

# MESSENGER and Venus Express observations of magnetic clouds

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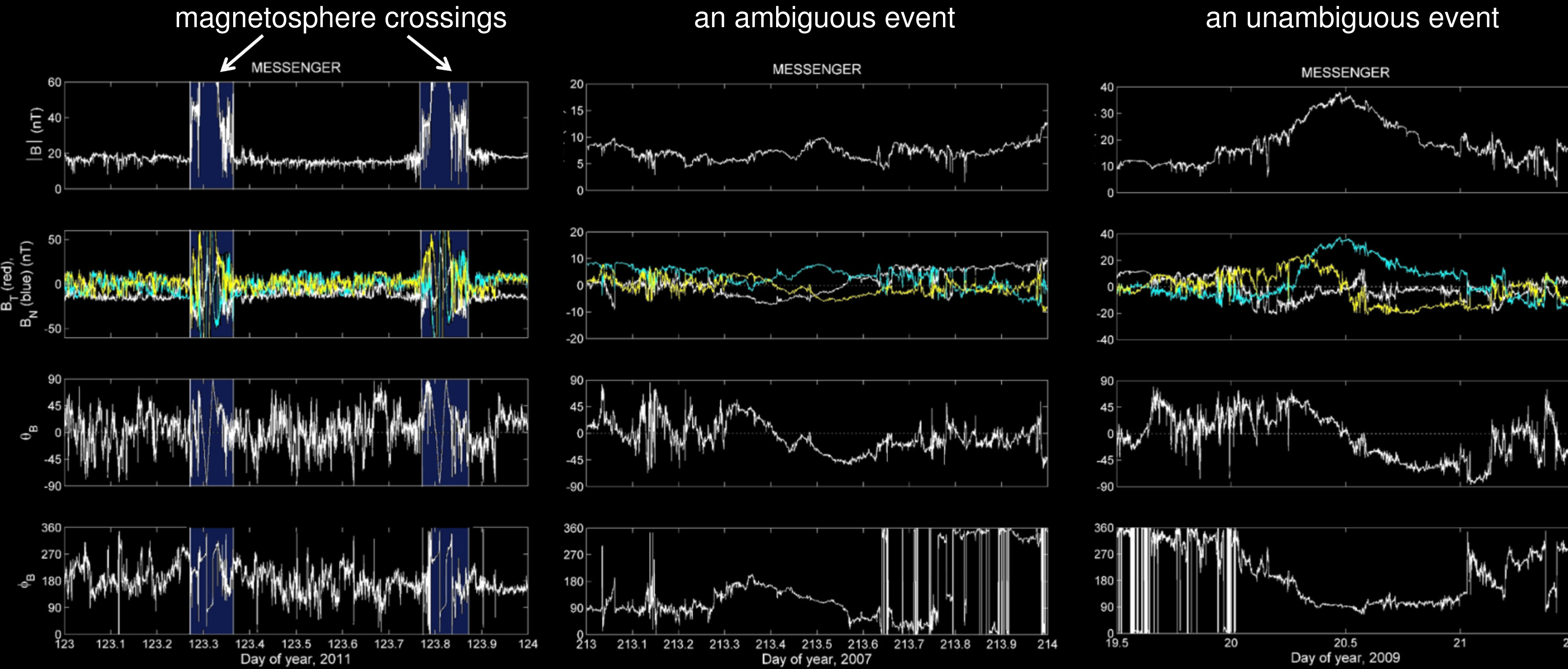
## 1. INTRODUCTION

Magnetic clouds are a magnetically well ordered subset of coronal mass ejections (CMEs) observed in interplanetary space. We present details of a catalogue of magnetic clouds that were observed by the *MESSENGER* and *Venus Express* spacecraft.

Despite their planetary focus, both spacecraft spent significant amounts of time in the solar wind, allowing transient structures such as magnetic clouds to be observed.

The two spacecraft offer the first long term, sub-1 AU in situ observations of the solar wind since the time of *Helios*.

## 2. EXAMPLE DATA

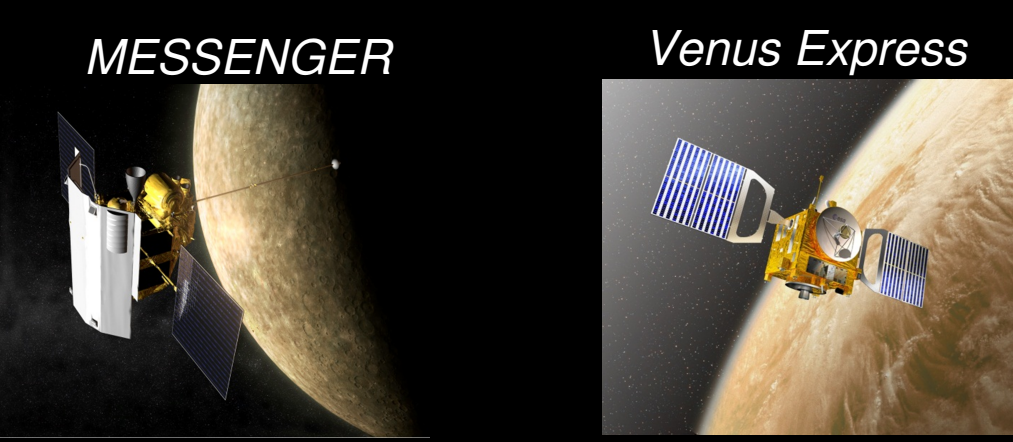


IDENTIFICATION CRITERIA

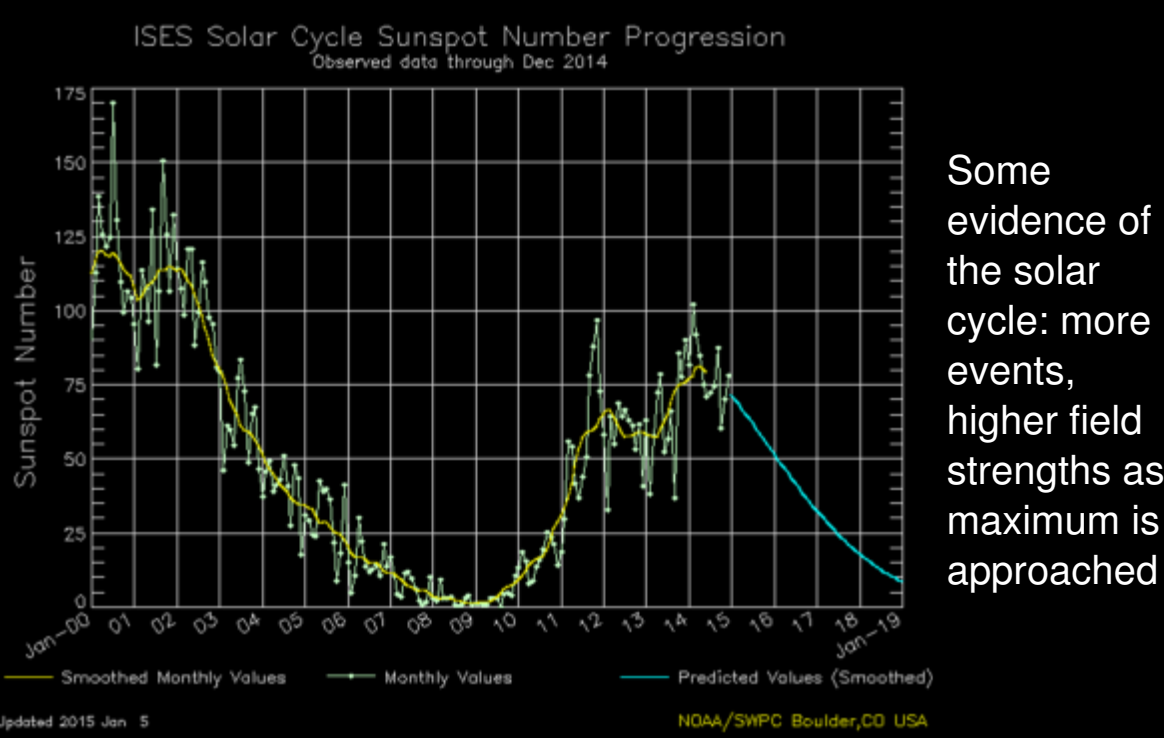
→ Field direction rotation (*not necessarily smooth over short durations*)

→ Field strength enhancement

→ Duration > 5 hours



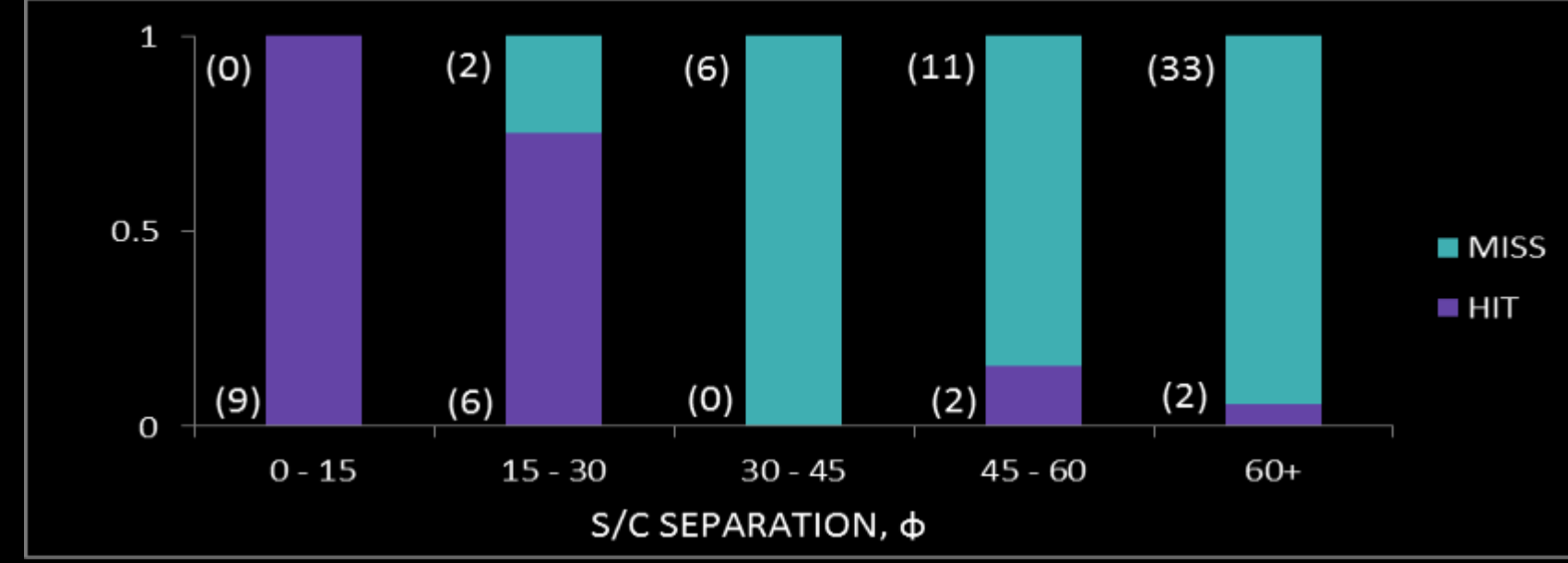
## 3. CATALOGUE SUMMARY



	MES	VEX
Total no. of events	38 (2005, 2007-2012)	55 (2006 - 2012)
2007	4 events < R > = 0.69 AU < Bmax > = 18 nT	7 events < R > = 0.72 AU < Bmax > = 17 nT
2008	2 events < R > = 0.61 AU < Bmax > = 29 nT	3 events < R > = 0.72 AU < Bmax > = 15 nT
2009	7 events < R > = 0.44 AU < Bmax > = 33 nT	10 events < R > = 0.72 AU < Bmax > = 14 nT
2010	13 events < R > = 0.46 AU < Bmax > = 31 nT	15 events < R > = 0.72 AU < Bmax > = 24 nT
2011	10 events < R > = 0.42 AU < Bmax > = 76 nT	14 events < R > = 0.72 AU < Bmax > = 27 nT

## 4. LONGITUDINAL EXTENT

If *MES* or *VEX* sees a magnetic cloud, what is the probability that a second spacecraft, separated by angle  $\phi$  in heliocentric longitude, will also see signatures of the cloud?



(STEREO-A, -B and ACE have been used to provide secondary observations, as well as *MES* and *VEX*)

## 5. CATALOGUE APPLICATIONS

- \* 1 AU-observed events may also have been observed by *MES* and *VEX* → multi-point observations and studies
- \* Statistical properties of sub-1AU clouds may be determined: how are they different to 1 AU statistics? (cf. *Helios*-era studies)
- \* Useful to validate or constrain remote observation (e.g., STEREO HI) models → *HELICATS* WP4