

**MEMORANDUM OF UNDERSTANDING**

**BETWEEN**

**CIMA RESEARCH FOUNDATION  
-INTERNATIONAL CENTER OF  
ENVIRONMENTAL MONITORING-**

**AND**

**UNIVERSITY CORPORATION OF  
ATMOSPHERIC RESEARCH**

**ACTING ON BEHALF OF**

**NATIONAL CENTER FOR  
ATMOSPHERIC RESEARCH**

**ON**

**COLLABORATION FOR ATMOSPHERIC RESEARCH**

A Memorandum of Understanding made and entered in to this xx Day of **November** in the year 2008 ("Effective Date") by and between **CIMA Research Foundation, International Center of Environmental Monitoring located at Via Magliotto 2, Savona, Italy 17100** herein referred to as "**CIMA**", which expression shall where the context admits include its successor or assignees of the First Part, and,

University Corporation of Atmospheric Research (UCAR), acting on behalf of National Center for Atmospheric Research located at 1850 Table Mesa Drive, Boulder, CO 80307, herein referred to as "**NCAR**", which expression shall where the context admits include its successor or assignees of the Second Part, and

Whereas, the CIMA is engaged in basic and applied research in hydrometeorology science and its aim is to advance science and engineering in environmentally related fields, focusing on public health and safety, civil protection and the preservation of terrestrial and water-related ecosystems. This aim is accomplished through scientific research, technology transfer and high level training services;

Whereas, NCAR is engaged in research in atmospheric and related science problems and is recognized for its scientific contributions to our understanding of the earth system, including climate change, changes in atmospheric composition, weather formation and forecasting and the impacts of all of these components on human societies; and

Whereas, CIMA and NCAR have discussed to joint research on some areas of mutual interest and to establish a Joint Collaboration for Atmospheric Research

Now therefore, both parties hereto agree as follows:

## **2. Joint responsibilities:**

2.1 CIMA and NCAR agree that all efforts to be conducted in support of this Joint Collaboration for Atmospheric Research are subject to the availability of funds, resources, management approval, mutually agreed upon collaboration, and staff availability. If there is to be an exchange of funds between the two institutions, the work will be performed as per mutually agreed terms and conditions and as established under a separate funding agreement(s) between the parties.

Additionally, in the event any services require additional understandings such as, but not limited to, those related to the licensing of technology for research or commercialization purposes, or the need to enter into a separate agreement, the parties shall in good faith enter into negotiations to produce written obligations and terms associated with such understandings.

2.2 CIMA and NCAR intend to jointly convene workshops on themes related to purposes of advancement in the understanding of physical processes, field-campaigns, numerical prediction, and for training purposes, with particular attention to the extreme hydrometeorological events over complex orography areas in the Mediterranean region.

2.3 CIMA and NCAR will jointly engage in the collaborative projects detailed in the Appendix: i) Microphysical and turbulent parameterizations influence on high-resolution

numerical modeling of idealized deep moist convective scenarios; ii) Uncertainty in high resolution numerical modeling of extreme precipitation events over complex orography in the Mediterranean area.

### **3. Responsibilities of CIMA**

3.1 CIMA will address the study of different sources of uncertainties associated with the high resolution numerical modeling of intense precipitation processes both in idealized and real deep moist convective scenarios.

3.2 CIMA will provide computer time and local expenses (lodging and subsistence) to support visiting scientists from NCAR for periods of up to three months.

### **4. Responsibilities of NCAR**

4.1 NCAR will provide expert advice on the numerical simulation and dynamical modeling of intense precipitation processes, with emphasis on phenomena associated with deep moist convective over complex orography regions.

4.2 NCAR will provide computer time and local expenses (lodging and subsistence) to support visiting scientists from CIMA for periods of up to three months.

4.3 NCAR will support use of its state-of-art numerical models and mesoscale data assimilation systems in collaborative research.

4.4 NCAR will provide guidance to implement an efficient data management system.

### **5. Finance**

5.1 Each party shall be responsible for providing facilities, and other mutually agreed upon support.

5.2 CIMA acknowledges that any and all expenses, such as but not limited to travel expenses, housing, or other costs that CIMA incurs as a result of, or related to, this MOU shall be entirely borne by CIMA. NCAR shall have no obligation to pay CIMA any expense or costs that CIMA may incur, nor assume any liability or risk of CIMA as a result of, or related to, the obligations and/or performance under this MOU, except as provided for by paragraph 4.2 above. However, the caveat of availability of funds, resources, management approval, mutually agreed upon collaboration, and staff availability as provided for by paragraph 2.1 above shall take precedence over paragraph 5.2.

5.3 NCAR acknowledges that any and all expenses, such as but not limited to travel expenses, housing, or other costs that NCAR incurs as a result of, or related to, this MOU shall be entirely borne by NCAR. CIMA shall have no obligation to pay NCAR any expense or costs that NCAR may incur, nor assume any liability or risk of NCAR as a result of, or related to, the obligations and/or performance under this MOU, except as provided for by paragraph 4.2 above. However, the caveat of availability of funds, resources, management approval, mutually agreed upon collaboration, and staff

availability as provided for by paragraph 2.1 above shall take precedence over paragraph 5.3. .

5.4 CIMA and NCAR may explore funding support from their own resources for the collaborative work and support for visiting scientists at respective institutions. They may also submit, as opportunity provides, joint projects for support from the National Science Foundation (NSF), Office of Global Program (OGP) in the United States (US), US Agency for International Development, Ministry of University and Research in Italy, EU funding opportunities and international agencies like the World Meteorological Organization (WMO), United Nations Cultural, Education and Scientific Organization (UNESCO) and Global Environmental Fund.

## **6. Intellectual Properties and Ownerships**

6.1 It is understood by CIMA and NCAR that the intellectual property of each party is defined and ownership rights are established as follows:

6.2 "NCAR Intellectual Property" is defined as NCAR software, designs, processes, drawings, patents, patent applications, continuation-in-part, inventor rights in the United States and foreign countries and applications therefore, all United States and foreign copyrights and all other literary property and author rights, whether or not copyrightable, all know-how, whether or not protected by patent, copyright and trade secret or otherwise, and all materials incorporating, embodying, or representing any of the NCAR Intellectual Property in whatever format.

6.3 NCAR Rights. All rights, title and interests, including patents, copyrights, trademarks and any other intellectual property, in and to, NCAR Intellectual Property, shall be held solely by NCAR.

6.4 "CIMA Intellectual Property" is defined as CIMA software, designs, processes, drawings, patents, patent applications, continuation-in-part, inventor rights in the United States and foreign countries and applications therefore, all United States and foreign copyrights and all other literary property and author rights, whether or not copyrightable, all know-how, whether or not protected by patent, copyright and trade secret or otherwise, and all materials incorporating, embodying, or representing any of the CIMA Intellectual Property in whatever format.

6.5 CIMA Rights. All rights, title and interests, including patents, copyrights, trademarks and any other intellectual property, in and to, CIMA Intellectual Property, shall be held solely by CIMA.

6.6 Developments jointly carried out by CIMA and NCAR and which do not incorporate either party's Intellectual Property ("Joint Technology") will be jointly owned and either party has the right to exploit the Joint Technology in any manner without an accounting to the other.

6.7 In case of projects funded by other agencies such as the ones mentioned in Item 5.2, separate agreement may be worked out among NCAR, CIMA and the agencies concerned.

6.8 No license under any patent, copyright, trade secret or other intellectual property is either granted or implied by the disclosing of Information by the disclosing party to the receiving party, except where otherwise recited in this Agreement.

#### **7.0 Laws/Regulations/ Hold Harmless**

7.1 This MOU and the respective performance of the parties hereunder shall be subject to all applicable regulations and laws of the United States of America and the Republic of Italy.

7.2 Export Controls. This MOU and the respective performance of the parties hereunder, shall be subject to all applicable export control laws and regulations of the United States of America and the Republic of Italy. CIMA agrees that it will comply with all U.S. Export Laws and Regulations regarding the export or re-export of NCAR Intellectual Property, NCAR Improvements, NCAR Documentation, Joint Technology and Joint Documentation to any country outside the United States or to a non- "U.S. Person."

7.3 Hold Harmless. This MOU does not bind or purport to bind the U.S. Government or the National Science Foundation (NSF), an independent agency of the U.S. Government. Consequently, CIMA shall hold the U.S. Government and the NSF harmless from any liability as a result of any activities conducted under this MOU.

#### **8. Validity**

This MOU will remain valid for a period of five years from the date of signing ("Effective Date"), subject to availability of resources and mutual agreement to collaborate. The research projects to be undertaken in the first stage are outlined in the Appendix. The MOU may be reviewed and renewed thereafter for such period and on mutually agreed terms and conditions.

#### **9. Termination**

9.1 Either party upon three (3) months advance notice may terminate this MOU without liability.

9.2 All written notices, communications and deliveries between NCAR and CIMA with reference to this MOU shall be sent to the respective address of the party, or to such other individuals as the parties may designate in writing from time to time, as follows:

#### **10. Points of Contact**

##### **For NCAR**

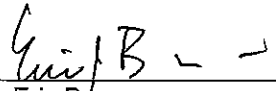
Technical Contact:  
Dr. Richard Rotunno  
Senior Scientist  
NCAR  
1850 Table Mesa Drive  
Boulder, CO 80305

##### **For UCAR**

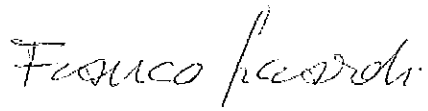
Contractual Contact:  
Ms. Virginia L. Taberski  
Manager, Sponsored Agreements  
UCAR  
1850 Table Mesa Drive  
Boulder, CO 80305

**11. OFFICIAL SIGNATURES**

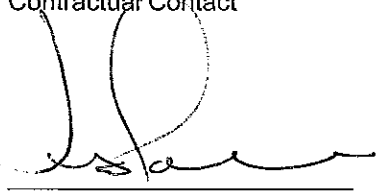
**For NCAR**

  
\_\_\_\_\_  
Dr. Eric Barron  
NCAR Director

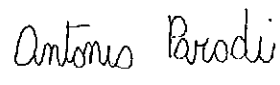
**For CIMA Research Foundation**

  
\_\_\_\_\_  
Prof. Franco Siccardi  
CIMA Research Foundation President

**For UCAR**

Contractual Contact  
  
\_\_\_\_\_  
Ms. Virginia L. Taberski  
Manager, Sponsored Agreements

**For CIMA Research Foundation**

Technical Contact  
  
\_\_\_\_\_  
Dr. Antonio Parodi  
Project leader

## Appendix

Flash flood-producing storms in the area of Mediterranean are usually convective in nature. These phenomena are often responsible for extreme hydrometeorological events with serious and relevant consequences from a social and economic viewpoint; consequently a better understanding of the fundamental aspects of convective processes at storm-scale can be of great value both theoretically and operationally.

Atmospheric modelling has benefited over recent years from the growing use of cloud-resolving models, run at very fine resolution, with the ability of solving for the internal cloud structure, as well as from the increased availability of distributed meteorological observations coming from traditional sensors, like raingauges, and non-traditional ones, like space-borne and ground-based weather radars. Obviously such a potential increase of our understanding requires reliable methods to deal with the uncertainty associated with the models themselves and with the observations required both for validating and driving the models.

The scientific community has been discussing whether a drastic increase of resolution of limited-area numerical predictions can significantly reduce the uncertainty of the model predictions and that of the end user.

On the one hand computer resources now allow one to easily run a three-dimensional explicit simulation of a thunderstorm with 1-km grid spacing. The long record of atmospheric simulations seems to suggest that this grid spacing is sufficient to simulate deep moist convective processes, since the typical scale of a convective cell is of order of 10 km in all three directions.

On the other hand, an increasing number of studies indicate a strong dependence and sensitivity of the meteorological predictions on numerical and physical details when the adopted horizontal resolution is of order of the micro- (1 km) scale or much smaller (order of 100 m).

Along these lines, CIMA Research Foundation and NCAR will jointly engage in the two collaborative projects detailed in the following:

1) Microphysical and turbulent parameterizations influence on high-resolution numerical modelling of idealized deep moist convective scenarios

A set of simplified atmospheric scenarios (e.g. supercell, squall-line, radiative convective equilibrium) will be identified and studied by means of high resolution numerical simulations with Cosmo Model and WRF.

Particular attention will be paid to determine at which grid-spacing the convection-resolving solutions statistically converge from a turbulence perspective with respect to flow field structure, transport properties and precipitation forecast. Different turbulent closures and microphysical parameterizations will be used and their impact on the spatial-temporal structure of convective fields will be discussed.

2) Uncertainty in high resolution numerical modeling of extreme precipitation events over complex orography

A catalogue of extreme precipitation events observed during last few years and representative of flash flood-producing storms in small-to-medium size Italian catchments will be modeled at very fine resolution with the COSMO Model and WRF.

The activity will aim to gain a deeper understanding of precipitation processes over areas with complex orography, characteristic of Mediterranean coastline, and to provide a contribution to the identification of the main sources of uncertainty associated with their prediction.

Particular attention will be paid to role of the initial-condition sensitivity identified as the most limiting of forecast accuracy.

Furthermore, different turbulent closures and microphysical parameterizations will be used and the performances of COSMO-Model and WRF run at very fine resolution will be investigated and evaluated against distributed meteorological observations coming from traditional and non-traditional sensors (e.g polarimetric radar observations of the Italian radar network). The metric of the comparison between predictions and observations will range from classical meteorological score indices to the use of meteorological forward operators like polarimetric radar simulator.