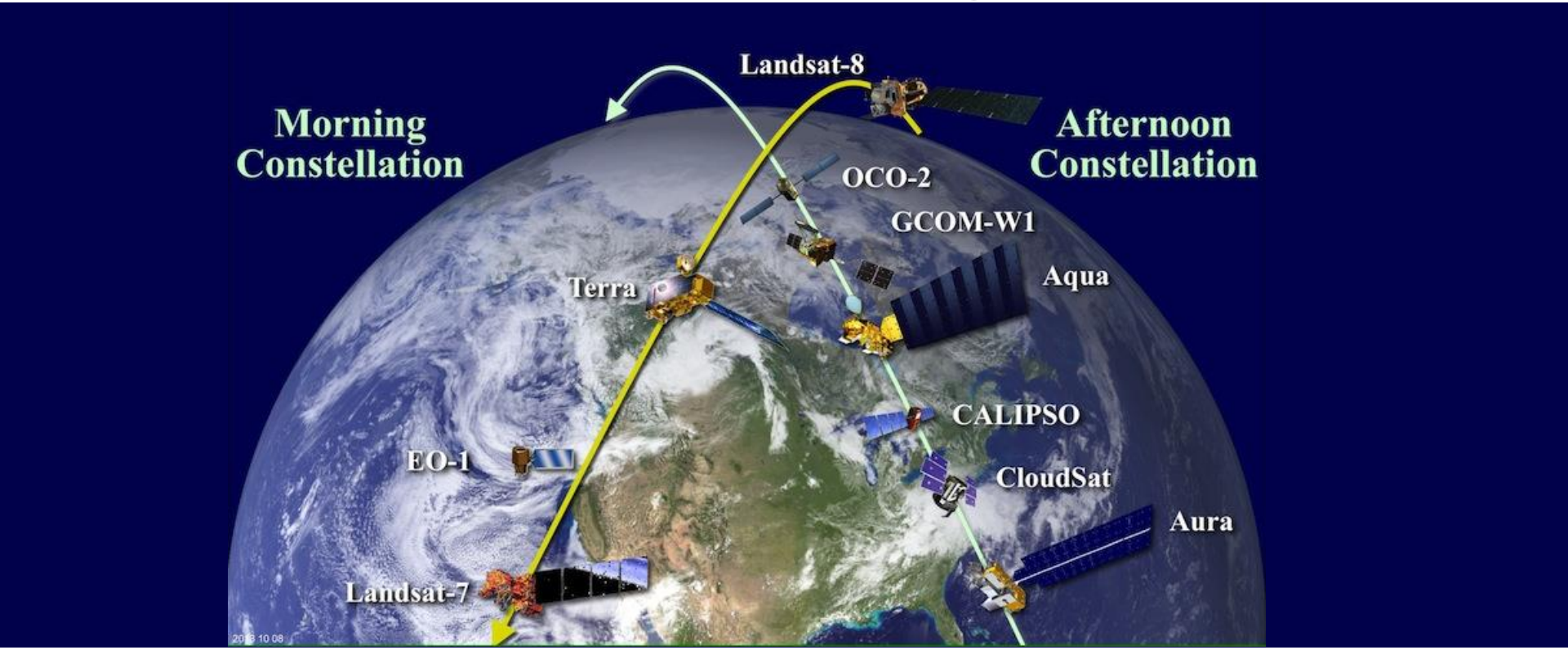
International Earth Observing Constellations



INTRODUCTION

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- ***Welcome to all the members of the Mission Operations Working Group (MOWG) of the International Earth Observing Morning and Afternoon Constellations!***

- *Welcome especially to the new team members, Clifford Graham and Joseph Bartsch from CloudSat at KAFB:*

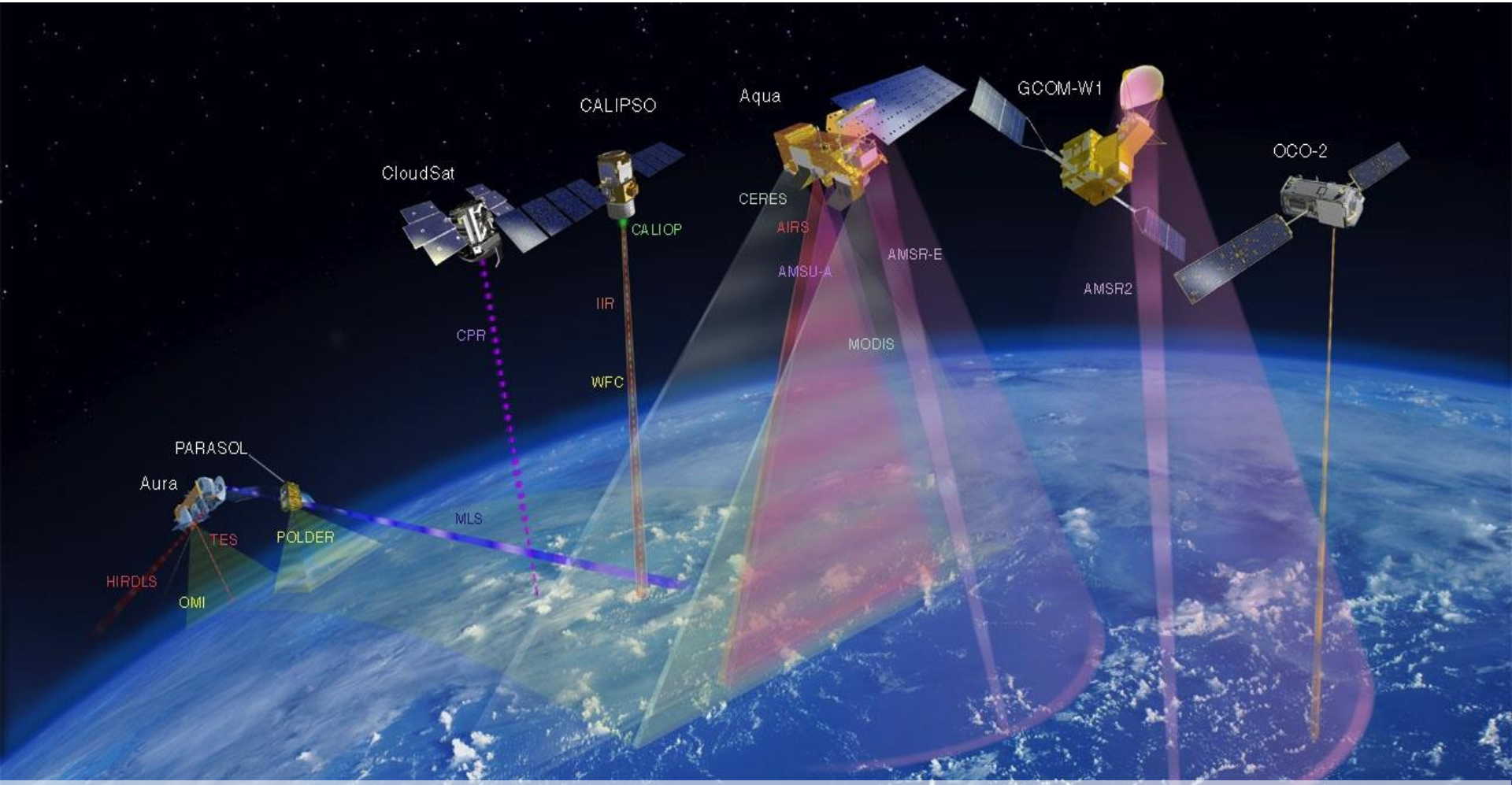
- *Welcome to our telecon participants.*

MOWG Charter

The Constellation mission teams enable nearly simultaneous science observations by coordinating their operations and cooperating with each other to ensure the safety of the constellations.

Mission Operations Working Group
June 2-4, 2015

A-Train Science Graphic
(*from Steve Platnick, A-Train Project Scientist*)



The Earth Science Mission Operations (ESMO) Project at the NASA Goddard Space Flight Center (GSFC) leads the Morning and Afternoon Constellation mission operations working group (MOWG) to address constellation safety. The MOWG goal is to ensure the safety of the constellation satellites to enable/maximize coincidental observations.

Constellation History*

- **Morning Constellation** officially began in 1999 with the Landsat-7 launch in April and Terra launch in December (joining Landsat-5). Landsat-5 was already on-orbit. EO-1 and SAC-C successfully joined in November 2000. Landsat-8 launched in February 2013.
- **Afternoon Constellation** (A-Train) began with the Aqua launch in May 2002, followed by Aura in July 2004, PARASOL in December 2004, and the joint CALIPSO/CloudSat launch in April 2006 ("formation flying")
- **A-Train Mission Operations Working Group (MOWG)** officially met for the first time in March 2003, preceded by an exploratory discussion between LaRC (John Stadler) and GSFC (Angie Kelly and Lauri Newman)
- **OCO (2010) and Glory (2011)** launches failed due to launch vehicle fairing problems
- **GCOM-W1** successfully launched in May 2012
- **OCO-2** successfully launched in July 2014
- **Next missions**: ?

Significant Meeting Topics

- Terra Exit Plans
- CALIPSO Laser Swap Plans
- CALIPSO and CloudSat Future Plans
- OCO-2 First Year of operations
- Communications with Foreign Satellite Operators (FSOs) – Status update
- Revised CARA Concept of Operations – Lessons learned
- Spring 2015 IAM Series Lessons Learned
- "No slew" maneuvers for Aqua – Status update
- CCS Future Release Plans
- NASA HQ Perspective (including Senior Review status and the planned 2016 Science Symposium)
- Current state of the missions, end-of-mission plan, and action plan for unexpected credible contingencies

State of the Constellations

- **Morning Constellation**
  - Terra and its 5 instruments are performing nominally, except ASTER SWIR.
  - Landsat 7 and Landsat 8 are performing nominally
  - EO-1 is currently ~22 km below Landsat 7 & Terra; continuing science observations
- **Afternoon Constellation**
  - A-Train IAM Series (Spring 2015) successfully conducted
  - OCO-2 is completing its first year in the A-Train.
  - Aqua, Aura, and GCOM-W1 are performing nominally
  - CloudSat is operating in Daylight-only Operation (Do-Op) mode; formation flying with CALIPSO
  - CALIPSO is performing nominally; making plans to switch lasers

Constellations are operating successfully and producing valuable science data
Excellent cooperation! Still growing and learning!

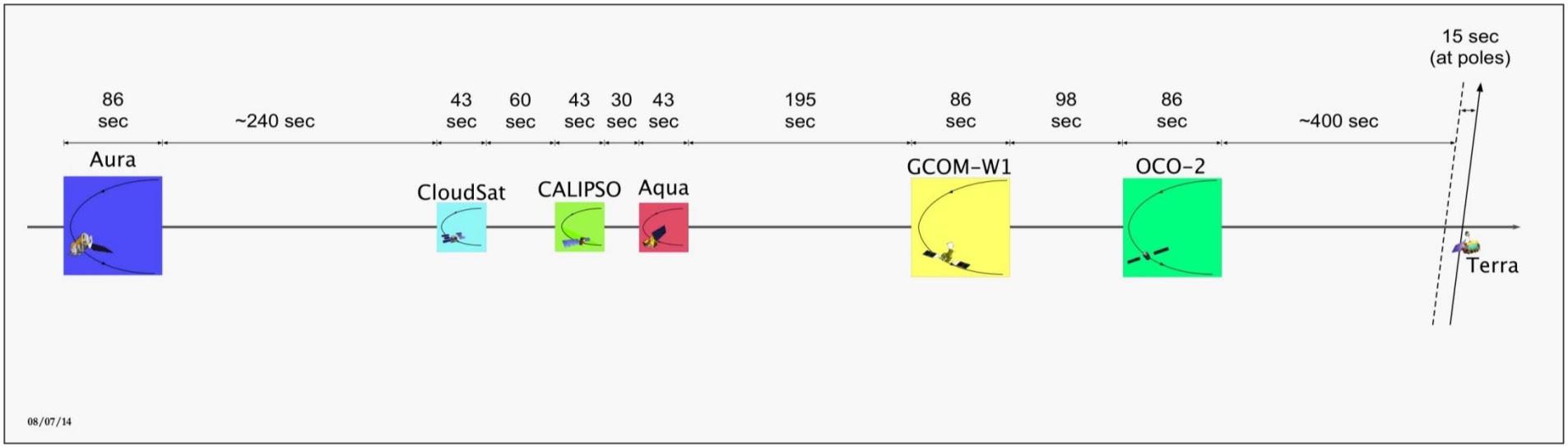
Since the last meeting . . .

Constellation Mission Operations Working Group (MOWG) Meeting
NASA Langley Research Center (Hampton, Virginia)
October 15-17, 2014

Since the last meeting . . .

- **OCO-2 completed 11 months in orbit!**
- **CALIPSO Laser Swap Review conducted**
- **CCS Release 7.0 deployed in December**
- **A-Train annual inclination adjust maneuvers (IAMs) completed during March – May**
- **CloudSat UV anomaly in April 16-18**
- **Terra Exit Plans are under review**
- **The *Operations Coordination Plan For The Morning and Afternoon Constellations Constellation* was approved**

Afternoon Constellation
Current Orbital Configuration



A-Train IAM Series (Spring 2015)

- A-Train IAMs were conducted per agreements in the *Afternoon Constellation Coordinated Plan for the 2015 Inclination Adjust Maneuvers* document (Rev. 2)
- Replanning was necessary due to a Aqua IAM replan. ***Thanks to all teams for a expeditious effort!***
- **21 IAMs were performed between March 5 and May 13**

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
March	**March 1**	**2**	**3**	**4**	**5** ▶**CloudSat #1**	**6**	**7**
	8 *Daylight saving time starts (U.S.)*	**9**	**10**	**11** ▶**GCOM-W1 #1**	**12** ▶**CALIPSO #1**	**13**	**14**
	15 ▶**OCO-2 #1**	**16**	**17**	**18** ▶**Aqua #1**	**19** ▶**Aura #1**	**20**	**21** *Spring Equinox (Japan)*
	22	**23** ▶**OCO-2 #2**	**24**	**25** ▶**Aqua #2**	**26** ▶**Aura #2**	**27**	**28**
	29 *Daylight saving time starts (France)*	**30**	**31**	**April 1** ▶**Aqua #3**	**2** ▶**Aura #3**	**3** *Good Friday (US/France)* ▶**OCO-2 #3**	**4**
April	**5** *Easter (US/France)*	**6** *Easter Monday (France)*	**7**	**8**	**9**	**10**	**11**
	12	**13**	**14**	**15** ▶**Aqua #4**	**16** ▶**Aura #4**	**17**	**18** ▶**OCO-2 #4**
	19	**20**	**21**	**22** ▶**Aqua #5**	**23** ▶**Aura #5**	**24**	**25** ▶**OCO-2 #5**
	26	**27** ▶**CALIPSO #2**	**28**	**29** *Shōwa Day (Japan)* ▶**CloudSat #2**	**30**	**May 1** *May Day (France)*	**2**
May	**3** *Constitution Memorial Day (Japan)*	**4** *Greenery Day (Japan)*	**5** *Children's Day (Japan)*	**6** *Constitution Memorial Day observed (Japan)*	**7**	**8** *Victory Day (France)*	**9**
	10	**11**	**12**	**13** ▶**GCOM-W1 #2**	**14** *Ascension Day (France)*	**15**	**16**

KEY: ▶= Inclination maneuver ▲ = Other maneuver ☼ = Afternoon Constellation telecon ** **Date may vary** ❁ If needed

Upcoming Events . . .

- **International Satellite Constellations/ Formation Flying Workshop (IWSCFF)*** — **June 8-11 (Delft, Netherlands)**
- **Fall 2015 MOWG Meeting** — **Details *TBD***
- **A-Train 3rd International Science mtg*** — **TBA**

*--NCTS registration required

Meeting Logistics

- **Presentations**
  - Please e-mail your presentations to warren.f.case@nasa.gov.
  - All the presentations will be made available within 2 weeks via Goddard WebDrive server. Download instructions will be sent.
  - Let us know if your presentations are "***not for public view***".
- **Telecon Number: 1-844-467-6272, code 830887#**
- **Splinter Sessions –** See schedule
- **Traditional group photo –** Day 1 during afternoon break
- **Wi-Fi**
  - NASA users: Use your standard login to the NASA wi-fi
  - Non-NASA users: Log in to "**Guest-CNE"**. Enter '**NASA**' as the *Sponsoring Organization*
- **Group Dinner:**
  - Wednesday, June 3 @6:30 p.m. Details to be provided.

Arigatou Gozaimasu

Merci

Thank you

Questions?

Additional Information

Mission Operations Working Group
June 2-4, 2015
Constellation MOWG Action Items
October 2014 Meeting (at LaRC)

#	Assignee	Description	Status/Due Date
1410-01	CARA	Analyze close approaches which have required mission team action on short notice. Determine why the approaches were identified later in the process than most other events. Note that this action may be handled during a CARA User Forum.	OPEN / To be discussed at June 2015 MOWG meeting. Report the conclusions of this analysis in Summer 2015.
1410-02	Aerospace Corporation	Present the results of their risk study analyzing the Terra exit options. This study will include the risk of the Terra satellite itself being hit by debris and any subsequent risks to the remaining satellites in the 705-km constellations or satellites attempting to enter or exit the constellations. Thus it will entail characterizing the debris environments at the range of altitudes from 4 km below the constellations to re-entry plus the associated orbital lifetimes associated with Terra starting 4km and 19 km below the 705-km reference altitude.	OPEN / Mid-January 2015 summary to ESMO (Closed) Present results at the Spring 2015 MOWG meeting
1410-03	NASA HQ Program Executive	Invite the NASA Orbital Debris Program Office and the Office of Safety and Mission Assurance (OSMA) teams to the next MOWG meeting (which will include a presentation of the Aerospace Corporation study results).	CLOSED / April 2015
1410-04	MOWG Teams	Provide CARA with the list of e-mail addresses to receive legacy reports once the new report becomes the regular CARA report. Note that the 2 reports will be available for ~1 month to enable users to provide feedback.	CLOSED / October 24, 2014.
1410-05	MOWG Teams	Review CARA's new operations concept and provide feedback to the CARA team. This includes comparing the legacy report with the new report (weekly feedback desirable).	CLOSED / Feedback on new reports weekly with final feedback by November 28, 2014.
1410-06	ESMO	Present their analysis of impacts and concerns from cancelling the Aqua and Aura IAMs in 2018 to the Project Scientists. ESMO will report the Project Scientist feedback to the mission teams.	CLOSED / A. Kelly provided the Project Scientist feedback to mission teams on October 27 and 28.
1410-07	T. Sweetser CloudSat	Document his suggested alternative to the proposed approach of cancelling the 2018 Aqua IAMs.	CLOSED / E-mail was sent on October 16, 2014
1410-08	GSFC FD	Update their previous no slew analysis presentation using the latest data. ESMO will provide this data to the constellation mission teams.	CLOSED / Analysis sent to teams by November 21, 2014
1410-09	Aqua team	Present the results of Aqua no slew maneuvers.	OPEN / Spring 2015 MOWG mtg

Constellation MOWG Action Items
Older Actions Still Open
(from September 2013 and April 2014 meetings)

#	Assignee	Description	Status/Due Date
1309-05	CARA	Report on: •the benefits of using owner operator covariances compared to the existing approach and •any recommendations on how a mission should implement it.	OPEN. To be presented at June 2015 MOWG meeting.
1309-09	CARA	Implement approved methods for sharing collision avoidance and risk mitigation data with other nations. • Email distribution lists, file repositories, etc. • Phone numbers	OPEN. Actively working / Date TBD
1309-11	CARA	Analyze our timeline for working future close approaches with another nation and factor that into our risk management process.	OPEN. Actively working. To be presented at June 2015 MOWG meeting.
1404-08	USGS	Investigate options for communications with Chinese space agency during close approach events. Review the timeline for communication and coordination with foreign spacecraft operators (FSOs) for high interest events.	CLOSED. Discussed at meeting in Saskatoon (June 2014). Liu Jianbo from the Chinese Institute of Remote Sensing and Digital Earth (RADI) took the action to provide a SJ 11 point of contact to USGS. This action has been overtaken by other activities being pursued by CARA.