Climate prediction and Application using a Dynamical Downscaling

Yoo-Bin Yhang
Climate Prediction Team

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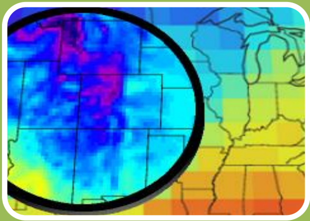
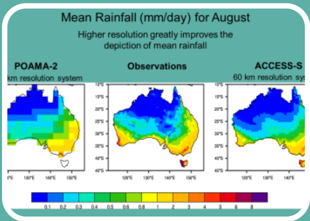
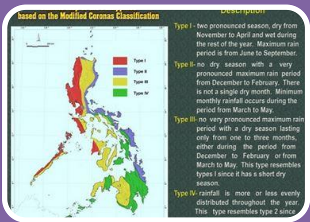


Introduction of dynamical downscaling



Seasonal forecast using a dynamical downscaling



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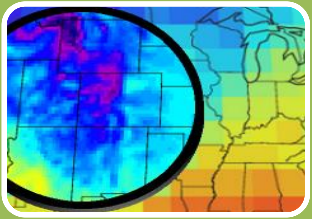

Introduction of dynamical downscaling

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Downscaling

Definition

A strategy for generating locally relevant information from global-scale data such as Global Circulation Models (GCMs) or reanalysis data

Method

★ ***Statistical Downscaling***

uses equation to convert global-scale data to regional-scale output by utilizing statistical regressions that link local variables to particular predictors in global-scale data

Advantage ① less computational effort
② enable to use ensemble GCM results
③ enable to correct bias modeled by GCMs

Disadvantage ① dynamic imbalance in regional output
② weak physical interpretation for downscaled variables

Downscaling

Method

★ ***Dynamic Downscaling***

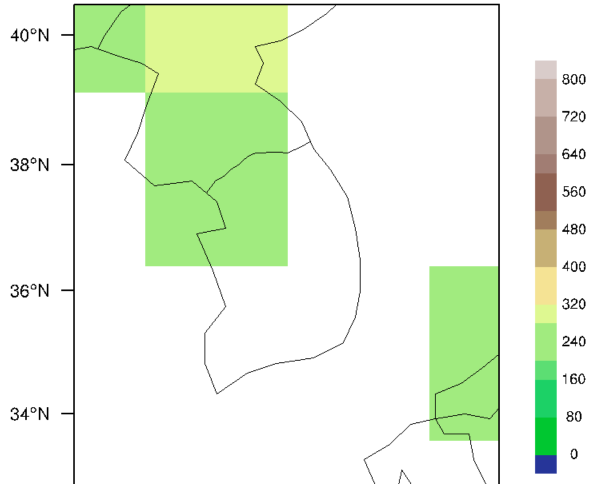
uses a regional dynamic model by nesting the regional model into a specific region of a larger-scale “mother” domain and fitting output from global-scale GCMs or reanalysis data into the model

Advantage ① enables dynamically balanced output
② enables physical interpretation on how global features affect local weather

Disadvantage ① huge amount of computational effort
② essentially impossible to make ensembles
③ model’s systematic and non- systematic biases

Statistical & Dynamical downscaling Models

coarse resolution



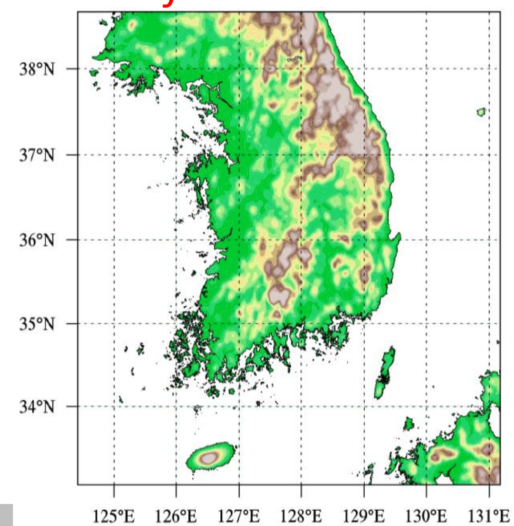
Statistical Model

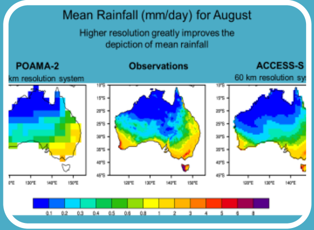
- Based on statistical relationships
- Station-scale
- Computationally undemanding
- Depends on predictor/predictand
- Low-frequency climate variability

Dynamical Model

- Based on regional climate models
- Fine-scale gridded
- Requires computing resources
- Depends on IC/BC
- Various outputs
- Dynamically/physically consistent ways

fine resolution





Seasonal forecast using a dynamical downscaling

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Regional Modeling

Necessity

Although long-term weather/climate predictions are most reliable at the global level, people want to know about the weather/climate at the local level.

Method

◦ One way downscaling from GCM (or Reanalysis data) to Regional model
→ driven by the GCM (or Reanalysis data)
◦ uses locally specific data, such as topography and land of conditions, etc.
◦ uses its own physics and dynamics

Importance of IC/BC in dynamical downscaling models

" Garbage In – Garbage Out " Paradigm

From http://blog.marksgroup.net/

IC/BC		Climate Model		Model Output
GARBAGE DATA	→	PERRECT MODEL	→	GARBAGE RESULTS
GARBAGE DATA	→	GARBAGE MODEL	→	GARBAGE RESULTS

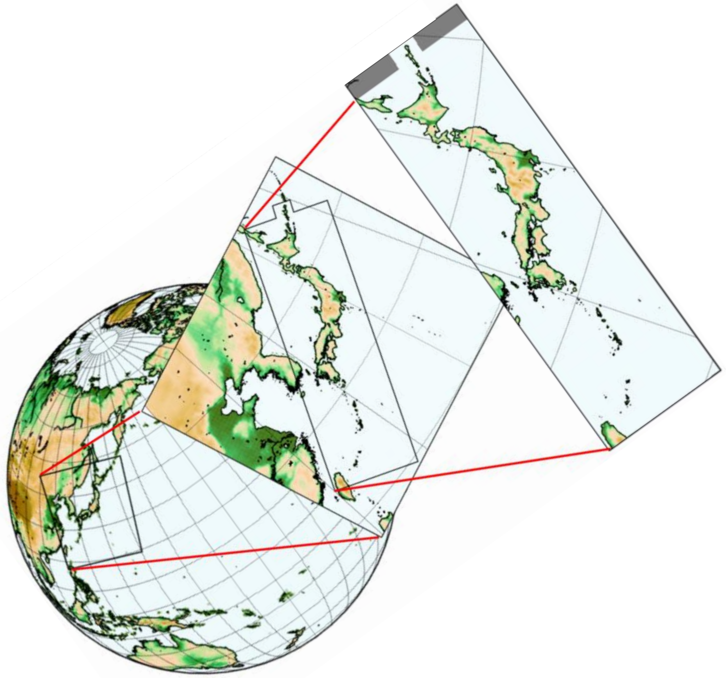
Determining model domain and resolution

1. Horizontal and vertical resolution ?

=> *Resolutions* should be fine enough to the scales of forcings of interest.
=> All the model *parameterization* schemes are model resolution dependent.
=> *The ratio of driving data* versus RCM horizontal resolution is in the range of 3-8.

2. Experimental domain ?

=> Considering *the lateral buffer zone*
=> It is preferable to place the lateral boundaries not over areas of *complex topography*.
=> *Internal variability* usually increases with domain size
=> *Computational Limitation*.



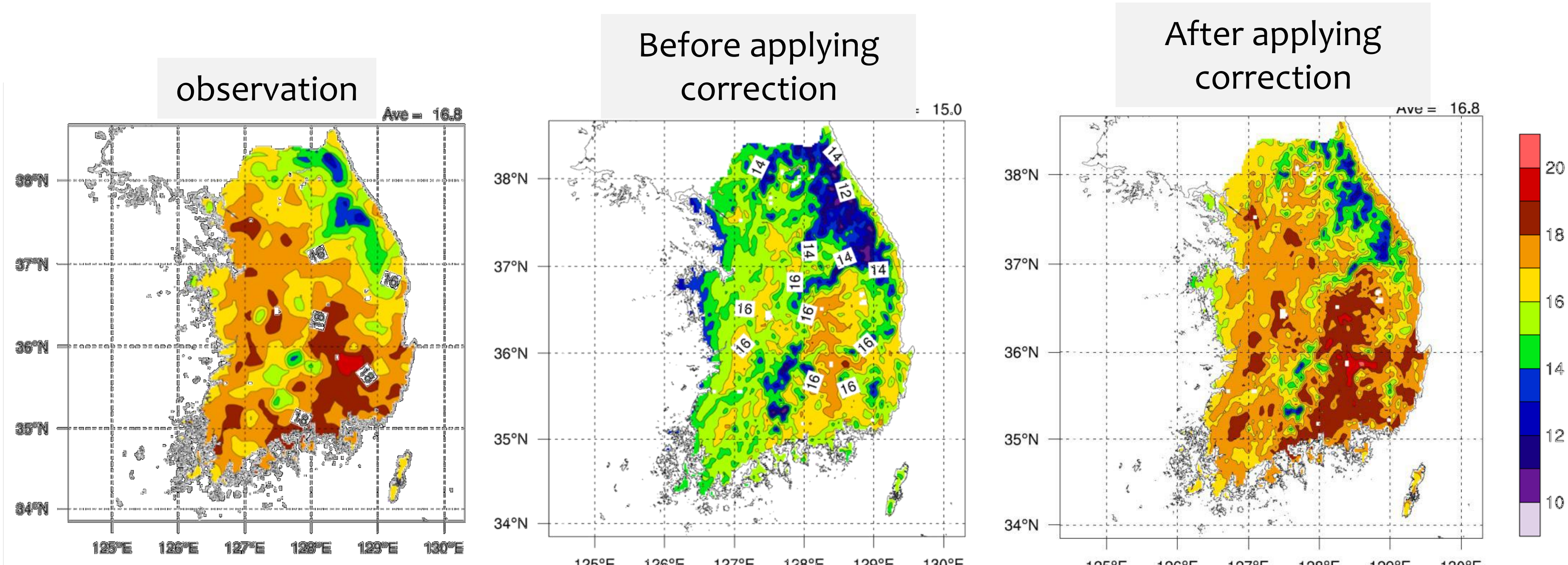
3. Customization of RCMs

=> Physics adequacy
=> Spin-up
=> Other options (e.g., chemical, nudging ..)

Statistical post processing

Systematic biases in model output

=> It is impossible for climate models to simulate and forecast nature perfectly due to errors and uncertainties in initial conditions, the model physics and parameterizations, and the complex nature of earth systems (Lorenz 1963). In order to overcome these problems, systematic biases in model results are often statistically corrected as a post-process.



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Obrigado
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