Kobe, 22 March, 2013

Down-Scaling Simulation System (DS^3)

A mesoscale super-high-resolution modelling on horizontal convective rolls: The impacts of landuse and buildings

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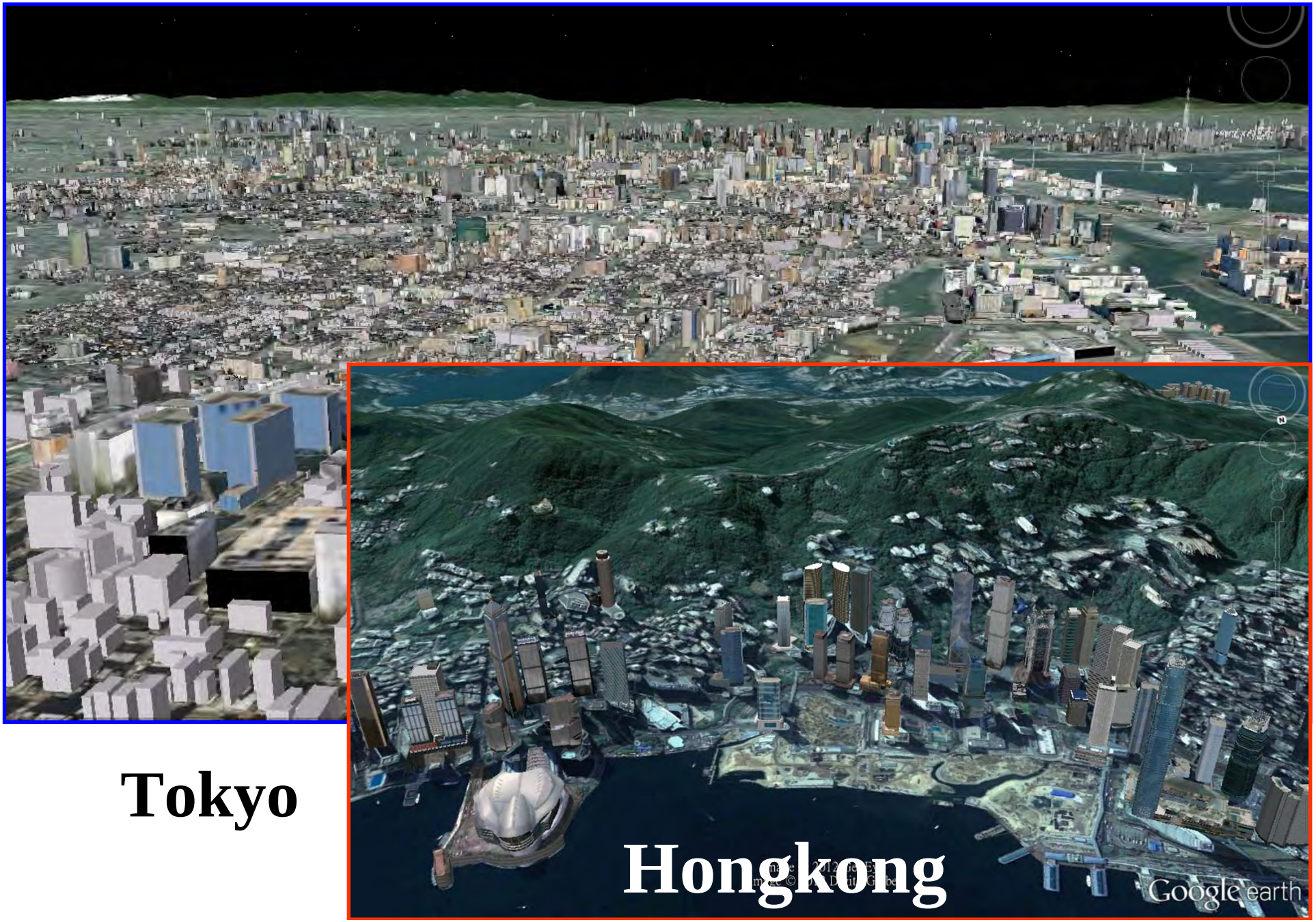
Outline

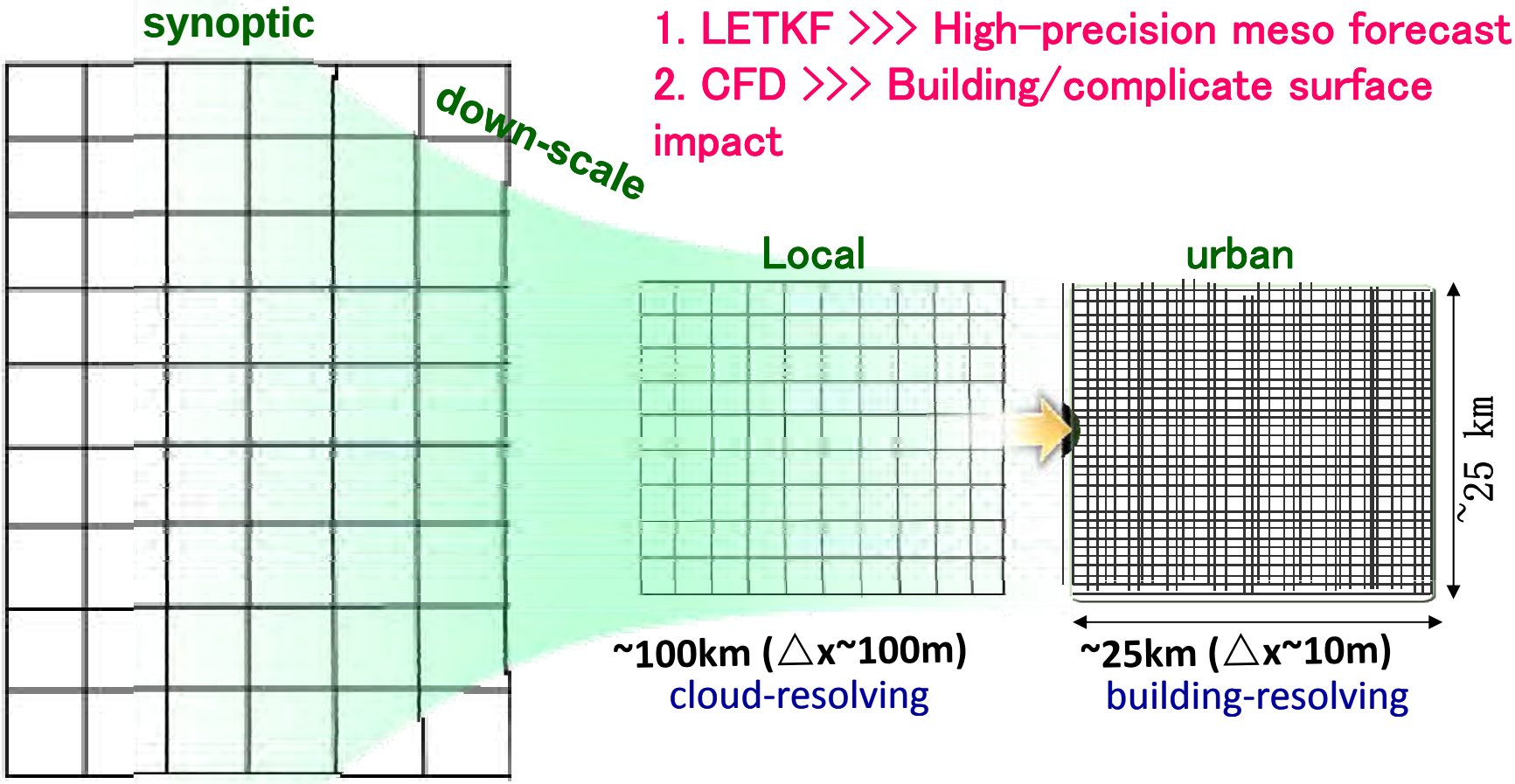
- The framework of DS^3
- Verification on horizontal convective rolls (HCRs)
- Sensitive experiments on buildings and landuse
- Summary and ongoing works

Complex geometries on urban area



Tokyo

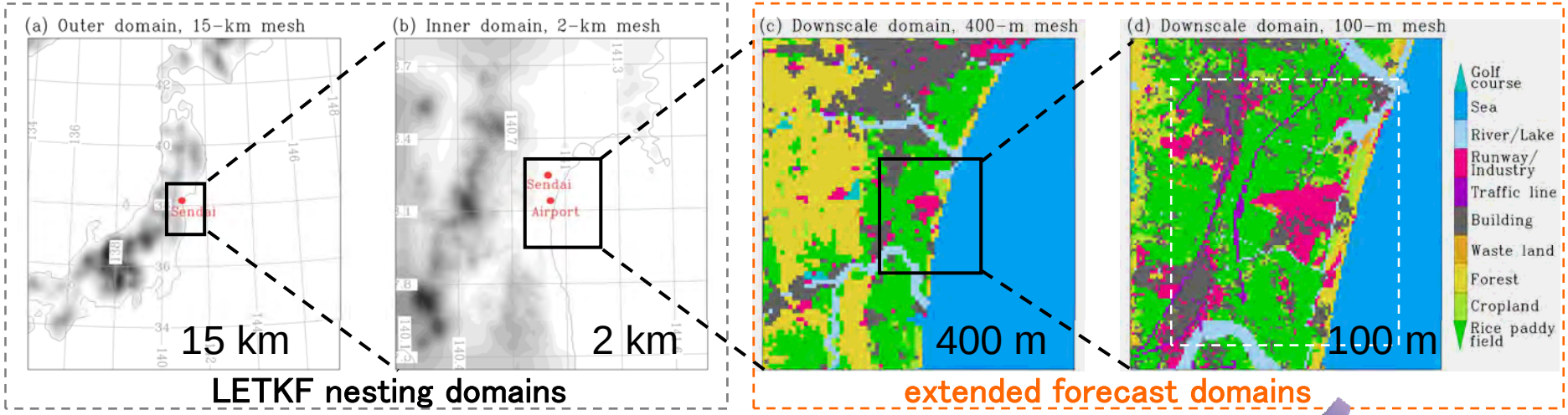
DS^3: 10m-mesh for a urban domain

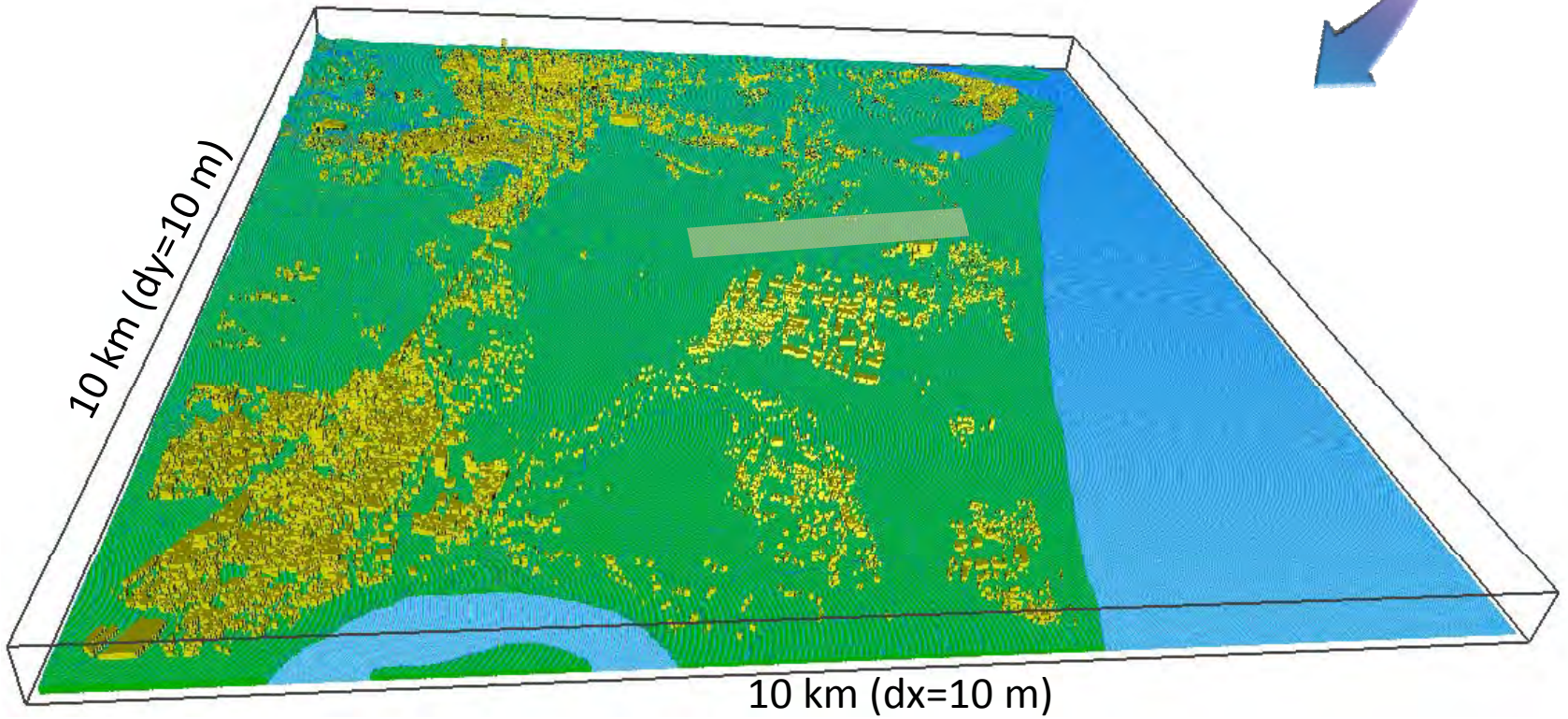


Down-Scaling Simulation System (DS^3)
combines JMA-NHM (Saito et al. 2007) + SIMPLERgo (Sha 2008).

JMA-NHM: JMA Non-Hydrostatic Model
SIMPLERgo: Semi-Implicit Method for Pressure-Linked Equations Revised, Version-1 Code

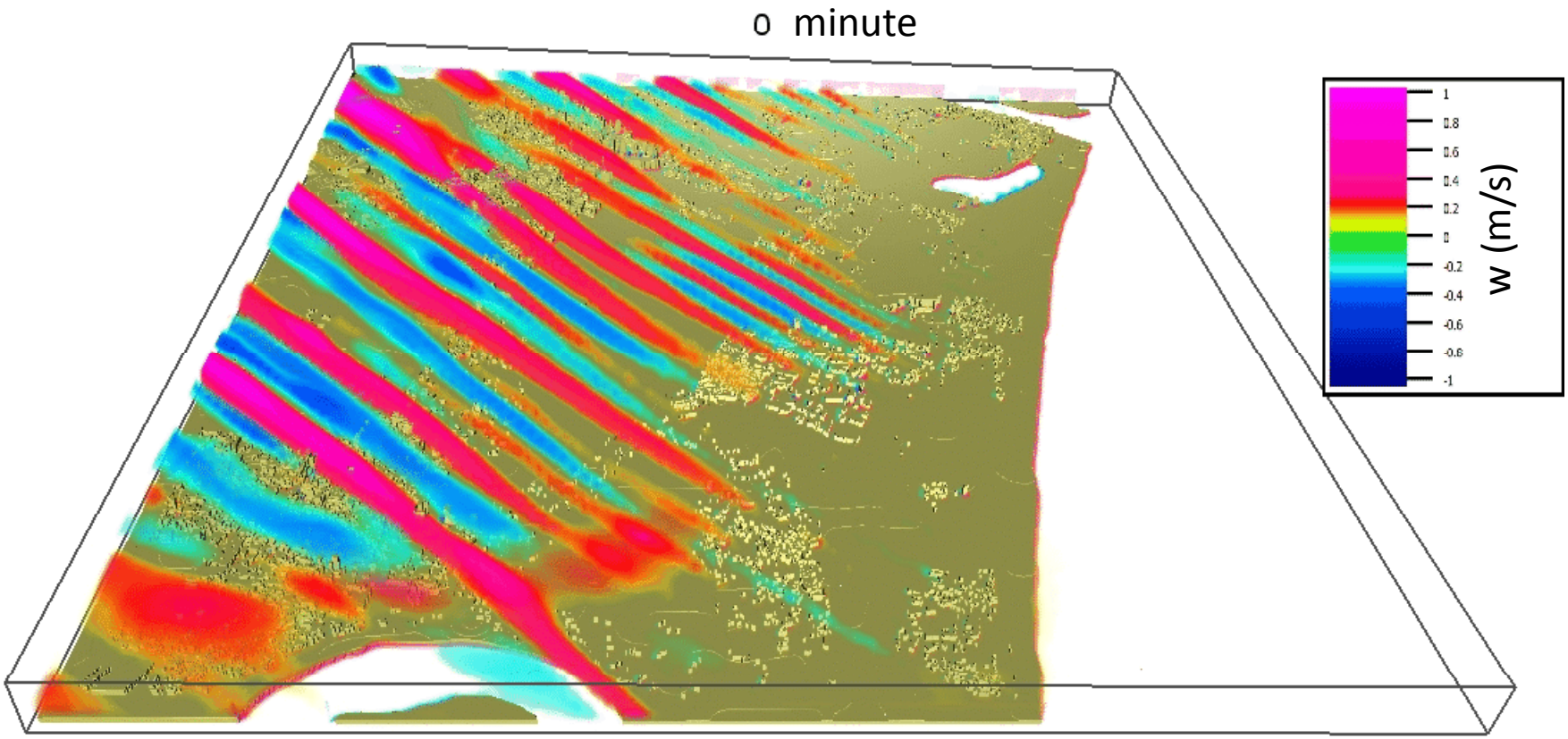
Domain Setting of DS^3





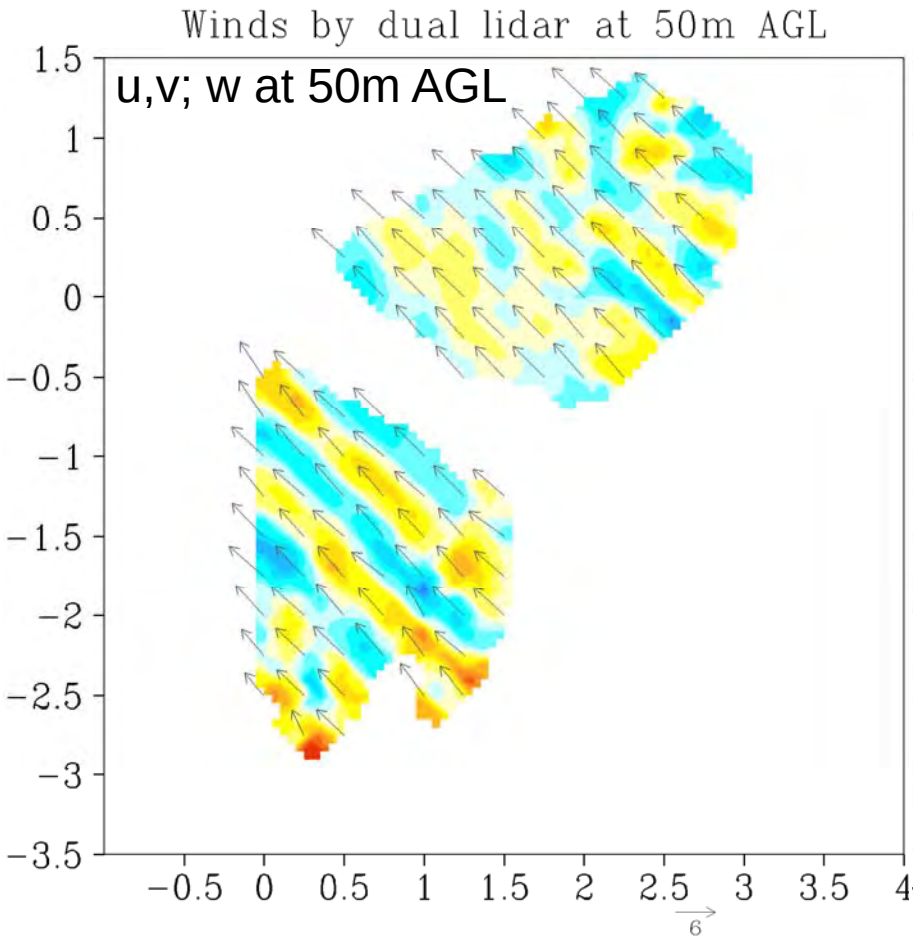
10-minute simulation by DS^3

for the sea breeze over Sendai airport on 13 JST, 19 June, 2007

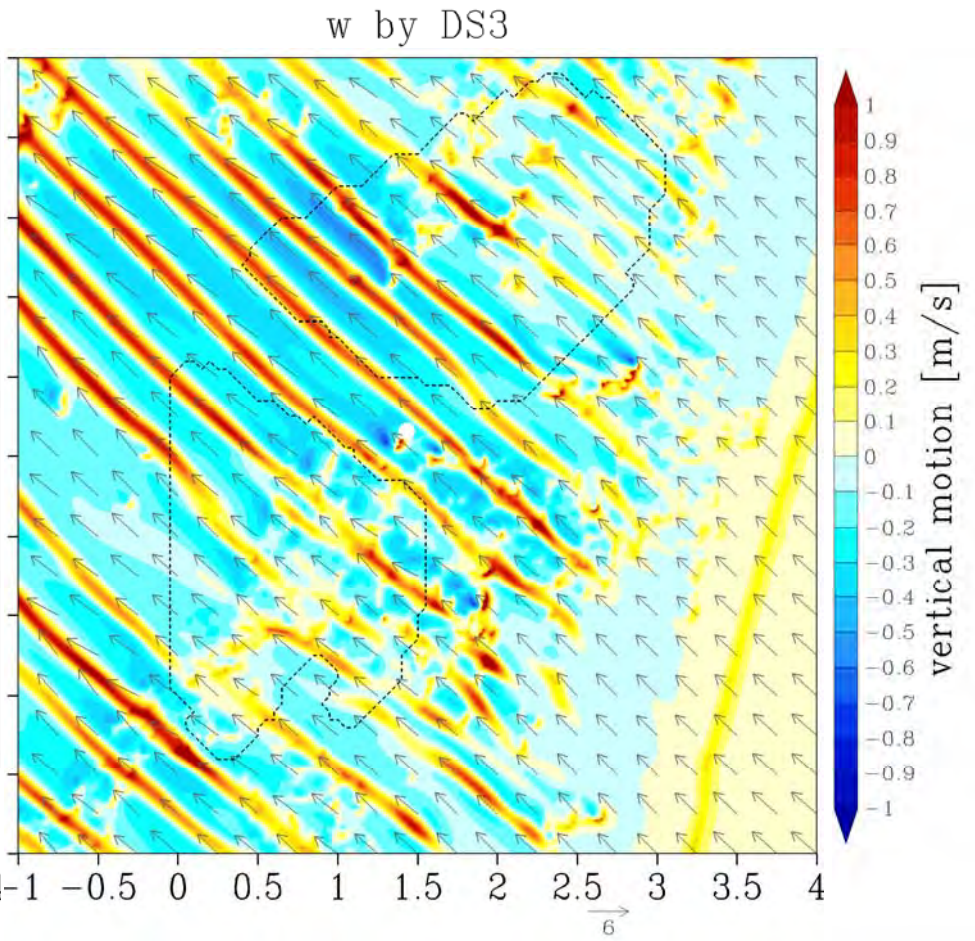


HCRs over Sendai Airport

Dual Doppler lidar observation

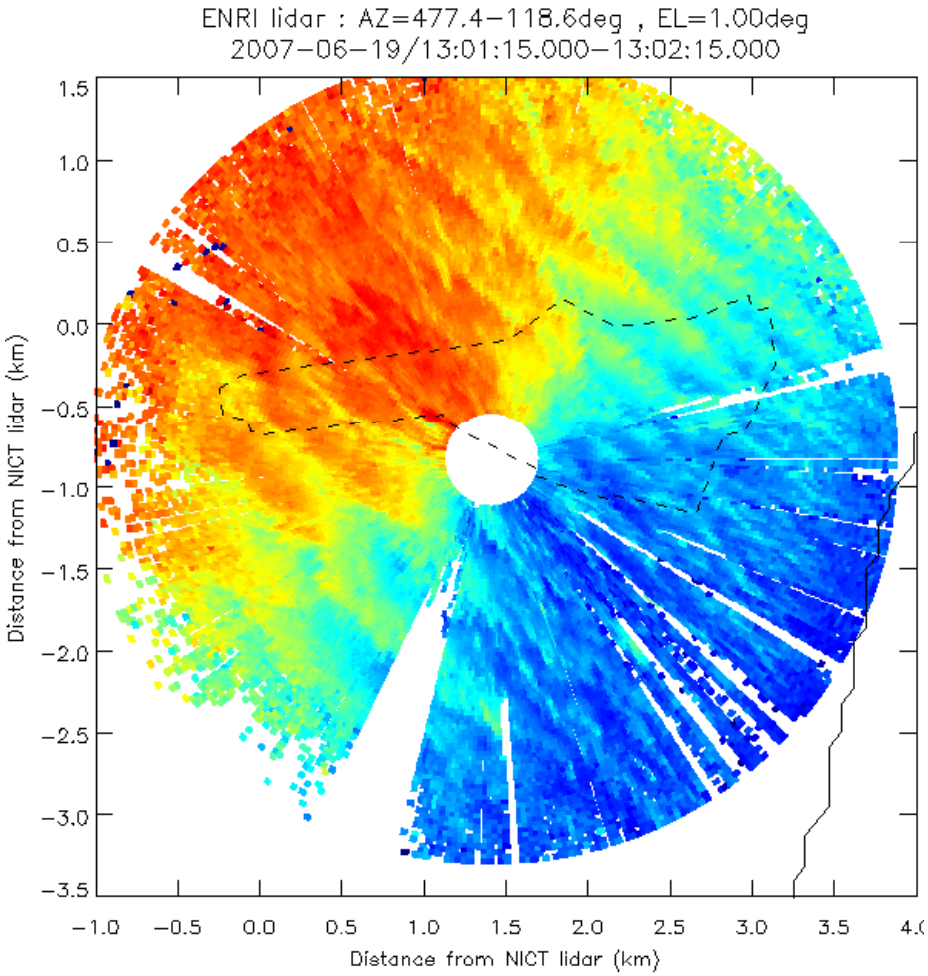


DS³ modeling based on analyzed data

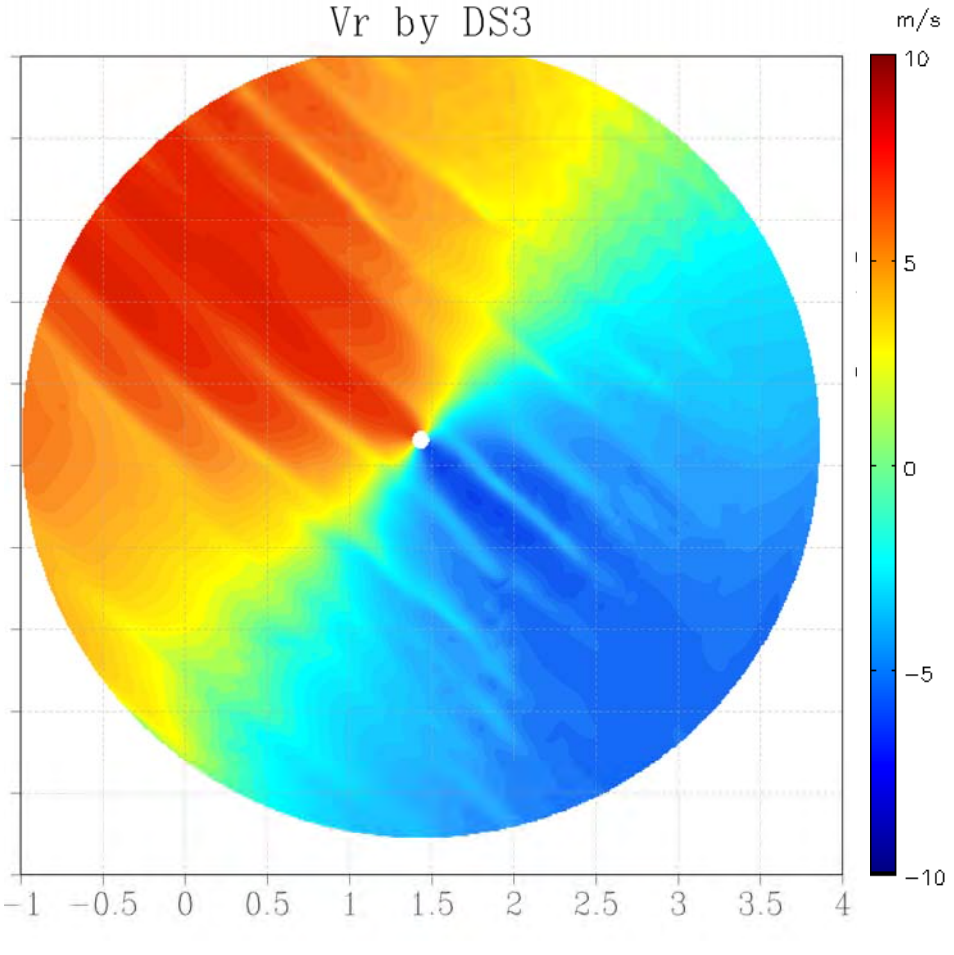


The streaks of near-surface winds

Lidar PPI Scan of radial velocity

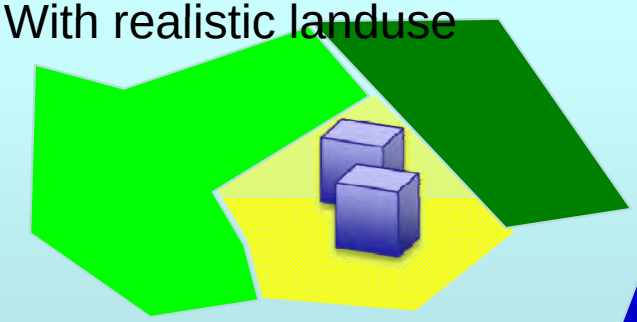


DS^3 modeling based on analyzed data

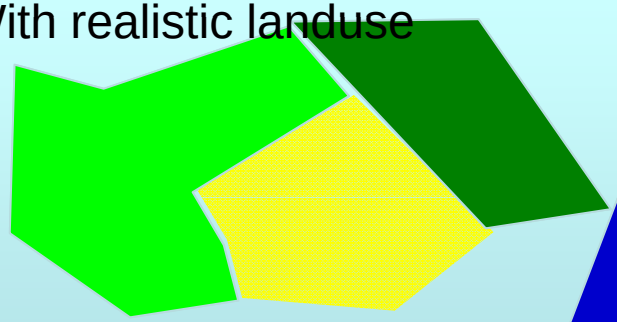


Sensitive Experiments

(1) with buildings
With realistic landuse

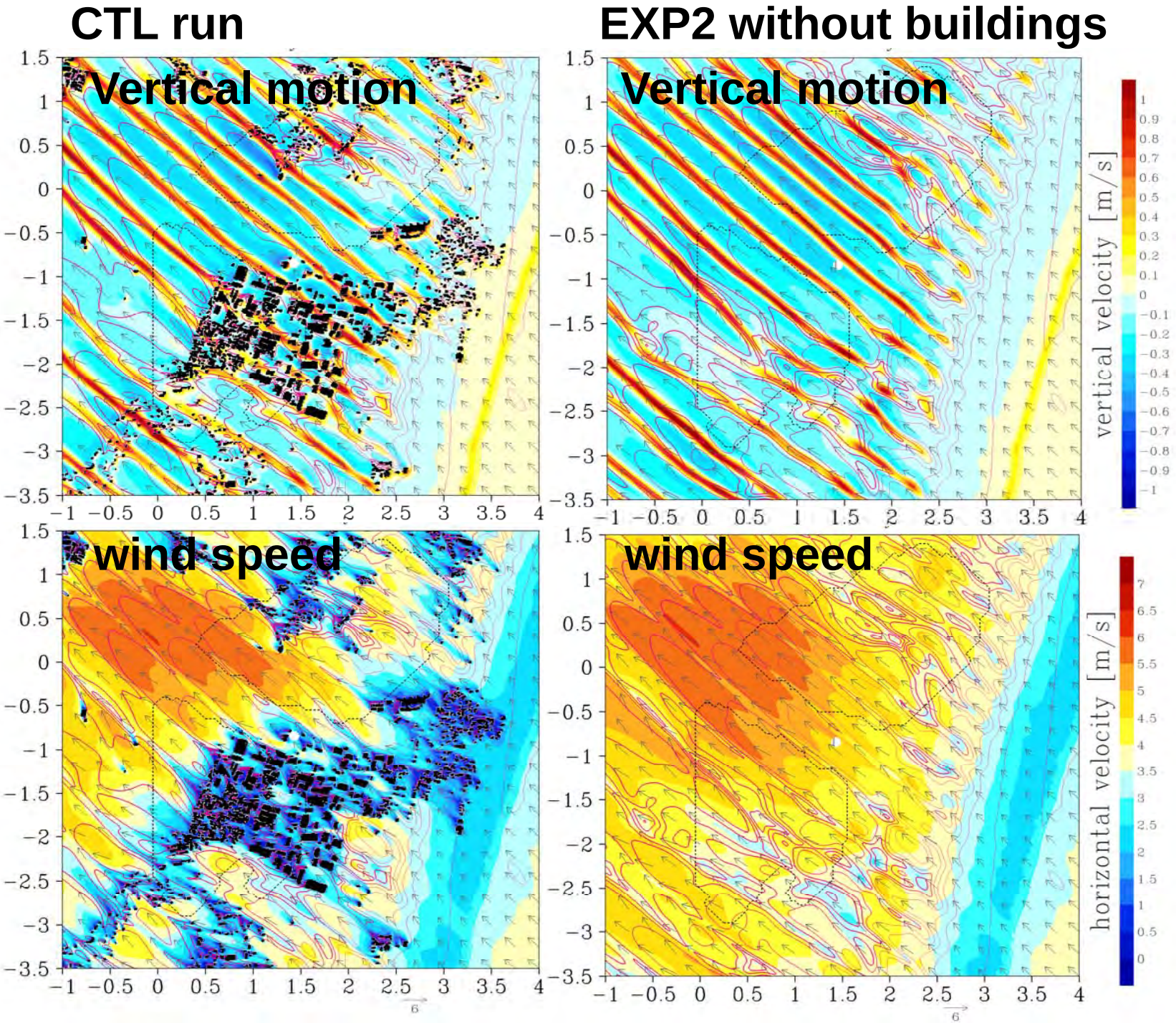


(2) without buildings
With realistic landuse

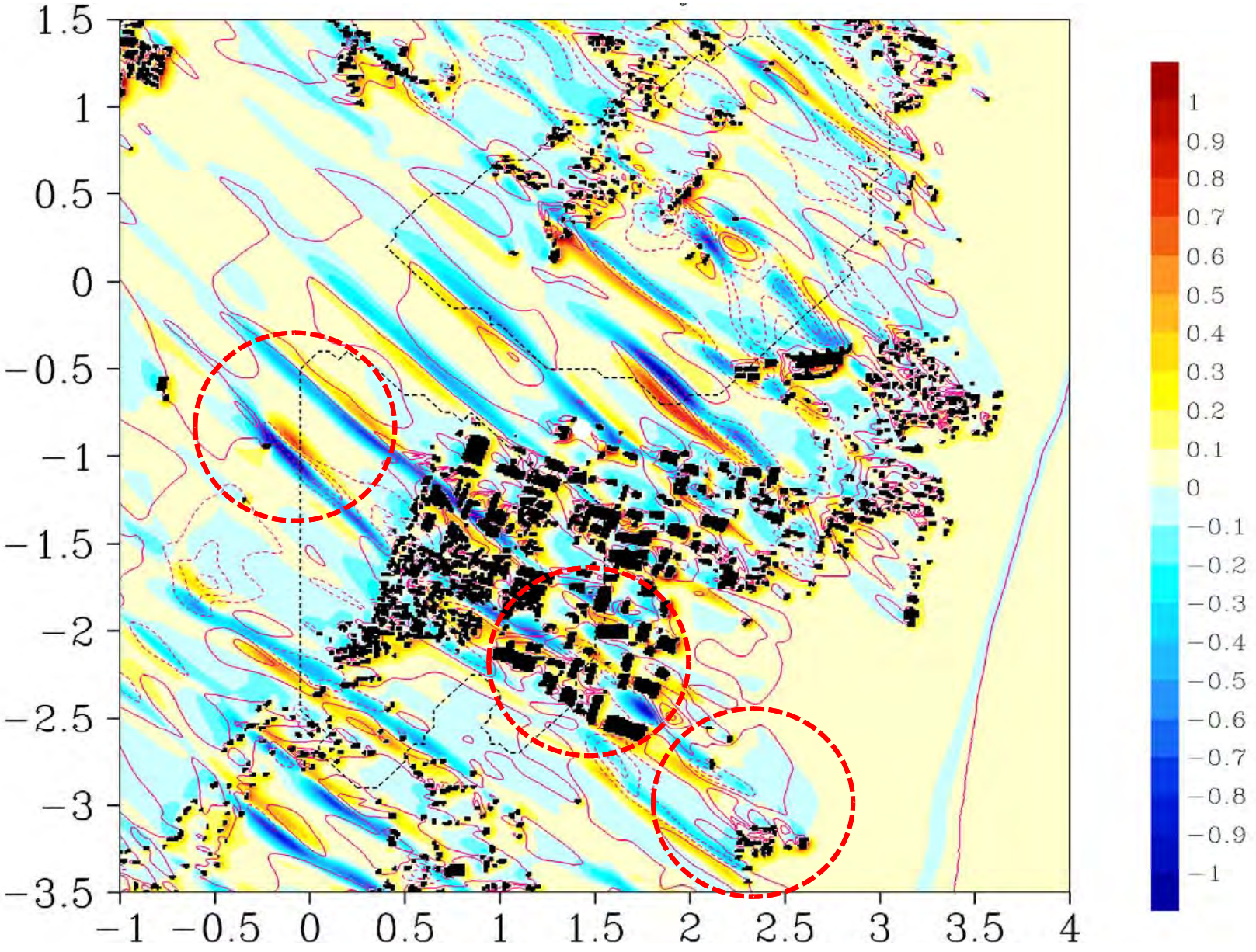


(3) without buildings
All lands >>> forest

(4) without buildings
All lands >>> rice paddy field

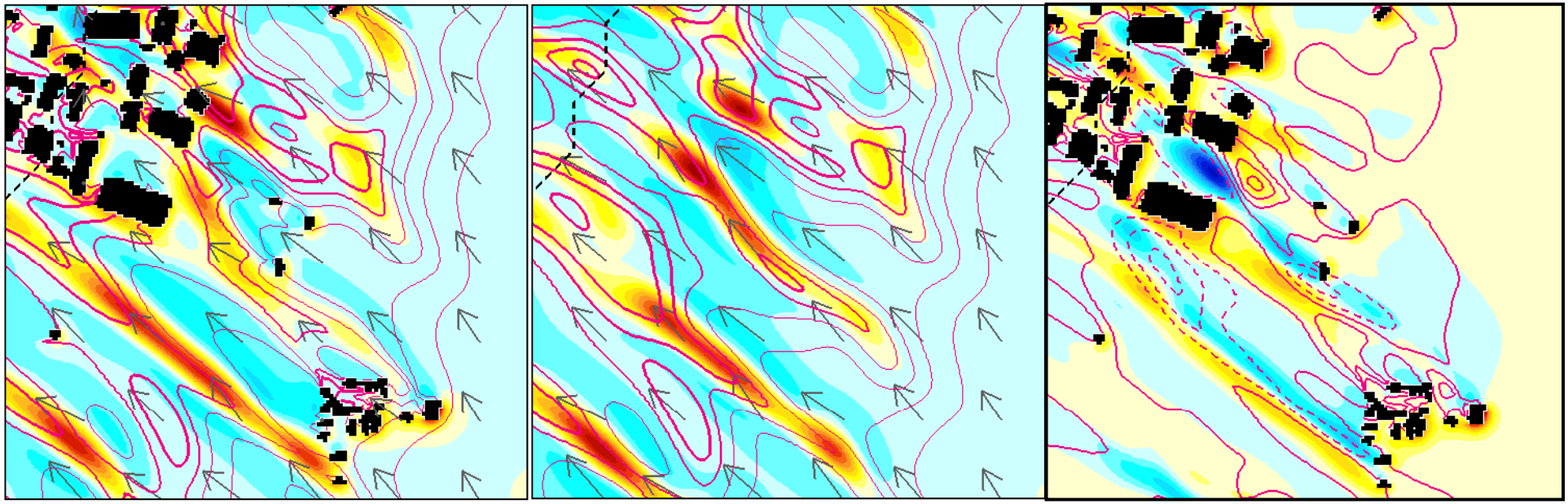

CTL run
EXP2 without buildings
Vertical motion
Vertical motion
wind speed
wind speed
vertical velocity [m/s]
horizontal velocity [m/s]

Difference of W and T between w/o buildings



Vertical motion at 50 m AGL
Temperature and winds at 20 m AGL

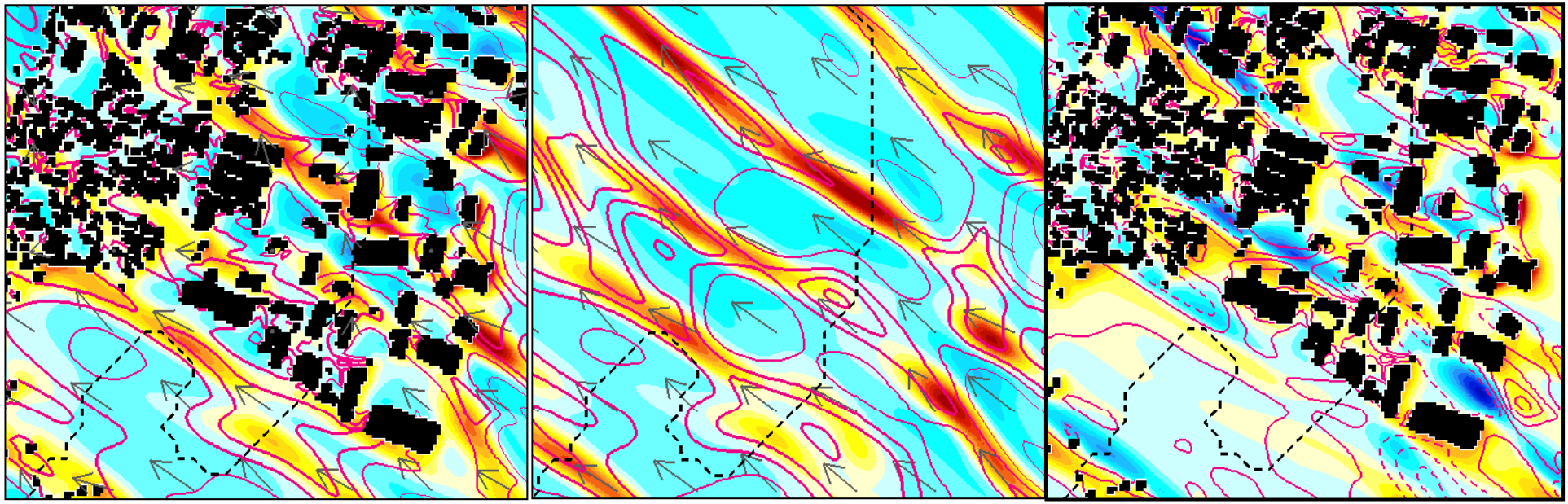
CTL run | EXP2 without buildings | Difference



Upstream scattered buildings

Vertical motion at 50 m AGL
Temperature and winds at 20 m AGL

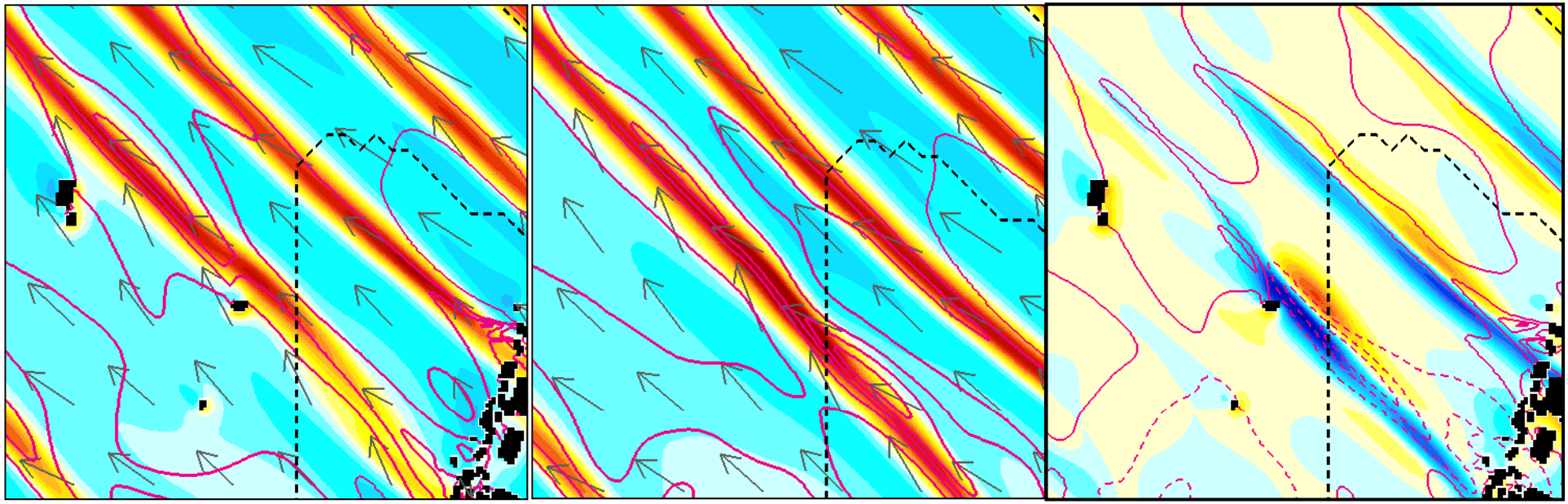
CTL run | EXP2 without buildings | Difference



Dense buildings

Vertical motion at 50 m AGL
Temperature and winds at 20 m AGL

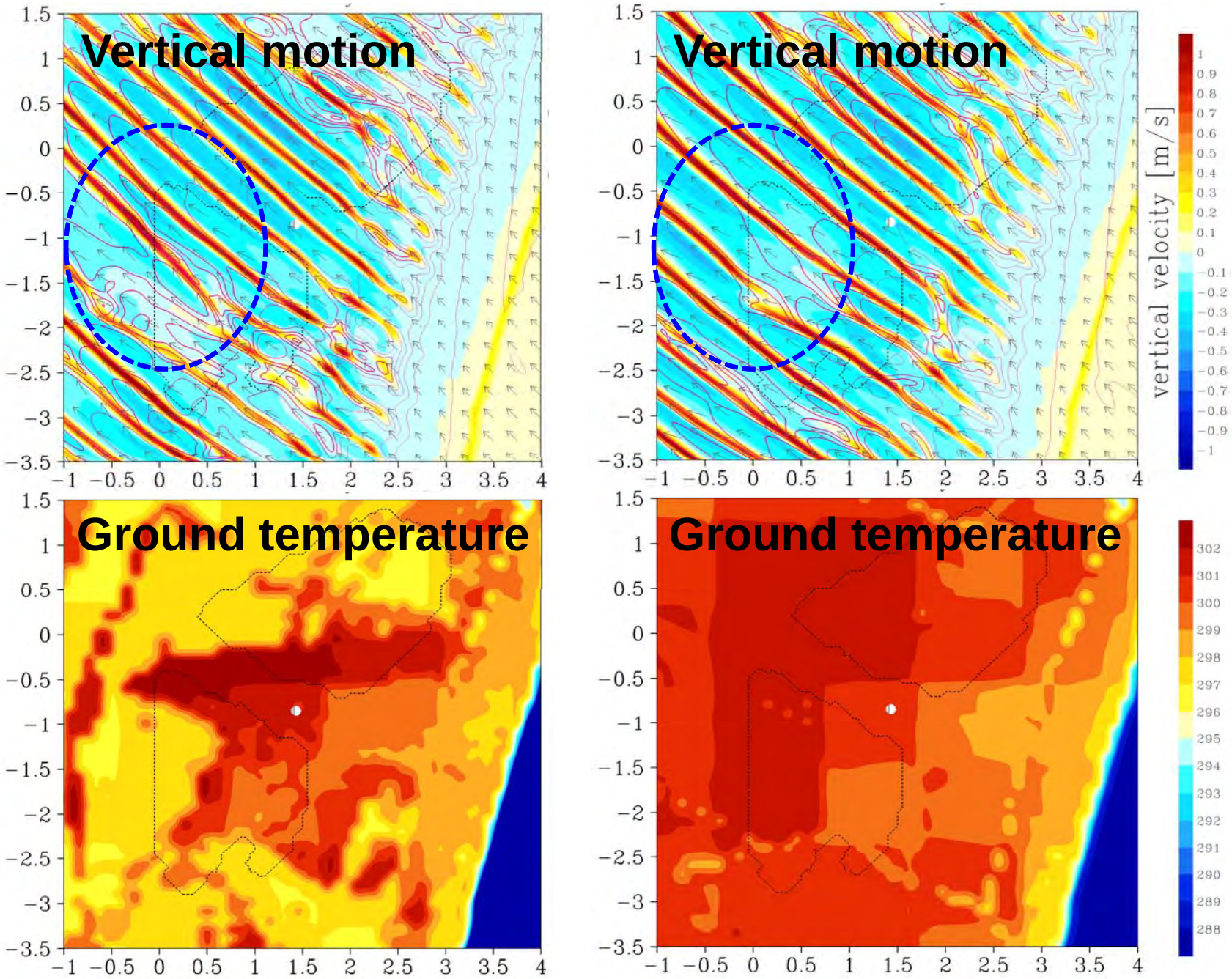
CTL run | EXP2 without buildings | Difference



Downstream isolated buildings

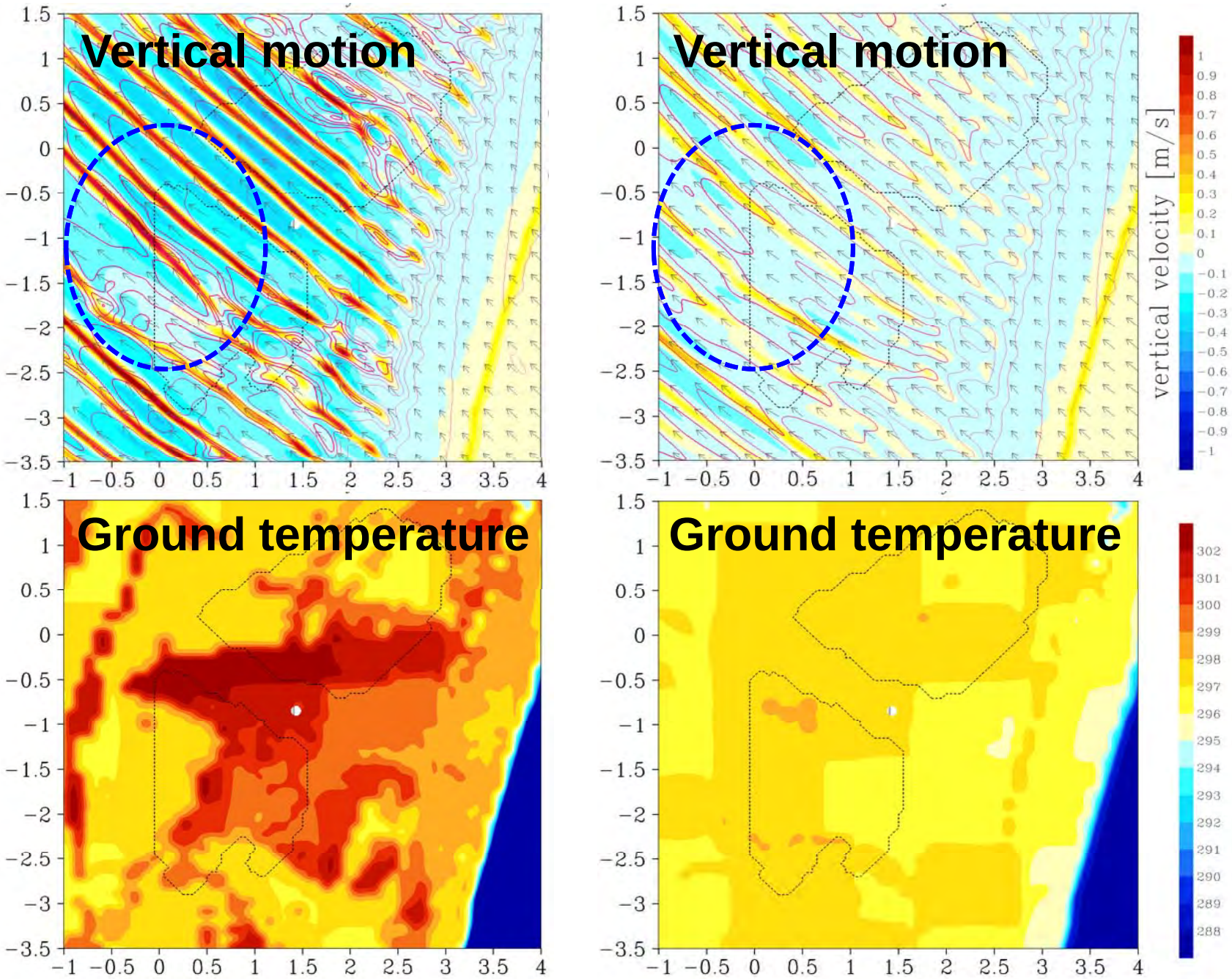
EXP2 Realistic landuse

EXP3 Lands >>> forest

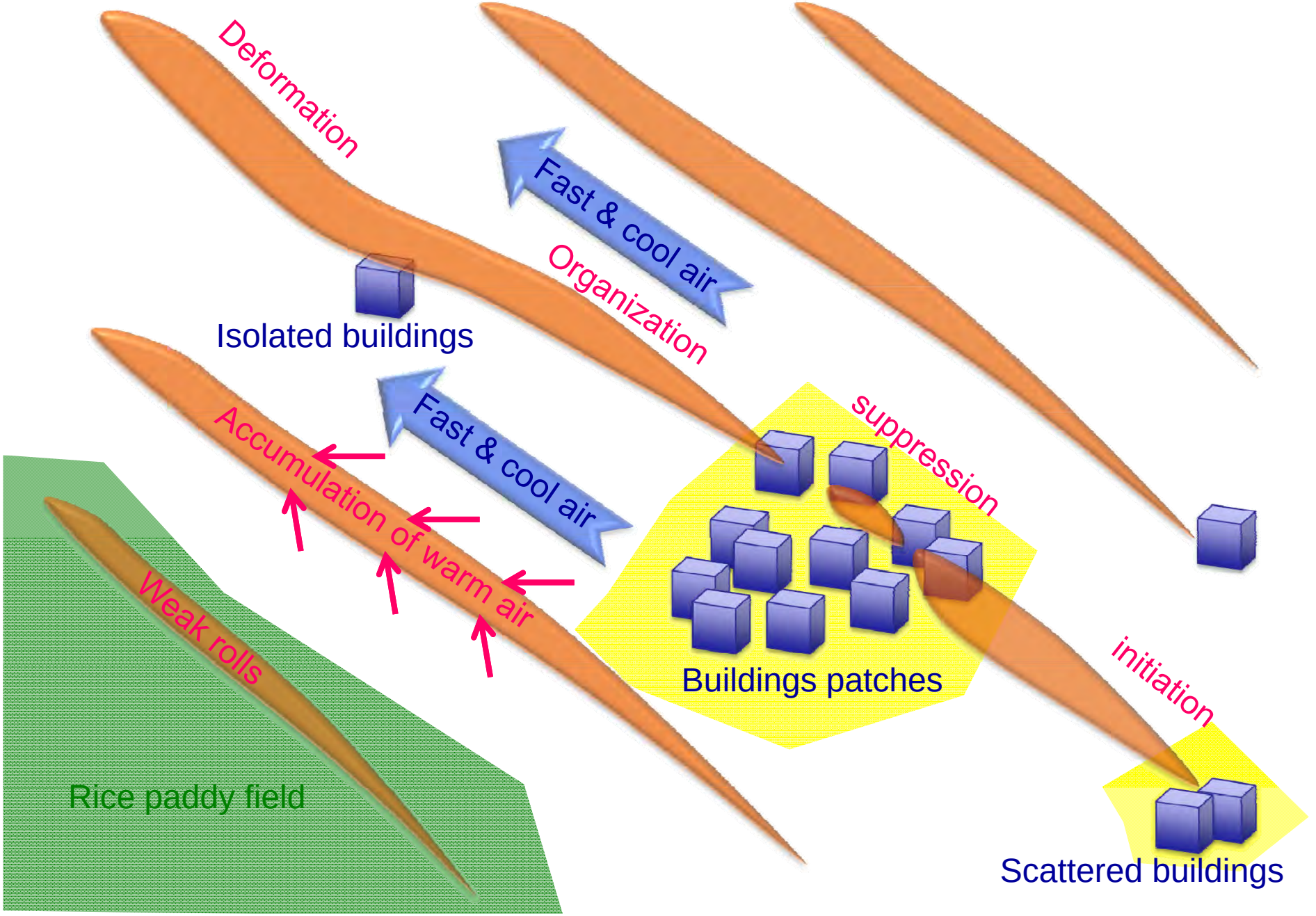


EXP2 Realistic landuse

EXP3 Lands >>> rice paddy field



Schematics of the building/landuse impacts



Progress and Plan

The progress of this year:

For the first time, the sea-breeze HCRs is reproduced in a realistic modeling with reasonable accuracy.

The impacts of buildings and landuse on the HCRs can be illustrated on an unprecedented super-high-resolution.

The plan of next year:

(1)To parallelize DS^3 for a larger domain calculation;

(2) Next case study on the frontal head of sea breeze.

Thank you for your attention