Questions & Answers Sessions 2

Please type your questions in the Question Box. We will try our best to get to all your questions. If we don't, feel free to email Amita Mehta (amita.v.mehta@nasa.gov) or Sean McCartney (sean.mccartney@nasa.gov).

Question 1: Can you comment on the original concept of urban areas as islands as opposed to a continuum of built-up materials from ex-urban to urban area?
Answer 1: We speak of urban areas as islands due to the concentration of built up area. In reality this is a continuum of decreasing built up areas from urban to ex-urban environments. Due to the dependency of ex-urban areas on the former, they have higher dispersed residential developments. There will be heat islands within ex-urban areas, but from a health standpoint and observed land surface temperatures, urban areas have a higher concentration of built up areas within and among the downtown core, with corresponding diurnal higher land surface temperatures.
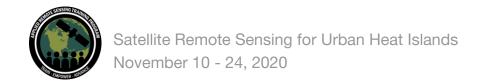
Question 2: I am concerned about the applicability of these UHI results. Can this be linked to CO_2 emissions since emissions also lead to warming? In order words can estimates of UHI be correlated with CO_2 emissions or can they be used to estimate possible emissions.
Answer 2: At the intra-urban scale, the mechanisms that drive CO2 are different than those that heat up urban areas. While one might imagine that hotter areas may require air conditioning or other mechanical devices that drive energy demand, those correlations are not necessarily directly attributable to hotter urban areas.

Question 3: How do these community volunteers get motivated to participate? How do the organizers/facilitator mobilize?
Answer 3: This has a lot to do with the local partnerships. It is done in a very bottom up method. Stipends are sometimes used and volunteer time. This goes from training, to reporting, to reimbursement for gas use.

Question 4: In the low resource environment (budget), what is the best alternative to measure temperatures? Is there any inexpensive instrument/method?

Answer 4: Often what we have seen is that satellite imagery is the quickest, least expensive way to gather this information. There is a difference between satellite imagery and ground based measurements though but satellite imagery is a good first choice. Inexpensive thermometers can be distributed. A mobile campaign allows for a large collection of data.

Question 5: For the random forest regression. How did you avoid overfitting? This can be tricky since there is high spatial correlation.
Answer 5: For each area, we look at the specific measurements and draw concentric buffer rings (25m, 50m, 100m, etc) and are run in a model independently to predict for that specific measurement. The models seem to be holding up well with spatial autocorrelation.

Question 6: What steps are being taken to have open data satellite data with higher spatial resolution (10m) for temperature monitoring and prediction?
Answer 6: All of the data from NASA's fleet of satellites are freely available to the public. There is always a compromise between spatial, temporal, and spectral resolutions. NASA is scheduled to launch Landsat 9 towards the end of next year (2021) which will improve the *temporal* resolution of LST-derived products, but will not improve the spatial resolution. The instruments on Landsat 9 are similar to those currently operating on Landsat 8.

Question 7: Can you report an r-squared and significance for the observers v. predicted temperature plots?
Answer 7: Random forest does not give a traditional r-squared. We use a 70 observed /30 predicted holdout method. Stationary measurements are compared to mobile.

Question 8: Have you done any correlations with UHI and ground level ozone?
Answer 8: No, not yet. Atmospheric chemistry interactions are occurring. At 2m above ground level (where we measure) there may be ozone interaction but we have not evaluated this fully.

Question 9: Which dynamic model did you use?
Answer 9: Random Forest

Question 10: Is the application used to evaluate the association of green interventions and heat available?
Answer 10: The role diff land covers play in heat. In 2021, we are having walking measurements where cities are planning green interventions. Our models are regional and at the city block level in situ measurements are useful.

Question 11: What are the advantages and disadvantages of using air temperature measurements to estimate land surface temperature?
Answer 11: We have conducted 32 of these campaigns in the USA and the middle east for modeling. Landcover vs land surface vs air temp and are evaluating the conditions the land surface is correlated to air temp. High altitude vs low altitude play a role (microclimates). This is challenging and we are a couple years out.

Question 12: I would like to know if there were predictor variables other than the sentinel bands used in the random forest model?
Answer 12: We do not use other predictor variables. Clear days with a high pressure system with limited wind and these are important factors. Incorporating elevation is tricky.

Question 13: What kind of datasets are required for ENVI met models?
Answer 13: We need a built environment (building footprint, height, materials). ENVI met does not cover all cities in the world. In Portland, ENVI does not have a default so we had to bring in the building materials. ENVI is not something you run across an entire city.

Question 14: Can you elaborate on what you think may be causing the differences in satellite versus ground data? Is it that the ground measurements are hyper-local?
Answer 14: One major contributor is what is happening on the ground. In built up areas in limited green or open spaces, the satellite images tend to be warmer than air temps. There may be some level of evapotranspiration. Hyper local measurements can be part of it but also the extent of which water is affecting it. You can have a lot of variability in a pixel.

Question 15: The presentation mentioned modeling air temp from land temp, is there any benefit in modelling the inverse relationship?

Answer 15: Air temp to calculate land surface temp. Benefit: not certain. LST can be derived easily from thermal IR. The amount of mixing in the column bc of the diversity of landcover in that patch of space can be a factor.

Question 16: What are the mitigation options for overcoming slow cooling down areas of a city?
Answer 16: Mitigation: materials on the land in the built up areas may be holding that temp. Keep the radiation from reaching those materials to reduce thermal gain (shading, green ivy walls, changing the reflectivity of roads, etc).

Question 17: Can you summarize the generic pattern you find between LST (satellite) and air temperature using in situ/mobile monitors?
Answer 17: The pattern has a lot to do with what is on the landscape. LST does not pick up humidity. The amount of built up vs green space of a water contained feature seem to be affecting what is going on. Watered grass comes out very diff than dry grass.

Question 18: Is there a database to access in-situ/mobile data across the US?
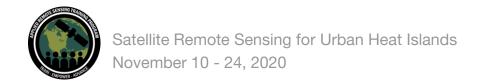Answer 18: Yes. For the US, we push all our data to osf.org.

Question 19: Which urban temperature remediation treatments have the best cost/benefit ratios (e.g., green roofs, surface albedo brightening, planting trees)?
Answer 19: The least expensive option is to try to find ways to increase greenery (caution, depending on the space and tearing up asphalt (removed). Grass requires a lot of maintenance. Cool surfaces (Global Cool Cities Initiatives/Alliance) are doing interesting work on the cost benefit.

Question 20: We can calculate urban heat islands from different indexes such as SUHI (Surface) and UHI. My question is, are those indexes comparable?
Answer 20: It varies a lot by region. Indices vary based upon the conditions (topo, altitude, wind, landcover). This is a big area of research going forward.

Question 21: Do you have any predictive models related to urban heat islands or related to LULC?
Answer 21: This random forest model is predictive of UHI air temp.

Question 22: The UHI research community has developed its own urban characterization scheme called the land cover classification zone (LCZ, Local Climate Zone?). I'm curious if you have investigated that characterization scheme in addition to the NLCD (National Land Cover Database) land cover classification scheme shown in your presentation?
Answer 22: LCZ are still relatively coarse. We are trying to get down to the street level to help identify different routes to help reduce the public impact. LCZ are good for research but operationally, more local will be the way to go.

Question 23: Is there a benefit in including air quality measurements in the air temperature modelling of UHI?
Answer 23: We are looking at AQ, polluted and hot areas that further compromised health. Stay tuned.

Question 24: How do vehicular emissions affect the urban heat island?
Answer 24: HVAC systems can push hot air onto a street, vehicle emissions do contribute as well. We are looking into this. Our hunch is that it is 10-20% effect.

Question 25: Regarding instruments they used in the heat watch campaign. How did they achieve 1 second data and how is it connected to response time of the instruments?
Answer 25: We looked into instruments with high response time as well as GPS. SD cards store the data locally. The firmware in the instrument allows for 1 sec data.

Question 26: How did you use random forest to 'interpolate' the temperature measurements?
Answer 26: We don't interpolate air temp. We create an entirely locally based model not just with air temp, interpolation may give error because there may be landcover under the interpolation area that may be affecting actual ground based measurements.

Question 27: What do you think about using Local Climate Zone classification for UHI studies like yours in place of classical Land use /Land cover?
Answer 27: see previous answer

Question 28: What is the difference between local scale urban heat island and urban heat island?

Answer 28: There is an intra-variation within a city due to a number of factors landcover, land use).

Question 29: Can we measure heat index near wetland areas? What do we call that index?
Answer 29: Water makes this tricky. You can get reflectivity from the water. So far there is not a name for this index.