ICAO DRONE ENABLE 2022
UTM Data Requirement RFI Session

UTM based Data Sharing
to Improve Low Altitude Spatial Information for Safe UAS Operations

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Introduction

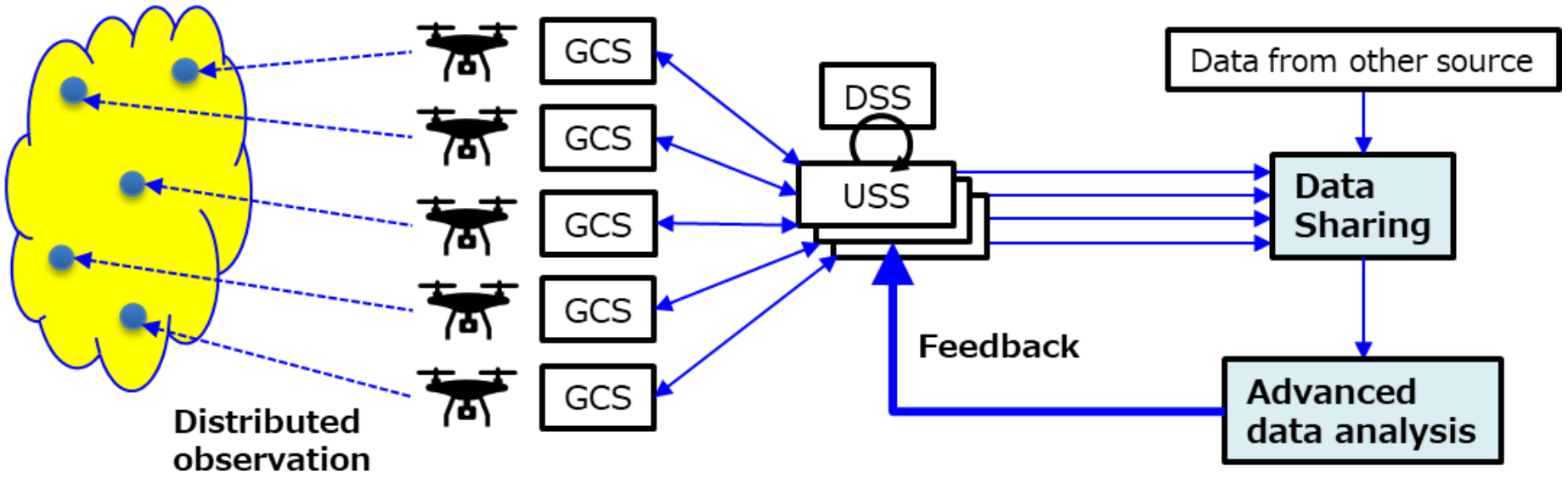
UTM based Collaborative Data Sharing Concept

- ✓ UTM manages UAS operations safely, economically, and efficiently in collaboration with all parties in the eco-system.
- ✓ To improve the safety and efficiency of UAS operations, it is necessary to acquire a variety of low altitude spatial information.
- ✓ Such as weather, ground/airborne obstructions (including manned aircraft) and radio environment are necessary to improve the safety and efficiency of UAS operations.
- ✓ We are proposing UTM based collaborative data sharing concept to extract valuable spatial information from the shared big-data.

UTM based Data Sharing Concept

Outline of the Concept

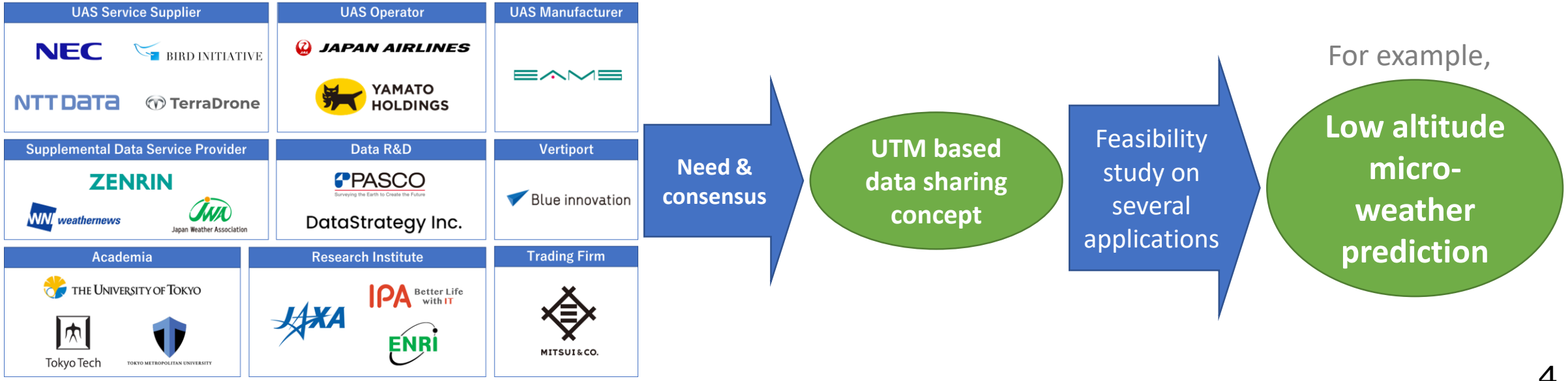
1. Distributed data observed by flying UAS themselves
2. Shared beyond the boundaries of business entities in UTM eco-system
3. Big-data created and analyzed to extract valuable information
4. Feedback the information to the UTM eco-system



UTM based Data Sharing Concept Study

Voluntary Study Group

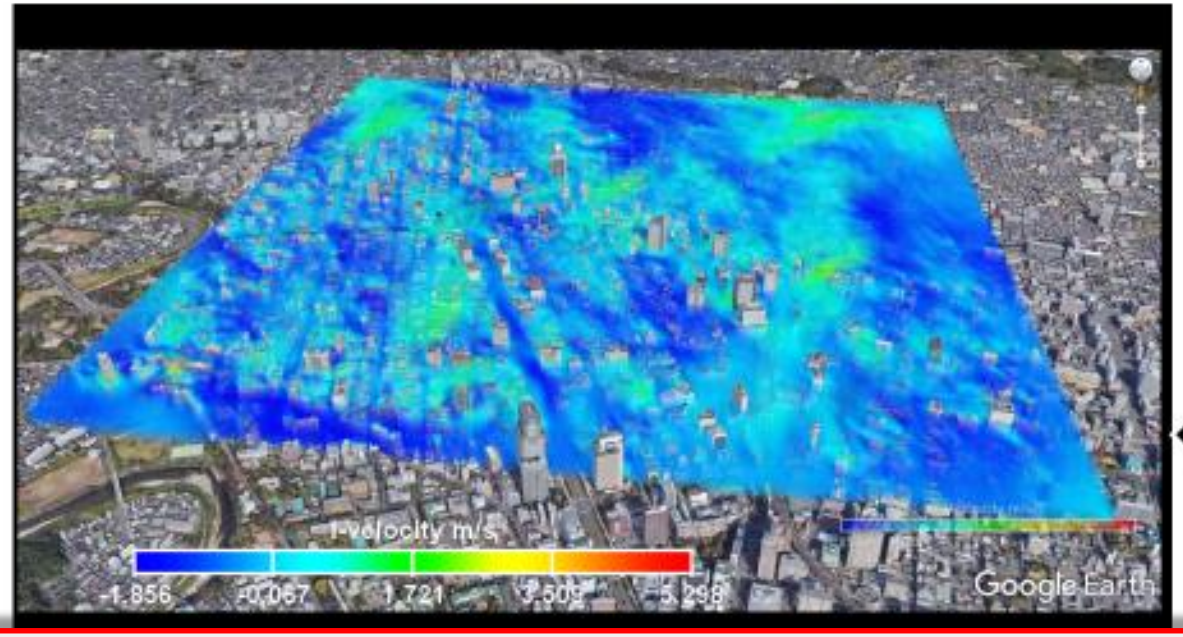
- ✓ Established with voluntary members (more than 20 organizations) since 2019
- ✓ Not only improving the safety and efficiency of UAS operations, but also public interest such as sharing aerial photos in disasters
- ✓ Confirmed the strong need of the data sharing concept in the drone industry
- ✓ Low altitude micro-weather prediction improvement as a PoC example

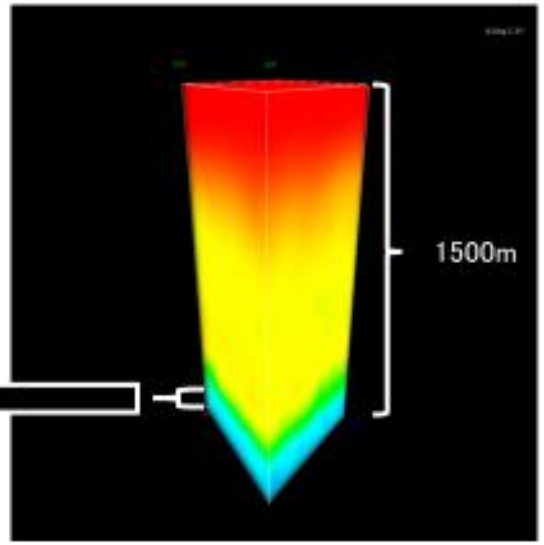


Application Example) Micro-meteorological Prediction

Micrometeorology simulation

- Example of Wind field near the surface at Sendai from Micrometeorology Simulation with MSSG





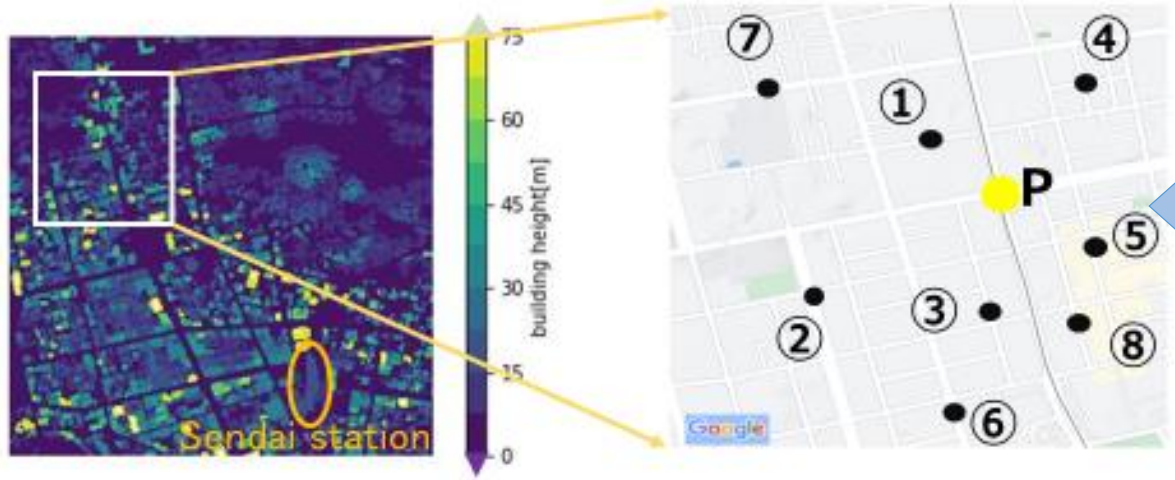
High resolution simulation as a "**ground truth**"

Reference: Morita, T., Onishi, R., Yasuda, Y., Kubo, D., Kimura, A., and Osedo, A., "Impact of Drone Observation on Micrometeorology Predictions," WCCM-XV, APCOM-VIII, 2022.

Application Example) Micro-meteorological Prediction

Prediction Experiment setting

- Points of weather data used for experiment
  - Time series of data were extracted for machine learning
    - Prediction point
      North-west of Sendai Station in Japan(P)
    - Observation point
      North-west of Sendai station in Japan(①~⑧)



Micrometeorology Simulation areas, Prediction point (P) and observation points (①~⑧) north-west of Sendai Station

Observation points including drones, and prediction point

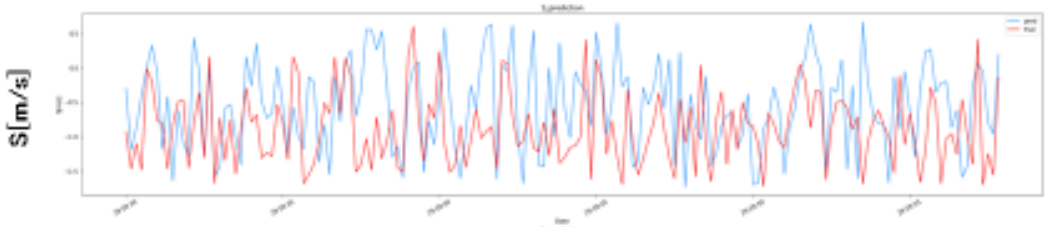
Reference: Morita, T., Onishi, R., Yasuda, Y., Kubo, D., Kimura, A., and Osedo, A., "Impact of Drone Observation on Micrometeorology Predictions," WCCM-XV, APCOM-VIII, 2022.

Application Example) Micro-meteorological Prediction

Result

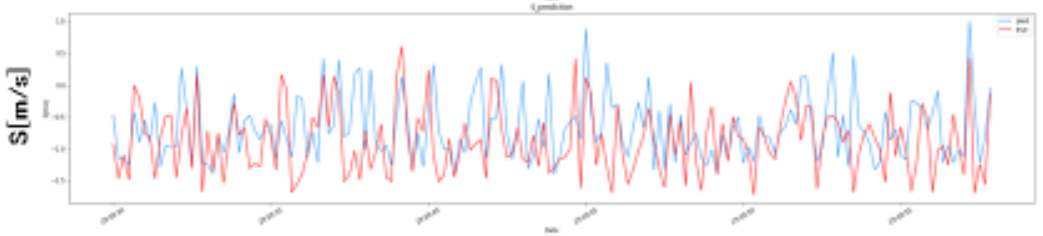
Horizontal wind speed (S) prediction by LSTM 1 minutes later

Case-1(Surface)



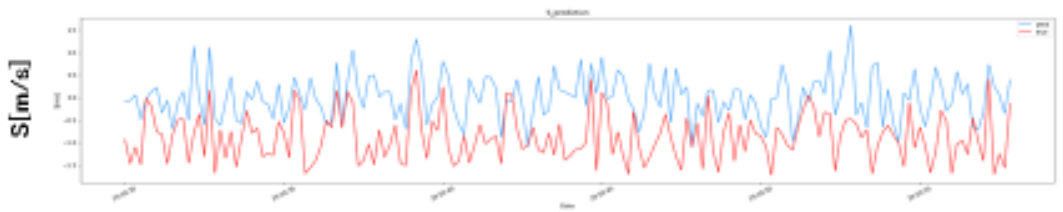
RMSE = 0.864

Case-2(Surface + Drone)



RMSE = 0.619

Case-3(Surface + moderately high altitude)



RMSE = 1.127

Low-altitude distributed drone observations improve the micro-weather prediction accuracy!

Case-2 prediction shows the best → Drone observation will help improving urban micrometeorology prediction

Reference: Morita, T., Onishi, R., Yasuda, Y., Kubo, D., Kimura, A., and Osedo, A., "Impact of Drone Observation on Micrometeorology Predictions," WCCM-XV, APCOM-VIII, 2022.

Requirement and What Data Should be Shared?

Requirement for the Data

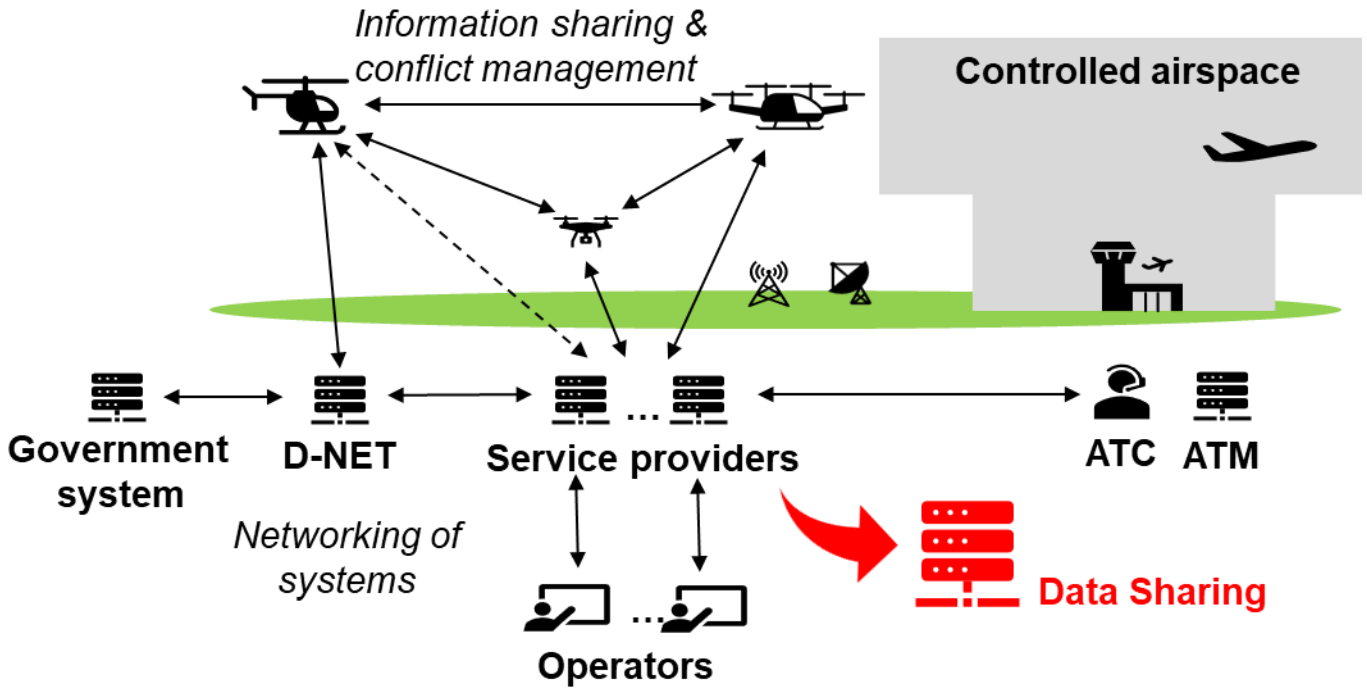
- ✓ Various quality of observation data depending on the each UAS sensor performance
- ✓ How to handle the reliability of the resulting estimates?
- ✓ Without the proof of reliability, initially use the information only to improve operational efficiency not for safety

What Kind of Data Should be Shared?

- ✓ Candidates: weather, ground/airborne obstructions (including manned aircraft) and radio environment.
- ✓ Possibility of other beneficial values extracted from the shared data
- ✓ Researches required to identify what kind of data we should be shared for future UTM improvement

Realization of Advanced Air Mobility (ReAMo) Project

- ✓ ReAMo project, launched by NEDO (New Energy and Industrial Technology Development Organization, Japan) aims to realize integrated traffic management of AAM (e.g., drones and eVTOLs) and conventional VFR aircraft flying in low-altitude airspace.
- ✓ Key technologies included;
  - Flight information sharing
  - USS/PSU/VAS system integration
  - Conflict management
  - Autonomy
  - CNS
  - **Data sharing & analysis**
    - **Data sharing R&D**
    - **UTM standardization**
    - **Future applications**



Standardization / Values to Third Parties

Need for standardization

- ✓ For data sharing over the UTM eco-system, standardization is extremely important
  - ✓ Observation conditions, sensor performance, and data quality
  - ✓ Data distribution architecture and protocol

Potential to provide values to third parties (outside of UTM eco-system)

- ✓ Stakeholders agree that sharing data creates value in the collaborative area
- ✓ In addition, UTM data sharing has a potentials to provide values to third parties (maybe commercial applications)
- ✓ For example, micro-weather prediction also valuable “for people, daily life”
- ✓ For commercial applications, strict community agreement must be required

Summary

- ✓ **UTM based collaborative data sharing can create values;**
  1. Distributed data observed by flying UAS themselves
  2. Shared beyond the boundaries of business entities in UTM eco-system
  3. Big-data created and analyzed to extract valuable information
  4. Feedback the information to the UTM eco-system
- ✓ Confirmed strong need of this concept through our study with industries.
- ✓ **Micro-weather prediction study showed the feasibility to improve the low altitude wind prediction using distributed drone observations.**
- ✓ Challenges;
  - ✓ Diverse quality of observations and reliability of the processed information
  - ✓ Standardization: architecture, protocol, quality, conditions, and so on
  - ✓ Commercial applications in the future
- ✓ **A proof of concept including flight experiments is planned in the NEDO ReAMo* project** just started.

**ReAMo: Realization of Advanced Air Mobility Project*