ICMGP 2024

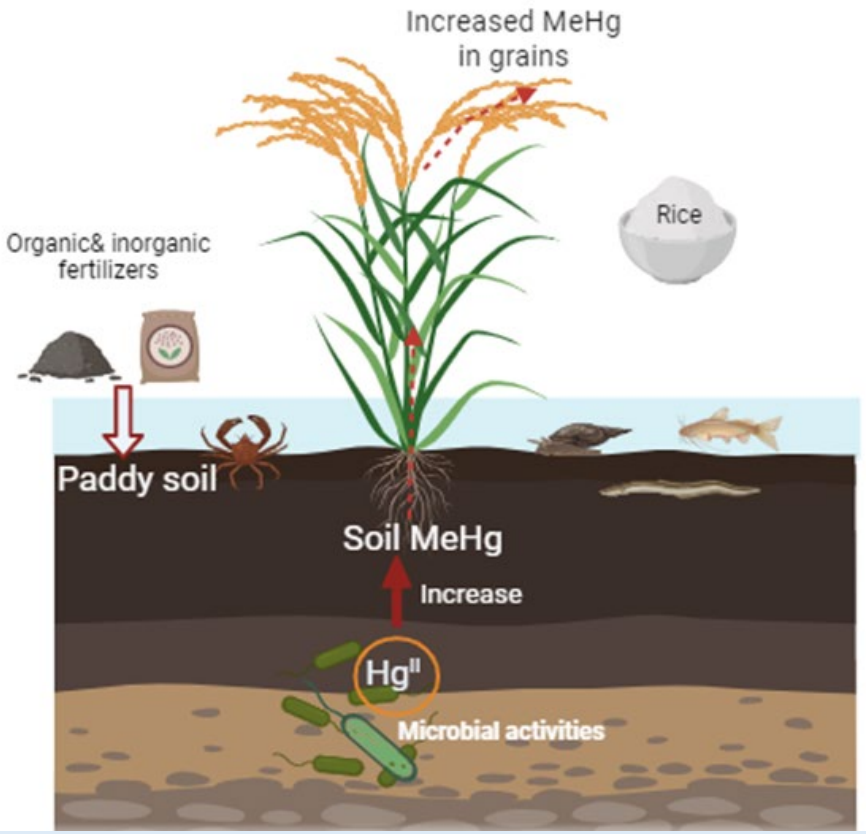
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

Mary Chuong[1]

Kongkea Phan[2], Knut Irgum[1], Ulf Skyllberg[3], Erik Björn[1]

[1]Umeå University, Sweden
[2]International University, Cambodia
[3]Swedish University of Agricultural Sciences, Umeå, Sweden

Research Topic: Occurrence and controlling factors of methylmercury in noncontaminated rice paddy soil



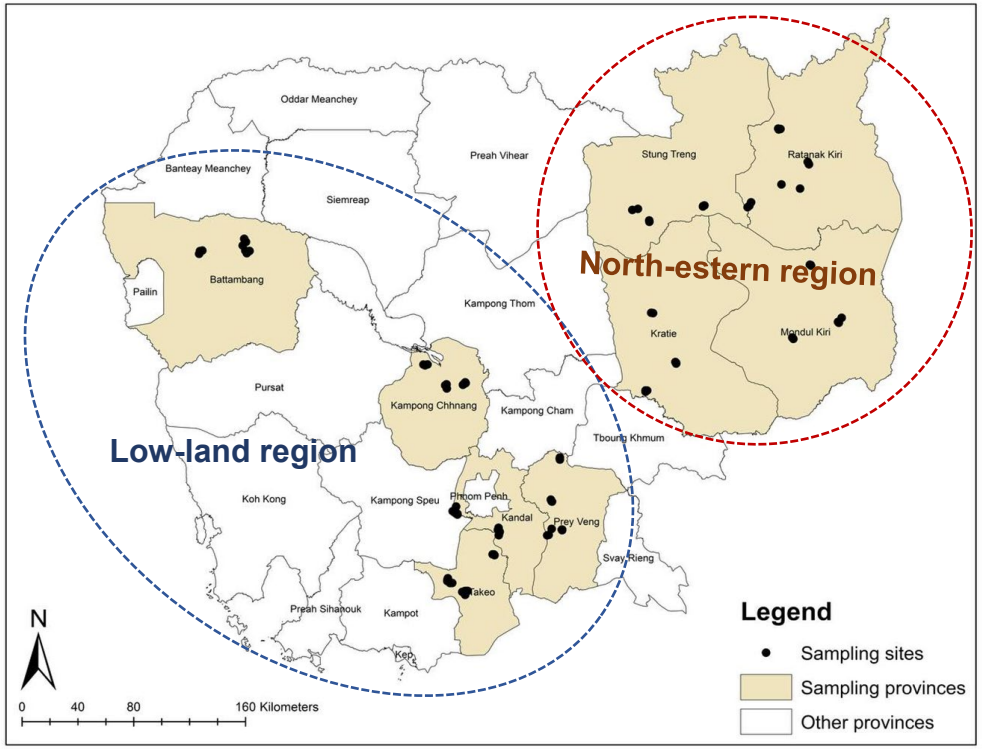
- ❑About 520.4 million metric tons of rice was consumed globally in 2022/2023.
- ❑Paddy soil was known as a hot spot for MeHg production.
- ❑MeHg could bioaccumulate to rice grain.
- ❑MeHg formation in rice paddy soil were greatly studied in China with little focus in other countries.
- ❑MeHg formation in non-contaminated rice paddy soil is generally understudied.
- ❑Major knowledge gaps exist regarding occurrence and cycling of Hg and MeHg in Cambodia.

❖Study Objectives:

- Determine the concentration levels of Hg and MeHg in non contaminated soil in different regions and soil types in Cambodia.
- Identify the driving factors controlling MeHg level in the soil.

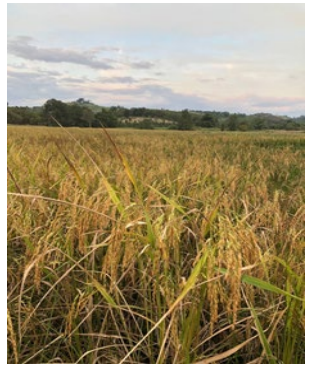
Sampling design

Sampling sites in Cambodia



Low-land region (wet season)

North-estern region (wet season)



Low-land region (dry season)

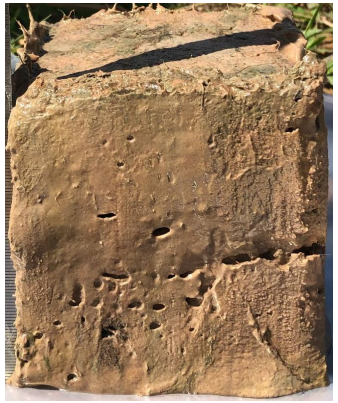
Soil profile and collected samples

❖**The selection of sampling location was based on:**

- Soil type availabilities
- Rice production area
- Hg contamination histories

Sample collection and soil type selection

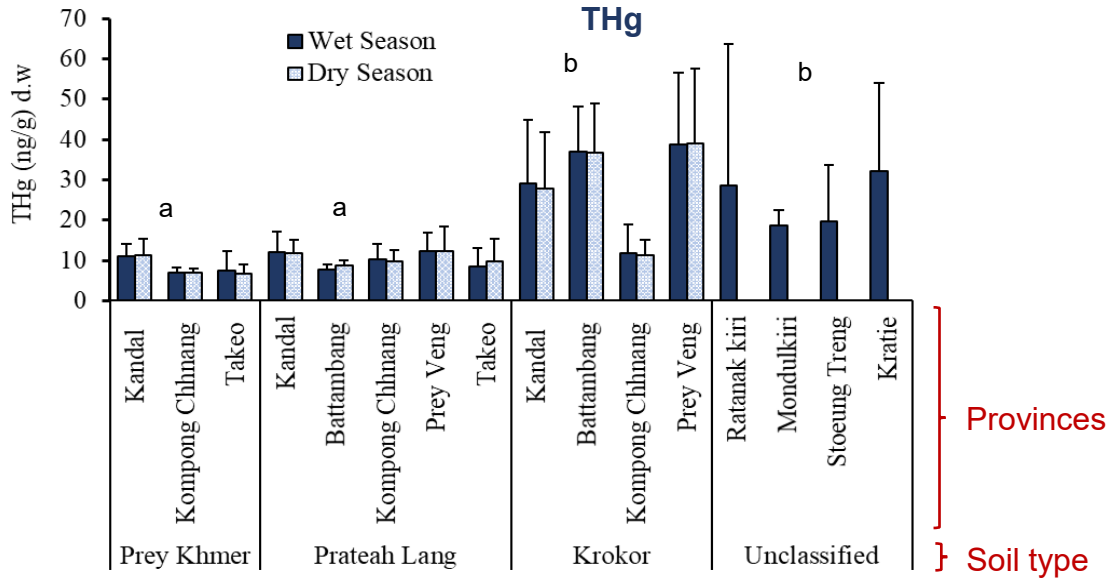
Characteristics	Soil types			
	Prey Khmer	**Prateah Lang**	**Krokor**	**Unclassified**
Region	Low land	Low land	Low land	North-east
Topsoil texture	Sandy	Sandy	Clay	Clay
Subsoil texture	Sandy	Loamy or Clay	Sandy	Sandy/clay
Color	Light brown to light grey	Pale Brown/ pinkish tinge	Gray/brown	
Rice growing coverage (%)	10-12	25-30	15	

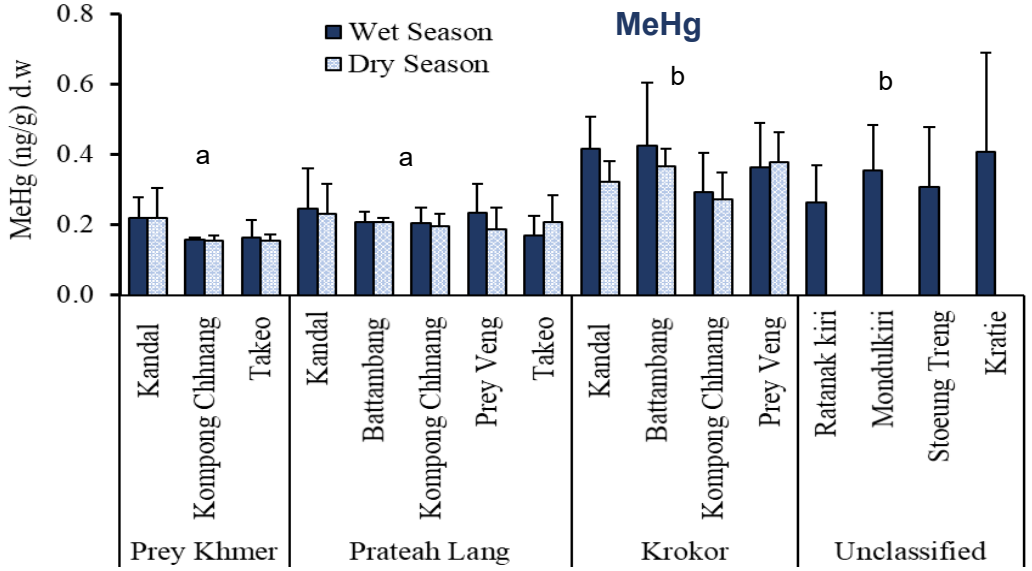



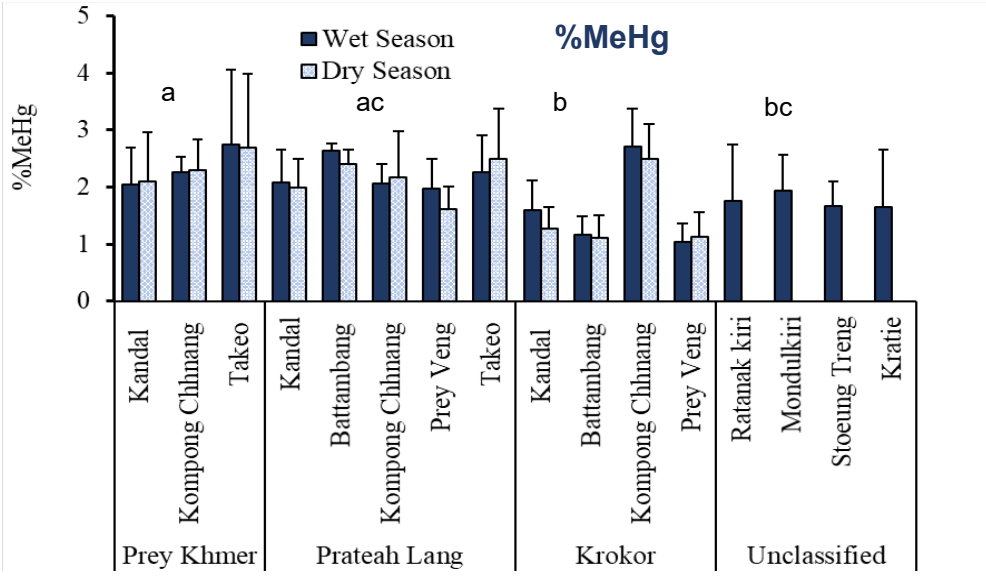
- Total number of collected samples from both samplings: 164 top soil samples, 101 paddy water samples
- Soil preservation methods: Freezing and freeze-drying
- Soil sample preparation: Grinding and milling

Concentration of THg and MeHg, % MeHg

Soil N=164	THg (ng/g)	MeHg (ng/g)	%MeHg (MeHg/THg)	Dry mass (%)
Min	2.5	0.13	0.36	13
Max	110	1.0	5.1	43
Average	18	0.30	1.9	25







- Geographical is less important than soil texture.
- Soil type had impact on THg and MeHg amount while seasonal changes had no impact.

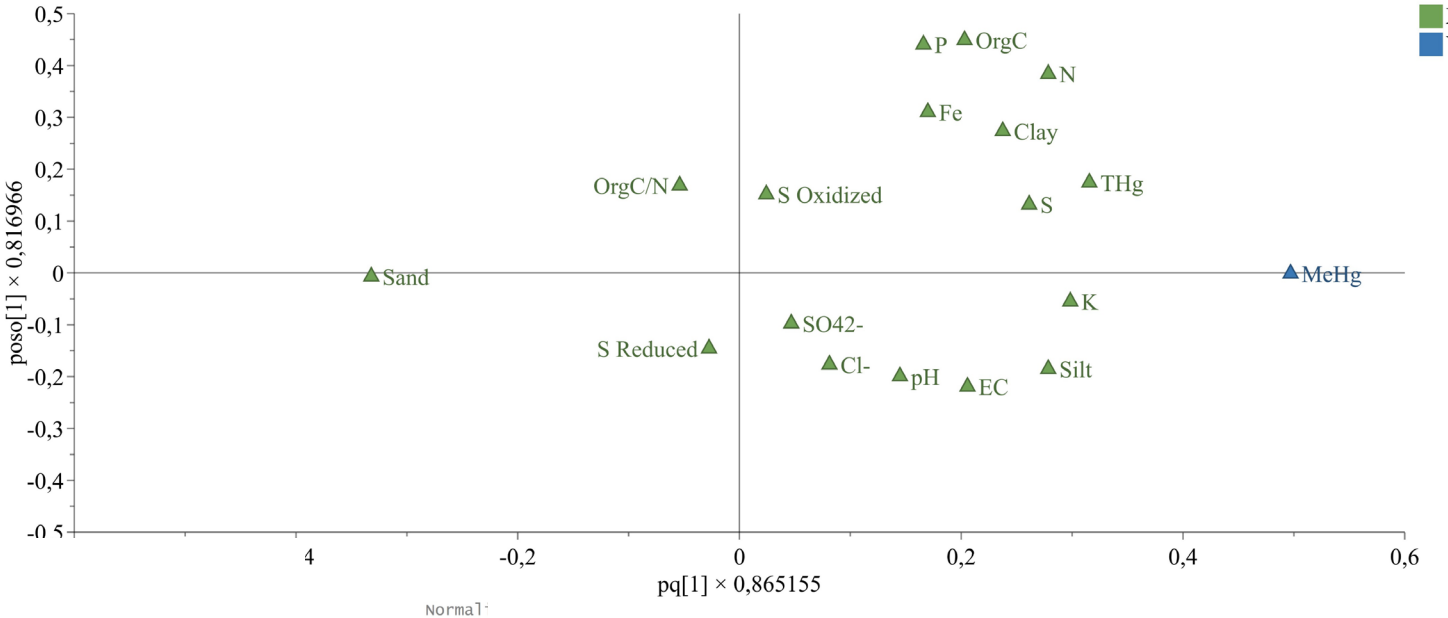
Controlling factor of MeHg amount in the soil

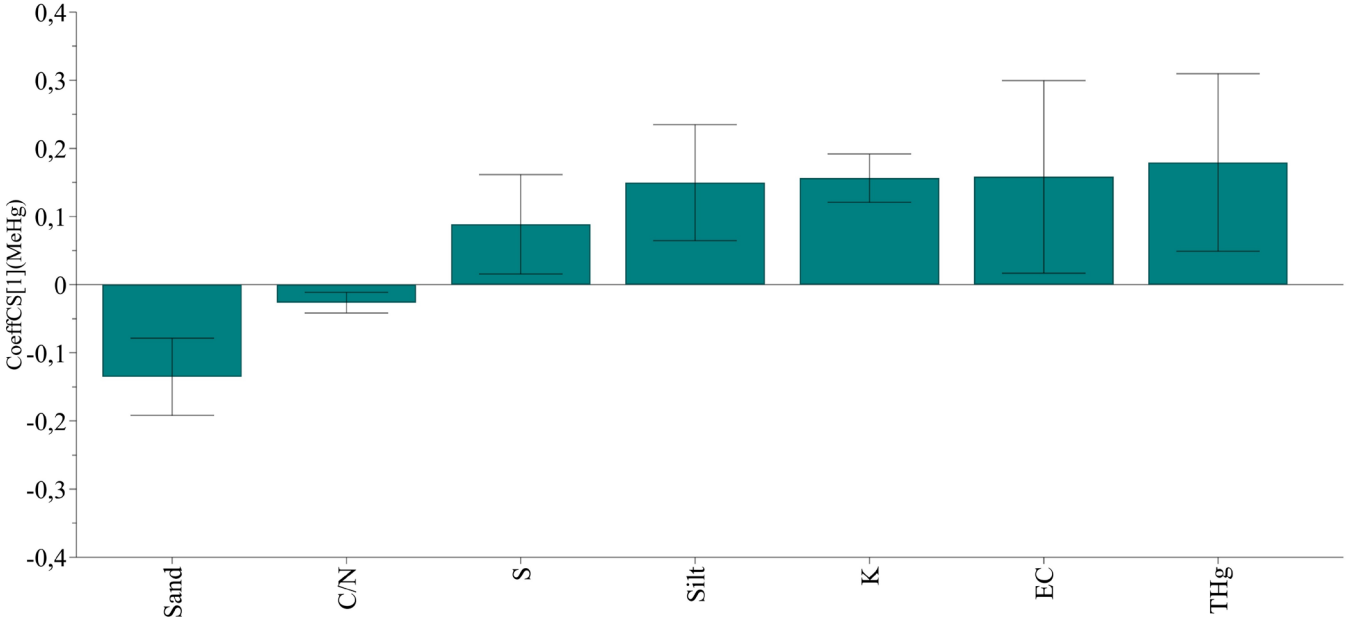
❖**Orthogonal Projection to Laten Structure (OPLS)**

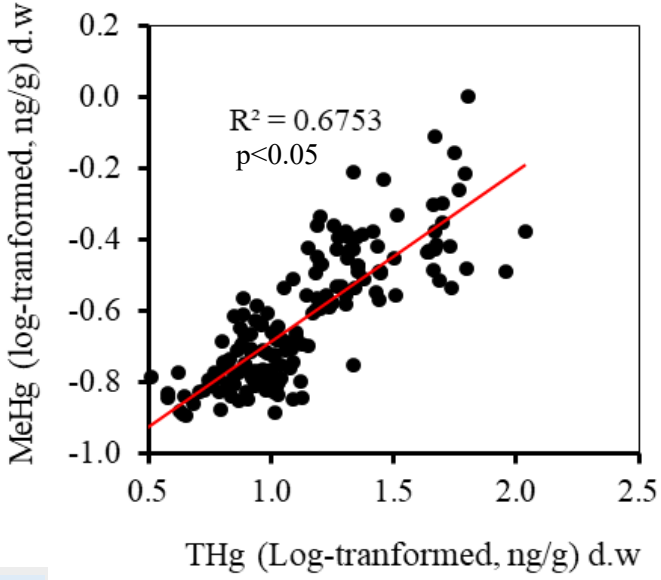
parameters:

- Soil texture: Clay, silt, sand
- Soil geochemistry: OrgC, S, Fe, THg,

  S Reduced, S Oxidized
- Soil nutrient: N, P, K, C/N
- Paddy overlying water: SO_4^{2-} , Cl^- , pH, EC





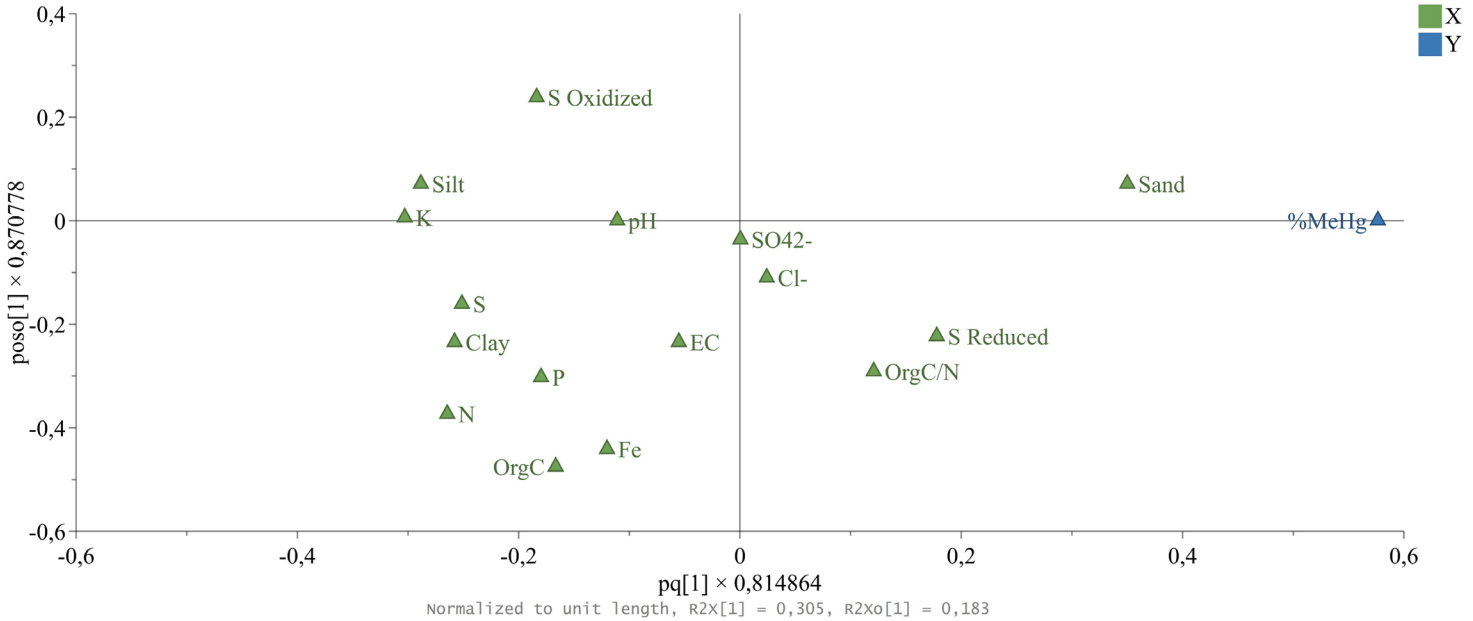


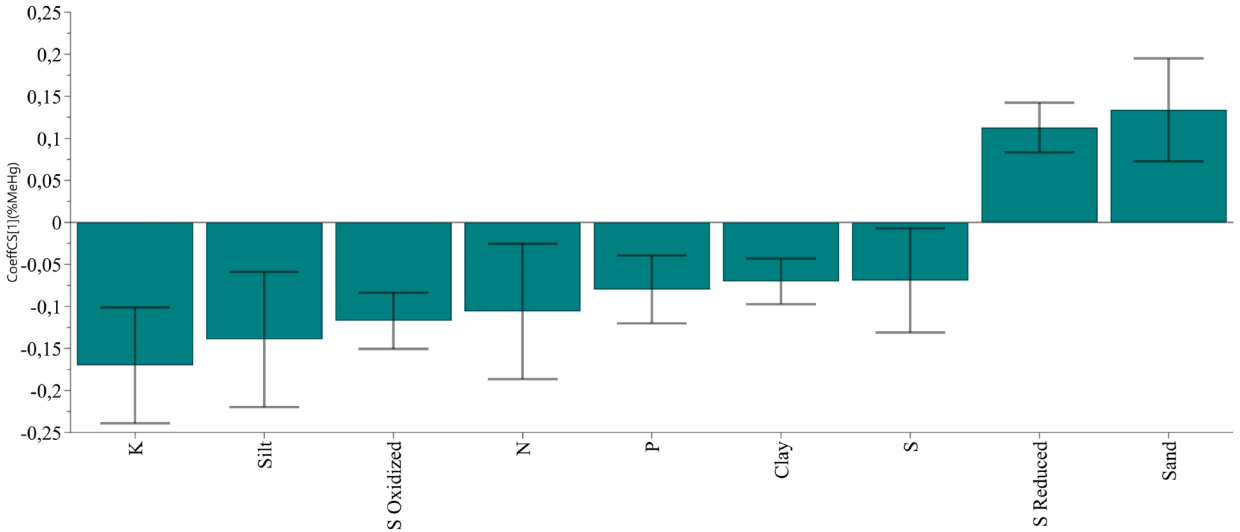
- **THg is a key factor controlling MeHg amount in selected soil.**

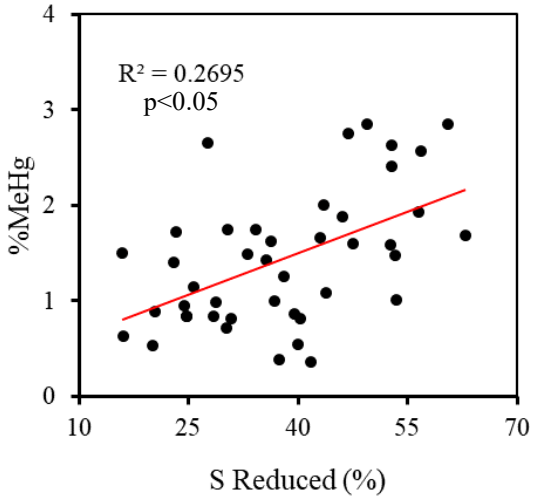
Controlling factors of %MeHg in the soil

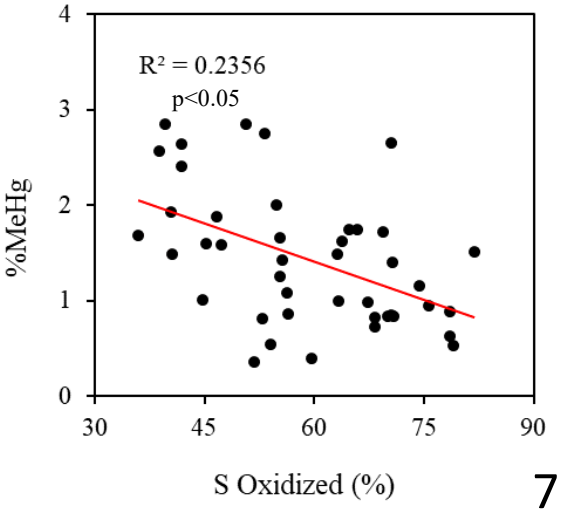
❖OPLS parameters:

- Soil texture: Clay, silt, sand
- Soil geochemistry: OrgC, S, Fe, S Reduced, S Oxidized
- Soil nutrient: N, P, K, C/N
- Paddy overlying water: SO_4^{2-} , Cl^- , pH, EC



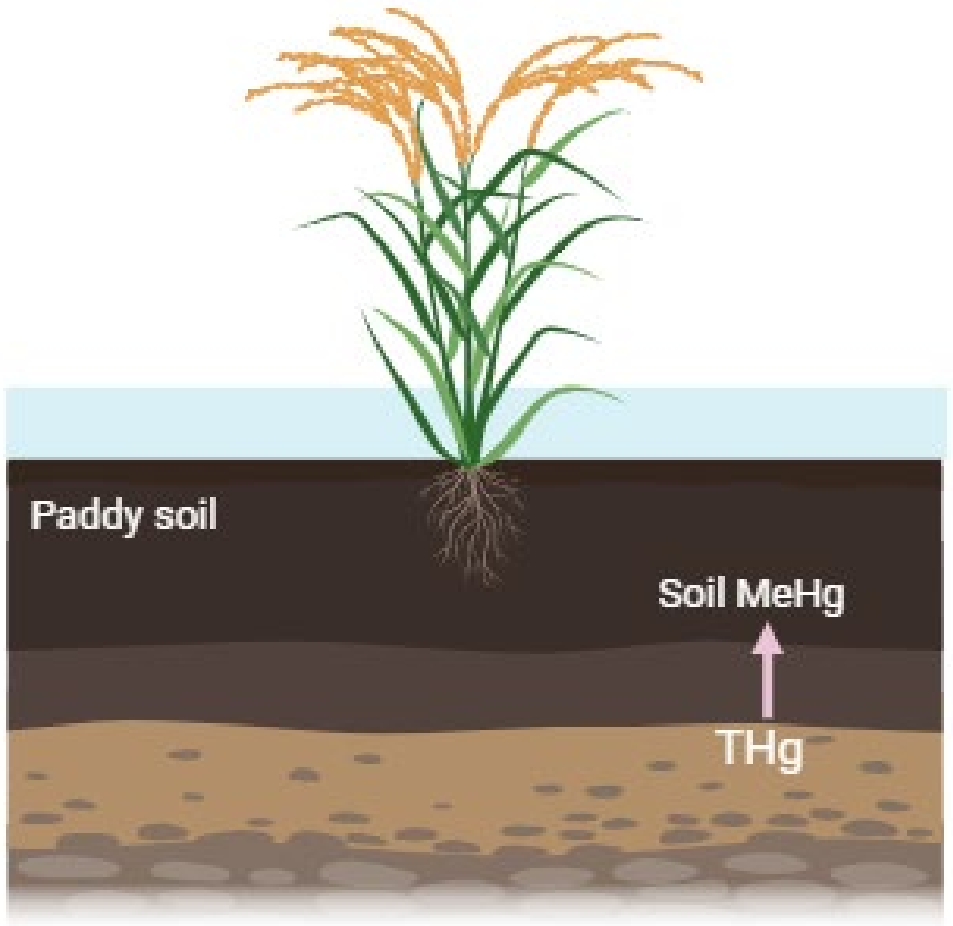






- **S Reduced** = RSH+RSR+RSSR, **S Oxidized** = Sulfate + Sulfonate

Conclusion



- **First study** reporting Hg and MeHg amount and its controlling factors in rice paddy soil in Cambodia.
- Hg and MeHg level in the selected soil were below the permissible level set by Chinese and Korean environmental ministry.
- Soil with smaller particles had higher Hg and MeHg amounts.
- **THg is a key driving factor controlling MeHg level in selected non contaminated soil.**
- Sulfur chemical speciation was statistically correlated with %MeHg.

Acknowledgement

Main supervisor:

Erik Björn

Co supervisor:

Ulf Skyllberg

Sida

SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

Royal University of Phnom Penh

- Knut Irgum
- Kongkea Phan
- Sofi Jansson
- Hg-Umeå team

Thank you all for joining me today!

Contact: mary.chuong@umu.se