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Federal Department of Foreign Affairs FDFA
Swiss Agency for Development and Cooperation SDC



Deutsche Gesellschaft
für Internationale
Zusammenarbeit (giz) GmbH



Remote sensing-based information and insurance for crops in emerging economies <http://www.riice.org>

Remote Sensing-Enhanced Crop Monitoring System

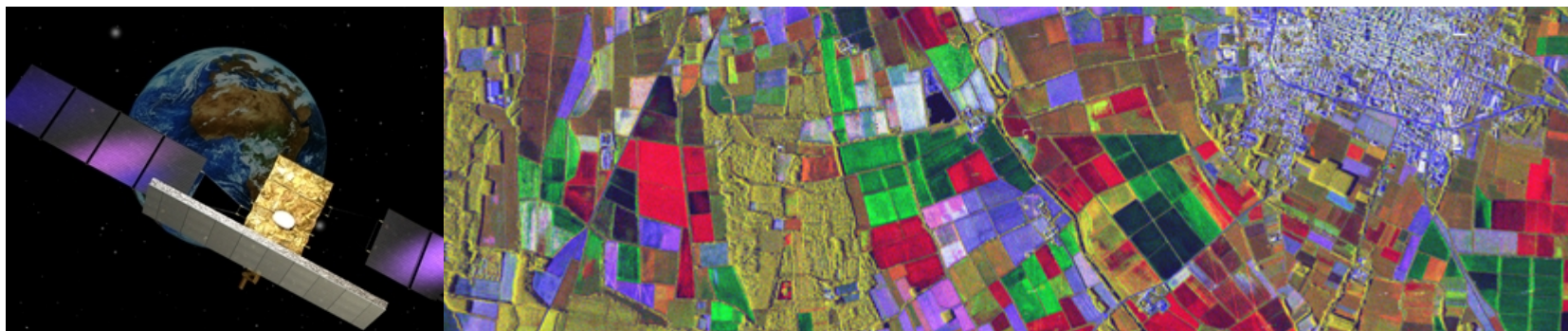
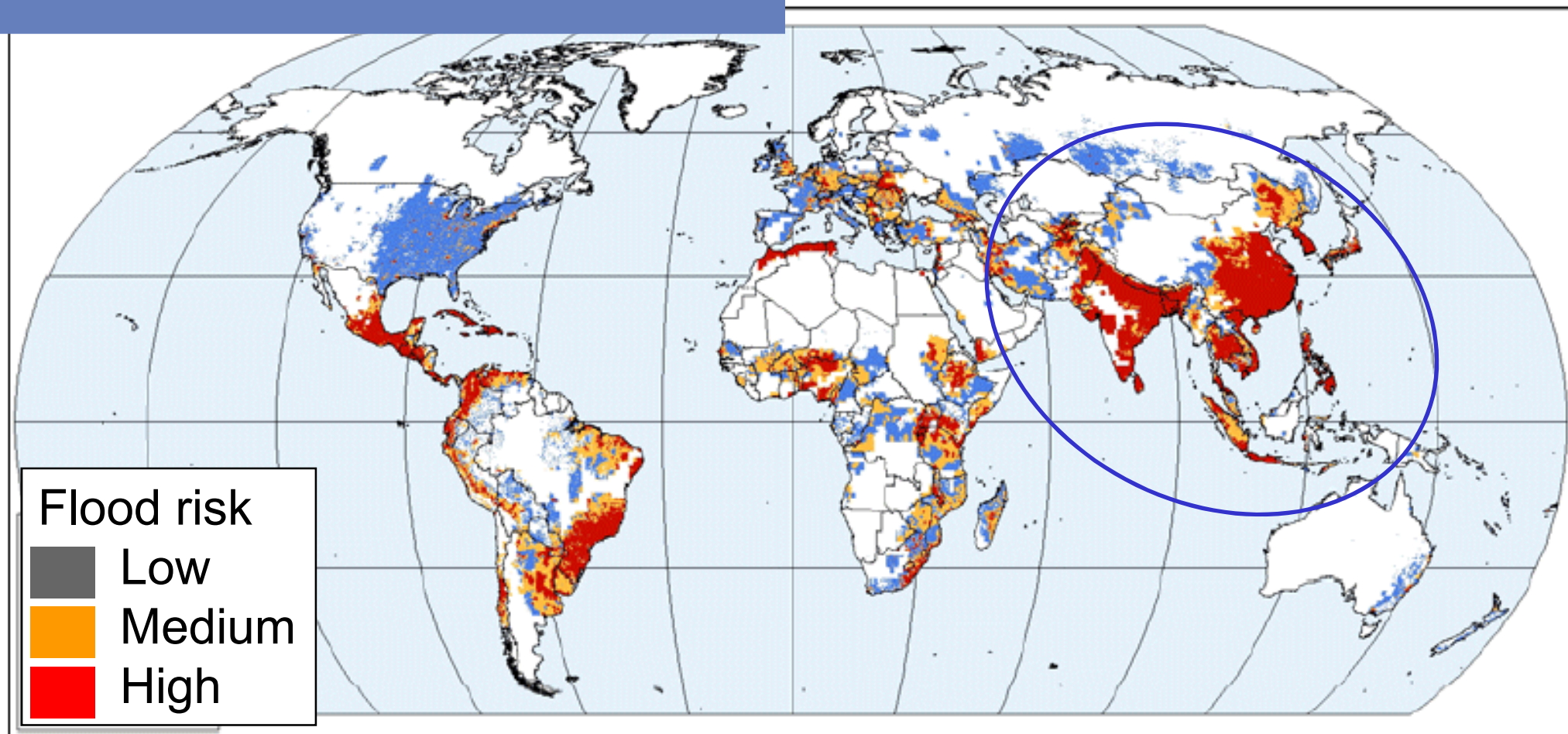


Image source: e-geos (Italian Space Agency & Telespazio)

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Prosperidad Abonete¹, Emma Quicho¹, Jeny Ravis¹, Arnel Rala¹, Mary
Rose Mabalay², Eduardo Jimmy Quilang²

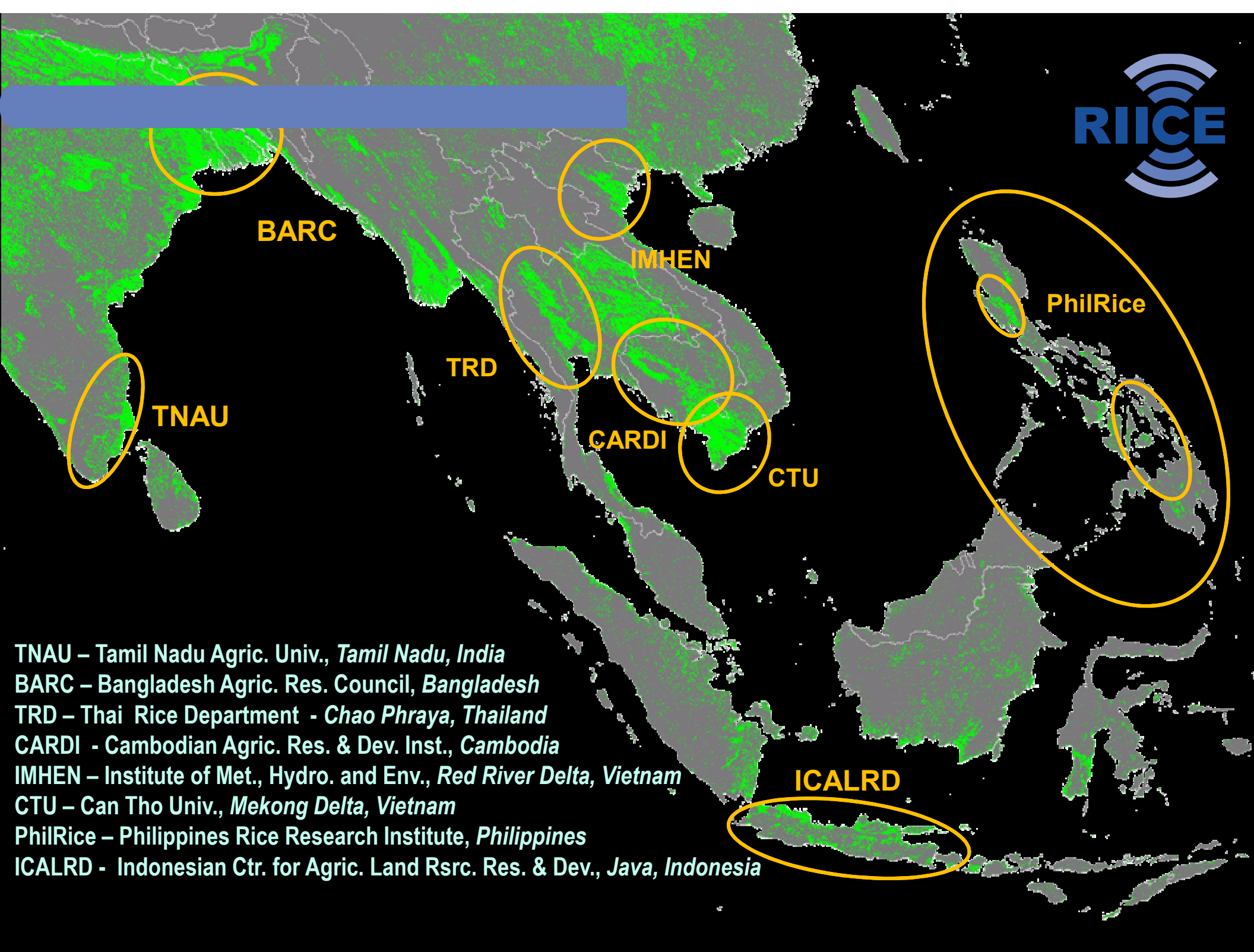
¹International Rice Research Institute (IRRI), ²Philippines Rice Research Institute (PhilRice), ³sarmap SA

Climate risks – 20 million hectares of rice are vulnerable to flooding



- **Rice:** Asia is the largest rice market: consumers & producers
- **Poverty:** Asia has the highest concentration of poverty
- **Climate:** Flood affects the major rice producing areas of Asia

If we want to increase resilience and improve food security then a timely rice information system linked to a crop insurance model is one possible approach



BARC

IMHEN

PhilRice

TNAU

TRD

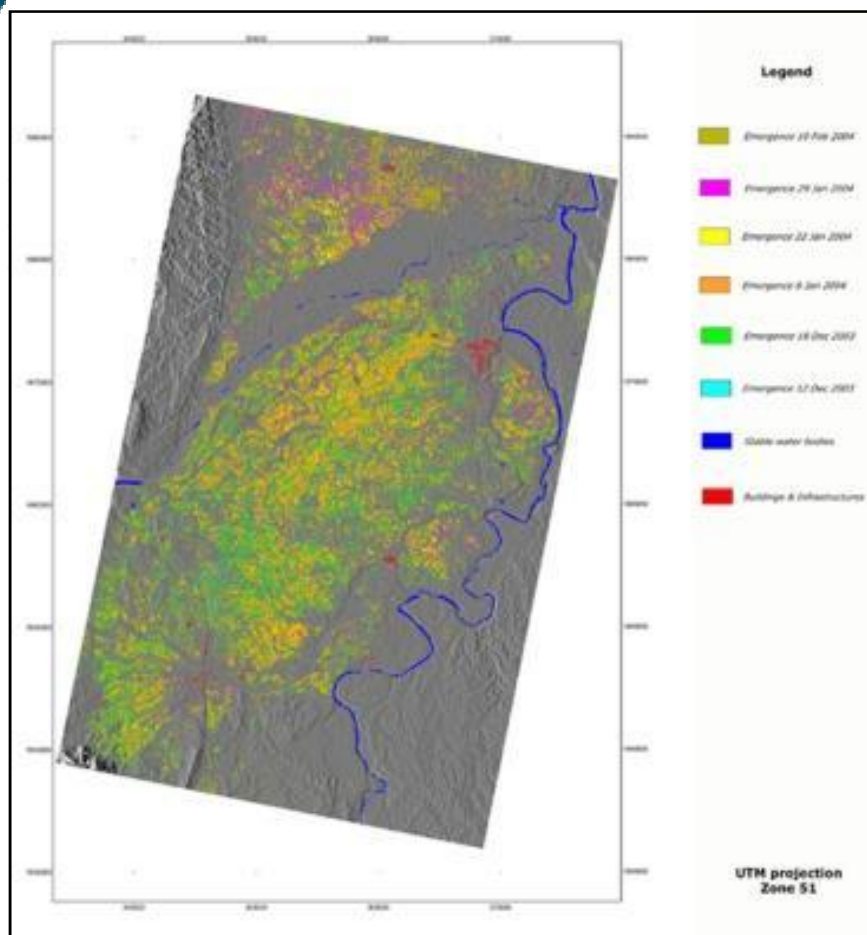
CARDI

CTU

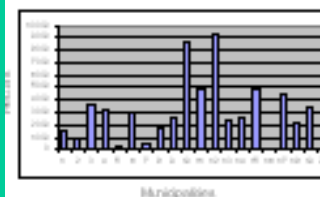
ICALRD

TNAU – Tamil Nadu Agric. Univ., *Tamil Nadu, India*
BARC – Bangladesh Agric. Res. Council, *Bangladesh*
TRD – Thai Rice Department - *Chao Phraya, Thailand*
CARDI - Cambodian Agric. Res. & Dev. Inst., *Cambodia*
IMHEN – Institute of Met., Hydro. and Env., *Red River Delta, Vietnam*
CTU – Can Tho Univ., *Mekong Delta, Vietnam*
PhilRice – Philippines Rice Research Institute, *Philippines*
ICALRD - Indonesian Ctr. for Agric. Land Rsrc. Res. & Dev., *Java, Indonesia*

Remote Sensing tells you where and when,
crop model tells you how much

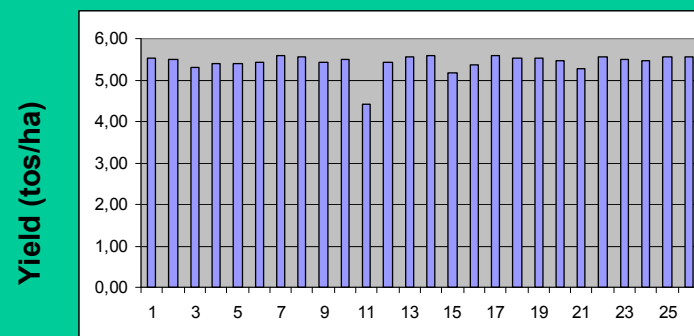


Acreage

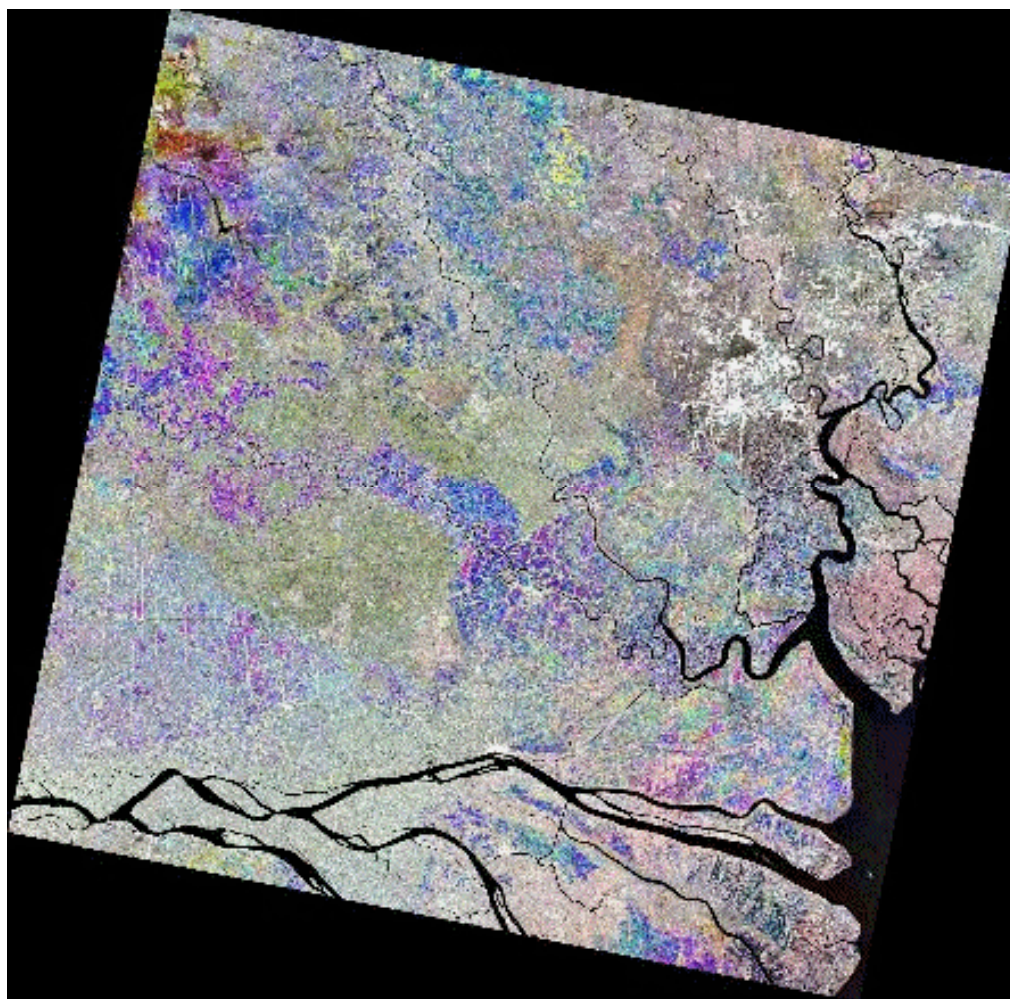
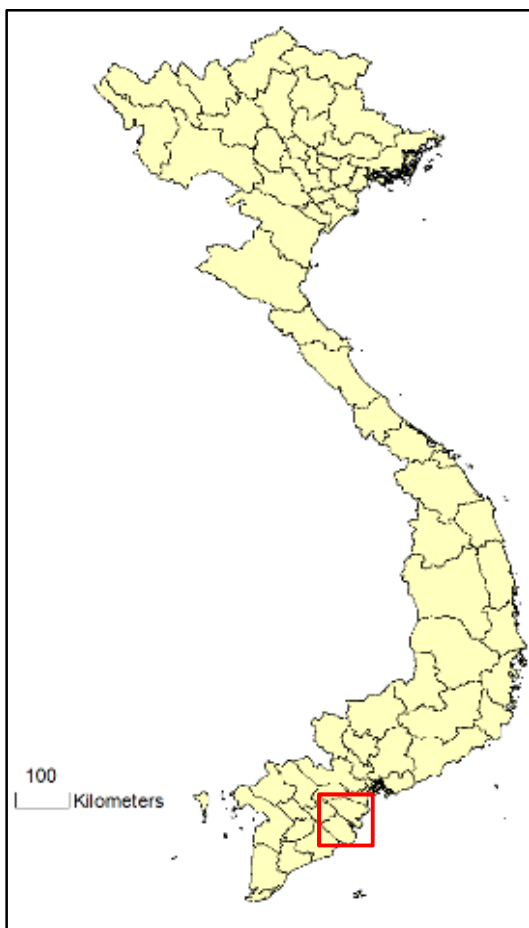


Municipality	Emergence 10 Feb 2004	Emergence 29 Jan 2004	Emergence 22 Jan 2004	Emergence 9 Jan 2004	Emergence 18 Dec 2003	Emergence 12 Dec 2003
1						
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Yield



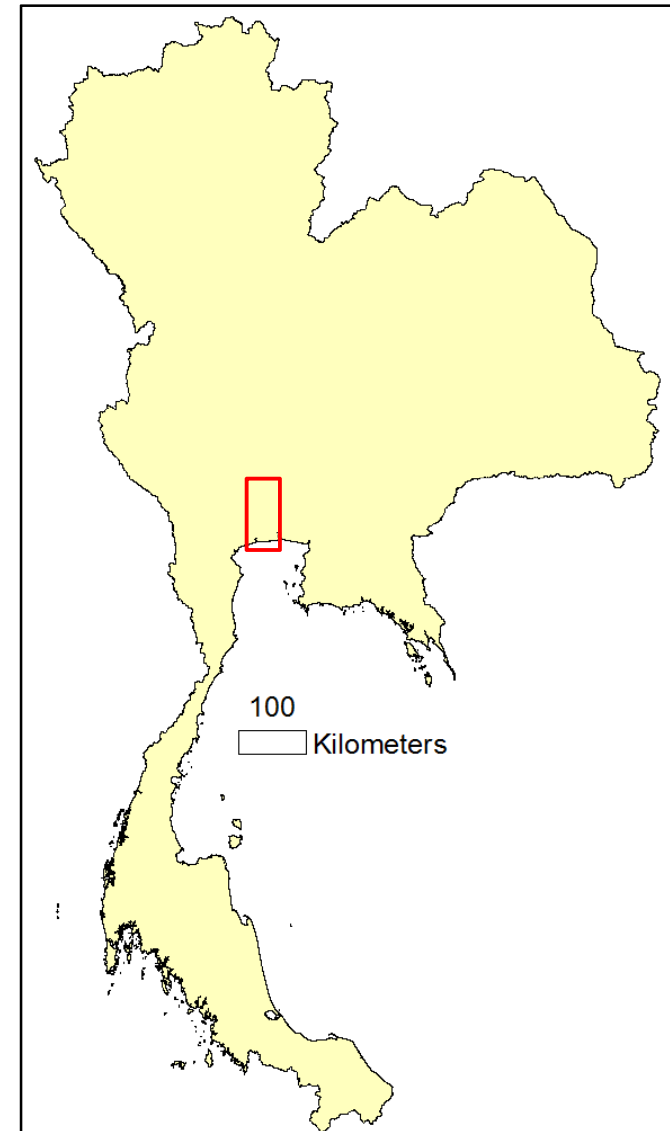
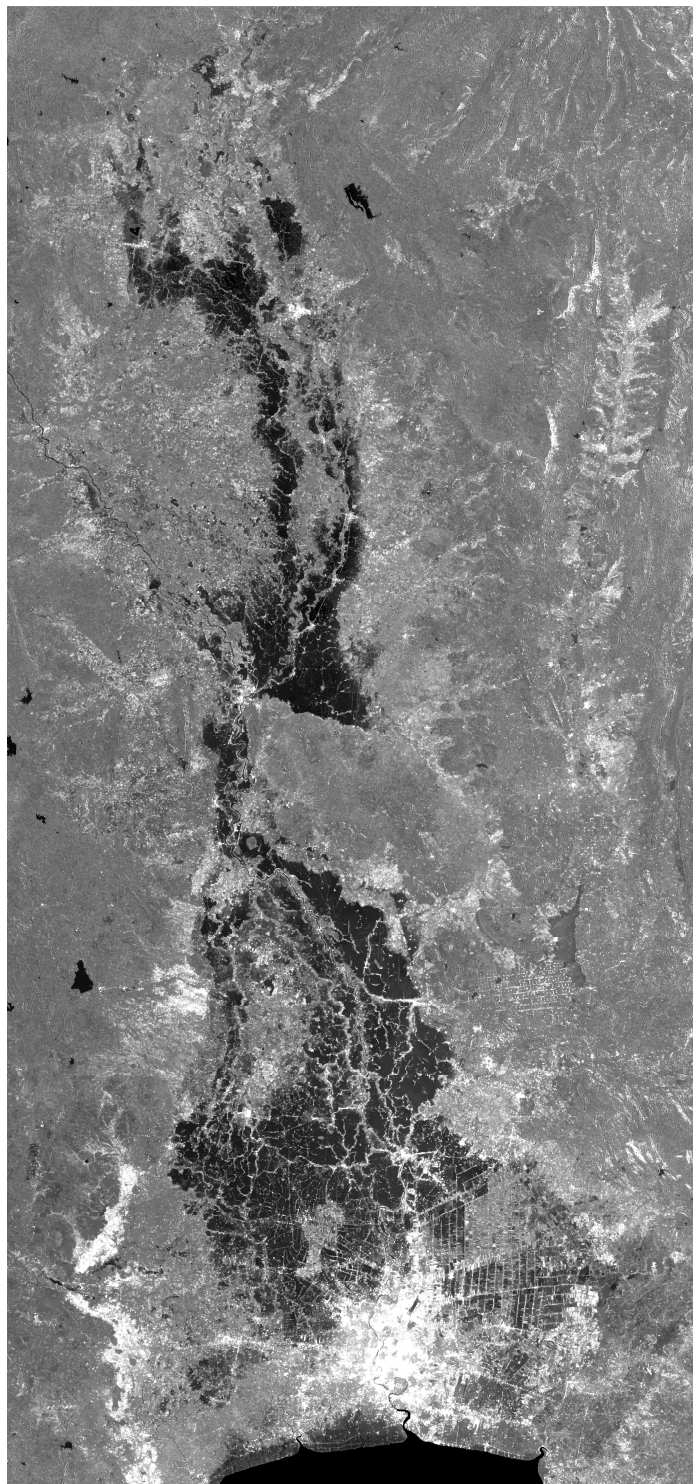
Municipalities



Radar images of Central
Thailand from
Sep 13 2011
Oct 13 2011
Nov 01 2011

Bangkok is at the
bottom

Area in black is surface
water which moves from
north to south towards
Bangkok

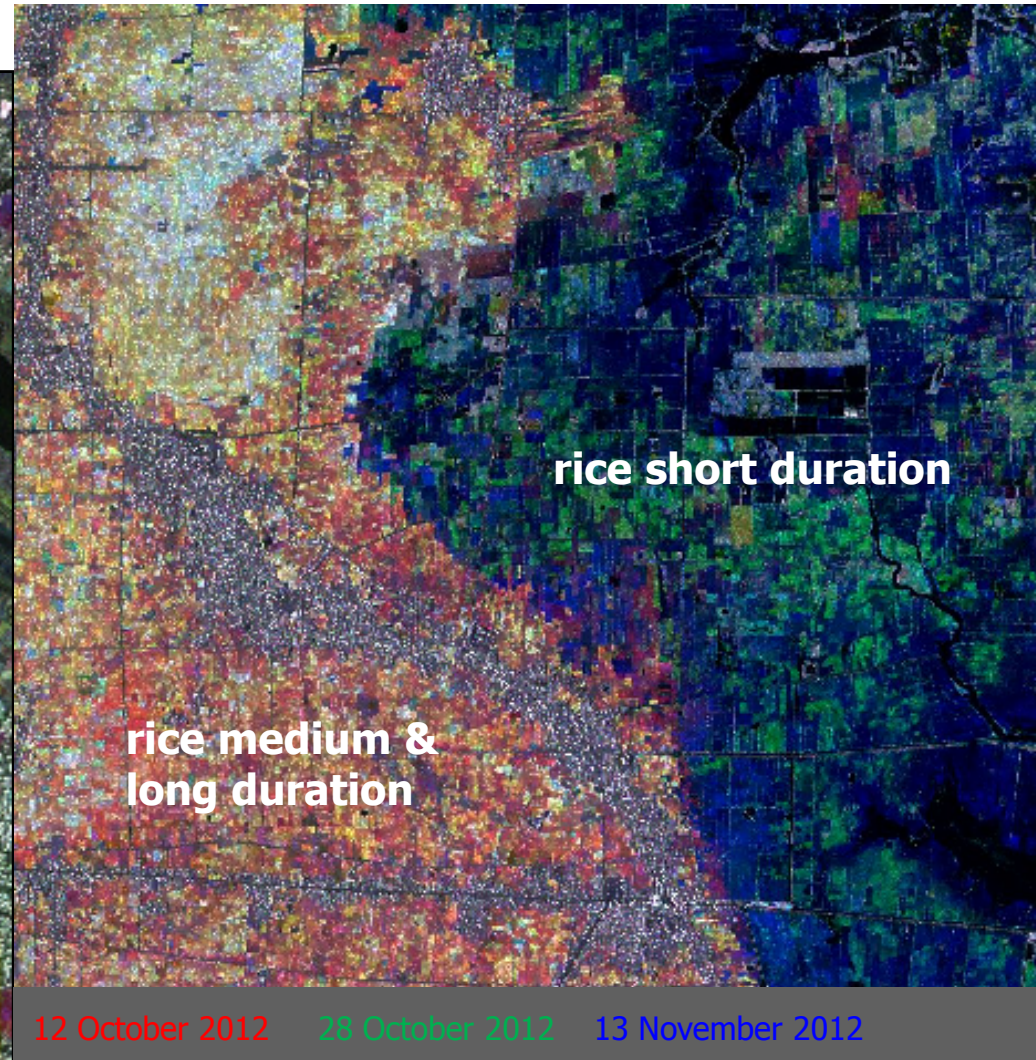
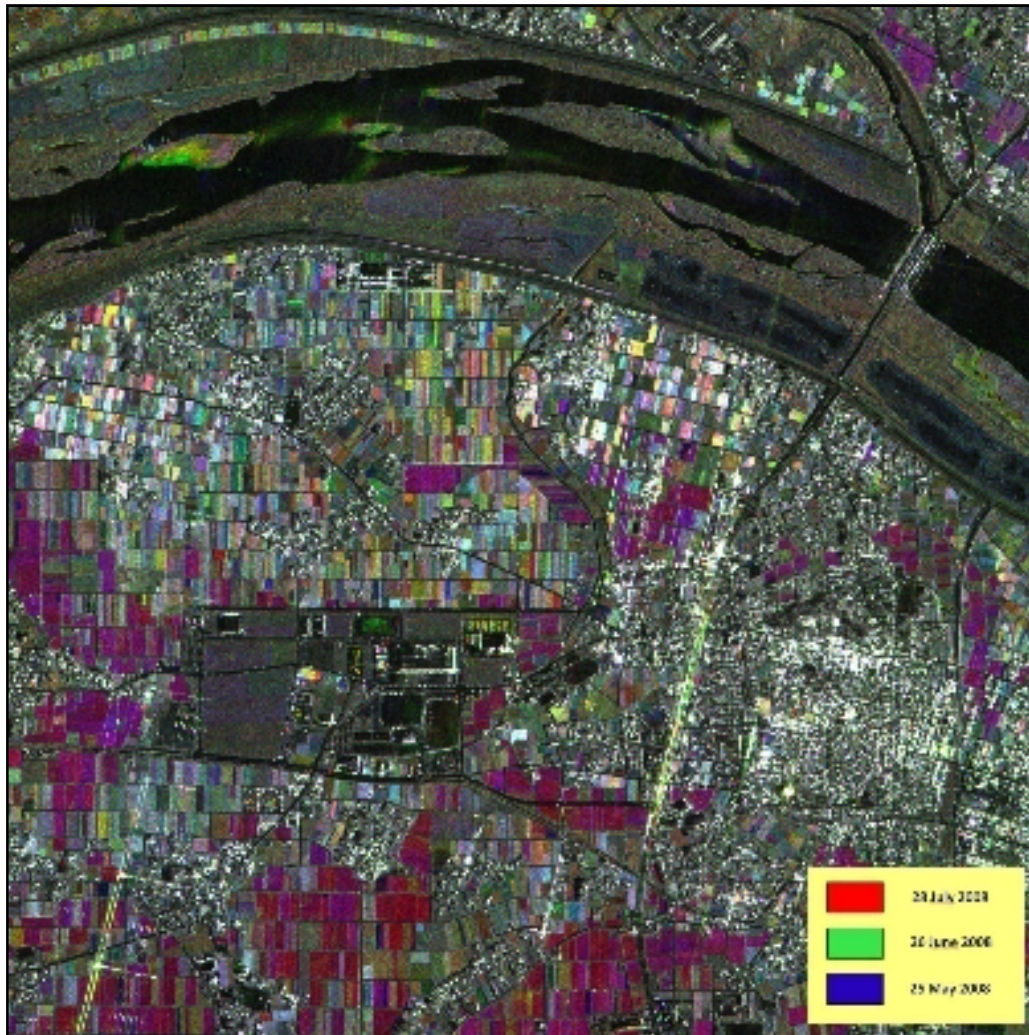


Apr 1, 2013

ECONOMIES

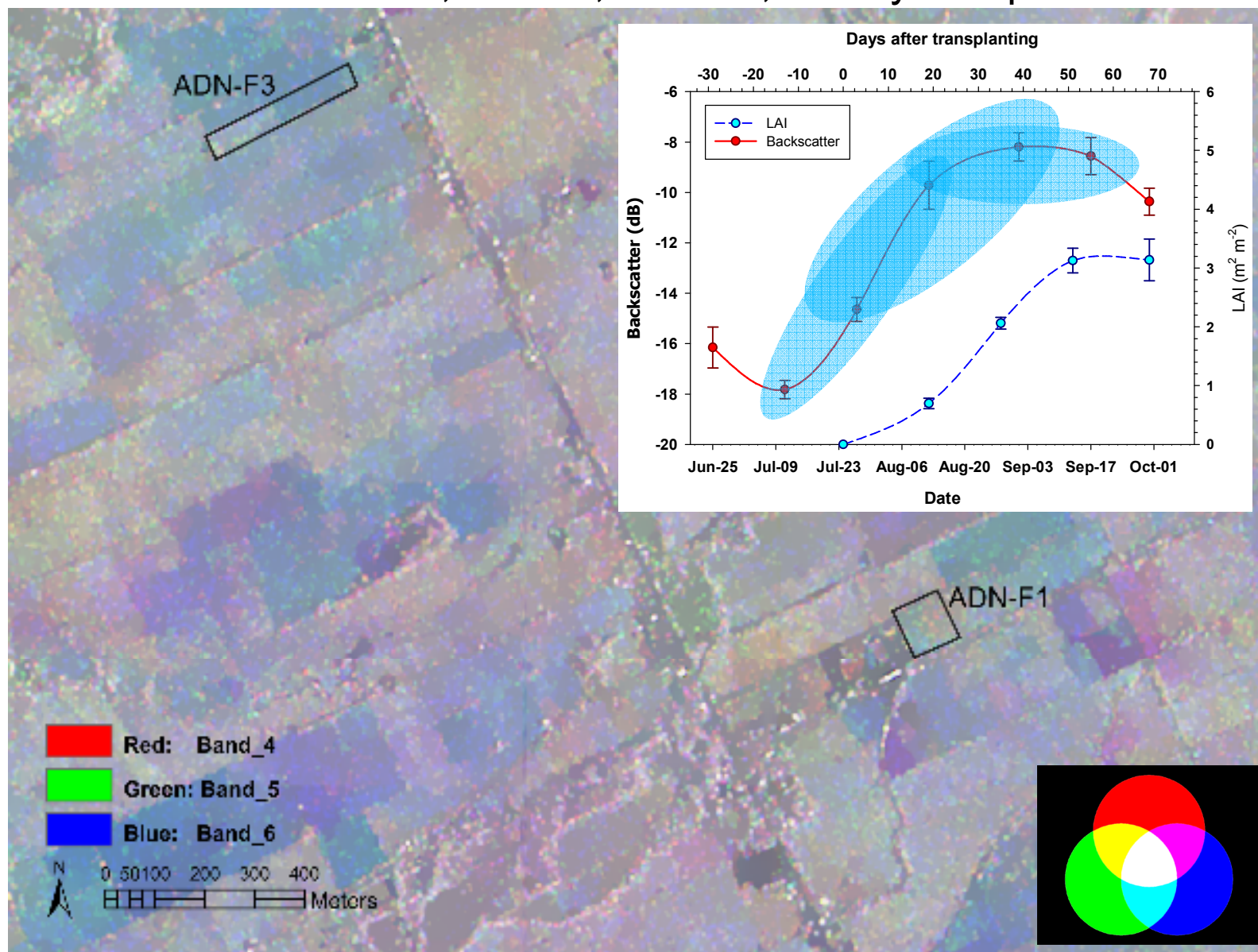


Cosmo-SkyMed, 3m resolution



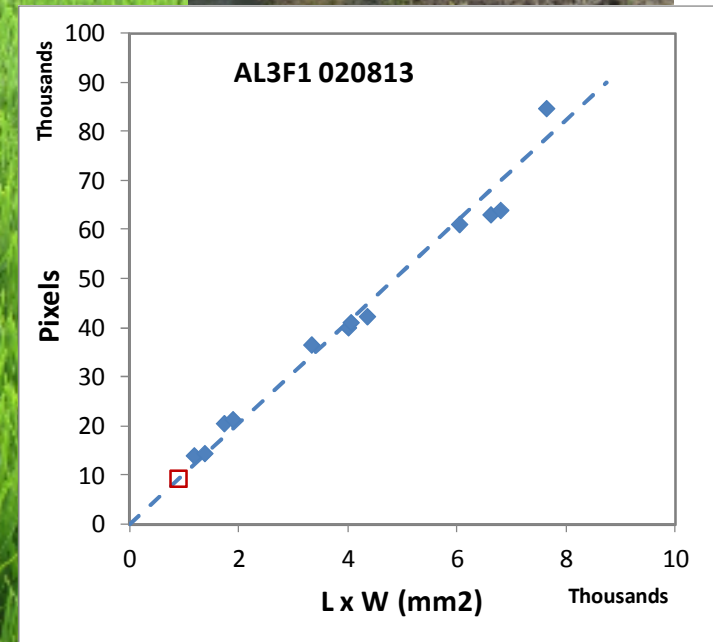
Agusan Del Norte, Philippines, Wet Season 2012

SAR: CSK, x-band, 3-m res, 16 days freq.



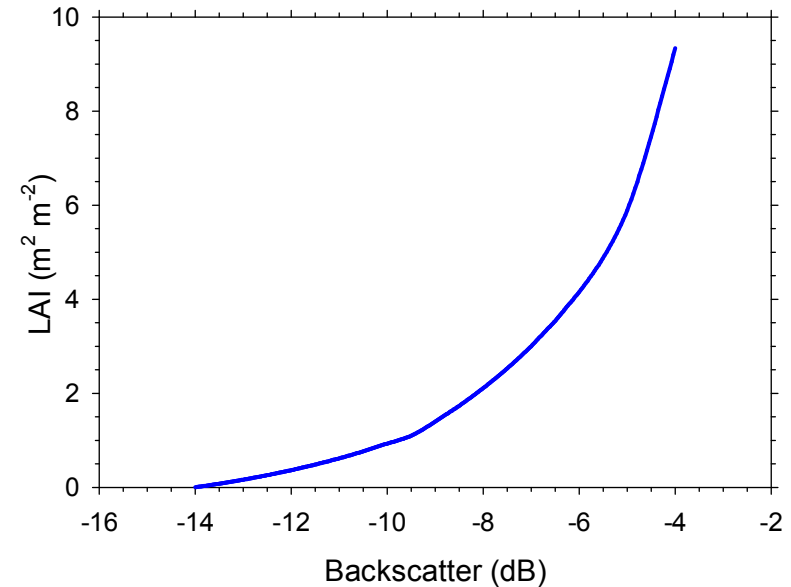
Apr 1, 2013

ECONOMIES



Cloud* based semi-empirical model for LAI as a function of radar backscattering from lowland rice

$$LAI = \frac{B + A \left(\ln \left[\frac{10^{0.1\sigma^\circ} - \alpha \cos \theta}{\sigma_{BG}^\circ} \right] \cos \theta / 2\beta \right)}{\ln \left[\frac{10^{0.1\sigma^\circ} - \alpha \cos \theta}{\sigma_{BG}^\circ} \right] \cos \theta + C}$$



LAI (output) is Leaf area index ($\text{m}^2 \text{m}^{-2}$)

σ° (**input**) is radar backscatter (dB)

α (**parameter**) is backscatter coefficient at full canopy closure ($\text{m}^2 \text{m}^{-2}$)

β (**parameter**) is coefficient of attenuation per unit canopy water ($\text{m}^2 \text{kg}^{-1}$)

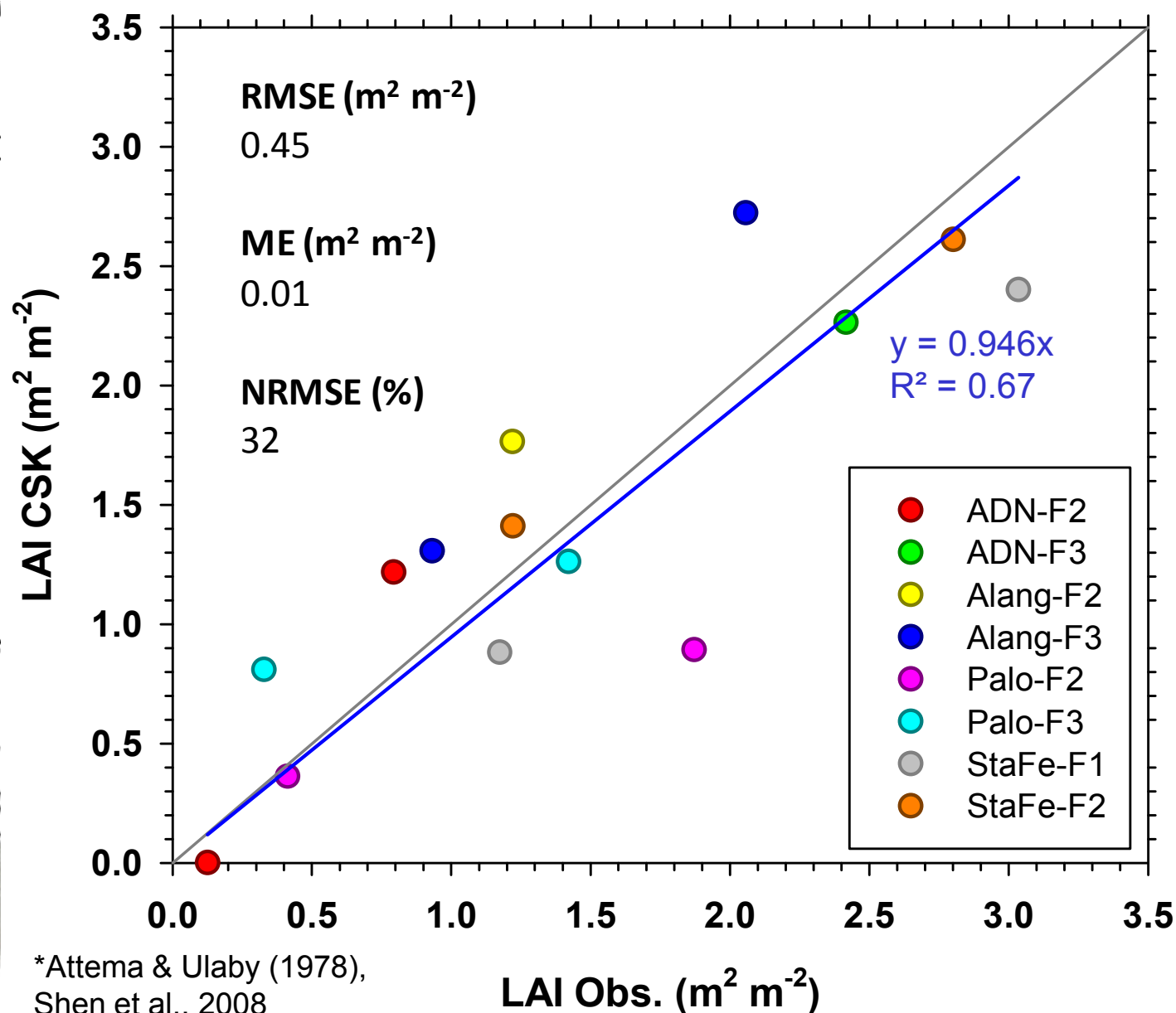
σ_{BG}° (**parameter**) is backscatter from canopy background ($\text{m}^2 \text{m}^{-2}$)

θ (**parameter**) is incident angle of radar beam ($^\circ$)

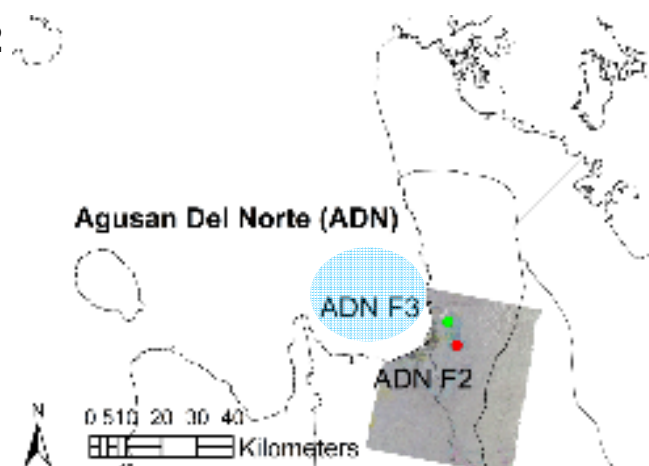
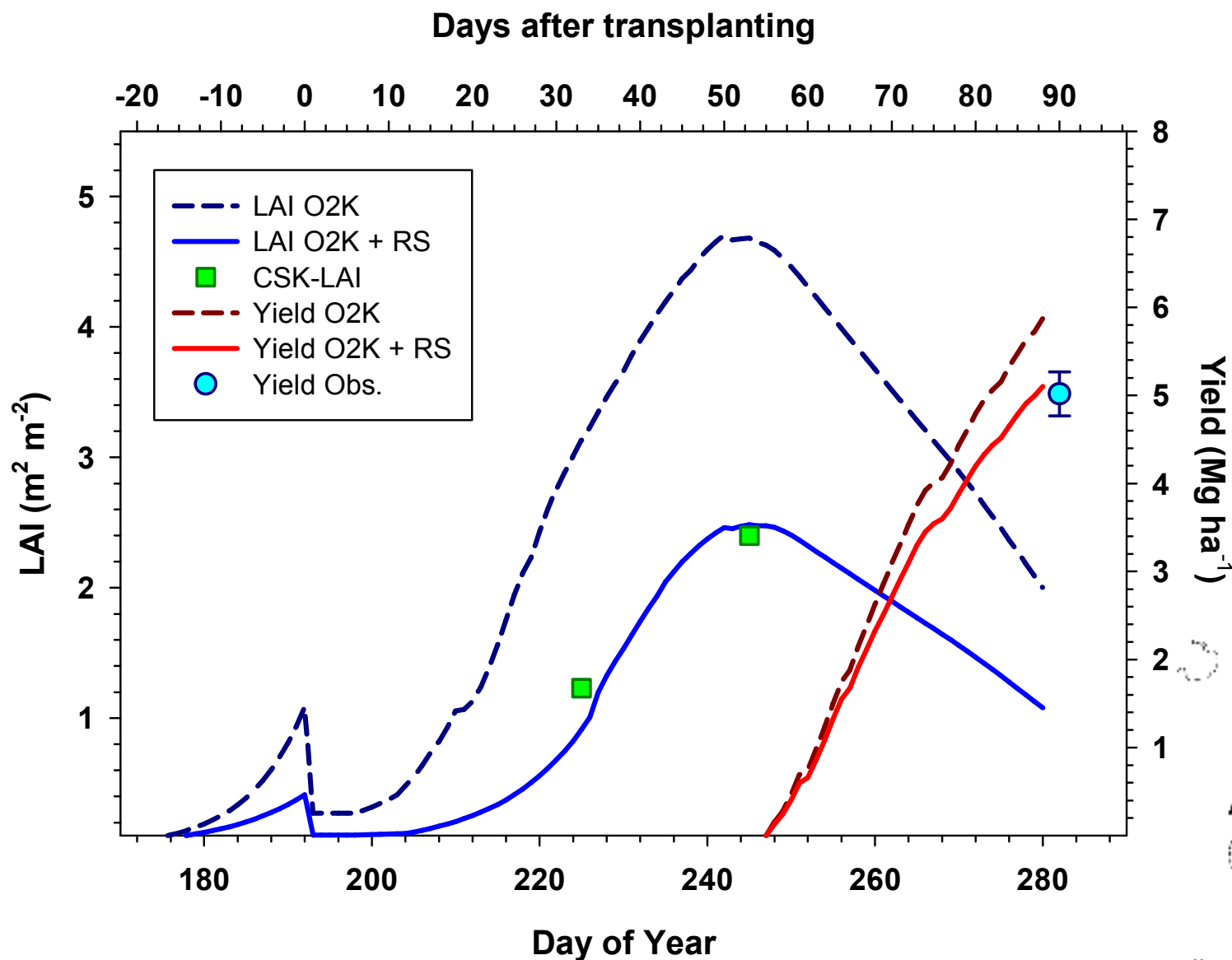
A, B, and C (parameters) are non-linear reg. coefficients for LAI vs $W \cdot h^\#$, where W is amount of canopy water (kg m^{-3}) and h is canopy height (m) and $A = 10.22468$, $B = 0.3379559$, and $C = 1.7230986$

*Attema & Ulaby (1978); #Shen et al., 2008

Cloud* based semi-empirical model for LAI as a function of radar backscattering from lowland rice

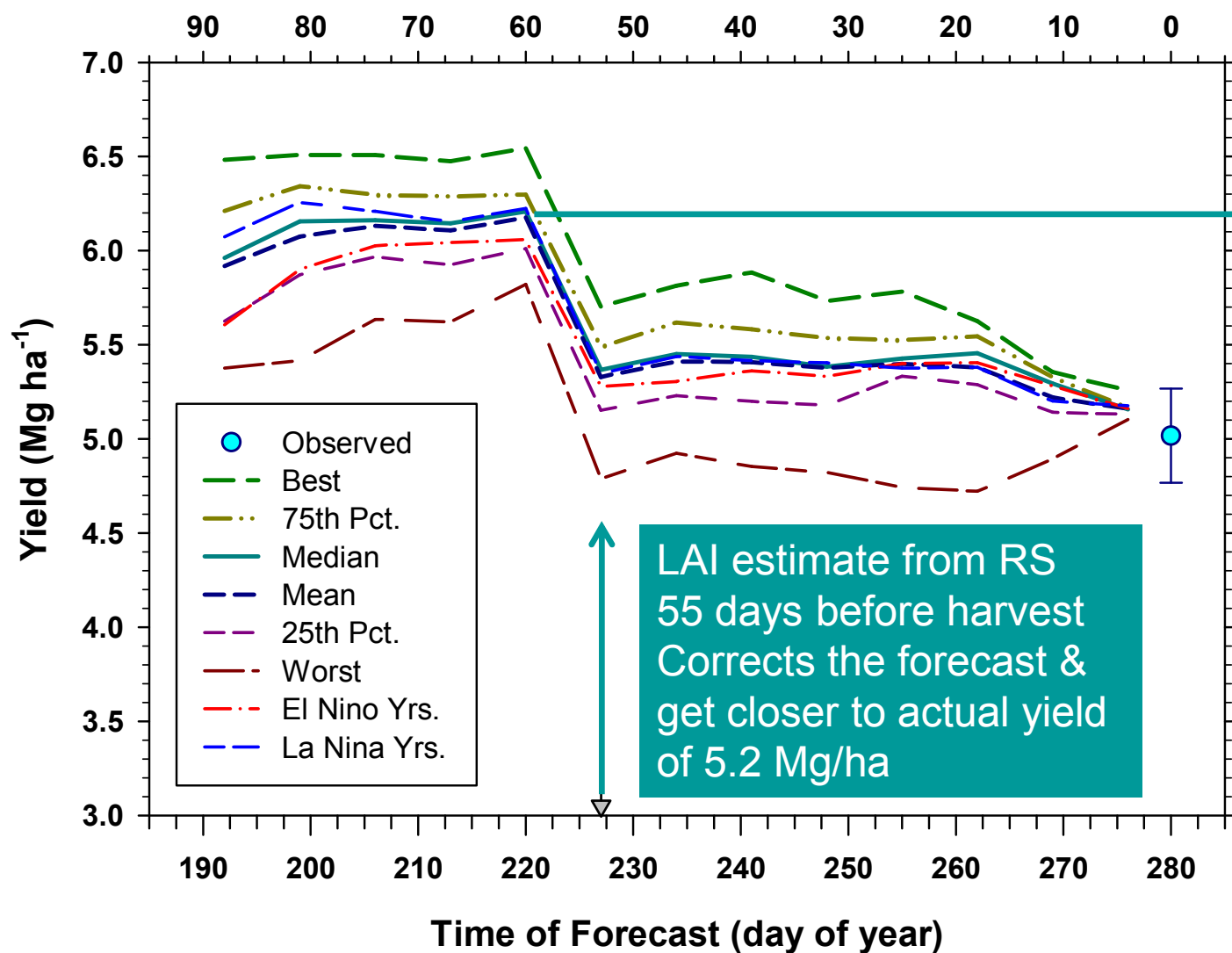


Linking SAR-based remote sensing data (CSK-LAI) with ORYZA2000 (O2K) *Post-season simulation*



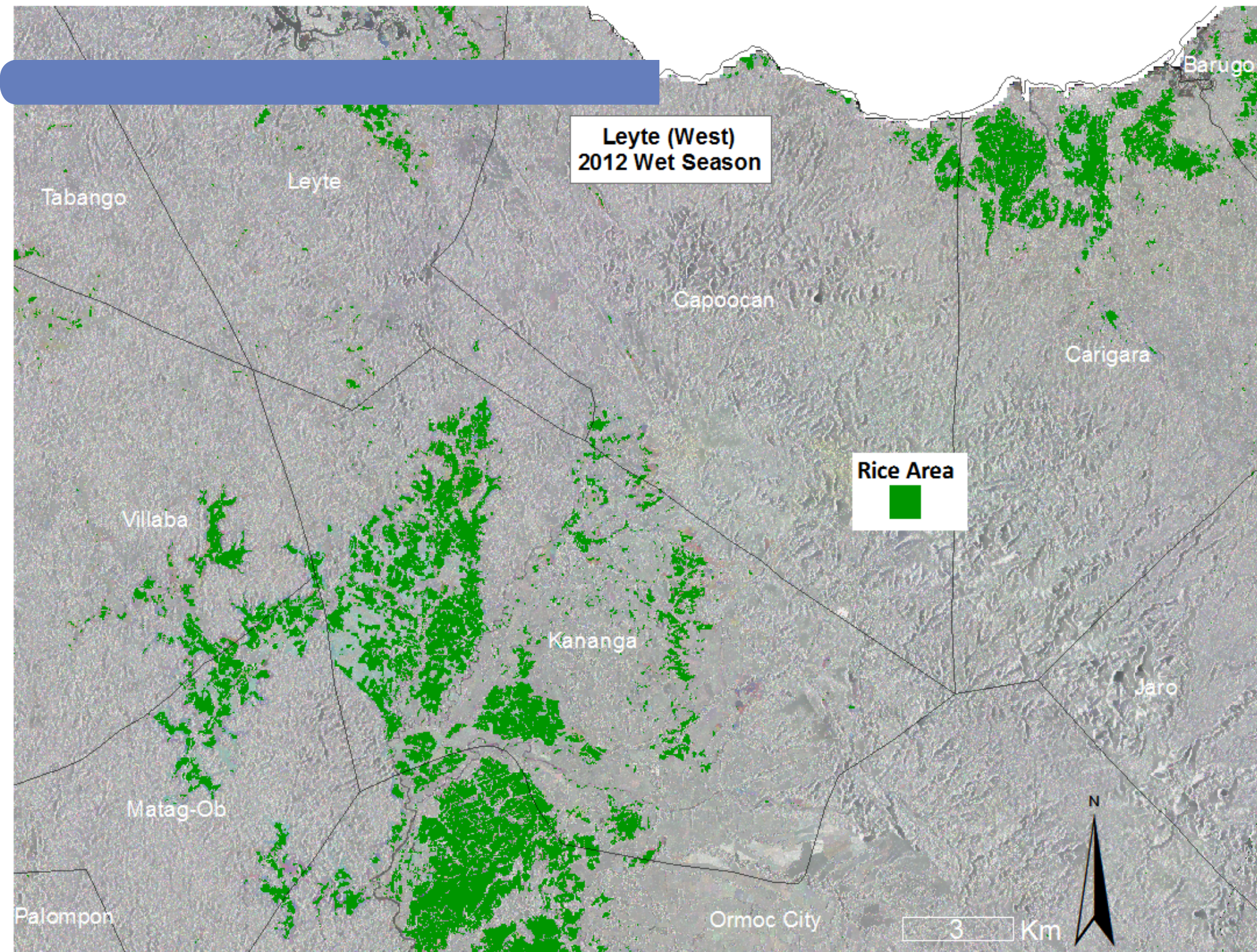
Linking SAR-based remote sensing data (CSK-LAI) with ORYZA2000 (O2K) *Ex-ante Simulation (Forecasting)*

Duration of Forecast (days)



Forecast without RS
= 6.2 Mg/ha

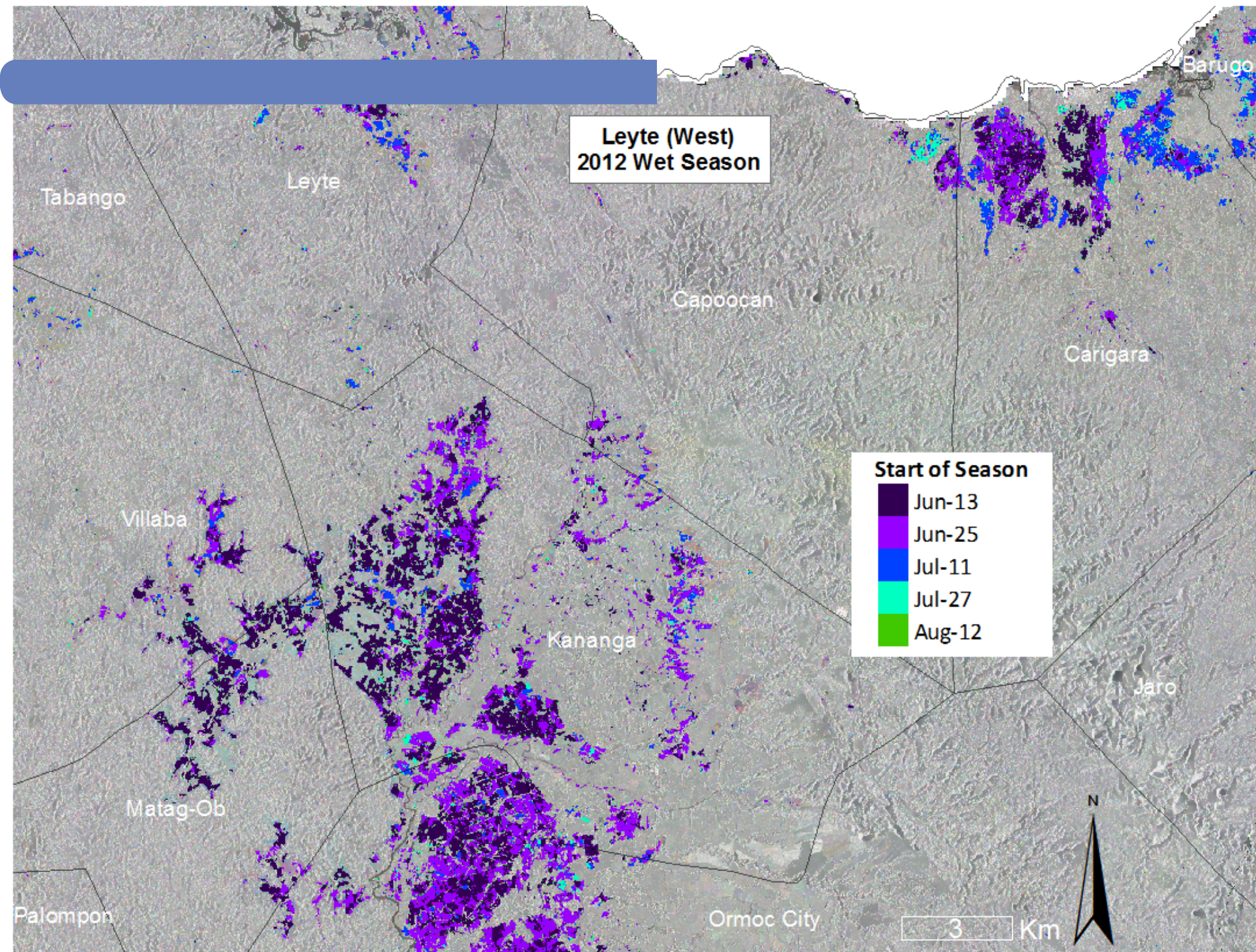




**Leyte (West)
2012 Wet Season**

Start of Season

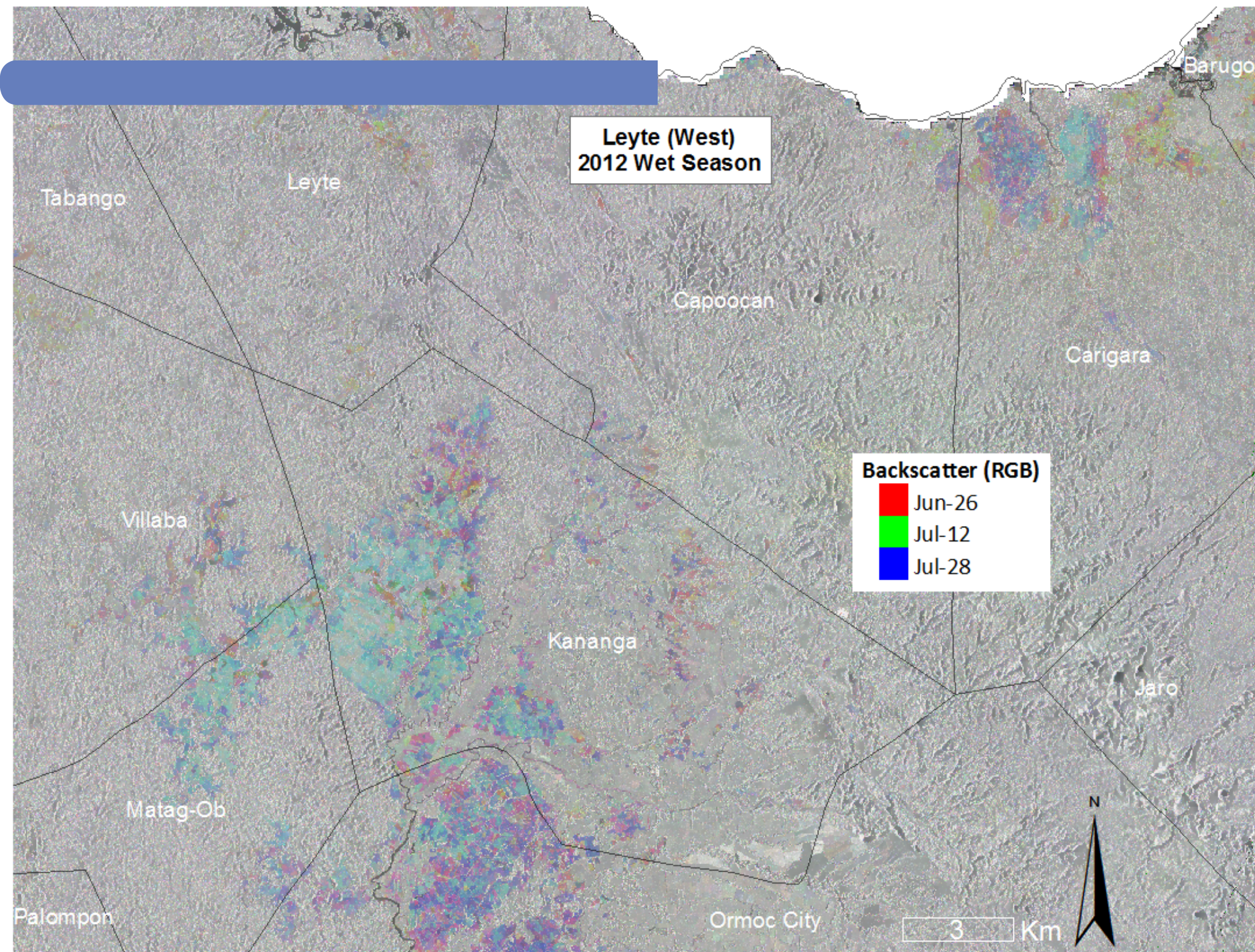
- Jun-13
- Jun-25
- Jul-11
- Jul-27
- Aug-12



**Leyte (West)
2012 Wet Season**

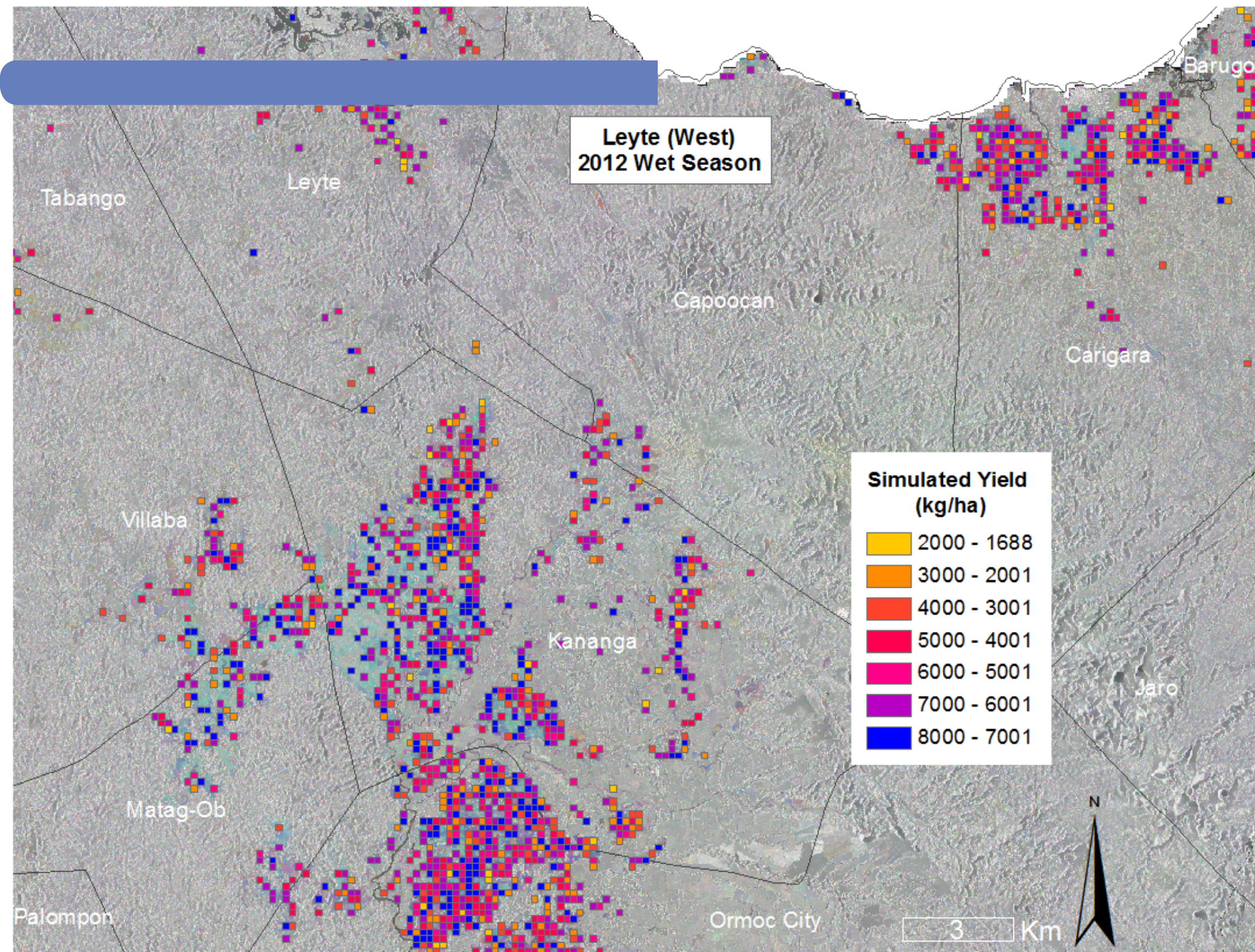
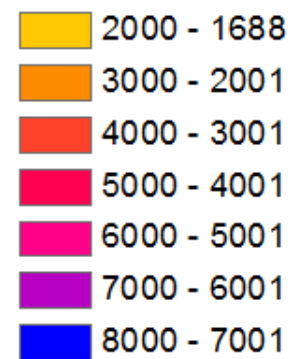
Backscatter (RGB)

Jun-26
Jul-12
Jul-28

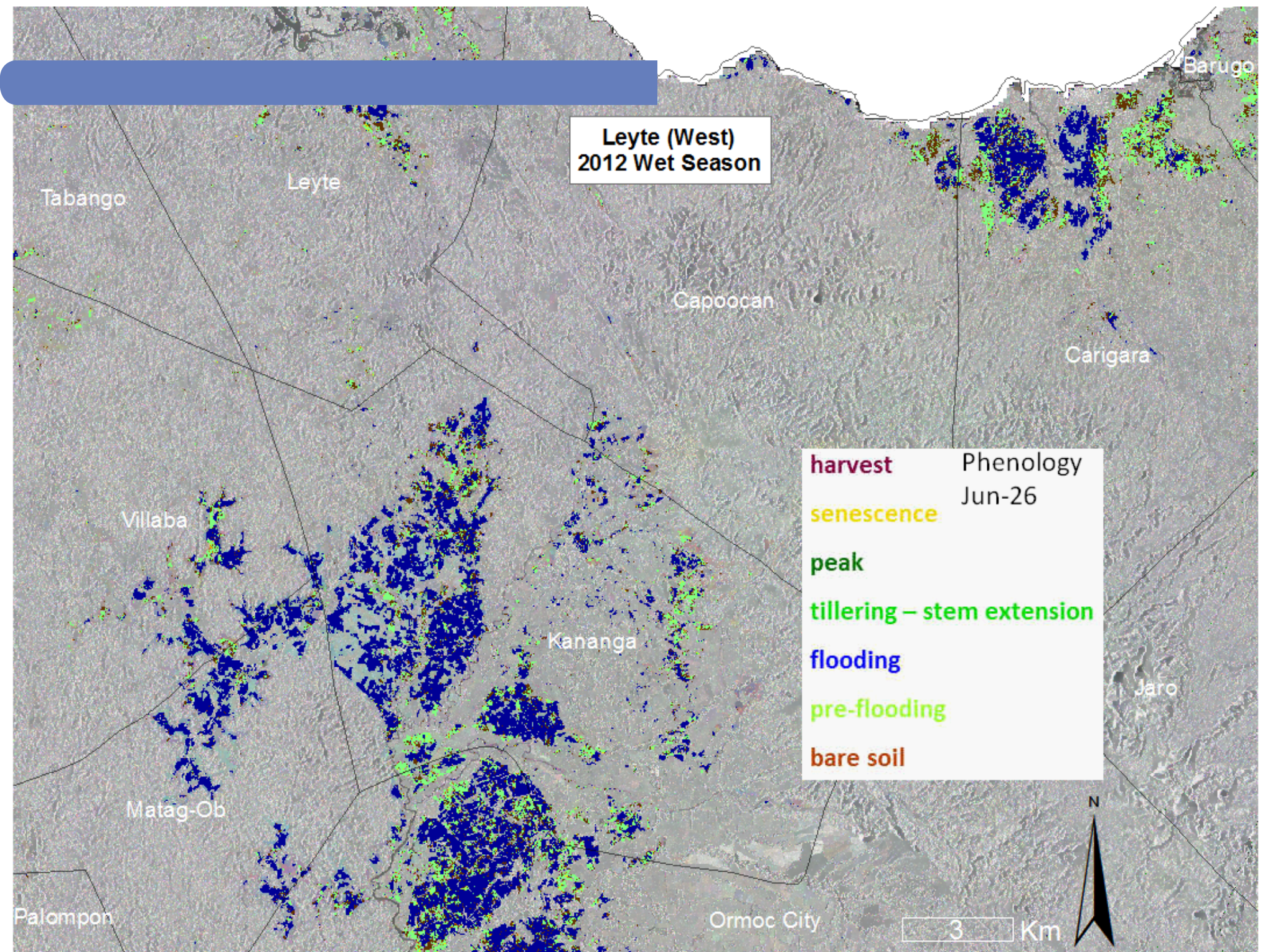


**Leyte (West)
2012 Wet Season**

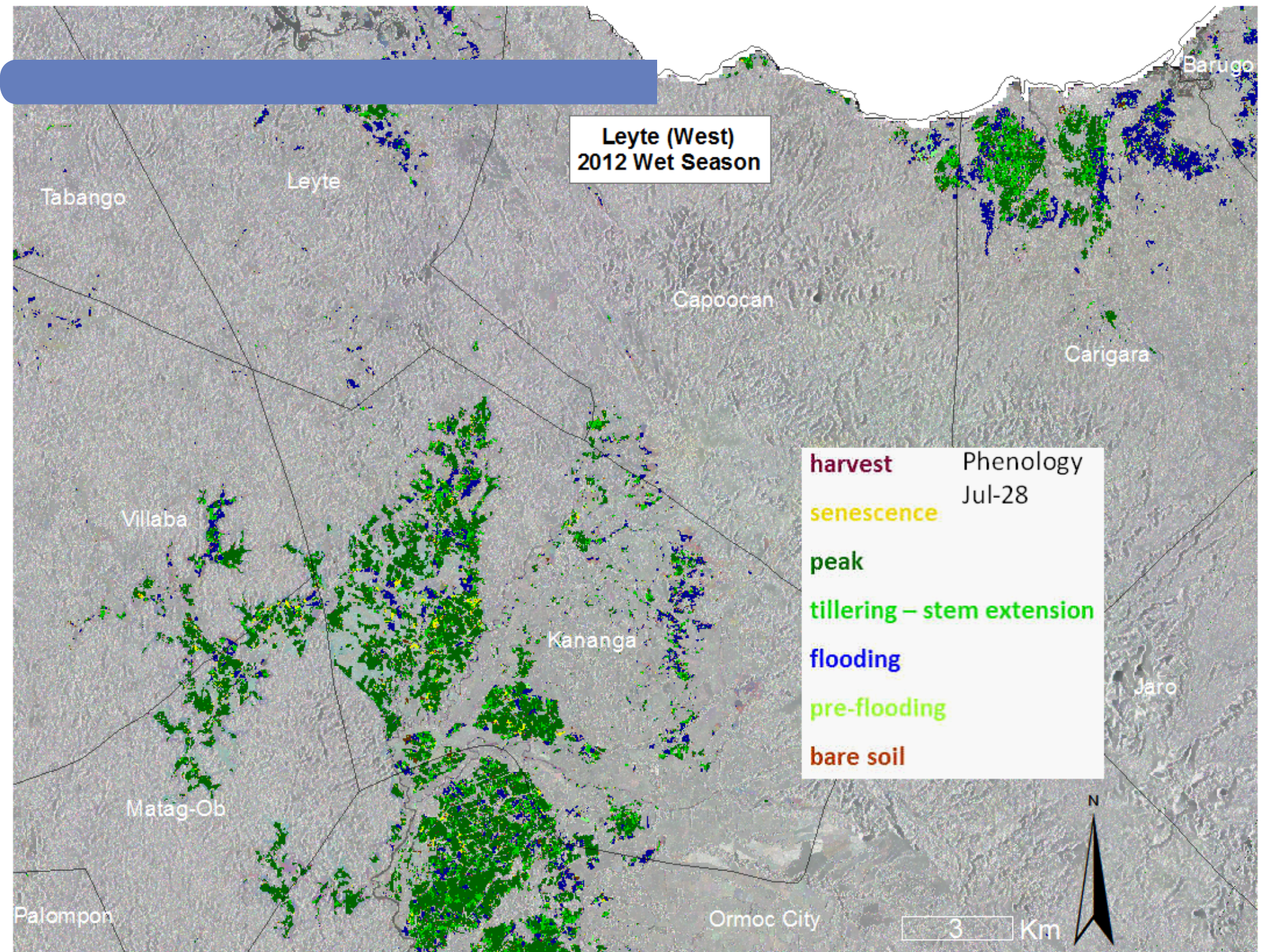
**Simulated Yield
(kg/ha)**



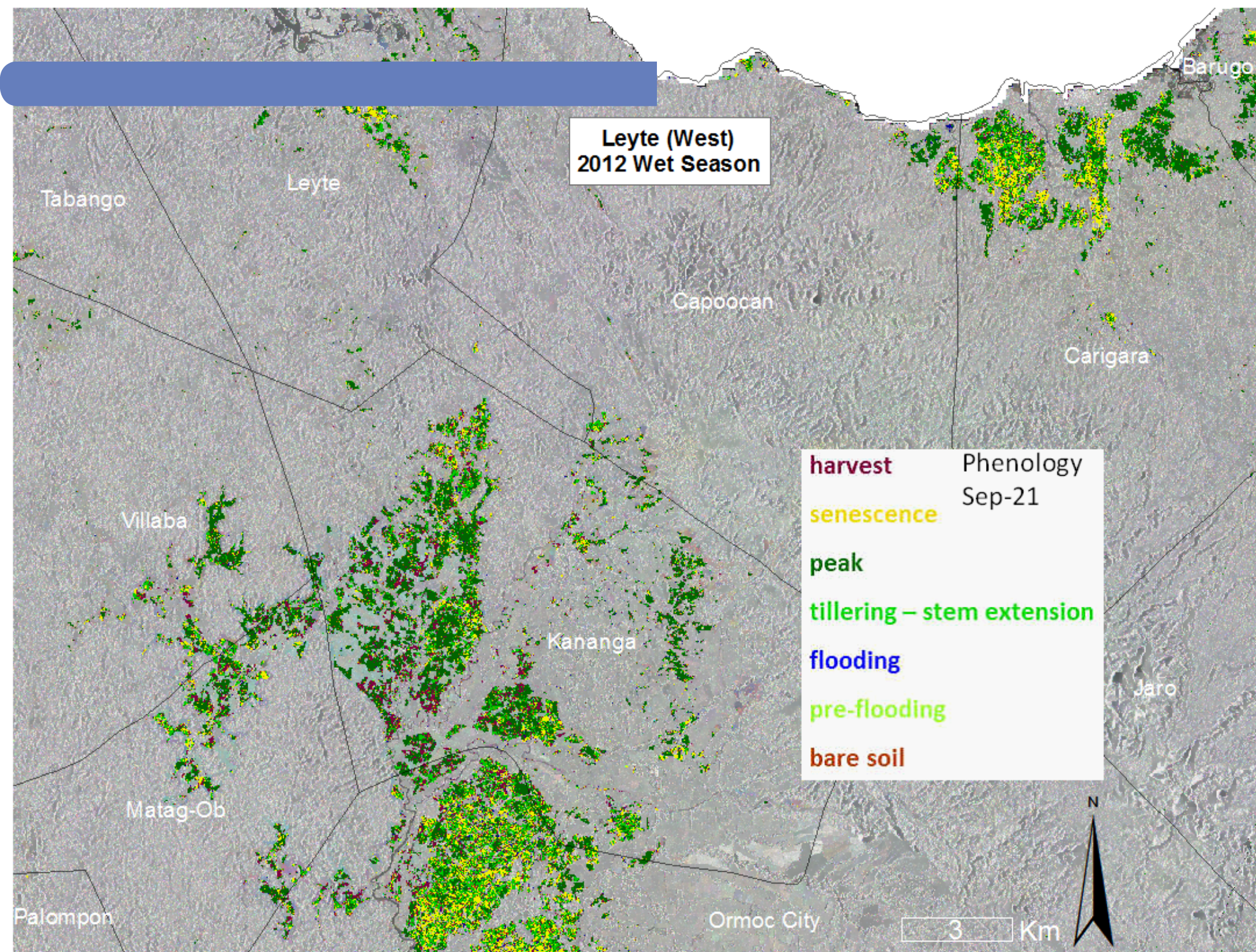
**Leyte (West)
2012 Wet Season**



**Leyte (West)
2012 Wet Season**



**Leyte (West)
2012 Wet Season**



Thank You!

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<http://www.riice.org>

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for a Better World

