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

Article I - Scope

This Agreement provides a framework for projects between the Taipei Economic and Cultural Representative Office in the United States (TECRO) and the American Institute in Taiwan (AIT), hereinafter referred to individually as a "party" and together as the "parties". It describes the scientific and technical activities to be undertaken by AIT, through its designated representative, the National Oceanic and Atmospheric Administration (NOAA), United States Department of Commerce, including but not limited to NOAA's Global System Laboratory (GSL) of the Earth System Research Laboratories, and TECRO, through its designated representative, the Central Weather Bureau of Taiwan (CWB).

This Agreement also provides for Implementing Arrangements (IA) to be undertaken by AIT, through its designated representative, in support of TECRO, and its designated representative. The initial IA for this Agreement, Implementing Arrangement (IA) #32, is to distinguish it from the prior 31 Scopes of Work (SOWs) approved between TECRO and AIT under prior Agreements related to Meteorology and Forecast System Development since 1989. IA #32 is included as an annex to this agreement.

The projects to be undertaken pursuant to this Agreement are cooperative efforts between the Parties, through their designated representatives.

This Agreement provides for continuing development in areas of mutual interest in the fields of meteorology and forecast systems development including providing technical expertise, training, and scientific exchange activities on a reimbursable basis.

This Agreement is of interest to both TECRO and AIT. In addition to the technical objectives to the territories represented by TECRO, as listed in Article II, the products of this Agreement will provide substantial value through development of new and upgraded capabilities and applications that can be integrated into systems operated by the AIT designated representative, NOAA.

This Agreement replaces 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, signed on October 20 and 21, 2016.

This Agreement is a continuation of a succession of Agreements between TECRO and AIT, since approximately 1989, specific to the scope of weather forecast improvement.

Article II - Objectives

The broad objective of this Agreement is to establish a framework to enable AIT through its designated representative as appropriate, to carry out reimbursable technical cooperation with TECRO, through its designated representative as appropriate. The technical objectives of the cooperation are:

A. To undertake cooperative activities that will strengthen the weather forecasting capability of the territories represented by TECRO;

B. To provide technical assistance to plan and implement weather forecast systems for the territories represented by TECRO;

C. To provide professional development and training for participants from the territories represented by TECRO selected by TECRO or its designated representative;

D. To exchange materials and information and transfer technology from AIT, through its designated representative, to TECRO, through its designated representative; and

E. To promote joint consideration of scientific and technical exchange programs.

Article III - Cooperative Activities

Cooperative activities under this Agreement are to be described in IAs. The general nature of these cooperative activities was determined through consultations between the parties, through their designated representatives. Specifically,

A. Activities under this Agreement shall include conducting collaborative research projects, developing systems specifications and acquisition plans, developing meteorological observation, processing and display systems, managing systems implementation, exchanging information, exchanging scientists and technical experts, convening seminars and meetings, training participants, and engaging in other forms of cooperation in the areas of weather forecasting systems, climate prediction systems, marine forecast systems, meteorological observing systems, tsunami monitoring and information exchange, providing technical assistance and services for hardware or software upgrade or repair for new or existing systems, and related science and technology as may be mutually agreed.

B. TECRO and AIT shall conclude IAs regarding scientific cooperation activities under this Agreement. Such IAs shall be subject to the terms of this Agreement and if there is a conflict between any provision(s) of an IA and this Agreement then applicable provisions of this Agreement shall govern.

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Article IV - Coordination

Overall coordination of the activities covered by this Agreement and its IAs and the provision of certain administrative facilities and support for this Agreement shall be the responsibility of TECRO and AIT and their designated representatives. Responsibility for managing the specific activities undertaken, and the role of other entities in these activities, shall be determined mutually by TECRO and AIT and their designated representatives, and specified in the relevant IAs.

Article V - Responsibilities of AIT

AIT agrees to perform, through its designated representative as appropriate, the following activities and provide the following resources in support of the joint project activities under this Agreement:

A. Provide overall management of the cooperative activities under this Agreement;

B. Consult, as necessary and appropriate, with representatives of other agencies;

C. Designate appropriate authorities to be responsible for coordination with the staff of TECRO's designated representative;

D. Determine staffing requirements and select and assign personnel, institutions and firms as necessary to fulfill AIT's responsibilities for implementation of activities under this Agreement. (This selection process is expected to be carried out solely on the basis of professional capability, academic qualification, experience, and other merit factors. All procurement actions by AIT's designated representative shall be conducted in accordance with applicable procurement regulations.);

E. Provide all necessary logistical support to the staff of AIT's designated representative and its contractors including travel arrangements, per diem, and visa assistance, in accordance with applicable regulations and contract terms;

F. Provide administrative support including office space and access to facilities, equipment, and services at the sites of AIT's designated representative for work performed by its designated representative in connection with activities under this Agreement;

G. Provide administrative support for preparing formal reports for delivery by TECRO and AIT.

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C. TECRO shall ensure that AIT and its designated representative are held free and clear of all customs duties and imposition of charges by the authorities represented by TECRO in their territory. Neither AIT, nor its designated representative shall be required to pay any duties or taxes in executing the terms and conditions of this Agreement.

D. TECRO, through its designated representative, shall provide overall coordination project activities at the CWB facility and assign appropriate staff to perform the activities defined in this Agreement.

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A. TECRO shall provide funds to AIT for all personnel, equipment, facilities, or other services provided to TECRO, or its designated representative, by AIT or its designated representative, as required to carry out activities pursuant to this Agreement and each respective IA.

B. AIT shall provide TECRO with documentation supporting requests for reimbursement in accordance with applicable financial regulations and practice of AIT and its designated representative.

C. The total cost for the duration of this Agreement is estimated to be a minimum of $7,000,000 USD and a maximum of $15,000,000 USD, with funds transferred from TECRO to AIT for services provided by AIT to TECRO, through their designated representatives. In each year under the Agreement the fund transfers from TECRO to AIT for services provided by AIT to TECRO, through their designated representatives, are estimated to be a minimum of $1,400,000 USD up to a maximum of $3,000,000 USD.

D. Fund transfers shall occur pursuant to Article VIII of this Agreement. IAs shall be prepared through discussions between the designated representatives with work scope agreed by the Parties. The agreed work must be consistent with Article II – Objectives of this Agreement.

E. IAs may include optional tasks that could be exercised at any time during the duration of the Agreement by a fund transfer and instruction to execute the optional tasks.

F. IAs do not need to repeat provisions found in this Agreement; rather, they shall make a statement to confirm that the planned work is consistent with the provisions of this Agreement.

G. AIT's performance under this Agreement and NOAA's performance of work as the AIT Designated Representative under this Agreement are subject to availability of funds.

Article VIII – Scope of Work and Estimated Costs

In accordance with Article VII – Financial Arrangements, TECRO shall pay AIT, in association with the project covered by this IA. The estimated costs are as follows:

Year	Advance transfer of 50% of funds	Completion Transfer of 50% of funds	Total Estimated Cost
1	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
2	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
3	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
4	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
5	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD

The total estimated cost for activities described in this Agreement is expected to be a minimum of $7,000,000 USD up to maximum of $15,000,000 USD. TECRO agrees to transfer 50 percent of the funds to AIT in advance of the performance of work described in this Agreement or its IAs, with the remaining 50 percent to be transferred upon completion of the work described in this Agreement or IAs, to the extent that funds for this purpose have been provided by TECRO.

All budget figures are estimated. Actual amounts shall be accrued for purposes of fulfilling the financial arrangements described in the Agreement.

The Scope of Work (SOW) and annual budget estimates are found in an attachment to this Agreement.

Article IX - CWB Joint Team Assignments at NOAA

Several tasks encourage CWB visitors at NOAA facilities at GSL, National Environmental Satellite, Data, and Information Service (NESDIS), the Climate Prediction Center (CPC) and the Meteorological Development Laboratory (MDL). The primary effort of TECRO, through CWB staff at NOAA during the Agreement period shall be directed towards the satellite data, AWIPS II development tasks, gain familiarity with the operations of the CPC International Monsoon Desk. It is important that qualified CWB staff be available to work at NOAA research and operations facilities during the period of this IA. Specific assignments shall be made to most efficiently use the available personnel resources. Assignments for the qualified CWB staff members are provided in the attached SOW.

Article X – Privileges, Exemptions, and Immunities

TECRO shall retain oversight of, remain in contact with, and provide appropriate support to Taiwan researchers working in NOAA-affiliated facilities under this Agreement. The Participants consider individuals participating in visits to be consultants to their respective representative organizations as appropriate while in the territory represented by the other Party. The Parties agree that individuals participating in visits under this Agreement shall not be treated as designated employees of their respective representative organizations and therefore such individuals shall not be entitled to the privileges and immunities under the 2013 TECRO-AIT Agreement on Privileges, Exemptions and Immunities. Nothing here is intended by the Parties as an amendment or other change to the 2013 Agreement, the provisions of which must be satisfied before any privileges, exemptions, or immunities may be provided by either Party.

Article XI - Intellectual Property Considerations

A. TECRO and AIT support the widest possible dissemination of information provided, exchanged, or arising under this Agreement, subject to the need to protect pre-existing proprietary information or other intellectual property rights.

B. No activity described in this Agreement, or any technology or other information exchanged in the course of activities under this Agreement, is expected to give rise to, or implicate any existing, intellectual property rights. Reports, specifications, and computer software prepared under this Agreement are also expected not to be subject to intellectual property protection.

C. Information transmitted by either party to this Agreement to the other party shall be accurate as reasonably practicable, but the transmitting party does not warrant the suitability of the information transmitted for any particular use or application by the receiving party or by any third party. Information developed jointly by the parties shall be accurate to the best knowledge and belief of both parties. Neither party warrants the accuracy of the jointly developed information or its suitability for any particular use or application by either party or by any third party.

Article XII - Liability

Except for damage to, or loss of, property of AIT or of its designated representative that is caused by AIT or personnel of its designated representative, TECRO agrees to indemnify AIT and its designated representative for any acts or omissions by TECRO and/or its representatives and their employees resulting in damage to, or loss of, such property, arising out of activities associated with this Agreement.

In addition, all property made available to TECRO and/or public or private interests under this Agreement or its IAs is tested and quality controlled by the standard procedures implemented by AIT's designated representative. After CWB tests and accepts such property, neither AIT nor its designated representative makes any warranties, either expressed or implied, regarding the proper functioning of the equipment, including any systems hardware or software, or the accuracy of any data obtained from such equipment. Neither AIT nor its designated representative assume any liability to TECRO or other recipients of its property or data, nor will they reimburse or indemnify such parties for property damage, personal injury, death, or any losses whatsoever.

Article XIII- Period of Agreement and Amendment/Termination

This Agreement shall become effective when signed by both parties on the date of the last signature. This Agreement shall terminate 5 years after the date of the last signature and may be amended at any time by mutual consent of TECRO and AIT . The parties shall review this Agreement annually to determine whether it should be amended, extended, or terminated. Any party may terminate this Agreement by providing sixty (60) days written notice to the other party. Termination of this Agreement also terminates at the same time all IAs of this Agreement unless they have been previously terminated. It is understood that the parties shall attempt to reach mutual agreement on the termination dates to allow orderly termination of activities and repatriation of personnel. The parties intend to reach an equitable adjustment for any termination through consultations, which shall provide for payment to AIT for its designated representative for services rendered and expenses incurred prior to the termination, in addition to termination settlement costs reasonably incurred by NOAA relating to commitments that became firm prior to termination.

Article XIV – Other Provisions

Should disagreements arise on the interpretation of the provisions of this Agreement, or amendments thereto, that cannot be resolved at the operating level, the area(s) of disagreement shall be stated in writing by each party and presented to the other party for consideration.

IN WITNESS WHEREOF, the undersigned, being duly authorized, have signed this Agreement.

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

Robin Cheng

Robin J.C. Cheng
Deputy Representative

3/16/2021
Date

FOR THE AMERICAN INSTITUTE IN TAIWAN

Ingrid Larson

Ingrid D. Larson
Managing Director

3/15/2021
Date

Annex
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

Implementing Arrangement #32

I.2020 Scope of Work

Task #1 Development and Improvement of Satellite Products for Surface Radiation and Air Quality Monitoring and Prediction

1. Aerosol optical depth (AOD)
    a. Revise/update/fine-tune the surface reflectance relationships for the area of interest:
        - use more, seasonally representative Advanced Himawari Imager (AHI) data, and
        - better account for time-of-day changes in land-surface spectral reflectance relationships;
    b. Implement and test updated surface reflectance relationships;
    c. Re-evaluate AHI AOD product;
    d. Update/complete document;
    e. Prepare updated package (code + documents + test data) for delivery.
2. Air quality estimation
    a. Revise AOD vs. surface PM 2.5 regression analysis and apply the models to generate surface PM 2.5 maps for the territory represented by TECRO in near real time
        - Provide the maps to CWB for evaluation
    b. Conduct quantitative evaluation of AHI derived surface PM 2.5 with ground-based observations
    c. Implementation of AHI aerosol detection algorithm on tars.umd.edu and completion of 2017-2018 AHI dust detection data
    d. Tag AHI AOD vs. surface PM 2.5 with smoke/smog and dust mask flags and stratify the data for regression analysis.
3. Surface solar radiation
    a. Revise/update narrowband-to-broadband conversions,
    b. Implement and test updated conversions;

c. Re-evaluate AHI Direct Solar Radiation (DSR) product;
d. Update/complete document;
e. Prepare updated package (code + documents + test data) for delivery.

4. Derivation of Surface Solar Insolation From CRTM
   a. The interface modules to couple the CRTM outputs with the existing new NESDIS STAR AHI SSI algorithm are developed and will be delivered together with the improved CRTM package.

Task #2 – High-Resolution Quantitative Precipitation Estimation and Quantitative Precipitation Forecast (HRQ2) Applications Improvement

1. Machine learning (ML) based radar QPE
   a) Expansion of training data
   b) Expanded evaluations for more weather regimes
   c) Evaluations of the preliminary ML model in real-time
2. Taiwan operational radar QPE R&D support
   a) Development of a precipitation rate category product
   b) Development of a Radar QPE Quality Index (RQI) product
   c) Continued evaluations and enhancements of the CWB operational radar QPEs
3. Web-based product display and QPE verification tools
   a) Development of a new web-based product display tool
   b) Development of a new web-based QPE verification tool

Task#3 - Enhancement of Nowcasting Decision Assistance Tools

1. AWIPS2/ VLab
   a) Continue to support the customization of all other MDL decisions-assistance applications;
   b) Support the use of extra data sources such as lightning and model data for SCAN application;
   c) Continue to support the Virtual Lab use for CWB to access AWIPS2 resources
2. Continue and extend the machine-learning development of local Taiwan-based thunderstorm predictors.
   a) Continue testing the hierarchy of machine-learning models after beginning with logistic regression and simple (MLP) artificial neural networks, and extending to evolutionary programming (EP) models in order to determine which approach is optimal (including an adaptive approach).
   b) Enhance the ML algorithms and explore the best algorithm for each of the

divided regions.

c) Using more data events and data sources provided by CWB to extend capabilities.

3. Support the MDL's version of ANC at the CWB for its use in operations.

Task #4 - Development of High-Resolution Product Generation Assistance Tools for AWIPS II

1. Continued general AWIPS II support and transition assistance
    a. Provide System Administration Training at CWB by GSL subject matter experts.
    b. Provide User Training at CWB by GSL subject matter experts.
    c. Assist with upgrade to Build 18.1
2. Common AWIPS Visualization Environment (CAVE) Annotation Tool (to replace Weather Contour Editor)
    a. Deliver evaluation version 2.0
        - Improve core code
        - CWB import-export converters
        - Application interface and framework
        - Additional new features
    b. Deliver production version 1.0
        - Basic support operation
        - Transitional capabilities
        - Improve performance
    c. Deliver production version 2.0
        - Enhance capabilities based on feedback
        - Improve performance
3. Hazard Services transition (to modernize warning capabilities)
    a. Host CWB visitor to learn Hazard Services functionality and development for 4 to 6 months at GSL in Boulder CO.
    b. Assist with assessing CWB requirements for Hazard Services
        - Hazard types
        - Product output formats

Task #5 – Enhancement of Next Generation Global to Regional Prediction System

1. Hosting CWB modeling visitor to participate in FV3GFS testing, evaluation and implementation activity for 12 Months at EMC in College Park, Maryland.
2. EMC colleagues to visit CWB to conduct technical workshops on FV3GFS, FV3CAM, GDAS, GEFS (four visits, 1-2 EMC scientists for each visit) for 1 to 2 weeks.
3. Facilitating CWB manager's visit to EMC for project review meeting for 1 week.
4. Deliver observation files for HYCOM- LETKF and NWW3- LETKF.

5. Build Hybrid Coordinate Ocean Model (HYCOM)-LETKF based regional
6. Ocean Data Assimilation (ODA) system for the sea and ocean areas that encompass the island of Taiwan. Transfer of technology to MMC for near-real-time applications of an ocean forecast system for the territory represented by TECRO.

Task #6 - Continuing Interaction on Earlier Cooperative Projects

1. NOAAPORT data supply support
2. Provide regional, near-real time products of GloTEC and ROTI map.
3. Real-time data from GNSS receivers in the territory represented by TECRO.
4. DART consultation and a site visit support
5. Visitors and travel support
6. GSL Machine learning work

Task #7 – Development of GOES-R Decision Support Products from Himawari-8

1. Develop Himawari-8 visibility product (Phase 2)
    a. Host visitor and collaborate on integrating fog and cloud/aerosol optical depth products into visibility.
2. Implement cloud-based Precipitation product
    a. Tune for Himawari-8/AHI using radar data
    b. Upgrade CLAVR-x installation at MSC/CWB to include tuned precipitation
3. Continue RGB and CLAVR-x product support
    a. Identify key CLAVR-x products and create xml files for The Geostationary Operational Environmental Satellite-R Series (GOES-R) annotation in AWIPS II (colorbar, axis labels, ranges)
    b. Update training of the CLAVR-x cloud mask from collocated The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO)/ Himawari-8 scenes
    c. Deliver a updated utility package being tested to convert AHI "HSD" format as well as HimawariCast tools (L1b imagery) and geo2grid (L2) to CWB Technical and training support to CWB visitor for 3 months at its facility in Madison, Wisconsin.

Task #8 –Tsunami Warning Enhancement Efforts for the Territory Represented by TECRO

1. Construct Hualien tsunami flooding model (or another site in the territory represented by TECRO with available data) for use in T-web software environment and validate using tide gauge data from the 2011 Japan tsunami. Requires bathymetric data at 50m resolution from

Professor Wu.

2. Provide CWB training for Tweb and ComMIT.
3. Provide maintenance and support of the Tweb and ComMIT software for testing and experimental forecast use.
4. Provide software for modeling with a customized initial tsunami source. ComMIT interface for tsunami forecast modeling would allow for custom sources integration, in addition to the pre-computed source selection. Pre-computed sources allow for fast forecast computations for real-time predictions. The custom sources provide capabilities for additional custom tsunami sources, but they may not be suitable for real-time forecast purposes.
5. Construct as many tsunami flooding models for population centers of the territory represented by TECRO as resources permit. Ideally, these models will cover locations of 40 gauges around the territory represented by TECRO to allow independent validation of the tsunami forecast with the tide gage records, and to perform tests with data from prior tsunami events. Bathymetry information is to be supplied to PMEL by the CWB.

II. 2020 Annual Budget Plan

Tasks	**Personnel**	**Travel/Training**	**Total**
Task #1 (NESDIS/GSL)	$200,000	$25,000	$225,000
Task #2 (NSSL)	$250,000	$0	$250,000
Task #3 (MDL/GSL)	$260,000	$0	$260,000
Task #4 (GSL)	$250,000	$0	$250,000
Task #5 (NCEP/EMC)	$130,000	$	$130,000
Task #6 (GSL)	$575,000	$260,000	$835,000
Task #7 (CIMSS)	$200,000	$0	$200,000
Task #8 (PMEL)	$140,000	$0	$140,000
Total	$2,005,000	$285,000	$2,290,000

III. 2020 Visitor Plan

1. A research assistant from CWB Weather Forecast Center will visit NOAA/ESRLs/GSL for up to 3 months.
2. A research assistant from CWB Meteorological Information Center will visit NOAA/ESRLs/GSL for up to 6 months.
3. A research assistant from CWB Meteorological Research Center will visit NWS/NCEP/EMC for up to 3 months.

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C. TECRO shall ensure that AIT and its designated representative are held free and clear of all customs duties and imposition of charges by the authorities represented by TECRO in their territory. Neither AIT, nor its designated representative shall be required to pay any duties or taxes in executing the terms and conditions of this Agreement.

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E. IAs may include optional tasks that could be exercised at any time during the duration of the Agreement by a fund transfer and instruction to execute the optional tasks.

F. IAs do not need to repeat provisions found in this Agreement; rather, they shall make a statement to confirm that the planned work is consistent with the provisions of this Agreement.

G. AIT's performance under this Agreement and NOAA's performance of work as the AIT Designated Representative under this Agreement are subject to availability of funds.

Article VIII – Scope of Work and Estimated Costs

In accordance with Article VII – Financial Arrangements, TECRO shall pay AIT, in association with the project covered by this IA. The estimated costs are as follows:

Year	Advance transfer of 50% of funds	Completion Transfer of 50% of funds	Total Estimated Cost
1	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
2	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
3	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
4	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD
5	$0.7M USD to $1.5M USD	$0.7M USD to $1.5M USD	$1.4M USD to $3M USD

The total estimated cost for activities described in this Agreement is expected to be a minimum of $7,000,000 USD up to maximum of $15,000,000 USD. TECRO agrees to transfer 50 percent of the funds to AIT in advance of the performance of work described in this Agreement or its IAs, with the remaining 50 percent to be transferred upon completion of the work described in this Agreement or IAs, to the extent that funds for this purpose have been provided by TECRO.

All budget figures are estimated. Actual amounts shall be accrued for purposes of fulfilling the financial arrangements described in the Agreement.

The Scope of Work (SOW) and annual budget estimates are found in an attachment to this Agreement.

Article IX - CWB Joint Team Assignments at NOAA

Several tasks encourage CWB visitors at NOAA facilities at GSL, National Environmental Satellite, Data, and Information Service (NESDIS), the Climate Prediction Center (CPC) and the Meteorological Development Laboratory (MDL). The primary effort of TECRO, through CWB staff at NOAA during the Agreement period shall be directed towards the satellite data, AWIPS II development tasks, gain familiarity with the operations of the CPC International Monsoon Desk. It is important that qualified CWB staff be available to work at NOAA research and operations facilities during the period of this IA. Specific assignments shall be made to most efficiently use the available personnel resources. Assignments for the qualified CWB staff members are provided in the attached SOW.

Article X – Privileges, Exemptions, and Immunities

TECRO shall retain oversight of, remain in contact with, and provide appropriate support to Taiwan researchers working in NOAA-affiliated facilities under this Agreement. The Participants consider individuals participating in visits to be consultants to their respective representative organizations as appropriate while in the territory represented by the other Party. The Parties agree that individuals participating in visits under this Agreement shall not be treated as designated employees of their respective representative organizations and therefore such individuals shall not be entitled to the privileges and immunities under the 2013 AIT-TECRO Agreement on Privileges, Exemptions and Immunities. Nothing here is intended by the Parties as an amendment or other change to the 2013 Agreement, the provisions of which must be satisfied before any privileges, exemptions, or immunities may be provided by either Party.

Article XI - Intellectual Property Considerations

A. AIT and TECRO support the widest possible dissemination of information provided, exchanged, or arising under this Agreement, subject to the need to protect pre-existing proprietary information or other intellectual property rights.

B. No activity described in this Agreement, or any technology or other information exchanged in the course of activities under this Agreement, is expected to give rise to, or implicate any existing, intellectual property rights. Reports, specifications, and computer software prepared under this Agreement are also expected not to be subject to intellectual property protection.

C. Information transmitted by either party to this Agreement to the other party shall be accurate as reasonably practicable, but the transmitting party does not warrant the suitability of the information transmitted for any particular use or application by the receiving party or by any third party. Information developed jointly by the parties shall be accurate to the best knowledge and belief of both parties. Neither party warrants the accuracy of the jointly developed information or its suitability for any particular use or application by either party or by any third party.

Article XII - Liability

Except for damage to, or loss of, property of AIT or of its designated representative that is caused by AIT or personnel of its designated representative, TECRO agrees to indemnify AIT and its designated representative for any acts or omissions by TECRO and/or its representatives and their employees resulting in damage to, or loss of, such property, arising out of activities associated with this Agreement.

In addition, all property made available to TECRO and/or public or private interests under this Agreement or its IAs is tested and quality controlled by the standard procedures implemented by AIT's designated representative. After CWB tests and accepts such property, neither AIT nor its designated representative makes any warranties, either expressed or implied, regarding the proper functioning of the equipment, including any systems hardware or software, or the accuracy of any data obtained from such equipment. Neither AIT nor its designated representative assume any liability to TECRO or other recipients of its property or data, nor will they reimburse or indemnify such parties for property damage, personal injury, death, or any losses whatsoever.

Article XIII- Period of Agreement and Amendment/Termination

This Agreement shall become effective when signed by both parties on the date of the last signature. This Agreement shall terminate 5 years after the date of the last signature and may be amended at any time by mutual consent of AIT and TECRO. The parties shall review this Agreement annually to determine whether it should be amended, extended, or terminated. Any party may terminate this Agreement by providing sixty (60) days written notice to the other party. Termination of this Agreement also terminates at the same time all IAs of this Agreement unless they have been previously terminated. It is understood that the parties shall attempt to reach mutual agreement on the termination dates to allow orderly termination of activities and repatriation of personnel. The parties intend to reach an equitable adjustment for any termination through consultations, which shall provide for payment to AIT for its designated representative for services rendered and expenses incurred prior to the termination, in addition to termination settlement costs reasonably incurred by NOAA relating to commitments that became firm prior to termination.

Article XIV – Other Provisions

Should disagreements arise on the interpretation of the provisions of this Agreement, or amendments thereto, that cannot be resolved at the operating level, the area(s) of disagreement shall be stated in writing by each party and presented to the other party for consideration.

IN WITNESS WHEREOF, the undersigned, being duly authorized, have signed this Agreement.

FOR THE AMERICAN INSTITUTE IN TAIWAN

Ingrid D. Larson
Managing Director

3/15/2021
Date

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

Robin Cheng
Robin J.C. Cheng
Deputy Representative

3/16/2021
Date

Annex
to the

AGREEMENT BETWEEN THE AMERICAN INSTITUTE IN TAIWAN AND THE TAIPEI ECONOMIC AND CULTURAL REPRESENTATIVE OFFICE IN THE UNITED STATES FOR TECHNICAL COOPERATION IN METEOROLOGY AND FORECAST SYSTEMS DEVELOPMENT

Implementing Arrangement #32

I.2020 Scope of Work

Task #1 Development and Improvement of Satellite Products for Surface Radiation and Air Quality Monitoring and Prediction

1. Aerosol optical depth (AOD)
    a. Revise/update/fine-tune the surface reflectance relationships for the area of interest:
        - use more, seasonally representative Advanced Himawari Imager (AHI) data, and
        - better account for time-of-day changes in land-surface spectral reflectance relationships;
    b. Implement and test updated surface reflectance relationships;
    c. Re-evaluate AHI AOD product;
    d. Update/complete document;
    e. Prepare updated package (code + documents + test data) for delivery.
2. Air quality estimation
    a. Revise AOD vs. surface PM 2.5 regression analysis and apply the models to generate surface PM 2.5 maps for the territory represented by TECRO in near real time
        - Provide the maps to CWB for evaluation
    b. Conduct quantitative evaluation of AHI derived surface PM 2.5 with ground-based observations
    c. Implementation of AHI aerosol detection algorithm on tars.umd.edu and completion of 2017-2018 AHI dust detection data
    d. Tag AHI AOD vs. surface PM 2.5 with smoke/smog and dust mask flags and stratify the data for regression analysis.
3. Surface solar radiation
    a. Revise/update narrowband-to-broadband conversions,
    b. Implement and test updated conversions;

c. Re-evaluate AHI Direct Solar Radiation (DSR) product;
d. Update/complete document;
e. Prepare updated package (code + documents + test data) for delivery.

4. Derivation of Surface Solar Insolation From CRTM
   a. The interface modules to couple the CRTM outputs with the existing new NESDIS STAR AHI SSI algorithm are developed and will be delivered together with the improved CRTM package.

Task #2 – High-Resolution Quantitative Precipitation Estimation and Quantitative Precipitation Forecast (HRQ2) Applications Improvement

1. Machine learning (ML) based radar QPE
   a) Expansion of training data
   b) Expanded evaluations for more weather regimes
   c) Evaluations of the preliminary ML model in real-time
2. Taiwan operational radar QPE R&D support
   a) Development of a precipitation rate category product
   b) Development of a Radar QPE Quality Index (RQI) product
   c) Continued evaluations and enhancements of the CWB operational radar QPEs
3. Web-based product display and QPE verification tools
   a) Development of a new web-based product display tool
   b) Development of a new web-based QPE verification tool

Task#3 - Enhancement of Nowcasting Decision Assistance Tools

1. AWIPS2/ VLab
   a) Continue to support the customization of all other MDL decisions-assistance applications;
   b) Support the use of extra data sources such as lightning and model data for SCAN application;
   c) Continue to support the Virtual Lab use for CWB to access AWIPS2 resources
2. Continue and extend the machine-learning development of local Taiwan-based thunderstorm predictors.
   a) Continue testing the hierarchy of machine-learning models after beginning with logistic regression and simple (MLP) artificial neural networks, and extending to evolutionary programming (EP) models in order to determine which approach is optimal (including an adaptive approach).
   b) Enhance the ML algorithms and explore the best algorithm for each of the

divided regions.

c) Using more data events and data sources provided by CWB to extend capabilities.

3. Support the MDL's version of ANC at the CWB for its use in operations.

Task #4 - Development of High-Resolution Product Generation Assistance Tools for AWIPS II

1. Continued general AWIPS II support and transition assistance
    a. Provide System Administration Training at CWB by GSL subject matter experts.
    b. Provide User Training at CWB by GSL subject matter experts.
    c. Assist with upgrade to Build 18.1
2. Common AWIPS Visualization Environment (CAVE) Annotation Tool (to replace Weather Contour Editor)
    a. Deliver evaluation version 2.0
        - Improve core code
        - CWB import-export converters
        - Application interface and framework
        - Additional new features
    b. Deliver production version 1.0
        - Basic support operation
        - Transitional capabilities
        - Improve performance
    c. Deliver production version 2.0
        - Enhance capabilities based on feedback
        - Improve performance
3. Hazard Services transition (to modernize warning capabilities)
    a. Host CWB visitor to learn Hazard Services functionality and development for 4 to 6 months at GSL in Boulder CO.
    b. Assist with assessing CWB requirements for Hazard Services
        - Hazard types
        - Product output formats

Task #5 – Enhancement of Next Generation Global to Regional Prediction System

1. Hosting CWB modeling visitor to participate in FV3GFS testing, evaluation and implementation activity for 12 Months at EMC in College Park, Maryland.
2. EMC colleagues to visit CWB to conduct technical workshops on FV3GFS, FV3CAM, GDAS, GEFS (four visits, 1-2 EMC scientists for each visit) for 1 to 2 weeks.
3. Facilitating CWB manager's visit to EMC for project review meeting for 1 week.
4. Deliver observation files for HYCOM- LETKF and NWW3- LETKF.

5. Build Hybrid Coordinate Ocean Model (HYCOM)-LETKF based regional
6. Ocean Data Assimilation (ODA) system for the sea and ocean areas that encompass the island of Taiwan. Transfer of technology to MMC for near-real-time applications of an ocean forecast system for the territory represented by TECRO.

Task #6 - Continuing Interaction on Earlier Cooperative Projects

1. NOAAPORT data supply support
2. Provide regional, near-real time products of GloTEC and ROTI map.
3. Real-time data from GNSS receivers in the territory represented by TECRO.
4. DART consultation and a site visit support
5. Visitors and travel support
6. GSL Machine learning work

Task #7 – Development of GOES-R Decision Support Products from Himawari-8

1. Develop Himawari-8 visibility product (Phase 2)
    a. Host visitor and collaborate on integrating fog and cloud/aerosol optical depth products into visibility.
2. Implement cloud-based Precipitation product
    a. Tune for Himawari-8/AHI using radar data
    b. Upgrade CLAVR-x installation at MSC/CWB to include tuned precipitation
3. Continue RGB and CLAVR-x product support
    a. Identify key CLAVR-x products and create xml files for The Geostationary Operational Environmental Satellite-R Series (GOES-R) annotation in AWIPS II (colorbar, axis labels, ranges)
    b. Update training of the CLAVR-x cloud mask from collocated The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO)/ Himawari-8 scenes
    c. Deliver a updated utility package being tested to convert AHI "HSD" format as well as HimawariCast tools (L1b imagery) and geo2grid (L2) to CWB Technical and training support to CWB visitor for 3 months at its facility in Madison, Wisconsin.

Task #8 –Tsunami Warning Enhancement Efforts for the Territory Represented by TECRO

1. Construct Hualien tsunami flooding model (or another site in the territory represented by TECRO with available data) for use in T-web software environment and validate using tide gauge data from the 2011 Japan tsunami. Requires bathymetric data at 50m resolution from

Professor Wu.

2. Provide CWB training for Tweb and ComMIT.
3. Provide maintenance and support of the Tweb and ComMIT software for testing and experimental forecast use.
4. Provide software for modeling with a customized initial tsunami source. ComMIT interface for tsunami forecast modeling would allow for custom sources integration, in addition to the pre-computed source selection. Pre-computed sources allow for fast forecast computations for real-time predictions. The custom sources provide capabilities for additional custom tsunami sources, but they may not be suitable for real-time forecast purposes.
5. Construct as many tsunami flooding models for population centers of the territory represented by TECRO as resources permit. Ideally, these models will cover locations of 40 gauges around the territory represented by TECRO to allow independent validation of the tsunami forecast with the tide gage records, and to perform tests with data from prior tsunami events. Bathymetry information is to be supplied to PMEL by the CWB.

II. 2020 Annual Budget Plan

Tasks	**Personnel**	**Travel/Training**	**Total**
Task #1 (NESDIS/GSL)	$200,000	$25,000	$225,000
Task #2 (NSSL)	$250,000	$0	$250,000
Task #3 (MDL/GSL)	$260,000	$0	$260,000
Task #4 (GSL)	$250,000	$0	$250,000
Task #5 (NCEP/EMC)	$130,000	$	$130,000
Task #6 (GSL)	$575,000	$260,000	$835,000
Task #7 (CIMSS)	$200,000	$0	$200,000
Task #8 (PMEL)	$140,000	$0	$140,000
Total	$2,005,000	$285,000	$2,290,000

III. 2020 Visitor Plan

1. A research assistant from CWB Weather Forecast Center will visit NOAA/ESRLs/GSL for up to 3 months.
2. A research assistant from CWB Meteorological Information Center will visit NOAA/ESRLs/GSL for up to 6 months.
3. A research assistant from CWB Meteorological Research Center will visit NWS/NCEP/EMC for up to 3 months.