





# WILDFIRE MONITORING OF NATURAL DISASTER AND ITS RISK ASSESSMENT USING REMOTE SENSING METHODS IN MONGOLIA

—— An Application of APSCO Data Sharing Service Platform

23 October 2025 | Presented by

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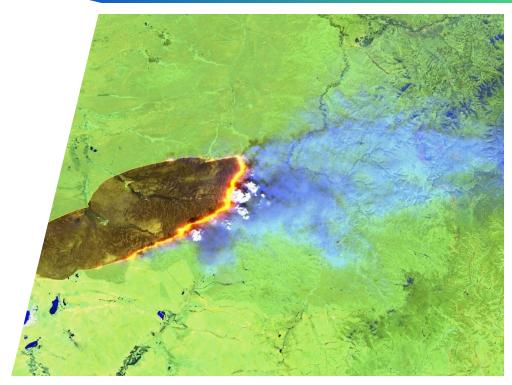


Is Wildfires a Natural Disaster in Mongolia?

#### **CONTENTS**



- Project objectives
- Literature review
- Study results
  - Fieldworks
  - Satellite image analysis
  - Sharing results
- Conclusions





#### **RESEARCH OBJECTIVES**



#### Goal

Mainly this project studies the action of wildfire disasters, estimates risk assessment of its spatial distribution, and contributes to developing the wildfire management and monitoring system on national and regional levels using remote sensing technologies.

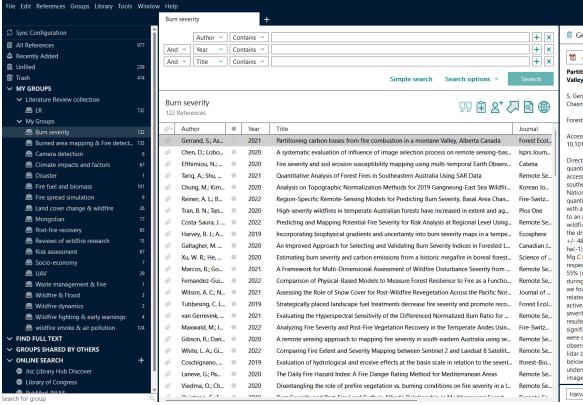
# **Objectives**

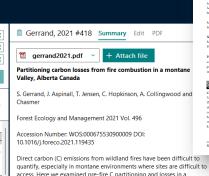
- To develop the methods of wildfire detection based on satellite imagery, which are supported by the APSCO DSSP project.
- To estimate risk assessment of wildfire spatial distribution using satellite imagery.
- To analyze the spatiotemporal implementation to wildfire and the damage assessment.

#### LITERATURE REVIEW



A literature review of wildfire has been completed in approximately 732 papers for last 5 years and analyzed on all papers that have been completed.





quantify, especially in montane environments where sites are difficult to access. Here we examined pre-fire C partitioning and losses in a southern Canadian montane valley ecosystem, in Waterton Lakes National Park, Alberta Canada, The objectives of this study were to: (a) quantify the C loss due to combustion at a moist riparian site compared with a dry undulating upland site and (b) compare C loss observations to an active multi-spectral lidar remote sensing index. C losses from wildfire were consistently greater at the wet riparian site compared with the dry valley site. Average soil C losses were 92.92 Mg C ha(-1) (st. dev. +/- 48.60 Mg C ha(-1)) and 58.05 Mg C ha(-1) (st. dev. +/- 37.19 Mg C ha(-1)). Average tree C losses were 114.0 Mg C ha(-1) (std.dev. +/- 9.9 Mg C ha(-1)) and 86.9 Mg C ha(-1) (std. dev. +/- 13.5 Mg C ha(-1)) respectively. C losses from trees were greater than soils, where trees lost 55% (moist riparian ecosystem) and about 60% (drier valley site) of C during combustion. Using post-fire multi-spectral airborne lidar data. we found that increased proportion of charred soils were significantly related to enhanced reflectivity in SWIR, resulted in more negative active normalised burn ratio (aNBR) results, indicating enhanced burn severity. Increased proportional cover of regenerating vegetation resulted in less negative aNBR both at the drier site, though no significant relationships between aNBR and charred vs. vegetated results were observed at the moist riparian site. No significant relationship was observed between depth of burn/soil Closs and aNBR derived from lidar data, indicating potential limitations when using burn indices for below canopy burn severity. The use of multi-spectral lidar may improve understanding of below canony fire fuels and C losses in ontical imagery, which often occludes these important components of fire

Insert



marketing values. They affect the regional and global climate by means of biolog chemical, and physical processes that influence atmospheric composition, hydrol cycle, and planetary energetics [1]. In addition to the forests' benefits to the clim

they help all living creatures, especially humankind, by filtering the water, purifying the air, and preventing crossion [2]. Furthermore, forests are home to numerous plants and

animals, and they supply fundamental natural resources from timber and food to medicin plants [3]. However, wildfires affect around 350 million hectares of land annually [4,5]

of forest fires can be categorized into: (i) human activities such as land use land cover (LULC) changes, campfires, smoking, etc., and (ii) natural conditions such as lightnin

and these fires result in the loss of huge amounts of forest cover. The fund

# **LITERATURE REVIEW**

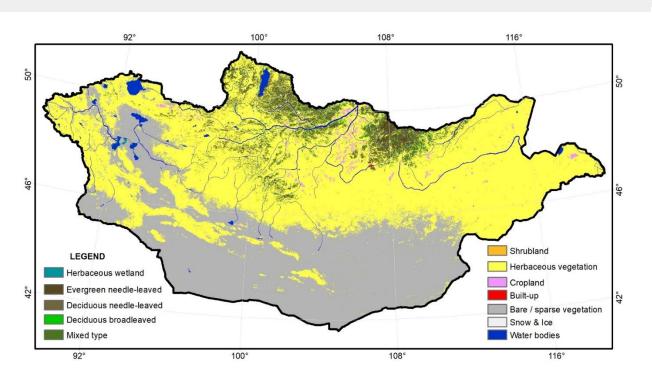


Categories	Topic Groups in Wildfires	Number of Papers
1	Mongolian Wildfire Studies	17
2	Reviews of Wildfire Research	13
3	Burn Severity	122
4	Burned Area Mapping & Fire Detection	133
5	Camera Smoke Detection	6
6	Climate Impacts and Factors	67
7	Disaster	1
8	Fire Fuel and Biomass	101
9	Fire Spread Simulation	9
10	Land Cover Change & Wildfire	26
11	Post-Fire Recovery	63
12	Risk Assessment Analysis	67
13	Socio-Economic Analysis	7
14	UAV	29
15	Waste Management	1
16	Wildfire & Flooding	3
17	Wildfire Dynamics	3
18	Wildfire fighting & Early Warnings	4
19	Wildfire Smoke, Air pollution, and Aerosols	124

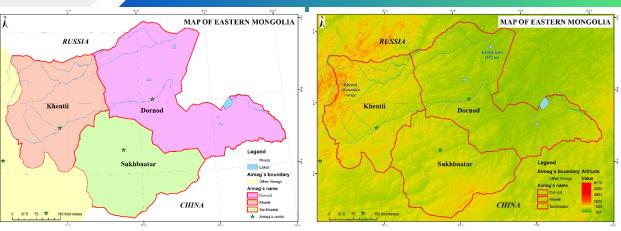
Journal Name	Number	Journal Rank
ournar rame	of Papers	(IF)
1 Remote Sensing	222	5.349 (Q1-Q2)
2 Remote Sensing of Environment	32	13.85 (Q1)
3 Fire-Switzerland	31	2.726 (Q2-Q3)
4 Forests	20	3.282 (Q1)
5 International Journal of Wildland Fire	19	3.398 (Q1)
6 Atmospheric Chemistry and Physics	17	7.197 (Q1)
7 Atmosphere	16	3.11 (Q3)
8 Forest Ecology and Management	15	4.384 (Q1)
9 Korean Journal of Remote Sensing	15	0.29 (-)
10 IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing	11	4.715 (Q1)
11 Environmental Research Letters	10	6.947 (Q1)
12 Isprs International Journal of Geo-Information	9	3.099 (Q2-Q3)
13 Isprs Journal of Photogrammetry and Remote Sensing	9	11.774 (Q1)
14 Land	9	3.905 (Q2)
15 Sensors	9	3.847 (Q2)
16 Ecosphere	8	3.593 (Q2)
17 International Journal of Remote Sensing	8	3.531 (Q2-Q3)
18 Scientific Reports	8	4.997 (2)
19 Geomatics Natural Hazards & Risk	6	3.922 (Q2)
20 Geophysical Research Letters	6	5.576 (Q1)
21 Ieee Transactions on Geoscience and Remote Sensing	6	8.125 (Q1)
22 International Journal of Applied Earth Observation and Geoinformation	6	7.672 (Q1)
Remote Sensing Applications-Society and Environment	6	-
24 Remote Sensing in Ecology and Conservation	6	5.787 (Q1-Q2)
25 Science of the Total Environment	6	10.754 (1)

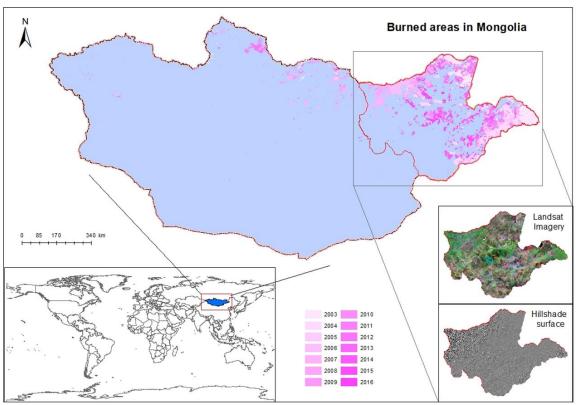
## **STUDY AREA**











#### SATELLITE DATA COLLECTION



Sentinel-2, Landsat 8 and GaoFen-1,2 satellite images Multispectral Instrument (MSI) data exhibits the great potential of enhanced spatial and temporal coverage for monitoring biomass burning which could complement other coarse active fire detection products.

MCD64A1 product has been used for wildfire detection, which is time ranged in 20 years from 2001 to 2021. it is helpful to estimate wildfire hotspot analysis.

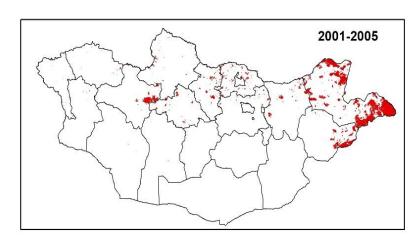
Nº	Cnoctral Band	Spatial	Centre	Band Width
IN⊇	Spectral Band	Resolution (nm)	Wavelength (nm)	(nm)
1	Coastal aerosol	60	443	20
2	Blue	10	494	65
3	Green	10	560	35
4	Red	10	665	30
5	Vegetation red edge	20	704	15
6	Vegetation red edge	20	740	15
7	Vegetation red edge	20	781	20
8	NIR 1	10	834	115
8	Narrow NIR or NIR 2	20	864	20
9	Water vapour	60	944	20
10	SWIR – Cirrus	60	1375	30
11	SWIR 1	20	1612	90
12	SWIR 2	20	2194	180

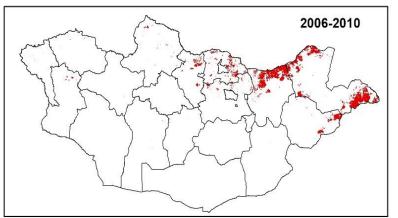
Landsat-7	ETM+ Bands (μm)		Landsat-8 OLI and TIR.	S Bands (µm)	
=			30 m Coastal/Aerosol	0.435 - 0.451	Band 1
Band 1	30 m Blue	0.441 - 0.514	30 m Blue	0.452 - 0.512	Band 2
Band 2	30 m Green	0.519 - 0.601	30 m Green	0.533 - 0.590	Band 3
Band 3	30 m Red	0.631 - 0.692	30 m Red	0.636 - 0.673	Band 4
Band 4	30 m NIR	0.772 - 0.898	30 m NIR	0.851 - 0.879	Band 5
Band 5	30 m SWIR-1	1.547 - 1.749	30 m SWIR-1	1.566 - 1.651	Band 6
Band 6	60 m TIR	10.31 - 12.36	100 m TIR-1	10.60 – 11.19	Band 10
	=		100 m TIR-2	11.50 – 12.51	Band 11
Band 7	30 m SWIR-2	2.064 - 2.345	30 m SWIR-2	2.107 - 2.294	Band 7
Band 8	15 m Pan	0.515 - 0.896	15 m Pan	0.503 - 0.676	Band 8
			30 m Cirrus	1.363 - 1.384	Band 9

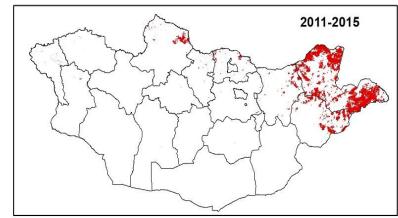
Nº	Near the Shiliin Bogd mountain, Dariganga soum, Sukhbaatar province	Bayan-Uul, Bayandun soums, Dornod province
1	2021.04.0 5	2020.04.11
2	2021.04.20	2020.04.16
3	2021.05.05	2020.04.23
4	2021.05.15	2020.05.01
5	2021.07.19	2020.05.08
6	2021.08.18	2020.06.20
7	2021.09.17	2020.07.22
8	2021.09.27	2020.08.21

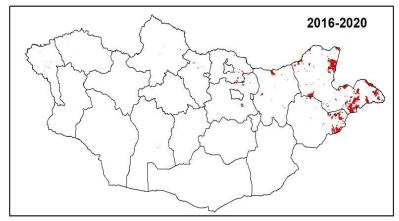
## **WILDFIRE DETECTION**

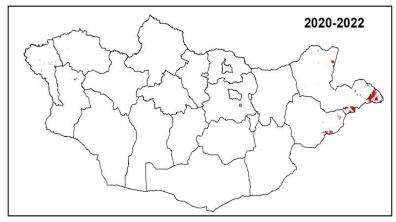












Detected Wildfires in Mongolia on each 5 years between 2001 and 2022

Satellite data source: MOD64A1

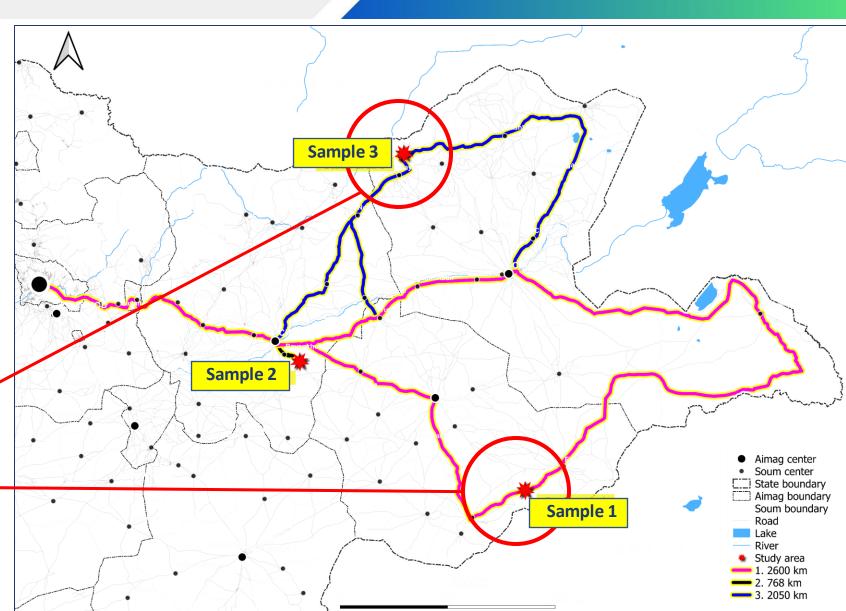
## FIELD VISIT STUDY - SAMPLING



Field trips were made by three times to Eastern Mongolia.

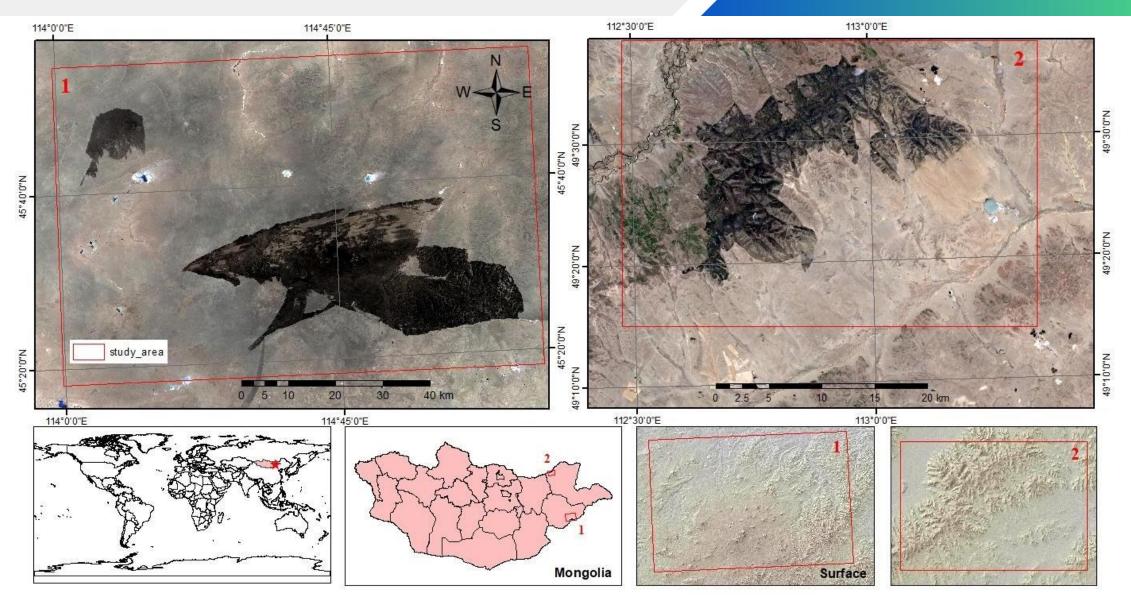
We selected 2 areas where there were wildfires and conducted research.

- 1. Bayandun and Bayan-Uul soums of Dornod province
- 2. Dariganga soum of Sukhbaatar province



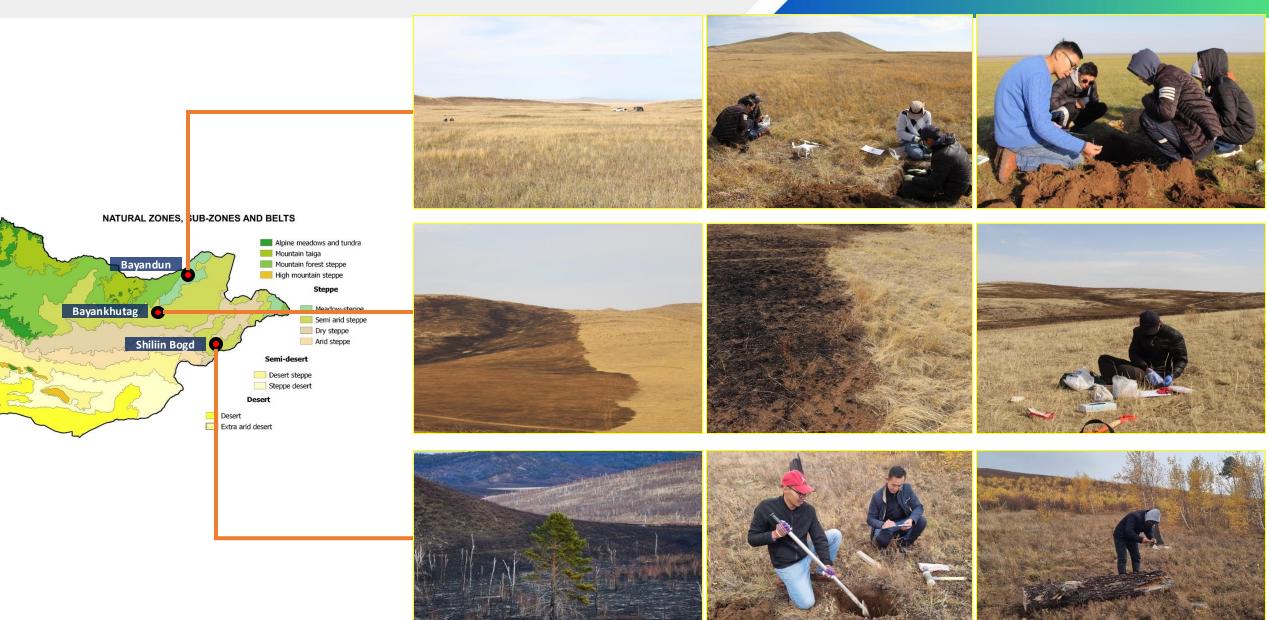
## **SAMPLED WILDFIRE AREA**





# FIELD WORK - SAMPLING (BIOGENIC VOLATILE)





#### SOIL SURVEY RELATED TO IMPACT OF WILDFIRE







Parameter		San	iple 1			San	nple 2	
S	Mean	Max	Min	StDev	Mean	Max	Min	StDev
рН	7.32	7.92	6.78	0.31	7.33	7.90	6.87	0.25
CaCO <sub>3</sub>	2.98	22.90	0.00	6.93	1.49	14.54	0.00	3.71
SOM	2.63	4.56	1.47	0.79	2.57	3.38	1.43	0.50
EC	0.09	0.16	0.05	0.04	0.07	0.14	0.01	0.03
$P_2O_5$	2.11	3.27	1.18	0.58	1.44	3.20	0.70	0.57
K <sub>2</sub> O	32.39	123.2 0	7.83	30.69	31.52	114.55	8.55	29.96
Sand	49.56	62.87	36.54	8.52	51.60	61.85	38.15	5.89
Silt	38.58	49.61	27.37	7.82	36.48	48.29	26.04	5.47
Clay	11.86	13.86	9.76	1.23	11.92	13.57	10.50	0.84







The post-fire related field researches were conducted on September 12-13, 2022 and September 17-20, 2022. The aim of this research is to define the post-fire effects on soil chemistry and physical properties, investigating the effect of heat on the soil layer during ignition and burning of organic combustible (yellow grass) and studying the changes in soil nutrients (Microbial biomass, N, C/N) due to repeated exposure to fire.

# WILDFIRE IMPACT ON THE SOIL CHEMICAL PROPERTIES



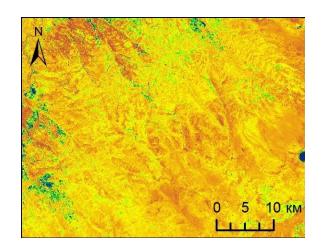
Location	Vegetation	Soil type	Post fire sampling date	Fire severity	Measured properties	Observed change in the soil	
					Soil PH		
					Salt		
					Conductivity	Increased	
					Ca+Mg	ilicieaseu	
Bayankhutag	Congeners, variegated		2 years		Calcium		
soum, Khentii	grass-	Kastanozems	post-fire	Low	Kali		
province	congeners				Calcium carbonate	No Change	
					Humus		
					Magnesium	Decreased	
					Phosphorous		

## **WILDFIRE SEVERITY ANALYSIS**

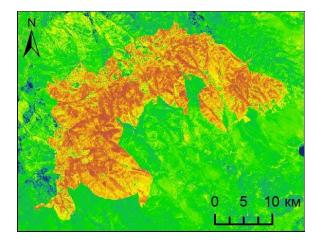


Index	Formula using different bands	Investigating purpose of index
NBR	$(NIR-SWIR_2)/(NIR+SWIR_2)$	Normalized Burn Ratio
dNBR	NBRpre-fire-NBRpost-fire	Burn severity
RBR	$RBR = \frac{(dNBR)}{\left(NBR_{pre-fire} + 1.001\right)}$	Relativized Burn Ratio
NDVI	(NIR-R)/(NIR+R)	Vegetation condition

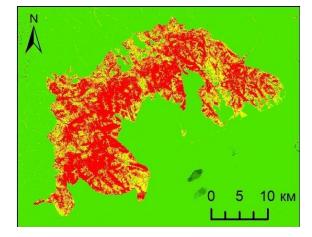
dNBR	Severity Level
< -0.25	Enhanced regrowth, high(post-fire)
-0.250.1	Enhanced regrowth, low(post-fire)
- 0.1- +0.1	Unburned
0.1-0.27	Low severity
0.27-0.44	Moderate-low severity
0.44-0.66	Moderate-high severity
> 0.66	High severity



Normalized Burn Ratio /pre/



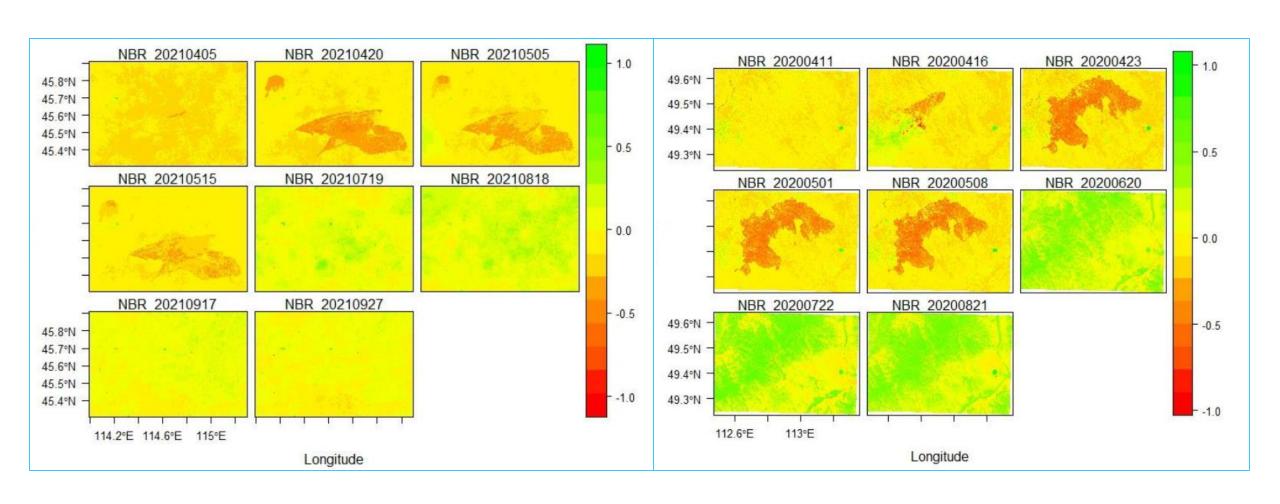
Normalized Burn Ratio /post/



classification of the dNBR

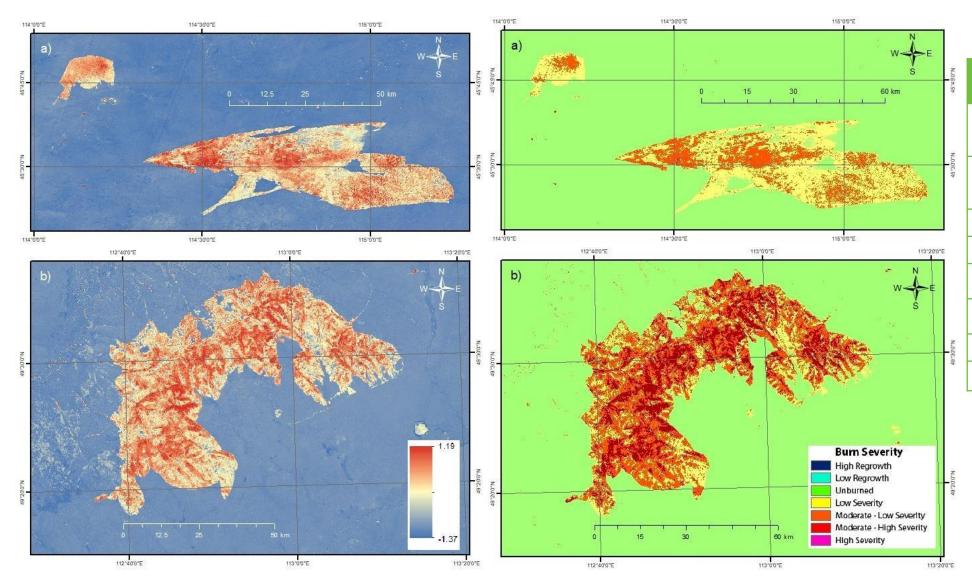
#### **WILDFIRE SEVERITY ANALYSIS**





## **WILDFIRE SEVERITY ANALYSIS**

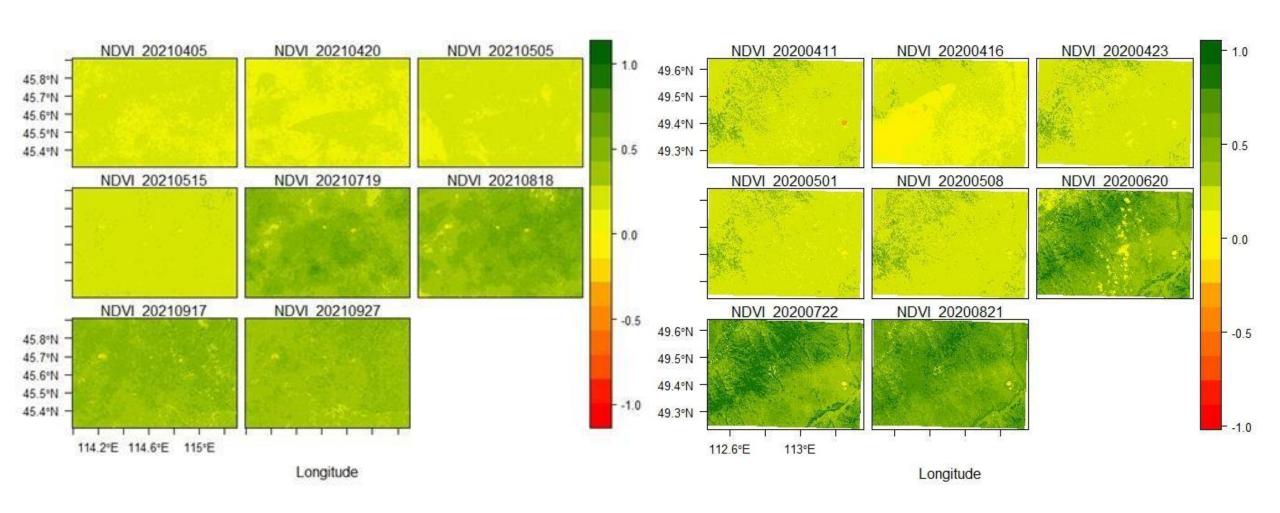




Severity Level	Sample 1 Area (ha)	Sample 2 Area (ha)
Enhanced	_	_
regrowth, high		
(post-fire)		
Enhanced	_	_
regrowth, low		
(post-fire)		
Unburned	5715400	102689.4
Low severity	757340	15423.7
Moderate-low severity	404570	29529.4
Moderate-high	2360	13160.2
severity		13100.2
High severity	-	18.3
Total area burned	1164270	58131.6

#### **WILDFIRE RECOVERY ANALYSIS**





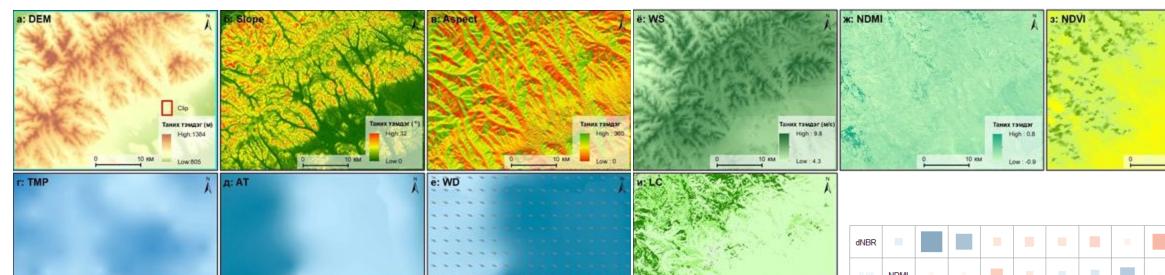
# DIFFERENCES OF PRE-WILDFIRE AND RECOVERED POST-WILDFIRE





## **INFLUENCING FACTORS ANALYSIS**





Tanux тэмдэг

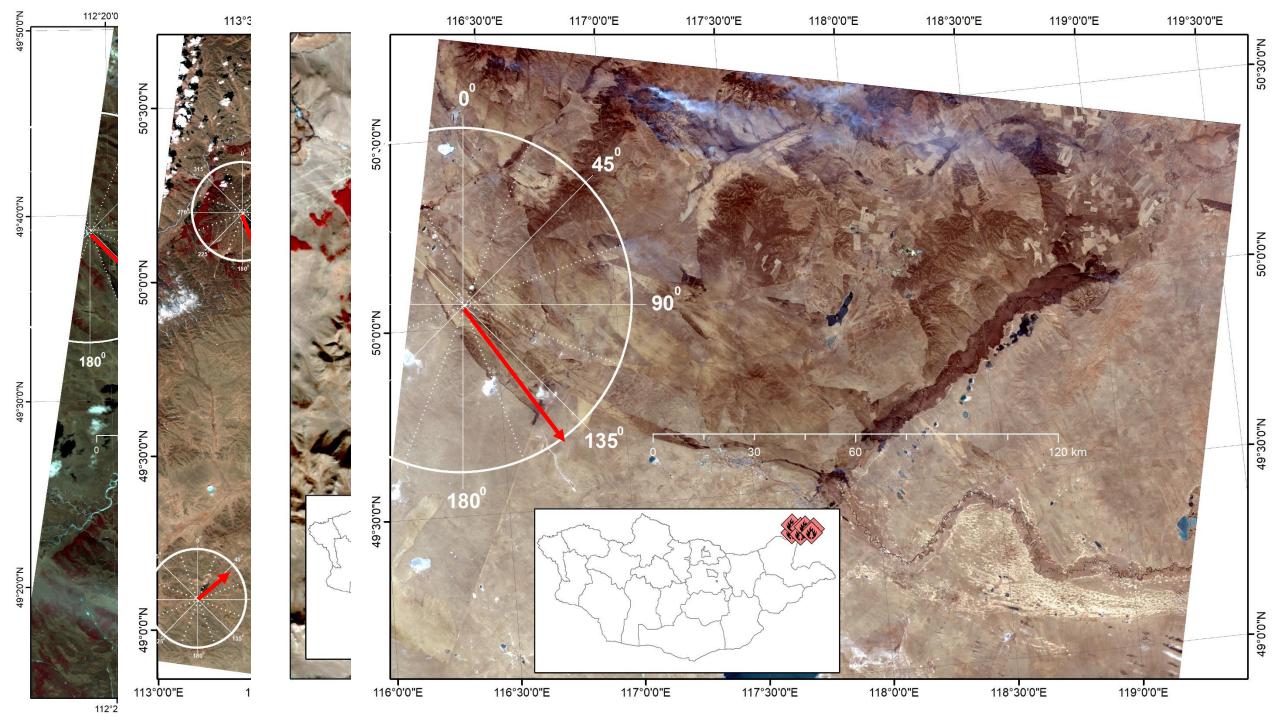
Oli

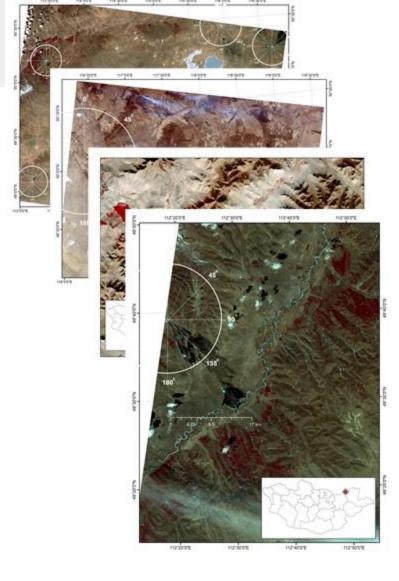
Syr ceer
San-asp

10 км

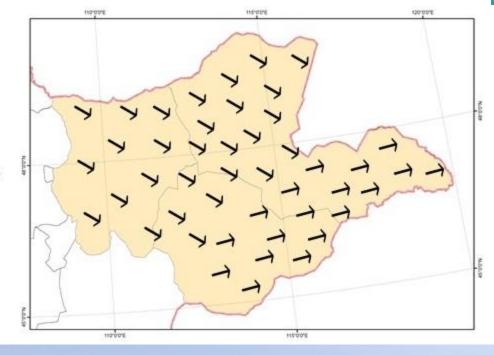
				statistics				
Nº	Category	Index	Abbreviation	Minimum	Maximum	Mean 1021.3 6.6 166 7.2 4.2 339.3 6.8 -0.2	StD	
1	Lond	Elevation (m)	DEM	804.6	1383.7	1021.3	120.4	
2	Land surface	Slope(°)	Slope	0	32	6.6	4.9	
3	Surface	Aspect (°)	Aspect	0	360	166	99	
4		Total monthly precipitation (mm)	TMP	4.3	15.4	7.2	1.4	
5		Average air temperature (C°)	AT	4.1	4.4	4.2	0.1	
6	Climanta	Wind direction	WD	338.4	339.9	339.3	0.5	
7	Climate	Wind speed (m/s)	WS	4.3	9.8	6.8	0.8	
8		Normalized Difference Moisture Index- NDMI	NDMI	-0.8	0.9	-0.2	0.05	
9	Vegetation	Normalized Difference Vegetation Index- NDVI	NDVI	0.05	0.9	0.2	0.06	
10	_	Landcover	LC	Foi	rest, pasture,	shrub, cro	р	

dNBR											
0.05	NDMI				-						
0.40	-0.02	NDVI			-						-
0.23	-0.01	0.40	Elevation								-
-0.05	-0.12	0.05	0.30	Slope							-
	-0.04	0.00	0.07	0.05	Aspect						-
	0.04	-0.34	-0.21	-0.08	-0.06	WD					-
	0.06	-0.38	-0.27	-0.10	-0.07	0.98	WS				-
	0.18	0.32	0.40	0.13	0.04	-0.16	-0.19	LC			_
-0.22	-0.01	-0.28	-0.30	-0.01	0.04	-0.05	0.00	-0.11	Pre		
	-0.05	0.33	0.20		0.06	-0.99	-0.98	0.16		Temp	





Wind directions are based on sampled wildfires





## **LABORATORY ANALYSIS - FIRE RECOVERY ANALYSIS AND DAMAGES**





After fire

First sampled study area

Spring to Autumn







After fire

Spring to Autumn



Second sampled study area







## **WILDFIRE FIELDWORK ADVENTURES**



Safety traveling and dropping grasses bottom of the car



It was cold in Autumn dry season



After 4 times of fieldwork

- Mongolian wildfire team©









Wetland



Border zone of China and Mongolia



There are no restaurants

# RESULT DISSEMINATION - PUBLISHED SCIENTIFIC JOURNAL



• 1 paper: A journal with a high (Q1, Q2) impacted

Status: Published Sep. 2023

**Journal: Fire 6(10), 373;** 

https://doi.org/10.3390/fire6100373





Article

# Assessment of Burn Severity and Monitoring of the Wildfire Recovery Process in Mongolia

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tensification of climate change around the world, the incidence of natural year by year, and monitoring, forecasting, and detecting evolution using look are important methods for remote sensing. This study aimed to monitor

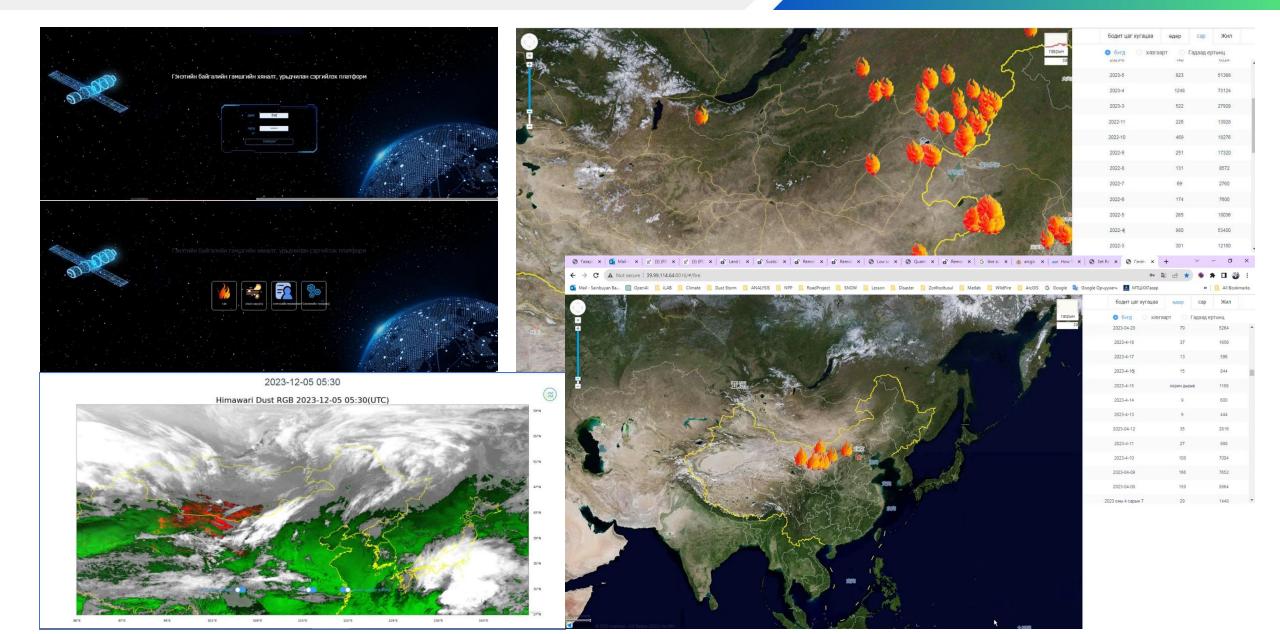
#### **CONCLUSIONS**



- Wildfires are not natural disaster in Mongolia. If human properties are damaged in wildfires, we can call it disaster.
- Mongolian wildfires are increasingly caused by factors related to climate change. However, wildfires in natural zones show interesting phenomena. Site selection was demonstrated in two different natural zones, including forest-steppe and steppe areas. The wildfire severity of the forest-steppe zone was higher than the wildfire severity of the steppe zone. The wildfires in the steppe area were influenced by winds. The winds in this area are stronger than the winds in forest-stepped areas. Therefore, wildfires in the steppe burn at a low intensity.
- In the recovery process, there are no effects on the sites with vegetation growing. The quality of vegetation cover grew back better than it was before the wildfire. However, the cover percentage is lighter than before the wildfire. Only tree bark and skin are affected by wildfire in forest-steppe areas. Therefore, wildfire damage is estimated to be low after the recovery process. Nature is cleaning itself.
- Finally, our wildfire research projects have been completed on NUM successfully. The research is still continuing.

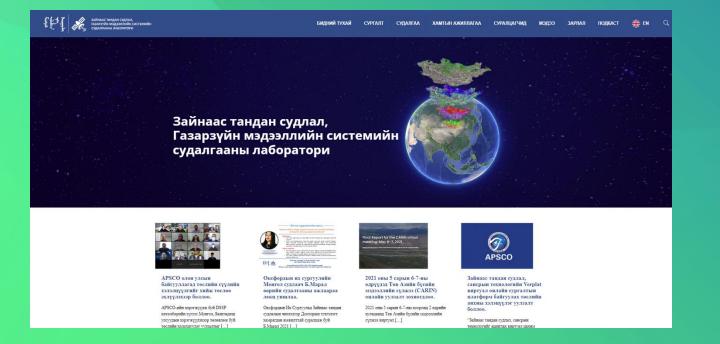
# Wildfire and yellow dust platform is developing for next







# Thank you for your kind attention.



#### Contact us:

Website: <a href="http://geo.num.edu.mn/ilab">http://geo.num.edu.mn/ilab</a>

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