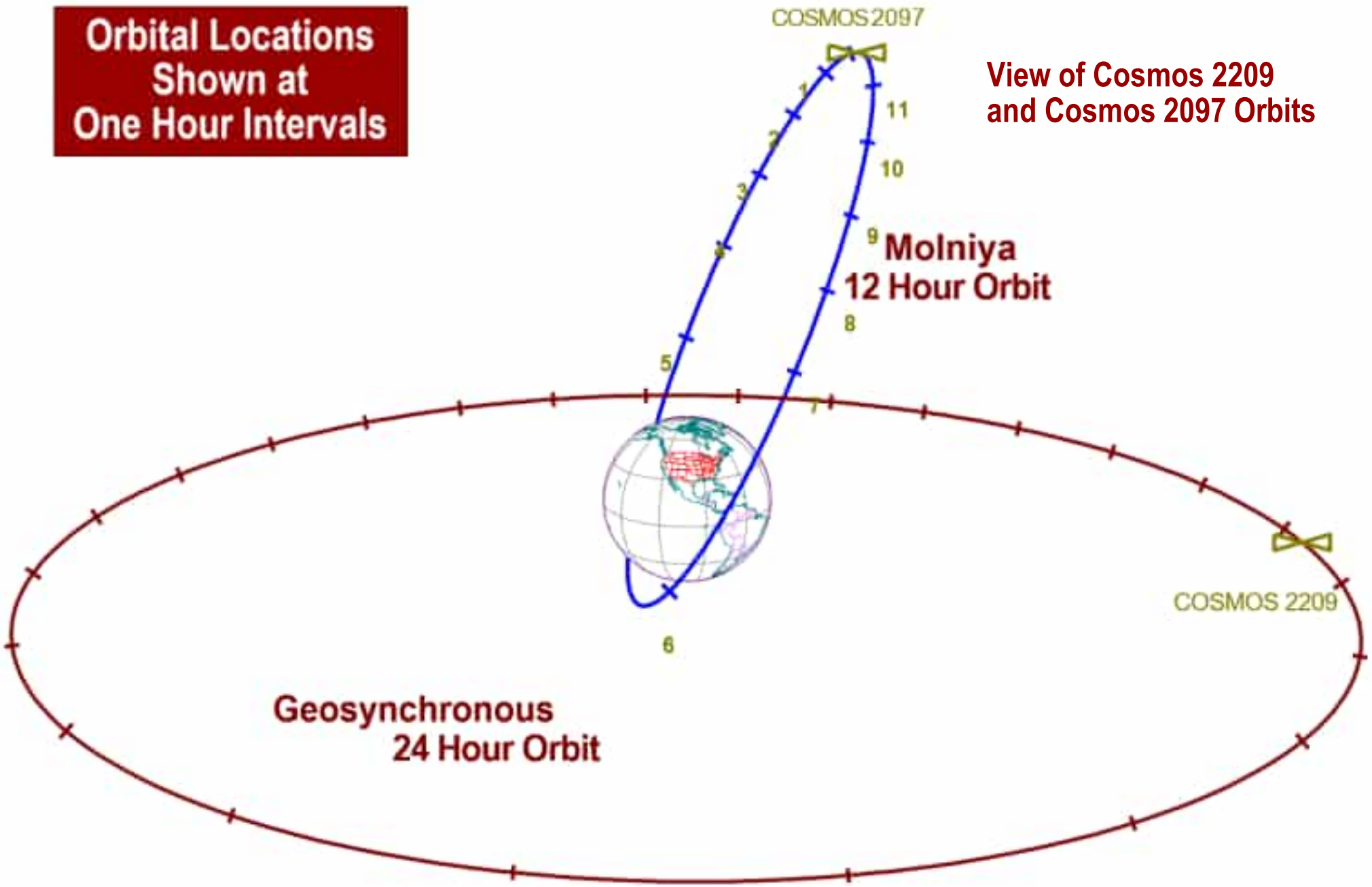
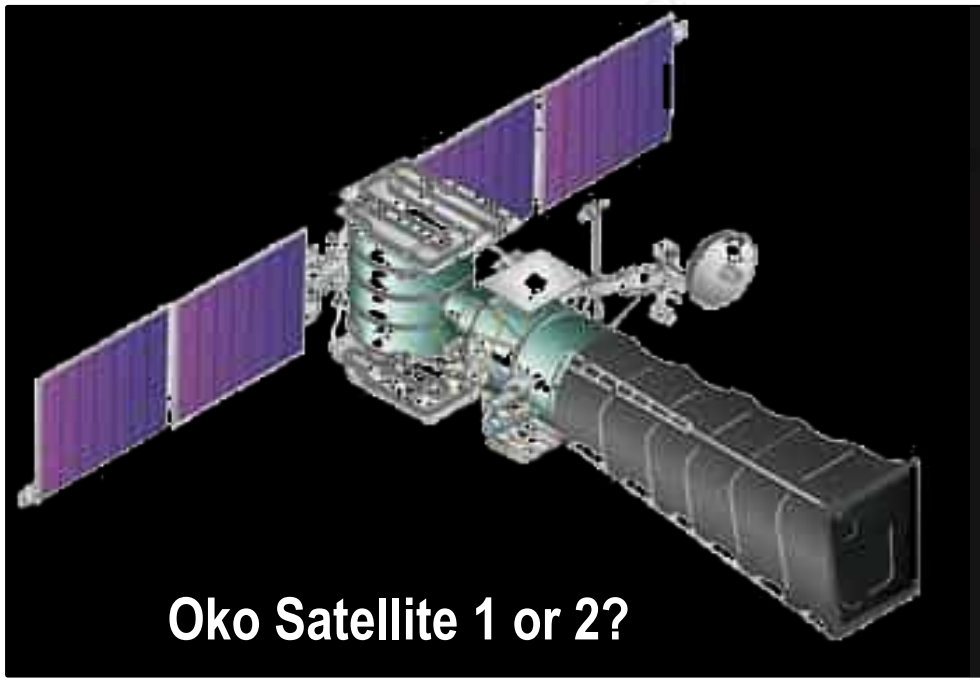
Russia Has Space-Based Early Warning Satellites in Two Distinctly Different Orbits – Geosynchronous and Molniya



Russia Has Space-Based Early Warning Satellites in Two Distinctly Different Orbits – Geosynchronous and Molniya



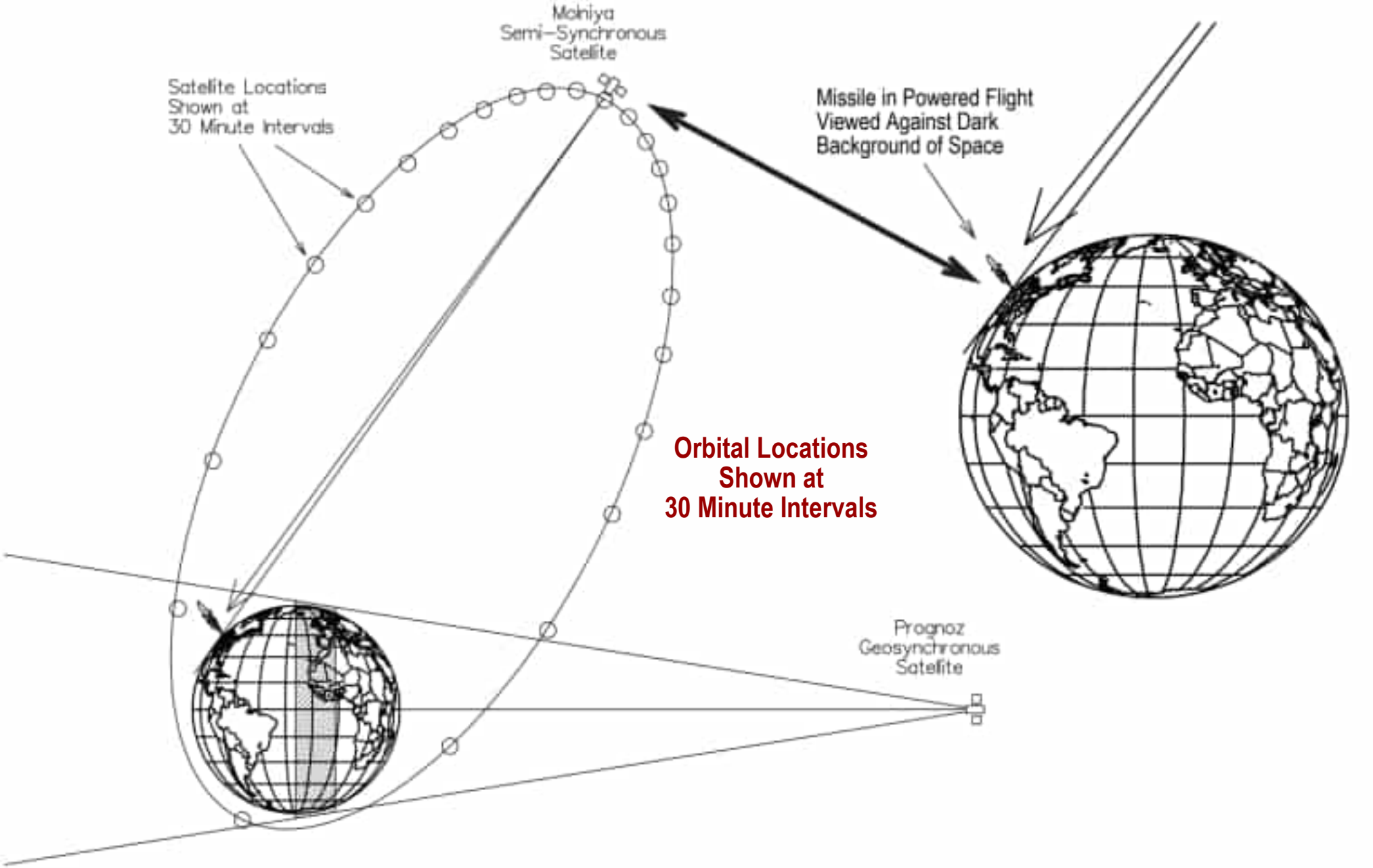
Oko Satellite 1 or 2?

"Tundra"Satellite?

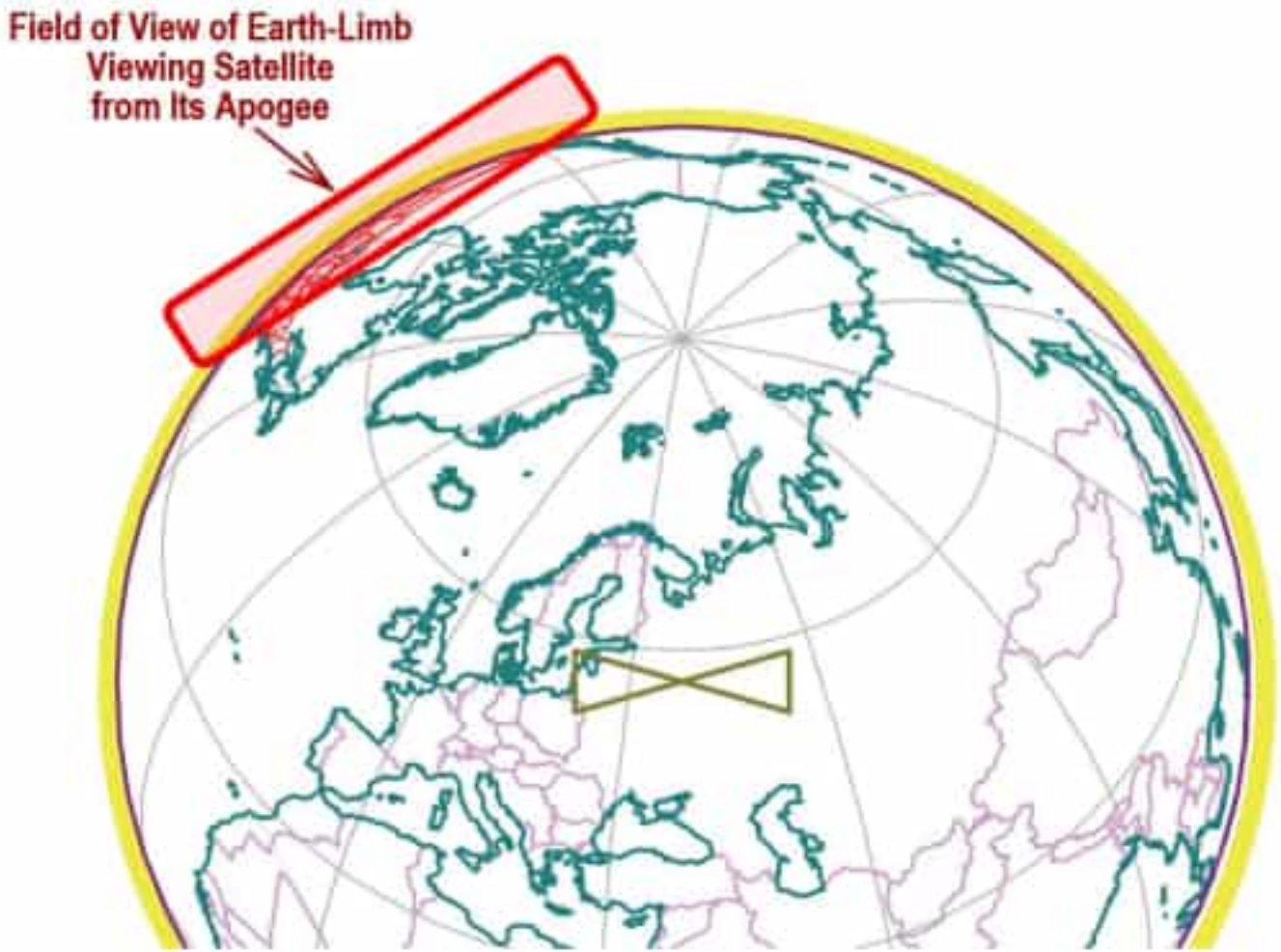
Russian Molniya Infrared Satellite Constellation

Russian Molniya Infrared Satellite Constellation

This Constellation Was Fully Populated during the False Alert of 1995
Nine Oko-1 or Oko-2 Satellites Required for 24-Hour Coverage



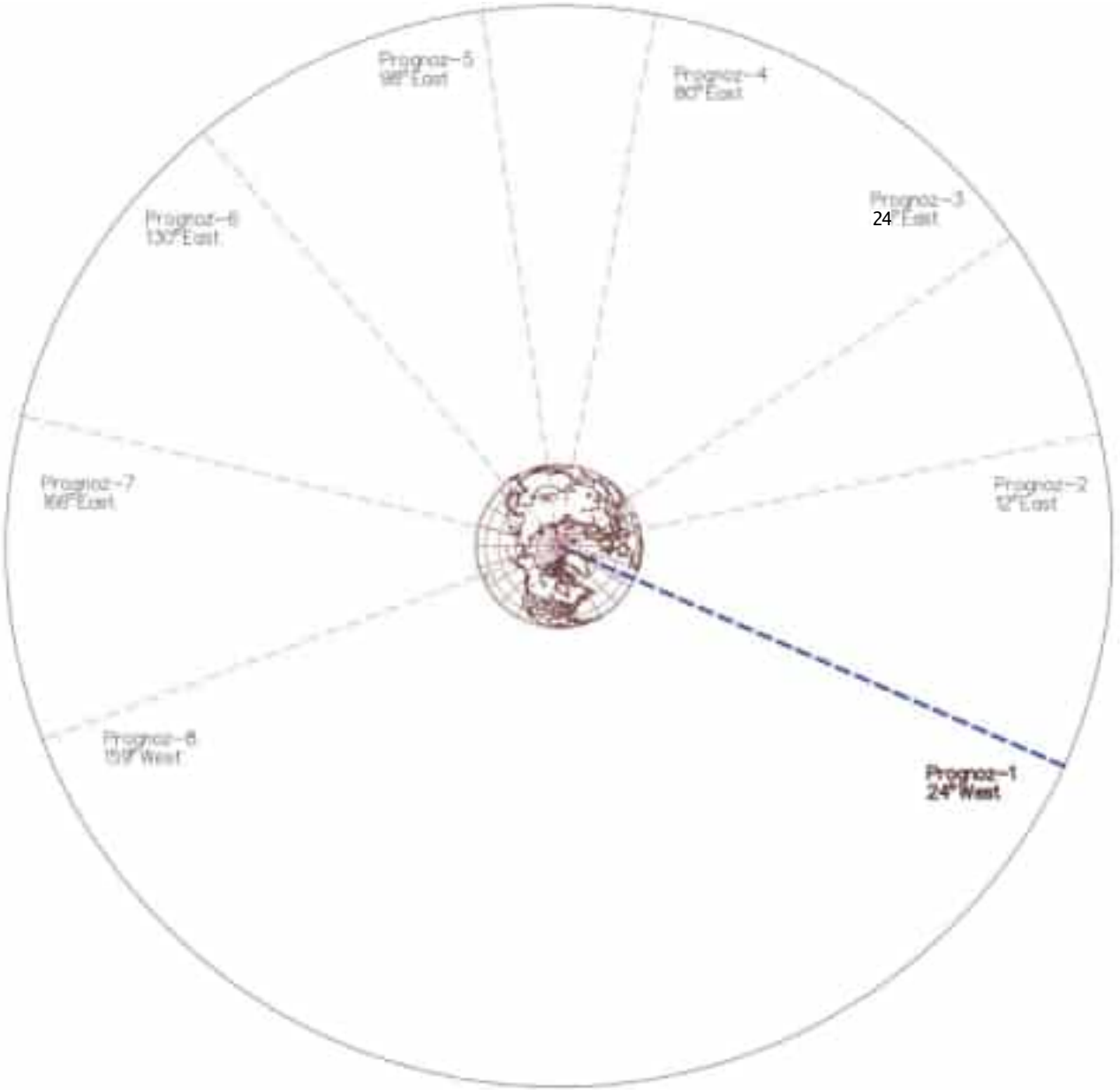
View of Earth-Limb from Apogee of Cosmos 2510



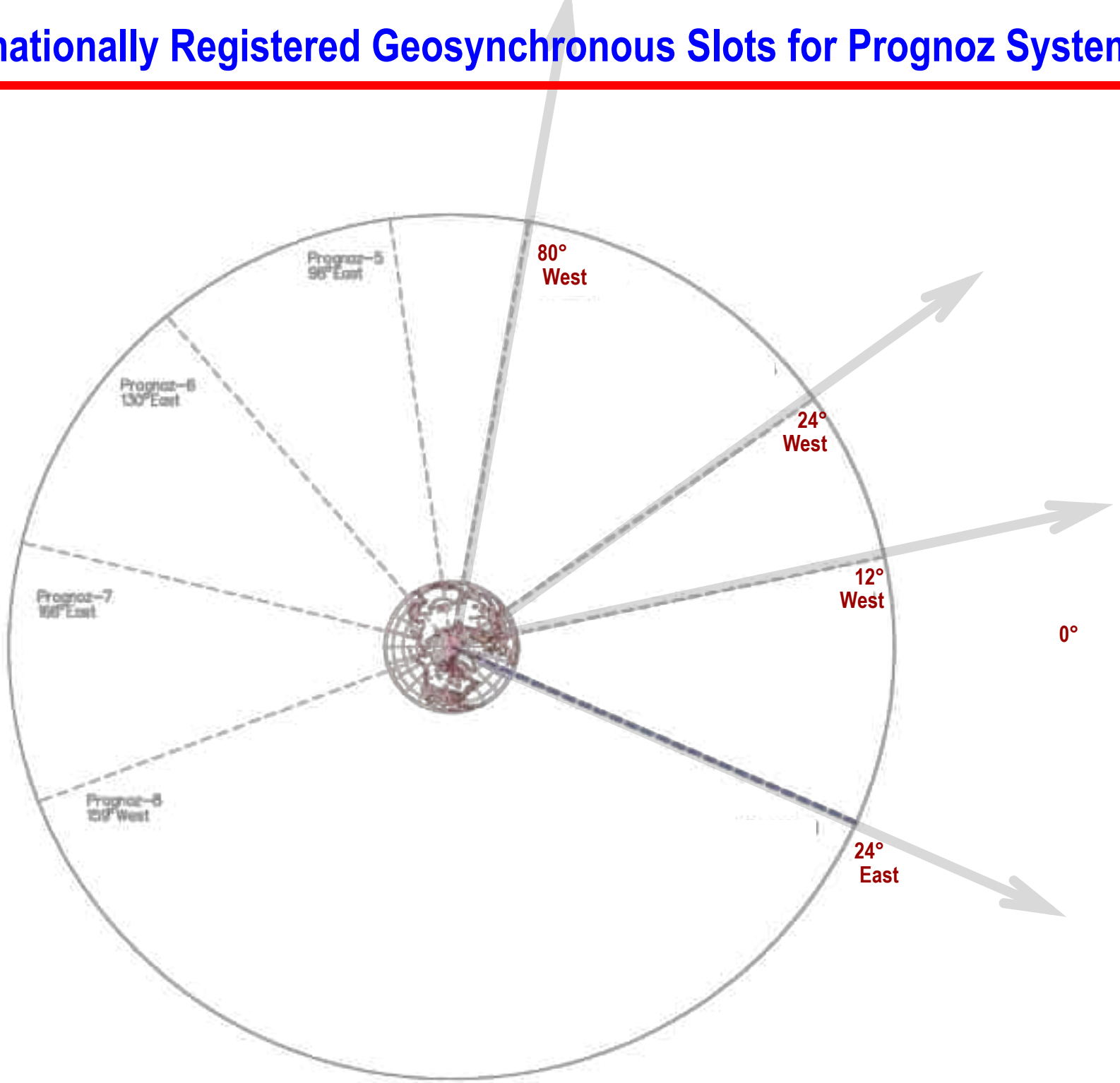
Russian Prognoz Infrared Satellite Constellation

(Geosynchronous Constellation)

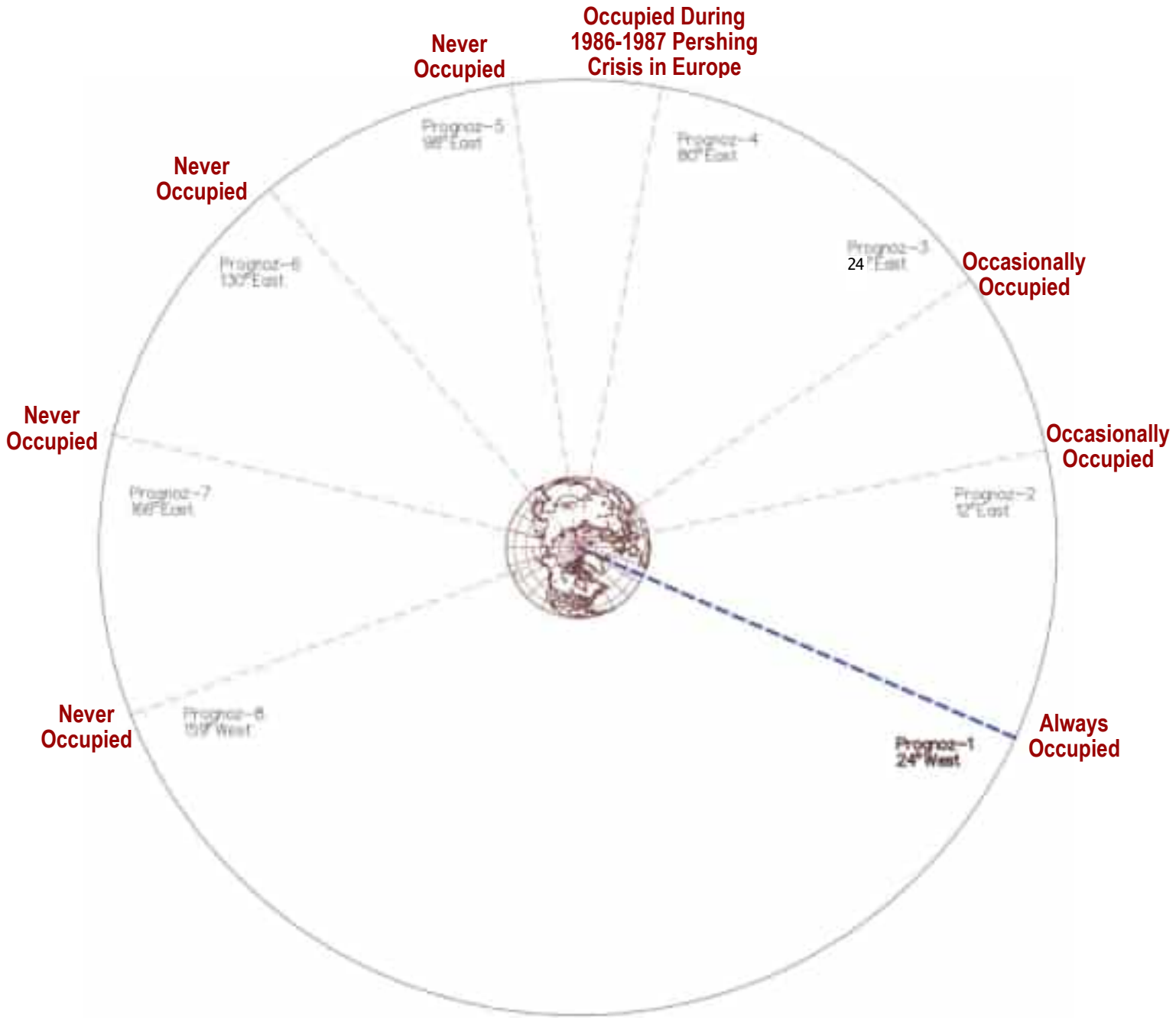
View of Internationally Registered Geosynchronous Slots for Prognoz System



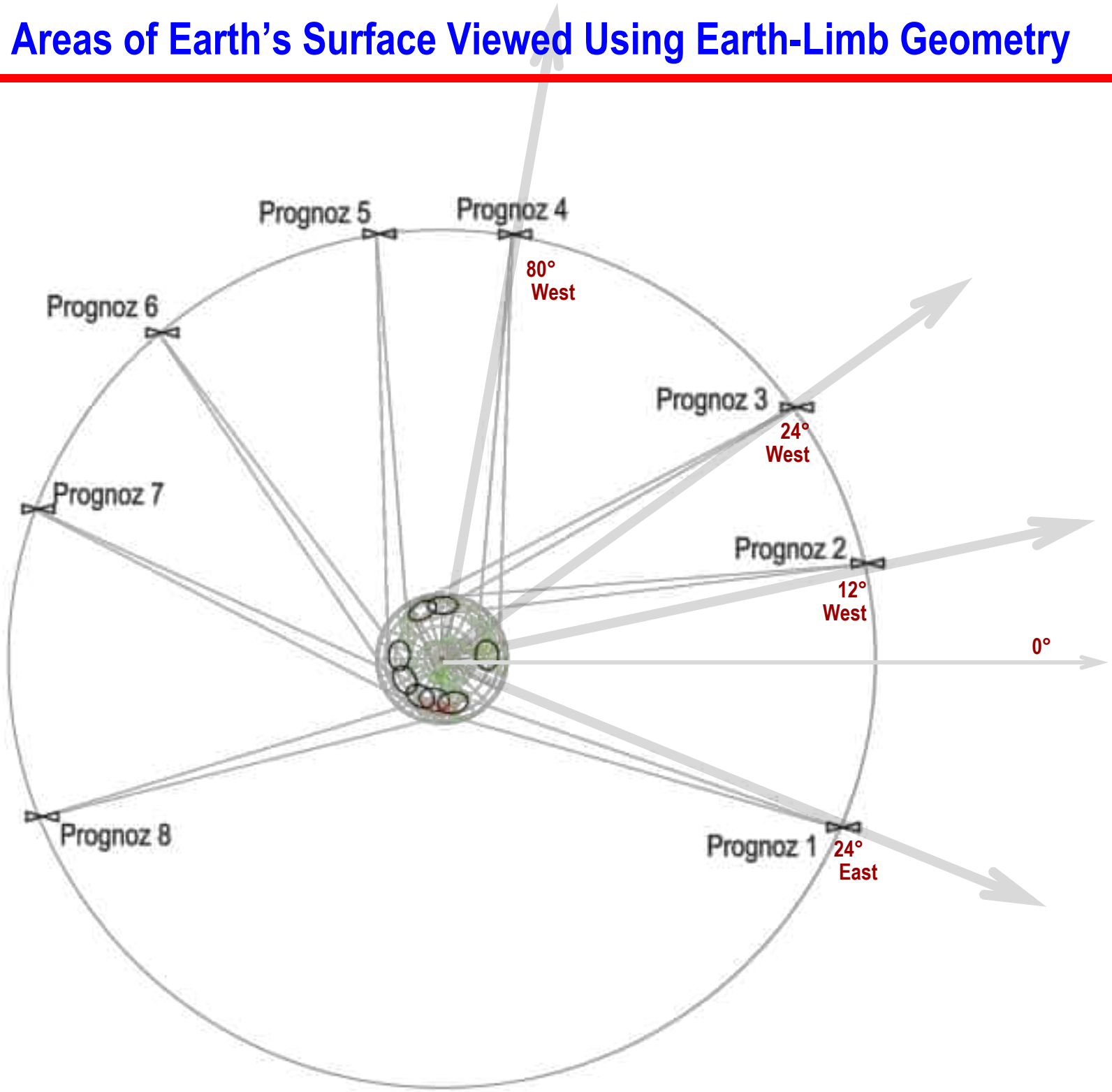
View of Internationally Registered Geosynchronous Slots for Prognoz System



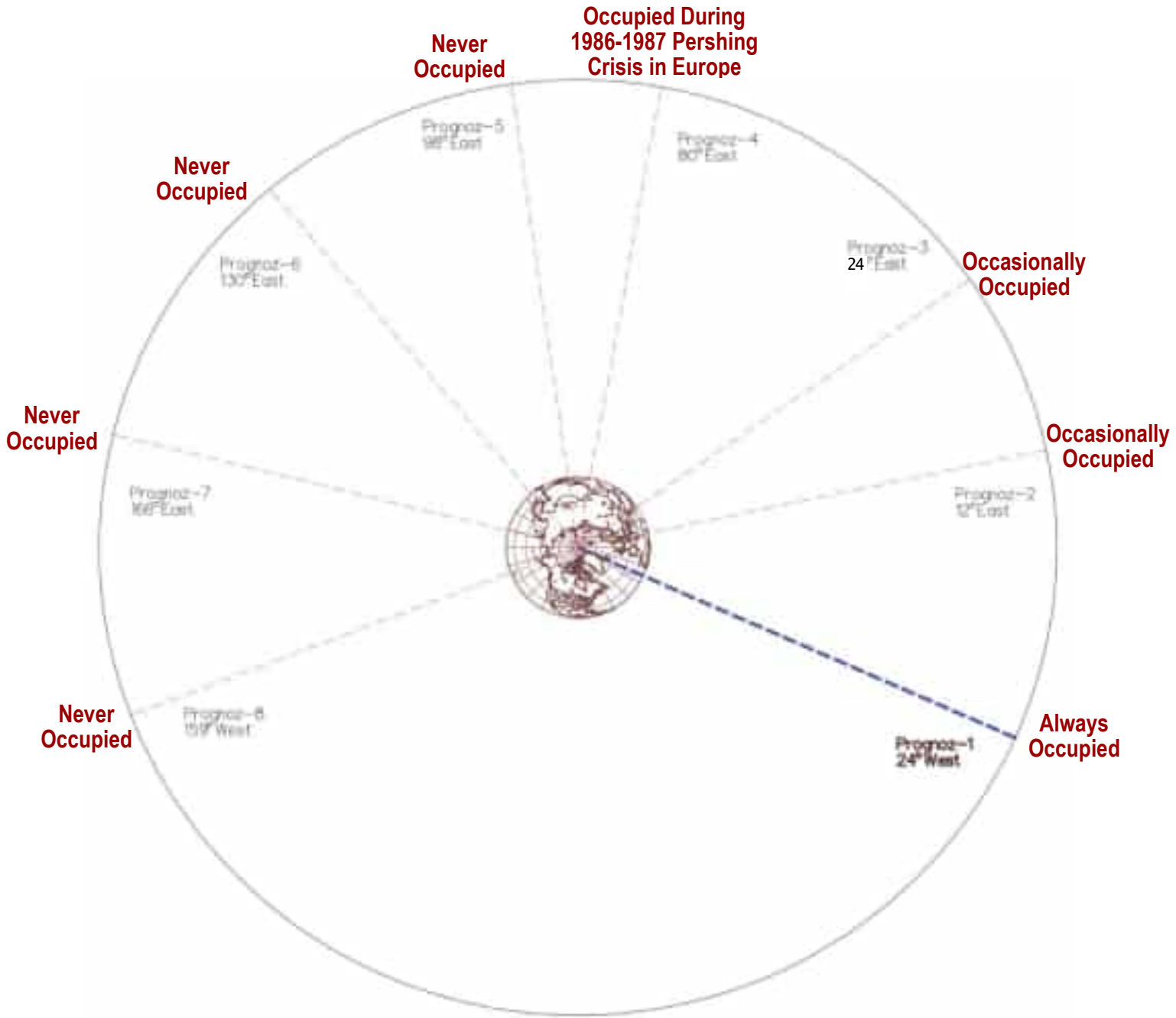
View of Internationally Registered Geosynchronous Slots for Prognoz System



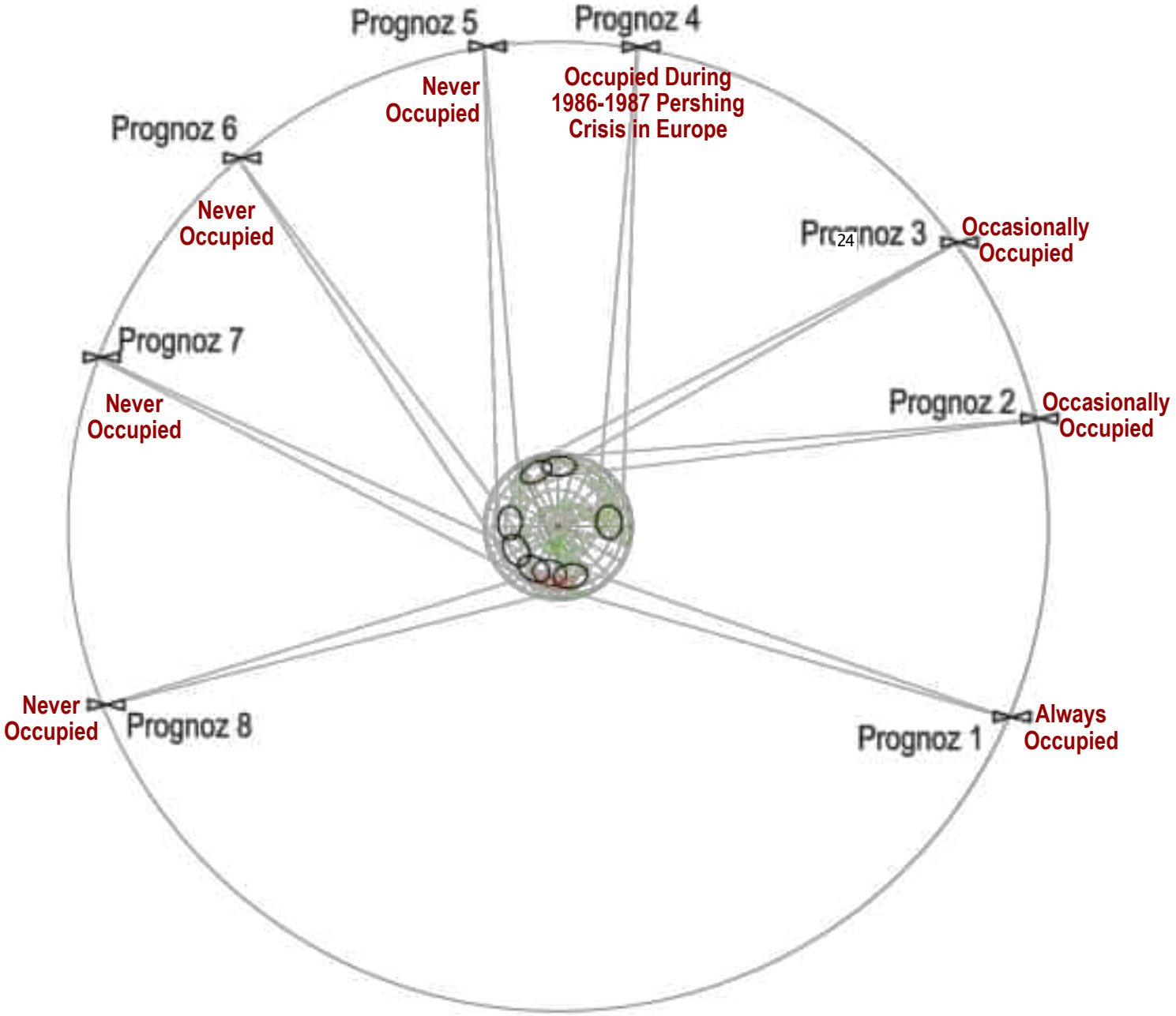
Possible Areas of Earth's Surface Viewed Using Earth-Limb Geometry



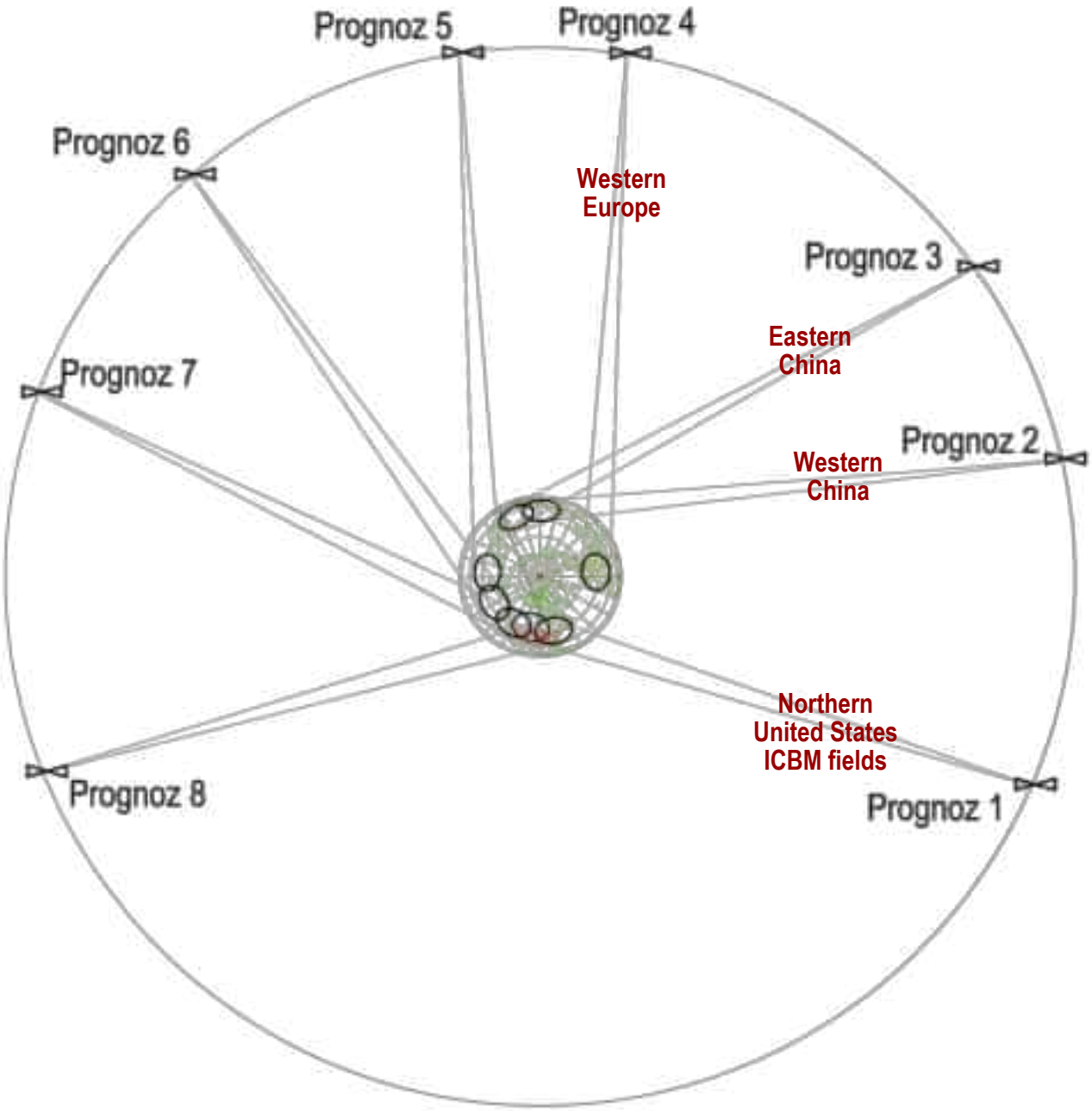
View of Internationally Registered Geosynchronous Slots for Prognoz System

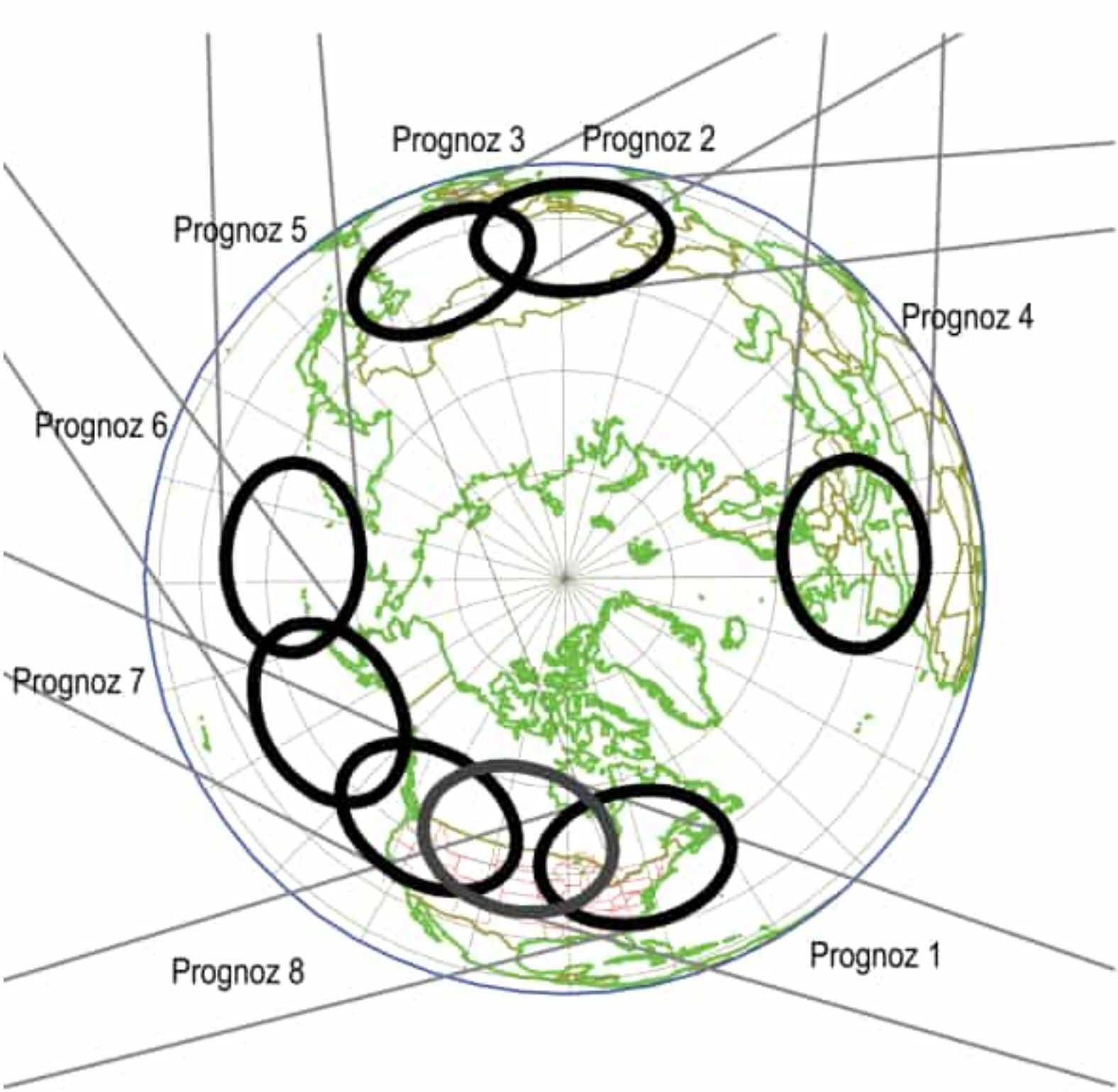


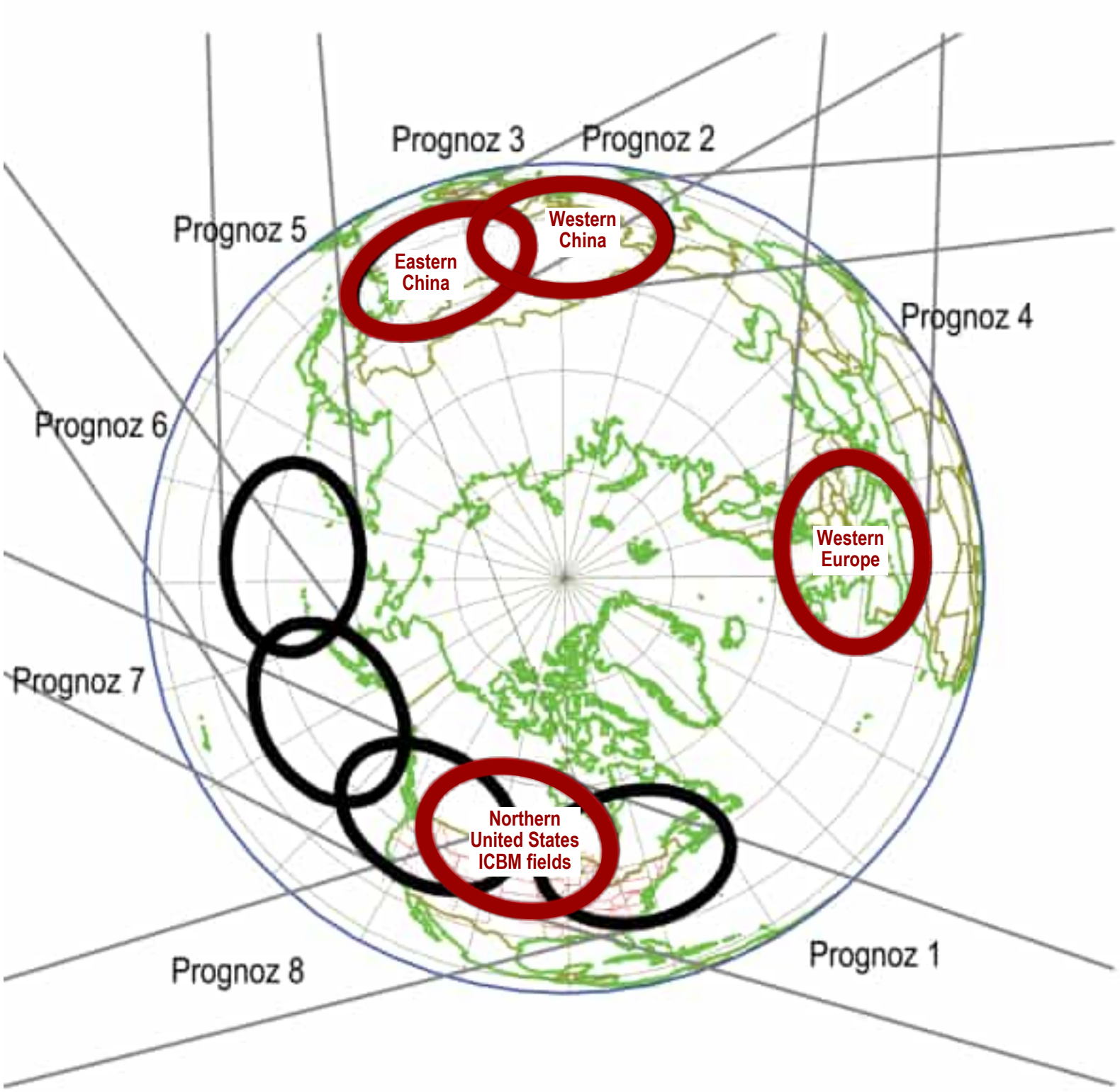
Possible Areas of Earth's Surface Viewed Using Earth-Limb Geometry



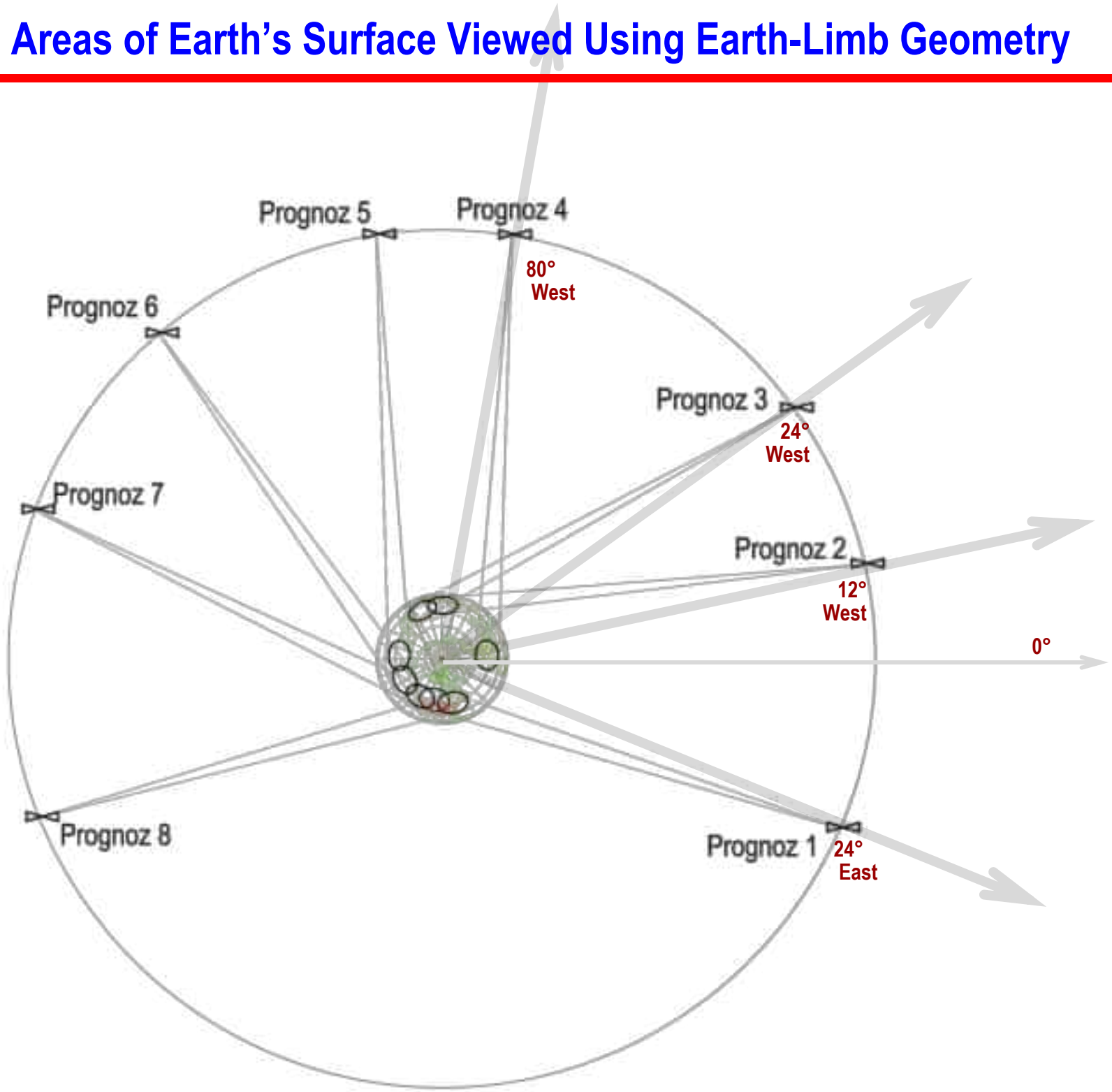
Possible Areas of Earth's Surface Viewed Using Earth-Limb Geometry




Prognoz 3
Prognoz 2
Prognoz 5
Prognoz 4
Prognoz 6
Prognoz 7
Prognoz 8
Prognoz 1


Prognoz 3
Prognoz 2
Prognoz 5
Western China
Eastern China
Prognoz 4
Prognoz 6
Western Europe
Prognoz 7
Northern United States ICBM fields
Prognoz 8
Prognoz 1

Possible Areas of Earth's Surface Viewed Using Earth-Limb Geometry



Rough Estimate of Current State of Russia's Early Warning Satellite Systems

(Geosynchronous and Molniya Systems)

Russia Has Been Launching New Class of Satellites Called "Tundra"

The orbital parameters of the four Tundra satellites that have so far been launched:

1. Cosmos 2510 (EX1) (Tundra 11L),Int'l Code 2015-066A
   NORAD catalog no.: 41032; Lightning[25] 38552 x 1626 km, 63.37° November 17, 2015, Active

2. Cosmos 2518 (EKS 2) (Tundra 12I), Int'l Code 2017-027A
   NORAD catalog no.: 42719 Lightning[26] 38552 x 1626 km, 63.37° May 25, 2017, Active[27]

3. Cosmos 2541 (EKS 3) (Tundra 13I), Int'l Code 2019-065A
   NORAD catalog no.: 44552 Lightning[28] 38537 x 1646 km, 63.83° September 26, 2019. Active

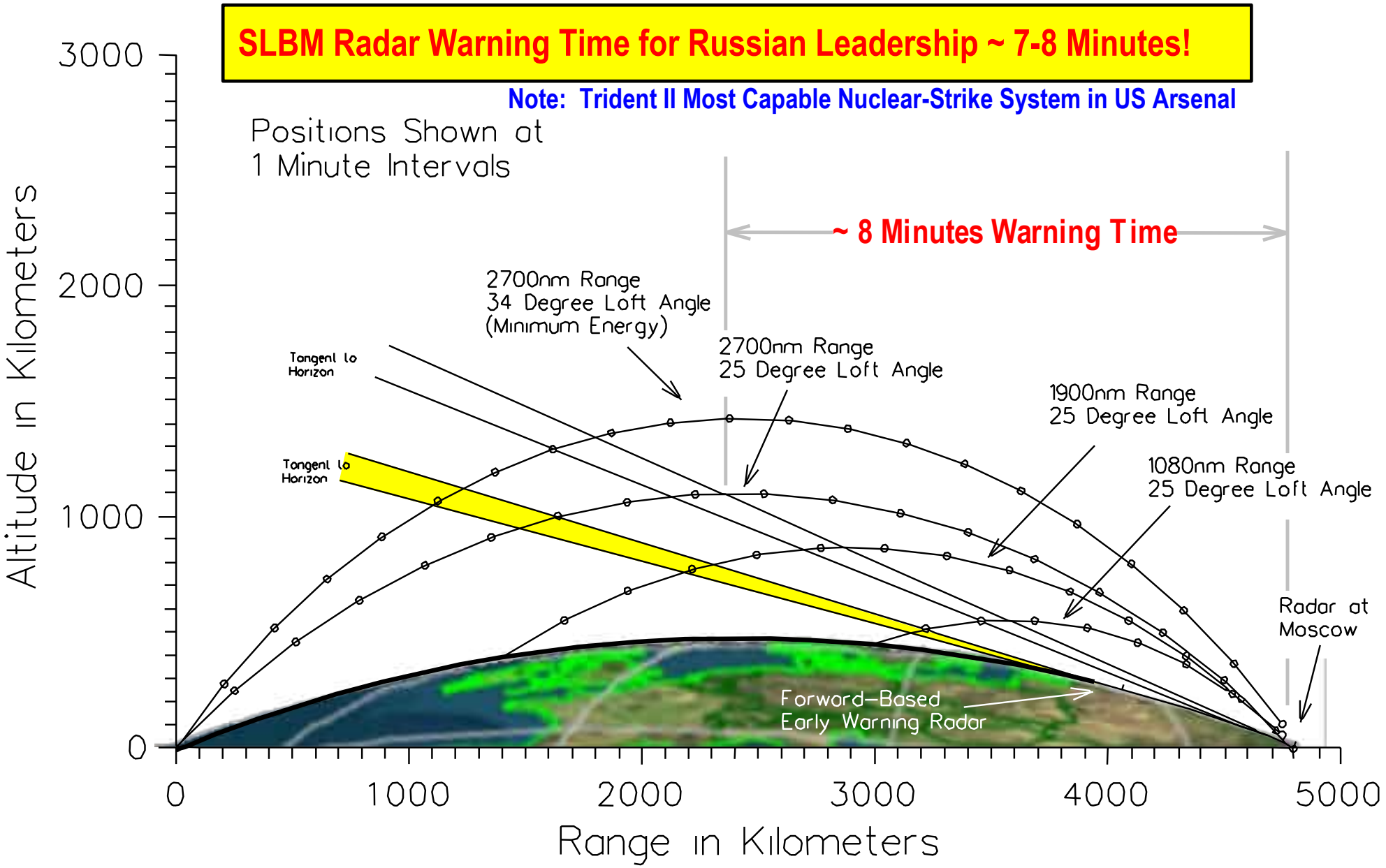
4. Cosmos 2546 (EKS 4) (Tundra 14I), Int'l Code 2020-031A
   NORAD catalog no.: 45608 Lightning[6] 35807 x 1654 km, 63.83° May 22, 2020, Active

All satellites have been launched into Molniya orbits
This means that the newest Russian satellites are still using earth-limb viewing

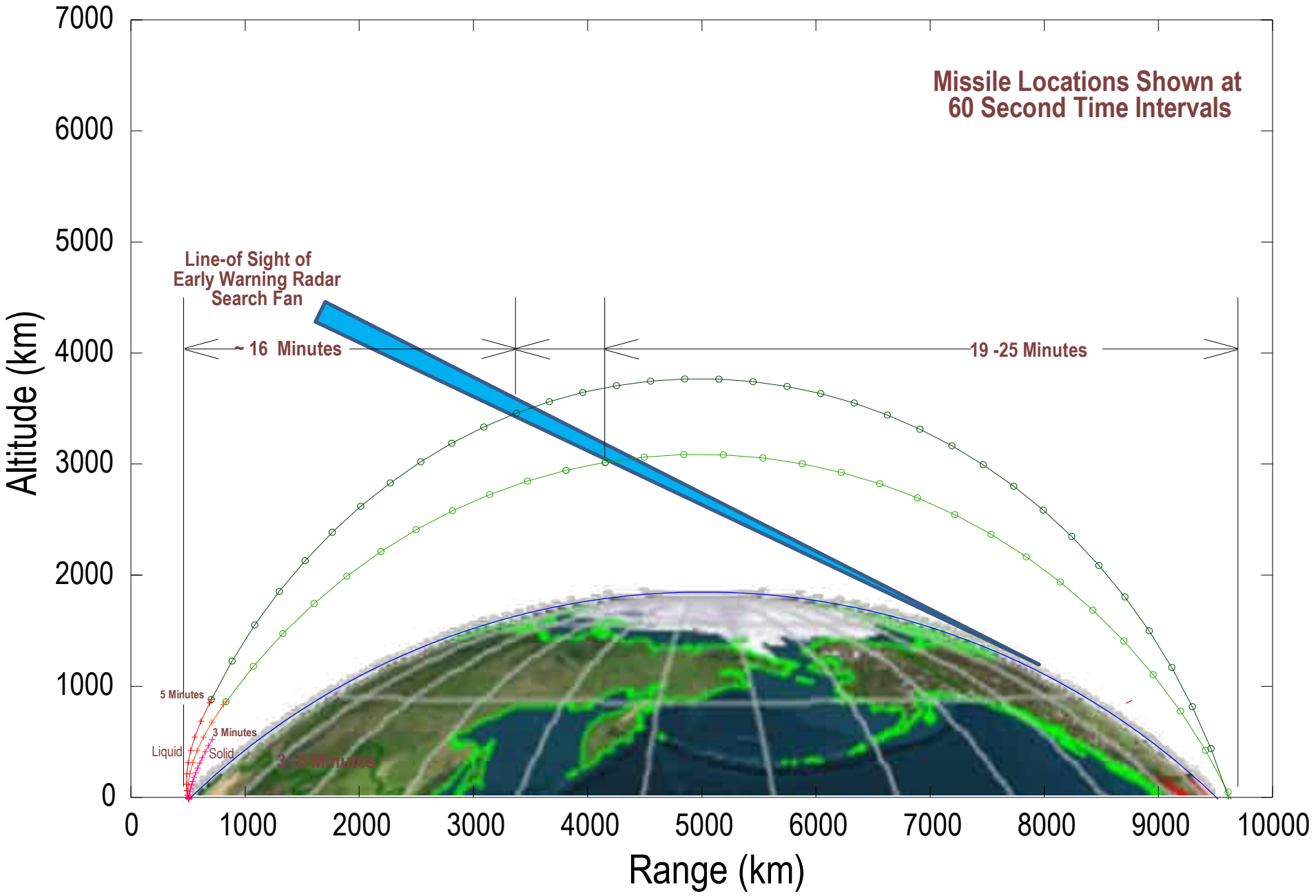
There are now no (or possibly only one) prognosis satellite in orbit
this indicates that the Russians have given up on using Earth-limb viewing satellites for more general global launch-surveillance.

Russian early warning is now essentially limited to UHF and VHF line-of-sight radars and Over-the-Horizon radars – which can be easily jammed and are highly dependent on the stability of the ionosphere at the northern latitudes where they operate.

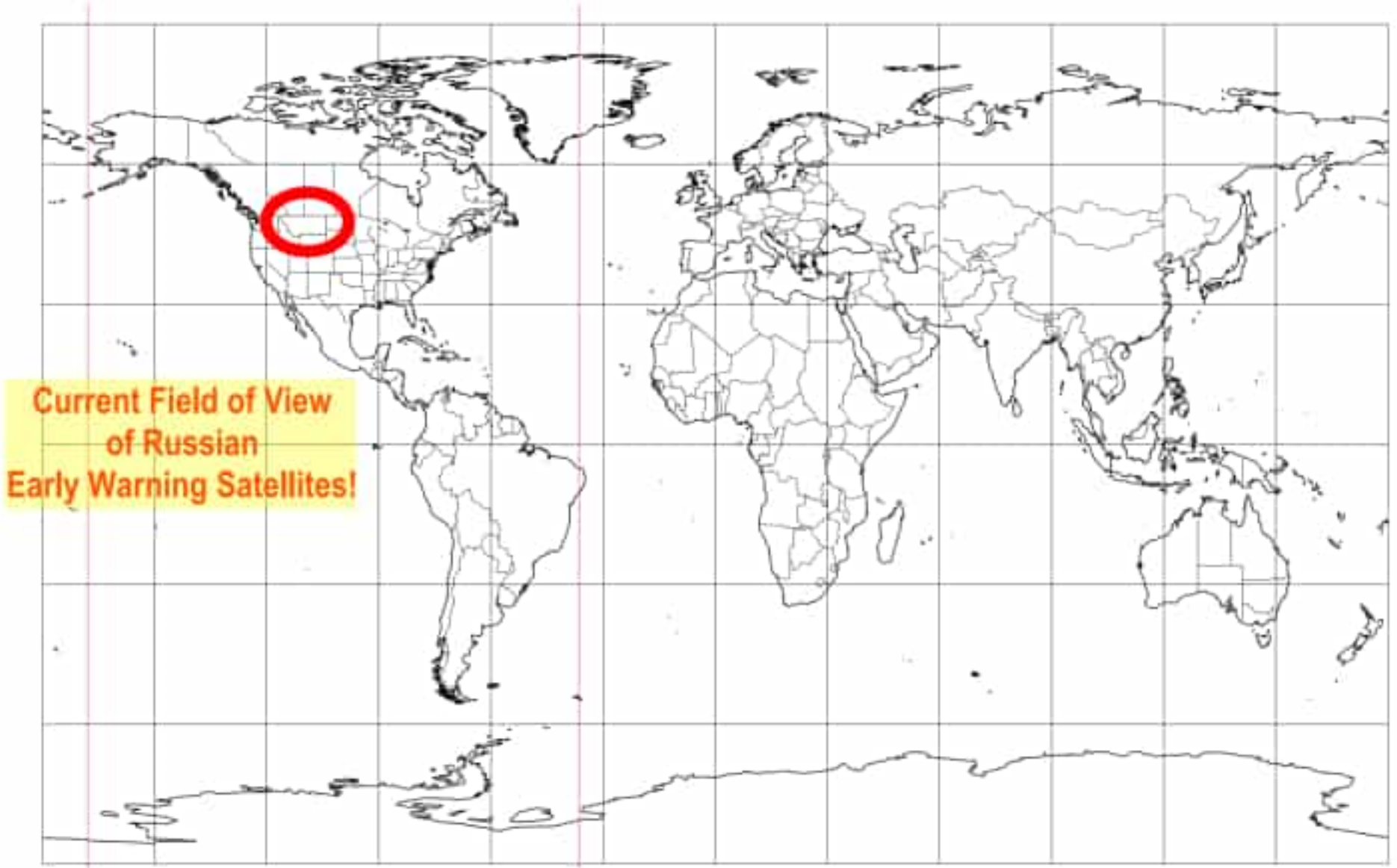
Russian Leadership Has 1/3 to 1/4 the Warning Time Compared to That of US Leaders



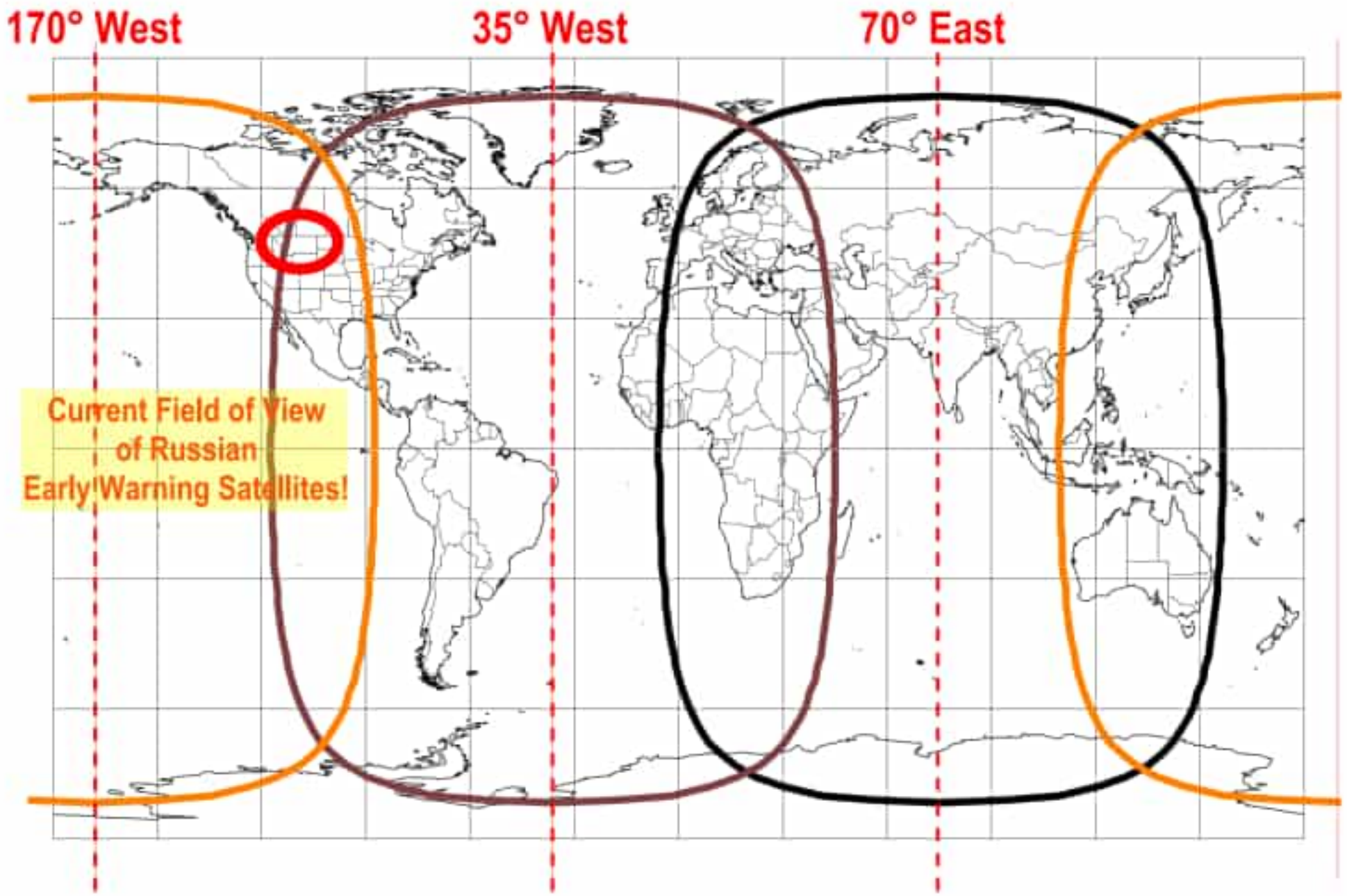
Warning Times Associated with a Russian Strategic Nuclear Attack with Land-Based ICBMs



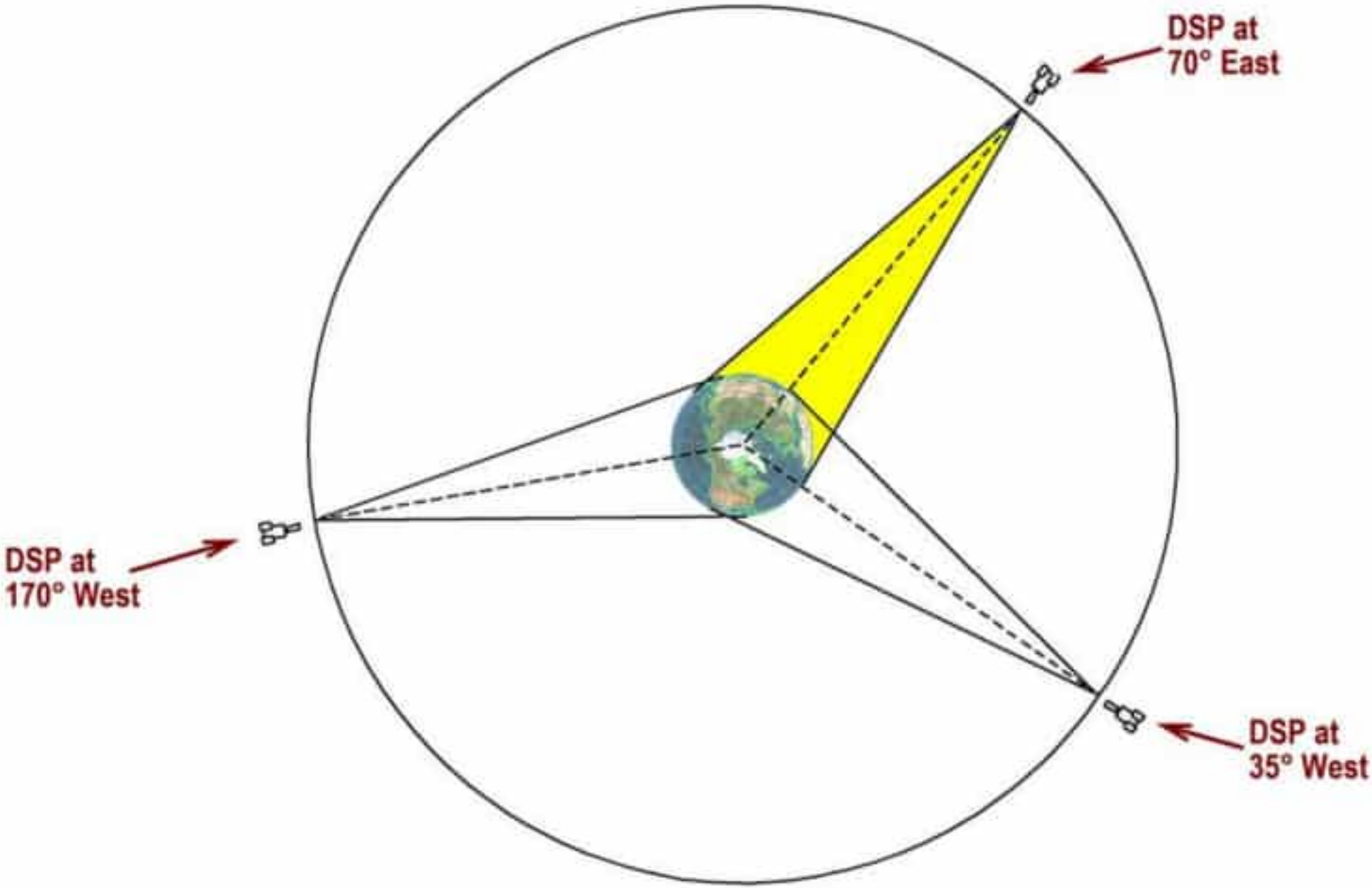
Current Field of View of Russian Molniya AND Prognoz Early Warning Satellite Constellations



Comparison of Russian and US Early Warning Satellite Fields of View

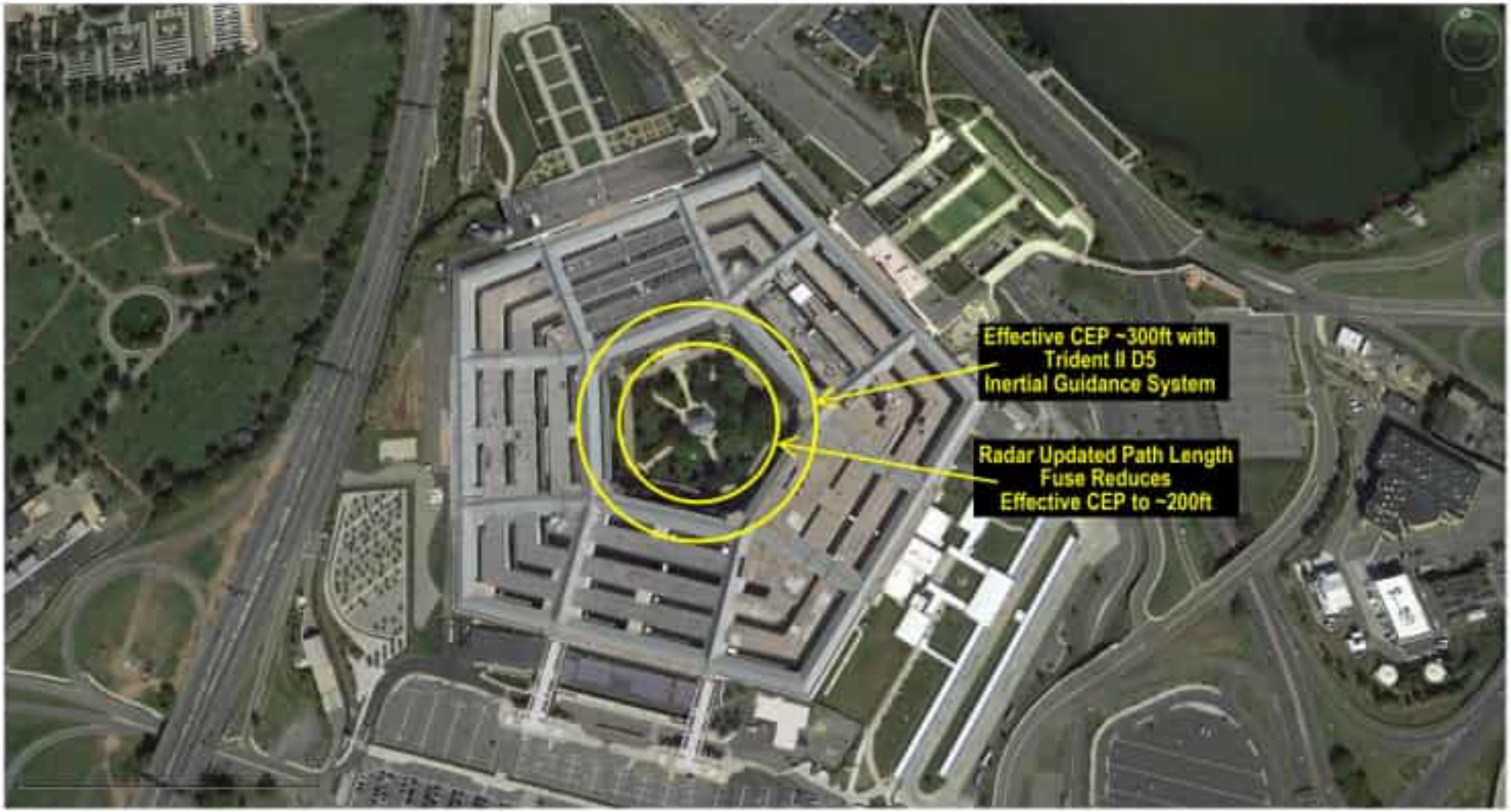


Rough Locations of US **LOOK-DOWN** Early Warning Satellites



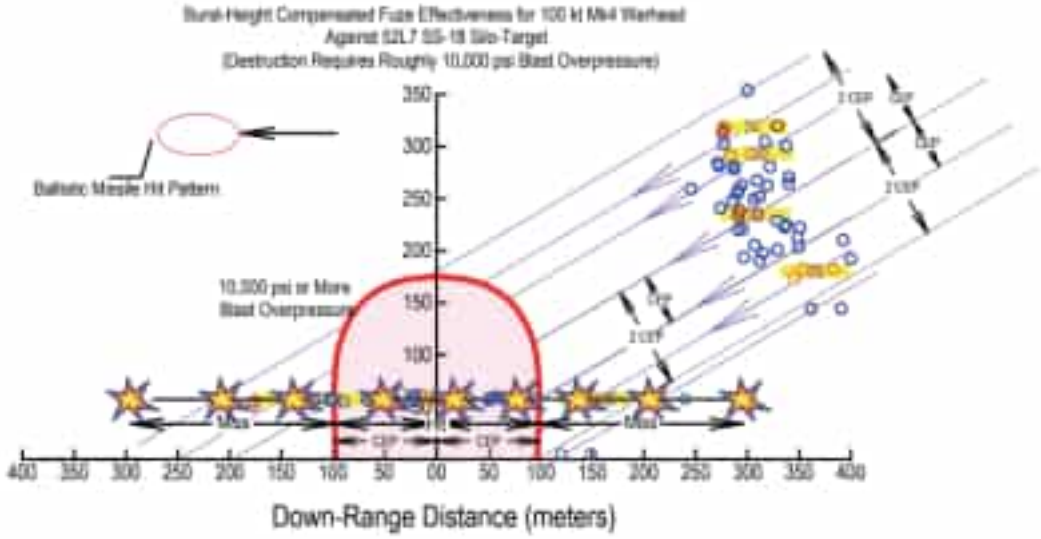
POINT OF INSTABILITY
US is Dramatically Increasing Its Hard Target Capabilities

Ballistic Missile Accuracy Improvements Currently in Progress in the US Nuclear Force Modernization Program is Drastically Increasing the Killing Power of Each US Warhead

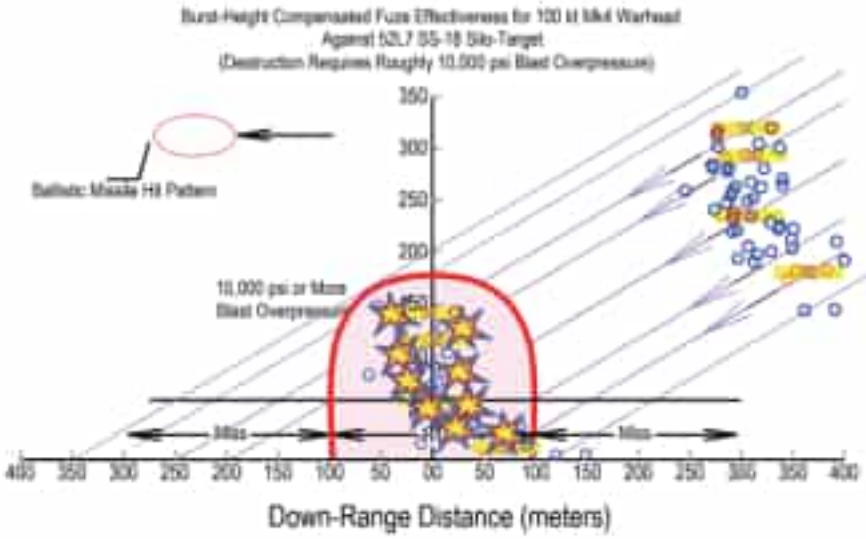


Comparison of the Effects of "*Constant* Burst Height" and "*Variable* Burst-Height" Fuses for 100 kt Mk4 Warhead Against 52L7 (10,000 psi) SS18 Silo-Targets

HOW THE TRIDENT ADVANCED FUSE INCREASES THE KILLING POWER OF THE MK4A WARHEAD

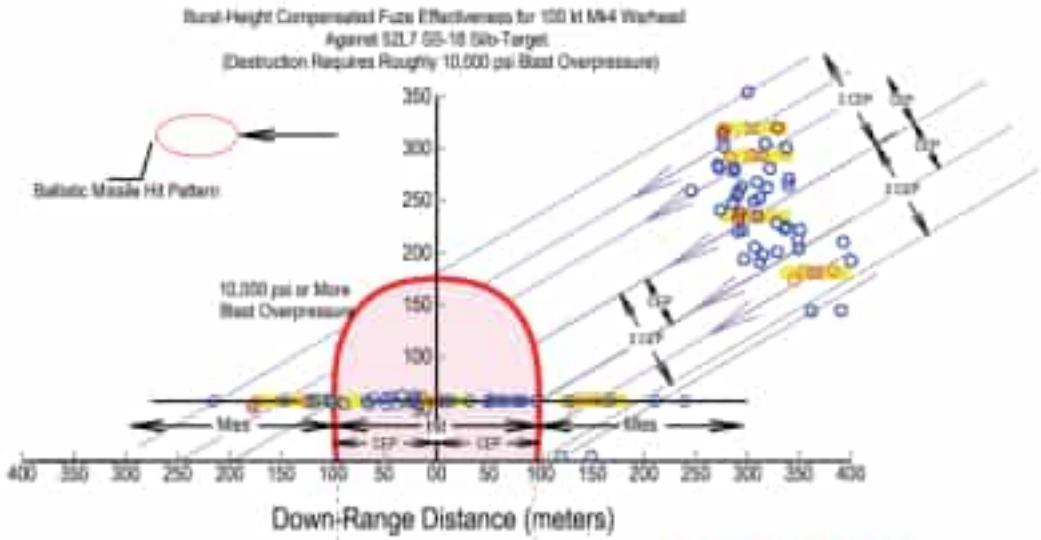


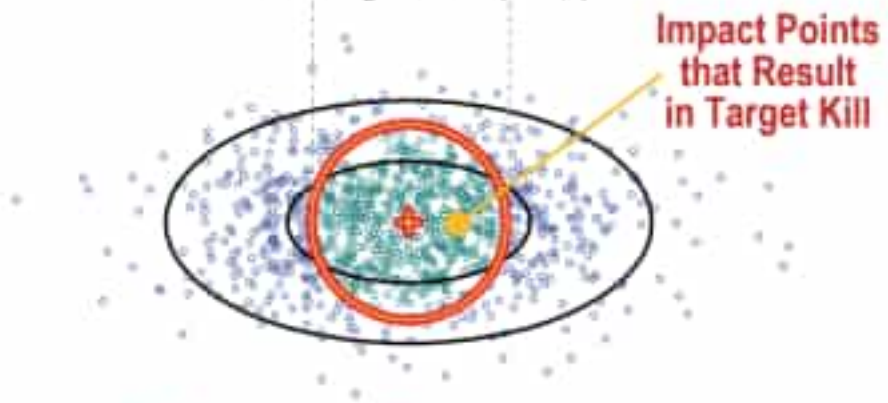
Warheads All Detonate at the Same Altitude



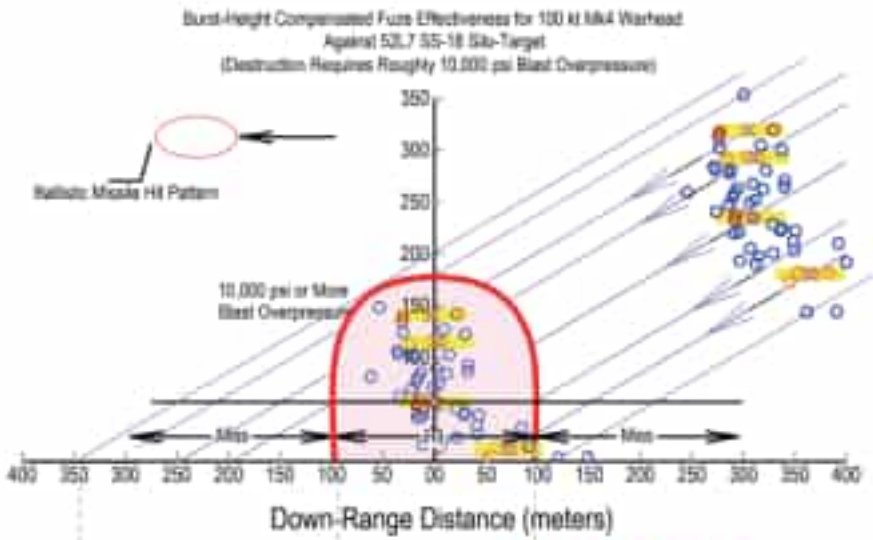
Warheads Detonate Within Lethal Volume

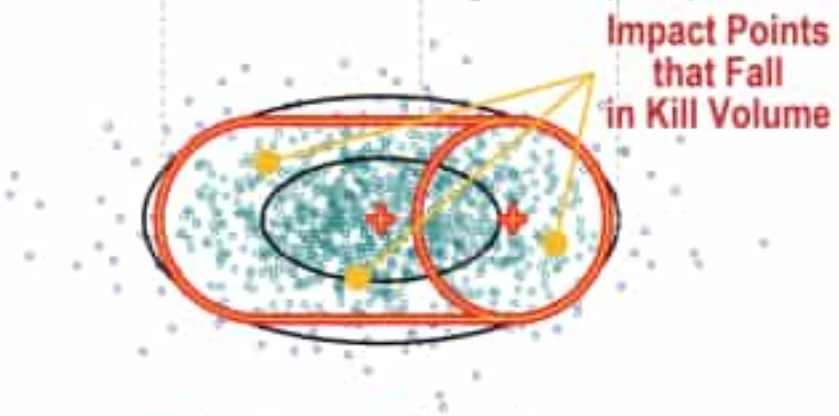
Comparison of the Effects of "*Constant* Burst Height" and "*Variable* Burst-Height" Fuses for 100 kt Mk4 Warhead Against 52L7 (10,000 psi) SS18 Silo-Targets





Probability of Detonating Within Lethal Volume = 0.56

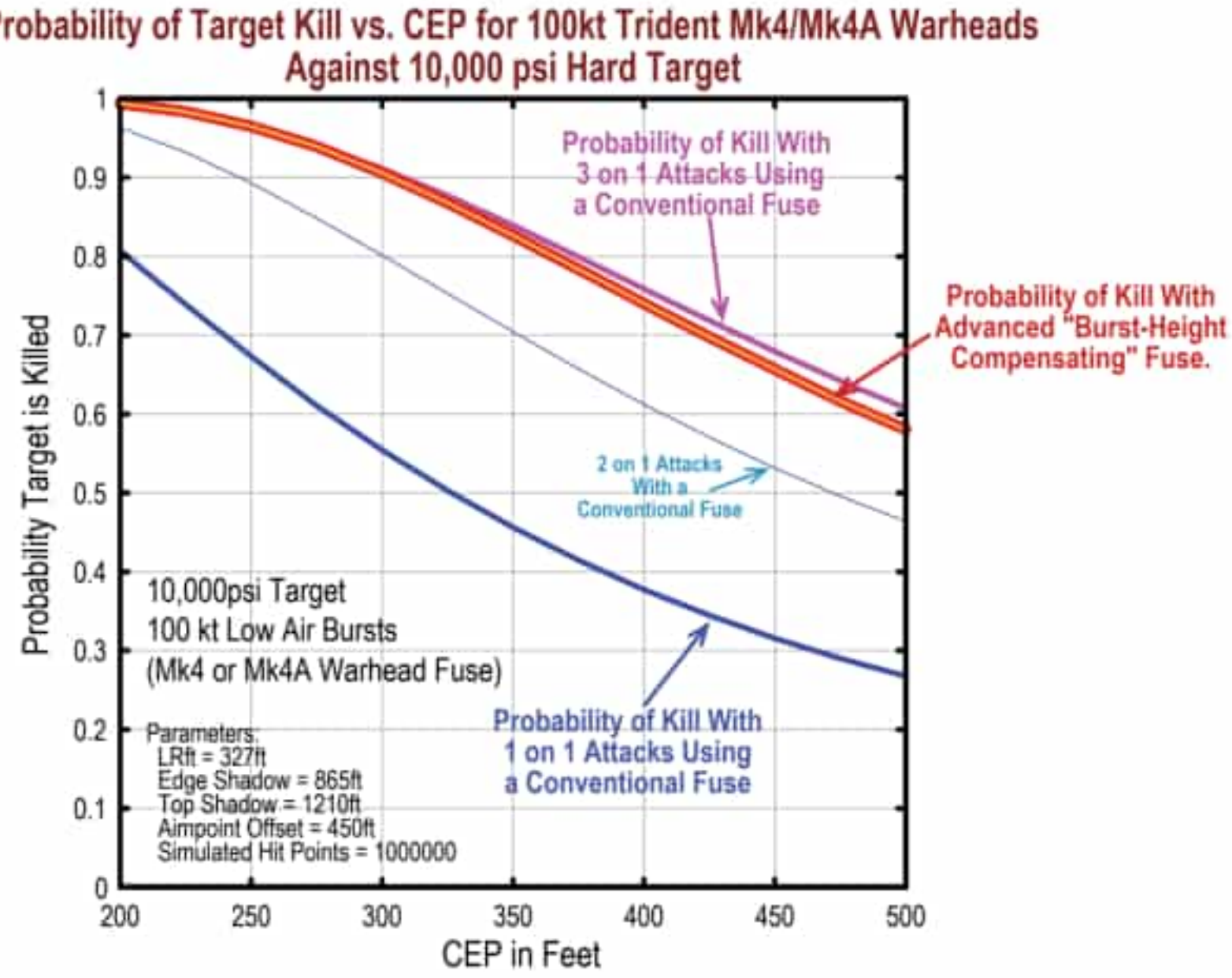




Probability of Detonating Within Lethal Volume = 0.91

POINT OF INSTABILITY
Essentially All US SLBM Warheads Will Have a Very High Probability of Kill Against the Hardest Russian Silo-Based ICBMs

Probability of Target Kill vs. CEP for 100kt Trident Mk4/Mk4A Warheads Against 10,000 psi Hard Target

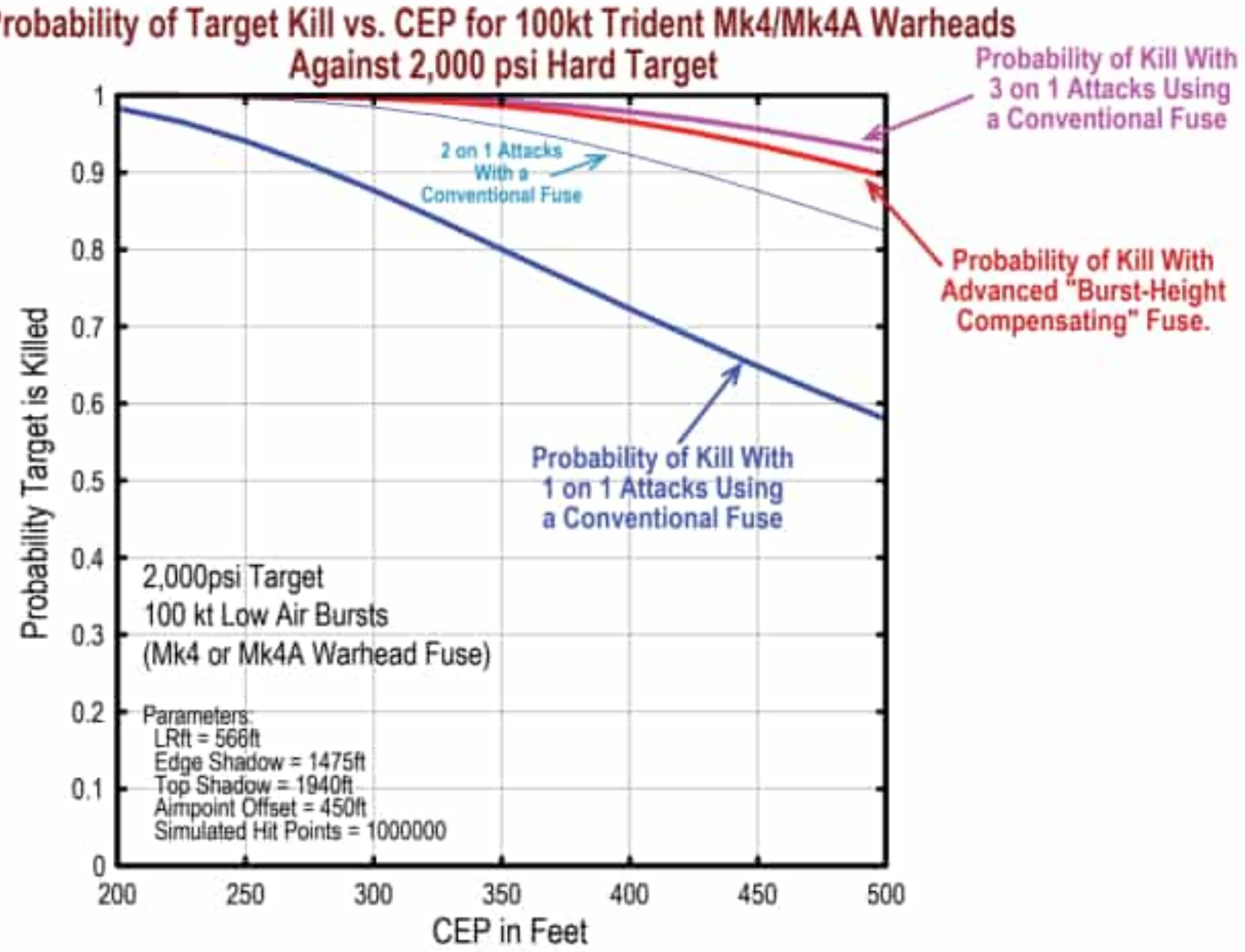


POINT OF INSTABILITY

The US Treats the Hardest Russian ICBMs as Hard to the Effects of a 10,000 psi Blast

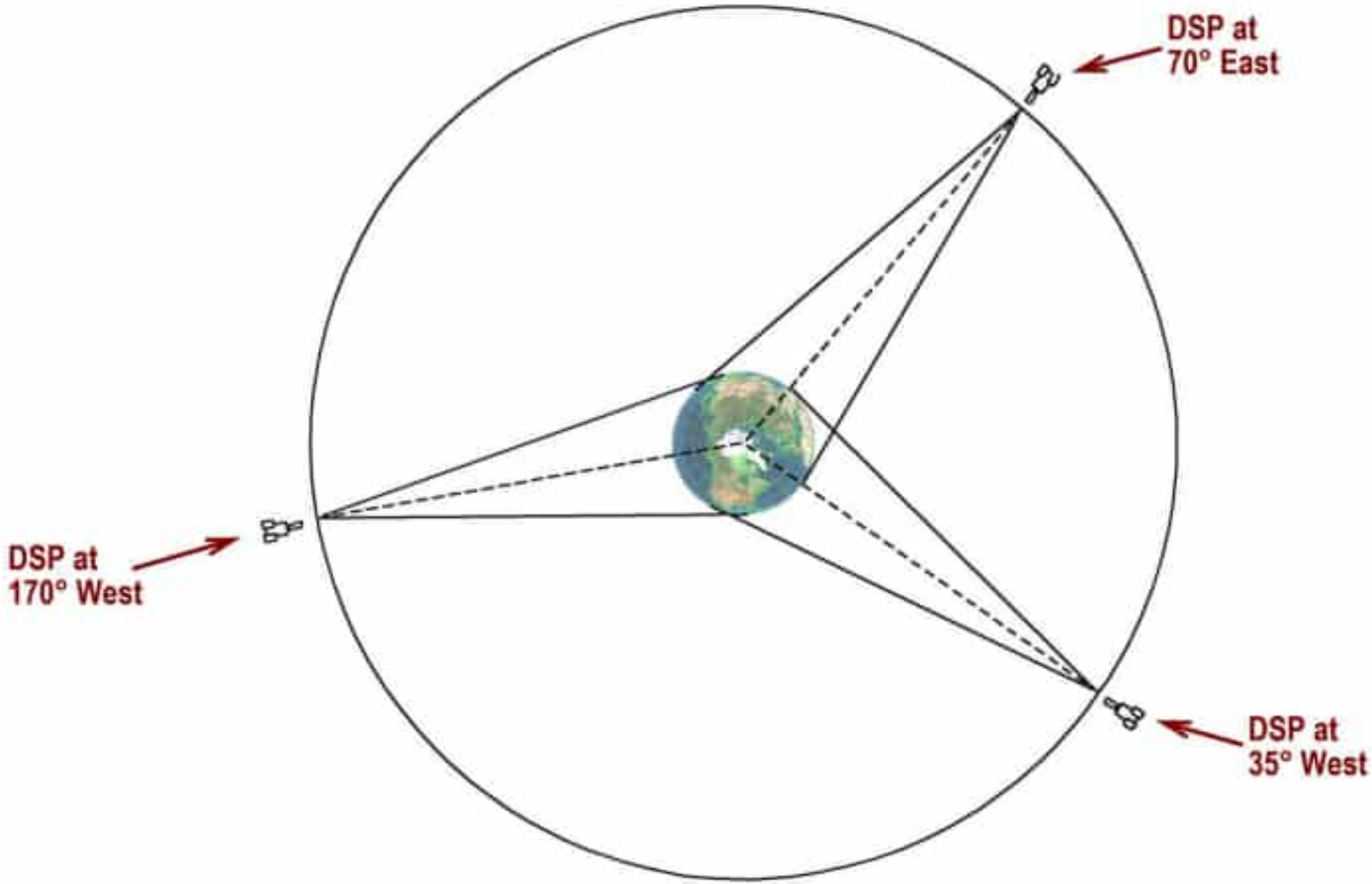
The Russians Assess The Hardness of Their ICBMs to be Less Than 2,000 psi Blast

Probability of Target Kill vs. CEP for 100kt Trident Mk4/Mk4A Warheads Against 2,000 psi Hard Target



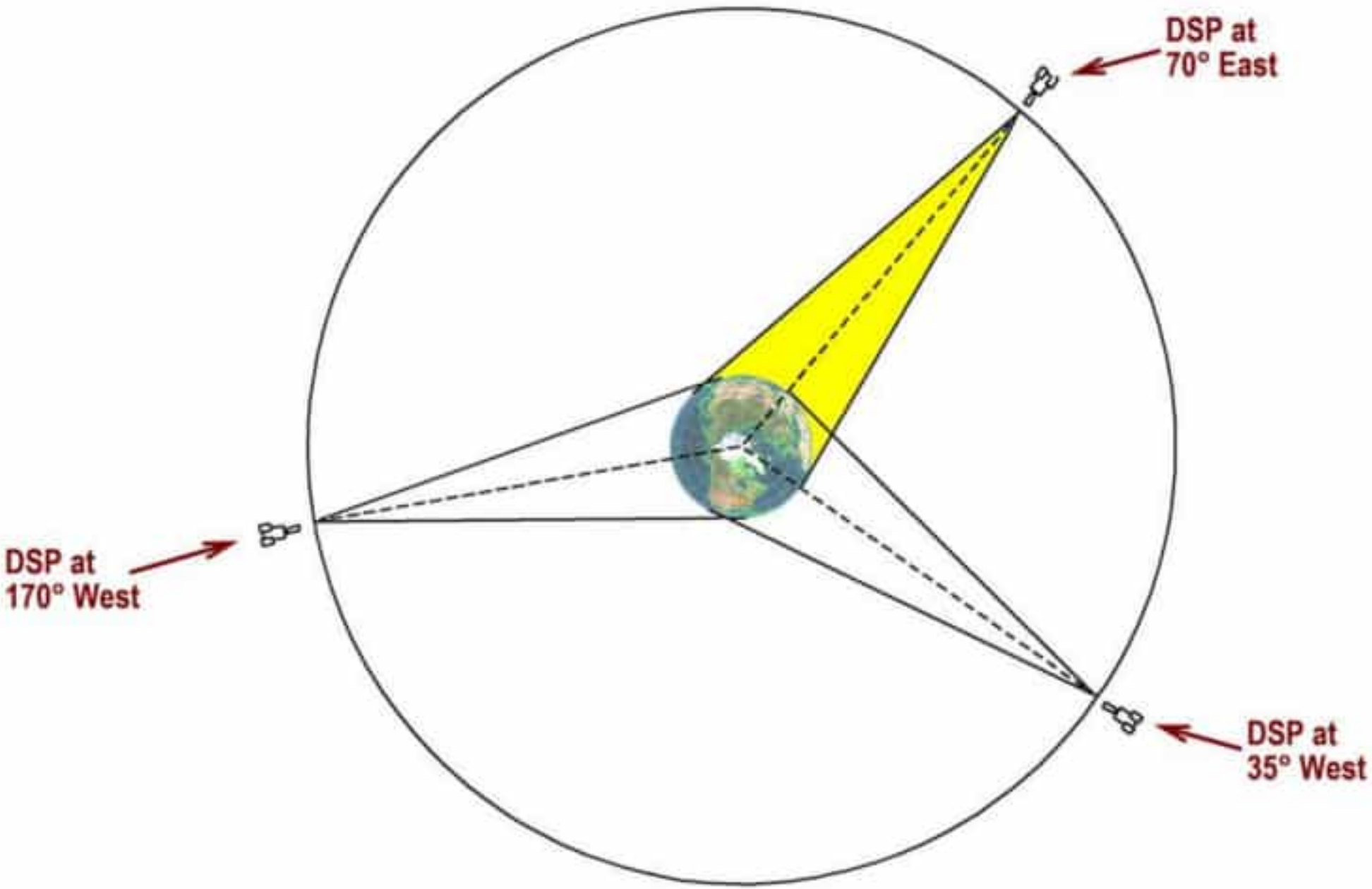
US Satellites Look STRAIGHT DOWN at the Earth

Rough Locations of US **LOOK-DOWN** Early Warning Satellites

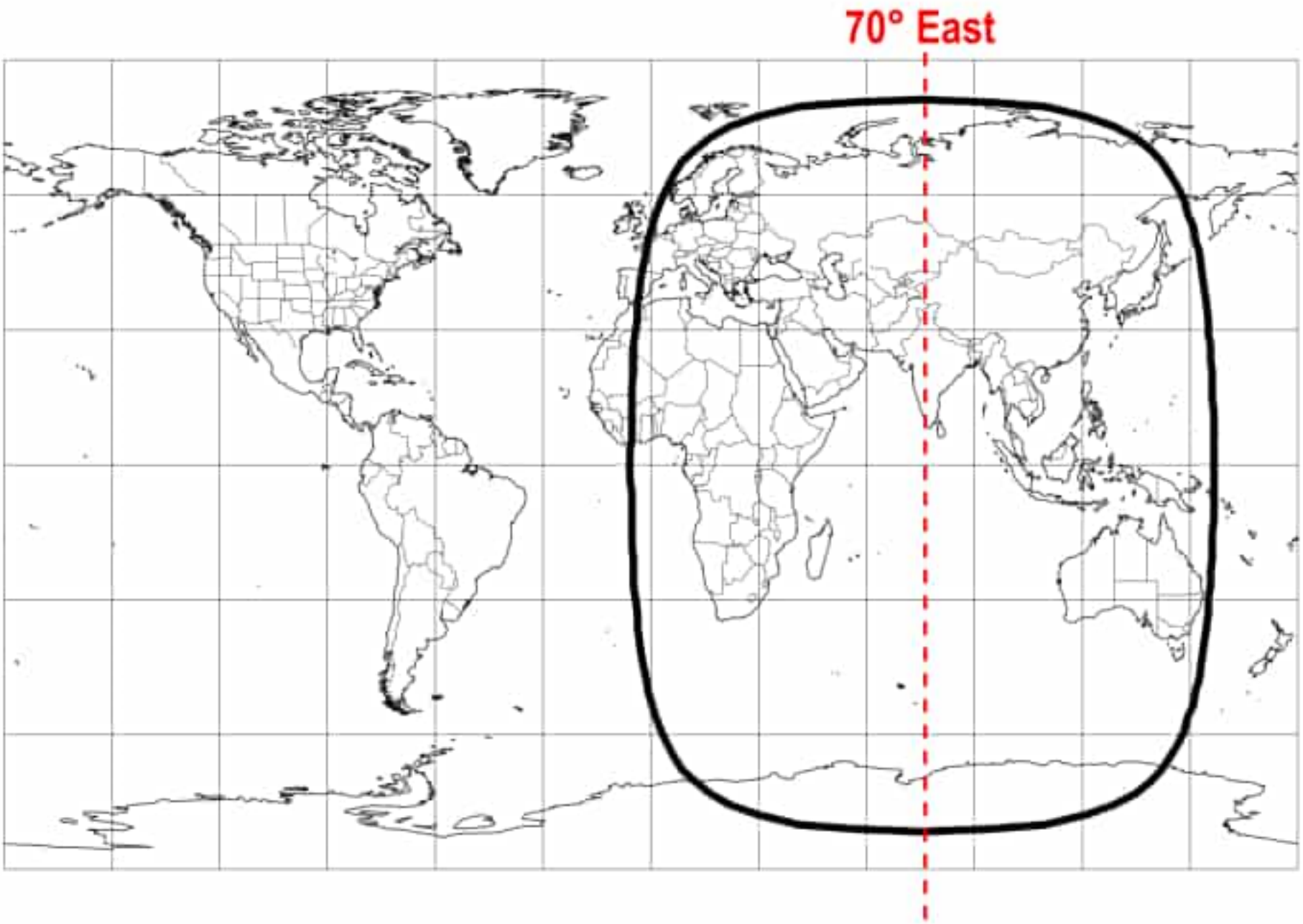


Areas of US Global Monitoring of Missile Launch

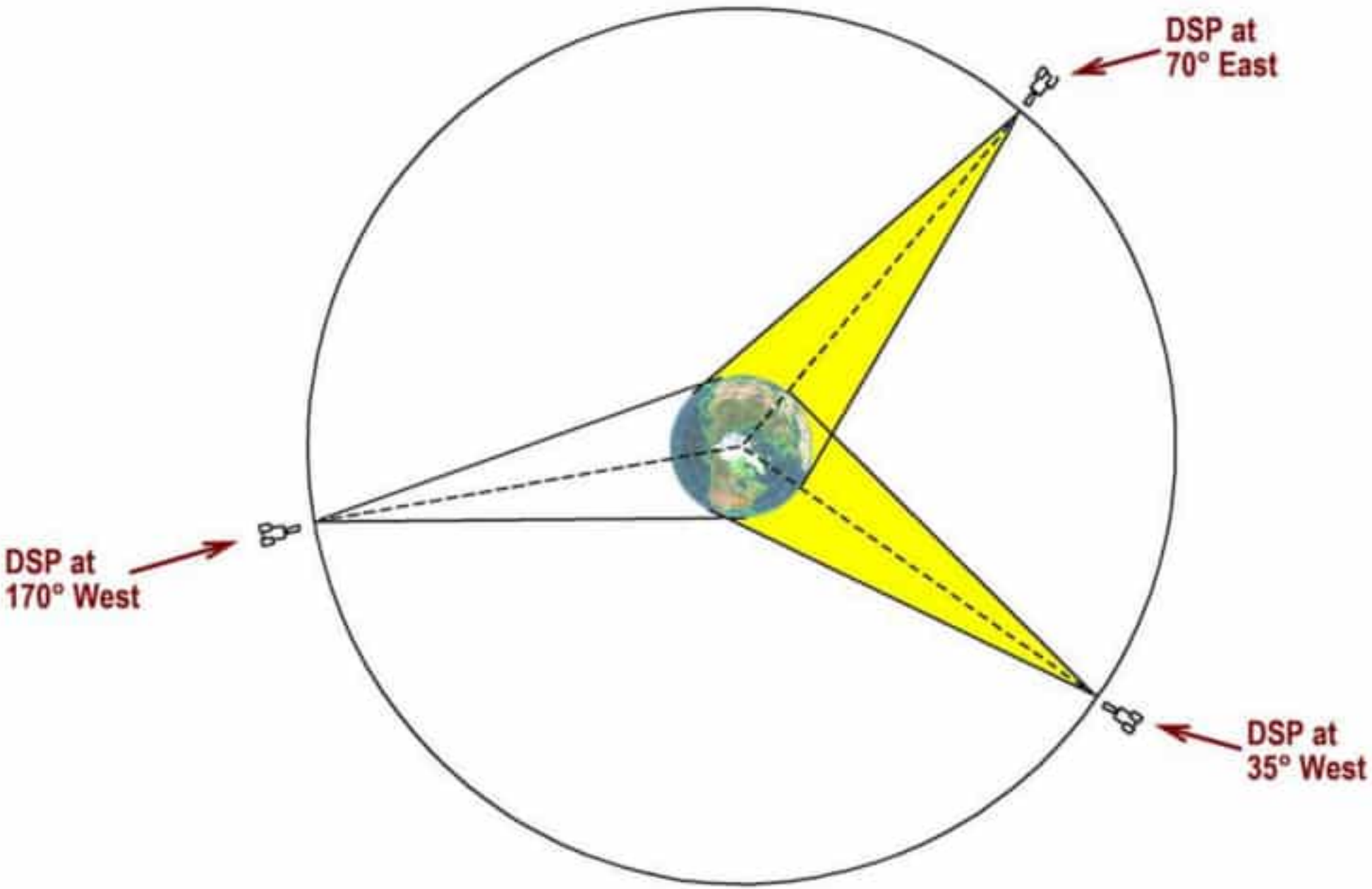
Rough Locations of US **LOOK-DOWN** Early Warning Satellites



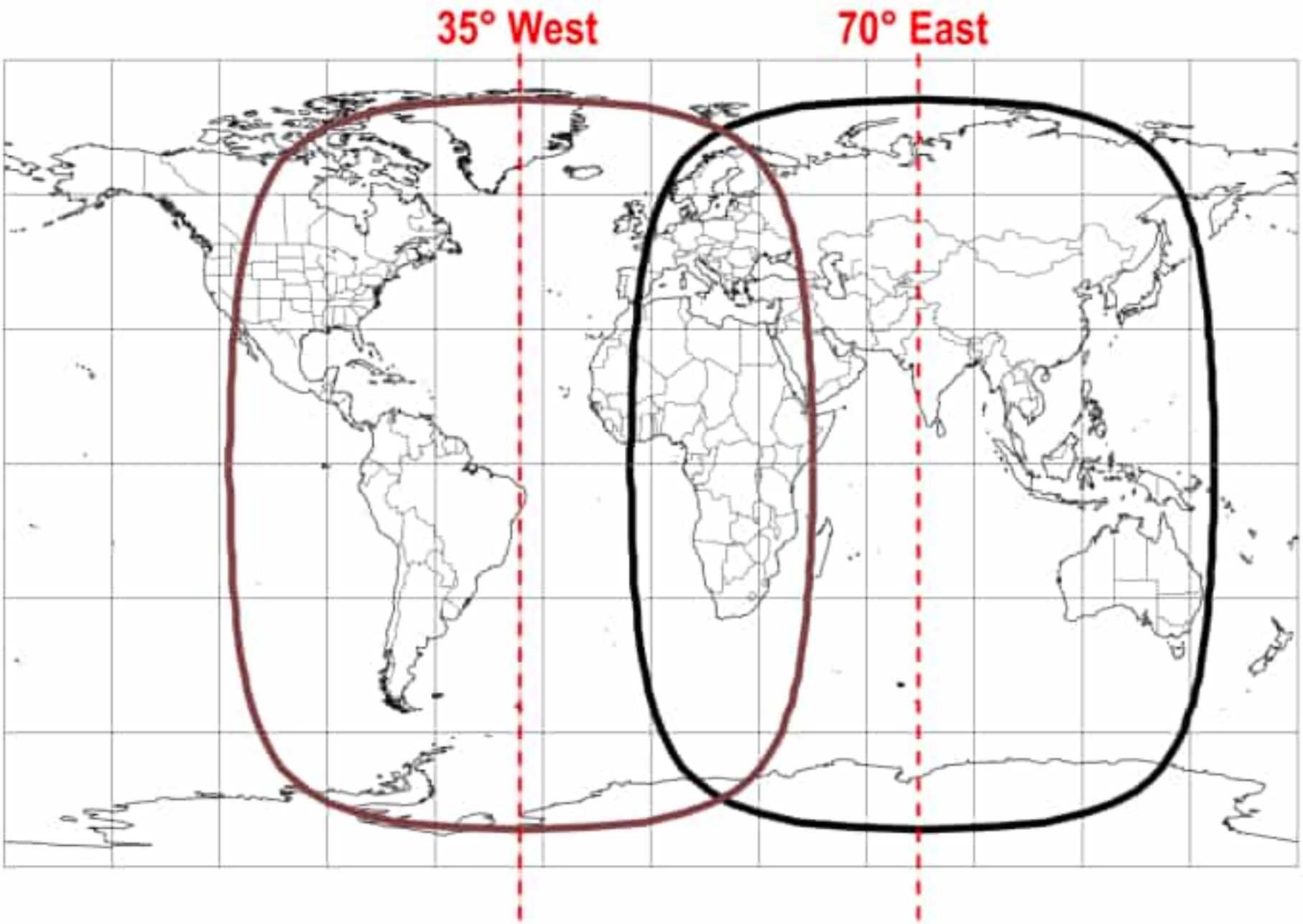
Field of View **LOOK-DOWN** of US Geosynchronous Early Warning Satellite at 70° West



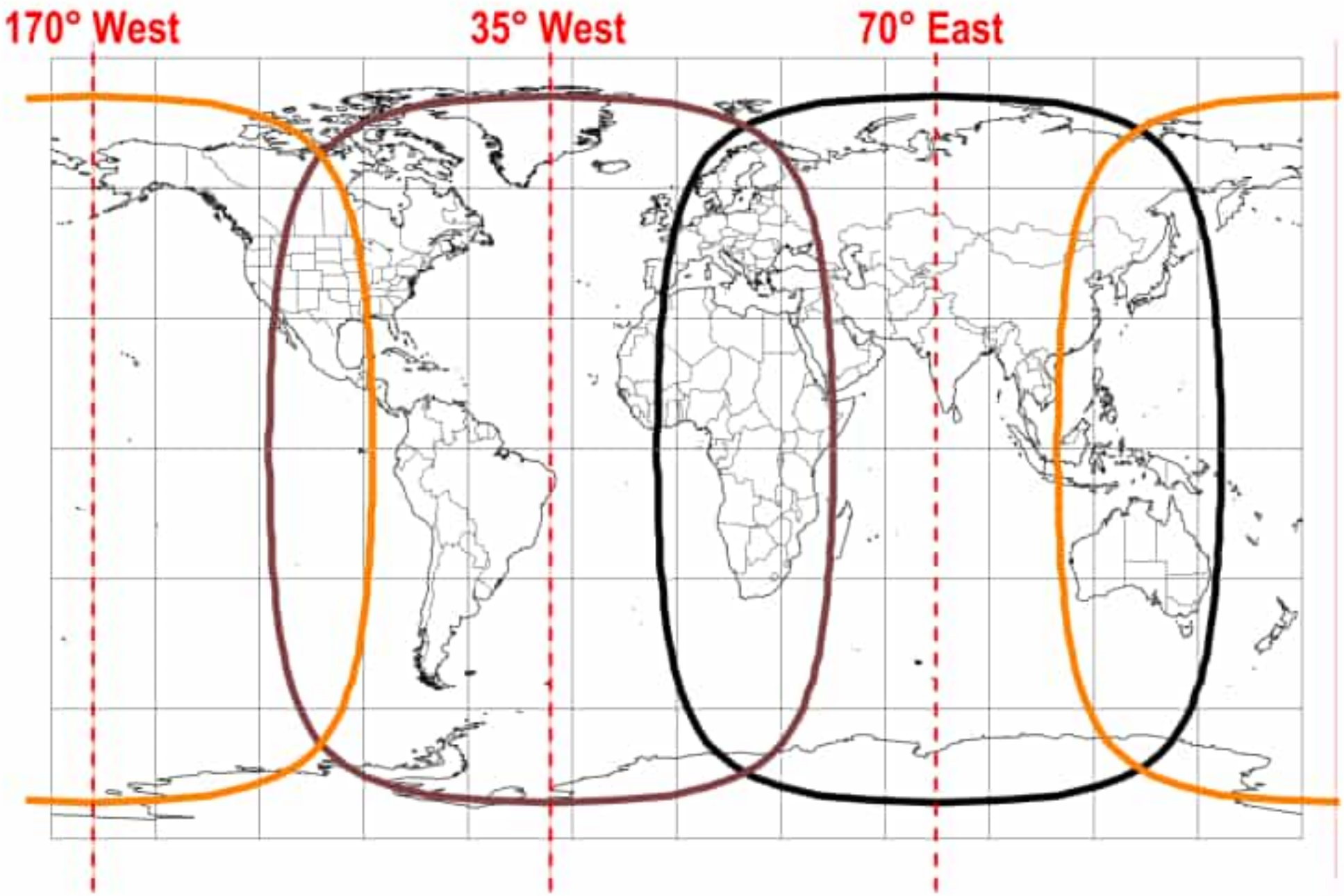
Rough Locations of US **LOOK-DOWN** Early Warning Satellites



Fields of View of US Geosynchronous Early Warning Satellite at 70° West and 35° East

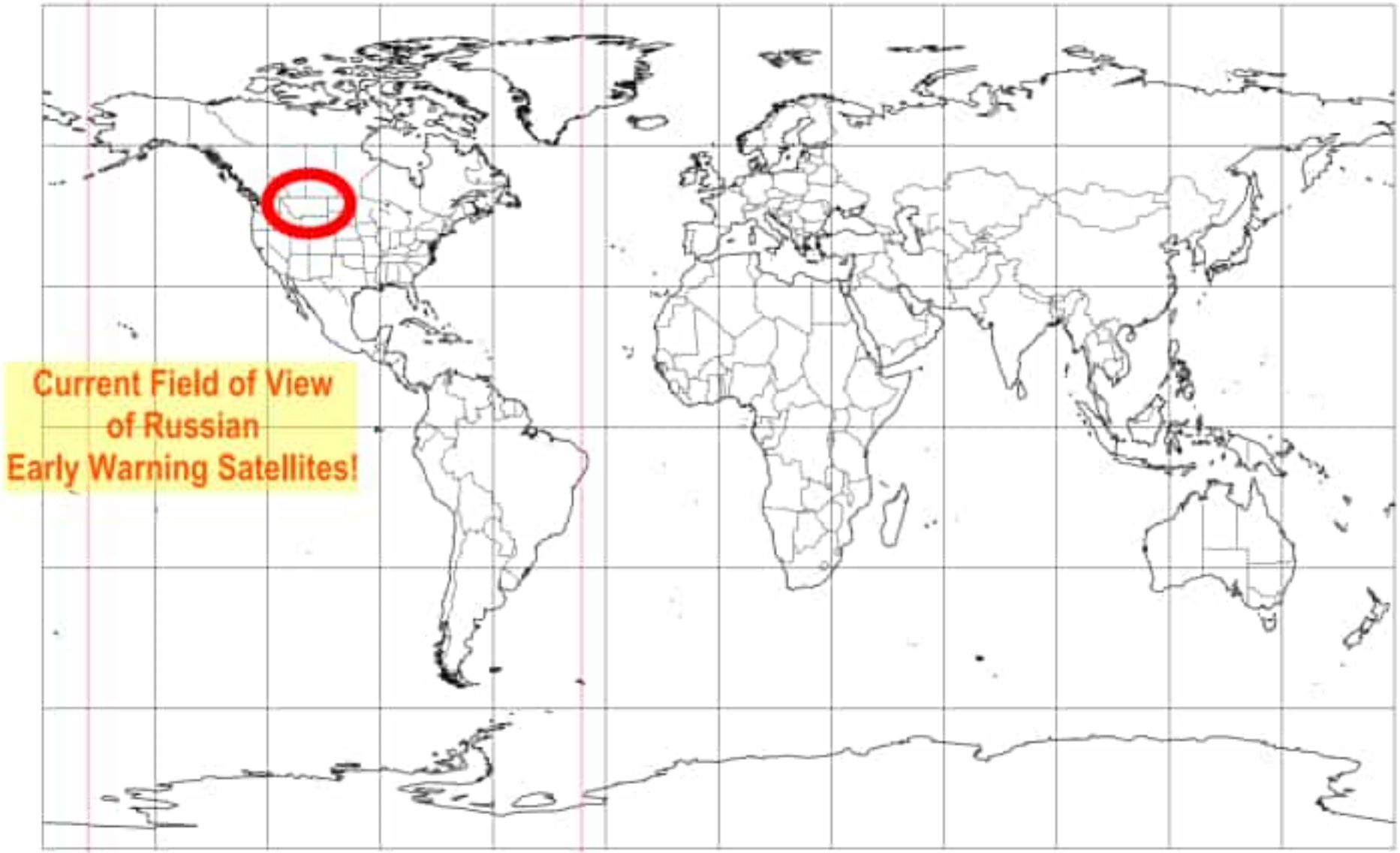


Fields of View of US Early Warning Satellite at 70° West, 35° East, and 170° East



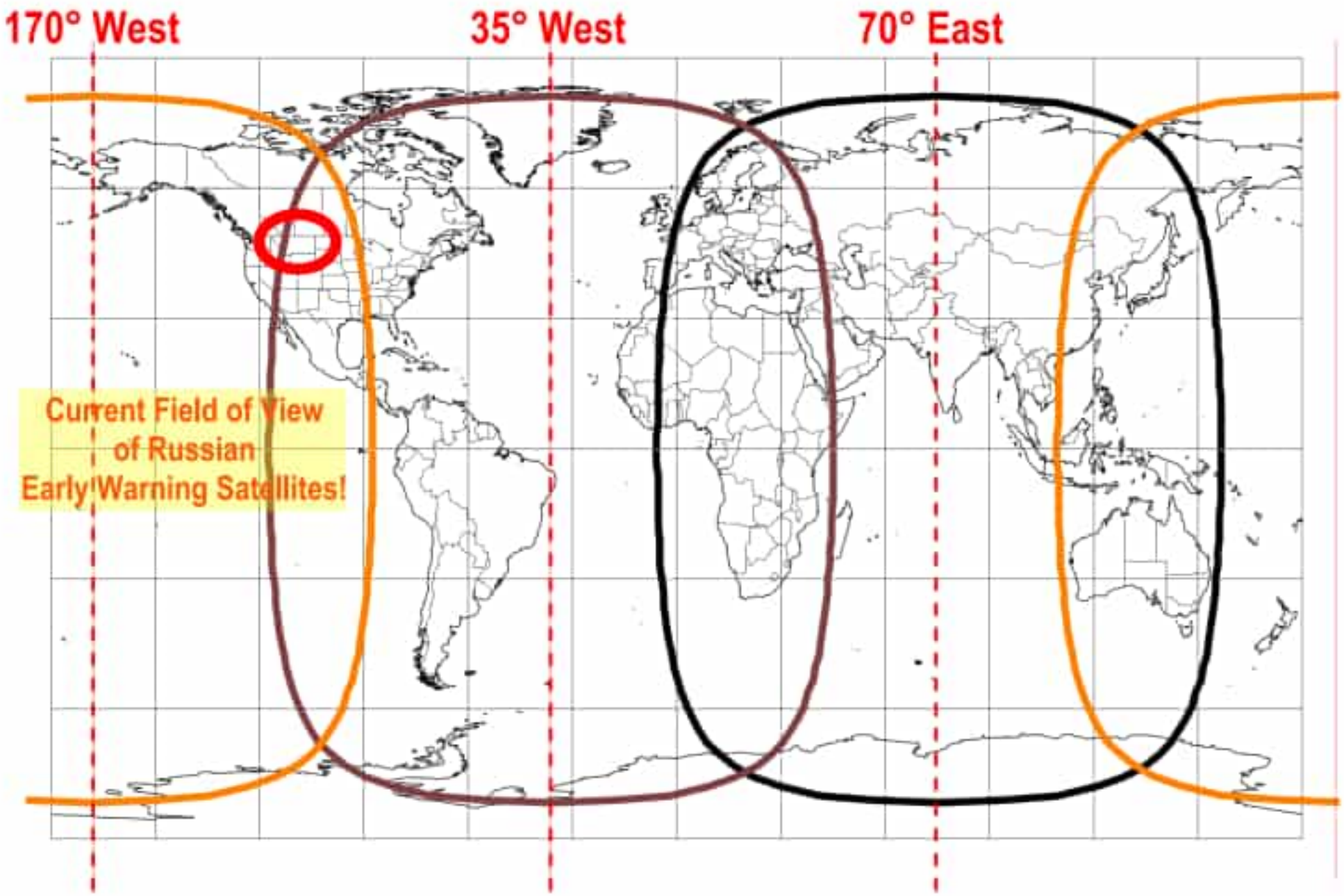
Areas of US Russian Monitoring of Missile Launch

Current Field of View of Russian Molniya AND Prognoz Early Warning Satellite Constellations

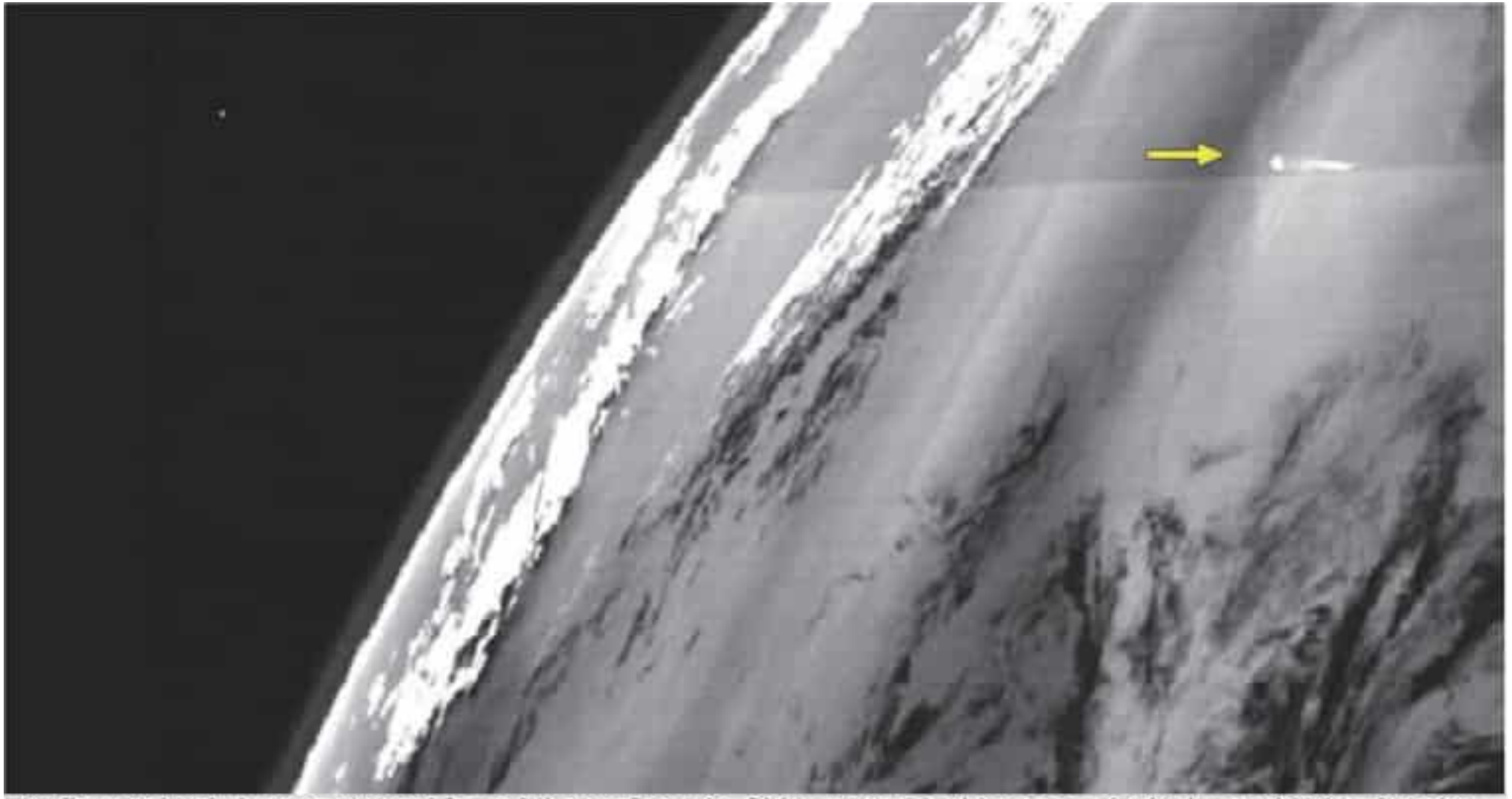


Comparison of Russian and US Areas of Missile Launch Monitoring

Comparison of Russian and US Early Warning Satellite Fields of View

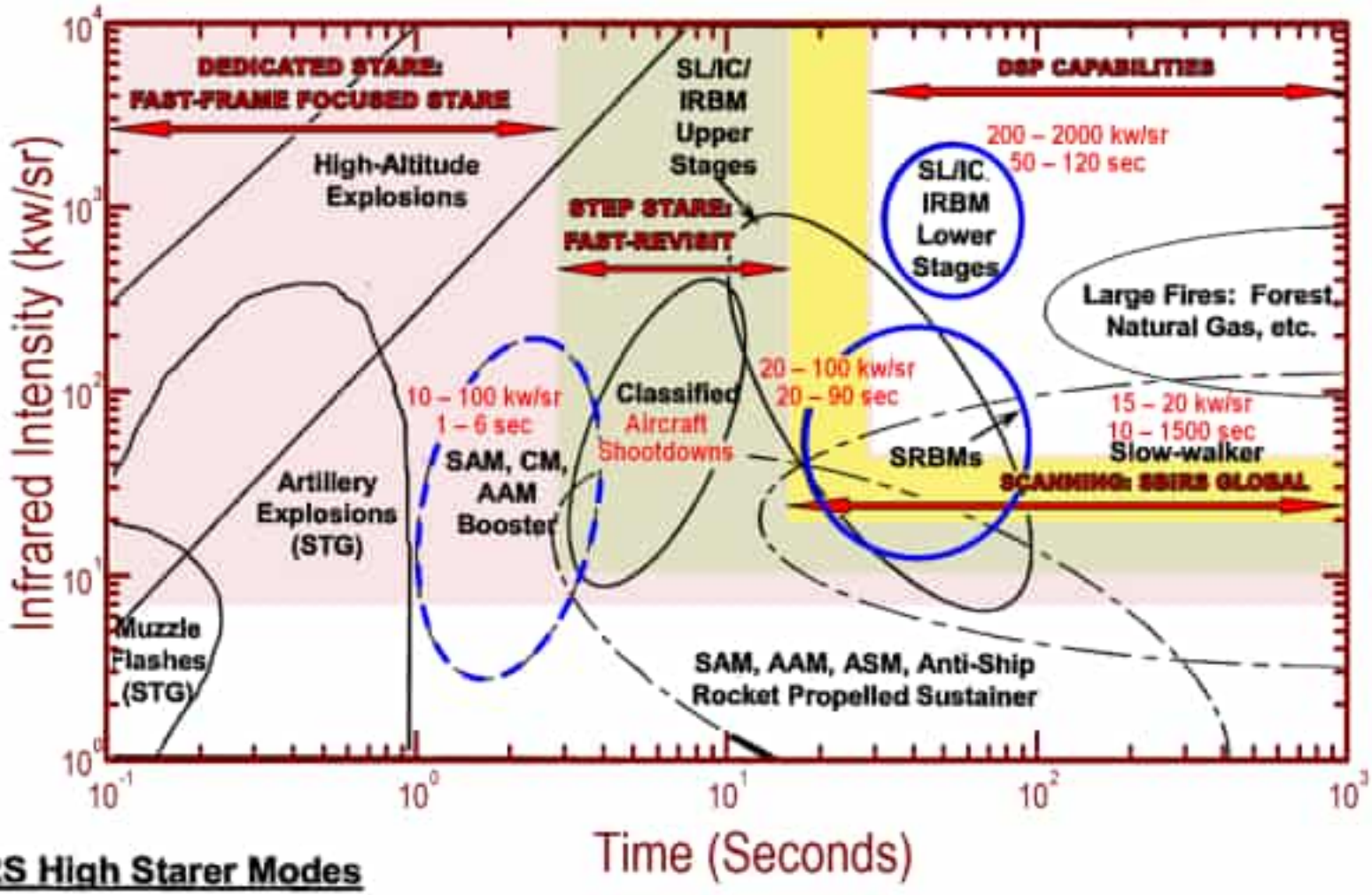


Space-Based Infrared System Infrared Image of Delta IV Launch Vehicle in Flight



The first and only image released for public use from the Sbirs system is this one exclusively provided to Aviation Week for publication in Nov. 20, 2006. It captures the heat plume emitted by a Delta IV predawn launch from Vandenberg AFB, California, Nov. 4, 2006, that was carrying a Defense Meteorological Satellite Program spacecraft en route to insertion into polar orbit. The plume is readily visible against the backdrop of Earth, which in the wee morning hours sees little heat and sunlight. This image was degraded by the Air Force for unclassified use. Credit: U.S. Air Force

Representative SWIR & STG Intensity and Duration of IR Events

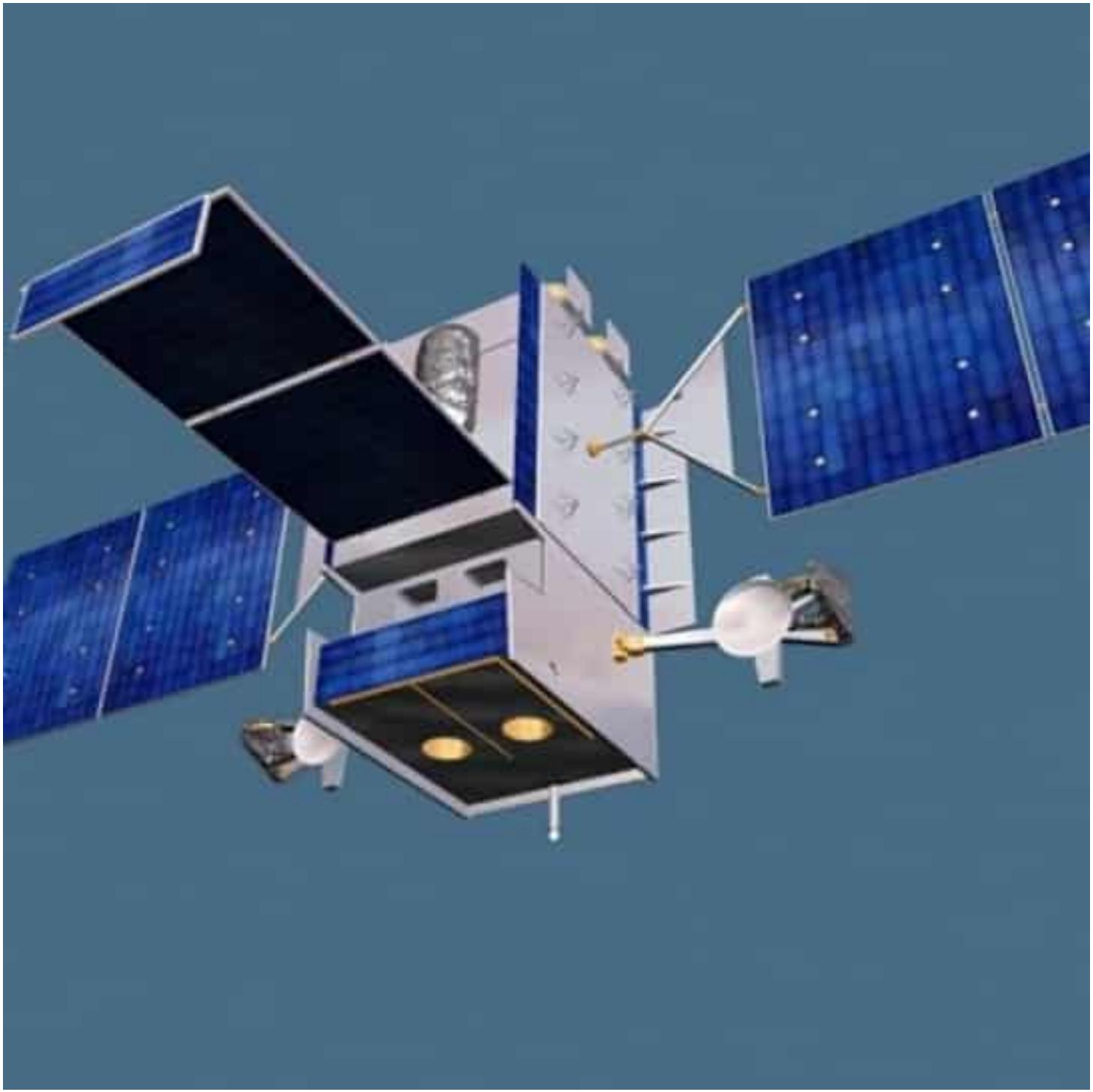


SBIRS High Starer Modes

- **Step-Stare - Theater Major Regional Conflict (MRC)**
- **Step-Stare - TI Fast Revisit Focused Area (FR FA)**
- **Dedicated Stare – Fast Frame Focused Area (FF FA)***
- ***Step-Stare - TI High Sense Focused Area (HS FA) – not shown***

SBIRS Transformational Capability
Col. Roger Teague
Commander, Space Group
Space Based Infrared Systems Wing
Space and Missile Systems Center
30 November 2006

Depiction of a Space-Based Infrared System Satellite



Space-Based Infrared System Satellite Under Consruction