Appendix M

Country Paper: Thailand

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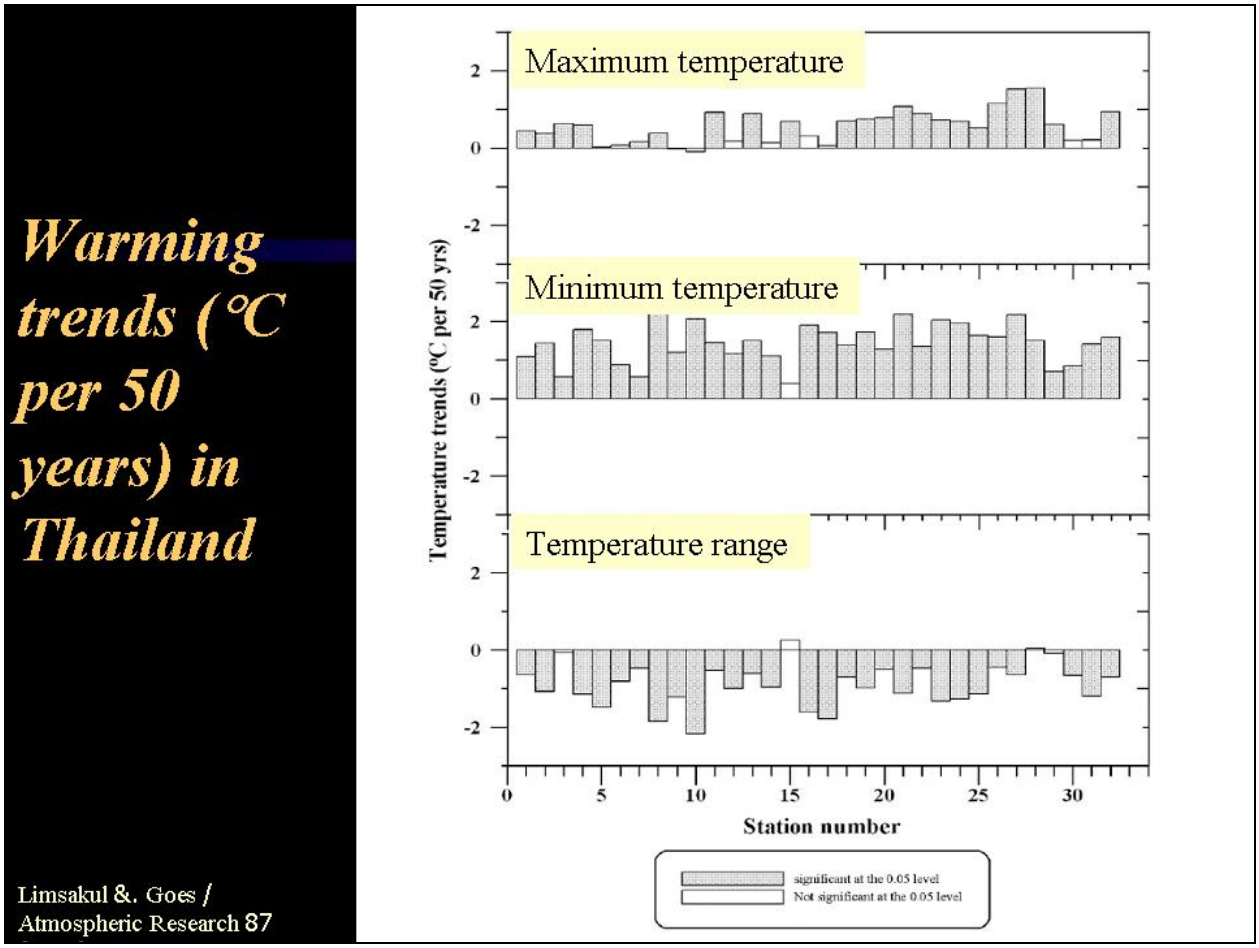
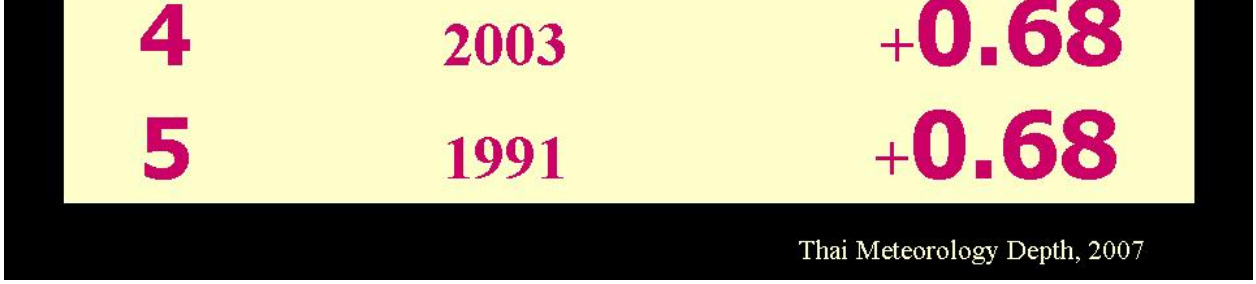
Dr. Amnat Chidthaisong is an Assistant Professor at the Joint Graduate School of Energy and Environment (JGSEE), an international graduate education and research consortium of five institutions in Thailand.

Dr. Amnat holds a PhD in Applied Bioscience and Biotechnology from Mie University in Japan. His postdoctoral researches were on microbial ecology at the Max-Planck Institute for Microbial Ecology in Germany and stable isotope biogeochemistry at the University of California in Irvine, USA. His research fields include carbon cycle greenhouse gas biogeochemistry, and climate change.

Outlines

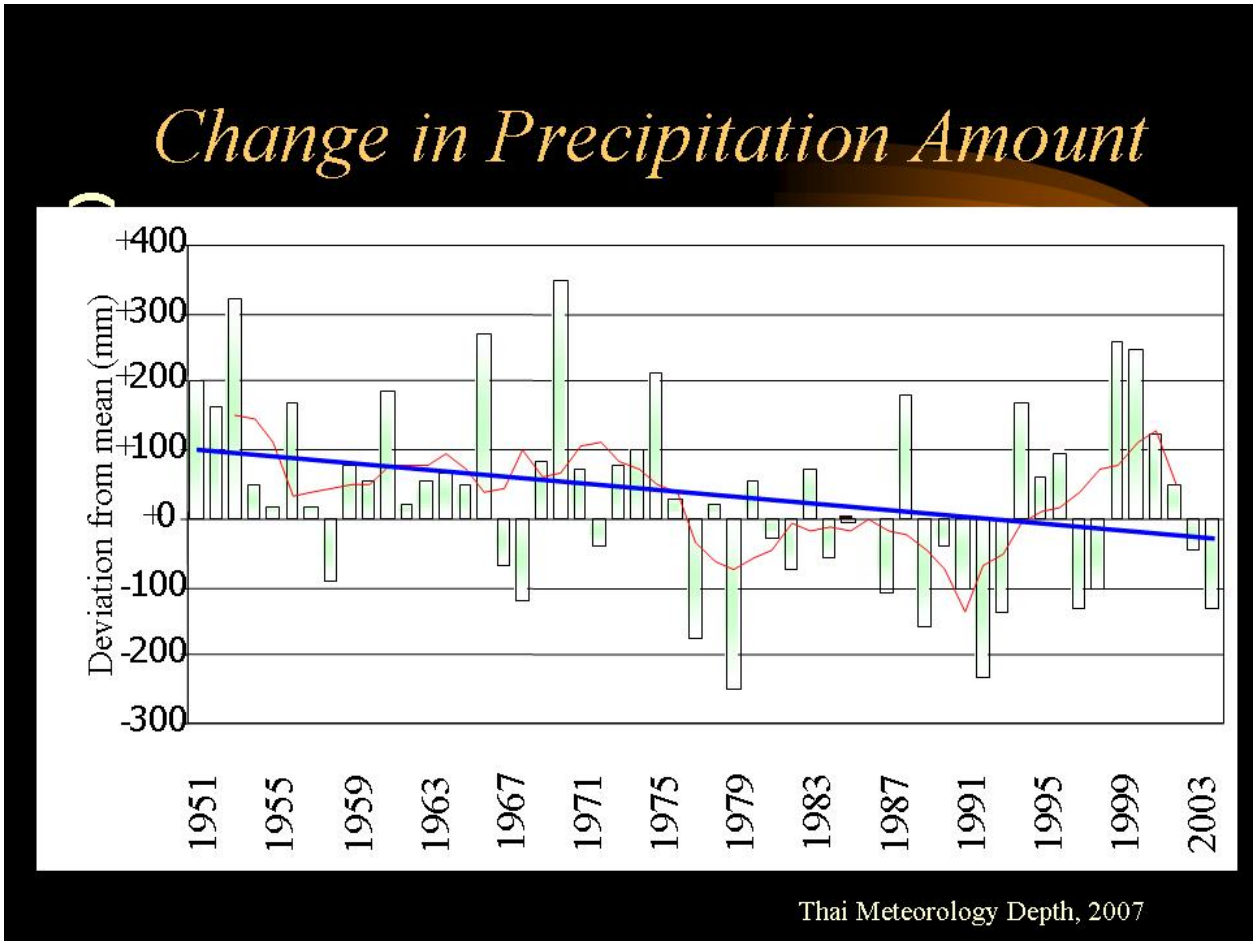
- Climate change situation in Thailand
- Climate impact study in Thailand
- Other related researches
- Future plans
- Concluding remarks

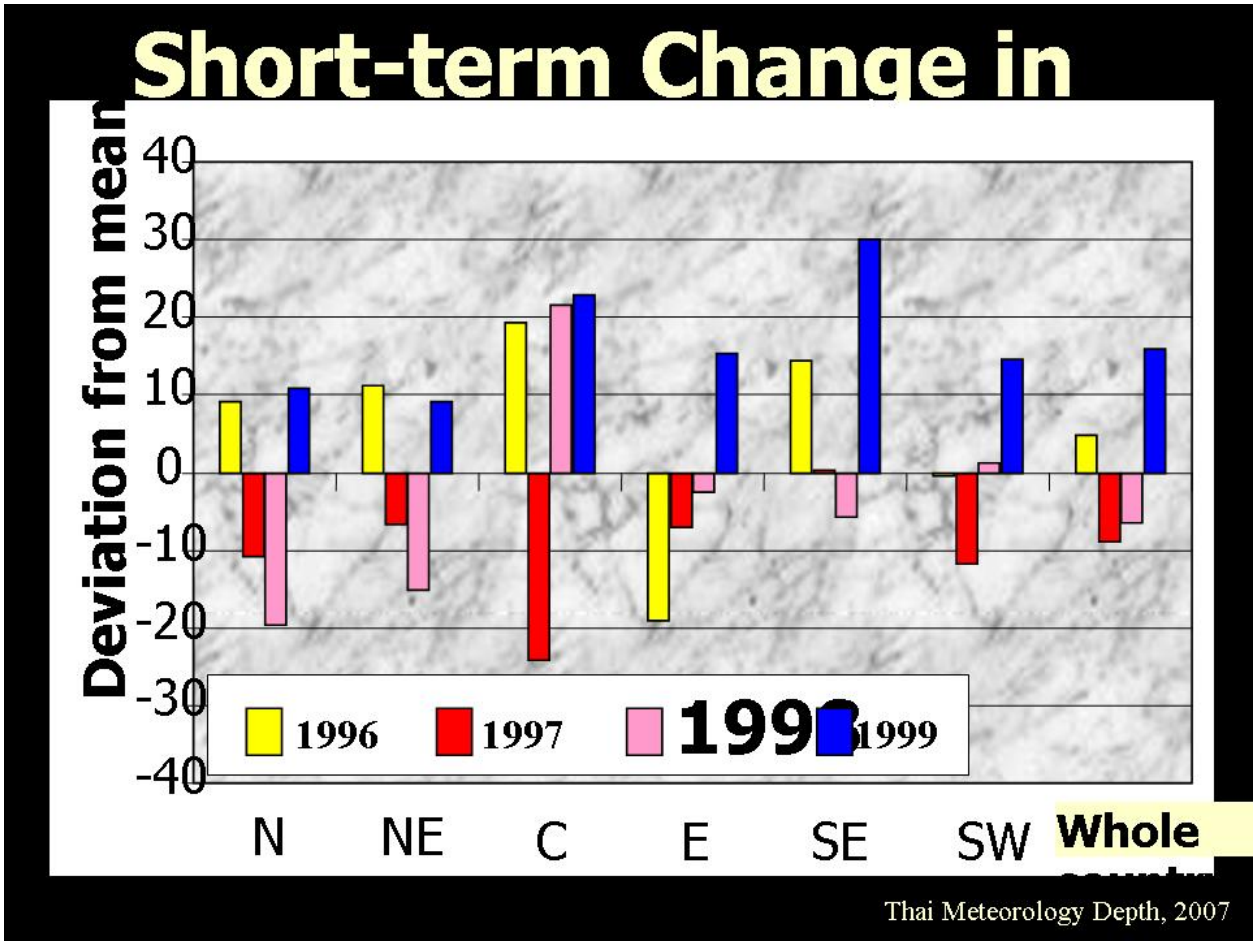

Warming trends (°C per 50 years) in Thailand
Limsakul &. Goes / Atmospheric Research 87
Maximum temperature
Minimum temperature
Temperature range
Temperature trends (°C per 50 yrs)
Station number
significant at the 0.05 level
Not significant at the 0.05 level

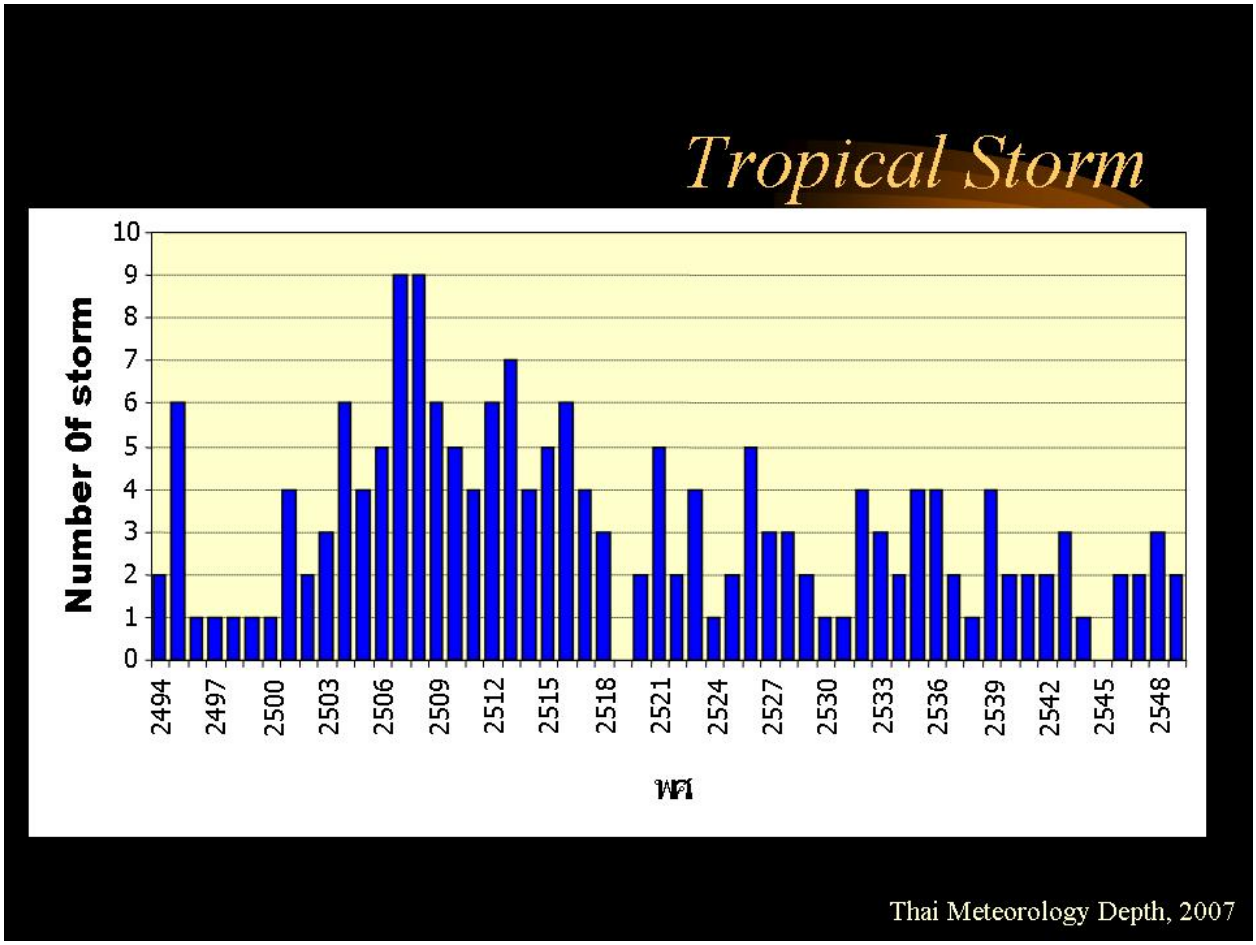

Five Warmest Years Since 1961
Rank
Year
Temperature compared to the average 1961-2005 (°C)
1
1998
+1.18
2
1997&2005
+0.79
3
2004
+0.73
4
2003
+0.68
5
1991
+0.68
Thai Meteorology Depth, 2007

Records in Thailand Show;

- A clear warming of annual averaged maximum and minimum temperatures at most stations
- Maximum temperature increased with an overall trend of 0.56 °C per 50 yrs
- Minimum temperature significantly increased at faster rate with overall trend of 1.44°C per 50 yrs
- A significant reduction of temperature ranges over almost parts of Thailand, ranges are narrowing at rates ranging from -0.1 to -2.2 °C per 50 yrs.

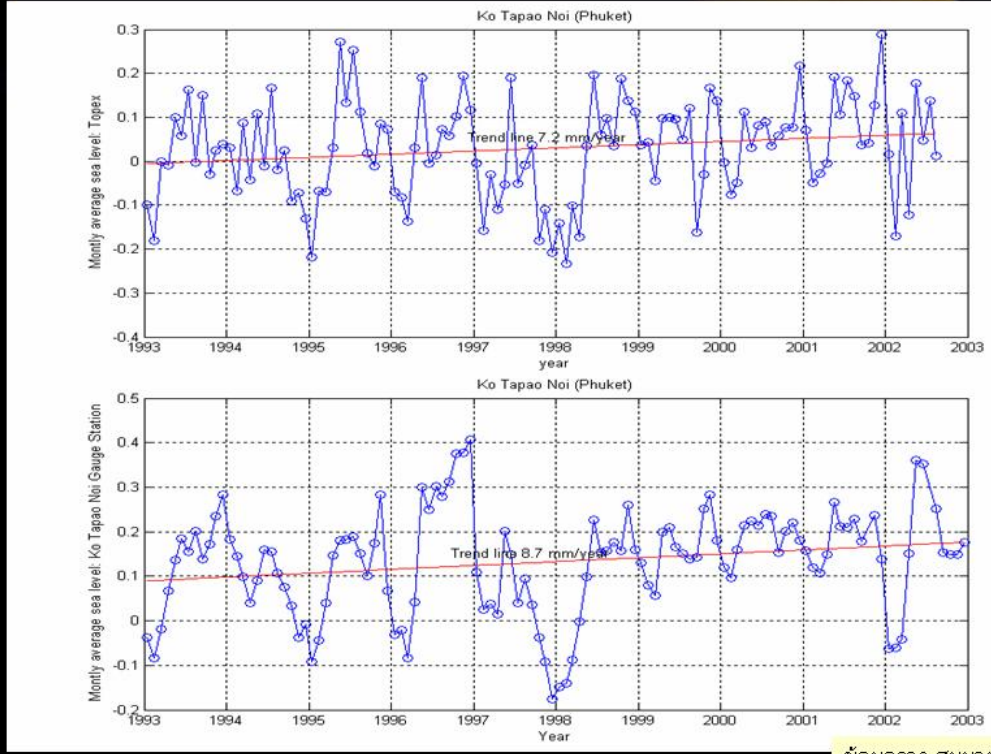

Change in Precipitation Amount
+400
+300
+200
+100
+0
-100
-200
-300
Deviation from mean (mm)
1951
1955
1959
1963
1967
1971
1975
1979
1983
1987
1991
1995
1999
2003
Thai Meteorology Depth, 2007


Short-term Change in
Deviation from mean
40
30
20
10
0
-10
-20
-30
-40
1996
1997
1999
N
NE
C
E
SE
SW
Whole
Thai Meteorology Depth, 2007


Tropical Storm
Number Of storm
10
9
8
7
6
5
4
3
2
1
0
2494
2497
2500
2503
2506
2509
2512
2515
2518
2521
2524
2527
2530
2533
2536
2539
2542
2545
2548
Thai Meteorology Depth, 2007

Sea Level Rise

Phuket Station-10 Year increase rate– 7.2 mm per year



ข้อมูลจาก สมมาตร เนียมนิล (2549)

Climate Change Impacts Study in Thailand

- **Thailand country studies on climate change**
  - **In 1996 US Country Studies Program provided technical and financial assistance to study climate change including climate modeling**
  - **Used outputs of 6 GCMs Coarse scale**
- **START**
  - **Physical impact assessment**
  - **1x, 1.5x and 2xCO_2**
  - **Agriculture, forest, river basin**

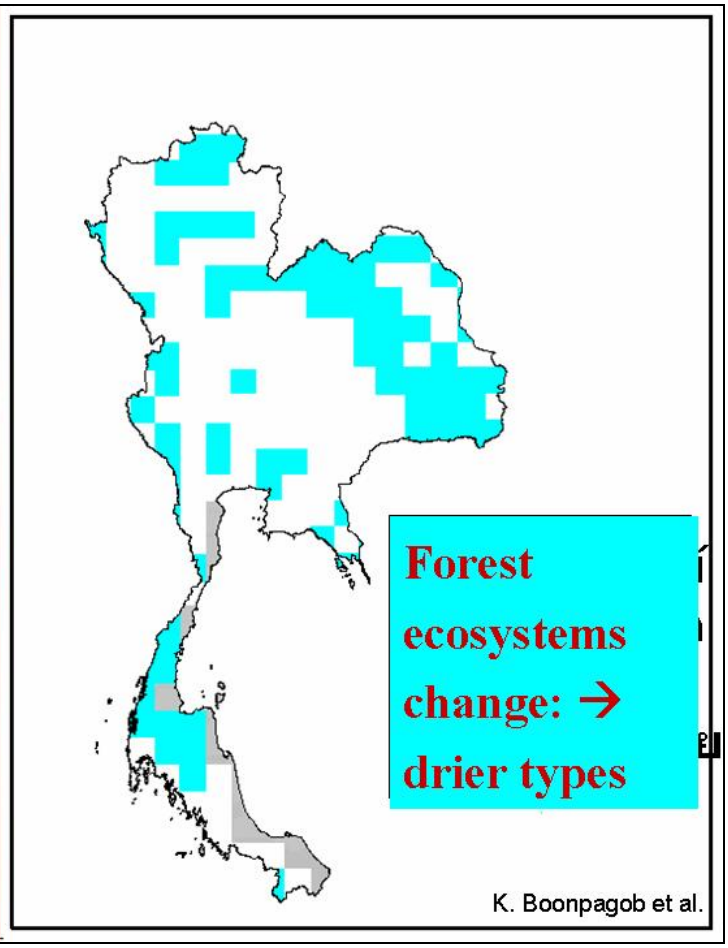
K. Boonpragob, S. Shinvanno

1996 US Country Studies Program

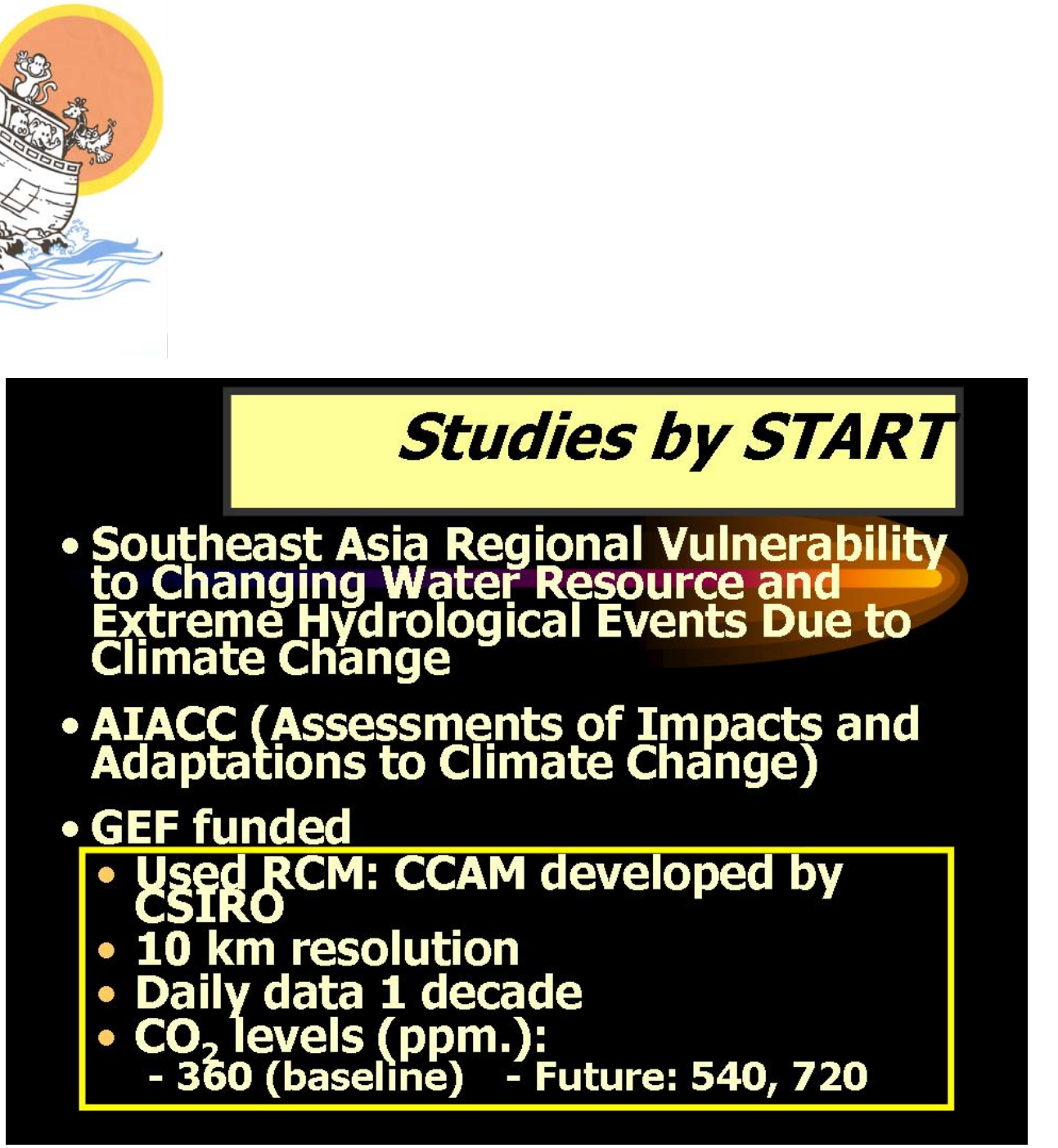
Thailand Climate change hot spot

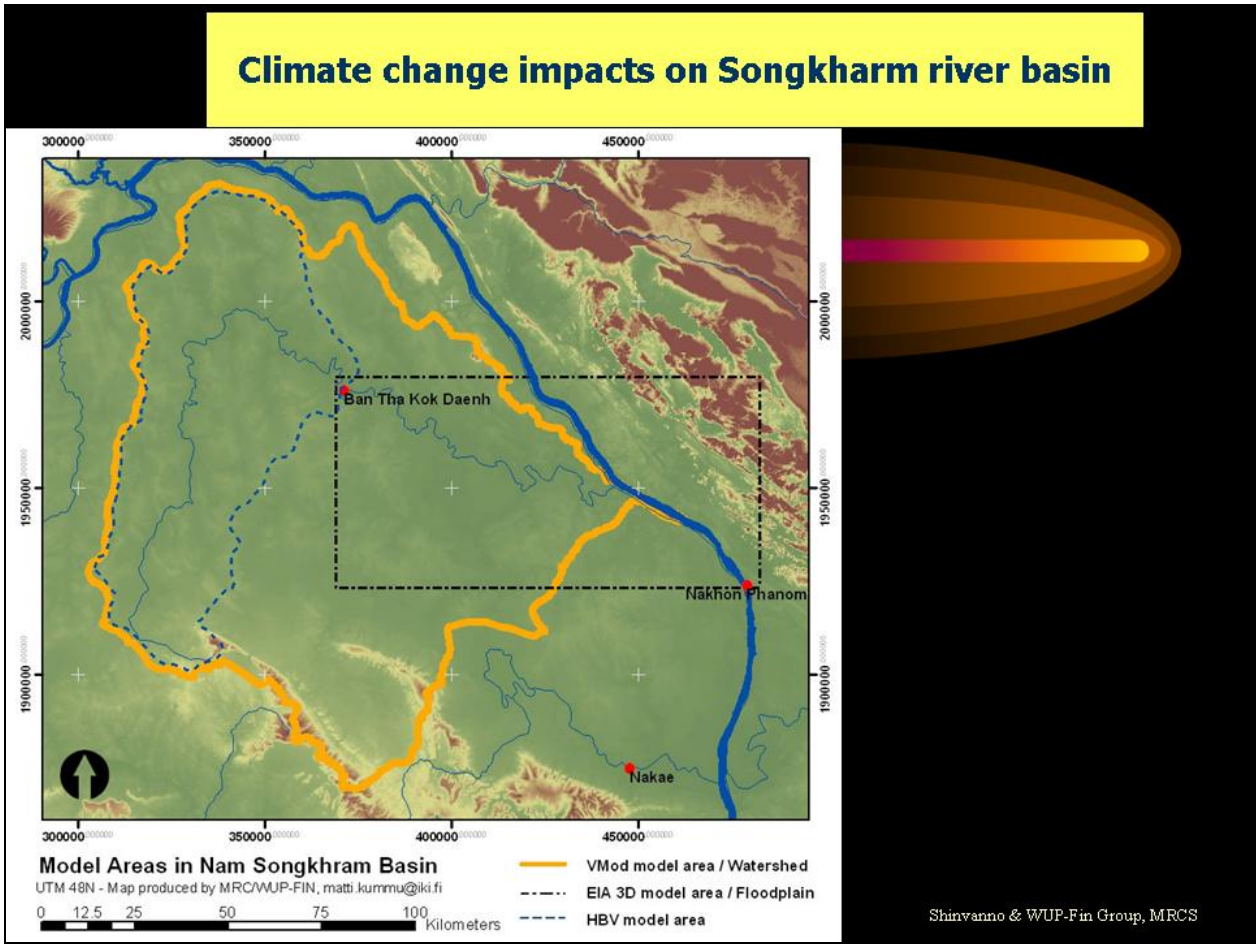
Assesses from GCM UK 89

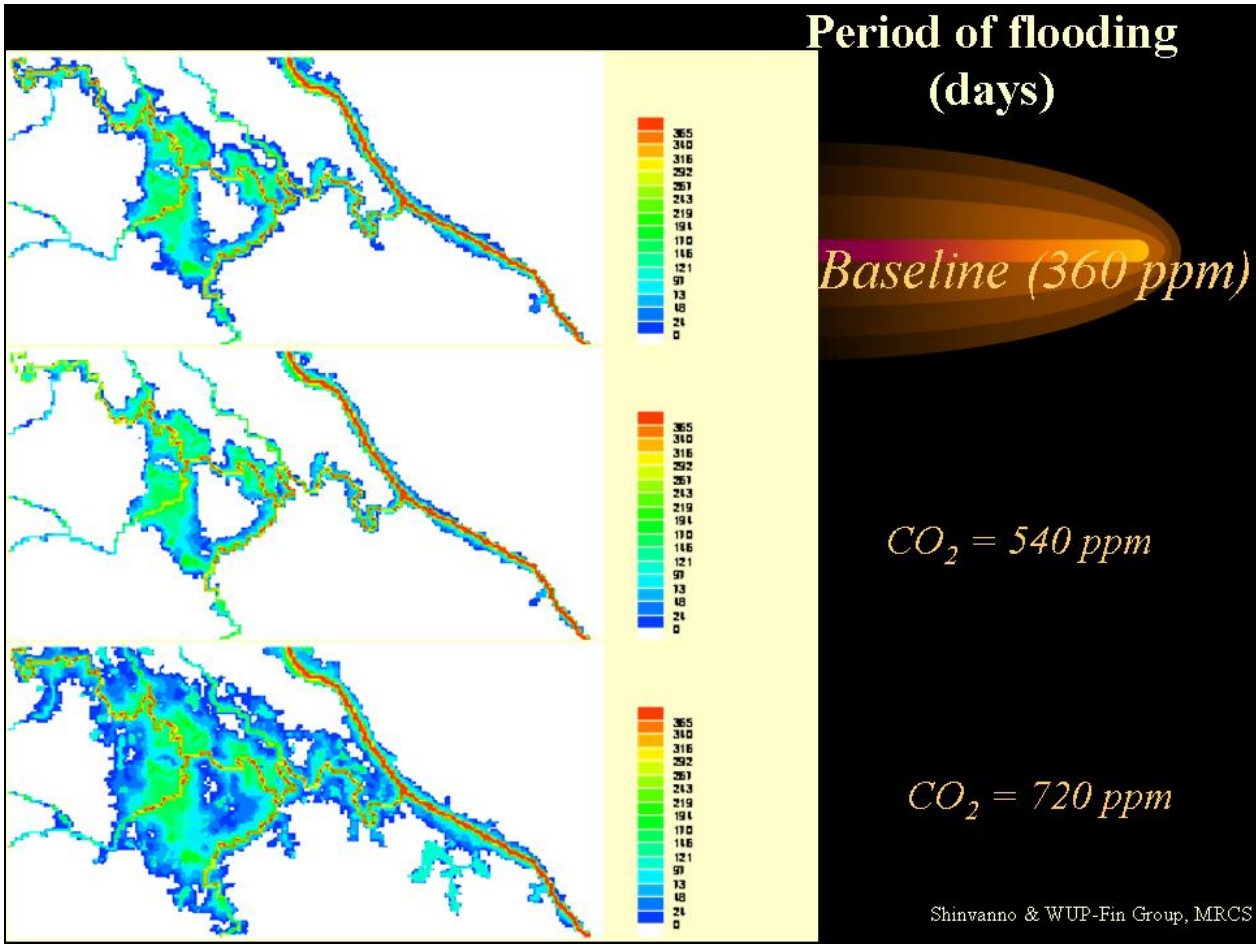
and Holdridge Life Zone Classification

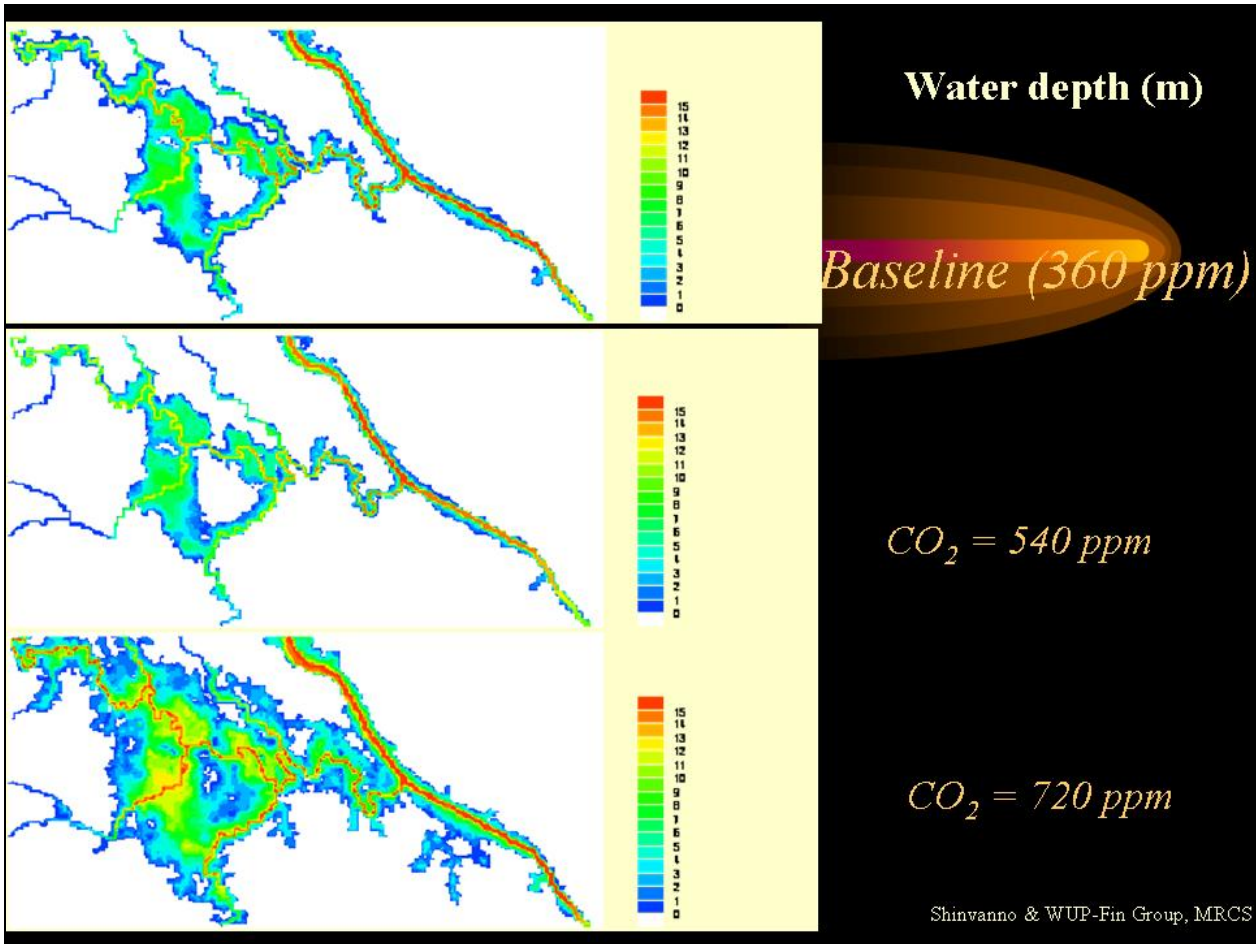


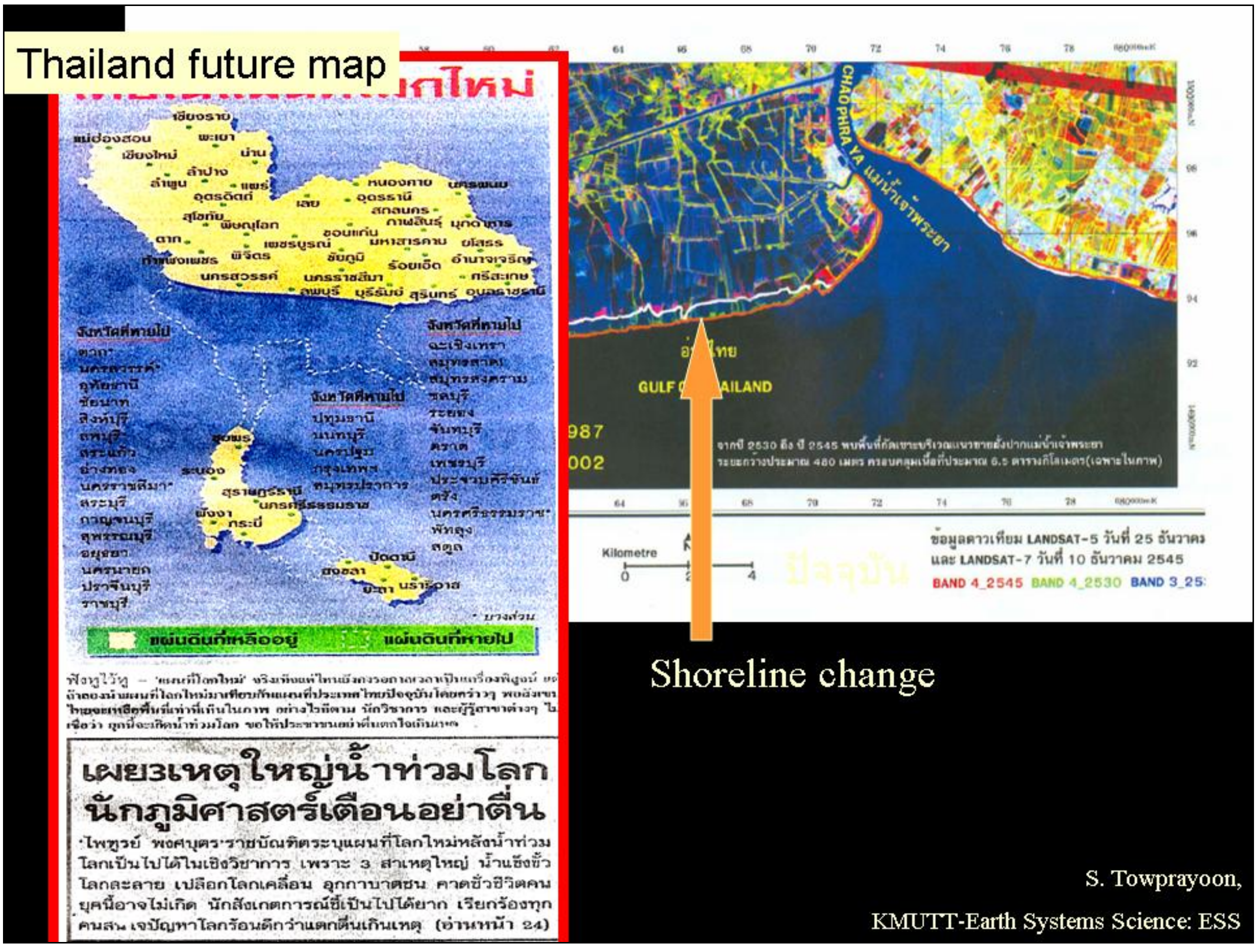

Forest change in Thailand
• Area not change, but composition of forest species
– Subtropical life zone decreases from 50 → 12-22%
– In the South, tropical life zone increases from 45%→80%
– Subtropical dry forest would be disappeared and replaced by subtropical very dry forests
Source: ONEP 2008

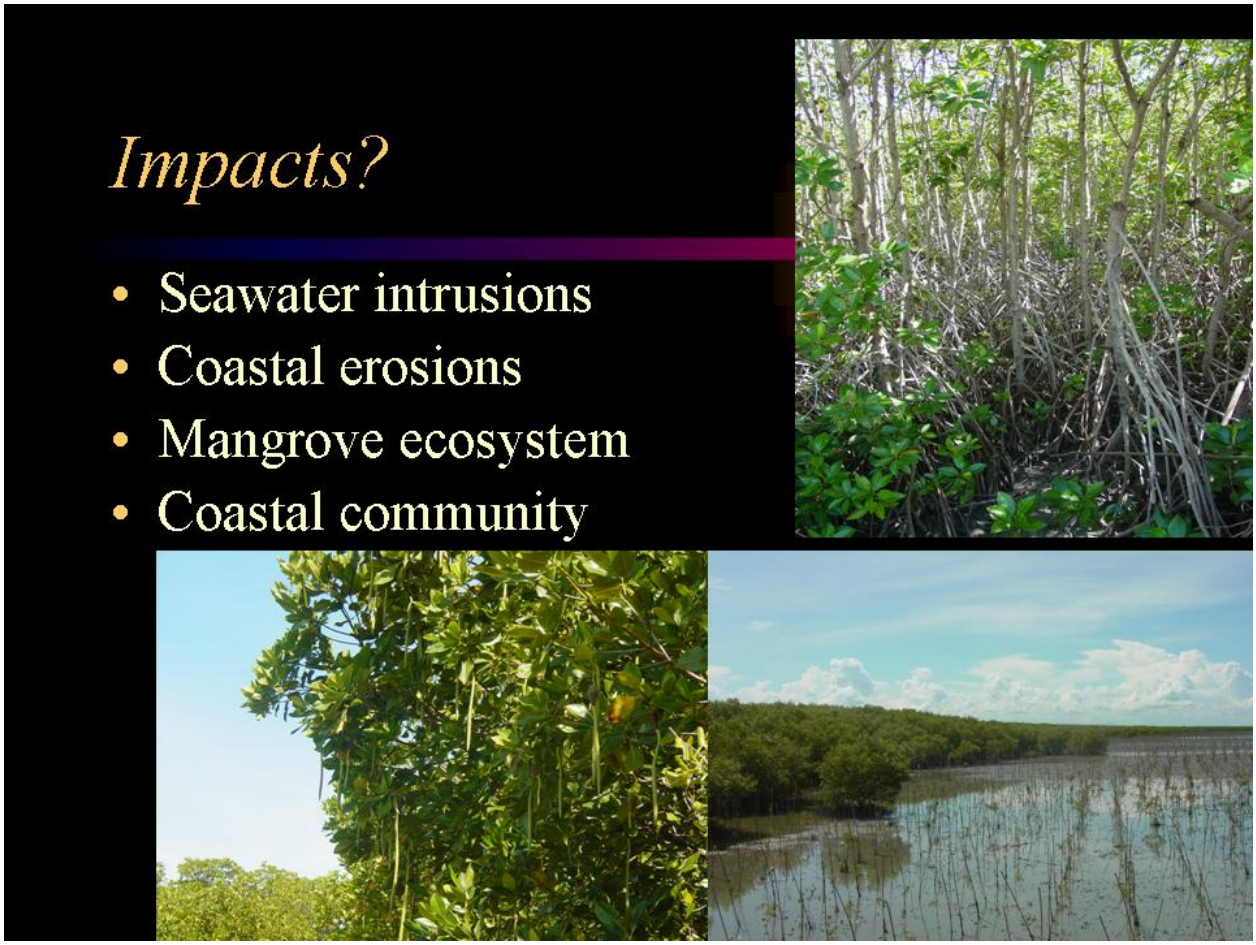

Studies by START
• Southeast Asia Regional Vulnerability to Changing Water Resource and Extreme Hydrological Events Due to Climate Change
• AIACC (Assessments of Impacts and Adaptations to Climate Change)
• GEF funded
• Used RCM: CCAM developed by CSIRO
• 10 km resolution
• Daily data 1 decade
• CO_2 levels (ppm.):
- 360 (baseline) - Future: 540, 720

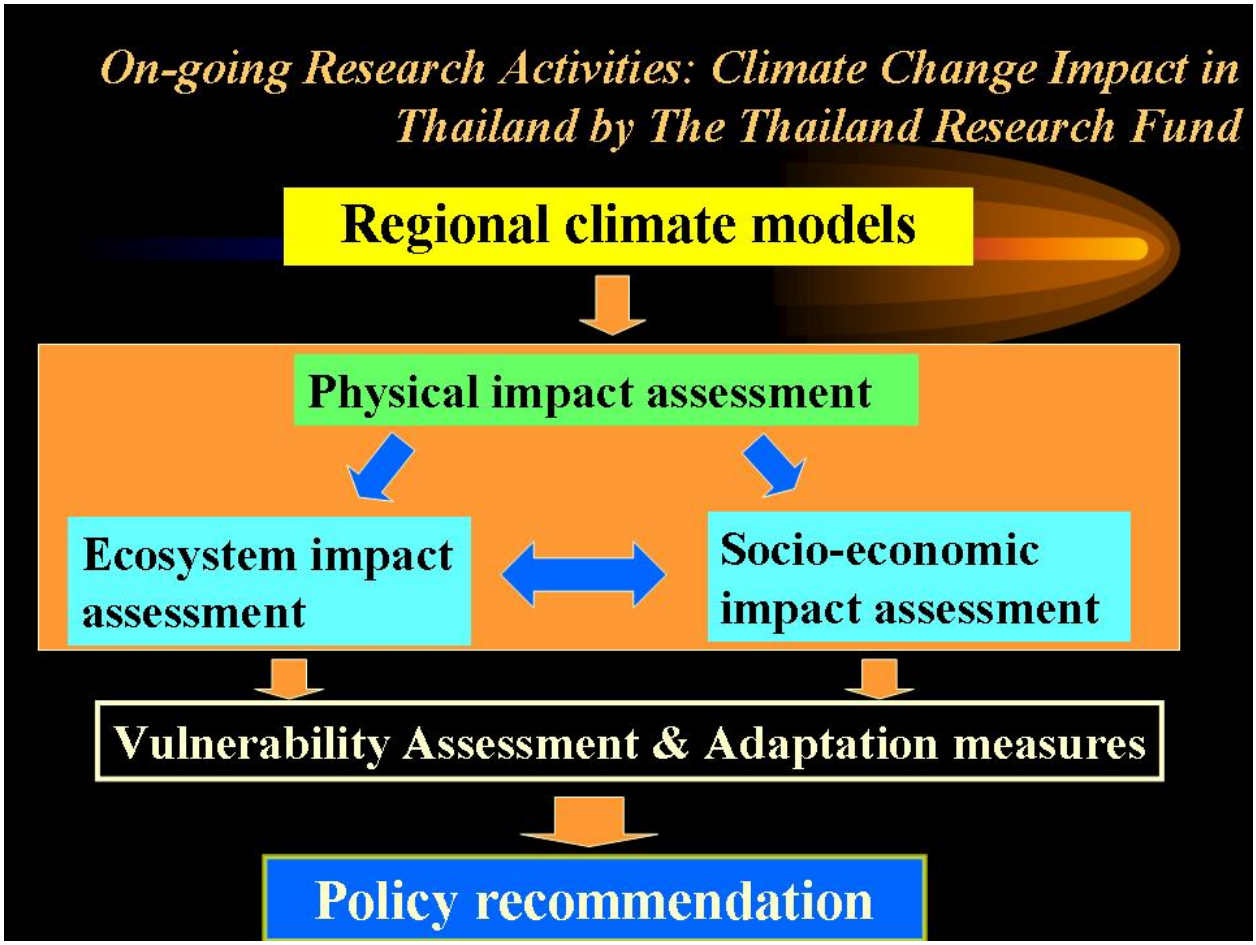

Climate change impacts on Songkharm river basin
300000
350000
400000
450000
2000000
1950000
1900000
Ban Tha Kok Daenh
Nakhon Phanom
Nakae
Model Areas in Nam Songkhram Basin
UTM 48N - Map produced by MRC/WUP-FIN, matti.kummu@iki.fi
0 12.5 25 50 75 100 Kilometers
VMod model area / Watershed
EIA 3D model area / Floodplain
HBV model area
Shinvanno & WUP-Fin Group, MRCS


Period of flooding
(days)
Baseline (360 ppm)
CO_2 = 540 ppm
CO_2 = 720 ppm
Shinvanno & WUP-Fin Group, MRCS


Water depth (m)
Baseline (360 ppm)
CO_2 = 540 ppm
CO_2 = 720 ppm
Shinvanno & WUP-Fin Group, MRCS


Thailand future map
เผยเหตุใหญ่น้ำท่วมโลก
นักภูมิศาสตร์เตือนอย่าตื่น
CHAO PHRAYA
GULF OF THAILAND
Kilometre
Shoreline change
S. Towprayoon,
KMUTT-Earth Systems Science: ESS


Impacts?
• Seawater intrusions
• Coastal erosions
• Mangrove ecosystem
• Coastal community

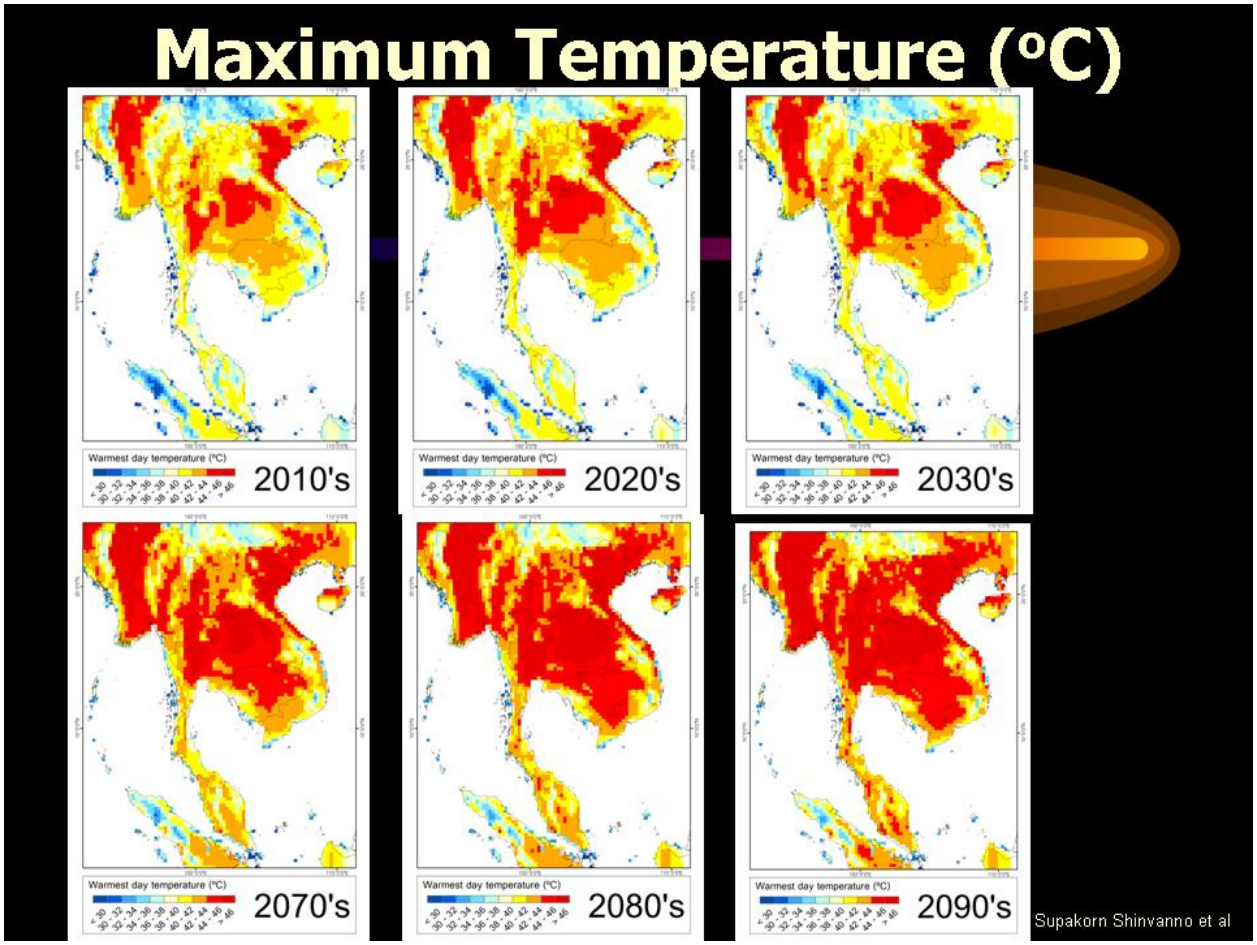

On-going Research Activities: Climate Change Impact in Thailand by The Thailand Research Fund
Regional climate models
Physical impact assessment
Ecosystem impact assessment
Socio-economic impact assessment
Vulnerability Assessment & Adaptation measures
Policy recommendation

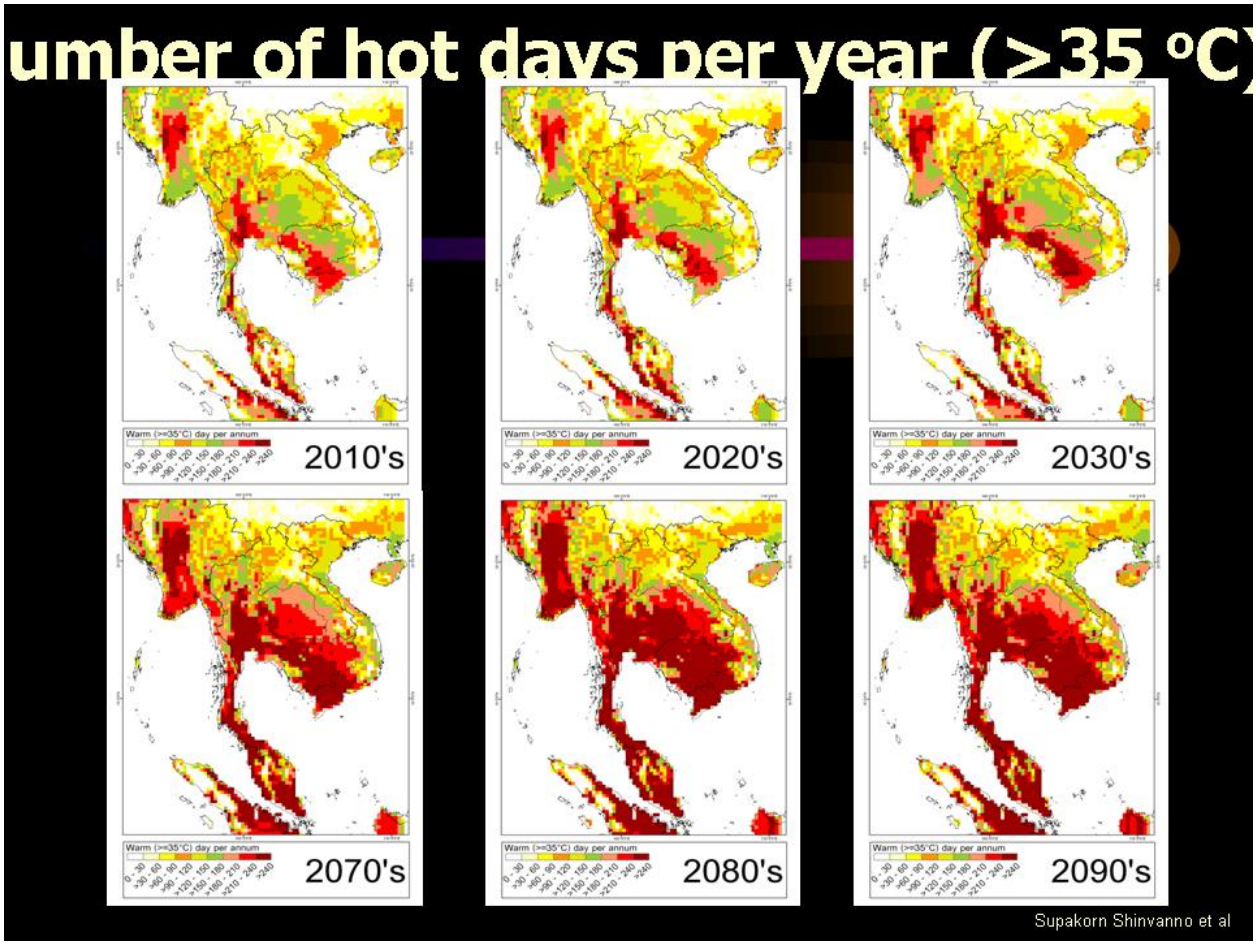
Main objectives

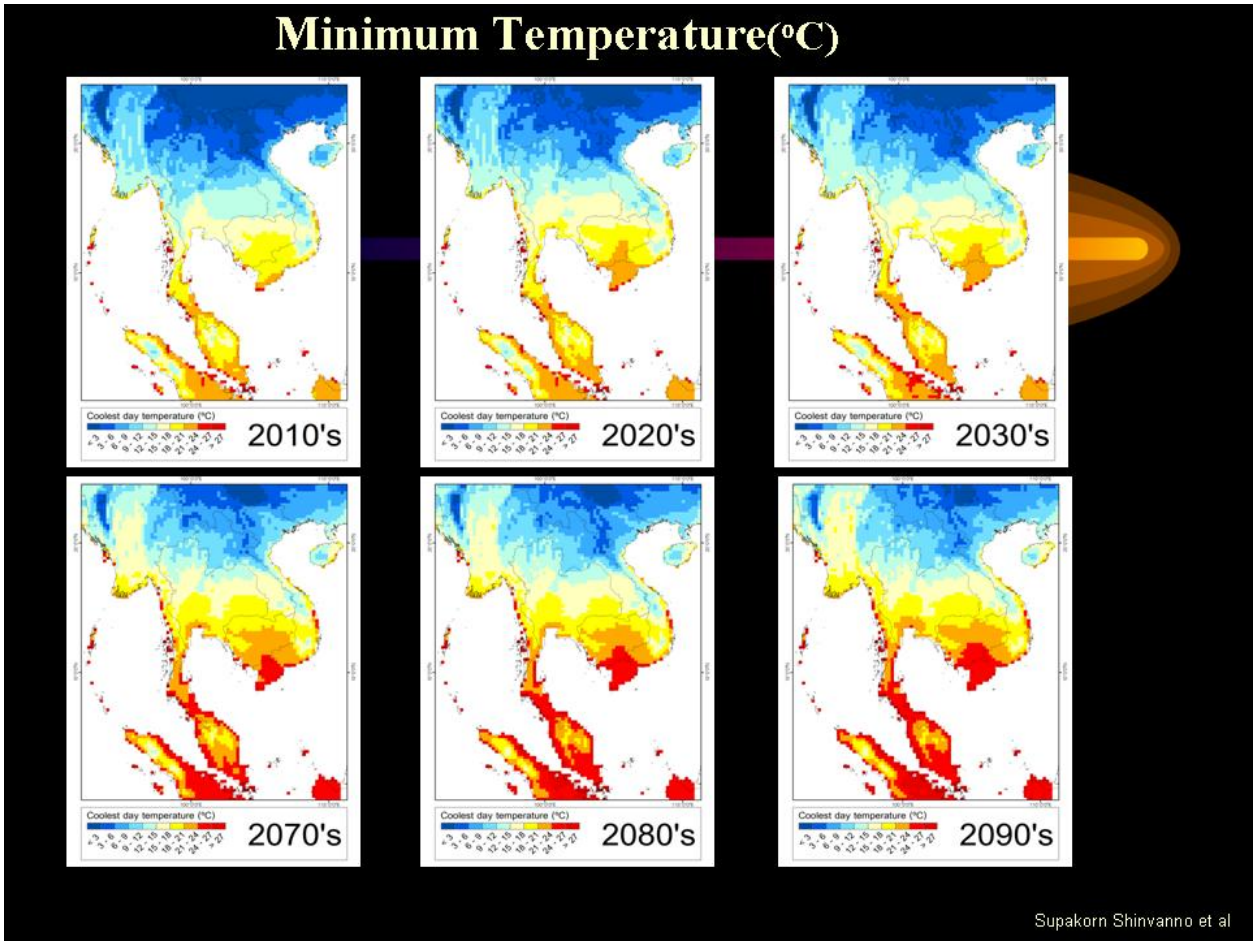
- Assessing physical climate change using regional climate modeling approach
- Assessing climate change impacts on Thai ecosystems (Agriculture, forestry, coastal systems, etc.)
- Develop tools and methodology for socio-economic impact assessments
- Policy/measures

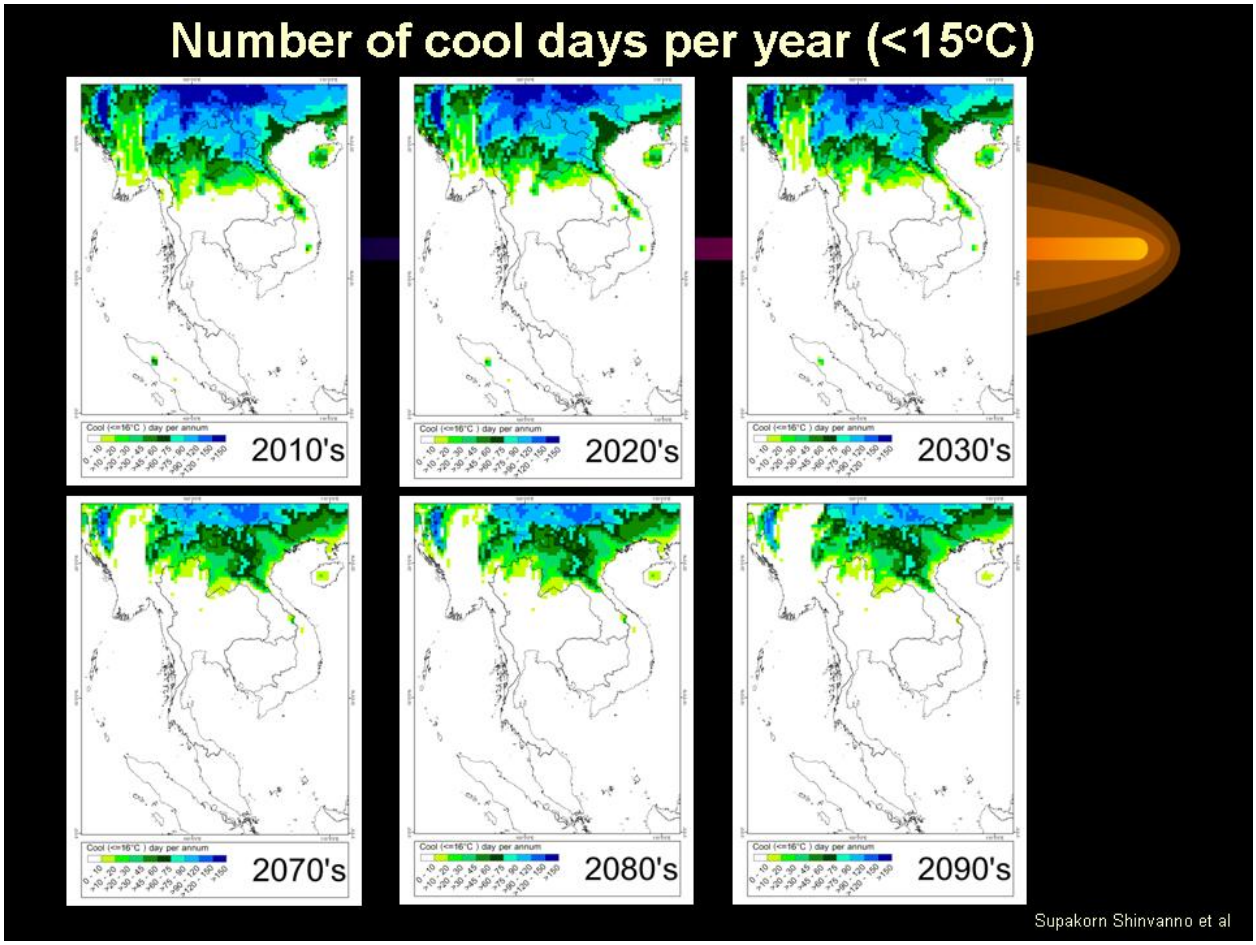
Physical Impact Assessments

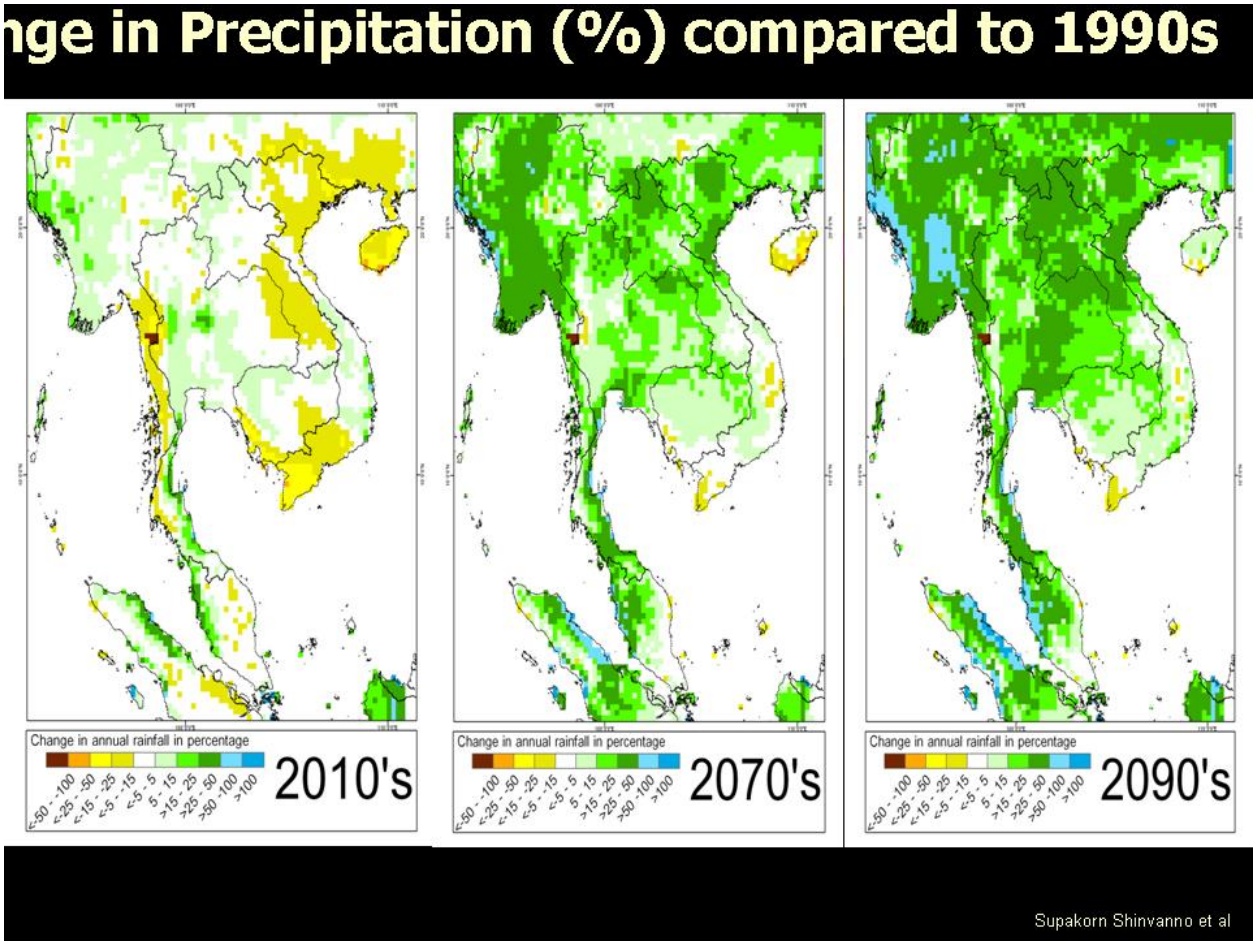
Researchers	Models	Emission Scenarios	Global dataset	Downscale technique	Resolution	Time frame	
Shinvanno et al.	PRECIS	A2 & B2	ECHAM4	Statistical	25×25	1960-1989	2010-2099
Towprayoon et al	RegCM3	A2 & B2	ECHAM5	Dynamic	20×20	1971-1990	2007-2027
Boonprakop et al	GCM – GFDL–R30	A2 & B2	ECHAM4	Statistical	50×50	1961-1990	2010-2039
Kreusuwan et al	MM5	A2 & B2	ECHAM4	Dynamic	25×25	1961-1990	2010-2040


Maximum Temperature (°C)
Warmest day temperature (°C)
2010's
Warmest day temperature (°C)
2020's
Warmest day temperature (°C)
2030's
Warmest day temperature (°C)
2070's
Warmest day temperature (°C)
2080's
Warmest day temperature (°C)
2090's
Supakorn Shinvanno et al


umber of hot days per year (>35 °C)
2010's
2020's
2030's
2070's
2080's
2090's
Supakorn Shinvanno et al


Minimum Temperature(°C)
Coolest day temperature (°C)
2010's
2020's
2030's
2070's
2080's
2090's
Supakorn Shinvanno et al


Number of cool days per year (<15°C)
2010's
2020's
2030's
2070's
2080's
2090's
Supakorn Shinvanno et al


nge in Precipitation (%) compared to 1990s
Change in annual rainfall in percentage
2010's
Change in annual rainfall in percentage
2070's
Change in annual rainfall in percentage
2090's
Supakorn Shinvanno et al

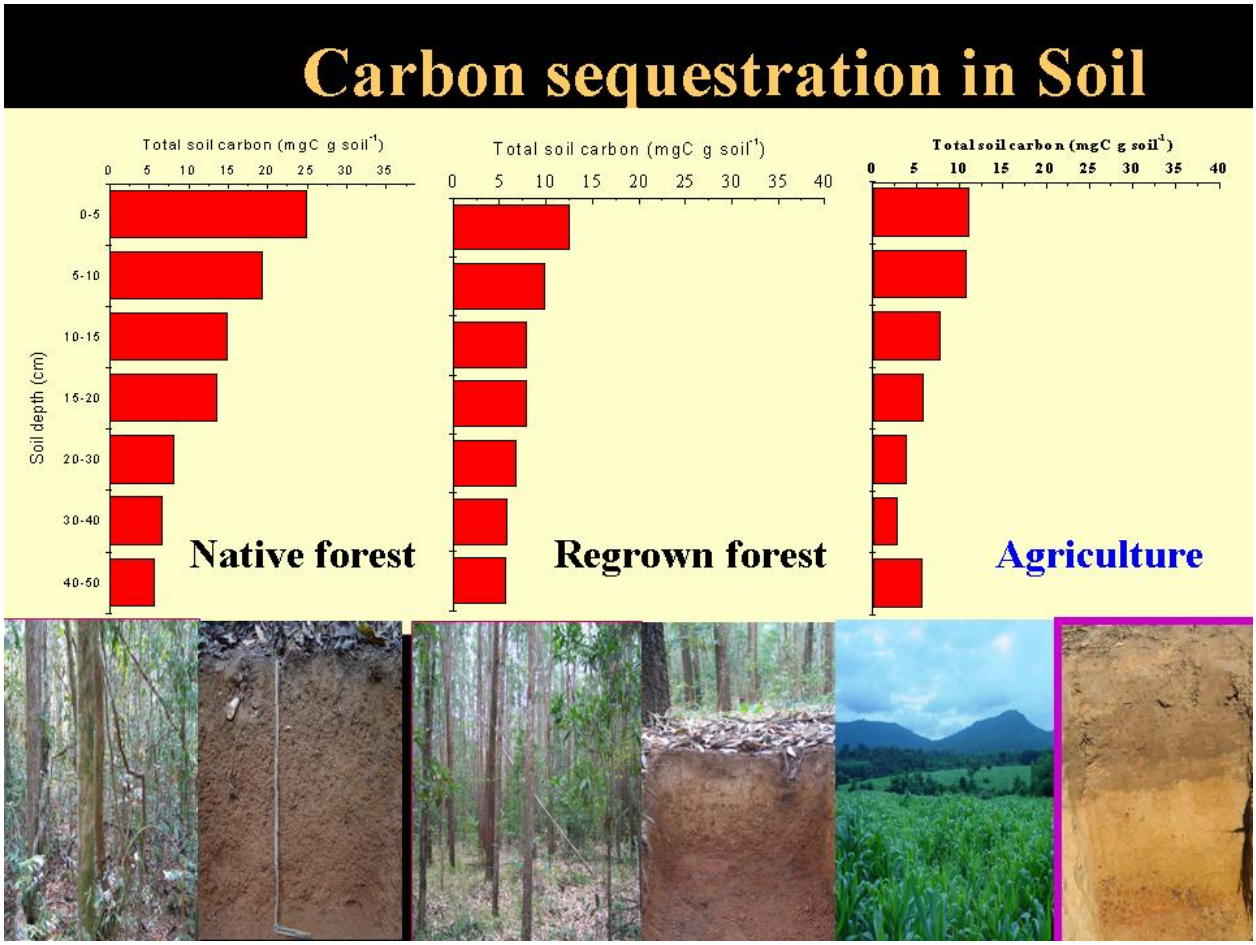
So far, for SRES A2 scenario:

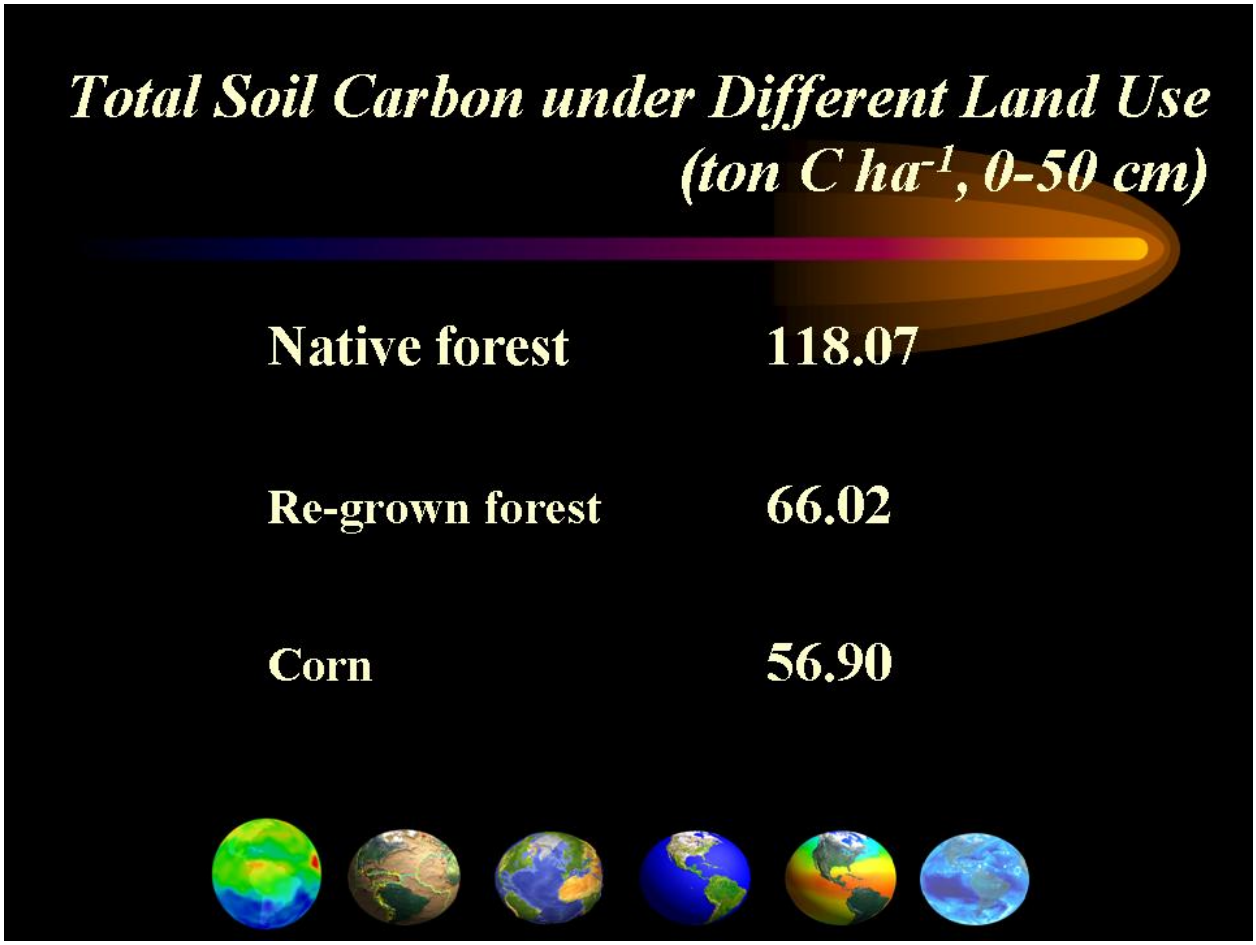
- **Temperature increase 1-2 °C**
- **summer lengthened by 1-2 months**
- **winter shortened by 1-2 months**
- **length of rainy season remains the same,**

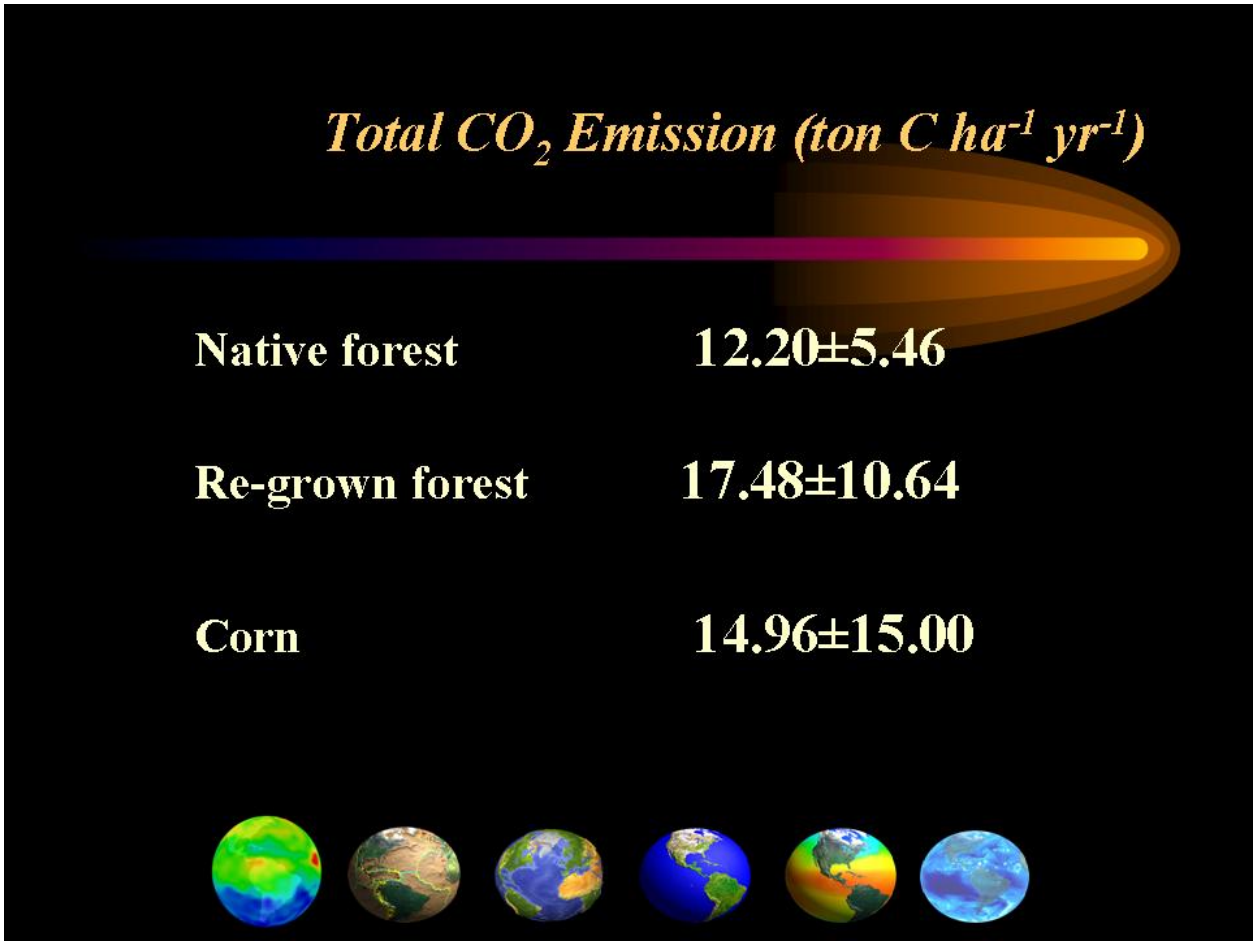
but yearly precipitation increases by 10-20%

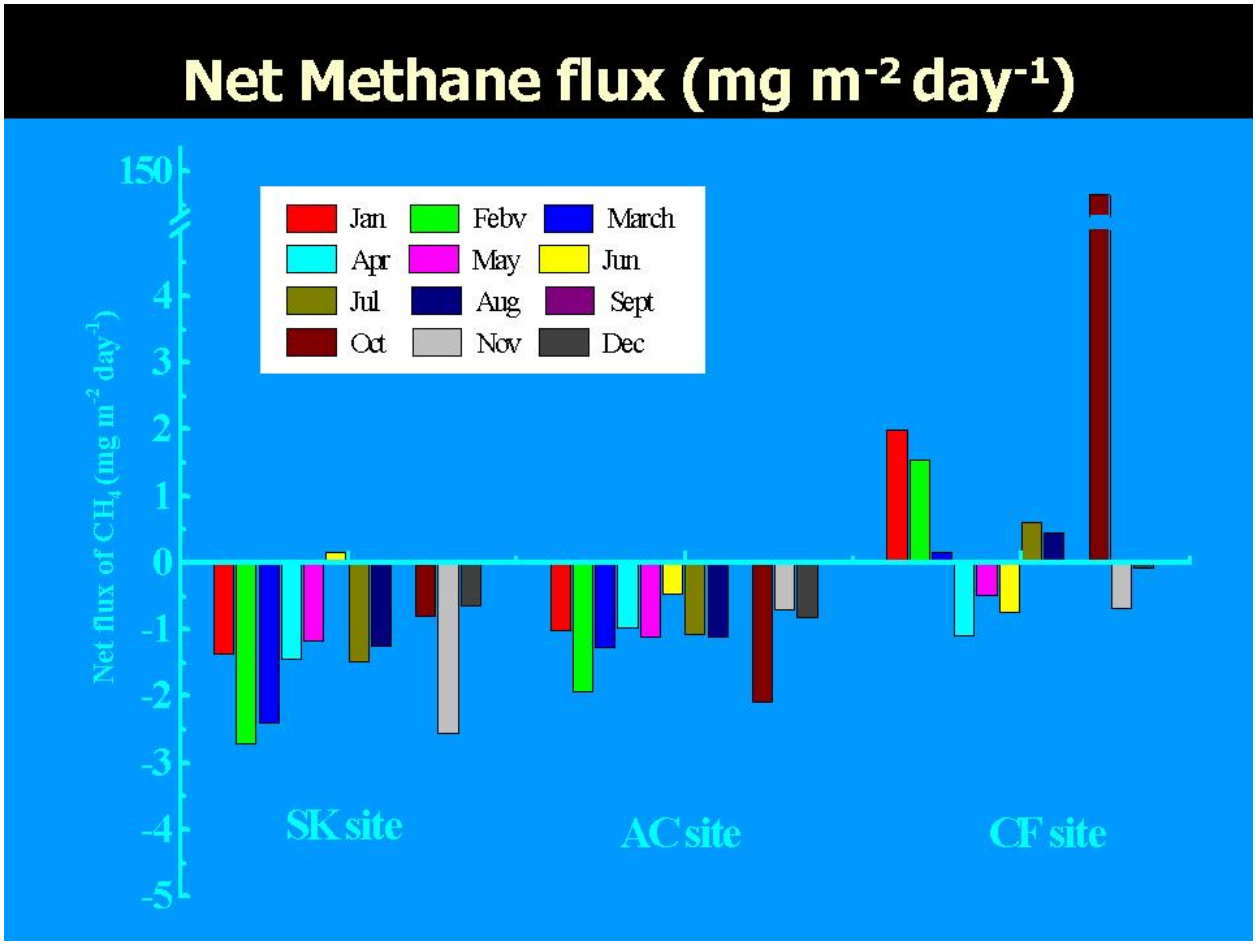
☞20-30% of species assessed are likely to be at increased riskof extinction if warming exceed 1.5-2.5C (relative to 1980-99, IPCC AR4, 2007)


Other related studies

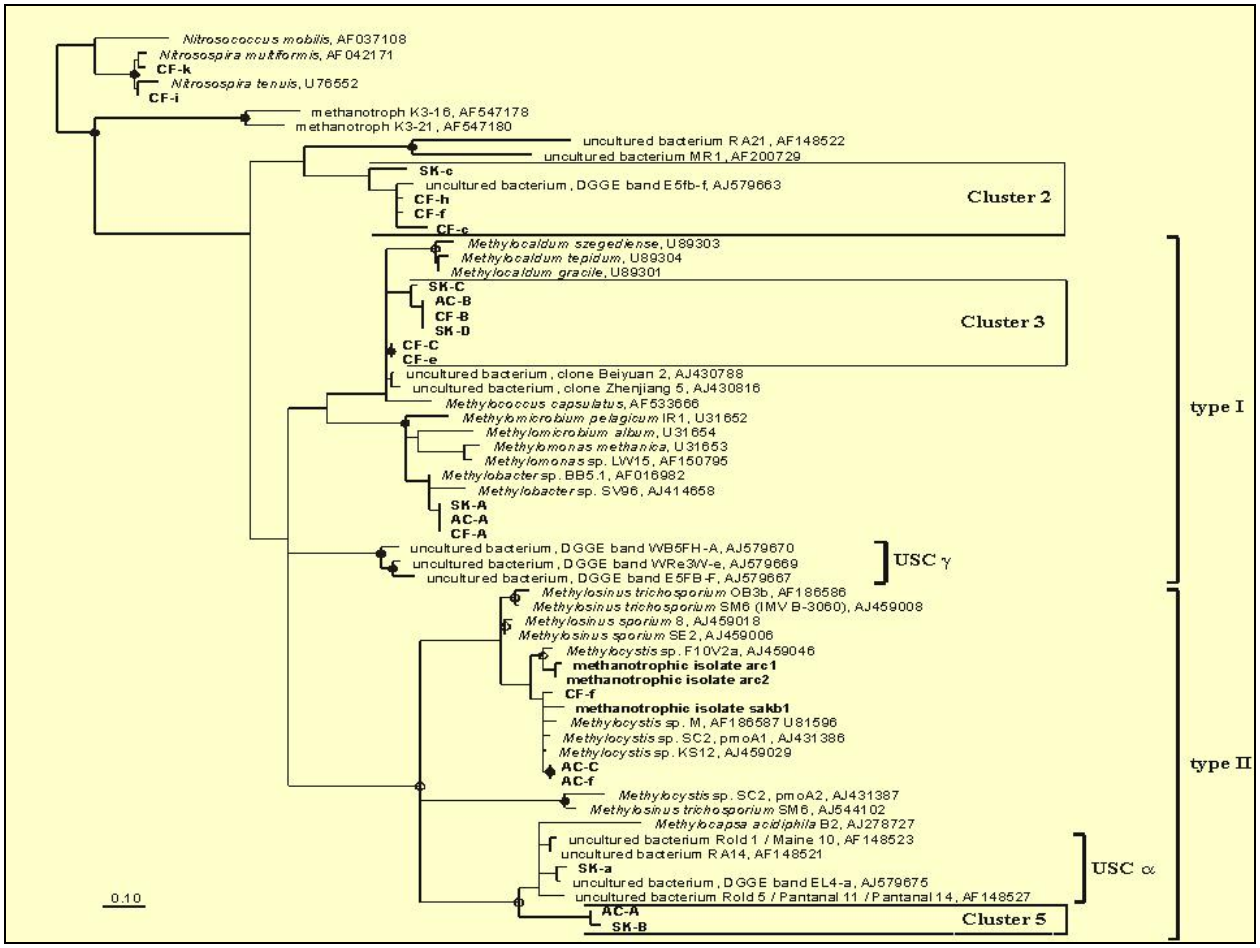

Carbon sequestration in Soil
Total soil carbon (mgC g soil-1)
0 5 10 15 20 25 30 35
Soil depth (cm)
0-5
5-10
10-15
15-20
20-30
30-40
40-50
Native forest
Total soil carbon (mgC g soil-1)
0 5 10 15 20 25 30 35 40
Regrown forest
Total soil carbon (mgC g soil-1)
0 5 10 15 20 25 30 35 40
Agriculture

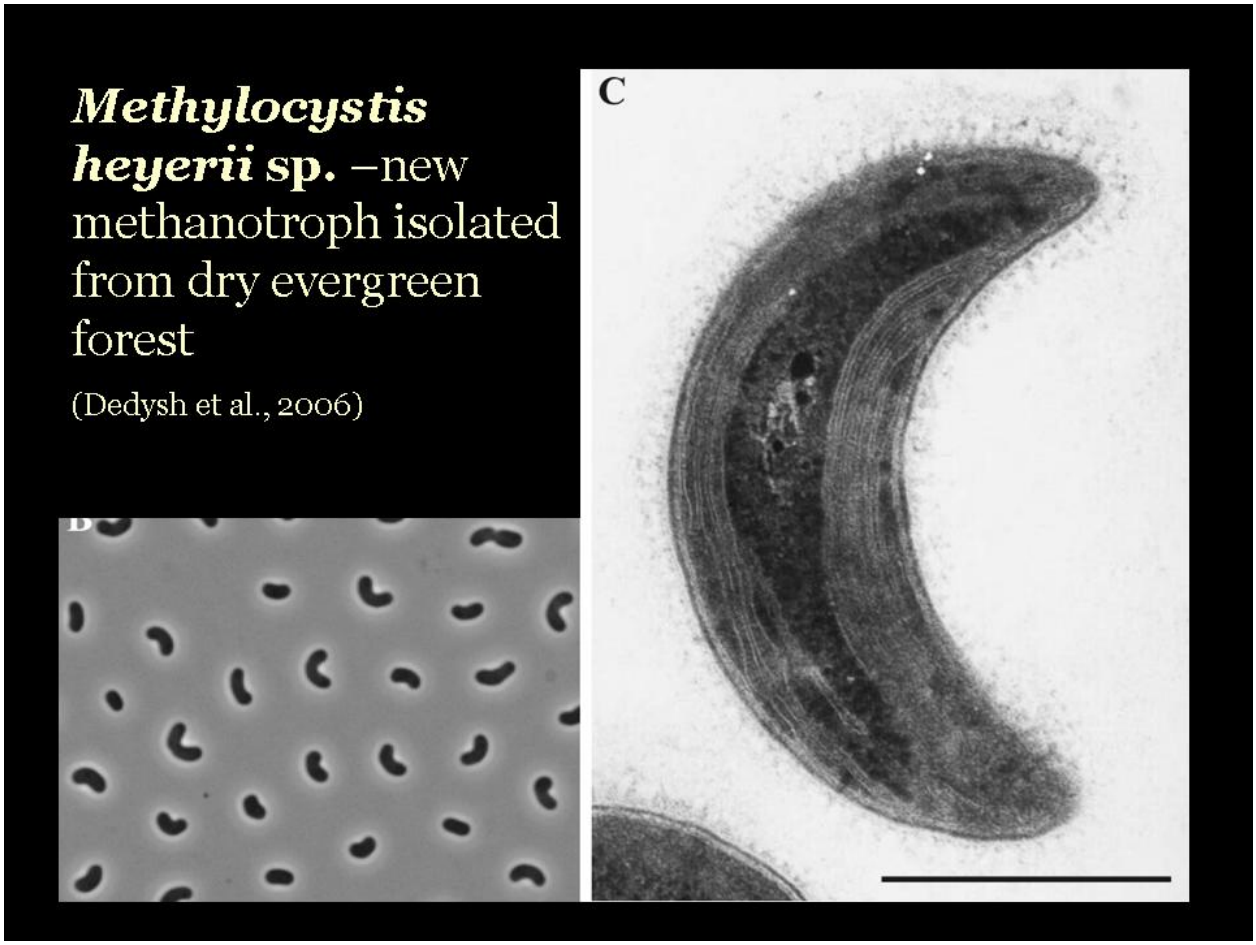

Total Soil Carbon under Different Land Use
(ton C ha-1, 0-50 cm)
Native forest
118.07
Re-grown forest
66.02
Corn
56.90


Total CO_2 Emission (ton C ha^{-1} yr^{-1})
Native forest
12.20±5.46
Re-grown forest
17.48±10.64
Corn
14.96±15.00

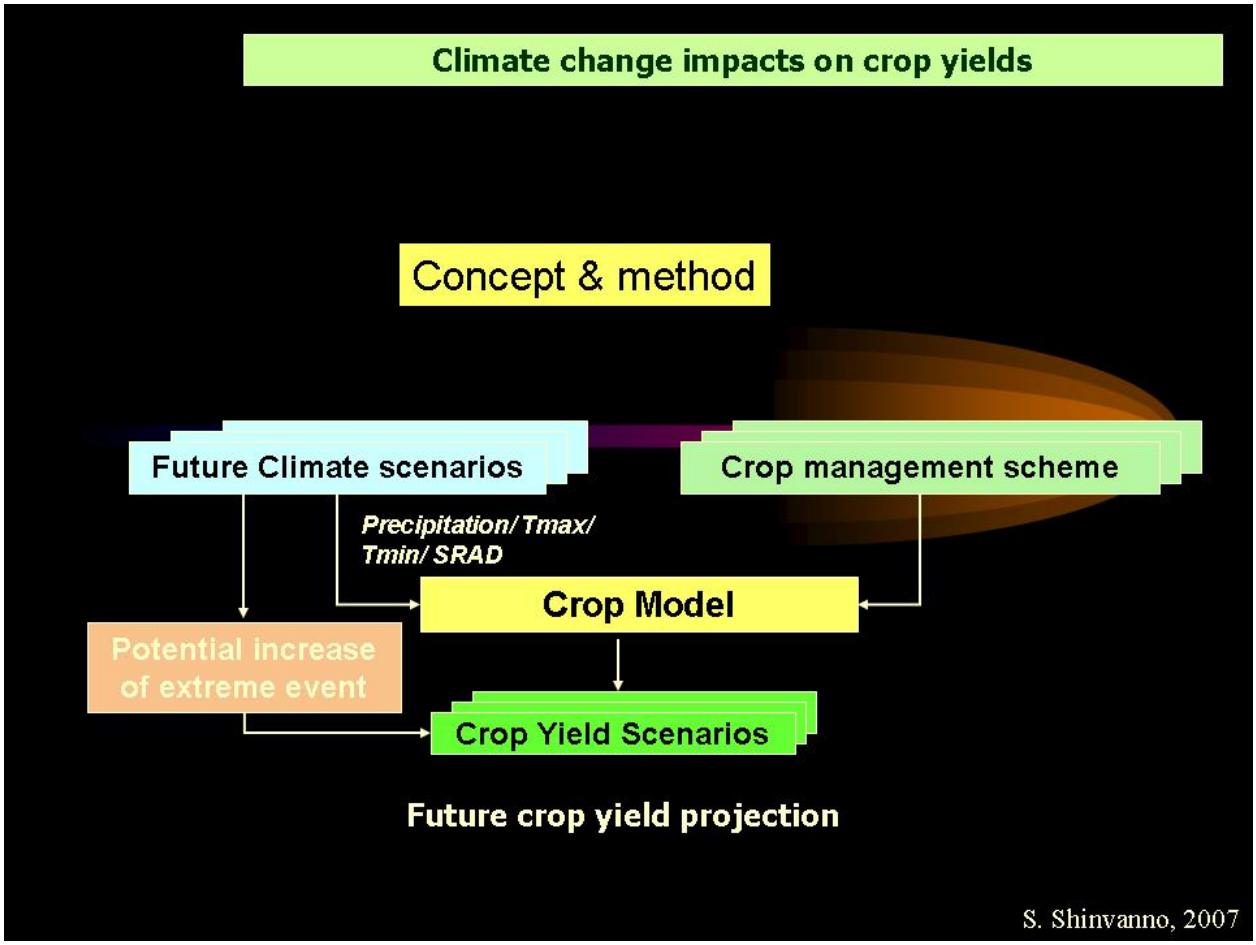

Net Methane flux (mg m-2 day-1)
Jan
Febv
March
Apr
May
Jun
Jul
Aug
Sept
Oct
Nov
Dec
150
4
3
2
1
0
-1
-2
-3
-4
-5
Net flux of CH4 (mg m-2 day-1)
SK site
AC site
CF site

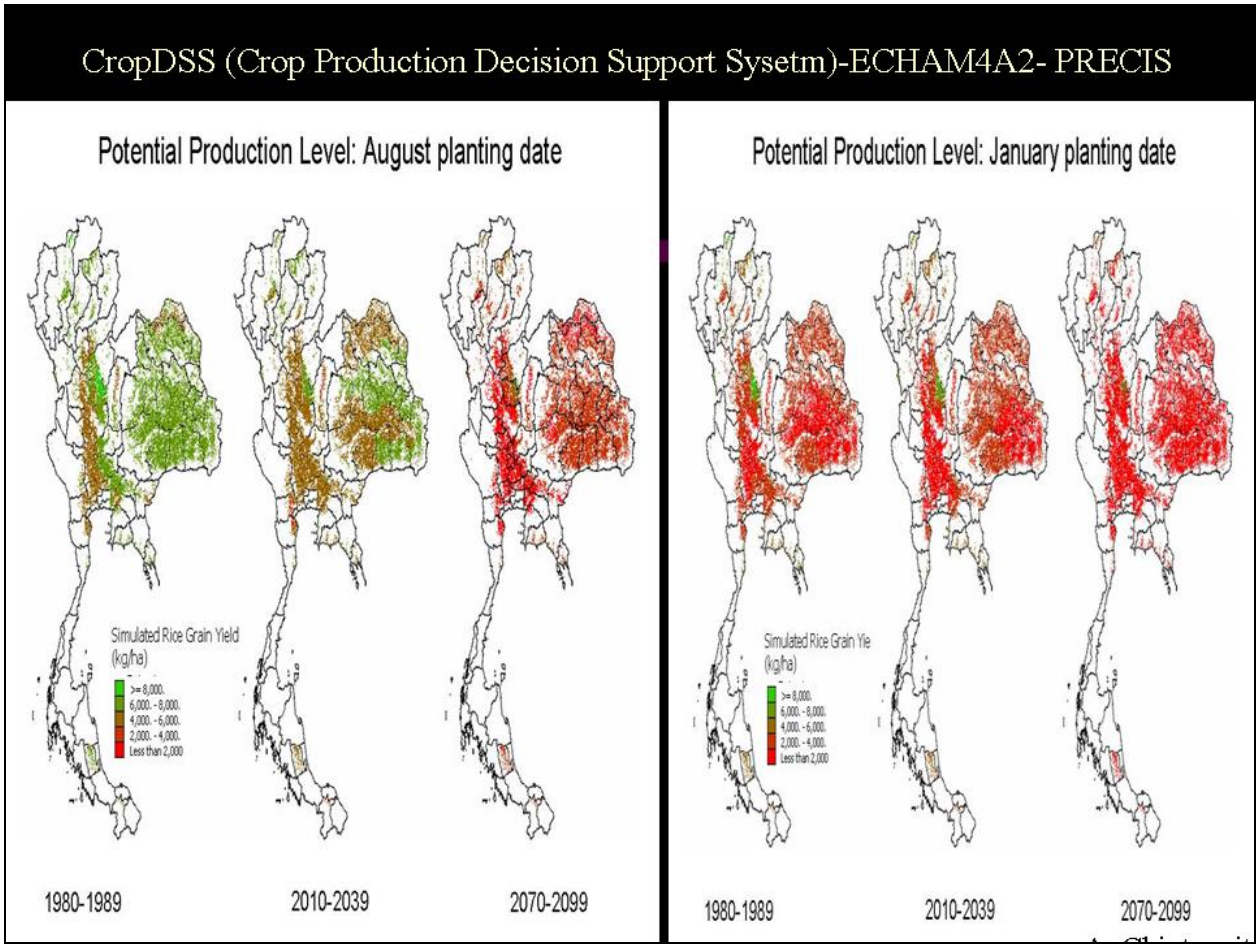
- **Natural forest soil (Dry Evergreen)**
  -Able to oxidize ambient concentration (1.75 ppm)
  -not efficient at higher concentration
- **Agricultural soil (Maize)**
  - **Not efficient at ambient concentration**
- **Reforest soil (*Acacia mangium*)**
  - **Both ambient and high concentration**

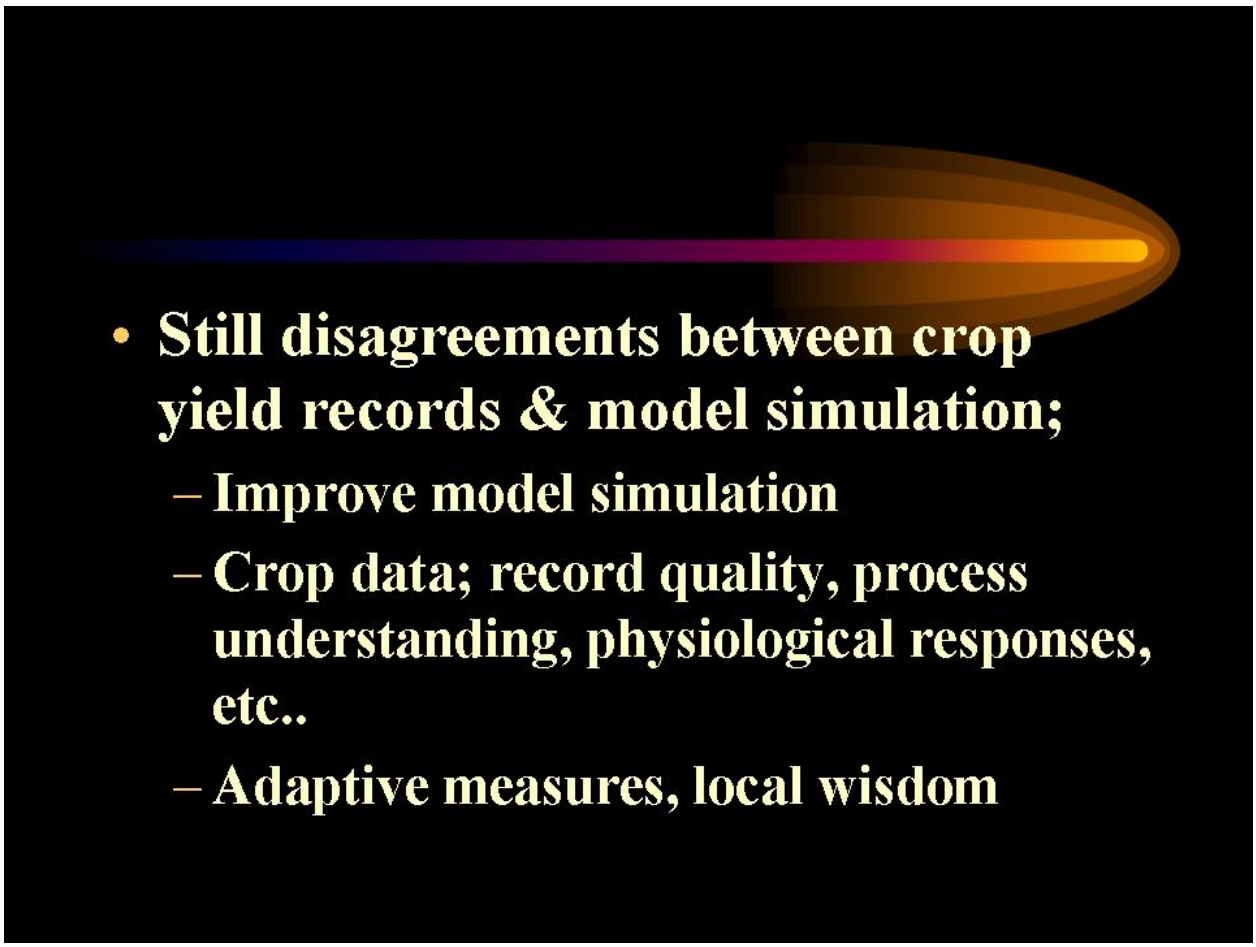

Nitrosococcus mobilis, AF037108
Nitrosospira multiformis, AF042171
CF-k
Nitrosospira tenuis, U76552
CF-i
methanotroph K3-16, AF547178
methanotroph K3-21, AF547180
uncultured bacterium RA21, AF148522
uncultured bacterium MR1, AF200729
SK-c
uncultured bacterium, DGGE band E5fb-f, AJ579663
CF-h
CF-f
CF-c
Cluster 2
Methylocaldum szegediense, U89303
Methylocaldum tepidum, U89304
Methylocaldum gracile, U89301
SK-C
AC-B
CF-B
SK-D
Cluster 3
CF-C
CF-e
uncultured bacterium, clone Beiyuan 2, AJ430788
uncultured bacterium, clone Zhenjiang 5, AJ430816
Methylococcus capsulatus, AF533666
Methylomicrobium pelagicum IR1, U31652
Methylomicrobium album, U31654
Methylomonas methanica, U31653
Methylomonas sp. LW15, AF150795
Methylobacter sp. BB5.1, AF016982
Methylobacter sp. SV96, AJ414658
SK-A
AC-A
CF-A
uncultured bacterium, DGGE band WB5FH-A, AJ579670
uncultured bacterium, DGGE band WRe3W-e, AJ579669
uncultured bacterium, DGGE band E5FB-F, AJ579667
USC γ
type I
Methylosinus trichosporium OB3b, AF186586
Methylosinus trichosporium SM6 (IMV B-3060), AJ459008
Methylosinus sporium 8, AJ459018
Methylosinus sporium SE2, AJ459006
Methylocystis sp. F10V2a, AJ459046
methanotrophic isolate arc1
methanotrophic isolate arc2
CF-f
methanotrophic isolate sakb1
Methylocystis sp. M, AF186587 U81596
Methylocystis sp. SC2, pmoA1, AJ431386
Methylocystis sp. KS12, AJ459029
AC-C
AC-f
Methylocystis sp. SC2, pmoA2, AJ431387
Methylosinus trichosporium SM6, AJ544102
Methylocapsa acidiphila B2, AJ278727
uncultured bacterium Rold 1 / Maine 10, AF148523
uncultured bacterium RA14, AF148521
SK-a
uncultured bacterium, DGGE band EL4-a, AJ579675
uncultured bacterium Rold 5 / Pantanal 11 / Pantanal 14, AF148527
AC-A
SK-B
Cluster 5
USC α
type II
0.10


Methylocystis heyerii sp. –new methanotroph isolated from dry evergreen forest
(Dedysh et al., 2006)
C


Future Plans
• Impacts by sectors/ecosystems
• Socio-economic assessments
• Vulnerability
• Adaptation


Climate change impacts on crop yields
Concept & method
Future Climate scenarios
Crop management scheme
Precipitation/ Tmax/
Tmin/ SRAD
Crop Model
Potential increase
of extreme event
Crop Yield Scenarios
Future crop yield projection
S. Shinvanno, 2007


CropDSS (Crop Production Decision Support Sysetm)-ECHAM4A2- PRECIS
Potential Production Level: August planting date
Simulated Rice Grain Yield (kg/ha)
>= 8,000.
6,000. - 8,000.
4,000. - 6,000.
2,000. - 4,000.
Less than 2,000
1980-1989
2010-2039
2070-2099
Potential Production Level: January planting date
Simulated Rice Grain Yie (kg/ha)
>= 8,000.
6,000. - 8,000.
4,000. - 6,000.
2,000. - 4,000.
Less than 2,000
1980-1989
2010-2039
2070-2099


• Still disagreements between crop yield records & model simulation;
– Improve model simulation
– Crop data; record quality, process understanding, physiological responses, etc..
– Adaptive measures, local wisdom

Concluding Remarks

- In the past, research was focused on capacity building, and currently on use of such experiences on impacts & adaptation studies
- Data available on physical climate change (temperature & precipitation)—changes are consistent with global trends
- Data also highlights roles of forest ecosystem to sequester atmospheric carbon
- Some impact studies available, but not yet specifically focused on impacts to biodiversity
- Preliminary data suggest high vulnerability of various ecosystems to climate change/variability


Thank you