



Galactic cosmic rays as signatures of coronal mass ejections

<u>M. Dumbovic¹</u>; B. Vrsnak¹; B. Heber²; L. Kramaric¹; M. Horlock²; I. Benko¹; K. Martinic¹

[1] Hvar Observatory, Faculty of Geodesy, Uni. Zagreb

[2] Department of Extraterrestrial Physics, CAU Kiel

Interplanetary transients: ICMEs vs CIRs



ICMEs vs CIRs: GCR signatures



Modelling GCRs in the heliosfere



SOLAR WIND CONVECTION

collective movement with solar wind



gradient and curvature drifts irregularities causing random walk, i.e. diffusion

ADIABATIC ENERGY LOSS

Momentum loss due to expansion of HMF

SMALL SCALE IRREGULARITIES causing DIFFUSION

NON-UNIFORM FIELD

causing PARTICLE DRIFTS

HVAR OBSERVATORY, FACULTY OF GEODESY, UNIVERSITY OF ZAGREB

Modelling ICME-related GCRs



Each region modelled

Shock/sheath: stationary convection-diffusion eq. (PDB, Wibberenz+1998)

Ejecta: time-dependent diffusion-expansion eq. (ForbMod, Dumbovic+2018)

Recovery: empirical exponential recovery eq. (Lockwood+1986)

ForbMod best-fit function



Means to measure FD amplitude for ejecta-related FDs

Dumbovic+(In prep)

HVAR OBSERVATORY, FACULTY OF GEODESY, UNIVERSITY OF ZAGREB



ForbMod best-fit function

Synthetic data: = theoretical ForbMod curve + noise

small MSE and close to ID line large MSE (close/away from ID line) away from ID line (small/large MSE)

Analysis of amplitude difference between theoretical and best-fitted curve:

MSE<0.01 --> FD amplitude error <10%

Dumbovic+(In prep)

IVAR OBSERVATORY. FACULTY OF GEODESY. UNIVERSITY OF ZAGREE

ForbMod best-fit function



HVAR OBSERVATORY. FACULTY OF GEODESY. UNIVERSITY OF ZAGREE

Take away messages:

- GCRs can be used as signatures of interplanetary transients
- Classical 2-step Forbush decrease can be modelled using three different models
- ejecta-related FD can be modelled by ForbMod, a time-dependent diffusion-expansion model for flux-rope FDs
- Best-fit function using ForbMod solution has been established, which can fit ejecta-related FD profiles easy and well

Thank you for your attention!

HVAR OBSERVATORY, FACULTY OF GEODESY, UNIVERSITY OF ZAGREB