



Promoting Cooperative Solutions for Space Sustainability

US Perspectives on SSA

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Space Situational Awareness: Strategic Challenges
for India
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Promoting Cooperative Solutions for Space Sustainability

Organizational Authority for SSA

- SSA was originally part of the North American Aerospace Defense (NORAD) mission
 - Located in Cheyenne Mountain, Colorado
- In 1985, United States Space Command (USSPACECOM) was created to take over the Unified Command for the space mission
 - In 1989 mission was given to the 1st Command and Control Squadron (1 CACS)
 - Still located in Cheyenne Mountain
- In 2002, USSPACECOM merged with United States Strategic Command (USSTRATCOM)
 - 1 CACS renamed 1st Space Control Squadron (1 SPCS)



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Organizational Authority for SSA (con't)

- In 2007, the SSA mission was transferred to the 614th Air Operations Center (AOC)
 - Vandenberg Air Force Base, California
 - 614th AOC became the nucleus of the Joint Space Operations Center (JSpOC)
 - JSpOC mission was to do command and control for all US military space activities
- In 2010, USSTRATCOM given authority to provide SSA services to commercial and foreign actors
 - Begin negotiating SSA Sharing Agreements with other governments



Promoting Cooperative Solutions for Space Sustainability

18 SPCS SLIDES



18th Space Control Squadron



18 SPCS: Conjunction Assessment Process





Overview

- 18 SPCS Mission
- Conjunction Assessment Process
- On-Orbit statistics
- Recent and Future Improvements



18 SPCS Mission

18 SPCS Mission

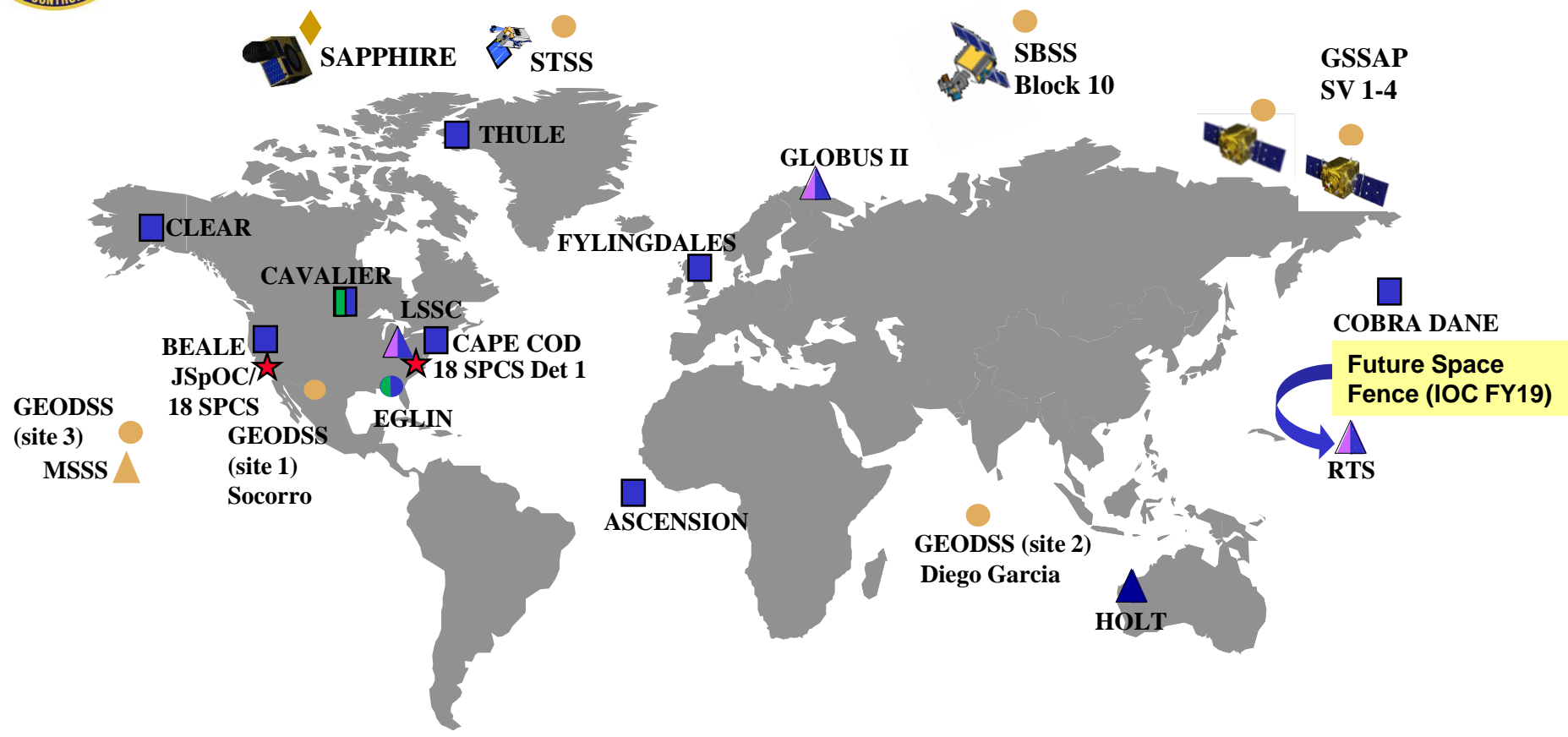
Deliver foundational Space Situational Awareness to assure global freedom of action in space

18 SPCS Vision

Global innovator and leader- providing unrivaled SSA through operational excellence

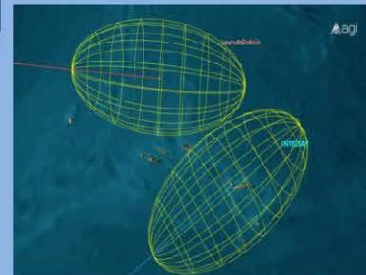
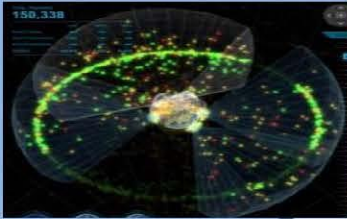


U.S. Space Surveillance Network



- | | | | |
|-----------------|-------------------|----------------|-------------------|
| Tracking Radar | Optical Telescope | ● Dedicated | ★ SSN C2 |
| Detection Radar | SSN C2 | ■ Collateral | ◆ Dedicated Int'l |
| Imaging Radar | | ▲ Contributing | |

18 SPCS Mission Lifecycle



Agreement for Sharing
Space Situational
Awareness Services
Between Department of
Defense...

**Foundational
SSA**

Track

- Space Surveillance Network
- 300,000 taskings/day
- 18 sensor sites

Positional Data

Identify

- Catalogue Maintenance (23,000+ objects)
- Reentry Assessment
- Break-up Processing
- SSA Sharing
- Conjunction Assessment
- Human Space Flight Safety
- Advanced Analysis

Detect

- Launch Support
- Launch CA

Tasking Rqmts



Master Space Plan
External Mission Support
Data
Space-track.org

Timely & Accurate
Data

**18 SPCS
produces foundational
SSA to support global users**





Current CA Process

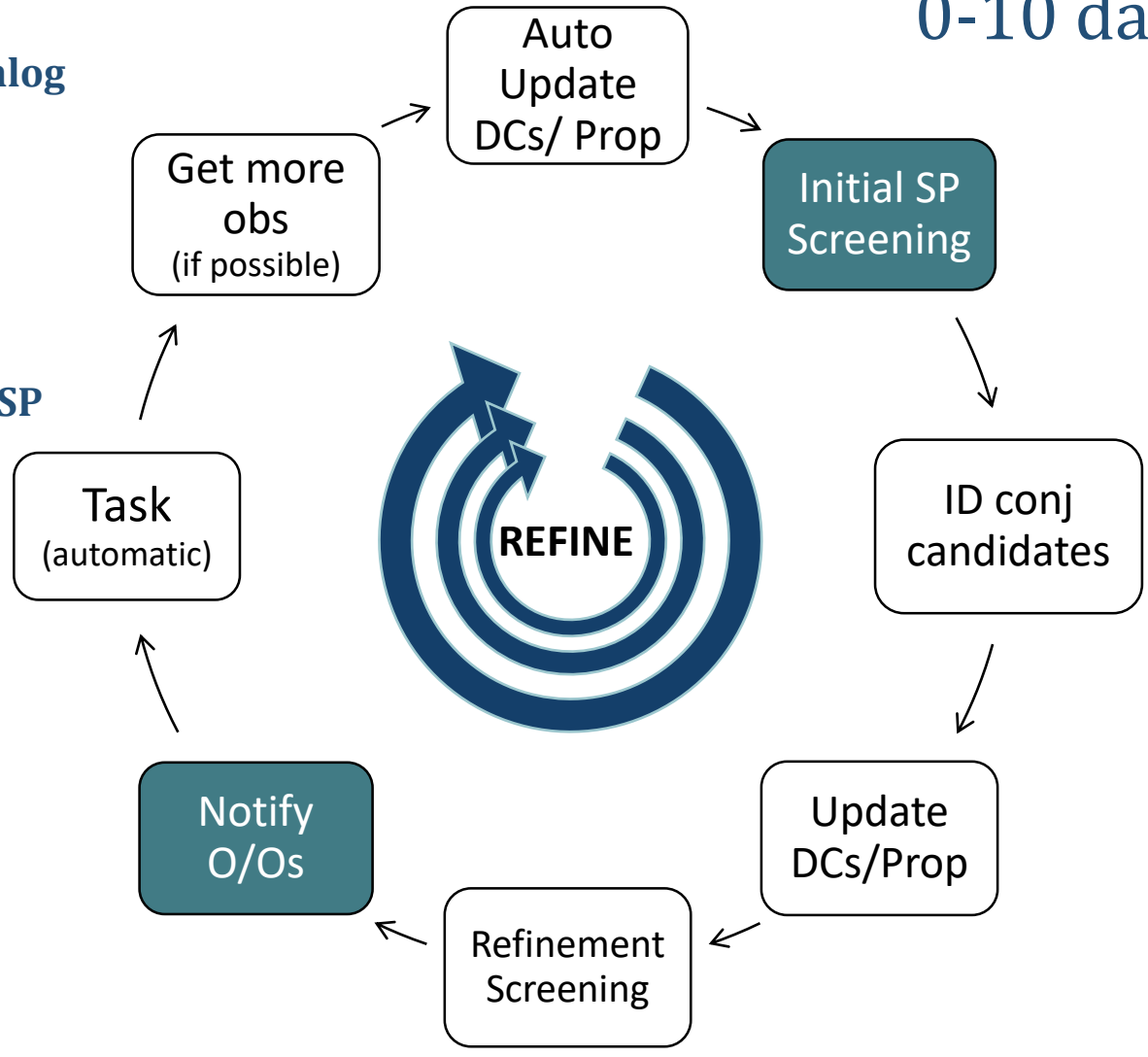
0-10 days prior to TCA

High Accuracy Catalog (SP vs SP):

- Deep Space: Every 24 hours
- Near Earth: Every 8 hours

O/O Ephemeris vs SP (Eph vs SP) and O/O Ephemeris vs O/O Ephemeris (Eph vs Eph)

- High-Interest: On demand
- Deep Space & Near Earth Routine: Every 8hrs





Initial Screening Volumes

Orbit Regime	Orbit Regime Criteria/Definition	Propagate	Radial	In-Track	Cross-Track
DEEP SPACE Basic	Period > 225 mins (GEO, HEO, MEO)	10 days	10 km ellipsoid		
NEAR EARTH Basic Covariance	Period < 225 mins (LEO)	7 days	1 km ellipsoid		
GEO Advanced	1300min < Period < 1800 min Eccentricity < 0.25 & Inclination < 35°	10 days	20 km ellipsoid		
HEO Advanced	Perigee < 2000 km & Eccentricity > 0.25	10 days	20 km ellipsoid		
MEO Advanced	600 min < Period < 800 min Eccentricity < 0.25	10 days	20 km ellipsoid		
LEO 4 Advanced Covariance	1200 km < Perigee ≤ 2000 km Eccentricity < 0.25	7 days	0.5 km	2 km	2 km
LEO 3 Advanced Covariance	750 km < Perigee ≤ 1200 km Eccentricity < 0.25	7 days	0.5 km	12 km	10 km
LEO 2 Advanced Covariance	500 km < Perigee ≤ 750 km Eccentricity < 0.25	7 days	0.5 km	28 km	29 km
LEO 1 Advanced Covariance	Perigee ≤ 500 km Eccentricity < 0.25	7 days	2 km	44 km	51 km



Reporting Criteria

REPORTING CRITERIA			
Mode	Space-Track	Emergency Criteria	Emergency Phone Call Criteria
Method	CDM	CDM, and email	CDM, email, and phone call
Deep Space (DS)	(1) TCA \leq 10 days and Overall miss \leq 10km (2) Advanced criteria: all results	TCA \leq 3 days and Overall miss \leq 5km	TCA \leq 3 days and Overall miss \leq 500 m
Near Earth (NE)	(1) TCA \leq 3 days and Overall miss \leq 1km and $P_c \geq e^{-4}$ (2) Advanced criteria: all results	TCA \leq 3 days and Overall miss \leq 1km and $P_c \geq e^{-4}$	TCA \leq 3 days and Overall miss \leq 1km and $P_c \geq e^{-2}$



Conjunction Assessment Messages

Operator Panel

CDM Directory Manage Admin Help

CDM:

Organizations: CDM Account TCA Start Date (UTC): 2014-06-06 TCA End Date (UTC): 2014-09-23 Load CDMs

Show 10 entries Search All Columns:

CONSTITUTION	MESSAGE ID	CREATED	SAT 1 ID	SAT 1 NAME	SAT 2
CDM Account	27431_conj_30739_2014167161545_16512380434	2014-06-14 12:09:25	2002-024B	FENGYUN 1D	1999-025AS
CDM Account	27431_conj_30739_2014167161545_16613043442	2014-06-15 12:22:35	2002-024B	FENGYUN 1D	1999-025AS
CDM Account	27431_conj_30739_2014167161545_16712161227	2014-06-16 10:06:49	2002-024B	FENGYUN 1D	1999-025AS
CDM Account	27431_conj_12457_2014242225920_240121557621NE	2014-08-28 10:27:09	2002-024B	FENGYUN 1D	1981-0
CDM Account	27431_conj_12457_2014242225920_241112654629NE	2014-08-29 10:02:51	2002-024B	FENGYUN 1D	1981-0
CDM Account	27431_conj_12457_2014242225920_242095352682NE	2014-08-30 07:41:15	2002-024B	FENGYUN 1D	1981-0
CDM Account	27431_conj_82525_2014253110836_251094945656NE	2014-09-08 07:43:35	2002-024B	FENGYUN 1D	UNKN
CDM Account	27431_conj_82525_2014253110836_252093944656NE	2014-09-09 08:08:40	2002-024B	FENGYUN 1D	UNKN

The United States Joint Space Operations Center (JSpOC) has identified a close approach between COMMON NAME (SCC# XXXXX) and SCC#XXXXX

Time of Closest Approach: 2014/09/12 04:20:55.000(UTC)
Overall miss distance: 333.0m
Radial miss distance (RELATIVE_POSITION_R): 165.5m
In-Track miss distance (RELATIVE_POSITION_T): 163.0m
Cross-track miss distance (RELATIVE_POSITION_N): -239.8m.

Please reply to us to acknowledge that you received this close approach notification. (Replying to this email will send your message to JSpOCspaceCorrespondence@us.af.mil)

For more information on this close approach, including covariance values, the full Conjunction Data Message (CDM) is available after logging in to the Space-Track website at this link https://www.space-track.org/expandedspacedata/query/class/cdm/CONSTITUTION/ALL/MESSAGE_ID/36413_conj_31485_2014255042055_2520939441037NE/formats/kvn/emptyresult/show

If you do not have a Space-Track account please apply for one here: <https://www.space-track.org/auth/createAccount> and then contact jspoc.sssharing@us.af.mil for access to Conjunction Data Messages.

If you would like another estimate using your ephemeris, please send it to JSpOCspaceCorrespondence@us.af.mil as an attachment in the format shown in this document: https://www.space-track.org/documents/Ephemeris_Format_10Apr14.pdf using this naming convention: https://www.space-track.org/documents/JSpOC_File-Naming_Scheme.pdf

Thank you for your time and assistance. Please contact us if you have questions.

Very Respectfully,

JSpOC Orbital Protection Team
Vandenberg Air Force Base, California USA
Commercial: 1-805-605-3533
JSpOCspaceCorrespondence@us.af.mil

Conjunction Data Messages (CDM)

- Conjunction **data**
- Provided for all events within CDM criteria
- CCSDS standard
- Posted to Space-Track.org

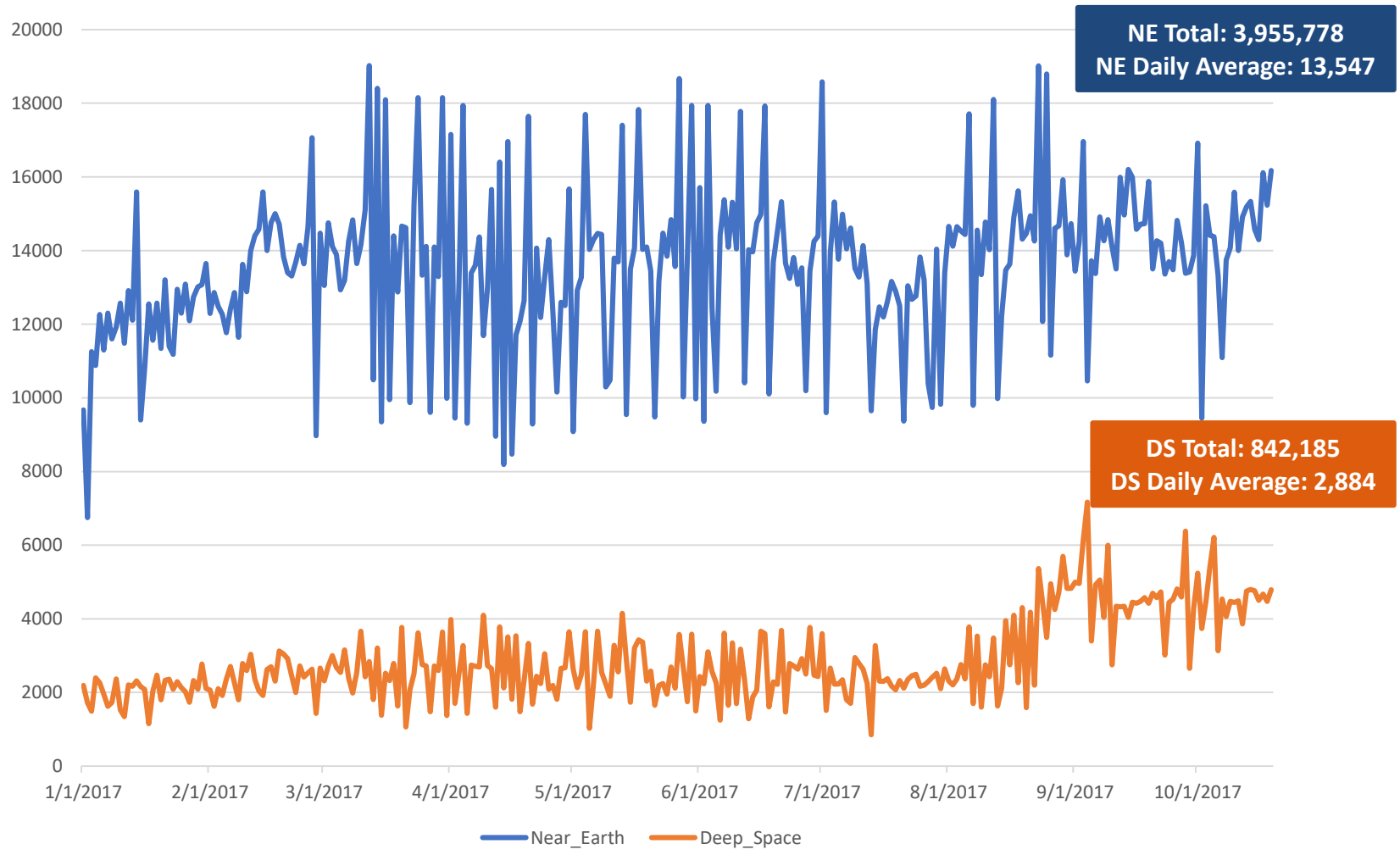
Close Approach Notification (CAN)

- Conjunction **warning**
- Provided for all events that the 18 SPCS consider an **emergency**
- 18 SPCS-specific message
- Emailed to satellite operator



CDMs Per Day

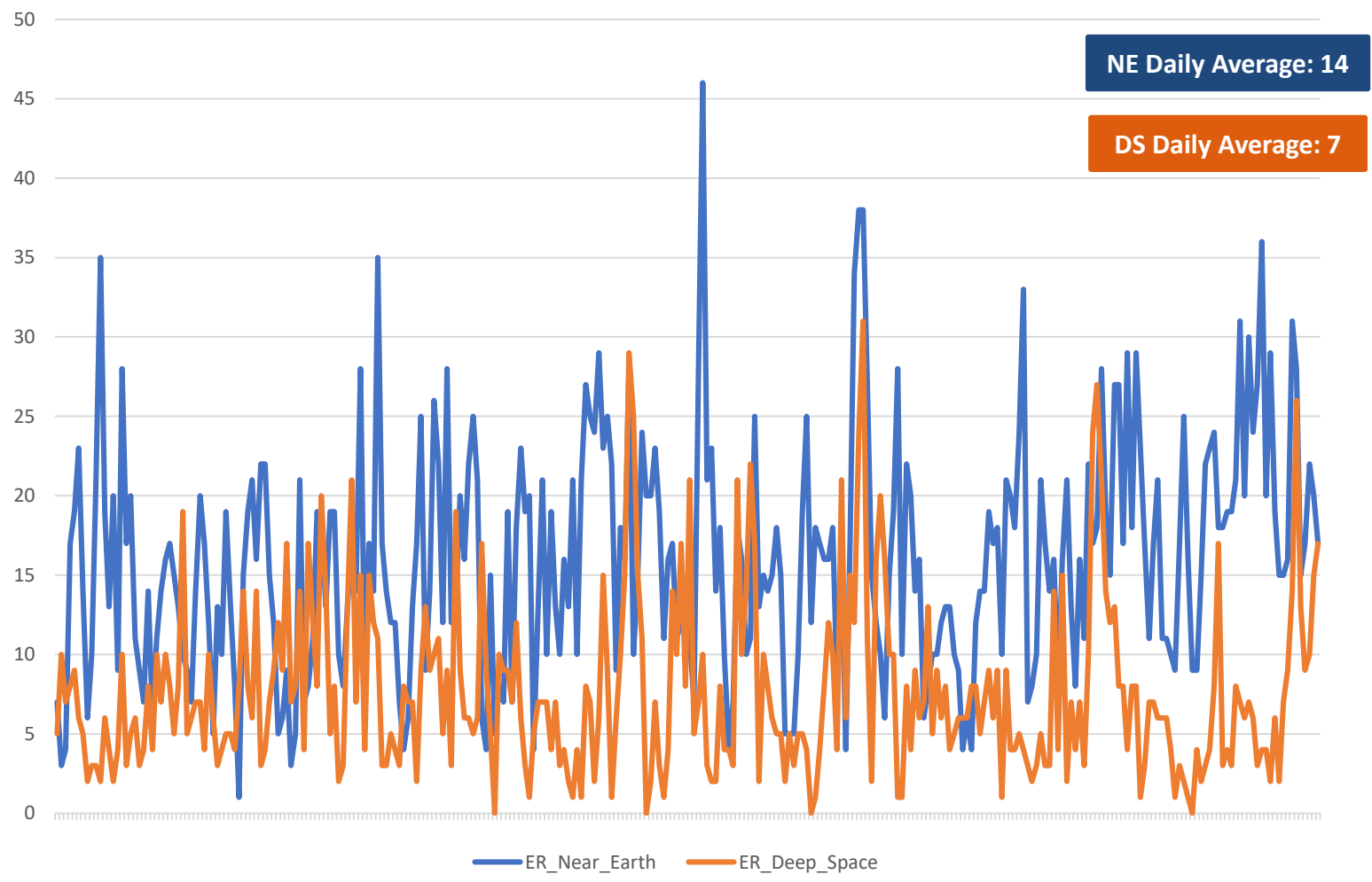
Total CDMs / Daily





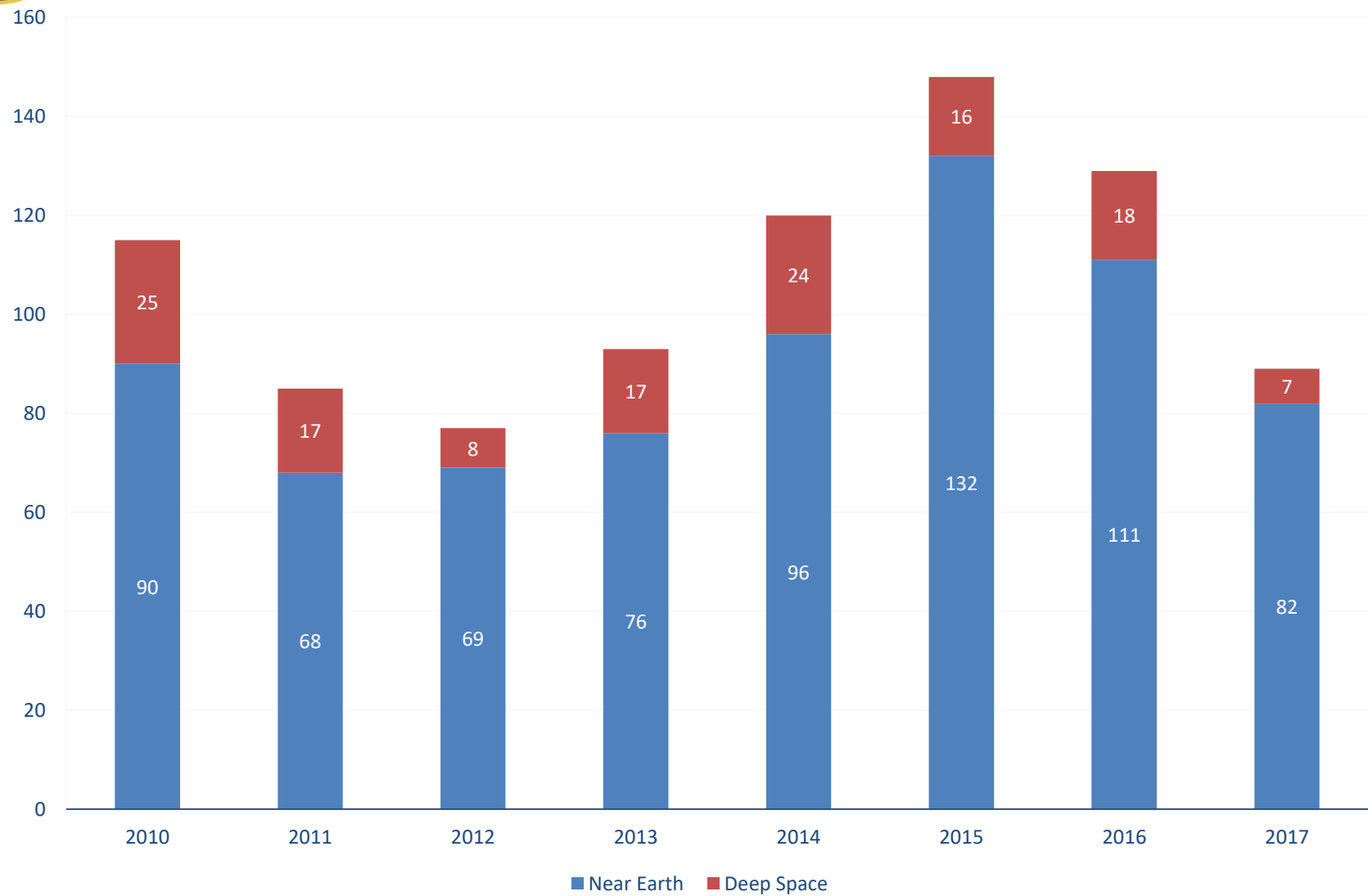
Emergency Close Approach Notifications

Emergency Reportable CDMs / Daily





O/O-confirmed COLA Maneuvers





Recent and Future Improvements

- Recent Improvements
 - Ephemeris vs ephemeris screenings
 - Implementation of Non-Traditional Data Pre-Processor (NDPP)
 - Testing O/O-provided spacecraft size for Pc calculation
 - O/O-provided maneuver notifications via Space-Track.org
- Future Improvements
 - Screen O/O-provided ephemeris through duration
 - Report SP vs O/O ephemeris results
 - Operationalize O/O-provided spacecraft size for Pc

*available for O/Os who have a USSTRATCOM SSA Sharing Agreement and approved ODR



Public Conjunction Notifications

- Entrance Criteria:
 - All regimes:
 - » Time of closest approach (TCA) ≤ 72 hours
 - » Both objects non-maneuverable
 - Or, maneuverability can't be confirmed
 - » Both objects $\geq 5\text{m}^2$
 - Determined by RCS or known spacecraft size
 - » High-quality orbit determination (OD)*
 - Near Earth (Period ≤ 225 minutes)
 - » Probability of Collision (Pc) $\geq 10\%$
 - Deep Space (Period > 225 minutes)
 - » Miss distance ≤ 500 meters
- Public notifications:
 - Email to all satellite operators
 - Announcement on Space-Track.org



Summary

- 18 SPCS Mission
 - Conjunction Assessment Process
 - On-Orbit statistics
 - Recent and Future Improvements
-



Promoting Cooperative Solutions for Space Sustainability

Organizational Authority for SSA (con't)

- In 2016, the JSpOC mission is broken up
 - Space threat assessment, battle management, and C2 mission transferred to the National Space Defense Center (NSDC) at Schriever Air Force Base, Colorado
 - SSA mission was transferred back to the 18th Space Control Squadron (18 SPCS)
- In 2018, the JSpOC will be renamed the Combined Space Operations Center (CSpOC)
 - Integrating of allies and commercial partners
 - Refocus on providing space support to theater warfighters



Promoting Cooperative Solutions for Space Sustainability

US Policy on SSA and STM

- US has been holding interagency discussions on SSA policy since 2011
 - Began under the Obama Administration as part of the implementation of the 2010 National Space Policy
 - Implementing Directive on Space Traffic Management
 - Efforts continued under the Trump Administration
 - Expected to announce new policy in SPD-3 on June 18
- Key issues
 - Civil agency authority for part of the SSA mission
 - Relationship and interactions between civil agencies and DOD
 - Protection of sensitive data
 - Leveraging commercial and international sources of data



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Thank you

Questions?

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