



Impacts of climate variability and water resources development on river flows and water balance of Huai Luang Watershed, Thailand

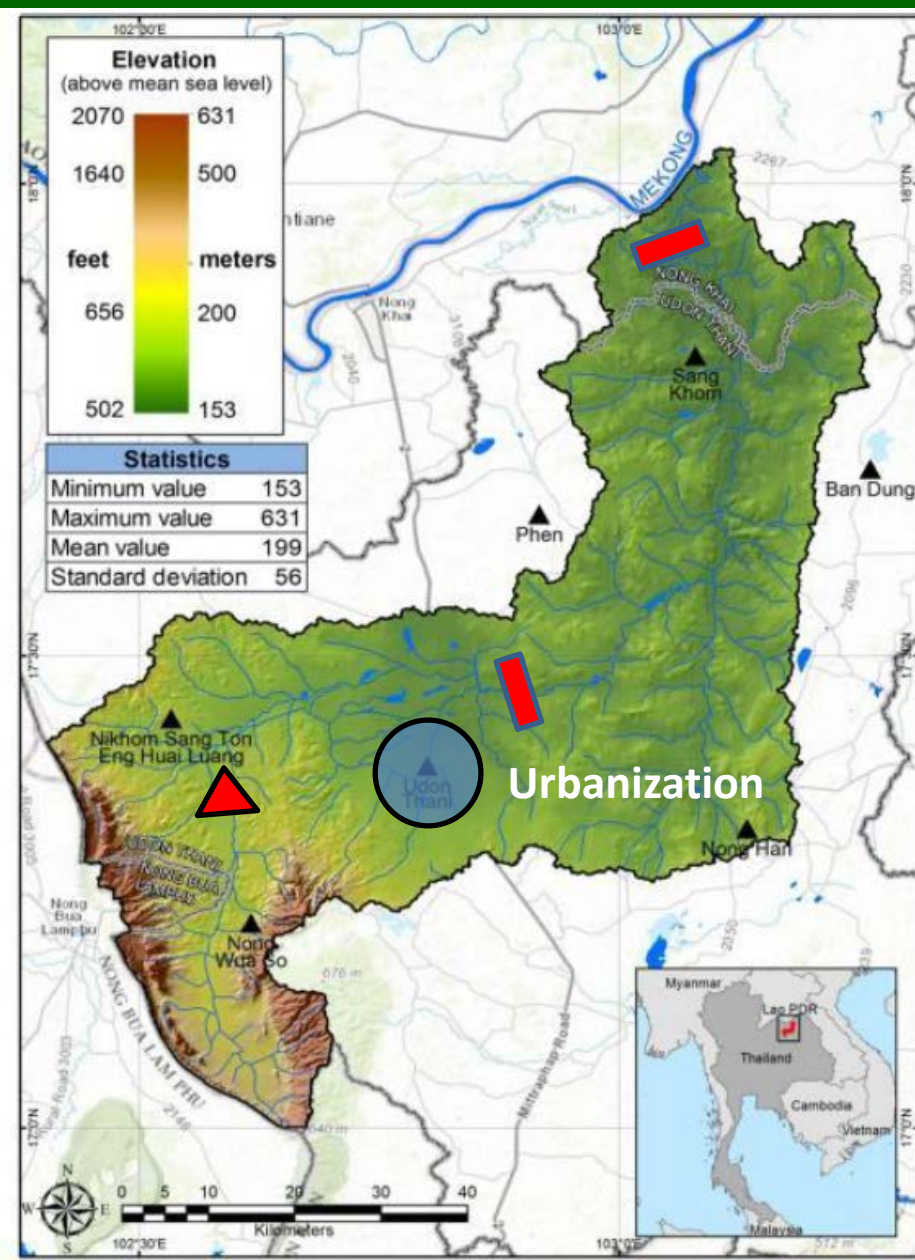
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Aekkapol Aekakkararungroj, Rattana Hormwichian

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Warsaw University of Life Sciences
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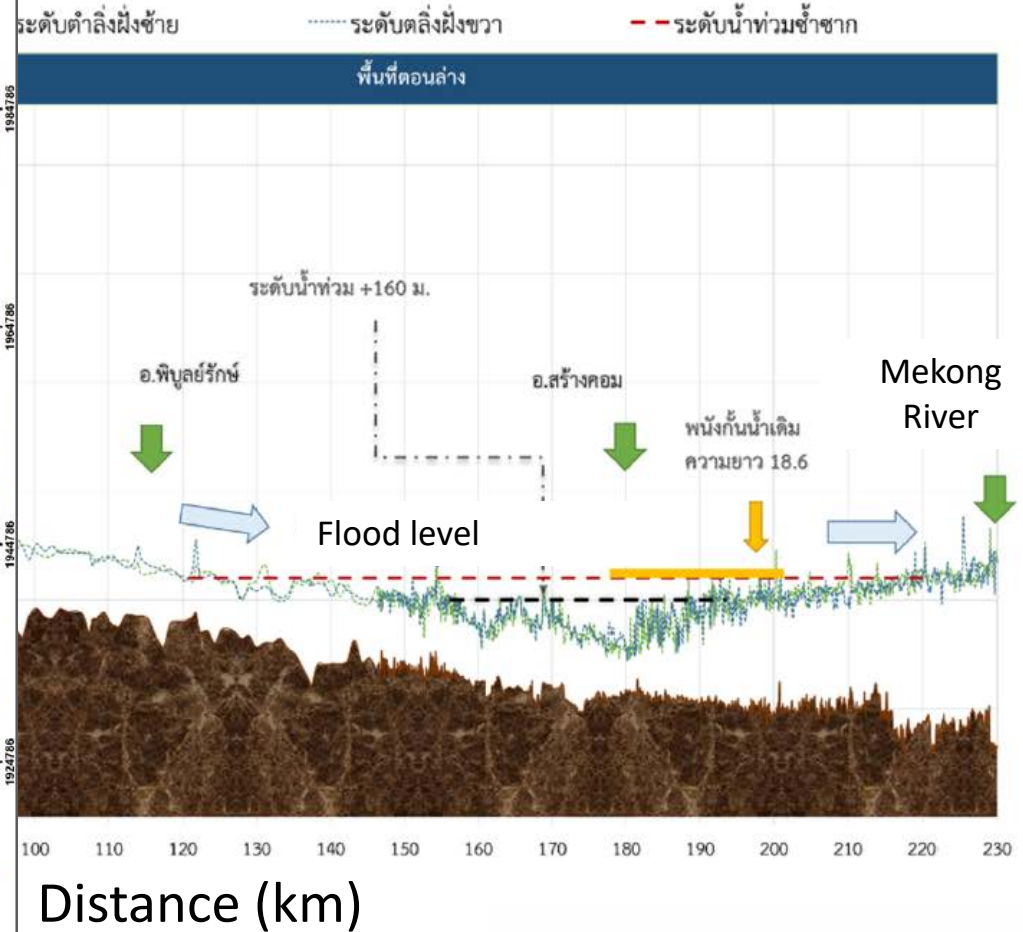
Study area

- ❖ Watershed area: 4,122 km²
- ❖ Monthly temp: 16.3-36.3°C
- ❖ Annual rainfall: 1,145–2,174 mm
- ❖ Land-use:
 - 68% agriculture
 - 14% forest
 - 6% urban area
- ❖ Stakeholders in the basin have highlighted that changing rainfall pattern/variation and impacts of water resources development are the most critical concerns

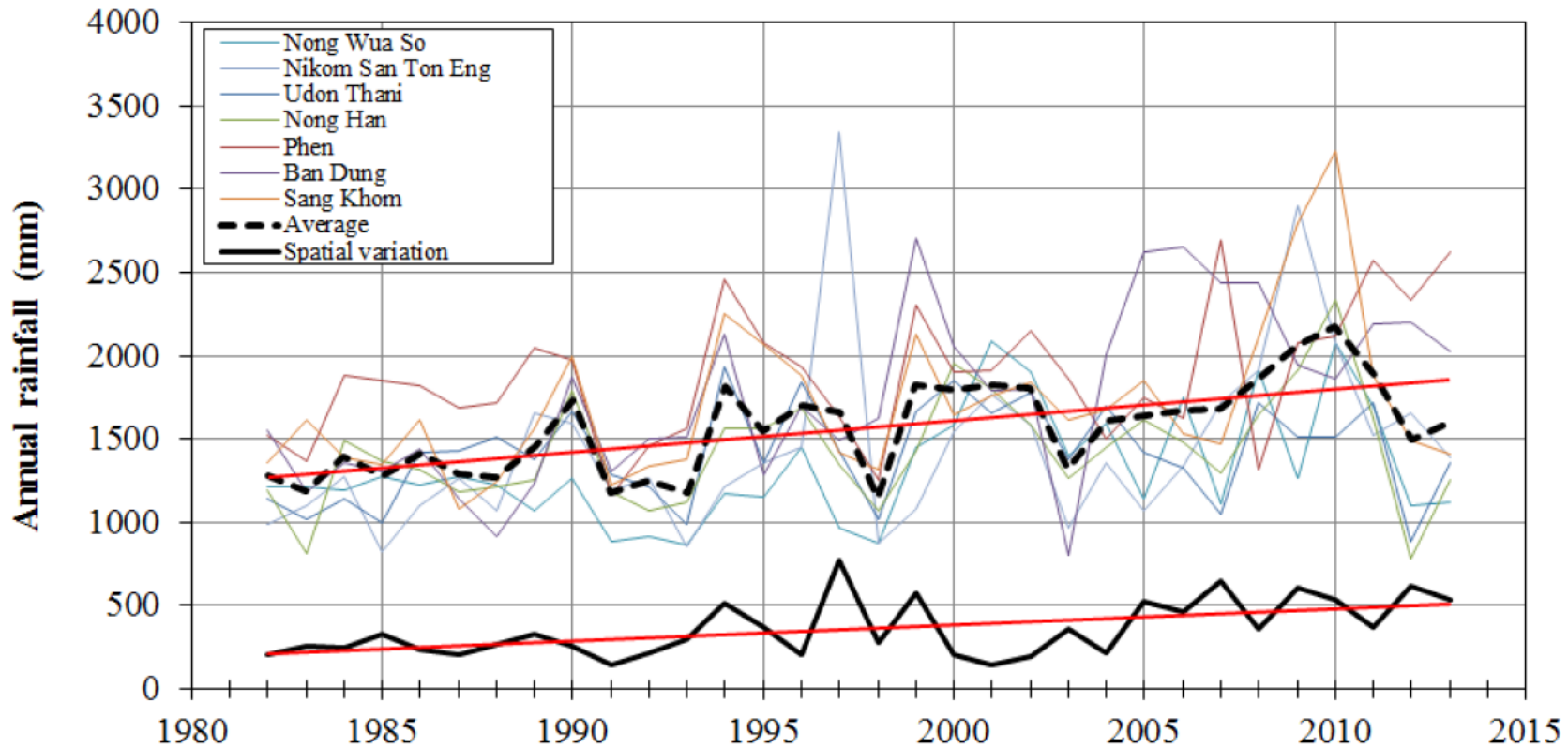


River Profile

Flood in 2011



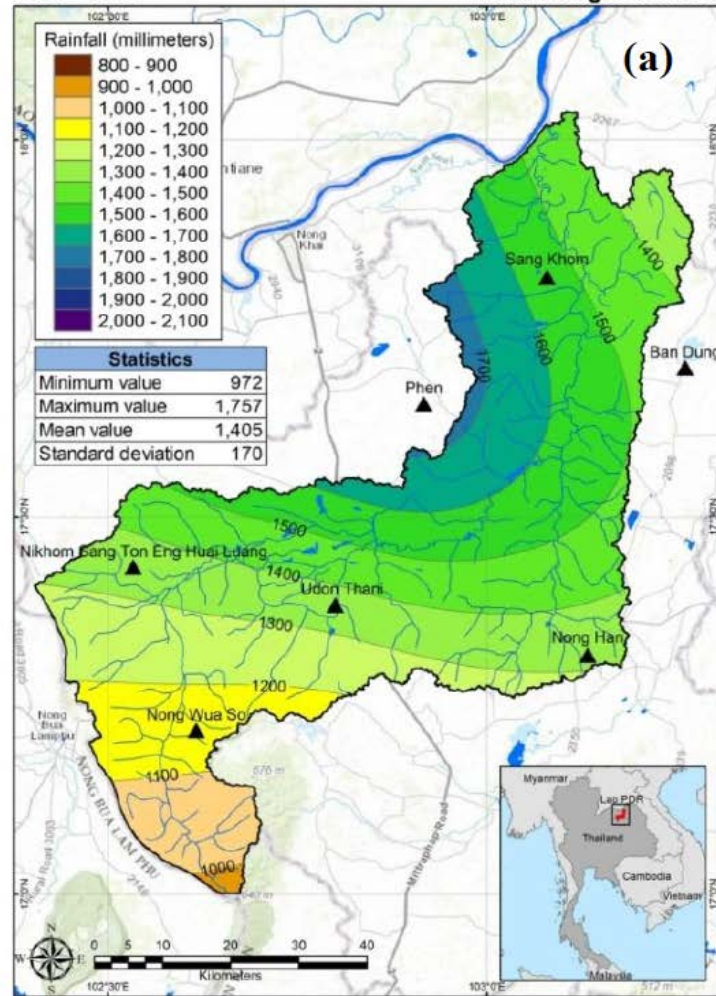
Rainfall analysis: trend and variation



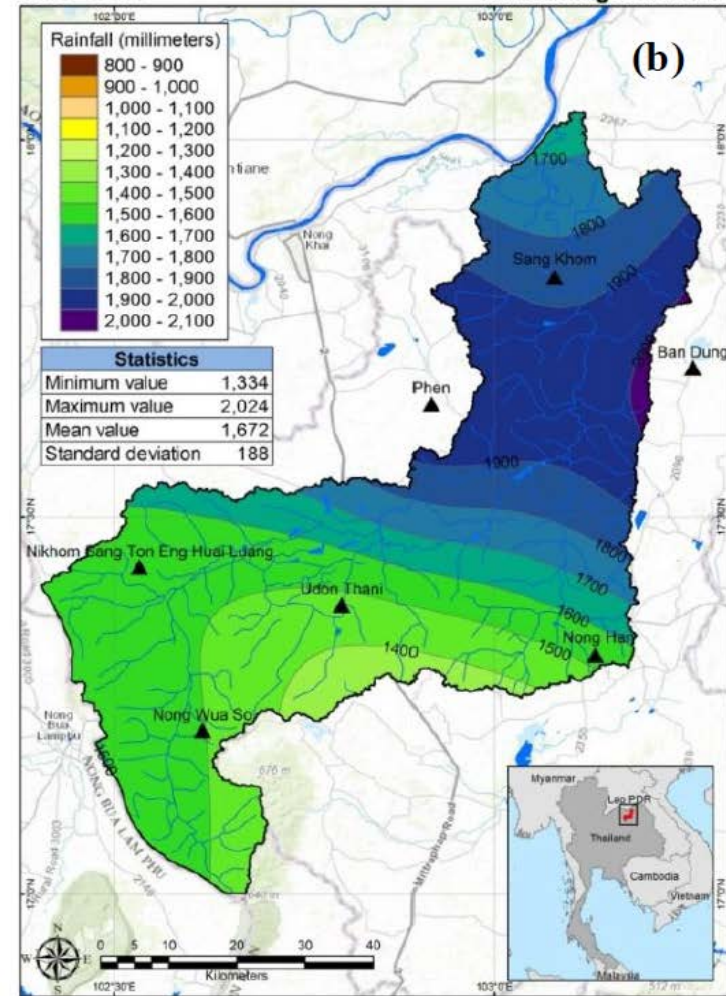
- ❖ An increasing trend of annual rainfall during 32 year-period from 1982–2013
- ❖ The variation of annual rainfall has double from ± 250 mm during 1982–1993 to ± 500 mm during 1998–2013

Rainfall analysis: spatial distribution

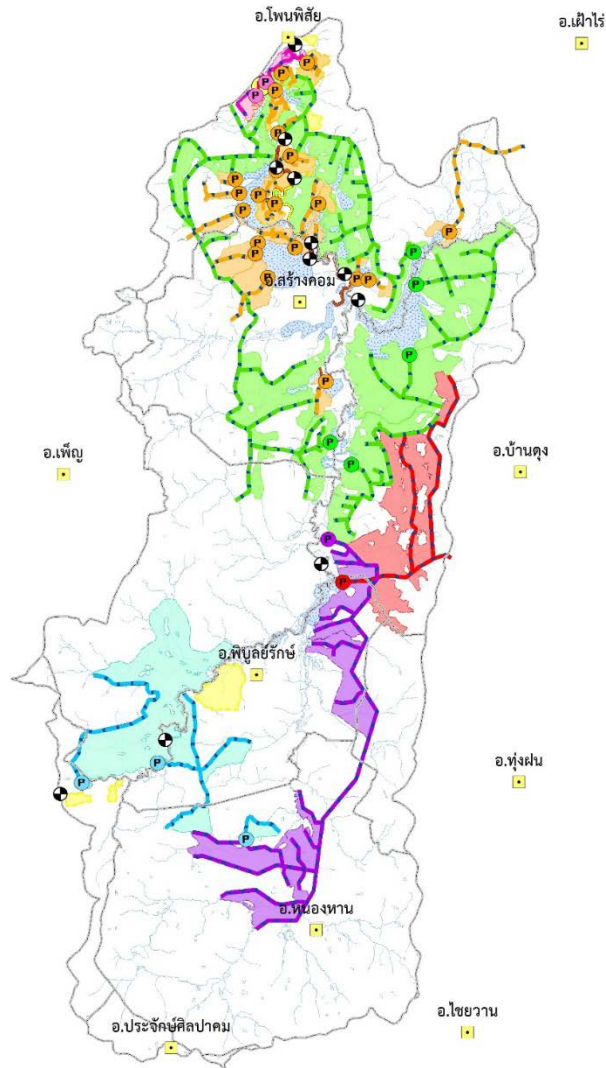
Annual
1982 - 1997
Rainfall Distribution
Huai Luang Sub-basin



Annual
1998 - 2013
Rainfall Distribution
Huai Luang Sub-basin



Water resources development plan



- ❖ Increase irrigation area
 - 315,195 rai (127,557 ha)
 - 200,000 rai (80,938 ha)
- ❖ Reduce water shortage for irrigation
- ❖ Reduce flood area 54,390 rai (22,011 ha)
- ❖ Increase water supply for domestic and industrial use

Modelling Tools

Rainfall-Runoff model

Water allocation model



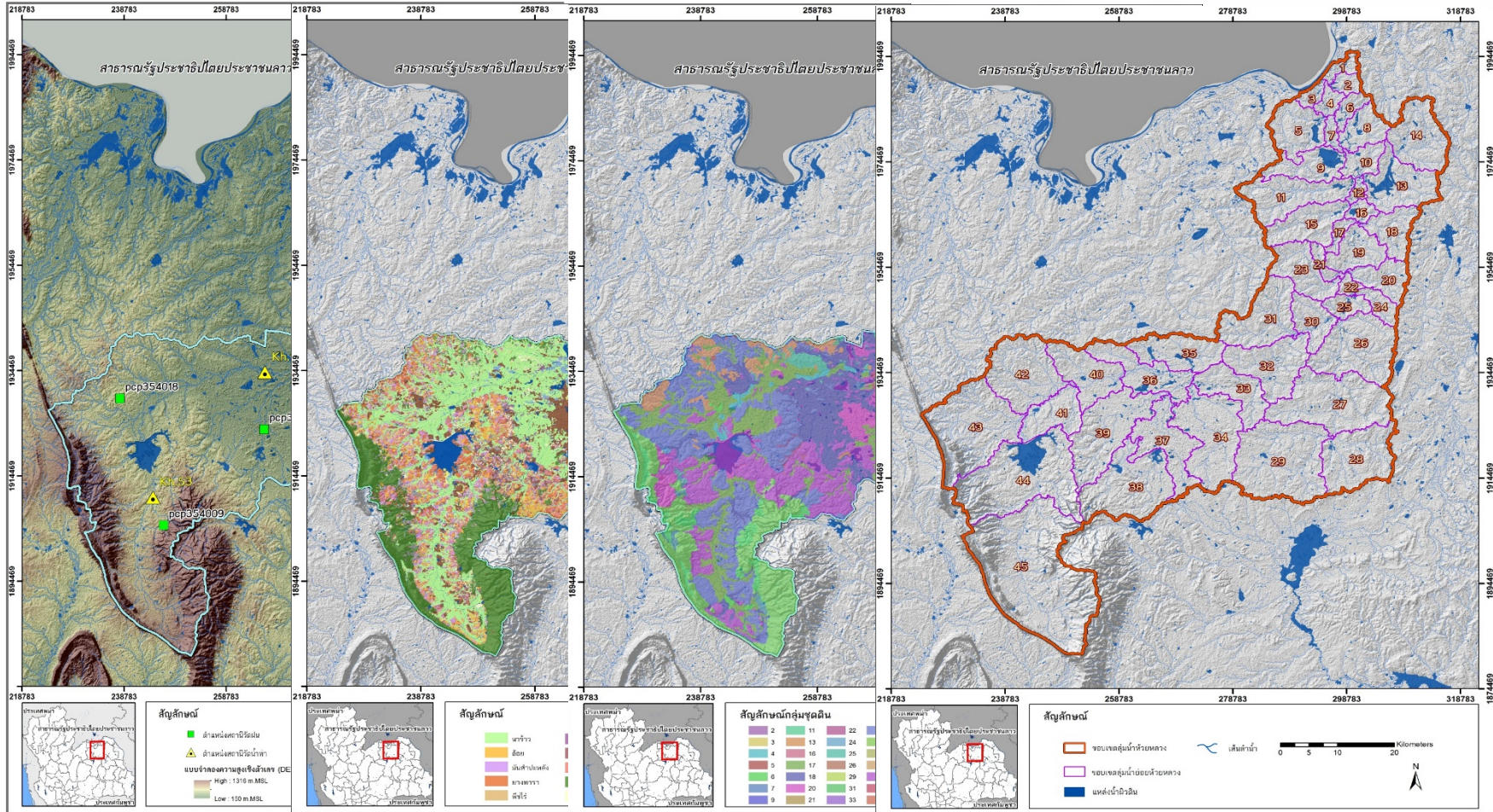
Water
Evaluation
And
Planning



Hydrodynamic and flood model

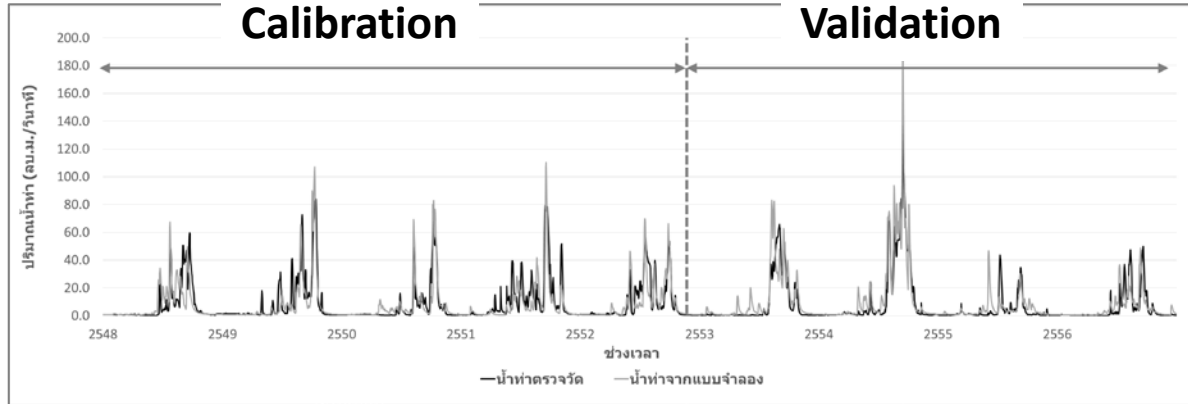
SWAT Model Setup

Topo/weather Land cover Soil SWAT Subbasin



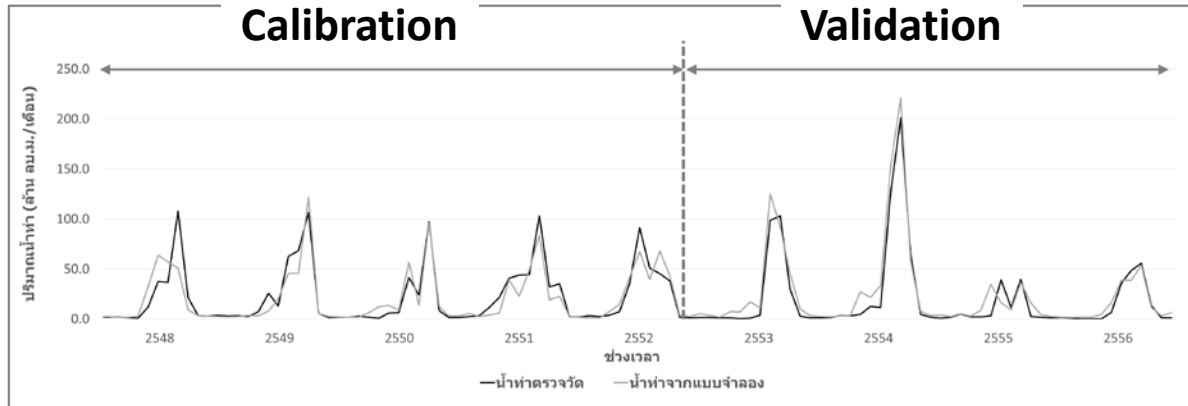
SWAT Model Calibration and Validation

Daily flows



| Indicator | Cal | Val |
|----------------|------|------|
| R ² | 0.74 | 0.76 |
| NSE | 0.69 | 0.70 |

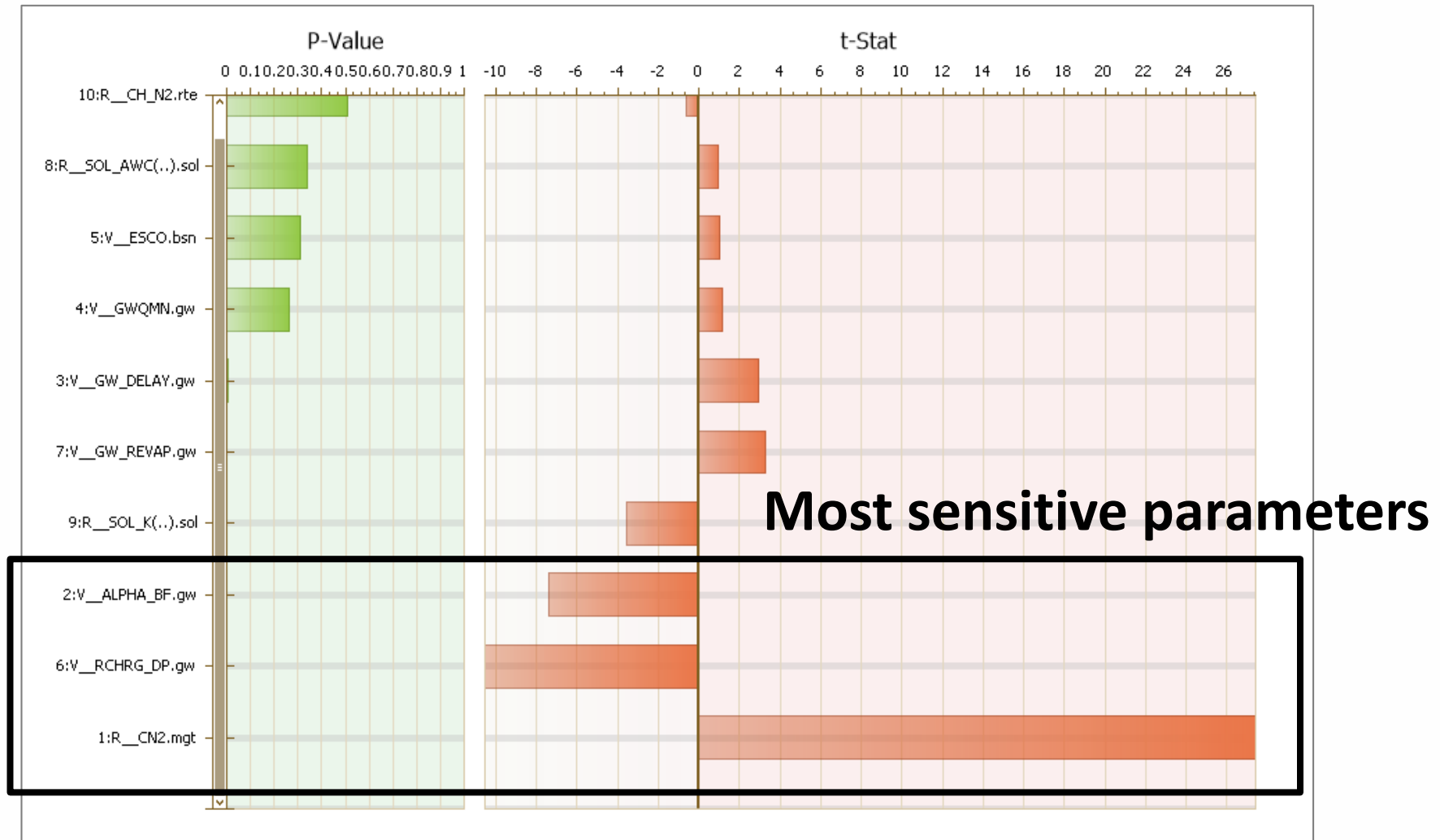
Monthly flows



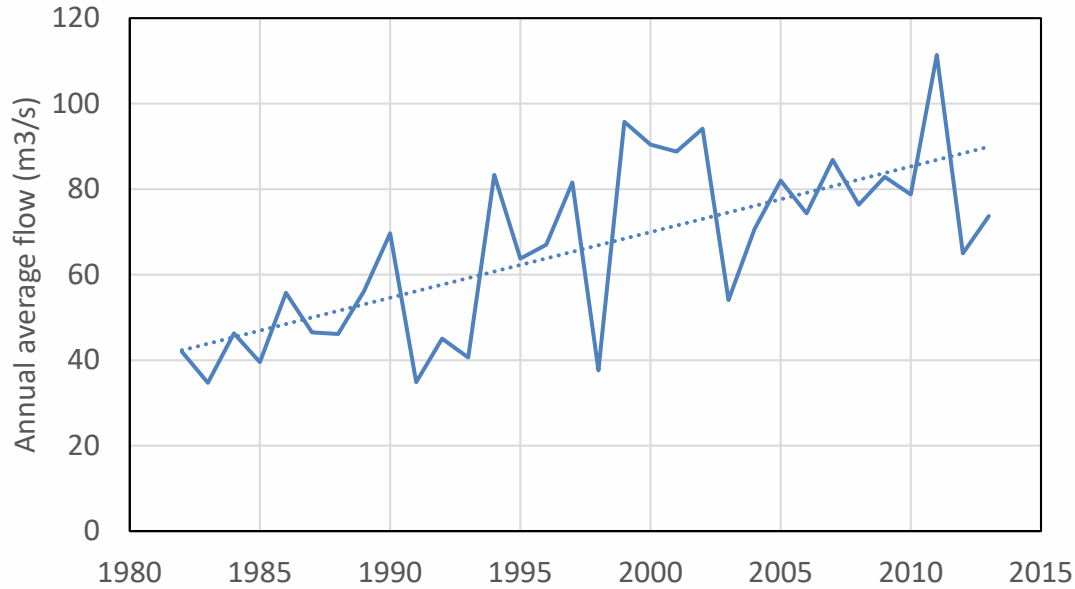
| Indicator | Cal | Val |
|----------------|------|------|
| R ² | 0.81 | 0.91 |
| NSE | 0.79 | 0.84 |

Satisfactory

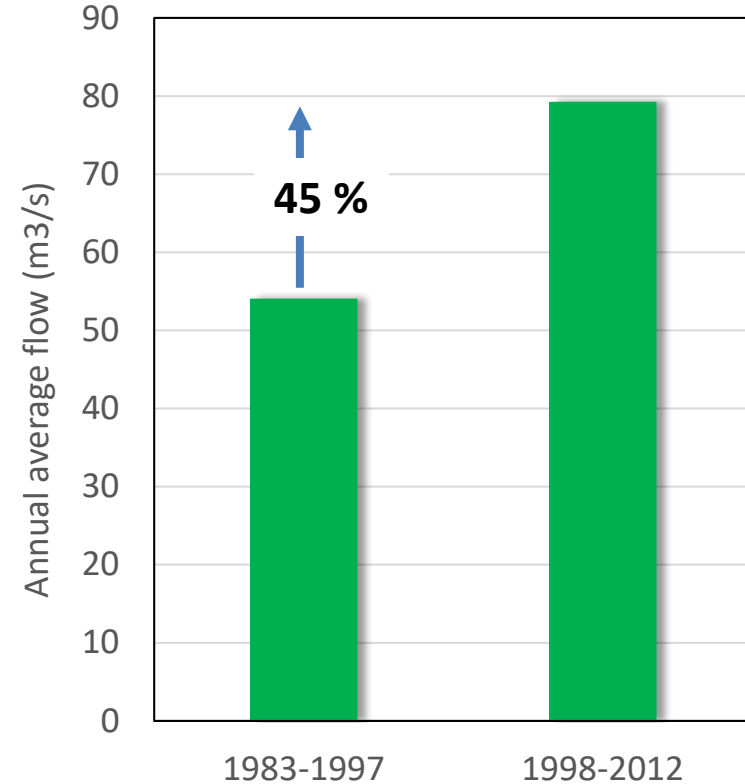
Global Sensitivity Analysis



Simulated Flow Analysis

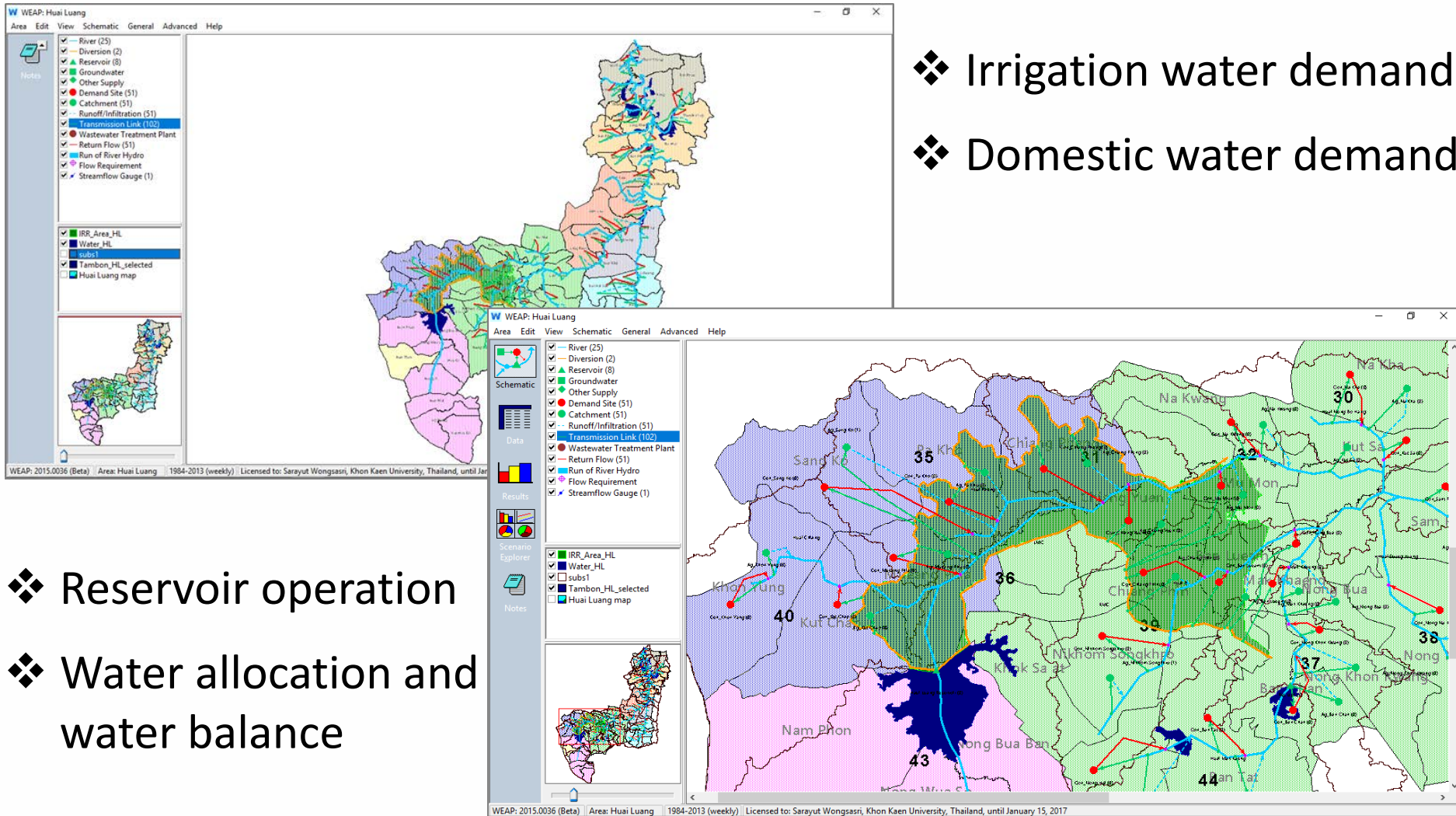


An increasing trend of annual flows at the outlet during 30 year-period from 1983–2012



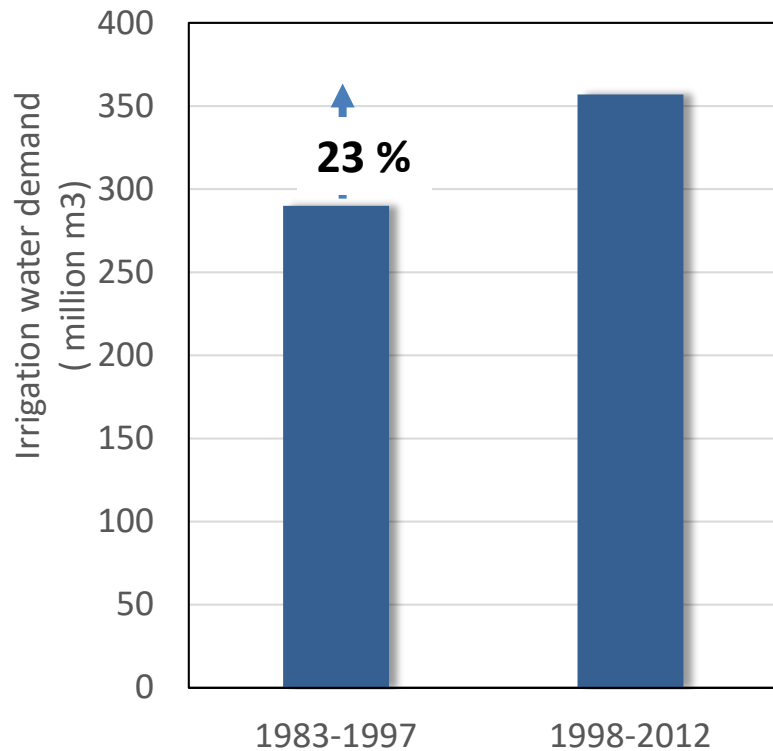
WEAP Model Setup

- ❖ Irrigation water demand
- ❖ Domestic water demand

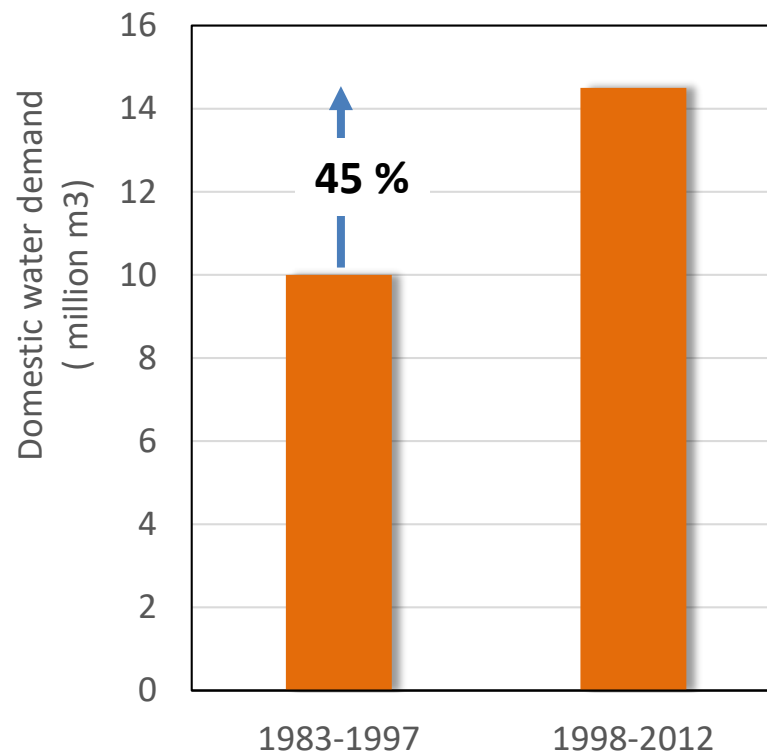


- ❖ Reservoir operation
- ❖ Water allocation and water balance

Water Demand Estimation



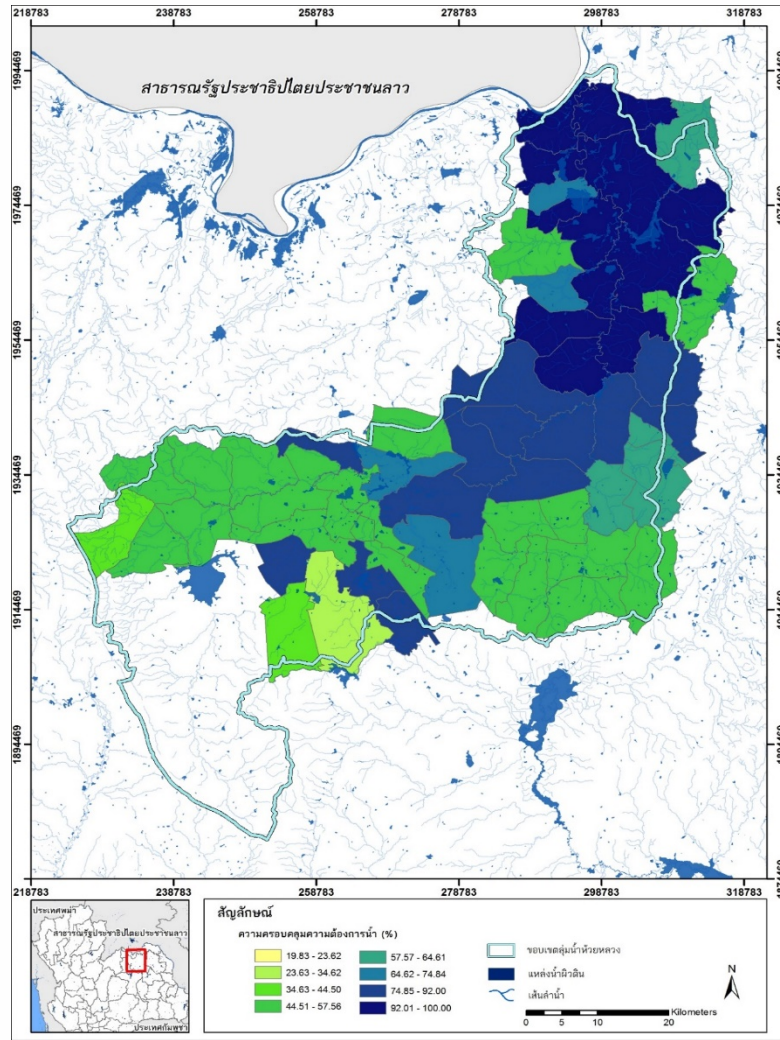
Irrigation water demand



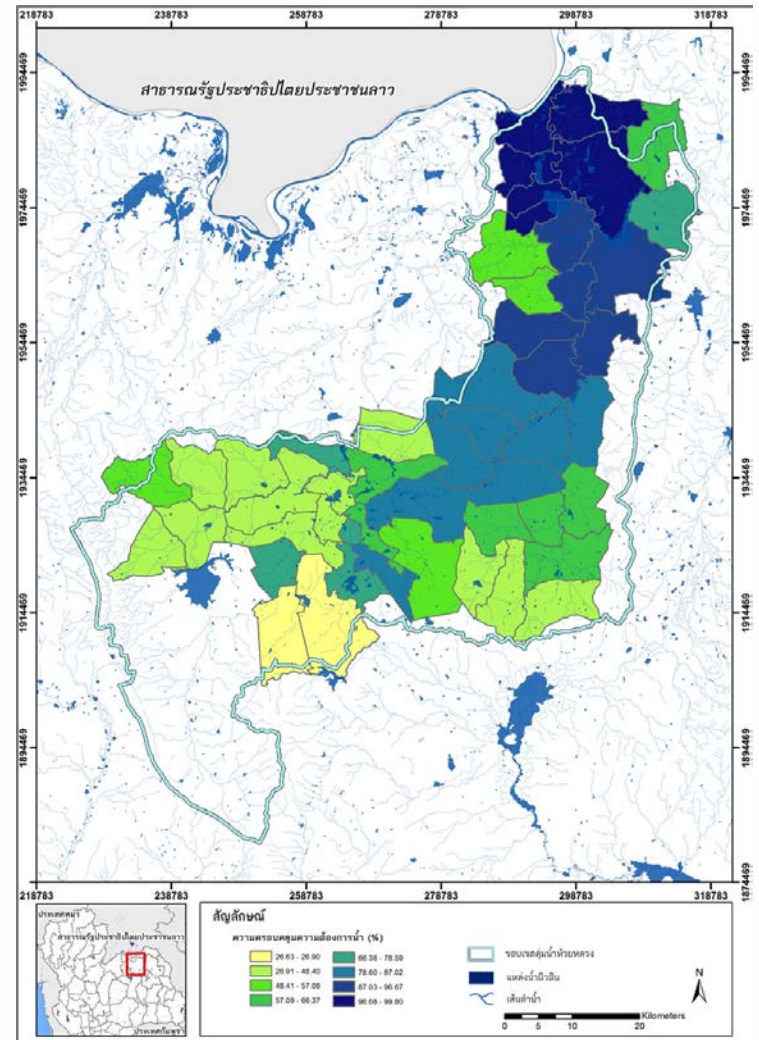
Domestic water demand

Percentage of water supply coverage

Domestic water use



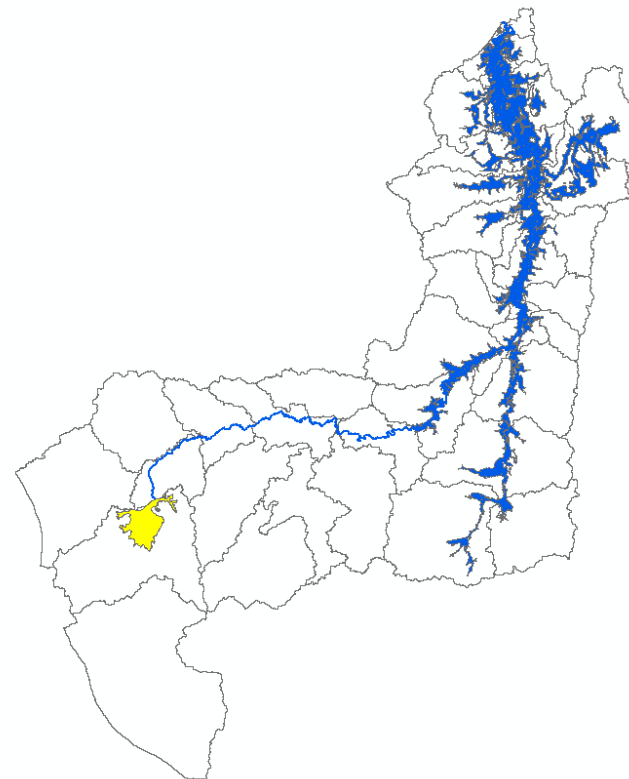
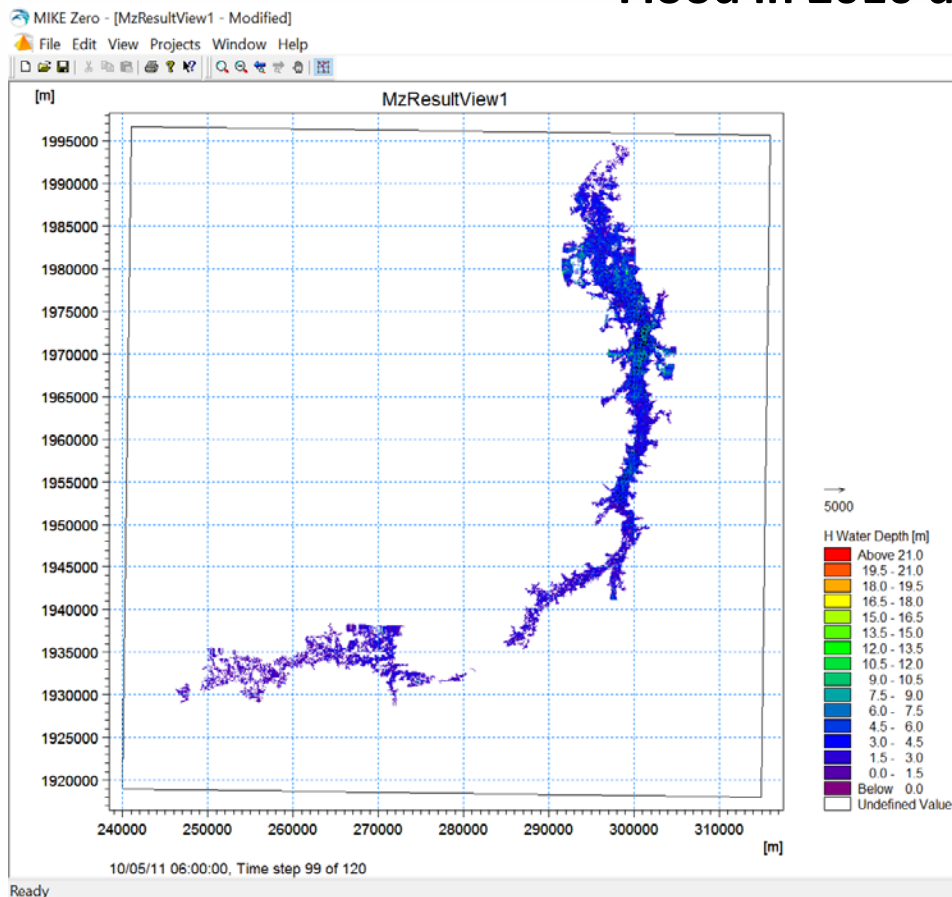
Irrigation water use



Conclusion

Next step: Flood Modelling

Flood in 2010 during Sep-Oct



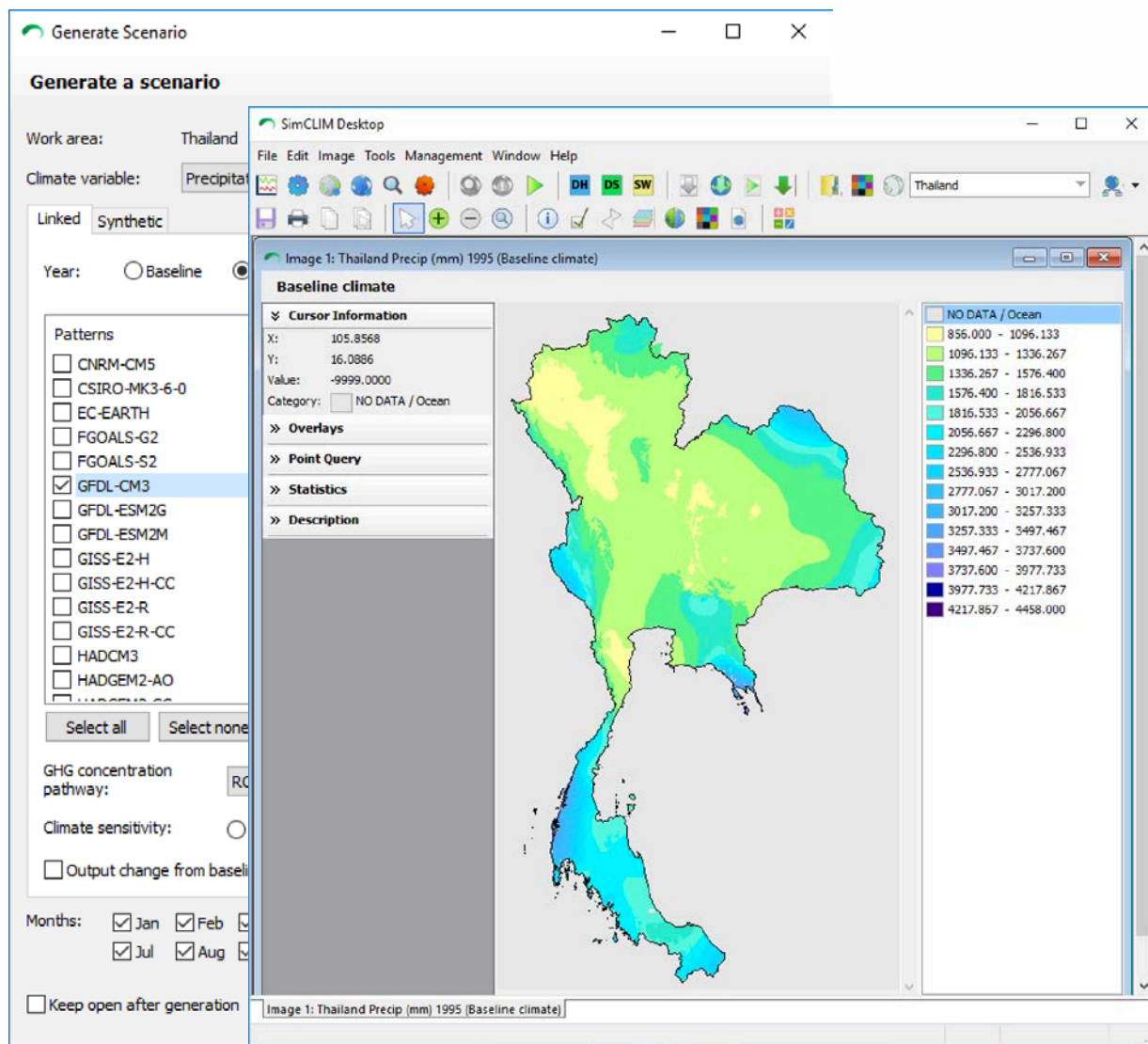
Mike Flood (M11+M21)

Field Survey

Next step: Impacts of Climate Change



- Climate change projection database
- 1x1 km resolution
- Contain 4 RCPs and 40 GCMs from the CMIP5
- Generate monthly change factors (rainfall, temperature, humidity, solar radiation) for the SWAT model



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THANK YOU