



→ ADVANCED COURSE ON RADAR POLARIMETRY 2019

22–25 January 2019 | ESA–ESRIN | Frascati (Rome), Italy

COSMO-SkyMed Second Generation

Luigi DINI (Italian Space Agency, Italy)

23/01/2019

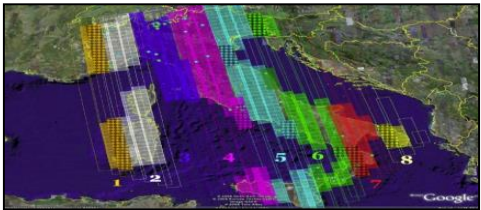
COSMO-SkyMed Second Generation (CSG) is the follow on mission to COSMO-SkyMed (CSK), currently operating in orbit, aimed at assuring operational continuity and performance improvement in supplying the SAR imaging services through data and image products, such to preserve and enhance the ability of customers and operational users to fulfil their mandates

- Operational continuity/preserve
- Performance improvements/enhance

Cosmo-SkyMED is a dual system mission

Cosmo-SkyMED is a user driven/on demand system: Differently from other Earth Observation systems (e.g.Sentinel, Landsat, etc.), it is mainly designed for fast and prompt reaction to asynchronous on-demand requests from users.

Even if CSG System is mainly conceived to optimize on-demand requests, it will be able to perform systematic acquisitions over pre-defined areas



Wet Mass @ Launch	~2226 Kg (Current estimation)
Operational Lifetime	7 years
Launcher	Soyuz
Operative Autonomy	24 h
Attitude Stabilization	3 axes
Navigation and Time Reference	GPS
SAR Payload	X-Band (9.6 GHz)
Imaging Capability	Multimode with electronic steering
Data Down Link Rate	X-Band (2X260 Mbps)
On-Board Storage Memory (EOL)	1530 Gbit

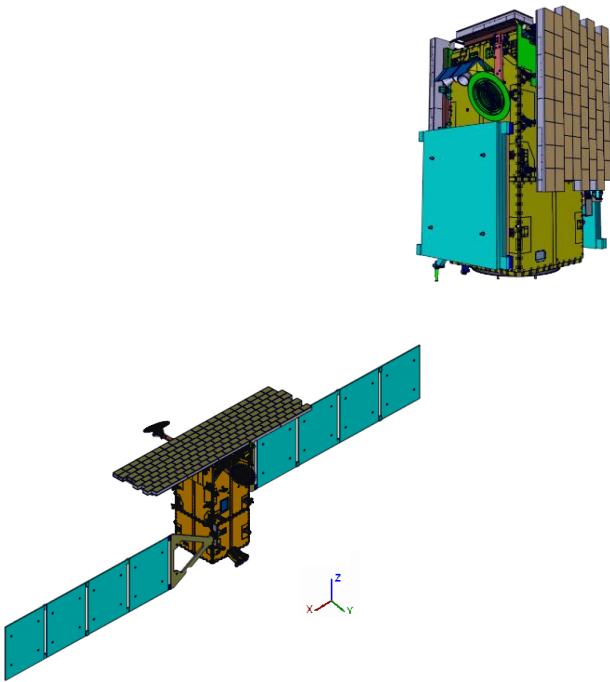


Image credit TAS-I

Orbit type:	SSO dawn-dusk
Repeat Cycle /#Revolutions	16 days/237
Orbital Period	97.1 min
Inclination	97.86°
Eccentricity:	0.001185
Argument of perigee:	+ 90°
height:	619.6 km
LTAN:	6:00 a.m.

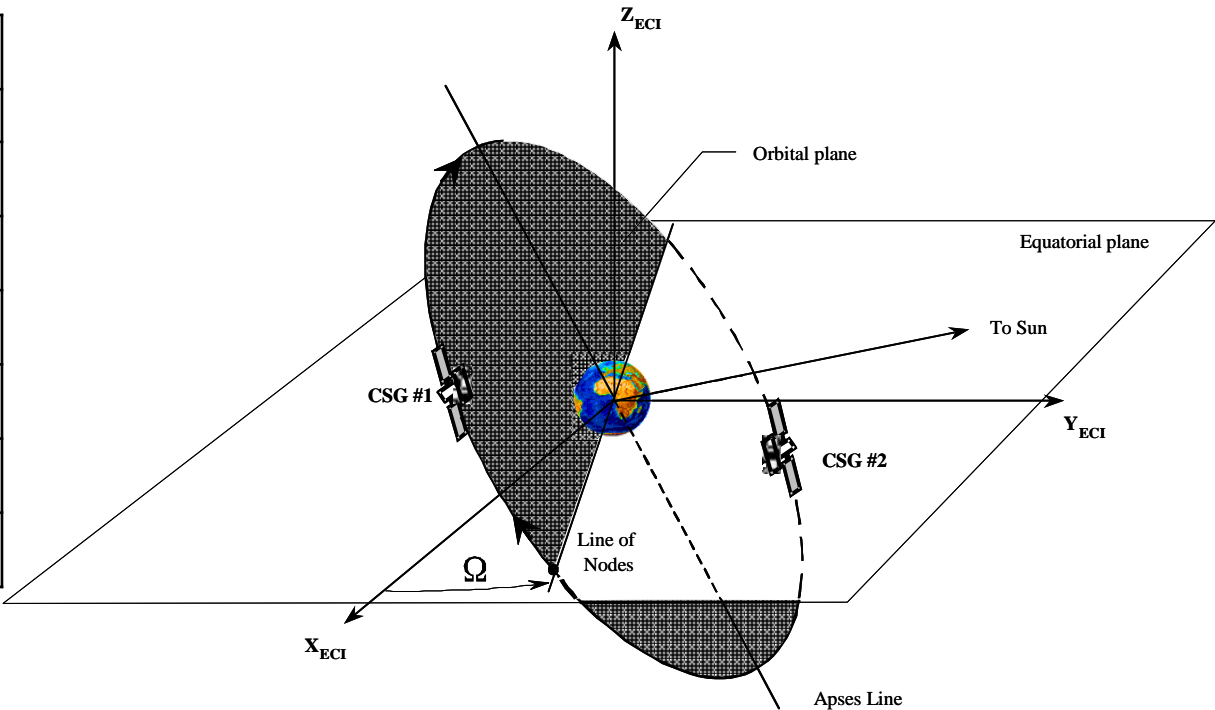
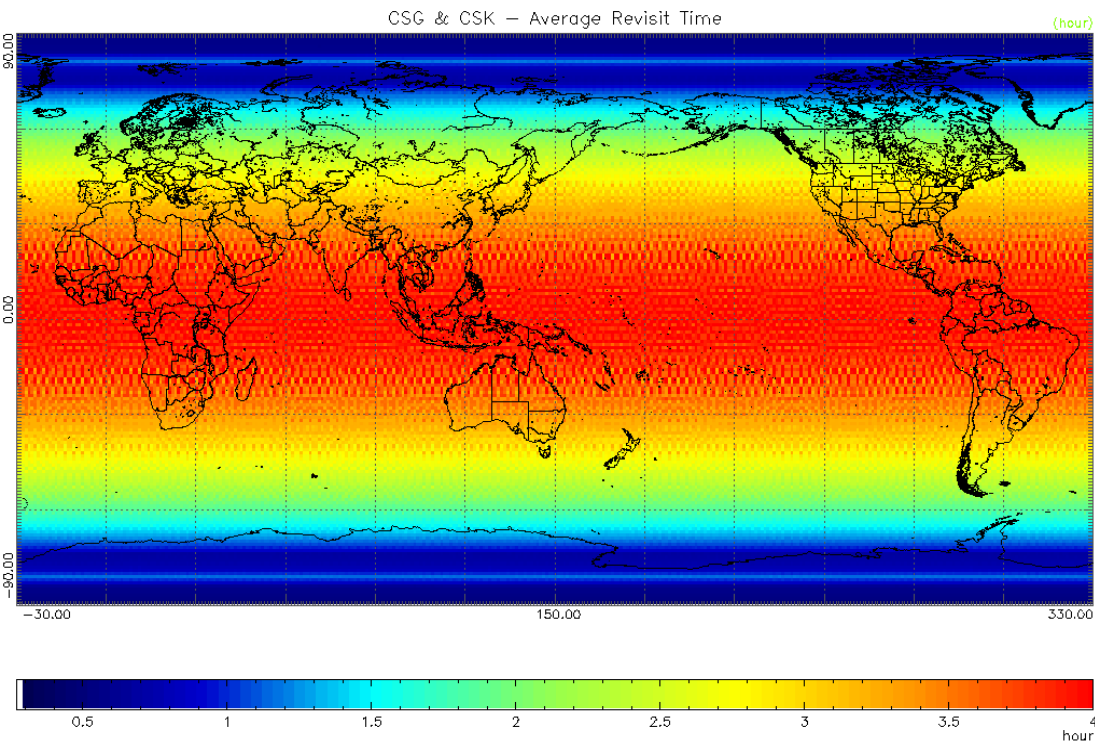


Image credit TAS-I



CSK + CSG Average revisit Time

- ✓ ~ 4 h. @ equator (CSK alone~6 h.)
- ✓ ~ 2.5 h. @ Europe (CSK alone~3.5 h.)

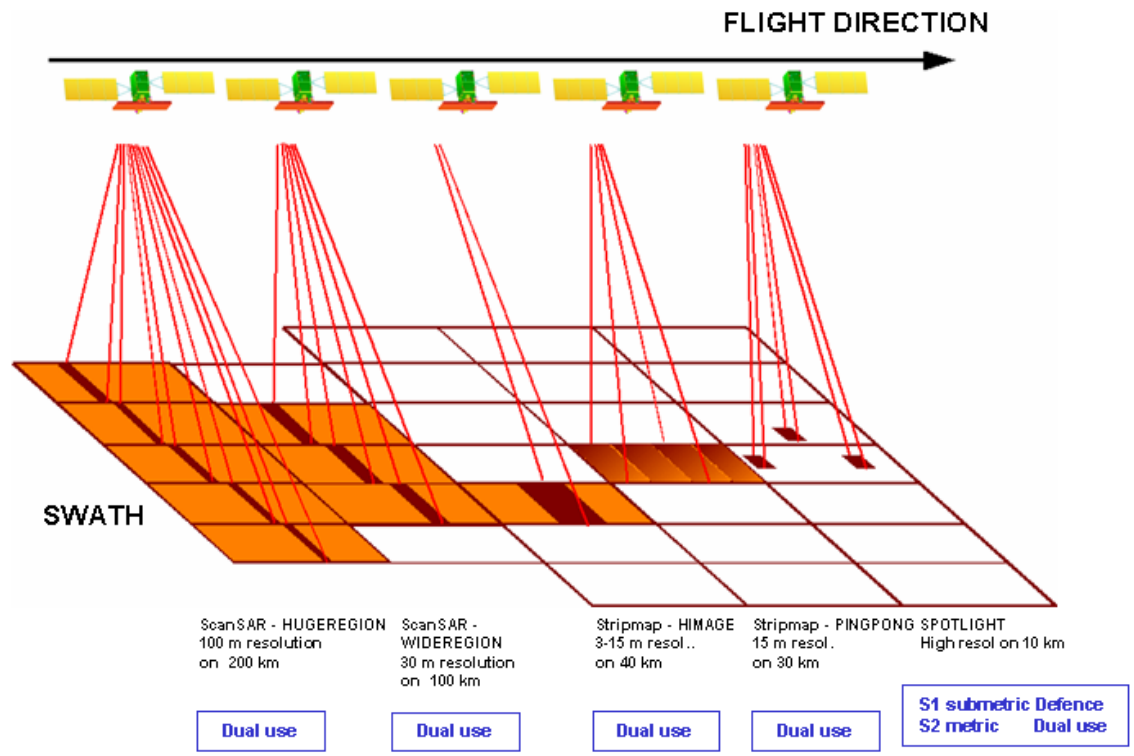
Image credit TAS-I

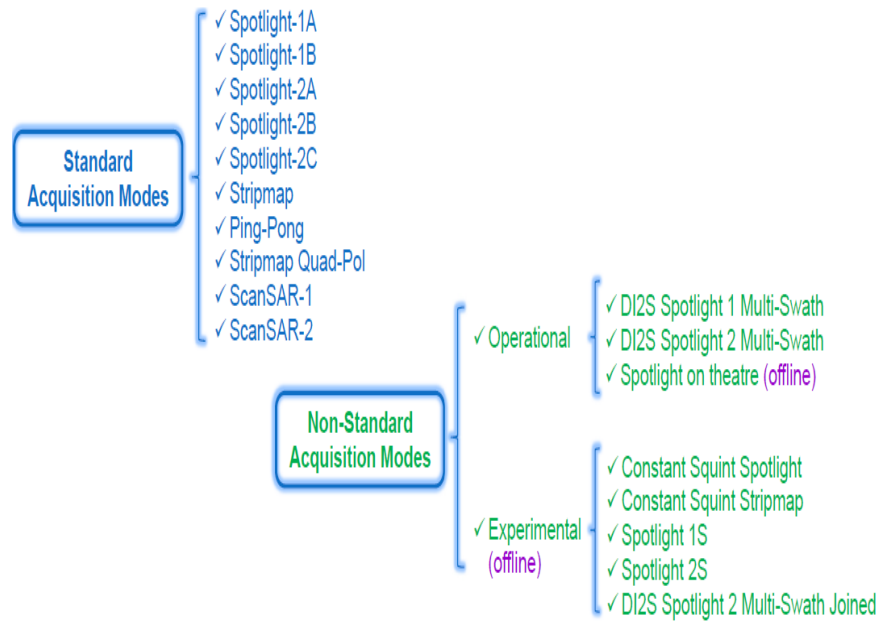
Image credit TAS-I



Multimission

- UGS (User Ground Segment)
- SDC (Sar Dual control Center)
- External Stations
- Ground Fiducial networks
- Additional data providers
- Cmaps/Dmaps/TUC/TUP (only CSK)





	Polarisation	Access Region [°]	Swath [Az x Rg] [km x km]	Resolution [Az x Rg] [m x m]	NESZ [dB]	Scientific Geolocation [m]
Spotlight 2A	Single / Dual	20 - 25 25 - 50 50 - 60	Goal: 3.1 x 7.3 Goal: 3.2 x 7.3 Goal: 4.4 x 7.3	0.35 x 0.55 0.35 x 0.51 0.35 x 0.48	Goal: -23.5 Goal: -22.5 Goal: -20	1.25 (90% CE)
Spotlight 2B	Single / Dual	20 - 60	10 x 10	0.63 x 0.63	-20	1.25 (90% CE)
Spotlight 2C	Single / Dual	20 - 25 25 - 50 50 - 60	Goal: 5 x 10	0.8 x 0.8	Goal: -22 Goal: -20 Goal: -19	1.25 (90% CE)
Stripmap	Single / Dual	20 - 50 50 - 60	40 x 40 40 x 30	3 x 3	-22	2 (90% CE)
Ping-Pong	Dual / Quad	20 - 60	30 x 30	12 x 5	-22	10 (3σ)
Stripmap Quad-Pol	Quad	20 - 45	40 x 15	3 x 3	-22	2 (90% CE)
ScanSAR 1	Single / Dual	20 - 60	100 x 100	20 x 4	-22	10 (3σ)
ScanSAR 2	Single / Dual	20 - 50 50 - 60	200 x 200 200 x 190	40 x 6	-22	10 (3σ)

CSK/CSG Spotlight standard mode:

Separation between spotlight images is ~100 km.

CSG Theatre mode :

The platform agility allows to perform pitch maneuvers.

The ground separation of spotlight images can be 0 km.

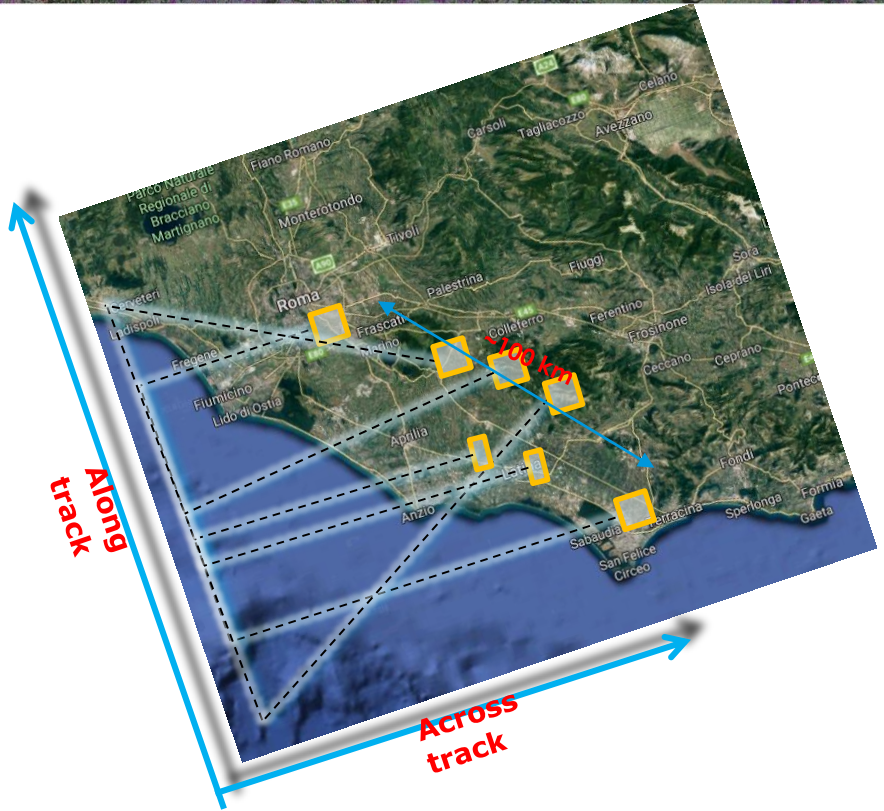
More images in a theatre region can be acquired.

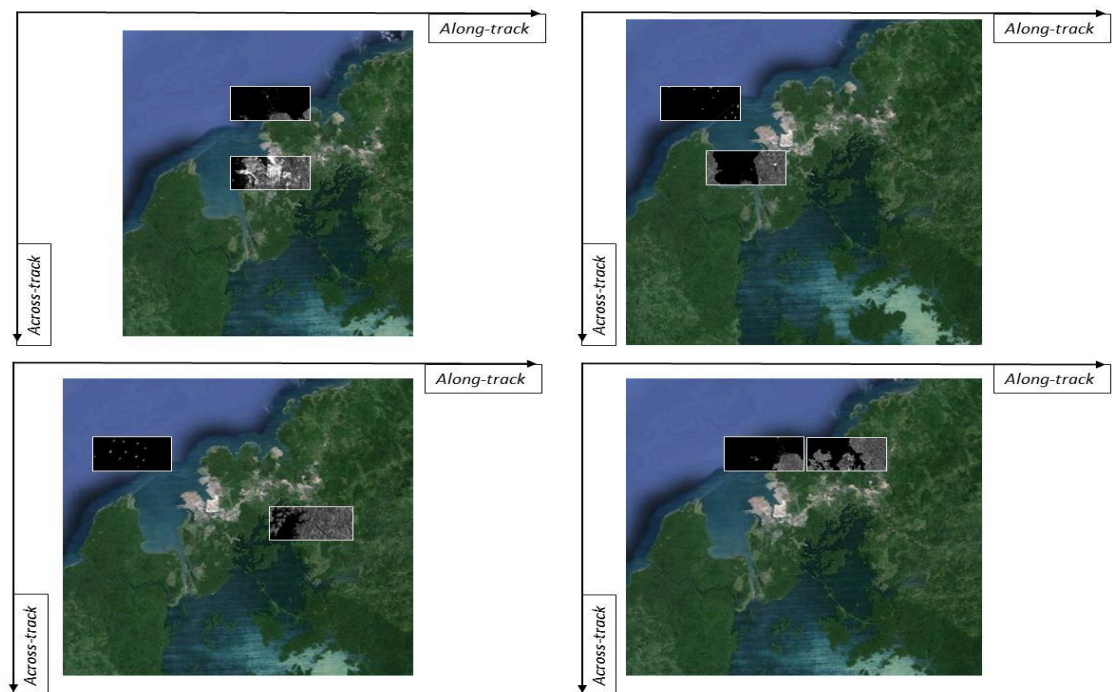
CSG DI2S:

The SAR instrument capabilities allows to acquire two targets almost simultaneously.

The ground separation of spotlight images can be 0 km.

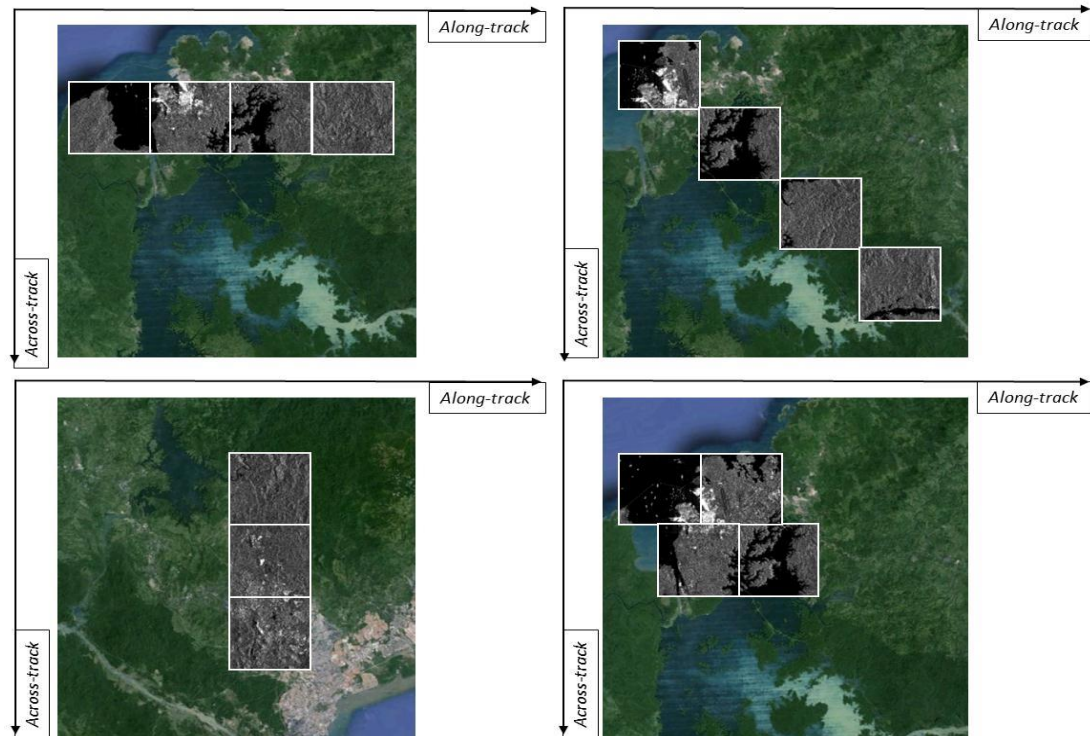
The range swath is reduced.





- ✓ SAR works @ double PRF
- ✓ odd impulses are processed to acquire one image
- ✓ even impulses are processed to acquire the other image

Image credit TAS-I



- ✓ SAR acquires while maneuvering around pitch axis => No zero Doppler azimuth
- ✓ Acquisitions can be either adjacent or scattered

Squinted and adjacent acquisitions on a theatre scenario

Image credit TAS-I

Image credit TAS-I

SAR Standard Products

- **Level 0, RAW** (In-Phase and Quadrature of the echoed data, not focused)
- **Level 1A, SCS** (In-Phase and Quadrature of the focused data)
- **Level 1B, DGM** (Amplitude of the focused data, multilooked, Hamming weighted)
- **Level 1C, GEC** (Amplitude of the focused data ,Geo-coded, Ellipsoid corrected)
- **Level 1D, GTC** (Backscattering coefficient of the observed scene, multilooked, Geo-coded, Terrain corrected)

CSG Not Standard Products

- **QUICK LOOK**
- **SPECKLE FILTERED**
- **COREGISTERED**
- **INTERFEROMETRIC**
- **COHERENCE**
- **DEM**
- **MOSAIKED**
- **CROPPED**

- Phase C (Design): completed (Nov. 2017)
- Phase D (AIT): ongoing
- Phase E (Operations/Utilization):
 - Launch CSG-1: Q4 2019 (estimated, contract with Arianespace already signed)
 - Operations CSG-1: Q2 2020 (6 months estimated commissioning phase)
 - Launch CSG-2: Q4 2020
 - Operations CSG-1/2 (complete constellation): Q2 2021

- Open call for the scientific community: <https://www.asi.it/en/agency/calls-and-opportunities/calls/cosmo-skymed-constellation-data-utilization>
- ASI Funded projects
- Interagencies/ intergovernmental agreements

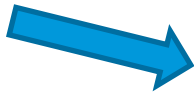
- Improved platform agility
- Enhanced SAR capabilities
- Increased number of spacecraft in constellation (CSK/CSG+Saocom)



Capability to acquire data over a crisis area with:

- a better spatial resolution (i.e. better details)
- a better revisit time (i.e. more frequently)

- Multipolarization (Dual quadpol)
- Multifrequency (X+L)



- capability to identify more targets to keep under monitoring
- PolInSAR might even increase the number of classes and the precision of target identification



THANK YOU!

