APEIS Capacity Building Workshop on Integrated Environmental Assessment in the Asia Pacific Region
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Demonstrative presentation of AIM/Impact model

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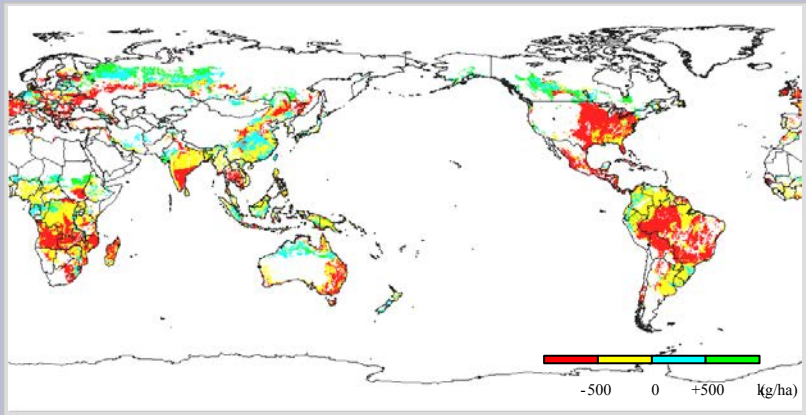
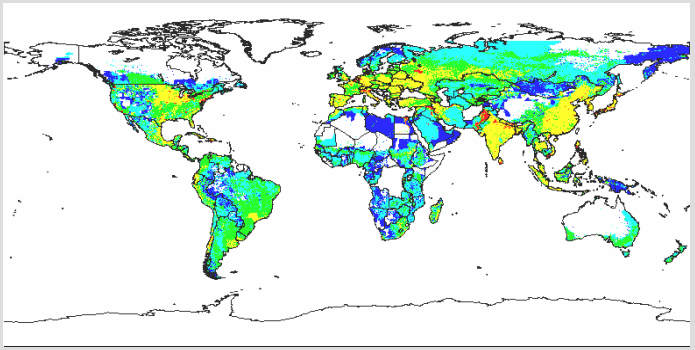
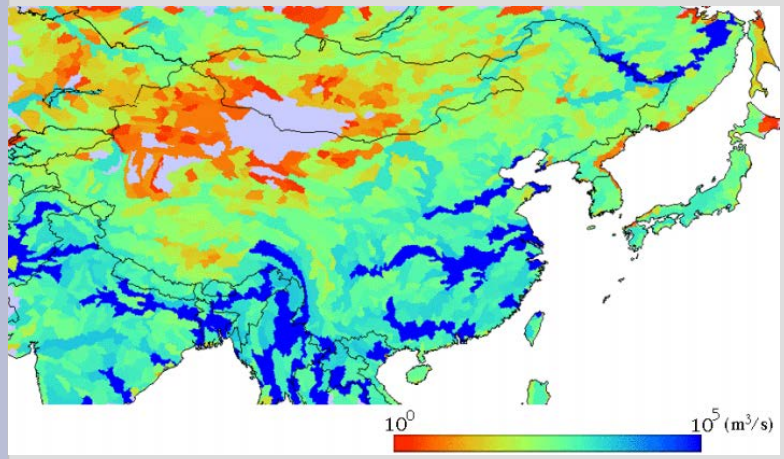
Outputs of AIM/Impact



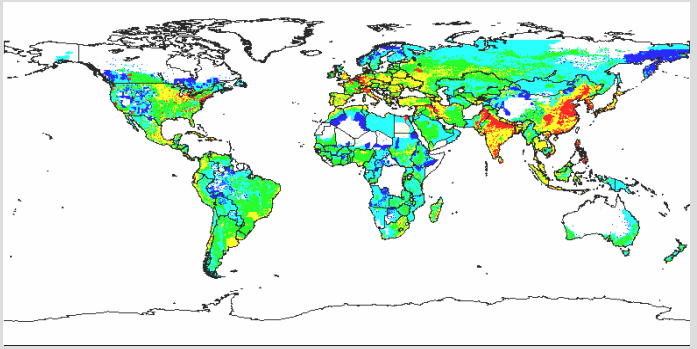
Change of crop productivity



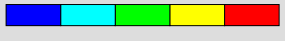
1990



Change of river discharge



2050



Water withdrawal

Objective of the course

- Introduction of standard procedures of impact assessment using AIM/Impact.
- Demonstration of specific procedures of assessment of potential crop productivity under anticipated climate change.
  - STEP1: Collection of input data
  - STEP2: Scenario development
  - STEP3: Parameter setting and simulation
  - STEP4: Display and analysis of the results
- Brief introduction of AIM/Impact [Country]

Standard work flow of impact assessment in AIM/Impact

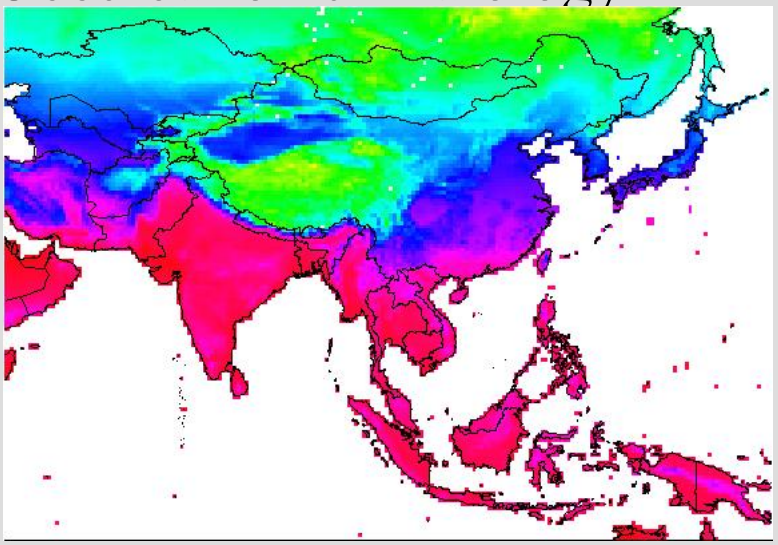
- 1. Collection of input data and importing them into GIS database
  - GRASS GIS
- 2. Future scenario development
  - Interpolation
  - Simple climate model and Pattern scaling
- 3. Simulation
  - Parameter setting
- 4. Display and analysis of the results
  - Visualization
  - Aggregation
  - Feedback or higher impact

GRASS (Geographic Reseoucres Analysis Support System)

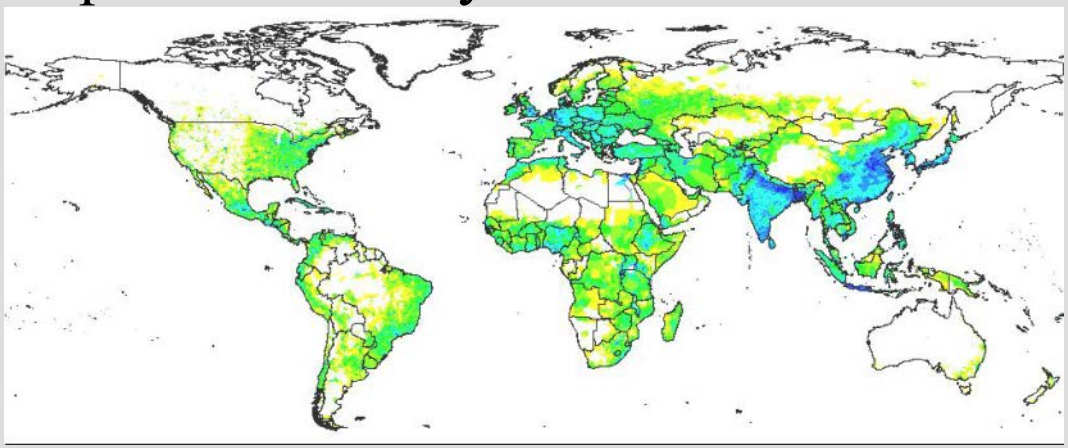
- Gegraphical Information System Software
- Run on unix oprating systems (Solaris, Linux, etc.)
- Advantage
  - Distributed on internet (Free)
  - Raster (gridded) data
  - Source codes available (C language)
  - Modules can be developed by users with the GRASS developers' library.
- Disadvantage
  - Unix
  - Inexcelent graphical user interface

Example of spatial data managed in GRASS GIS

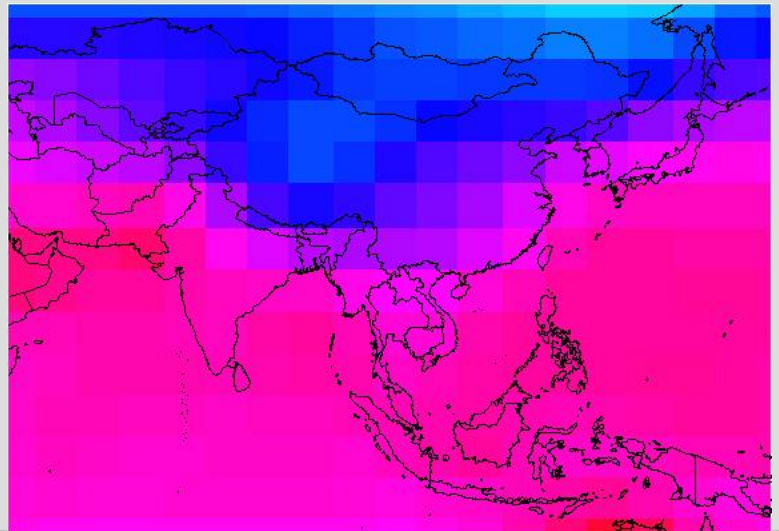
Obserbation climatology



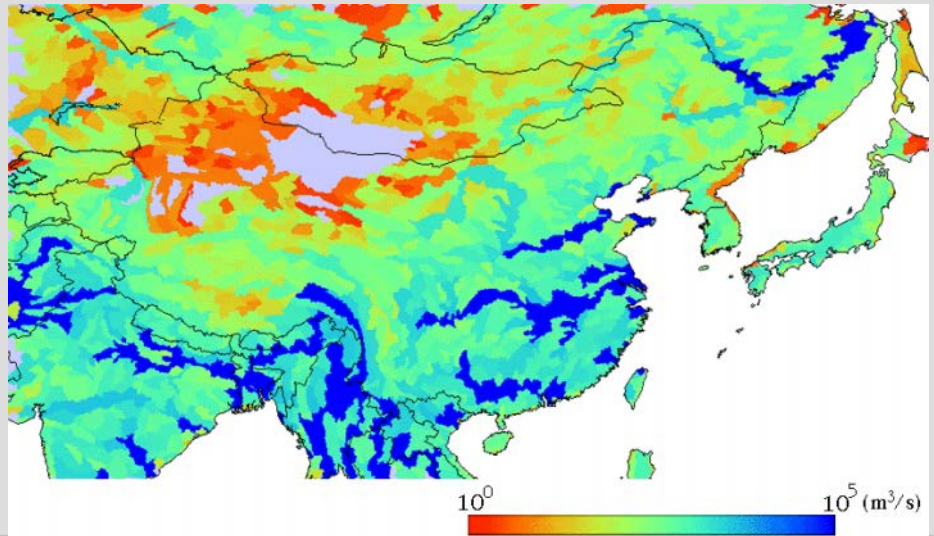
Population density



GCM results



Assessment results



Data collection

- Current climate
  - Monthly or daily mean climatology
    - CRU/UEA LINK climatology (1901-1996, 0.5x0.5, monthly)
    - GEWEX/NASA ISLSCP (1987 and 1988, 1.0x1.0, monthly, daily or 6-hourly)
- Future climate projection
  - Output of General Circulation Models (GCMs)
    - IS92a simulations (IPCC-DDC)
    - SRES simulations (IPCC-DDC)
    - Simulation by CCSR/NIES
  - Output of Regional Climate Models (RCM)
    - Not available yet

Data collection

- Soil
  - Chemical and physical character of soil
    - FAO Soil Map of the World
- Landuse
  - Landuse classification derived from remote-sensing data
    - 1km x 1km GLCC (EDC/EROS/USGS)
- Population
  - Gridded population density
    - GPW2 (CIESIN/Colombia University, 2.5min)
    - LandScan2000 (1km x 1km)

Climate scenario

- Future changes of climate (temperature, rain, radiation, wind etc.) are deduced from GCMs results distributed at IPCC-DDC or provided by NIES/CCSR.
- In order to compromise with the very low resolution of GCM results, the results of GCMs are interpolated and current observed climatology is used for expressing spatial detail.
- For assessing various future path of GHG emission, "pattern scaling method" is employed to develop climate scenario.

Pattern scaling

GHG increase run (GCM)

| Minus

Control run (GCM)

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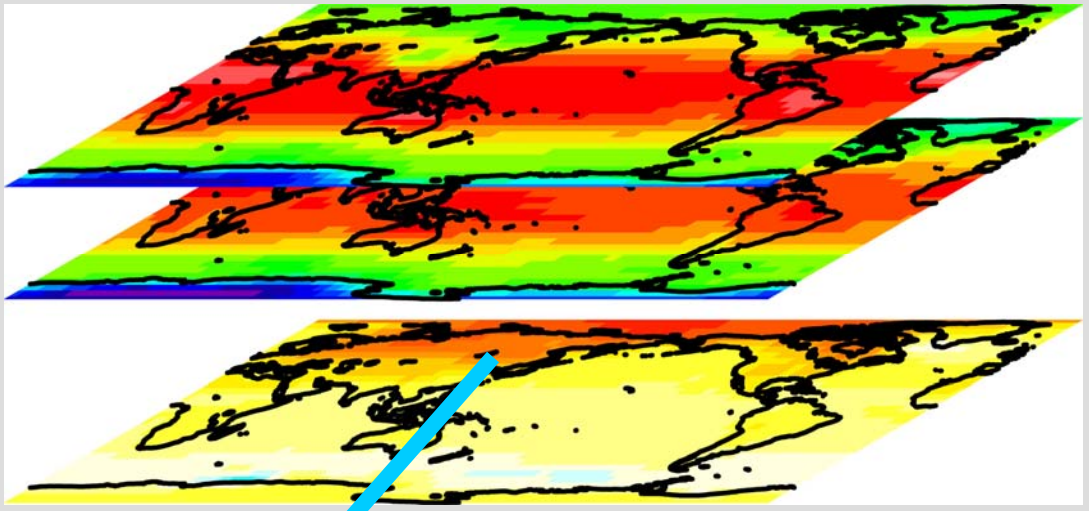
Spatial pattern of
climate change (GCM)



Spatial interpolation

Scaling

Interpolated and scaled
spatial pattern of CC

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Current climate (observed)

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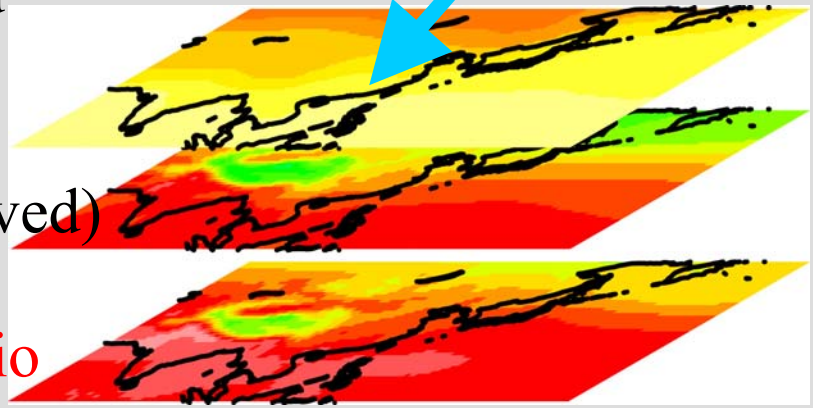
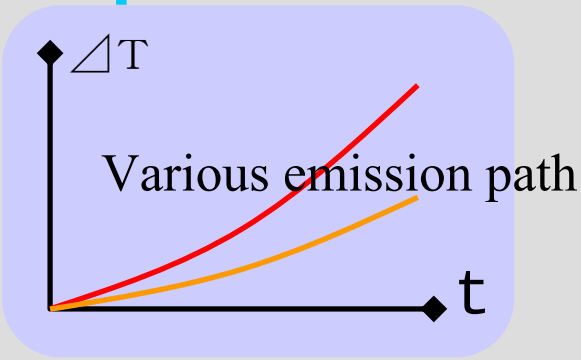
Climate change scenario





Simple climate model

Simulation

- Simulation models in AIM/Impact are Unix shell files which consist of GRASS commands originally developed using GRASS-GIS library and standard GRASS commands included in the GRASS distribution.
- Some models refer to the model parameter files for reading assumption or information other than spatial input data managed in GIS.

Models in AIM/Impact

- Water balance model
  - Penman PET
  - Thornthwaite PET
  - Surface runoff
- River discharge model
- Potential crop productivity model
- Water demand model
- Malaria potential model
- Vegetation classification model
- Vegetation move possibility model

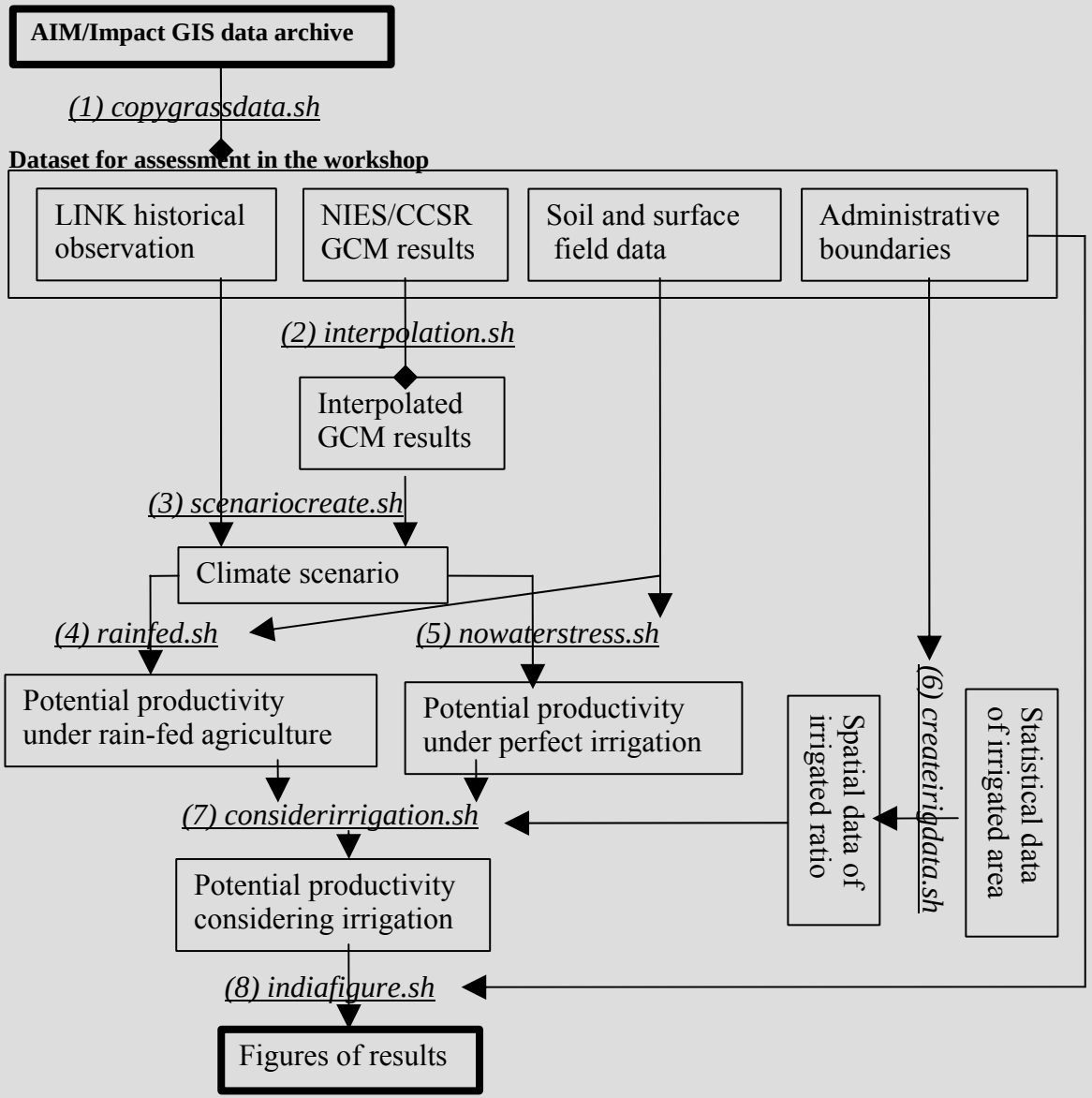
Visualization and analysis

- Grasping spatial pattern of impact through visualization
  - Detection of critically damaged region
  - Time series analysis based on animation
- Spatial aggregation
  - Aggregation (spatial average) based on administrative boundaries
  - Time series trend
  - Linkage with the other assessment frameworks (ex. Economic model)

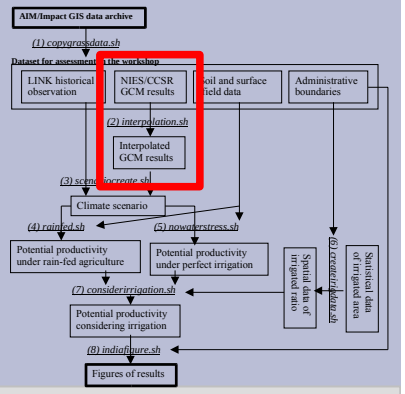
Demonstration of assessment of agricultural impact

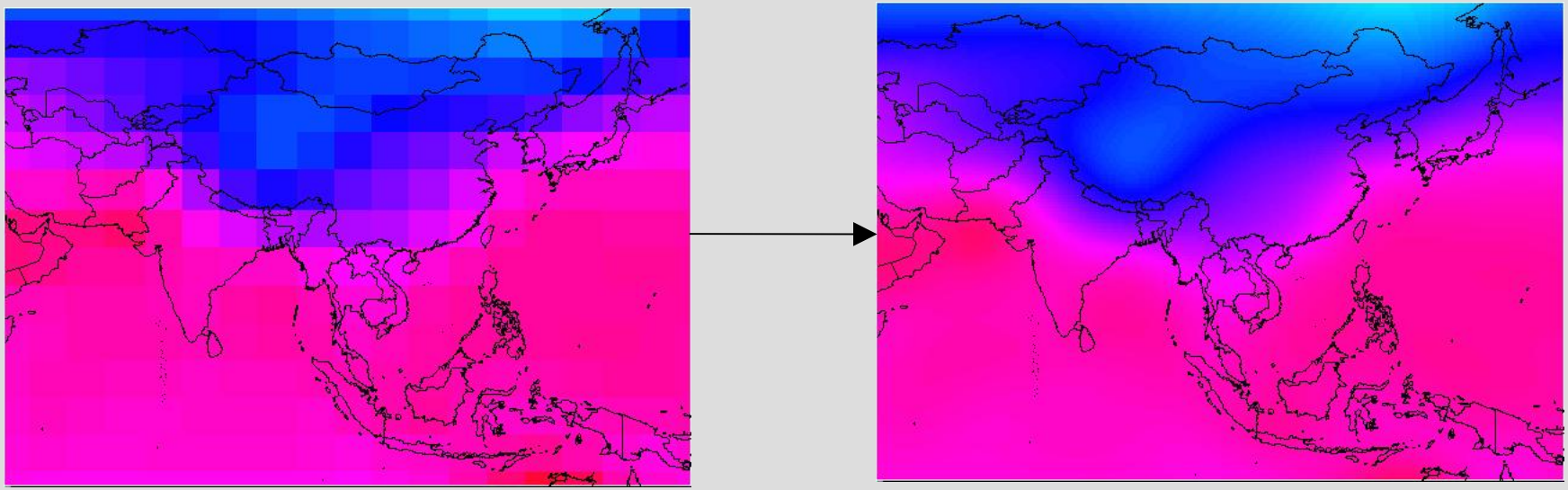
- What will be done in the demonstration
  - Calculate potential crop productivity of rice and winter wheat in Asia.
  - Display some figures of the results focusing India.
- Objective
  - Demonstrate the procedure to assess climate change impact using AIM/Impact with going through simplified assessment processes step by step.

Procedure


AIM/Impact GIS data archive
(1) copygrassdata.sh
Dataset for assessment in the workshop
LINK historical observation
NIES/CCSR GCM results
Soil and surface field data
Administrative boundaries
(2) interpolation.sh
Interpolated GCM results
(3) scenariocreate.sh
Climate scenario
(4) rainfed.sh
(5) nowaterstress.sh
(6) createirrigdata.sh
Potential productivity under rain-fed agriculture
Potential productivity under perfect irrigation
Spatial data of irrigated ratio
Statistical data of irrigated area
(7) considerirrigation.sh
Potential productivity considering irrigation
(8) indiafigure.sh
Figures of results

Interpolation (interpolation.sh)

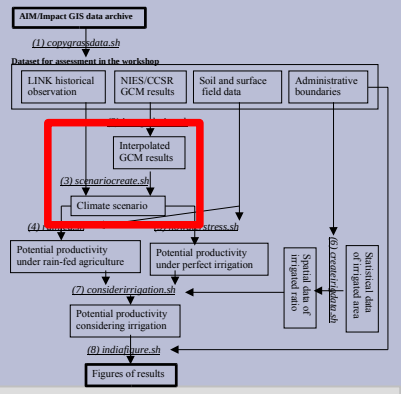


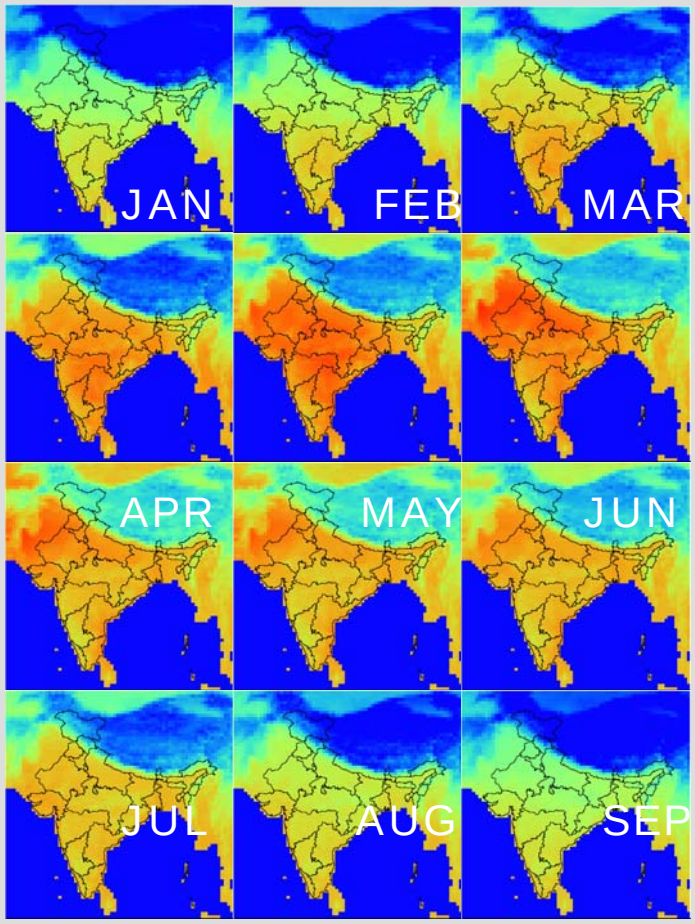


NIES/CCSR GCM (5.6 x 5.6)
Monthly mean temperature in 2050s under IS92a scenrio.

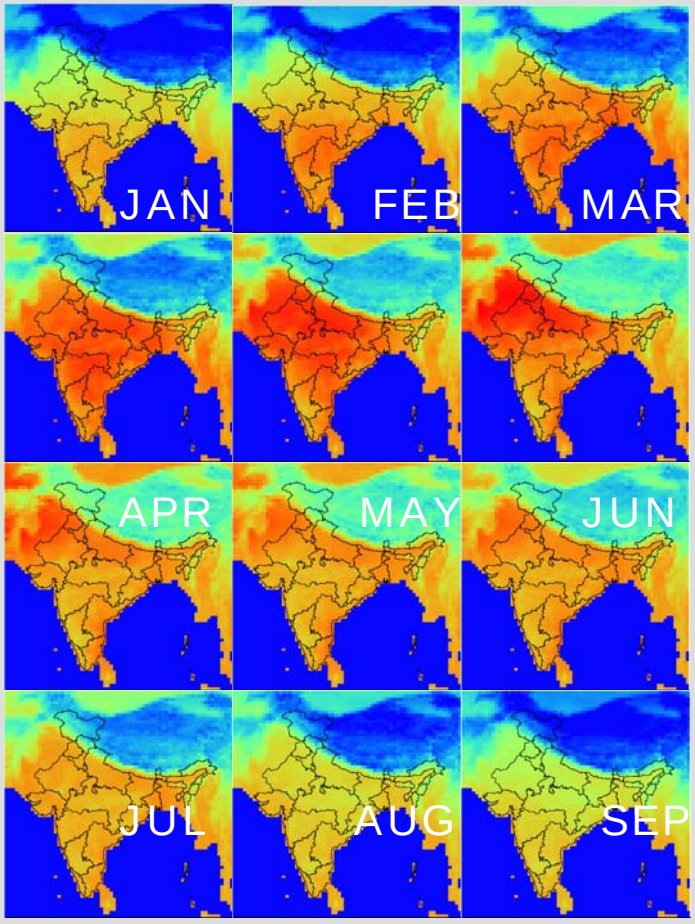
Spline interpolation
0.5 x 0.5

Temperature scenario (scenariocreate.sh)

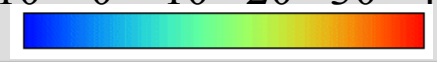




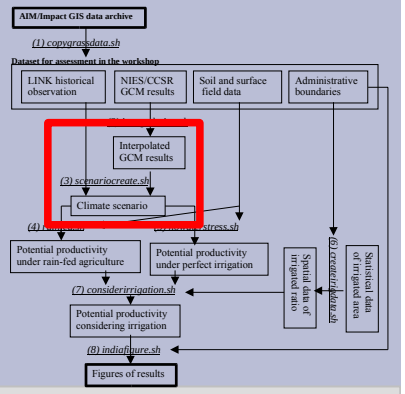
LINK historical temperature (1961-1990)

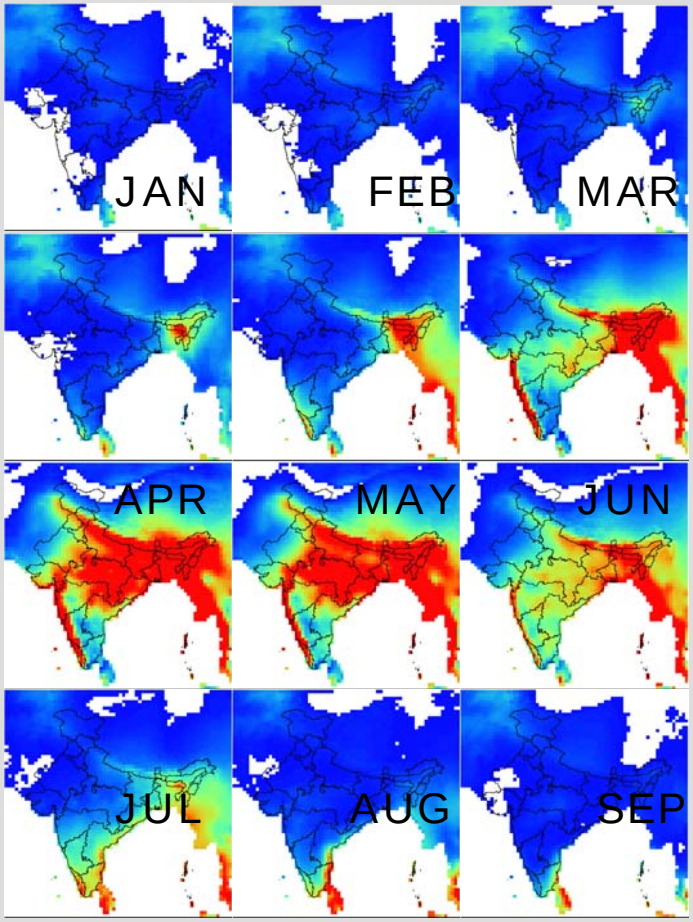


Temperature scenario (2050s, CCSR/NIES model)

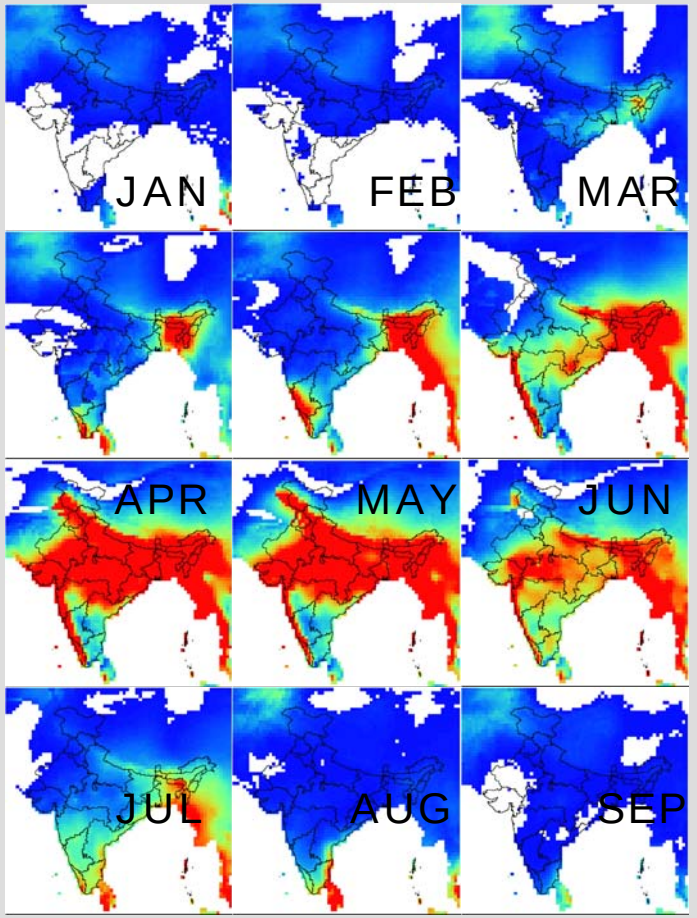


Precipitation scenario (scenariocreate.sh)

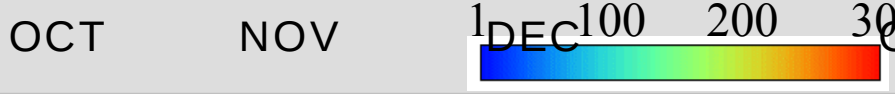




LINK historical precipitation (1961-1990)



Precipitation scenario (2050s, CCSR/NIES model)

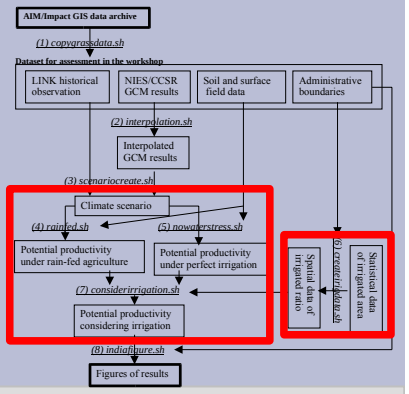


Example of parameter

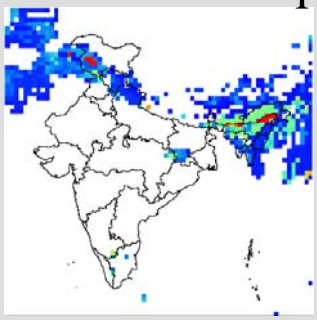
Characteristics of crop growth

cropname	WheatSC	WheatWC	Whitepotato	PhaseolusbeanTEC	PhaseolusbeanTRC	Soybean	Rice	Cotton	Sweetpotato	Cassava	Pearlmillet	SorghumTRC	MaizeTRC	SorghumTEC	MaizeTEC
crop_kind	1	1	1	1	2	2	2	2	2	2	3	3	3	4	4
m_gp	100	200	150	90	120	120	130	160	150	330	90	120	120	110	110
min_gp	90	90	90	50	50	75	80	150	90	180	55	90	70	90	70
m_lai	5	5	5	4	4	4	5	3	4.5	3	4	4	4	3	4
m_hi	0.4	0.4	0.6	0.3	0.3	0.35	0.3	0.07	0.55	0.55	0.25	0.25	0.35	0.25	0.35
bean	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
hi_kind	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
gp_kind	1	0	0	1	0	0	0	0	0	0	0	0	0	2	2
thres_l	5	5	7	7	7	13	12	15	10	10	15	15	12	15	12
thres_u	25	25	30	32	32	38	36	38	40	35	45	38	40	38	40

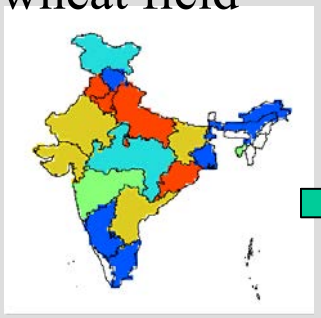
Potential productivity of winter wheat



Rain-fed assumption

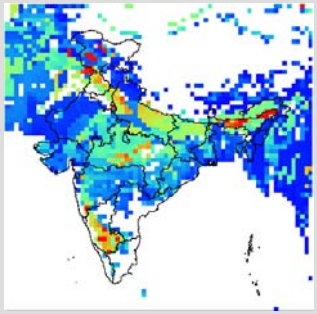


Irrigated ratio of wheat field

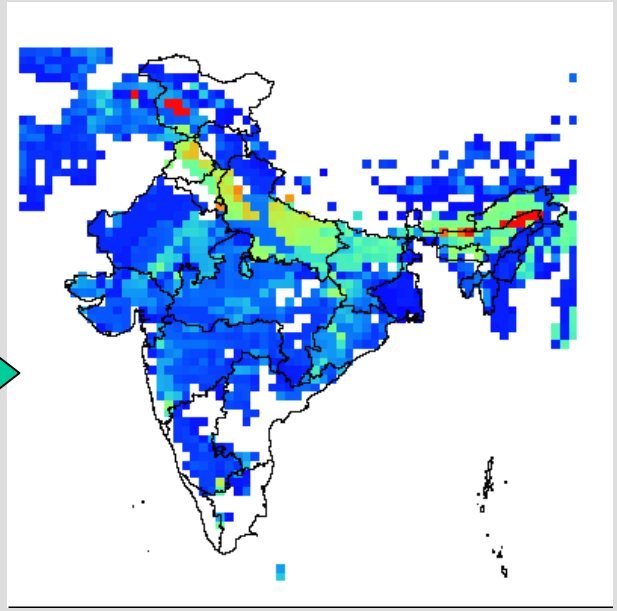


0 50 100 (%)

Perfect irrigation (No water stress)



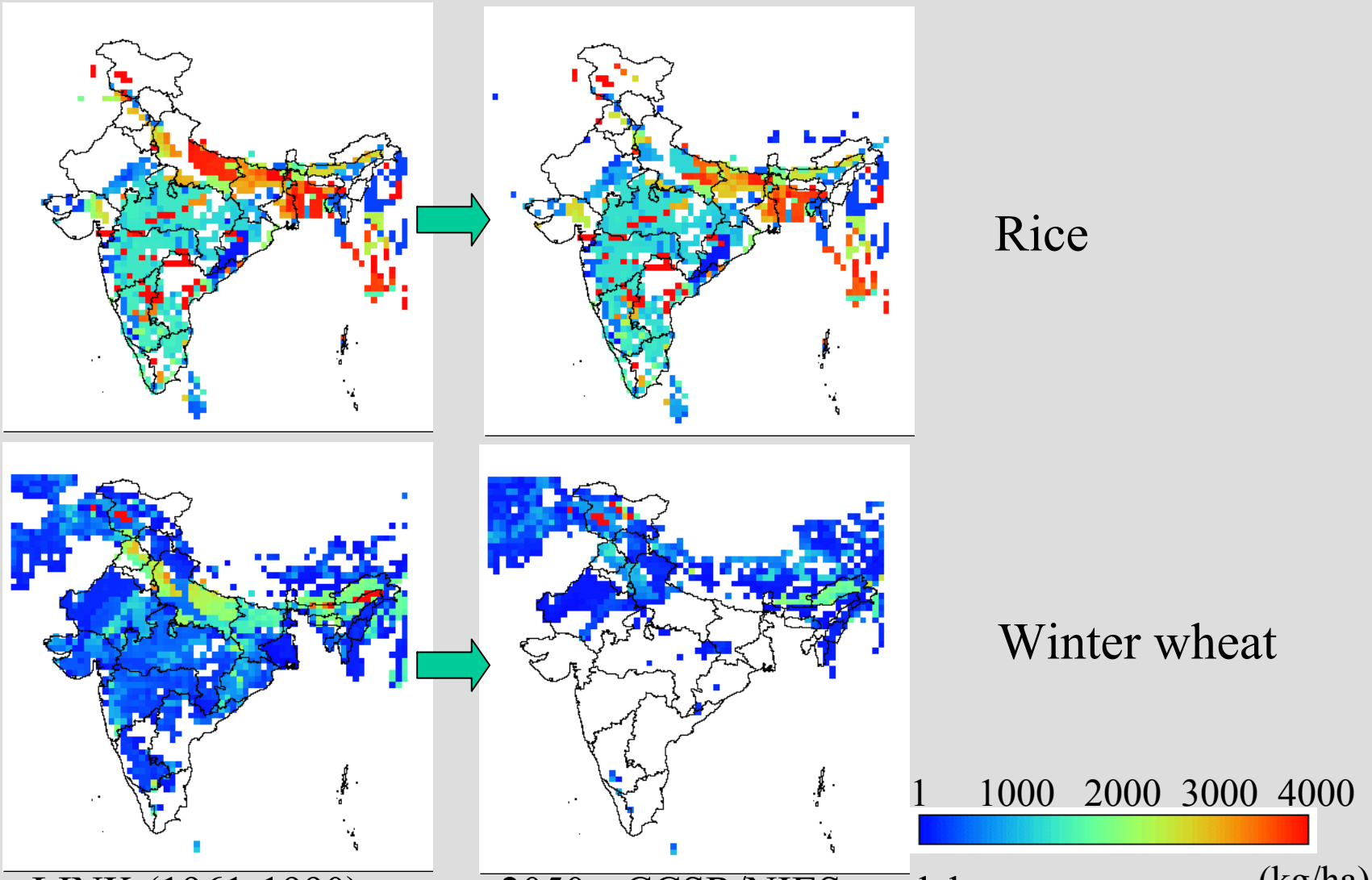
Combined (weighted average)



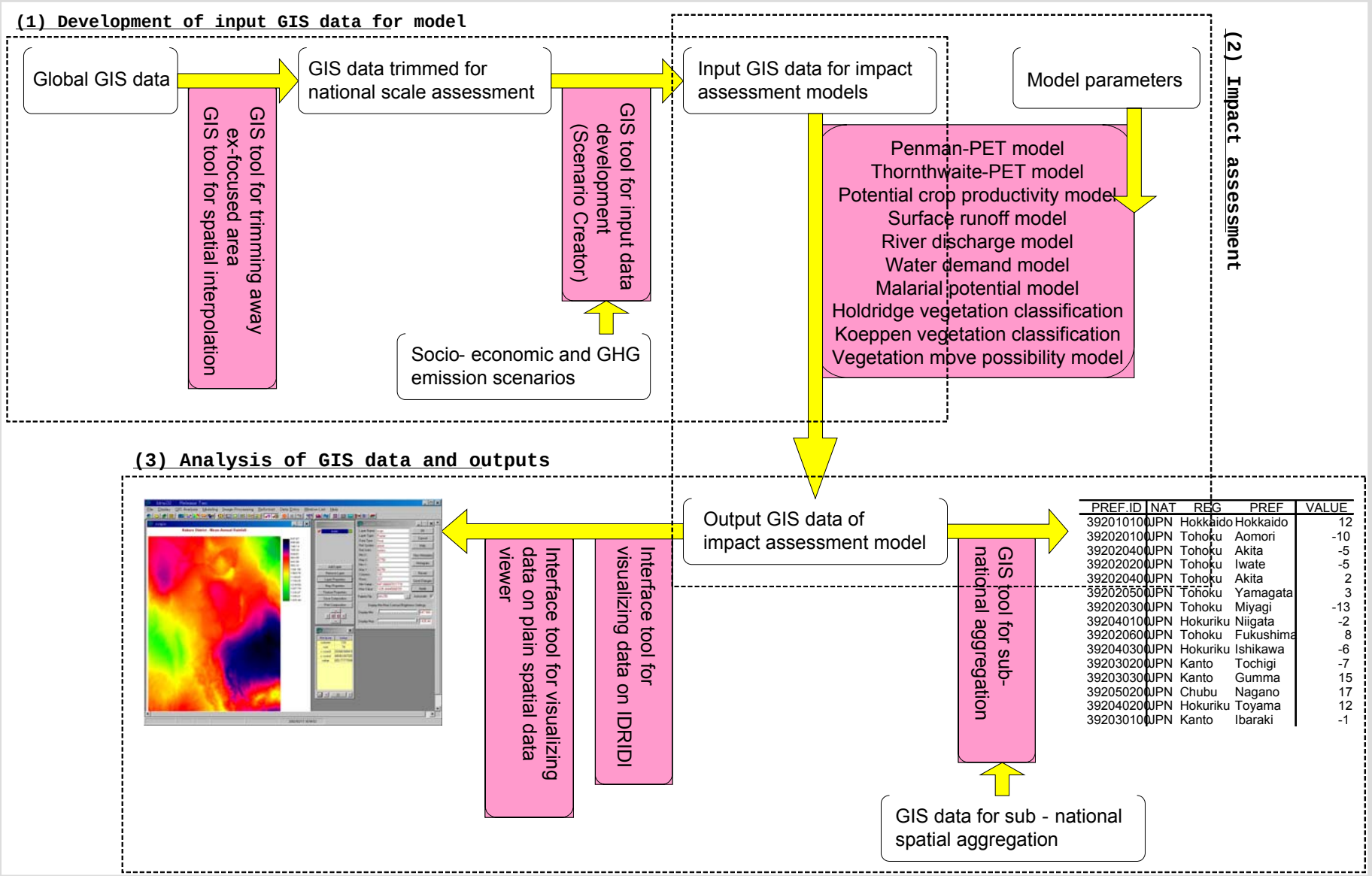
Estimated winter wheat potential productivity under current climate

1 1000 2000 3000 4000 (kg/ha)

Change of potential productivity of rice and wheat



AIM/Impact [Country]



Features of AIM/Impact [Country]

- Package of models, tools and data for scenario analysis of national-scale climate change impact assessment
- Executable on PC-Windows (no need to learn UNIX & GRASS)
- Bundled datasets for basic assessment
- Readily achievement of spatial analysis
- Detailed manual documents