NCM
UAEREP
National Center of Meteorology
UAE Rain Enhancement Program

www.uaerep.ae

C7

The UAE Research Program for Rain Enhancement Science

7th Cycle Solicitation

UAEREP is an international research initiative designed to advance the science and technology of rain enhancement by offering managed grant assistance to selected teams of researchers.

United for
Water Security

The UAE Research Program for Rain Enhancement Science

7th Cycle Solicitation

Program Information

PROGRAM SECRETARIAT

National Center of Meteorology (NCM)

UAE Research Program for Rain Enhancement Science (UAEREP)

PROGRAM CONTACT INFORMATION

The URL of the Program's comprehensive Web Portal is www.uaerep.ae

For general information about the program, please contact info@uaerep.ae

For specific questions about application preparation or the use of the web portal, please contact info@uaerep.ae

Portal Opening Date:	December 08, 2026
Registration:	Required before pre-proposal submission, Please register by March 05, 2027
Pre-Proposal:	Required, Due Date: March 12, 2027 by Midnight Greenwich Mean Time (GMT)
Full Proposal:	Invitation Only, Due Date: August 28, 2027 by Midnight GMT
Type of Award:	Cooperative Agreement - anticipated commitment of one to three years.
Number of Awards:	Up to five awards. Indirect Cost (F&A) a maximum of 20% of the budgeted direct costs.
Funding Amount:	The 7th Cycle total available funding of USD 3M will be distributed among up to five awards across the pairs of funding-to-period categories listed below: • Category 1: ≤ USD 500k for 1-year project periods (two 6-month payments ≤ USD 250k) • Category 2: ≤ USD 1M for 2-year project periods (two annual payments ≤ USD 500k) • Category 3: ≤ USD 1.5M for 3-year project periods (three annual payments ≤ USD 500k) Funding limits for each invited full proposal will be communicated to applicants following the pre-proposal review phase. Awardees will be announced in January 2028, based on a rigorous, two-stage merit review and selection process.
Indirect Cost (F&A):	A maximum of 20% of the budgeted direct costs.

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SECTION 1

I. INTRODUCTION

The UAE Research Program for Rain Enhancement Science (UAEREP) invites innovative research and technology proposals that advance the field of rain enhancement, particularly in arid regions. To date, the program has funded 17 awards (across 6 award cycles), which have advanced, and continue to advance, the science and technologies that underpin cloud seeding operations in the UAE and have contributed to the global knowledge base on rain enhancement (www.uaerep.ae). See Appendix A for information and hyperlinked content on previous and ongoing projects.

This 7th Cycle proposal solicitation is based on the vision and strategic elements of the program, outlined in the 2025-2030 Strategic Plan (https//assets.ncm.gov.ae/assets/uaerep-strategic-plan-2026.pdf). The National Center of Meteorology's (NCM) vision is for UAEREP to become the globally recognized standard for rain enhancement research, development, demonstration, and deployment of technologies and operations that enhance rainfall and water security in the UAE and globally.

To achieve this vision, the UAEREP strives to

- Establish scientifically validated technology platforms and verification techniques that contribute to enhancing rainfall and water security in the UAE and globally
- Position the UAE as the global leader in the science, technology, and implementation of rain enhancement

The program is built on the following pillars

- Managed Grant Assistance through technical oversight and evaluation
- International Collaboration with industry, government, and academia
- Capacity Building and Knowledge Transfer
- Multidisciplinary Research and Innovation

SECTION 2

II. PROGRAM SCOPE

Priority Research Areas

Over the past year, NCM has undertaken a carefully coordinated review of the UAEREP research thrust areas and current project outcomes, involving external experts in rain enhancement and related fields.

For the UAEREP's 7th Cycle, the program will focus on five Strategic Elements / Thrust Areas

- Optimized Seeding Materials
- Novel Cloud Formation and/or Rain Enhancement Systems
- Autonomous Unmanned Aircraft Systems
- Limited-Area Climate Interventions
- Advanced Models, Software, and Data

The chart below shows how the 17 previously funded awards have contributed to these five Thrust Areas (see Appendix A). Awards may contribute to more than one Thrust Area. In particular, integration of results across Thrust Areas is a desirable feature of UAEREP projects, especially as progress is made toward operational readiness.

Thrust Area Cycle # - Last Name	Optimized Seeding Material	Novel CF and/or RE Systems	Autonomous UAS	Limited-Area Climate Interventions	Advanced Models, Data and Software
C1 - Murakami					
C1 - Zou					
C1 - Wulfmeyer					
C2 - Korhonen					
C2 - Harrison					
C2 - Lawson					
C3 - Abshaev					
C3 - Xue					
C3 - Frew					
C4 - Delle Monache					
C4 - Baker					
C5 - Cantrell					
C5 - Matras					
C5 - Rosenfeld					
C6 - Dixon					
C6 - Zou					
C6 - Branch					

Program Scope

Progress toward operational readiness in the five Thrust Areas proceeds through a series of Technology Readiness Level (TRL) ranges identified as

- TRL 1-3 Research -- Basic and Applied Research with focus on application-oriented Proof-of-Concept (including simulations)
- TRL 4-5 Development -- Prototype development and validation in lab and then relevant environments (including simulations and software/ code development)
- TRL 6-8 Demonstration -- Engineering-scale and full-scale systems demonstrated in relevant and then operational environments
- TRL 9 Deployment -- full systems deployed in actual operations with ongoing monitoring and refinement

In the current funding cycle, projects will be selected based on their potential contribution to advancing the program toward targeted outcomes for 2030. Proposed projects should endeavor to advance the program by generating new knowledge and technologies that will either (i) move technologies forward toward deployment readiness or (ii) offer new and innovative insights and approaches to achieving the goals of one or more thrust areas.

All proposed projects should describe a clear direction toward a targeted level of operational readiness (e.g. from Fundamental Research to Technology Development, or from Prototype to System Demonstration and Validation). Therefore, articulation of progress toward technology readiness according to the steps shown above is essential. Redundancy or overlap with previously funded awards should be avoided. Proposers must review the results from prior awards (Appendix A) to demonstrate how the proposed work builds upon, complements, or is clearly distinguished from previous UAEREP-funded research. Furthermore, involvement of the UAE research community in proposed activities is strongly encouraged.

Applicants must identify one (or more) Priority Research Question (PRQ), End Point (EP), and Specific Research Topic (SRT) that their proposal addresses, as tabulated below. Projects addressing multiple Thrust Areas should clearly identify a primary Thrust Area and demonstrate how the additional Thrust Areas contribute to a coherent, integrated research program rather than parallel activities.

Program Scope

Thrust Area: Optimized Seeding Materials		
Priority Research Question (PRQ)	**2030 End Point (EP) quant/qual target + TRL score**	**Specific Research Topic (SRT)**
PRQ1 What are the physical and chemical properties of optimized seeding materials for arid and semi-arid environments and how should they be manufactured and dispersed?	EP1.1 Codified, standardized methodologies for quantifying and benchmarking seeding material properties and techniques. (Benchmarking should include comparison against relevant existing materials/strategies - TRL 7).	SRT1.1.1 Designing (including using AI assisted design) and understanding the particle properties and mechanisms that make seeding materials effective.
		SRT1.1.2 Characterizing seeding agents and their post-dispersion behavior (particle growth rates, ionization states, and chemical stability).
		SRT1.1.3 Dispersal mechanisms for seeding material.
		SRT1.1.4 Quantification of optimal seeding amounts.
		SRT1.1.5 Environmental effects/ toxicity of seeding agents.
PRQ2 What seeding strategies should be employed for optimal effect of seeding materials in an arid or semi-arid environment? (This would also be applicable for strategies that use more than one kind of material.)	EP2.1 Cloud seeding modeling and/or field trials to evaluate seeding materials, strategies, and dispersion methodologies in a variety of cloud conditions and types, with a focus on environments relevant for conditions in the UAE (TRL 6).	SRT2.1.1 Quantifying the natural background aerosol and cloud properties in the seeding area, which is needed to assess effectiveness of seeding.
		SRT2.1.2 Modeling to quantify seeding strategies (location, timing, and optimal amounts) as a function of cloud type and environmental conditions.
		SRT2.1.3 Field trials to verify seeding strategies (location, timing, and optimal amounts) as a function of cloud type and environmental conditions. (The null tests could include not seeding, seeding at the wrong time, and seeding at the wrong place, etc...)
PRQ3 What is the complete chain of processes, from identification of a suitable cloud, to seeding/ dispersal?	EP3.1 Codified recommendations for optimal seeding materials and methodologies for specific cloud conditions (TRL 6)	SRT3.1.1 Cost-benefit analysis tool for identifying microphysical advantages seeding materials provide vs. cost and ease/difficulty of implementation.

Program Scope

Thrust Area: Novel Cloud Formation/Rain Enhancement Systems		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ1 What novel techniques or systems (other than conventional cloud seeding methods) can be developed or further enhanced to optimize the properties of effective cloud condensation nuclei (CCN) and/or ice-nucleating particles (INP) in order to enhance precipitation in arid and semi-arid regions?	EP1.1 Proof-of-concept demonstration from modeling through laboratory-scale validation, achieving a high degree of statistical agreement between modelled outputs and experimental results (TRL 1-3).	SRT1.1.1 Fundamental modeling of CCN and INP activation, aerosol hygroscopicity, and droplet nucleation mechanisms in arid and semi-arid environments.
		SRT1.1.2 Development of theoretical frameworks for non-conventional approaches to enhance CCN and INP properties and activation efficiency.
		SRT1.1.3 Development of coupled modeling–experimental validation methodologies.
		SRT1.1.4 Computational simulation of aerosol–cloud interactions and precipitation-related microphysical processes.
		SRT1.1.5 Feasibility assessment of advanced CCN and INP materials and emerging atmospheric intervention concepts.

Program Scope

Thrust Area: Novel Cloud Formation/Rain Enhancement Systems		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
	EP1.2 Prototype technique or device for laboratory experiments Demonstrate reliable enhancement in CCN activation, droplet growth, or aerosol effectiveness (e.g., larger but fewer) under laboratory/cloud chamber conditions. Validate prototype functionality and experimentally supported precipitation enhancement mechanisms (TRL 3-4).	SRT1.2.1 Development of laboratory-scale prototype systems for CCN and INP activation and droplet growth enhancement.
		SRT1.2.2 Investigation and optimization of laboratory-scale techniques for enhancing CCN and INP activation and droplet growth.
		SRT1.2.3 Cloud chamber validation of aerosol effectiveness and CCN-/INP-mediated precipitation enhancement mechanisms.
		SRT1.2.4 Experimental investigation of advanced physical techniques for enhancing CCN and INP activation and cloud microphysical processes.
		SRT1.2.5 Controlled laboratory studies of turbulence, ionization, airflow, and thermal effects influencing CCN and INP activation.
	EP1.3 Prototype technique or device for field testing. Demonstrate > 10% enhancement in targeted precipitation during pilot field trials under UAE-relevant conditions, quantified relative to a pre-defined no-seeding control baseline, with performance validated through comprehensive field observations and statistical analysis. Demonstrate operational feasibility, scalability, environmental safety, and multi-platform integration capability (TRL 5-6).	SRT1.3.1 Development and field validation of novel non-conventional techniques or systems for enhancing CCN and INP properties and precipitation processes.
		SRT1.3.2 Advanced atmospheric intervention techniques for enhancing CCN & INP activation, droplet growth, and cloud microphysical processes.

Program Scope

Thrust Area: Novel Cloud Formation/Rain Enhancement Systems		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ2 What novel techniques or methods can be developed or further optimized to enhance the conversion from clouds to precipitation in arid and semi-arid regions?	EP2.1 Proof-of-concept demonstration from modeling through laboratory-scale validation, achieving a high degree of statistical agreement between modelled outputs and experimental results (TRL 1-3).	SRT2.1.1 Development of numerical and AI-assisted models for cloud-to-precipitation conversion enhancement
		SRT2.1.2 Modeling of droplet activation, growth, collision-coalescence, and precipitation triggering processes under arid atmospheric conditions
	EP2.2 Prototype technique or device for laboratory experiments Demonstrate repeatable enhancement (>20–30%) in droplet formation, growth, or collision efficiency under controlled laboratory conditions. Functional laboratory-scale prototype validated through repeatable experiments and diagnostics (TRL 3-4).	SRT2.2.1 Investigation of atmospheric microphysical enhancement mechanisms for droplet growth and precipitation formation
		SRT2.2.2 Novel precipitation enhancement techniques in advanced cloud chamber platforms
	EP2.3 Prototype technique or device for field testing Demonstrate > 10% enhancement in targeted precipitation during pilot field trials under UAE-relevant conditions, quantified relative to a pre-defined no-seeding control baseline, with performance validated through comprehensive field observations and statistical analysis. Validated prototype system suitable for controlled outdoor or pilot-scale deployment (TRL 5-6).	SRT2.3.1 Multi-modal sensing and adaptive control methods for real-time optimization of cloud-to-precipitation conversion
		SRT2.3.2 Acoustics and pressure-wave-based precipitation enhancement techniques
		SRT2.3.3 UAV or ground-based targeted cloud microphysics modification systems under UAE-relevant atmospheric conditions

Program Scope

Thrust Area: Novel Cloud Formation/Rain Enhancement Systems		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ3 What novel methodologies can be reliably used to exploit cloud dynamics to enhance precipitation in arid and semi-arid regions?	EP3.1 Proof of concept demonstration from modeling through laboratory-scale validation, achieving a high degree of statistical agreement between modelled outputs and experimental results (TRL 1-3).	SRT3.1.1 Modeling of cloud dynamics responses to atmospheric and cloud microphysical perturbations under arid-region atmospheric conditions
	EP3.2 Prototype technique or device for laboratory experiments Demonstrate repeatable enhancement (>20–30%) in cloud microphysical processes associated with precipitation formation, quantified relative to a predefined control baseline and validated through comprehensive laboratory measurements and statistical analysis. Functional laboratory-scale experimental platform validated through repeatable diagnostics and controlled cloud microphysics studies (TRL 3-4).	SRT3.2.1 Experimental investigation of cloud dynamics and microphysical mechanisms influencing droplet growth, collision-coalescence, and precipitation initiation
	EP3.3 Prototype technique or device for field testing Demonstrate >10% enhancement in precipitation-related cloud dynamics or microphysical parameters under UAE-relevant atmospheric field conditions, quantified against a pre-defined no-seeding control baseline, with performance validated through comprehensive field observations and statistical analysis. Validated field-deployable prototype system or methodology suitable for controlled outdoor or pilot-scale operation (TRL 5-6).	SRT3.3.1 Development and field validation of atmospheric intervention systems for controlled modification of cloud dynamics and precipitation processes
	EP3.4 Prototype Atmospheric Perturbation System for Field Trials Develop and field-test a prototype system capable of generating localized atmospheric perturbations leading to measurable cloud precursor formation over scales of tens of meters under real atmospheric conditions (TRL 6).	SRT3.4.1 Development of field-deployable atmospheric perturbation systems for cloud triggering
		SRT3.4.2 Real-time atmospheric monitoring and feedback control for optimization of the prototype system
		SRT3.4.3 Field validation, performance quantification, and precipitation assessment of the prototype atmospheric perturbation system under UAE conditions

Program Scope

Thrust Area: Novel Cloud Formation/Rain Enhancement Systems		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ4 How can cloud formation be reliably triggered under marginal atmospheric conditions (not just existing clouds enhanced)?	EP4.1 Demonstrate Controlled Cloud Initiation in UAE-Relevant Atmosphere (TRL4-5) • Demonstrate intentional initiation of persistent cloud under marginal atmospheric conditions in at least 30–40% of UAE-relevant test cases where natural cloud formation would normally not occur. • Validate measurable increases in localized liquid water content, aerosol activation, and droplet nucleation compared with baseline atmospheric conditions.	SRT4.1.1 Atmospheric perturbation dynamics turbulence, humidity redistribution, and localized updraft generation
		SRT4.1.2 Aerosol, plasma and ion-mediated condensation triggering for artificial cloud formation
		SRT4.1.3 Multi-physics modeling/simulation of cloud initiation under UAE-relevant atmospheric conditions
		SRT4.1.4 Advanced diagnostics and remote sensing techniques for detection and validation of artificial cloud initiation signatures

Program Scope

Thrust Area: Novel Cloud Formation/Rain Enhancement Systems		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ5 How can the synergistic effects of combining multiple intervention mechanisms be developed to increase the efficiency of droplet formation, growth or precipitation?	EP5.1 Proof-of-Concept of Synergistic Interventions (TRL 3-4) • Demonstrate >20% improvement in droplet formation/growth efficiency compared with single mechanisms. • Validate the scientific feasibility of combining multiple intervention mechanisms in laboratory conditions.	SRT5.1.1 Fundamental interaction studies and numerical/ theoretical modeling of coupled atmospheric intervention mechanisms
		SRT5.1.2 Investigation of synergistic enhancement of CCN activation, droplet nucleation, and droplet growth
		SRT5.1.3 Identification of optimal timing, spatial overlap, and sequencing between multiple intervention methods
	EP5.2 Integrated Laboratory Prototype (TRL 4-5) • Achieve > 20 % relative precipitation enhancement under >50% of tested UAE-relevant atmospheric conditions, demonstrating consistent performance compared to single-mechanism approaches. • Develop and validate an integrated laboratory-scale multi-mechanism prototype.	SRT5.2.1 Development of integrated laboratory-scale multi-mechanism atmospheric intervention systems with synchronization and control capabilities
		SRT5.2.2 Development of in-situ diagnostics and sensing for droplet formation, aerosol activation, and atmospheric perturbation monitoring
		SRT5.2.3 Experimental validation of repeatability, stability, and scalability of synergistic interventions
	EP5.3 Field-Ready Demonstrator with Optimization Framework (TRL 5-7) • Demonstrate >10% enhancement in cloud microphysics and atmospheric perturbation indicators, with >20% precipitation improvement through AI-assisted optimization under UAE field conditions compared to single-mechanism approaches. • Develop a field-ready multi-mechanism demonstrator integrated with a predictive optimization framework for varying UAE atmospheric conditions.	SRT5.3.1 Development of field-deployable multi-mechanism atmospheric intervention demonstrators
		SRT5.3.2 AI/data-driven optimization frameworks for selecting and controlling intervention combinations
		SRT5.3.3 Field validation and operational assessment of synergistic atmospheric perturbation and precipitation precursor enhancement, including efficiency, environmental impact, safety, and scalability under UAE conditions

Program Scope

Thrust Area: Unmanned Aerial Systems (UAS)		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ1 (umbrella). How can UAS be integrated into the full rainfall-enhancement mission chain, including validation, delivery, monitoring, and feedback within NCM?	EP1 Integrative – spans EP1–EP5. Obliges every PRQ2–PRQ6 proposal to demonstrate upstream/downstream plug-in (TRL 3-5).	SRT1.1 Reference architecture & systems-engineering framework for the UAS-enabled mission chain.
PRQ2. How can onboard sensing, nowcasting, data assimilation, and decision support enable real-time identification of seedable clouds?	EP2. Near-cloud and in-cloud sensing + seedability diagnosis + autonomous targeting; identifies seedable cloud volumes in near-real-time with high agreement against expert NCM operators (TRL 3-6)	SRT2.1 Hybrid AI + physics decision-support for onboard seedability diagnosis & autonomous targeting.
		SRT2.2 Integration of near-cloud and in-cloud sensing technologies into established UAS platforms.
PRQ3. How can UAS safely and accurately deliver seeding materials with controlled timing, dosage, and dispersion under observed cloud conditions?	EP3. Small fixed-wing UAS replicating manned hygroscopic cloud-targeting and seeding in UAE airspace; payload accuracy comparable to piloted aircraft (TRL 6-7).	SRT3.1 Precision delivery mechanisms for established UAS platforms.
PRQ4. How can Human-in-the-Loop (HITL) autonomy, Command and Control (C2) reliability, safety assurance, and regulatory compliance support repeated Beyond Line-of-Sight / Beyond Visual Line-of-Sight (BLOS/ BVLOS) UAS missions in UAE airspace?	EP4. Operationally reliable, redundant C2 / data-link for multiple simultaneous UAS, with GCAA-acceptable safety case and HITL operating concept (TRL 5-7).	SRT4.1 BLOS/BVLOS communications & C2 architecture for coordinated multi-UAS operations.
		SRT4.2 HITL autonomy framework + safety case & GCAA regulatory dossier.

Program Scope

Thrust Area: Unmanned Aerial Systems (UAS)		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ5. How can multiple UAS be coordinated for reconnaissance, sensing, targeting, and delivery across 1–5 km² areas within sub-hourly forecast windows?	EP5. Coordinated swarm performing cloud reconnaissance, in-cloud validation and delivering up to 4 kg of seeding material across 1–5 km² within <1 h forecast lead time (TRL 5-7).	SRT5.1 Coordination protocols for multi-UAS recon/ validation/seeding swarms.
		SRT5.2 Real-time adaptive swarm strategies under complex atmospheric conditions.
PRQ6. How do UAS-based seeding operations compare with crewed seeding aircraft in terms of accuracy, response time, safety, cost, data value, and rainfall response?	EP6. Quantitative metrics & net-value framework validated over multiple UAE field seasons; methodology adopted into NCM CONOPS (TRL 7-8).	SRT6.1 Performance, value & impact benchmarking framework for UAS vs. crewed seeding.

Program Scope

Thrust Area: Limited-Area Climate Interventions		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ1 Can landforms (orography) be modified to enhance clouds and precipitation? (Landform Modification [LFM])	EP1.1 Initiate pilot project of LFM for enhancing cloud and precipitation development (TRL 5-7).	SRT1.1.1 Observation, theoretical, or modeling studies which demonstrate effectiveness of new LFM approaches, identify key processes/constraints, and support pilot development.
		SRT1.1.2 Pilot evaluation and development
		SRT1.1.3 New concepts for LFM – barriers, canals, valley blocking etc.
		SRT1.1.4 Economic and technical feasibility, linking pilot-to-operational scales.
PRQ2 Can land surface characteristics (e.g. albedo, roughness) be modified to enhance clouds and precipitation? (Land Cover Modification [LCM])	EP2.1 Initiate pilot project of LCM, or hybrid/combined LCM/LFM methods for enhancing cloud and precipitation development (TRL 5-7).	SRT2.1.1 Research to demonstrate effectiveness of new LCM approaches, evaluate pilot studies, identify key processes.
		SRT2.1.2 New LCM concepts – mixed agricultural/solar/LFM zones
		SRT2.1.3 Economic and technical feasibility, linking pilot-to-operational scales.

Program Scope

Thrust Area: Limited-Area Climate Interventions		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ3 Can stable inversion layers be manipulated at certain locations, or during certain time periods, to decrease static stability and enhance rainfall? Or can convection inhibition be decreased using methods for heating, moistening, or lifting surface air masses?	EP3.1 Theoretical, modeling and experimental techniques developed to reduce inversion layer strength at a local scale supported by laboratory studies (TRL 2-4).	SRT3.1.1 Understanding of thermodynamics/dynamics of convection initiation, particularly in relation to sea breeze interactions, using models, theory, and data analysis
		SRT3.1.2 Investigation of potential means to reduce or breach inversion layers at prime locations – artificial updrafts, land surface or lower-tropospheric heating, airmass lifting, wind deformation and convergence lines.
PRQ4 Can aerosol distributions over the UAE be modified in such a manner that more efficient cloud and rainfall formation processes can occur?	EP4.1 Theoretical, modeling and experimental techniques to impact the major source regions of aerosols in such a manner that more efficient cloud and rainfall formation processes can occur (TRL 2-4).	SRT4.1.1 Research to understand how aerosol loads/sources and their atmospheric distribution interact with clouds/rainfall and thermodynamic environment – using current or new datasets, remote sensing, theory, and models
		SRT4.1.2 Investigate potential pathways for marine/terrestrial aerosol interventions – CCN, solar radiation budget, diabatic heating, in conjunction with relevant natural/manmade aerosol/particulate matter types and aerosol source region interventions.
		SRT4.1.3 Develop specific applications for aerosol manipulation (ship/aircraft/balloon/jet-based aerosol injection), attribution and monitoring (ground-based, airborne, or satellite measurements)

Program Scope

Thrust Area: Limited-Area Climate Interventions		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ5 Can atmospheric moisture be enhanced or redirected to support convective cloud and precipitation development, including consideration of the sea breeze?	EP5.1 Theoretical, modeling and experimental techniques to positively impact atmospheric moisture in a manner that will support convective cloud and precipitation development (TRL 2-4).	SRT5.1.1 Investigation of potential means for concentrating or increasing water vapor in the lower atmosphere to decrease CIN and intensify convective processes – artificial water-vapor injection, sea breeze funnelling, encouragement of horizontal and vertical moisture convergence etc.
PRQ6 How may intentional regional solar radiation perturbations impact on temperatures, cloud microphysics, weather patterns, and/or affect precipitation enhancement activities over the UAE?	EP6.1 Modeling or experimental studies to understand which regional SRM techniques may be applicable in the UAE and how they would impact precipitation / cloud microphysics / temperatures / weather patterns (TRL 2-4).	SRT6.1.1 Understanding processes associated with MCB / MSB, cirrus-thinning/thickening and other aerosol interventions, and how they could influence clouds/ rainfall and extreme temperatures through phenomena such as the sea breeze.
		SRT6.1.2 Drawing from large-scale proposed geoengineering MCB/cirrus techniques for scaling down to specific regional/mesoscale approaches

Program Scope

Thrust Area: Advanced Models, Software and Data		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ1 What aspects of models can be improved to enhance seeding planning?	EP1.1 Enhance operational seeding models — accuracy in location/timing of precip + reliable uncertainty; hybrid physics + AI for speed & accuracy; focus on nowcasting (0–6 h) - TRL 8-9.	SRT1.1.1 Open-source community seeding modeling, incl. parameterizations for silver iodide, new seeding materials, and charged-droplet seeding.
		SRT1.1.2 Connect laboratory and regional scales via a hierarchy of models (high-fidelity Lagrangian superdroplet / DNS).
		SRT1.1.3 Novel hybrid physics + AI methods, incl. differentiable programming and reduced-order modeling.
		SRT1.1.4 Expand AI weather / foundation models that represent seeding effects on clouds and atmospheric state.
		SRT1.1.5 Hybrid ML/AI-guided cloud-chamber experiments targeting seeding processes to improve parameterizations / reduce forecast uncertainty.
	EP1.2 Expand data assimilation by incorporating new platforms/sensors; focus on nowcasting (0–6 h) - TRL 8-9.	SRT1.2.1 High-resolution (1–3 km) Arabian Peninsula / Middle East reanalysis, assimilating local radar, for AI training, process-based and climatological studies.

Program Scope

Thrust Area: Advanced Models, Software and Data		
Priority Research Question (PRQ)	2030 End Point (EP) quant/qual target + TRL score	Specific Research Topic (SRT)
PRQ2 How can the effectiveness of rain enhancement methods in the UAE be assessed?	EP2.1 Codify means of evaluating current effectiveness of operational cloud seeding (TRL 5-6).	SRT2.1.1 Develop tool to codify a causal framework to assess whether operational seeding / land-atmosphere interactions increase surface-level precipitation. Investigate causal machine learning methods to the assessment of cloud seeding or other proposed climate intervention strategies

Program Scope

Characteristics of a Successful Proposal

Projects should carefully describe the observational, modeling, and data analysis strategies that will be used. The creation and use of comprehensive databases, historical and new data, and the analysis and re-analysis of previous experiments are strongly encouraged, as is the planning and implementation of field experiments and campaigns. A listing of NCM and UAEREP datasets and model configurations that can be made available to awarded projects is provided in Appendix B.

Proposers should carefully review projects funded in the previous six cycles of the program (detailed in Appendix A with hyperlinks to each project's content – e.g., publications, reports, webpages). Emphasis should be given to the development of high-impact projects involving academic, industry, and government collaborators; i.e. 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 scale. Proposals should provide sufficient detail about these resources such that their benefits to the program can be adequately assessed.

As noted above, proposals should aim to achieve an advanced level of technology readiness by the completion of the research program. Proposals should specify the initial and targeted technology readiness with clear alignment to the levels of technology readiness desired for the particular theme or themes being addressed. The progression from its starting point to a higher level of operational readiness should be described and will be considered in the evaluation of proposals.

Successful proposals in this competition will have the following general characteristics

- A clear description of how the proposed research will build on or enhance previous work in the rain enhancement field, particularly research previously supported by the UAEREP.
- A clear hypothesis on which the work plan is based.
- Clear milestones and deliverables toward focused outcomes and not necessarily solutions to all problems.
- A scope and scale to fully justify the proposed funding request.
- Sufficient expertise and experience of the project team to effectively carry out a multi-institutional, complex project.
- A demonstrated institutional commitment by the lead organization and any partnering institutions.

Additionally, all successful proposals will include the following specific components

- A project plan that integrates research, capacity building/education, and knowledge transfer

III. TIMELINE FOR THE UAEREP SEVENTH CYCLE (2027)

Registration:
Due by March 05, 2027

Pre-proposal:
Due by Midnight (GMT) March 12, 2027

Invited full proposals notified:
May 31, 2027

Invited full proposals:
Due by Midnight (GMT) August 28, 2027

Award notification:
January 2028

Anticipated start date of the awards:
March 1, 2028

SECTION 4

IV. AWARD INFORMATION

Award Information

The 7th Cycle total available funding of USD 3M will be distributed among up to five awards across the pairs of funding-to-period categories listed below

- Category 1 ≤ USD 500k for 1-year project periods (two 6-month payments ≤ USD 250k)
- Category 2 ≤ USD 1M for 2-year project periods (two annual payments ≤ USD 500k)
- Category 3 ≤ USD 1.5M for 3-year project periods (three annual payments ≤ USD 500k)

Funding limits for each invited full proposal will be communicated to applicants following a pre-proposal review phase. Based on a rigorous, two-stage merit review and selection process, awardee(s) will be announced in January 2028.

Funds will be awarded through a cooperative agreement, which gives the Program Secretariat a significant oversight engagement with the awardees. The project principal investigator (PI) directs the project with the assistance of any Co-PIs. The PI and the PI's sponsoring organization have fiscal responsibility for the award and primary management responsibility for the conduct of the proposed activities. The cooperative agreement, however, will state the nature and extent of expected Program Secretariat involvement, such as receipt of periodic reports and undertaking of regular progress evaluations. A detailed agreement ensures that the responsibilities of each party are fully understood.

Support for each phase of the Cooperative Agreement for the award will be contingent upon satisfactory outcomes as documented in progress reports submitted annually for review by the Program Secretariat. In addition, site visits will be held to evaluate progress and future plans, with an emphasis on the quality of the research and expected ability to meet the project goals and objectives.

Specific Award Conditions are elaborated further in section VIII. AWARD ADMINISTRATION INFORMATION.

SECTION 5

V. ELIGIBILITY INFORMATION

Eligibility Information

Who May Submit Proposals

Domestic (UAE) or foreign, public or private, non-profit or for-profit organizations are eligible to receive this cooperative agreement award. All eligible entities must clearly demonstrate that they have access to the facilities and infrastructure necessary to carry out the proposed project. Eligible entities must also agree to the fiscal arrangements that the Program Secretariat requires to ensure that awardees are able to responsibly manage the awarded funds.

Who May Serve as Principal Investigator (PI)

The PI must have substantial research and management experience in the associated field of science and/or engineering to lead the Project. Co-PIs may share in the responsibility of the scientific or technical direction of the project. The first name listed on the application will serve as the primary liaison to the Program Secretariat and have responsibility for the project management and the submission of reports.

Limit on Number of Pre-Proposals per Organization

There are no restrictions to the number of pre-proposals that can be submitted to this competition by a single organization. However, it should be noted that any one organization may only receive one award per competition cycle.

Limit on Number of Pre-Proposals per PI or Co-PI

There are no restrictions to the number of pre-proposals that can be submitted by a PI or Co-PI, but it should be noted that a PI or Co-PI may only receive one award per competitive cycle.

Additional Eligibility Info

Proposals submitted to the program must not have already received funding or currently be under review by another funding entity.

Based on the merit review of the pre-proposals, a select number of PIs will be invited to submit full proposals. Only invited full proposals will be evaluated and eligible for the award.

SECTION 6

VI. PREPARATION AND SUBMISSION INSTRUCTIONS

Preparation And Submission Instructions

Applications will be evaluated in a multi-phase merit review process. A pre-proposal will be required, and those pre-proposals judged most promising by a review panel and the Program Secretariat will be invited to submit full proposals with a specified budget limit.

Registration on Online Submission Portal Required

Registrations from the intended PI/Lead Institution should be completed at least one week before the pre-proposal submission deadline. This allows sufficient time to resolve any technical issues related to accessing and submitting the pre-proposal requirements on the online portal. The registration should include a brief description (not exceeding 500 words) of the scope of work, the approach, and the potential list of participants. The Program Secretariat will not be responsible for any technical issues occurring during the submission process for anyone registering after the recommended deadline.

Register by March 05, 2027.

The Registration must be filled out online at www.uaerep.ae.

Preparation And Submission Instructions

Pre-Proposal Required

Pre-proposals and all referenced documents must be submitted through www.uaerep.ae no later than Midnight, March 12, 2027 (GMT). The submission process requires the completion of online forms for the pre-proposal cover page (basic administrative information) and list of project personnel, followed by uploading the pre-proposal content, including supplementary and budget information, in PDF format, to the web portal. A Conflict of Interest (COI) form is also required. The COI templates are downloadable from the web portal, and the completed form must be uploaded to the portal. Once required forms have been submitted, the proposer will receive an e-mail notification that the application has been received.

Detailed preparation instructions are given below. Pre-proposals that are not compliant with the guidelines provided may be rejected without review. Pre-proposals must contain the items listed below and adhere strictly to the specified page limitations. No additional information may be provided as an appendix or by links to website pages. Figures and tables must be included within the applicable page limit. Pre-proposals should contain an overview of the proposed research and approach, with sufficient detail to allow assessment of the major ideas and approaches to be used. Anticipated partners and participants should be identified, but their involvement will not be binding at this phase. However, neither the PI nor the PI's sponsoring institution may be changed after the submission of the pre-proposal.

The pre-proposal shall comply with the following specifications

- Written in English
- Paper size when printed ISO A4
- Margins 2.5 cm (top, bottom and sides)
- Spacing single spaced
- Font no smaller or more condensed than Times New Roman (acceptable fonts also include Arial, Helvetica, Palatino Linotype or Georgia), 12 point for text and 10 point for figures and tables

The pre-proposal will contain the following elements

Cover Page (to be filled out online via the web portal)

Consists of project title, PI and Co-PI (if any) information, intended project duration, sponsoring organization information, and list of senior personnel and their institutional affiliations.

Preparation And Submission Instructions

A PDF file containing the following sections to be uploaded via the web portal

Project Summary and Description (1-page minimum, 3-page maximum)

The Project Summary and Description should articulate a vision that clearly outlines the research being addressed and breakthroughs being sought, aligned with the intended project duration. It should provide sufficient information on the UAEREP Thrust Area(s) being specifically addressed, the related research to be conducted (hypotheses, concepts, methods, approaches, data measurements, and analyses) and anticipated outcomes with a clear indication of the progression of technologies and models that will be developed. The proposed approaches must be clearly aligned with the priority research questions and specific research topics that the work is intended to address, and it must be clear how the proposed project will transform or significantly impact the research area and its broader implications for rain enhancement, particularly for arid regions such as the UAE. It should identify the roles and responsibilities of the PI and/or other senior project leadership, if relevant, along with their respective institutions. The project summary and description should be informative to those working in the same or related field(s), and understandable to a scientifically or technically literate reader. Links to URLs or other supplementary information may not be used.

Note For the pre-proposals, descriptions of facilities, equipment, and other resources are not required. If this information is an essential component of the research being proposed, it should be indicated briefly within the Project Summary and Description. Significant planned in-kind contributions are important and should be included in the Project Summary and Description.

References cited (no minimum, 2-page maximum)

Each reference must include the full citation. Applicants must be especially careful to follow accepted scholarly practices in providing citations for source materials relied upon when preparing any section of the document. This section must include bibliographic citations only and is not to be used to provide parenthetical information outside of the project description. It is important to be succinct and select only those references pertinent to the proposed research. Reference numbers should also be shown in the text of the project description. Use of published works should conform with international copyright treaties and best scholarly practices.

Preparation And Submission Instructions

CVs of PI, Co-PI(s), and senior research personnel (maximum 1-page for each individual)

For the PI, Co-PI(s), and each senior research personnel listed on the project's cover page, one-page should be provided that includes full name and title, institutional affiliation, brief summary of expertise and relevant experience, and several sentences elucidating the investigator's role in the project, along with other information (e.g. publications, patents, etc.) deemed relevant.

Budget (half-page maximum)

Provide a budget for each year (up to three years) of the project using the table below. The proposed budget should be consistent with the needs and complexity of the proposed activity. Note that indirect costs are limited to 20%.

Item	Description/Value
Total Requested Budget (USD)	
Indicative Annual Distribution (USD)	Year 1
	Year 2 (if applicable)
	Year 3 (if applicable)
Primary Cost Drivers (list one or more cost categories)	Personnel / Equipment / Fieldwork / Compute / Travel / Other (specify)
	Year 1
	Year 2 (if applicable)
	Year 3 (if applicable)
In-Kind Contributions	Yes/No If yes, briefly describe and provide cost estimate (USD)

Budget limits for full proposals will be communicated to invited applicants following the pre-proposal review.

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Preparation And Submission Instructions

Required Supplementary Documents

Conflict of Interest Form (Use Excel template provided via the web portal)

The PI is required to submit a spreadsheet listing conflicts of interest for all persons listed on the Cover Page. The template, which has supplementary instructions, must be downloaded from the web portal, and instructions for use of the template must be strictly followed. The completed form should then be uploaded to the web portal.

Additional Information (in a single PDF document)

- List of suggested reviewers or reviewers not to include (with a brief explanation or justification for why the reviewer should be excluded from consideration).
- Three keywords that describe the research proposal, listed in order of priority.
- Identification of proprietary or privileged information (if applicable).

Preparation And Submission Instructions

Full Proposal By Invitation Only

For invited full proposals, all referenced documents must be submitted electronically through www.uaerep.ae no later than midnight August 28, 2027 (GMT).

Questions relating to the submission process may be directed to the Program Secretariat. Once required forms have been submitted, proposers will receive an e-mail notification from the Program Secretariat that the application was received.

Full proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the stated guidelines. Full proposals will be accepted only if invited by the Program Secretariat. When preparing a full proposal for this competition, proposers are advised to review the Program Description and the Proposal Review Information found in this solicitation for general guidance pertinent to this program. Proposers are encouraged to refer to the web portal frequently for updated information and answers to frequently asked questions. In particular, proposers should look for updates on currently funded projects to avoid redundancy and to identify new research opportunities, potential partnerships, and other relevant linkages. Information about on-going projects funded by the UAEREP can be found on the Program website www.uaerep.ae

The full proposal shall comply with the following specifications

- Written in English
- Paper size when printed ISO A4
- Margins 2.5 cm (top, bottom and sides)
- Spacing single spaced
- Font no smaller or more condensed than Times New Roman (other acceptable fonts include Arial, Helvetica, Palatino, Linotype or Georgia), 12 point for text and 10 point for figures and tables

The full proposal package includes

(1) Cover Page (online form)

(2) Executive Summary (online form)

The following PDF documents are to be uploaded via the Web Portal

(3) Project Description

(4) Facilities, Equipment, and Other Resources description

Preparation And Submission Instructions

(5) Biographical Sketches Including Current and Pending Support

(6) References Cited

(7) Supplementary Documents

And the following .xls (or .xlsx, Microsoft Excel) documents (or other spreadsheet forms, as agreed to by the Program Secretariat) are to be uploaded via the Web Portal

(8) Budget pages for each year and cumulative period

(9) Conflict of Interest (COI) spreadsheet

Note that the proposal will be reviewed as a stand-alone document. Links to URLs or other supplementary information not otherwise specifically allowed for this competition shall not be used as part of the evaluation process.

The full proposal will contain the following elements

(1) Cover Page (to be filled out online via the Web Portal)
Consists of project title, PI and Co-PI (if any) information, intended project duration, sponsoring organizational information, proposed total budget, and list of senior personnel and their institutional affiliations.

(2) Executive Summary (Maximum of 500 words, to be filled out online via the Web Portal)
The Executive Summary should include the rationale, vision, and potential impact of the proposed research program, including how it substantially contributes to advancing the field of rain enhancement, particularly in arid regions. It should be an overall description of the proposed activity with emphasis on UAEREP Thrust Area(s) being addressed, a statement of objectives, aligned with the priority research questions and specific research topics the work will address, methods to be employed, and major partners and their respective integrated contributions. The summary should be targeted towards those working in the same or related fields, but also understandable to a scientific or otherwise technically literate audience.

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(3) Project Description (an uploaded PDF file that includes sections A-F below)

Total maximum page limit for the Project Description is 20 pages. Within the description, flexibility is given to the PI to adjust the length of the sections as appropriate to the project. However, the description must contain all the sections specified, and it must also conform to the overall page limit.

A. Table of Contents (TOC)

List of project narrative sections and corresponding page numbers. The TOC does not count against the page limit.

B. Research Program (Minimum 8-pages)

This section must address the appropriate elements of the merit review criteria for full proposals. Proposers should carefully review projects funded in previous six cycles of the program (See Appendix A with hyperlinks under each PI name navigating to the project final report and/or webpage). Redundancy and duplication of funded awards should be avoided unless proposals can clearly and specifically demonstrate how they will build upon and enhance results already achieved. The following elements are expected

1. Provide a compelling vision that clearly outlines specific program aims and objectives, aligned with the priority research questions and specific research topics that are intended to be addressed for targeted themes. Describe in detail the research to be undertaken and specifically how it will build upon and/or complement projects already awarded by the UAEREP while directly addressing one or more of the UAEREP Thrust Areas and research priorities. The narrative should include the overarching goal or question and how it is relevant to the Program. Within the research plan, provide background, objectives, including hypotheses to be tested, and specific aims. Milestones and the overall timeline for completion of the project must be provided along with a clear description of the progression expected for each technology, model, or other relevant deliverable that will be developed.

2. Provide a description of the experimental design, methodologies and techniques, and analyses, as well as proposed assessment and validation methodologies. If available, provide preliminary data to support the feasibility of the proposed work. However, in cases where preliminary results are not available, other means of demonstrating the feasibility of the approach are encouraged. The approach and methods to be employed should be clearly articulated. Address any potential pitfalls and describe mitigation approaches that will be employed.

3. Include details of how any data obtained will be validated and analyzed, and offer a full description of any required data management plan, including activities to make data available and widely accessible.

4. Identify major partners and their respective contributions, particularly in-kind contributions, as appropriate. The contribution of each partner to the integrated research goals must show that the total effort is integrated and greater than the sum of the separate efforts.

5. Identify any potential social or environmental impacts of the project with appropriate plans to mitigate them.

6. Elaborate the significance of the proposed activity to the field of rain enhancement and other disciplines that may benefit.

C. Capacity Building (Minimum, 1-page)

Provide a plan that shows how the research will be integrated with education and training for rain enhancement and, where relevant, related disciplines. Include expected regional impacts of planned activities with regard to research infrastructure. Provide the plan for engaging other partners to enhance regional capability and involvement. Emphasis should be placed on capacity building in the UAE.

D. Knowledge Transfer (Minimum, 1-page)

Discuss how the data, knowledge, technologies and models generated from the research program will be made available to UAEREP and the broader research community. Describe training and educational opportunities that will be created for researchers or workers in the field, especially within the UAE. Describe mechanisms that may attract new small businesses or enhance their capability to undertake activities in the field.

E. Management Plan (Minimum, 2-pages)

Provide a clear description of how the overall program will be managed. Detail should include lines of authority, communication among team members, how decisions will be made and who makes them, how partnerships are integrated, how unforeseen pitfalls and mid-course corrections will be handled (if necessary), how external advice is incorporated, incorporation of outreach to ensure meaningful national and international collaborations, and mechanisms that will be used to integrate and involve various stakeholders.

F. Timeline (1 page)

Provide an anticipated timeline, including planned activities, project milestones, and deliverables for the period of the award. A Gantt chart to display milestones and deliverables is required. The expected technology progression of deliverables

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should be noted where appropriate.

(4) Facilities, Equipment and Other Resources (no page limit)

Provide a detailed description of institutional and other resources that will be available to the project, including information on the availability of sufficient infrastructure and technical expertise to ensure effective usage of any major equipment or instrumentation. Include technical specifications of new equipment or instrumentation if the development of these is part of the proposal.

This section is descriptive only, and not to be used as additional space to elaborate the Research Program description.

(5) References Cited (No page limit)

Each reference must include the full citation. Applicants must be especially careful to follow accepted scholarly practices in providing citations for source materials relied upon when preparing any section of the document. While there is no established page limitation for the references, this section must include bibliographic citations only and must not be used to provide parenthetical information outside of the project description. It is important to be succinct and select only those references pertinent to the proposed research. Reference numbers should be shown in the text of the research proposal. Use of published works should conform to international copyright treaties and the best scholarly practices.

(6) Biographical Sketches (2-page limit per person, in a single PDF document)

Biographical sketches, including listing of prior or ongoing research projects of relevance to the program, are required for the PI, Co-PIs, and all senior research personnel. Biographical sketches should convey information that demonstrates the individual's expertise as related to the proposed research, and should include

- Vitae, listing professional and academic essentials and present affiliation.
- A brief description (not more than five sentences) on how stated expertise is relevant to the proposal.
- List of up to 5 publications most closely related to the proposed project and up to 5 other significant publications. Patents, copyrights or software systems developed may be included as well.

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However, only up to 10 items will be considered in the merit review.

(7) Required Supplementary Documents (in a single PDF document)

- Letters of Collaboration/Support A support letter must be provided and signed by an authorized senior management representative of the lead institution. Include only other letters from individuals or organizations that are integral to the proposed project, whether or not they are receiving financial support. Ensure that the letters specifically address involvement in some aspect of the project. Letters of endorsement alone are not appropriate.
- List of suggested reviewers, or reviewers not to include (with a brief explanation or justification for why the reviewer should be excluded).
- Up to three keywords that describe the project, listed in order of priority.
- Identification of proprietary or privileged information and/or relevant background intellectual property (if applicable).

(8) Budget and Budget Justification (Excel spreadsheet template to be downloaded from the Program Web Portal and completed)

Provide a budget for each year of the project and a cumulative budget in the format specified in the Excel spreadsheet. The proposed budget should be consistent with the feedback provided from the pre-proposal review period. Note that indirect costs are limited to 20%. If additional support beyond what is requested from the UAEREP is necessary and anticipated to complete the proposed project, the PI must identify and provide documentation of the availability of those funds.

The PI's institution will receive the full grant amount partitioned into payment increments as determined by the duration of the project. It is the responsibility of the lead institution (and/or PI) to track budgets and make payments to collaborating institutions (if any). As part of the full proposal submission, a separate budget spreadsheet should be filled in by each collaborating institution's Co-PI. The annual totals from the collaborator budget sheet(s) should be listed in the lead institution's overall project budget spreadsheet under the designated section (Subcontracts, Subawards) for each year.

(9) Conflict of Interest Form (Excel spreadsheet to be downloaded from the Program Web Portal and completed)

The PI is required to submit a spreadsheet listing conflicts of interest for all persons listed on the Cover Page of the proposal. The template, which has supplementary instructions, must be downloaded from the web portal and instructions for use of the template must be strictly followed. The completed form, which is the same as required for the pre-proposal, must be uploaded to the portal. For the full proposal, an update of the form provided for the pre-proposal, reflecting any changes in proposed personnel, may be used. If there are no changes, simply upload the previous form via the Web Portal.

SECTION 7

VII. PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposal Processing & Review Procedures

Merit Review Principles and Criteria

The UAEREP strives to enhance the level of research and innovation in the field of rain enhancement as well as adjacent fields. To identify which projects to support, the Program Secretariat relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing rain enhancement effectiveness and efficiency, particularly in arid regions. The reviewers will be instructed to base their critique and scores solely on the written materials provided in the application. Therefore, links to URLs or other supplementary information not otherwise specifically allowed for this competition shall not be used as part of the evaluation process.

The reviewers will be selected based on the following criteria 1) scientific and engineering expertise pertinent to the submitted proposals to ensure ability to evaluate competence, significance, and impact of the proposed activity; 2) generalized knowledge of fields related to atmospheric science, and particularly rain enhancement; and 3) extensive knowledge of the scientific and engineering enterprise, including managing and evaluating large research projects. All reviewers will be instructed in the Program's confidentiality, conflict of interest, and ethics guidelines, and will be required to sign confidentiality and conflict of interest forms to indicate their agreement to abide by these policies.

The Program Secretariat will be responsible for overseeing the proposal submission process, review of conflicts of interest (COIs), panel selection and assignments, and the review and award processes. The Program Secretariat makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects. In all cases, the decisions of the Program Secretariat are final.

Proposal Processing & Review Procedures

Criteria for Pre-proposals

Given that the evaluation of the pre-proposals will be based on limited written materials, the merit review process will address the critical elements deemed necessary to determine whether the applicants should be invited to submit a full proposal. Pre-proposal evaluations will be based on the following criteria

Alignment with UAEREP Thrust Area(s) and research priorities

Research excellence, impact, and quality

Experience and/or expertise of the proposers, and potential for success

Multidisciplinary collaboration across academic, industry, and government partners

Budget Feasibility major cost elements, scalability of scope, and alignment with objectives

Criteria for Full Proposals

The full proposals will be evaluated via an extensive panel review based on the defined review criteria. Each of the major criteria shown below will be given full consideration during the review and decision-making processes, and provided a numerical score. Each stated criterion is important but none, by itself, is sufficient for a successful proposal. Therefore, reviewers will address all criteria and also provide an overall impact score based on their assessment of likelihood of success in advancing the field and in meeting the UAEREP objectives. Each criterion will receive a numerical score, and the final score will be calculated based on the percent weight of each criterion. Listed after each individual criterion are some of the questions the reviewers will consider in providing their assessments.

Proposal Processing & Review Procedures

Overall Scientific and Technical Merit, Significance, and Innovation 35%

- How does the proposed activity address important aspects of the UAEREP Thrust Area(s) and related priority research topics?
- If the aims of the proposal are achieved, how will the outcomes be advanced toward practical impact?
- Is the research based on sound and testable physical hypotheses - and if so how?
- Does the planned work clearly challenge or seek to validate current research or technology paradigms - and if so, how?
- How are the concepts, approaches, and technologies proposed novel?
- What is the planned technology progression of technologies, models and other relevant deliverables?
- Is the research distinct from projects already funded through the program?
- What are the expected tangible outcomes of the project, including patents, commercialization opportunities, databases, and observational capabilities?

Approach 20%

- How well conceived and organized is the proposed activity?
- Does the plan incorporate clear, measurable criteria for assessing scientific, technical, and operational success appropriate to the proposed stage of technology readiness?
- Does the project duration of one, two, or three years align with the scope and depth of work proposed?
- Does the plan include clear milestones, measurable deliverables, and a realistic progression of technologies, models, software, or operational capabilities toward the targeted level of technology readiness?
- If experimental, will the design adequately test, and the evaluation plan adequately validate, the hypotheses?
- Are the computational models, laboratory equipment, or field experimental equipment and infrastructure supported with commitments, appropriate, and well planned?
- Is there a correct use of statistics as a supporting tool?
- Is the data plan consistent with the research proposed and with the solicitation's data principles?
- Does the application identify risks and, if so, are plans in place to mitigate these risks?
- Does the approach identify and account for any potential environmental and social impacts?

Proposal Processing & Review Procedures

Investigator/Team 20%

- How well qualified is the proposer (individual or team) to conduct the project?
- Does the team have a strong balance of academic, industry, and government collaborators capable of delivering a program that is highly coordinated and with significant impact? Are multi-institutional, multi-national collaborations, and linkages between universities/colleges, national laboratories, private sector research laboratories, and/or state and local government organizations included?
- To what extent are UAE personnel, including those from NCM, expected to be involved in the proposed research?
- If early-stage researchers are involved, how adequate is their training and experience?
- For established researchers, have they demonstrated an ongoing record of accomplishments that have significantly advanced the fields of the proposed research?
- If the project is collaborative or multi-PI, do the researchers have complementary and integrated expertise and to what extent does the collaboration show added benefit?
- Is the leadership approach, governance and management structure appropriate for success of the project?

Capacity Building 15%

- How is capacity building integrated within the research plan and how does it impact the field of rain enhancement globally and in the UAE?
- What is the potential of the work to increase the visibility and reputation of the field, or to grow the field regionally and/or globally?
- Are there educational and experiential opportunities for graduate students, new researchers, and/or technical workforce, especially in the UAE?
- Will the project establish impactful and lasting research, operational, or technical capabilities that strengthen the UAE's long-term leadership in rain enhancement science?

Proposal Processing & Review Procedures

Resources and Budget 10%

- Is the proposed budget within the limit communicated to the applicant from the pre-proposal review stage?
- If needed, have additional sponsors or means of support been identified to complement the proposed project budget?
- Does the research team have access to adequate facilities and infrastructure to conduct the proposed research, and has the team demonstrated the necessary institutional commitment to be successful?
- Does the research team exhibit the ability to manage a complex project?
- Are the project costs complete and fully documented?
- Is the budget fully justified and reasonable in relation to the proposed research?
- Are additional resources and in-kind contributions stated in the proposal logical, justified, and providing clear contribution to the proposed project impact?

Proposal Processing & Review Procedures

Review and Selection Process

Both pre-proposals and full proposals submitted in response to this program solicitation will be evaluated by panel review and augmented by ad hoc reviews. Only PIs of pre-proposals recommended by the pre-proposal review panel will be invited to submit the more elaborate full proposals.

The reviewers will be required to base their comments on the review criteria described above. Each application will be evaluated by at least three expert reviewers. The applications will be scored based on the rating system below.

Review Criteria and Scoring Matrix

Criteria Scores for Pre-Proposals & Full Proposals		
Criterion	Score	Description
High	5	Outstanding/Exceptional
	4	Excellent
Medium	3	Very Good
	2	Good/Satisfactory
Low	1	Fair/Marginal
	0	Poor/Non-compliant

Proposal Processing & Review Procedures

A limited number of pre-proposals judged the most promising by a panel of experts and agreed upon by the Program Secretariat will be invited to submit full proposals. All applicants will be notified of results. Each applicant will subsequently be provided with the reviewers' comments on the pre-proposal's merits. As part of the pre-proposal feedback process, UAEREP will provide each PI invited to submit a full proposal with a maximum allowable budget (budget cap) for their full proposal. The Program Secretariat's decision on whether to invite a pre-proposal applicant to submit a full proposal is final.

The full proposal review panel will use the above criteria to identify a small number of full proposals deemed worthy to be considered by the Program Secretariat for final selection. After the Program Secretariat selects awards, the selected PIs and their institutions will be contacted. Proposers are cautioned that no commitment should be inferred until the cooperative agreement is officially signed by both the NCM, as funder, and the PI's institution.

Once an award decision has been finalized, all applicants are provided feedback about their full proposals. In all cases, reviews are treated as confidential documents. Copies of reviews and a panel summary for the full proposals, excluding the names of the reviewers or any reviewer-identifying information, are sent to the PI by the Program Secretariat.

SECTION 8

VIII. AWARD ADMINISTRATION INFORMATION

Notification of the Award

Up to five awards will be announced in January 2028.

Award Conditions

The Award consists of (1) the award letter, which includes any special provisions applicable to this cooperative agreement; and (2) the budget, which indicates the amounts, by categories of expense, on which the Program Secretariat has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures).

The awards are made in the form of Cooperative Agreements issued by NCM (the funder). The Cooperative Agreements will have an extensive section of negotiated conditions relating to the period of performance, statement of work, awardee responsibilities, NCM responsibilities, joint NCM-awardee responsibilities, funding and funding schedule, reporting requirements, management and performance indicators, key personnel, and other conditions. NCM has responsibility for providing general oversight and monitoring to help assure effective performance and administration. Although individual awards are negotiated, and thus will vary depending on the requirements of the project and performers, all will comply with the following basic agreement policies

Roles and Responsibilities

The agreement will elaborate the roles and responsibilities between the funder and the awardee and among awardee partners, including who has final managerial and decision authority within the project if disputes arise, how decisions are made, how and when funds are distributed, and under what conditions, and how disagreements are handled.

Data Policy

Data generated are expected, except in rare circumstances, to be available for open dissemination and use after validation and initial analysis.

Award Administration Information

Intellectual Property (IP) and Property Rights

Terms for tangible and intellectual property generated are specified in the Cooperative Agreements. However, no funds will be awarded until the funder is convinced that the project partners have negotiated and agreed on divisions of roles and funding, and on IP ownership matters. Timely notification of discoveries and inventions will be required.

Allowable Uses of Award Funds

The award is restricted to a maximum of 20% overhead for any institution, and budget items related to fees or profits will not be allowed. It is important to note that the 20% overhead may be applied to all direct costs. Equipment purchased in excess of $5,000 (US) will be exclusively for the use of the project during the duration of the award. Expenditures must meet a “fair and reasonable” standard, and the Program Secretariat retains the right to audit awardees to determine acceptable use of funds.

Settlement of Disputes

The award must stipulate how disputes and disagreements between parties will be settled. Between awardee and funder, appeals will be allowed on decisions made relevant to evaluations, but the funder may limit the number of such appeals and retains ultimate decision authority.

Changes to Personnel

The PI or Co-PIs on the project must not be changed without the express agreement of the funder. The funder must also be notified in a timely fashion of any changes to senior personnel or partner roles.

Award Administration Information

Reporting Requirements and Evaluations of Performance

Discussed separately below but detailed as elements of the cooperative agreements.

Reporting and Evaluation Requirements

The Principal Investigator must submit project progress reports to the Program Secretariat at least 30 days prior to the end of each budget period. The report must include details of both progress and future plans as the information provided will serve as the basis for performance assessment and a decision for continued funding. To augment this review, during the course of the cooperative agreement members of the Program Secretariat will conduct site visits that may also involve other experts in the field. This team of visitors will prepare site visit reports, evaluate progress and highlight any concerns. The PI will be asked to provide written responses to questions raised by the site visit panel. Within 60 days following expiration of the award, the PI is also required to submit a final project report and a project outcomes report for the general public, which is intended to be made available on the UAEREP website.

NCM UAEREP

Appendix “A”
UAEREP Strategy

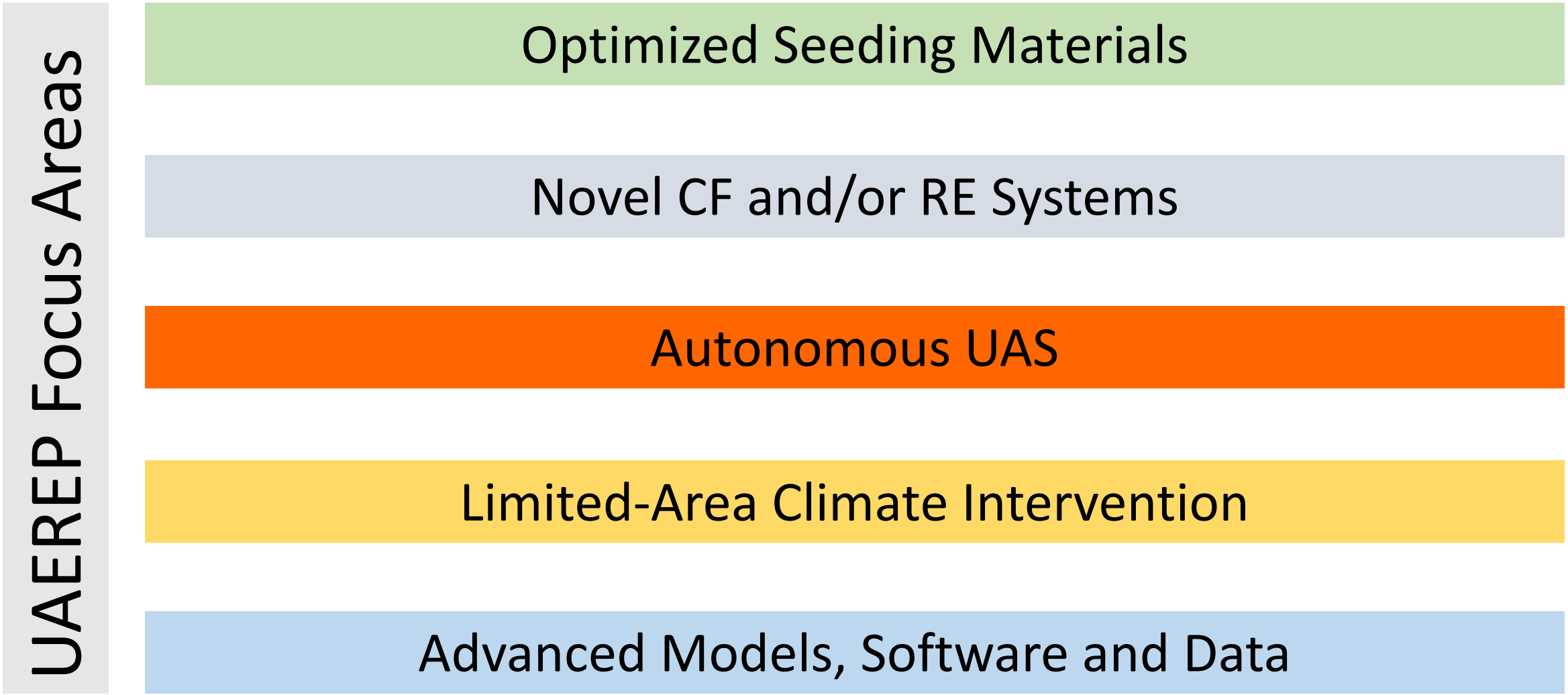
United for ***Water Security***

UAEREP STRATEGIC PLAN

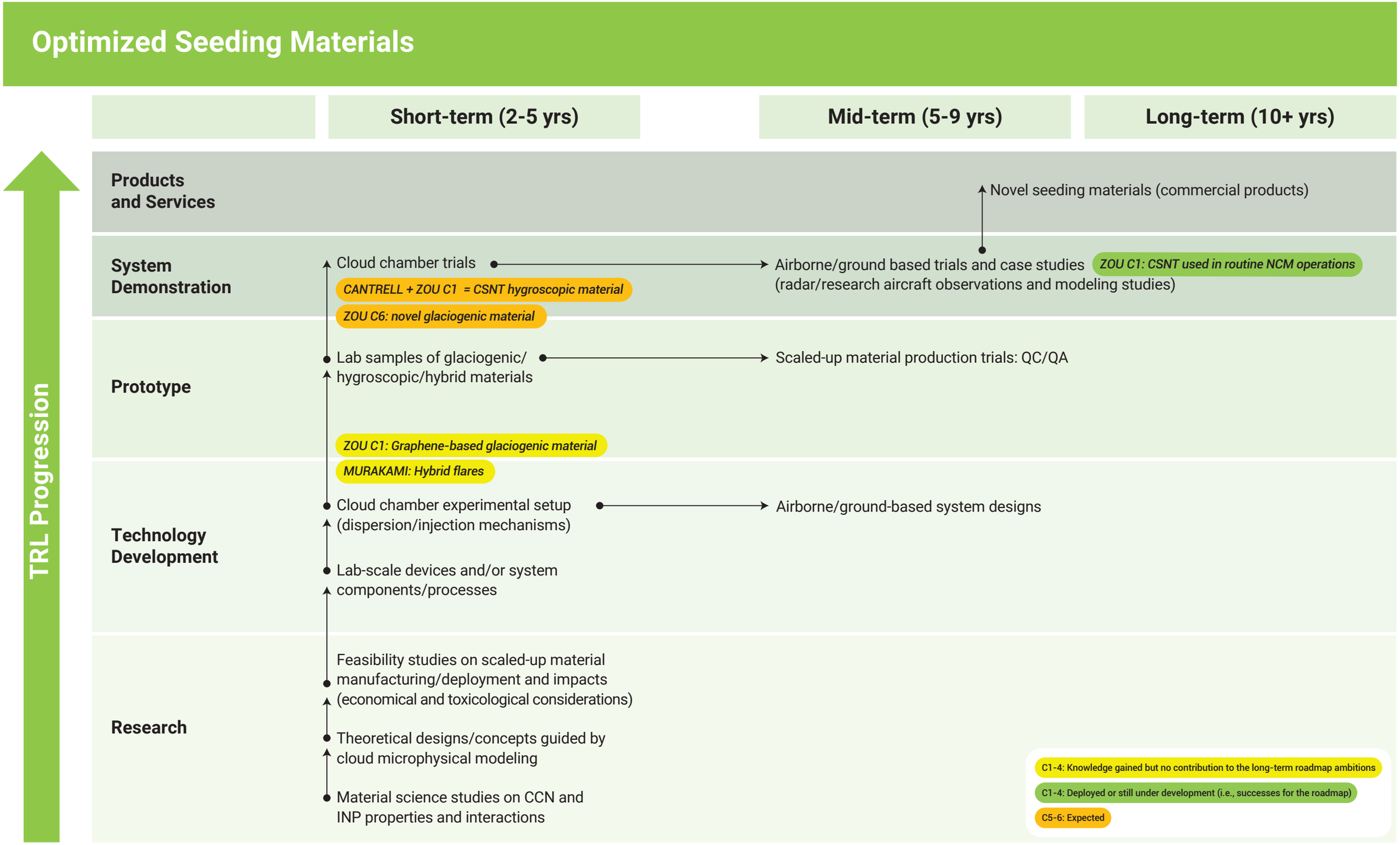
VISION	Become the **globally recognized** model for **rainfall enhancement research**, **development**, **demonstration** and **deployment** of technologies and operations in the **UAE** and **globally**			
MISSION	To establish scientifically validated technology platforms and verification techniques that contribute to enhancing rainfall and water security in the UAE and globally.	To position the UAE as the global leader in the science, technology and implementation of rain enhancement.		
PILLARS	Managed Grant Assistance: Technical oversight & evaluation	International Collaboration: Industry-government-academia	Capacity Building and Knowledge Transfer	Multidisciplinary Research and Innovation
STRATEGIC ELEMENTS	Optimized Seeding Materials	Novel CF* and/or RE* Systems	Autonomous UAS	Limited-Area Climate Interventions	Advanced Models, Software and Data

***CF: Cloud Formation**
***RE: Rainfall Enhancement**

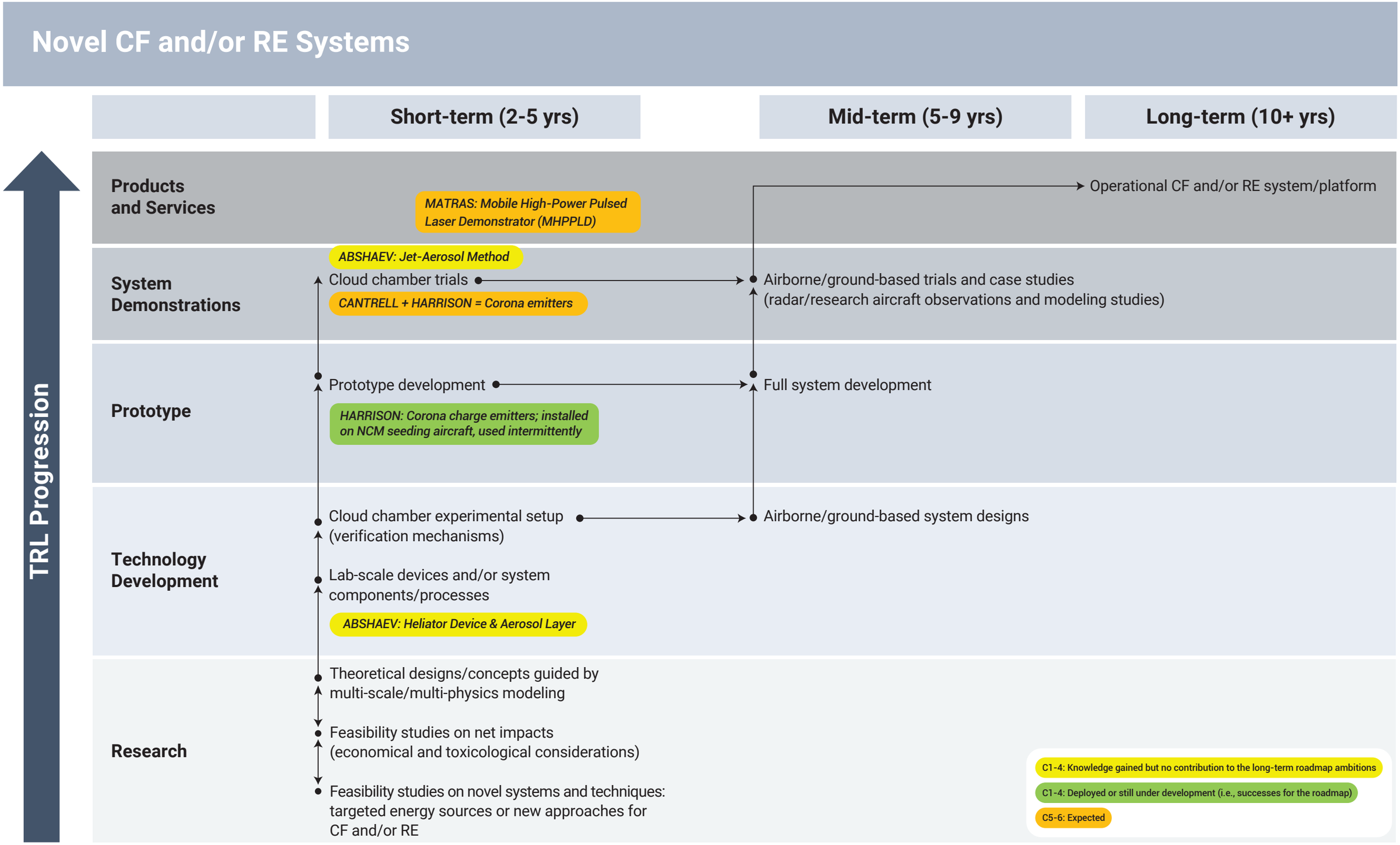
Roadmaps for UAEREP Strategic Elements



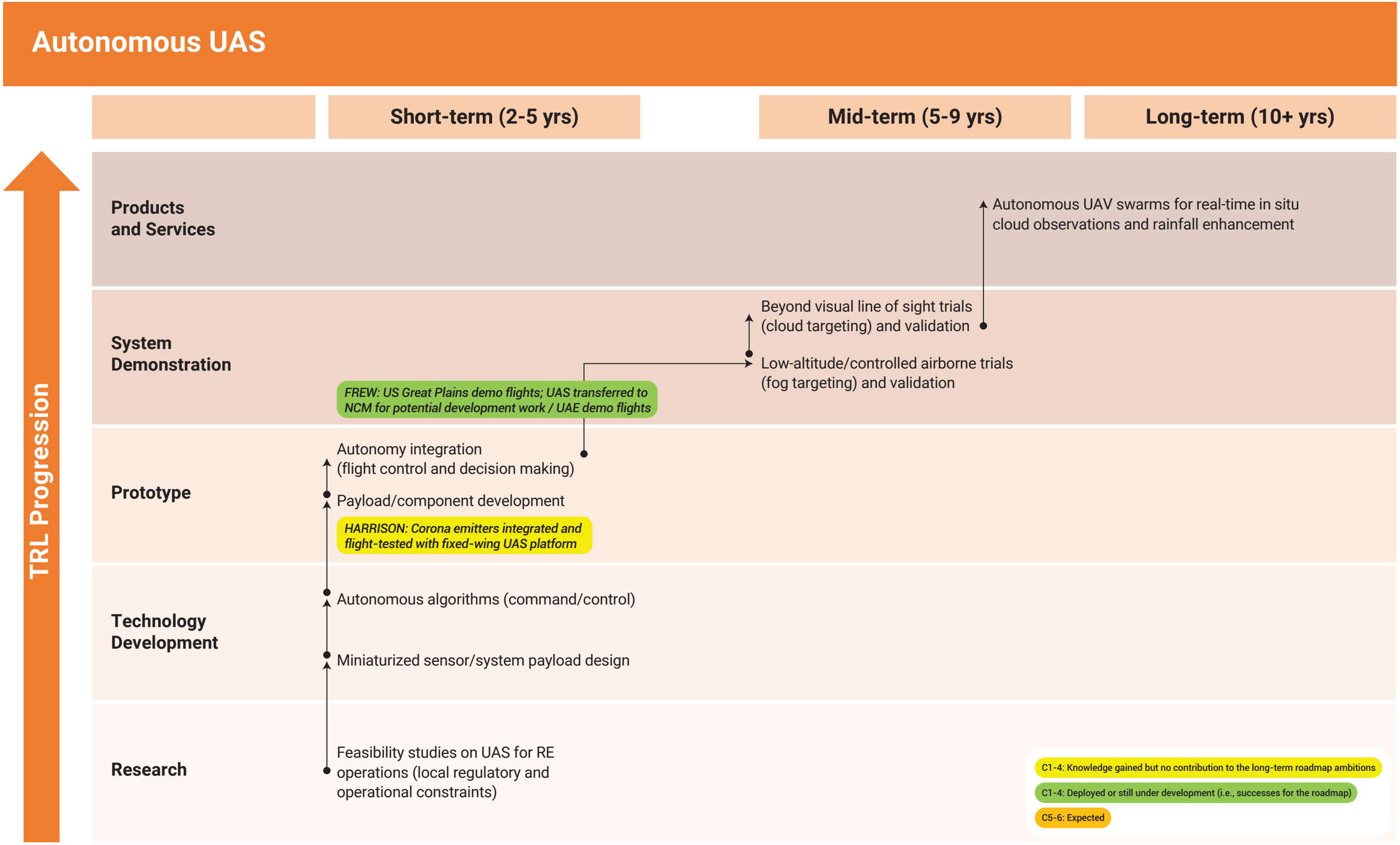
Optimized Seeding Materials



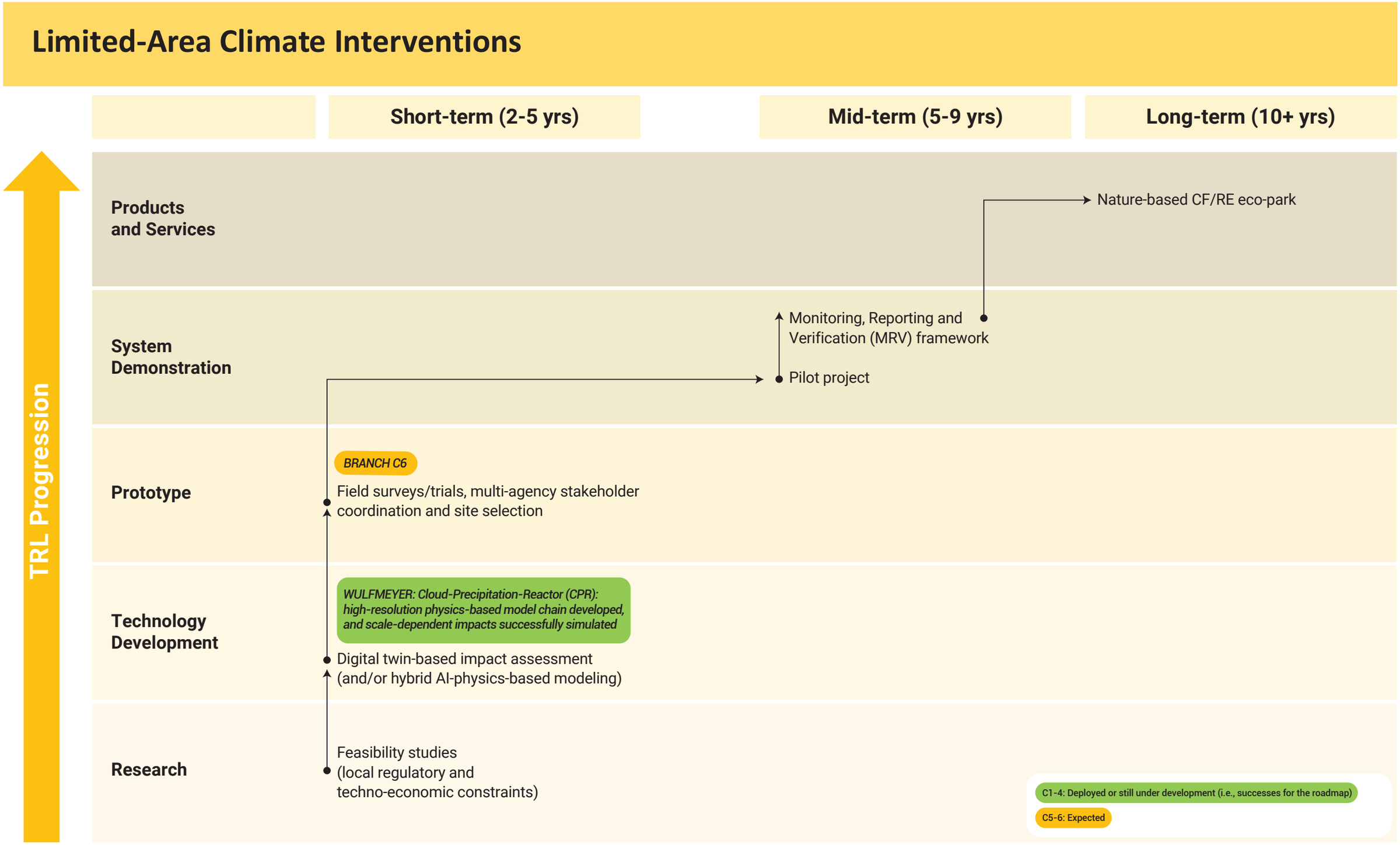
Novel CF and/or RE Systems



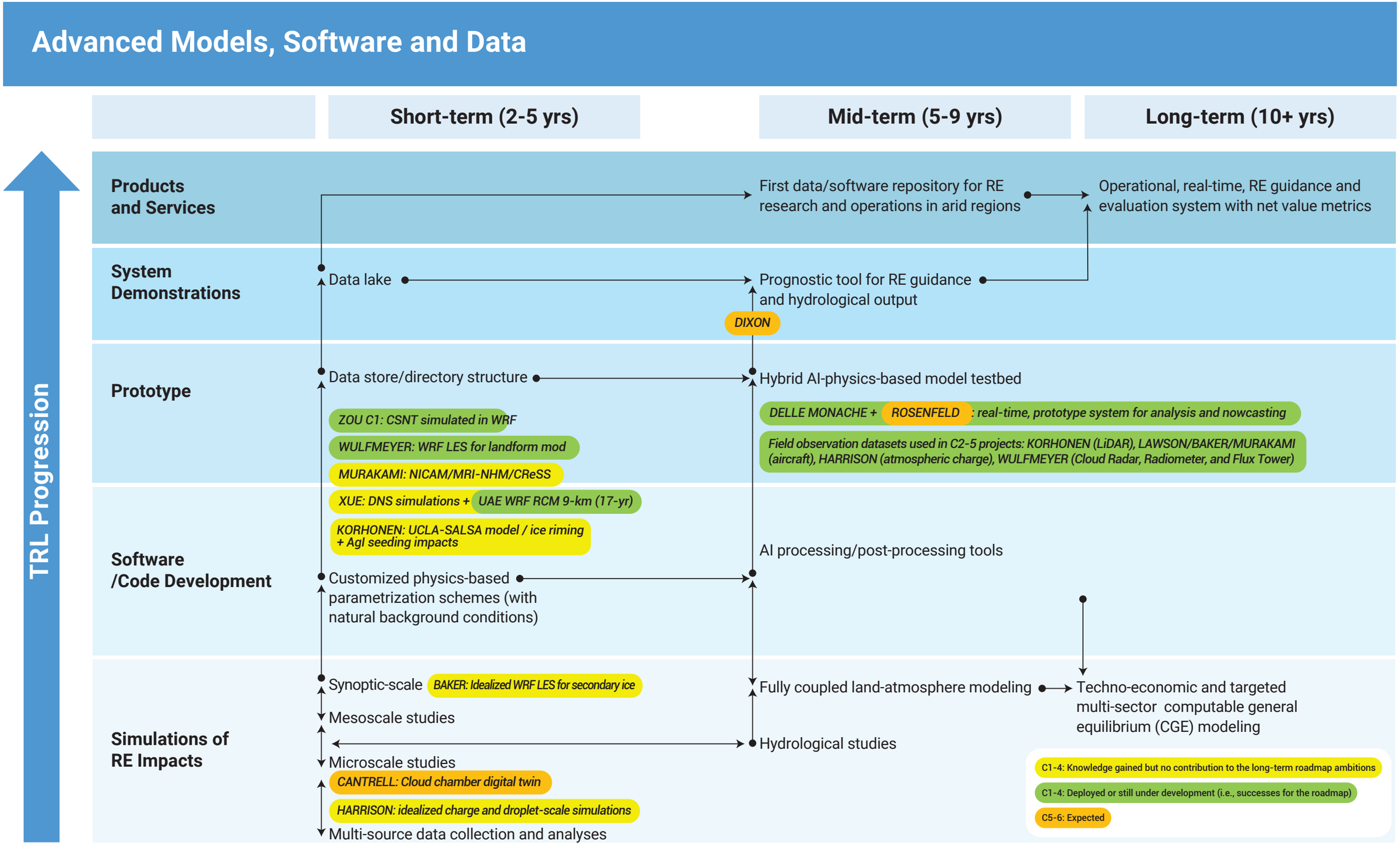
Autonomous UAS



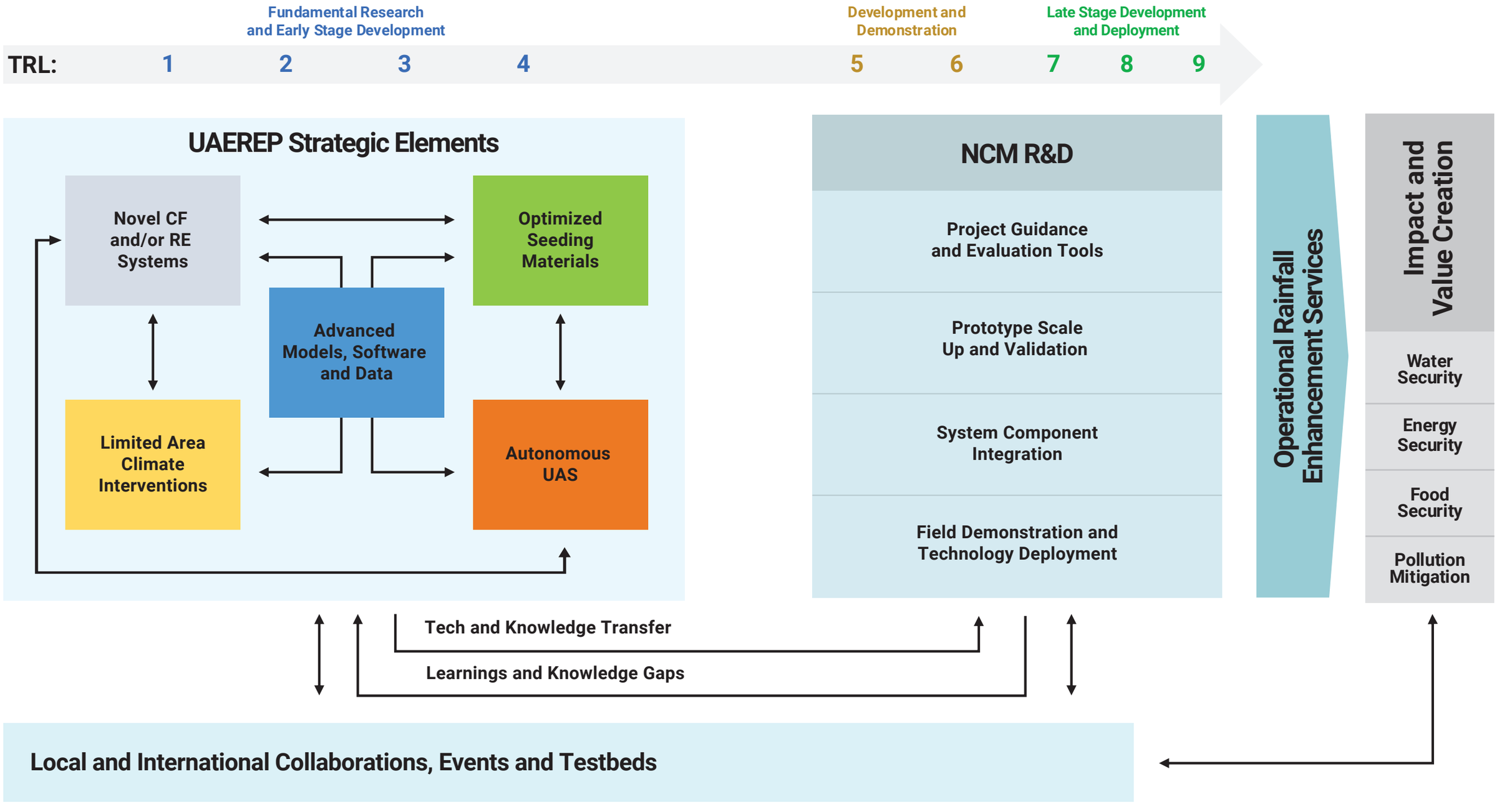
Limited-Area Climate Interventions



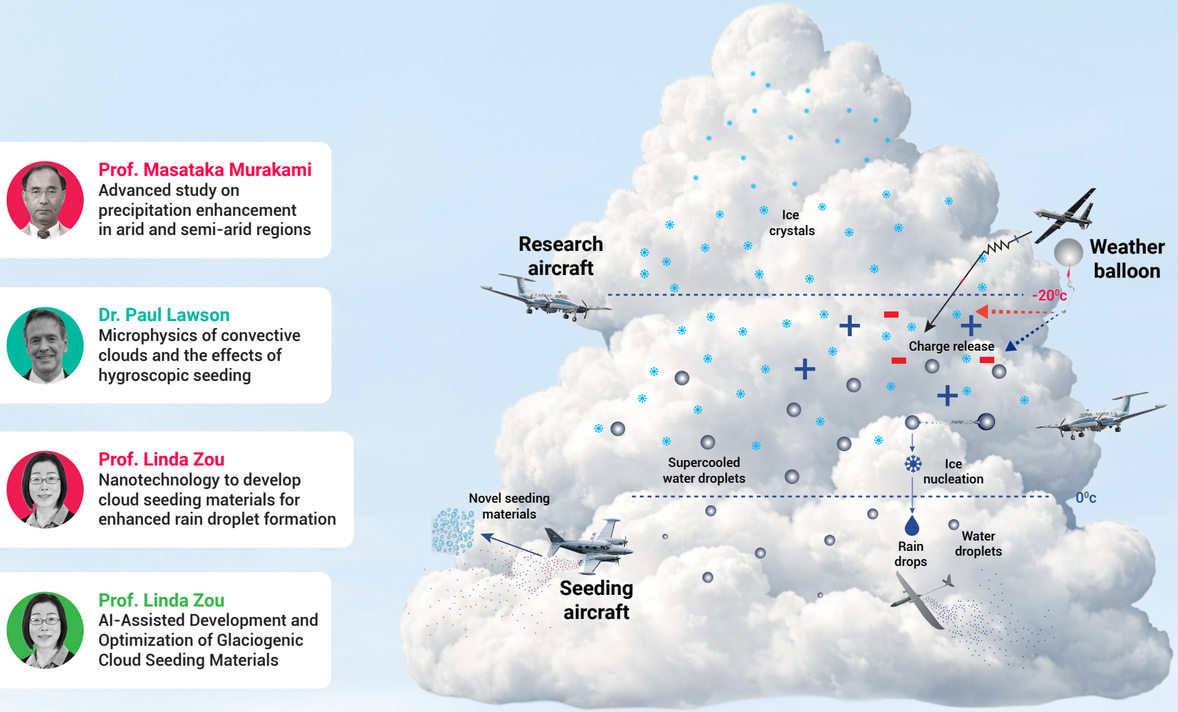
Advanced Models, Software and Data



The Role of NCM R&D in Demonstration and Deployment



Cycle 1 | Cycle 2 | Cycle 3 | Cycle 4 | Cycle 5 | Cycle 6



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

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

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

Prof. Linda Zou
AI-Assisted Development and Optimization of Glaciogenic Cloud Seeding Materials



Prof. Giles Harrison
Electrical aspects of rain generation

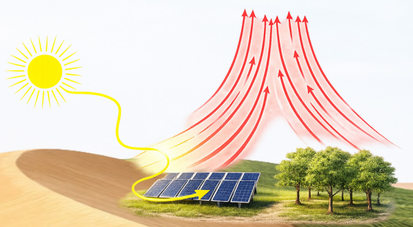


Dr. Bradley Baker
Improving the chemical and physical properties of seeding materials through electric charges



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

Convergence zone





Dr. Oliver Branch
Rainfall enhancement through modification of land cover and land form (RAINLAND)

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

Jet engine composite system





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

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

UAS launch platform

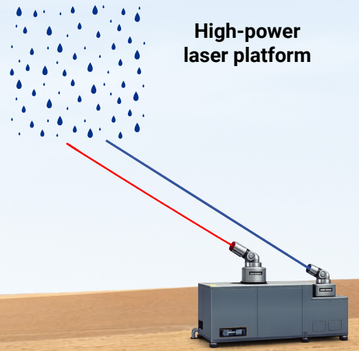




Prof. Eric Frew
Targeted observation and seeding using autonomous unmanned aircraft systems

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

High-power laser platform



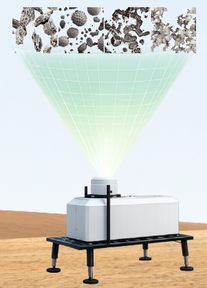


Dr. Guillaume Matras
Laser-based rain triggering demonstrator with remote sensing technology

Dr. Michael Dixon
Advancing Cloud Seeding Science with Dual-Polarization Radar Signatures and AI

LiDAR

Background aerosols





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

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

Research and development facility

Cloud chamber experiments

AI-informed cloud seeding guidance



NCM UAEREP

Appendix “B”

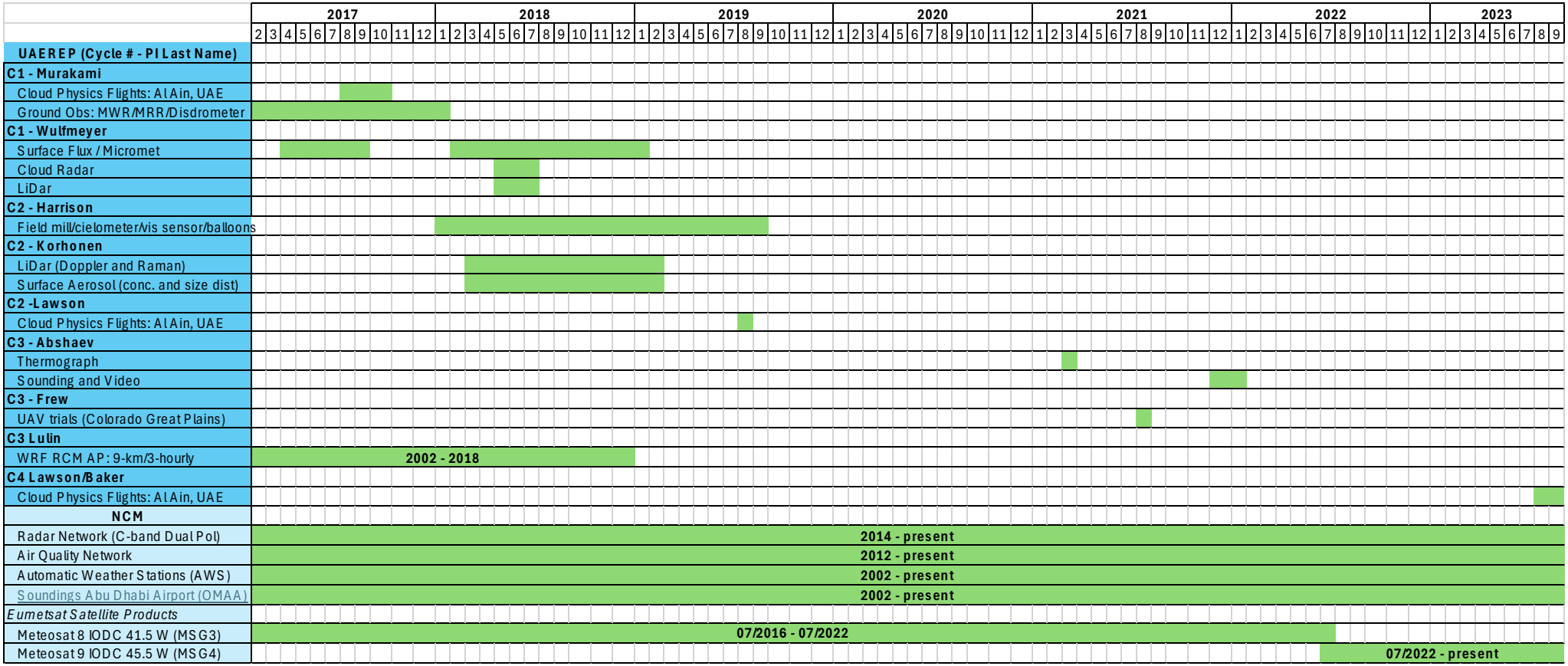
NCM-UAEREP Datasets and Models

United for ***Water Security***

NCM-UAEREP Datasets and Models

Fact Sheet - August 2024

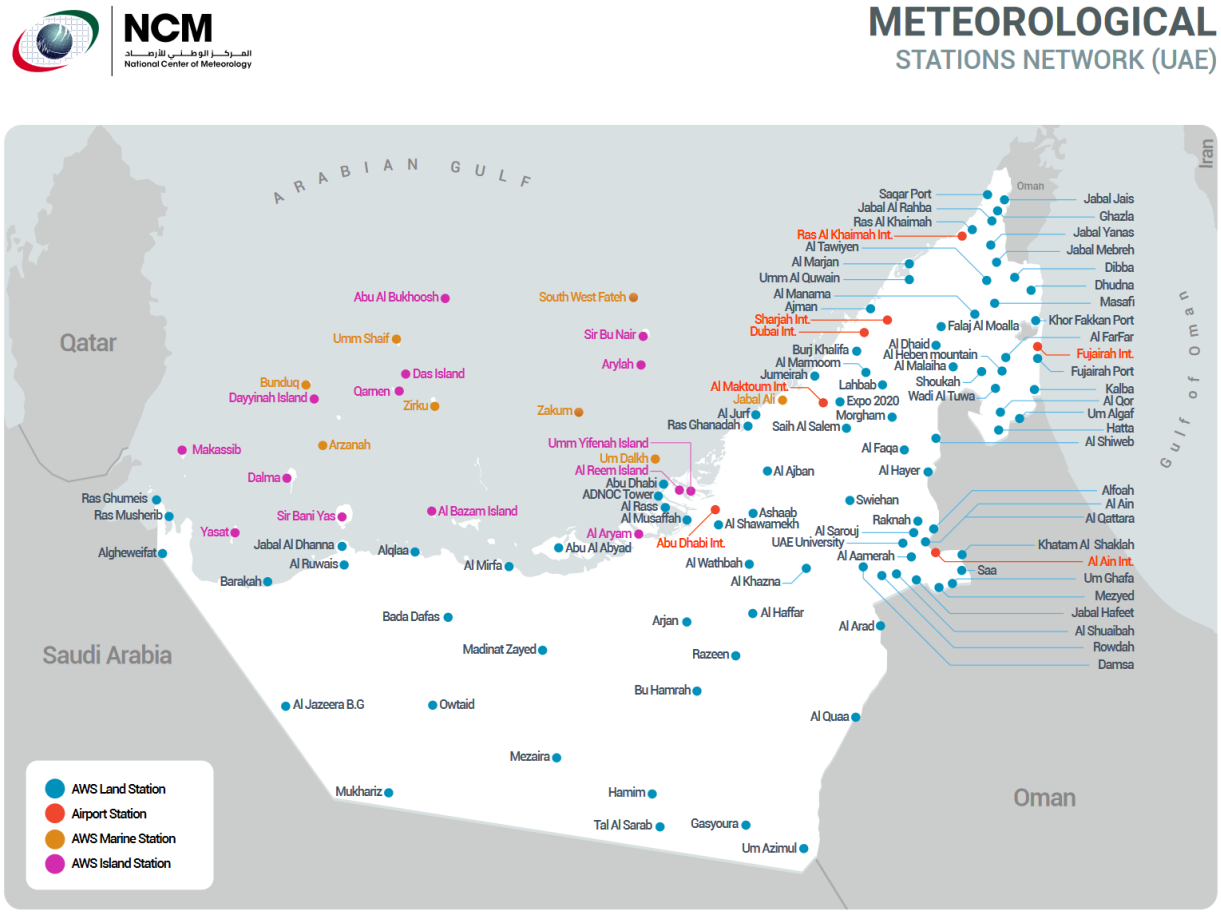
Dataset Coverage Periods



NCM datasets

1. Automatic Weather Station (AWS) Network

Webpage link here

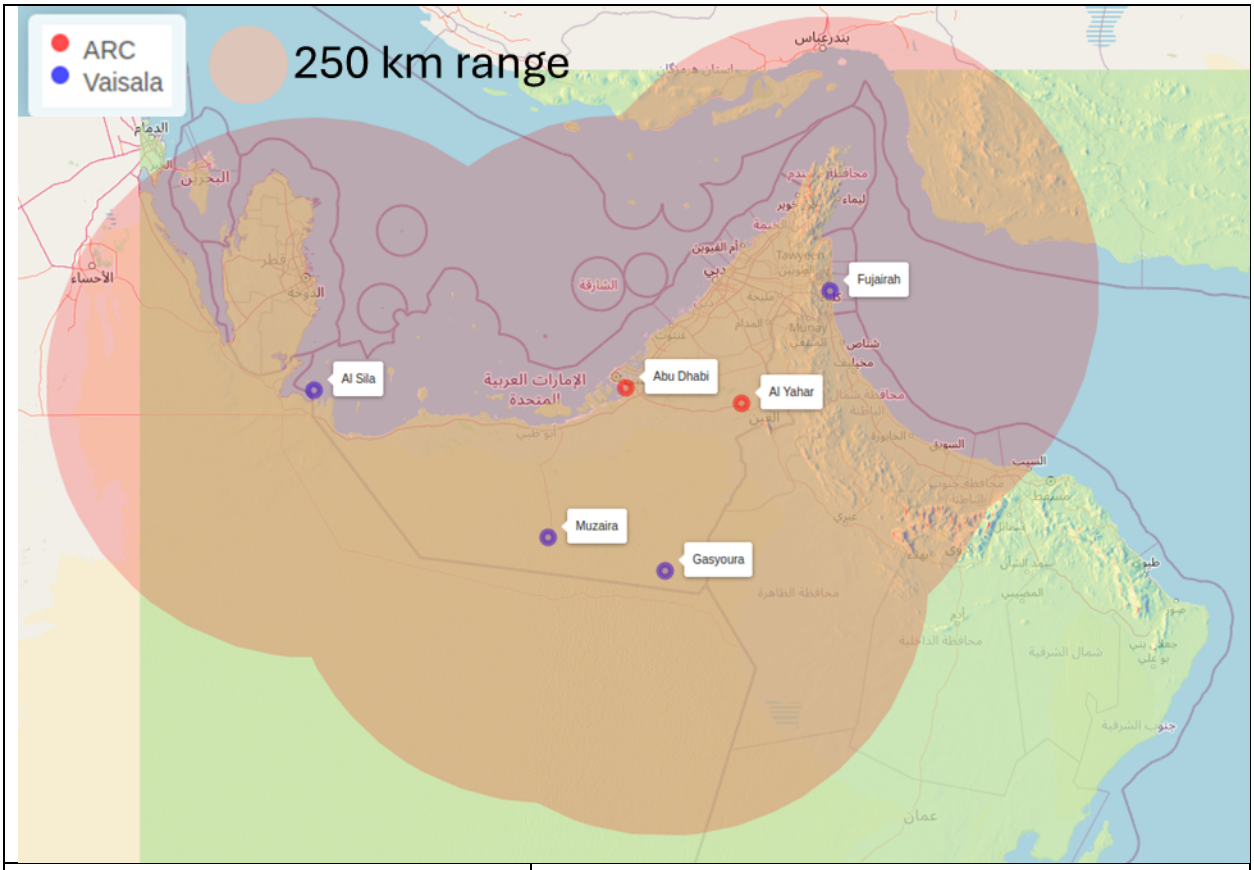


2. Upper Air Soundings: Abu Dhabi Airport (00 and 12 UTC)

Webpage link here: Station Code OMAA

3. Radar Network

Webpage link here



Technology

- 6 Radar
- C-Band
- Dual polarization
- 250 km range
- 11 scan heights
- 6 minute scan duration
- Top down scan
- 1 degree beam width

Primary data

- Radial dBZ
- Radial Velocity (up to 32 m/s)

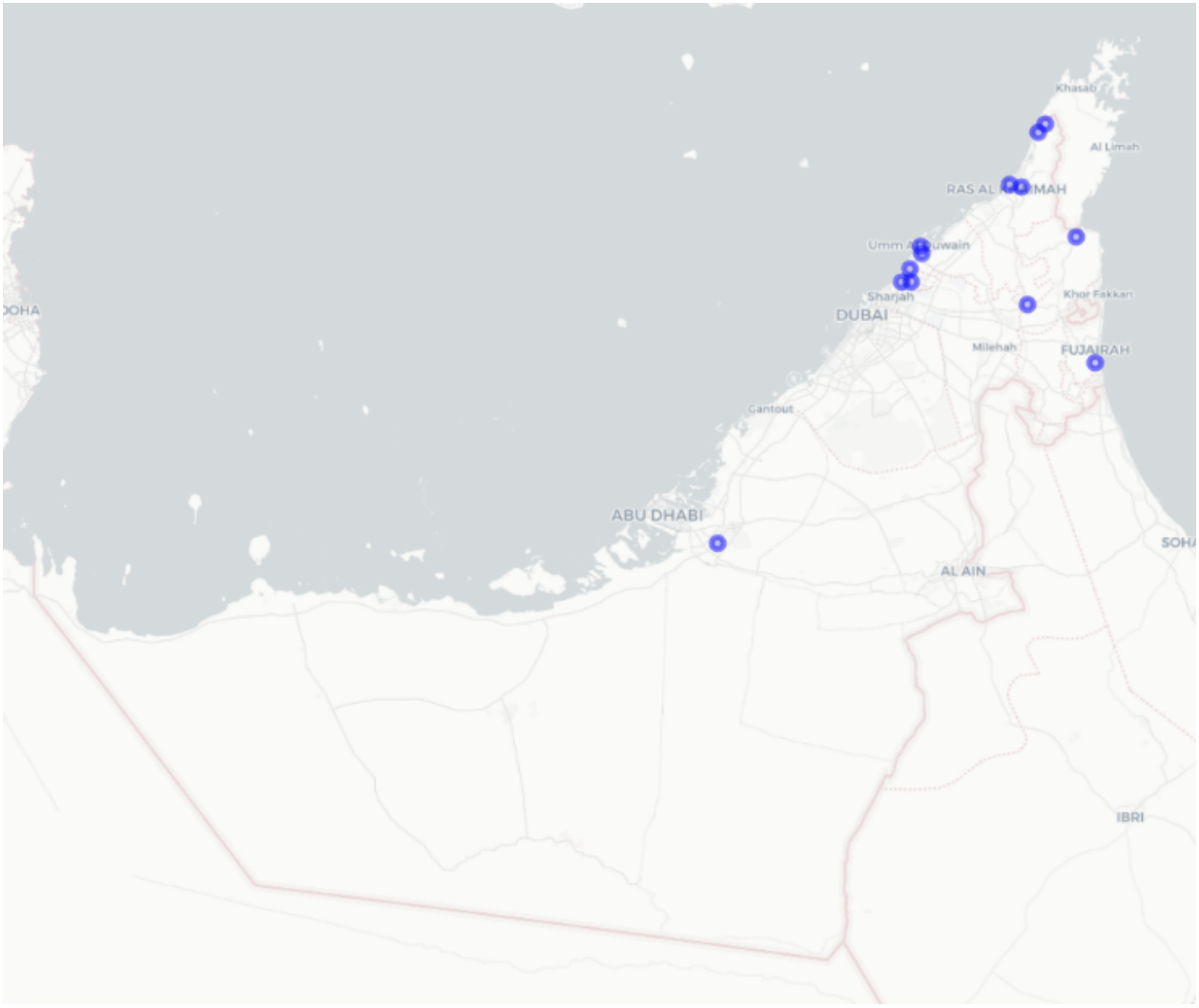
Secondary data

- Precipitation Accumulation (ZR)
- Precipitation Hybrid-rate from Dual-Pol, used for Quatitive Precip. Estimation. (QPE)
- QPE Accumulation
- **V**ertically **I**ntegrated **L**iquid Water (VIL)
- **V**elocity **A**zimuth **D**isplay (VAD, Wind profile)
- Particle identification from Dual-Pol data

4. Air Quality

Webpage link here

In general, most sites are urban and are indicative of background + local sources



					Elements									
N°	**Stations**	**Lat**	**Lon**	**Period**	SO2	H2S	NO	NO2	NOx	CO	O3	BTEX	PM2.5	PM10
1	Al Burairat	25.78	56.00	Oct 2012-pres	x		x	x	x	x			x	x
2	Al Hamra UQ	25.54	55.55	Feb 2020-pres	x			x			x	x	x	x
3	Al Hamriyah	25.45	55.50	Oct 2012-pres	x		x	x	x	x			x	x
4	Al Jeer	26.03	56.10	Oct 2012-pres	x	x	x	x				x	x	x
5	Al Maqta UQ	25.51	55.55	Feb 2020-pres	x			x	x	x			x	x
6	Al Qasimiyah	25.79	55.94	Oct 2012-pres	x			x	x	x	x		x	x
7	Al Shawamikh	24.33	54.64	Aug 2019-pres	x			x			x	x	x	x
8	Ghalilah	25.99	56.07	Oct 2012-pres	x		x	x	x	x	x		x	x
9	Kalba	25.07	56.32	Oct 2012-pres	x	x	x	x	x	x	x		x	x
10	Mushiref	25.40	55.46	Oct 2012-pres	x		x	x	x	x	x		x	x
11	Al hameidah	25.39	55.50	Oct 2012-pres	x		x	x	x	x	x		x	x
12	Dibba	25.57	56.24	Oct 2023-pres	x	x		x				x	x	x
14	Thoban	25.30	56.02	Feb 2024-pres	x			x			x		x	x

5. Satellite

Meteosat 8 IODC 41.5 W (MSG3) available from July 2016 to July 2022

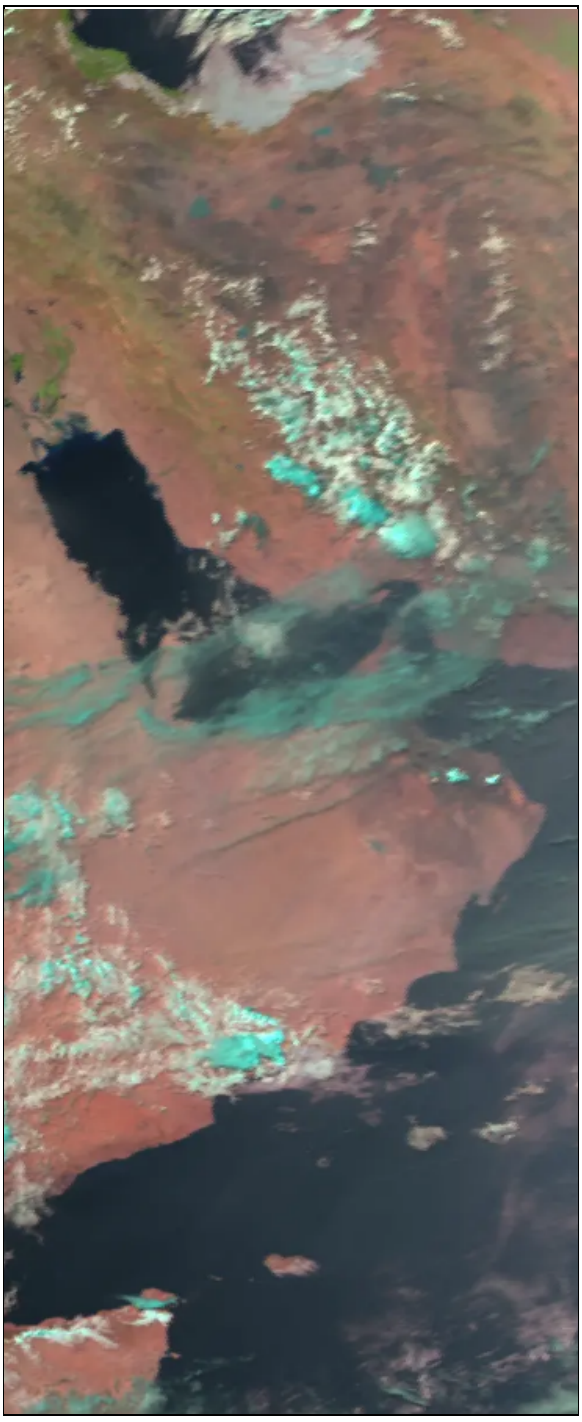
Meteosat 9 IODC 45.5 W (MSG4) available from July 2022 to Present

Primary data

- MSG4 IODC
- Near real time
- Every 15 minutes

Secondary data

- Optimal Cloud Analysis (OCA) Effective Radius
- 1 per hour

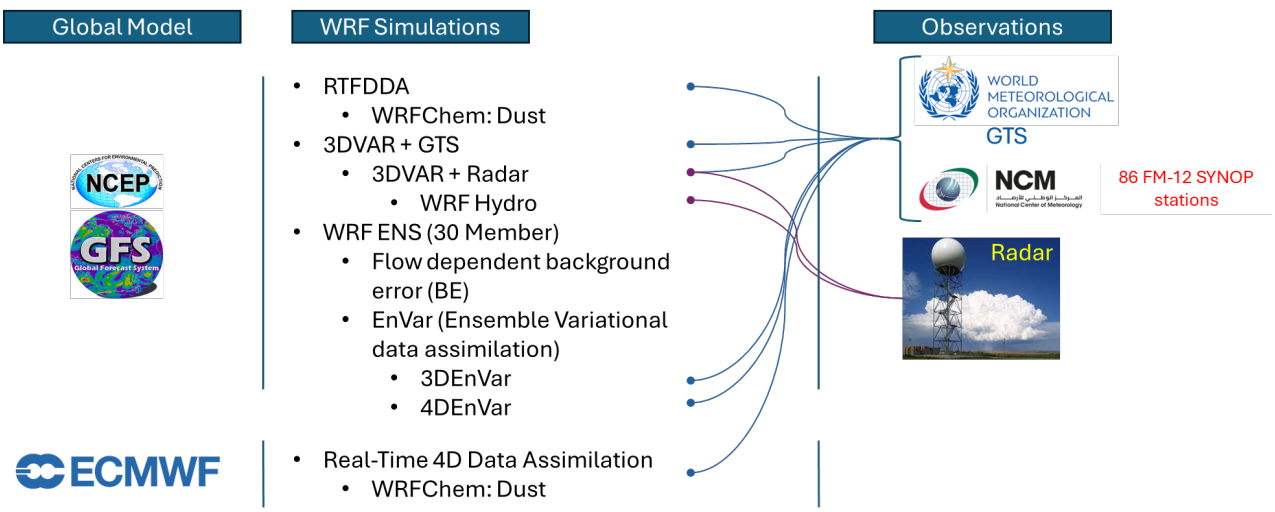


6. Models and Data Assimilation

Available input data sets:

- GFS 0.25 degree
- ECMWF HRES
- GTS

WRF Simulations



UAEREP Datasets

NOTE: See full information in final reports for each project here.

C1 - Murakami

https://japan2016uaerep.wordpress.com/

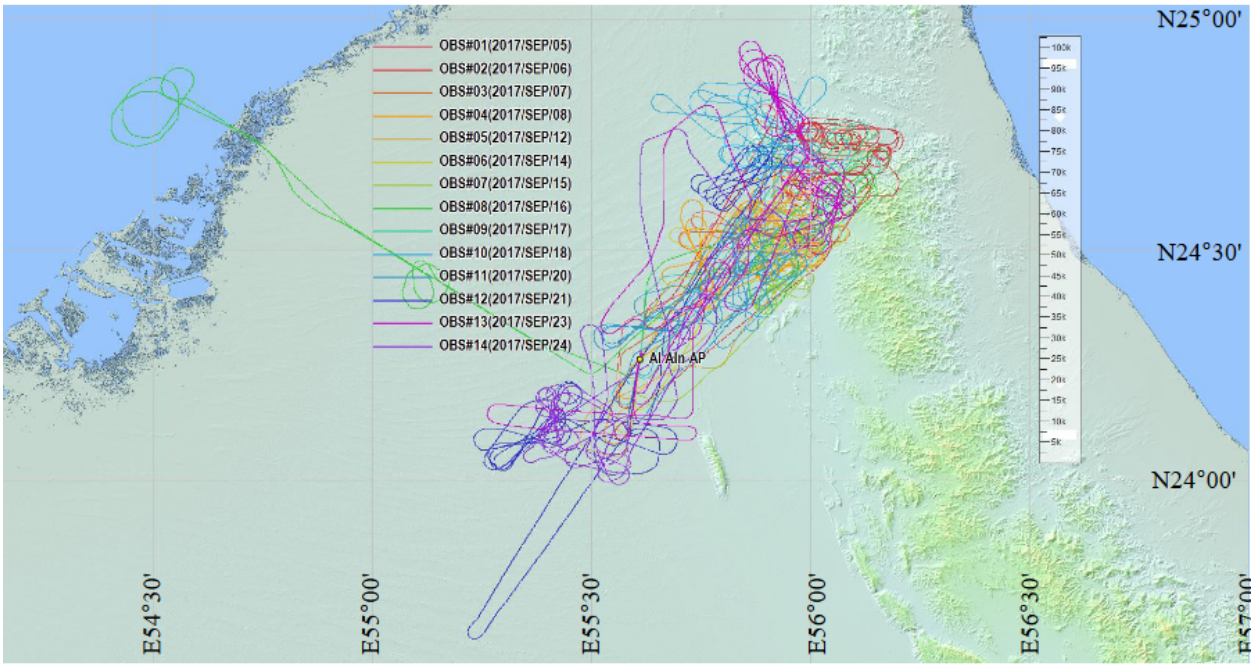
Observations

Cloud Physics Research Aircraft

14 research flights in September 2017.

Most flights over the Al Ain region and Hajar Mountains.

Flight Track - All Obs. (2017/Sep/05-24)



Instrument	Variable
PCASP	Size distribution off aerosols / 30 bins / 0.095 to 2.9 μm
FSSP	Size distribute on of cloud droplets / 15 bins / 3.5 to 45.5 μm
CAS	30 bins / 0.0575 to 47.5 μm
CIP	Cloud droplet imager / 62 bins / 25 to 1550 μm
Probes	Temperature / Pressure / LWC / Dew point T / Water vapour density

Ground

https://japan2016uaerep.wordpress.com/ground-based-obs/

Observations site: Al Ain Airport

Dates: Deb 2017 to Jan 2018

Instrument	Variable
Microwave Radiometer	Cloudbase / LWC / Liquid water path / Temperature profile
Micro Rain Radar	Radar Reflectivity
Optical Disdrometer	Precipitation

Laboratory

Size distribution and hygroscopicity of 3 seeding flares. Later compared to field measurements.

Models

The modelling system comprised:

NICAM: Nonhydrostatic I Cosahedral Atmospheric Model. (Global model)

MRI-NHM (Regional/mesoscale model)

Japanese Meteorological Agency (JMA) Numerical Prediction Division (NPD) and Meteorological Research Institute (MRI) Nonhydrostatic Model.

Idealized model to investigate seeding material effect on cloud.

CReSS: Cloud Resolving Storm Simulator (High resolution model)

The new hygroscopic seeding scheme for double-moment cloud microphysics model was built on the CCN activation scheme newly introduced into CReSS to simulate hygroscopic seeding from below cloud base in a realistic way.

C1 - Wulfmeyer

https://ocal.uni-hohenheim.de/en

Observations

Micromet

Observation site: Al Alin Airport

Dates: April 2017 to Oct 2017; February 2018 to January 2019

Instrument	Variable
Eddy covariance	Air temperature / Relative humidity / Surface radiation fluxes / Horizontal and vertical wind components / sensible heat flux / Water vapour content / latent heat flux / Surface pressure / Soil temperature / Soil humidity / Soil heat flux

Quicklook:

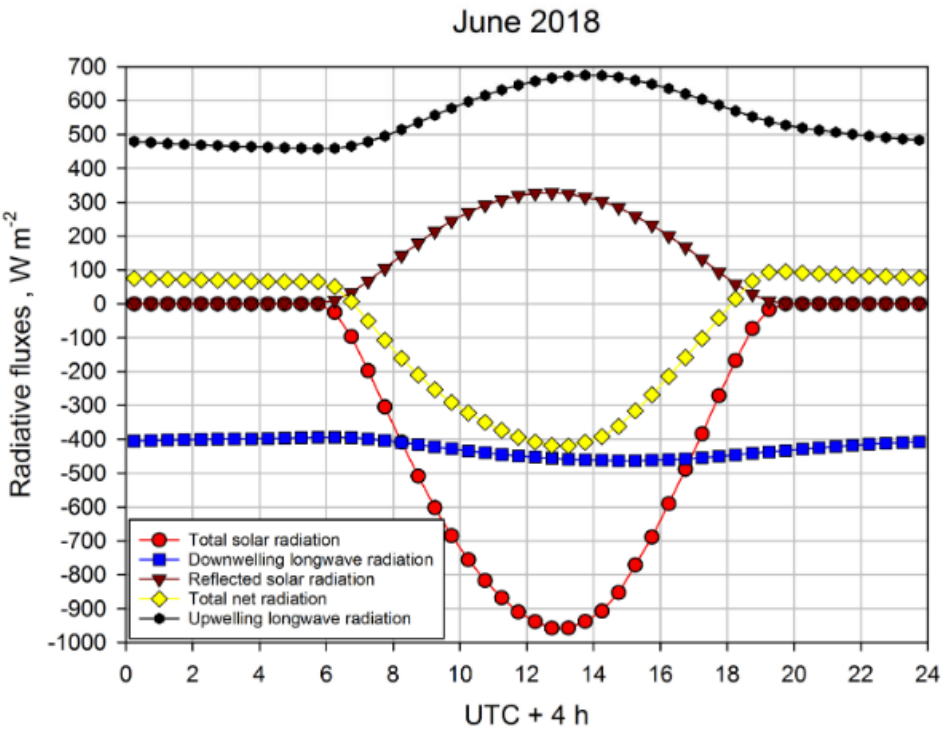


Fig. RC1+1: Typical diurnal cycle of all shortwave and longwave radiation components and the derivation of the resulting incoming net radiation.

Cloud radar and wind lidar

Observation Site: Hajar mountains

Dates: May to July 2018

Plots available at: http://guest.metek.de/mbc2/scan/domescan.html

Highlights of measurements:

https://ocal.uni-hohenheim.de/fileadmin/einrichtungen/ocal/Highlights_OCAL_field_measurements.pdf

Models

WRF

Highlights of model work package:

- Inclusion of local soil and LULC data (available in the WRF Blended section)
- GNSS data assimilation (moisture profiles from GPS signals)
- Use of shallow convection scheme
- High resolution in the vertical (100 levels)
- High resolution modelling over the Hajar Mountains to identify pre-convection environment

C1 - Zou

Model

The focus of this project was the modification of seeding material using nano-technology. A new seeding material was developed in the lab. Some simulations were conducted using a NWP (WRF), to demonstrate the potential effect of the new seeding material on cloud growth. The code of this scheme is included in the WRF Blended code.

C2 - Harrison

Observations

Observation site: AL Ain Airport

Dates: January 2018 to September 2019

Instrument	Variable
Ceilometer (Vaisala CL 31)	Cloud base height / Back scatter
A Campbell CS110 electric field mill	Electrical charge
Biral SWS100 visibility sensor	Visibility

C2 - Korhonen

Observations

Observation site: Sharjah

Dates: Mar to May 2018 / Aug to Sep 2018 / Nov 2018 to Feb 2019

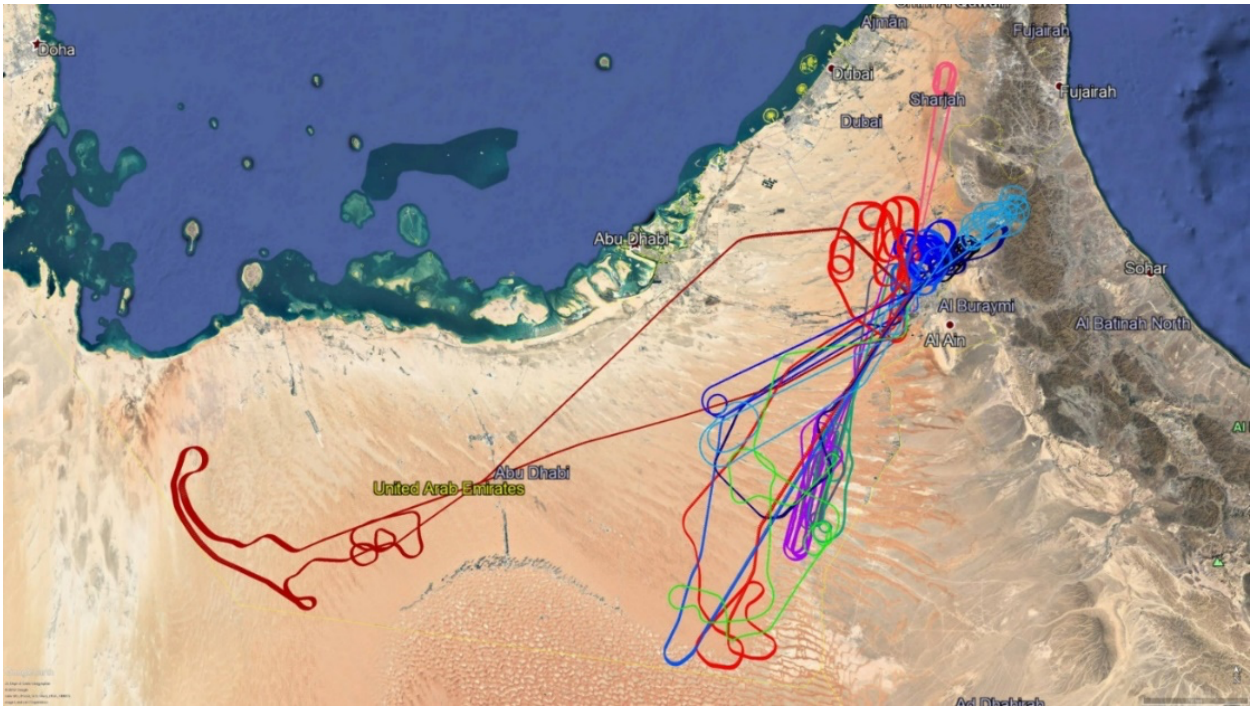
Instrument	Variable	Notes
Raman Lidar	Backscatter. Points vertically	Elastic backscatter channels at 355, 532, and 1064 nm, Two rotational–vibrational Raman channels at 387 and 607 nm, Two linear depolarization channels at 355 and 532 nm, One water vapour detection channel at 407 nm. Two near-field elastic backscatter channels at 355 and 532nm Two near-field rotational–vibrational Raman channels at 387 and 607 nm. Vertical resolution of 7.5m in temporal steps of 30 s
Doppler Lidar (HALO)	Vertical profiles: attenuated backscatter, Doppler velocity, dissipation rate, horizontal winds, wind shear, boundary layer classification.	
CCN Counter (DMT CCN-100)	Total concentration of CCN	Size segregation: 10–250 nm; 20 bins; Measured at supersaturations of 0.1, 0.2, 0.3, 0.6, and 1.
Differential Mobility Particle Sizer	Aerosol size distribution	7 to 800 nm (0.007 to 0.8 µm). 30 bins

References:
Raman Lidar: https://doi.org/10.5194/acp-20-8909-2020
Doppler and CCN: https://doi.org/10.5194/acp-22-481-2022

C2 - Lawson

Cloud Physics Research Aircraft

Six cloud and aerosol sampling flights during August 2019 over the UAE (primarily northeast)



Instrument	Variable	Notes
CPC	Ultra fine mode aerosol	0.01-3 um
PCASP	Aerosol size dist and conc	0.1-3 um
FCDP	Coarse mode aerosol spectra and conc	1.5-50 um
FFSSP	Cloud particle spectra and conc.	3-100 um
2D-S10Hva	Cloud particle shapes and spectra	10-3000 um
2D-S50Hb-Hawkeye	Cloud particle shapes and spectra	50 – 6400 um
CPI-Hawkeye	Cloud Particle shapes	2.3 – 2300 um
HVPS	Precip particle shape and spectra	150 um – 2 cm
Nevzorov	Liquid and total water content	
AIMMS	State parameters (T, pressure, humidity)	

Model

Idealized seeding microphysics code for WRF.

C3 - Xue

Laboratory

Cloud chamber experiments and DNS modelling

Model

Microphysics scheme available in WRF Blended code.

- Xue/ University of Pecs/NCAR bin scheme mp_physics=99

Datasets

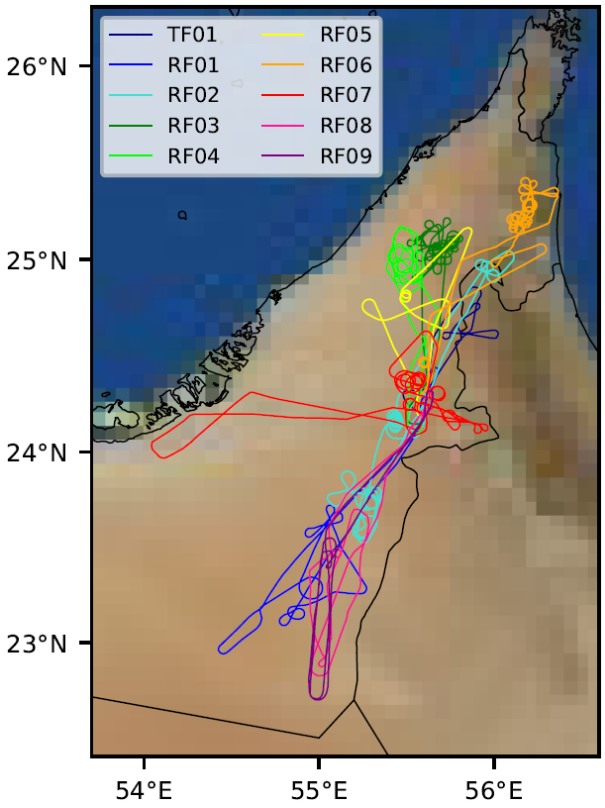
- Climate run of 17 years (2002 - 2019) using WRF at 9km resolution

C4 - Baker

Cloud Physics Research Aircraft

Nine flights with limited cloud and aerosol sampling during August-September 2023.

Same instruments as in C2 – Lawson (above), in addition to a K-band radar.



KU-NCM WRF Model Integration Project: "WRF Blended"

A collaborative project between NCM and Khalifa University's ENGEOS lab. The aim was to incorporate all UAEREP project's modeling work into a single WRF-compatible code base. Below is a description of the datasets and codes available on the NCM HPC.

Model

Surface roughness

Change to surface roughness based on the micrometeorological measurements of Wulfmeyer et al.

- The value of 1.3-2.2 mm is roughly an order of magnitude smaller than that employed in numerical models such as WRF, but is in the range of in situ estimates in other arid regions.
- The sensitivity of the model's predictions to a change in the roughness length is explored, and it is found to be considerable in this region: for otherwise the same experimental set up, a decrease in the hard-coded roughness length by an order of magnitude led to
    - an increase in the horizontal wind speed by up to 1 m/s,
    - a drop in the sensible heat flux by as much as 10 W/m^2
    - an increase in the daytime surface and air temperature by up to 2.5 K and 0.5 K, respectively.
    - When compared against observed values, the usage of a more realistic roughness length improves in particular the model wind speed forecasts for strong winds (> 6 m/s).

Soil Texture and LULC changes

There is a clear increase in the skill of the model forecasts. In particular:

- The air temperature bias is typically reduced by 0.5-1.5 K, but up to 2.5 K at some sites such as Dubai where the change from desert to urban LULC substantially improved the model's cold bias;
- At Abu Dhabi's Airport where radiosonde profiles are available for evaluation, the temperature and humidity bias are reduced between 950 and 750 hPa likely a result of a better simulation of the vertical mixing in the bottom 3 km of the atmosphere.

Seeding Schemes

Zou/Curic

- Realtime seeding scheme in WRF.
- Found to run too slowly for operational purposes but suitable for research runs.

Lawson/TAU liquid bin scheme microphysics

- Idealized microphysics scheme.
- No ice phase.
- The standard 2D squall line test case has been modified and can be run in test/em_squall2d_x/.
- Register to use the code.

Harrison Electrification Scheme

- Idealized scheme for simulating in-cloud electrical interactions.

Xue/University of Pecs/NCAR bin scheme mp_physics=99

- A bin/spectral double-moment cloud microphysics scheme.
- Six hydrometeor species (cloud water, ice water, rain, snow and graupel, besides water vapour).
- 36 mass-doubling size bins.
- 10-12 times more computationally expensive than commonly used microphysics schemes such as the Thompson-Eidhammer scheme.