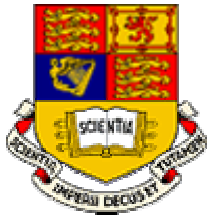

Correlation of magnetic field intensities and solar wind speeds of events observed by ACE.

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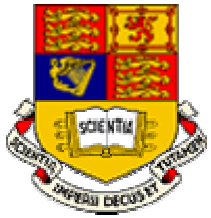
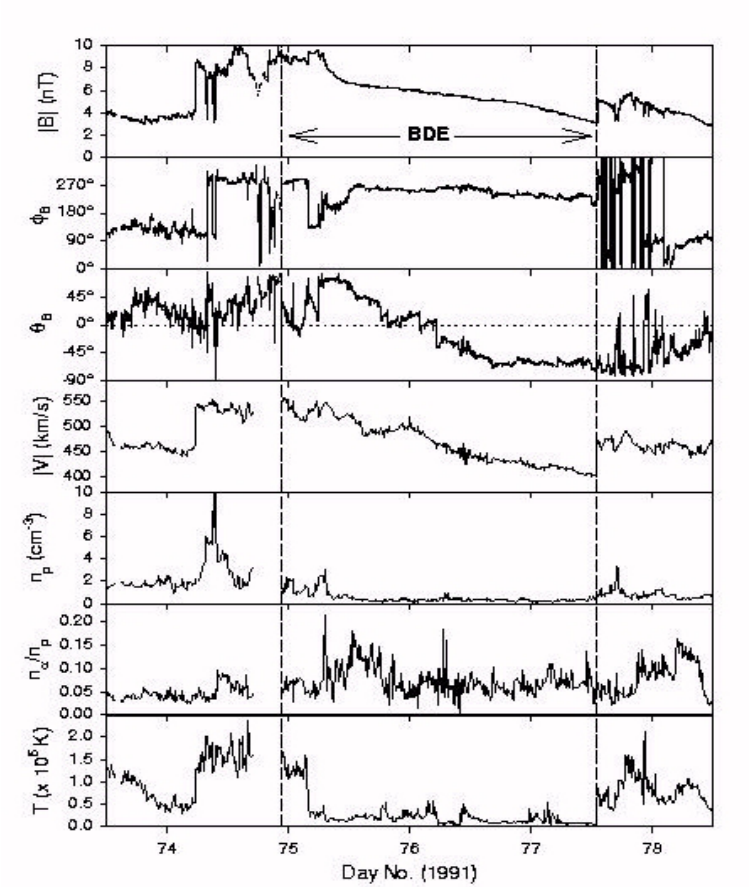


Abstract

The relationship between the magnetic field intensity and speed of solar wind events is examined using approximately three years of data from the ACE spacecraft. No pre-selection of CMEs or magnetic clouds is carried out. The correlation between the field intensity and maximum speed is shown to increase significantly when |B| > 18nT for 3 hours or more. Of the 24 events satisfying this criterion, 50% are magnetic clouds, the remaining half having no ordered field structure. A weaker correlation also exists between southward magnetic field and speed. Sixteen of the events are associated with halo CMEs leaving the Sun 2 to 4 days prior to the leading edge of the events arriving at ACE. Events selected by speed thresholds show no significant correlation, suggesting different relations between field intensity and speed for fast solar wind streams and ICMEs.

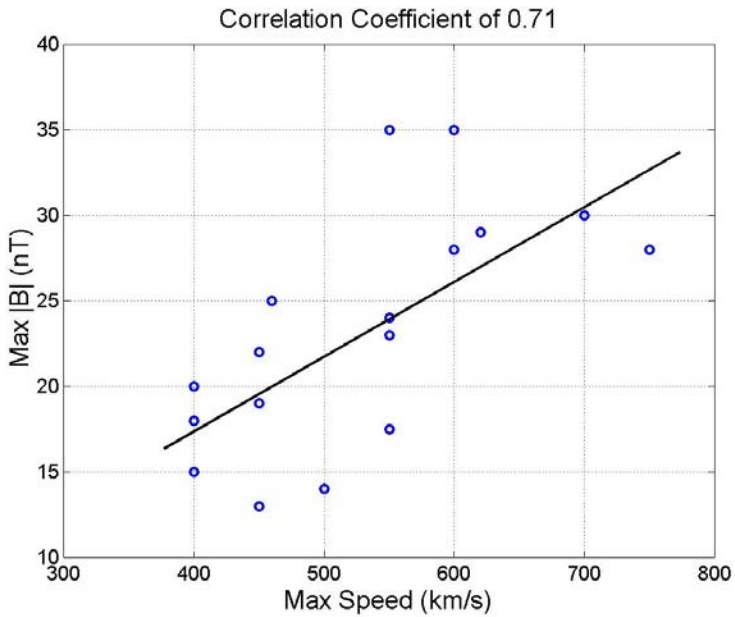
Magnetic Clouds

- *Burlaga et al.,* [1981], defined magnetic clouds as ICMEs with:
  - A smooth rotation in the magnetic field direction
  - An enhanced field magnitude
  - A low proton temperature
- Approximately 1/3 of ICMEs have a magnetic cloud signature.



Background

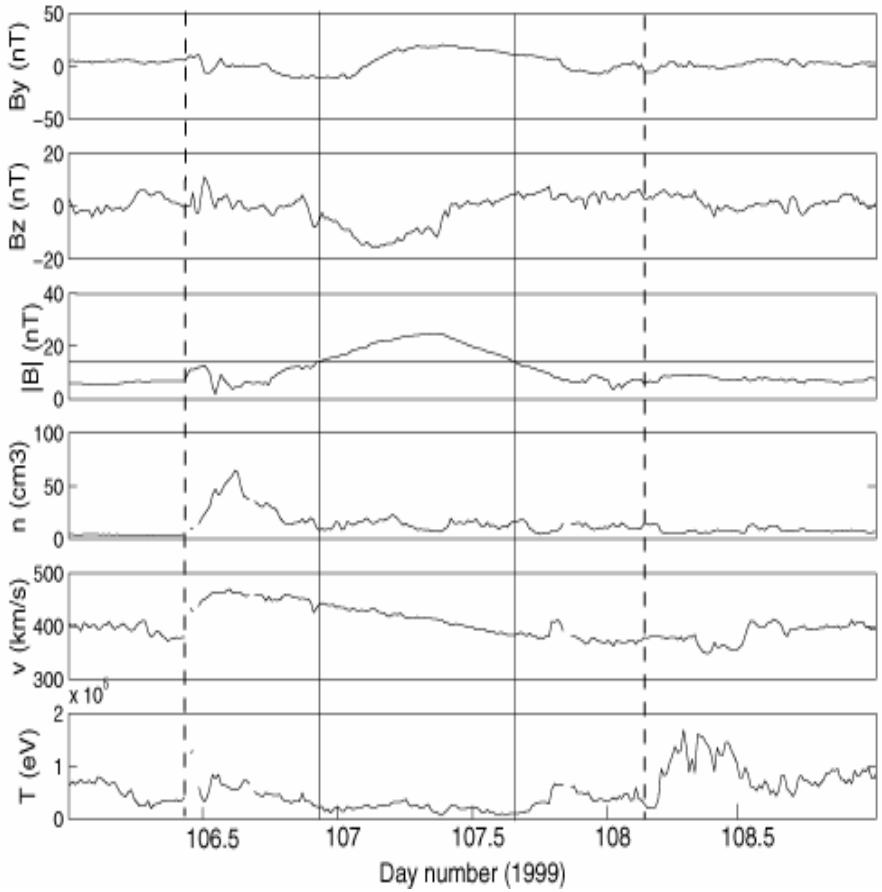
- *Gonzalez et al.,* [1998], showed the existence of a positive correlation between $|\mathbf{B}|_{\mathbf{max}}$ and $\mathbf{V}_{\mathbf{max}}$ for a restricted set of magnetic clouds.
  - Cloud observations were made by a variety of spacecraft.



- Examine general validity of *Gonzalez at al,*. [1998], result using:
  - A large, continuous data set (~3 years of ACE data).
  - A systematic selection of interplanetary events.

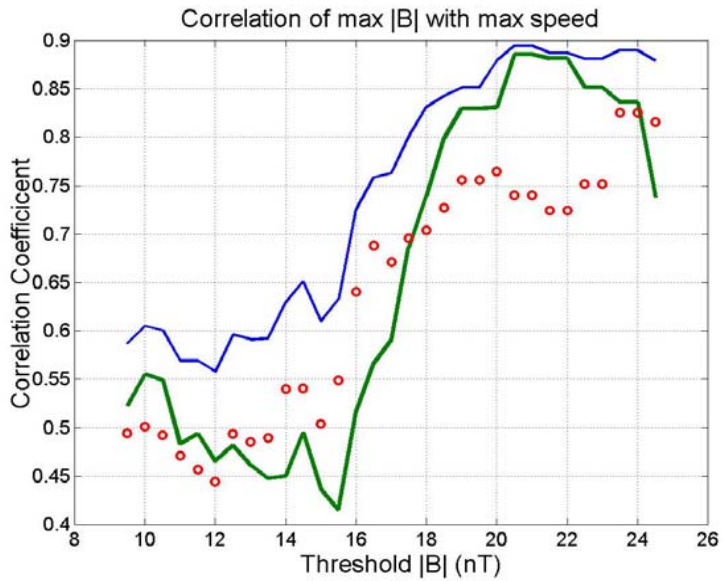
Definition of an ‘Event’

- Magnetic clouds (or other geoeffective events) were not chosen *per se*.
- An ‘event’ was defined as a region of solar wind with |B| above a threshold value for a minimum of 3 hours.
- To find the maximum speed associated with an event, 0.5 day before/after |B| boundaries was sampled.



Effect of |B| threshold.

- The |B| threshold is applied to the data set to select events.
- $|B|_{max}$ and V_{max} are found for each solar wind event.
- The linear correlation between $|B|_{max}$ and V_{max} is calculated, as in *Gonzalez et al.,* [1998].
- Events selected by a |B| threshold $\geq$ 18nT show a marked increase in $|B|_{max}$ and V_{max} correlation.



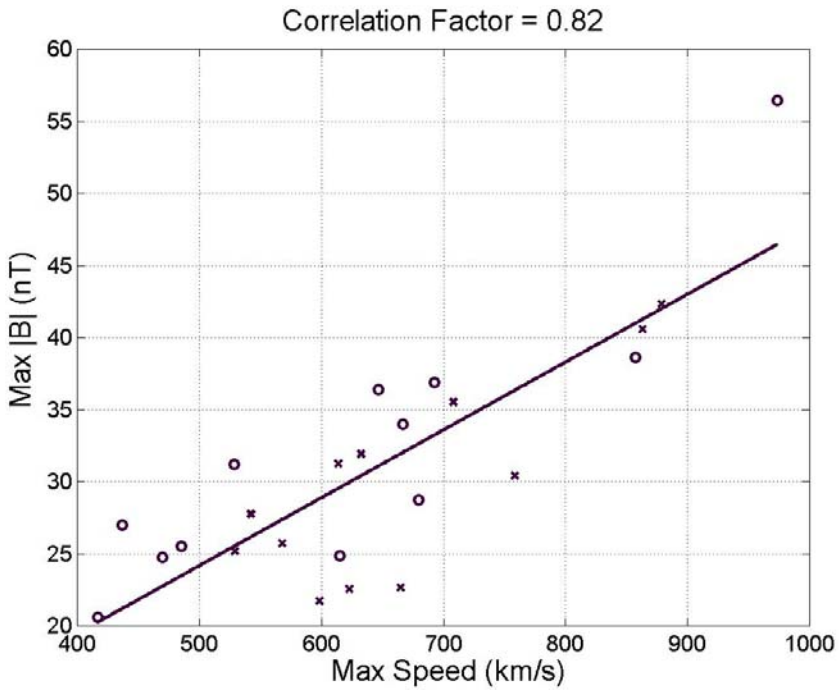
Linear correlation coefficient

Spearman correlation coefficient

Gradient of $|B|_{max}$ - V_{max} scatter plot

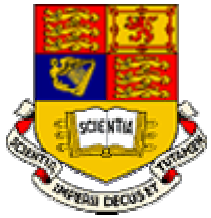
$|B| \geq 18nT$

- Events selected by a threshold of 18nT have a highly linear and statistically significant correlation between $|\mathbf{B}|_{\mathbf{max}}$ and $\mathbf{V}_{\mathbf{max}}$.
- Of the 24 such events:
  - 12 had some degree of rotation in the magnetic field direction.
  - 19 were associated with halo CMEs leaving the Sun 2 to 5 days prior to their arrival at ACE.



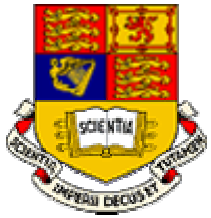
X - Magnetic cloud like.

O - No rotation in field direction.



Conclusions

- Correlation between $|B|_{max}$ and V_{max} is not limited to magnetic clouds - it extends to all events within the solar wind with a high magnetic field magnitude.
- The increase in $|B|_{max}$ - V_{max} correlation for events selected by a higher |B| threshold:
  - is not associated with a significant change in the ratio of cloud / non-cloud events.
  - could be due to the closest approach of the spacecraft to the centre of an event (gradients in magnetic field magnitude are expected across events, whereas gradients in speed are not).
  - could indicate that speed relative to the solar wind may be more important than absolute speed in slower events.



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