

Fact Sheet on PUB’s Thematic Request-for-Proposal (RFP) 22/01 Utilizing Emerging Technology to Develop Coastal and Inland Datasets to Support Coastal Protection Effort

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BACKGROUND

1. The Competitive Funding for Water Research (CWR) is a competitive funding scheme under the Urban Solutions & Sustainability (USS) domain. The aim of the CWR is to develop innovative and high-impact solutions to meet national water needs and ensure water security, sustainability, and resilience. At the same time, the CWR will support basic, applied and translational R&D to pre-position the water sector to meet future challenges, such as those brought about by climate change

PRESENT CALL

2. Sea level rise poses an existential threat to Singapore and coastal cities across the world. Based on the 2nd National Climate Change Study (V2) for Singapore¹, the mean sea level in Singapore is projected to rise by about 1 meter by year 2100, compared with the baseline period of 1980 to 2009. PUB, as the national coastal protection agency is developing plans to safeguard the nation's coastal areas against rising sea levels and extreme rainfall.
3. This RFP is a part of PUB's research programme on coastal protection and flood management to support the development of adaptation solutions that are effective, multi-functional, adaptive and sustainable. The RFP focuses on using emerging technologies to collect coastal and inland datasets of Singapore's coastal processes.
4. The use of data to understand hazards and coastal responses to sea level rise is a necessary precursor to understanding and managing coastal flood and erosion risks. Data from monitoring programmes enables the identification of longer-term trends, calibration of models and provides for new data to be incorporated into hazard mapping and plans. High quality data in risk assessments will likely lead to reduced damage and maintenance costs over time.

4.1 Gaps in Coastal Datasets

Currently there are limited long-term data for Singapore's coastal processes (particularly for the currents and waves). Available wave and current datasets around the Singapore's coastline are very limited and scattered in space and time and of variable quality as data were collected for specific development projects using in-situ buoys or Acoustic Doppler Current Profilers (ADCPs). Deployment and operation of conventional wave buoys for long term monitoring are challenging as Singapore's coastal waters are heavily utilized for maritime activities. These conventional sensors in tropical sea water are also subjected to high level of bio-fouling and will require regular and costly maintenance.

4.2 Lack of understanding of contribution of ship wakes to Singapore's wave states

Coastal waves are the principal source of energy at Singapore's littoral zone and together with currents, are the main drivers for coastal erosion and sediment transport. They are the essential input parameters in numerical

¹ Available at <http://ccrs.weather.gov.sg/Publications-Second-National-Climate-Change-Study-Science-Report>

models, studies of erosion and sediment transport, and design of coastal protection measures. Singapore's coastal waves, however, have significant interference from ship wakes due to high maritime traffic in local coastal water. Further studies on ship wake effects are required due to the difficulties in screening out its effect from wave measurements. It is therefore necessary to quantify ship wakes contribution before further evaluation of climate change effects on local coastal waves.

4.3 Augmenting Flood Datasets

PUB is developing a Coastal-Inland Flood Model to simulate flood events under the combined effects of higher sea levels and intense rainfall. One of the features of this model is the use of 2D surface flow to understand flood impact. High resolution data such as flood duration (in mins) and depth (in mm), location and extent (in m²) of flooding is required for the calibration of the flood model to accurately simulate Singapore's complex and dynamic urban hydrology and hydraulics. There is growing potential to tap on the vast amount of data available from Closed Circuit Television (CCTV) images, Unmanned Aerial Vehicle (UAV) with remote sensors and citizen-sourced smartphone images to provide reliable and quality data on flood parameters.

5. This Thematic RFP hence solicits proposals in the following areas:

- **Focus Area 1:** Establish proof-of-concept for the feasibility of real-time, remote, and low-maintenance sensors, such as radar and satellite-based sensors, for PUB's long-term monitoring of Singapore's wave and current.
- **Focus Area 2:** Develop an automated framework to quantify ship wake contribution in Singapore's nearshore wave field.
- **Focus Area 3:** Establish proof-of-concept for the feasibility of using opportunistic CCTV footages, UAV with remote sensors and citizen-sourced smartphone images to provide automated and reliable estimate of the areal extent and depth of inland and coastal flooding.

Focus Area 1

6. Focus Area 1 is a Proof-of-Concept (POC) of remote wave sensing technology to establish the feasibility of sensors that PUB could adopt for long term monitoring of Singapore's wave and current. This includes a technology scan on the available sensor technology, such as but not limited to X-band radar, high frequency radar, stereoscopic system, satellite image, tethered UAV-buoy system. The justification of the proposed sensor(s) shall be submitted via an inception report. The Applicant may recommend one (1) or more types of remote sensors for the POC to compensate for the limitations of a single sensing technology.
7. The POC shall minimally cover four Singapore's coastal sites (at nearshores and deeper waters, exact locations to be subsequently determined) for the different sensors to demonstrate the sensor feasibility and efficiency for long term monitoring. The results should be validated against conventional wave sensors such as bottom mount Acoustic Doppler Current Profiler (ADCP) or surface mounted sensors on buoys which should be included as part of the proposal. A procedure or maintenance regime

shall be established to ensure that the conventional sensors deployed are working reliably. It will also be important that in any proposed sensor system that there is a regular means of validating data, and this shall be explicitly mentioned in the proposal.

8. The proposal should include development of standards/procedures to process collected raw data for interpretation of long-term wave (e.g., spectral wave height analysis, spectral direction analysis) and current information. The standards/procedures should also include necessary components such as filtering of tidal component, time stamp for analysis period and filtering of noise data. The proposal should specify methods such as using Artificial Intelligence to identify noise/anomalies in the data. Such anomalies may, for example, be due to sensor failure or due to an actual perturbation in the real system (for example from a ship wake) and it is important that the system can flag this up and correctly identify the cause. Reliable interpretation of the data should therefore be an important part of the system and a data logging platform developed to interrogate from this point of view.
9. The proposal should include the development of a framework to facilitate exchange, analysis and interpretation of long-term wave and current information. The proposal should also include the recommendation of a long-term automated wave and current monitoring programme covering proposed monitoring sites and operating and maintenance regimes of the remote sensors.
10. The proposed sensor(s) should be able to monitor offshore waves and current at a water depth of approximately 20m, nearshore waves and current at a water depth of approximate 3m to 5m. The sensors shall be able to monitor:
 - Wave height, at accuracy: $\pm 10\text{cm}$
 - Wave period, at accuracy: $\pm 0.1\text{s}$
 - Wave direction, at accuracy: $\pm 2^\circ$
 - Current velocity (along the water column), at accuracy: $\pm 0.1\text{m/s}$
 - Current direction, at accuracy: $\pm 2^\circ$
11. In addition, the proposed solution(s) shall have low maintenance requirements. As much as possible, the proposed solution(s) shall be ex-situ (out of the sea water) with minimum exposure to the seawater (e.g., mounted/hovering above the water surface), have an operational life expectancy of at least 25 years and require less than one recalibration required per year. The sensor should have at least one year of internal data storage with network connection for real-time monitoring.
12. The Applicant shall propose the period of deployment and data collection for the POC of the sensor(s), but it shall not be less than one (1) year.

Focus Area 2

13. Focus Area 2 is to develop an automated framework to quantify ship wake contribution in Singapore's nearshore wave field. The proposal should include a development of a machine learning methodology to process vessel transiting information from Automated Identification System (AIS data) and near shore wave data. The Applicant may propose a standalone wave monitoring programme or one in combination with Focus Area 1.

14. The proposal should include developing a numerical model and algorithm to replicate the observations to quantify ship wake contribution to local wave state, so as to facilitate analysis, design and operation of coastal structures.
15. The proposal should quantify the ship wake magnitudes for different vessels at different segments along Singapore coasts and the ship wake interaction with natural coastal processes.

Focus Area 3

16. Focus Area 3 is a POC of computer vision technology to develop an automated flood monitoring system using flood event images from different visual platforms, such as opportunistic CCTV cameras, UAV with remote sensors and crowdsourcing data from citizens smartphones and social media postings to facilitate data acquisition during flood events. As data will be arriving from different sources, algorithms shall be developed to cross interpret data from these sources for validation purposes.
17. The flood monitoring system should be able to monitor and provide information on:
 - Flood levels, extent of flood and its development with time,
 - Velocity and duration of surface flows
18. The proposal may utilise a hybrid of approaches by combining different visual sensing techniques to compensate for the limitations of a single visual platform. It should also develop a database for storage and interpretation of data and a user-interface for assessing and analysis of CCTV, UAV and social media images for flood information. For social media images, the system shall be able to detect that the images are true and from the current flood location and event. The proposal should include description on how Artificial Intelligence (AI) algorithms will be used to interpret and understand visual information.

GENERAL REQUIREMENT

19. All research activities have to be carried out in Singapore. Cross-disciplinary and multi-disciplinary research proposals are strongly encouraged, as well as proposals from research consortia involving partners drawn from different private and public organisations and academic institutions, including international collaborations with renowned experts to introduce new research capabilities and transfer of technical expertise to Singapore.
20. R&D proposals already funded by other agencies or being considered for funding by other agencies will not be considered under the present call. Applicants will need to declare other funding sources in the application.

ELIGIBILITY AND FUNDING SUPPORT

21. This call is open to Institutes of Higher Learning (IHLs), public sector entities and private sector companies based locally in Singapore. Under this Thematic RFP, IHLs and public sector entities will qualify for 100% funding support of approved qualifying

costs and 30% overheads. Funding support for non-Singapore entities² is up to 30%, Large Local Enterprises³ up to 50%, Singapore Small Medium Enterprises⁴, start-ups and not-for-profits up⁵ to 70%.

22. Funding for private sector entities will be conditional on collaboration with a public research performer. This is applicable for research projects⁶ with grant amount >\$500K and testbedding/demonstration/scale-up projects⁷ with grant amount >\$2M.
23. A local Science Technology Licensing Office (STLO) must be appointed in projects that fund non-Singapore entities, regardless of whether a public research performer is involved in the project to manage the foreground Intellectual Property, if any, in Singapore for maximum utility, and also help to provide fair access to Singapore entities in the public and private sector.

APPLICATION PROCEDURE

24. To apply, the Applicant must submit the proposal using the 'CWR Application Form', which can be downloaded from the online Integrated Grant Management System (IGMS)⁸. Please refer to **Annex A** for detailed guidelines for proposal submission and **Annex B** for account creation in IGMS.
25. The proposal shall include, but not limited to:
 - i. Scope – clear description of the scope of the study
 - ii. Approach and methodology – full technical details on the approach and methodology of the proposal to deliver the expected outcome
 - iii. Project Team - The proposed team members' expertise, previous related work and experience (2-page CVs shall be submitted for the Lead Principal Investigator, as well as for all co-PIs and Collaborators).
 - iv. Budget - Detailed budget required for the project (broken down into the various cost categories of manpower, equipment, other operating expenses, and overseas travel).
 - v. Timeline - Timeline for the project, showing intermediate milestones to be achieved.

² Defined as entity with <30% local shareholding, determined by the ultimate individual ownership

³ Defined as entity with ≥30% local shareholding; and more than \$100M in annual turnover

⁴ Defined as entity with ≥30% local shareholding; and has Group Annual Sales Turnover of not more than \$100M, or maximum employment of 200 employees

⁵ To qualify as an SG not for profit, the entity must meet all 3 of the following criteria: (1) Registered and physically present in Singapore; (2) Core funding (i.e. excl. competitive grant funding) is derived entirely/ mostly from SG entities; (3) Managed by a Board, which is at least half appointed by SG entities

⁶ End TRL 1-4

⁷ End TRL 5-8

⁸ <https://researchgrant.gov.sg>

- vi. Deliverables - Expected research outputs and outcomes and proposed key performance indicators (KPIs), technical and non-technical, for the project.
 - vii. Intellectual Property (IP) - highlight how the IP created will be owned and commercialised, and how the benefits from these commercialisation plans can be accrued to Singapore.
26. The deadline for the Proposal submission is on **15 July 2022, 4:00 pm** (Singapore time, GMT +08:00).

EVALUATION CRITERIA

27. The Secretariat has the discretion to send the proposals to international peer reviewers for technical/scientific merit review. If appropriate, proposals from the IHLs may also be sent to Industry Resource Persons and/or relevant national agencies for review of commercial viability and/or national relevancy respectively. This is then followed by evaluation by CWR's Project Evaluation Panel (PEP), which comprises of local and international experts as members. The PEP shall evaluate the proposal based on the criteria given in Para 26, referencing reviews from the international peer reviewers, and make a recommendation whether to fund it.
28. All Proposals are evaluated against the following criteria:
- i. Excellent science and cutting-edge technology, with proposed activity involving innovative and cutting-edge research that seeks to bring together the best R&D talent available.
 - ii. Significant economic or social benefits, to be accrued to Singapore through either tangible measures (creation of intellectual property, start-up companies, spin-out enterprises, etc) or potential for commercialisation into new products/services/technologies deployed to solve national needs.
 - iii. Robust management and governance, with adequate checks and balances, a clear structure of accountability, as well as reasonable milestones and deliverables.
 - iv. Reasonableness of the proposed budget.
29. The Secretariat is under no obligation to award research grant in whole or in part to any proposal. The Secretariat may require proposals to be revised as it sees fit to enhance research outcomes, facilitate integration of research concepts and technologies, and optimise funding resources. The Secretariat's decision on project and funding support will be final and shall be abided by the applicants.

MAXIMUM PROJECT BUDGET AND DURATION

30. The Principal Investigator (PI) is free to put up a joint proposal to cover beyond a single Focus Area if it is assessed to have synergy to carry out multiple Focus Areas concurrently.

31. Funding support for each Focus Area will not exceed **S\$2 million** (excluding overheads). The Applicant should contribute in-kind services, cash, or a combination of the two towards the proposed project. In-kind services can include labour, materials, and other services. In-kind contributions demonstrate the participation and commitment of the applicants to the project.
32. The maximum funding period for the Research Proposal is **3 years**, regardless whether it covers a single or multiple focus areas.

POINT OF CONTACT

33. For more information, please contact:
- Dr Seah Teik Tian ([Seah Teik Tian@pub.gov.sg](mailto:Seah_Teik_Tian@pub.gov.sg))
 - Ms Yunita Tan ([Yunita TAN@pub.gov.sg](mailto:Yunita_TAN@pub.gov.sg))
 - Dr Peng Na ([Peng Na@pub.gov.sg](mailto:Peng_Na@pub.gov.sg))

ANNEX A: GUIDELINES FOR SUBMISSION OF PROPOSAL IN IGMS

Closing Date: 15 July 2022, 4:00 pm (Singapore time, GMT +08:00).

1. This RFP is a single full proposal stage.
2. Applicants are required to lodge the application via the online IGMS at <https://researchgrant.gov.sg/> before the stipulated closing date and time for the Request-for-Proposal (RFP). Late or separate submission outside of IGMS will not be considered.
3. **For new IGMS user, account registration is required for first time application.** New users would need to ensure his/her CorpPass account has been set-up, using his/her SingPass account.—To set up a CorpPass account, please visit www.CorpPass.gov.sg. Applicants are advised to allow sufficient time (at least 2 weeks) for their respective companies to be registered, including registering their respective researcher profiles in the IGMS prior to submitting proposals. Please refer to **Annex B** for further information.
4. The Lead PI is required to submit the application online, with all supporting documents, through IGMS. Once PIs have submitted their documents online, their applications will be routed to the Office of Research (ORE) and Director of Research (DOR) (or equivalent) of their respective Host Institution for online endorsement and approval. **Submission is considered complete only when it is endorsed by ORE and approved by DOR in IGMS before the deadline. Incomplete submissions may be rejected.**
5. For collaborative projects, the Lead PI will have to list out him/herself as “LeadPI” in IGMS and the co-PI(s) as “TeamPI”. Both PI and co-PI(s) will have to have an account in IGMS. Only the Lead PI is required to submit the proposal in IGMS. Co-PI(s) will be able to view and edit the proposal submitted by the Lead PI.
6. If the Lead PI and the co-PI(s) are from different entities, the proposal will have to indicate the budget requested for the different entities accordingly. **In IGMS, please ensure that the budget line items are allocated to the correct entity by tagging the budget line items to the correct role i.e., LeadPI or TeamPI.**
7. All relevant sections of the online IGMS proposal application form should be filled out completely, with the CWR Application Form and supporting documents uploaded as separate attachments. **The online application process may take time and hence please refer to IGMS website for full details of the application process.**
8. The documents required to be submitted are:
 - a. Application Form
 - b. Detailed Budget Estimates
 - c. Curriculum Vitae of Lead PIs, Co-PIs and Collaborators

Please restrict each attachment to be less than 4MB.

9. Please follow the naming convention and format for labelling of softcopy attachments:

Attachment	Naming Convention	Format of attachment
Application Form	Proposal_ <i>Host Institution name_</i> <i>Proposal title</i>	MS Word or pdf
Detailed Budget Estimate	Detailed Budget_ <i>Host Institution name_</i> <i>Proposal title</i>	MS Excel
CVs	CV_ <i>Name of PI/Co-PI/Collaborator</i>	MS Word or pdf
Other supporting documents	Supporting Doc_ <i>Proposal title</i>	MS Word or pdf

Important: Where relevant privileged or confidential information is needed to help convey a better understanding of the project, such information should be disclosed and must be clearly marked in the proposal.

10. Should there be revisions to the submitted proposal, Lead PI is to delete previous submission(s) and only keep the final proposal in the system. Failing to do so may lead to evaluation of wrong version of the proposal.
11. Please download the Integrated Grant Management System (IGMS) User Guide from the IGMS system for all instructions and guidelines on the submission process and information relating to the Grant Call.
12. For enquiries on the RFP, please email to PUB_GLOBALHYDROHUB@pub.gov.sg. For other enquiries pertaining to IGMS system, please email IGMS helpdesk at Helpdesk@researchgrant.gov.sg

ANNEX B: IGMS ACCOUNT CREATION

1. Before you begin, please familiarise yourself with the various training guides on navigating the IGMS system.
2. The various guides and manuals will help you understand the roles of various users in the IGMS and the application process. These documents can be downloaded from: <https://researchgrant.gov.sg/Pages/TrainingGuides.aspx>
3. The registration of the company or institution within IGMS is mandatory as part of the proposal submission workflow.
4. Please refer to the SOP below for the creation of a new company/institution within IGMS.

Creation of Account for Local Users

Step 1:

To register a new entry in IGMS, companies/institutions will need to send an e-mail to Ms Chay Peck Si at PUB_GLOBALHYDROHUB@pub.gov.sg, by **31 May 2022**, with the following details:

Subject: *Creation of new Company/Institution in IGMS for RFP2201*

Details of the New Company/Institution to be Created in IGMS

- Full Name of Company:
- Indicate Local Company or Foreign Company:
- Indicate Public Company or Private Company:
- UEN (for local company) or Unique Identifier (for foreign Company):

The CWR Secretariat will inform the companies/institutions when their accounts have been created.

Step 2:

For Lead PI who will be submitting the application under their company/institution, the role of HI Admin is necessary for the assignment of relevant roles (“ORE” and “DOR”)⁹ to other IGMS users in the company/institution.

After the company/institution has been created in IGMS, IGMS would grant him/her the Principal Investigator (PI) role by default. The CWR Secretariat will inform them to nominate an HI Admin and arrange with IGMS to change the role of the person from a Principal Investigator (PI) to an HI Admin. The following steps will apply:

⁹ **Note:** To complete a proposal submission, **3 distinct roles** are required from any company or institution to endorse the proposal, namely: Lead Principal Investigator (PI), Office of Research (ORE) and Director of Research (DOR).

- (1) The company/institution will need to nominate an HI Admin. The HI Admin (including all other intended IGMS users) will need to ensure that his/her CorpPass account has been setup.
- (2) The HI Admin will need to login to IGMS using his/her CorpPass account to register/update his/her profile inside IGMS.
- (3) After the HI Admin has been successfully registered in IGMS, the HI Admin will notify the Secretariat with the information below:
 - Full Name of HI Admin:
 - E-mail Address of HI Admin:
 - Designation of HI Admin in his/her company:

Once granted the role as an HI Admin, he/she can proceed to assign the relevant roles (e.g. “DOR”, “ORE”, etc.) to the various users within his/her organisation.

Since an HI Admin can concurrently hold the role of Lead PI, he/she will be able to select different profiles upon login to IGMS:

- (a) Login as HI Admin – to maintain institution & user profiles
- (b) Login as PI – to apply for grant call.

Creation of Account for Foreign Users

For local companies/institutions with foreign staffs without access to CorpPass/SingPass. The following steps apply:

- (1) All foreign users from the company (i.e. **HI Admin, DOR, ORE, PI**) will “**Register**” themselves in IGMS via “**Login for overseas users without CorpPass/SingPass**”.

- (2) After all the foreign users have been successfully registered in IGMS, the **HI Admin** will notify the Secretariat with the information below:
 - (a) Full Name of HI Admin:
 - (b) E-mail Address of HI Admin:
 - (c) Designation of HI Admin in his/her company:
 - (d) Full Name of DOR (if DOR is foreign user):
 - (e) E-mail Address of DOR (if DOR is foreign user):
 - (f) Designation of DOR in his/her company (if DOR is foreign user):
 - (g) Full Name of ORE (if ORE is foreign user):
 - (h) E-mail Address of ORE (if ORE is foreign user):

- (i) Full Name of Foreign Lead PI/Co-PI(s)*:
- (j) E-mail Address of Foreign Lead PI/Co-PI(s)*:

**list down all the foreign users that requires tagging to a company/institution*

- (3) The Secretariat will follow up with IGMS to tag the foreign user to your company.
- (4) Once the above foreign users have been added, tagged and assigned in IGMS, they can then proceed to login to IGMS via the “**Login for overseas users without CorpPass/SingPass**” section.

Note: The **HI Admin** cannot add a new foreign user. However, the **HI Admin** can change the role of a user or delete an existing user in his/her company.