

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

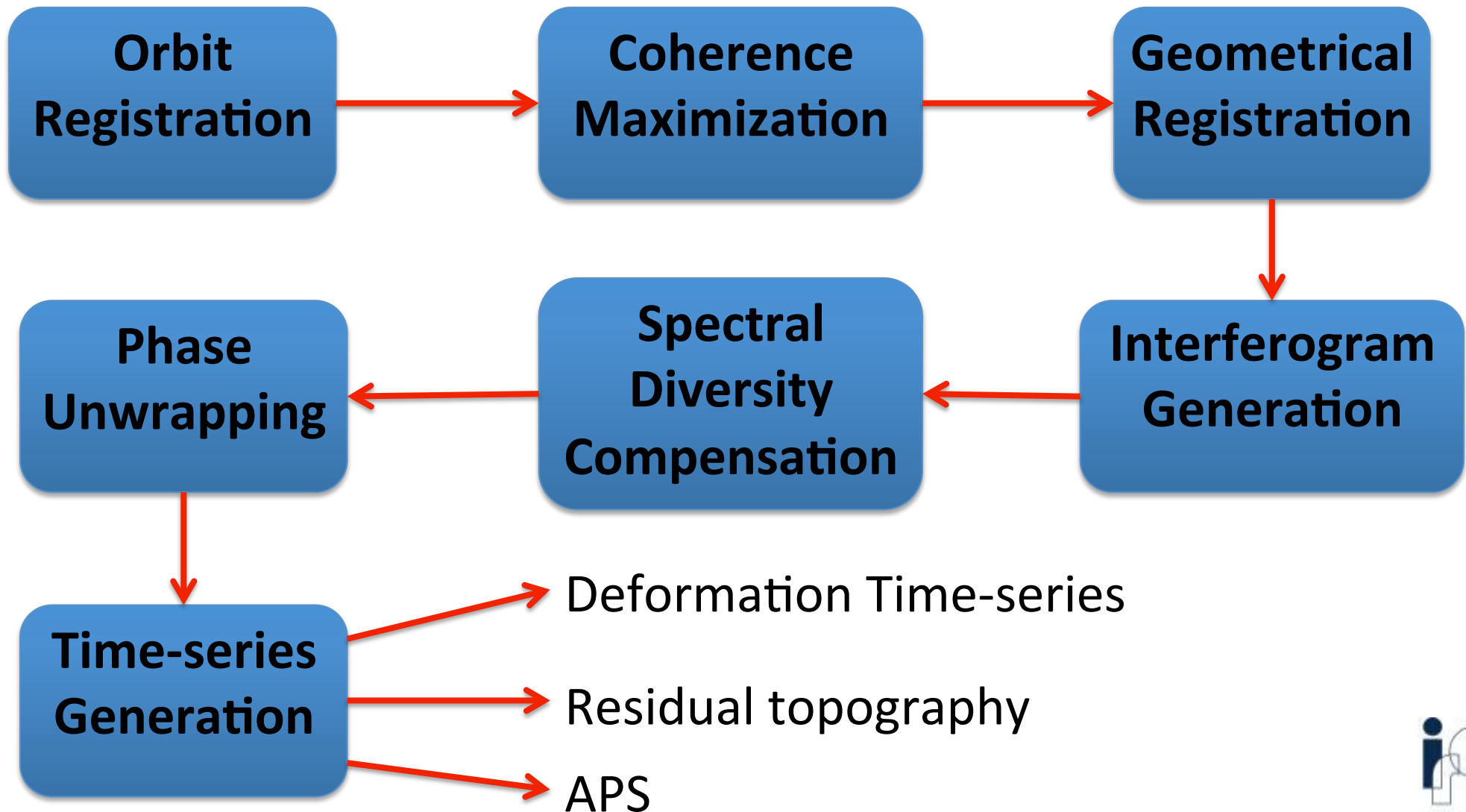
M. Manunta, Berardino P., Bonano M., De Luca C., Elefante S.,
Fusco A., Lanari R., Manzo M., Pepe A., Sansosti E., Zinno I., Casu F.



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SBAS-DInSAR Block Diagram



Registration Steps

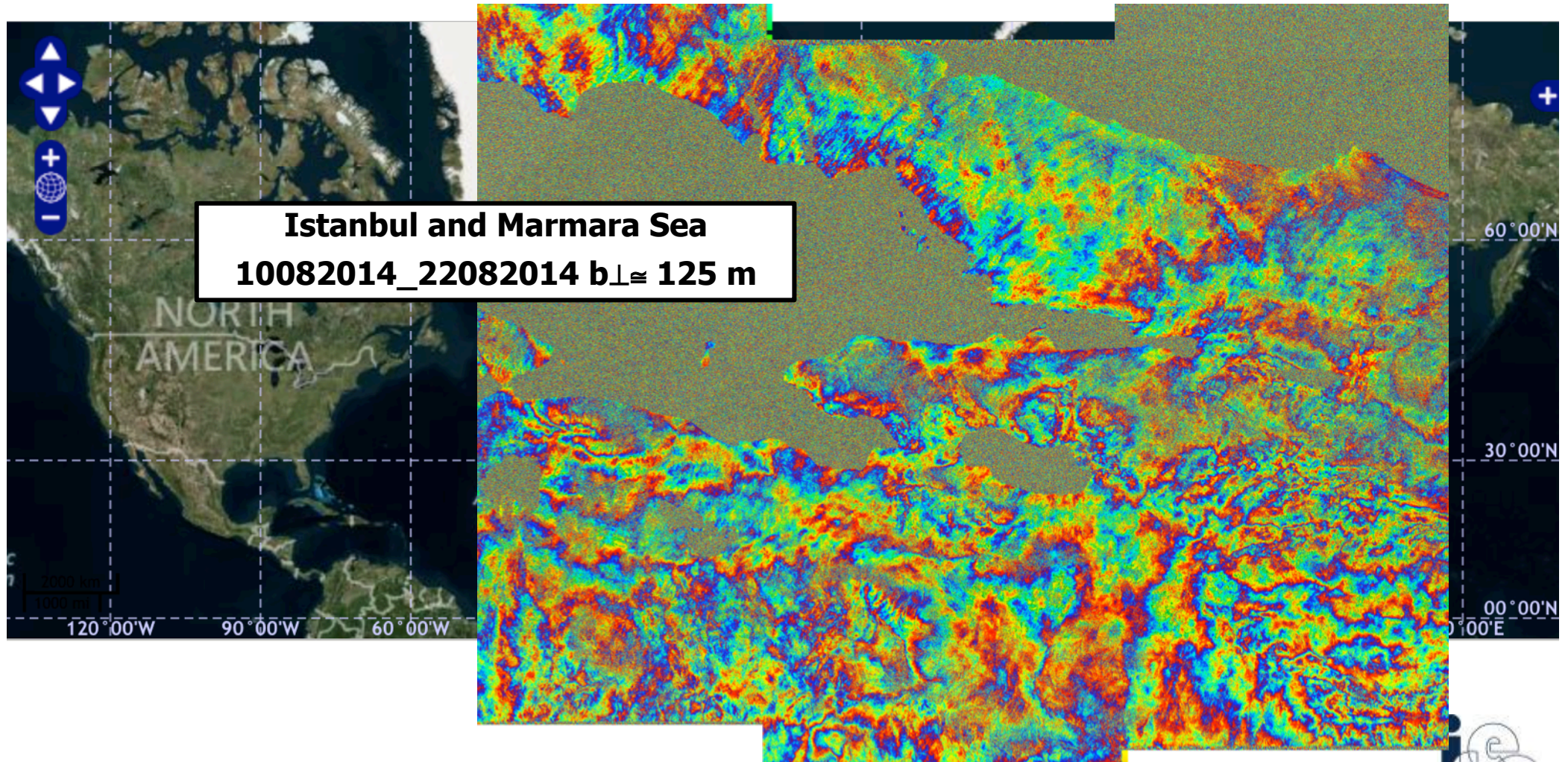
Orbit Registration: Rigid offset, it is retrieved in one point exploiting orbit and target location (DEM) information.

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

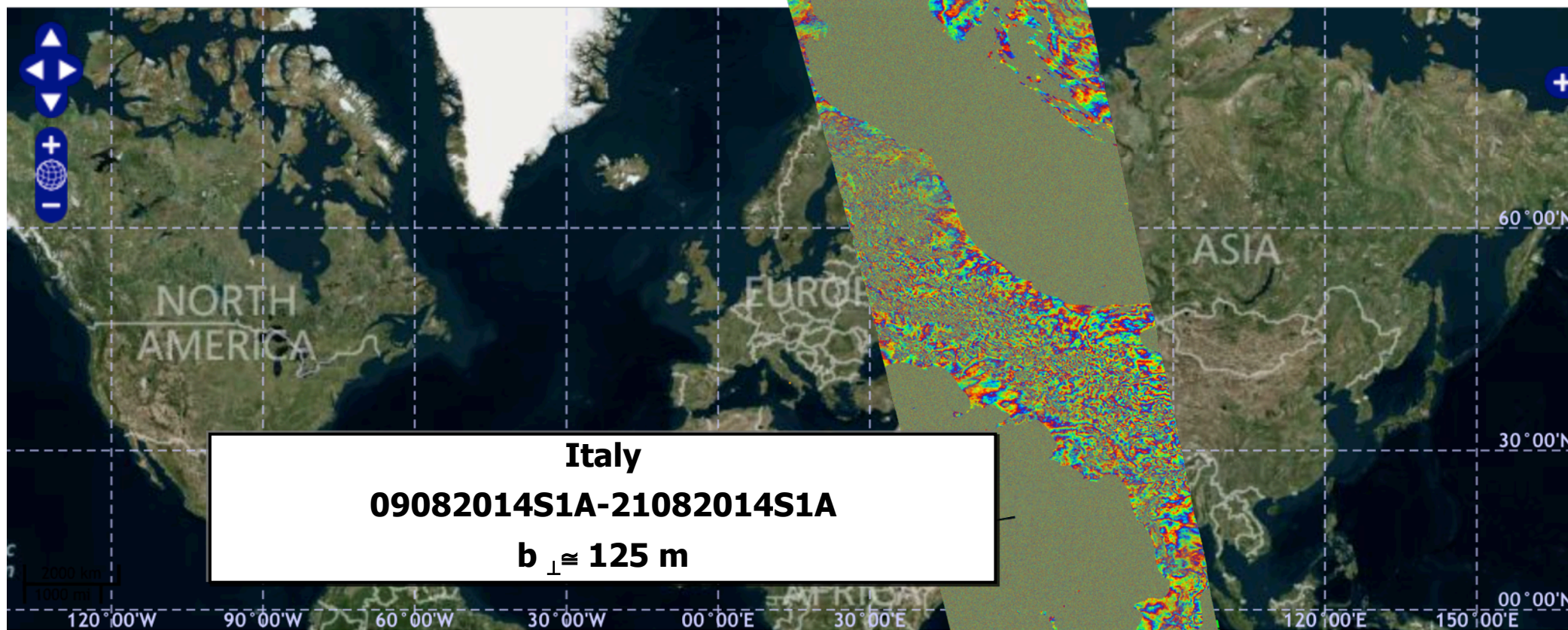
Geometric Registration: it is performed point by point, using orbit and location (DEM) information

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

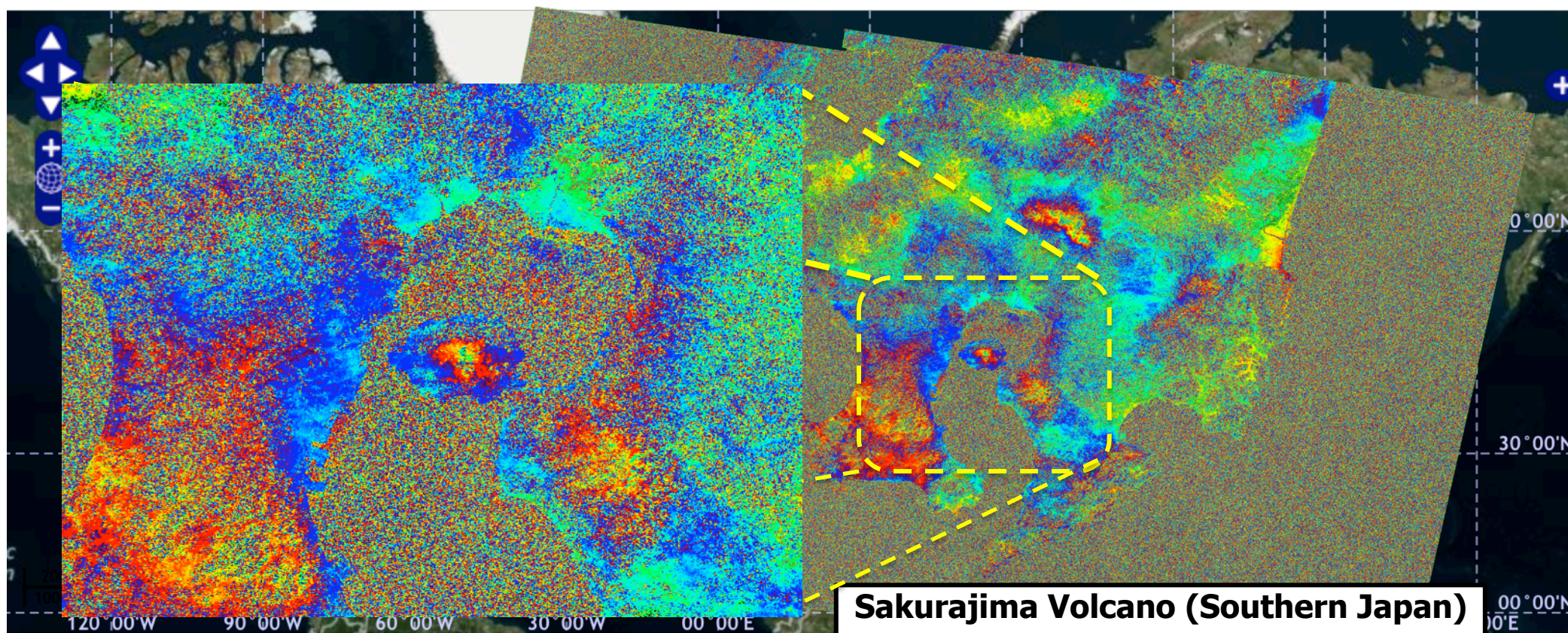
S-1A Commissioning Phase



S-1A Commissioning P



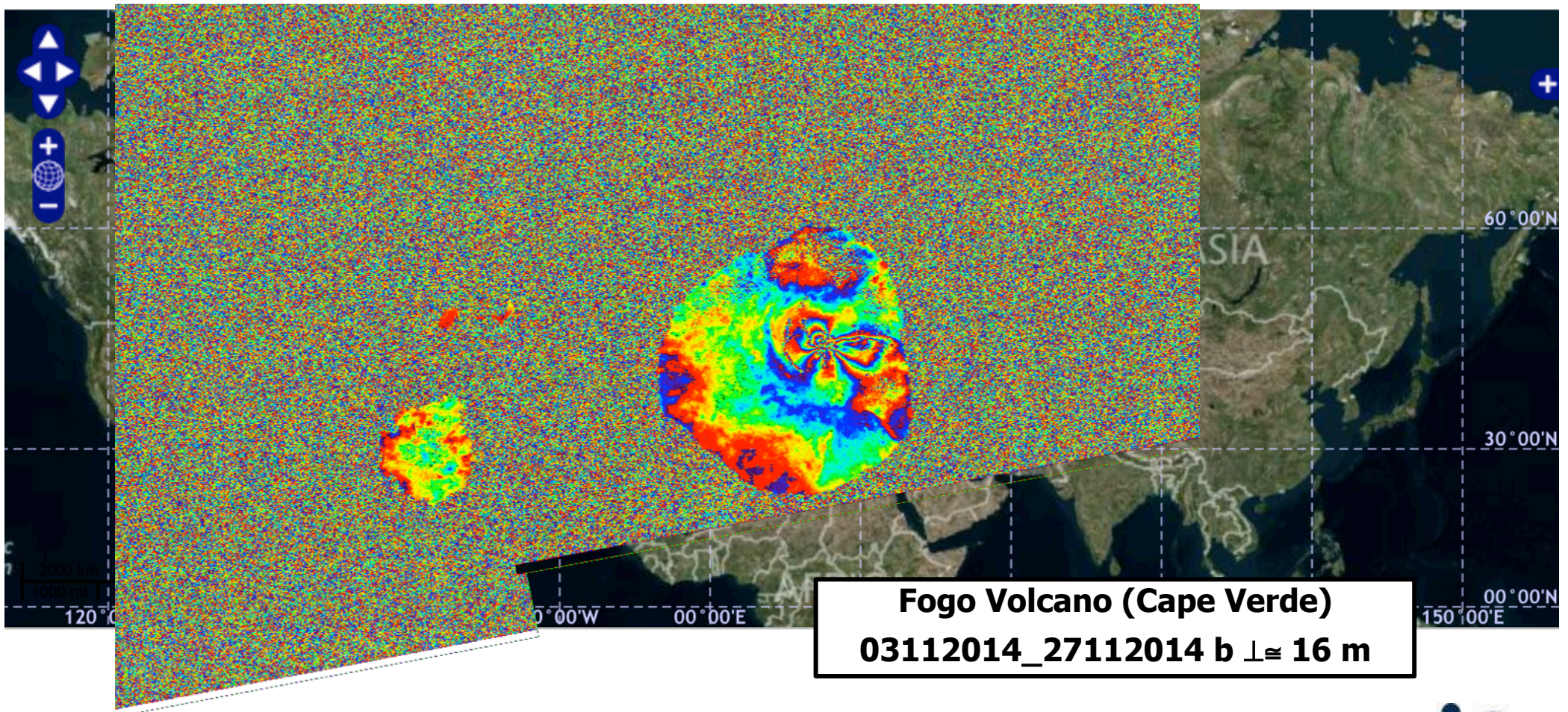
S-1A Operational Phase



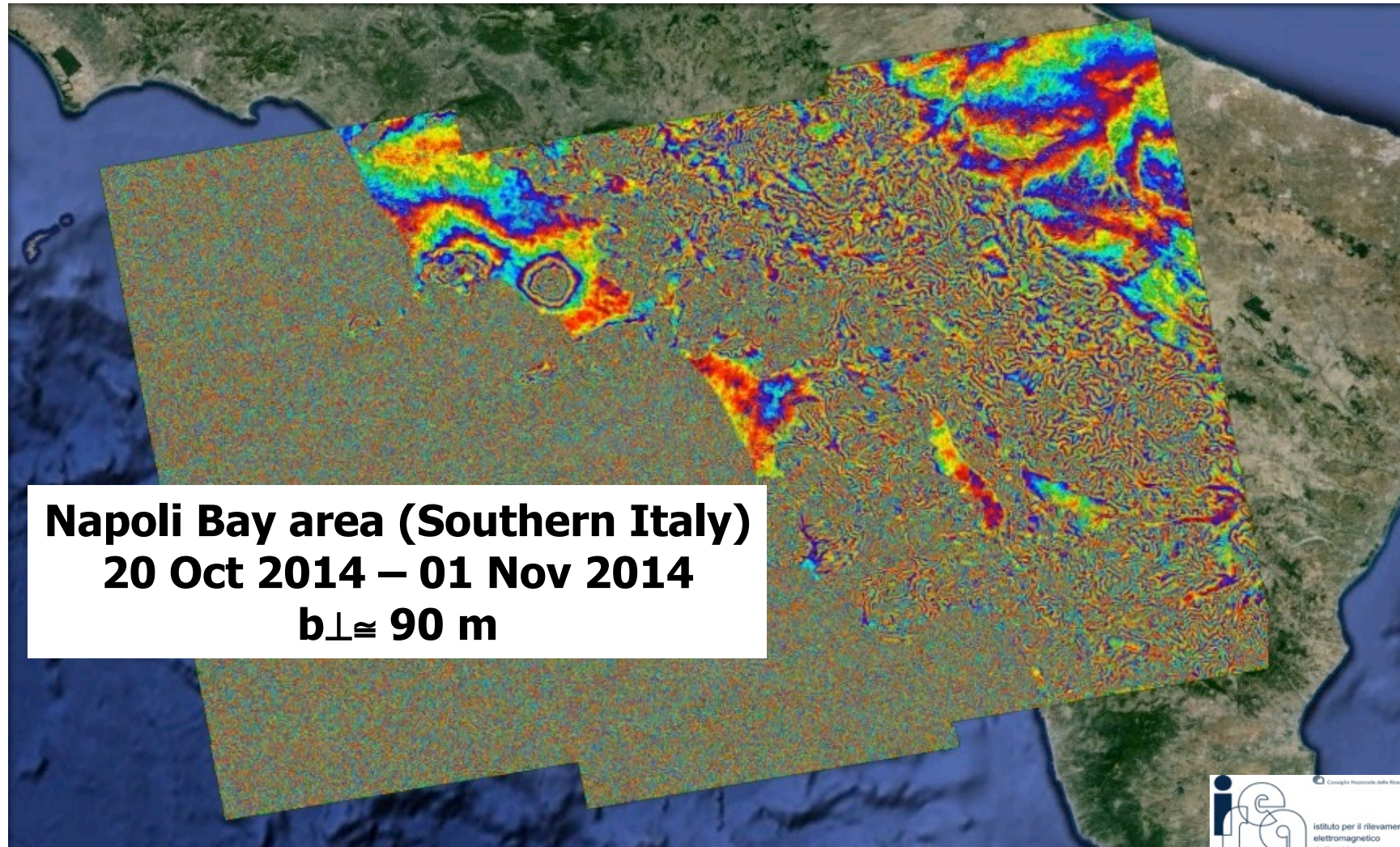
Sakurajima Volcano (Southern Japan)

21112014_03122014 $b_{\perp} \approx 100$ m

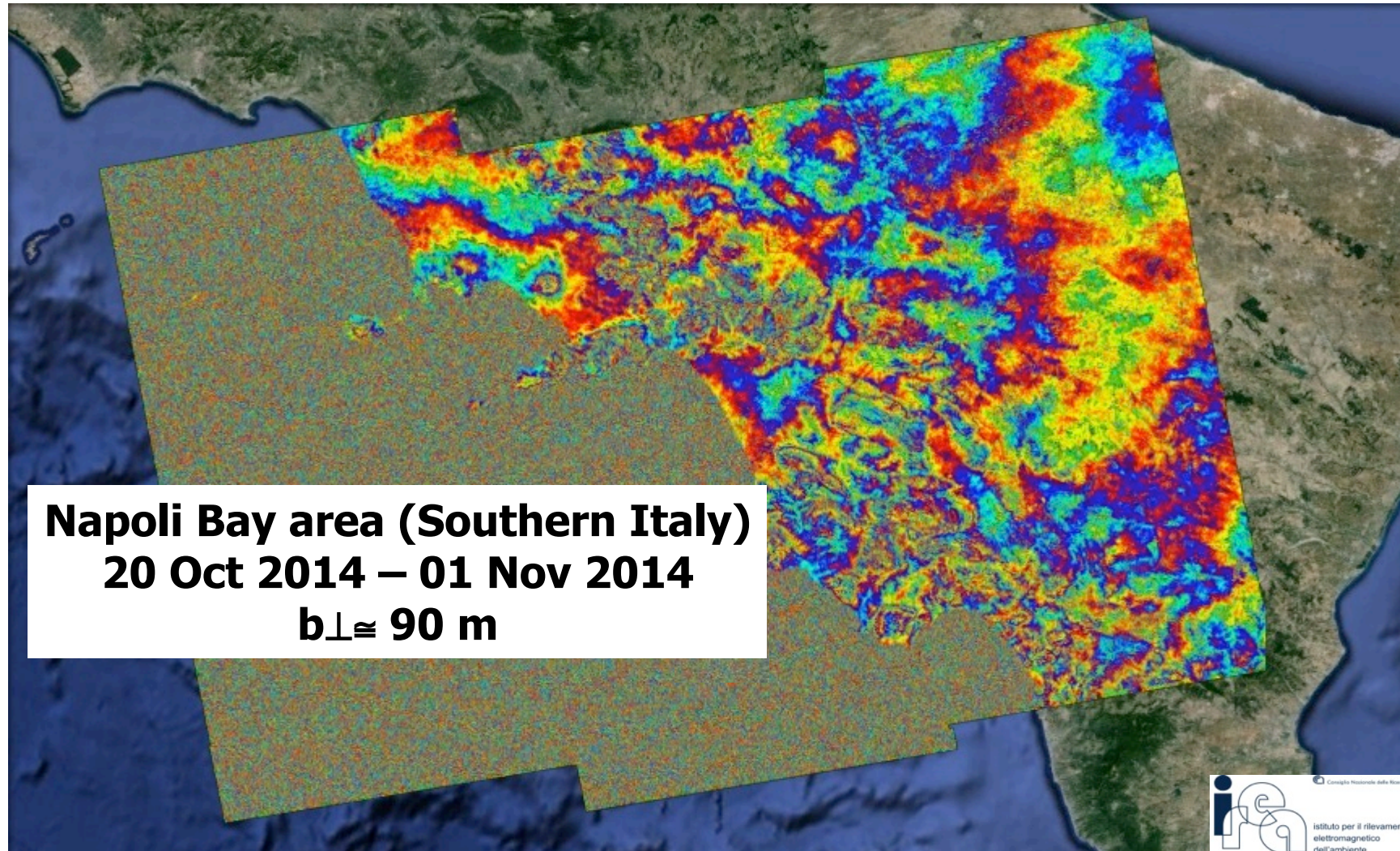
S-1A Operational Phase



S-1A Operational Phase



S-1A Operational Phase



Orbit Information: Annotated vs. External

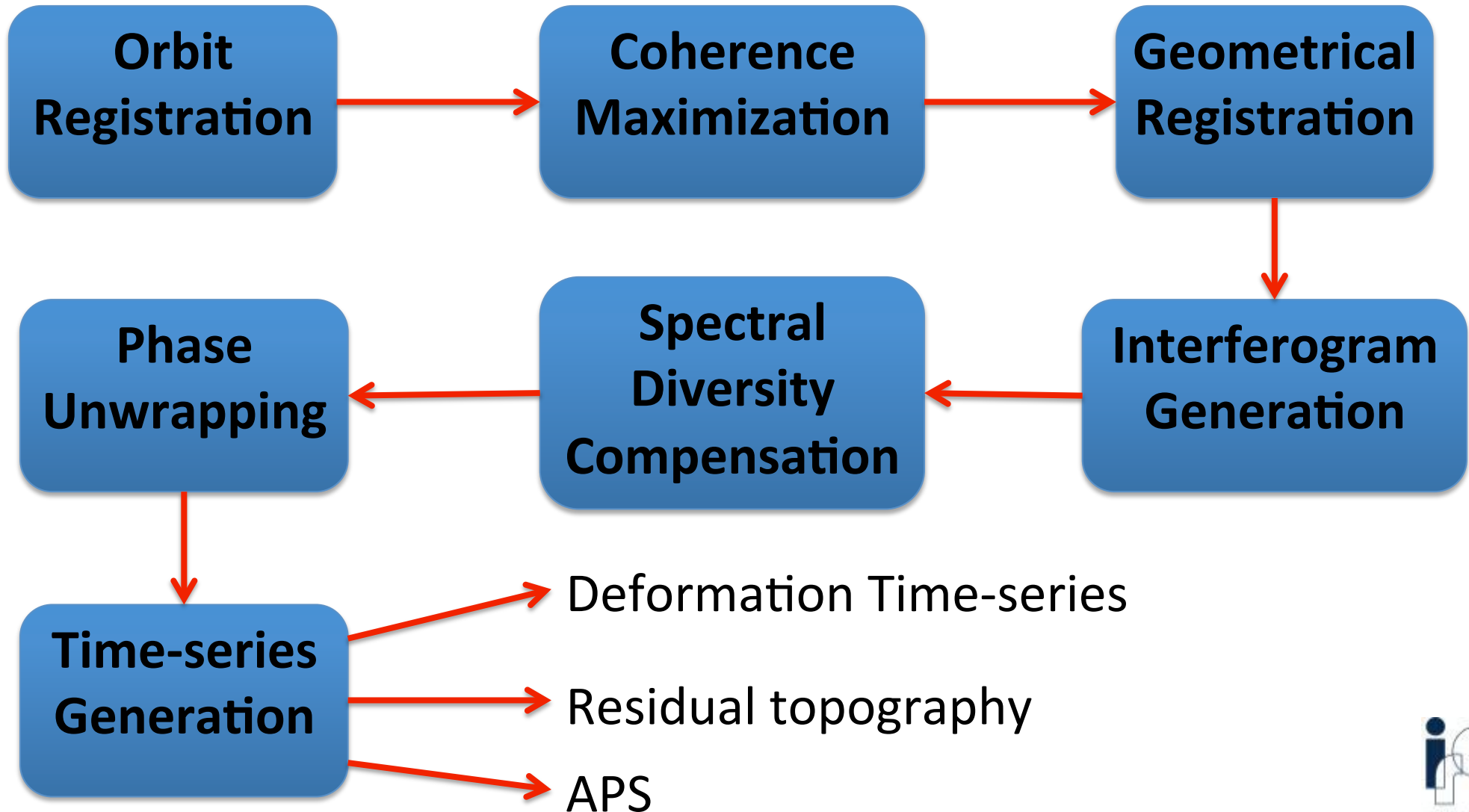
External: 10-sec State Vectors

Annotated: 1-sec State Vectors

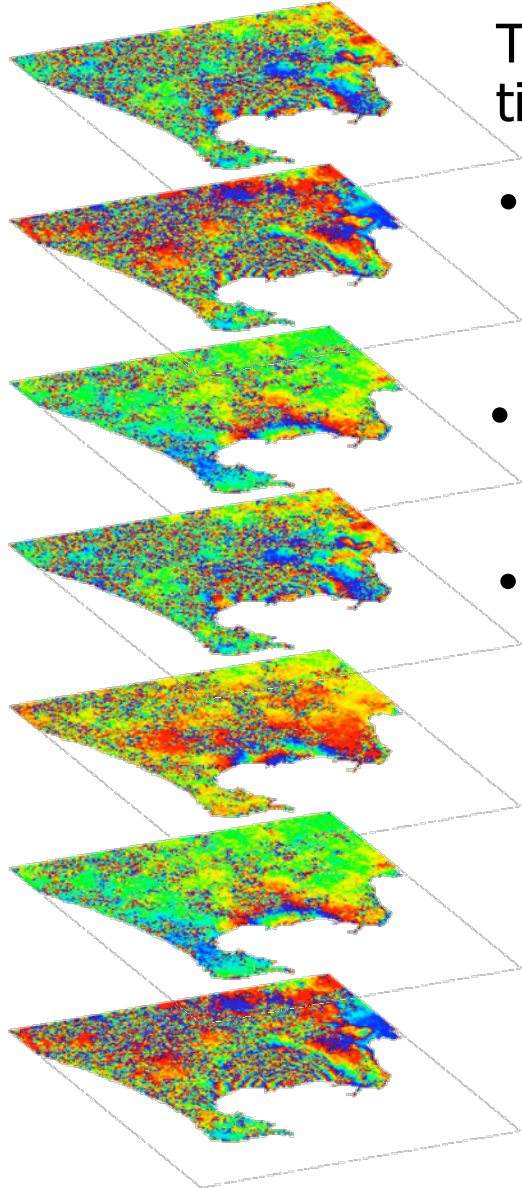
Annotated Orbit are generated by exploiting External Orbit

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:

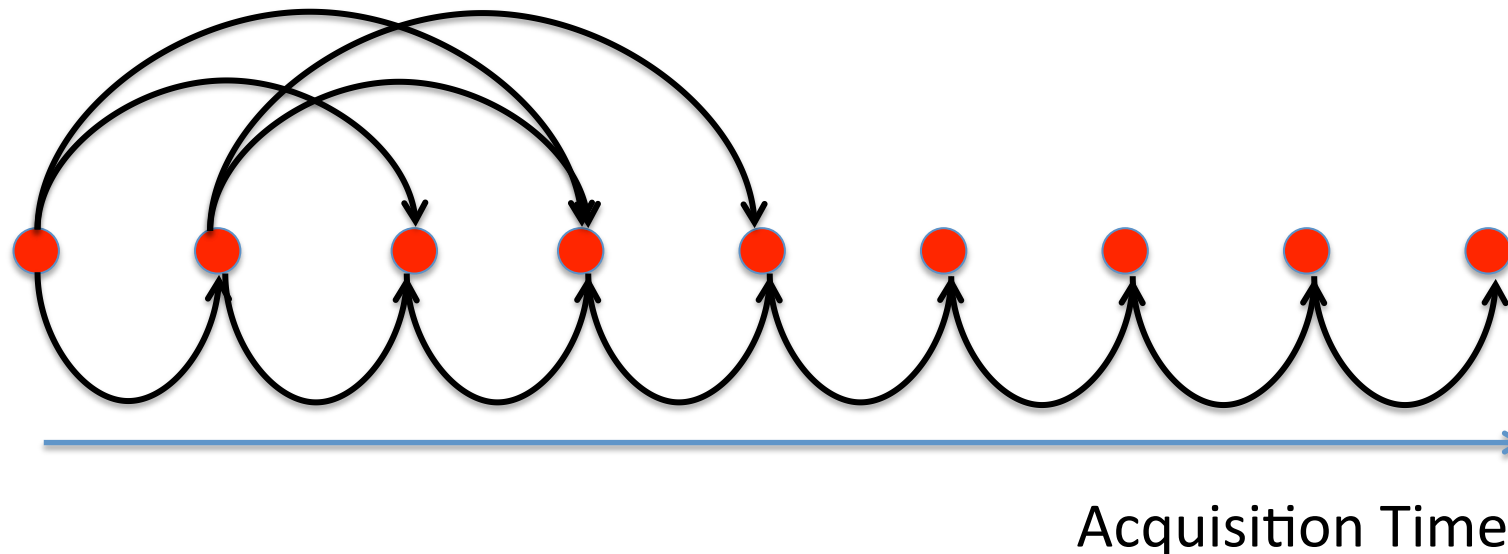
- \approx **1 - 2 mm/year** on the mean deformation velocity
- \approx **5 - 10 mm** on the single displacement

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 $3 \times (\text{Number of acquisitions})$



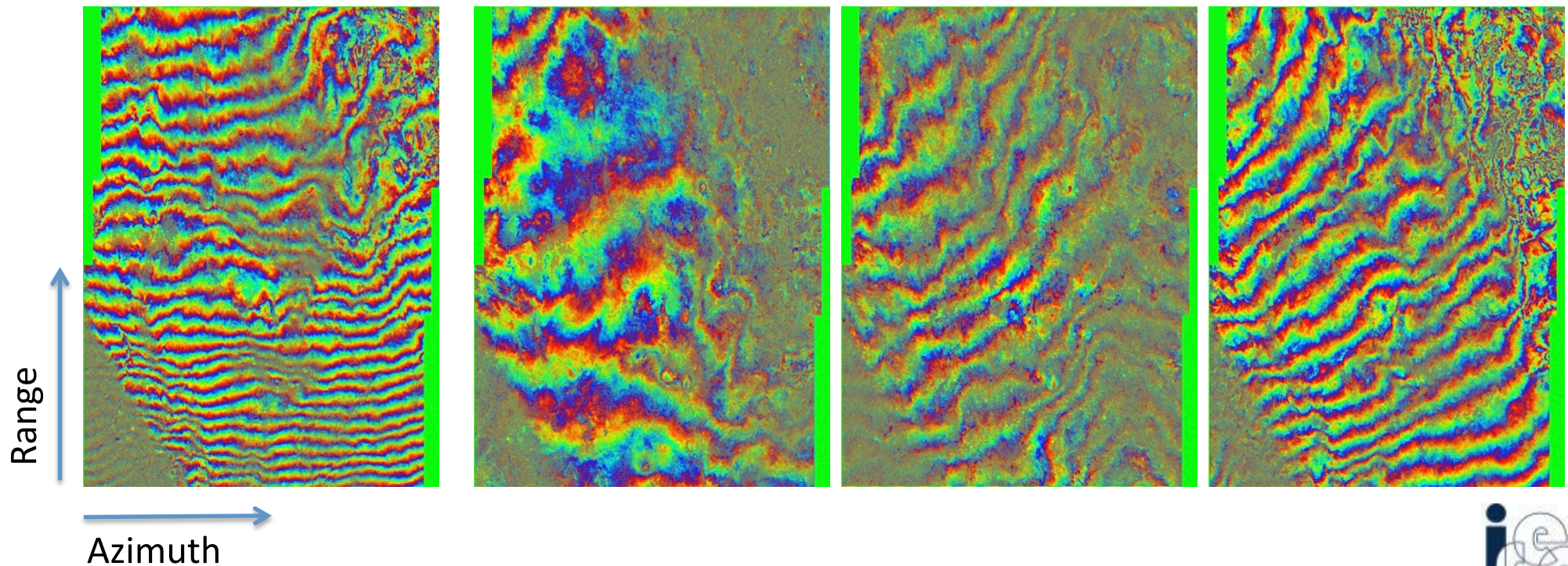
TOPS SBAS results: RS2 TOPS campaign over Mexico City

	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

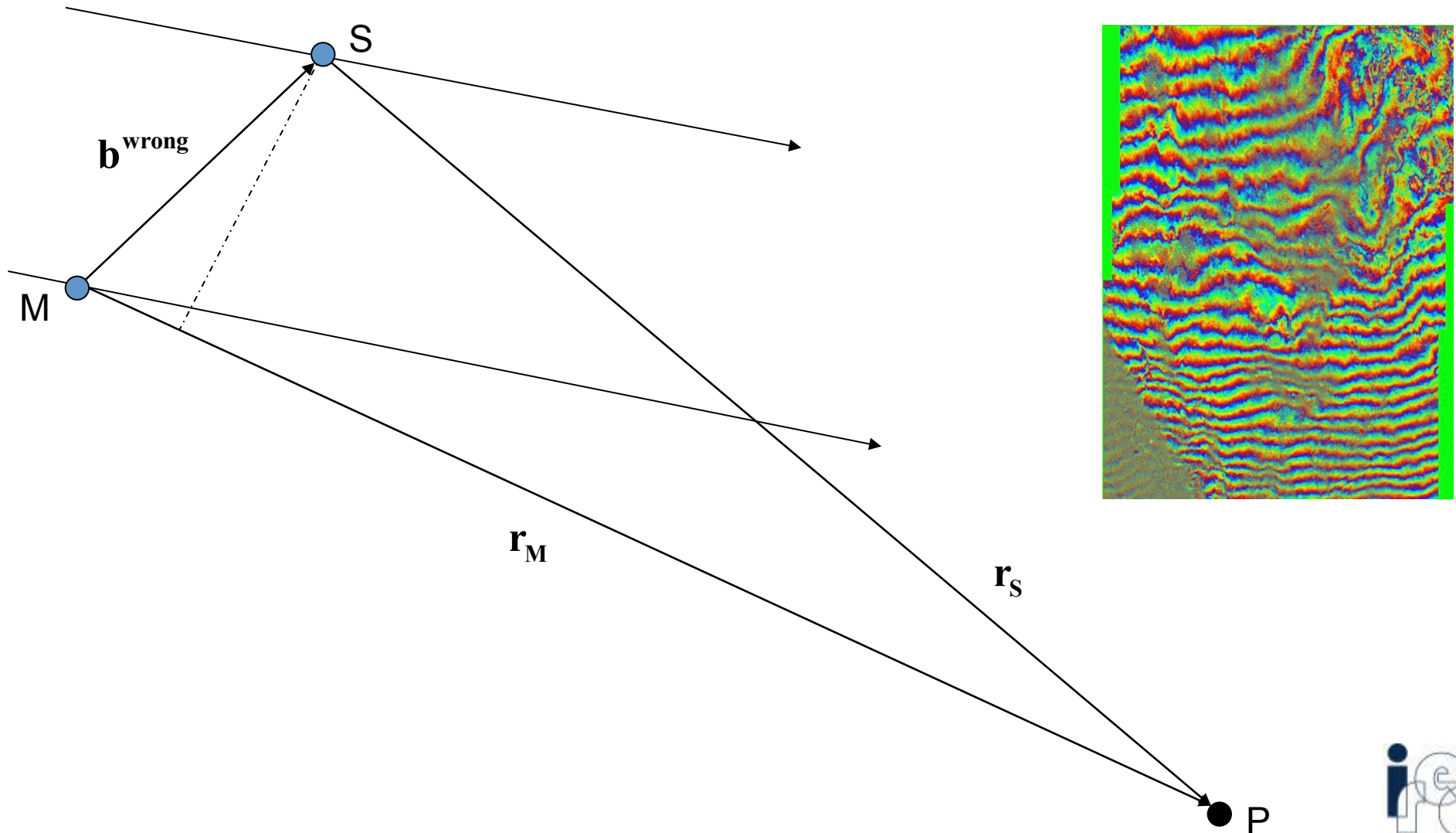
TOPS SBAS results: RS2 TOPS campaign over Mexico City

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

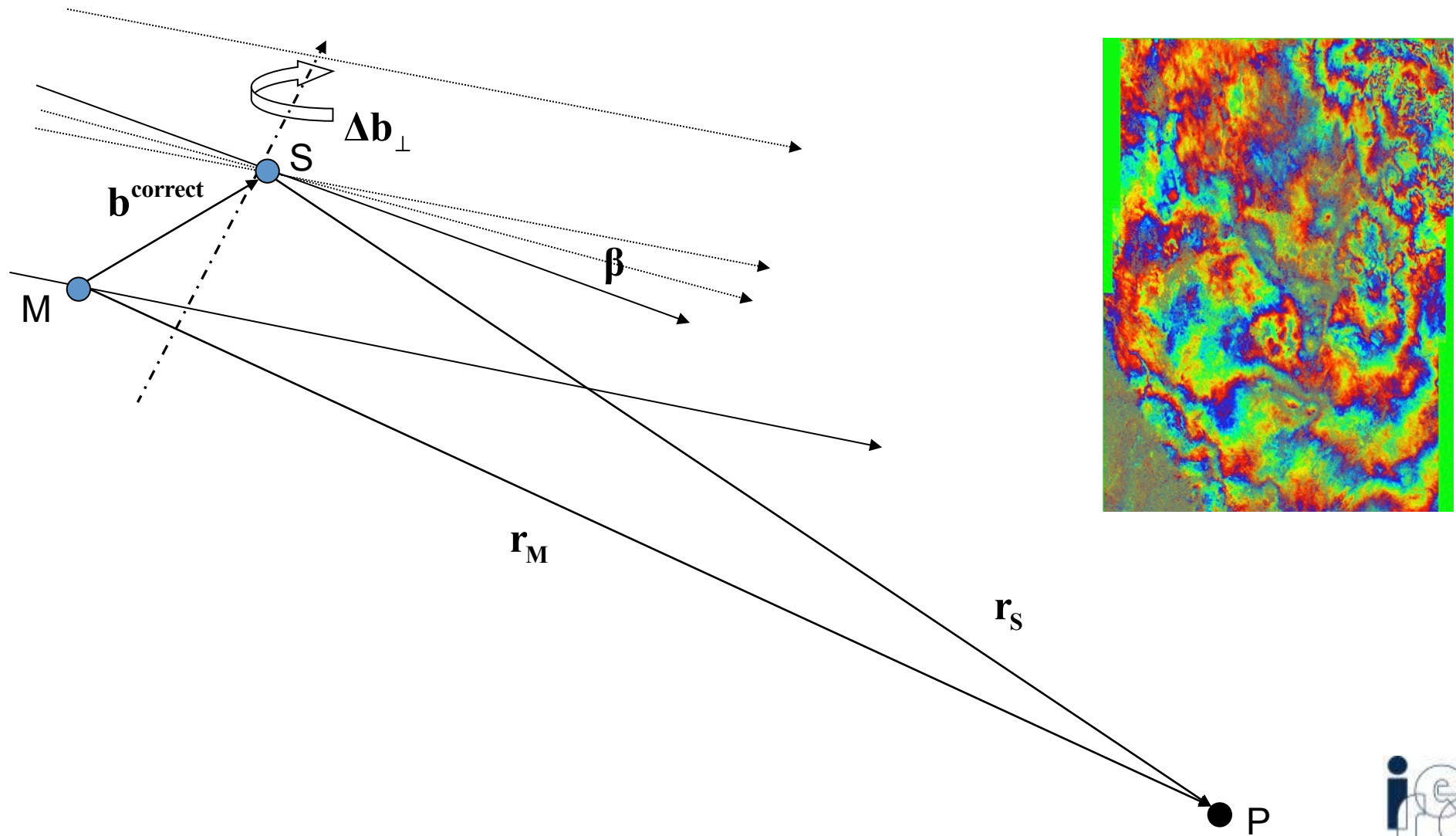
Several RS2 TOPS scenes are affected by significant orbit errors



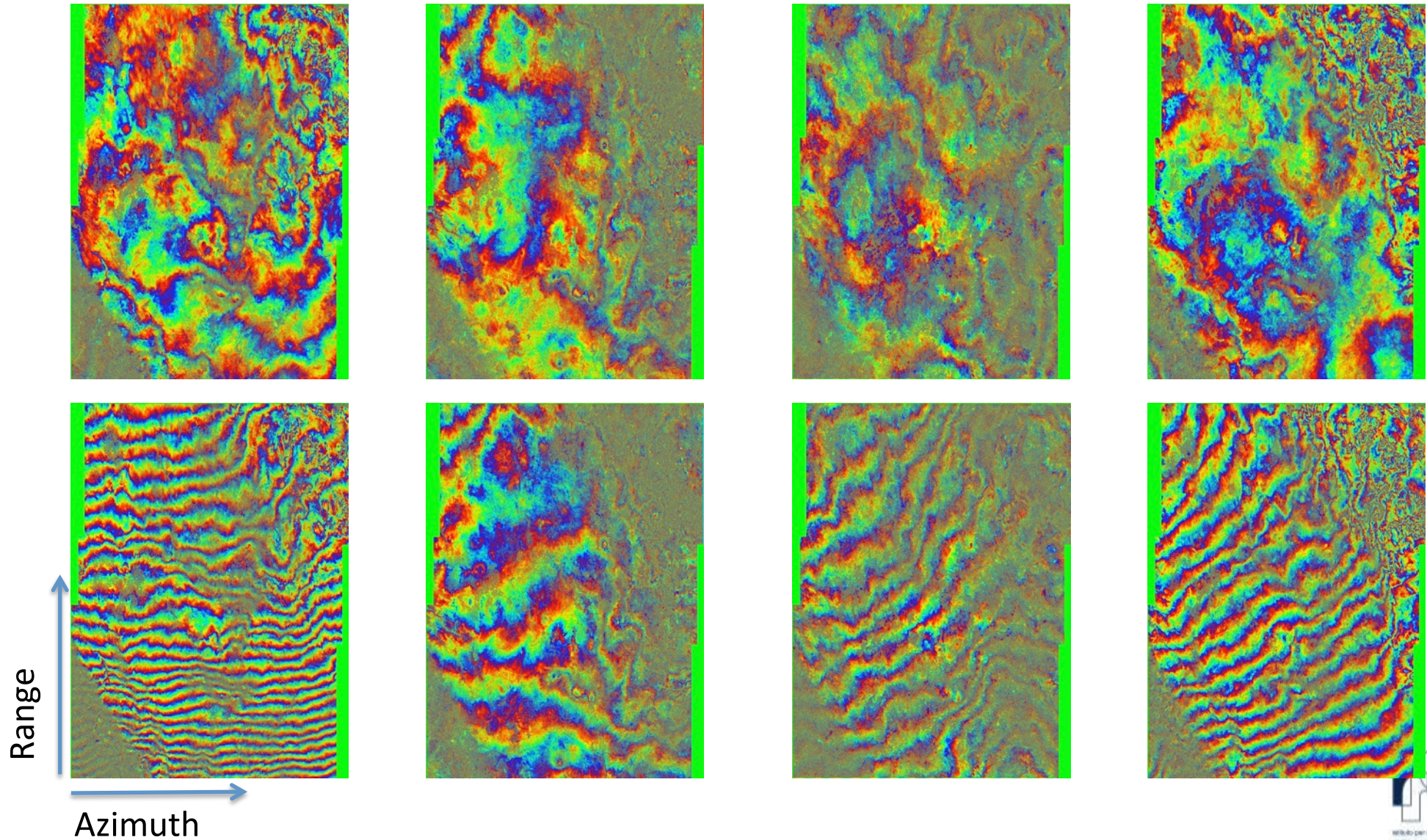
RS2 TOPS interferograms: orbital parameter correction



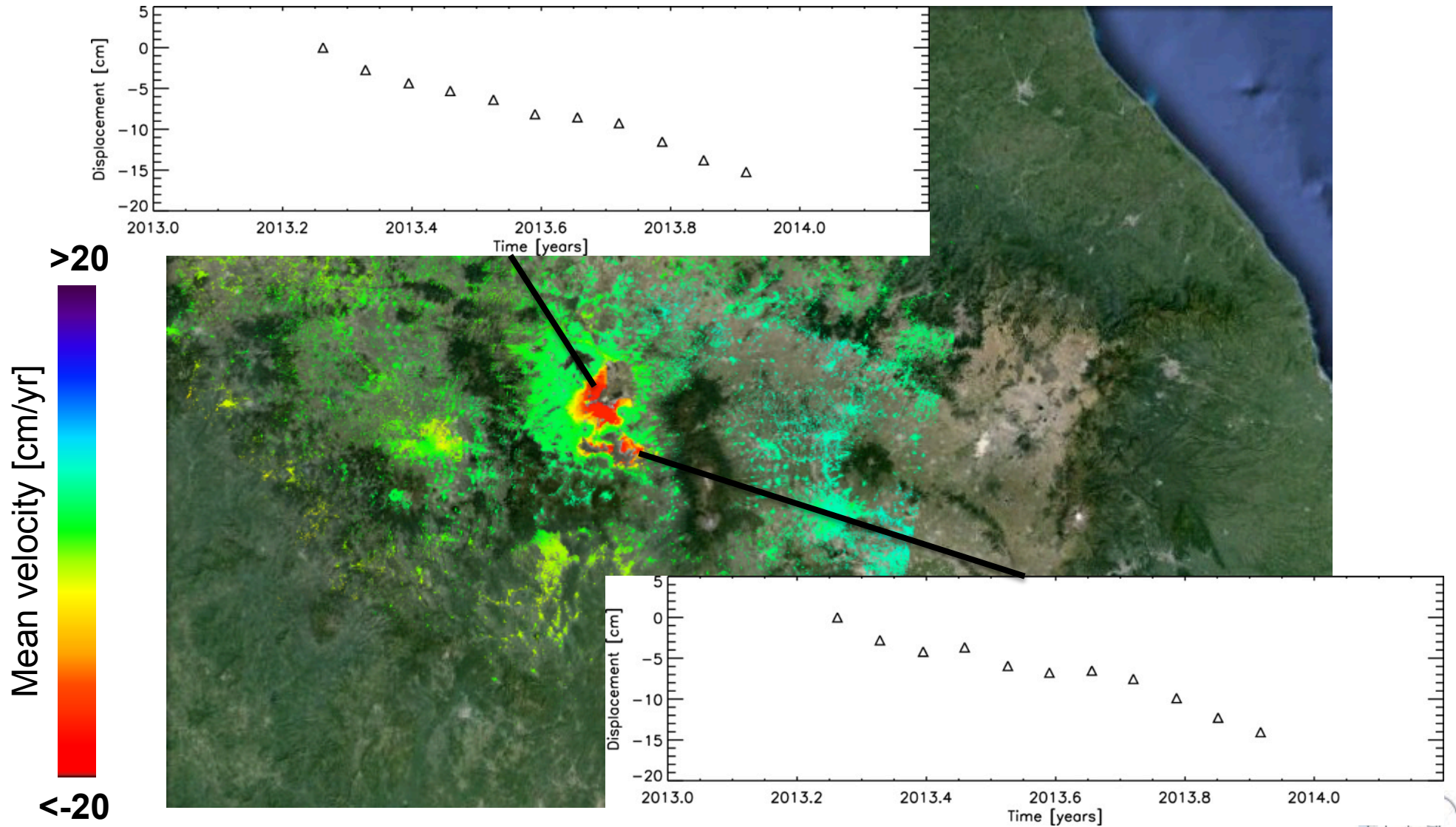
RS2 TOPS interferograms: orbital parameter correction



RS2 TOPS interferograms: orbital parameter correction

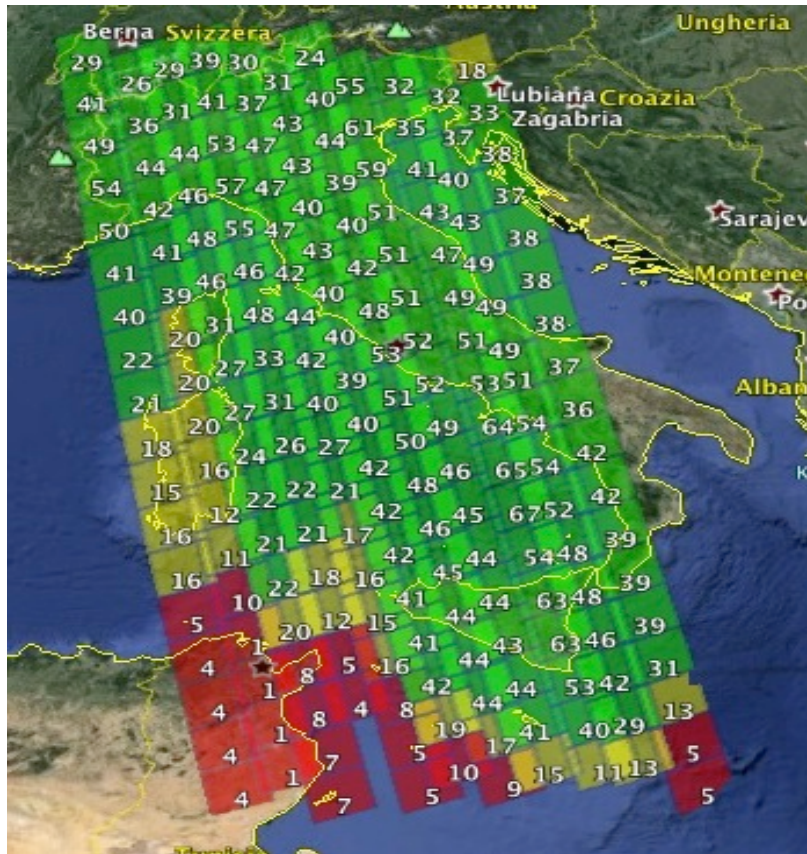


TOPS SBAS results: RS2 TOPS campaign over Mexico City



Upcoming step: Big Data processing

ESA archives have guaranteed large availability of ERS-ENV scenes



ENVISAT coverage over Italy
2003-2010
Only ascending tracks



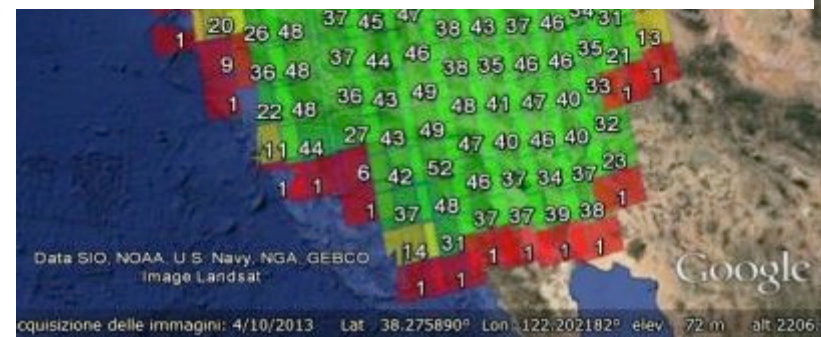
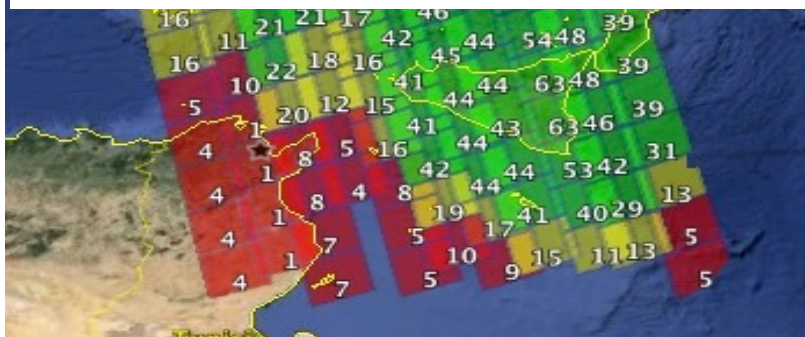
ENVISAT coverage over California
and Nevada 2003-2010
Only ascending tracks

Upcoming step: Big Data processing

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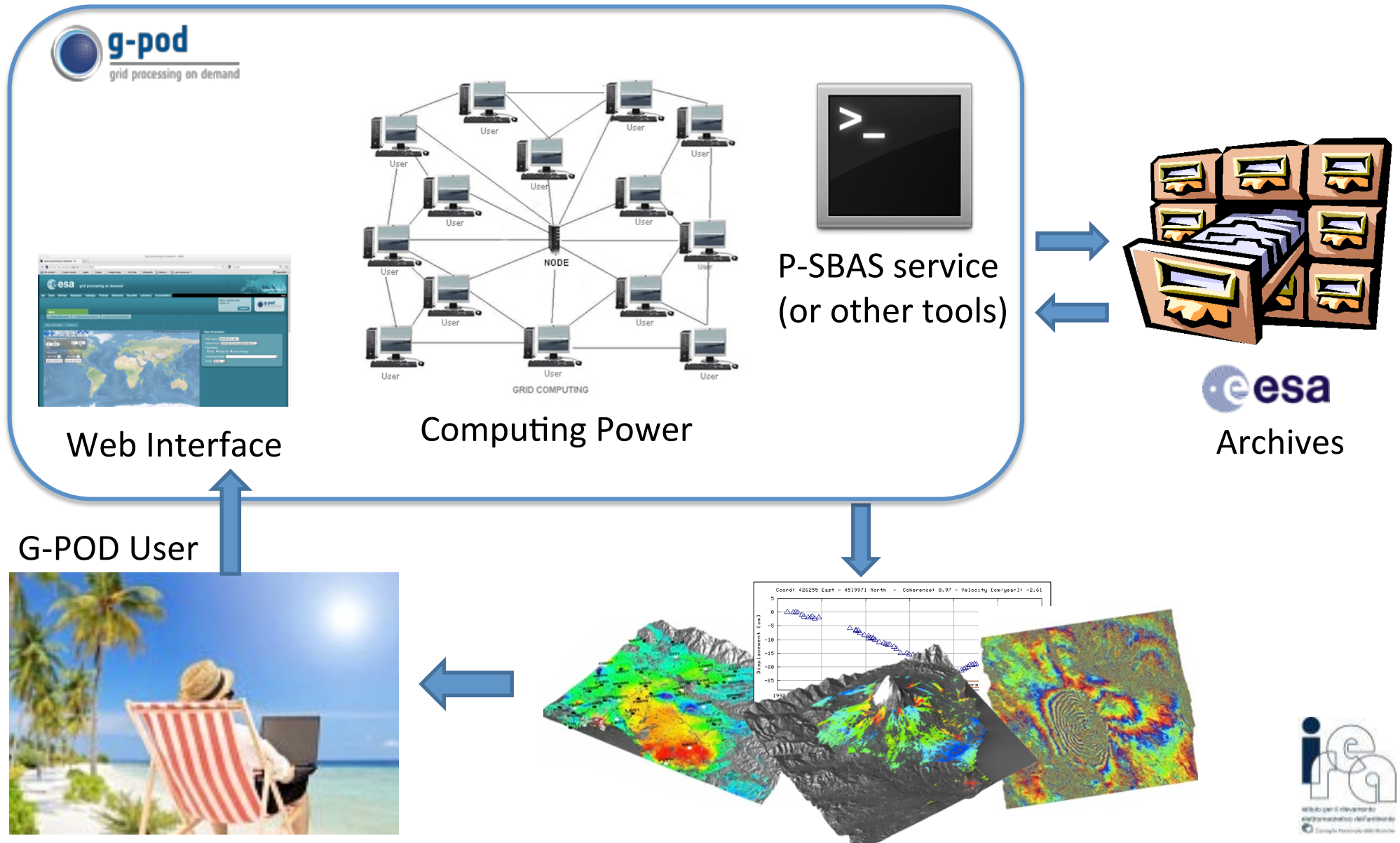
≈ 150 Frames x 4 Nodes for frame ≈ 600 Nodes
≈ 1 day



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 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

The screenshot displays the G-POD web portal interface. At the top, the ESA logo and "grid processing on demand" text are visible. The navigation menu includes Home, Services, Workspace, Catalogue, Products, Schedulers, My profile, Admin, and Documentation. The user's name "Name: Credits: 1" and a "Logout" button are shown in the top right corner. The main content area is titled "INSAR SBAS" and features three tabs: "1- DATA SELECTION", "2- PROGRESSING STATUS", and "3- RESULTS VISUALIZATION". Below the tabs, there are buttons for "Save in Workspace" and "Process it!".

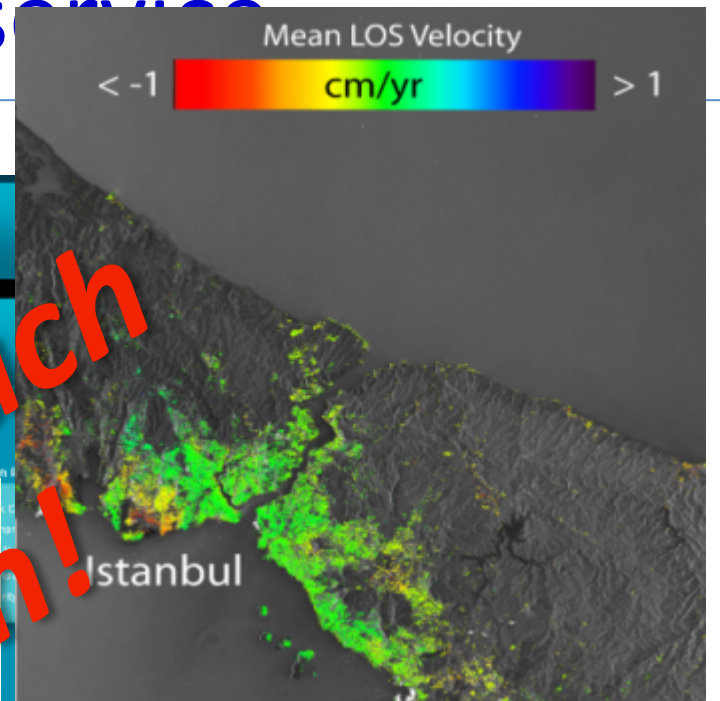
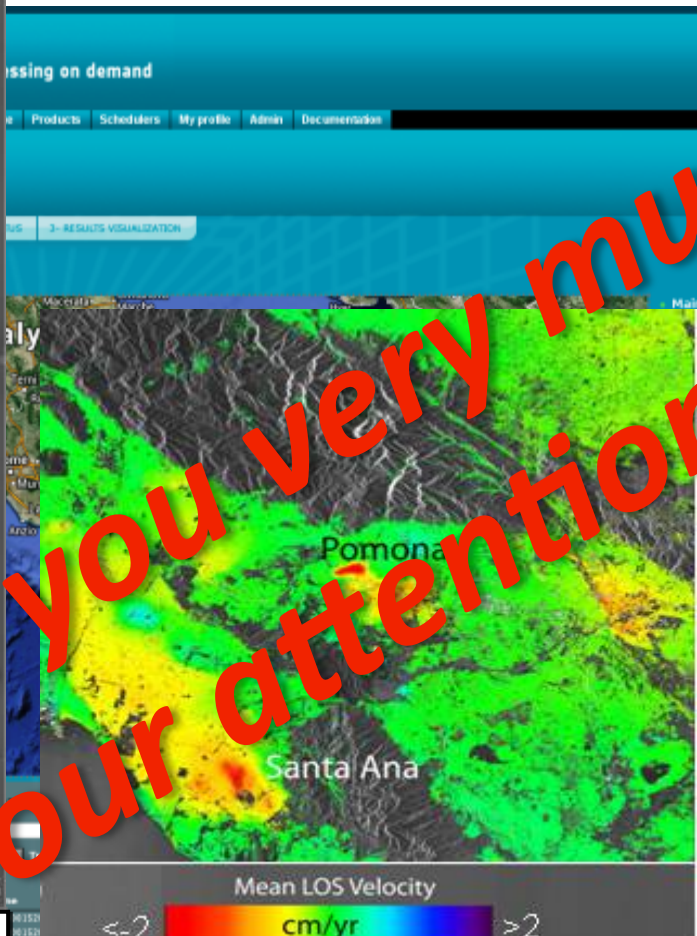
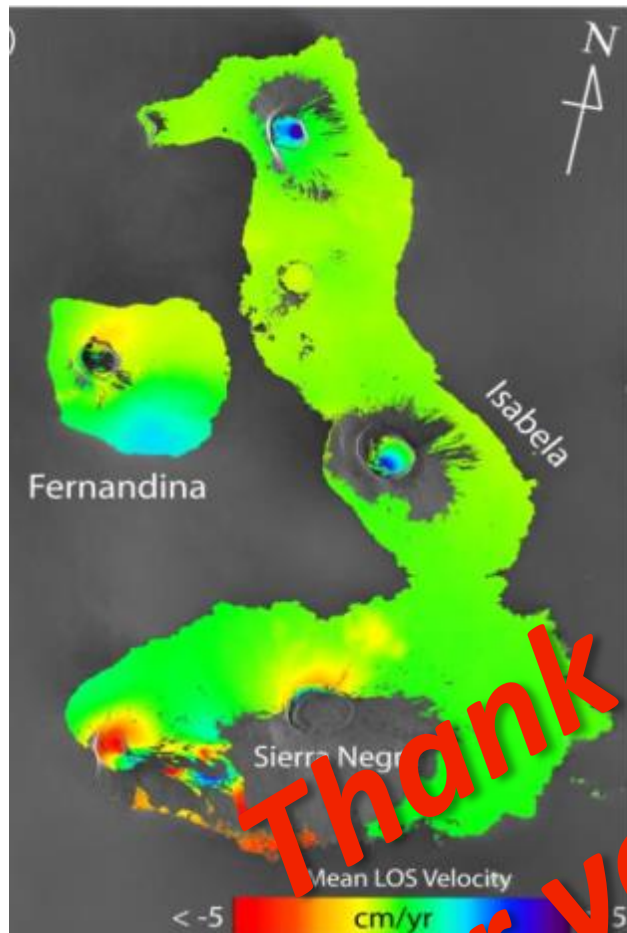
The central part of the interface is a map of Italy with a yellow box highlighting the Naples region. To the right of the map is a "Main Parameters" panel with the following settings:

- Task Caption: INSAR SBAS
- Publish Server: Portal
- Compression: None Single File Unique Package
- Computing Element: CSRRVCE-EL-SUE6MBs
- Priority: Normal

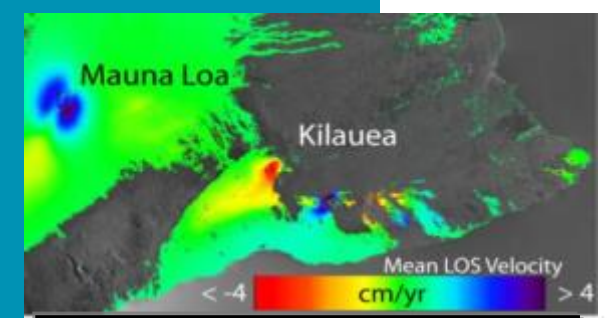
Below the map, the "Reference Point" is set to 14.905, 40.935, with UTM Zone 33 and Central Meridian 15. A search bar contains the query "NR4 - ASAR Image Mode source packets level 0 (ASA_IM) - Track Number: 239". Below this, a table lists the received files:

File Name	Start time	Stop time	Track
ASA_IM_8CMR2086540E_204729_00800152047_00129_21726_3203 MI	2006-04-20T23:47:25.748Z	2006-04-20T23:47:38.828Z	129
ASA_IM_8CMR2086571E_204731_00800152049_00129_22728_3039 MI	2006-07-05T23:47:31.630Z	2006-07-05T23:47:46.718Z	129
ASA_IM_8CMR2086591E_204733_00800152051_00129_23730_3049 MI	2006-09-13T23:47:34.902Z	2006-09-13T23:47:50.090Z	129
ASA_IM_8CMR2086611E_204735_00800152053_00129_24732_3059 MI	2006-09-13T23:47:38.174Z	2006-09-13T23:47:53.362Z	129
ASA_IM_8CMR20861618_204730_00800152052_00129_24731_3046 MI	2006-10-18T23:47:39.220Z	2006-10-18T23:47:45.308Z	129
ASA_IM_8CMR20861122_204734_00800612053_00129_24732_3057 MI	2006-11-02T23:47:44.895Z	2006-11-02T23:48:09.638Z	129
ASA_IM_8CMR20861122_204734_00800612053_00129_24732_3067 MI	2006-11-02T23:47:36.890Z	2006-11-02T23:47:52.648Z	129
ASA_IM_8CMR20870131_204731_00800612053_00129_25734_3368 MI	2007-01-03T23:47:21.865Z	2007-01-03T23:47:37.404Z	129
ASA_IM_8CMR20870131_204731_00800612053_00129_26736_3378 MI	2007-01-10T23:47:25.550Z	2007-01-10T23:47:38.330Z	129

G-POD Web Portal of P-SBAS service



Istanbul (T429)



Hawaii (T93)

Thank you very much for your attention!