SET

Anemomilos

Operational Dst from real-time data streams and forecast algorithms

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Geomagnetic Space Weather Affects Technology

- Satellite drag
- Power grid GIC
- Aviation radiation
- GPS position accuracy
- Communication outages
- Satellite surface charging

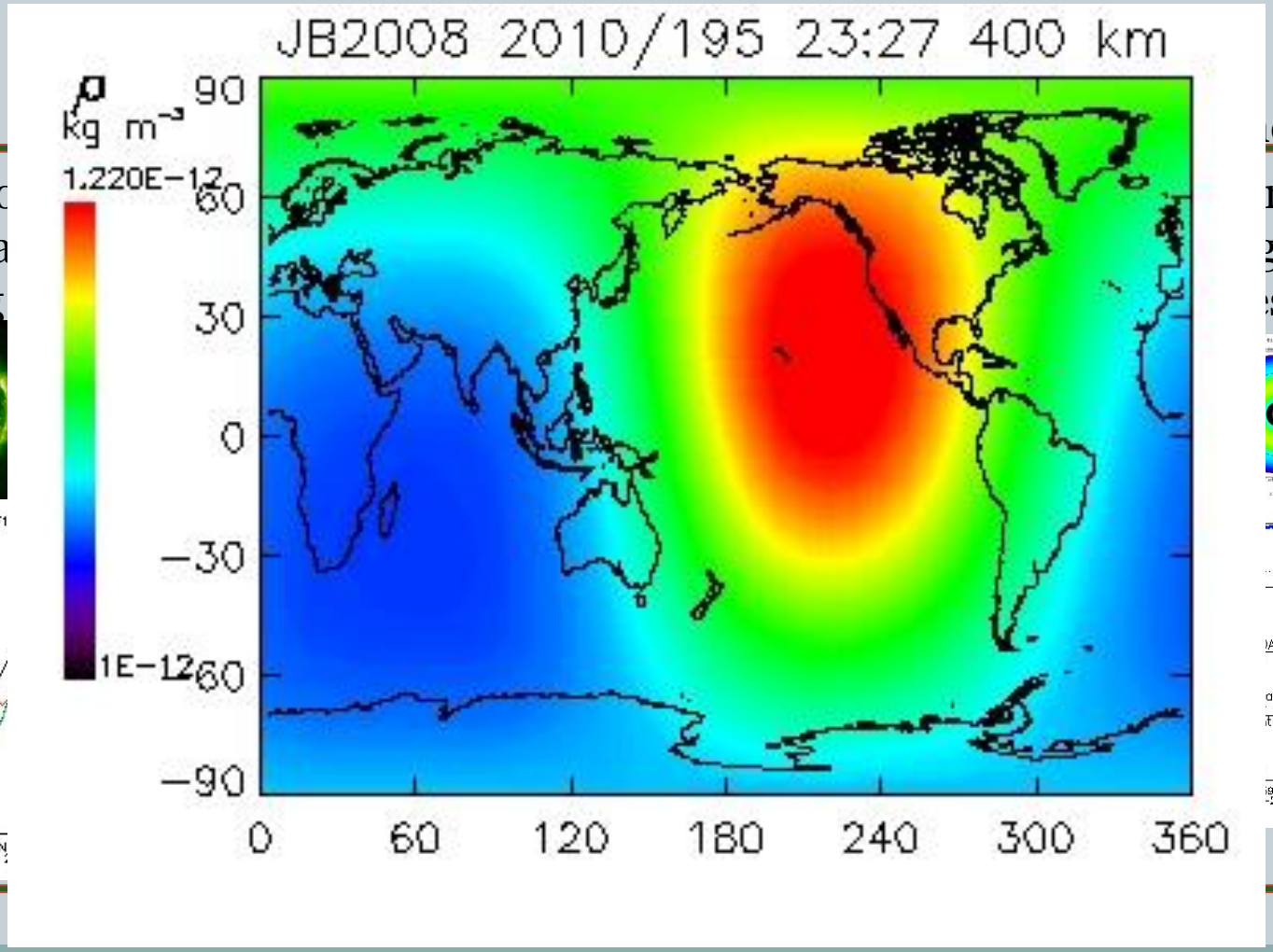
Turning Measurements into Useful Products

- **Real-time Dst:** operational data is now being produced by several institutions
- **Forecast Dst:** operational algorithms (prime/stream A and redundant/stream B) now being tested
- **Distributed Network:** Real-time and forecast Dst is collected/produced/delivered via a distributed network to provide end-user content (a supply chain)
- **Satellite Drag End Product:** Dst is an input into JB2008 thermospheric density model used for operational satellite drag calculations

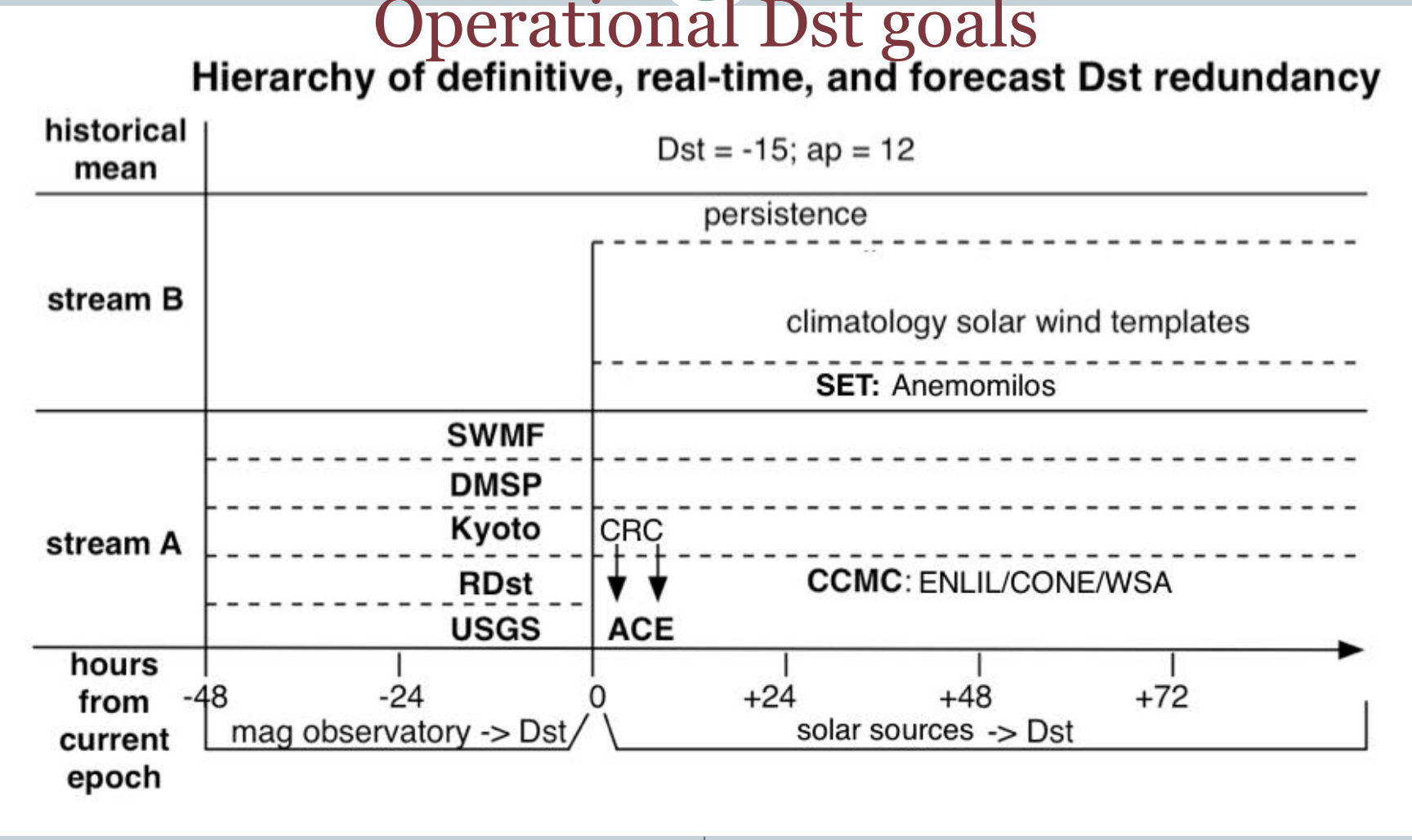
SPACE ENVIRONMENT TECHNOLOGIES

Space Research *Space Operations* *Space Standards*

OPERATIONAL DST



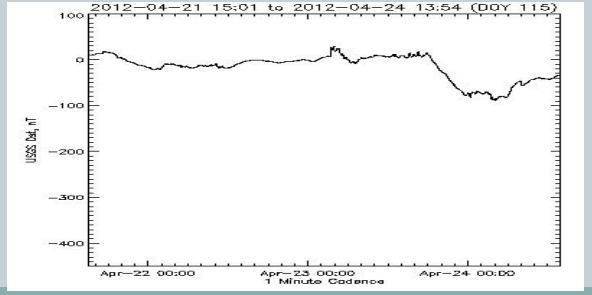
Operational Dst goals



Real-time operational Dst

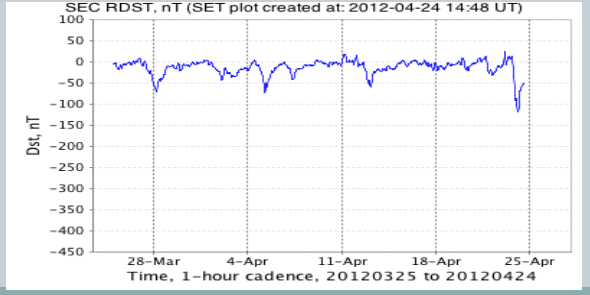
USGS

- uses up to 4 magnetic observatories (HER, SJN, HON, KAK)
- produces 1-minute Dst



SEC

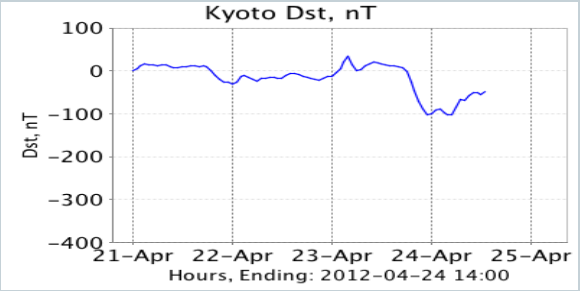
- uses up to 4 magnetic observatories (HER, SJN, HON, GUA)
- produces 1-hour Dst



Real-time operational Dst

Kyoto

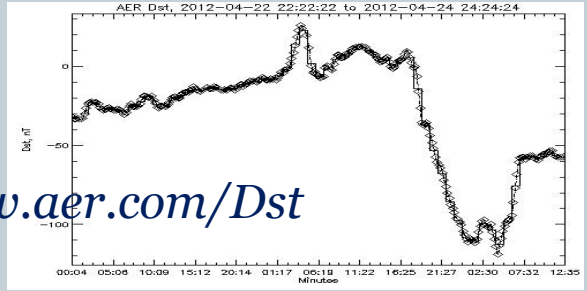
- uses up to 4 magnetic observatories (HER, SJN, HON, KAK)
- produces 1-hour Dst



AER & SET DMSP

- uses SSM data from 2-4 DMSP satellites
- produces 1-hour Dst

http://www.aer.com/Dst



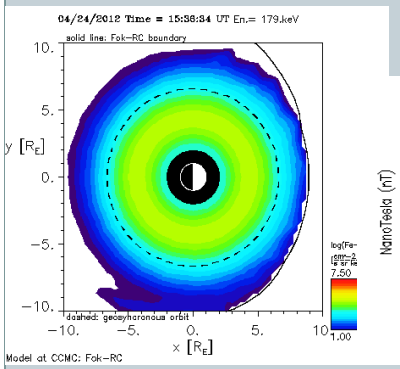
Real-time operational Dst

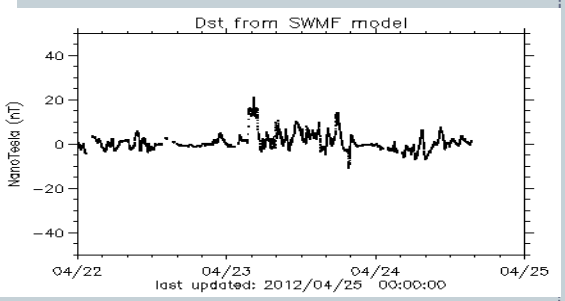
CCMC

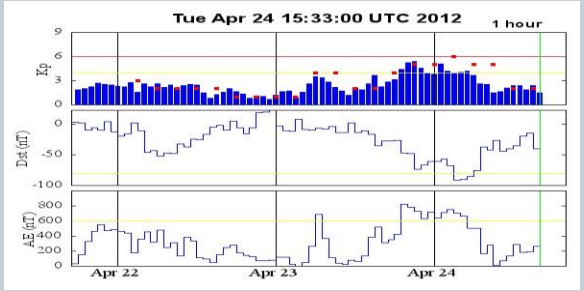
- uses SWMF and Fok Ring Current
- produces 1-minute Dst

Other sources

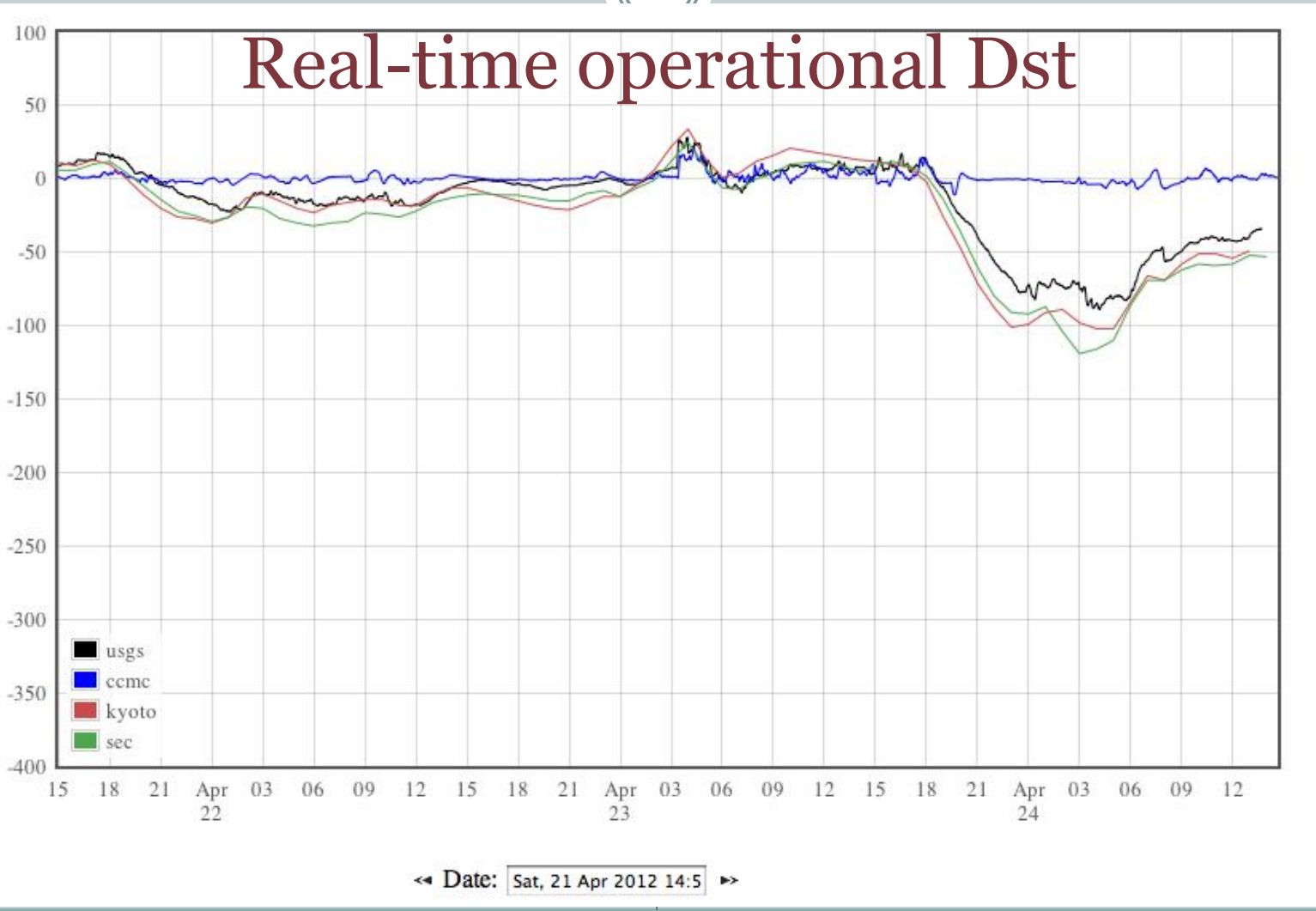
- Rice, UCB, Berkeley, …
- produce 1-hour Dst







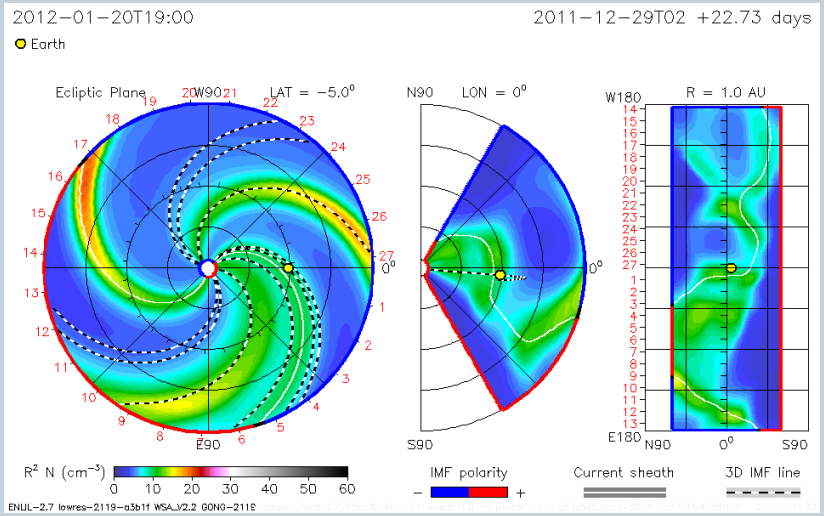
OPERATIONAL DST

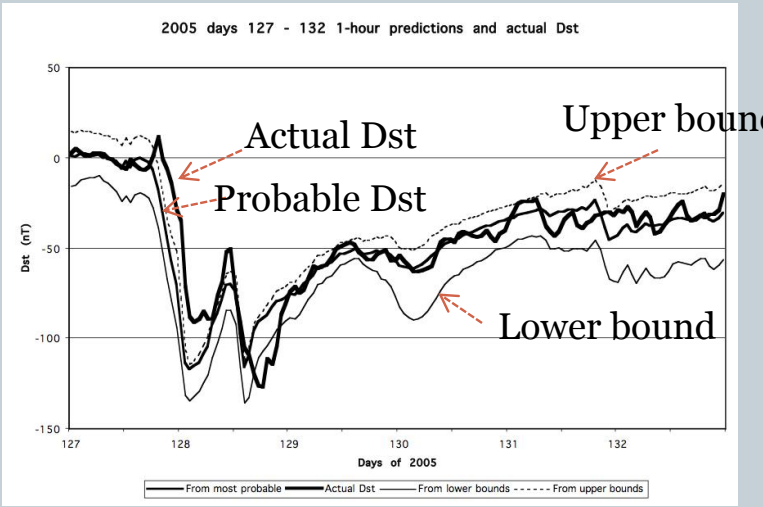


OPERATIONAL DST

Dst operational forecasting – Stream A

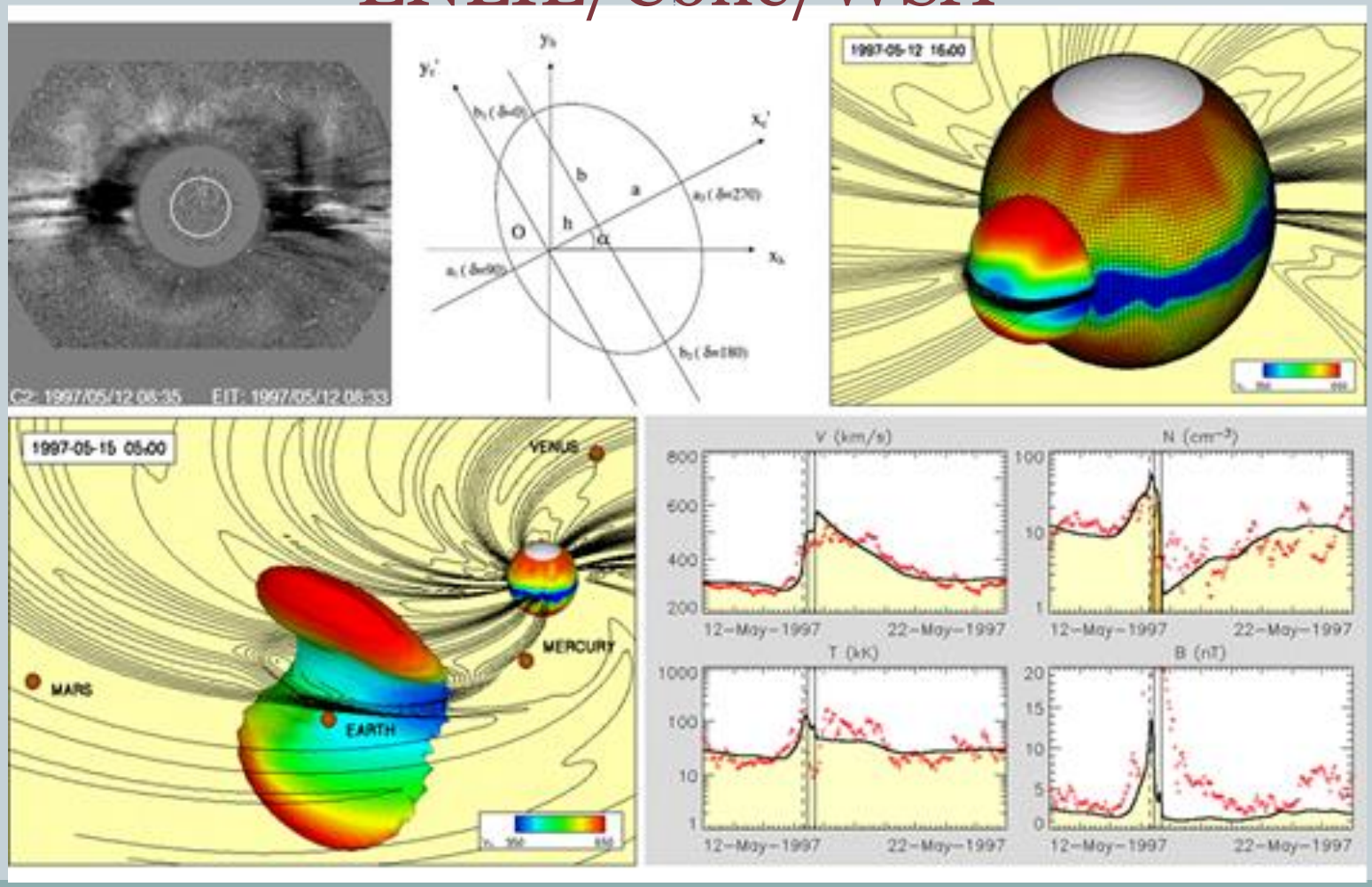
- ENLIL/Cone/WSA
  - 72-hour forecast of hourly Dst
- Carmel Research Center
  - 1–5 hour forecast of Dst



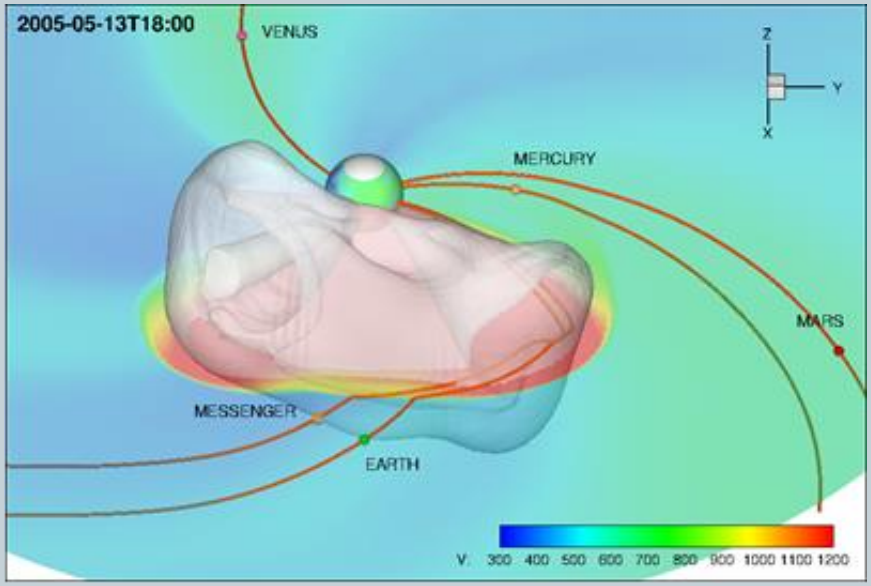


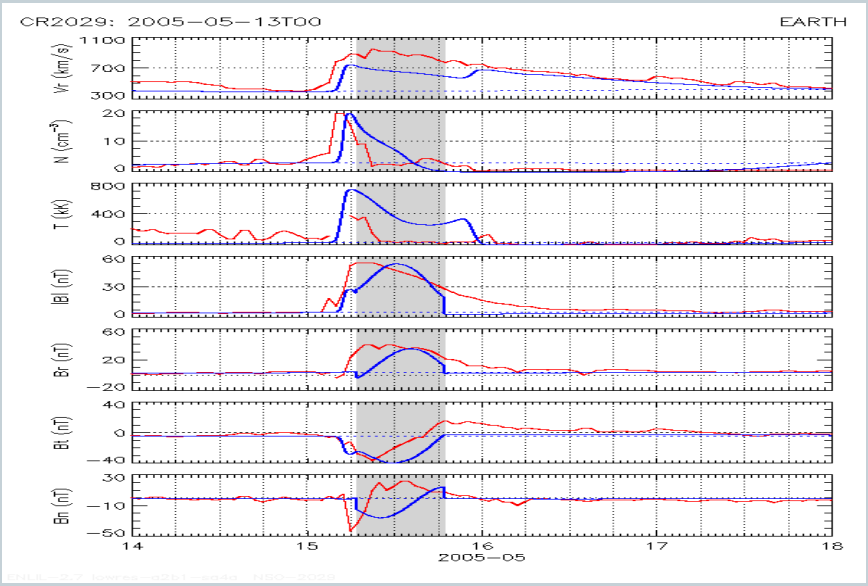
OPERATIONAL DST

ENLIL/Cone/WSA



ENLIL/Rope/WSA





Dst operational forecasting – Stream B

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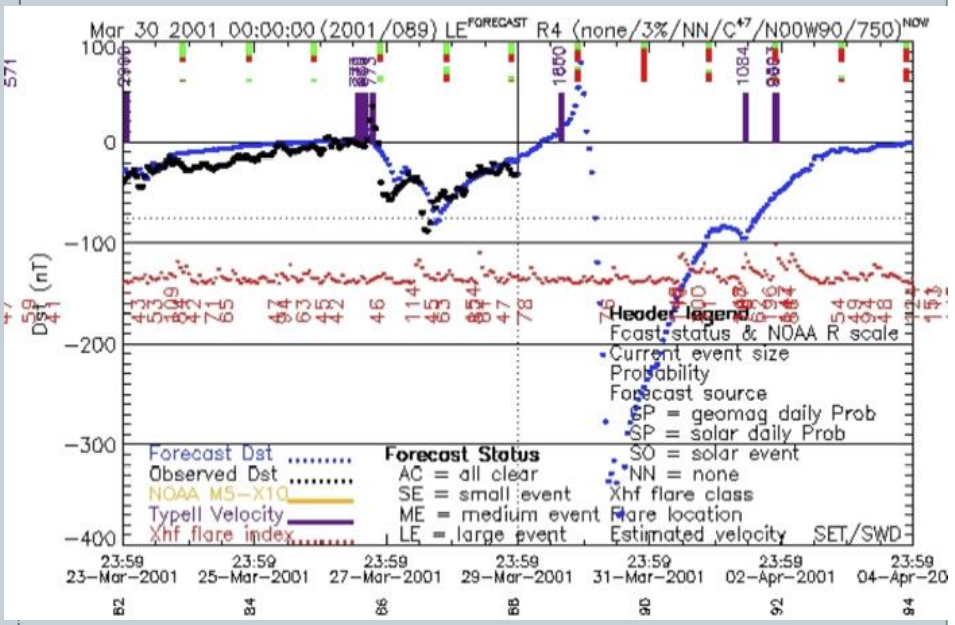
- Greek word for "windmill"
- 6-day forecast of hourly Dst
- data-driven deterministic algorithm
- uses 3 solar observables to simplify cone & identify events



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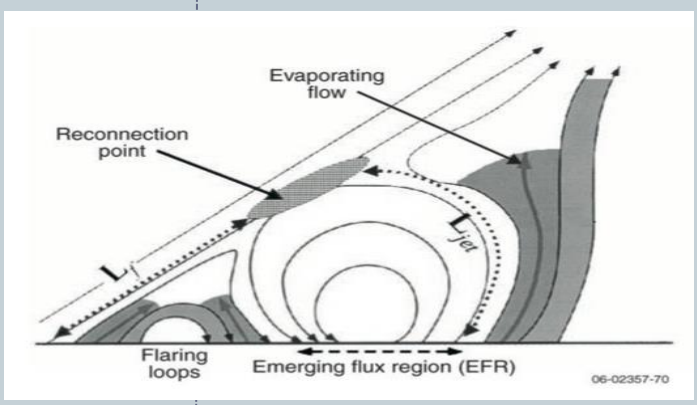
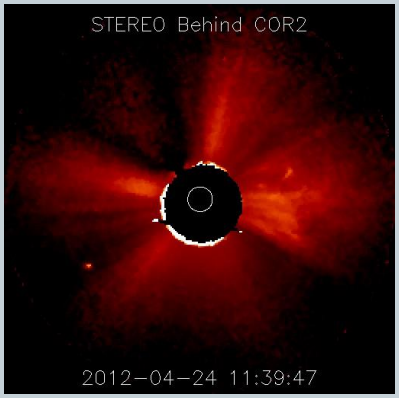
Background
- ejecta (particles) continually shed from flares
- larger ones are CMEs
- evidence in coronagraph images

3 observables needed
- ejecta **speed**
- flare **location**
- ejecta **quantity** (diameter)





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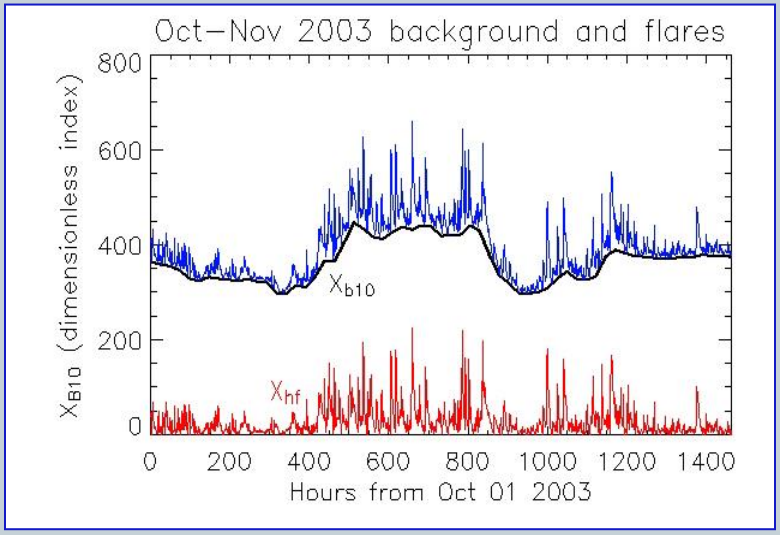
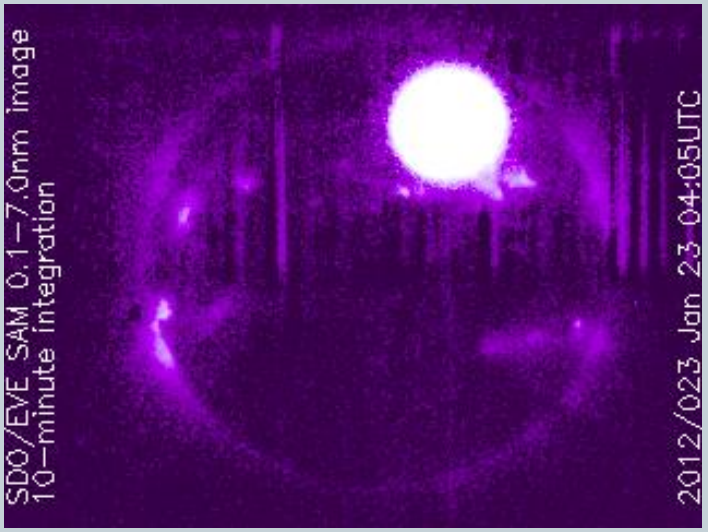
Quantity of ejecta
- individual flare magnitude proxy (Xhf)



Location of ejecta
- flare brightness centroid from SDO/EVE SAM



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Speed of ejecta

- post-analysis time-of-flight speeds used in 2001 & 2005
- NO DIRECT OBSERVABLES OR PROXIES FOUND YET

How to estimate speed

- ✓ Assume 750 km s^{-1}
- ✓ Real-time re-analysis
- ? rate change of brightness of flare Xhf index during the rise to peak
- ? other proxies

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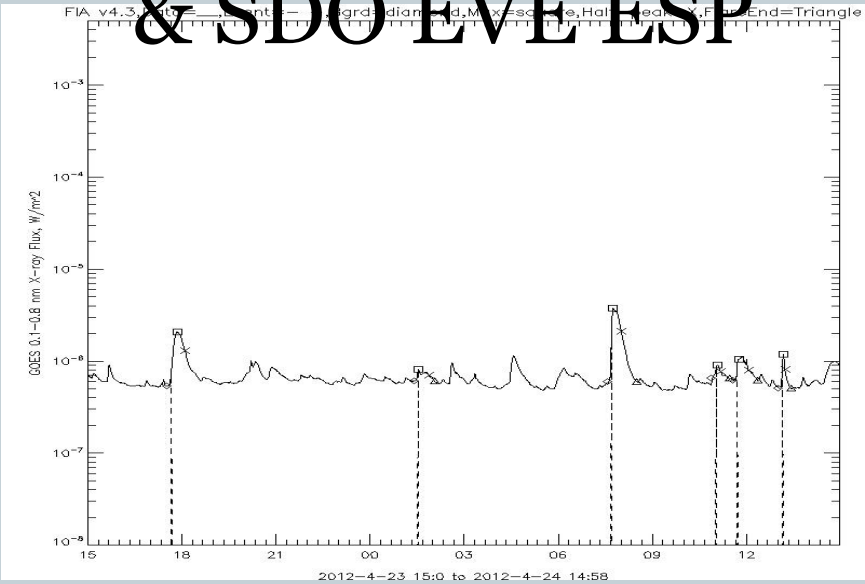
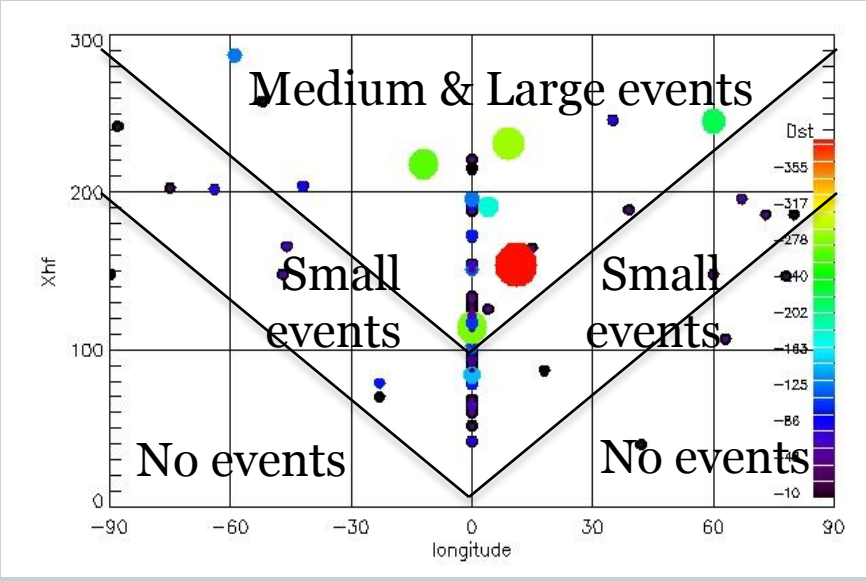
Rate change of flare brightness proxy

- use GOES XRS & SDO EVE ESP



Relationship between Dst event size, Xhf, and disk longitude

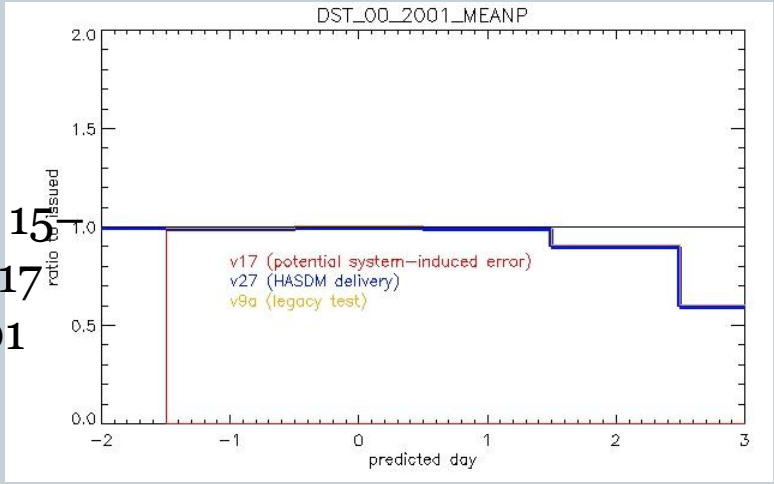


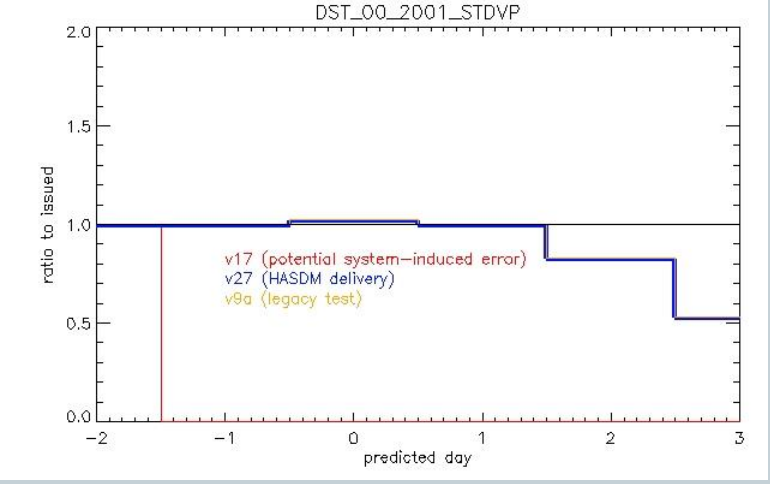
OPERATIONAL DST

Mean value ratio of forecast to issued

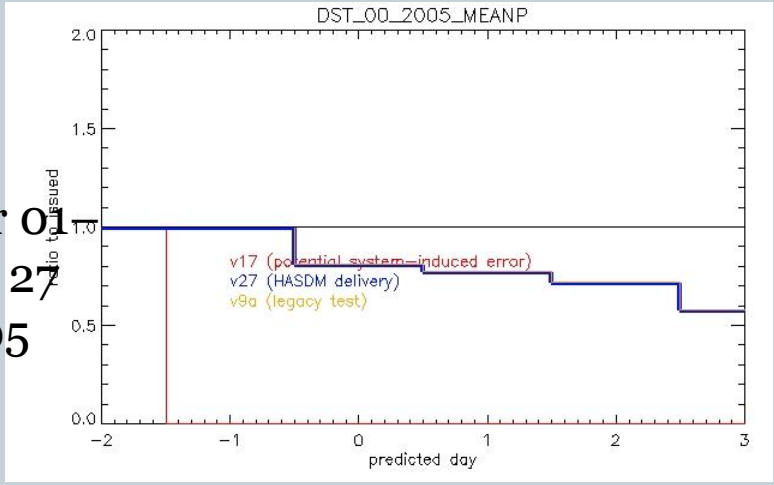
1-σ ratio of forecast to issued

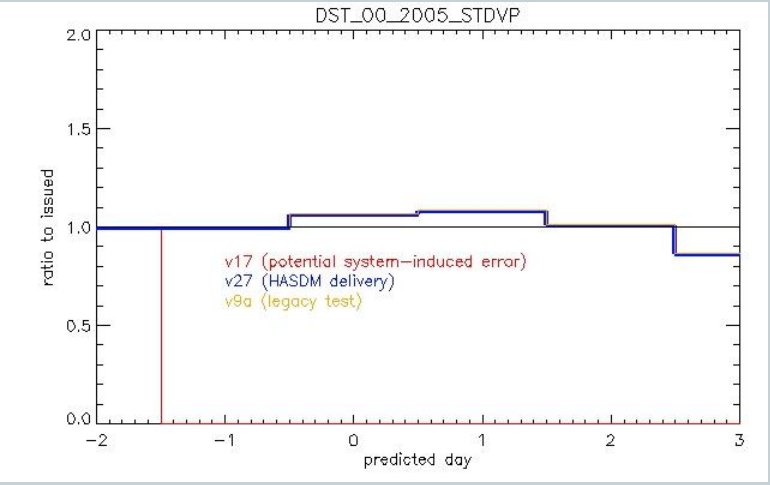
Jan 15 – Jul 17 2001

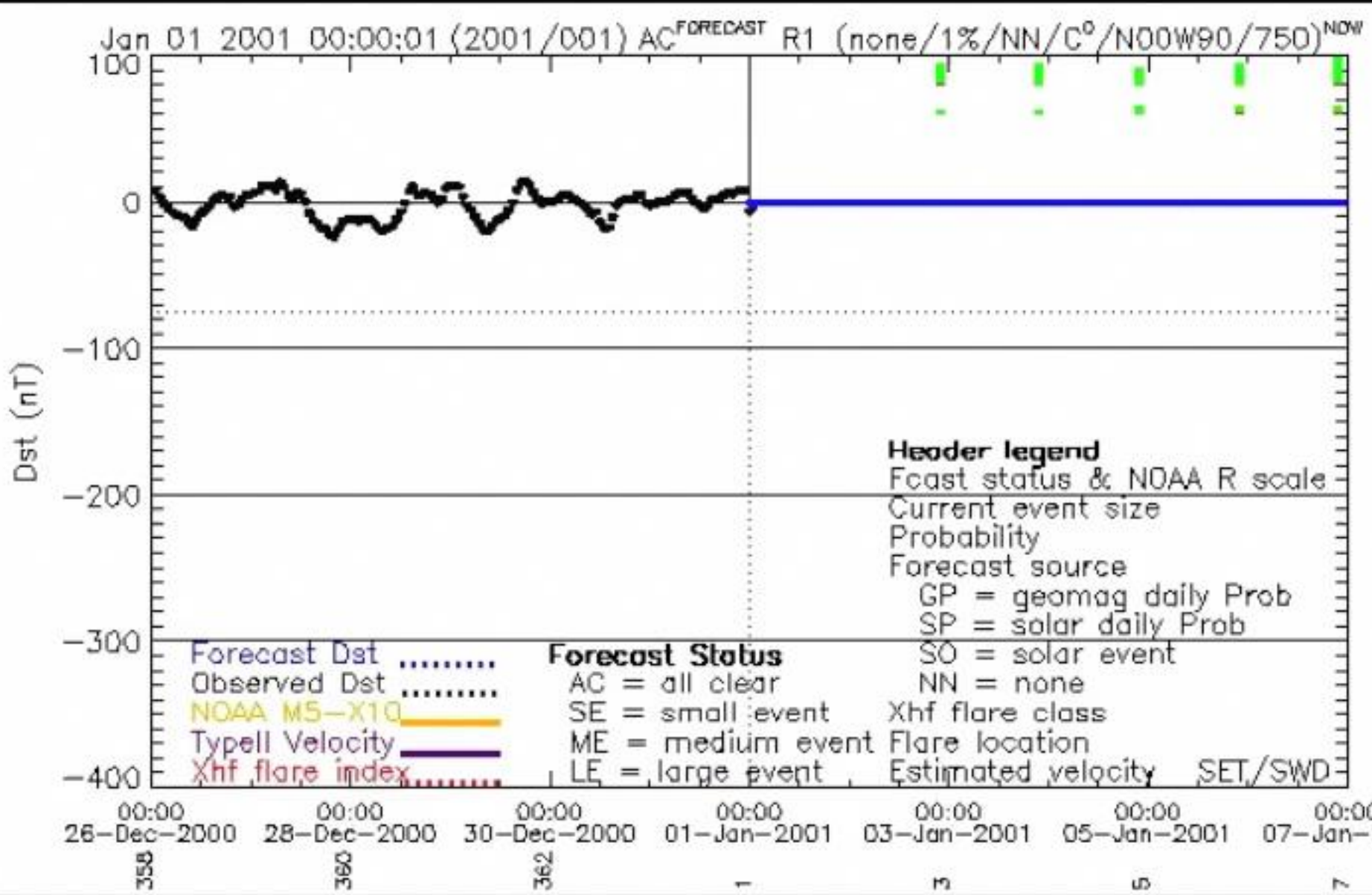




Mar 01 – Sep 27 2005







http://www.youtube.com/watch?v=uz2qe6MIkwo