Modeling the Hydrology of Watersheds over Java Island, Indonesia

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Abstract. Java is one of the major islands in Indonesia – both in terms of size and population. Located near the equator where the Inter Tropical Convergence Zone (ITCZ) transits during both in its northern southern journey, this region receives heavy rainfall. Coupled with hilly terrain this leads to landslides, flooding and, with increasing socio-economic growth, stress on water resources. Thus, a detailed understanding of the island's hydrologic processes is crucial for effective water resource management and mitigation against the aforementioned natural hazards. To this end, a fully distributed hydrologic model - Variable Infiltration Capacity (VIC) model – has been implemented over the watersheds on this island. This is one of the first applications of VIC in maritime equatorial regions. The study island, consisting of numerous watersheds was divided into 40 grid cells of 0.5^o x 0.5^o spatial resolutions. The model was run with 3 soil layers at a 24 hour time step inclusive of the period 1948 to 2012, limited by the availability of calibration and validation streamflow data. Model inputs and meteorological data were initially obtained from a global data set. These were further refined by local scale data from the Indonesian Water Department. A Monte Carlo approach was used for model calibration in which a number of model parameters (six in all) were sampled from the multivariate space and the combination with the best performance was selected. The model was calibrated and validated over different time periods for each of 10 selected watershed. Preliminary results led to substantial variability in model performance across the island, with Nash-Sutcliffe Efficiency (NSE) scores for calibration and validation ranges of 0.02 – 0.72 and 0.05 – 0.53 respectively. The low NSE scores are potentially due to coarseness of model inputs that lack heterogeneity in climate and land surface, as well as data quality issues, both of which are being addressed. This modeling framework offers a flexible approach to quantifying hydrologic response including floods and can be further used to explore hydrologic sensitivities to potential land cover and climate changes.