WORLD METEOROLOGICAL ORGANIZATION

PROGRAMME ON PHYSICS AND CHEMISTRY OF CLOUDS AND WEATHER MODIFICATION RESEARCH

WMP

REPORT No. 32

REGISTER

OF

NATIONAL WEATHER MODIFICATION PROJECTS

1996

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TABLE OF CONTENTS

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.

This present Register is the twentieth such publication issued. It is based on information obtained from Member countries on experiments and operations sponsored by government agencies or private concerns that took place during 1996

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. These columns contain information that was obtained from WMO Member countries in response to questionnaires sent to them in December 1997. The questionnaires are reproduced as Annexes A and B to ensure that the tabular information will be readily understood by readers. These are printed in the four languages used for relevant reports and publications of the Organization. Annex A refers to present projects reported in Section IV for the 1996 projects. Annex B refers to completed projects or those where physical and/or statistical evaluation have been carried out that are reported in Section VII.

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 1996.

Requests for further information concerning the projects reported may be addressed to the reporting agency for each country which is indicated in Section V. The WMO Secretariat would be pleased to assist if requested.

II. DETAILED EXPLANATION OF INFORMATION COLUMNS

(The figure in brackets following the column heading title indicates a similar item in the questionnaire, see Annex A).

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 (1) and (2)

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 (3)

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

Column 4: Name of project (4)

Reference numbers are also quoted when supplied.

Column 5: Location of project area (5)

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 (6)

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 (7)**

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 (8)**

Abbreviations are as follows:

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

Column 9: **Agents, dispersal rates (8)**

Self-explanatory.

Column 10: **Characteristics of clouds treated, seeding criteria (9)**

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

Column 11: **Active period during reporting year (10)**

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 (12) and (13)**

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

III. MEMBER COUNTRIES REPORTING 1996 PROJECTS

Page

IV. REGISTER OF 1996 REPORTED PROJECTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
AUSTRIA											
AUS-1	Op. Hail	1,800 km^2	Hail Test Program - STYRIA	STYRIA (46°50' N 15°45' E)	1985 Every year Yes	Agr. (P)	3 A/C with acetone burners and pyrotechnic flares for seeding cloud bases	AgI 15l/hour Total consumption 300 kg for year	Convective clouds, bases colder than 10°C and tops colder than -20°C. Seeding criteria: regional forecasts and radar data (C-Band)	May-Sept 36 days	Evaluation based on historical records, crop damage and hail pad data, report planned in 1998 EIS-No C/B-No
AUS-2	Op. Hail	500 km^2	Lower Austria - Hail Test Program (HTP-N)	Lower Austria (48°20' N 15°35' E)	1981 Every year Yes	Agr. (P)	3 A/C with acetone burners and pyrotechnic flares for seeding cloud bases	AgI, 15l/hour Total consumption 36 kg per year	Convective clouds with bases colder than 10°C and tops colder than -20°C. Seeding criteria: as AUS-1	May-Sept 15 days	Evaluation, based as in AUS-1, planned for end of 1998
CANADA											
CAN-1	Op. Hail	26,400 km^2	Alberta Hail Suppression Project	Province of Alberta (Lacombe to High River)	1996 Yes	Ins. (P)	Cloud-base Cloud-top and in-cloud seeding with acetone burner and flares from 3 A/C. Seeding	AgI, Flares: one 20g flare every 5 sec. For in -cloud seeding and 1-2 150g flare per run.	Convective clouds with bases colder than 10°C and top temperature between O°C and -20°C.	15 June-15 Sept 30 days	Evaluation based on historical records. EIS-No C/B-No

IV. REGISTER OF 1996 REPORTED PROJECTS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
							performed at an altitude between -5°C and -10°C on the upshear dide of the cloud when no clearly defined feeder turrets are visible	Total yearly consumption: 157.64 kg of AgI in flares and 5.5 kg of AgI dispersed with acetone burners.	Seeding criteria maximum radar reflectivity > 35dbz above the -5°C level. The micro-structure of the unseeded clouds is measured.		
CHILE											
CHI-1	Res. Dev. Op. PE (E)		Regiones		1991 Inter- rupted Yes	Agr. (G, P) Hyd. (G)	Cloud top, Cloud-base and in-cloud seeding from one a/c at -10° level	AgI Total Yearly consumption: 3,904 kg	Convective and orographic clouds with bases warmer than +10°C and tops colder than -20°C. Seeding Criteria based on radar and aircraft observations and meteorolgical experience	June-Sept	Evaluation based on historical records. Evaluation document planned . EIS-No C/B-Yes

IV. REGISTER OF 1996 REPORTED PROJECTS

CHINA											
CN-1	Op. PE Hail	200,000 km^2	Precipitation Enhancement and Hail Suppression	Jilin Province	1958 Every year Yes	Agr. (G)	Cloud top and in-cloud seeding with dry ice from One A/C at temp. about -10°C. Explosives on rockets and shells are also used.	Dry-ice 100-1000g/km. Total consumption 200kg during the year	Convective, and stratiform clouds with bases colder than 10°C and top temp. between 0 and -20°C . Seeding criteria: cloud base height < 1.5 km Cloud depth > 600m	Apr-July 103 days	Evaluation based on historical records and hail pad data EIS-No C/B-Yes
CN-2	Op. PE, Hail (E); (R)	150,000 km^2		Shandong Province	1988 Every Year Yes	Agr. (G) Wea. Ser.	In-cloud seeding with acetone burner from 1 A/C at temp. between -5°C and -10°C. Explosives on shells also used.	AgI 300g/hour. Total yearly consumption: 7.5 kg	Convective and stratiform clouds, with bases colder than 10°C and top temp. between 0° and -20°C. Seeding criteria: cloud base < 1.5 km cloud depth > 2000m	March-Oct. 26 days	Evaluation based on comparison with control area EIS-No C/B Yes

IV. REGISTER OF 1996 REPORTED PROJECTS

CN-3	Op. PE, (E), Hail	10,000 km^2		Shanxi Province (36°30'N 109°00 E)	1988 Inter-rupted Yes	Agr. (G) Wea.	In-cloud seeding at temp. below -5°C with acetone burner from one A/C. Rockets and shells also used	AgI, 125g/hour. Total consumption 30 kg/year	Stratiform clouds with bases warmer than 10°C and tops warmer than -20°C. Seeding criteria: cloud base < 1km Cloud top > 5km Radar echo > 15dBz	Mar-June 18 days	No evaluation planned EIS-Yes C/B-Yes
CN-4	Res. Op. PE, Hail,	17,000 km^2		Guizhou Province	1974 Every year Yes	Agr. (G)	In-cloud seeding with rockets and artillery shells at temp. -20°C to 0°C.	AgI, Total consumption: 45 kg during the year.	Convective stratiform and orographic clouds with bases colder than 10°C and tops colder than - 20°C.	Mar-Sept 214 days	Evaluation based on historical records and crop damage and hail pad data EIS-Yes C/B-Yes
CN-5	Op. Res. PE (E)	25,000 km^2 target	Snowfall Enhancement by Aircrat along Tiashan Mountains	Northern Xinjiang Province	1978 Every year Yes	Agr. (G) Wea. Ser.	One A/C with acetone burner for in-cloud seeding at temp. -10°C - -25°C	AgI. 500g/hr Total consumption 15kg during the year	Convective and stratiform clouds with bases colder than 10°C and top temp. < -20°C. Seeding criteria: radar reflectivity > 10 dBz cloud top height > 3km	Nov-Jan 70 days	Evaluation based on comparison with crop damage data EIS-No C/B-Yes

IV. REGISTER OF 1996 REPORTED PROJECTS

									cloud depth > 1.5 km		
CN-6	Op. PE Hail	200,000 km^2		Guangxi Autonomous Region	1990 Every year Yes	Agr. (G)	In-cloud and cloud top seeding with acetone burner from 1A/C Artillery Shells are also used	AgI, 300g/hour. Total consumption: 10 kg	Convective and stratiform clouds with bases colder than 10°C and top warmer than -20°C seeding criterion radar echo > 25 dBZ	March-May 40 days	Evaluation based on crop damage and hail pad data. EIS-Yes C/B-Yes
CN-7	Op. PE,	30,000 km^2		Anhui Province	1988 Inter-rupted Yes	Agr. (G)	In-cloud seeding with acetone burner from one A/C at temp below 0°C.	AgI. 160 g/hour Total yearly consumption 7 kg	Stratiform clouds with base temp. colder than 10°C and top temp between 0°C and -20°C Seeding criterion: radar echo between 10 dBZ and 30 dBZ.	Aug-Sept. 28 days	
FRANCE											
FR-1	Res. Op. Hail	80,000 km^2 target 420,000 km^2 control	ANELFA	Aquitain and Rhodanien Basins and Loire Valley	1952 Every year Yes	Agr. (P)	Ground-based seeding with 590 acetone burners	AgI 8, g/hour per generator. Total yearly consumption 578 kg	Convective clouds with bases warmer than 10°C and tops colder than -20°C. Seeding criterion:	Apr-Oct 57 days	Evaluation based on crop damage and hail pad data. Report is available EIS-Yes C/B-Yes

									hailstones with diameter exceeding 15 mm being predicted		
FR-2	Res. Dev PE (R) Hail	5,000 km^2 Target 2,000 km^2 control	Test of Modification of the Hailstorm Characteristics by Seeding Hygroscopic Nuclei at the Cloud Bases	Departments Garonne and Moyenne	1993 Every year Yes	(P).	Cloud-base seeding with pyrotechnic flares from 2 A/C	NaCl + KCl, 30 kg/hour.	Convective clouds with bases warmer than 10°C (June-Aug) and colder than 10° (May and Sept). Cloud top temp. below -20°C. Seeding criteria: hail predicted and confirmed near the target area; updraft exceeding 4 m/s;	Hail May-Oct 13 days PE: Feb-April, Oct.	Evaluation based on data from hail pads and 5cm-radar observations EIS-Yes B/C-Yes
GERMANY											
GE-1	Op. Hail	2,500 km^2 target 7,500 km^2 control	Hail Prevention Stuttgart Area	Stuttgart area	1980 Every year Yes	Agr. (P)	Cloud base seeding with acetone burners from 2 A/C	AgI, 1.4kg/hour of 7% solution. Total consumption 30.4 kg	Convective clouds with bases warmer than 10°C and tops colder than -20°C Seeding criteria: degree of convective	May-Oct 11 days	Estimation based on comparison with historical records and hail pad data. Report available EIS-Yes C/B-Yes

IV. REGISTER OF 1996 REPORTED PROJECTS

									instability, radar echo top height		
GE-2	Op. Dev. Hail	4,000 km^2 target	Hagelabwehr/ Hagelforschung-sverein Rosenheim	Northwester side of the Alps (10°40' E to 12°30' E)	1975 Every year Yes	Muni-cipal	As GE-1	AgI, 0.5 kg per hour. Total consumption: 22.6 kg per year	Convective clouds as GE-1. Seeding criteria based on temp., temp. advection, vertical wind speed, humidity, height of troposphere, radar echo height	May-Sept 11 days	Evaluation based on hail observation data. Report available EIS-No C/B-No
IRAN, ISLAMIC REPUBLIC OF											
IR-1	Op. PE Inc.	100 km^2 target 100 km^2 control	Study of precipitation enhancement project in Yazad Province	Shirkoon mountains in the west of Yazad province with height 4077 m	1995 Yes (?)	Wea. Ser.	G/B seeding with 30 acetone burners	AgI, 41,25 g/hour. Total Yearly consumption: 391.67 kg	Convective clouds with bases colder than 10°C and top temp between 0°C and -20°C Seeding criteria are based on temperature humidity and cloud type.	Jan-Apr 120 days	Evaluation based on comparison with historical records. Evaluation document planned: EIS-Yes B/C-Yes

IV. REGISTER OF 1996 REPORTED PROJECTS

ISRAEL											
IS-1	Op. PE	50,000 km^2 1,500 km^2 control	The Israeli Rain Enhancement Project	Northern Israel	Experi-ments: 1960 Operatio ns: 1975 Every year Yes	Agr. (G) Hyd (G)	40 G/B acetone burners and 3 A/C with acetone burners seeding at cloud base level	AgI G/B: 12 g/hour A/C: 500 g/hour Total yearly consumption 250 kg	Convective clouds with bases colder than 10°C and tops warmer than -20°C (usually) or colder (sometimes). Microphysics of the unseeded clouds measured from research aircraft. Seeding criteria: cloud top colder than -8°C; suitable wind direction	Jan-Apr, Nov-Dec 100 days	Estimation based on comparison with historical records. Report available EIS-No C/B-Yes
JAPAN											
JP-1	Res. PE (E) PR	500 km^2	Study on Feasibility of Orographic Snow Cloud Modification by Seeding	Niigata and Gunma Prefectures	1994 Every year Yes	Wea. Ser.	Cloud top seeding with dry ice from 1 A/C	Stratiform clouds with bases colder than 10°C and top temp. between 0°C and -20°C. Microphysics of unseeded clouds is	Dry ice 10g/sec. Total consumption: 50 kg during the year	Jan-Mar, Nov-Dec 30 days	No evaluation planned EIS-No C/B-Yes

								measured from aircraft. Seeding criteria: cloud top temp. > -20°C and horizontal uniformity of clouds			
JORDAN											
JOR-1	Res. Op. Ext. (R) Inc. PR	14,500 km^2	Precipitation Enhancement Program in Jordan (PEPJ)	North Middle and South of Jordan area, east of Jordan Valley	1986 Interrupted during 1990/91 season Yes	Wea. Ser.	G/B seeding with 23 acetone burners. Cloud top, cloud base and in-cloud seeding with pyrotechnic flares from 1 A/C. In-cloud seeding at temp. -12°C to -20°C	Airborne, AgI, 240 gm/hr, with the total yearly consumption of 50 kg. G/B: 12 g/hour per each of 23 acetone burners	All types of clouds with bases colder than 10°C and top temp. between 0°C and -20°C. Seeding criteria: approach of depression and/or unstable atmospheric conditions.	Jan-May Oct-Dec 33 days	Evaluation based on historical records. Report EIS-Yes C/B-Yes To be published in WMO Bulletin
KOREA, REPUBLIC OF											
KOR-1	Res. PE	1,962 km^2	Experimental Research of Cloud Seeding	Mid-eastern Korea (37.8 N, 128.4 E)	1995 Every Year Yes	Res.	Seeding with 6 acetone burners from ground and 1 A/C	AgI, 30 g/hr. Dry ice 100 kg/hr. Total yearly consumption 10 kg and 600 kg, respectively	Orographic and stratiform clouds with bases colder than 10°C and top temp. between 0°C and -20°C. Seeding	G/B seeding: Jan-Feb. Airborne Seeding : Mar-Nov: totallly 20 days	Evaluation based on AgI analyses in the ground rain samples EIS-No C/B-No

									criteria: cloud top temp < -5°C cloud depth > 100m		
LIBYAN ARAB JAMAHIRIYA											
LI-1	Op., PE, Inc	25,000 km^2 target, 40,000 km^2 control	Cloud Seeding Project	Jafara Plain, west coast of Libya	1980 Every ye ar Yes	Wea. Ser.	Cloud top and in-cloud seeding with pyrotechnic flares from 3 A/C	AgI at a rate of 140 g/h. Total yearly consumption 5.0 kg	Convective clouds with bases colder than 10°C and top temp. between 0° and -20°C. Seeding criteria: cloud tops colder than -8°C, LWC > 0.5 g/m, ice partical content < 10/l	Jan-Mar Oct-Dec	Evaluation based on comparison with historical records, report planned EIS-No B/C-No
MACEDONIA, THE FORMER YUGOSLAV REPUBLIC OF											
MAC-1	Op. Hail	25,000 km^2	Hail Suppression	Republic of Macedonia	1971 Every ye ar Yes	Wea. Ser.	In-cloud seeding with rockets at -6° - -12°C temp. levels	AgI	Convective clouds with bases colder than 10°C and tops colder than -20°C. Seeding criteria: top temp. -28°C or lower, logorithm of maximum reflectivity	Apr-Oct 27 days	Evaluation based on comparison with historical records

									exceeding 3.5 and maximum reflectivity region above 0°C level		
MOROCCO											
MO-1	Res. Op. PE (E) Inc	16,400 km^2 target 6,000 km^2 control	Programme AL CHAIT	Atlas Mountains, Central Basin	1984 Every year Yes	Wea. Ser. (G)	Seeding cloud tops, bases and in-cloud with 15 G/B acetone burners, and propane dispensers and pyrotechnics from 2 A/C	G/B seeding: AgI 20 g/hour, NaI 6 g/hour. Airborne seeding: NaI 115 g/h. Propane 2kg /hour, pyrotechnic flares 1-2 per cloud. Total yearly consumption: AgI 45 kg and 15 kg NaI And 61 pyrotechnic flares	Convective and orographic clouds with bases colder than 10°C and top temps. warmer than -20°C Seeding criteria: LWC > 0.1 g/m^3 along 10 km or LWC > 0.3 g/m^3 along 2-3 km	Jan-Apr Nov-Dec 31 days	Estimation based on comparison with historical records. Report available EIS-Yes C/B-Yes
MONGOLIA											
MON-1	Res. Dev. PE (for Fighting Forest Fires)		"Hail suppression-7" "Precipitation-3"	49°N 102°E	Hail 1991 Precipitation: 1996 Every Year Yes	Agr. (P) For. (G) Wea. Ser.	In-cloud seeding with pyrotechnic flares and explosives on rockets and shells for hail suppression. In-cloud	AgI in pyrotechnic flares, total consumption 28 kg Dry ice. Total consumption: 3000kg	Convective and orographic clouds with top temps. Between 0°C and -20°C Seeding criterion:	May-Sept Hail: 21 days PE: 10 days	Evaluation based on comparison with historical records. EIS-Yes C/B-Yes

							dryice dispersal from 1 A/C for precipitation enhancement. Seeded layer temp. are -10°C– -20°C.		radar echo > 25-30 dBZ		
NEW ZEALAND											
NZ-1	Op. Hail	400 km^2	Small scale Hail cannon	Hawkei Bay	1995 Every year (?)	Agr. (G)		Hail Cannon	Convective clouds	Nov-Feb	
NORWAY											
NO-1	Op. Fog	Airport runway area		Oslo Airports: Fornebu and Gardermoen	- Every year Yes	Trans. (G)	A/C dispersing dry ice at fog top level	Dry ice	Fog at temp. colder than 0° but warmer than -20°C	Jan-Feb Nov-Dec	
RUSSIAN FEDERATION											
RF-1	Res. Op. PE Inc. Hail	15,000 km^2 target, 12,000 km^2 control		Northern Caucasus	1986 Every year Yes	Agr. (G) Wea. Ser.	In-cloud seeding with pyrotechnic flares on rockets for hail suppression. Top-cloud seeding with dry ice and nitrogen from 1 A/C for PE. Seeded layer	AgI Dry ice, nitrogen. Total consumption during the year: 8kg, 1000kg and 800kg respectively	Convective and stratiform cloud with bases colder than -10°C and top temp. between 0°C and -20°C. Microphysics of the unseeded clouds measured.	May-Aug 30 days	Evaluation based on comparison with historical records and crop damage. Evaluation document planned. EIS-Yes B/C-Yes

							temp. are between -8°C and -15°C.		Seeding criteria. Cloud top temp. below -10°C cloud depth > 2km.		
SLOVENIA											
SLO-1	Op. Hail	3,000 km^2	Slovenian Hail Suppression Project	North Eastern Slovenia	1971 Every year (?)	Agr. (G) Wea. Ser.	In-cloud seeding with pyrotechnic flares on rockets and cloud-base seeding with acetone burners from 2 A/C. Cloud-layer seeding at temp. -5°C to -15°C	AgI, 8 g/km^3 of cloud. Total consumption 20 kg during the year	Convective clouds with bases warmer than 10°C and tops colder than -20°C Seeding criterion: radar reflectivity ≥ 40 DBZ at height exceeding 0°C level by 1.5 km	June-Aug 13 days	Estimation based on historical records and crop damage data. EIS-No
SOUTH AFRICA											
SA-1	Dev. PE	Two target areas, 30,000 km^2 each	National Precipitation Research Program	Target 1: Bethlehem, Free State Target 2: Tzaneen, Northern Province	1990 Every year Yes	Res. Wea. Ser.	Seeding of cloud bases with pyrotechnic flares from 3 A/C	NaCl, KCl, In pyrotechnic flares	Convective clouds with base temp. between 7°C and 13°C and tops colder than -20°C Seeding criteria: radar reflectivity ≥ 30 DBZ,	Oct-Dec	Evaluation based on randomized radar tracking of cells and streamflow data EIS-No C/B-Yes

IV. REGISTER OF 1996 REPORTED PROJECTS

									well defined updraft area at cloud base		
SPAIN											
SP-1	Op. Hail	10,000 km^2	Nalogal	Northern Spain (Alava, La Rioja, Novarra)	1969 Every Year	Agr. (G)	G/B seeding with acetone burners	AgI.	Convective clouds with top temp. < -20°C. Seeding criterion based on hailstorm prediction	May-Sept	Evaluation based on hail pads EIS-No C/B-No
SP-2	Op.Hail	2,800 km^2	Compana de Lucha Antigranizo en Aragon 1996	Zaragoza and Teruel Provinces	1970 Every year Yes	Agr. (G)	G/B seeding with 137 acetone burners	AgI, 5.8 l/generator. Total yearly consumption 794 l	As SP-1	May-Oct 31 seeded days	Evaluation based on crop damage data EIS-No
SYRIAN ARAB REPUBLIC											
SY-1	Dev. Op. PE (E) Inc.	150,000 km	Syrian Rain Enhancement Project	All over the country	1991 Every year Yes	Agr. (G)	Cloud top and in-cloud seeding with pyrotechnic flares at temp. < -13°C or < -17°C (depending on flare type) from 4 A/C	AgI. Total yearly consumption: 16.2 kg	Convective and orographic clouds with bases colder than 10°C and top temp. between 0°C and -20°C	Jan-May Nov-Dec	Evaluation is based on historical records EIS-No C/B-No

IV. REGISTER OF 1996 REPORTED PROJECTS

THAILAND											
TH-1	Op. PE (E) Inc.	2,500 km^2 target, 2,500 km^2 control	Thailand Rainmaking Operation	Drought areas throughout Thailand	1969 Every year Yes	Agr. (G)	Cloud top, cloud base and in-cloud seeding by solid dispersal from 3 A/C. at a level of 3.3 km	$CaCl_2$ and CaO, 50 kg/min; Urea and ammonium nitrate, 50 kg/min. NaCl	Convective and orographic clouds with bases warmer than 10°C and tops warmer than 0°C. Seeding criterion: Suitable clouds	Mar-Oct 180 days	Evaluation based on crop damage data EIS-Yes C/B-Yes
TH-2	Res. PE Inc.	500 km^2 (floating target)	Applied Atmospheric Resources Research Program (AARRP): Warm Cloud Seeding Activity	Northern Thailand (17°48N 98°26E)	1995 Every Year Yes	Agr. (G)	In-cloud solid dispersal from 2 A/C	$CaCl_2$ 100 kg/min	Conv. clouds with bases warmer 10°C and tops warmer than 0°C. Seeding crit: cloud top above 3.3 km with temp. ≥ 0°C; cloud diameter 2-6 km; updraft velocity > 2.5 m/s; LWC ≥ 0.5 gm/m^3; no clouds with tops higher 10 km or echo cores closer 10 km	July-Oct 90 days	Evaluation based on randomized experiment EIS-Yes C/B-No

IV. REGISTER OF 1996 REPORTED PROJECTS

TH-3	Res. PE	13 km^2 floating target (single convec-tive cloud)	AARRP: Cold Cloud Seeding Activity	Northern Thailand (17°48N - 98°26 E)	1991 Every year Yes	Agr. (G)	In-cloud seeding from 1 A/C with pyrotechnic flares at temp. about -8°C	AgI, 20 g per flare, per second. Total yearly consumption: 7.3 kg	Convective clouds with bases warmer than 10°C and cloud top temp. between 0° and -20°C. Seeding criteria: isolated cloud with no Cb echo within 10 km; updrafts ≥ 5 m/s; supercooled LWC ≥ 1 g/m^3	Apr-June 75 days	Evaluation based on randomized experiment EIS-Yes C/B-Yes
UZBEKISTAN											
UZ-1	Op. Cloud Disp-ersal	250 km^2	Cloud dispersal over Tashkent city for precipitation suppression	Tashkent city, Uzbekistan Republic	1993	Wea. Ser.	Dry ice and liquid nitrogen dispersal from 6 A/C	Dry ice, 0.5 - 1.0 kg/km. Total consumption 10,000 kg. Liquid nitrogen. Total consumption 500 kg.	Stratiform clouds with bases warmer than 10°C and top temp between 0°C and - 20°C. Seeding criteria: cloud top temp ≤ -4°C; cloud depth ≥ 400m	Mar 1 day	Evaluation based on precipitation amount EIS-Yes C/B-Yes

IV. REGISTER OF 1996 REPORTED PROJECTS

UZ-2	Op. Hail	7,360 km^2	Anti-Hail Protection of Crops	Fergana Valley, Kashkadajya Samark and Surhadarya regions	1969 Every year Yes	Agr. Wea. Ser. Hyd.	In-cloud seeding with pyrotechnic flares on rockets and shells. The seeded layer temp. between -3°C and -9°C.	AgI Total yearly consumption 74.2 kg	Convective clouds with bases warmer than 10°C and tops colder than -20°C seeding criterion: Hail being predicted	Apr-Aug 89 days	Evaluation based on crop damage data. Report planned EIS-Yes C/B-Yes
YUGOSLAVIA											
YU-1	Op. Hail	66,000 km^2	Hail Suppression in Serbia	Republic of Serbia	1967 Every year Yes	Agr. (G)	In-cloud seeding with pyrotechnics on rockets at temp. -4° to -12°C	AgI	Convective clouds with bases colder than 10°C and tops colder than -20°C. Seeding criteria: maximum reflectivity region above 0°C level, cloud top colder than -28°C	Apr-Oct	Evaluation based on comparison with historical records and crop damage data EIS-No C/B Yes

V. ADDRESSES OF REPORTING AGENCIES

AUSTRIA	Central Institute of Meteorology and Geodynamics Department of Climatology Hohe Warte 38 A-1190 VIENNA Austria
CANADA	Atmospheric Environment Service 4905 Dufferin Street DOWNSVIEW, Ontario Canada M3H 5T4
CHILE	Ministerio de Agrocultura Unidad de Emergencias Agricolas Teatinos No. 40, 6 Piso SANTIAGO Chile
CHINA	China Meteorological Administration Weather Modification Office 46 Baishiqiao Road BEIJING 100081 China
FRANCE	Association Nationale d'Etude et de Lutte Contre les Fleaux Atmospheriques 52, rue Alfred Duméril 31400 TOULOUSE France
	Association Climatologique de la Moyenne Garonne Aerodrome d'Agen 47520 LE PASSAGE France
GERMANY	University of Hohenheim D-70593 STUTTGART Germany
	Landratsamt Rosenheim Wittelsbacherstr. 53 83022 ROSENHEIM Germany

IRAN, ISLAMIC REPUBLIC OF	Islamic Republic of Iran Meteorological Organization TEHRAN Islamic Republic of Iran
ISRAEL	Israel Meteorological Service Rain Enhancement Division P.O. Box 20 BEN GURION AIRPORT 70100 Israel
JAPAN	Japan Meteorological Agency Meteorological Research Institute 1-1 Nagamine TSUKUBA, Ibaraki 305 Japan
JORDAN	Jordan Meteorological Department Jordan Precipitation Enhancement Programme P.O. Box 341011 - Marka AMMAN Jordan
KOREA, REPUBLIC OF	Korea Meteorological Administration Meteorological Research Institute Hydrometeorology Research Lab. 2, Waryong-dong, Chongno-gu SEOUL, 110-360 Republic of Korea
LIBYAN ARAB JAMAHIRIYA	Meteorological Department P.O. Box 5069 TRIPOLI Libyan Arab Jamahiriya
MACEDONIA, THE FORMER YUGOSLAV REPUBLIC OF	Republic Hydrometeorological Institute Skupi bb 91000 SKOPJE The Former Yugoslav Republic of Macedonia
MOROCCO	Direction de la Météorologie Nationale Service de Recherche Atmospheriques/CNCRM Hay Hassani CASABLANCA Morocco

MONGOLIA	Hydrometeorological Agency of Mongolia Weather Modification Center Khudaldaany Gudamj-5 (for Khurynshim Center" ULAANBAATOR-11 Mongolia
NEW ZEALAND	Meteorological Services of New Zealand National Institute of Water and Atmospheric Research Box 109695 AUCKLAND New Zealand
NORWAY	Civil Aviation Authority P.O. Box 8124 Dep 0032 OSLO Norway
RUSSIAN FEDERATION	Russian Federal Service for Hydrometeorology and Environment Monitoring Office for Weather Modification and Natural Disaster Events 12 Novovaganikovskii Lane MOSCOW 123242 Russian Federation
SLOVENIA	Hydrometeorological Institute Vojkova 1/B LJUBLJANA 1000 Slovenia
SOUTH AFRICA	S.A. Weather Bureau Private Bag X15 BETHLEHEM 9700 South Africa
SPAIN	Gobierno de Aragon Centro de Proteccion Vegetal Apartado 727 ZARAGOZA 50080 Spain
	Servicio Interprovincial de Defensa Antigranizo de Alava, la Rioja y Navarra 4 Milicias 4-1°- 26003 LOGRONO Spain

SYRIAN ARAB REPUBLIC	Meteorological Department of Syria P.O. Box 4211 Mazzeh Jabal DAMASCUS Syrian Arab Republic
THAILAND	Bureau of the Royal Rainmaking and Agricultural Aviation Kasetsart University Phaholyotin Rd., Chatuchak BANGKOK 109000 Thailand
UZBEKISTAN	Uzbek Administration for Modification of Hydrometeorological Processes 72, K. Makhsumova Str. 700052 TASHKENT Uzbekistan
YUGOSLAVIA	Federal Hydrometeorological Institute Bircaninova 6 11001 BEOGRAD Yugoslavia

VI. MEMBER COUNTRIES REPORTING ON COMPLETED PROJECTS

LOCATION AND TERRAIN	PURPOSE AND DURATION	AGENT AND ALTITUDE OF SEEDING	REFERENCES TO PUBLISHED RESULTS	CONTACT FOR INFORMATION
FRANCE				
Hilly and flat terrain in southwestern France Target: 80,000 km^2 Control: 420,000 km^2 Both areas fixed	Suppression of hail from convective and frontal clouds 44 years Apr-Oct	Agent: AgI from 590 ground-based generators. Control is based on hail pad data and crop damage data. Seeding criterion: hail with diameter ≥ 15 mm predicted. Seeding unit: 1 day with 8 hours of seeding. Evaluation method: bivariable test with logorithmic transformation. Result: 42% decrease in hail mass at 0.01 statistical significance level. See also 1992, 1993-1994 and 1995 Registers	Dessens, J., 1986, "Hail in southwestern France II: Results of a 30 year Hail Prevention Project with AgI seeding from the ground" - J. Appl. Meteor. and Climate, 25, pp. 48-58 Association Nationale d'Etude et de Lutte contre les Fleaux Atmospheriques, Brochure N45 (1997), 39 pp.	ANELFA 52, rue Alfred Dumeril 31400 TOULOUSE France
GERMANY				
Hilly terrain in Stuttgart area Target: 2,500 km^2 Control: 4 areas, 2,500 km^2 each Areas are fixed and adjacent	Suppression of hail from convective clouds 17 years Apr-Oct	Airborne seeding with AgI at cloud base level. For more information on project design see Registers for 1992 and 1995. For a sample set of 16 seeded and 14 unseeded units (1996) no definite result obtained. More precipitation recorded within 100 cm downwind of the target.		University of Hobenheim STUTTGART Germany

IRAN, ISLAMIC REPUBLIC OF				
Mountainous terrain in Yarz Province (32°N, 55°NE) Target: 100 km^2 Control: 100 km^2 Areas are 100 km apart	Precipitation Enhancement from convective clouds 1996-1997 Jan-Apr., Dec	Agent: AgI from 30 ground-based generators standard seeding period: 1-2 hours a day. Total duration of seeding for two years: 316,5 hours Control is based on precipitation gauges in target and control areas, 10 gauges in each . Result : more precipitation		Islamic Republic of Iran Meteorological Organization Tehran Islamic Republic of Iran
JORDAN				
Hill and flat terrain. Fixed target: 14,500 km^2 Target only	Precipitation increase and extension of wet period. Oct-Dec 1996 Jan-May 1997 Orographic and frontal clouds	Agent: AgI, and NCl (2% solution in acetone) being seeded from 23 G/B burners and 2 airborne burners at 2.5 - 3.5 km. Seeding rate: 12g/hour for each G/B burner and 120 g/hour for each of the two airborne burners. Length of the A/C seeding track: 50 km. LWC and Ice particle concentration in unseeded clouds are measured. Standard seeding period: 70 hours. Seeding criterion: cloud top temp.between -12° to -20°C; LWC and ice particle concentration also accounted for . Control is based on data from 17 recording precipitation gauges. Evaluation based on comparison with historical data and on precipitation efficiency maps. Results: a 17% increase in	Tahboub .I.K, "A study on a 10 year period of cloud seeding over Jordan" (to be published in WMO Bulletin)	Jordan Meteorological Department Jordan Precipitation Enhancement Programme P.O. Box 341011 Marka AMMAN Jordan

		precipitation amount at a 0.05 significance level. Extended area effect: a 10-4% increase in precipitation downwind of the target area.		
KOREA, REPUBLIC OF				
Mid-eastern Korea (Andong Catchment Area) Flat terrain Target: 1962 km^2 Fixed.	Experimental Research of Cloud Seeding. About two years of precipitation enhancement from frontal clouds. Jan-June	Agent: AgI being seeded from 6 G/B acetone burners and dispersed with 20g AgI flares launched from aircraft. The seeding altitude is about 3 km, the rate being 40 flares during one experiment. Standard seeding periods: G/B - 8 hours, airborne - 1 hour.Seeding criteria:Cloud top temp ≤ -5°C.Cloud depth ≥ 100m Control is based on 21 precipitation gauges in the target area		Hydrometeorology Research Lab., Meteorological Research Institute, 2, Waryong-dong, Chongno-gu SEOUL 110-360 Republic of Korea
MOROCCO				
Atlas Mountains. Mountainous terrain Target: 16,400 km^2 Control: 6,000 km^2 Both fixed, 100 km apart	Rainfall and snowfall augmentation from all types of clouds Nov-Apr	Ground-based 15 G/B generators and airborne seeding with AgI and NaI temp. less -5°C. Seeding rate 0.375 kg/hour. Seeded unit: individual storm. Seeding criteria are based on meteorological analyses, model results, radar, satellite data. Evaluation basis: data from 20 and 10 rain gauges in target and control areas. Statistical method: Multiresponse Permutation Test. Result: Increase in rainfall. See also 1995 register.		Direction de la Météorologie Nationale Service de recherches atmospheriques/CNCRM Aéroport CASA/ANFA CASABLANCA Morocco

SYRIAN ARAB REPUBLIC				
Mountainous, hilly and flat terrain Target: 150,000 km^2 Control: variable Location of target and control areas are variable, depending on clouds and wind direction	Precipitation enhancement from orographic, convective and frontal clouds 1991-1997 Nov-May	Agent: AgI. Airborne seeding at 4-7 km. Standard seeding duration: 200 hours/year. Basis for evaluation: 125 precipitation gauges (including 32 recording) in target area. Result: 9-20 % precipitation increase at 0.05 significance level	Sixth WMO Scientific Conference on Weather Modification (Italy, 1994) WMO TD/No. 596, Vol. 1, pp. 325	Syrian Ministry of Agriculture and Agrarian Reform Rain Enhancement Project DAMASCUS Syrian Arab Republic
UZBEKISTAN				
Hilly terrain near Tashkent city. Target: 250 km^2	Dispersion of stratiform and frontal clouds over Tashkent city. 4 years Mar.	Agent: dry ice and liquid nitrogen at a rate of 180-360 kg/hour at an altitude of 4 km. Seeding criteria: cloud top temp. < -4°C, cloud depth >400m. Standard seeding period: 7-16 hours results: less precipitation and more gaps in cloud shield.		Main Adminisration for Hydrometeorology, Weather Modification Office. 85 Mahsumov street Tashkent Uzbekistan
Fixed Target, 7380 km^2 Fergana Valley, Kashkadarya, Samarkand and Surkhandarya regions	Anti-rail protection of crops. Convective clouds. Apr-Aug. 1969-1986	Agent: AgI dispersed from flares on rockets and shells at levels with temp between -3°C and -9°C. Seeding criteria based on radar reflectivity at a wavelength of 10cm. Standard seeding period: 2-30 min number of seeded zones: 209 basis for evaluation: changes in cloud radar characteristics and crop damage data. Results. Less hail but no changes in precipitation		Main Administration for Hydrometeorology, Weather Modification Office 85 Mahsumov Street TASHKENT Uzbekistan

VIII. MEMBER COUNTRIES REPORTING *NO* WEATHER MODIFICATION PROJECTS IN 1996

Argentina
Armenia
Australia
Azerbaijan
Bahrain
Belize
Boshia and Herzegovina
Botswana
Brunei
Bulgaria
Cameroun
Czech Republic
Colombia
Costa Rica
Ecuador
Egypt
El Salvador
Eritrea
Estonia
Finland
Gambia
Greece
Guinea-Bissau
Hong Kong
Hungary
Iceland
India
Jamaica
Kazakstan
Kyrgyz Republic
Latvia
Lebanon
Lithuania
Luxembourg
Macao
Madagascar
Malta
Malaysia
Mauritius
Micronesia, Federated States of
Namibia
Niger
Pakistan
Papua New Guinea
Philippines
Portugal
Romania
Saudi Arabia
Senegal
Seychelles
Singapore
Slovak Republic
Salomon Islands
Sri Lanka
Sudan
Sweden
Switzerland
Tanzania, United Republic of
Trinidad and Tobago
United Kingdom
Uruguay
Venezuela

WORLD METEOROLOGICAL ORGANIZATION

R/CLA/4, ANNEX A
FORM (1 January 1996)

PROGRAMME ON PHYSICS AND CHEMISTRY OF CLOUDS AND WEATHER MODIFICATION RESEARCH

QUESTIONNAIRE TO GATHER DATA FOR THE 1996 REGISTER OF NATIONAL WEATHER MODIFICATION PROJECTS

PLEASE MARK APPROPRIATE BOXES

MEMBER OF WMO

No weather modification activities in 1996

(Please return this form even if no weather modification activities have taken place this year).

1. TYPE (PURPOSE) OF WEATHER MODIFICATION ACTIVITY OR PROJECT:

   (a) Precipitation enhancement

   Activity is response to emergency (e.g., droughts)

   Activity is for routine water supply augmentation

   Goal is to extend wet period

   Goal is to increase precipitation during wet period

   (b) Precipitation redistribution

   (c) Hail suppression

   (d) Fog dispersal

   (e) Other (please specify):

2. THIS IS PRIMARILY A (Research. . . . .) (Development . . .) (Operational . . . . .) ACTIVITY

3. PROJECT AREA

(a) Approximate size of the project target area (km^2):

(b) Approximate size of the control area (if used) (km^2):

4. NAME AND/OR REFERENCE OF PROJECT:

5. LOCATION OF AREA IN WHICH PROJECT IS CARRIED OUT:

6. PROJECT HISTORY

(a) Year project started:

(b) Has project been implemented each year since it was started?

Yes No Not known

(c) Is it expected to continue during the coming year?

Yes No Not known

7. NATURE OF ORGANIZATION SPONSORING PROJECT
(Please place X in appropriate box)

ACTIVITY OF ORGANIZATION	GOVERNMENT	PRIVATE
Agriculture		
Energy		
Forestry		
Hydrology		
Research Foundation		
Transportation		
Weather Service		
Other (please specify)		

8. PROJECT ACTIVITY THIS YEAR

(a) During the current reporting year, what months did seeding or other weather modification activity take place?

(Note: if reporting period extends over two years, as it might if a project spanning December and January is being reported, please indicate the years being reported, one example might be: December 1995, January-February 1996; another might be: January-February 1996, December 1996).

(b) On how many days will this activity take place?

9. DESCRIPTION OF WEATHER MODIFICATION APPARATUS, MODIFICATION AGENT AND THEIR DISPERSAL RATES, TECHNIQUES EMPLOYED, ETC. (see instructions)

(a) Seeding delivery system:

Ground	How many generators?_____
Aircraft	How many aircrafts? _____
Rockets	Artillery shells

Other (please specify): .....

(b) Type of Generator:

Acetone burner	Pyrotechnic flare
Explosive	Liquid spray
Solid dispersal	Other: .....

(c) Location of release of seeding material:

Ground	Cloud base
Cloud top	In-cloud

If release is in-cloud, at what temperature or other criterion?

Seeding Material	Rate of Consumption (give units)	Total Consumption during this year (kg)
AgI		
PBI_2		
Dry Ice		
NaCl		
Propane		

10. CHARACTERISTICS OF CLOUDS TREATED:

(a) Convective (cumulus) Orographic Layer (stratiform)

(b) Generally, the cloud base temperature (°C) are:

Warmer than +10°C Colder than +10°C

(c) Generally, the cloud top temperatures are:

Warmer than 0°C

Colder than 0°C but warmer than -20°C

Colder than -20°C

(d) Is the microstructure of the unseeded cloud measured? Yes/No

(e) Criteria used to select days or clouds for treatment:

11. PROVISIONS FOR EVALUATION

(a) None

(b) Randomized experiment

(c) Comparison with historical records

(d) Crop damage Hail pads

(e) Other:

(f) Is a document on the evaluation available or planned? YES NO

(g) If so, is it available to WMO? YES NO

12. MISCELLANEOUS

(a) Was an environmental impact study prepared for this project? YES NO

(b) Has an analysis been made of the expected (or actual) costs and benefits? YES NO

13. ORGANIZATION IN CHARGE OF PROJECT:

(a) Name of key technical person:

(b) Organization:

(c) Postal address:

14. OPTIONAL REMARKS:

15. REPORTING AGENCY:

(a) Name of reporting agency:

(b) Official title of responsible office:

(c) Postal address:

. . . . . .

(Signature) (Date)

Please complete and return this questionnaire as soon as possible, and in any case not later than 30 January 1998.

The Secretary-General
World Meteorological Organization
41, Avenue Giuseppe-Motta
Case postale 2300
1211 GENEVA 2
Switzerland

NOTES FOR COMPLETING REPORT ON WEATHER MODIFICATION ACTIVITIES

Weather modification activities which should be included in the Register

The seeding or dispersing into clouds or fog of any substance with the object of altering drop-size distribution, producing ice crystals or the coagulation of droplets, altering the development of hail or lightning, or influencing in any way the natural development cycle of clouds or their environment.

Any other activity performed with the intention of producing artificial changes in the composition, behaviour or dynamics of the atmosphere.

For example:

(a) The use of fires or heat sources to influence convective circulation or to evaporate fog;

(b) The modification of the solar radiation exchange of the earth or clouds, through the release of gases, dusts, liquids or aerosols into the atmosphere;

(c) The modification of the characteristics of land or water surfaces by dusting or treating with powders, liquid sprays, dyes, or other materials;

(d) The releasing of electrically charged or radioactive particles, or ions, into the atmosphere;

(e) The application of shock waves, sonic energy sources, or other explosive or acoustic sources to the atmosphere;

(f) The use of aircraft and helicopters to produce downwash for fog dispersal as well as the use of jet engines and other sources of artificial wind generation;

(g) The use of lasers or other sources of electromagnetic radiation.

Weather modification activities which need not be included in the Register

Activities of a purely local nature, such as the use of lightning deflection or static discharge devices in aircraft, boats, or buildings, or the use of small heat sources, fans, fogging devices, aircraft downwash, or sprays to prevent the occurrence of frost in tracts or fields planted with crops susceptible to frost or freeze damage.

Note: One completed copy of this form is requested for each weather modification activity (hereafter referred to as the project).

ADDITIONAL EXPLANATION OF QUESTIONS FOR THE REGISTER OF NATIONAL WEATHER MODIFICATION PROJECTS

ITEM 1 - Mark (X) in the box that corresponds to purpose of activity. By project is meant a related series of weather modification activities having a common objective and conducted at a particular location.

ITEM 2 - Mark (X) in the box corresponding to goal of the activity:

- Research - investigating scientific questions;
- Development - field work to optimize procedures;
- Operational - field work intended directly for economic benefits.

ITEM 3 - The Target Area is the area over which an effect is sought. The Control Area (or Areas) are areas that are chosen so as to be unaffected by the seeding material and used to evaluate results within the Target Area.

ITEM 4 - Enter the name and/or reference of projects used by operator. If the project was reported in the previous Register, please quote the WMO Register number which appears in column 1.

ITEM 5 - Indicate the location of the weather modification project by geographical co-ordinates and name of the region.

ITEM 6 - (a) Enter the year in which the first activities under the present project took place;

(b) Indicate if there were breaks in activities or if activities took place each year since it was started;

(c) Indicate whether the project is expected to continue by marking (X) in the appropriate box.

ITEM 7 - Indicate the principal interests of the organization that funds the project by marking (X) in the appropriate box (use multiple marks if appropriate).

ITEM 8 - During what months did the project operate in the field and on how many days did operations take place? Any other information related to the scope of the activity would be helpful. In some cases projects span two years. It is desirable that the portion conducted only within the reporting year be included in the Register for a particular year. If this is not practical, please indicate the years in which the activities took place, for example, December 1996, January-February 1997.

ITEM 9 - By weather modification apparatus is meant any apparatus used with the intention of producing artificial changes in the composition, behaviour or dynamics of the atmosphere. For example: AgI smoke generators, propane devices, flares, rockets, artillery projectiles, jet engines, etc.

(a) Seeding delivery system. Indicate, by marking (X) in the appropriate box, the nature of the delivery system, ground based, airborne, etc.;

(b) Indicate the way the seeding material is prepared for dispersal (e.g., by burning an acetone solution of silver iodide complex). Solid dispersal refers to the release of pellets (e.g., dry ice), powder (e.g., NaCl), etc.;

(c) Indicate the location at which seeding material is dispersed;

(d) Indicate what seeding material is used and the rate of dissemination (mass per unit of time, mass per cloud, etc.). Indicate total amount of material dispensed during the reporting period in kilograms.

ITEM 10 - (a) Indicate, by marking (X) in the box, the general characteristics of the clouds that are selected for treatment;

(b) Indicate the predominate range of cloud base temperatures;

(c) Indicate the predominate range of cloud top temperatures;

(d) What are the characteristics that distinguish days or clouds that are treated from those that are not treated?

ITEM 11 - This question relates to the evaluation of the effectiveness of the project. More information on the means used to judge the merit of the project are welcomed and can be described under Item 14 or on a separate page.

ITEM 12 - This question relates to any analysis that has been made to predict and/or measure the total change in the environment that is affected by the activity and, separately, the economic benefits expected or achieved.

ITEM 13 - Please supply the name and address of agency to which any request for further information should be directed.

ITEM 14 - This item is to permit the reporting person to include any information not covered by items 1 through 13 but which he feels is significant or of interest such as references to published reports describing results of the weather modification operation or experiment. Any information not previously reported, definite plans for a new project, information that is sought, etc., may be outlined under Item 14.

ITEM 15 - Please supply the name and address of the agency that is transmitting this information to WMO.

REPORT ON COMPLETED MODIFICATION PROJECT

(Please mark X in box or boxes which apply)

MEMBER OF WMO:

1. DESCRIPTION OF PROJECT

1.1 Project identification (name/location/organization):

1.2 Purpose(s) of project

Precipitation augmentation - rainfall snow

Hail suppression

Lightning suppression

Other (please specify):

1.3 Major cloud type involved:

Orographic Cumulus Stratiform Frontal

2. DURATION OF PROJECT

2.1 Project duration in years:

2.2 Operational period within each year:

From: . . . . . To: . . . . . inclusive.

3. SEEDING OPERATION

3.1 ***Seeding agent***: AgI CO_2 NaCl

Other (please specify):

3.2 ***Generator(s):*** On ground Airborne

If on ground, please give number of generators:

3.3 ***Procedure for airborne seeding***:

Altitude of seeding (m):

Length of seeding track (m or km):

Seeding rate (kg h^{-1}):

4. PROJECT DESIGN

4.1 ***Basic design:***

Target only Target + control Cross-over

4.2 ***Distance between areas (km):***

4.3 ***Area definition***:

Fixed Variable

If variable, give basis for definition:

4.4 ***Area subdivisions, if any*** (give number and nature):

5. PROJECT SITE

5.1 ***Project terrain:***

Mountainous Hilly Flat

5.2 ***Size of target area*** (km^2):

5.3 ***Size of control area*** (km^2):

5.4 ***Number of precipitation gauges:***

5.4.1 All types of precipitation gauges in target area:

5.4.2 Recording precipitation gauges in target area:

Recording precipitation gauges in control area:

5.5 Other verification quantities (e.g. radar reflectivity, aircraft cloud measurements, hailpads, etc.):

6. EXPERIMENTAL UNIT

6.1 Duration of unit in hours or days:

6.2 Conditions determining whether unit is seedable or not:

6.3 Total number of units seeded and not seeded (in case of cross-over design this applies to each area):

6.4 Randomization of experimental units:

Unrestricted Restricted

If restricted, give nature of restriction:

6.5 Standard seeding period (hours):

7. OVERALL PROJECT RESULTS (no stratification or partitioning)

7.1 Name of statistical test(s) and/or analysis (analyses):

7.2 Transformation(s) for each test:

7.3 Results for each test and/or analysis:

7.3.1 Qualitative:

No difference More precipitation Less precipitation Less Hail Mass

Other qualitative results:

7.3.2 Quantitative:

Seed/no-seed ratio: . . . . . Statistical significance:

8. BASIS FOR ASSESSMENT OF RESULTS

8.1 Analytical specifications fixed BEFORE the project began

8.1.1 Nature of stratification(s), if any:

8.1.2 Sample size for each stratification (No. of seed/no-seed units):

Seed: . . . . . No seed: . . . . . .

8.1.3 Test(s) and/or analysis (analyses) for each stratification:

8.1.4 Transformation(s) for each stratification and each test:

8.1.5 Results for each stratification, test and transformation:

Qualitative: Quantitative:

8.2 Analytical specifications chosen AFTER the project began

8.2.1 Nature of partitioning(s):

8.2.2 Sample size for each partition (No. of seed/no-seed units):

Seed: . . . . . No seed: . . . . . .

8.2.3 Test(s) and/or analysis (analyses) for each partition:

8.2.4 Transformation(s) for each partition and each test:

8.2.5 Results for each partition, test and transformation:

Qualitative: Quantitative:

9. EXTENDED AREA EFFECTS (i.e. outside the target area)

9.1 Sign of effect:

9.2 Maximum distance observed:

9.3 Statistical significance (size of area and probability):

10. COMMENTS

11. PRINCIPAL REFERENCES TO PUBLISHED RESULTS (where details of above may be found):

WEATHER MODIFICATION PROGRAMME REPORTS

1. Review of Warm Cloud Modification by Bh. V. Ramana Murty (September 1984) (TD No. 5)
2. Papers presented at the Fourth WMO Scientific Conference on Weather Modification (Honolulu, Hawaii, 12-14 August 1985) (TD No. 53)
3. Notes for the International Cloud Modelling Workshop/Conference (Irsee, Federal Republic of Germany, 15-19 July 1985) (out of print) (TD No. 57)
4. Register of National Weather Modification Projects 1983 (November 1985) (TD No. 78)
5. The Evaluation of Hail Suppression Experiments - Report of Meeting of Experts (March 1986) (TD No. 97)
6. Information concerning Weather Modification directed to Government Decision-Makers (June 1986) (TD No. 123)
7. Trends in Weather Modification. 1975-1983 (L.R. Koenig, Geneva, November 1986)
8. Report of the International Cloud Modelling Workshop (Irsee, Germany, 15-19 July 1985) (TD No. 139)
9. Register of National Weather Modification Projects - 1984 and 1985 (Geneva, July 1987) (TD No. 182)
10. Register of National Weather Modification Projects - 1986 (Geneva, December 1988) (TD No. 208)
11. Report of the Second International Cloud Modelling Workshop (Toulouse, 8-12 August 1988) (TD No. 268)
12. Papers submitted to the Fifth WMO Scientific Conference on Weather Modification and Applied Cloud Physics (Beijing, China, 8-12 May 1989) (TD No. 269)
13. Register of National Weather Modification Projects - 1987-1988 (TD No. 330)
14. Register of National Weather Modification Projects - 1989 (Geneva, May 1991) (TD No. 417)
15. Report of a Meeting of Experts to Review Findings and Make Recommendations on the Saudi Arabia Cloud Physics Experiment (SACPEX) (Geneva, 14-16 November 1990)
16. Report of the Seventeenth Session of the Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research (Geneva, 19-23 November 1990)

17. WMO Meeting of Experts on the Role of Clouds in the Chemistry, Transport, Transformation and Deposition of Pollutants (Obninsk, 30 September - 4 October 1991) TD No. 448)

18. Register of National Weather Modification Projects 1990 (TD No. 449)

19. Proceedings - WMO Workshop on Cloud Microphysics and Applications to Global Change (Toronto, Canada, 10-14 August 1992) (TD No. 537)

20. Report of the Third International Cloud Modelling Workshop (Toronto, Canada, 10-14 August 1992) (TD No. 565)

21. Register of National Weather Modification Projects 1991 (TD No. 575)

22. Sixth WMO Scientific Conference on Weather Modification Volumes I and II (Paestrum, Italy, 30 May - 4 June 1994) (TD No. 596)

23. Register of National Weather Modification Projects 1992 (TD No. 686)

24. Eighteenth Session of the Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research (Geneva, Switzerland, 30 January - 3 February 1995) (TD No. 687)

25. Register of National Weather Modification Projects 1993 and 1994 (TD No. 745)

26. Expert Meeting to Review the Present Status of Hail Suppression (Golden Gate Highlands National Park, South Africa, 6-10 November 1995) (TD No. 764)

27. Nineteenth Session of the Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research (Geneva, Switzerland, 5-9 May 1997) (TD No. 820)

28. Register of National Weather Modification Projects - 1995 (TD No. 851)

29. Report of the Fourth International Cloud Modelling Workshop (Clermont Ferrand, France, 12-16 August 1996) (TD No. 901)

30. Proceedings of the WMO Workshop on Measurements of Cloud Properties for Forecasts of Weather and Climate (Mexico City, 23-27 June 1997) (TD - No. 852)

31. Seventh WMO Scientific Conference on Weather Modification (Chiang Mai, Thailand, 17-22 February 1999) (TD No. 936)

32. Register of National Weather Modification Projects 1996 (WMO-TD No. 939)