

VH-RODA and CEOS WGCV SAR

SAOCOM MISSION Overview

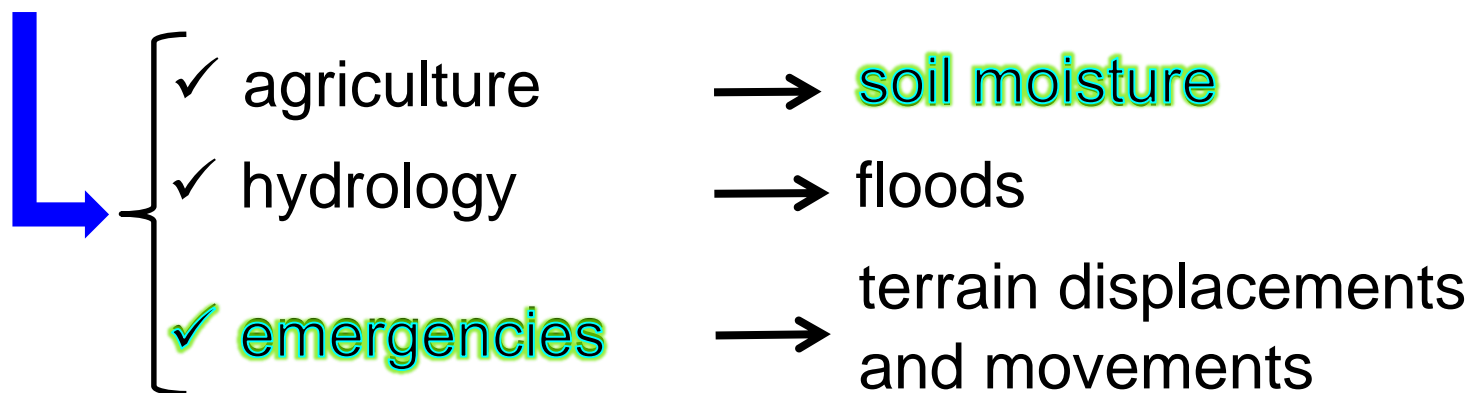
L. Frulla

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*November 18-22. 2019
ESRIN, Frascati
Italia*



To satisfy **user needs** and the Space Information Sectors-**National Space Program**



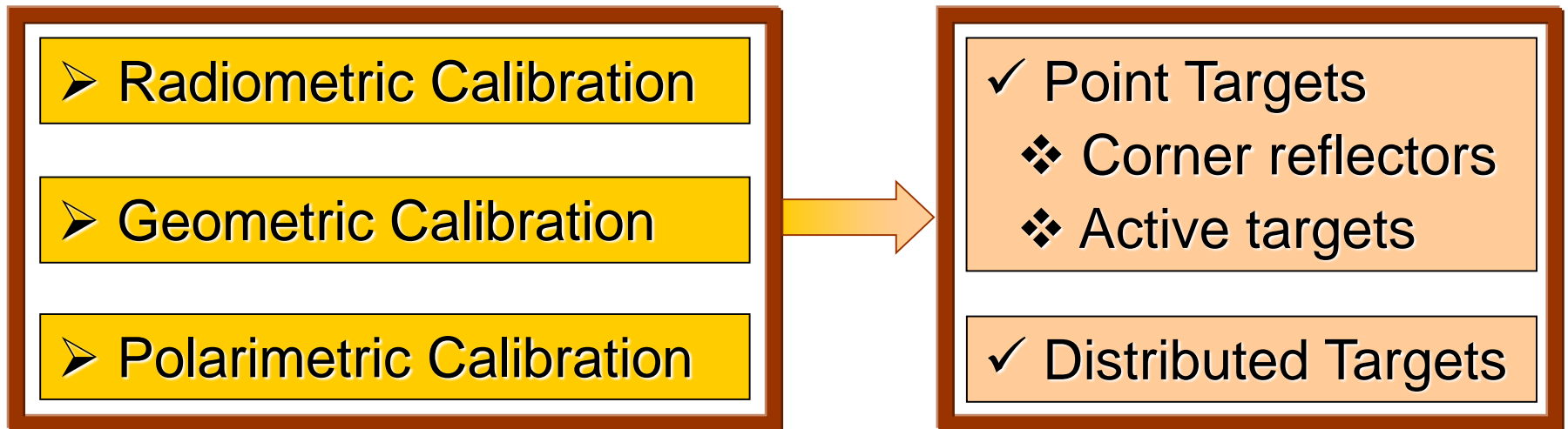
To operationally integrate **SIASGE** composed by the **SAOCOM Constellation** and the **COSMO-SkyMed Constellation** (because of the agreement with ASI)

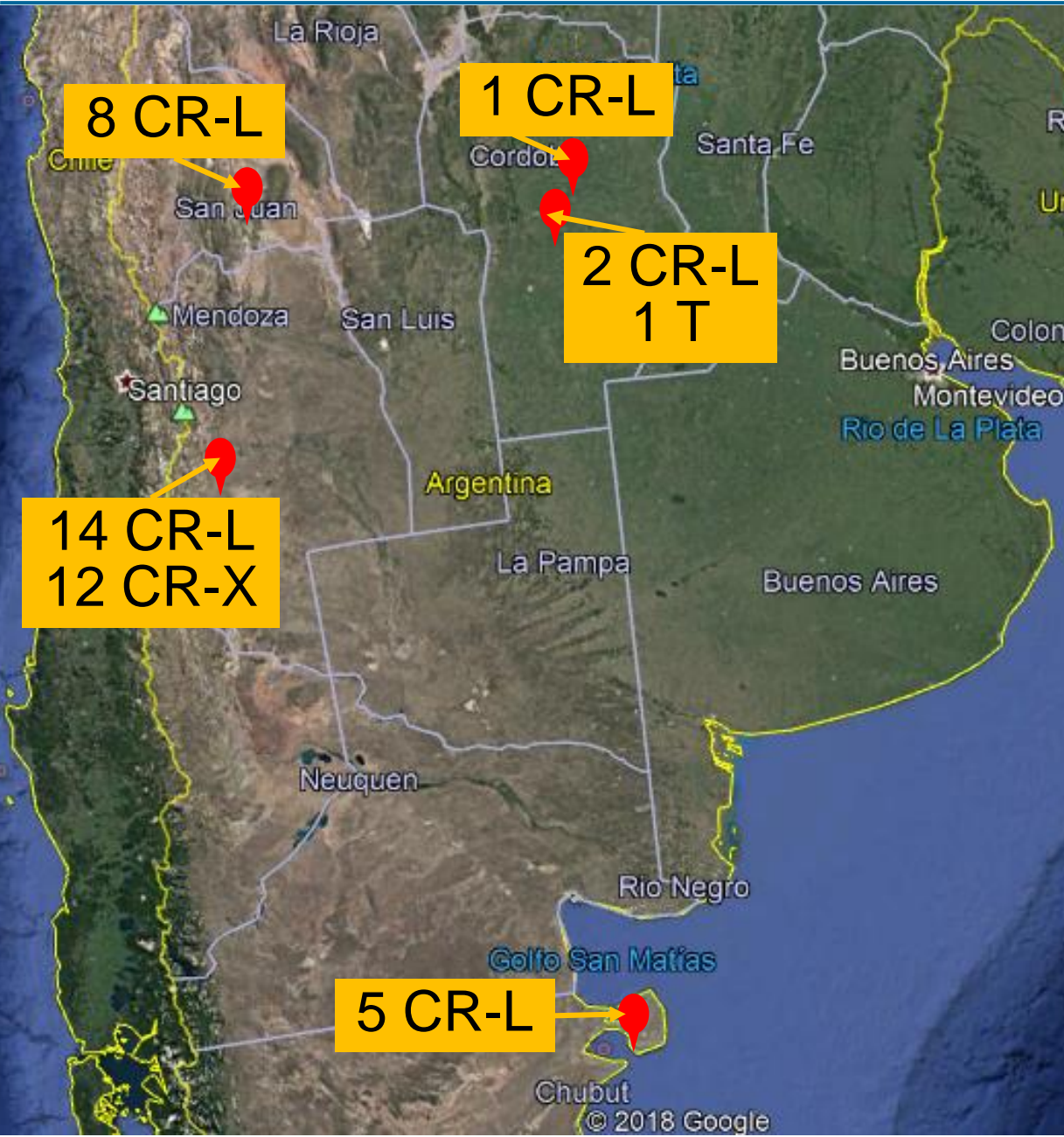
constellation of satellites ✓ SAOCOM-1A ✓ SAOCOM-1B	2 twin located at 180° (opposite) launched on October 7 th of 2019 to be launched in the time-frame February-March
inclination	97.89°
altitude	620 km
local time of asc. node	05:57:45 am
time for one orbit	97.2 minutes
repetition cycle	16 days (1 satellite)/ 8 days (constellation)

mission lifetime	5 years
acquisition modes	real time/stored
coverage	world wide
pulse BW & duration	up to 50 MHz & 60 μ s (programmable)
PRF	up to 2500 Hz per channel (programmable)
radiated peak power	3.9 kW (EOL), 5.5 kW (BOL)
quantization	BAQ 12 to 4 bits (default), 8 bits BATQ
mass memory	256 Gbits
download bitrate	310 Mbps
σ°	-35 to 5 dB
absolute radiometric accuracy (required)	≤ 0.5 dB (QP) , ≤ 1 dB (SP, DP)
polarimetric accuracy	≤ 0.3 dB

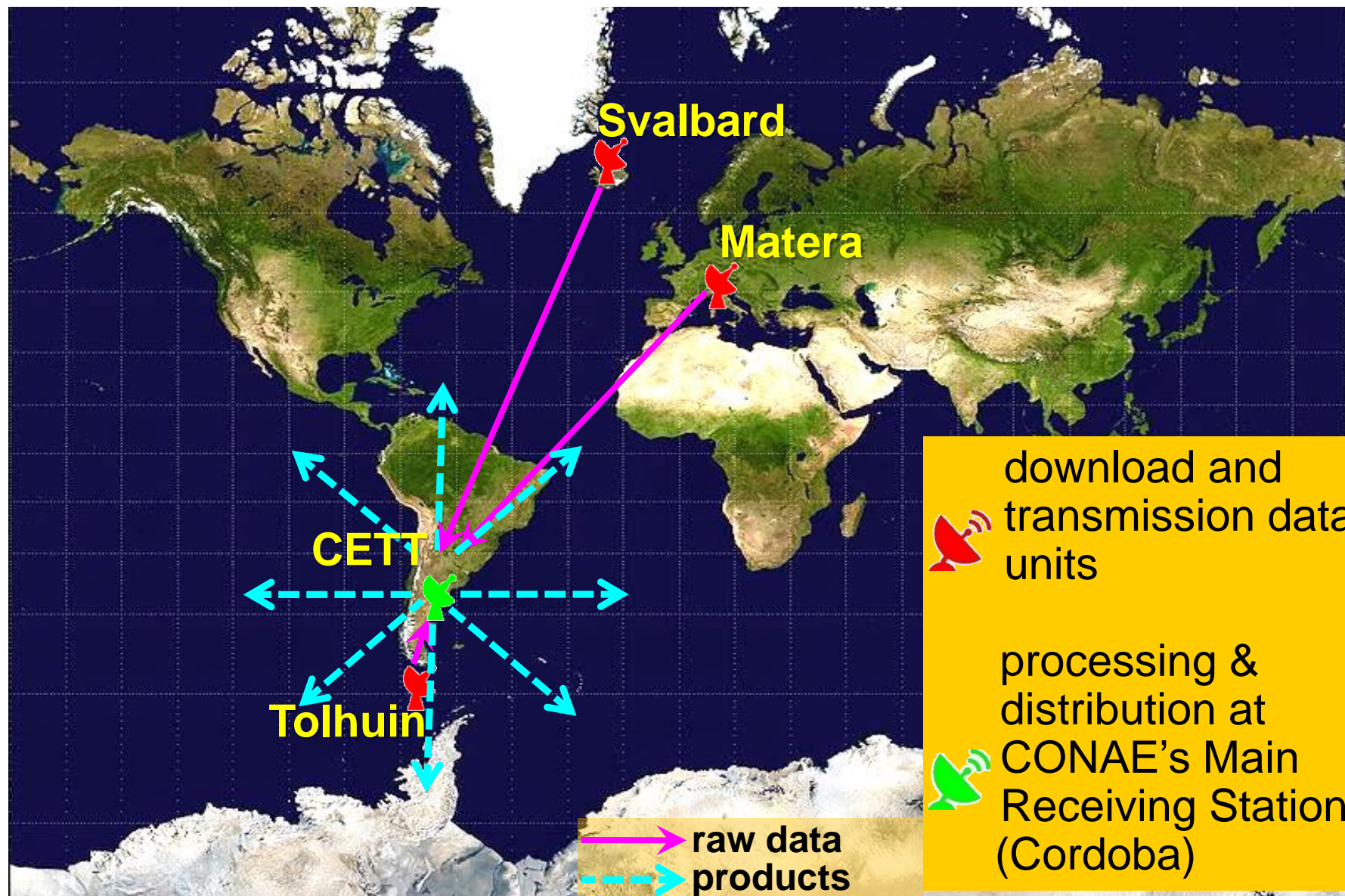
geolocation accuracy (required) ✓ on line ✓ 2 days orbit (rapid) ✓ 18 days precise orbit	depends on precise orbit determination ≤ 90 m ≤ 70 m ≤ 25 m
looking direction	right (nominal)/left (capability)
↙ right looking	✓ continuous acquisitions of 10 minutes when the satellite is in visibility of CETT ✓ 15 minutes per orbit as an average on a daily basis ✓ 20 minutes of non continuous acquisitions in an orbit
↘ left looking	up to 5 min according to resources and preserving spacecraft safety, returning afterwards to the nominal side looking

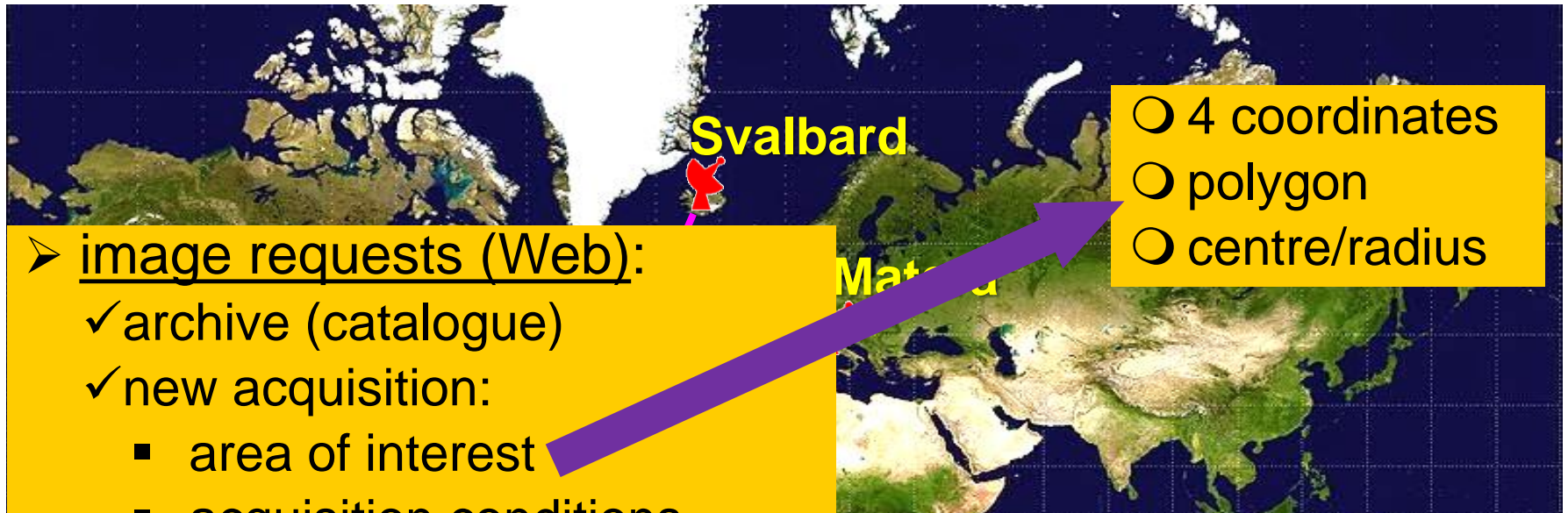
- All L band SAR **operative modes** are calibrated, including **internal** and **external calibration**
- External calibration is implementing according to the **calibration plan** and will be held during the whole mission for SAOCOM 1A and SAOCOM 1B





- ~ 3 m side (L-band)
- $\sigma_0 \sim 38.1$ dB
- variable pointing (azimuth and elevation)
- *in-situ* control ~ each 2 months
 - ✓ structural status and pointing checkings
 - ✓ environmental checking (vegetation)
 - ✓ drainage holes (free)





- image requests (Web):
 - ✓ archive (catalogue)
 - ✓ new acquisition:
 - area of interest
 - acquisition conditions

- 4 coordinates
- polygon
- centre/radius

- Products:
 - ✓ Level 1
 - ✓ Level 2

- download and transmission data units
- processing & distribution at

- SripMap
- TOPSAR Narrow
- TOPSAR Wide
- Circular

- ↔ Single Look Complex-SLC
- ↔ Detected Image-DI
- ↔ Ground Ellipsoid Corrected-GEC
- ↔ Geocoded Terrain Corrected-GTC

SAOCOM Main Features of Level 1 Products: StripMap Single and Dual Polarizations

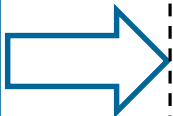


Beam Position	Minimum Incidence Angle Range		Nominal Spatial Resolution		Minimum Swath Width (ground range) [km]	Nominal Azimuth Length [km]	Nominal Equivalent Number of Looks	
			L1A Products	L1B, L1C, and L1D Products			L1A (SLC)	L1B (DI), L1C (GEC), L1D (GTC)
	Near range [deg]	Far range [deg]	Ground Range x Azimuth [m x m]	Ground Range x Azimuth [m x m]				
S1	20.7	25.0	10 x 5	10 x 10	49.7	74.1	1	2
S2	24.9	29.2			52.3			
S3	29.1	33.8			61.4			
S4	33.7	38.3			65.7			
S5	38.2	41.3			49.1			
S6	41.3	44.5			55.6			
S7	44.6	47.1			48.0			
S8	47.2	48.7			31.9			
S9	48.8	50.2			31.1			

Beam Position		Minimum Incidence Angle Range		Nominal Spatial Resolution		Minimum Swath Width (ground range) [km]	Nominal Azimuth Length [km]	Nominal Equivalent Number of Looks	
				L1A Products	L1B, L1C, and L1D Products			L1A (SLC)	L1B (DI), L1C (GEC), L1D (GTC)
		Near range [deg]	Far range [deg]	Ground Range x Azimuth [m x m]	Ground Range x Azimuth [m x m]				
SP/DP	TNA	24.9	38.3	10 x 30	30 x 30	176.3	222.3	1	3
	TNB	38.2	47.1			150.2			
QP	TNA	17.6	27.3	10 x 50	50 x 50	109.9	222.3	1	5
	TNB	27.2	35.5			108.8			
TW		24.9	48.7	10 x 50	50 x 50	353.7	444.6	1	5
TW		17.6	35.5	10 x 100	100 x 100	218.1	444.6	1	10

L1 products

SLC

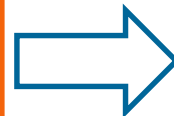


StripMap QP,
TNQP, TWQP

L2 products

✓ Land Cover
Classification Map
(LCC)

✓ Surface Soil
Moisture Map
(SSM)

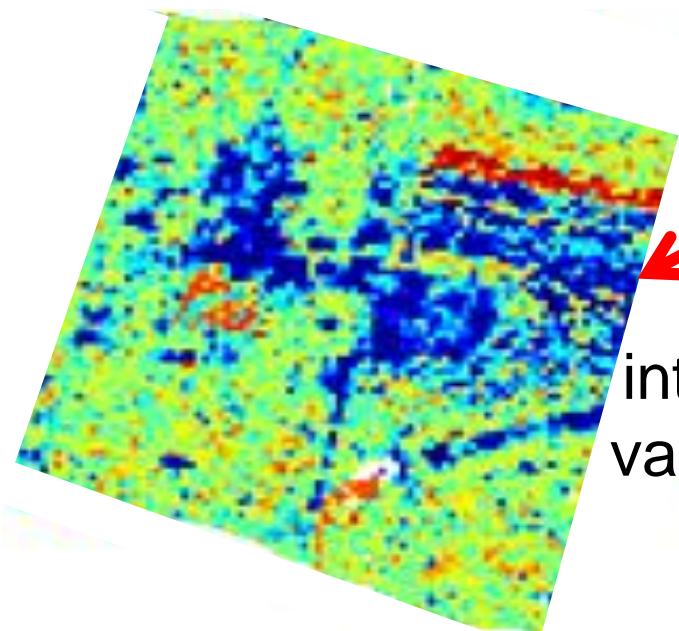
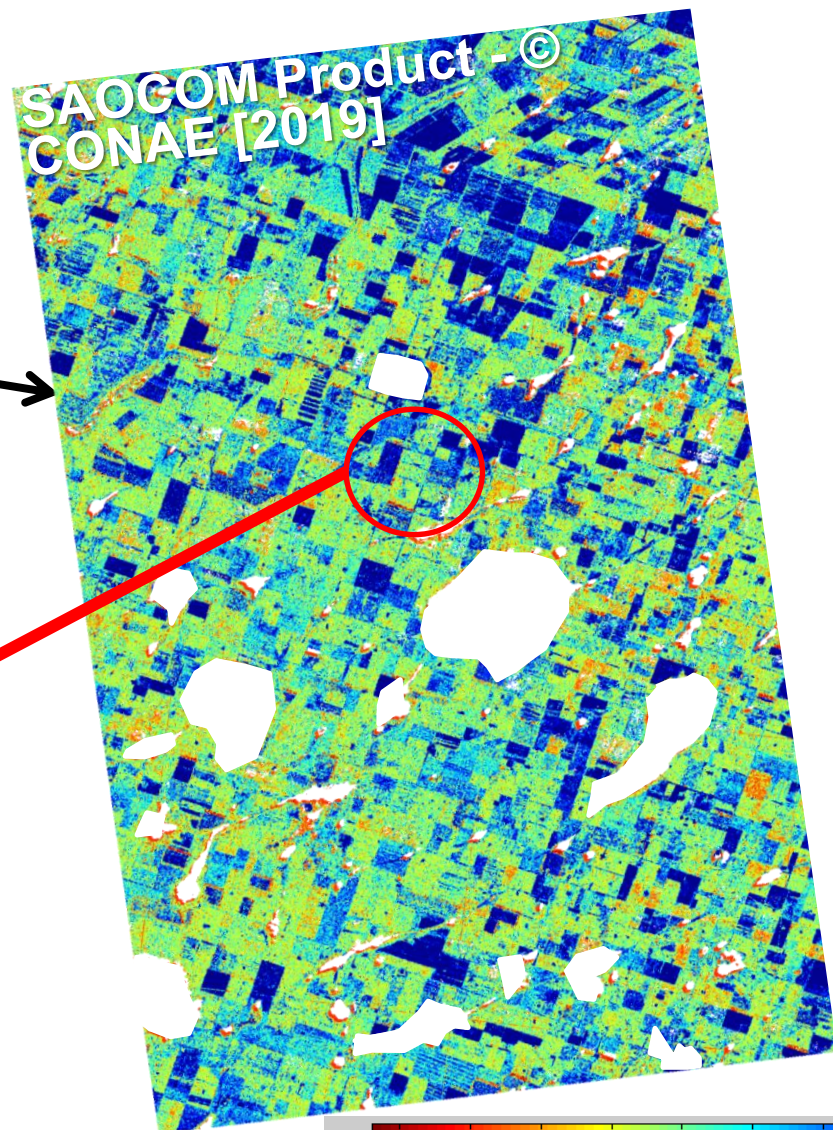


Higher Level
products

Support System
for Decision
Making in
Agriculture
(DSS)

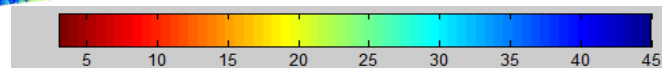
Fusarium Wheat
Head Blight
Disease
(FIM)

Hydrological and
Emergency
Management
(HEM)



intra-plot
variations

spatial resolution: 150 m - 800 m



soil moisture [vol/vol]

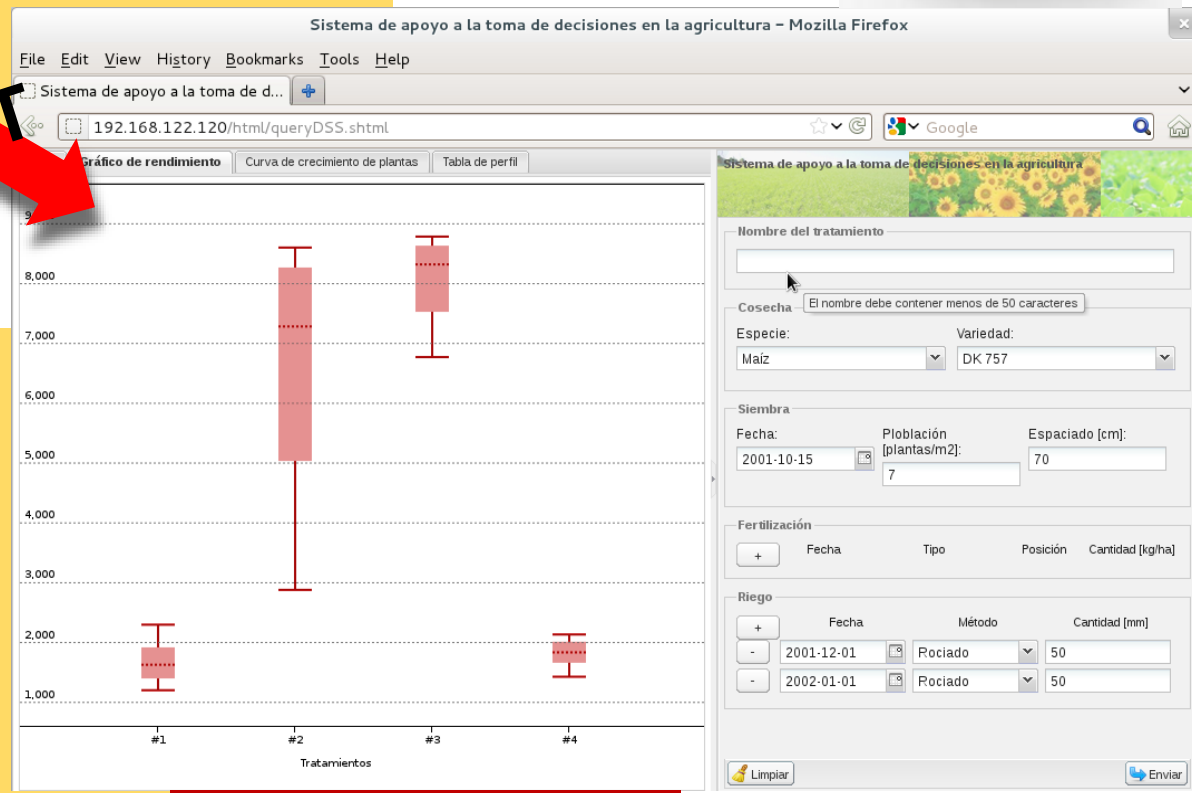
SAS-DSS: Support System for Decision Making in Agriculture



- ✓ different crop yield scenarios
- ✓ geographical coordinates
- ✓ species type
(maize, wheat, sunflower, soybean)
- ✓ seed type
- ✓ timeframe

INPUT

OUTPUT



Decision support:

- sowing
- fertilization
- watering
- fertilizers use optimization
- crop yield estimation
- soil moisture profile

up to 2 m
in depth

SAS-FIM: *Fusarium* Wheat Head Blight Disease



Fusarium: fungus that is installed at the base of the wheat ear

INPUT

OUTPUT

- ✓ geographical coordinates
- ✓ meteorological data
- ✓ sowing data
- ✓ timeframe

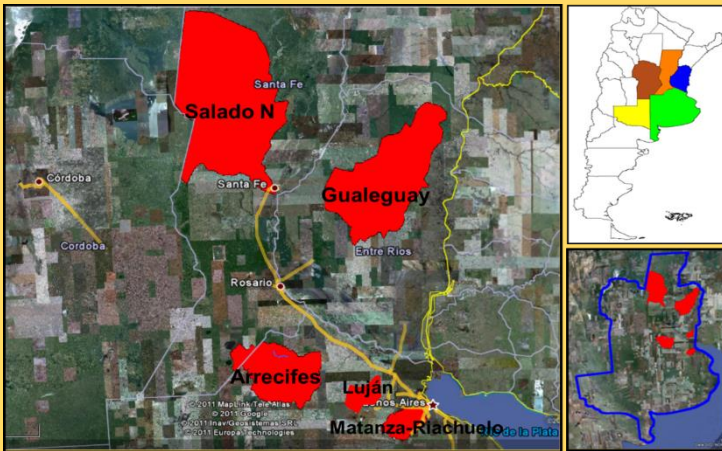
The screenshot displays the SAS-FIM web application interface. At the top, there is a 'Map date' selector set to '2001-10-30'. Below this is a map of a region in Argentina, with various locations labeled. To the right of the map is a 'Calendar' widget for May 2001. Below the map is an 'Experiment Table' with columns: VARIETY, SOWING DATE, PLANT POPULATION, ROW SPACING, FERTILIZATION DATE, FERTILIZATION TYPE, and FERTILIZATION POSITION. The table contains one row of data for 'ESCORPION' sown on '2001-05-29' with a population of 300 and row spacing of 21. Below the table is a 'FimIndexGraph.png' showing a line graph of the FIM Index over time from September to November. The y-axis ranges from 0 to 35, and the x-axis shows months. The graph shows a sharp increase in the index starting in October, reaching a peak of approximately 35 in November. A color scale on the right of the graph ranges from 0 (green) to 40 (red).

Support :

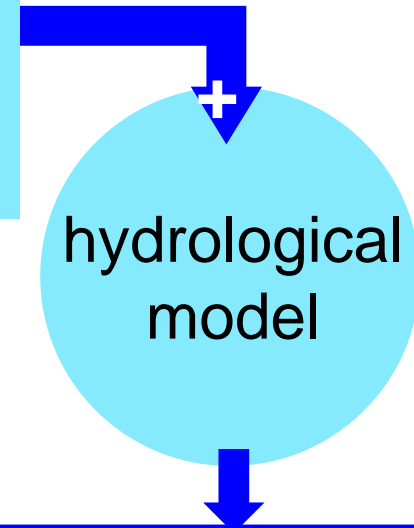
- afection index
- *fusariosis* status
- agrochemical use optimization
- progress afection estimation

Basins:

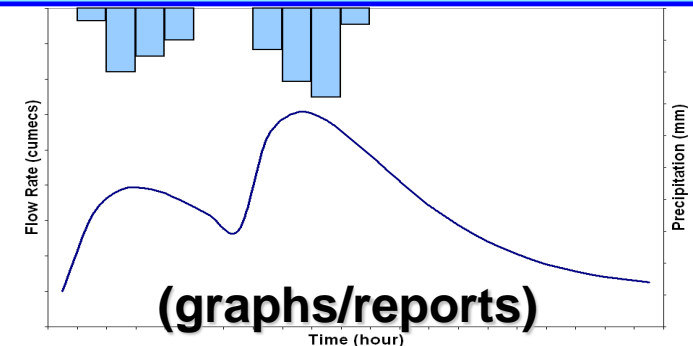
- ✓ Salado Norte
- ✓ Gualeguay
- ✓ Arrecifes
- ✓ Luján
- ✓ Matanza-Riachuelo
- ✓ Areco



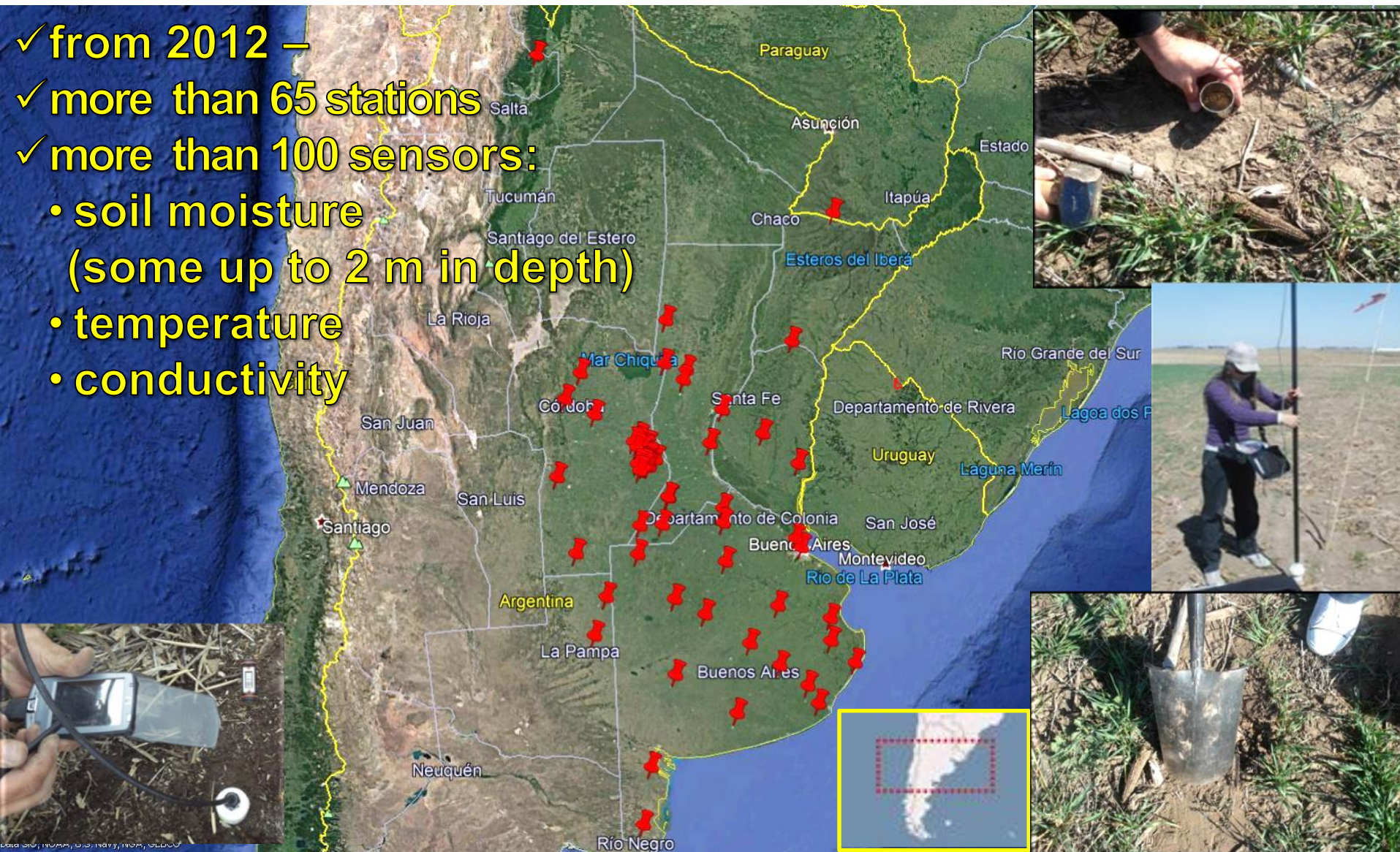
- ❖ precipitation
- ❖ evapotranspiration
- ❖ SAR soil moisture map



- ✓ deterministic forecast
- ✓ medium and long term probabilistic forecast
- ✓ flood guidance



- ✓ from 2012 –
- ✓ more than 65 stations
- ✓ more than 100 sensors:
 - soil moisture (some up to 2 m in depth)
 - temperature
 - conductivity



November 19th, 2019

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Phase 1:

- ✓ core site (at Córdoba) equipped with dense sensors network for soil moisture measurements
- ✓ one complete year of field campaigns to gather ground truth capturing the agricultural cycle

Agricultural Cycle from Main Crops on Pampa region

Crop	Jan	Feb	Mar	Abr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wheat												
Maize												
Sunflower												
Soybean												
Fallows												
Wheat Fallows												
Maize Fallows												
Sunflower Fallows												
Soybean Fallows												

Crops / Stages: sprout

growth

maturity

stubble

Wheat



Maize



Sunflower



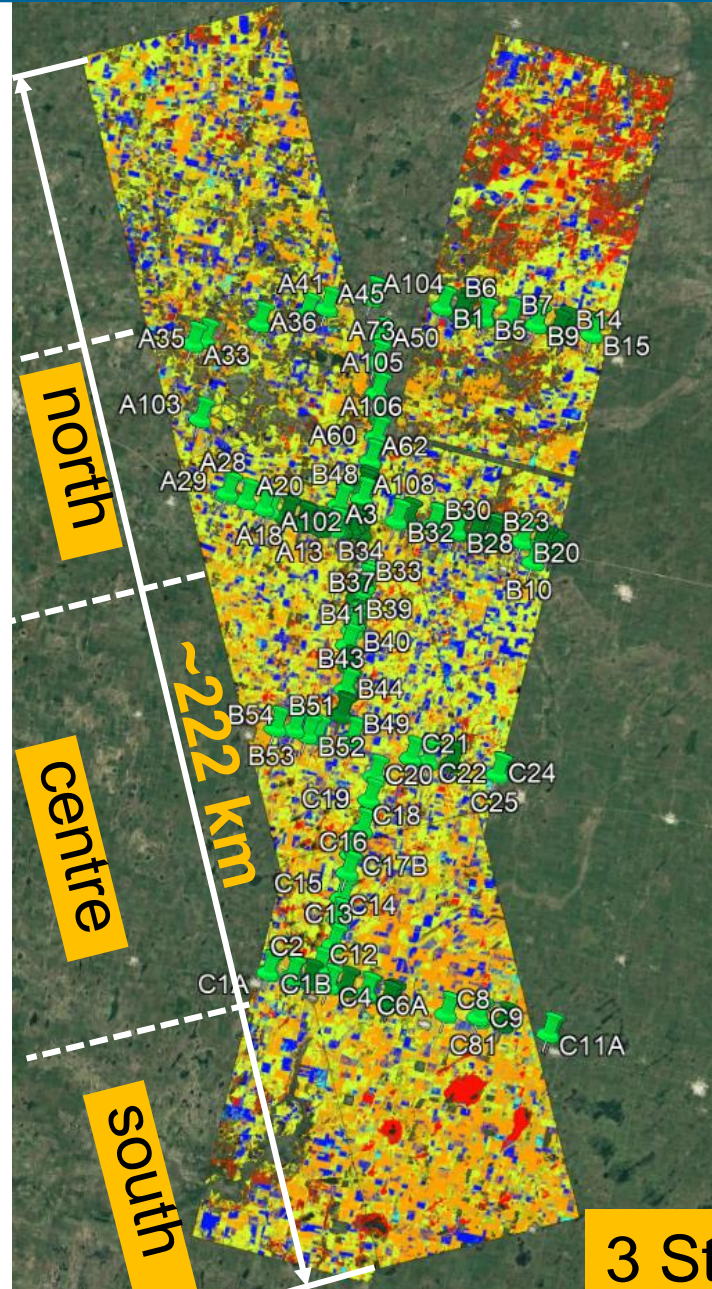
Soybean



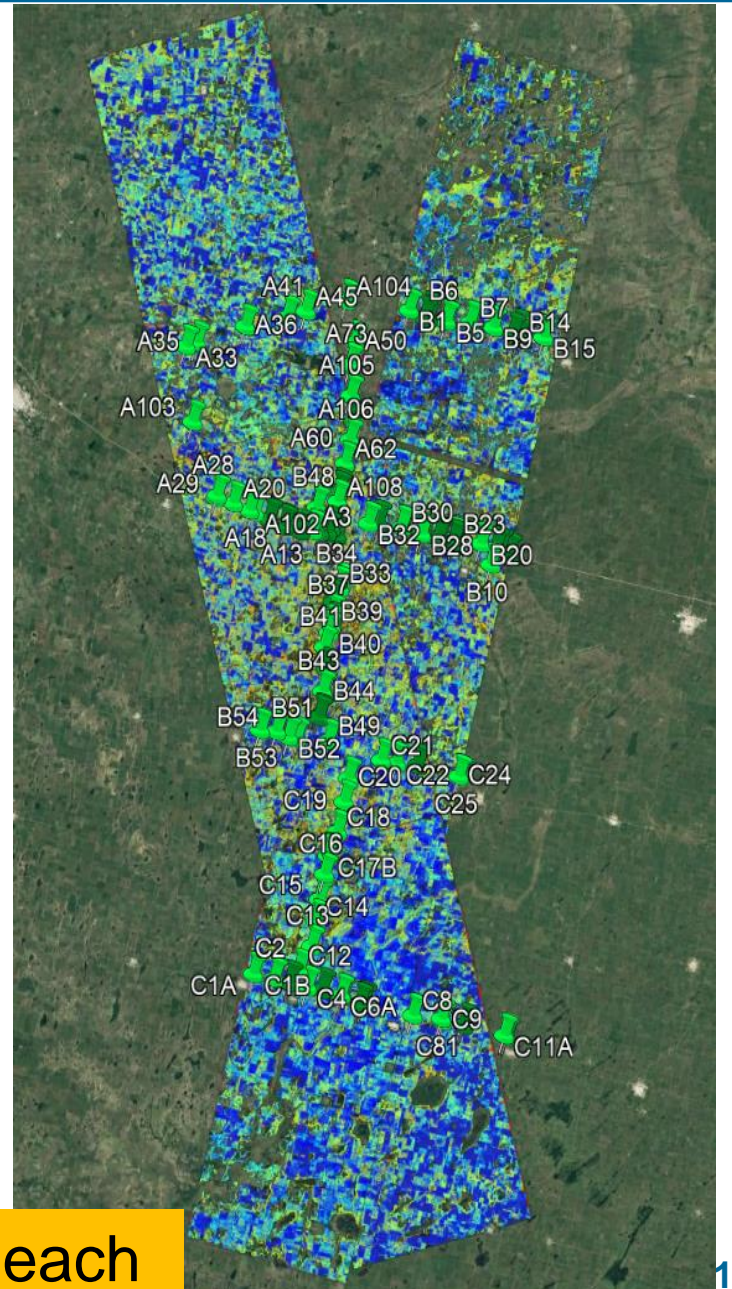
Phase 2:

- ✓ extension over the whole region of interest

CalVal Soil Moisture: Phase 1



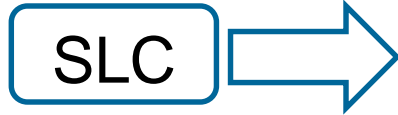
fields
campaigns
underway:
03/03/2019,
19/03/2019,
06/05/2019,
22/05/2019,
25/07/2019,
26/07/2019,
27/09/2019,
13/10/2019,
29/10/2019,
16/12/2019,
17/01/2020,
02/02/2020,
18/02/2020



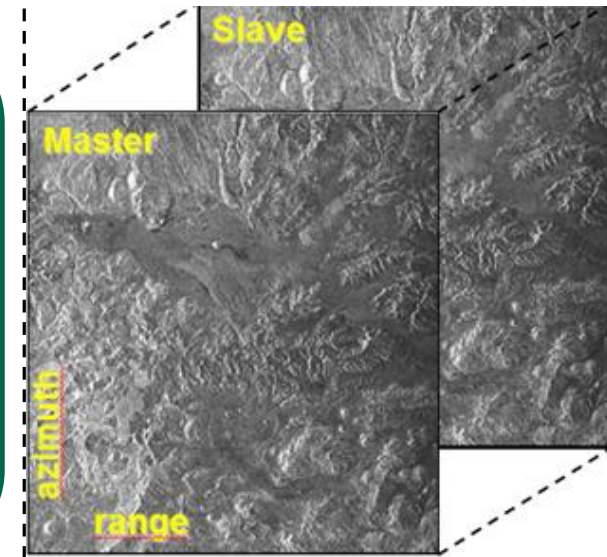
3 StripMap ~74 km each

L1 products

L2 products



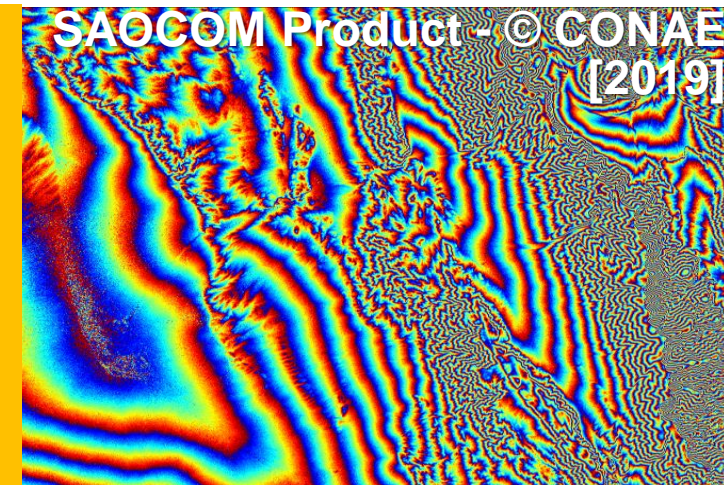
- ✓CRG: Co-registered interferometric stack
- ✓IPH: Flat interferogram
- ✓IPHG: Differential interferogram
- ✓Coherence Map



StripMap
SP,DP,QP

- ✓ Interferograms are available, both in slant range and geocoded in ground range
- ✓ Easily ordered from SAOCOM Catalogue

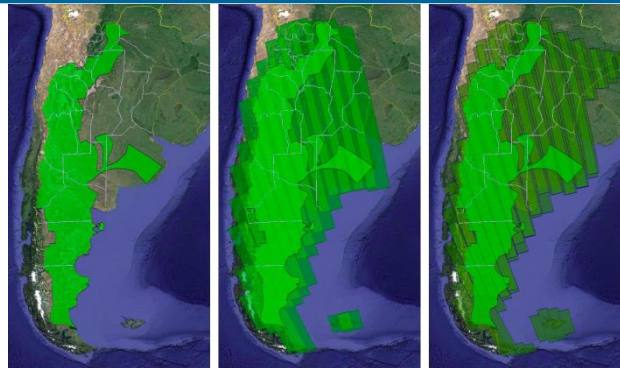
- SAO1A, StripMap, VV (CORDOBA)
- angles ~ 26° - 28°
- descending
- 16/feb/19 (master), 31/jan/19 (slave)
- perpendicular distance between orbits: 674 m
- fringe phase range: $-\pi$ a $+\pi$



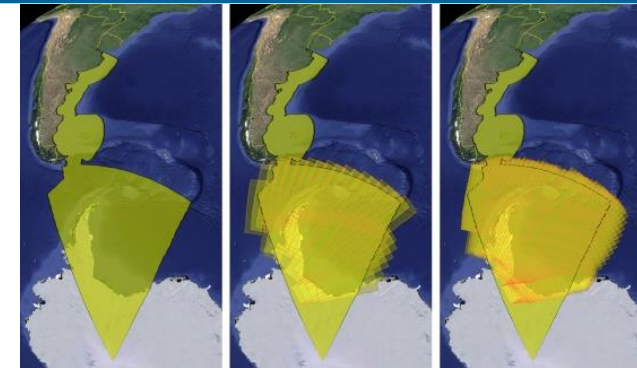
Mission Acquisitions: Integral Mission Acquisition Scenario



ARG-1: Soil Moisture



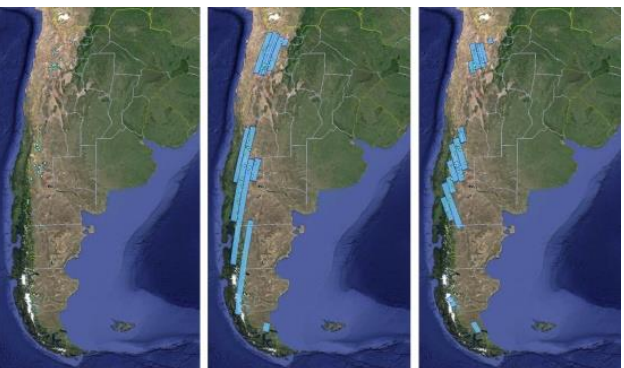
ARG-9:
Desertification and
draught



ARG-15b: Marine
surveillance –
Antartic sea

A predefined set of acquisitions over Argentina to guarantee an archive of useful data for specific applications (more then 20)

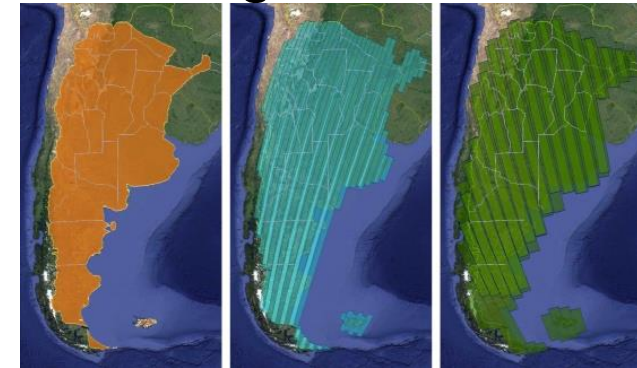
ARG-7: Volcanoes

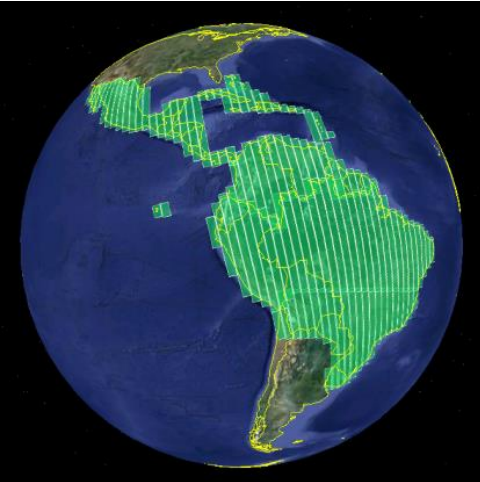


ARG-18: Glaciers

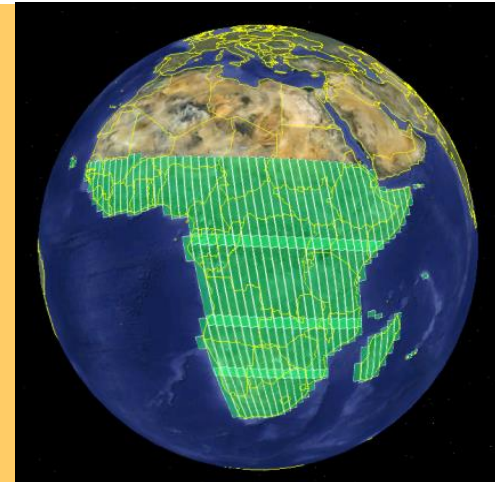


NAT: Annual National
Coverage

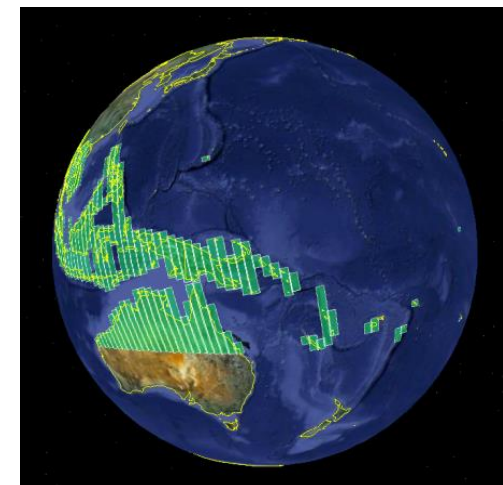
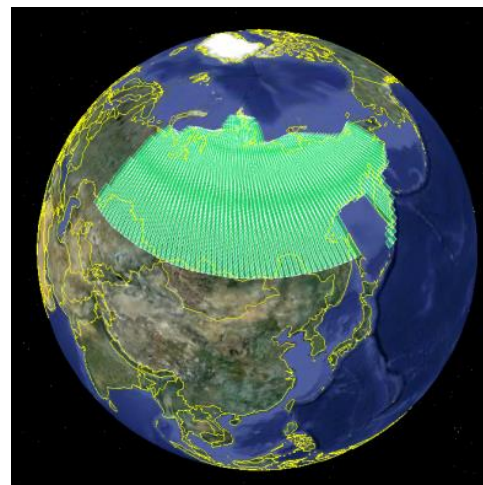
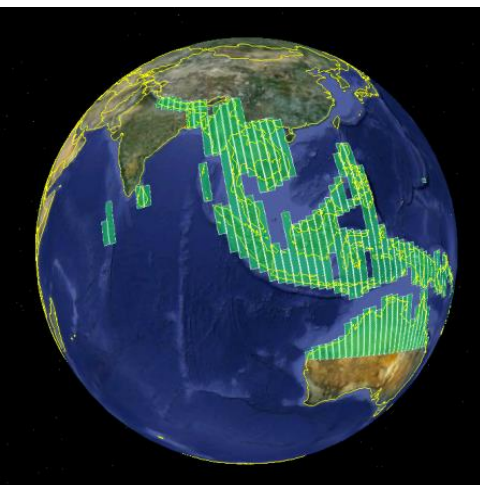




- Global Background Mission:
- Building a consistent archives over global forest
 - Polar regions
 - Supporting GEO, UNFCCC REDD+



Currently we are experimenting with different acquisition strategies in order to refine the products



- ↪ From ASI-CONAE cooperation:
 - ASI **exclusivity** area: **30°- 80°N latitude** , **10°W-50°E longitude**
 - ASI **interest** area: **25°W-120°E longitude** , **0°-80°N latitude**
 - Other areas

↪ License to use have to be signed (for all cases)

↪ Point of contacts

➤ **exclusivity area case:**
ASI have to define

➤ other areas case:

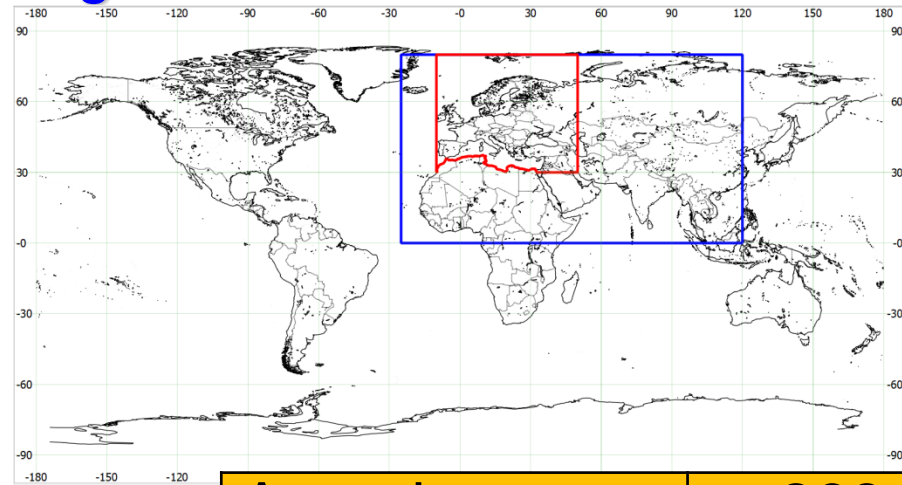
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lfrulla@conae.gov.ar

✓ commercial use:

www.saocom.com.ar (VENGO)



Antartica	268
Europe	479
Africa	5753
Asia	3584
Indonesia	1435
Oceania	1039
Oceans	2762
Total of scenes	22698

↪ Image acquisitions until now

South America	4688
North America	2690



Vatican

ROME

International
Airport
Leonardo Da
Vinci

Fiumicino

Ostia

Thank you for your attention

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