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I. INTRODUCTION

As part of the activities which WMO carries out in its Programme on the Physics and Chemistry of Clouds and Weather Modification Research, a Register of National Weather Modification Projects is kept. The Register has existed since 1975 when the Seventh World Meteorological Congress agreed that an inventory of activities within Member countries related to weather modification should be initiated and maintained. Periodic reviews have all recommended that the Register be continued. The Register is providing information also of interest to number of UN programmes outside WMO.

This present Register is based on information obtained from Member countries on experiments and operations sponsored by government agencies or private concerns that took place during 2003 and 2004.

To assist the reader in understanding the content of each of the 12 columns used in the tabular presentation found within, detailed explanations are provided in Section II.

The names of Member countries who provided the information reported in this Register are listed in Sections III. Section VII provides summaries of completed projects and Section VIII indicates which countries reported that no weather modification activities had taken place in 2003 and 2004.

II. DETAILED EXPLANATION OF INFORMATION COLUMNS

Column 1: WMO Register No.

This consists of country indicator letters (according to the ISO Standard 3166-1974) and a serial number for each project.

Column 2: Objective of project, type of organization carrying it out

Dev.	=	Development	PE	=	Precipitation Enhancement
Ext.	=	Extend wet period	(E)	=	Emergency
Fog	=	Fog dissipation	(R)	=	Routine
Hail	=	Hail suppression	PR	=	Precipitation Redistribution
Inc.	=	Increase during wet period	Res.	=	Research
Op.	=	Operational			

Column 3: Approximate size of project area

Given in square kilometres for target and control (if any) areas.

Column 4: Name of project

Reference numbers are also quoted when supplied.

Column 5: Location of project area

In some cases where co-ordinates of several points delineating the area were given, these have been replaced by a single point at approximately the centre of the area. Towns and islands may be denoted by name; A/P = Airport.

Column 6: Year project commenced and continuity

Date	--	year project started
Every year	--	indicates project has operated every year
Interrupted	--	indicates project has not operated every year
No	--	indicates project will not be continued
Yes	--	indicates project will be continued

(?) -- indicates project status is unknown

Column 7: Nature of organization sponsoring project

Indicated by abbreviations as follows:

Agr.	=	Agricultural	Muni.	=	Municipal
Def.	=	Defense	(P)	=	Private
Enr.	=	Energy	Rec.	=	Recreation
For.	=	Forestry	Res.	=	Research
(G)	=	Government	Trans.	=	Transportation
Hyd.	=	Hydrological	Wea. Serv.	=	Meteorological

Column 8: Apparatus, seeding location

Abbreviations are as follows:

Air	=	Airborne	G/B	=	Ground-Based
A/C	=	Aircraft	Temp.	=	Temperature

Column 9: Agents, dispersal rates

Self-explanatory.

Column 10: Characteristics of clouds treated, seeding criteria

LWC	=	Liquid Water content	Temp.	=	Temperature
Obs.	=	Observations			

Column 11: Active period during reporting year

Months of activity are inclusive.

Jan	=	January	July	=	July
Feb	=	February	Aug	=	August
Mar	=	March	Sept	=	September
Apr	=	April	Oct	=	October

May	=	May	Nov	=	November
June	=	June	Dec	=	December

Column 12: Documentation

"EIS" indicates that an environmental impact study has been made; "C/B" indicates that a costs and benefits analysis has been made.

MEMBER COUNTRIES REPORTING 2003-2004 PROJECTS

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AUSTRALIA											
AUS-1	PE Inc. Op.	Target area 8233 km^2	Tasmanian Area cloud seeding operation 2003 (TASCO 2003)	Tasmanian central highlands	1998 Sept- Every year Yes	Energy (G)	Aircraft acetone burner seeding in cloud at –10^{o}C level or cloud tops warmer than –10^{o}C.	AgI at 383 g/hr 14.16 kg /year	Layer clouds with bases colder than 10^{o}C and tops colder than 0^{o}C but warmer than –20^{o}C. Supercooled water content 0.1 g/m^2. Cloud depth >1/2 . Wind speed < 7.5 kt cloud top temp colder than –5^{o}C.	April-Nov. 28 suitable seeded days	Evaluation based on results of 25000 ft joint HEC/CSIRO randomized. Trial of 79-83 inclusive. No documents EIS – Yes C/B Yes
AUSTRIA											
	PE Inc. Op.	Target area 1800 km2	Hail test project - Styria	46o 30’ – 47o15’ N 15o30’ – 16o00’ E	1985 Every year Yes	Agr (P)	3 Aircrafts acetone burner and pyrotechnic flare cloud base	AgI solution 11 liter/hr Total consumption 803 l	Convective clouds with bases colder than 10^{o}C and tops colder than –20^{o}C. No microstructure measured, subjective criteria, regional weather forecast and C-Band raider	May – August 2003 24 days	Evaluation based on historical records Crp damage and hail pads. Evaluation available. Documents to WMO EIS –No C/B No
BULGARIA											
BG-1	Op. Res. Hail Supp.	16683 km^2	Bulgarian Hail supresión project	NW Bulgaria 43^o 20– 44^{o}0 22^{o}30E – 24^{0}40E South Bulgaria 42º-42º35’N 24’00 – 26^{0}30’E	1969 Interrrupted Yes	Agr (G)	Rocket-based pyrotechnic flares for in cloud seeding	AgI 82 kg/rocket	Convective clouds; bases warmer than +10^{o}C and tops colder than –20^{o}C: Seeding criteria based on radar echo, cloud heights and reflectivity.	May-Sept. 36 days	Evaluation based on comparison with historical records crop damage. Evaluation document done available to WMO. EIS-No C/B-Yes
CANADA											

CAN-1	Op. Hail	26,000 km^2	Alberta hail suppression project	Province of Alberta (Lacombe to High River). Priority given to cities of Calgary and Red Deer.	1996 Every year Yes	Ins.(P)	3 aircrafts generator with acetone burner pyrotechnic flare. Seeding cloud based and cloud top between –5°C and –10°C on the upshear side of convective cells.	AgI. Flares: one 20g every 5 sec. Annual consumption 173.35 kg.	Convective clouds; bases colder than +10°C and tops colder than –20°C: Seeding criteria: radar defined cells with max. reflectivity 35 dbz, heights above –5 and are considered to be potential hail threat and urban or populated area	1 June – 15 Sept. 27 days.	Evaluation based on comparison with historical records. Document available. EIS-No C/B-Yes
CROATIA											
CR-1	Hail supp Op.	Project area 24100 km^2	Hail suppression	North Croatia, between Sava and Drava rivers	1976 Every year Yes	Agr (G) Insurance (P) company	Ground rockets. Generators with acetone burners. Release is in ground -8oC to –12oC	AgI 10 kg /day 610 kgs	Convective, clouds warmer than +10°C and tops colder than –20°C. No microstructure measured Top > hight of –28oC Hight of 45dbz > hight 0oC + 1.4 km	May - Sept. 2003 153 days	No evaluation Comp historical records Hail pads Documents available EIS – No C/B-No
FRANCE											
FR-3	Hail supp Res. Op	Target area 60000 km^2 Control area 420000k m^2	ANELFA Association Nationale d'Etude et de lutte contre les fléaux Atmosphériques	Bassin Aquitain, Bassin Rhodanien Vallée de la Loire	1952 Every year Yes	Agr Asso ciation sans but lucratif	Ground seeding 680 generators Acetone burner Ground seeding dispersal	AgI 8 g /hours/ generators 540 kg per year	Convective clouds. Temp warmer than +10°C and tops colder than –20°C Prévision des chutes de grêle au sol pouvant provoquer des dommages aux cultures.	15 April – 15 October 59 days	Hail pads Doc available In WMO EIS-Yes C/B-Yes
GERMANY											

GER-1	Hail Supp Res Op.	Target area 4400 km^2	Halgelab wehr Hagel forschung Rosenheim	Mountainous to hilly terrain from 1900 MSL to 500 MSL on Northern Side of Alps	1975 Every year Yes	County	2 aircrafts with acetone burner seeding at cloud base	AgI 6l/hour 37 kg	Convective clouds cloud base warmer than +10°C tops colder than –20°C temp.advection, vertical windspeed humidity altitude of troposphere radar echos infrared satellite photos.	April - Sept 19 days	Doc of hail fall document planned available EIS-No C/B-No
					GREECE						
GR-1	Op. Res. Hail Supp	5000 km^2 Target area	Hellenic National Hail suppression project	NW Greece	1984 Interrupted Yes	Agr (G)	3 aircraft. Hail sound canons and sound shock waves.	AgI 4 gr/sec	Convective and orographic clouds with bases colder than 10°C and tops colder than –20°C. Seeding criteria cloud tops higher 5 km and radar reflectivity higher than 35 dbz.		Evaluation based on comparison with historical records, crop damage and hail pads. Doc available EIS-Yes C/B-Yes
					HUNGARY						
HU-1	Op. Hail	Target 13,000 km^2	NEFELA Hail Suppression Associaiton	Baranya Somogy Tolna counties	1991 Every year Yes	Agr (G) (P)	141 ground generators acetone burners.	AgI 8 gr/l Total consumption 230 Kg	Convective clouds with bases warmer than +10°C, tops both warmer and colder than –20°C. No microstructure measured. Hail forecast	May-Sept. 40 days	No evaluation No doc. EIS-No C/B-No
					MALAYSIA						

MAL-1	Op. PE (E)	Whole country No control area	Drought operation	Whole country	1997 Every year Yes	Wea. Serv. (G)	In cloud seeding with liquid spray from 2 A/C. Seeding in moderate size cumulus (tops 10-1200 feet)	NaCl, 200 kg per day Total annual consumption 6,000 kg	Convective clouds with bases warmer than +10°C, tops colder than 0°C but warmer –20°C 10,000 ft and in moderate size seeding level in cloud 5,000 ft	Periods from 27 Feb to 2 April 2003; 8 May to 6 June 2003; 16 Sept to 6 Nov 2003 58 days	No evaluation provision EIS-No C/B-No
MACEDONIA, REPUBLIC OF											
Ma-1	Op Hail	8000 km2	Hail supression project	Whole country	1971 Every year Yes	Wea Ser (G)	Rockets In cloud seeding	Ag I 400 gr Total 58.4 kg	Convective clouds with with bases warmer than +10°C, tops colder than 0°C . Criteria: Hzmax > H0° Hzmax – 25 dbz > H –14° H echo top > H –28°	May - September 20 days	Comp with historical records Doc available EIS – No C/B - No
MOROCCO											
MOR-1	PE E Prec Inc. Res. Op.	Target 14,300 km²	ALGHAIT	Haut Atlas Between 31°-25° 32°50 N and 5° 25 and 7° 25W	1984 every year Yes	Wea Serv (G)	Ground seeding Cloud top material 15 generators 2 aircrafts	AgI 16g/l acetone. Total consumption 80 kg. Propane 1 btl of 35 kg/10 hrs total: 500 btls	Convective clouds and orographic cloud base T° colder than +10°C. Colder than 0°C but wamer than –20°C.	1er Nov 2002 – 30 April 2003. 30 jours	Evaluation with historical records. Document available EIS-Yes C/B-Yes
RUSSIAN FEDERATION											
RF-1	PE (E) Op. Dev Res Water supply PR Fire sup	Target 90,000 km²	Regulation of precipitation Airplane laboratory	Republic Saha	1986 Every year Yes	Agr (G) Met Serv (G)	rockets, generator with pyrotechnic flare. Release of seeding is cloud base and in-cloud..	AgI 50 kg/year.	Convective clouds with base colder than +10°C, top temp colder than –20°C T°br < -10°C and Δ h> 2km	April-September 97 days	Comparison historical records. Crop damage Hail pads Doc available in WMO. EIS-Yes C/B-Yes
SERBIA AND MONTENEGRO											

SM-1	Hail Supp Op	Target Area 77 134 km^2	Hail supp system in Serbia	The territory of Republic of Serbia	1967 Every year Yes	Agr (P) Wea. Serv	Rockets, In cloud seeding from -4°C to -12°C.	AgI 8.36 kg/units 4065.2 kg	Convective clouds coldler than +10°C top temperatures colder than –20°C. Radar reflectivity log>4.5. Max radar reflectivity height above 0°C. Height of increase radar echo above –14°C and radar echo to height above –28°C.	15 April – 15 October 54 days	Comparison historical records. Crop damage Doc available in WMO. EIS-No C/B-Yes
UBEKISTAN											
UZ-1	Hail Supp Op	Target area 7380 km2	Hail prevention of agriculture of crops on the teriitory of Rep of Uzbekistan	Namangan, Andijan, Samakand, Kashkadarya, Surkhandarya districts	1969 Every year Yes	Agr Gov	Rockets Pyrotechnic flare In cloud seeding	Ag I 20gr/km^3 56.7 kg	Convective clouds Temp at cloud base above +10°C. Top below –20°C Measured cloud microstructure.	1 April 31 Aug. 37 days	Comparison with histrorical records Doc yes EIS-No C/B-Yes
ZIMBABWE											
ZIM-1	PE Water supply aug Increase precip During wet period Op	Target area 390 757 km2	National cloud seeding operation (NASCO)	Harare	1968 Interrupted Yes	Wea Serv Gov	Aircraft Potassium/ Sodium, lithium carbonate/ magnesium oxide flares (burner)	NaCl 19% of flares KCl 65%; liCO3 1%; MgO 15%.	Convective clouds Temp at cloud base above +10°C. Temperature, updraft, type of clouds, height of clouds	Dec-March 70 days	Evalution carried out before project implementation Doc yes Not available EIS-No C/B-No

MEMBER COUNTRIES REPORTING ON COMPLETED PROJECTS

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LOCATION AND TERRAIN	PURPOSE AND DURATION	AGENT AND ALTITUDE OF SEEDING	REFERENCES TO PUBLISHED RESULTS	COMMENTS AND CONTACT FOR INFORMATION
FRANCE				
ANELFA Bassin Aquitain – Bassin Rhodanien – Vallée de la Loire 60000km^2	Hail suppression Cumulus clouds 51 years 15 April – 15 October	AgI. Ground generators 680. Fixed area definition. 9 départements du sud ouest de la France 2 départements du centre de la France 4 départements du sud-est de la France Hilly terrain. Target area. 60000km^2 Mesure physique des chutes de grêle à l'aide d'un réseau de 1086 grêlimètres installés sur la zone cible. 1 jour unité expérimentale journées ensemencées en moyenne pour chaque department Seeding period : 8 h/day Etude des correlation entre : quantité de substance active dispersée dans les cellules à grêle et intensité des chutes de grêle (nb des grelons de plus 7mm diamètre) 42% diminution du nombre de grêlons de diamètre supérieurs à 7mm 1% signification statistique	Dessens J., 1998 : A physical evaluation of hail suppression project with silver iodide ground burners in South western France. J. Applied meteo, 37, 1588-1599 Dessens J. and R. Fraile, 2000. The effect of silver iodide seeding on hail stone size distribution. J. Weather modification, 32, 26-30. Dessens J. and C. Berthet and J.L. Sanchez. 2003, The French hail prevention programme ANELFA: Results updating and proposal for duplication: 8th WMO scientific conference on Wea Mod (Casablanca, Morocco, 7-12 April 2003) WMO No. 39 pp 295-298.	L'Evaluation du programme ANELFA de prevention de la grêle par générateur au sol n e suit pas la procedure classique par triage au sort utilize en mofication du tps. Cette evaluation porte sur l'étude des distributions dimentionnelles des grelons en function du taux d'ensemensement. Dr Claude Berthet ANELFA 52 rue Alfred Duméril 31400 TOULOUSE

MACEDONIA, THE FORMER YUGOSLAV REPUBLIC OF				
Hail suppression project	Hail suppression Cumulus 31 year May to September AgI Target only. Fixed area: Hilly terrain. 8000 km2 Radar reflectivity			PR
MOROCCO				
Haut Atlas. Programme Al-Ghait. Hilly terrain.	Precipitation Augmentation rainfall and snow. Orographics cumulus, stratiform and system frontal clouds 19 years 1 November – 30 April.	AgI. Iodure de sodium + acetone G/B and airborne seeding from 15 G/B generators. 3000 m altitude. 200 to 260 km longueur de la trajectoire Zone clble. Target zone. Radar. LWC > 0.1/m3 sur 1 distance de 10 km. ACP, MRPP, regression linéaire. Augmentation des precipitations: 17% statistique.		Dr Grana Laidi Direction de la Météorologie Nationale BP 8106 Casa-Oasis CASABLANCA
UZBEKISTAN				

Hail prevention of agriculture crops of the territory of Rep of Uzbekistan.	Hail suppression. Cumulus clouds: 34 years from 1 April to 31 August AgI seeding Target only. Fixed area. Mountainous terrain. 7380 km2 target area. Precipitation gauges 58 Radar reflectivity, riding round territories caused by hail to fix the size of hailstones and defining of damage.		Imamdjanov Kh. A.. Parametical model of hailstorms clouds /SANI. 1982. Issue 100 (181)pp. 14-20 Djuraev A.D. Imandjanov Kh. A., NazarovB. Sh. Use of radar data in calculation of economical effectiveness of hail prevention activity /SANI 1988 – Issue (126 207) pp.83-86. Imandjanov Kh. A. Kamalov B.A. Weather modification in Uzbekistan SANIGMI 2001 p.120	The administration on Weather Modification of Glavgidromet of the Republic of Uzbekistan, Taskent. Experimental Unit: Duration of 2-30 minutes, maximum 1.5 hour; Conditions if the unit is seedable – RL should be 10^{-8} cm^{-1}, vertical extent of the zone in the cloud with reflectivity 10-9 cm should be 2.5 km and more; Total number of seeded units is 128, including 68 on hail prevention and 60 on hail interruption. Standard seeding period was from 2 minutes to 1.5 hours; Transformation for each test – decrease of radar reflectivity and geometrical characteristics of cloudiness.

VIII. MEMBER COUNTRIES REPORTING *NO* WEATHER MODIFICATION PROJECTS IN 2003-2004

Algeria
Argentina
Bahrain
Barbados
Belize
Benin, République du
Brunei Darussalam
Colombia
Costa Rica
Cote d'Ivoire
Cyprus
Denmark
Dominican Republic
Ecuador
Egypt
Estonia
Finland
Gambia
Georgia
Guyana
Hong Kong, China
Iceland
India
Japan
Kazakhstan, Republic of
Kyrgyz Republic
Liban
Lithuania
Maldives
Malta
Mauritius
Mexico
Myanmar
The Netherlands
New Zealand
Niger
Papua New Guinea
Pakistan
Paraguay
Peru
Poland
Qatar
Republica Dominica
Salvador El
Saudi Arabia
Singapore
Slovakia
Slovenia

South Africa
St Lucia
Sudan
Sweden
Switzerland
Trinidad and Tobago
Turkey
Uganda, Republic of
United Kingdom
Uruguay
USA, NOAA