



Supporting Kyrgyz Herding Communities Using Satellite Earth Observation

An overview of the **SIBELIUS** project
supported by the UK Space Agency



A presentation for the Sixth Annual Life in Kyrgyzstan Conference 2020

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Nagima Alimbekova (GIS), Aibek Karabaev (Mercy Corps)



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Nature of the Problem

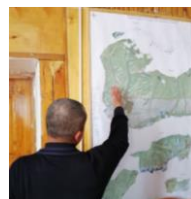
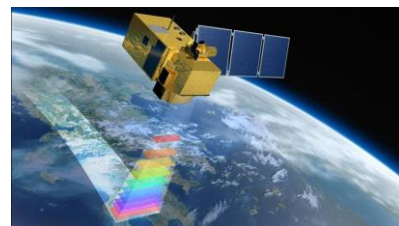
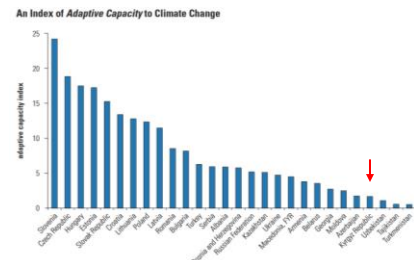
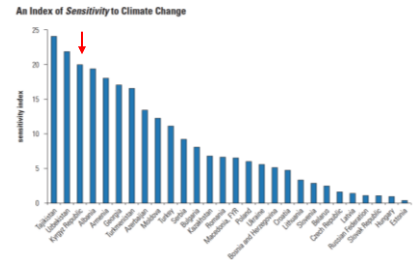
Deteriorating pasture and lack of basic pasture information

- Pasture plays an important role for Kyrgyzstan's people and economy
 - Pasture comprises 48% of its territory
 - Agriculture supports 23% of its population
- But severe levels of pasture degradation
 - Pasture is becoming less productive
 - Decreased biomass
 - Encroachment of unpalatable vegetation (karagana)
 - 60% of its pasture lands in a degraded condition
- Problems compounded by a lack of basic pasture information
 - Confirmed by fieldwork interviews in our test sites



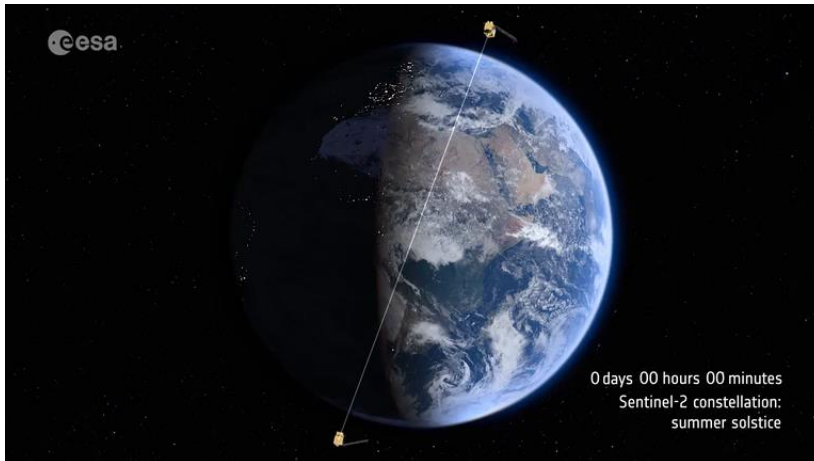
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Satellite Earth Observation Sentinel-2



Sentinel-2 has two satellites operating on opposite sides of the same polar orbit

Multi-spectral high-resolution imaging from within the optical range

Sentinel-2 is used for:

- Land monitoring:
 - Vegetation (pasture)
 - Soil moisture
 - Water cover
 - Snow
 - Agriculture (yield prediction)
 - Forest fires
- Waterways and coastal areas
- Applications for emergency services

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- eOsphere Limited
- Deimos Space
- University of Leicester
- CNPS (Mongolia)

Our Team



- Mercy Corps
- Department of Pastures, Livestock and Fisheries within the Ministry of Agriculture, Food, Industry and Land Reclamation
- Kyrgyzhydromet
- Kompanion Bank

Plus many new stakeholders and potential end users
e.g. Camp Alatau, ARIS etc.

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SIBELIUs in Kyrgyzstan achievements

- SIBULIUs.kg started in October 2019
- However, in this time we have made much progress
- Helped by copying a technical solution developed by the SIBELIUs project in Mongolia which started in 2018



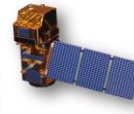
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The Kyrgyz Open Data Cube

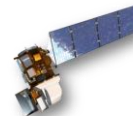
- We have built the Kyrgyz Open Data Cube
- An efficient way to host “analysis ready” satellite data and derived products on:
 - pasture
 - snow
 - drought
- Historical and current
- Satellites:
 - Sentinel-2, Landsat-8 (five years)
 - MODIS & VIIRS (10 years)



Sentinel 2



MODIS



Landsat 8



VIIRS

Higher resolution
~10 m

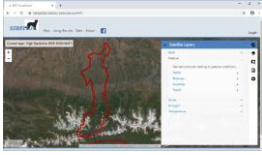
Lower resolution
~250 m

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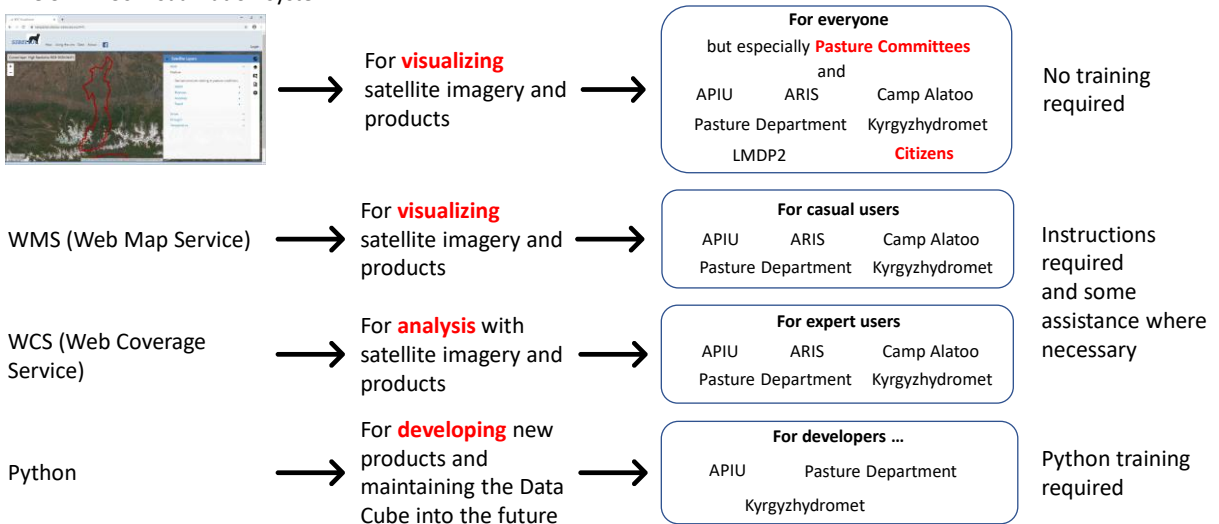
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The SIBELIUS Visualization system



Data Access and Training: tailored for each user group

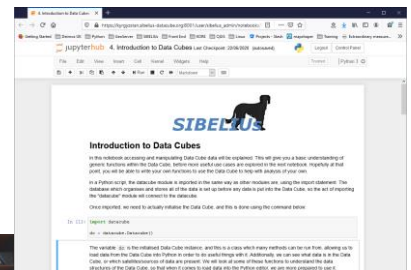


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Specialist Training Programme

- Conducted regular Python coding training on how to use satellite data and the Data Cube
- Pasture Department, APIU, ARIS, Camp Alatoo, Kyrgyzhydromet



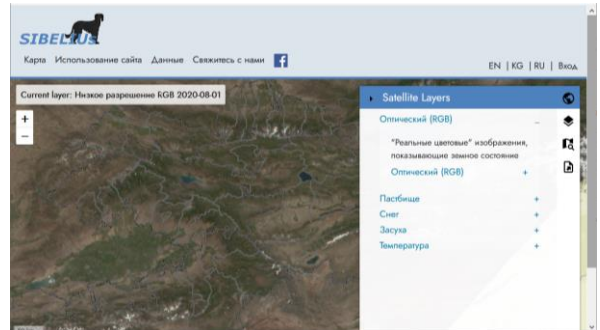
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The SIBELIUS Visualisation Website

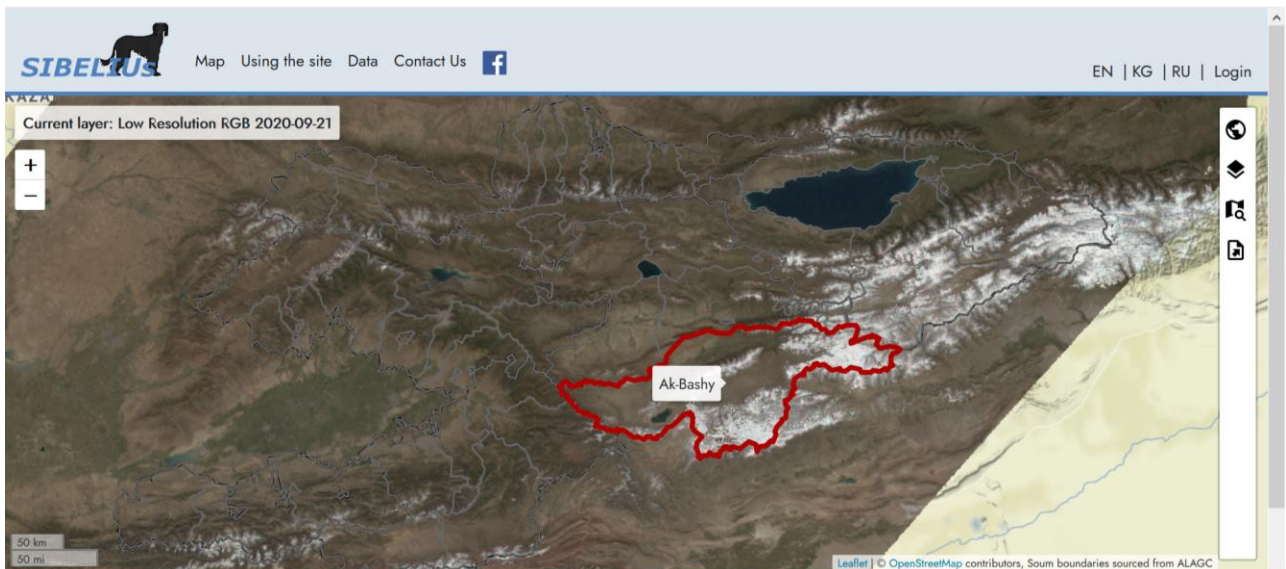
- We have built the Kyrgyz Visualisation website
- Version 1.0 released 1st September
- In English, Kyrgyz & Russian
- Providing easy access to satellite derived environmental products
- A key aim is to promote this in the Pasture Committees
- Focus is pasture
 - But also drought, snow and temperature



<https://kyrgyzstan.sibelius-datacube.org:8443/map/en>

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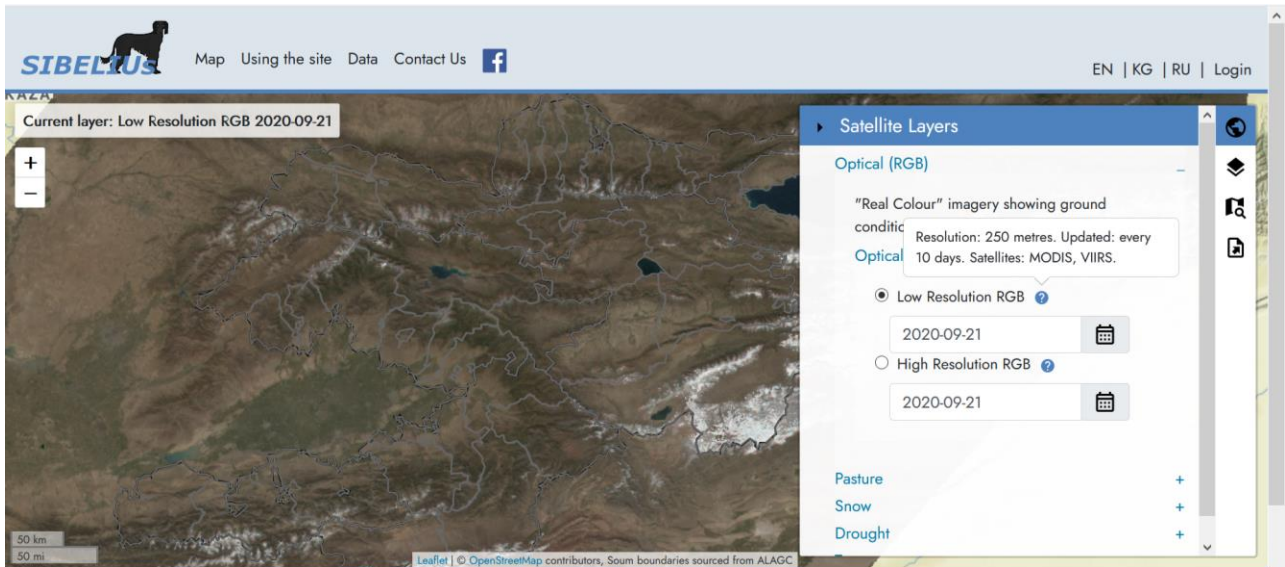
Opening the SIBELIUS visualisation website



<https://kyrgyzstan.sibelius-datacube.org:8443/map/en>

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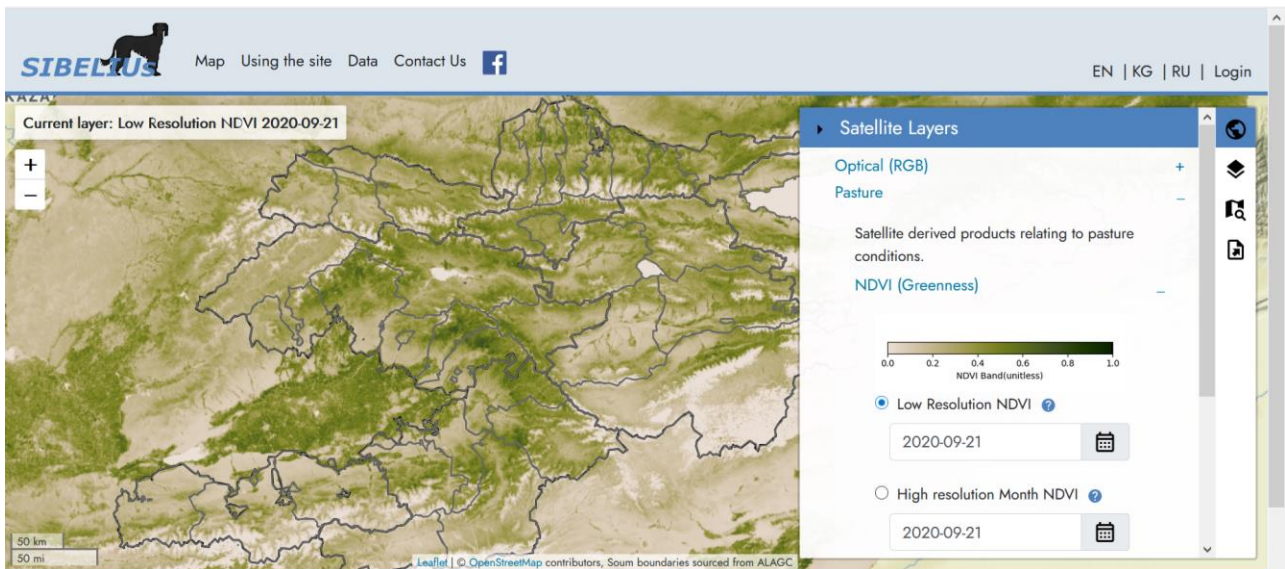
Introducing the satellite derived information



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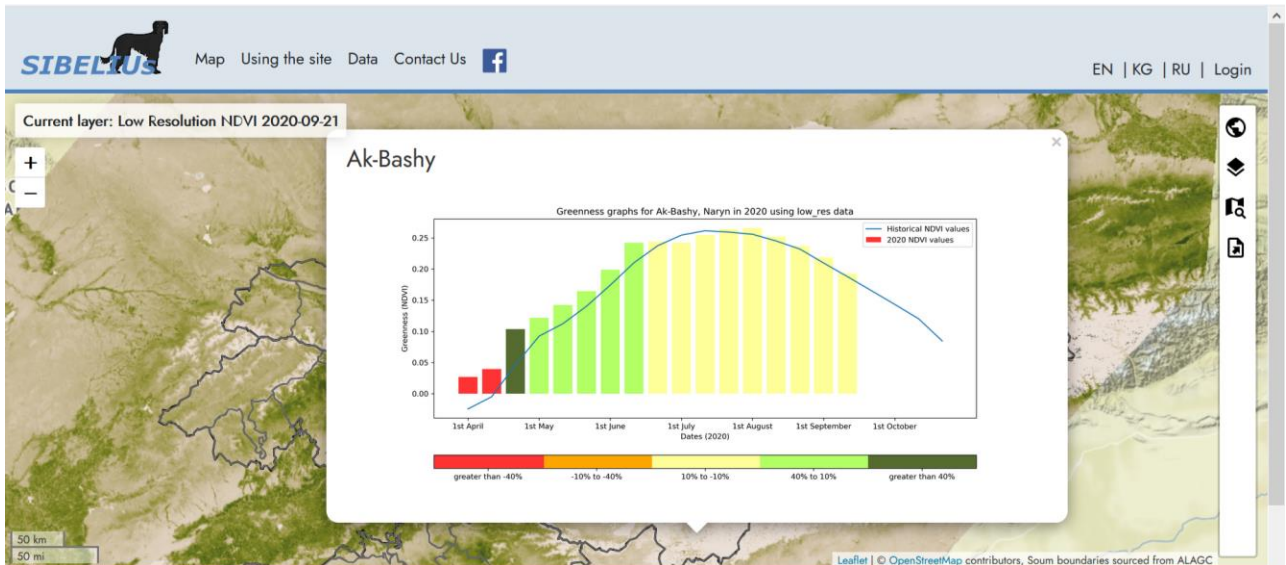
Pasture countrywide



<https://kyrgyzstan.sibelius-datacube.org:8443/map/en>

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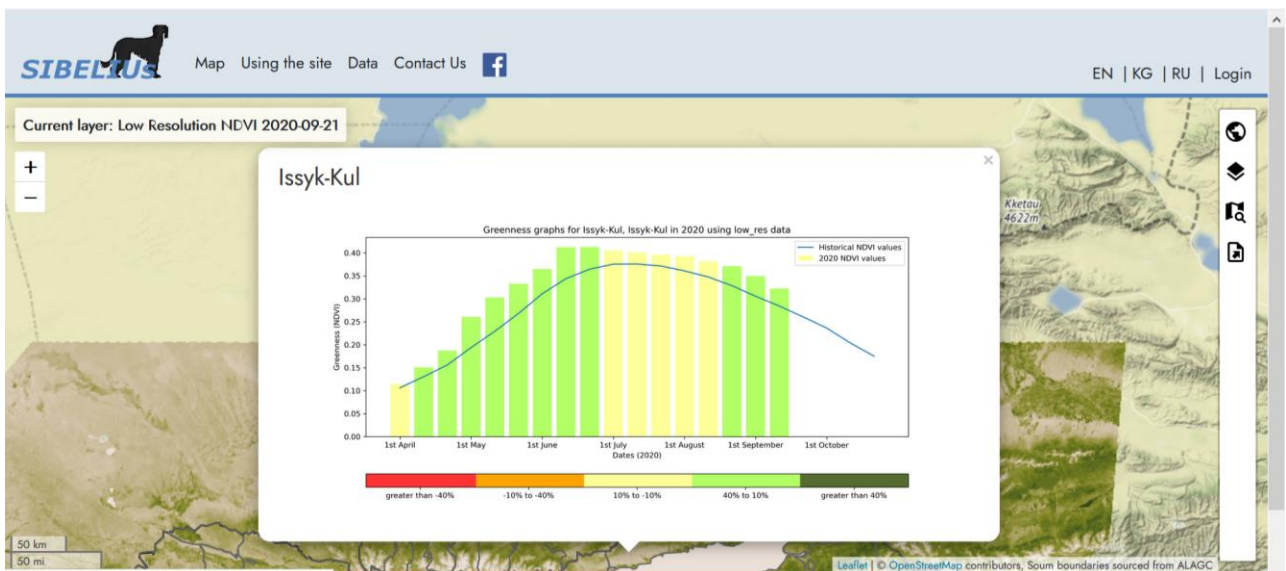
Greenness graphs



<https://kyrgyzstan.sibelius-datacube.org:8443/map/en>

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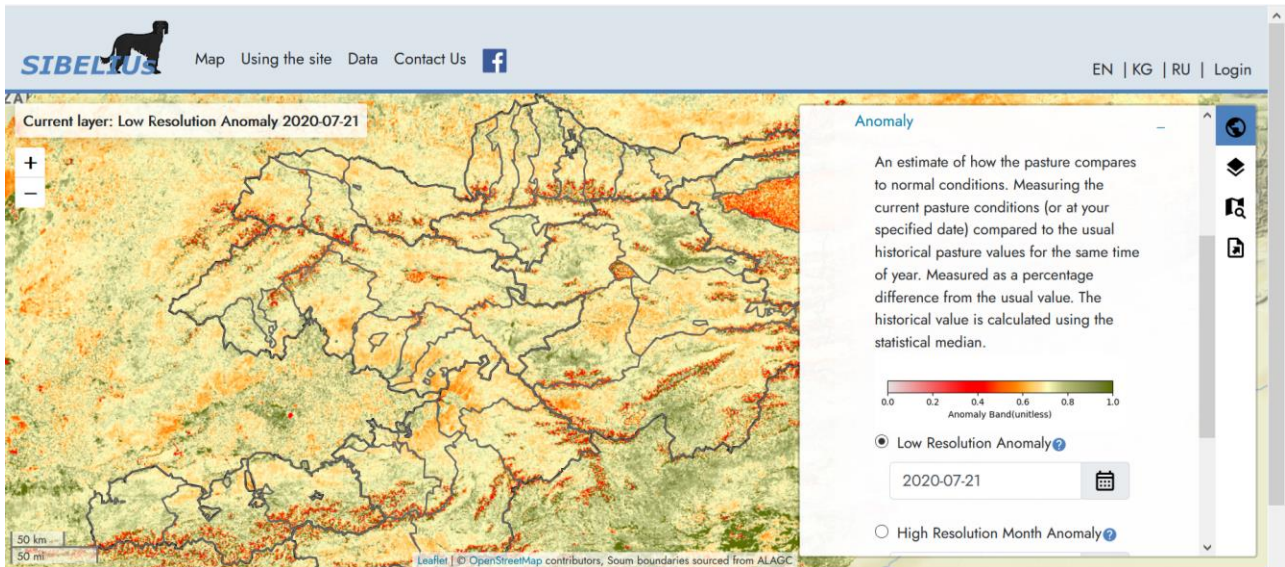
Greenness graphs



<https://kyrgyzstan.sibelius-datacube.org:8443/map/en>

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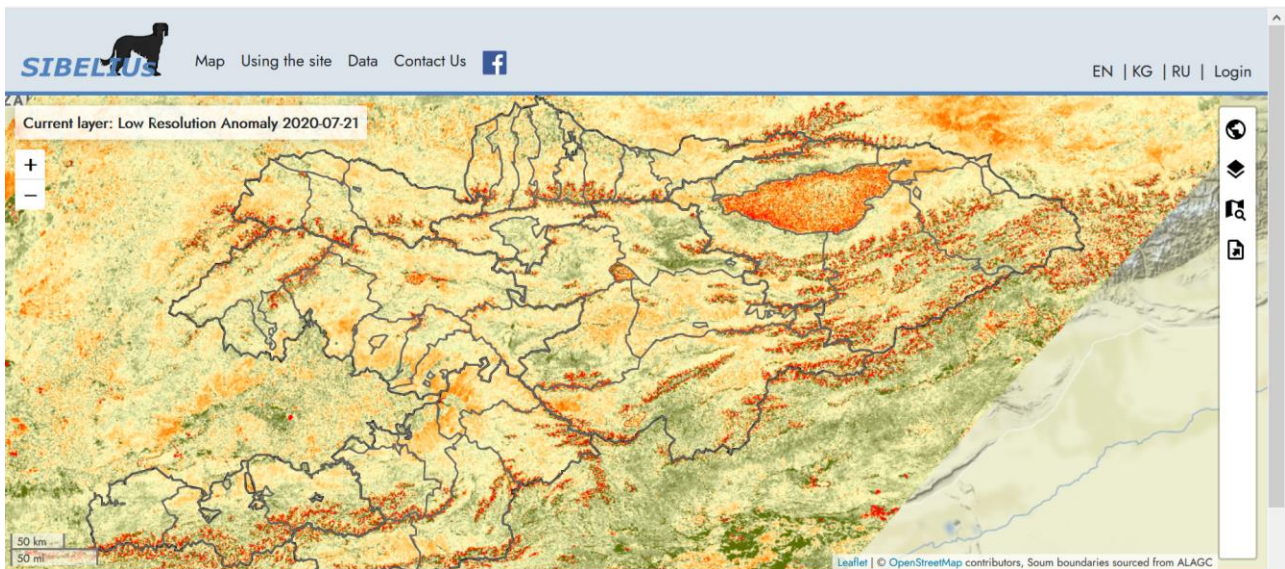
NDVI Greenness anomaly



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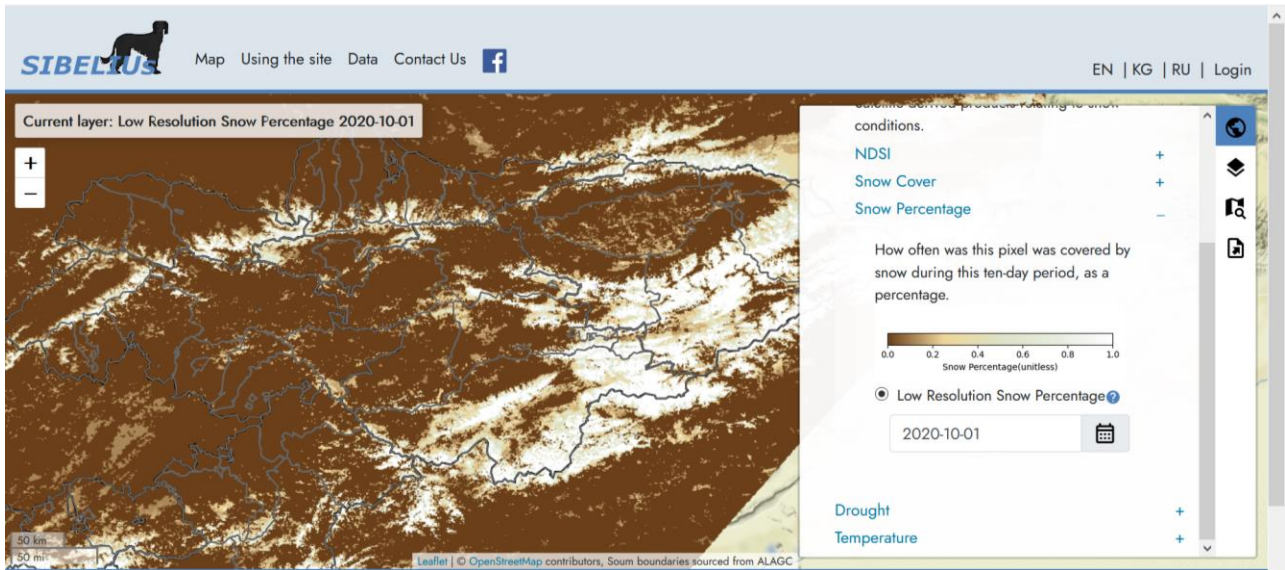
NDVI Greenness anomaly



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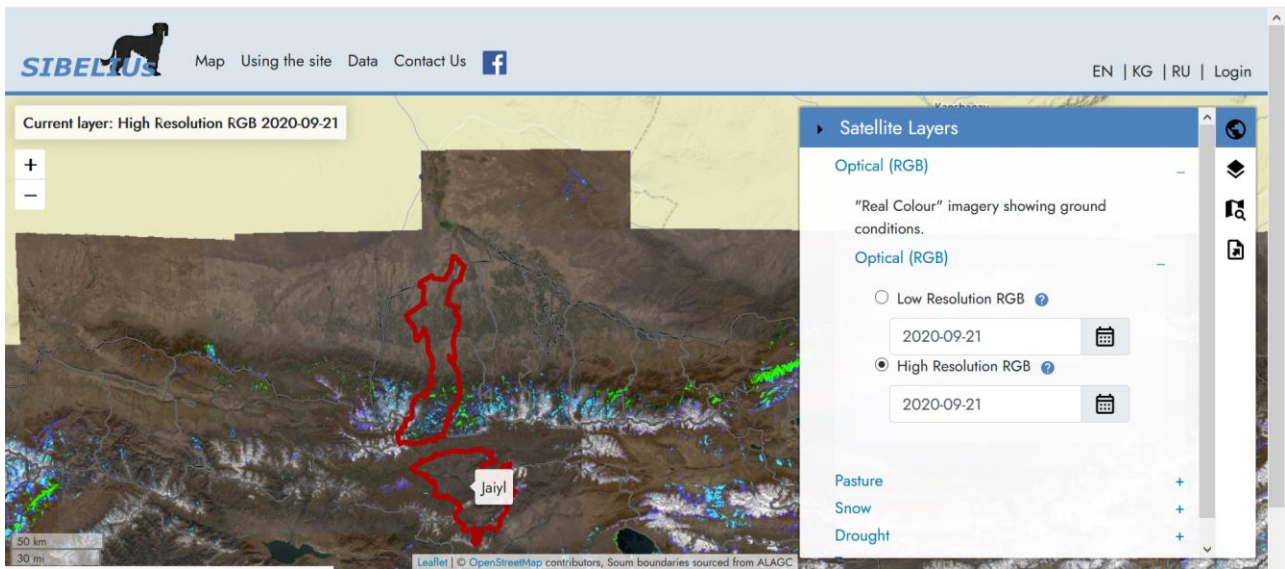
Snow



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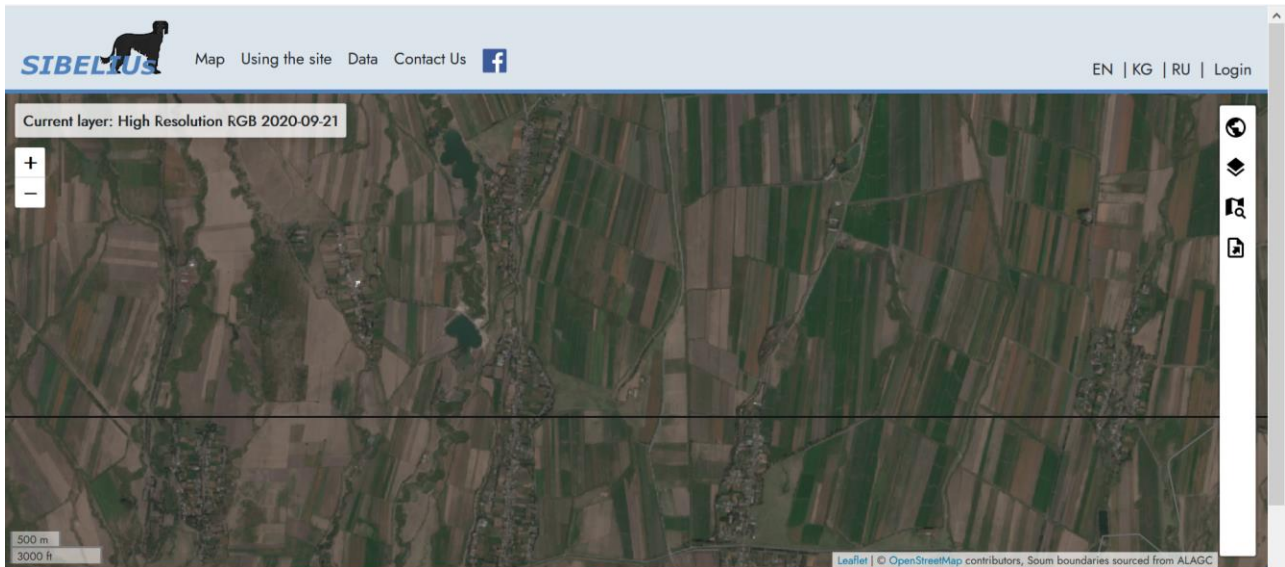
Higher resolution RGB



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Higher resolution RGB (September)



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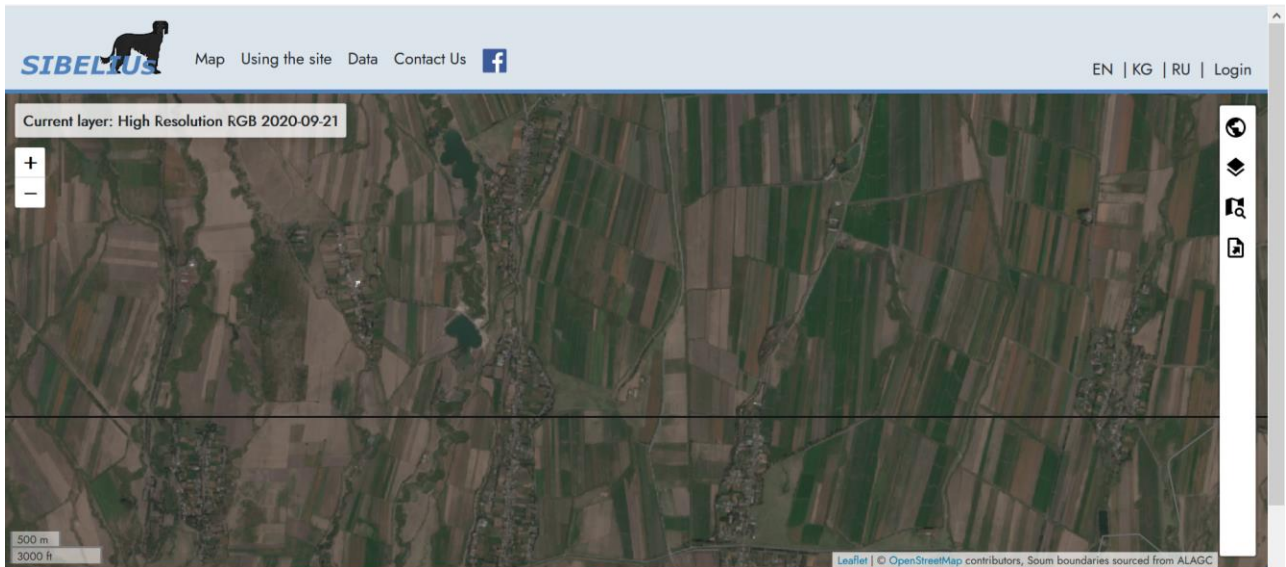


Agriculture

- The resolution is ideal for examining agricultural crops
- Understanding the impacts of problems on crops:
 - Droughts
 - Hail damage
 - Disease etc
- When to irrigate
- Crop yield prediction is increasingly common using satellite EO

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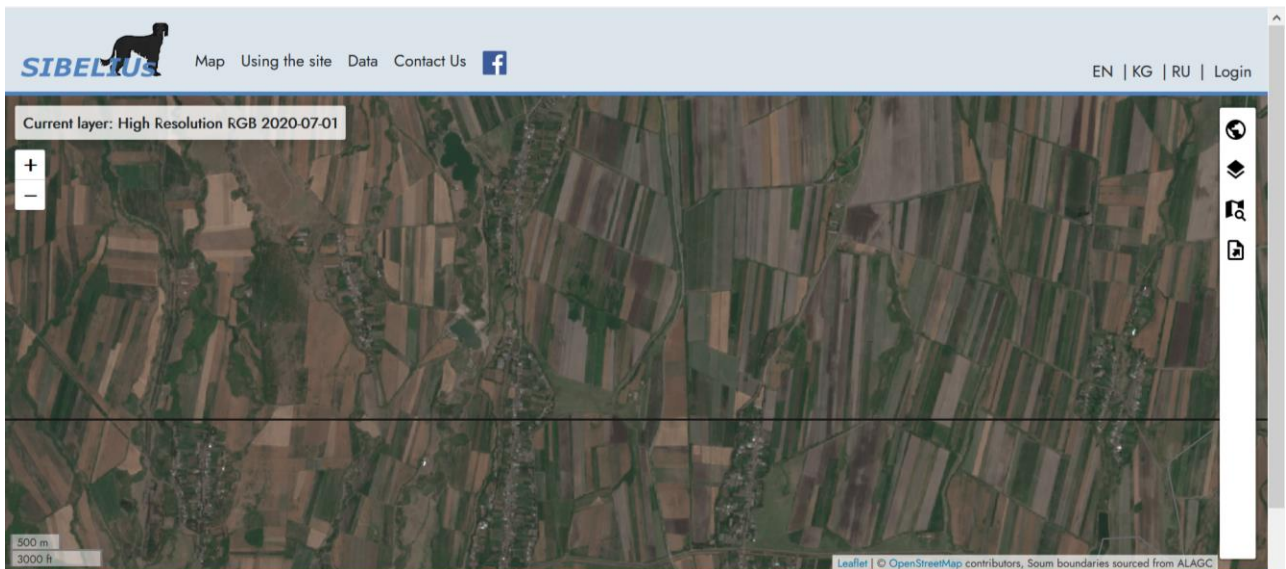
Higher resolution RGB (September)



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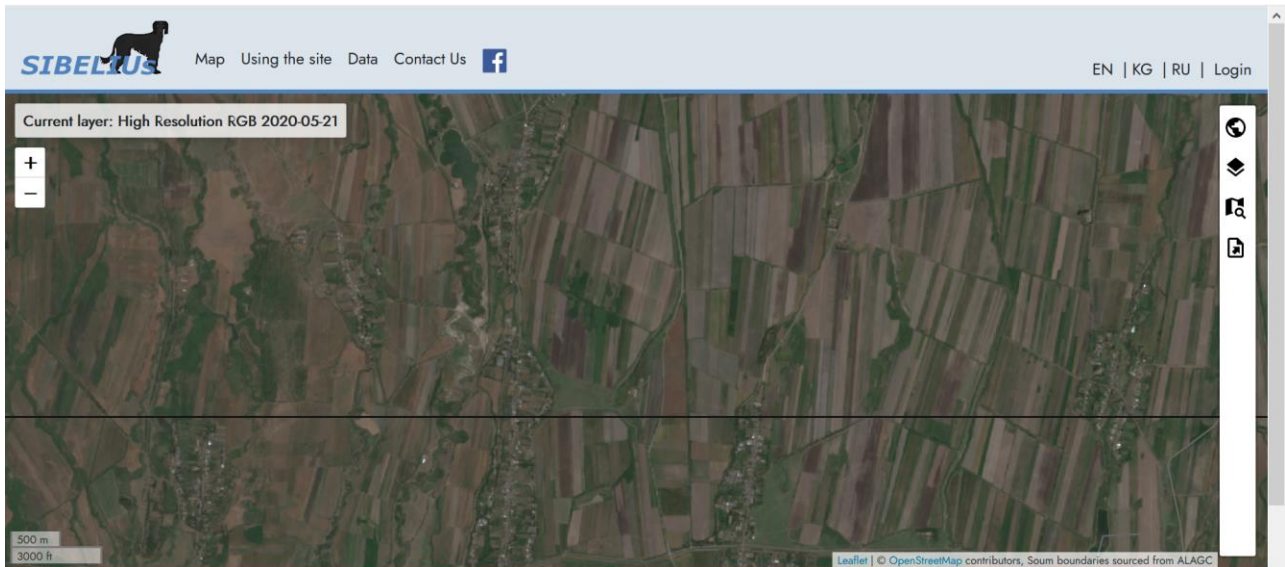
Higher resolution RGB (July)



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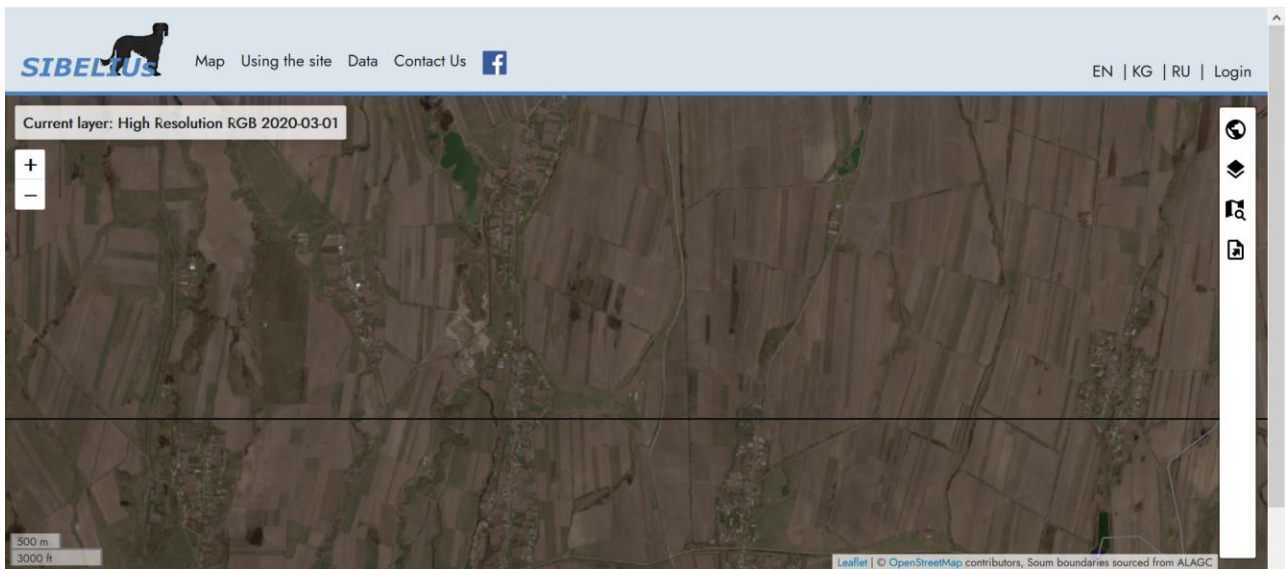
Higher resolution RGB (May)



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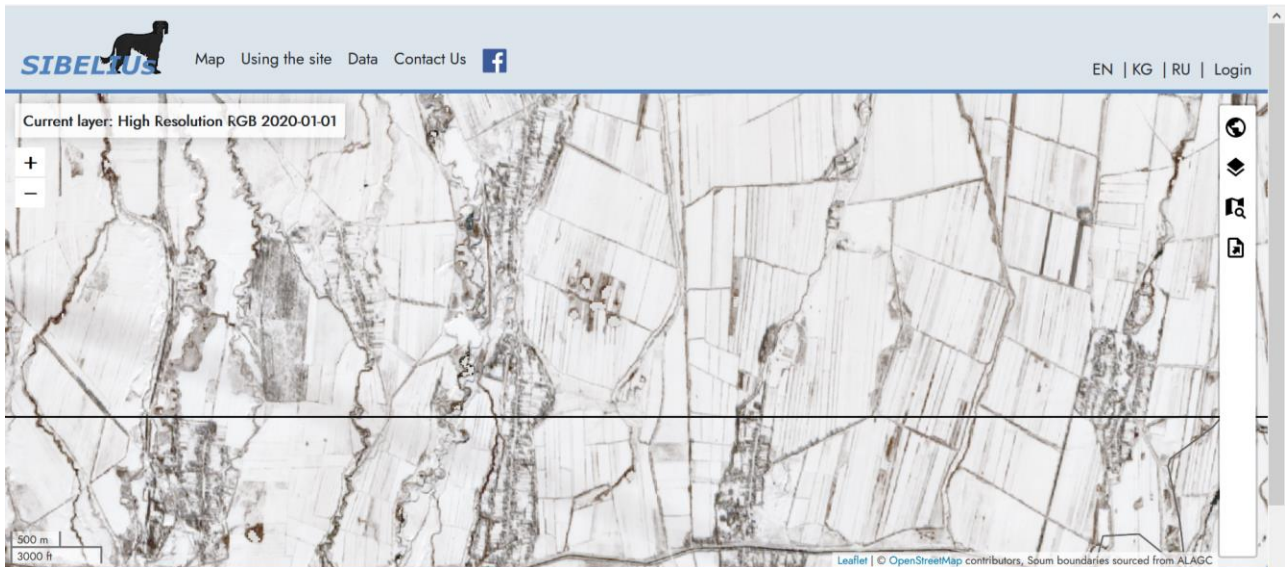
Higher resolution RGB (March)



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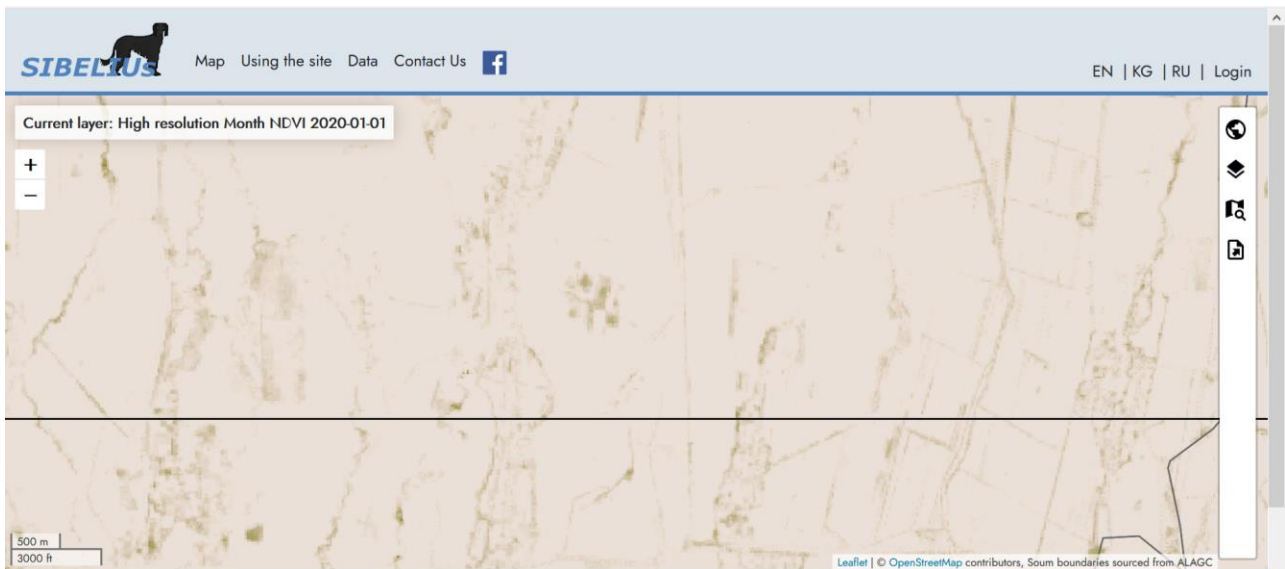
Higher resolution RGB (January)



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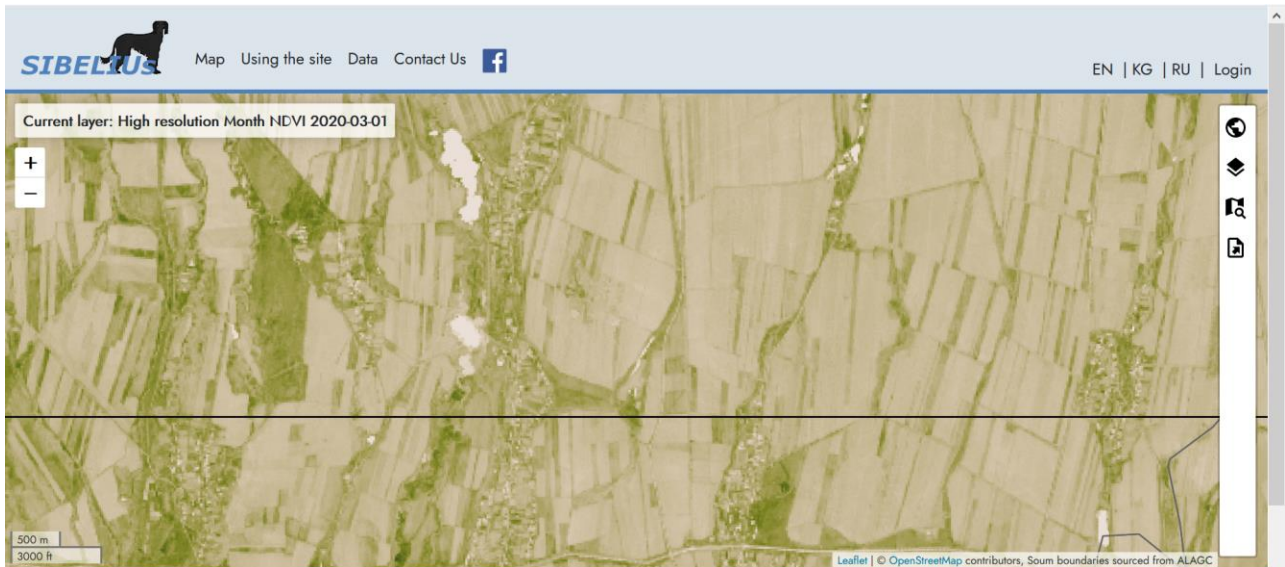
Higher resolution NDVI (January)



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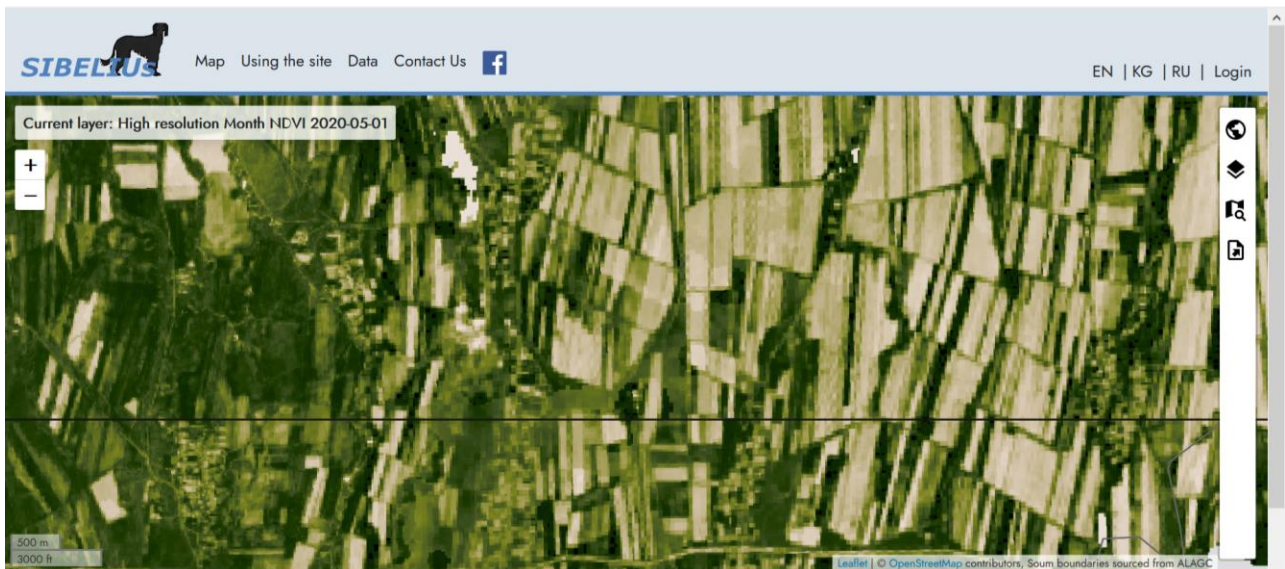
Higher resolution NDVI (March)



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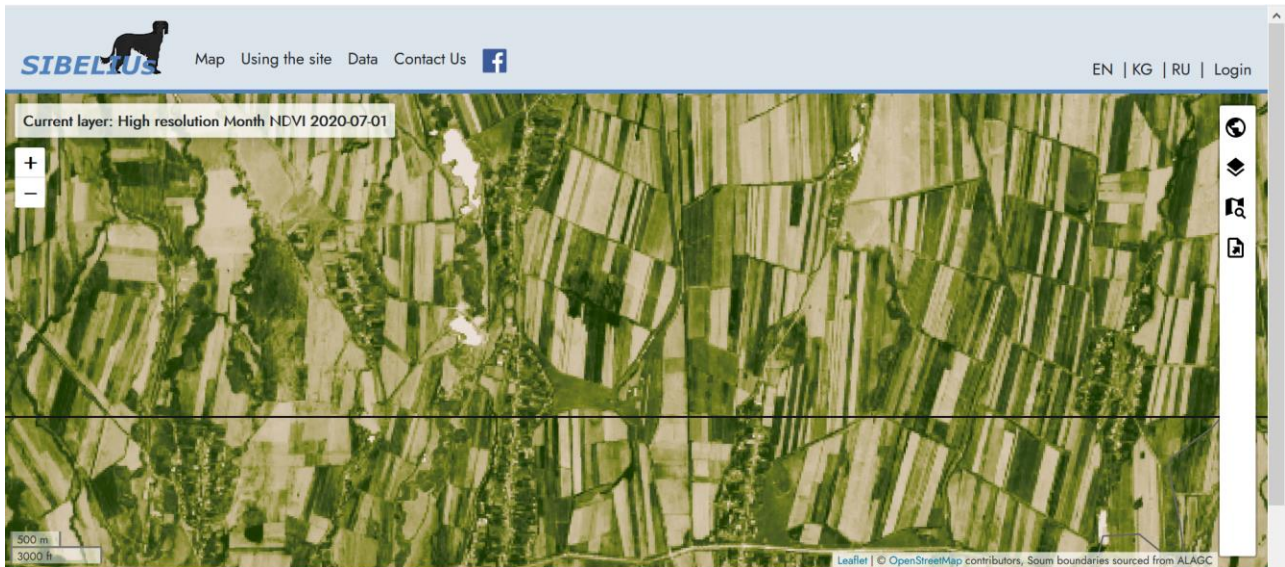
Higher resolution NDVI (May)



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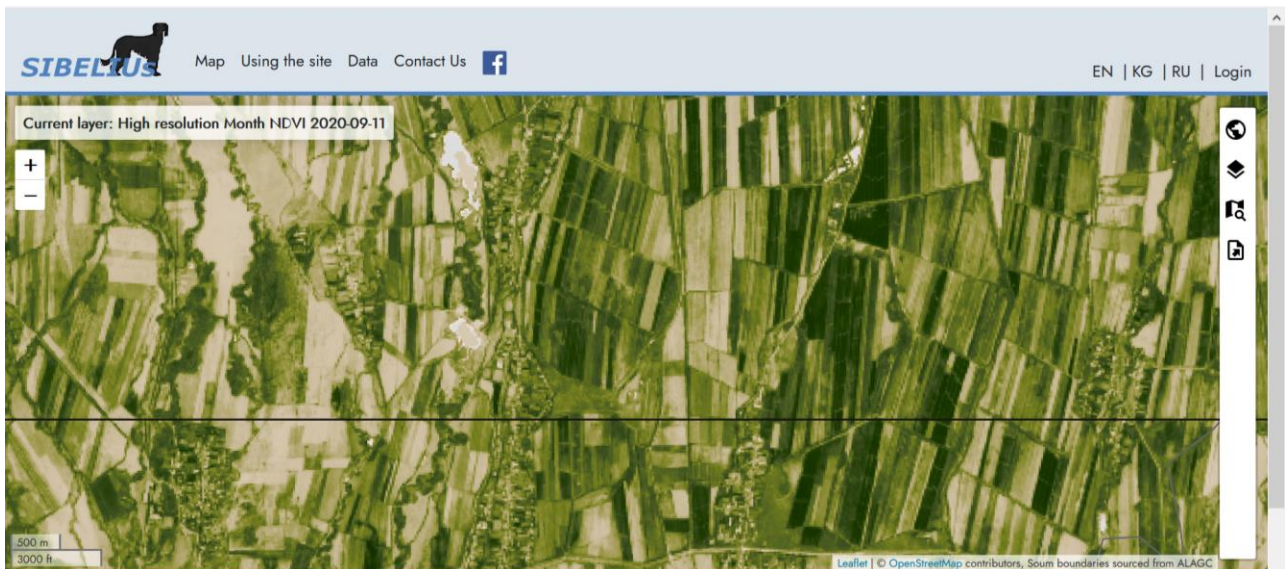
Higher resolution NDVI (July)



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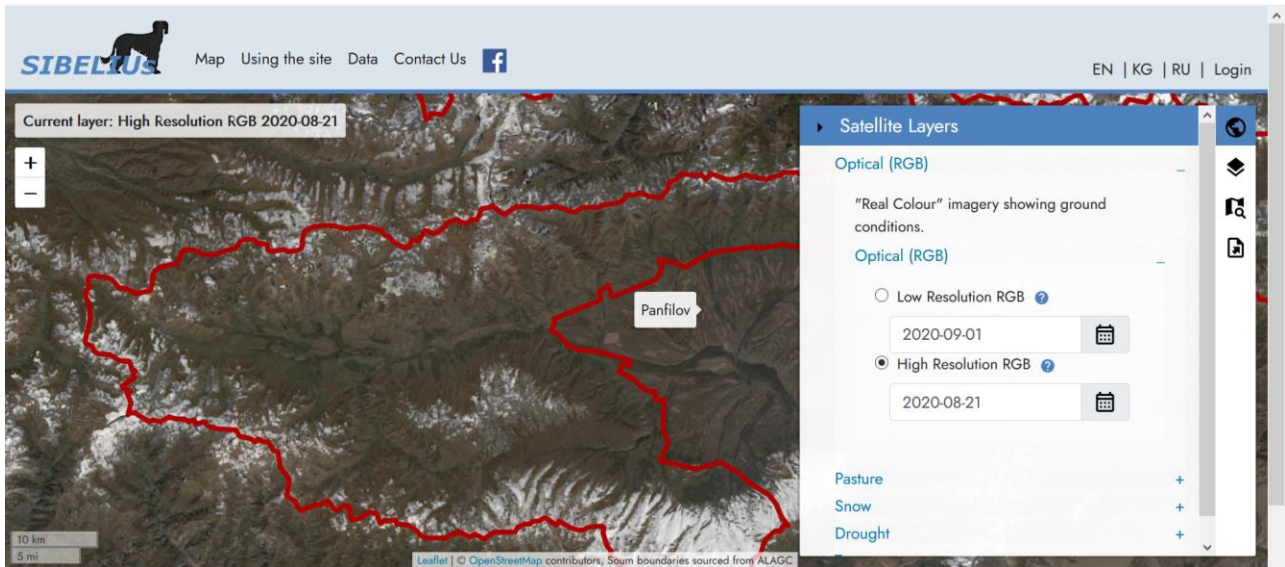
Higher resolution NDVI (September)



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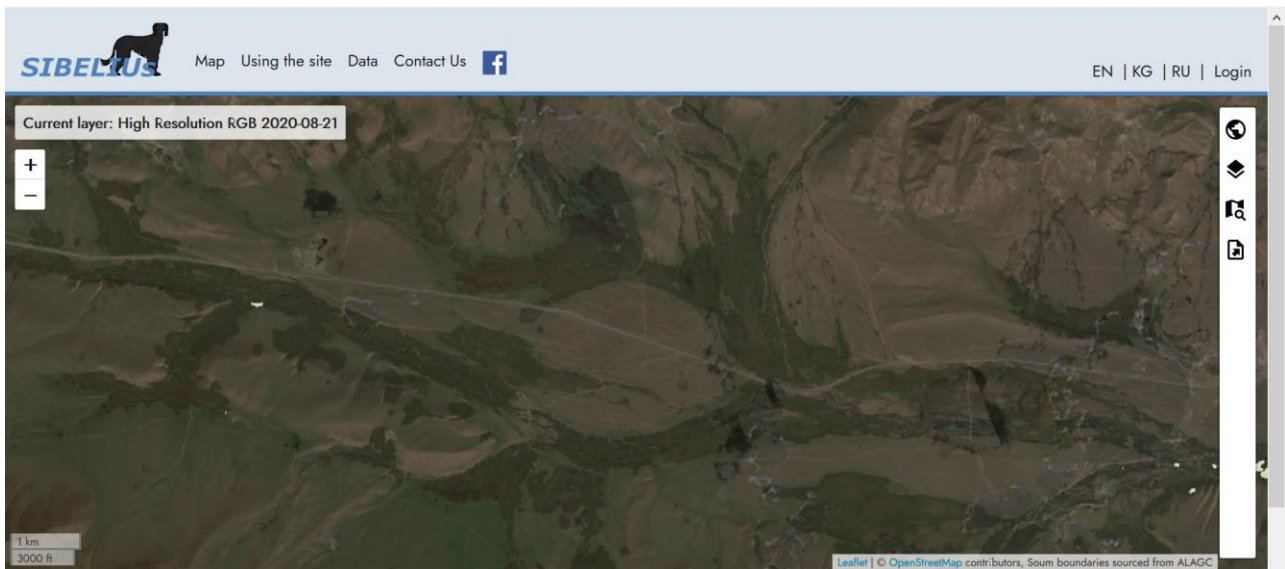
The Suusamyр valley



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The Suusamyр valley



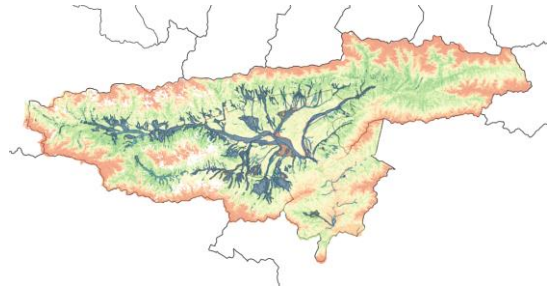
<https://kyrgyzstan.sibelius-datacube.org:8443/map/en>

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Demonstration use cases

- Demonstrated “Use Cases” focussed on key Kyrgyz issues:
 - Mapping karagana in the Suusamyr valley
 - Mapping pasture productivity in the Suusamyr valley
- To demonstrate that satellite data can readily be used to address important issues
- Megan is a summer internship physics student from Southampton University



Karagana is an inedible bush that is spreading in many parts of Kyrgyzstan, reducing the pasture available to livestock. The Suusamyr Valley is an important pasture region in Kyrgyzstan. Megan has created an updated karagana map of the Suusamyr Valley, based on Sentinel-2 data acquired in 2020. Shows where this has increased since the last map that was made, which was based on data from 2014. Overall there is an increase from 6.3% to 7.1%.

For further details please see sibelius-kyrgyzstan.org/news/

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Data layers, Search & Export

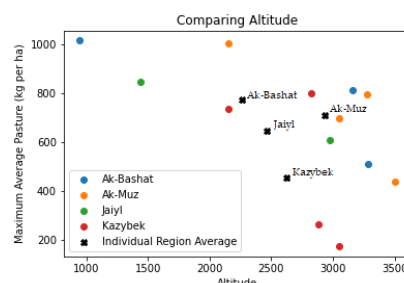
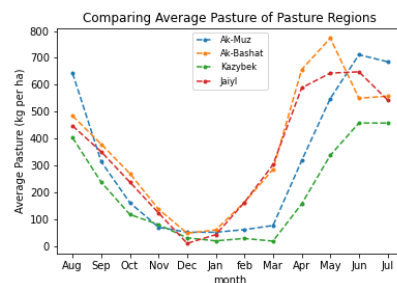
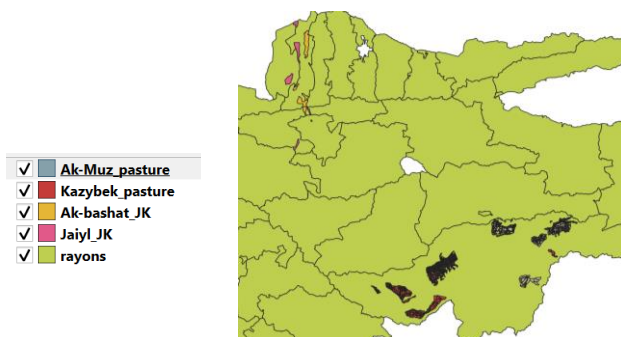
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Demonstration use case: pasture biomass

- Examining pasture biomass in the SIBELIUS project's 4 test sites



For further details please see sibelius-kyrgyzstan.org/news/

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Visualisation Website & Pasture Committees

- We are keen to introduce the website to Pasture Committees
- Planning a training programme in the test sites
- Key aim is to develop online and video training material in our test sites in collaboration with the Pasture Committees
- So our training material will reflect real priorities
- Can then roll out across the country

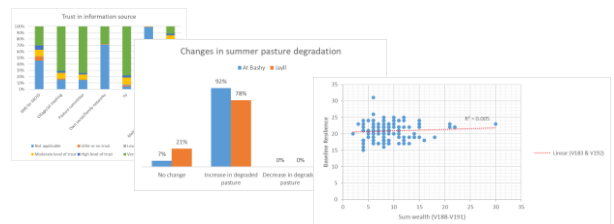
<https://kyrgyzstan.sibelius-datacube.org:8443/map/en>

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Interviews for Understanding Requirements and Resilience

- In February & March, conducted surveys in the project's two test sites
 - Ak-Bashat and Jaiyl Aiyl Okmotu in Jaiyl region, Chuy Oblast
 - Ak-Muz and Kazybek Aiyl Okmotu in At-Bashy raion, Naryn Oblast.
- Interviewed 203 households
- To understand requirements & priorities
- To understand technical infrastructure
- To measure resilience using a SIBELIUS defined metric



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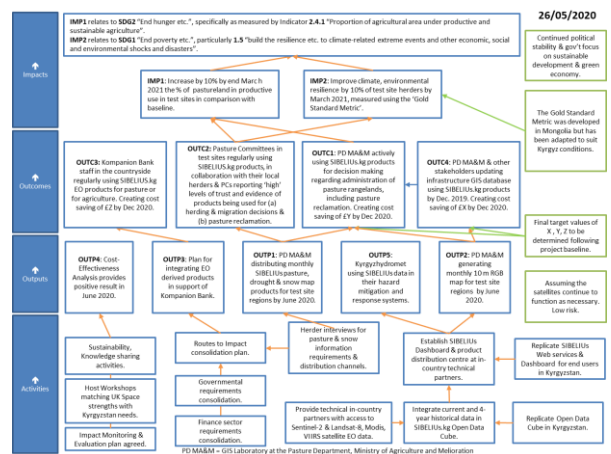
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UN SDGs



- All IPP projects have goals defined in terms of the UN SDGs
- IMP1 relates to SDG2 “End hunger etc.”, specifically as measured by Indicator 2.4.1 “Proportion of agricultural area under productive and sustainable agriculture”.
- IMP2 relates to SDG1 “End poverty etc.”, particularly 1.5 “build the resilience etc. to climate-related extreme events and other economic, social and environmental shocks and disasters”.



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SIBELIUs Resilience Metric

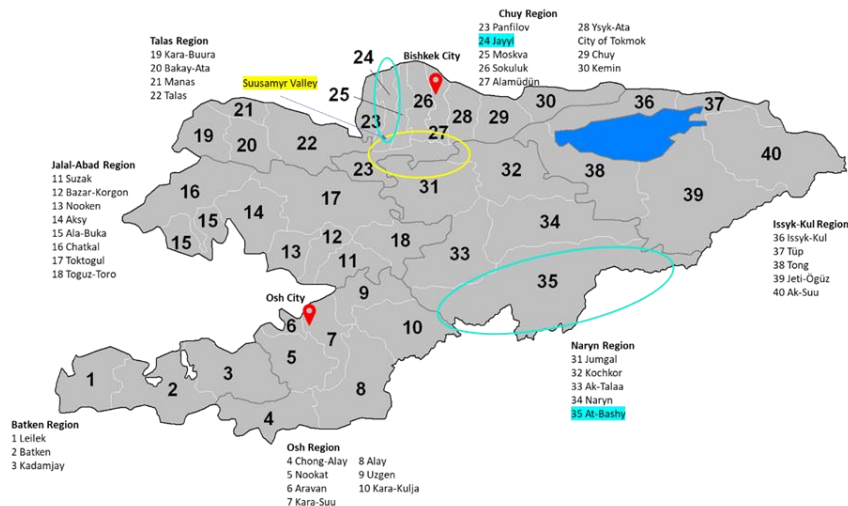
- Overall Baseline and Endline Resilience figures, comprising 4 key dimensions of resilience:
 - 1. Increased Preparedness and Coping Mechanisms
 - 2. Increased Resilience of Systems and Livelihoods
 - 3. Better Access to Communications/ Access to and use of Information
 - 4. Improved Decision-making and Planning
- All scores are aggregates from household survey responses
- Focus on aspects of resilience that SIBELIUs can influence
- Focus on *changes* in resilience over the project term
- Households need improvements in 2 out of 4 dimensions to count towards our 10% goal



Professor Caroline Upton, University of Leicester

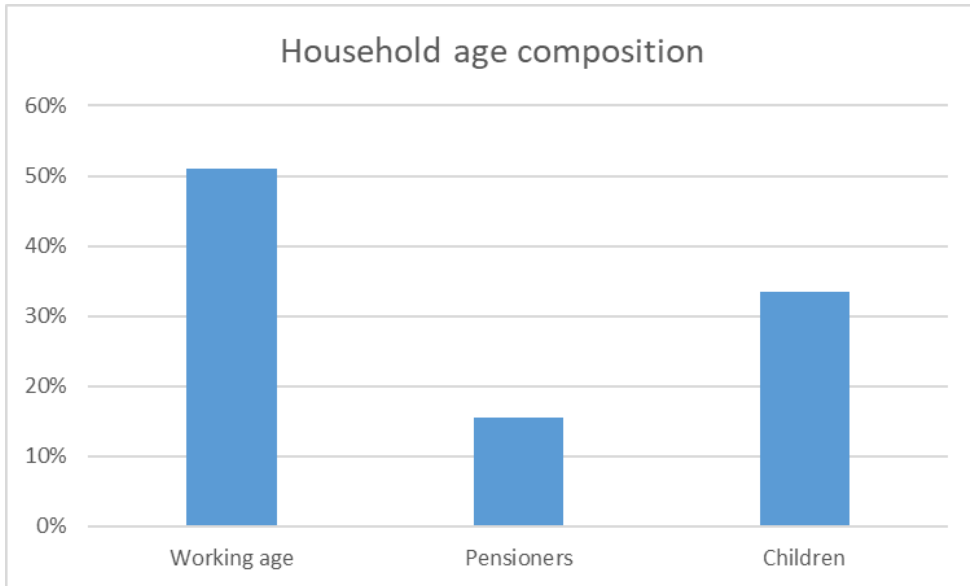
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SIBELIUs project test sites

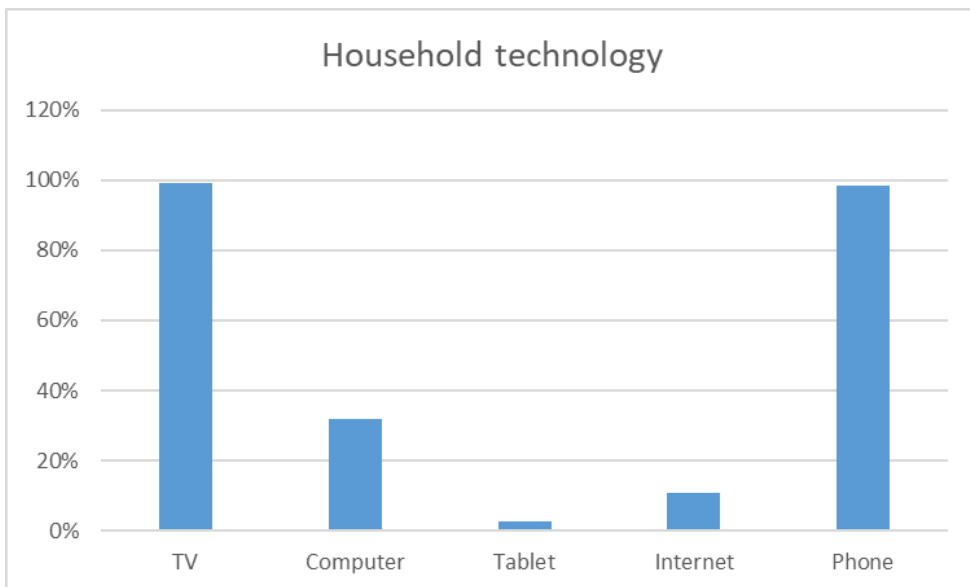


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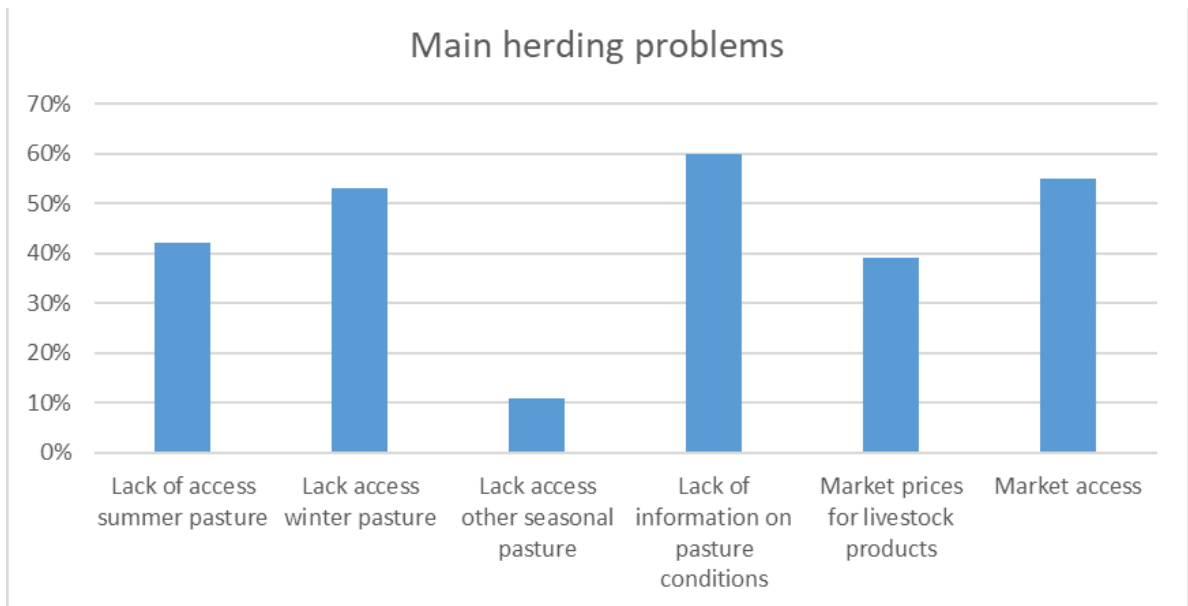
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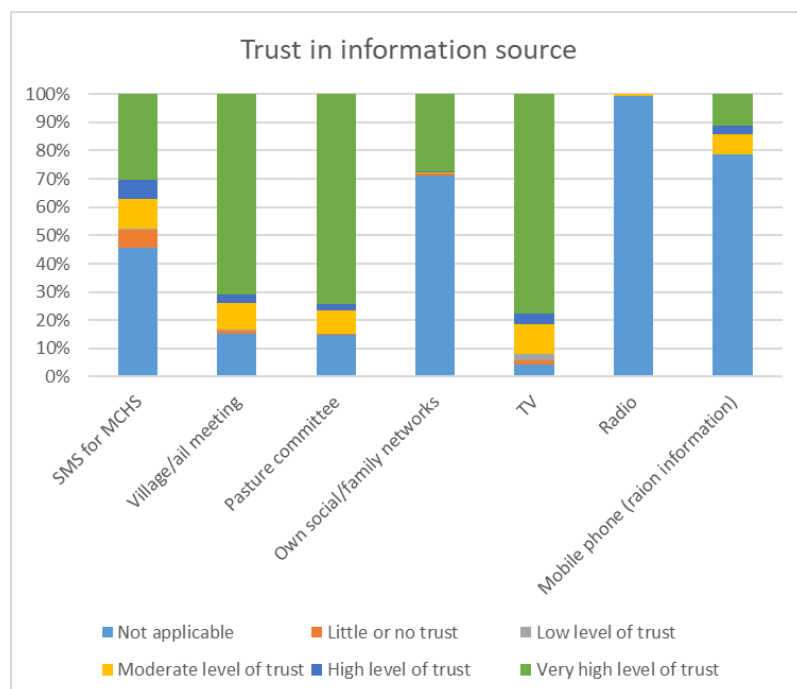
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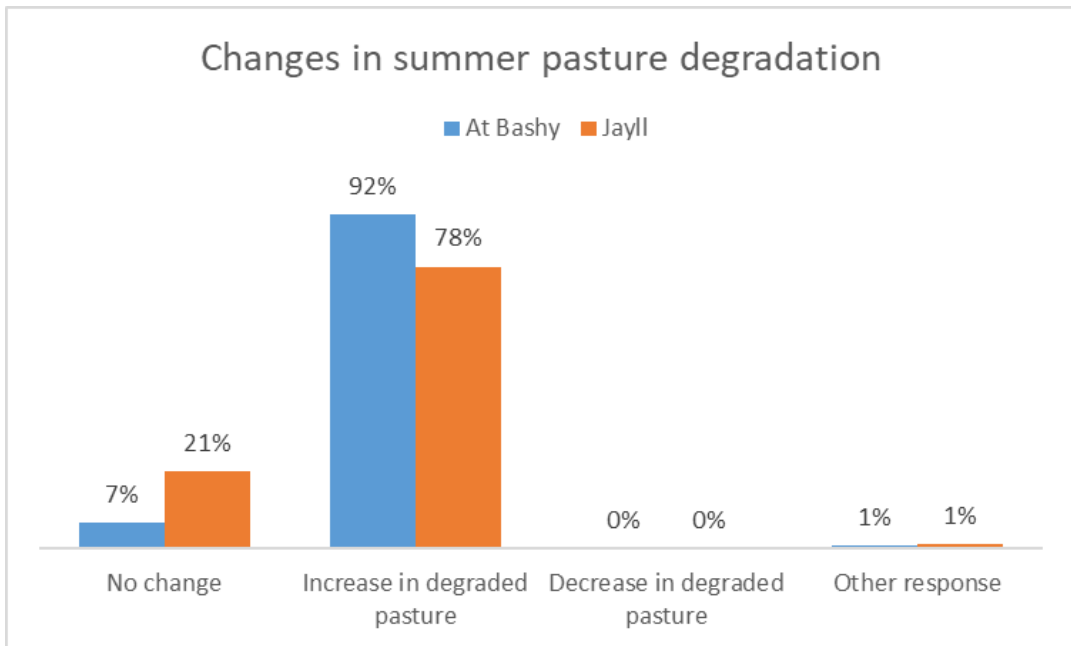
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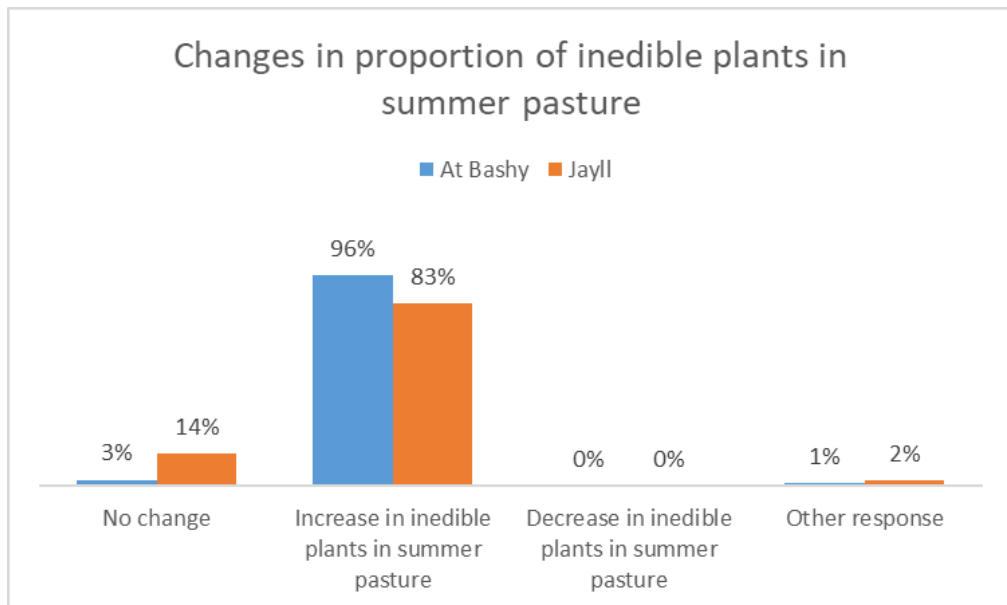
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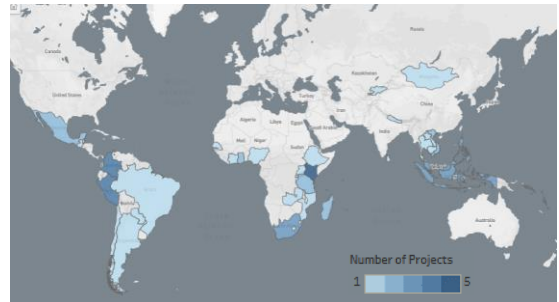
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International Partnership Programme (IPP)



- SIBELIUS is a part of the UK Space Agency's International Partnership Programme (IPP)
- Primary Aim:
 - Using UKSA's expertise and capability delivered through industry and academia, to deliver solutions whose outputs lead to a **measurable and sustainable economic or societal benefit/impact** in chosen partner country or region
- Secondary Aim:
 - Develop valued and sustainable partnership arrangements which lead to **growth opportunities for the Space community**
- Funding for SIBELIUS ends on 31 March 2021



<https://www.spacefordevelopment.org/>

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Possible future developments

Monitoring & Evaluation for ground-based pasture interventions

- Monitoring changes in biomass, degradation, karagana etc in different regions, following ground-based interventions, for example, fixing roads and bridges, grazing rotation schemes, karagana removal etc. Providing quantitative metrics to analyse the success of given interventions

Training and capacity building

- There is a strong requirement for an increase in skills to better enable Kyrgyz citizens to use satellite technology to apply to national priorities
- In collaboration with Kyrgyz Universities

Agriculture

- Agriculture is an important sector for Kyrgyzstan which would benefit from the recent advances that earth observation can deliver, now that ~10m pixel data is available from Sentinel-2 satellites

Mudslides and landslides

- Satellite derived soil moisture products can support agencies mitigating against risks of mud slides, avalanches and flash flooding, which are significant problems in Kyrgyzstan

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Thank you

- **Contact details**

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- Chinara Saporova csaporova@mercy Corps.org

