

An Observationally Constrained Analytical Model for Predicting the Magnetic Field Vectors of Interplanetary Coronal Mass Ejections at 1 AU

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Coronal mass ejections (CMEs) are powerful expulsions of gigantic clouds containing magnetized plasma that routinely erupt from the Sun and propagate out through the solar system. When such an eruption is directed toward the Earth with high speed and has a southward component of the magnetic field (B_z), an intense magnetic storm occurs upon the impact of the CME on Earth's magnetosphere. The storm can occur when the CME's interplanetary flux rope (FR) and/or the sheath between the FR and the associated shock has southward B_z . Therefore, a prior knowledge of the strength and orientation of the magnetic field embedded in the FR is required in order to forecast the severity of geomagnetic storms caused by CMEs.

We have developed an observationally constrained analytical model, the INterplanetary Flux Rope Simulator (INFROS), for predicting the magnetic-field vectors of interplanetary CMEs (ICMEs). The main architecture of INFROS involves using the near-Sun flux rope properties obtained from the observational parameters that are evolved through the model in order to estimate the magnetic field vectors of ICMEs at any heliocentric distance. As a proof of concept, we validate INFROS for an Earth-impacting CME which occurred on 2013 April 11. The predicted magnetic field profiles of the associated ICME show good agreement with those observed by the in-situ spacecraft, namely, WIND (see Figure). Importantly, the maximum strength (10.5 ± 2.5 nT) of the southward component of the magnetic field (B_z) obtained from the model prediction is in agreement with the observed value (11 nT). INFROS shows promising results in near real time which could prove to be a useful space-weather forecasting tool compared to the time-consuming and computationally expensive MHD models.

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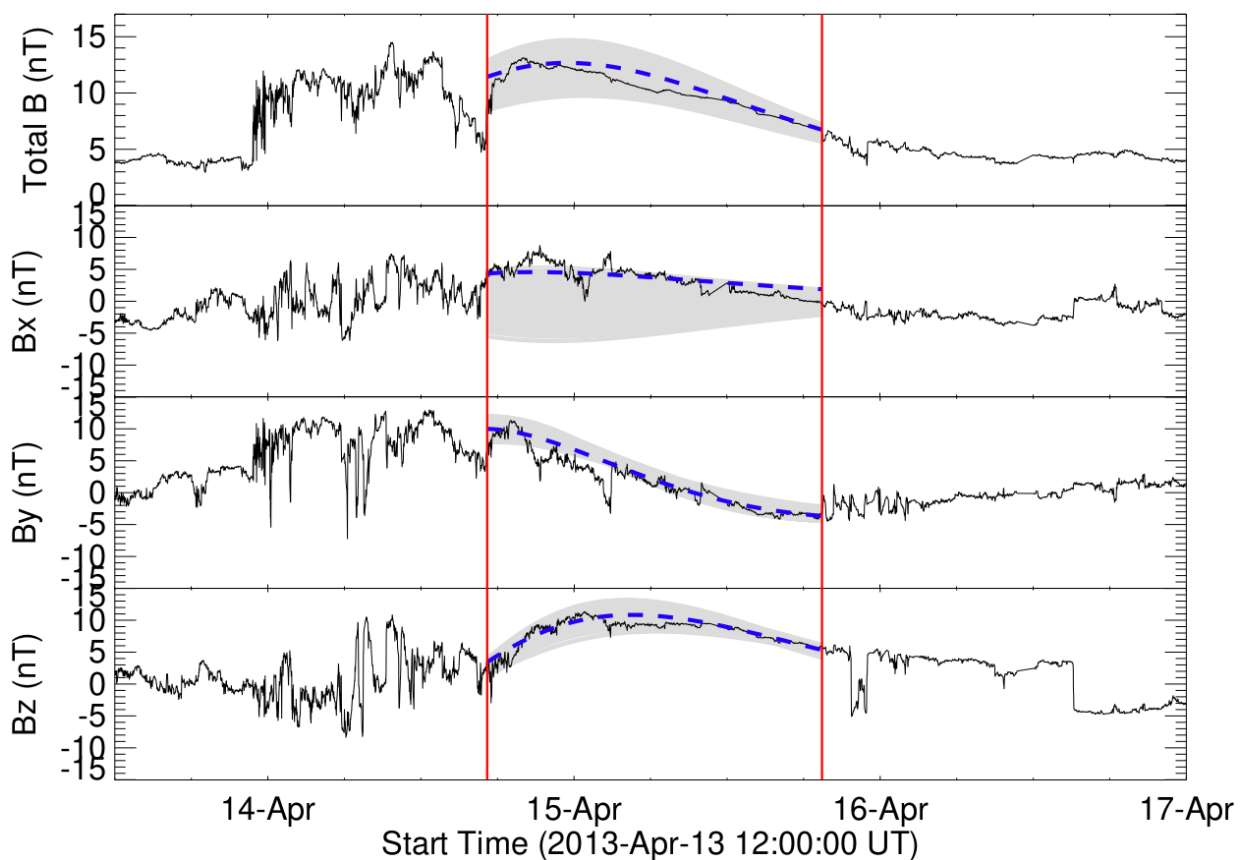


Figure : Magnetic vectors of the ICME as detected by the Wind spacecraft for the 2013 April 14 ICME event. The two red vertical lines denote the magnetic cloud (MC) boundary. The blue dashed lines denote the predicted magnetic vectors obtained from the model which best match the observed magnetic profiles of the MC. The gray shaded regions denote the uncertainty in predicting the respective magnetic vectors.

HONOURING AN ACT OF BRAVERY DURING THE REPUBLIC DAY CELEBRATIONS AT USO

The 71st Republic Day of our Nation was celebrated at Udaipur Solar Observatory PRL with the hoisting of the National Flag amid the reverberating chorus of the National Anthem by the staff and students of USO. The occasion was indeed befitting to honour an act of bravery and selflessness on the part of **Mr. Sunil Nagda**, a 28-year old Home Guard, who rescued a drowning girl from Fatehsagar Lake Udaipur on Sunday the 24th of November 2019. The girl, who was riding a scooter with her friend, fell into the water after losing control of the vehicle which rammed into the railing along the lake. The pillion rider who lay injured on the road cried for help to which several people passing by stopped, but nobody in the crowd attempted to rescue the drowning girl. Mr. Nagda was on his motorcycle when he saw the crowd gathered around the lakeshore. On hearing the situation, he jumped into the water without any hesitation and rescued the girl despite lacking formal training for such scenarios. Mr. Nagda managed to bring the girl to safety following a great struggle. An ambulance took the girl to the hospital for treatment. Mr. Nagda has been a part of the security detail at USO since 2011. He was honoured with a Merit Award from the PRL Director and presented a memento from USO personnel on 26th January 2020 for his act of courage. We are very proud of Mr. Nagda for his exemplary action of saving a girl from the clutches of death.



FAREWELL TO DR. SYED IBRAHIM

We bid farewell to Dr. Syed Ibrahim, a Post Doctoral Fellow at USO, as he moves to the Aryabhata Research Institute of Observational Sciences (ARIES) Nainital to continue his post-doctoral career. Dr. Syed Ibrahim spent two years at USO collaborating with Dr. Bhuwan Joshi. Students and staff gathered on 3rd January 2020 to wish him all the very best for his research endeavours.

