Estimation of Monthly Mean Global Solar Radiation

(first results at USA level)

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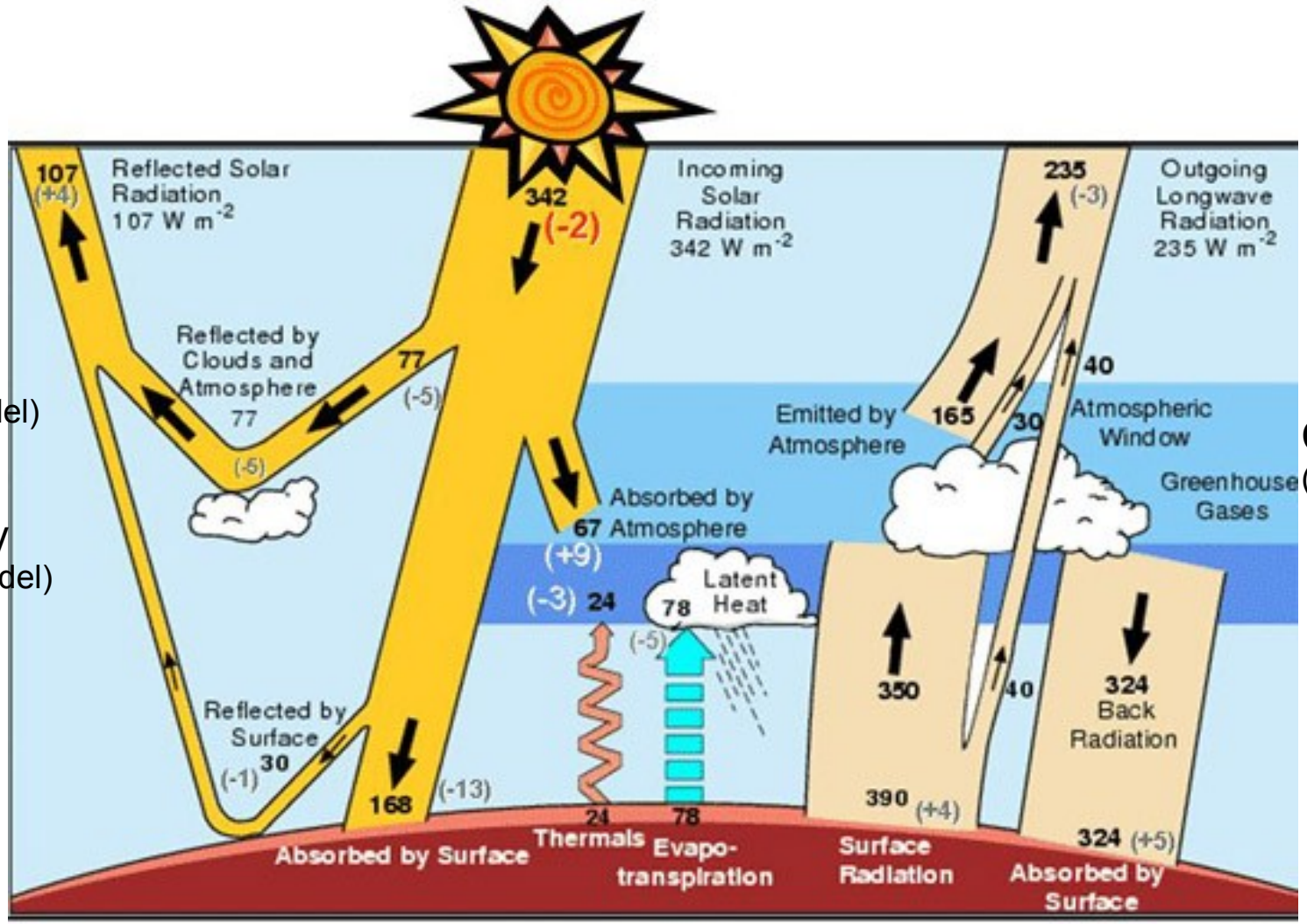
EarthEnv group call on April 15th 2014

Physical aspect of solar radiation

Position of the sun
(geometric equations)

Aerosol
(Atmospheric model)

Linke turbidity
(Atmospheric model)



Clouds
(Satellite product)

Albedo
(Satellite product)

Aspect and Slope of the relief

Model r.sun in GRASS

- Clear-Sky
  - DEM, Albedo, Linke Turbidity
- Real-Sky
  - DEM, Albedo, Linke Turbidity, Cloud, Aerosol

Global Radiation

- Diffuse Radiation - Aerosol
- $Beam_{(direct)}$ Radiation - Cloud
- Reflected Radiation – Albedo and Aspect/Slope

Model r.sun in GRASS

- Clear-Sky ? ?
  - DEM, Albedo, Linke Turbidity
- Real-Sky ? ? ?
  - DEM, Albedo, Linke Turbidity, Cloud, Aerosol

Global Radiation

- Diffuse Radiation - Aerosol
- $Beam_{(direct)}$ Radiation - Cloud
- Reflected Radiation – Albedo and Aspect/Slope

Input Data Sources

- DEM > GMTED2010 (Validation at 1km)
- Linke T. > NODATA (use constant value 1 = transparent atmosphere)
- Albedo > Modis (2km - 16-day values > linear trend for daily observations)
- Cloud > Modis (1km - monthly values > linear trend for daily observations)
- Aerosol > Modis (1degree - monthly values > linear trend for daily observations

Validation Data Sources

- National Solar Radiation Data Base (858 stations) Pyranometer
  - Improvement > stations from:
    - Aeronet
    - Other sources at world level

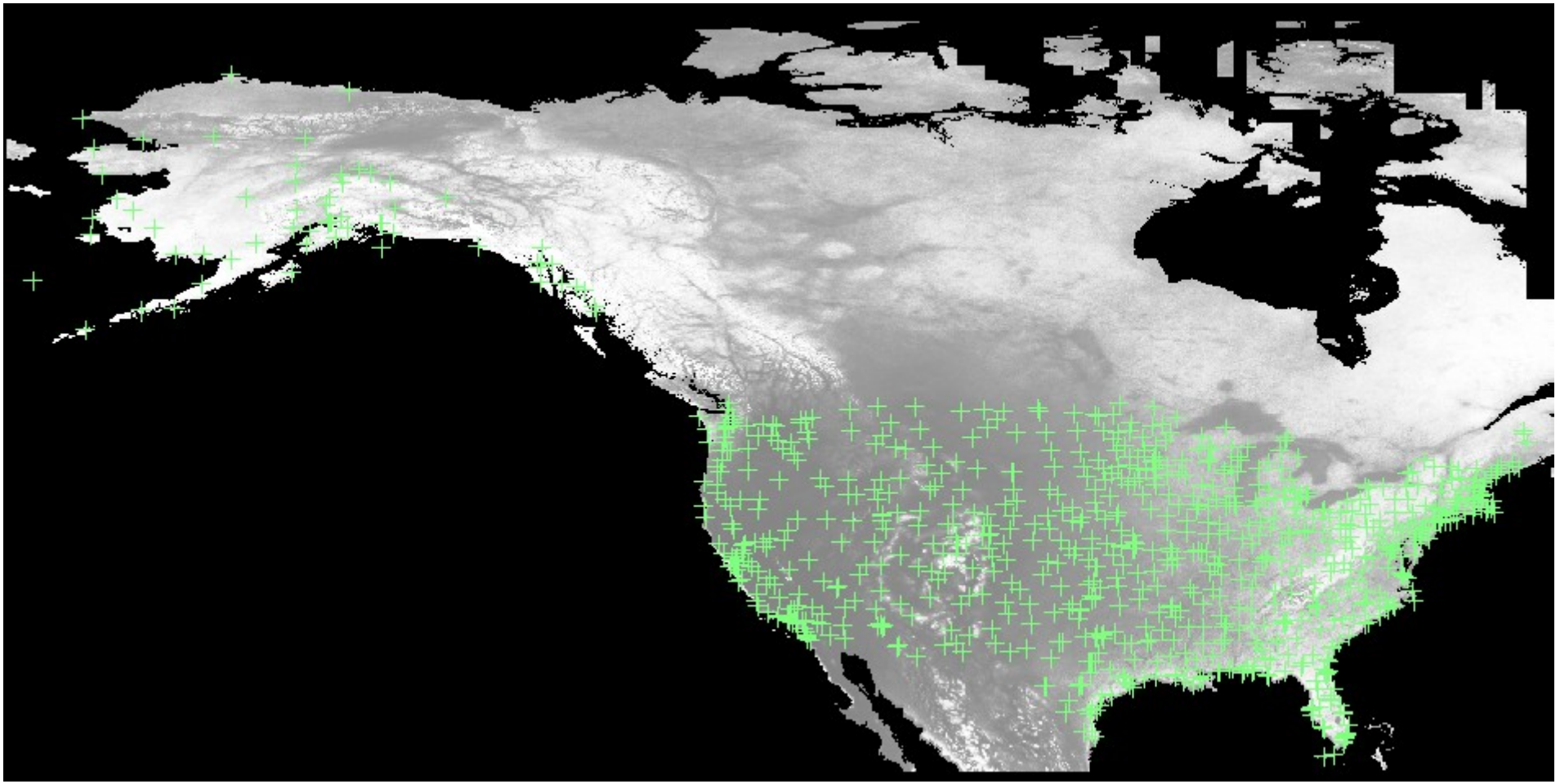
Global Radiation – To validate the monthly Global radiation

- Diffuse Radiation – To validate the Aerosol effect
- $Beam_{(direct)}$ Radiation – To validate the Cloud effect
- Reflected Radiation – To validate Albedo and Aspect/Slope

Real-Sky

DEM, Albedo, Linke Turbidity, Cloud, Aerosol

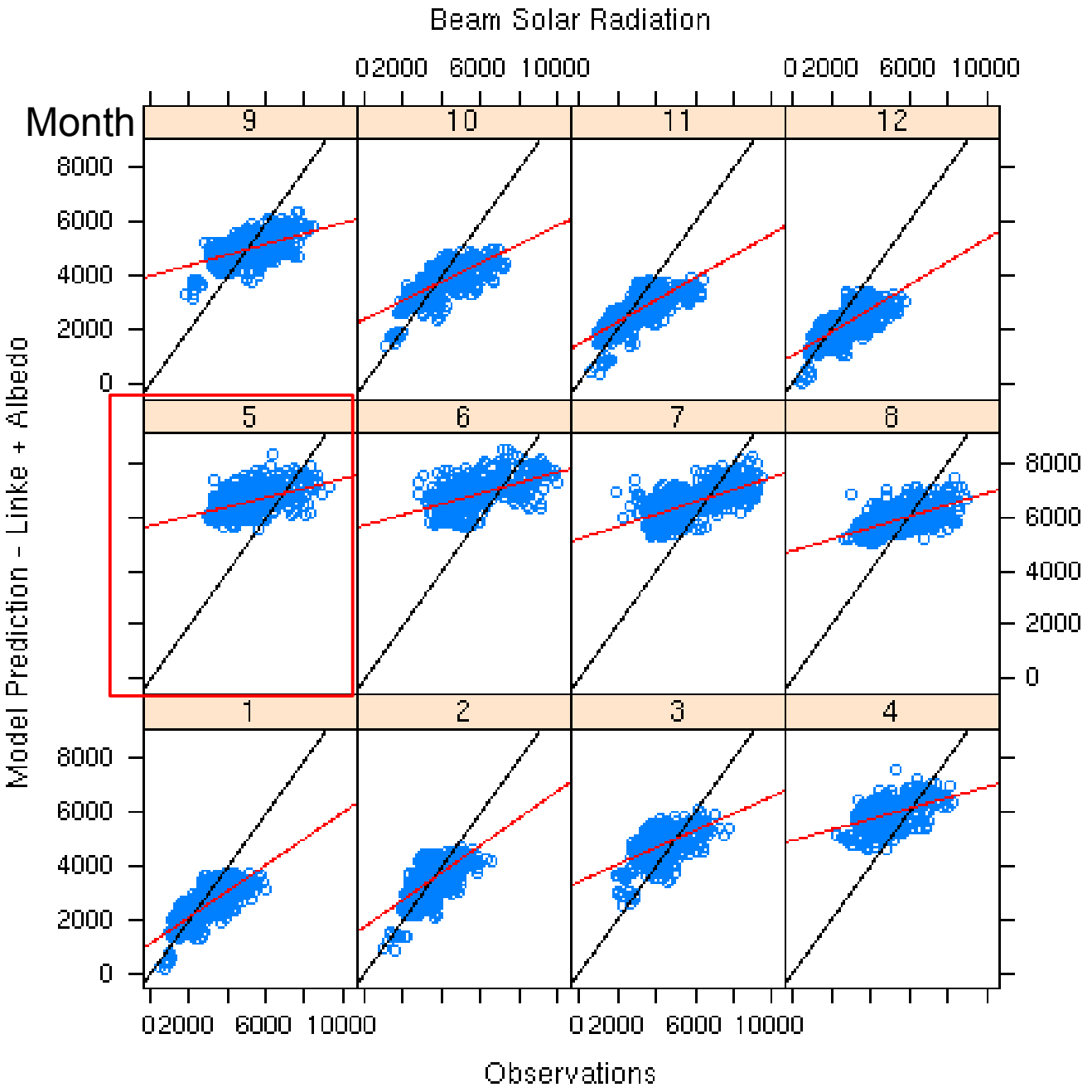
July



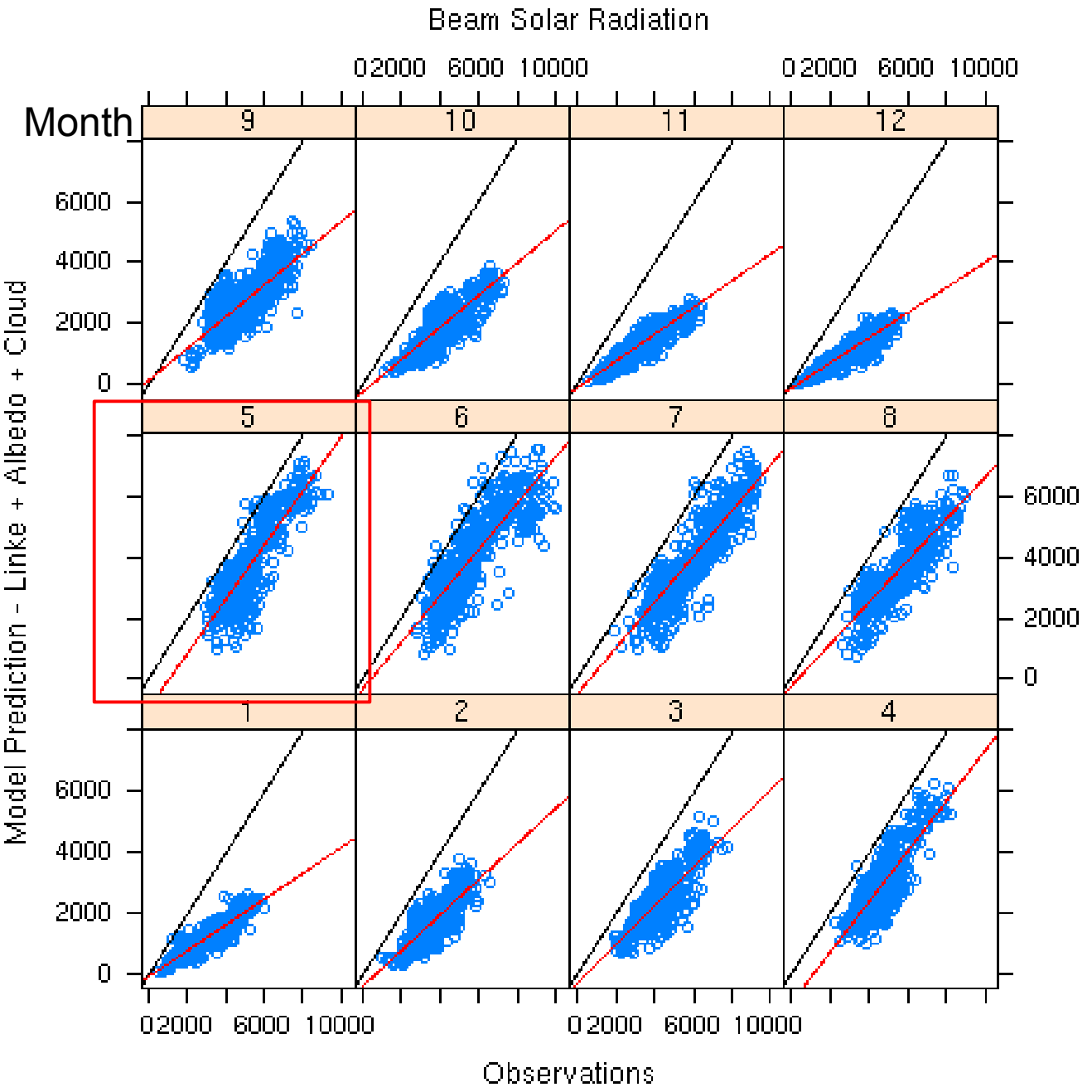
Validation procedure

- Modelled vs Observed
  - Global Radiation
  - Diffuse radiation
  - Beam radiation (no observations only modelled)

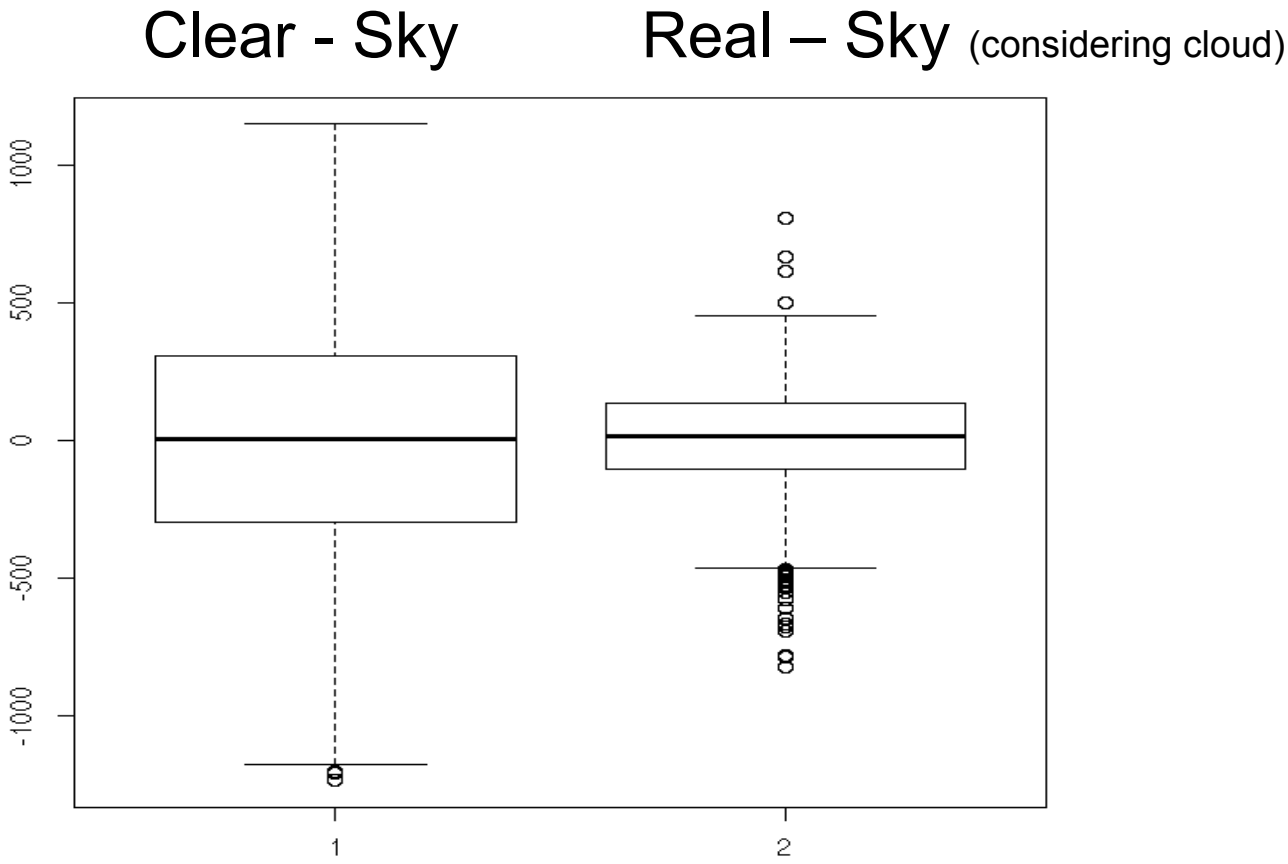
Clear - Sky


Beam Solar Radiation
Month
9
10
11
12
5
6
7
8
1
2
3
4
Model Prediction - Linke + Albedo
Observations
0
2000
4000
6000
8000
02000
6000
10000

Real - Sky


Beam Solar Radiation
Month
9
10
11
12
5
6
7
8
1
2
3
4
Model Prediction - Linke + Albedo + Cloud
Observations
0
2000
4000
6000
10000

Box Plot of the residuals for May



Improvement: data

- Aerosol > Modis (1degree - monthly values > linear trend for daily observations)

  1 to 10km - spline line to derive daily observations

- Cloud > Modis (1km - monthly values > linear trend for daily observations)

  1km - spline line to derive daily observations

- Linke T. (NODATA, use constant value = 1)

  indirect derive from the Aerosol and atmospheric water vapor (Pierre Ineichen 2008)

- Albedo > Modis (2km - 16-day values > linear trend for daily observations)

  1km - 8-day values - spline line to derive daily observations

- DEM > GMTED2010 (Validation at 1km) Prediction at 250m

Improvement: observations

- Increase number of observations
  - Check agreements between different data sources
  - Perform cross validation
  - Estimate the model error contribution for
    - Global radiation
    - Beam radiation
    - Diffuse radiation

Improvement: model

- Migrate from r.sun GRASS6 to r.sun GRASS7
- Increase tiling overlapping for global level prediction