

Supplementary Text

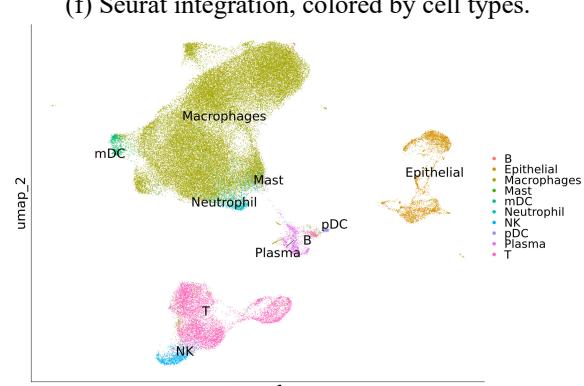
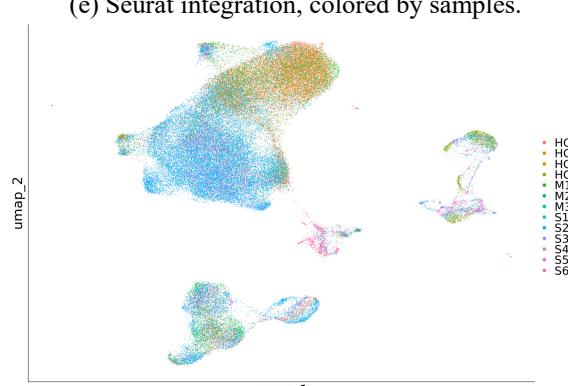
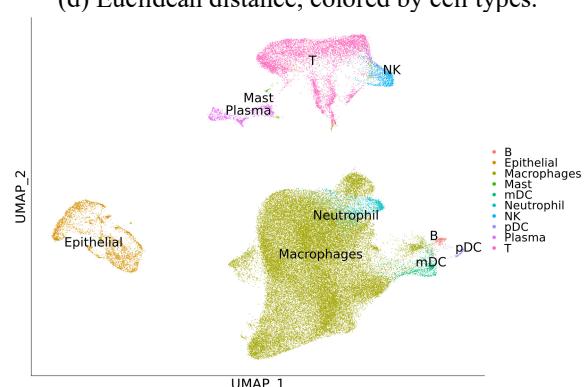
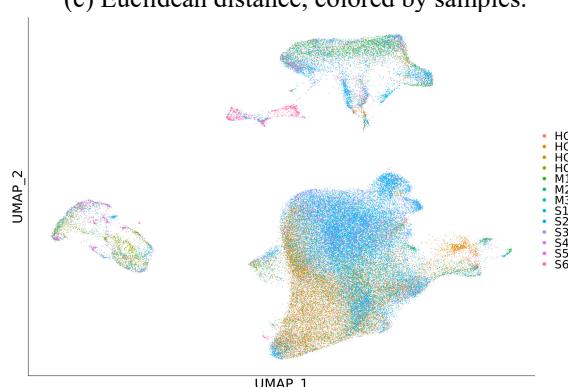
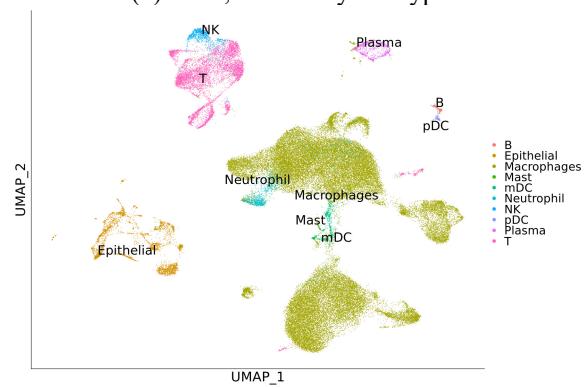
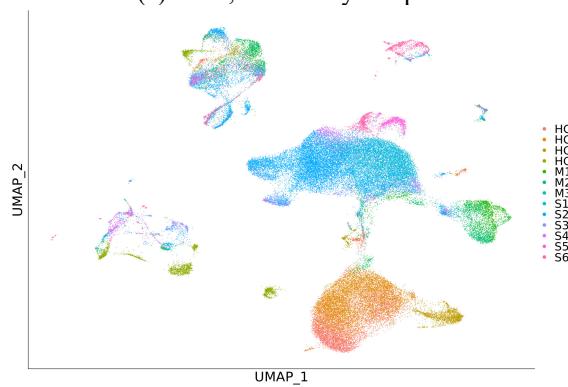
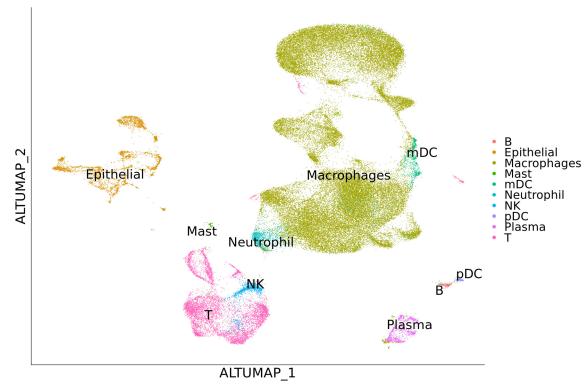
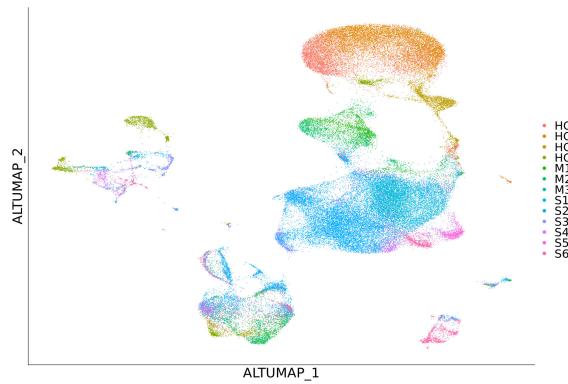
Results on COVID-19 immune compartment dataset

We compare the result of BCD and the other three methods in Supplementary Figure 1. As discussed in the main text, only BCD delineates the gradual changes in macrophages among health controls, moderate cases and severe cases (Supplementary Figure 1a and 1b). For Euclidean distance, a large group of macrophages in moderate cases show a strong batch effect and are out of the main macrophage cluster (Supplementary Figure 1c and 1d). Seurat integration and Harmony are able to such batch effect, and each yields a unified cluster for macrophages (Supplementary Figure 1f and 1h). However, they both mix the moderate cases with the health controls, blurring the trajectory of immune cells across the progression of the disease (Supplementary Figure 1e and 1g). Similar phenomena can also be observed in other cell types.

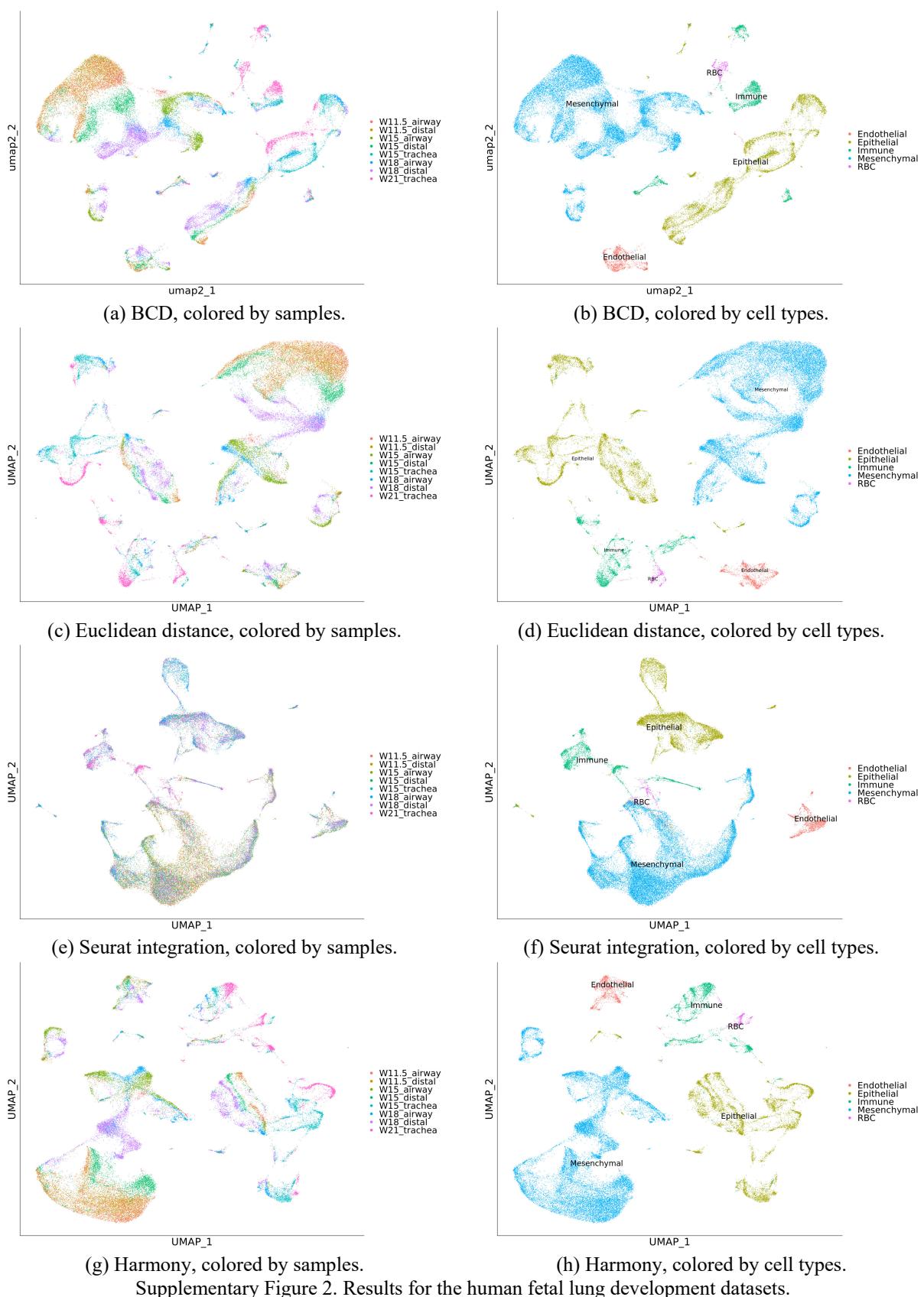
Results on human fetal lung development dataset

We compare the result of BCD and the other three methods in Supplementary Figure 2. As discussed in the main text, BCD delineates the gradual changes in macrophages along time and tissue location (Supplementary Figure 2a and 2b). For Euclidean distance, the batch effect overcomes the similarity of cells. As a result, the mesenchymal cells from small airways and distal lung are separated into two clusters (Supplementary Figure 2c and 2d). Seurat integration removes the batch effect but creates an admixture of all time points and all locations, blurring the trajectory of development (Supplementary Figure 2e and 2f). In this particular case, Harmony also fails to remove such batch effect (Supplementary Figure 2g and 2h). Similar phenomena can also be observed in other cell types.

Figures with detailed cell types do not fit on letter-sized paper. They are included in the supplementary files.



Supplementary Figure 1: Results for the COVID-19 immune compartment datasets.



Supplementary Figure 2. Results for the human fetal lung development datasets.