



NCM
UAEREP
National Center of Meteorology
UAE Rain Enhancement Program

United for Water Security

UAE Rain Enhancement Program:

**A global nexus for a
more resilient climate**

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WATER SECURITY GLOBAL CONTEXT



01

Current efforts to address water scarcity are insufficient to prevent dire consequences.



02

Over two billion people face tainted drinking water, emphasizing the need for sanitation improvements.



03

Water scarcity lacks the public focus and funding it deserves, a glaring disparity.

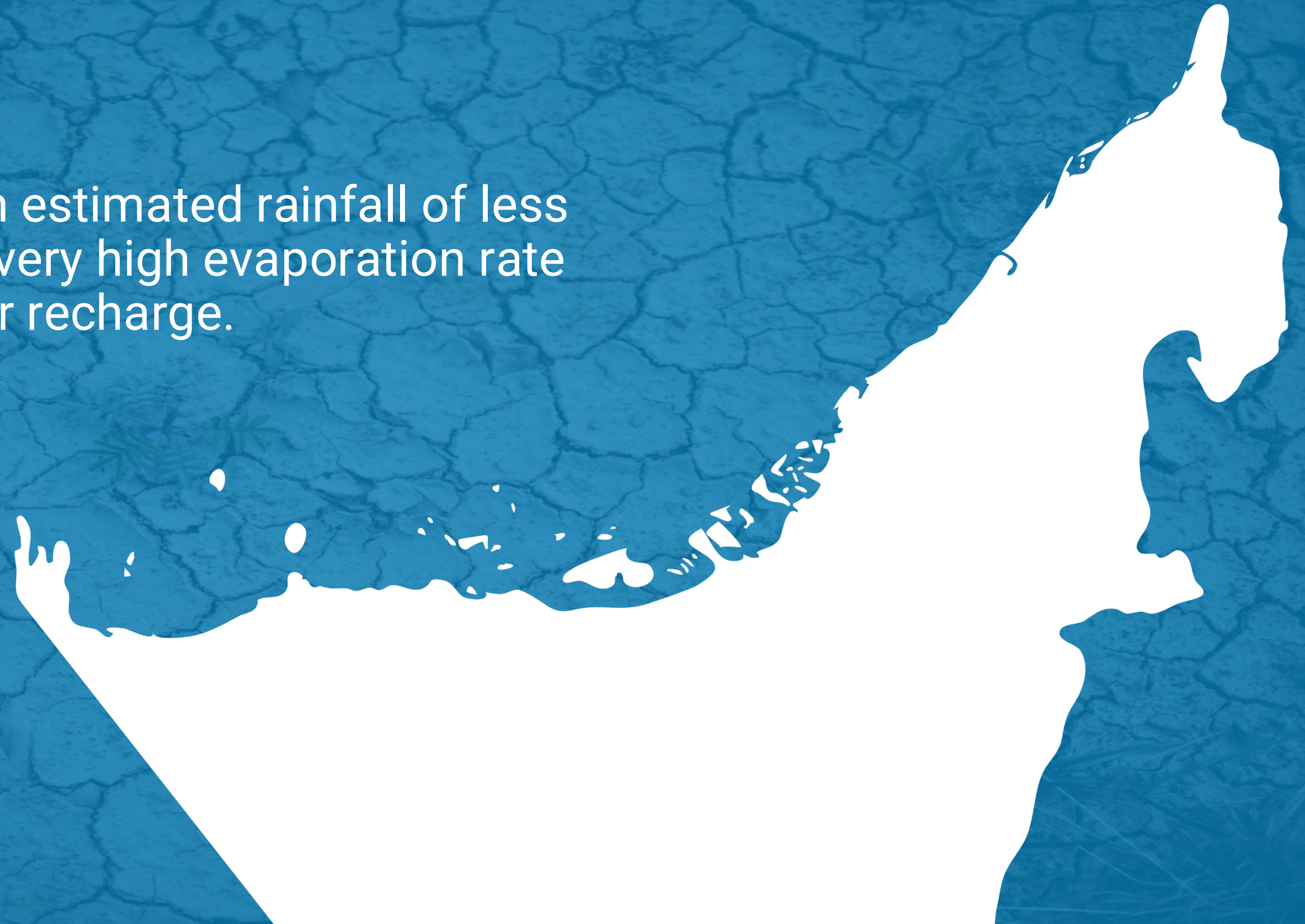


04

Escalating water scarcity worsens existing global threats like climate change and pandemics.

THE UAE CLIMATE

The UAE climate is dry with an estimated rainfall of less than 100 mm per year, with a very high evaporation rate and a low rate of ground water recharge.



RAIN ENHANCEMENT FROM THE LENS OF WEATHER MODIFICATION

Rainfall enhancement has historically been a key weather modification solution that the UAE has pioneered. Here are some significant benefits that we are looking to achieve:

01

Reducing the need for desalinated water, leading to lower energy use and fewer carbon emissions.

02

Supporting rain-fed agriculture, minimizing groundwater depletion and desalinated water use, thus lowering the agricultural carbon footprint.

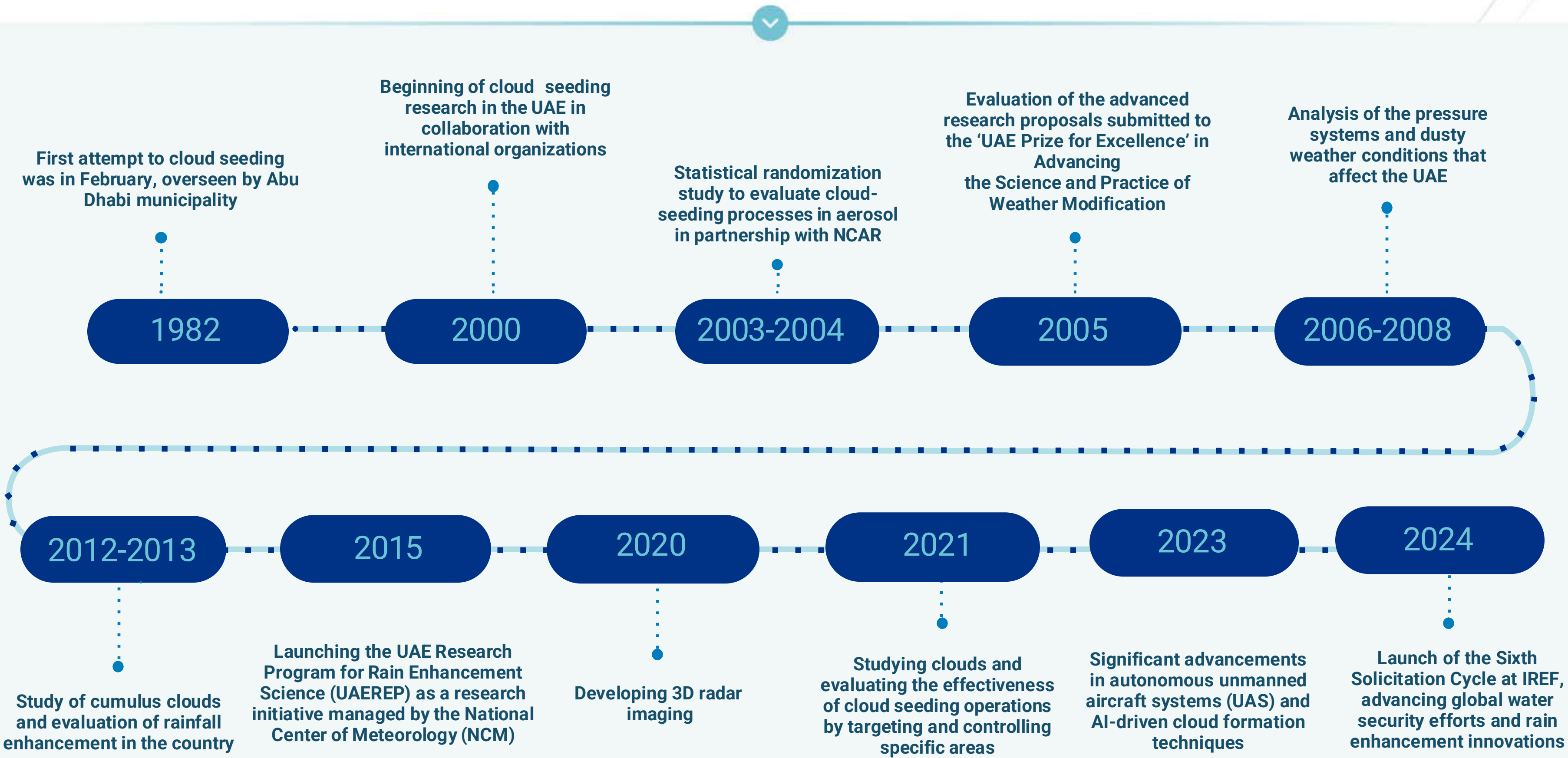
03

Restoring desert ecosystems, fostering biodiversity by creating wildlife habitats.

04

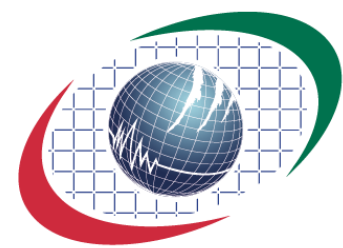
Providing an economically viable, environmentally friendly approach to address water scarcity through advanced weather modification techniques.

RAIN ENHANCEMENT TIMELINE IN THE UAE



UAE's RAIN ENHANCEMENT PROGRAM COMPONENTS

Operations



NCM

المركز الوطني للأرصاد
National Center of Meteorology

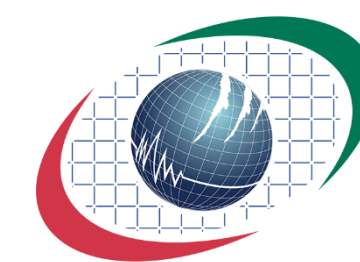
- UAE based operations
- Regional and international programs support

Manufacturing



- Weather Enhancement Technology

Research



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National Center of Meteorology
UAE Rain Enhancement Program

- UAE Research Program for Rain Enhancement Science

UAE CLOUD SEEDING OPERATIONS IN NUMBERS



No. of Aircrafts

4

No. of Pilots

12

Type of Aircraft

Kingair C90 GTI

No. of Flares

48

Flight Hours per Operation

3

Ground Generator Specifications

Units	No. of Flares	Control Method
5	48	Via GSM from the control room



CASE STUDY 2020: CLOUD SEEDING ECONOMICAL VALUE

390



NCM conducted 390 cloud seeding operations

1000



Total hours of cloud seeding operations

5.6B m³



The accumulated volume of the rainfall amount over the country

50%



of these rainy clouds were amenable and conducted cloud seeding operations

10%



is contributed to the total volume of the water

280M



which is equivalent to around 280 Million cubic meters

0.31\$



each cubic meter costs (according to DEWA in 2020)

1/25



the cost effective compared to the desalination plants is 1 to 25

\$3.5M



is the total cost of cloud seeding operations in 2020, in comparison to desalination which costs around \$86 Million dollars.

CLOUD SEEDING MANUFACTURING

Flare Composition

70% Potassium Chloride to attract tiny water droplets and as a nuclei of condensation

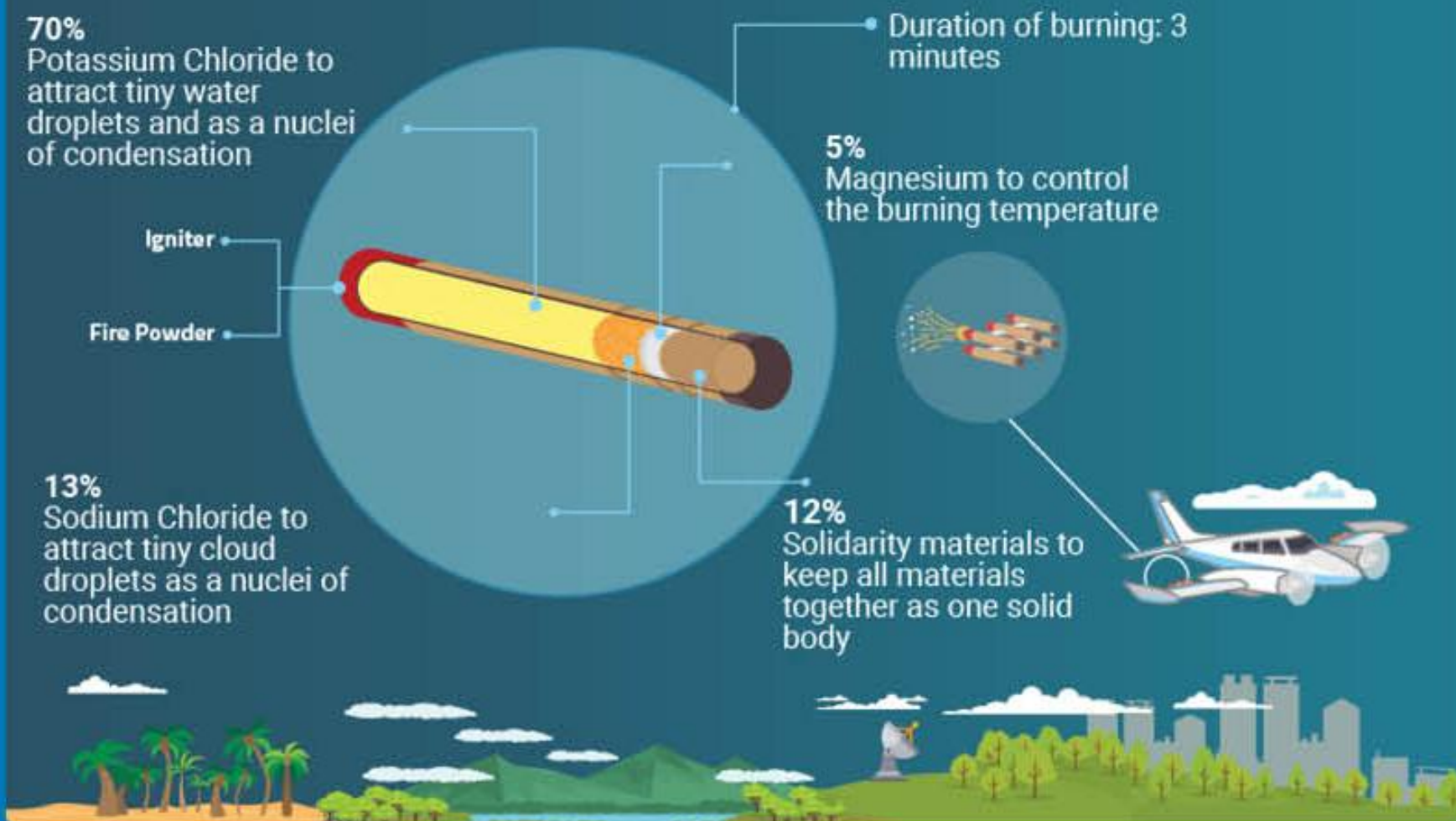
Igniter
Fire Powder

13% Sodium Chloride to attract tiny cloud droplets as a nuclei of condensation

Duration of burning: 3 minutes

5% Magnesium to control the burning temperature

12% Solidarity materials to keep all materials together as one solid body



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Established the Weather Enhancement Technology Factory in 2016

Types of Flares

- Hygroscopic flares for aircraft
- Ground generator flares
- Novel Nanomaterial flares

Annual Production Capacity

Up to **21,000** per year

The strategic support for pioneering researchers has made the UAE the exclusive global producer of cloud seeding nano-material



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**UAE Research Program for
Rain Enhancement**

UAEREP Overview

THE UAE RESEARCH PROGRAM FOR RAIN ENHANCEMENT SCIENCE (UAEREP)



An initiative of the UAE Presidential Court that is overseen by the National Center of Meteorology (NCM)



Offers a grant biannually valued at \$ 1.5M to each awarded researcher over a 3 year period for their innovative projects in rain enhancement science



Invites researchers from domestic or foreign, public or private, non-profit or for-profit organizations and, in some cases, individuals to submit their research proposals

UAEREP OVERALL STRATEGY



VISION

To become the globally recognized model for rainfall enhancement research, development, demonstration, and deployment of technologies



MISSION

To establish scientifically validated technology platforms and techniques that contribute to enhancing rainfall and water security globally, positioning the UAE as a leader in rain enhancement

OUR APPROACH TO DELIVER ON OUR STRATEGY



01

Enhance the level of research and innovation in the field



02

Advance scientific understanding of rainfall enhancement



03

Advance state-of-the-art techniques in rainfall enhancement practices and operations



04

Enhance and further develop capacity in the field both locally and globally

THE UAERP'S MILESTONES



The UAE became a key platform for rain enhancement research as part of its global efforts in weather modification



Led the first ever Townhall meeting on rain enhancement during EGU 2019



Introduced innovations in rain enhancement such as AI and Nano technologies



Featured on National Advanced Science Agenda 2031 and received the UAE's Future Fit seal

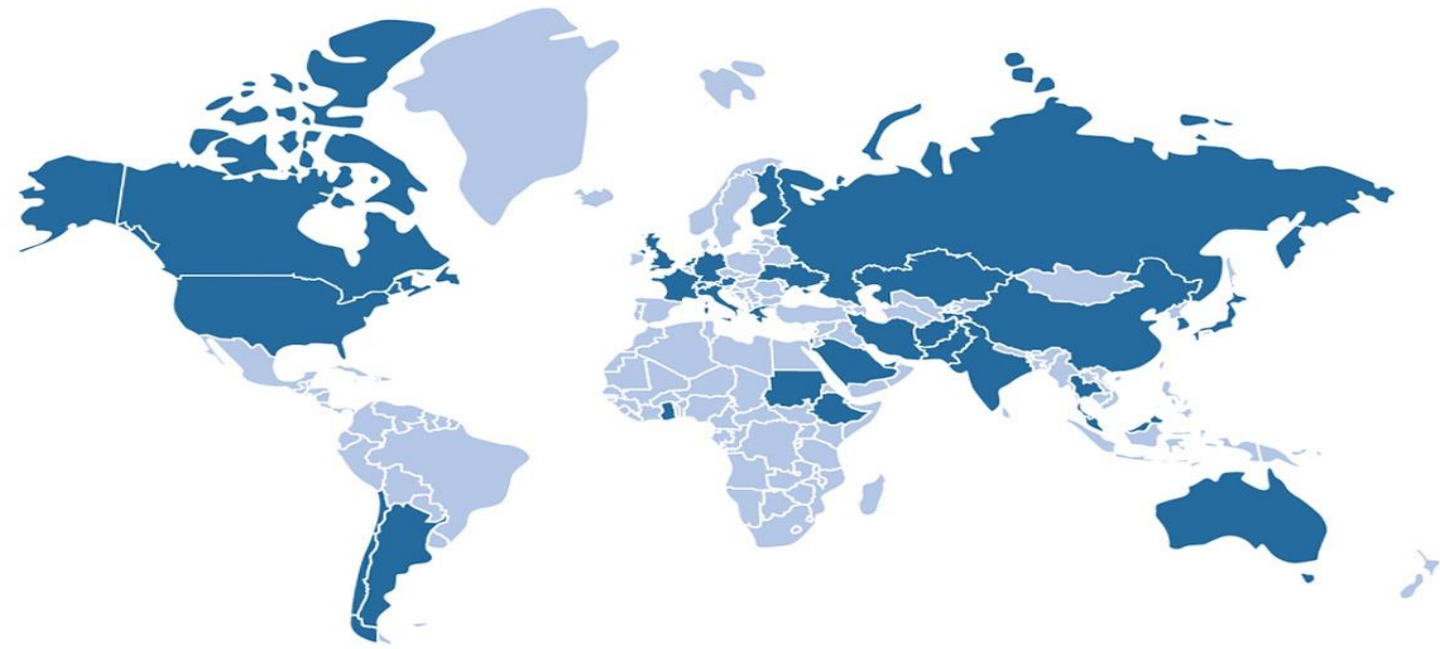


Empowered the youth to actively participate in rain enhancement research projects

nature

Featured in the Nature magazine & received significant interest from international media (NY Times AFP and NBC TV)

UAEREP GLOBAL OUTREACH 2015-2024



76+

Countries Involved



3700

Stakeholders



720

Researchers Engaged



USD 22.5 MILLION

Provided as grants since 2016



14

Awardees



208

Researchers Involved



45

Research institutes



09

Countries

PARTNERS



UAEREP SCIENTIFIC CONTRIBUTIONS 2015-2024

97

Published Scientific
Articles

08

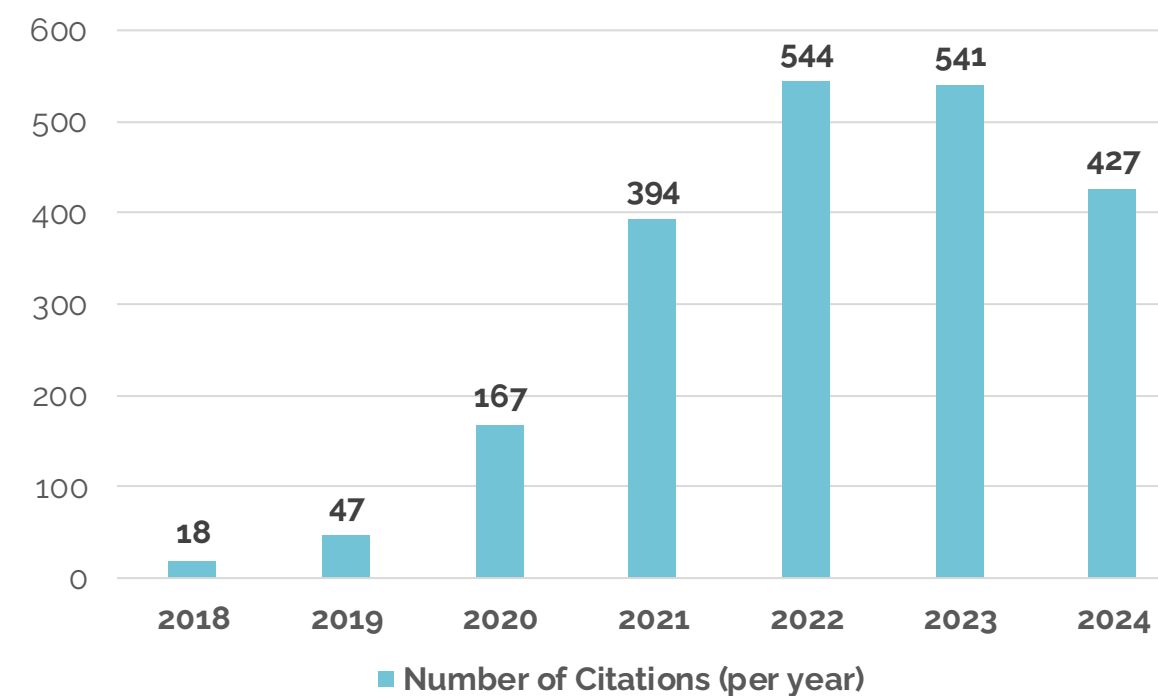
Obtained and
Filed Patents

113+

Conference
Proceedings

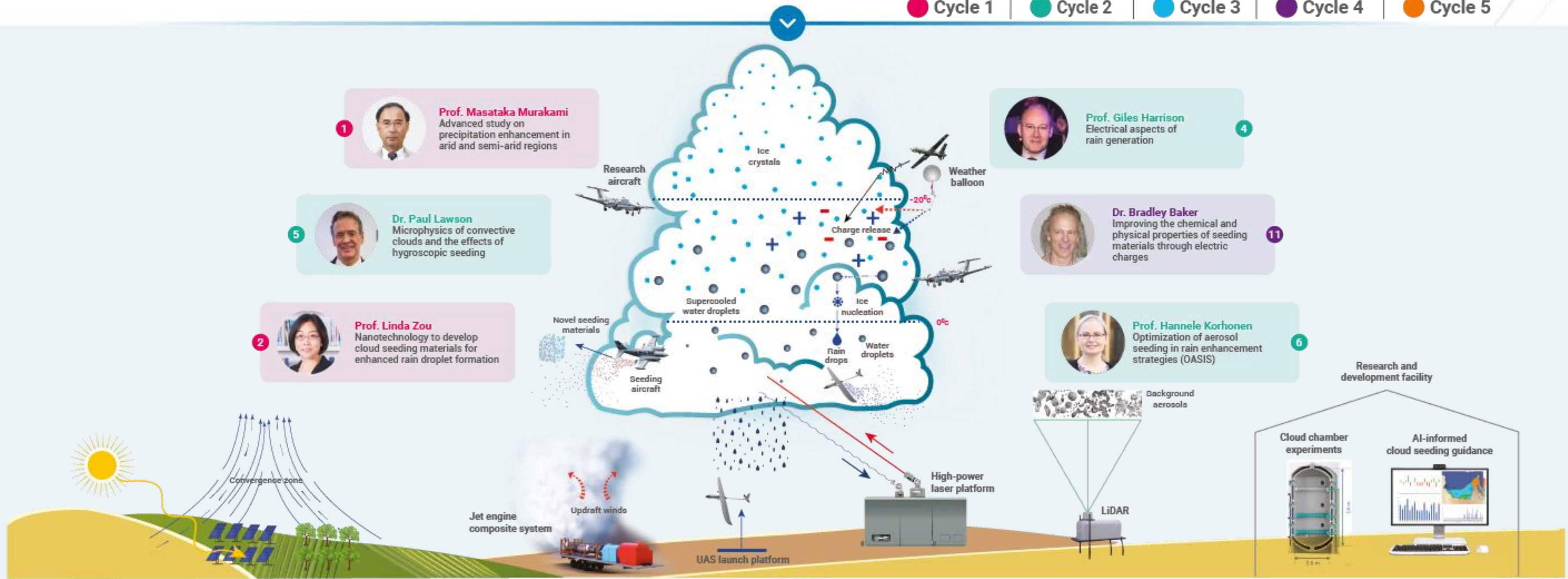
Total Citations

2156



UAERP AWARDEE PROJECTS (2015-2024)

● Cycle 1 | ● Cycle 2 | ● Cycle 3 | ● Cycle 4 | ● Cycle 5



1 **Prof. Masataka Murakami**
Advanced study on precipitation enhancement in arid and semi-arid regions

4 **Prof. Giles Harrison**
Electrical aspects of rain generation

5 **Dr. Paul Lawson**
Microphysics of convective clouds and the effects of hygroscopic seeding

11 **Dr. Bradley Baker**
Improving the chemical and physical properties of seeding materials through electric charges

2 **Prof. Linda Zou**
Nanotechnology to develop cloud seeding materials for enhanced rain droplet formation

6 **Prof. Hannele Korhonen**
Optimization of aerosol seeding in rain enhancement strategies (OASIS)

Research and development facility
Cloud chamber experiments | AI-informed cloud seeding guidance

3 **Prof. Volker Wulfmeyer**
Optimizing cloud seeding by advanced remote sensing and land cover modification

7 **Dr. Ali Abshaev**
On the creation of updrafts for the formation of artificial clouds and rainfall

8 **Prof. Eric Frew**
Targeted observation and seeding using autonomous unmanned aircraft systems

13 **Dr. Guillaume Matras**
Laser-based rain triggering demonstrator with remote sensing technology

10 **Dr. Luca Delle Monache**
A Hybrid Machine Learning Framework for Enhanced Precipitation Nowcasting

12 **Prof. Daniel Rosenfeld**
Identification of Clouds' Microphysical Seedability in an Actionable Manner

9 **Dr. Lulin Xue**
Using Advanced Experimental Numerical Approaches to Untangle Rain Enhancement UAE-NATURE

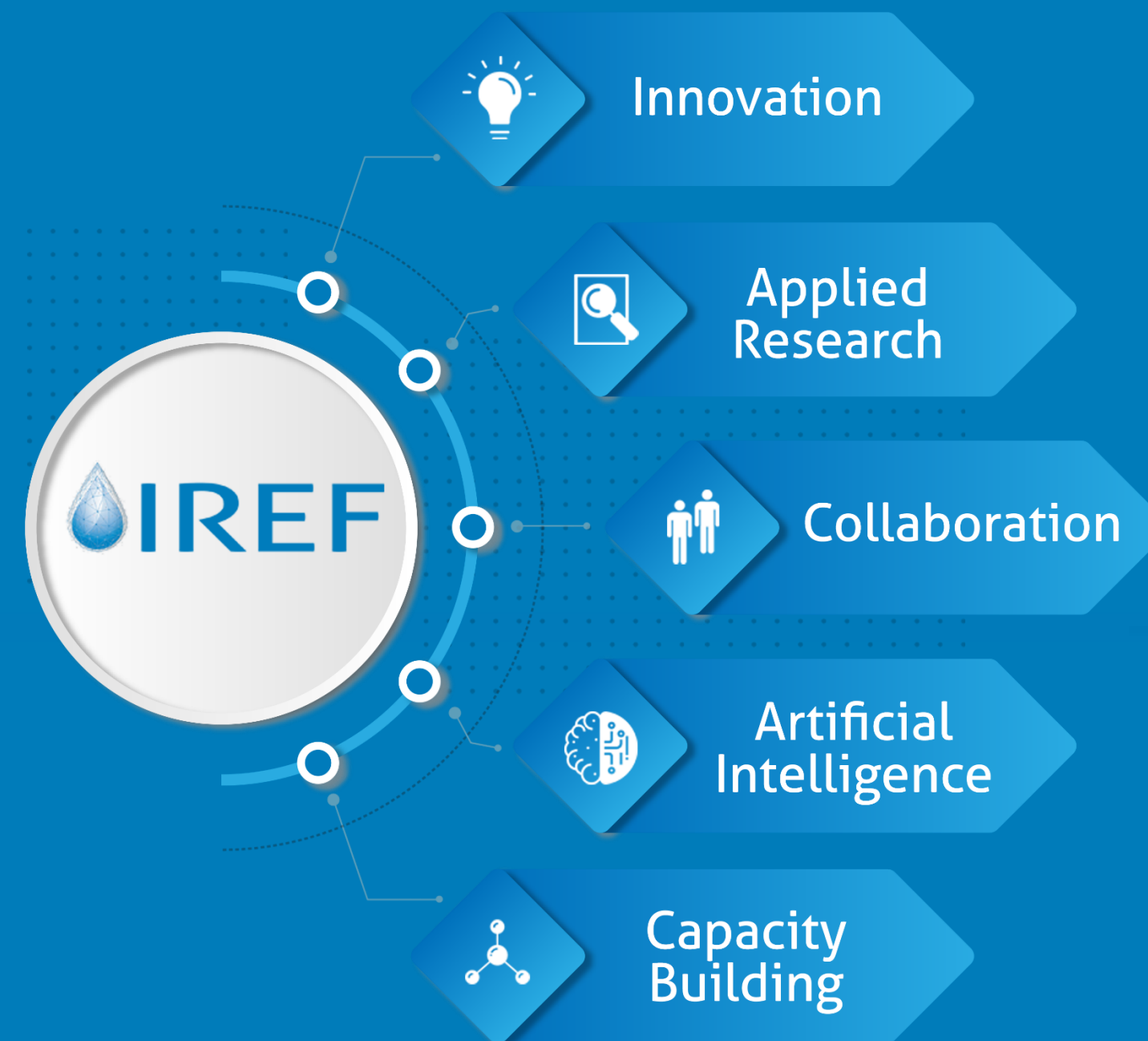
11 **Prof. Will Cantrell**
Laboratory and Modelling Studies of Cloud Susceptibility to Hygroscopic Seeding

THE INTERNATIONAL RAIN ENHANCEMENT FORUM (IREF)



The International Rain Enhancement Forum (IREF)

is a global platform that brings together leading international and national experts, researchers, scientists and stakeholders to tackle pressing water and sustainability issues worldwide



CELEBRATING A DECADE OF GLOBAL OUTREACH

You are Invited

Join us at the **7th International Rain Enhancement Forum (IREF)**, celebrating a decade of global contributions in rain enhancement science.



عشرة أعوام من التواصل
العالمي في البحث والابتكار
TEN YEARS OF GLOBAL
OUTREACH, RESEARCH
& INNOVATION

UAERP's
10th Anniversary



Launching UAERP's
6th Award Cycle



8 Sessions



80 Speakers



January 28 to 30, 2025



Conrad Abu Dhabi Etihad Towers, UAE

REVIEW. ALIGN. PREPARE.

UEAREP's 6th Cycle's Research Focus Areas



Optimized seeding
materials



Rain enhancement
systems



Autonomous unmanned
systems (UAS)

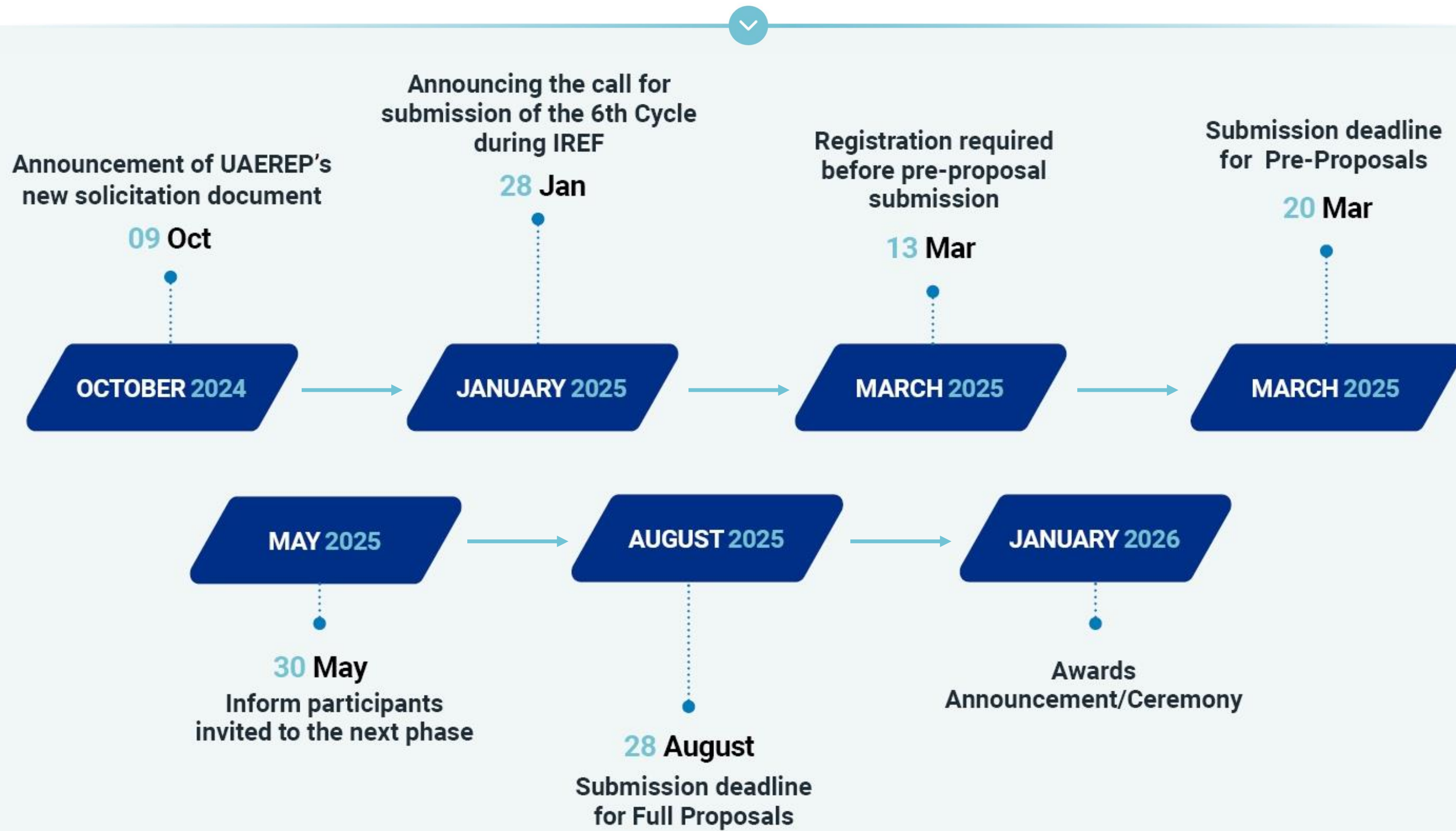


Limited-area climate
intervention



Advanced models,
software and data

6th CYCLE SOLICITATION: TIMELINE



CHARACTERISTICS OF A WINNING PROPOSAL

01

Emphasis should be given to the development of high-impact, large team projects involving academic, industry and government collaborators.

- Multi-institutional, multi-national collaborations, and linkages between universities/colleges, national laboratories, private sector research laboratories, and/or state and local government organizations, as appropriate to the project.

02

Proposals should aim to achieve an advanced level of technology readiness by the completion of the research program.

- Prototype and/or model validation in a research environment is the minimum expectation.
- Field testing of a developed technology and/or integration of developed software tools with weather research and forecasting system is desired.
- Proposals should specify the initial and targeted TRL(s) of the deliverables.

EVALUATION CRITERIA

Projects are selected each year to share the awards grant through a rigorous, two-phase merit review process, based on a series of criteria

Pre-Proposal Review Stage

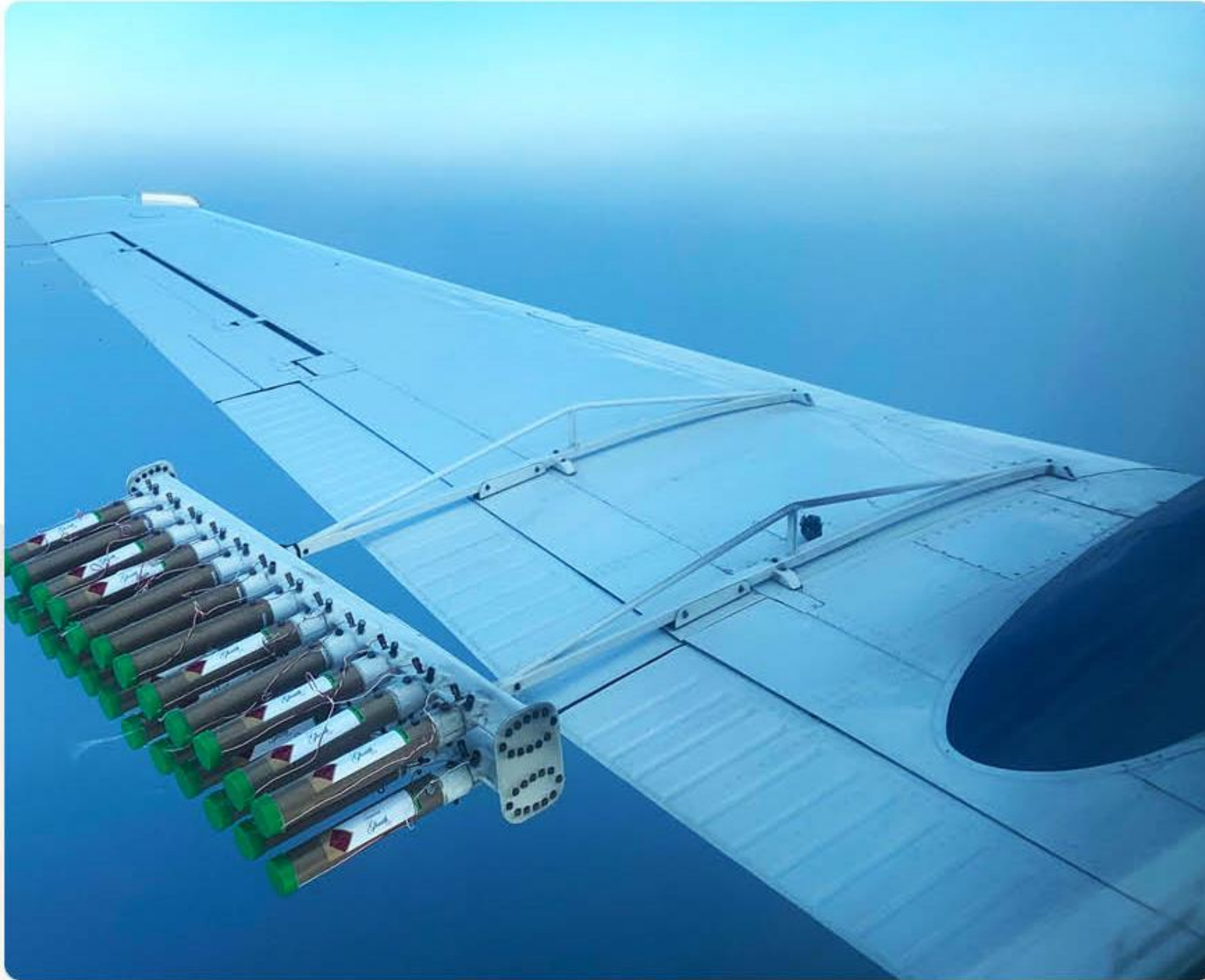
- 01** Proposed research excellence, impact, and quality
- 02** Experience and/or expertise of the proposers, and potential for success
- 03** Multidisciplinary collaboration across academic, industry and government partners
- 04** Potential to enhance or transform the UAE weather modification research community and industry

Full Proposal Review Stage



- 35%** Overall Scientific and Technical Merit, Significance and Innovation
- 20%** Investigator / Team
- 20%** Approach
- 15%** Capacity Building
- 10%** Resources and Budget

SUPPORTING SCIENTISTS WORLDWIDE



NCM-R&D SUPPORT



Continuous technical support and assistance to all the awardees. Provision of needed data, logistics, facilities and advice that the awardees request to support their research efforts and experiments

UAEREP SECRETARIAT SUPPORT



Monitoring the awardees' project deliverables through regular reports to ensure the research is moving in the right direction, in the correct timeframe, while also providing advice for any arising issues

UNITED FOR WATER SECURITY



Join us in advancing global water security through collaborative research and innovative weather modification solutions. We unite experts, foster partnerships, and drive impactful initiatives.

Together, we are **United for Water Security**, shaping a more sustainable future for all.



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