Ensemble CME Forecasting

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Overview

- Background
- Methods
- Results
- Future Work
WSA – Enlil Model

- Ensembles are new to Space Weather forecasting
- Currently only one prediction is made per CME

http://www.swpc.noaa.gov/wsa-enlil/
TOOLS

- CAT (CME ANALYSIS TOOL)
  Observational inputs

- ZEUS
  Simulations
Ensembles

- Used widely in terrestrial forecasting
- Chaotic system
- Space Weather: Determinative system

Hurricane Katrina forecast tracks, 1 day apart
Why?

- WSA – Enlil is used in-house at SWPC to make forecasts
- No study has been conducted on real events
- Accurate time of arrival predictions for CMEs
- Are there ways to alter the current process?
Hypothetical Models
6 events

- 4 Fast, 2 Slow
- Varying pointings

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Errors with ambient background

**Green** – Predicted arrival of CME
**Black** – Actual arrival of CME

Distribution of Enlil errors
- Median error: 6 hours
- RMS error: 9 hours
Operational Enlil vs. model

Errors with:
- Cone Parameters
- Ambient background
- Different versions of Enlil – Research/Operational
Near-Real-Time Events

- 21-member ensemble run for each event using A5B1
- ‘Official CME Parameters’ run for each event using A3B2
- ‘Official CME Parameters’ for each event with improved background speeds using A5B1
Results

- Background is IMPORTANT
- Average Error (A5B1):
  - Before ambient improved: ~10.8 hours
  - After ambient improved: ~ 5.8 hours
- Further improvement in predictions may result from better CME characterization
Future Work

- MORE EVENTS!
- Verify ambient background results
- Implement tools to update forecast using improved ambient background
- Investigate ways to reduce error in cone parameters
Thank you!

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- National Science Foundation
- NOAA - SWPC
- Curt de Koning
- Vic Pizzo
- Rodney Viereck
- Marty Snow
- Erin Wood