



Urbanization and Climate Change in South China

Johnny Chan

***Guy Carpenter Asia-Pacific Climate Impact Centre
School of Energy and Environment
City University of Hong Kong***

Outline

- **Background**
- **Effects of urbanization**
- **Evidence**
- **Summary**

Hong Kong



Guangzhou



Urban Area vs. Farmland

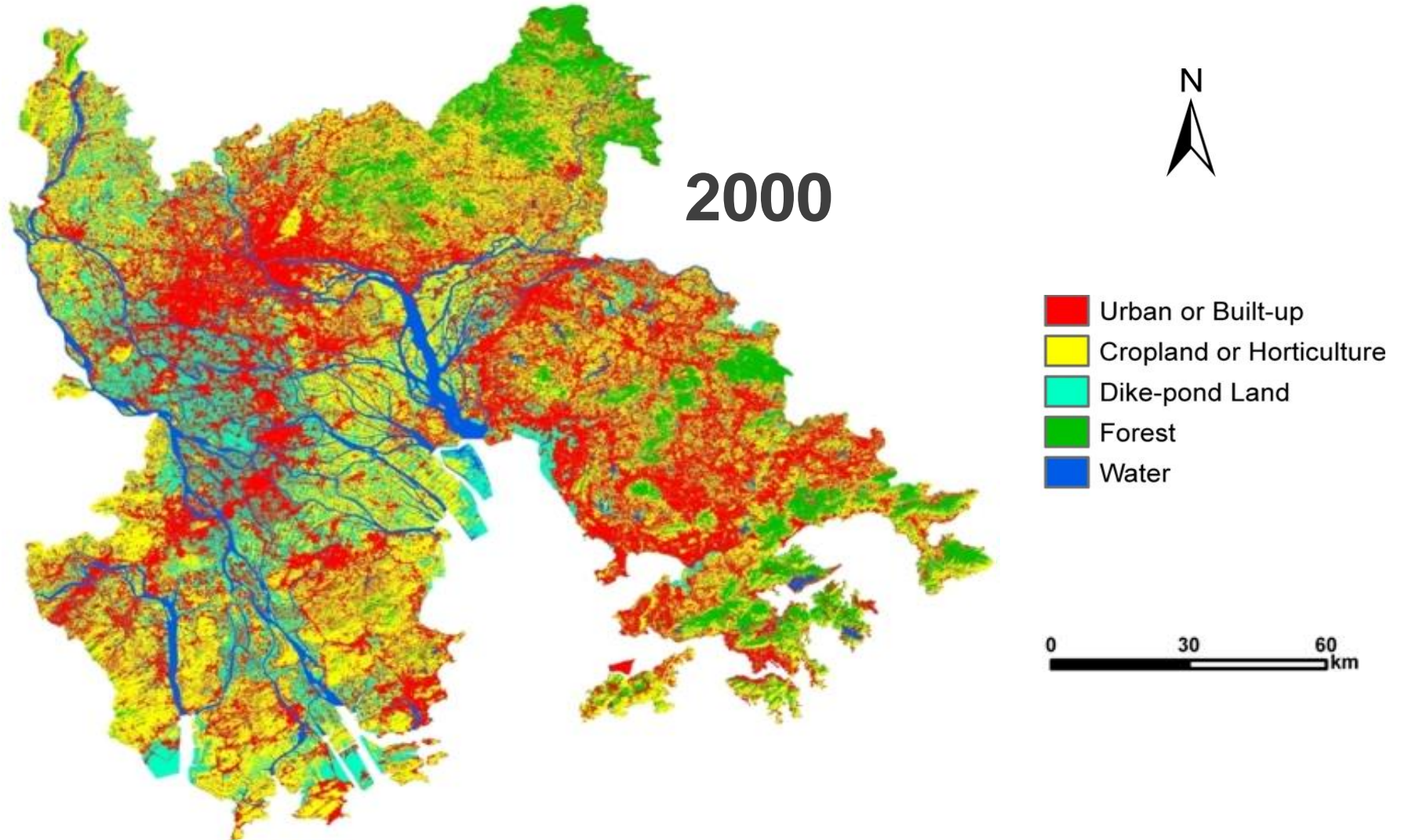
Shenzhen



Farmland in Guangdong

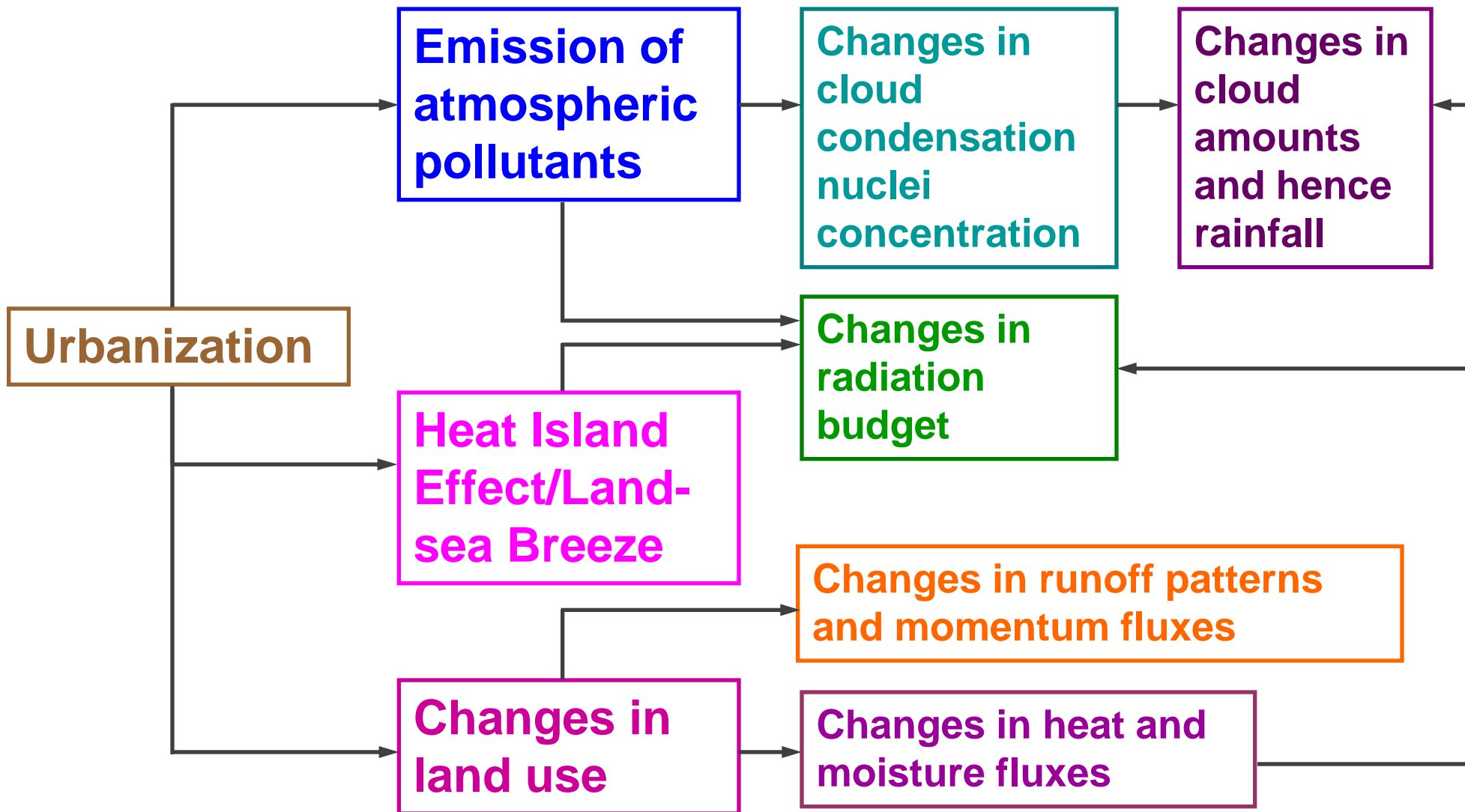


Urban or Built-up Area in the Pearl River Delta

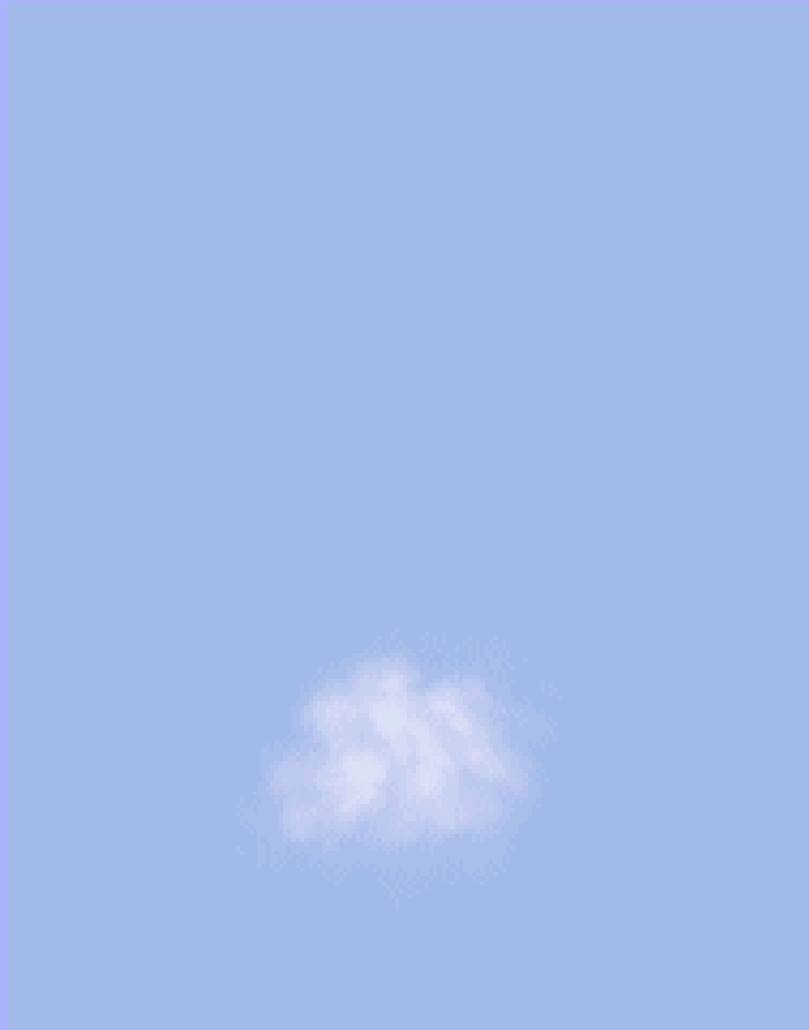


| | | | | | |
|--|------|---|------|---|------|
| Year : | 1980 | → | 1990 | → | 2000 |
| Urban or Built-up (km ²) : | 2230 | → | 3950 | → | 6570 |

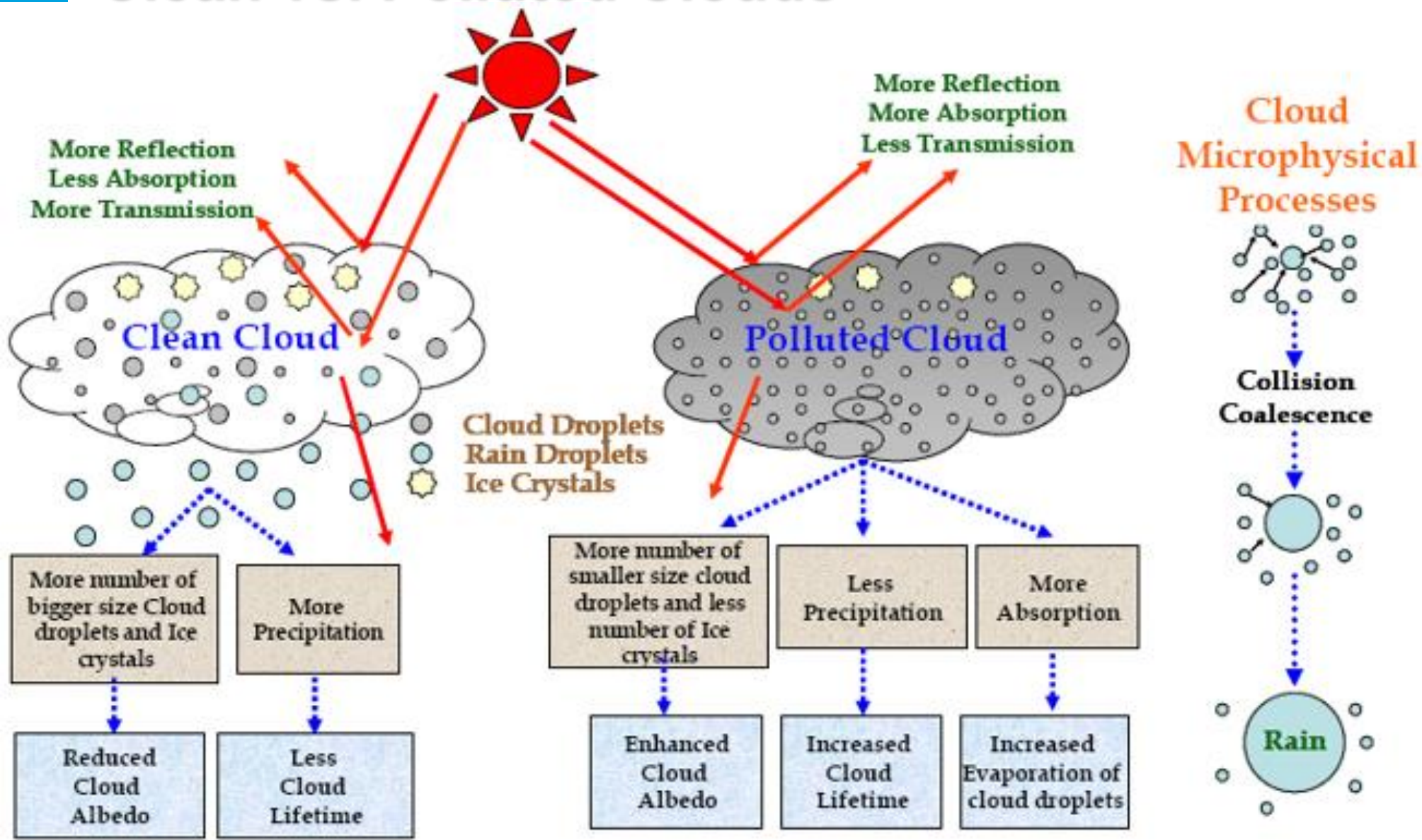
Effects of Urbanization on Climate



Cloud and Rain Formation

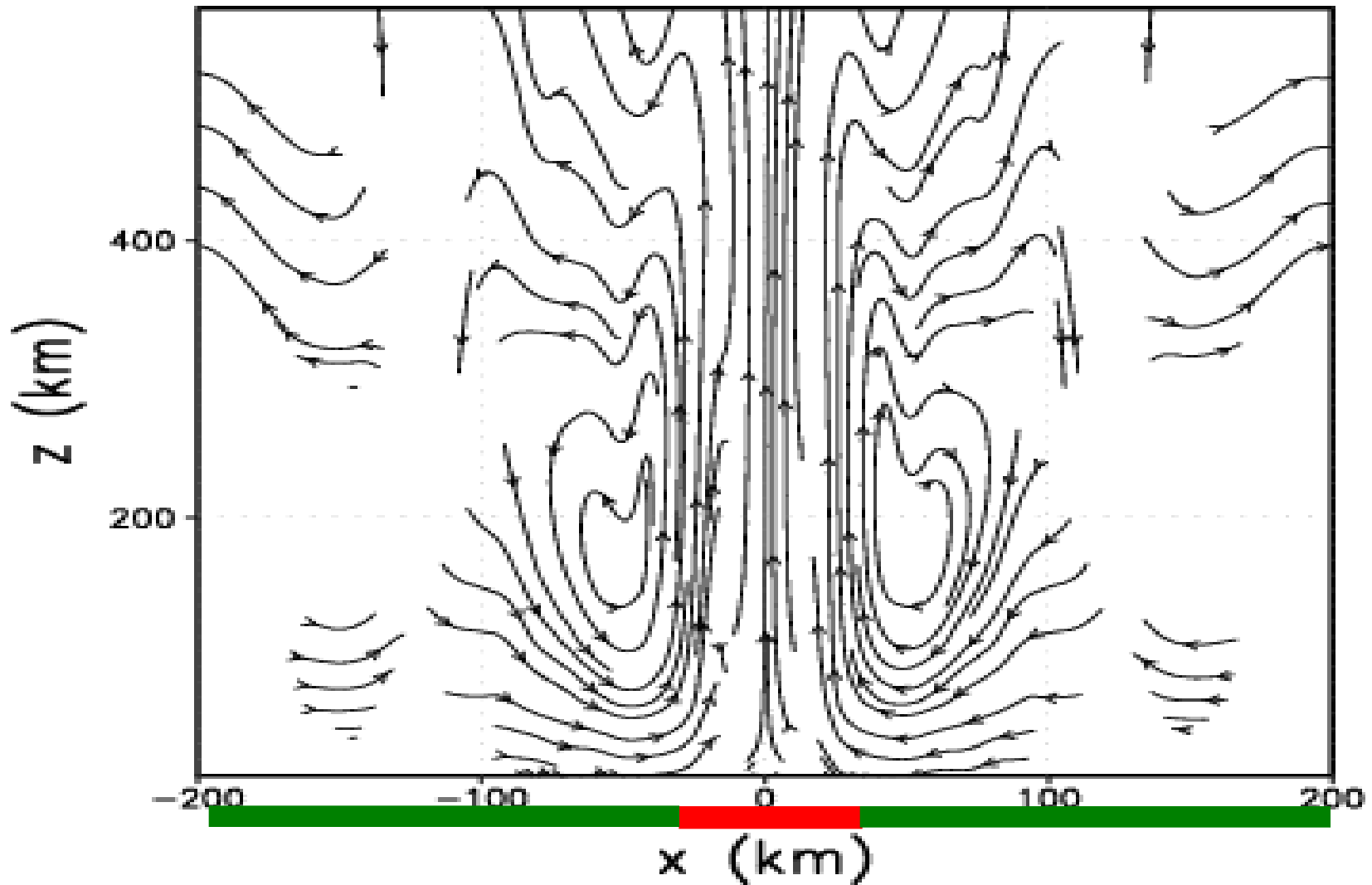


Clean vs. Polluted Clouds

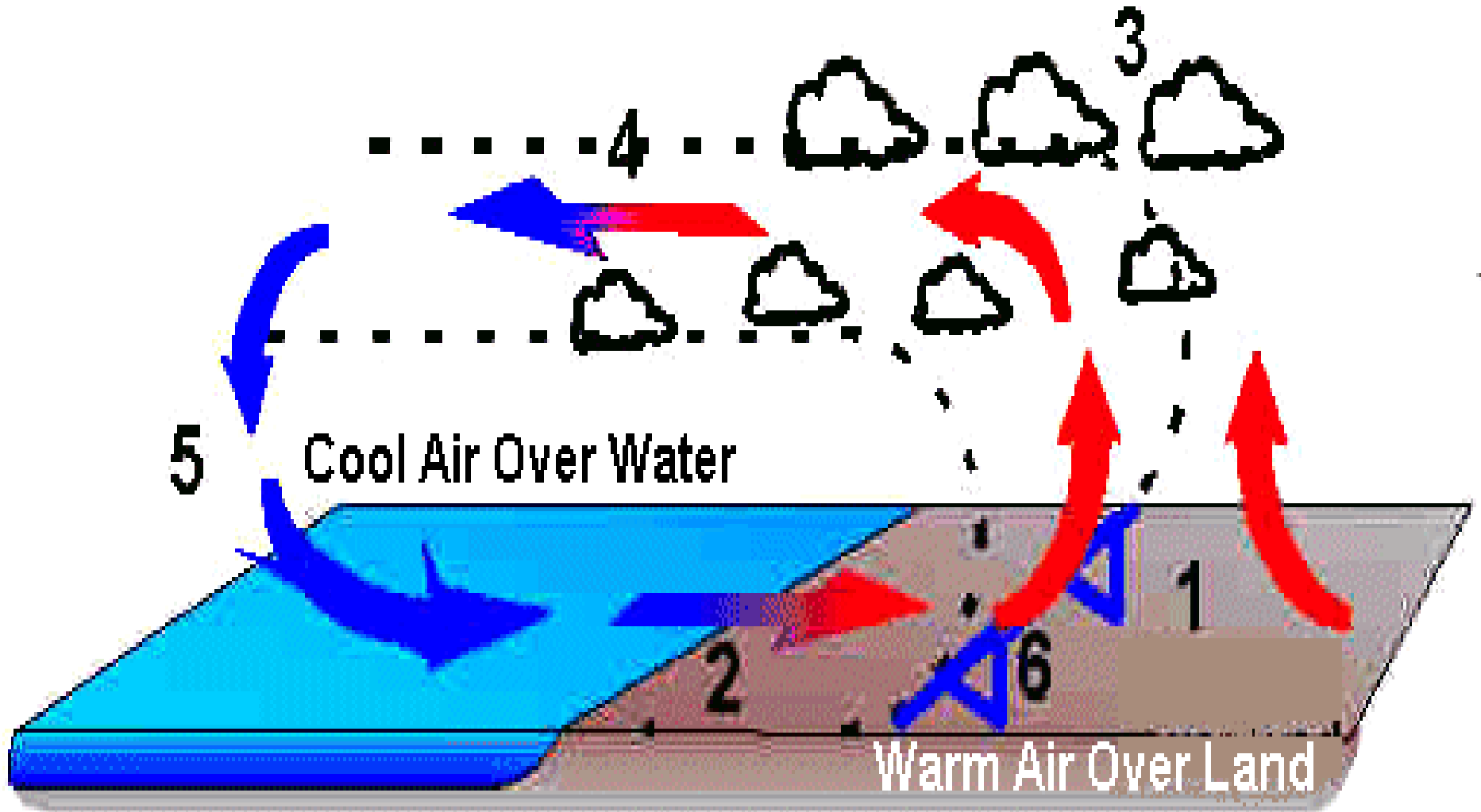


Heat Island Effect

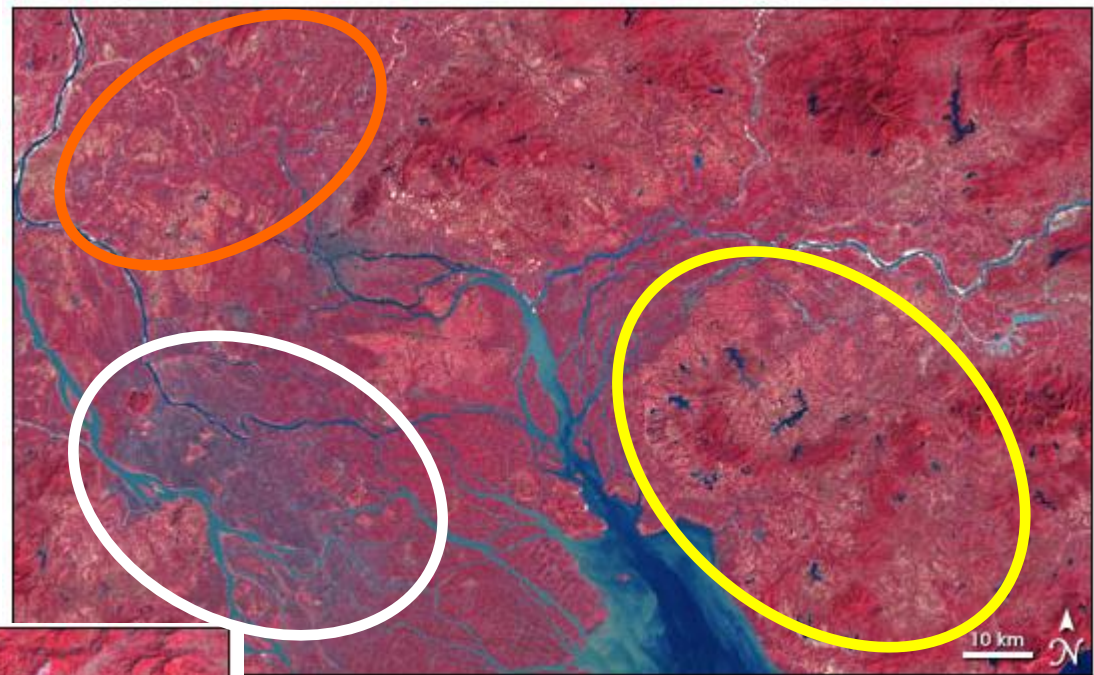
HOUR=00



Land-sea Breeze Circulation



Land Use Changes



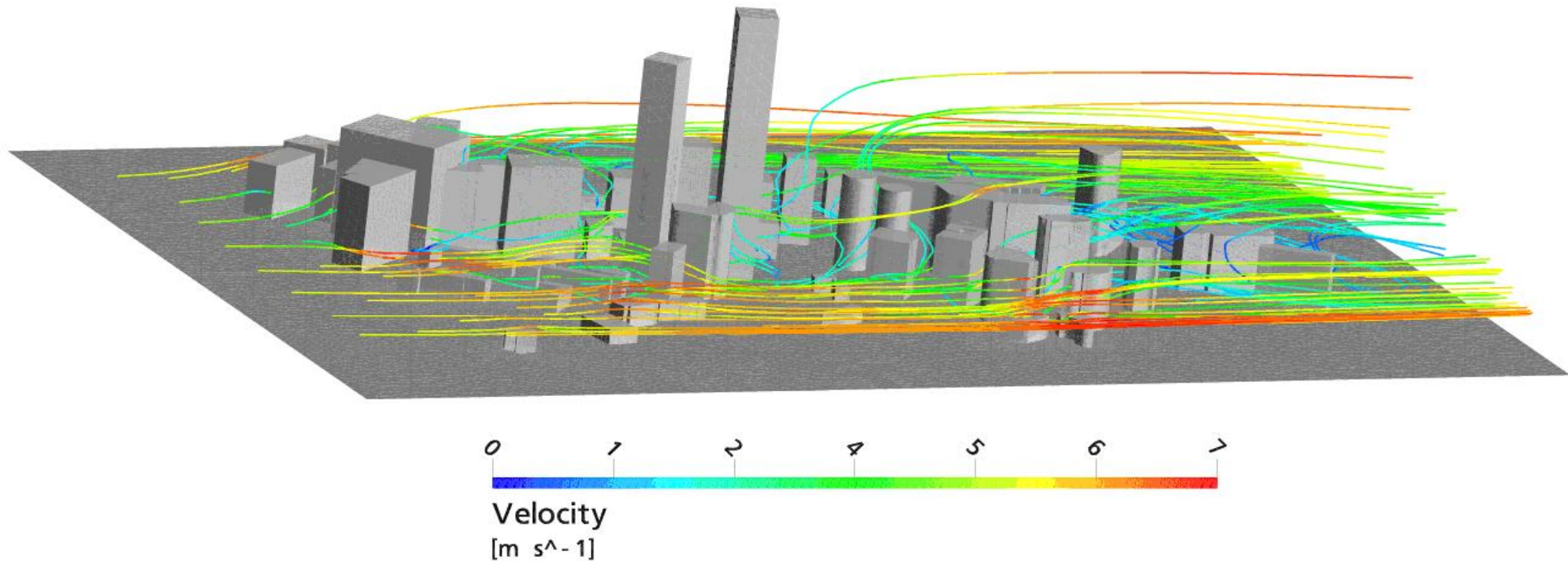
1979



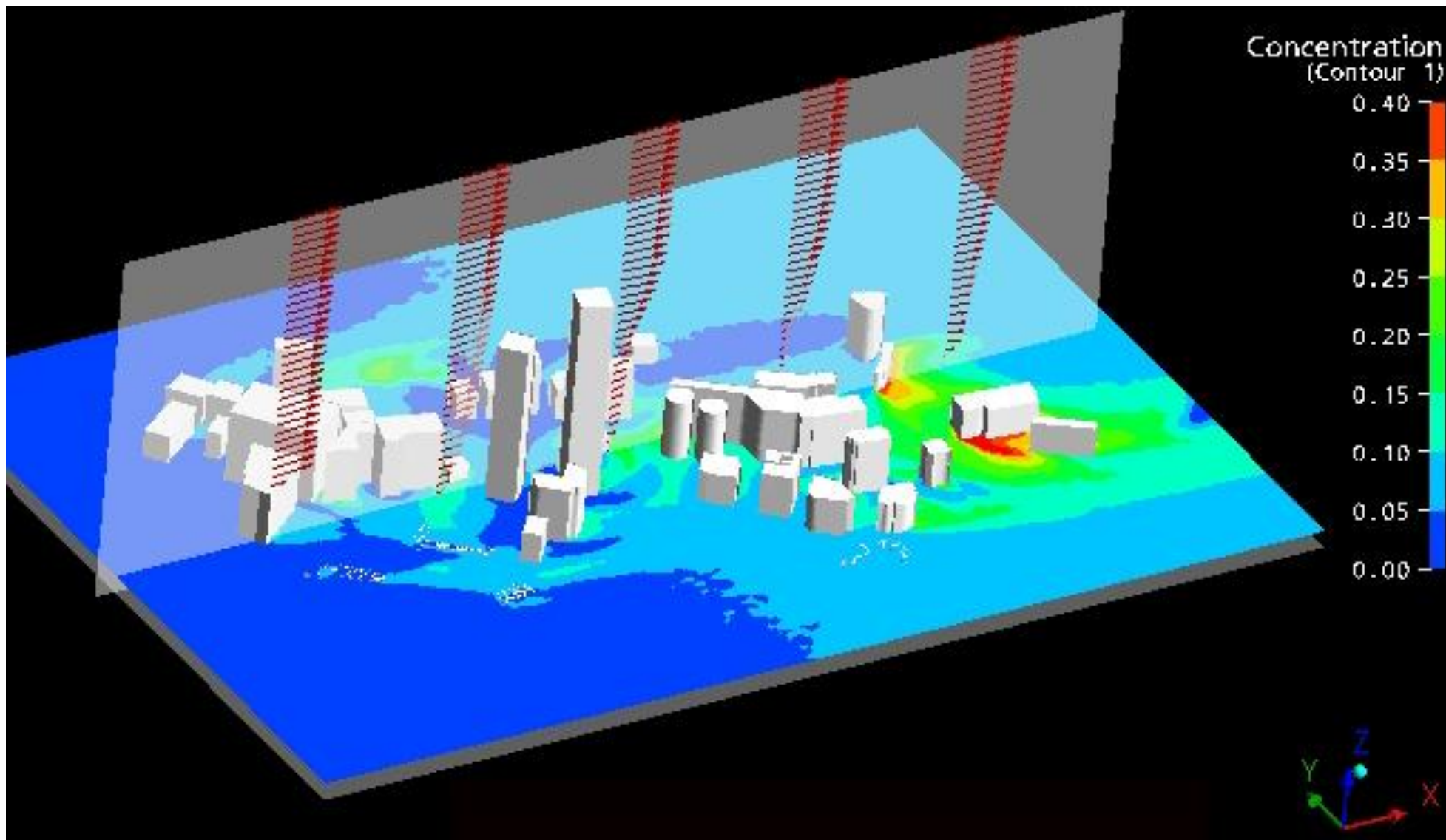
2003

January 10, 2003

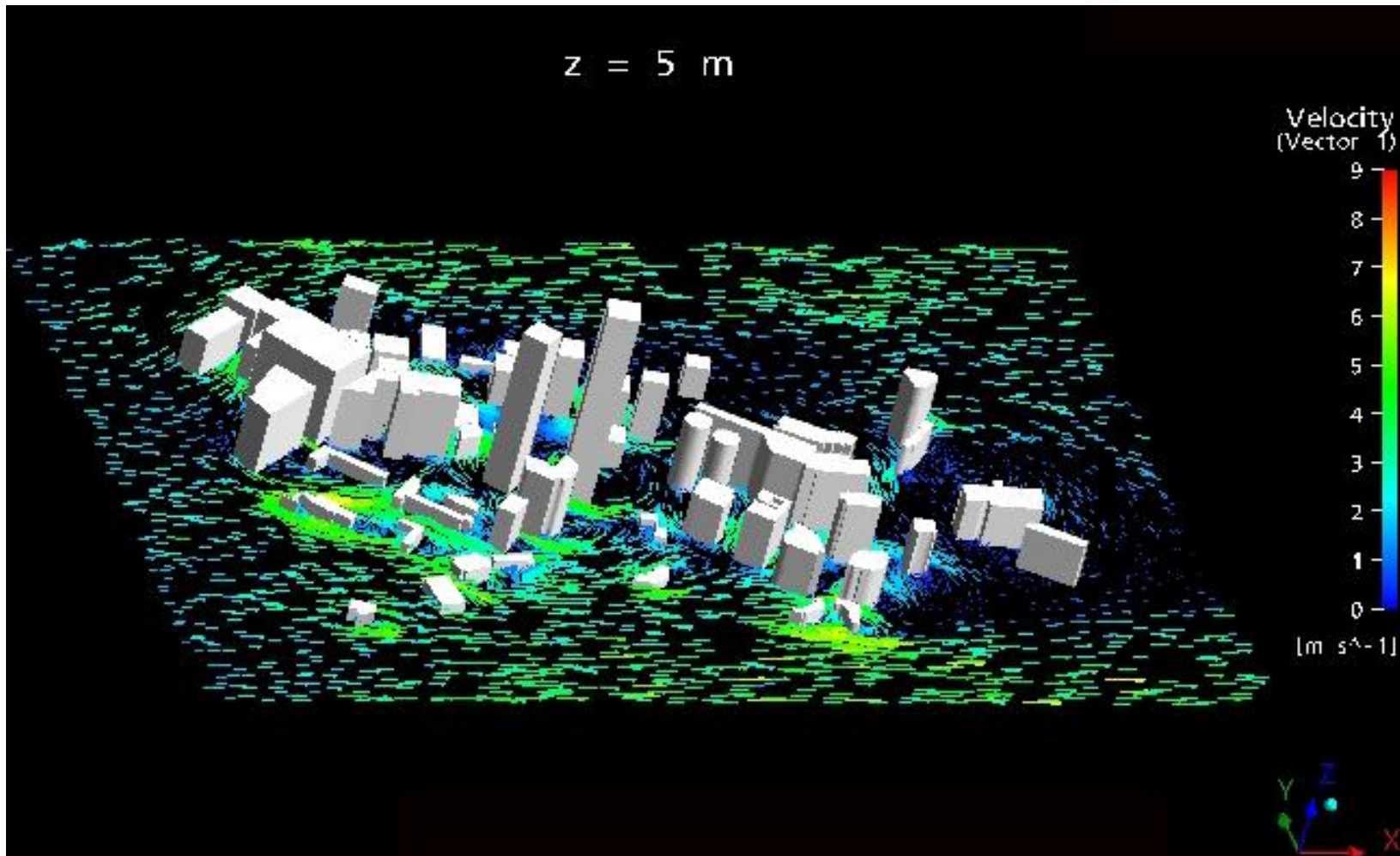
Simulated Flow in a densely built area



Simulated Vertical Wind Profile



Simulated Flow pattern at 5 m



Land-Atmosphere Exchanges

ATMOSPHERE

reduced due
to large
number of
buildings,
especially tall
ones

momentum
exchange



increased due
to heat island
effect

heat
exchange



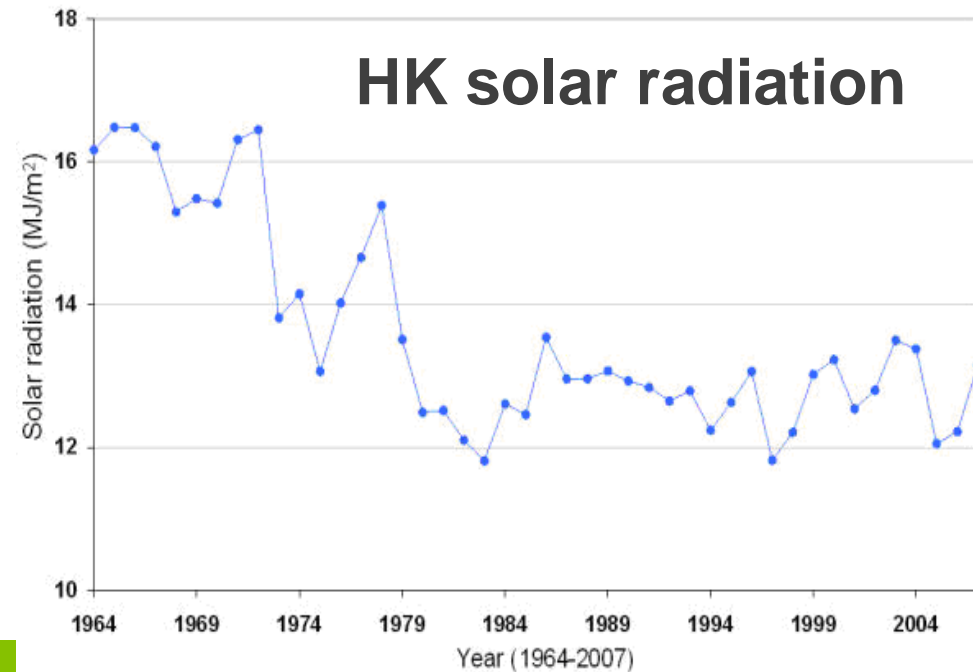
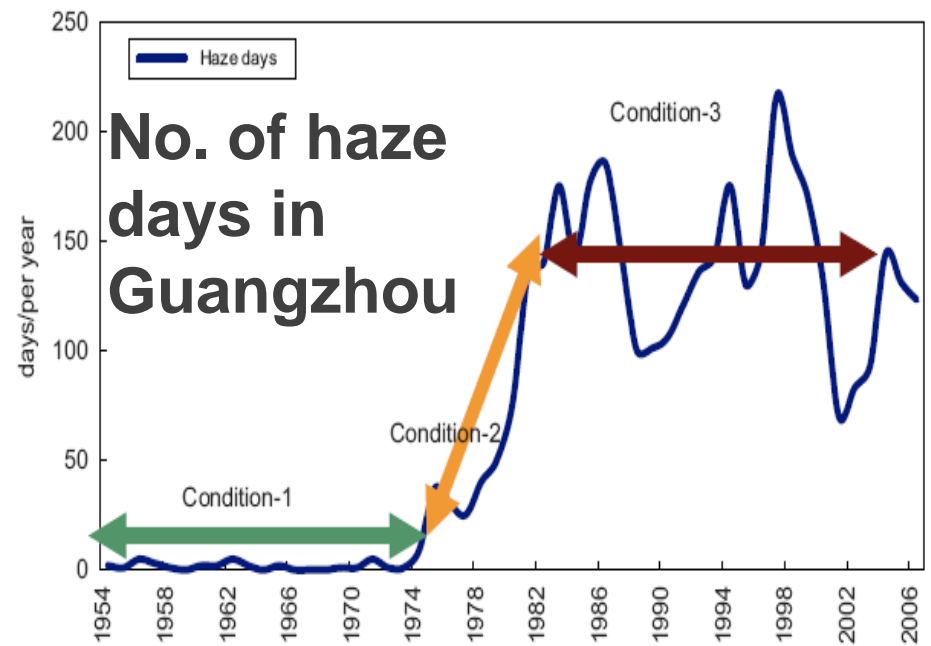
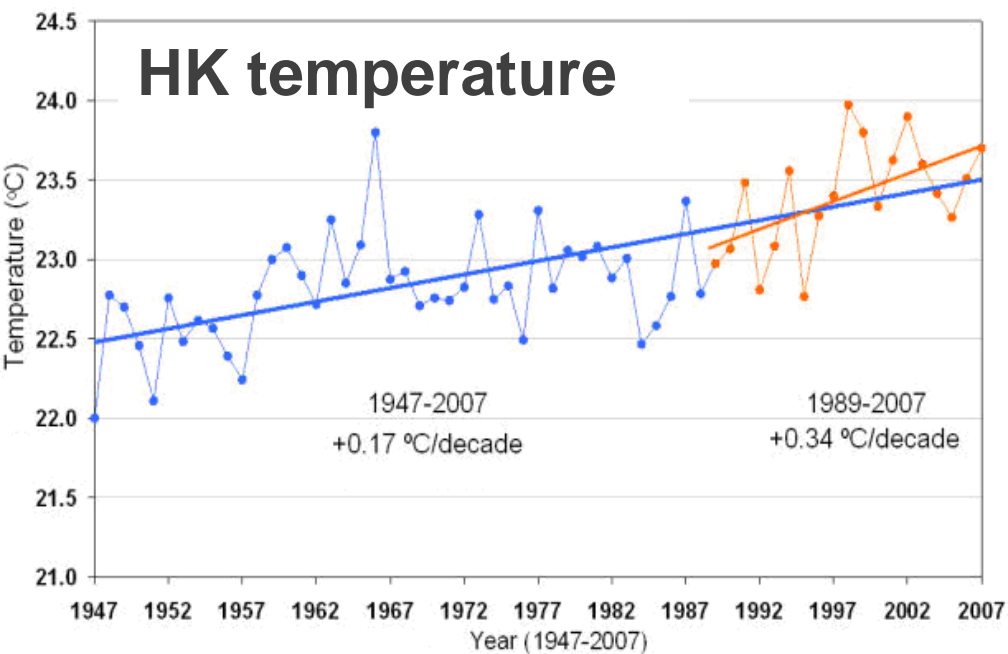
evaporation

reduced due to
increase in paved
land vs. soil

absorption of
rain water

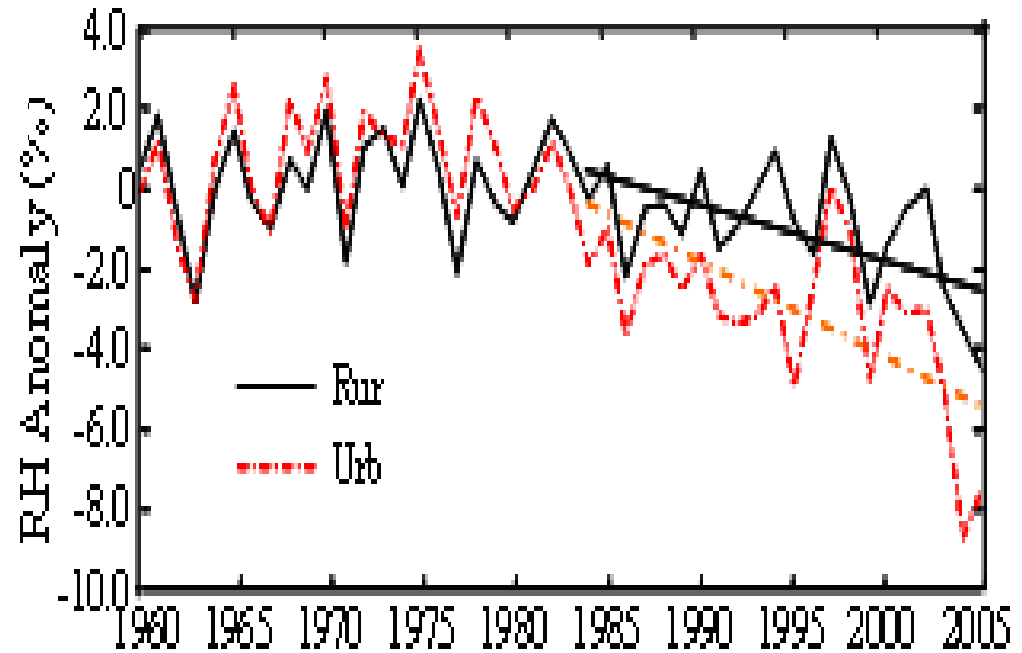


LAND

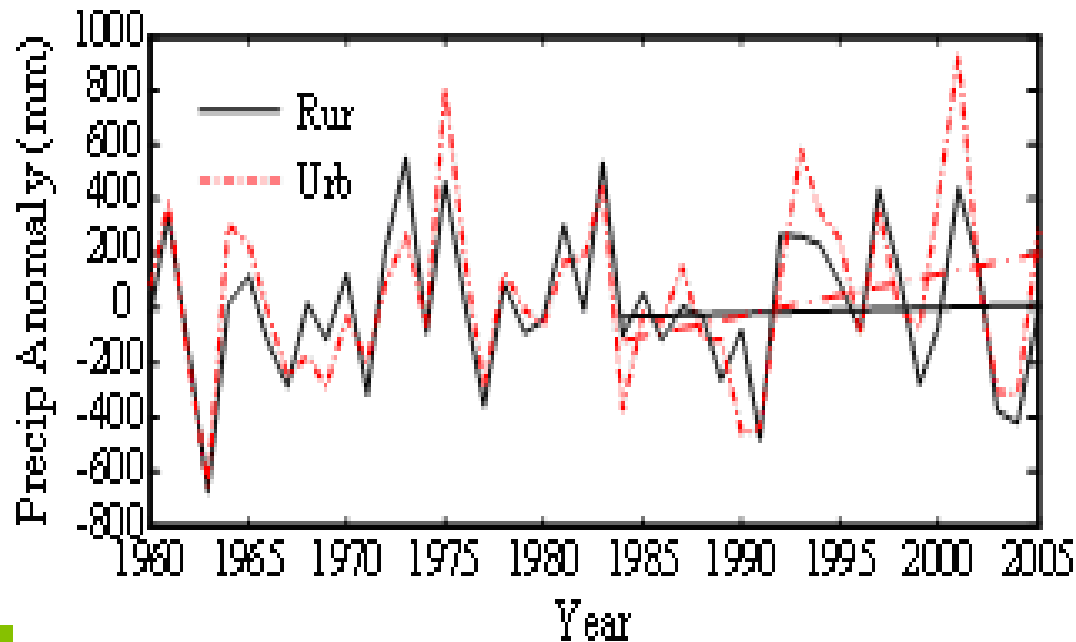


**Climate Change
in the PRD
(related to
radiation)**

PRD relative humidity



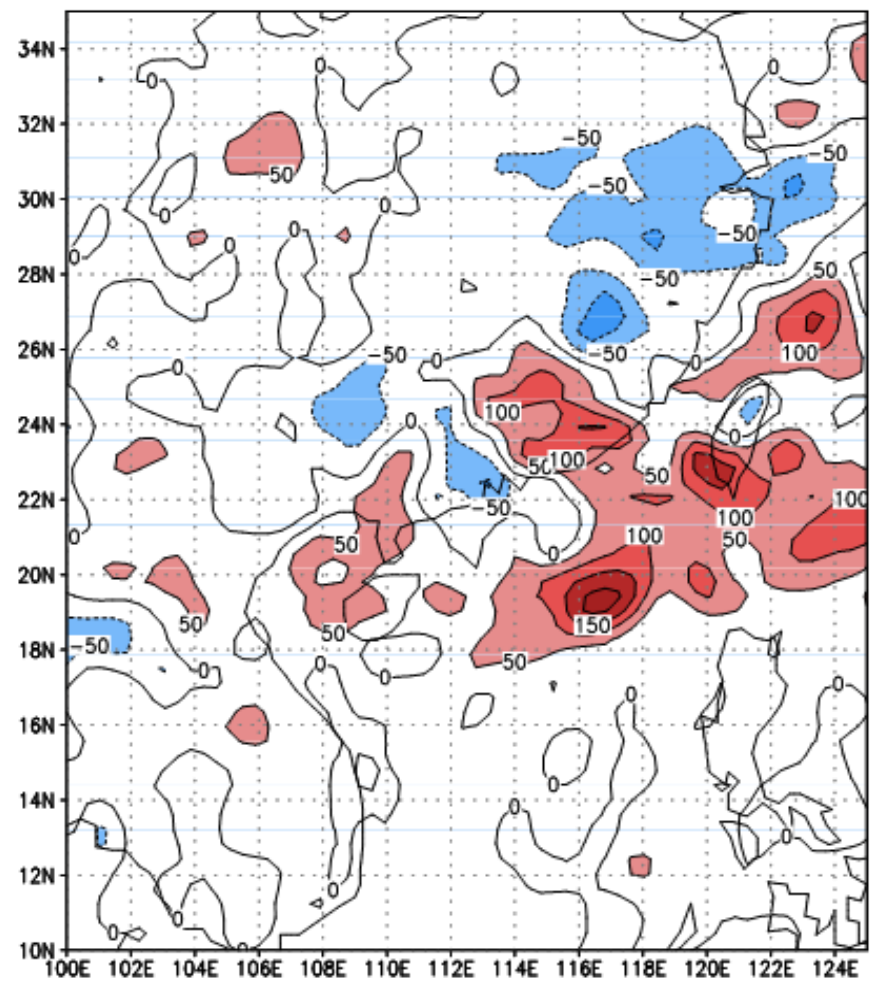
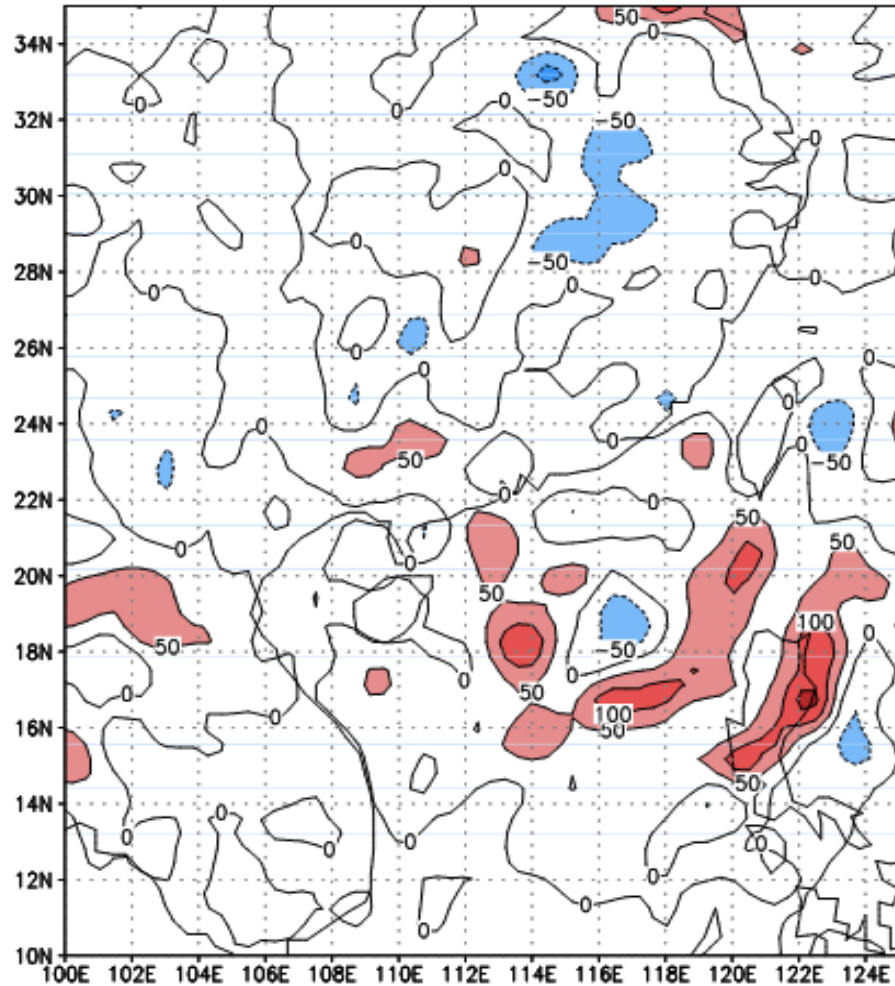
PRD rainfall



**Climate Change
and Urbanization
in the PRD
(related to water)**

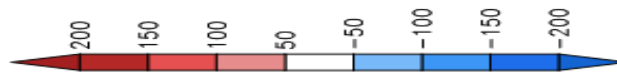
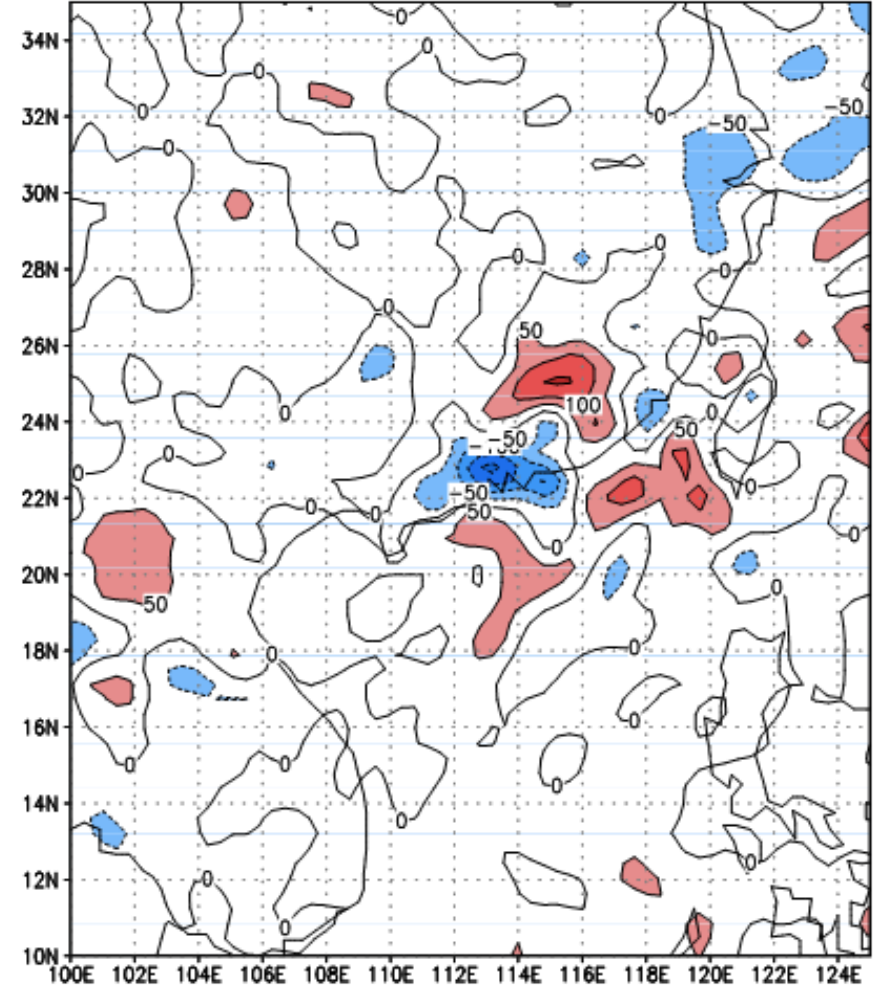
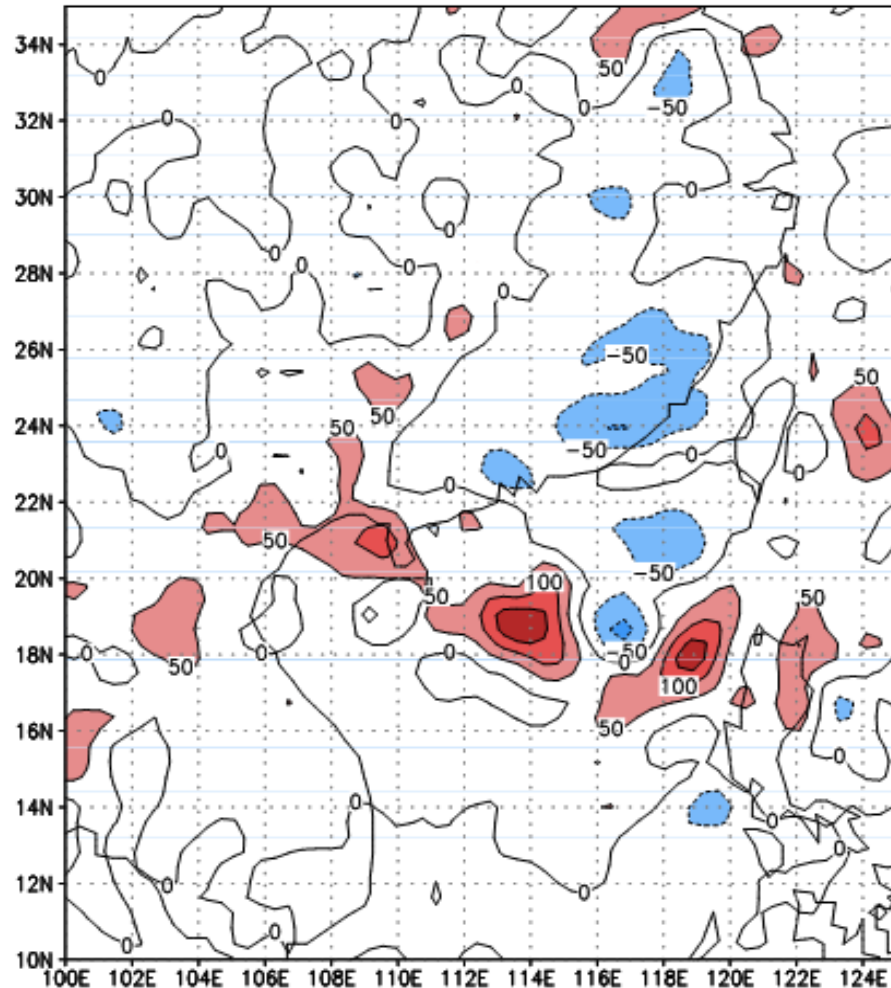
Effect of increasing the roughness of the Earth's surface on rainfall

Total Diff in May 1998 (mm) (Rough-Ctrl) Total Diff in June 1998 (mm) (Rough-Ctrl)



Effect of turning off the moisture flux on rainfall

Total Diff in May 1998 (mm) (Noqflx-Ctrl) Total Diff in June 1998 (mm) (Noqflx-Ctrl)



Summary

- **Urbanization causes substantial changes in the energy balance of the region**
- **Such changes in energy balance will cause changes in wind flow patterns, not only within the region but also those areas downstream of the urbanized region.**
- **A comprehensive study of the effects of urbanization on regional climate needs to be carried out to quantify such effects.**
- **How such effects may be modified under global warming also needs to be ascertained.**