SAC : KSNDMC : RENEW : MOU : 03 : 2022

Memorandum of Understanding

Between

Karnataka State Natural Disaster Monitoring Centre, Bengaluru
Department of Revenue (Disaster Management)
Government of Karnataka

And

Space Applications Centre, Ahmedabad
Indian Space Research Organisation

For

Collaboration in the area of Meteorology

August 2022

This Memorandum of Understanding is made and entered into on the 26th day of August 2022

between

Space Applications Centre, Department of Space, Government of India, Ahmedabad - 380015 (hereinafter called SAC, which expression shall, unless the context does not admit, include its successors and assigns), on ONE PART

and

Karnataka State Natural Disaster Monitoring Centre, Bengaluru, Department of Revenue (Disaster Management), Government of Karnataka (which expression shall include, unless the context does not admit, its successors and assigns), on the OTHER PART;

(Hereinafter collectively referred to as 'THE PARTIES').

Preamble

Space Applications Centre, Ahmedabad conducts research and development in satellite communication and remote sensing. SAC has designed and built communication, remote sensing and meteorological satellite payloads and satellite communication earth stations. Currently SAC is engaged in the development of INSAT and GSAT series of communication satellites and remote sensing satellites like IRS, OCEANSAT, CARTOSAT, RISAT, Kalpana, INSAT-3D and so on. SAC is carrying out research in weather forecasting, oceanographic, atmospheric and climatic science with an emphasis on the use of satellite observations. SAC is continuously engaged in developing algorithms for parameter retrieval from satellite data, satellite data processing for weather forecast applications and satellite data assimilation in the NWP models. SAC, ISRO has established a procedure to run the Weather Research and Forecasting (WRF) model for all India short-range weather forecast at high spatial resolution (5 km over India). The conventional and satellite observations available from ISRO and other national and international agencies are used to improve model predictions. These weather predictions are also disseminated to public through MOSDAC web portal (www.mosdac.gov.in).

KSNDMC (formerly known as Drought Monitoring Cell) has been responsible for providing Science & Technology (S&T) inputs for managing and mitigating natural disasters in Karnataka State. KSNDMC is engaged in number of activities related to synergizing S & T activities and providing a common platform for the response players in Disaster Management in Karnataka State. KSNDMC has installed a dense network of weather monitoring stations which comprises Solar Powered GPRS enabled Telemetric Weather Stations (TWS) at 920 *Hoblis* (~250 Sq. km), Telemetric Rain Gauge Stations (TRG) at all the 6500 *Grampanchayaths* (~25 Sq. km) and 182 Water Level Sensors (WLS) at major reservoir and storm water drainages in urban areas. The data on Temperature, Relative Humidity, Wind Speed, Wind Direction, Rainfall Intensity and amount of Rainfall is being collected at every 15 minutes. The near-real time data collected through the network is being analysed, maps and reports generated at real time.

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The weather-related Alerts, Early warnings and Advises are being disseminated through email, social media and SMS to the mobile phones of State level to *Grampanchayath* level officers of all line departments of GoK. To disseminate weather related information and related advises directly to the general public a 24x7 interactive Help Desk "VARUNA MITRA" is operational throughout the year. Around 6-7 thousand calls, mostly from the farmers, have been answered by VARUNA MITRA every day. The services of VARUNA MITRA has been helping the farmers to plan their agricultural activities, minimise the Crop loss due to weather aberrations and / or increase the yield and the related profit because of timely intervention in their agricultural activities. The near-real time data and report has been helping the State Government in planning and executing disaster management and mitigation plans at micro-level.

SAC & KSNDMC are putting collaborative efforts in generating and disseminating *Grampanchayath* level weather forecast for Karnataka. The near-real time weather data, collected by KSNDMC through the weather monitoring stations network installed in Karnataka, have been shared with SAC. The 5 km spatial resolution weather forecast (Temperature, Relative Humidity, Cloudiness, Wind Speed, Wind Direction and Rainfall) on 12 hourly intervals for next three days generated by SAC have been provided to KSNDMC. The forecast has been disseminated through various modes to the end-users on day-to-day basis.

Whereas, KSNDMC and SAC have a long history of mutual informal cooperation in the scientific domains of interest on need basis. However, it was felt that the engagement process be institutionalized to facilitate a roadmap for future meaningful interactions that draw on the mutual strengths of these organizations

Towards this, a formal engagement between KSNDMC and SAC was agreed upon and MoU was signed in March 2017 to continue and strengthen the collaborative work towards uninterruptedly generating and disseminating *Grampanchayath* level weather forecast for Karnataka. The validity of this MoU was for a period of 5 years. Salient Achievements made under this MoU are as follows: -

1. KSNDMC shared TWS observed temperature and moisture data that are assimilated in the SAC operational WRF model
2. KSNDMC gauge measurements are utilized for the verification of the WRF rainfall forecasts
3. KSNDMC gauge measurements are assimilated in the JAXA GSMaP rainfall product
4. KSNDMC TWS temperature and moisture measurements are utilized to assess the WRF model forecasts
5. KSNDMC provided lightning data is being analysed for developing lightning algorithm from satellite observations
6. SAC scientist Installed and configured WRF model and its assimilation system in the KSNDMC server

Also, the details of the papers published in prominent journals are as follows:

Prashant Kumar*, R.M. Gairola, T. Kubota, C.M. Kishtawal	Hybrid assimilation of satellite rainfall product with high density gauge network to improve daily estimation: a case of Karnataka, India.	Journal of the Meteorological Society of Japan, 99, no. 3 (2021): 741-763.

S. Bhomia, Prashant Kumar*, and C.M. Kishtawal	Evaluation of the weather research and forecasting model forecasts for Indian summer monsoon rainfall of 2014 using ground-based observations.	Asia-Pacific Journal of Atmospheric Sciences 55, no. 4 (2019): 617-628.

ARTICLE–1: MoU

KSNDMC recognizes the importance of utilising latest developments in the field of Meteorology for upgrading the skills of its personnel in environment state (weather) forecasting. KSNDMC also recognises that SAC by virtue of its focus in the field of current technologies is an organisation having 'State-of-the-art' infrastructure and a set of highly accomplished and reputed scientists. The purpose of this collaboration would be to synergise the expertise of SAC with the aim of keeping the KSNDMC in step with rapid development in the specific field of environment Sciences and the latest development in Satellite Technology, in particular.

Therefore, in consideration of the mutual understanding and goodwill exhibited during the execution of first phase of collaboration, both SAC and KSNDMC hereby agree to sign a renewal of Memorandum of Understanding (MoU) on mutually agreed scope / terms hereinafter mentioned.

ARTICLE-2: SCOPE OF THE MoU

This MoU defines the broad framework of interaction and engagement of the two parties and spells out the rights and responsibilities of the parties hereto. The broad scope of MoU includes the following areas but is not limited to: -

1. Sharing of the in-situ data for validation of satellite retrieved parameters
2. Utilization of satellite products for KSNDMC operations.
3. Carry out joint validation of satellite data products vis-a-vis weather experienced.
4. Combined efforts for the development of forecasting (convective system) models.
5. Short term specialized training in the field of satellite meteorology.
6. Upgradation of High-resolution Atmospheric Models development and validation.
7. Facilitation of Satellite data assimilation in NWP models.

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8. Deployment of newer data collection platforms.
9. Institutionalising satellite data sharing mechanisms.
10. Institutionalising mechanisms for capability development in the field of satellite data processing for meteorological applications.
11. Sharing satellite-based Soil Moisture products for the State on regular basis.

ARTICLE-3: SHARING OF FACILITIES/ RESPONSIBILITIES

Both SAC and KSNDMC shall encourage interactions between personnel, scientists, research fellows, faculty members of both the organizations through the following arrangements: -

1. KSNDMC will share the in-situ data with SAC for satellite instrument calibration as well as the retrieval algorithms validation for in-house use only.
2. Operational use and validation of SAC generated weather parameters by KSNDMC.
3. Promulgating extensive use of MOSDAC website by KSNDMC for day-to-day operations within KSNDMC and rendering frequent feedback on the utility of the products hosted/ required to be hosted.
4. Conduct of short-term specialized training capsules/programs at locations mutually agreed upon.
5. Use of ISRO developed AWS & Radiosonde's by KSNDMC for operations and suggestions to improve their design.
6. Carrying out validation for atmospheric models using in-situ data by KSNDMC and sharing the results between two organisations.
7. Regular verification of the WRF model forecasts independently by KSNDMC shall be helpful for further improvement of the model

SAC Responsibilities

1. To generate rainfall and weather forecast at 5 km spatial resolution for Karnataka and share it with KSNDMC through ftp for dissemination.
2. If any problem occurs in sharing the daily forecast, SAC will intimate KSNDMC.
3. Nominate a single point of Technical contact from SAC side for communication regarding technical / operational activities under the purview of this project. The contact person is expected to have reasonably good understanding of the operations, processes w.r.t the project.
4. Provide training to the scientific personnel of KSNDMC towards utilisation of products developed by SAC if need be.
5. SAC will inform KSNDMC regarding any update/changes in the model setup.

KSNDMC Responsibilities

1. To share the location details of the weather observation stations installed in Karnataka.

KSNDMC

SAC

2. To provide observational weather data collected from the weather monitoring stations.
3. If any problem occurs in sharing the daily data files, KSNDMC will intimate SAC.
4. To ensure availability of ftp server at KSNDMC for downloading and uploading of data.
5. Nominate a single point of Technical contact from KSNDMC side for communication regarding technical / operational activities under the purview of this project. The contact person is expected to have reasonably good understanding of the operations, processes and requirements of KSNDMC.
6. Nominate a single point of contact from KSNDMC for addressing the administrative activities under the purview of this project.
7. To periodically carryout forecast validation exercise jointly with Technical personnel of SAC.
8. To prepare and submit periodical reports on nature of work and the results achieved.
9. KSNDMC will share other ground observations with SAC for the improvement in the model predictions.
10. KSNDMC will share TRG (Telemetric Rain Gauge) observations (collected every 15 minutes) to SAC for satellite validation and other applications in real-time/final data after quality control with minimum latency
11. KSNDMC will provide lightning measurements and TWS (Telemetric Weather Station) data (collected every 15 minutes) to SAC for various applications including data assimilation in the WRF model.

Joint responsibilities and Co- ordination:

1. Each party shall pursue its own research and operational programmes that involve data from other sources.
2. Each party shall appropriately acknowledge the contribution of the other party while publishing the work in National/International journals or in any other form.
3. Both KSNDMC and SAC shall work together to provide science & technology-based inputs towards Disaster Risk Reduction, Resilient Agriculture in Karnataka.
4. Both KSNDMC and SAC shall meet periodically for knowledge sharing.

General

1. Any amendments to this MoU will be treated valid and effective if made in writing with consent of both the parties of this MoU.
2. Party will not assign its responsibilities to third party without consent of other party.
3. This MoU will be in effect as long as there is no breach of responsibilities by the parties or terminated by the parties on mutual consent. Parties obligations if any, will survive even after the termination of MoU.

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ARTICLE-4: COORDINATION

SAC and KSNDMC together will cooperate in the following areas: -

1. Cooperation in operationalization/ utilisation/ calibration of ISRO developed observational Met equipment such as AWS, Radiosondes.
2. Participation in mutual training programmes and workshops conducted at KSNDMC and SAC.
3. Mutual data sharing in identified areas.

Specific Areas of further coordination to include: -

1. Creating/ ensuring satellite data products availability to KSNDMC through dedicated FTP over Internet/ leased lines.
2. SAC can help in providing various Met parameters at KSNDMC as described below:

INSAT 3DR Imager Data

1. Satellite Imagery (jpg/png format) for both Vis and IR1 channels clearly delineating low (< 6500 FT), medium (6500 – 20,000 FT) high (> 20,000 FT) and convective clouds through appropriate colour scheme. Further, the capability to filter/enhance specific layers of clouding based on pixel values.
2. Delineation of AOD/OLR/ UTH in images.
3. Atmospheric Motion Vectors (CMVs, WVWs etc.)
4. Instantaneous and Daily Precipitation Estimates.

INSAT 3D/3DR Sounder Data

1. To provide temperature and humidity profiles for any point (at any given Latitude & Longitude). Further the capability to generate a thermodynamic diagram depicting positive, negative areas with respect to stability indices such as LI, KI, SI, TTI and values of CAPE, CINE, LCL, LFC, EL and Freezing level.
2. Ability to generate temperature/humidity maps at various pressure levels and stability indices maps.
3. Development and service support of AWS and Radiosondes for their use.
4. Location and event specific Atmospheric forecasts based on satellite data.

ARTICLE-5: EFFECTIVE DATE AND DURATION

This MoU shall be effective from the date of signing of MoU and valid for a **period of Five (05) years from that day.** The validity of the MoU may be extended by mutual agreement which shall be in writing and signed by both the parties.

ARTICLE-6: PRE-CLOSURE

This agreement is signed in the interest of the nation and the mutual professional benefits of the two organisations and is valid for the specified period agreed upon therein. However, in the event of any requirement to pre-close this agreement on reasons that warrant such an act,

KSNDMC

the same may be done with mutual consultations and prior intimation to the affected parties with a notice **not less than three months** in advance. The pre-closure of this agreement shall not be liable for any compensation to or from either of the parties under this agreement.

ARTICLE-7: CONFIDENTIALITY

Information received/gathered in due course of performance of this MoU either written or oral in respect of but not limited to any software/hardware material, product specifications, designs, financial, information, documents etc., shall be deemed to be in private domain and it shall not be made public or shared with any other party without the prior written consent of the party which owns it.

ARTICLE 8: AMENDMENTS

This MoU represents the understanding between SAC (ISRO) and KSNDMC in the present circumstances and supersede any earlier understanding written hitherto with respect to the subject matter of the agreement.

No amendments or modification of the MoU shall be valid unless it is made in writing and signed by both the parties and specifically stating the same to be an amendment of the MoU. The modifications changes shall become part of the MoU from the date on which they are executed unless otherwise agreed to in writing.

ARTICLE-9: FORCE MAJEURE

Force Majeure is an event for which either party cannot be held accountable. For events constituting force majeure, they must be unforeseeable, external to both the parties and unavoidable. Neither party shall bear responsibility for the complete or partial non-performance of any of its obligations, if the non-performance results from such Force Majeure circumstances as Flood, Fire, Pandemic, Earthquake and other acts of God, as well as War, Military operations, blockade, Acts or Actions of state Authorities or any other circumstances beyond the control of the parties that might arise after the conclusion of the MoU. In the event of any dispute arising out of Force Majeure wherein any of the party under this agreement is unable to meet the specific requirement due to the reasons beyond the control of the organization, the same may be resolved on mutually agreeable terms and conditions including waiver if applicable with regard to time, space, quantity or quality of the deliverables.

ARTICLE-10: INTELLECTUAL PROPERTY AND PUBLICATION

General Clauses

1. Each party will ensure appropriate protection of intellectual Property rights (IPR) generated from cooperation pursuant to MoU, consistent with laws, rules and regulations of India.
2. In case research is carried out solely and separately by the party or the research results are obtained through the sole and separate effort of the Party, the party concerned

alone will apply for grant of IPR and once granted, the IPR will be solely owned by the party concerned.

3. In case of research results obtained through joint activities, the grant of IPR will be sought by both the parties jointly and once granted these rights will be jointly owned by the parties.

4. The parties shall not assign any rights and obligations arising out of the IPR generated to inventions/activities carried out under the MoU to any third Party without prior written consent of the other party.

Publication

Any publication, document and/or paper arising out of joint work conducted by the participants pursuant to this MoU will be jointly owned. The use of the name, logo and/or official emblem of the participants on any publication document and/or paper will require prior permission of the both the participants. It may however be ensured that the official emblem and logo is not misused.

ARTICLE-11: DISPUTE SETTLEMENT MECHANISM

(i) All disputes arising between the parties in any way connected with this agreement or in regard to the interpretation of the context thereof shall be resolved amicably on mutual consultations and negotiations between the parties. If the matter remains un-resolved, the same will be referred to Director SAC, ISRO and Director, KSNDMC, whose decision will be final. Notwithstanding, anything mentioned in the above para, the party to this MOU with written mutual consent may take recourse of any alternative dispute settlement mechanism.

(ii) Notwithstanding, anything mentioned in the above para, the party to this MOU with written mutual consent may take recourse of any alternative dispute settlement mechanism.

ARTICLE-12: GOVERNING LAW

This MOU shall be governed as per provisions of the applicable Indian Laws.

ARTICLE-13: MISCELLANEOUS

The headings and sub-headings are inserted for convenience only and shall not affect the construction of this Agreement.

After this Agreement has been signed, all preceding understandings/ negotiations and correspondence pertaining to it shall become null and void.
All disputes or differences arising out of or in connection with this understanding shall be settled only through mutual discussions and negotiation.

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ARTICLE-15: FOCAL POINTS

Space Applications Centre Dr. Atul Kumar Varma Head, ASD/AOSG/EPSA Phone: 079-26916045 e-mail: avarma@sac.isro.gov.in FAX: 079-26916075	Karnataka State Natural Disaster Monitoring Centre S S M Gavaskar Junior Scientific Officer, KSNDMC Phone: 080-67355100 e-mail: dmc.gavaskar@gmail.com

IN WITNESS WHEREOF PARTIES HERE TO HAVE ENTERED INTO THIS AGREEMENT EFFECTIVE AS ON THE DATE AND YEAR FIRST WRITTEN ABOVE.

On Behalf of:

Karnataka State Natural Disaster Monitoring Centre

By:

Name: Dr. Manoj Rajan

Director
Karnataka State Natural Disaster Monitoring Centre
Bangalore

Designation: Commissioner & Director, KSNDMC

Witness:

1. S.S.M. Gavaskar (S.S.M. GAVASKAR) JS.O., KSNDMC

2. (CS-Emily Prabha) JSO, KSNDMC

Space Applications Centre

By:

26/08/2022

एन. एम. देसाई/N. M. DESAI
विशिष्ट वैज्ञानिक/ निदेशक
Distinguished Scientist/Director
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भारत सरकार/Govt. of India
अहमदाबाद/Ahmedabad 380015

Name: N. M. DESAI

Designation: Director, SAC

Witness:

1. (GD-AOSG) 02/09/2022

2. 02/09/2022 (Head, ASD/AOSG)