Interacting effects of socio-political and environmental factors on rangeland dynamics in the Altai Mountains in Central Asia

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NEW YORK, MONDAY, DECEMBER 9, 1991

"All the News That's Fit to Print"

The New York Times

Late Edition

New York: Today, limited sun, perhaps a shower late. High 62. Tonight, cooler. Low 40. Tomorrow, cloudy, a light shower. High 41. Yesterday, high 59, low 45. Details are on page D10.

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DECLARING DEATH OF SOVIET UNION, RUSSIA AND 2 REPUBLICS FORM NEW COMMONWEALTH

Frantic Moves Came to Light In Days Before Maxwell Died

As the Empire Was Crumbling

A special report.

By STEVEN PROKESCH

Special to The New York Times

LONDON, Dec. 8 — At the time of his mysterious death on Nov. 5, Robert Maxwell almost certainly knew he was about to be caught.

He had drained hundreds of millions of dollars from his two flagship public companies and from employee pension funds in a frantic attempt to keep his heavily indebted publishing empire afloat.

The auditors of the Maxwell empire, Coopers & Lybrand Deloitte, were to conduct their next regular audit of the pension funds in a couple of months. And Coopers would have quickly dis-

TAKE OVER A-ARMS

Newborn Bureaucracy Is Inheriting Functions of Old Authority

By SERGE SCHMEMANN

Special to The New York Times

MOSCOW, Dec. 8 — The leaders of Russia, Ukraine and Byelorussia declared today that the Soviet Union had ceased to exist and proclaimed a new "Commonwealth of Independent States" open to all members of the former union.

In a series of statements issued after

A remarkable opportunity to better understand the social and economic drivers on rangeland change because it presents a homogeneity of culture and ecology (high elevation grasslands sharing the distinctive Altai biota) intersected by a striking geopolitical differences

By ALAN RIDING

Special to The New York Times

MAASTRICHT, the Netherlands,

nance division.

That discovery led the main holding companies of the Maxwell empire to

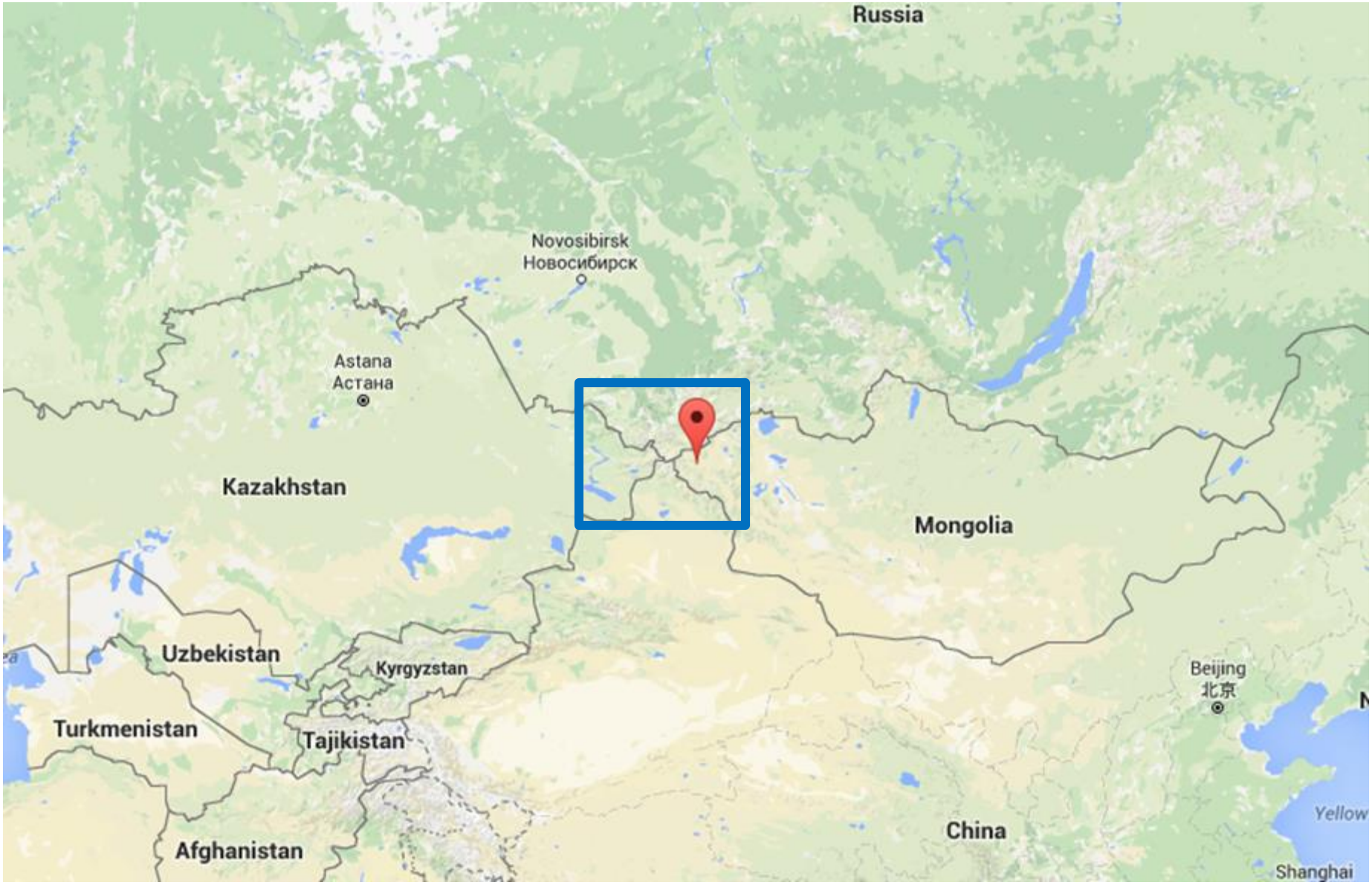
MOSCOW, Dec. 8 — Ever since the August coup d'état, the Soviet Union

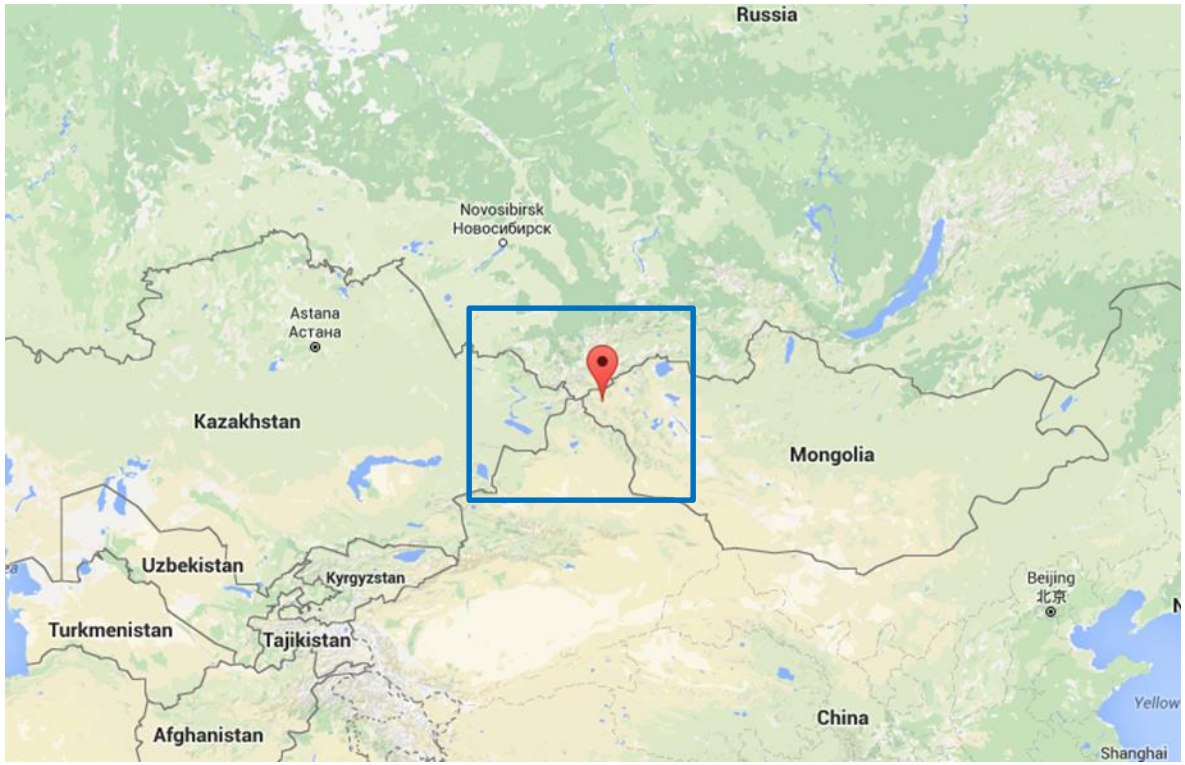
Gorbachev's Vain Pleas Make His Eclipse Clear

happened. This is a fact they can confirm with their daily lives, as they go to factories that have run out of materi-

if he did, whether the military or other levers of power would support him.

The three cofounders of the new commonwealth" — President Boris N.


Russia
Novosibirsk
Новосибирск
Astana
Астана
Kazakhstan
Mongolia
Uzbekistan
Kyrgyzstan
Turkmenistan
Tajikistan
Afghanistan
China
Beijing
北京
Yellow
Shanghai



Changes after the 1991 USSR Collapse:

China's Altai Mountain area grazing systems remain similar to those in Mongolia, Kazakhstan and Russia during the Soviet era: carefully planned, heavily subsidized and intensive.

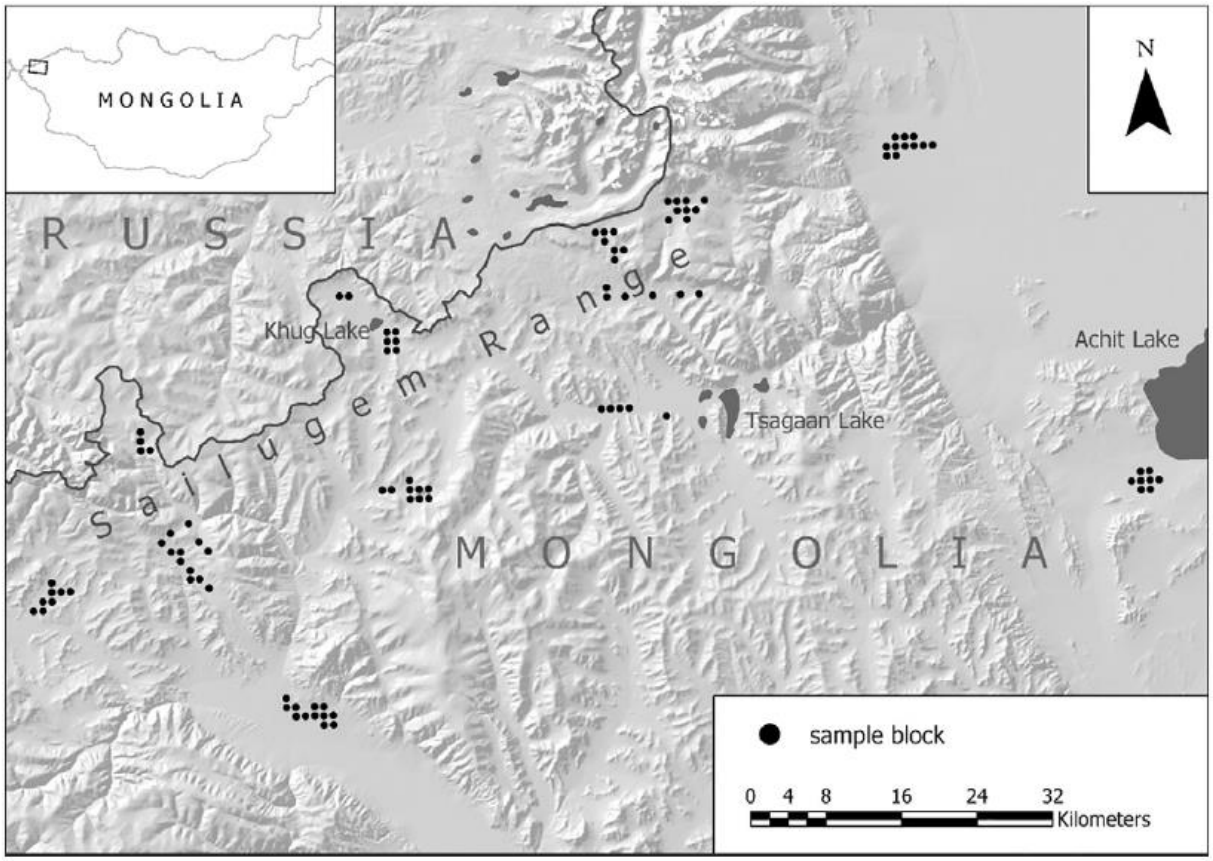
This is in stark contrast to Russia's and Kazakhstan's livestock industries, which have dwindled, and Mongolia's, which have both greatly expanded in response to global markets for cashmere and changed in herd composition.

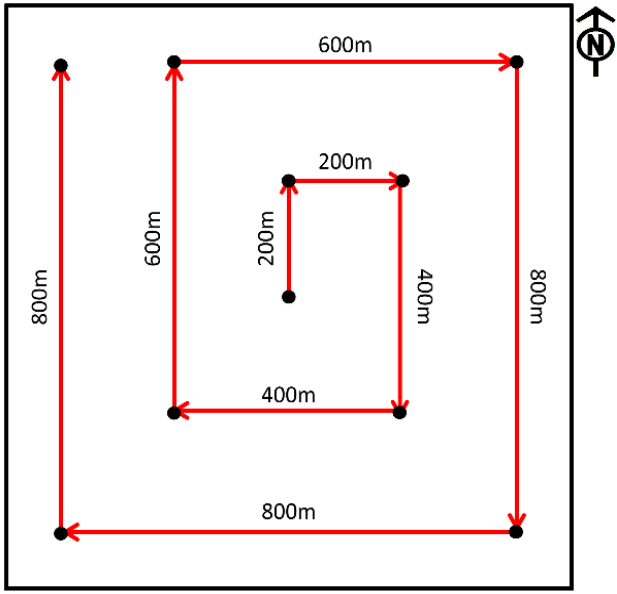
Examine land-cover change consequences of the collapse of top-down government approaches to managing grazing resources of mountain regions.

Photo credits: James Gibbs, SUNY-ESF

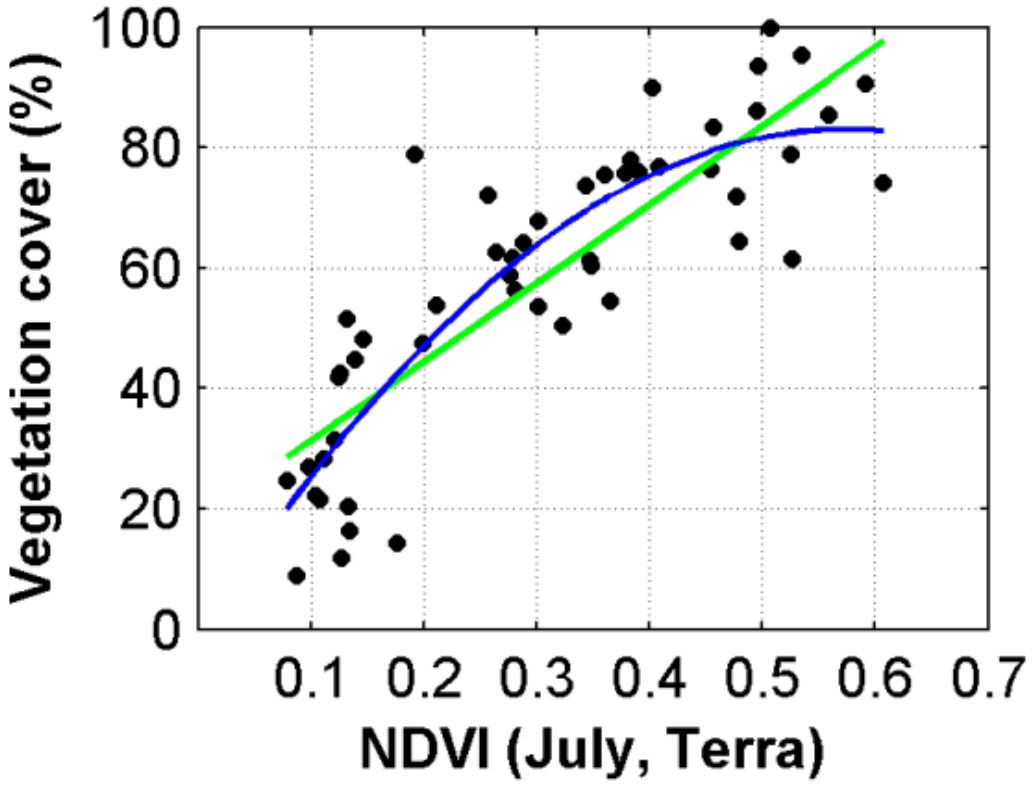
Q1: How accurately do satellite data capture vegetation cover in grasslands?

Ground Validation of NDVI-Vegetation Relationship





% Vegetation cover vs NDVI

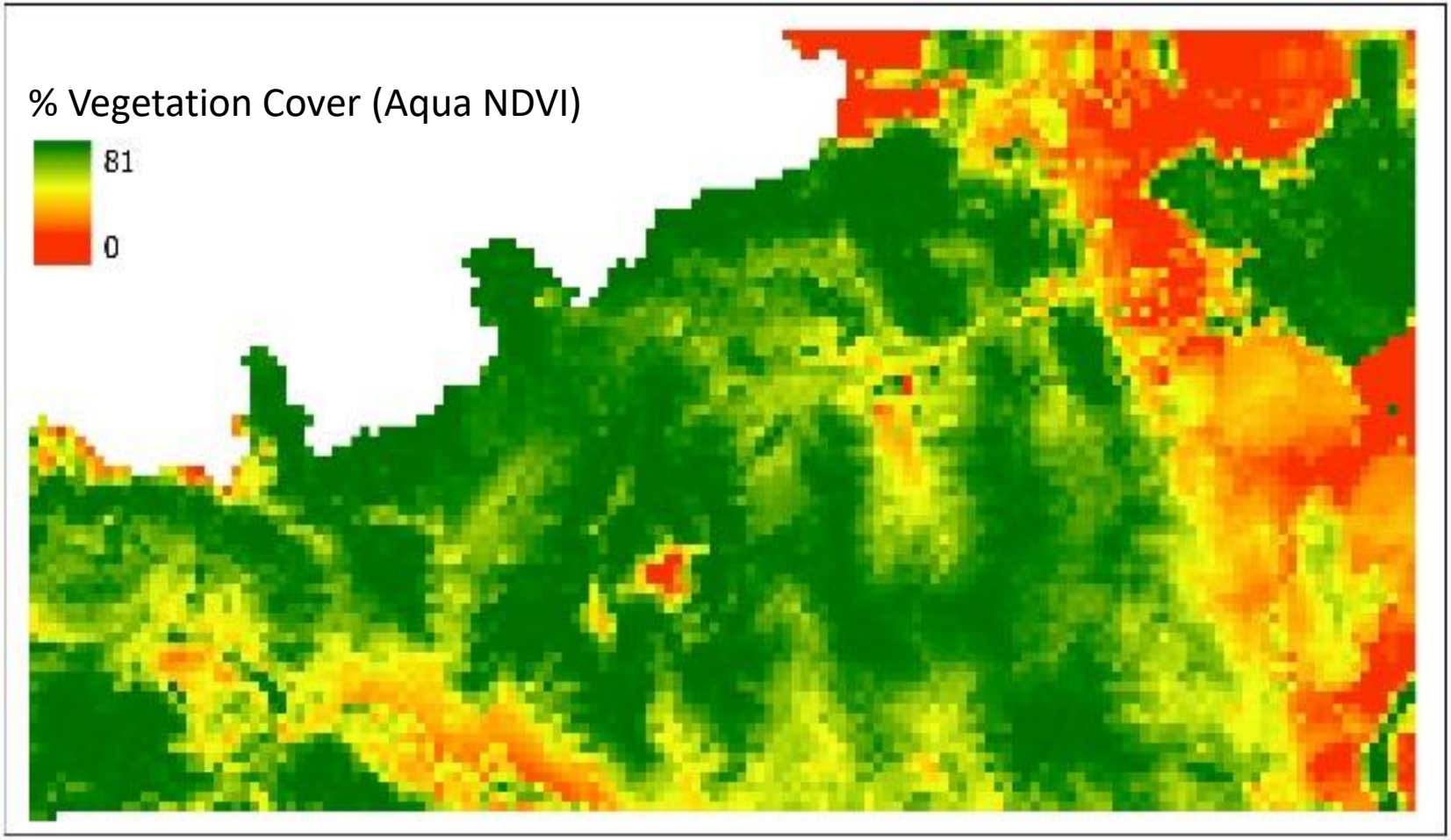


Observe

Both Aqua and Terra VIs for **May** were highly predictive of July vegetation cover (R^2 = 0.80 – 0.84)

Predict

Paltsyn, M.Y., Gibbs, J.P., Iegorova, L.V. and Mountrakis, G., 2017. *Estimation and Prediction of Grassland Cover in Western Mongolia Using MODIS-Derived Vegetation Indices*. ***Rangeland ecology & management***, *70*(6), pp.723-729.



We can now:

- Estimate current vegetation on ground using satellite data
- Map rangeland conditions efficiently across entire region
- Predict conditions 1-2 months ahead

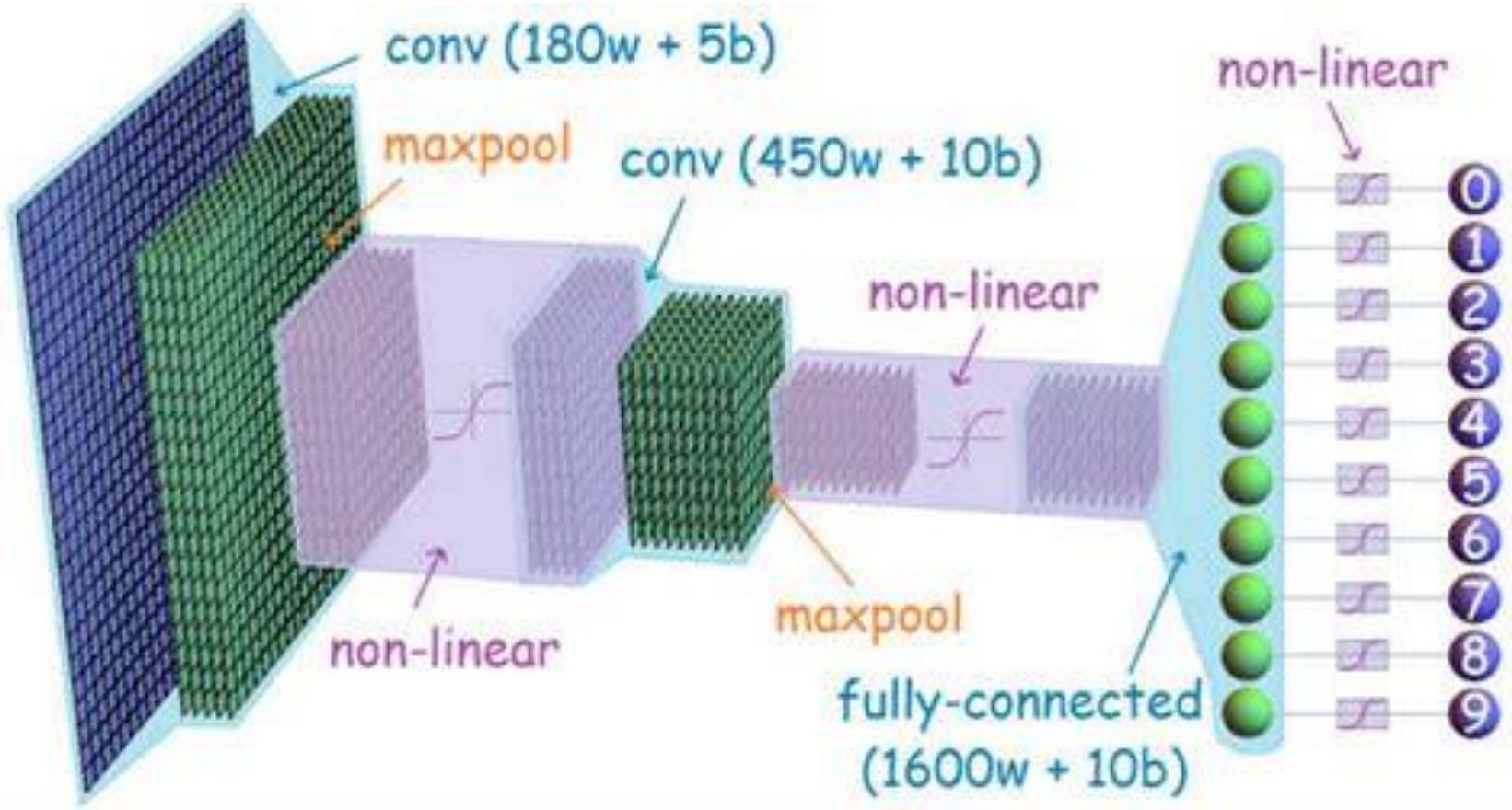
Q1: How accurately do satellite data capture vegetation cover in grasslands?

Q2: Do promising new RS classification methods (Deep Learners) offer substantial advantages?

Deep Learners have demonstrated significant advances in multiple fields. What is their added value for RS tasks?

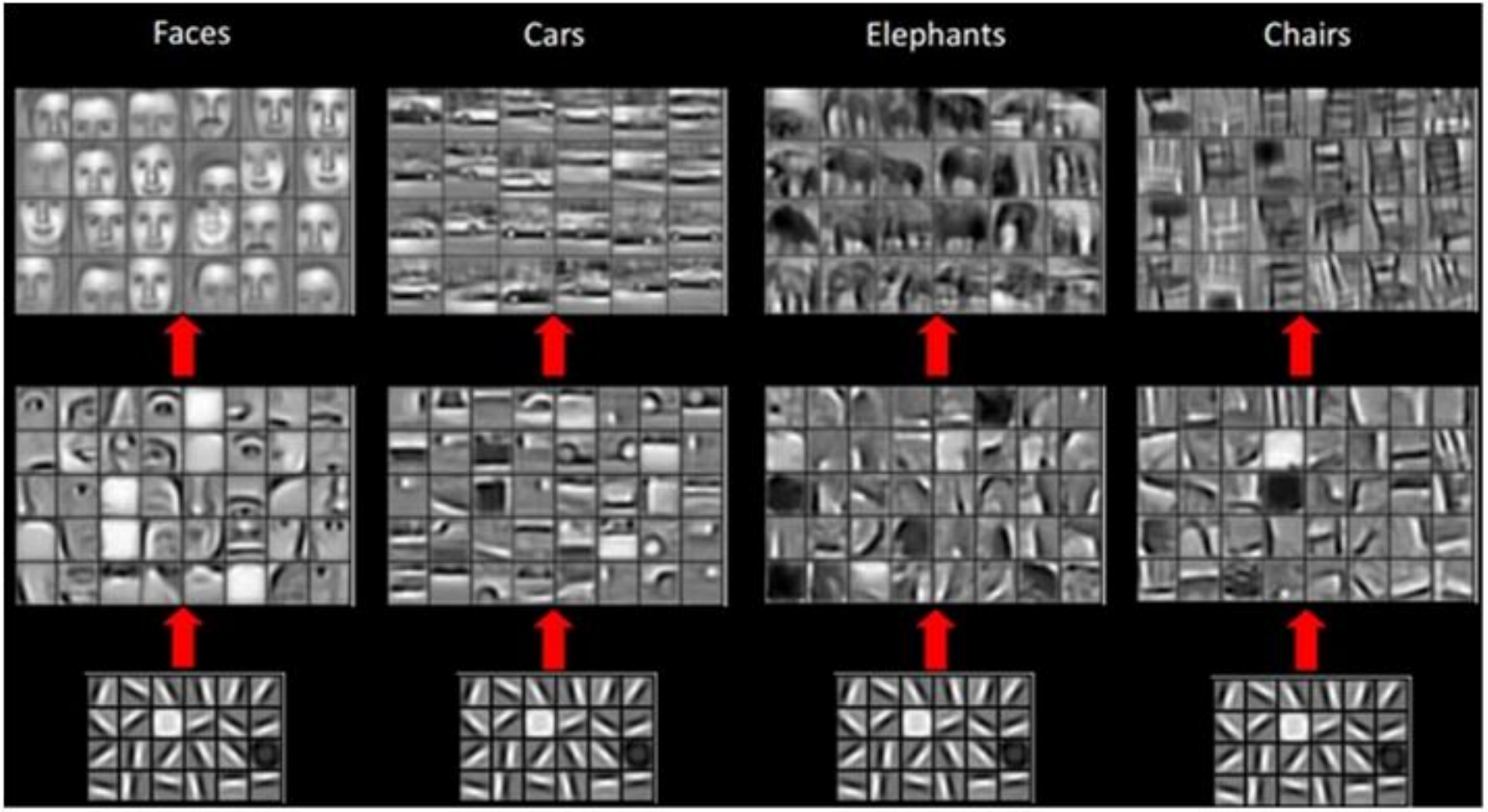
Meta-analysis of 92 studies that offer direct comparisons of Deep NNets vs SVMs

Meta-analysis of 92 studies – Deep NNets vs SVMs



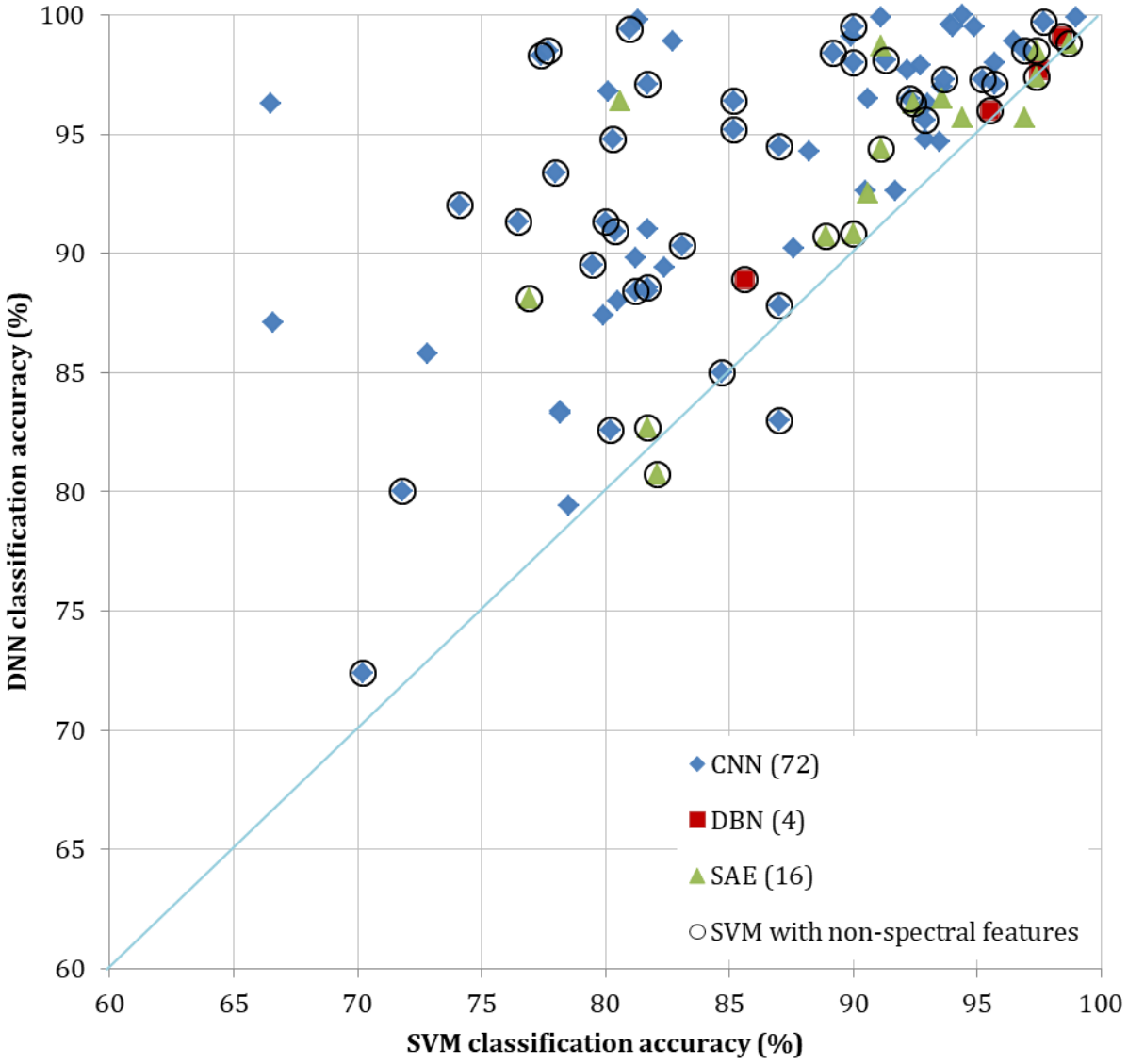
Convolutional Neural Network (CNN), Deep Belief Network (DBN), Stacked AutoEncoder (SAE)

Meta-analysis of 92 studies – Deep NNets vs SVMs



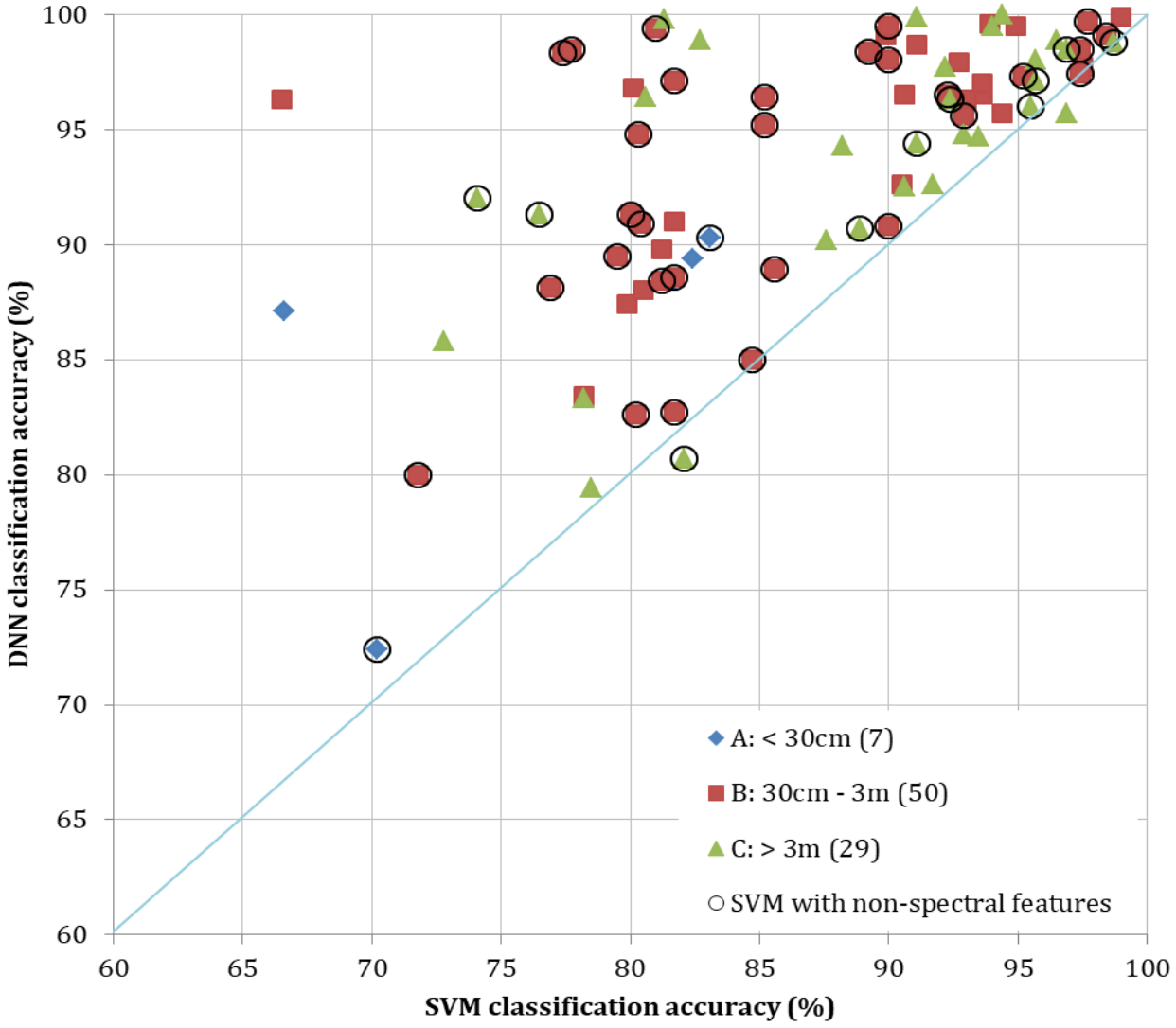
Convolutional Neural Network (CNN), Deep Belief Network (DBN), Stacked AutoEncoder (SAE)

Meta-analysis of 92 studies – Deep NNets vs SVMs



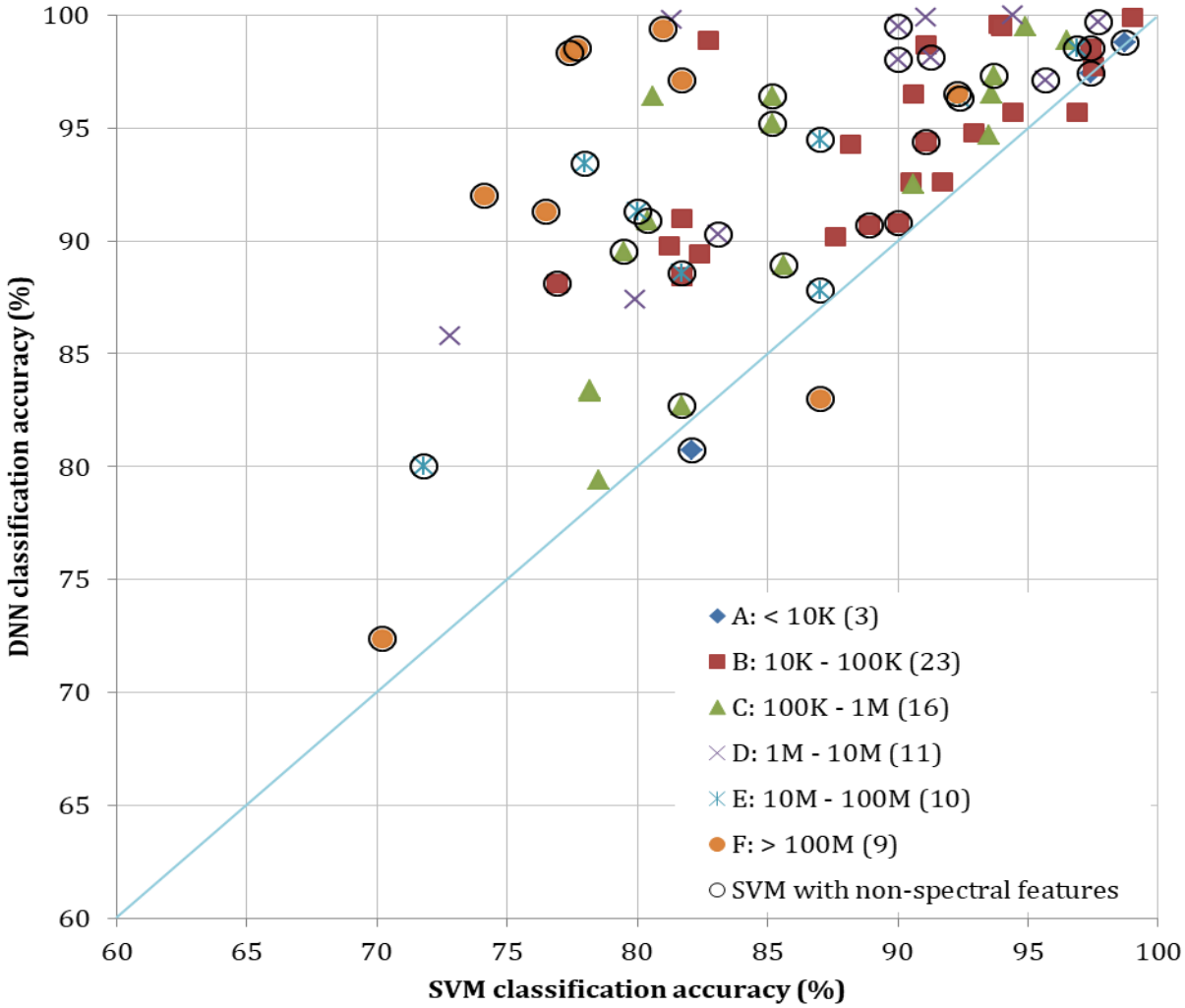
Convolutional Neural Network (CNN), Deep Belief Network (DBN), Stacked AutoEncoder (SAE)

Meta-analysis of 92 studies – Deep NNets vs SVMs



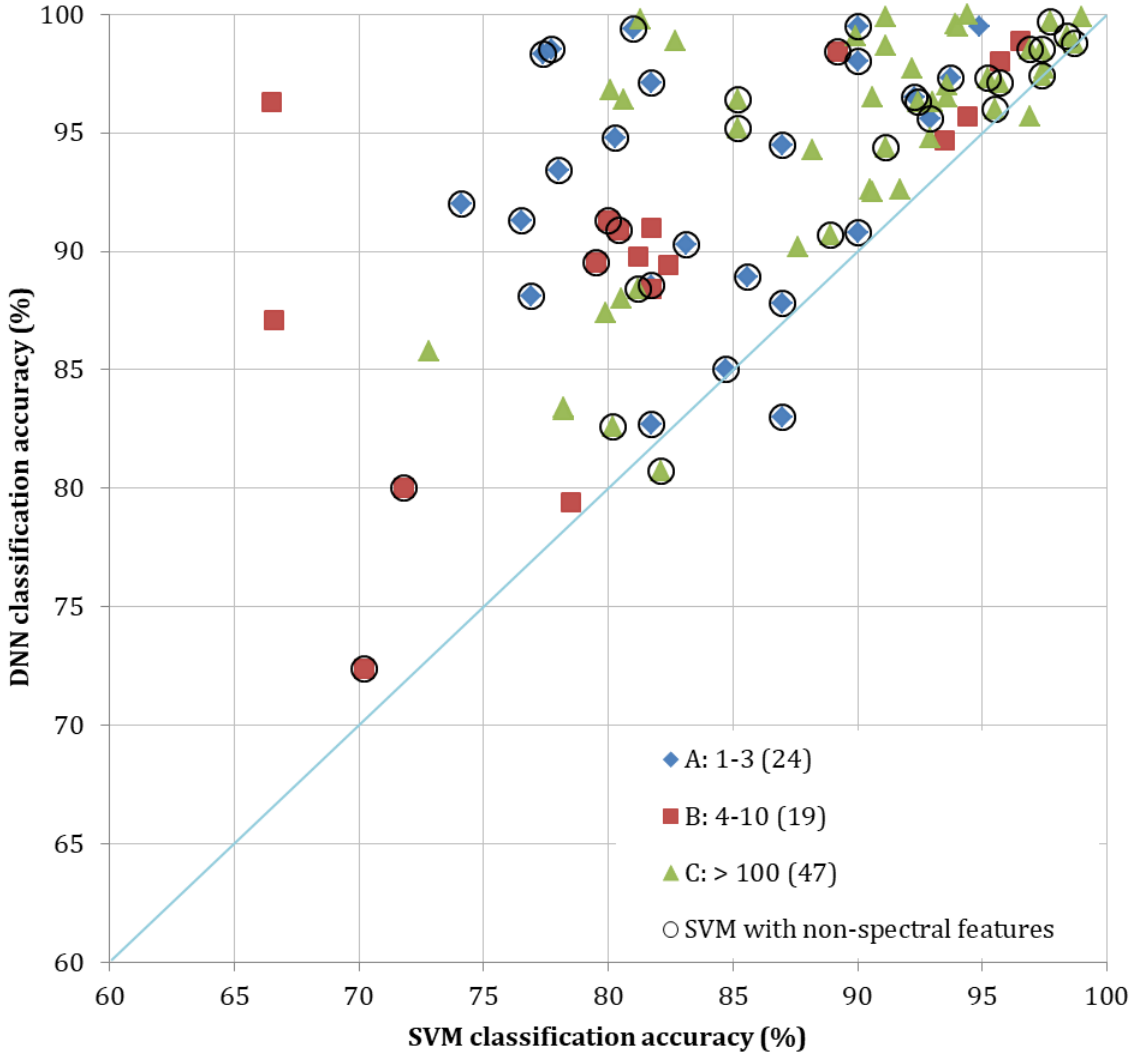
Effect of Spatial Resolution: Benefits slightly higher for smaller pixel sizes

Meta-analysis of 92 studies – Deep NNets vs SVMs



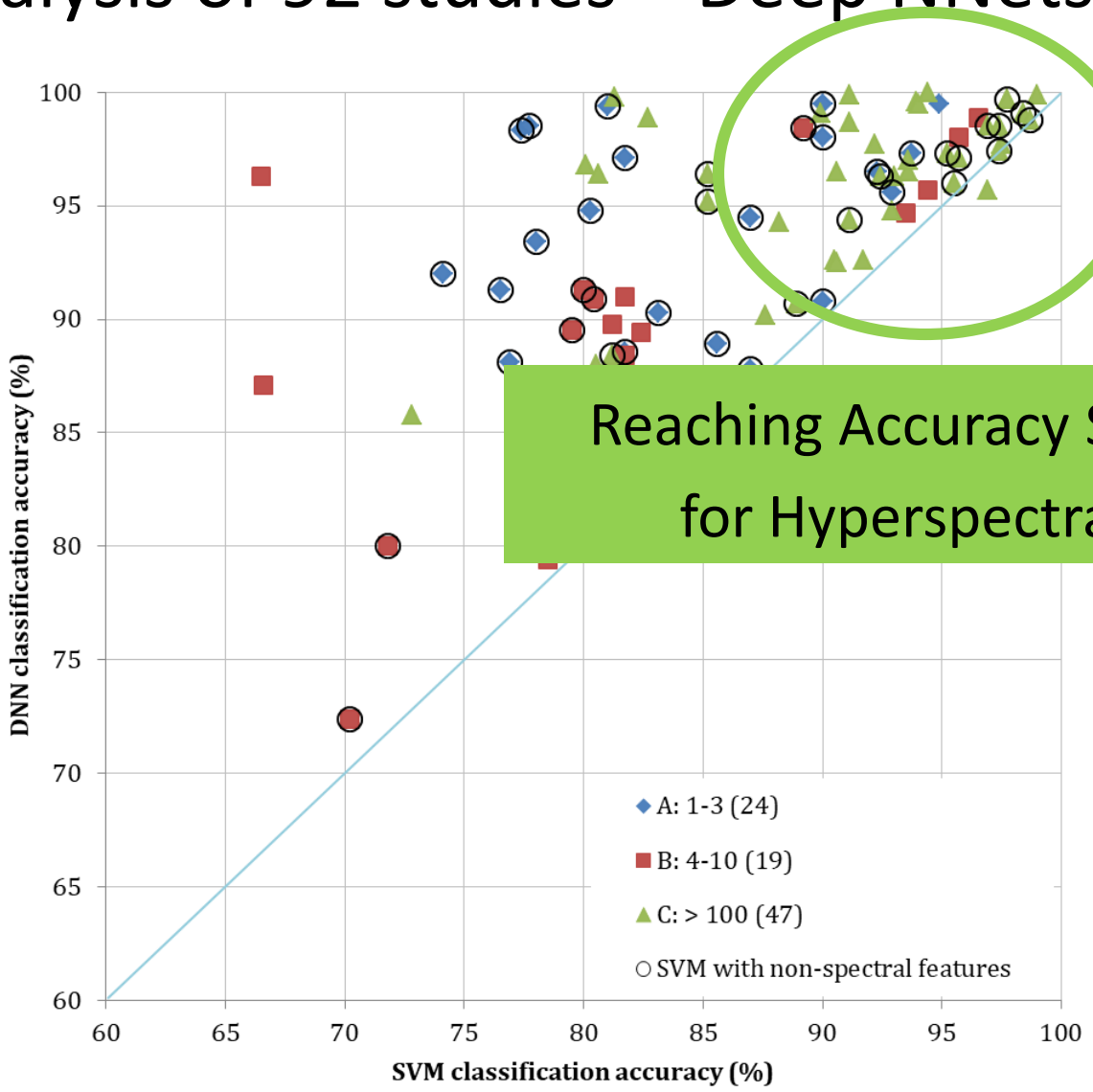
Effect of Network Complexity: No need to overcomplicate things!

Meta-analysis of 92 studies – Deep NNets vs SVMs



Effect of Spectral Resolution: Limited

Meta-analysis of 92 studies – Deep NNets vs SVMs



Reaching Accuracy Saturation for Hyperspectral Data

Effect of Spectral Resolution: Limited

Meta-analysis of 92 studies – Deep NNets vs SVMs

Deep learners are promising for VHR data

In House >3M reference samples

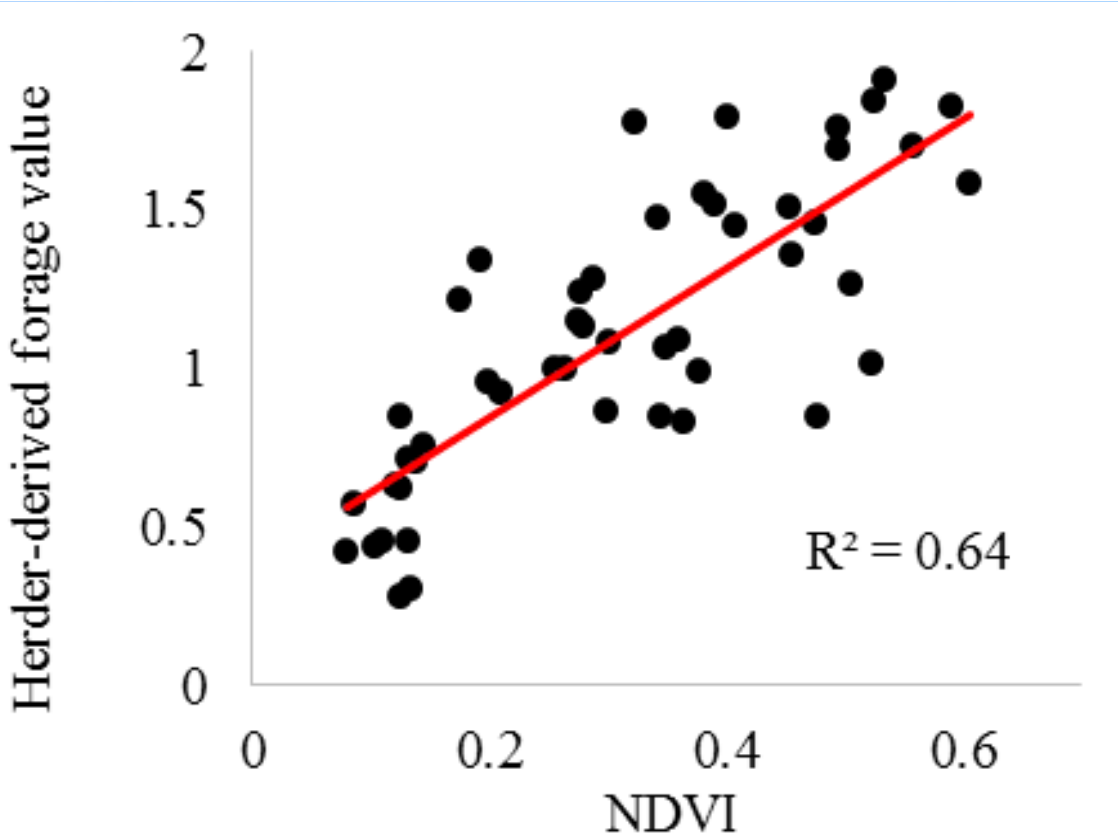
Collaborations

Αλλαζουμε ταχυτητα

Moving from Pixels to People

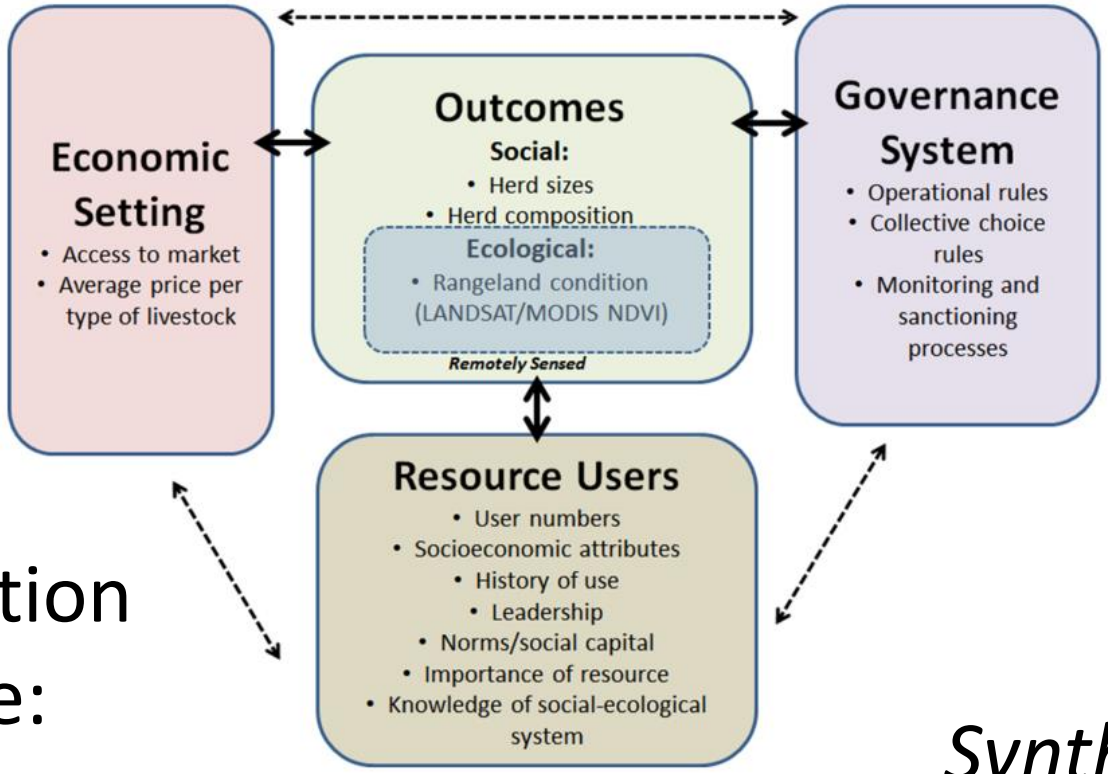
Q3: Can we link Traditional Ecological Knowledge to satellite-derived vegetation indices?

TEK in relation to NDVI



Q4: Can a socioecological model explain vegetation trends?

Interacting effects of socio-political and environmental factors on rangeland dynamics in the Altai Mountains in Central Asia



Data collection complete:

50+ herders interviewed in all four countries

Synthesis now in process

Herders Survey

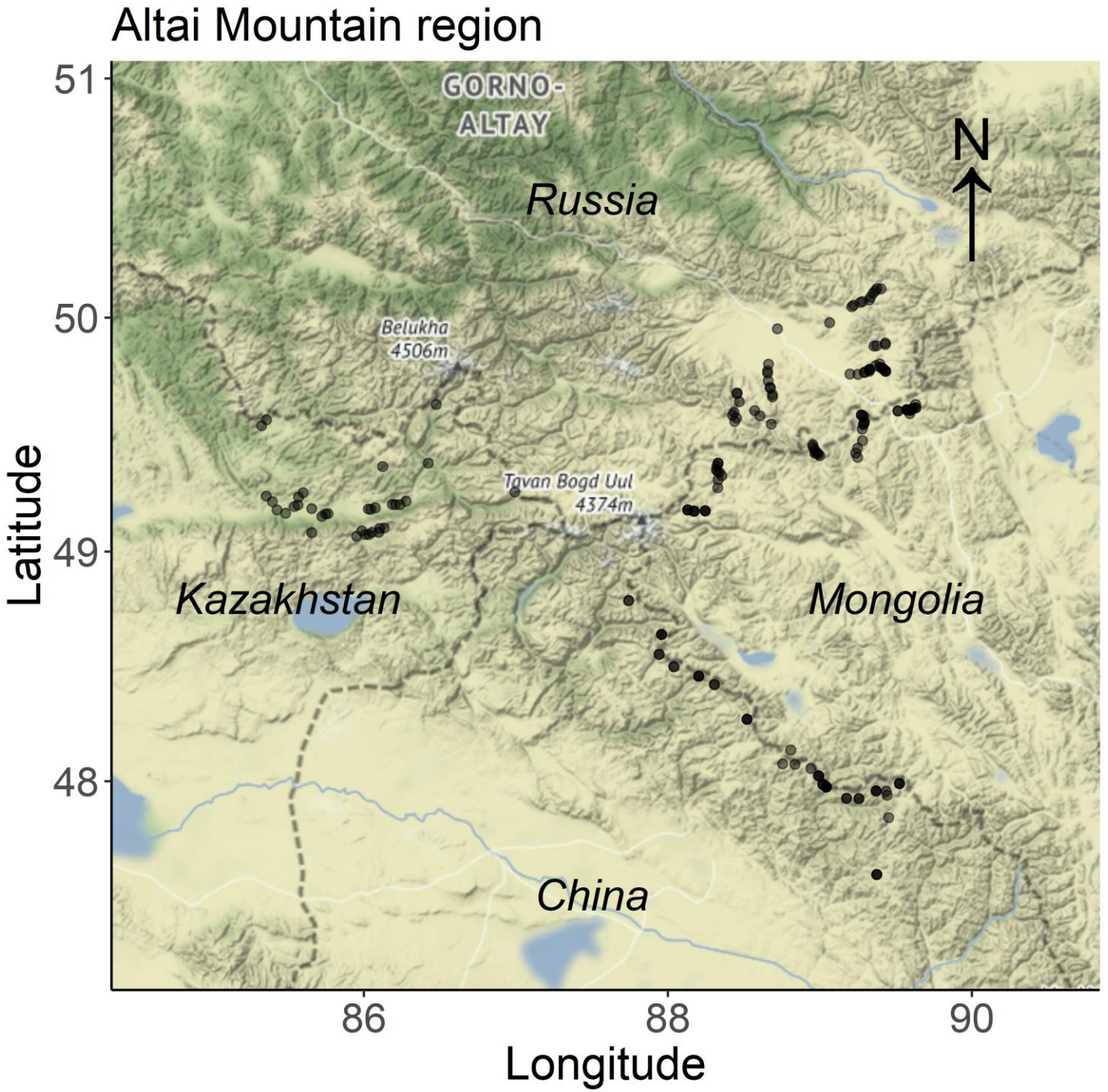
Координаты места проведения опроса по GPS:	Широта:		**Дата:**
	Долгота:		
	Место опроса (долина/урочище):		**Кто опрашивал:**

Состояние пастбищ

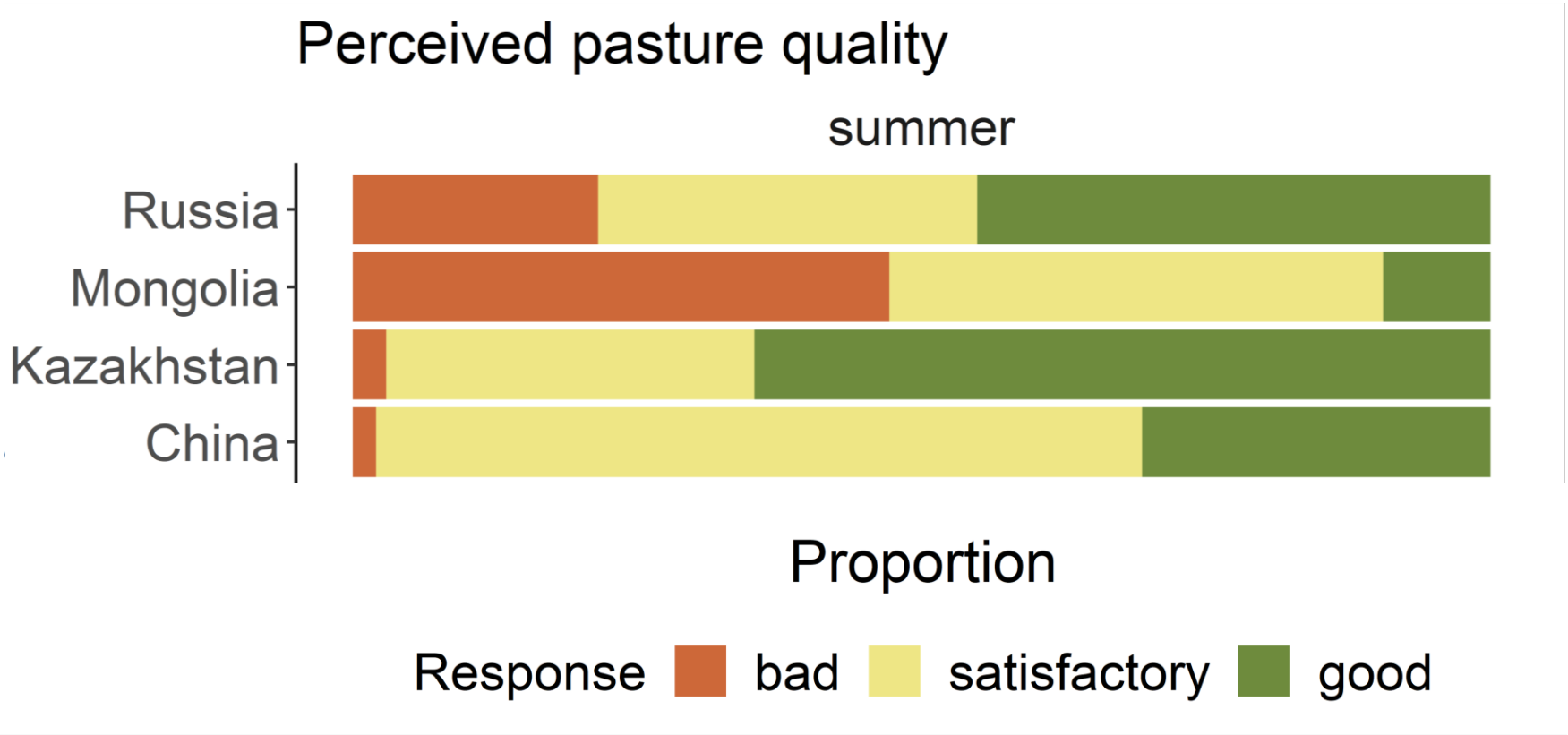
	a. Очень хорошее	b. Хорошее	c. Удовлетворительное	d. Плохое
1. Как Вы оцениваете состояние Ваших летних пастбищ в этом году?				
2. Как Вы оцениваете состояние Ваших зимних пастбищ в этом году?				

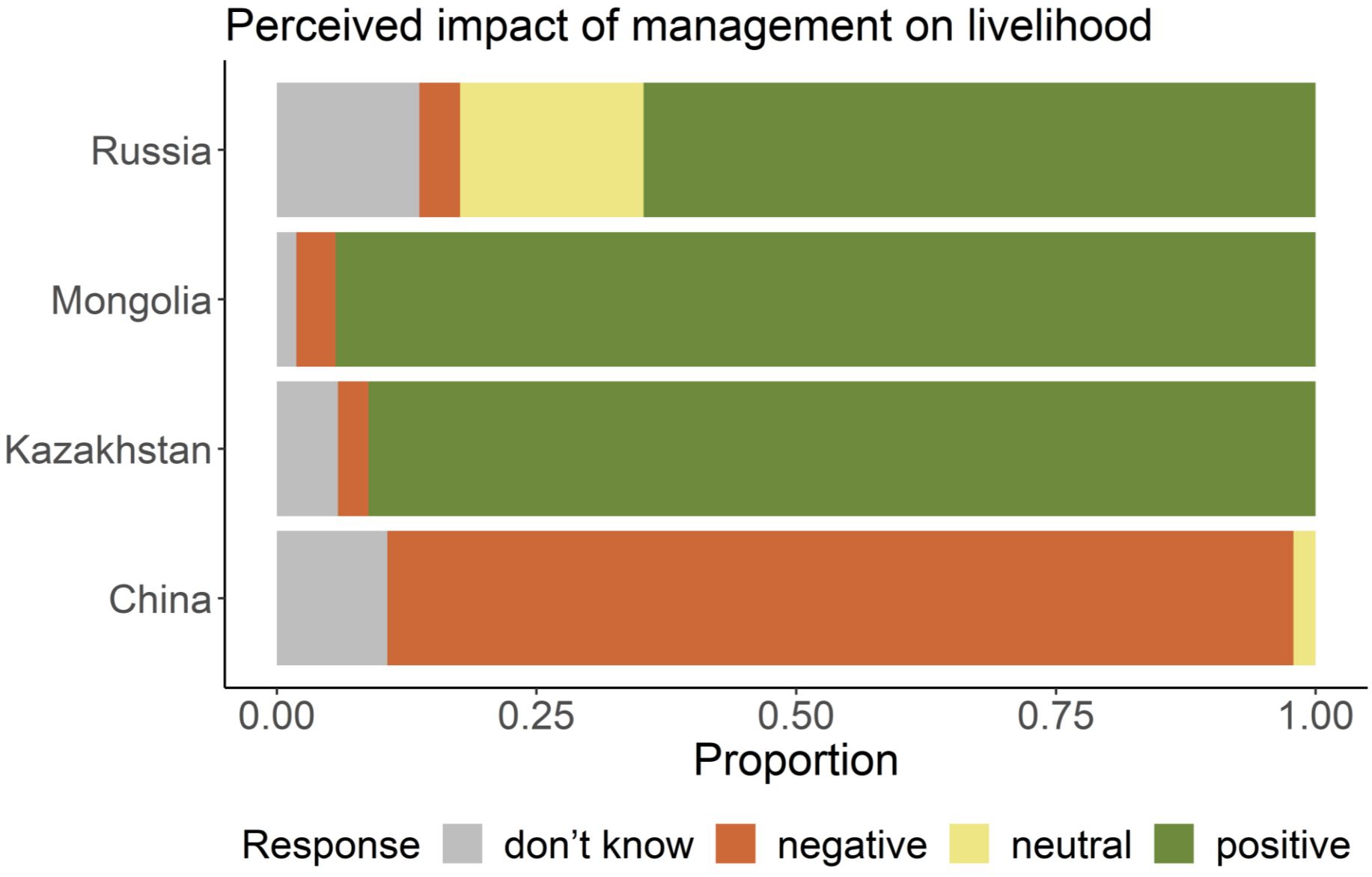
3. Какова Ваша оценка состояния Ваших пастбищ в период с 2006 по 2015 гг.?

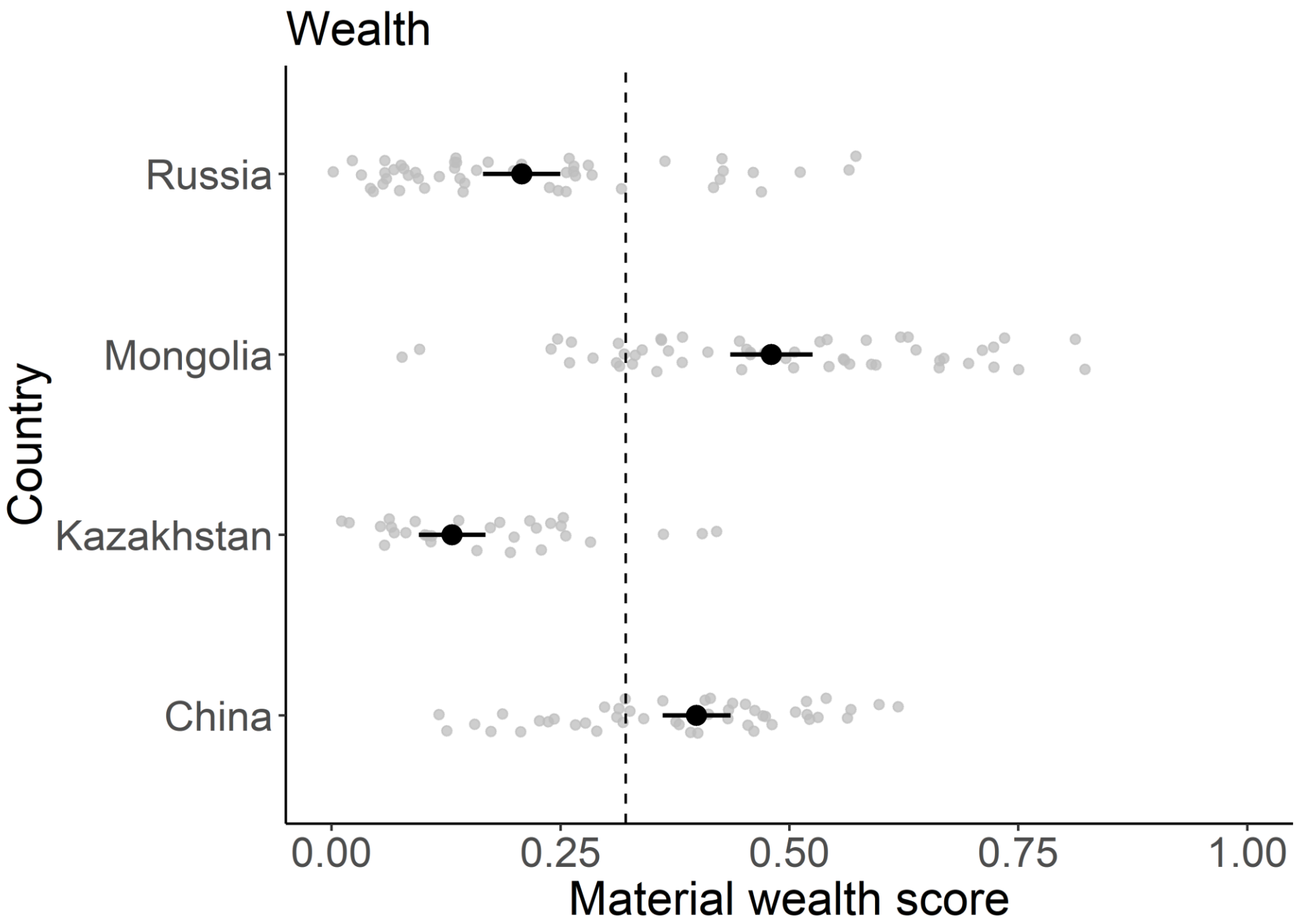
	Хорошее	Среднее	Плохое
2015			
2014			
2013			
2012			
2011			
2010			
2009			
2008			
2007			
2006			


Altai Mountain region
GORNO-
ALTAY
Russia
N
Belukha
4506m
Tavan Bogd Uul
4374m
Kazakhstan
Mongolia
China
51
50
49
48
Latitude
86
88
90
Longitude

Analysis Ongoing – Early Results


Perceived pasture quality
summer
Russia
Mongolia
Kazakhstan
China
Proportion
Response
bad
satisfactory
good


Perceived impact of management on livelihood
Russia
Mongolia
Kazakhstan
China
0.00
0.25
0.50
0.75
1.00
Proportion
Response
don’t know
negative
neutral
positive


Wealth
Russia
Mongolia
Kazakhstan
China
Country
0.00
0.25
0.50
0.75
1.00
Material wealth score

Moving from Pixels to People

Q5: Can we generate a timely, policy-relevant rangeland dynamics monitoring tool?

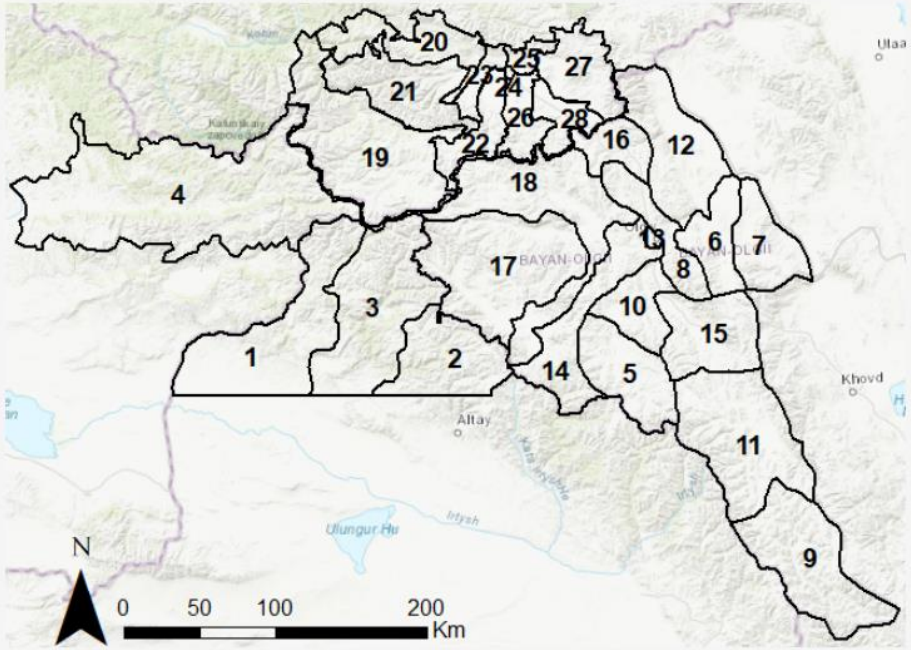
“Vital Signs”

- 28 regions
- 4 indicators
- “real-time”

Altai Vital Signs

Select an indicator

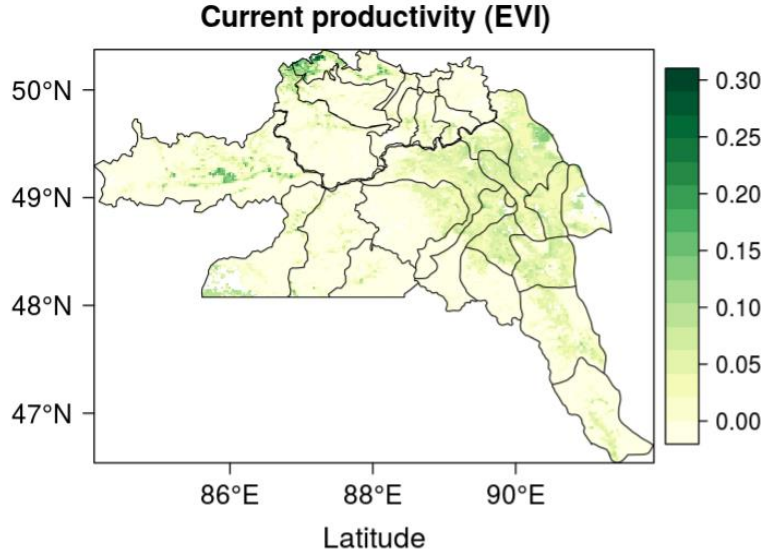
Productivity
Land surface temperature
Precipitation
Snow

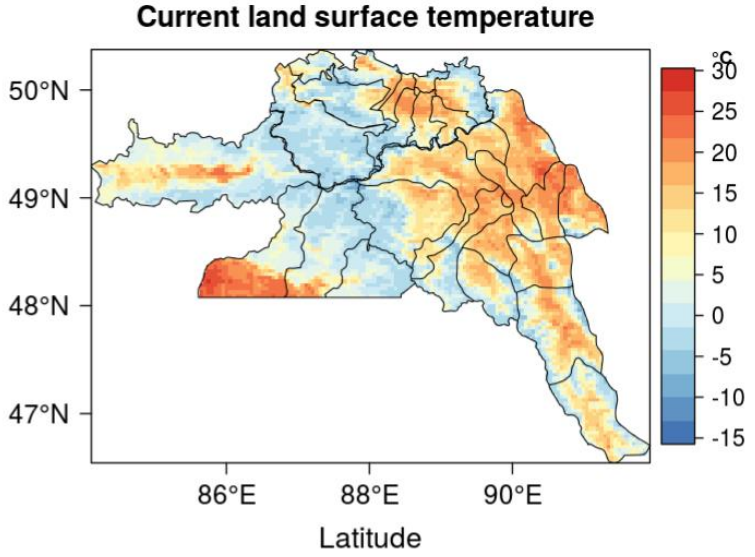


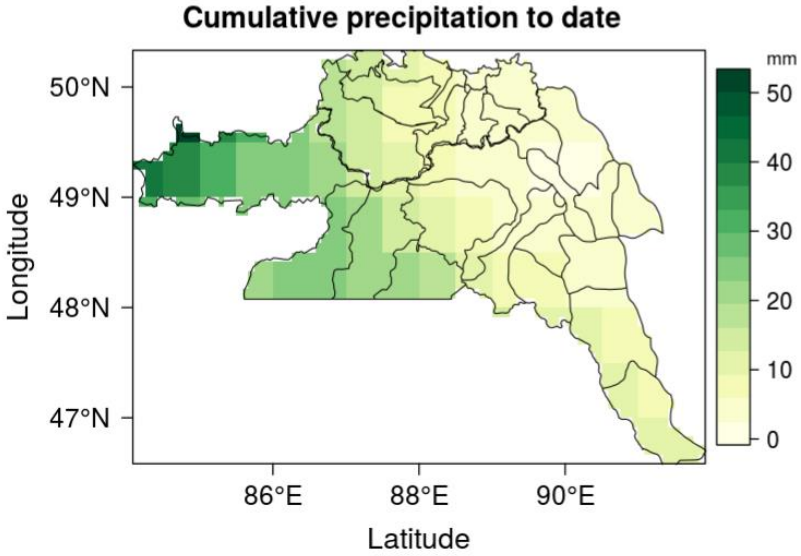
Created by Bradley Cosentino and James Gibbs

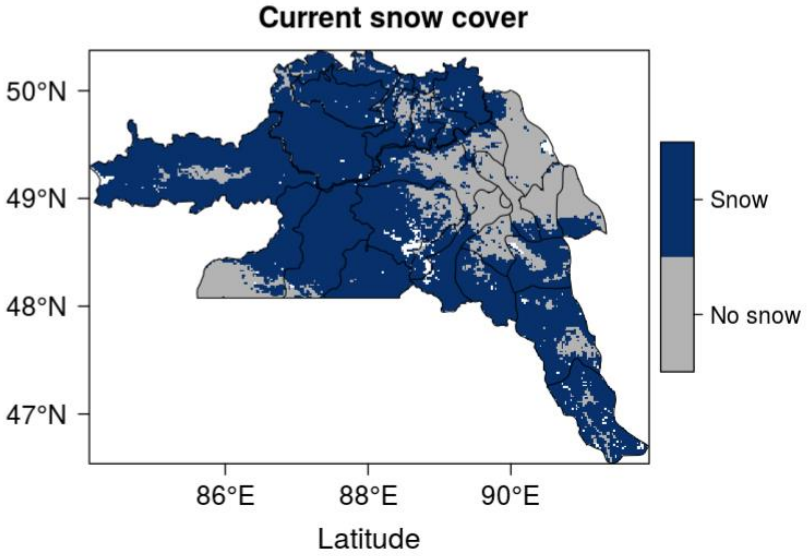
“Vital Signs”

- 28 regions
- 4 indicators
- “real-time”









Productivity

Altai Vital Signs: Productivity (NDVI, EVI)

Biweekly NDVI & EVI relative to historical observations.

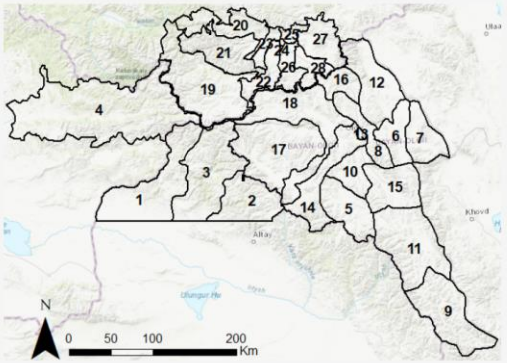
Choose a productivity metric

- (•) NDVI
- ( ) EVI

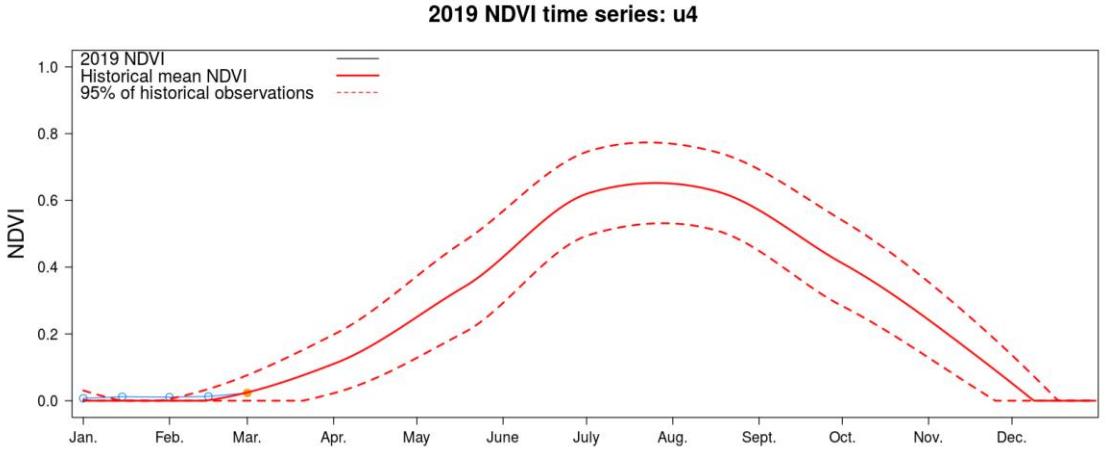
Choose a monitoring unit

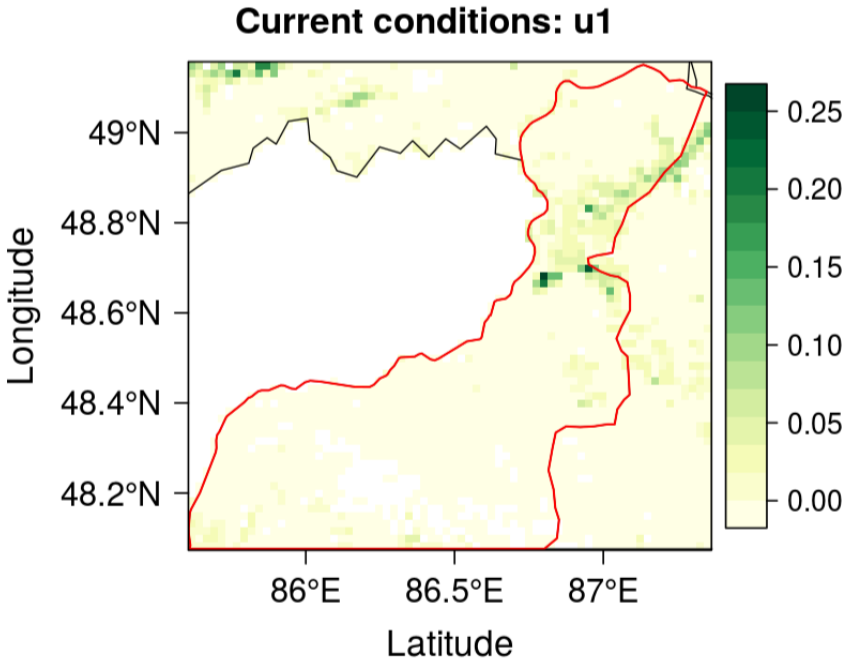
4. Katon-Karagayskiy / Катон-Карагайский

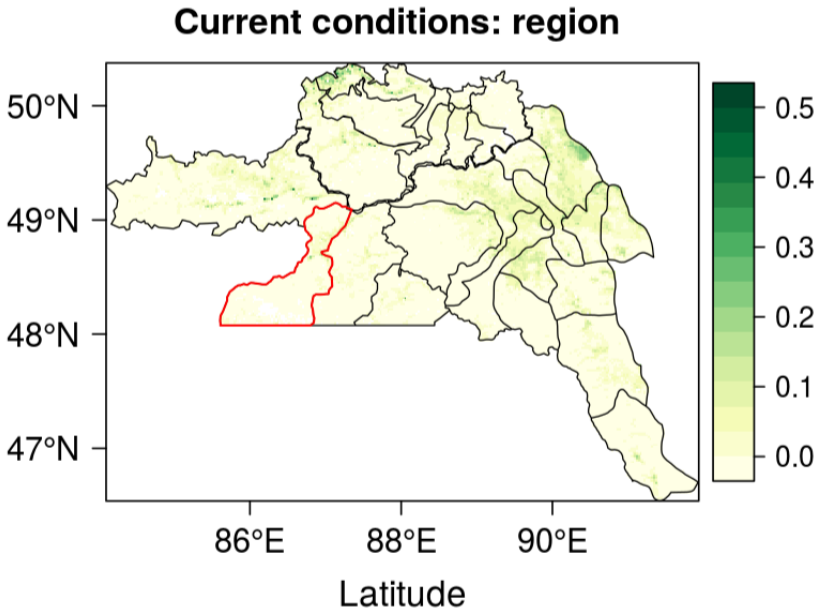
NDVI & EVI are measured on a scale from 0 to 1. Values closer to 1 indicate dense vegetation.

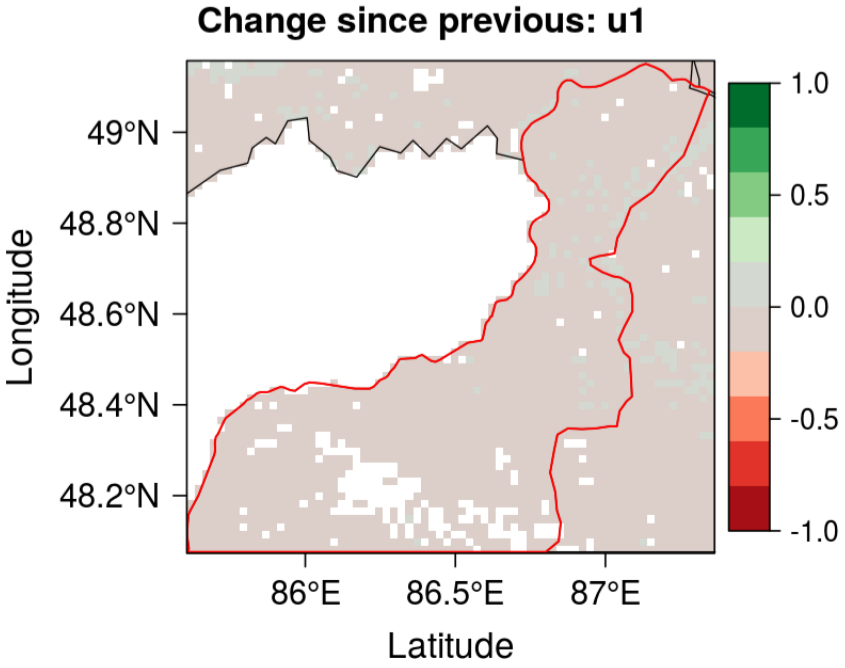


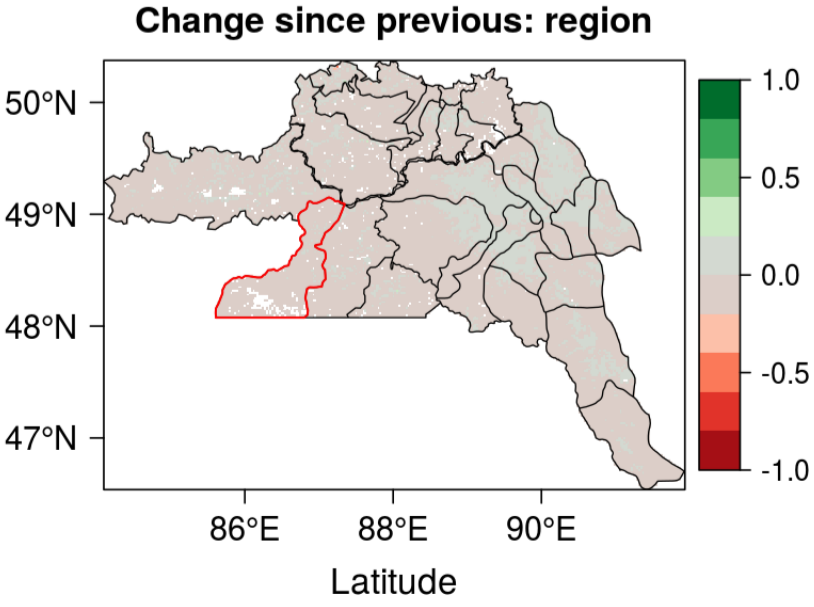
Data source: MODIS/Terra Vegetation Indices, MOD13A1 v6




Current conditions: u1
49°N
48.8°N
48.6°N
48.4°N
48.2°N
Longitude
86°E
86.5°E
87°E
Latitude
0.25
0.20
0.15
0.10
0.05
0.00


Current conditions: region
50°N
49°N
48°N
47°N
86°E
88°E
90°E
Latitude
0.5
0.4
0.3
0.2
0.1
0.0


Change since previous: u1
49°N
48.8°N
48.6°N
48.4°N
48.2°N
Longitude
86°E
86.5°E
87°E
Latitude
1.0
0.5
0.0
-0.5
-1.0


Change since previous: region
50°N
49°N
48°N
47°N
86°E
88°E
90°E
Latitude
1.0
0.5
0.0
-0.5
-1.0

Land Surface Temperature

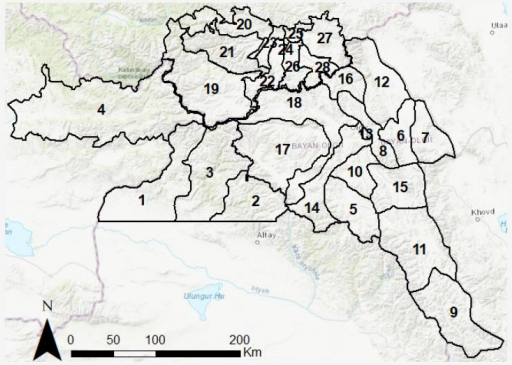
Altai Vital Signs: Land surface temperature (LST)

Biweekly land surface temperature relative to historical observations.

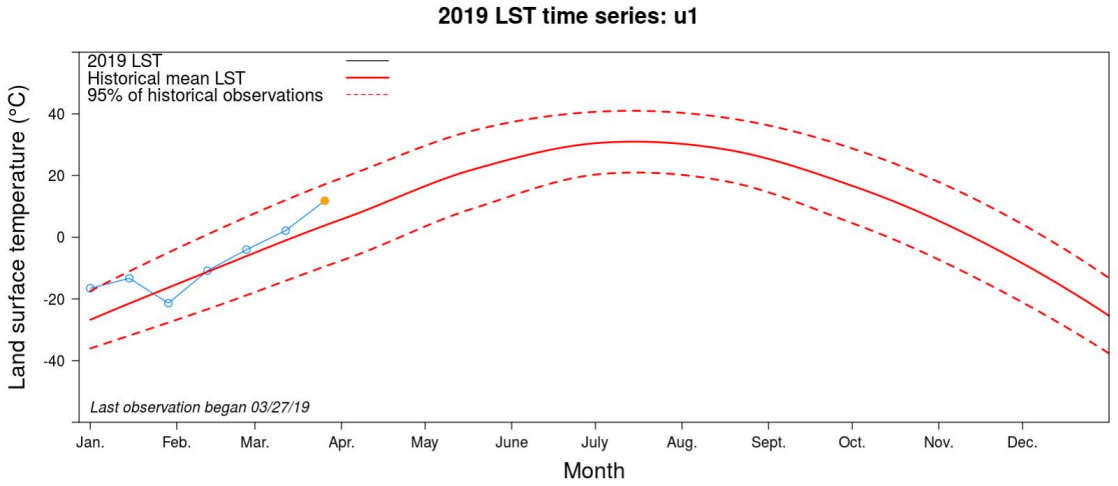
Choose a monitoring unit

1. Habahe / 哈巴河

Other information about snow data entered here.



Data source: MODIS/Terra Land Surface Temperature, MOD11A1 v6



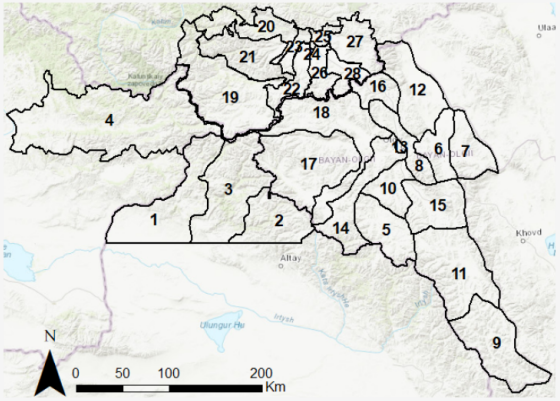
Precipitation

Altai Vital Signs: Precipitation

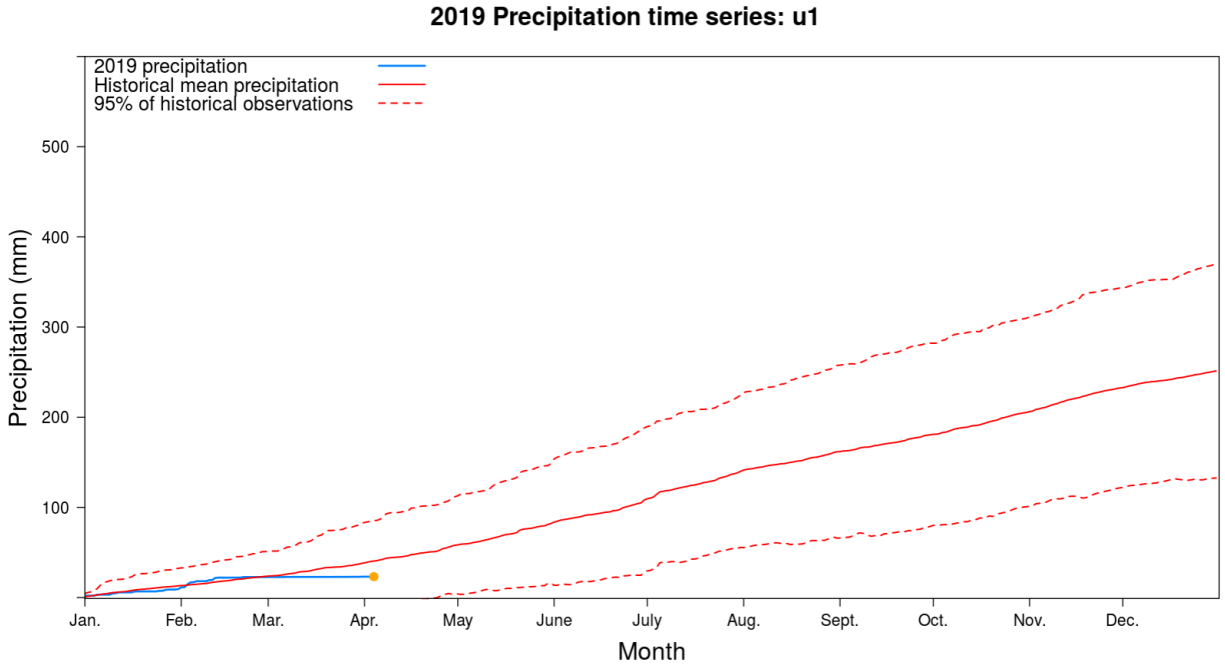
Cumulative daily precipitation relative to historical observations.

Choose a monitoring unit

1. Habahe / 哈巴河



Data source: CPC Global Unified Precipitation data provided by NOAA/OAR/ESRL PSD, Boulder, Colorado, USA



Snow Cover

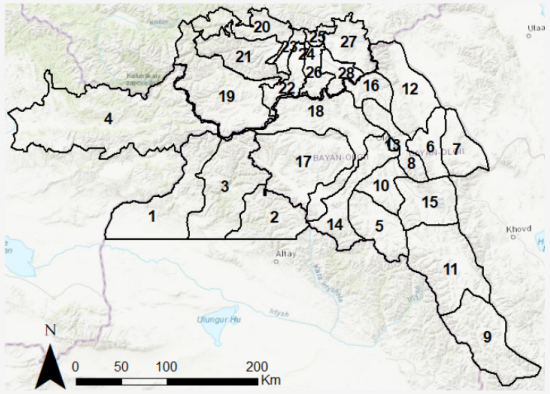
Altai Vital Signs: Snow cover (SNOW)

Maximum snow cover during-day periods relative to historical observations.

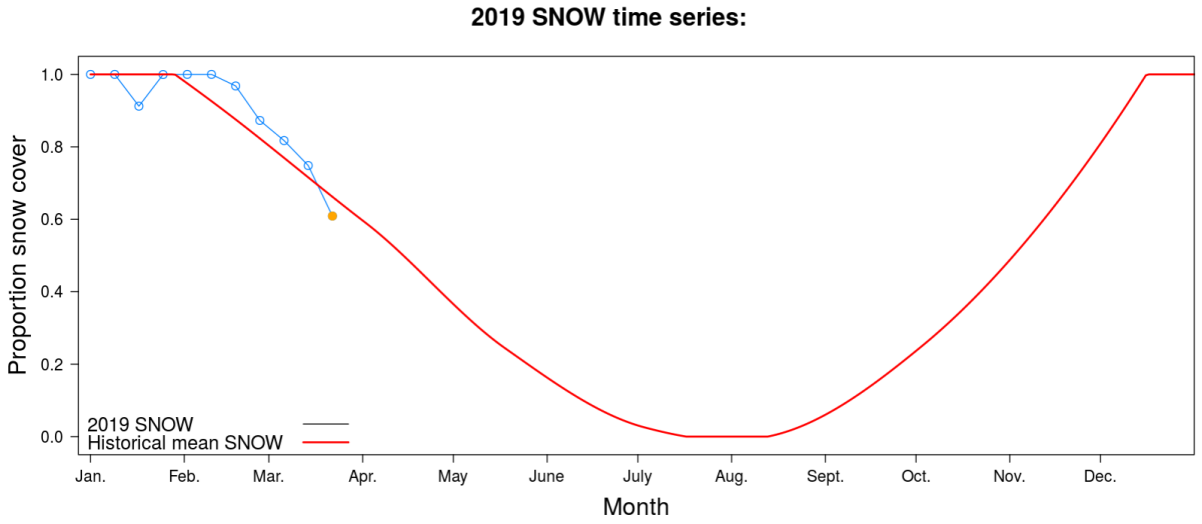
Choose a monitoring unit

1. Habahe / 哈巴河

Other information about snow data entered here.



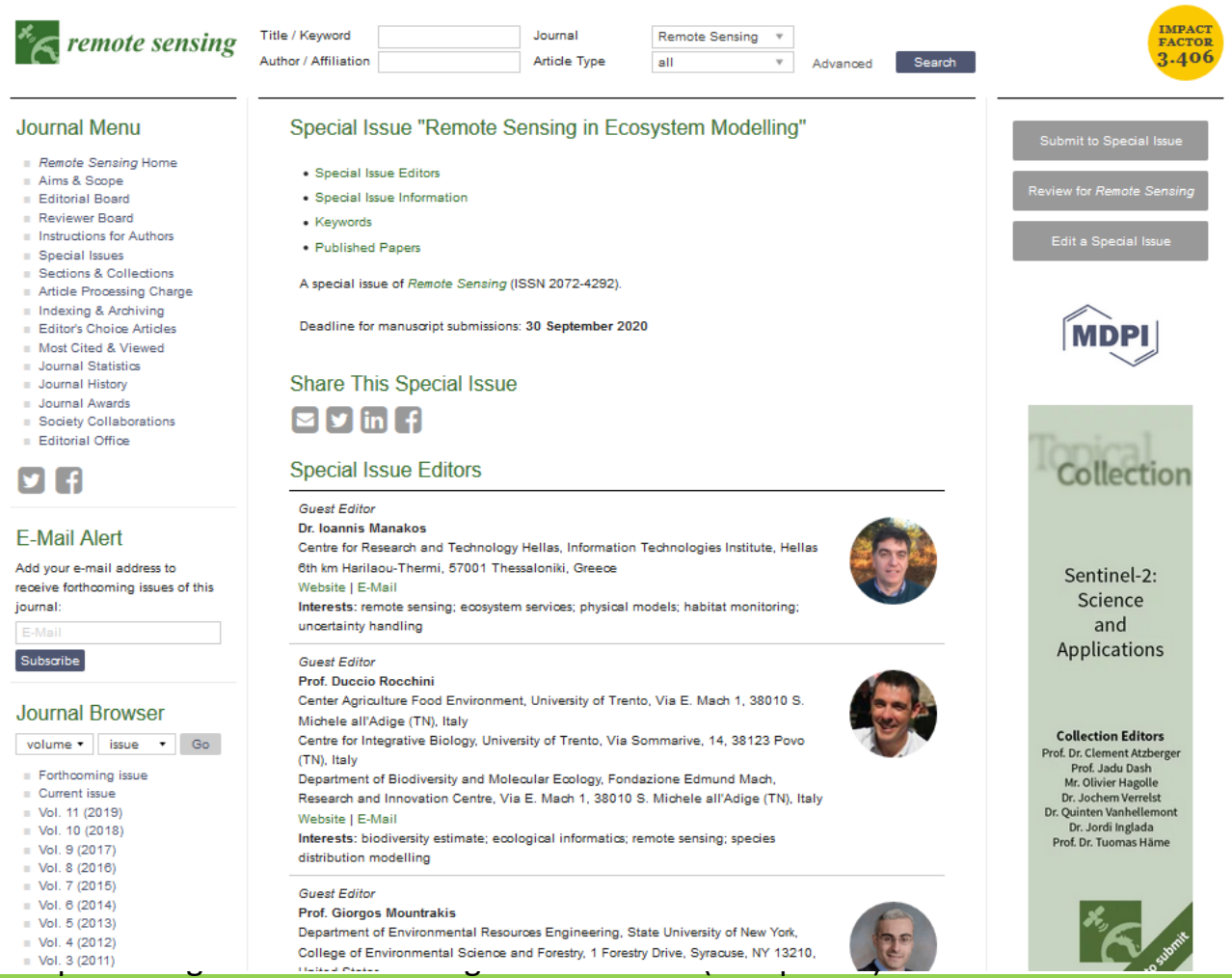
Data source: MODIS/Terra Snow Cover 8-Day L3 Global 500m Grid, Version 6



Next steps

- Modeling
  - Forecasting NDVI & EVI
  - Finalize Deep Learning classifiers
  - Complete SocioEconomic Model
- Outreach
  - “Lite” version of our web portal for weaker internet connections in region
  - Workshop among stakeholders on tool use in late 2019

Productivity



Remote Sensing in Ecosystem Modelling: Remote Sensing Journal (open for submissions)

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Web Portal (under construction):
Altai Mountains "Vital Signs" Rangeland Monitoring and Forecasting Tool
https://altai.shinyapps.io/splash/

Questions

Photo credit James Gibbs