Multi-location evaluation of oryza2000 model in simulating anthesis and maturity dates of rice varieties in Bangladesh

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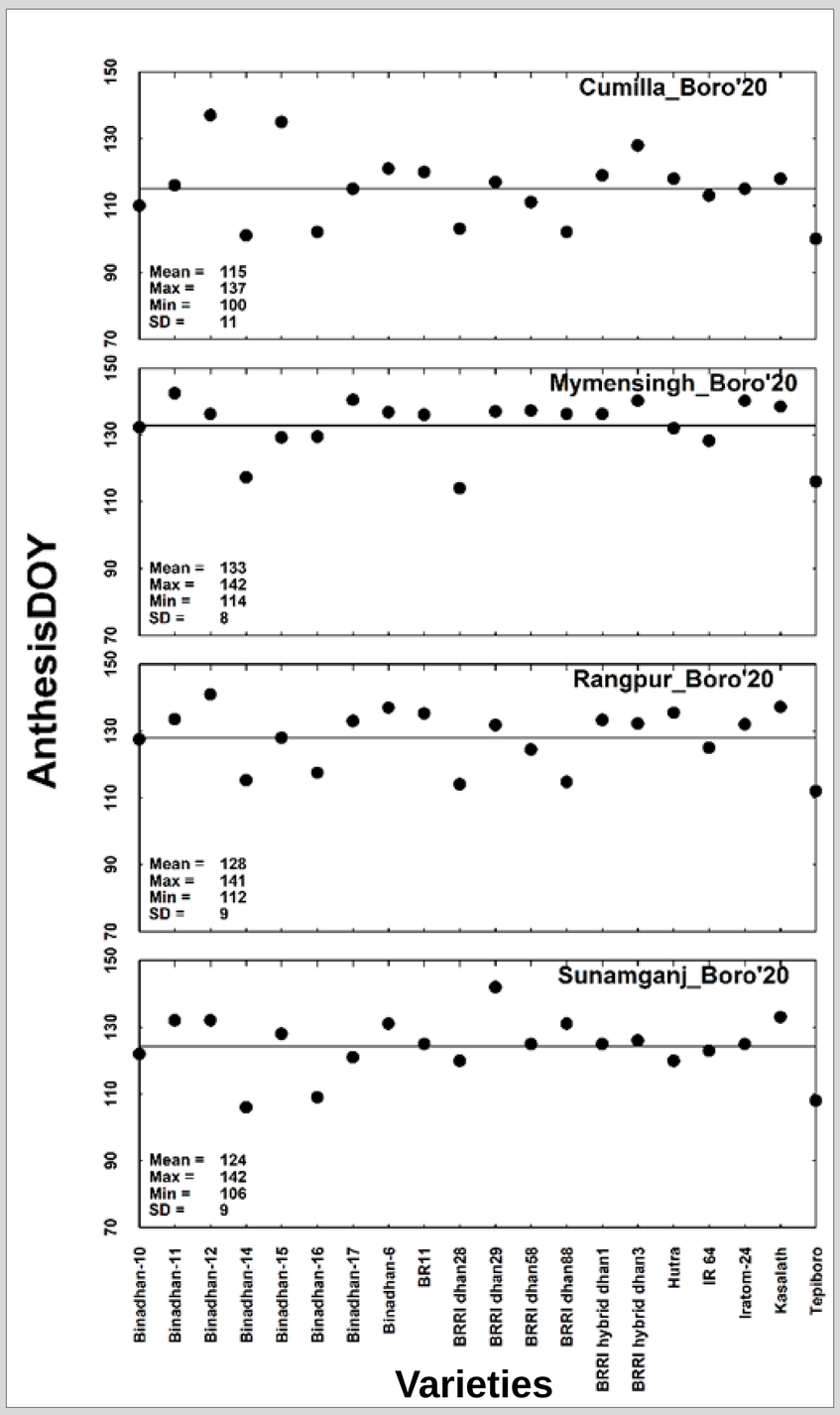
INTRODUCTION

- Accurate simulation of phenological stage is crucial in the application of crop growth models to predict eco-physiological and yield processes.
- ORYZA2000 is the most wide-spread crop model for simulating rice growth
- Its phenological output is driven mainly by temperature and by eight crop parameters.
- However, spatial variability in climatic conditions + the cultivation of diverse rice varieties, introduce substantial uncertainty in model applications.
- Determination of crop phenological parameters and modeling tests are important for the simulation of other crop growth processes and for modelling upscale.

RESULTS

1. Strong variation of observed anthesis (and maturity dates) among variety, locations, and seasons.



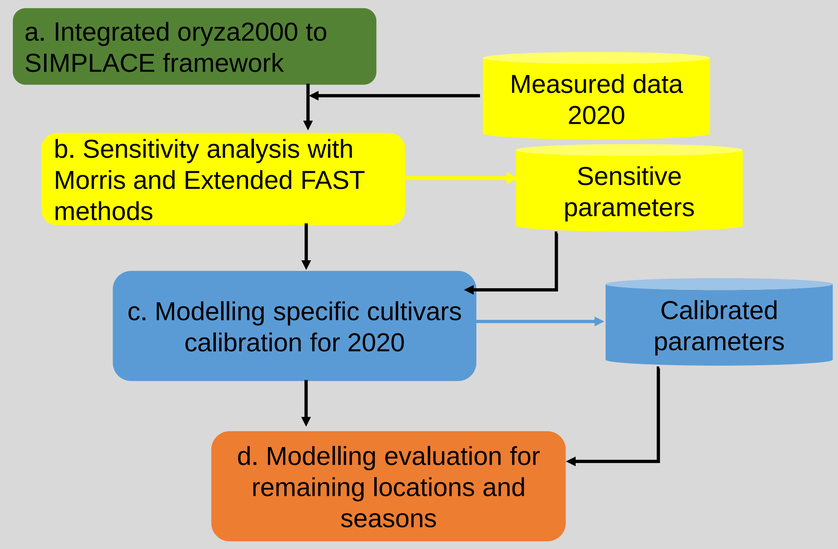
2. List of key phenological parameters for anthesis and maturity after Morris and extend FAST sensitivity methods with 10 parameters

Growing phase	Phenology parameter	Explaination and units	Effect measure effects (μ*) (days)	Interaction effects (σ) (days)
Anthesis	cDVRP	development rate during panicle development, °Cd[1]	55	59
	cDVRJ	development rate during the juvenile, °Cd[1]	67	85
Maturity	cDVRR	development rate during the reproductive phase, °Cd[1]	43	86

MATERIALS AND METHODS

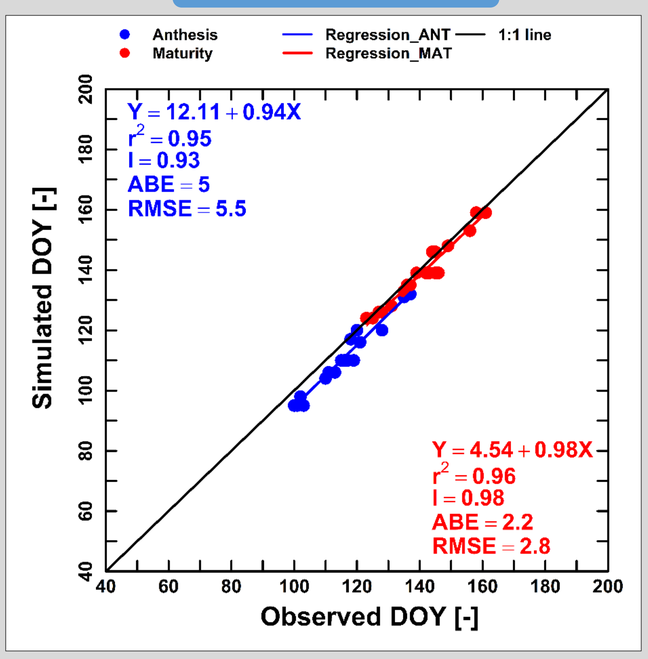
- **Crop models**:
- Integrated the ORYZA2000v2v13 model to the SIMPLACE modelling framework
- Sensitivity analysis: Morris and Extended FAST methods
- **Experimental data:**
- Field trials: **4** locations (Cumilla, Mymensingh, Rangpur, and Sunamganj in Bangladesh
- Growing season: **20** rice varieties grown over 3 Boro rice seasons (2020–2022)
- Field measured data: dates of anthesis and maturity

Modelling workflow



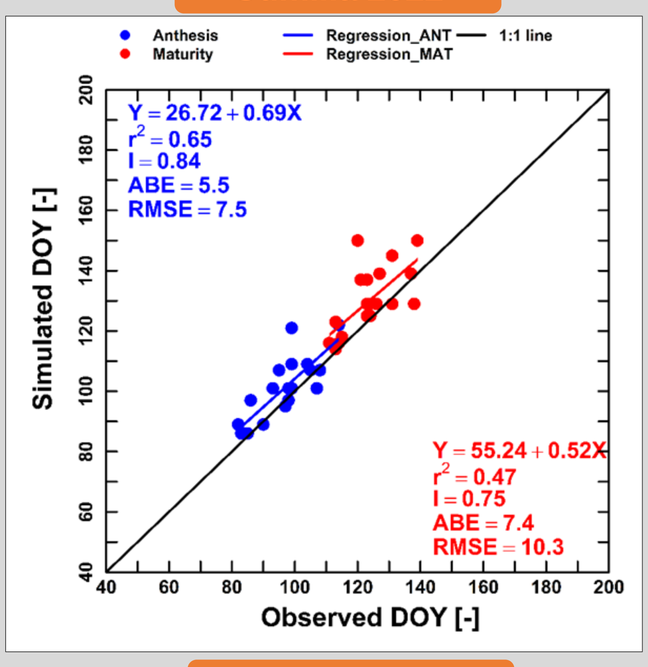
3. Good simulation of anthesis and maturity dates in variety-specific model calibration

Cumilla 2020

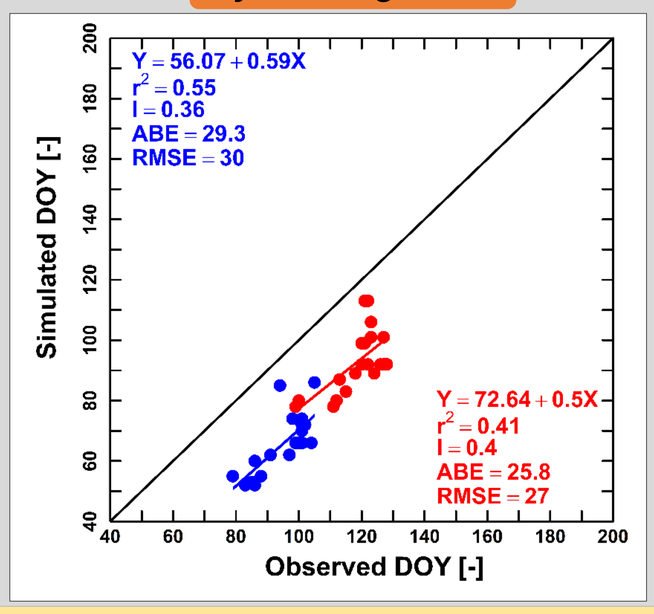


4. Variable prediction accuracy, with RMSE ranging from 8–25 days for anthesis and 9–32 days for maturity

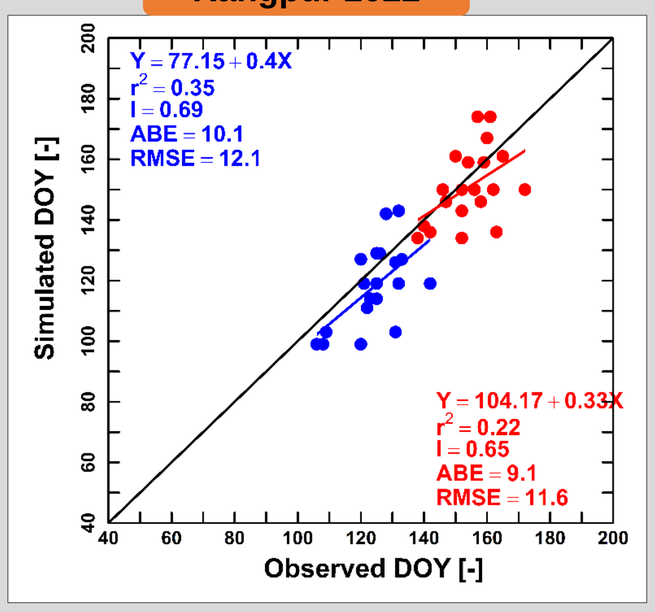
Cumilla 2022



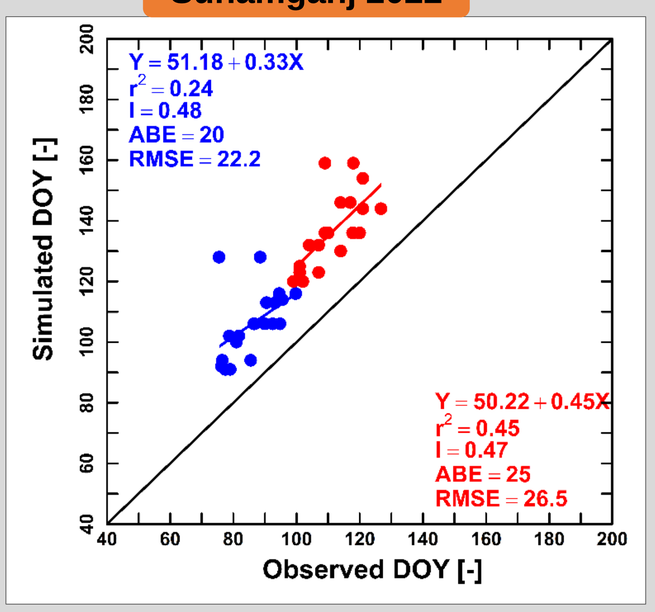
Mymensingh 2022



Rangpur 2022



Sunamganj 2022



HIGHLIGHTS

- First time oryza2000 has been implemented in SIMPLACE and tested with field measured data
- Variety-specific parameters derived from one season and location is not generic enough for other seasons and locations.

OUTLOOK

- Further work should focus on the calibration processes to find suitable parameters that capture the interaction of genotype with location and seasonal changes in temperature.
- Further modeling application for other soil-crop growth processes and data (open for future collaboration in rice yield simulations)

References:
Ender et al., (2023), Bouman et al., (2001)

Project: COINS co-developing innovations for sustainable land management in West African smallholder farming systems

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