Weather Modification Activities in Mongolia

National Agency for Meteorology and Environmental Monitoring (NAMEM)

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Introduction to Weather Modification

Mongolia's pioneering efforts in weather modification began in 1989 with a joint Soviet-Mongolian expedition utilizing an IL-18 'Cyclone' aircraft as a meteorological laboratory. Over the following decade, field studies and operational activities focused on enhancing precipitation and protecting crops from hail through cloud seeding techniques.

Key milestones include:

- The establishment of the 'Rain Enrichment' Center in 2002, which was later integrated into the National Agency for Meteorology and Environmental Monitoring (NAMEM).
- The launch of a network of mobile expeditions in 2007 to expand weather modification operations across the country.

As of 2023, Mongolia's weather modification program comprises 45 operational expeditions equipped with 38 ground-based generators, demonstrating significant progress in its capabilities."

Introduction to Weather Modification

Aircraft IL-18 was used for cloud study in 1990 and 1991.

Aircraft YAK-40 in 1989.

Reagent (AgI) fixed with aircraft.

A joint Soviet-Mongolian expedition, conducted between 1989 and 1991, investigated cloud formation and properties over Mongolian territory. The goal was to explore the potential for weather modification through cloud seeding. Silver iodide (AgI) was used as a reagent to influence precipitation patterns.

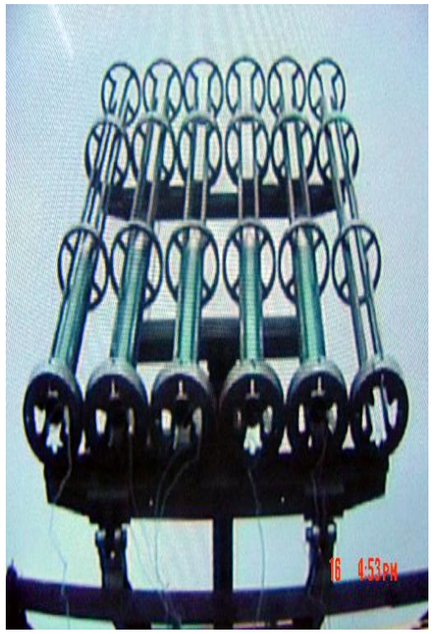
MAJOR ACTIVITIES OF WEATHER MODIFICATION

Hail Suppression Operations between 1991-2002

Hail suppression efforts were conducted in various regions of Mongolia between 1991 and 2002, targeting 97,736 hectares of grain fields. Notable locations included Kharkhorin in Övörkhangai province (1991-2002), Khotont and Tövshrüüleh soums in Arkhangai province (1993-1996), Ugtaaltsaidam soum in Töv province (1996-1998), and nine sites in the Orkhon River valley. Of the 136 hail-producing clouds treated, 98.6% were successfully suppressed, leading to crop loss reductions ranging from 82.5% to 100%.

37 mm artillery

Precipitation Enhancement Process



JFJ-1 model missiles and their associated launching devices used between 1996 and 2003

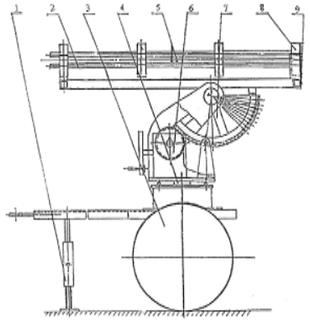
RYI-6300 model rain-inducing rockets were used in Tuv and Ömnögovi provinces in 2006-2007

A National Emergency Commission directive in 1991 and 1996 led to significant contributions towards suppressing widespread forest and steppe fires across several Mongolian provinces. The intervention is estimated to have had a substantial impact, contributing to the extinguishment of 50-60% of identified fire hotspots.

Technique And Technology Used For Weather Modification

JFJ-3 model rocket launcher

No.	Specification	Missile Type	JFJ-1A
1	Total length of the missile	mm	624 ± 3
2	Missile weight	kg	1.16 ± 0.15
3	Cross-section	mm	-44
4	Detonation altitude Reflection (85°)	km	3.8 ± 0.2
5	Explosive substance (TNT)	g	120 ± 5
6	Reagent (AgI)	g	3.0 ± 0.1
7	Condensation nucleus, particle speed		4.5 * 10^9
8	Relevant altitude		550~850
9	Storage temperature, duration	°C, years	0...+40, 3
10	Ambient temperature, °C (operating temperature)	°C	-10~+50



3.2- р зураг. RYI-6300 пуужин харвах төхөөрөмжийн хийц.
1-Чиргүүл, түүний гарны тулгуур; 2- пуужин чиглүүлэгч хоолойн савх; 3- чиргүүлийн дугуй; 4-чиглүүлэгч хоолойг хэвтээ өнцгөөр эргүүлэх босоо гол; 5-тэжээлийн утасны тегстелийн авалцуур (контакт)-ын товруу; 6- чиглүүлэгч хоолойн хэвтээ өнцгийг өөрчлөх бариул; 7- чиглүүлэгч хоолойн босоо өнцгийг тохируулах хуваарийн нүх бүхий хэвтээ гол; 8- чиглүүлэгч хоолойн цапраг; 9-пультээс ирэх тэжээлийн утас залгах залгуур.

RYI-6300 model rocket launcher

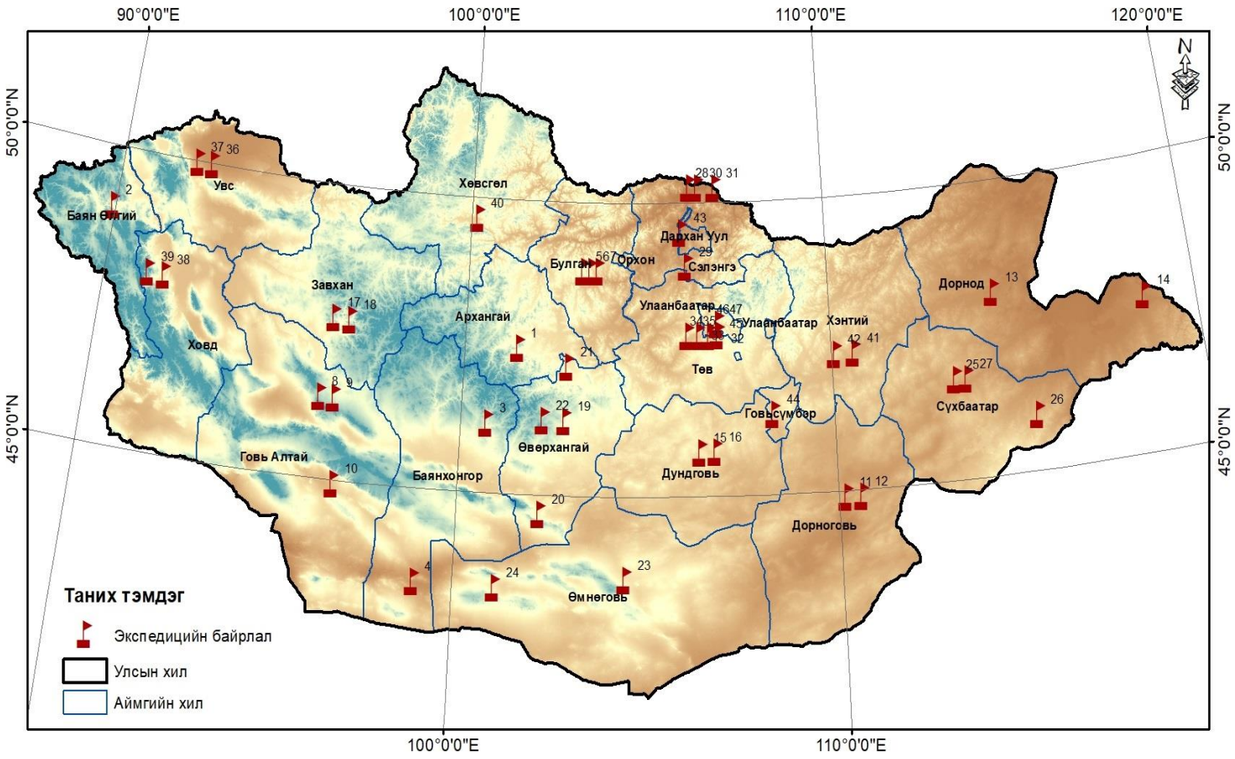
No.	Specification	Missile Type	RY1-6300
1	Total length of the missile	mm	1350
2	Missile weight	kg	5.45
3	Cross-section	mm	-66
4	Detonation altitude Reflection (85°)		6.3
5	Explosive substance (TNT)	g	120 ± 5
6	Reagent (AgI)	g	10
7	Condensation nucleus, particle speed		1.03 * 10^15
8	Relevant altitude		550~850
9	Storage duration	years	3
10	Ambient temperature, °C (operating temperature)	°C	-30~+45
11	Storage temperature	°C	-40~+50

Technique And Technology Used For Weather Modification

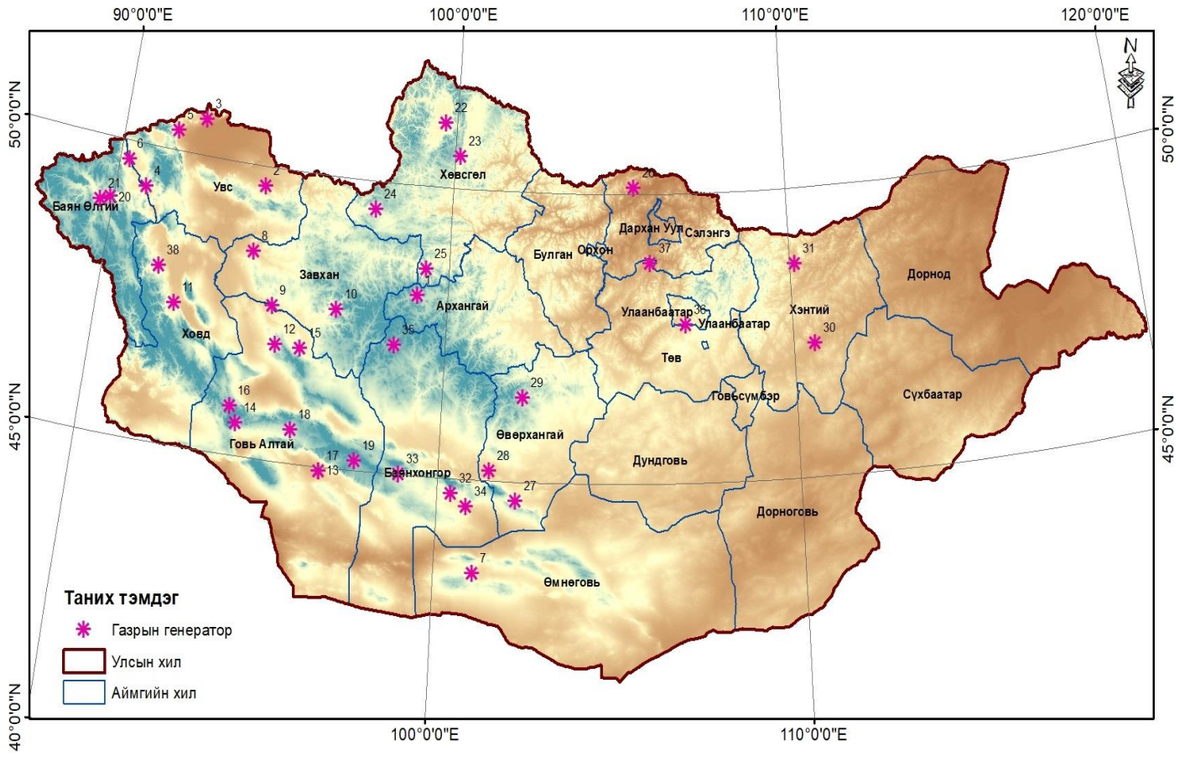
RYG-1 Model Igniting Furnace

Specification	Value	Units
Total length of the igniting reagent	398	mm
Diameter of the igniting reagent	46.0	mm
Total weight of the igniting reagent	925 ± 20	g
Weight of the igniting substance in the reagent	535 ± 5	g
Silver iodide (AgI) content in the igniting reagent	>10	g
Efficiency of 1 gram of silver iodide (AgI) at -100°C	> 1.03 x 10^15	
Micro-radius of reagent decomposition	0.01-0.05	

Current Condition of the Weather Modification Activities in Mongolia



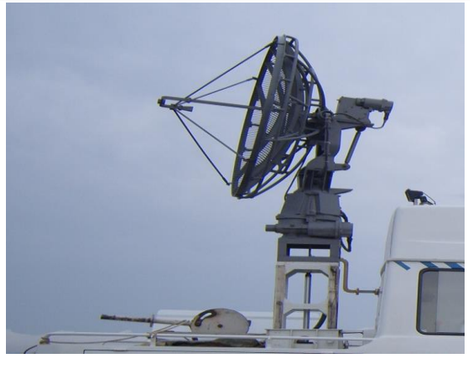
Expedition location



Ground based generator’s location

As of 2023, 45 expedition, 3 of backup equipment, and 38 ground generators are in operational.

Locations of Mobile Radar Stations

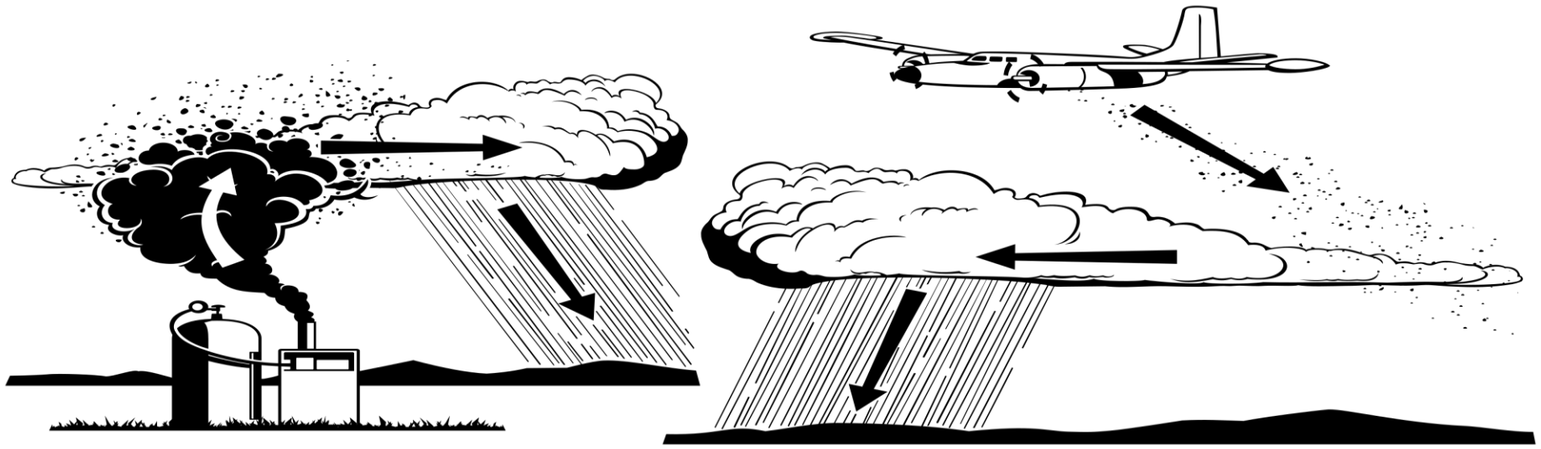


Ulaanbaatar	2007
Khovd	2008
Dalanzadgad	2008
Baruun-Urt	2008
Undurkhaan	2013
Sukhbaatar	2013

MAIN APPLICATIONS OF WEATHER MODIFICATION TECHNOLOGY

Climate change, an unprecedented natural phenomenon, poses significant risks to humanity. Mongolia is particularly vulnerable to the escalating frequency of natural disasters, including droughts, dzuds, pasture degradation, sandstorms, and forest and steppe fires.

Weather modification technologies are emerging as a critical strategy to address these challenges in Mongolia.

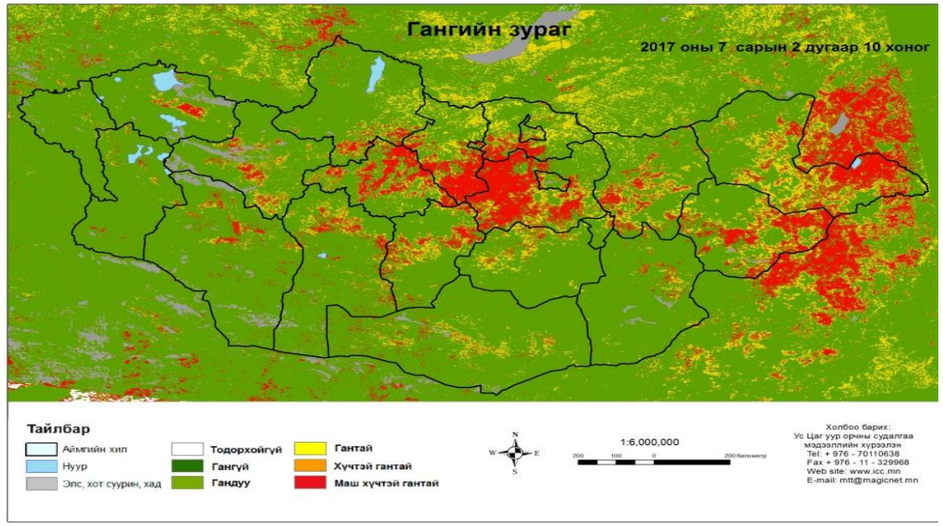


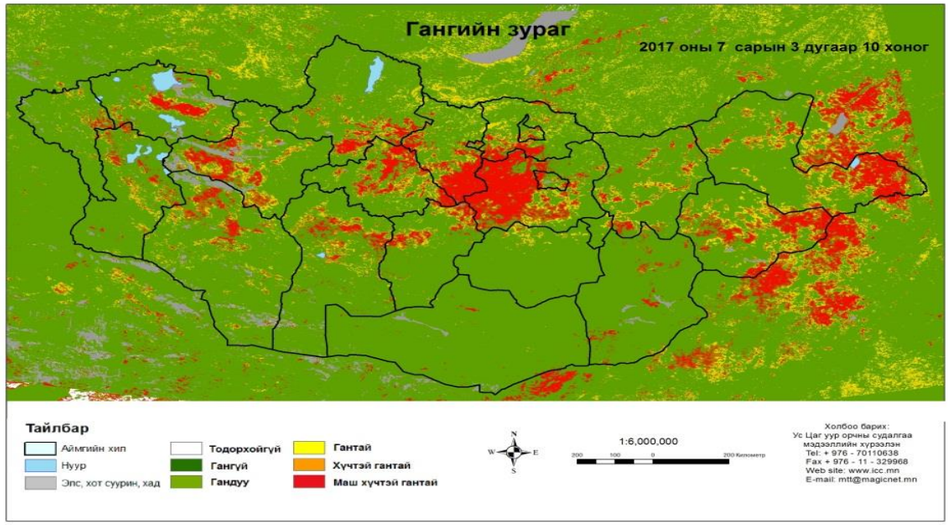
To mitigate the negative impacts of climate change

To support the environmental condition of the region affected by drought and desertification

To increase the yield of cultivated and pasture plants

To provide support for extinguishing forest and field fires





Drought in July of 2017

1

Second-10 days

Mongolia's arid, mountainous terrain, coupled with its landlocked location and a history of overgrazing, makes it highly susceptible to desertification. Since 1940, near-surface air temperatures in Mongolia have risen by 2.3°C, exacerbating this vulnerability.

2

Third-10 days

Desertification in Mongolia has significantly worsened over the past decade. The area affected by severe desertification has increased dramatically. The Gobi Desert, which now covers 41.3% of Mongolia's landmass, has expanded by 3.4% during this period.

- Mongolia faced a severe wildfire crisis in recent years. In 2016, a total of 48 wildfires broke out across the country, affecting 31 soums in 13 provinces. These fires consumed 176,000 hectares of land, resulting in one fatality, eight injuries, and the loss of two homes.
- The following year, the situation worsened. A staggering 138 wildfires were reported across 61 soums in 14 provinces in 2017. These fires ravaged 31,200 hectares of forest and a vast 3.2 million hectares of pastureland. The economic impact was substantial, with property damage estimated at 1.3 billion Mongolian tugrik and environmental losses reaching a staggering 10.7 billion tugrik.
- Experts attribute the majority of these forest fires to human error, estimating that 96% are caused by human carelessness or negligence.

CHALLENGES AND LIMITATIONS

Numerous challenges and obstacles hinder the effective implementation of weather modification technologies in Mongolia.

Technological constraint

- ***Cost:*** Implementing weather modification technologies expensive, particularly for developing nation like Mongolia
- ***Limited technology:*** Current technologies are not sufficiently advanced and reliable to achieve desired weather modification outcomes consistently and efficiently.

  (Robust system for validating precipitation enhancement is urgently required)

Public acceptance

- ***Misconceptions:*** Sometimes there are public misconceptions and fears about weather modification, which hinder its effective implementation.

THANK YOU FOR YOUR ATTENTION!