The post-monsoon rainfall in the western Cambodia – its mechanism and occurrence factors

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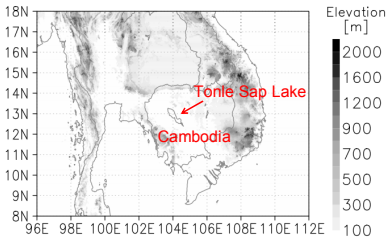


Abstract:

From the analysis of the data of an Automatic Weather Station at the southwest lakeshore and 30 raingauges all around the lake, the authors found that about 30~40% of the post-monsoon rainfalls in the western Cambodia happened even with no water vapor convergence at the scale of the Indochina Peninsula, especially from midnight to early-morning. From numerical simulations, it was suggested that the land-lake-atmosphere interaction caused by Tonle Sap Lake contributed to bringing these rainfalls. It was shown that nocturnal land-breeze circulation generated a weak lined-up convective system along the southwest lakeshore and it developed into a deeper convective system which accompanied rainfall when the large-scale northeasterly blew strongly in a moderate level.

Based on the understanding of the mechanism of the the post-monsoon rainfalls in the western Cambodia, the authors found out the three requisite conditions for these events: Firstly, abundance of precipitable water (>≈40mm) is required. Decrease of precipitable water in China at late November reduces water vapor over Cambodia, resulting in the disappearance of the locally-produced rainfall after this period. Secondly, development of the land-breeze from the southwest of the lake is required. It should be stronger than about 0.15m/s. This land-breeze generates a weak lined-up convective system along the southwest lakeshore. Although it never brings precipitation by itself, it develops into a larger convective system with rainfall when it meets moderately strong northeasterly. This northeasterly is the third requirement. However, if it is too strong, it suppresses the land-breeze from the southwest lakeshore. The moderate strength of the northeasterly wind, around 0.6~4.0m/s, is required.

1. Background

① Rainfall Prediction in Cambodia

- available hydro-meteorological data → very limited (from interviews)
  - → people can get only small amount of information
- rain-fed agriculture → water resources management is difficult
  - → Decision making of farmers for planting is based on
    (i) information from government, (ii) farmers' experiment, (iii) traditional prediction (from numerical simulation)
- Tonle Sap Lake → local atmospheric water circulation → rainfall
  - → Rainfall area = granary of Cambodia

There is no radio sonde data

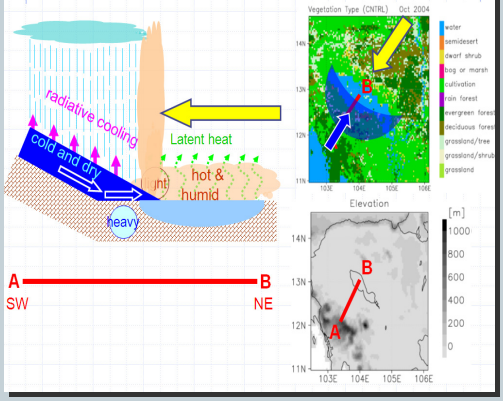
→ GCM reanalysis data would have large errors to be used as an initial condition of RCM

→ simulation for averaged condition: OK.

→ simulation for individual case study: difficult.

→ +information from in-situ observation data

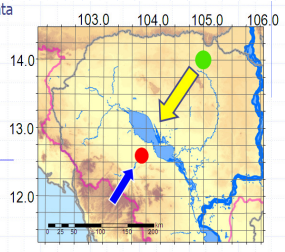
② Mechanism of rainfall from numerical simulation



2. Data

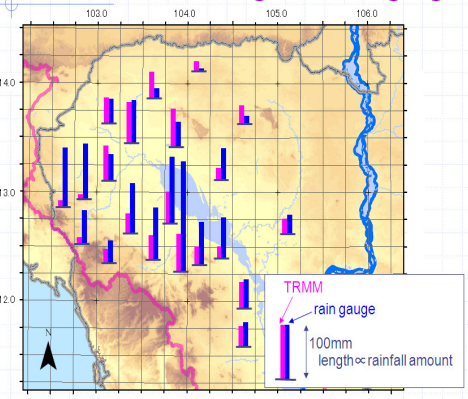
③

- Automatic Weather Station data
  - <obserge land-breeze from southwest>
  - take samples: every 1sec.
  - take record:every 10min.
  - wind data: 10m from surface
- large-scale atmosphere: by NCEP-FNL reanalysis data
  - <wind ward side of the nocturnal northeasterly>
  - spatial resolution: 6hourly
  - temporal resolution: 1.0degree



✓ What is the preferable conditions for the post-monsoon rainfall ?

④ rainfall (TRMM VS ground raingauge)

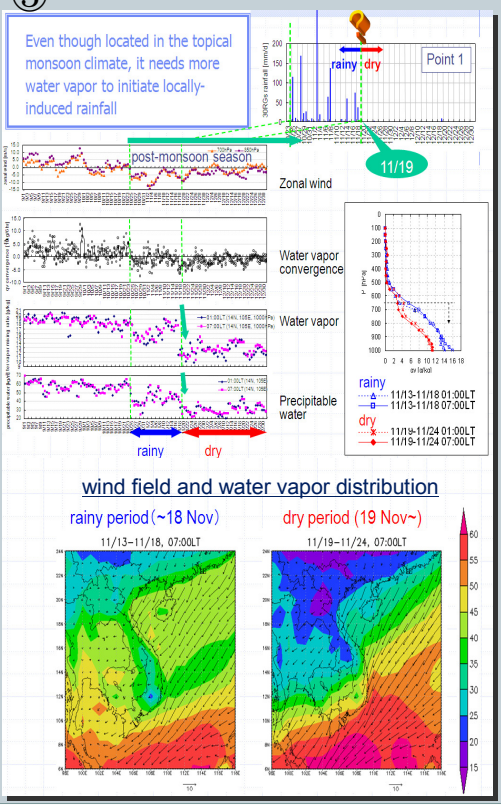


Since the accuracy of the TRMM/3B42 product in this region was not good, we newly established the ground-based rain-gauge network and trained the local staffs to maintain the instruments.
Here we used this data for the analysis.

3. Results

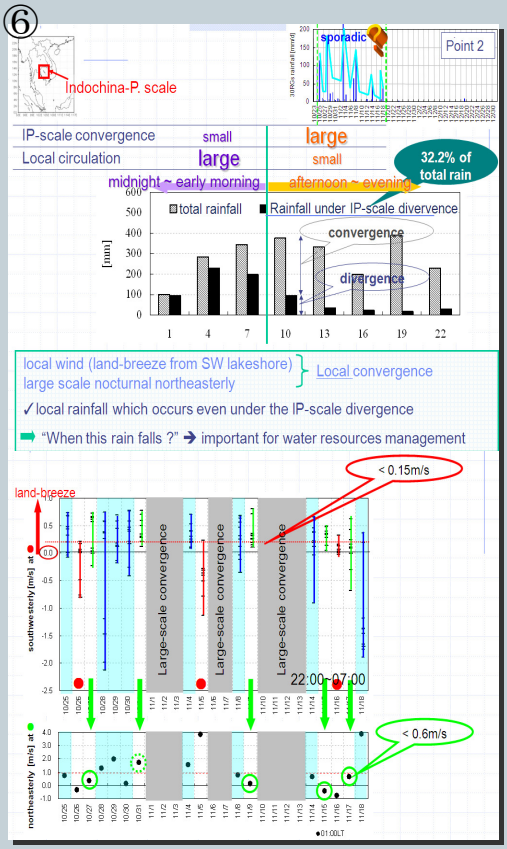
⑤

Even though located in the topical monsoon climate, it needs more water vapor to initiate locally-induced rainfall



wind field and water vapor distribution

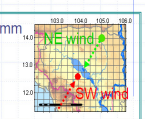
⑥



4. Conclusions

⑦ Requisite conditions for the post-monsoon rainfall

① Existence of precipitable water more than about 40mm
- ✓if atmosphere converges in IP-scale,
- → Daytime rainfall. 60~90mm in the western Cambodia



② Formation of local convergence by SW wind and NE wind

local circulation
weak convection over the lake
>0.15m/s

Large-scale pressure pattern
forced convection with disturbances
→ collect water vapor to the convergence zone
>0.6m/s

→ Nighttime rainfall. 30~40mm in the western Cambodia

✓Cambodia: initial condition of atmosphere is unknown

✓Tonle Sap Lake: controlling factor for the local cirlulation

→ Possibility for the locally-induced rainfall prediction

<reference>
Tsujimoto K. and T. Koike: Requisite conditions for post-monsoon rainfall in Cambodia by looking through 2009 rainfall data, Journal of Hydroscience & Hydraulic Engineering, accepted, 2011.