GOSAT Mission Operation System

Nov. 5, 2008
@Toranomon Pastral

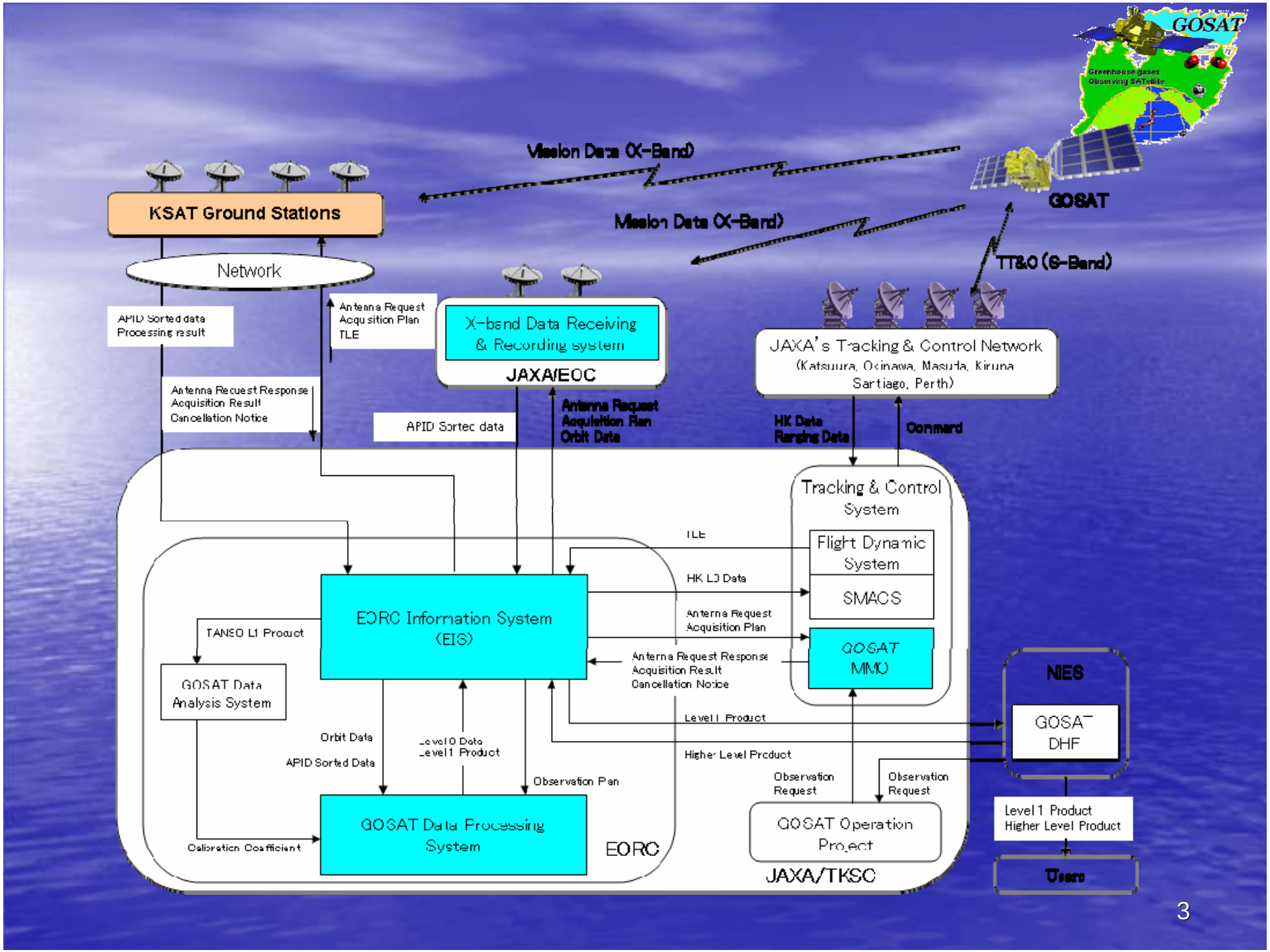
Toshiaki TAKESHIMA
JAXA/EORC

JAXA GOSAT Mission Operation System

Mission Operation system is for mission planning, data acquisition, data processing, data archiving, and data distribution.

- Mission Management Organism (MMO)
- Data Acquisition Control System (DACS) (EOC*)
- X-band Data Receiving Antenna（EOC)
- X-band Data Recording System for GOSAT (EOC)
- High Latitude X-band Station（KSAT* Svalbard）
- EORC Information System (EIS)
- Processing Control System (PCS)
- GOSAT Specific Data Processing Subsystem (Level 0 ＆ TANSO Level 1 Processing）
- Automatic Alert System (AAS)

* EOC: Earth Observation Center, JAXA
KSAT: Kongsberg Satellite Service


GOSAT
Greenhouse gases Observing SATellite
Mission Data (X-Band)
Mission Data (X-Band)
GOSAT
TT&C (S-Band)
KSAT Ground Stations
Network
APID Sorted data Processing result
Antenna Request Acquisition Plan TLE
X-band Data Receiving & Recording system
JAXA/EOC
JAXA's Tracking & Control Network
(Katsuura, Okinawa, Masuda, Kiruna Sartiago, Perth)
Antenna Recuest Response Acquisition Result Cancellation Notice
APID Sortec data
Antenna Request Acquisition Plan Orbit Data
HK Data Ranging Data
Command
Tracking & Control System
Flight Dynamic System
SMACS
GOSAT MMO
TLE
HK LO Data
Antenna Request Acquisition Plan
Antenna Request Response Acquisition Result Cancellation Notice
EORC Information System (EIS)
TANSO L1 Product
GOSAT Data Analysis System
Orbit Data
APID Sorted Data
Level 0 Data Level 1 Product
Observation Plan
Calibration Coefficient
GOSAT Data Processing System
EORC
Level 1 Product
Higher Level Product
Observation Request
Observation Request
GOSAT Operation Project
JAXA/TKSC
NIES
GOSAT DHF
Level 1 Product Higher Level Product
Users

Mission Management Organization (MMO)

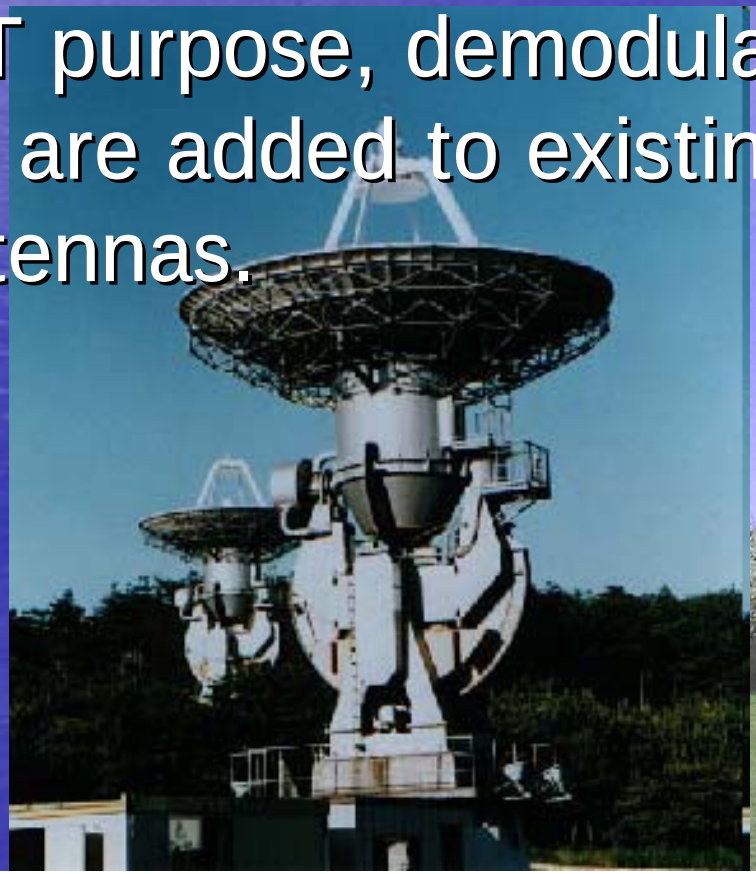
- MMO accepts observation requests for GOSAT mission sensors and make plan for sensors operation and data downlink.
- MMO is also responsible for downlink antenna assignment.
- MMO locates at TT&C operation room for GOSAT and the same operator controls it together with Satellite Management and Control System (SMACS).

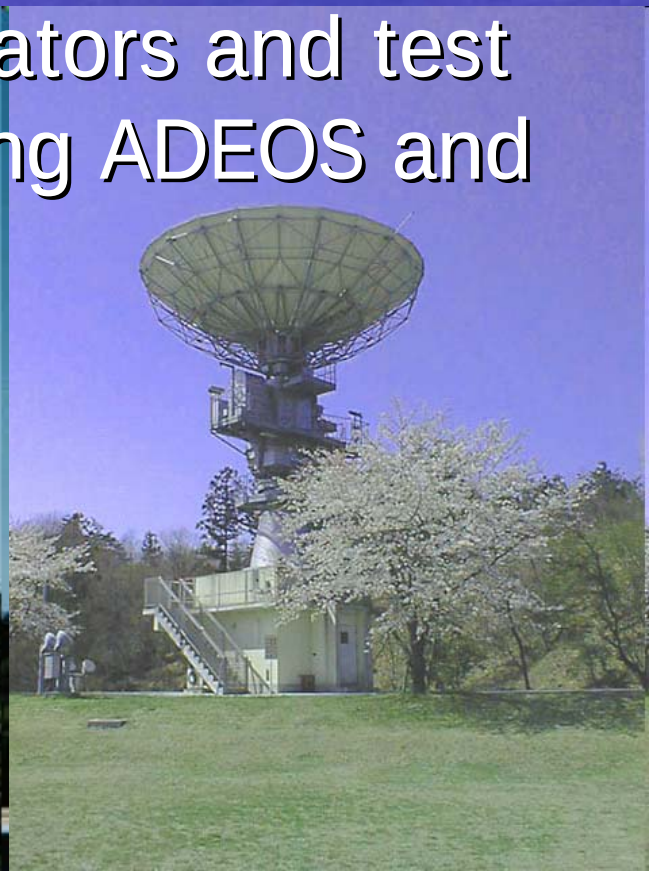
EOC Data Acquisition Control System (DACS)

- DACS controls EOC data receiving and recording systems and assigns EOC resources according to the MMO requests

EOC Data Receiving System

- EOC Data Receiving System tracks GOSAT satellite. It receives and demodulates GOSAT mission data downlink via X-band.
- For GOSAT purpose, demodulators and test modulator are added to existing ADEOS and MOS-1 antennas.





Data Recording System for GOSAT

- Data Recording System records demodulated data sent from X-band receiving system as Raw Data. In pararell, it sorts the demodulated data according to their APID and records as APID sorted data.
- It sends recorded APID sorted data to GOSAT data processing system via EORC Information System (EIS).
- Operation can be done by the same operator for receiving system.
- This system is also applicable to any other satellites using CCSDS format

High Latitude Abroad X-band Receiving Station（KSAT SvalSat）

- SvalSat is an X-band receiving station locates at 78 degree north of latitude.
- SvalSat has visibility for every GOSAT orbit of 14-15 ones per day.
- 5-7 GOSAT downlinks to SvalSat per day are planned.
- SvalSat send APID sorted data to JAXA/EORC.
- Data Transmission will use academic network such as GEANT/SINET.

EORC Information System (EIS)

- EIS is constructed as a common infrastructure for Tsukuba Earth Observation Research Center (EORC).
- For GOSAT, it takes care of data interface control, data archiving, and user services.

Processing Control System (PCS) for GOSAT

- PCS controls GOSAT specific data processing subsystem as an outer function.
- PCS takes care of planning for data processing, product scene definition, data interface control, results management, etc.
- PCS can be applicable to other global observation satellites data processing with relatively simple revision.

GOSAT Specific Data Processing System

- Data Processing System perform level 1 processing for GOSAT TANSO FTS and CAI.
- It also equips visual inspection function.

Automatic Alert System (AAS)

- AAS receives alert mails from registered systems and transfers the alert to the registered personnel via e-mail.
- AAS sends alert mail when the registered systems cease to send periodical alive mail.
- AAS follows up non-conformances until the problem is fixed.

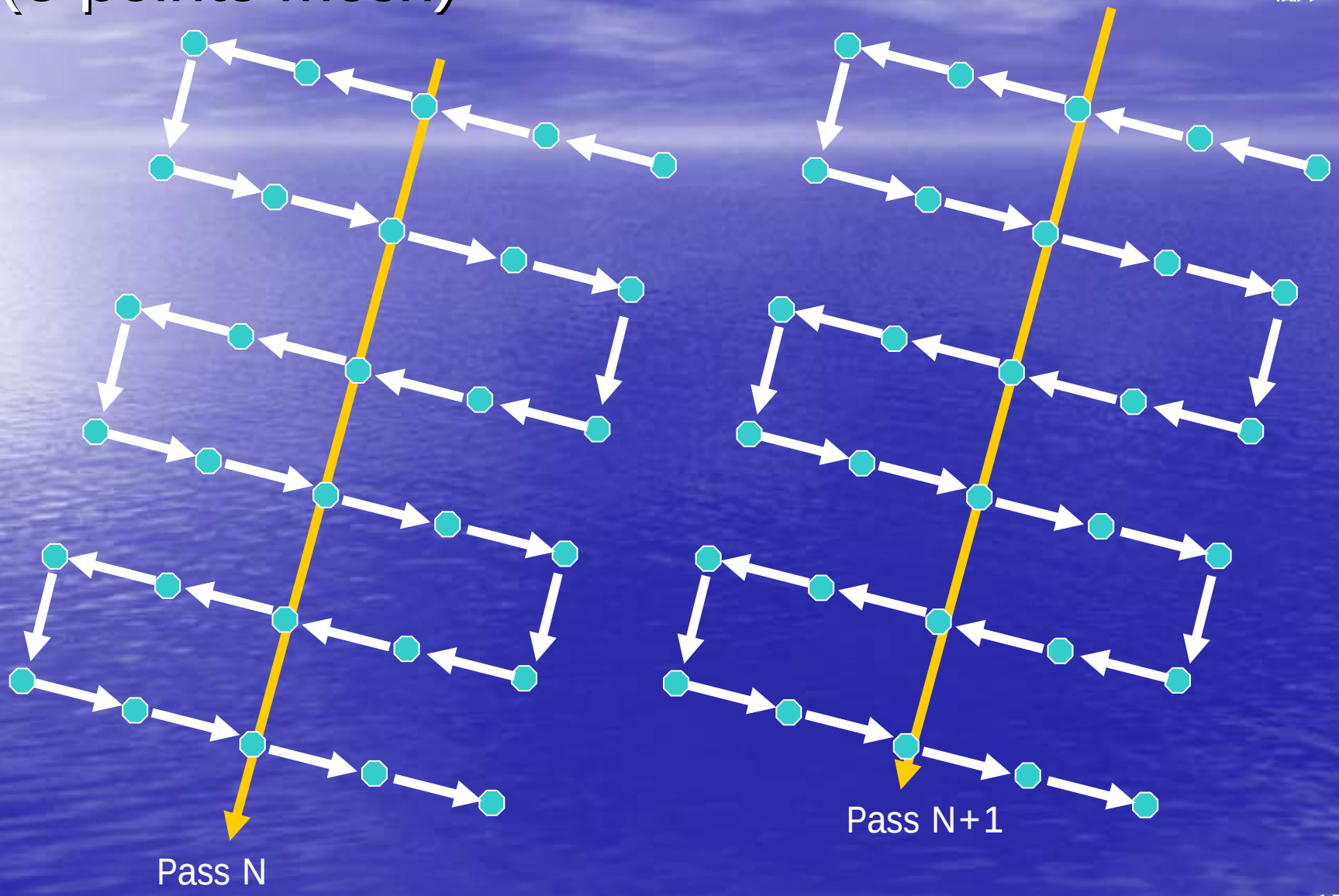
TANSO/FTS Observation Modes

Observation Mode		Outline
Observation Mode Ⅰ	Day Observation	Mesh points observation with SWIR and TIR bands.
	Night Observation	Mesh points observation with TIR bands.
Observation Mode Ⅱ		SWIR only observation mode without pointing mirror control for the case of power supply contingency
Target Mode	Sunglint Observation	Sunglint observation
	Target Mode Observation	To observe specified target locations requested through observation requests.
Calibration Mode	Moon Calibration	Calibration for SWIR band using full moon. This calibration will be planned once a year.
	Solar Irradiatnce Calibration	This calibration is done at satellite dawn in every orbit.
	Instrument Function Calibration	Perform mechanical calibration using 1.55 μm semi-conductor laser.
	Electrical Calibration	Calibrate onboard signal processing by inputting voltage standard signal
Diagnostic Mode		Check refrigerator status when necessary

TANSO/CAI Observation Mode

Observation Mode		Observe Earth surface during day
Calibration Mode	Moon Calibration	Calibration for SWIR band using full moon. This calibration will be planned once a year.
	Electric Calibration	Calibrate onboard signal processing by inputting voltage standard signal
	Night Calibration	Calibrate night offset level.

Mesh Pattern Observation Mode (5 points mesh)

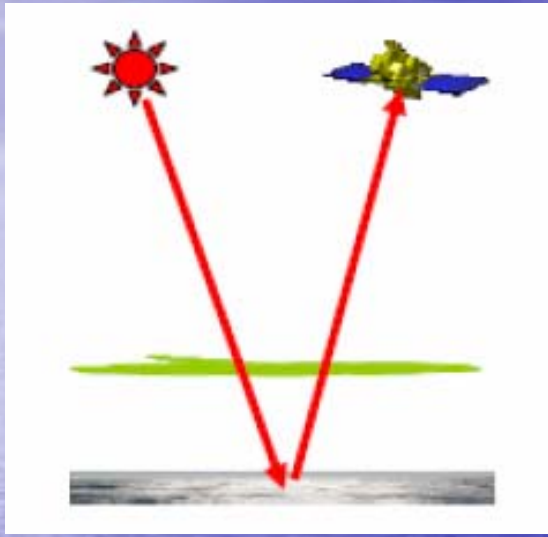


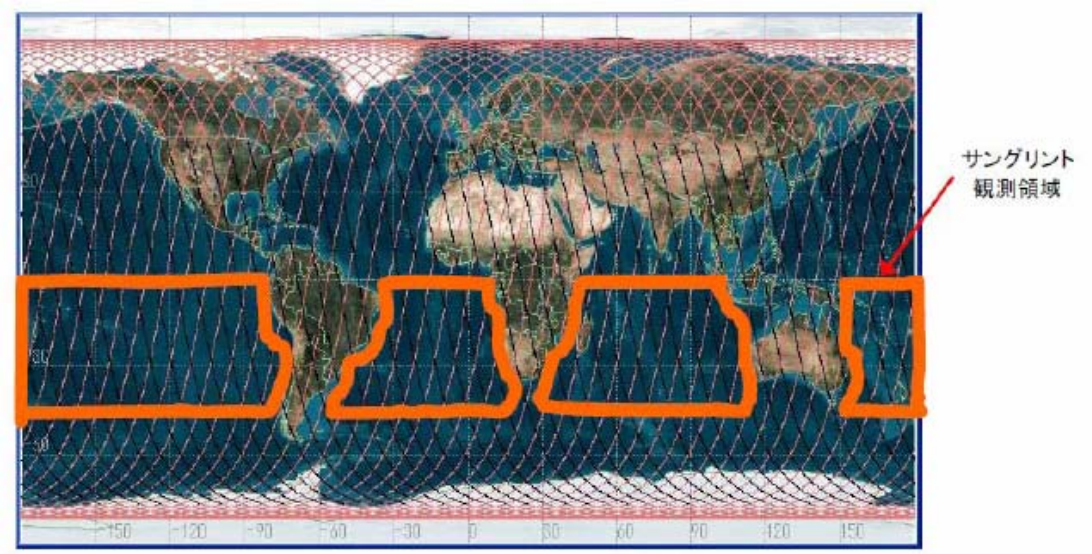
Daytime: SWIR+TIR Nighttime: TIR only

Standard Mesh Pointing Observation

# of points for cross track direction	Distance of neighbor points at latitude of 30 deg (km)	Distance of neighbor along tracks latitude of 30 deg. (km)	Time for 1 point observation (sec)	Time for 1 exposure (sec)	Number of exposures for 1 point observation
1	788.8	90.3	12.8	4.0	3
3	262.9	283.1	13.2	4.0	3
5	157.8	152.2	4.0	4.0	1
7	112.7	114.9	2.0	2.0	1
9	87.6	86.2	1.1	1.1	1

Sunglint observation





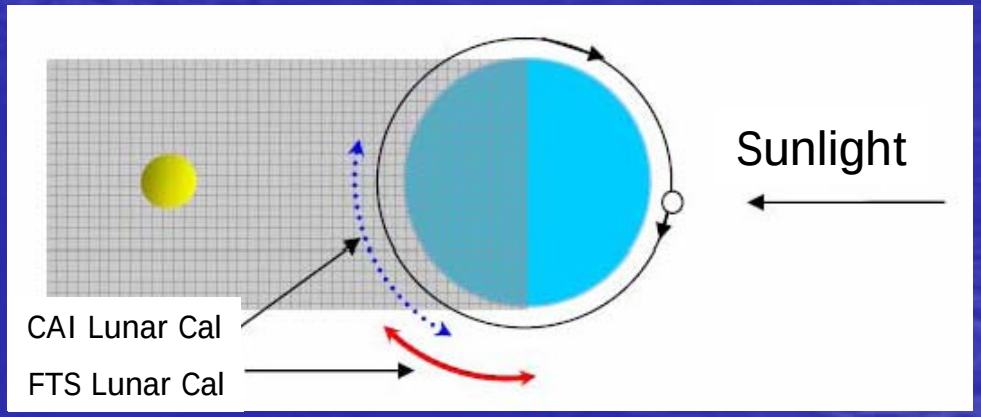
- Sunglint observation is for better statistics for SWIR bands over water reflection of sun light.
- Sunglint observation is done with target mode
- Sunglint observation is done with mirror fixed

Target Mode Observation

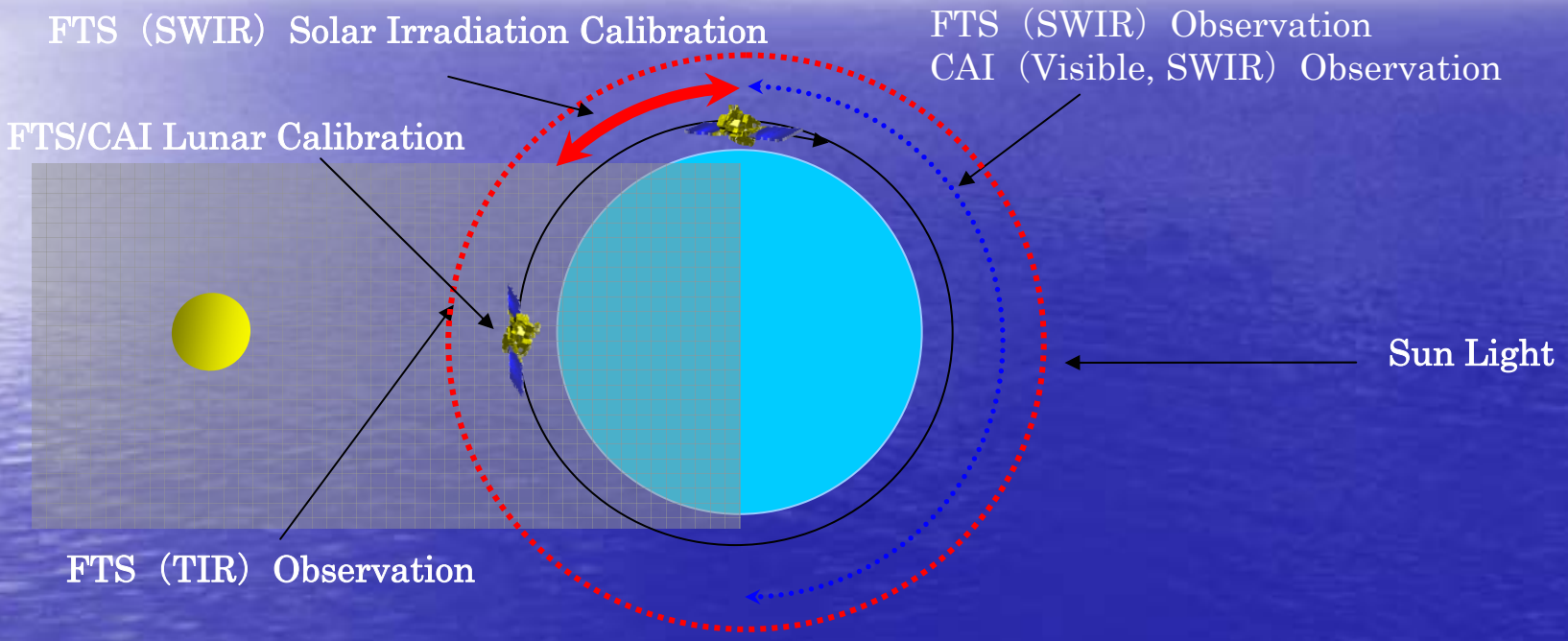
- Observe the positions specified by observation requests
- One point or continuous multiple points target mode is available
- Maximum 8 sets limitation for target mode per orbit
- Sunglint observation is also a target mode observation
- Target points table has capacity of 3000 points parameters

TANSO/FTS Onboard Calibration

- Solar Irradiance Calibration
  - Done during satellite dawn while satellite in daytime and zeneith point in nighttime
- Blackbody and Cold Sky Calibration
  - Done as pair
  - m and n times during daytime and nighttime, respectively, in an orbit（m+n≦16）
  - To avoid losing the same altitude data phase of these calibration is determined with a function of date
- Lunar Calibration
  - Done once a year using 1.3 orbits during full moon time
- Instrument Function Cal.
  - Once a month
- Electrical Calibration
  - Once a month

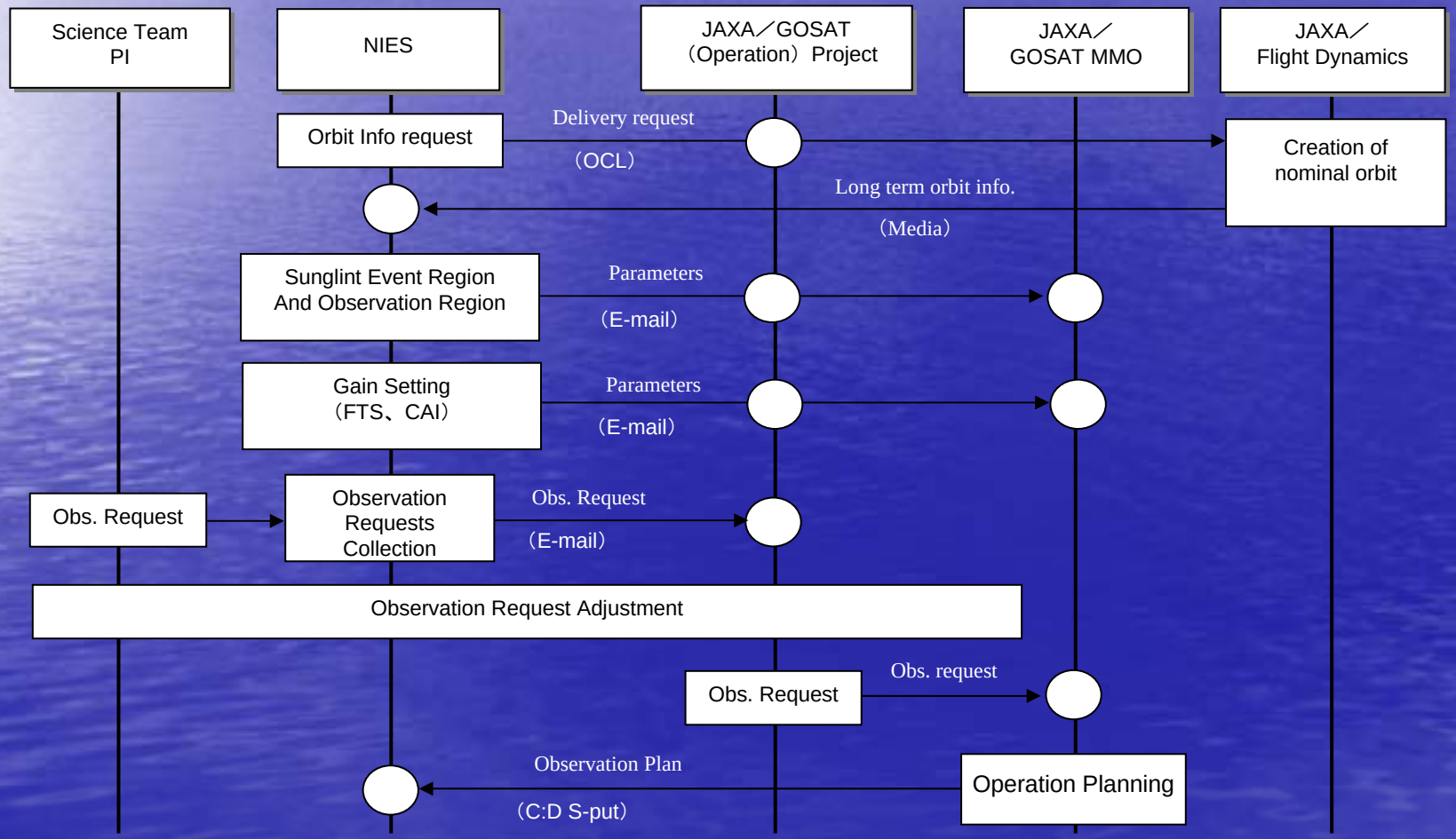


Basic Observation Pattern



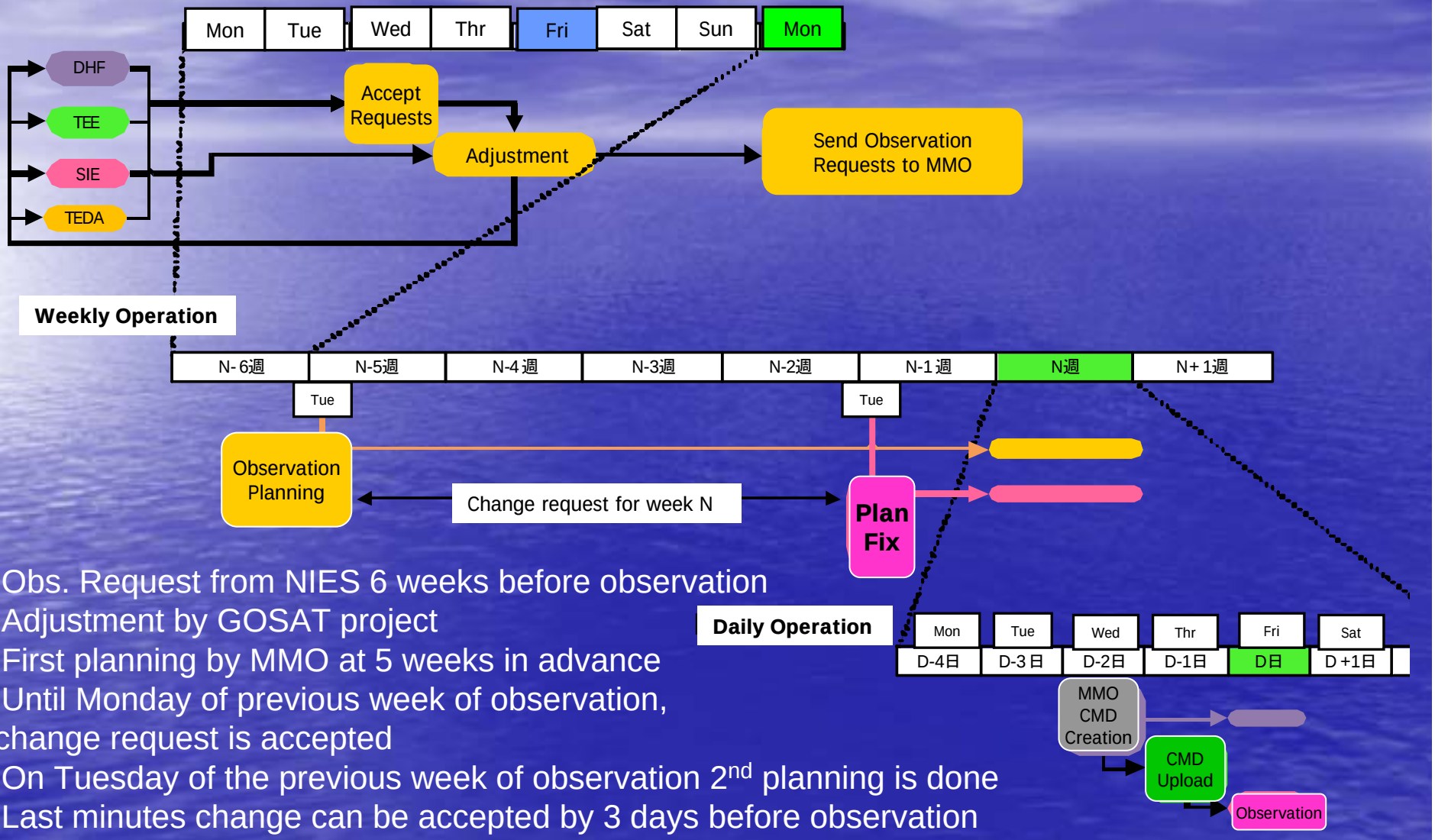
Observation Requests and Planning

- NIES collects observation requests from Science Team and PIs
- Merge NIES observation requests with JAXA original one and GOSAT project adjusts them
- MMO accepts observation requests after adjustment to plan observation.
- Observation plan is delivered to NIES



Timeline for Observation Requests

【運用プロジェクト観測要求受付・調整】



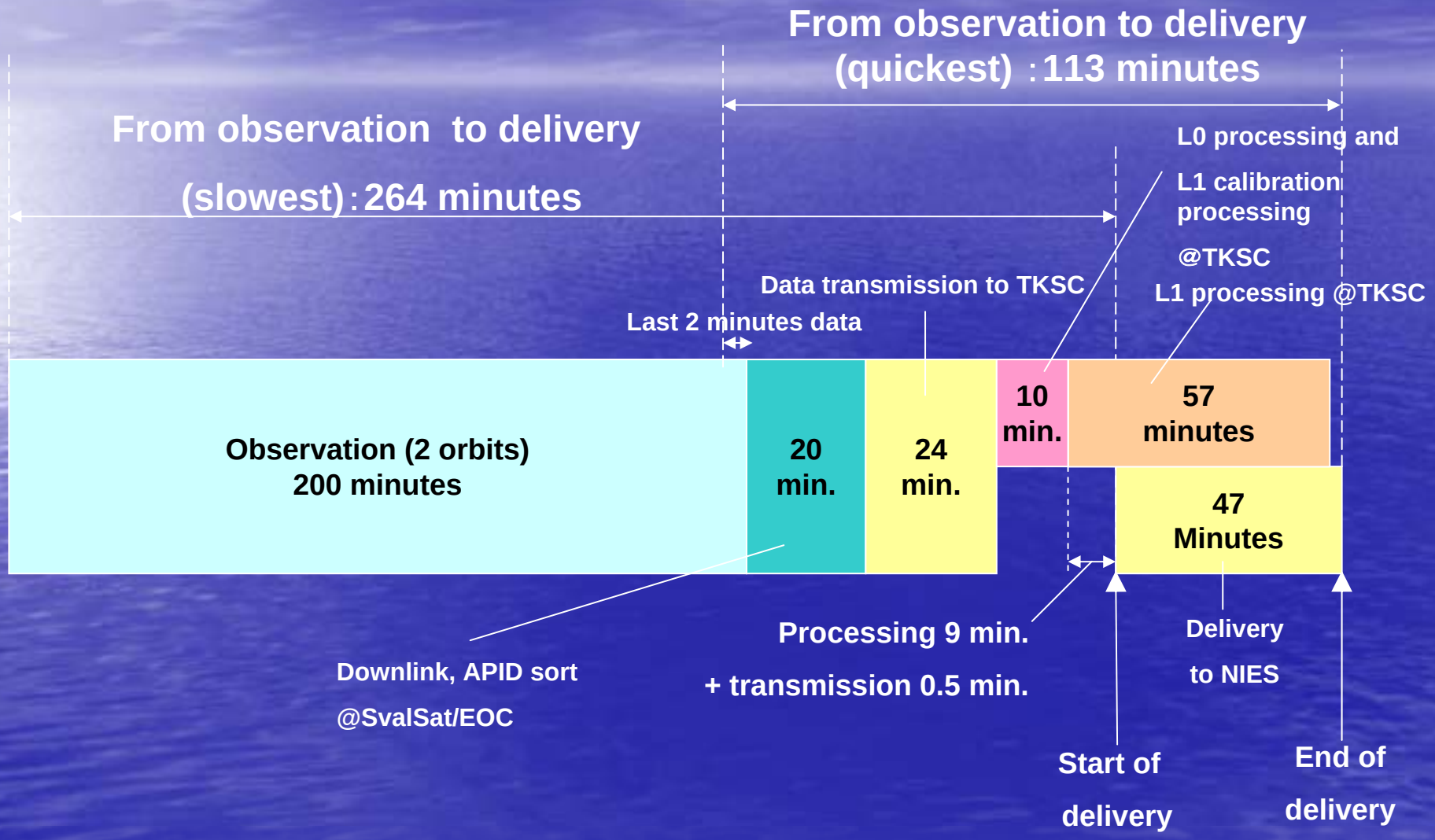
- Obs. Request from NIES 6 weeks before observation
- Adjustment by GOSAT project
- First planning by MMO at 5 weeks in advance
- Until Monday of previous week of observation, change request is accepted
- On Tuesday of the previous week of observation 2nd planning is done
- Last minutes change can be accepted by 3 days before observation
- Final observation plan and commands are made 2 days before
- Command upload to GOSAT 1 day before

Flow from observation to data production

- Observation — 1 downlink per every 2 orbits
- Wait before downlink — Less than 2 min. for TANSO
- Downlink — 1 downlink takes 4-10 min. 1 minute downlink transmits 0.9 GB data.
- Processing at station — APID sorting: It takes 2-3 timed longer than downlink time
- Data Transmission — Effective 20Mbps connection
- L0 processing — < 5 min.
- L1 Calibration Processing — < 5 min.
- L1 Processing — Faster than 1/3 of observation duration
- L1 Data Transmission — Effectively 20Mbps connection

NIES

Timeline from observation to delivery of FTS L1 products

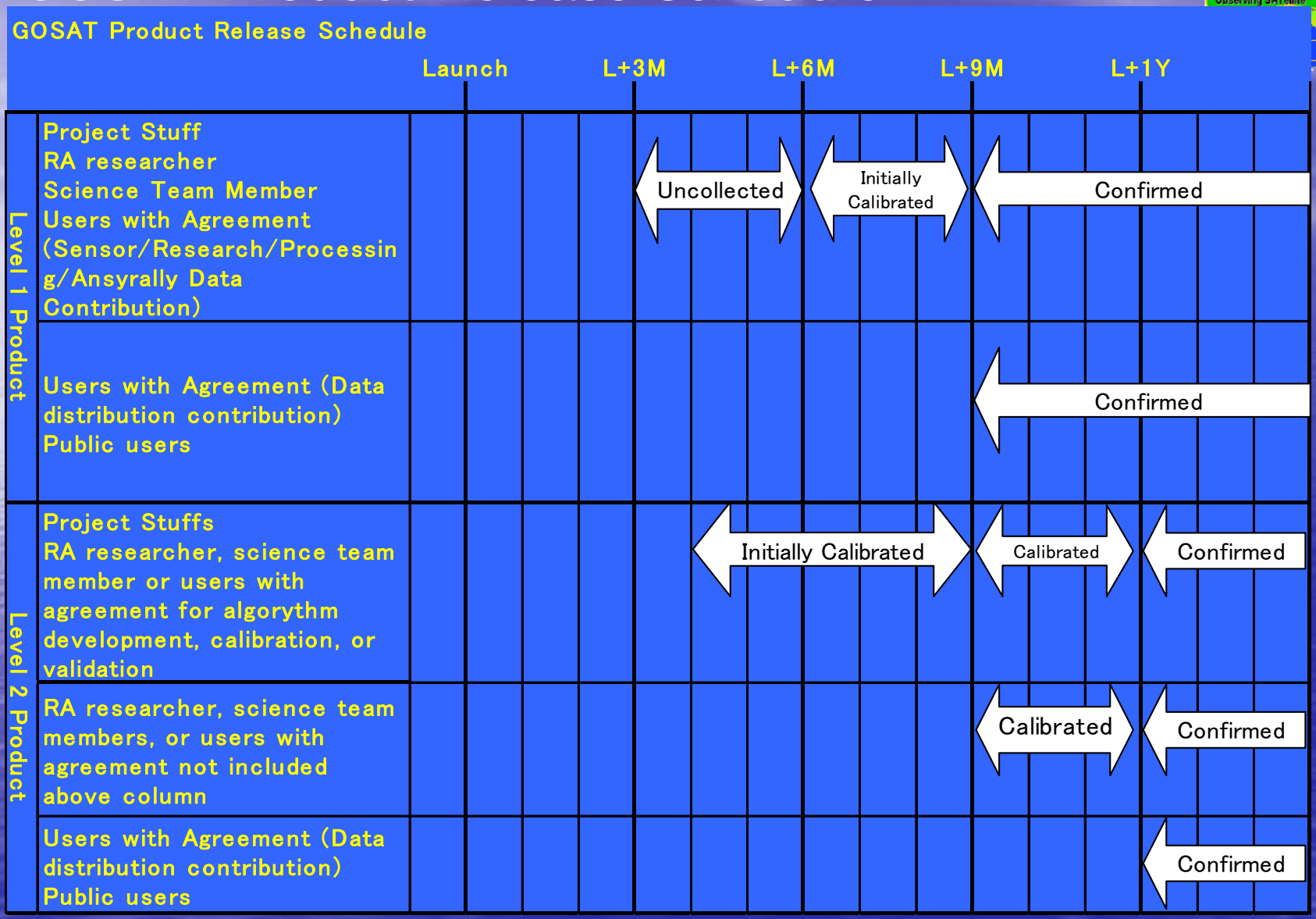


GOSAT JAXA TANSO Products

	Products	Outline
FTS	Level 1A/B	L1A product covers 1/60 orbit interferogram data for mesh pointing observation accompanied with geometric information and radiometric calibration information. L1B is spectrum data with FFT on interferogram data of L1A
	Level 1A/B Target Mode	Same as Level 1A/B but for Target Mode Observation.
	Level 1A/B Calibration	Interferogram and Spectrum data of FTS calibration modes except for lunar calibration. One calibration products contains one downlink data.
	Level 1A/B Lunar Cal.	Interferogram and spectrum data of FTS lunar calibration mode
CAI	Level 1 Product	Day-Earth surface observation data for half orbit by digital number accompanied with geometric information and radiometric calibration information.
	Level 1 Calibration	Calibration mode data for CAI except for lunar calibration. One calibration product contains one downlink data.
	Level 1 Lunar Calibration	Lunar Calibration mode data for CAI. This product contains one full lunar calibration data.

FTS L1B is standard product and open to public, but FTS L1A and CAI L1 data are internal products and available to limited users

GOSAT Product Release Schedule



Level 3 and 4 product will be distributed when NIES release confirmed version