Tier 3 estimation of methane emissions from rice fields

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The Tier 3 approach of this study

Development of a process-based model (DNDC-Rice)

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Construction of an activity database on rice cultivation in Japan

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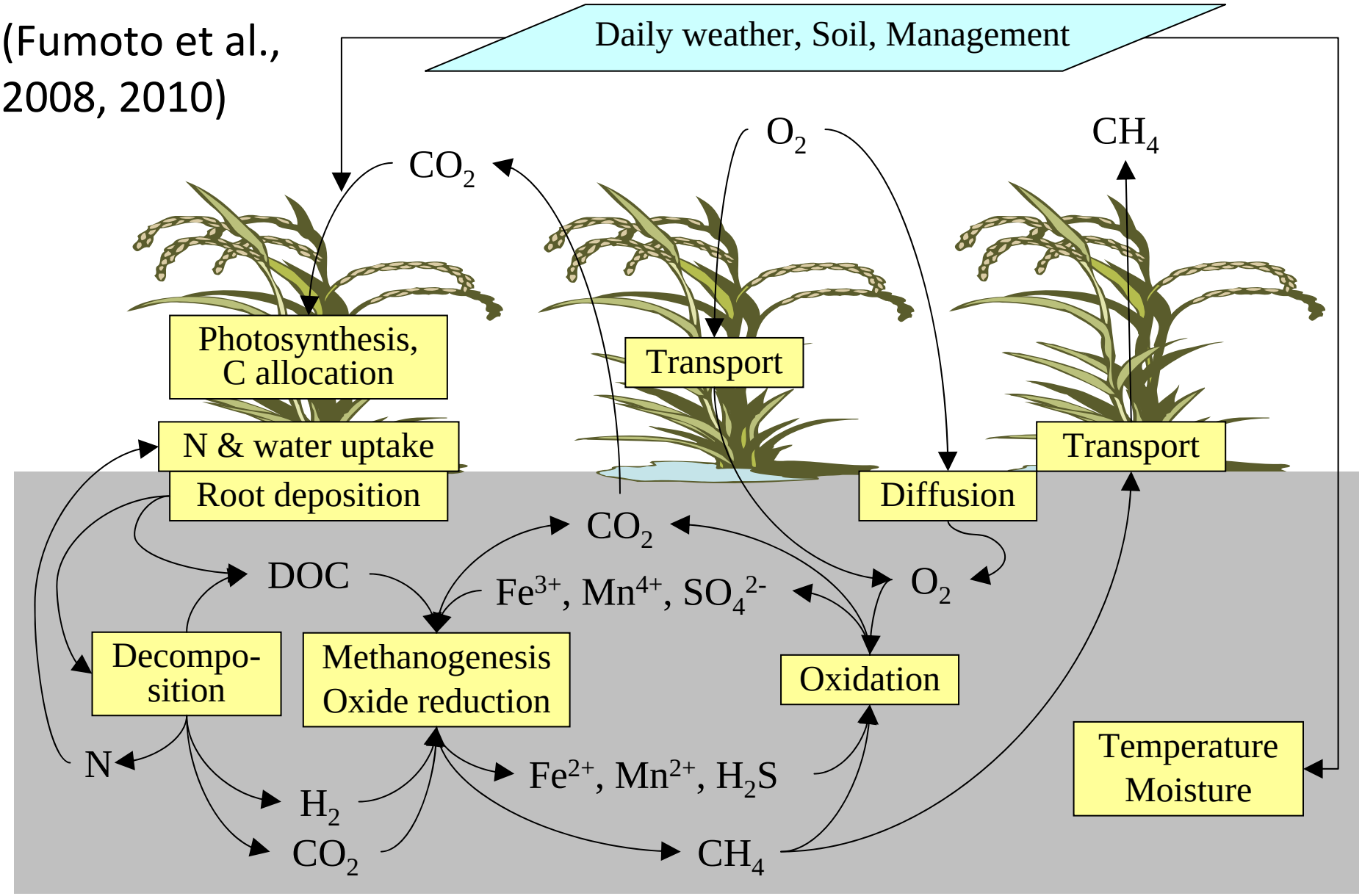
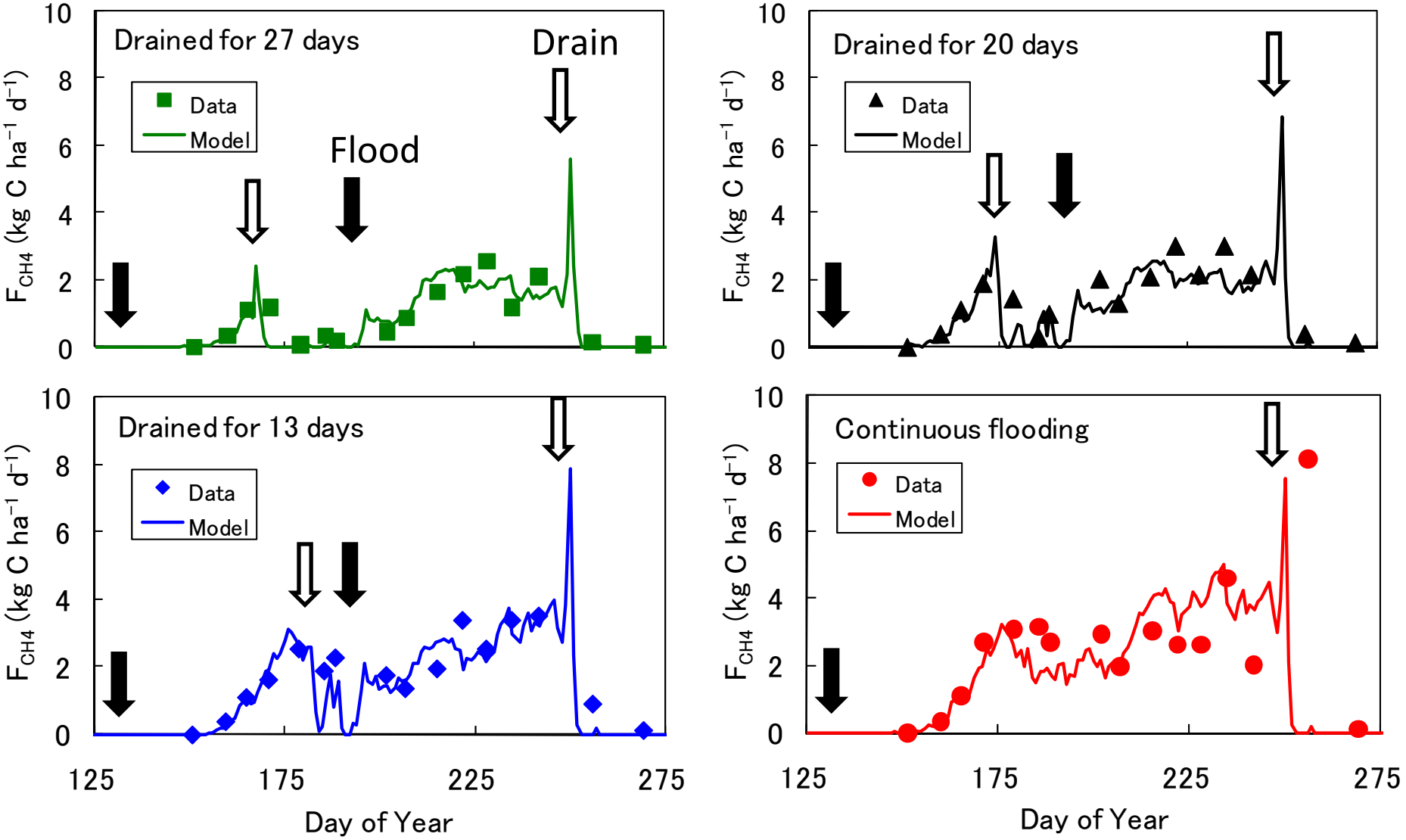
Estimation of CH_4 emission inventory

Rice ecosystems simulated by DNDC-Rice model

(Fumoto et al., 2008, 2010)

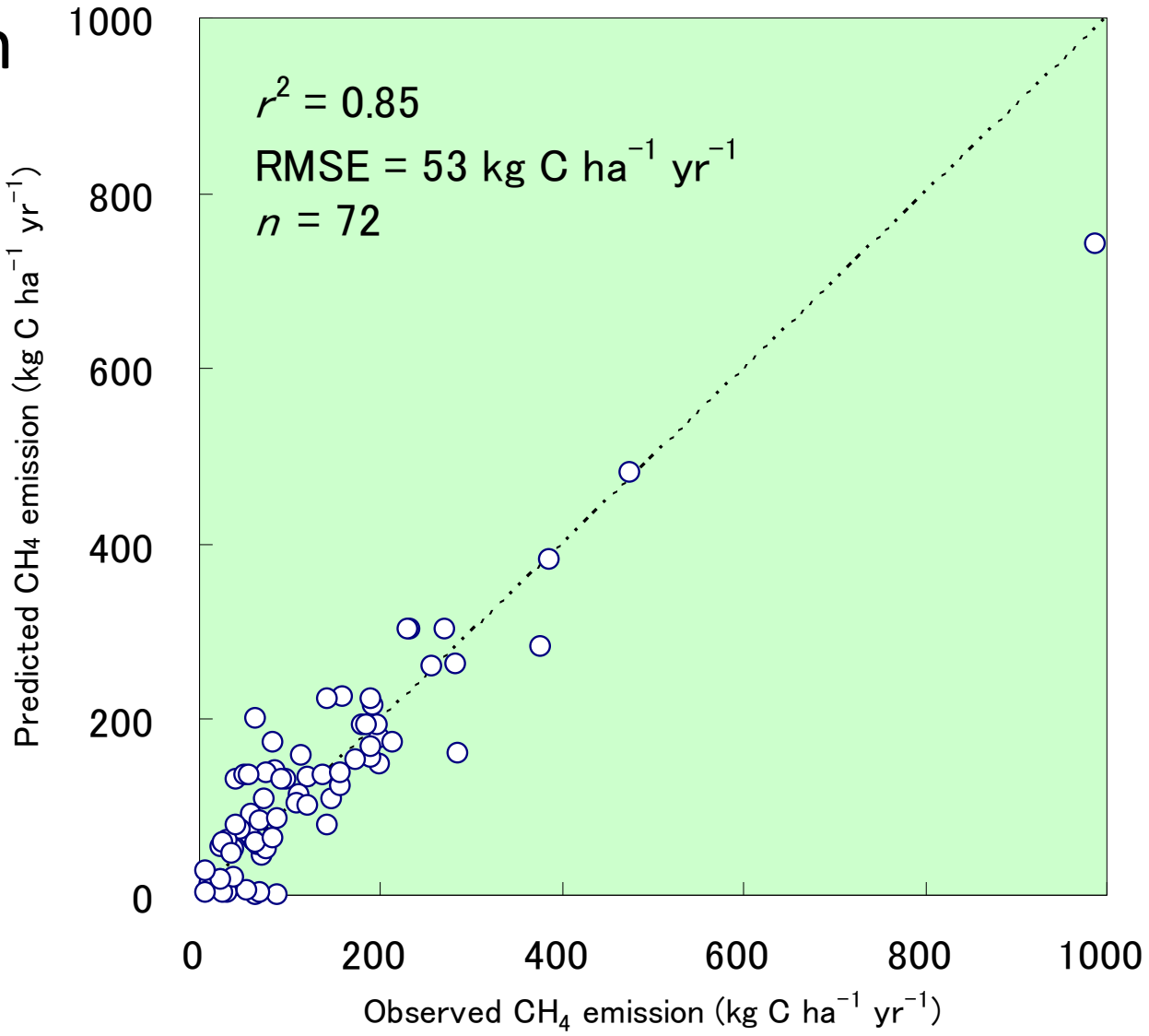


Prediction of CH_4 emissions under varied water regimes



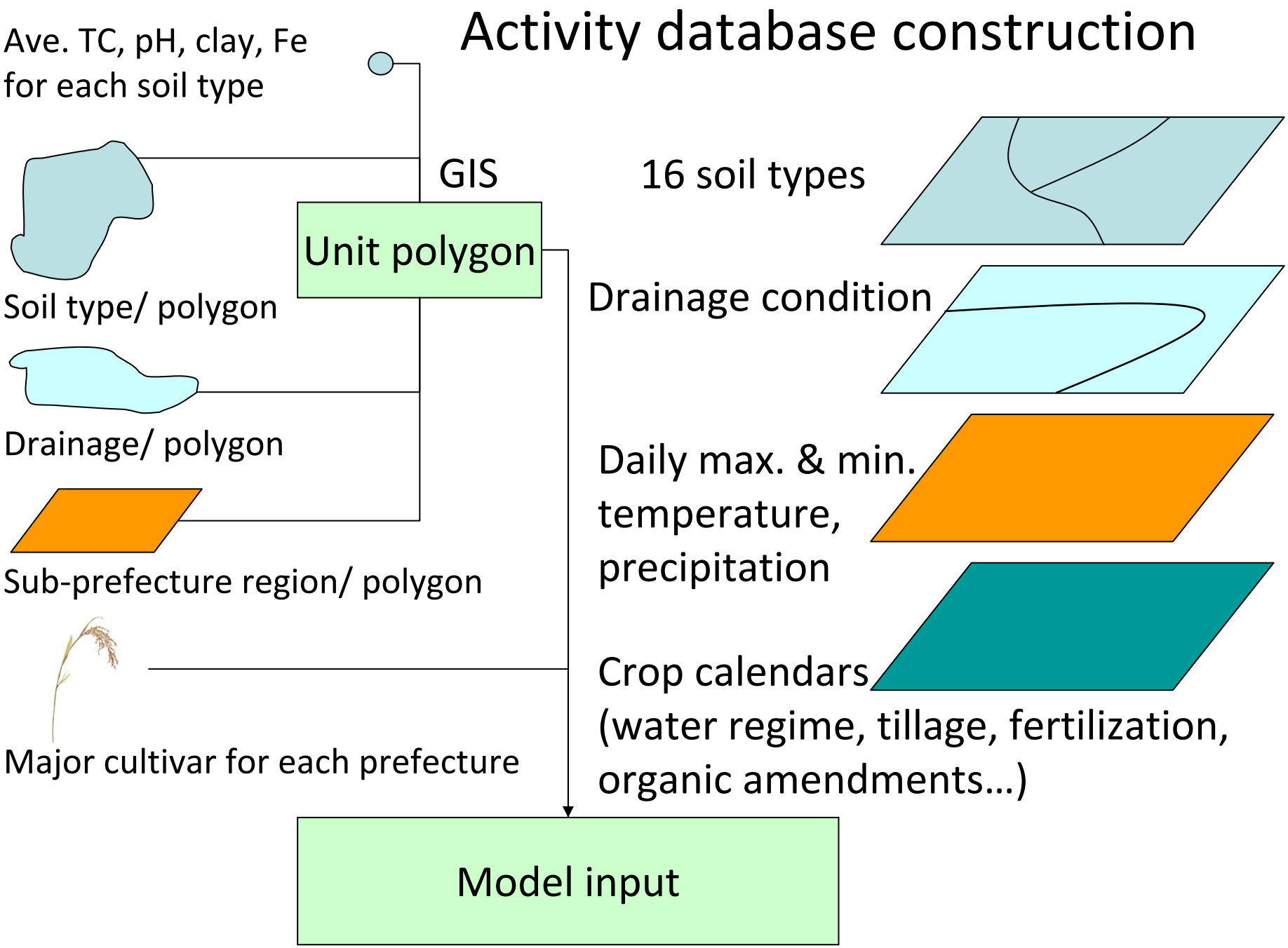
Measured and predicted daily CH_4 fluxes from a rice field with varied durations of midseason drainage (Fumoto et al., 2010).

Model validation with site-scale CH_4 emission data



Measured and predicted seasonal CH_4 emissions from 17 rice field sites in Japan. Every site had CH_4 emission data under different years, organic amendments or water regimes.

Activity database construction



Incorporating the drainage condition to calculate soil moisture

- Data source: Land Consolidation Survey (MAFF*, 2001) which describes semi-quantitative 3 classes of draining rate of croplands in Japan.
- Maximum draining rate in the model:

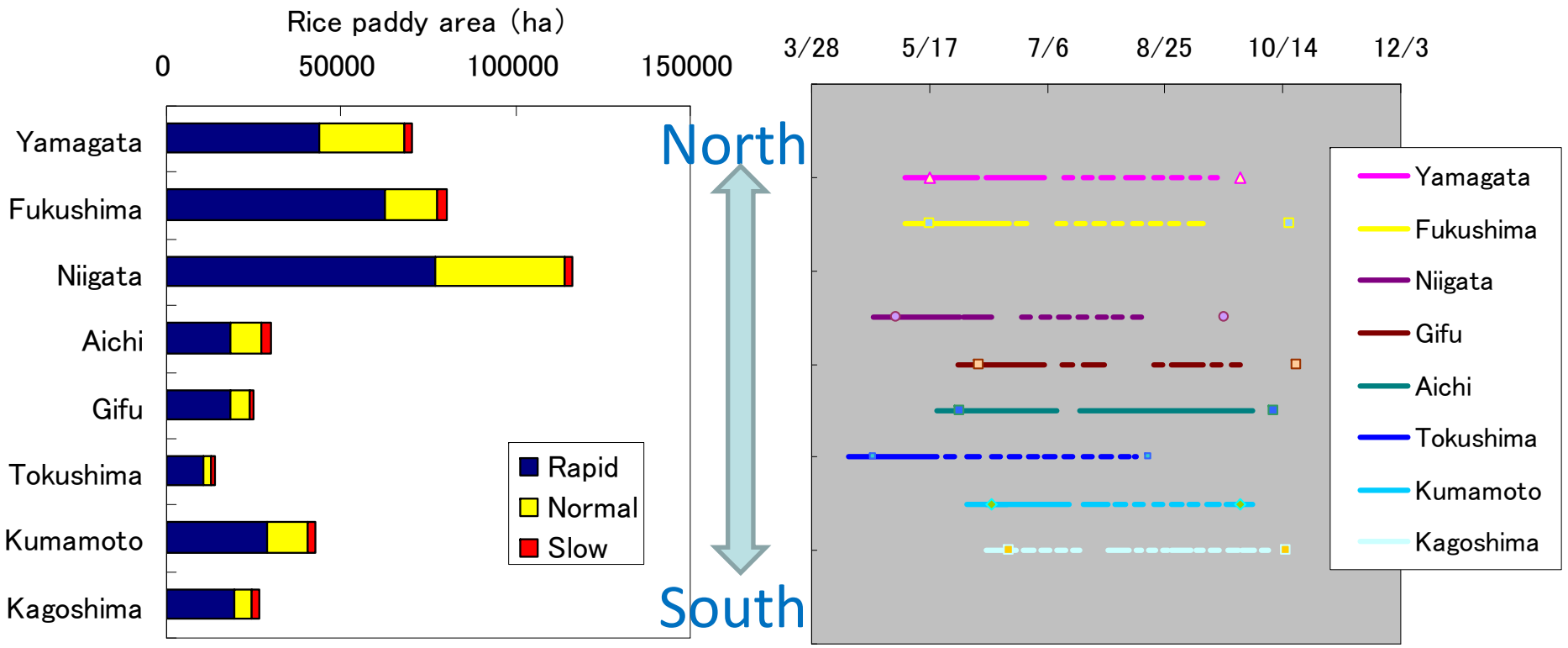
  Rapid → 20 mm day^{-1}

  Normal → 10 mm day^{-1}

  Slow → 5 mm day^{-1}

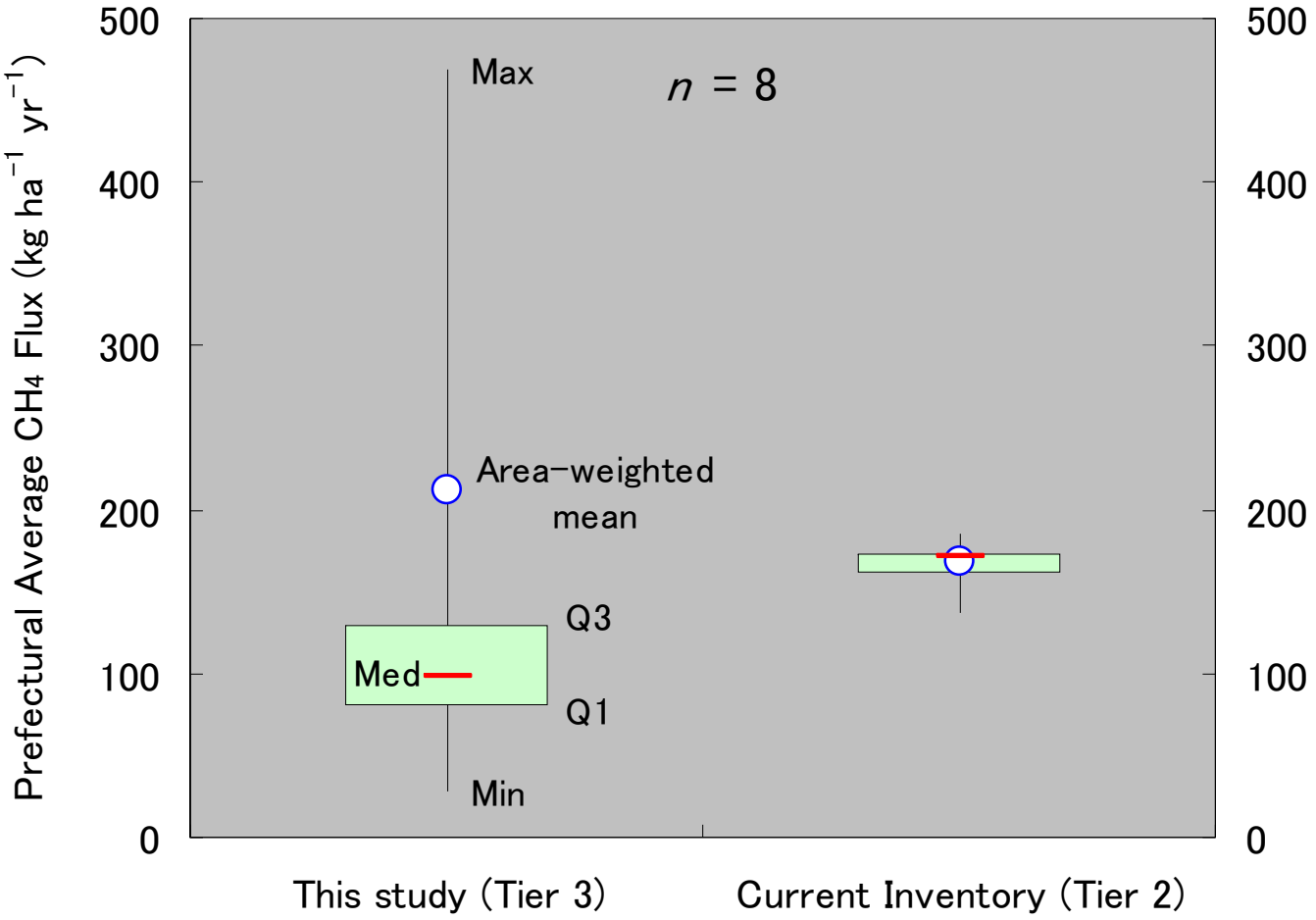
*Ministry of Agriculture, Forestry and Fishery, Japan.

Activity data: rice paddy area and crop calendar



(Left) rice paddy area of each draining rate class, (right) transplanting / harvest dates and irrigated periods for selected 8 (out of 47) prefectures of Japan (Hayano et al., 2009).

Result: Wider spatial variation in CH_4 emissions than the current inventory based on a Tier 2 approach.



Box plot of prefectural average CH_4 fluxes (n = 8), estimated by this study and by Japan's current GHG inventory.

Summary

- A process-based model (DNDC-Rice) has been developed to predict CH_4 emission from rice fields.
- An activity database has been constructed on the weather, soils, drainage condition, and managements for rice cultivation in Japan.
- Using the model and activity database, Japan's CH_4 emission inventory is being refined by a Tier 3 approach.