Response to Comments of Referee #3

Sincere thanks are extended for the encouraging evaluation and thoughtful suggestions on the manuscript. The positive assessment of the value and potential usefulness of the proposed dataset is greatly appreciated. All comments have been carefully addressed, and the manuscript has been further revised to improve clarity and overall presentation. The revisions and clarifications in the manuscript are highlighted in **red**, and the responses are provided in **blue** below.

Comments:

This paper presents a valuable and well-constructed dataset that bridges DMSP-OLS and NPP-VIIRS observations to produce a long-term, monthly, and consistent nighttime light (NTL) product. The effort to reconstruct VIIRS-like monthly data from historical DMSP records is important, and I believe this dataset will be highly useful for a wide range of socioeconomic and urban studies. The manuscript is generally well written, and the results are promising. I have several minor suggestions that could further strengthen the paper:

Comment #1: The manuscript mentions the saturation and blooming effects in DMSP data. It would be helpful to provide quantitative evidence demonstrating how well saturation and blooming effects are mitigated compared to the raw DMSP data.

Response: Thank you for this helpful suggestion. In the revised manuscript, we have provided additional quantitative and qualitative evidence to demonstrate the mitigation of saturation and blooming effects from following aspects.

First, we supplemented a quantitative comparison between the original DMSP and simulated VIIRS data for 2012 in Fig. 8(d). The results show that the proposed model effectively remaps the original 0–63 DMSP DN values into a broader radiometric range, both compressing and expanding them. The reconstructed VIIRS-like data are therefore no longer constrained by DMSP's limited dynamic range, indicating effective mitigation of saturation effects. In addition, the statistics shown in the upper-left panel of Fig. 8 further support this result, with 16.42% of pixels with DMSP DN = 63 reassigned to simulated VIIRS-like values greater than 63, providing additional quantitative evidence that saturated pixels are released from the original upper limit constraint.

Second, to illustrate the reduction of blooming effects, we added visual comparisons in three representative regions at the top of Fig. 8. All examples are displayed within the same 0–63 range to ensure direct visual comparability with the original DMSP data. Under this consistent setting, the reconstructed NTL data exhibit clearer boundaries, reduced overglow, and enhanced spatial detail.

Third, in the spatial validation (Section 5.1), we included additional comparisons for two representative regions in Fig. 21 and revised the related descriptions of Figs. 19 and 20. Specifically, Figs. 19 and 20 present side-by-side comparisons of DMSP and reconstructed VIIRS-like data for Beijing and Shanghai across representative years and months, enabling direct visualization of seasonal and interannual variations. In Beijing, the reconstructed results exhibit clearer urban boundaries, reduced blooming, and more stable seasonal variation than the original DMSP data. In Shanghai, the reconstructed results not only reduce blooming effects but also alleviate saturation in highly illuminated urban cores, leading to a more differentiated representation of brightness gradients and urban expansion. Fig. 21 further provides temporal comparisons of total NTL intensity in these two cities. In regions strongly affected by blooming, such as Beijing, the reconstructed data

suppress anomalously inflated bright areas and produce a more stable temporal pattern. In regions more strongly affected by saturation, such as Shanghai, the reconstructed data better capture the continued growth of NTL, particularly after 2010. These additions provide more comprehensive evidence of the effectiveness of the proposed method in mitigating saturation and blooming.
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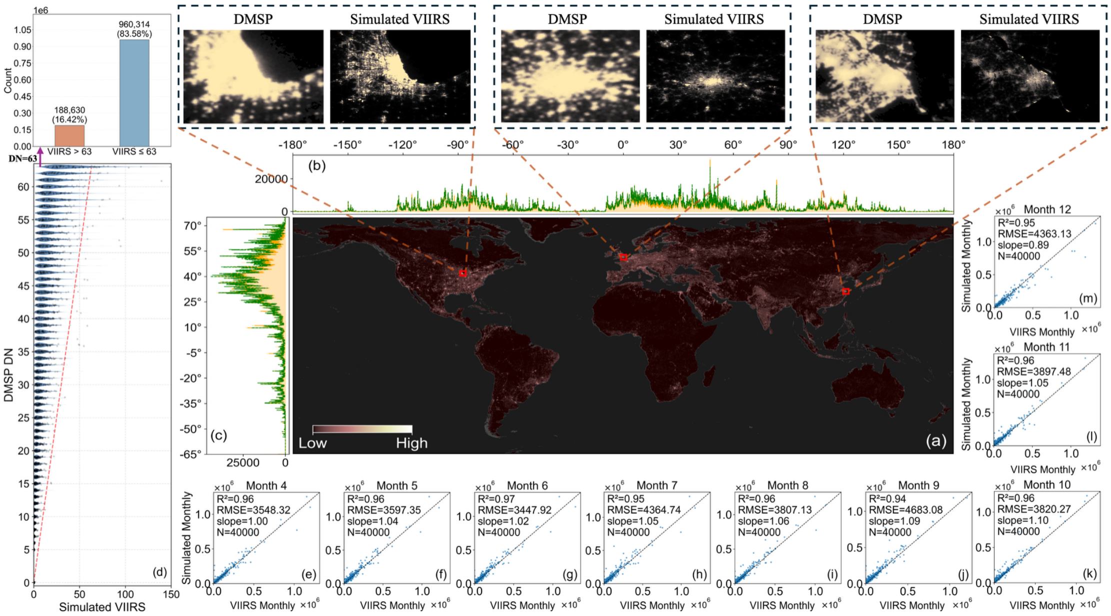

Figure 1. The simulated VIIRS-like data. **(a)** The generated global NTL intensity in 2012. **(b)** The longitudinal and **(c)** latitudinal sum of VIIRS NTL (orange) and Predicted VIIRS (green) with 1° bin (unit: nW cm^{-2} sr^{-1}). **(d)** Distribution of simulated VIIRS NTL across DMSP DN levels. **(e)** to **(m)** illustrate the city-level prediction errors of the total monthly VIIRS-like NTL from April to December 2012 at the global scale (unit: nW cm^{-2} sr^{-1})."

About Figs. 19 and 20:

"To characterize the long-term spatiotemporal evolution of NTL captured by the constructed dataset, reconstructed VIIRS-like NTL distributions for two representative developing megacities, Beijing and Shanghai, together with the corresponding DMSP observations, are presented for different months and key years during 1992–2012, as shown in Figs. 19 and 20. In both figures, representative years are arranged in columns and different months in rows, allowing the seasonal variability and interannual evolution of urban NTL to be directly visualized while enabling a side-by-side comparison between the original DMSP data and the reconstructed VIIRS-like results. In Beijing (Fig. 19), NTL data in the early years are mainly concentrated within the urban core, with limited spatial extent. Over time, both brightness intensity and illuminated coverage increase continuously and gradually expand toward peripheral areas, revealing clear signatures of urban expansion and functional spillover. Compared with the original DMSP observations, the reconstructed VIIRS-like results exhibit clearer boundaries, reduced blooming effects, and improved spatial separability. The spatial configuration remains relatively stable across months, indicating that seasonal variation is mainly reflected in brightness changes rather than in fundamental changes in spatial structure. In Shanghai (Fig. 20), the spatial pattern is characterized by stronger high-intensity aggregation, with a bright urban core already evident in the early years, followed by rapid outward expansion along major urban corridors and toward coastal areas in later years, resulting in progressively more continuous and compact NTL distributions. Compared with Beijing, Shanghai exhibits higher overall brightness levels and faster spatial expansion in most months, reflecting a more concentrated urban structure and stronger economic activity. The comparison with the original DMSP images further shows that the reconstructed VIIRS-like NTL not only suppresses blooming effects but also alleviates saturation in highly illuminated areas.

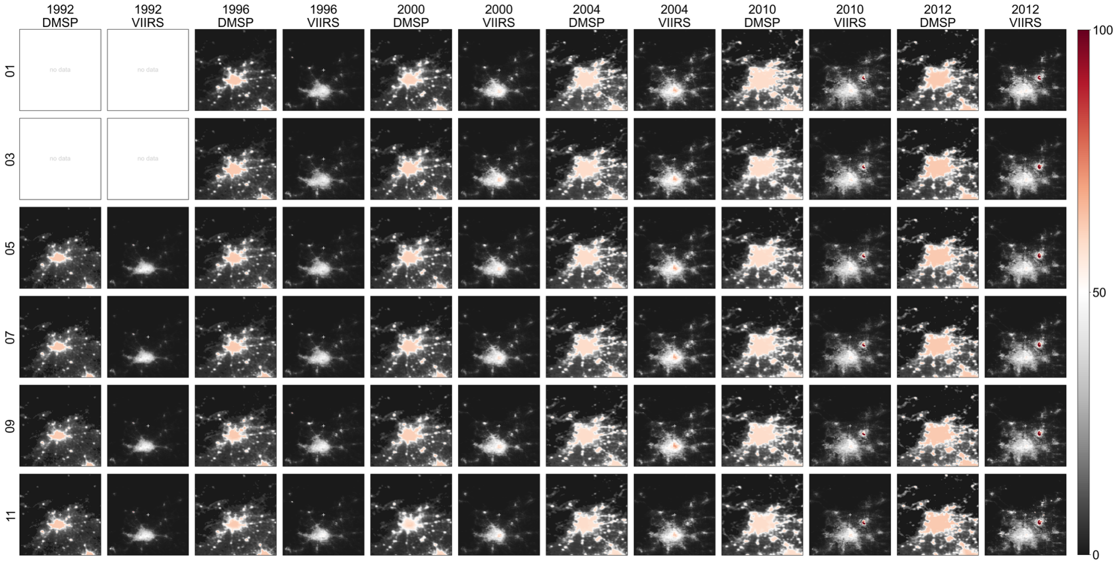

Figure 2. Seasonal and interannual spatial patterns of DMSP and reconstructed VIIRS-like NTL in Beijing from 1992 to 2012.

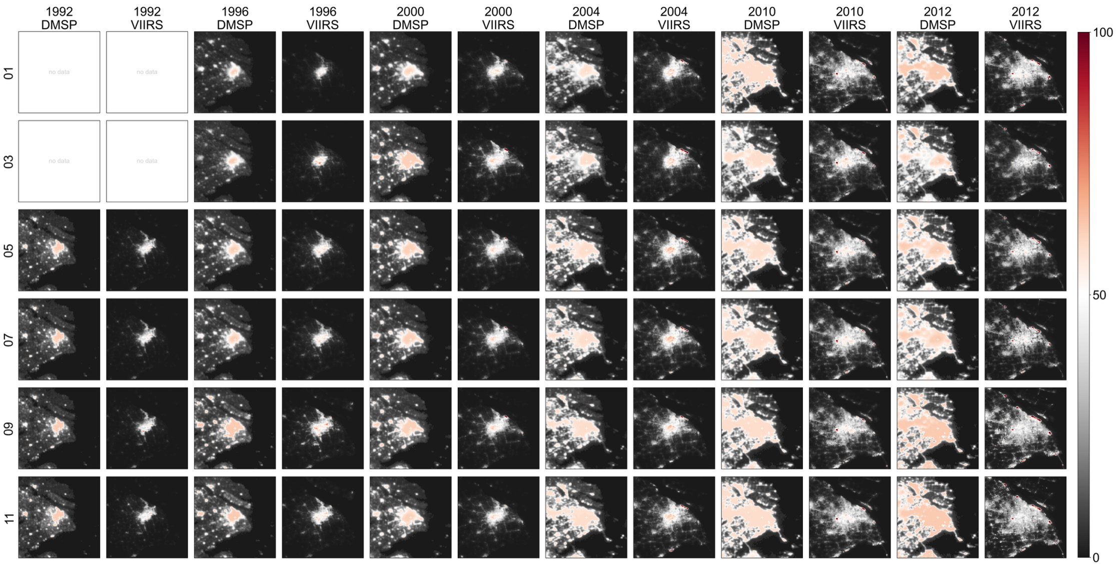

Figure 3. Seasonal and interannual spatial patterns of DMSP and reconstructed VIIRS-like NTL in Shanghai from 1992 to 2012."

About Fig. 21:

"A quantitative assessment of the seasonal and interannual dynamics of total NTL intensity was further conducted for Beijing and Shanghai, as shown in Fig. 21. The temporal profiles reveal clear and consistent intra-annual fluctuations in both cities, indicating that the reconstructed VIIRS-like data effectively preserve seasonal variability while also reflecting long-term interannual growth. In Beijing (Fig. 21(a)), the simulated VIIRS-like series exhibits a smoother temporal trajectory than the original DMSP totals, with reduced abnormal peaks and compressed excessively bright values, suggesting that blooming effects have been substantially mitigated. In Shanghai (Fig. 21(b)), the reconstructed MVNL series not only shows a similar improvement in suppressing blooming effects but also exhibits consistently higher total light values than the corresponding DMSP DN totals after 2010. This pattern suggests that the saturation limitation in the original DMSP observations has been effectively alleviated, enabling the reconstructed data to more accurately capture the ongoing increase in NTL intensity associated with rapid urban growth.

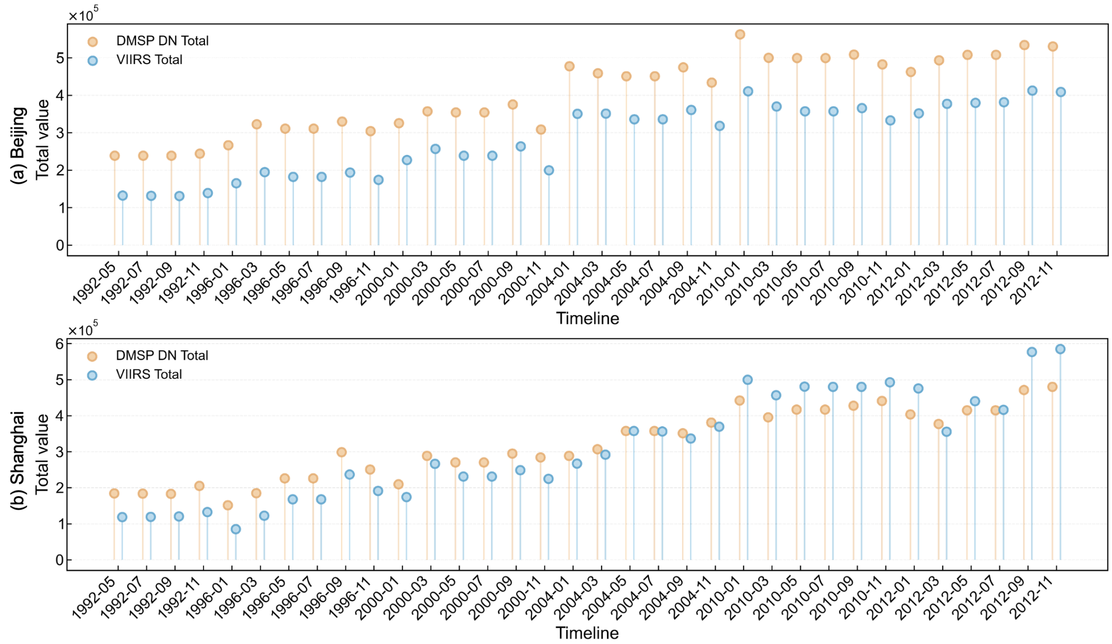

Figure 4. Seasonal and interannual NTL comparison from DMSP and simulated VIIRS in representative cities: **(a)** Beijing and **(b)** Shanghai."

Comment #2: Please ensure consistent use of the term "nighttime light (NTL)" throughout the manuscript (e.g., around Line 310).

Response: Thank you for this careful observation. In the revised manuscript, we have checked and standardized the terminology throughout the text to ensure consistent use of "nighttime light (NTL)". Relevant instances have been corrected accordingly.

Comment #3: The discussion of seasonal variation (e.g., Figures 19 and 20) is informative, but could be strengthened by including quantitative metrics to more clearly demonstrate how well seasonal dynamics are captured. In addition, a comparison with the seasonal patterns derived from monthly DMSP data would be valuable, as it could further highlight the improvements and added value of the proposed dataset.

Response: Thank you for this suggestion. In the revised manuscript, we further strengthened the analysis of seasonal variation in two aspects. **First**, we added quantitative temporal comparisons for two representative regions in Fig. 21. The results show that the reconstructed dataset preserves clear intra-annual fluctuation patterns while providing a more stable and coherent representation of seasonal variability than the original DMSP data. In Beijing, the comparison suggests that blooming effects are substantially reduced in the reconstructed series, as reflected by the suppression of anomalously inflated light totals and a more consistent seasonal pattern. In Shanghai, the reconstructed results not only reduce blooming but also alleviate saturation. Specifically, the simulated VIIRS-like light totals are consistently higher than the corresponding DMSP DN totals after 2010, suggesting that the original 0–63 DMSP range is insufficient to capture nighttime light dynamics in this rapidly developing, highly illuminated region. **Second**, we revised the descriptions of Figs. 19 and 20, and supplemented the comparison between the original DMSP observations and the reconstructed VIIRS-like results for Beijing and Shanghai across different months and representative years. These visual comparisons further highlight the improvements in seasonal continuity, boundary clarity, blooming suppression, and spatial detail. Together, these additions provide more comprehensive evidence that the proposed dataset offers a clearer and more temporally coherent representation of seasonal dynamics than the original monthly DMSP observations.

About Fig. 21:

"A quantitative assessment of the seasonal and interannual dynamics of total NTL intensity was further conducted for Beijing and Shanghai, as shown in Fig. 21. The temporal profiles reveal clear and consistent intra-annual fluctuations in both cities, indicating that the reconstructed VIIRS-like data effectively preserve seasonal variability while also reflecting long-term interannual growth. In Beijing (Fig. 21(a)), the simulated VIIRS-like series exhibits a smoother temporal trajectory than the original DMSP totals, with reduced abnormal peaks and compressed excessively bright values, suggesting that blooming effects have been substantially mitigated. In Shanghai (Fig. 21(b)), the reconstructed MVNL series not only shows a similar improvement in suppressing blooming effects but also exhibits consistently higher total light values than the corresponding DMSP DN totals after 2010. This pattern suggests that the saturation limitation in the original DMSP observations has been effectively alleviated, enabling the reconstructed data to more accurately capture the ongoing increase in NTL intensity associated with rapid urban growth.

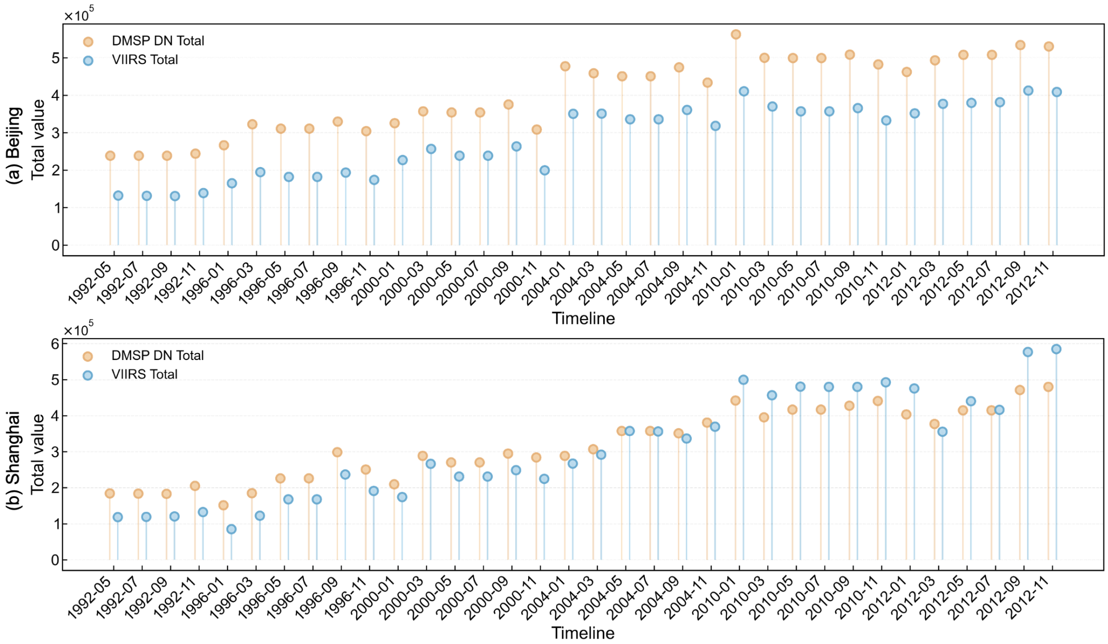

Figure 5. Seasonal and interannual NTL comparison from DMSP and simulated VIIRS in representative cities: **(a)** Beijing and **(b)** Shanghai.

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About Figs. 19 and 20:

"To characterize the long-term spatiotemporal evolution of NTL captured by the constructed dataset, reconstructed VIIRS-like NTL distributions for two representative developing megacities, Beijing and Shanghai, together with the corresponding DMSP observations, are presented for different months and key years during 1992–2012, as shown in Figs. 19 and 20. In both figures, representative years are arranged in columns and different months in rows, allowing the seasonal variability and interannual evolution of urban NTL to be directly visualized while enabling a side-by-side comparison between the original DMSP data and the reconstructed VIIRS-like results. In Beijing (Fig. 19), NTL data in the early years are mainly concentrated within the urban core, with limited spatial extent. Over time, both brightness intensity and illuminated coverage increase continuously and gradually expand toward peripheral areas, revealing clear signatures of urban expansion and functional spillover. Compared with the original DMSP observations, the reconstructed VIIRS-like results exhibit clearer boundaries, reduced blooming effects, and improved spatial separability. The spatial configuration remains relatively stable across months, indicating that seasonal variation is mainly reflected in brightness changes rather than in fundamental changes in spatial structure. In Shanghai (Fig. 20), the spatial pattern is characterized by stronger high-intensity aggregation, with a bright urban core already evident in the early years, followed by rapid outward expansion along major urban corridors and toward coastal areas in later years, resulting in progressively more continuous and compact NTL distributions. Compared with Beijing, Shanghai exhibits higher overall brightness levels and faster spatial expansion in most months, reflecting a more concentrated urban structure and stronger economic activity. The comparison with the original DMSP images further shows that the reconstructed VIIRS-like NTL not only suppresses blooming effects but also alleviates saturation in highly illuminated areas.

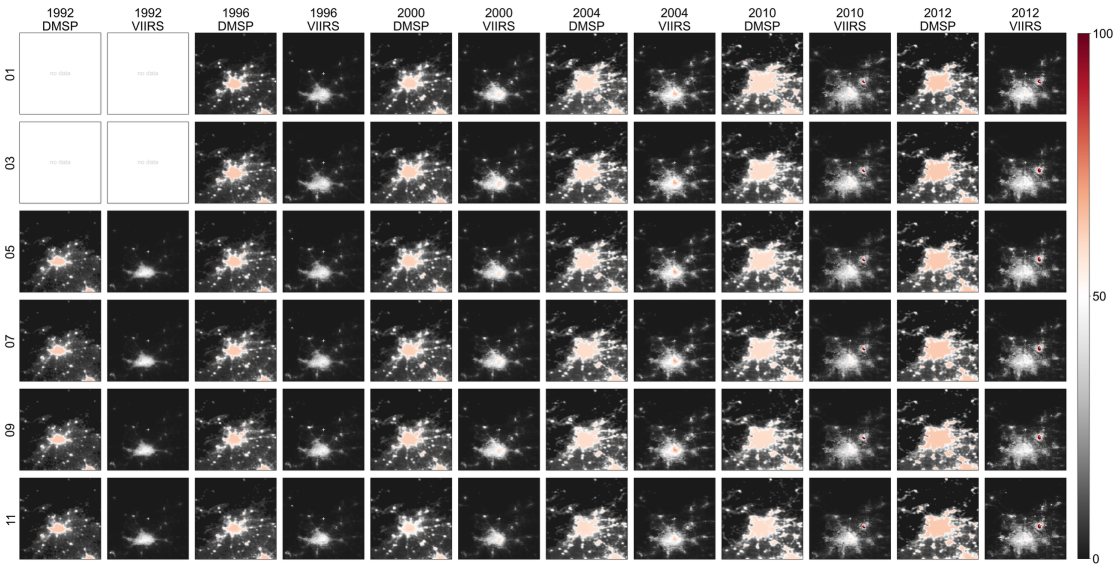

Figure 6. Seasonal and interannual spatial patterns of DMSP and reconstructed VIIRS-like NTL in Beijing from 1992 to 2012.

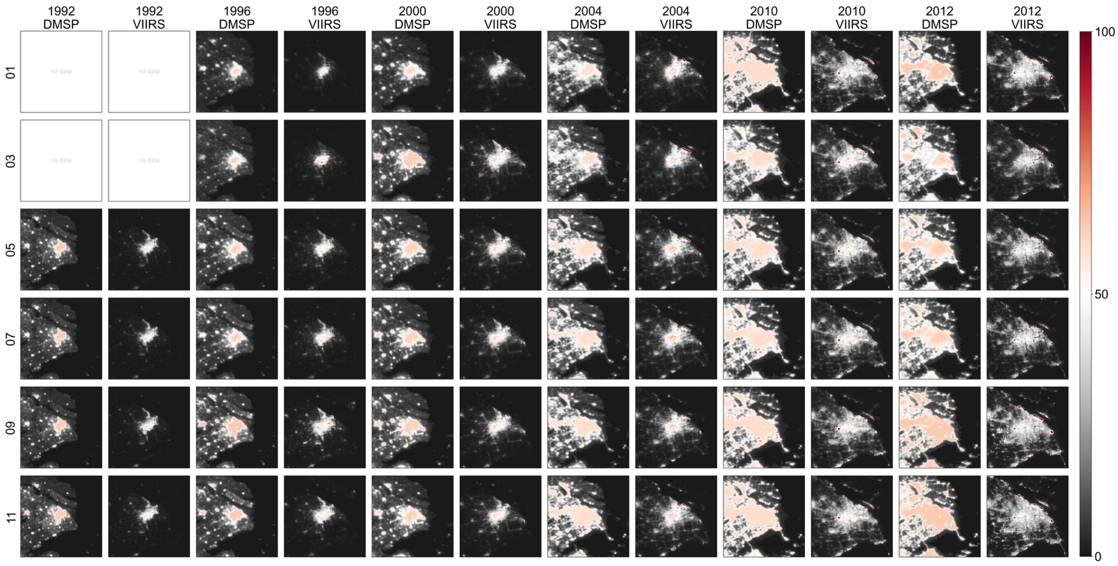

Figure 7. Seasonal and interannual spatial patterns of DMSP and reconstructed VIIRS-like NTL in Shanghai from 1992 to 2012."

Comment #4: The model is trained using data from 2013, while overlapping data are available for both 2012 and 2013. Please clarify why 2012 was not included. A comparison between models trained on different years (e.g., 2012 vs. 2013) could also help demonstrate the robustness of the approach.

Response: Thank you for this insightful comment. Although part of the overlapping period, 2012 was not used for model training because the EOG monthly VIIRS data began only in April 2012. As a result, the corresponding annual composite cannot adequately capture the full-year variation in nighttime light, which may introduce bias in cross-sensor model learning. In contrast, 2013 provides complete and consistent observations from both DMSP and NPP-VIIRS, making it more suitable for establishing the cross-sensor mapping.

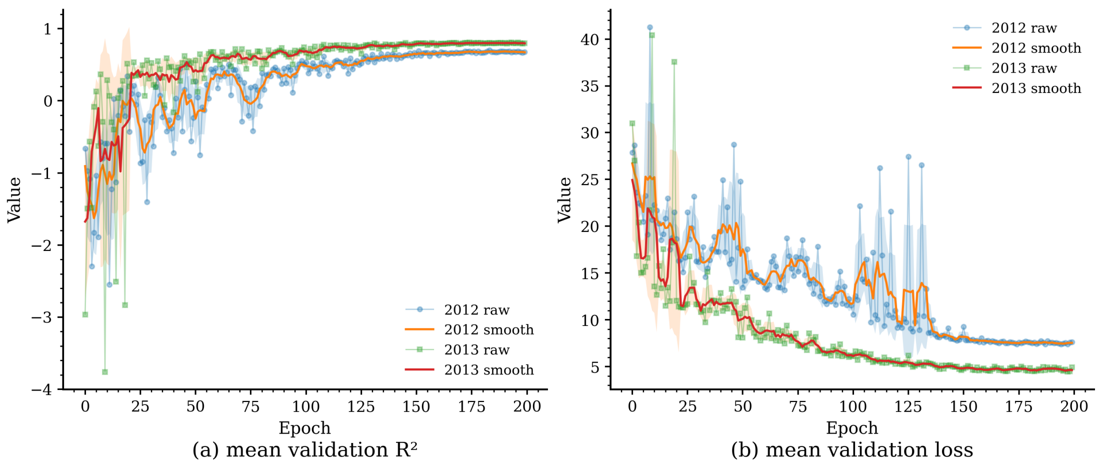

Figure A1. Performance of models trained using the data from 2012 and 2013, respectively.

To address this issue, we conducted additional comparative experiments by training the model using 2012 and 2013 data under the same settings. The quantitative results (Fig. A1) show that the model trained on 2012 data yields a lower validation R^2 of 0.7008, which is 10.70% lower than that obtained with 2013 data. In addition, the point-wise validation loss is consistently higher when 2012 is used as the training year. These results further support the rationale for selecting 2013 for model training. Considering the current length of the manuscript, we have not included the additional comparison figure in the revised paper. Instead, we have strengthened the discussion in the data selection section to explain why 2013 was chosen for model training rather than 2012.

Statement (on page 5, lines 163-166):

"Cross-sensor calibration in this study relied on NPP-VIIRS NTL observations from 2013, when both NPP-VIIRS and DMSP-OLS were in operation, and complete annual observations were available from both sensors. Although 2012 was also an overlapping year, the monthly NPP-VIIRS record began only in April, making its annual composite less representative of full-year NTL variation and therefore less suitable for model calibration."

Comment #5: The proposed network consists of three major functional modules; the overall architecture appears relatively complex. While the design is technically sound, it would be helpful to include, in Section 3.2, a discussion comparing the proposed model with simpler baseline networks (e.g., conventional CNN-based architectures). Such comparisons would help clarify the rationale for adopting the current design and its added value.

Response: Thanks for the comment. In the revised manuscript, we have added comparative experiments with several representative CNN-based baseline networks, including FCN, UNet, DeepLab v3+, and HRNet, better to demonstrate the rationale and effectiveness of the proposed architecture. The results show that the proposed NightNet achieves the best overall performance among the compared methods, with a PSNR of 52.42, an SSIM of 0.9930, and an R^2 of 0.8078. In particular, although some baseline models, such as DeepLab v3+, also achieve relatively strong performance, NightNet still yields substantial improvements, especially in R^2, indicating stronger consistency with the target VIIRS-like radiometric characteristics. From a model design perspective, these improvements are closely related to NightNet's dedicated functional modules. The multi-level deformable alignment and fusion module helps address spatial misalignment and heterogeneous feature inconsistency between DMSP and auxiliary data, the hierarchical contextual feature enhancement module strengthens the recovery of complex urban structures and illumination gradients, and the multi-task synergistic learning module introduces additional structural constraints to stabilize training and improve generalization. Therefore, the proposed architecture is not only empirically more effective but also more suitable for solving the key challenges of cross-sensor VIIRS-like NTL reconstruction.

In addition, the comparison also shows that the improved performance is not solely due to increased model complexity. For example, DeepLab v3+ has significantly higher model parameters (40.34M) than the proposed model (9.21M), yet yields lower reconstruction accuracy. This demonstrates that the proposed architecture achieves a better balance between model complexity and performance. These results quantitatively demonstrate the added value of the proposed multi-module design, and corresponding descriptions have been incorporated into Section 4.1 (pages 14 and 15, lines 464–474 in the revised manuscript).

Supplementary experiments:

"**Table 1.** Quantitative comparison of the proposed method with baseline networks

Method	Params. (M)	FLOPs (G)	PSNR	SSIM	R^2

FCN	1.18	1.10	46.89	0.9676	0.3817
UNet	0.79	51.49	46.37	0.9623	-
DeepLabv3+	40.34	17.26	50.44	0.9877	0.4878
HRNet	18.80	7.30	46.42	0.9620	-
NightNet	9.21	9.80	52.42	0.9930	0.8078

A comparison between NightNet and several widely used representative baseline networks, including FCN (Long et al., 2015), UNet (Ronneberger et al., 2015), DeepLabv3+ (Chen et al., 2018), and HRNet (Wang et al., 2021), was conducted to evaluate the effectiveness of the proposed architecture and clarify the rationale for its design. The quantitative results in terms of model complexity and reconstruction performance are presented in Table 1. As shown, our NightNet achieves the best overall performance, with the highest PSNR (52.42), SSIM (0.9930), and R^2 (0.8078), indicating superior reconstruction accuracy and structural consistency. Although some baseline models, such as DeepLab v3+, also show relatively strong performance, their results remain inferior to those of NightNet. Moreover, the DeepLab v3+ model has more model parameters (40.34M parameters) than NightNet (9.21M), yet yields lower reconstruction accuracy. The result indicates that NightNet can achieve better reconstruction performance with relatively lower model complexity and computation."