Strong wind risk of structures in Japan and prediction of strong wind

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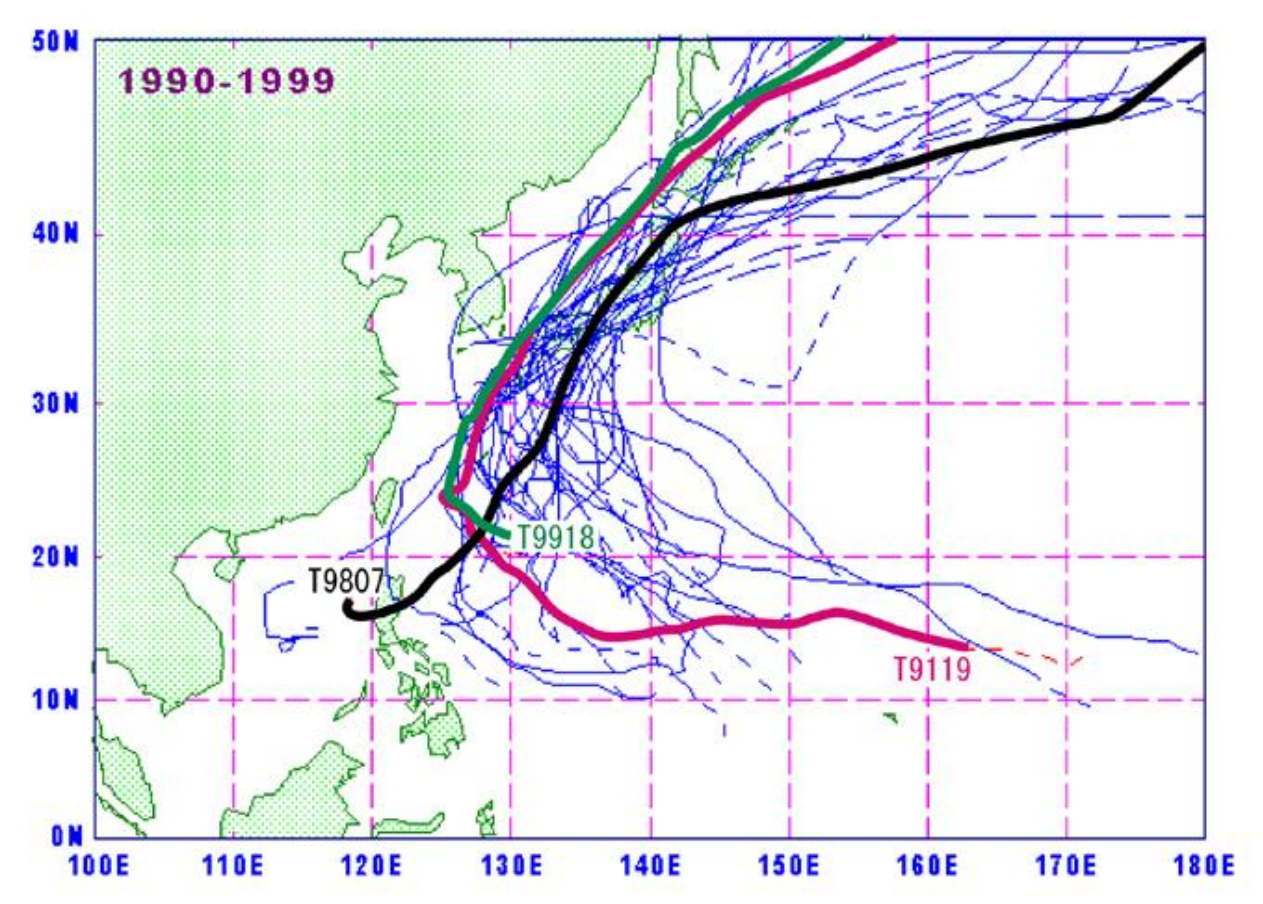
Wind engineering and resistant structures D.P.R.I.

Strong wind hazard in Japan

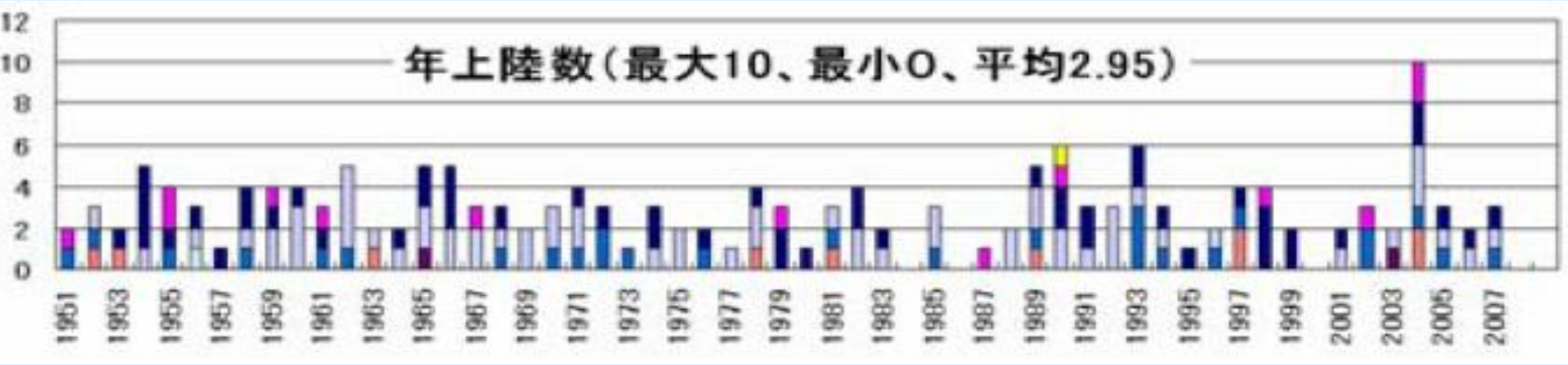
- **By typhoon**
  - Wide area
  - Large amount of ross
  - Variety of disaster
- **By tornado**
  - Local area
  - Strong wind damage

Typhoon

Trajectories of landed typhoon



Number of landed typhoon



↑洞爺丸台風（１９５４）

↑伊勢湾台風（１９５９）

↑第２室戸台風（１９６１）

↑第２宮古島台風（１９６６）

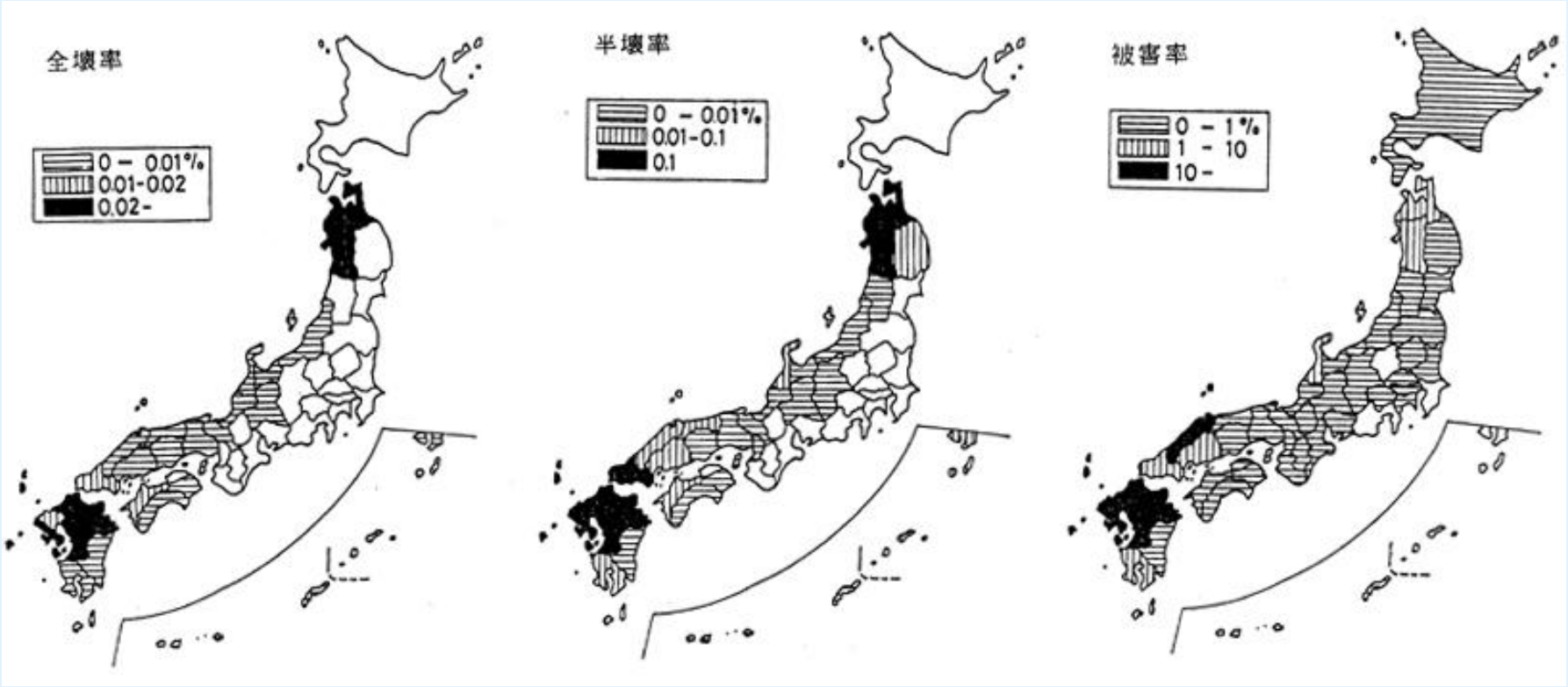
↑台風９１１９号（１９９１）

↑台風９８０７号（１９９８）

↑台風９９１８号（１９９９）

↑台風０４１８号（２００４）

Damaged area

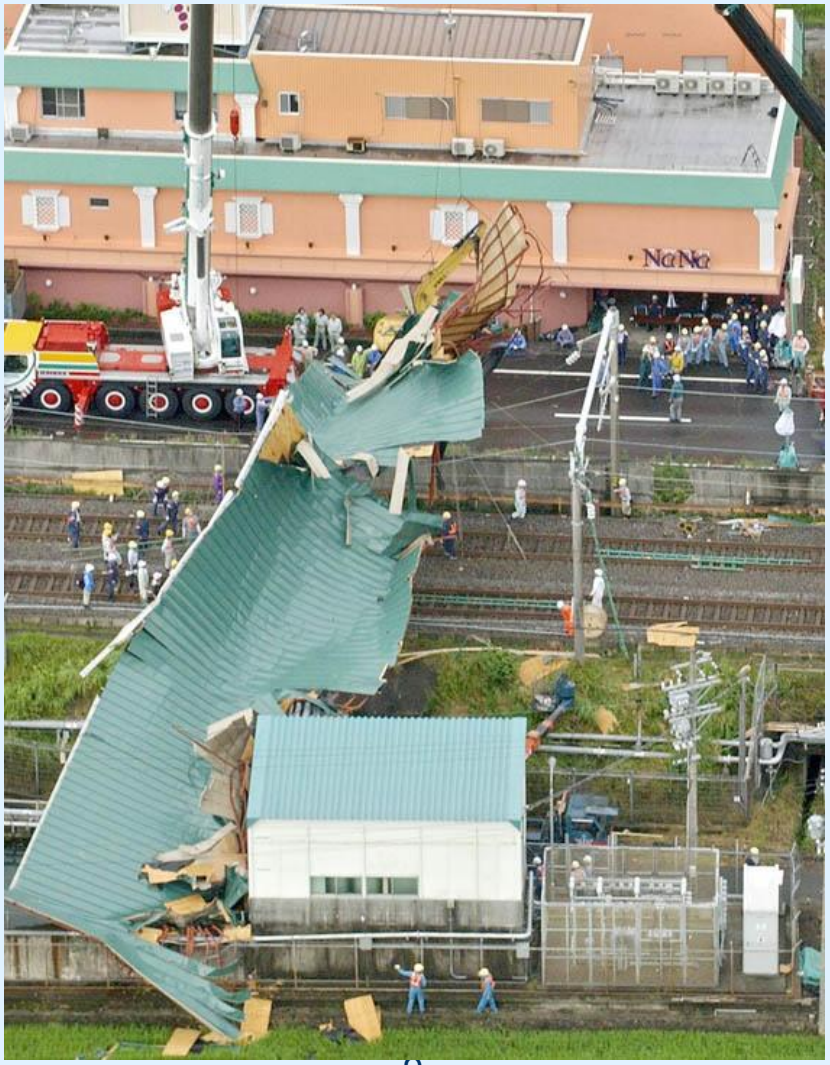


Houses

Roofing

内部

Domino ! (Secondary damage)



Trees

Power lines

Wind turbine

七又風力発電2号機

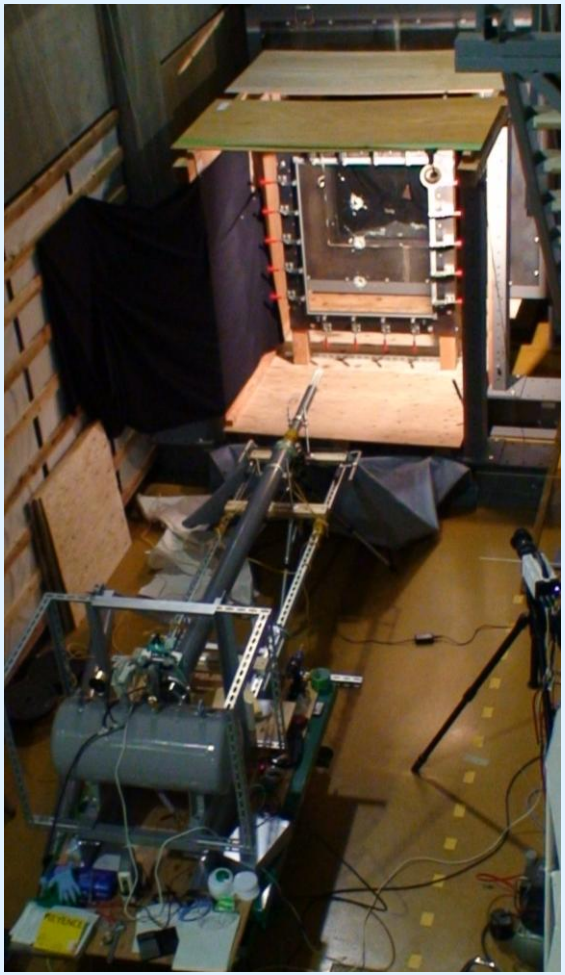
宮古土地改良事業の風力発電機

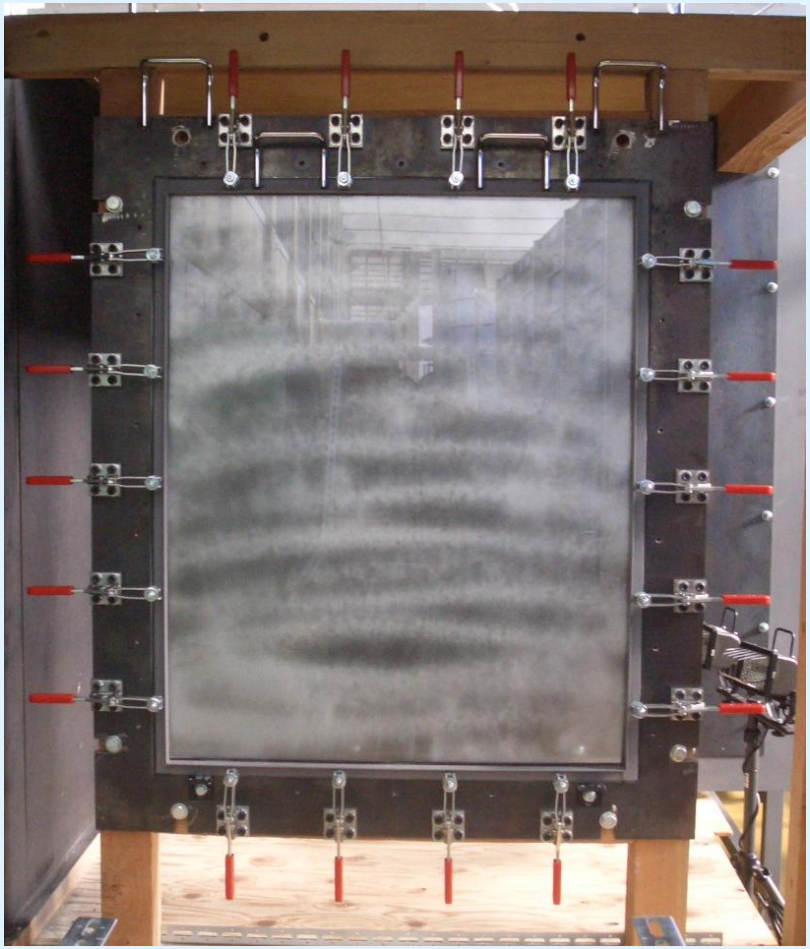
狩俣風力発電5号機（タワー基部）

Light weight house

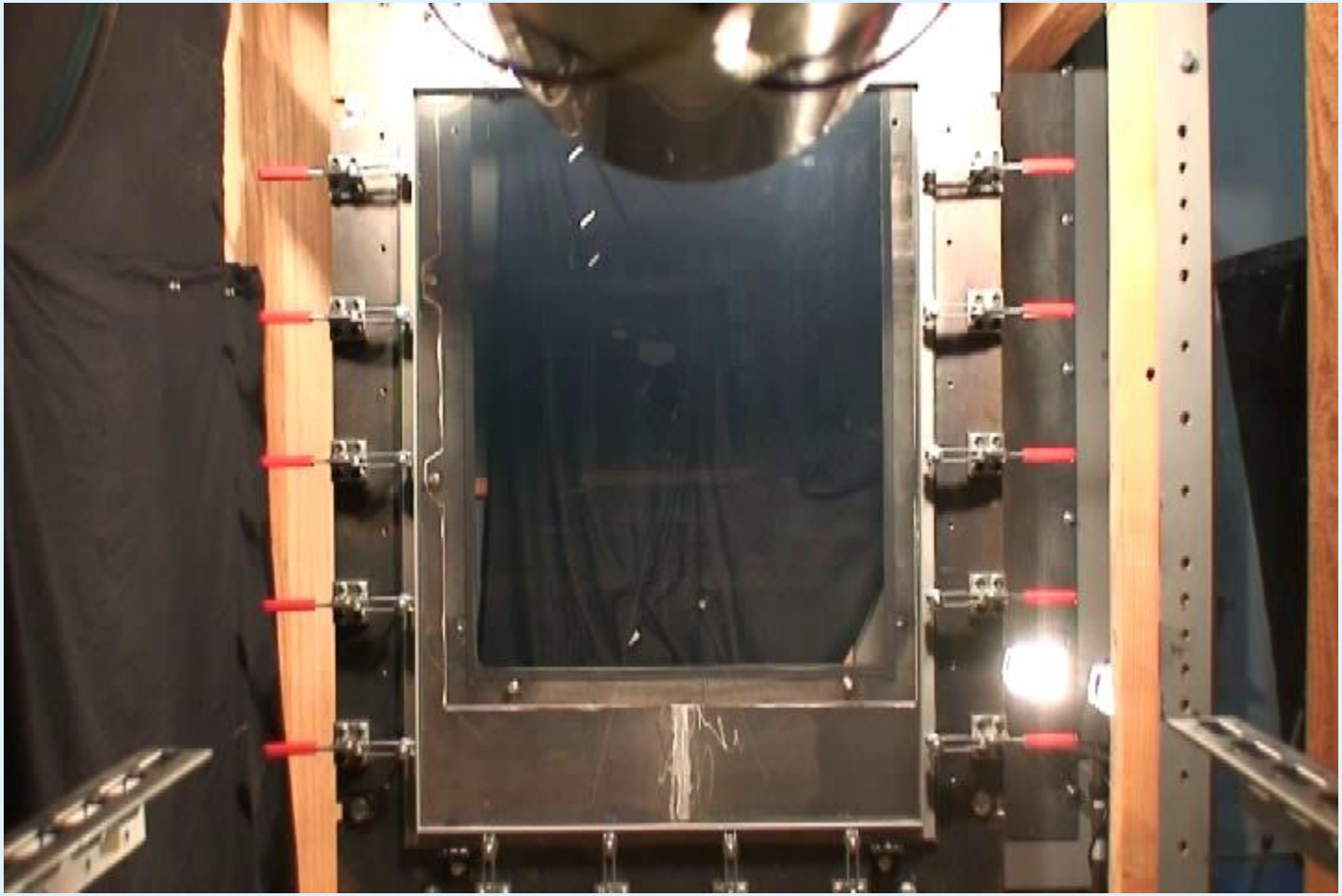
Tornado

Impact test of flying debris





Air cannon



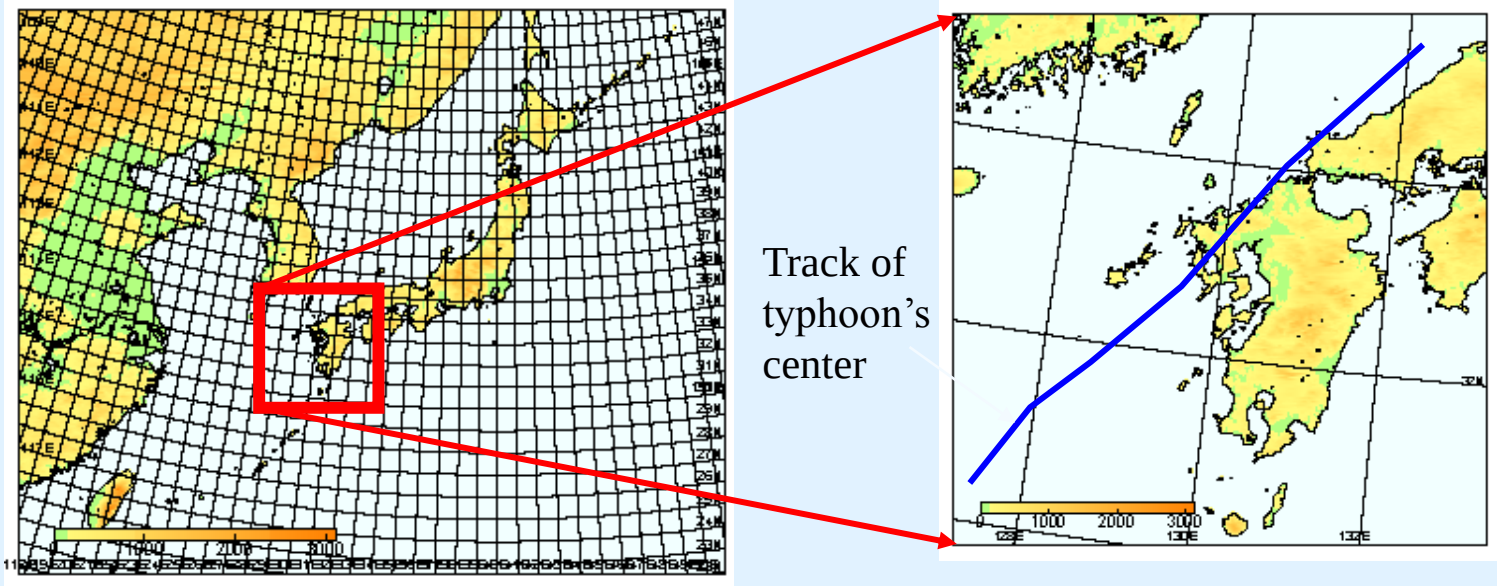
Impact by roof tile

Prediction of strong wind

- **Typhoon**
  - Mesoscale climate model : JMANHM,WRF
  - Observed wind record : NeWMek
- **Tornado**
  - Large Eddy Simulation

Typhoon simulation

Typhoon Songda in 2004

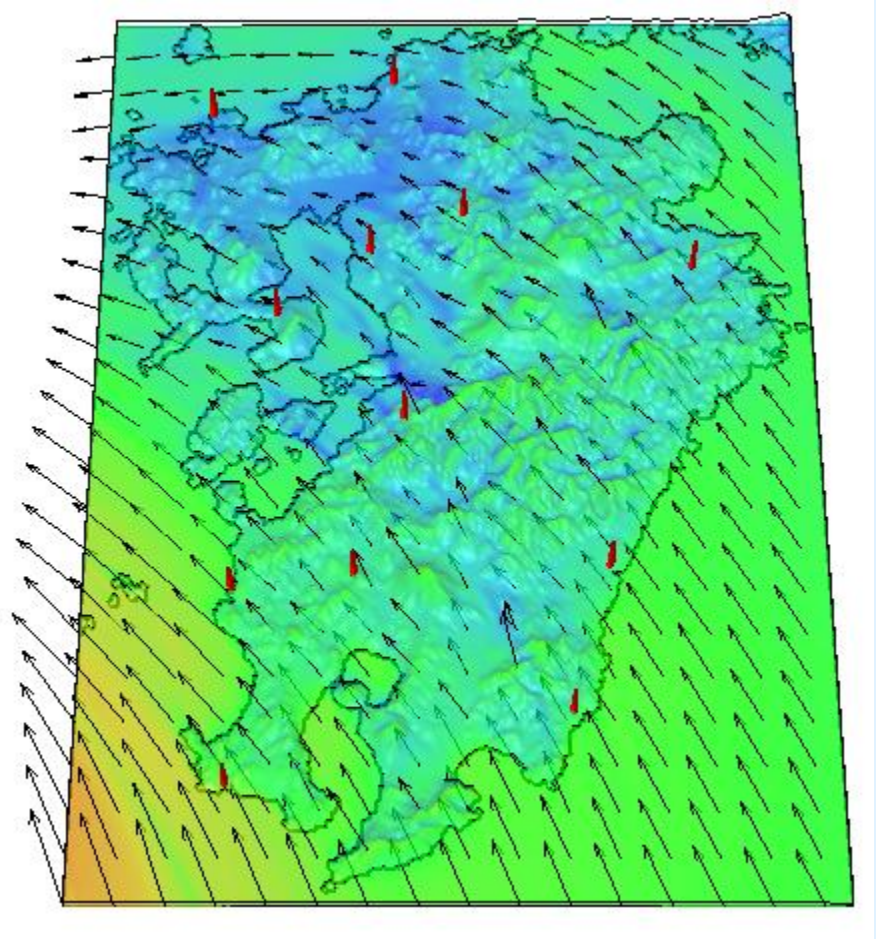


Parent region with 5 km horizontal mesh : 721×577×50 .
Initial condition : interpolated from JMA-RANAL,
Boundary condition : JMA-RSM

Calculation region with 1 km horizontal mesh : 600×600×50

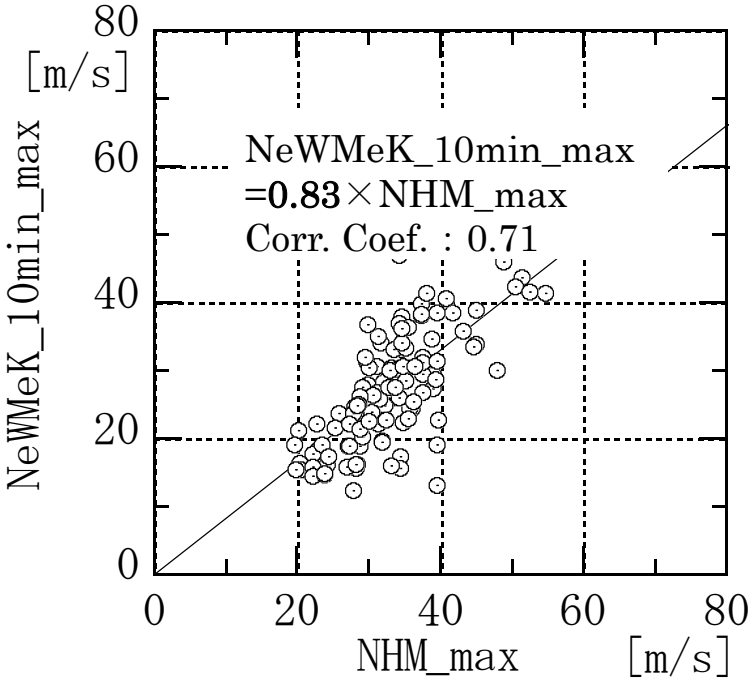
JMANHM, Start at 15:00 UTC on Sep. 6 in 2004, Integrated 15 hours, Output every steps:10 sec.

Wind field at 10m

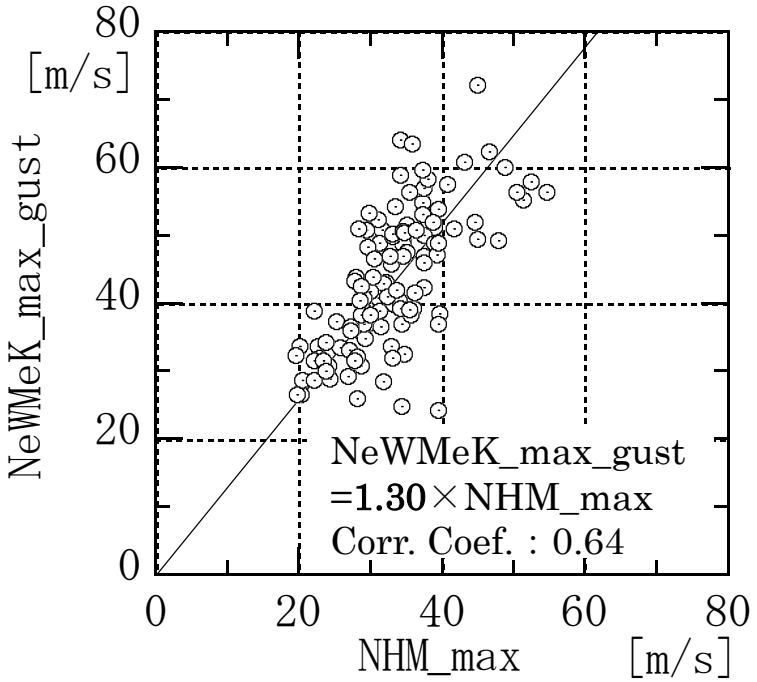


Observation (NeWMek)

Correlation between Simulations and observations



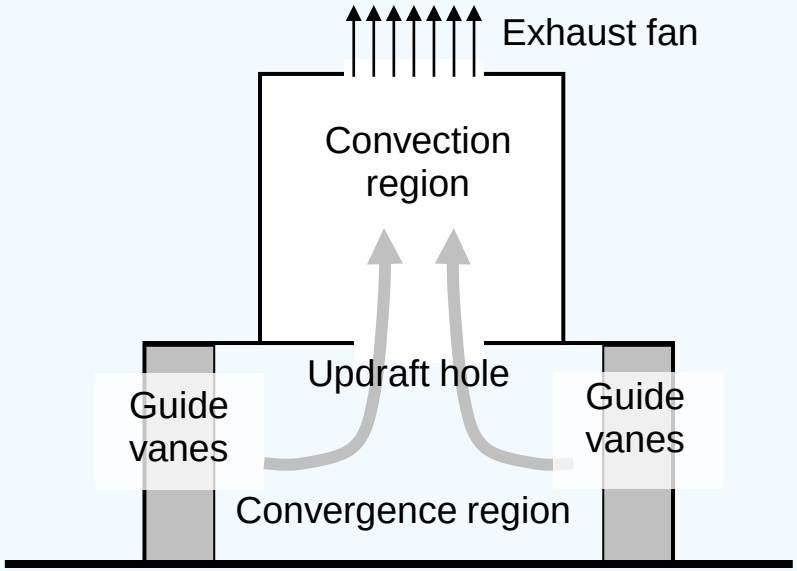
Between maximum values of wind speed (JMANHM) and 10 minute maximum wind speed (NeWMeK)

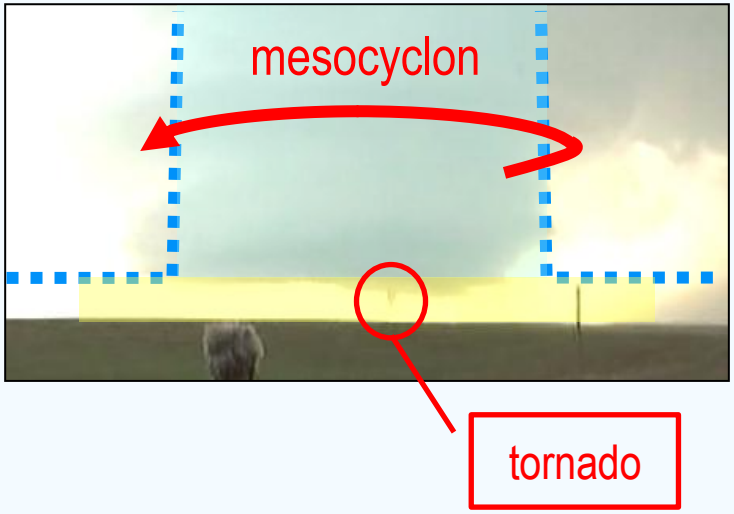


Between maximum values of wind speed (JMANHM) and maximum gust (NeWMeK)

Tornado simulation

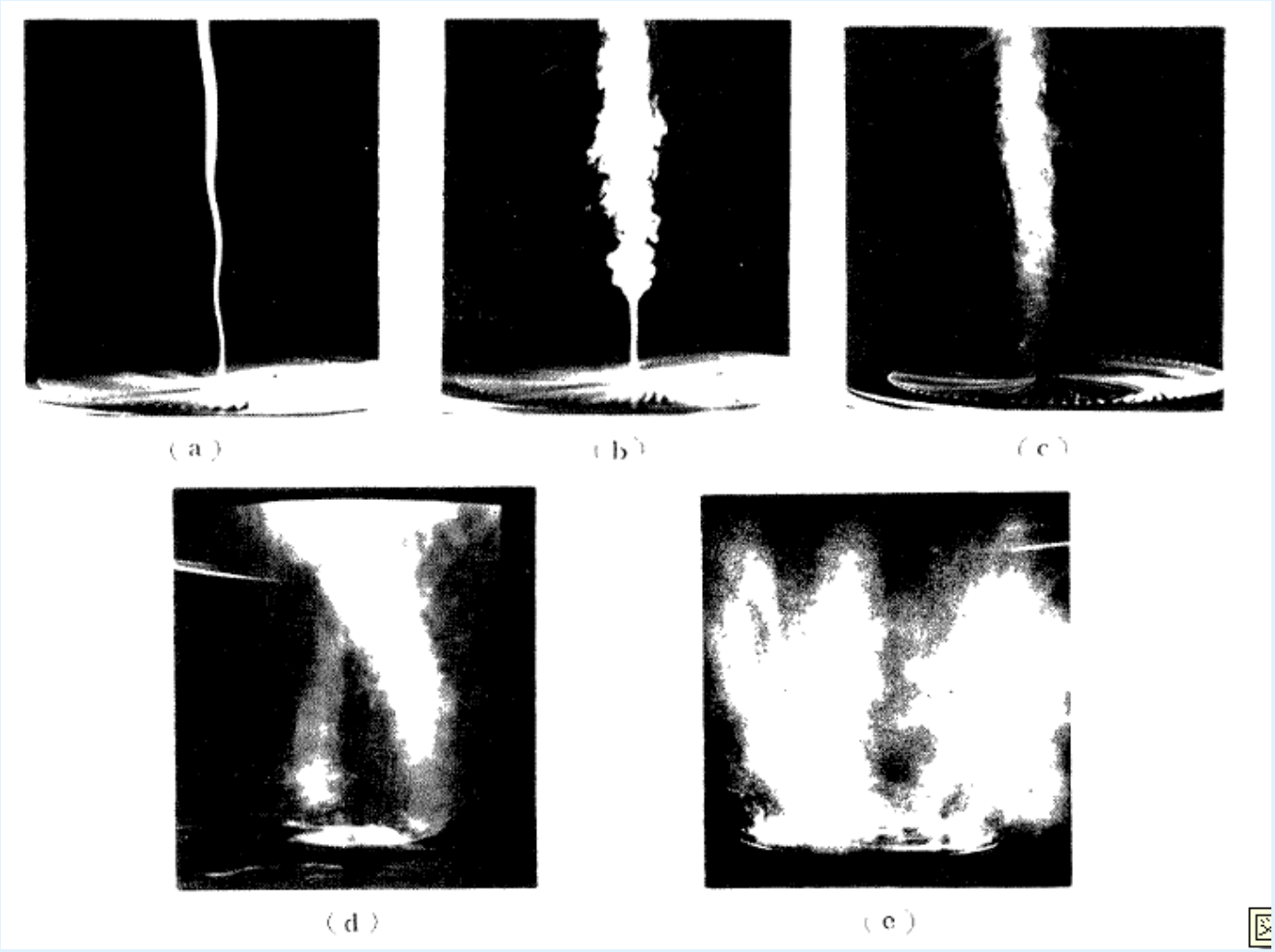
Tornado simulator



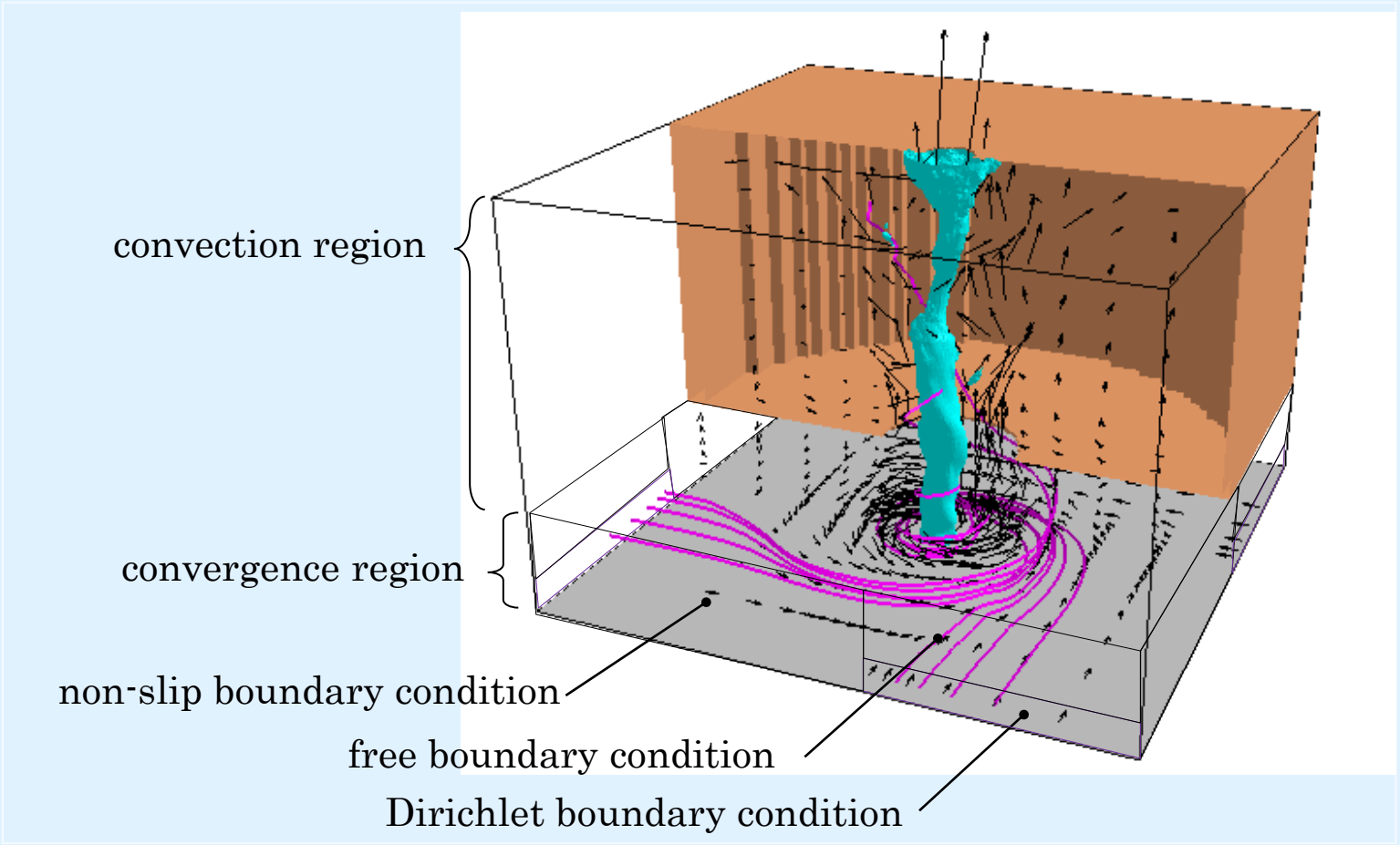


Calculation region : laboratory t ornado simulator
(by Church et. al or by Monji etc.)

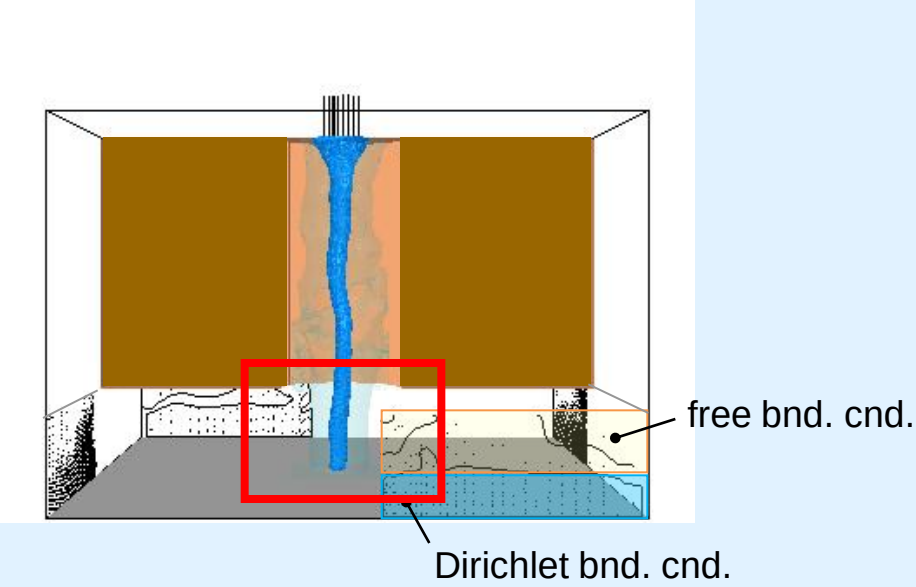
Variety of generated vortices

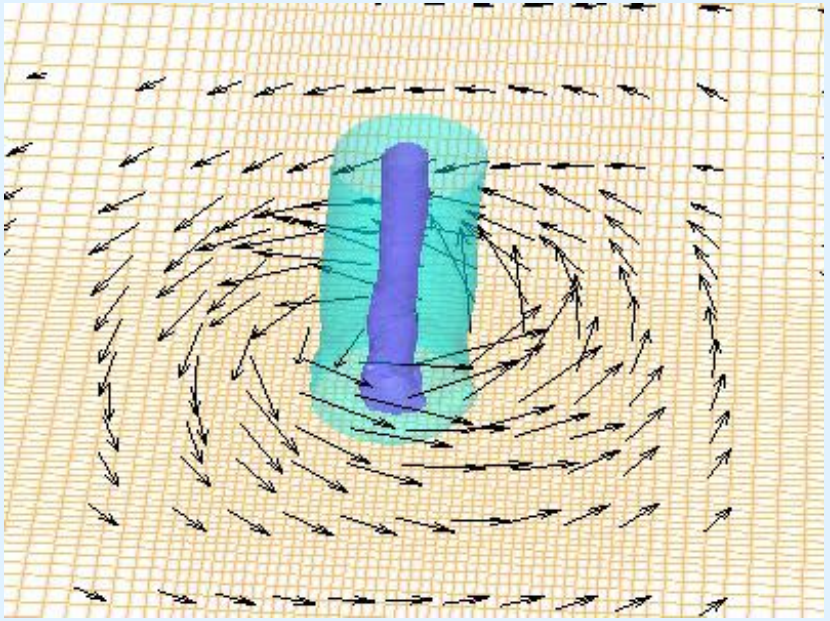


Numerical tornado simulator



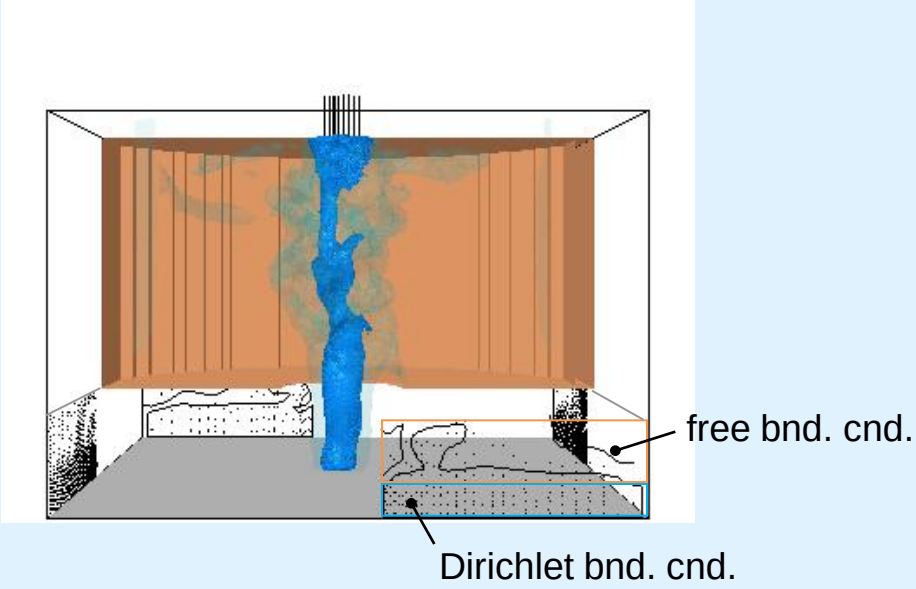
Generated vortex

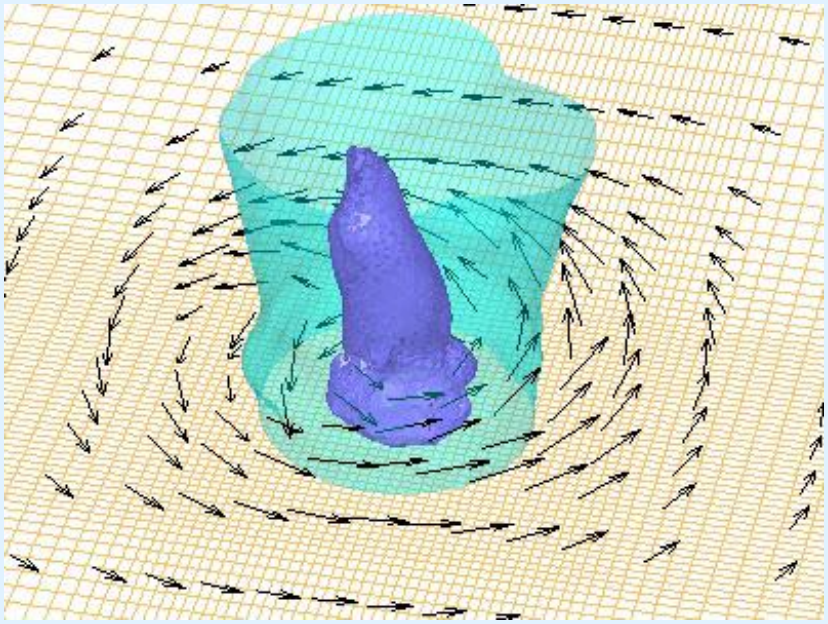




Single core type with no down flow region in the core

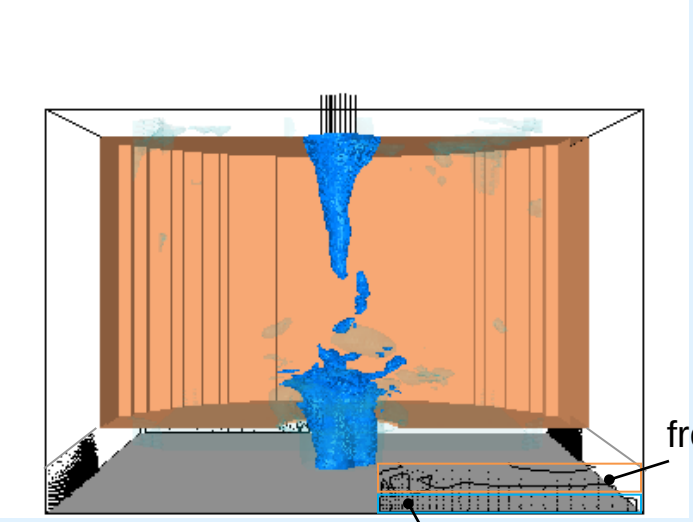
Generated vortex

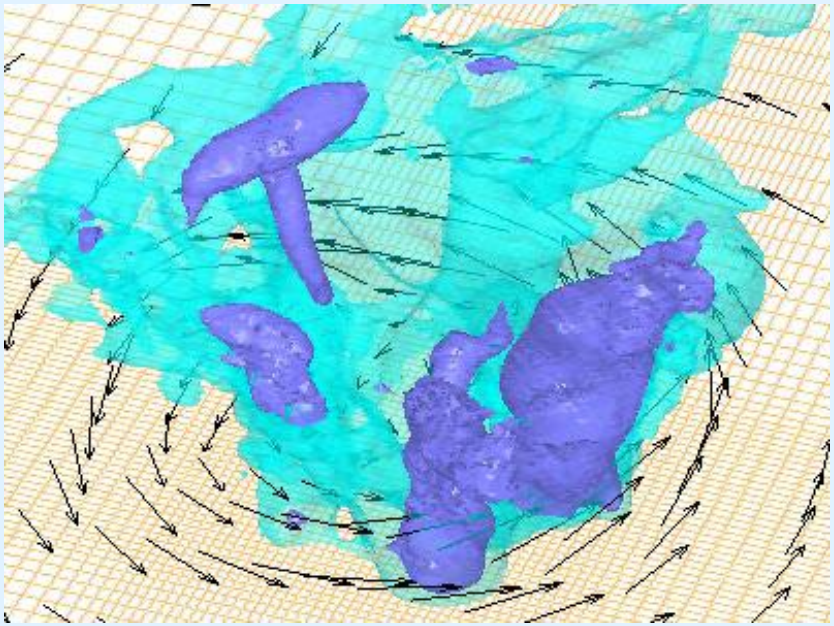




single core type with down flow region in the core
(two cell type → trajectory calculation of debris)

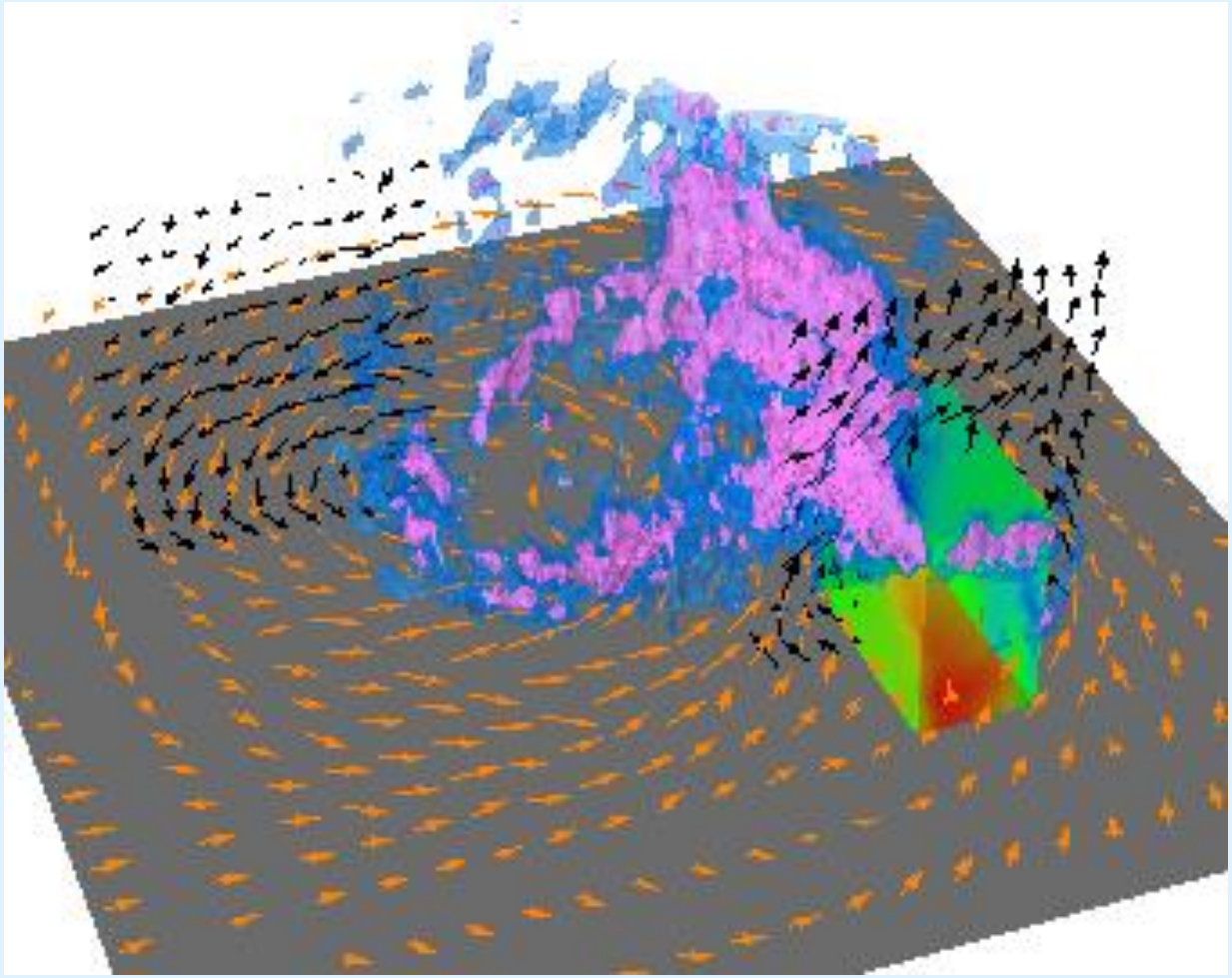
Generated vortex



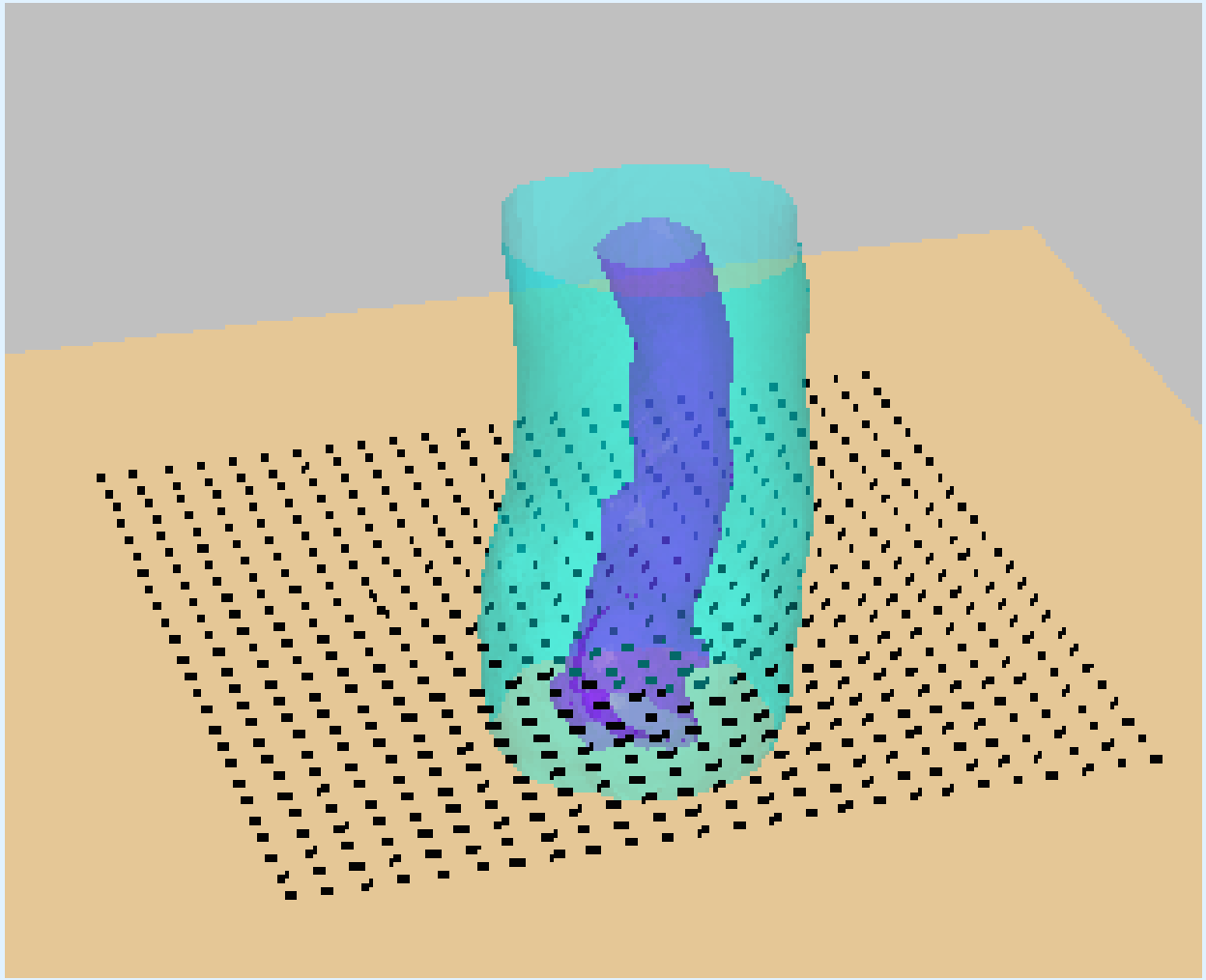


multi-core type

Tornado near structure



Debris in tornado



Summary

□ Strong wind hazard in Japan

- **Strong wind risk of structures in Japan and prediction of strong wind**

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Will be continue to the next presentation by Prof. Nishijima.

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Thank you for your attention !