

# The loss assessment for Cho-Shui river basin in the end of century under climate change

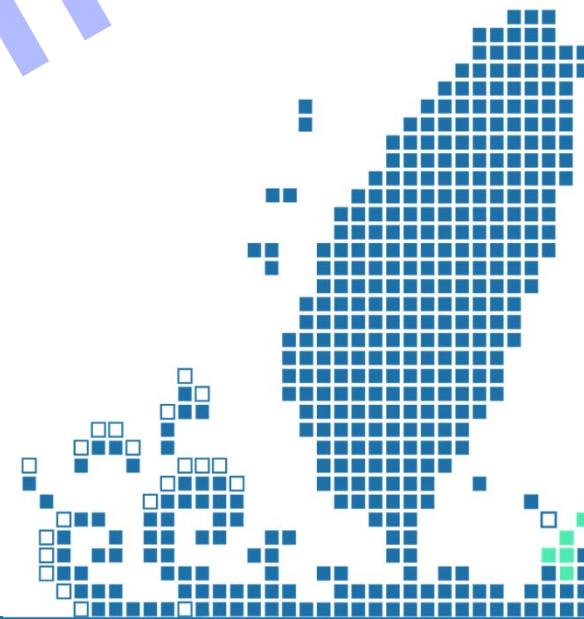
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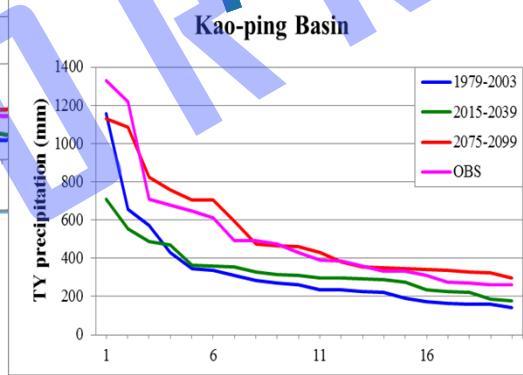
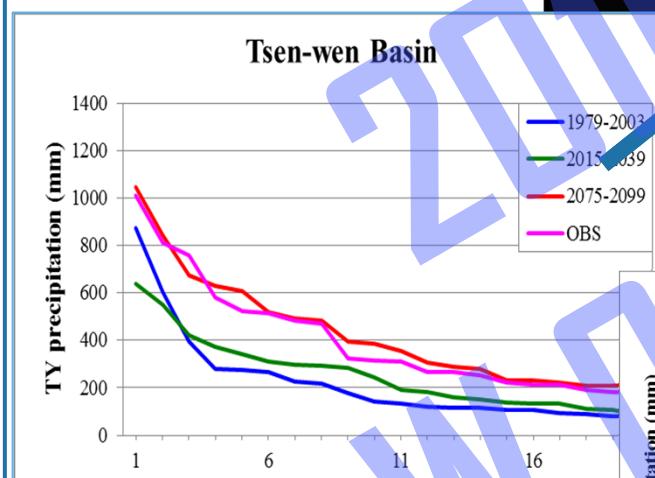
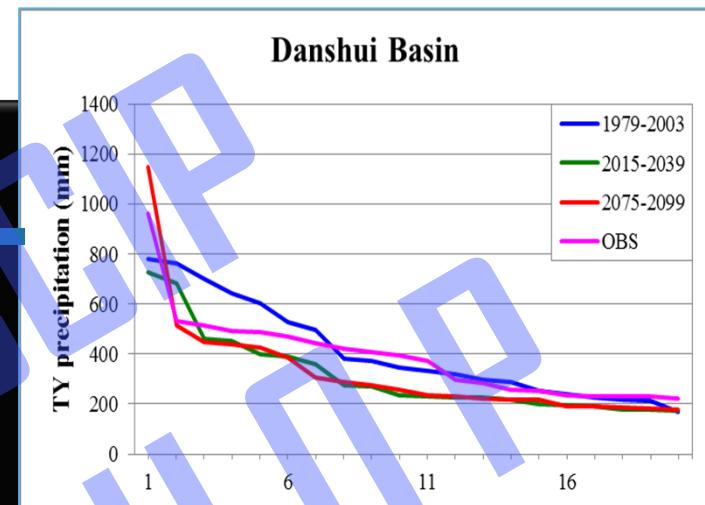
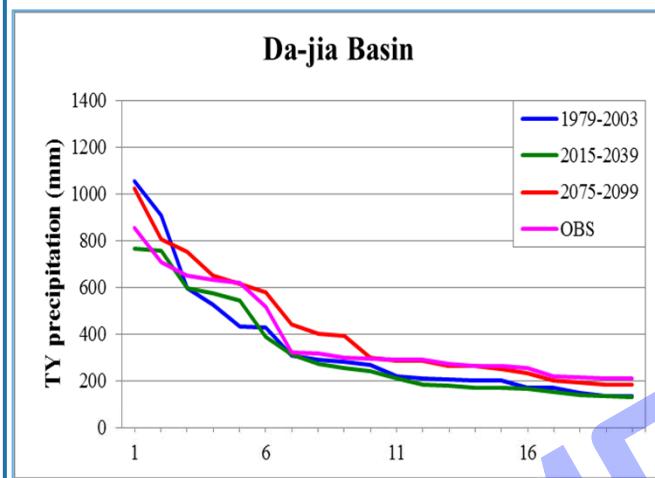


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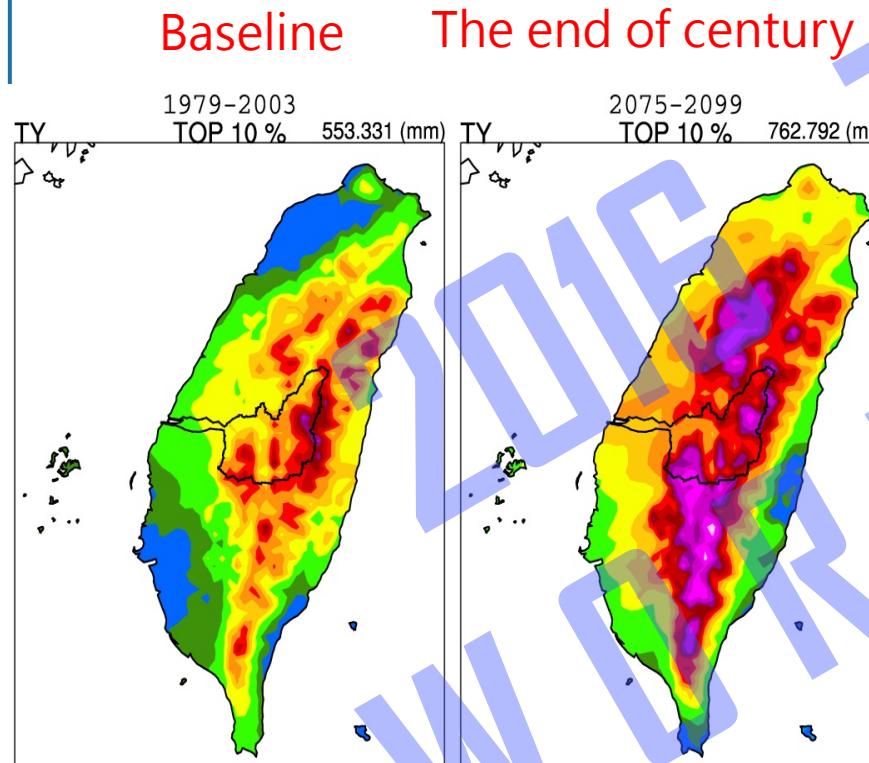


# Five Basin Analysis

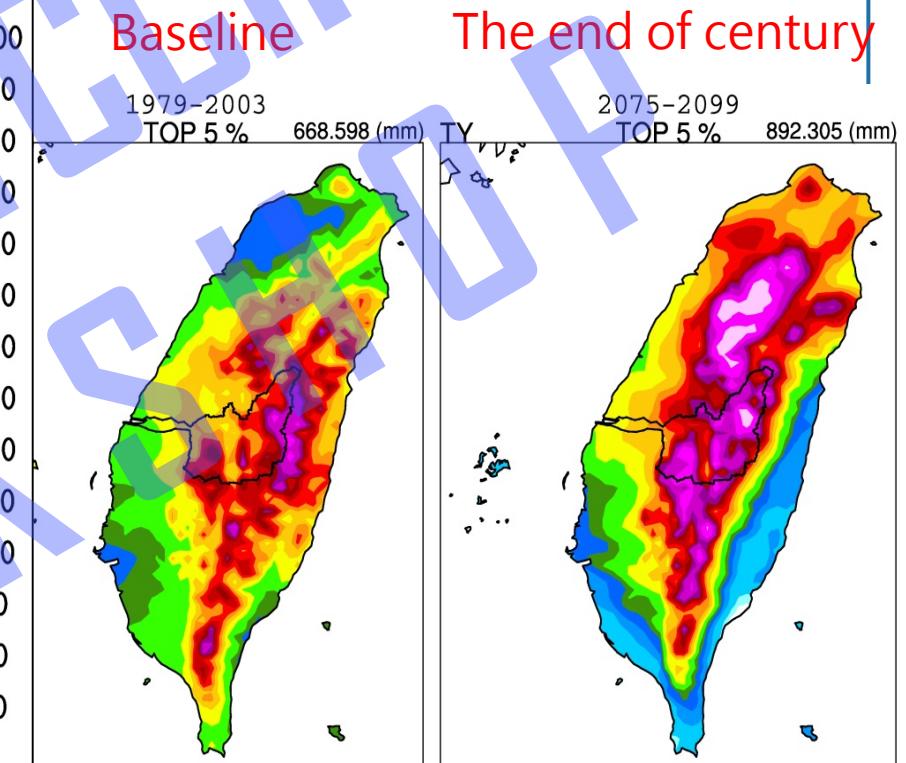


# Typhoon events analysis

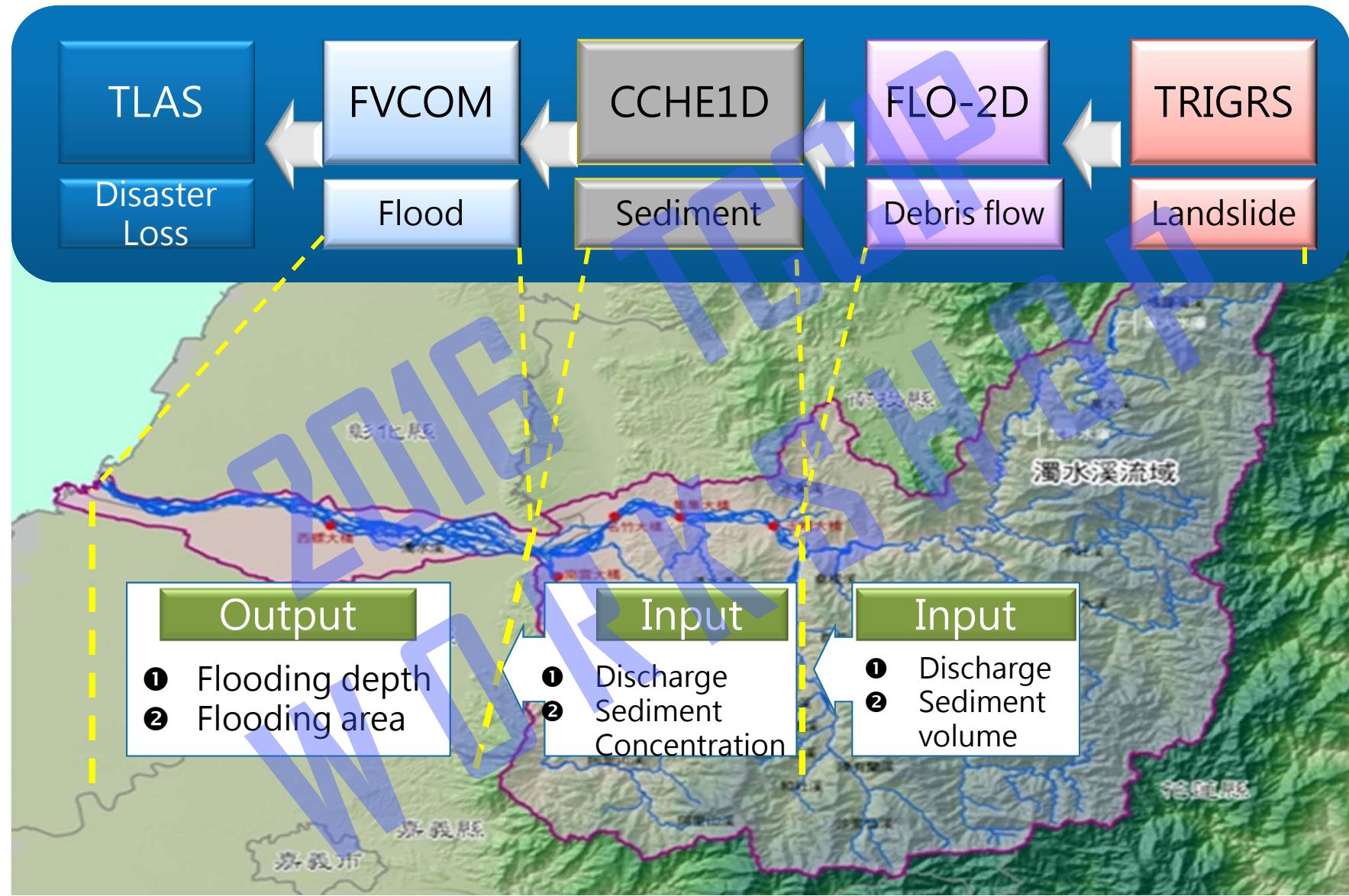
Top 10% events



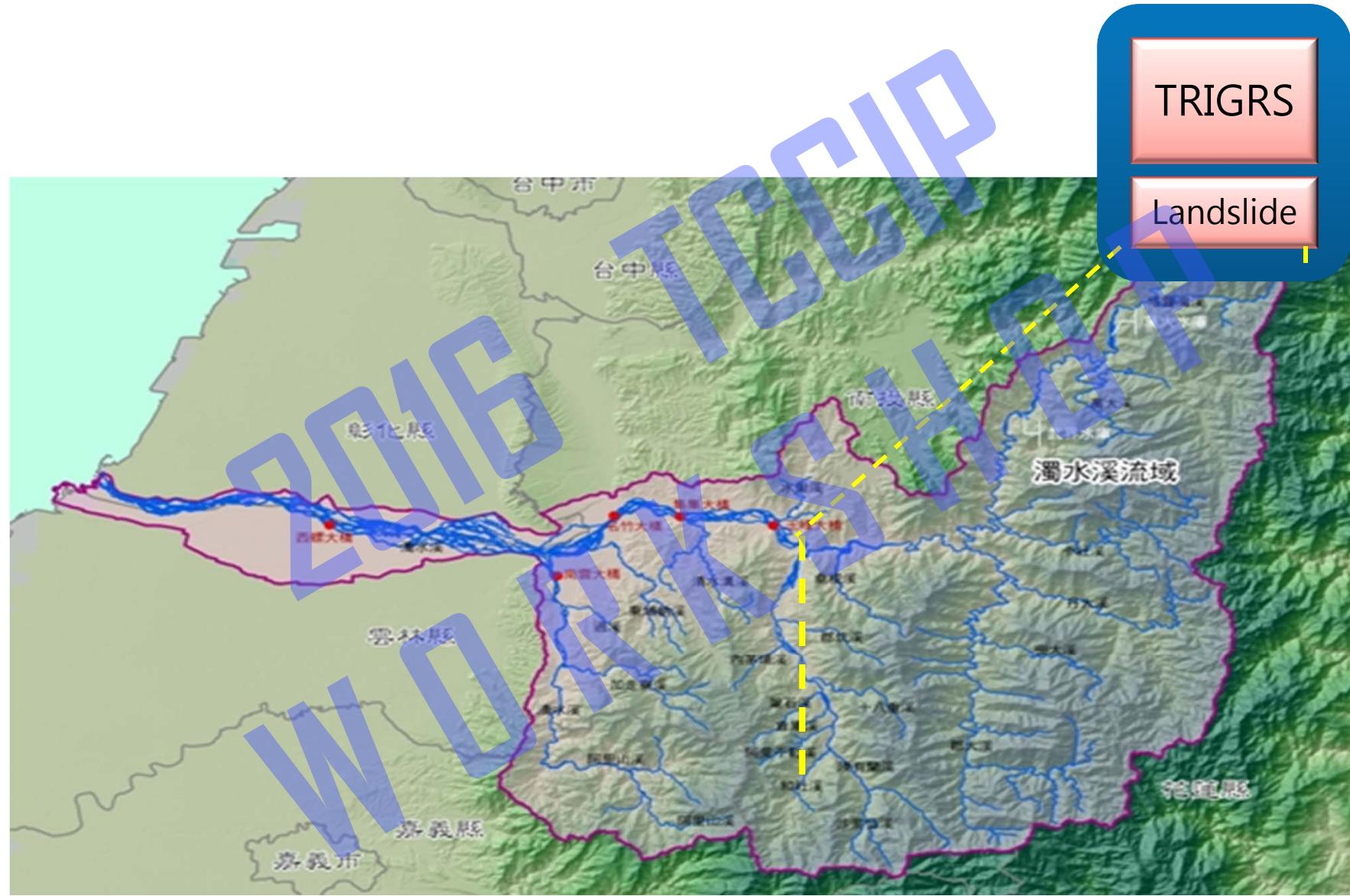
Top 5% events



# Assessment Models

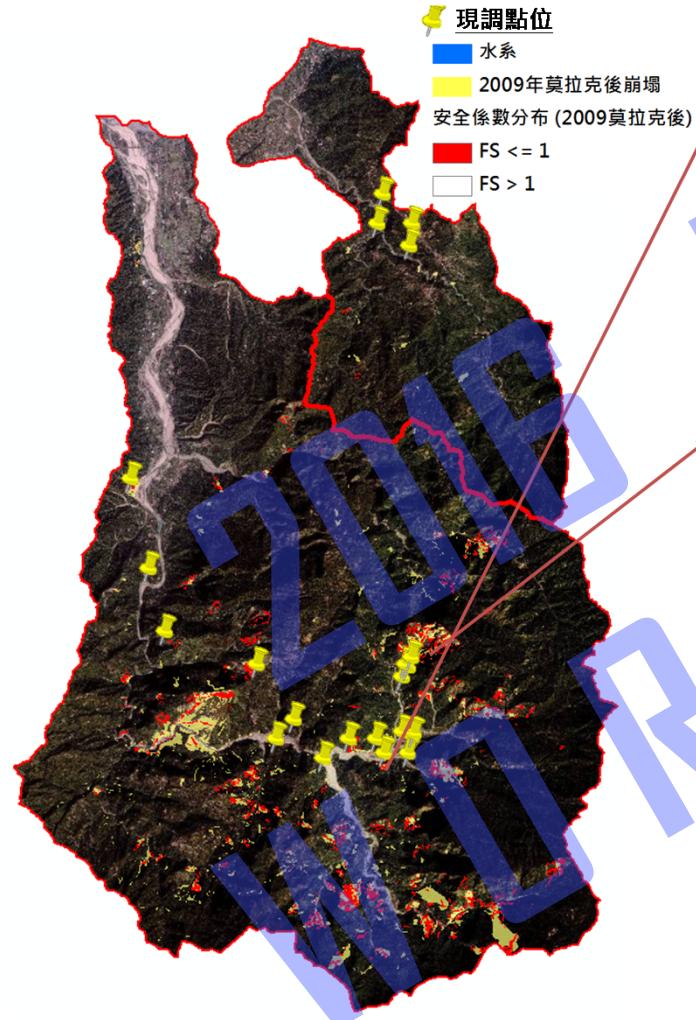


# Assessment Models

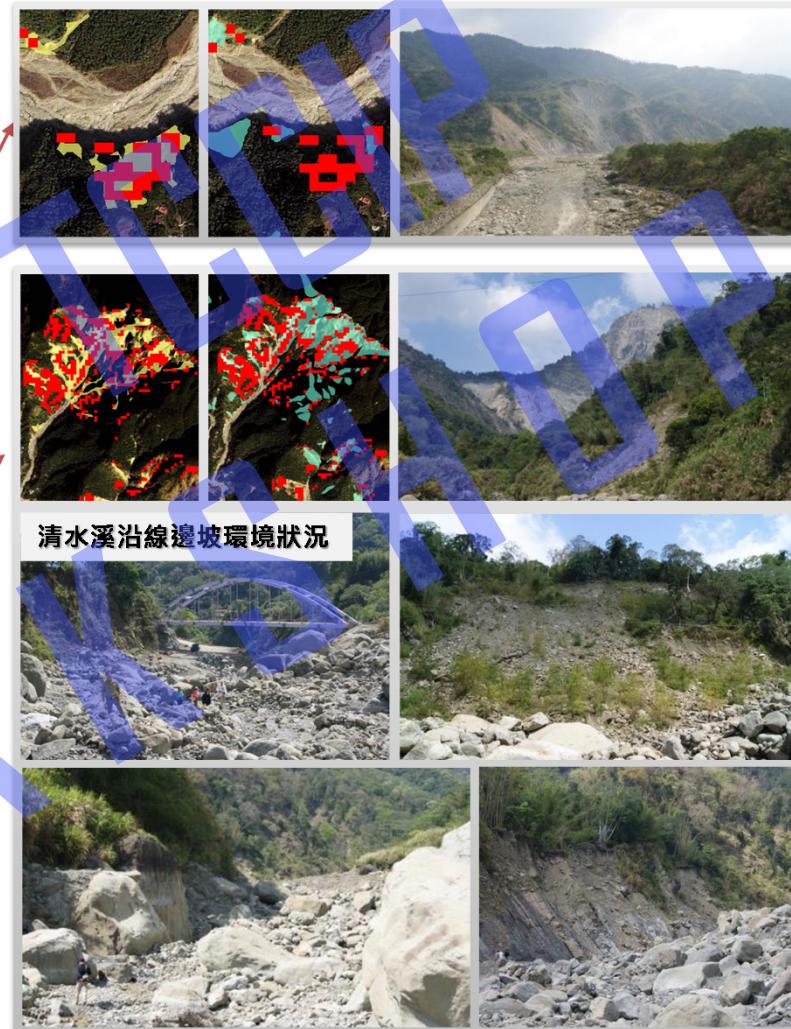


# Field investigation

## **Chinsui and Dongpurui catchment**



2009年莫拉克後崩塌 2014年岩屑崩滑(地調所)



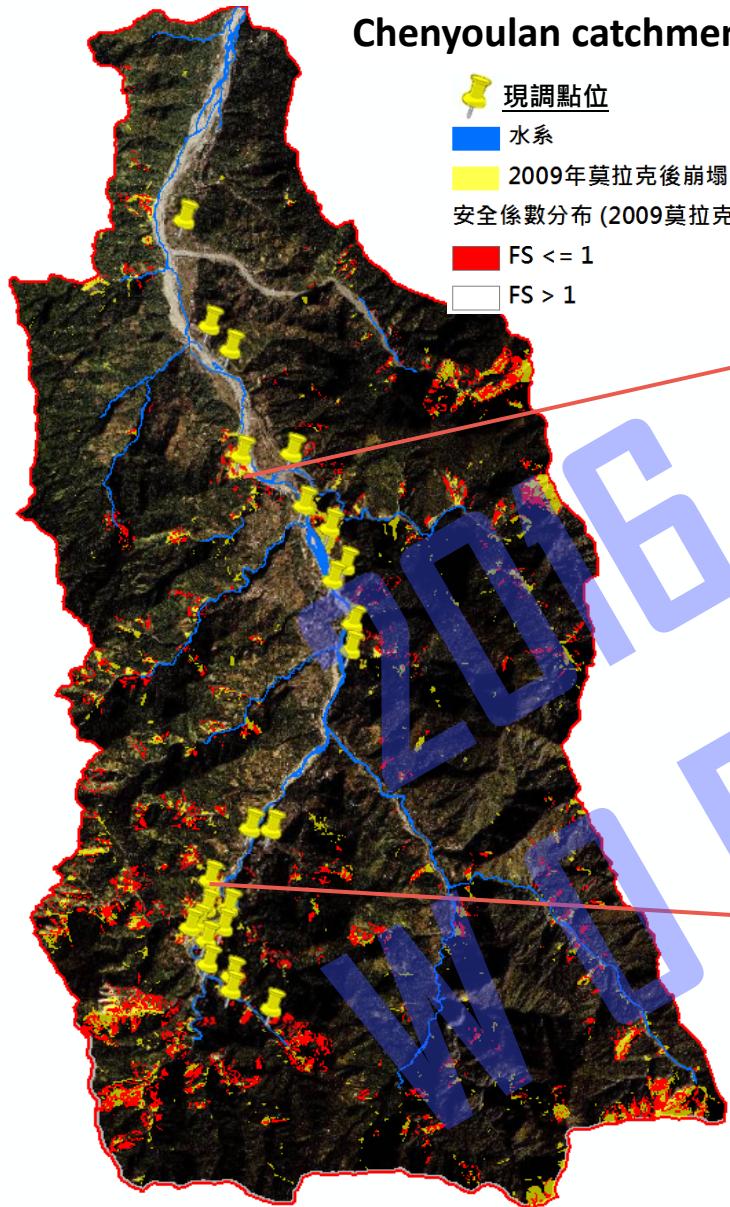
# Calibration for landslide

- Calibration was by multi history events, which MSR >70% is the standard.

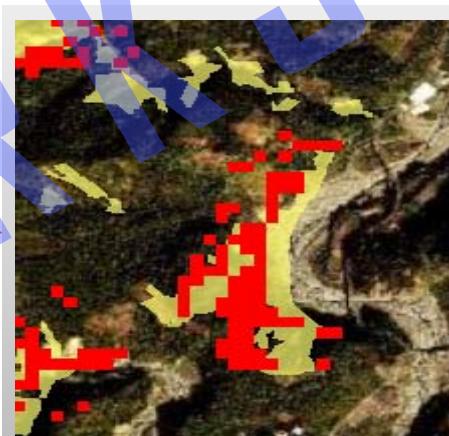
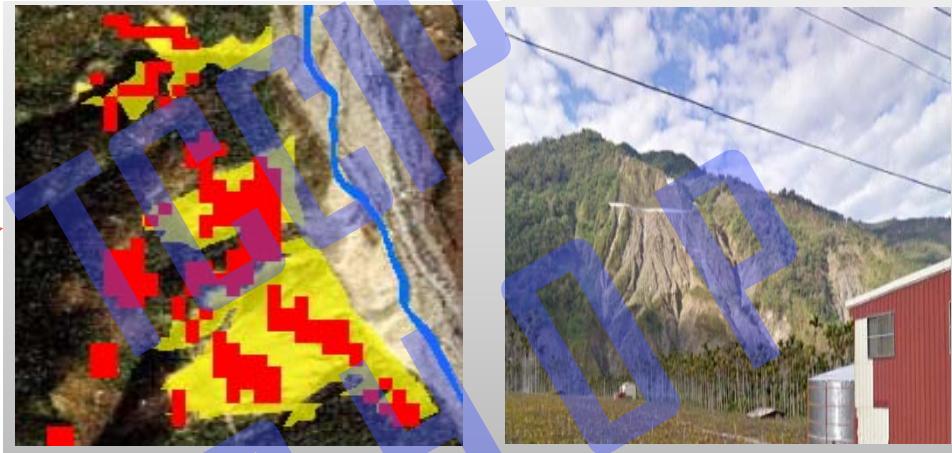
Simulated result					
			Landslide correct rate (SRn, %)	Non-landslide correct rate (SRC, %)	Modified success rate (MSR, %)
Calibration	2004	Typhoon Mindulle	0.89	0.77	0.82
	2005	0612 rainfall	0.84	0.93	0.88
		Typhoon Haitung			
		Typhoon Taili			
	2007	Typhoon Korosa	0.72	0.78	0.75
	2008	Typhoon Kamegi	0.86	0.71	0.78
		Typhoon Fong-Hung			
		Typhoon Chun-Mi			
		Typhoon Shinlaku			
Validation	2009	Typhoon Morakot	0.90	0.68	0.79

※ Calibration unit: sub-catchment

# Validation for landslide

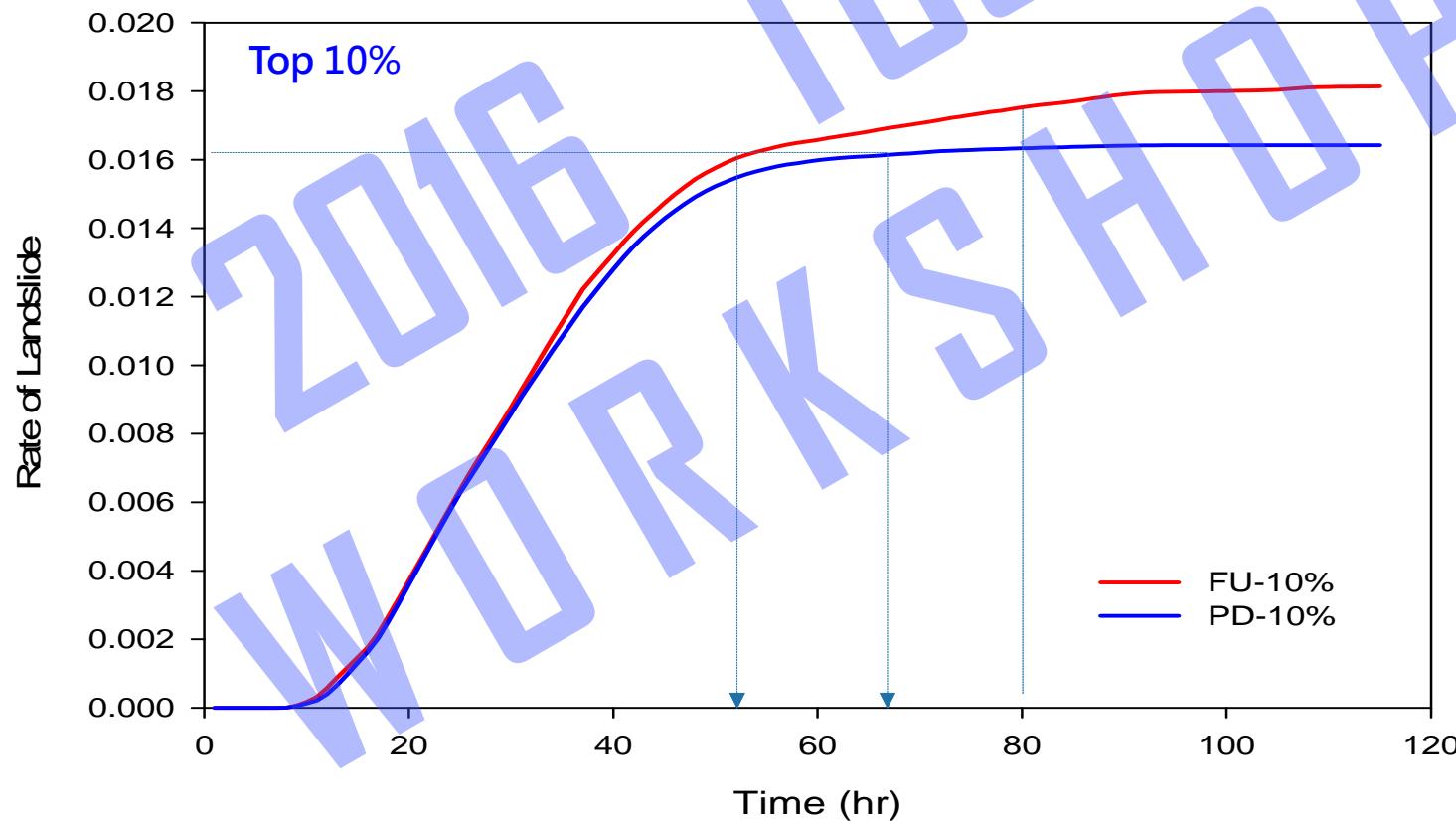


Landslide after typhoon  
Morakot, 2009



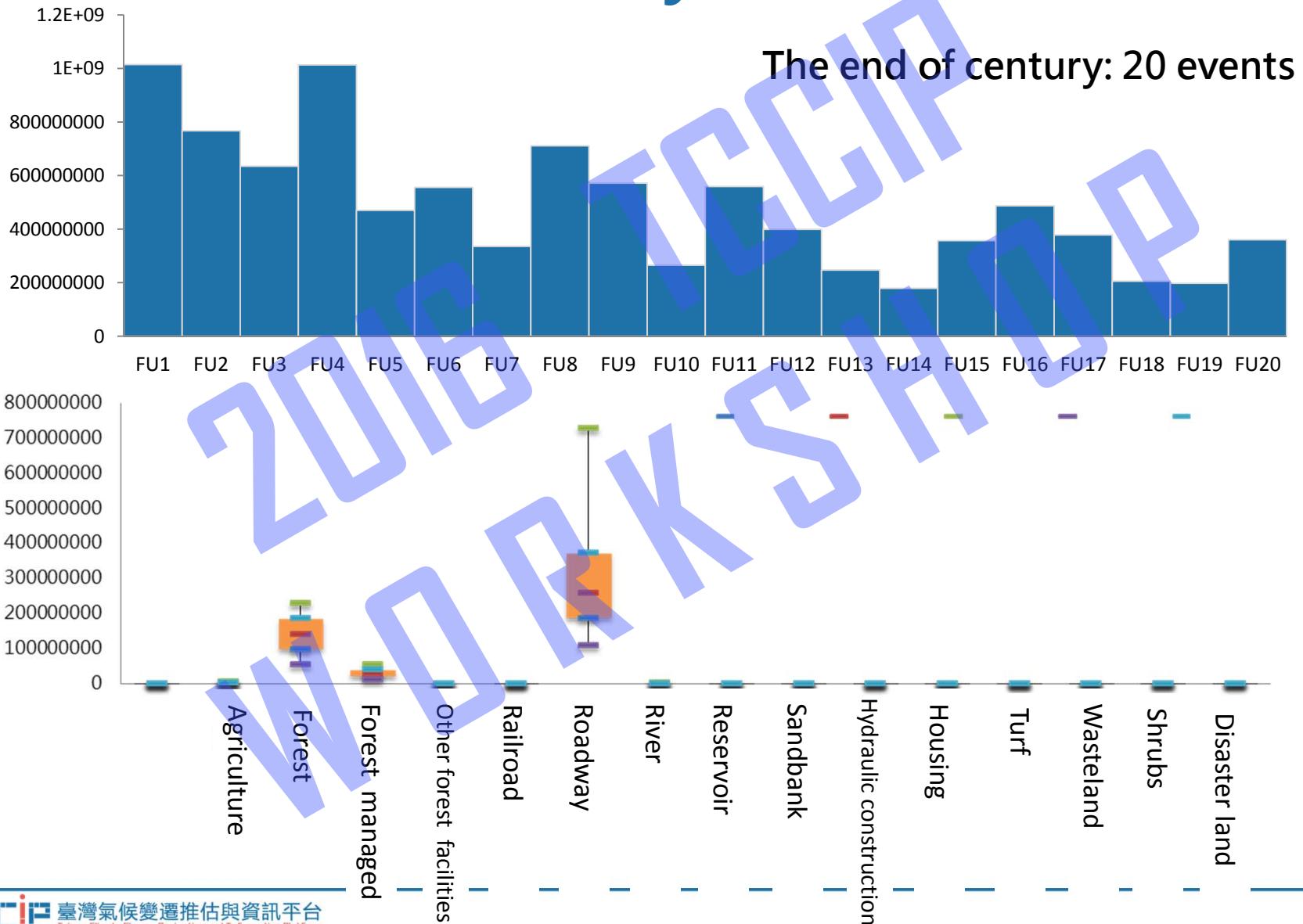
# Landslide changing rate

- ➲ Landslide areas and volumes are with more serious situation in the end of century. It is affected by future rainfall type, shorter duration and higher intensity.
- ➲ Landslide occurrence time will be earlier, more landslide will be triggered in the future.



# Landslide Loss assessment

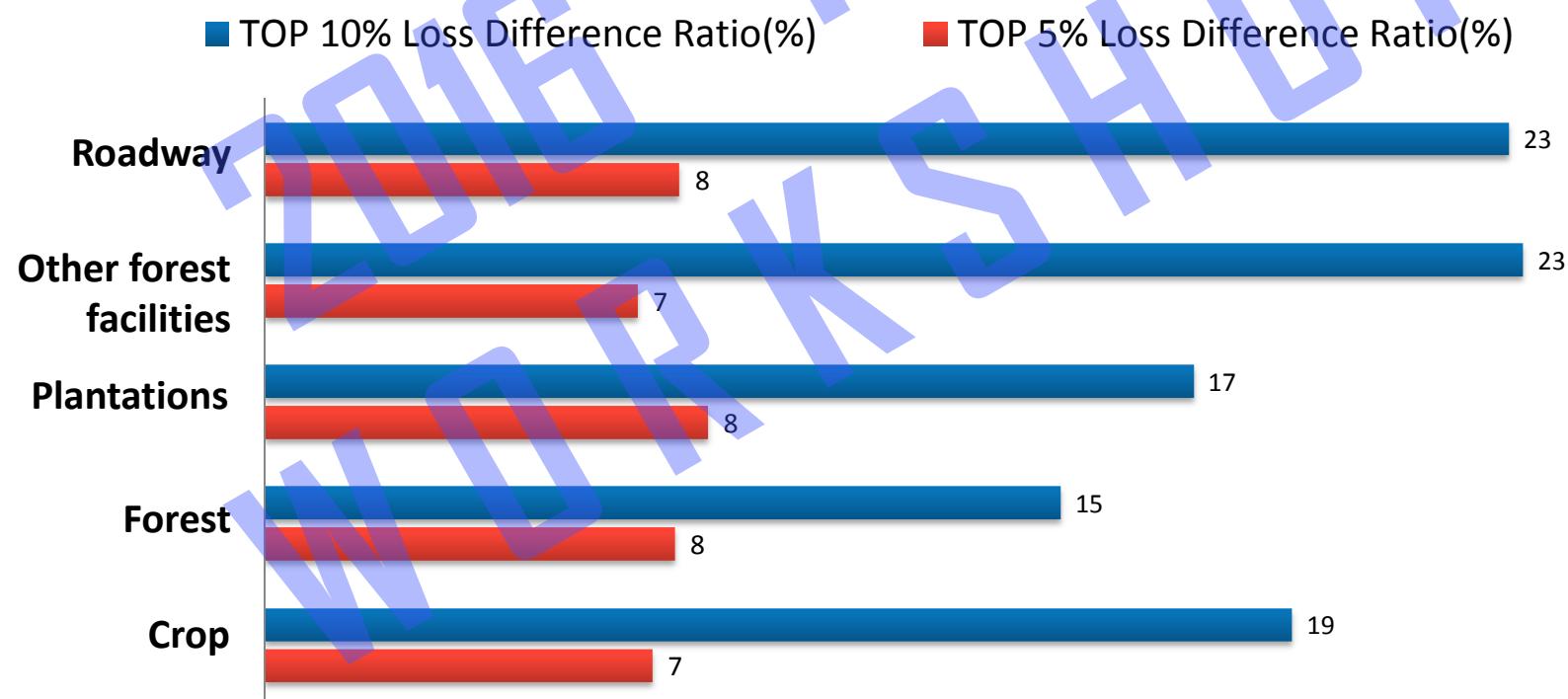
## -The end of century



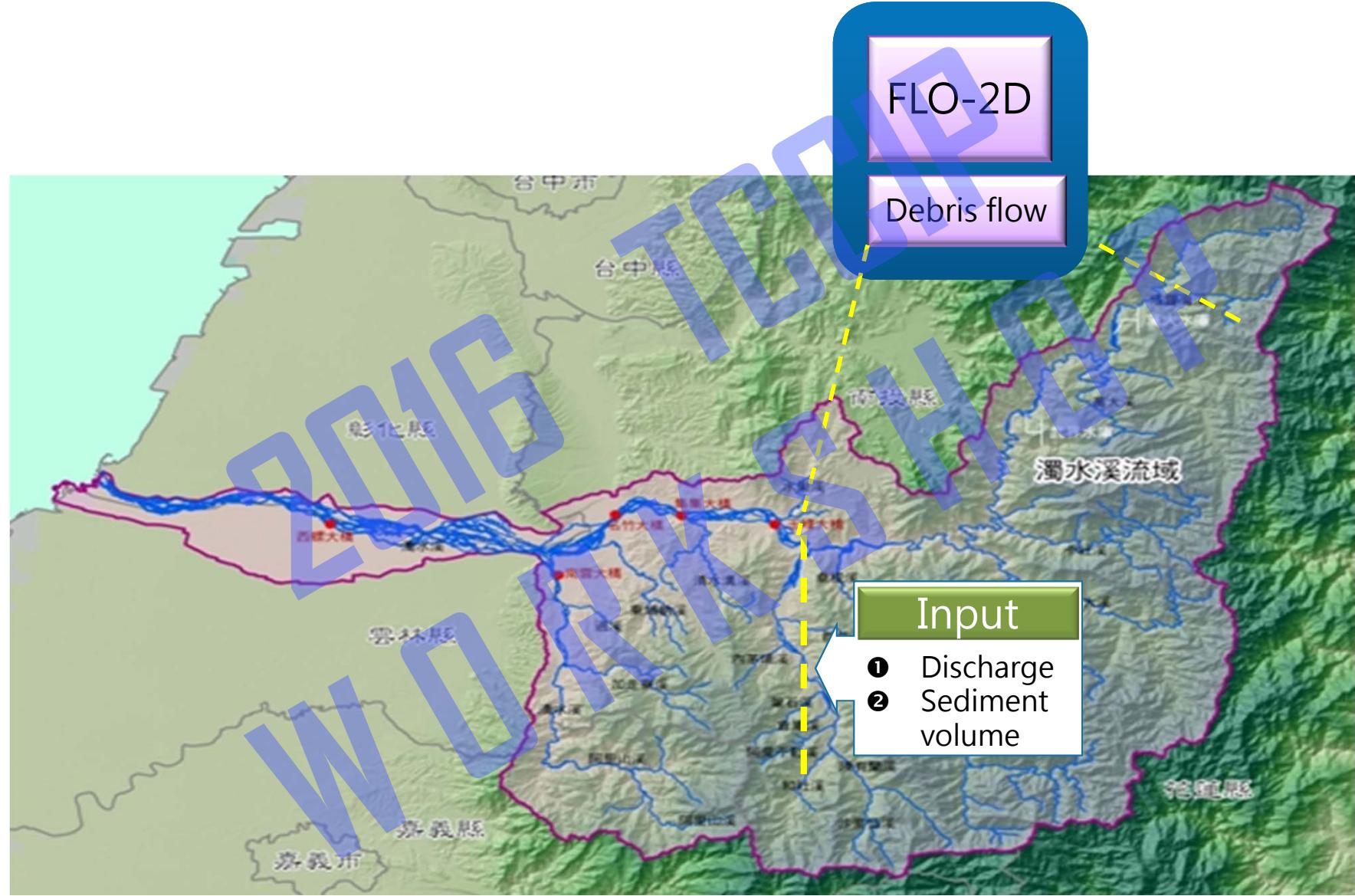
# Landslide loss assessment

**Top 5%** average disaster loss at the end of century is **8.91** billion NTD,  
which is **8%** higher than it in baseline

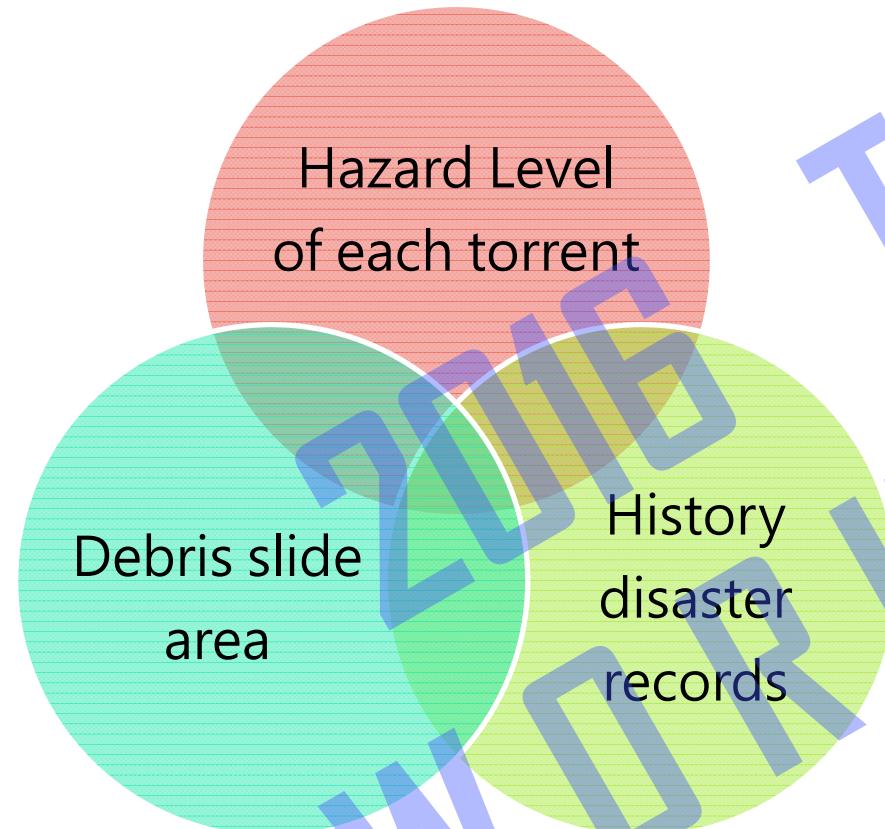
**Top 10%** average disaster loss at the end of century is **8.57** billion NTD,  
which is **21%** higher than it in baseline.



# Assessment Models



# Debris Flow Selection

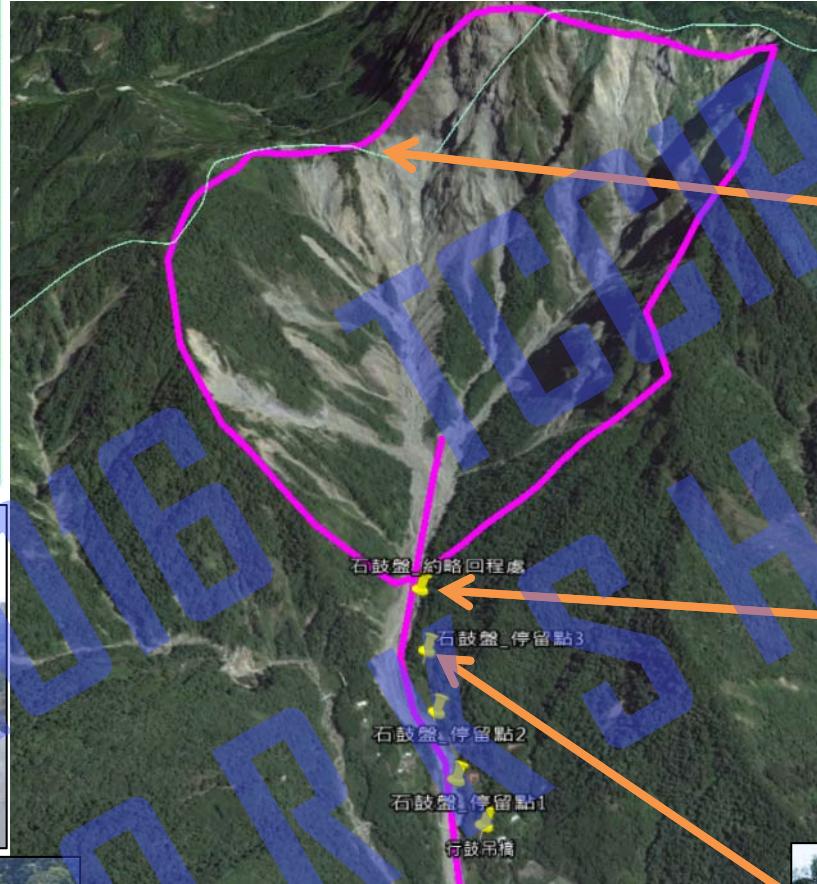


Total 40 debris flow were selected

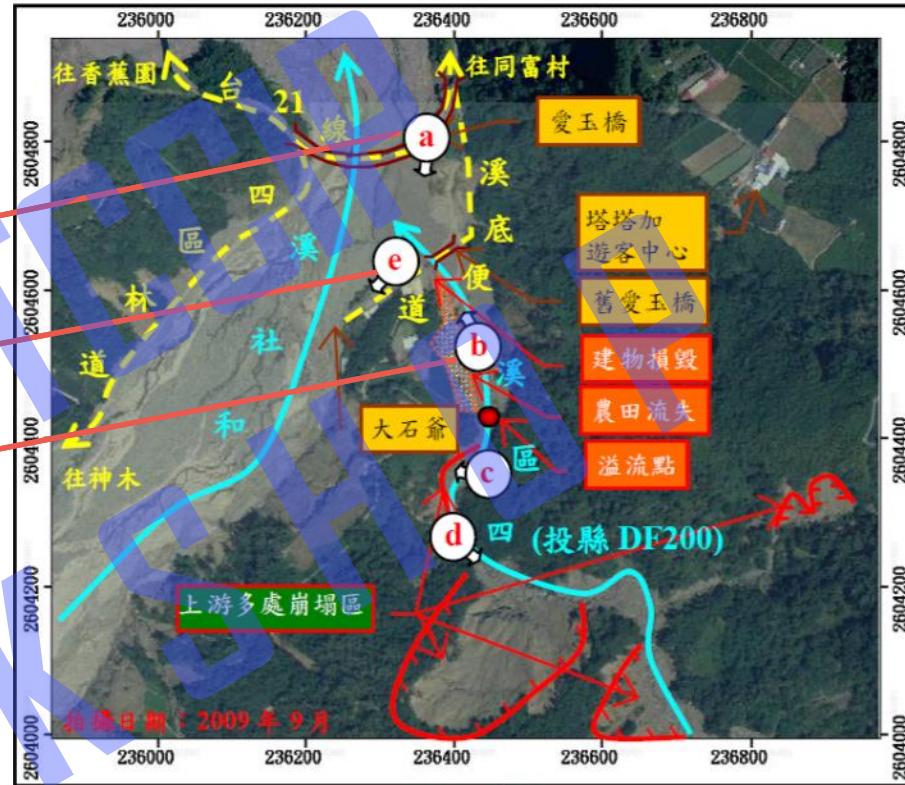
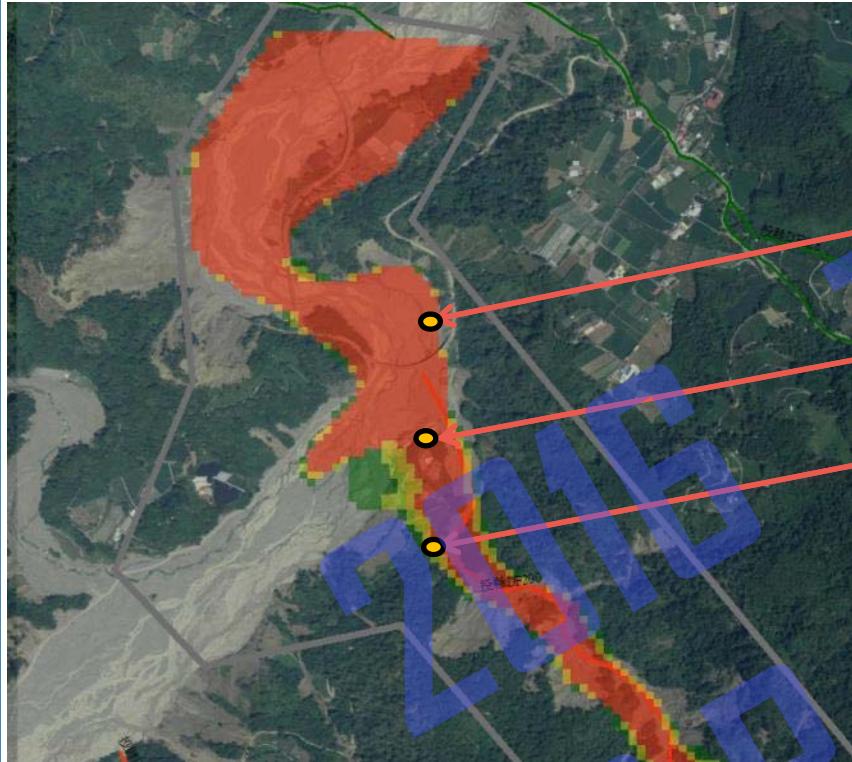
投縣DF026	投縣DF189	投縣DF223
投縣DF080	投縣DF190	投縣DF224
投縣DF132	投縣DF191	投縣DF226
投縣DF142	投縣DF193	投縣DF227
投縣DF159	投縣DF194	投縣DF236
投縣DF165	投縣DF196	雲縣DF012
投縣DF166	投縣DF199	嘉義DF004
投縣DF167	投縣DF200	嘉義DF008
投縣DF178	投縣DF201	嘉縣DF039
投縣DF181	投縣DF202	嘉縣DF040
投縣DF185	投縣DF213	嘉縣DF041
投縣DF186	投縣DF216	嘉縣DF059
投縣DF188	投縣DF219	嘉縣DF073

- Hazard level: Based on the definition by SWCB,

# Debris flow onsite investigation



# Debris flow Calibration



Nantou DF200 is with high debris flow potential

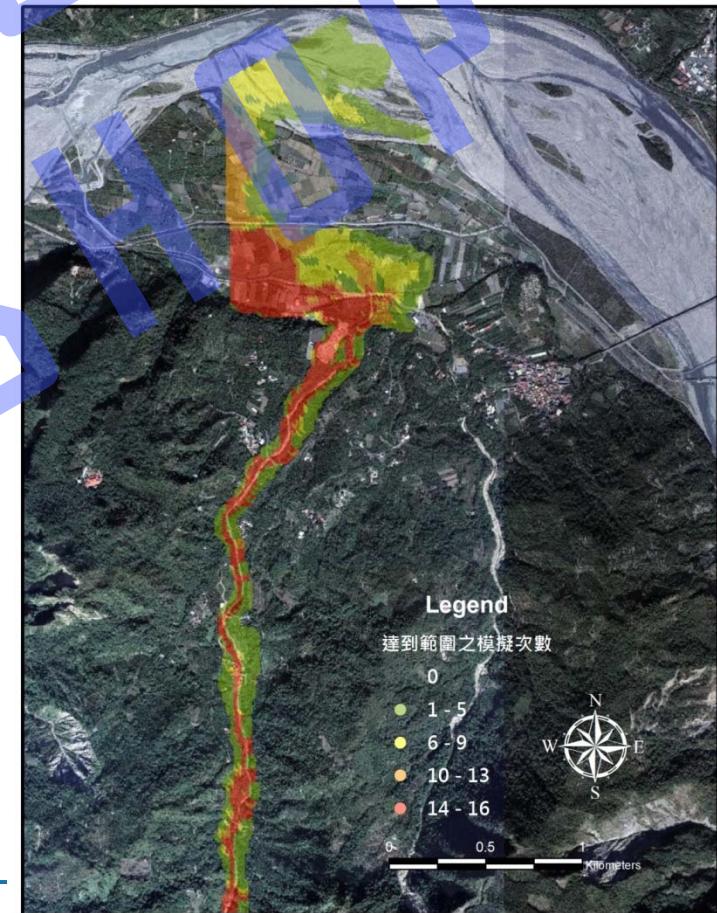
1. Large number of sediment accumulates at *a* spot and *b* spot, and *e* spot was buried by 1-3m.
2. accumulation area above *d* point matches with topography on aerial photographs.

# Parameter modification and sensitivity test

- Select the parameters and decide their max and min value.
- Modified the exponent value of yield stress and viscosity, laminar flow resistance, and sediment concentration :

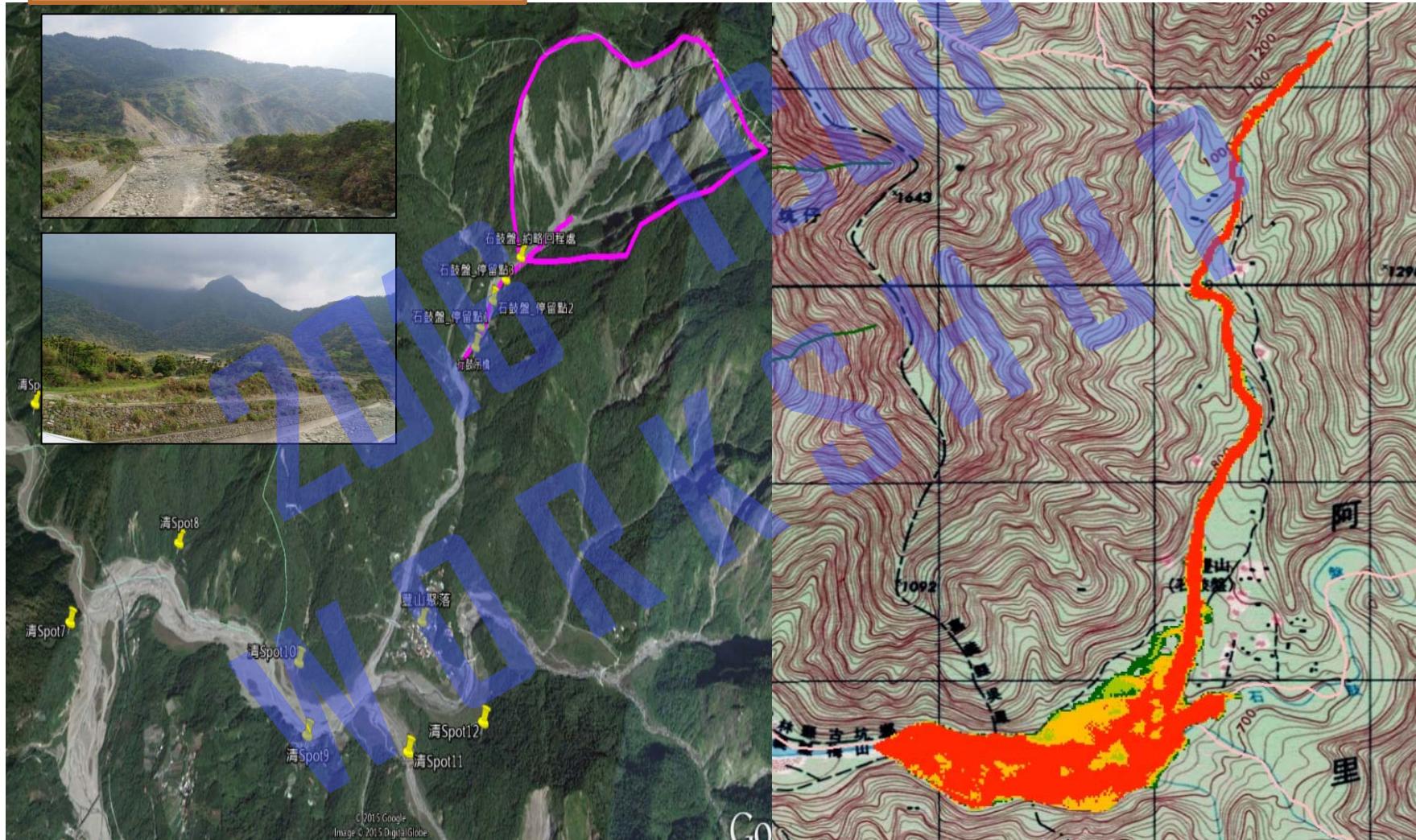
Parameter	Max (+1)	Min (-1)
Exponent of yield stress, B1	11.66	7.862
Exponent of viscosity, B2	3.538	0.797
Laminar flow resistance, K	10000	500
Sediment concentration, Cv	0.65	0.50

Result	Coefficient
Interception	646723.11
B1	8839.55
B2	-130290.91
K	-6.57
Cv	-21817.50

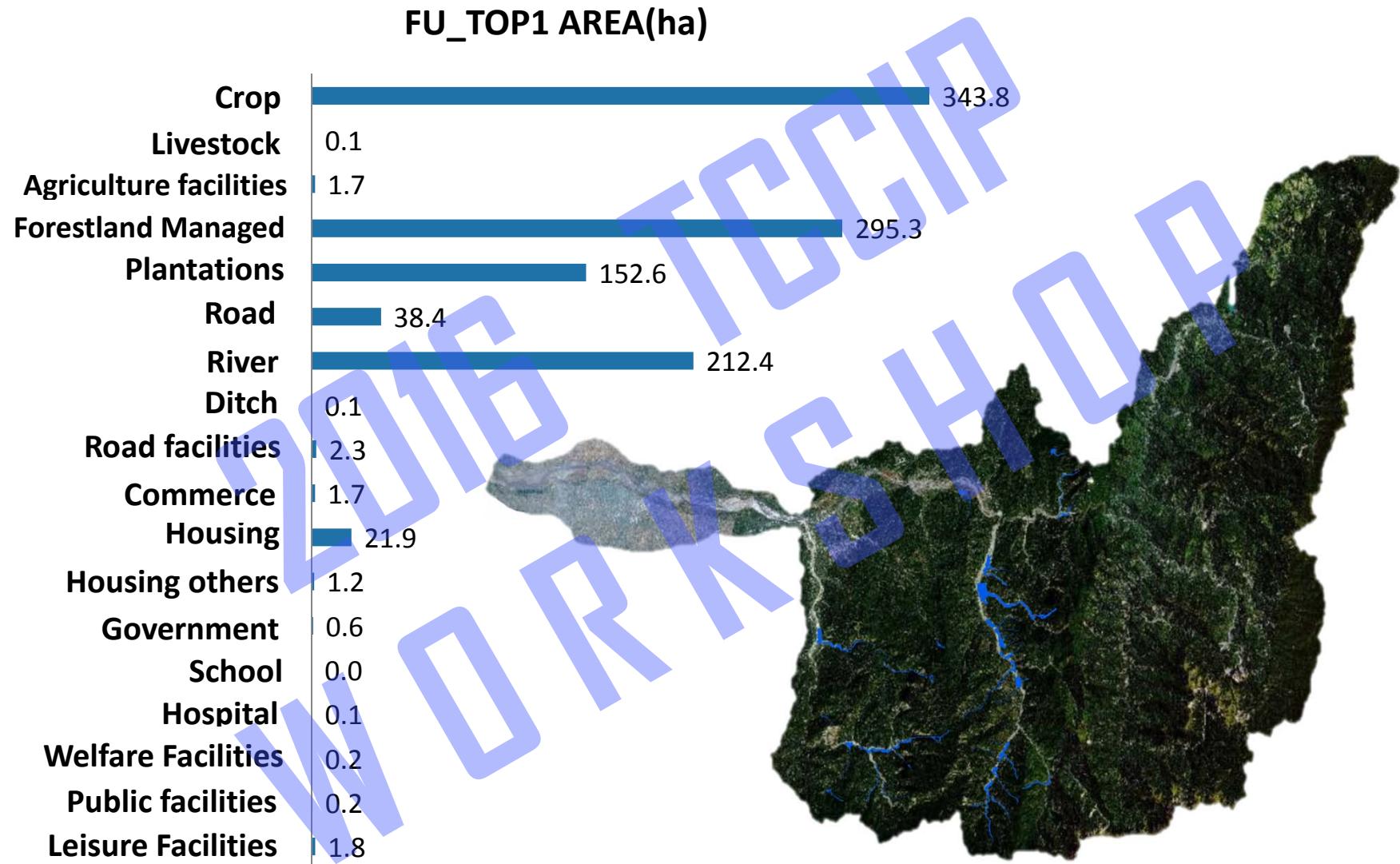


# Validation

## Ching-Sui-xi catchment

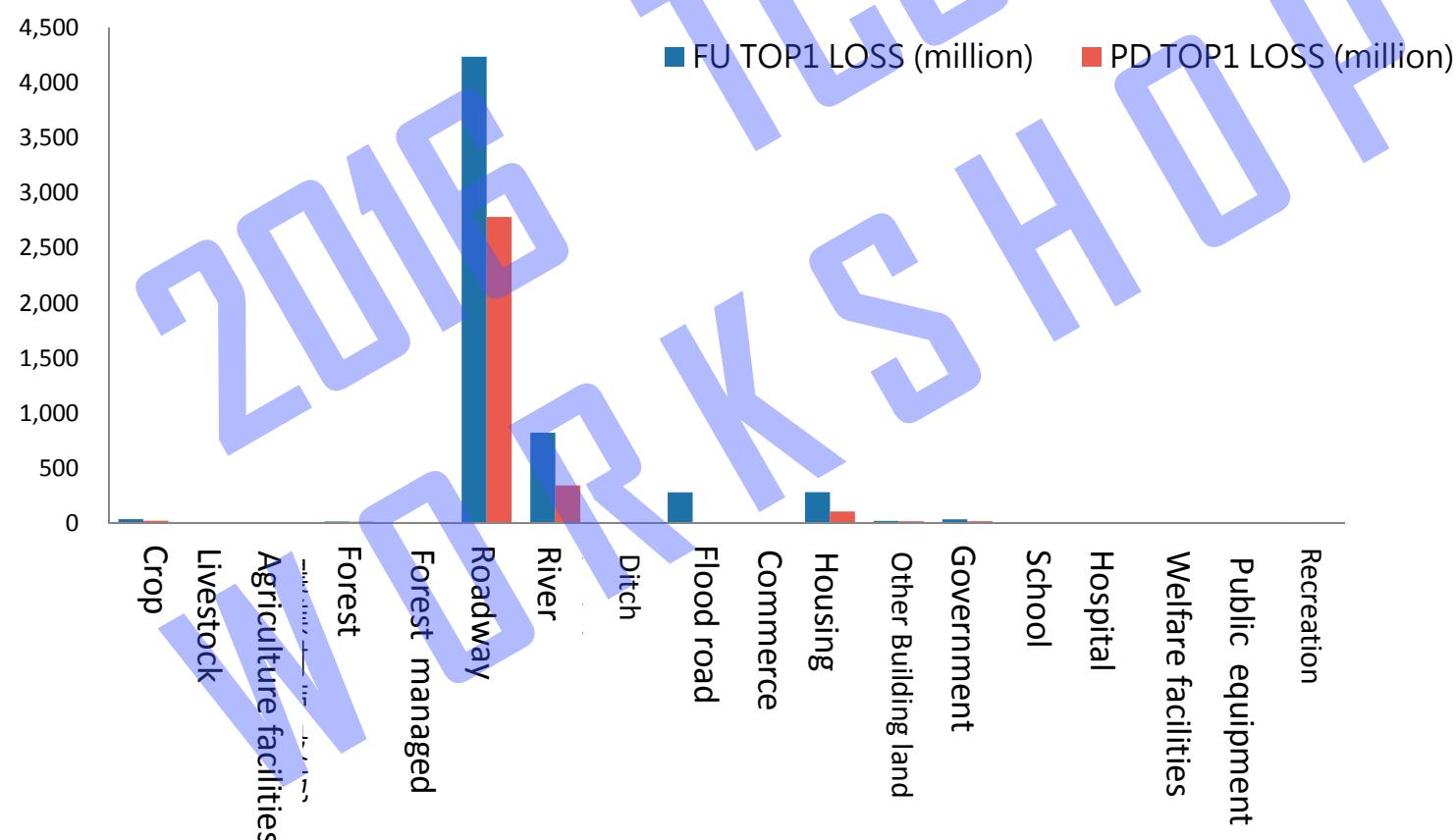


# Debris flow simulation-Top1 event

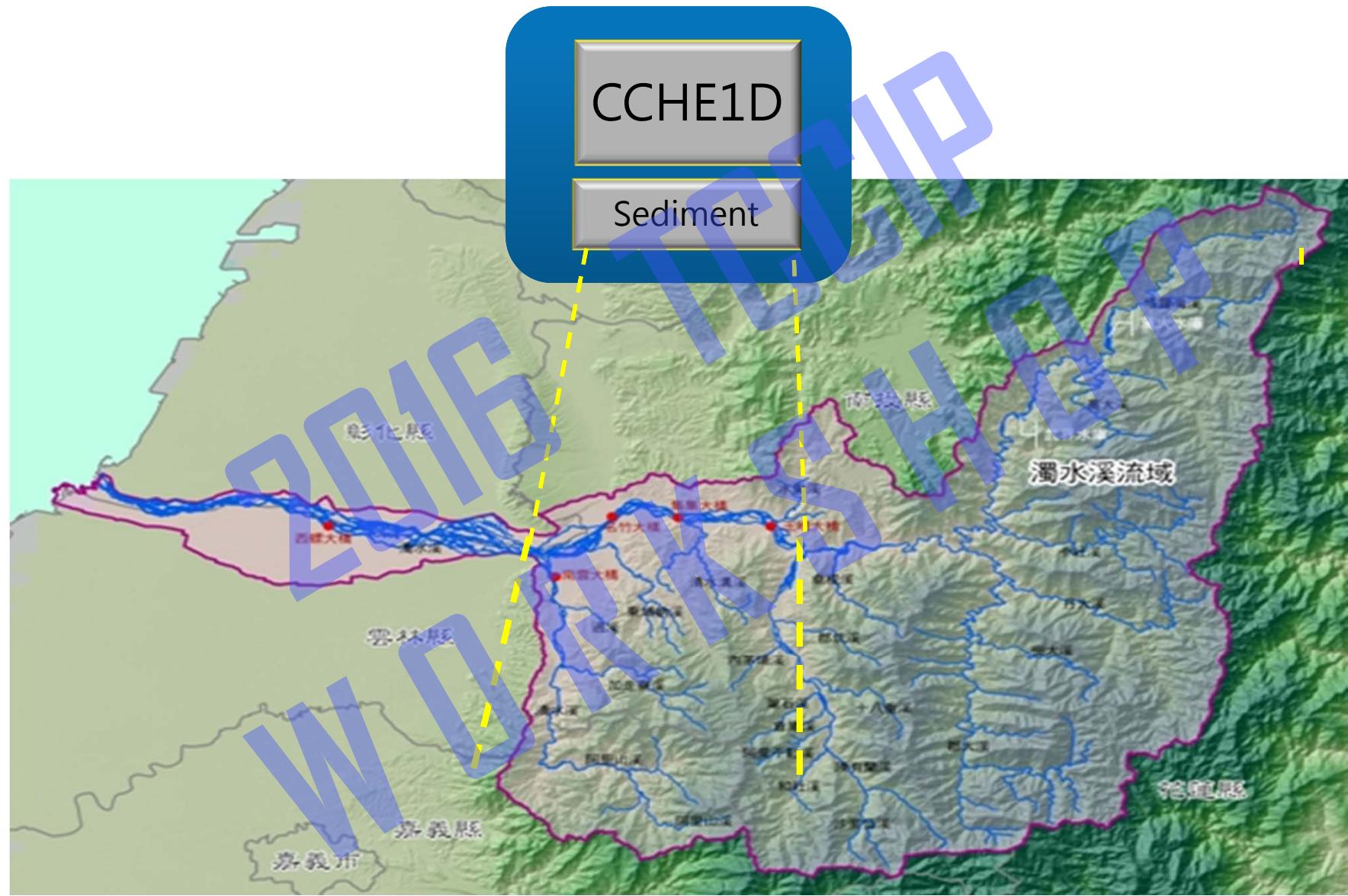


# Debris flow simulation- Top1 event

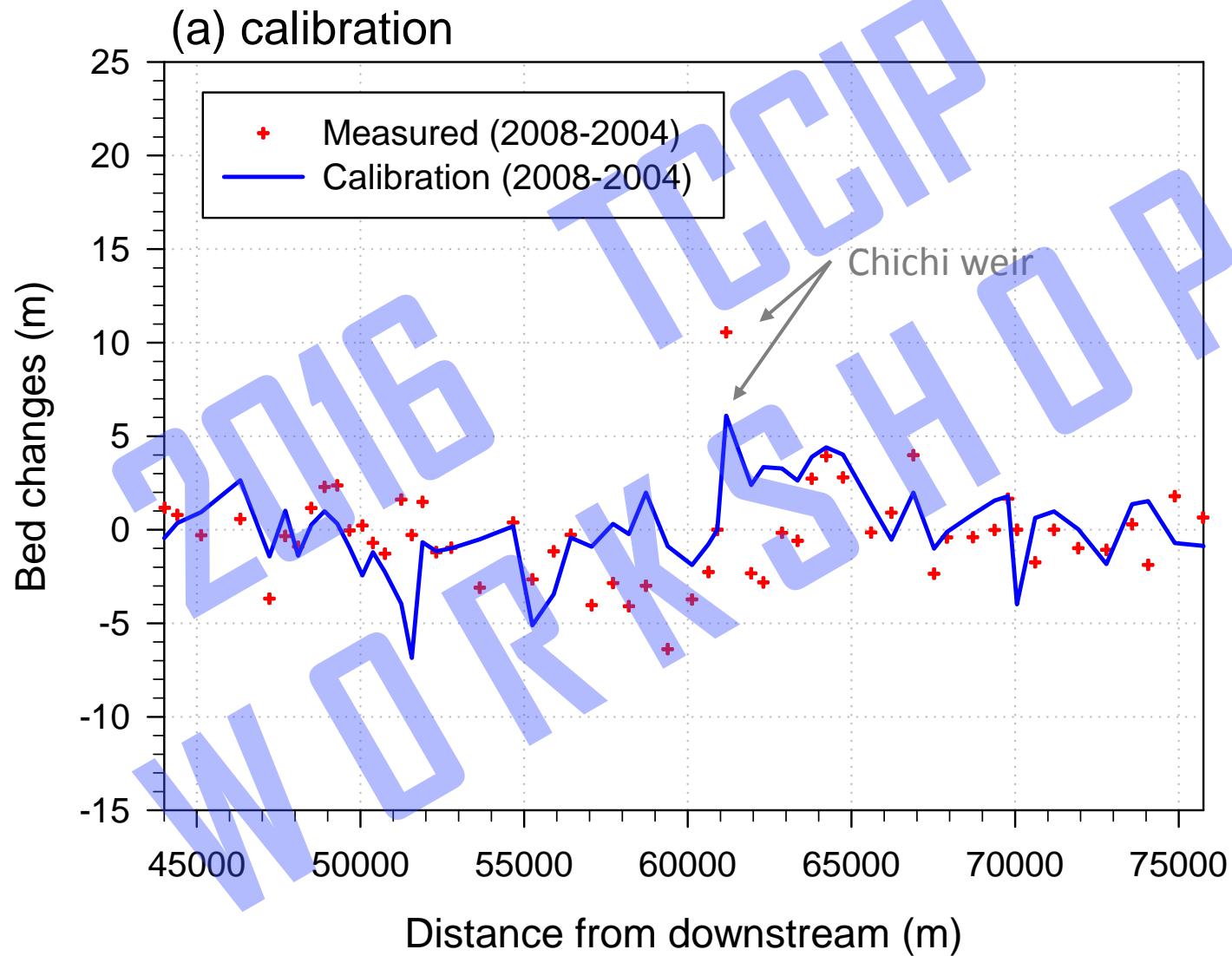
Category	The end of century (FU)	Baseline (PD)	Ratio (FU/PD)
Households affected	659	298	2.21
Disaster loss (Billion NTD)	5.77	3.32	1.74



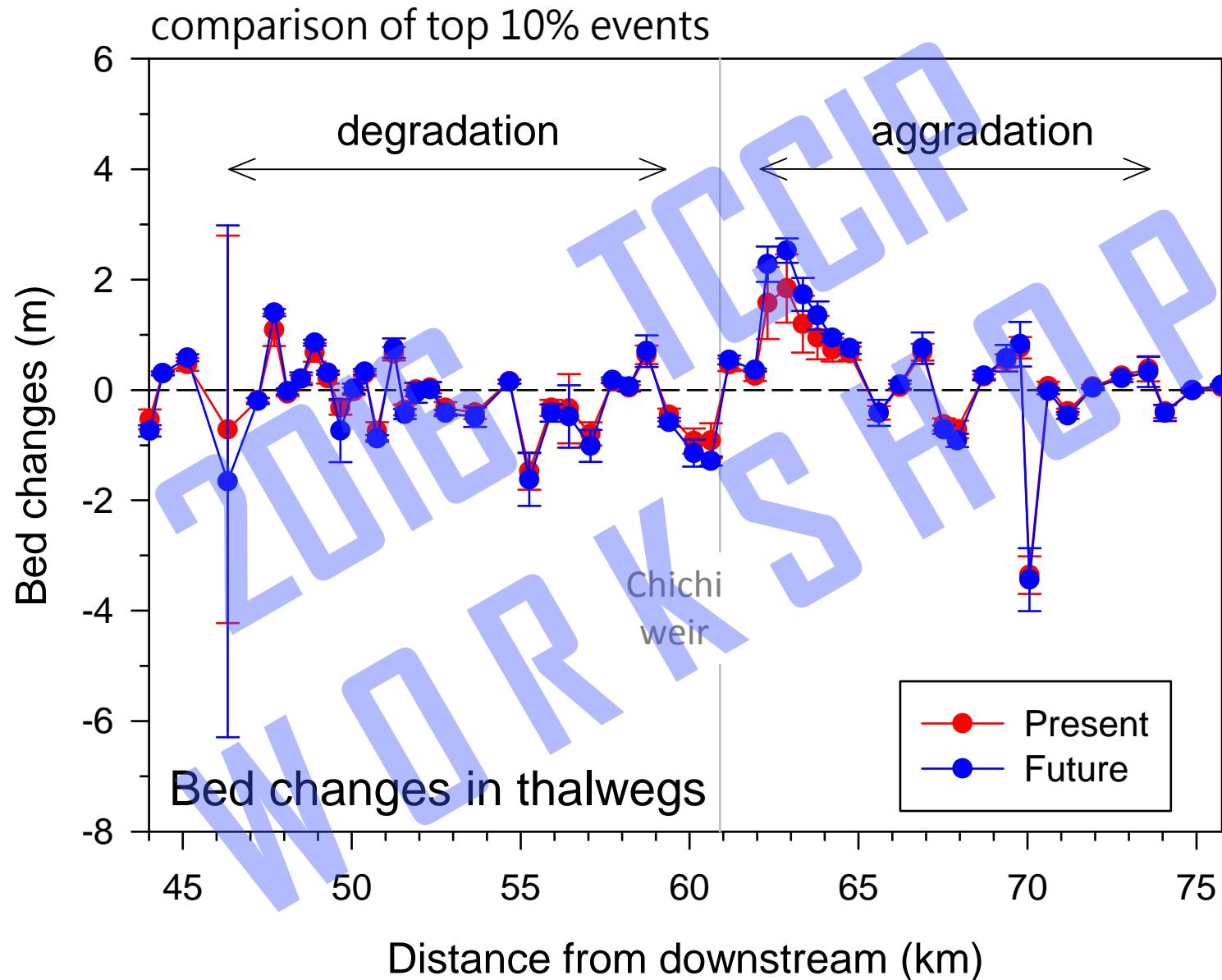
# Assessment Models



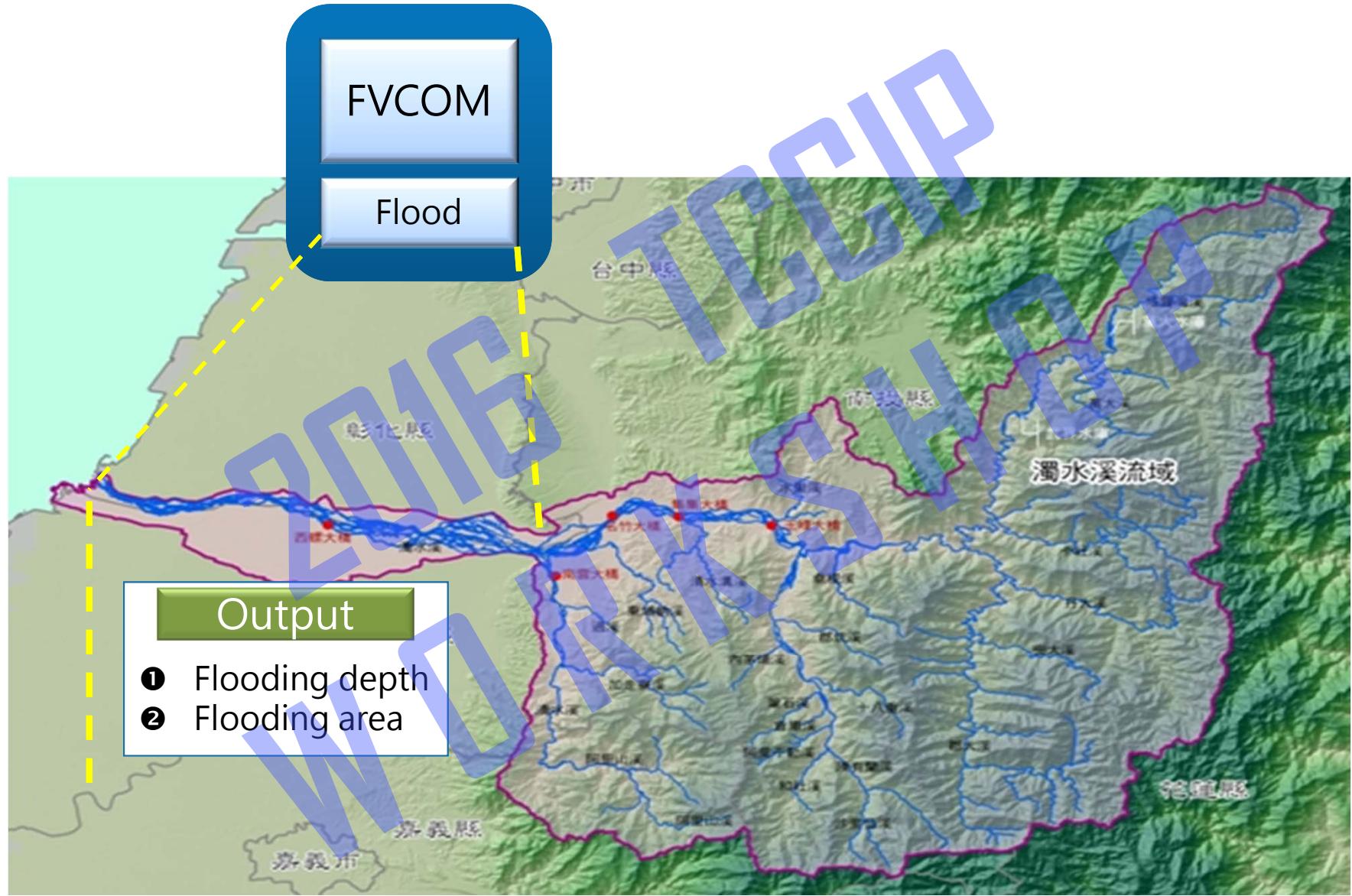
# Calibration and validation of channel network simulation



# Channel network results



# Assessment Models



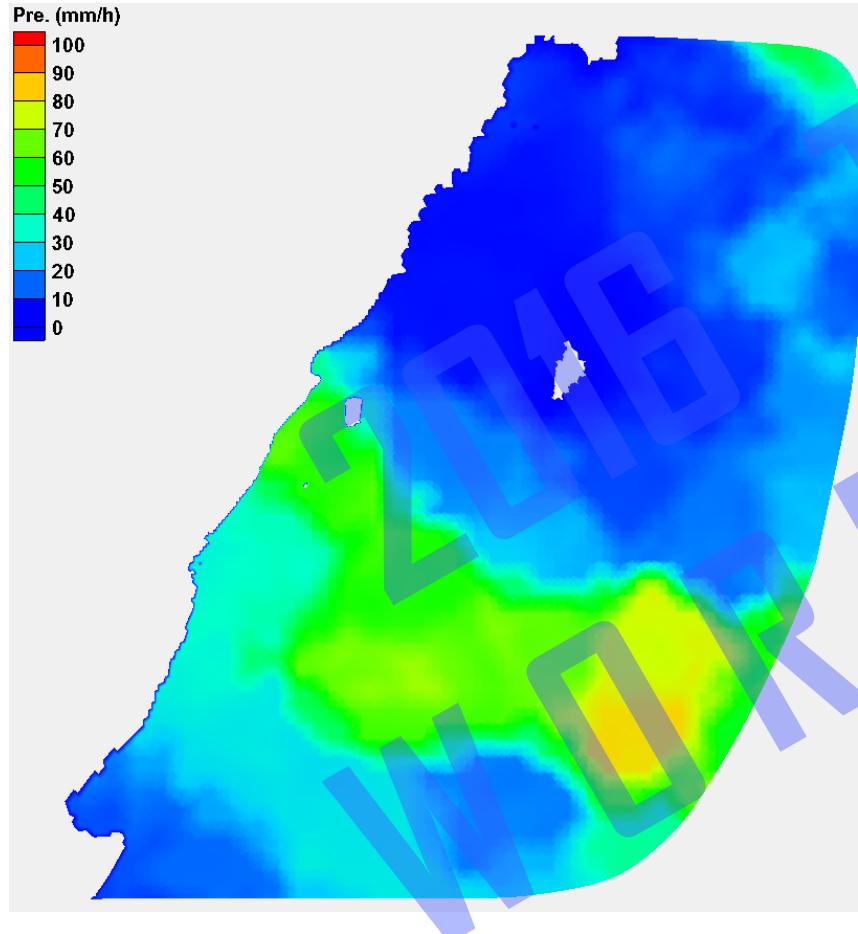
# Flooding simulation



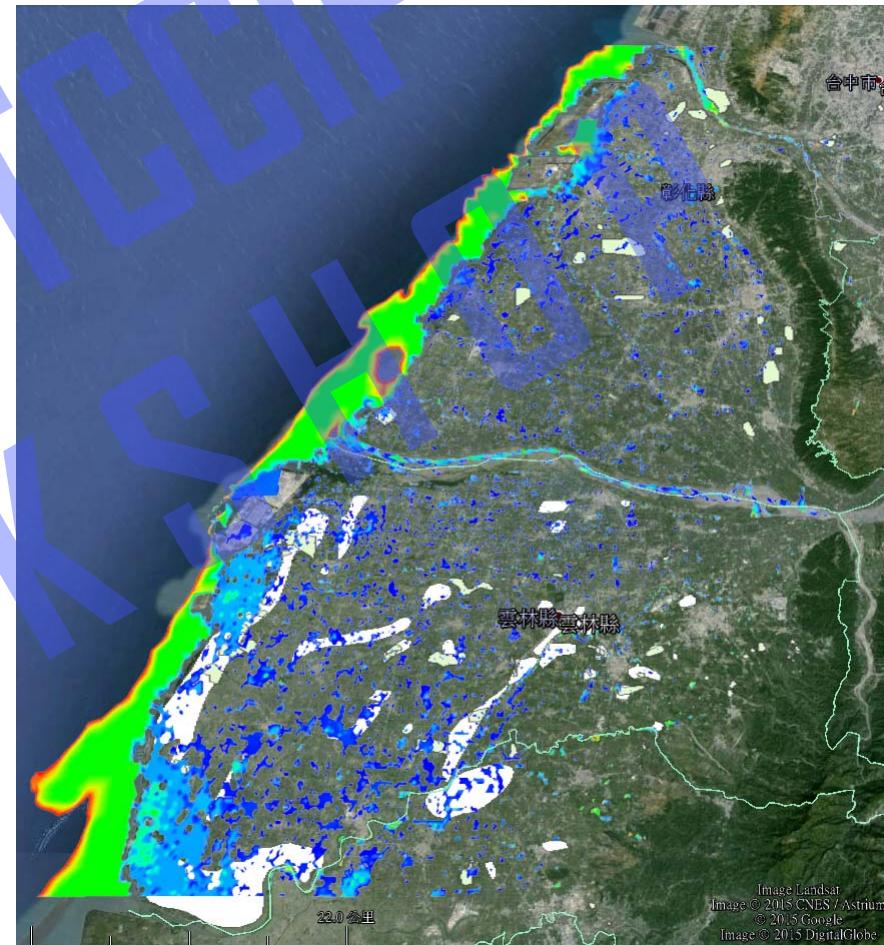
- Discharge station:  
→ Chang-Yun bridge
- Water level station:  
→ Shi-Zou bridge, Zi-Chan bridge
- Tide station:  
Bo-Zi-Ryao fishing harbor

# Flooding area calibration

Rainfall distribution by typhoon Kamegi, July 18<sup>th</sup>, 2008



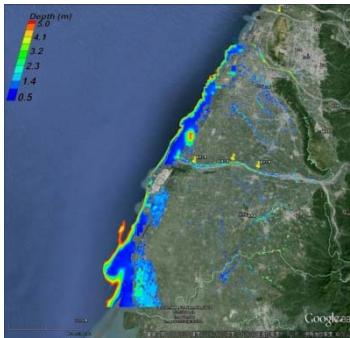
Flooding area: Typhoon Kamegi, 2008 (color) and history data (white)



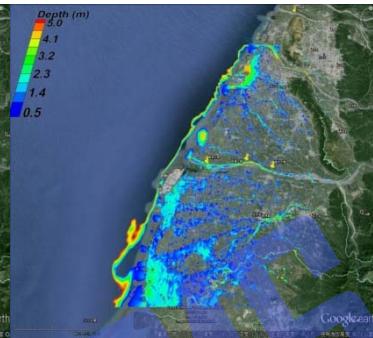
# Flooding scenario simulation

Baseline

197902



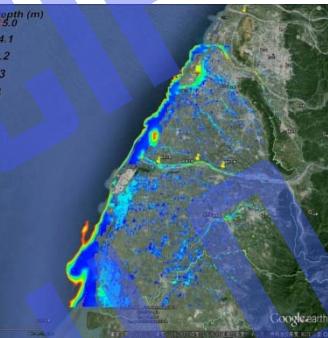
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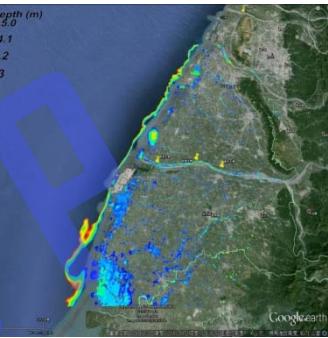
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199402

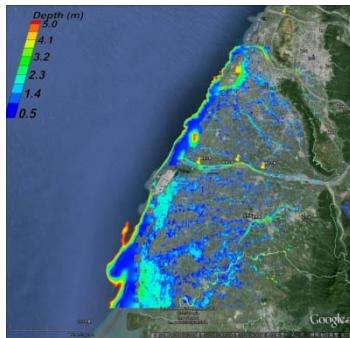


199703

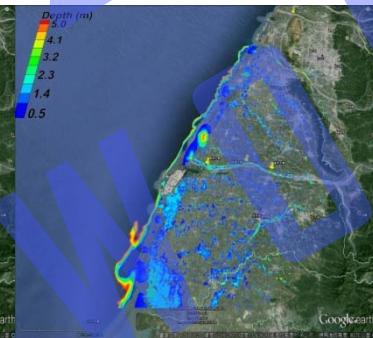


The end of century

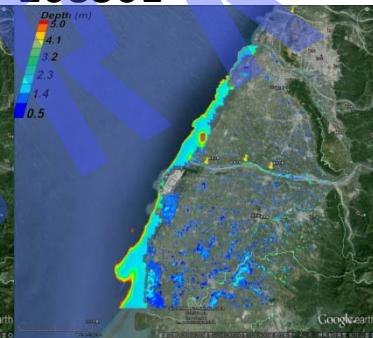
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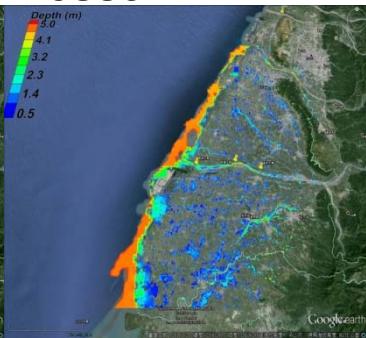
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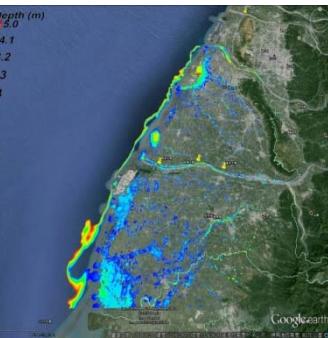
208301



208801



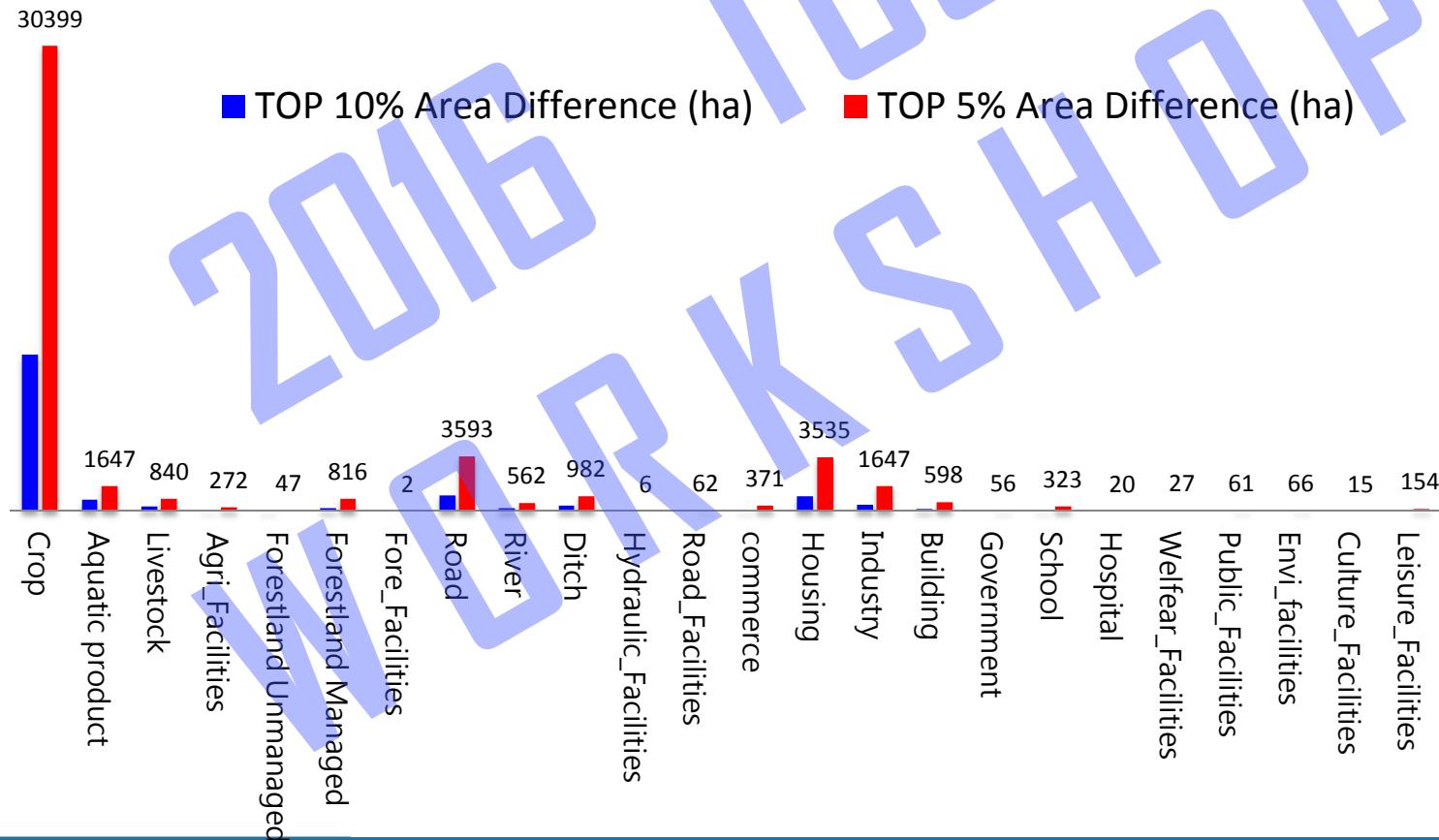
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# Flood area difference analysis

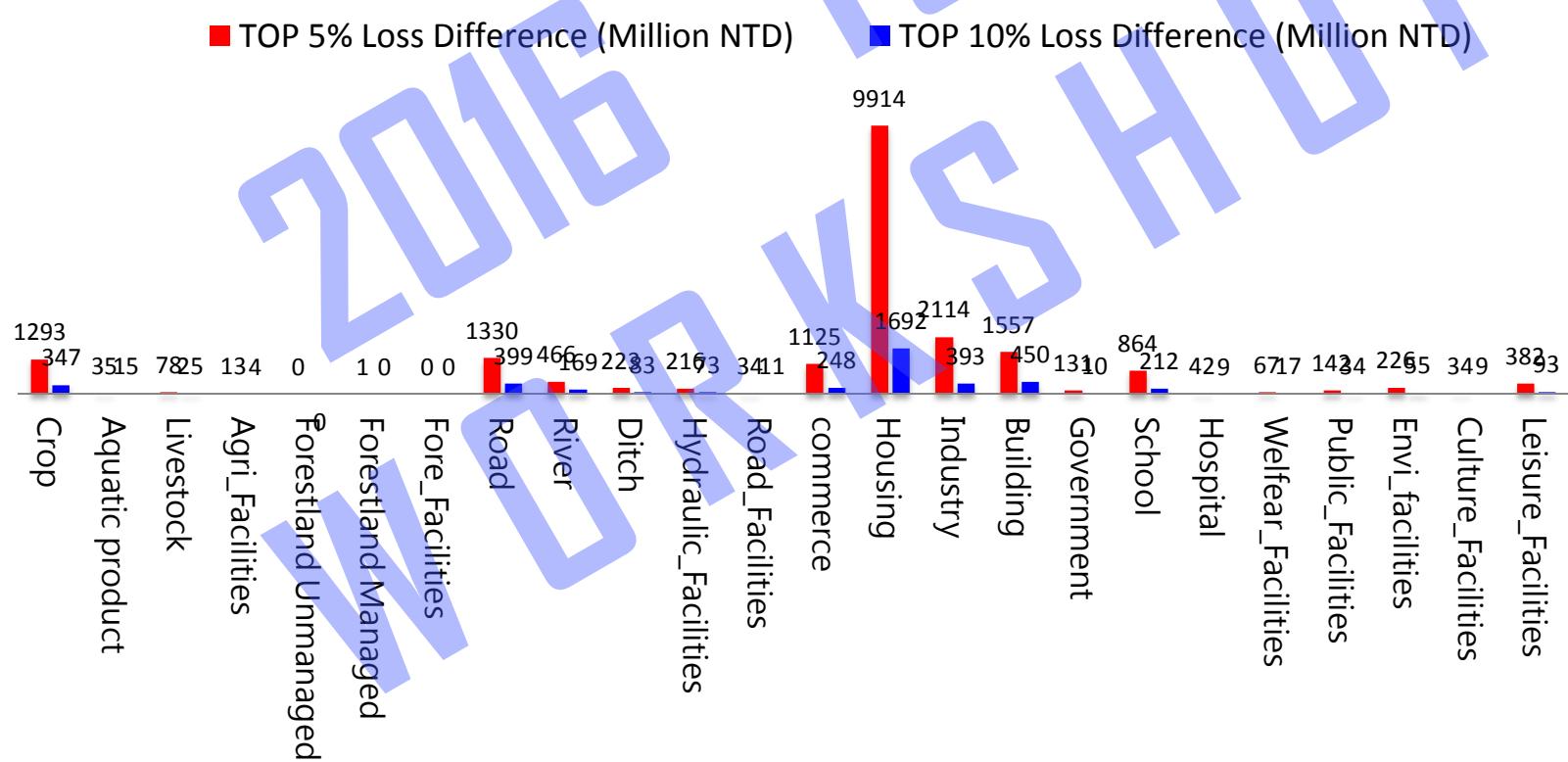
Top 5% average flood area at the end of century will increase 31%

Top 10% average flood area at the end of century will increase 6%

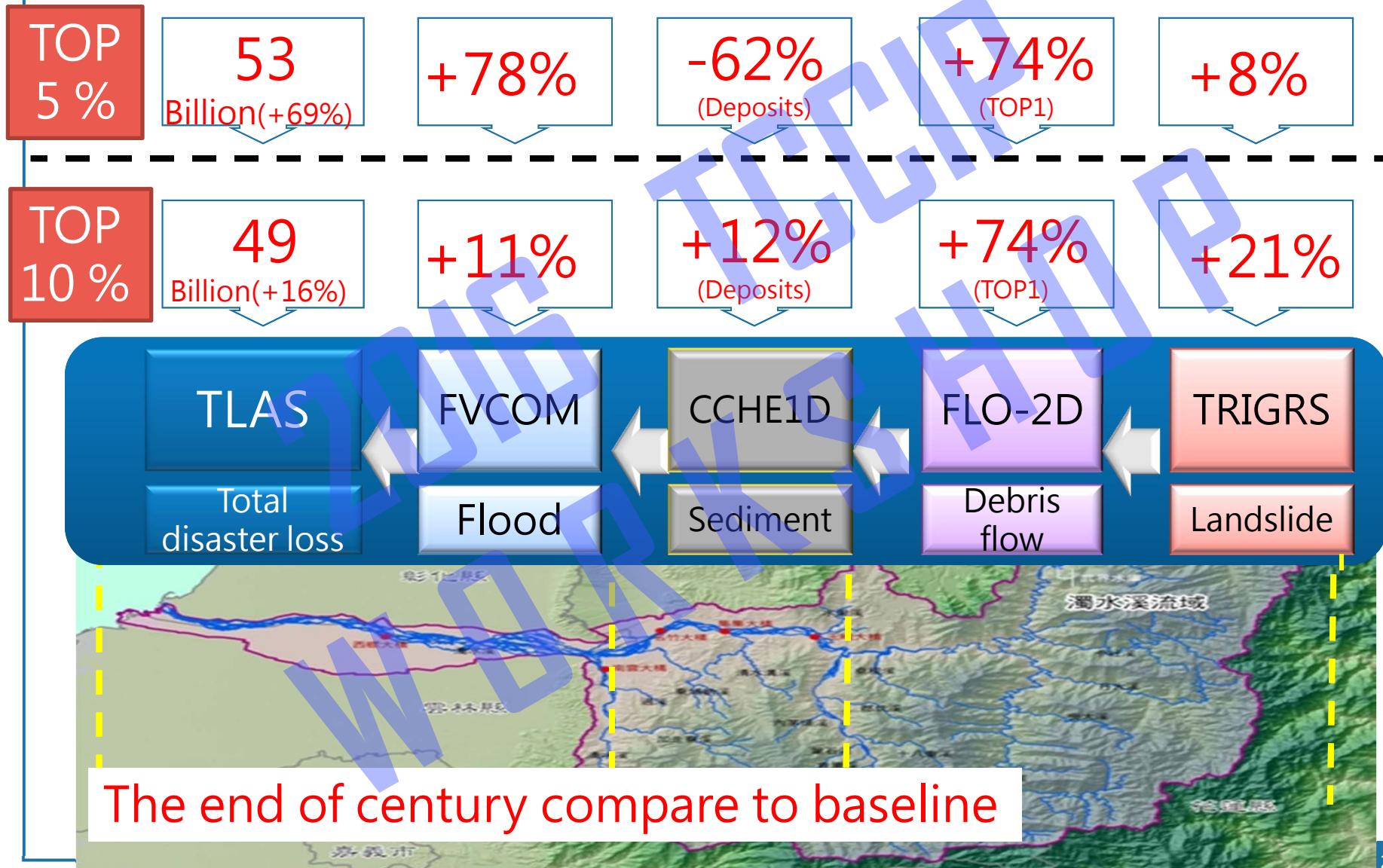


# Loss difference analysis

Loss compare	Average loss-baseline (billion NTD)	Average loss-the end of century (billion NTD)	Ratio (F/P)
Top 5%	26	46	1.78
Top 10%	39	43	1.11



# Loss assessment of comprehensive river basin





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