

**DRAGON 2021 SYMPOSIUM**  
**Dragon 5 1<sup>st</sup> Year Results Reporting**  
**21 to 23 July 2021**

Friday, 23 July 2021

# **Integration of multi-source Remote Sensing Data to detect and monitoring large and rapid landslides and use of Artificial Intelligence for Cultural Heritage preservation**

**1<sup>st</sup> year reporting ID:56796**

European LI: **Joaquim J. Sousa**

Chinese LI: **Jinghui Fan**

## Project's main goals:

- detect and analyze recent rapid landslide events with satellite and ground based EO data;
- **evaluate the stability of landslides, forecast when and how hazards might happen in future, generate future hazard scenarios and provide support for disaster prevention and damage reduction to authorities;**
- use latest EO technologies for monitoring historical structures leading to the early detection of potential risks and thus making it possible to increase security and significantly reduce maintenance costs;
- **develop an AI system to process and analyze huge amount of data.**

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since July 2021) for no. of scenes of high bit rate data (e.g. S1 100 scenes). If data delivery is low bit rate by ftp, insert "ftp"

ESA Third Party Missions	No. Scenes
1. RADARSAT-2 ftp	4
2. PAZ	10
3.	
4.	
5.	
6.	
Total:	14
Issues:	

ESA, Explorers & Sentinels data	No. Scenes
1. Sentinel -1	1103
2. ERS-1/2	164
3. Envisat	90
4.	
5.	
6.	
Total:	1357
Issues:	

Chinese EO data	No. Scenes
1.	
2.	
3.	
4.	
5.	
6.	
Total:	
Issues:	

## Team Composition:



**J. Sousa** (EU LI)

**L. Reis**



**Fan Jinghui:** (CH LI)

**Z. Perski** (PI)



**S. Steger** (PI)

**Bai Shibiao** (PI)

MTI Techniques for deformation

Extreme weather events

Vegetation monitoring

Artificial Intelligence

Gravitational mass movement

Ground measurements

Natural Hazards

Segmentation of SAR and optical data

Modeling

GIS and RS



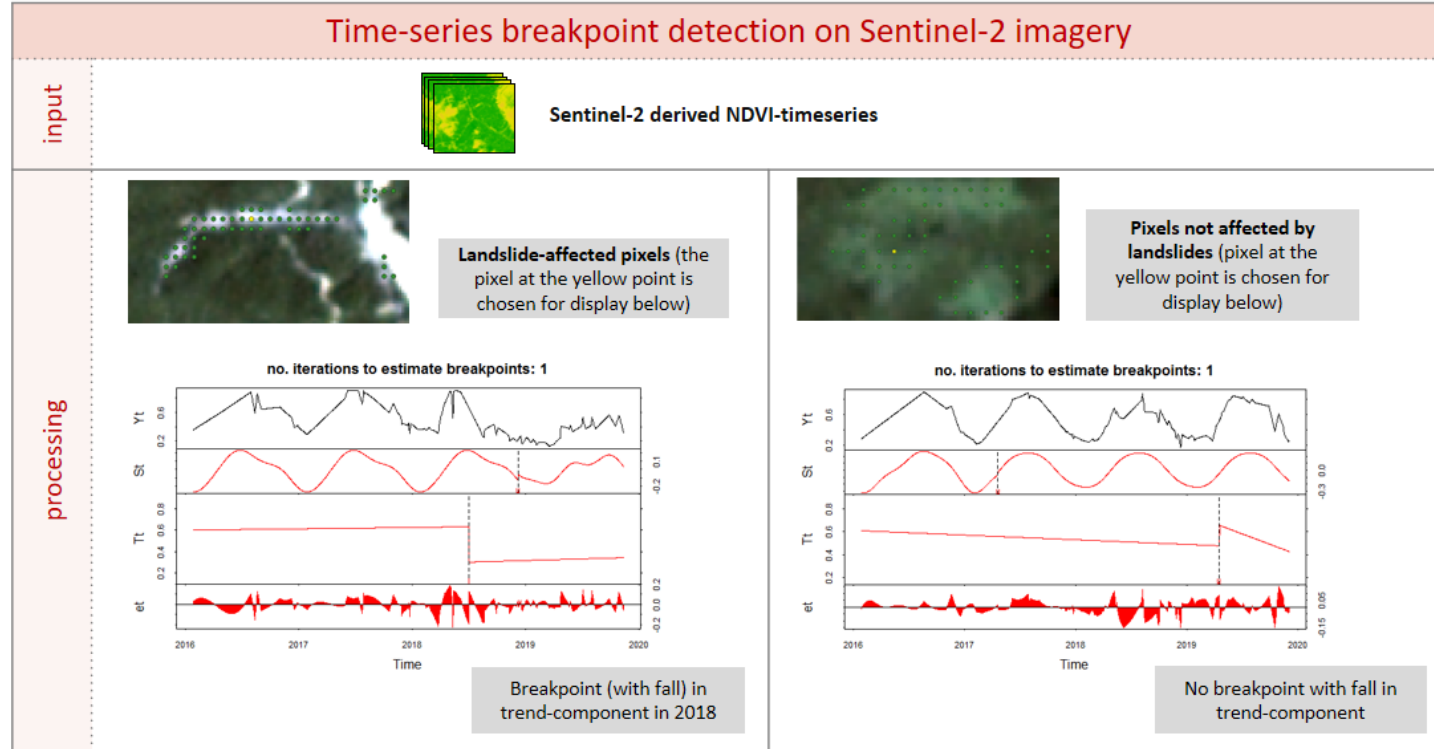
## 1<sup>st</sup> year results:

### Landslide Detection through Optical Imagery Time-Series Analysis in the *Longnan Region* and the *European Alps*

- Building upon the results of the Dragon 4 project, we investigate further in **automated landslide detection approaches using high-resolution optical imagery** (i.e. Sentinel-2)
- **Time-series analysis** has shown to be an efficient technique for identifying major landslide events both spatially and temporally
- Multi-temporal change detection demonstrated to **minimize false-positives e.g. through artefacts or agricultural activity** that result in bi-temporal change-detection approaches



## Research approach



Verbesselt, J. et al., 2010. Detecting trend and seasonal changes in satellite image time series. *Remote Sensing of the Environment* 114, 106-115

Figure 2: Time-series breakpoint analysis using BFAST algorithm

## Outlook

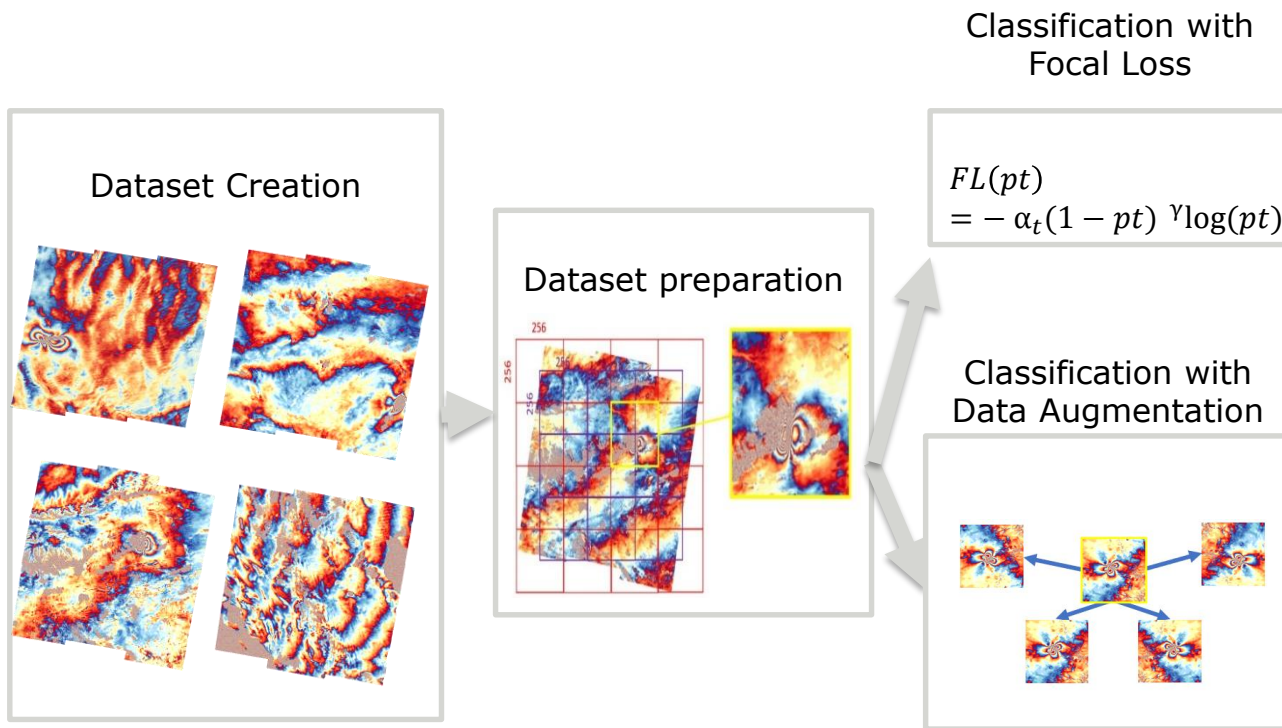
- Contribute to **further research in process-understanding** of landsliding and **regional susceptibility analysis**:
- Investigate in **landslide predisposing conditions** through the recognition of preceding land-cover changes
- Explore **triggering causes** by linking landslide events with rainfall data or seismic activity records





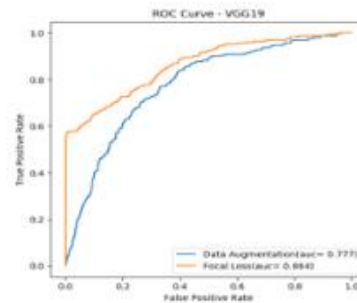
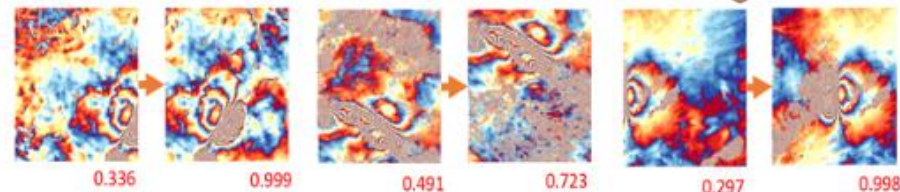
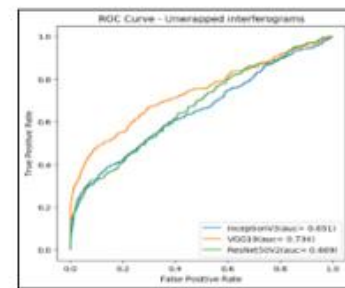
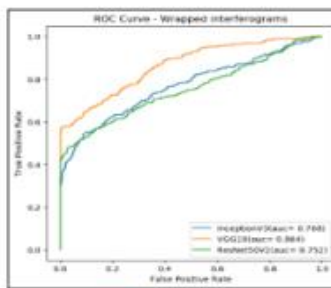
## 1<sup>st</sup> year results: Artificial Intelligence

### ML Segmentation Models to Automatically Identify Areas Affected by Earthquakes



## Dataset

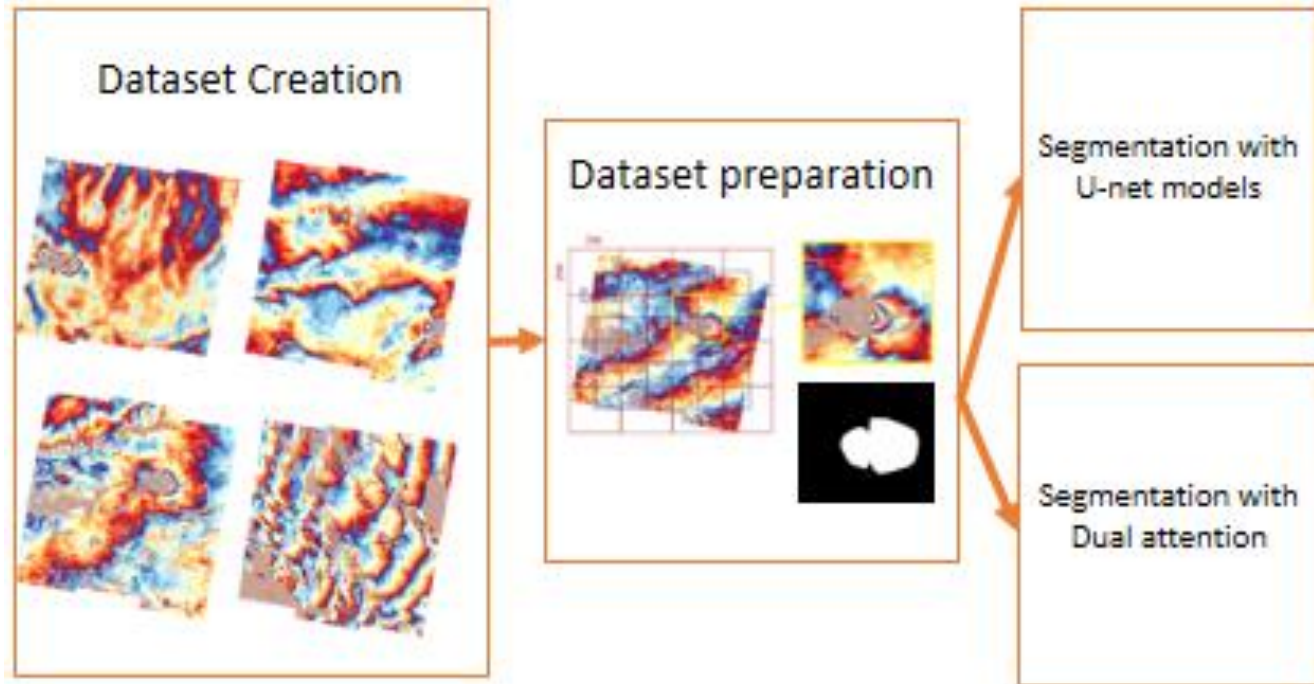
	Train	Validation	Test
Earthquake fringes (deformation)	499	380	252
No deformation	14979	4051	3826



Focal loss performs better than data augmentation to deal with unbalanced data

## 1<sup>st</sup> year results: Artificial Intelligence

ML Segmentation Models to Automatically Identify Areas Affected by Earthquakes



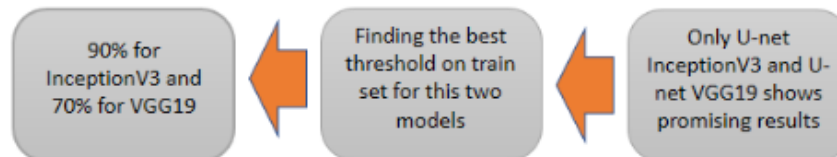
## Dataset

	Train	Validation	Test
Earthquake fringes (deformation)	499	380	252

## Models evaluation

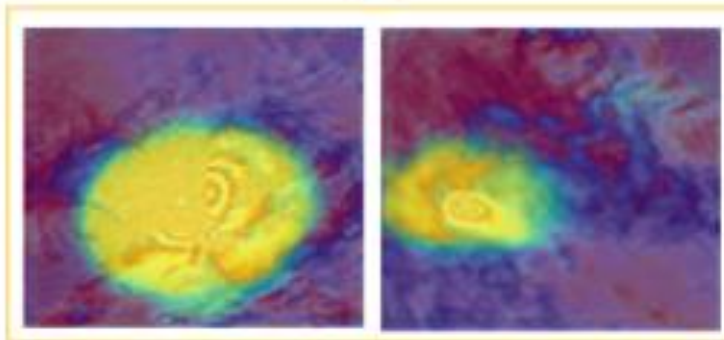
First test with 50% threshold →

	Model	IoU Score	Dice Score	Accuracy
U-net	InceptionV3	0.43	0.59	0.83
	VGG19	0.32	0.47	0.85
	Resnet50	0.13	0.22	0.80
Dual attention	Resnet50	0.25	0.39	0.84

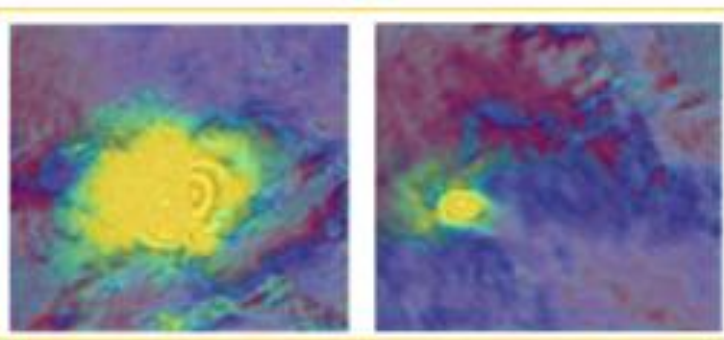


Model	IoU Score	Dice Score	Accuracy
InceptionV3	0.48	0.63	0.87
VGG19	0.47	0.62	0.85

**InceptionV3**  
can found fringes but is not good  
to detect margins

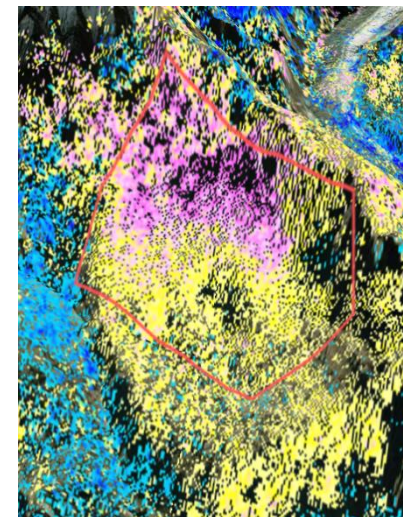
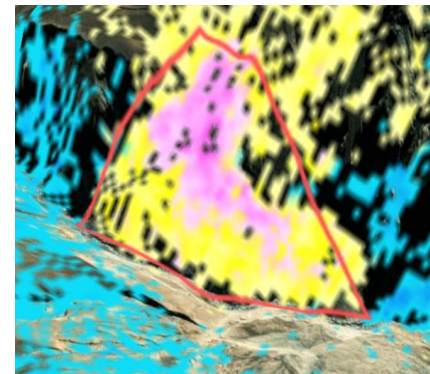
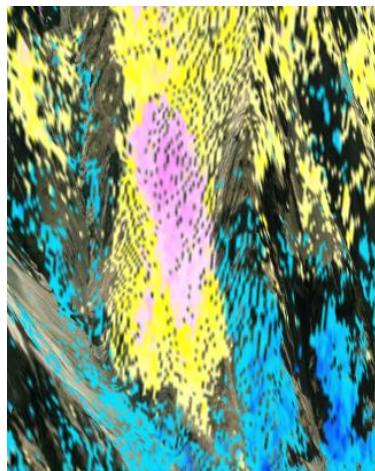
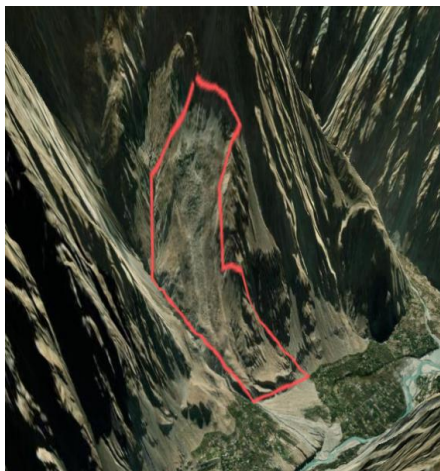


**VGG19**  
better find fringes and margins  
but interpret noise as fringes





## 1<sup>st</sup> year results: Gilgit research area



## Planning & contribution of the partners for the following year

1. Team 1 will start the integration of multi-source data to use AI techniques to develop a prototype system for risks detecting and alerting
- 2. Team 2 will implement the presented methodology for breakpoint detection on Sentinel-2 images ;**
3. Team 3 will be dedicated to Shuping-Fanjiaping landslide area is a traditional study area of Dragon project in the Three gorge area and Landslides in the slope of Fushun West Open pit Coal Mine, Liaoning Province;

## Young Scientists

1. One YS already integrated Team1 to develop AI and InSAR skills. The previously presented results were obtained by YS;
- 2. Three Chinese YS are planned to join the Portuguese group to improve their AI skills**
3. as soon as the pandemic allows, several joint activities will be carried out.