

Carbon Budget and Process Network in a Rice Paddy

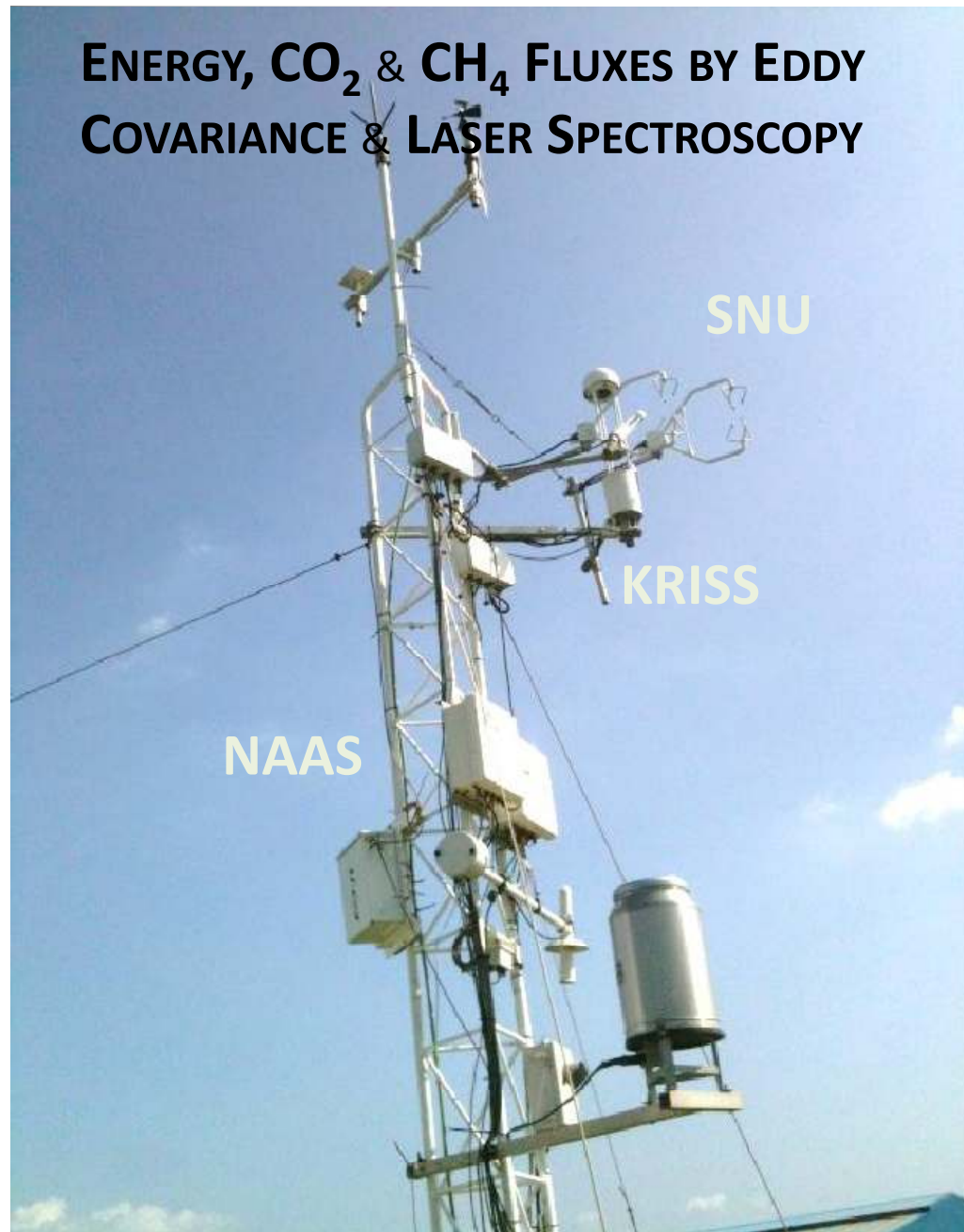
Joon Kim^{1,2*}, Juyeol Yun¹, Namgoo Kang³ and
Kyo Moon Shim⁴

1. *Complex Systems Science Lab., Dept. of Landscape Architecture & Rural Systems Engineering, Seoul National University (SNU), Korea*
2. *Interdisciplinary Program in Agricultural & Forest Meteorology, SNU, Korea*
3. *Korea Research Institute of Standards and Science (KRISS), Korea*
4. *National Academy of Agricultural Science (NAAS), Korea*

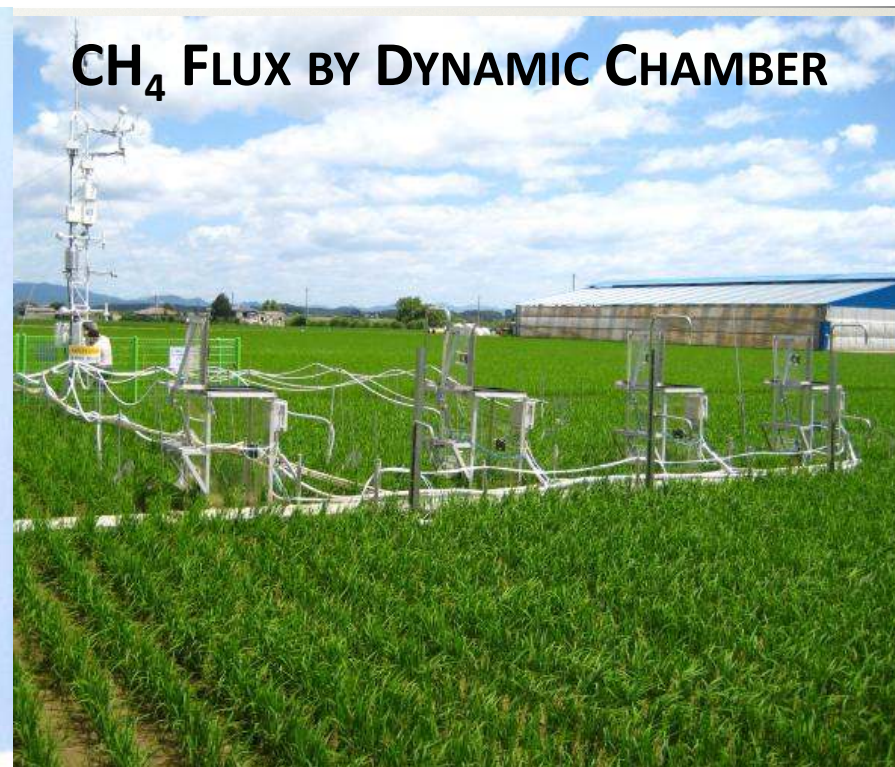
*joon@snu.ac.kr



ENERGY, CO₂ & CH₄ FLUXES BY EDDY COVARIANCE & LASER SPECTROSCOPY



CH₄ FLUX BY DYNAMIC CHAMBER



AsiaFlux GRK

(32°44'N, 126°51'E)

Rice Paddy site, Gimje, Korea



AsiaFlux Tower Network

AsiaFlux (www.asiaflux.org) is the Asian arm of FLUXNET, the worldwide research network of flux monitoring towers for carbon, water and energy cycles in terrestrial ecosystems

Just like GAW, we're the watchmen on the towers, working and taking care of key ecosystems in Asia

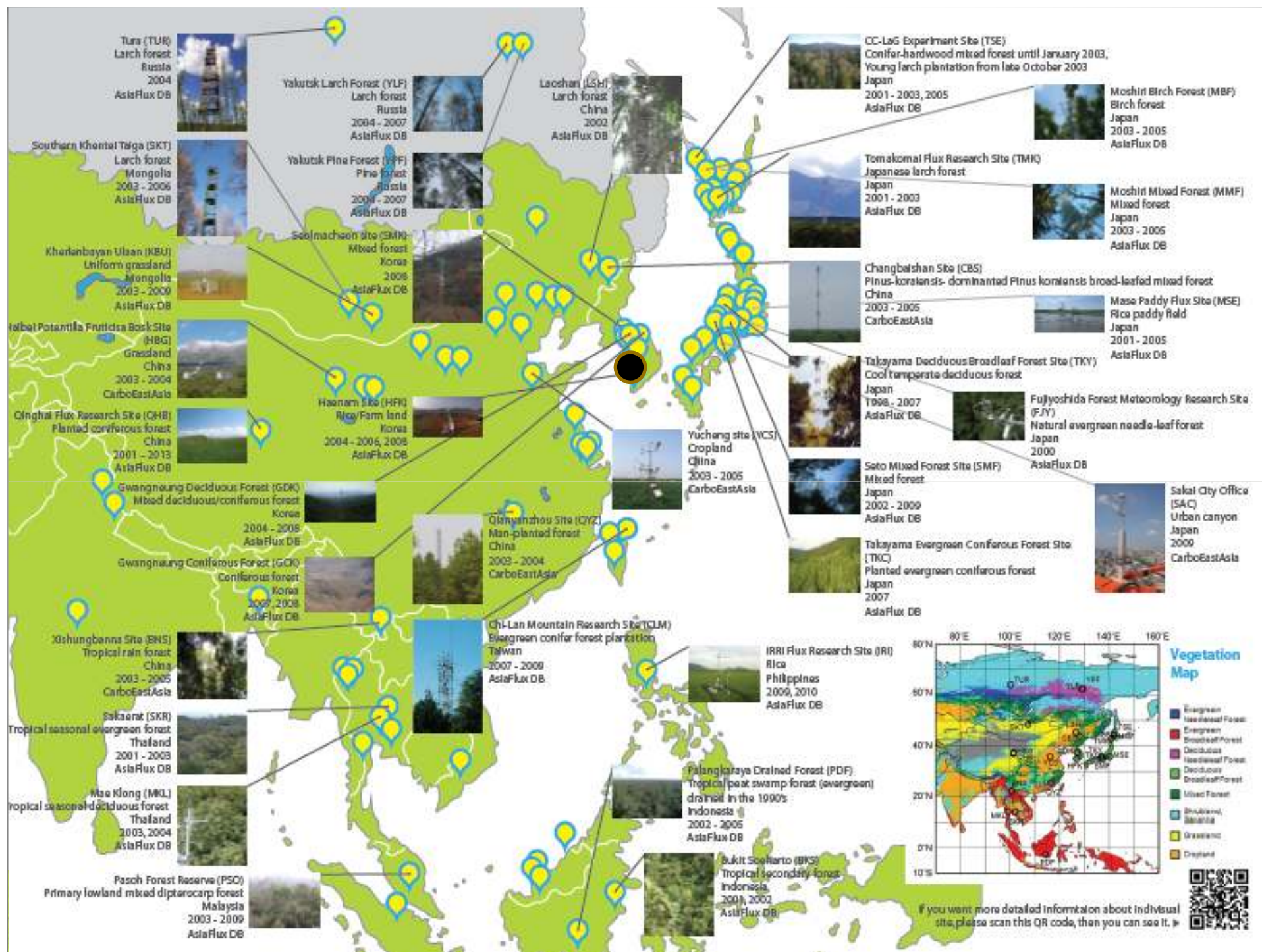


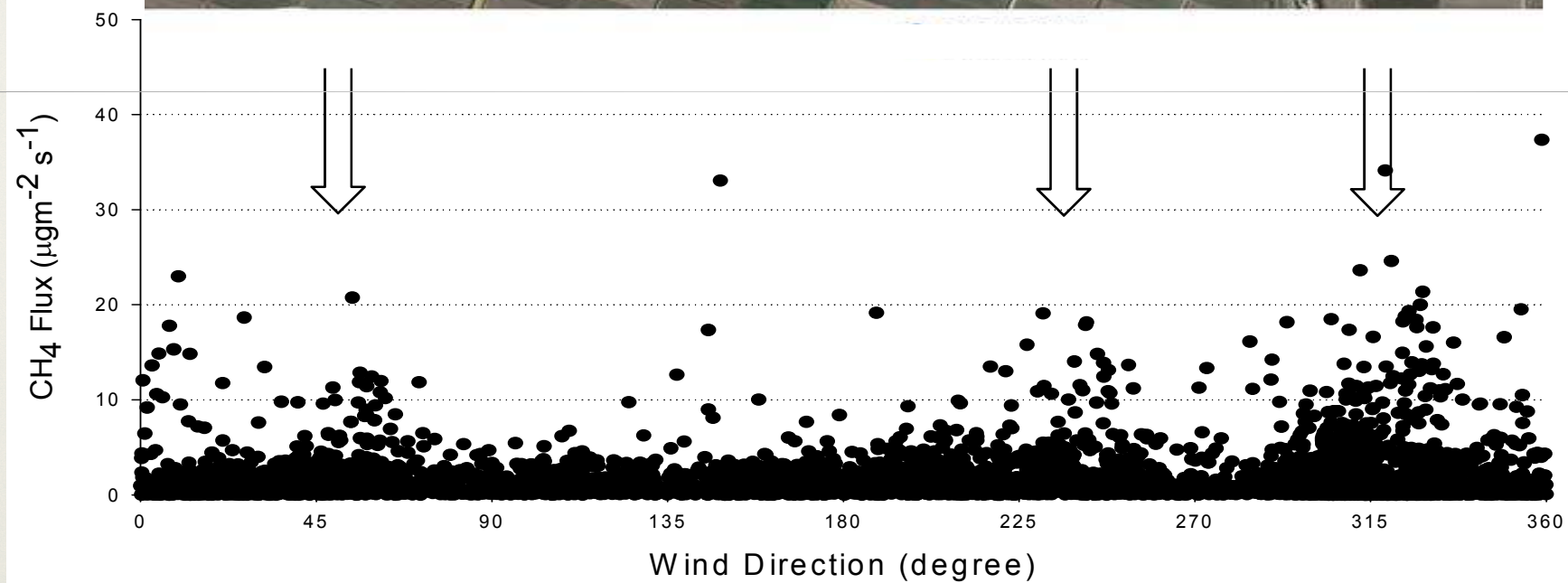
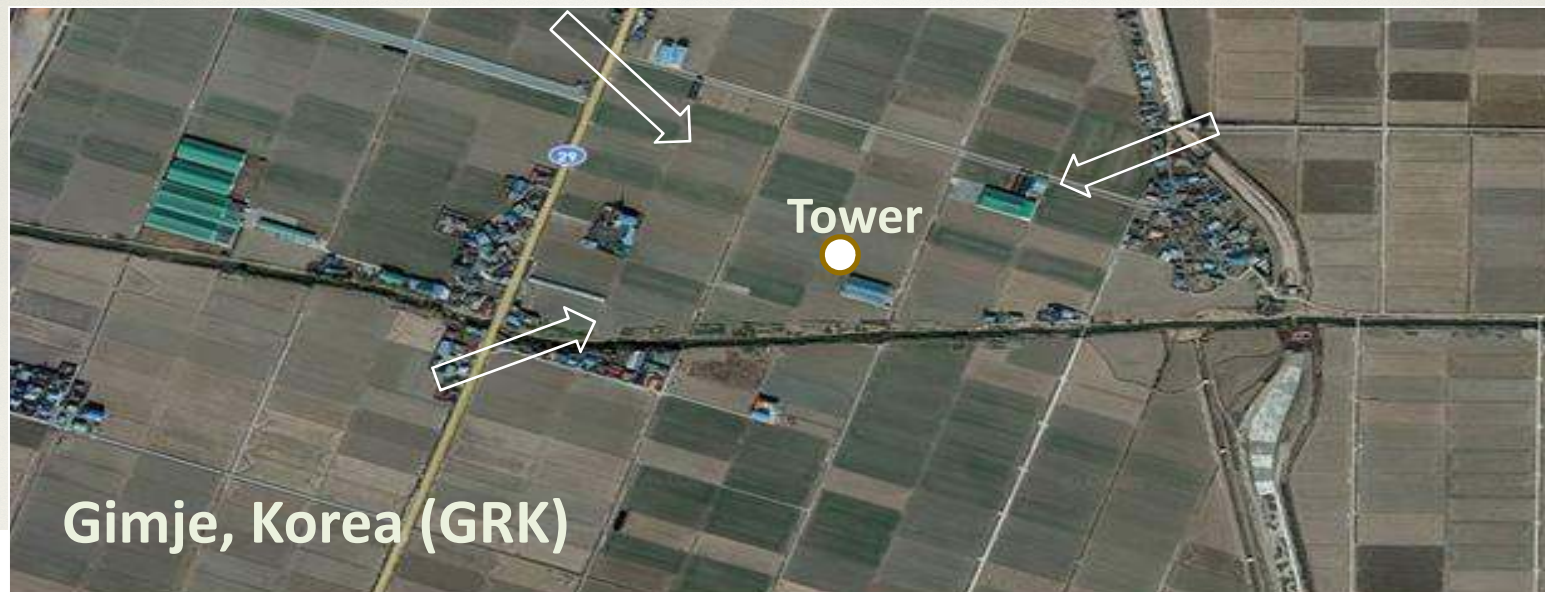
AsiaFlux Vision

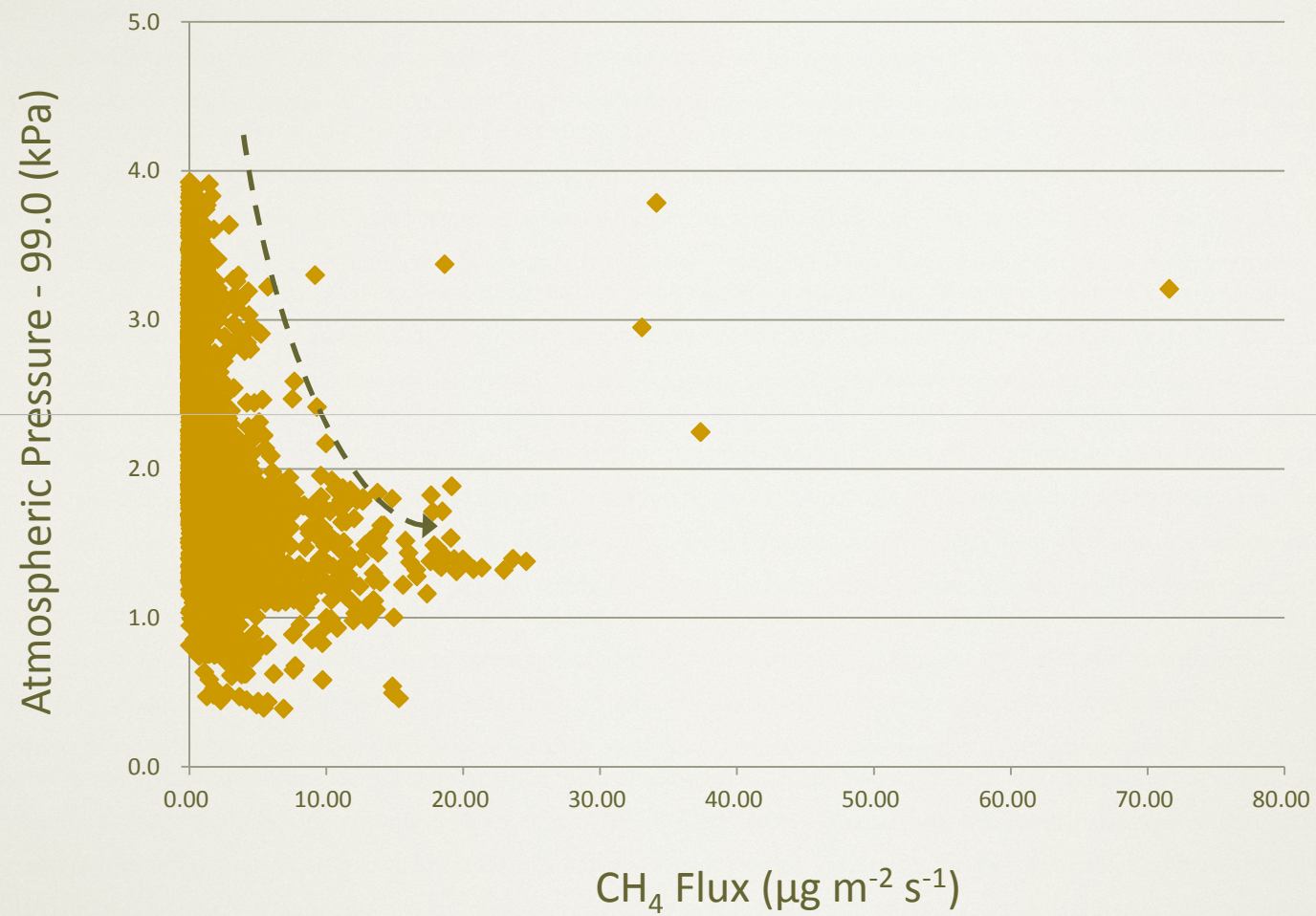
a community where science & technology work more directly for sustainable ecological-societal systems in Asia by focusing on :

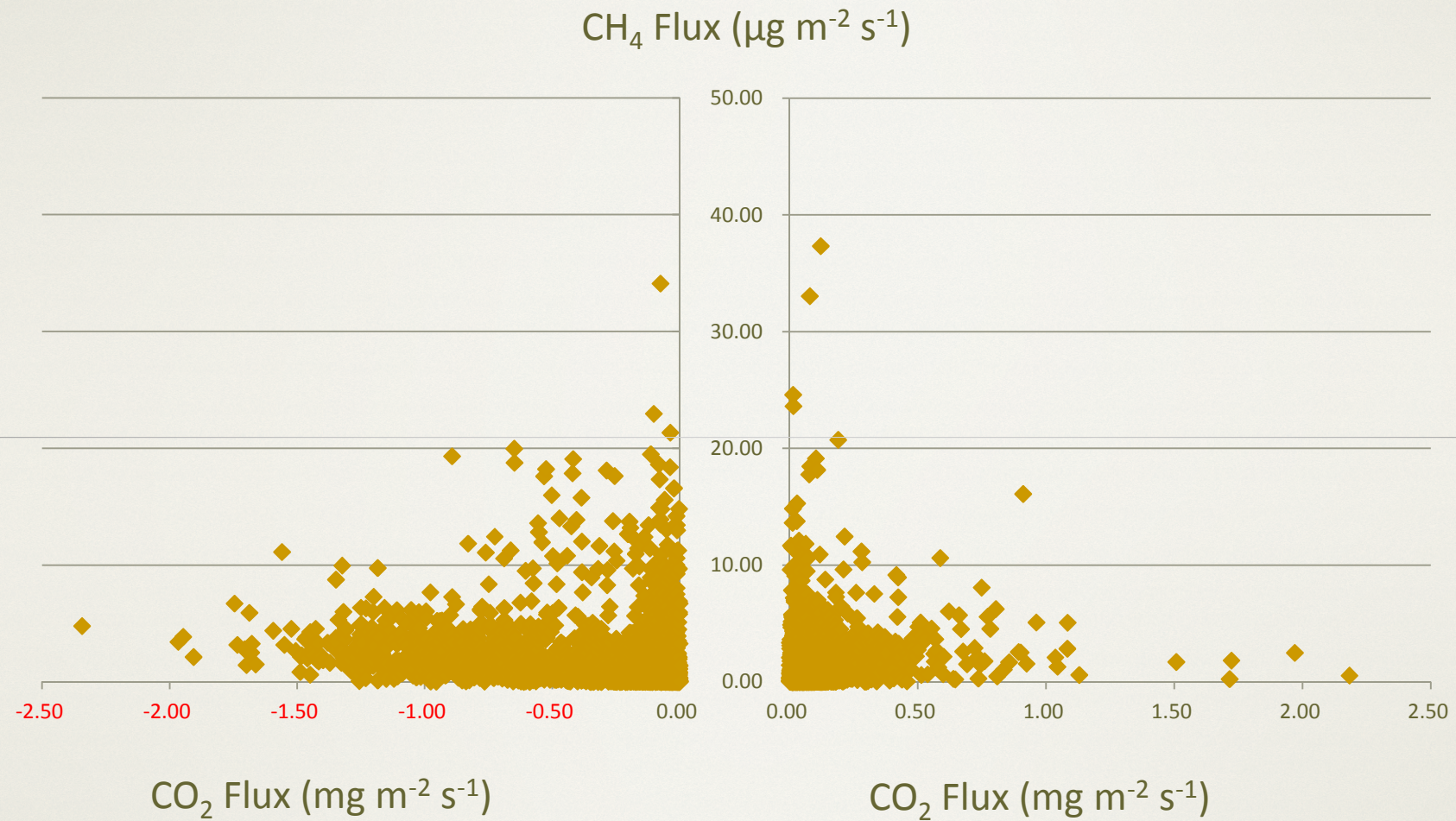
- (1) developing collaborative researches and datasets on energy, matter, and information flows in key ecosystems in Asia;
- (2) providing workshops and training on current and future challenges posed by global change;
- (3) cultivating the next generation of scientists with skills and perspectives enabling them to engage in regional sustainability challenges in Asia as informed leaders and stewards.











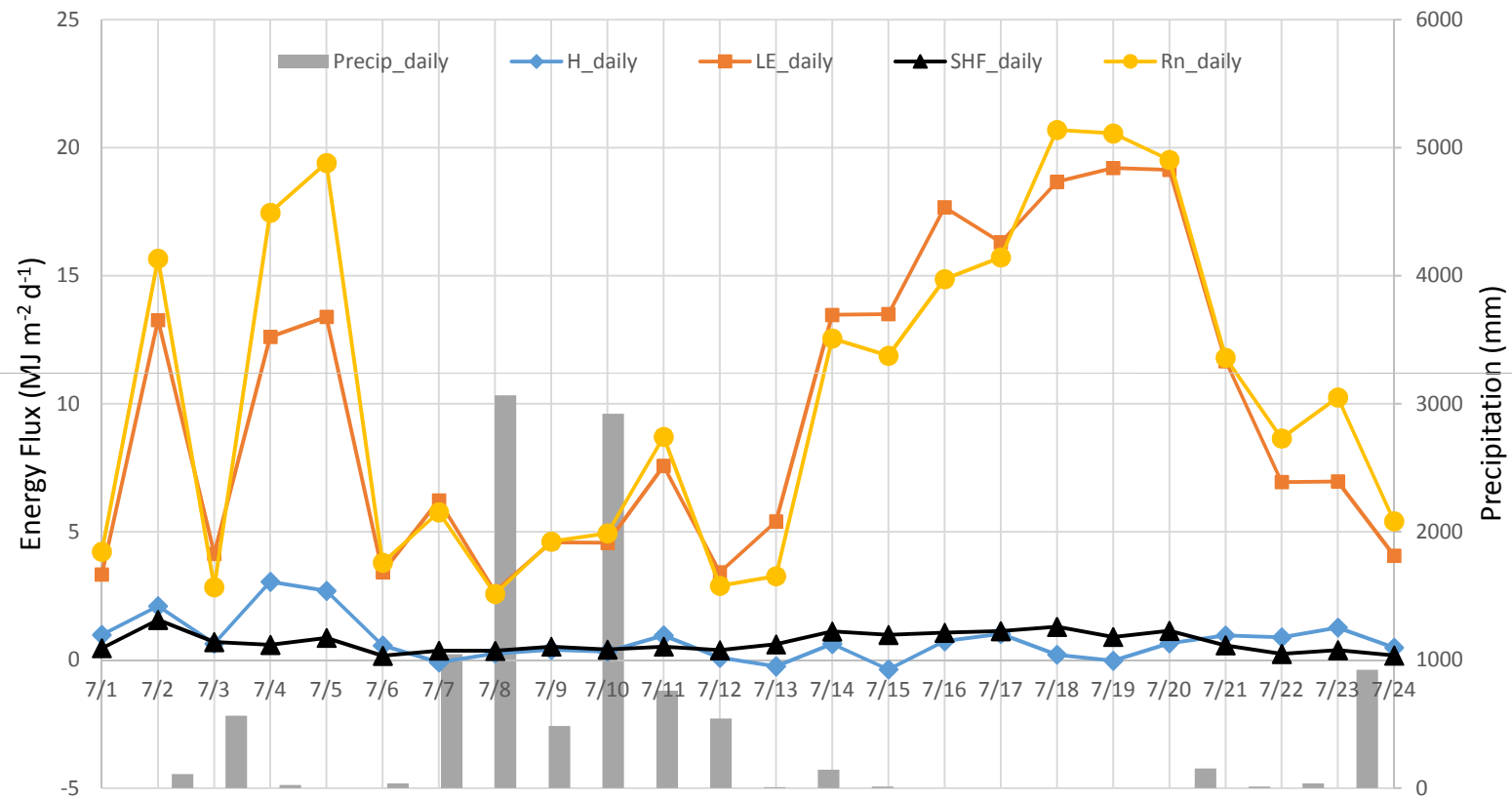
Energy Balance (GRK)

1. Green-Up / Tillering (7/1 ~ 7/24)

rice transplanting on 6/19, water-logged

LAI = 1.2 Precip = 1084 mm

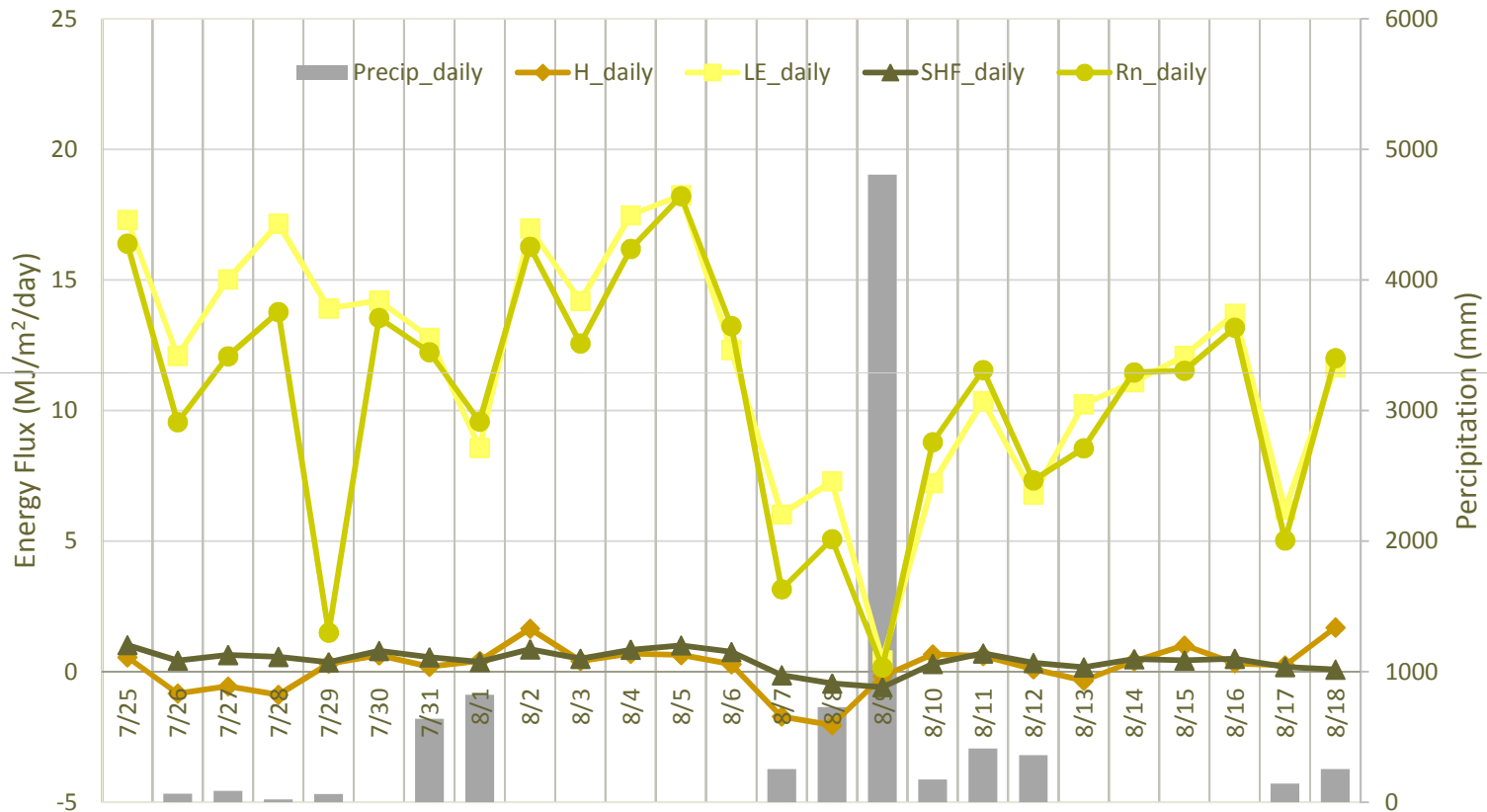
MJ m ⁻² d ⁻¹	H	LE	SHF	Rn
Mean	0.8	9.7	0.7	10.3
SD	0.9	5.8	0.4	6.4



Energy Balance (GRK)

2. Peak Growth / Heading (7/25 ~ 8/18)
water drained on 7/25, fertilized on 8/19
LAI = 3.0 Precip = 885 mm

MJ m ⁻² d ⁻¹	H	LE	SHF	Rn
Mean	0.2	11.7	0.4	10.5
SD	0.9	4.4	0.4	4.7



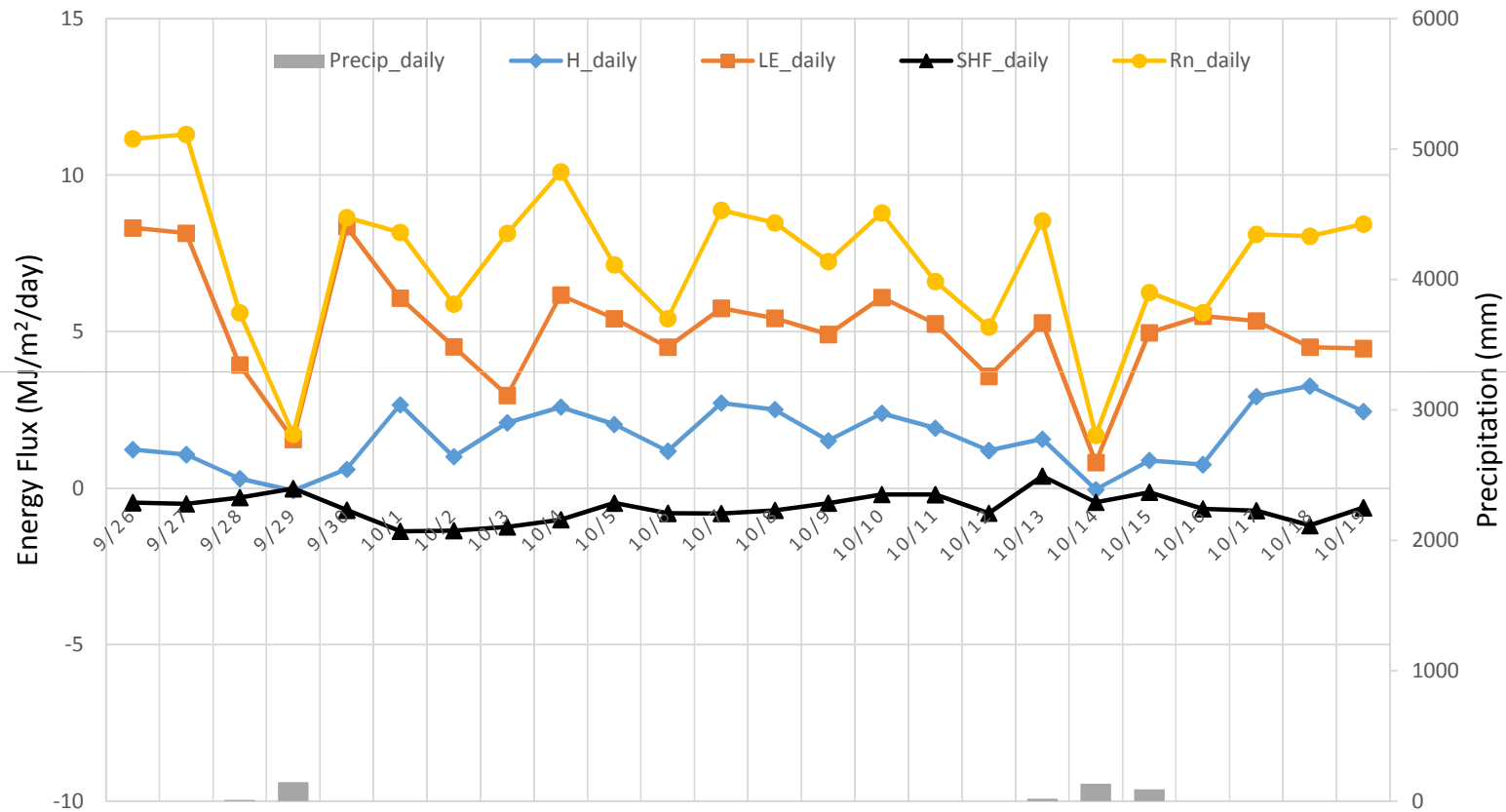
Energy Balance (GRK)

4. Senescence (9/26 ~ 10/15)

drained on 9/26, harvest on 10/16

LAI = 5.0 Precip = 40 mm

MJ m ⁻² d ⁻¹	H	LE	SHF	Rn
Mean	1.6	5.1	-0.6	7.3
SD	1.0	1.8	0.4	2.4



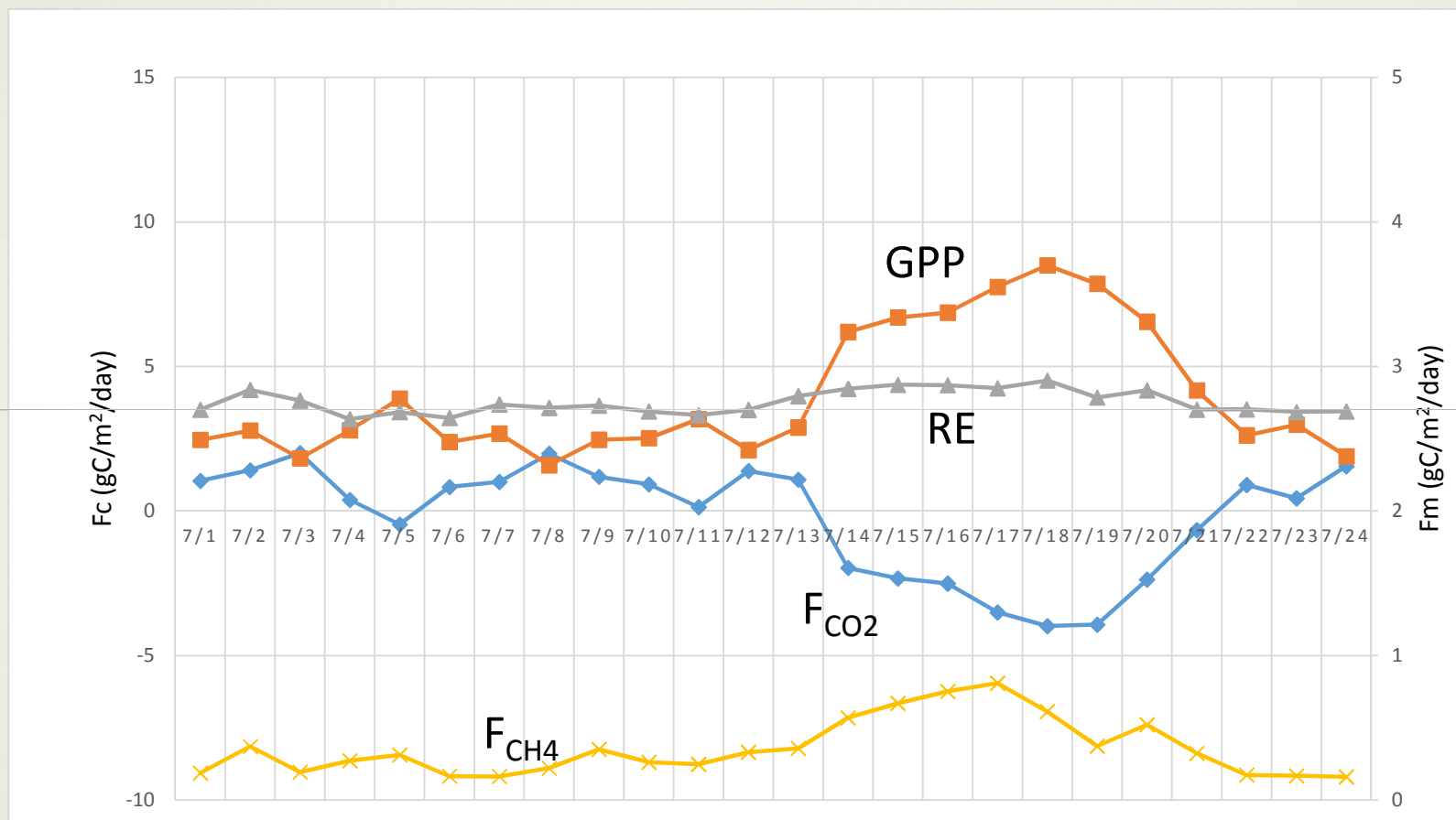
Carbon Balance (GRK)

1. Green-Up / Tillering (7/1 ~ 7/24)

rice transplanting on 6/19, water-logged

LAI = 1.2 Precip = 1084 mm

$\text{gCm}^{-2}\text{d}^{-1}$	F_{CO_2}	GPP	RE	F_{CH_4}
total	-5.5	95.7	90.2	8.6
average	-0.2	4.0	3.8	0.4
stdev	1.9	2.2	0.4	0.2



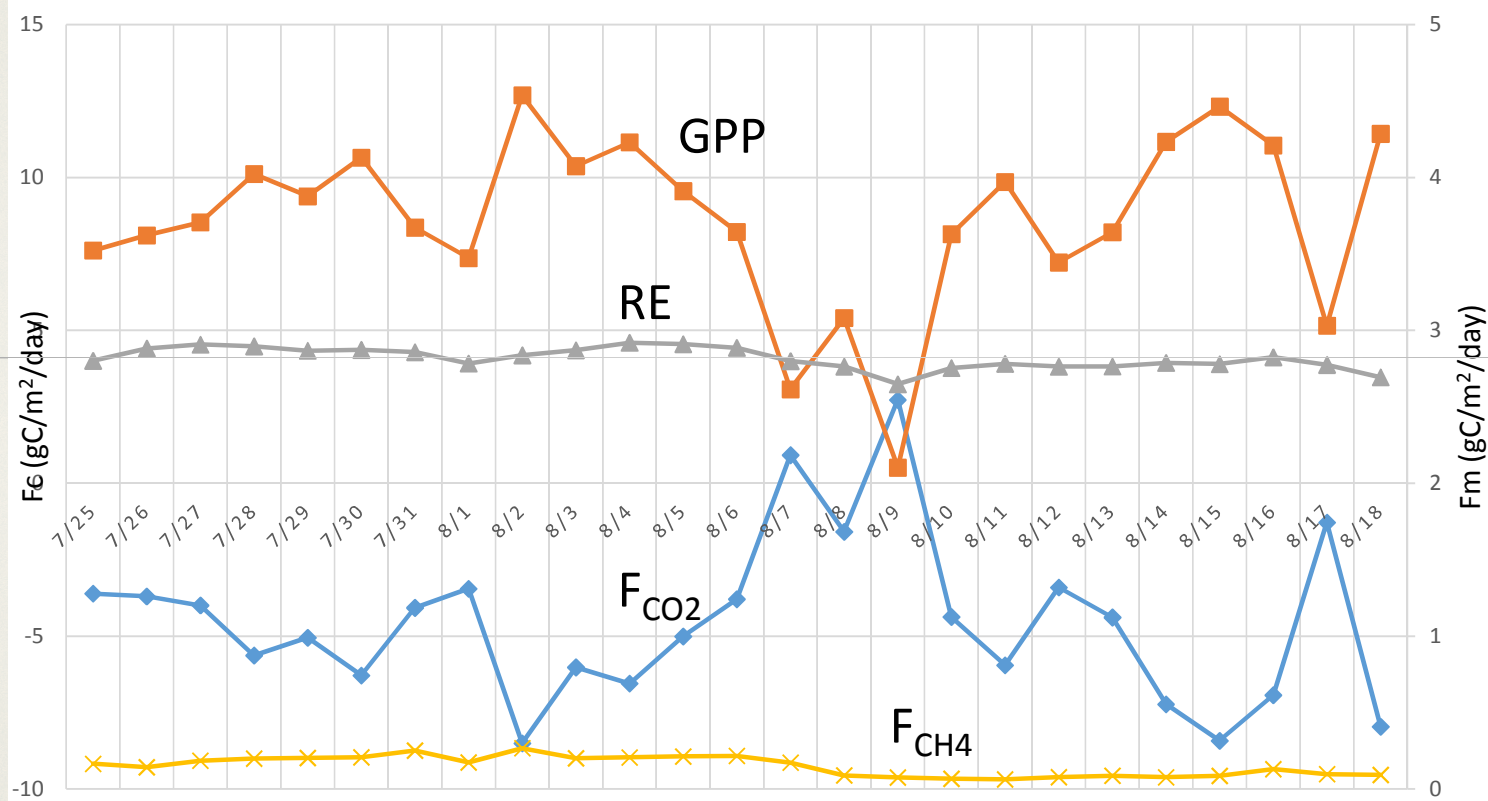
Carbon Balance (GRK)

2. Peak Growth / Heading (7/25 ~ 8/18)

water drained on 7/25, fertilized on 8/19

LAI = 3.0 Precip = 885 mm

$\text{gCm}^{-2}\text{d}^{-1}$	F_{CO_2}	GPP	RE	F_{CH_4}
total	-113.5	215.7	102.1	3.8
average	-4.5	8.6	4.1	0.2
stdev	2.7	2.8	0.4	0.1



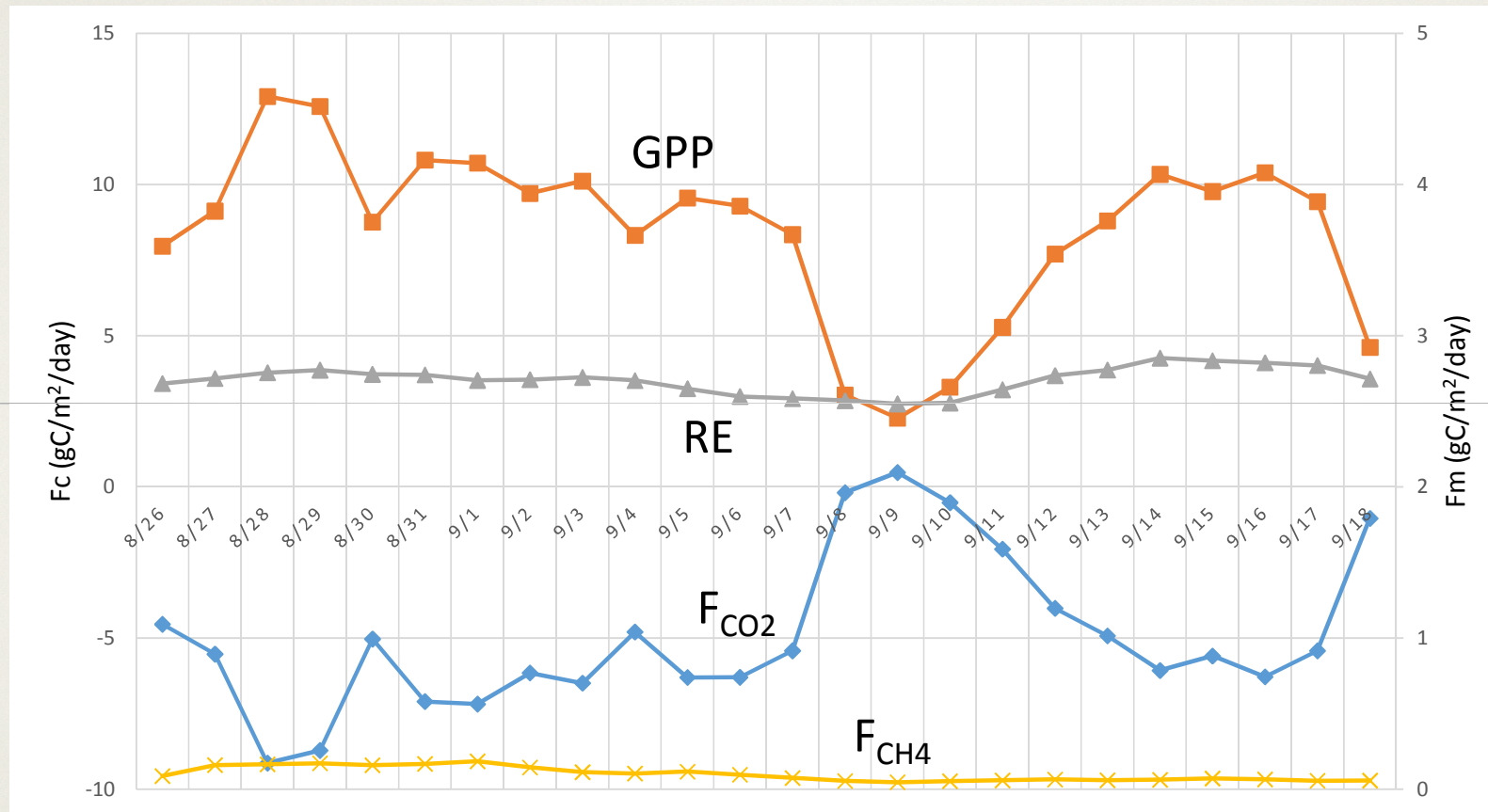
Carbon Balance (GRK)

3. Grain-Filling (8/26 ~ 9/18)

irrigation/drainage from 8/26

LAI = 4.6 Precip = 121 mm

$\text{gCm}^{-2}\text{d}^{-1}$	F_{CO_2}	GPP	RE	F_{CH_4}
total	-118.4	203.1	84.7	2.4
average	-4.9	8.5	3.5	0.1
stdev	2.6	2.8	0.4	0.1



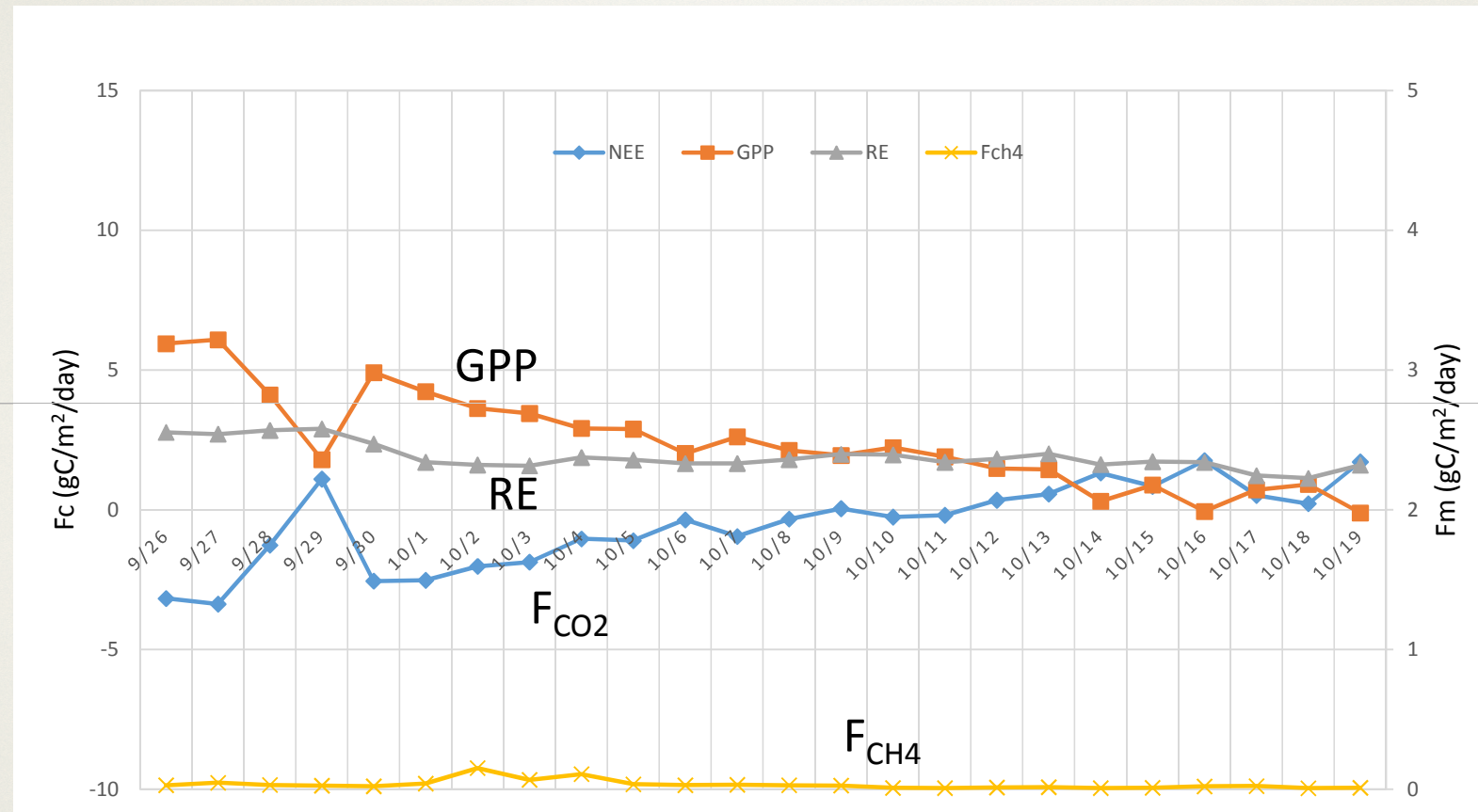
Carbon Balance (GRK)

4. Senescence (9/26 ~ 10/15)

drained on 9/26, harvest on 10/16

LAI = 5.0 Precip = 40 mm

$\text{gCm}^{-2}\text{d}^{-1}$	F_{CO_2}	GPP	RE	F_{CH_4}
total	-12.6	58.3	45.7	0.8
average	-0.5	2.4	1.9	0.0
stdev	1.5	1.7	0.5	0.0



Carbon Balance in Rice Paddy

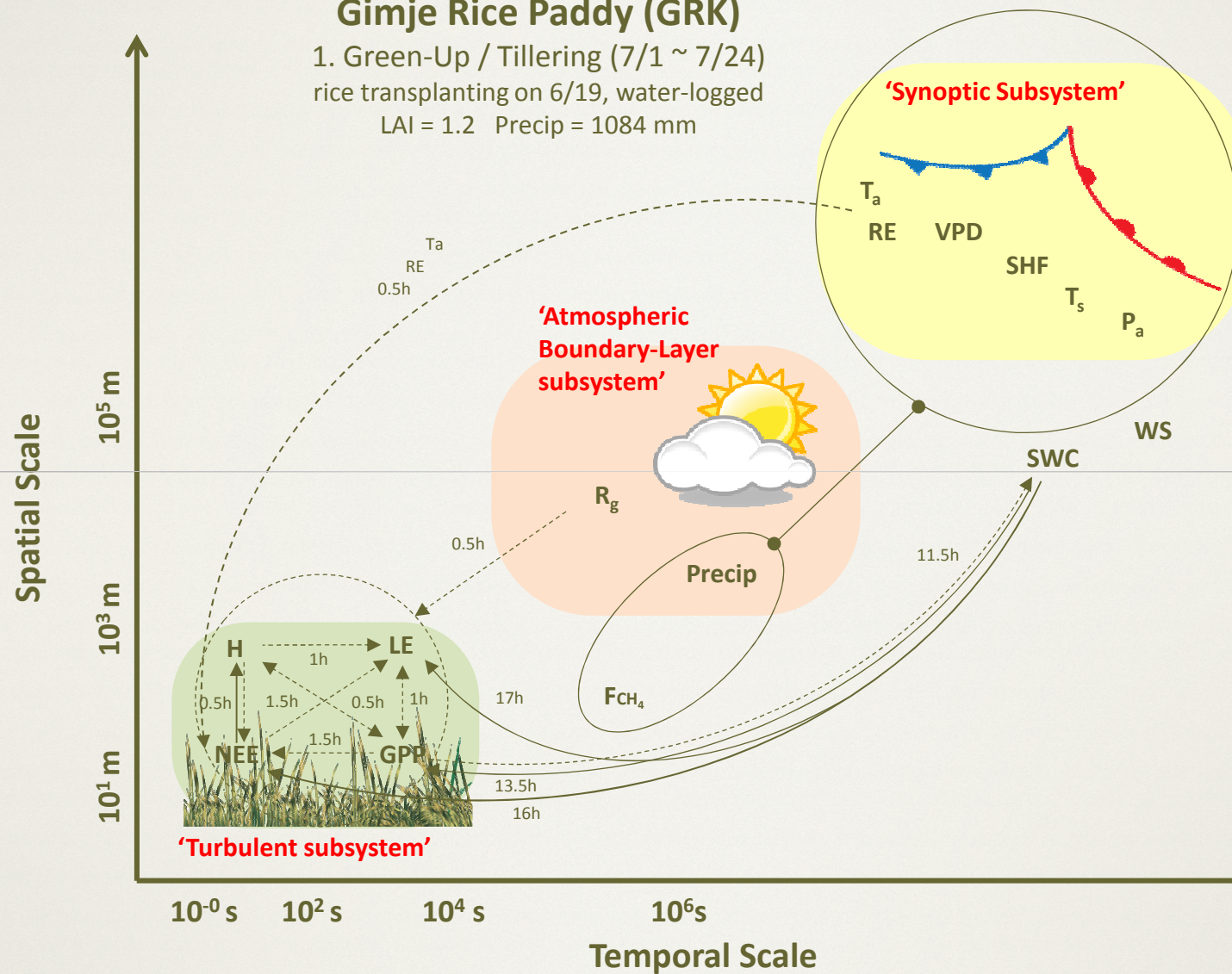
(after Transplantation to Harvest)

7/1-11/19 (142 days)	GPP	RE	F_{CO2} F_{CH4}	
	(g C m ⁻²)			
Sum	702	412	-289	17*
SD	3.8	1.1	3.1	0.2

* higher global warming potential

Gimje Rice Paddy (GRK)

1. Green-Up / Tillering (7/1 ~ 7/24)
rice transplanting on 6/19, water-logged
LAI = 1.2 Precip = 1084 mm

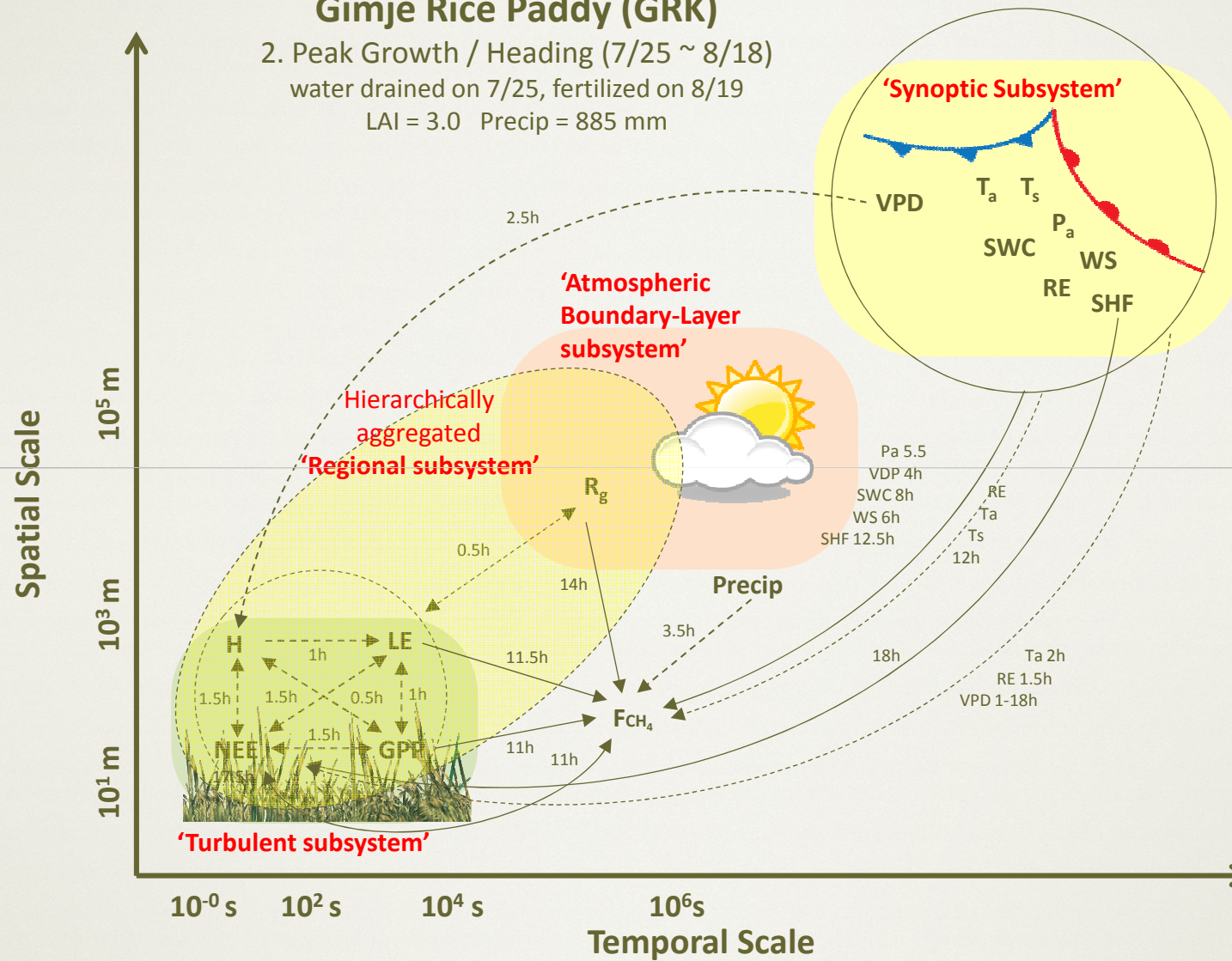


Gimje Rice Paddy (GRK)

2. Peak Growth / Heading (7/25 ~ 8/18)

water drained on 7/25, fertilized on 8/19

LAI = 3.0 Precip = 885 mm



Key message

- Flux tower networks provide unique DB for understanding ecosystem processes & responses to environmental change
- Monitoring energy, matter and information flows in ecological-societal systems requires new approaches (systems thinking, information-theoretic framework) for analysis and synthesis
- Communication between flux communities and GAW related communities becomes increasingly important
- Look forward to collaborations with GAW communities to establish standardized platforms for 'monitoring' - collection & synthesis of observations to narrative, providing feedback that serves as the source of learning for successful adaptation

Self-Organizing Hierarchical Open Systems Approach

