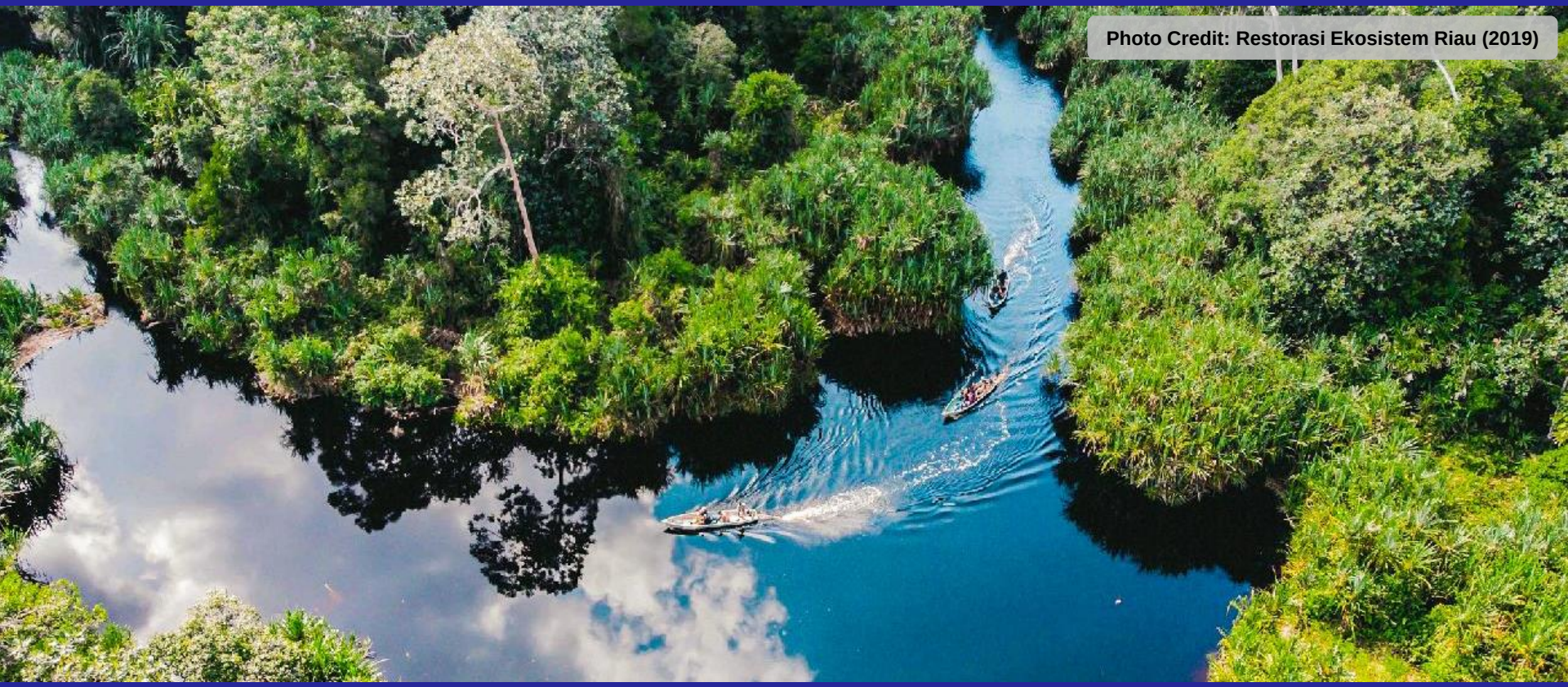


Understanding Spatial and Temporal Variability of Water Balance from Tropical Peatland Landscape

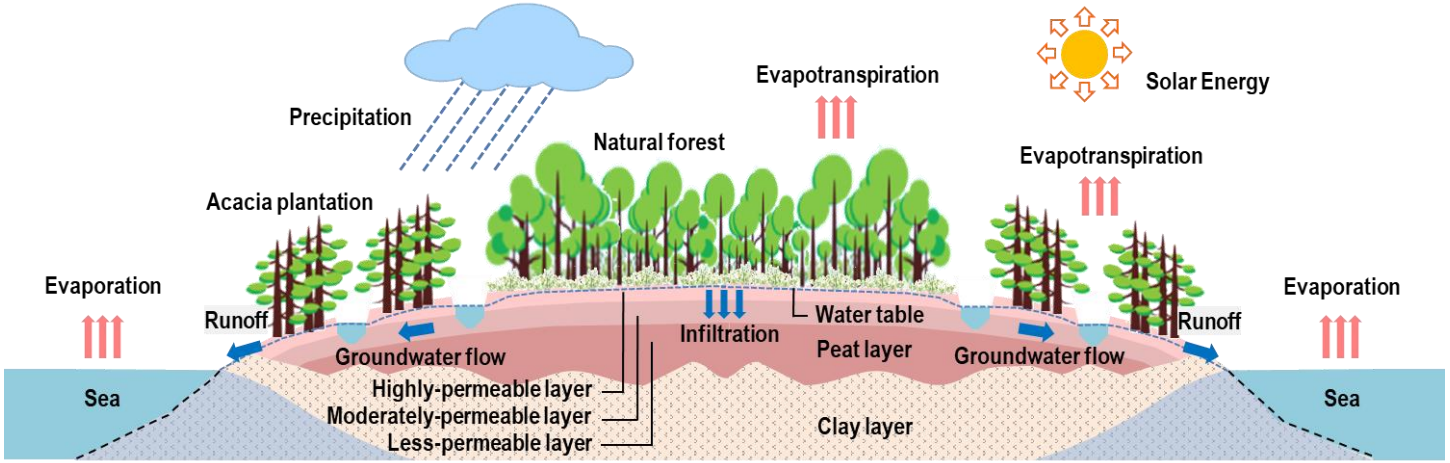
Adibtya Asyhari*, Rahila J. Tanjungsari, Yogi Suardiwerianto, M. Fikky Hidayat, Sahat M. Marpaung, M. I. Faisal Harahap, Tubagus M. Risky, and Luke J. Esprey

Asia Pacific Resources International Holdings Limited (APRIL), Indonesia

*corresponding author at adibtya_asyhari@aprilasia.com

Motivation and Objectives

Schematic Diagram of Hydrological Processes in Tropical Peatland Landscape



Motivation:

- Alteration of hydrological regime due to climate and/or land cover change may result in significant impacts to tropical peatland ecosystem *(1,2)*
- Limited comprehensive hydrological study in tropical peatlands due to its complexities related to various flow interactions and external disturbances *(3)*
- Application of a physically-based hydrological model to simulate the hydrological processes in tropical peatland landscape

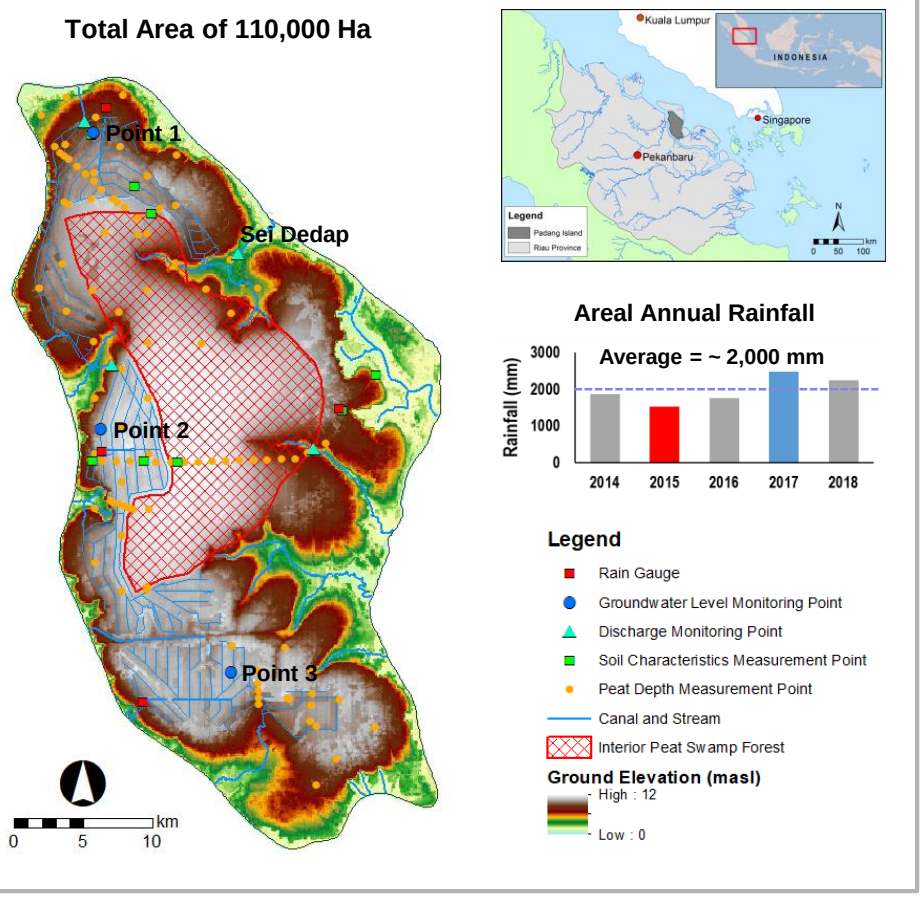
Objectives:

- Investigate the hydrological processes in tropical peatland landscape
- Evaluate the boundary impact from water management practice to the peat swamp forest
- Evaluate the long-term impact of land cover change to the water balance

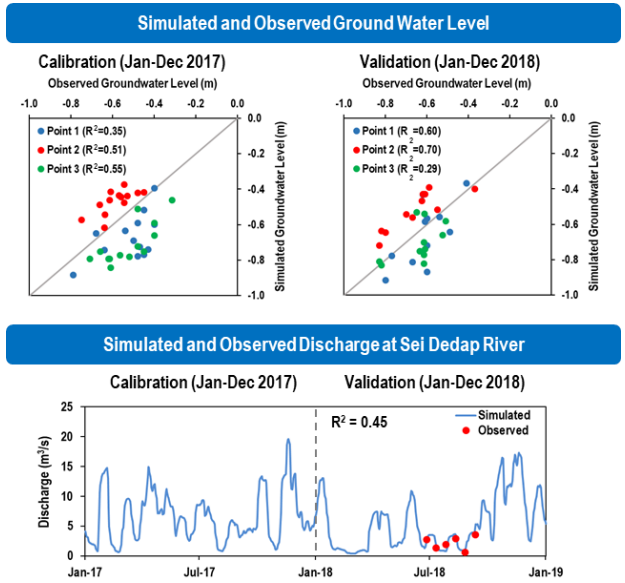
Methodology

A coupled MIKE SHE and MIKE Hydro River model was developed for Padang Island, Indonesia - a mosaic landscape of peat swamp forest, plantation forest and smallholder agriculture.

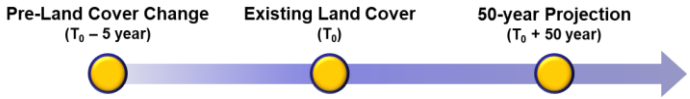
The Study Area



Calibration and Validation

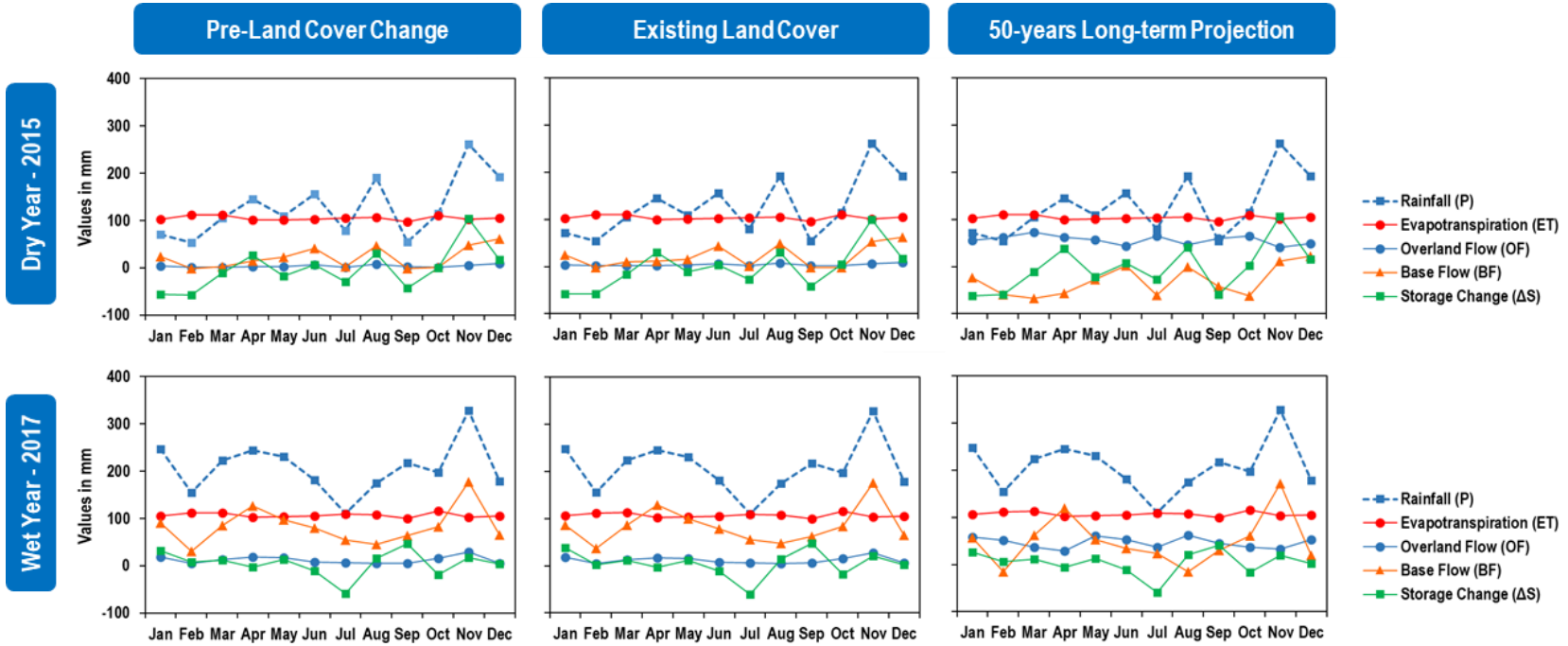


Scenario Development



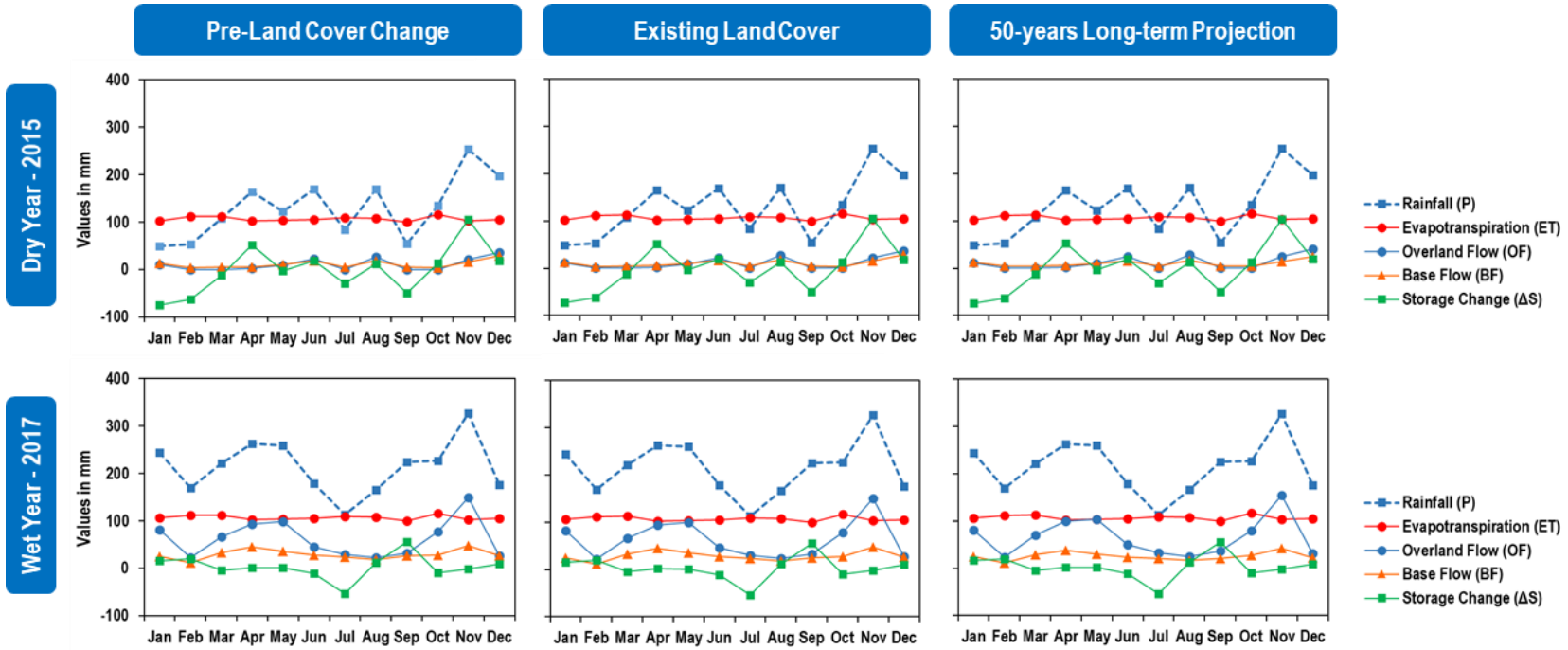
Subsidence rate of 0.034 m year^{-1} for peat swamp forest and 0.043 m year^{-1} for plantation forest *(4)*

Long-term Impacts to Water Balance (Padang Island)



- The water balance is predominantly controlled by climatic variables.
- ET remains relatively constant throughout both the dry and wet year and accounts for the main water loss (50 - 80% of total rainfall).
- In the period with rainfall deficit, ET demand depletes the surface and subsurface water storage.
- In the period with rainfall excess, the water is transformed into water storage, BF and OF.
- The existing land cover exhibits similar water balance compared to the pre-land cover change scenario. The long-term projection indicates that there is a shift in the hydrological flow path, as OF increases and BF decreases, mainly due to change in the hydraulic gradient from peat subsidence.

Long-term Impacts to Water Balance (Interior Peat Swamp Forest *)

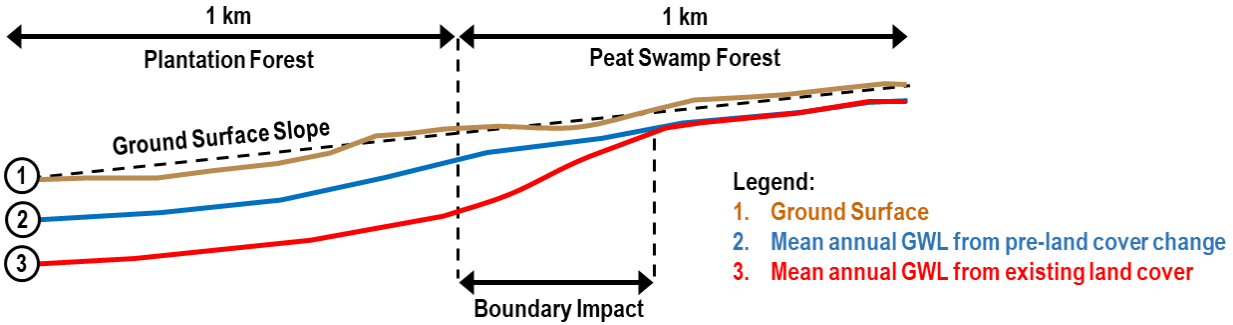


- The water balance for the interior peat swamp forest exhibits similar dynamics to those of the entire island, except for the higher OF than BF, particularly in the wet year. This is due to the natural characteristics of the peat swamp forest which is frequently inundated and has limited natural drainage system.
- The water storage fluctuates following rainfall variability and is also depleted from the ET demand even without artificial water management system.
- The water balance for the interior peat swamp forest remains relatively intact in the long-term projection with no apparent impact from peat subsidence.

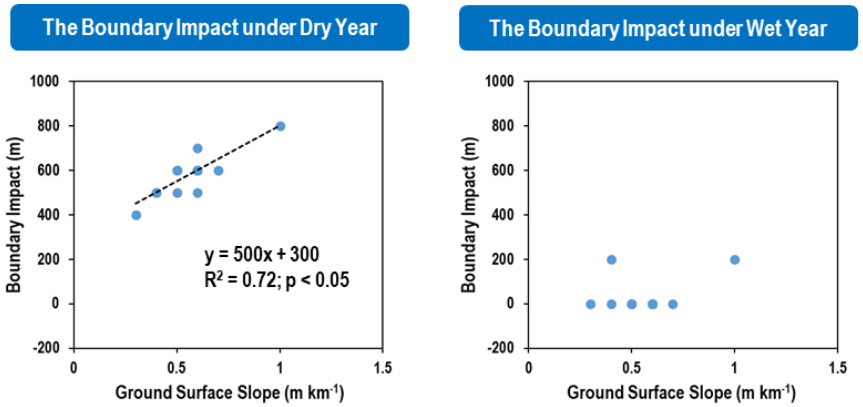
***Interior peat swamp forest in the central part of the island as delineated in the figure in Slide #3**

Boundary Impacts to Peat Swamp Forest

The boundary impact = the distance of influence from water management practice to GWL in PSF



The relationship between boundary impact and ground surface slope from twenty transects:



- The boundary impact increases with higher ground surface slope.
- The boundary impact is observed in the dry year, while it is not apparent in the wet year.

References

1. Cobb, A.R, Hoyt, A.M, Gandois, L., Eri, J., Dommain, R., Salim, K.A., Kai, F.M., Su'ut, N.S.H., Harvey, C.F. (2017). How temporal patterns in rainfall determine the geomorphology and carbon fluxes of tropical peatlands. *Proceedings of the National Academy of Sciences*, 114 (26), E5187-E5196.
2. Wijedasa, L.S., Sloan, S., Page, S., Clements, G.R., Lupascu, M., Evans, T.A. (2018). Carbon emissions from Southeast Asia peatlands will increase despite emission reduction schemes. *Global Change Biology*, 24 (10), 4598-4613.
3. House, A.R., Thompson, J.R., Sorensen, J.P.R., Roberts, C., Acreman, M.C. (2016). Modelling groundwater/surface water interaction in a managed riparian chalk valley wetland. *Hydrological Processes*, 30 (3), 447-462.
4. Evans, C.D., Williamson, J.M., Kacaribu, F., Irawan, D., Suardiwerianto, Y., Hidayat, M.F., Lauren, A., Page, S. (2019). Rates and spatial variability of peat subsidence in Acacia plantation and forest landscapes in Sumatra, Indonesia. *Geoderma*, 338, 410-421.