Geographically Weighted Regression Analysis Applied to the Establishment of Paddy Field Flooding Loss Functions

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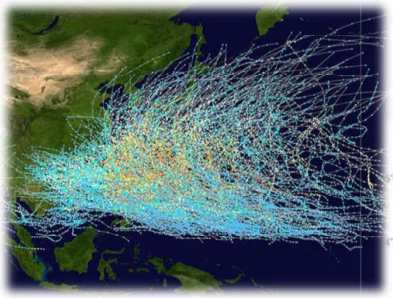
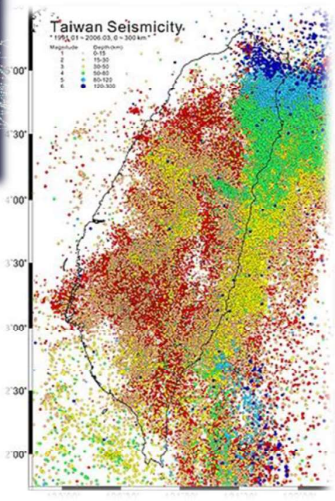
INTRODUCTION

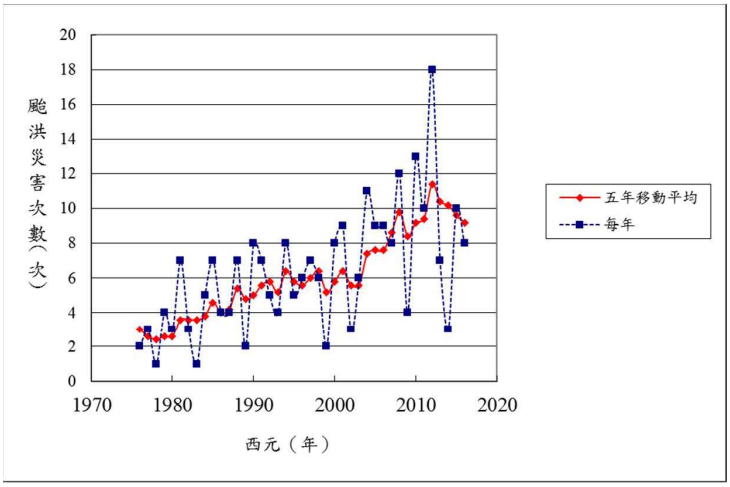
- Background
  - Natural disaster
    - Typhoon
    - Flood
    - Earthquake
    - Landslide
  - World back statistics
    - 73% at the risk of 3 disasters
    - 90% at the risk of 2 disasters





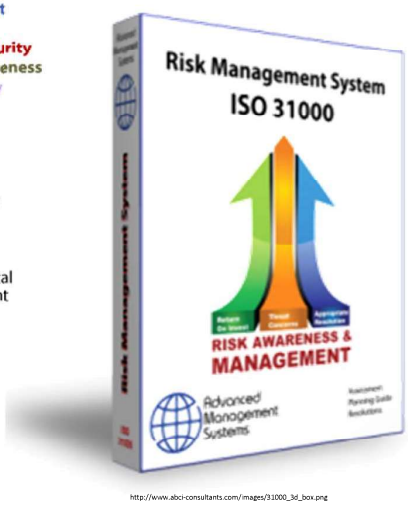
INTRODUCTION

- National Fire Agency, Ministry of the Interior(MOI)



INTRODUCTION

- ISO 31000



http://www.abci-consultants.com/images/31000_3d_box.png

http://www.abci-consultants.com/images/man+iso_puzzle.png

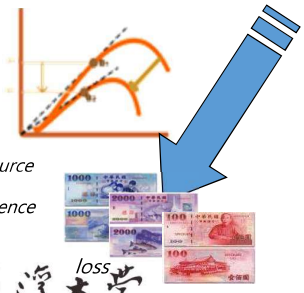
INTRODUCTION

Hazard
-- source of potential harm

Exposure
--extent to which an organization/stakeholder is subject to an event

Physical Exposure

Vulnerability
-- intrinsic properties of something resulting in susceptibility to a risk source that can lead to an event with a consequence



loss

Analysis

Risk
-- effect of uncertainty on objectives

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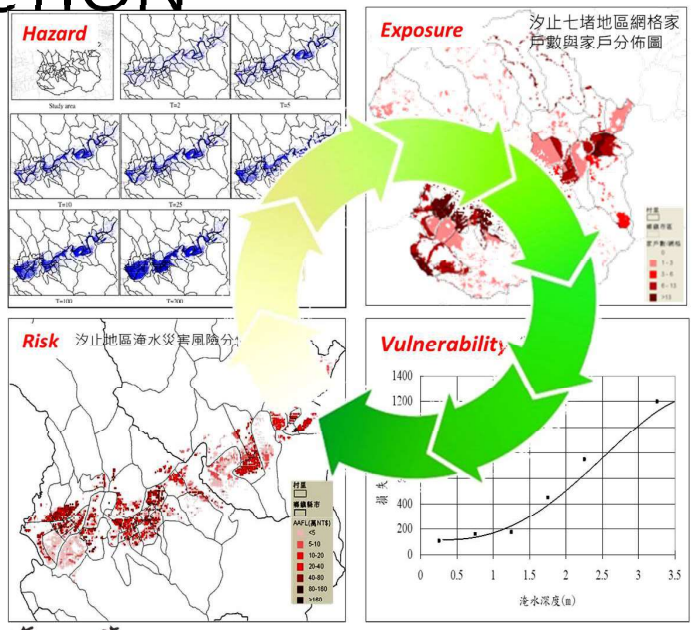
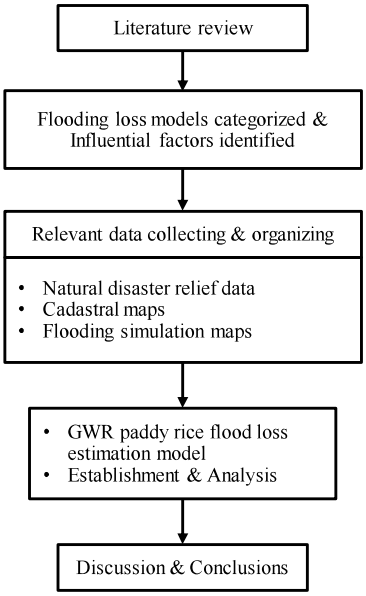
INTRODUCTION



INTRODUCTION

- Subject
  - Establishing the paddy field flood loss function
  - Increasing the capability of risk management

RESEARCH FRAM E WO R K



METHODOLOGY

- Factory of loss
  - Area
  - Depth
  - Duration
  - Velocity
  - Deposit
  - Salinity

Depth	Blanc et al. (2008); Brémond (2011); CA30 (2009); Deleuze et al. (1991); Devaux-Ros (2000); Dunderdale and Morris (1997a); Du Plessis and Viljoen (1997); Dutta et al. (2003); Erdlenbruch et al. (2007); Förster et al. (2008); Goulter and Morgan (1983); Hoes and Schuurmans (2006); Jonkman et al. (2008); Lacewell and Eidman (1972); Lacewell et al. (2006); McDonald (1970); Morris and Hess (1988); Penning-Rowsell et al. (2005); SIEE et al. (2003); USACE (1985)
Duration	Agenais (2010); Brémond (2011); CA30 (2009); Consuegra Zammit (1992); Deleuze et al. (1991); Du Plessis and Viljoen (1997); Duthion (1982); Dutta et al. (2003); Förster et al. (2008); Goulter and Morgan (1983); Morris and Hess (1988); Penning-Rowsell et al. (2005); Pierson et al. (1994); Poirée and Ollier (1973); USACE (1985)
Velocity	Agenais (2010); Brémond (2011); CA30 (2009); Devaux-Ros (2000); SIEE et al. (2003); USACE (1985)
Deposit	Pierson et al. (1994); USACE (1985)
Salinity	Agenais (2010)

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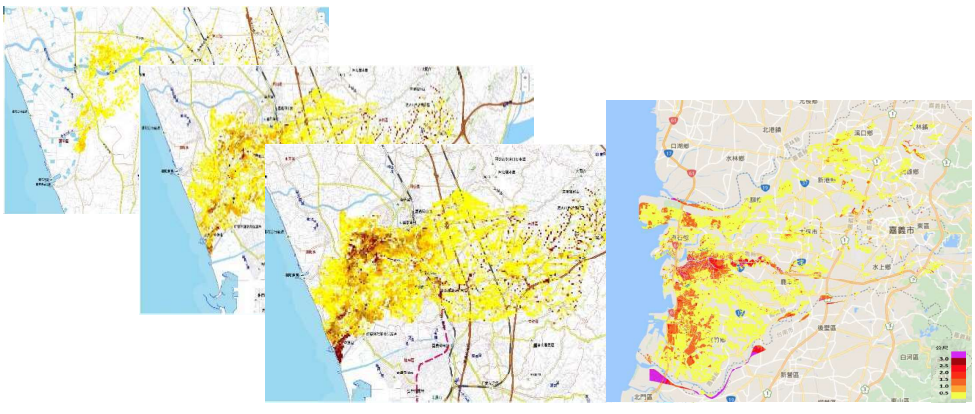
METHODOLOGY

- Collection of inundation potential maps



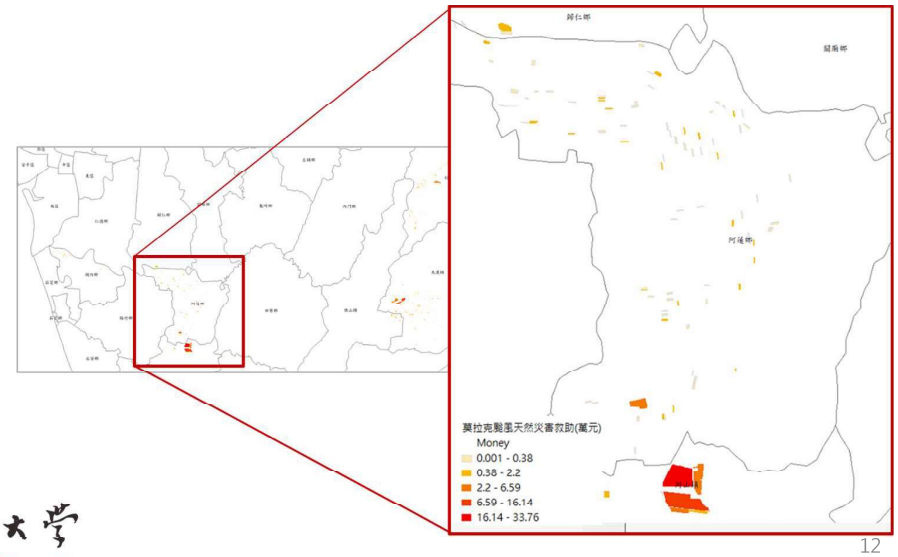
METHODOLOGY

- Collecting and organizing of disaster data in agriculture

Year	County	District	Section	Subsection	Land No.	Area (ha)	Loss (10^3NY$)
98	屏東縣	高樹鄉	高樹段	0	1410007	0.31	9.3
98	屏東縣	高樹鄉	大路關段	舊大路關小段	1200002	0.28	8.4
98	屏東縣	高樹鄉	大路關段	舊大路關小段	1200003	0.03	0.9
98	屏東縣	高樹鄉	大路關段	舊大路關小段	1180099	0.17	5.1
98	屏東縣	高樹鄉	田子段	0	4120001	0.04	1.2
98	屏東縣	高樹鄉	田子段	0	4130016	0.33	9.9
98	屏東縣	高樹鄉	大路關段	舊大路關小段	3180000	0.25	7.5
98	屏東縣	高樹鄉	舊寮段	0	1491452	0.34	10.2

METHODOLOGY

- Paddy rice relief distribution for natural disaster



METHODOLOGY

- Global regression analysis method- Ordinary Least Squares approach(OLS)

$$y = \beta_0 + \beta_1 x_1 + \mathrm{K} + \beta_n x_n + \varepsilon$$

y in Equation (1) is flooding loss (in unit of NT$). x_i's are independent variables, in which i=1 for flooding depth (cm), and i>1 for the factors identified from relevant researches. β_0, $\beta_1,\ldots,\beta_n$ are coefficients of OLS regression and ε is residual.

METHODOLOGY

- Geographic weighted regression model (GWR) (Brunsdon et al., 1996)

$$Y_i = \beta_0(u_i,v_i) + \beta_1(u_i,v_i)\cdot X_1 + \ldots + \beta_n(u_i,v_i)\cdot X_n + \varepsilon_i$$

Y_i is the value of flooding loss taken natural logarithm at location i.

X_i's are independent variables, in which i=1 for reciprocal of flooding depth and i>1 for the factors identified from relevant researches as in Equation (1).

(u_i,v_i) is the coordinates for location i.

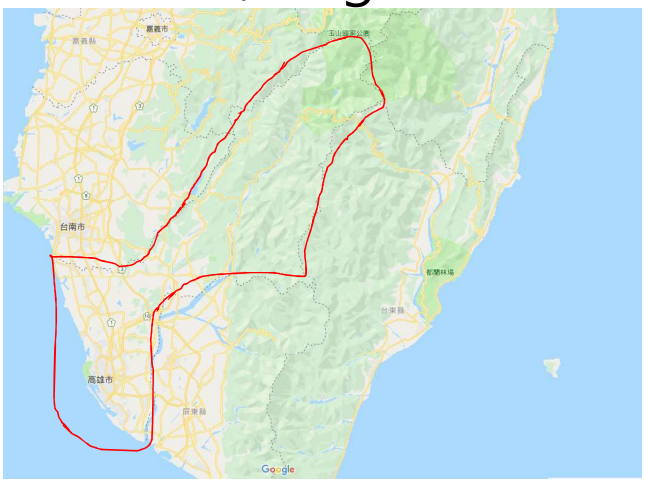
$\beta_i(u_i,v_i)$'s are coefficients of OLS regression and ε_i's are residuals.

METHODOLOGY

- Using Moran I test statistic check Global regression analysis method and Geographic weighted regression model .

CASE STUDY

- Location: Kaohsiung
- Disaster: Typhoon Morakot, Aug. 8 2009



CASE STUDY

CONCLUSION

- The result of Global regression analysis method
  - Area is the important factor.
  - The effect of depth is not obvious.
  - With the spatial system error
  - R squares is 0.86
- Geographic weighted regression model
  - Without the spatial system error
  - R squares is 0.98

Thank you