American Commercial Space Weather Association

Jennifer Gannon
Computational Physics, Inc.

American Commercial Space Weather Association

ACSWA is a collective voice for the commercial space weather sector and an **advocate for research and operations across the space weather enterprise.**

CRC Carmel Research Center

ASTRA

SET

aer Atmospheric and Environmental Research

GeoOptics

SciencePrime

cpi Computational Physics, Inc.

SEC

SHA Space Hazards Applications, LLC

PLANETIQ

Space Services Holdings

PRA Propagation Research Associates

NEXTGEN Federal Systems

QUP NOW

Predictive Science, Inc.

ACSWA American Commercial Space Weather Association 2010

http://www.acswa.us

XPLORE®

ACSWA companies are **growing** and now provide **over 85 FTEs** of support to the space weather enterprise.

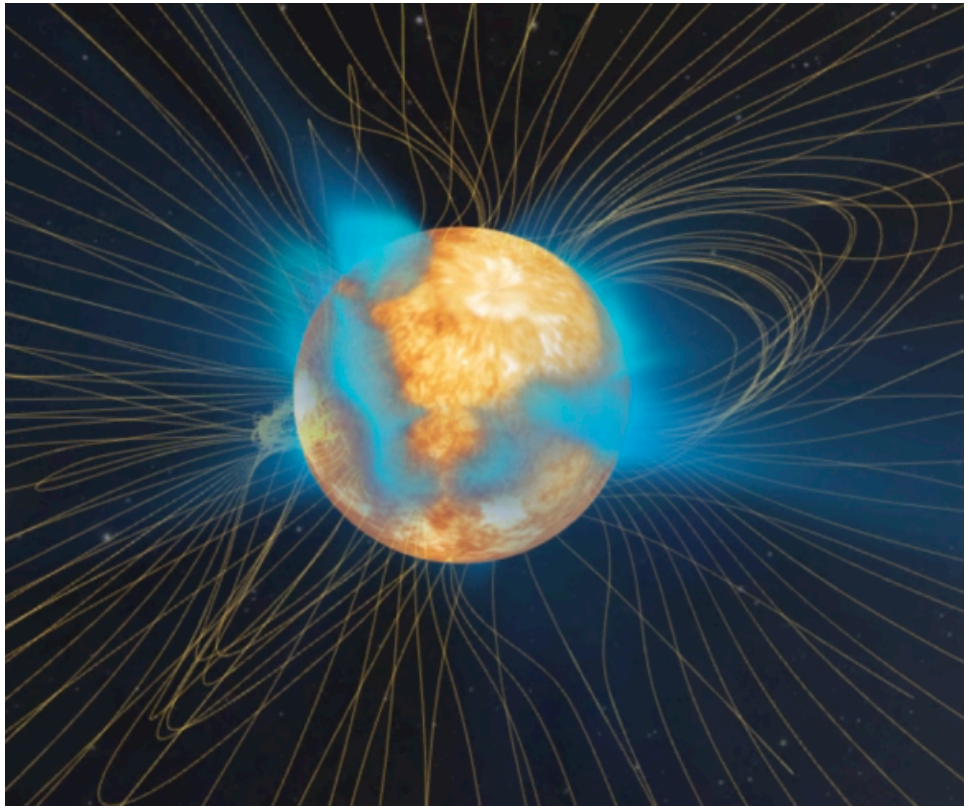


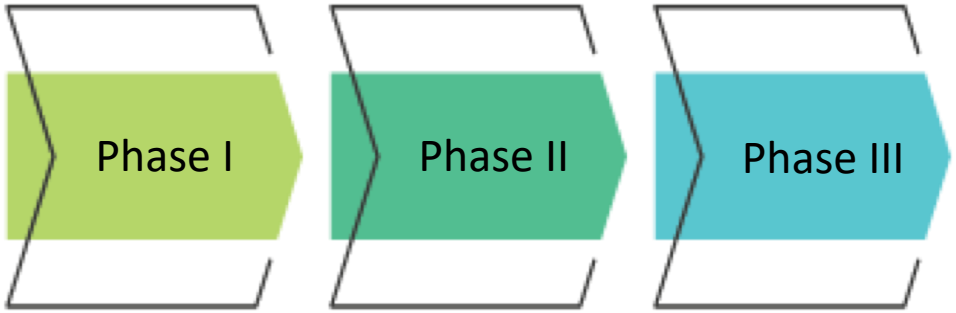
Image credit: Predictive Science, Inc.

Science

Engineering

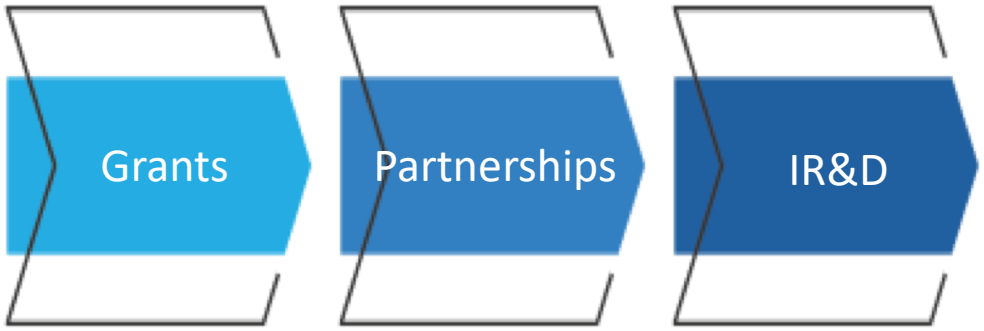
Data and Operations

ACSWA companies are a source of **targeted, applied, and fundamental research** across Helioscience disciplines.



- **Funded** by NSF, NASA, DoD, and DoE grants
- NASA, NOAA, Air Force, and Space Force **SBIRs**

- **Cross-sector collaborations** with universities, government labs, and commercial partnerships
- **Internal** research and development

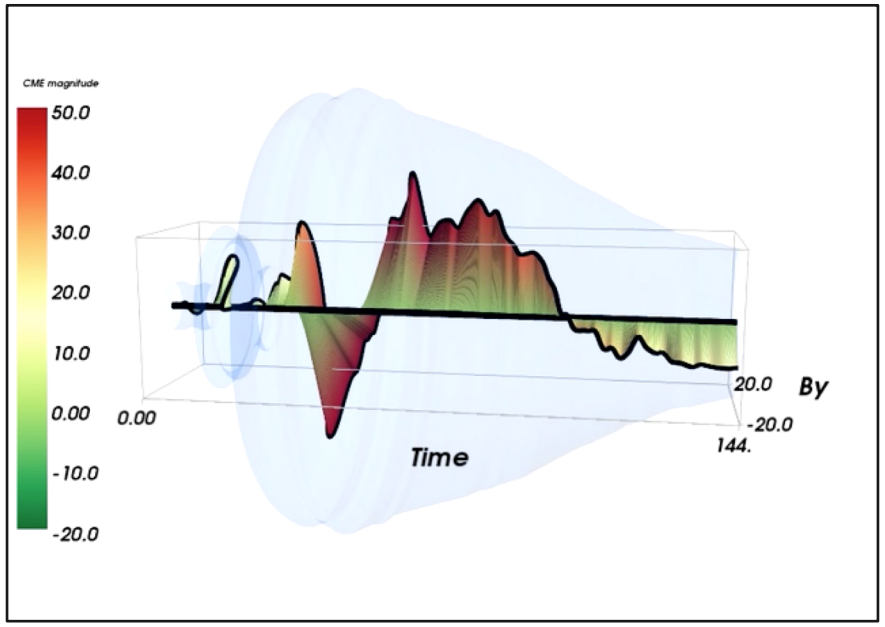


ACSWA companies are builders of **real-time** and **operational models** of the Sun, solar wind, and space.

NEXTGEN FEDERAL SYSTEMS

CRC CARMEL RESEARCH CENTER

Predictive Science, Inc.



aer

SHA Space Hazards Applications, LLC

Solar wind visualization (image courtesy A. Engell, NextGen Federal Systems)

ACSWA companies are **instrument** and **data producers**.

SET

Radiation Monitors

Radio Occultation

Sensors and Cubesats (and mission ops)

Magnetometers and Optical Imagers

S.881 - PROSWIFT ACT

“Space-based and ground-based observations provide crucial data necessary to understand, forecast, and prepare for space weather phenomena.”

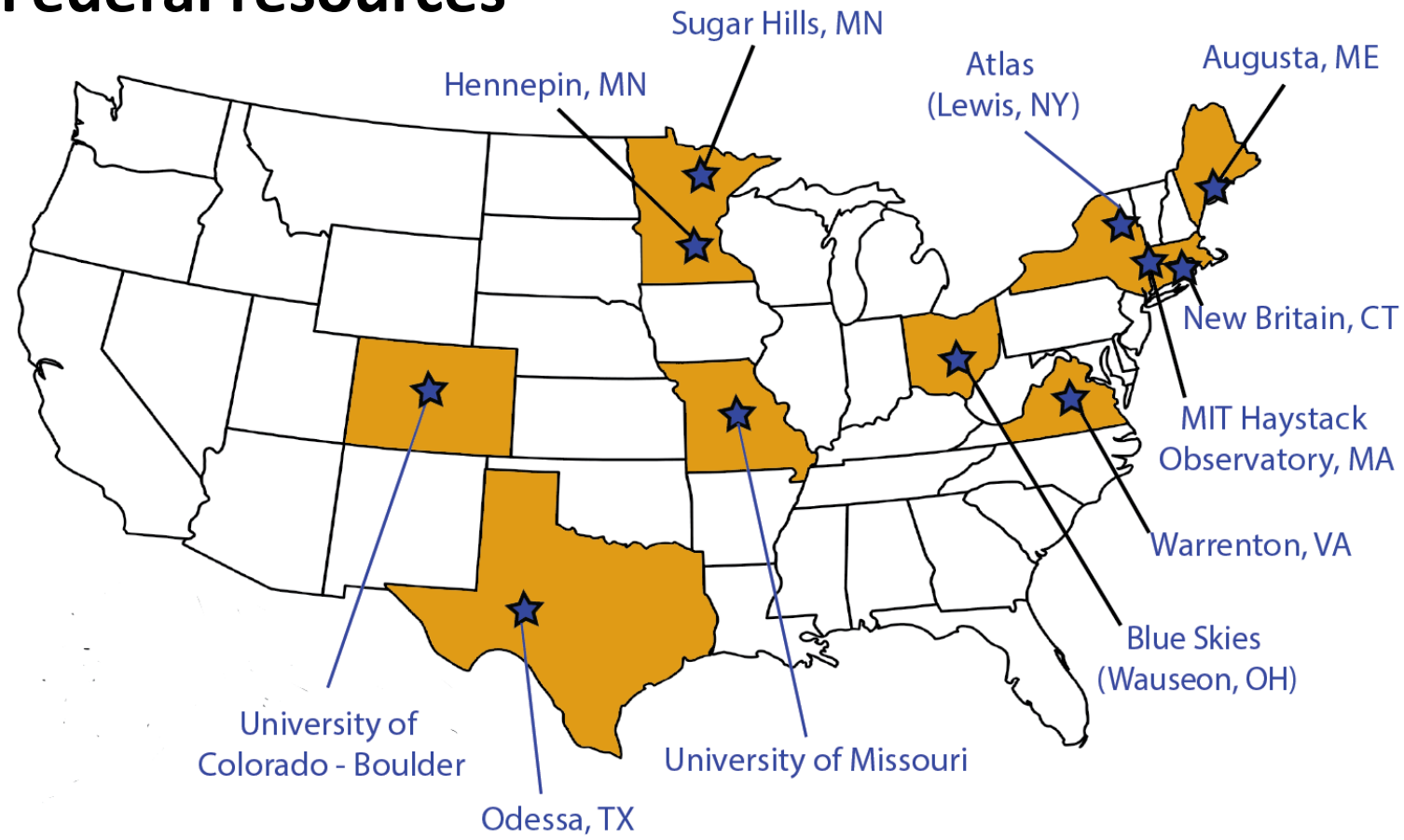
Ground-based instrument infrastructure (CPI)

ACSWA companies continue to work with Congress to promote space weather activities.

ACSWA companies look forward to participating in the planned PROSWIFT Act tasks and providing space-, air- and ground-based observations and services.

COMPUTATIONAL PHYSICS, INC.

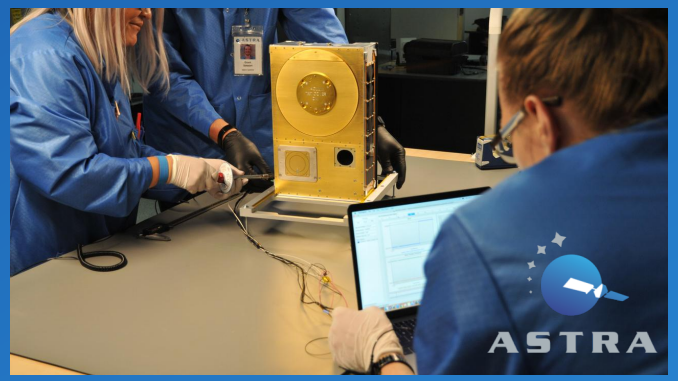
Cost-effective, secure, real-time data to augment Federal resources

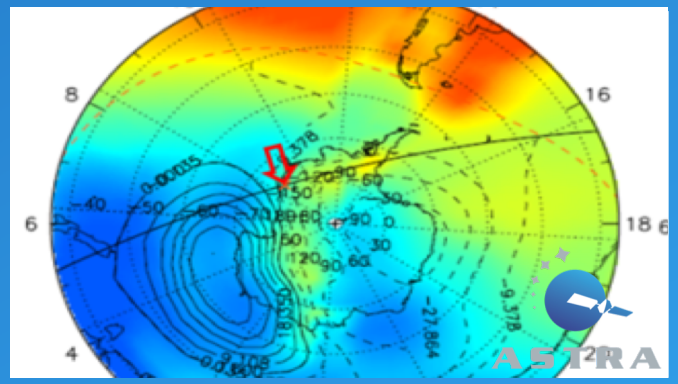


- 10 new real-time, **operational magnetometers** (20 total, including commercial sales)
- Ground-based imagers that can be used for **auroral boundary detection**
- **CRADA with Space Weather Prediction Center** to evaluate quality and reliability of our operational data streams
- Collaborators in **NASA missions** – GOLD, MAVEN

Atmospheric & Space Technology Research Associates

Technology Solutions for Earth, Space and Everything In-between





Smallsat & CubeSat Development

- **Mission Development & Hardware Build**
- **24/7 Satellite Mission Operations**
- **DoD 8 x 6U CubeSat Constellation**
  - **5 currently on orbit**
- **NASA SORTIE Mission – currently on orbit**
- **Cubesat-based EO/IR Weather Systems**
  - ✓ **Build Phase: Air Force Cloud Imaging Sat**
  - ✓ **Design Study: NOAA Weather Constellation**

Sensor Development & Miniaturization

- **Space-based & Ground-based Sensors for Space Domain Awareness (GPS, HF, RF)**
- **Space-based Ultraviolet sensors**
- **Space-based VIS/SWIR/MWIR/LWIR**
- **Software-Defined Radio / FPGA Expertise**
- **Communication Systems (RF & Laser)**
- **Bathymetric LiDAR**
  - ✓ **Littoral, Riverine & Lake environments**

Atmospheric Remote Sensing & Modeling

- **First principles models of Ionos/Thermos**
- **Assimilative Modeling of Ionosphere, Thermosphere & Electrodynamics**
- **OSSE Tools for Ionosphere & Thermosphere**
- **Deployed autonomous GPS monitors**
  - ✓ **NOAA Tides using GPS reflectometry**
  - ✓ **NOAA TAO buoys for scintillation/TEC**
- **Ionospheric location/timing corrections**
  - ✓ **NOAA GPS Precise Positioning Tool**

Compact Radiation Monitor plus app

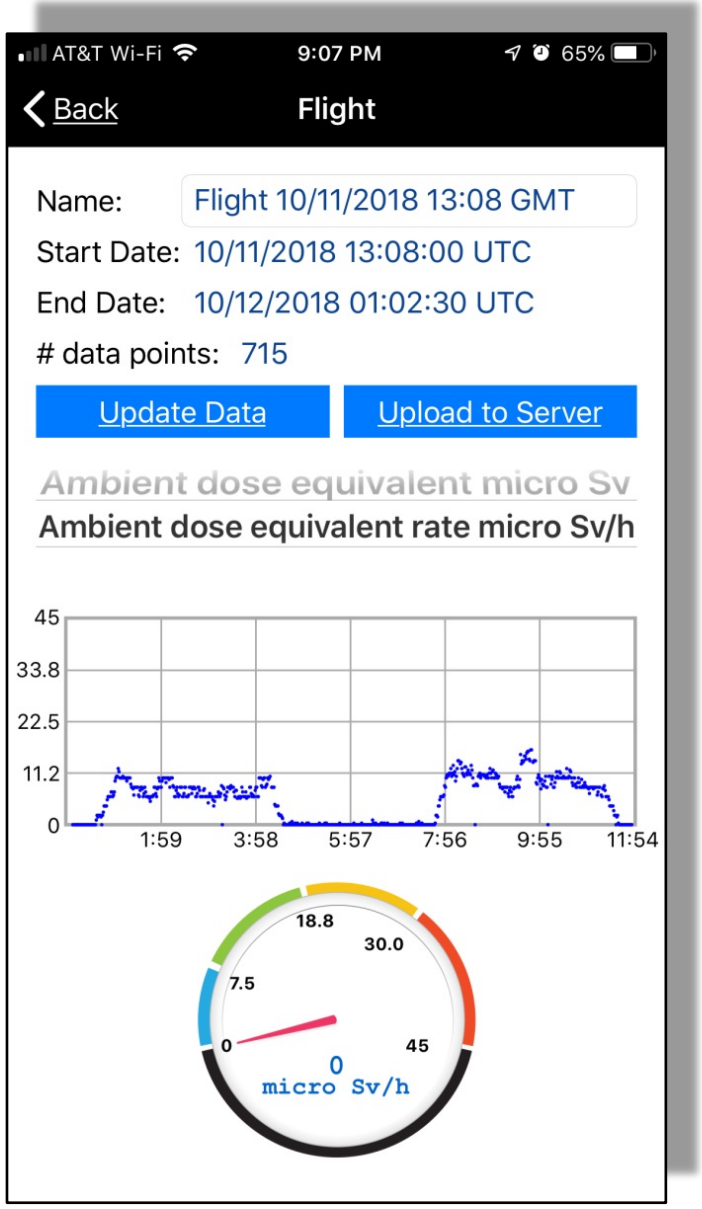
State-of-the-art ARMAS Flight Module 7 (FM7) with Bluetooth

Features:

- Measurement of absorbed dose in silicon
- Small size and mass
- Data retrieval via Bluetooth paired with smartphone or tablet app
  - Display current status on app
  - Use plane's WiFi to transmit to ground as needed
- Levels 2–3 real-time dose rates provided (absorbed, equivalent dose, & ambient dose equivalent rates)

Status:

- 4 units delivered 2018
- First production run for business jets complete in Q1 2019



Ionospheric & Tropospheric Data

GeoOptics

CICERO Satellites

"**C**ommunity **I**nitiative for
Continuing **E**arth **R**adio **O**ccultation"

Cion Receiver

Products

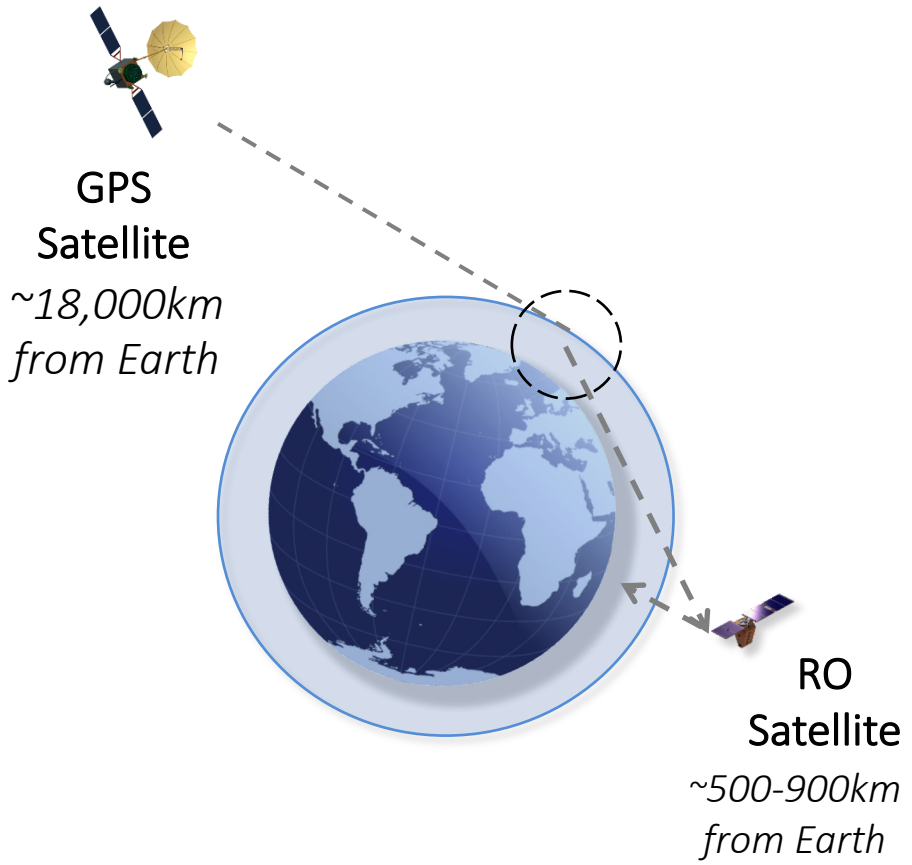
Troposphere

Bending Angle, Refractivity, Density, Pressure, Temperature, Moisture, Absolute Altitude Measurement

Ionosphere

Total Electron Count (TEC)

Radio Occultation (RO)



NextGen Federal Systems – Enterprise IT in Space Weather

Top 5000 Fastest Growing Company in America for 5 consecutive years, as recognized by Inc. 5000.

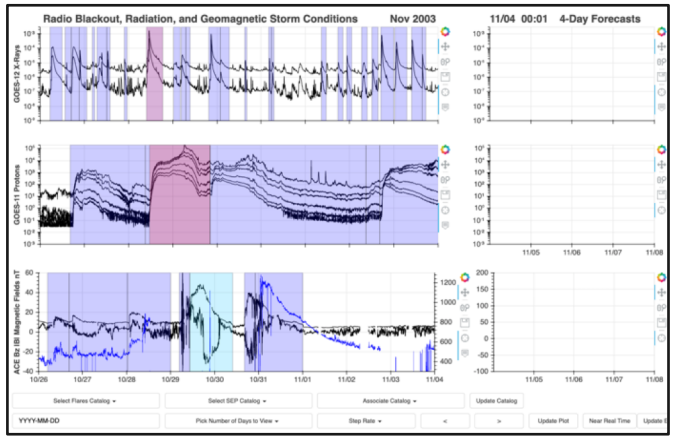
Inc. 5000 #211 2016 | Inc. 5000 #440 2017 | Inc. 5000 #1096 2018 | Inc. 5000 #1703 2019 | Inc. 5000 #2437 2020

Building a Virtual Space Wx O2R-R2O Center

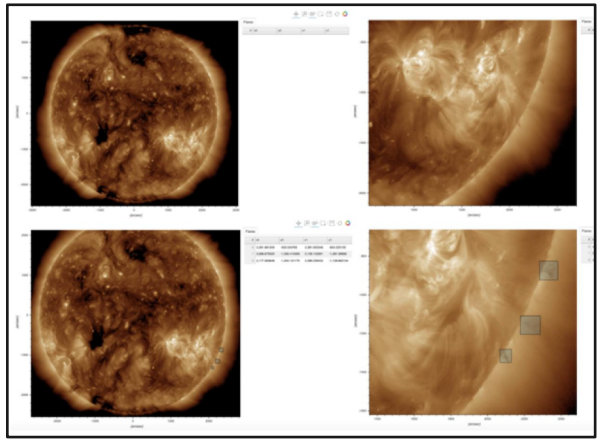
An ecosystem for collaborative and repeatable space weather data processes, science and forecasting

NextGen's ecosystem currently has 5 awarded NASA O2R Teams using it

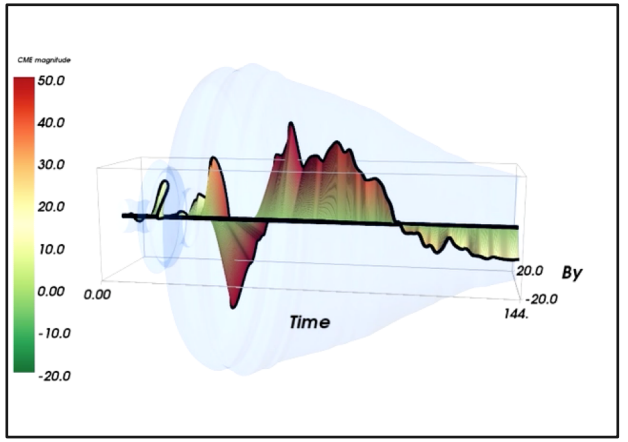
Solar drivers and forecasts



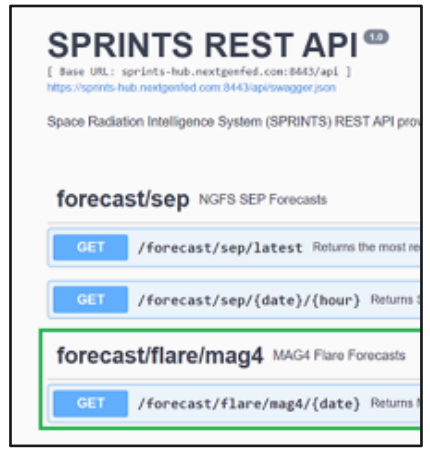
Analyze TBs of helio data



CME Assessment Tool



Machine 2 Machine



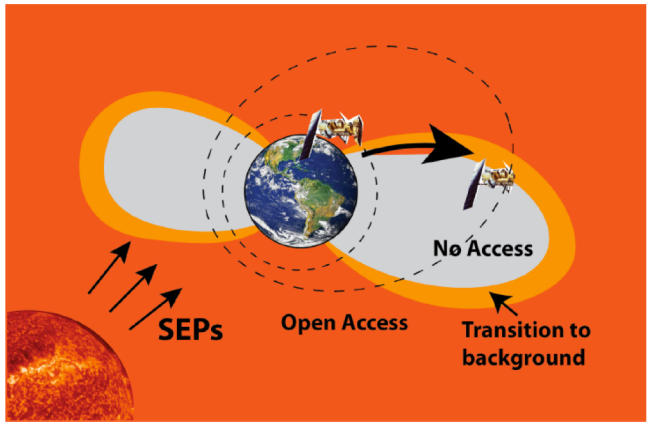
SHA
Space Hazards Applications, LLC

Monitoring and forensics of space weather impacts to satellites

SHA's suite of models and applications give users the real time space radiation hazard and its historical context for their specific satellite orbits and design specifications.

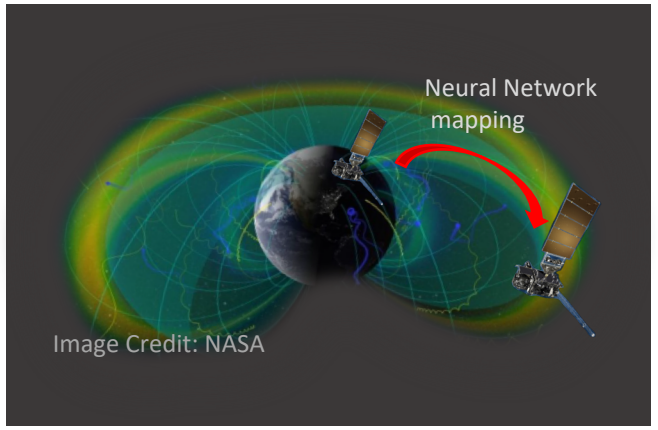
SPAM

Real time data driven model of high energy ions that cause Single Event Upsets (SEUs)



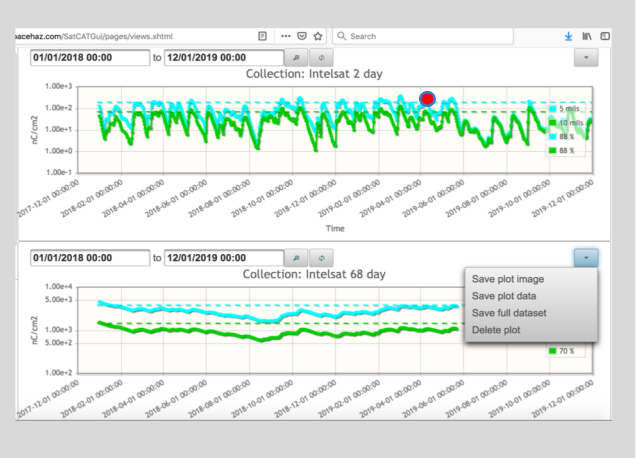
SHELLS

Real time machine learning global model of high energy electron intensity



SatCAT

Online configurable tool to generate and view internal charging levels and SEU's tailored for user defined satellites, shielding thickness, materials and mission duration.



Carmel Research Center, Inc. uses quantitative 3D models to predict space weather propagation

CARMEL RESEARCH CENTER

ACSWA American Commercial Space Weather Association 2019

Founding member

Space Weather Forecasting

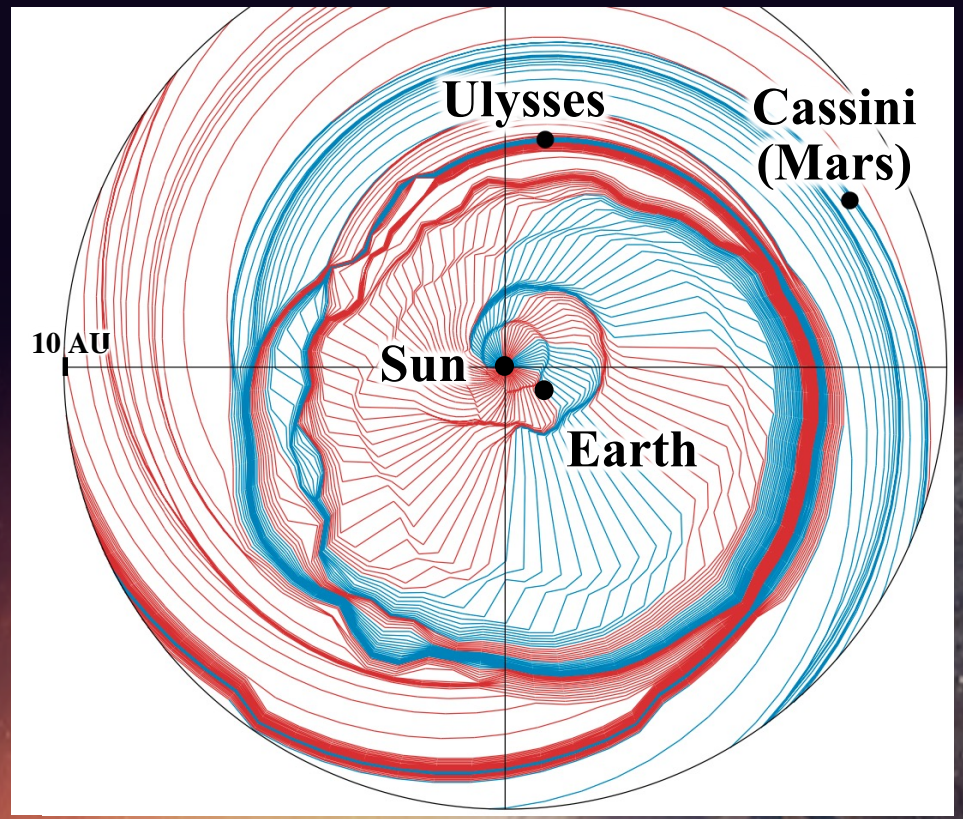
We analyze solar events and the dynamic environment through which they propagate to predict major impacts on Earth, near-Earth technology, and any space missions or data.

Space Traveler Health Forecasting

We predict space weather phenomena that cause serious health problems for space travelers.

devriei@aol.com
CarmelResearchCenter.com
ACSWA.us

Solar events travel through space and evolve in 3D.



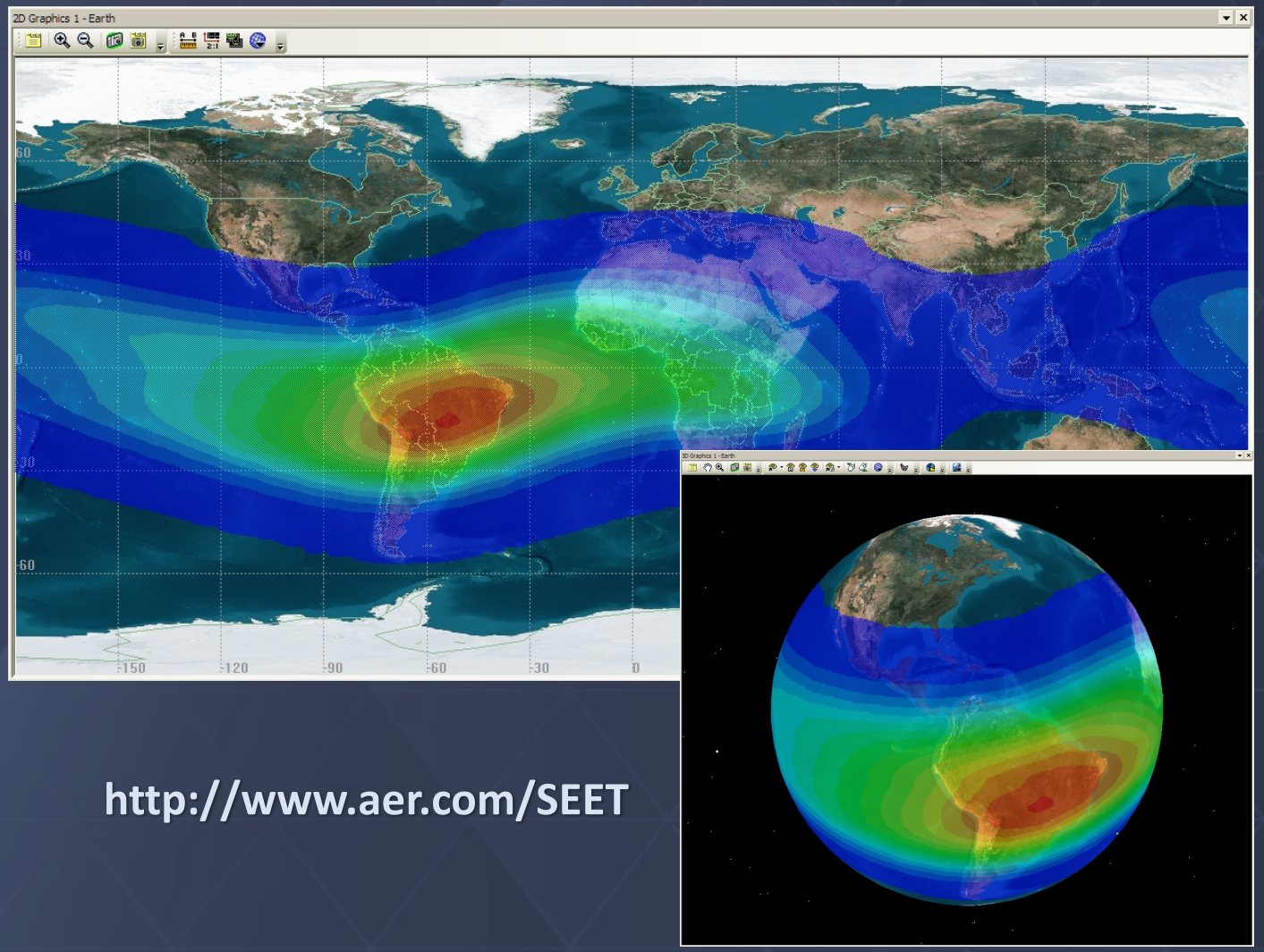
Our 3D models provide earlier forecasts with greater precision and accuracy.

Atmospheric and Environmental Research (AER)

STK SEET™

STK Space Environment and Effects Tool

- Robust custom handling of the modeled radiation environment – using IRENE starting in March 2020
- Compute SAA transit times and probable fluxes for custom orbits
- Compute magnetic fields, trace field lines and magnetic conjunctions
- Compute Solar and Galactic Cosmic Ray fluences
- Estimate mean temperature due to solar and reflected Earth radiation



http://www.aer.com/SEET

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Space Weather Workshop Talks by ACSWA Companies

Wednesday, April 21

3:45pm ET **ASTRA Ionospheric Observations and Modeling Ionospheric Conditions** Geoff Crowley, Atmospheric & Space Technology Research Associates (ASTRA)

Thursday, April 22

10:05am ET **Automated Radiation Measurements for Aerospace Safety - Dual Monitor (ARMAS-DM)** Kent Tobiska, Space Environment Technologies

10:29am ET **A Tool for Defining Solar Particle Access to the Magnetosphere (SPAM) for Satellite Anomaly Attribution** Janet Green, Space Hazards Applications

10:45am ET **Enhancing Geomagnetically Induced Current Understanding and Prediction over Continental United States** Chigomezyo Ngwira, Atmospheric & Space Technology Research Associates (ASTRA)

11:09am ET **Interactive Tool for Modeling Multiple Solar Eruptions** Tibor Török, Predictive Science Inc

1:35pm ET **Ionospheric Radio Occultation Measurements from GeoOptics Commercial Satellites** Conrad Lautenbacher, GeoOptics