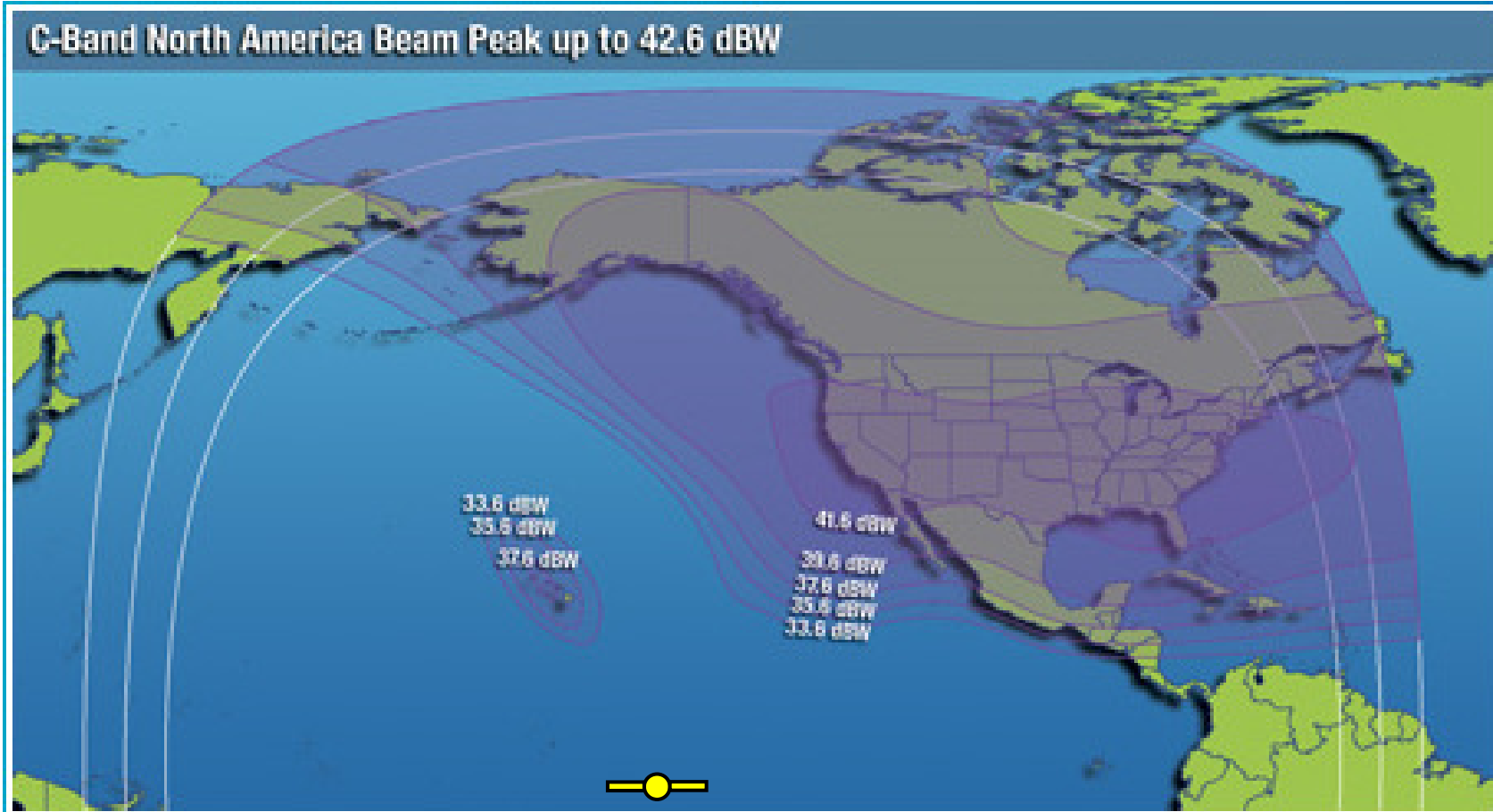


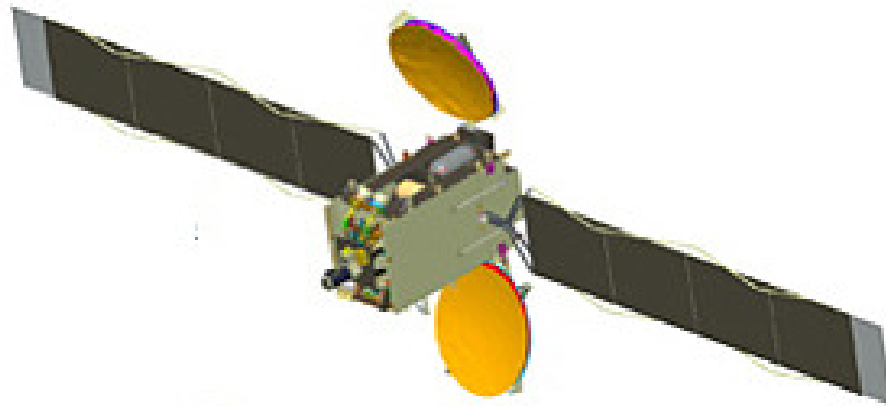
A Summary of the Galaxy 15 Incident and its Impact on Space Sustainability

Brian Weeden
Technical Advisor
Secure World Foundation



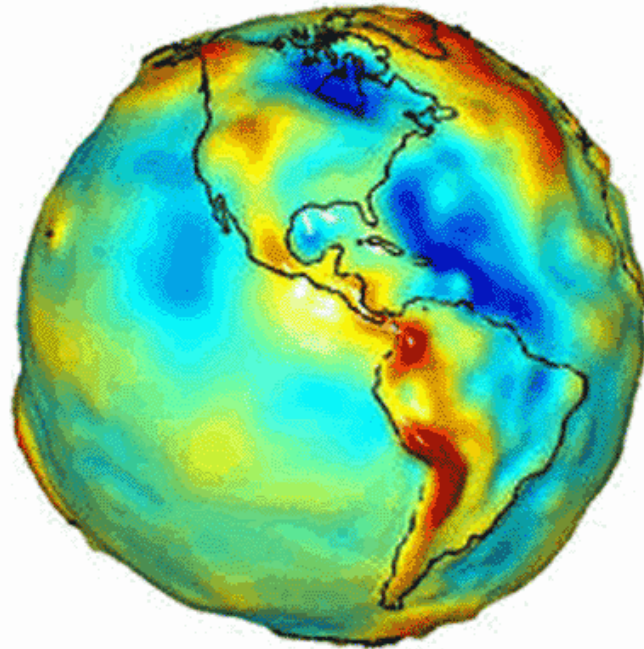
Credit: Intelsat General

- April, 2010, Galaxy 15 stopped responding to commands and transmitting telemetry
- Galaxy 15's communications payload remained active and was able to rebroadcast any C-band signals it received while drifting
 - “Open microphone”

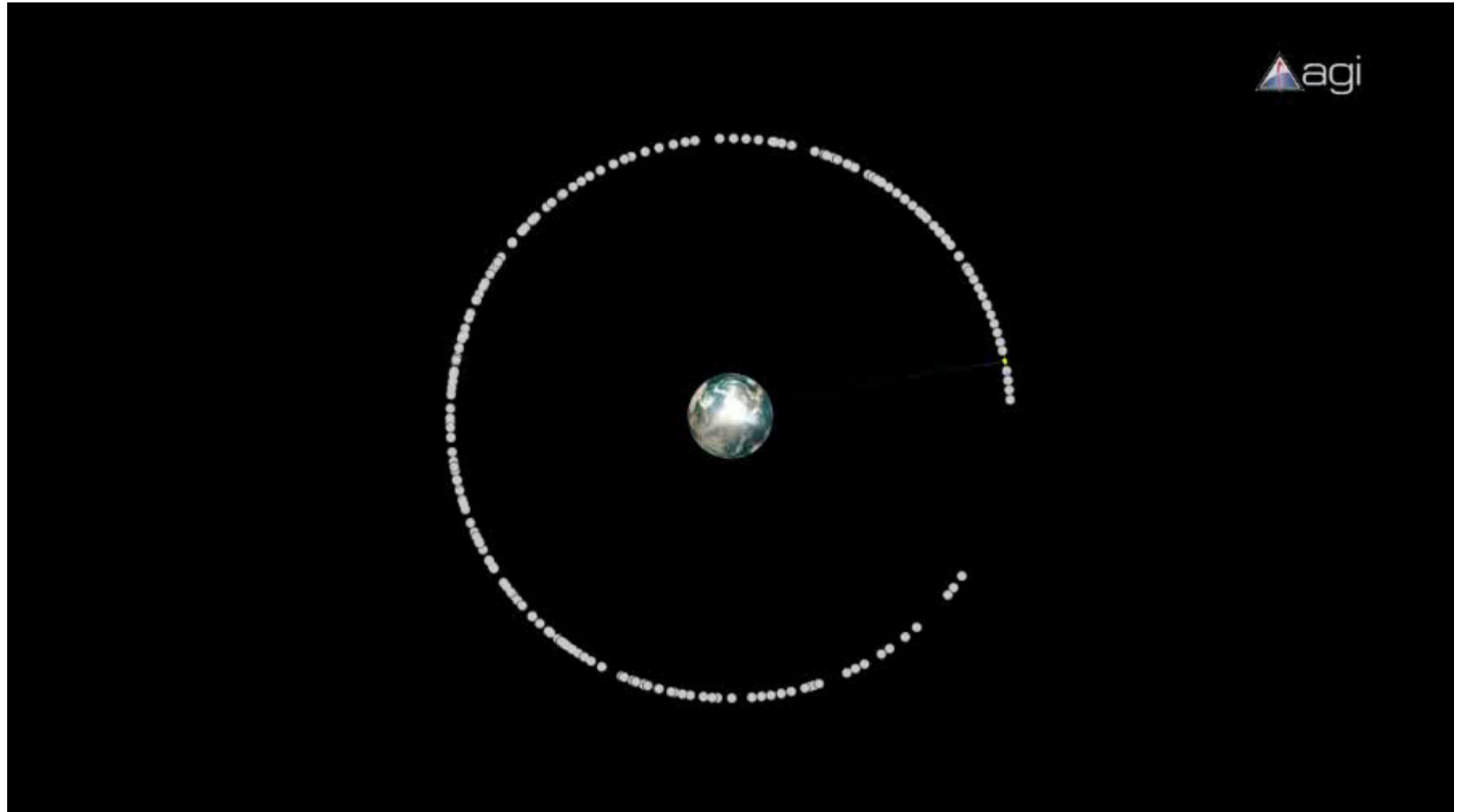


*The Star-2 Satellite Bus
Credit: Orbital Sciences*

- All satellites in the GEO belt are pulled east or west from their assigned orbital slots by variations in the Earth's gravitational field



*Gravitational Map generated by GRACE satellite
Credit: NASA*



- Between May and December, 15 maneuvers were conducted by other satellites
- Mitigation Team
 - Intelsat
 - SES
 - SatMex
 - Telsat Canada
 - Orbital Sciences

- Galaxy 15 drifted past SES-1 satellite from 4-18 Dec, 2010
 - SES-1 relays data from several US weather tracking and forecasting satellites to US National Weather Service (NWS)
 - Interference from Galaxy 15 caused a brief outage with the satellite data feed on 6 Dec



NWS Advanced Weather Interactive Processing System
Credit: National Oceanographic and Atmospheric Administration

- On 23 December, 2010, Galaxy 15's battery finally drained and the satellite's command unit reset
- Shortly thereafter, Galaxy 15 started accepting commands again and was placed in safe mode
- Galaxy 15 was maneuvered to an orbital slot at 93 W
- Intelsat is currently running a series of diagnostic tests to evaluate whether or not the satellite can return to service

- Originally, space weather was suspected to have caused the malfunction

Space Weather Message Code: ALTK07
Serial Number: 81
Issue Time: 2010 Apr 05 0956 UTC

ALERT: Geomagnetic K-index of 7
Threshold Reached: 2010 Apr 05 0955 UTC
Synoptic Period: 0900-1200 UTC
Station: Boulder
Active Warning: No
NOAA Scale: G3 - Strong

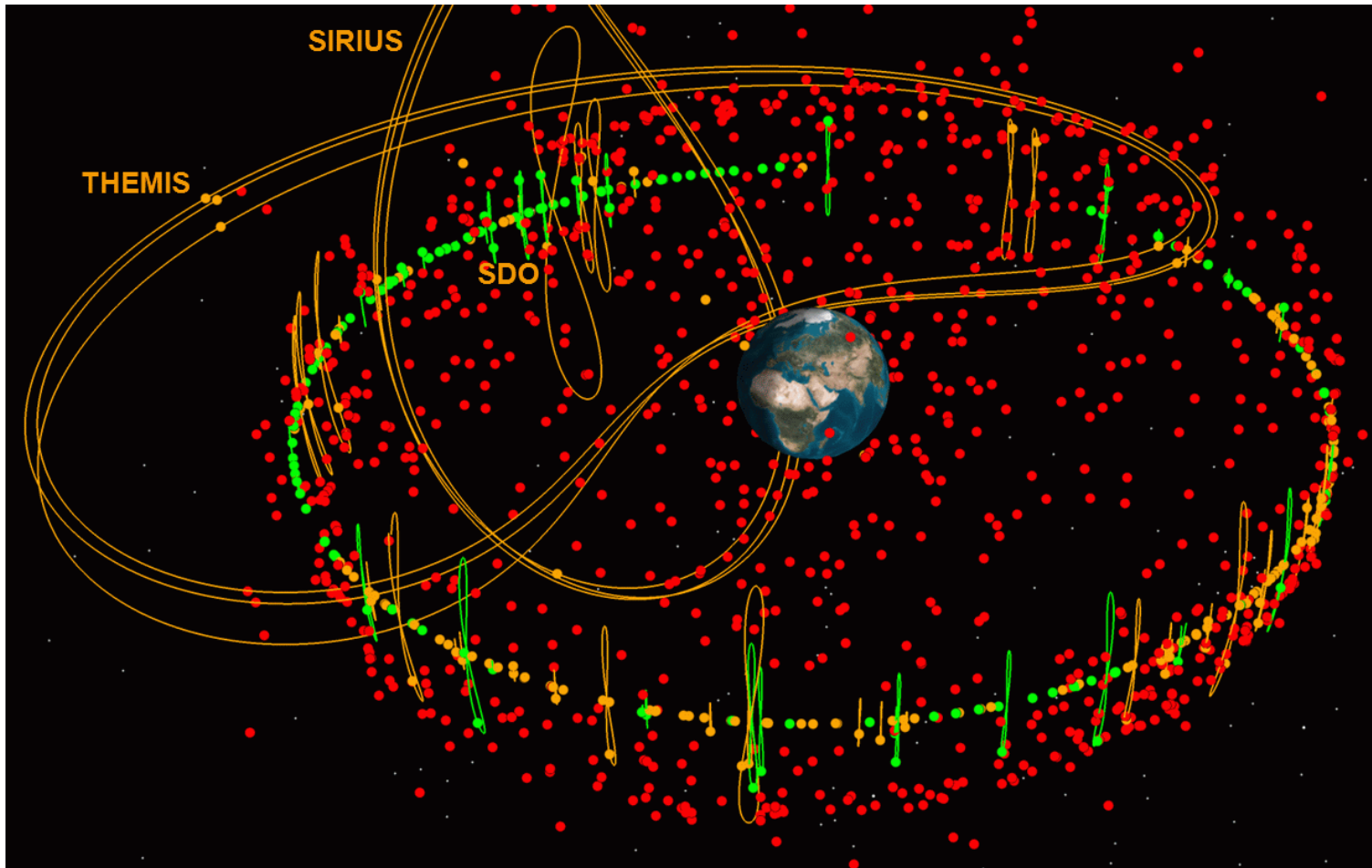
Space Weather Message Code: ALTEF3
Serial Number: 1651
Issue Time: 2010 Apr 05 0949 UTC

ALERT: Electron 2MeV Integral Flux exceeded 1000pfu
Threshold Reached: 2010 Apr 05 0915 UTC
Station: GOES-11

- Electrostatic discharge was later found to have been the cause
 - Full investigation and report due soon

A more realistic picture of the GEO region

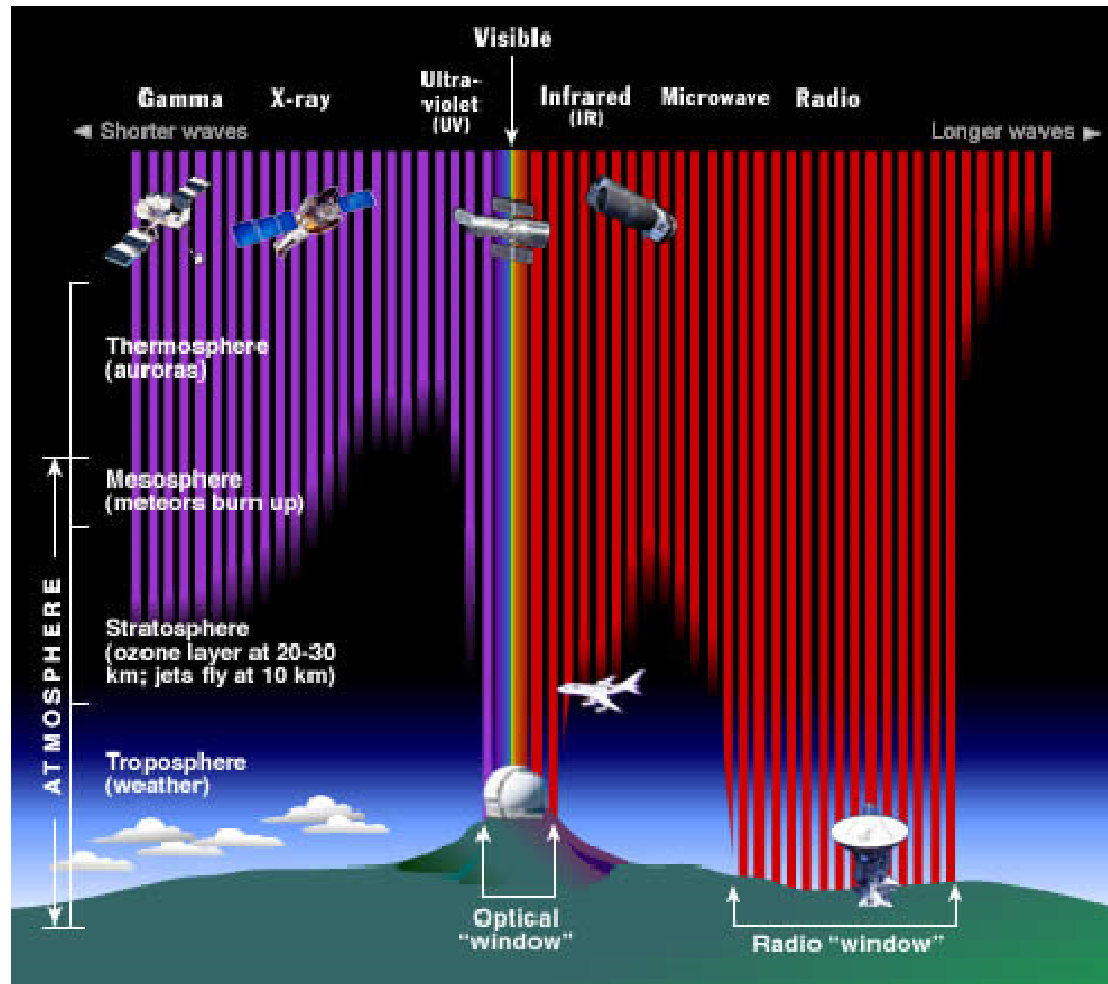
Promoting Cooperative Solutions for Space Security



Credit: Analytical Graphics Inc.

Atmospheric absorption of the EM spectrum

Promoting Cooperative Solutions for Space Security



Credit: Space Science Telescope Institute

- On-orbit failure is just one of the potential scenarios that could cause physical or radio frequency interference in the GEO belt
 - Constant maneuvering in/out of slots
 - Wide variation in station-keeping practices
- Communication and coordination between all satellite operators is essential to minimizing the negative impacts of similar events
 - Intelsat and rest of mitigation team set the example
 - Potential source of operator best practices?

- Space situational awareness (SSA) is key to diagnosing problems and resolving these types of situations
 - No one actor can have the best SSA
 - Some level of data sharing is required
- At some point, active debris removal will be necessary to eliminate the debris threat in both LEO and GEO
 - Initial technical analysis and feasibility being done now
 - Significant legal and policy challenges need to be discussed

Thank You.

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