SBAS-DInSAR processing chain for Interferometric Wide Swath Sentinel-1 data

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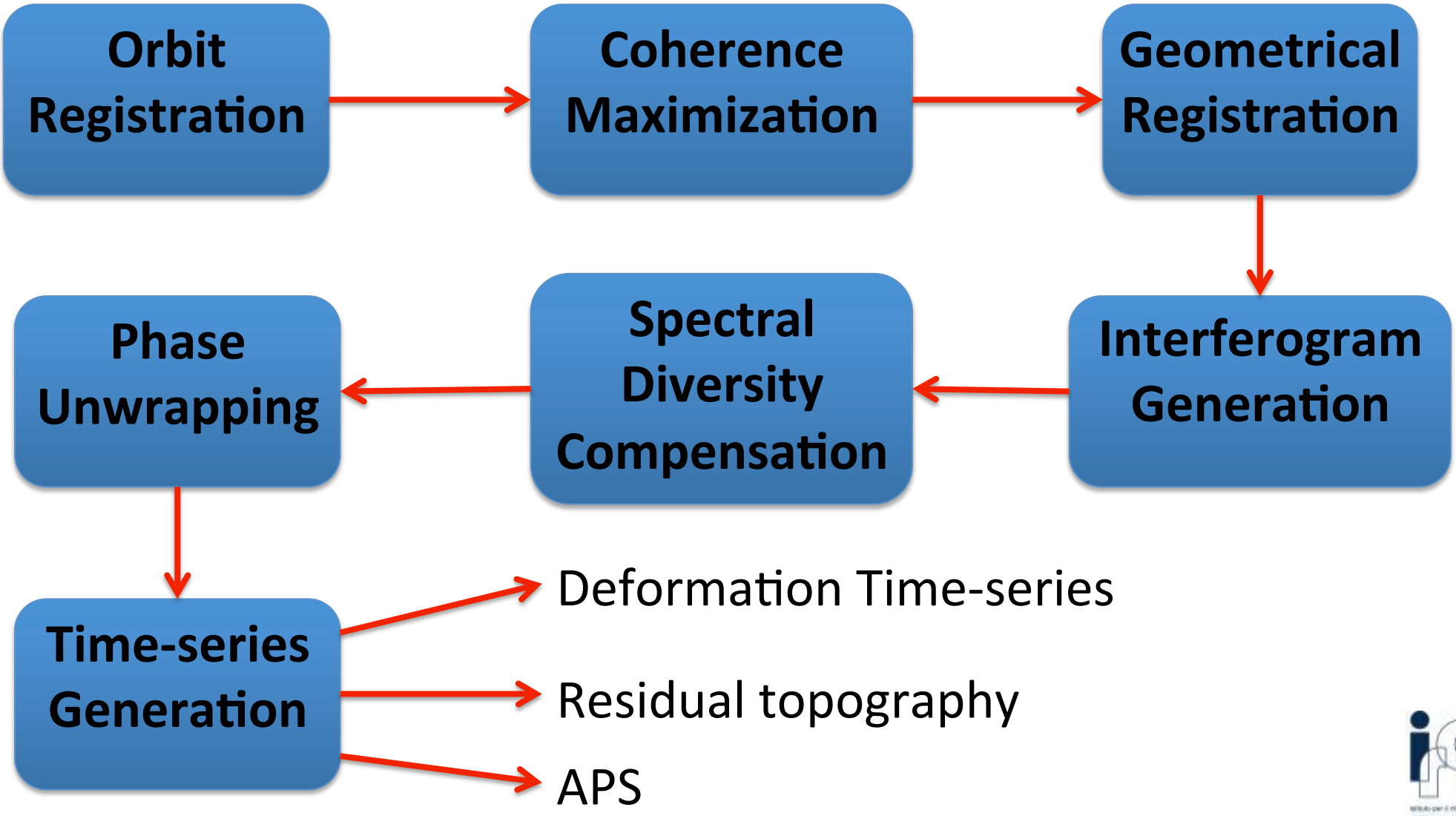
SBAS-DInSAR Block Diagram



Registration Steps

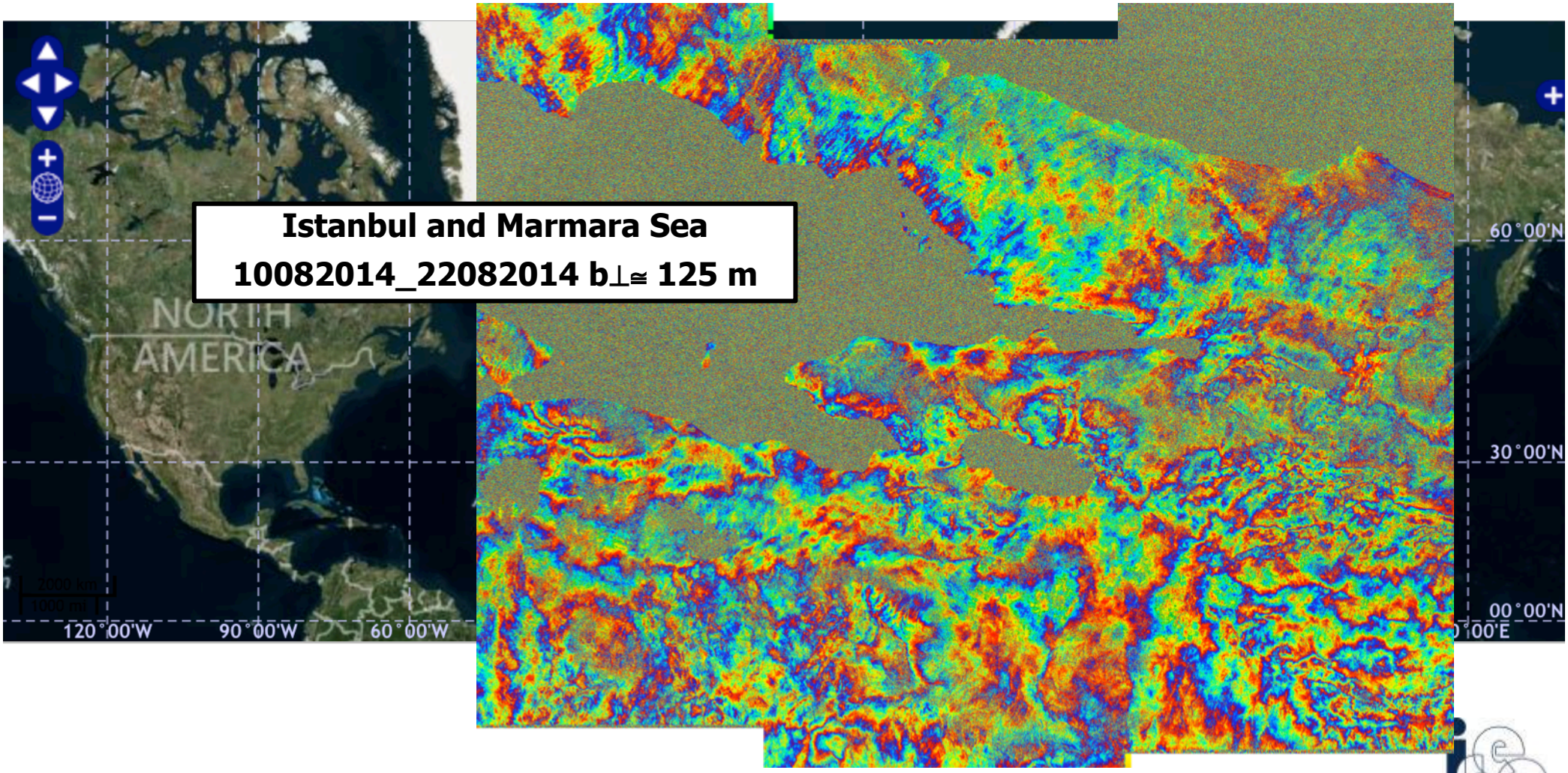
Orbit Registration: Rigid offset, it is retrieved in one point exploiting orbit and target location (DEM) information.

Coherence Maximization: Rigid offset, it is retrieved in one patch by maximizing the number of coherent points

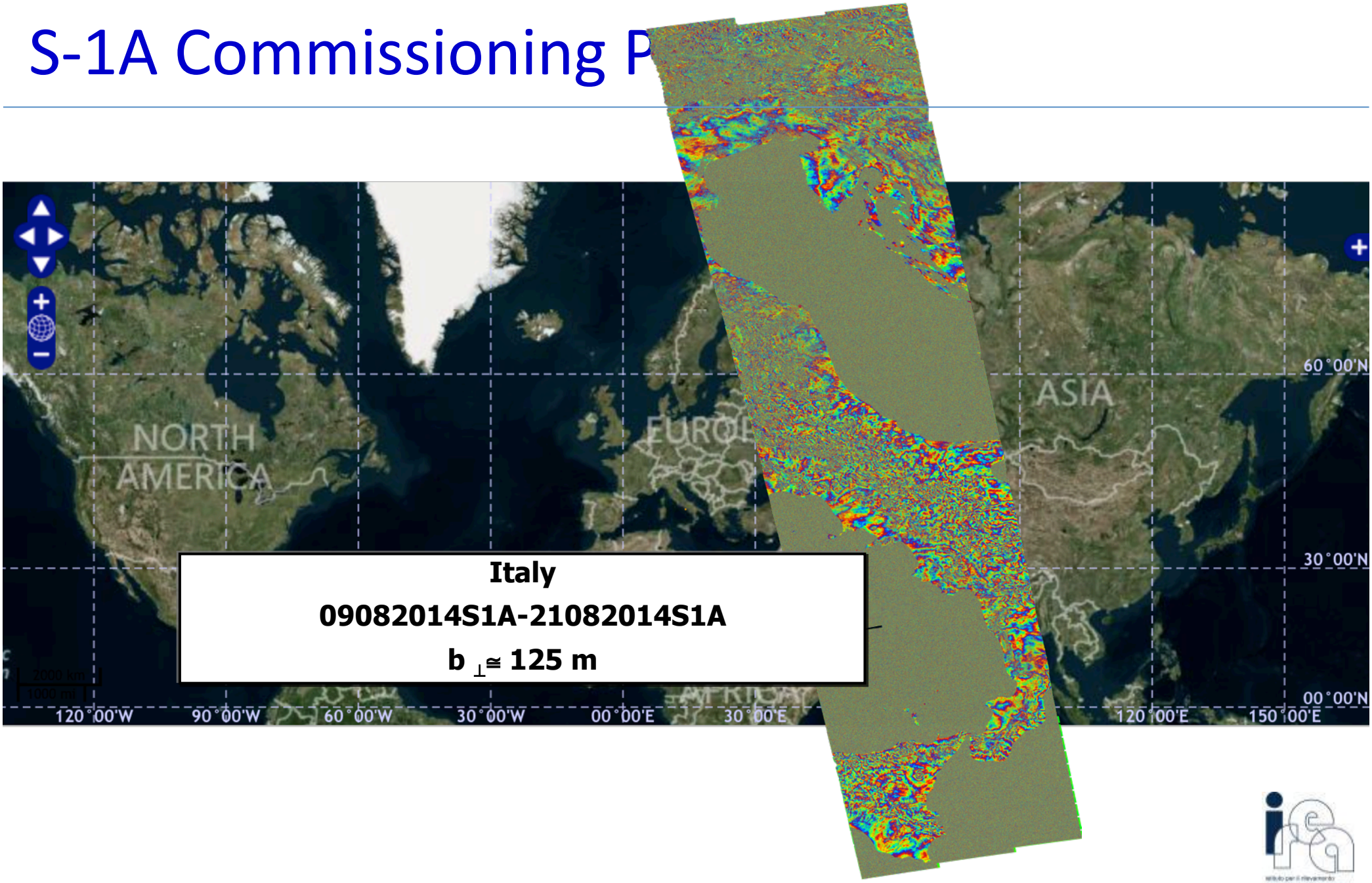
Geometric Registration: it is performed point by point, using orbit and location (DEM) information

Spectral Diversity Compensation: the residual phase, estimated through Spectral Diversity method, is compensated directly from interferograms, without performing again the interpolation of slave images.

S-1A Commissioning Phase



S-1A Commissioning P

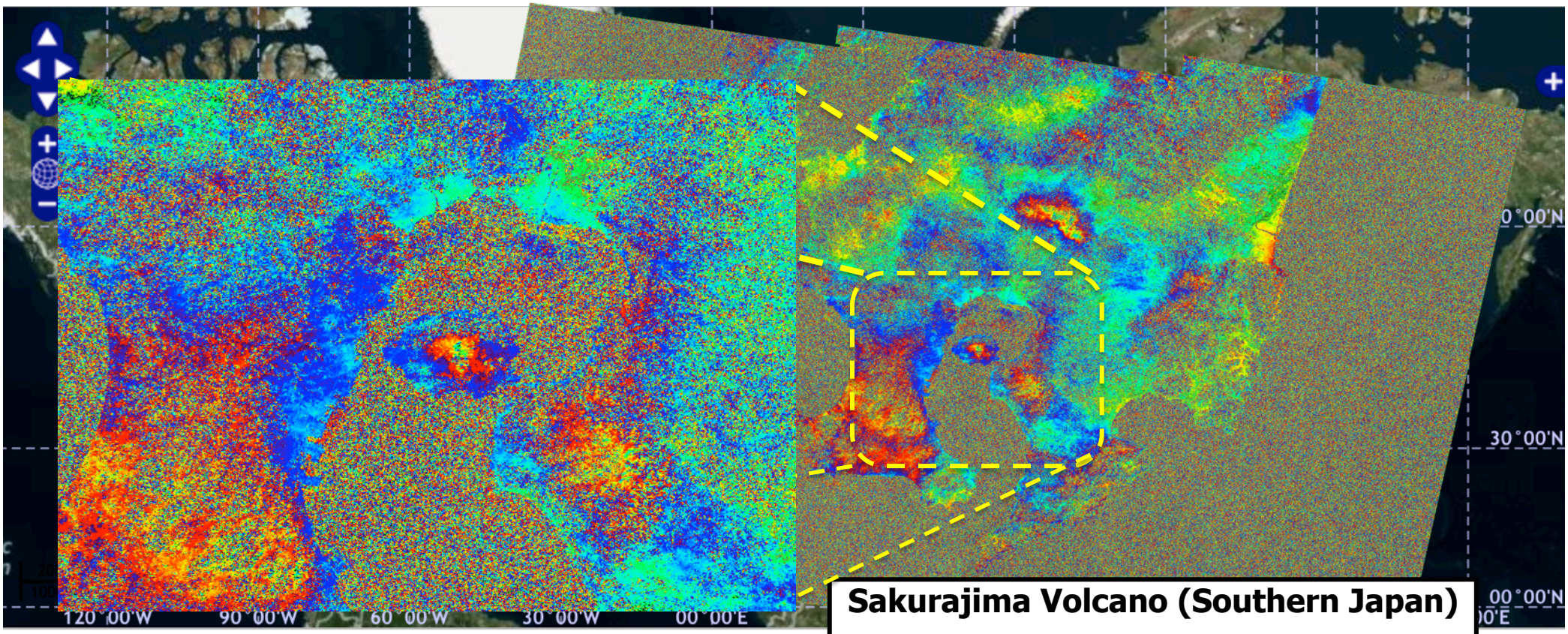


Italy

09082014S1A-21082014S1A

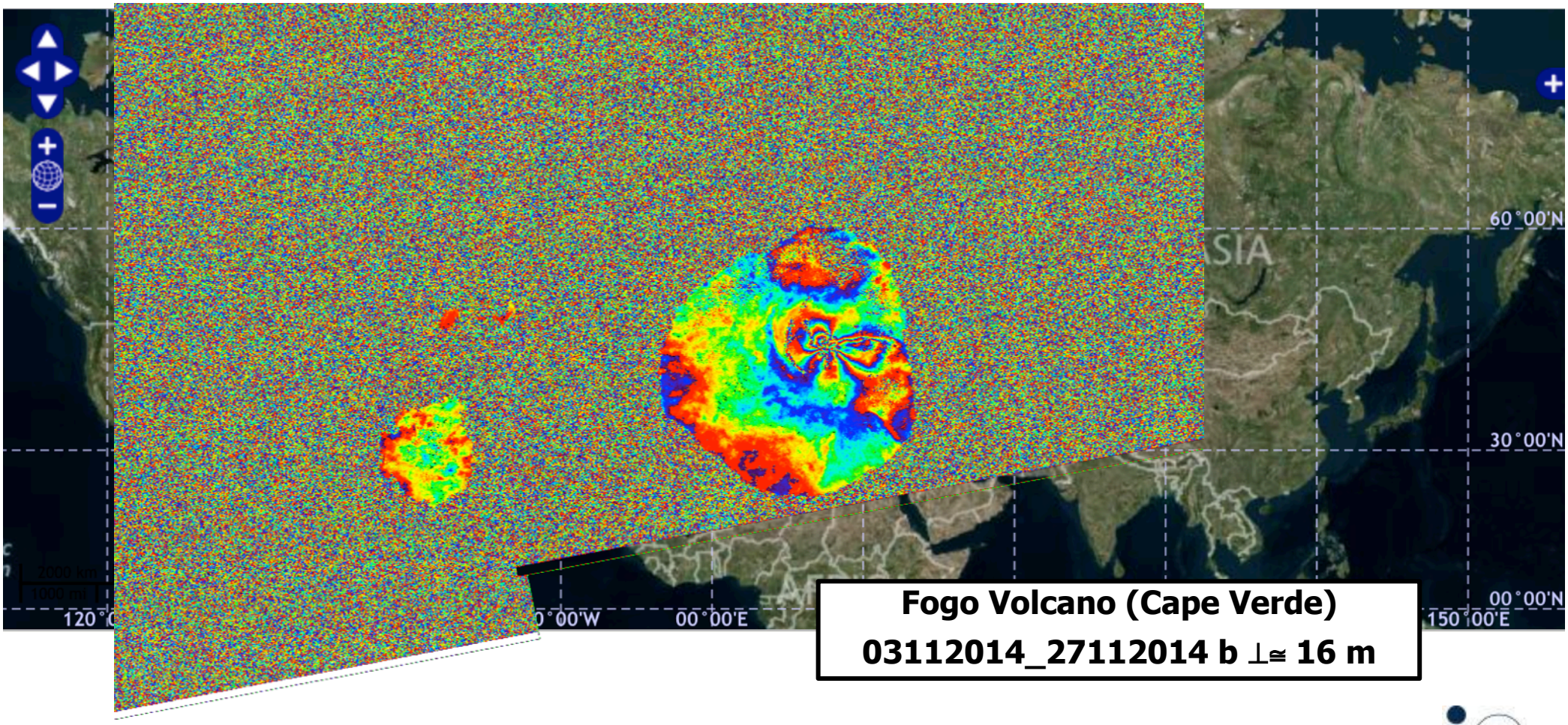
$b_{\perp} \cong 125$ m

S-1A Operational Phase



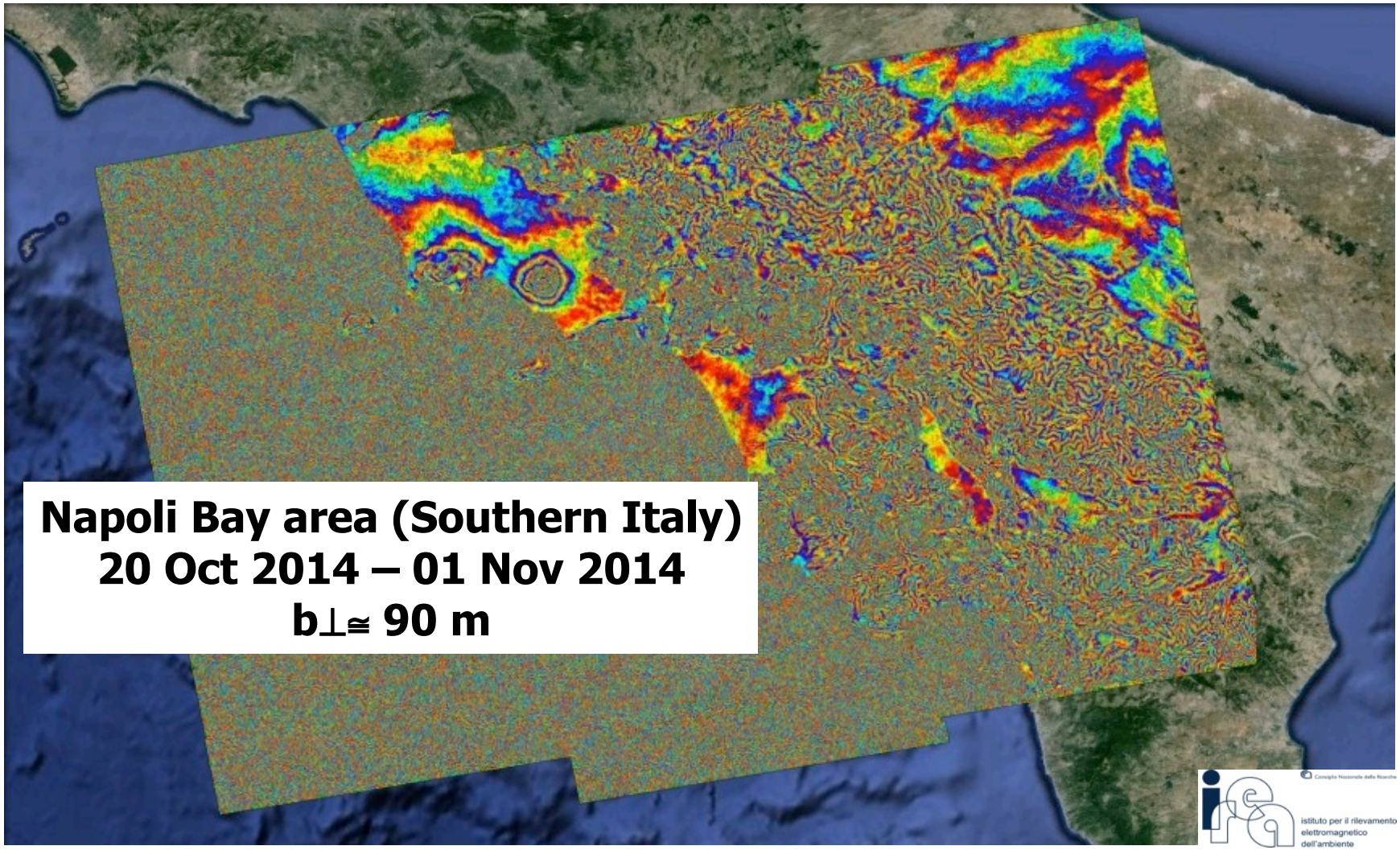
Sakurajima Volcano (Southern Japan)
21112014_03122014 b⊥≅ 100 m

S-1A Operational Phase



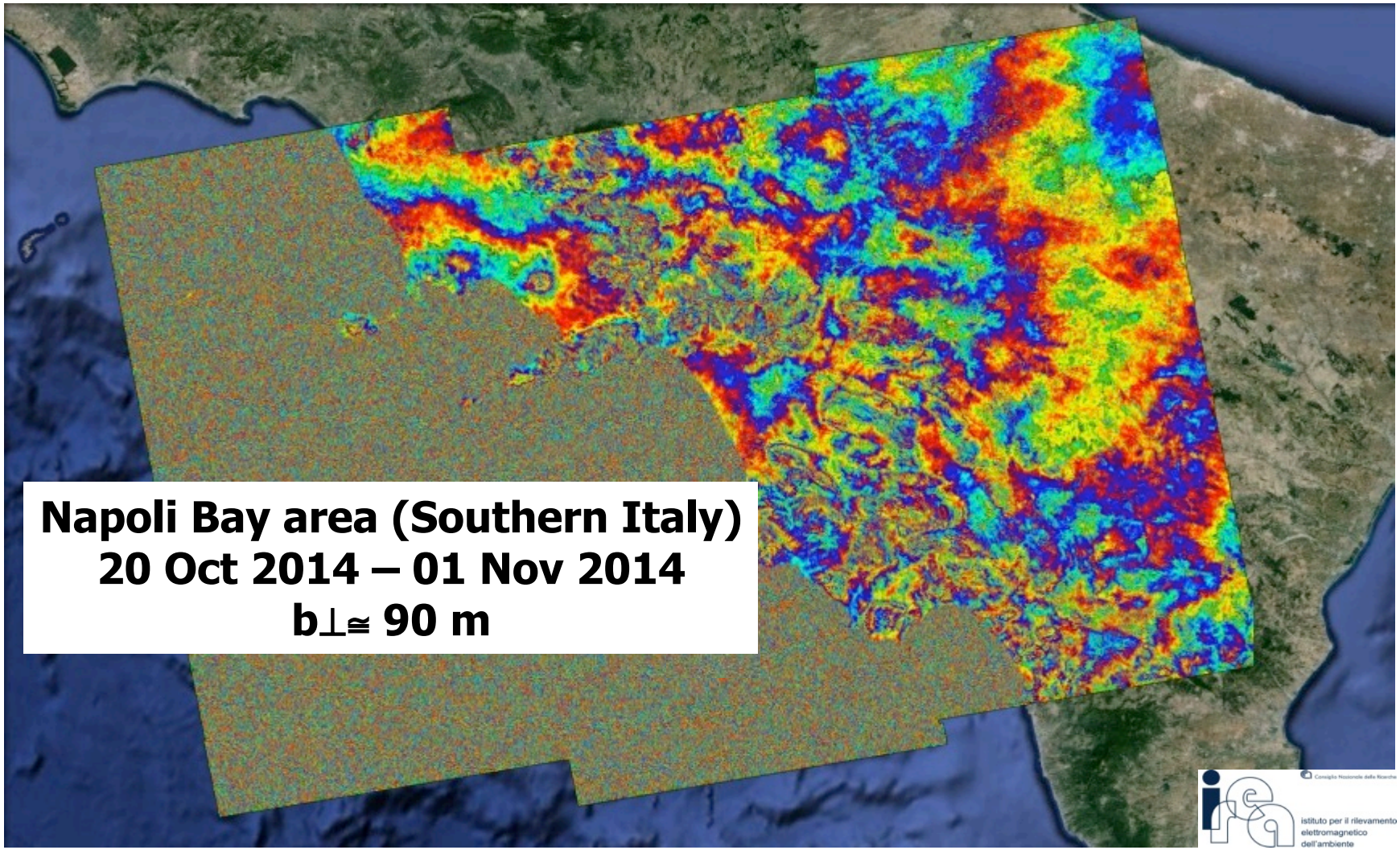
Fogo Volcano (Cape Verde)
03112014_27112014 b ⊥≅ 16 m

S-1A Operational Phase



istituto per il rilevamento elettromagnetico dell'ambiente

S-1A Operational Phase



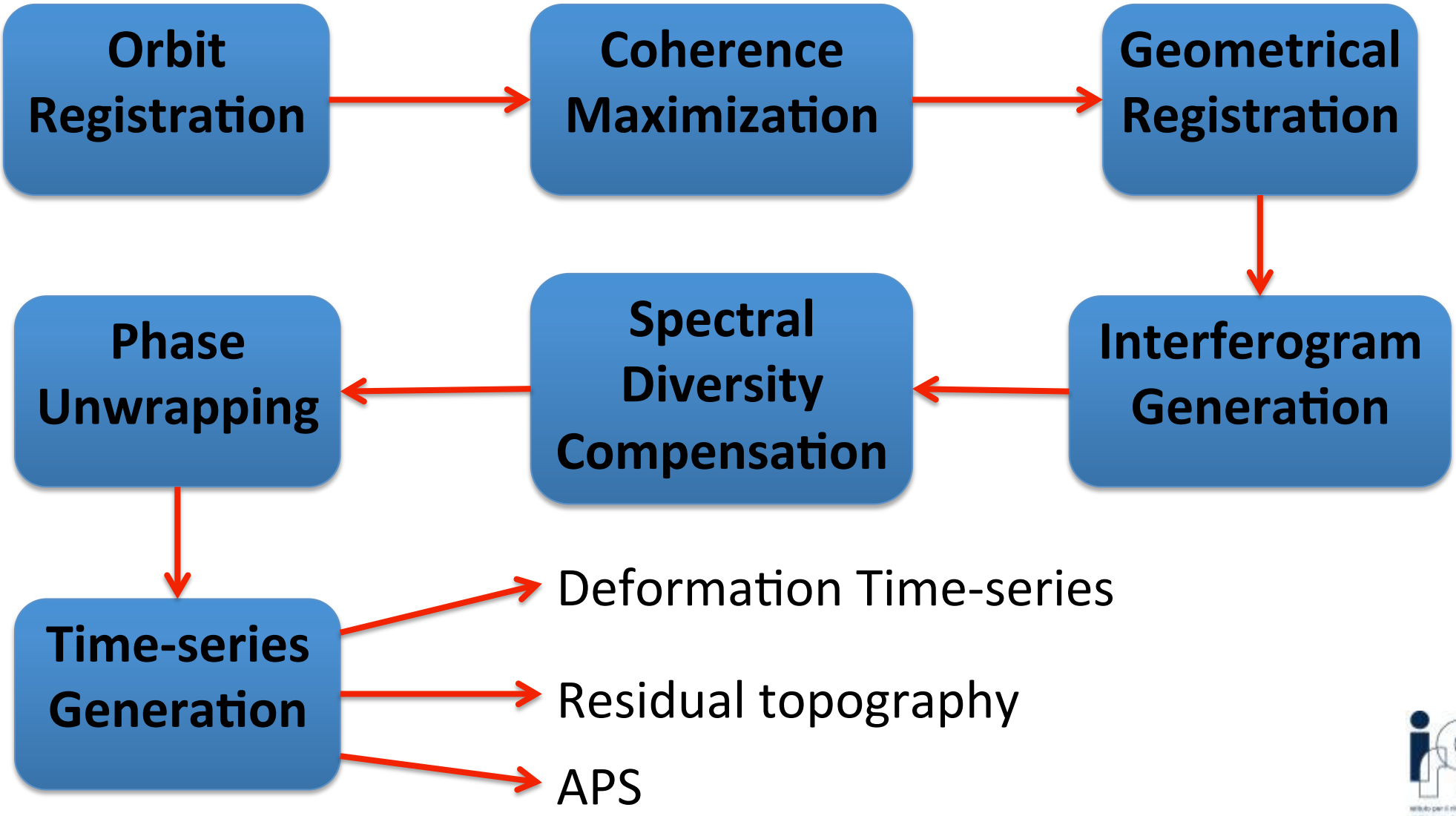
istituto per il rilevamento elettromagnetico dell'ambiente

Orbit Information: Annotated vs. External

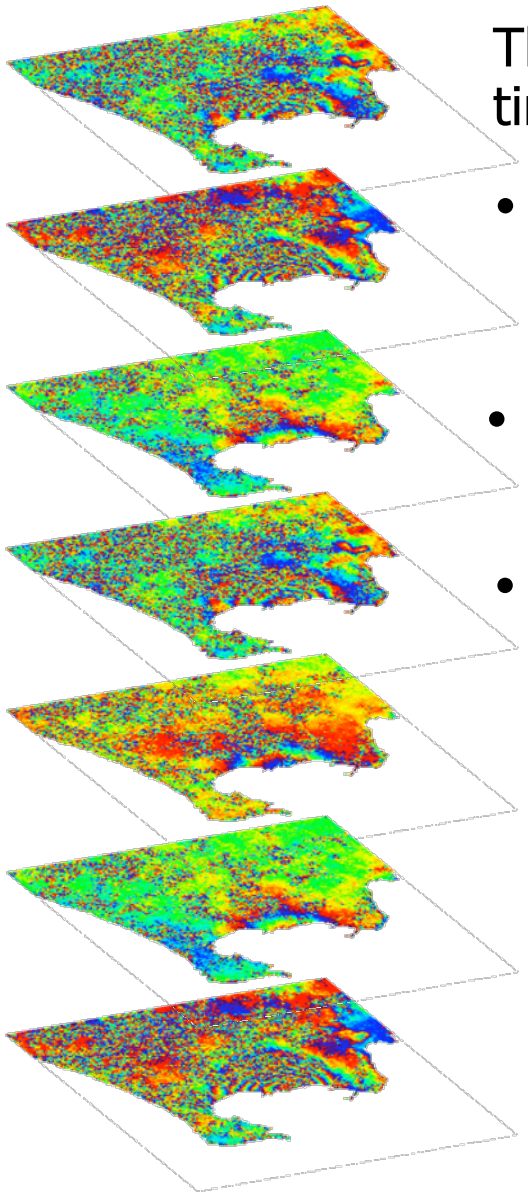
External: 10-sec State Vectors
Annotated: 1-sec State Vectors
Annotated Orbit are generated by exploiting External Orbit

Acquisition Date	Annotated Information		External Information (S1A_OPER_AUX_RESORB)	
	Orbit	Coherence	Orbit	Coherence
20-10-2014	0.0	0.0	0.0	0.0
01-11-2014	6.806	6.981	6.963	6.996
13-11-2014	1.546	1.296	1.276	1.293
25-11-2014	7.110	7.335	*NA*	*NA*
Mean Error	**0.21**		**0.02**	

SBAS-DInSAR Block Diagram



SBAS approach: key points



The **SBAS** approach allows to produce "long term" deformation times-series by:

- exploiting interferograms characterized by a "small baseline" in order to limit the noise (decorrelation) phenomena, thus maximizing the number of investigated pixels;
- using no *a priori* or model information on the investigated deformation signal;
- PhU operation is usually performed by applying MCF or EMCF techniques.

Achieved accuracies:

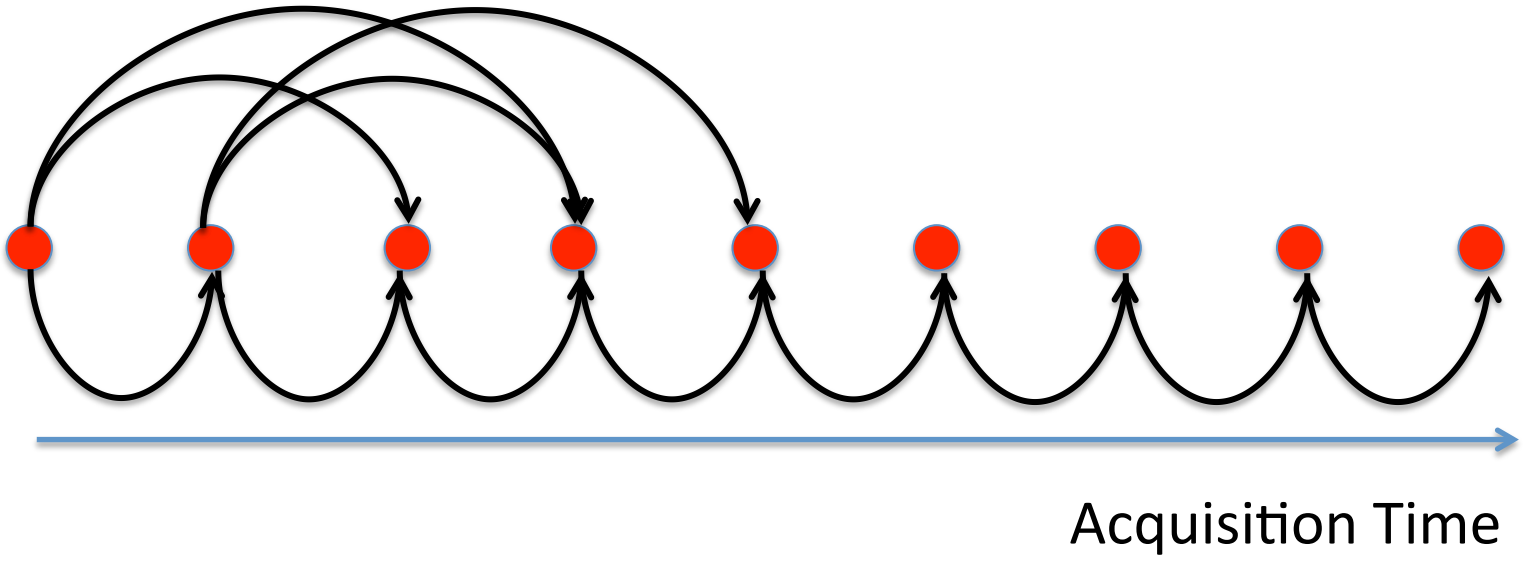
- ≈ **1 - 2 mm/year** **on the mean deformation velocity**
- ≈ **5 - 10 mm** **on the single displacement**

S-1A SBAS approach: pair selection

Orbital tube of Sentinel-1 should be very short, therefore no perpendicular baseline constraint needs to be applied.

To get redundancy of interferograms, each acquisition is coupled with the 3 following scenes in time.

The number of interferograms is about 3*(Number of acquisitions)



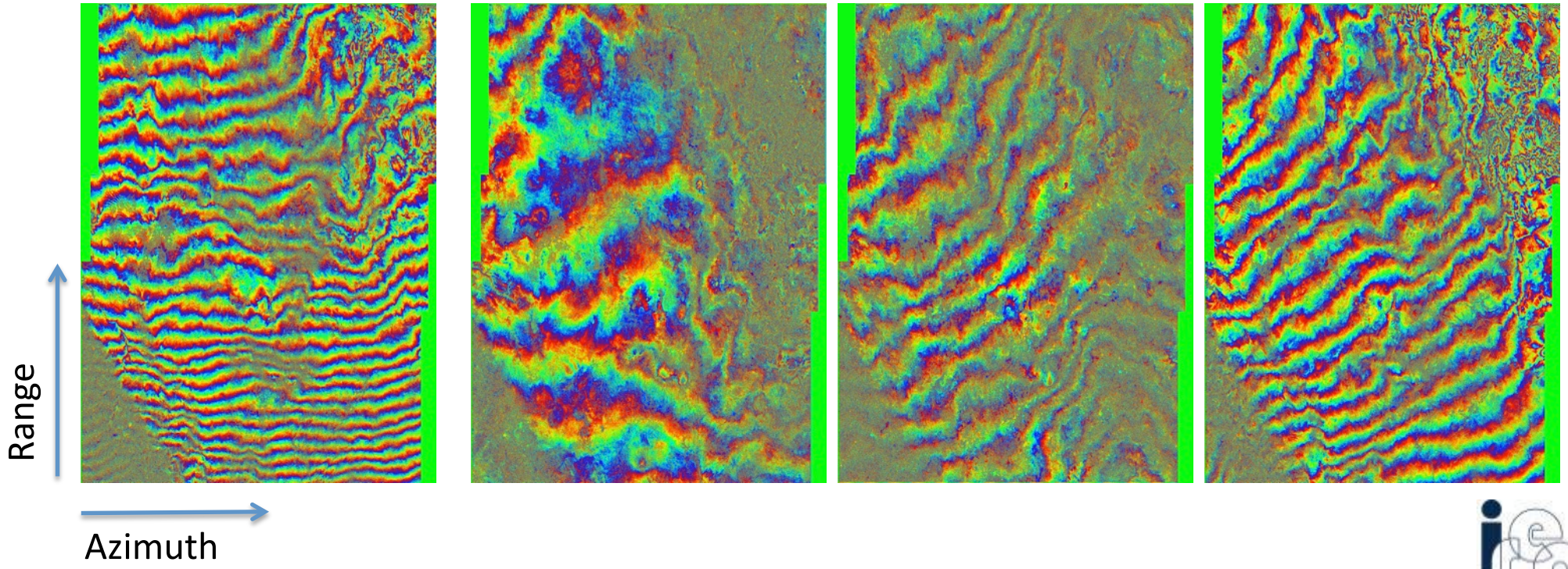
TOPS SBAS results: RS2 TOPS campaign over Mexico City

	Baseline		
Acq. Time	Perp. [m]	Parallel [m]	Along track [m]
04042013	-27	-30	14
28042013	-120	-98	-13
22052013	-65	-53	-22
15062013	70	30	-12
09072013	129	81	-13
02082013	0	0	0
26082013	-117	-99	8
19092013	50	-36	10
13102013	-35	-103	29
06112013	124	21	20
30112013	-23	-82	9

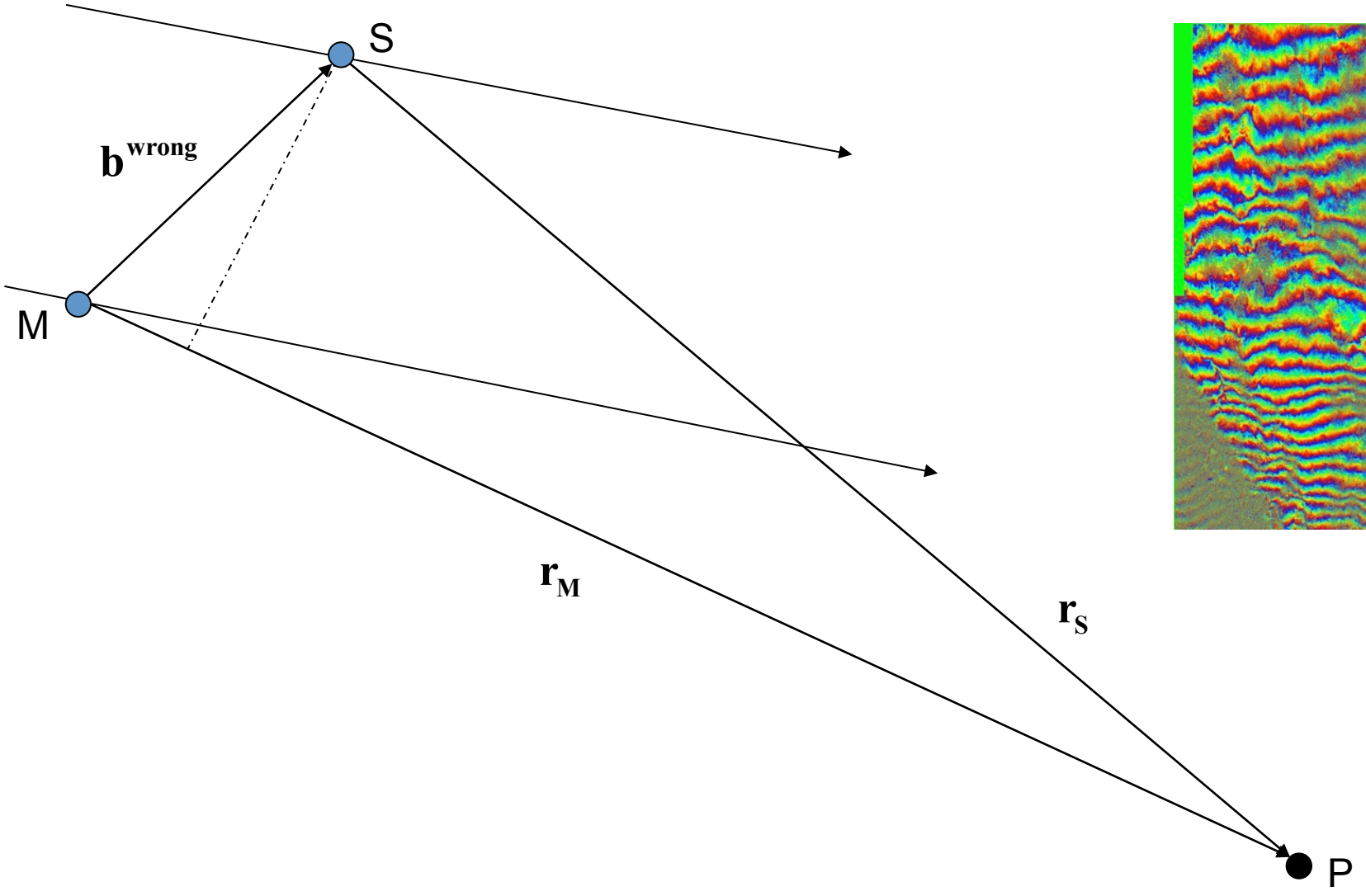
TOPS SBAS results: RS2 TOPS campaign over Mexico City

RS2 TOPS interferograms show good coherence (24 days revisit time)

Several RS2 TOPS scenes are affected by significant orbit errors



RS2 TOPS interferograms: orbital parameter correction



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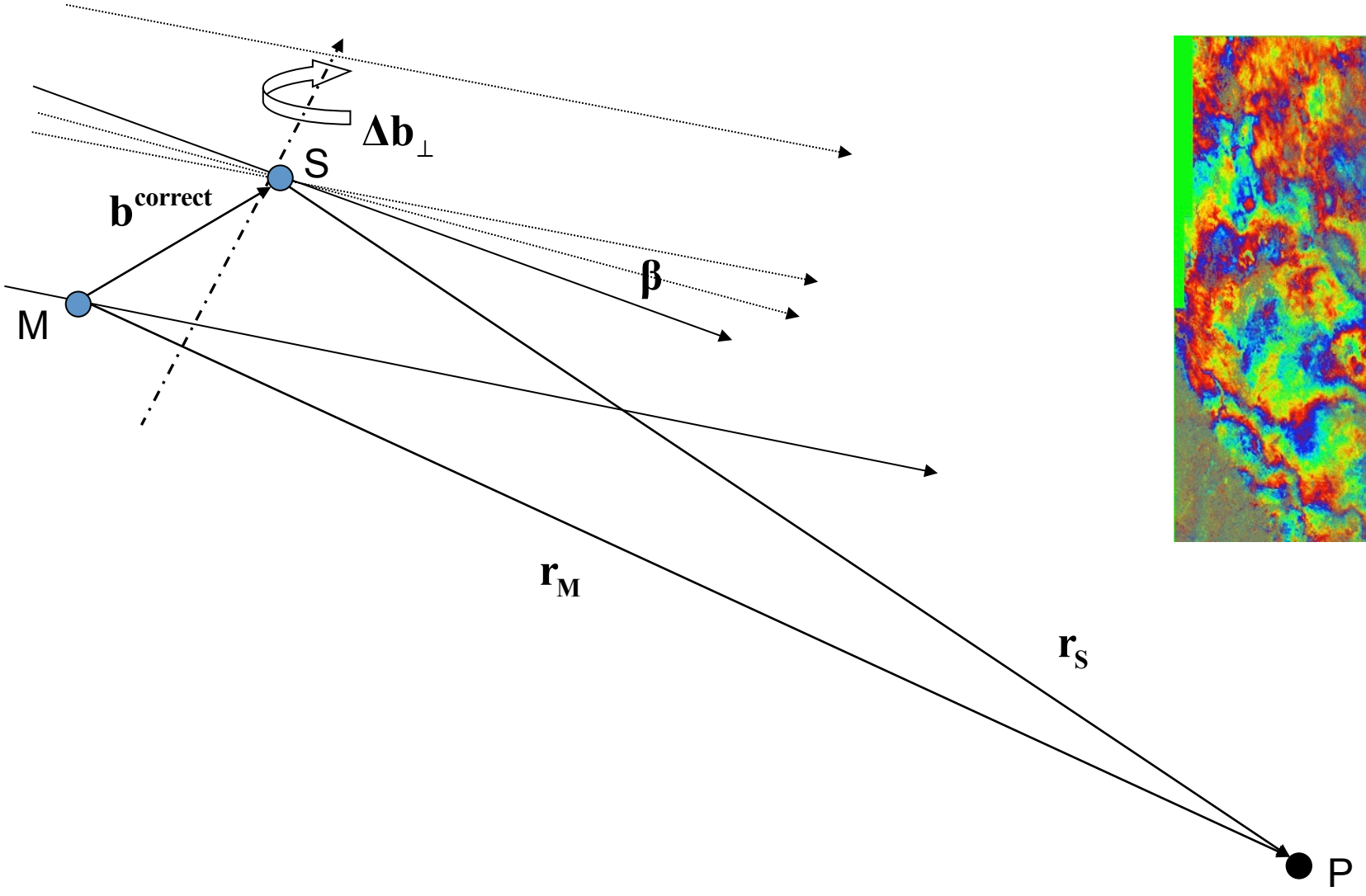

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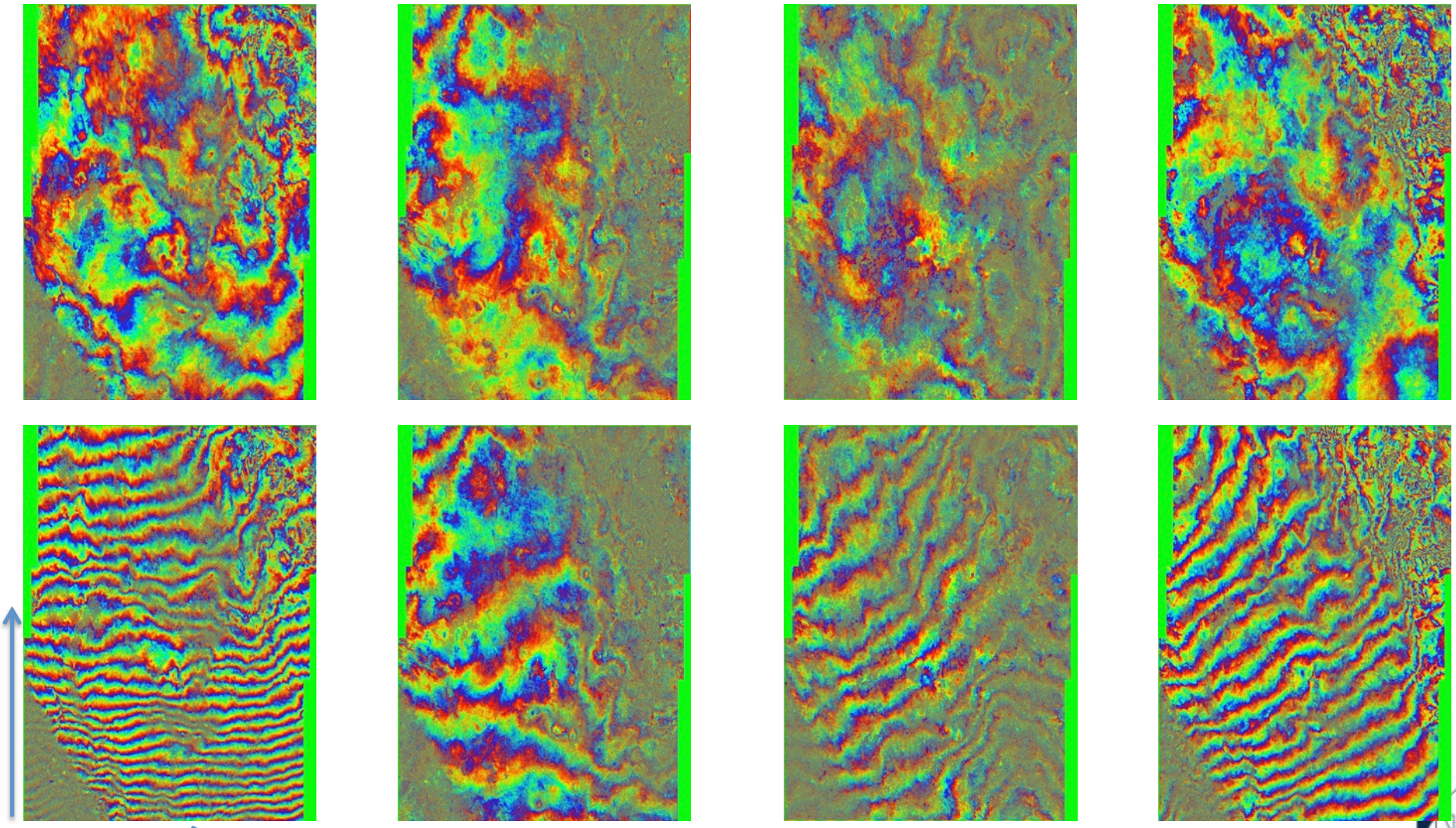

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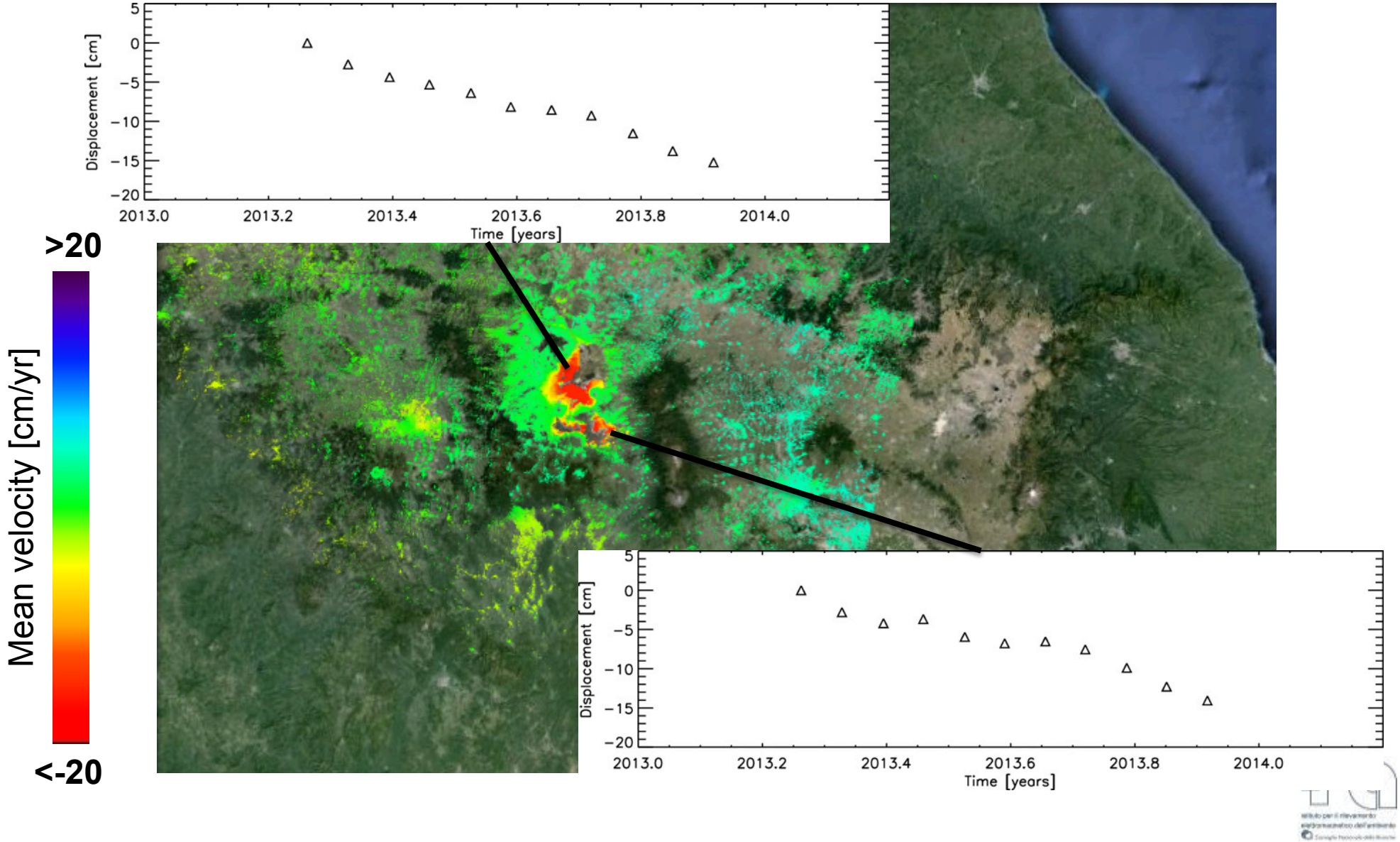
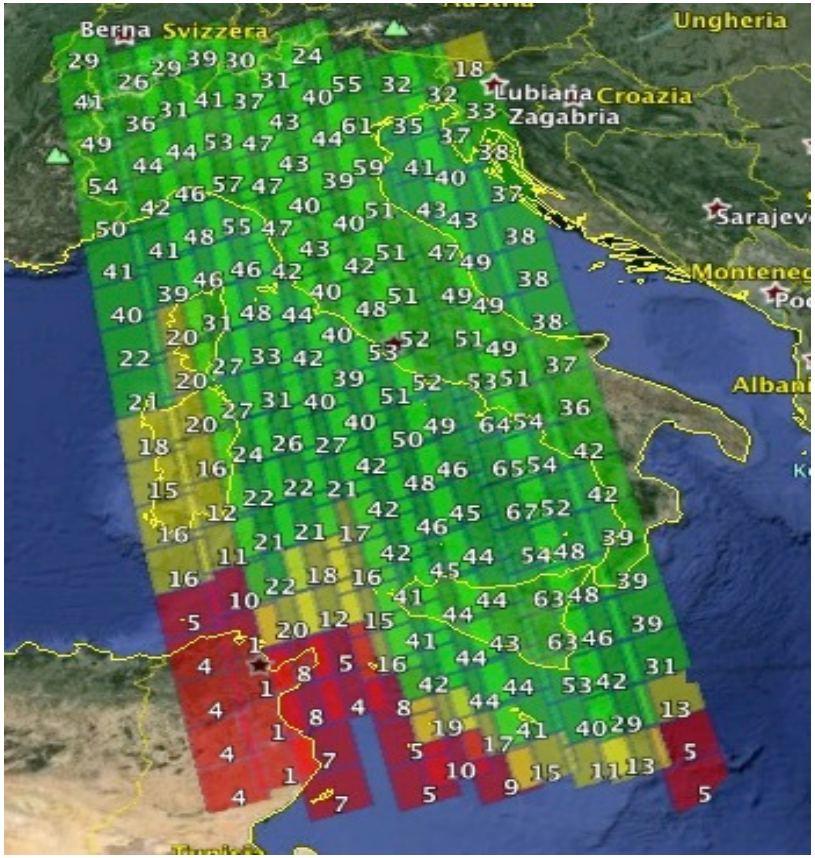
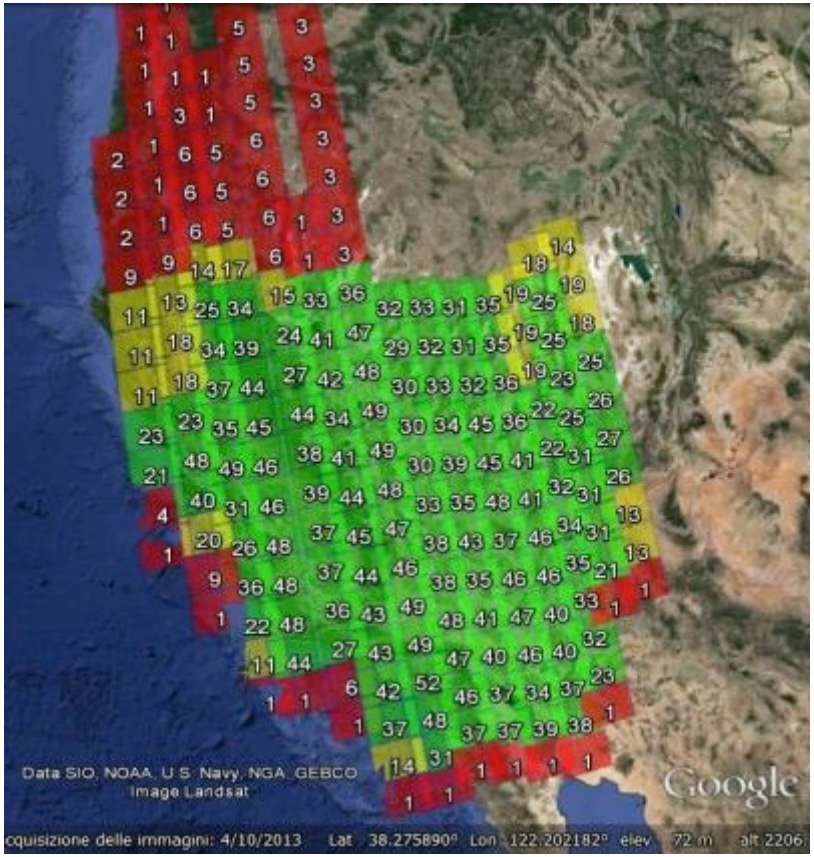


Upcoming step: Big Data processing

ESA archives have guaranteed large availability of ERS-ENV scenes



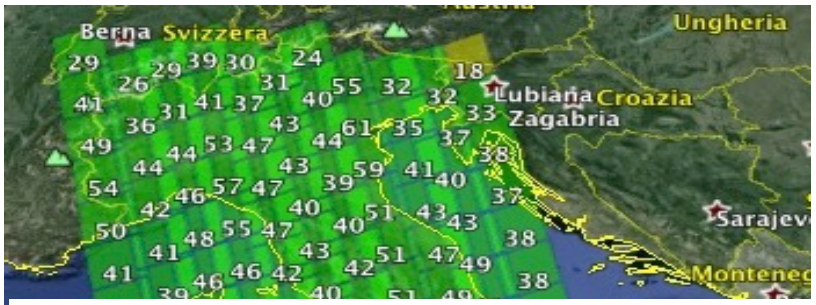
ENVISAT coverage over Italy
2003-2010
Only ascending tracks

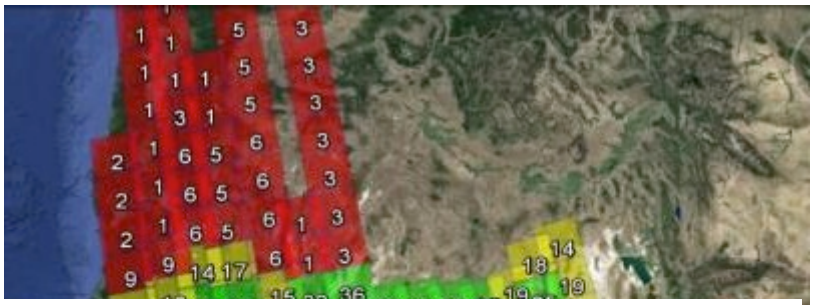


ENVISAT coverage over California
and Nevada 2003-2010
Only ascending tracks

Upcoming step: Big Data processing

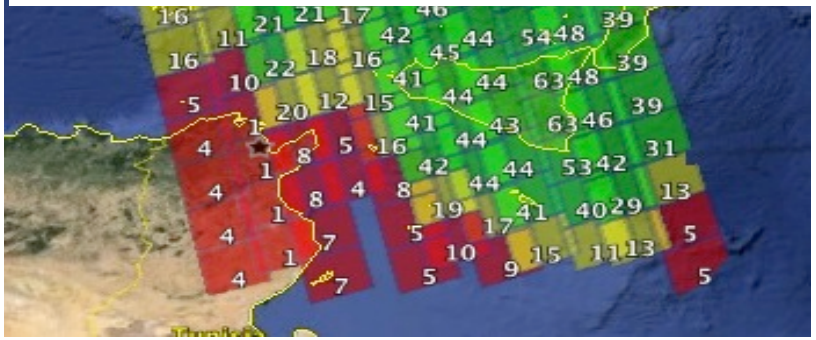
ESA archives have guaranteed large availability of ERS-ENV scenes

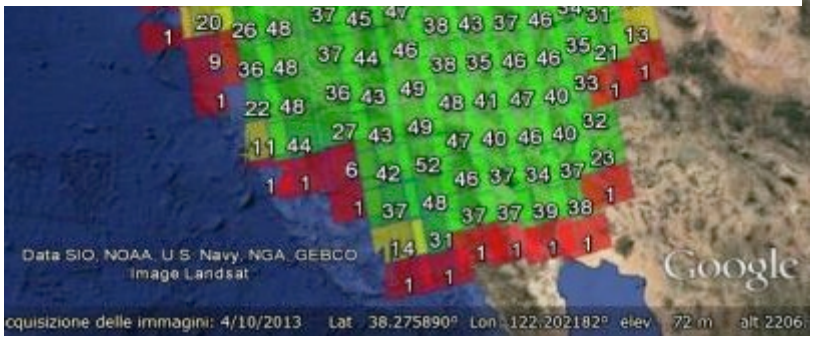




≈ 150 Frames x 4 Nodes for frame ≈ 600 Nodes

≈ 1 day



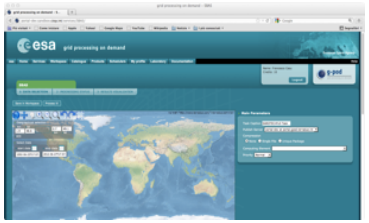


ENVISAT coverage over Italy
2003-2010
Only ascending tracks

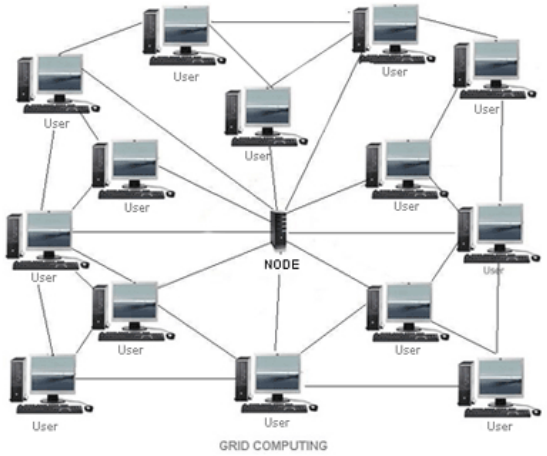
ENVISAT coverage over California
and Nevada 2003-2010
Only ascending tracks

ESA-Grid Processing on Demand (G-POD)

g-pod
grid processing on demand

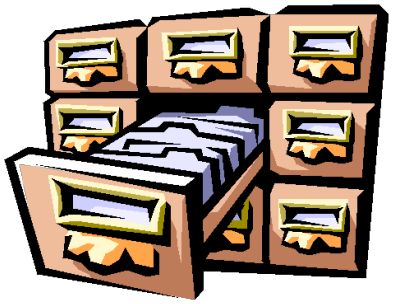


Web Interface



Computing Power

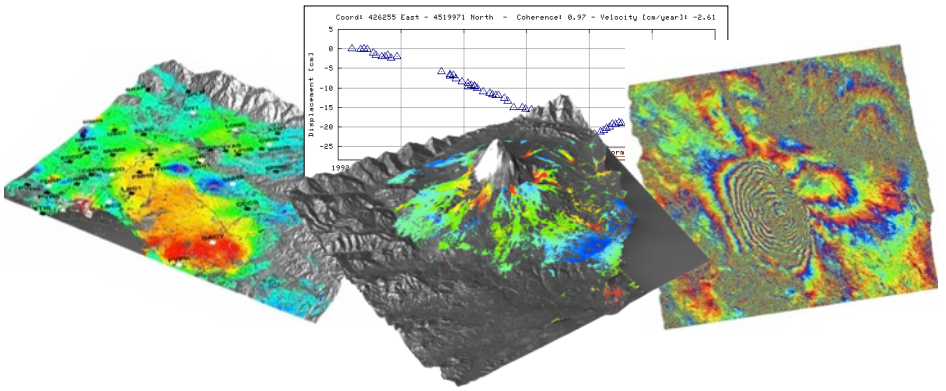
P-SBAS service
(or other tools)



esa

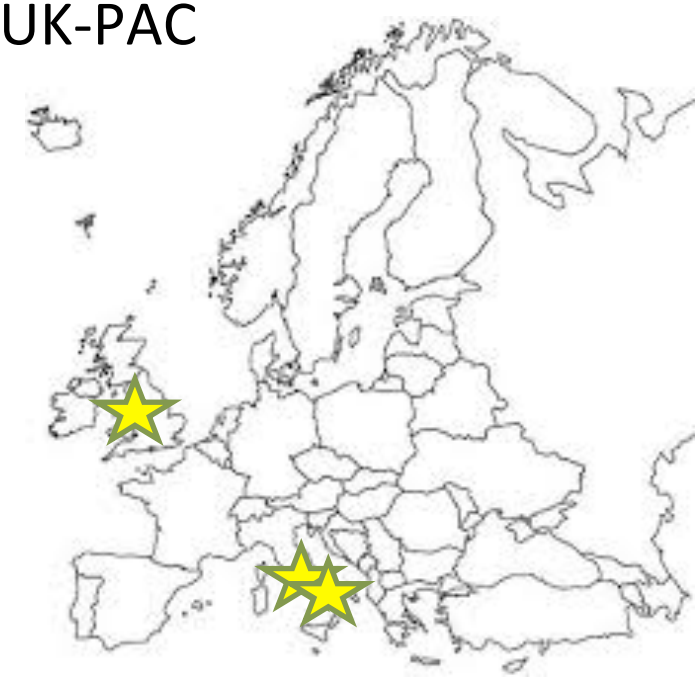
Archives

G-POD User



G-POD computing facilities

- Currently, computing facilities at ESRIN and UK-PAC

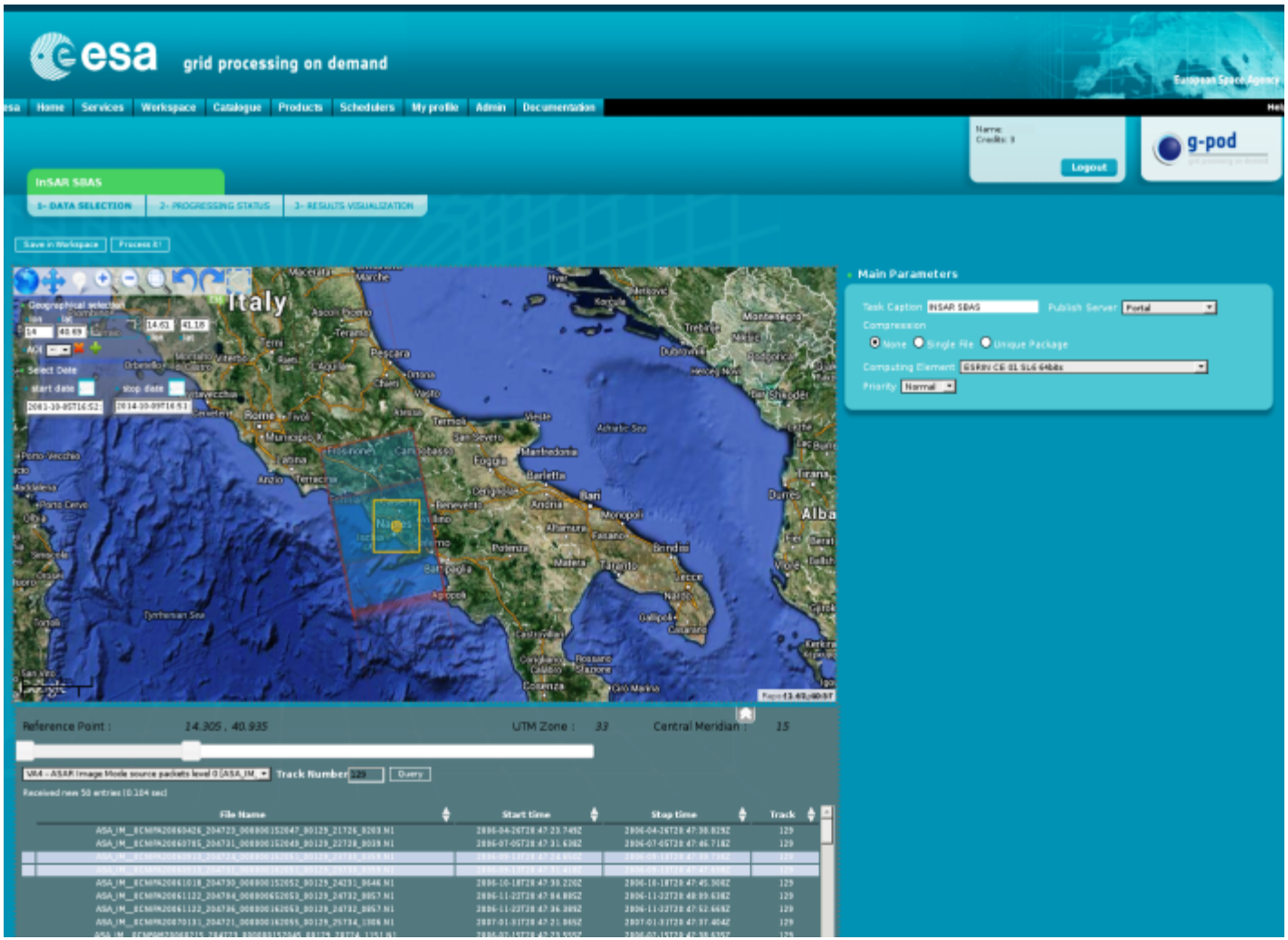


- more than **350 CPUs in**
- about **70 Nodes**
- **330 TB** of local on-line Storage
- internal dedicated **1 Gbps LAN**
- **1 Gbps** for external connection
- **Globus software** on Linux

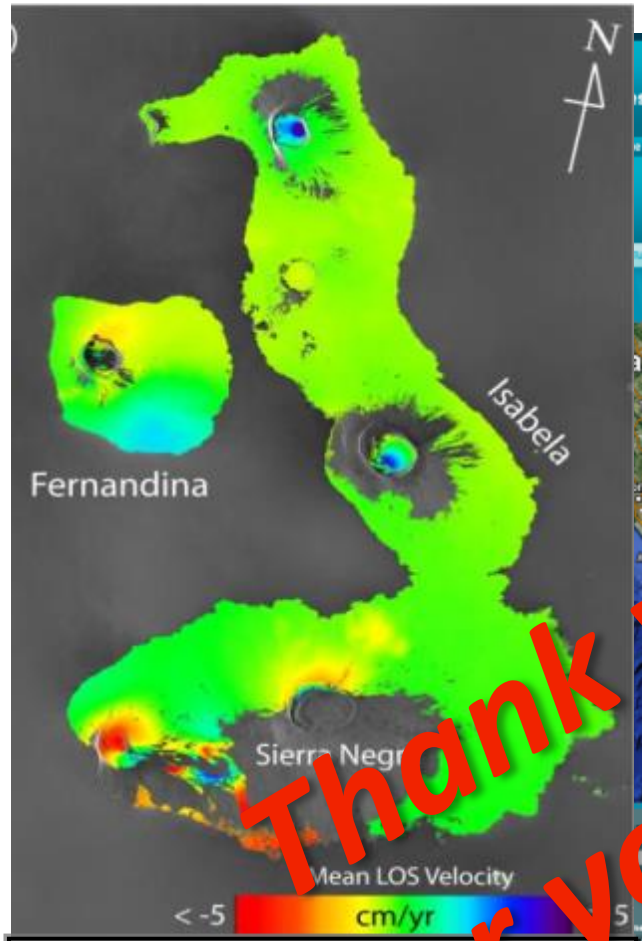
- Thanks to the flexibility of the GRID architecture, G-POD can easily **federate** additional computing and storage resources, also in **Cloud** environments

- **CNR-IREA** nodes recently federated

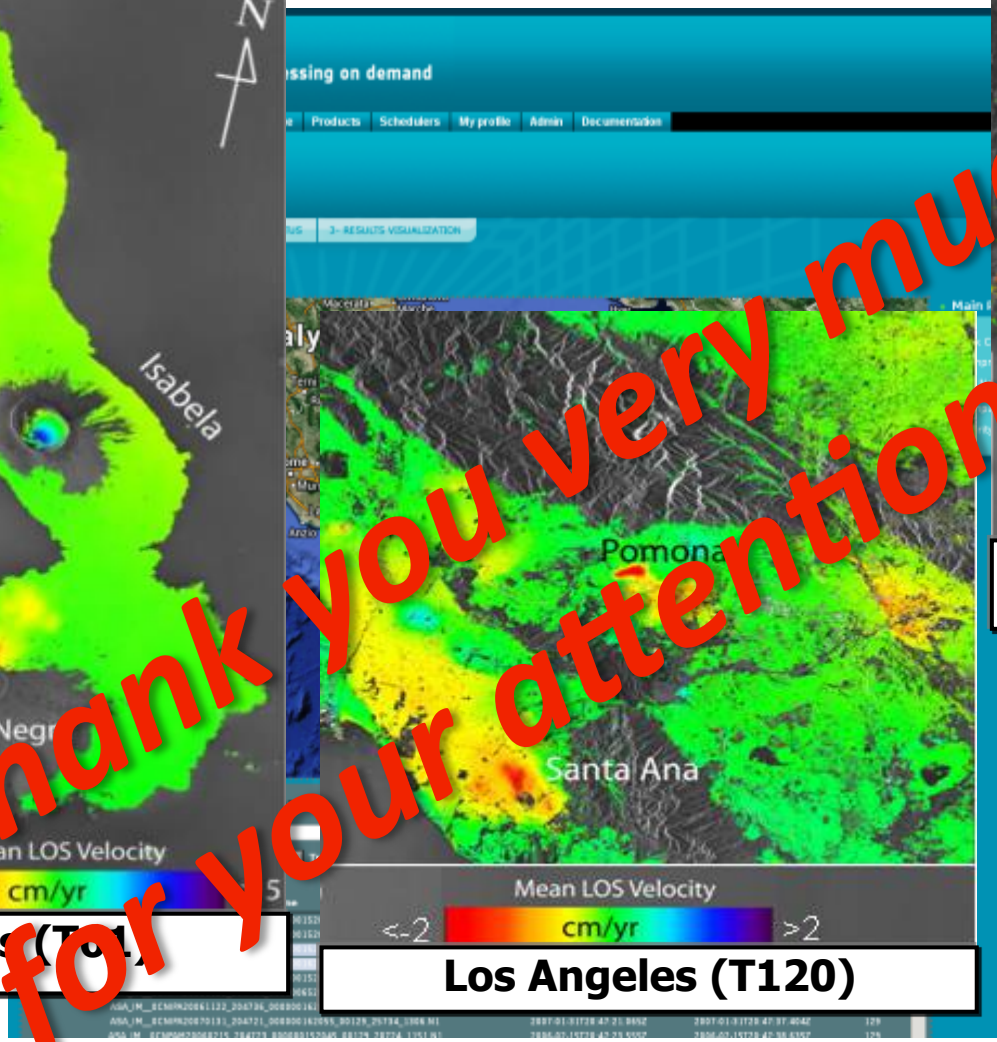
G-POD Web Portal of P-SBAS service



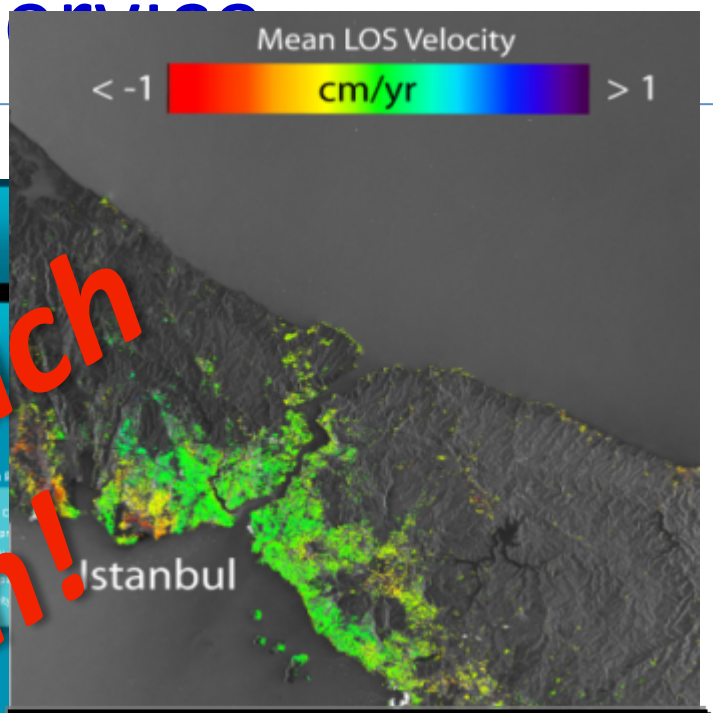
G-POD Web Portal of P-SBAS service



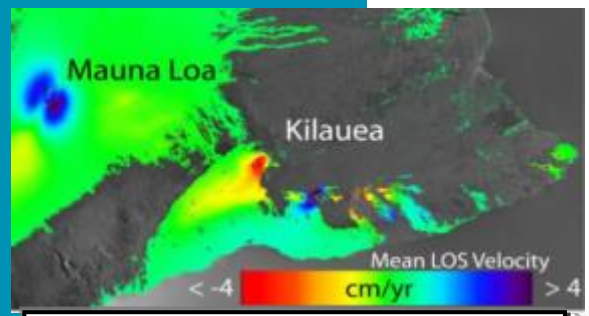
Galapagos (T61)



Los Angeles (T120)



Istanbul (T429)



Hawaii (T93)

Thank you very much for your attention!