

Emergency Management Service

Experience on S-1 Data Use in EMS Mapping



Emergency
Management

EC Joint Research Centre
with contributions from EMS service
providers
ESRIN, May 2018

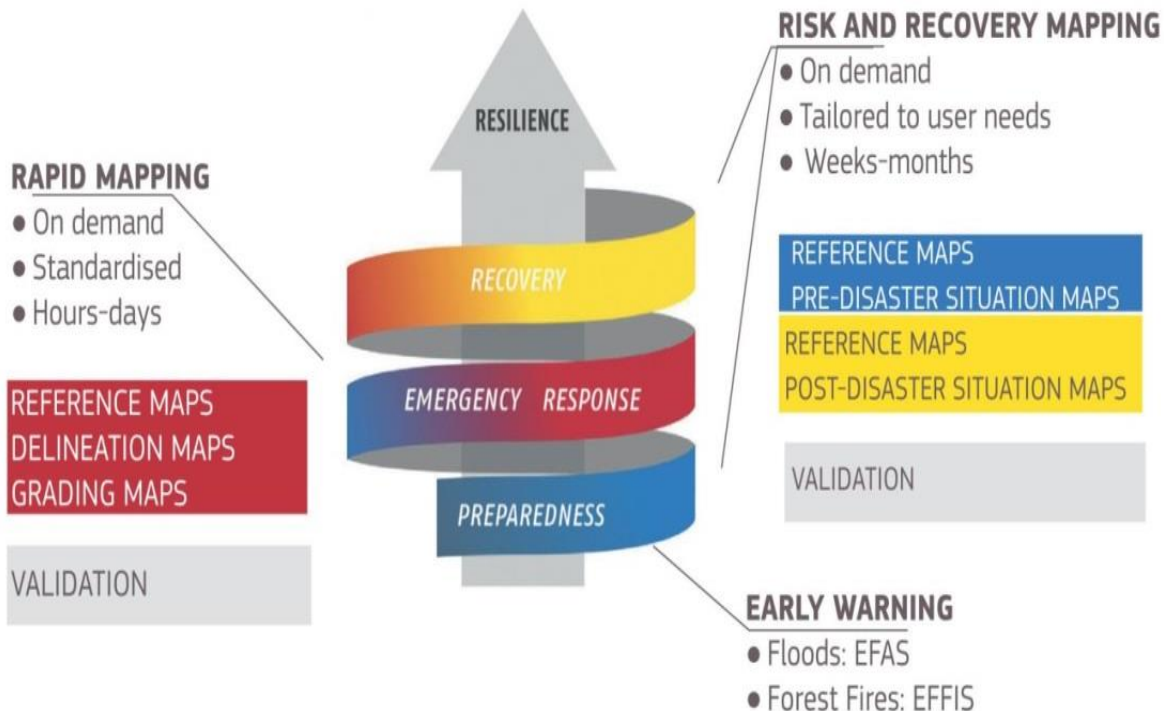




Copernicus EMS

Emergency Management

- Operational since 2012
- Addressing natural & man-made disasters globally





Focus on the Mapping modules

- On-demand services with defined user schema for RM, RRM
- Majority of image data are from Copernicus Contributing Missions
- Increased usage of Sentinel-1 in all modules

Rapid Mapping (RM)

- 24/7/365
- Highly standardised workflow & products
- Rapid tasking & delivery of satellite images
- Delivery in hours/days

Risk and Recovery Mapping (RRM)

- Not-24/7/365
- Supporting situations which do not require immediate action
- Tailored to user needs (case specific)
- Delivery in weeks/months

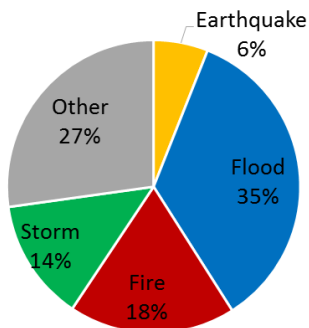
Validation (activated by JRC)

- Verification of outputs produced by RM and RRM on a sample basis
- To guide service improvement and evolution



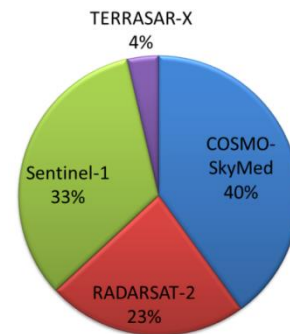
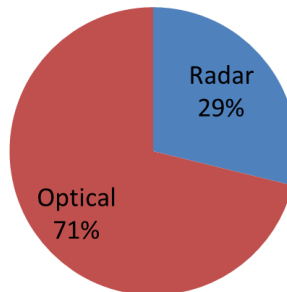
Rapid Mapping

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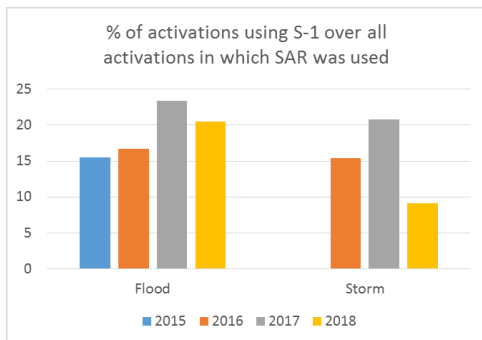


- 285 activations since 2012
- S1 mainly used for floods and storms

Sensor type



- 29% of maps produced in RM are based on SAR products
- 33% of SAR products are from S-1



Improved S-1 handling for
emergency requests
promoted its use in Rapid
Mapping



Rapid Mapping review

- Sentinel-1 is a very good sensor for Rapid Mapping of flooded areas
- Availability of **Sentinel-1** mission improves the potential acquisitions and the possibility to cover the AoI required by the user
- Since end-2017 S-1 is considered for all SAR tasking requests (independent from target res. class) => good back-up solution in case of CCM cancellations

Needs and requirements (improvements):

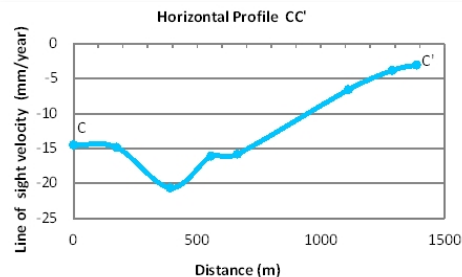
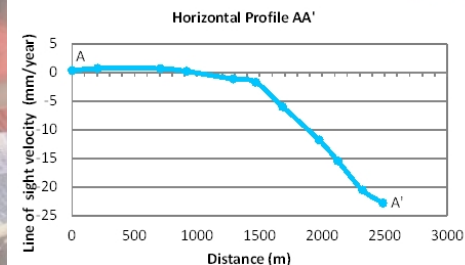
- **Timeliness** – Sentinel-1 contribution is still limited to working hours only
 - ✓ In some cases RM image request was not in time to switch to the NRT production for S-1 acquisitions already planned or could not be included in mission planning (concerns week-ends)



Risk & Recovery Mapping – Example EMSN030

Dynamics of ground deformation analysed from satellite imagery 2014-2016 from S-1

(in the study also 1998-2014 from ERS 1-2 and ASAR)



2003-2010 LOS deformation rates (mm/year)



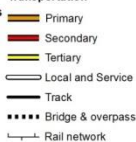
Populated places



Utilities



Transportation



Buildings



Hydrography



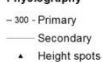
Mining data



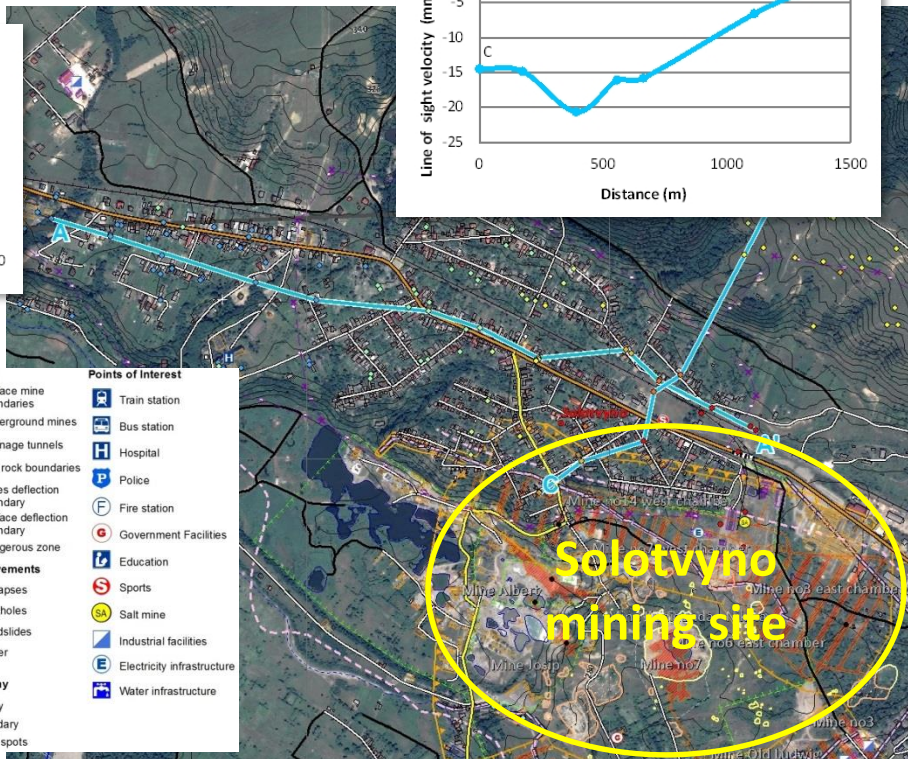
Ground movements



Physiography



Points of Interest





Risk & Recovery Mapping – Example EMSN030

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Derived sinkhole and landslide risk for assets

Subsidence Risk

0,08 - 0,75

0,75 - 2,00

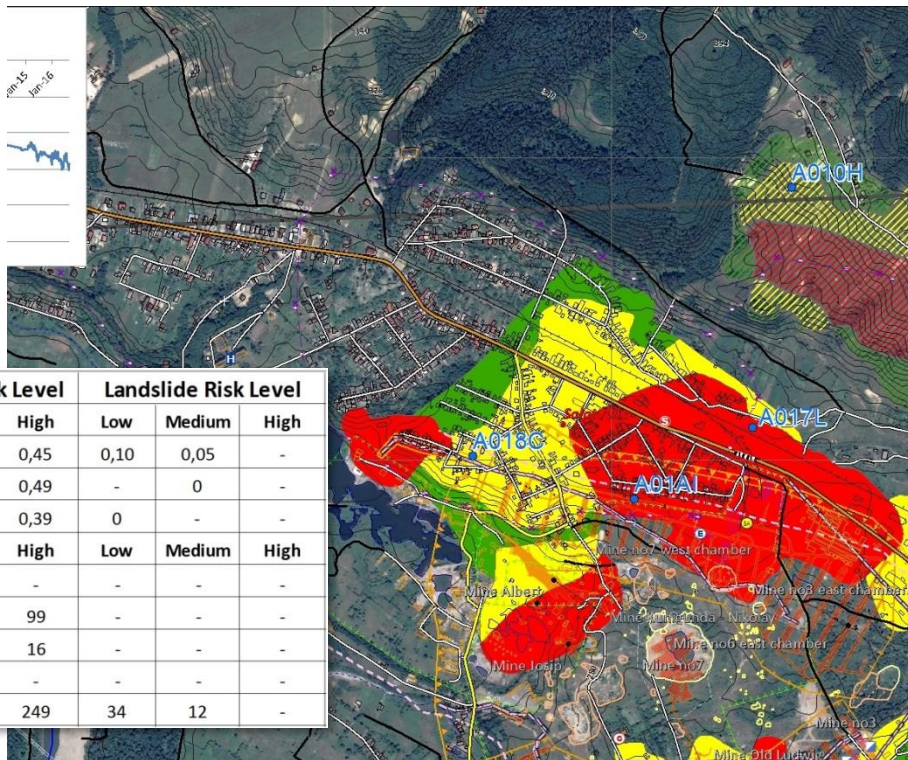
2,00 - 3,00

Landslide Risk

0,08 - 0,75

0,75 - 2,00

2,00 - 3,00



Assets at risk	Subsidence Risk Level			Landslide Risk Level		
	Low	Medium	High	Low	Medium	High
Built-up areas (sqkm)						
Residential	0,82	0,64	0,45	0,10	0,05	-
Commercial	0,63	0,63	0,49	-	0	-
Industrial	0,35	0,52	0,39	0	-	-
POIs (Nr)	Low	Medium	High	Low	Medium	High
Airport	-	-	-	-	-	-
Commercial, Public & Private Services	79	44	99	-	-	-
Industry & Utilities	9	13	16	-	-	-
Places of Worship	-	2	-	-	-	-
Other	391	441	249	34	12	-



Risk & Recovery Mapping – Review

Data access

- Access through Copernicus (or Open) Hub is seamless
- Good experience downloading data using Sentinel Data hub API

Data quality

- For ground motion in Ukraine (EMSN030): fit for the purpose: continuous, consistent and accurate measurements to generate robust results
- For Floods and landslides in Peru (EMSN038): appropriate and fit for the purpose in situation, when no other optical data were available to properly cover the spatial and temporal extent
- For floods in Germany (EMSN046): The six-day repeat cycle is not frequent enough to map maximum flood extent and the evolution of the flood using interferometric coherence

Needs and new requirements

- It would be interesting to have free and open X-band (more accurate deformation estimates in urban areas) and L-band (measurements in peri-urban and agricultural areas) data as well
- More frequent acquisitions for mapping floods
- Include Sentinel-1 SLC data for utility on Google Earth Engine



Validation - Examples

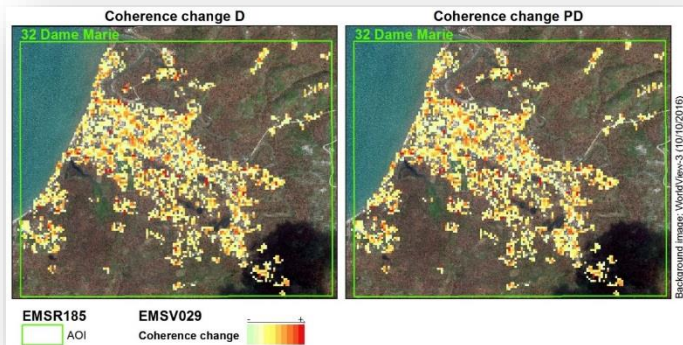
Validation of Rapid Mapping of building damage from cyclone in Haiti

Purpose

- Assess S1 multi temporal coherence for building damage grading at building block level using WV3 as reference
- four different coherence based algorithms tested

Main conclusions

- Due to the “big” pixel size in relation to the size of the buildings, the pixel does not contain only buildings but de-correlation sources as trees -> low coherence
- Starting from low coherence, the reduction of coherence due to the building damage is not significant enough to detect the damage



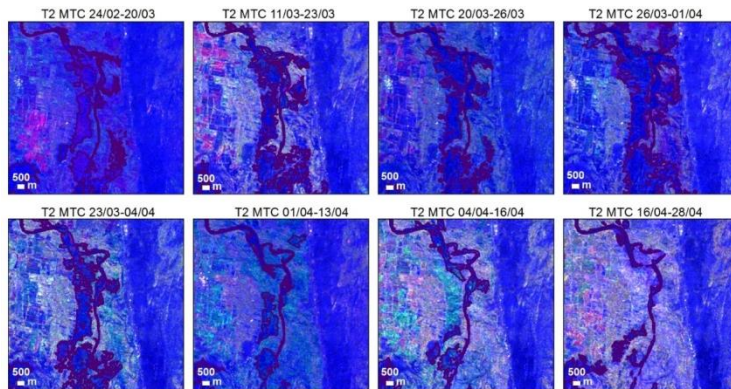


Validation - Examples

Validation of Rapid Mapping floods in Peru

Purpose

- Investigation of S1 for regional flood extent monitoring



Main conclusions

- 250km swath -> good for *regional*
- Revisit time -> good for monitoring
- Backscatter&coherence are better than backscatter only
- the analysis of the most adequate polarisation is crucial to obtain the best results.

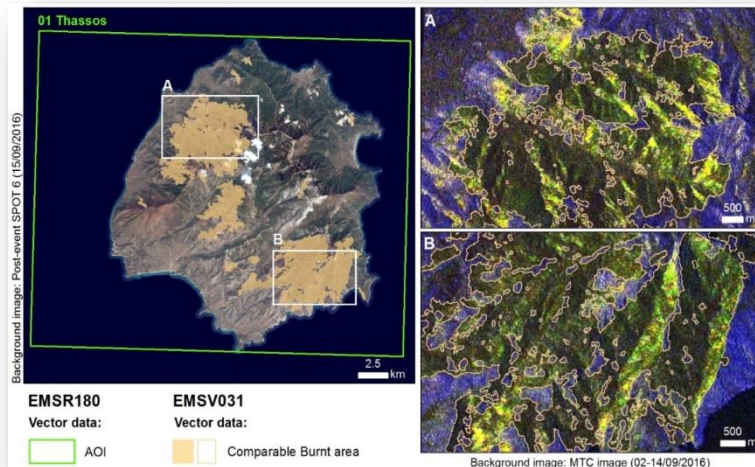


Validation - Examples

Validation of Rapid Mapping activation fires on Thassos Island

Purpose

- Assess S1 for automatic burnt area detection using S2 as reference
- Multi Temporal Coherence approach



Main conclusions

- Very good thematic accuracy
- Some limitations due to topographic effects and in the areas of bare soil
- Coherence images from ascending and descending orbits minimized the effect of the terrain



Data access

- Positive experience with Copernicus Hub (JRC and SP)

Data quality

- Adequate resolution, swath and temporal revisit for flood detection and monitoring
- Complementary information from backscattering, coherence and polarization
- Very good accuracy for burnt area detection (limitations due to topography and bare soil)



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Thank you!

emergency.copernicus.eu/mapping

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