Vertical Flight Society

2020 eVTOL Infrastructure Workshop Series

Workshop #2 / Urban Air Mobility Weather Systems

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Question & Answer Session

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QUESTION

What is the vertical and horizontal precision of the HEMS tool?

ANSWER

- Stephanie - The HEMS tool enables visualization of underlaying weather information. The resolution of the weather information depends on a particular source.
    - The vertical resolution for the forecast information is every 1000ft AGL, up to 6,000ft AGL. This is due to the height resolution of the model.
    - The horizontal resolution for both the ceiling and visibility analysis and the forecast products is ~12km.
        - The resolution of the C&V product is 2.5km, however the effective resolution (ie. detail) of the product is such that the resolution difference does not look much different visually.
        - The goal is to implement a progressive display capability in the future so that as a user zooms into the map, the resolution will increase.

- Matthias – The HEMS tool enables visualization of underlaying weather information. The resolution of the weather information depends on a particular source.

QUESTION

Is historical weather data available from the HEMS Weather Tool? For example, if a developer was evaluating a vertiport location, would they be able to get data that would provide insight on historical weather patterns at that location?

ANSWER

- Stephanie – The National Centers for Environmental Information provide the official archive for weather data. Check out: https://www.ncdc.noaa.gov

QUESTION

On the HEMS Weather Tool, what kind of model do you use to interpolate the weather forecast from different weather measurements?

ANSWER

- Stephanie – The HEMS tool only has an analysis product (ie. Interpolation between current observations) for ceiling and visibility. This is provided by the Gridded Localized Aviation MOS (GLMP) product developed at the NOAA Meteorological Development Laboratory (MDL).
    - You can read more about that product here:

www.weather.gov/mdl/lamp_about

QUESTION

In regard to the updated HEMS Weather Tool, where is the data for ceiling and visibility coming from? Is it an observation or a model?

ANSWER

- Stephanie – The HEMS tool C&V product is provided by one model, the Gridded Localized Aviation MOS (GLMP) product developed at the NOAA Meteorological Development Laboratory (MDL).
    - You can read more about that product here: www.weather.gov/mdl/lamp_about
    - The analysis uses observations closest to the valid time and interpolates between those observations using statistical background information.
    - The forecast is just the modeled forecast information valid at the top of each hour.

QUESTION

Does anyone see wanting to collect wind information from UAM vehicles in real time?

ANSWER

- Marilyn – This may be a valuable tool in the same manner that we use PIREPs to inform current conditions.

- Don – Absolutely! This data is essential to improve real time situational awareness and improve micro-weather predictions.

QUESTION

Dr. Steiner, what kind of model do you use to interpolate the weather forecast from different weather measurements?

ANSWER

- Matthias – Weather prediction models use observations to initiate model runs. This process is called data assimilation. There are several different approaches utilized by prediction centers around the world. These techniques attempt to bring the model state into balance with the observed state of the atmosphere. The better the initial conditions can be captured in the model the better the predictions become. However, the influence of the observations tends to get lost after a few hours into the simulation. The most common data assimilation techniques include variational, nudging, and/or statistical approaches.

QUESTION

You discussed making improvements to the "human interface" for AWC's products -- could you speak to the current status and future plans for APIs, etc? If operators want to pull data into their own systems to use for algorithm/AI-driven assistance about flight planning and fleet management etc … what tools are available there and what work is planned to improve that?

ANSWER

- Stephanie – At AWC we currently have a test API that sends out our text products (METARs, TAFs, AIRMETs, etc)
- We are also working on providing the gridded values of the GFA in a netcdf file format for FAA. Eventually this will include the data for the GFA-LA (future HEMS) as well.
    If you'd like more info on getting this data feel free to contact me.

QUESTION

Dr. Steiner can you elaborate on what to expect in terms of deliverables from a user perspective in the next 5-years?

ANSWER

- Matthias – I am not entirely sure what you mean by deliverables from a user perspective. The research community aims to improve the weather prediction capabilities that eventually may transition into operations either at a national prediction center or the private sector. While national prediction centers tend to serve the broader public, private sector vendors may offer tailored solutions for specific applications like unmanned aerial system operations.
- The research community is also developing specific solutions that may include translation of weather into operational impacts and guidance in support of decision making.

QUESTION

From by background in cargo UAS programs - I think very localized Wx and wind fields that are impacted by far wake fields from vertical structure in an Urban environment need to be considered and sensors provided to keep from downwind, excessive cross wind or turbulent boundary layer approaches to landings and takeoff to cruise are more import to safe operations - versus area sustained or wind gust spread? Is this an infrastructure question, nav routing problem or Wx consideration - or all of the above for safe ops question?

ANSWER

- Don – All of the above:
    - Infrastructure that includes placement of sensors that can measure flows in "hot zone" areas.
    - Air Navigation that receives data identifying "hot zones" and informing aircraft of the risk.
    - Weather consideration is important to predict an active hot spot with a coupled atmospheric/CFD model and information provided to the operator and airspace manager will come from the Weather Supplemental Data Service Provider serving the Traffic Management System

QUESTION

Dr. Steiner regarding "statistical wind/gust" description. What about the (possibly) emerging capability that a flock of UAM are used to real-time sensing the wind environment at local level, in order to provide indications to the "urban air traffic management" that may be in turn used to adjust/tune the UAM flight path?

ANSWER

- Matthias – Absolutely! We have been arguing that all aerial vehicles should be equipped with meteorological sensors and share that information in real time for enhanced situational awareness and also help improve micro-weather predictions. While an aerial vehicle experiencing significant gusts is already in it, the information shared in real time will help other aircraft avoid it through smart traffic management and flight routing approaches.

QUESTION

Predictions are one part - an array of Wx sensors that provide real-time observations are another more important thing for ops. Also, some of the vertically developed vertiport designs - seemed to ignore US Navy lessons of wake field problems of landing helicopters on a deck. Will the Wx / environmentals part of the equation feedback into more realistic designs for vertiports where the t/o and landing areas are not in a bad part of wind field?

ANSWER

- Don – I love the analogy to a carrier deck. Will cause me to review literature. We in the weather community would love to provide the environmental weather info for vertiport placement and design if they ask us for it.

QUESTION

Dr. Steiner, thanks for this interesting presentation. What kind of CFD are you using? RANS? What are your boundary conditions?

ANSWER

- Matthias – The animations I showed were created using a capability developed at NCAR. We essentially rewrote a numerical weather prediction model from scratch to be fully resident in a GPU environment in order to maximize acceleration of the processing. Also, we had to develop code to properly embed an urban landscape (e.g., retrieved from high-resolution lidar observations). We are now in a position to achieve near-real-time, limited-domain simulations of building-resolving urban environments. We named our capability FastEddy®.
- At present, we are using models like the High-Resolution Rapid Refresh (HRRR) to set the boundary conditions and initialize the FastEddy® simulations. In this way we can actually drive the building-resolving simulations with actual dynamic weather conditions rather than what CFD and RANS simulations can do.

QUESTION

Will weather information be made available within UAM vehicles? If so, how might it be delivered?

ANSWER

- Marilyn – This is something to be determined. The FAA has a Weather Technology in the Cockpit program (WTIC) that could be valuable to UAM operations.

- Don - This is still unclear. It will depend on the requirement. Some form of machine to machine weather communication should be required both to the aircraft and from the aircraft. It would get delivered through standard UTM communication protocols after the weather data is translated into a WXTM compliance format.

QUESTION

How should gusts be considered in wind loading simulations / calculations on aircraft apart from steady wind loads?

ANSWER

- Matthias – Good question. Research is ongoing trying to understand the implications of gusts on aircraft response to turbulence, etc. While modern aircraft may have autopilots that can absorb the effects of gusts on the aircraft, the notable actions taken by the control

surfaces will have an impact on the battery power consumption and thus drain batteries more rapidly.

QUESTION

What is the likelihood that pax-carrying VT?

ANSWER

- Don – Very likely at some point. This is what Uber Elevate is banking upon for their business model.

QUESTION

Is there an anticipated timeframe in which we expect wind-data infrastructure to be available in urban settings?

ANSWER

- Don – Not at this time. There are no government programs in the National Weather Service or FAA planning for this. Local and State governments and the private sector are the best bets to provide sensors and services in the foreseeable future.

- Rex – The challenge will be how we gather the information. Due to the complexed nature of the wind patterns that are found in urban environments and urban canyons, utilizing standard wind sensing instrumentation will not give you the complete picture needed for safe operations. One area of technology that is showing some promise is 3D lidar measurements being used to identify wind and turbulence around wind turbines, buildings, and bridges.

QUESTION

What is the likelihood that pax-carrying eVTOL ops will be required to have aircraft dispatchers following flights and watching weather developments?

ANSWER

- Marilyn – That would depend on future rulemaking and policy decisions but could certainly benefit operations in the NAS.

- Don – Very likely in the next 10-15 years. Beyond that, technology, machine learning and other technologies, along with regulations will dictate whether dispatch becomes automated.

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- Rex – You may see a mirroring of the Helicopter Air Ambulance industry in this area where in it is not a full-blown part-121 dispatch center but rather an Operational Control Center. This information can be found in FAA AC 120-96A, Operations Control Center (OCC) for Helicopter Air Ambulance (HAA) Operations. Click Here for more information.

QUESTION

Can you give us your perspective on the interrelationship on the stability and comfort of eVTOLs (maybe something for a future session with OEMs?) that addresses some of the questions raised in this session.

ANSWER

- Don – That is a question better for engineers and human factors experts to address, but my perspective is research is required to figure out the right acceptable ratio.

- Rex – NASA Ames is currently working on a project that would be capable of replicating the ride quality for passengers utilizing their Vertical Motion Simulator (VMS)

QUESTION

What are your thoughts on having sensors on the aircraft that download to the weather system?

ANSWER

- Don – This is absolutely a need. Whether it gets dictated by the government to have those devices or are funded or accepted by aircraft owners is the key question.

- Matthias – The discussion will also have to address proprietary aspects of data ownership, etc.

- Rex – This will be a must have system to maximize operations in urban canyons where wind currents and turbulence are influenced by architecture and constantly changing.

- **Address Additional Questions To: infrastructure@vtol.org**

- **Or Visit: www.vtol.org/infrastructure**