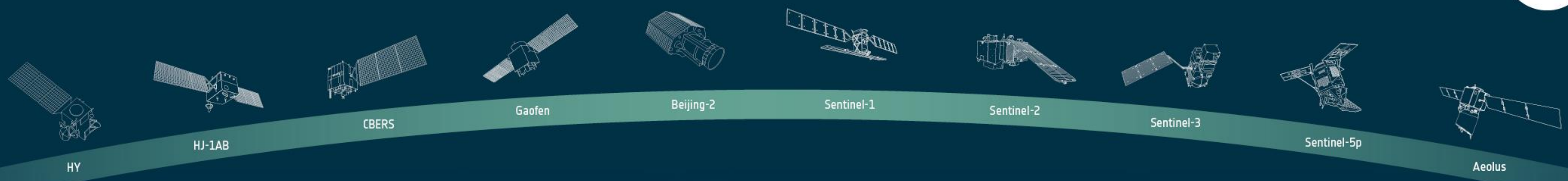

2022 DRAGON 5 SYMPOSIUM

MID-TERM RESULTS REPORTING

17-21 OCTOBER 2022

[PROJECT ID. 57971]

[AUTOMATED IDENTIFYING OF ENVIRONMENTAL CHANGES USING SATELLITE TIME-SERIES]

<10:20 AM – 11:50 AM, 18.OCT.2022>

ID. 57971

PROJECT TITLE: AUTOMATED IDENTIFYING OF ENVIRONMENTAL CHANGES USING SATELLITE TIME-SERIES

PRINCIPAL INVESTIGATORS: [YUNSHENG WANG, YAN SONG]

CO-AUTHORS: [MARIANA B. CAMPOS, EETU PUTTONEN, SIJIA WANG, JIE SUN]

PRESENTED BY: [YUNSHENG WANG, YAN SONG]

Contents

- Project Objective
- Details of the EO Data

- Close-range remote sensing collection and in-situ measurements (Finland)
- Recent results (after 2 years of activity)
- Outlook

- Remote Sensing Ecological Index (RSEI) based monitoring of environmental dynamics (China)
- Recent results (after 2 years of activity)
- Outlook

Project's Objectives

- Explore the linkage between close-range RS time-series and EO time-series in environmental dynamics
- Understand main impact factors for the differences between close-range RS and EO observations
- Develop new EO calibration approaches to assist more accurate observation of environmental dynamics
- Use Remote Sensing Ecological Index (RSEI) for monitoring ecological dynamics and their spatial-temporal differentiation

EO Data Delivery

Data access (list all missions and issues if any). NB. in the tables please insert cumulative figures (since July 2020) 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. Sentinel-2 B8	**14**
2. Sentinel-2 B8A	**14**
3. Sentinel-2 B11	**14**
4.	
5.	
6.	
Total:	**42**
Issues:	

ESA Third Party Missions	No. Scenes
1. Sentinel-5p / L3_NO2	**1258**
2.	
3.	
4.	
5.	
6.	
Total:	**1258**
Issues:	

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

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Close-Range Remote Sensing Data (Finland)

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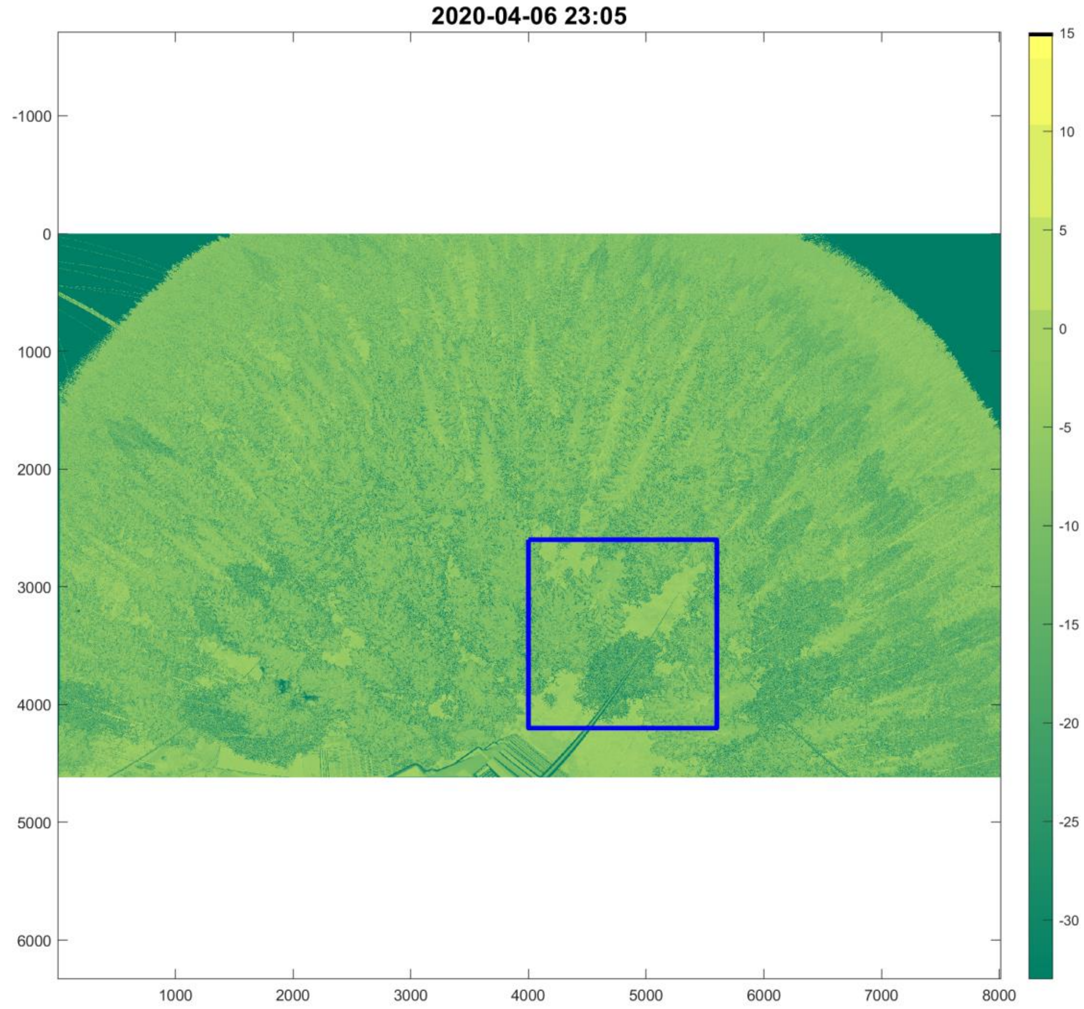
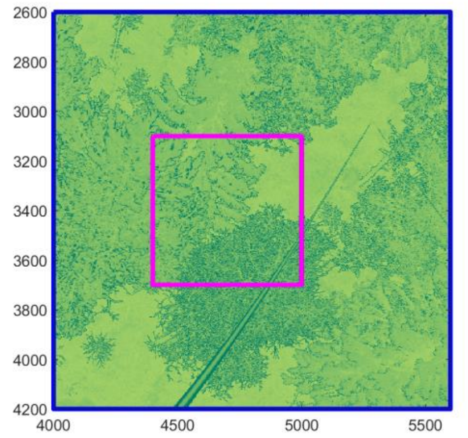
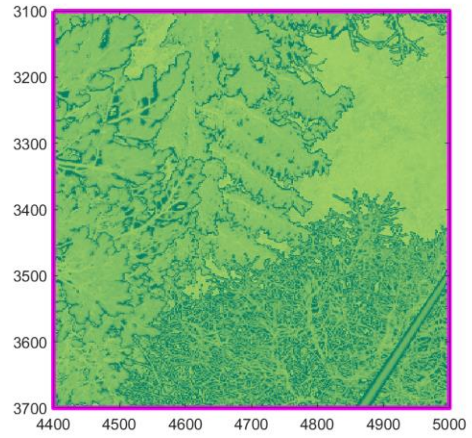
Close-Range Remote Sensing Data (Finland)







Long-term observation:

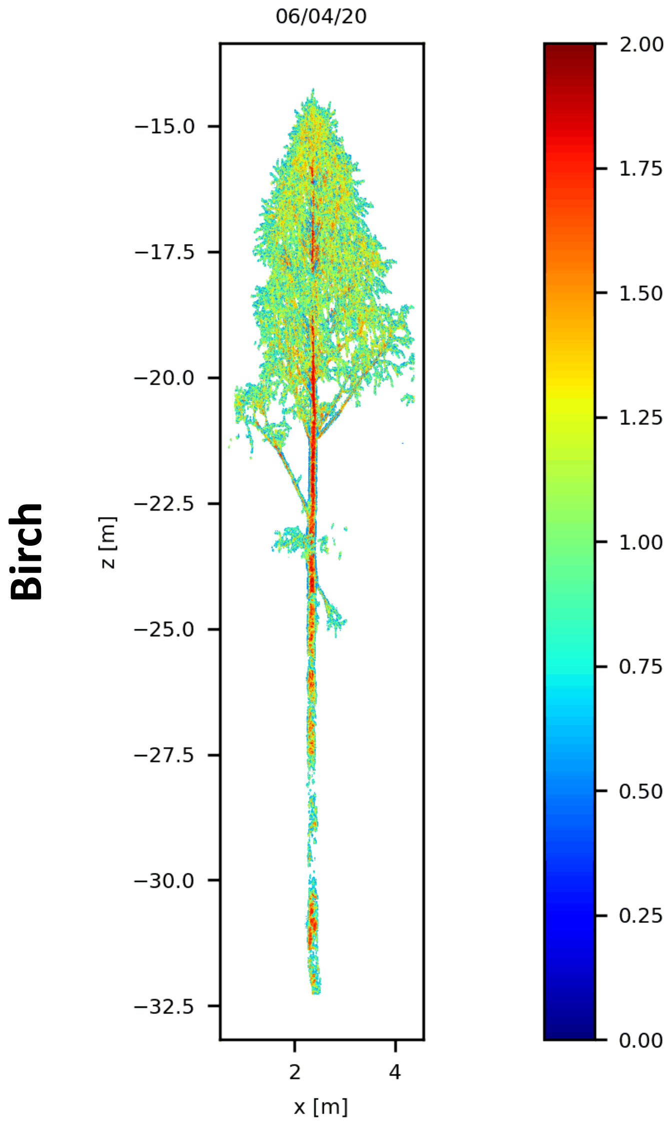
- **Single wavelength LiDAR: 1550 nm**
- **Spatial Resolution: 1cm 3D point spacing @ 100m**
- **Temporal Resolution: 1 scan per hour**
- **Observation area: 4 ha, over 4000 individual trees**
- **Available data collection Apr.2020 – Jul.2021 Aug.2022 -**

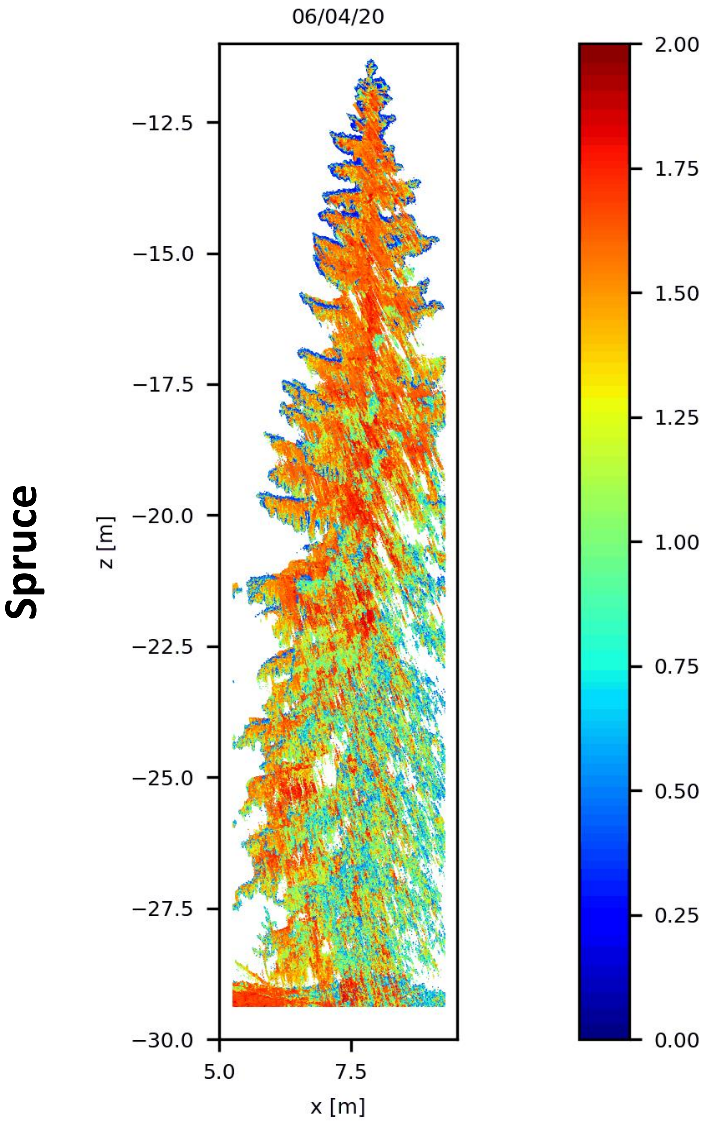
***In situ* measurement:**

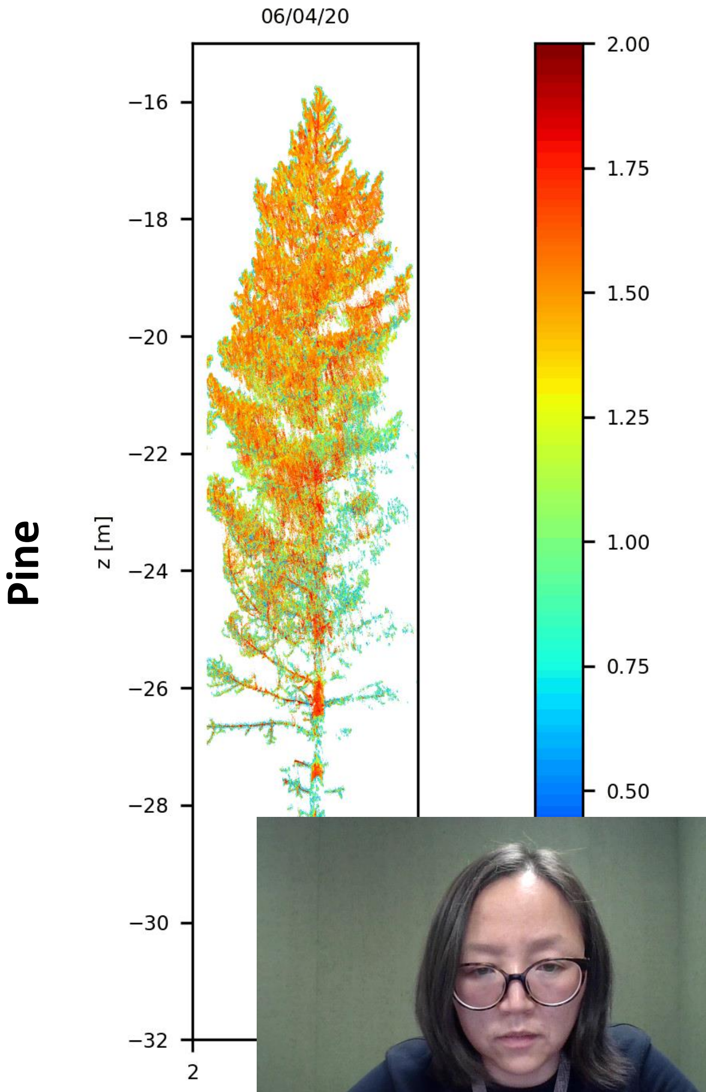
- **Field measured tree parameters**
-

Campos MB, Litkey P, Wang Y, Chen Y, Hyyti H, Hyyppä J and Puttonen E. 2021. A Long-Term Terrestrial Laser Scanning Measurement Station to Cont
Monitor Structural and Phenological Dynamics of Boreal Forest Canopy. *Front. Plant Sci.* 11:606752. https://doi.org/10.3389/fpls.2020.606752

Recent Results – LiPhe Observations

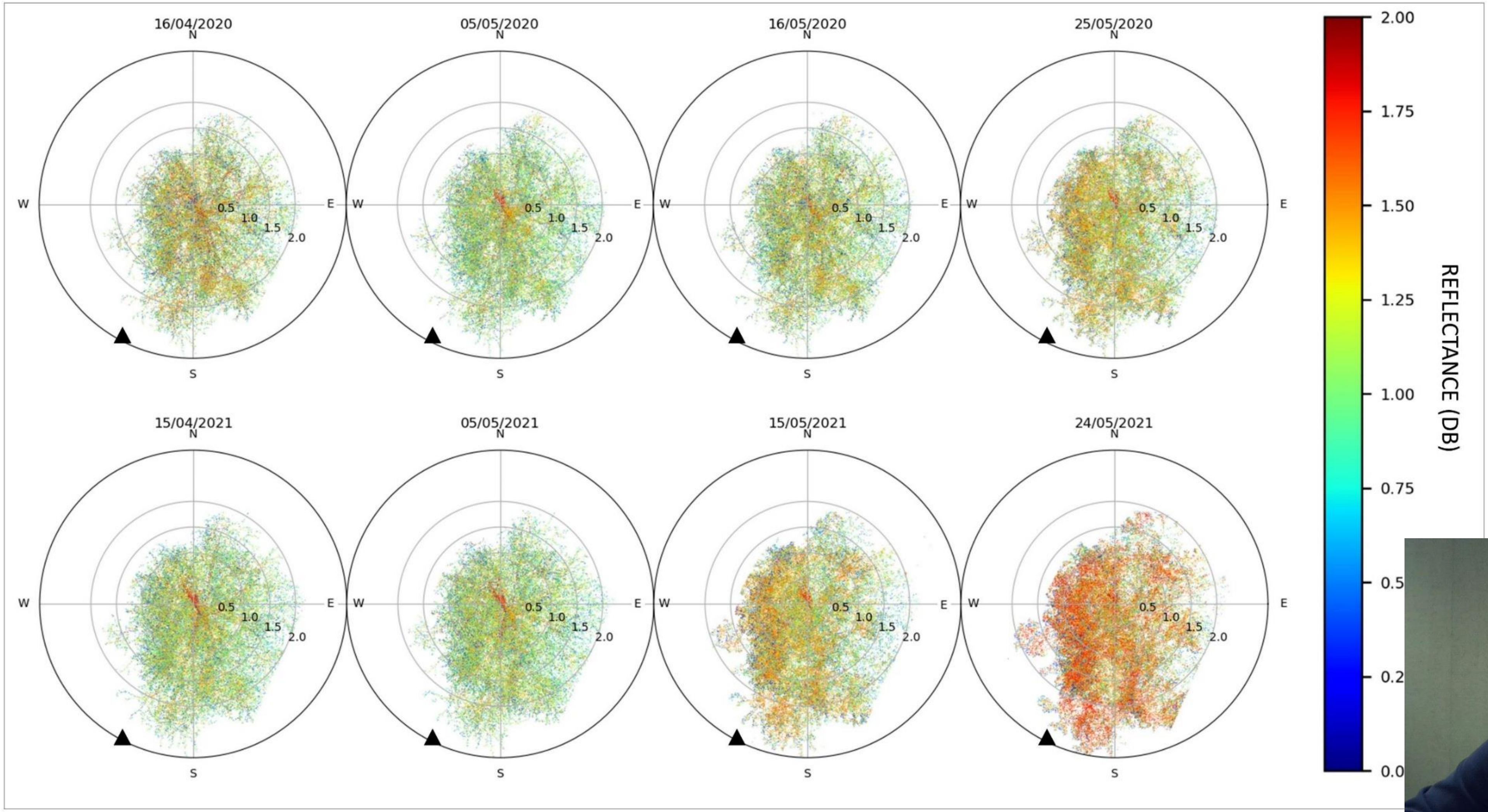




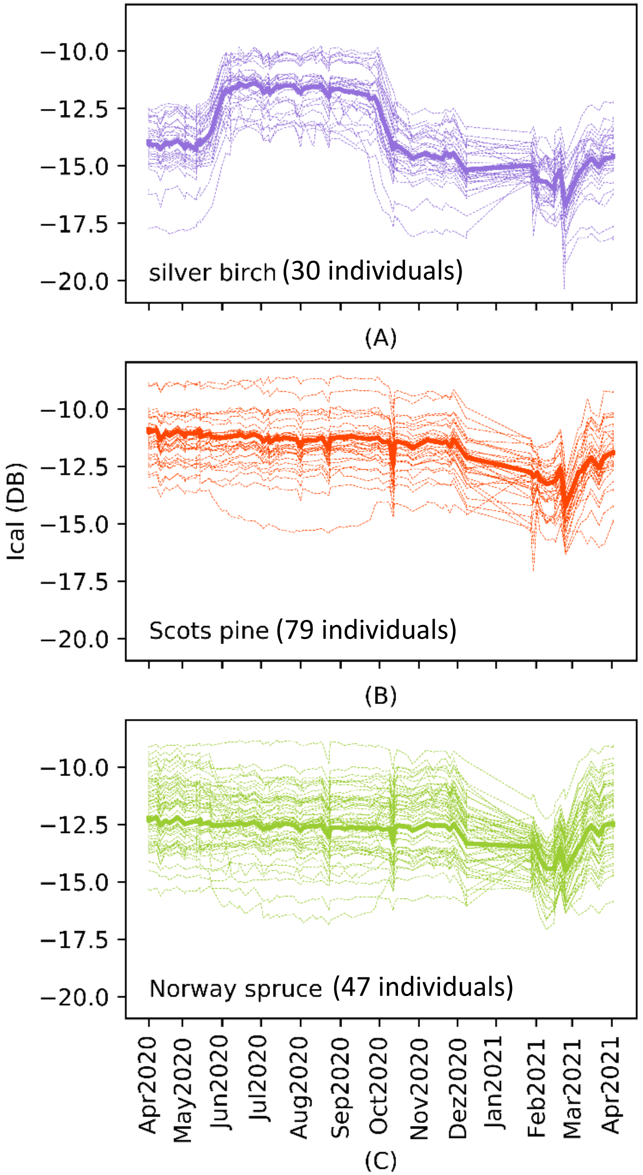


Recent Results – LiPhe Observations

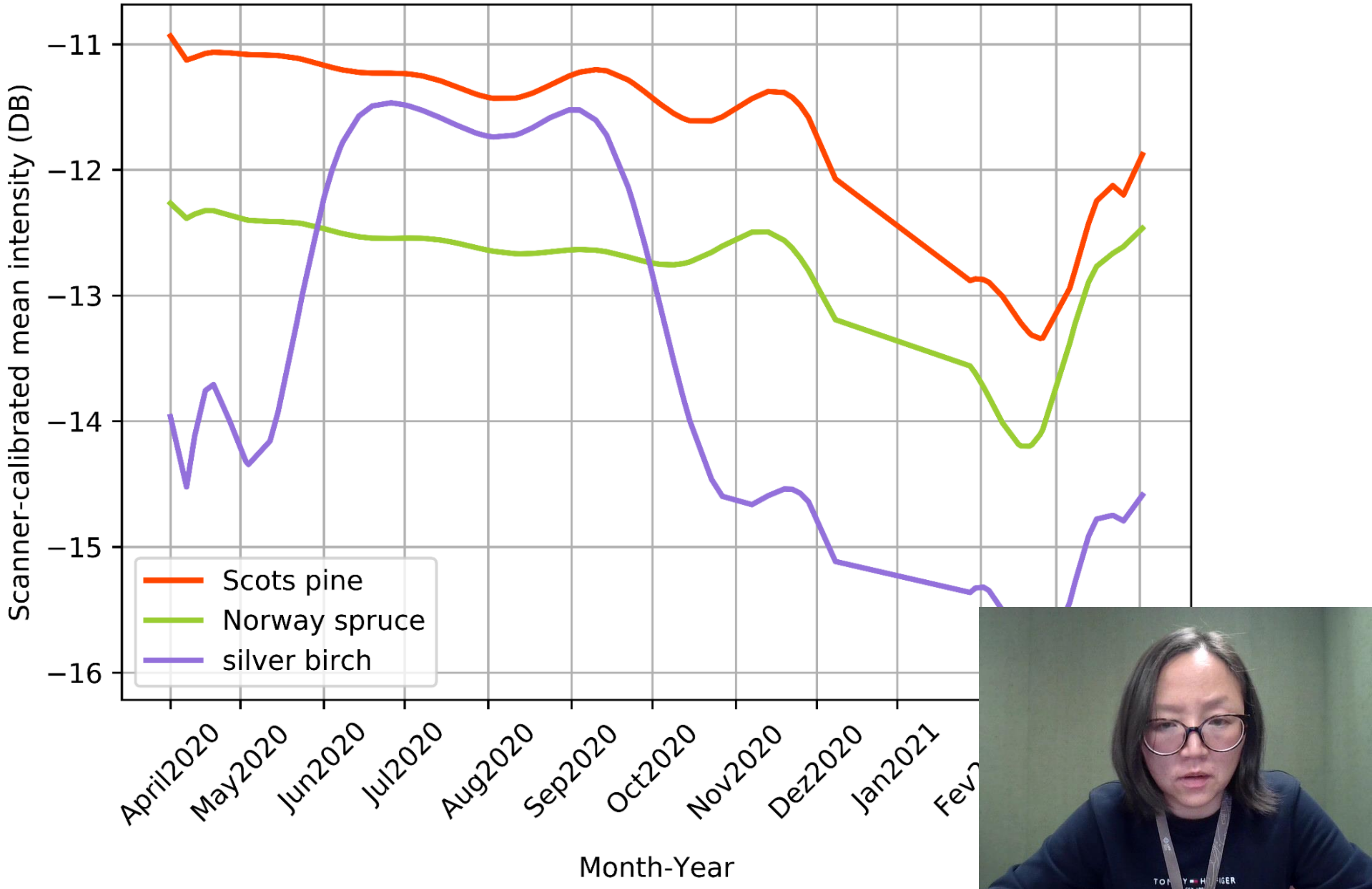
- Highly detailed tree-level seasonal variations, e.g., on backscattering intensity
  (example: backscattering intensity change at a silver birch crown in 2020, 2021)



Recent Results – LiPhe Observations



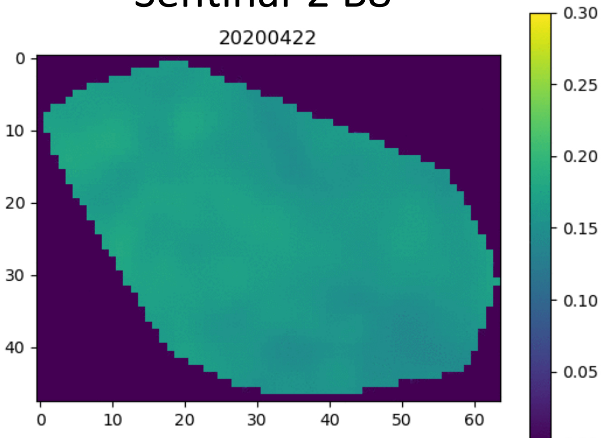
Species-specific pattern of backscattering intensity dynamics in a year



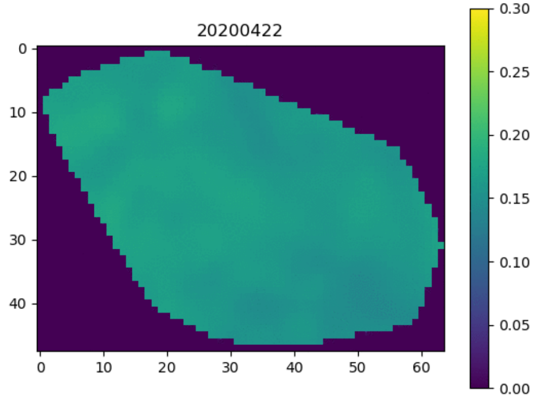
Recent Results – Comparison with Sentinal-2 data

Rasterized LiPhe data (10m resolution)& Individual trees

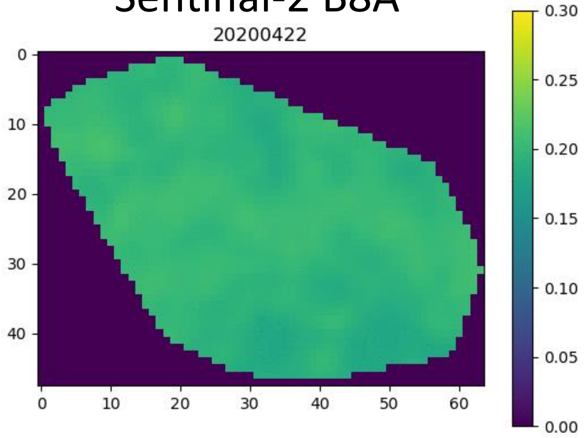
Sentinal-2 B8



Sentinal-2 B11



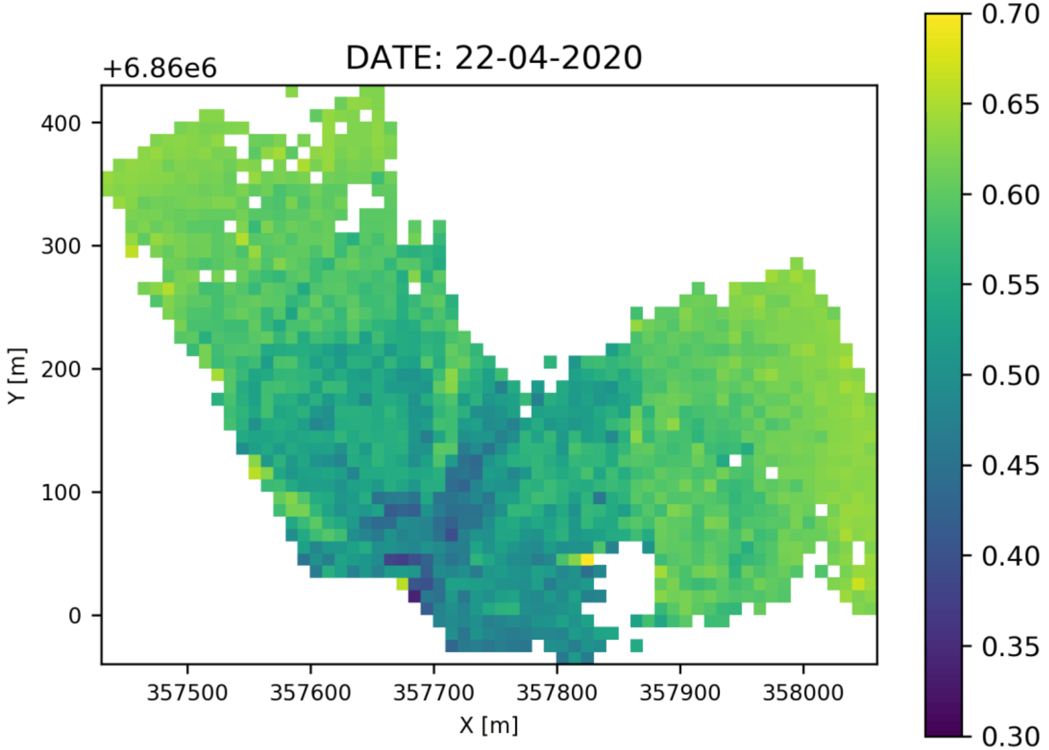
Sentinal-2 B8A



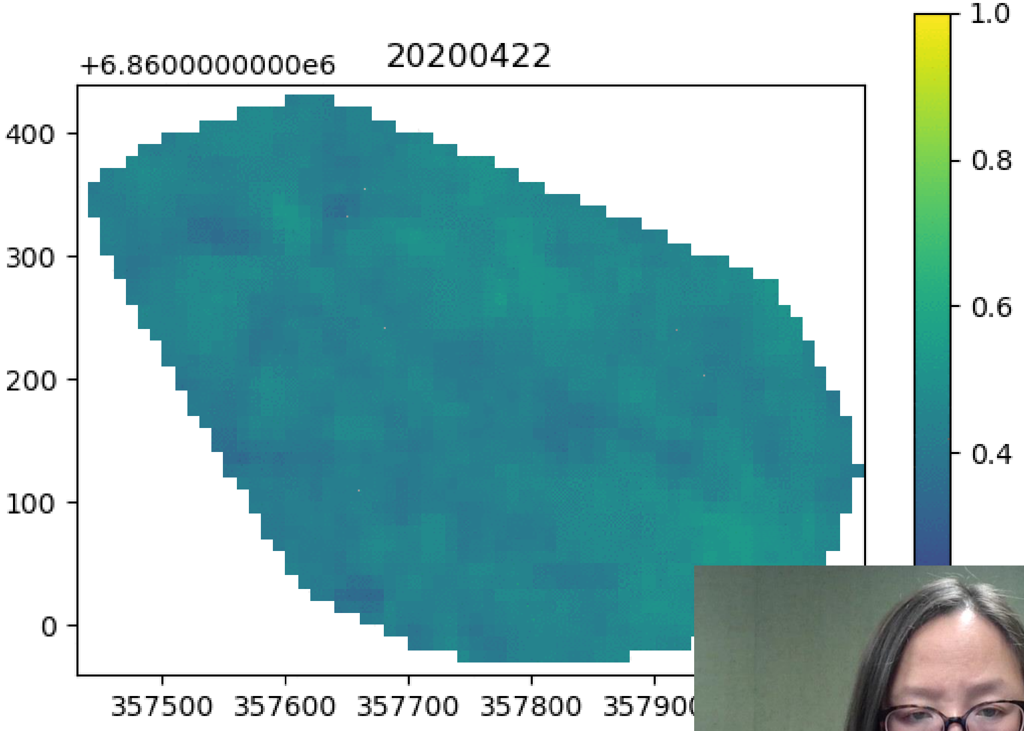
Recent Results – Comparison with Sentinal-2 data

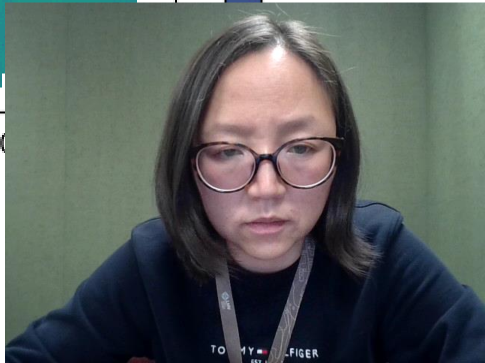
Comparison of dynamics in 14 different days (valid from Sentinal-2) in 2020-2021

LiPhe Intensity Value



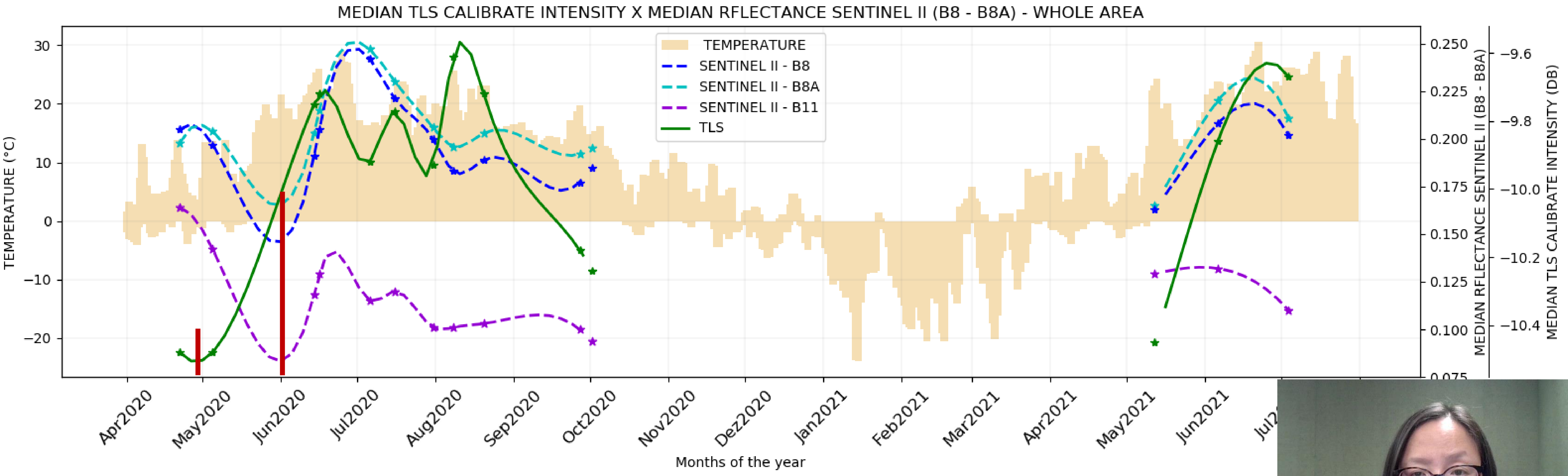
Sentinal-2 NDVI





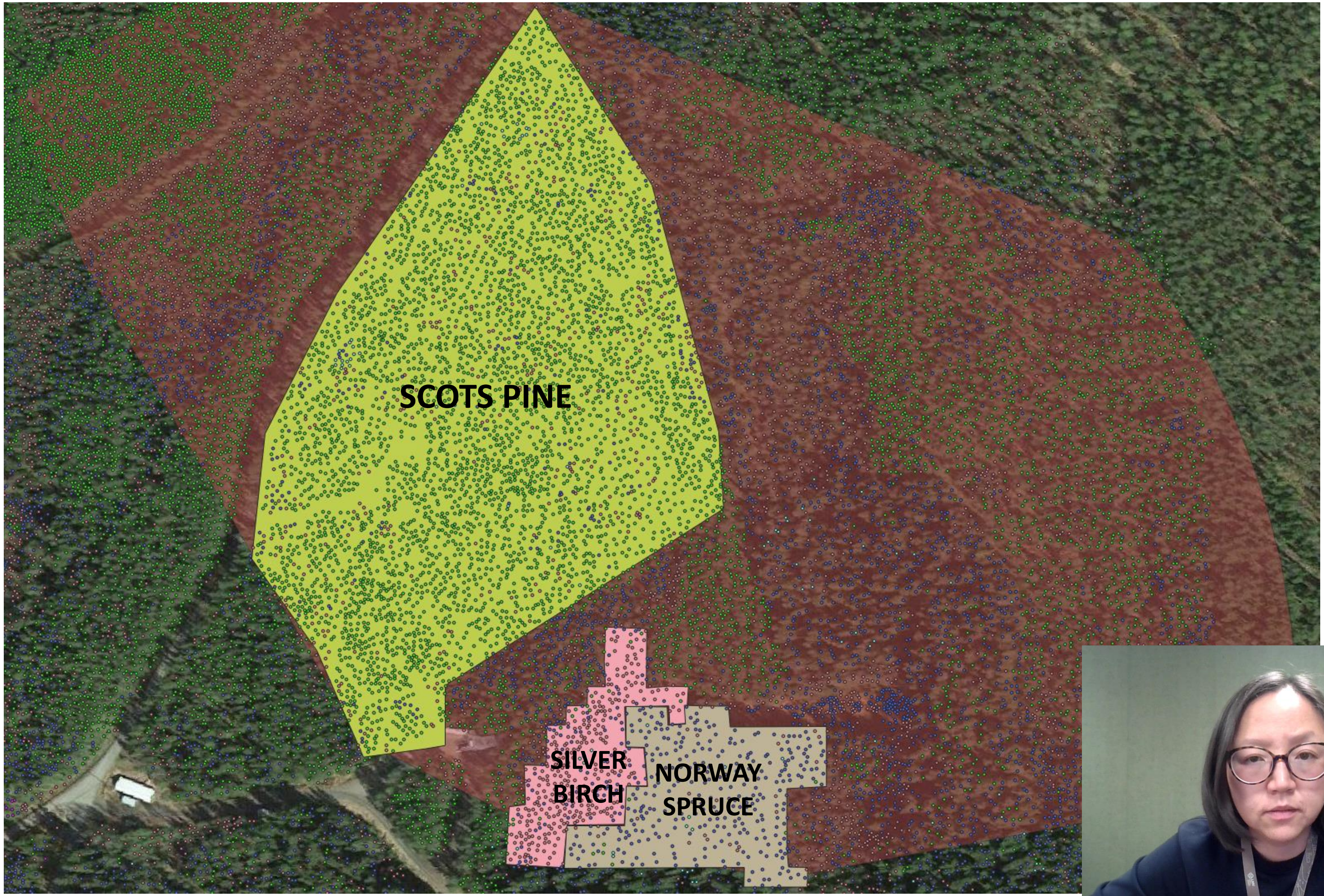
Recent Results – Comparison with Sentinal-2 data

Earlier indication of leaf sprout timing from LiPhe station observations

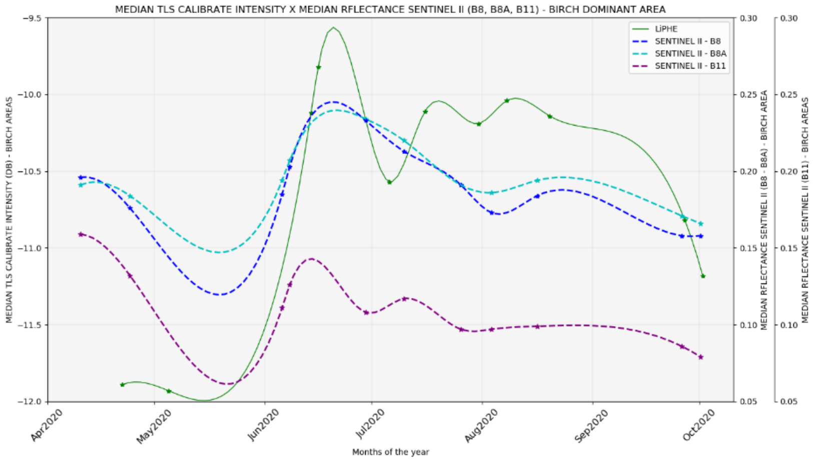


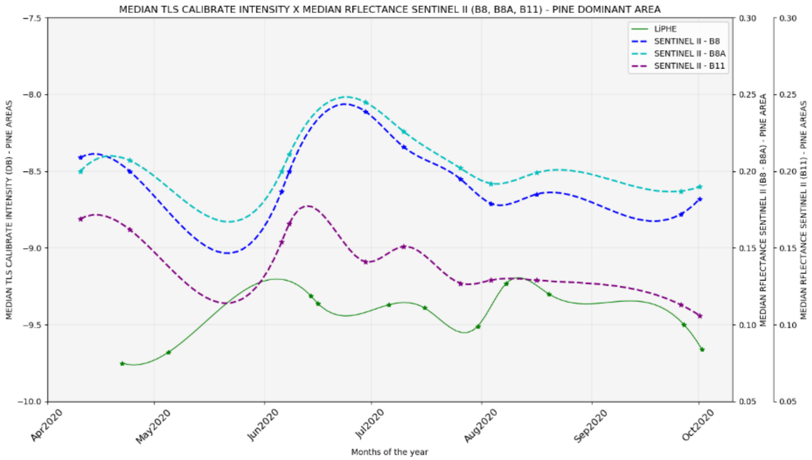
Recent Results – Comparison with Sentinal-2 data

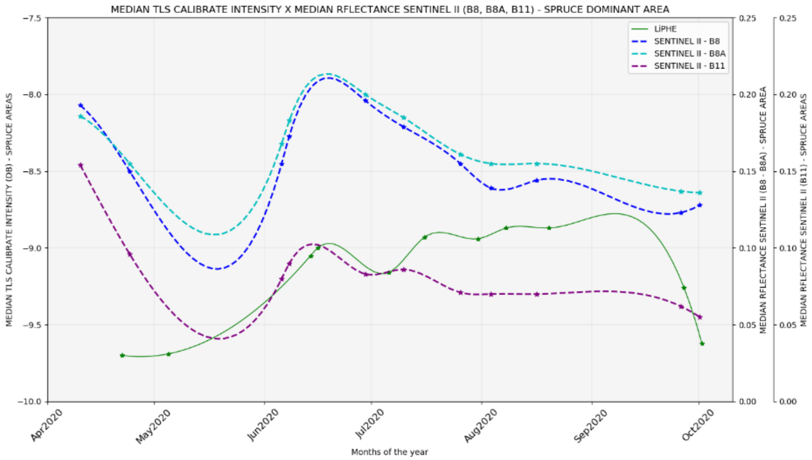
Species-specific Intensity dynamics from Sentinal-2?

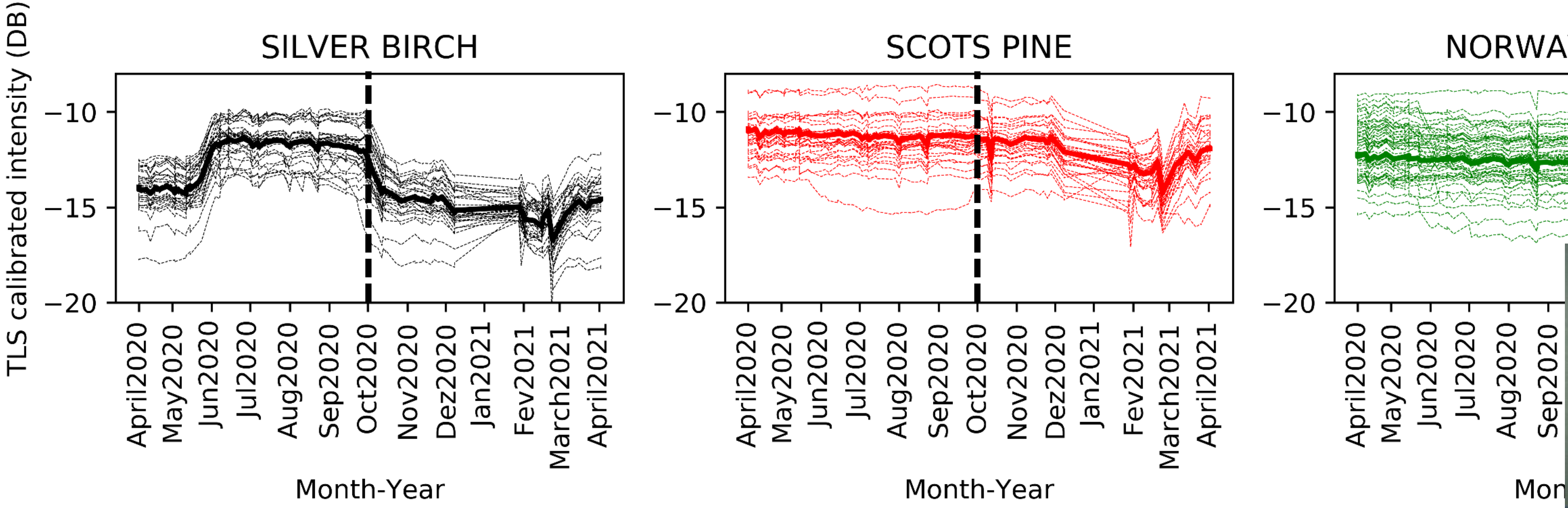


Recent Results – Comparison with Sentinal-2 data









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Outlook

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- What are the main factors influencing the sensitivity of Sentinal-2 data towards phenological events?
- Anyways to calibrate the sentinal-2 observations to improve their sensitivity and accuracy?
  e.g., using information about terrain, lower part of canopies, etc.
- Would such experiments repeatable? Can the knowledge derived from LiPhe forest station be generalized to other forest types?

NLS NATIONAL LAND SURVEY OF FINLAND

UNITE FOREST-HUMAN-MACHINE INTERPLAY

ACADEMY OF FINLAND

Background

- Shanxi Province is rich in mineral resources, with the proven coal reserves ranking first in the country. Long term coal mining has produced pollutants such as coal gangue, coal mine gas and mine water. At the same time, rapid urbanization has increased the burden on the environment, causing environmental pollution problems such as soil, air and water to worsen, which seriously restricts the harmonious and sustainable development of the ecological economy.

Fig.1 Remote sensing image of a coal mine

Fig.2 Traditional ecological monit

Study area & methods

- Shanxi province has complex geomorphic types, including mountains, hills, platforms and plains. Mountains and hills account for 80% of the total area of the province, while plains and valleys account for 20% of the total area.

- The RSEI model, which couples the four indicators of greenness, humidity, heat and dryness, has the advantage of objective and automatic weight allocation, and is widely used in the field of ecological remote sensing.

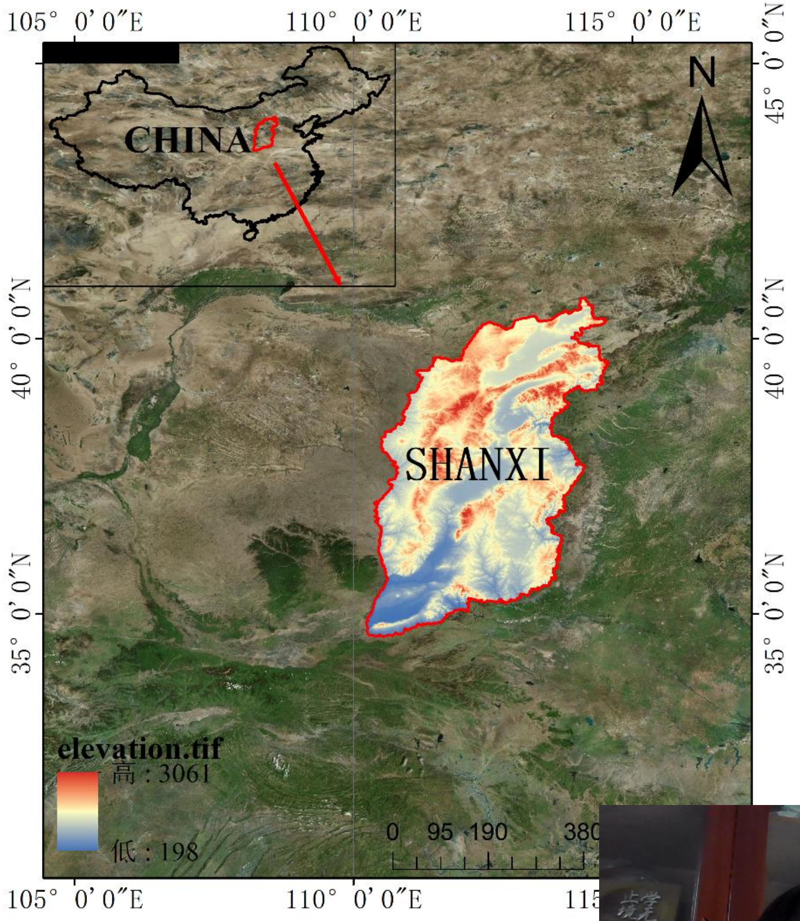


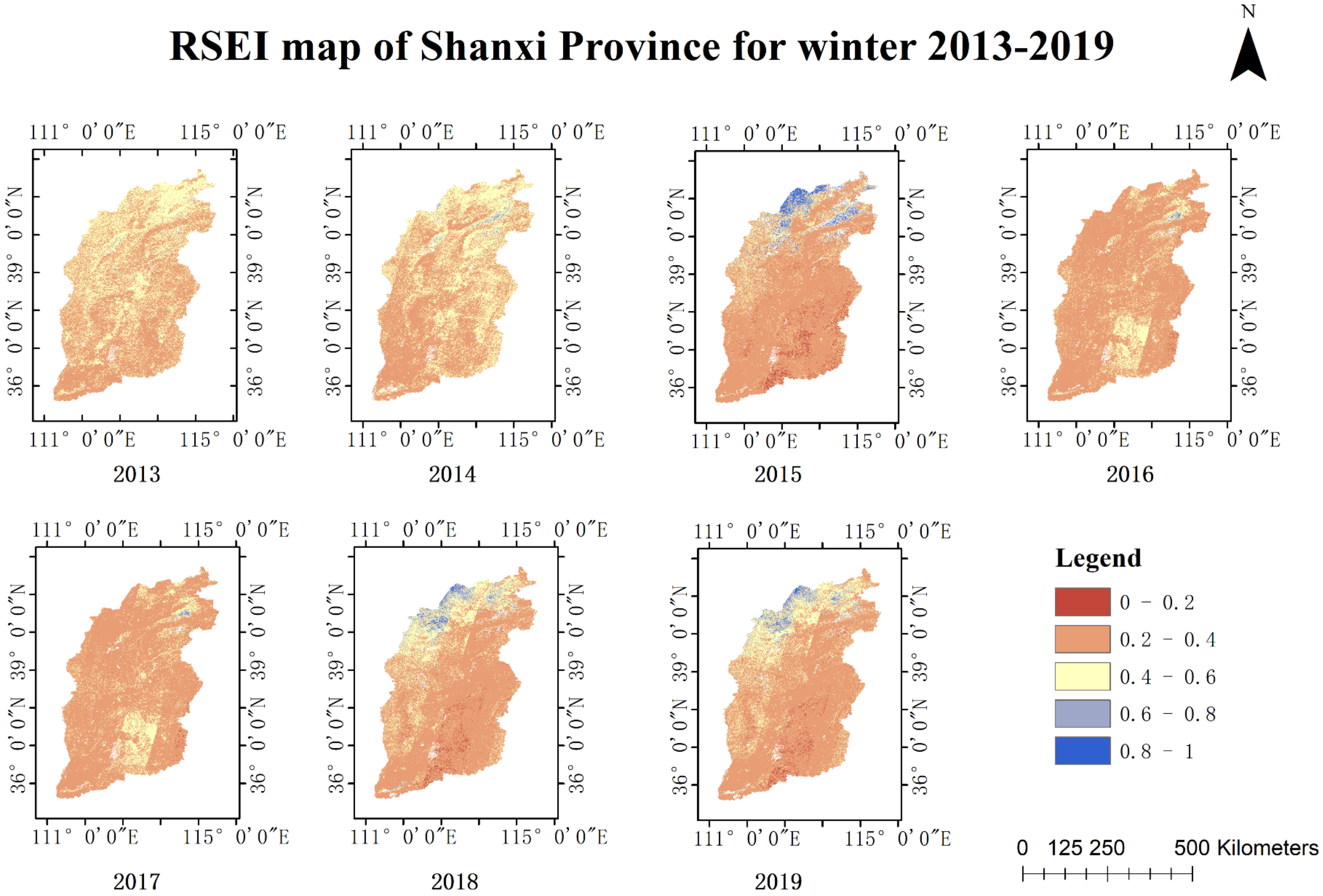
Fig.3 Geographical Location of

Data List

Indicator	Time	Source Data	Resolution	Interval Day
NDVI	Winter 2013-2019	MODIS/006/MOD09A1	500m	8
WET	Winter 2013-2019	MODIS/006/MOD09A1	500m	8
LST	Winter 2013-2019	MODIS/006/MOD11A2	1000m	8
NDBSI	Winter 2013-2019	MODIS/006/MOD09A1	500m	8
No2	Winter 2019-2021	COPERNICUS/S5P/OFFL/L3_NO2	1 degree	1
Water_mask	2019	JRC/GSW1_3/YearlyHistory	---	----

Table.1 List of used data

Distribution Map of Winter RSEI



global spatial autocorrelation

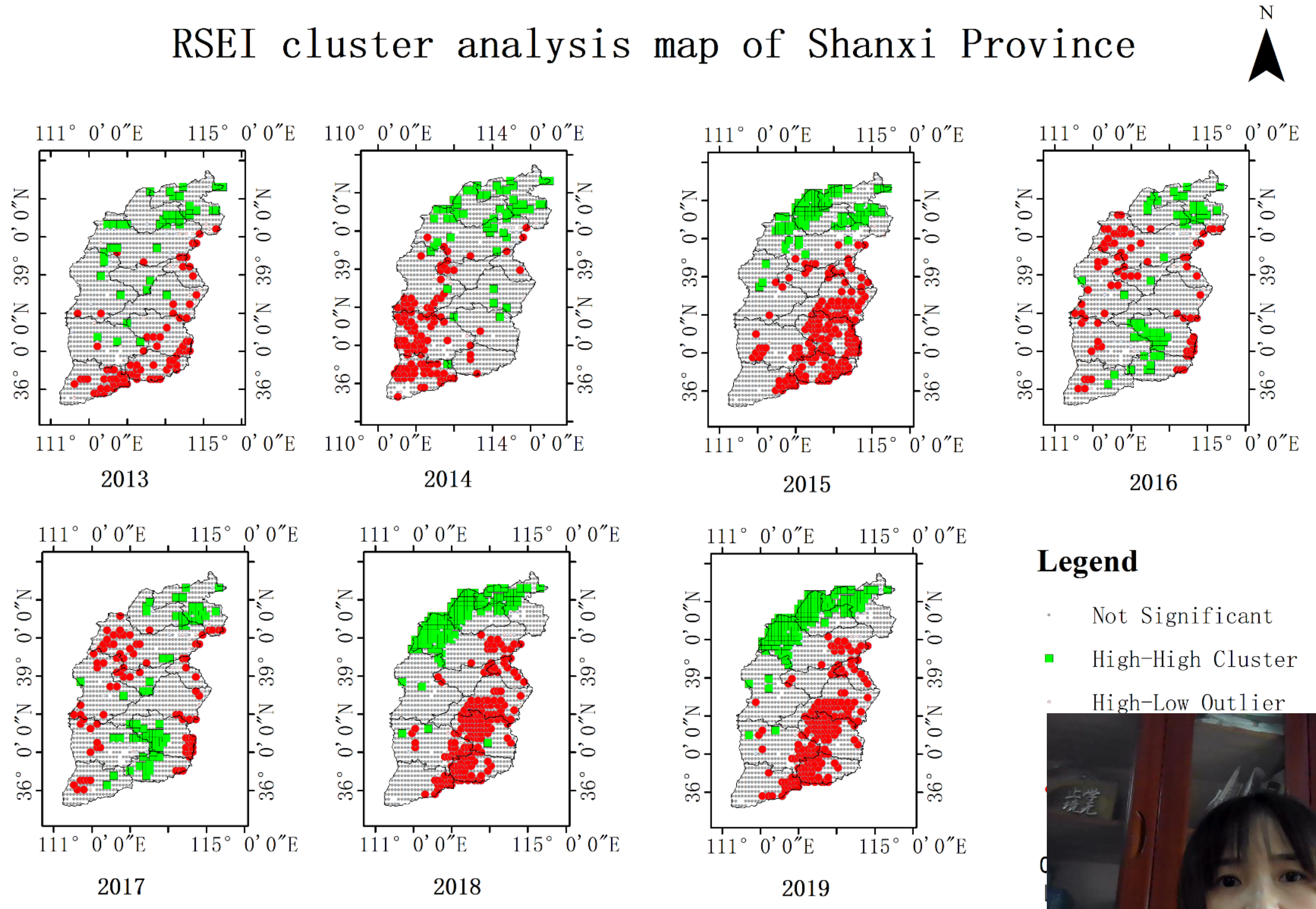
Year	Moran’I	P value	Z value	Correlation
2013	0.23	0	8.59	positive
2014	0.28	0	10.6	positive
2015	0.5	0	25.0	positive
2016	0.36	0	13.6	positive
2017	0.36	0	13.4	positive
2018	0.51	0	26.0	positive
2019	0.54	0	27.0	positive

Table.2 global spatial autocorrelation reslt of shanxi province

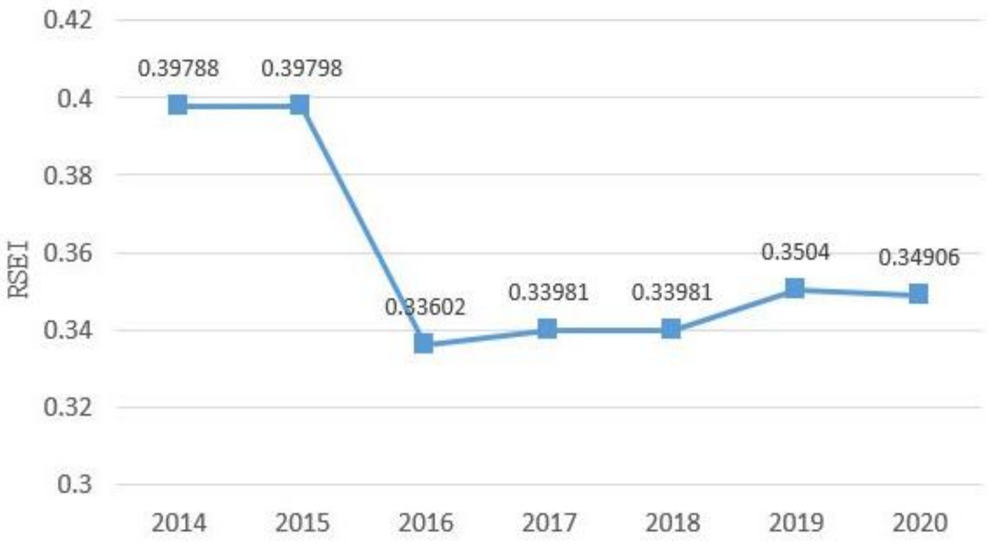
Local Autocorrelation Result

The global spatial autocorrelation analysis shows that the data has positive correlation. The RESI graph is sampled at an interval of 30m * 30m, and invalid values are eliminated. The results of local autocorrelation of the sampling point results are shown in the figure to the right.

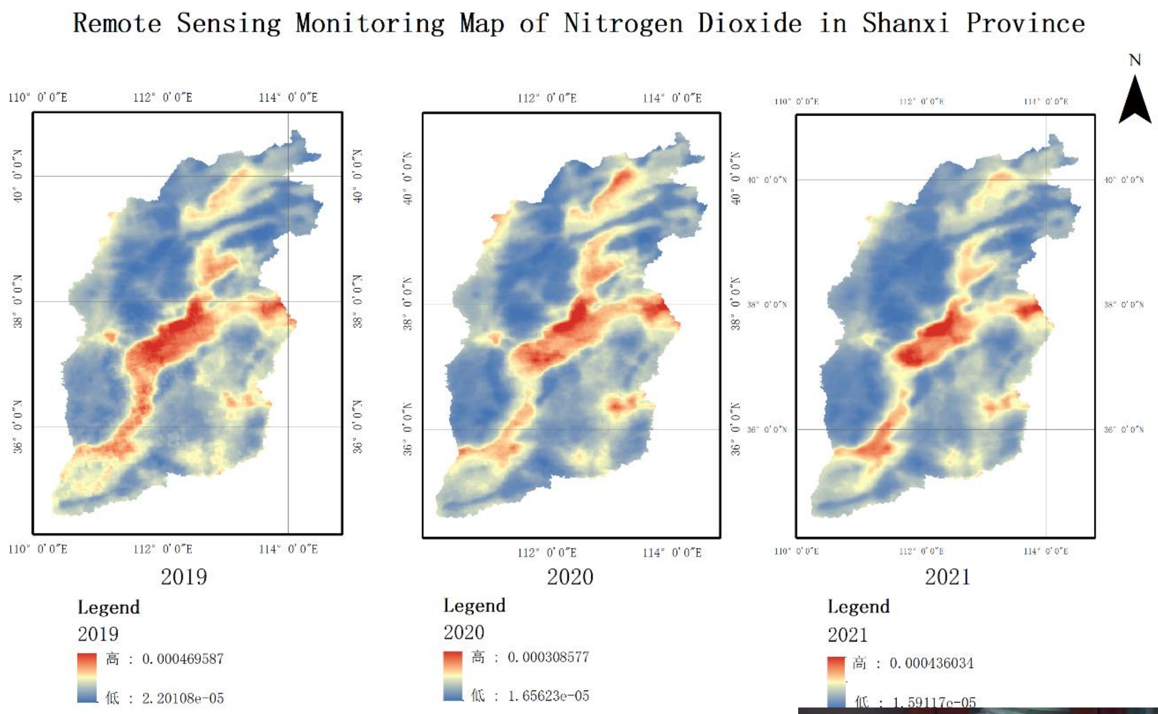
Where HH represents the RSEI high value aggregation, and LL represents the low value aggregation.



Trend chart & NO2 Data



Trend Chart of Winter RSEI Average in Shanxi Province from 2013 to 2019



OUTLOOK

1. Is RSEI applicable to forest ecosystem in mountainous areas of Shanxi Province?

2. What are the main driven forces of the significant decline of the RSEI of Shanxi province in 2015?

3. Studies on seasonal ecological quality change of Shanxi Province from 2019 to 2022 based on nitrogen dioxide data