



G9-2: Applications of community land model (CLM3) to semi-arid Mongolian Grassland

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1. Background hydrometeorology in arid climate

- Smaller amount of Precipitation(P)
 - ✓ Larger fraction of E against P (larger E/P)
 - ✓ Smaller amount of P-E (available water resources)
- Larger Variability of P, E, P-E
 - ✓ At the scale of interannual and interseasonal
 - ✓ Linked with **vulnerability** of natural and social systems

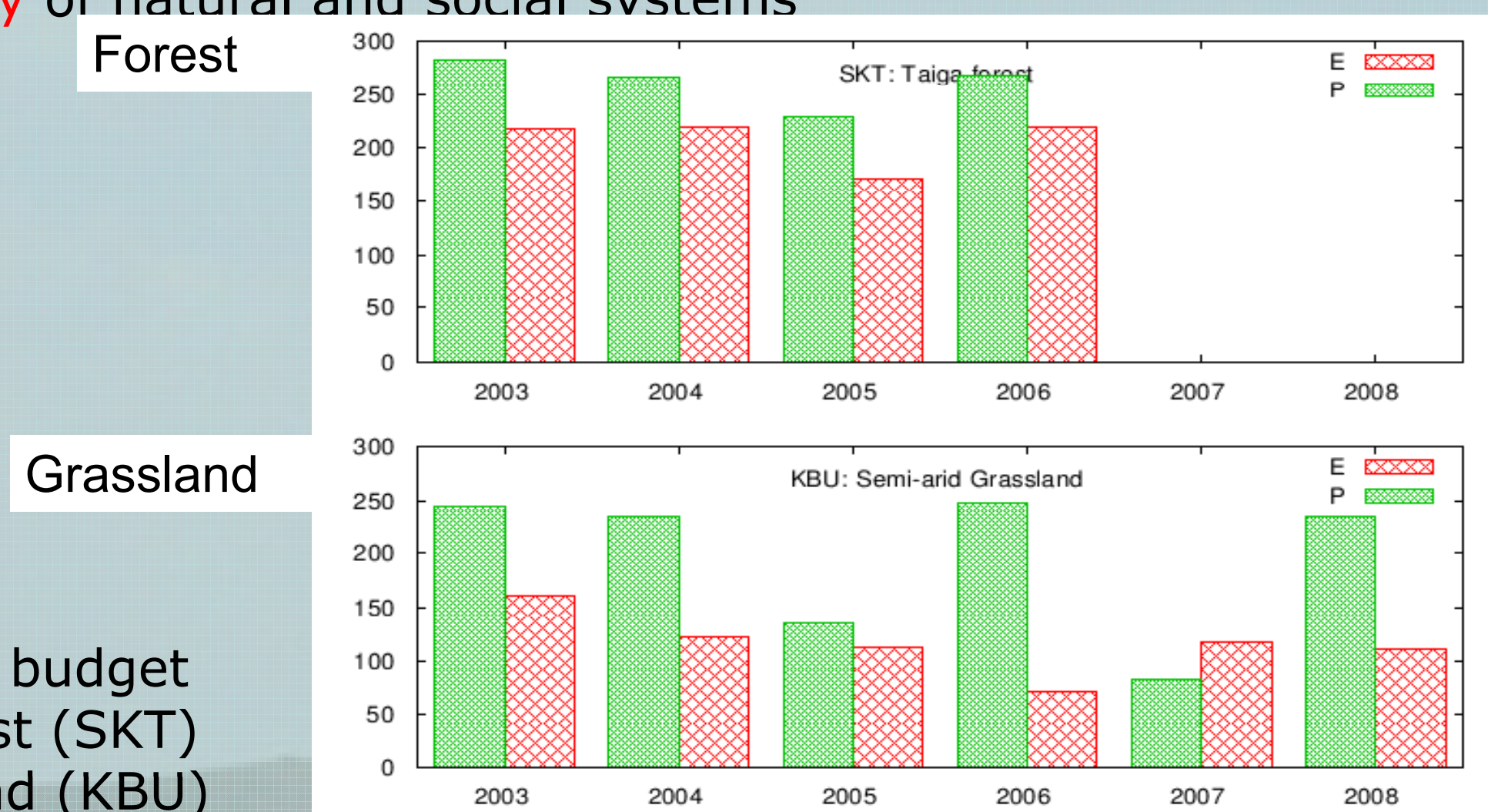


Figure 1: Multi-year water budget observed at a taiga forest (SKT) and a semi-arid grassland (KBU)

2. Goals

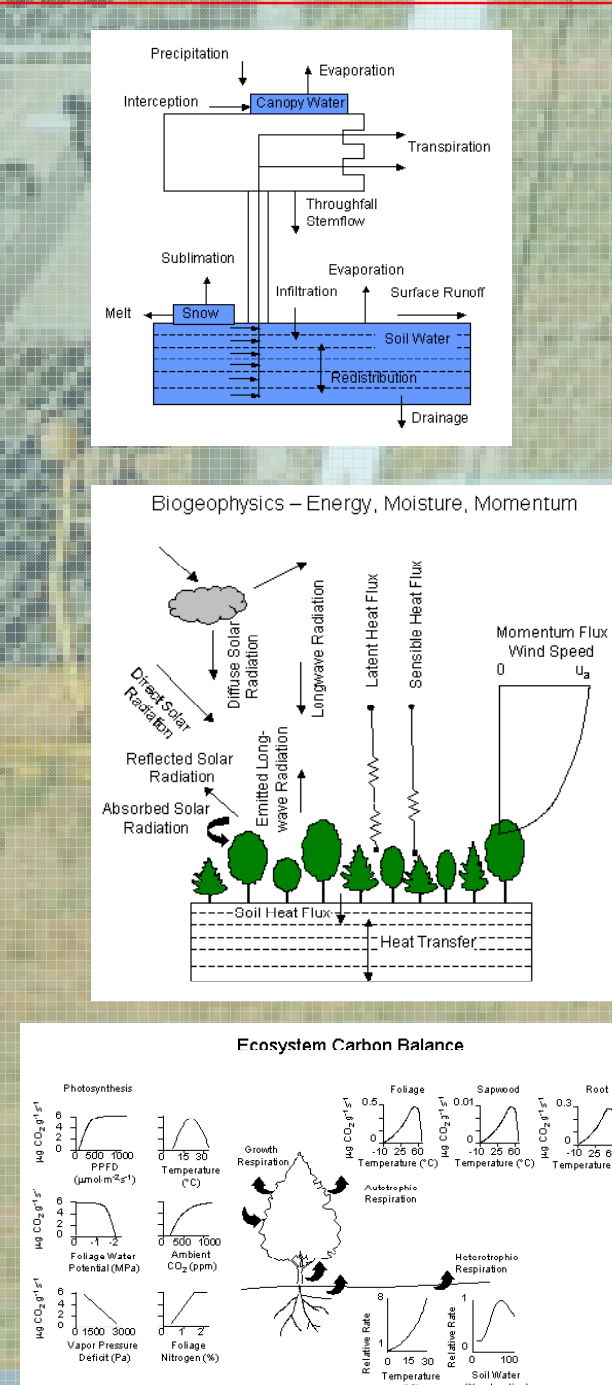
- To evaluate applicability of land surface models (LSMs) to Asian arid/semi-arid land surface, in order to answer the questions

- ✓ Are the variability of heat & water cycle reproducible with models?
- ✓ What is the key phenomena in energy and water cycle at arid landsurface?
- ✓ What is the key parameters in the models?

4. Model & model-run specifications

Model: Community land model (CLM) ver.3

- land surface fluxes
 - ✓transpiration: conductance-type
 - ✓CO₂: func(PAR, enzyme, etc)
- soil & snow processes
 - ✓10 layers, Richard's eqn
- Hydrology
 - ✓discharge, infiltration
- Radiation
 - ✓radiation transfer model within canopy
- Othres (not used here)
 - ✓dynamic vegetation, bVOC
 - ✓biogeochemistry



Specifications of computation

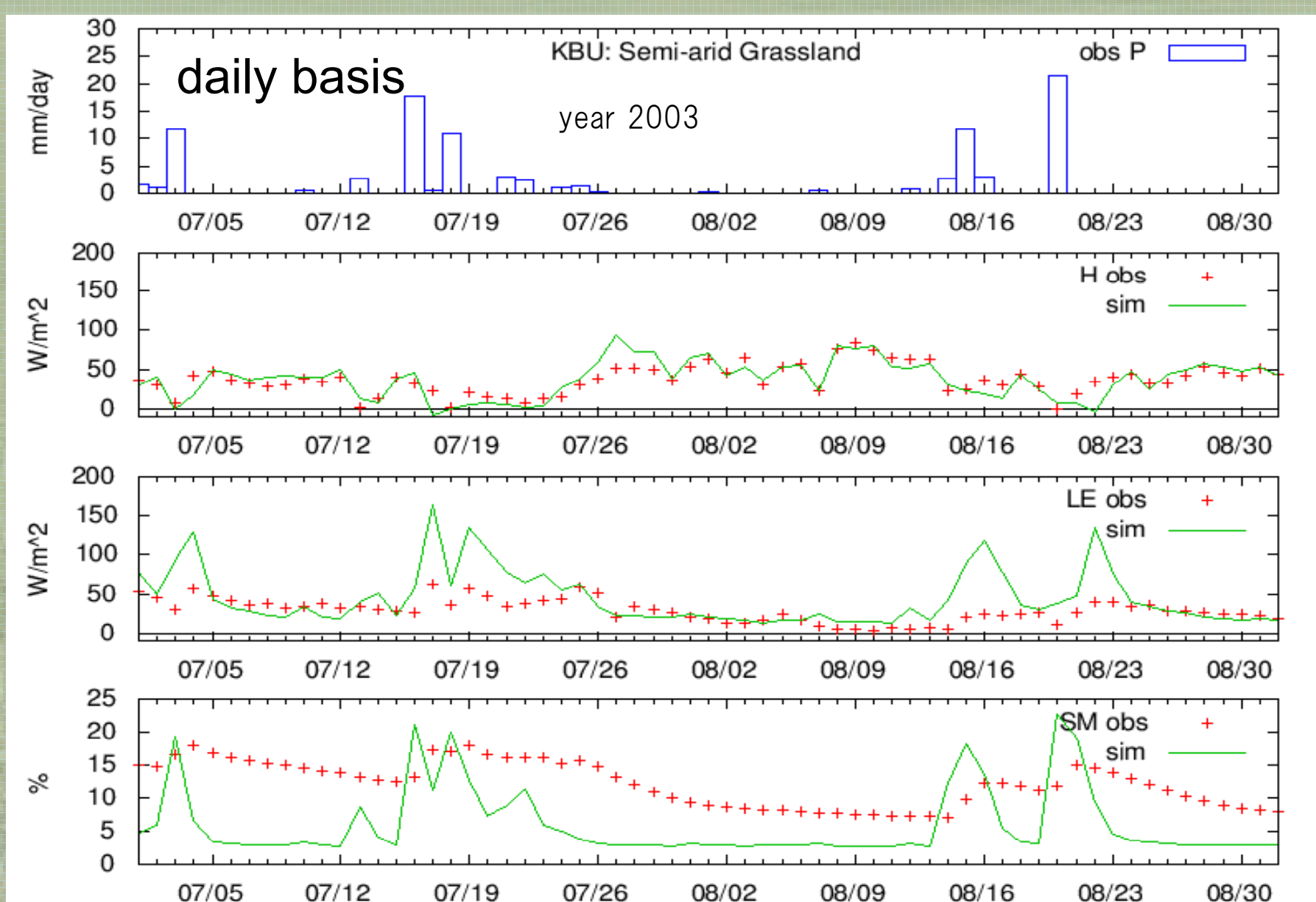
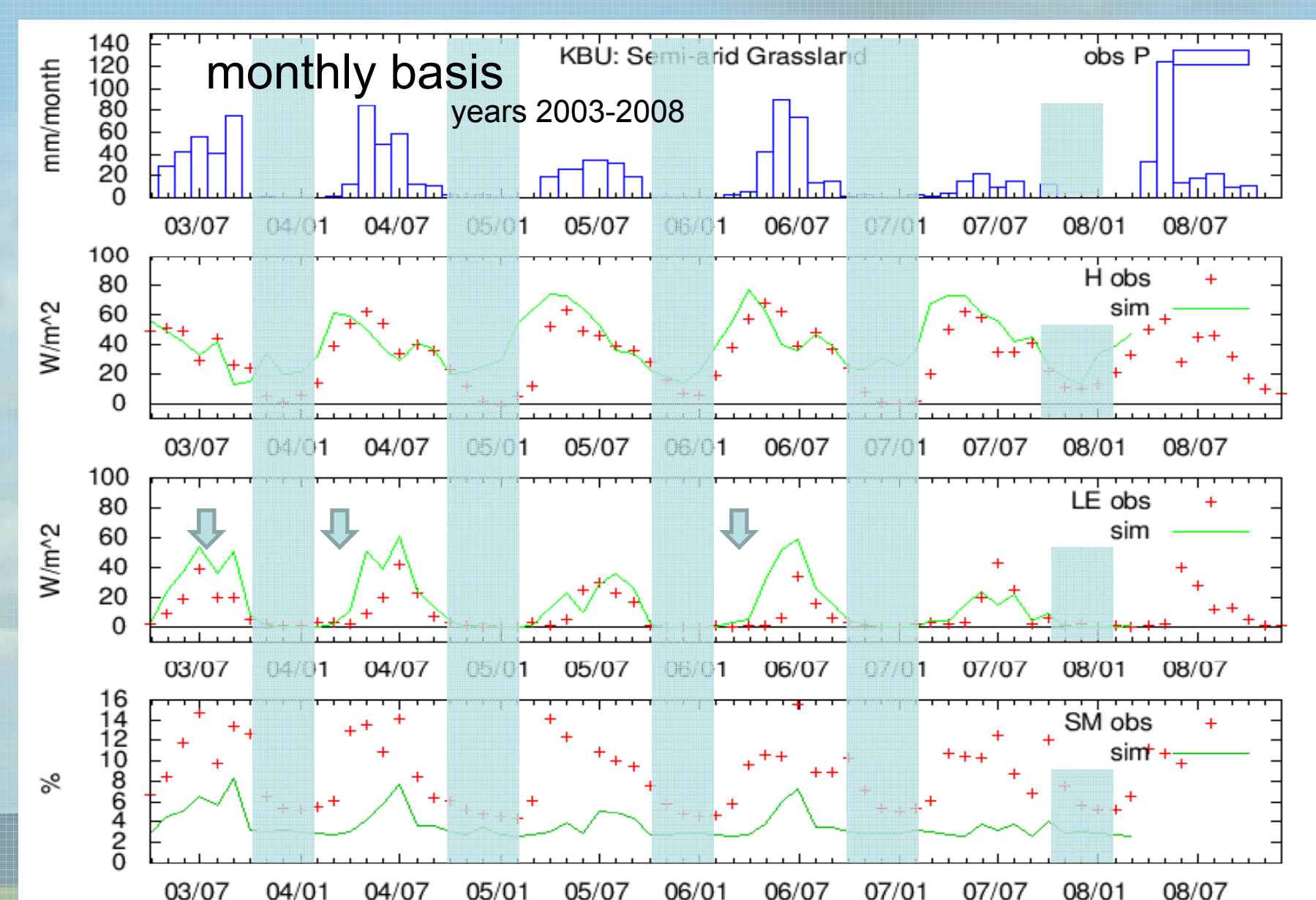
- ✓Period: 2003. 4 – 2008.4 (5 years)
- ✓Location: KBU (grassland)
- ✓Vegetation: C3 grassland 100%

Data inputs

- ✓using insitu observations as much as possible
 - atmospheric forcing: insitu observation (T, q, u, Sd)
 - soil characteristics (color, compound etc): observed
 - vegetation (LAI, SAI, height, etc): observed
 - micrometeorological (z0, d0, etc): observed
- ✓others: use references (Bonan, et al, 2002)

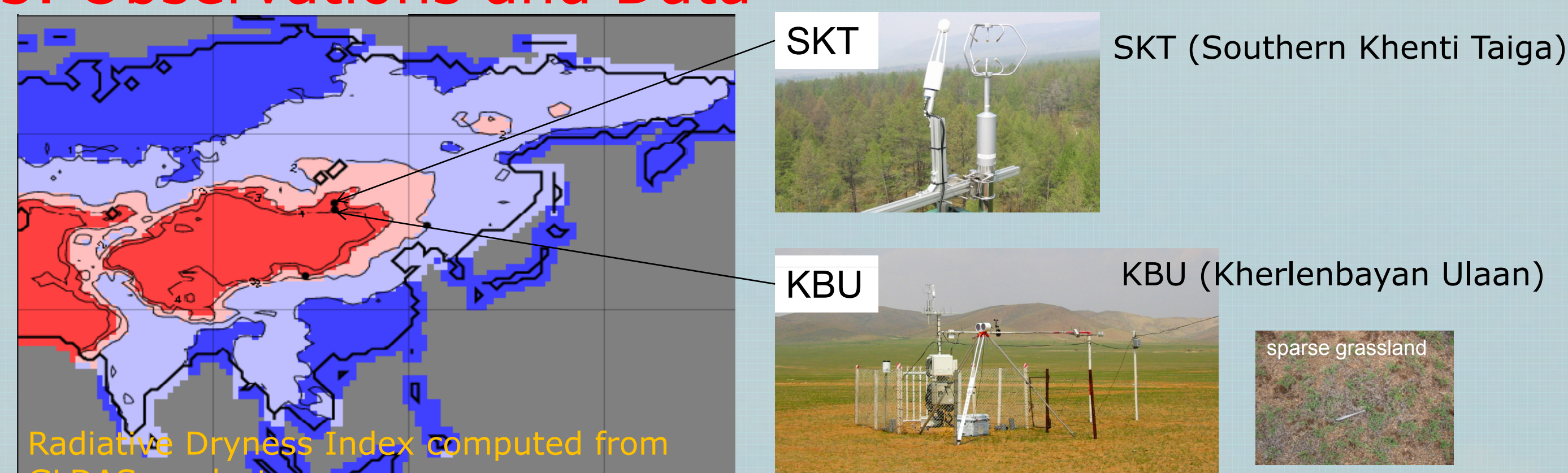
5. Results: validation with the observations

Monthly basis:
The model better reproduces H than E.



Daily basis:
E is overestimated by the model especially right after the rainfall events.

3. Observations and Data



The both sites are among the CEOP ref. sites and AsiaFlux registered sites



6. Sensitivity Analysis

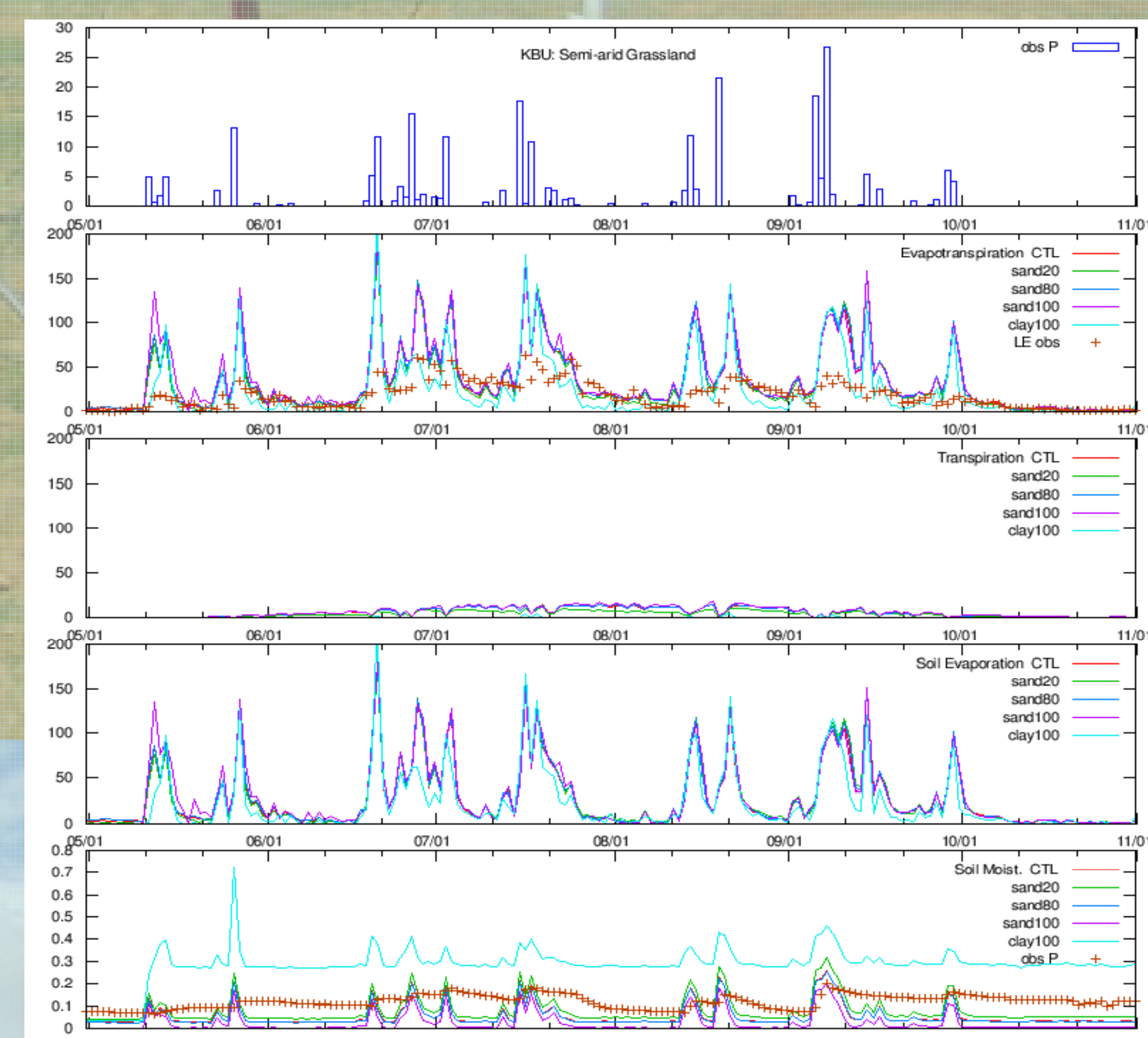
- Objectives
 - ✓to seek key parameters in simulating landsurface processes
- Parameters in question
 - ✓Soil properties (computed from soil texture)

Observed			Sand20			Sand40			Sand100			Clay100		
Layers	%CLAY	%SAND	Layers	%CLAY	%SAND	Layers	%CLAY	%SAND	Layers	%CLAY	%SAND	Layers	%CLAY	%SAND
1	11	74	1	11	20	1	11	40	1	0	100	1	100	0
2	11	74	2	11	20	2	11	40	2	0	100	2	100	0
3	11	74	3	11	20	3	11	40	3	0	100	3	100	0
4	11	74	4	11	20	4	11	40	4	0	100	4	100	0
5	12	68	5	12	20	5	12	40	5	0	100	5	100	0
6	12	68	6	12	20	6	12	40	6	0	100	6	100	0
7	10	77	7	10	20	7	10	40	7	0	100	7	100	0
8	3	94	8	3	20	8	3	40	8	0	100	8	100	0
9	3	92	9	3	20	9	3	40	9	0	100	9	100	0
10	3	92	10	3	20	10	3	40	10	0	100	10	100	0

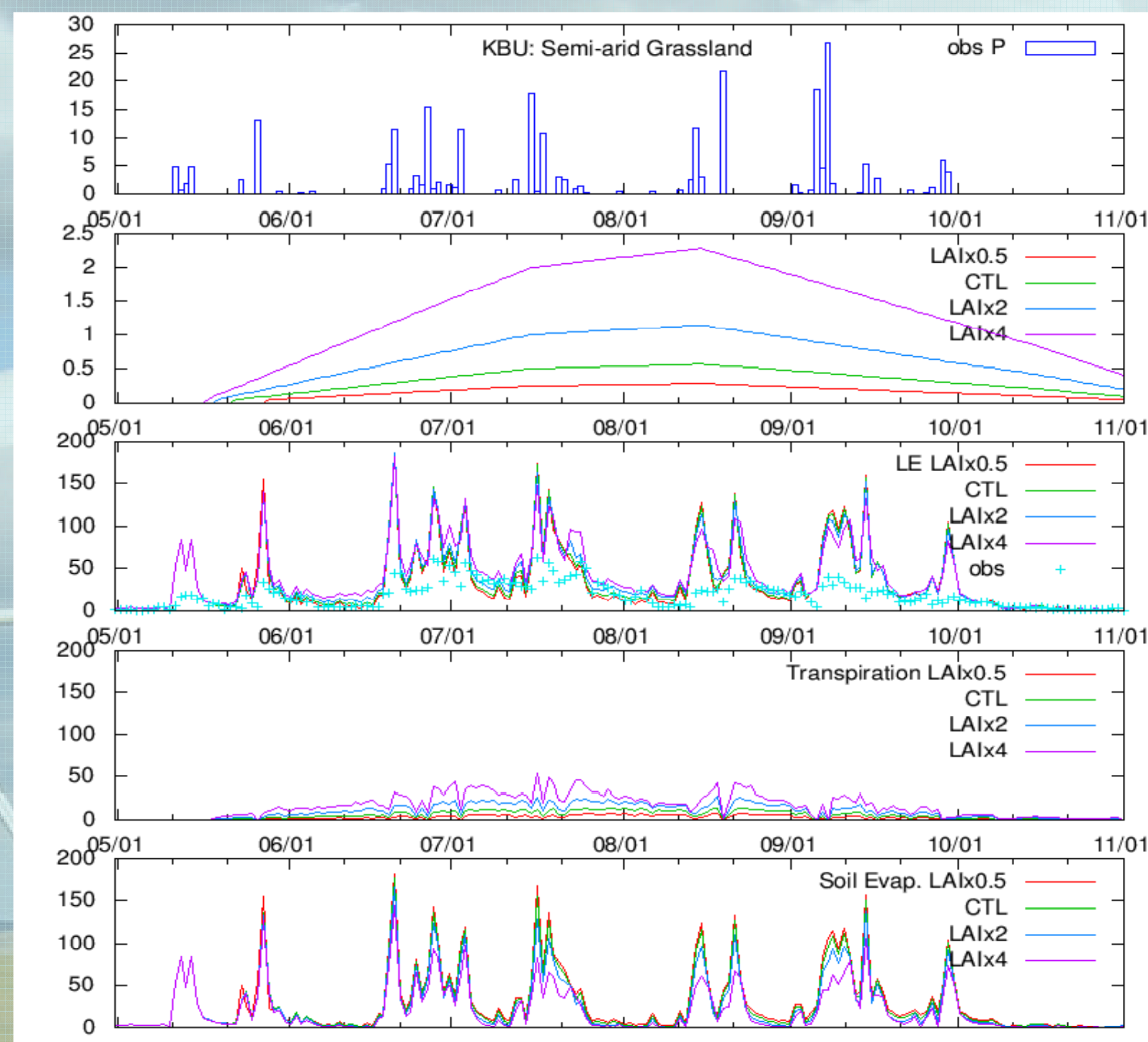
✓LAI

✓observation x 0.5, 2, 4

- Results:



Sensitivity to soil texture:
Evaporation is not sensitive to soil texture except for the extreme case.



Sensitivity to LAI
Evaporation is fairly sensitive to LAI even at sparse grassland

7. Conclusions (tentative):

- CLM applicability
 - ✓Reproduces H relatively well
 - ✓Overestimates E right after precipitation events.
 - soil evaporation schemes?
 - dead liter?
- Sensitivity tests
 - ✓small (negligible) sensitivity to soil properties
 - ✓relatively larger sensitivities to LAI even at sparse grassland