Spruce Forest Kyrgyzstan

The Kyrgyz Republic
BASELINE ATLAS

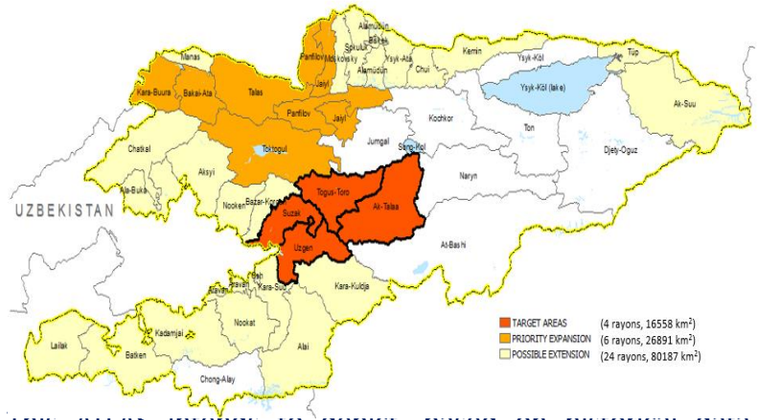
National Overview

Table of Content

Baseline ATLAS

Foreword

The baseline Atlas of Climatic, Topographic, Land Use and Population Resources in Kyrgyzstan collects information, maps and statistics on national and sub-national resources in Kyrgyzstan, focusing the analysis on 4 Rayons (districts) identified as target areas for the proposing Green Climate Fund project: **"Carbon Sequestration through Climate Investment in Forests and Rangelands (CS-FOR)**



This ATLAS intends to depict, based on historical data, current conditions and future trends for natural and anthropic resources, which will be the basis for the assessment of the level of impact of the occurring changing climate and capacity to cope with it by communities, in order to identify vulnerabilities and assess risks. Such analysis will be used to develop mitigation and/or adaptation strategies and propose related actions.

The ATLAS includes four parts and one annex: the first two parts describe resources at national level and for the core target area including 4 rayons: Suzak. Toguz-Toro, Ak-Talaa and Uzgen; the other two parts describe methodology and results of detailed analysis for pasture and forest areas in the core target rayons; the annex provides an additional overview of available resources and conditions for the identified priority expansion area, which includes 4 + 2 more rayons at the north-west of the Country.

The Author

Demography

Population and Geography (Kyrgyzstan)

AREA: **199 900** km^2
POPULATION: **5.835** million in habitants (2014), 1.7 % increase per year (2010-2014)
DENSITY: **29** inhabitants/km^2
CAPITAL CITY: **Bishkek** (**14.7%** of national population)
URBAN POPULATION: **35.7%** living in cities and towns
RURAL POPULATION: **64.3%** living in approximately 1,800 villages, clustered in *aiyl aimak* (Rural Municipality Areas), spread in lowland and mountainous valleys along rivers and streams
Sources: World Bank Development Indicators, UNDP - HDI, ILO

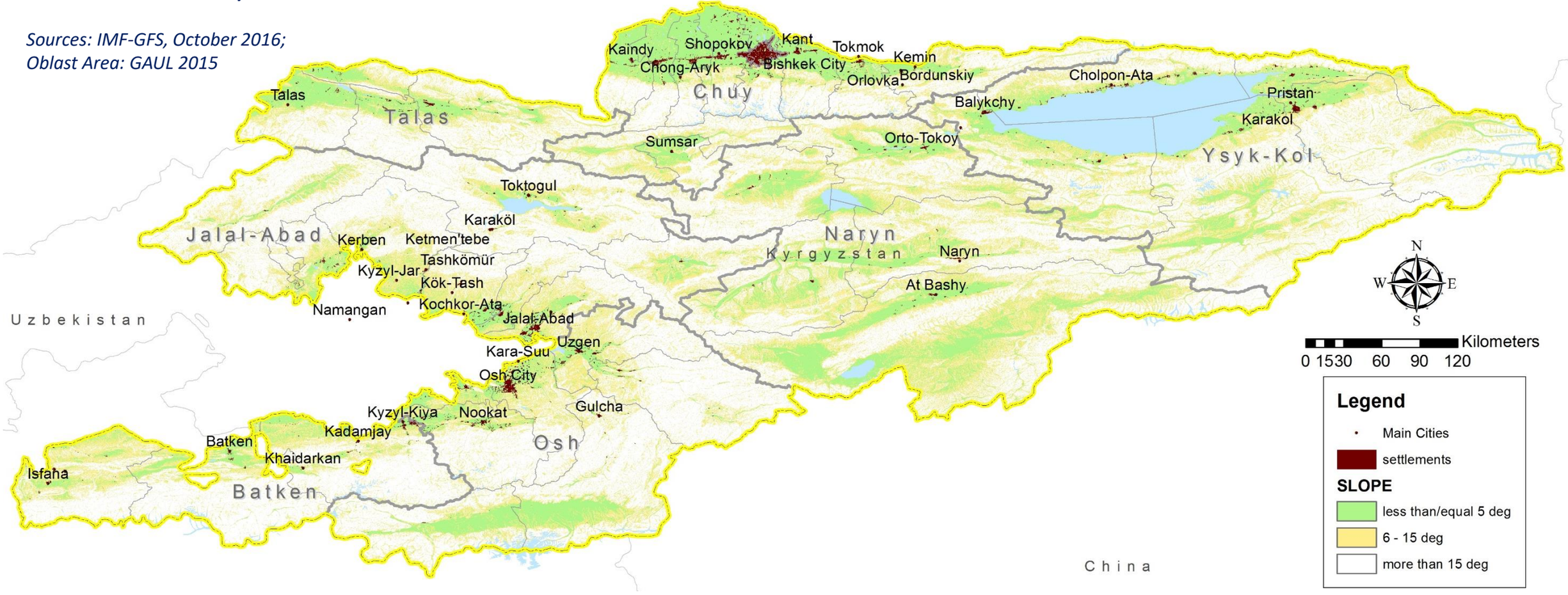
Territorial Organization:

- 7 regions (oblasts) + municipalities of Bishkek and Osh
- 40 rayons + 12 cities of oblast significance + 11 cities of rayon significance
- 440 ayil districts and 19 township councils (*average municipal size: 12 712 inhabitants*)

Oblasts

Oblast/City	Population	Area (km²)	Capital
Batken	382,426	16,607	Batken
City of Bishkek	762,308	215	Bishkek
Chüy	770,811	19,795	Tokmok
Jalal-Abad	869,259	33,480	Jalal-Abad
Naryn	249,115	45,334	Naryn
Osh	1,175,998	29,354	Osh
Talas	199,872	11,434	Talas
Ysyk-Köl	413,149	43,022	Karakol

Sources: IMF-GFS, October 2016;
Oblast Area: GAUL 2015

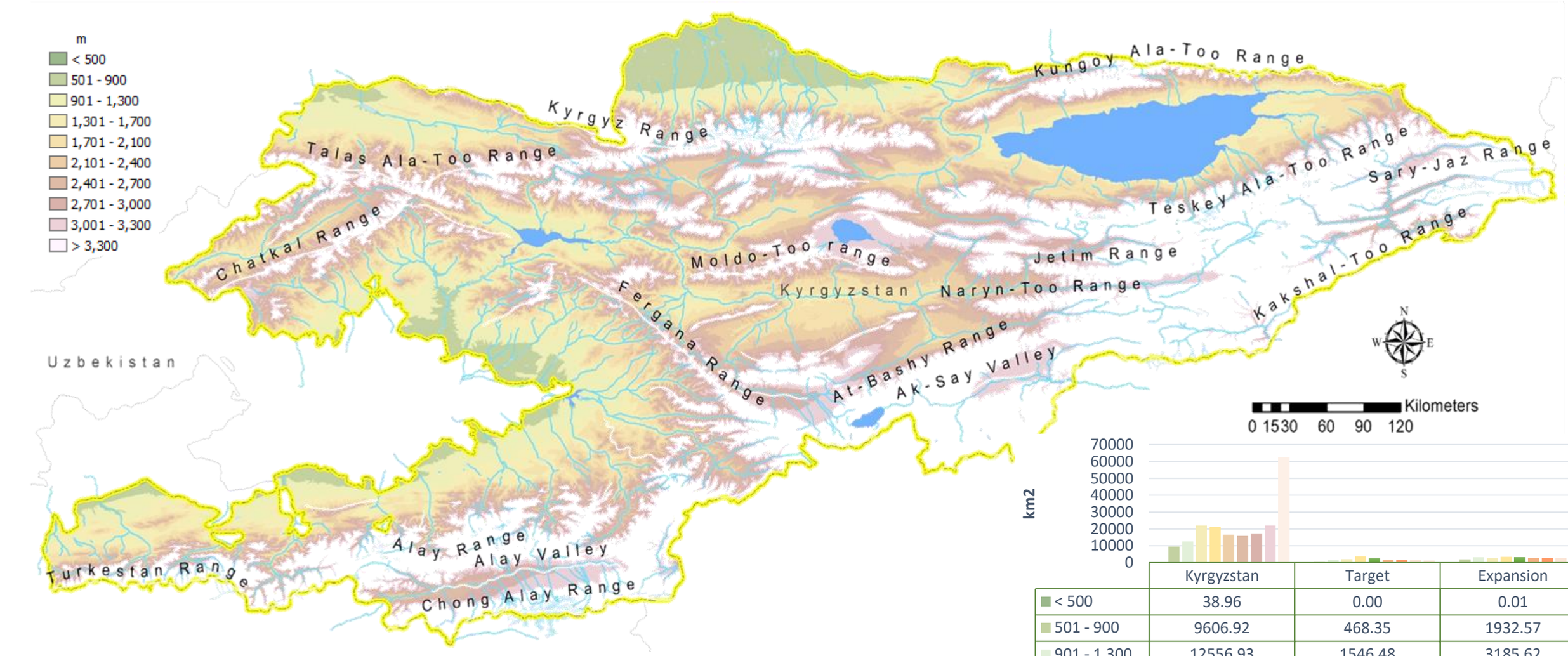


Source: UN CARTOGRAPHIC SECTION

Elevation

Kyrgyzstan is landlocked, with many tall peaks, glaciers, and high-altitude lakes. 93 % is mountainous dominated by the Tien Shan range. It mostly lies on land situated at elevations between 1,000 meters and 7,400 meters, with more than 40 percent of the country above 3,000 meters, and three quarters of that under permanent snow or glaciers.

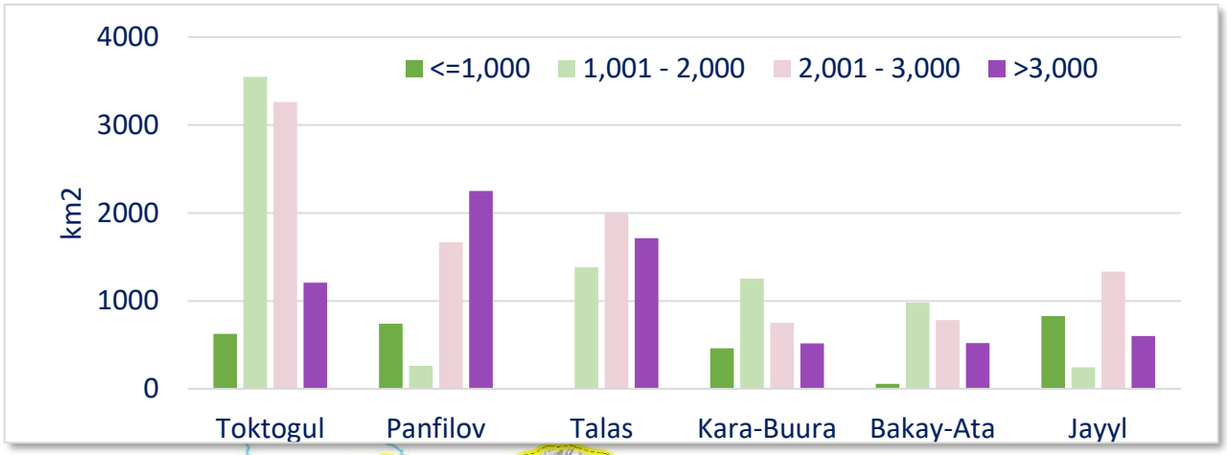
Mountains in the central part of the country effectively isolate the northern and southern populations of Kyrgyzstan, especially in the winter, when snow closes many of the roads.

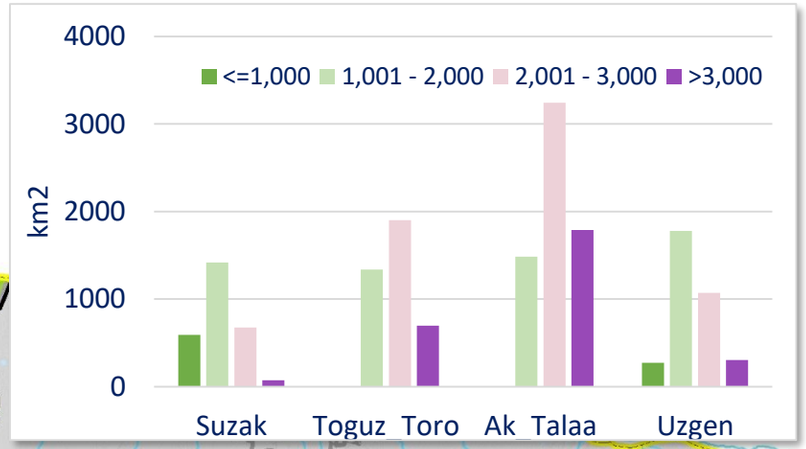


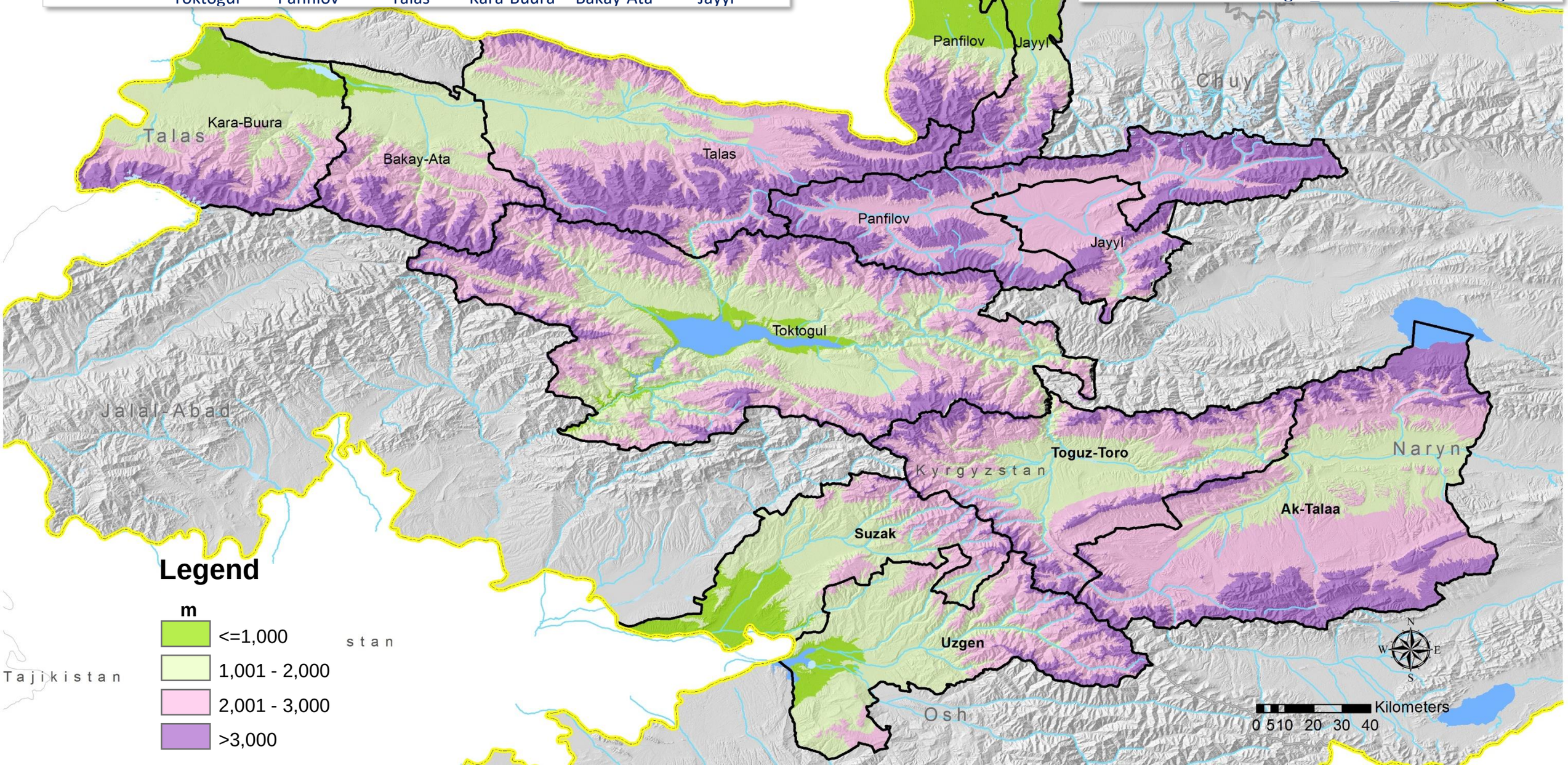
	Kyrgyzstan	Target	Expansion
< 500	38.96	0.00	0.01
501 - 900	9606.92	468.35	1932.57
901 - 1,300	12556.93	1546.48	3185.62
1,301 - 1,700	22059.19	2067.25	2728.17
1,701 - 2,100	21287.40	3817.95	3490.85
2,101 - 2,400	16525.57	2372.50	3125.07
2,401 - 2,700	15873.16	1789.37	2822.73
2,701 - 3,000	17319.01	1706.67	2809.89
3,001 - 3,300	21789.89	1610.76	2907.96
> 3,300	62186.31	1247.78	3981.99

Source: ASTER Global Digital Elevation Model (GDEM); OpenStreetMap waterways; NaturalEarth high resolution colored shaded relief.

Area (km²) by 4 class of elevation: expansion and target areas







Looking down over the valley of the Naryn River

Factsheet

In Kyrgyzstan most rivers are fed by glaciers and/or snow melt. Peak flows occur from April to July, with 80–90 percent of the flow in about 120–180 days extending into August or September. There are six main river basin groups (from the largest to the smallest):

- Syr Darya river basin covers 55.3 percent of the country
- Chu, Talas and Assa river basins, cover 21.1 percent of the country
- Southeastern river basins cover 12.9 percent of the country
- Lake Issyk-Kul internal and interior basin, cover 6.5 percent of the country
- Amu Darya river basin covers 3.9 percent of the country
- Lake Balkhash basin covers 0.3 percent of the country

Source: WWF / HydroSHE. http://www.hydrosheds.org/page/overview; ASTER GDEM; Projection: Geographic

Factsheet

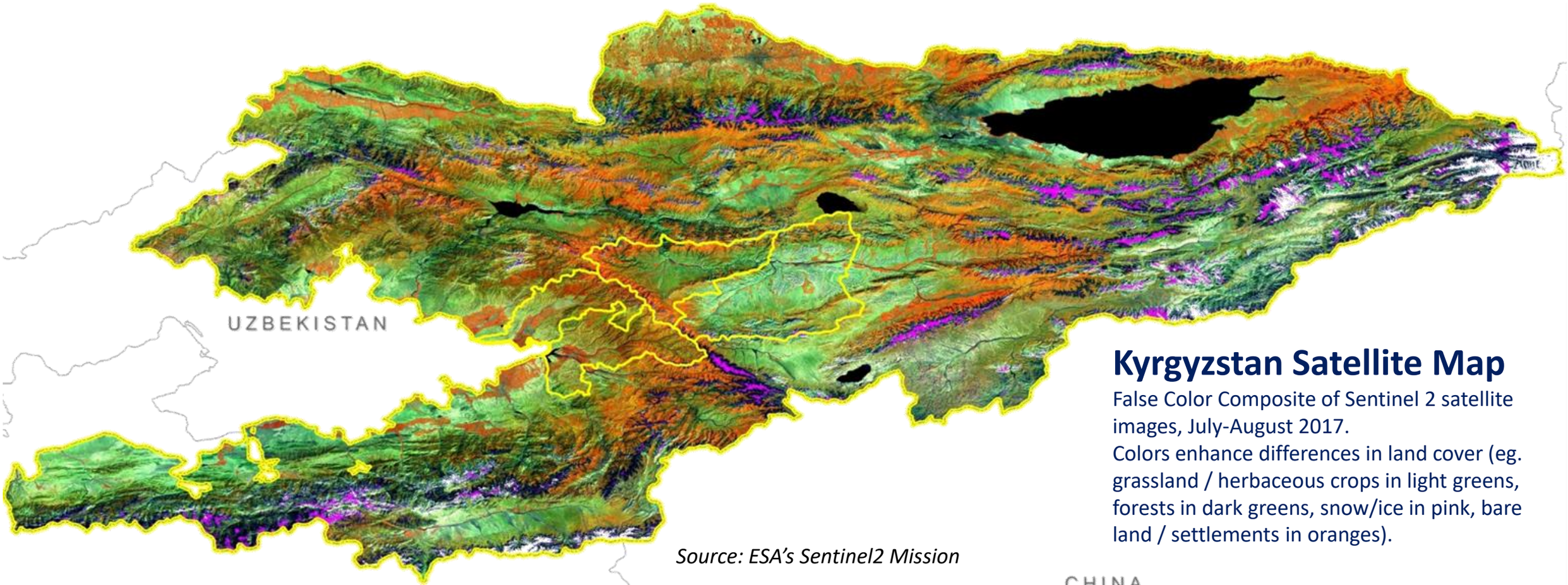
As of 1ST January, 2015, the total area of agricultural land was 10.6 million ha (53% of total land reserves), including

- 9 million ha of pastures
- 1.2 million ha of cultivated land
- 168,437 ha of hayfields
- 36,000 ha of perennials, and
- 38,645 ha of fallow lands

Arable land comprises only 7 percent of the total land area, compared with more than 50 percent for range and forest land

The largest share (85 %) of agricultural lands is comprised of pastures, which is constantly decreasing, and croplands (irrigated and non-irrigated) for a 12.1% of all agricultural lands. The other is mountains, glaciers, and high- altitude steppe that is used for grazing.

Source: Official data of the State Institute for Land Management (GIPROZEM)



Kyrgyzstan Satellite Map

False Color Composite of Sentinel 2 satellite images, July-August 2017.
Colors enhance differences in land cover (eg. grassland / herbaceous crops in light greens, forests in dark greens, snow/ice in pink, bare land / settlements in oranges).

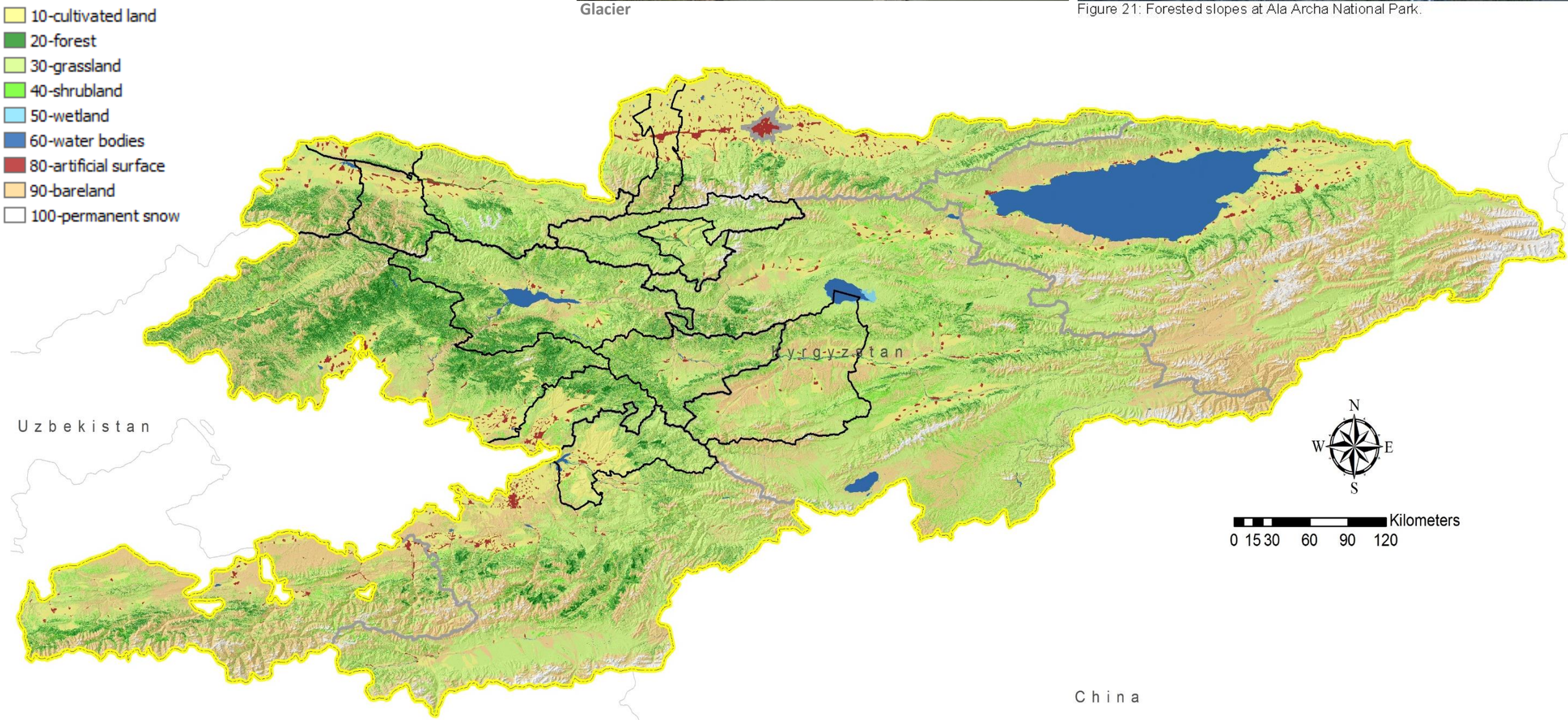
Source: ESA's Sentinel2 Mission

GlobeLand30, 2010

Ten major land cover classes extracted form processing mainly Landsat images, dated around 2010, at a resolution of 30x30m.

Glacier

Figure 21: Forested slopes at Ala Archa National Park.



World Designated Protected Areas 2018

Kyrgyzstan has a relatively well-established system of protected areas. Altogether they cover 13,403 km^2, which is about 6.7% of the country's total area (2018).

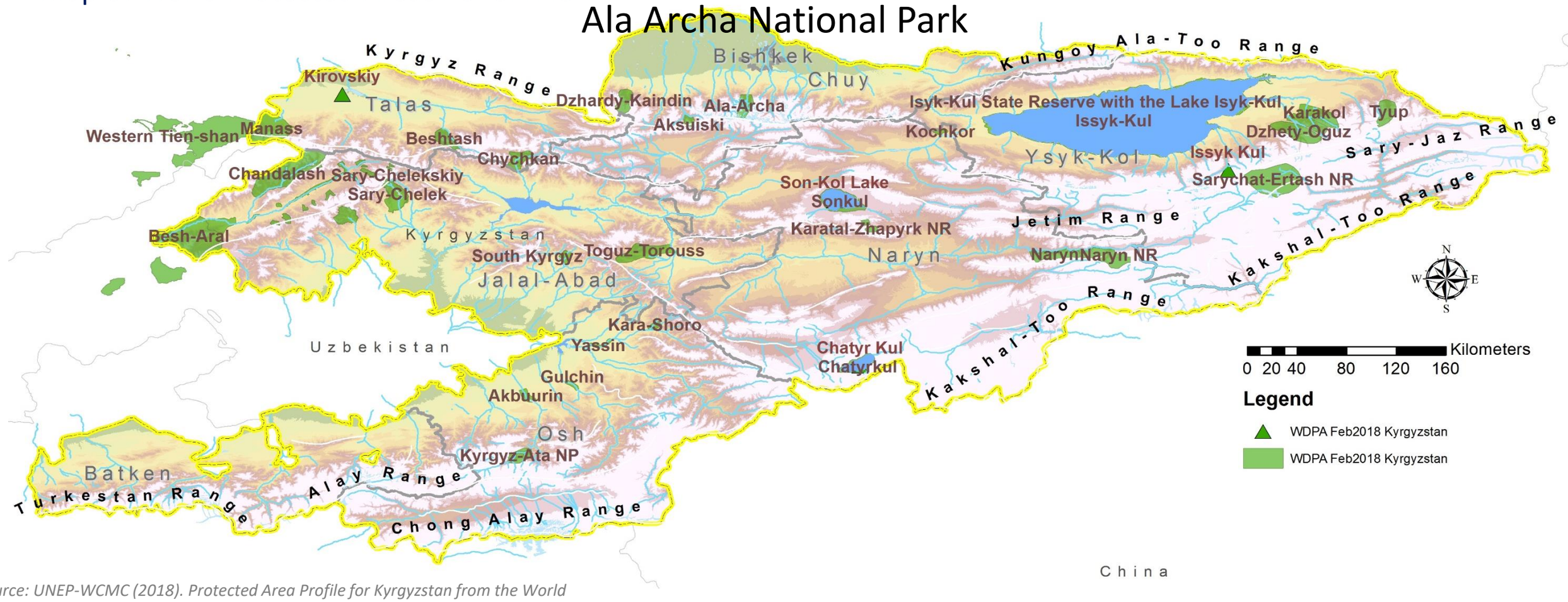
They include

- **29 national designations** (1 national park, 4 nature parks, 15 wildlife refuge, 7 state nature reserves) and
- **6 international designations** (2 UNESCO-MAB Biosphere reserves, 1 world heritage site, and 3 Ramsar/wetland sites).

Lake Issyk-Kul is included in the list of **world famous wetlands** (Ramsar Convention on Wetlands).

Ala Archa National Park

Map of World Protected Areas 2018. FAO



Source: UNEP-WCMC (2018). Protected Area Profile for Kyrgyzstan from the World Database of Protected Areas, February 2018. www.protectedplanet.net/country/KGZ

Climatic Zones

Kyrgyzstan lies in a zone of dry continental climate. However, a number of regions with their own microclimate occur in Kyrgyzstan. These are governed by altitude and their position relative to the larger climatic zones. Lake Issyl Kul, which does not freeze, exerts a local influence on the climate of the adjacent regions.

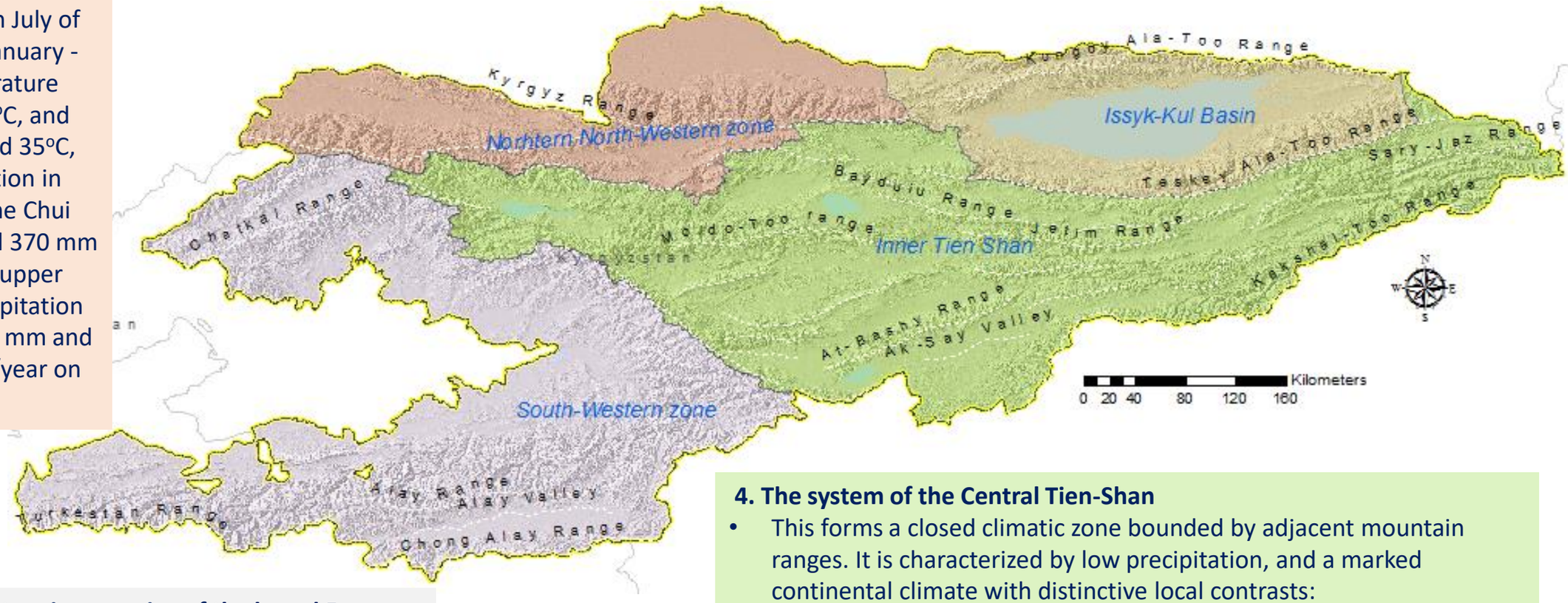
Climatic zones change with the altitude. At lower altitudes the microclimate is drier, showing the typical characteristics of continental climate with marked contrasts between the summer and winter seasons. With increasing altitude, temperatures are lower and humidity increases so that diurnal variations and differences between the summer and winter seasons are less marked. The territory of Kyrgyzstan is divided into four climatic zones:

1. The northern and north-western part, including the Chui, Talas and Kemin valleys. They are surrounded by the Talas, Kyrgyz and Cho-Kemin mountain ranges:

- a relatively humid climate with mean annual temperature between 5 – 10°C,
- a mean temperature in July of +20 to +25°C, and in January -10 to -5°C, The temperature reaches –30°C to –-34°C, and the maximum is around 35°C,
- atmospheric precipitation in the northern part of the Chui valley averages around 370 mm a year, whereas in the upper part of the valley precipitation increases to 425 – 500 mm and can exceed 1 000 mm/year on mountain slopes.

3. North-eastern Kyrgyzstan with Lake Issyk Kul and the Kungey Ala-Too and Terskey Ala-Too mountain ranges.

- This zone is evidently affected by Lake Issyk-Kul that lies at an altitude of 1 609 m above sea level and does not freeze during the winter. The lake therefore has a stabilizing influence on the local climate, giving:
- Mild winters, relatively warm summers and smooth fluctuations of annual temperature
- Mean annual temperatures at the level of the lake are 6 – 8°C, in January –3 - -7°C and in July 17 – 23°C,
- Precipitation in the central part of the basin ranges from 250 to 300 mm/year, whereas in the eastern part it can be as much as 400 mm a year with up to 800 mm a year falling on the mountain slopes.



2. South-western Kyrgyzstan, i.e. margins of the broad Fergana valley, the Chatkal and Alai valleys and the adjacent mountain ranges.

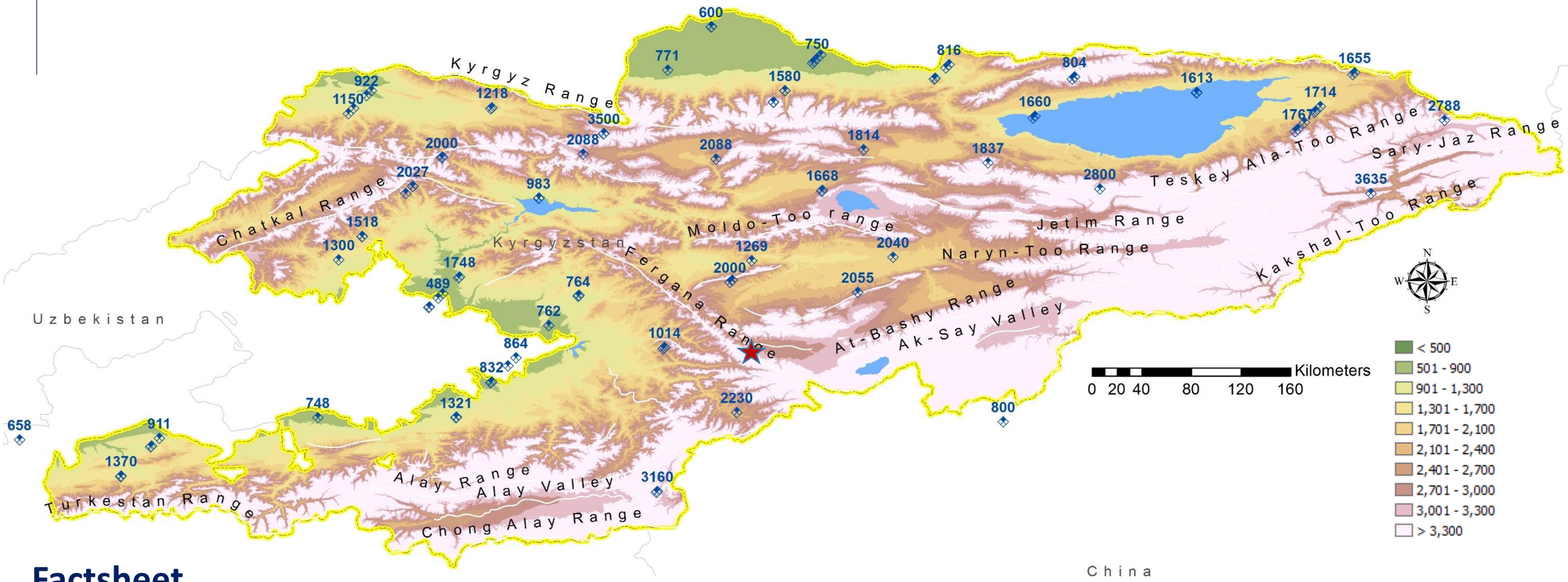
- relative to other climatic zones, this is the warmest and most humid with maximum rainfall in winter.

4. The system of the Central Tien-Shan

- This forms a closed climatic zone bounded by adjacent mountain ranges. It is characterized by low precipitation, and a marked continental climate with distinctive local contrasts:
- Annual mean temperature varies from about 9°C at an altitude of 1 000 m above sea level down to – 10°C at altitudes exceeding 4 000 m above sea level with minima reaching – 56°C and maxima at the altitudes mentioned above of 37°C and 22°C.

Source: http://www.geominprojects.com/5-kyrgyzstan.html?jazyk=en

Meteorological Stations



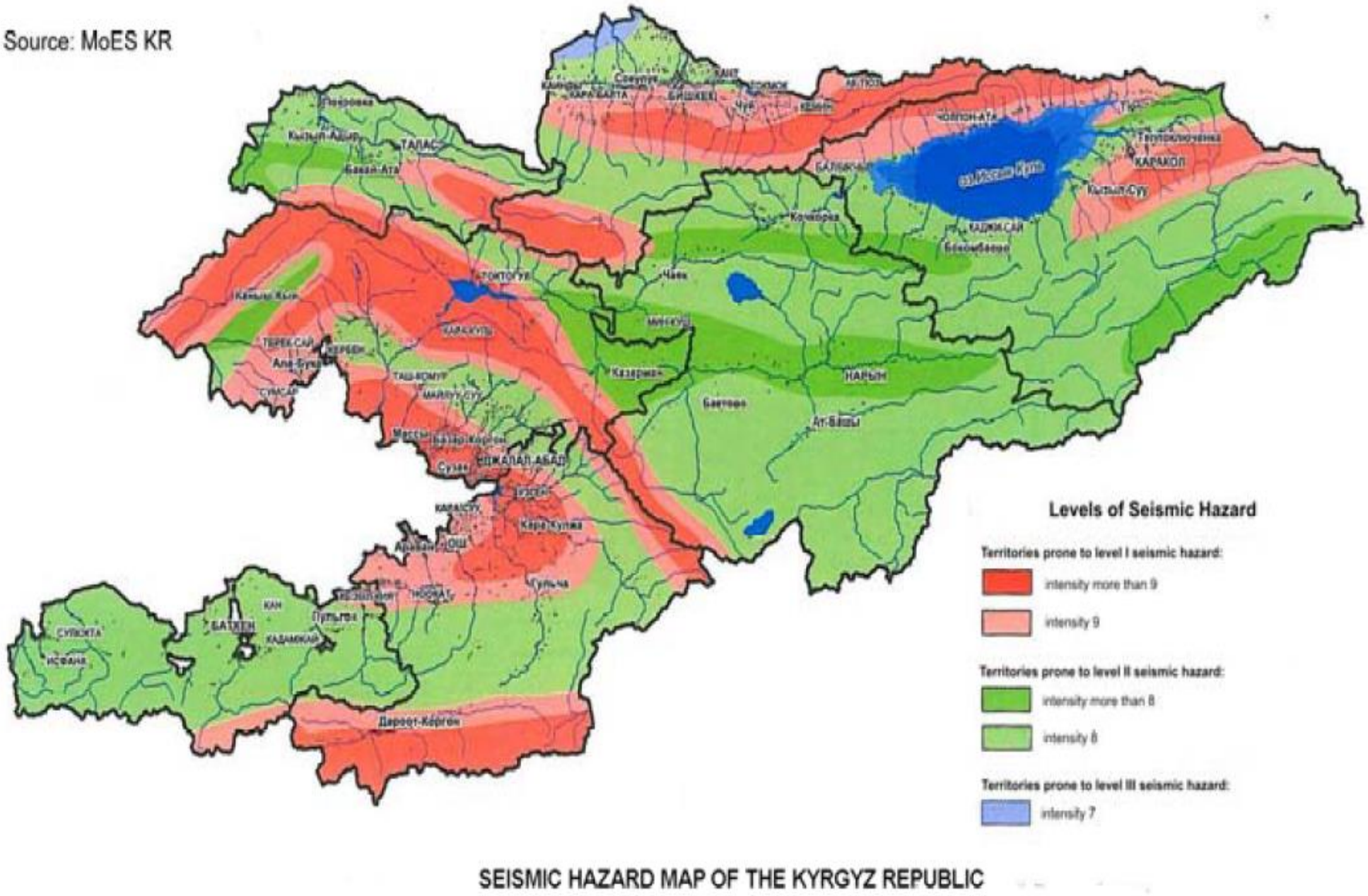
Factsheet

Station type	count
automatic meteorological station	54
meteorological station	20
agrometeorological station	10
united hydrometeorological station	6
regional center for hydrometeorology	4
avalanche station	3
meteorological post	2
automatic meteorological station - agrometeorological station	1
lake observatory	1
Grand Total	**101**

Earthquake hazard

Of all natural hazards taking place in Kyrgyzstan, earthquakes are the most dangerous. Earthquakes take place unexpectedly and are often followed by secondary phenomena (landslides, rock falls, fires, etc.). Almost the whole territory of Kyrgyzstan is prone to high seismic hazards. Approximately 20% of the total area of the country (~40,000sq.km) is prone to potential earthquakes of high intensity (MSK 9), and in the 158,000sq.km of the territory (79%) earthquakes of intensity 8 MSK may take place40.

Source: MoES KR



SEISMIC HAZARD MAP OF THE KYRGYZ REPUBLIC

The map of seismic hazards shows the expansion of territories prone to earthquakes with indication of various intensities (7-9 and above) where three levels of seismic hazard prone areas are identified.

According to the Institute of Seismology forecast for the next 5 years (2009-2014), high intensity earthquakes with magnitude of 5.2-6.6 and intensity of 6-8 may take place in the territories of North Tien-Shan (along the Kungei Ala-Too ridge).

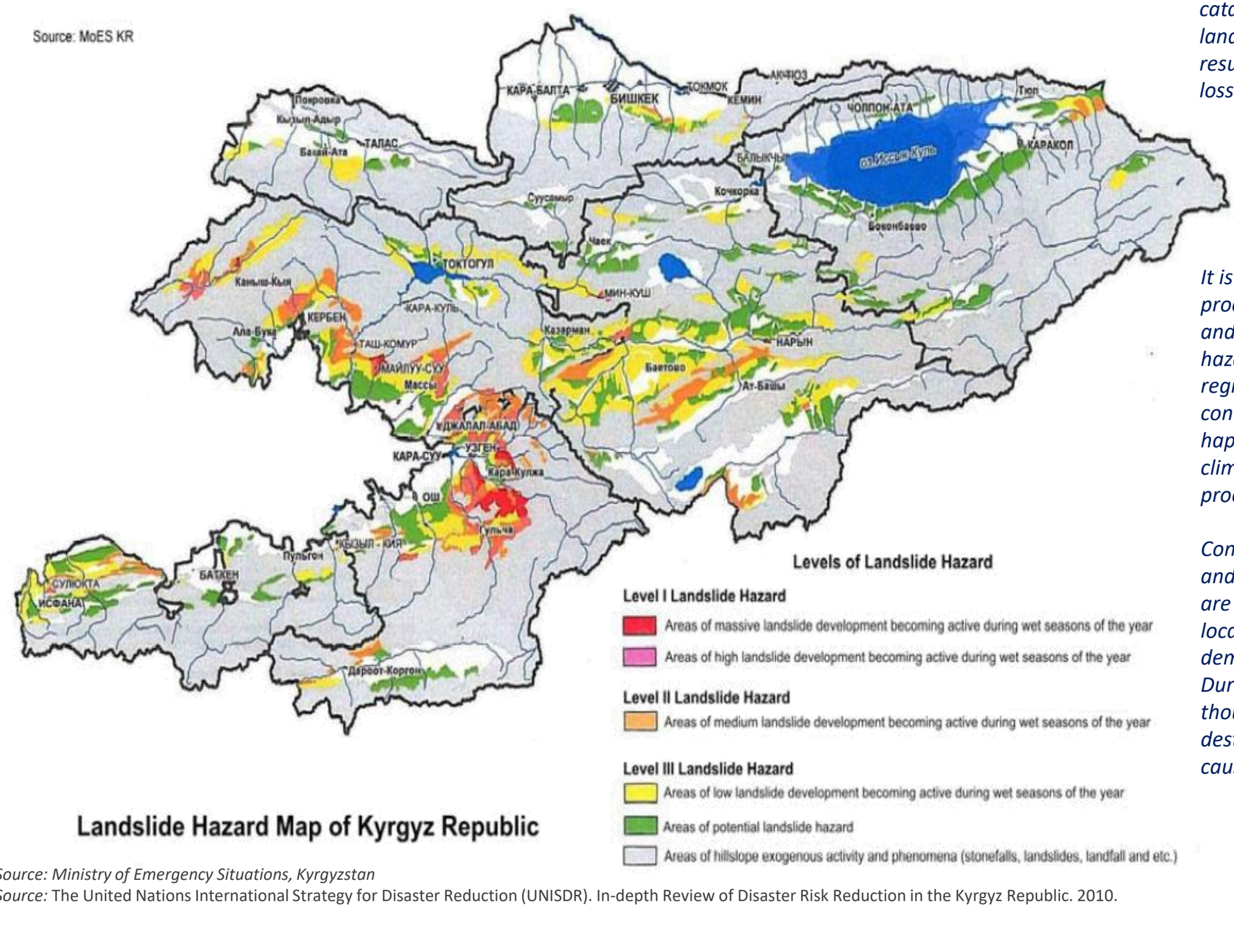
Source: Ministry of Emergency Situations, Kyrgyzstan
Source: The United Nations International Strategy for Disaster Reduction (UNISDR). In-depth Review of Disaster Risk Reduction in the Kyrgyz Republic. 2010.

Landslides

There are more than 5,000 active landslides on the territory of the Kyrgyz Republic, of which 3,500 are located in the southern regions. To a certain degree, 509 settlements are exposed to the landslide process. These prone areas accommodate more than 10,000 houses, which require anti-landslide measures or resettlement of the population.

During the last 15 years, over 300 catastrophic disasters caused by landslides were registered, which resulted in economic damages and loss of life.

Source: MoES KR



Landslide Hazard Map of Kyrgyz Republic

It is observed that landslide processes have become more active and new locations of landslide hazard emerged even in those regions, where due to geological conditions landslides are less likely to happen. This may be caused by climate change and seismic activity processes.

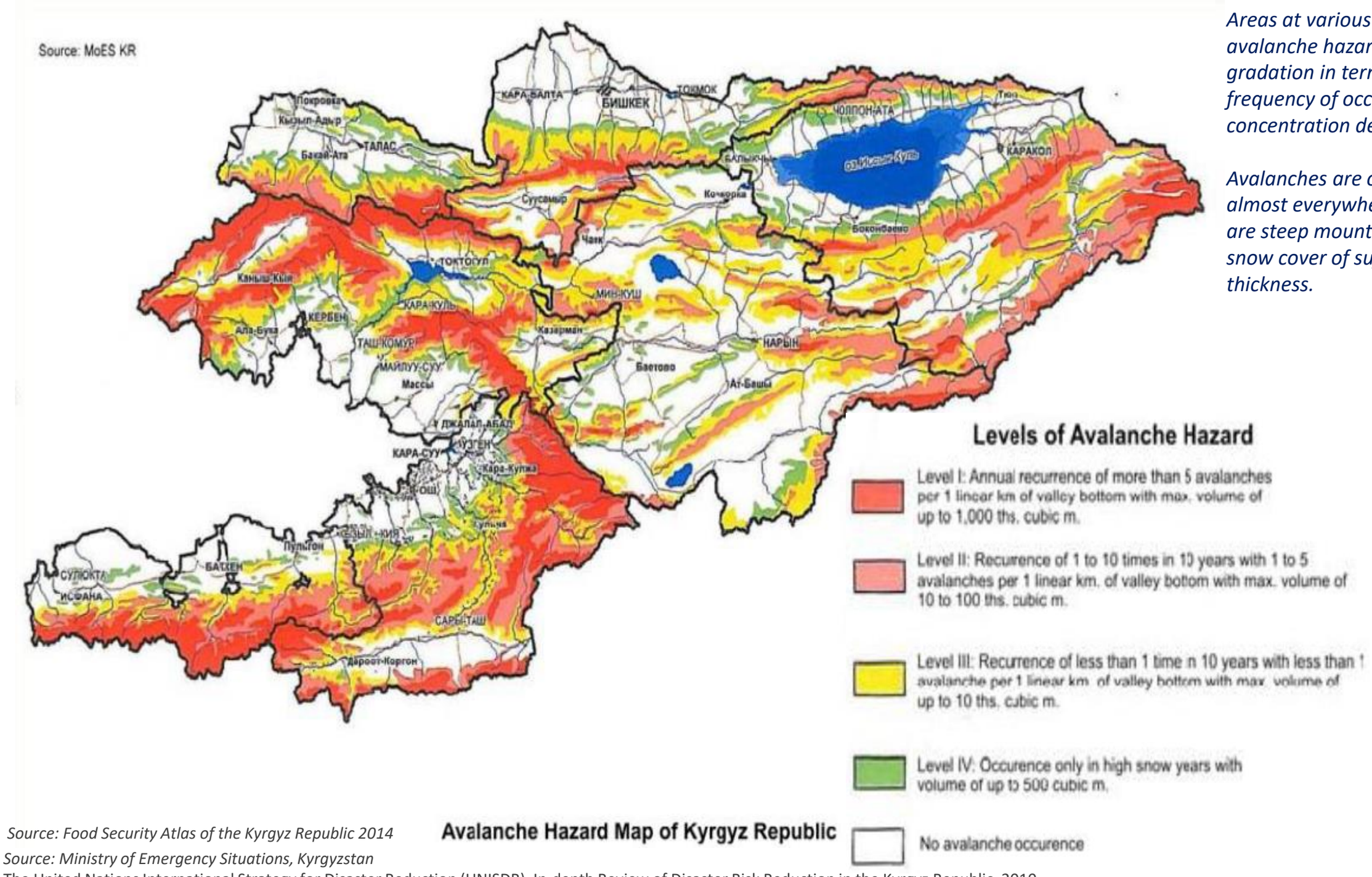
Construction of protective structures and landslide stabilization measures are implemented only in several locations because of substantial demand for resources and funds. During the past decades, over 8.5 thousand residential homes were destroyed as the result of disasters caused by landslide processes.

Source: Ministry of Emergency Situations, Kyrgyzstan

Source: The United Nations International Strategy for Disaster Reduction (UNISDR). In-depth Review of Disaster Risk Reduction in the Kyrgyz Republic. 2010.

Avalanche hazard forecast

In addition to landslides, avalanches occur frequently in the Kyrgyz Republic. More than one-half of the territory of the Republic is exposed to the avalanche hazard. The geomorphological structure of deeply cut mountain relief determines intensive avalanche activity in case of active precipitation and presence of a steady deep snow cover. The highest avalanche activity takes place in the basins of the following rivers: Chandalash, Chychkan, Uzun-Akmat, Chatkal and Suusamyr.56 Of these rivers, Suusamyr is the tributary to Kokomerin river at the road section 3



Areas at various degree of avalanche hazard with a gradation in terms of volumes, frequency of occurrence, and concentration density.

Avalanches are observed almost everywhere where there are steep mountain slopes and snow cover of sufficient thickness.

Source: Food Security Atlas of the Kyrgyz Republic 2014

Source: Ministry of Emergency Situations, Kyrgyzstan

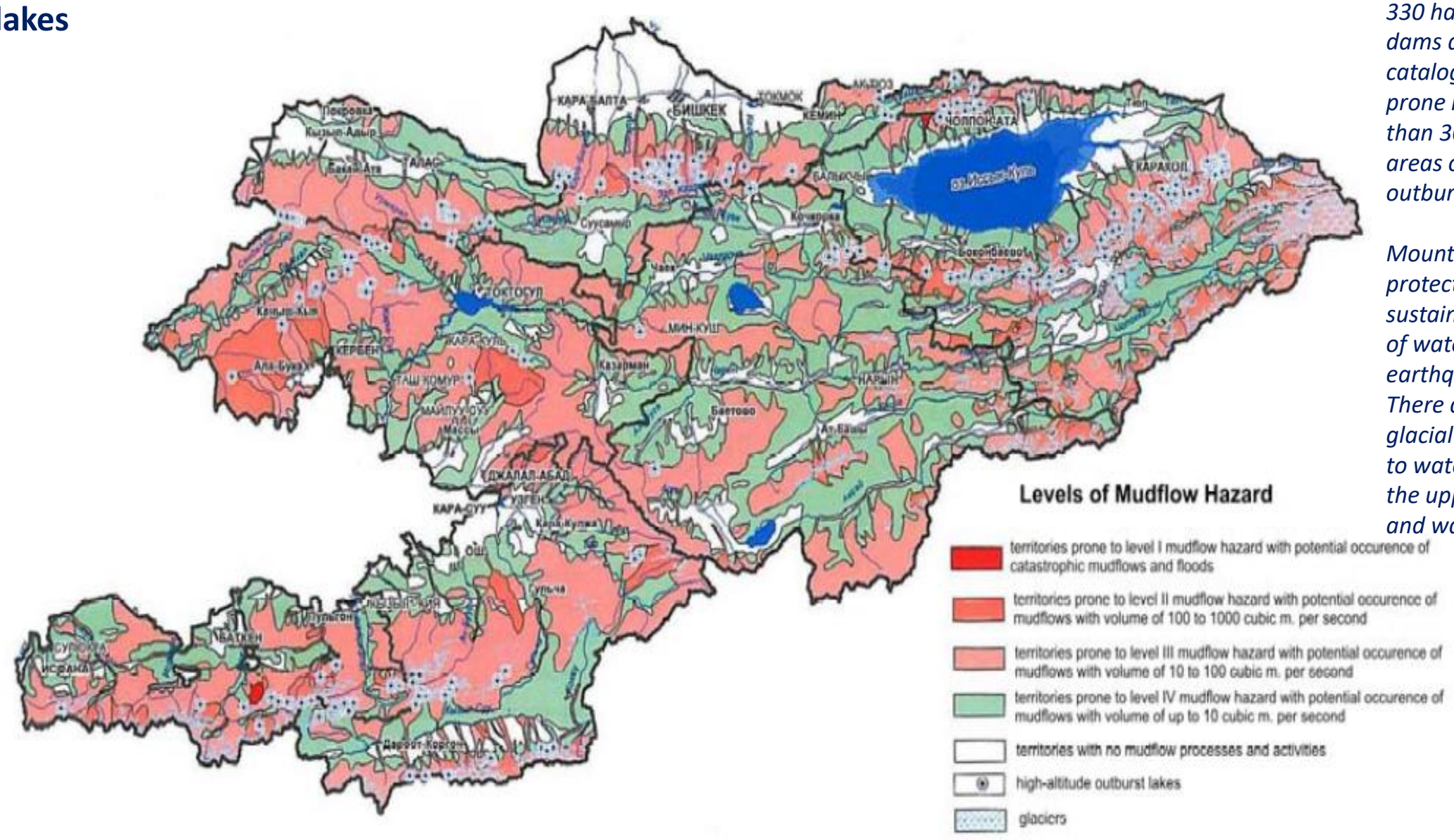
The United Nations International Strategy for Disaster Reduction (UNISDR). In-depth Review of Disaster Risk Reduction in the Kyrgyz Republic. 2010.

Mudflows, flashfloods and water outbursts from high altitude lakes

There are around 3,900 mudflow and flood prone river basins on the territory of the Kyrgyz Republic with the length of 10km and more. There are cases of mudflow registered in 1,153 settlements, which resulted in various damages.

The republic has around 2,000 high altitude lakes, of which 330 have unsustainable water dams and are included in the catalogue of water outburst prone lakes. There are more than 300 settlements in the areas of possible water outbursts from lakes.

Mountainous lakes, which are protected with more sustainable dams, present a risk of water outbursts during earthquakes of high magnitude. There are also moraine and glacial high altitude lakes prone to water outbursts located in the upper reaches of mudflow and water flow prone rivers.



Mudflow Hazard Forecast Map of the Kyrgyz Republic

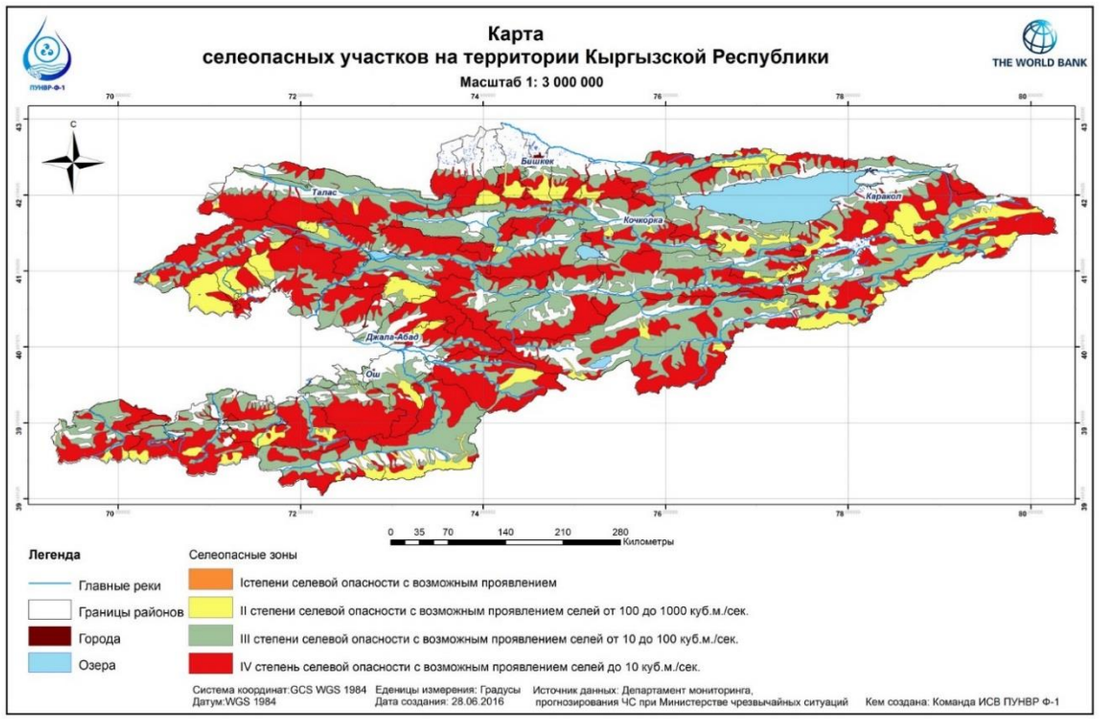
Source: Ministry of Emergency Situations, Kyrgyzstan

Source: The United Nations International Strategy for Disaster Reduction (UNISDR). In-depth Review of Disaster Risk Reduction in the Kyrgyz Republic. 2010.

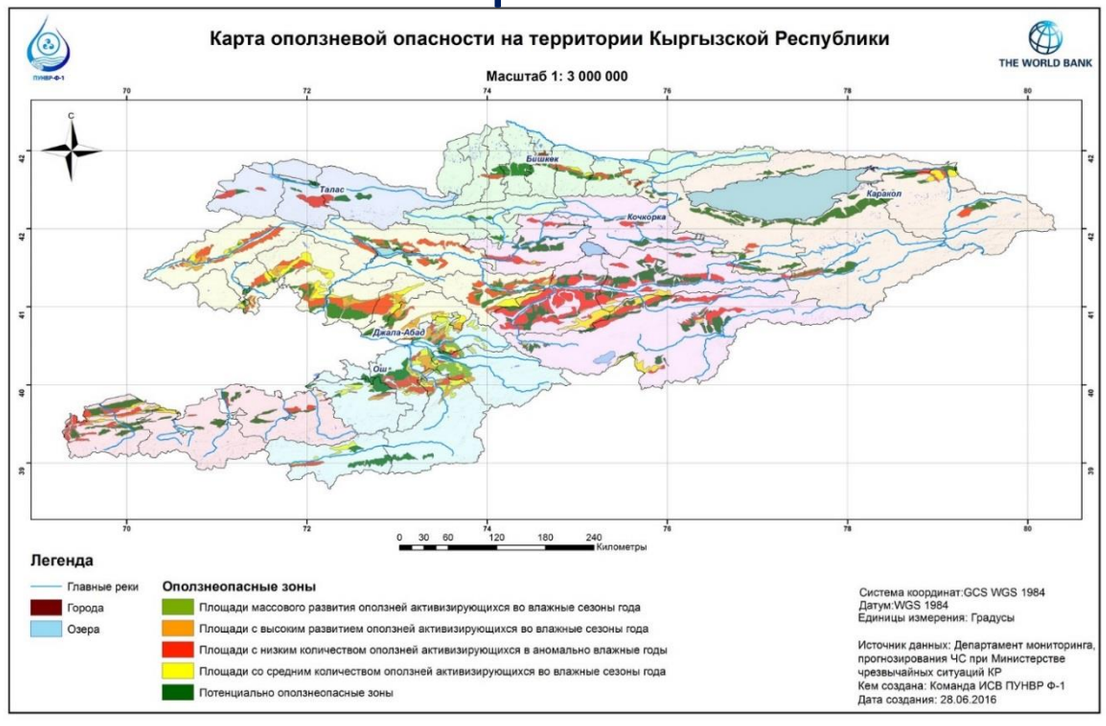
Climate Change related Hazards

NATIONAL OVERVIEW

Mudslides



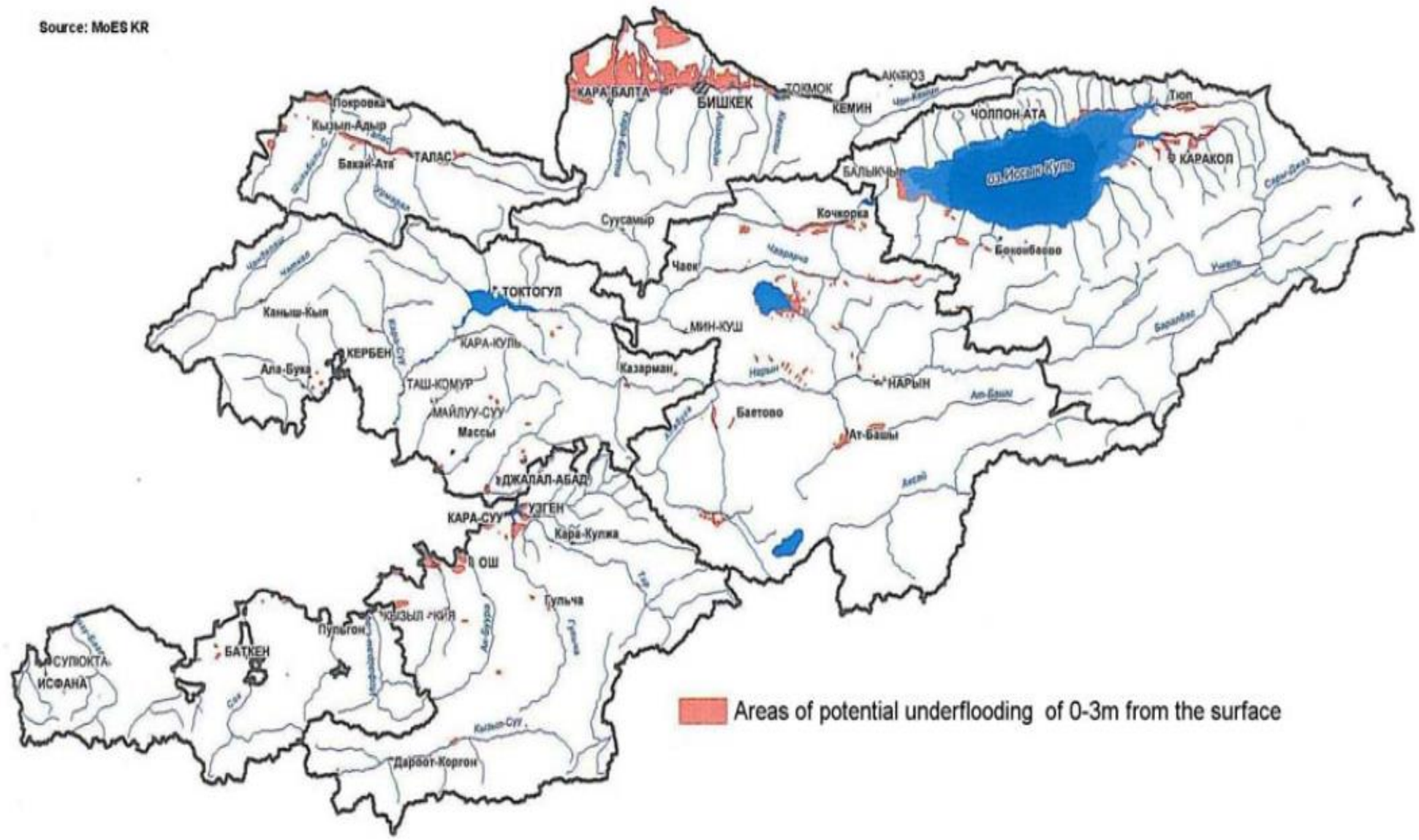
Landslides forecast map



Landslide/Mudslide/Flooding

Under flooding (water logging) caused by increased groundwater levels

According to the data from the Kyrgyz Comprehensive Hydrological Expedition, the under flooding processes exist in the Kyrgyz Republic on the area of 3,200 sq.km. Currently, the under flooding processes exist on the territory of 316 settlements and significant areas under crops



Groundwater Flooding Forecast Map of Kyrgyz Republic

The largest waterlogged areas which are located in the central part of the Chui intermountain valley produce a negative impact on residential houses, social infrastructure facilities, agricultural lands and private land plots in Bishkek (northern part), Kant, Tokmok, Kara-Balta as well as some other towns.

There is a narrow waterlogged strip in the central part of Talas basin, which affects a number of residential houses in Talas city. There are also a number of waterlogged areas in the western and eastern parts of Issyk-Kul intermountain valley near Lake Issyk-Kul, east part of Son-Kul Lake as well as a number of hydropower plants of the Kyrgyz Republic - all these pose a risk of the slow destruction of residential houses as well as social, economic and cultural infrastructure facilities.

Source: Ministry of Emergency Situations, Kyrgyzstan
Source: The United Nations International Strategy for Disaster Reduction (UNISDR). In-depth Review of Disaster Risk Reduction in the Kyrgyz Republic. 2010.

Hot spots of climate change derived hazards

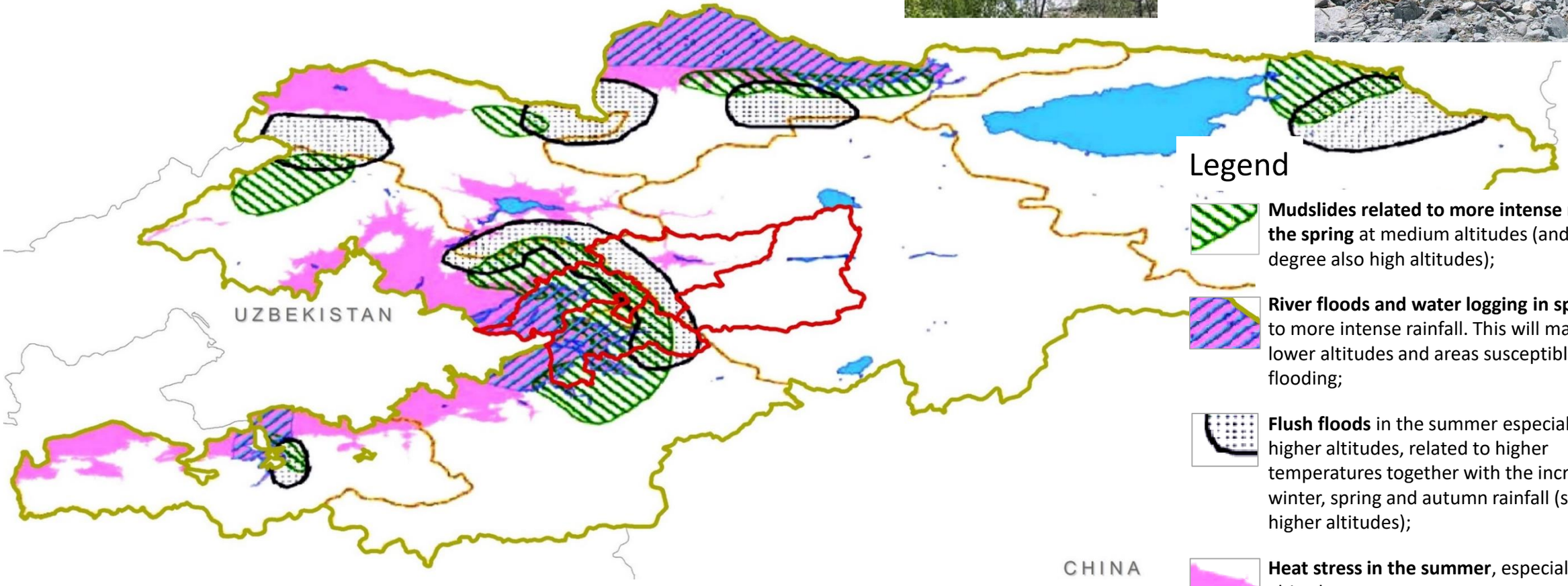
Kyrgyzstan is one of the most vulnerable countries to climate change in Central Asia, suffering from drought, land and mudslides while flooding events and river banks erosion are set to increase in frequency and intensity.

Forests and pastures are already under stress because of anthropic pressure and are among the most sensitive resources being impacted by climate change.

According to available and recent literature, communities of the Naryn river watershed located in the districts of of Jalal-Abad, Osh and Naryn are among the most vulnerable as the area is subject to the combined effects of the different direct and indirect impacts of climate change.

House destroyed by a landslide in Jalal-Abad oblast

Map of hot spots of climate change derived hazards



Source: IFAD/GOK 2013

Climate Change related Hazards

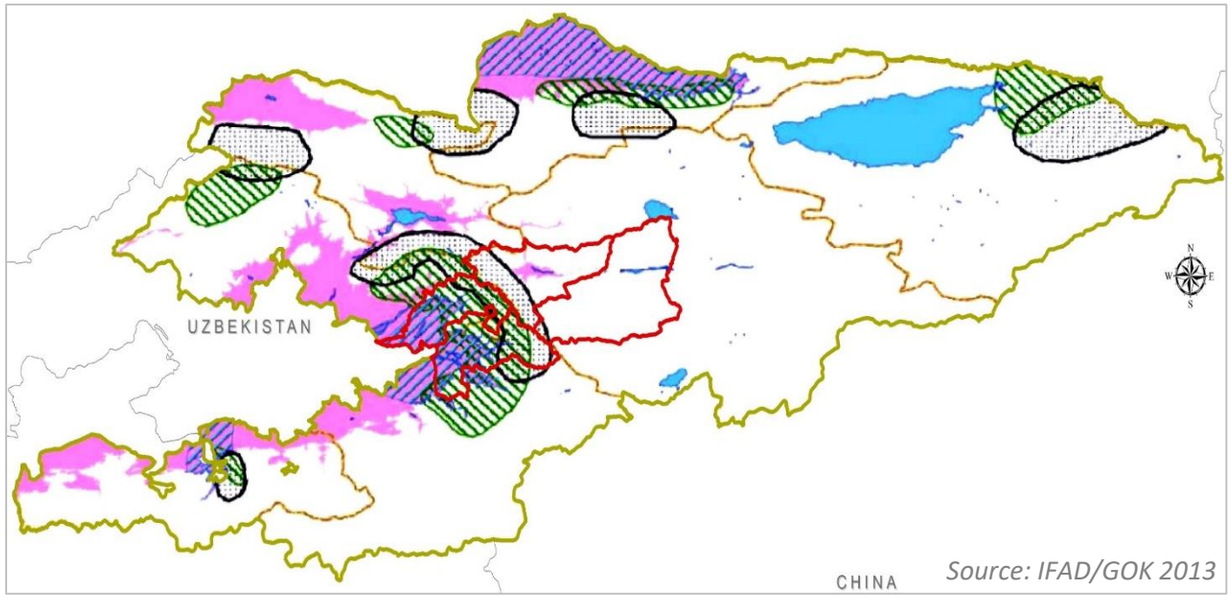
By estimating the cumulative presence of different types of hazards in each rayon of Kyrgyzstan, a classified map of climate change related risks was compiled.

Mudslides related to more intense rainfall in the spring at medium altitudes (and in a lesser degree also high altitudes);

River floods and water logging in spring, due to more intense rainfall. This will mainly affect lower altitudes and areas susceptible to flooding;

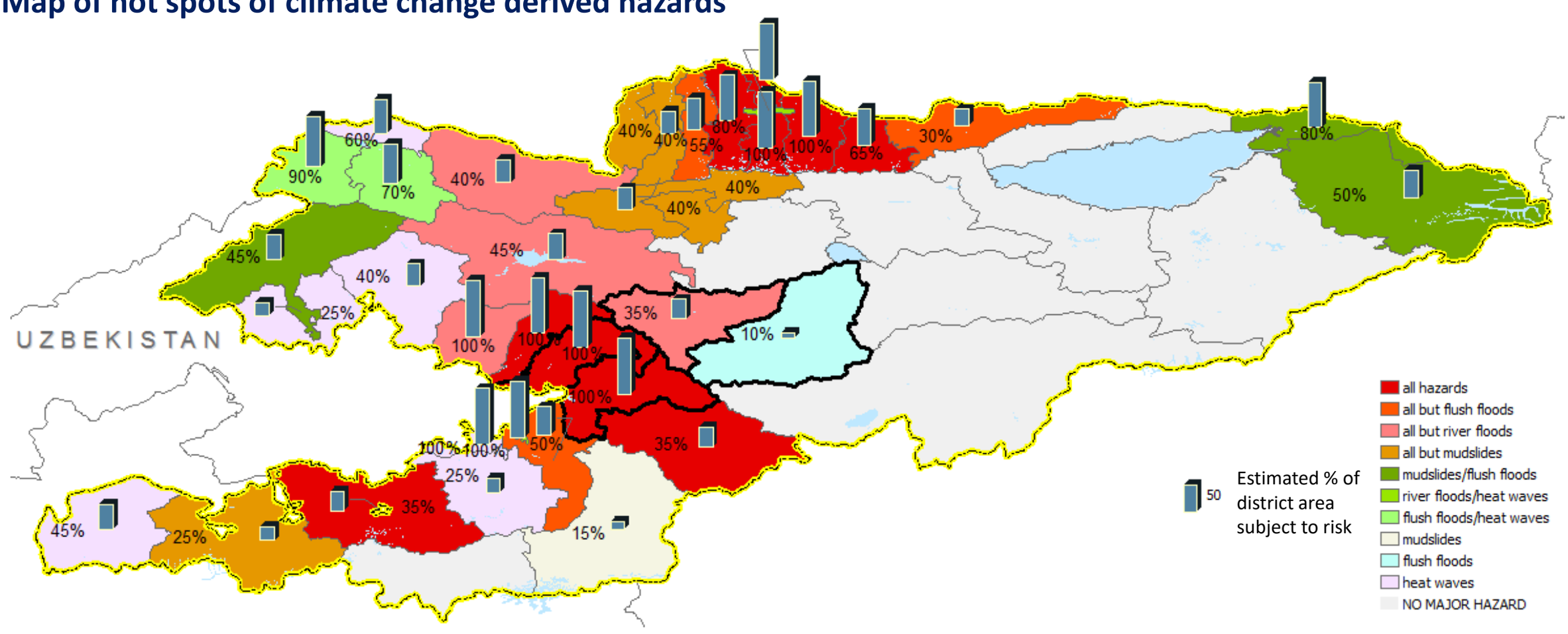
Flush floods in the summer especially at higher altitudes, related to higher temperatures together with the increase in winter, spring and autumn rainfall (snow at higher altitudes);

Heat stress in the summer, especially at lower altitudes;



Source: IFAD/GOK 2013

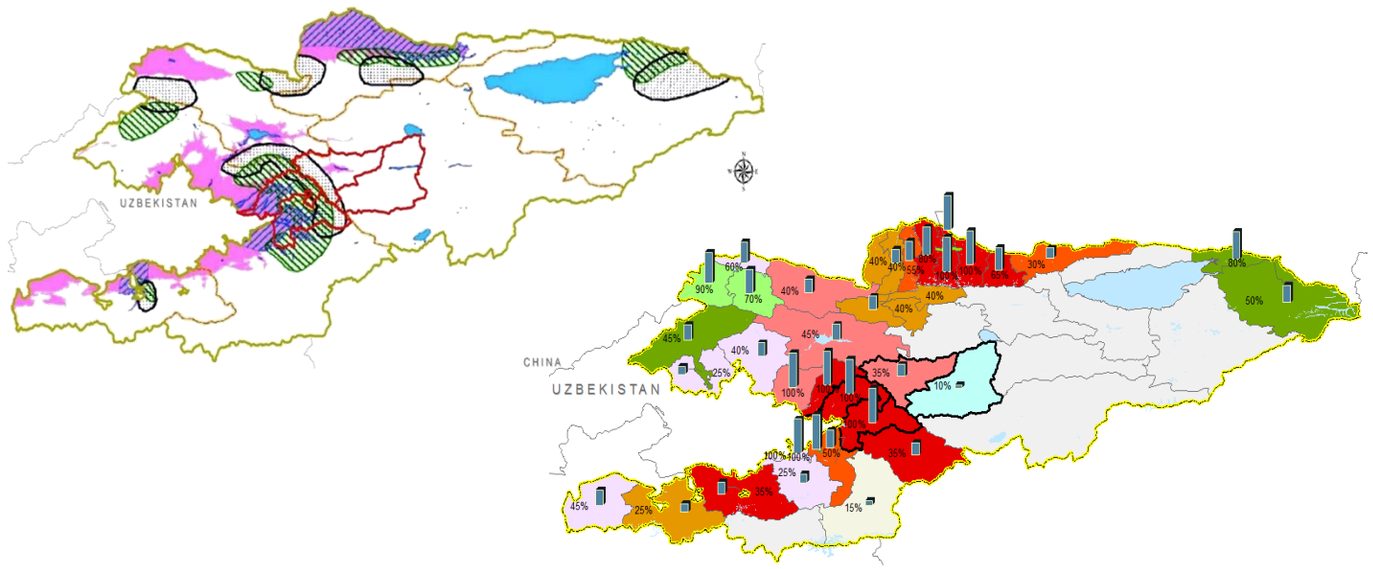
Map of hot spots of climate change derived hazards



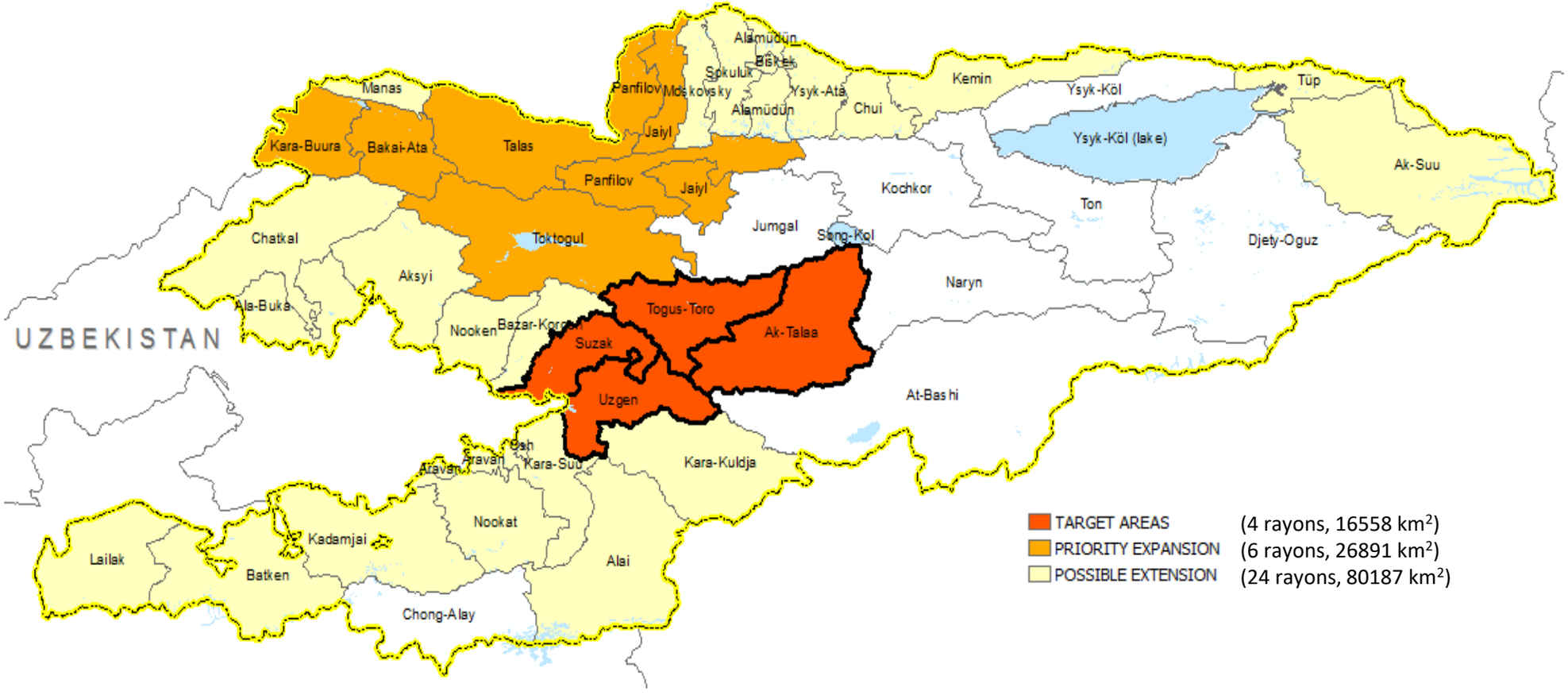
Source: IFAD/GOK 2013

Priority areas for project actions

Type and impact of different risks were used to identify a priority target are, a potential priority expansion area, and possible further extension areas.



Priority areas for Climate Change mitigation/adaptation actions in Kyrgyzstan



Walnut Forest Arslanbob © Kabar News Agency

The Kyrgyz Republic
BASELINE ATLAS

Core Target Area

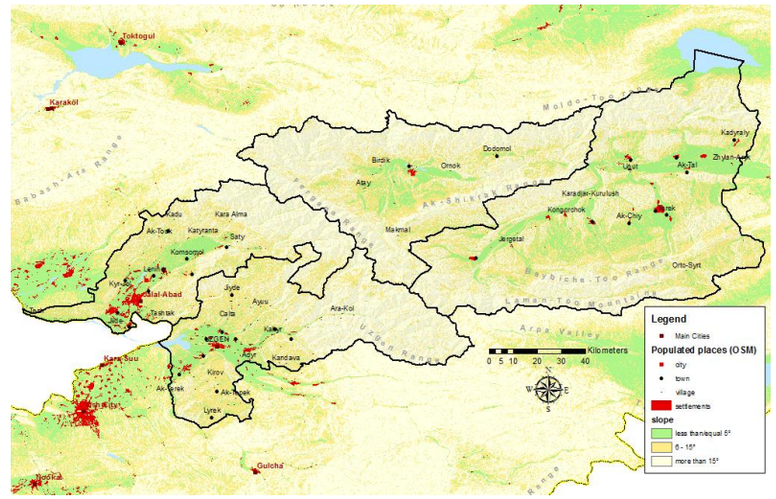
Table of Content

Core TARGET area

Foreword

This is a component of the **Kyrgyz Republic Baseline Atlas** which enters in the details of demographic, topographic, climatic and land resources concerning the four Rayons identified by the proposing project as core target: Suzak (Jalal-Abad), Toguz-Toro (Jalal-Abad), Ak-Talaa (Naryn) and Uzgen (Osh).

It is the result of collecting publicly available information and data or local datasets, perform QA&QC, implement models, when required, to generate new data, and then produce maps and statistics by topic of interest.



Particular focus has been given to issues related to Climate Change and its impact on sectors of great importance in Kyrgyzstan such as pastoralism and forestry.

Several climatic variables have been measured and crossed check with topographic conditions, vegetation patterns and long time trends in order to better understand the ongoing processes that have shaped current landscapes, and provide solid evidence to target areas for mitigation and adaptation actions with higher probability of success.

The Atlas is a regional synthesis at disposal of debates, negotiations and decision-making that will take place next during the project cycle. It does not cover all topics pertaining to the region, but an effort was made to cover some of the most critical for the purpose of the project.

The Author

Population and Geography

This area covers 17,409 km^2, which is about 8.7% of the national extent. The target area is made by four rayons from three oblasts, and include 60 villages, 25 pasture user associations, 14,500 households and 580,000 beneficiaries *(Sources: GCF/FAO)*

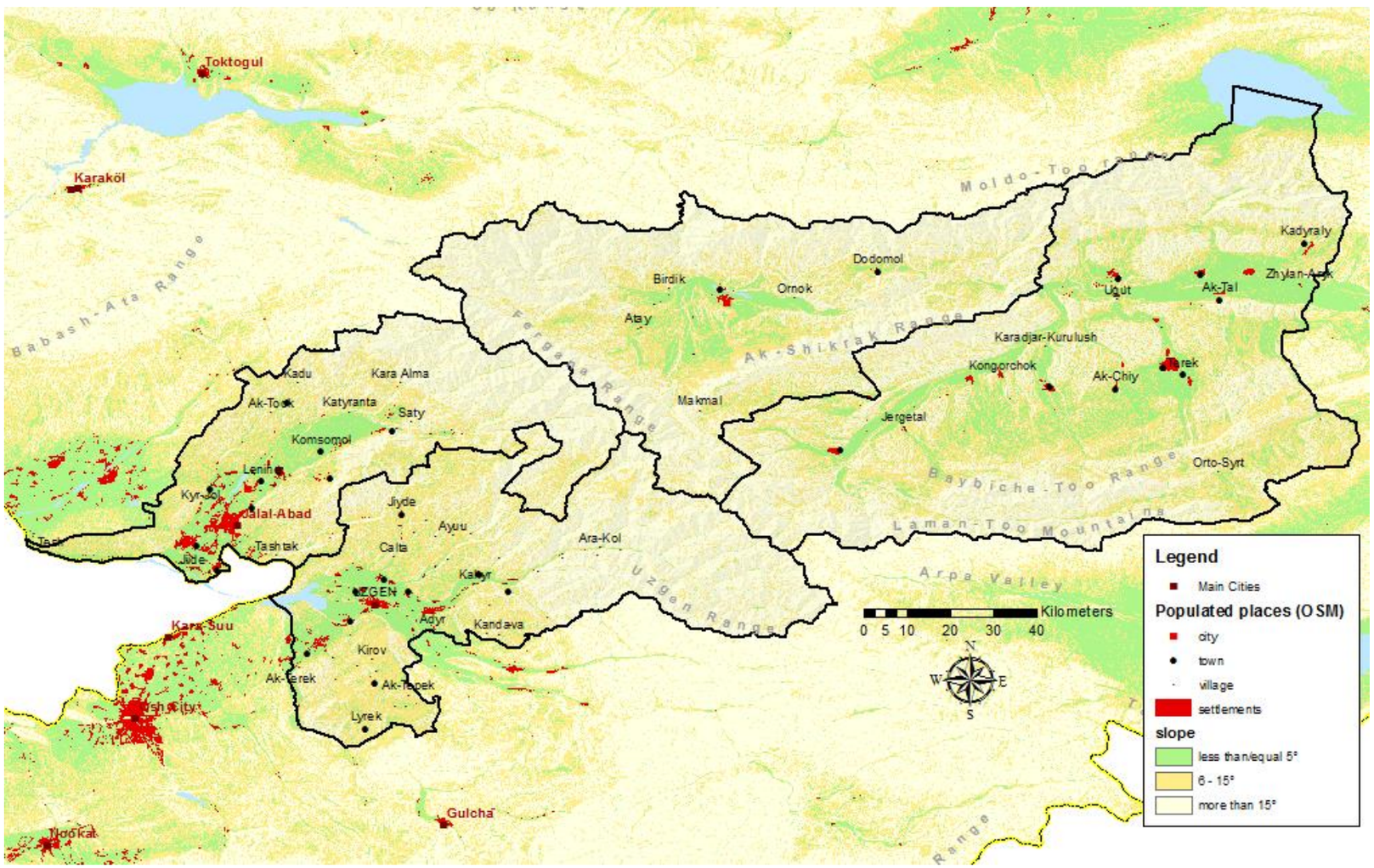
Most of populated places are located on flat areas or foothills at low altitude, making them at risk of climatic hazards such as landslides, mudflows, flooding etc..

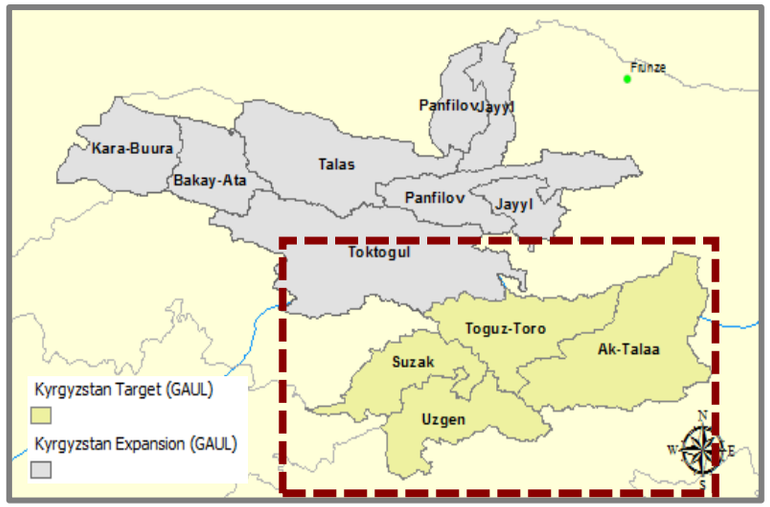
Statistics

			Census 2009	Estimate 2016		
Rayon	Oblast	Area (km^2)	Total resident pop	Total pop	Urban pop	Rural pop
Suzak	Jalal-Abad	3,019	241,200	277,500	11,300	266,200
Toguz-Toro	Jalal-Abad	3,816	22,100	24,000	0	24,000
Ak-Tala	Naryn	7,266	30,600	32,100	0	32,100
Uzgen	Osh	3,308	228,600	256,400	56,100	200,300
TOT		17,409	522,500	590,000	67,400	522,600

Source: Kyrgyzstan Population Statistics. OCHA. https://data.humdata.org/dataset/kyrgyzstan-population-statistics

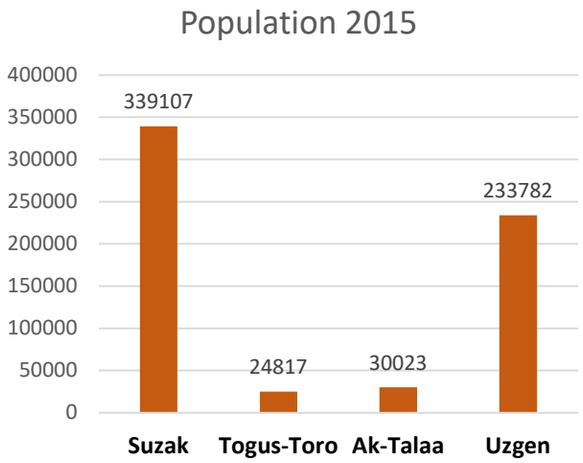
Settlements

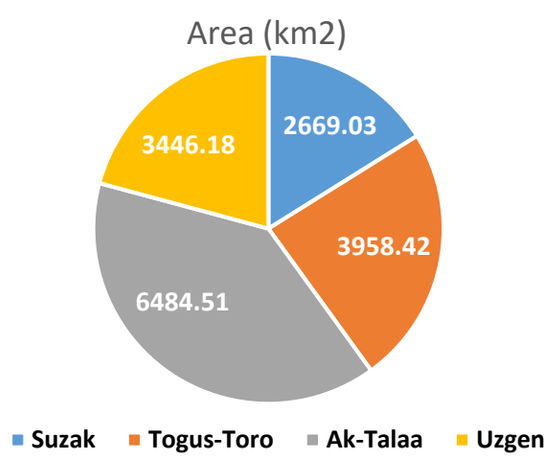


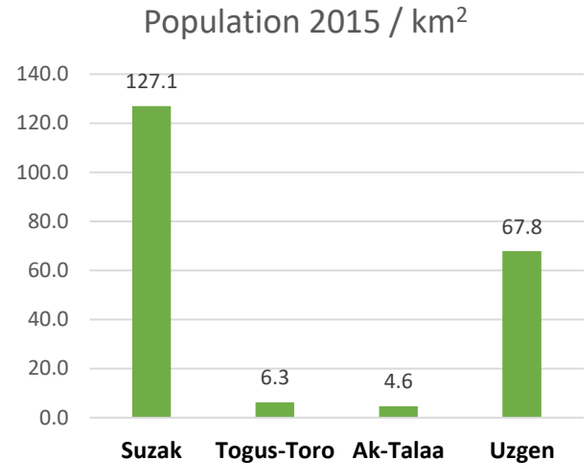


Target Area: Population and Geography

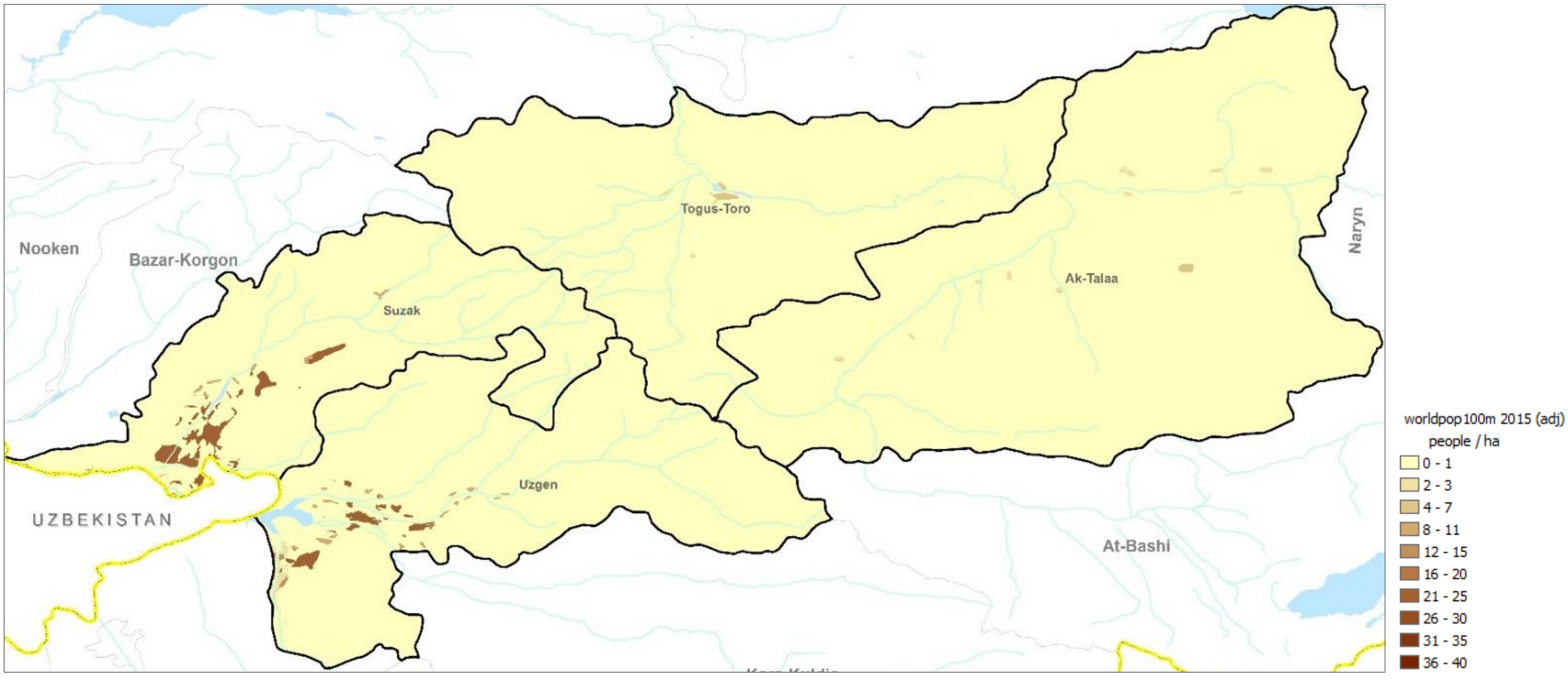
DEMOGRAPHY







Map of population density 2015

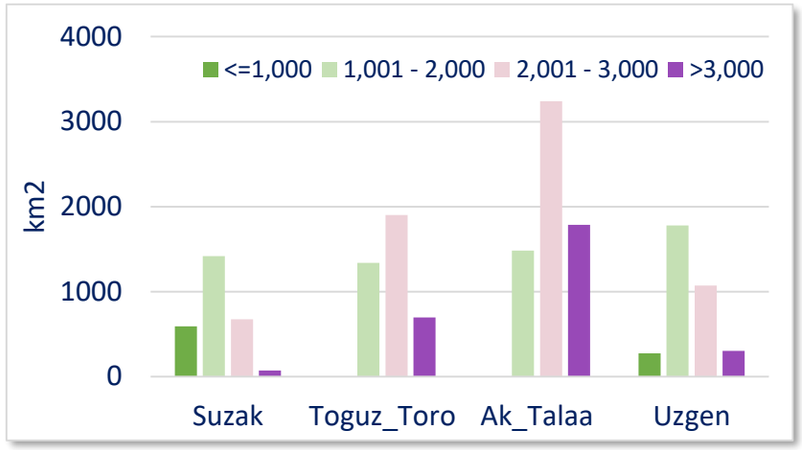


Source: WorldPop project. http://www.worldpop.org.uk/

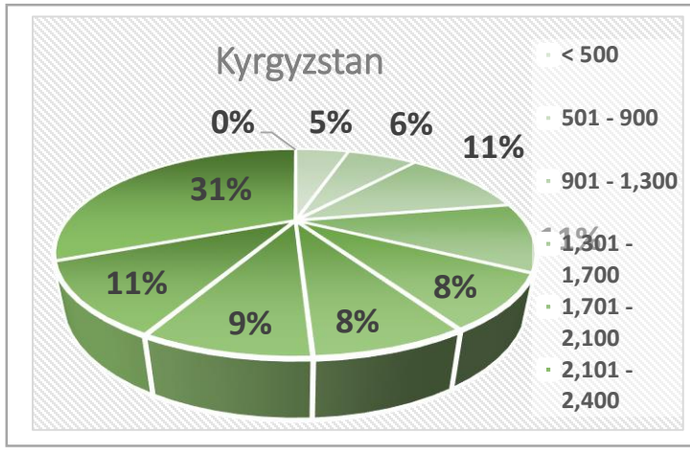
Target Area: Elevation

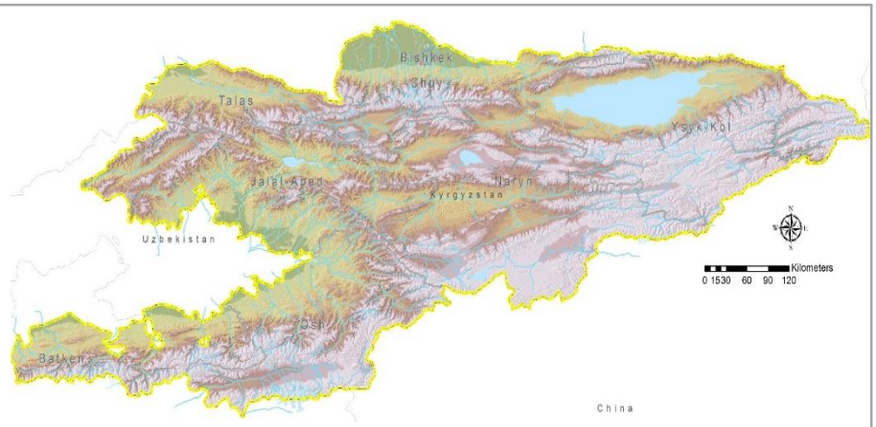
TOPOGRAPHY

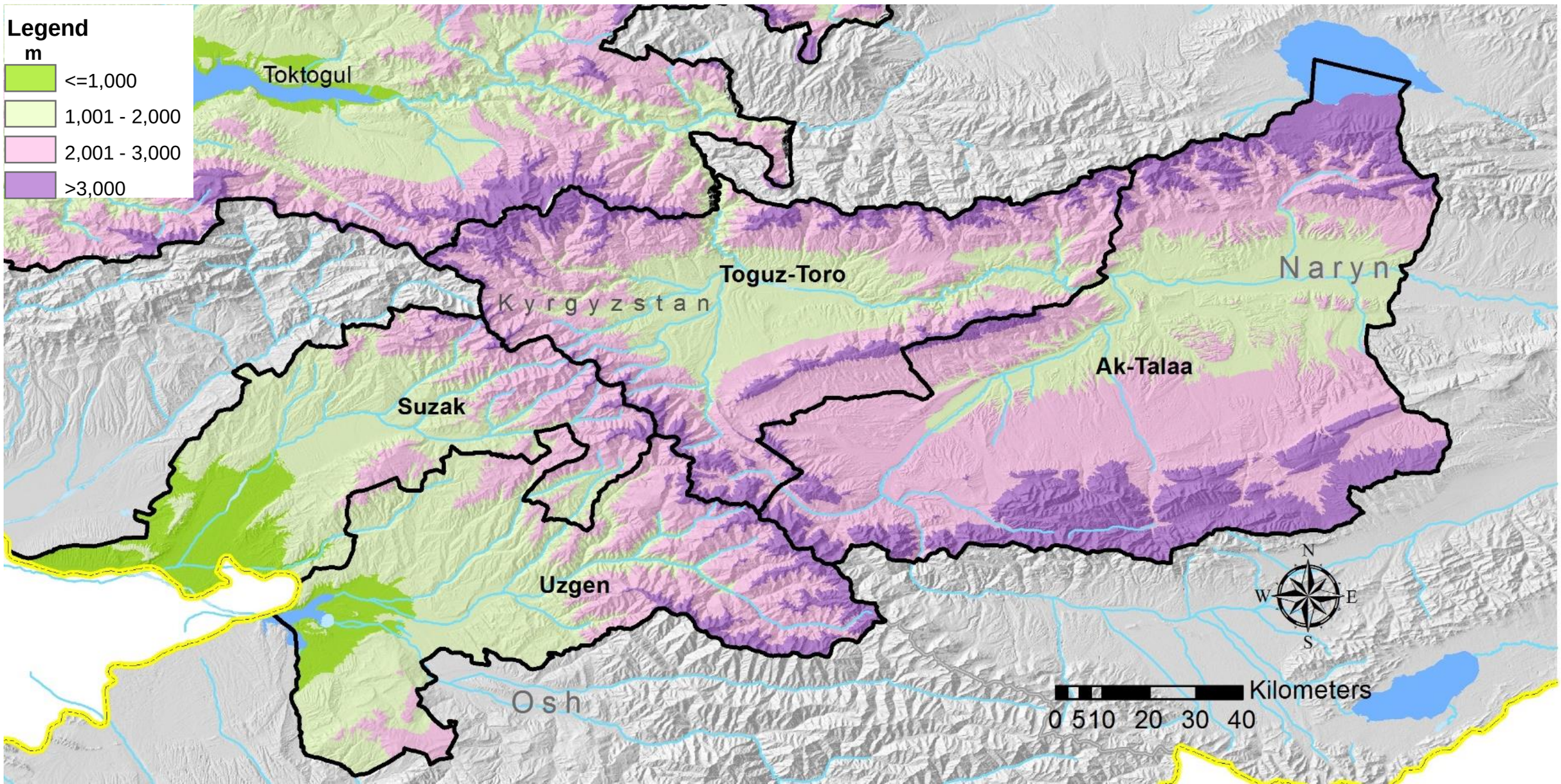
Area (km²) by 4 class of elevation



Kyrgyzstan

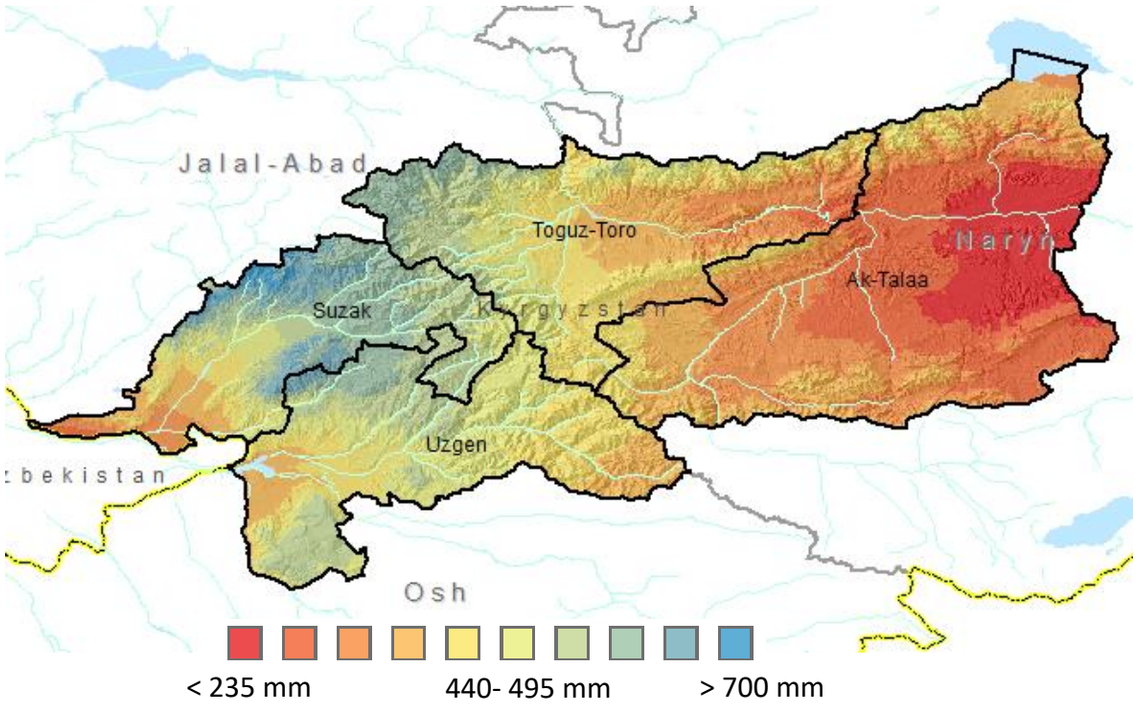




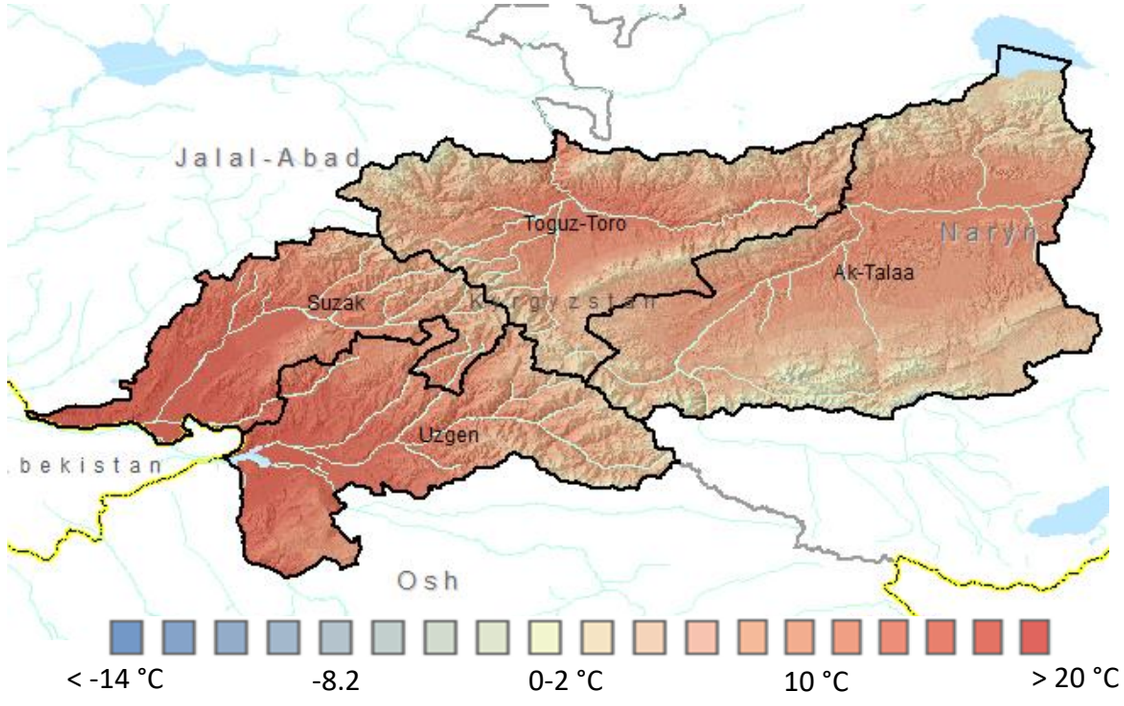


Target Area: Precipitation and Temperature distribution

Annual Total Precipitations (average 1970-2000)



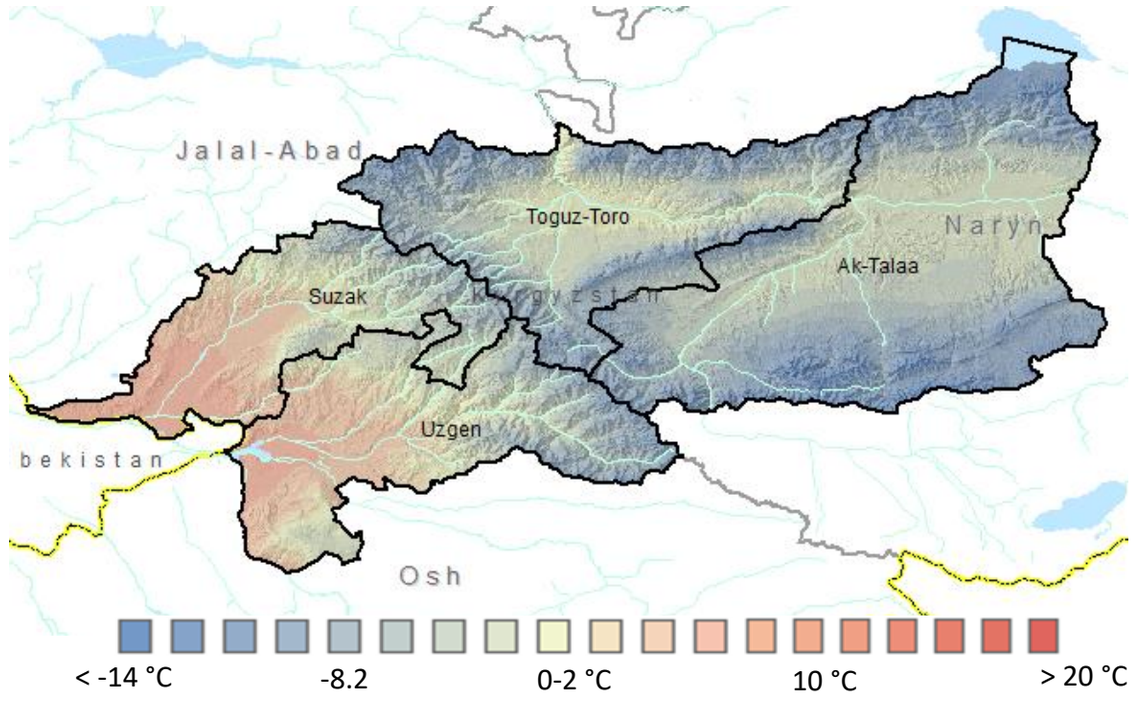
Annual Mean Max Temperature (average 1970-2000)



By district (average 1970-2000)

Rayon	PRECIPITATIONS (mm)	MAX TEMPERATURE (°C)	MIN TEMPERATURE (°C)
Suzak	556	14.5	1.7
Toguz-Toro	476	9.0	-3.7
Ak-Talaa	347	8.0	-4.7
Uzgen	511	13.3	0.6

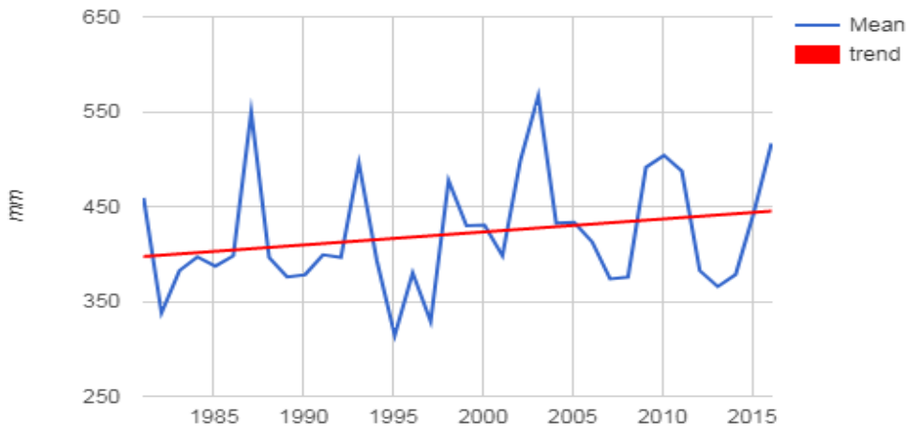
Annual Mean Min Temperature (average 1970-2000)



Source: WorldClim Version2 - http://worldclim.org/version2

Target Area: Annual Total Precipitation

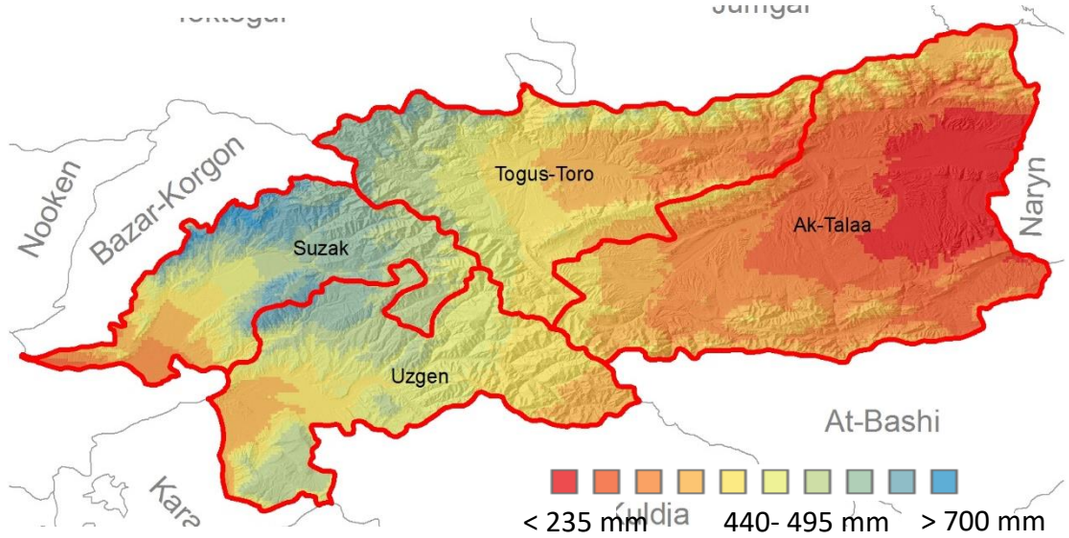
Distribution 1981-2016: country



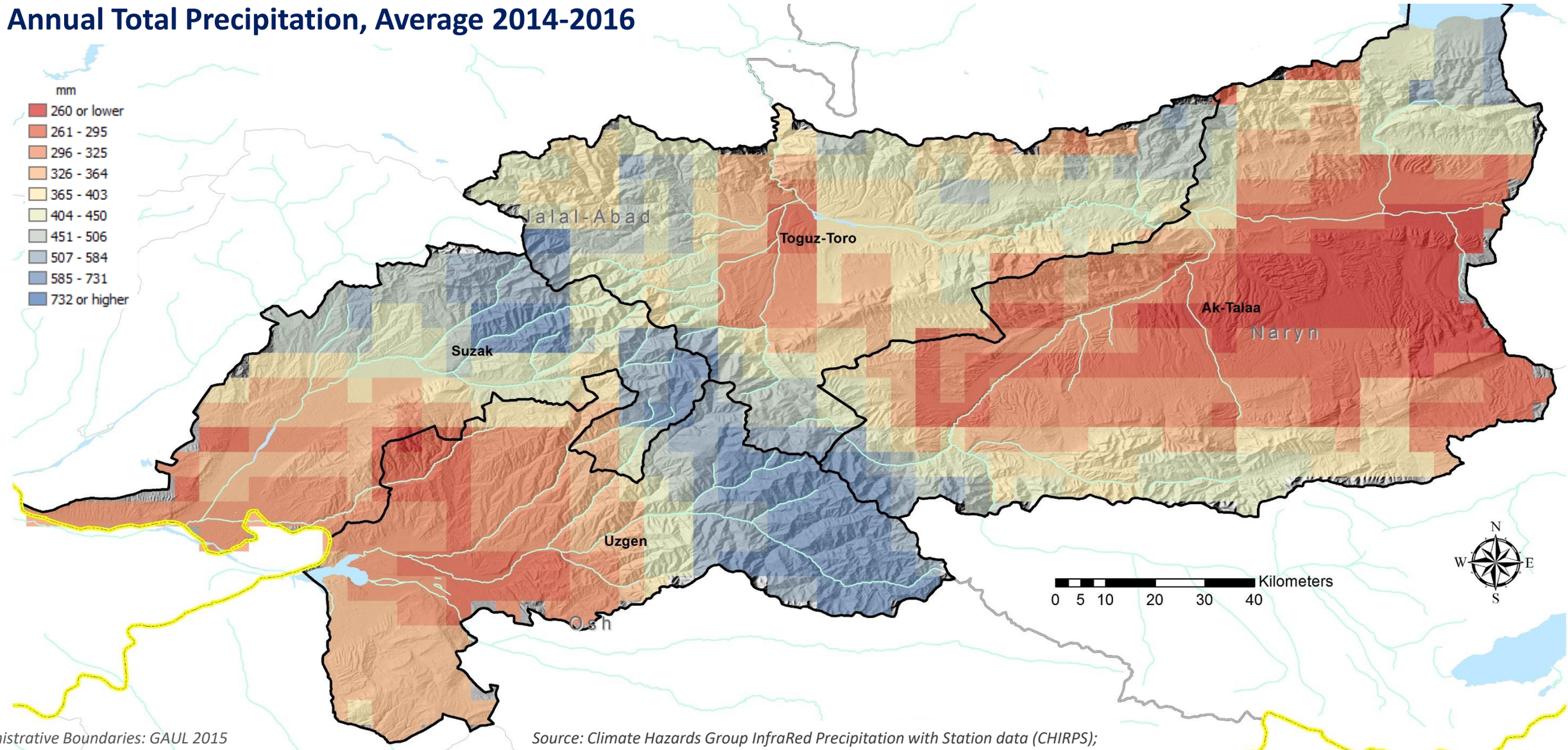
Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS);

Annual Mean 1970-2000

Source: WorldClim2;



Annual Total Precipitation, Average 2014-2016

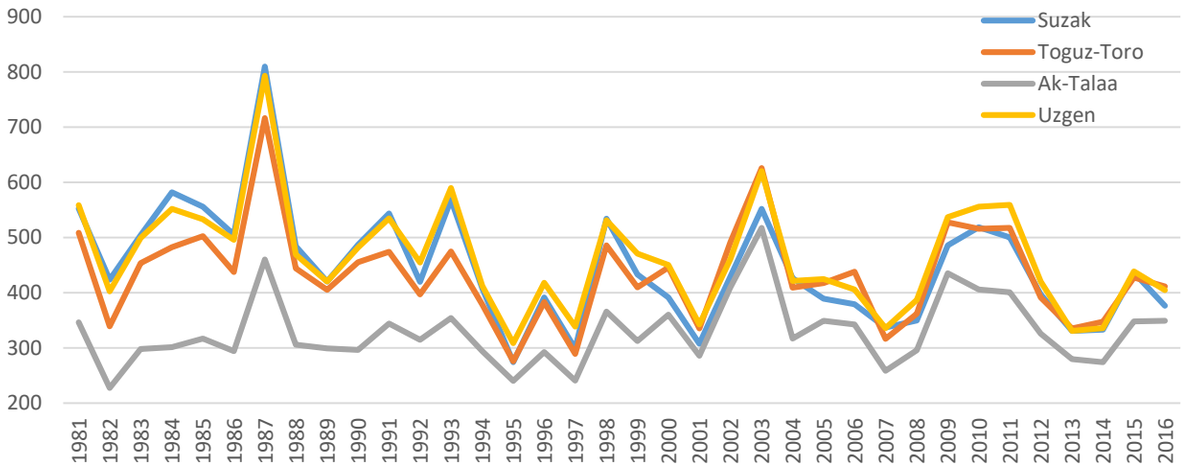


Administrative Boundaries: GAUL 2015

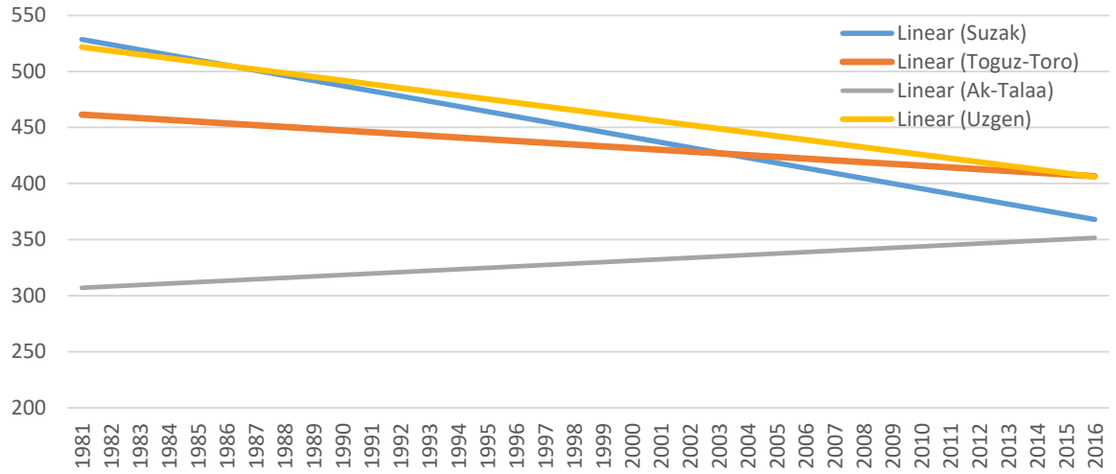
Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS);

Target Area: Annual Precipitation trend

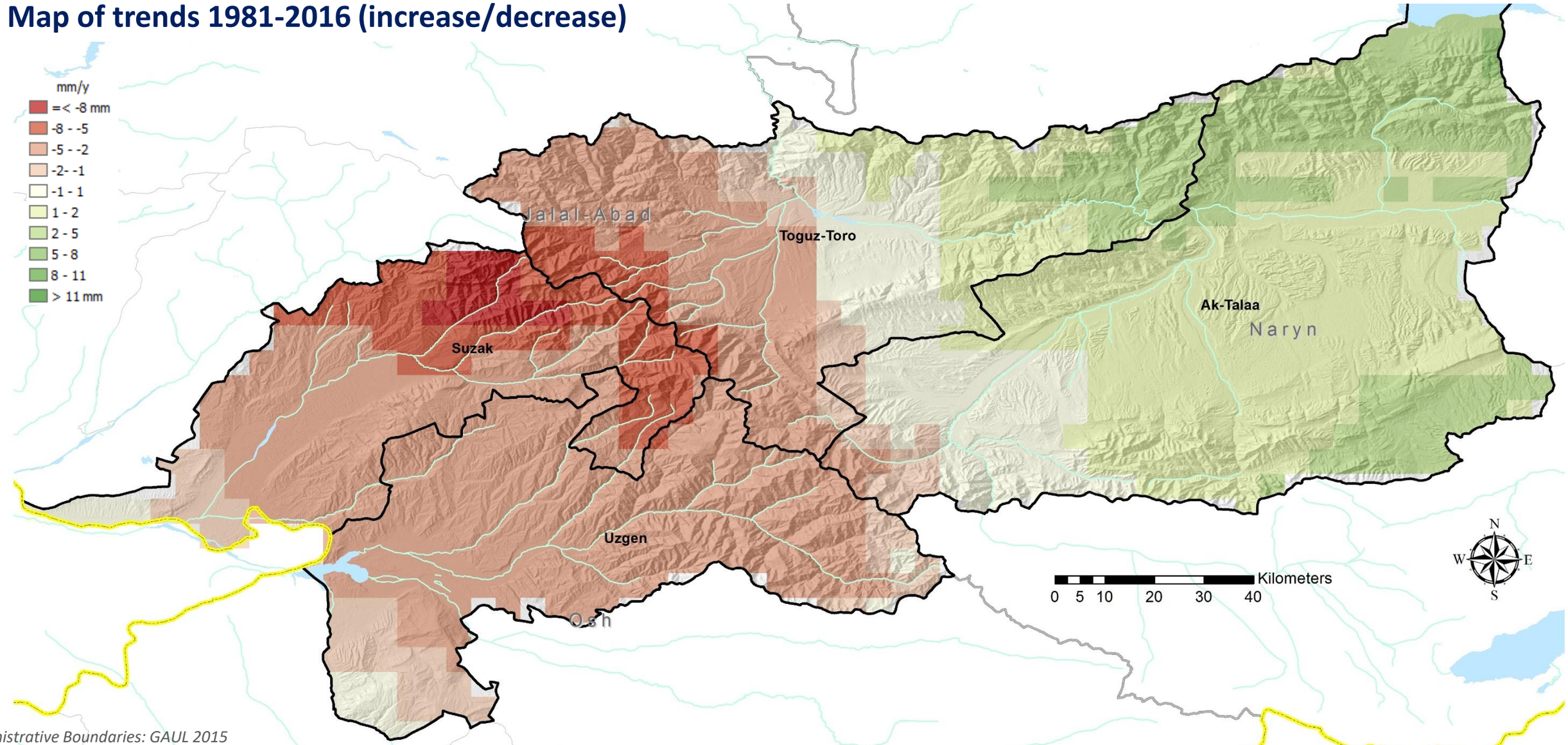
Annual Precipitation 1981-2016: target rayons



Linear Trend 1981-2016 by rayon



Map of trends 1981-2016 (increase/decrease)

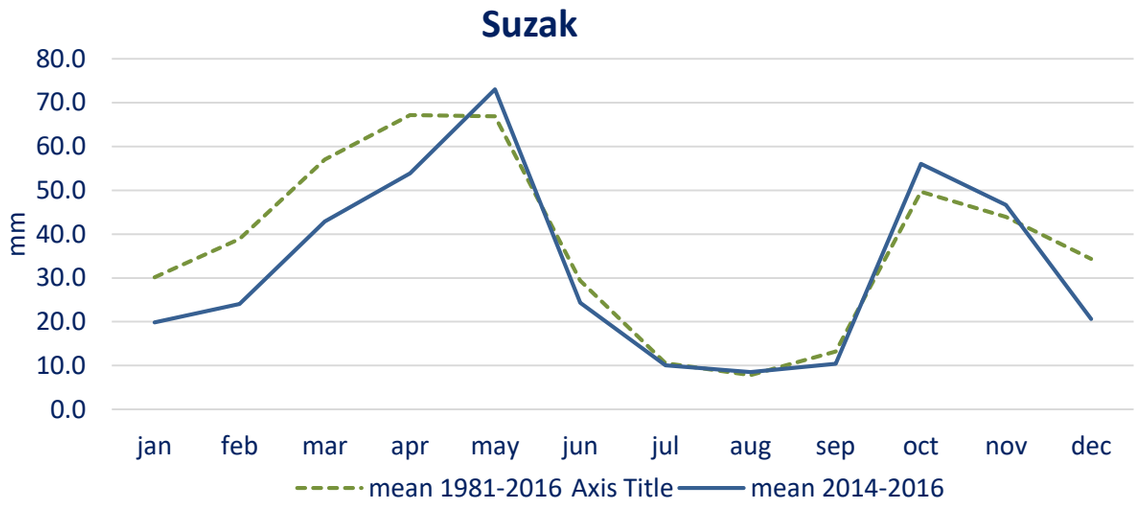


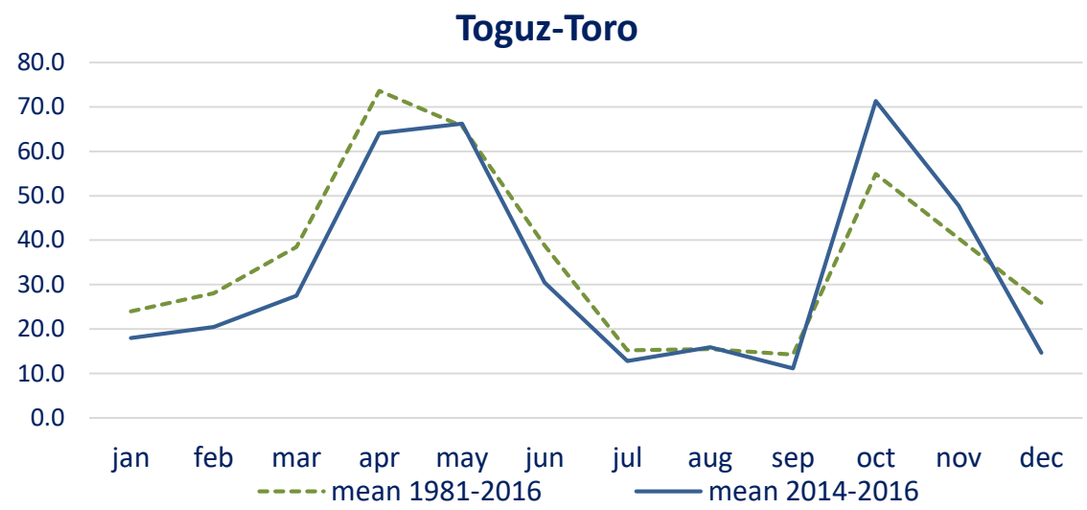
Administrative Boundaries: GAUL 2015

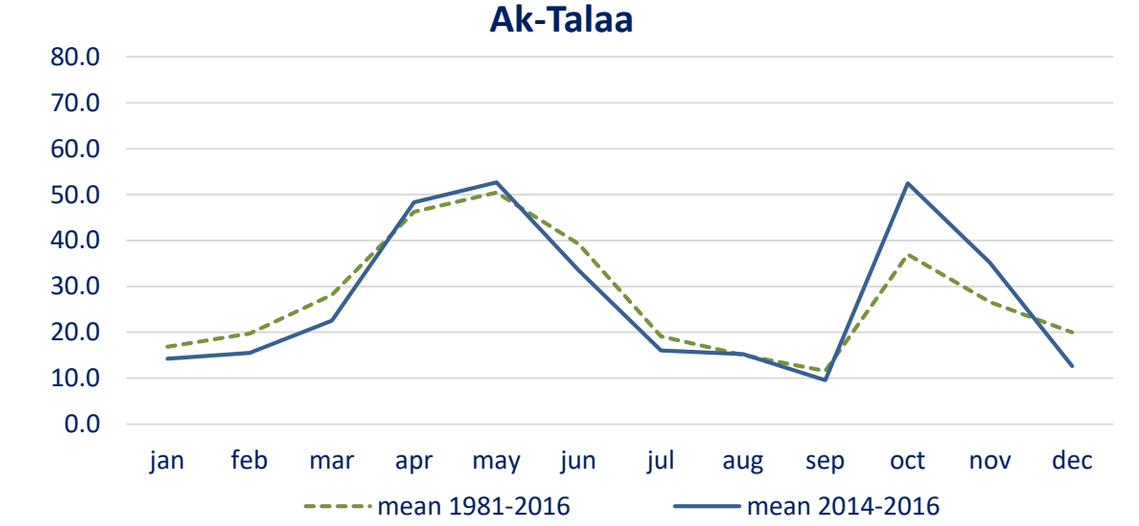
Target Area: Precipitation Anomalies

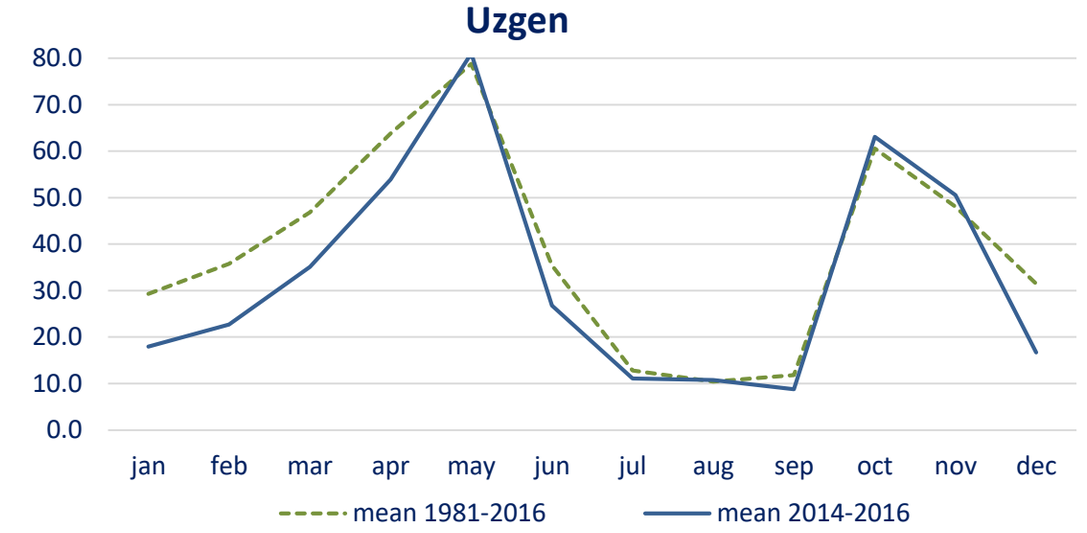
Monthly anomalies: mean 2014-2016 vs. 1981-2016

Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)
Administrative Boundaries: GAUL 2015



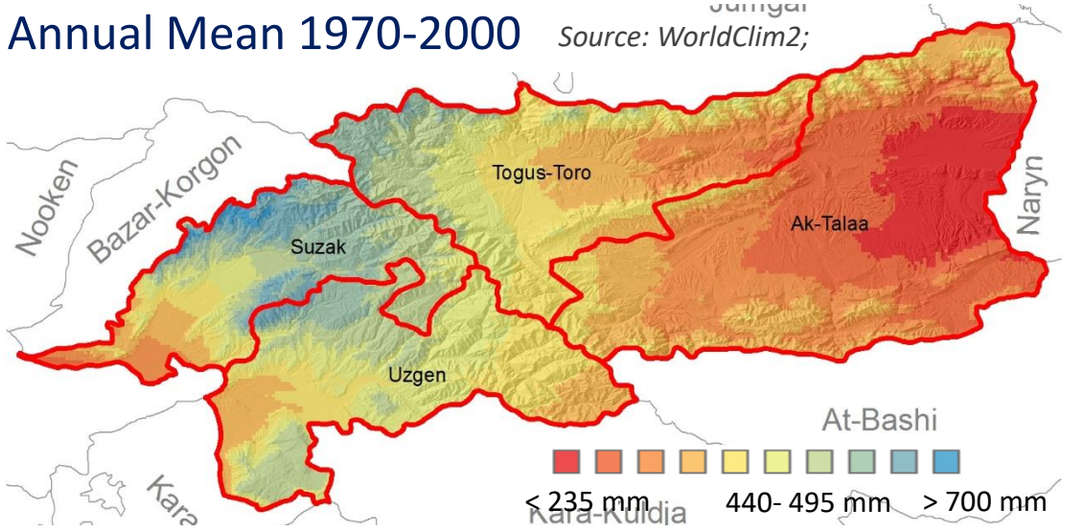


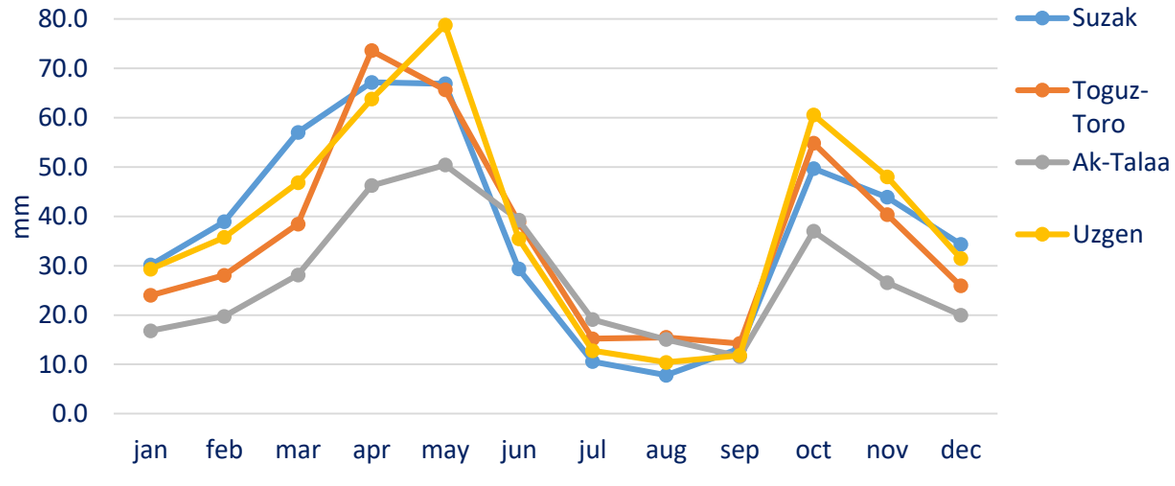




Annual Mean 1970-2000

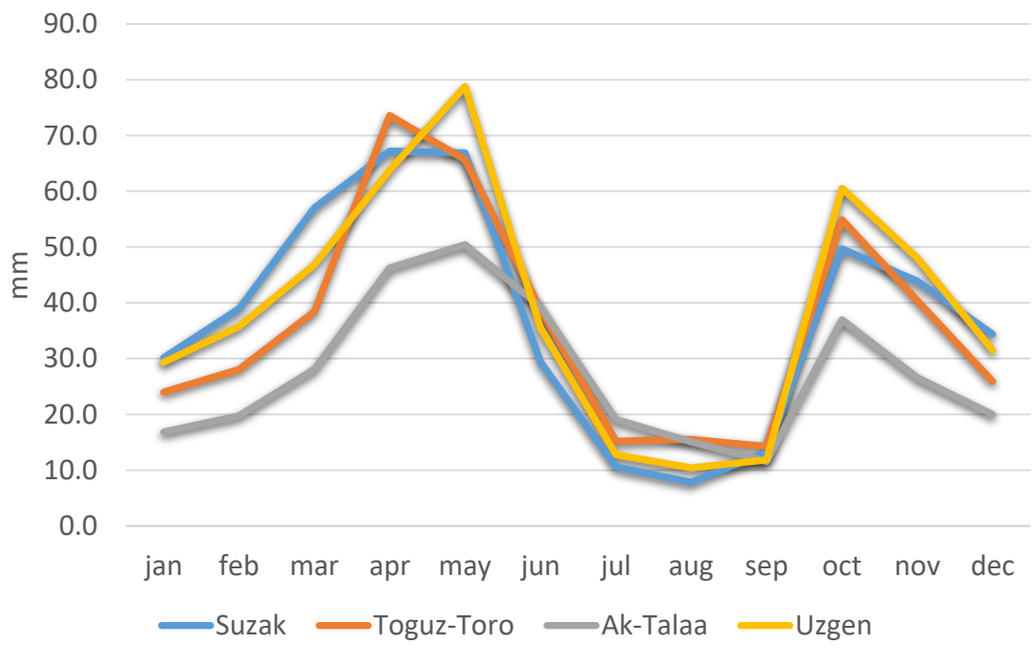
Source: WorldClim2;



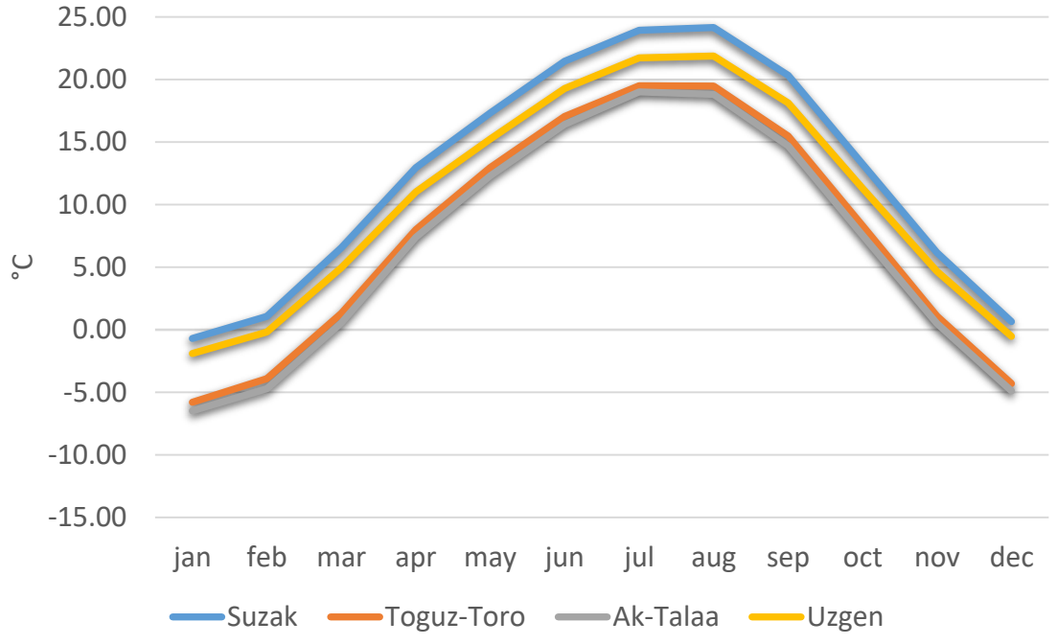


Target Area: Monthly Precipitation and Temperature profiles

Monthly Precipitations (1981-2016)



Monthly Max Temperature (1989-2016)



Climate Factsheet

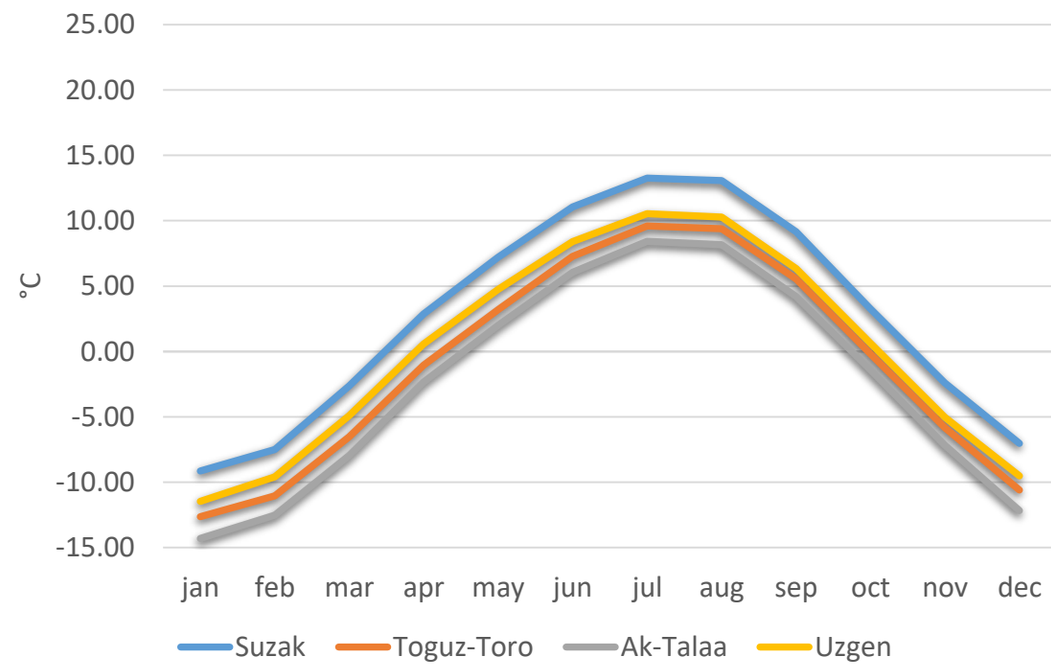
The **valley-sub-mountain zone** (from 900-1,200 m) experiences hot summers, snowless and temperate winters, and low precipitation.

The **mountain zone** (from 900–1,200 to 2,000–2,200 m) is characterized by a temperate climate, which has warm summers and cold, snowy winters.

The **high-mountain zone** (from 2,000–2,200 to 3,000–3,500 m) is cooler in the summer and has relatively cold, snowless winters, with temperatures ranging from well below zero to 16 °C.

The **nival belt zone** (from 3,500 m and higher) has a polar climate and is covered by numerous snowfields and glaciers.

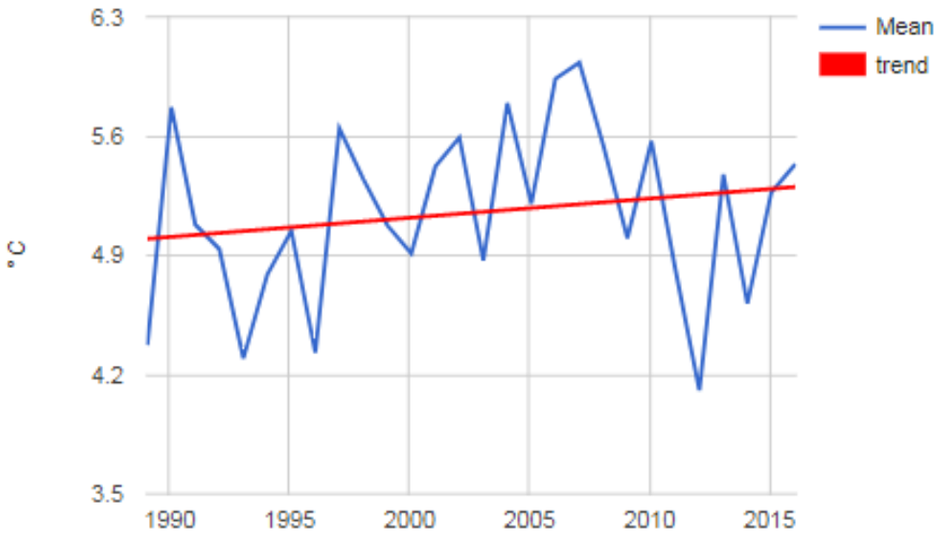
Monthly Min Temperature (1989-2016)



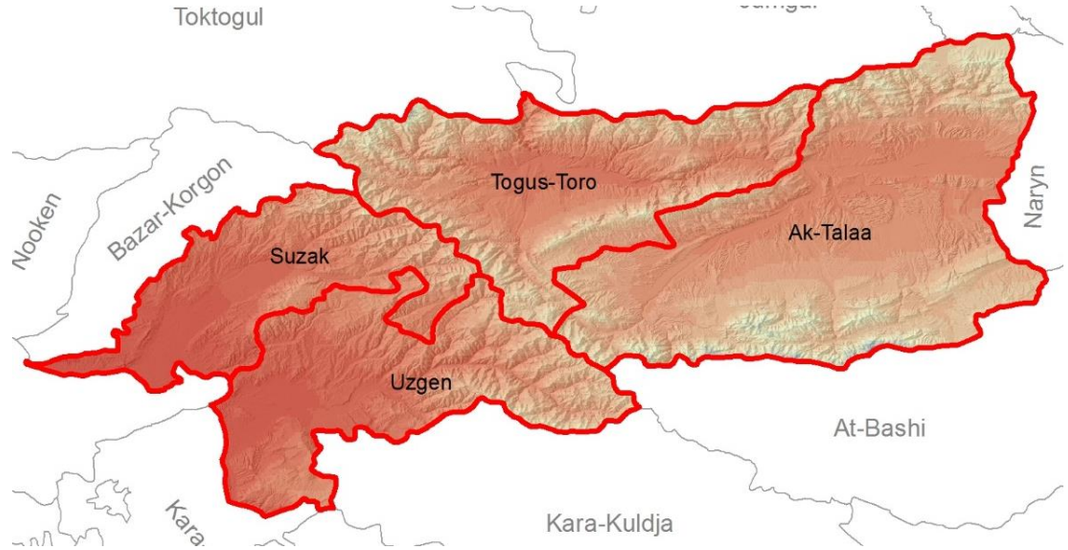
Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS), European Centre for Medium-Range Weather Forecast (ECMWF).

Target Area: MAX Temperature

Distribution MAX Temperature, national

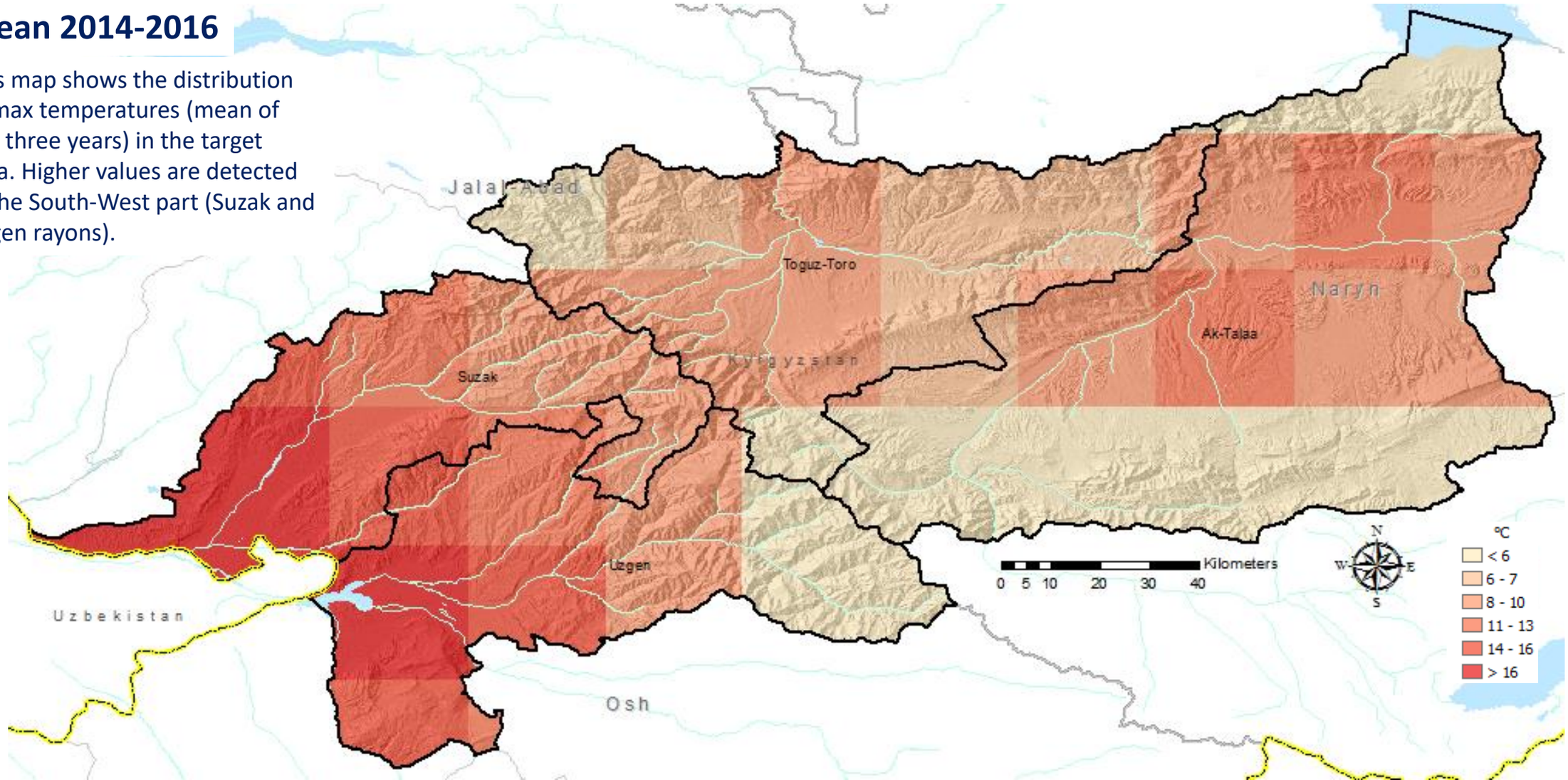


MAX Temperature, mean 1970-2000



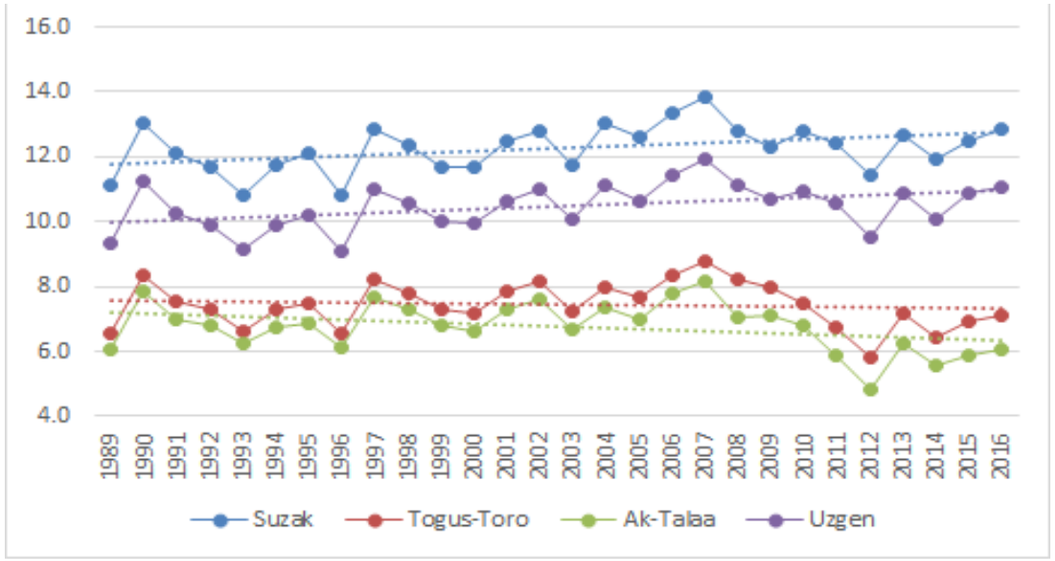
Mean 2014-2016

This map shows the distribution of max temperatures (mean of last three years) in the target area. Higher values are detected in the South-West part (Suzak and Uzgen rayons).

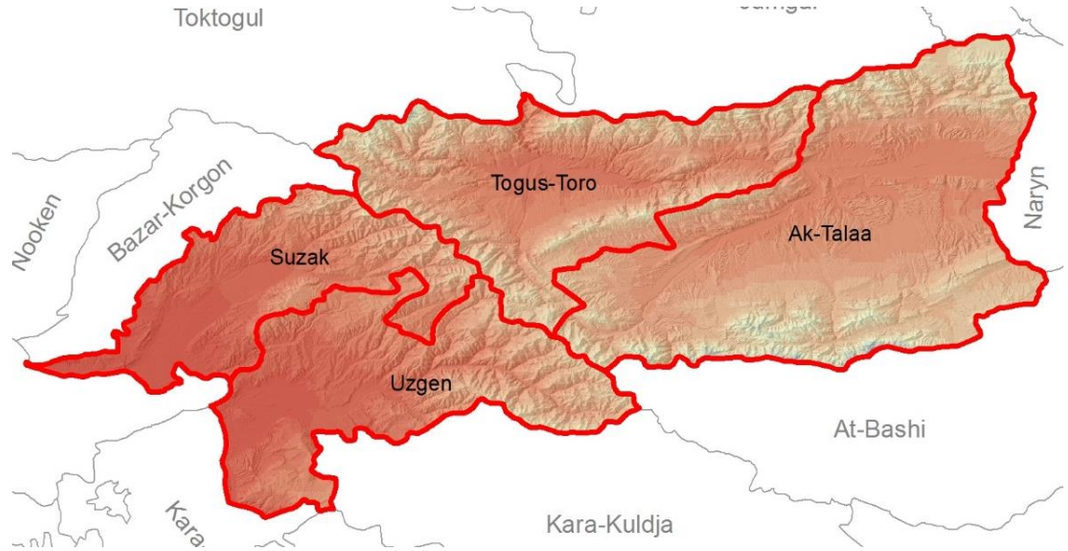


Target Area: Linear Trend MAX Temperature

Distribution target rayons

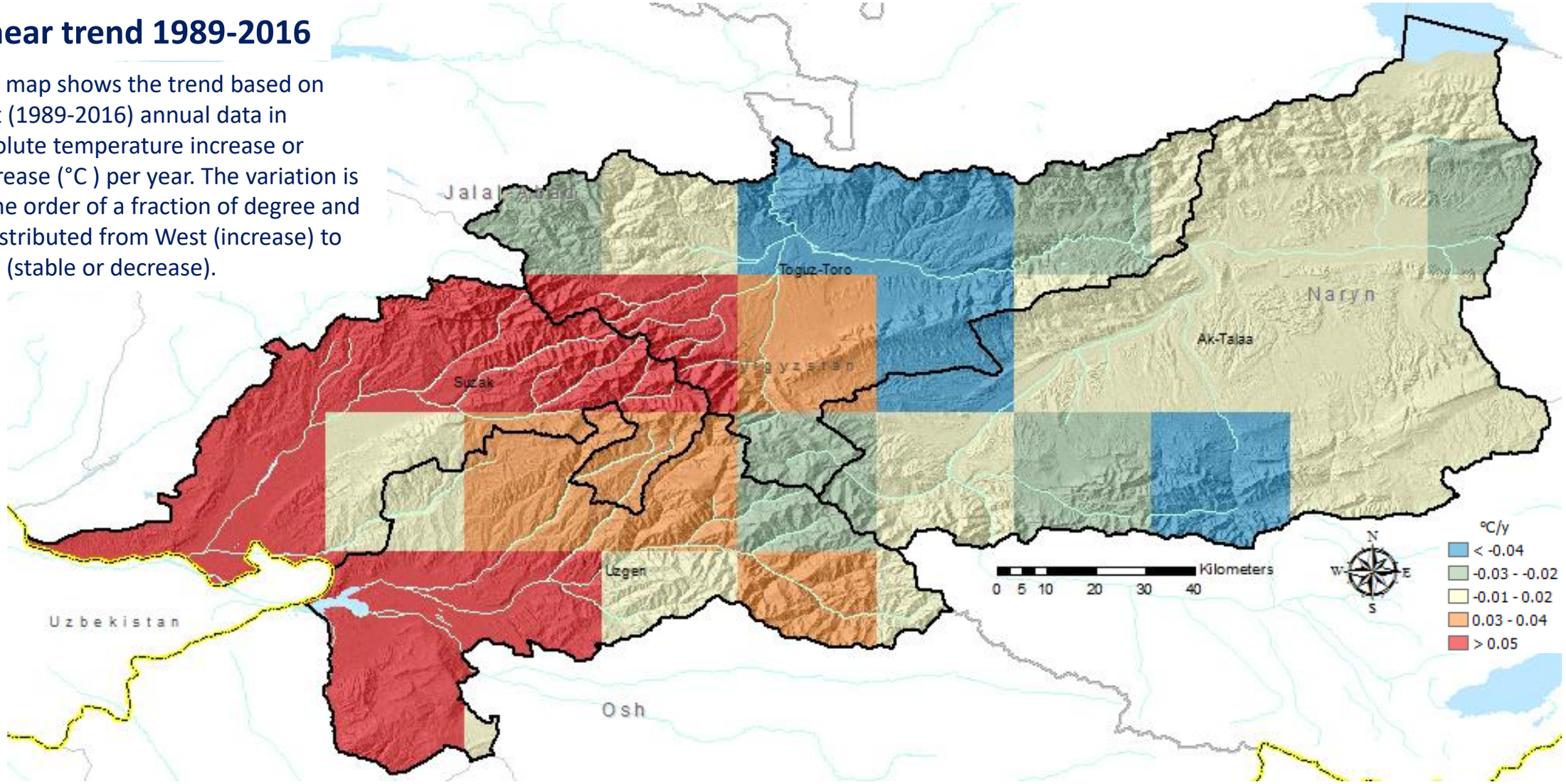


MAX Temperature, mean 1970-2000



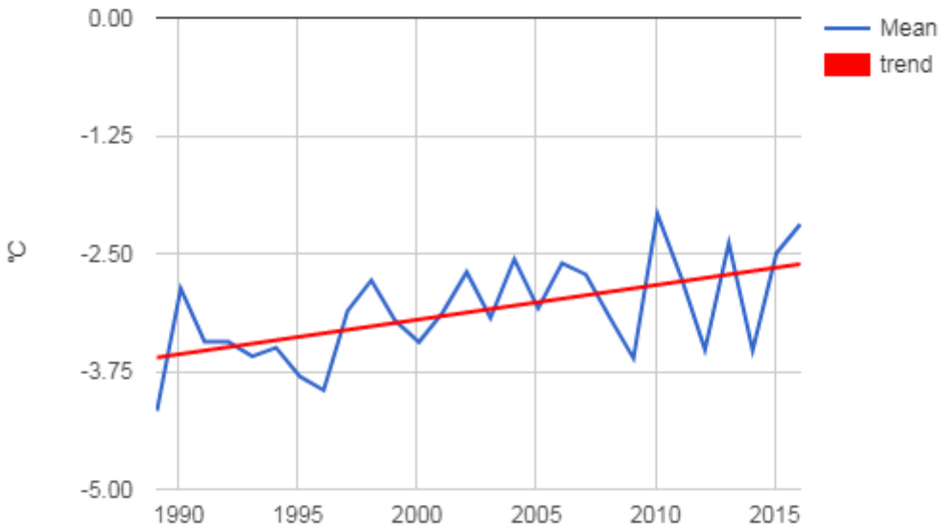
Linear trend 1989-2016

This map shows the trend based on past (1989-2016) annual data in absolute temperature increase or decrease (°C) per year. The variation is in the order of a fraction of degree and is distributed from West (increase) to East (stable or decrease).

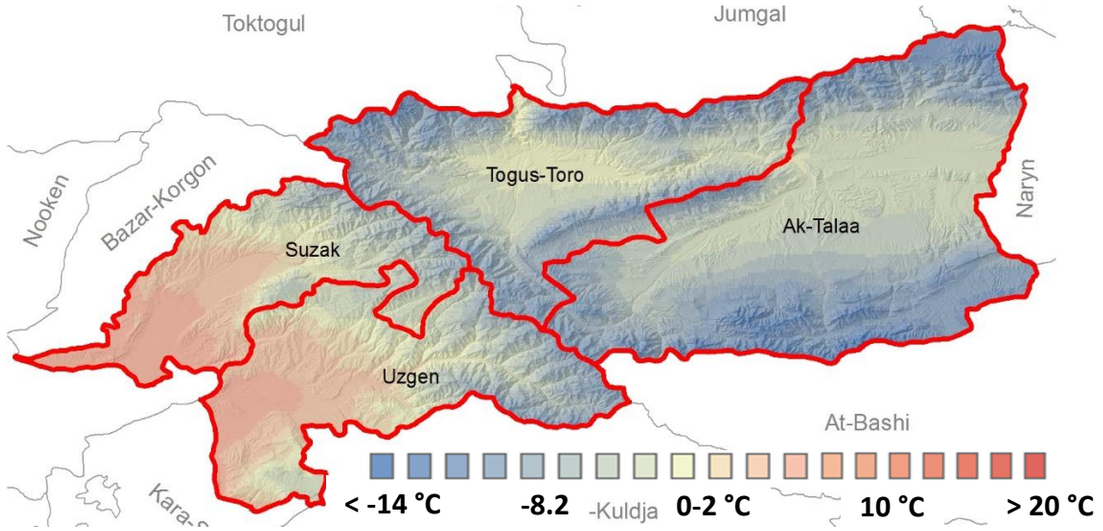


Target Area: MIN Temperature

Distribution MIN Temperature, national

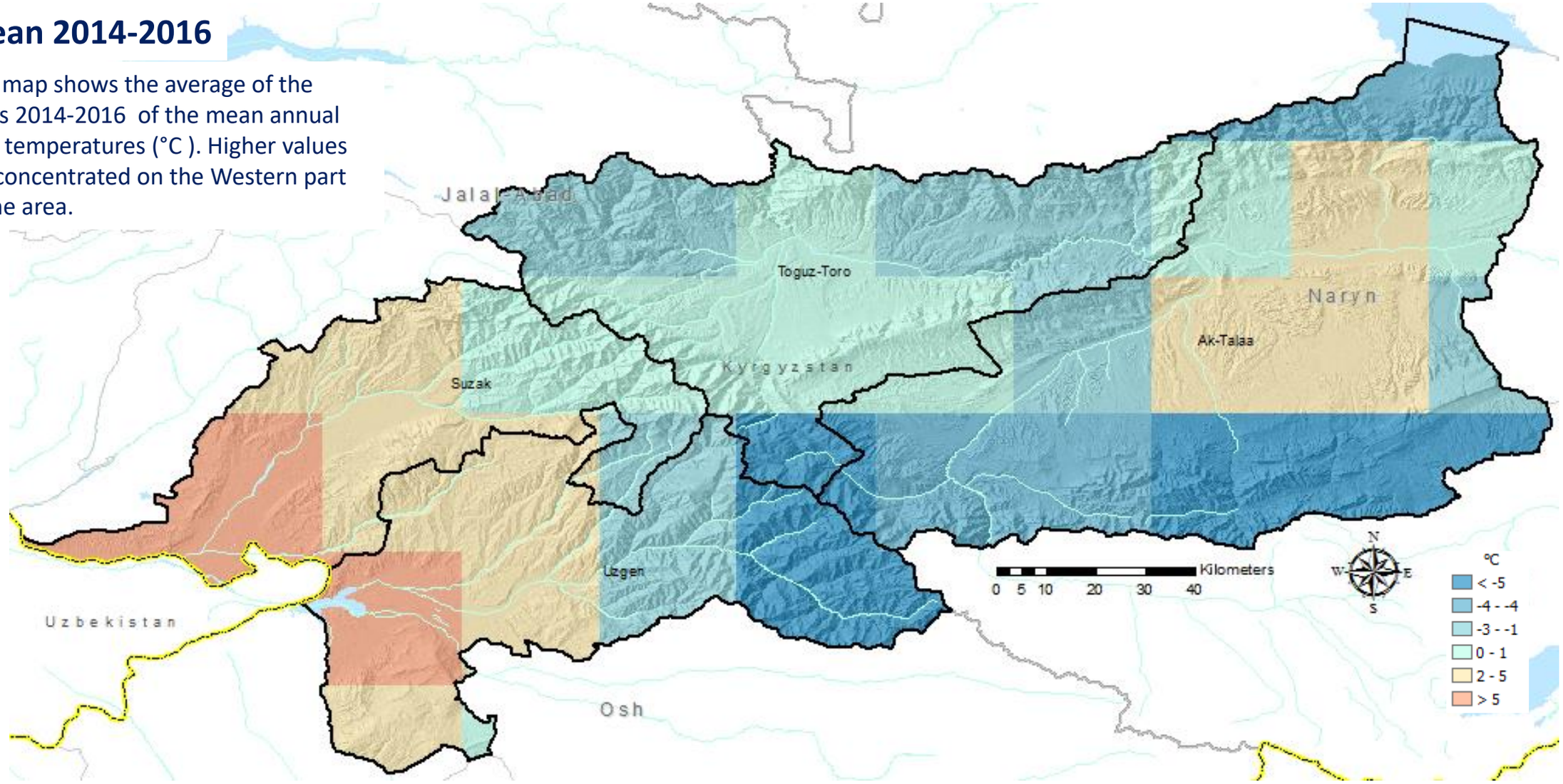


MIN Temperature, mean 1970-2000



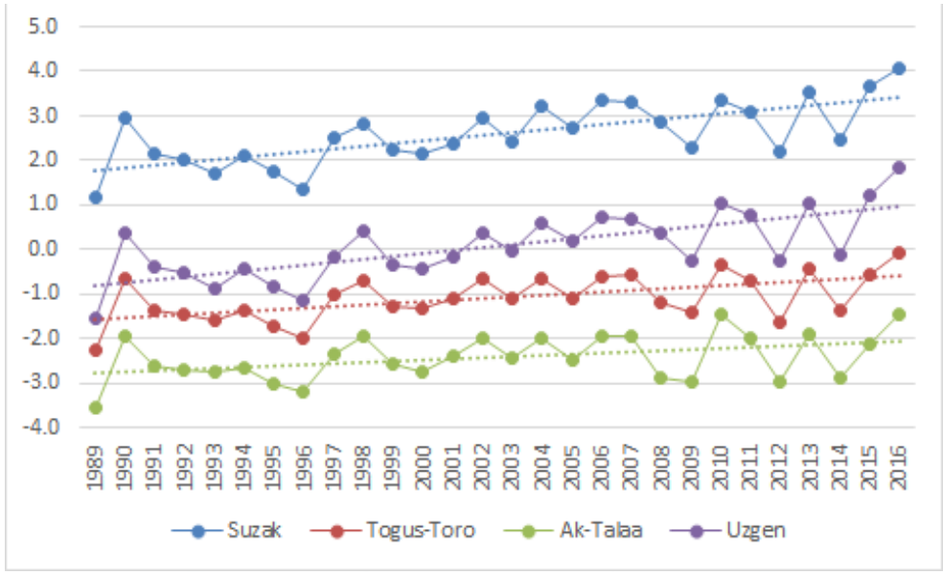
Mean 2014-2016

This map shows the average of the years 2014-2016 of the mean annual MIN temperatures (°C). Higher values are concentrated on the Western part of the area.

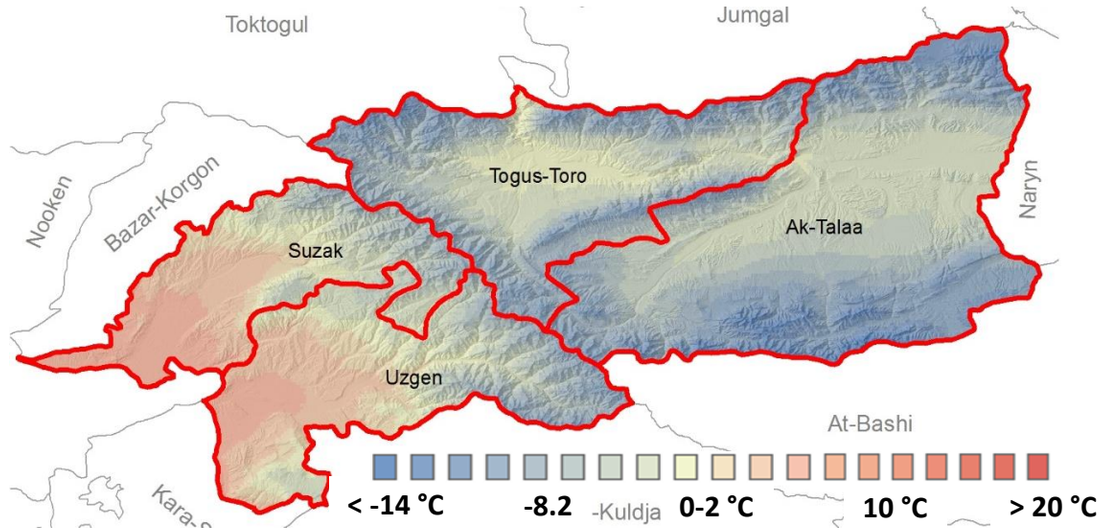


Target Area: Linear Trend MIN Temperature

Distribution MIN Temperature, target rayons

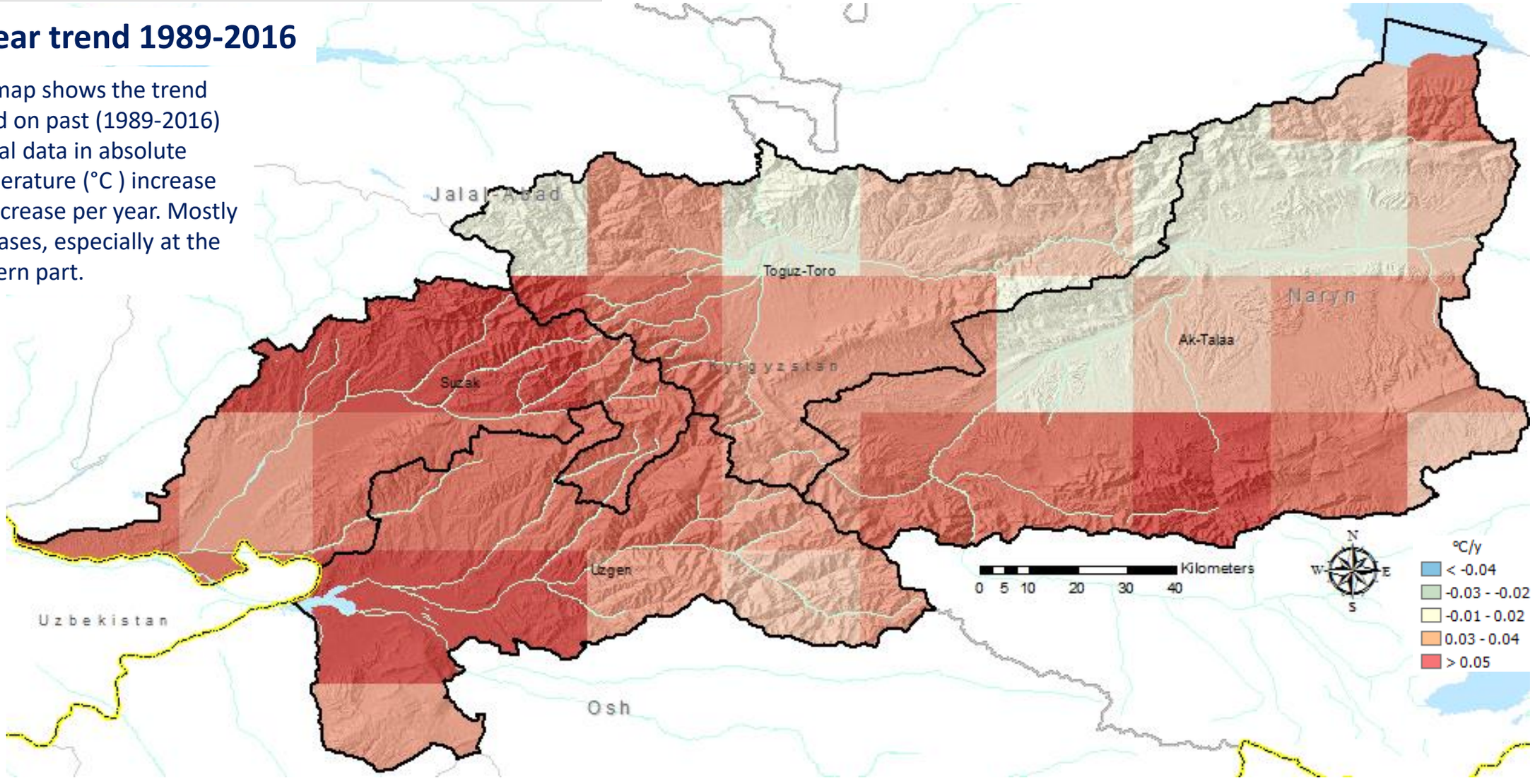


MIN Temperature, mean 1970-2000



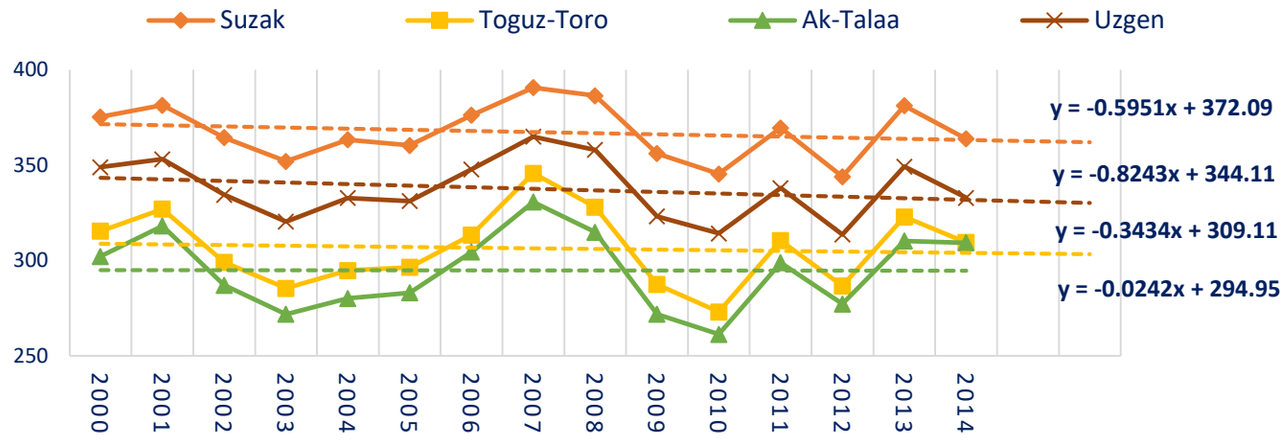
Linear trend 1989-2016

The map shows the trend based on past (1989-2016) annual data in absolute temperature (°C) increase or decrease per year. Mostly increases, especially at the western part.

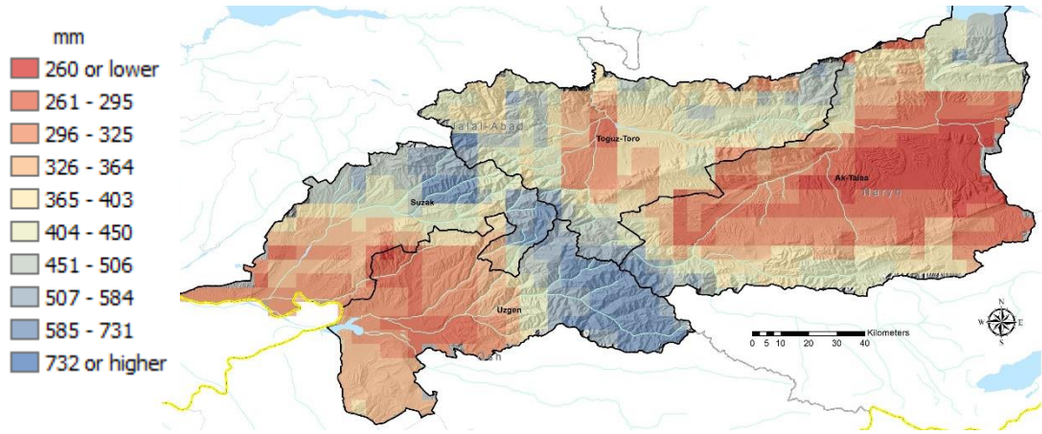


Target Area: Potential Evapotranspiration (PET)

Potential Evapotranspiration by Rayon (MODIS)



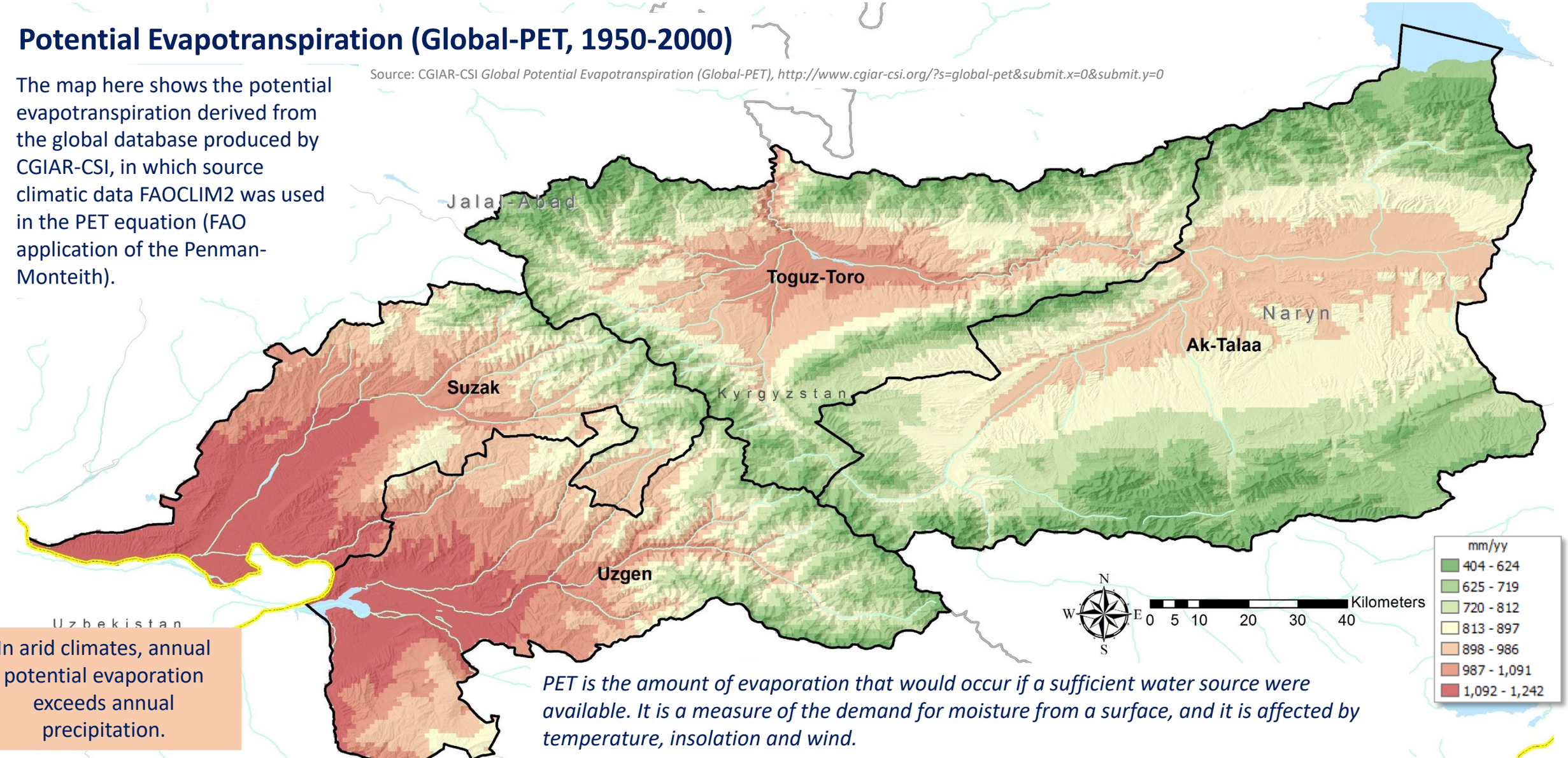
Annual Total Precipitation, Average 2014-2016



Potential Evapotranspiration (Global-PET, 1950-2000)

The map here shows the potential evapotranspiration derived from the global database produced by CGIAR-CSI, in which source climatic data FAOCLIM2 was used in the PET equation (FAO application of the Penman-Monteith).

Source: CGIAR-CSI *Global Potential Evapotranspiration (Global-PET), http://www.cgiar-csi.org/?s=global-pet&submit.x=0&submit.y=0*

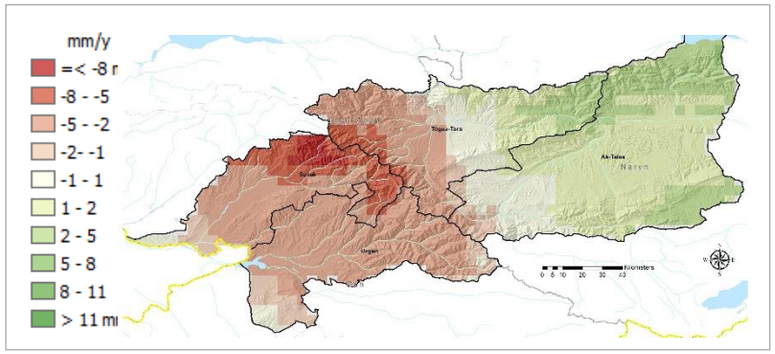


In arid climates, annual potential evaporation exceeds annual precipitation.

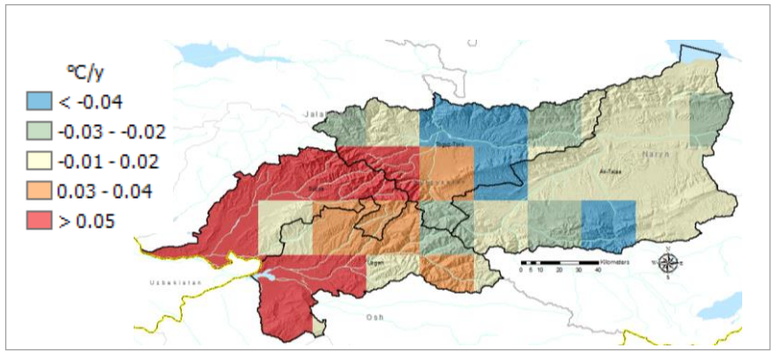
PET is the amount of evaporation that would occur if a sufficient water source were available. It is a measure of the demand for moisture from a surface, and it is affected by temperature, insolation and wind.

Target Area: Potential Evapotranspiration (PET)

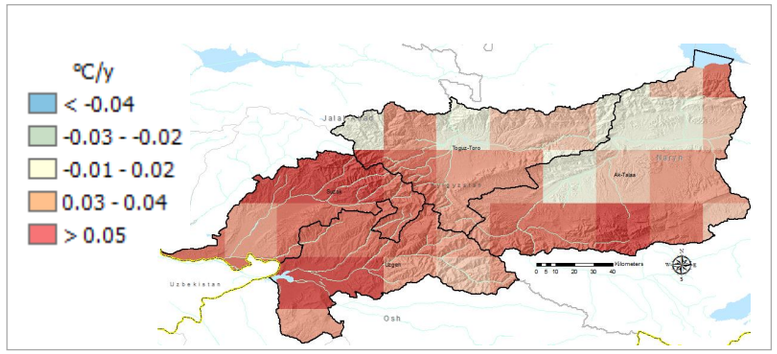
Precipitations trend



MAX Temperature trend

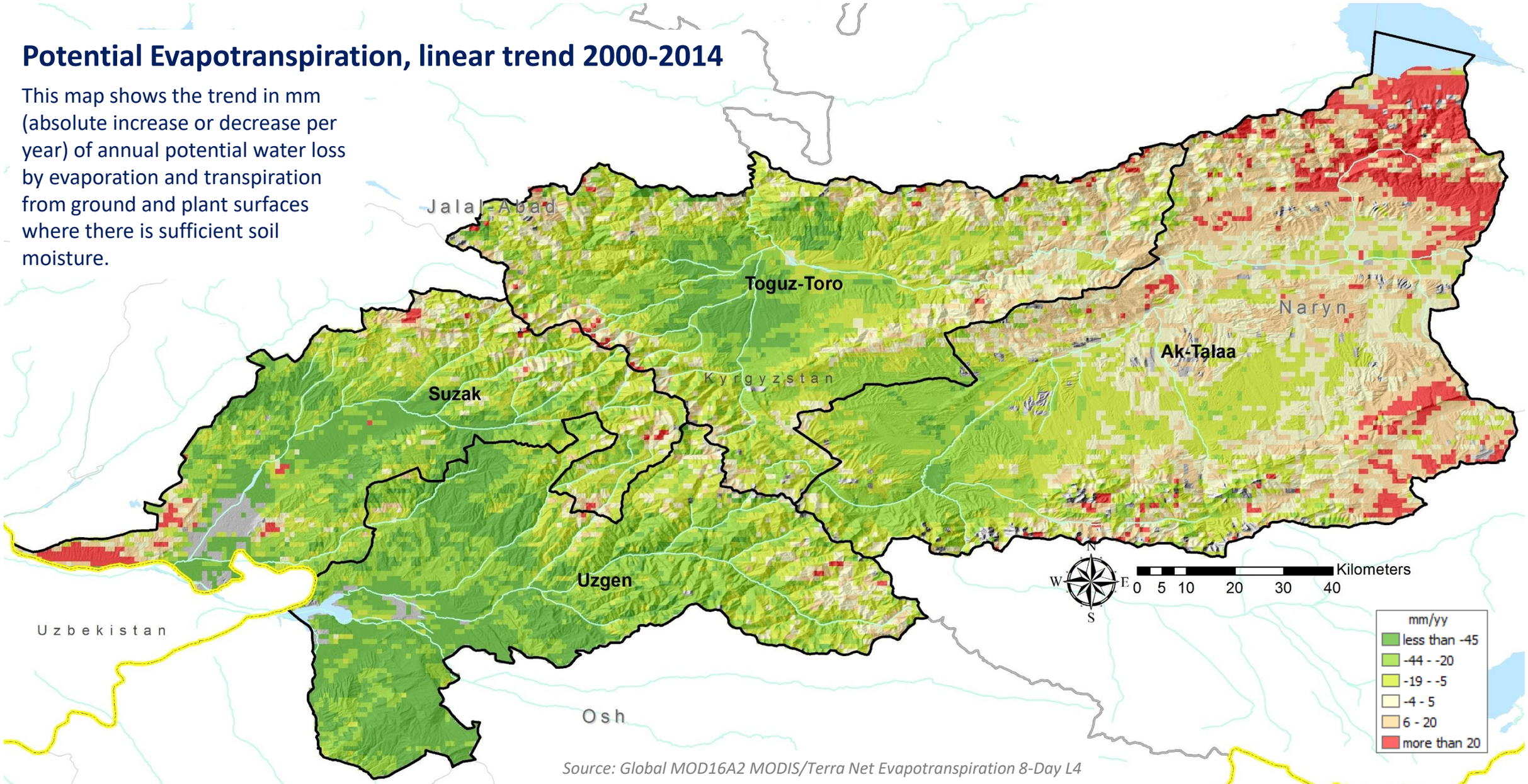


MIN Temperature trend



Potential Evapotranspiration, linear trend 2000-2014

This map shows the trend in mm (absolute increase or decrease per year) of annual potential water loss by evaporation and transpiration from ground and plant surfaces where there is sufficient soil moisture.

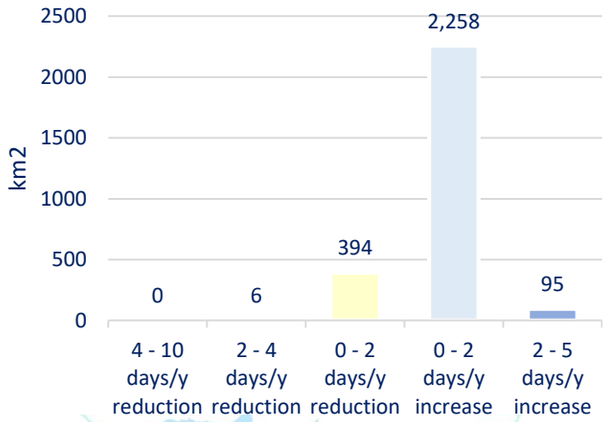


Source: Global MOD16A2 MODIS/Terra Net Evapotranspiration 8-Day L4

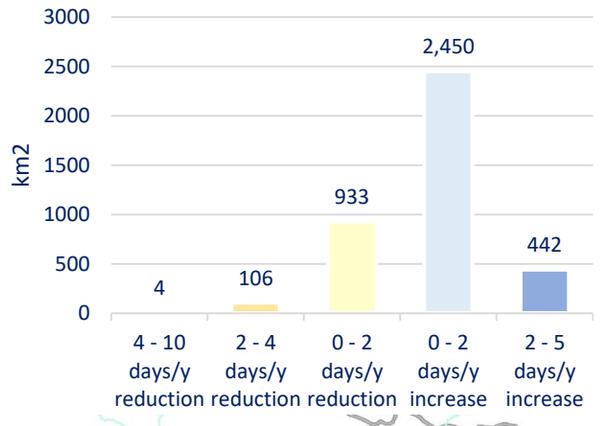
Target Area: Snow Cover Frequency trend

Snow Cover Frequency: Area (km²) by class of frequency

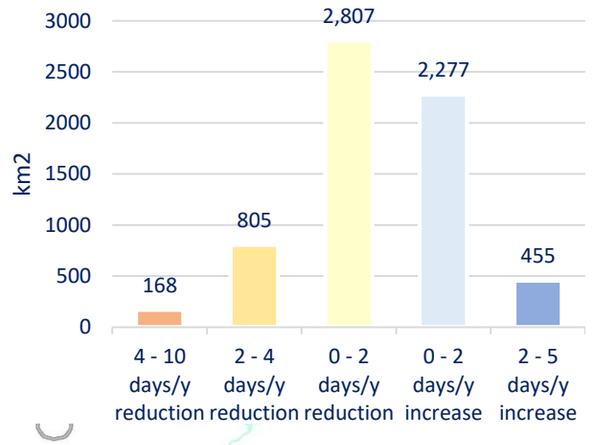
Suzak



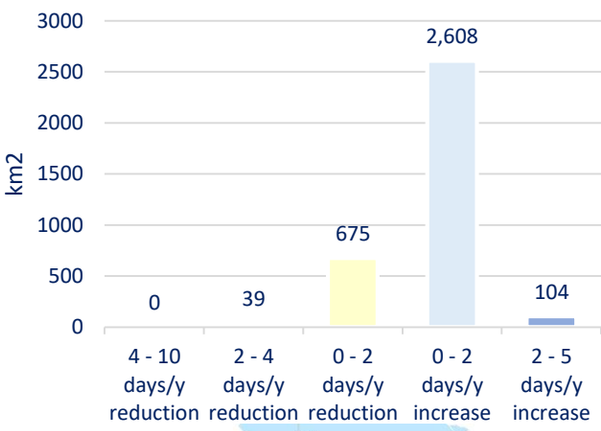
Toguz-Toro



Ak-Talaa

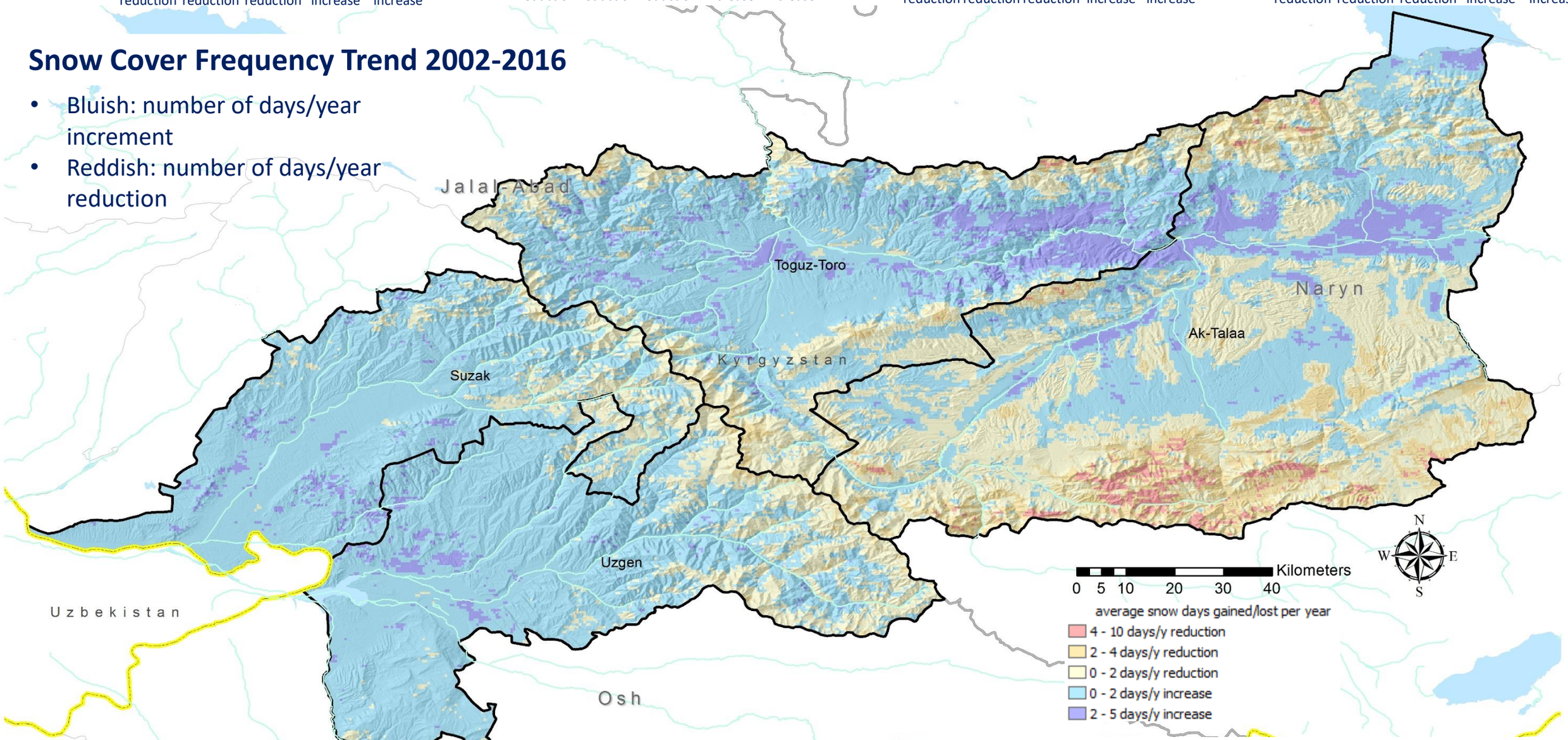


Uzgen



Snow Cover Frequency Trend 2002-2016

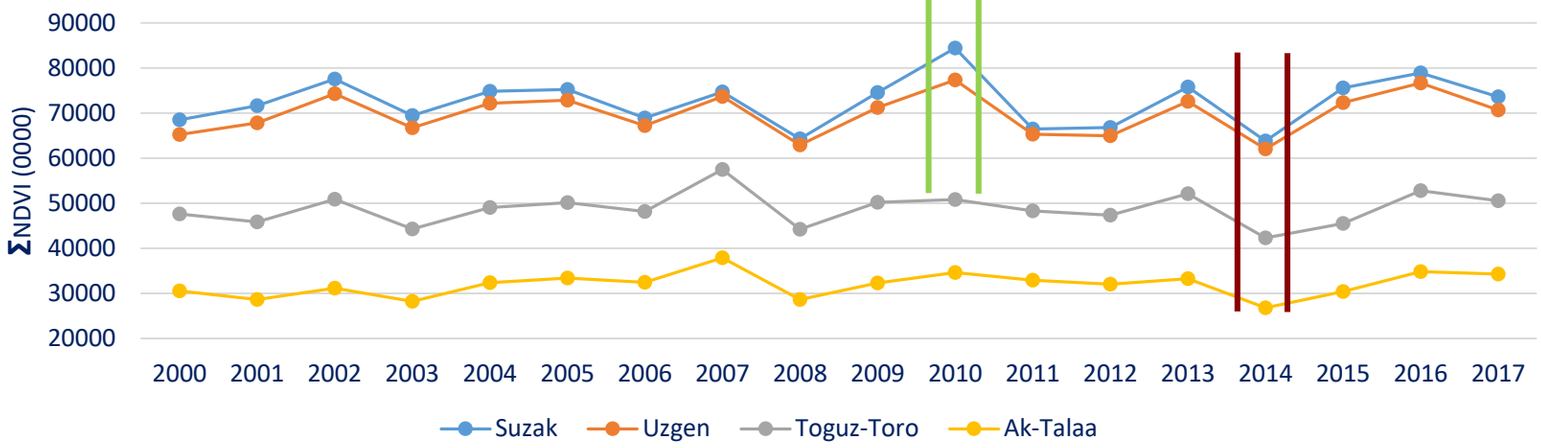
- Bluish: number of days/year increment
- Reddish: number of days/year reduction



Source: MOD10A1.005 MODIS/Terra Snow Cover Daily L3 Global 500m

Target Area: NDVI Distribution

Annual NDVI (sum): time series 2000-2017



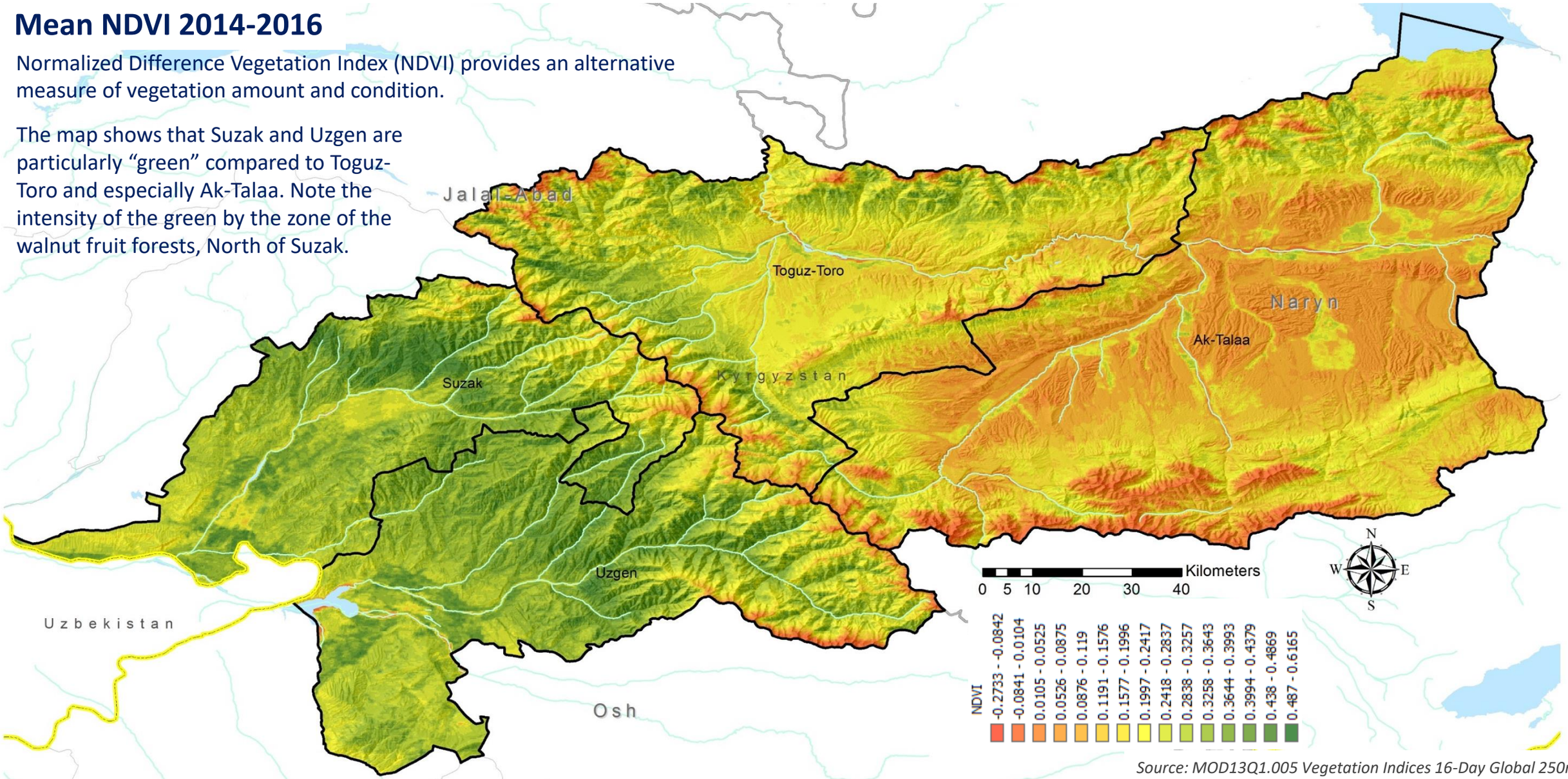
The annual Sum NDVI (chart) is computed by summing all Rayon's mean NDVI in each year (filtered only "green" values: > 0.2). It is a proxy of the annual accumulated greenness.

Suzak and Uzgen show the highest values. Ak-Talaa shows the worst greenness sum and pattern. 2014 was an year particularly penalized (low precipitations) while 2010 was highly productive in Suzak and Uzgen

Mean NDVI 2014-2016

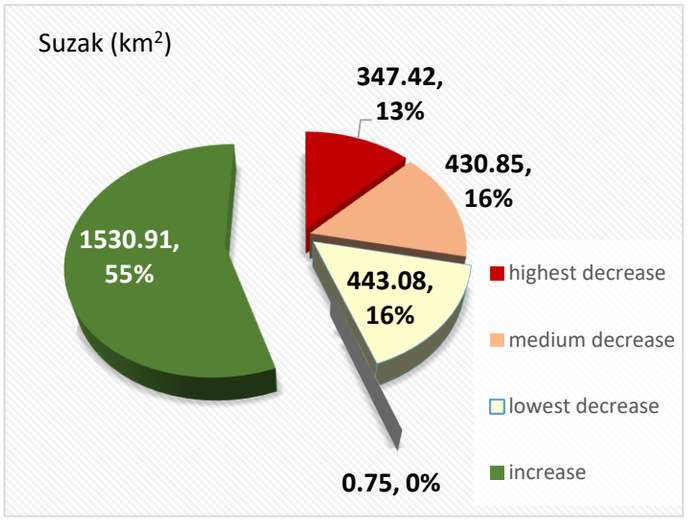
Normalized Difference Vegetation Index (NDVI) provides an alternative measure of vegetation amount and condition.

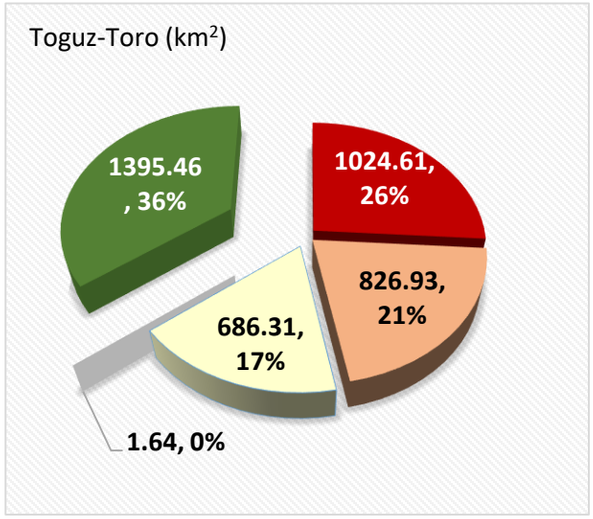
The map shows that Suzak and Uzgen are particularly "green" compared to Toguz-Toro and especially Ak-Talaa. Note the intensity of the green by the zone of the walnut fruit forests, North of Suzak.

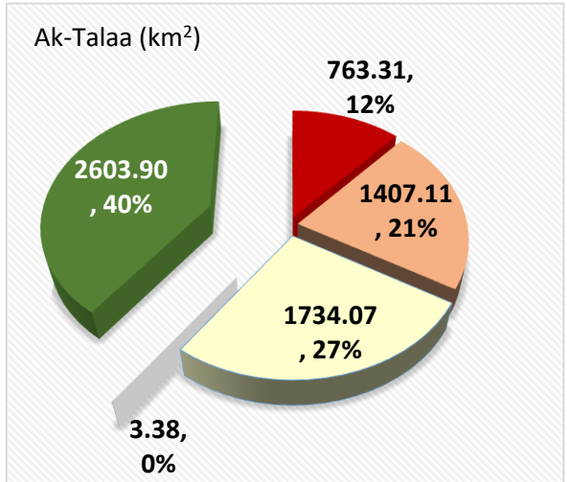


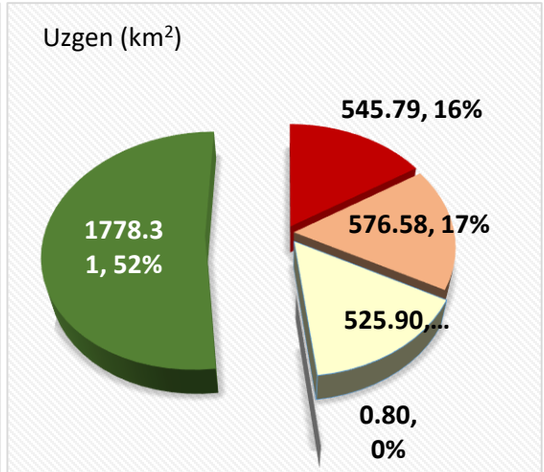
Source: MOD13Q1.005 Vegetation Indices 16-Day Global 250m

Target Area: NDVI Trend 2003-2016





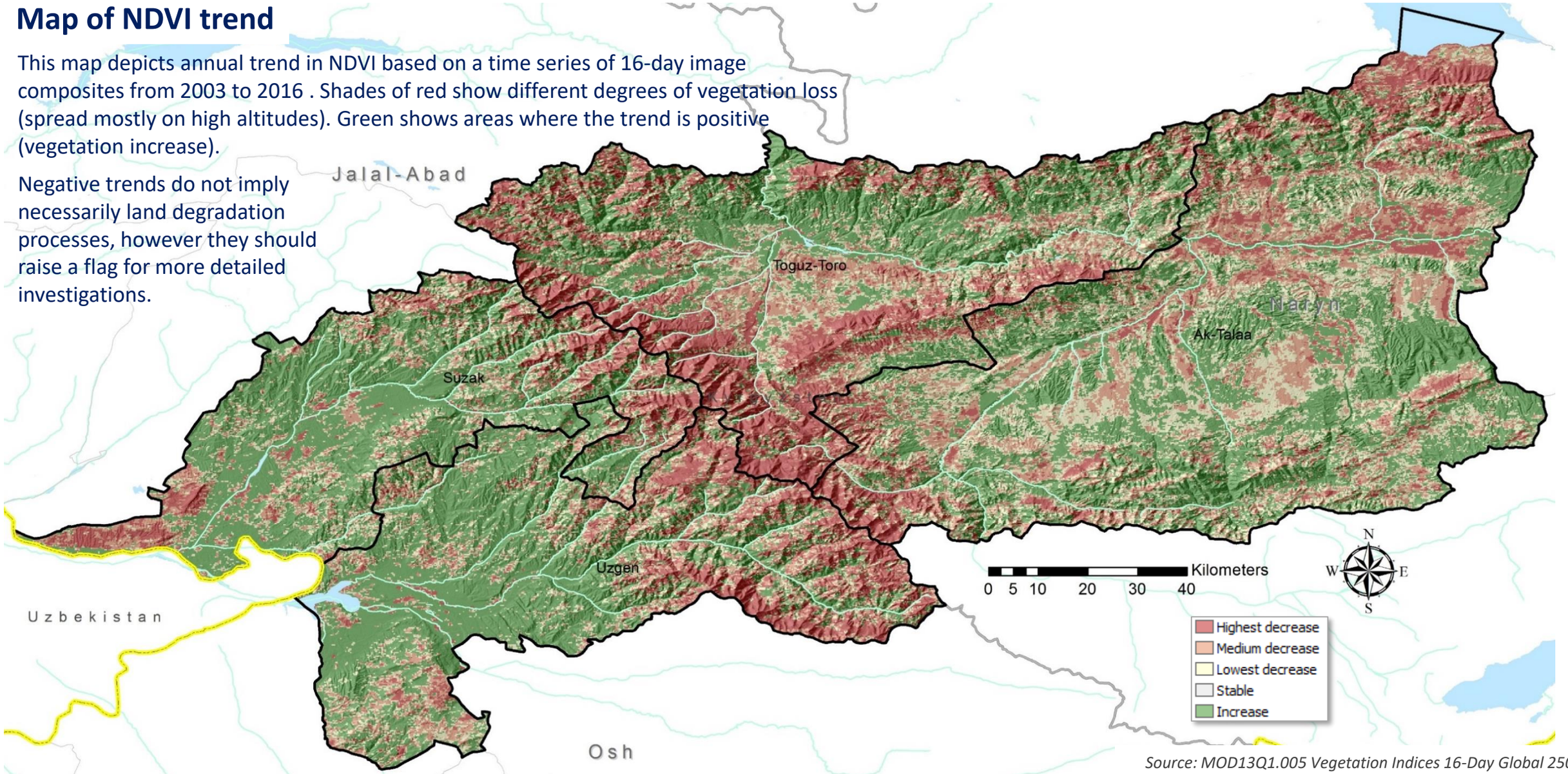




Map of NDVI trend

This map depicts annual trend in NDVI based on a time series of 16-day image composites from 2003 to 2016 . Shades of red show different degrees of vegetation loss (spread mostly on high altitudes). Green shows areas where the trend is positive (vegetation increase).

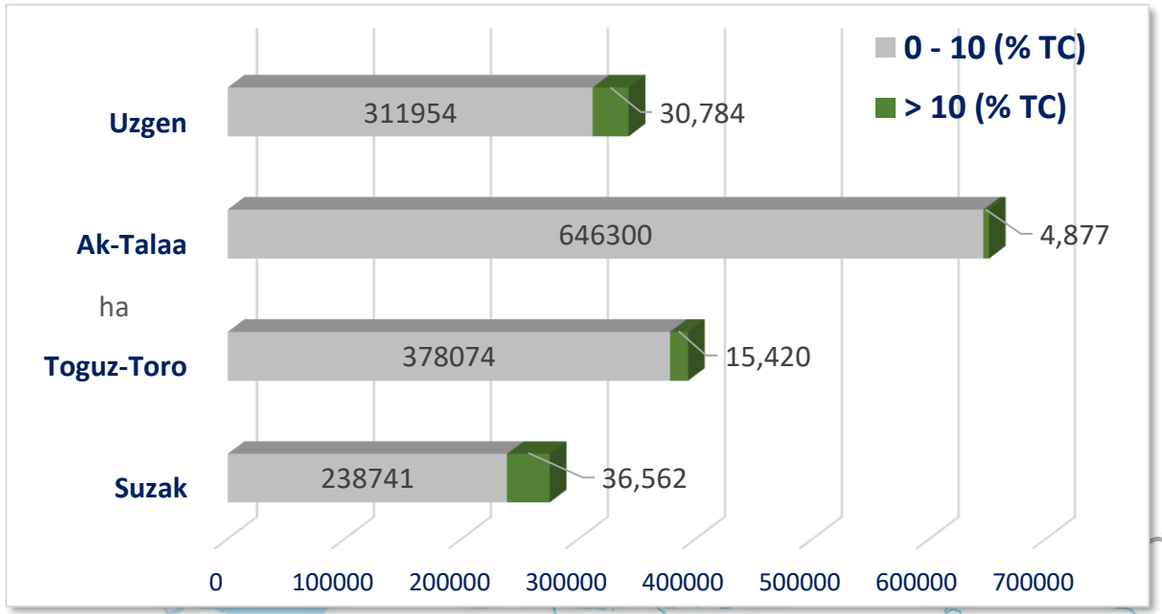
Negative trends do not imply necessarily land degradation processes, however they should raise a flag for more detailed investigations.



Source: MOD13Q1.005 Vegetation Indices 16-Day Global 250m.

Target Area : Forest Cover 2016

Forest Cover (Tree Cover > 10%)



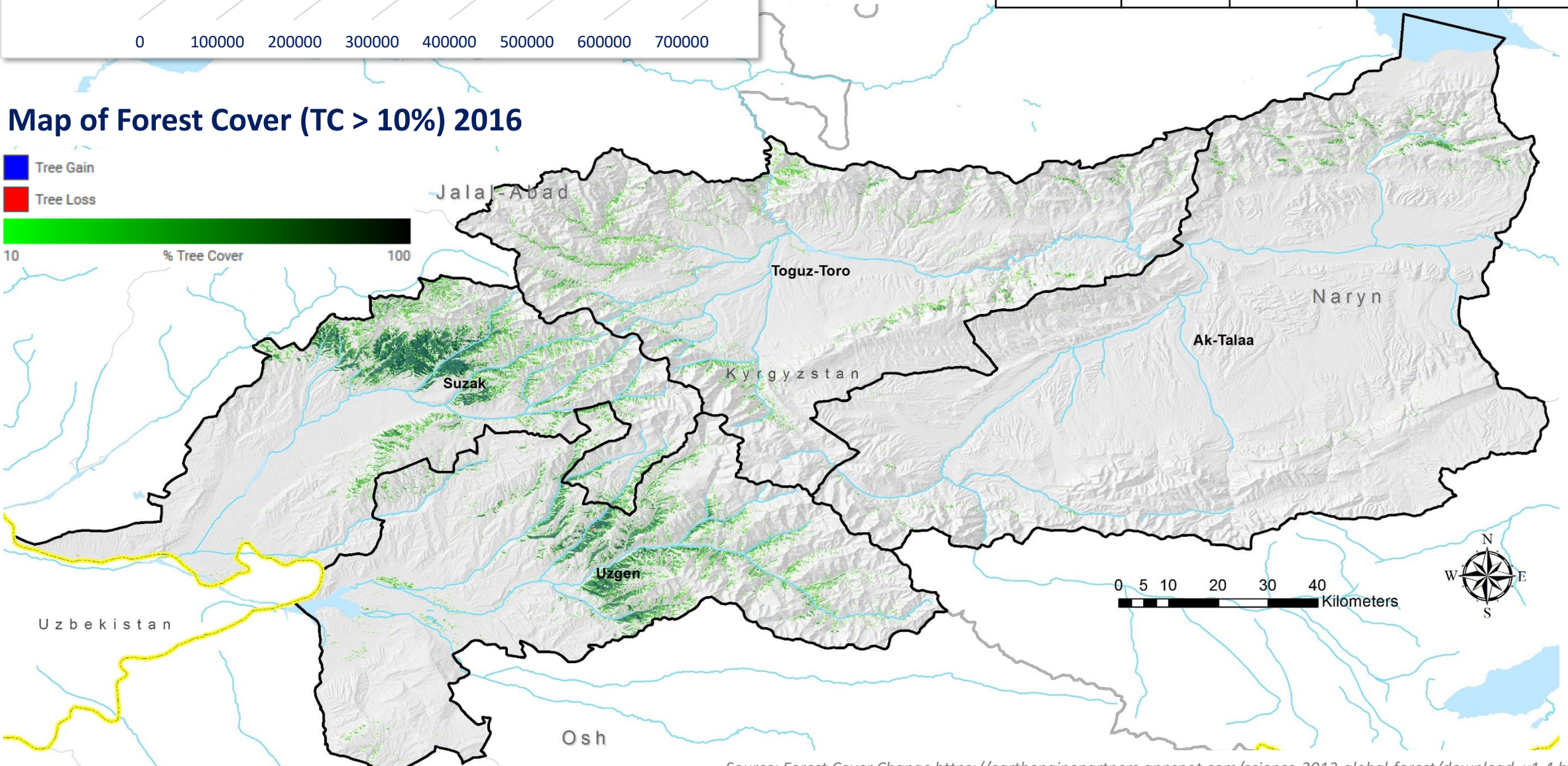
Tree Cover > 0% 2016: statistics by rayon

(ha)	Suzak	Toguz-Toro	Ak-Talaa	Uzgen
TC > 0% (2000)	32388	15192	4785	27037
GAIN 2000-2015	6	12	3	4
LOSS 2000-2015	36	11	38	56
TC > 0% (2016)	32358	15193	4750	26985
Rayon area (GAUL)	275013	393197	650802	342458
Tree Covered Area (%)	11.8%	3.9%	0.7%	7.9%

National stats

Tree Covered Area (ha)	Area Lost (ha)	Area Gained (ha)	Average Canopy Cover	Tree Covered Area
1004723	3731	465	47%	5.05%

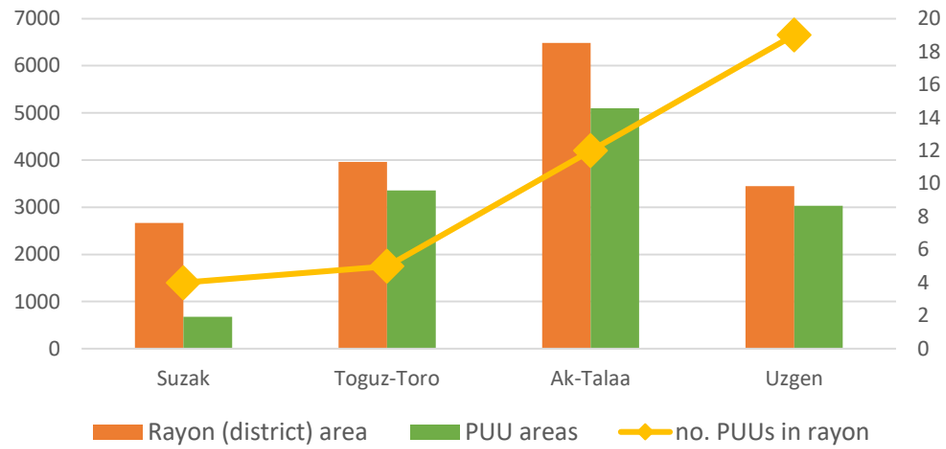
Map of Forest Cover (TC > 10%) 2016



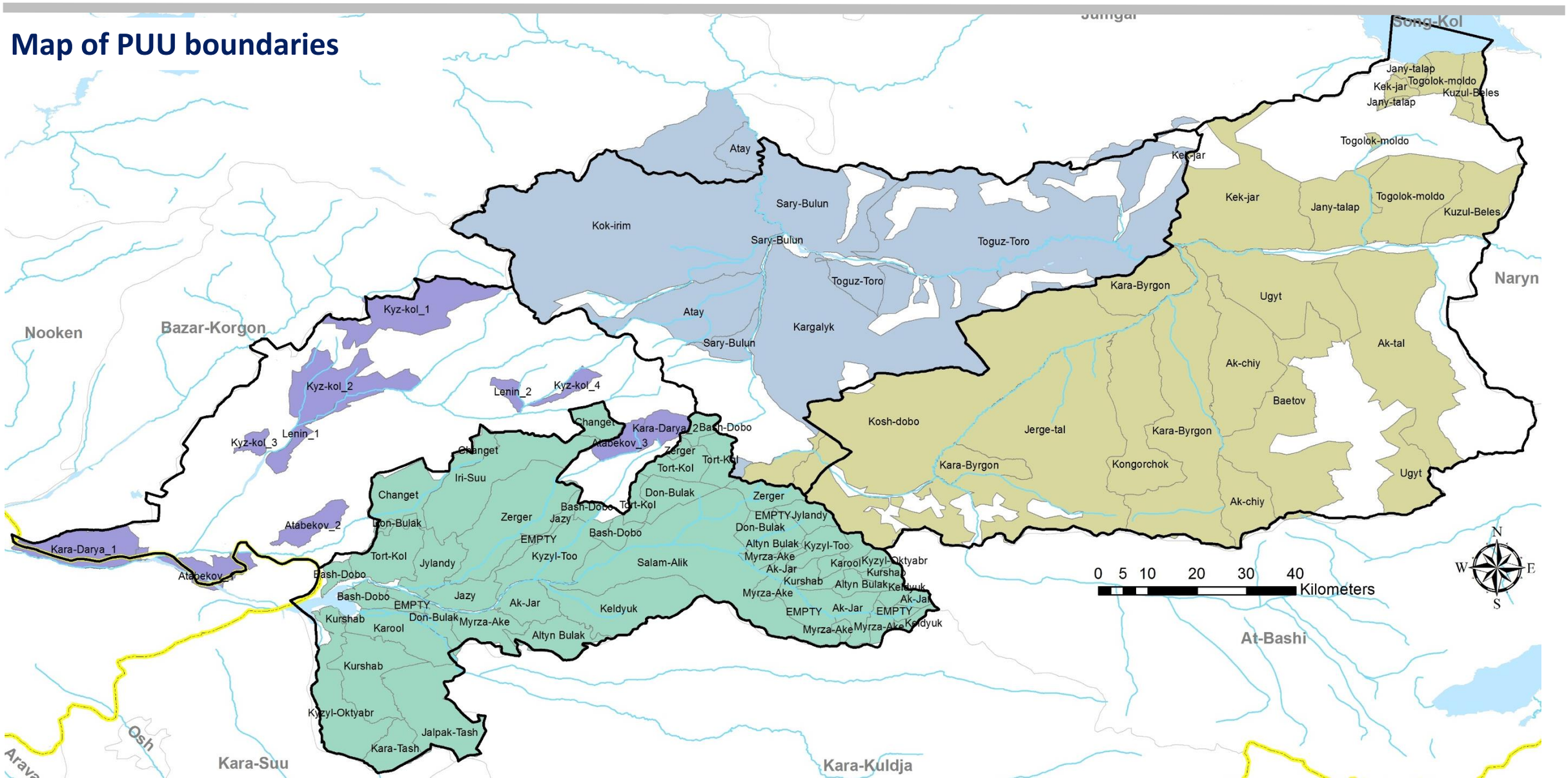
Source: Forest Cover Change https://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.4.html

Target Area: Pasture User Unions (partial coverage)

Available PUU area / number

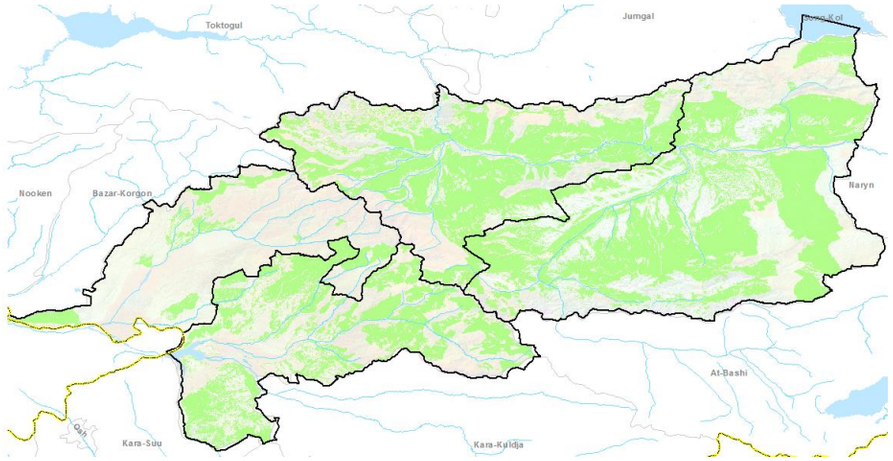


Map of PUU boundaries

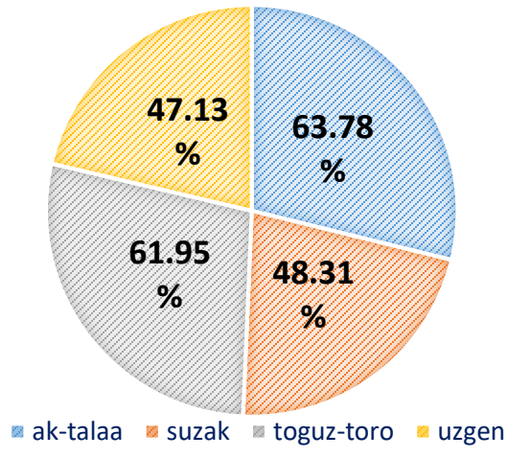


Target Area: Pasture PUU (partial coverage) / Forest (Hansen tree cover > 10%)

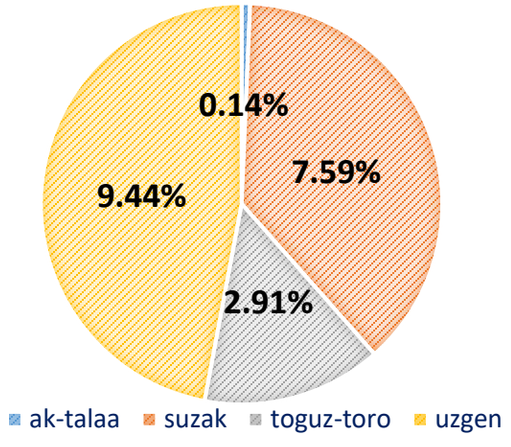
Pasture (Pasture User Unions)



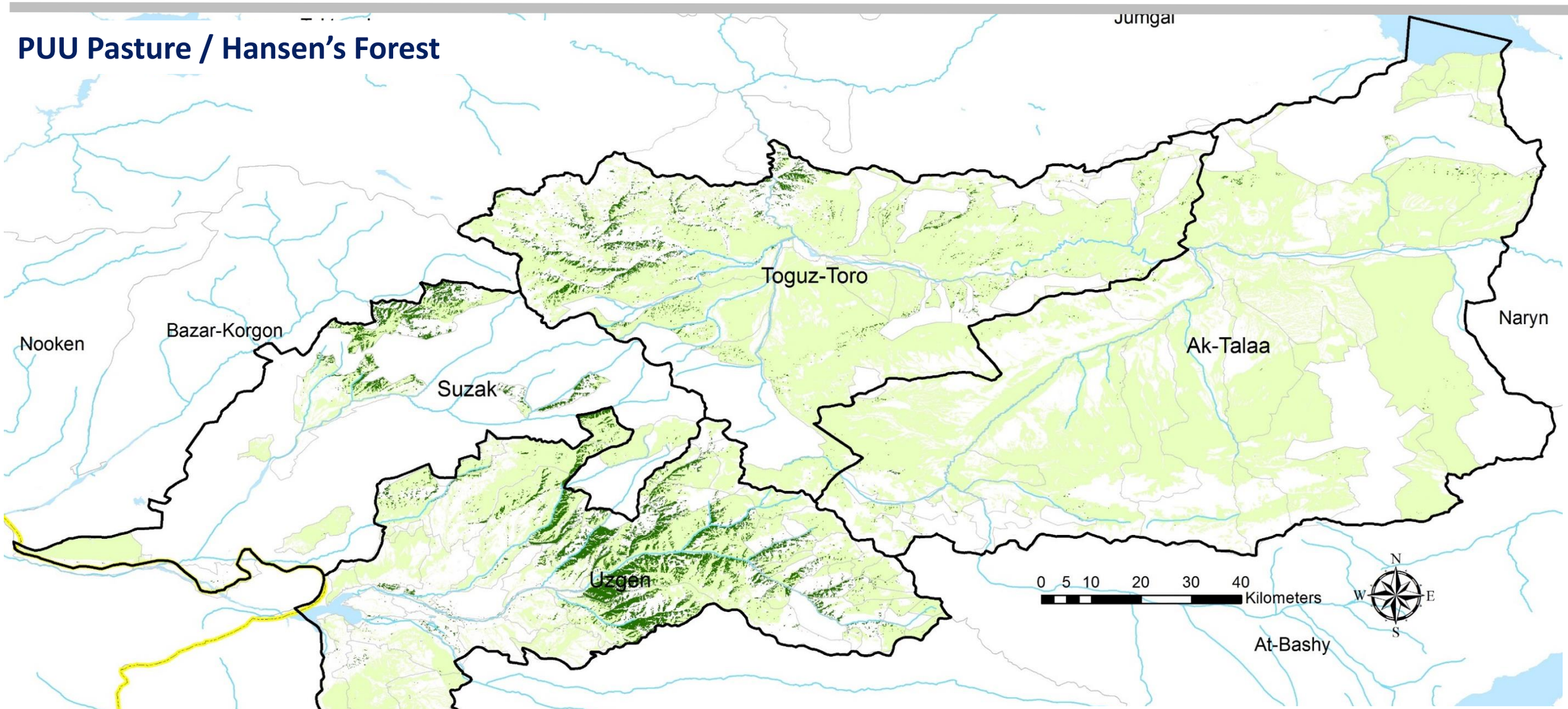
Rate of pasture in PUUs



Rate of forest in PUUs



PUU Pasture / Hansen's Forest

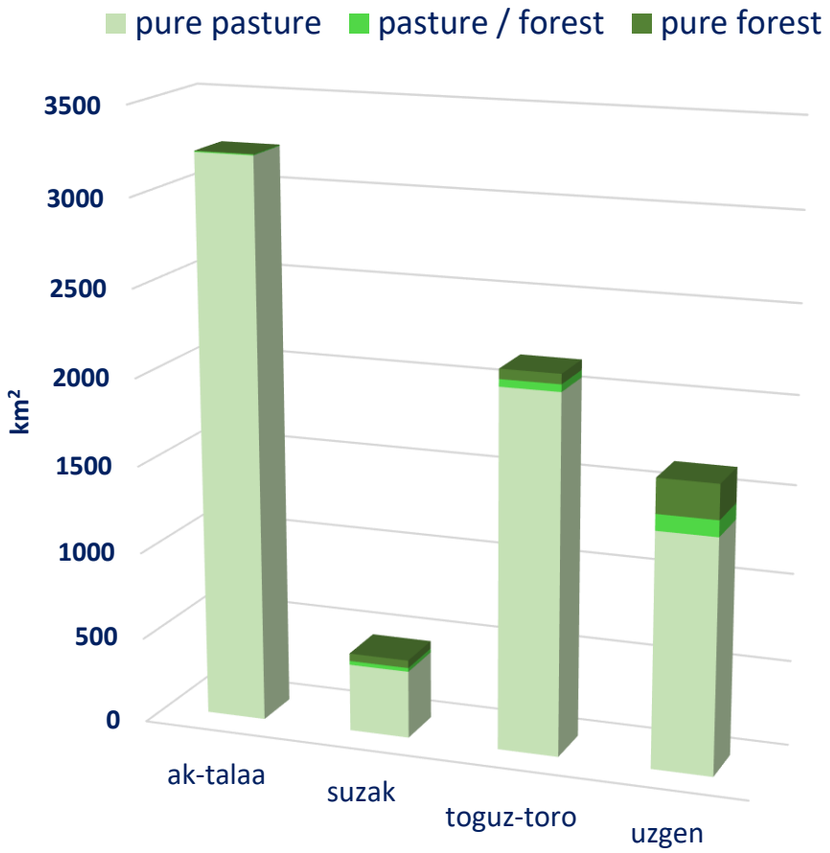


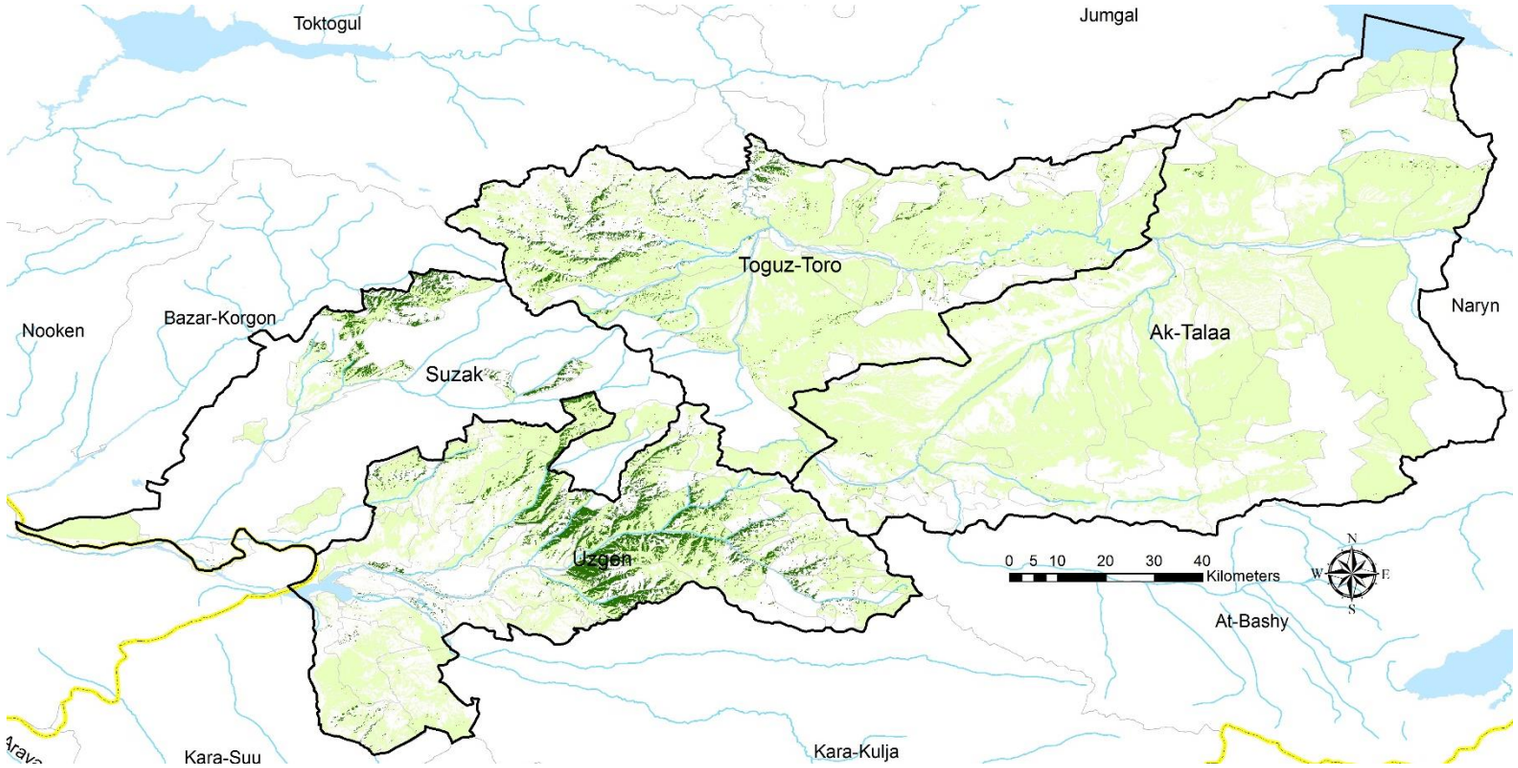
Forest data: Global Forest Change 2000-2016

- http://earthenginepartners.appspot.com/science-2013-global-forest
- http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.4.html

Target Area: Pasture PUU (partial coverage) / Forest (Hansen tree cover > 10%)

PASTURE





Forest data: Global Forest Change 2000-2016

- http://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.4.html

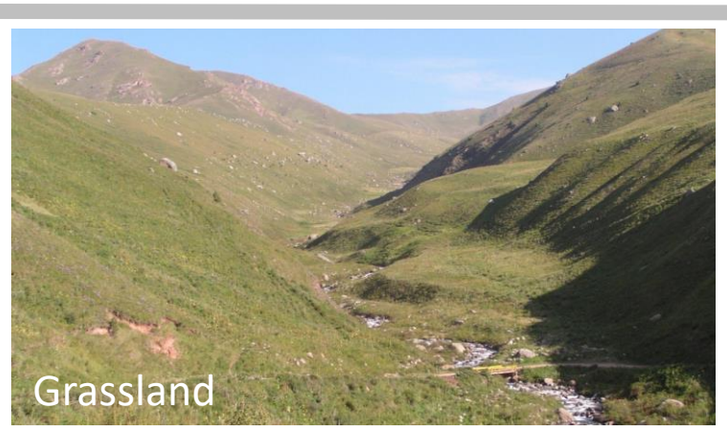
PUUs (km²)	pure pasture	pasture / forest	pure forest
Ak-talaa	3220.87	5.09	1.87
Suzak	396.55	22.26	43.51
Toguz-toro	2062.28	41.97	56.82
Uzgen	1354.96	92.67	197.93

This statistics have been generated by combining pasture data from PUUs and global forest (>10% TC) 2016 database:

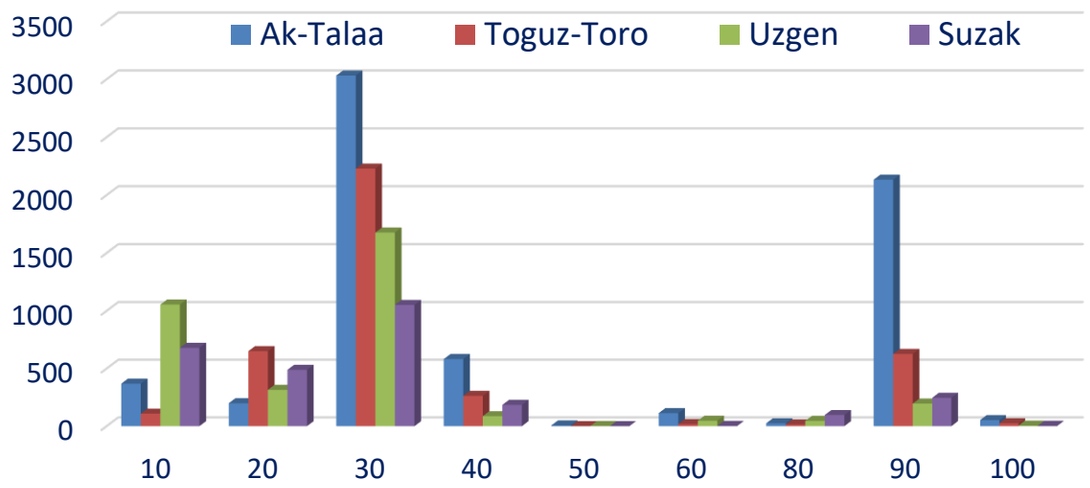
- Pure pasture: pasture which is not forest
- Pasture/forest: pasture from PUUs which is also forest according to the Global Forest Change (GBF) database;
- Pure forest: forest detected in areas non classified pasture according to PUUs

Pure pasture + pasture/forest gives the total area of pastures by PUUs

Pure forest + pasture/forest gives the total area of forests according to the GBF database



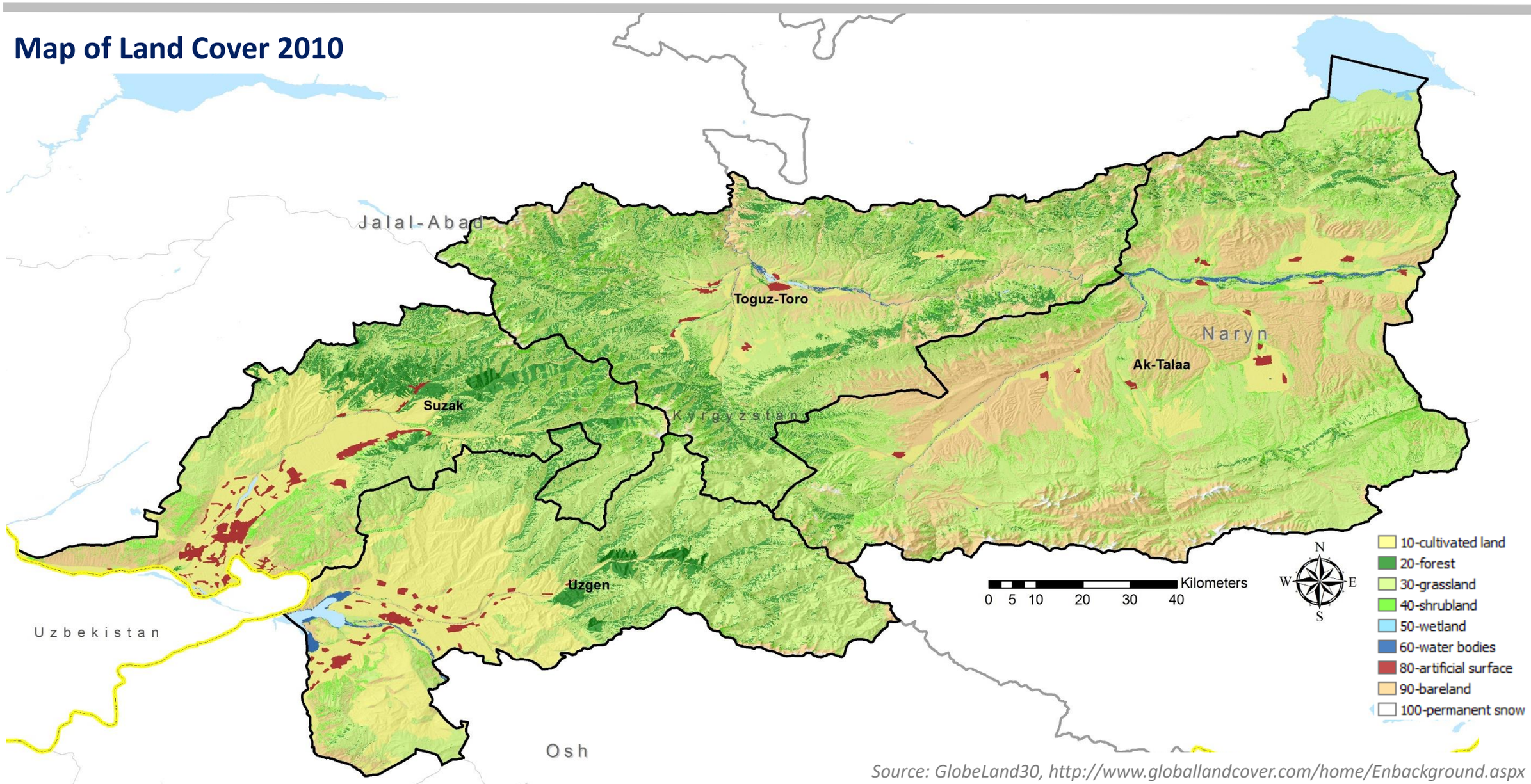
Target Area: Land Cover 2010 (GlobeLand30)



km²	Ak-Talaa	Toguz-Toro	Uzgen	Suzak	tot
10-cultivated land	368.8	108.7	1054.6	679.7	**2211.7**
20-forest	199.0	650.2	314.9	488.4	**1652.4**
30-grassland	3031.6	2228.3	1676.3	1051.3	**7987.5**
40-shrubland	582.3	263.1	86.8	184.9	**1117.0**
50-wetland	6.1	0.0	1.1	0.0	**7.2**
60-water bodies	113.0	18.1	47.3	2.8	**181.2**
80-artificial surface	24.9	15.3	45.9	96.7	**182.8**
90-bareland	2133.4	626.1	195.8	246.2	**3201.4**
100-permanent snow	52.9	25.2	4.7	3.1	**85.9**
Tot	**6511.8**	**3934.9**	**3427.4**	**2753.0**	**2753.0**

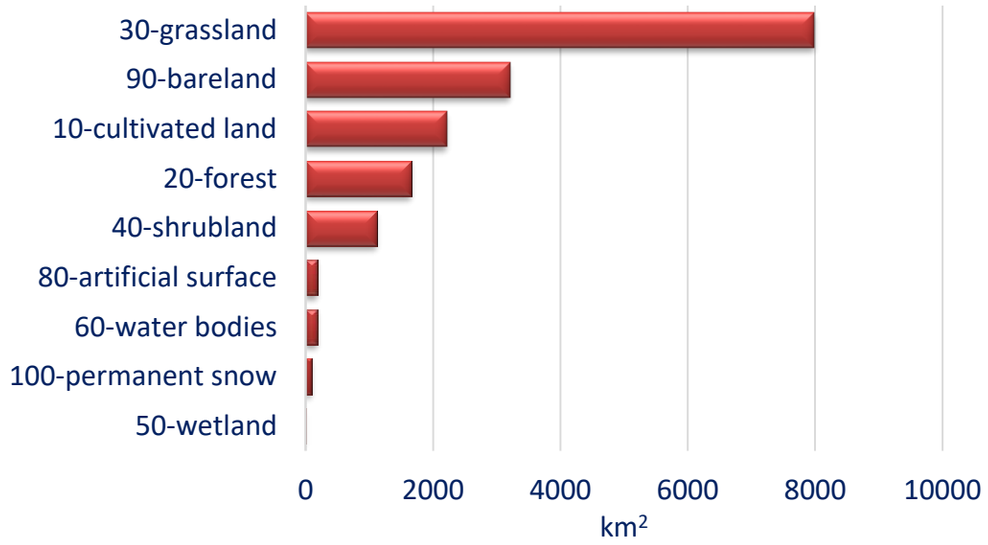
Source: GlobeLand30, http://www.globallandcover.com/home/Enbackground.aspx

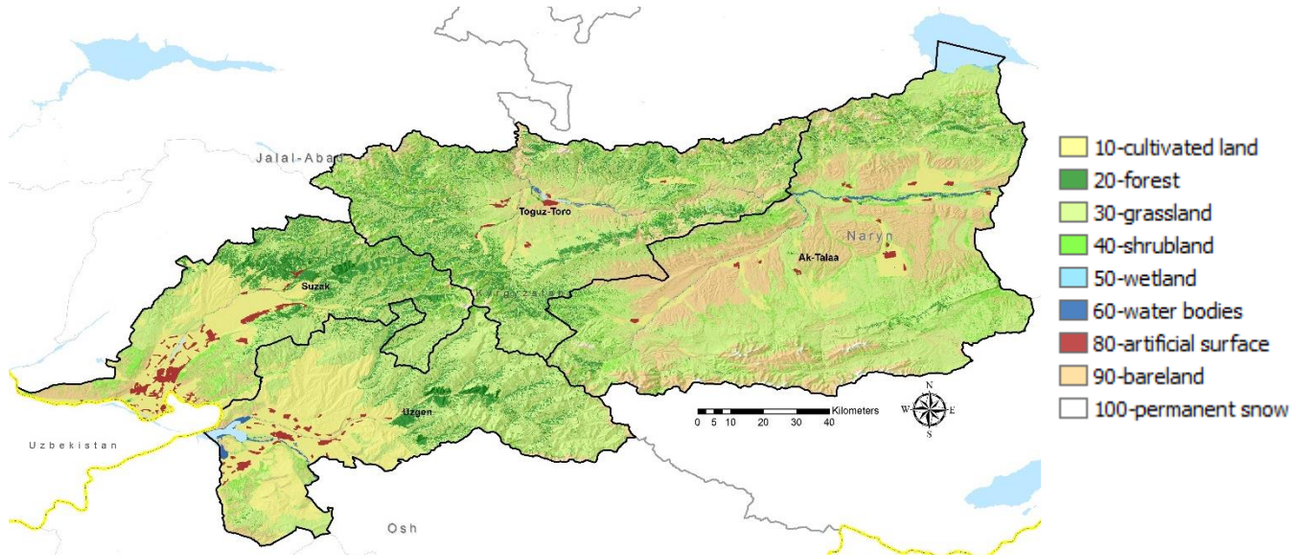
Map of Land Cover 2010



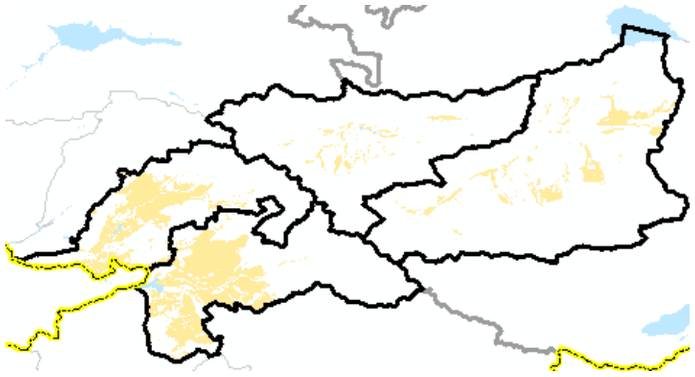
Source: GlobeLand30, http://www.globallandcover.com/home/Enbackground.aspx

Target Area: Land Cover 2010 (GlobeLand30)

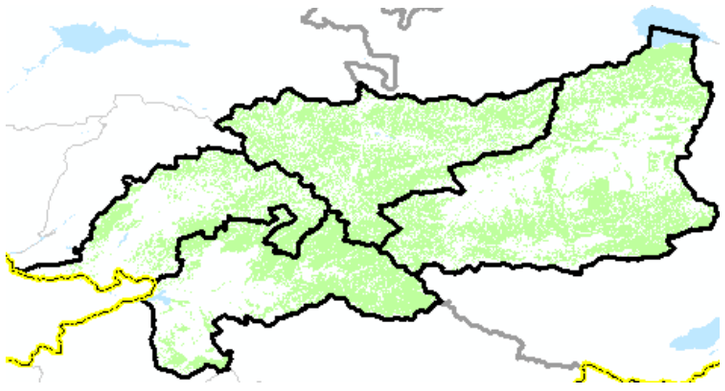




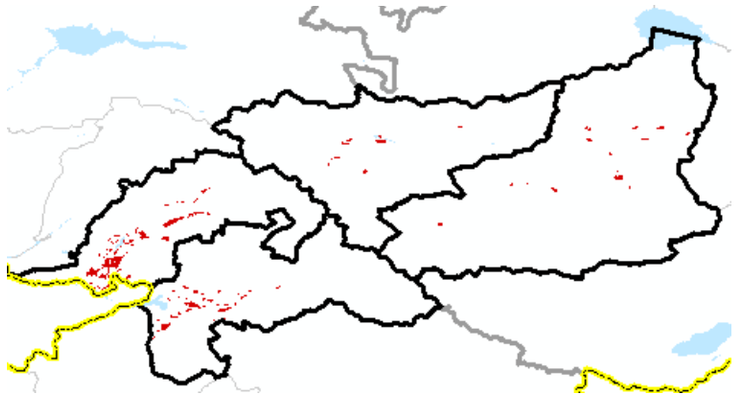
10-Cultivated land



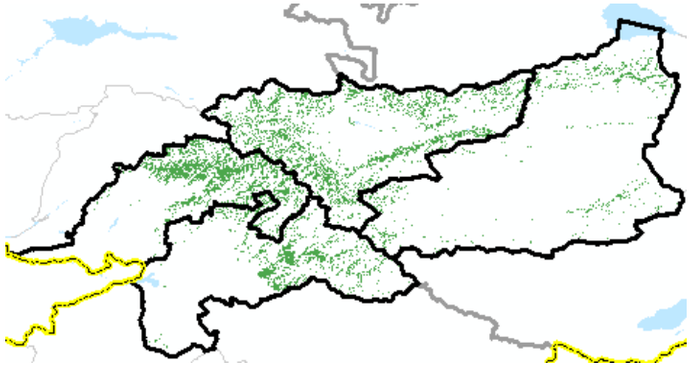
30-Grassland



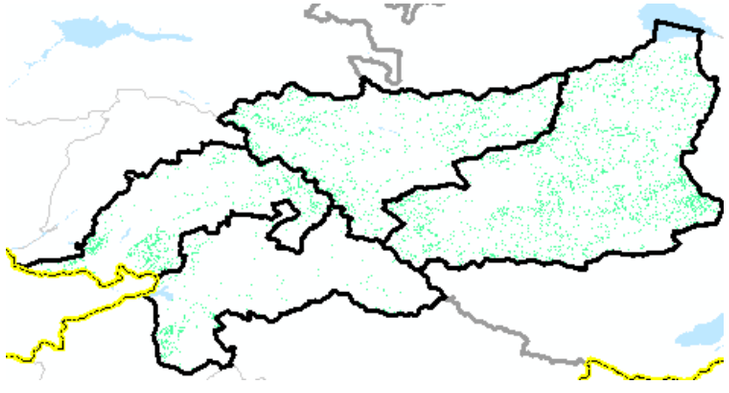
80-Artificial surface



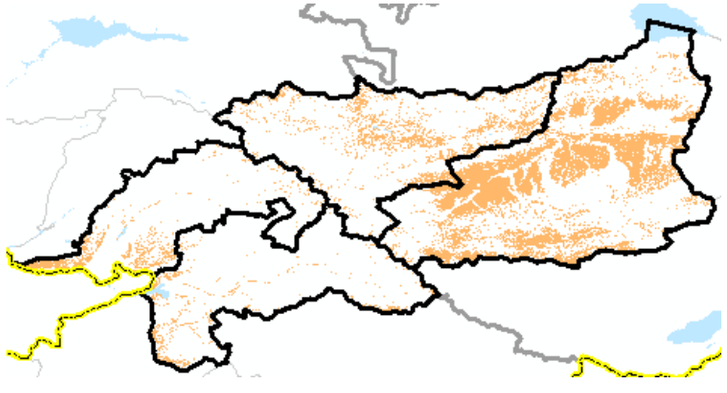
20-Forest



40-Shrubland



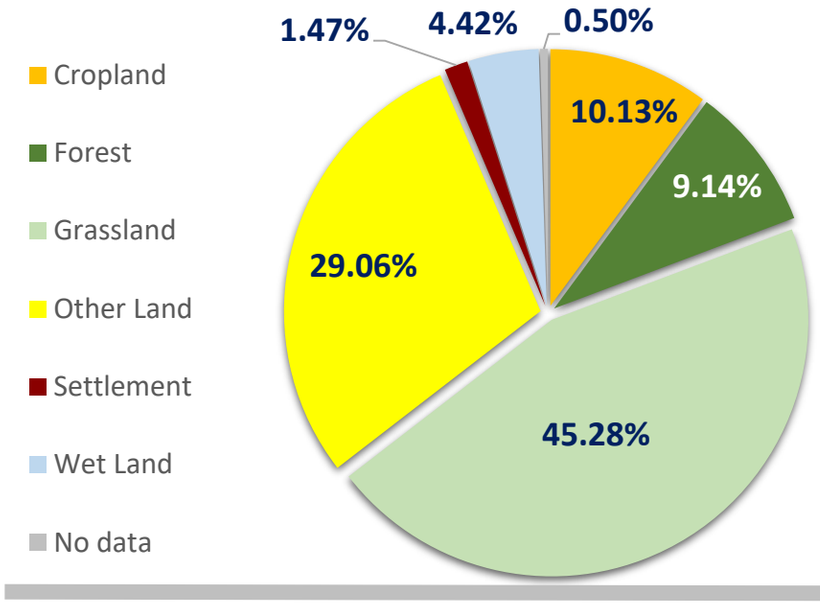
90-Bare land



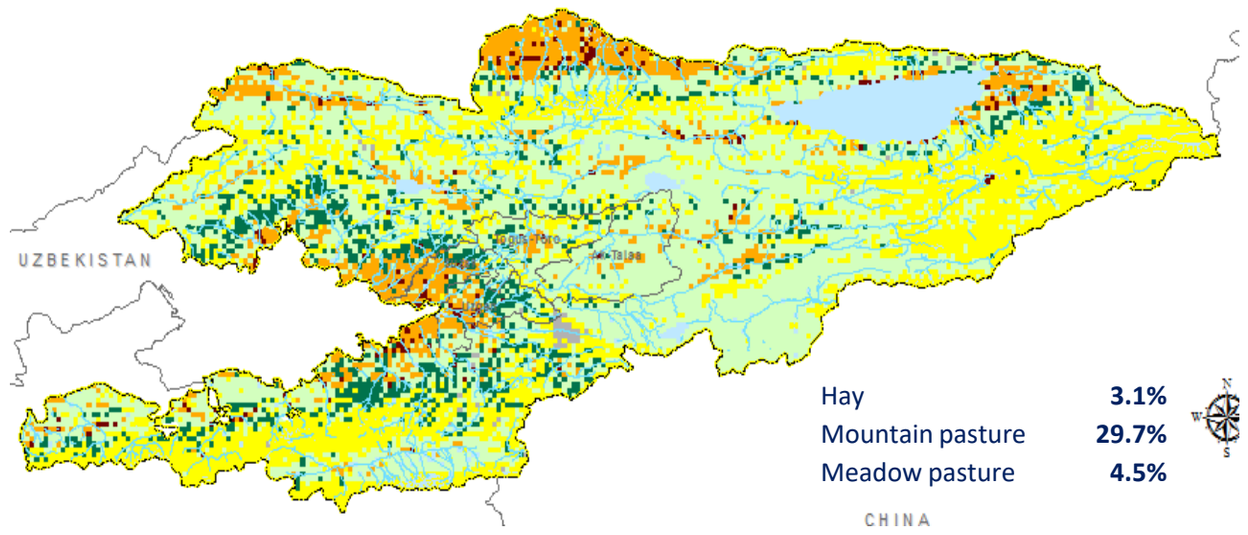
Source: GlobeLand30

Target Area: Sample based estimates (Collect Earth survey 2016)

LAND COVER



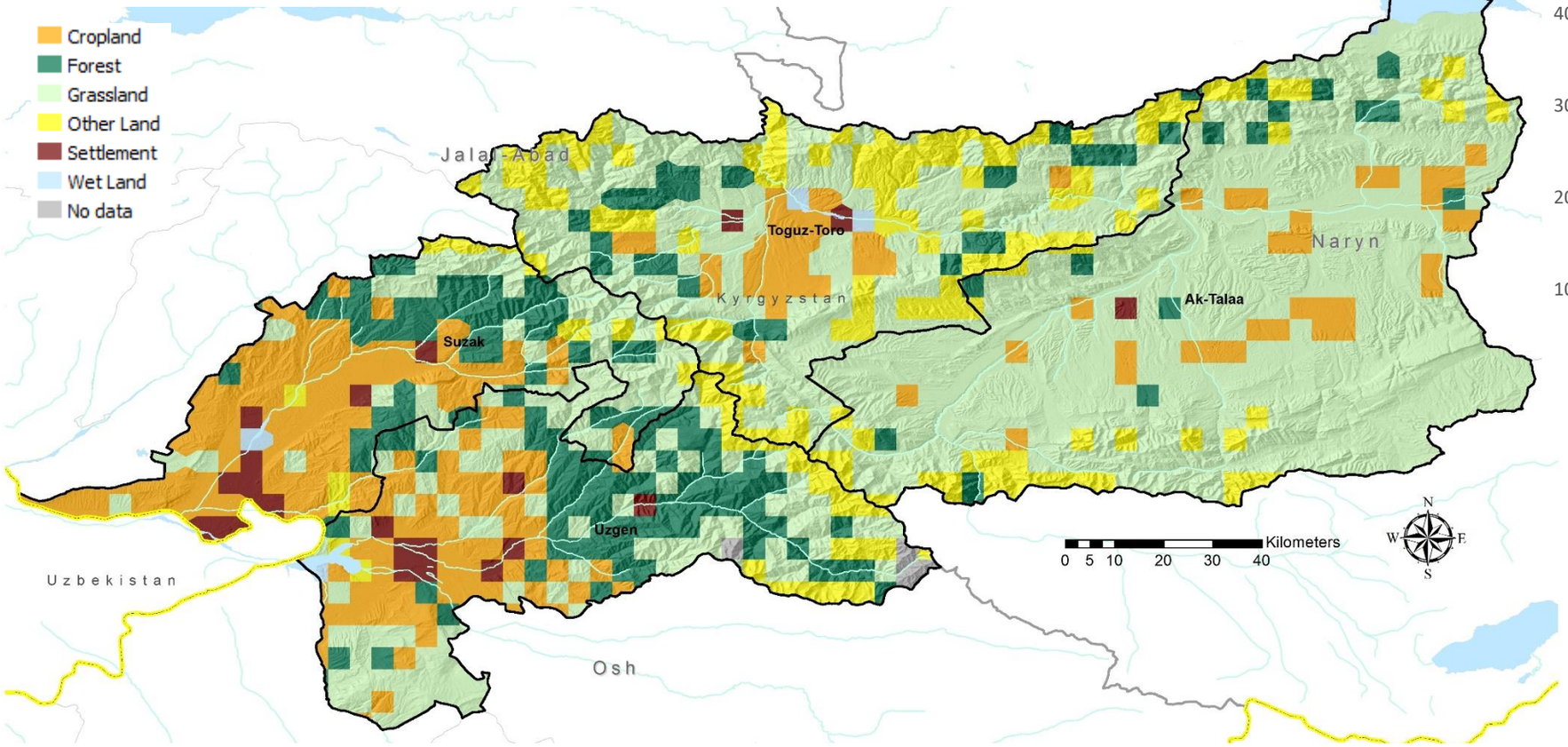
Proportion of different land uses nationwide

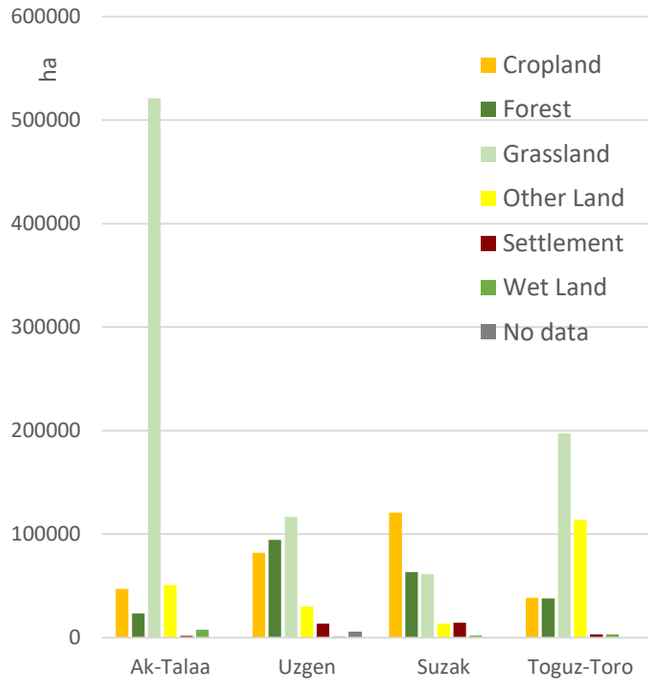


Map of Land Use 2016 out of sample based survey (Collect Earth)

Simplified Land use distribution based on 13,200 circa sample points (nationwide) compiled and interpreted using FORIS Collect Earth tool.

Collect Earth: http://www.openforis.org/tools/collect-earth.html





Pastures Kyrgyzstan

The Kyrgyz Republic
BASELINE ATLAS

Core Target Area: PASTURE ANALYSIS

Pasture Analysis

INTRODUCTION

Objective

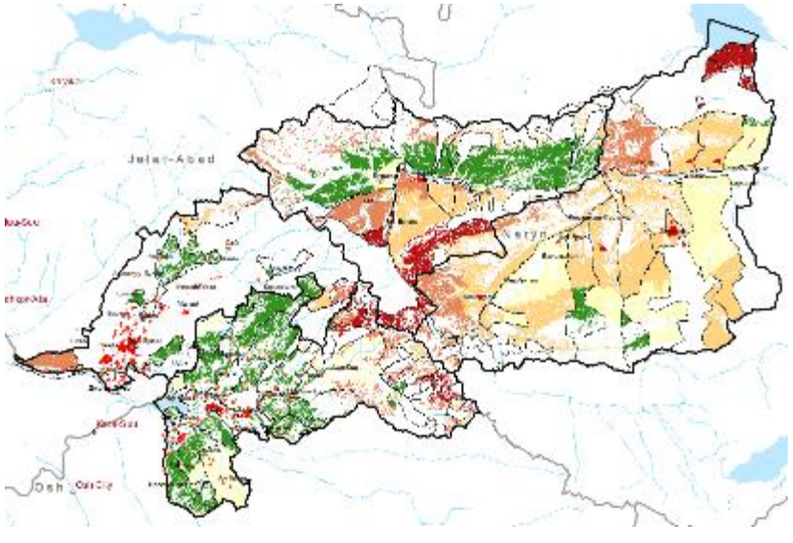
- Analyze vegetation status and climatic conditions for pasture areas stratified according to topographic characteristics (slope and range of altitude). These data, summarized and presented here for a subset of 26 identified areas in the 4 core target Rayons, intend to provide objective and evidence based elements for targeting pasture areas for potential mitigation/adaptation actions to climate change.

Data

- Pasture and boundaries from Kyrgyzstan's Pasture Users Unions (PUU) geodatabases
- Climatic data from Google Earth Engine's platform
- Historical 2003-2016 vegetation indices (NDVI) from Google Earth Engine's cloud
- Topography from ASTER GDEM 30m

Outputs x target core area (4 rayons)

- PUU's pasture layer
- PUU's borders layer
- Stratified pastures layer per slope (<25%) and seasonal type (< 1500m, 1500-2500m, and > 2500m)
- 2003-2016 NDVI trend map
- Classified map of pastures based on average NDVI trend value (annual increment/reduction of vegetation) in the area.



Methodology

I. PUU's pasture and border layers

Geodatabases of PUU data were processed to extract pasture areas and PUU borders.

II. Elevation / slope layers

The Elevation layer has been derived from ASTER GDEM (30m) by aggregating 3 classes of altitude consistent with common distinction of seasonal pastures:

- winter (<1500m),
- spring/autumn (1500-2500m),
- summer (>2500m)

The *Slope* layer has been derived from ASTER GDEM (30m) by selecting slopes less than 25%.

III. Unique pasture areas per topographic and administrative characteristics

Pastures in different PUUs have been combined with classes of altitude and slope to identify 165 unique areas for further climatic and vegetation condition analysis.

IV. Classified map of pastures based on average NDVI trend

The 165 pasture units have been used to extract the average value in the area from the historical NDVI trend map, and categorize it in 5 classes of trends:

- Highest index decrease
- Moderate decrease
- Low decrease
- Very low decrease
- Index increase

The area found with positive trend (61) were considered as of less priority and therefore excluded form further analysis, at the moment.

104 areas were found with negative trends and processed for extracting 1. historical NDVI profiles from 16 day composite, 250m resolution NDVI data for the period 2003-2016 and 2. climatic trends for precipitations, temperatures, potential evapotranspiration and annual snow cover frequency.

Results

A detailed description of the results are described in this atlas for 26 out of the 104 areas detected with negative vegetation trends. This selection represent the 4 target rayons, the different types of pastures (altitude range) and the various categories of negative trends measured.

Glossary

Grassland: an area dominated by grass or grass-like vegetation

Pasture: Land with grass or herbage, used or suitable for the grazing of livestock.

Concept: ∑NDVI

The Normalized Difference Vegetation Index (NDVI or greenness) is a remotely sensed product that can be used as a proxy of vegetation productivity. In this analysis, the annual NDVI sum has been quantified for each pasture area, selecting only "green" values (NDVI > 0.2) and used to derive the trend for the period of analysis: 2003-2016.

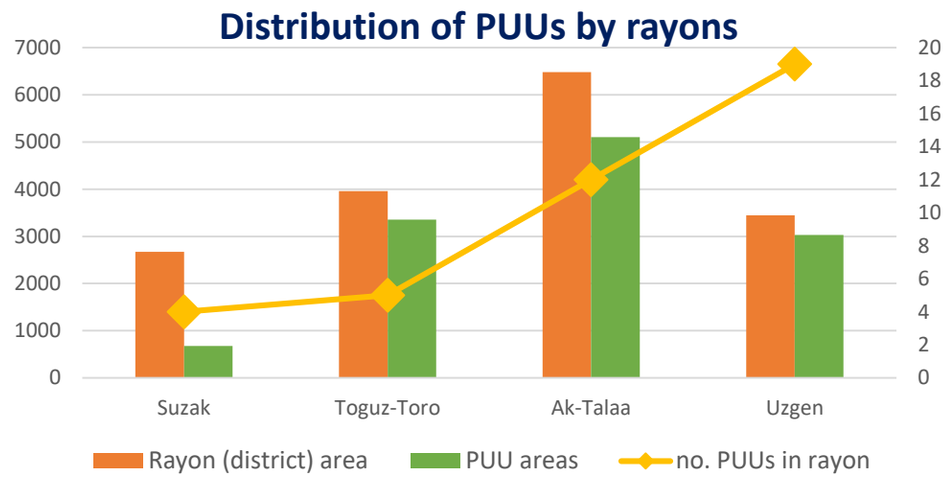
Each pasture unit has been evaluated for the average trend of NDVI in the area, the inter annual variability of greenness production, and climatic conditions to infer status and trend of the pasture.

PUU Borders

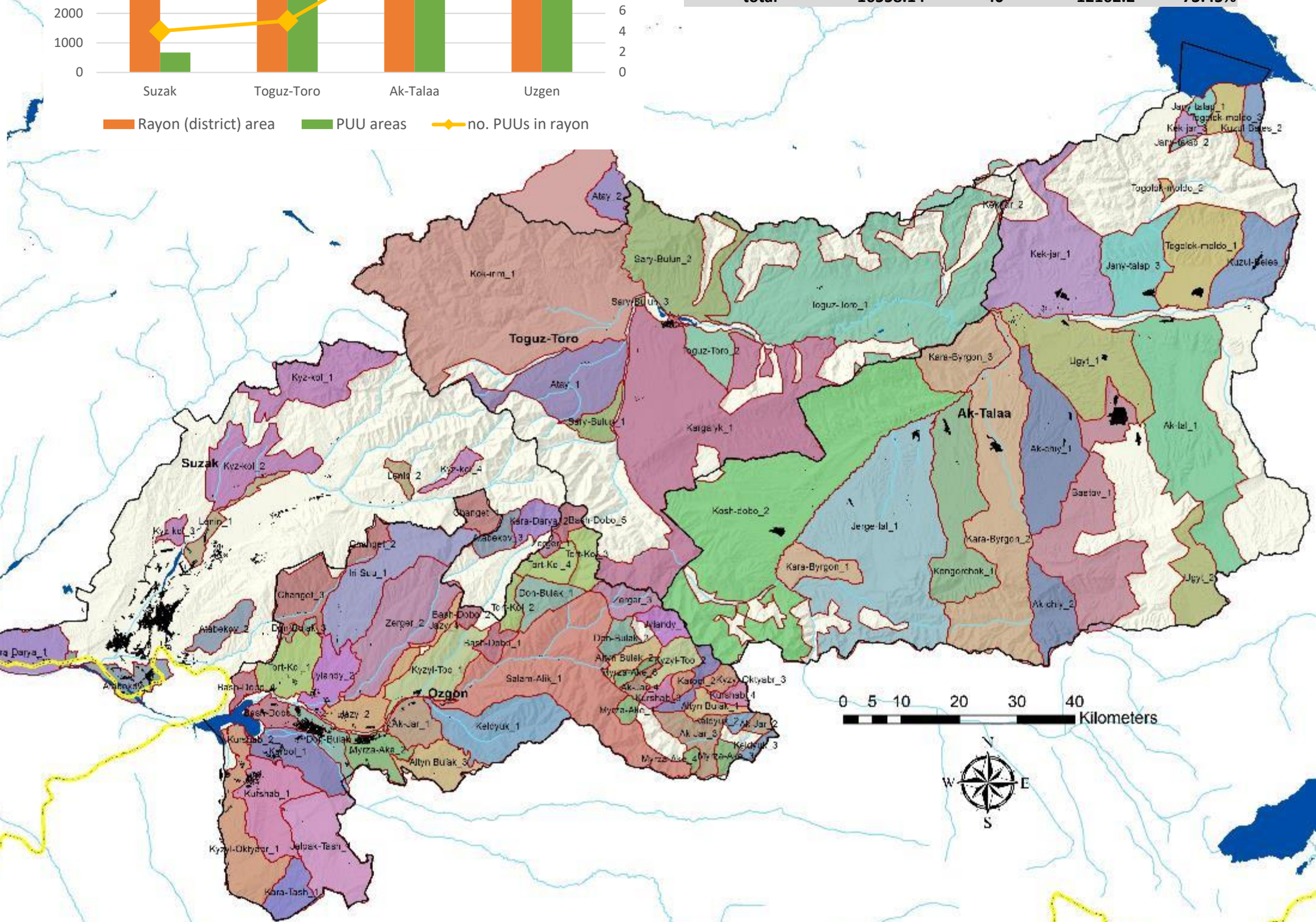
Overall, 40 PUUs were identified, covering 73.4% of the total target area.

Toguz Toro, Ak-talaa and Uzgen are covered between 80 and 90%, while Suzak near 25%.

The process to complete the coverage of PUUs in the 4 target Rayons is on going.



Rayon	Rayon area (km²)	no. PUUs	PUU area (km²)	% PUU area
Suzak	2669.03	4	677.73	25%
Toguz-Toro	3958.42	5	3353.08	85%
Ak-Talaa	6484.51	12	5101.89	79%
Uzgen	3446.18	19	3029.5	88%
total	**16558.14**	**40**	**12162.2**	**73.45%**

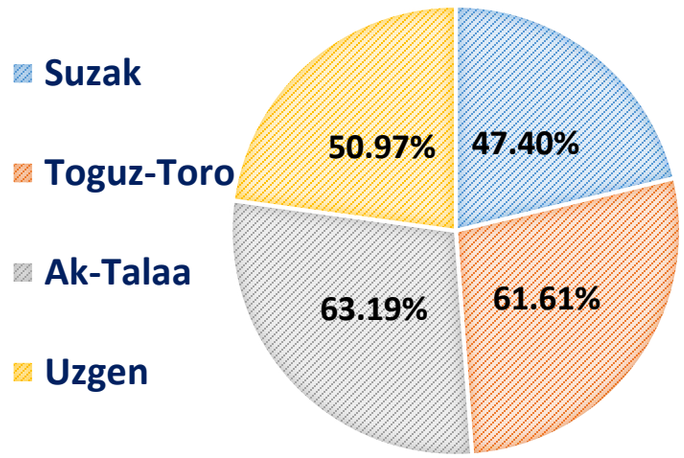


PUU Pastures

Pastures were found in 39 PUUs covering 59% of the total PUUs area.

The process to complete the coverage of pastures in the 4 target Rayons is on going.

Percentage of pasture in PUUs

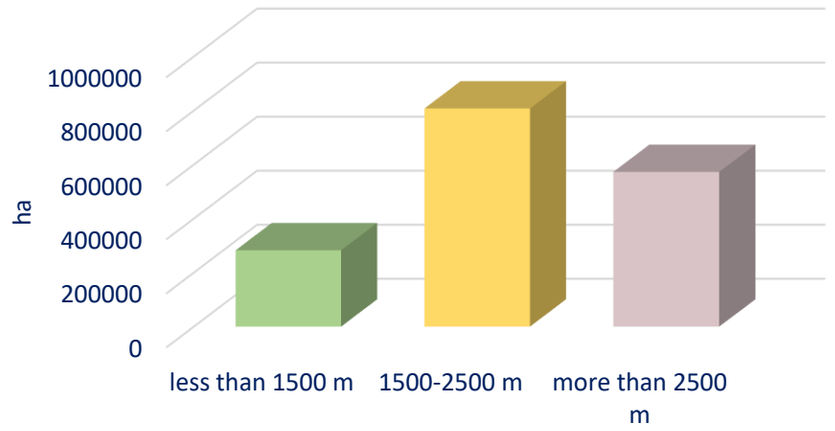


Rayon	Rayon area (km²)	PUU area (km²)	no. PUUs	Pasture area (km²)	% Pasture area
Suzak	2669.03	677.73	5	321.27	47.40%
Toguz-Toro	3958.42	3353.08	12	2065.73	61.61%
Ak-Talaa	6484.51	5101.89	4	3223.87	63.19%
Uzgen	3446.18	3029.5	18	1544.26	50.97%
	16558.14	**12162.2**	**39**	**7155.13**	**58.83%**

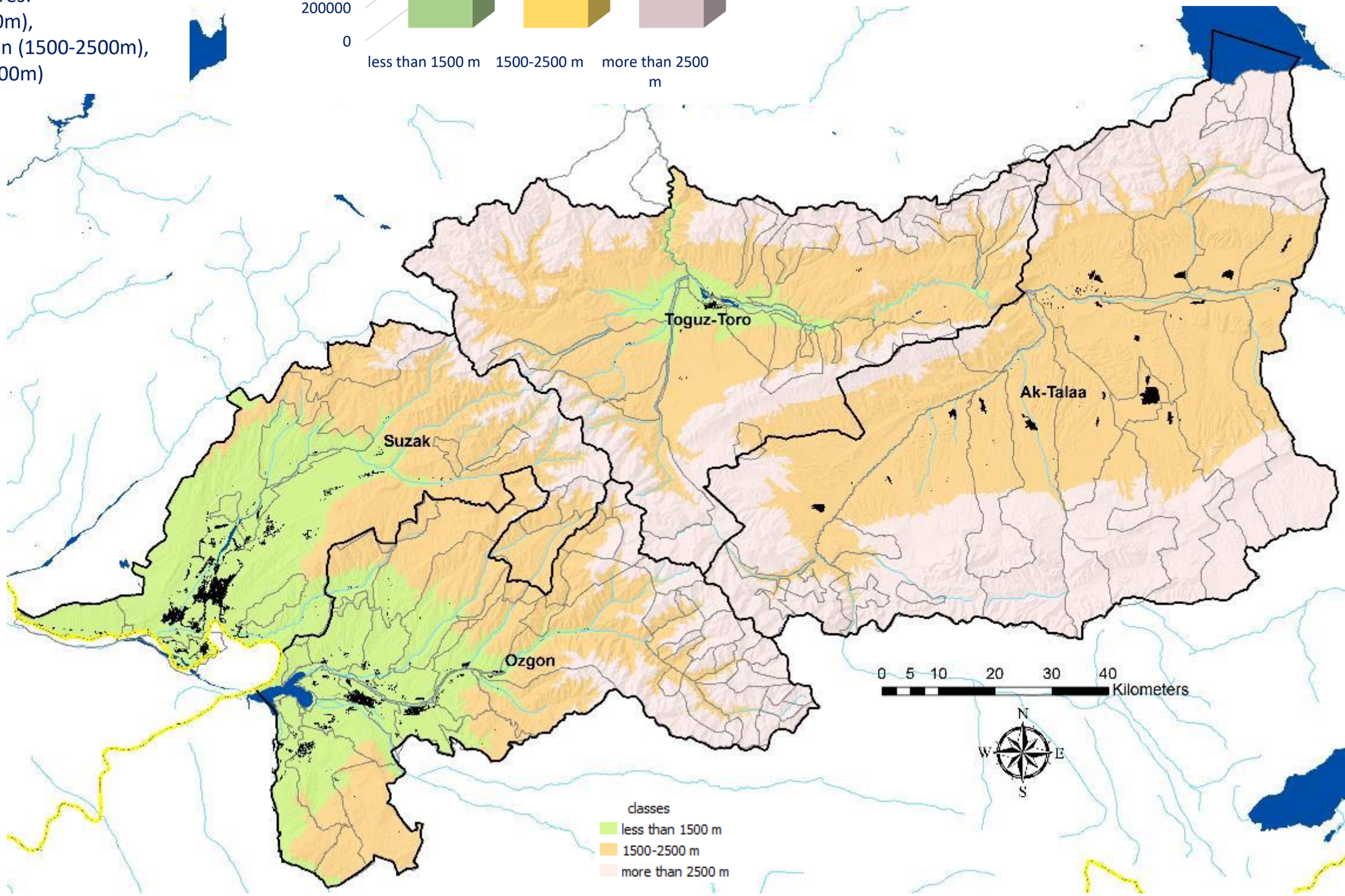
Elevation

Elevation from ASTER GDEM layer (30m), aggregated in 3 classes consistent with common distinction of seasonal pastures:

- winter (<1500m),
- spring/autumn (1500-2500m),
- summer (>2500m)

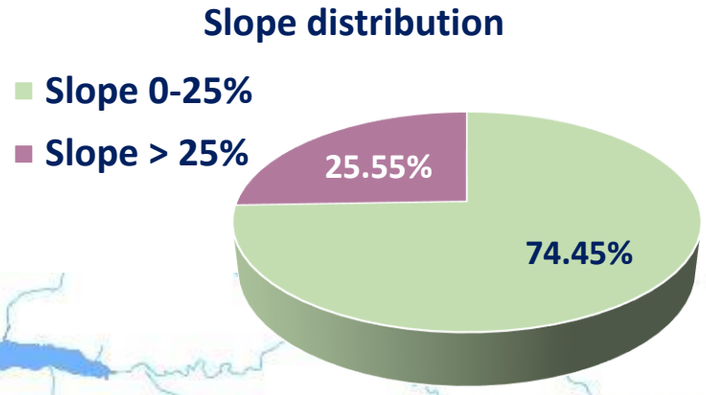


Altitude	Area (ha)
less than 1500 m	282455.6
1500-2500 m	807494.6
more than 2500 m	572758.6
Grand Total	**1662708.9**

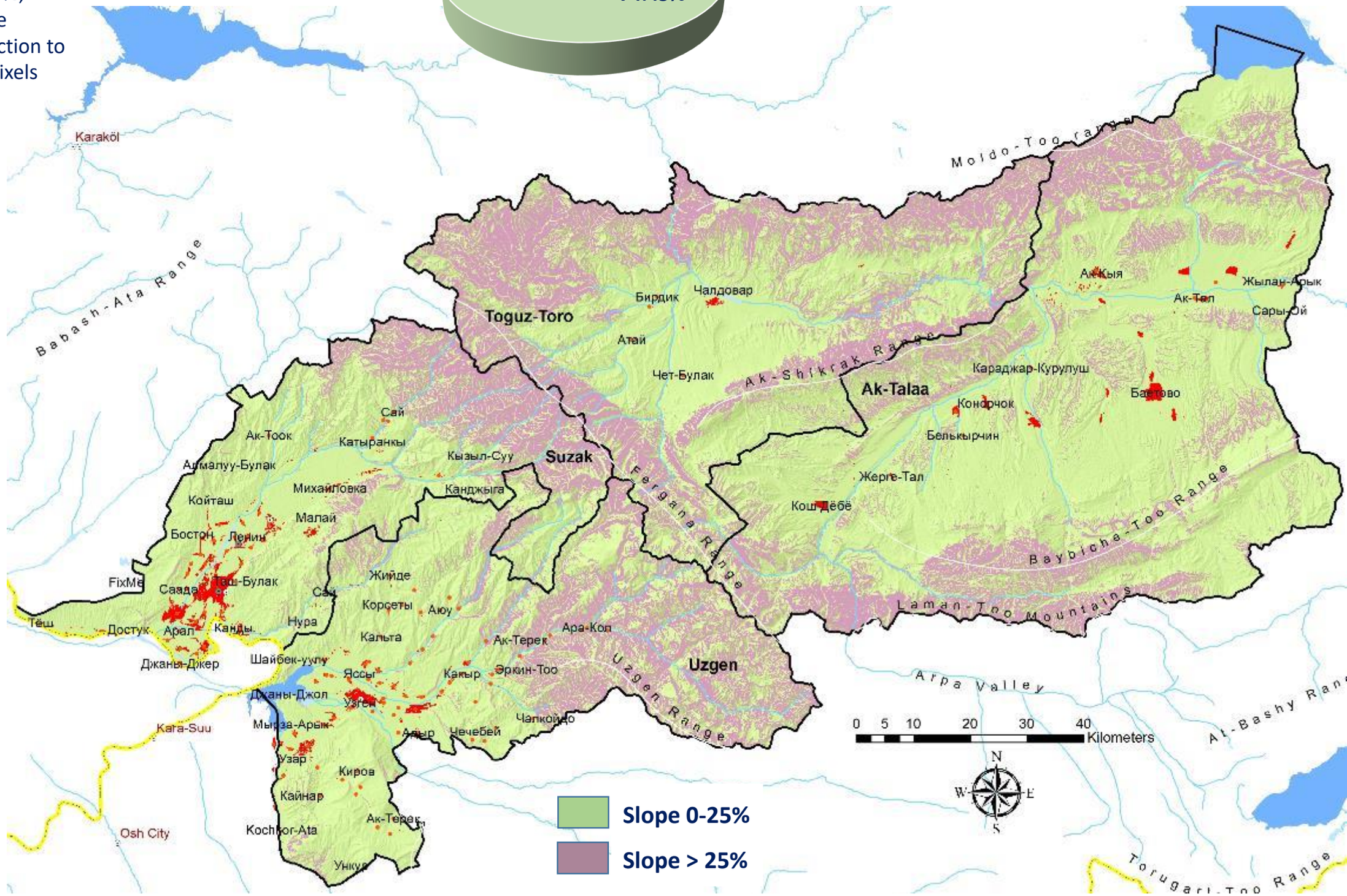


Slope

Used ASTER GDEM's slope layer (30m)
Classified in 2 classes of slope: 0-25%; > 25%;
Applied three time majority filter function to remove isolated pixels



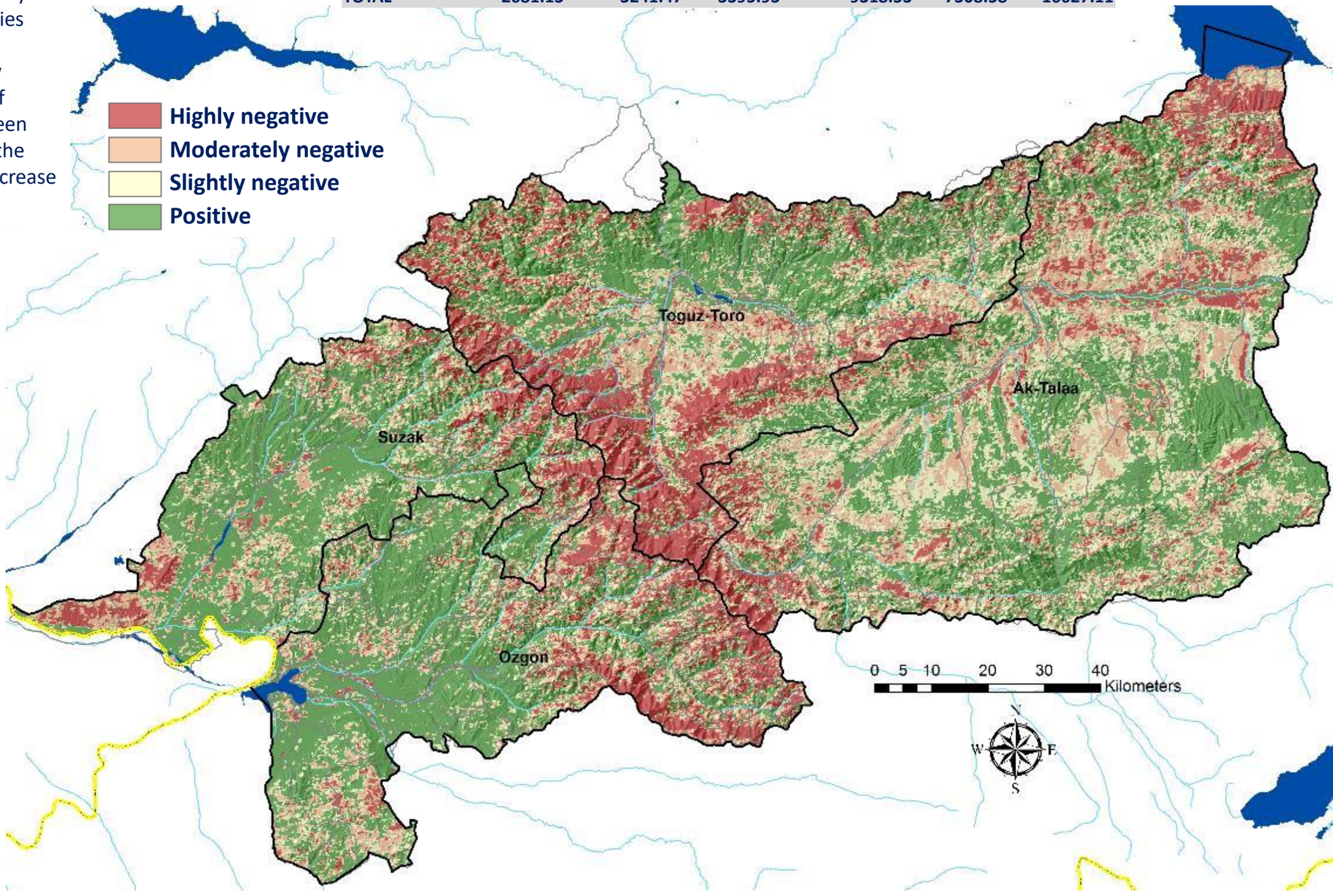
Slope	Total area (ha)
Slope 0-25%	1,237,927
Slope > 25%	424,784
Grand Total	**1,662,711**



NDVI trend 2003-2016

Using MODIS based NDVI data, this map depicts annual trend in NDVI index based on 16 days composite time series from 2003 to 2016. Shades of red show different degrees of vegetation loss. Green shows area where the trend is positive (increase vegetation).

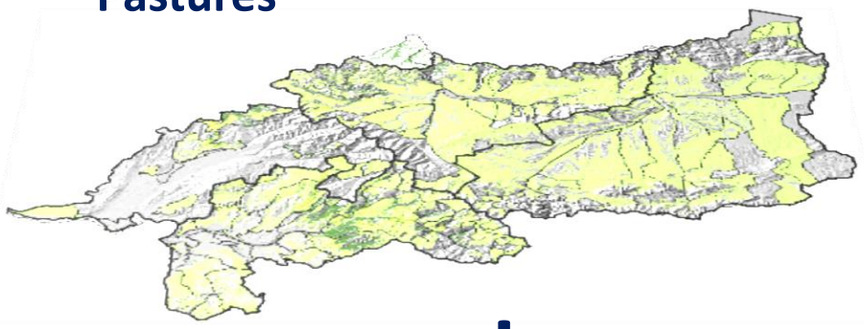
Rayon	highly negative	moderately negative	slightly negative	total negative km^2	Positive km^2	total area km^2
Suzak	347.42	430.85	443.83	1222.11	1530.91	2753.02
Toguz-Toro	1024.61	826.93	687.94	2539.48	1395.46	3934.94
Ak-Talaa	763.31	1407.11	1737.45	3907.87	2603.90	6511.77
Uzgen	545.79	576.58	526.70	1649.07	1778.31	3427.38
TOTAL	**2681.13**	**3241.47**	**3395.93**	**9318.53**	**7308.58**	**16627.11**



Stratification approach for classifying pasture areas

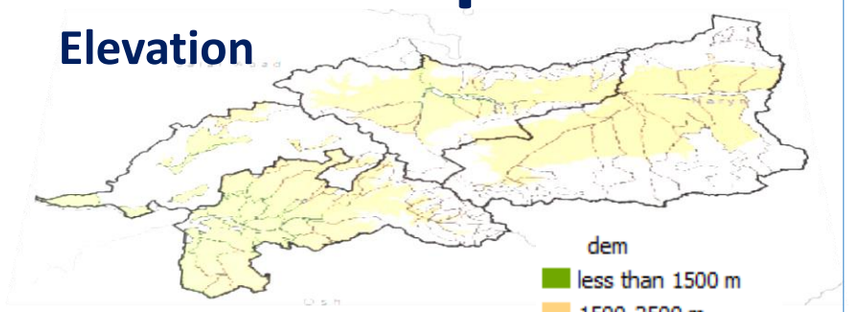
Pastures in different PUUs have been combined with classes of altitude and slope to identify 165 unique areas for further climatic and vegetation condition analysis.

Pastures



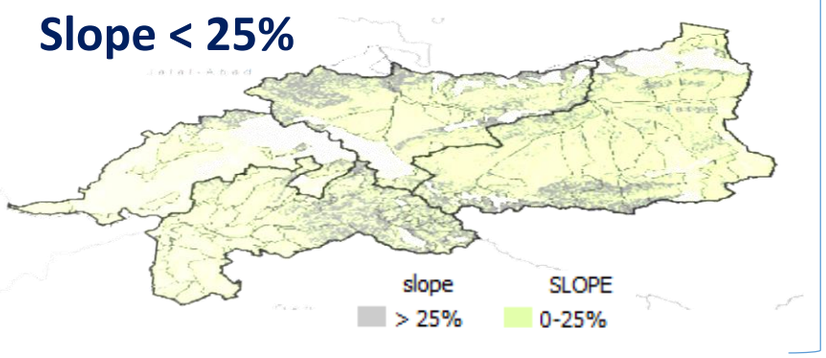
+

Elevation

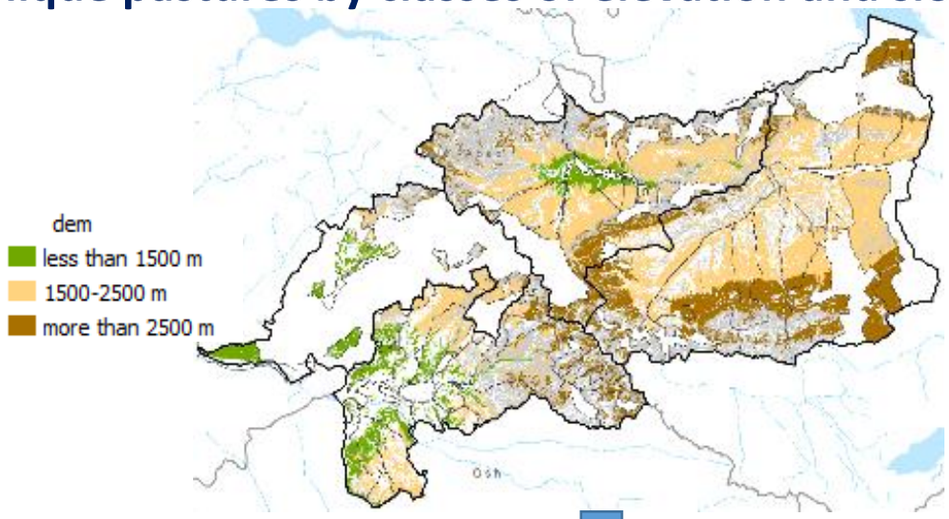


+

Slope < 25%

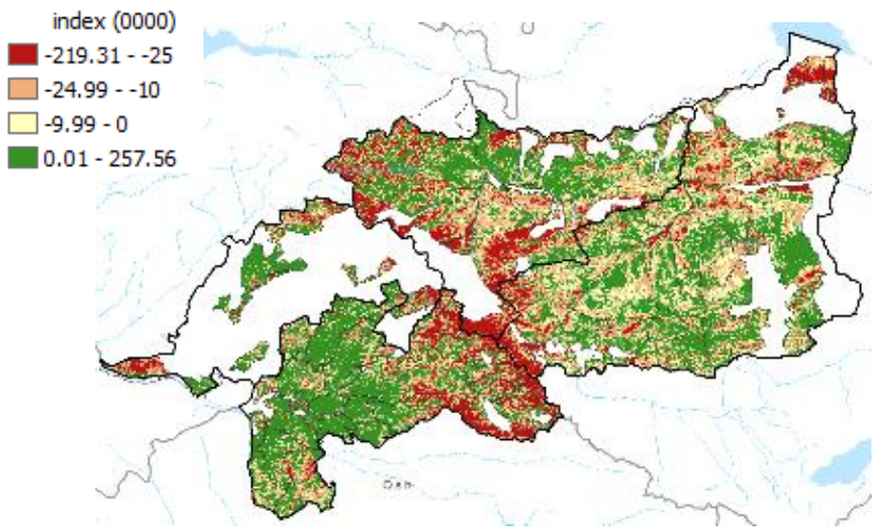


Unique pastures by classes of elevation and slope



Classification by zonal mean

Trend NDVI 2003-2016

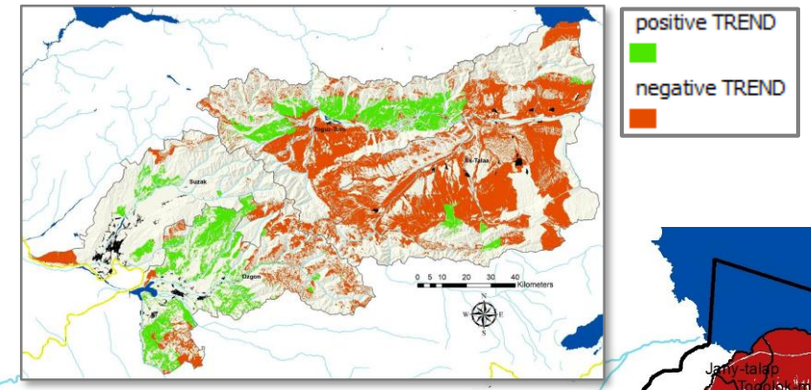


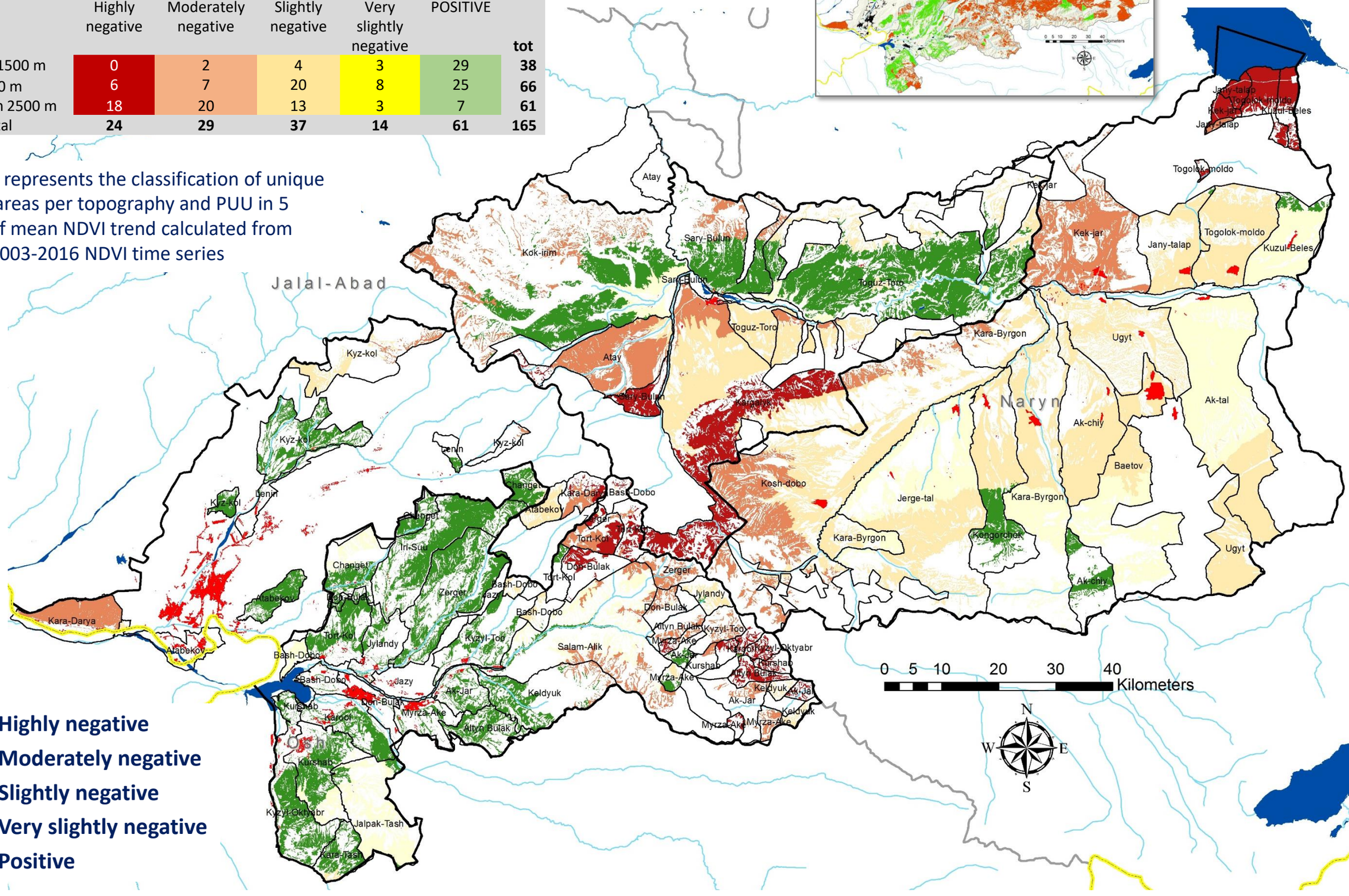
Next...

Classified map of pasture areas, stratified per topography and PUU, based on mean NDVI trend

	Highly negative	Moderately negative	Slightly negative	Very slightly negative	POSITIVE	tot
less than 1500 m	0	2	4	3	29	**38**
1500-2500 m	6	7	20	8	25	**66**
more than 2500 m	18	20	13	3	7	**61**
Grand Total	**24**	**29**	**37**	**14**	**61**	**165**

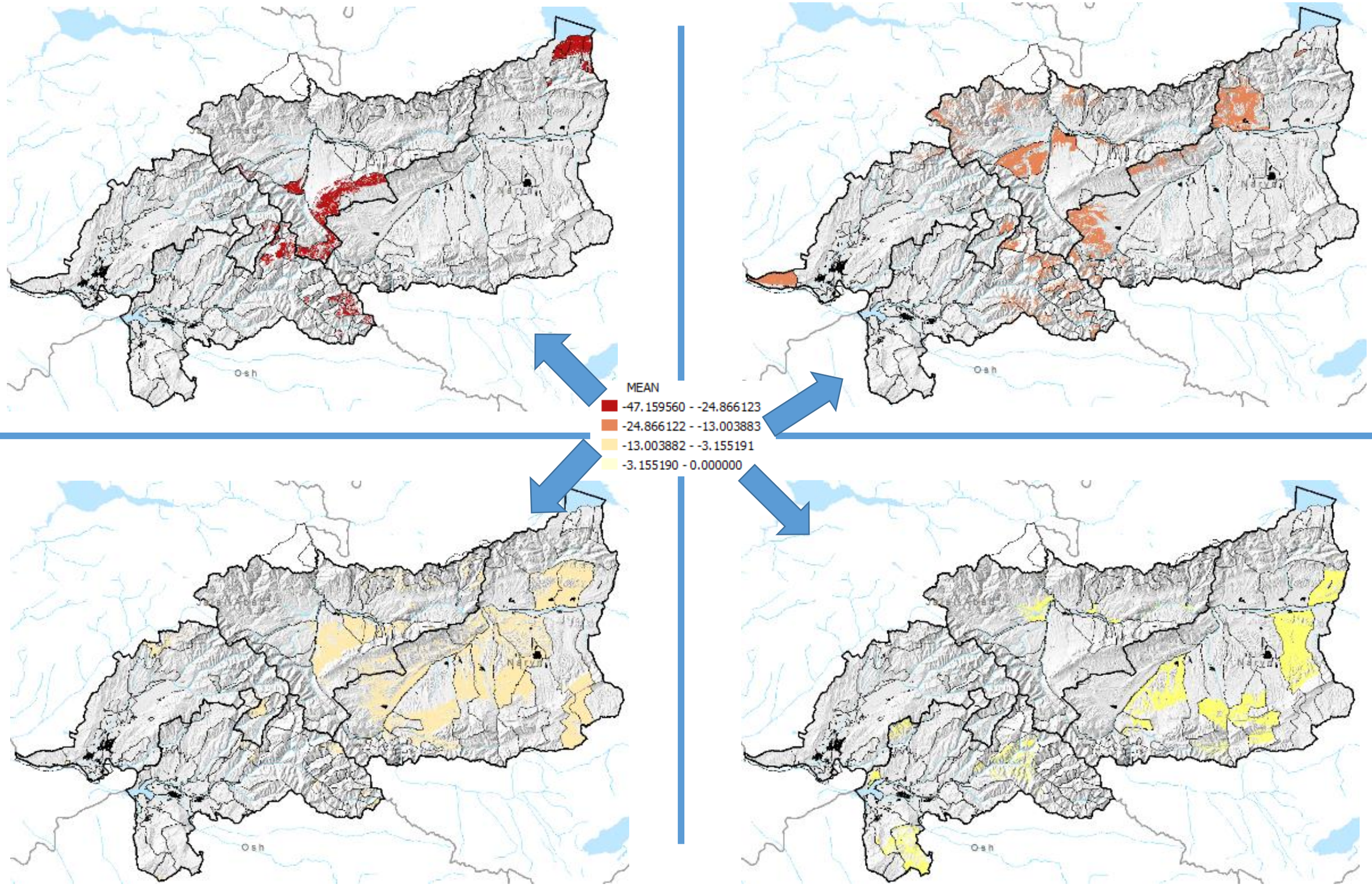
The map represents the classification of unique pasture areas per topography and PUU in 5 classes of mean NDVI trend calculated from MODIS 2003-2016 NDVI time series





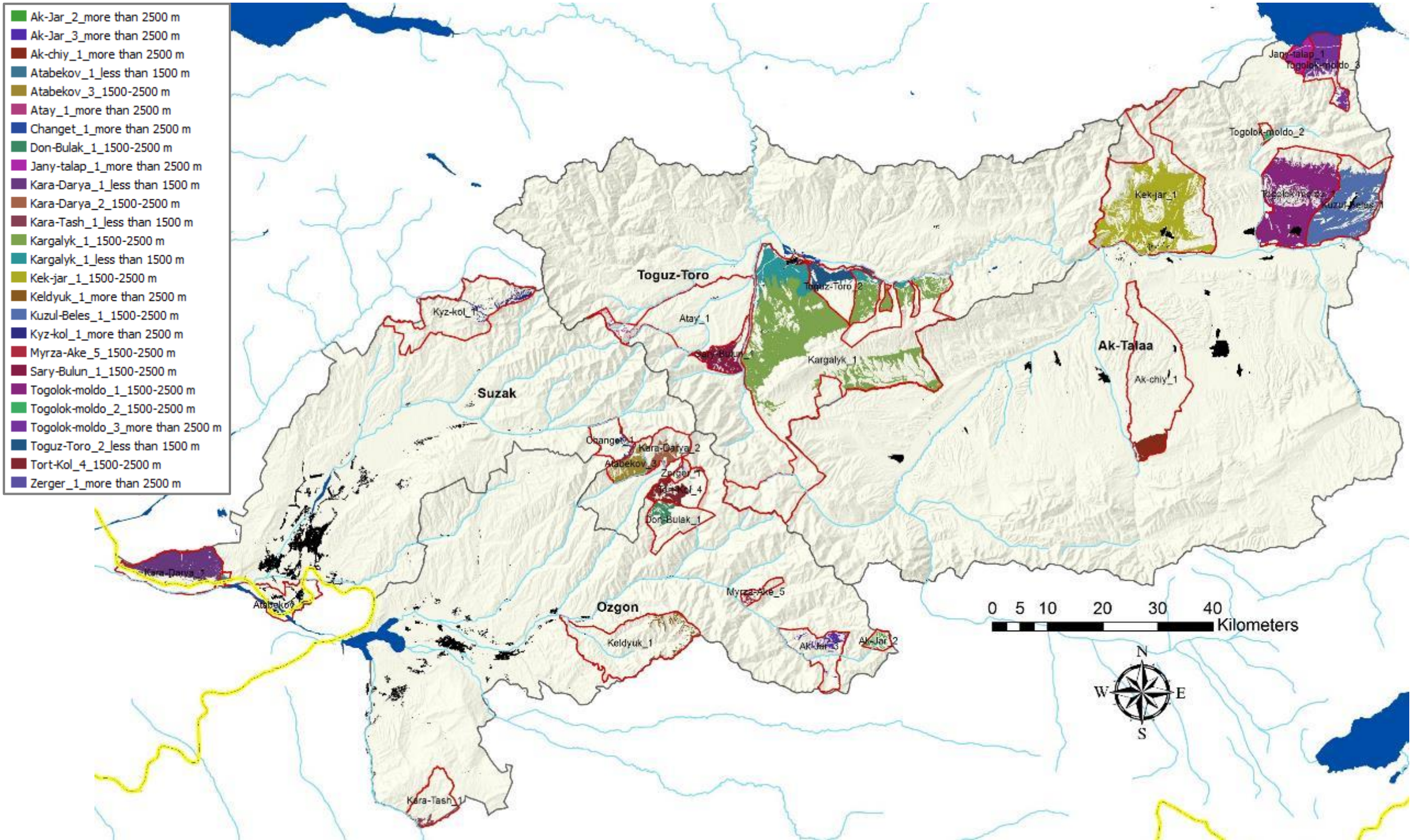
- **Highly negative**
- **Moderately negative**
- **Slightly negative**
- **Very slightly negative**
- **Positive**

Pastures by range of negative NDVI trend: 104 units in 4 classes



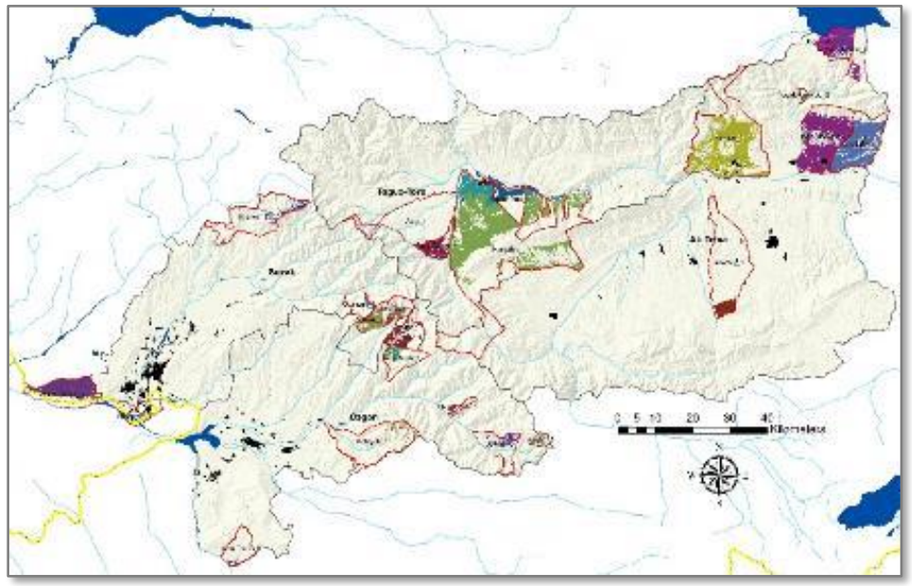
Map of 26 selected pasture areas

This selection was made to represent examples for each of the 4 target rayons, for different type of pastures (three altitude ranges) and for category of negative trend (1st to 4th group) created according to level of NDVI reduction in the time series



Statistics of 26 selected pasture areas representing the four groups of negative NDVI trends identified by this analysis

This sample of 26 “cases” is 25% of all pasture units detected with negative trend, and 16% of all unique pasture areas identified with the adopted stratification approach. It is not exhaustive but it provides a picture of the characteristics of pastures in various conditions.



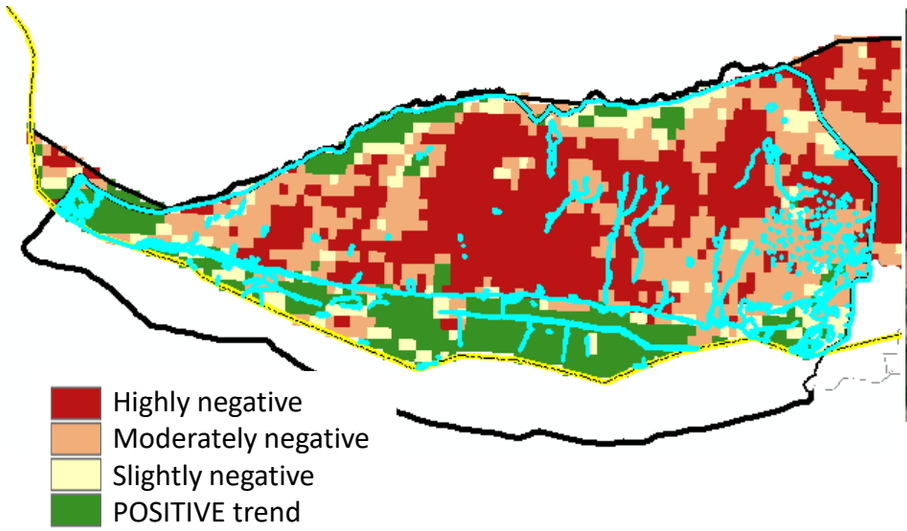
ID	PUU	PUU_part	dem	name	area (ha)	rayon	slope	Mean NDVI trend	GROUP
26	Atay	Atay_1	more than 2500 m	Atay_1_morethan_2500m	404.41	toguz-toro	less than 25%	-47.15956	1
55	Jany-talap	Jany-talap_1	more than 2500 m	Jany_talap_1_morethan_2500m	1884.05	ak-talaa	less than 25%	-33.27537	1
7	Ak-Jar	Ak-Jar_2	more than 2500 m	Ak_Jar_2_morethan_2500m	386.57	uzgen	less than 25%	-32.044803	1
146	Togolok-moldo	Togolok-moldo_3	more than 2500 m	Togolok_moldo_3_morethan_2500m	4335.69	ak-talaa	less than 25%	-31.637451	1
43	Don-Bulak	Don-Bulak_1	1500-2500 m	Don_Bulak_1_1500_2500m	963.84	uzgen	less than 25%	-30.750553	1
131	Myrza-Ake	Myrza-Ake_5	1500-2500 m	Myrza_Ake_5_1500_2500m	225.79	uzgen	less than 25%	-30.064965	1
136	Sary-Bulun	Sary-Bulun_1	1500-2500 m	Sary_Bulun_1_1500_2500m	2771.28	toguz-toro	less than 25%	-30.005012	1
144	Togolok-moldo	Togolok-moldo_2	1500-2500 m	Togolok_moldo_2_1500_2500m	247.56	ak-talaa	less than 25%	-26.004503	1
70	Kara-Darya	Kara-Darya_1	less than 1500 m	Kara_Darya_1_lessthan_1500m	6507.04	suzak	less than 25%	-22.283859	2
88	Keldyuk	Keldyuk_1	more than 2500 m	Keldyuk_1_morethan_2500m	967.40	uzgen	less than 25%	-20.68179	2
8	Ak-Jar	Ak-Jar_3	more than 2500 m	Ak_Jar_3_morethan_2500m	875.35	uzgen	less than 25%	-19.664448	2
108	Kyz-kol	Kyz-kol_1	more than 2500 m	Kyz_kol_1_morethan_2500m	854.23	suzak	less than 25%	-16.978361	2
71	Kara-Darya	Kara-Darya_2	1500-2500 m	Kara_Darya_2_1500_2500m	1338.51	suzak	less than 25%	-16.534166	2
156	Tort-Kol	Tort-Kol_4	1500-2500 m	Tort_Kol_4_1500_2500m	1817.74	uzgen	less than 25%	-15.904546	2
82	Kek-jar	Kek-jar_1	1500-2500 m	Kek_jar_1_1500_2500m	15310.06	ak-talaa	less than 25%	-13.862912	2
76	Kargalyk	Kargalyk_1	less than 1500 m	Kargalyk_1_lessthan_1500m	5504.77	toguz-toro	less than 25%	-13.517722	2
151	Toguz-Toro	Toguz-Toro_2	less than 1500 m	Toguz_Toro_2_lessthan_1500m	2290.43	toguz-toro	less than 25%	-11.920578	3
142	Togolok-moldo	Togolok-moldo_1	1500-2500 m	Togolok_moldo_1_1500_2500m	13292.14	ak-talaa	less than 25%	-11.831292	3
75	Kargalyk	Kargalyk_1	1500-2500 m	Kargalyk_1_1500_2500m	26987.73	toguz-toro	less than 25%	-11.372199	3
19	Atabekov	Atabekov_1	less than 1500 m	Atabekov_1_lessthan_1500m	229.35	suzak	less than 25%	-10.179352	3
161	Zerger	Zerger_1	more than 2500 m	Zerger_1_morethan_2500m	36.53	uzgen	less than 25%	-9.1712	3
2	Ak-chiy	Ak-chiy_1	more than 2500 m	Ak_chiy_1_morethan_2500m	1832.87	ak-talaa	less than 25%	-6.176614	3
74	Kara-Tash	Kara-Tash_1	less than 1500 m	Kara_Tash_1_lessthan_1500m	313.79	uzgen	less than 25%	-5.273345	3
22	Atabekov	Atabekov_3	1500-2500 m	Atabekov_3_1500_2500m	2138.95	suzak	less than 25%	-4.472624	3
39	Changet	Changet_1	more than 2500 m	Changet_1_morethan_2500m	330.13	uzgen	less than 25%	-3.447457	3
104	Kuzul-Beles	Kuzul-Beles_1	1500-2500 m	Kuzul_Beles_1_1500_2500m	10163.31	ak-talaa	less than 25%	-1.38721	4

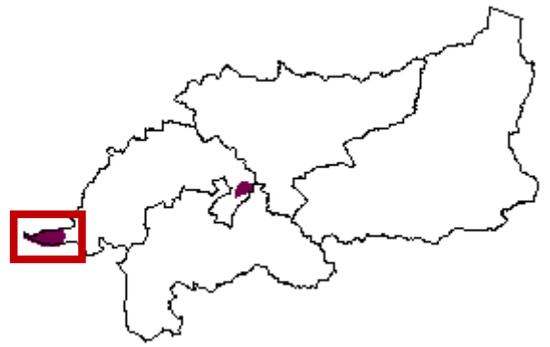
SUZAK

PUU Kara-Darya: Parcel 1, < 25% slope, < 1500m altitude

PASTURE ANALYSIS (Sample)

NDVI trend map and 3D view in Google Earth

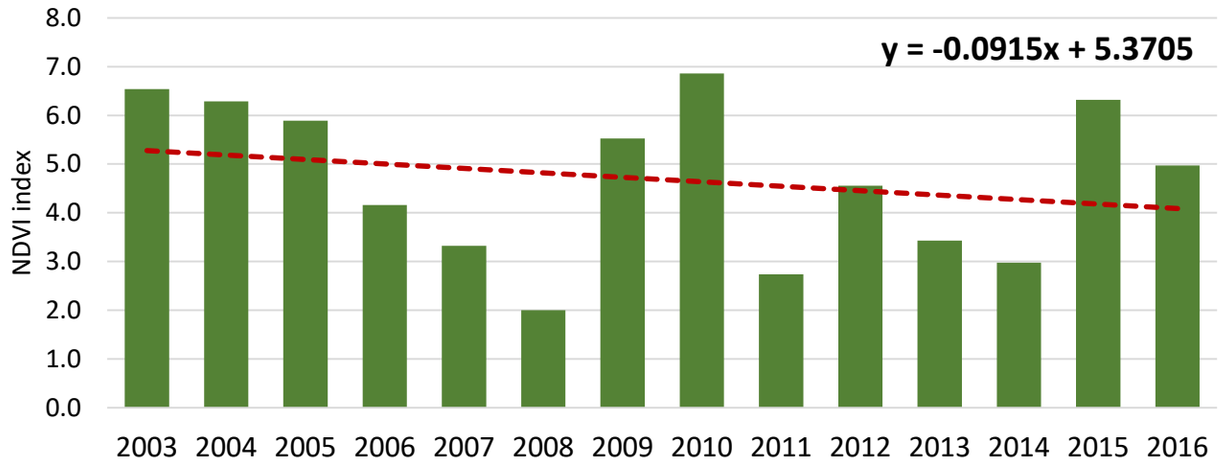




ID	5
PUU	Kara-Darya
PUU PARCEL	Kara-Darya_1
Area (ha)	6507.04
Rayon	Suzak
Altitude range	less than 1500 m
Slope	less than 25%
Mean NDVI Trend (0000)	-22.284
GROUP	2
SUM NDVI 2000-2017	86.574
MEAN NDVI 2000-2017	0.317
MAX NDVI 2000-2017	0.664
MIN NDVI 2000-2017	0.200
STDEV NDVI 2000-2017	0.106

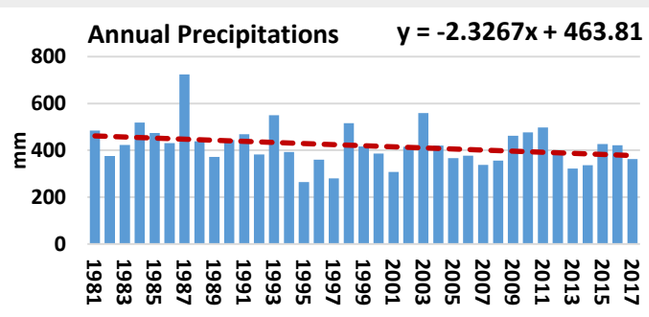
The average mean and max NDVI indicate that the greenness productivity is moderate. The area is also subject to a high negative NDVI trend.

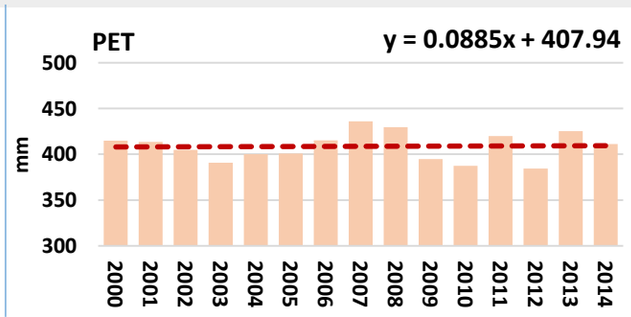
Annual SUM NDVI and trend line: PUU's "winter" pastures with less than 25% slope

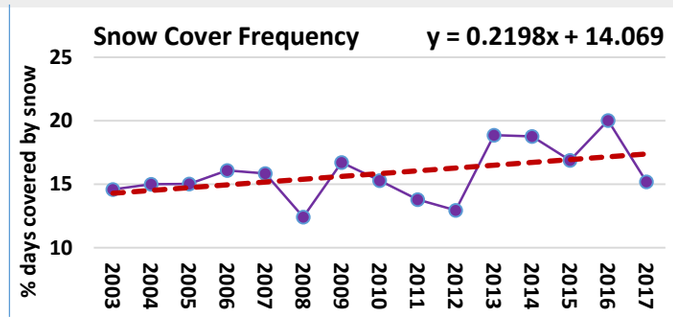


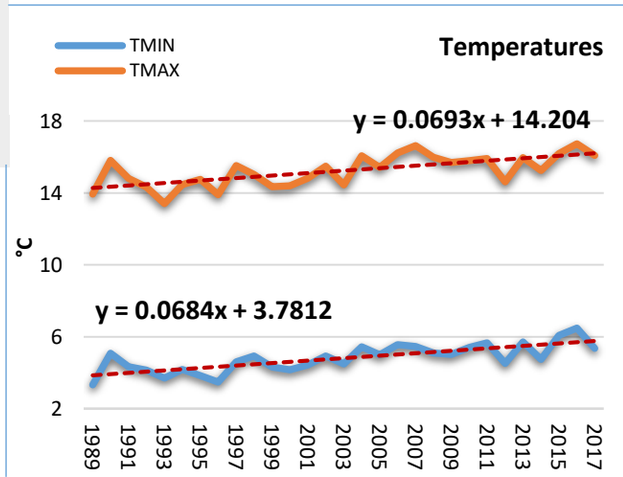
The NDVI time series analysis shows a negative trend in accumulated annual greenness (∑NDVI > 0.2) between 2003 and 2016, as confirmed by NDVI trend map above.

PUU Kara-Darya: TRENDS









Google Earth 3D Image with Forest cover and Leshoz borders

The Kyrgyz Republic
BASELINE ATLAS

Core Target Area: FOREST ANALYSIS

Forest Overview

INTRODUCTION

Objective

- Provide a basic overview of forest resources in the project target area by using previously developed databases and information. The forest layer has been stratified by 45 State Forest Fund (leshoz) and 2 National Reserve territories in the target Rayons and used to extract statistics, compare with NDVI time series trend, and develop informative slides with graphic, text, vegetation and climatic statistics for 8 selected territories with different vegetation conditions and located in different Rayons: Suzak, Toguz-Toro, Ak-Talaa and Uzgen.

Data

- Forest data from Hansen's Global Forest Change database 2016
- State Forest Fund boundaries from 2009 Map of forestry mandate area distribution in Kyrgyz Republic
- Forest types from 2009 Forest Map of forest location of Kyrgyzstan (Kyrgyz/Swiss Project, KIRFOR)
- NDVI trend 2003-2016 from MODIS MOD13A1 product
- Topography from ASTER GDEM 30m

Outputs x target core area (4 rayons)

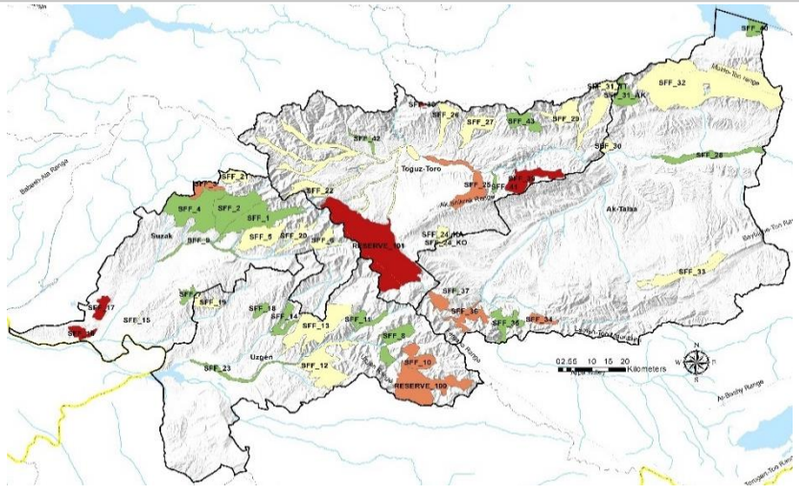
- Forest territories border layer
- Forest layer stratified by forest territory (leshoz and national reserve)
- Classified map of forest territories by mean NDVI trend 2003-2016.
- Detailed analysis for 8 selected territories

Methodology

47 territories in the target rayons have been used to extract the mean NDVI trend value 2003-2016 by using a zonal statistics technique, and have been classified by using 3 classes of negative trend and 1 for all positives (see map).

I. Forest layer

In absence of a recent, official national forest map, the forest layer here adopted is derived from the Hansen's Global Forest Cover Change 2016, v 1.4 dataset.



II. SFF and National Reserve borders layer

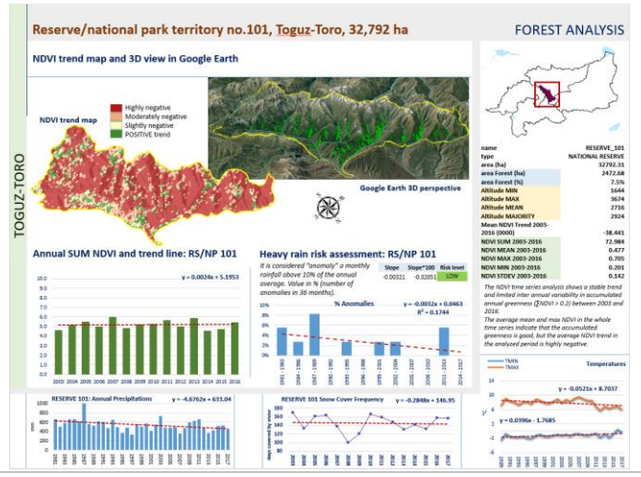
In absence of official boundaries, leshoz and reserve territories in the target Rayons have been derived digitizing boundaries from the a geo-referenced version of the layer available at the Kyrgyzstan's REACH Mapping Tool [*http://reach-initiative.kg/*].

III. NDVI 2003-2016 trend layer

The NDVI trend layer is generated using the Google platform and is derived from processing MOD13A1 Vegetation Indices 16-Day L3 Global time series available from 2003 to 2016.

Results

By using the forest layer, territories, the NDVI trend and various databases from the Google platform, statistics on percentage of forests and level of greenness have been generated. For a selection of 8 territories in the range of worse NDVI trend and representing the 4 target rayons, text, graphic and charts have been collected and assembled for each area to provide a comprehensive and holistic overview.

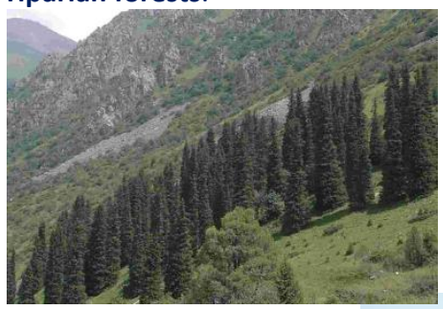


Glossary

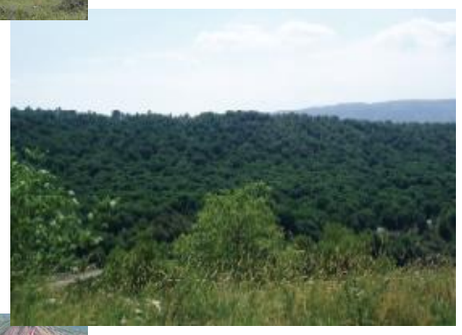
Hansen Tree Cover class: "Trees are defined as vegetation taller than 5m in height and are expressed as a percentage per output grid cell**"**

Forests in Kyrgyzstan

The forest covered rate of Kyrgyz is only 4.3%. Forests of Kyrgyzstan are significantly divided into three typical forest vegetation: **Spruce forests** of the northern mountainous region, **Walnut forest** of southwest, **Juniper forest** towards the southern border of Tajikistan. In addition, the willows and gummy forests have been distributed throughout as **shrub and riparian forests**.



Spruce forest



Walnut forest

Riparian forest

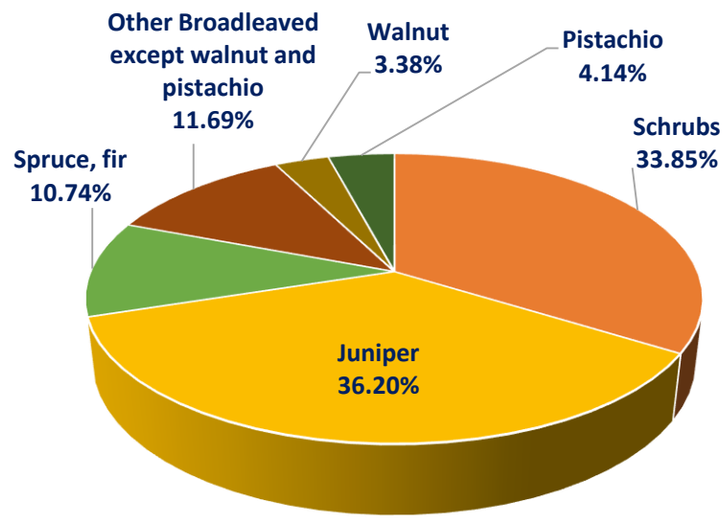
Juniper forest

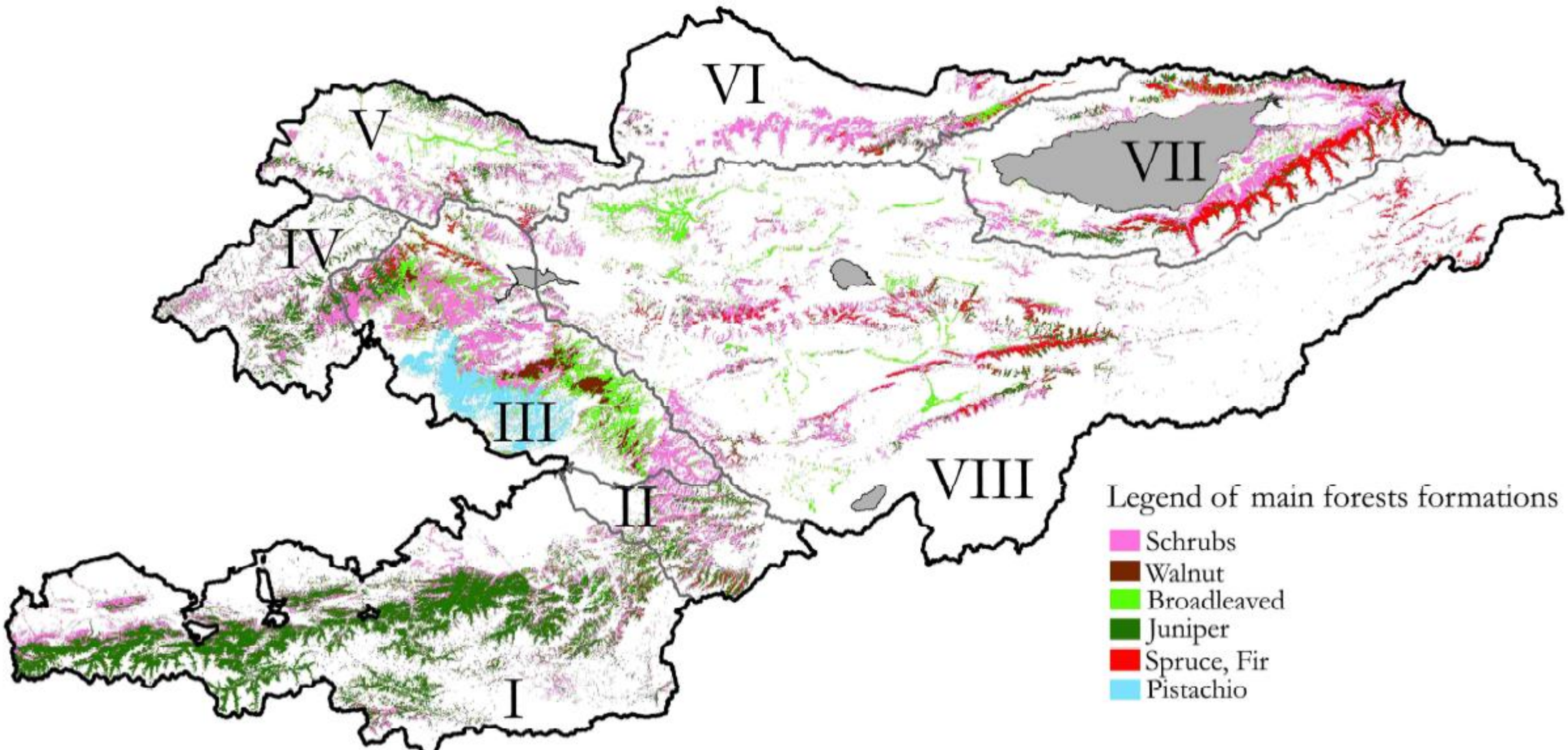
Map of Forest Locations

Source: 2008 Grisa E. Forest typology in the Kyrgyz Republic (http://msri-hub.ucentralasia.org/node/4483)
This map has been developed by ECOGIS Public Foundation and by Ennio Grisa, 2003-2008 and it is part of the "Forest Typology in the Kyrgyz Republic" publication (2008), produced for the KIRFOR project in cooperation between the Government of Kyrgyzstan and the Swiss Cooperation.

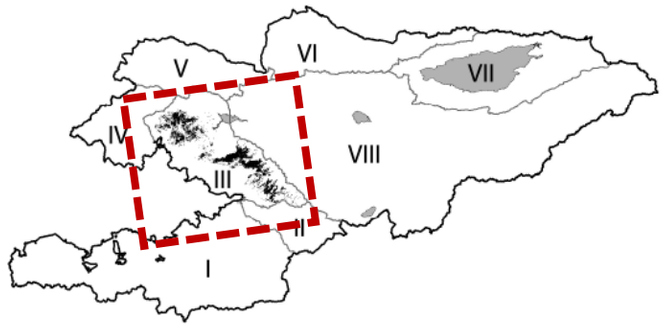
This study provides an estimate of forest resources in the Country using remote sensing technology combined with field and existing data.

Forest type (area %)





Landscape of an individual area of the Walnut Fruit Forests



Source: 2008 Grisa E. Forest typology in the Kyrgyz Republic (http://msri-hub.ucentralasia.org/node/4483)
Depending on site conditions there takes place the formation of certain forest formations. In the areas with severe conditions (dry soils of poor fertility) there grow shrubs and partly hawthorn and juniper stands, in the better forest growth conditions – maple forests.

The walnut forest stands occupy the most favorable habitats, i.e. the sites with the most moistened and fertile soils. In the picture, there can be seen the negative impact of the anthropogenic pressure resulting in the formation of deforested areas and soil erosion.

1.1 Walnut forest with false brome grass
1.2. Walnut forest with additional moistening
1.3 Walnut forest with spruce and fir species
1.4. Walnut forest with hawthorn species
1.5. Walnut forest with maple and apple
1.6 Walnut forest of park-like nature
2 Pistachio
3 Almond
4 Apple
5 Maple
6 Hawthorn

7.1 Juniper forest of elfin-wood form
7.2 Juniper forest, moistened with high-stem grasses
7.3 Juniper forest, dry with low-stem grasses
7.4 Juniper forest of riverbed valleys
7.5 Juniper forest (open) with shrubs
7.6. Juniper forest on rock debris;
7.7 Juniper forest on rocks

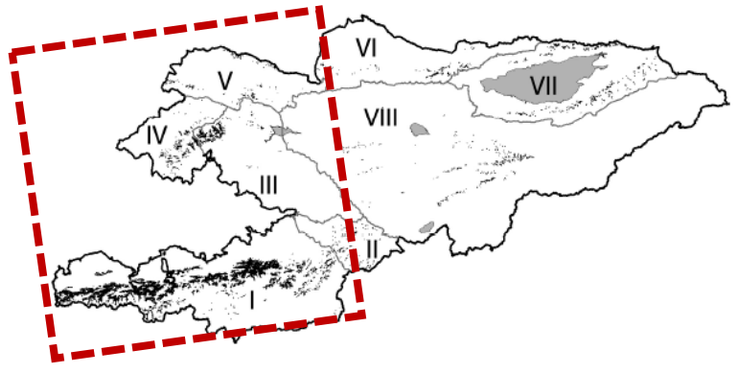
8.1 Spruce forest with high-stem grasses
8.2 Spruce forest of high mountains
8.3 Spruce forest with mosses
8.4 Spruce forest with rowan species
8.5 Spruce forest with low-stem grasses
8.6 Spruce forest of riverbed valleys
8.7 Spruce forest (open) with shrubs
8.8 Spruce forest with juniper species
8.9 Spruce forest on rocks

9 Fir
10 Riverside and riverbed forests
11 Thick shrubs on mountain slopes
Pa Pasture

Landscape of the Juniper Forests

Source: 2008 Grisa E. Forest typology in the Kyrgyz Republic (http://msri-hub.ucentralasia.org/node/4483)

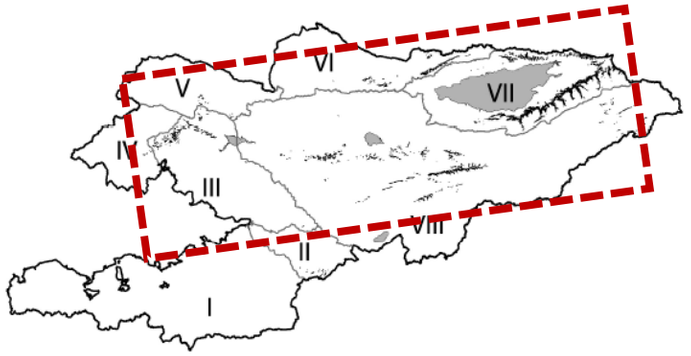
In Kyrgyzstan, the juniper forests occupy large tracts representing a kind of zone of coniferous tree vegetation. They are located mainly on the steep slopes and have a very important ecological role.



1. **Juniper forest, moistened with high-stem grasses**
2. **Juniper forest, dry with low-stem grasses**
3. **Juniper forest of elfin-wood form**
4. **Juniper forest of river-bed valleys**
5. **Juniper forest (open) with shrubs**

Landscape of the Spruce Forests

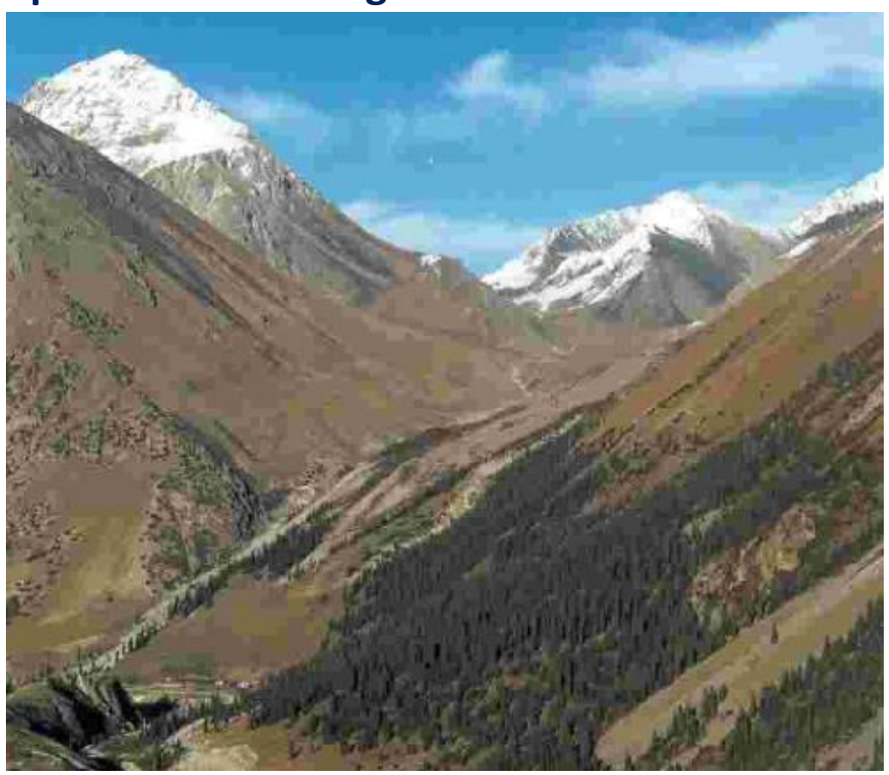
Source: 2008 Grisa E. Forest typology in the Kyrgyz Republic (http://msri-hub.ucentralasia.org/node/4483)
In Kyrgyzstan, the dark coniferous forests are formed by two conifer species – Shrenk spruce (Tien-Shan spruce) and Semenov spruce which is an endemic in Kyrgyzstan.



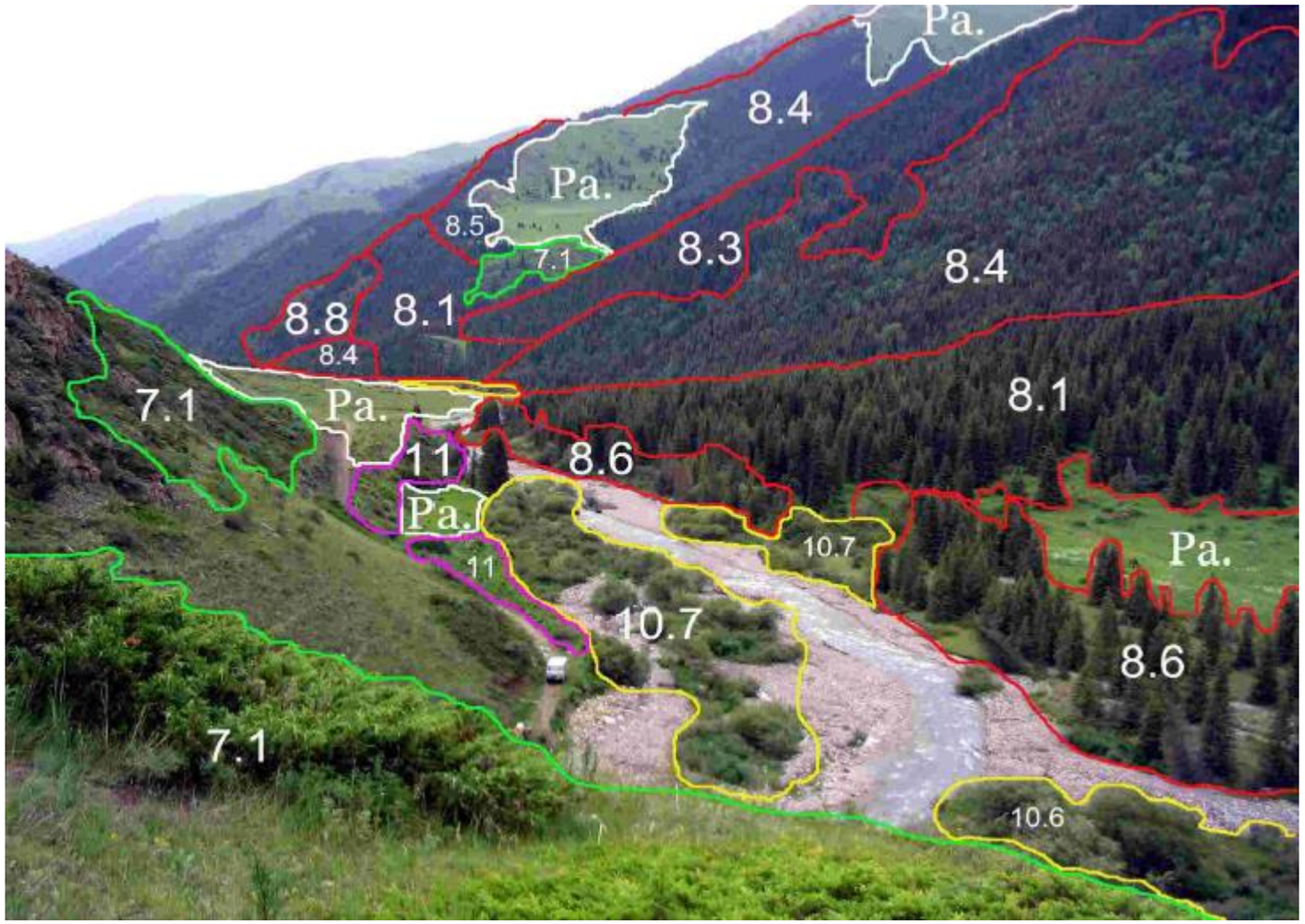
The spruce forests in the area of their distribution grow on the slopes in a mosaic-like pattern: the spruce trees are grouped in strips and small arrays interspersed with glades, debris, and rocks.

The spruce forest stands occupy, mainly, the slopes of the northern expositions (shadowed), while on the sunny slopes they grow only when there is additional moisture supply resulting from the condensation of moisture received from the nearby rocks

Spruce forest on high mountains



Landscape of spruce forests with interpretation



7.1 Juniper forest of elfin-wood form
7.2 Juniper forest, moistened with high-stem grasses
7.3 Juniper forest, dry with low-stem grasses
7.4 Juniper forest of riverbed valleys
7.5 Juniper forest (open) with shrubs
7.6. Juniper forest on rock debris;
7.7 Juniper forest on rocks

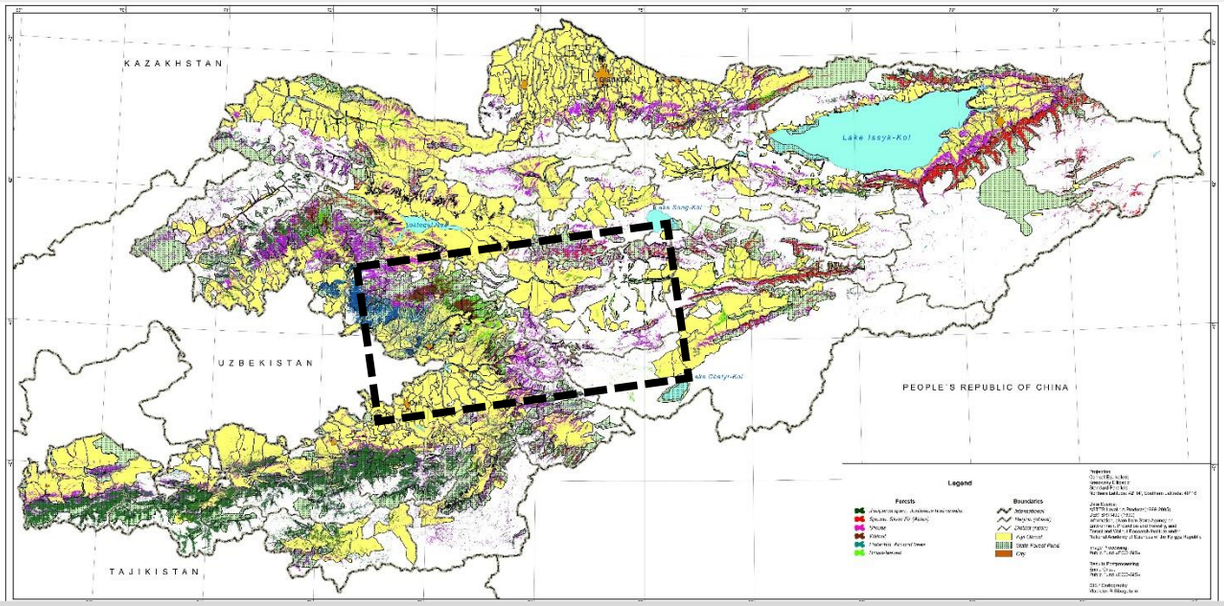
8.1 Spruce forest with high-stem grasses
8.2 Spruce forest of high mountains
8.3 Spruce forest with mosses
8.4 Spruce forest with rowan species
8.5 Spruce forest with low-stem grasses
8.6 Spruce forest of riverbed valleys
8.7 Spruce forest (open) with shrubs
8.8 Spruce forest with juniper species
8.9 Spruce forest on rocks

9 Fir
10 Riverside and riverbed forests
11 Thick shrubs on mountain slopes
Pa Pasture

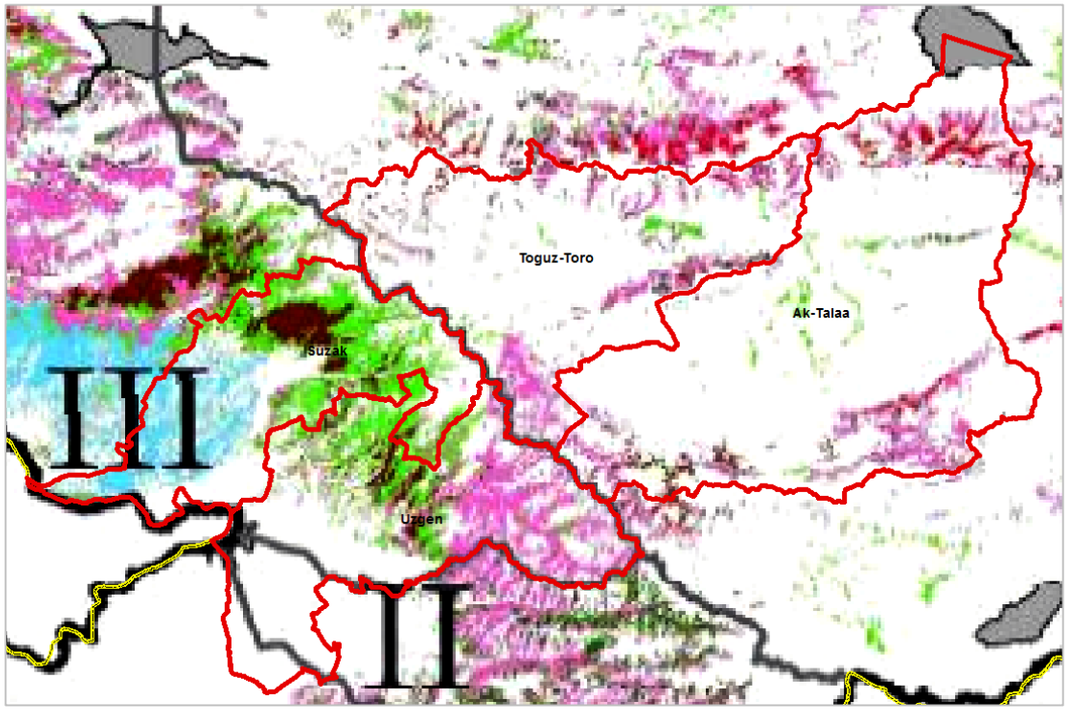
Map of forest location in the Kyrgyzstan

This map has been developed by ECOGIS Public Foundation and by Ennio Grisa and published in 2009.

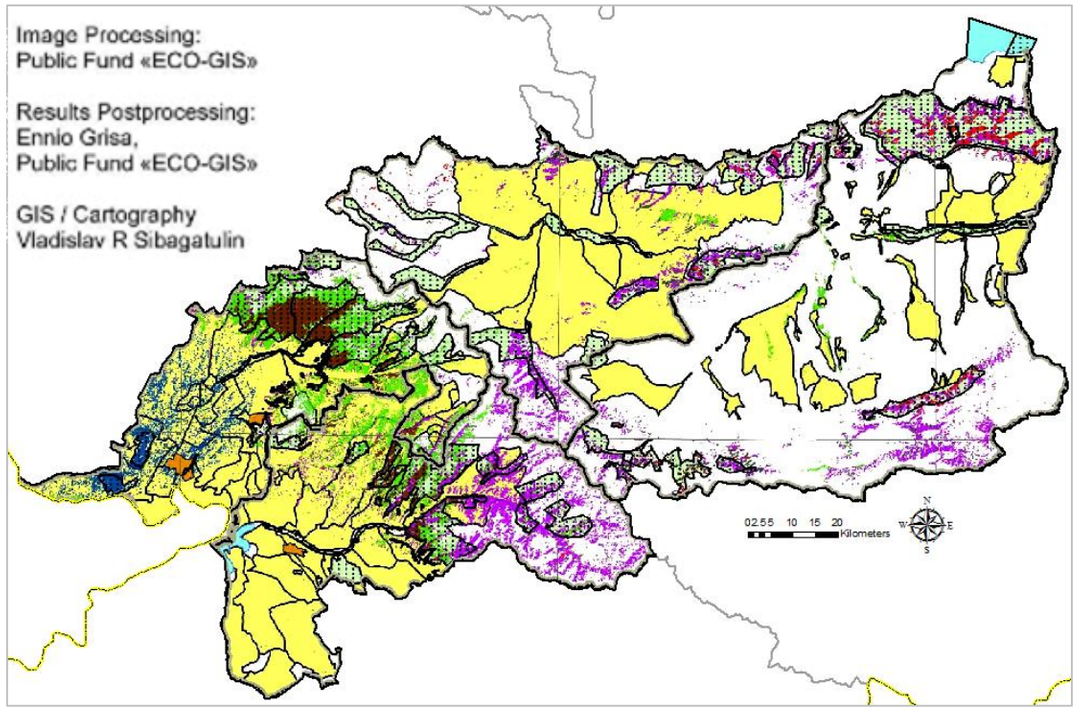
Source: 2009 Map of forest location in the Kyrgyz Republic (http://msri-hub.ucentralasia.org/node/3540)



Zoom to Target Area



Schrubs
Walnut
Broadleaved
Juniper
Spruce, Fir
Pistachio



Forests

- *Juniperus spec., Juniperus horizontalis*
- *Spruce, Silver Fir (Abies)*
- *Shrubs*
- *Walnut*
- *Pistachio, Almond trees*
- *Broad-leaved*

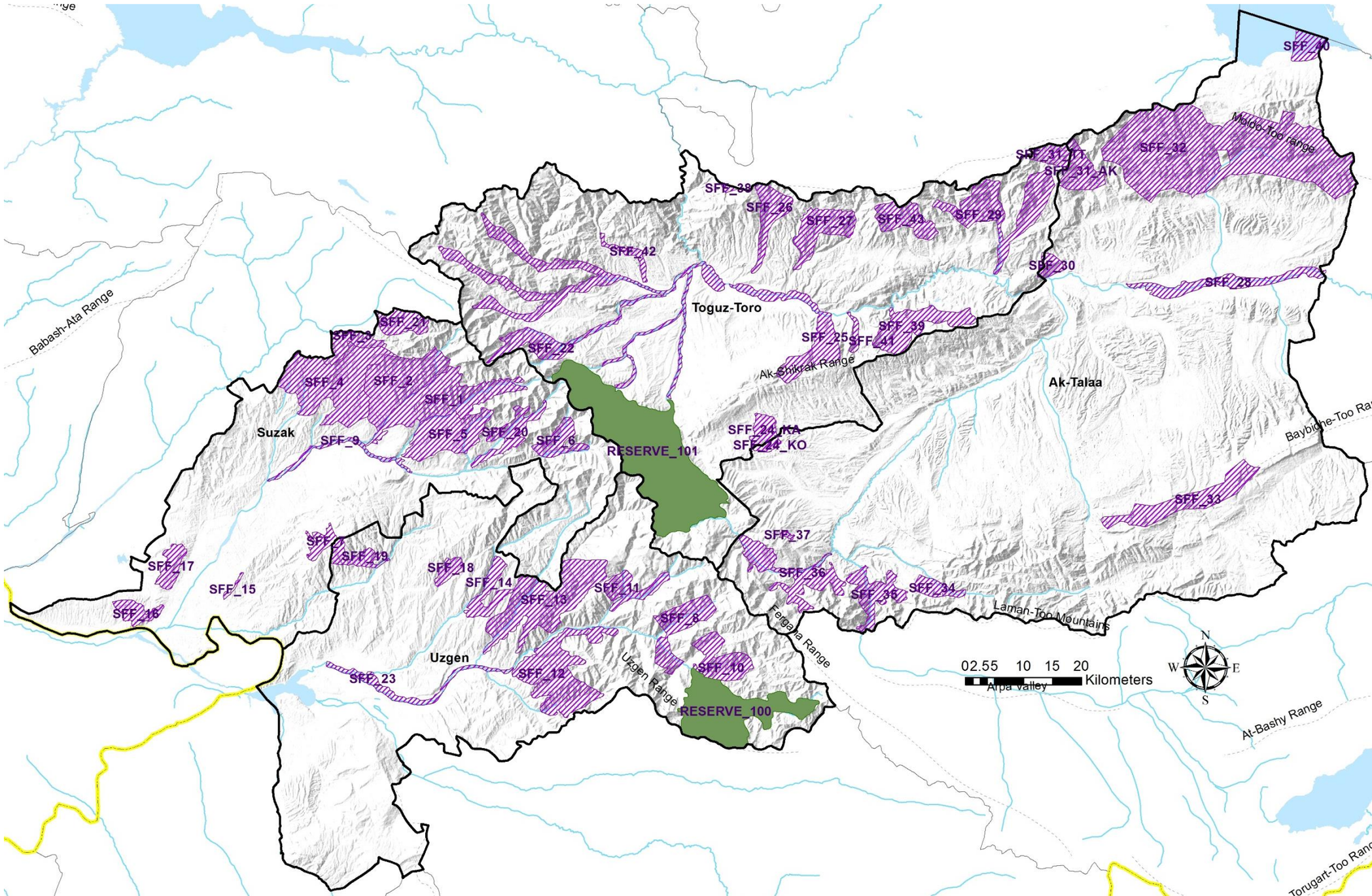
Boundaries

- *International*
- *Region (oblast)*
- *District (raion)*
- *Aiyl Okmot*
- *State Forest Fund*
- *City*

Map of State Forest Fund and National Reserve territories in the

name	area ha
RESERVE_100	14946.55
RESERVE_101	32792.31
SFF_1	10868.93
SFF_2	10255.71
SFF_3	2664.40
SFF_4	15148.99
SFF_5	7781.34
SFF_6	2734.42
SFF_7	1485.29
SFF_8	5515.16
SFF_9	1725.21
SFF_10	4966.95
SFF_11	3137.10
SFF_12	12011.53
SFF_13	13870.07
SFF_14	2957.38
SFF_15	259.96
SFF_16	2048.24
SFF_17	2250.63
SFF_18	1365.19
SFF_19	2210.04
SFF_20	3557.24
SFF_21	3021.18
SFF_22	19675.92
SFF_23	3051.54
SFF_24_KA	1870.38
SFF_24_KO	623.11
SFF_25	7139.56
SFF_26	3919.71
SFF_27	5350.85
SFF_28	5039.14
SFF_29	10319.23
SFF_30	1305.89
SFF_31_AK	3772.54
SFF_31_TT	2051.50
SFF_32	45227.09
SFF_33	7613.48
SFF_34	1806.02
SFF_35	4330.60
SFF_36	6719.83
SFF_37	190.01
SFF_38	235.17
SFF_39	6404.94
SFF_40	2265.20
SFF_41	671.44
SFF_42	1128.24
SFF_43	4043.33
TOT SFFs	254589.69
TOT RESERVEs	47738.86
TOT	302328.55

The forests of the Kyrgyz Republic are State property and form a unified State Forestry Fund (SFF) which includes forests and lands that are not covered with forest but earmarked for future forestry activities. In 2003, the total area of the State Forest Fund lands was reported to be 3.3 million ha. Forests cover 4.3% or 865,000 ha of the territory of the Kyrgyz Republic. In 2005, the forest cover of the Kyrgyz Republic was estimated at 869,300 ha representing 4.5% of the country's total land area (FAO, 2006).

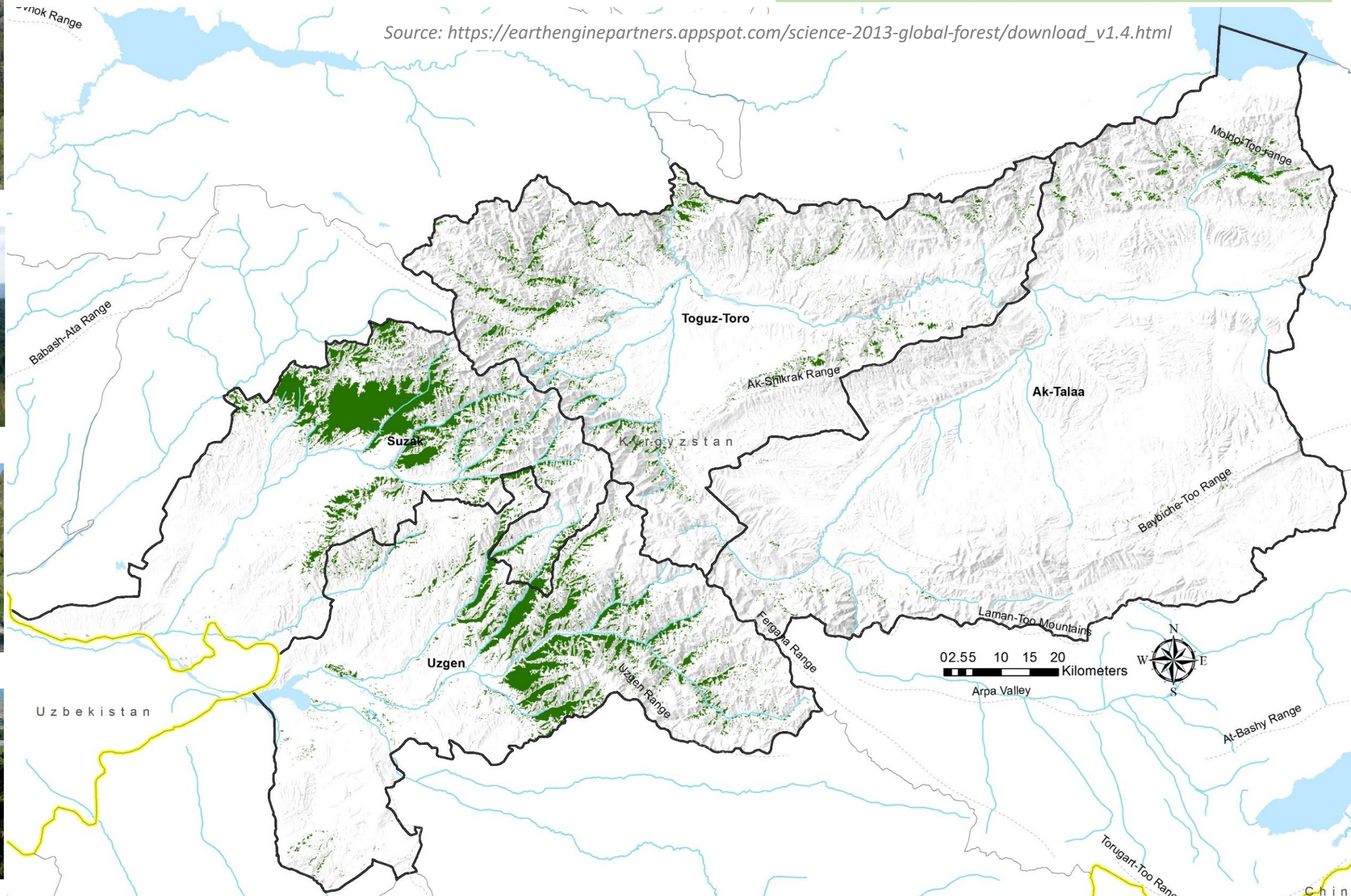


Forests (Hansen Global Forest, 2016)

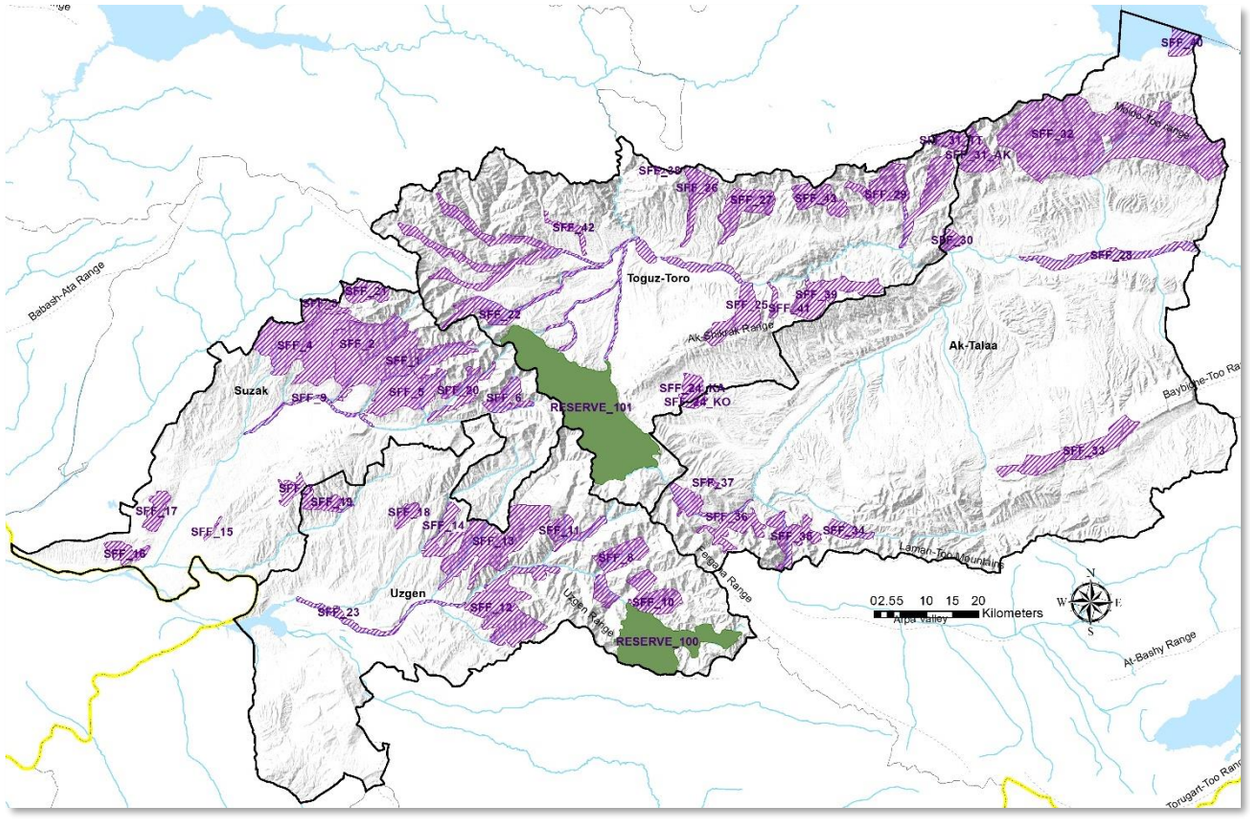
The forest cover is a subset of the Global Forest 2016 database produced in collaboration between the University of Maryland, Google, USGS, and NASA. It uses Landsat satellite images to map tree cover globally for the years 2000 and 2010 at 30-meter resolution. Note that “tree cover” is the biophysical presence of trees and may take the form of natural forests or plantations existing over a range of canopy densities. The “Tree Cover” class is here defined as “all vegetation taller than 5 meters in height”.

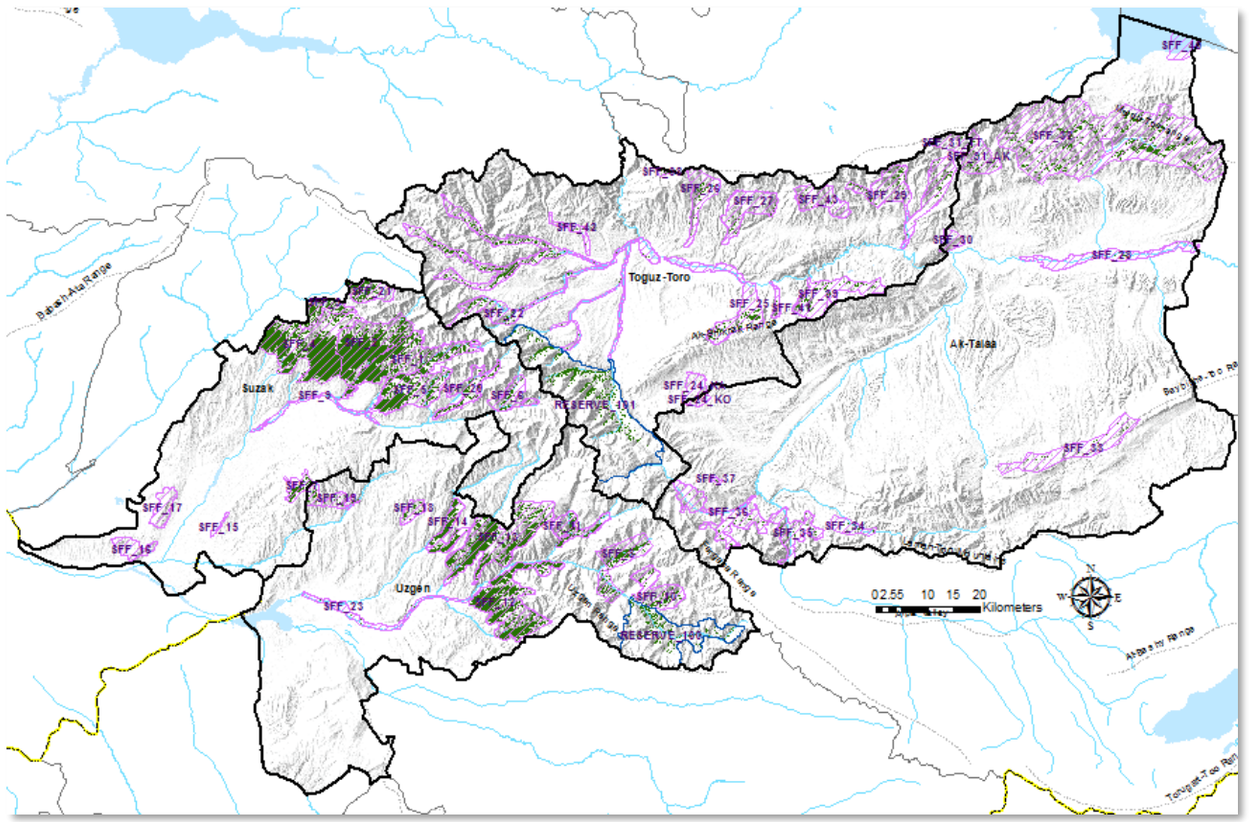
	Rayon (ha)	Forest (Tree Cover > 10%)	
	ha	*ha*	*%*
Suzak	275,302.10	36,561.60	13.28%
Toguz-Toro	393494.3	15420.3	3.92%
Ak-Talaa	651,177.20	4,877.10	0.75%
Uzgen	342738.1	30784.3	8.98%
TOTAL	**1,662,711.70**	**87,643.30**	**5.27%**

Source: https://earthenginepartners.appspot.com/science-2013-global-forest/download_v1.4.html



Forest (Hansen) by SFF/Reserve unit



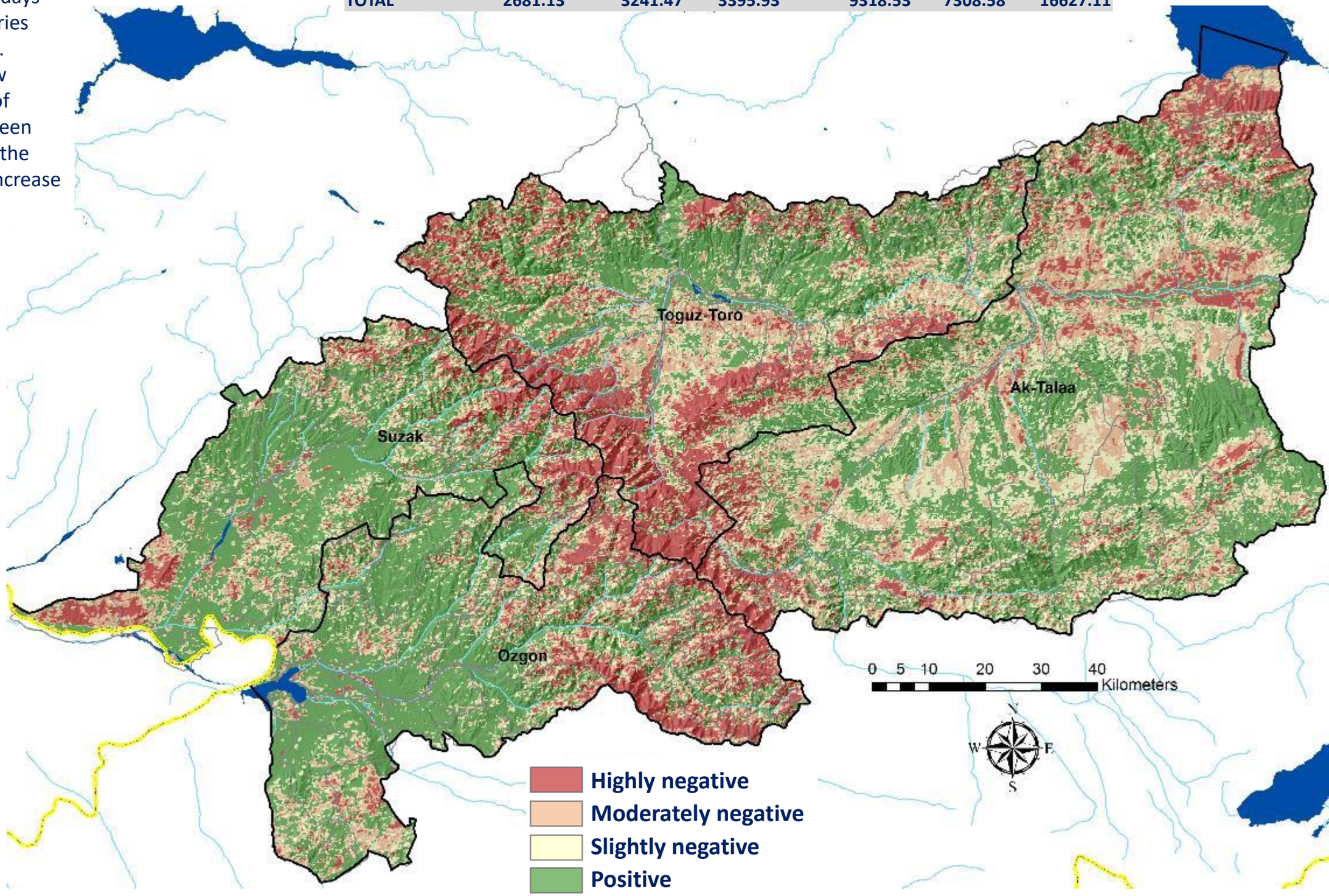


name	area (ha)	area Forest (ha)	area Forest (%)
RESERVE_100	14946.55	1251.66	8.37%
RESERVE_101	32792.31	2472.68	7.54%
SFF_1	10868.93	4853.27	44.65%
SFF_2	10255.71	5334.68	52.02%
SFF_3	2664.40	1063.49	39.91%
SFF_4	15148.99	8190.57	54.07%
SFF_5	7781.34	3153.13	40.52%
SFF_6	2734.42	333.63	12.20%
SFF_7	1485.29	483.83	32.57%
SFF_8	5515.16	1095.93	19.87%
SFF_9	1725.21	18.72	1.09%
SFF_10	4966.95	659.84	13.28%
SFF_11	3137.10	788.61	25.14%
SFF_12	12011.53	6228.65	51.86%
SFF_13	13870.07	5289.23	38.13%
SFF_14	2957.38	1674.54	56.62%
SFF_15	259.96	0.00	0.00%
SFF_16	2048.24	0.00	0.00%
SFF_17	2250.63	0.00	0.00%
SFF_18	1365.19	202.67	14.85%
SFF_19	2210.04	306.22	13.86%
SFF_20	3557.24	973.50	27.37%
SFF_21	3021.18	988.23	32.71%
SFF_22	19675.92	2837.08	14.42%
SFF_23	3051.54	133.00	4.36%
SFF_24_KA	1870.38	4.51	0.24%
SFF_24_KO	623.11	5.26	0.84%
SFF_25	7139.56	600.15	8.41%
SFF_26	3919.71	269.91	6.89%
SFF_27	5350.85	149.61	2.80%
SFF_28	5039.14	35.35	0.70%
SFF_29	10319.23	645.47	6.25%
SFF_30	1305.89	1.50	0.11%
SFF_31_AK	3772.54	215.15	5.70%
SFF_31_TT	2051.50	18.72	0.91%
SFF_32	45227.09	3302.26	7.30%
SFF_33	7613.48	121.09	1.59%
SFF_34	1806.02	88.69	4.91%
SFF_35	4330.60	121.47	2.80%
SFF_36	6719.83	269.91	4.02%
SFF_37	190.01	30.91	16.27%
SFF_38	235.17	49.59	21.09%
SFF_39	6404.94	589.70	9.21%
SFF_40	2265.20	0.74	0.03%
SFF_41	671.44	66.69	9.93%
SFF_42	1128.24	112.82	10.00%
SFF_43	4043.33	63.62	1.57%
	302328.55	**55096.30**	**18.22%**

NDVI trend 2003-2016

Using MODIS based NDVI data, this map depicts annual trend in NDVI index based on 16 days composite time series from 2003 to 2016. Shades of red show different degrees of vegetation loss. Green shows area where the trend is positive (increase vegetation).

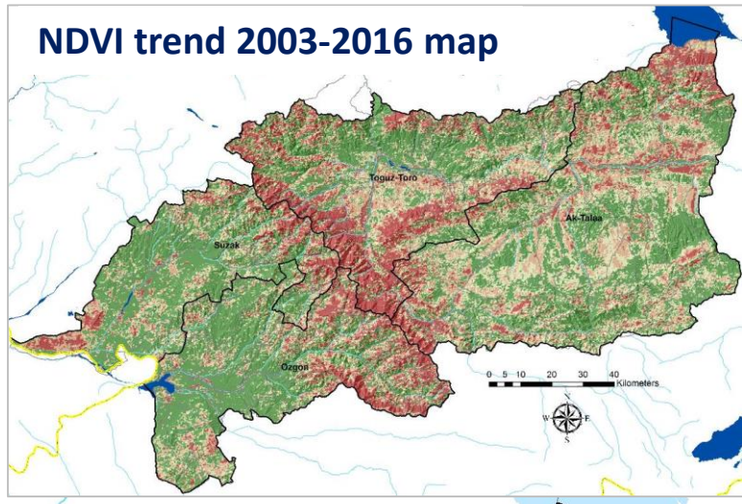
Rayon	highly negative	moderately negative	slightly negative	total negative km^2	Positive km^2	total area km^2
Suzak	347.42	430.85	443.83	1222.11	1530.91	2753.02
Toguz-Toro	1024.61	826.93	687.94	2539.48	1395.46	3934.94
Ak-Talaa	763.31	1407.11	1737.45	3907.87	2603.90	6511.77
Uzgen	545.79	576.58	526.70	1649.07	1778.31	3427.38
TOTAL	**2681.13**	**3241.47**	**3395.93**	**9318.53**	**7308.58**	**16627.11**

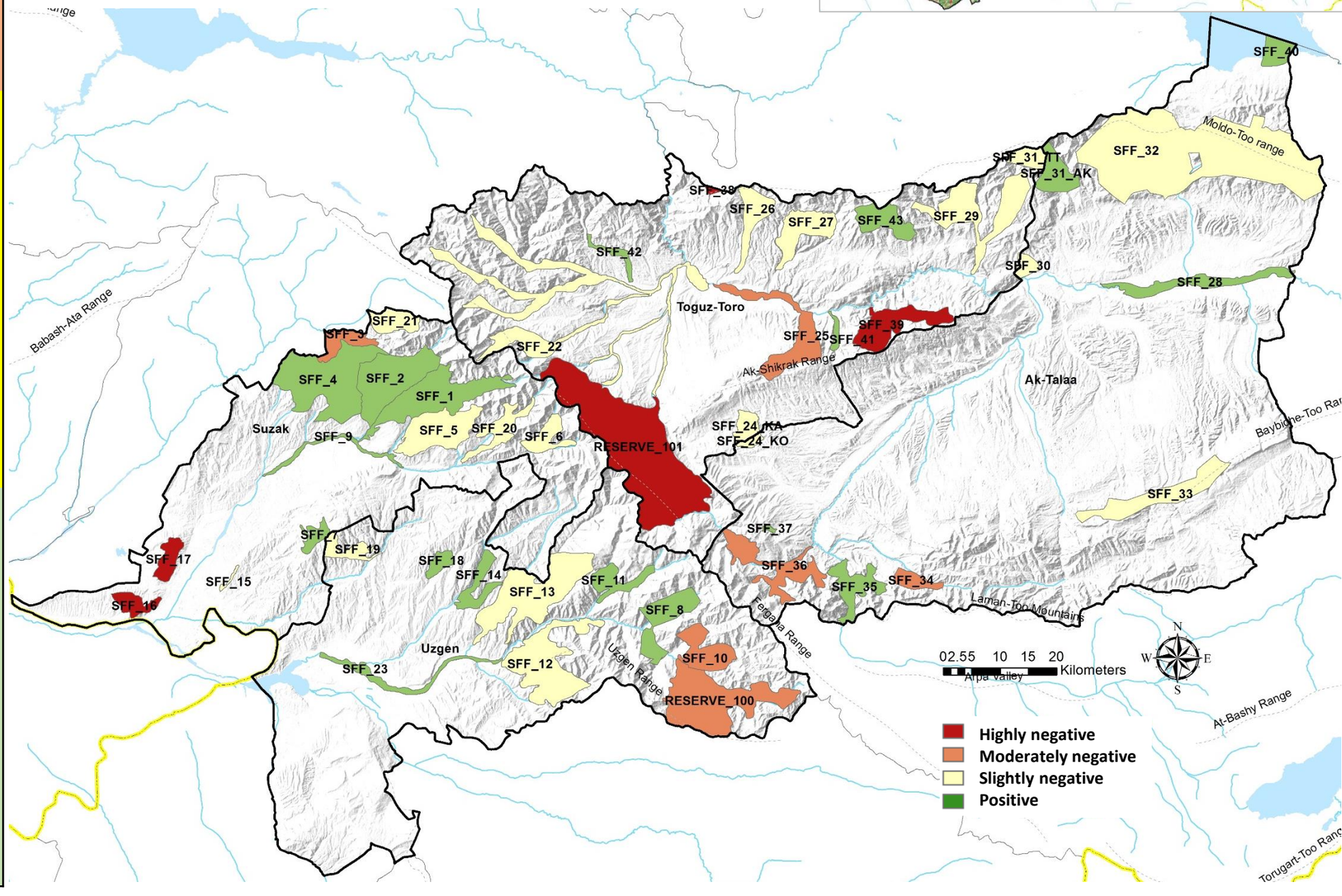


Classification of SFF and Reserve territories based on mean NDVI trend 2003-2016

name	area (ha)	area Forest (ha)	Mean NDVI Trend (0000)
RESERVE_101	32792.31	2472.68	-38.441
SFF_38	235.17	49.59	-37.806
SFF_17	2250.63	0.00	-27.203
SFF_39	6404.94	589.70	-26.532
SFF_16	2048.24	0.00	-24.583
RESERVE_100	14946.55	1251.66	-18.133
SFF_3	2664.40	1063.49	-15.069
SFF_36	6719.83	269.91	-14.736
SFF_25	7139.56	600.15	-14.189
SFF_34	1806.02	88.69	-13.915
SFF_10	4966.95	659.84	-10.956
SFF_20	3557.24	973.50	-9.632
SFF_26	3919.71	269.91	-8.389
SFF_13	13870.07	5289.23	-8.341
SFF_15	259.96	0.00	-8.331
SFF_21	3021.18	988.23	-8.091
SFF_31_TT	2051.50	18.72	-7.860
SFF_22	19675.92	2837.08	-7.190
SFF_32	45227.09	3302.26	-7.099
SFF_24_KA	1870.38	4.51	-7.037
SFF_30	1305.89	1.50	-5.599
SFF_19	2210.04	306.22	-4.529
SFF_5	7781.34	3153.13	-3.506
SFF_6	2734.42	333.63	-3.464
SFF_33	7613.48	121.09	-2.630
SFF_27	5350.85	149.61	-1.676
SFF_12	12011.53	6228.65	-0.755
SFF_29	10319.23	645.47	-0.143
SFF_24_KO	623.11	5.26	-0.026
SFF_35	4330.60	121.47	0.131
SFF_41	671.44	66.69	0.857
SFF_4	15148.99	8190.57	1.147
SFF_43	4043.33	63.62	1.288
SFF_31_AK	3772.54	215.15	1.498
SFF_11	3137.10	788.61	1.542
SFF_14	2957.38	1674.54	1.776
SFF_8	5515.16	1095.93	2.567
SFF_1	10868.93	4853.27	2.870
SFF_18	1365.19	202.67	4.481
SFF_28	5039.14	35.35	5.039
SFF_9	1725.21	18.72	7.187
SFF_2	10255.71	5334.68	7.722
SFF_37	190.01	30.91	9.236
SFF_7	1485.29	483.83	10.591
SFF_40	2265.20	0.74	14.220
SFF_42	1128.24	112.82	16.823
SFF_23	3051.54	133.00	25.714

Mean NDVI trend	area (ha)	Forested area (ha)	% Forest
Highly negative	43731.29	3111.97	7.12%
Moderately negative	38243.31	3933.75	10.29%
Slightly negative	143402.95	24627.99	17.17%
Positive	76951.00	23422.60	30.44%
	302328.55	55096.30	18.22%





Classification of SFF and Reserve territories based on mean NDVI trend 2003-2016

Highlighted SFFs (8) have been analyzed in detail. See next pages

Forest: statistics of forest presence detected by Hansen's database
Altitude: statistics from Digital Elevation Model (ASTER GDEM 30m) in the SFF area
Trend: mean 2003-2016 annual NDVI trend 2003-2016 (0000) in SFF
NDVI 2003-2016: overall statistics from 16 day based time series

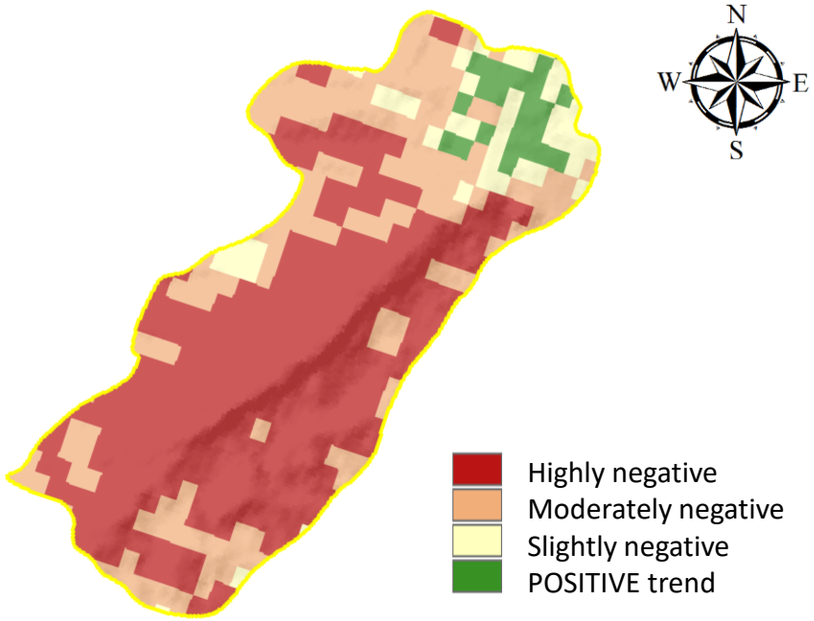
			HANSEN Forest		ALTITUDE (m)				NDVI Trend 2003-2016	NDVI 2003- 2016				
name	name2	area (ha)	area (ha)	area (%)	MIN	MAX	MEAN	MAJORITY	Mean (0000)	SUM	MEAN	MAX	MIN	STDEV
RESERVE_101	RESERVE_101_Toguz-Toro	32792.31	2472.68	7.54%	1644	3674	2716	2924	-38.441	72.98	0.4770	0.7050	0.2010	0.1418
SFF_38	SFF_38_Sary-Bulun	235.17	49.59	21.09%	2508	3028	2765	2766	-37.806	88.97	0.5327	0.7699	0.2057	0.1577
SFF_17	SFF_17_Kara-Almin	2250.63	0.00	0.00%	791	1242	1019	1020	-27.203	75.39	0.3128	0.5725	0.2009	0.0926
SFF_39	SFF_39_Toguz-Toro	6404.94	589.70	9.21%	1371	3760	2609	2704	-26.532	59.51	0.3696	0.5149	0.2011	0.0900
SFF_16	SFF_16_Kara-Almin	2048.24	0.00	0.00%	712	1140	959	1026	-24.583	65.18	0.2963	0.5704	0.2000	0.0898
RESERVE_100	RESERVE_100_Uzgen	14946.55	1251.66	8.37%	1774	4206	2863	2669	-18.133	76.66	0.4791	0.6862	0.2053	0.1439
SFF_3	SFF_3_Kara-Almin	2664.40	1063.49	39.91%	1472	2680	2040	2085	-15.069	108.47	0.5620	0.8455	0.2056	0.1584
SFF_36	SFF_36_Kosh-dobo	6719.83	269.91	4.02%	2113	3817	2712	2535	-14.736	62.91	0.3957	0.6158	0.2021	0.1143
SFF_25	SFF_25_Kargalyk	7139.56	600.15	8.41%	1252	3621	2049	1277	-14.189	55.63	0.3477	0.4951	0.2051	0.0807
SFF_34	SFF_34_Jerge-tal	1806.02	88.69	4.91%	2689	3538	3008	2858	-13.915	67.59	0.4446	0.6661	0.2018	0.1167
SFF_10	SFF_10_Karool	4966.95	659.84	13.28%	1957	3192	2574	2618	-10.956	88.61	0.5306	0.7777	0.2090	0.1585
SFF_20	SFF_20_Kara-Almin	3557.24	973.50	27.37%	1581	2941	2115	1932	-9.632	100.18	0.5692	0.8228	0.2042	0.1732
SFF_26	SFF_26_Sary-Bulun	3919.71	269.91	6.89%	1439	3319	2541	2884	-8.389	77.13	0.4791	0.6866	0.2003	0.1401
SFF_13	SFF_13_Kyzyl-Too	13870.07	5289.23	38.13%	1211	2918	1872	1875	-8.341	119.80	0.5872	0.8532	0.2006	0.1740
SFF_15	SFF_15_Tash-Bulak	259.96	0.00	0.00%	766	1082	930	1030	-8.331	92.59	0.3534	0.6748	0.2012	0.1192
SFF_21	SFF_21_Kyz-kol	3021.18	988.23	32.71%	1646	3860	2457	2105	-8.091	90.58	0.5328	0.7505	0.2078	0.1464
SFF_31_TT	SFF_31_Toguz-Toro	2051.50	18.72	0.91%	2628	3911	3150	3014	-7.860	49.05	0.3744	0.5637	0.2044	0.0940
SFF_22	SFF_22_Kara-Suu	19675.92	2837.08	14.42%	1224	3862	1990	1241	-7.190	84.82	0.4610	0.6770	0.2027	0.1438
SFF_32	SFF_32_Kek-jar	45227.09	3302.26	7.30%	1976	3904	2935	3197	-7.099	64.74	0.4098	0.5954	0.2009	0.1093
SFF_24_KA	SFF_24_Kargalyk	1870.38	4.51	0.24%	2293	2718	2447	2450	-7.037	57.21	0.3488	0.6030	0.2012	0.1064
SFF_30	SFF_30_Kek-jar	1305.89	1.50	0.11%	1532	2468	2011	2130	-5.599	25.31	0.2556	0.3343	0.2009	0.0354
SFF_19	SFF_19_Changet	2210.04	306.22	13.86%	1247	2270	1752	1642	-4.529	112.65	0.5168	0.8094	0.2099	0.1561
SFF_5	SFF_5_Kara-Almin	7781.34	3153.13	40.52%	1378	2894	1929	1943	-3.506	116.36	0.5936	0.8412	0.2006	0.1654
SFF_6	SFF_6_Kara-Almin	2734.42	333.63	12.20%	1835	3192	2263	2191	-3.464	83.40	0.5054	0.7346	0.2163	0.1374
SFF_33	SFF_33_Baetov	7613.48	121.09	1.59%	2409	3541	2976	3051	-2.630	63.68	0.3980	0.6147	0.2001	0.1102
SFF_27	SFF_27_Toguz-Toro	5350.85	149.61	2.80%	1392	3387	2547	2991	-1.676	80.35	0.4727	0.7299	0.2004	0.1508
SFF_12	SFF_12_Salam-Alik	12011.53	6228.65	51.86%	1240	2744	1950	2027	-0.755	119.20	0.5960	0.8446	0.2110	0.1795
SFF_29	SFF_29_Toguz-Toro	10319.23	645.47	6.25%	1495	3661	2517	2749	-0.143	66.13	0.3694	0.5535	0.2015	0.0989
SFF_24_KO	SFF_24_Kosh-dobo	623.11	5.26	0.84%	2301	2740	2511	2519	-0.026	63.59	0.3785	0.6388	0.2024	0.1221
SFF_35	SFF_35_Kosh-dobo	4330.60	121.47	2.80%	2158	3766	2716	2783	0.131	40.28	0.2857	0.3985	0.2005	0.0533
SFF_41	SFF_41_Kargalyk	671.44	66.69	9.93%	1357	2576	1889	1687	0.857	53.99	0.3067	0.4398	0.2007	0.0692
SFF_4	SFF_4_Kara-Almin	15148.99	8190.57	54.07%	1341	2929	1818	1738	1.147	125.18	0.5989	0.8277	0.2127	0.1553
SFF_43	SFF_43_Toguz-Toro	4043.33	63.62	1.57%	2016	3798	2883	2847	1.288	68.22	0.4401	0.6662	0.2136	0.1239
SFF_31_AK	SFF_31_Ak-Talaa	3772.54	215.15	5.70%	2305	3990	2912	2814	1.498	60.04	0.3706	0.5637	0.2047	0.0903
SFF_11	SFF_11_Salam-Alik	3137.10	788.61	25.14%	1509	2718	2020	1988	1.542	113.56	0.5884	0.8452	0.2052	0.1789
SFF_14	SFF_14_Zerger	2957.38	1674.54	56.62%	1288	2160	1734	1838	1.776	124.03	0.5906	0.8556	0.2056	0.1709
SFF_8	SFF_8_Altyn Bulak	5515.16	1095.93	19.87%	1599	3102	2257	2281	2.567	100.74	0.5724	0.8126	0.2050	0.1681
SFF_1	SFF_1_Kara-Almin	10868.93	4853.27	44.65%	1234	2566	1903	1839	2.870	114.25	0.5920	0.8407	0.2004	0.1716
SFF_18	SFF_18_Zerger	1365.19	202.67	14.85%	1383	2012	1638	1549	4.481	120.74	0.5564	0.8188	0.2072	0.1500
SFF_28	SFF_28_Ak-tal	5039.14	35.35	0.70%	1561	1859	1633	1640	5.039	23.55	0.2265	0.2682	0.2007	0.0159
SFF_9	SFF_9_Kyz-kol	1725.21	18.72	1.09%	991	1658	1185	1173	7.187	68.52	0.3263	0.7670	0.2000	0.0991
SFF_2	SFF_2_Kara-Almin	10255.71	5334.68	52.02%	1276	2910	1845	1821	7.722	127.25	0.6299	0.8579	0.2290	0.1688
SFF_37	SFF_37_Kosh-dobo	190.01	30.91	16.27%	2567	3005	2779	2831	9.236	71.93	0.4467	0.6793	0.2023	0.1218
SFF_7	SFF_7_Atabekov	1485.29	483.83	32.57%	1218	2153	1694	1572	10.591	109.78	0.5203	0.8158	0.2081	0.1617
SFF_40	SFF_40_Togolok-Moldovan	2265.20	0.74	0.03%	2995	3031	3006	3005	14.220	55.16	0.3727	0.5819	0.2070	0.0919
SFF_42	SFF_42_Atay	1128.24	112.82	10.00%	1397	2560	1823	1562	16.823	77.28	0.3770	0.5896	0.2022	0.1133
SFF_23	SFF_23_Jazy	3051.54	133.00	4.36%	883	1296	1029	959	25.714	83.67	0.3530	0.6709	0.2005	0.0901

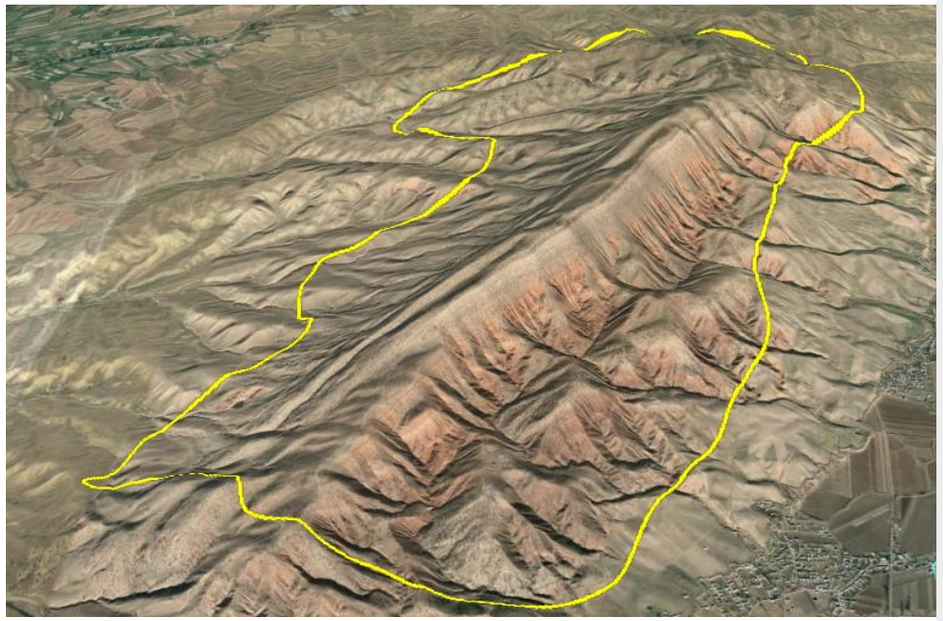
SUZAK

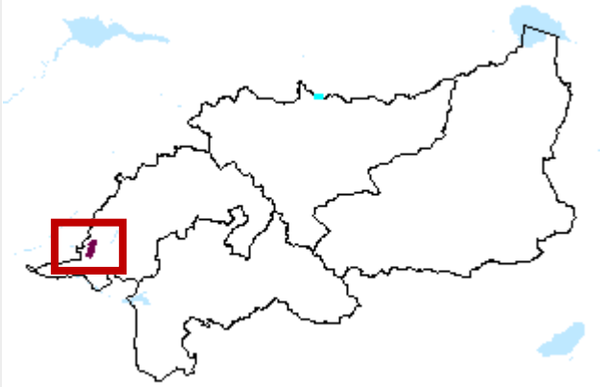
State Forest Fund (leshoz) territory no.17, Suzak, 2,251 ha

FOREST ANALYSIS (Sample)

NDVI trend map and 3D view in Google Earth

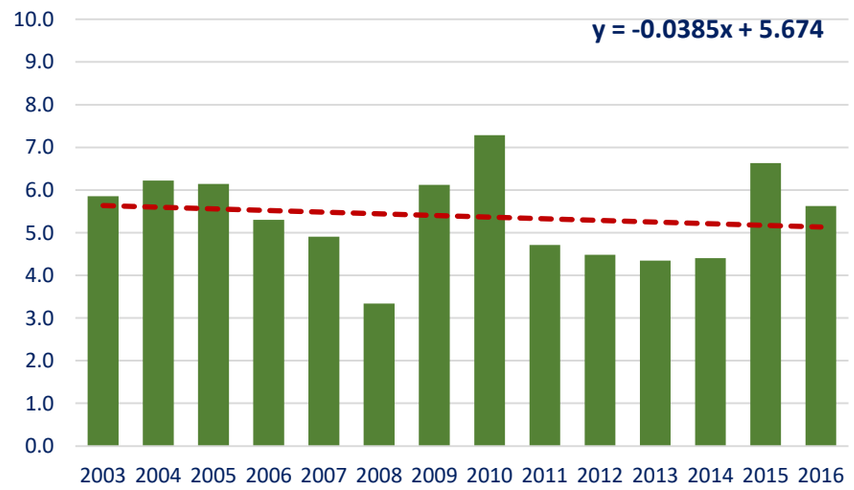






name	SFF_17_Kara-Almin
type	LESHOZ
area (ha)	2250.63
area Forest (ha)	0.00
area Forest (%)	0.0%
Altitude MIN	791
Altitude MAX	1242
Altitude MEAN	1019
Altitude MAJORITY	1020
Mean NDVI Trend 2003-2016 (0000)	-27.203
NDVI SUM 2003-2016	75.389
NDVI MEAN 2003-2016	0.313
NDVI MAX 2003-2016	0.573
NDVI MIN 2003-2016	0.201
NDVI STDEV 2003-2016	0.093

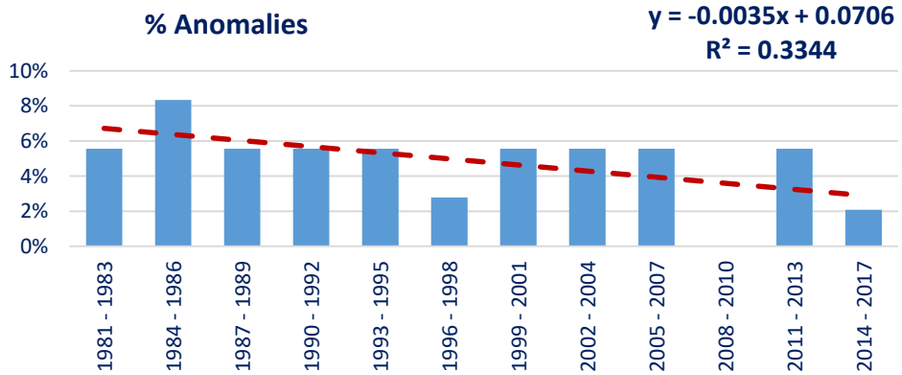
Annual SUM NDVI and trend line: SFF 17



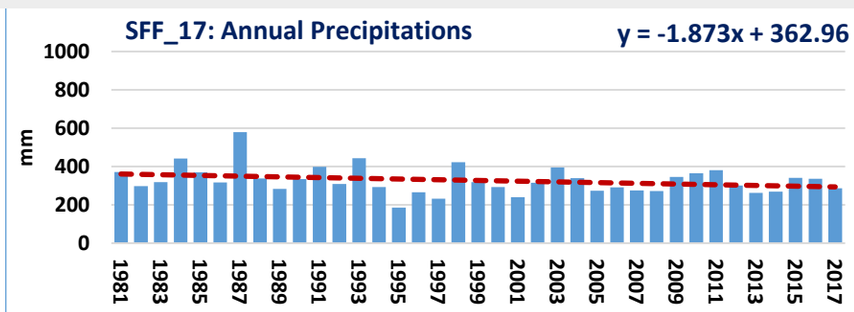
Heavy rain risk assessment: SFF 17

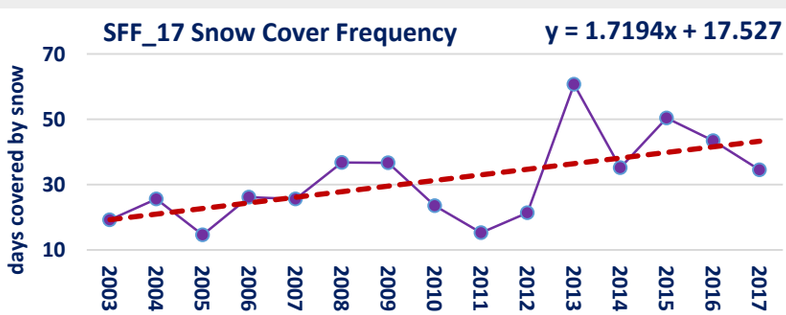
It is considered "anomaly" a monthly rainfall above 10% of the annual average. Value in % (number of anomalies in 36 months).

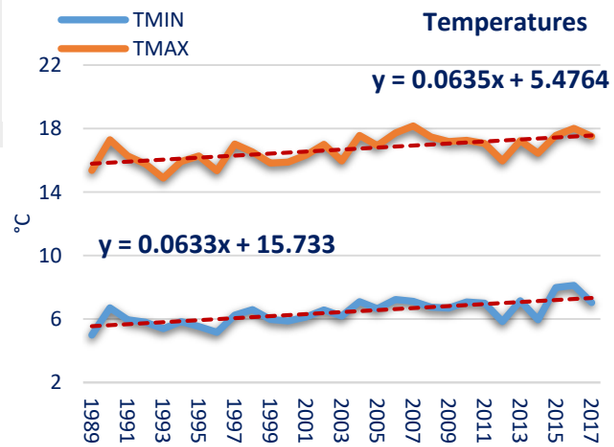
Slope	Slope*100	Risk level
-0.003472	-0.347222	LOW



The NDVI mean and max in the area suggest that the greenness production averaged in the area is very low and is associated also with a substantial overall negative trend in NDVI.
The NDVI time series analysis between 2003 and 2016, (also for the map), shows a pronounced negative trend with evident inter annual variability in accumulated annual greenness (∑NDVI > 0.2).







Toktogul - Reservoir, © Gerhard Huber

The Kyrgyz Republic
BASELINE ATLAS

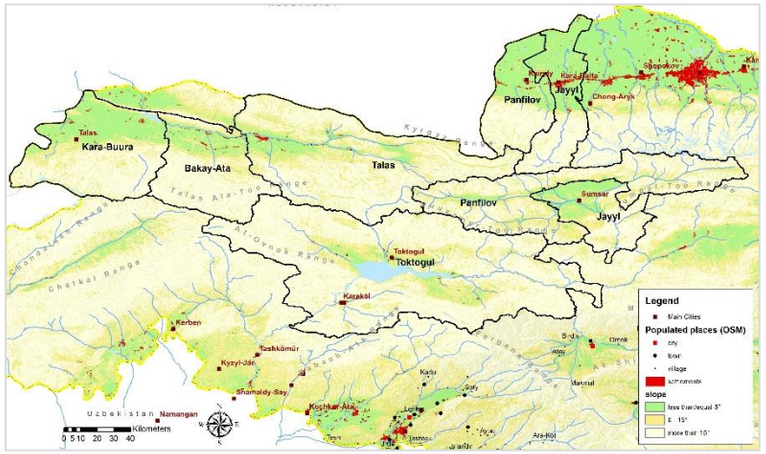
Control / Expansion Area

Table of Content

EXPANSION area

Foreword

This is a component of the **Kyrgyz Republic Baseline Atlas** which enters in the details of demographic, topographic, climatic and land resources concerning the six Rayons identified by the proposing project for potential expansion: Jaiyl (Chui), Panfilov (Chui), Toktogul (Jalal-Abad), Bakai-Ata (Talas), Kara-Buura (Talas) and Talas (Talas). Panfilov and Kara-Buura, however, are considered second priority expansion area compared to the other four. It is the result of collecting publicly available information and data or local datasets, perform QA&QC, implement models, when required, to generate new data, and then produce maps and statistics by topic of interest.



Particular focus has been given to issues related to Climate Change and its impact on sectors of great importance in Kyrgyzstan such as pastoralism and forestry.

Several climatic variables have been measured and crossed check with topographic conditions, vegetation patterns and long time trends in order to better understand the ongoing processes that have shaped current landscapes, and provide solid evidence to target areas for mitigation and adaptation actions with higher probability of success.

The Atlas is a regional synthesis at disposal of debates, negotiations and decision-making that will take place next during the project cycle. It does not cover all topics pertaining to the region, but an effort was made to cover some of the most critical for the purpose of the project.

The Author

Expansion Area: Population and Geography

Population and Geography

This area covers 26,891 km^2, which is about 13.5% of the national extent, with a population of 345,700 people, which is around 5.7% of the national population. The expansion area is made by six rayons from three oblasts. Almost 80% of the population of these six rayons lives in rural areas.

			Projected population		
Rayon	Oblast	Area (km^2)	Total 2016	Urban 2016	Rural 2016
Jaiyl	Chui	2,994	102,600	44,200	58,400
Panfilov	Chui	4,869	44,400	8,800	35,600
Toktogul	Jalal-Abad	8,646	19,000	19,000	0
Bakai-Ata	Talas	2,672	49,500	0	49,500
Kara-Buura	Talas	2,618	63,700	0	63,700
Talas	Talas	5,092	66,500	0	66,500
TOTAL EXPANSION		26,891	345,700	72,000	273,700
KGZ		199,263	6,034,000		

https://data.humdata.org/dataset/kyrgyzstan-population-statistics

Kyrgyzstan

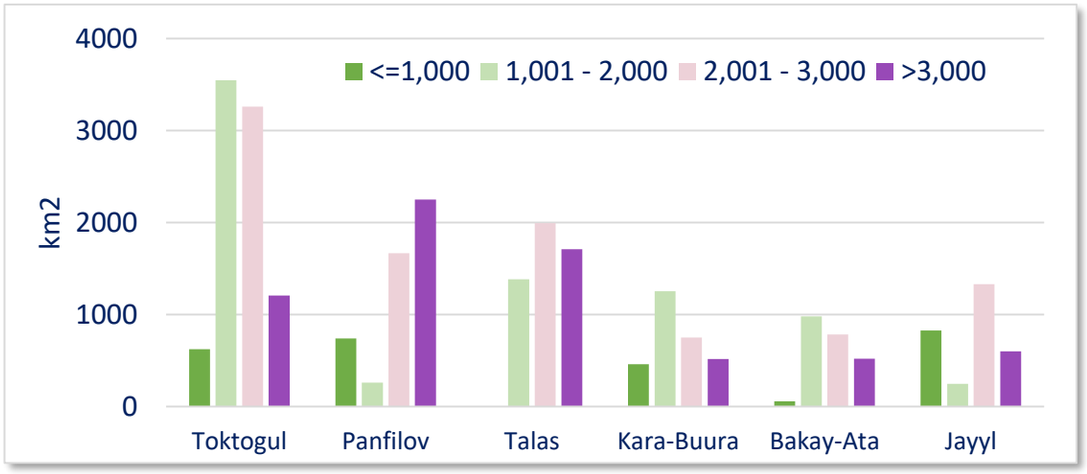
Projected Population 2016	6,034,000
Pop. Density per km^2 2016:	31.5

UN Data. http://data.un.org/CountryProfile.aspx?crName=Kyrgyzstan

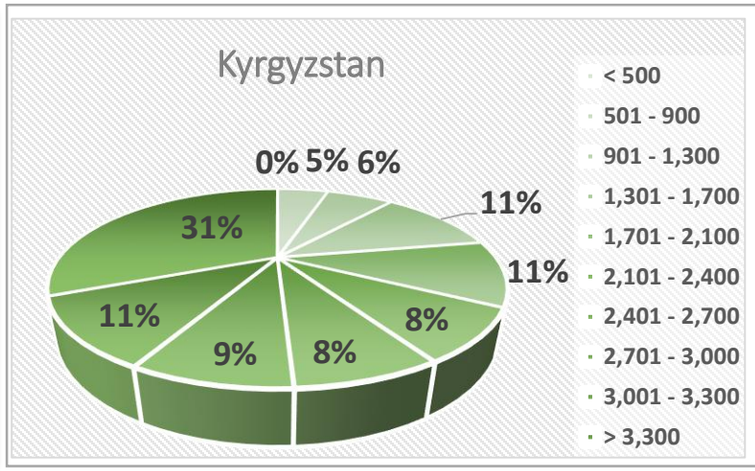
Settlements

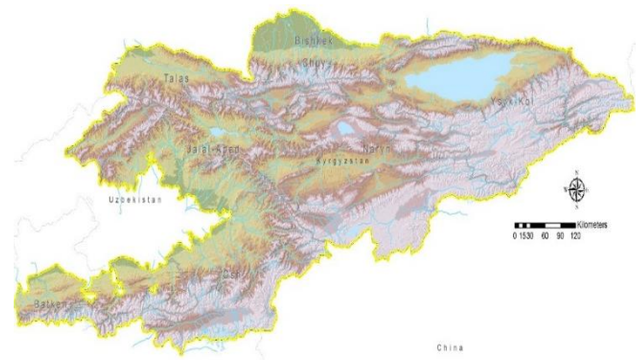
Expansion Area: Elevation

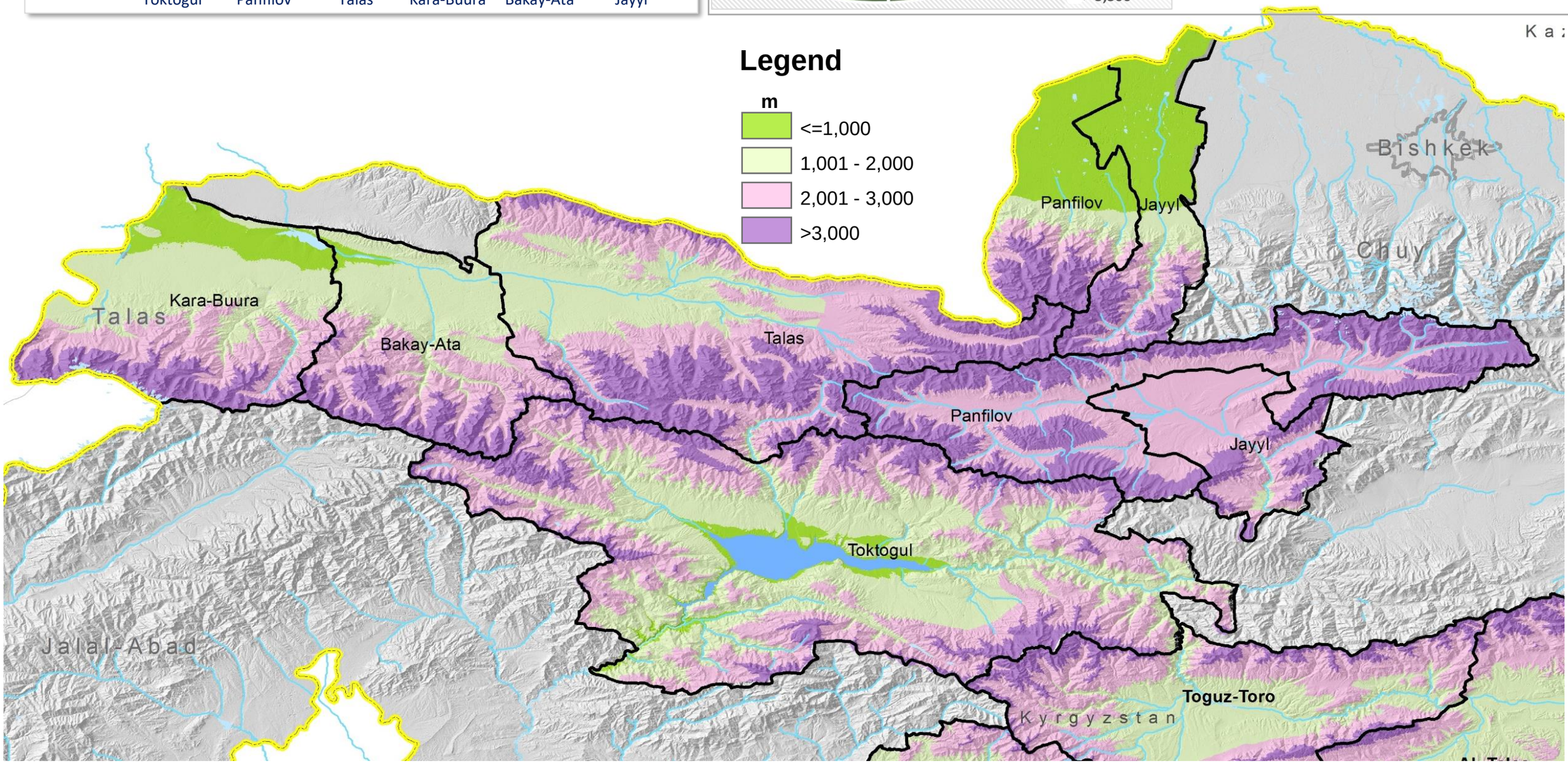
Area (km²) by 4 class of elevation



Kyrgyzstan



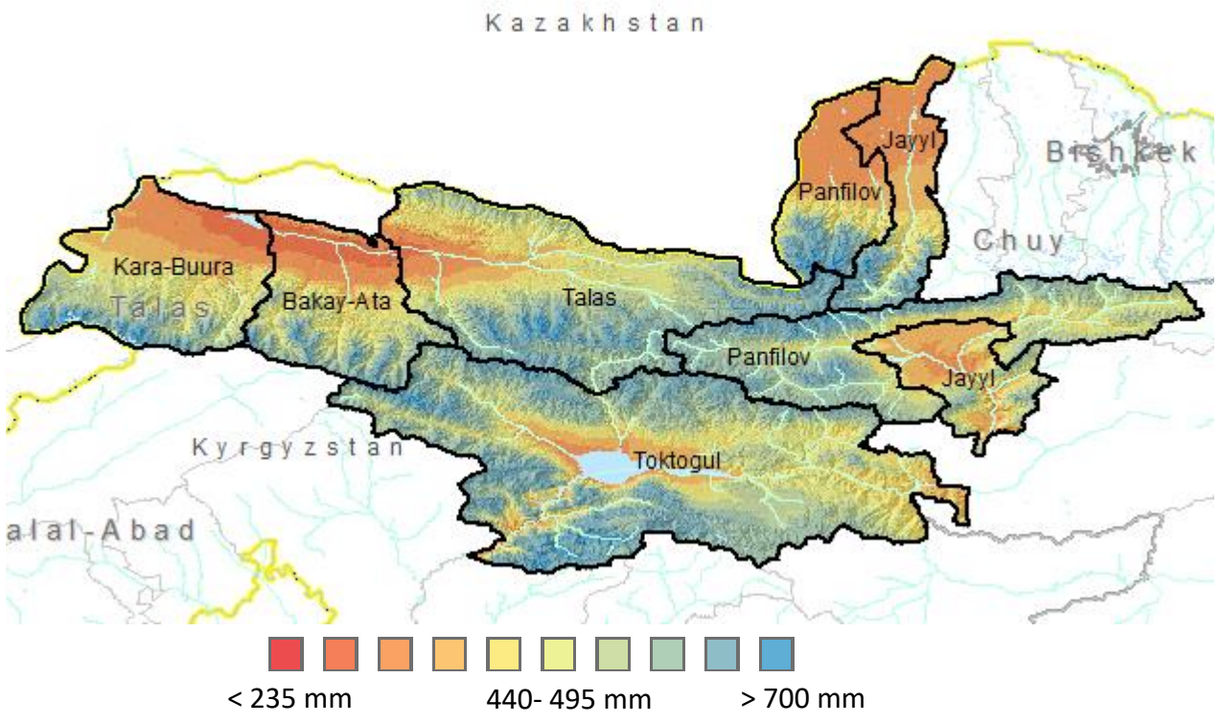




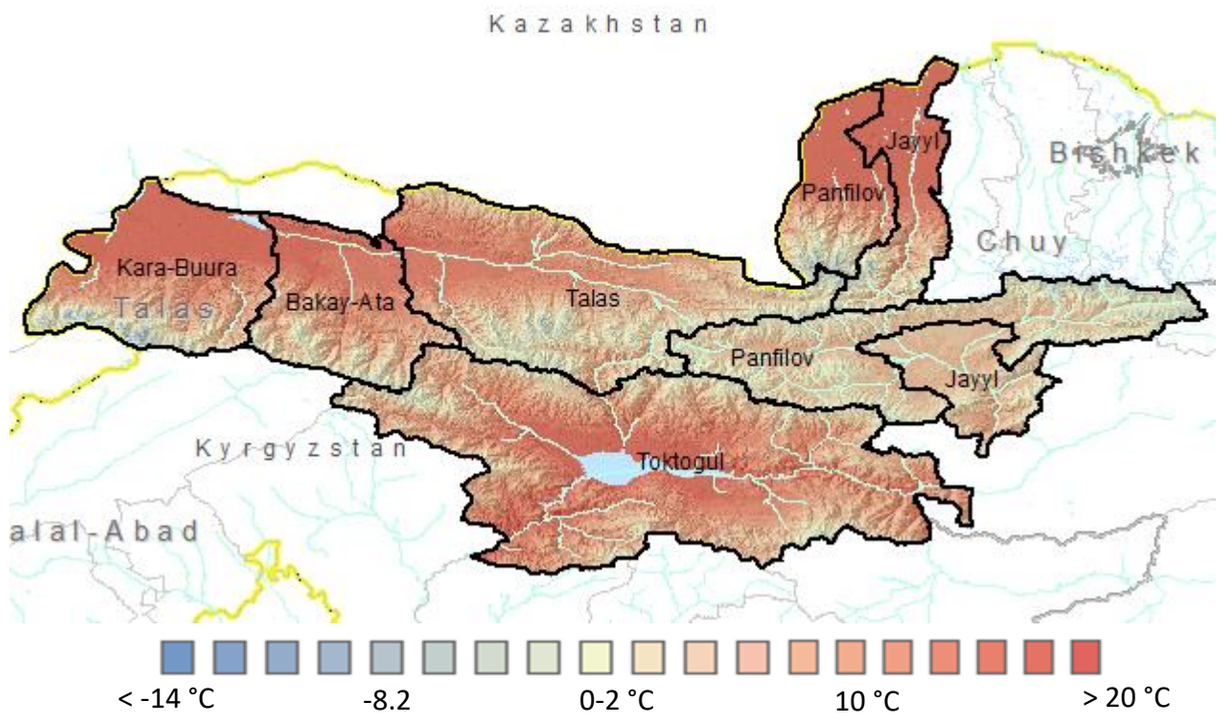
Expansion Area: Precipitation and Temperature distribution

CLIMATE

Annual Total Precipitations (average 1970-2000)



Annual Mean Max Temperature (average 1970-2000)

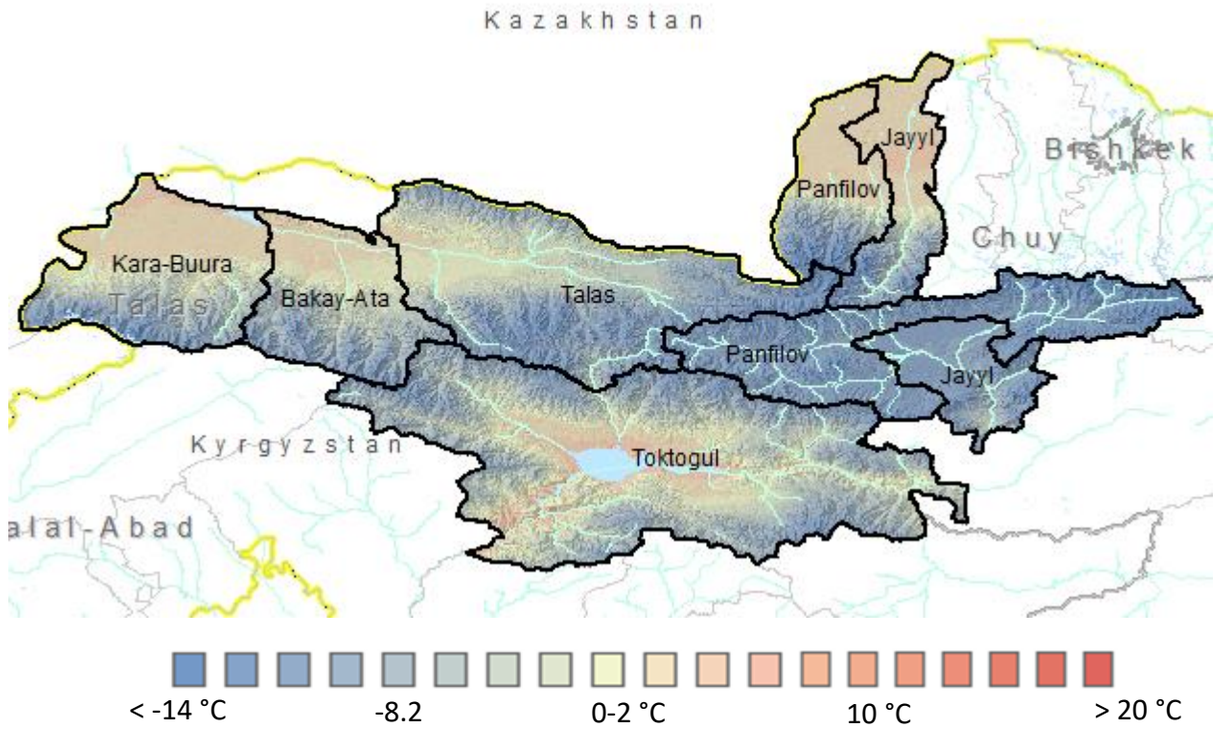


By district (average 1970-2000)

Name	PRECIPITATIONS (mm)	MAX TEMPERATURE (°C)	MIN TEMPERATURE (°C)
Toktogul	568	10.4	-2.3
Panfilov	553	5.9	-6.9
Talas	560	7.7	-4.8
Kara-Buura	488	11.5	-1.0
Bakay-Ata	493	10.2	-2.4
Jayyl	468	9.0	-4.2

Source: WorldClim Version2 - http://worldclim.org/version2

Annual Mean Min Temperature (average 1970-2000)



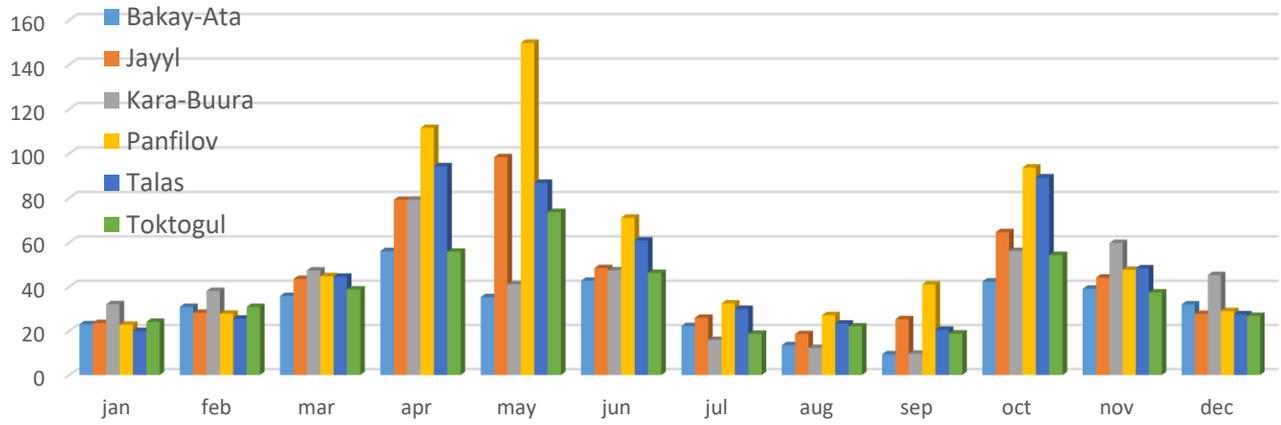
Expansion Area: Precipitation

Annual Total and Monthly Averages

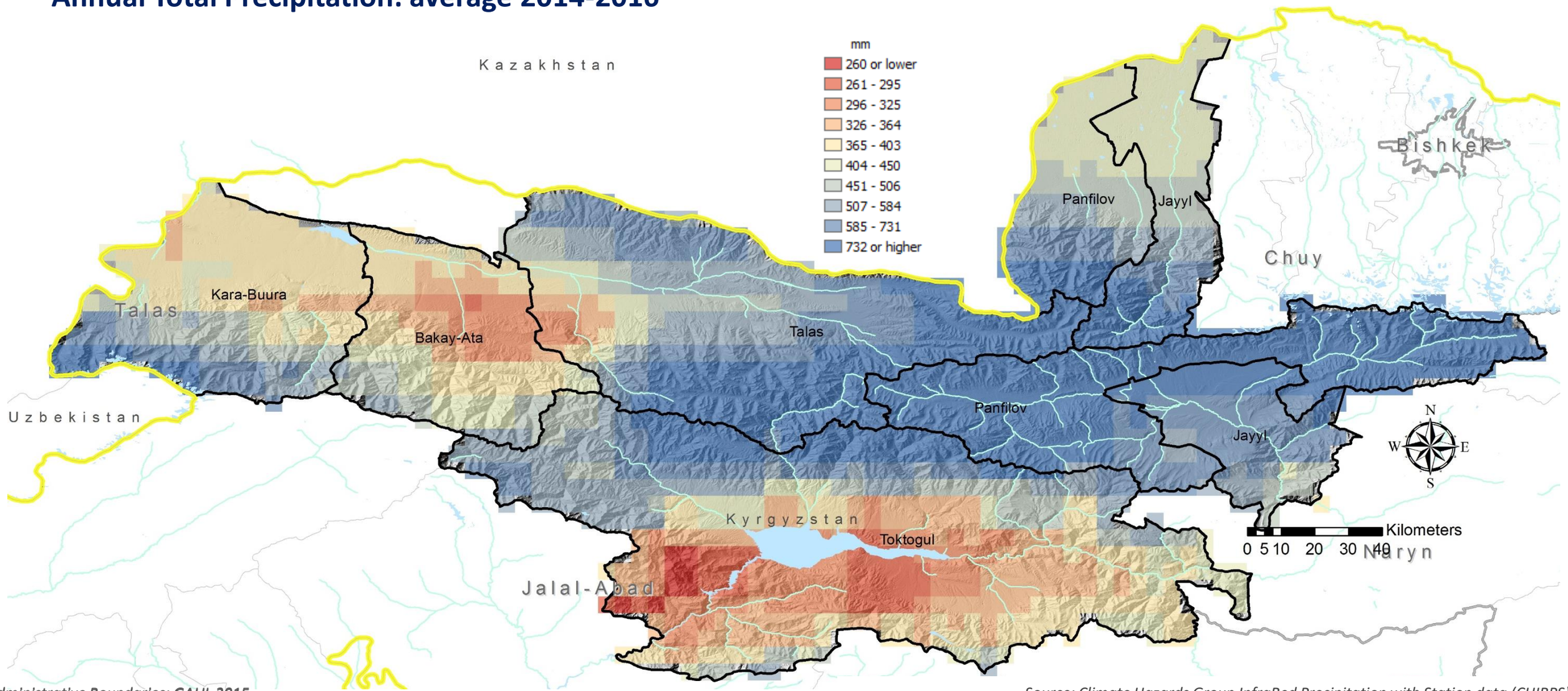
The map below shows concentration of precipitations in Central-Eastern part of the area (Talas, Paniflov and Jayyl). The other three district show lower precipitations, especially in Centre-South Toktogul. Toktogul is also the district with worse negative trend in precipitations (see next map).

The monthly averages (chart on the right) show Panifilov, Jayyl and Talas as the most rainy districts, expanding their spring rainy season from Apr to May-Jun. The driest districts instead show lower precipitations and with a pick only in Apr and Oct.

Monthly averages 1981-2016



Annual Total Precipitation: average 2014-2016

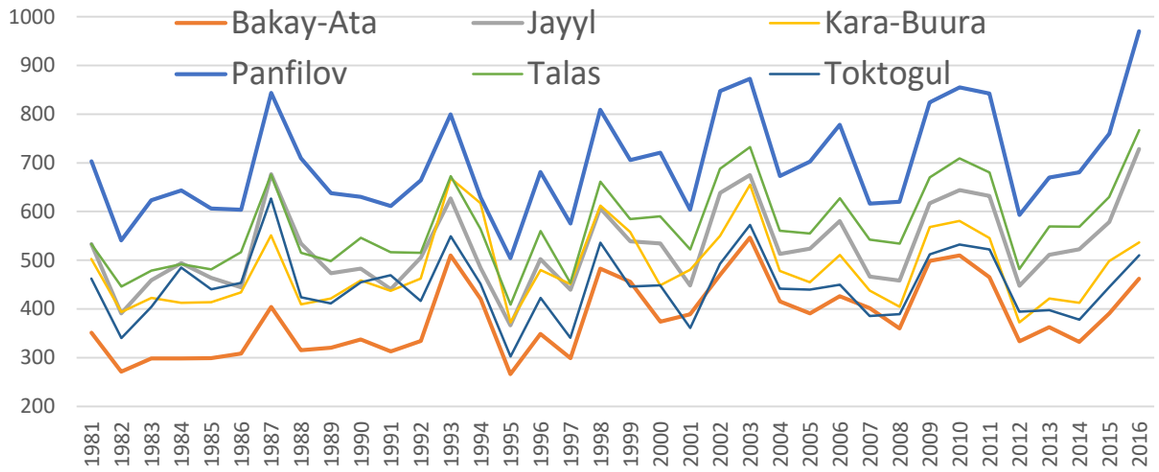


Administrative Boundaries: GAUL 2015

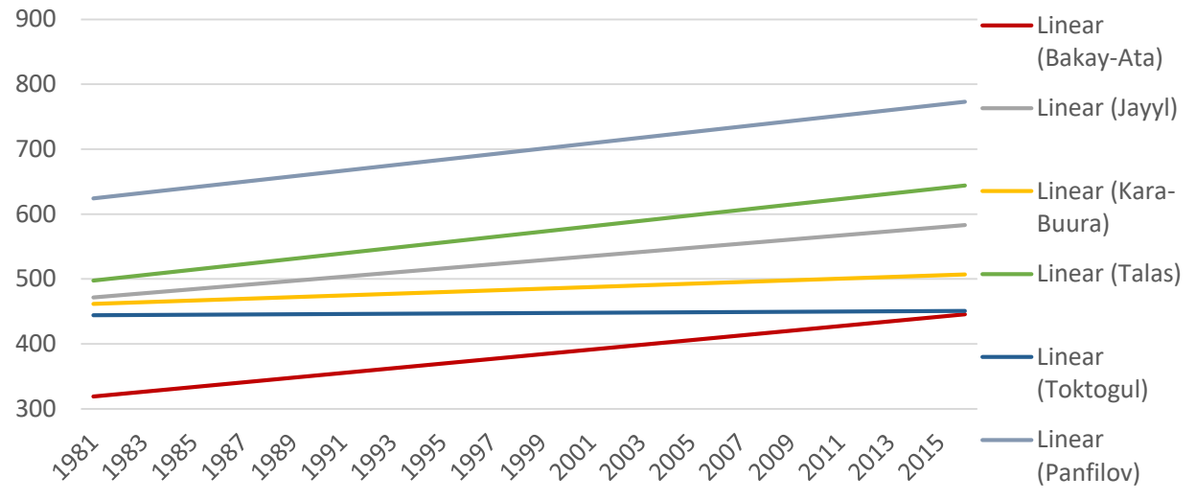
Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)

Expansion Area: Annual Precipitation Trend

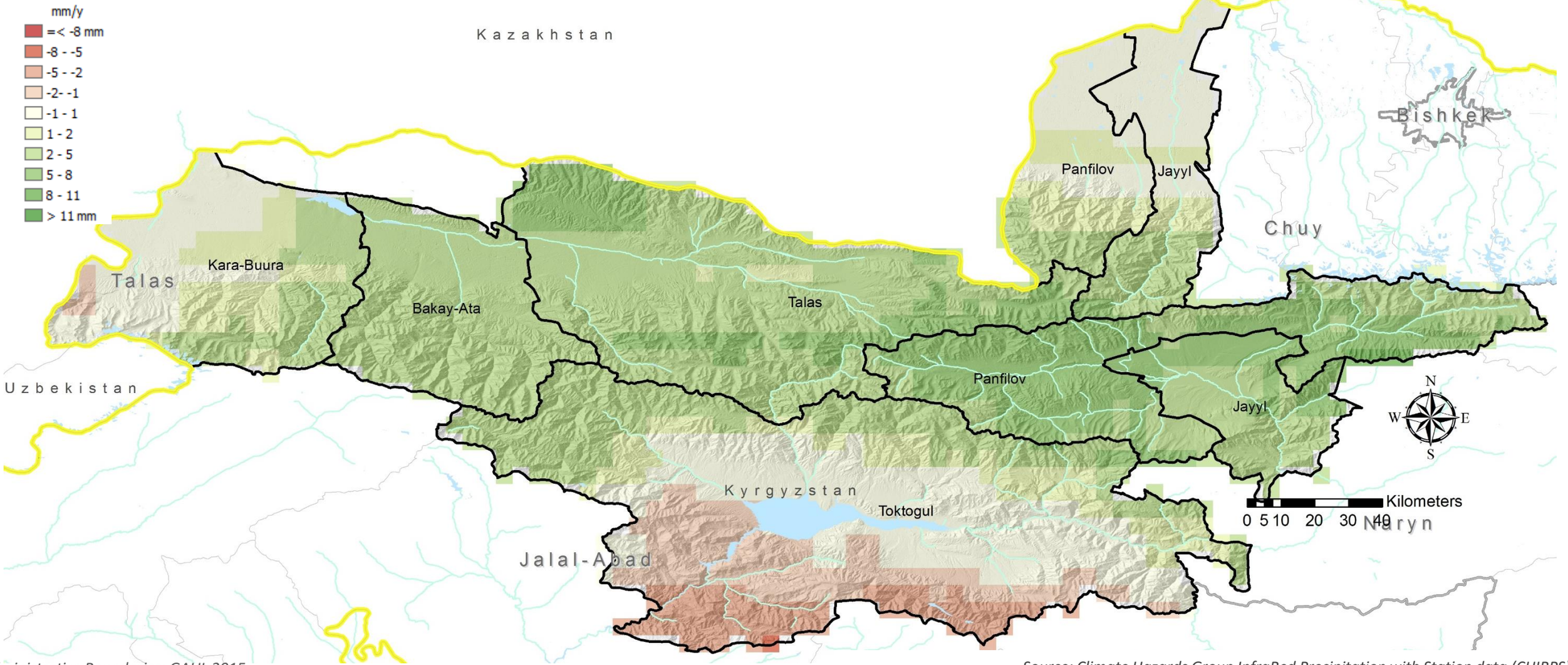
Distribution 1981-2016



Linear Trend 1981-2016 by rayon



Map of trends 1981-2016 (increase/decrease)

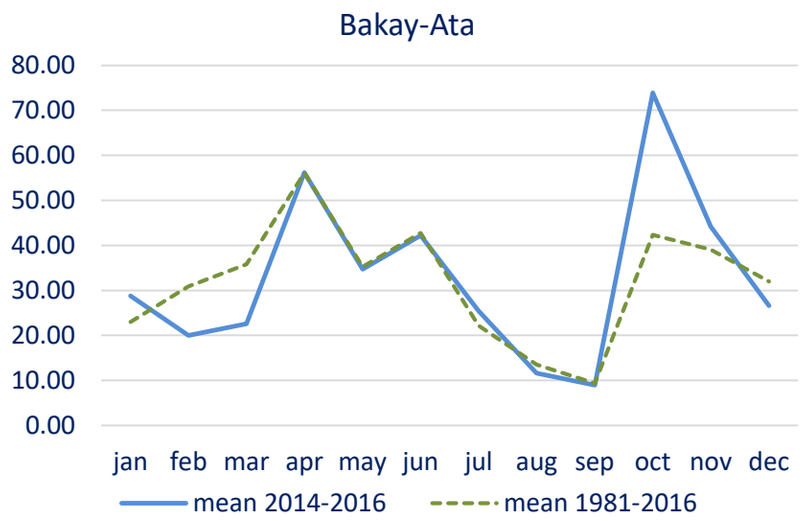


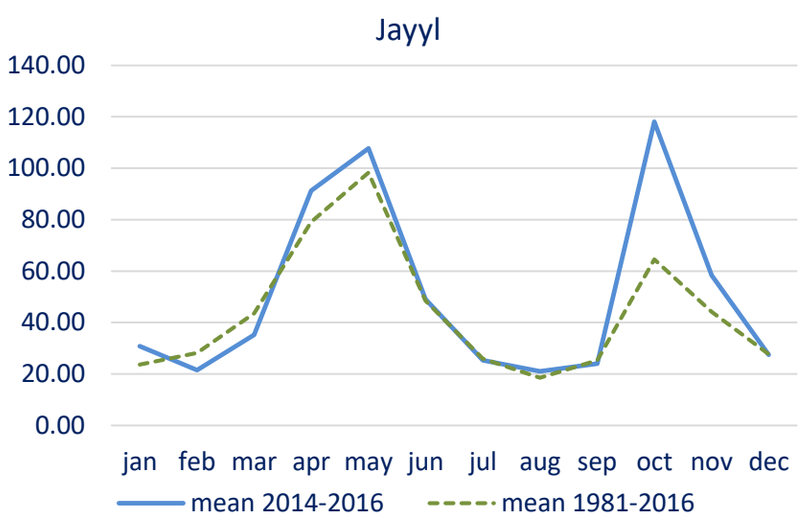
Administrative Boundaries: GAUL 2015

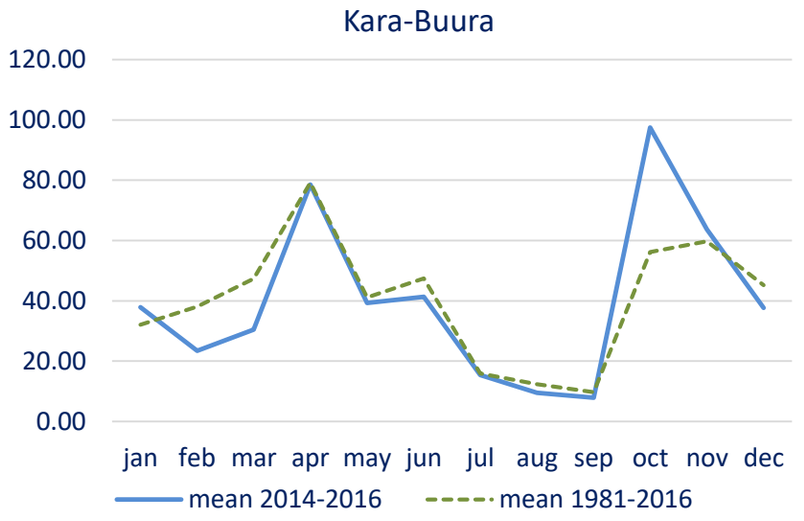
Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)

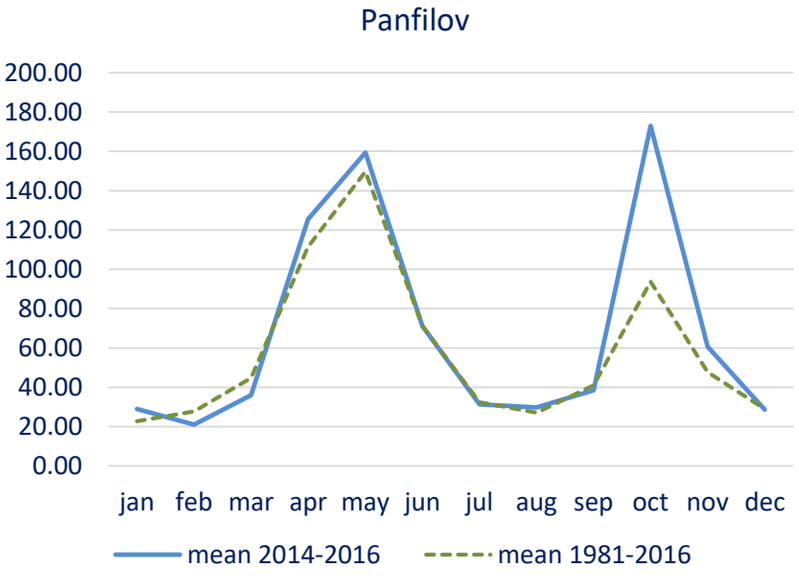
Expansion Area: Precipitation Anomalies

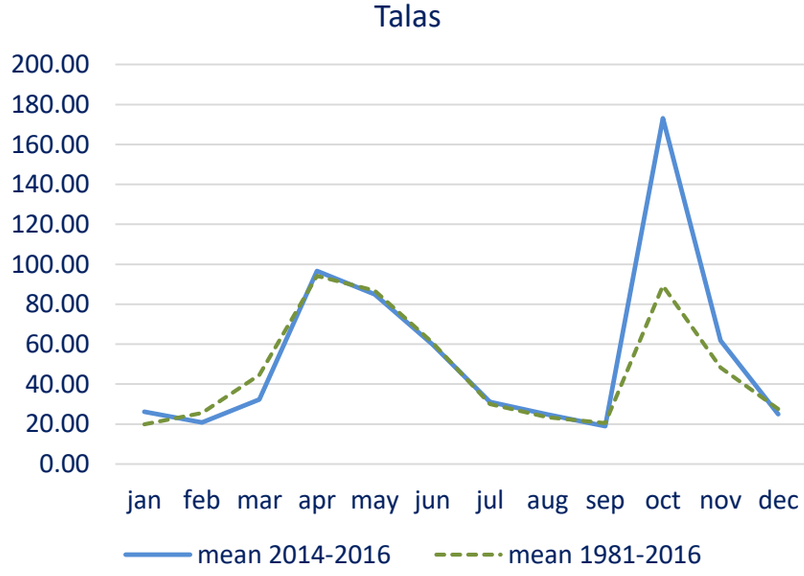
Monthly averages: mean 2014-2016 vs. 1981-2016

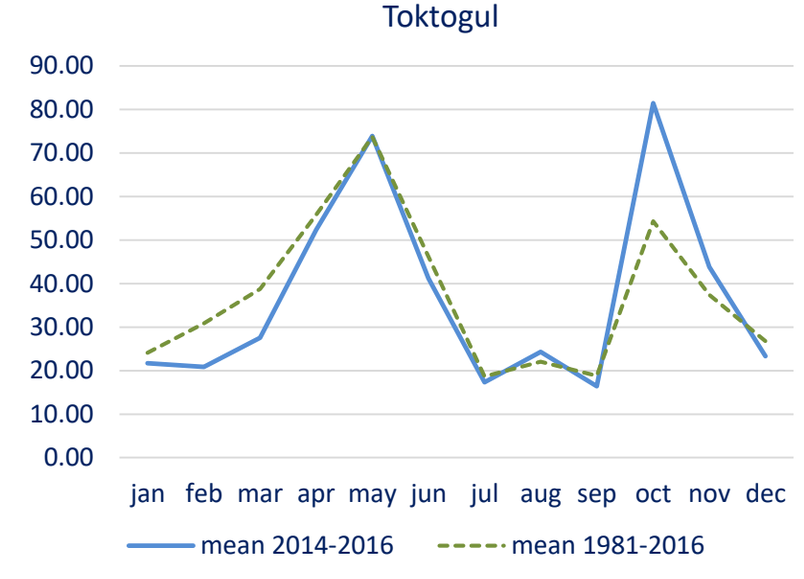




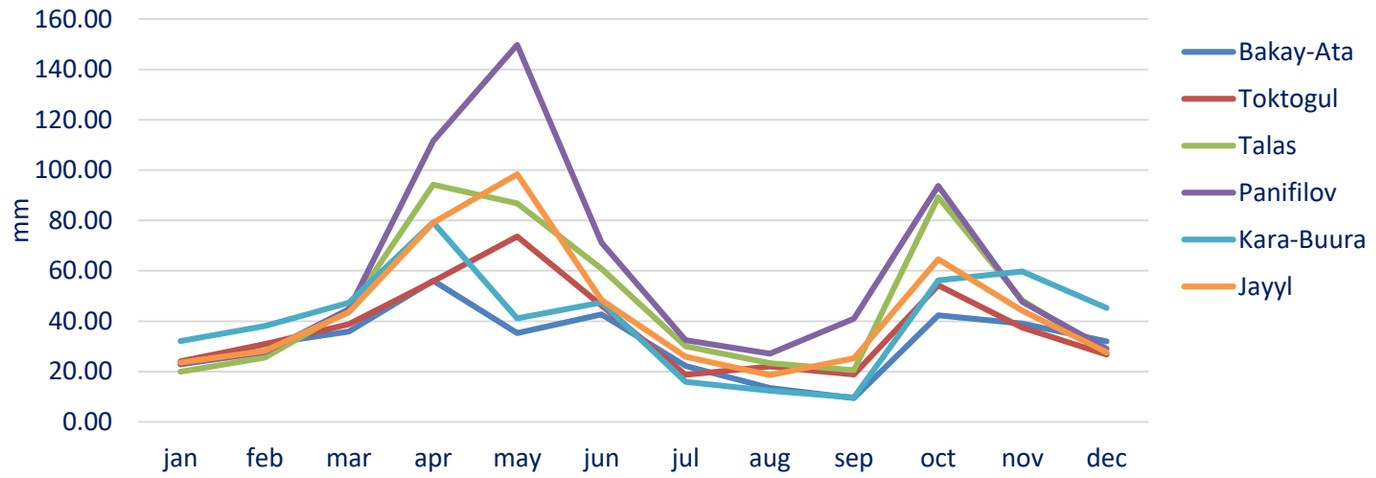








Monthly averages 1981-2016

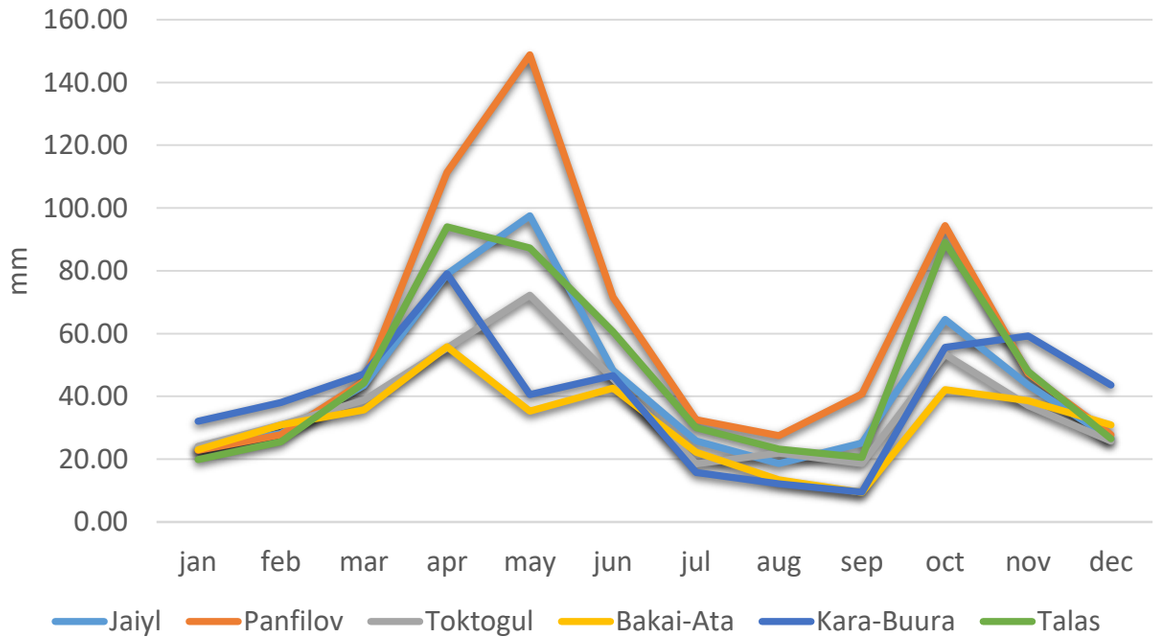


Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)

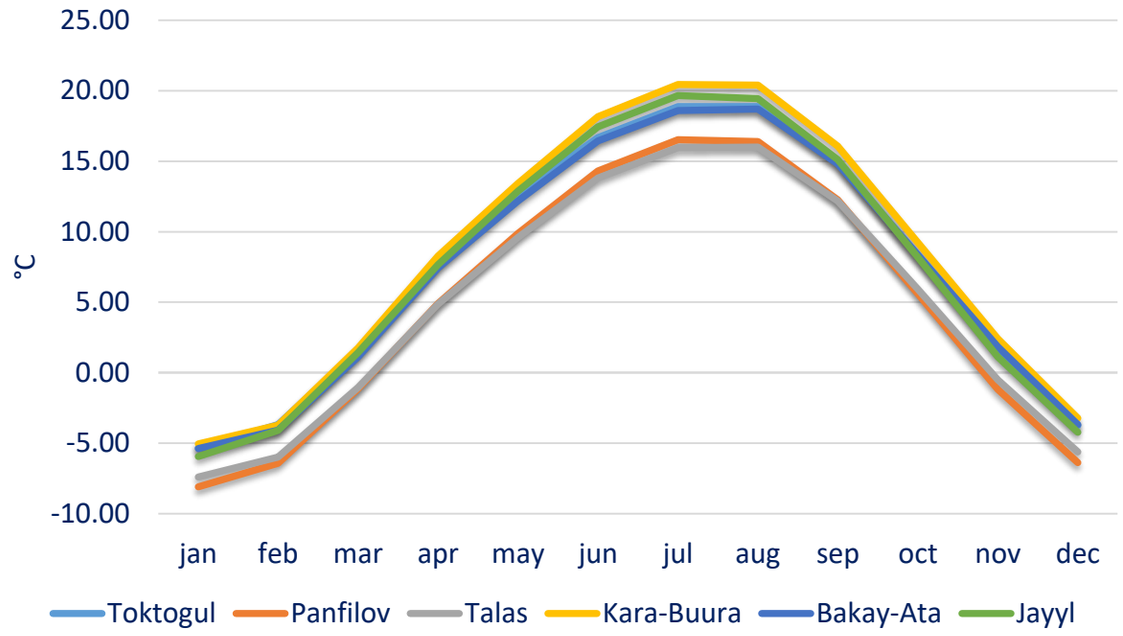
Administrative Boundaries: GAUL 2015

Expansion Area: Monthly Precipitation and Temperature profiles

Monthly Precipitations (1981-2016)



Monthly Max Temperature (1989-2016)



Climate Factsheet

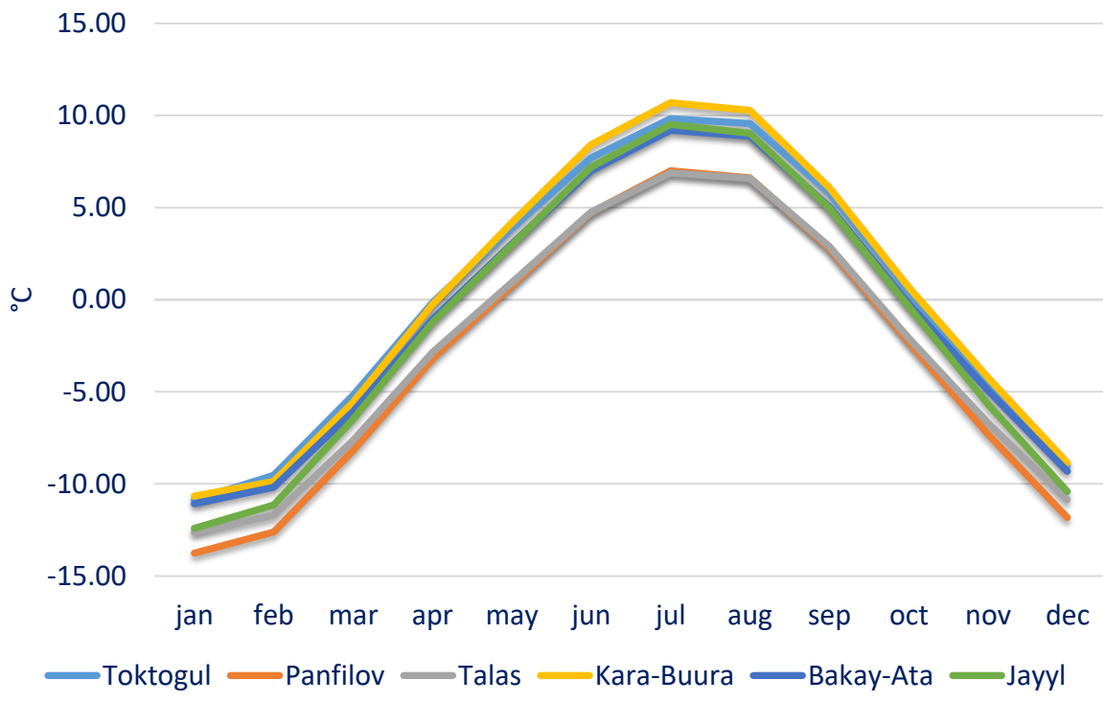
The **valley-sub-mountain zone** (from 900-1,200 m) experiences hot summers, snowless and temperate winters, and low precipitation.

The **mountain zone** (from 900–1,200 to 2,000–2,200 m) is characterized by a temperate climate, which has warm summers and cold, snowy winters.

The **high-mountain zone** (from 2,000–2,200 to 3,000–3,500 m) is cooler in the summer and has relatively cold, snowless winters, with temperatures ranging from well below zero to 16 °C.

The **nival belt zone** (from 3,500 m and higher) has a polar climate and is covered by numerous snowfields and glaciers.

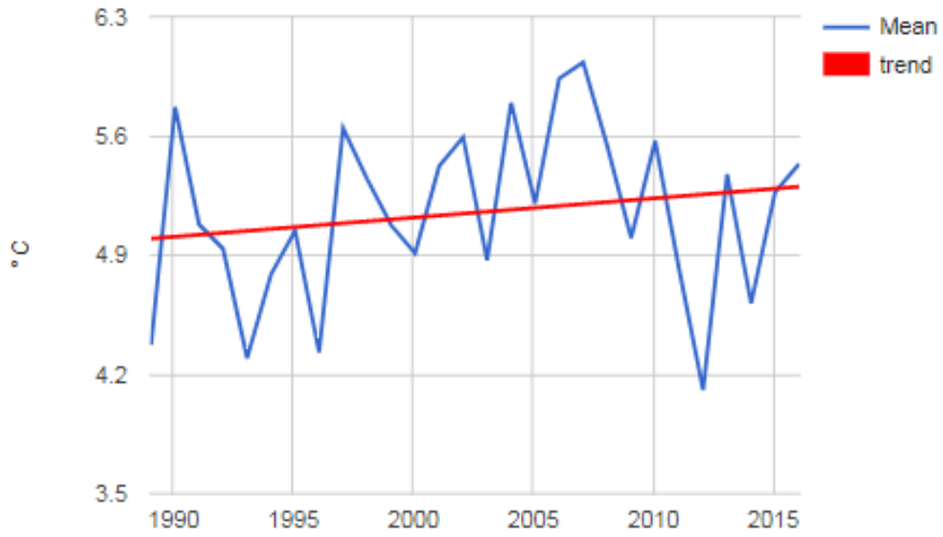
Monthly Min Temperature (1989-2016)



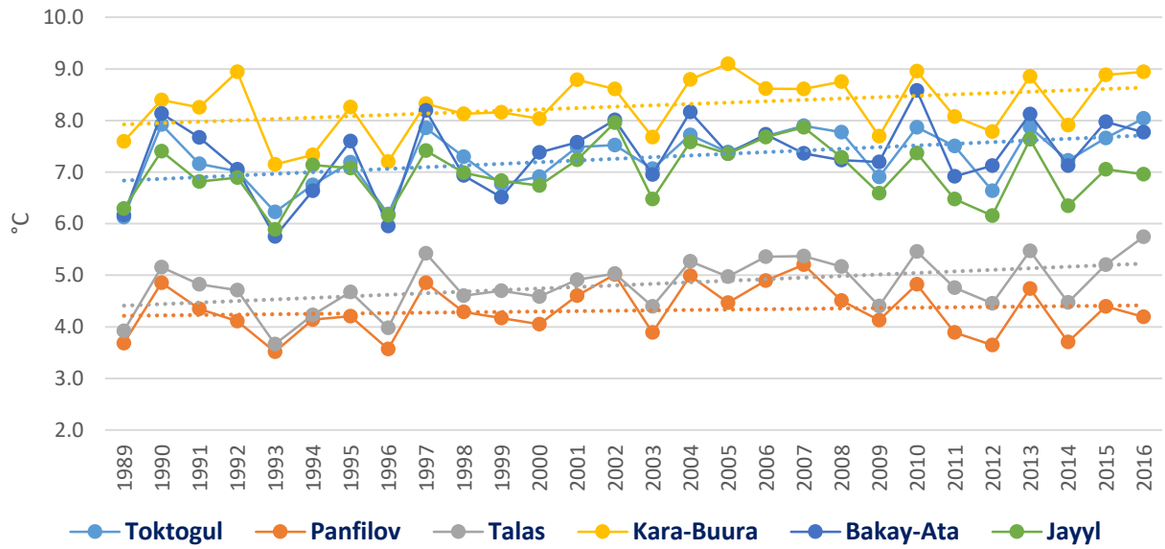
Source: Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS)
Source: European Centre for Medium-Range Weather Forecast (ECMWF).

Expansion Area: MAX Temperature

MAX Temperature, annual mean, Kyrgyzstan



MAX Temperature, annual mean, 1989-2016

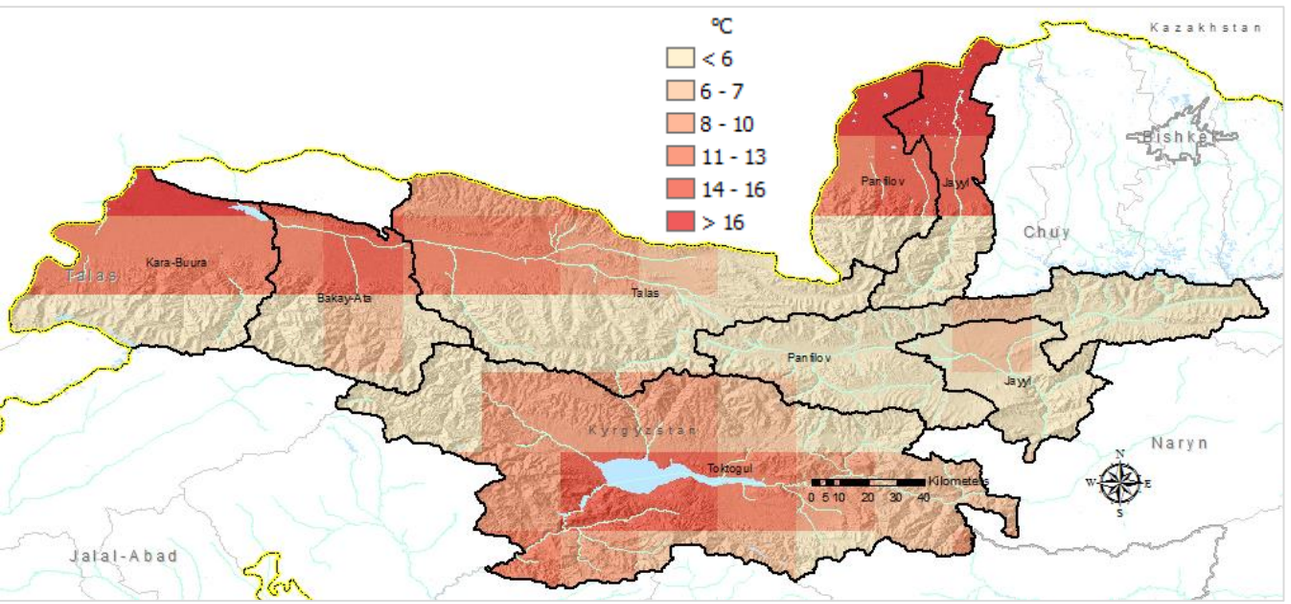


The charts above, which plots the full time series and the linear trend, confirm a general increase of maximum temperatures at national as well as rayon level.

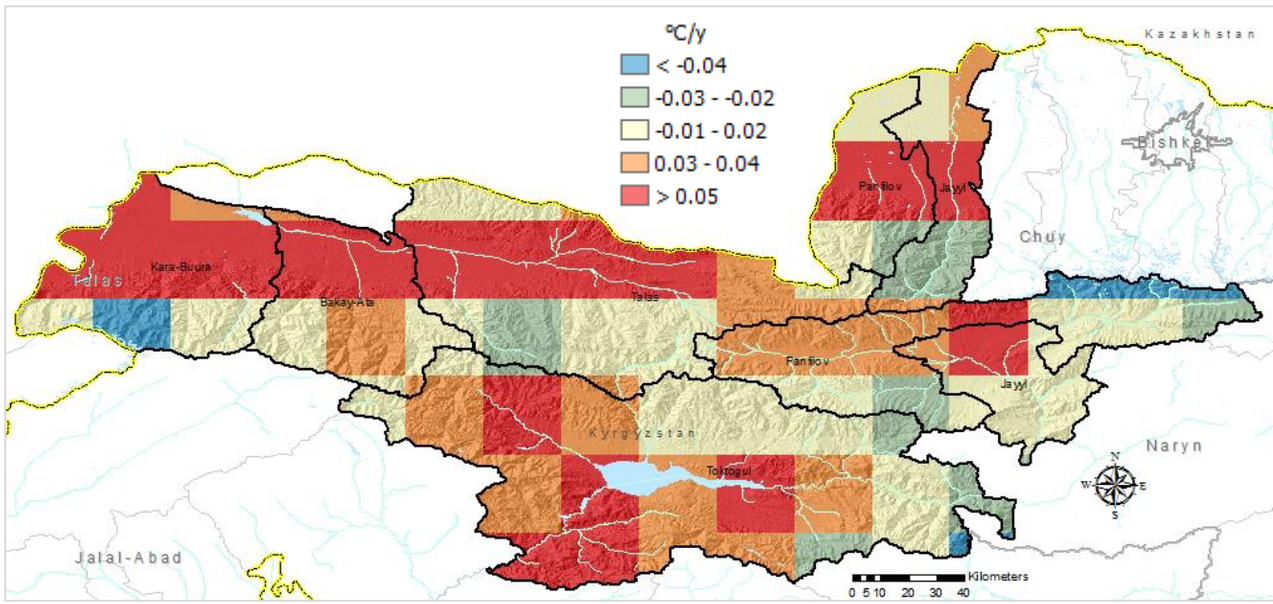
The map below on the left shows the distribution of maximum temperatures (mean of last three years) in the expansion area.

The map below on the right shows the trend based on past (1989-2016) annual data in absolute °C (increase or decrease) per year. The variation is very small; however, there are areas where the trend is to reduce temperatures (limited extend) and areas where trends are positive, which means increase of a fraction of degree per year (max total increase from 1989 to 2016 is more than 1.45 °C).

MAX Temperature 2014-2016 (mean)

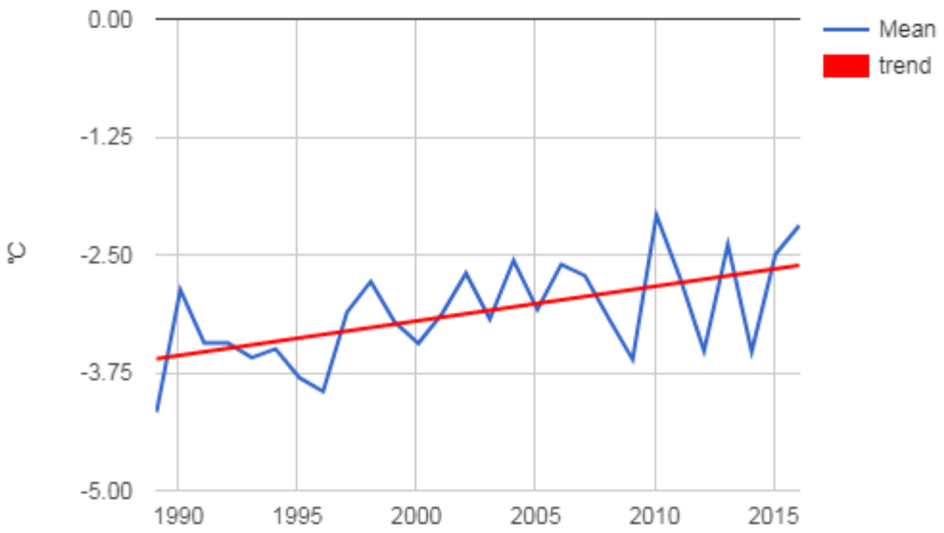


MAX Temperature Linear Trend 1989-2016

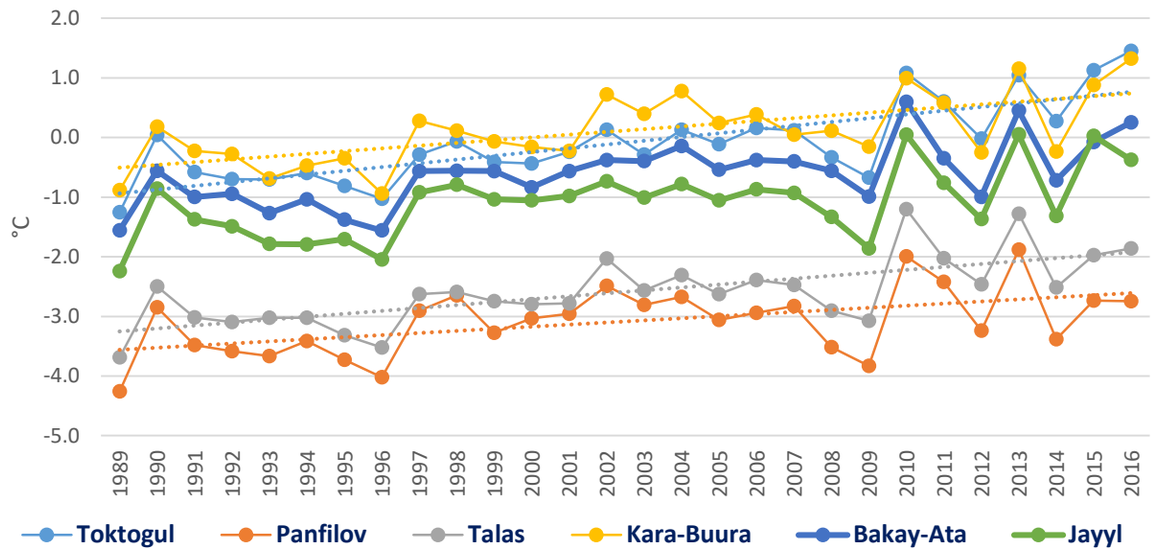


Expansion Area: MIN Temperature

MIN Temperature, annual mean, Kyrgyzstan



MIN Temperature, annual mean, 1989-2016

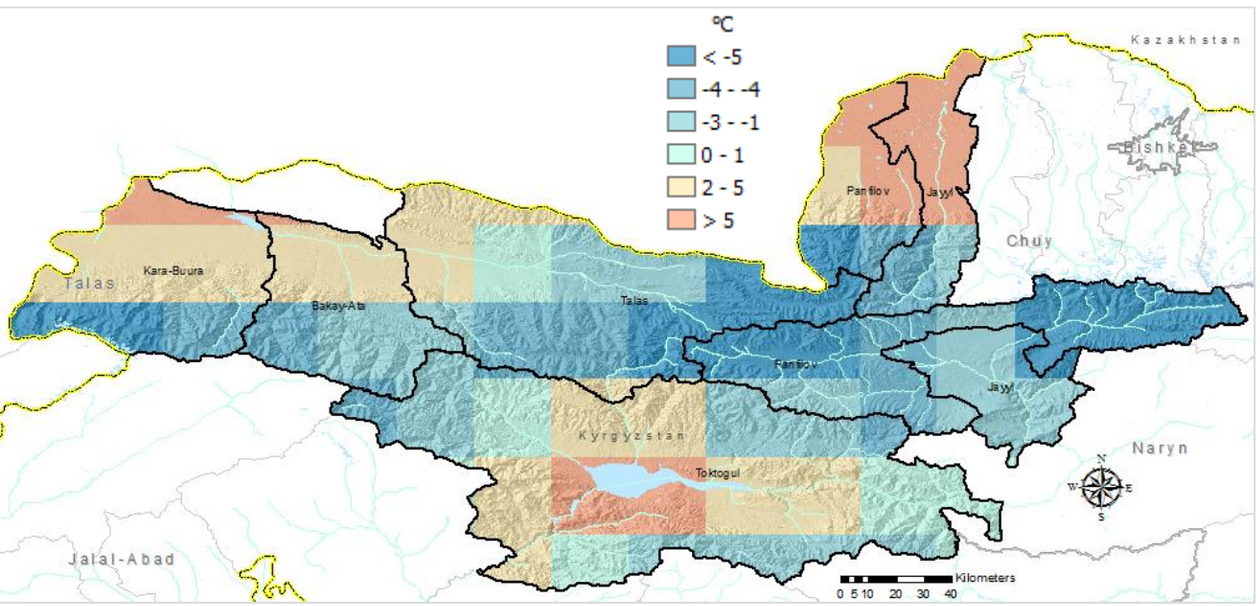


The charts above, which plots the full time series and the linear trend, confirm a general increase of minimum temperatures at national as well as rayon level.

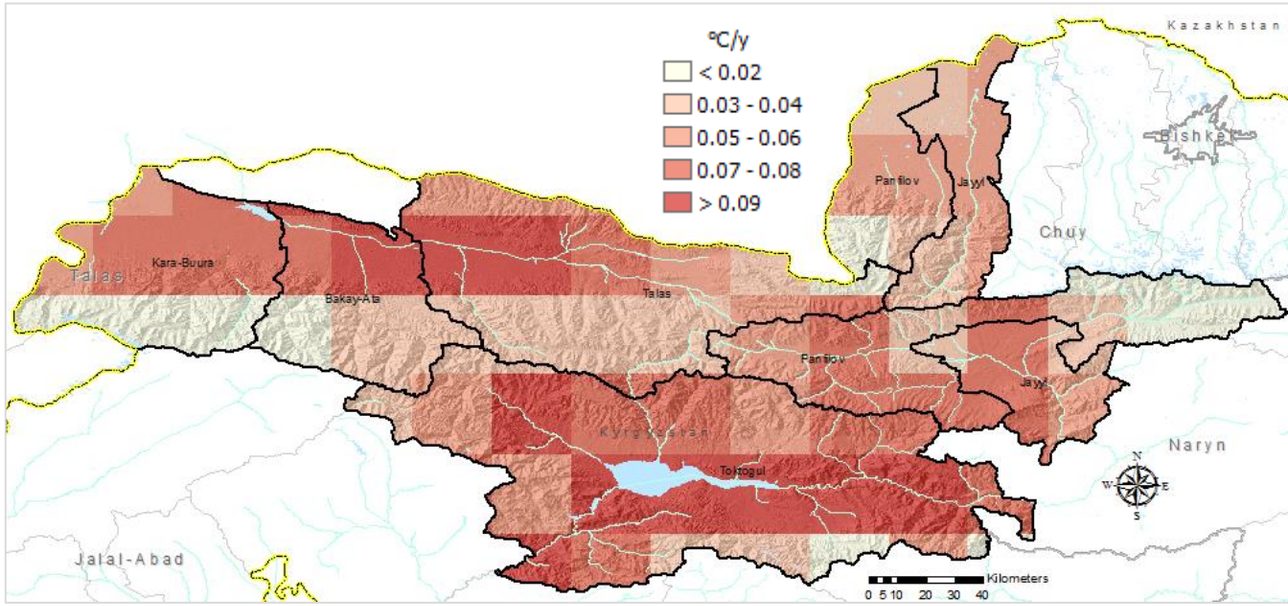
The map below on the left shows the distribution of minimum temperatures (mean of last three years) in the expansion area.

The map below on the right shows the trend based on past (1989-2016) annual data in absolute °C (increase or decrease) per year. The variation is very small; however, almost everywhere trends are positive, which means increase of a fraction of degree per year (max total increase from 1989 to 2016 is more than 2.61 °C).

MIN Temperature 2014-2016 (mean)



MIN Temperature Linear Trend 1989-2016



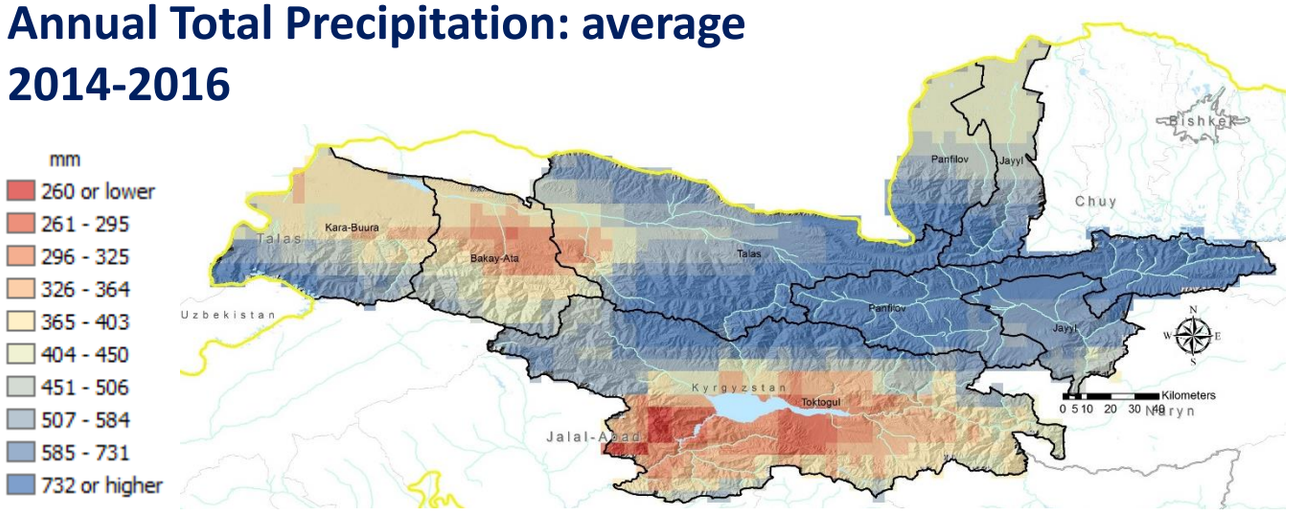
Expansion Area: Potential Evapotranspiration (PET)

PET is the amount of evaporation that would occur if a sufficient water source were available. It is a measure of the demand for moisture from a surface, and it is affected by temperature, insolation and wind.

The map on the right shows the mean annual total precipitations of last three available years (source MODIS).

In arid climates, annual potential evaporation exceeds annual precipitation.

Annual Total Precipitation: average 2014-2016

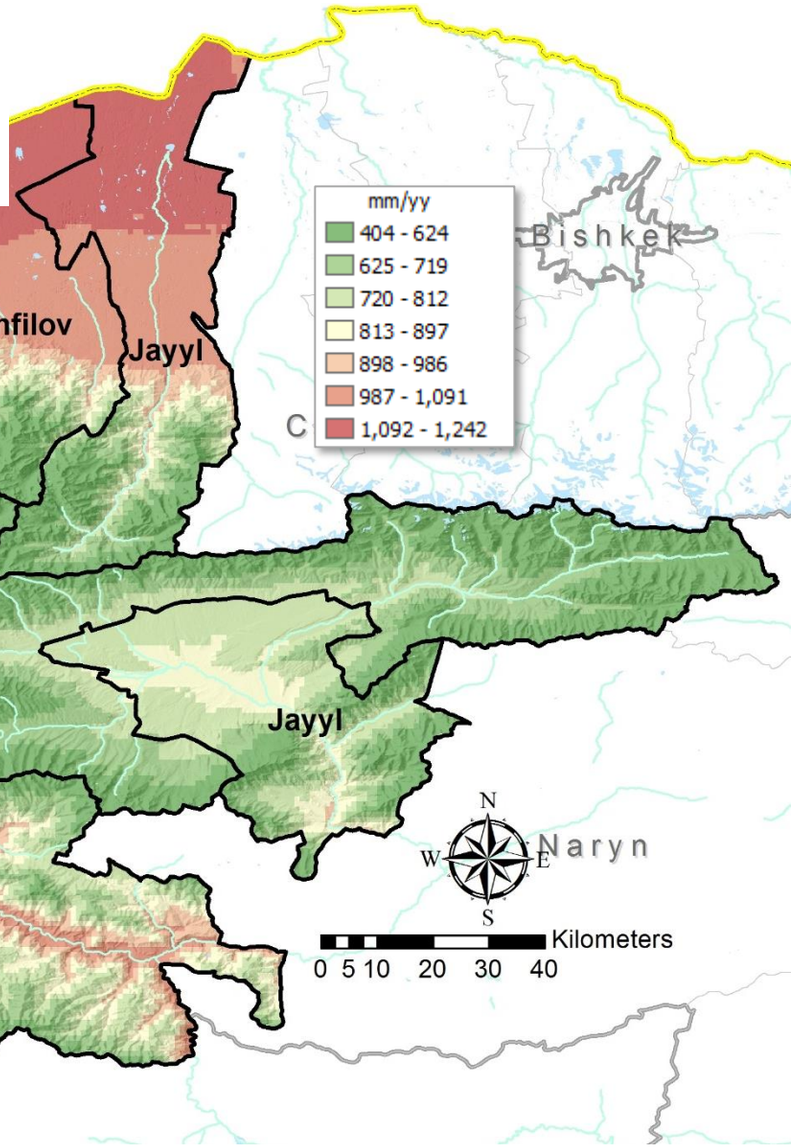


Source: Global MOD16A2 MODIS/Terra Net Evapotranspiration 8-Day L4

Potential Evapotranspiration (Global-PET, 1950-2000)

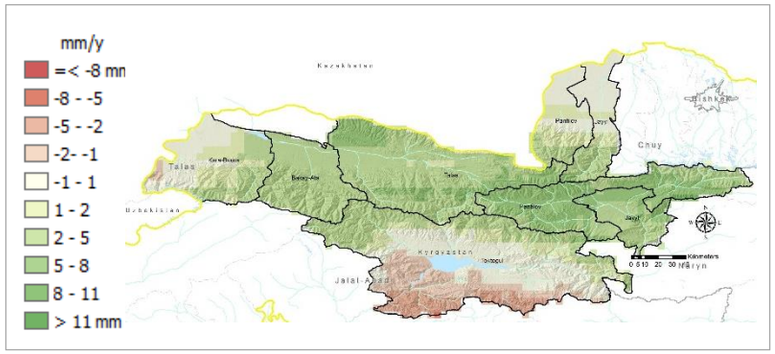
The map below shows the potential evapotranspiration derived from the global database produced by CGIAR-CSI, in which source climatic data FAOCLIM2 was used in the PET equation (FAO application of the Penman-Monteith).

Source: CGIAR-CSI Global Potential Evapotranspiration (Global-PET), http://www.cgiar-csi.org/?s=global-pet&submit.x=0&submit.y=0

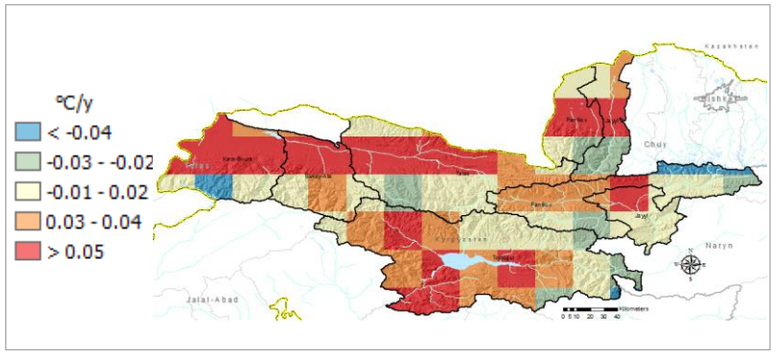


Expansion Area: Potential Evapotranspiration (PET)

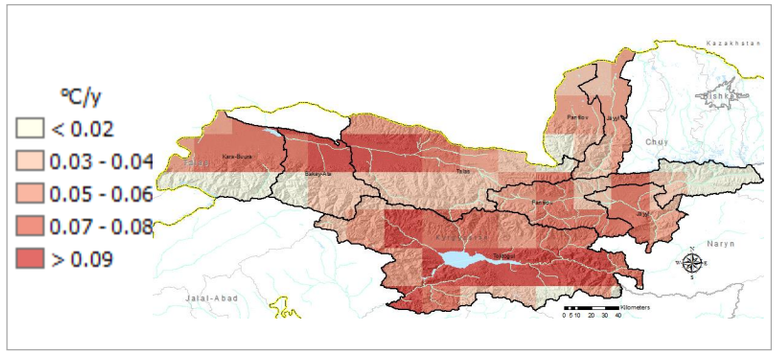
Precipitations trend



MAX Temperature trend



MIN Temperature trend



Potential Evapotranspiration, linear trend 2000-2014

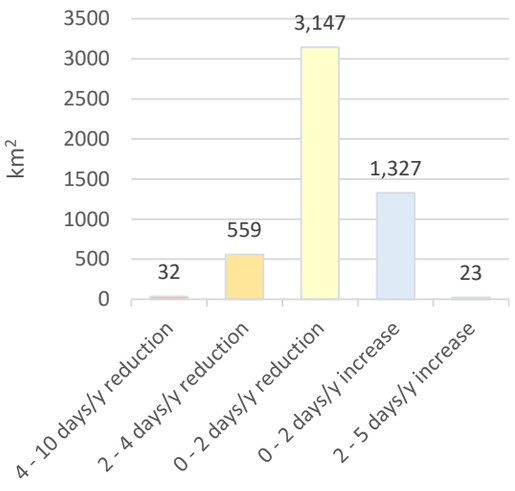
This map shows the trend in mm (absolute increase or decrease per year) of annual potential water loss by evaporation and transpiration from ground and plant surfaces where there is sufficient soil moisture.

Source: Global MOD16A2 MODIS/Terra Net Evapotranspiration 8-Day L4

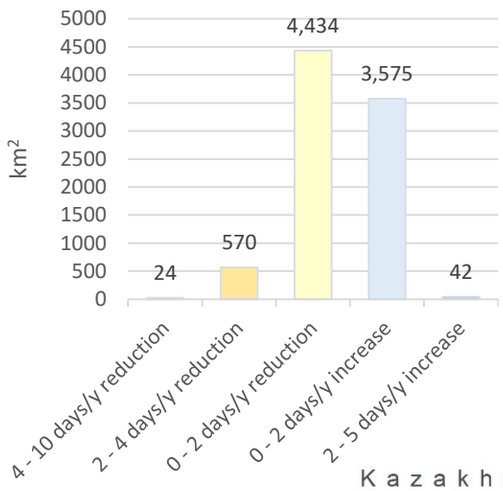
Expansion Area: Change in number of days/year covered by snow

Snow Cover Frequency: Area (km²) by class of frequency

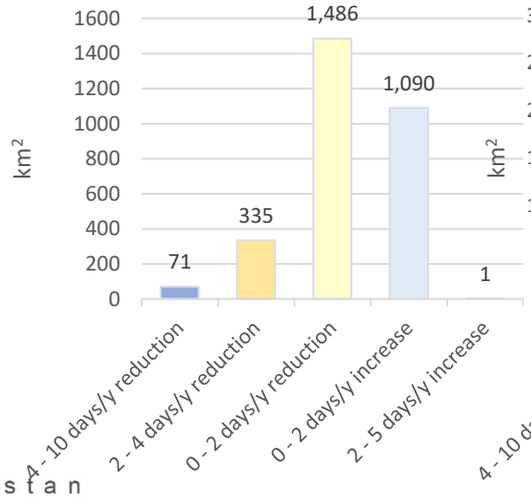
Talas



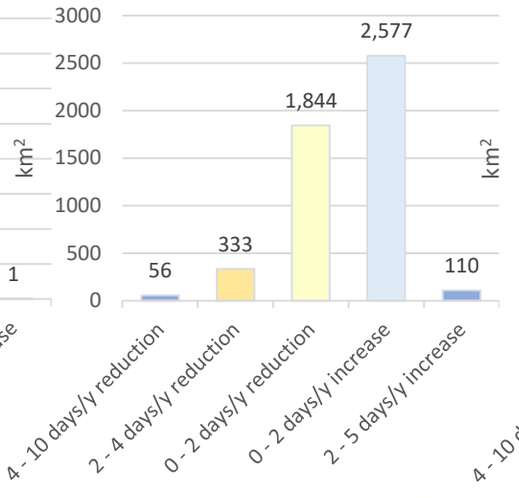
Toktogul



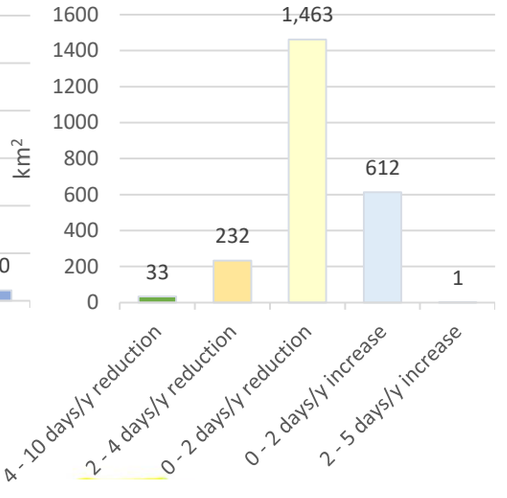
Kara-Buura



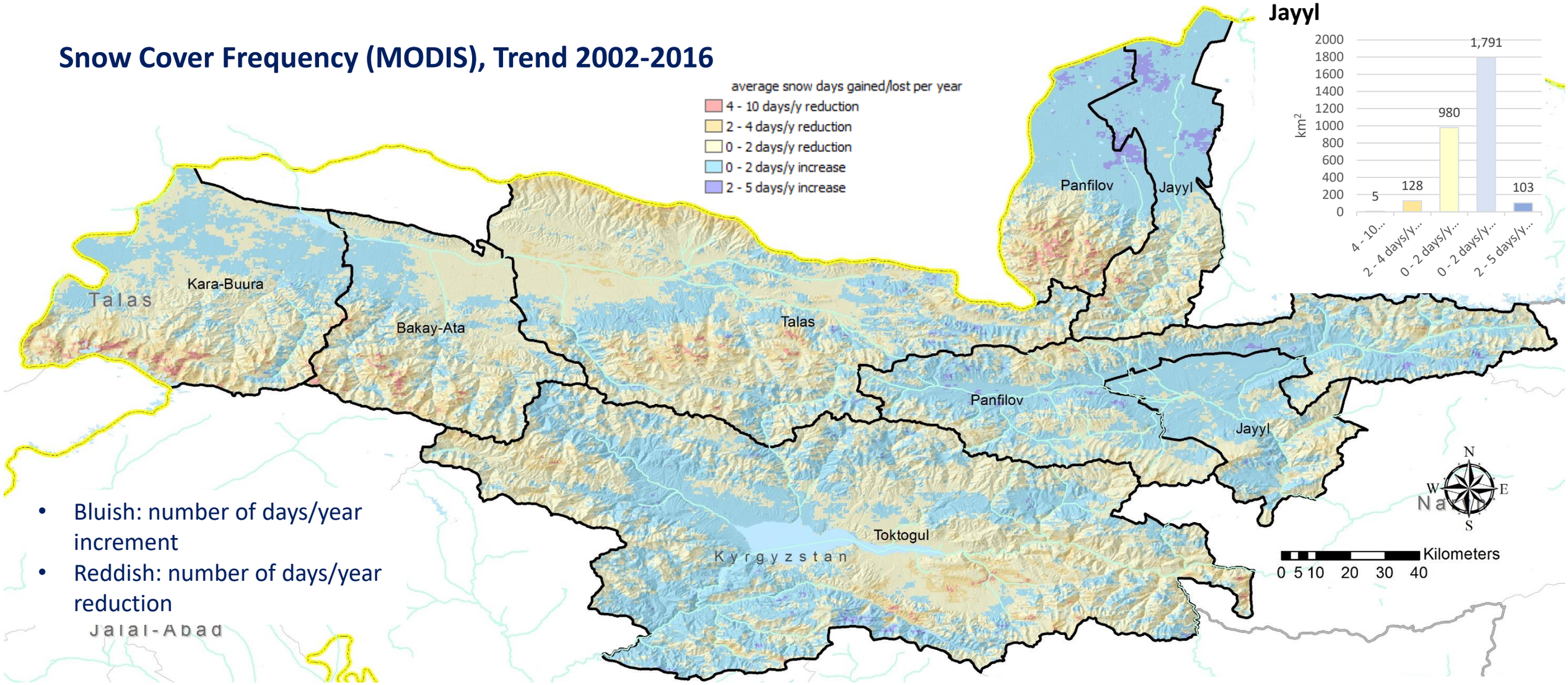
Panfilov



Bakay-Ata



Snow Cover Frequency (MODIS), Trend 2002-2016



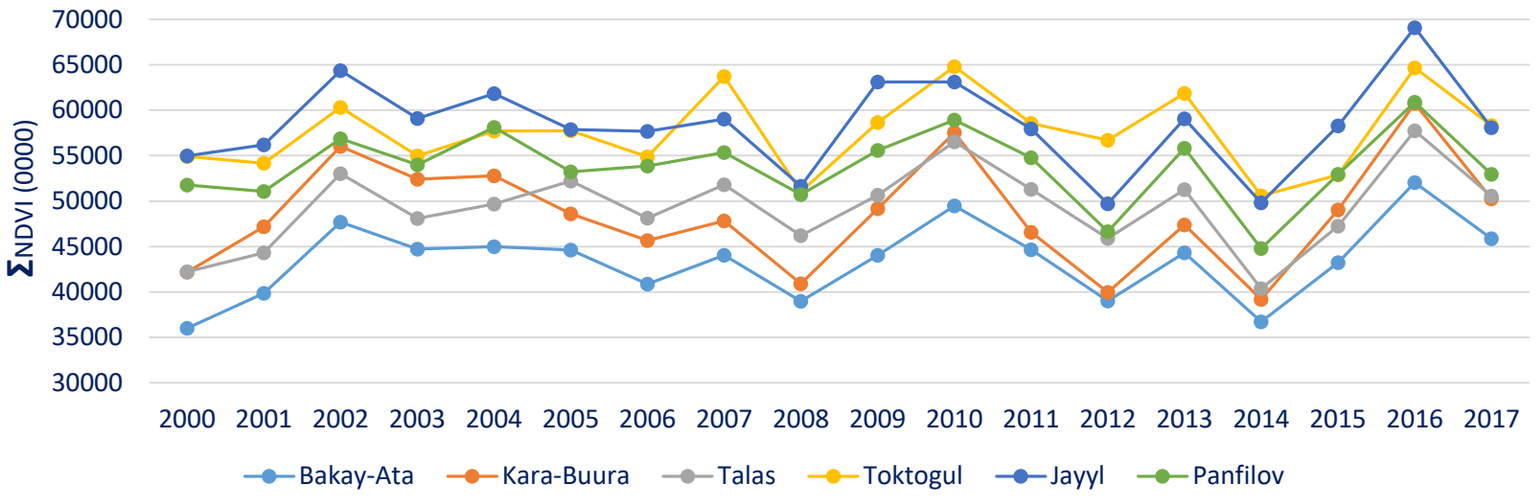
Jayyl

- Bluish: number of days/year increment
- Reddish: number of days/year reduction

Source: MOD10A1.006 MODIS/Terra Snow Cover Daily L3 Global 500m

Expansion Area: vegetation from satellite

Annual Sum NDVI (of means in each rayon): time series 2000-2017



Normalized Difference Vegetation Index (NDVI) provides an alternative measure of vegetation amount and condition.

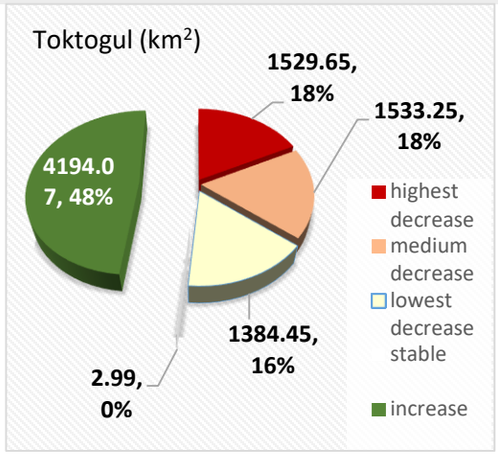
Annual sum NDVI indicator (chart) is computed by adding the mean in each rayon per date. It represents annual accumulated greenness.

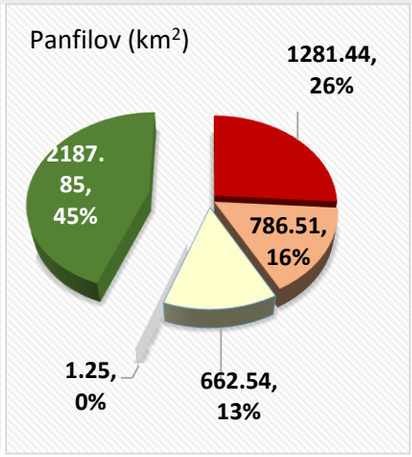
Jayyl and Toktogul shows highest values. Bakay-Ata shows the worst greenness pattern.

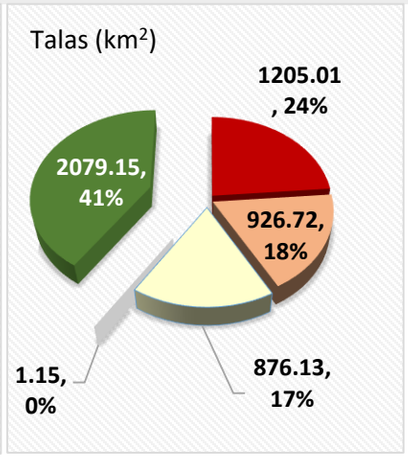
Mean NDVI 2014-2016

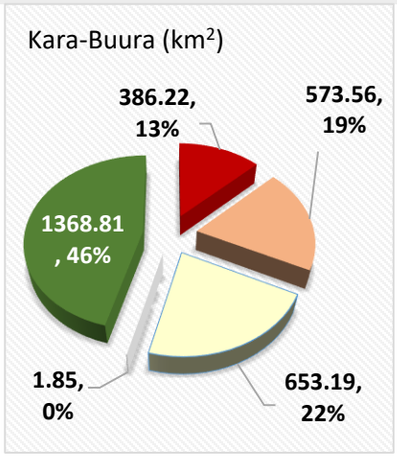
Source: MOD13Q1.005 Vegetation Indices 16-Day Global 250m

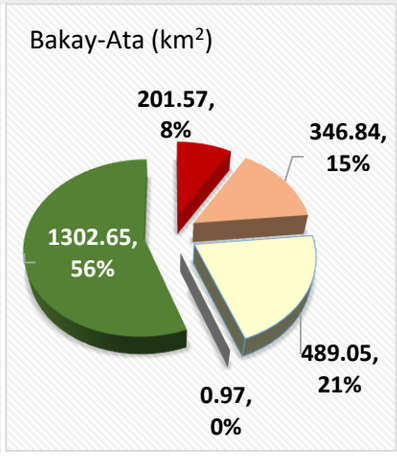
Expansion Area: NDVI trend 2003-2016

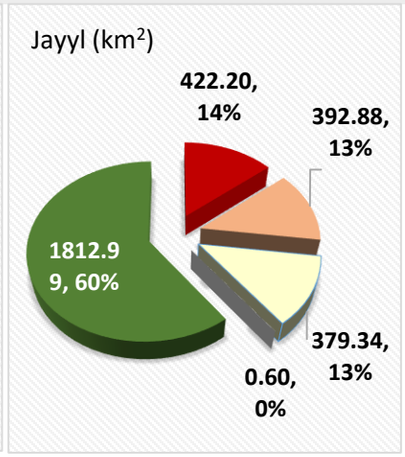






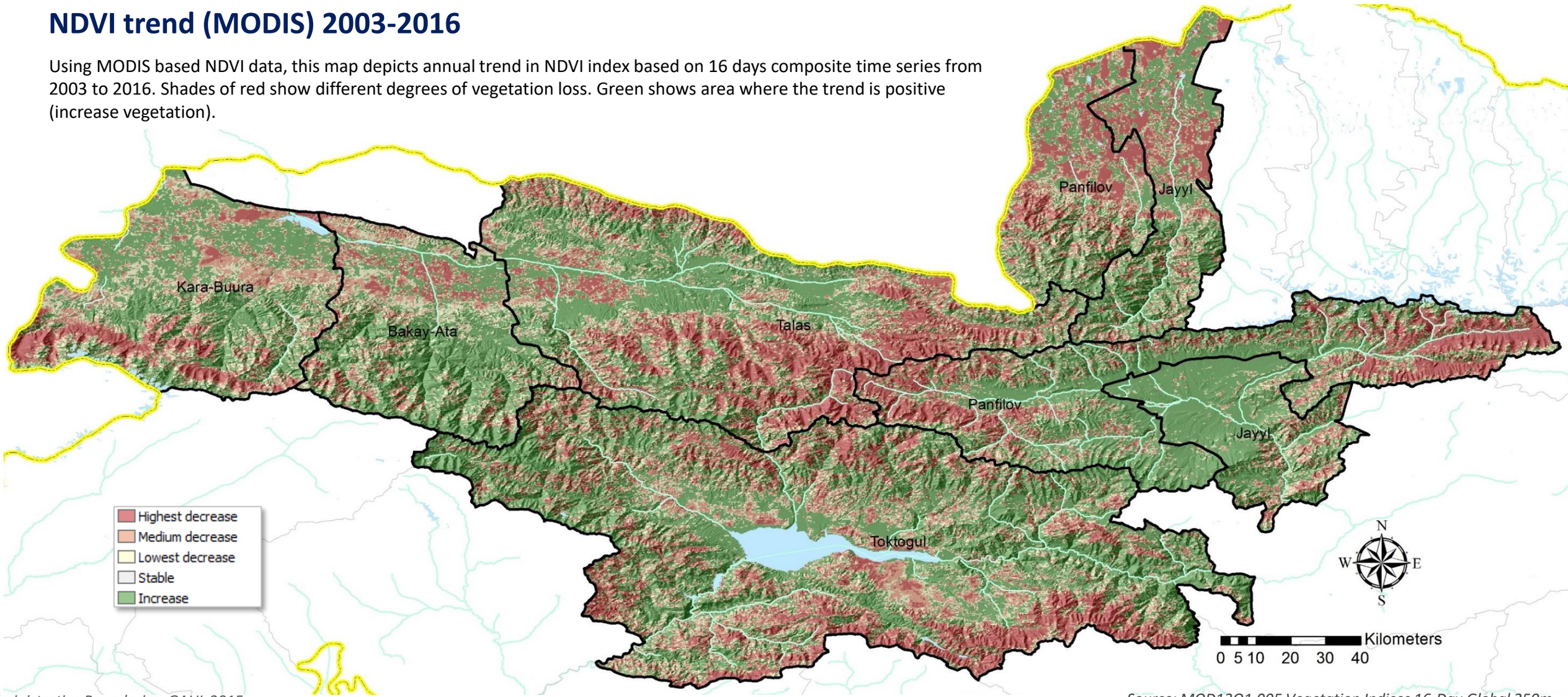






NDVI trend (MODIS) 2003-2016

Using MODIS based NDVI data, this map depicts annual trend in NDVI index based on 16 days composite time series from 2003 to 2016. Shades of red show different degrees of vegetation loss. Green shows area where the trend is positive (increase vegetation).

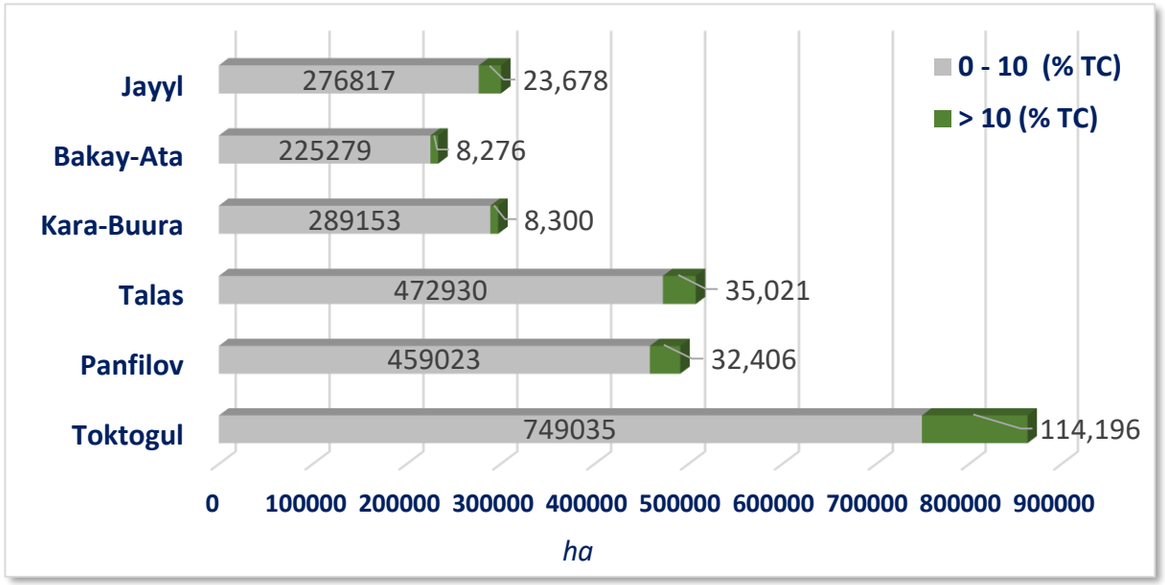


Administrative Boundaries: GAUL 2015

Source: MOD13Q1.005 Vegetation Indices 16-Day Global 250m.

Expansion Area : Forest Cover 2016

Forest / non Forest 2016: statistics by rayon



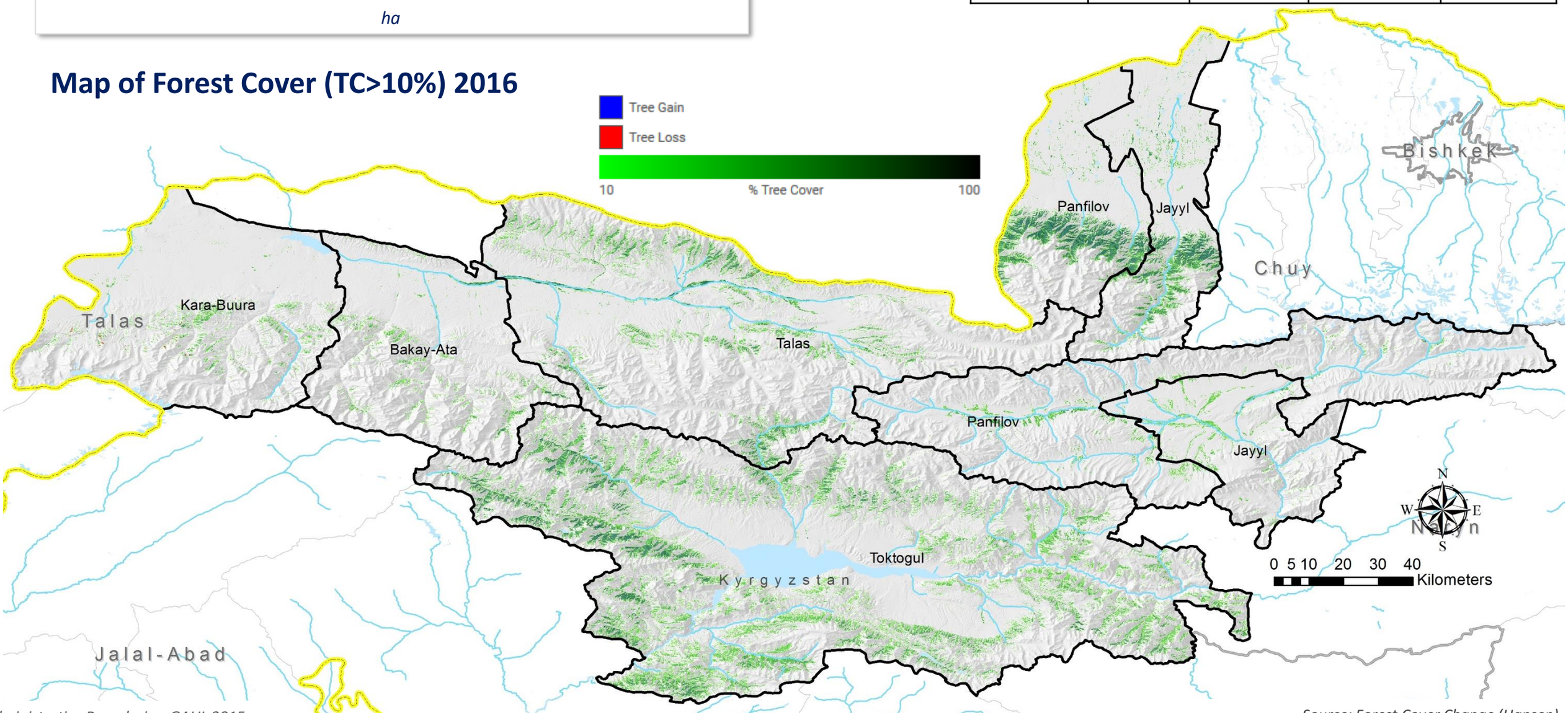
Tree Cover > 0% 2016: statistics by rayon

(ha)	Toktogul	Bakay-Ata	Kara-Buura	Talas	Panfilov	Jayyl
TC > 0% (2000)	105946	9195	8976	33690	29105	22004
GAIN 2000-2015	27	2	4	19	16	11
LOSS 2000-2015	132	34	207	102	57	41
TC > 0% (2016)	105841	9163	8773	33607	29064	21974
Rayon area (GAUL)	863231	233555	297453	507951	491429	300495
Tree Covered Area (%)	12.3%	3.9%	2.9%	6.6%	5.9%	7.3%

National stats

Tree Covered Area (ha)	Area Lost (ha)	Area Gained (ha)	Average Canopy Cover	Tree Covered Area
1004723	3731	465	47%	5.05%

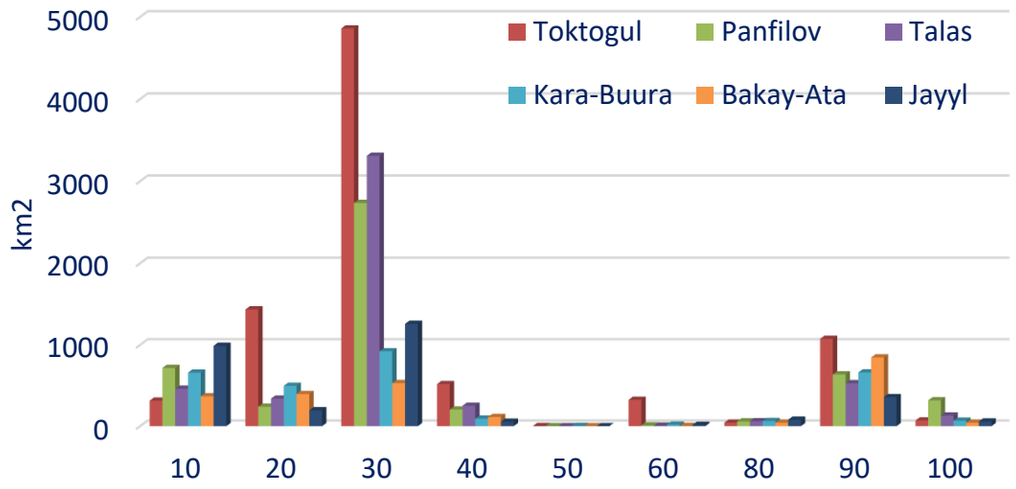
Map of Forest Cover (TC>10%) 2016



Administrative Boundaries: GAUL 2015

Source: Forest Cover Change (Hansen)

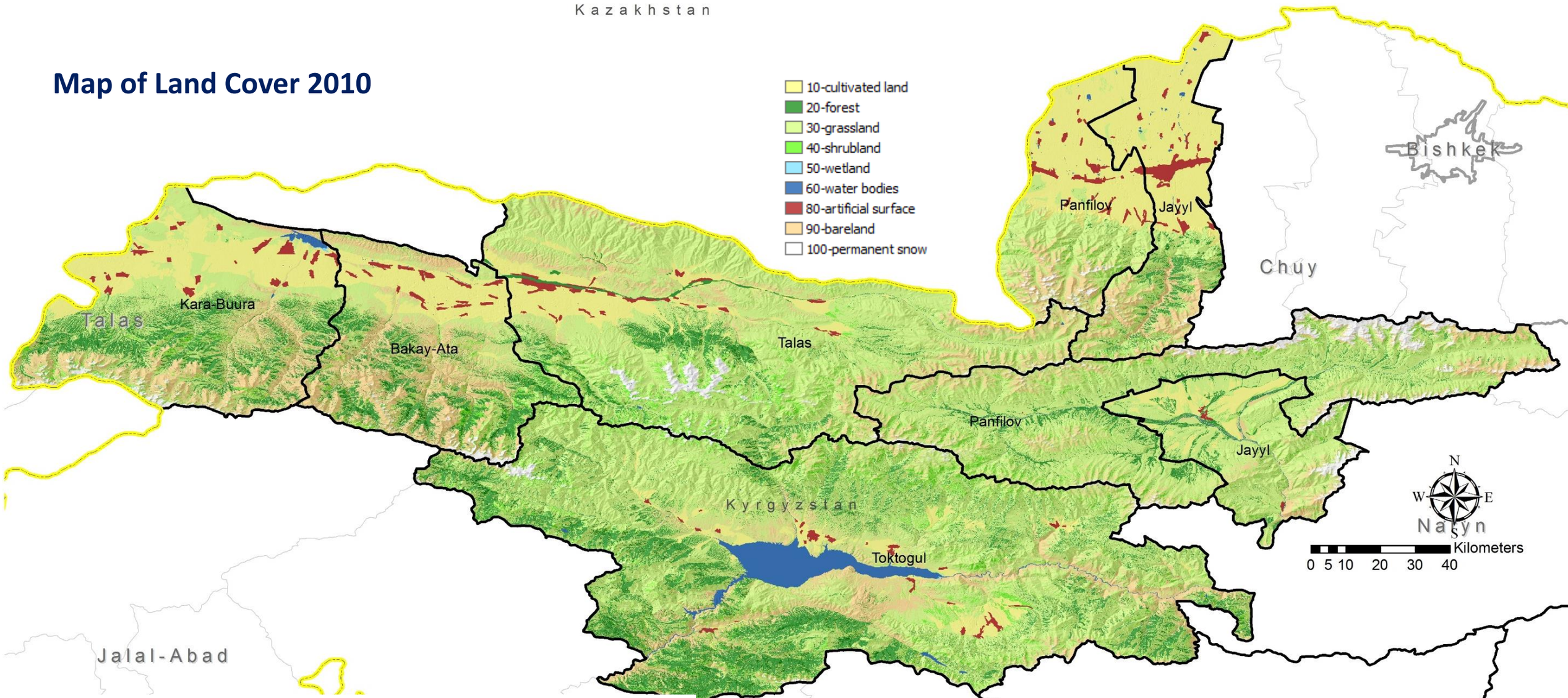
Expansion Area: Land Cover 2010 (GlobeLand30)



km2	Toktogul	Panfilov	Talas	Kara-Buura	Bakay-Ata	Jayyl	tot
10-cultivated land	314.5	716.7	460.8	658.6	367.5	988.5	**3506.6**
20-forest	1437.5	239.2	339.2	497.1	395.6	195.6	**3104.2**
30-grassland	4860.1	2735.2	3309.2	921.5	529.8	1259.6	**13615.4**
40-shrubland	518.0	204.8	251.4	93.0	112.9	54.5	**1234.6**
50-wetland	0.5	0.0	0.0	2.3	0.1	0.0	**2.9**
60-water bodies	324.6	9.4	6.7	18.4	2.6	15.1	**376.8**
80-artificial surface	43.8	58.6	61.2	62.9	42.8	79.8	**349.1**
90-bareland	1074.7	637.4	529.1	661.8	846.4	357.2	**4106.5**
100-permanent snow	70.7	318.3	130.7	68.0	43.5	57.7	**688.8**
Tot	**8644.4**	**4919.6**	**5088.2**	**2983.6**	**2341.1**	**3008.0**	**26984.9**

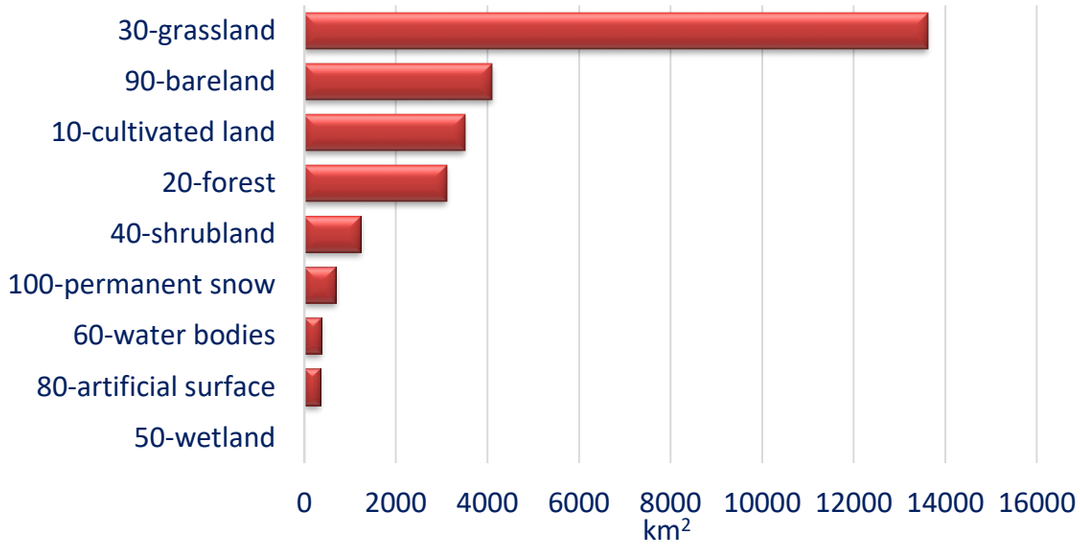
Source: GlobeLand30, http://www.globallandcover.com/home/Enbackground.aspx

Map of Land Cover 2010



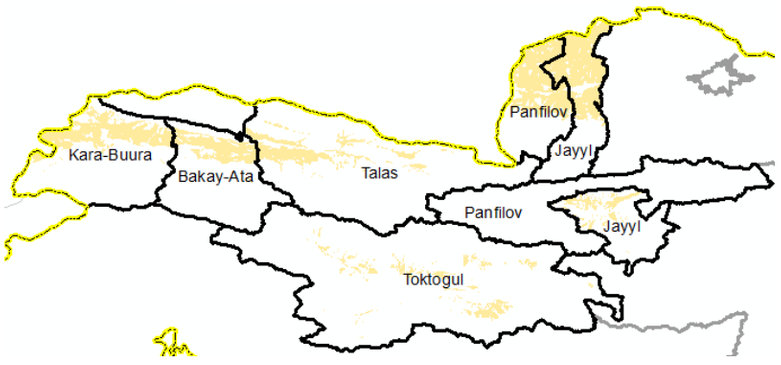
Source: GlobeLand30, http://www.globallandcover.com/home/Enbackground.aspx

Expansion Area: Land Cover 2010 (GlobeLand30)

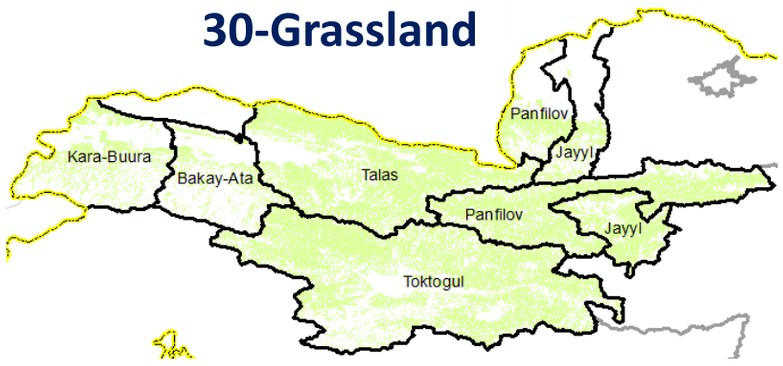


Source: GlobeLand30

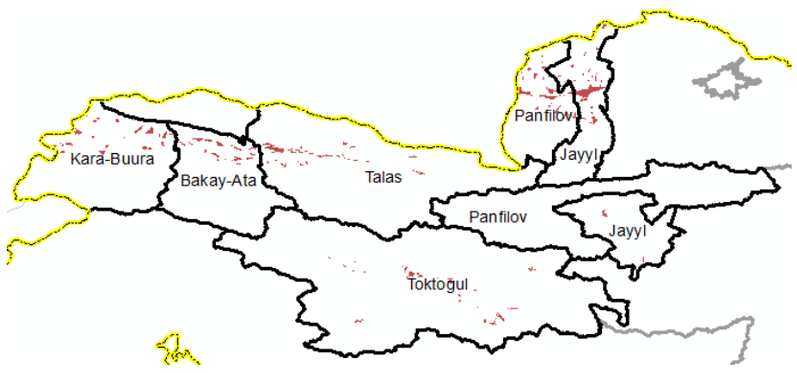
10-Cultivated land



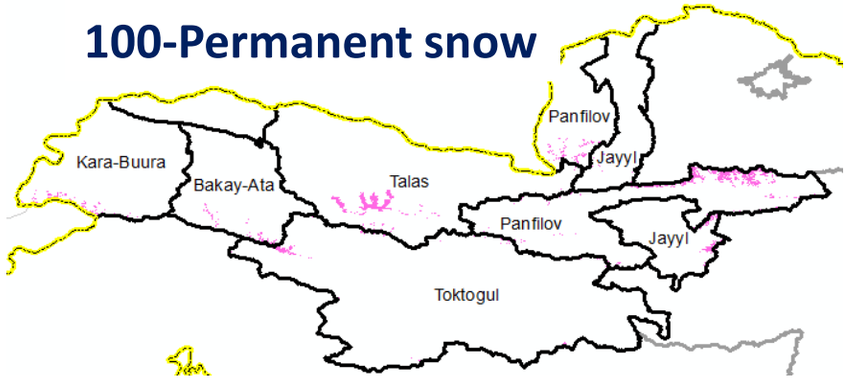
30-Grassland



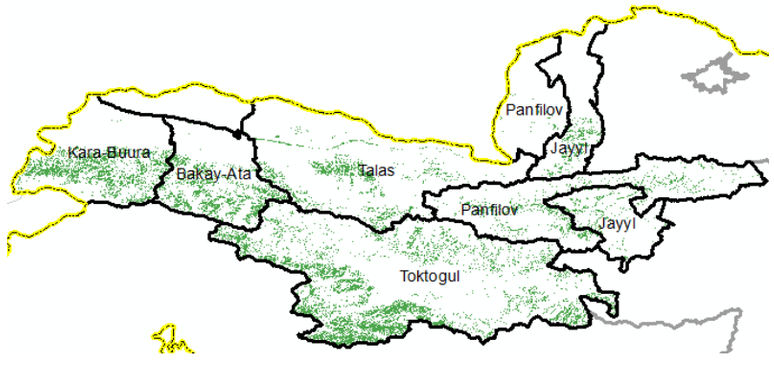
80-Artificial surface



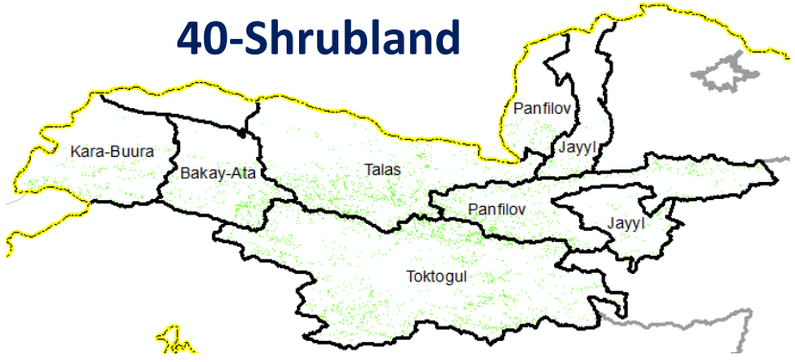
100-Permanent snow



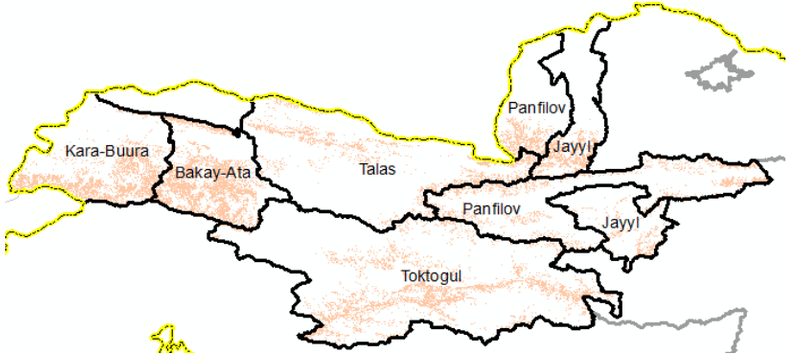
20-Forest



40-Shrubland

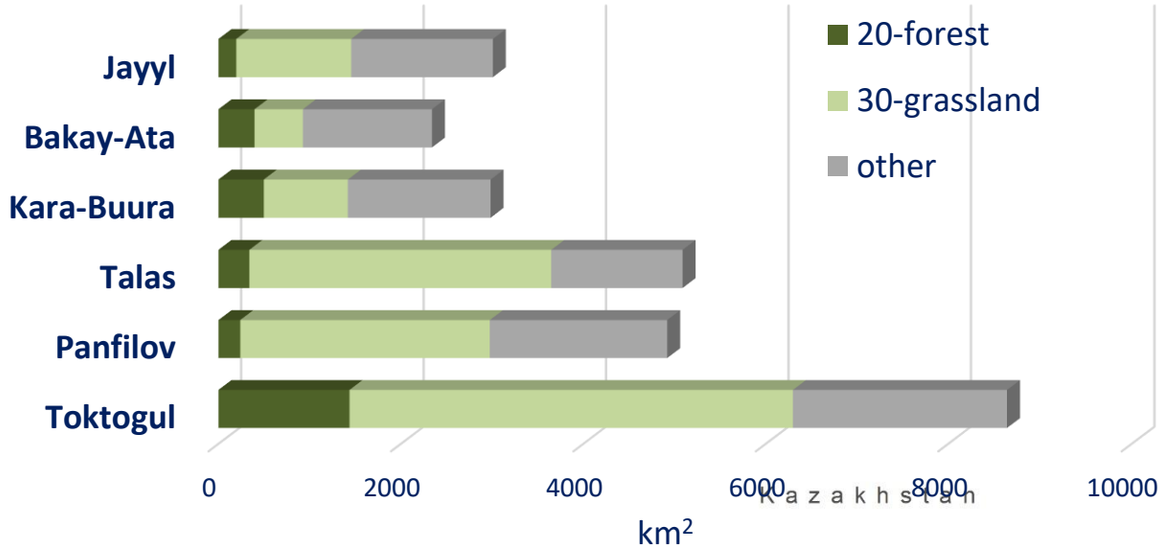


90-Bare land



Expansion Area : Grassland / Forest (2010)

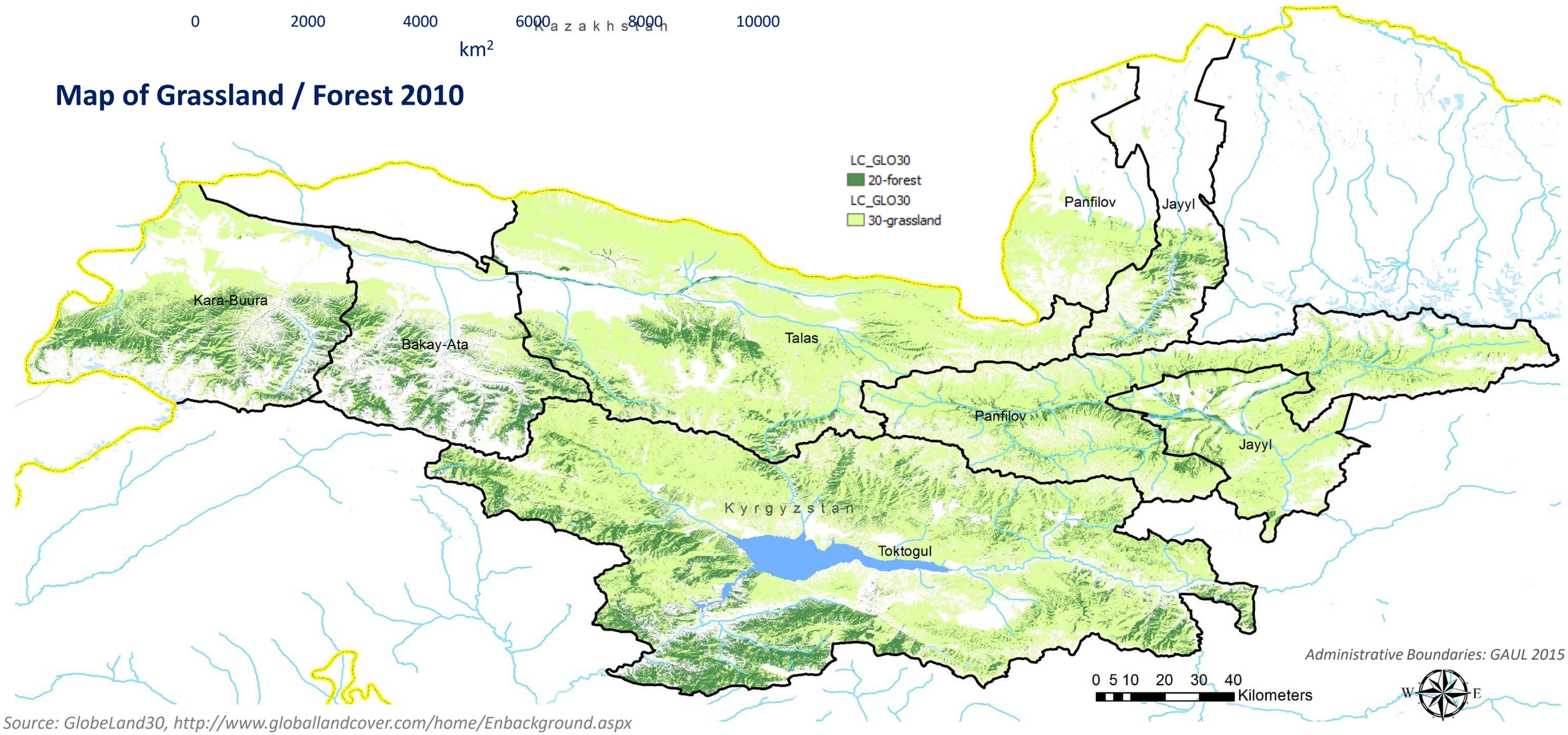
Forest / Grassland Cover 2010 by rayon



km²	Toktogul	Panfilov	Talas	Kara-Buura	Bakay-Ata	Jayyl	Tot
20-forest	1437.5	239.2	339.2	497.1	395.6	195.6	**3104.2**
30-grassland	4860.1	2735.2	3309.2	921.5	529.8	1259.6	**13615.4**
other	2346.8	1945.2	1439.8	1565.1	1415.8	1552.7	**10265.3**
Tot	**8644.4**	**4919.6**	**5088.2**	**2983.6**	**2341.1**	**3008.0**	**26984.9**

Source: GlobeLand30, http://www.globallandcover.com/home/Enbackground.aspx

Map of Grassland / Forest 2010

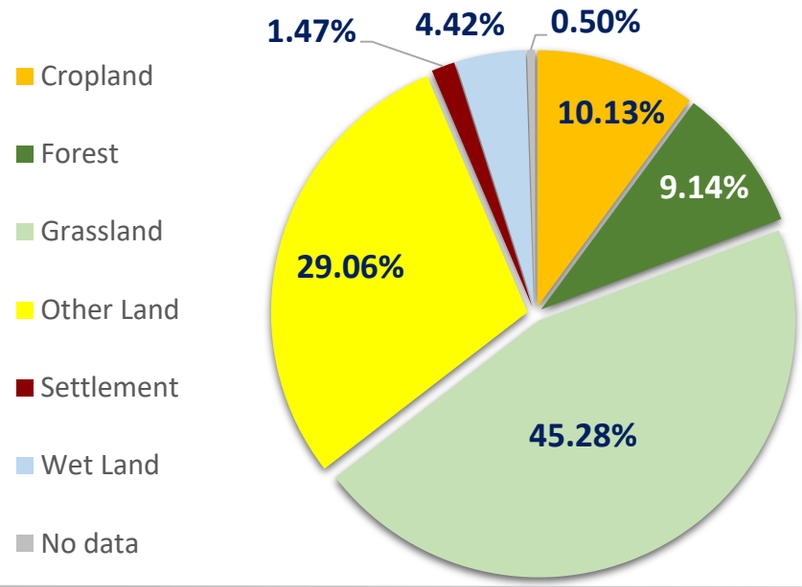


Administrative Boundaries: GAUL 2015

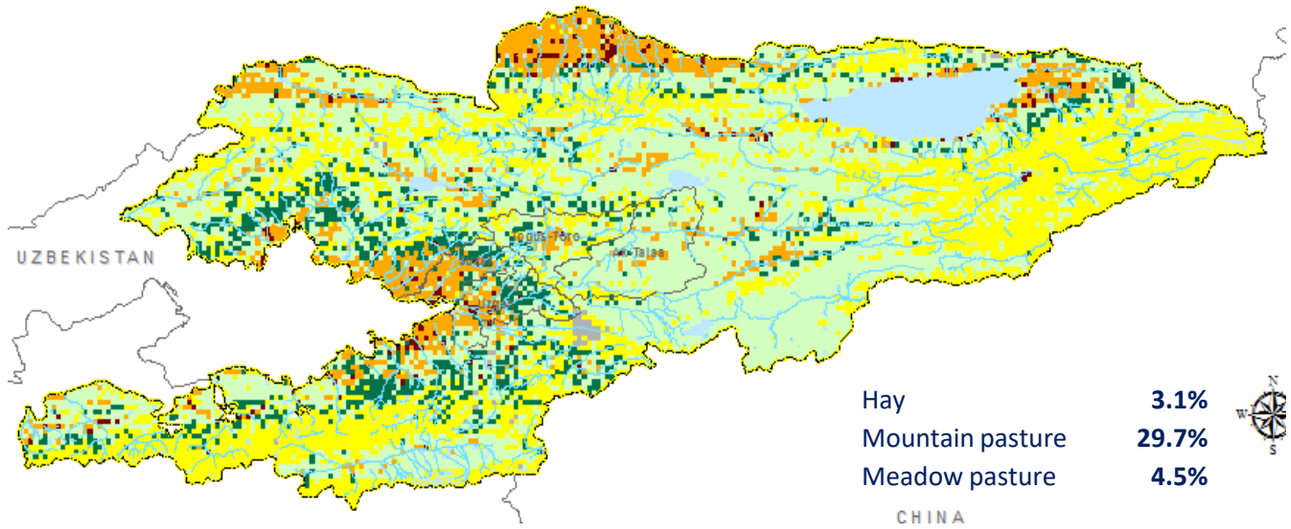
Source: GlobeLand30, http://www.globallandcover.com/home/Enbackground.aspx

Target Area: Sample based estimates (Collect Earth survey 2016)

LAND COVER

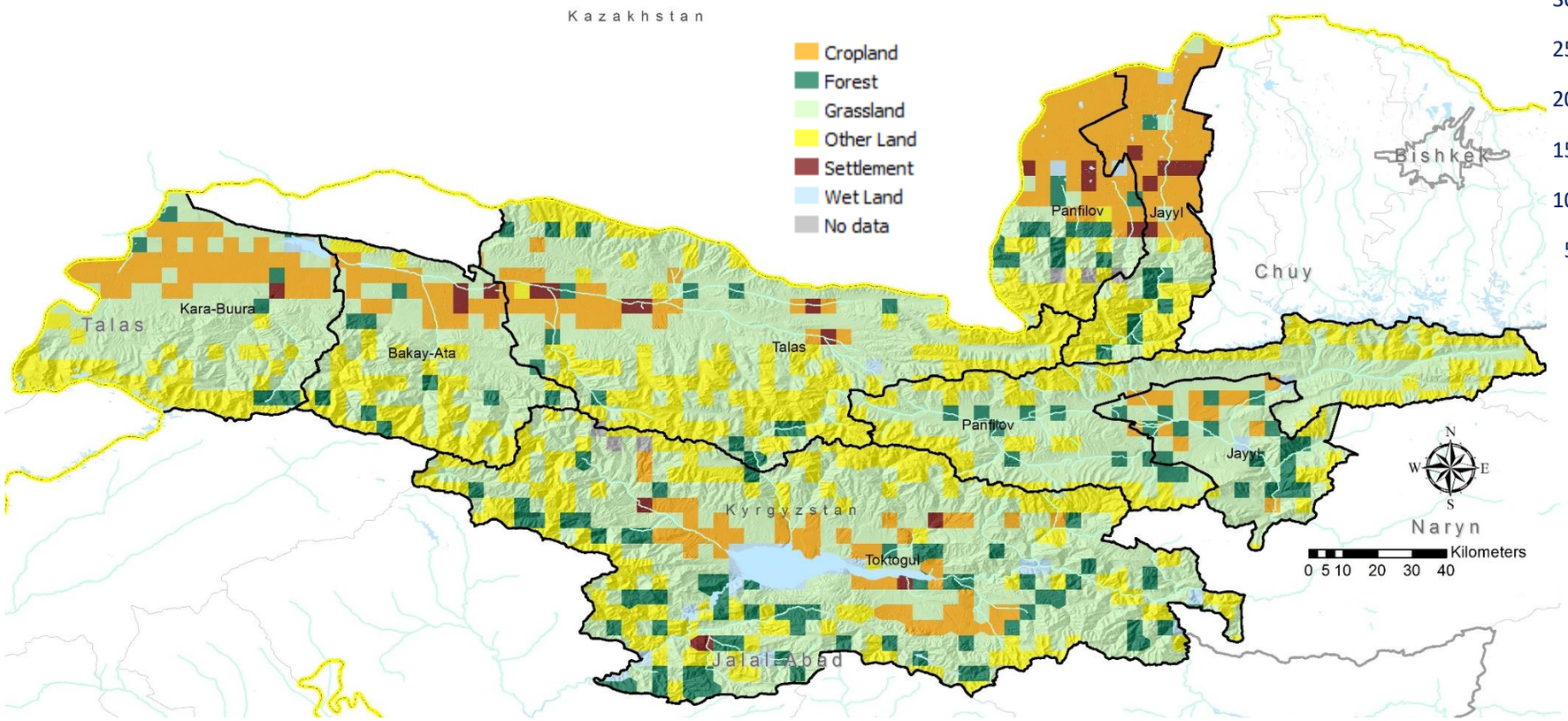


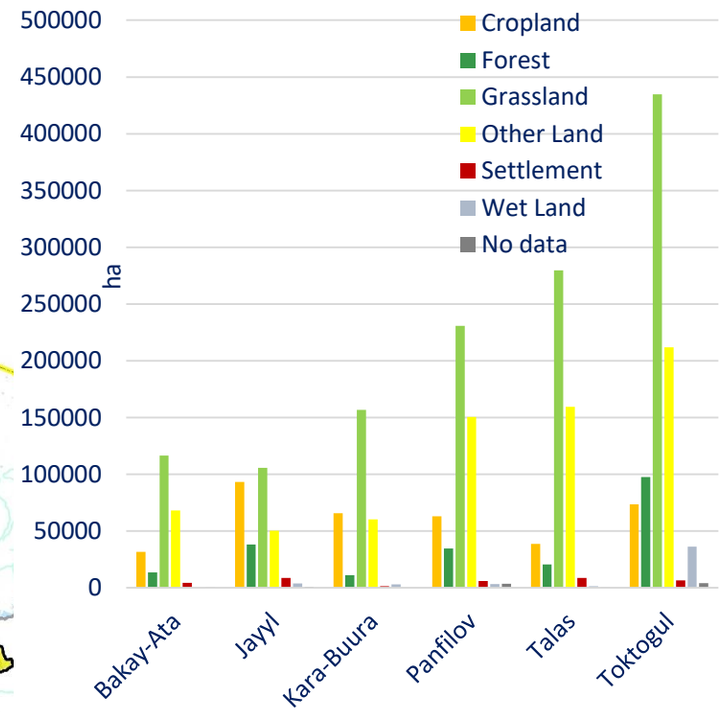
Proportion of different land uses nationwide



Map of Land Use 2016 out of sample based survey (Collect Earth)

Simplified Land use distribution based on 13,200 circa sample points (nationwide) compiled and interpreted using FORIS Collect Earth tool.





Collect Earth: http://www.openforis.org/tools/collect-earth.html