



World Meteorological Organization
Weather • Climate • Water

WMO Expert Committee on Weather Modification Research

To promote scientific practices in weather modification research. This is done through the WMO Expert Team on Weather Modification and through organizing the quadriennial scientific conferences on weather modification.

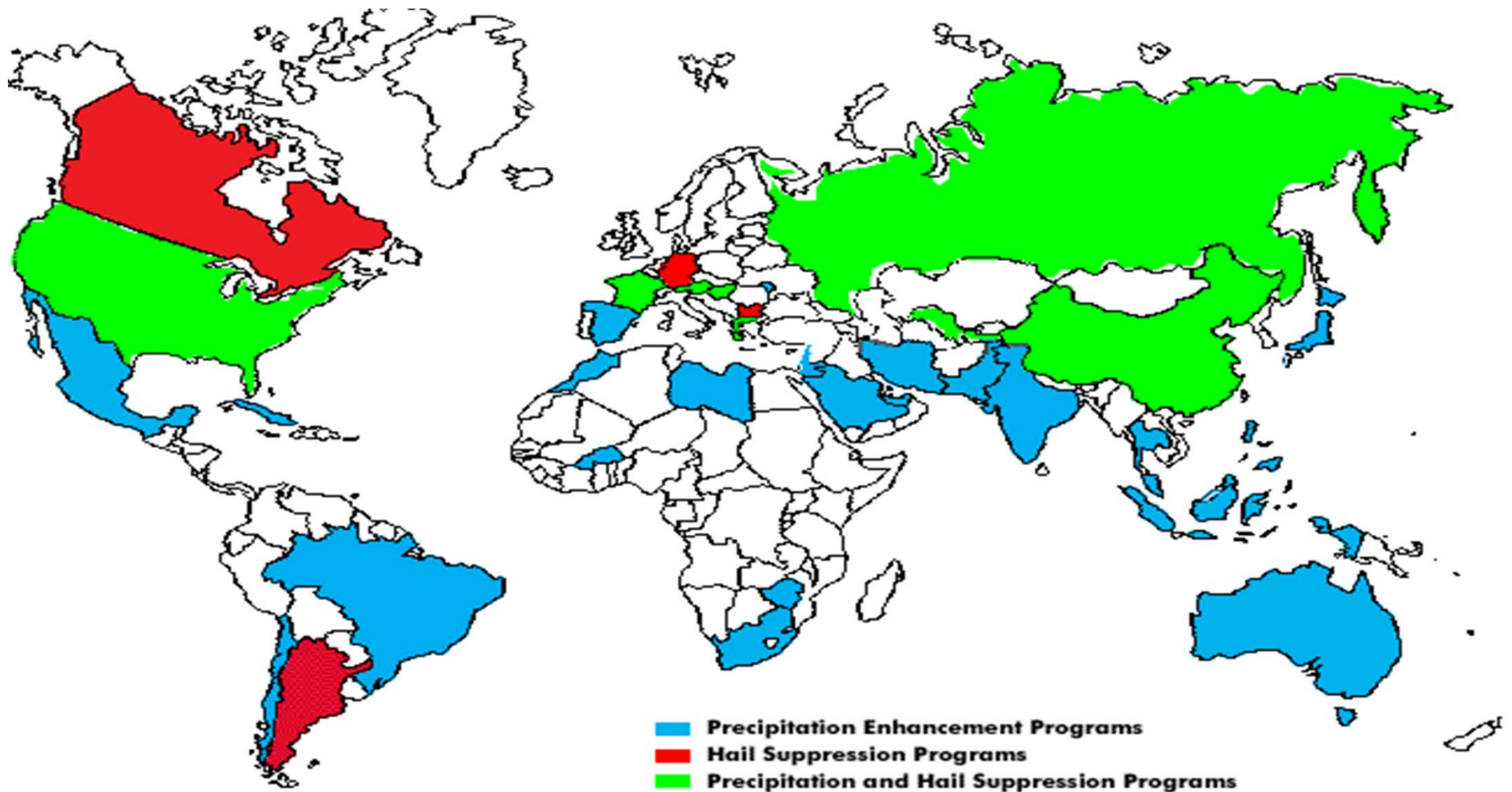
Report
October 2016

Members

Position	Family Name	Given Name	Affiliation	Country	Starting Date	email
Chair	BRUINTJES	Roelof	NCAR	USA	April 2011	roelof@ucar.edu
Member	ABSHAEV	Ali	High Mountain Geophysical Institute	Russian Federation	January 2016	abshaev.ali@mail.ru
Member	ALUSA	Alex	Government	Kenya	October 2011	alexalusa@gmail.com
Member	FLOSSMAN	Andrea	Observatoire de Physique du Globe de Clermont Ferrand	France	January 2016	a.flossmann@opgc.univ-bpclermont.fr
Member	KHANTIYANAN	Warawut	DRRAA	Thailand	October 2011	warawutkun@gmail.com
Member	KOREN	Ilan	Tel Aviv University	Israel	January 2016	Ilan.Koren@weizmann.ac.il
Member	MANTON	Michael	U of Monash	Australia	2007	michael.manton@sci.monash.edu.au
Member	MURAKAMI	Masataka	JMA	Japan	2007	mamura@mri-jma.go.jp
Member	THARA	Prabhakaran	Indian Inst of Tropical Meteorology	India	January 2016	thara@tropmet.res.in
Member	YAO	Zhanyu	CMA	China	January 2016	yaozy@cams.cma.gov.cn

Weather Modification Around the World

56 Countries with active cloud seeding programs



Mission and Functions

- To keep under review, on behalf of OPAG-WWRP and OPAG-EPAC, relevant research, advise CAS on issues requiring attention related to weather modification and suggest mechanisms for addressing such issues;
- To review the criteria for conducting weather modification research to ensure the quality of the science, from the initial design to the final evaluation of field experiments, taking into account advances in supporting fields, including cloud physics, atmospheric chemistry, numerical modelling;
- To serve as a focal point and provide advice and assistance to Members on the manner and means of transferring competence for planning scientific experiments; and
- To assist in the drafting of WMO documents on the status of weather modification and guidelines for providing advice to Members and to propose revisions to these documents where necessary.

Activities since 2015

- **Number of countries doing weather modification programs increased from 52 in 2015 to 56 in 2016 and several new programs in individual countries**
- **Expert team meeting in Thailand in 2015 drafted a new statement on weather modification. Statement went through a rigorous review process which highlighted some additional issues that need to be addressed**
- **Meteorological Services are often asked to provide advice and most of the time refer to the Expert Team (examples)**
- **Several Expert Team members participated in several international and local meetings over the past year. The important meetings were:**
 - **WMO-CMA weather modification course**
 - **UAE research grant program for Rainfall Enhancement Science in Arid and Semi-Arid regions of the world**

Activities since 2015

WMO Statement on Weather Modification Research and Guiding Principles for the Planning of Weather Modification Activities

- Several independent experts around the world reviewed the documents.
- Reviewers highlighted some legacy issues with the document such as addressing both operations and research programs.
- Several modifications were made to the document.

Activities since 2015

WMO Statement on Weather Modification Research and Guiding Principles for the Planning of Weather Modification Activities

- Review the mission of the Expert Team and purpose of the of the WMO statement on Weather Modification.
- Continue to provide advice to member countries upon their request and participate in research programs organized by individual countries.
- Continue to solicit funds for the trust fund and possibly from WMO solely for the meetings of the Expert Team.

International Research Programs

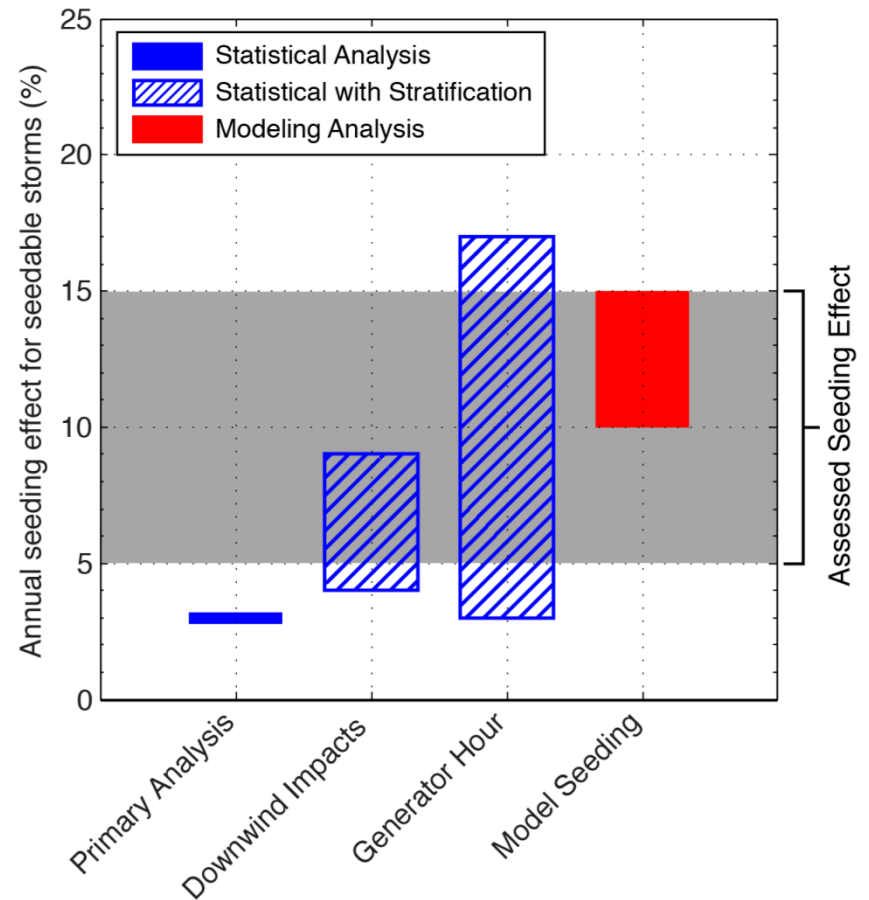
UAE research grant program for Rainfall Enhancement Science in Arid and Semi-Arid regions of the world

- Competitive grant program with a thorough review process.**
- Program annually has US\$5 million to distribute and operate the program. Approximately 3 awards are made every year since the beginning of 2015 with grants typically in the order of 500k per year for three years for researchers**
- Program is widely advertised around the world.**

Future Research Activities

SNOWIE: Seeded and Natural Orographic Wintertime clouds—the Idaho Experiment

- Major US-NSF and State of Idaho research program with intensive field efforts planned for early 2017.
- Will include two instrumented aircraft, 7 microwave radiometers, three mobile dual polarization X-band radars and a suite of ground-based instrumentation.
- Large modeling component with aerosol and seeding components.



Recent Scientific highlights

Cloud Aerosol Interaction Precipitation Enhancement Experiment (CAIPEEX)

- Konwar M., Maheskumar R.S., Kulkarni J.R., Freud E., Goswami B.N., Rosenfeld D., Aerosol control on depth of warm rain in convective clouds, *Journal of Geophysical Research*, , **117**, July 2012, D13204, DOI:10.1029/2012JD01785, 1-10.
- Kulkarni J.R., Maheshkumar R.S., Morwal S.B., Padma kumari B., Konwar M., Deshpande C.G., Joshi R.R., Bhalwankar R.V., Pandithurai G., Safai P.D., Narkhedkar S.G., Dani K.K., Nath A., Nair Sathy, Sapre V.V., Puranik P.V., Kandalgaonkar S.S., Mujumdar V.R., Khaladkar R.M., Vijaykumar R., Prabha T.V., Goswami B.N., The Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX): overview and preliminary results (2012), *Curr. Sci.*, Vol.**102**, 2012, 413-425
- Prabha T.V., Khain A., Maheshkumar R.S., Pandithurai G., Kulkarni J.R., Goswami B.N. (2011), Microphysics of Premonsoon and Monsoon Clouds as Seen from In Situ Measurements during the Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX), *J. Atm. Sc.*, Vol.**68** , 2011, DOI: 10.1175/2011JAS3707.1, 1882-1901

Recent Scientific highlights

- Several other research program ongoing in China, Israel, Thailand, Indonesia
- Most research programs funded outside the auspices of the NMHS's except for China where CMA is heavily involved in both research and operations.
- About 60% of all operational programs globally are conducted and funded separately from the NMHS.
- Funding for research programs in weather modification has grown substantially over the past 5 years.

Interactions with other working groups

- SDS - dust mixed with other pollutants
- TMR – Aerosol-Cloud-Precipitation interactions
- HIWEATHER – Role of aerosols, microphysical-dynamical interactions in severe weather
- Others also in different ways

Trust Fund

- **Very little contributions to the Trust Fund**
- **Continue to follow up on Trust Fund opportunities**
- **Leverage of Existing research efforts and conferences to conduct Expert Team meetings.**
- **With new Expert team members working on alternative methods to secure funding for Expert Team meetings.**

Future Plans

- Updating the Mission and Functions of the Team to align with WWRP goals and align better with other WWRP working groups.
- Developing a plan for next two years:
 - Drafting a updated scientific review of the current status of weather modifications research
 - Redraft the WMO statements to align better with the mission and simultaneously addressing the common requests that WMO and the Expert Team receives from member countries.
 - Organize regional workshops to inform both NMHS and decision makers on the scientific status of weather modification
- Coordinate and enhance international research programs and identify linkages with other WWRP programs.