

CytoAtlas: Pan-Disease Single-Cell Cytokine Activity Atlas

Data Sources

~29M cells + ~31K bulk samples

Single-Cell

CIMA **6.5M cells**

421 donors, healthy population

Inflammation Atlas **6.3M cells**

main/val/ext, 20 diseases

scAtlas **6.4M cells**

Normal + Cancer, multi-organ

parse_10M **9.7M cells**

12 donors \times 90 cytokines (+PBS)

Bulk RNA-seq

GTEx **19.8K samples**

~50 normal tissues, TPM

TCGA **11.1K samples**

33 cancer types, RSEM

Activity Inference

Ridge regression → GPU-accelerated

3 Signature Matrices

CytoSig **43 cytokines**

LinCytoSig **178 cell-type specific**

SecAct **1,170 secreted proteins**

Pipeline

1. Pseudobulk aggregation
(donor, donor \times celltype)
2. Gene expression matrix
(genes \times samples)
3. Ridge regression
(signature \times samples \rightarrow activity)
4. Cross-sample correlation
(predicted vs observed)

Validation

6 datasets \times 3 signatures

7 Validation Analyses

Overall Performance **\$4.1**

Spearman ρ across all targets

Per-Tissue Stratified **\$4.2**

GTEx tissues / TCGA cancer types

Cross-Dataset Comparison **\$4.3**

CytoSig vs SecAct across 6 datasets

Best/Worst Targets **\$4.4**

Top and bottom correlated targets

Cross-Dataset Consistency **\$4.5**

Same targets across datasets

Aggregation Levels **\$4.6**

Donor \rightarrow celltype \rightarrow single-cell

Bulk RNA-seq Validation **\$4.7**

GTEx + TCGA concordance