Climate Modeling

Chapter 3. Fundamental analysis of climate data

Chapter 4. Regional climate change projections

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Outline

Lecture 6

- 3.1 Statistical analysis of four-dimensional atmospheric data

Lecture 7

- 3.2 Statistical analysis of global climate projection data

Lecture 8

- 4.1 Statistical downscaling

3.2 Statistical analysis of global climate projection data

4.1 Statistical downscaling

Climate Projection data

- Models run: Continuously Run
  - Period of running:
    - Initial time: at certain time in the past
    - End time: at certain time in the future
    - Duration: Decades to hundreds of years, including present and future periods
  - Present Climate simulation:
    - Including Baseline period
    - Based on the “observed data” of Greenhouse Gass emissions
  - Future Climate projection:
    - Based on the Greenhouse Gass emission Scenarios: RCP4.5, RCP8.5,…

Climate Projection data

- Extract data for analysis
  - Determine the baseline period
  - Determine the future time slices
    - Duration of each future time slice must be equal to the duration of baseline period
    - For example:
      - Baseline period: 1986-2005 (20 years)
      - Future periods: 2036-2055 or 2046-2065, 2076-2095 or 2080-2099, … (20 years)
  - Determine what characteristics will be calculated
    - Annual, monthly mean, Extreme Indices, Extreme events,…
    - For example: Drought Indices

Examples: Data

- Observations:
  - The VnGP gridded observation rainfall data
  - The APHRODITE gridded observation temperature data
- Projection Data:
  - Gridded rainfall and temperature downscaled from global models by the RegCM for different scenarios and for present and future periods

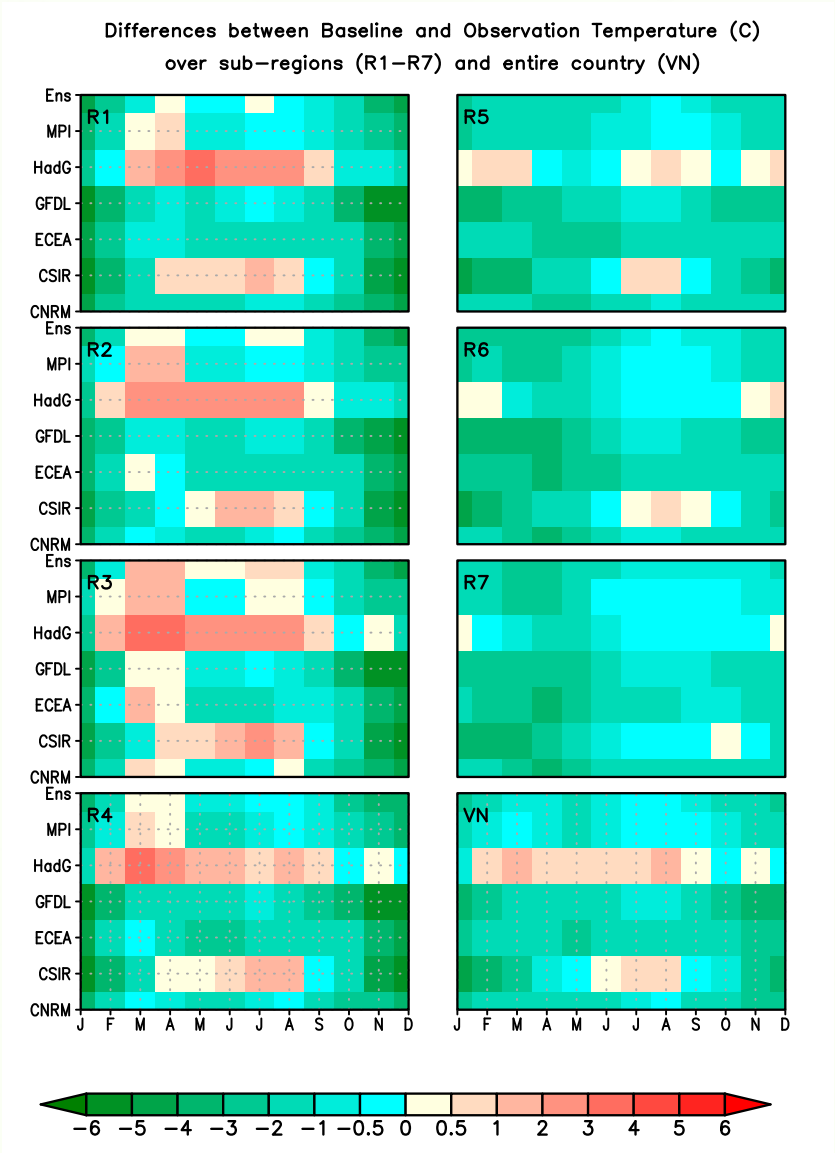
No	CMIP5 GCM	Country and Institution developed the GCMs	Horizontal Resolution	Note for RegCM outputs
1	CNRM-CM5	Centre national de Recherches Meteorologiques, France	1.41×1.41	CNRM
2	HadGEM2	Hadley Centre, UK	1.25×1.875	HadG
3	MPI-ESM-MR	Max Planck Institute for Meteorology, Germany	1.875×1.875	MPI
4	EC-Earth	EC-Earth consortium, EU	1.125×1.125	ECEA
5	CSIRO	CSIRO, Australia	1.875×1.875	CSIR
6	GFDL-ESM2M	GFDL, USA	2.5×2.0	GFDL

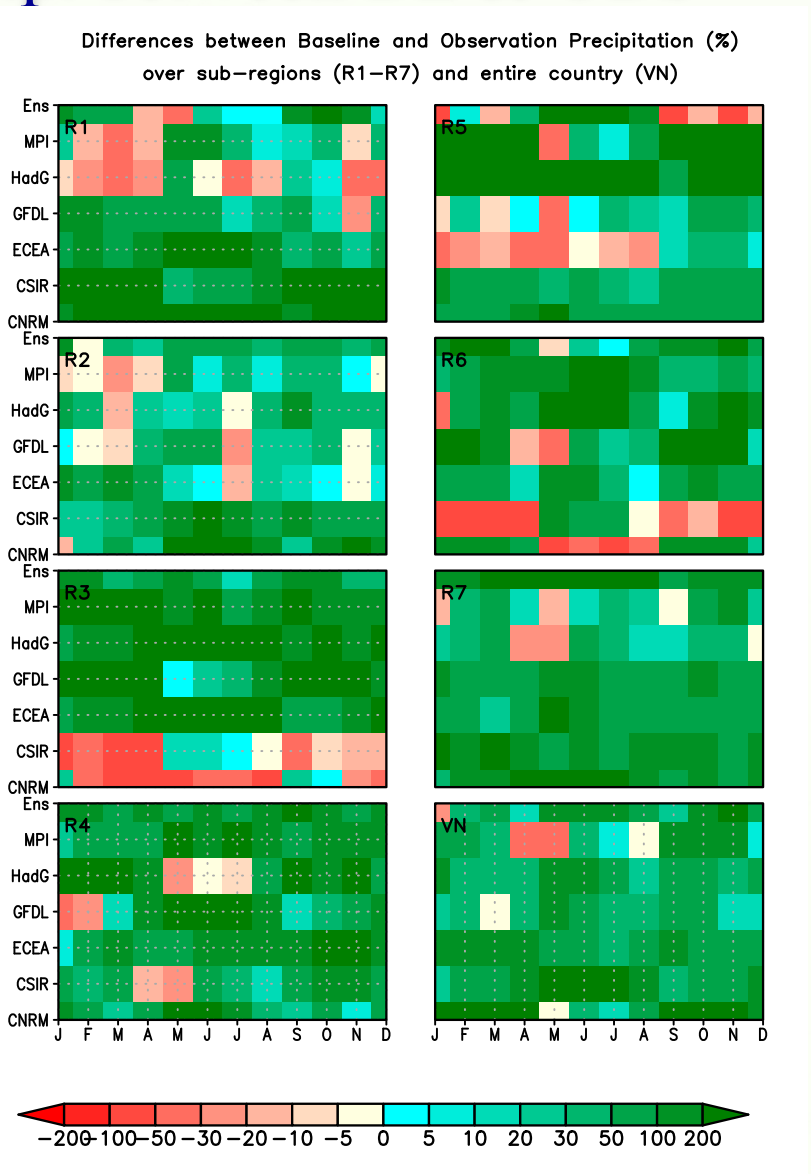
Examples: Methodology

- Evaluation of spatial and temporal distribution of precipitation and temperature over the baseline period:
  - How are differences between model simulations and observations?
- Assessment of Change in precipitation and temperature under global warming
  - How are differences between climates in future and in the baseline periods?
- Assessment of Changes in Drought characteristics under global warming
  - How will drought characteristics be changed?
- Presentation: It depends on what we want to show!

Examples: Some results

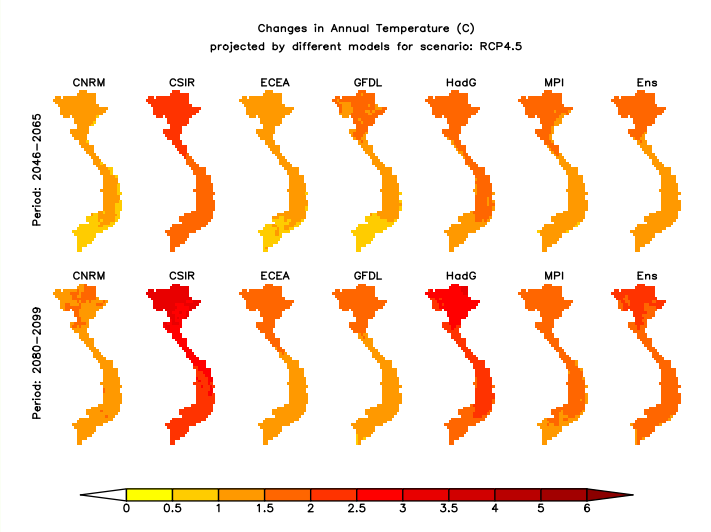
Differences of Temp. & Precip. between BL & OBS

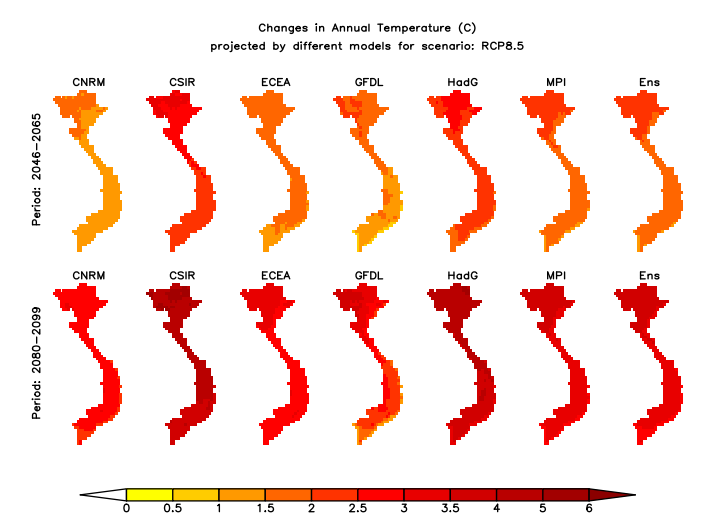


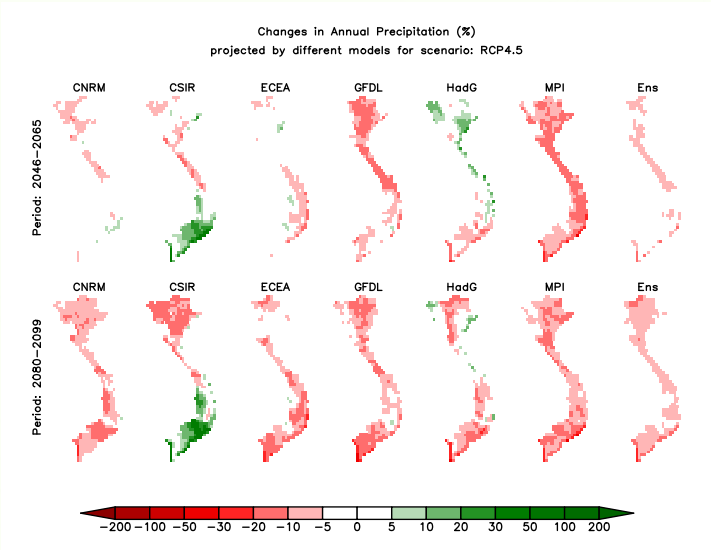


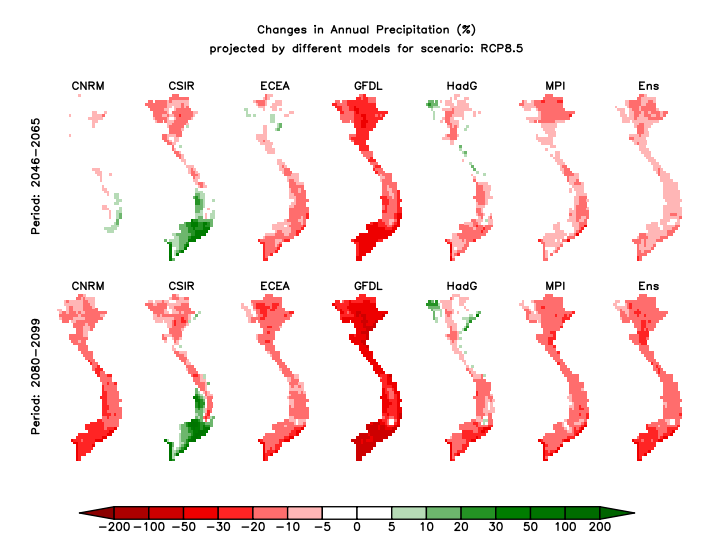
Examples: Some results

Changes in Temp & Precip



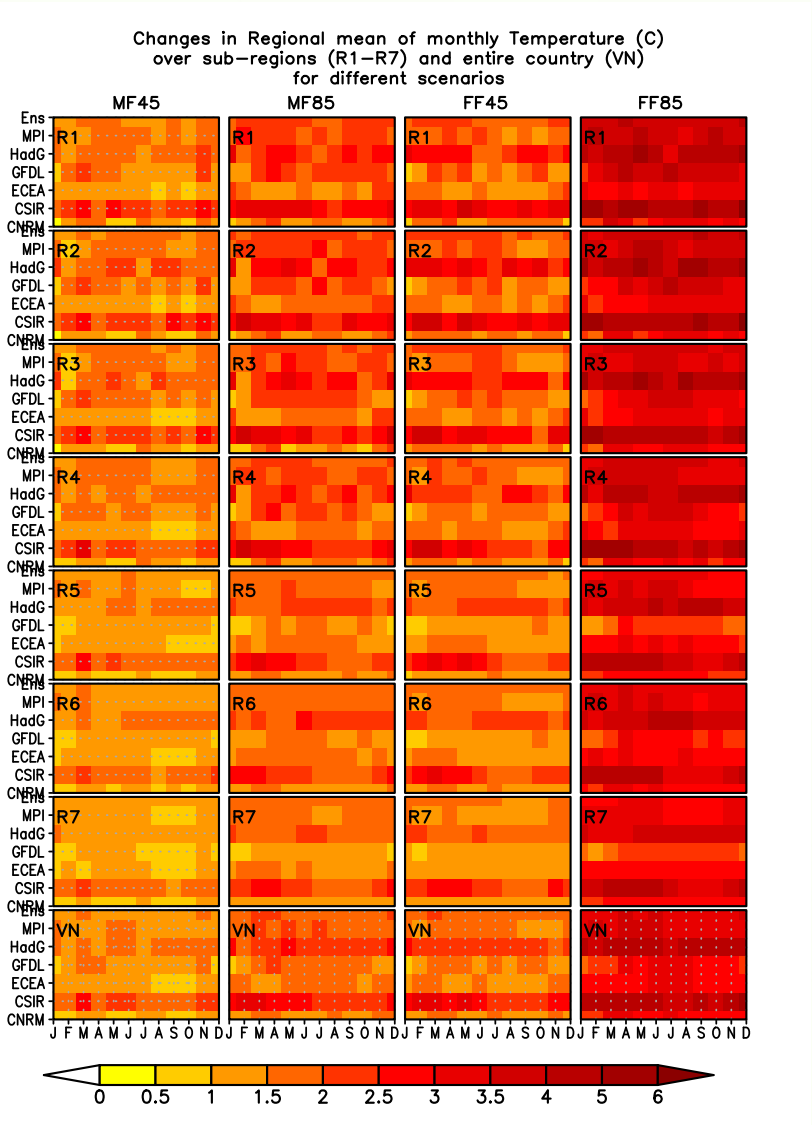


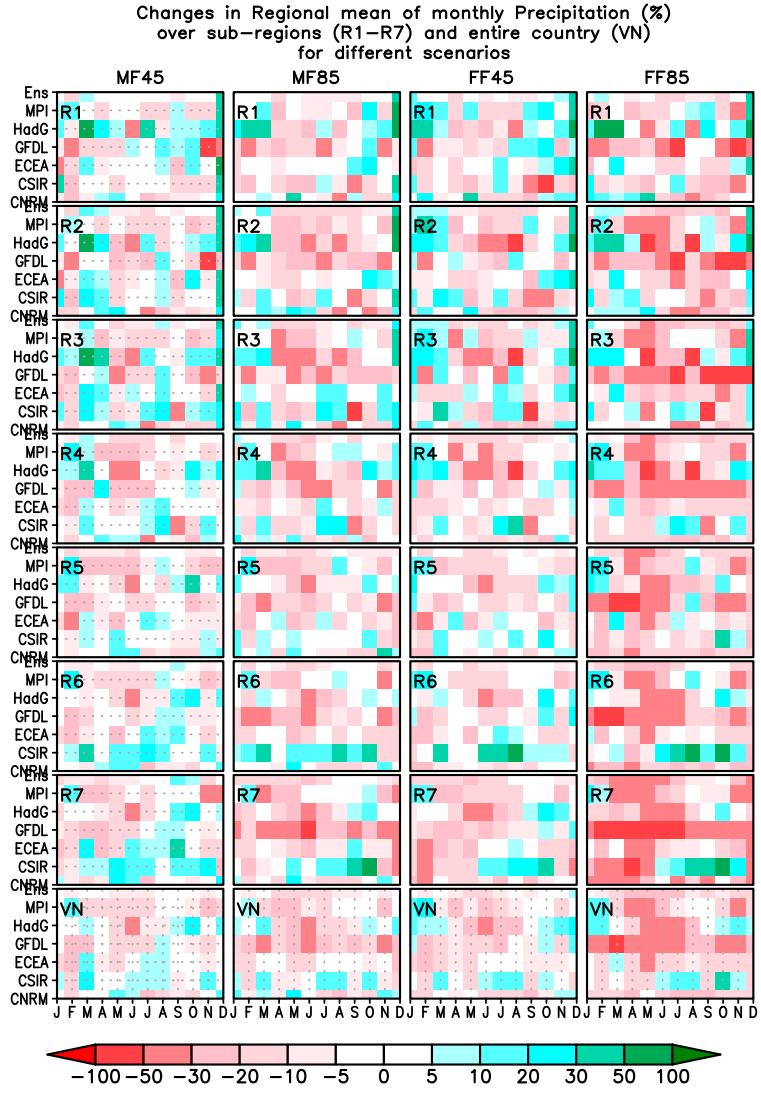




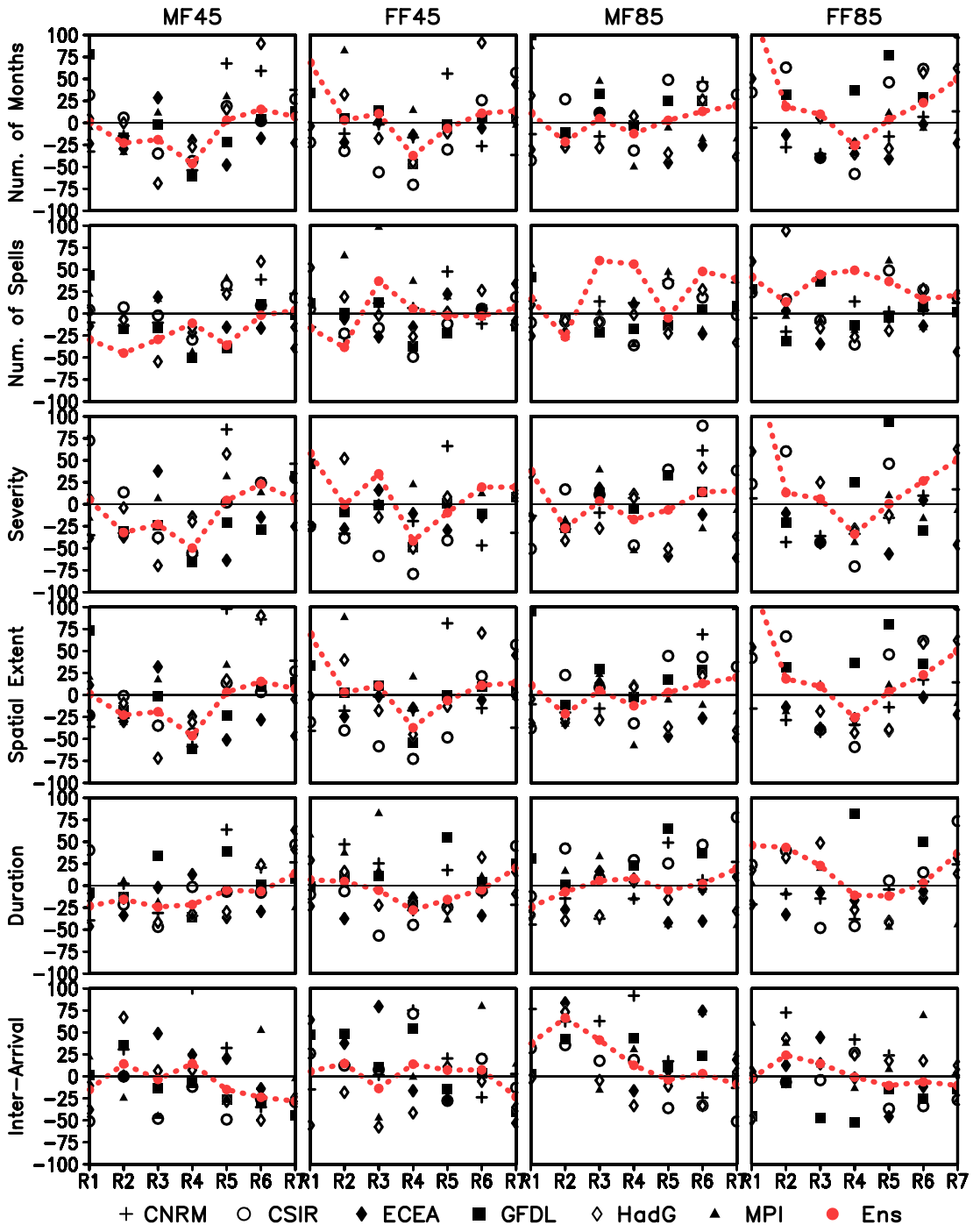
Examples: Some results

Changes in Temp & Precip





Examples: Some results



- Changes in drought characteristis over sub-regions (R1-R7)

Practices

- Introduce to the NetCDF
  - NetCDF files: Structure
  - Commands for exploring file contents
- GrADS and NetCDF files
  - Work on computer
- Homeworks