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Disentangling the Magnetic Flux Rope Topology from Coronal Mass Ejections

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It is not always straightforward to associate the measured plasma variables inside a magnetic cloud with a magnetic flux-rope topology. Therefore, to explain non flux-rope topology, recent theoretical and numerical work has focused on two scenarios based on the classical flux-rope theory. In one case, the complex structure is simply due to the off-axis detection of a magnetic cloud; in the other one, interaction of multiple CMEs on their way to Earth destroys the regularity of the magnetic field. Here, we present recent simulation results which show that the magnetic cloud paradigm itself may need to be revised. Using a realistic initiation mechanism for a Coronal Mass Ejection, we are able to simulate an interplanetary CME, which possesses at 1AU the characteristics of a magnetic cloud, like the smooth rotation of the magnetic field vector. However, no flux-rope structure is present in the simulated CME. In our model, reconnection following a shearing phase results in the appearance of erupting magnetic field lines showing writhe and not twist. By presenting synthetic white-light images and satellite data at 1AU, we argue that this type of ejections could not be distinguished from the classical picture of a flux-rope. We also present evidence that this initiation mechanism can help explaining some complex SEP observations such as those during the August 24, 2002 CME.