



Joint Meeting of the
Urban Stormwater Workgroup,
Modeling Workgroup, and
Climate Resiliency Workgroup
December 9, 2020
Meeting Minutes

Event webpage:

https://www.chesapeakebay.net/what/event/joint_modeling_wg_crwg_uswg_december_2020_meeting

This meeting will be recorded for internal use to assure the accuracy of meeting notes.

11:00 Announcements and Amendments to the Agenda – Norm Goulet, (USWG Chair), Northern Virginia Regional Commission

11:05 Overall Status and Direction of the Work – Norm Goulet, (USWG Chair), Northern Virginia Regional Commission and Lew Linker EPA-CBPO

- Norm Goulet provides a basis for the Joint meeting as a way to take a deep dive into the best way to update intensity-duration-frequency (IDF) curves.
 - This is combined with the need to help local jurisdictional units such as counties to address increased rain flow and a need to grasp TMDL guidelines.
 - These knowledge requirements can assist in dealing with the unknowns of climate change, such as how much precipitation events will change.
 - Such knowledge includes a need for better understanding of:
 - How new IDF curves can aide in stormwater prediction over the next 25-50 years
 - The ability of states to coordinate and push for future manual changes
 - A need to update current Atlas 14 modeling results
- Lew Linker adds the desire for a move from science towards implementation, more specifically on the county level with a focus on current and future stormwater flow projections.
 - This push towards local implementation requires the creation of new tools to better predict the future of stormwater flow.

11:15 Climate Change Planning for NYC Stormwater Management – Alan Cohn,
New York City Department of Environmental Protection

https://www.chesapeakebay.net/channel_files/41668/climate_planning_stormwater_acohn_120920.pdf

A presentation on how NYC has developed precipitation projections of 1 hour, 24 hour, and other durations for years of “up to 2039” and other future periods which contribute to its Climate Resiliency Design

Guidelines that provide step-by-step instructions to go beyond building code and standards. The updated and future projected precipitation projections are informed with historic climate data and by specific forward-looking climate data. A five minute discussion period follows the presentation.

- After seeing projected results for the year 2050 Dave Montali asks What is the base year for these 2050 projections?
 - Arthur DeGaetano says this is from the early 2000s.
- Tanya Spero asks what length of time short term duration refers to.
 - Alan Cohn answers sub hourly
- Alan Cohn talks about NYC design guidelines and the service life of sewer designs being between 50-100 years.
 - This prompts Norm Goulet to post a link to the NYC Climate Resiliency Design Guidelines:
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjbr5mfqMHtAhVouVkKHY9IA5gQFjAAegQIBhAC&url=https%3A%2F%2Fwww1.nyc.gov%2Fassets%2Fforr%2Fpdf%2FNYC_Climate_Resiliency_Design_Guidelines_v4-0.pdf&usg=AOvVaw2yJfXU-CHJj6XhJsOyCHCN
- In response to NYC examination of cloudburst green infrastructure from Denmark Jason Bernagros comments on DC DDOE doing some initial cloudburst planning with link posted:
https://www.dropbox.com/s/bpo6fa5mdzxdqbc/BGI_Workshop_DOEE_Final.pdf?dl=0
 - He then inquires if other municipalities in the CB are also doing cloudburst efforts in addition to how many cloudburst projects are being considered for implementation in NYC and how they have been identified/prioritized?
 - Alan Cohn answers that there are two projects identified opportunistically in SE Queens, both of which were identified as flooding hotspots which the NYC housing authority offered due to lack of inhabitants and renovation needs.
 - It was said that efforts are underway to gather city wide maps in order to gain a better understanding of vulnerable areas which might be developed with green infrastructure. It is hoped that new flood maps will be available by early 2021.
 - There is also an East Harlem feasibility study funded by FEMA and the Parks Department.
 - Jason Bernagros mentions how EPA did similar recreational-GI projects in San Juan, PR to address extreme flooding impacts in 2017 - 2018. They called this types of design water plazas: https://www.epa.gov/sites/production/files/2018-04/documents/sgia_cano_martin_pena_final_report_-english.pdf

- Norm Goulet asks what the liabilities are for some of the areas designed to flood, i.e. flooding basketball courts?
 - Alan Cohn answers there is nothing on the books regarding this aside from the need for fences which combined with limited flood depths should limit liabilities.
- Mathew Rowe asks what sort of monitoring is associated with the Queens pilot to evaluate success, site changes, etc.?
 - Alan Cohn says that monitoring is to be conducted in person and that criteria will need to be created as the project progresses.
- Matt Meyers then asked “Do the design criteria include evaluation of overland flow for larger storms in addition to 10-year conveyance and storage?”
 - Alan Cohn answers not yet but once overland maps are attained this should prompt discussion for appropriate drainage depths and infrastructure objectives.

11:40 IDF Curve Development for the Chesapeake Watershed – Arthur DeGaetano, Cornell U.

Art will present progress on IDF development for current and future time periods at the county scale for all Chesapeake watershed counties. A ten minute discussion period follows the presentation.

https://www.chesapeakebay.net/channel_files/41668/dec9_cbp_xrain_art.pdf

Previous June 2020 presentation here:

https://www.chesapeakebay.net/channel_files/40321/urbanstormwaterworkgroup_16june2020.pdf

- In response to the regional aggregation of stations to mimic Atlas 14 Tanya Spero asks if this method considers topographic differences or other representativeness qualities between lumped stations?
 - Arthur DeGaetano says that the station by station comparison does account for elevation. An adjustment factor to encompass for model stations additionally include elevation data.
- Jason Bernagros asks “In an ideal world, how frequently would the historical data used to produce Atlas 14 PDS be updated (~5, 10 years)?”

- Arthur DeGaetano answers that he does not know. The current Atlas 14 confidence intervals encompass the expected 2-3% increases in precipitation which are projected to occur. This makes it so that it would take roughly 20 years to have precipitation expectations fall outside of the initial confidence intervals.
- Jon Butcher commented that: There are problems with the LOCA training data that cause underestimation of 24-hr events. See new paper of G. Wang at “Projected changes of precipitation characteristics depend on downscaling method and training data: MACA vs. LOCA using the U.S. Northeast as an example.” J. Hydrometeorol., <https://doi.org/10.1175/JHM-D-19-0275.1>.
 - Arthur DeGaetano responds that they have looked at that a lot and have used MACA, and BCCA data as well. LOCA does underestimate extremes (by up to 70%). From this they see different behavior in model results due to the difference downscaling data used.
 - Keith Dixon at GFDL has used BCCA for temperature extremes, which are also applicable to precipitation extremes.
- More Qs for later time period
- UPDATE KATE NOT PRESENTING TODAY

12:30 IDF Curve Development and Application in the Chesapeake Stormwater Community – David Wood, Chesapeake Stormwater Network (CSN)

https://www.chesapeakebay.net/channel_files/41668/december_joint_wg_mtg_prez_david_wood.pdf

David will provide an update of CSN’s activities in organizing the Chesapeake stormwater community in the application of IDFs updated to present and future conditions in order to maintain resiliency of stormwater and restoration practices under climate change. A ten minute discussion period follows the presentation.

Previous June 2020 presentation here:

https://www.chesapeakebay.net/channel_files/40321/csn_climate_resilience_update_june_2020.pdf

- KEVIN DU BOIS has stated that he would add flooding as a conveyance vulnerability.
 - David Wood did not focus on floodplain management in this memo. Looked at ways to talk about flooding and shifting design paradigms to balance quantity and quality control on the implementation side.
 - Norm Goulet says flooding is driving many of the questions now.
- Jason Bernagros asks “For the resilient design memo, will you be addressing when the scale of implementing BMPs may need to be adjusted to capture additional runoff volumes (parcel-based BMPs versus regional BMPs (cloudburst, etc.)?)”

- David Wood says we are early in that stage and will be addressed as a broader principle to define potential resilience design guidelines.
 - Focus is on individual or parcel BMPs for site design.
- Norm Goulet looks forward to seeing state manuals and how they might differ across the Chesapeake Bay watershed.

1:00 Moderated Discussion – From Research to Implementation

A moderated discussion will cover the following questions:

- Are there any unaddressed questions in the previous presentations that should be addressed?
- How do we create a final product that is packaged to make it easiest on the CBP state agency partners to translate the data into new stormwater manuals?
- Alternately, are there other approaches being considered to address increasing precipitation?
- Where are the CBP State partner's thoughts on the uncertainty of the projections? How would PIs present uncertainty and how would the CBP State partners weigh that information when making updates to their regulations and manuals? What is the role of precipitation projections based on observations relative to climate change models for near term (2025,2035, etc.) projections?
 - Can state partners provide specific feedback about what they feel most comfortable with in terms of integrating climate projections into stormwater regs. so it can be considered by RAND and Cornell U. as they develop their end products.

Remaining questions from previous sections are now discussed

- Lew Linker asks if RCP 8.5 is appropriate? The incoming administration talks about plans to decarbonize by 2035 and the increased prevalence of electric cars is this still a valid assumption to make based on emissions?
 - Arthur DeGaetano says that is above his pay grade but he is doing both 8.5 and 4.5 for the website results. By 2050 the difference between RCP 4.5 and 8.5 show different trajectories. However before 2050 the differences are not noticeable.
- Jason Bernagros asks Would the website tool possibly look at having the projected IDF curve data available in a tabular format that could be used with stormwater management models?
 - Arthur DeGaetano states that yes, this can be made to fit user needs.
- Lew Linker asks What is the standing of long term (~90 year) observed precip trends by station in estimating precipitation 2 or 3 decades hence?
 - Lew Linker was tasked by CBP to look at climate change over a 30 year period thinking an ensemble of GCMs would be used.
 - STAC wanted long term projections of long term precipitation.
 - Would these projections be usable from this perspective
 - Arthur DeGaetano answers that you need at least 30 years to tease out multi decadal time scale occurrences.
 - Lew Linker talks about how beyond 30 years the STAC agrees that GCM models are appropriate to creating precipitation data. Less than 30 years projections should be based on at least 90 year data sets.
 - Arthur DeGaetano does not agree 100% but understands the perspective.
- Wilbert Thomas asks if CORDEX, LOCA, or another downscaling data set will be used for the final web tool?
 - Arthur DeGaetano wants input from group, this should be a practical not scientific decision:
 - Ensemble or models?
 - Ensemble of downscaling technique?
 - Different adjustment factors?
 - Maybe a one number scenario is the best application. Follow Alan Cohn to look at high end projections for most extreme cases.
 - Alan Cohn adds that this should all be encompassed in climate resilience guidelines.
 - Lew Linker adds that he would like to see an ensemble of ensembles at the county level.
 - Ensemble of GCMS and Downscaling techniques, which might be more readily used by practitioners due to better display of all of the variation between different scenarios based on different techniques used.
 - Arthur DeGaetano notes that the county level will present an adjustment to the IDF curves from Atlas 14.
- Anna Jalowska asks “Art, we work with ~6 km LOCA data, did you aggregate LOCA product to 30km?”

- Arthur DeGaetano misspoke that LOCA is 6km resolution, and Carnegie Mellon has been aggregating downscaled data to 22km CORDEX resolution to see how much difference this makes to county level adjustments.
 - This tests whether scale has a large impact on the downscaled data. The sensitivity does not have much impact on downscaling whether the resolution is coarser or larger in this case.
- Randall Greer asks “Will there be any consideration given to changing rainfall distribution? We recently adopted the NOAA Rainfall Distributions in Delaware and saw peak discharge estimates actually decrease compared to the previous NRCS Type II distribution.”
 - Arthur DeGaetano responds that this conflates two things,
 - NRCS II distribution takes a daily value and smears over time throughout the day.
 - Represent average conditions across broad areas, very large areas, from Florida to Maine
 - Atlas 14 makes IDF curve adjustments on a point by point basis.
 - Must also know storm durations, 1 hr, 6 hr, etc.
 - Must look on how to apply adjustment factors based on time scales.
 - It currently does not look like the distribution curves will need to be changed.
- Lew Linker asks Alan Cohn about climate resiliency guidelines which are currently applied to public sector buildings but wonders if this might be moved towards the private sector? If so when?
 - Alan Cohn contributes to design guidelines but the mayor's office makes the call. This is primarily applicable to public sector buildings and infrastructure. This is more guidance at this time, with a potential movement to mandates for public projects. For private property this is not the case, but remains guidance. This can only be made mandatory if input into the building code.
- Matt Meyers in Fairfax Co. VA looks at places of inadequate drainage. Have these projections been compared to the drainage standards of subdivisions and in particular new subdivisions (1990s and newer) vs older subdivisions which are now requiring rebuilding projects and lack adequate infrastructure?
 - David Wood wants to have follow up conversation. Philadelphia is starting to do this with drainage models and seeing where flooding has occurred.
 - Matt Meyers are older neighborhoods able to be updated based on current projections or will these projections be inadequate for redevelopment of older communities.
- (Bullet 2)Lew Linker asks how to best make a final product to create a packaged product to inform stormwater manuals?
 - Dave Montali does not think all the states function off of IDF curves. It

would prove beneficial to follow Arthur DeGaetano's ideas to have a single IDF curve adjustment factor which could be universally applied to ensure all areas are updated in the same way.

- Lew Linker due to time running out suggests that the last two bullets to answer state partners' thoughts on uncertainty projections as well as specific feedback they may have?
- George Onyullo states that the projections are made for a climate scale yet DC is a city, making this potentially problematic.
 - Lew Linker asks Arthur DeGaetano how to deal with this:
 - Arthur DeGaetano says DC is similar in spatial scale to several smaller counties in VA so it can be treated as a county with its own specific adjustment.
- Jim George if as a community we can reach a consensus on how we do IDF's that will be good. For now we have some framework for looking at how precipitation will change. The work by David Wood is a nice framework for what we have to look at. The CBP has experience working with different management styles from different states which is necessary for this issue. He is also interested in Jon Butcher's work where 1 yr 24 hr storm doesn't seem to change much. Since Maryland bases designs on that we are still not done due to issues such as cloudburst planning. We will have to step back and revisit what we are designing for. This may have changed over the past.
- In the chat a side conversation about large scale and PMP rainfall events occurs:
 - Don Lacquement asks "Has any of the research looked at projected increases in extreme rainfall events such as the 1000-yr or even the PMP for impacts on dam safety in the future?"
 - David Wood responds that both PA and VA have done PMP projections in the last 5 years. The VA report is here:
<https://www.dcr.virginia.gov/dam-safety-and-floodplains/document/pmp-exec-sum.pdf> PA is here:
<http://files.dep.state.pa.us/Water/Waterways%20Engineering/WaterwaysEngPortalFiles/PMP/FINAL%20Probable%20Maximum%20Precipitation%20Study%20for%20Pennsylvania.pdf>
 - Jason Bernagros provides the updated NRCS rainfall distribution methodology (2019), which uses Atlas 14 data:
<https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=43924.wba>
- Mathew Rowe is curious if climate data are so variable that you must look at longer term periods, ~30 years. If the climate is changing so fast, i.e. rapid intensification, how do we know, or is there a gap to know if things are changing more rapidly now than in the past. It seems as if there is a gap there.
 - Arthur DeGaetano says one way to do that is through his project where

he can take a long period of record and retain sequence of mother nature. (1930 to present). Say that we randomize the 90 year period with the 1950s now. If we randomize these dates what is the chance to see similar trends to what we see today? This can help us tease out if today's change is faster or simply a product of natural cycles.

- Mathew Rowe asks if anyone is doing that yet?
- Arthur DeGaetano says that he does not know of anyone doing that yet with extreme rainfall but some people have with temperature.
- Anna Jalowska adds that in general we lack tools. Current tools are good for 20-50 year events, These don't destroy roads like a 1000 year event. We need new methods to view these extreme events. Her group is looking into 500 year events with methods which are not necessarily designed for that. IDF curves assume little change since they are based on past periods. We lack tools to address nonstationarity or the derivation of 1000 yr events from 100yrs of data. We have a large gap which needs filled.
- Tanya Spero wants to raise a colleague who has tried to look at climate system stationarity or if the assumption breaks down through PRISM work. This was never published but utilized statistical methods and the stationarity assumption breaks down. Climate change is occurring in even 90 years of data. Localized trends appear, causing non uniform differences.
- Wilbert Thomas asks if "we can get a copy of all presentations today?"
- Norm Goulet says "All of today's presentations will be posted to today's calendar page.
- Breck Sullivan then adds a link to view the presentations
https://www.chesapeakebay.net/what/event/joint_modeling_wg_crwg_uswg_december_2020_meeting
- Dipman Kumar has a general question on if the return period has the same interpretation under non-stationarity as the current stationarity assumption in Atlas 14?
 - Alan Cohn says they currently plan based on a five year storm but recognize this will change on one way they have experimented with is by using a 10 or 50 year storm as a proxy event for future precipitation due to the comfortability of engineers compared to using updated IDF curves.
 - Lew Linker says it is one of the changes of the field on how to deal with more extremes of climate change.
 - Arthur DeGaetano says choice of periods is a 50 year chunk of data, based on research stating if a climate record with a trend, nonstationary, then what is the time period which minimizes error based on the trend within the data. 50 years minimizes the error fitting these distributions based on the trends within the data. In practice if you are using things with a 100 year lifetime then you might want to use a longer term

dataset, vs a shorter lifespan than you might want to focus on economic factors.

- Lew Linker asks Arthur DeGaetano
 - I wanted to ask and of course Norm Goulet jumped in if you see anything in the chat box, we need to address I wanted to ask you, aren't you and your team? Are you getting what you need from this discussion? In terms of direction? We've heard? Yes to 4.5 and 8.5 rcps? We've very much welcomed your incorporation of municipalities from the District of Columbia to some of the municipalities in Virginia. So kind of a little bit, counties plus, but, but are you at a head scratching moment somewhere in your development, where you really need some direction that you haven't yet received? Oh, and by the way, I think, as David said, and others have commented on that, that web design looks very good.
 - Arthur DeGaetano says "I think the one question is still dealing with kind of the spread between the models in the in the downscale, he makes some a bit of a loss as to how best to display that or, you know, how to display that how to convey that, you know, that would that would best suit your needs."
- Lew Linker poses the question Right, right. Well, we've heard from one voice in terms of how about an ensemble of assemblies and then collect all of the individual downscaling and, and ensemble GCMS. What other thoughts do we have from participants? How do we, how do we deal with the different downscaling and different I think, a part of the question also artists, the different ensembles, perhaps?
 - Arthur DeGaetano states that in NY all data was lumped together and range was shown, It gets cluttered and they still know how best to display data for use in manuals. A 75% range is suggested,
 - Lew Linker says he thinks that lumping data is a good solution and that 75% or a smaller range is a good idea. He reminds everyone that there is a desire to make data available for practitioners and practical people.
 - Lew Linker then asks if anyone else has any ideas on how to develop an ensemble of ensembles?
 - Jon Butcher says engineers need a number but range is also important and we need to know what range of solutions need to be dealt with and be looking for solutions that do well across that certainty.
 - Dave Montali suggests we don't need to worry too much about this range due to the fact that the data we are focused on is relatively short term, 55 years and that the lifespan of stormwater design which has a shorter lifespan than bridges and roads.
 - Arthur DeGaetano says he thinks Dave misheard him. What he referred to was that there was not a lot of

difference between whether we choose a high emissions scenario or a low emission scenario up to about 2050. And then beyond that, that becomes more important. That's not to say between now and say, 2015 2016, that the extreme rainfall recurrence intervals are not going to be very different than they are in Atlas 14.

- Dave Montali retracts his previous statement.
- Arthur DeGaetano continues to say that we will be on a similar pathway regarding carbon emissions for a time due to the slow ramping down of carbon emissions until carbon neutrality.
- Lew Linker refers to uncertainty and says “And along, John's thinking, we have uncertainty from the different ensemble GCM so that we would use uncertainty from the downscaling that we'd want to portray. But then as we go out, toward the century side, we have the additional uncertainty of the RCP. “ Lew Linker then wants to keep on track with the chat box and Norm Goulet.
- Norm Goulet says the discussion and chat reflect each other well. But that implementation is still a bridge too far, and in the meantime we need to work with states and see who is willing to make the leap and implement technology into stormwater handbooks.
- Lew Linker states that for this process you first need a tool to be able to aid in implementation. He then asks if any of the state, or municipal stakeholders have followed any of this or are working to implement any of the new information informing IDF curves?
 - Norm Goulet says VDOT is pursuing this wholeheartedly and looks to adopt something in the long run, This cooperation encompassing VA outside the CBP will be contracting RAND to do the same analysis on their region. This makes a common method throughout the entire state.
 - Arthur DeGaetano confirms this has happened.
 - Lew Linker states that if a county has any portion on the CB watershed it counts as within the watershed. This means likely MD and DE are likely completely covered. Since PA is incompletely covered he asks if anyone has an idea of how the entire state might be covered? He also asks Norm Goulet if it is correct that MD, VA, and DE now all have a common tool to develop principles?
 - Norm Goulet says yes.
 - ART says that NJ is also joining into analysis similar to the approach they have used so far.
 - Lew Linker says we are all learning together how to overcome the thought that stationarity is dead and that multiple states are working together.
- Chatroom has been having a sidebar conversation extending through break:

- Bill Keeling says he is “Not sure what was said about VA counties is valid considering the average size of VA counties is 262,654 acres whereas DC is less than 40K.”
- Jon. Butcher “ Part of the issue is semantic. We should stop referring to events of a given recurrence length and instead talk in terms of probability of occurrence. When conceived that way non-stationary concepts are more easily incorporated.”
- Dipmani Kumar “I agree with Jon but remember the return period is strongly linked in current practice with exceedance probability.”
- Alan Cohn “The way that the NYC Panel on Climate Change has communicated the ensemble of models and 10th, 50th, 90th percentile has been useful to us (not for precipitation intensity, but for other variables). We used the 90th percentile for the 2050s for floodproofing critical wastewater facilities for sea level rise, which becomes closer to the 50th percentile towards the end of the century.”
- Dipmani Kumar says “Yes - I think that communication method is the way to go in the future. Thank you Alan.”
- Wilbert Thomas says “Too many choices for climate data sets and downscaling procedures will be confusing to the user. I think the study team should select what they think is the best downscaling technique/climate data set and estimate the uncertainty across the GCMs.”
- Wilbert Thomas thinks Garrett County, MD may be outside the CBP watershed.
- Dipmani Kumar to everyone: “As a practitioner I have to say that The concept of return period and implied stationarity is so deeply ingrained that it will take time to understand in a non-stationary concept. I meant non-stationary context. And I still am not sure how the return period is to be interpreted in that context.”
- Norm Goulet calls for a five minute break.

1:40 Break

2:10 Climate Impacts to Restoration Practices & BMPs – Jon Butcher, Tetra Tech

[https://www.chesapeakebay.net/channel_files/41668/idfpresentation-butcher_120920_\(002\).pdf](https://www.chesapeakebay.net/channel_files/41668/idfpresentation-butcher_120920_(002).pdf)

Development of a statistical approach to update NOAA Atlas 14 IDF curves based on change in climate models and the application of the approach to assess future BMP performance, flood risk, and channel instability will be presented. A five minute discussion period follows the presentation.

- Norm Goulet introduces Jon Butcher saying he and his research team are with Tetra Tech “and they have just completed climate impact work for the Chesapeake Bay trust, also. So we’re going to be interested to do some comparisons between what Art’s gonna be coming up with and what John’s coming up with and see how they are similar, different, where we are and what we can do with it all.
- Jon Butcher has a final report of research findings: https://cbtrust.org/wp-content/uploads/Grant16928-Deliverable11-FinalProjectReport_120820.pdf
- Lew Linker ads that due to Kaye not presenting the discussion time has expanded.
 - Norm Goulet agrees
- Norm Goulet ads in chat topics:
- Arthur DeGaetano: “The rand/cornell/carnegie Mellon group has also looked at change factors using annual maximum series
- Julie.reichert-nguyen: “another co-benefit could be cooling related to temperature of nearby streams by enhancing infiltration in reference to water temperature.”
- Jon Butcher responds this is something they would like to do in the future.
- Lew Linker says thank you and he would like to understand slide 7, and the GCM’s present. How did Jon decide which GCMs to use and is it an ensemble?
 - Jon Butcher responds that he didn’t have a large amount of time to work on this but wanted to look at a range of GCMS and wanted to look at annual precipitation volumes. So he picked two scenarios near the middle of solutions and one on the wetter and one on the drier ends. It would have been better to do a subsetting based on the 10 year event since things don’t always follow the order you might expect. This was difficult with a grid based product near the water body.
 - Lew Linker says each station was set on a grid and the middle or the grid, with a mix of RCPs
 - Jon Butcher says they combined 32 GCMs at 2 RCPs; for 64 results. They then picked on near the 10th 90th and one at each end of the middle.
 - Lew Linker says ok a station by station approach.
 - Jon Butcher would have liked to show all 64 results.

- Lew Linker asks if you are using SWIM5 did temp and evapotrans cause increased volumes?
 - Jon Butcher focused on Urban BMPs and temp/ evapotranspiration are antecedent moisture conditions. It's not signif component for large storms, this is bigger in rural areas, Temp is not a good tool for precipitation.
- Mark Symborski asks if storms with 1 yr recurrence intervals are not expected to change much, could large scale climate change factors affect extended droughts or inundations, and how could they be planned locally to increase resiliency.
 - Jon Butcher this is important but can't be addressed with IDF curves, it needs continuous simulation. This allows to see the evolution of soil moisture and plant growth. They have done some of this looking at green and grey infrastructure. They used hydrology with an HSPF model. They also worked with AG BMPS in a future climate, more sensitive to plant components. For bioretention design this influences plant selection. This will need more research in the future.
- Norm Goulet asks if using different methodologies will lead to same results(i.e. Jon vs Art)?
 - Jon says we don't know but are interested. He suspects results will be similar in a broad sense, and ensemble means should be similar. One thing seen is LOCA not doing a good job of approx Atlas 14 predictions, especially around coasts. This is why they don't use LOCA directly. This is early work and Jon Butcher is not confident Atlas 14 in MD is not the best work.
- Arthur DeGaetano is more optimistic that methods would be very similar with the caveat that Art is looking at additional downscaling methods. Art is using an adjustment factor that is quantile based and wants to see Jon's quantile method. He thinks the two's work is more similar than not.
- Dave Montali asks if two similar products, both for MD, will fit together? How is best to present this research for utility and the way CBP is run?
 - Jon Butcher says this work is exploratory and they have a bigger better effort underway with Arthur DeGaetano's group. This should be a standard to base interpretations on for various states.
 - Arthur DeGaetano says methods are complimentary. They have now differences in approach. If this fits within a specific interval then it shows either results are reasonable and that both works will show validation.
 - Lew Linker says this will advance the future of known estimates of IDFs.
 - Arthur DeGaetano says If there is no agreement then this will foster increased research.
 - Lew Linker says this is great for creating an understanding of the why.
- Dave Montali says multiple lines of evidence are good but asks if Jon has a mean scenario to compare to Art's
 - Jon Butcher says there is not a mean, there are theoretical issues but scenarios run near the median were used.
 - Arthur DeGaetano creates a mean at the end and so can easily tease out a model to model comparison.
- Lew Linker asks for new participation.

- Jim George asks what path is seen forward to bring together a process that states could buy into which could be used to change thinking about design and management issues.
 - Norm Goulet says the plan is to compare Art and Jon's work through the Urban Stormwater WG. This will be worked through individual states to get info to them to influence potential changes and designs based on new IDF's into manuals. This won't happen overnight. This could take years to update manuals. This is just to get the ball rolling.
- Lew Linker asks for chat contributions:
 - Norm Goulet opens chat:
 - Karl Berger asks: When will the final results from the Rand project be available?
 - Norm Goulet says next year at the end of the summer.
 - Lew Linker asks if this is time for website roll out
 - Arthur DeGaetano says this is the hope and the track for release.
 - Lew Linker says we may want to ensure good coordination over the entire CB watershed, for Urban Stormwater WG.
 - Norm Goulet says he doesn't want this to go unused and counties to each go in different directions and that coordination is imperative.
- Mathew Rowe asks if redesigned stormwater costs are economically viable? Is there a cost benefit analysis underway to support this?
 - Lew Linker says once IDF's are projected this can be compared to current Atlas 14 and ask what would be used with Atlas 14 vs projected IDF. How do you cost out public safety, env protection, private property protection?
 - Jon Butcher cites an important part of this is the ancillary benefits and choosing designs which provide them compared to solely stormwater benefits.
- From the Chat Kevin Du Bois asks: "What level of outreach are you doing with military installations to ensure that they are using the same design criteria?
 - Lew Linker says this is somewhat down the road but useful to think about
 - Norm Goulet says there is a gap there.
 - Jon Butcher says the US Naval station at Norfolk is doing its own research.
- David Wood says Dr. Wang of ODU gave them IDF curve research but they have yet to do anything with it yet.

2:40 National Work on Forward Looking IDF Curve Development – Tanya Spero, Anna Jalowska, and Jason Bernagros, EPA ORD

https://www.chesapeakebay.net/channel_files/41668/cbpo_dec-2020-extreme_weather_final.pdf

Ongoing work by EPA's Office of Research and Development (ORD) will be presented including intensity, duration, frequency (IDF) curve and extreme weather research projects applicable to urban stormwater management. Applications include updates to the National Stormwater Calculator as well as climate data for EPA's Stormwater Management Model (SWMM). A five minute discussion period follows the presentation.

- From the chat Arthur DeGaetano asks "CORDEX also uses WRF as its RCM, and gives a final resolution of 22km. How is your downscaling using WRF different from the data available in CORDEX (are you using more GCMS)?"
- Tanya Spero posts in the chat the link for the publication of her and Anna's work: AM Jalowska & TL Spero, J. Geophys. Res. Atmos., (2019): <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2019JD031584>
- Jon Butcher posts in the chat: "Anna - LOCA also appears to underpredict extreme precipitation for the historical period. Did you compare the RELATIVE change from historic to future between LOCA, MACA, and WRF?"
 - Anna Jalowska answers that no because they have only 10 years of historical data available for WARF so this would not be an apples to apples comparison. We will have an extended historical period for the 12km domain.
- Arthur DeGaetano asks: "Anna - LOCA also appears to underpredict extreme precipitation for the historical period. Did you compare the RELATIVE change from historic to future between LOCA, MACA, and WRF?"
 - Anna Jolowska answers this did not matter as hourly data was produced and could be grouped into 24 hour day periods.
- Lew Linker asks Jason Bernagros if it is his understanding that the national climate change tools will be constantly updated in the face of new projections?
 - Jason Bernagros answers that this is the plan to have constant updates for these tools as projection data are updated.
- Lew Linker comments that an analysis ecosystem for IDFs is developing where national tools are becoming the latest go to tools for most up to date data is available, this contrasts for the most comprehensive management data which can inform decision making is based in the works such as that done by ART and JON.
- Lew Linker now opens the floor to questions regarding any of today's presentations and moves onto moderated questions.

3:10 Changing Precipitation Patterns on the Eastern Shore – Kaye L. Brubaker,

University of Maryland

- This presentation did not take place.

3:30 Moderated Discussion – Next Steps Toward Implementation

- What are the best next steps for Bay Program partners to get the research into updated design manuals and other standard means of implementation?
- For CBP state agency partners, what would be needed in order to begin the process of updating stormwater manuals and what are realistic timetables for this?

- How can CBP assist major stormwater implementation agencies such as State highway administrations and DOTs.
 - Should a smaller ad-hoc group be formed to continue these discussions with a more fast-paced and focused venue for developing a unified work plan and reporting back to the USWG, CRWG, and Mod WG on recommended approaches to the problem?
-
- Lew Linker asks to take all of the questions from the agenda together as they are all very interrelated.
 - Tanya Spero brings up the interest in the work Art and Jon are doing and she thinks the work she is doing is very complimentary and wants to know if there is room to add this to the ensemble?
 - Lew Linker adds that everyone is open to a collaborative approach and so the answer is yes. The issue becomes the last bullet for how to guide the decisions going forward.
 - David Wood sees this is a large amount of data with a complex topic that is still a while away from a finished product. He wants to gauge whether there is an interest of a smaller group discussing how to move the ball forward outside of the sizing and IDF curve information. Adding there are other opportunities to update design manuals for better targets for maintenance for better performance in the face of increased precipitation? What level of interest is there for stepping up and engaging in these conversations?
 - Lew Linker says joint meetings are maybe twice a year but that a small group could meet frequently and stay in constant contact with the workgroups and create a situation where questions are quickly answered.
 - Norm Goulet asks David Hirschman what he thinks the next steps would be?
 - David Hirschman says grant opportunities are available, which might split between implementation and planning to try and change specs but also get a buy in from stakeholders. He feels as if we don't start now then resilient design implementation will be extremely difficult.
 - Lew Linker asks if any economies of scale, i.e. if many counties combined efforts to move in a similar direction regarding resilient designs? Would it make it easier to update design manuals?
 - David Hirschman says there is strength in numbers especially if state representatives could be brought in as partners.
 - Dave Montali throws out the thought that if action is wanted to take place then research must be summarized and then change crediting to stormwater practices will drive jurisdictions to make changes.
 - Lew Linker clarifies that if effective strategies to current conditions could be proven useful this would credit the new projections.
 - Dave Montali says that he is unsure if credit or discredit is the way to go but that altered credibility is a strong motivator.

- Mark Bennet asks if any researchers have looked at how BMP efficiency might be impacted by upgrades in the IDF. if a BMP designed under an old IDF curve is working under a new IDF curve how is that BMP's efficiency affected?
 - Jon Butcher says this depends on the type of BMP as well as the type and magnitude of changes. More intense storms lead to higher bypass of BMP's and reduce treatment by BMP's. But more research is needed based on the intricacies of the changes which will occur.
- David Wood says a memo he works on is trying to synthesize different studies which have been done, and the range of values seen is broad. Several studies have measured efficiencies and seen from no decline to 10-15% declines for N P and sed. Other studies are looking specifically at overflow and bypass and see higher declines but with increased variability. He also asks if Virginia Tech is also looking at this?
- Jeremy Hanson is looking at three questions relating to
 - climate change impacts on nutrient and sed cycles in general,
 - climate change impacts on BMP performance, and
 - which BMPs have the best outcomes in the face of climate uncertainty.
- Randall Greer wants to tackle the implementation issues that all states have different regulatory strategies. He thinks it comes to convincing the regulatory community on using projected values compared to current values based on data.
- Alana Hartman responds to David as a member of the Urban Stormwater WG member from WV. SHe wants to know what concepts should be tested with grant funds and what local contacts should be gravitating towards? Tell us what can be done now.
- Norm Goulet references the chat:
 - Anna Jalowska comments to Art that "...here I showed PRISM data for hurricanes only, so I misspoke. The differences in date definition between PRISM data and station data is partially responsible for the difference in length of Matthew."
 - Kevin Du Bois comments "I think there's value in evaluating plant palettes which might be more effective at water uptake and/or transpiration."
 - Jason Bernagros comments "Lew Linker, one idea for supporting states with adopting new IDF curve data with their stormwater programs or manuals would be to provide guidance on how to do that. Step by step guidance on how that could be done. EPA developed a flood resilience checklist a few years ago that could be used as a model template: <https://www.epa.gov/smartgrowth/flood-resilience-checklist>"
 - Norm Goulet thinks this will not work citing RANY's comment that each state works so differently, and independently.
 - David Hirschman commented that he " Wanted to bring up another idea for jump-starting some updating specs. It might be possible to start with retrofits driven by MS4 TMDL plans to try various design modifications (maybe through grants), including sizing and design features that." Norm Goulet thinks this was alluded to by Alana and so has been covered.

- George Onyullo picks up where Randall Greer left and says we shouldn't look at the idea of IDF curves as an end but as a tool to change regulations. This is since regulations are the driver of implementation which is clear in the TMDL guidelines.
- Lew Linker comments that the last bulleted question could be resolved by a frequent smaller meeting of a subgroup to inform larger workgroups and would like to discuss this.
 - Norm Goulet thinks that this will happen due to personal overlap between workgroups but that we are looking too far down the road and that this is not ready to happen yet.
- Lew Linker comments that this has been helpful in making things easier to take a step forward.
- In the chat David Wood mentions "With that proof of concept on a voluntary basis, there might be more motivation for states to incorporate into manuals."
- The meeting is then adjourned.

4:15 Adjourn

Participants: Breck Sullivan, Anna Jalowska, Antonio F. Marquez, Arianna Johns, Chris Swason, Christina Lyerly, Clint Gill, Dave Montali, David Wood, Dipmani Kumar, Don Lacquement, Elaine Webb, Lisa Beatty, Gary Shenk, Gopal Bhatt, Ian T. Vinson, Isabella Bertani, Jamie Eberl, Jason Bernagros, Joel Carr, Jennifer Starr, Jeremy Hanson, Jesse Bash, Josh Thompson, Karl Berger, Keven Du Bois, Lew Linker, Lindsay Byron, Martin Hurd, Matt Fanghella, Matthew Rowe, Norm Goulet, Randell Greer, Ruth Minich-Hobson, Scott Crafton, Steve Bieber, Hilary Swartwood, Tammie Clary, Tanya Spero, Thomas Butler, Ted Tesler, Wilbert Thomas, Richard Tian, Nicole Carlozo, Melissa Deas, Mark Bennett, Matt Konfirst, Matt Meyers, Lena Easton-Calabria, KC Filippino, Julie Reichert-Nguyen, Jim George, Jesse Bash, Guido Yactayo, George Onyullo, Cassandra Davis, Bhanu Paudel, Ben McFarlane, Ashley Gordon, Alana Hartman, Alan Cohn, Kyle Hinson, Cathy W, Bruce Michaels, Allie Wagner, Kristin Saunders, Yibeltal Alene, Whitney Katchmark, Sophia Grossweiler, Ruth Minich-Bobson, Randell Greer, Mark Symborski, Lee McDonnell, Larry Sanford, Katie Peige, Kate McClure, James Dunbar, George Onyullo, Chris Swanson, David Hirschman