

Flood detection products to support emergency management services in the Lombardy region

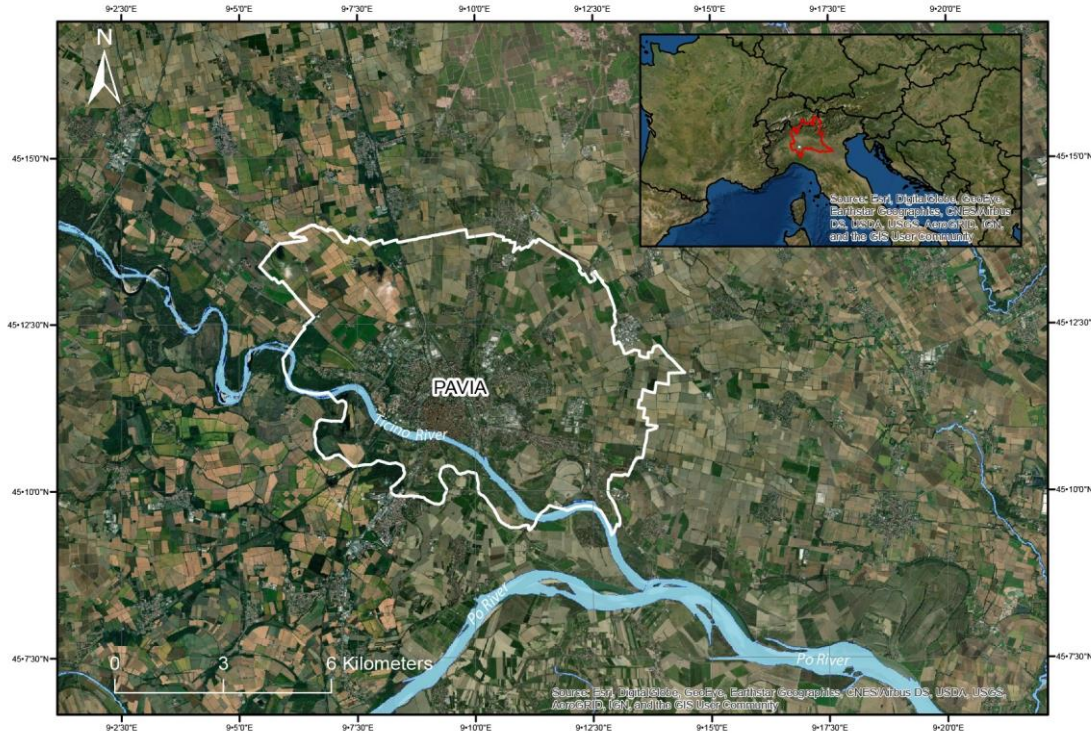
EGU 2022

NH6 – Remote Sensing & Hazards
6.4

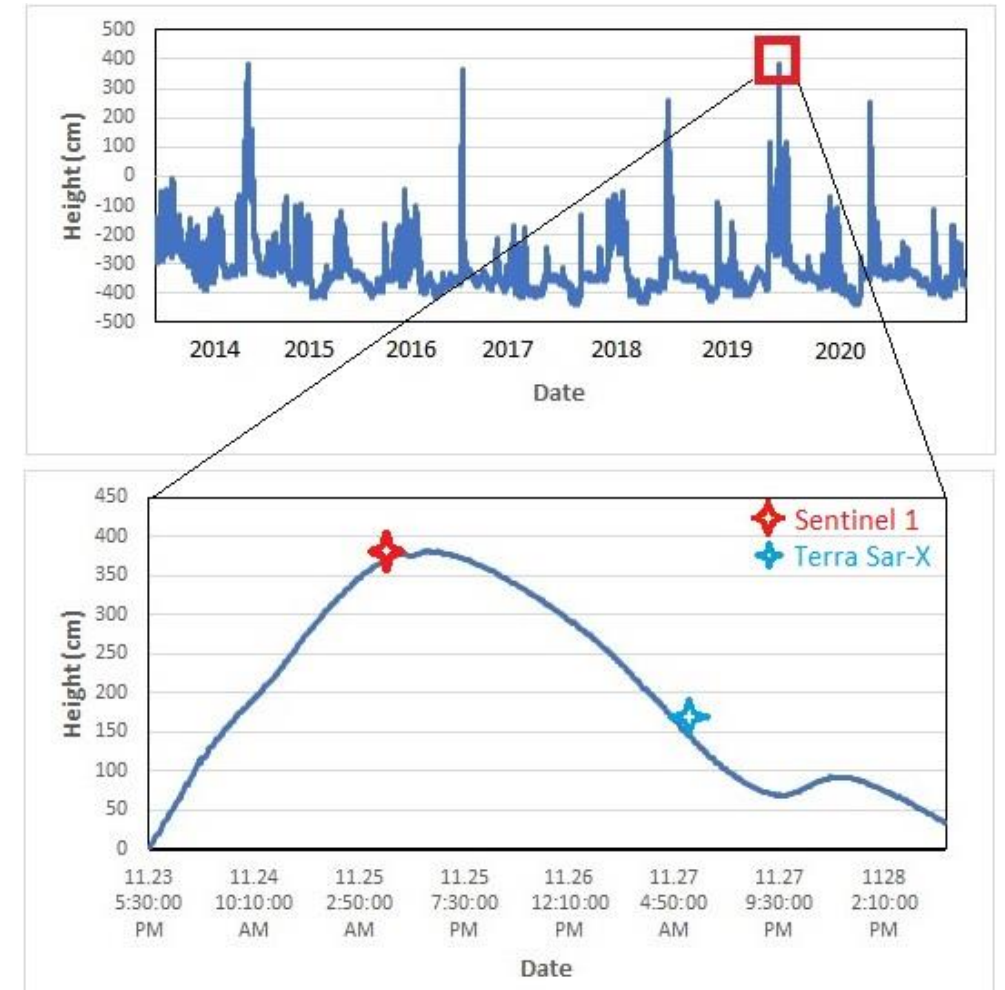
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Presented by: Ignacio Gatti

STUDY AREA



- Flood event on Ticino River: 25-11/27-11 (2019)
- High water in the flood-plain surface detected by sat. imagery.
- Total damage estimate of 250,699 €
(Source: Raccolta Schede Danni –RASDA, Lombardy Region)



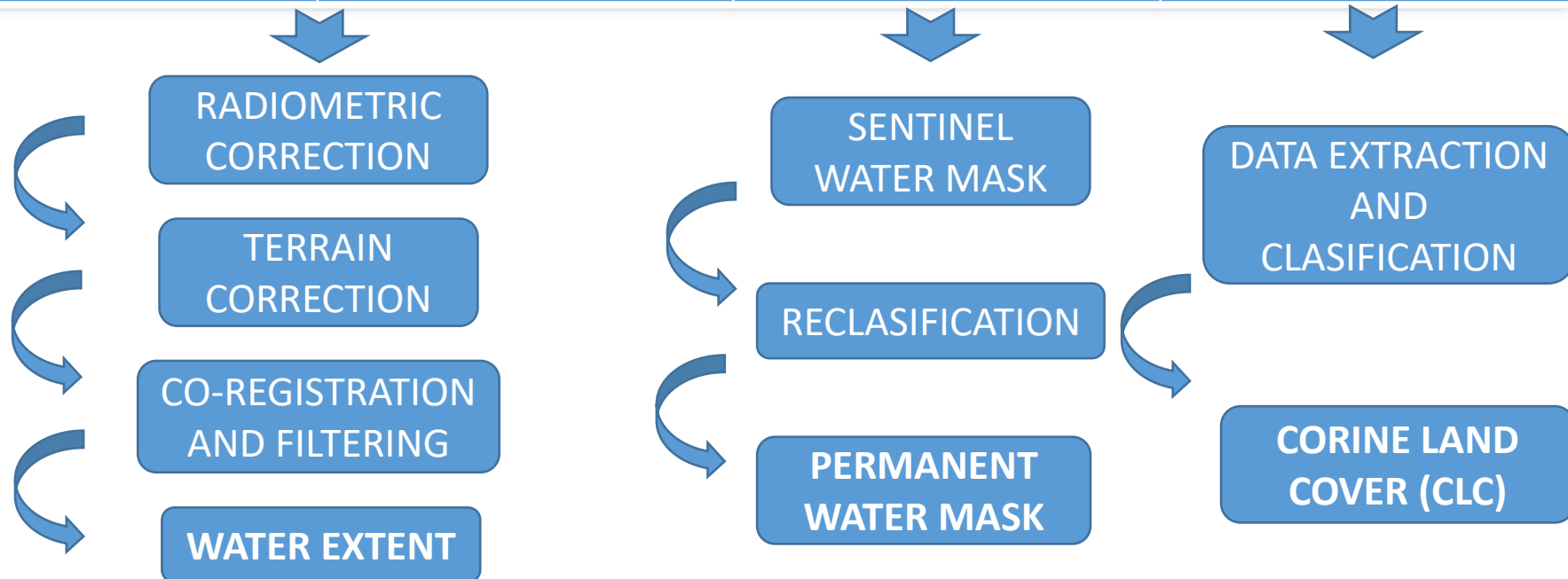
(Source: ARPA, Lombardy Region)

DATA AND METHODS

DATA

TERRA-SAR-X (TSX)	SENTINEL 1 (S1)	SENTINEL 2 (S2)	S2 LANDSAT 8 (L8)
22-09-2019 05:36 am (pre-flood) 27-11-2019 05:35 am UTM (flood)	26-10-2019 05:34 am (pre-flood) 25-11-2019 05:34 am UTM (flood)	13-11-2019 10:23 am UTM (pre-flood)	2017 - 2018 (several)

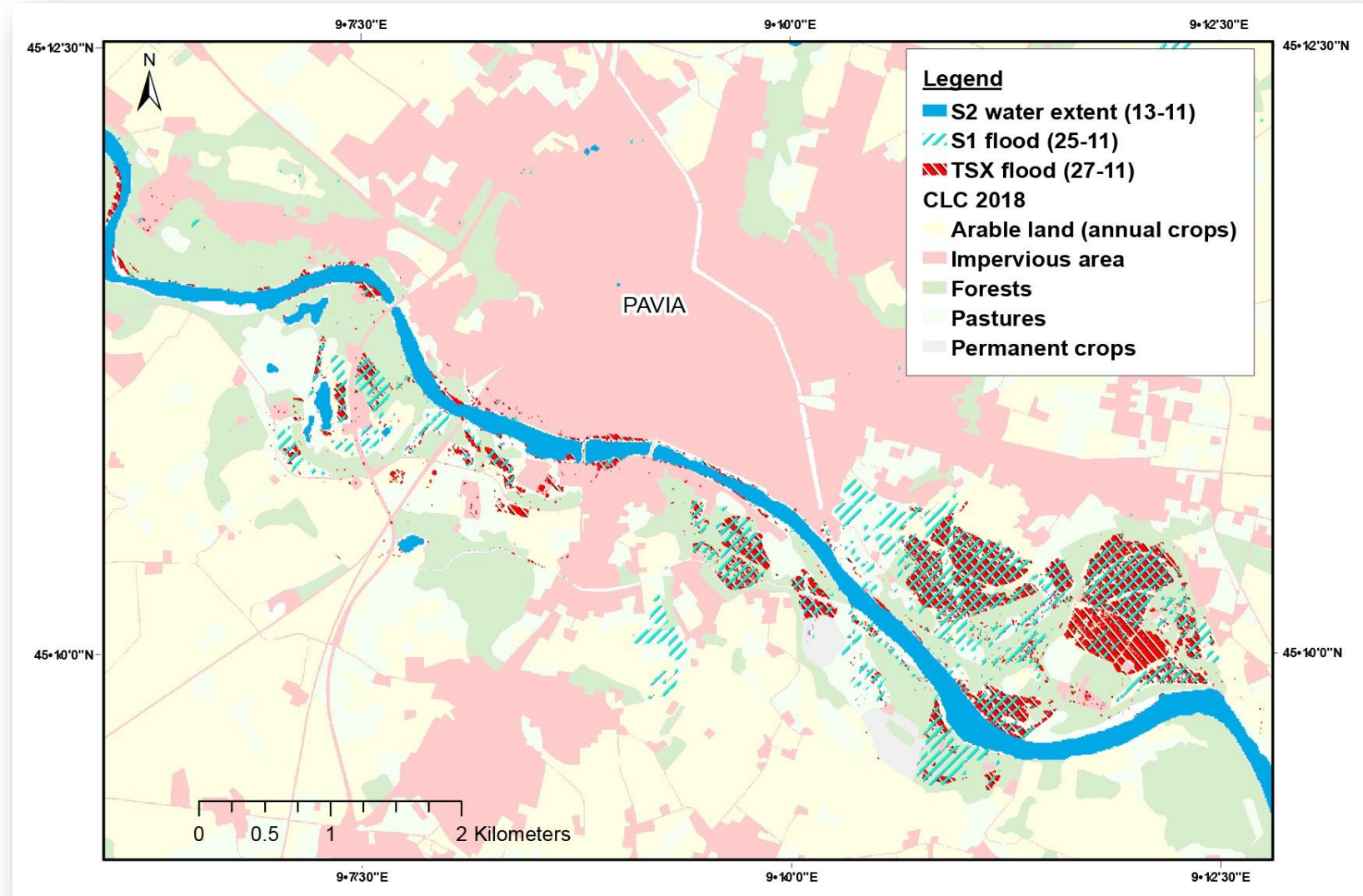
WORKFLOW



RESULTS

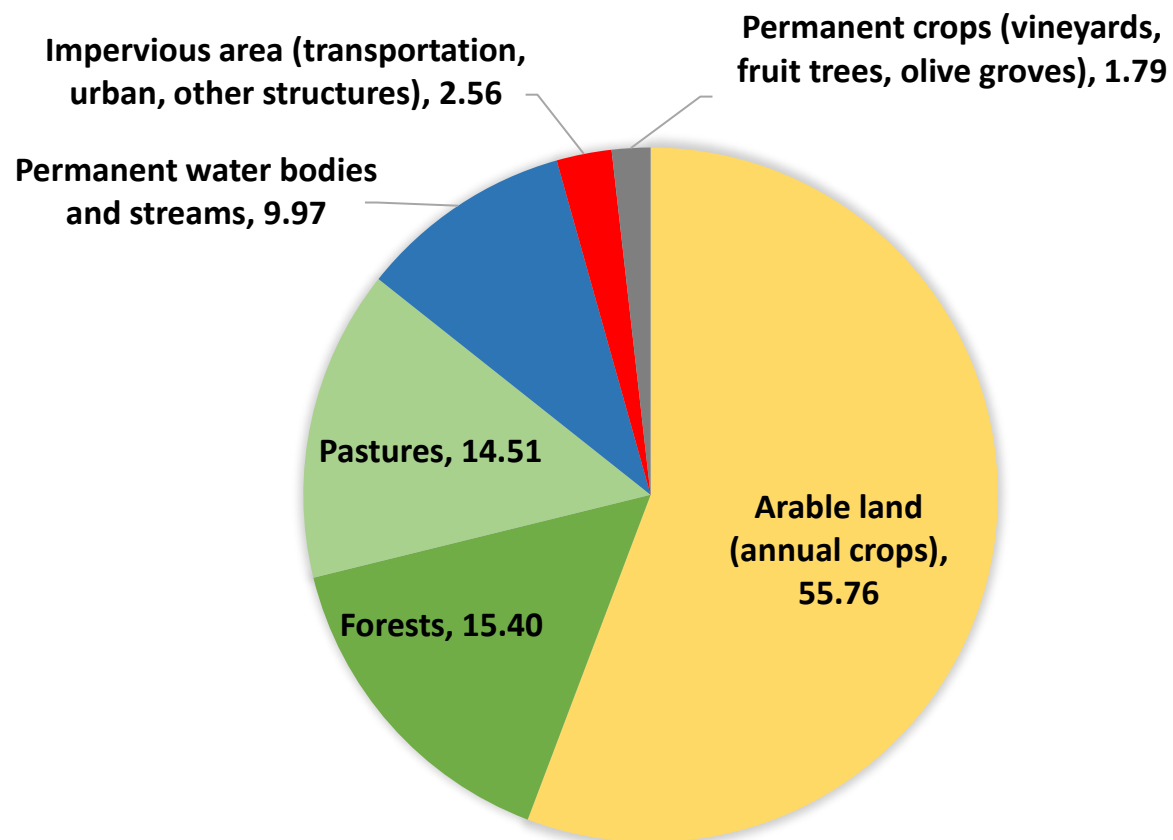
- There are some **differences** in the **extension** and **location** of the flooded areas.

Pavia Administrative Area (ha)	S1 flood (ha)	TSX flood (ha)
6323.5	235.5	188.5

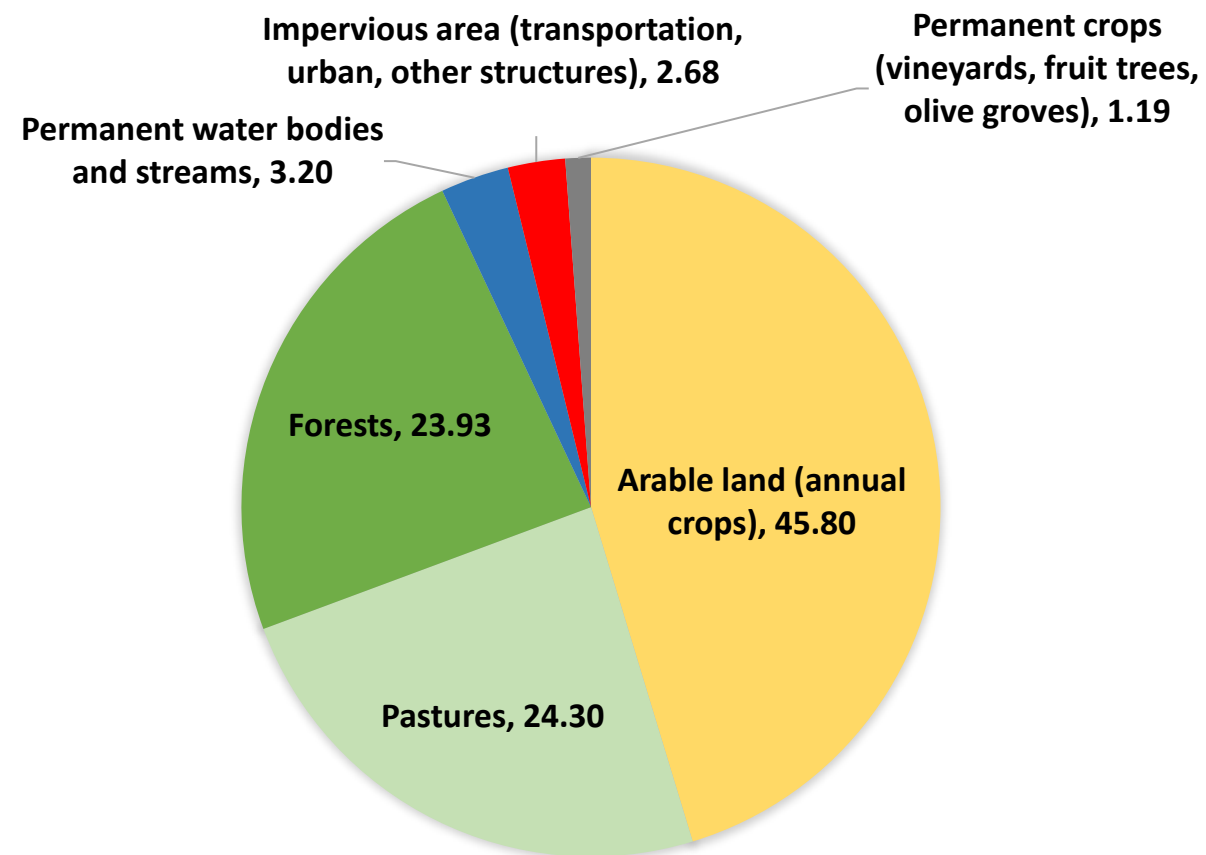


RESULTS

TSX FLOOD (%)



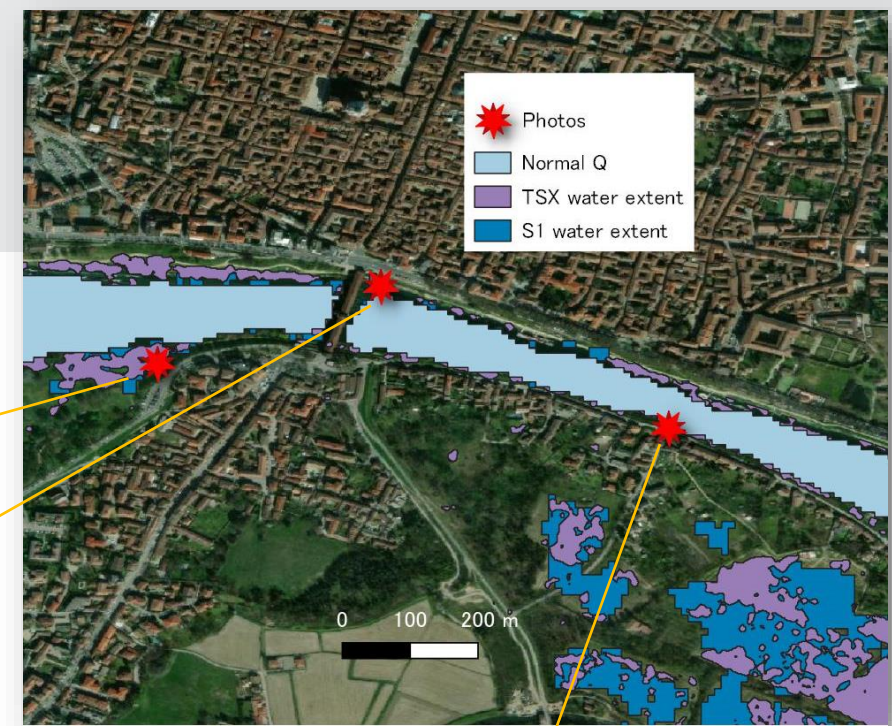
S1 FLOOD (%)



RESULTS

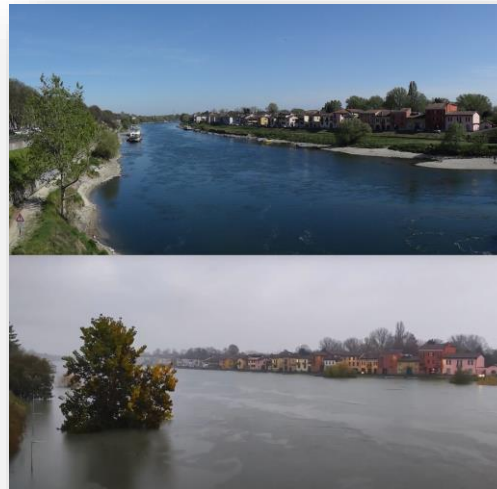
VALIDATION

- No optical satellite data or survey was available therefore, newspaper **photographs** were used to validate the TSX and S1 flood extension.



25-11-2019

Source: Corriere della Sera – You Reporter



24-11-2019

Source: Big Damone



25-11-2019

Source: TETO NEWS

FINDINGS I / FUTURE WORK II

Opportunities and challenges of using different flood detection products

I

- The use of multi sensors allows a detailed monitoring service in a short temporal span.
- TSX pixel size was smaller (1.8 m) than S1 (8.9 m), therefore, in relative small flood areas like this perform better than S1.
- TSX = X-band (3 cm of penetration) + HH polarization.
- S1 = C-band (6 cm of penetration) + VV polarization.
- There is 48 hours of time gap between one image from the other.

II

- The computation of water depth using Floodwater Depth Estimation Tool (FwDET-GEE) developed by Peter et al. (2020).
- Future work includes **impact estimation** and **vulnerability analysis** on the urban footprint area.  Probabilistic approach considering the infrastructure (e.g. INSUDE, Dottori et al. 2016).

Funded by the **NOCTUA** project, that aims to provide operational services for emergency management applications in the Lombardy region including floods, terrain displacement, subsidence and crop classification.



REFERENCES

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- Shrestha, M., Leigh, L., & Helder, D. (2019). Classification of North Africa for use as an extended pseudo invariant calibration sites (EPICS) for radiometric calibration and stability monitoring of optical satellite sensors. Remote Sensing, 11(7), 875. <https://doi.org/10.3390/rs11070875>
- ARPA – Lombardy Region <https://www.arpalombardia.it/Pages/Meteorologia/Richiesta-dati-misurati.aspx> (Obtained on 14-12-2021)
- Big Damone – Youtube channel - <https://www.youtube.com/watch?v=u-cytbUmML4> (Obtained on 12-04-2022)
- COPENICUS PROGRAM - ESA <https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-2-msi/msi-instrument> (Obtained on 11-12-2021)
- Corine Land Cover – ESA (A) <https://land.copernicus.eu/pan-european/corine-land-cover> (Obtained on 11-12-2021)
- Corine Land Cover – ESA (B) <https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-1-sar/resolutions/level-1-single-look-complex> (Obtained on 11-12-2021)
- Corriere della Sera – You Reporter - <https://www.youreporter.it/la-piena-del-fiume-ticino-24-e-25-novembre-2019/> (Obtained on 12-04-2022)
- EM- The International Disaster DATABSE <https://www.emdat.be/> (Obtained on 05-01-2022)
- Racolta Scheda Danni Lombardy Region <https://sicurezza.servizirl.it/web/protezione-civile/rasda> (Obtained on 04-01-2022)
- TETO NEWS - <https://tetonews.wordpress.com/2019/11/> (Obtained on 10-04-2022)

Thank you for your attention!

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ANNEX 1

DATA

PLATFORM	TERRA-SAR-X (TSX)	SENTINEL 1 (S1)	SENTINEL 2 (S2)	LANDSAT 8 (L8)
DATES	22-09-2019 05:36 am (pre-flood) + 27-11-2019 05:35 am UTM (flood)	26-10-2019 05:34 am (pre-flood) + 25-11-2019 05:34 am UTM (flood)	2017 - 2018 (several) + 13-11-2019 10:23 am UTM	2017 - 2018 (several, to fill S2 gaps)
SENSOR	Synthetic Aperture Radar (SAR)	Synthetic Aperture Radar (SAR)	Multispectral Instrument (MS)	Multispectral Instrument (MS)
BANDS	Microwave, X-band with single polarization: HH	Microwave, C-band with dual polarizations: VH VV	Band 2 – Blue Band 3 – Green Band 4 – Red Band 5 – Vegetation red edge: Band 6 – Vegetation red edge: Band 7 – Vegetation red edge: Band 8 – NIR Band 8A – Narrow NIR Band 9 – Water vapour Band 10 – Cirrus Band 11 – SWIR Band 12 – SWIR	Band 1 - Coastal aerosol Band 2 - Blue Band 3 - Green Band 4 - Red Band 5 – Near Infrared (NIR) Band 6 – SWIR 1 Band 7 – SWIR 2 Band 8 – Panchromatic Band 9 – Cirrus Band 10 – Thermal Infrared (TIRS) Band 11 – Thermal Infrared (TIRS)
SPECTRAL RESOLUTION	3.1 cm	5.6 cm	15 - 185 nm	16 – 187 nm
SPATIAL RESOLUTION	< 3 m	2.3 - 14.1 m	10 - 60 m	15 – 100 m
FINAL PRODUCT	Flood extension	Flood extension	Permanent water and Corine Land Cover (CLC) 2018	Corine Land Cover (CLC) 2018

ANNEX 2

DETAILED WORKFLOW

