Water balance in rice paddies in Laos

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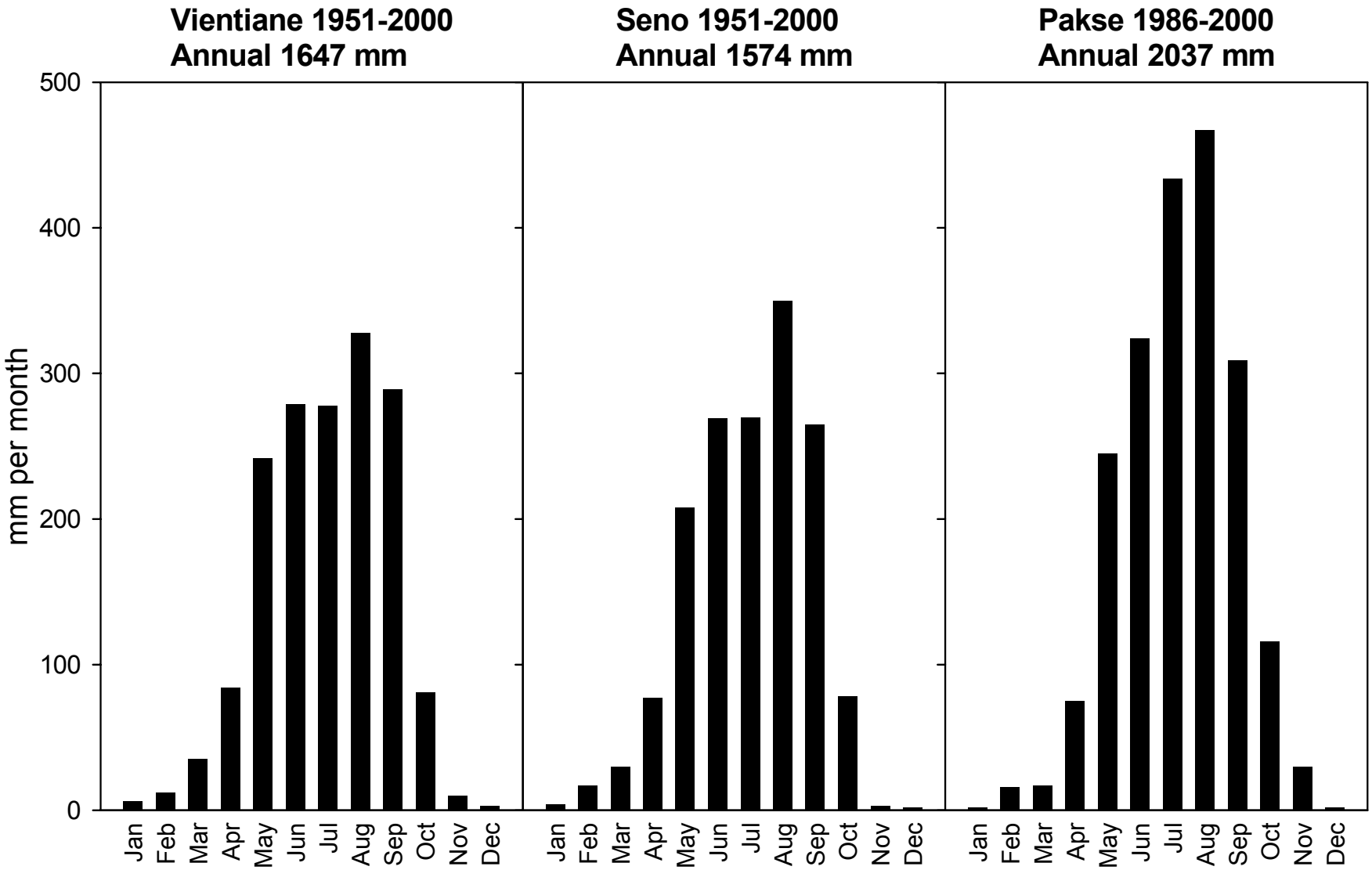
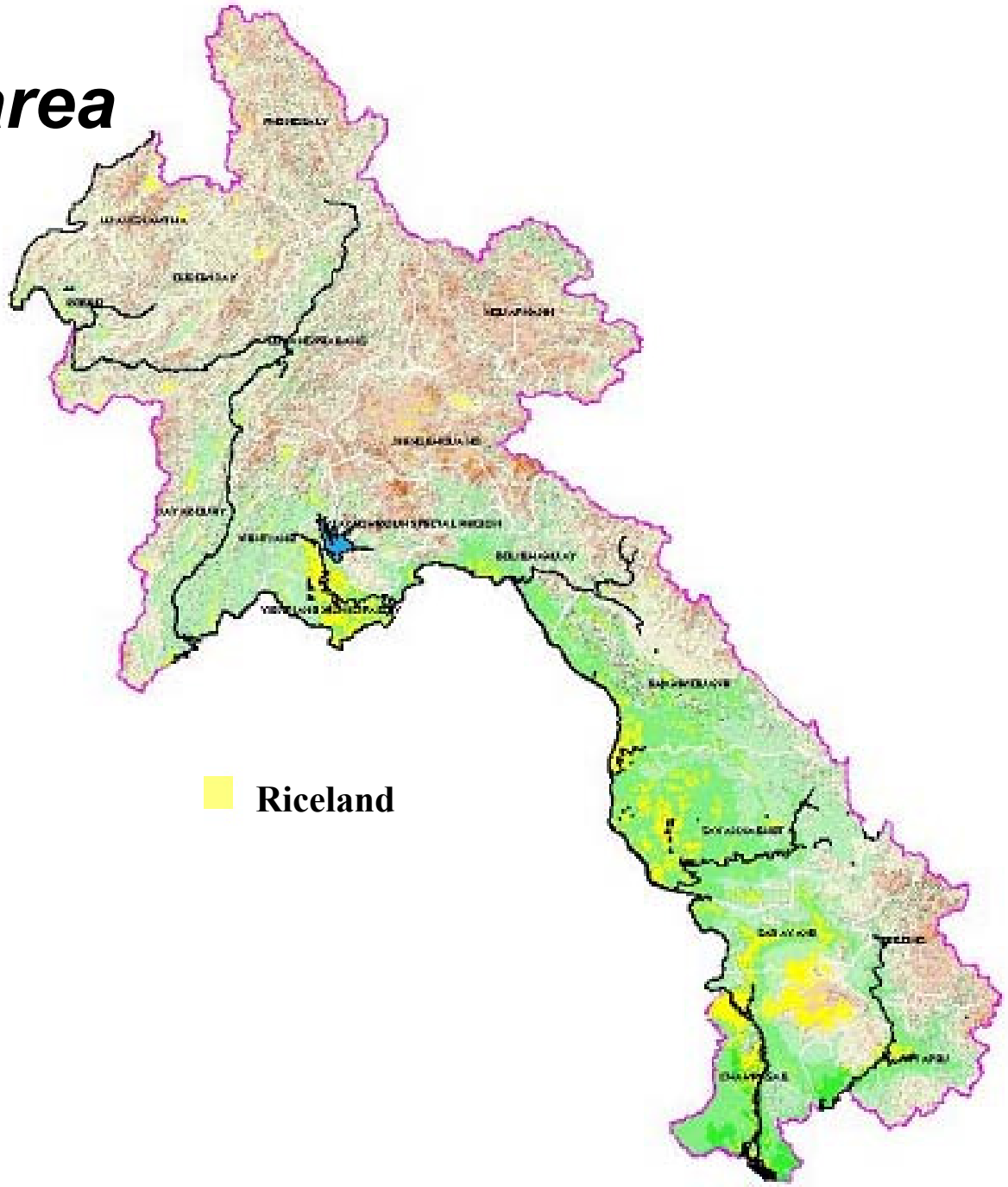
Introduction -Laos

- **Land: 240,000 km^2**
- **Population: 5.6 million**
- **Rice cultivation [source: FAOSTAT(2005)]**
  - **Area: 0.77 million ha, mostly rainfed lowland without irrigation water (65% of total rice growing area)**
  - **Production: 2.5 million tons**
  - **Yield: 3.3 tons per ha**
- **Monsoon climate**
  - **Wet season (Apr – Oct/Nov)– rice growing season**
  - **Dry season (Nov/Dec – Mar)**

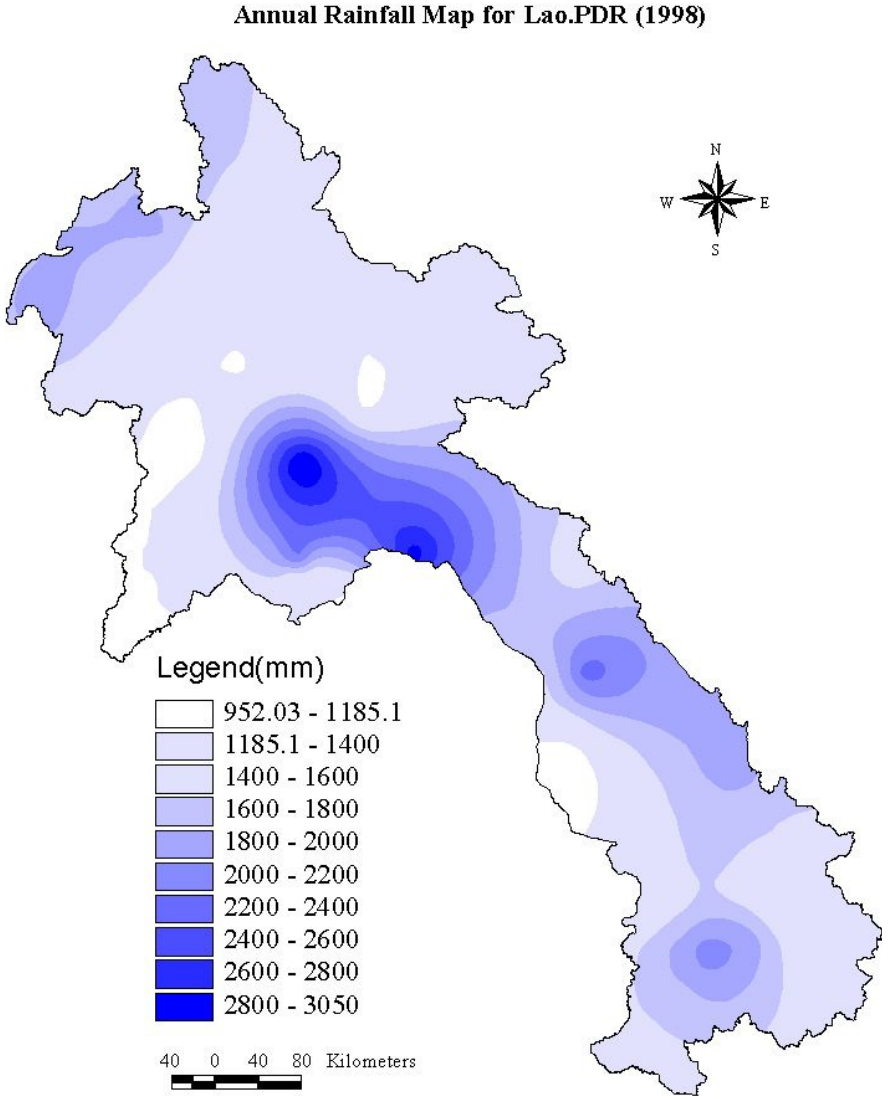
Monthly rainfall distribution

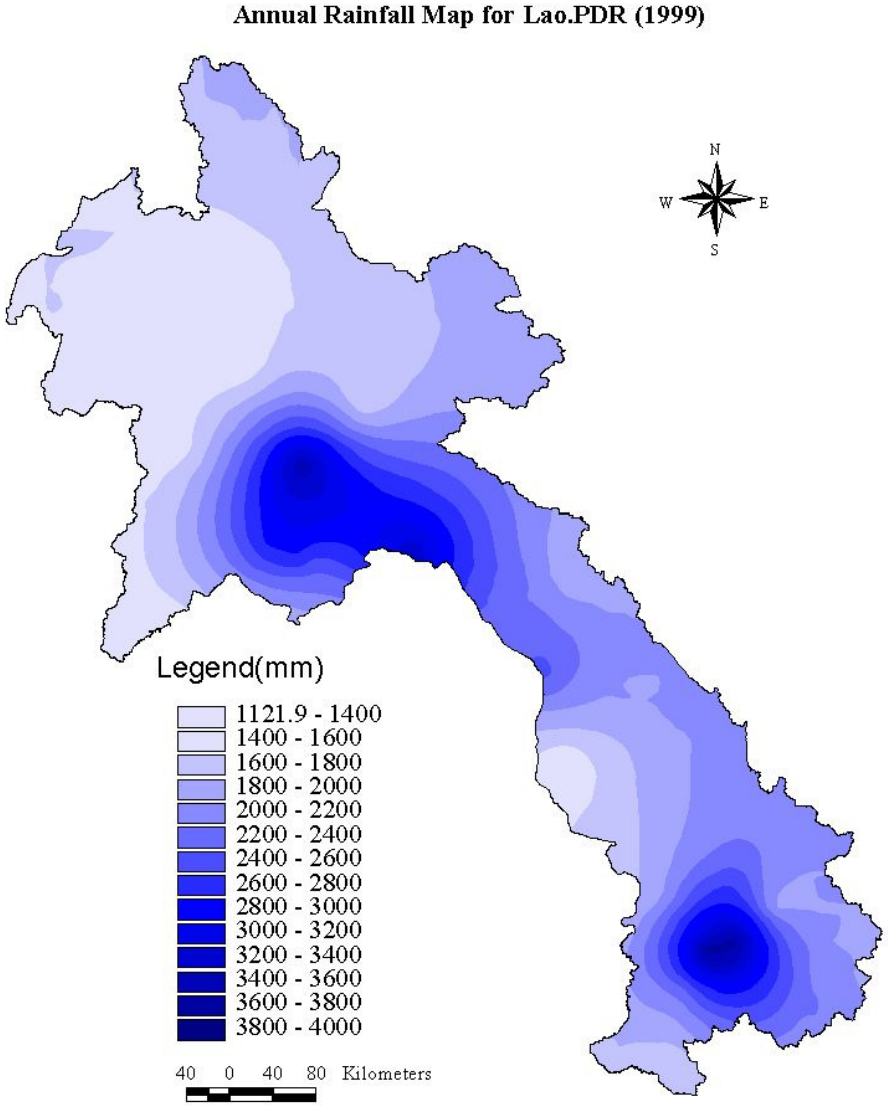


Rice growing area in Laos



Rainfall

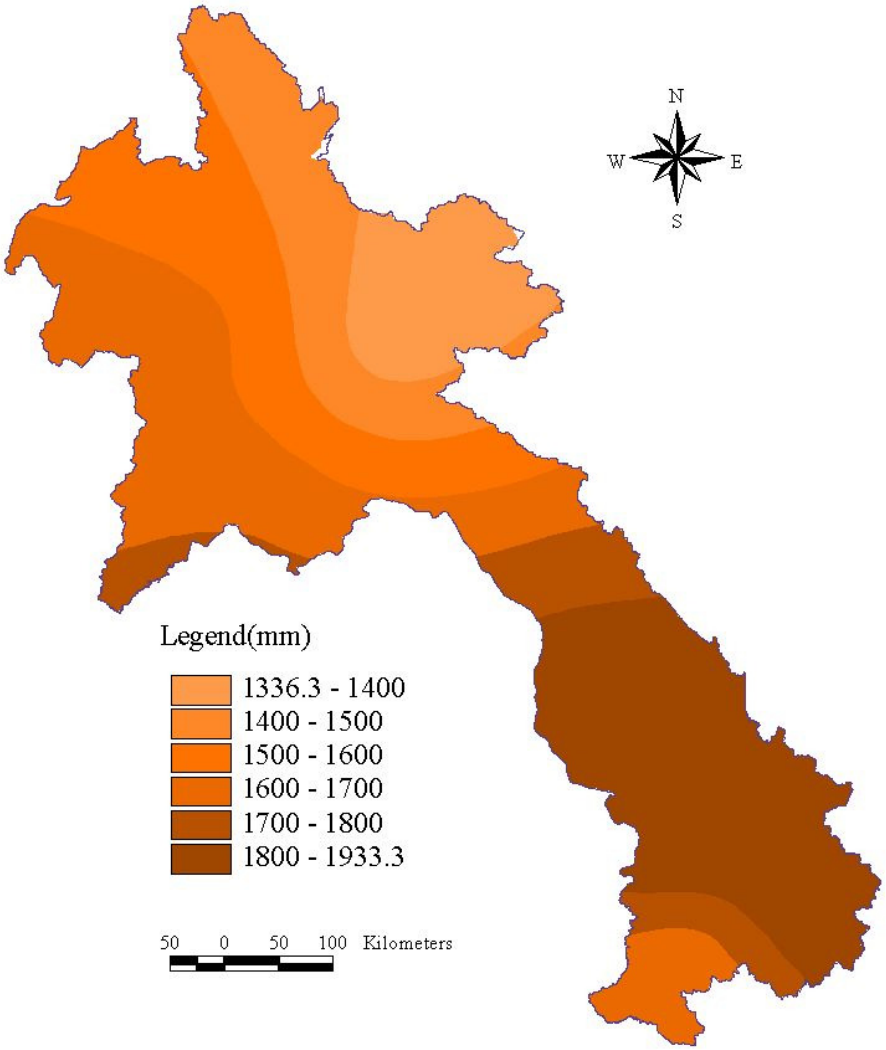




These and other maps were produced with data provided by the Meteorology Department

Potential evapotranspiration

Annual Potential Evapotranspiration Map for Lao.PDR (1998)



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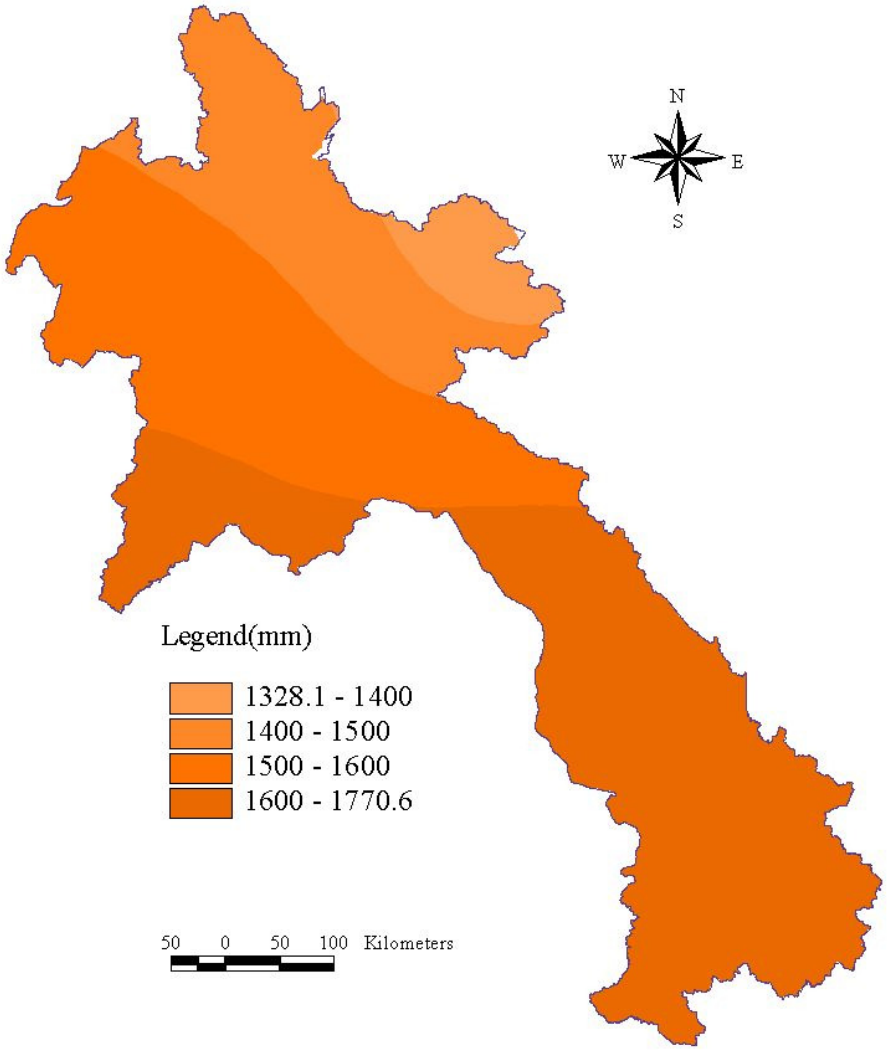
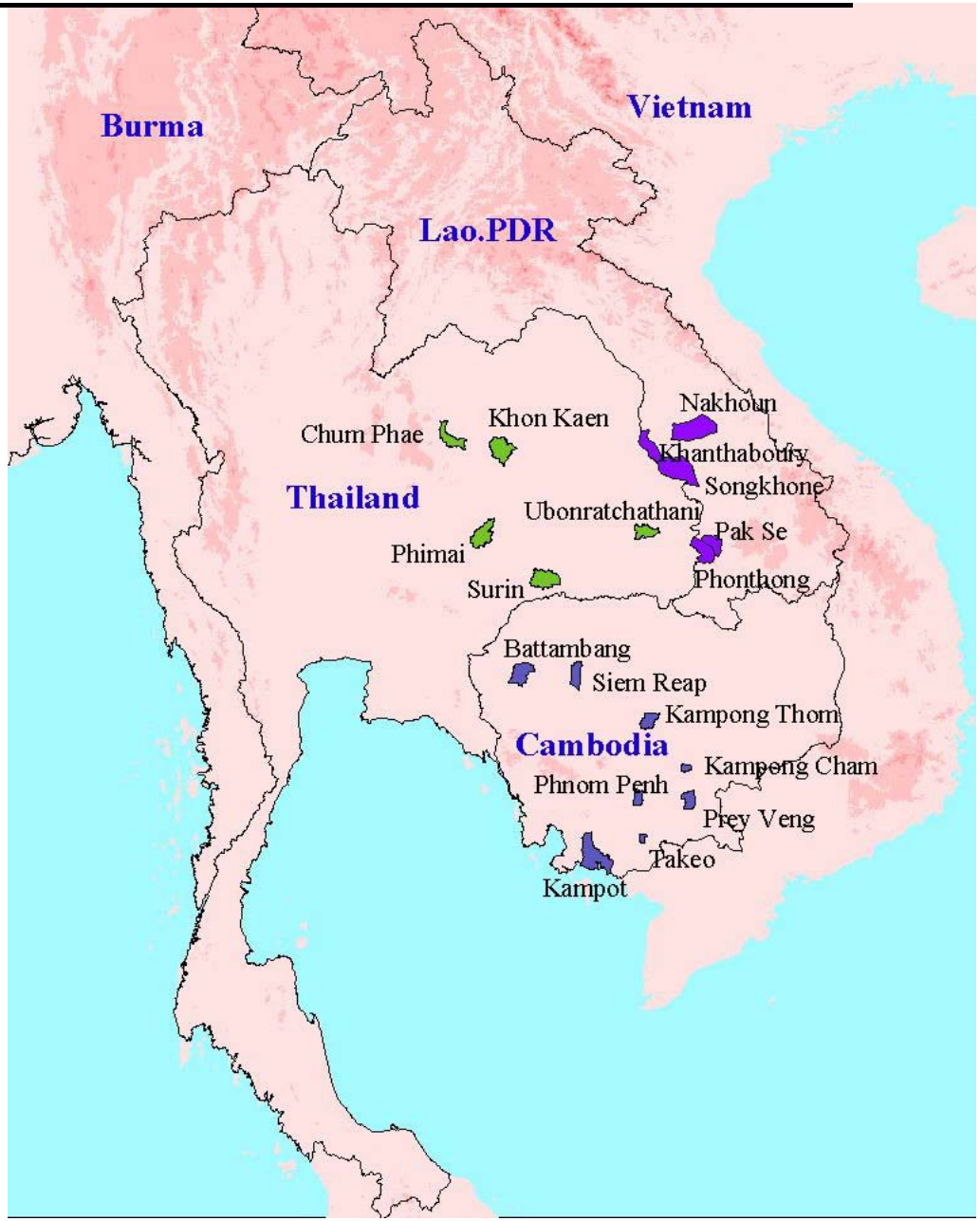
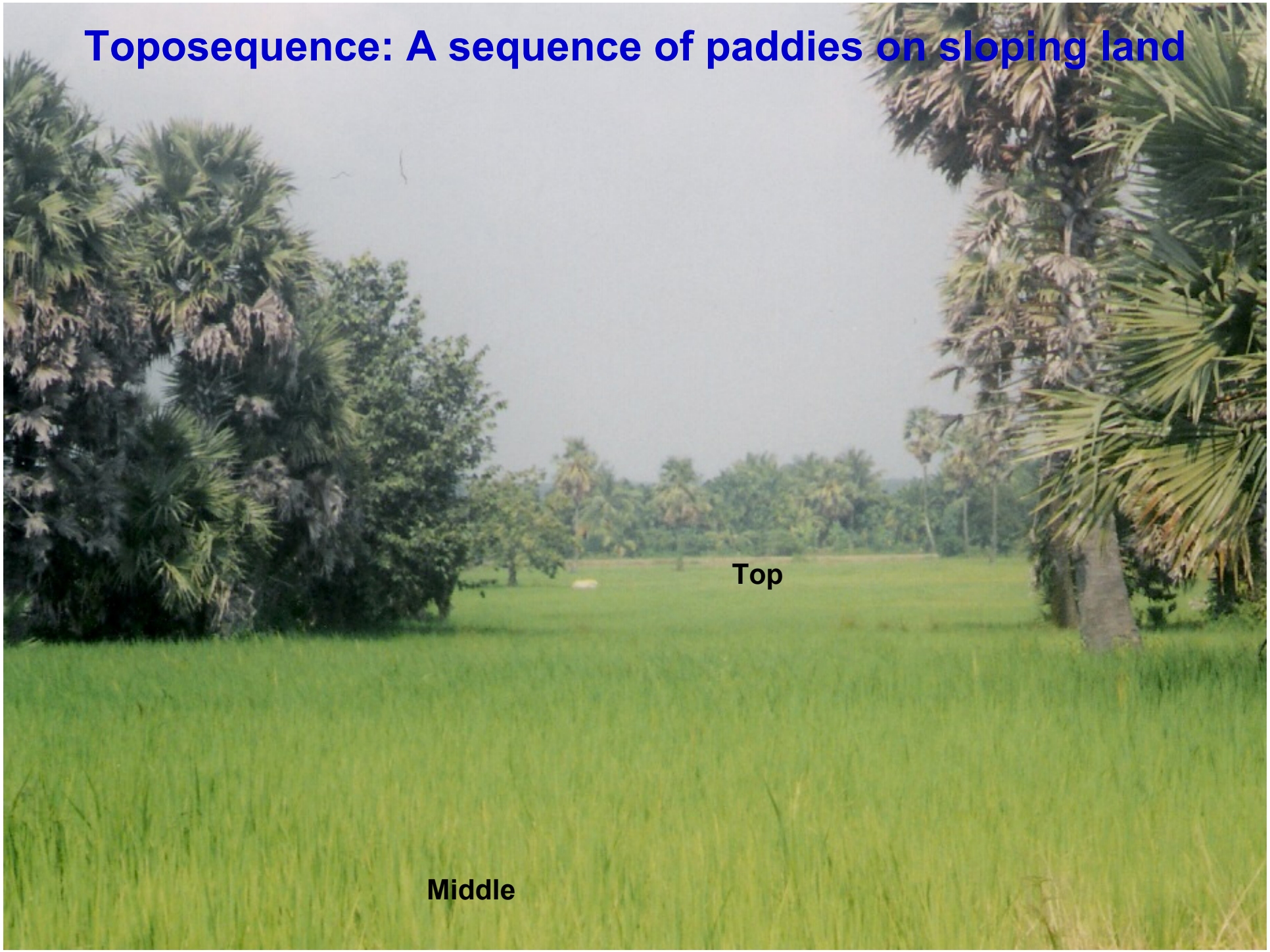


Water balance in the rainfed lowlands

- Northeast Thailand
- Southern Laos
- Cambodia



Toposequence: A sequence of paddies on sloping land



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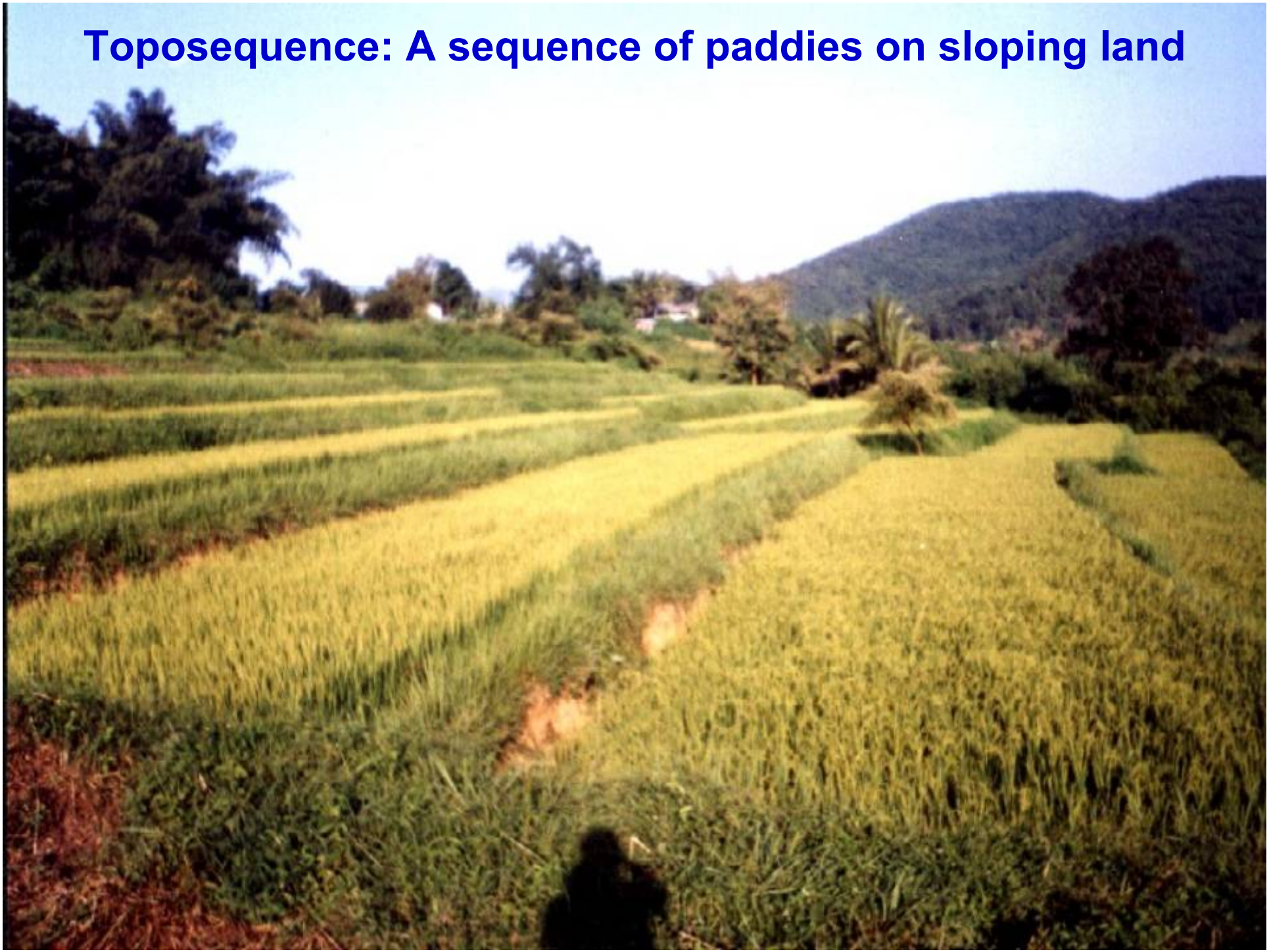
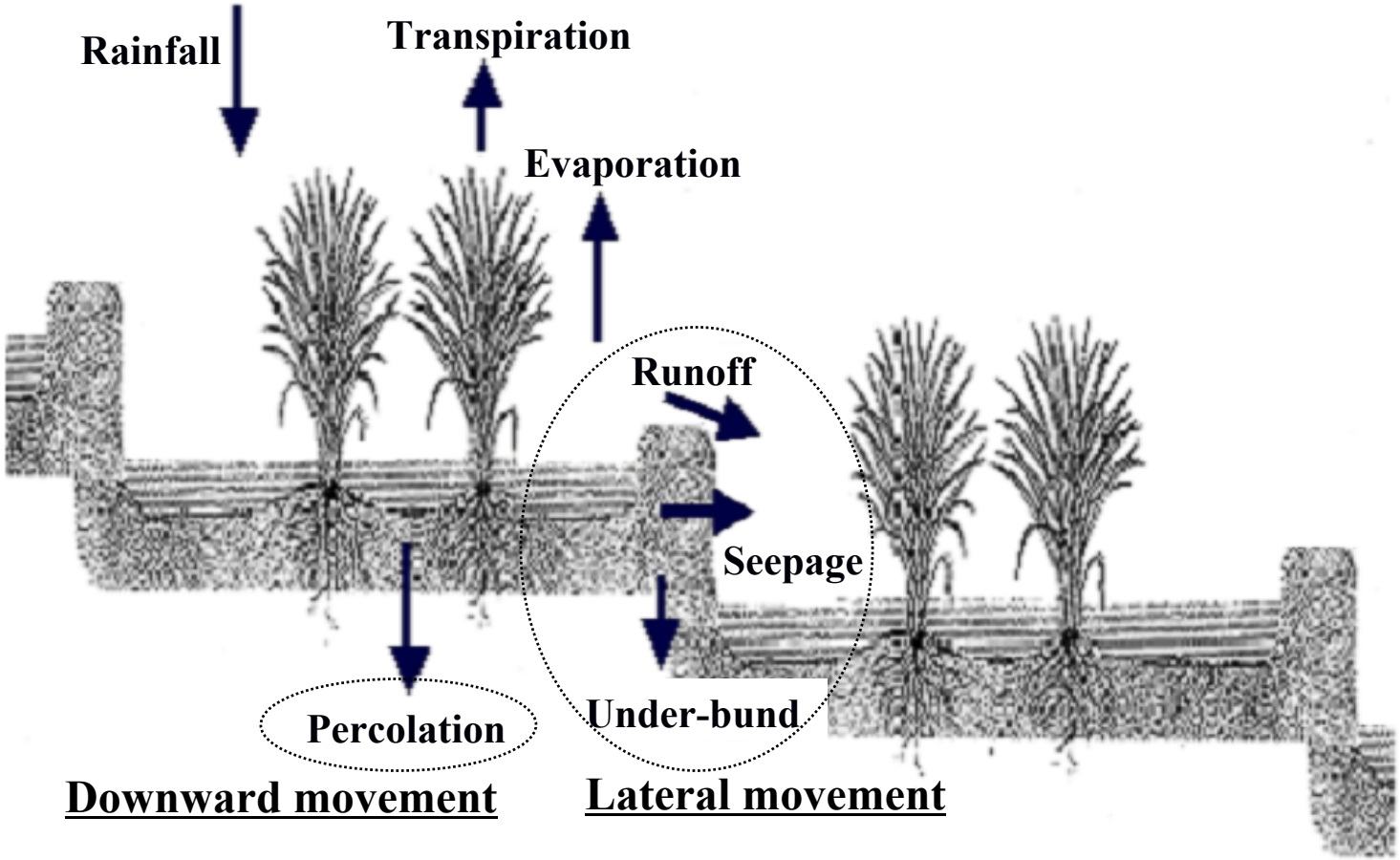


Paddy water balance



The water balance equation

$$\Delta S = R - ET - D - L$$

where

ΔS : change in water depth above the hardpan

- measured using a perforated PVC tube

R: rainfall

- measured at experimental sites or weather stations
- no other water input to the system, except supplementary irrigation

ET: evapotranspiration

- estimated with an energy balance-based ET model ***using data provided by the Meteorological Department***

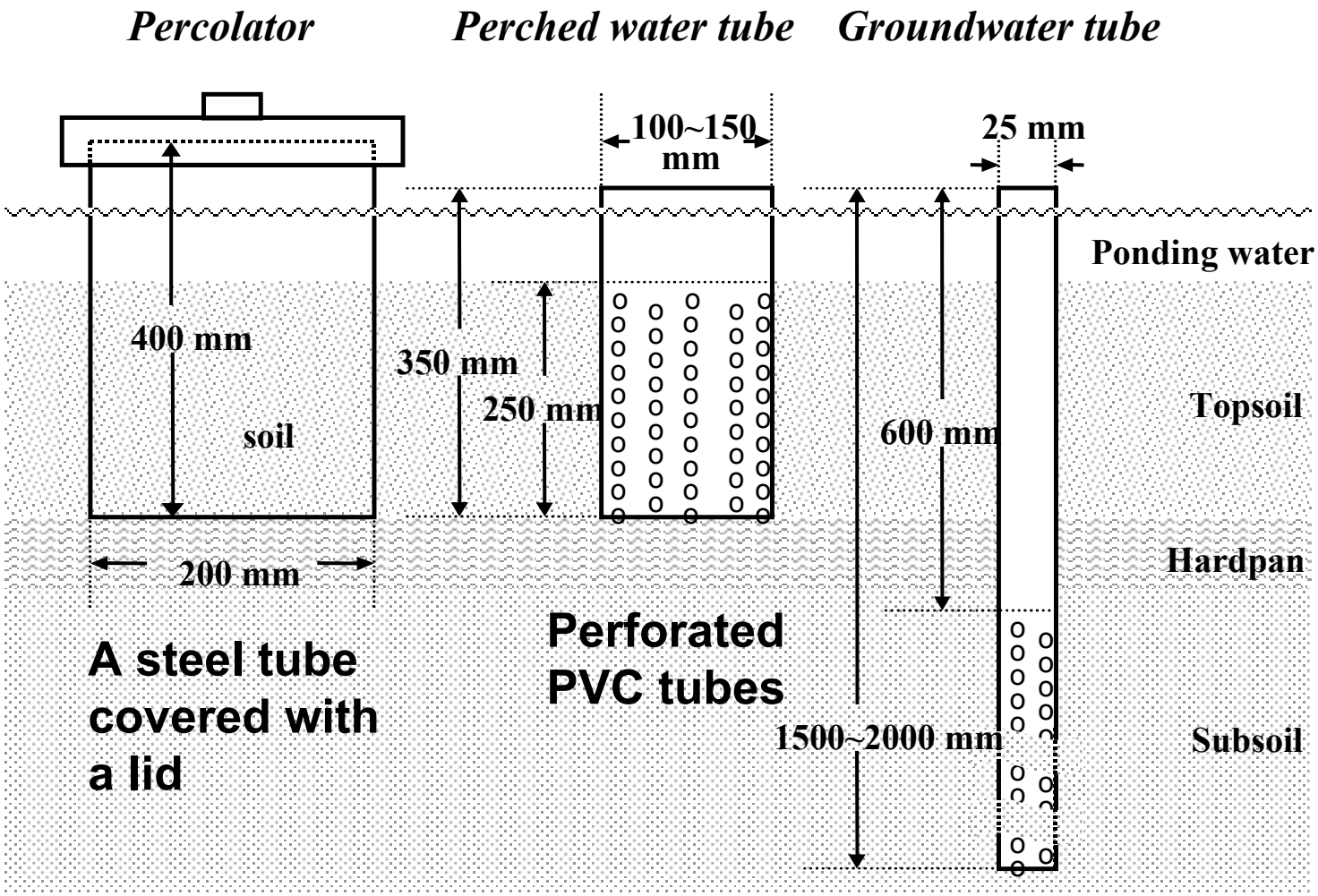
D: downward water flow (deep percolation loss)

- determined using a steel tube with a lid

L: Net lateral water flow (seepage, run-on/runoff, under-bund percolation)

- estimated by difference

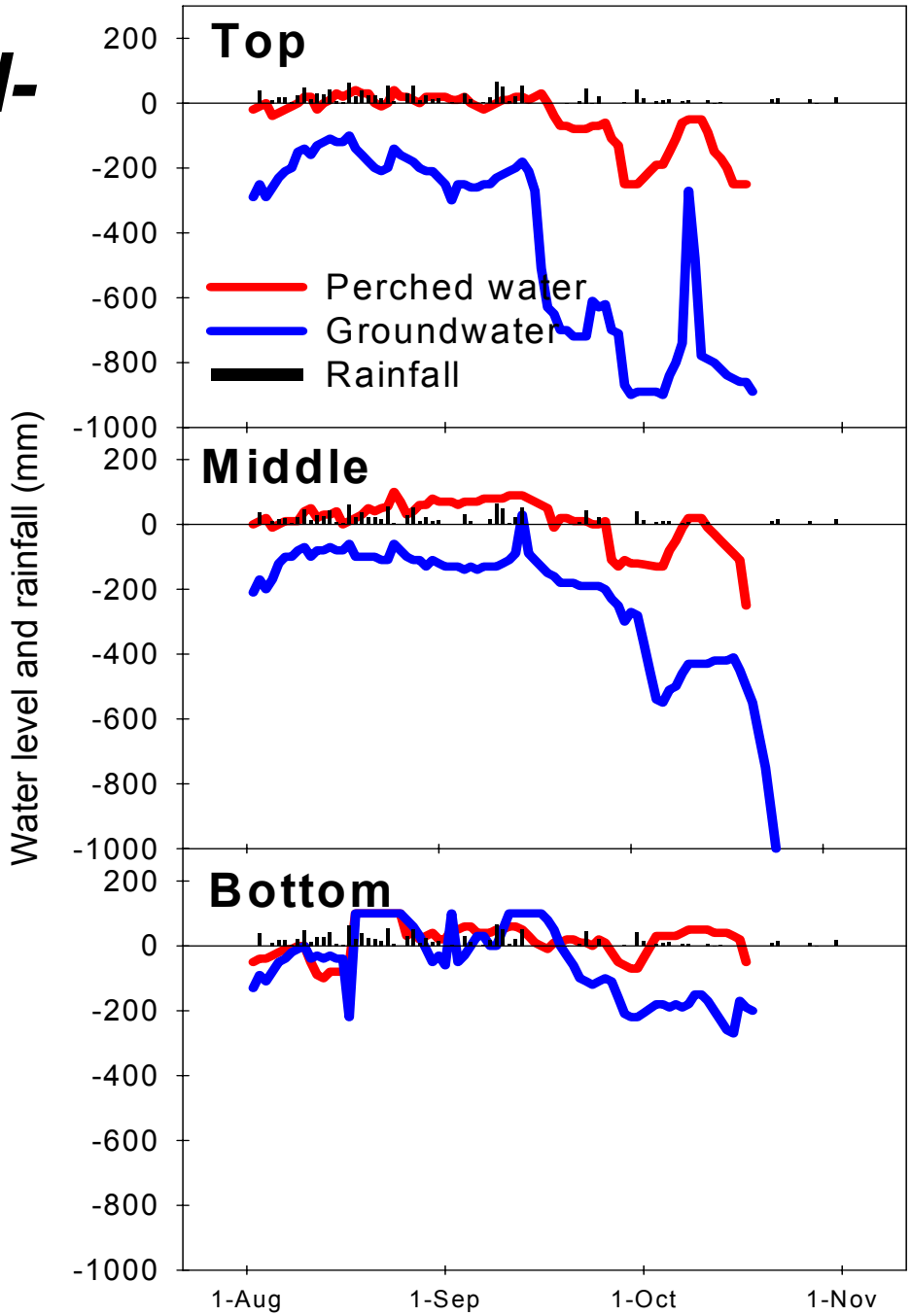
Water measurements




Groundwater tube
Percolator
Perched water tube

Perched- and ground-water table/head

- Examples of seasonal changes in the water levels at different toposequence positions in Pakse, Laos in the 2001 wet season
- Large variation in water levels across toposequence positions.
- Disappearance of standing water from the field is earlier in higher toposequence.



Percolation loss along the toposequence

- Percolation rate (mm per day) at top, middle and bottom toposequence positions in Southern Laos

- The higher position in the toposequence, the greater percolation loss.
  - ✓ Perhaps related to low clay content

Downward water flow (mm/day)

Location	Season	Top	Middle	Bottom
Pakse	2001	5.2	5.4	5.0
Phonthong	2000	4.9	4.1	4.4
Phonthong	2001	5.2	4.5	4.6
Songkhon	2002	5.8	4.6	4.1

Water budget in paddy fields (1)

Seasonal water budget (transplanting–maturity, mm)

Location	Season	R	ET	D+L				
				Top	Mid	Bot	Mean	CV%
Pakse	2000	1288	508	994	994	1058	1015	4
	2001	1212	547	883	928	874	895	3
Phonthong	2000	1078	491	686	630	595	637	7
	2001	1662	585	1222	1204	1236	1221	1
Khanthabouly	2001	949	557	617	571	603	597	4
Nakoun	2001	1073	555	677	672	670	673	1
Songkhon	2002	879	501	578	663	713	651	10

R = rainfall, ET = evapotranspiration, D+L = downward & lateral water loss

- ET = 35 to 59 % of rainfall
- D+L = 59 to 79 % of rainfall

Water budget in paddy fields (2)

Water budget (mm) at Pakse in 2001

	R	ET	D+L				
			Top	Mid	Bot	Mean	CV %
Early season	503	137	411	344	280	378	13
Seasonal	1212	547	883	928	874	895	3
Grain yield (t/ha)			3.4	3.9	1.6*		

R = rainfall, ET = evapotranspiration, D+L = downward & lateral water loss
Early season: the period of 4 weeks after transplanting
Seasonal: the period from transplanting to maturity
* Low yield due to flood

Mean grain yield (t/ha)at Phonethong (2000-2002)

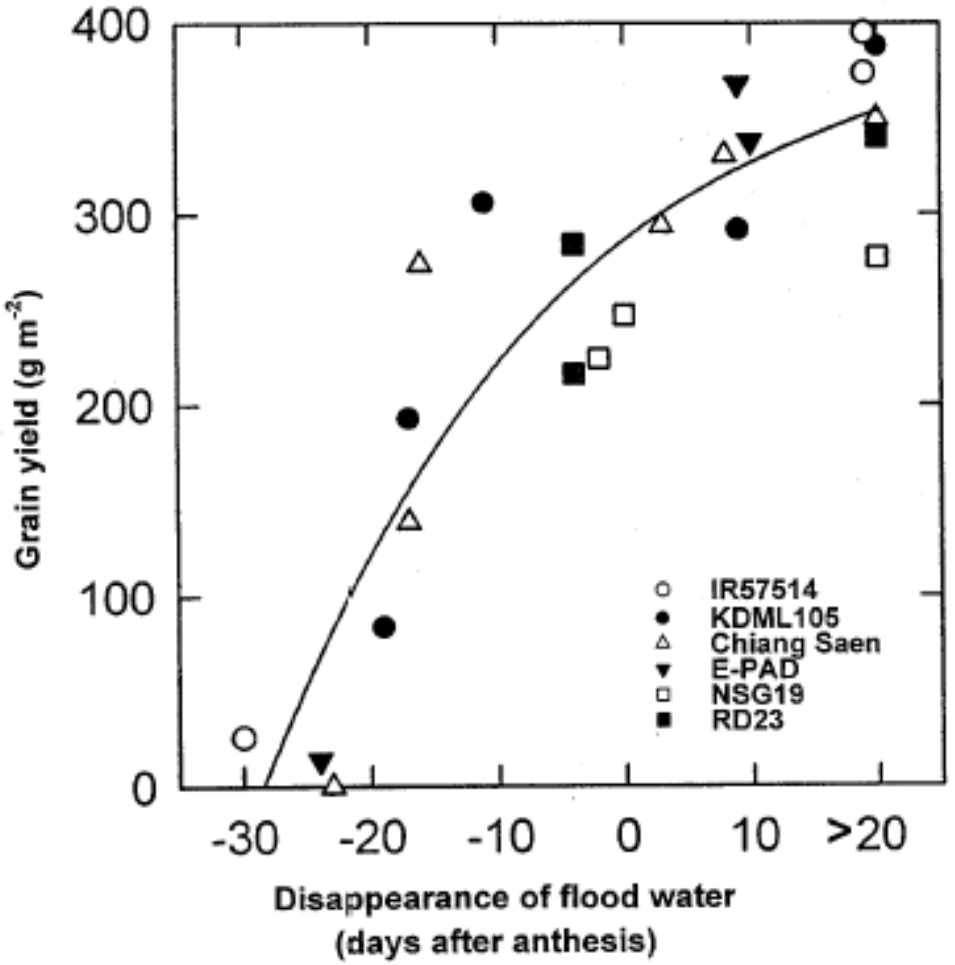
Top	Mid	Bot
1.9	2.4	2.3

- The downward plus lateral water loss (D+L) is small at the lower position in early season.
- Earlier disappearance of standing water from the field was associated with larger water loss by downward and lateral movement in early season.

Grain yield and water disappearance

- Northeast Thailand
  - Chum Phae
  - Khon Kaen
  - Phimai
  - Tha Phra
- 1992 and 1993 wet seasons

- Grain yield is associated with timing of the disappearance of standing water relative to flowering.
- The earlier the water disappearance, the lower the yield.



Jearakongman et al. (1995)

Data availability for Laos

- Daily rainfall data ***via the Meteorology Department***
  - 32 meteorological stations
  - 48 hydrological stations
- Daily/weekly data on surface water level at selected rice paddies
  - There provinces (Vientiane, Savannakhet , Champassak)
  - 1997 to 2005 wet seasons
- Daily/weekly data on water balance components at three different toposequence positions
  - Two provinces (Savannakhet , Champassak)
  - 2000 to 2002 wet seasons

Summary

- The higher the toposequence position, the earlier the standing water disappearance due to greater water loss by downward and lateral movement. This resulted in the difference in rice productivity.

- Data provided by the Meteorology Department enabled us to make maps and calculate evapotranspiration and hence water balance in the rice fields. This service is fully appreciated by us.