

**法規名稱：**IMPLEMENTING ARRANGEMENT #19 DEVELOPMENT OF A HIGH-RESOLUTION QUANTITATIVE PRECIPITATION ESTIMATION AND QUANTITATIVE PRECIPITATION FORECAST (HRQ2) SYSTEM PURSUANT TO THE AGREEMENT BETWEEN THE TAIPEI ECONOMIC AND CULTURAL REPRESENTATIVE OFFICE IN THE UNITED STATES AND THE AMERICAN INSTITUTE IN TAIWAN FOR TECHNICAL COOPERATION IN METEOROLOGY AND FORECAST SYSTEMS DEVELOPMENT

**簽訂日期：**民國 96 年 11 月 26 日

**生效日期：**民國 96 年 11 月 26 日

#### Article I - Scope

This Implementing Arrangement describes the scientific and technical activities to be undertaken by the American Institute in Taiwan (AIT), through its designated representative, the Global System Division (GSD), (formally the Forecast Systems Laboratory) of the Earth System Research Laboratory (ESRL) of the National Oceanic and Atmospheric Administration (NOAA), United States Department of Commerce. It provides for continuing development of the forecast system being developed by the Joint Forecast Systems Project. This project is a cooperative effort between the Central Weather Bureau (CWB), the designated representative of the Taipei Economic and Cultural Representative Office in the United States (TECRO), and AIT's designated representative, NOAA/ESRL/GSD. This Implementing Arrangement is of mutual interest to both TECRO and AIT, hereafter referred to as the parties. The products of this Implementing Arrangement will provide substantial value through development of new and upgraded capabilities and applications that can be integrated into other NOAA/ESRL/GSD systems.

#### Article II - Authorities

The activities described in this Implementing Arrangement will be carried out under the general terms and conditions established by the Agreement between the Taipei Economic and Cultural Representative Office in the United States and the American Institute in Taiwan for Technical Cooperation in Meteorology and Forecast Systems Development (TECRO-AIT

Agreement), and any subsequent revision as agreed to by the parties. This Implementing Arrangement is the nineteenth such arrangement under a succession of umbrella agreements between TECRO and AIT.

This Implementing Arrangement is hereby attached to that Agreement and becomes part of the Agreement.

### Article III - Services

During the period of Implementing Arrangement #19, TECRO' s and AIT' s designated representatives respectively, the CWB and NOAA/ESRL/GSD joint team, will focus on two tasks: (1) the development of a High-resolution Quantitative Precipitation Estimation and Quantitative Precipitation Forecast (HRQ2) System, and (2) continuing interaction on earlier cooperative projects. Tasks under this Implementing Agreement range from full scale developmental collaboration to system upgrades and support that allow systems to operate with the latest technical and scientific capabilities and specifications. These ongoing activities, described in more detail in the Statement of Work, will include the following two tasks:

#### Task #1 - High-Resolution Quantitative Precipitation Estimation and Quantitative Precipitation Forecast (HRQ2) System

During Implementing Arrangement #18, TECRO' s and AIT' s designated representatives, CWB and NOAA/ESRL/GSD respectively, continued to focus on the Quantitative Precipitation Forecast (QPF) for water accumulation and debris flow based on a new advanced 3D variational (3DVAR) data assimilation scheme as NOAA/ERSL/GSD' s part of HRQ2 task. This new task will support the operational needs from threats from flash flood, debris flow and landslide.

Motivated by CWB's request to establish a 3-D variational approach for the model initialization, TECRO' s and AIT' s designated representatives, CWB and NOAA/ESRL/GSD

respectively, selected to implement the GSI (Gridpoint Statistical Interpolation) analysis system which is used operationally by NOAA/NCEP (National Centers for Environmental Prediction). The GSI package is customized for CWB for the input data format in order to ingest CWB's own data. The initial CWB GSI package was tested and evaluated near the end of June 2006 with radar data and conventional observation data. GSI is set up for ingest of both radar radial velocities and satellite radiance data. For work in 2007, an effort will be required to assess the availability of satellite radiance data from geosynchronous or polar orbiting satellites and to write the software to deliver this to GSI. Satellite radiance data will enhance the analysis in the oceanic areas surrounding Taiwan. Before GSI can be utilized for short term precipitation forecasting, a diabatic scheme similar to that already in LAPS must be added to the GSI capability. During Implementing Arrangement #19, CWB and NOAA/ESRL/GSD will continue to include additional new observation data available for LAPS GSI.

GSI has the capability of ingesting model error statistics (variances) for optimizing its analysis. For this time phase, the ensemble error statistics are made up of sequential runs of the background model (either NFS15 or WRF). Error will be recovered from an independent analysis and statistics generated. These statistics will be updated within GSI to optimize the analysis at any time.

The new focus is to adopt a multiscale 3DVAR analysis scheme called STMAS (Space and Time Mesoscale Analysis System) as part of LAPS III for surface observations and other remote sensing data such as radar data. STMAS will be extended to 3DVAR and eventually a 4DVAR approach. In its 3DVAR version, STMAS will provide multiscale analysis using

an inhomogeneous observation distribution. Like GSI, STMAS can make use of updating error statistics and can be configured with a diabatic capability. These two large efforts (GSI and STMAS) may need to be prioritized by CWB management.

STMAS uses a sequence of variational minimization in both the space and time domains to obtain multi-scale grid analysis, which cannot be done through a single 3DVAR analysis. At NOAA/ESRL/GSD, STMAS is currently running every 15 minutes in real time using dense surface observation data. The STMAS analysis provides a good verification tool for high resolution model forecasts.

During Implementing Arrangement #19, TECRO' s and AIT' s designated representatives, CWB and NOAA/ESRL/GSD respectively, will extend STMAS development from using only surface data to include remote sensing data from CWB' s advanced radar network, and maybe satellite data. The goal is to develop STMAS as an advanced operational nonlinear analysis tool at CWB in Taiwan to improve local analysis and more importantly provide a prediction system during severe weather. An advantage of STMAS is that it has been developed at NOAA/ESRL/GSD and is not subject to unexpected changes or upgrades as would be GSI.

NOAA/ESRL/GSD has developed and accessed techniques to measure atmospheric Integrated Precipitable Water (IPW) values using ground-based Global Positioning System (GPS) receivers since 1993. The NOAA GPS-IPW network currently consists of 405 sites. There are three types of sites in the network; NOAA Wind Profilers Sites (NPN), Other NOAA Sites (ONS), and Other Agency Sites (OAS). The network is controlled by a software processing system developed by NOAA/ESRL/GSD. The current ground-based GPS-Met observing

software system consists of data acquisition, geodetic modeling, IPW processing and data evaluation, display and dissemination.

During Implementing Arrangement #19, TECRO' s and AIT' s designated representatives, CWB and NOAA/ESRL/GSD respectively, will ingest GPS observation data from the CWB GPS-Met network and process these data using the current NOAA GPS-Met Observing System. NOAA/ESRL/GSD then will transfer IPW values back to CWB for evaluation.

AIT' s designated representative, NOAA/ESRL /GSD, understands that the National Severe Storms Laboratory (NSSL) will continue research towards the refinement, development, and maintenance of applications required for the Central Weather Bureau (CWB), Water Resources Agency (WRA) and the Soil and Water Conservation Bureau (SWCB) operations. The NSSL research is directed towards improving the monitoring and prediction of flash floods and severe storm identification and short-term forecasting for the Taiwan environment. The NSSL research and development for IA#19 will focus the implementation of advanced QPE and VSQPF techniques as per: 1) implementation of a new HRQ2 infrastructure and code set, 2) the implementation of an advanced radar quality control specifically tuned for the Taiwan environment; 3) 500 meter resolution product generation; 4) assessment in using dual polarization radar for radar intercomparison and calibration; 5) verification and assessment of application performance.

## Task #2 - Continuing Interaction on Earlier Cooperative Projects

Several earlier cooperative tasks have been completed. Technology has been transferred successfully and is beginning to be used operationally at CWB. NOAA/ESRL/GSD'

s development activities in these areas continue, and further CWB-NOAA/ESRL/GSD interaction is important to keep CWB staff up-to-date on current developments. This task will allow continuing interaction at an appropriate level, including new software releases of the forecast information system including the AWIPS/D2D (OB7), radar display using D2D to replace POP, dual head display support, advanced ALPS training by NOAA/ESRL/GSD, AFPS text formatter technical support, and Internet-based forecast workstation (FX-C) with advanced drawing capability with touch screen support, NOAA data support, visitors training, exchange of visits, copying papers and reports, and e-mail interaction.

#### Article IV - Responsibilities of TECRO

In addition to participation in the joint project team, TECRO through its designated representative, CWB shall:

- A. Provide overall coordination project activities at the CWB facility;
- B. Assign appropriate staff to perform the activities defined in this Implementing Arrangement and provide support in accordance with the terms of the umbrella agreement; and
- C. Fulfill its responsibilities under the Statement of Work for Implementing Arrangement #19.

#### Article V - Responsibilities of AIT

In addition to participation in the joint project team, AIT, through its designated representative, NOAA/ESRL/GSD shall:

- A. Provide overall coordination project activities at the NOAA/ESRL/GSD facility in Boulder, Colorado;
- B. Provide administrative support for preparing reports for delivery to TECRO's designated representative, CWB, in accordance with this Implementing Arrangement ;
- C. Assign appropriate staff to perform the activities defined in this Implementing Arrangement and provide support in

accordance with the terms of the umbrella agreement; and  
D. Fulfill its responsibilities under the Statement of Work for  
Implementing Arrangement #19.

#### Article VI - Financial Provisions

In accordance with the TECRO-AIT Agreement, TECRO is required to reimburse AIT for all costs incurred by AIT's designated representative, NOAA/ESRL/GSD, in association with the project covered by this Implementing Arrangement. AIT shall transfer to NOAA/ESRL/GSD all payments made by TECRO to AIT for costs incurred by NOAA/ESRL/GSD in association with this Implementing Arrangement.

The total cost for activities described in this Implementing Arrangement is mutually agreed to be U.S. \$850,000. TECRO agrees to transfer fifty percent of the funds to AIT in advance, with the remaining fifty percent to be transferred upon completion of the year's activities, to the extent that funds for this purpose have been provided by TECRO.

The performance by AIT's designated representative of activities under this Implementing Arrangement is subject to the availability of funds.

#### Article VII - Intellectual Property Considerations

No intellectual property considerations are expected to arise in conjunction with activities described in this Implementing Arrangement. Existing system designs and computer software of the NOAA/ESRL/GSD Forecast System are in the public domain. Reports, specifications, and computer software prepared under this Implementing Arrangement also will be in the public domain once NOAA and CWB have approved them in final form.

#### Article VIII - Effective Date, Amendment, and Termination

This Implementing Arrangement is effective on the date of the last signature hereto and will terminate on March 30, 2009.

This Implementing Arrangement may be amended by mutual written



consent of the parties, and may be terminated by either party by providing 60 days written notice to the other party. The estimated completion date for the activities described in this Implementing Arrangement is June 30, 2008.

FOR THE TAIPEI  
ECONOMIC AND  
CULTURAL  
REPRESENTATIVE  
OFFICE IN THE  
UNITED STATES

FOR THE AMERICAN  
INSTITUTE  
IN TAIWAN

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Barbara Schrage  
Barbara Schrage  
Managing Director

Date

Date 10/5/07