Single Image Haze Removal Using Dark Channel Prior

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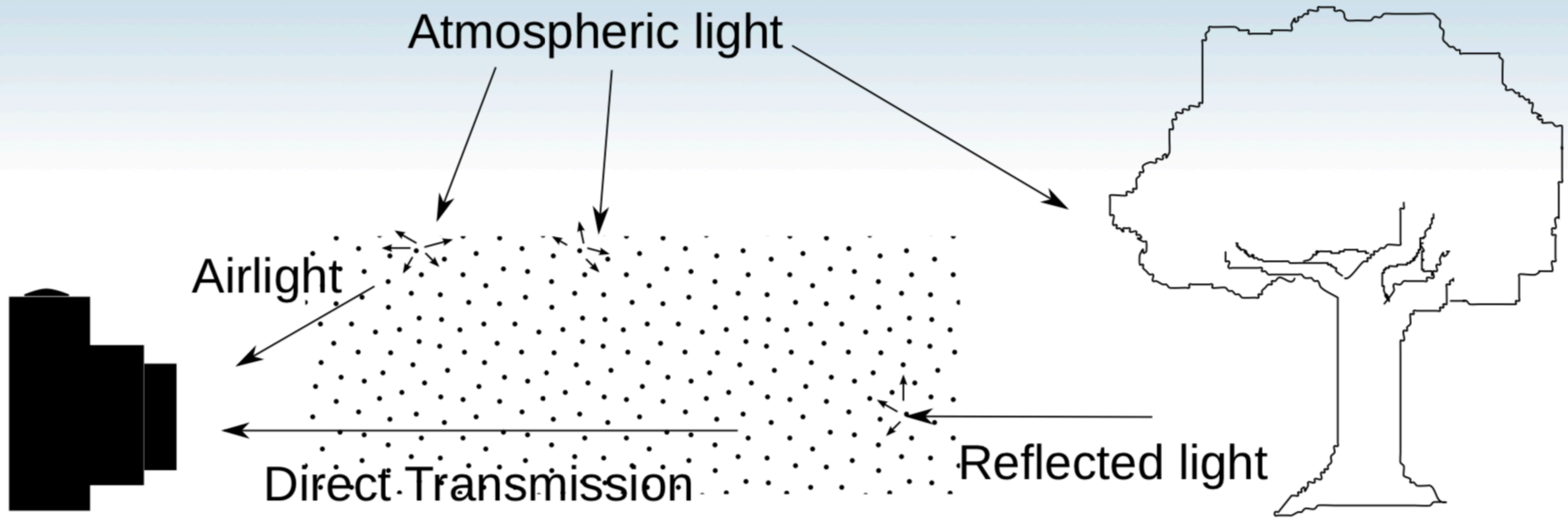
Imaging model



In haze/fog the image formation equation is given by

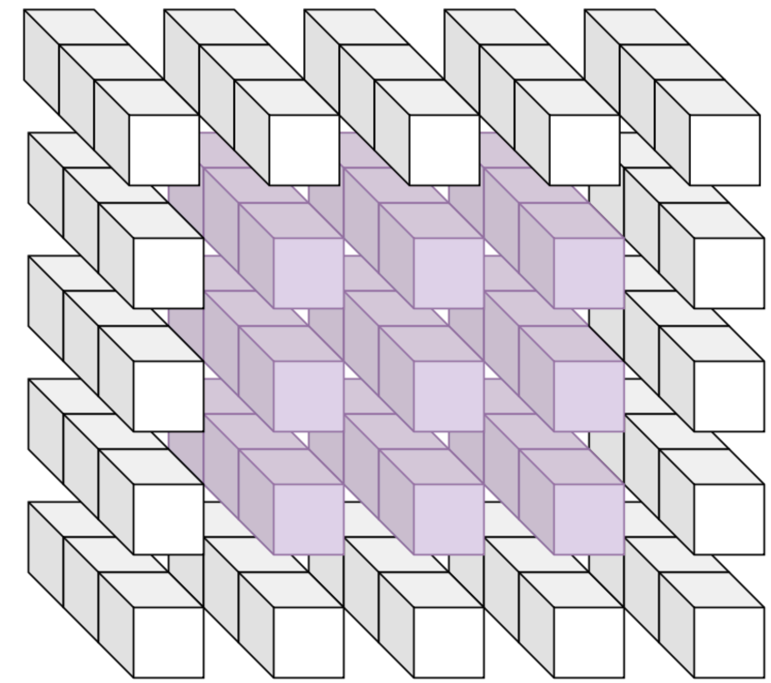
$$I(\mathbf{x}) = \underbrace{J(\mathbf{x})t(\mathbf{x})}_{\text{Direct transmission}} + \underbrace{(1 - t(\mathbf{x}))A}_{\text{Airlight}};$$

 http://san-santra.github.io/dehaze_ncvpripg15/slide_ncvpripg15.pdf

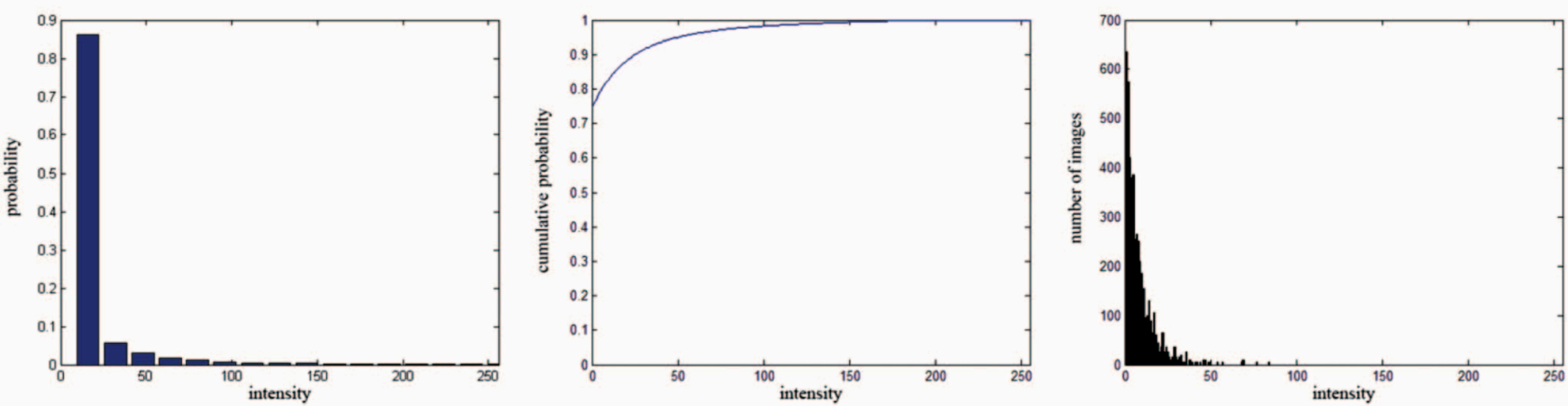
Dark Channel Prior

Dark Channel Prior

$$J^{dark}(\mathbf{x}) = \min_{\mathbf{y}\in\Omega(\mathbf{x}} \Big(\min_{c\in\{r,g,b\}} J^{c}(\mathbf{y})\Big)$$

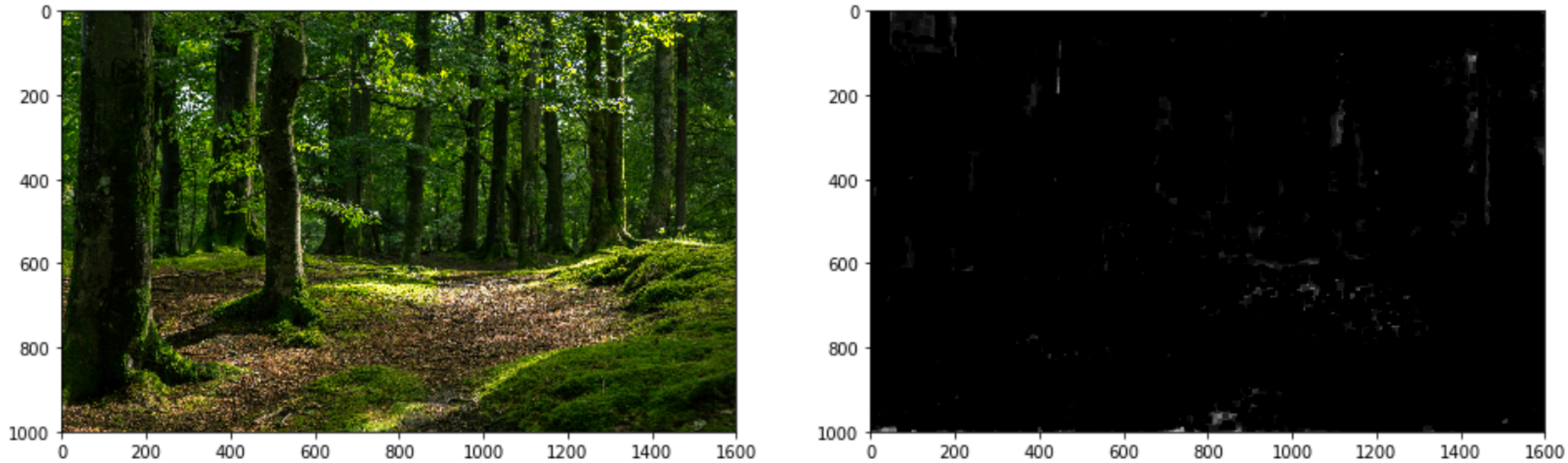


$$J^{dark} \rightarrow 0$$

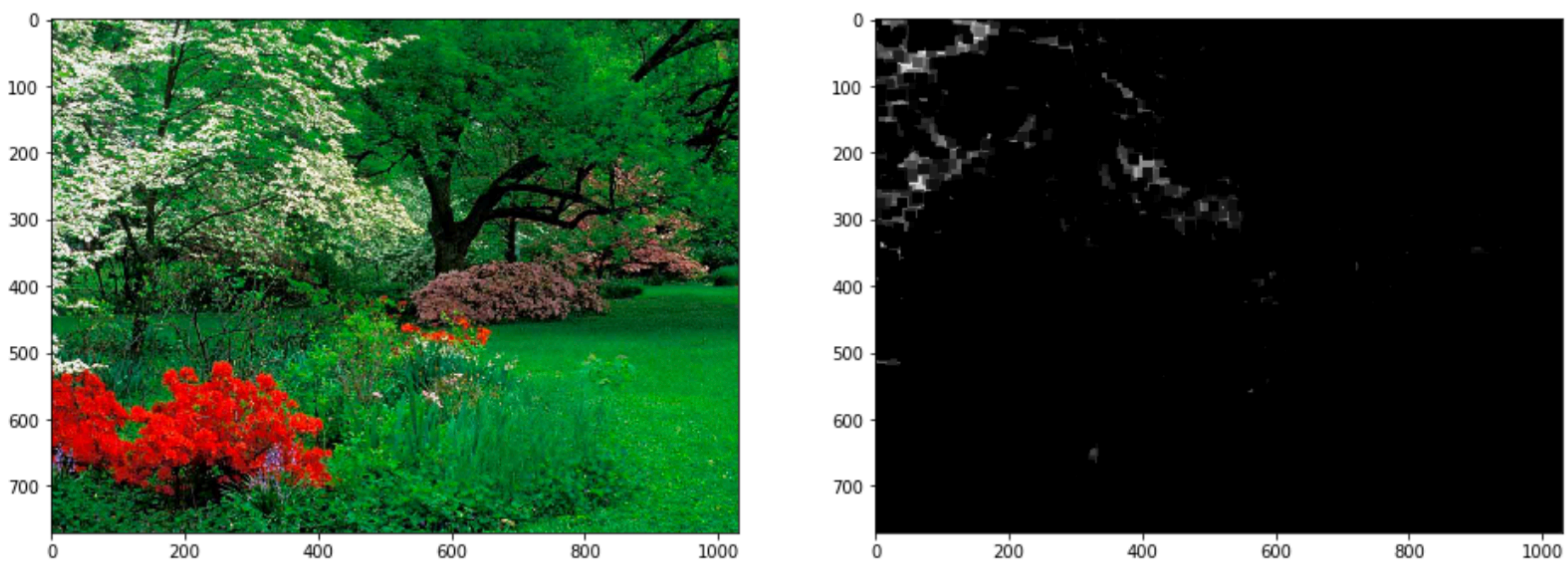


(a) (b) (c)

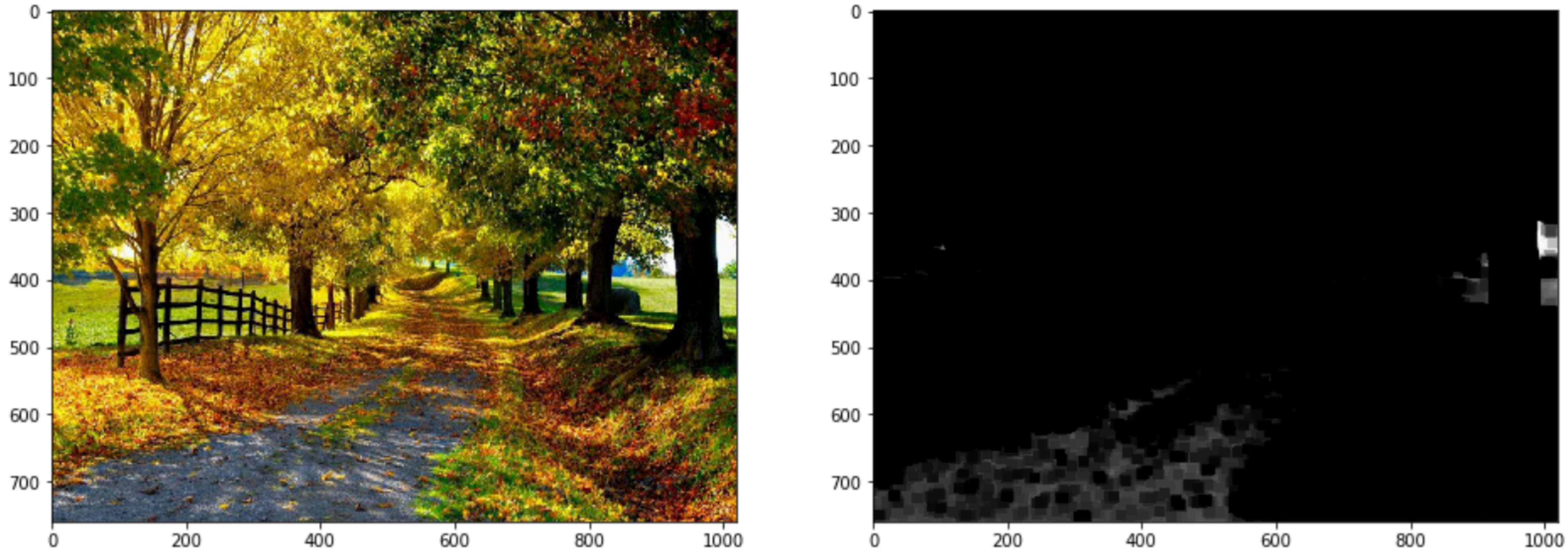
```
img0.dark_channel_visualize()
```



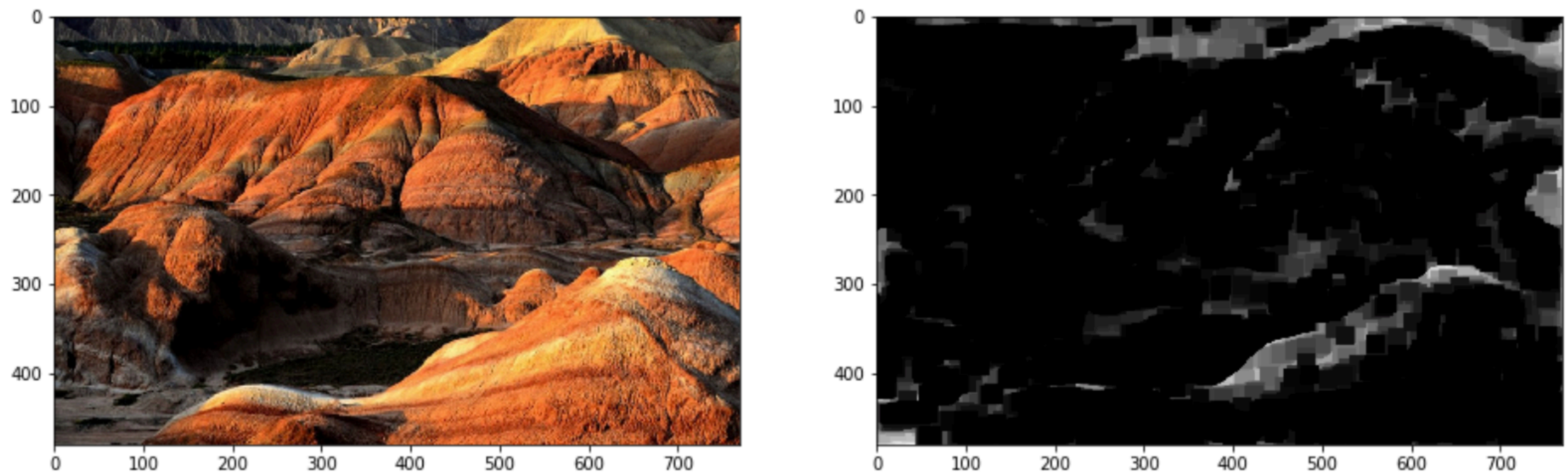

```
img1.dark_channel_visualize()
```



```
img2.dark_channel_visualize()
```

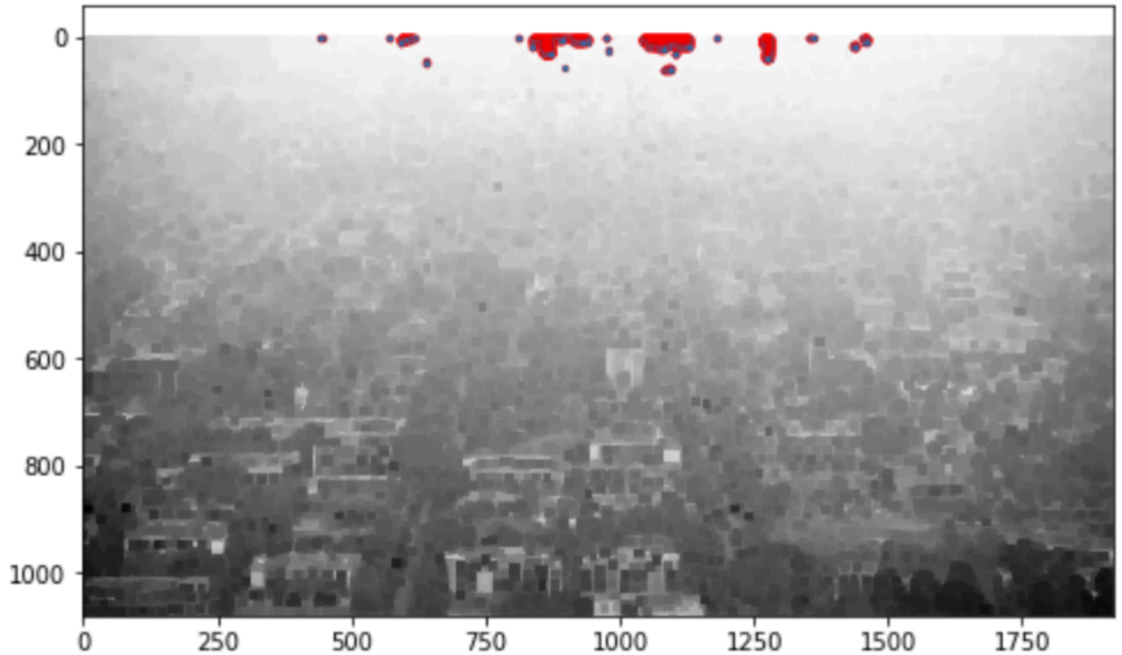


```
img3.dark_channel_visualize()
```

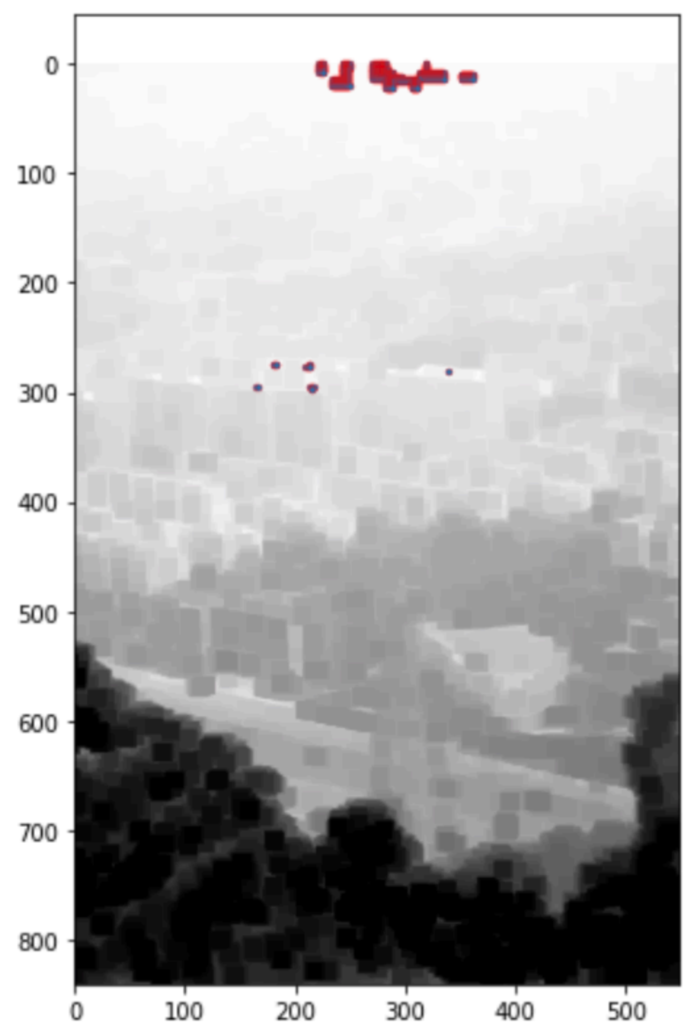


Atmospheric Light

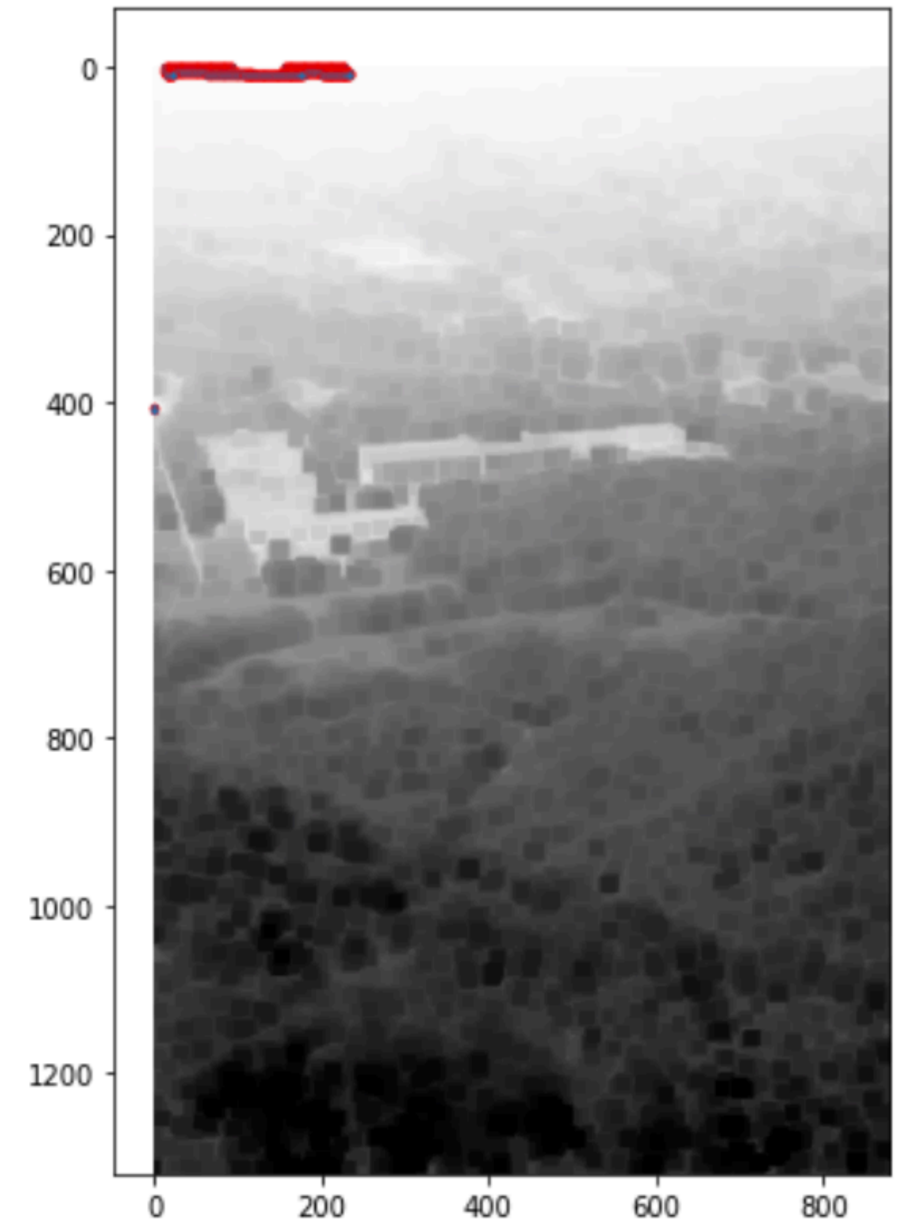
```
_ = img8.mark_top_k_percent_pixels()
```




```
_ = img9.mark_top_k_percent_pixels()
```




```
_ = img8.mark_top_k_percent_pixels()
```



Transmission

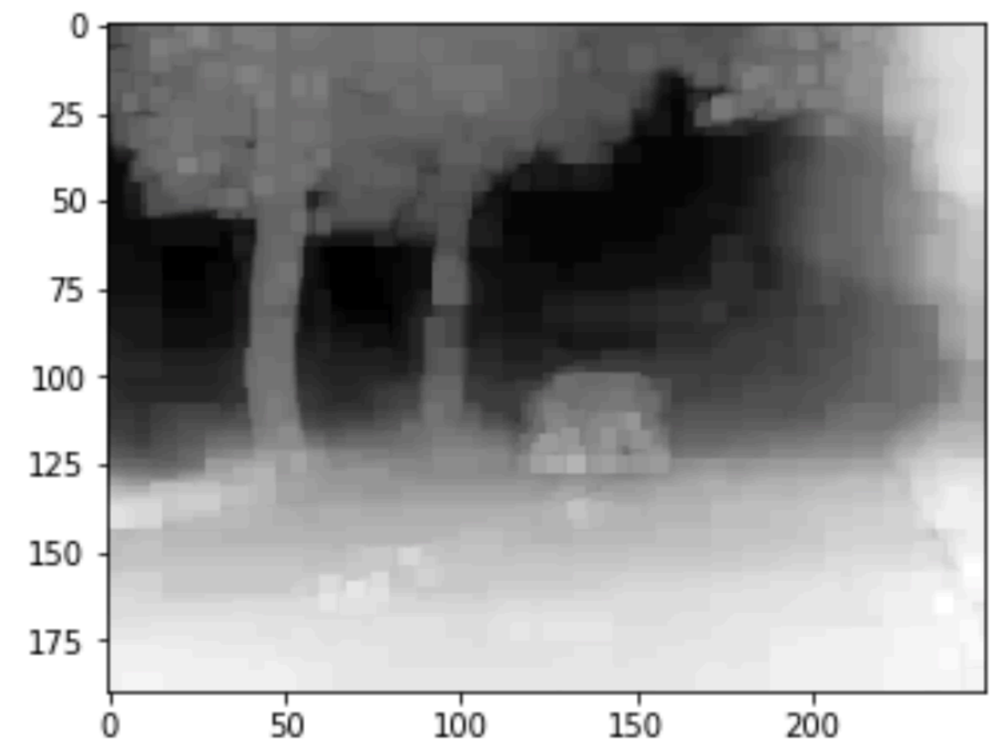
Transmission

$$\frac{I^c(\mathbf{x})}{A^c} = t(\mathbf{x})\frac{J^c(\mathbf{x})}{A^c} + 1 - t(\mathbf{x})$$

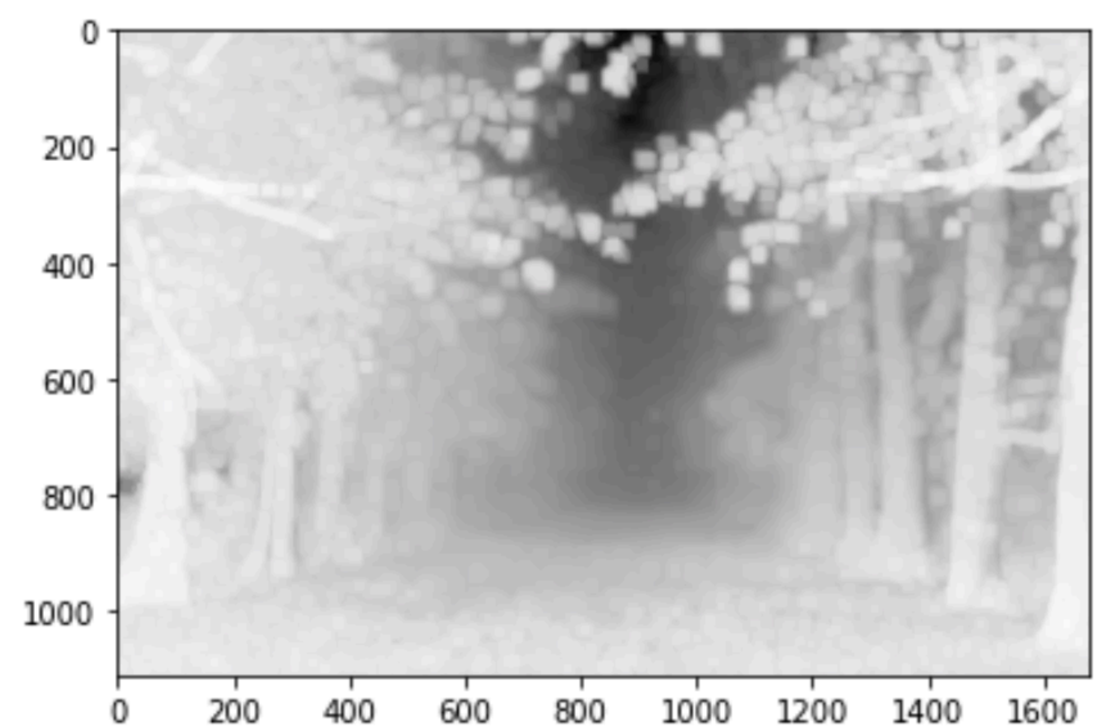
$$\min_{\mathbf{y}\in\Omega(\mathbf{x})}\Big(\min_{c\in\{r,g,b\}}\frac{I^c(\mathbf{y})}{A^c}\Big)\Big) = \widetilde{t}(\mathbf{x})\min_{\mathbf{y}\in\Omega(\mathbf{x})}\Big(\min_{c\in\{r,g,b\}}\frac{J^c(\mathbf{y})}{A^c}\Big)\Big) + 1 - \widetilde{t}(\mathbf{x})$$

$$\widetilde{t}(\mathbf{x}) = 1 - \omega\min_{\mathbf{y}\in\Omega(\mathbf{x})}\Big(\min_{c\in\{r,g,b\}}\frac{I^c(\mathbf{y})}{A^c}\Big)\Big)$$

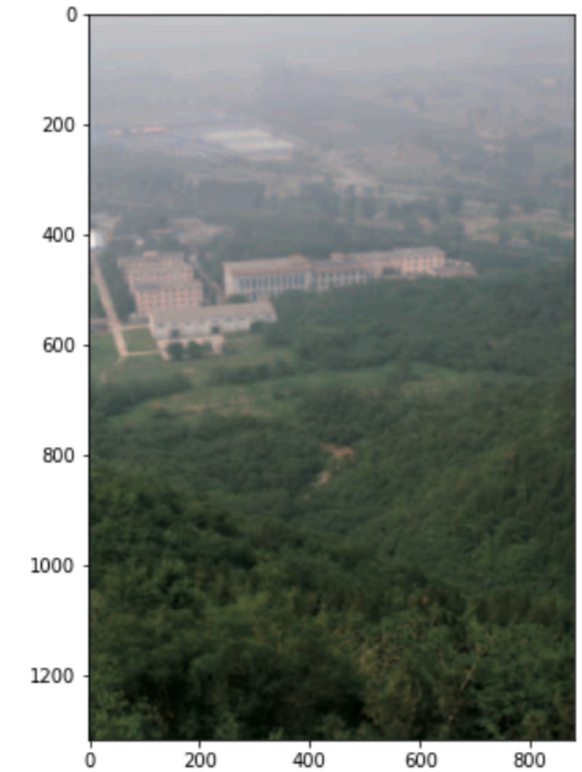
```
img6.show_trans_map()
```



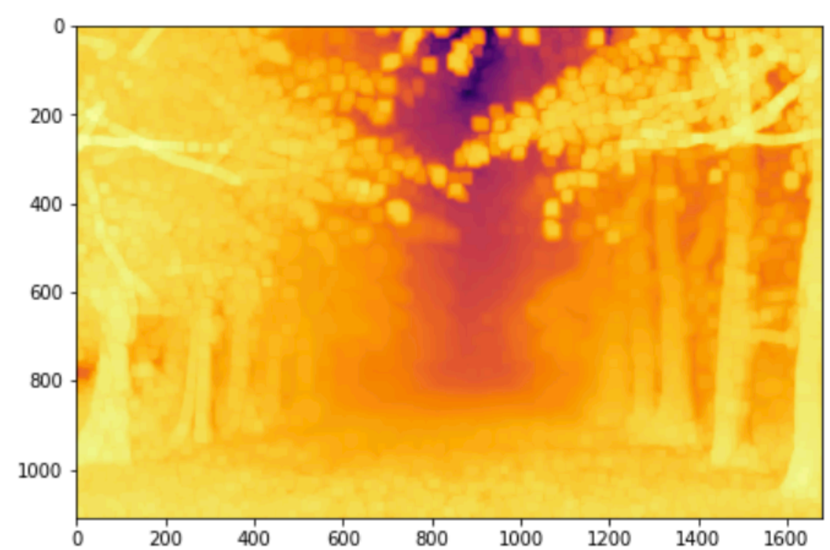

```
img7.show_trans_map()
```

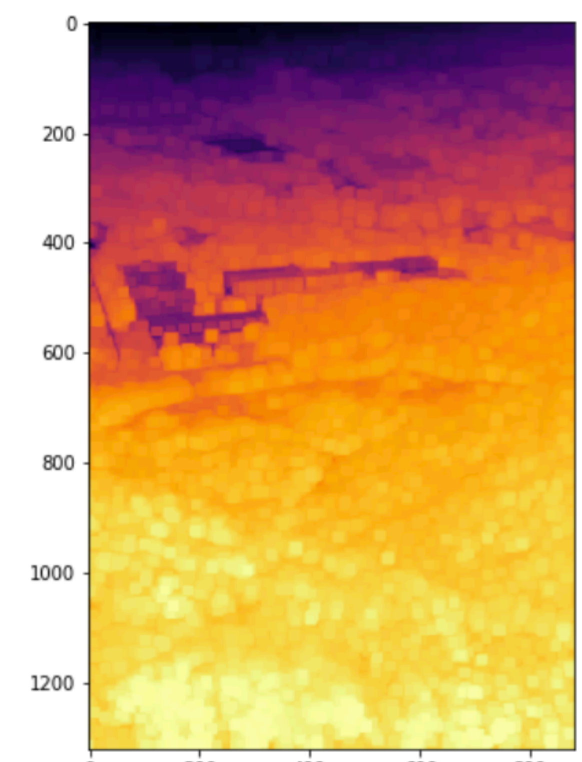


Transmission + depth map

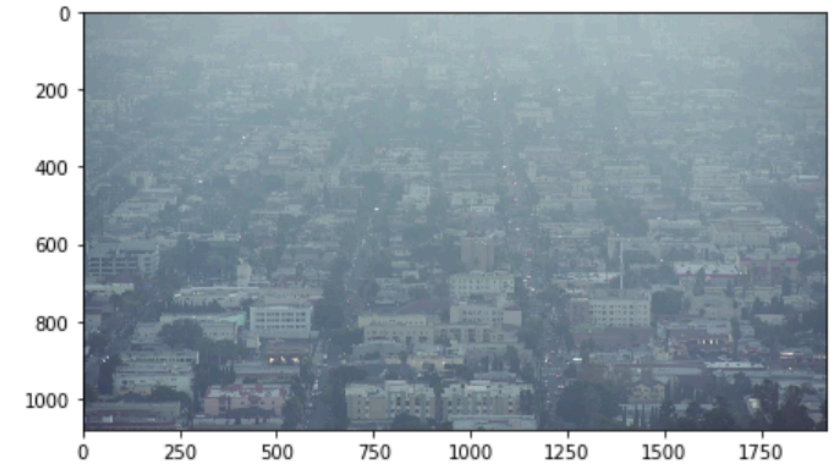


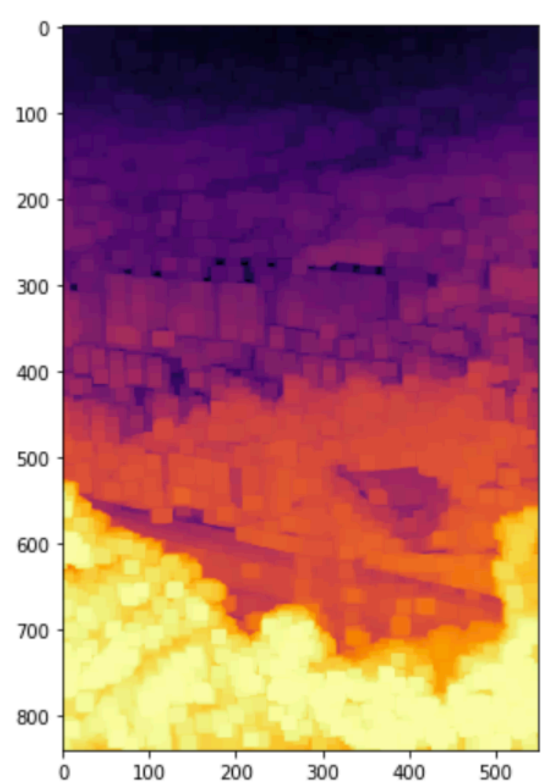
$$t(\mathbf{x}) = e^{-\beta d(\mathbf{x})}$$

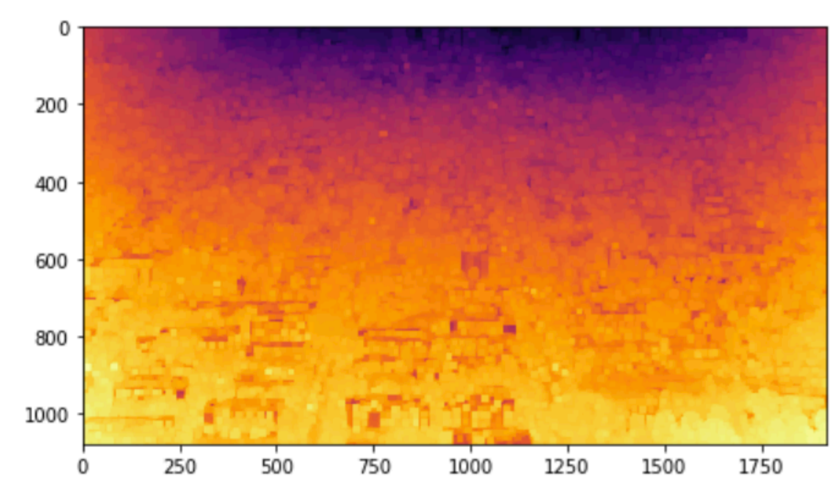




Transmission + depth map





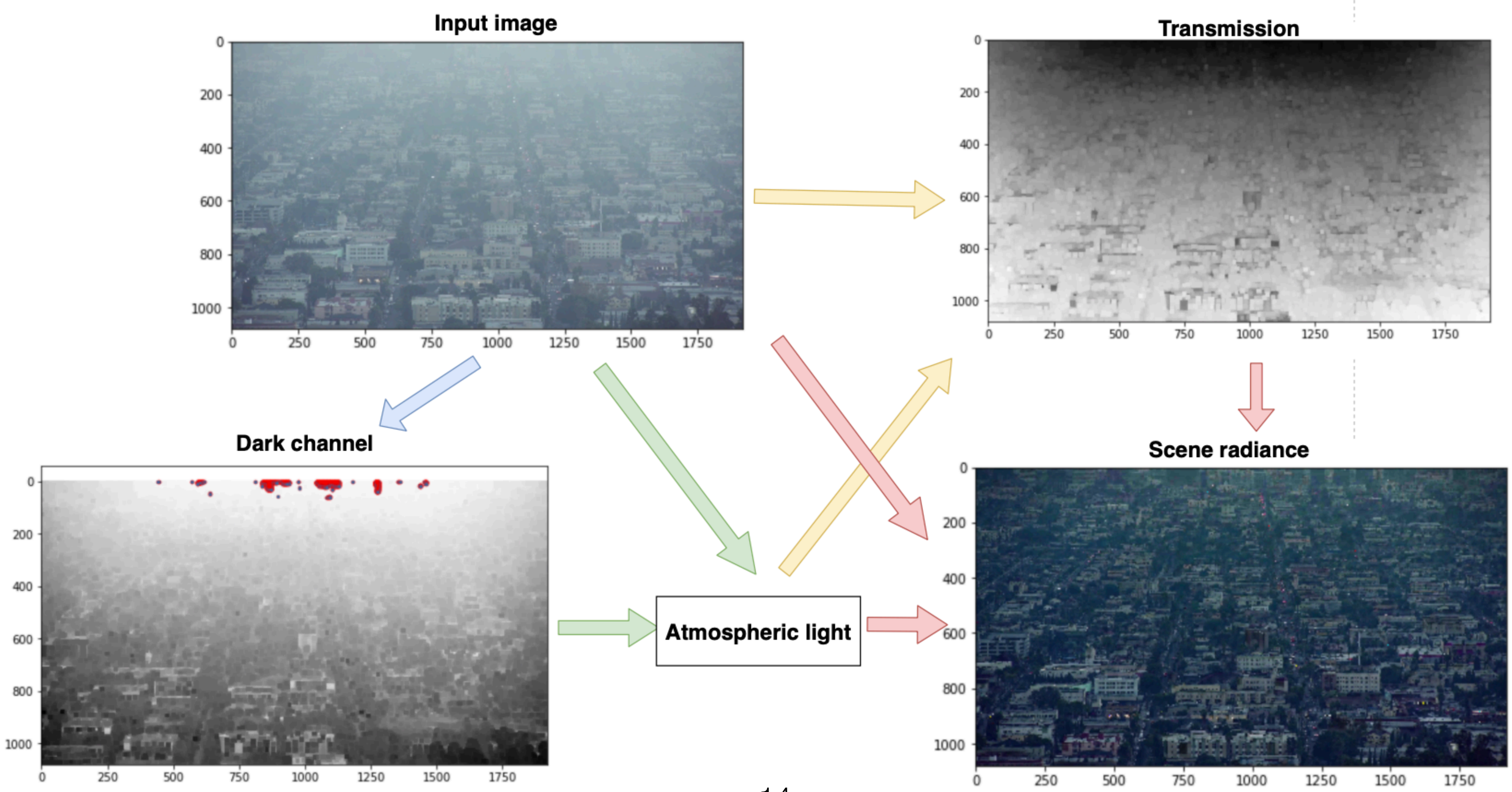


Recovering the scene radiance

Recovering the scene radiance

$$\mathbf{I}(\mathbf{x}) = t(\mathbf{x})\mathbf{J}(\mathbf{x}) + (1 - t(\mathbf{x}))\mathbf{A}$$

$$J^c(\mathbf{x}) = \frac{I^c(\mathbf{x}) - A^c}{\max(t_0, t(\mathbf{x}))} + A^c, \;\; c \in \{r, g, b\}$$



Results