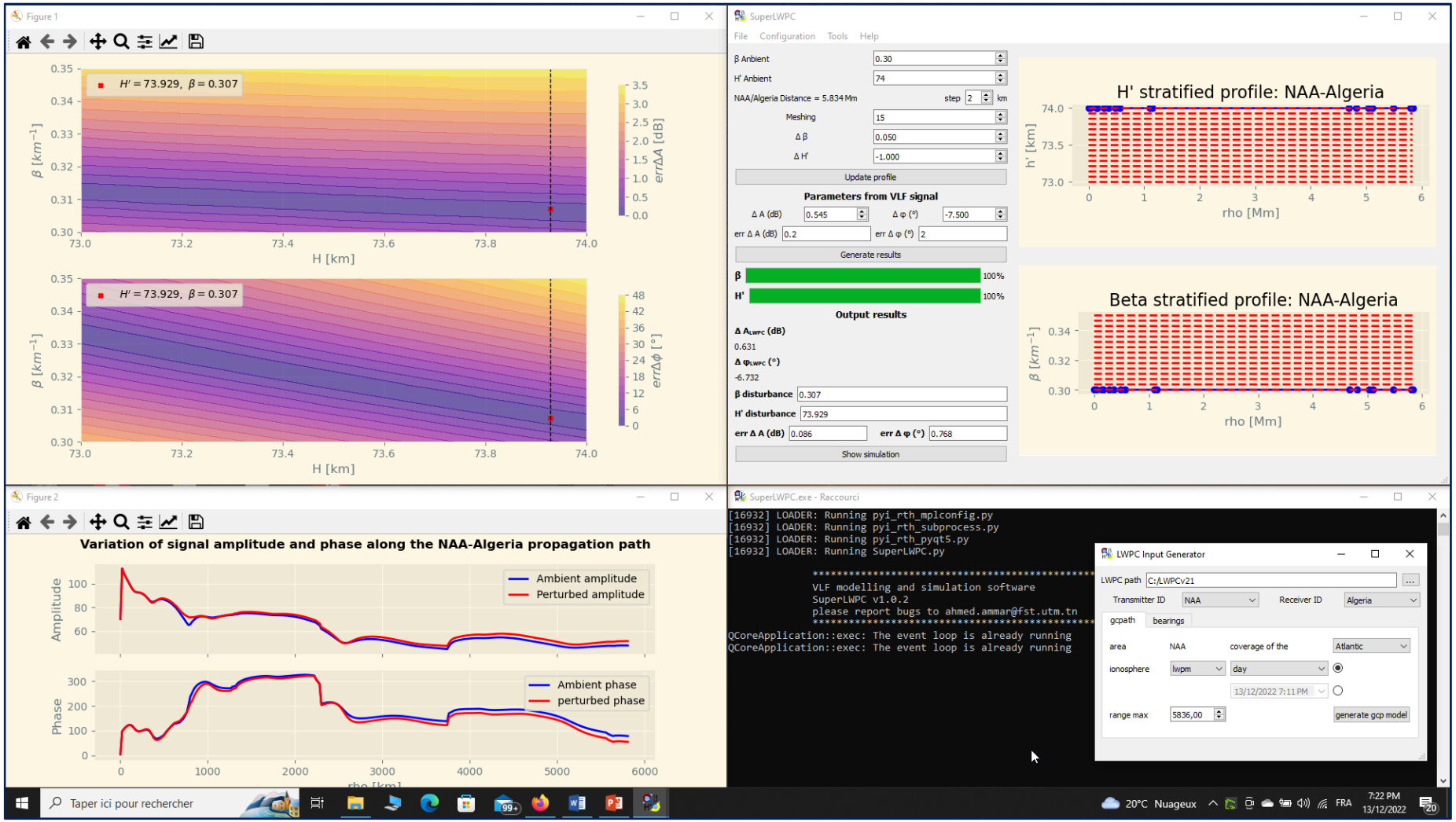




IV. Modelling and Simulations (SuperLWPC)

Open Source software : SuperLWPC https://github.com/lwpc-gui/SuperLWPC

The determination of the coefficients ***H'*** and β is done **interactively** during which we seek **to minimize the deviation** between the measured ELF/VLF/LF signal perturbations and the **introduced model**.



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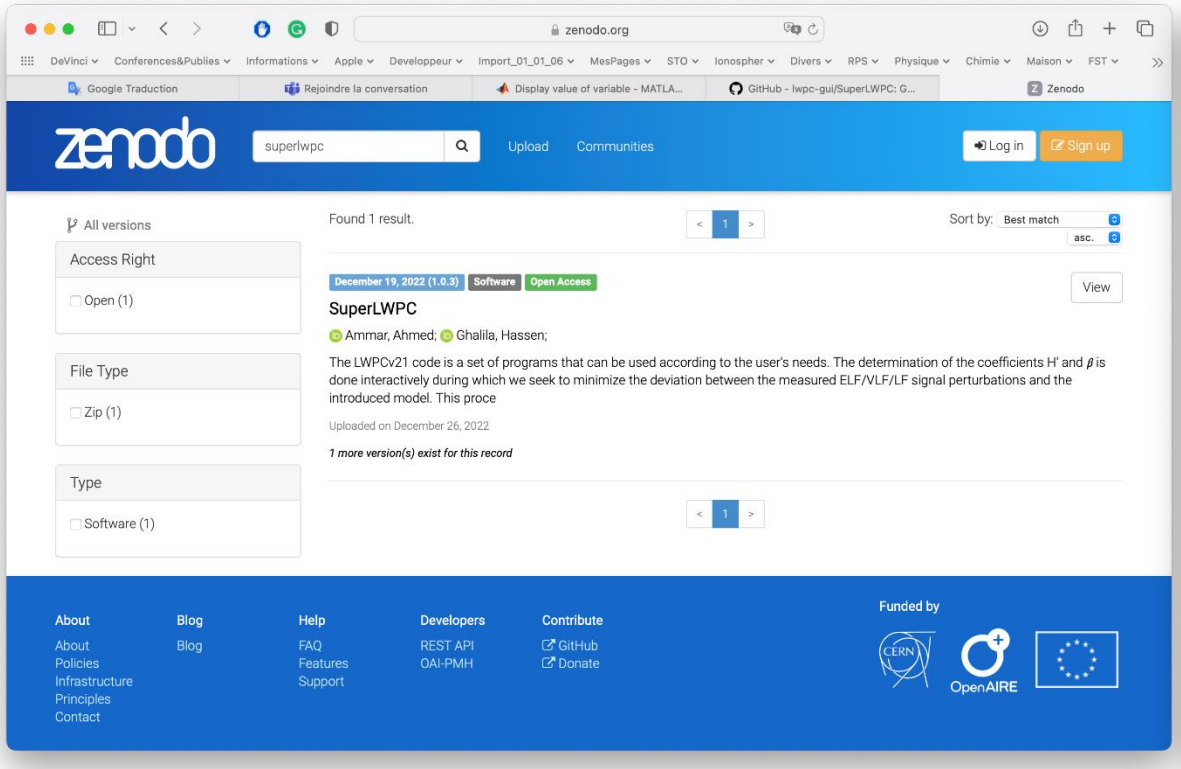
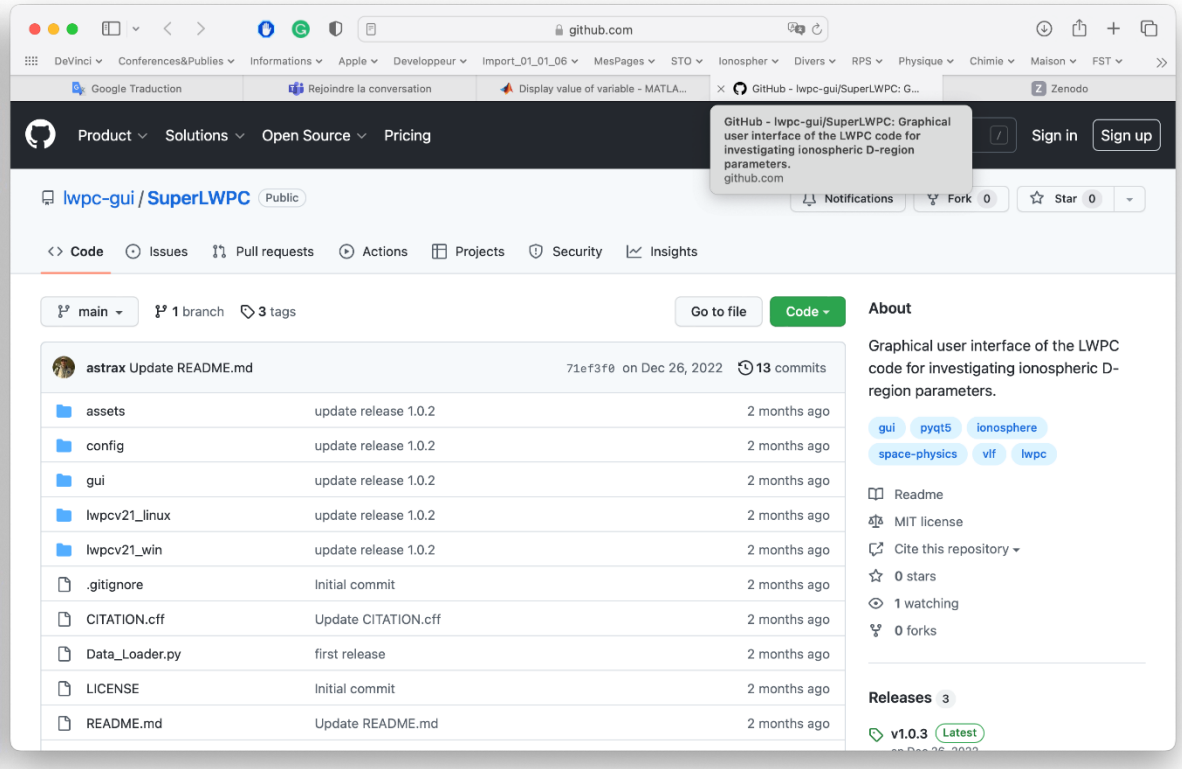
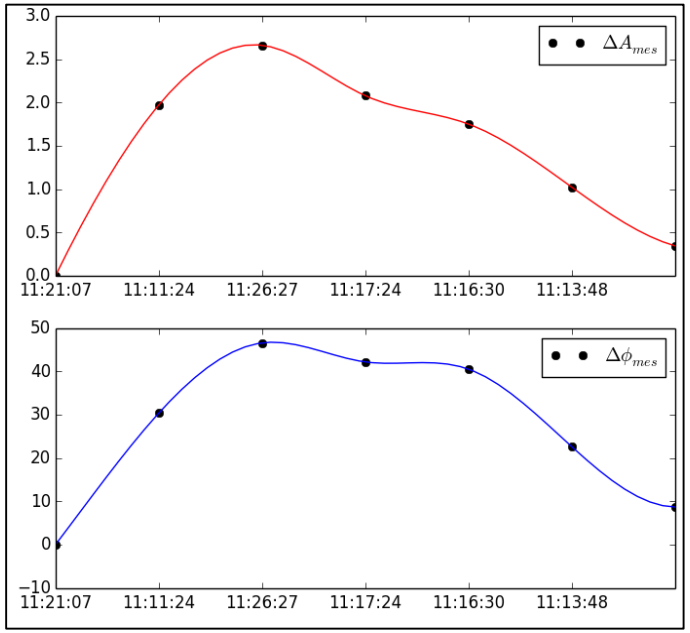




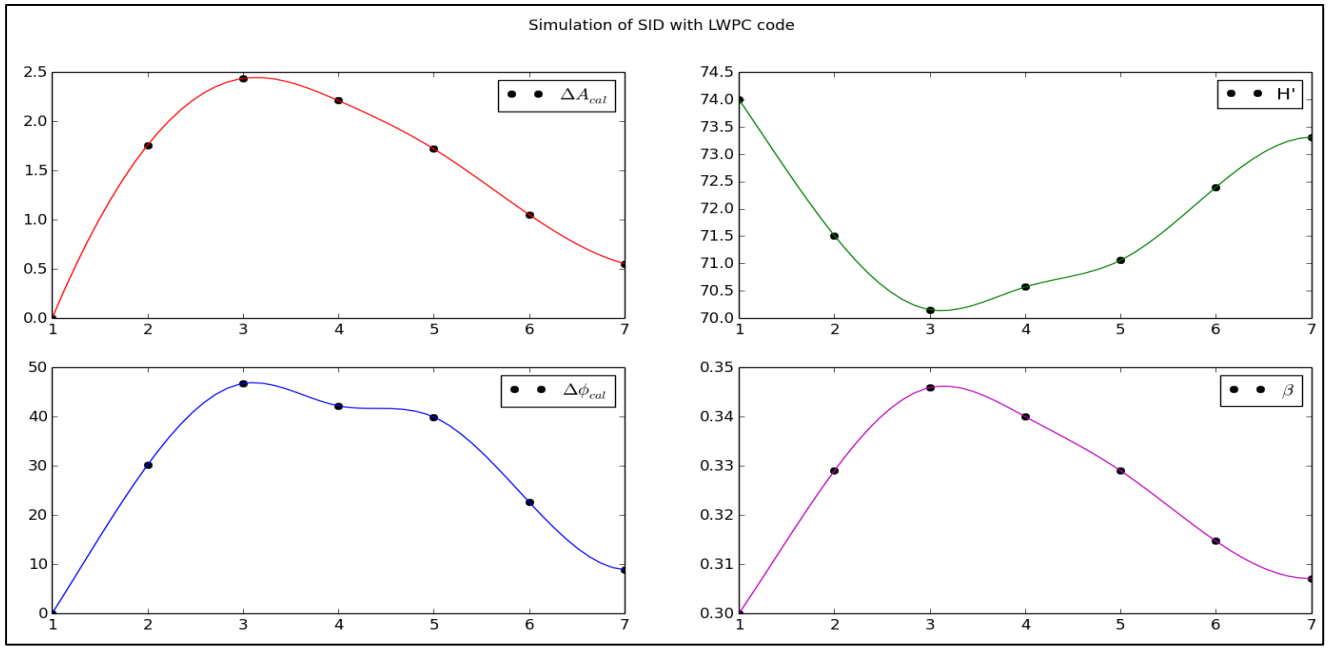
IV. Modelling and Simulations (SuperLWPC)

In our study, the Long Wave Propagation Capability (SuperLWPC) software was used to model the D region ionosphere during solar flares.



MEASUREMENT OF AMPLITUDE (dB) AND PHASE (˚) DURING THE RECORDING OF SOLAR FLARE

LWPC



AMPLITUDE (dB) AND PHASE (˚) VLF CALCULATED from the LWPC model.

Estimated values of the change in ionospheric parameters of Wait H' (km) and β (km^{-1})

In the LWPC, we use the empirical model of Wait (Wait and Spies, 1964) for the electron density profile valid up to 100 Km altitude.

$$N_e(h,t) = 1.43 \cdot 10^{13} e^{0.15h'(t)} e^{(\beta(t)-0.15)\cdot(h-h'(t))}$$ (cm^{-1})

- ***h'*** *(km) :The effective reflection height*
- ***β*** *(km^{-1}) : The sharpness*

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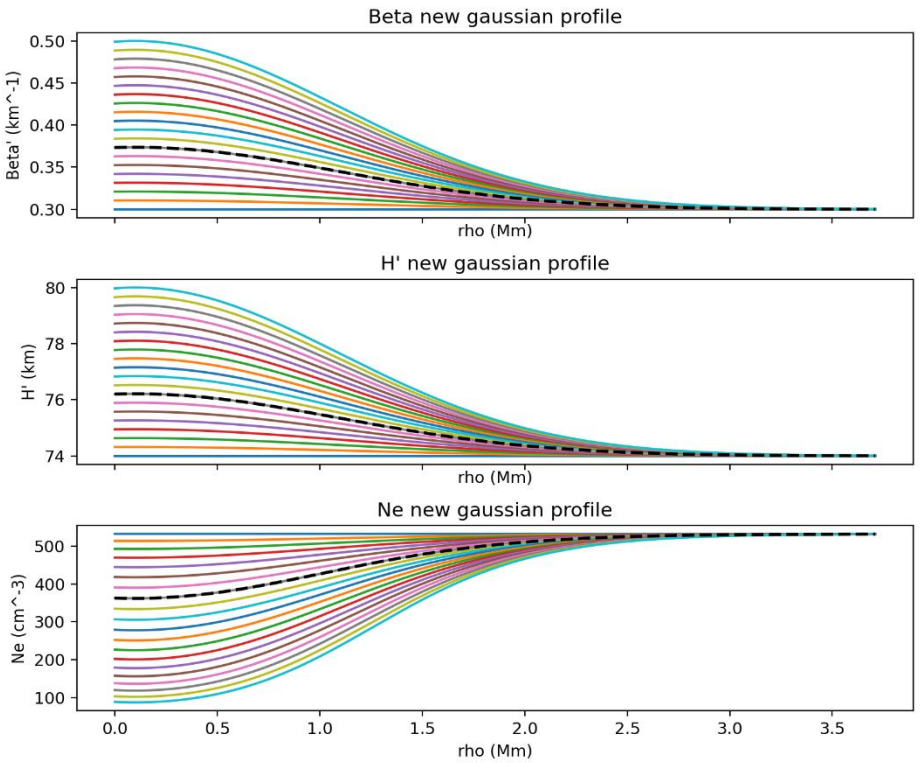

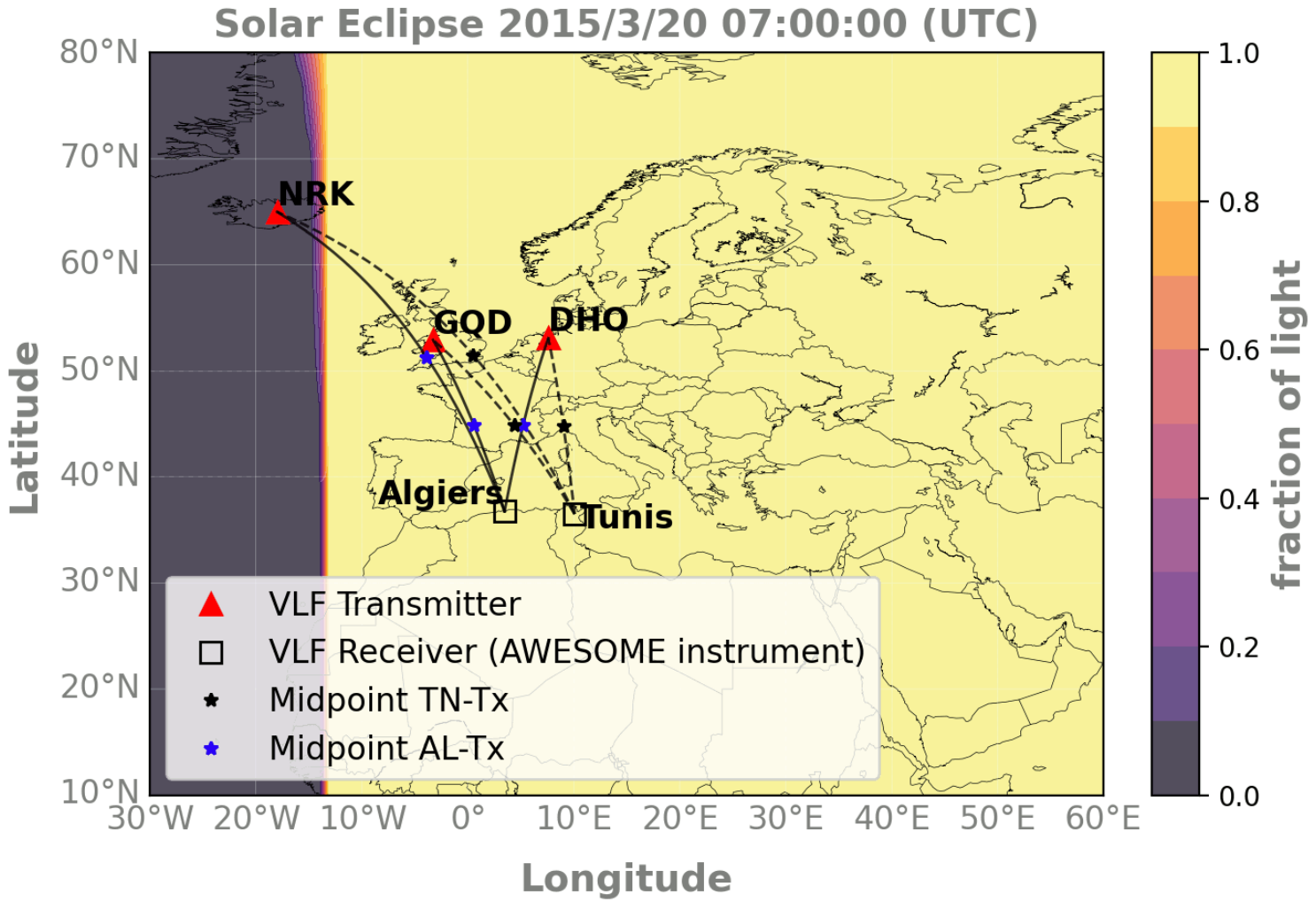

THANK YOU!