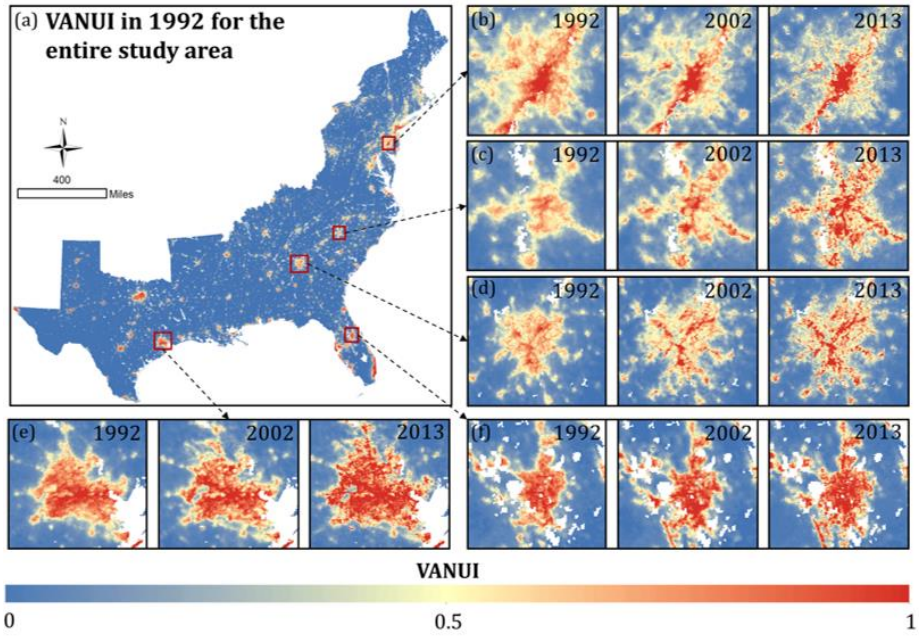
Response to RC 1

Dear first referee,

Thank you for providing such valuable comments and suggestions during the open discussion process. We provided detailed point-by-point responses to your concerns during our discussion and here, we'd like to reiterate our responses and provide details about our revision in a table.

Comments	Responses
"The manuscript is well organized and the results are very encouraging. This manuscript is worth of being published, but the following comments would be helpful for the authors to improve the quality of the manuscript."	Thanks for your encouragement and your positive comments. Your suggestions are indeed helpful for us to improve the quality of this manuscript.
Line 12, page 2: it would be helpful to provide some background information on how a hurricane is categorized, and explain how a category 5 hurricane looks like"	Thanks for your suggestions. We acknowledge that adding such information will benefit the readers. In the revision, we added some basic descriptions regarding the hurricane categorization: "Based on Saffir-Simpson Hurricane Scale, a hurricane is categorized in five levels by its wind speed: 74-95 mph as Category 1; 96-110 mph as Category 2; 111-129 mph as Category 3; 130-156 mph as Category 4; above 157 mph as Category 5.". In addition, we also stressed that category 5 is the highest category: "In 2016, Hurricane Mathew, a Category 5 (the highest category) hurricane, claimed a total of 34 direct deaths in U.S." See Page 2, Line 4-6 and line 14-15
"Line 13, page 2: Rephrase "125 billion and 50 billion dollars of damage respectively", this is confusing. Is the total damage 125 billion dollars? Or Is 125 billion dollars a part of damage? Current expression is more like the second case. The same clarification is needed for the 50 billion statement."	Thanks for pointing out this issue. We acknowledge our description might cause confusion to the readers. We have revised the sentence as "In 2017, Hurricane Harvey in the Gulf coast caused a total of 125 billion dollars of damage, ranking the second costliest hurricanes in the U.S. In the same year, Hurricane Irma in the Atlantic coast caused a total of 50 billion dollars of damage, ranking the fifth costliest hurricanes in the U.S ("Costliest U.S. tropical cyclones tables updated", 2018)." See Page 2, Line 13-18
"Line 13, page 6: How is R determined? Based on what factors?"	We apologize that we didn't give enough information for the setting of circular neighborhood (R). For density calculations, a neighborhood size (or search distance) has to be defined. We adopted the idea from the tool in ArcGIS called "Line Density" which calculates a magnitude-per-unit area from polyline features that fall within a radius around each cell. Here, we adopted the default setting of R in that function: "**The default is the shortest of the width or height of the output extent in the output spatial reference, divided by 30".** Per our calculation, the circular neighborhood R in our research area is 100 km.

	We added the setting of R in the revised manuscript as "The radius of R is set as 100 km in this study". We apologize for not specifying this parameter in the previous manuscript. See Page 7, line 10
"Line 24, page 6: It would be helpful to make reference to Figure 3 when mentioning the referencing area."	Thanks for your suggestion. We added "Fig. 3a" to the sentence as "We adopted the Elvidge et al. (2009) procedure to intercalibrate the DMSP/OLS NTL time series. Serving as the reference site (Fig. 3a), the geographic area of metropolitan Los Angeles and City of San Diego, CA maintains high conformity of NTL values throughout the 22-year period (Kyba et al., 2017; Hsu et al., 2015), which satisfies the "pseudo invariant" rule for calibration site selection (Elvidge et al., 2009)." See Page 7, Line 15-18
"Line 28, page 6: how many referencing lit pixels are used?"	Per our calculation, there are a total of 34,540 lit pixels (DN>0) in the reference site for our referencing satellite/year: F162007.
"Figure 3b2, page 10: this plot is very scattered as compared to the other two plots, any explanations?"	We believe that it is because F101992 is the very first satellite in the series. The long time interval from 2007 (our reference year) might lead to the scattered distribution pattern. However, we believe that the an R^2 of 0.946 still warrants a decent agreement for calibration. Our explanation in the manuscript is "The F101992 data (Fig. 3b2) exhibit less agreement due to its different satellite origin and a long time interval from 2007." See Page 10, Line 10-11
"Figure 4c, page 12: the level of the vertical axis is not correct."	We specifically select NDVI value above 0.1 to perform the intercalibration of MODIS and AVHRR. So, in the scatter plot, the origins should start from 0.1. In our previous manuscript, we illustrated: "Stratified sampling was applied to pixels with NDVI value above 0.1 to ensure that land covers in different NDVI ranges were equally sampled. Thirty thousand samples were collected within four hurricane-prone zones in years 2003, 2004 and 2005, respectively." See Page 7, Line 31, and Page 8, Line 1-2

"Figure 5, page 13: it is helpful to label which image is for 1992, 2002 and 2013."	Thanks for your suggestion. We labeled subfigures in Fig. 5. The new figure can be found here:  See Page 14, Figure 5
"Figure 7a, page 17: the ellipse is shown without being explained."	We explained the blue ellipse in our previous manuscript as "A decrease in human settlement intensity was observed mostly in the north (the U.S. Northeast region; blue ellipse in Fig. 7a) where several cities in the state of New York stand out, including Albany, Troy, and Johnstown." We changed "circle" to "ellipse" in this revision. See Page 17, Line 6-8
"Line 28, page 2: a better understanding"	We modified the sentence as: "a better understanding of the temporal and spatial dynamics of human settlement is needed for advanced damage assessment and sustainable urban planning." See Page 2, Line 30-31
"Line 34, page 2: Satellite to satellite"	"Satellite-derived" was modified to "satellite-derived" See Page 3, Line 3
"Line 5, page 3: referred as to referred to as"	"referred as" was modified to "referred to as"

	See Page 3, Line 10
"Line 16, page 3: were to was"	"were" was modified to "was" See Page 3, Line 22
"Line 18, page 3: significant to a significant"	"significant" was modified to "a significant" See Page 3, Line 24
"Line 10, page 5: has to have"	"has" was modified to "have". See Page 6, Line 5
Line 18, page 5: spell out USGS	The sentence has been modified as "provided by United States Geological Survey Earth Resources Observation and Science (USGS/EROS)" See Page 6, Line 13-15
"USGS Line 27, page 6: in the same to at the same"	"in the same" was modified to "at the same" See Page 7, Line 19
"Line 10, page 7: year to years"	The sentence has been modified as "Thirty thousand samples were collected within four hurricane-prone zones in years 2003, 2004 and 2005, respectively." See Page 8, Line 1-2
"Line 25, page 7: on to on the"	"on" was modified to "on the" See Page 8, Line 16
"Line 27, page 7: upwards or downwards to upward or downward trend"	"upwards or downwards" was modified to "upward or downward" See Page 8, Line 18
"Line 3, page 10: a R2 to an R2"	"a R2" was modified to "an R2" See Page 10, Line 11
"Line 7, page 12: year to years"	"year" was modified to "years" See Page 13, Line 7
"Line13, page 12: decreased to decrease by"	"decrease" was modified to "decrease by" See Page 13, Line 12-13
"Line 9, page 12: City to the city"	"City" was modified to "city" See Page 13, Line 9

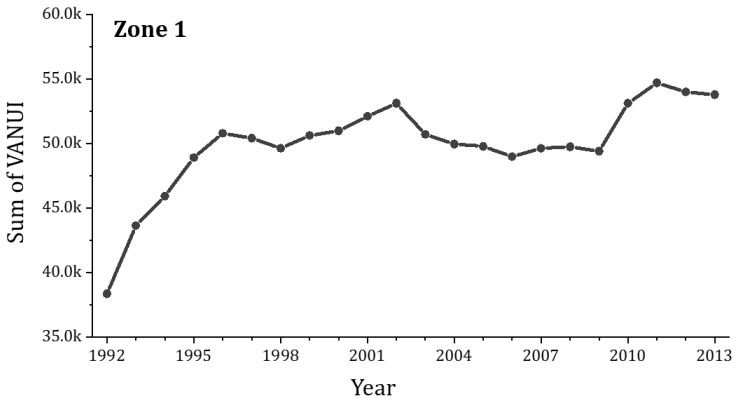
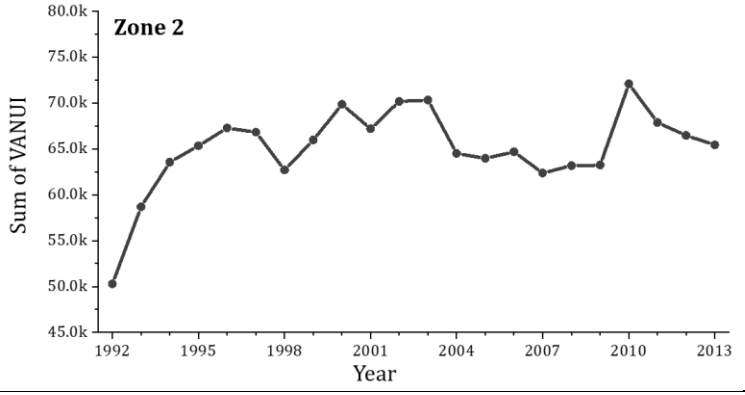
"Line 17, page 12: Houston reveals dramatic to Houston has a"	We modified this sentence to "Houston (Fig. 5e), for instance, has dramatically increased its human settlement." See Page 13, Line 17
"Line 3, page 13: matches to match"	"matches" was modified to "match" See Page 14, Line 3
"Line 8, page 13: affect to affects"	"affect" was modified to "affects" See Page 14, Line 8
"Line 1, page 15: percentage of area to percent area"	"percentage of area" was modified to "percent area" See Page 16, Figure 6 caption
"Line6, page 15: Zonal statistic to Zonal statistics; in to for"	We modified this sentence to "Zonal statistics were also summarized for the four hurricane-prone zones (Table 3)." Page 16, Line 6-7
"Line 7, page 15: Please rephrase "The net increase area calculates"	We modified this sentence to "The net increase area is defined as the area difference between pixels with a significant increasing and decreasing trend." See Page 16, Line 7-8
"Line 11, page 15: significant to a significant"	"significant" was modified to "a significant" See Page 16, Line 11
"Line 12, page 18: Please rephrase "The three two years (2016-2018)"	We modified this sentence to "The last three years (2016-2018) have seen consecutive above-average damaging Atlantic hurricane seasons." See Page 19, Line 12-13
"Line 18, page 19: Rephrase "an areal percentage of 4.22% in Zone 1 experienced significant increase in"	We modified this sentence to "Via trend analysis, 4.22% of the area in Zone 1 experienced a significant increase in settlement intensity, followed by 2.34% in Zone 2, 2.08% in Zone 3 and 1.65% in Zone 4, revealing higher pressure of human settlement and thus impacts from hurricanes in the frontmost coastal areas." See Page 20, Line 17-20

Response to RC 2

Dear second referee,

Thanks for providing your valuable insights during our open discussion. We are very glad that you are satisfied with our explanation on your major concerns. In this letter, we summarized our discussion and provided details of our revision in a table.

Comments	Responses
"To what extent the percentage of pixels with VANUI>0 is representative of an increased land development? If we look at the case of Philadelphia (Fig. 5b) the percentage does not significantly change from 1992 to 2013. What is changing here is the sum of VANUI values. Therefore, I strongly recommend to analyze the sum of VANUI to check for land development. If the sum of VANUI does not confirm your previous findings, then your analysis presents a major flaw and cannot be accepted for publication."	Thanks for pointing out the issue. We totally understand your concern. Here are the seasons we'd like to present to you. Firstly, VANUI = (1-vegetation) * light. We could claim that VANUI > 0 represents "lights AND impervious surface", meaning that it has to satisfy two requirements: 1) lights casted to a certain area and 2) that area has to have impervious surface. Traditional remote sensing (multispectral) that gauges urban expansion mainly consider the expansion of impervious surface. VANUI transcends those approaches by introducing another aspect of "lights". We believe that the evolvement of percentage of pixels (VANUI > 0) during the 22-year investigated period illustrates the trend of the expansion in each zone. If in Zone 1, there are 30% of pixels (VANUI > 0) in 1992 and 10 year later, there are 40% of pixels (VANUI > 0) in 2002, we believe the difference in the percentage illustrates the expansion of human settlement. Secondly, due to the saturation problem of DMSP (value capped at 63), we are worried that the sum of VANUI for large-scale analysis might suffer from some uncertainties (we did the sum of VANUI for different MSAs in CONUS, please see table 4). Thirdly, using the concept of "VANUI > a certain threshold" to perform regional analysis has been proved efficient by many (Li et al., 2016; Lu et al., 2018). In this study specifically, we set the threshold to 0. As for your concern, we confirmed that the trend of VANUI summation in different zones agrees well with what we have found using percentage of VANUI>0. We performed the statistics for Zone 1 and Zone 2 using sum of VANUI and found the same log trend while Zone 3 and Zone 4 exhibit no significant trend:

	 
*"Why sum slope to represent the rapidness of human settlement growth?*** Each pixel (1 km2) can have a maximum slope value of 1/22=0.045. By summing slopes in a region, I assume that you can get an estimate of growth, but this is proportional to the considered area (namely, one of the four hurricane-prone zones), thus you cannot compare trends. To do this, you should consider the average slope."*	Thanks for pointing the Theil-Sen slope issue. We totally agree with your opinion. Further, we'd like to explain our idea of using Theil-Sen slope. Mann-Kendall test only identifies pixels with significant trend (increasing or decreasing). It doesn't calculate the strength of the trend. After pixels are identified as having significant trend, Theil-Sen slope calculates how strong this trend is. By summing up all the Theil-Sen slopes in each zone, we can quantify the total increasing intensity in each zone. However, as you mentioned, this is proportional to the considered area. To solve this problem, we divided the summation of all the Theil-Sen slopes by the size of the zone. This is why (in Table 3) we added the column "Sum of Theil-Sen slope per 100,000 km^2". We are calculating the summation of Theil-Sen slope per unit in each zone.
"To what extent sum of slopes in Table 3 are significant? I do have serious concerns related to the slope values reported in Table 3. If we assume that the maximum slope per pixel is 0.045 and in zone 1 there are 312,453 pixels (all starting from 0 in 1992 and reaching 1 in 2013), then ideally the maximum sum value would be 14,060. How is this value related to 9.02 (per 100,000 km2)? Please elaborate more on this, to prove the significance of slope values."	Please let us explain our methodology (Mann-Kendall + Theil-Sen slope) in this study. Mann-Kendall identifies pixels with significant trend, and Theil-Sen further calculates the slope of those pixels that **have been identified**. As you pointed out, Zone 1 has 312,453 pixels. However, pixels with significant increasing trend only occupy 4.22% (Table 3), meaning that the we are only calculating the summation of Theil-Sen slope for around 13,185 pixels. Within those 13,185 pixels, only a small amount of pixels have increased from 0 (no

	urban at all) to 1 (fully urbanized). If, all the pixels in Zone 1 have max Theil-Sen slope (0.045), it should have a total of 593.3 (13,185 * 0.045). However, the total Theil-Sen slope in Zone 1 is around 28, meaning that pixels increasing from 0 to 1 occupy only a small percentage, which makes sense as areas that transform from pure rural (0) to pure urban (1) are limited in a developed country like U.S. In our perspective, the significance in Table 3 is not about the absolute value of "sum of Theil-Sen slope", but the comparison among different zones. After Mann-Kendall, as you may notice, the percentage of pixels with significant trend varies a lot in different zones (4.22% in Zone 1, nearly doubled from 2.34% in Zone 2). This statistic, however, only illustrates the coverage of significant pixels in different zones. It ignores the intensity of the increase. So we added the summation of Theil-Sen slope in order to capture the "intensity" of this increase. As we expected, Zone 1 have not only the highest percentage of significant pixels but also the highest intensity of this increase. In our revised manuscript, we illustrated that "As Table 3 suggests, 4.22% of the area in Zone 1 experienced a significant increase in human settlement, followed by 2.34% in Zone 2, 2.08% in Zone 3 and 1.65% in Zone 4. The statistics above suggest a noticeably positive relationship between the hurricane proneness of each zone and the percent area with a significant increase in settlement. The sum of Theil-Sen slope, on the other hand, established the relationship between the hurricane proneness and the increase rate of settlement in each zone. Zone 1 receives the most hurricane hits but has the strongest increase of settlement intensity, followed by Zone 2, Zone 3 and Zone 4." See Page 16, Line 9-14
Page 5 L. 13: "resampled to the 1 km pixel size". NTL are already at 1 km resolution.	DMSP NTL series has a resolution of 30 arc second, which transforms to around 1 km at the equator. However, the pixel size of raw DMSP data varies a lot, given different latitudes. In this study, we resampled both NTL and NDVI into 1 km grid using Lambert Azimuthal Equal-area projection.
Page 6 L. 20-21: categorization of hurricane-prone zones: what is the distribution of rho? You should consider (if not done yet) the frequency distribution of rho values to categorize zones.	Thanks for pointing out the categorization issue. We used Jenks optimization method (also called Jenks natural breaks classification method) to determine the arrangement of values into different class. The values in the sentence "Zone 4 (0-0.2), Zone 3 (0.2-0.5), Zone 2 (0.5-0.7) and Zone 1 (0.7-1.0)" are the rounded thresholds defined by Natural Jenks. We didn't include this information in the manuscript because we believe it is trivial compared to the entire workflow. Spearman's rho measures the strength of association between ranked variables. Since our density estimation is continuous, we believe Natural Jenks method is more valid in this case. We appreciate your understanding.
"L. 23-25: "Serving as the reference site in that study [Elvidge et al. 2009]". Elvidge et al 2009 considered Sicily as the reference site to perform	We sincerely apologize for the misuse of reference in our statement. Elvidge et al. (2009) did consider Sicily as reference site. In Hsu et al. (2015), they stated

intercalibration, not Los Angeles and the City of San Diego, as you stated in your manuscript."	that "Los Angeles was taken as the reference for the Radiance Calibrated products for two reasons. First, Los Angeles has long been a mature metropolis and the light change is negligible. Second, being a metropolis, it can provide samples with high DNs from the city center, as well as low DNs from the suburban area". We have revised this sentence as "Serving as the reference site (Fig. 3a), the geographic area of metropolitan Los Angeles and City of San Diego, CA maintains high conformity of NTL values throughout the 22-year period (Kyba et al., 2017; Hsu et al., 2015), which satisfies the "pseudo invariant" rule for calibration site selection (Elvidge et al., 2009)." See Page 7, Line 15-18
"L. 30: Why do you calibrate DN values if you employ NDVI values? Zhang et al 2013 use original DN values. Please justify this."	In the study of Zhang et al. (2013), he proposed the calculation of VANUI but he did not focus on forming a time series. Since our NDVI were derived from two different satellites, we think it is valid to perform a calibration for two NDVI products as it is reported that NDVI for AVHRR and MODIS are different in a minor way (Gallo et al., 2004).
"Page 7 L. 10: 30,000 samples – are 30,000 samples per year or 10,000 samples per year? Is this representative of the range of NDVI values within the study area? If I am correct, you examine 0.4% (if 30k in total) or 1.2% (if 30k per year) of pixel to intercalibrate NDVI values."	Sorry for the confusion this sentence might cause. It is 30,000 samples per year. We have modified the sentence as "Thirty thousand samples were collected within four hurricane-prone zones in years 2003, 2004 and 2005, respectively.". In terms of the representativeness, we believe a total of 90,000 should be enough for a simple linear calibration. The result of R^2 = 0.934 in the calibration of AVHRR and MODIS proves that the products of those two satellites are very similar. Many studies have compared and calibrated NDVI, but their sample sizes are mainly within thousands (Beck, et al., 2011) or tens of thousands (Gallo et al., 2004). See Page 8, Line 1-2
"Eq. 5: "k-1" should be "k=1". "j-k+1" should be "j=k+1""	"k-1" was modified to "k=1" and "j-k+1" was modified to "j=k+1" See Page 8, Equation 5
"Page 8 Eq. 6: "p-1" should be "p=1""	"p-1" was modified to "p=1" See Page 8, Equation 6
"L. 9: add the meaning of Z=0 in this sentence"	Thank you for pointing out the missing explanation of Z = 0. We have revised the sentence as "The Z value in Eq.7 represents the monotonic tendency of a time series. A positive Z indicates an increasing trend, while a negative Z indicates a decreasing one. A stable trend exists when the value of Z equals 0." See Page 9, Line 2-3
"L. 24: Fig 2a instead of Fig 1a"	"Fig 1a" was modified to "Fig 2a" See Page9, Line 18-19

"Page 9 L. 1-4: Hew Hampshire is missing. Please add it to the list."	We apologize for the missing New Hampshire in our list. This sentence has been revised as "The study area contains all U.S. states covered in the hurricane-prone zones (Fig. 2c): Maine, Massachusetts, New Jersey, New York, North Carolina, New Hampshire, Pennsylvania, Rhode Island, Tennessee, Texas, Maryland, Alabama, Arkansas, Connecticut, Delaware, DC, Florida, Georgia, Kentucky, Louisiana, Mississippi, South Carolina, Vermont, Virginia and West Virginia." See Page 9, Line 21-24
"Page 15 Caption of Fig 6: what does "and the like" mean here?"	We are sorry that the phrase "and the like" might cause confusion to our readers. The definition of "and the like" is more like the word "similarly". We do not think this phrase is a good fit in the sentence. We replaced "and the like" to "and so on" in this revised manuscript. See Page 16, Figure 6 caption.
"L. 6: I suggest to cite Fig 7 here"	Thanks for your suggestion. We cited Fig 7 in the sentence you pointed out. The sentence has been modified as "The Mann-Kendall trend test coupled with Theil-Sen slope estimator extracted the areas with significant change (increase or decrease) of human settlement in the 22-year period (Fig. 7)." See Page 16, Line 5-6
"Page 17 L. 1-3: how is this linked to the sum of slopes in table 3?"	The Theil-Sen slope in our study case is relatively small (normalized VANUI value ranges from 0-1 and the time period investigated covers a 22-year period). The sentence you pointed out aims to explain value range of Theil-Sen slope in our study, providing an example of what Theil-Sen slope measures and how it measures.
"Figure 7: You show in gray the urban area as derived from NLCD – does it show a yellow mann-kendall trend(i.e. insignificant)?"	Our investigated time period starts from 1992 and this NLCD product shows the urban area in year 1992. Our idea is to provide a "base map", showing the urban extent in the very first year. The red pixels in Fig 7 (b1) and (c1) show all the areas identified as "significant increasing" during the 22-year period (1992-2013). Yes, some urban areas in 1992 show significant increasing trend as their urbanization might further intensify (Theil-Sen slope statistics explore this intensification of urbanization).
"Page 18 L. 12: "The three two years": what does this mean?"	The sentence has been modified as "The last three years (2016-2018) have seen consecutive above-average damaging Atlantic hurricane seasons." See Page 19, Line 12-13
"References: Could you please list them in alphabetical order?"	Thanks for pointing out the issue. The references in the revised manuscript have been listed in alphabetical order.

Response to RC 3

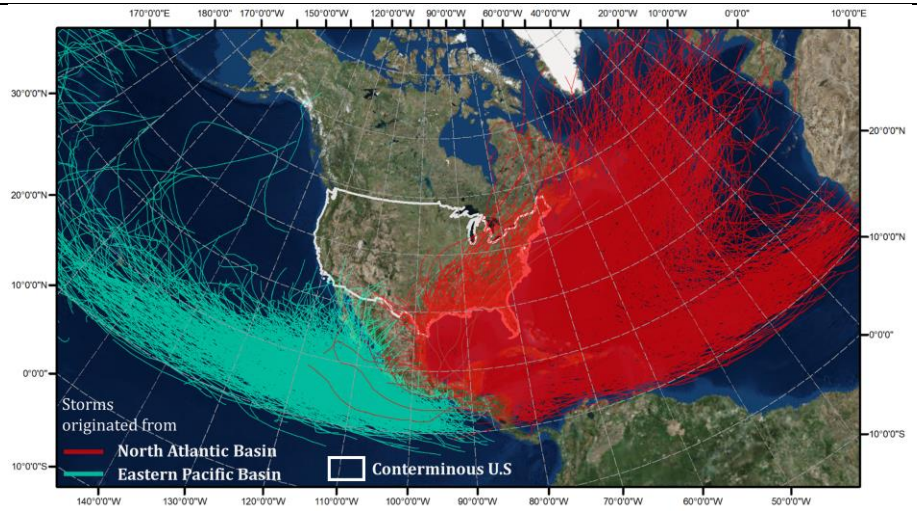
Dear third referee,

We would like to thank you for your comments and suggestions. In our open discussion, we provided point-by-point response to your concerns. In this letter, we reiterated important responses, summarized the conversations we had during the open discussion, and provided details about our revision.

Comments	Responses
"The goals of the study are not always declared clearly, and sometimes they are overstated. For example, in the last paragraph of the introduction (p.3, l. 14) the Authors state that the goal of the paper is "to monitor urbanization process and hurricane impact". First, NTL is only a proxy for (some features of) urbanization, and "monitoring urbanization process" goes far beyond what is presented in this paper. Second, "hurricane impact" can be ascribed to a variety of factors (storm duration, exposure, vulnerability, etc.) that are not accounted for either by NTL or the wind speed only. To sum up, the paper draws a comparison between i) an urbanization index based on NTL (and not directly between urbanization) and ii) the storm proneness, unless the link between VANUI and real urbanization (or, better, exposure to storms) is validated quantitatively."	Thanks for your comments on the general goal of this study. We apologize for the overstatement in the last paragraph of the Introduction section. In this revision, we modified this paragraph to make it more suitable "The goal of this paper is to illustrate the use of DMSP/OLS NTL data in 1992-2013 to monitor urbanization process and hurricane impacts on the U.S. Atlantic and Gulf coasts **using nighttime artificial lights as a proxy**. Hurricane-prone areas were first derived by calculating the track density from historical storm tracks in the North Atlantic Basin. An intercalibrated DMSP/OLS NTL time series was built in a yearly interval. Assisted with the NDVI data, the Vegetation Adjusted NTL Urban Index (VANUI) was used to characterize human settlement intensities in the study area. After that, a trend analysis was conducted to identify areas with a significant increase in human settlement intensity in different zones, in which the potential hurricane impacts were statistically evaluated. The spatiotemporal changes of human settlement **revealed from nighttime remote sensing in hurricane-prone zones** provide valuable information to evaluate the damage and to support decision making of urban development." In the conclusion, we stated "This study examined the spatiotemporal dynamics of **nighttime satellite-derived human settlement** in 1992-2013 in four zones at different levels of hurricane proneness on the U.S. Atlantic and Gulf Coasts." We believe our modified version is more suitable given the context of this study. We appreciate your suggestion on our Introduction section. See Page 3, Line 19-27 and Page 20, Line 9-10
"I have some doubts on the significance of the linkage between satellite-derived indexes such as VANUI and urbanization of an area. First, the use of NTL-derive indexes as a proxy of urbanization intensities and exposure to storms should be validated against urban maps and census data, at least for some significant regions/cities of the study area."	We totally understand your concerns regarding the satellite derived index and the exposure of storms. Please allow us to explain our insights on this one. Firstly, we believe the focus of our article is not to prove/validate the linkage between satellite-derived indexes and urbanization. Rather, this study applies well established satellite-derived urban index. To make our approach

	convincing, we did a detailed review on the application of satellites, especially nighttime satellite (DMSP/OLS series). We illustrated "Extensive attempts have been made to harvest the NTL observations from DMSP/OLS in applications including urban expansion and decay (Lu et al., 2018), settlement dynamics (Elvidge et al., 1999; Yu et al., 2014), socioeconomic development (Doll et al., 2000) and energy consumption (Chand et al., 2009)". Further, in the newly added section 2 "Intercalibration and desaturation of DMSP/OLS NTL series", we did another review on the applications of nighttime satellite – derived activity index: "A commonly used vegetation index, NDVI, is a useful indicator to reduce the saturation effect in DMSP/OLS data. Its practicality has been confirmed by many studies (Zhou et al., 2014; Liu et al., 2015). Lu et al. (2008) proposed a human settlement index (HSI) by merging normalized DMSP/OLS NTL data with the maximum NDVI in growing season derived from Moderate Resolution Imaging Spectroradiometer (MODIS). HSI has been proved rather efficient for settlement mapping in several testing sites in southeastern China. Zhang et al. (2013) develop a vegetation-adjusted NTL urban index (VANUI), which captures the inverse correlation between vegetation and luminosity. This simple index efficiently reveals the heterogeneity in regions with saturated DN values, which has been recognized by Shao and Liu (2014). Following the original design of NDVI that characterizes the inverse relationship between the near-infrared band and red band in vegetation, Zhang et al. (2015) designed a normalized difference urban index (NDUI) that characterizes the inverse relationship between vegetation and luminosity in a similar way. NDUI was evaluated in five testing sites in the U.S and proved to be effective in desaturating DN values in DMSP/OLS." We believe those aforementioned, widely recognized applications and the popularity of DMSP/OLS in long-term urban monitoring provide sufficient validity of our approach. As our study doesn't focus on proving the validity of satellite derived indices, we believe our approach has a great amount references as support for an application purpose. We sincerely appreciate your understanding. See Page 3, Line 11-14, and Page 4, Line 7-17
"Second, while it is evident that urbanization of rural areas produces an increased spatial extent of NTL, it is difficult for me to believe that a (moderate) decrease of population in an already urbanized area would reflect in a reduction of NTL. To put it simply, the streetlights are not kept off because some apartments become uninhabited, and the NTL differences linked to small population reductions are probably lower than uncertainties in the NTL data/calibration; buildings are rarely destroyed to restore cultivated fields.	Thanks for pointing out the decrease of NTL observed in our study. We well understand you concerns. In this response, we'd like to offer some evidence from other sources to back up the claim in our study. Firstly, we'd like to point out the existence of urban decay that has been stated in many studies: 1) "*Shrinking Cities in the United States of America*" by Pallagst (2009) 2) "*Viewing urban decay from the sky: a multi-scale analysis of residential vacancy in a shrinking U.S city*" by Deng and Ma (2015)

Rather, I see a very different resolution between 1992 and 2002 scenarios, which probably descends from the resolution of the NDVI. I think that substantial difference in the estimated extent of the urban area could descend from a sensibly different resolution of the processed data."	3) "*Shrinking Cities: Urban Challenges of Globalization*" by Martinez-Fernandez et al. (2012) 4) "*Ghost cities identification using multi-source remote sensing datasets: a case study in Yangtze River Delta*" by Zheng et al. (2017) 5) "*Ghost City Extraction and Rate Estimation in China Based on NPP-VIIRS Night-Time Light Data*" by Ge et al. (2018) Some of those studies above documented the reduce of artificial lights in cities and they believe the decreasing of light in cities is partly due to the migration pattern and the suburbanization process. Secondly, to statistically investigate pixels that have a decreasing trend, we utilized Mann-Kendall test at a significant level of 0.05. We believe that trend test with this level of significance reduces the impact of the uncertainties in the calibration process and is able to extract pixels with significant decrease of VANUI value. We acknowledge the difference of resolution between AVHRR (1 km) and MODIS (250 m). In this study, we resampled both of them to the same pixel size (1 km), carefully calibrated both of them in their 3 overlapping years using a total of 90,000 samples, and achieved an R^2 of 0.934. Based on the references that gave very promising NDVI calibration results between AVHRR and MODIS (Tucker et al., 2005; Fensholt et al., 2009), and our very high R^2, we believe we have built a stable enough NDVI time series to be fused with our nighttime series. However, we do recognize the different sensitivity of those two sensors and we believe it inevitably leads to some uncertainties in our VANUI series. In our manuscript, we claim this potential uncertainty as: "It could be noted that the VANUI maps in 2013 provide much finer details than those in 1992 and 2002. Given the unaltered spatial resolution of DMSP/OLS sensors, it can be explained by the different resolutions of the raw NDVI products from AVHRR (1km) and MODIS (250m). Although images have been resampled to the same pixel size (1km) and carefully calibrated in their time series, the intrinsic sensitivity of those two sensors still affects the VANUI outputs." See Page 14, Line 5-8
"The paper contains a huge number of abbreviations, which sensibly hinder the text readability particularly for not-familiar readers. I ask the Authors to limit the number of abbreviations to the minimum necessary (for example, NAB, CONUS, EPB, DN are of course not necessary."	We agree that a large number of abbreviations might hinder the readability of our manuscript. Following your suggestion, we replaced "CONUS" to "the conterminous U.S", "NAB" to "North Atlantic Basin", "EPB" to "Eastern Pacific Basin". In terms of DN, we decided to keep the short form so that it can be consistent with the notation in our calibration functions. The aforementioned abbreviations in the figures and captions have been replaced as well:

	 See Page 5, Figure 1
"The quality of the English should be significantly improved."	Thanks for pointing out the language issue. In our revision, we performed spelling/grammatical check for the entire document. The revised manuscript has been carefully proofread multiple times and refined by native English speakers.
"p.3, l. 6-9: applications of DMSP/OLS NTL data also encompass exposure to floods (Ceola et al., 2014, 2015)."	Thanks for providing this relevant reference. We added those two references to our Introduction section as "In comparison, satellite-derived nighttime light (NTL) data provides a unique and direct observation of human settlement via night lights (Ceola et al., 2014; Ceola et al., 2015)." See Page 3, Line 3-4
"p.3, l. 20: what is "disaster migration"? Furthermore, an analysis of storm proneness can undoubtedly provide valuable information to support urban planning. The spatiotemporal changes of human settlement is what we need to influence, not an input data to allow disaster mitigation."	We agree with your comment on disaster mitigation and we do not think disaster mitigation fits well in this context. This sentence has been revised as "The spatiotemporal changes of human settlement revealed from nighttime remote sensing in hurricane-prone zones provide valuable information to evaluate the damage and to support decision making of urban development." See Page 3, Line 25-27
"Section 2 should be merged with the following sections into a "Material and methods" section."	Thanks for your suggestion on the organization of Section 2. We agree that some information in Section 2 can be merged to Section 3. In this revised manuscript, we reorganized the structure by merging information regarding the DMSP/OLS dataset to Section 3. We changed the title of Section 2 to "Intercalibration and desaturation of DMSP/OLS NTL series". In this new Section 2, we mainly focus on illustrating the limitations of DMSP/OLS series, explaining why we need to perform intercalibration and desaturation, and presenting the methods we choose to adopt. We believe a stand-alone section benefits the readers' understanding of this problem. This stand-alone

	section also helps to keep "Methods" section more focused and concise. In addition, we expanded section 2 to provide a better background of some famous efforts in addressing intercalibration and saturation of DMSP/OLS data. The newly expanded section is attached: **2 Intercalibration and desaturation of DMSP/OLS NTL series** Due to the absence of on-board calibration and intercalibration, the annual DMSP/OLS NTL composites derived from multiple satellites in a span of 22 years were not comparable directly (Li and Zhou, 2017; Liu et al., 2012). This lack of continuity and comparability has posed great challenges in DMSP/OLS NTL based trend analysis (Tan, 2016). Elvidge et al. (2009) designed a three-step framework to intercalibrate the DMSP/OLS NTL composites. Those three steps are: 1) selecting a reference region; 2) selecting a reference satellite year; 3) performing a 2nd-order polynomial regression against the NTL reference data. This simple framework has been proven efficient in reducing discrepancies in digital number (DN) values of the DMSP/OLS NTL time series (Pandey et al., 2013) and has been adopted in many studies (Liu and Leung, 2015; Huang et al., 2016). Another notable limitation of DMSP/OLS NTL is the saturation of luminosity in the 6-bit (DN in a range of 0-63) imagery (Letu et al., 2010). Numerous attempts have been made to mitigate the saturation effect to retrieve the heterogeneity in areas with high intensity of human settlement. A commonly used vegetation index, NDVI, is a useful indicator to reduce the saturation effect in DMSP/OLS data. Its practicality has been confirmed by many studies (Zhou et al., 2014; Liu et al., 2015). Lu et al. (2008) proposed a human settlement index (HSI) by merging normalized DMSP/OLS NTL data with the maximum NDVI in growing season derived from Moderate Resolution Imaging Spectroradiometer (MODIS). HSI has been proved rather efficient for settlement mapping in several testing sites in southeastern China. Zhang et al. (2013) develop a vegetation-adjusted NTL urban index (VANUI), which captures the inverse correlation between vegetation and luminosity. This simple index efficiently reveals the heterogeneity in regions with saturated DN values, which has been recognized by other studies (Shao and Liu). Following the original design of NDVI that characterizes the inverse relationship between the near-infrared band and red band in vegetation, Zhang et al. (2015) designed a normalized difference urban index (NDUI) that characterizes the inverse relationship between vegetation and luminosity in a similar way. NDUI was evaluated in five testing sites in U.S and proved to be effective in desaturating DN values in DMSP/OLS. In this study, the intercalibration of DMSP/OLS data follows the method proposed by Elvidge et al. (2009) and the desaturation of DMSP/OLS data is achieved by using VANUI (Zhang et al., 2013). See Page 3, Line 28-32 and Page 4, Line 1-19
"p.5, l. 3: "were downloaded": : : and also used? Or not??"	We replaced word "downloaded" with word "used" in this revision See Page 4, Line 26-27
"of radius R"	We apologize that we didn't give enough information for the setting of circular neighborhood (R). In this case, R represents a **circular domain** and its radius (one of its attributes) defines the size of this domain. We adopted the idea from

	the tool in ArcGIS called "Line Density" which calculates a magnitude-per-unit area from polyline features that fall within a radius around each cell. Here, we adopted the default setting of radius of R in that function: "The default is the shortest of the width or height of the output extent in the output spatial reference, divided by 30". Per our calculation, the circular neighborhood R in our research area is 100 km. We added the setting of R in the revised manuscript as "The radius of R is set as 100 km in this study". We apologize for not specifying this parameter in the previous manuscript. See Page 7, Line 10
"p.19, l. 3: start a new paragraph after "the Atlantic Gulf coasts."	A new paragraph was started in this revision See Page 20, Line 3-7
"I note that, in a recent study by Viero et al. (2019), similar trends have been identified (and conclusions drawn) for a large coastal lowland in Italy, where population has been found to resettle in areas at high(er) risk of flooding. Interesting comparisons could be drawn."	Thanks for providing this reference. We acknowledge the close relationship between this reference and our study. In their article, they pointed out that anthropogenic landscape modifications can significantly affect flood hazard. We found this statement extremely helpful in backing up one of our statements. In this revision, we added this reference in the following context: "Additionally, intensification of human settlement always couples with anthropogenic environmental changes (deforestation, wetland destruction, etc.), potentially resulting in more severe impacts during hurricanes and floods (Viero et al., 2019)." See Page 19, Line 5-7
"In the bibliography, cited references should be ordered alphabetically. Please check all the bibliographic references throughout the text. For example, line 6 at page 2 should read "(Goldenberg et al., 2001)".	We apologize for the mistake of the intext citation you pointed out. We have checked all the references and the references in the revised manuscript have been listed in alphabetical order. See Page 2, Line 8
"ADDITIONAL REFERENCES"	All the additional references have been added per your suggestion. The references added in the revision include: 1. Ceola, S., Laio, F., & Montanari, A. (2014). Satellite nighttime lights reveal increasing human exposure to floods worldwide. Geophysical Research Letters, 41(20), 7184-7190. 2. Ceola, S., Laio, F., & Montanari, A. (2015). Human-impacted waters: New perspectives from global high-resolution monitoring. Water Resources Research, 51(9), 7064-7079. 3. Viero, D. P., Roder, G., Matticchio, B., Defina, A., & Tarolli, P. (2019). Floods, landscape modifications and population dynamics in anthropogenic

	coastal lowlands: The Polesine (northern Italy) case study. Science of The Total Environment, 651, 1435-1450.