CURRENT TEXAS WEATHER MODIFICATION *PERMITS*

June 2019

	Type	*No.*	*Effective*	*Expiration*
Panhandle Groundwater Conservation District	R-E	16-1	02-27-16	02-26-20
South Texas Weather Modification Association	R-E	17-1	03-06-17	03-05-21
West Texas Weather Modification Association	R-E, H-S	18-1	04-04-18	04-03-22
Trans-Pecos Weather Modification Association	R-E	18-2	04-16-18	04-15-22
SOAR Program (Rolling Plains)	R-E	18-3	06-16-18	06-15-22
Belding Farms	H-S	19-1	01-21-19	01-20-23

R-E Rain enhancement using cloud-seeding techniques and materials
H-S Hail suppression and rain enhancement using cloud-seeding techniques and materials
H-S Hail suppression *only* using hail-cannons

CURRENT TEXAS WEATHER MODIFICATION *LICENSES*

All licenses valid until September 1, 2019

Belding Farms Inc. (Fort Stockton)

Panhandle Groundwater Conservation District (White Deer)

Seeding Operations & Atmospheric Research (Plains)

South Texas Weather Modification Association (Pleasanton)

Southwest Texas Rain-Enhancement Association (Carrizo Springs)

Trans Pecos Weather Modification Association (Pecos)

West Texas Weather Modification Association (San Angelo)

Total Acreage

RAIN ENHANCEMENT TARGET AREAS IN TEXAS

2019

Project	*Base of Operations*	*Total Acres*
West Texas Weather Modification Association Begun in 1996 (23rd year)	San Angelo	6,608,315
CROCKETT, IRION, REAGAN, SCHLEICHER, STERLING, SUTTON, TOM GREEN COUNTIES		
South Texas Weather Modification Association 1997 (22nd year)	Pleasanton	3,756,059
ATASCOSA, BEE, FRIO, KARNES, MCMULLEN, WILSON COUNTIES		
Trans Pecos Weather Modification Association 2003 (16th year)	Pecos	9,609,271
CULBERSON, JEFF DAVIS, LOVING, PECOS, REEVES, WARD COUNTIES		
Panhandle Groundwater Conservation District 2000 (19th year)	White Deer	3,990,089
Seeding Operations and Atmospheric Research (SOAR) Program 2015 (4th year)	Stamford	2,949,806
FISHER, HASKELL, JONES, MITCHELL, NOLAN COUNTIES		
Edwards Aquifer Authority 1998 (21st year)	San Antonio	3,119,410
BANDERA, BEXAR, MEDINA, UVALDE COUNTIES		
	Total	***30,032,950***

17.7 percent
of Texas' land area

TEXAS RAIN ENHANCEMENT PROJECTS

2019 Directory

Panhandle Groundwater Conservation District
P. O. Box 637
White Deer TX 79097
(806) 883-2501
https://pgcd.us/programs/precipitation_enhancement/

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Weather Modification Association Annual Meeting
24-26 April 2019
Chandler, Arizona

Technical Program Agenda

Wednesday, April 24 – Ocotillo Meeting Room

08:00 AM Registration and Breakfast

08:30 AM Welcome – *Paul Kucera, WMA President*
Frank McDonough, WMA President-Elect

Session 1 – International Programs

08:40 AM **Preliminary Summary of Current Operational Weather Modification Programs Around the World** – *Daniel Breed*

09:00 AM **Rainfall Enhancement in Oman: Results from Fiver Years of Well Instrumented Randomized Field Trials** – *Stephen Beare, Analytecon*

09:20 AM **Assessing the Potential for Rainfall Augmentation in Saudi Arabia**– *Paul Kucera, UCAR/COMET*

09:40 AM **Alberta Hail Suppression Project Research Plans (2019-2020) –** *Bruce Boe, Weather Modification International*

10:00-10:20 AM – Break

Session 2 – Microphysical Observations and Modeling

10:20 AM **Improving the Cloud Seeding Program in Utah** – *Binod Pokharel, Utah Climate Center*

10:40 AM **Research Updates and Highlights from the SNOWIE Project –** *Sarah Tessendorf, NCAR*

11:00 AM **Supercooled Drizzle Drop Development in a Postfrontal Wintertime Layer Cloud from the SNOWIE Campaign –** *Adam Majewski, Univ. of Wyoming*

11:20 AM **Analysis of Radiometer Data for the La Sal Mountains of Southeastern Utah during the 2017-2018 Winter Season** – *Stephanie Beall, North American Weather Consultants*

11:40 AM **Supercooled Liquid Water and Vapor Observations from a Seeding Aircraft Equipped with a Narrow Beam Side Scanning G-Band Radiometer** – *Richard Stone, RHS Consultants*

12:00 AM-01:40 PM – Lunch Break

Session 3 – Aerosols and seeding effects and operational concerns - *Chair, Bruce Boe, Weather Modification International*

01:40 PM **Evaluation of the Cloud Seeding Suspension Criteria in the State of Utah** – *Krishna Khatri, Utah Division of Water Resources*

02:00 PM **An Experiment Designed to Test Ice Nucleation of Silver Iodide Seeding Flares using the Pi Cloud Chamber** – *David Delene, Dept. of Atmospheric Resources, University of North Dakota*

02:20 PM **Estimations of Downwind Cloud Seeding Effects on Utah** – *David Yorty, North American Weather Consultants*

02:40 PM **An Overview of the Impacts Human Activities Might have on Weather and Climate** – *T.P. DeFelice, University of Colorado*

03:00 – 03:20 PM – Break

Session 4 –

03:20 PM **A Hexcontagonal History of Sierra Snowflakes** – *Jesse Juchtzer,*

Desert Research Institute

03:40 PM **A Look at the Upper American River Basin Cloud Seeding Program** – *Todd Flanagan, North American Weather Consultants*

04:00 PM **Climatology of Favorable Conditions for Ground Based Cloud Seeding in the Wind River Range** – *Thomas Mazzetti, University of Wyoming*

04:20 PM **Airborne Seeding Operations in Wyoming and Colorado** – *Bruce Boe, Weather Modification International*

Thursday, April 25– Ocotillo Meeting Room

08:00 AM Registration and Breakfast

Session 5 – Operational Decision Making Tools and Electrically Charged Droplets

08:30 AM **TITAN and LROSE – Keeping the Software Alive, Available and Supported –** *Michael Dixon, NCAR*

09:00 AM **In-cockpit Radar Data for Decision Support in Operational Seeding –** *Farren Hiscutt, Electronic Systems Development and Roelof Burger North-West University*

09:20 AM **Cloud Seeding using Electrically Charged Water Droplets: Part 1: A New Conceptual Model for and Old Paradigm** – *Jonathan Jennings and Craig Funke, Texas Weather Modification Association*

09:40 AM **Cloud Seeding using Electrically Charged Water Droplets: Part 2: How to Charge Water Droplets** – *Arquimedes Ruiz-Columbie, Active Influence and Scientific Management*

10:00 AM **Cloud Seeding using Electrically Charged Water Droplets: Part 3: Operational Implementation and Preliminary Results** – *Daniel Martin, USDA*

10:20-10:40 AM – Break

Session 6 – Economics, Impacts and new Equipment

10:40 AM **An analysis of Economic Impacts of Cloud Seeding in North Dakota** – *Darin Langerud, North Dakota Atmospheric Resource Board*

11:00 AM **Effects of Climate Change on Agriculture and Opportunities for Weather Modification** – *Angela Wood, University of Vermont*

11:20 AM **On the Environmental Toxicity of Cloud Seeding Agents used during**

Weather Modification Operations – *T.P. DeFelice, University of Colorado*

11:40 AM **Conversion of Aircraft for Cloud Seeding, Cloud Physics, and Atmospheric Research** – *Neil Brackin, Weather Modification International*

12:00-1:30 PM – Lunch Break

1:30-5:00 PM Tour to the Granite Reef Dam, presentations from Salt River Project and Central Arizona Project personnel. Bus leaves hotel at 1:30 PM

6:00-7:00 PM WMA Social / NAWMC Silent Auction

7:00-9:00 PM WMA Annual Awards Banquet

Friday, April 26– Ocotillo Meeting Room

9:00-10:30 WMA Business Meeting

Country	State/Area	Objective	Size of area (km^2)	Delivery system
Russia	Northern Caucasus, Krasnoder district, Armenia	Hail suppression	~20,000	Rockets
Iran	Yazd region	Precipitation Enhancement	250	Aircraft, drones beginning 2017
UAE	Abu Dhabi desert	Precipitation Enhancement		Aircraft
India	Maharashtra	Precipitation Enhancement	1600	Aircraft
India	Karnataka	Precipitation Enhancement		Aircraft
India	Andra Pradesh (CAIPEEX)	Precipitation Enhancement		Aircraft
Malaysia		Precipitation Enhancement		Aircraft
Thailand	drought areas	Precipitation Enhancement	2500-3500	Aircraft (43)
Philippines	several provinces	Precipitation Enhancement		
Philippines	(PAGASA)	Precipitation Enhancement		Aircraft
Indonesia	(BPPT)	Precipitation Enhancement		Aircraft
South Korea		Precipitation Enhancement		Aircraft
China	Tibetan plateau	Precipitation Enhancement	~1.6M	Ground-based chambers, rockets, aircraft, drones
China	Beijing	Precipitation Enhancement		Aircraft
China	Shanxi	Precipitation Enhancement		Aircraft
China	Hebei	Precipitation Enhancement	~1.6M	Aircraft
Japan	Yagisawa Dam	Precipitation Enhancement		Aircraft
Germany	Hagelabwehr region	Hail suppression	2500	Aircraft
Germany	Rosenheim Anti-hail Program	Hail suppression	4800	Aircraft
France		Hail suppression		Ground-based generators
Spain	Saragoza	Hail suppression?		Ground-based generators

Austria	Styria	Hail suppression	~2000	Airraft
Austria	Langelois & Krems area	Hail suppression	500	Aircraft
Slovenia	Northeastern	Hail suppression	3000	Aircraft
Hungary	Baranya,Semogy,Tolna	Hail suppression	13000	Ground-based rockets
Bulgaria	Northern Danube Plain	Hail suppression	17000	?
Bulgaria	southern Bulgaria	Hail suppression	~2000	Aircraft
Greece	northwestern Greece	Hail suppression	~5000	Aircraft
Indonesia	Eight rice-producing provices	Precipitation Enhancement		Aircraft
Jordan	King Talal Reservoir	Precipitation Enhancement		Aircraft
Isreal	northern Isreal	Precipitation Enhancement	5000	Aircraft, ground-based generators
Libya		Precipitation Enhancement		Aircraft
Morocco	Atlas mts	Snowpack Enhancement	14300-16400	Aircraft, ground-based generators
Morocco	Programme Al-Ghait	Precipitation Enhancement		Aircraft
Mali		Precipitation Enhancement		Aircraft
Chad		Precipitation Enhancement		Aircraft
Burkina Faso	central Burkina Faso	Precipitation Enhancement	15000	Aircraft
Souith Africa	Cape	Precipitation Enhancement		Aircraft
Senegal	SENREP	Precipitation Enhancement		Aircraft
Argentina	Mendoza	Hail suppression		Aircraft
Argentina	Jujuy	Hail suppression		Rockets
Chile		Precipitation Enhancement		Ground-based generators
Peru				
Australia	Snowy mts	Snowpack Enhancement	2110	Ground-based generators
Canada	Calgary	Hail suppression		Aircraft

USA

California	Santa Barbara Project	Precipitation Enhancement	1295	Ground-based generators
California	Kings River Project	Snowpack Enhancement	5760	Ground-based generators
California	Upper American River	Snowpack Enhancement	490	?
Utah	Northern Projects area	Snowpack Enhancement	3240	Ground-based generators
Utah	Central/Southern Projects area	Snowpack Enhancement	25900	Ground-based generators
Utah	West Unitas Project area	Snowpack Enhancement	1550	Ground-based generators
Utah	Unita Mountains Project area	Snowpack Enhancement	2600	Ground-based generators
Utah	Wasatch Plateau	Snowpack Enhancement		Ground-based
Colorado	Gunnison Basin	Snowpack Enhancement	8070	Ground-based generators
Colorado	Central Colorado Rocky Mountains Program	Snowpack Enhancement		Ground-based generators
Colorado	Vail and Upper Arkansas Program	Snowpack Enhancement	704	Ground-based generators
Colorado	Grand Mesa	Snowpack Enhancement	2251	Ground-based generators
Colorado	Western San Juan Mountains Program	Snowpack Enhancement	2686	Ground-based generators
Colorado	Eastern San Juan Mountains Program	Snowpack Enhancement	2849	Ground-based generators
Nevada	Ruby Mountains	Snowpack Enhancement		Ground-based generators
Nevada	Santa Rosa Mountains	Snowpack Enhancement		Ground-based generators
Nevada	Spring Mountains	Snowpack Enhancement		Ground-based generators, aircraft
Nevada	Tahoe-Truckee Basins	Snowpack Enhancement		Ground-based generators
Nevada	Walker Basin	Snowpack Enhancement		Aircraft
Idaho	Central Mountain	Snowpack Enhancement	11810	Ground-based generators, aircraft
Idaho	HighCountry RCID	Snowpack Enhancement	17,100	Ground-based generators, aircraft

Texas	West Texas	Precipitation Enhancement	25,900	Aircraft
Texas	South Texas	Precipitation Enhancement	26,700	Aircraft
Texas	Edwards Aquifer	Precipitation Enhancement		Aircraft
Texas	Panhandle Groundwater	Precipitation Enhancement	33,100	Aircraft
Texas	Trans Pecos	Precipitation Enhancement	20,600	Aircraft
Texas	Colorado District Municipal Water District	Precipitation Enhancement	10500	Aircraft
Texas	Southern Ogallala Aquifer Rain Program	Precipitation Enhancement	23500	Aircraft
North Dakota	North Dakota Cloud Modification Project	Precipitation Enhancement, Hail Supression		Aircraft
Wyoming	Wind River Range	Snowpack Enhancement		Ground-based generators
Wyoming	Medicine Bow Mountains	Snowpack Enhancement		Aircraft

Seeding material	Year start operation	Reference/Source	Issues
AgI, liquid N_2, cement powder	1960 with interruptions	Map, WMO Conference papers	
AgI	2008	Map	
Hygroscopic flares	2001 with interruptions	Map, Conference papers	hardware problems
Hygroscopic flares	1973	Map, WMI?	
AgI and Hygroscopic flares		PC (Axisa)	intermittent program
Salt		Map, PC-Hiscutt, Axisa, WMI	
		PC (Axisa)	
Brine solution, salt?			C-130 brine; Cessna 340 being leased
Salt and hygroscopic flares	1969, 1995	Map, PC-Hiscutt, Axisa	15 radars, large well-run program
	2010	Map	
Salt		PC (Axisa)	limited capability aircraft
Salt, hygroscopic flares?		PC (Axisa)	CASA 212-200, Piper Cheyenne II
Hygroscopic flares		PC (Axisa)	
		Map	experimentation
	2017		
AgI		PC (Axisa)	
AgI		PC (Axisa)	
AgI		PC (Axisa)	
	2017		
Dry Ice, Salt, Hygroscopic Flares		Conference papers	
AgI	1979	Map	
AgI		Map	
	1975		
AgI		PC (Hiscutt)	
AgI		PC (Hiscutt)	

AgI	1985	Map	
AgI	1970's	Map	
AgI	(1971-2016) 2016	Map	
AgI	1991	Map	
?	1968	Map	
AgI	1990, 2019	Map, NWU	new program starting
AgI	1984	Map, PC (Hiscutt)	new contract, well-run program
Salt and hygroscopic flares	2005	Map PC (Hiscutt)	still active?
Hygroscopic flares	2016	Map	still active?
AgI	1960-1975, 1975	Map, refereed papers	on hold (politics, unstable country)
AgI	1984	Map	still active?
AgI	2002	WMI	still active?
Hygroscopic flares	2010	Map, PC (Hiscutt, WMI?)	not well-run, no useful radars, use satellite for directing aircraft
AgI		PC (Hiscutt)	damaged aircraft, no currrent operations
AgI	2001	Map	probably not active
AgI, hygroscopic?		PC (Hiscutt)	Considering program for drought
AgI	2005	Map	probably not active
AgI	1998	Map	
AgI		PC (Hiscutt)	considering upgraded technology: aircraft, radar
AgI		PC (Hiscutt)	
AgI	1950s, 2005	WMI? Map, refereed papers	active?
AgI		WMA	

AgI		NAWC
AgI		WMA
AgI		WMA
AgI	1989 with interruptions	Utah Division of Water Resources
AgI	1974 with interruptions	Utah Division of Water Resources
AgI	1989 with interruptions	Utah Division of Water Resources
AgI	1975-1987, 2003	Utah Division of Water Resources
propane		Utah Division of Water Resources
AgI	2002	Map, CWCB report (Oct 2015)
AgI	2002; 2012 expansion	CWRB permit
AgI	1976	CWRB permit
AgI	late 1970's	CWRB permit
AgI	1999	CWRB permit
AgI	2001	CWRB permit
AgI		DRI website
AgI		DRI website
AgI		DRI website
AgI		DRI website
AgI		DRI website
AgI		Map, reports and refereed papers
AgI	2003	Map, reports
AgI	2008	

		Texas Cloud Seeding website
AgI	1995	
		Texas Cloud Seeding website
AgI, hygroscopic?	1996	
		Texas Cloud Seeding website
AgI	1999	
		Texas Cloud Seeding website
AgI	2000	
		Texas Cloud Seeding website
AgI	2003	
		Texas Cloud Seeding website
AgI	1971	
		Texas Cloud Seeding website
AgI	2002	
		http://www.swc.nd.gov/arb/ndcmp/
AgI	1950's	
		WWDC website
AgI	2014	
		WWDC website
AgI	2018	

Map-etc group/Heinrich,Boll,Stiftung https://map.geoengineeringmonitor.org/

PC - personal communication

Iran to carry out cloud seeding project by drones in weeks

December 6, 2018 Society

TEHRAN – A cloud seeding project will be carried out within the next few weeks in some provinces of the country using planes and drones in cooperation with the Islamic Revolutionary Guard Corps Aerospace Force (IRGC AF), Farid Golkar, head of Iran's National Cloud Seeding Research Center has announced.

Top

Cloud seeding, a form of weather modification, is a method to change the amount or even type of precipitation. Rainfall occurs when super cooled droplets of water – those that are still liquid but are at a temperature below the usual freezing point of zero centigrade – form

ice crystals. Now too heavy to remain suspend in the air, these then fall, often melting on their way down to form rain.

Even in dry areas the air usually contains some water. This can be made to come together and form ice crystals by seeding the atmosphere with chemicals such as silver iodide or dry ice. They work to promote rainfall by inducing nucleation – what little water is in the air condenses around the newly introduced particles and crystallizes to form ice. The 'seeds' can be delivered by plane or simply by spraying from the ground.

Last year, due to lack of funds along with equipment preparation problems, the cloud seeding plan has not been performed, he said, adding this year, despite the shortcomings, it will begin, while must have been performed earlier in November, Golkar said.

After signing a memorandum of cooperation with the IRGC Aerospace Force and Ministry of Energy, the cloud seeding project will be launched across the country, he added, IRNA reported on Wednesday.

Due to limited budget and inaccessibility of appropriate seeding materials as well as some of the equipment and aircraft required, the IRGC AF proposed to carry out the plan using their planes.

He further explained that some seeding equipment have been produced domestically with our expert's great efforts, however, construction of some airborne sensors and other atmospheric equipment and parameters due to its complexity and high cost, as well as being time-consuming, is not economically profitable and we decided to purchase and import them from China, South Africa, Russia, the United Kingdom, India or Australia, which is hoped to gain importing permissions.

Due to the different flight conditions, such as high altitude restrictions and atmospheric conditions, aircraft's structure, and different seed delivery methods, cloud seeding in some provinces will be conducted for the first time by a drone, he stated.

Golkar went on to add that after result evaluation and pilot operations, the method will undergo necessary reforms and drones will pave the way for the cloud seeding developments.

Initially, the operations will be performed by planes in the provinces of Fars, Chaharmahal and Bakhtiari, Isfahan, Kohgiluyeh and Boyer-Ahmad, Kerman and Yazd, he noted, adding drones will be flown for cloud seeding in the provinces of South Khorasan, East and West Azarbaijan.

Top

Despite preparations and pilot operations, we are still waiting for the issuance of flight permits and administrative measures, such as the signing of MOU between the Ministry of Energy and the Aerospace Corps, he further stated.

Referring to social reactions and rumors about the harmfulness of this method, he highlighted that cloud seeding technique has been confirmed by valid scientific institutes such as the World Meteorological Organization and is performed based on climatic conditions in accordance with climate characteristic of an area, so using weather surveillance radars is rather beneficial, which has no adverse effects on air quality.

Pointing to the development of technology for extracting water from atmospheric resources in over 60 countries worldwide, Golkar noted that there is a great potential in this regard to compensate for water shortages and producing a renewable water resource.

Cloud seeding projects have been practiced in Iran over the past 20 years, targeting some provinces in central, western, northwestern and northern part of the country, namely, Gilan, Zanjan, West Azarbaijan and Kermanshah, Yazd, Chahar-Mahal and Bakhtiari, Kohgiluyeh and Boyer-Ahmad, Golkar stated.

Employing this technique appropriately can lead to increased precipitation by 15-20 percent per season, he also added.

Earlier in January, IRGC Aerospace Force Commander Amirali Hajizadeh expressed readiness to dispatch four aircrafts and some forces to help the Energy Ministry to carry out cloud seeding operations.

FB/MQ/MG

RELATED NEWS

Precipitations above normal level in first month of autumn

Will cloud seeding cause a blast of moisture in drought-stricken areas?

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Iran's Rescue and Relief Organization to be equipped with drones

IRGC has purchased equipment for cloud seeding

IRGC voices readiness to help seeding clouds

'Climate change impact on Iran doubles world average'

Why Iran is facing decreased rainfall?

Top

TAGS

drone rainfall cloud seeding precipitation

DRONE ARTICLES

50 molasses-spraying drone clear smog in Bangkok

Published 3 months ago on February 3, 2019
By **Feilidh Dwyer**

tdlr
Web Page Blocked

Air pollution is an unfortunate problem which affects many cities and regions i
world.

In Thailand's capital, Bangkok, the problem recently got so bad that a fleet of pl
and sprayed water and molasses in an attempt to reduce dust and clear the air

City authorities contacted a drone club in Bangkok to source the 50 drones wh
up to 10 litres of liquid on board. The drones sprayed in a 2.5 miles (4km) radius
scientists, the molasses (a viscous product that results from refining sugarcan
dust which then falls to the ground as a black droplet.

Poor air quality a serious problem in Thailand

According to the World Air Quality Index Project, central Bangkok is currently r
120 of fine air particulate matter per cubic meter of air. Between 0-50 parts of
considered "good" and anything over 100 immediately poses risks to those with
ailments such as asthma.

Bangkok is a densely populated, industrialized city with more than 8 million inh
the air pollution was so severe (approaching 200 parts per cubic meter) that sc
cancelled and residents took to social media to complain of irritated eyes and
blood.

Bangkok's Governor, Aswin Kwanmuang, has taken a number of recent measur
city including cloud seeding (a weather modification practice that involves dro
an attempt to make cloud form and rain to fall). He admits that drones are not a
solution to the problem but said that every little bit helps.

Although it's good to see that drones are making a positive difference in this in
polluted cities begin to reduce their reliance on burning fossil fuels to keep the
everyone.

To check out other drones for good stories, try:

- UAVs help survey poorly mapped areas of Africa
- UAV swarms can detect poisonous gasses in disaster zones
- Drones help kill rats on a remote island in the Galapogas

Prev Page 1 of 2

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DON'T MISS

Spanish drug smuggling gang used drones to monitor police

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What does it take to start drone business?

Feilidh Dwyer

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Freestyle Racing Drone

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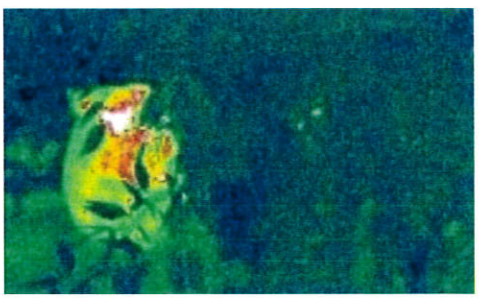

South China Morning Post

Science

China and Russia band together on controversial heating experiments to modify the atmosphere

- The countries are testing a technology for possible military application, say Chinese scientists involved in the project
- Militaries have been in a race to control the ionosphere, which allows radio signals to bounce long distances for communication, for decades

Topic | **China science**

Stephen Chen

Published: 3:30am, 17 Dec, 2018