基于简化生物圈模式（SiB2）的地表能量的模拟研究

张小华

汇报提纲

一 研究背景

二 研究方法

三 研究内容

四 主要结果

五 研究结论

一 研究背景

- （1）能量不闭合现象普遍存在。
- （2）SiB2模式的不确定性。

二 研究方法

（1）资料获取方法 → 涡动相关法

（2）资料预处理和质量控制（QC）→

- 野点去除
- 坐标旋转
- 超声虚温的湿度修正
- WPL修正

SiB2 模式简介与改进

SiB2模式需要输入6个实地测量的强迫变量：

（1）向下短波辐射（DSR）
（2）向下长波辐射（DLR）
（3）气温
（4）水汽压
（5）观测高度上的风速
（6）降水量

“强迫-恢复”方法的改进

SiB2中原有Deardorff方案：

地表温度（ Tg）的表达式

$$\frac{dT_g}{dt}=\frac{2G_0}{C_g d}-\omega(T_g-\overline{T})$$

改进后的表达式

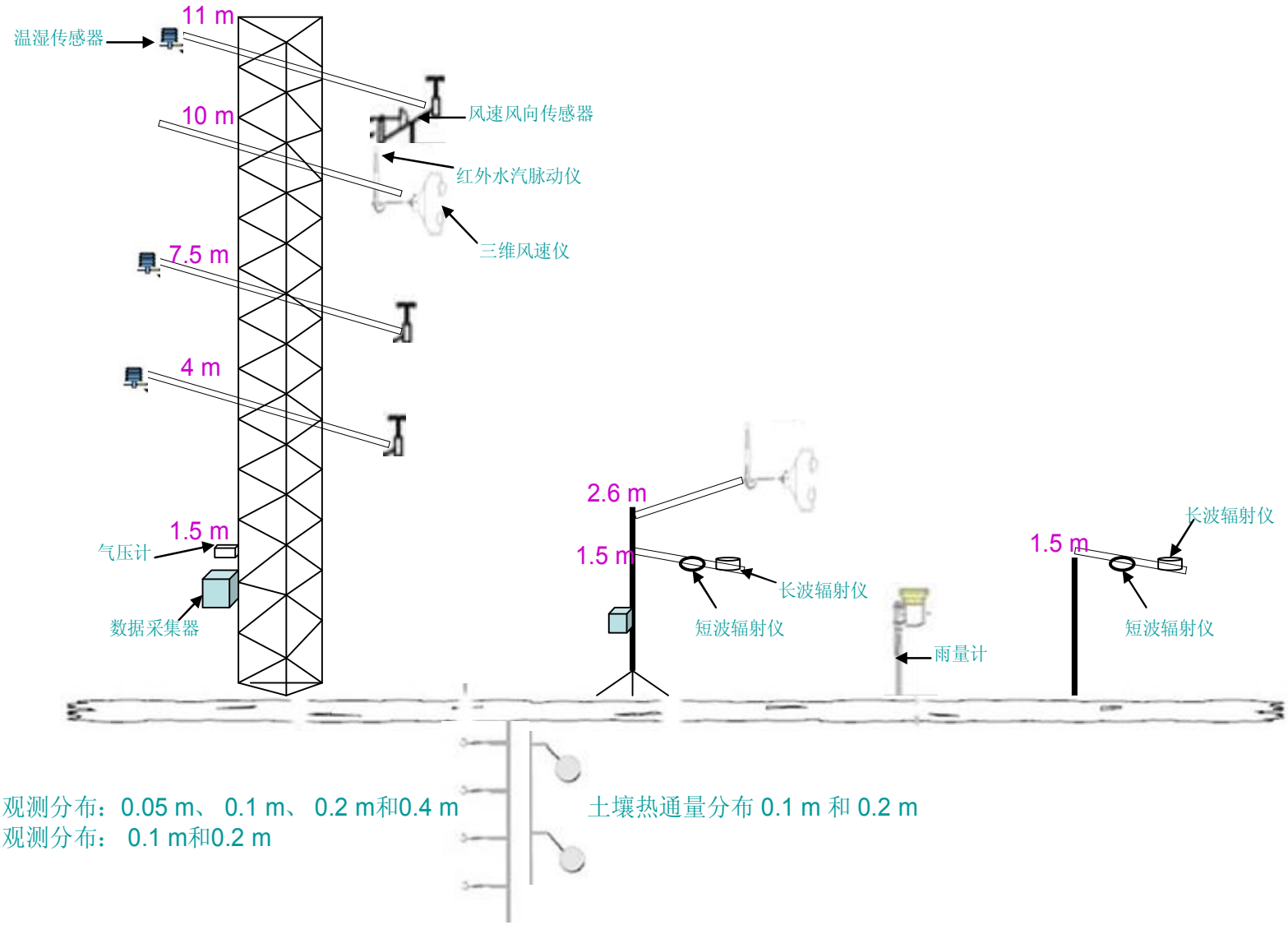
$$\frac{dT_g}{dt}=\frac{2G(0,t)}{C_g(\frac{2k}{N\omega})}-\omega(\frac{N}{M})(T_g-\overline{T})$$

地表日平均温度（$\overline{T}$ ）的表达式:

$$\frac{d\overline{T}}{dt}=G_0/\left[C_g(365\pi)^{1/2}d\right]$$

阳坊观测

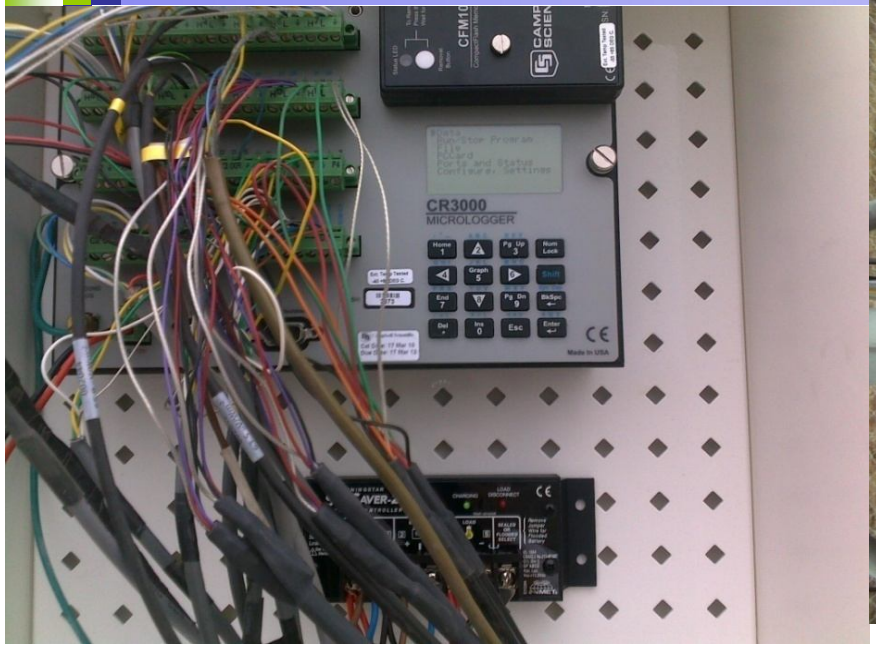

查看更多
地图
卫星
北寨路
上店路
下店村
A: 116.1121E，40.1627N，海拔：60 m
200 米
500 英尺
©2010 Google - Imagery ©2010 DigitalGlobe, Cnes/Spot Image, GeoEye, 地图数据 ©2010 Mapabc - 使用条款



土壤温度观测分布：0.05 m、 0.1 m、 0.2 m和0.4 m

土壤湿度观测分布： 0.1 m和0.2 m

土壤热通量分布 0.1 m 和 0.2 m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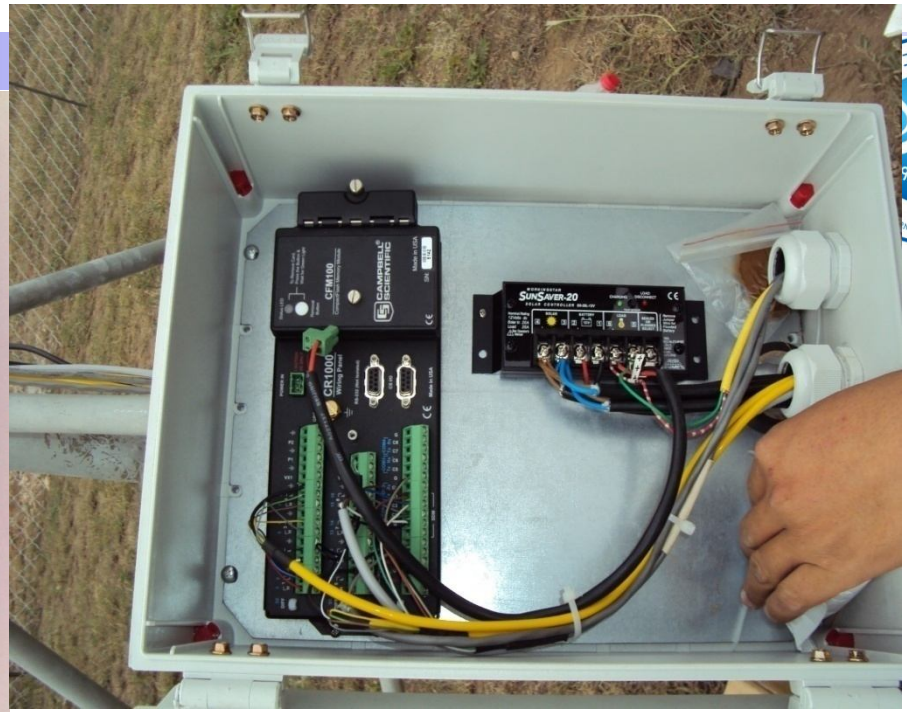

CAMPBELL SCIENTIFIC
CFM100
CR1000
SUNSAVER-20


Kipp & Zonen

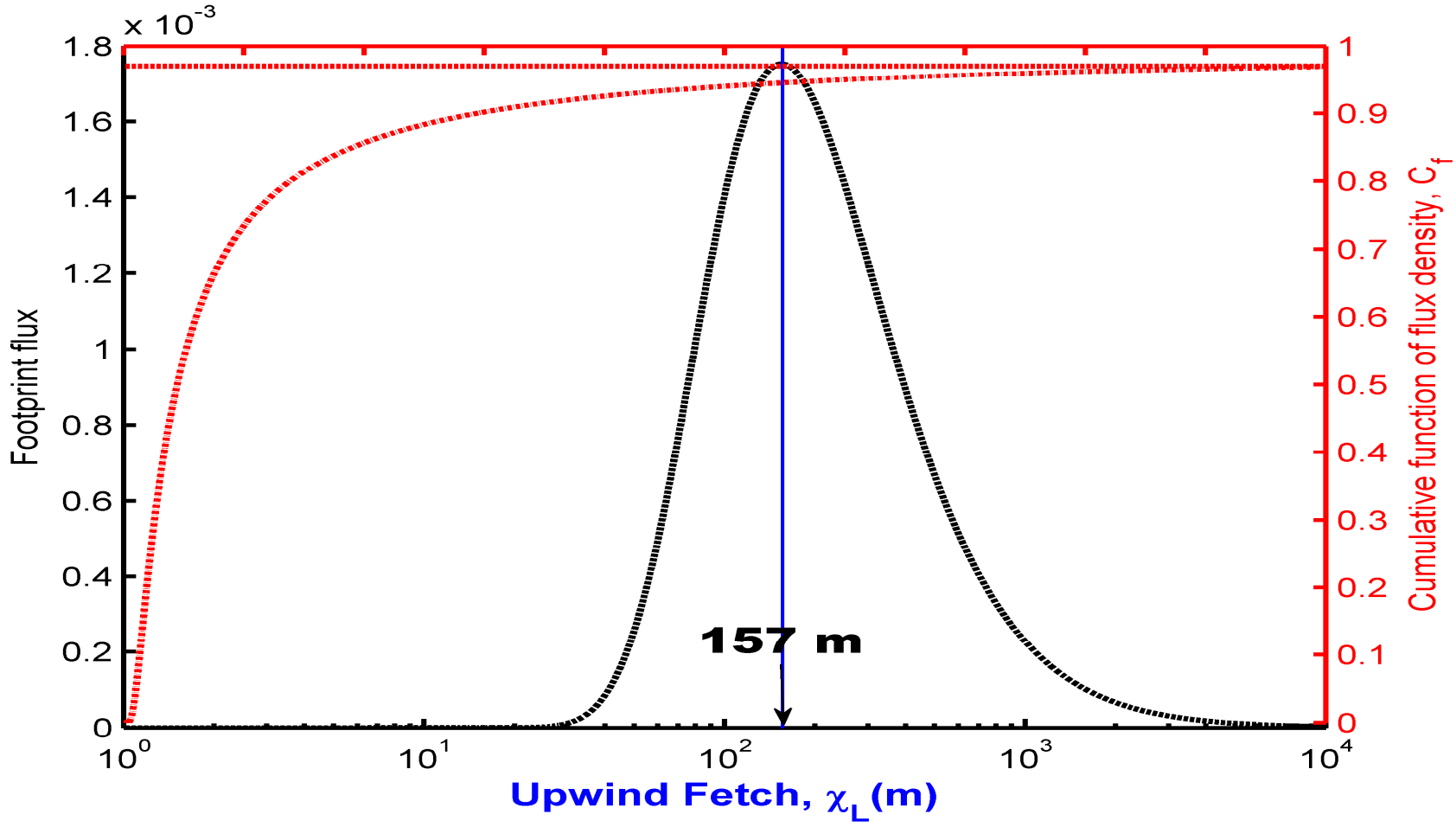
三 研究内容

对SiB2进行改进。使用原始的和改进后的SiB2模式模拟北京郊区和青藏高原草地地表能量的分配特征。对原始的和改进后的模拟结果进行比较。进一步验证模式的改进效果。

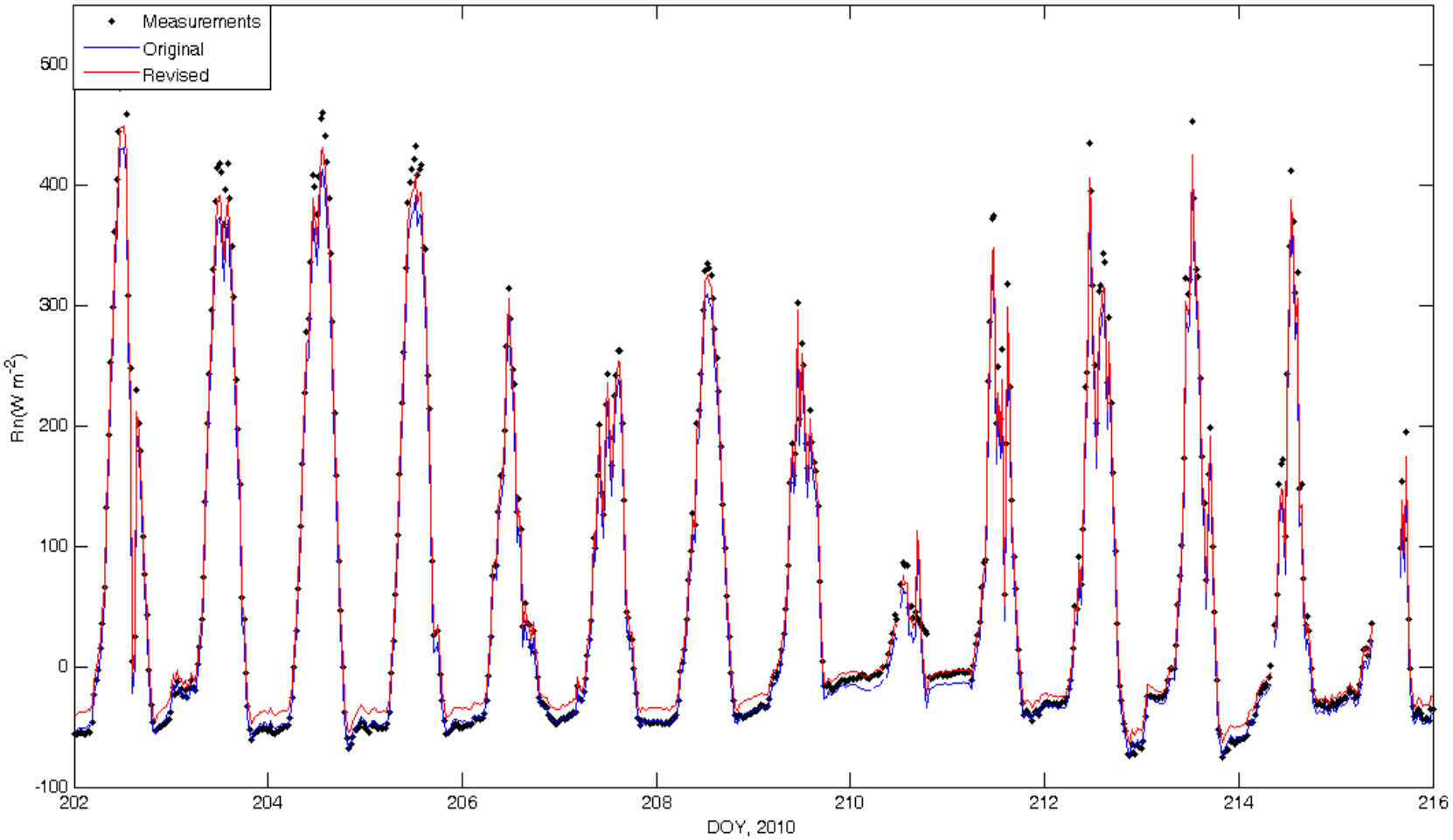
四 主要结果

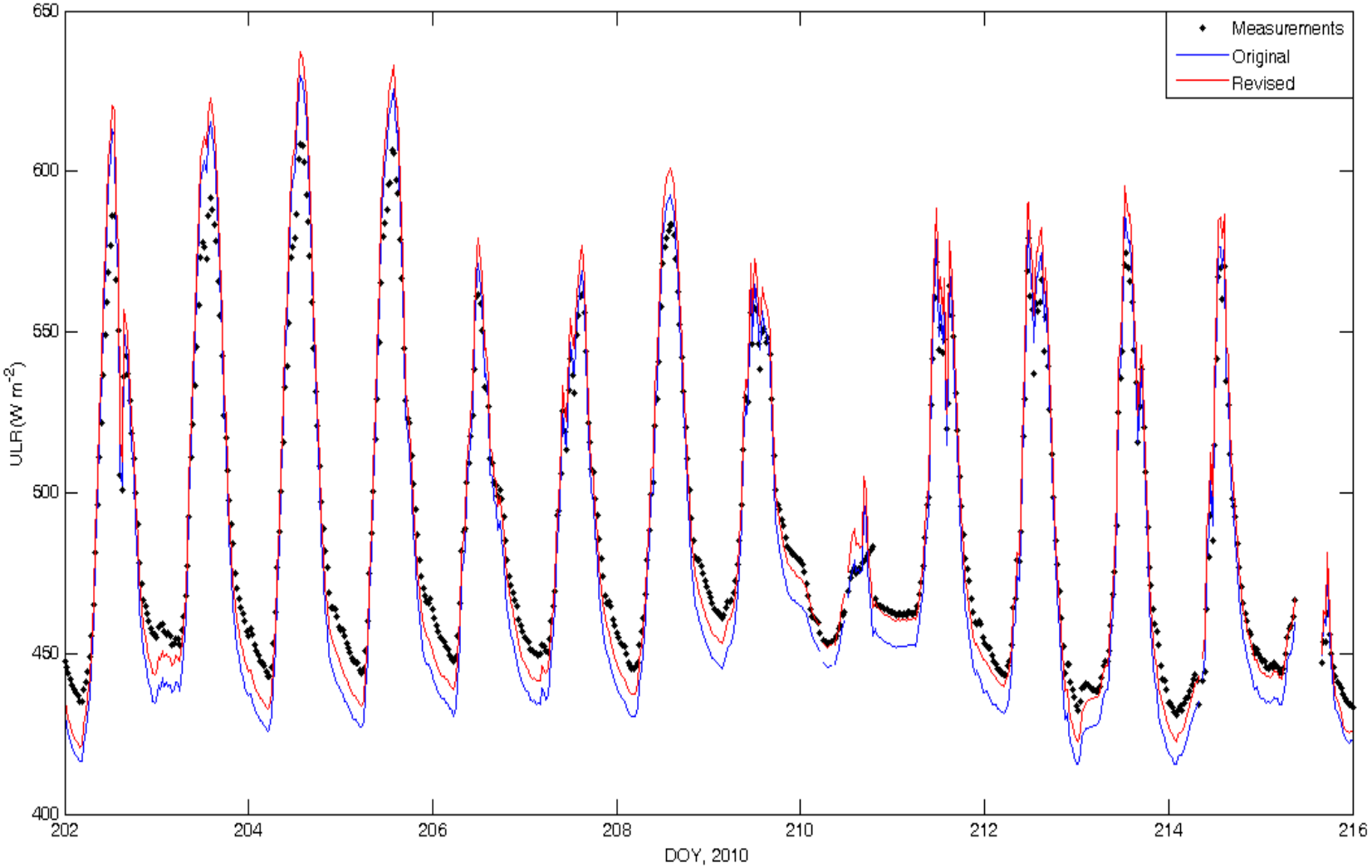
1 阳坊观测模拟结果

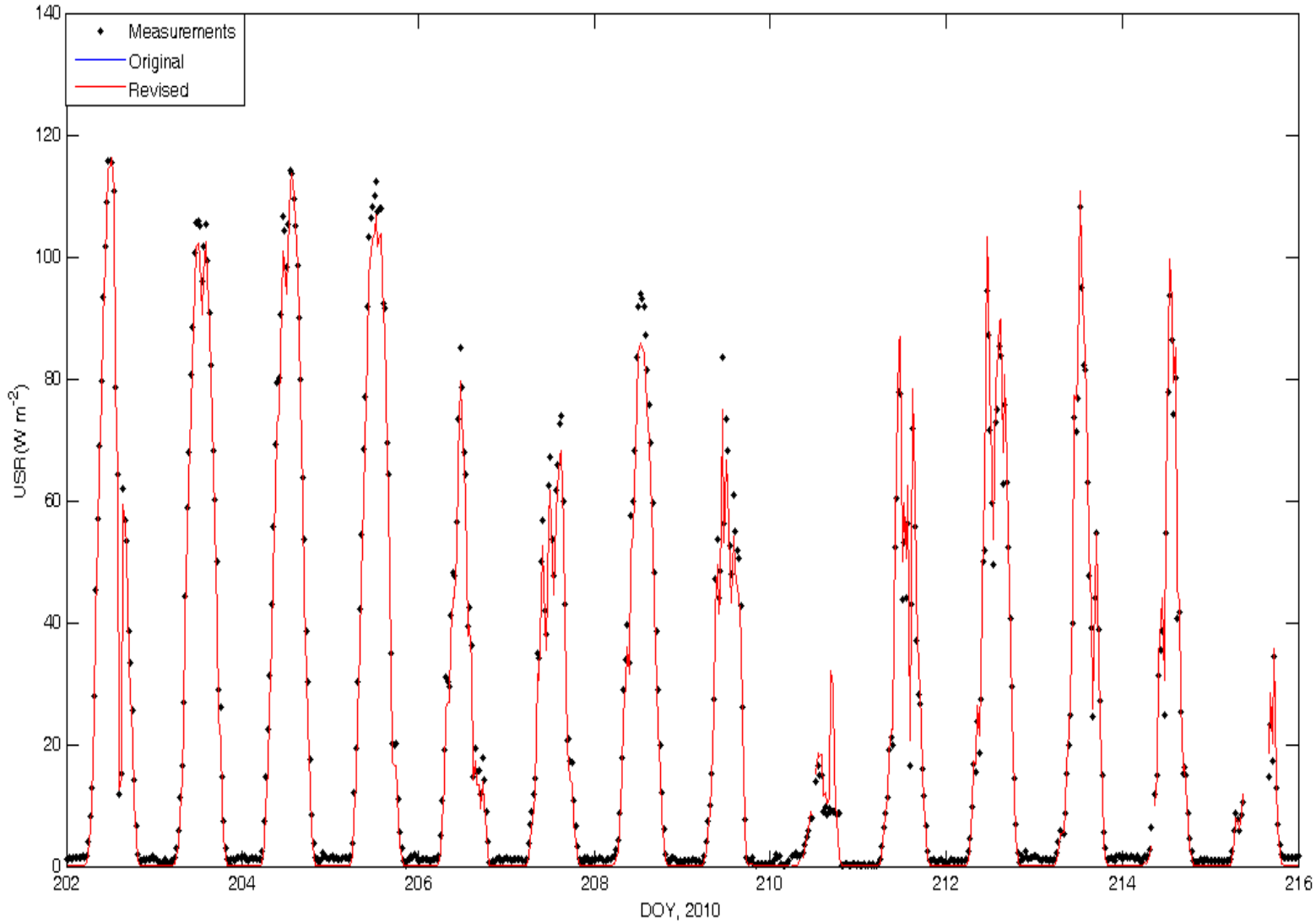
足痕分析



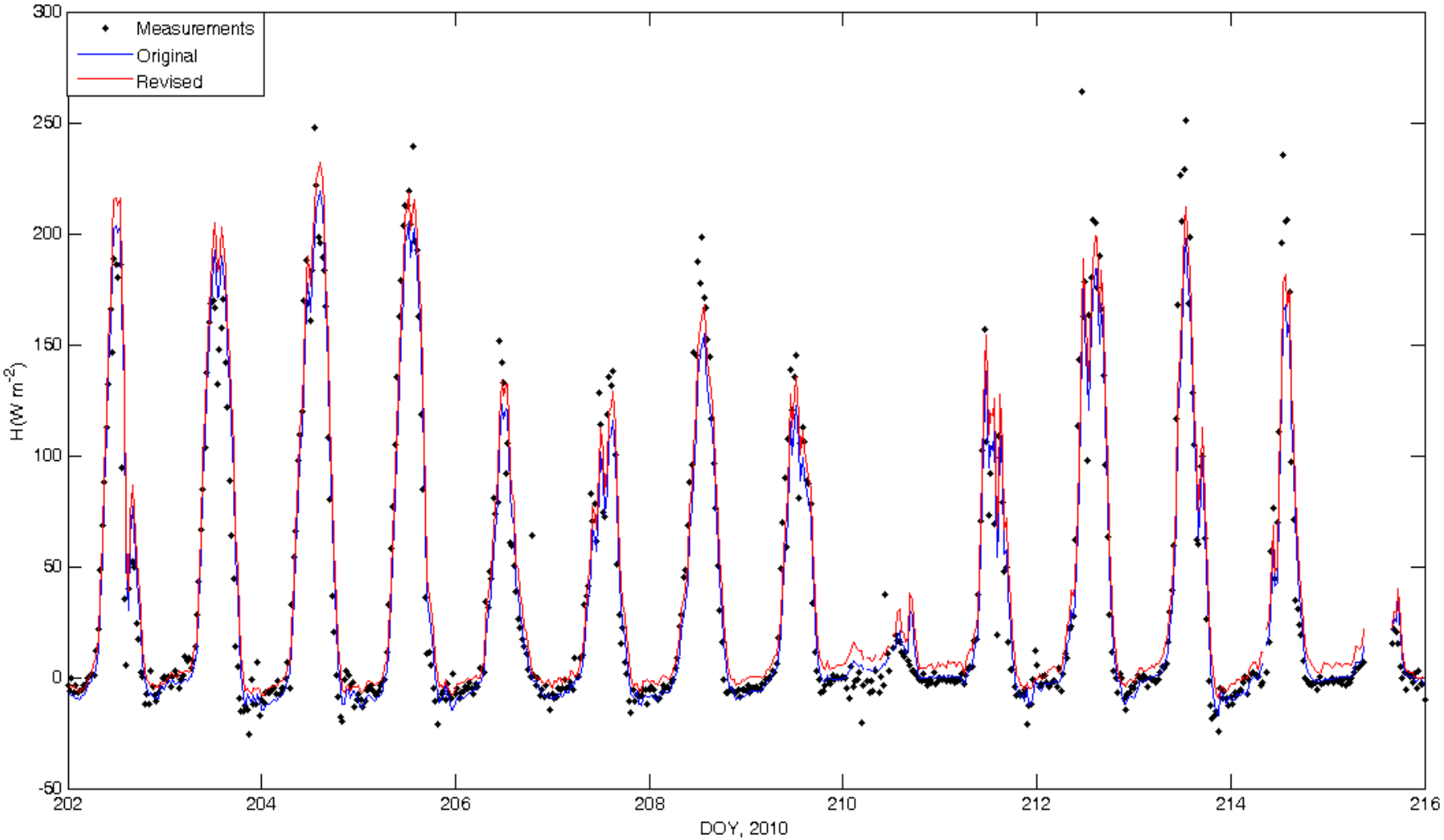
（1） 净辐射、向上长波辐射和向上短波辐射

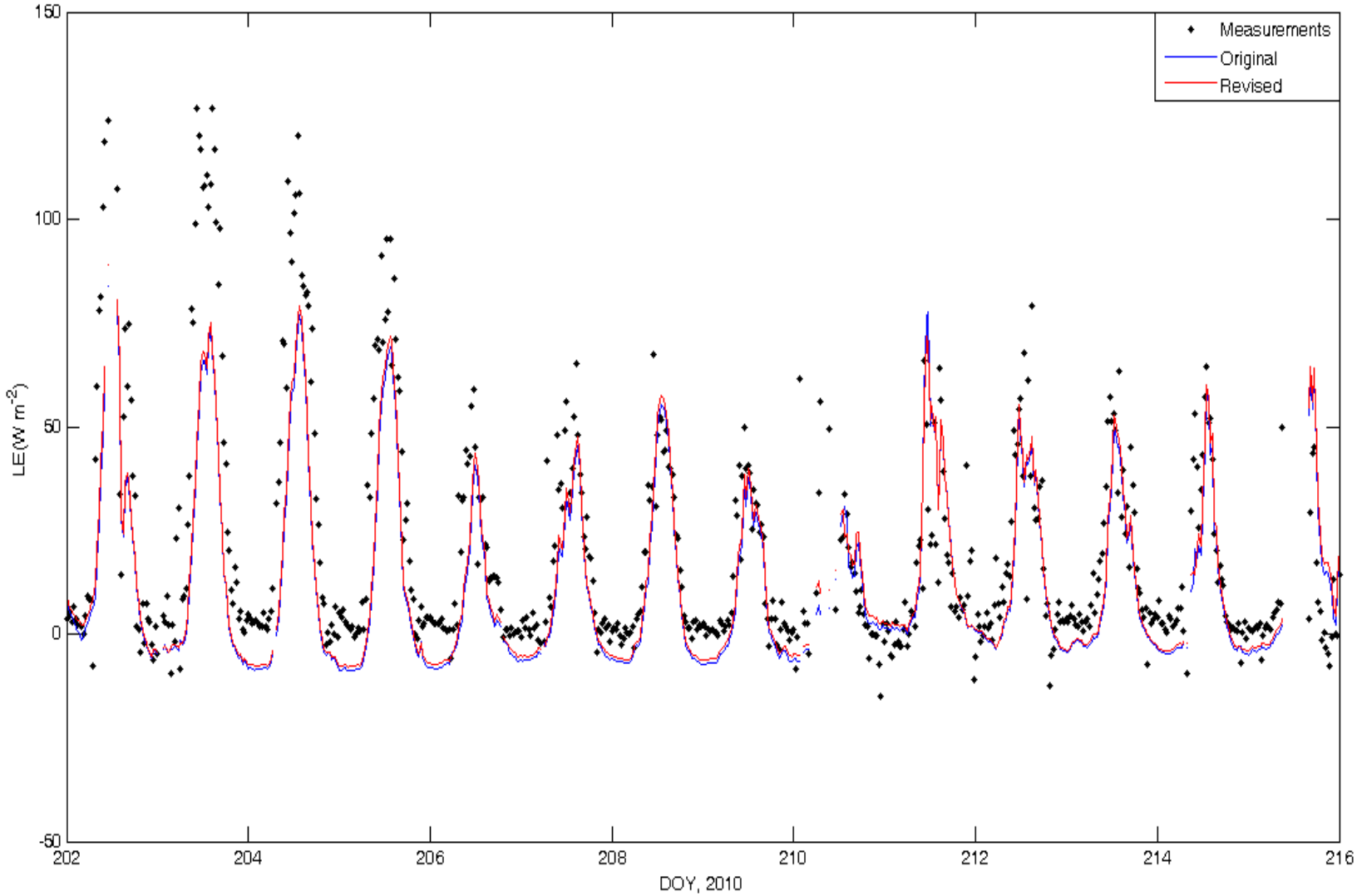


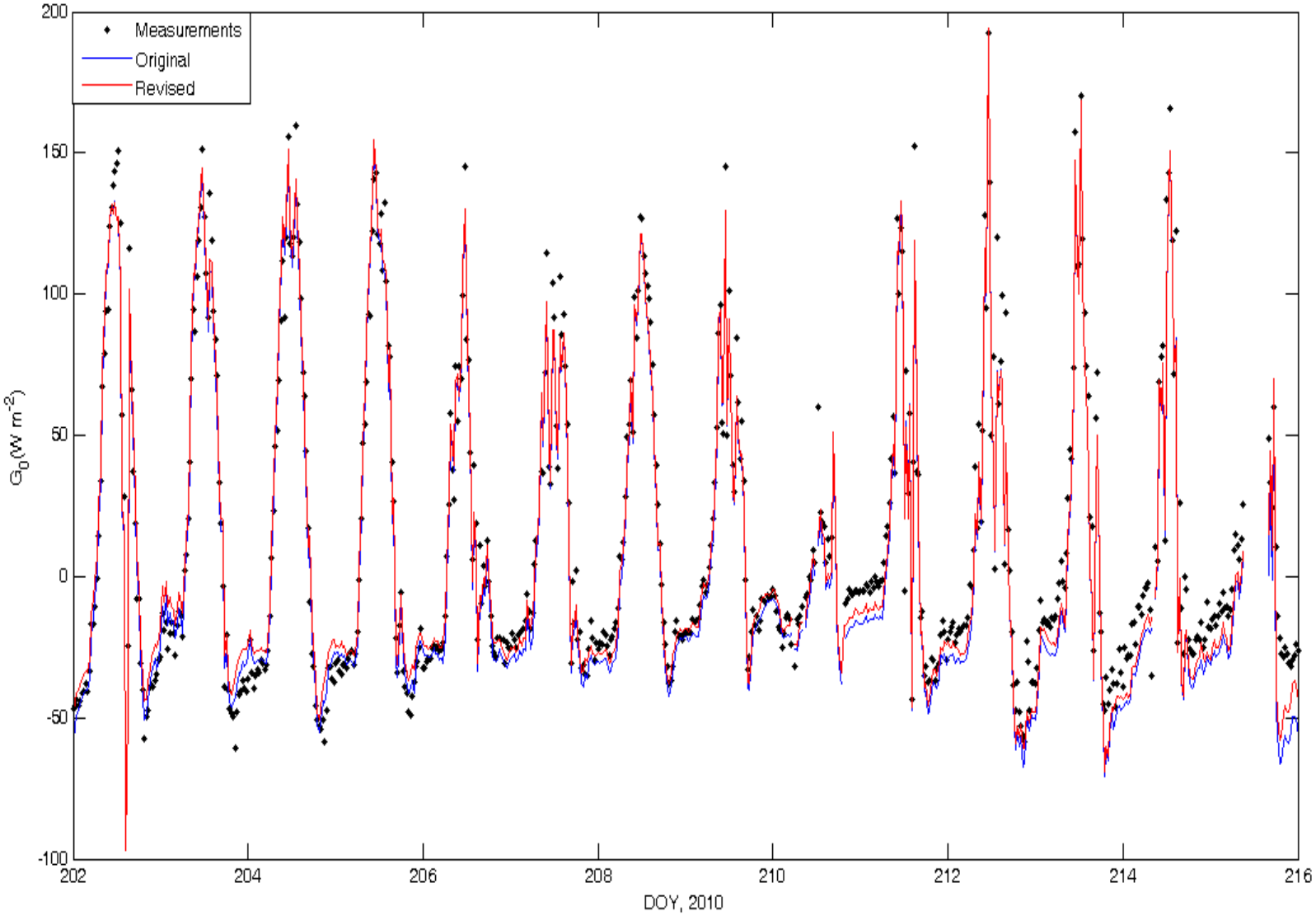

Measurements
Original
Revised
ULR(W m-2)
DOY, 2010
650
600
550
500
450
400
202
204
206
208
210
212
214
216

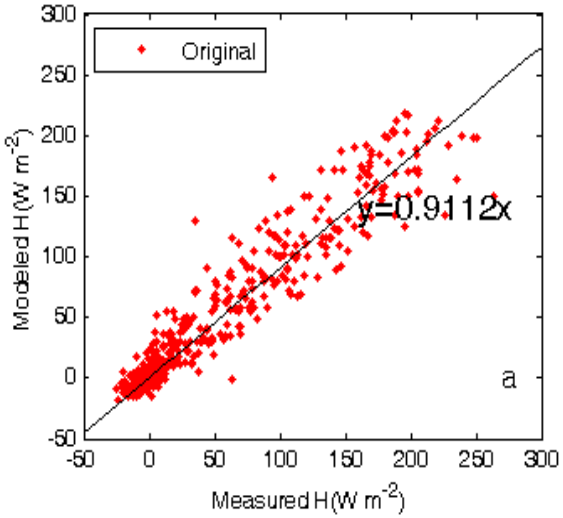

Measurements
Original
Revised
USR(W m-2)
DOY, 2010
0
20
40
60
80
100
120
140
202
204
206
208
210
212
214
216

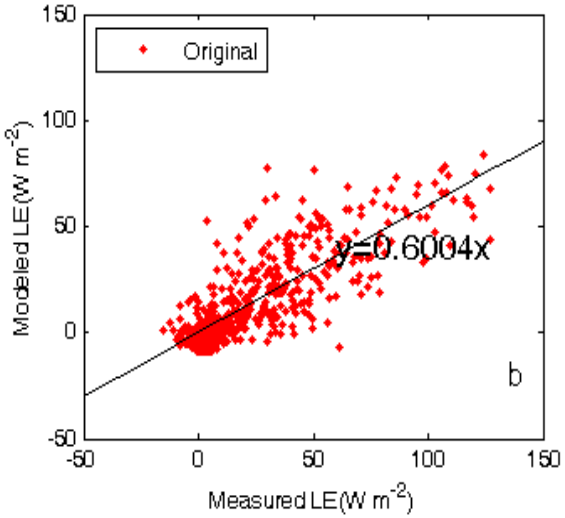
（2）感热、潜热和土壤热通量

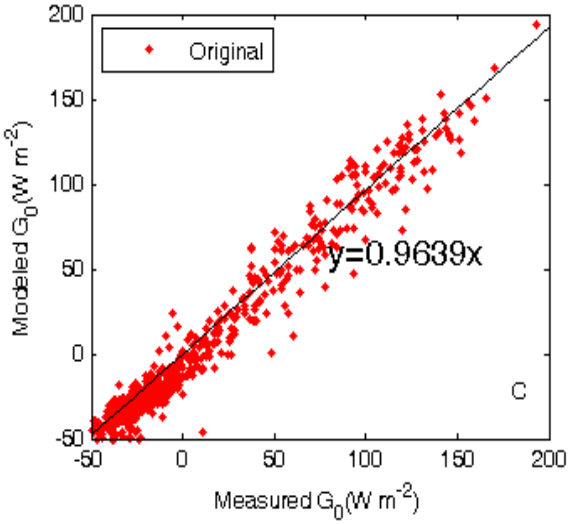


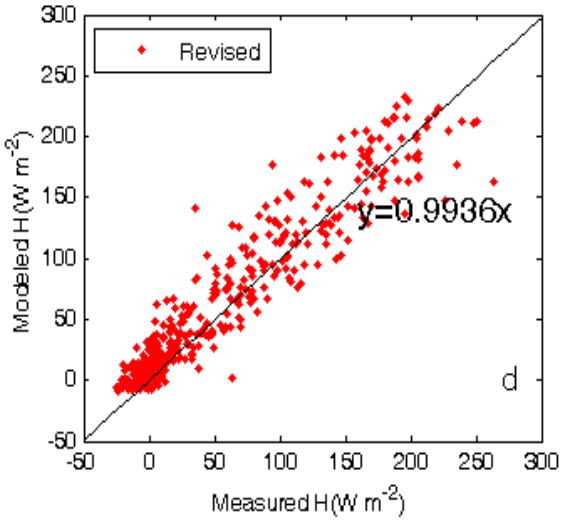

Measurements
Original
Revised
LE(W m-2)
DOY, 2010
150
100
50
0
-50
202
204
206
208
210
212
214
216

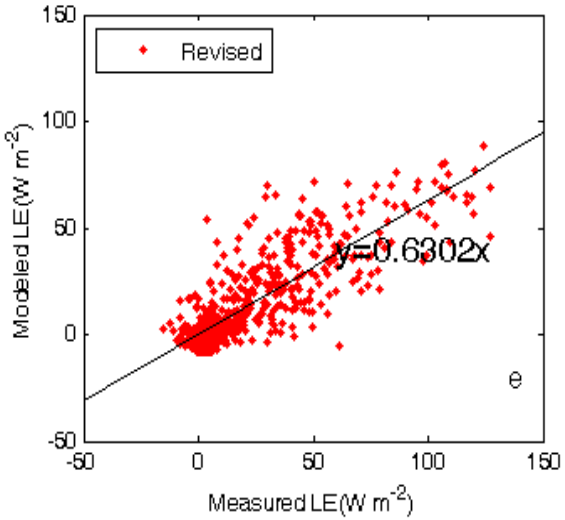

Measurements
Original
Revised
200
150
100
50
0
-50
-100
G_0(W m^{-2})
202
204
206
208
210
212
214
216
DOY, 2010

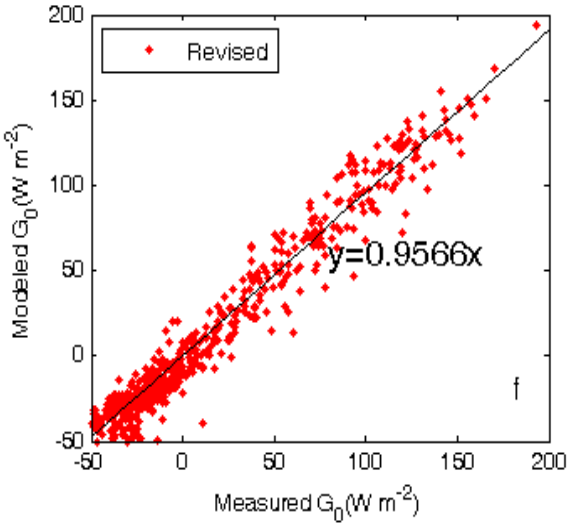

Original
y=0.9112x
Modeled H(W m-2)
Measured H(W m-2)
a


Original
y=0.6004x
Modeled LE(W m-2)
Measured LE(W m-2)
b

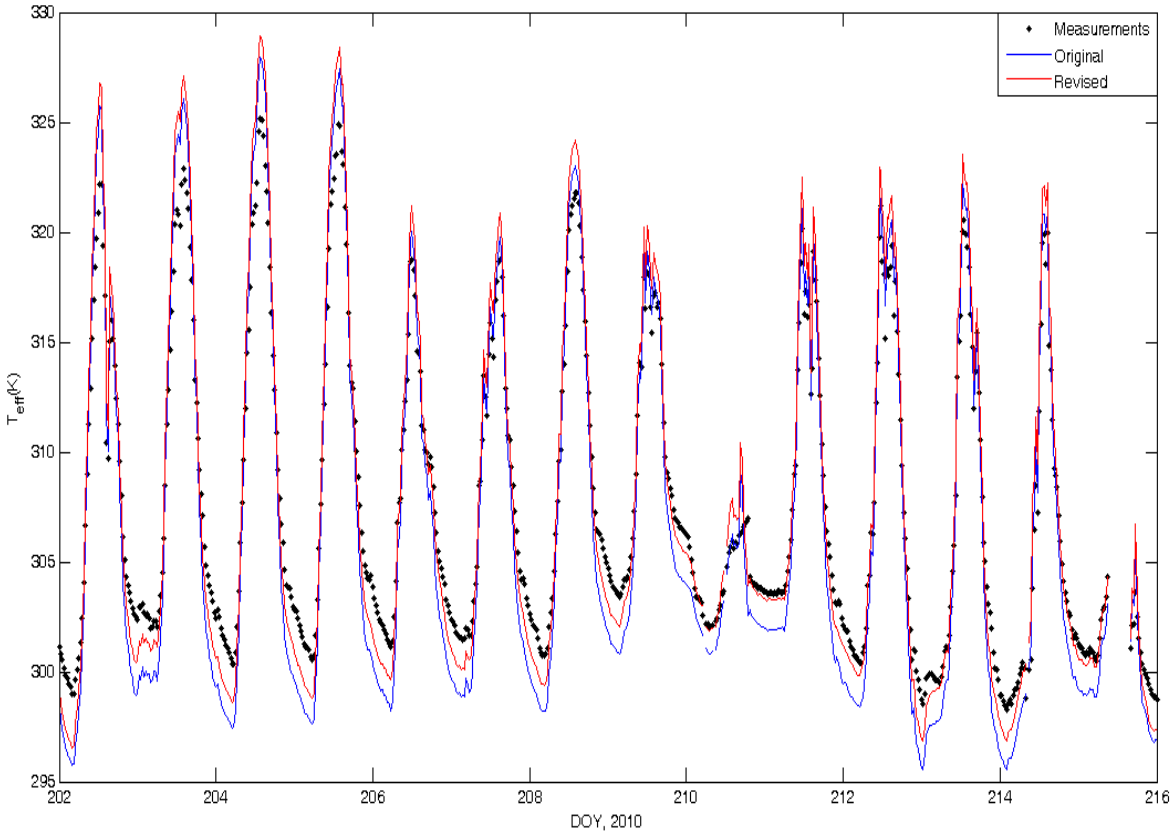

Original
y=0.9639x
Modeled G0(W m-2)
Measured G0(W m-2)
c

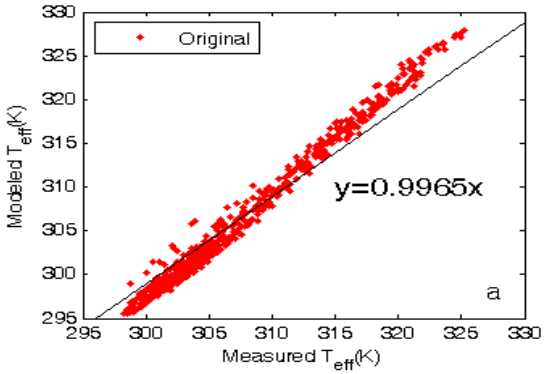

Revised
y=0.9936x
Modeled H(W m-2)
Measured H(W m-2)
d

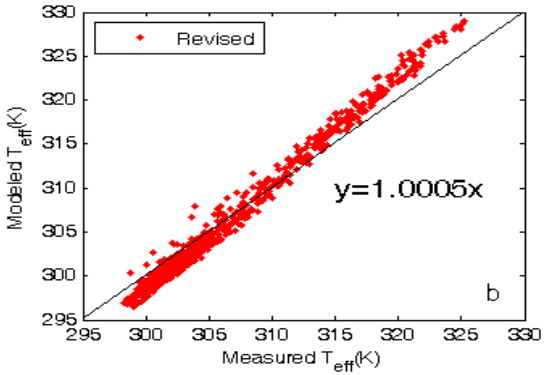

Revised
y=0.6302x
Modeled LE(W m-2)
Measured LE(W m-2)
e


Revised
y=0.9566x
Modeled G0(W m-2)
Measured G0(W m-2)
f

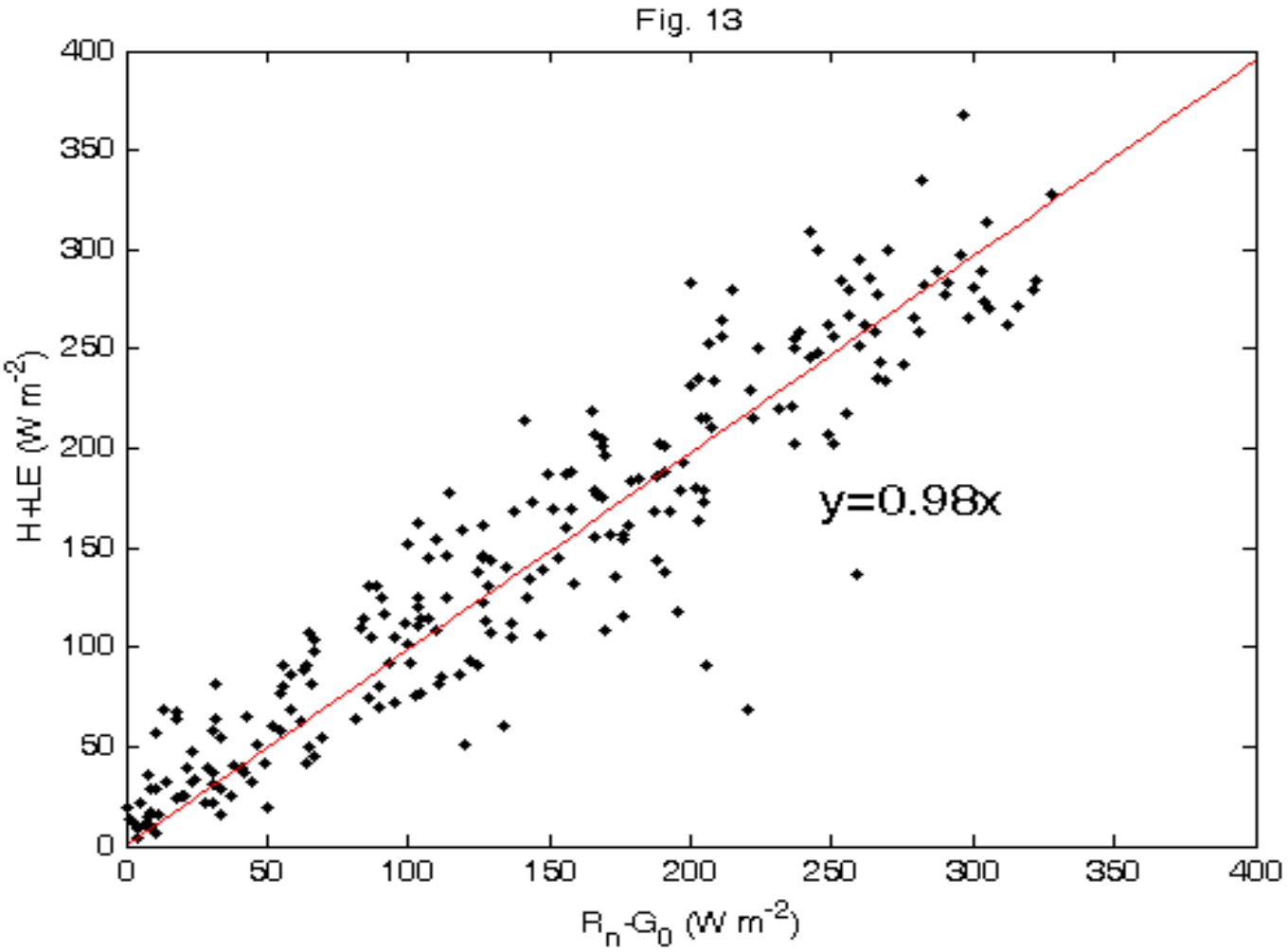
（3） 地表有效辐射温度


Measurements
Original
Revised
T_{eff}(K)
DOY, 2010


Original
y=0.9965x
a
Modeled T_{eff}(K)
Measured T_{eff}(K)


Revised
y=1.0005x
b
Modeled T_{eff}(K)
Measured T_{eff}(K)

（4）感热和潜热之和与地表可用能量的对比分布



小结

（1）改进版SiB2提高了向上长波辐射的模拟结果。

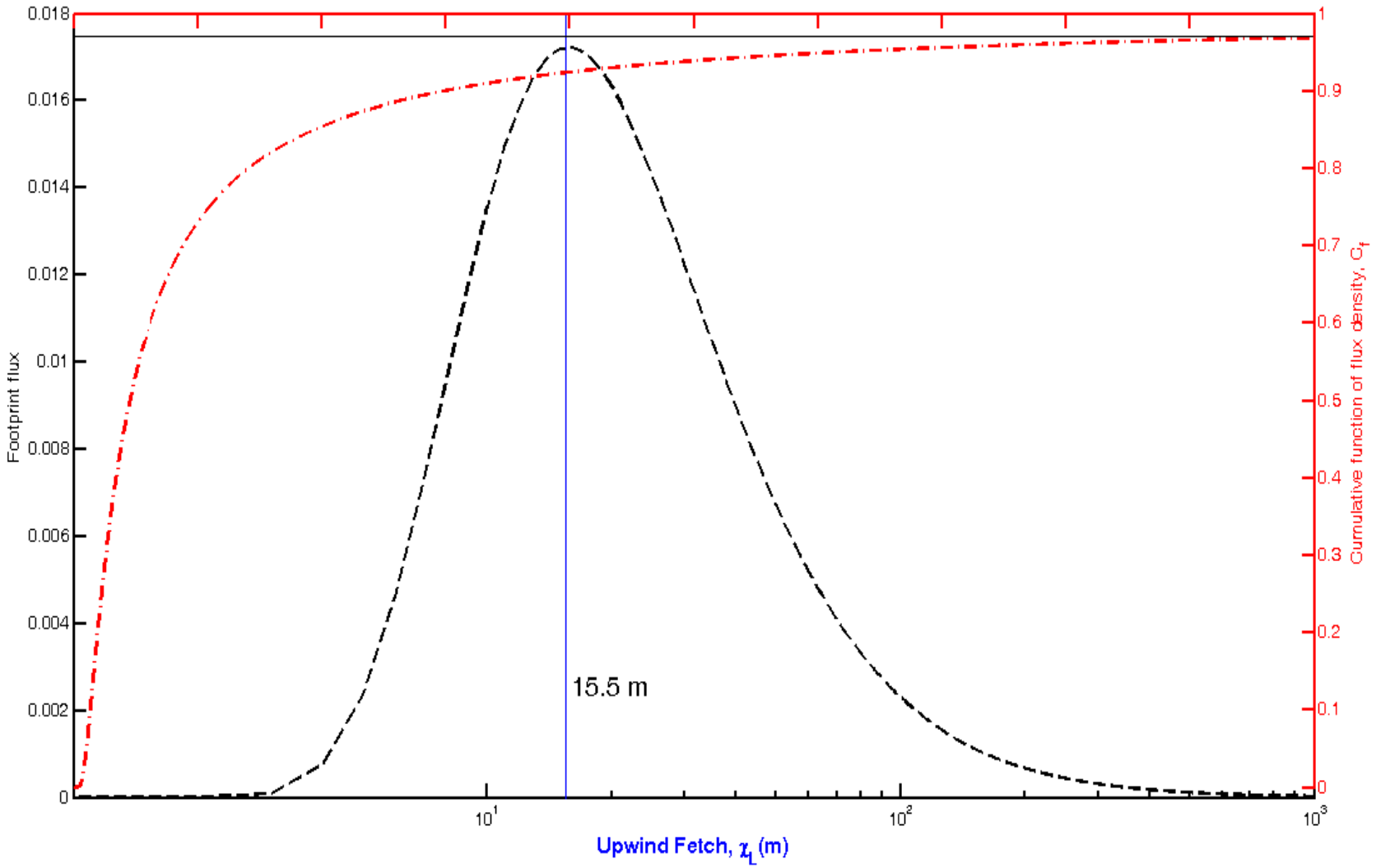
（2）由于整个实验阶段土壤体积含水量平均值为9.42%，土壤处于干旱状态。所以感热通量占总体能量分配的主导地位。

（3）改进版SiB2提高了夜间的土壤热通量的模拟能力。

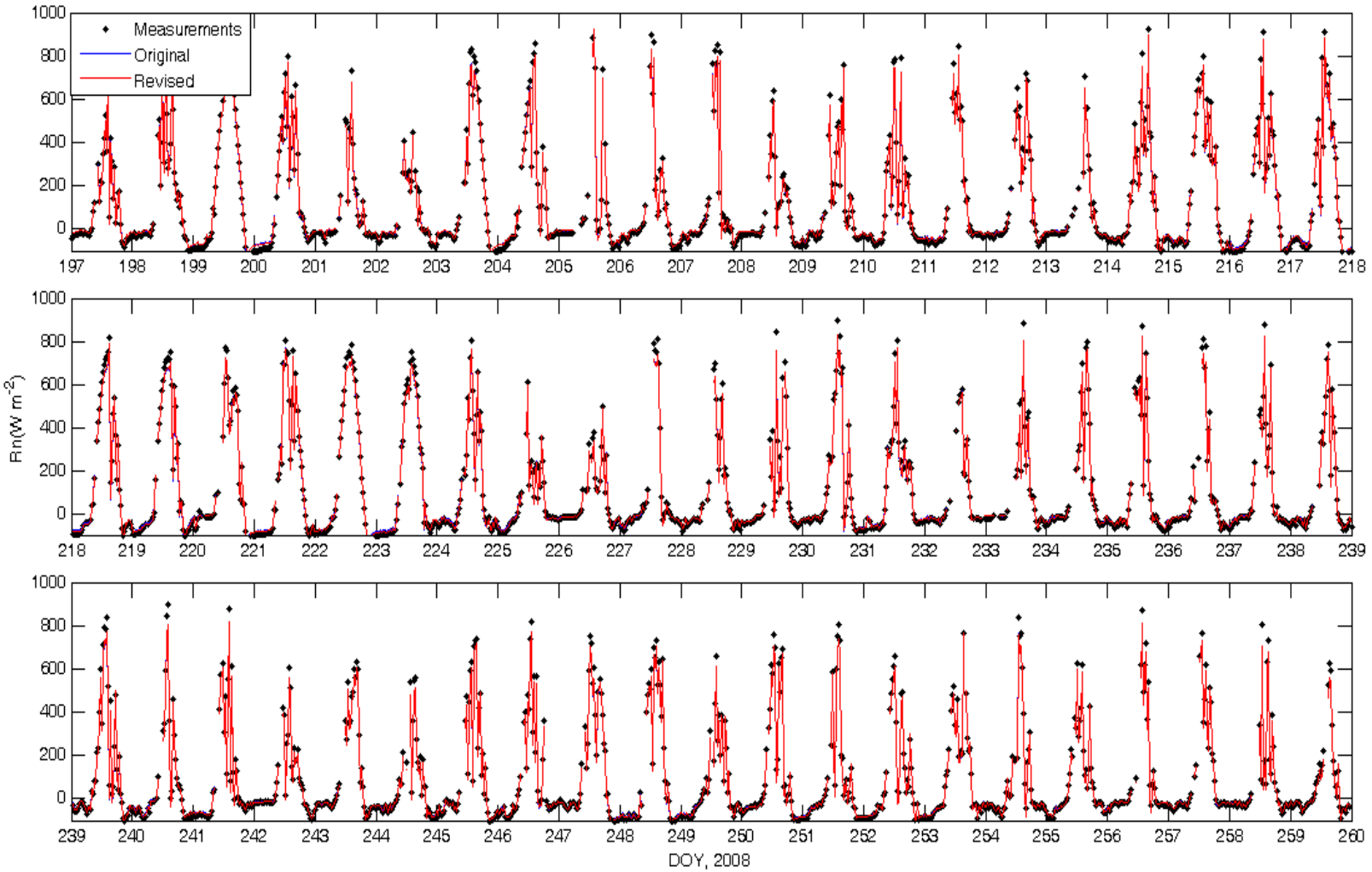
（4）改进版SiB2提高了地表有效辐射温度的模拟能力

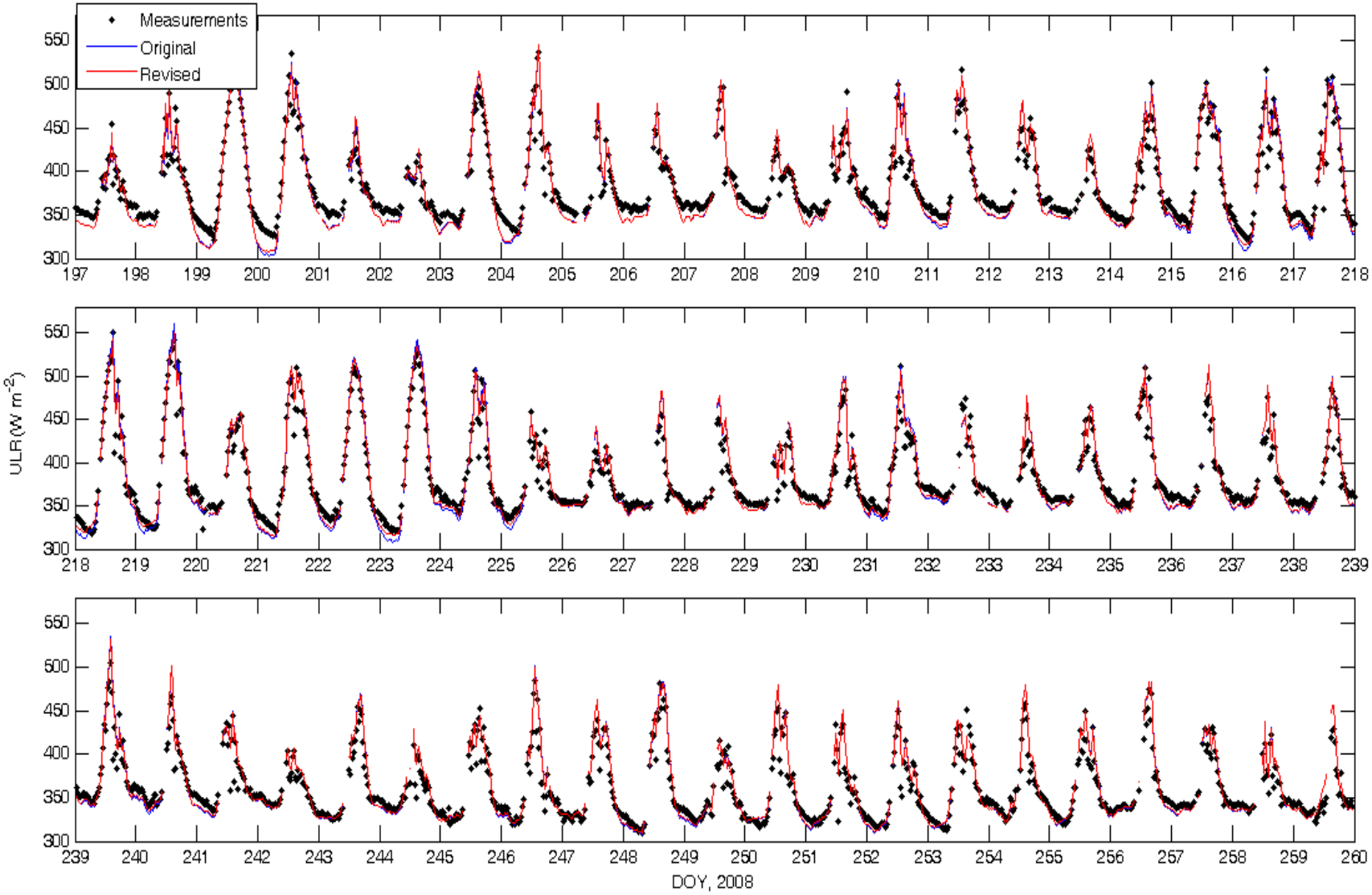
2 青藏高原那曲站

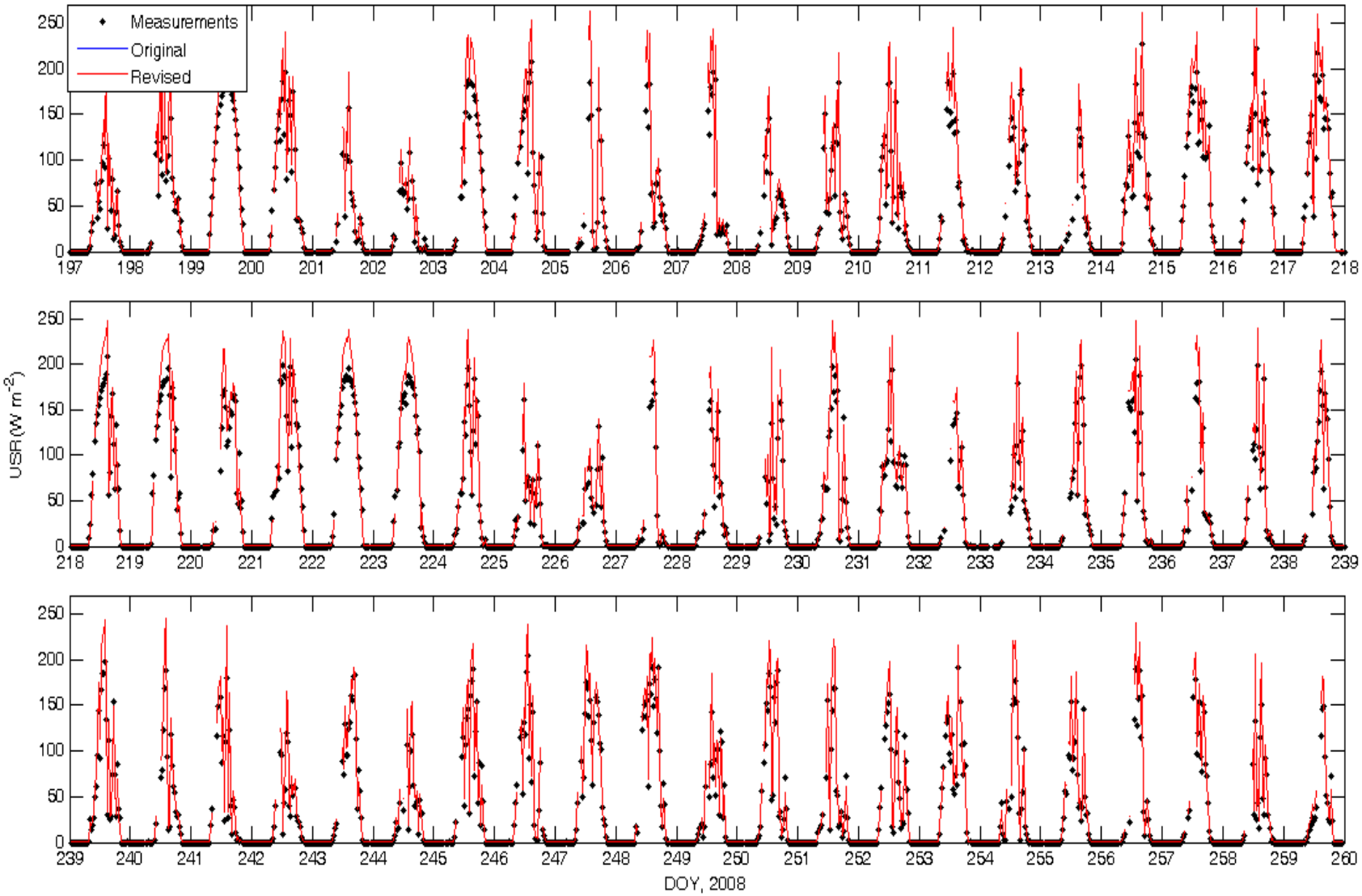
足痕分析

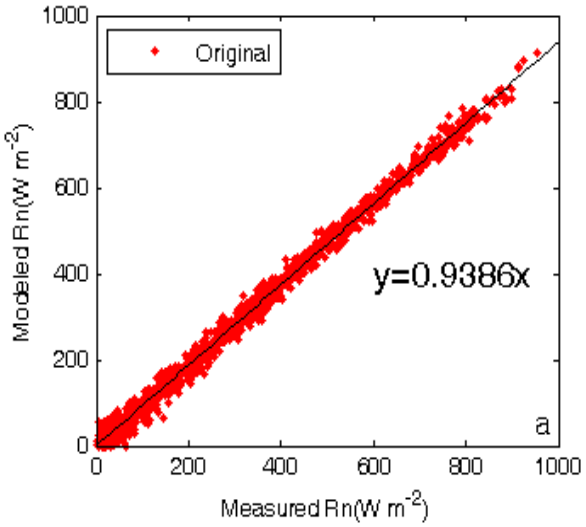


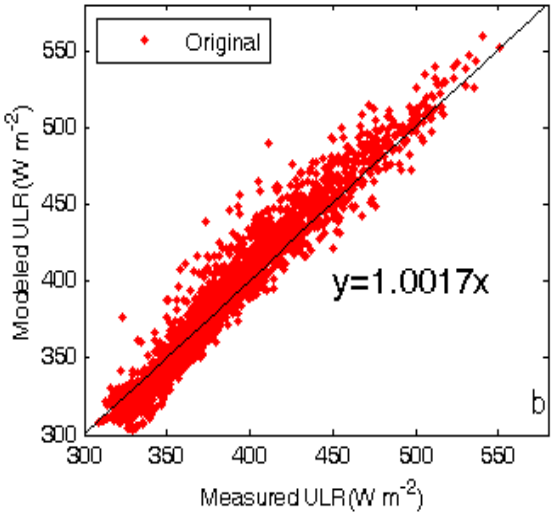
（1） 净辐射、向上长波辐射和向上短波辐射




Measurements
Original
Revised
ULR(W m-2)
DOY, 2008


Measurements
Original
Revised
USR(W m-2)
DOY, 2008


Original
y=0.9386x
Modeled Rn(W m-2)
Measured Rn(W m-2)
a


Original
y=1.0017x
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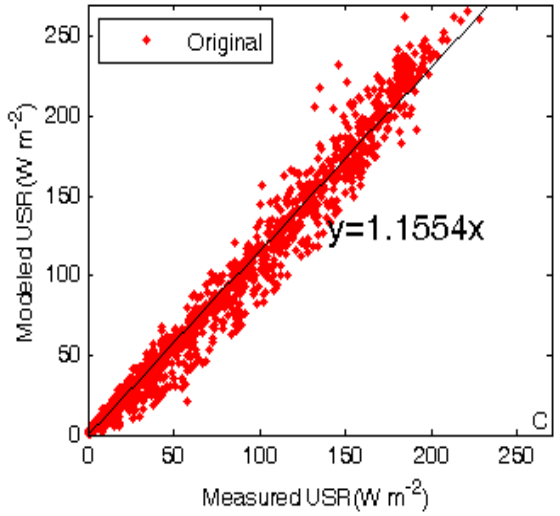
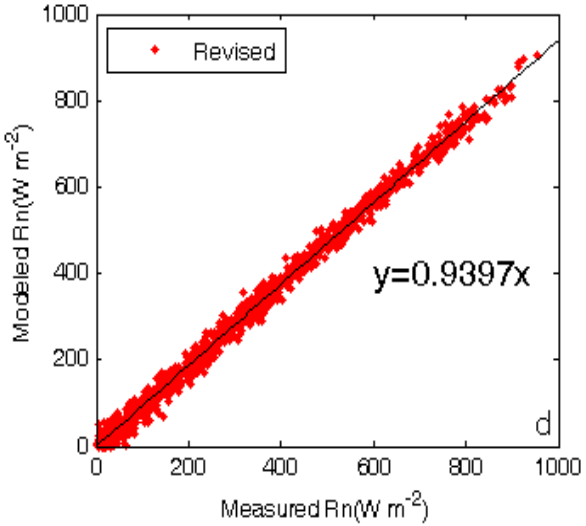
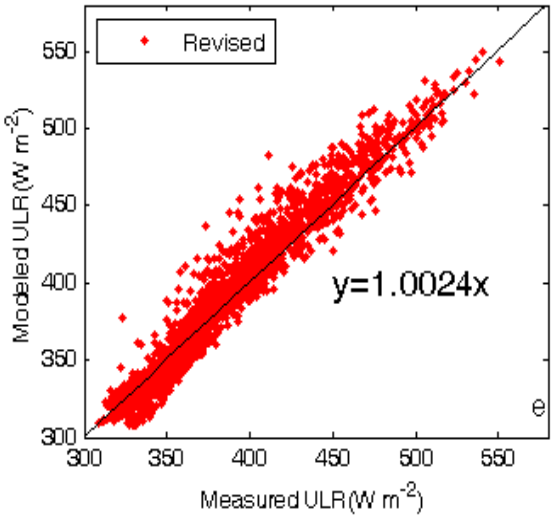
Measured ULR(W m-2)
b


Original
y=1.1554x
Modeled USR(W m-2)
Measured USR(W m-2)
c


Revised
y=0.9397x
Modeled Rn(W m-2)
Measured Rn(W m-2)
d


Revised
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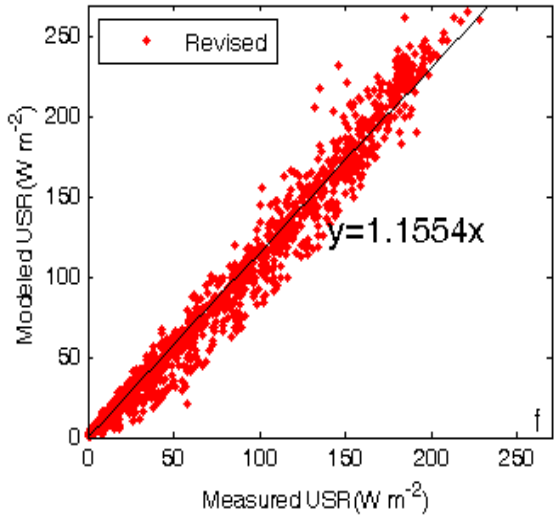
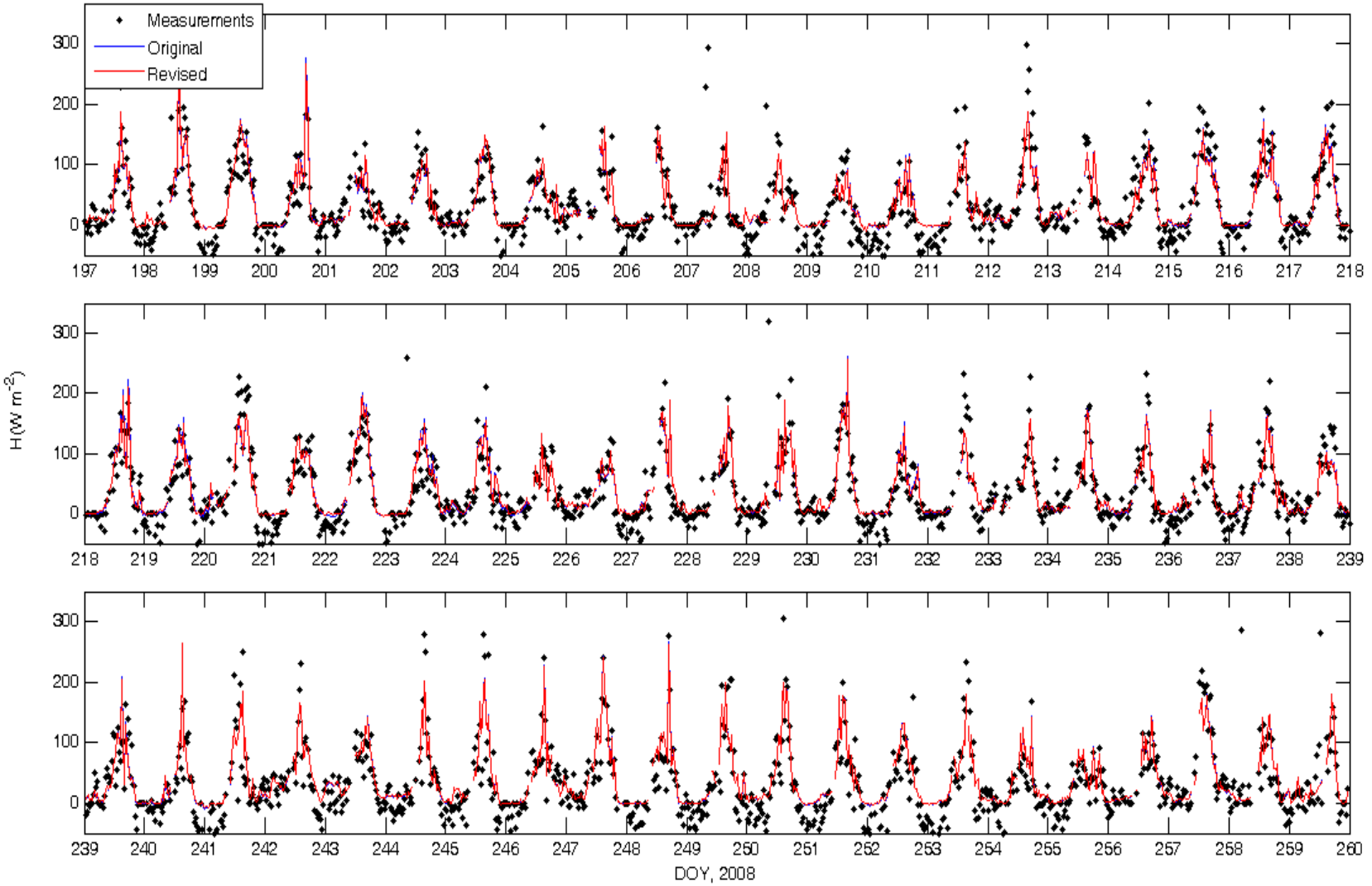
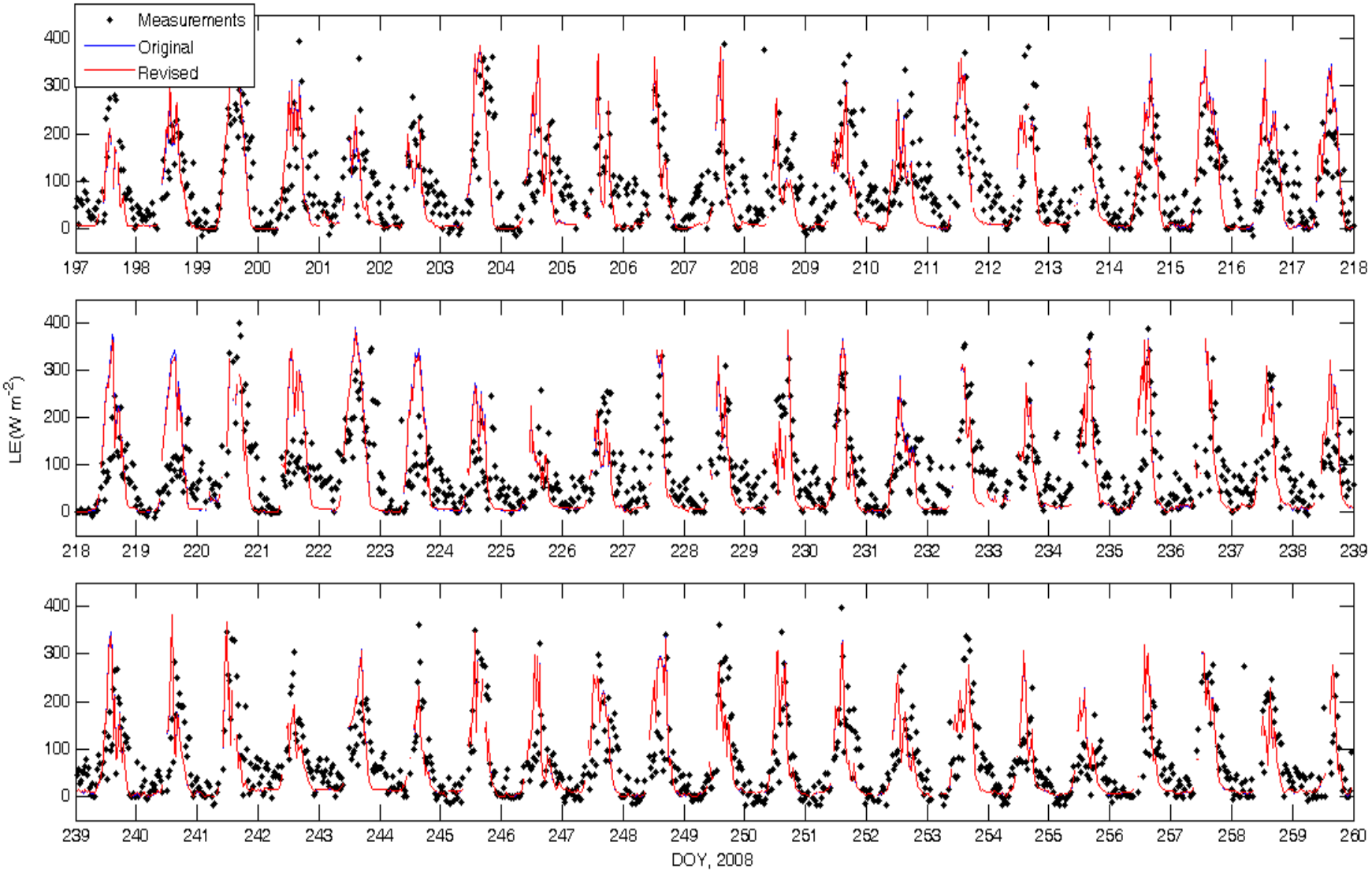
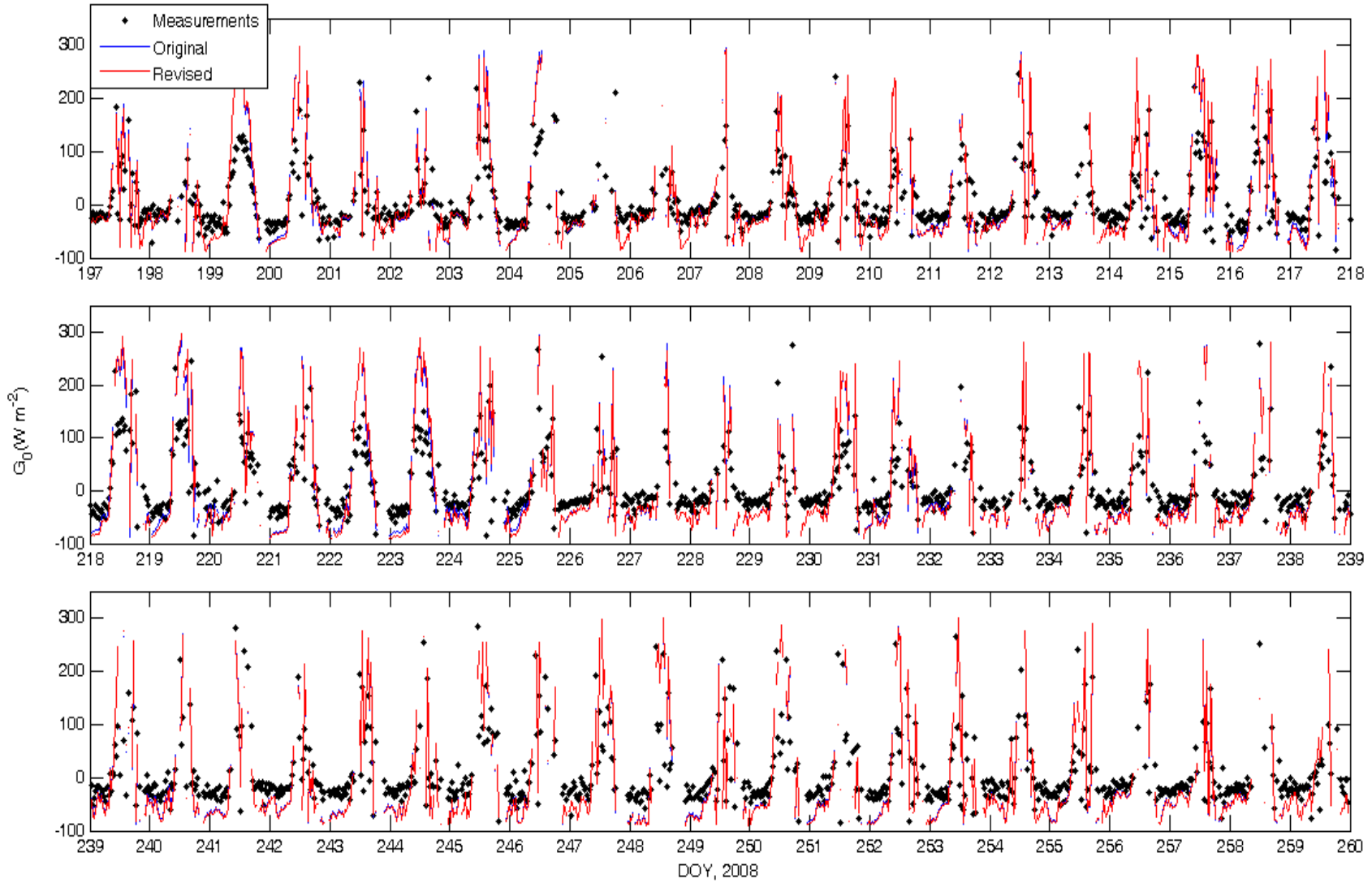
Measured ULR(W m-2)
e

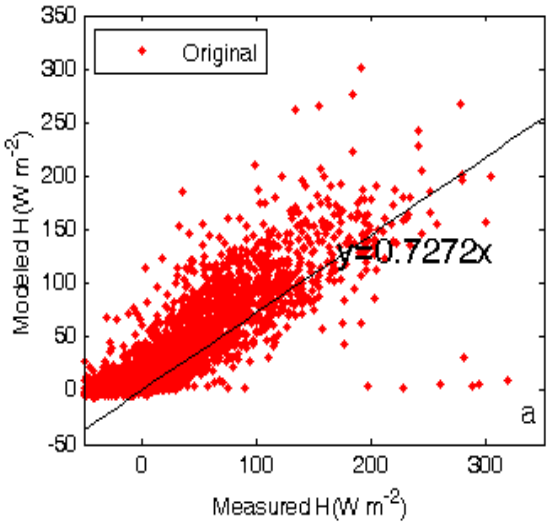

Revised
y=1.1554x
Modeled USR(W m-2)
Measured USR(W m-2)
f

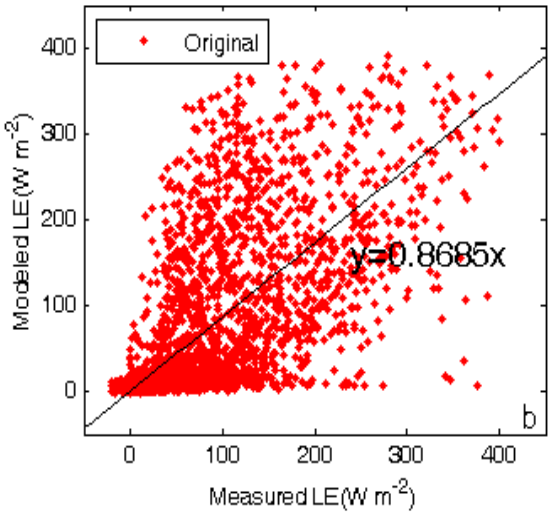
（2） 感热、潜热和土壤热通量

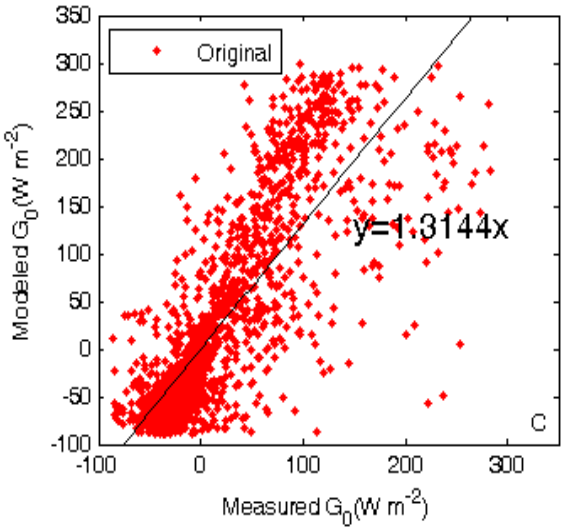


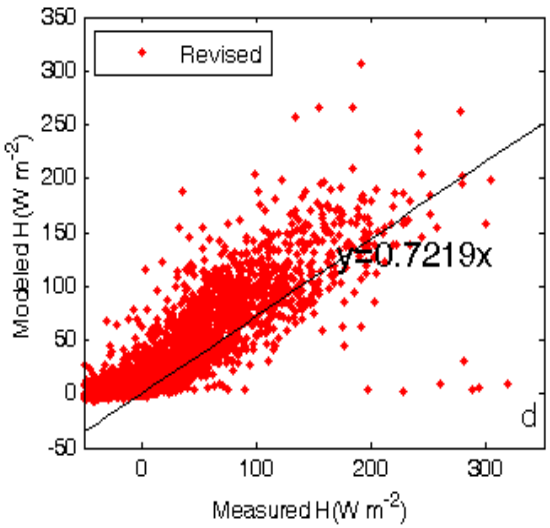

Measurements
Original
Revised
LE(W m-2)
DOY, 2008

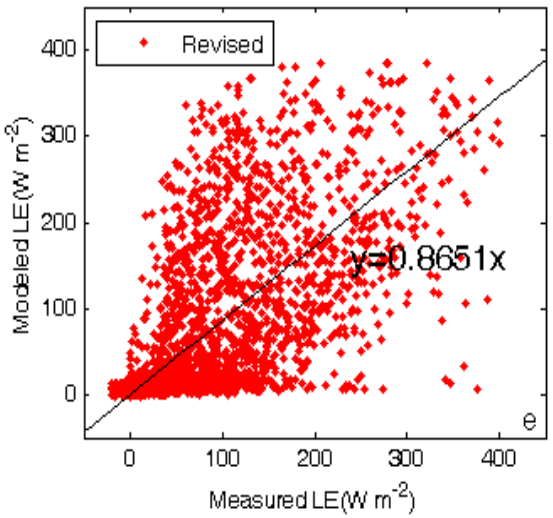

Measurements
Original
Revised
G_0(W m^{-2})
DOY, 2008

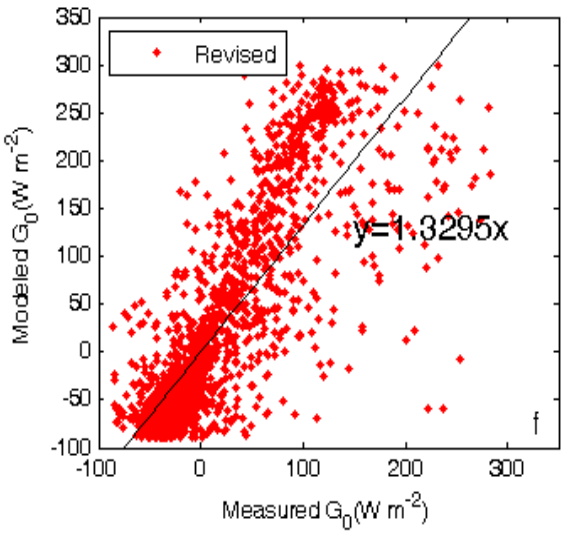

Original
y=0.7272x
Modeled H(W m-2)
Measured H(W m-2)
a


Original
y=0.8685x
Modeled LE(W m-2)
Measured LE(W m-2)
b


Original
y=1.3144x
Modeled G0(W m-2)
Measured G0(W m-2)
c


Revised
y=0.7219x
Modeled H(W m-2)
Measured H(W m-2)
d


Revised
y=0.8651x
Modeled LE(W m-2)
Measured LE(W m-2)
e


Revised
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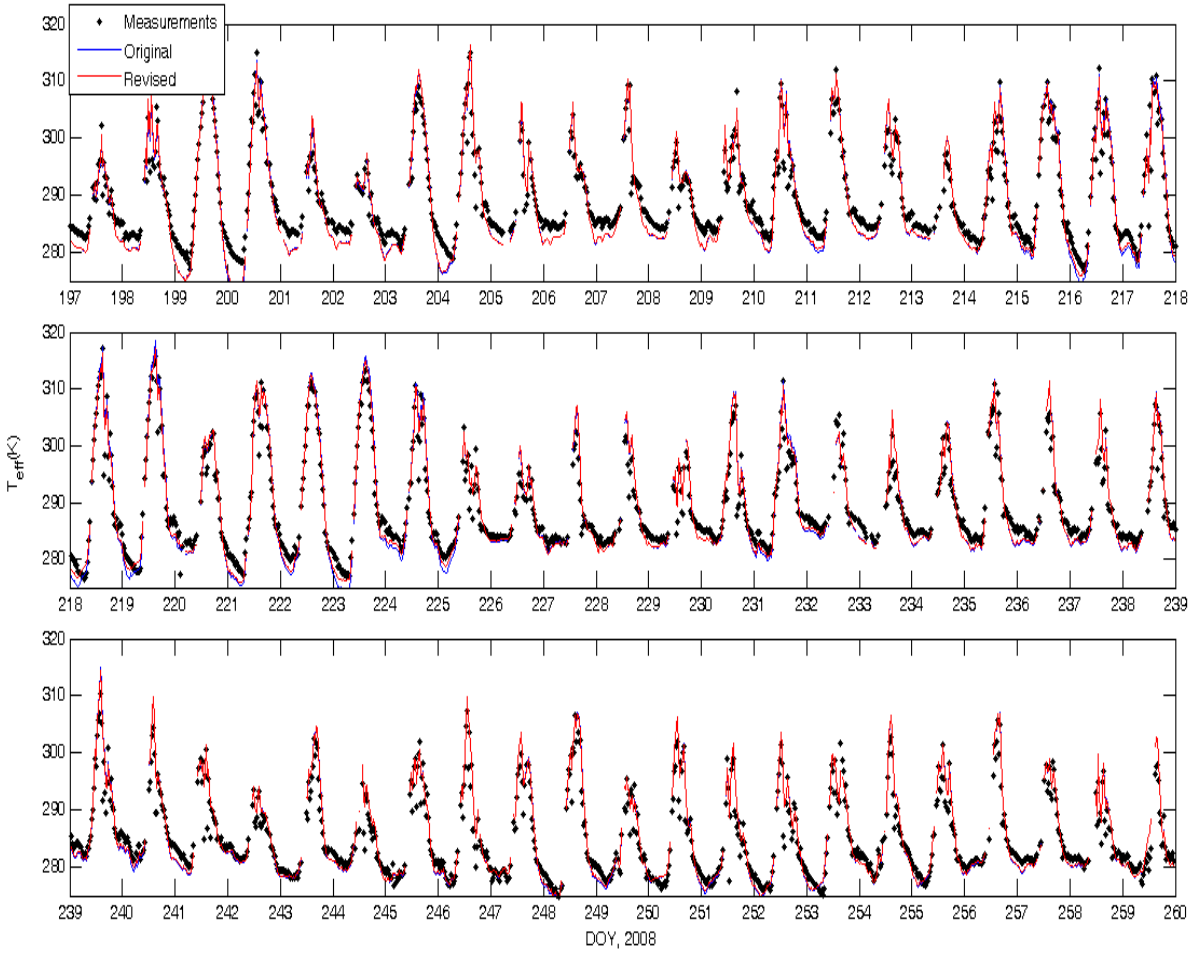
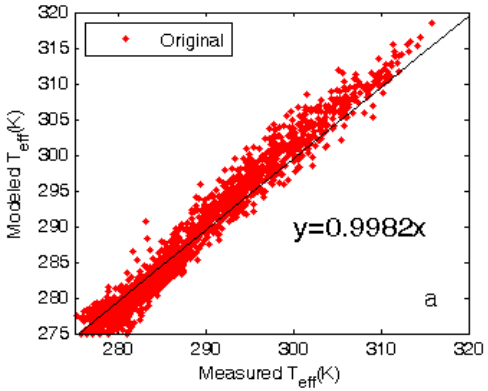
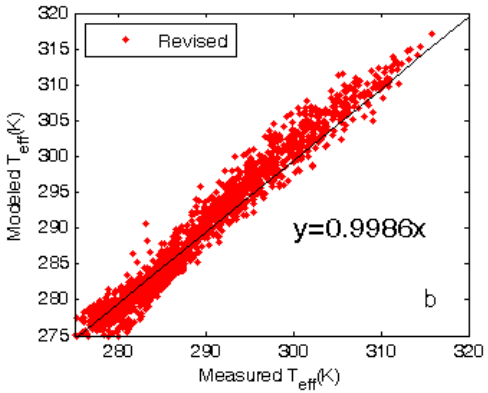
Modeled G0(W m-2)
Measured G0(W m-2)
f

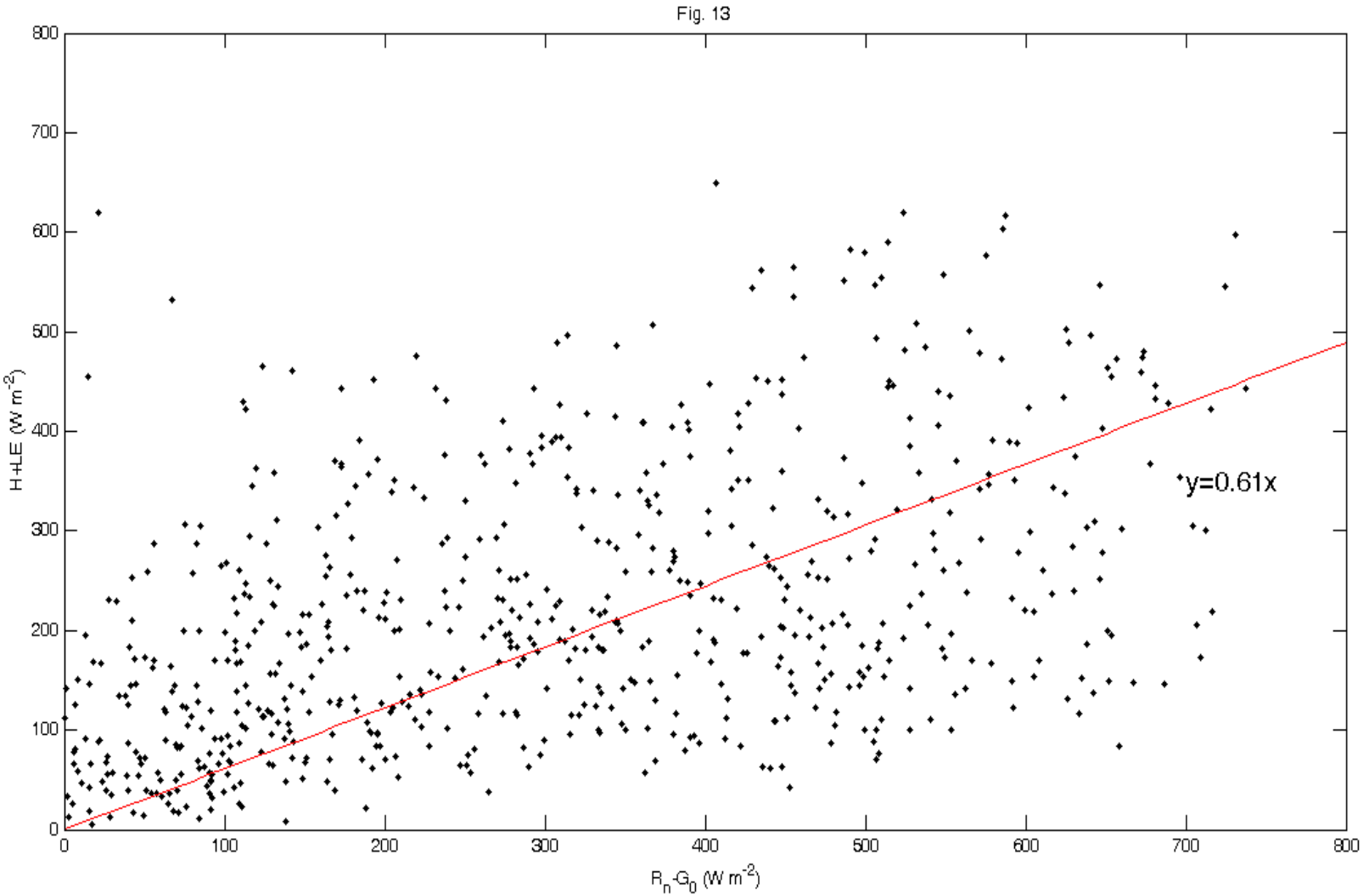
（3） 地表有效辐射温度


Measurements
Original
Revised
T_{eff}(K)
DOY, 2008


Original
y=0.9982x
a
Modeled T_{eff}(K)
Measured T_{eff}(K)


Revised
y=0.9986x
b
Modeled T_{eff}(K)
Measured T_{eff}(K)

（4）感热和潜热之和与地表可用能量的对比分布



小结

（1）改进版SiB2稍微高估向上长波辐射，没有改进向上短波辐射的模拟结果。改进版SiB2改善了潜热通量夜间的模拟结果。但是没有改善感热通量的模拟结果。

（2）整个实验阶段，青藏高原处于季风期，季风期间的降水使地表变得湿润，潜热通量增大，占主导地位。

(3)那曲站的土壤热通量值不是通过土壤热通量板实地测量得到的，而是通过计算得到的。所以导致模拟的值比计算的值大。

（4）改进版SiB2提高了地表有效辐射温度的模拟能力

五 研究结论

(1)北京阳坊和青藏高原那曲站的观测得到的向下短波辐射和空气温度、辐射各分量都呈现日变化

(2) 由于阳坊实验的观测时期正处少雨期，土壤处于干旱状态。所以感热通量占总体能量分配的主导地位。青藏高原那曲站的观测阶段处于季风期，季风期间的降水使地表变得湿润，潜热通量增大，占主导地位。

(3) 从这两个实验点的模拟结果可以看出，改进版SiB2提高了净辐射的模拟结果、稍微高估了向上长波辐射、但是没有改善向上短波辐射的模拟结果。

(4) SiB2模拟的和测量的感热通量、潜热通量和土壤热量通量时间变化一致。阳坊的模拟结果表明：改进版SiB2提高了感热通量和潜热通量的模拟结果。改进版SiB2提高了夜间的土壤热通量的模拟能力。而青藏高原那曲站的模拟表明：改进版SiB2改善了潜热通量夜间的模拟结果。

(5) 在整个模拟时间段，阳坊实验点和青藏高原那曲站的模拟结果都表明：改进版SiB2更新了土壤热传导率计算方法。从而提高了地表有效辐射温度的模拟能力(包括土壤地表温度)。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谢 谢！