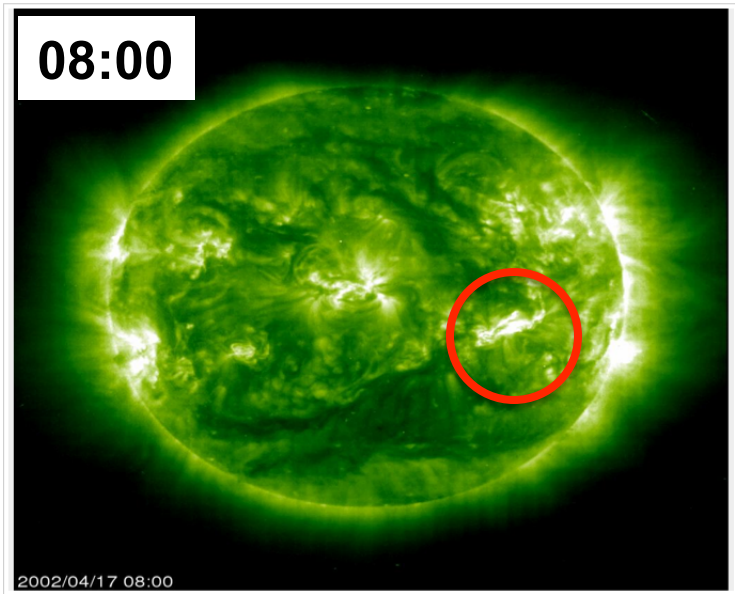
CME Start Time: **2002/04/17 08:00 UT**



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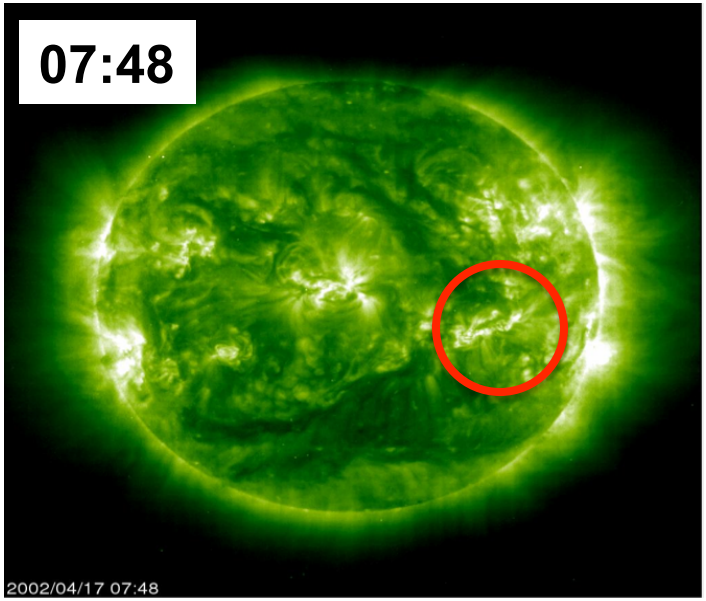

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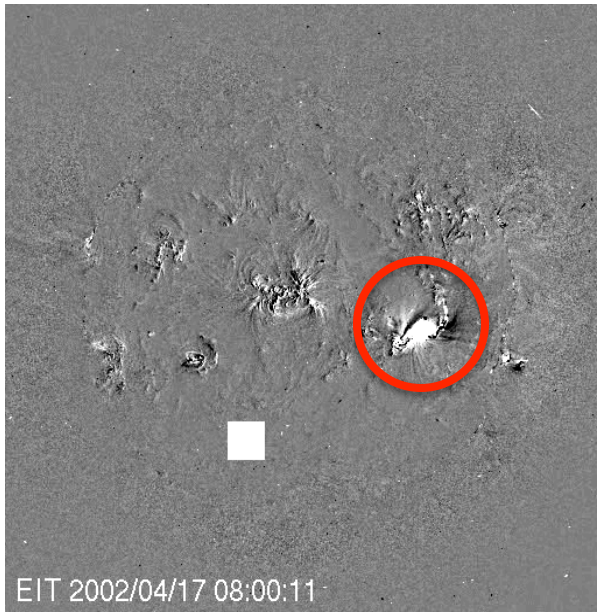
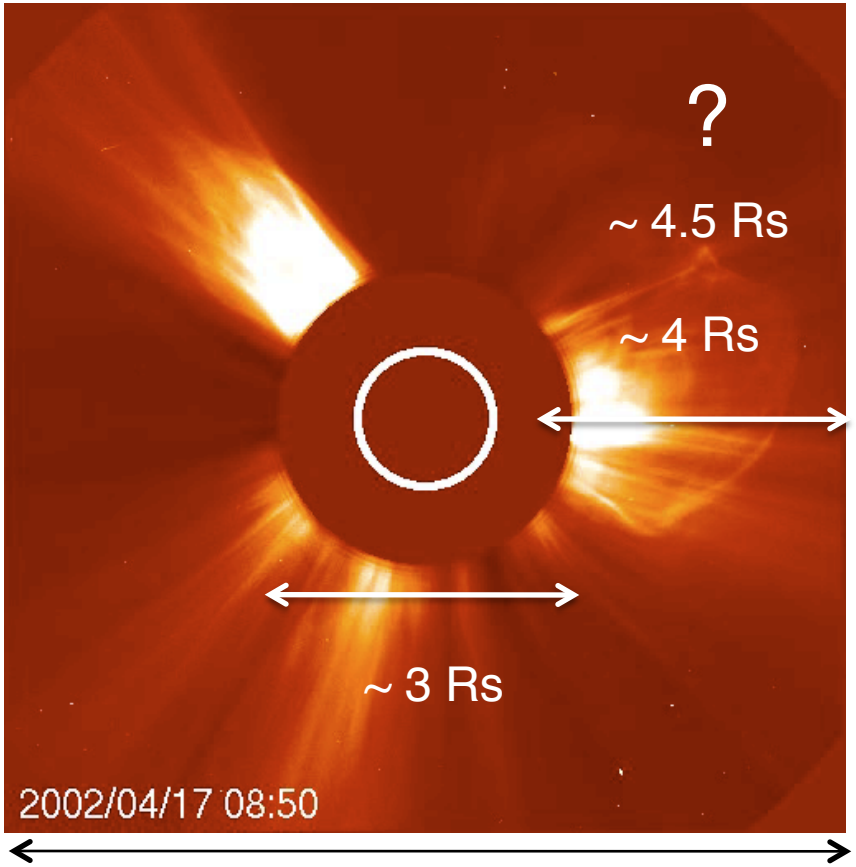


Challenges / Uncertainties

SOHO Lasco C2 coronograph



CME Speed in Solar Corona

(900 + 1000 + 965 +1200 +2*916+2*972+1000+1038) / 10=

V_{ave} = 988 km/s V_{min} = 900 km/s V_{max} = 1200 km/s

Estimate using semi-automatic CME analysis tool: Vr = 1134 km/s

CME Arrival Time Prediction

46 41 43 35 45 45 42.8 42.8 41.6 41.6 40.14

ΔT_r = **1au/ Vr = 36.7**

ΔT_{ave} = **42** ΔT_{min} = **35** ΔT_{max} = **46**

$\Delta T_{max} = 1.3\ \Delta T_{min}$

Shock Arrival Time Results

CME Detection by ACE Satellite
Apr 19, 08:00
$\Delta T = 48$ h

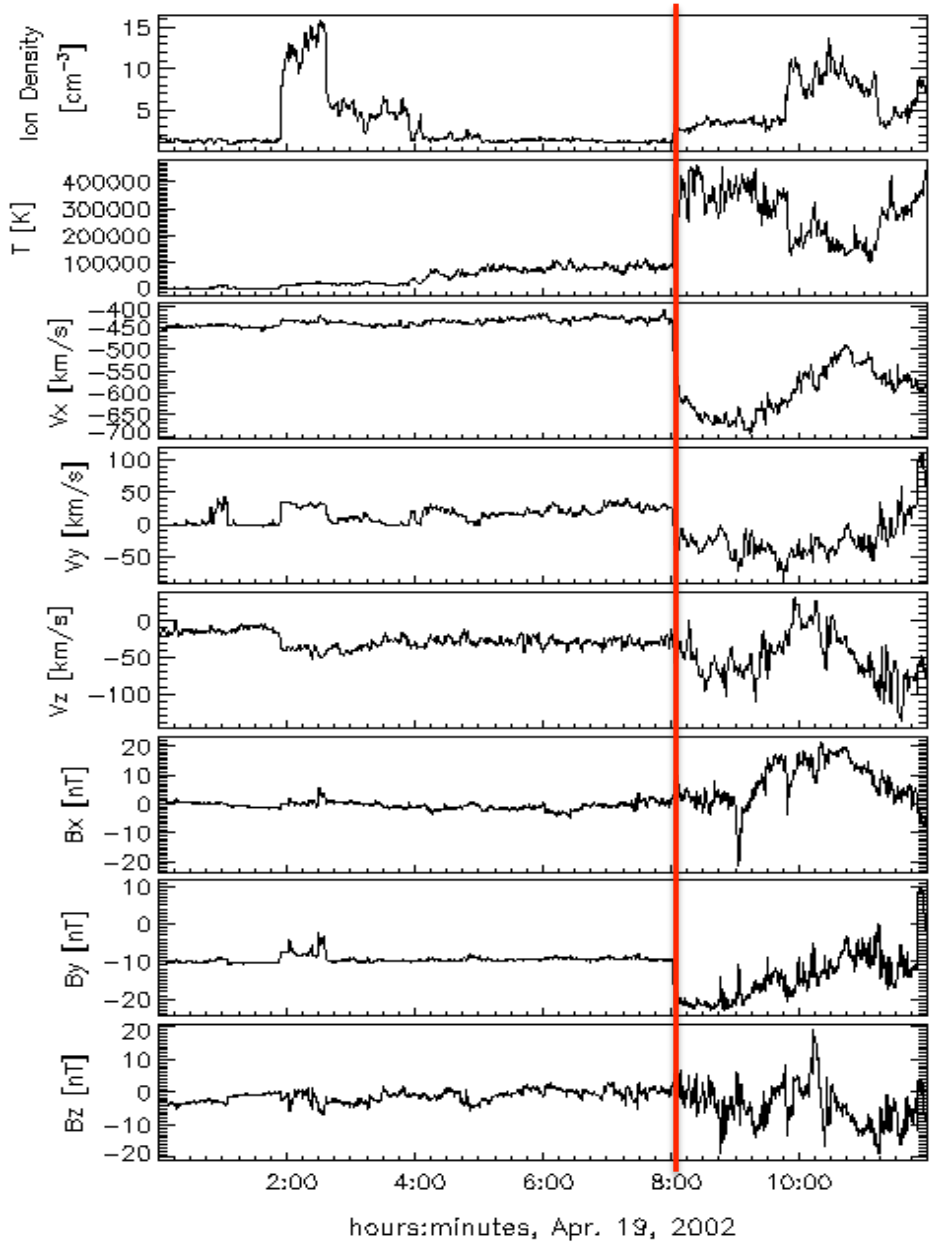
Climatology Model
Apr 19, 00:00
$\Delta T = 40$ h

LASCO C2 Image Analysis

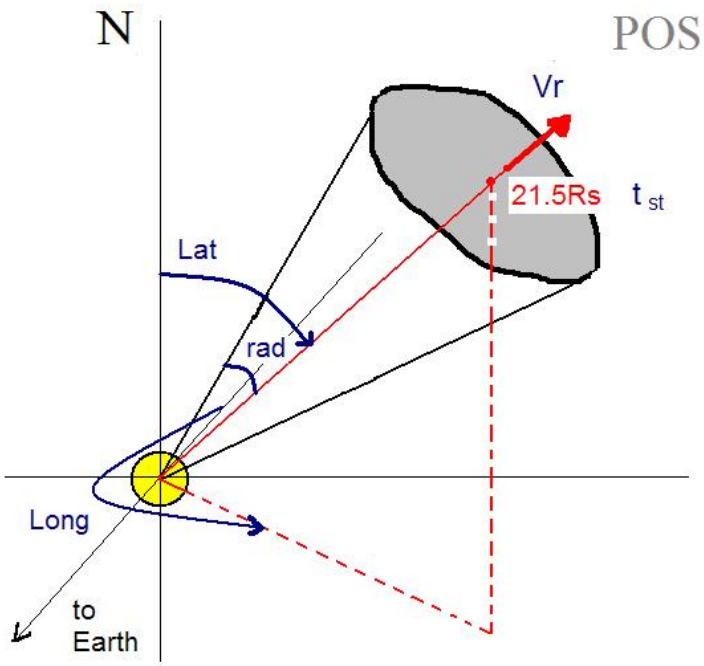
1. **Apr 18, 21:00**
   $\Delta T_{min} = 35$ h

2. **Apr 19, 05:00**
   $\Delta T_{max} = 46$ h

3. Apr 18, 22:42
   $\Delta T_r = 36.7$ h



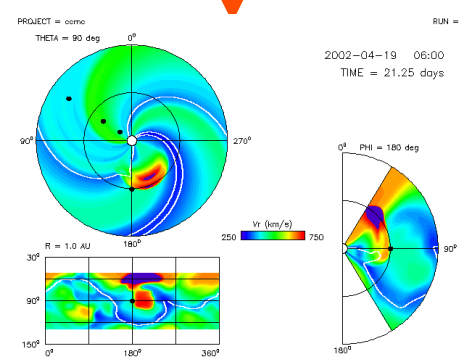
Cone Model Parameters – Input to the ENLIL Cone Model



Date=2002-04-17
Tstart=11:20 (UT)
Lat=77 deg
Long=202 deg
Rad=49 deg
Vr=1134 km/s

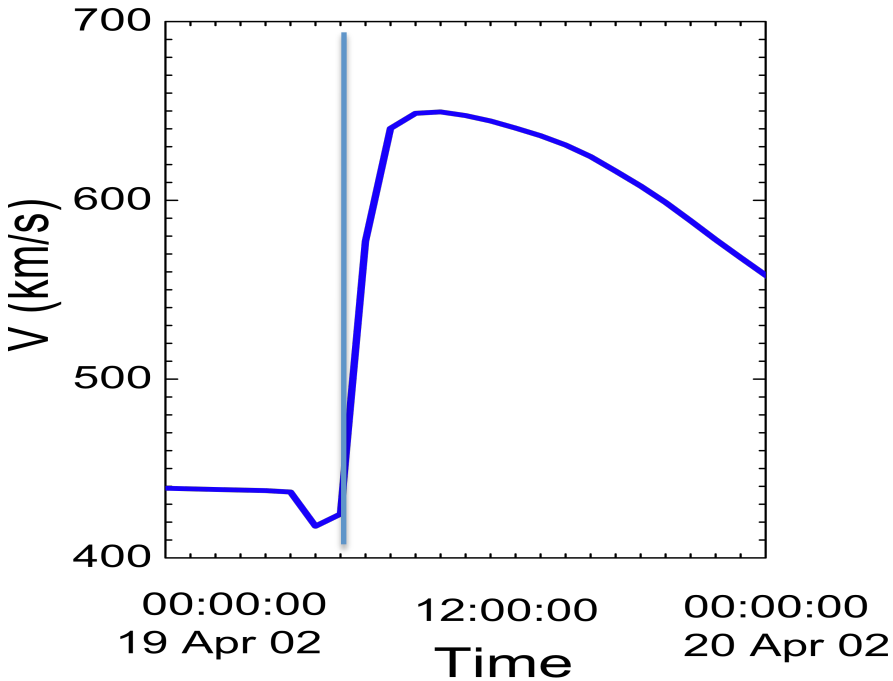
Input to ENLIL cone model run

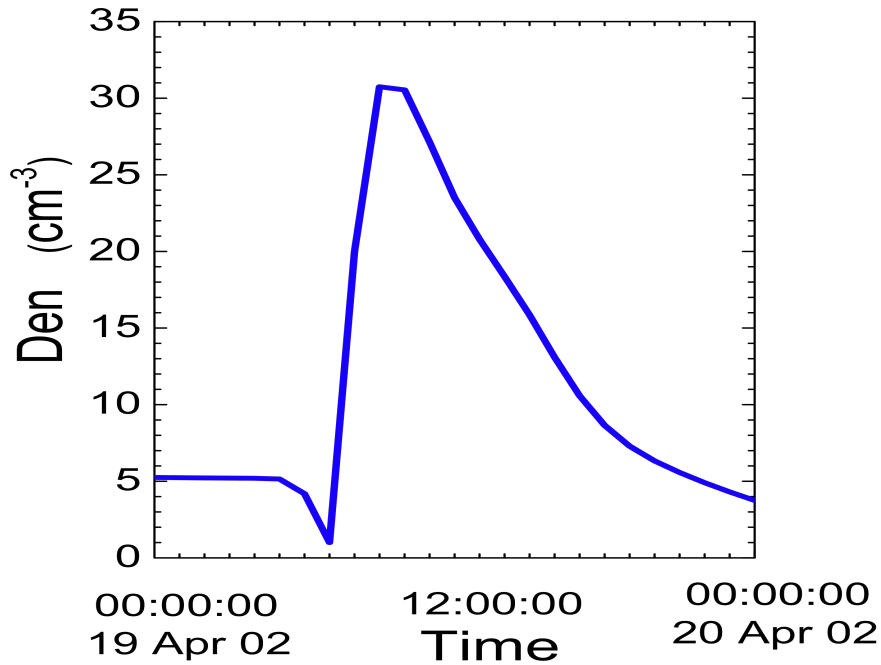
ENLIL cone model



- tstart - when cloud at 21.5Rs
- Latitude
- Longitude
- Radius (angular width)
- Vr - radial velocity

ENLIL Cone Model SAT Prediction

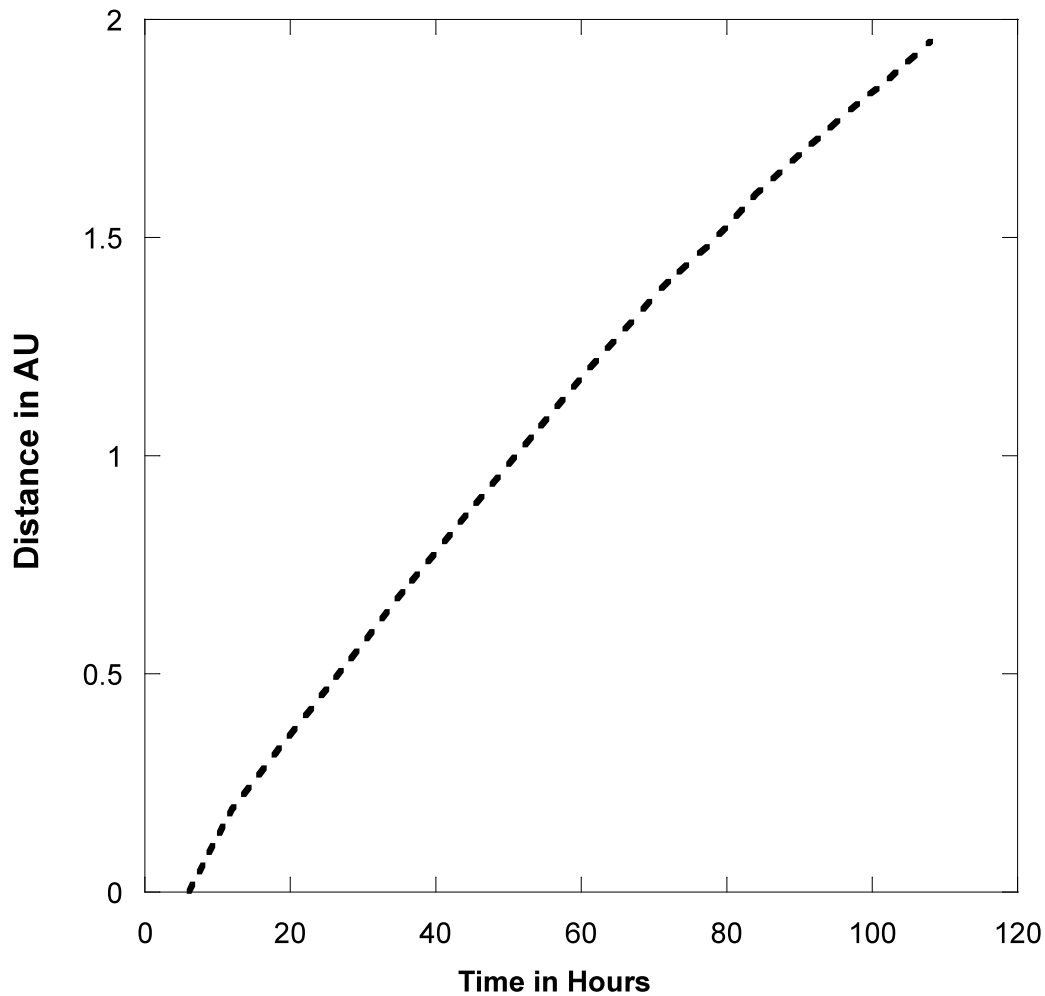




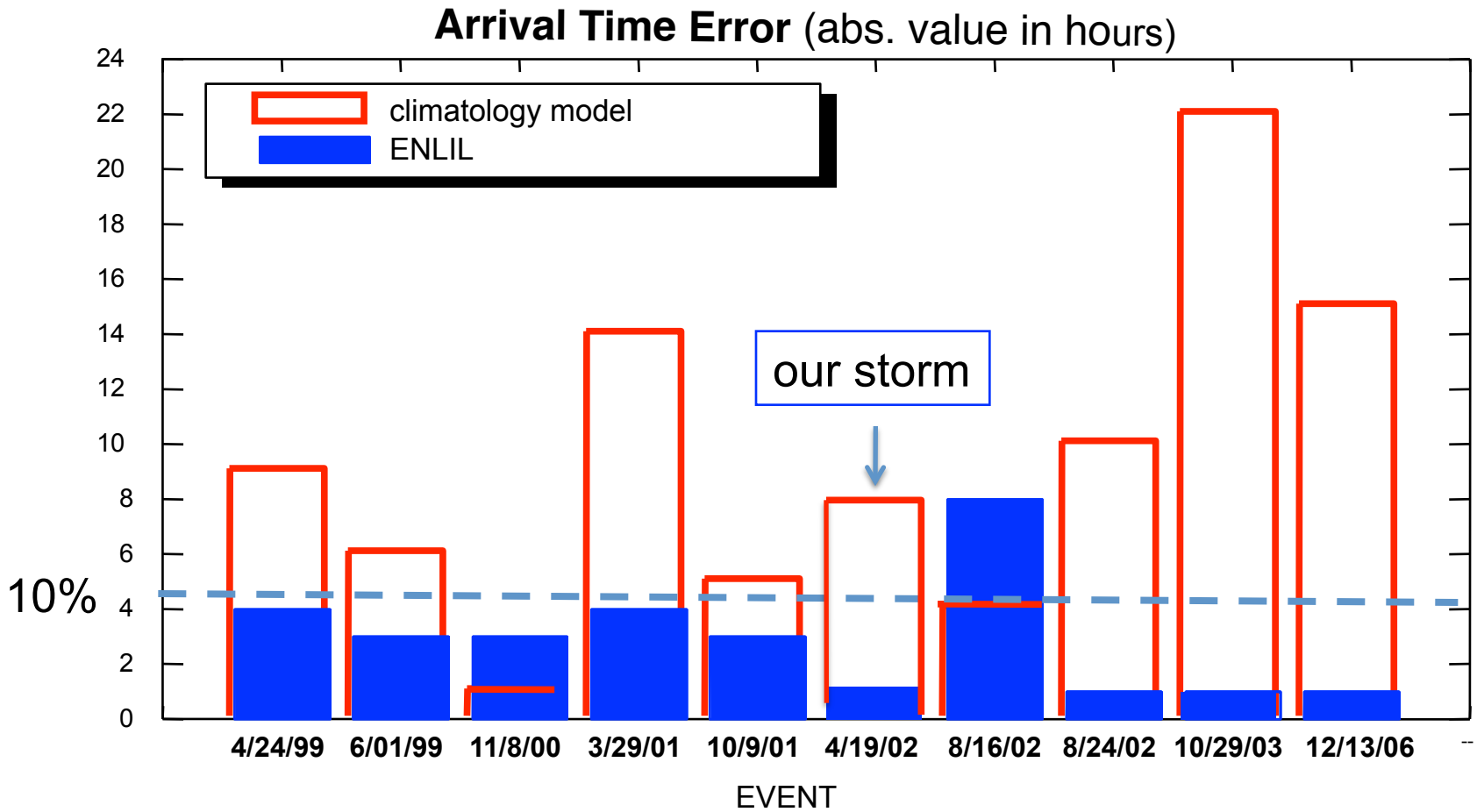
ENLIL: Density and velocity magnitude of the solar wind at the ACE position
(R=0.99 AU, Latitude=0 deg, Longitude=180 deg)

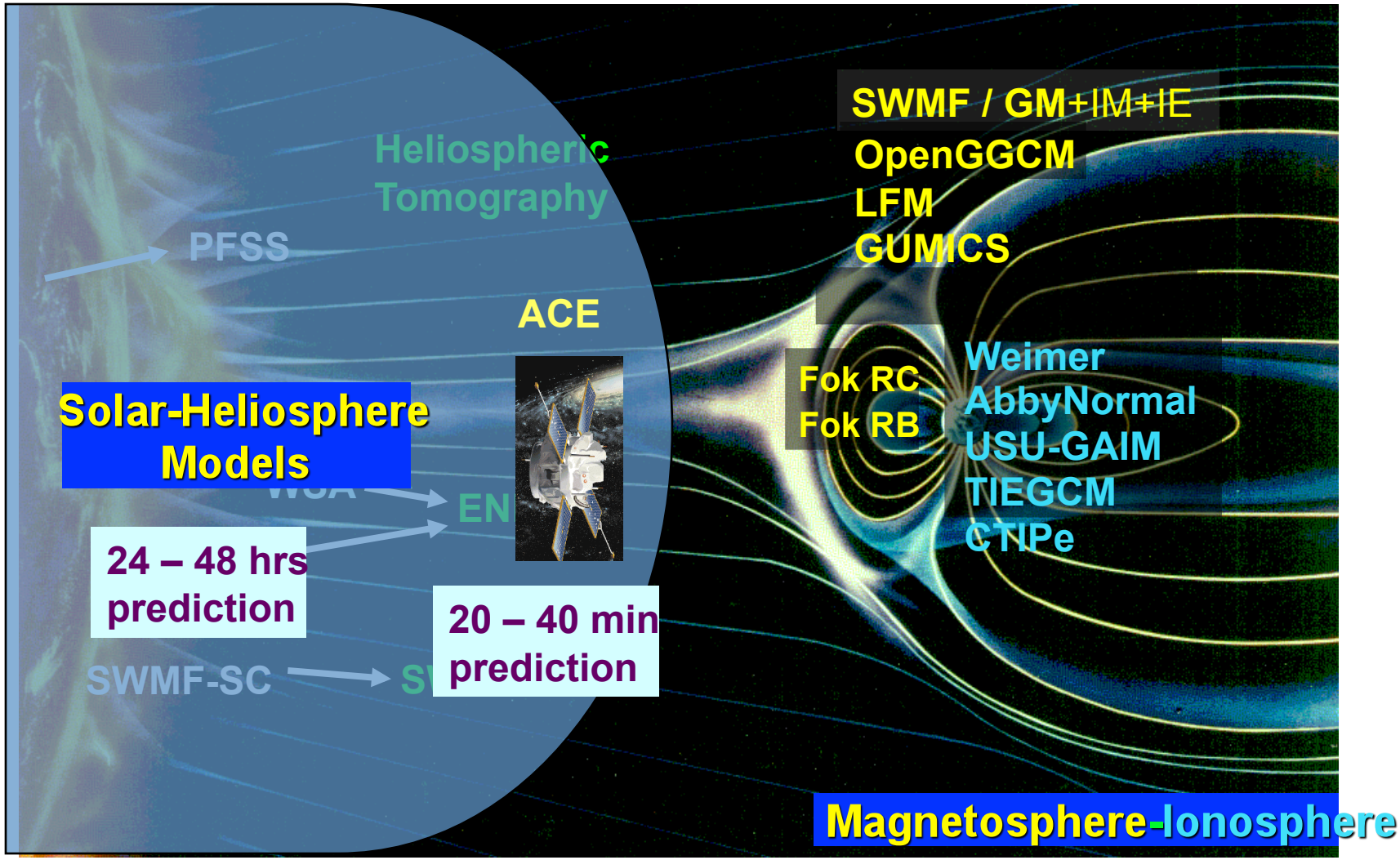
Apr 19, 07:00
ΔT = 47 h

CME Leading Edge Position



Shock Arrival Time Error For 10 CMEs
Enlil Cone Model vs. Climatology



Enlil Cone Model: < 10% error in 90% of events

Magnetosphere-Ionosphere Models