

ヒートアイランドの数値モデル の開発

平成18年 1月7日

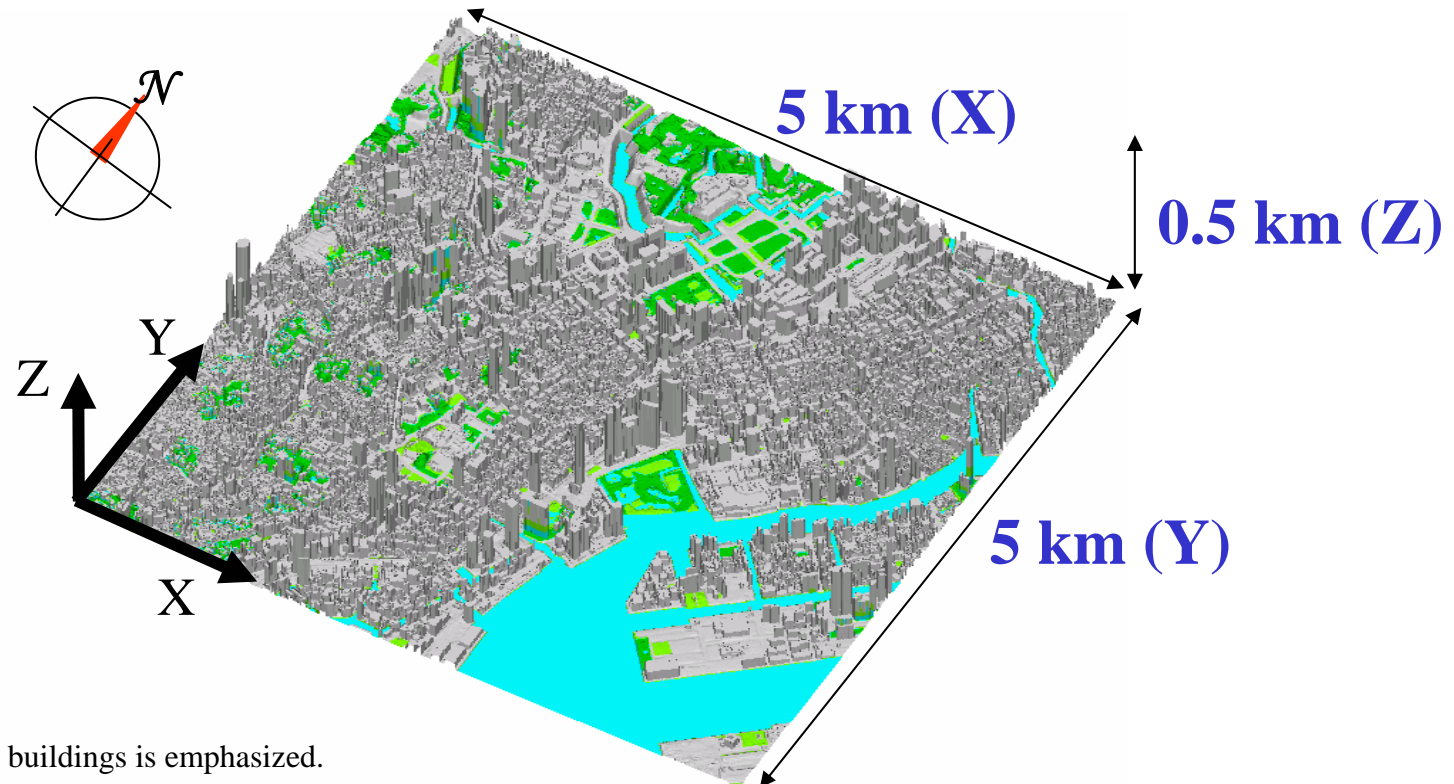
独立行政法人建築研究所
環境研究グループ

足永靖信

Computational domain

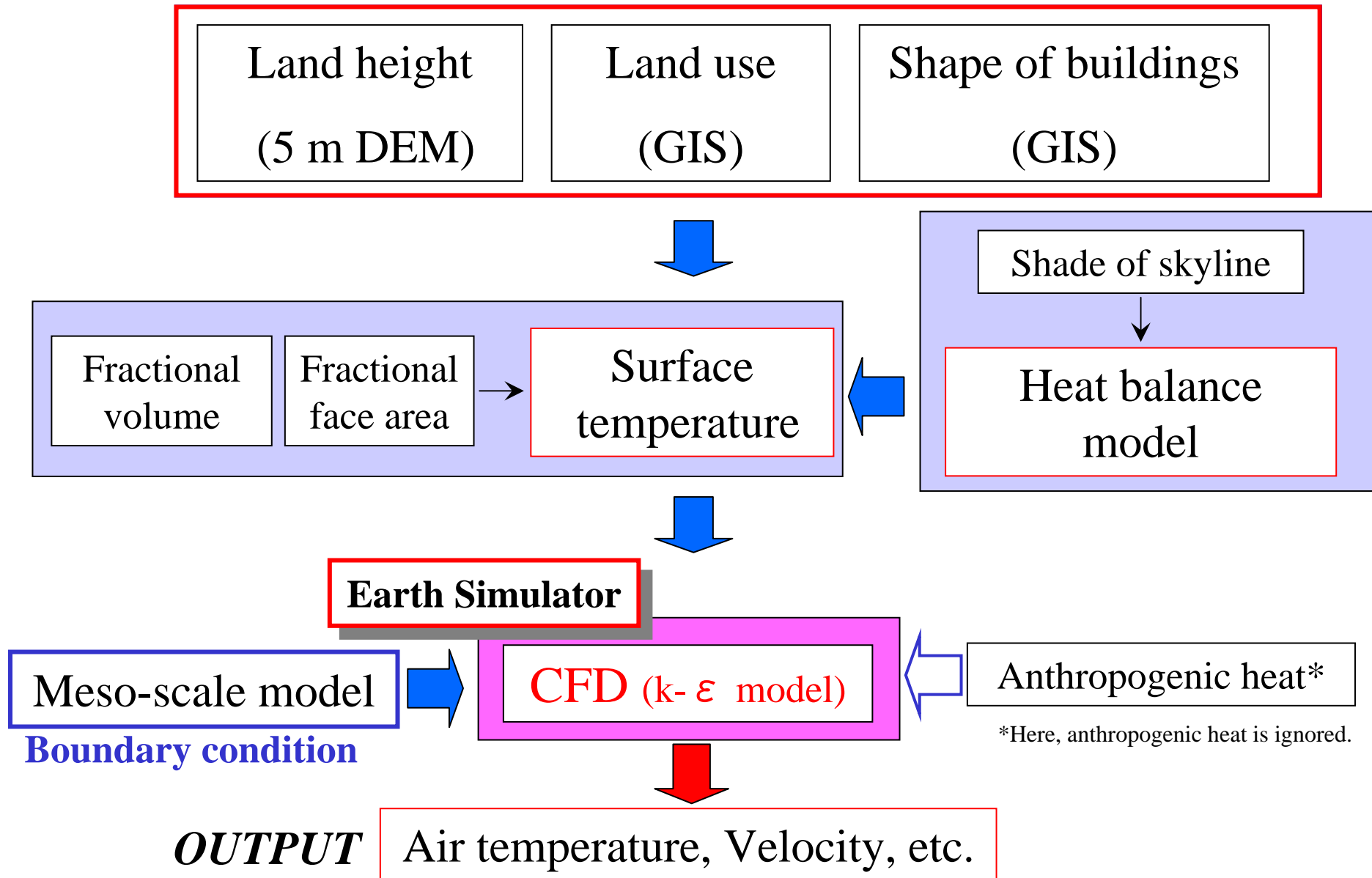
◆ $5 \text{ km}(X) \times 5 \text{ km}(Y) \times 0.5 \text{ km}(Z)$

- Width of mesh: 5 [m] (horizontal)
 $1 \sim 10 \text{ [m]}$ (Vertical)
- Number of grids: $10^8 = 1,000(x) \times 1,000(y) \times 100(z)$



Note that the height of the buildings is emphasized.

Diagram for urban heat island analysis



CFD: Method and Setup

Governing equation: 3-dimensional Navier-Stokes eq. *etc.*

Turbulent model: k- ϵ model

◆ Boundary conditions

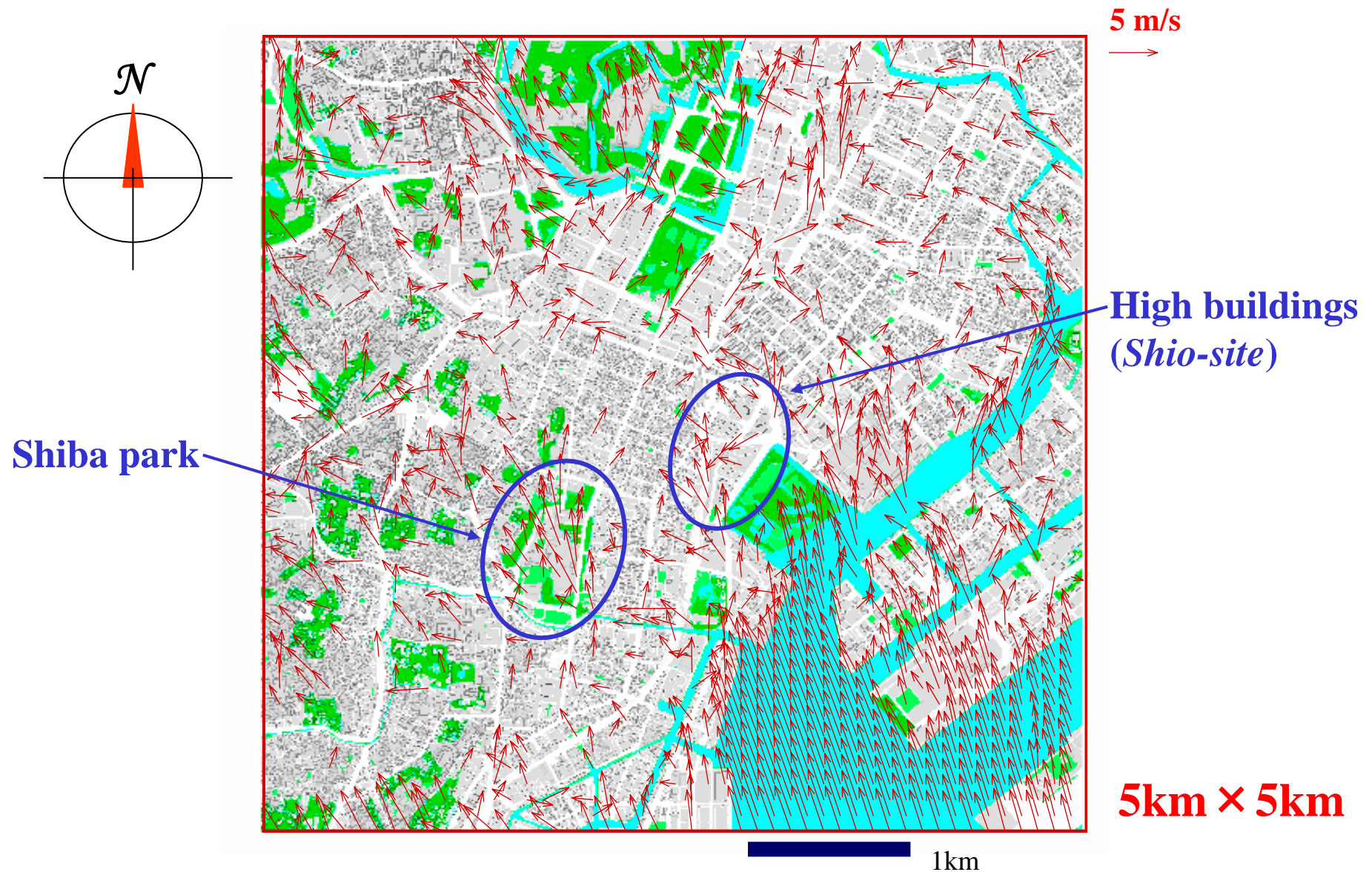
- Inlet/Upper boundary : **Mesoscale simulation data** (Locals) *etc.*
- Outlet boundary: Neumann condition
- Surface of earth : Generalized logarithmic low *etc.*

◆ Date and time: **Typical summer day**

14:00 (PM 2:00)

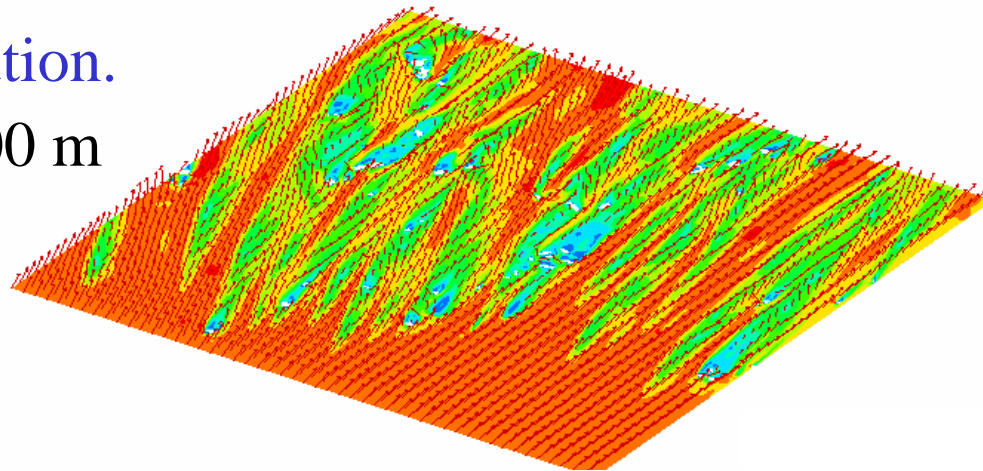
(Sun elevation 58.9° , Altitude azimuth 246.1°)

Velocity vectors at 10 m above ground.

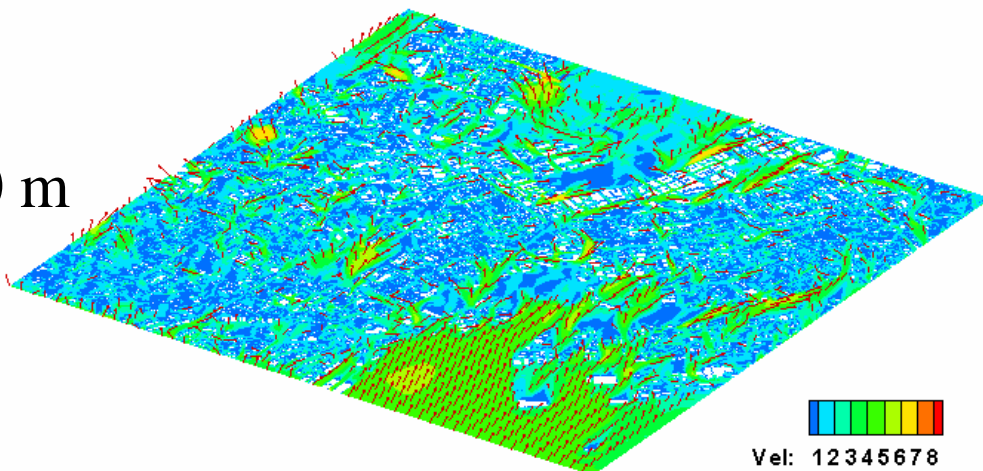


Velocity distribution.

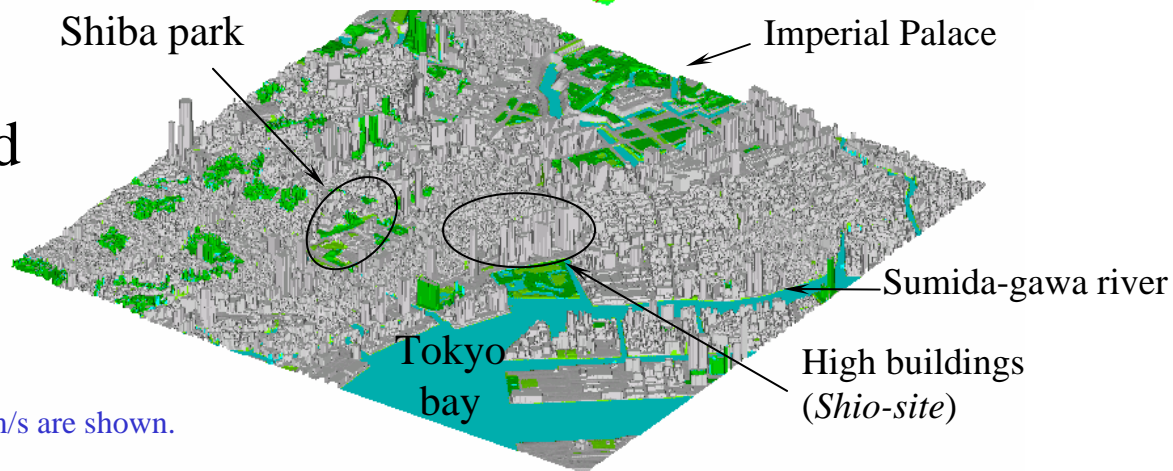
H = 100 m



H = 10 m



Ground

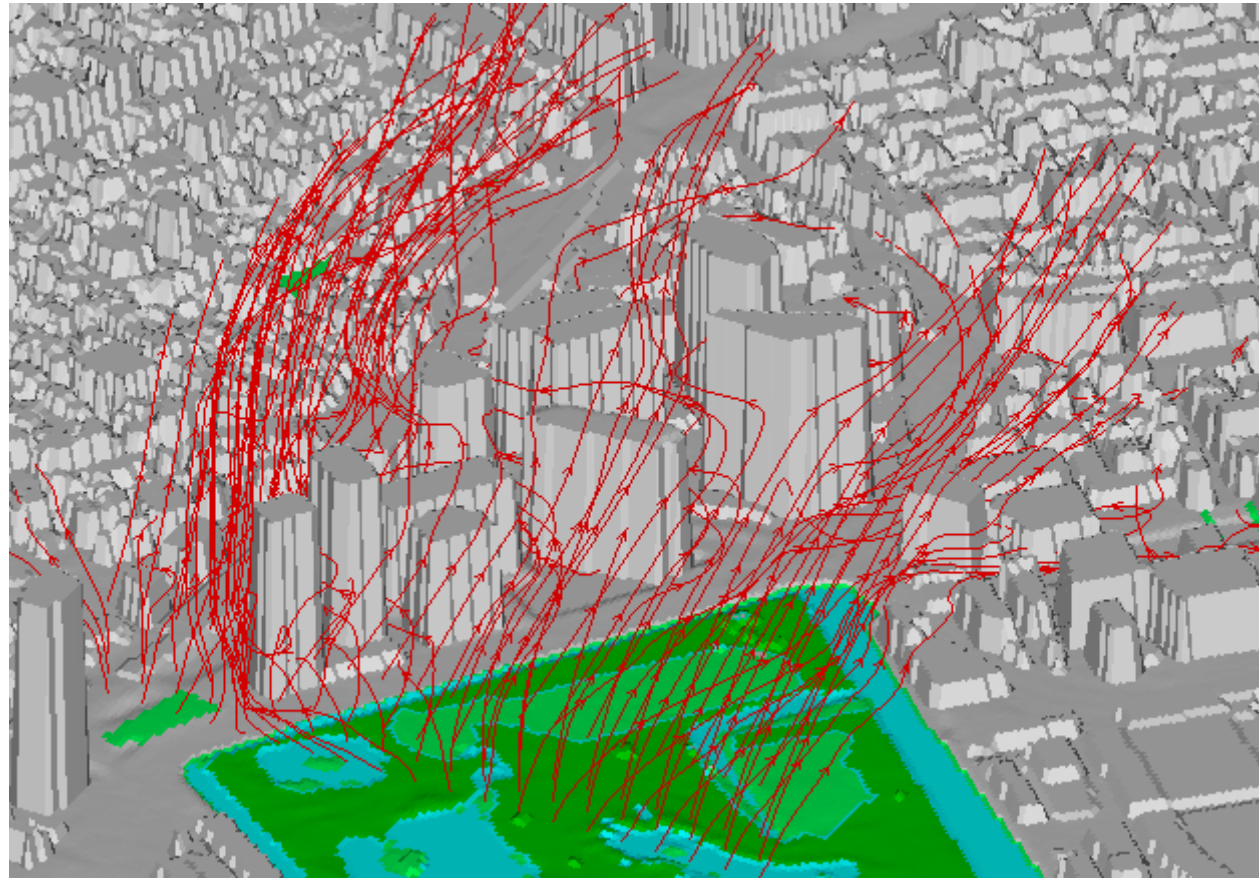


(風速ベクトル: 解像度1/20。
V<2m/sを未表示。)

Velocity distribution.
The velocity vectors more than 2 m/s are shown.

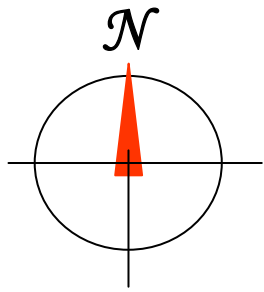
Streamlines

High buildings (*Shio-site*)



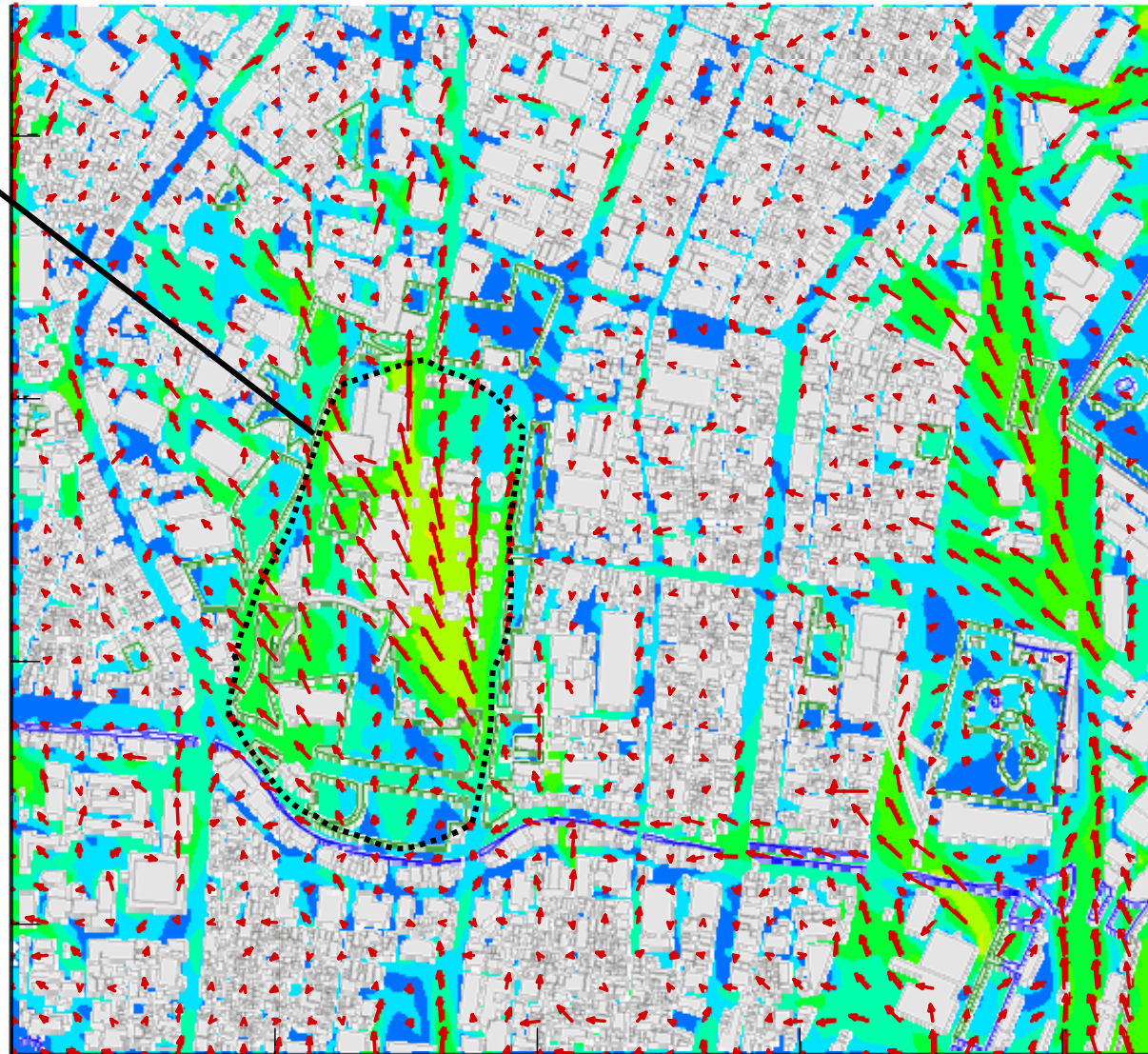
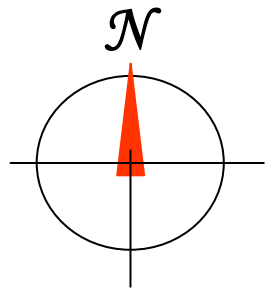
Shiba park.

Shiba park



Distributions of **velocity** at 10 m above ground.

Shiba park



→ 5 m/s

V [m/s]

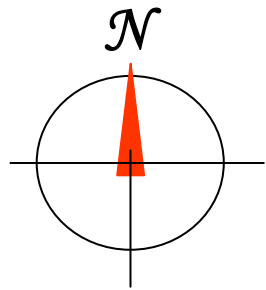


12345678

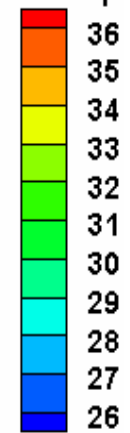
400m

Distributions of **temperature** at 10 m above ground.

Shiba park

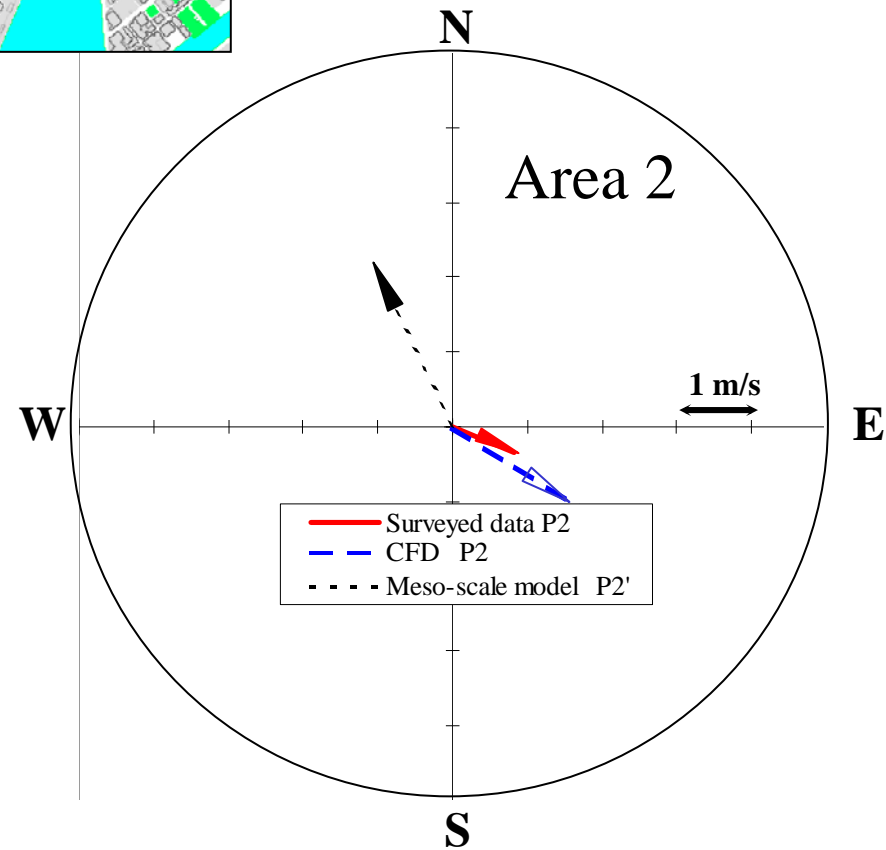
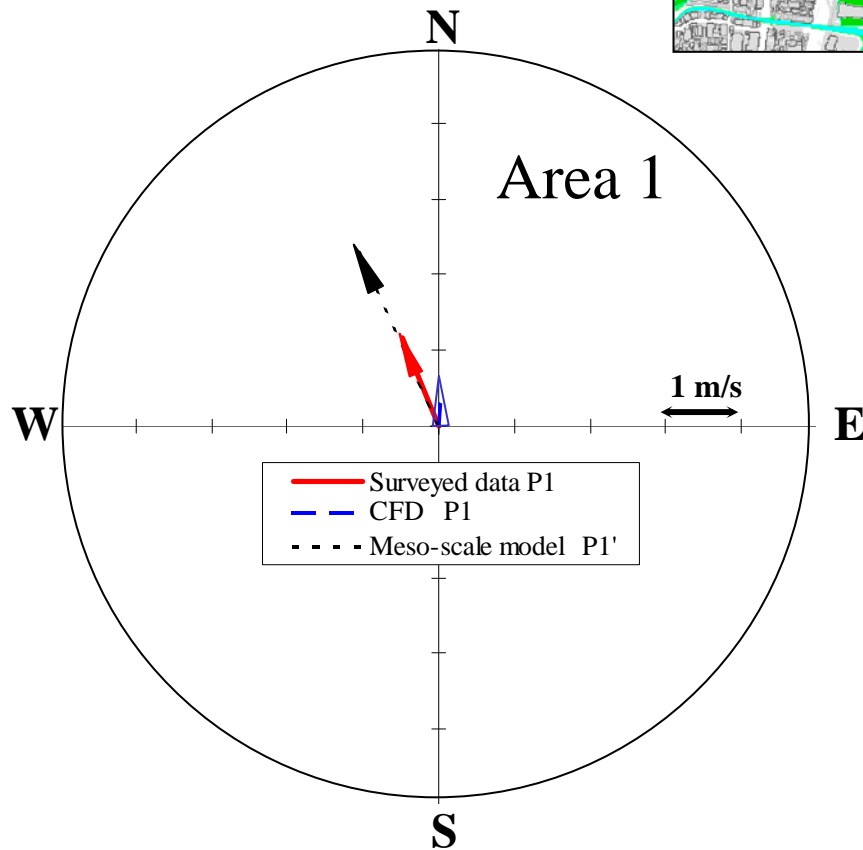
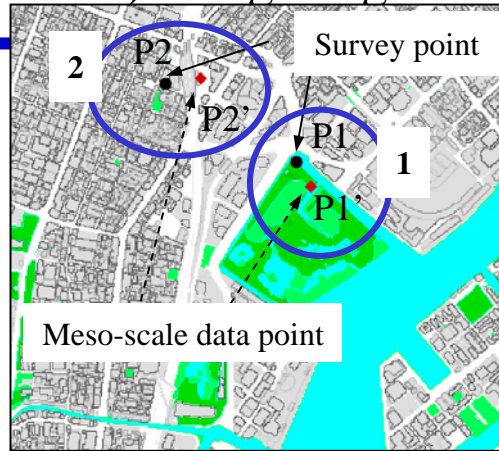


Air temperature
 T [$^{\circ}\text{C}$]



400m

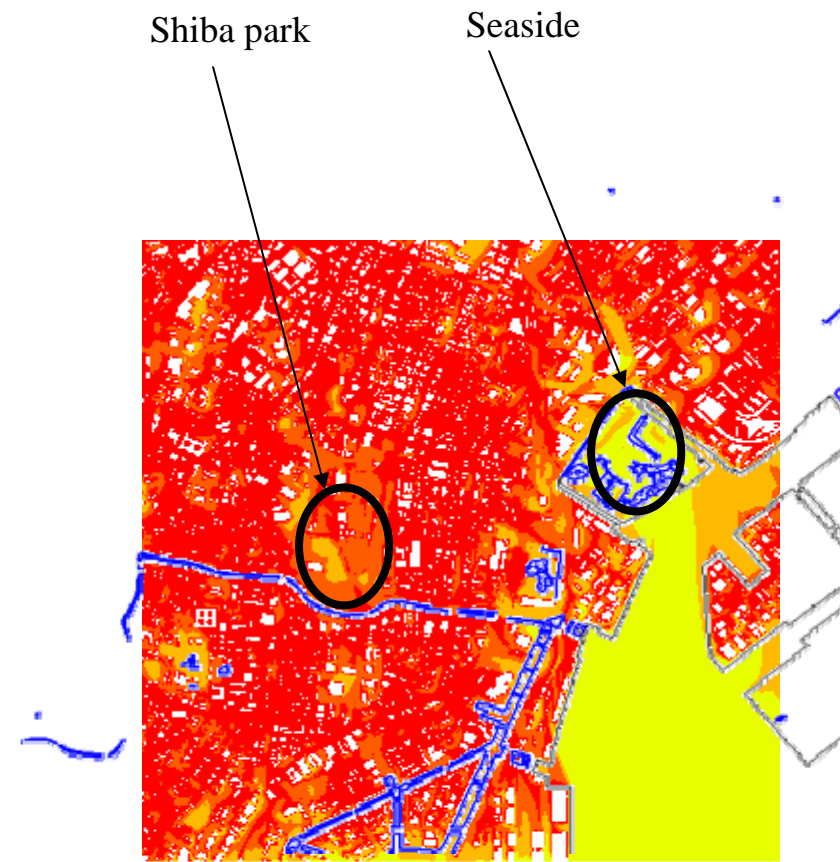
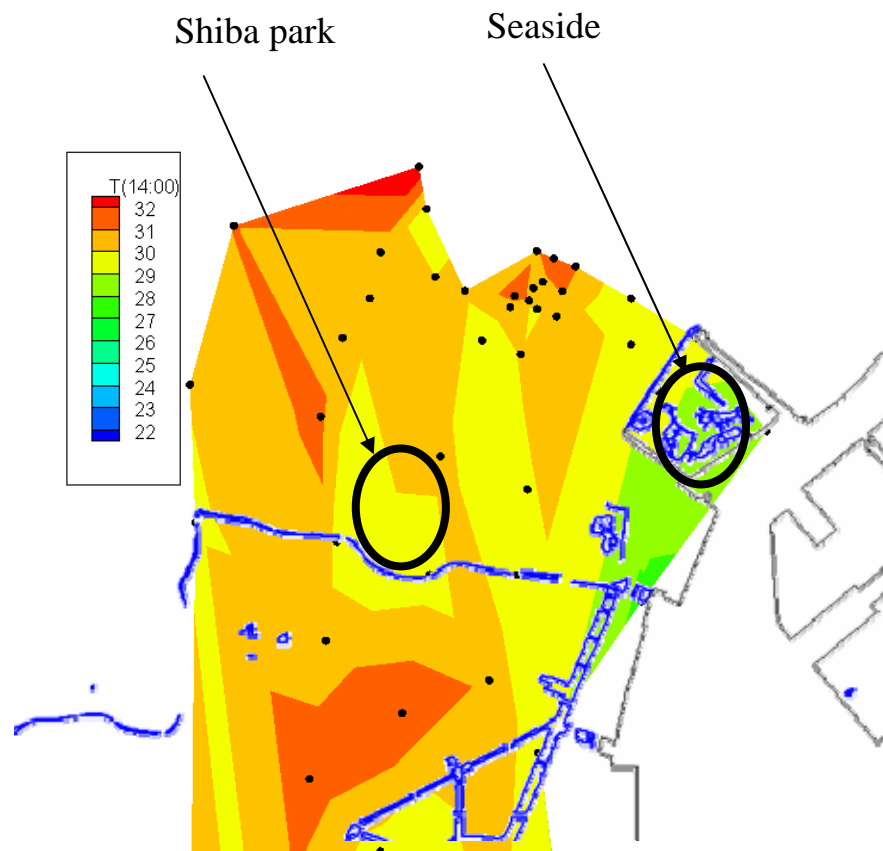
Wind directions at 14:00: Surveyed result, CFD and Meso-scale model.
Left figure: Area 1 (at the seaside) . Right figure: Area 2 (in the town)



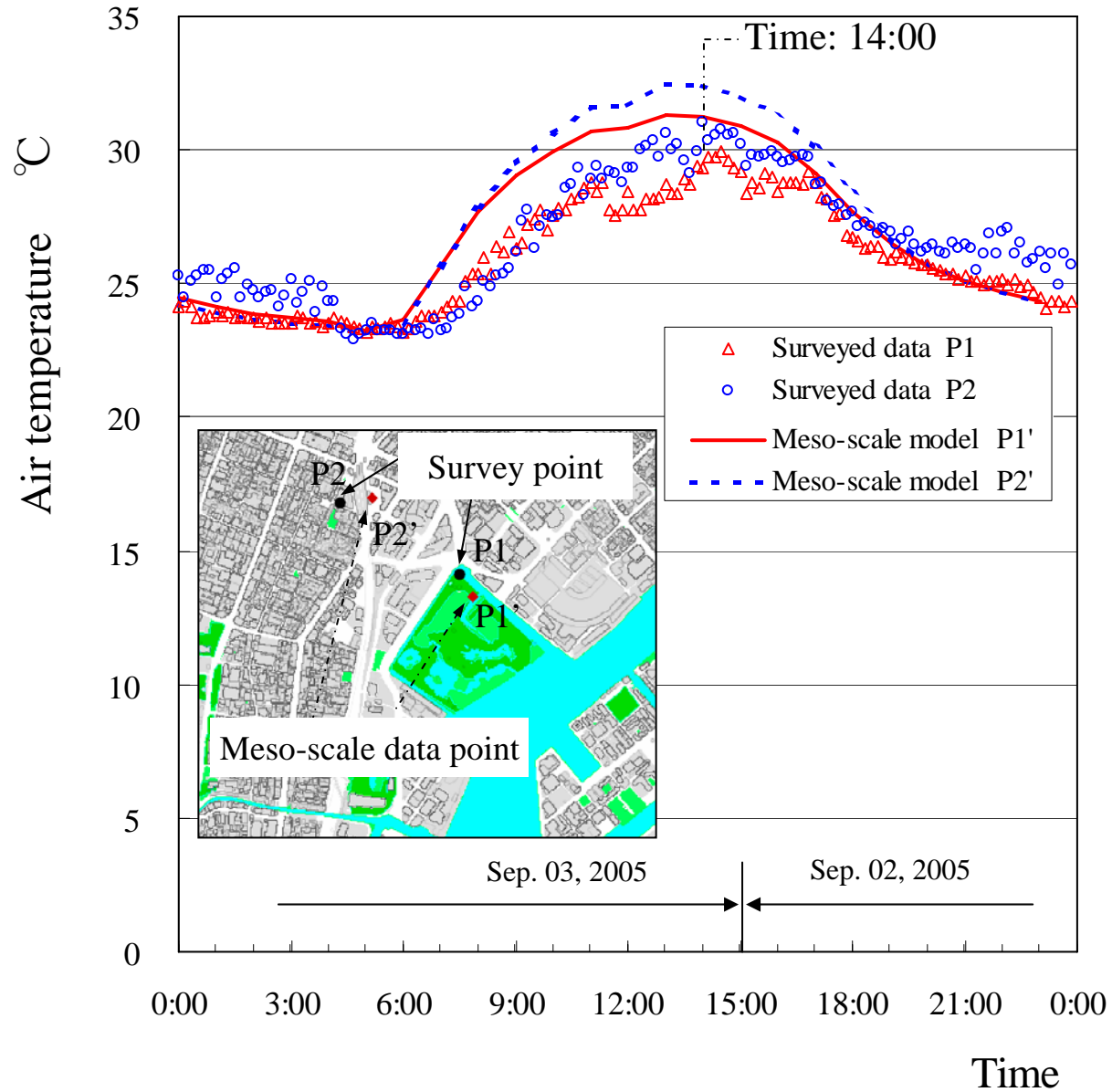
Comparison between the surveyed temperature and the simulated one.
In the left figure, the black closed-mark present the surveyed points.

H = 1.6 m

H = 2 m



Time evolution of temperature: Surveyed result and simulation result by Meso-scale model.



まとめ

- 1) 水平5mメッシュで東京臨海部のCFD解析を実施し、風速および気温を実測値と比較した。
- 2) 10km四方の解析に拡張するには20-40ノードの計算規模になるため、並列化効率の向上作業を行う。