Europska Unija
Ulaganje u budućnost
Projekt je sufinancirala Europska Unija iz Europskog socijalnog fonda

FORMATION OF CORONAL LARGE-AMPLITUDE WAVES AND THE CHROMOSPHERIC RESPONSE

[1]Slaven Lulić, [2]Tomislav Žic,[2]Bojan Vršnak

[1] Karlovac University of Applied Sciences, Trg J.J. Strossmayera 9, HR-47000 Karlovac, Croatia

[2] Hvar Observatory, Faculty of Geodesy, University of Zagreb, Kačićeva 26, HR-10000 Zagreb, Croatia

e-mail: slulic@vuka.hr, tzic@geof.hr, bvrsnak@geof.hr

INTRODUCTION

- Violent solar eruptions in the form of coronal mass ejections (CMEs) and flares, often cause pulsed disturbances propagating through the corona on a global scale
- These CME/flare ignited disturbances cause a variety of effects in the corona, transition region, and chromosphere, as observed in EUV-range, X-rays, radio-wavelength domain, as well as In the chromospheric and transition-region spectral lines
- The main objective of this study is quantitative analysis of the propagation of the coronal wave and the effects it causes in the transition region and chromosphere

THE MODEL

- In the following, a 2.5-D model is considered, meaning that all quantities are invariant along the z-coordinate, but the z-component of the magnetic field $B_z(x,y) \neq 0$ is included in the calculation.
- On the other hand, the z-component of the velocity is always kept zero ($v_z = 0$)
- the input and the basic output quantities are the density [ρ] the x- and y-component of the velocity [v_x, v_y] and all three components of the the magnetic field [B_x, B_y, B_z]

THE MODEL

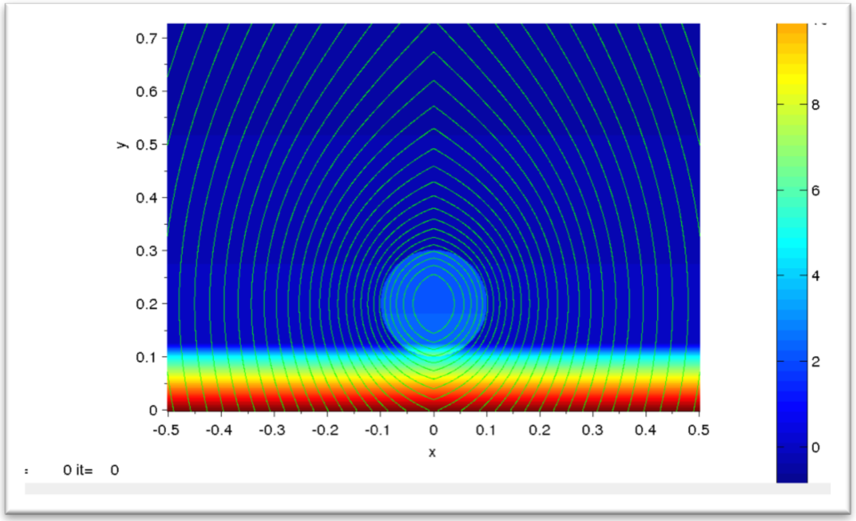
- All quantities are normalized, so that distances are expressed in units of the numerical-box length (L=1)
- velocities are normalized to the Alfvén speed v_A, and time is expressed in terms of the Alfvén travel time over the numerical-box length ($t_A=L/v_A$)
- We apply the approximation $\beta=0$, where β is the plasma-to-magnetic pressure ratio.
- The origin of the coordinate system is set at the numerical-box center

THE MODEL

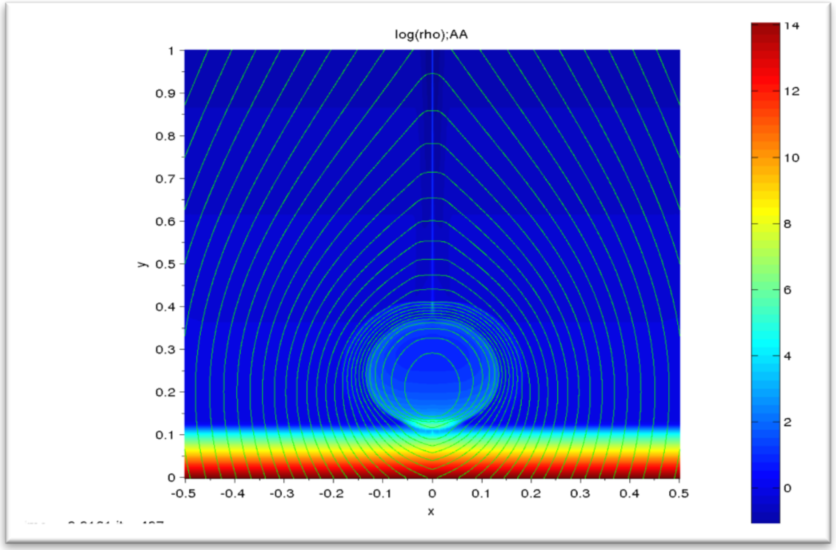
- We focused on the understanding of the propagation waves/shocks in lowest layers of the solar corona and their effects in the solar chromosphere, special attention is paid to the vertical profile of the density
- To reproduce the solar atmosphere, the numerical box is divided in three domains, corresponding to the chromosphere, transition region, and low corona

THE MODEL

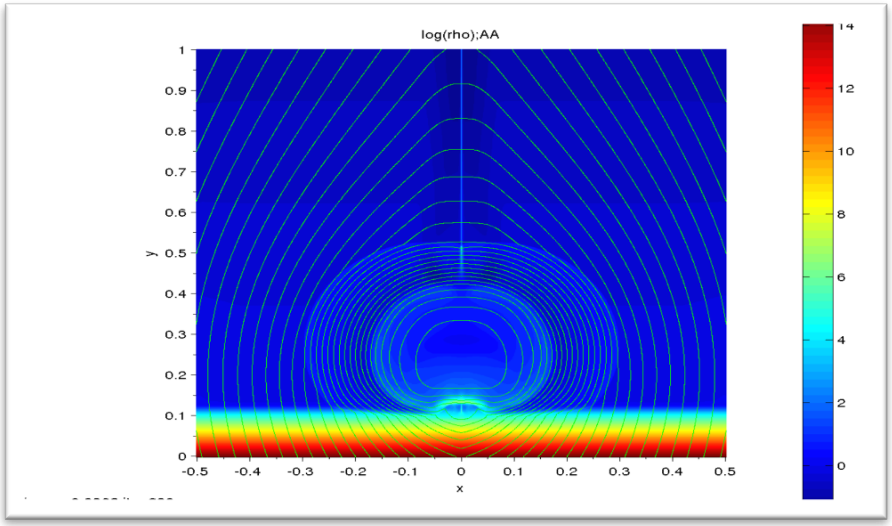
- The density is set to $\rho = 1$ at the base of the corona, i.e., the top of the transition region
- The lowest layer, representing the chromosphere, extends from $y = 0$ to $y = 0.1$
- In the applied model-atmosphere, in this domain the density decreases for ≈ 5 orders of magnitude, following the exponential law
- The next layer, representing the transition region [TR], extends from $y = 0.1$ to $y = 0.125$
- Over this height range, we apply a linear a density decrease of two orders of magnitude
- Above $y = 0.125$ extends the corona whose density decreases exponentially from $\rho = 1$, where we apply the scale height 100 times larger than in the chromospheric layer.



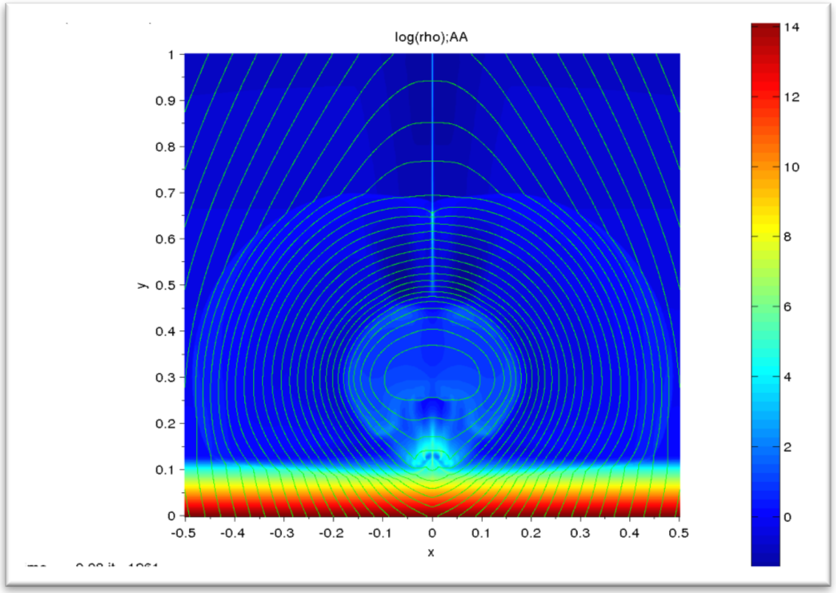
y
x
0 it= 0



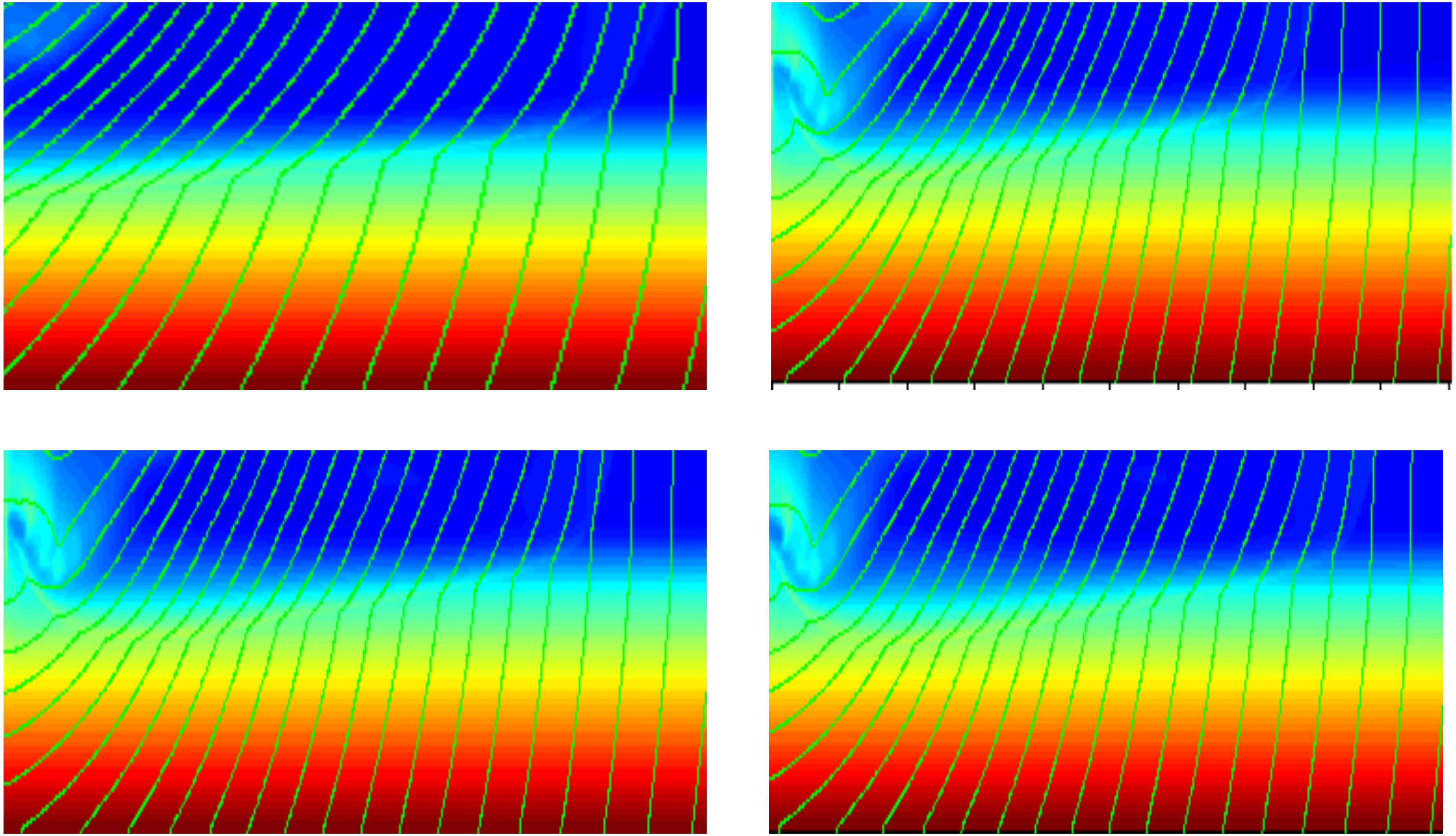
log(rho);AA
y
x



log(rho);AA
y
x



log(rho);AA
y
x



CONCLUSION

- To conclude, the chromospheric perturbation (corresponding to a Moreton wave) lags behind the transition-region and coronal perturbation (corresponding to an EUV wave).
- This is fully consistent with the observations of the sharp-wavefront EIT waves associated with Hα and HeI Moreton waves
- After the passage of a sharp coronal EUV wave associated with the Moreton wave, one can expect to observe a passage of a significantly-slower perturbation, manifested mainly as a density compression that propagates upward/sidewise, and is associated with slow upward relaxation of the lower corona, transition region and chromosphere
- Due to the inclination and the spatial extent, this feature should be observed as a wide/diffuse feature propagating from the source region, and being much slower than the sharp coronal EUV wavefront associated with the Moreton wave

ACKNOWLEDGMENTS

- We acknowledge the support of European Social Fund under the „PoKRet“ project.