**SES 2024**

художник П. Стоянов

**ИКИТ БАН**

# TerraSAR-X dual-pol polarimetric SAR data processing on paddy rice fields in different seasons

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БЪЛГАРСКА АКАДЕМИЯ НА НАУКИТЕ 155 BULGARIAN ACADEMY OF SCIENCES

## Abstract:

Rice is one of the important grains regarding human nutrition therefore the timely monitoring and accurate mapping of rice fields are of importance and the ultimate need for humans (Chandna and Mondal. 2020). Remote sensing provides a great source of information for monitoring the fields compared to traditional surveying methods hence commonly applied for monitoring and mapping of the agricultural fields. Many different crop types have been studied using EO data including both SAR and optical data. Compared to optical studies, the use of SAR data for agricultural purposes is relatively less. In Turkey, rice monitoring using remotely sensed data is quite limited. Yuzugullu et al (2017b) studied the same region of Rossi and Erten (2015) for morphological parameter (stalk height, leaf length and leaf width) estimation which needs higher resolution as TerraSAR-X. Rossi and Erten (2015) studied two years of horizontal-horizontal (HH) and vertical-vertical (VV) polarized TanDEM-X data and estimated the rice crop height in Edirne. They suggested including the texture of VV polarized data. In Bulgaria rice monitoring via remote sensing methods is almost not existing. Despite the major cereals, such as wheat and corn, rice growing in Bulgaria plays important role as a balancing crop and has great benefits for the irrigation systems.

This study represents an abstract of data processing of series from TerraSAR-X SAR data in dual polarimetric mode – special case (VV, HH), utilizing the high spatial resolution in Spotlight mode. SAR data is acquired following the rice crop calendar in different phenological stages in Bulgaria and Turkey. A twofold processing workflow is proposed: 1) simple processing via *ESA SNAP* software; 2) POL-SAR processing via *PolSARpro* software. First processing chain aims to derive SAR measurements in both polarizations, without any speckle filtering, in the native resolution. The polarimetric workflow aims to decompose dual polarimetric backscattered SAR signal to depict geometrical properties of the natural targets. Both workflows derived geocoded features, whereas the polarimetric chain reveals mostly of the polarimetric diversity in different phenological stages. The TerraSAR-X high resolution dual-pol SAR measurements are well utilized in the paddy rice crops investigation during the phenological development of the crop.

## Study Area

Study area are padddy rice fields located in Bulgaria and Turkey.



**BG test site near Saedinenie**
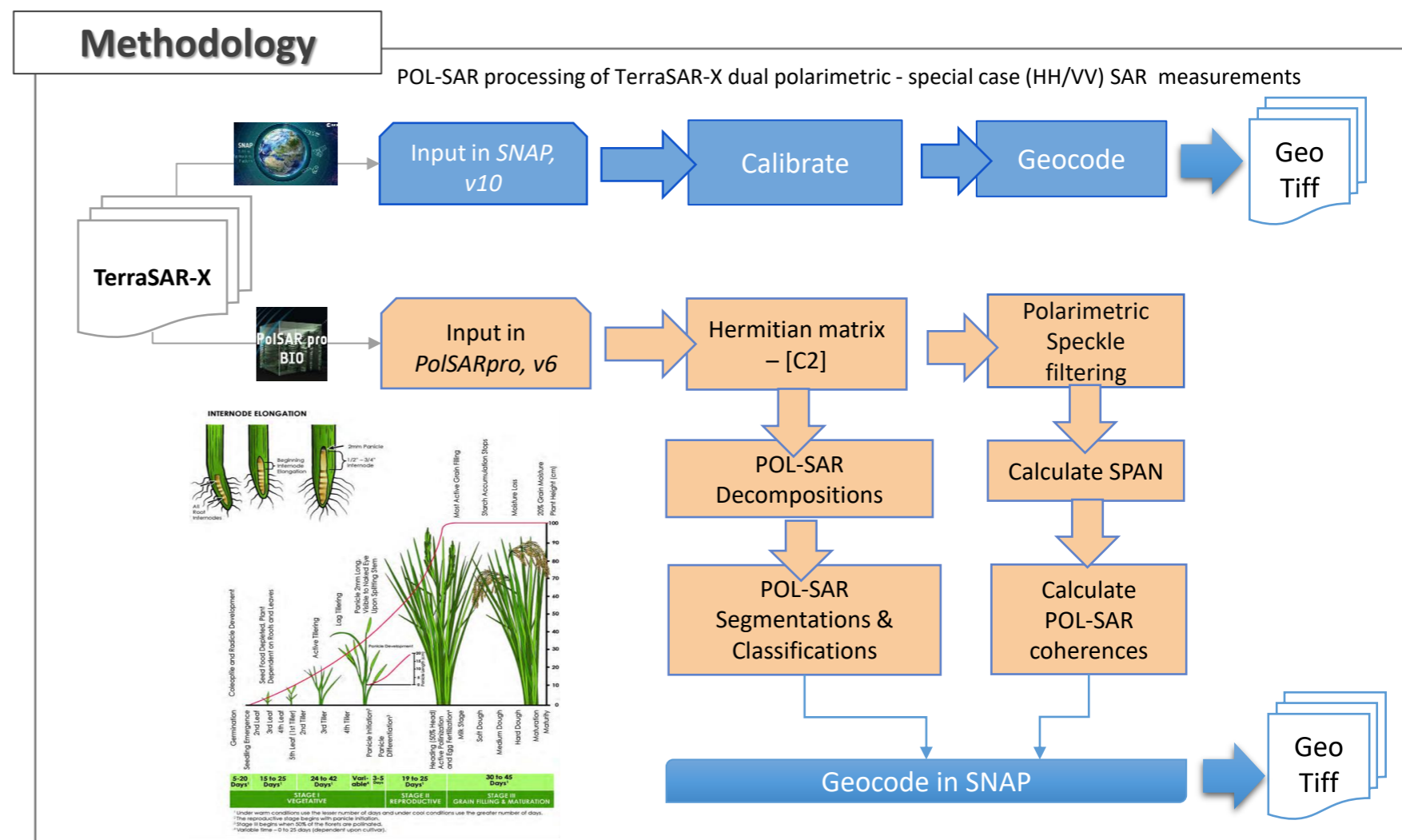
**TR test site near Gönen**
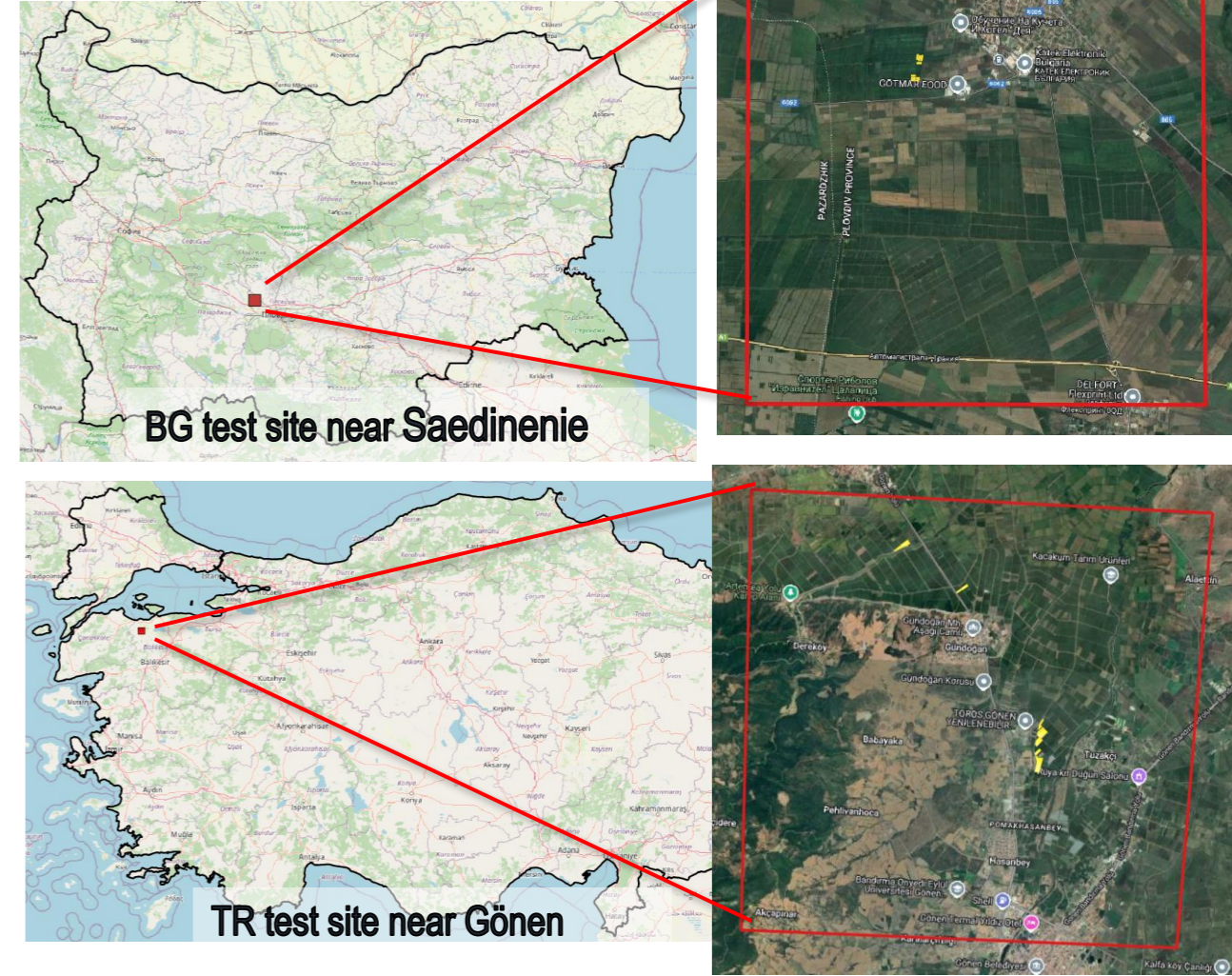
## Satellite Data

| AOI | # | ACQUISITION | Start Time | Orbit | Rel. Orbit | Inc. Angle [deg] | Spacing - r_R [m] | Spacing - r_A [m] |
|---|---|---|---|---|---|---|---|---|
| TR | #1 | 2024-06-30 | 04:10:53.069 | Descending | 153 | 47.72 | 0.909 | 2.723 |
| TR | #2 | 2024-07-18 | 15:57:22.387 | Ascending | 100 | 30.44 | 0.909 | 2.723 |
| TR | #3 | 2024-08-09 | 15:57:22.387 | Ascending | 100 | 30.44 | 0.909 | 2.723 |
| TR | #4 | 2024-09-11 | 15:57:22.387 | Ascending | 100 | 30.44 | 0.909 | 2.723 |
| TR | #5 | 2024-09-22 | 15:57:22.387 | Ascending | 100 | 30.44 | 0.909 | 2.723 |
| BG | #1 | 2024-06-29 | 04:27:33.214 | Descending | 138 | 43.53 | 0.909 | 2.622 |
| BG | #2 | 2024-08-06 | 04:36:06.081 | Descending | 47 | 29.19 | 0.909 | 2.622 |
| BG | #3 | 2024-09-19 | 04:36:06.081 | Descending | 47 | 29.19 | 0.909 | 2.622 |
| BG | #4 | 2024-10-18 | 16:23:40.410 | Ascending | 161 | 52.80 | 0.909 | 2.622 |

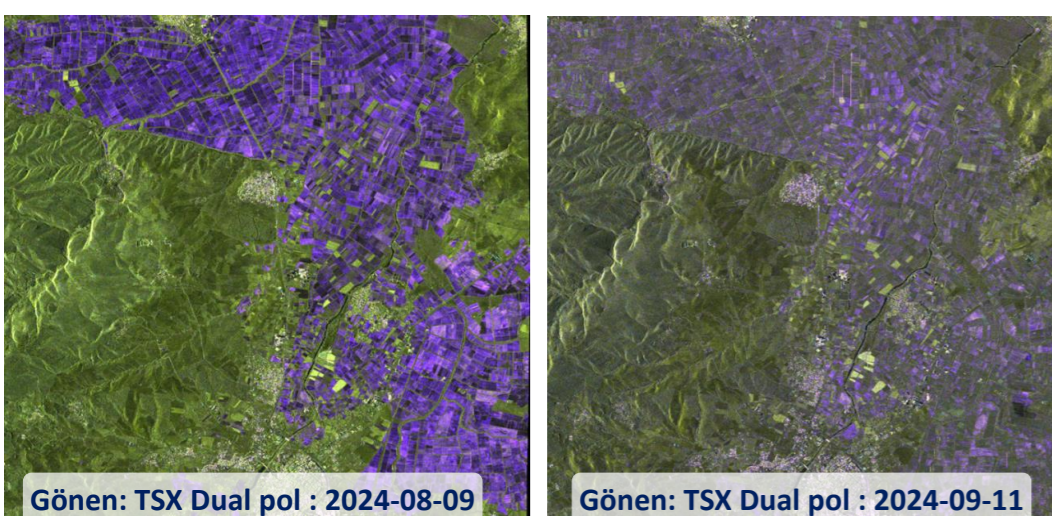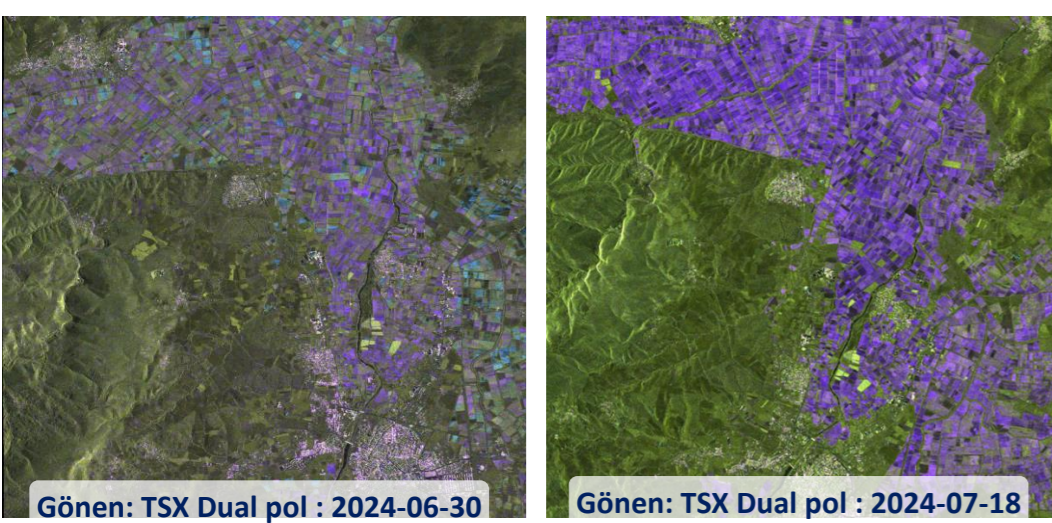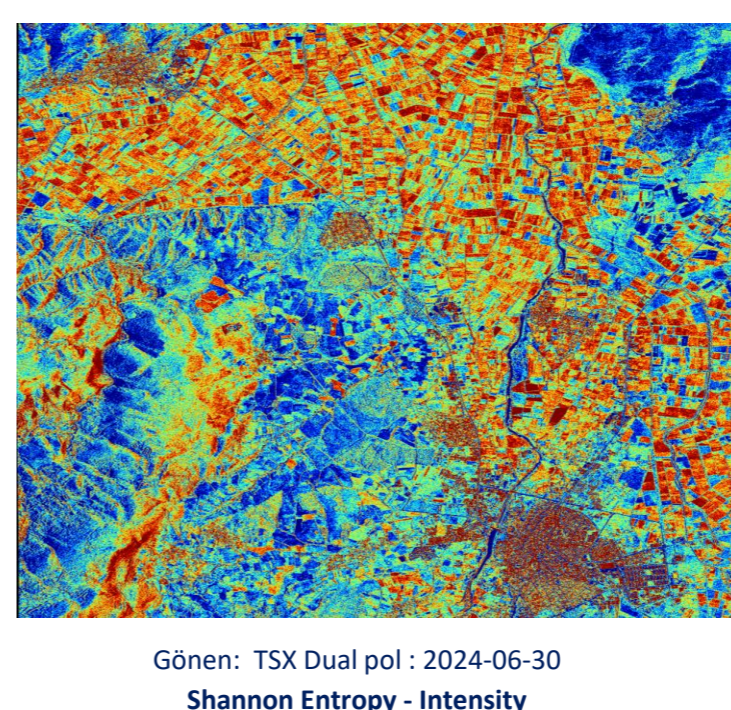The high resolution TerraSAR-X data is provided in the frame of TPM ESA data proposal.

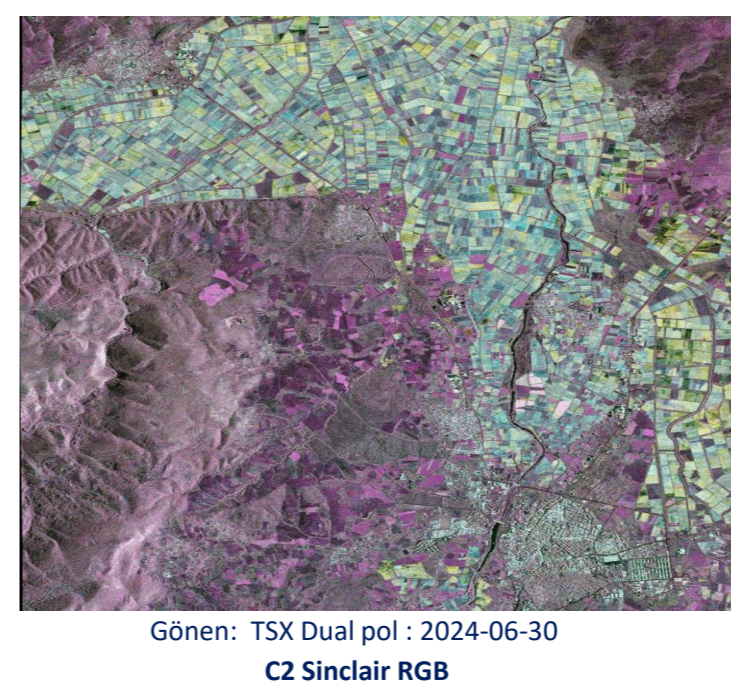**esa** European Space Agency

**TERRA SAR X**

**DLR**

## Methodology



POL-SAR processing of TerraSAR-X dual polarimetric - special case (HH/VV) SAR measurements

## Results

- SNAP workflow



**Gönen: TSX Dual pol : 2024-06-30**

**Gönen: TSX Dual pol : 2024-07-18**

**Gönen: TSX Dual pol : 2024-08-09**

**Gönen: TSX Dual pol : 2024-09-11**

**Gönen: TSX Dual pol : 2024-09-22**

**Saedinenie: TSX Dual pol : 2024-06-29**

**Saedinenie: TSX Dual pol : 2024-08-08**

**Saedinenie: TSX Dual pol : 2024-09-19**

TeraSAR-X dual-pol parameters:
- ☐ X-band
- ☐ Dual POL: HH+VV
- ☐ Product: SAR-SL
- ☐ Mode: Spotlight
- ☐ Scene size: 10 km x 10 km

- PolSARpro workflow



**Gönen: TSX Dual pol : 2024-06-30**
**C2 Sinclair RGB**

**Gönen: TSX Dual pol : 2024-06-30**
**α - angle**

**Gönen: TSX Dual pol : 2024-06-30**
**Shannon Entropy - Intensity**

**Gönen: TSX Dual pol : 2024-06-30**
**Anisotropy**