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Title: DREAM Integration of Space Weather Forecasts into Space Protection

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# DREAM

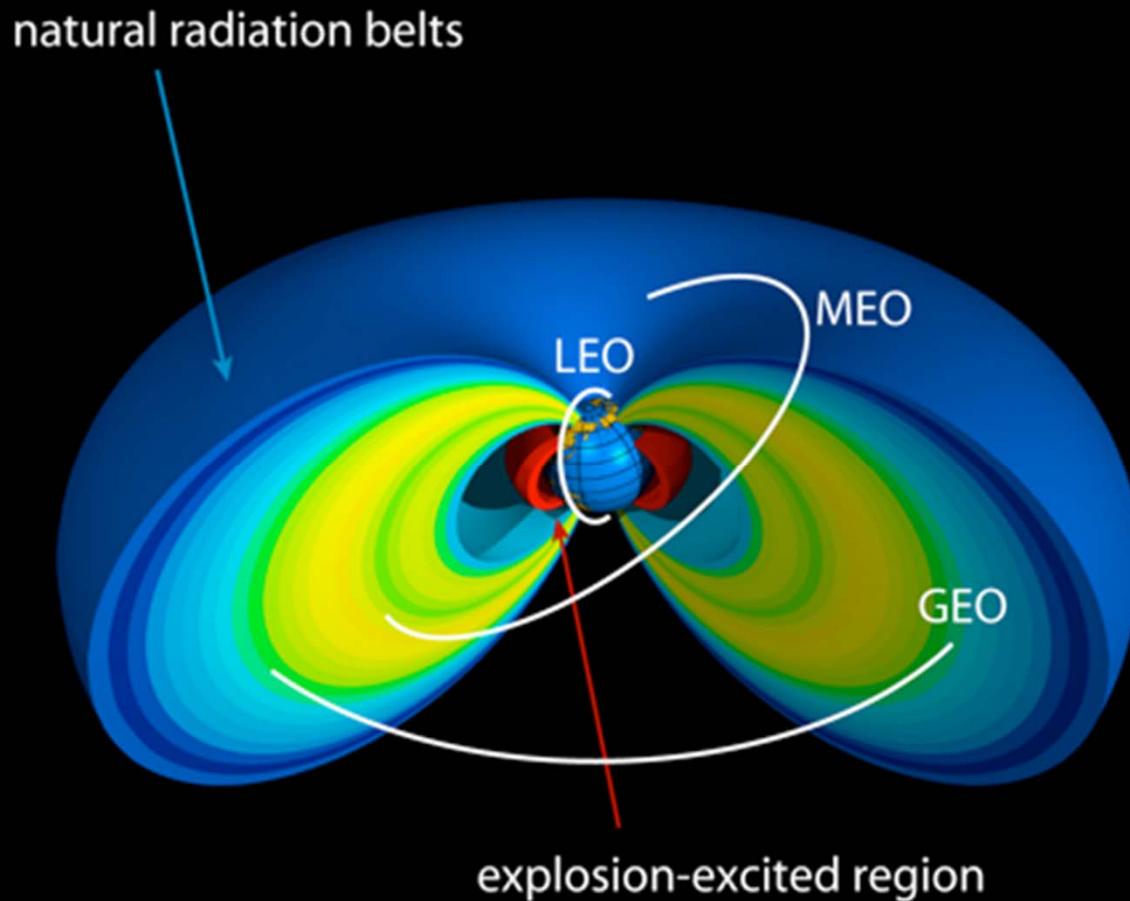
Integration of Space Weather Forecasts  
into Space Protection

Dr. Geoffrey Reeves

Space Science and Applications Group

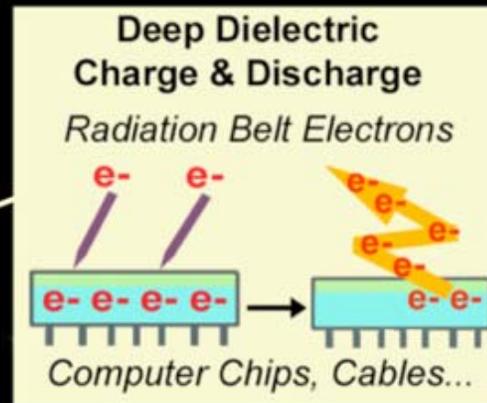
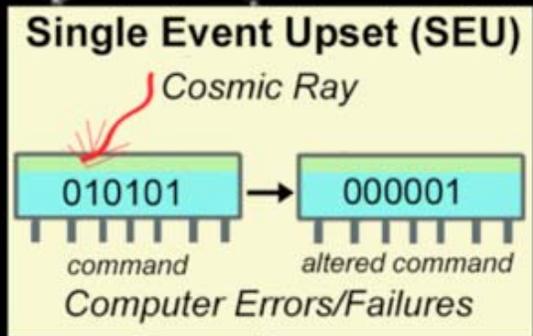
AMOS September 14, 2012

# Environment Assimilation Model



Developed by DOE/LANL to quantify risks from natural and nuclear  
Data Assimilation with GEO, GPS and other observations  
Objective: Provide real-time specification of the radiation environment

# Anomaly was or was not caused by Space Weather



artwork by Dave Bouwer

Anomaly  
Failure



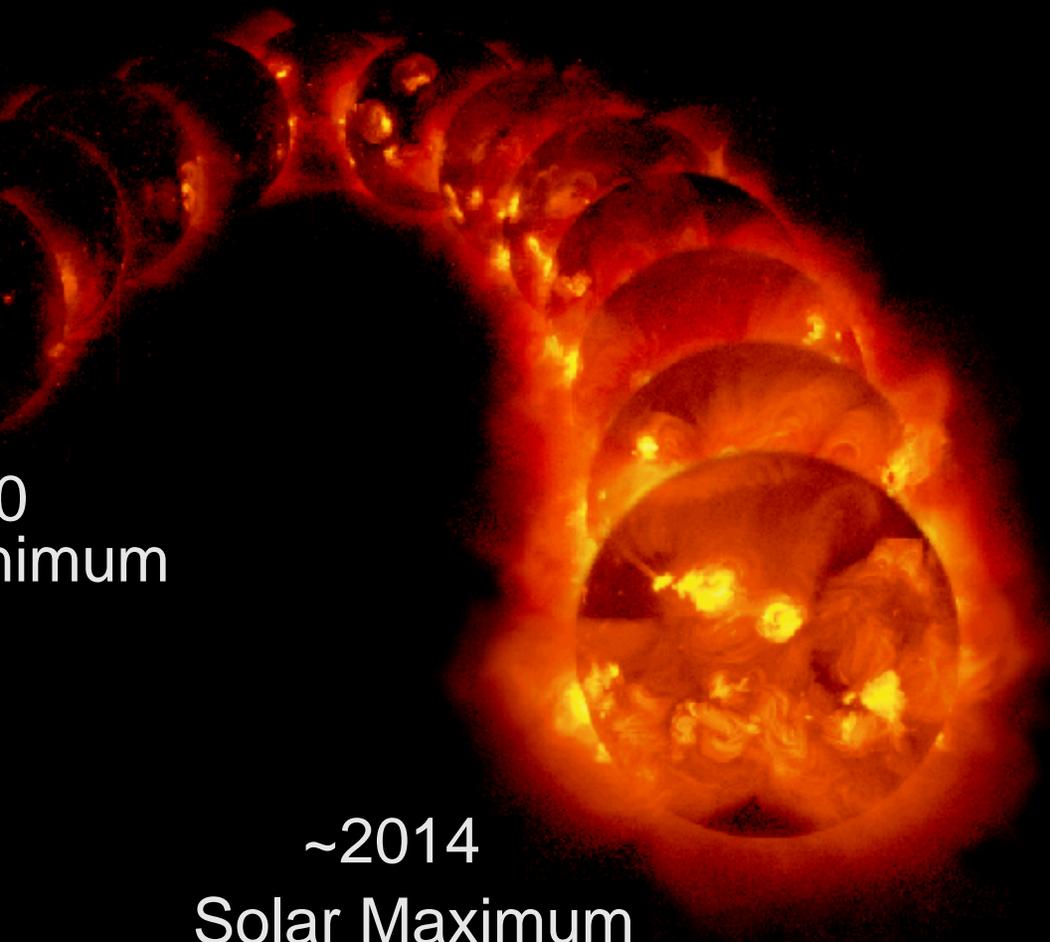
- Operator Error ?
- Mechanical Failure



Attribution  
Action

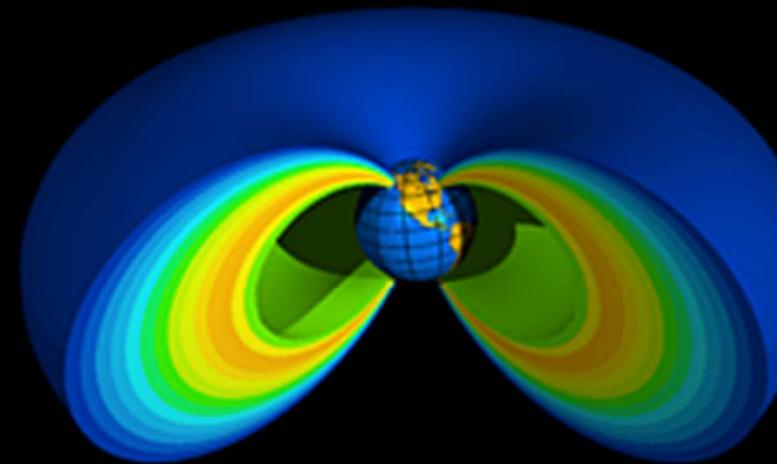
# Electron radiation belts using data assimilation

1-Year Solar Activity Cycle

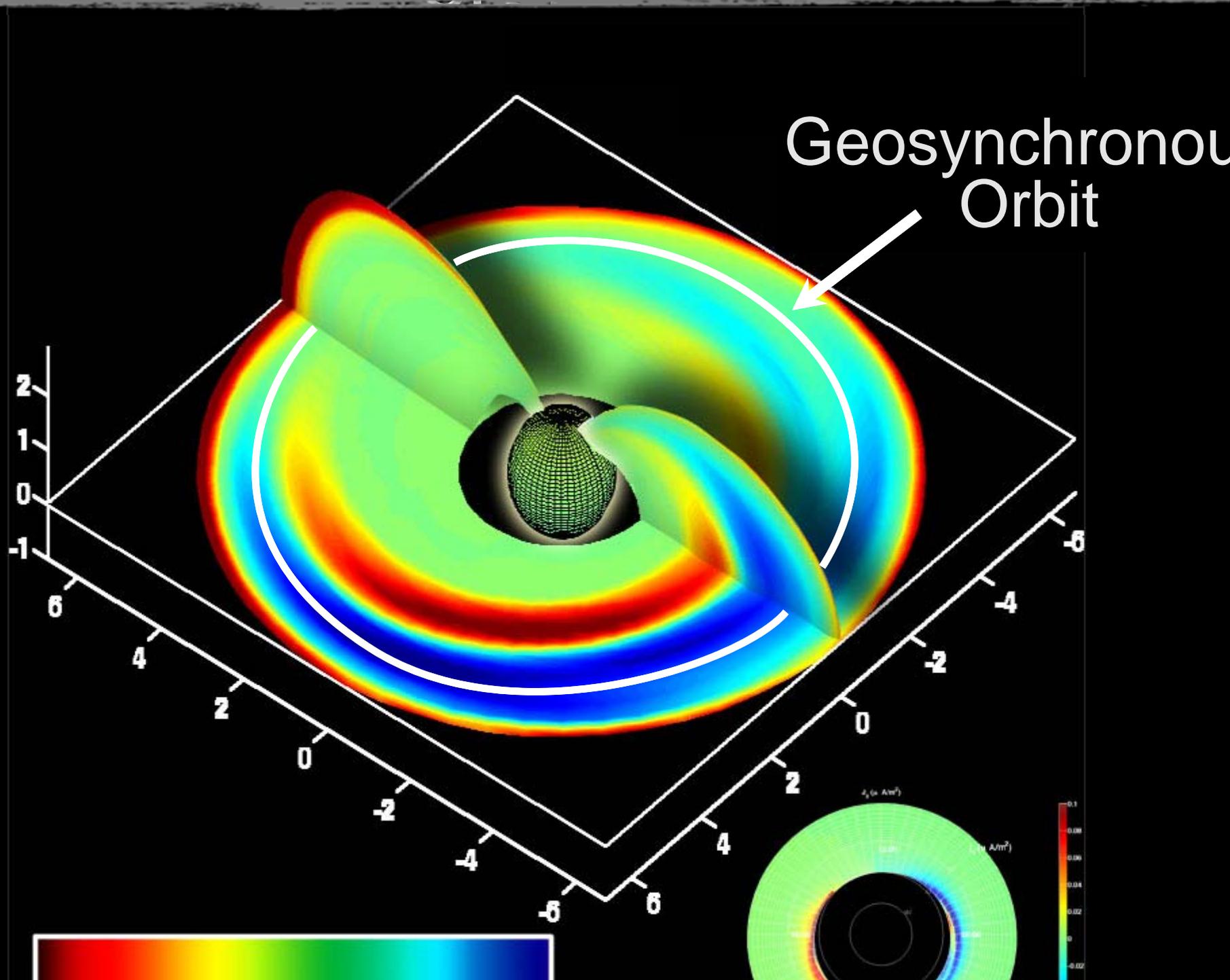


Radiation Belt Changes

1 frame = 18 hours

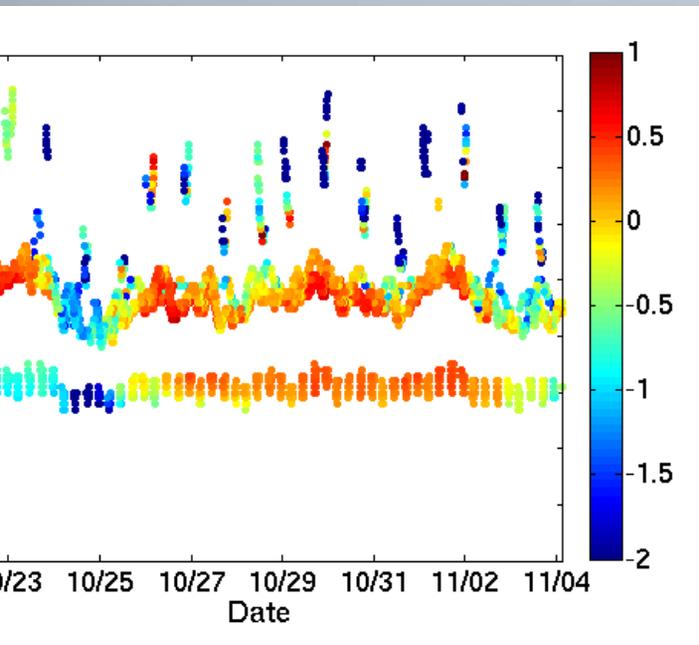


usually wrong - even at geosynchronous orbit

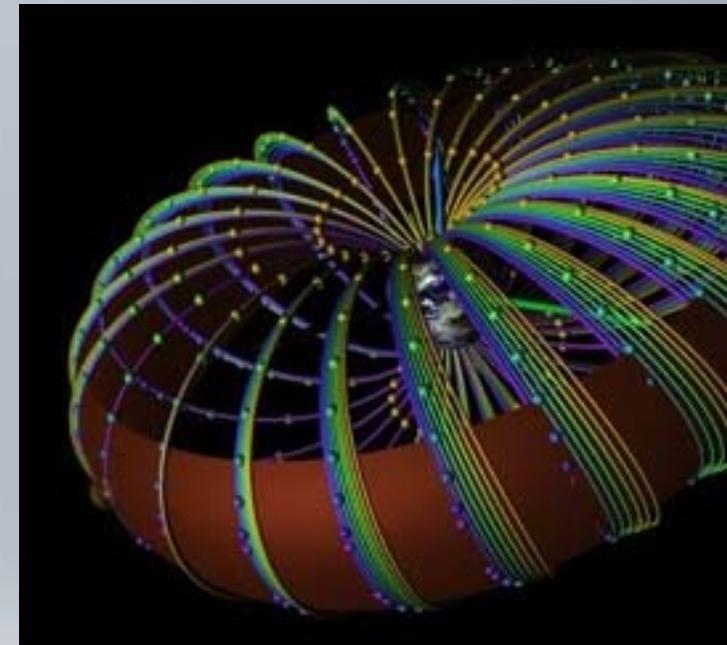


# Observations into global, data-driven solutions

Use and/or Heterogeneous Observations



Complex Physical System



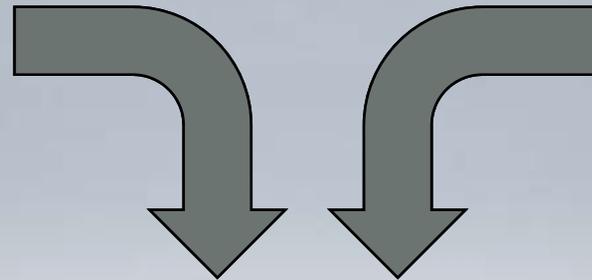
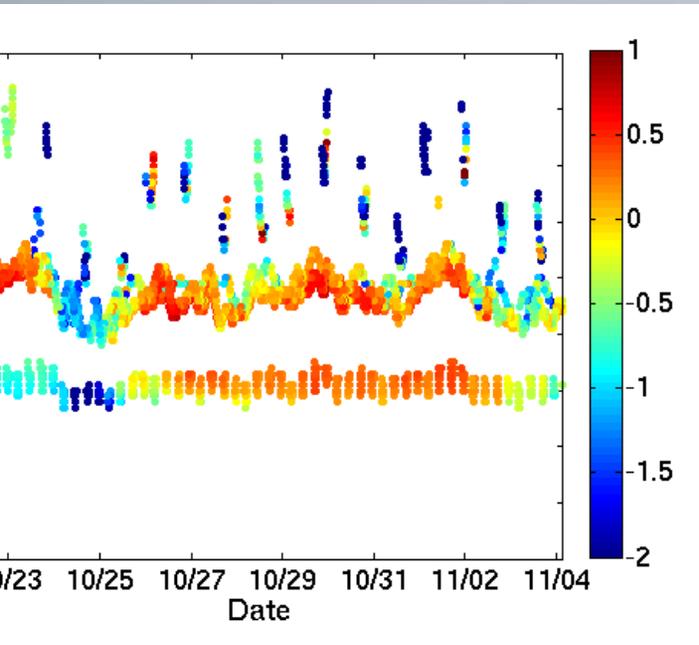
“Pure Physics” space weather models can be complex  
or lack real-time observations needed to drive them

Data Assimilation is a method to combine physical models with  
sparse or conflicting data to produce optimized global solutions

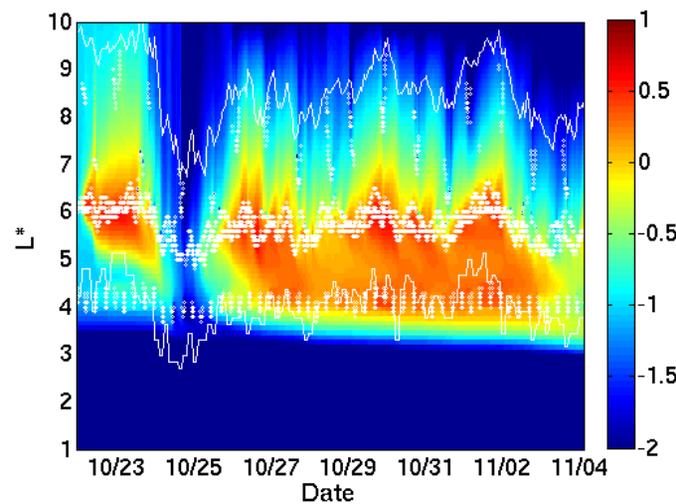
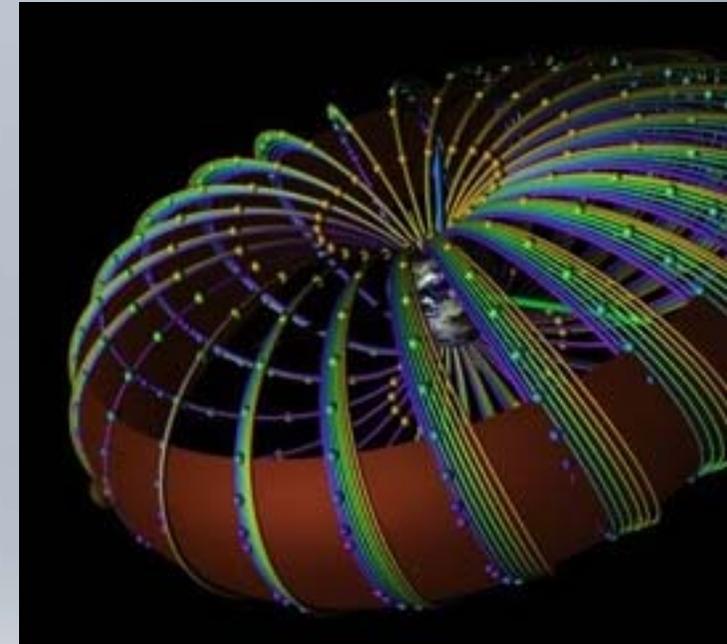
The assimilation, or ‘reanalysis’, gives information not present

# Observations into global, data-driven solutions

Use and/or Heterogeneous Observations



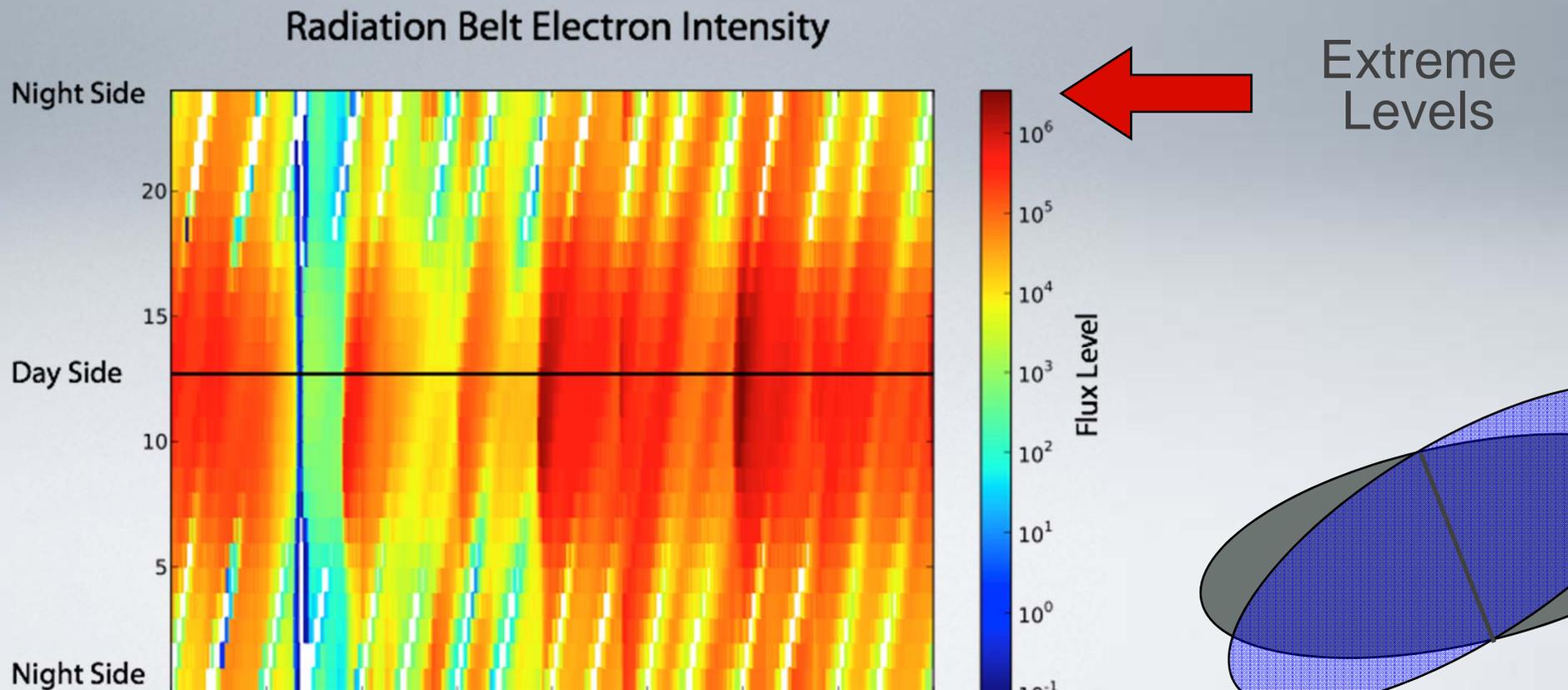
Complex Physical System



# Example Application

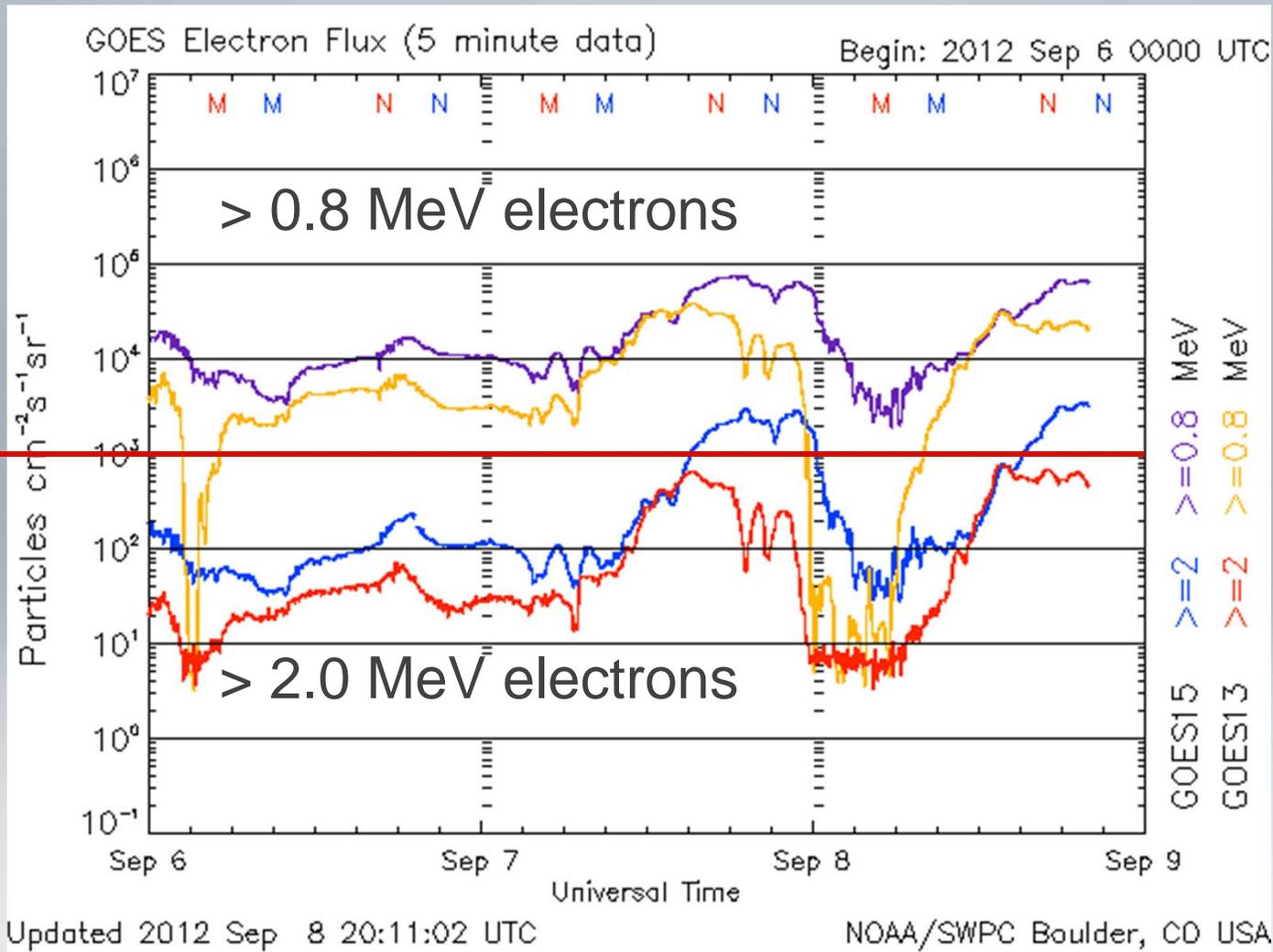
AF Request: Specify current space environment  
satellite in geosynchronous orbit  
(other orbits are possible but geo was the orbit of interest)

Determine whether the conditions are normal, or  
extreme



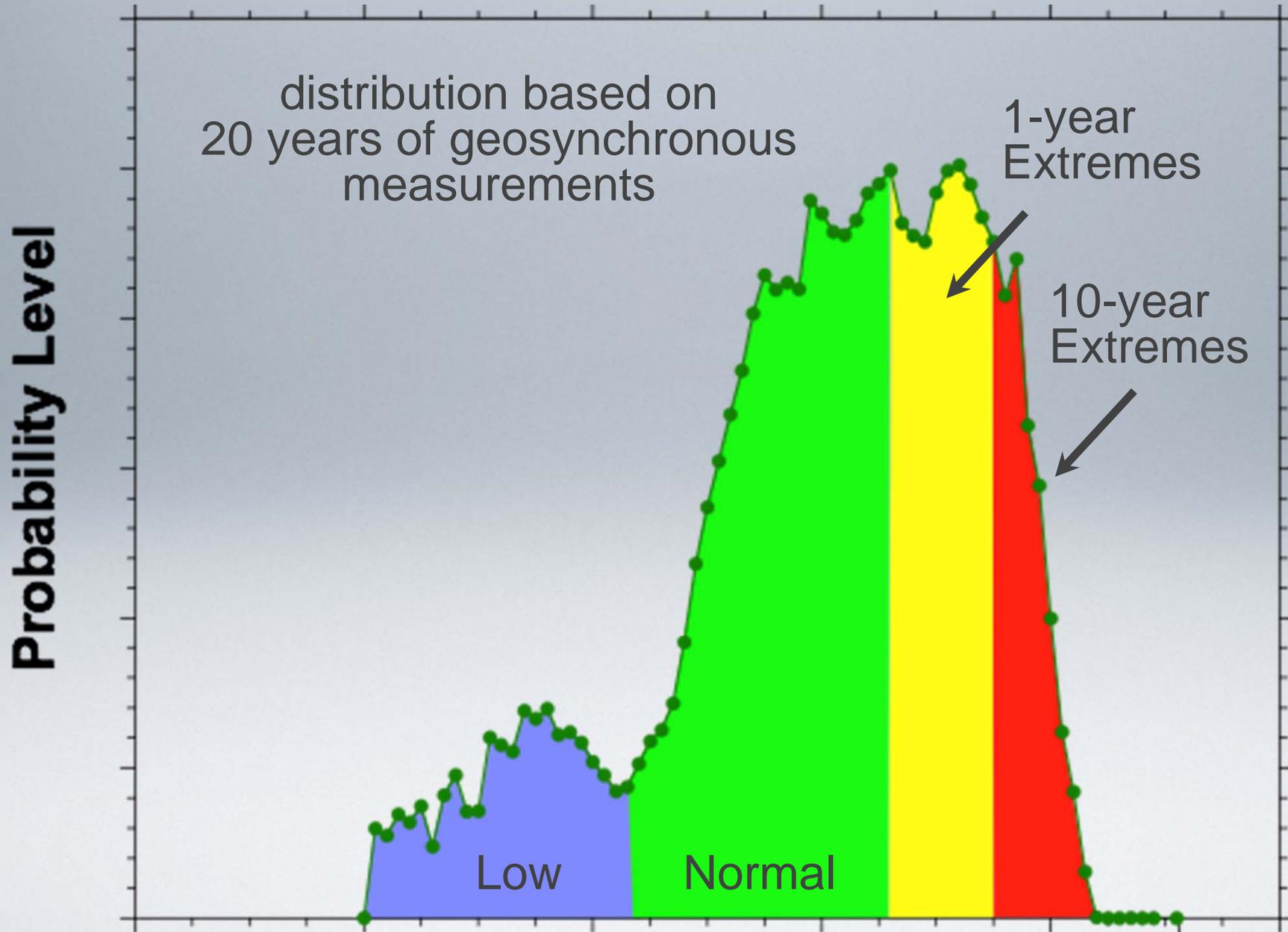
# System

electron  
level



NOAA issues an electron alert when

# System utilizes probability distributions



# System

ack real-time raw telemetry stream(s)

eprocess data for assimilation in DREAM

in the DREAM data assimilation model

in the DREAM “Fly-Through” tool to determine t  
vironment along the orbit of interest

valuate conditions relative to historic probability  
distributions in that particular orbit

r ultimate goal is to determine the likelihood th

plement a new real-time system with  
open source data

DAA GOES + NASA RBSP

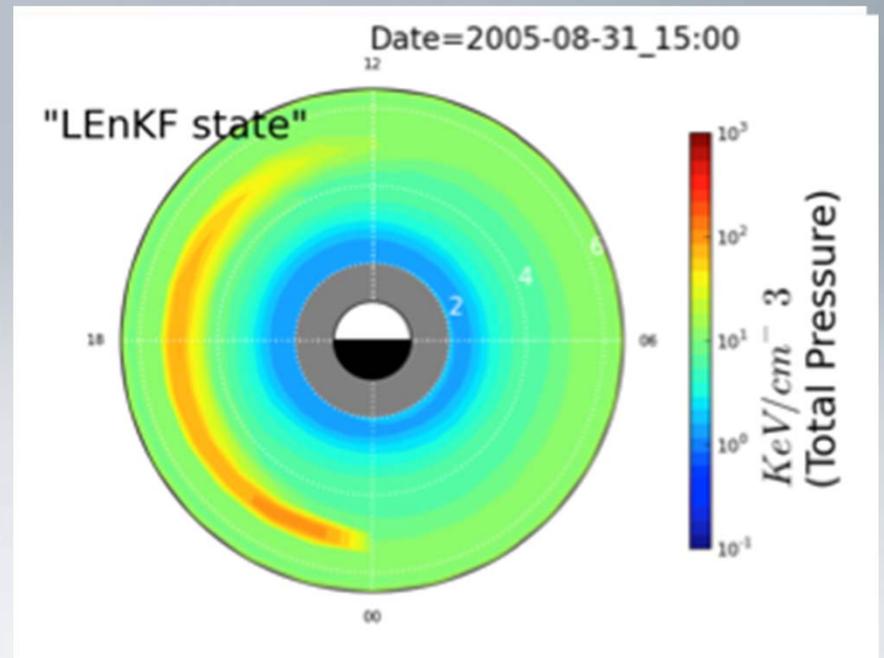
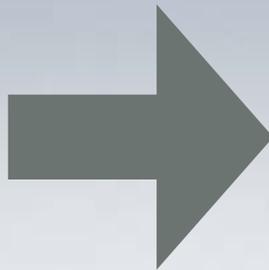
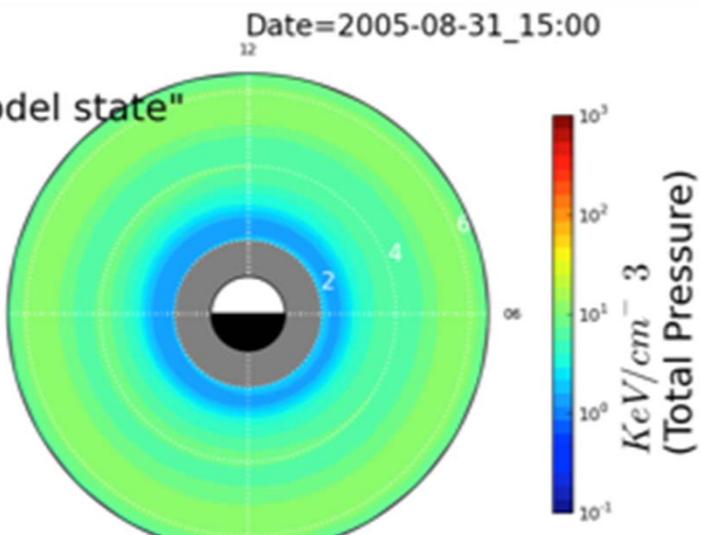
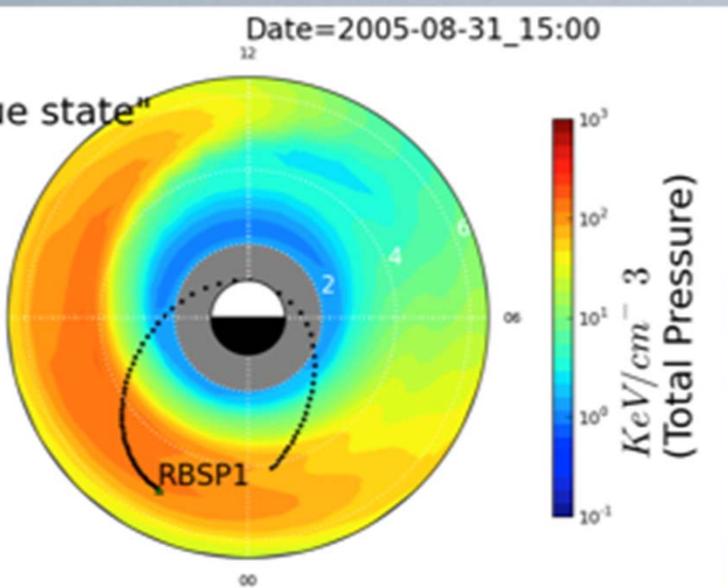
test in operational-like environment (LA

deploy in operational test-bed (Patrick  
B)

partners: AFRL, Aerospace

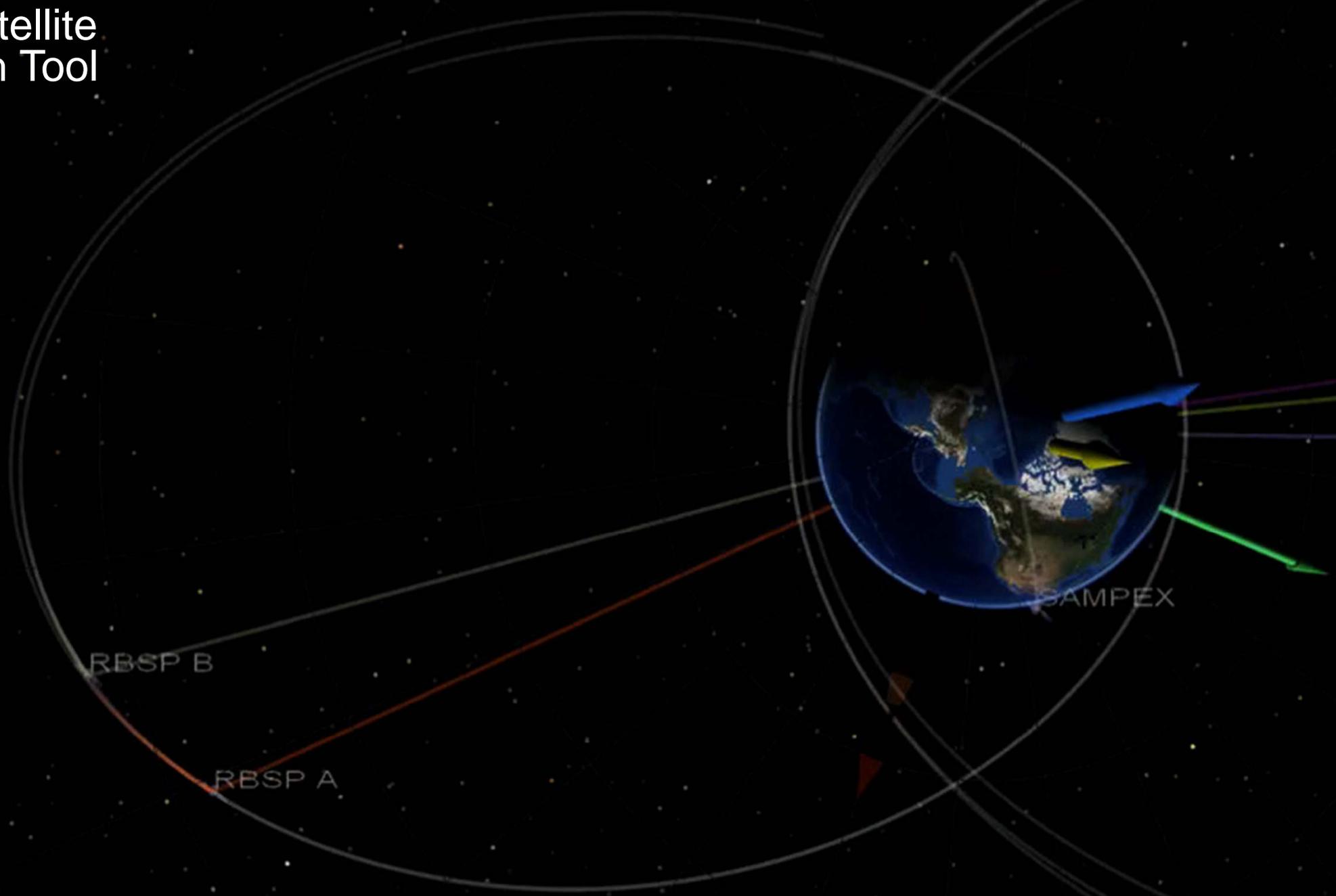
# DREAM

Surface Charging data assimilation mod



# Systems demonstration of SWx for SSA

1/ Satellite  
ough Tool



# Concluding Comments

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Space weather is widely viewed as a critical to effective SSA

AFRL-LANL-Aerospace partnership is trying to bring focus and innovation to new SWx capabilities operations

DREAM is a data-assimilation based radiation belt model

FY13 we are making DREAM operationally-ready both unclassified and classified levels