Spatial matching error in comparisons of satellite and surface fluxes

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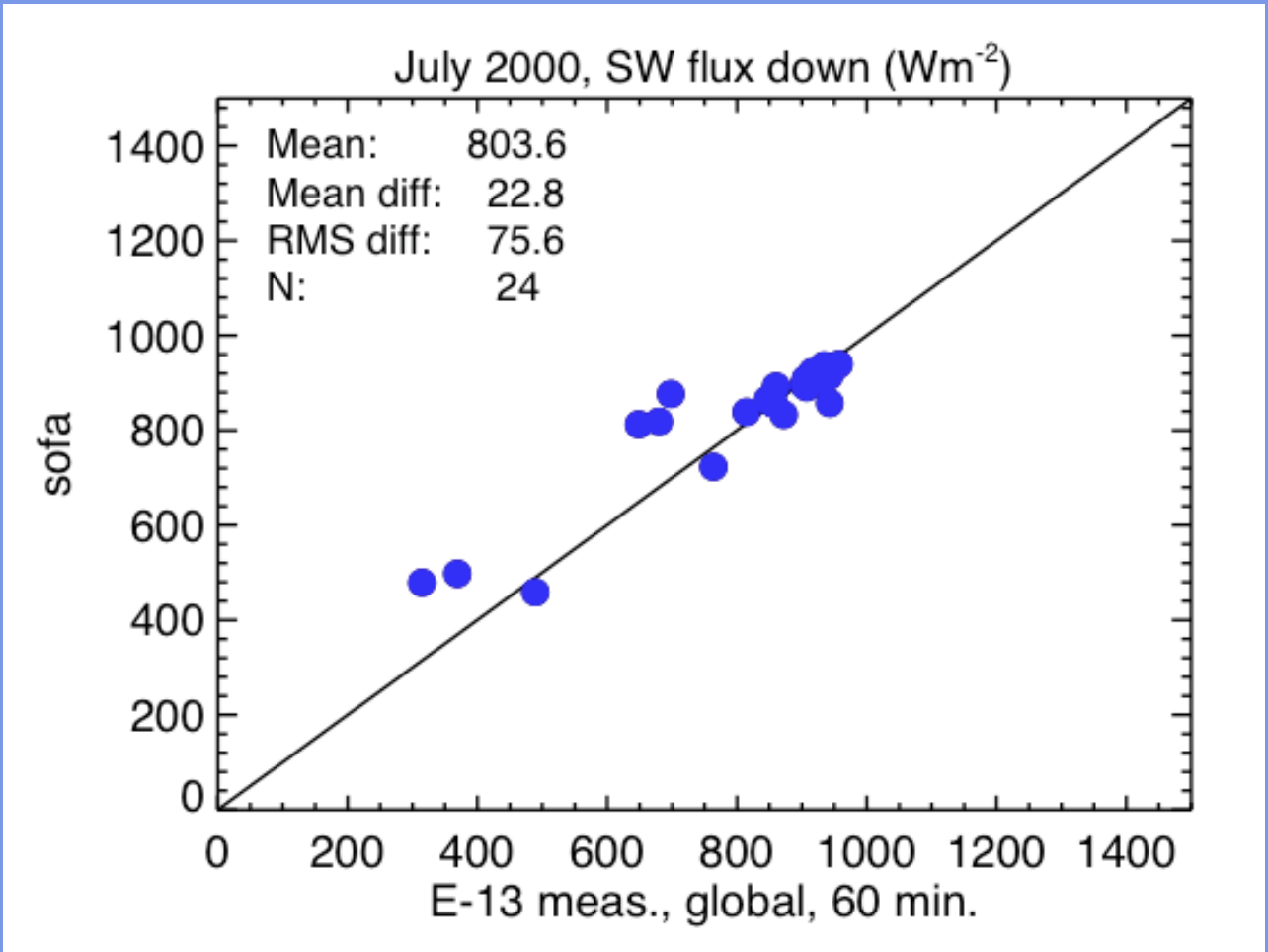
Example comparison



Radiometric surface data

Advantages:

- ♣ Direct measurements
- ♣ Calibrated
- ♣ Frequent (10s-1m)
- ♣ Available for long time periods
- ♣ Available at many locations (ARM, BSRN)

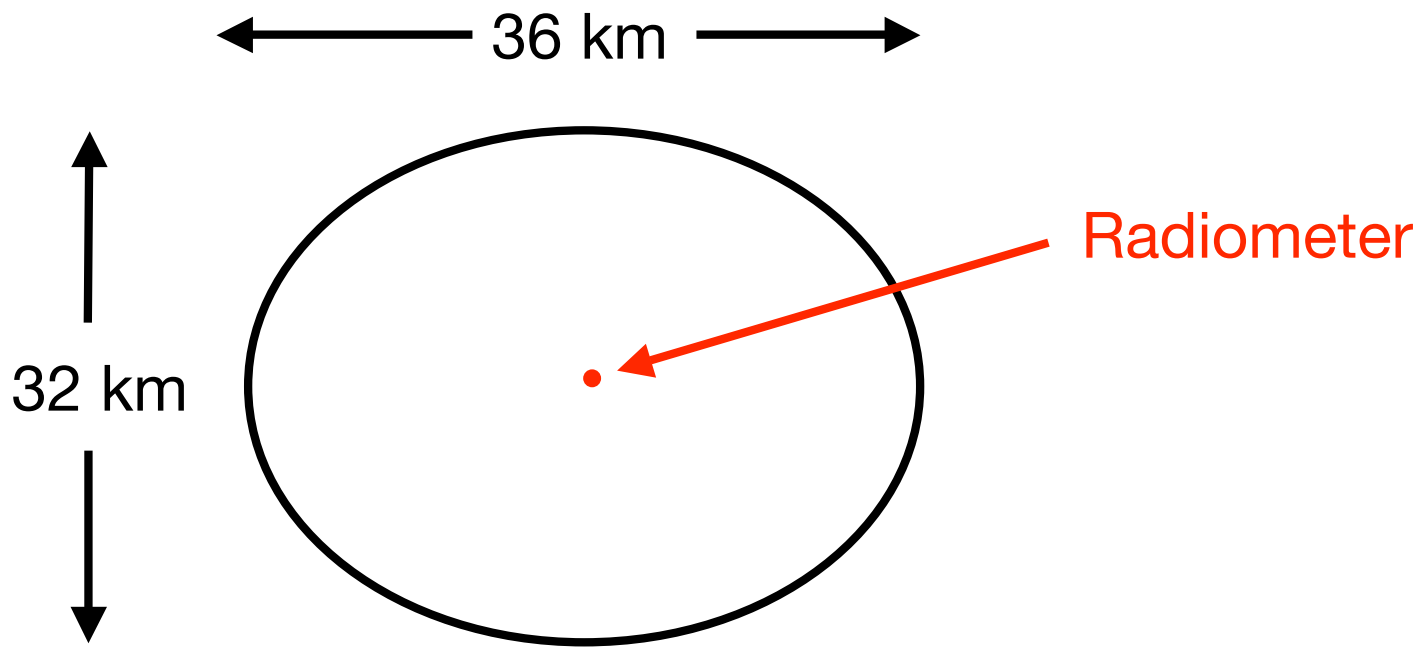
Major disadvantage:

- ♣ Different measurement geometry

Spatial mismatch

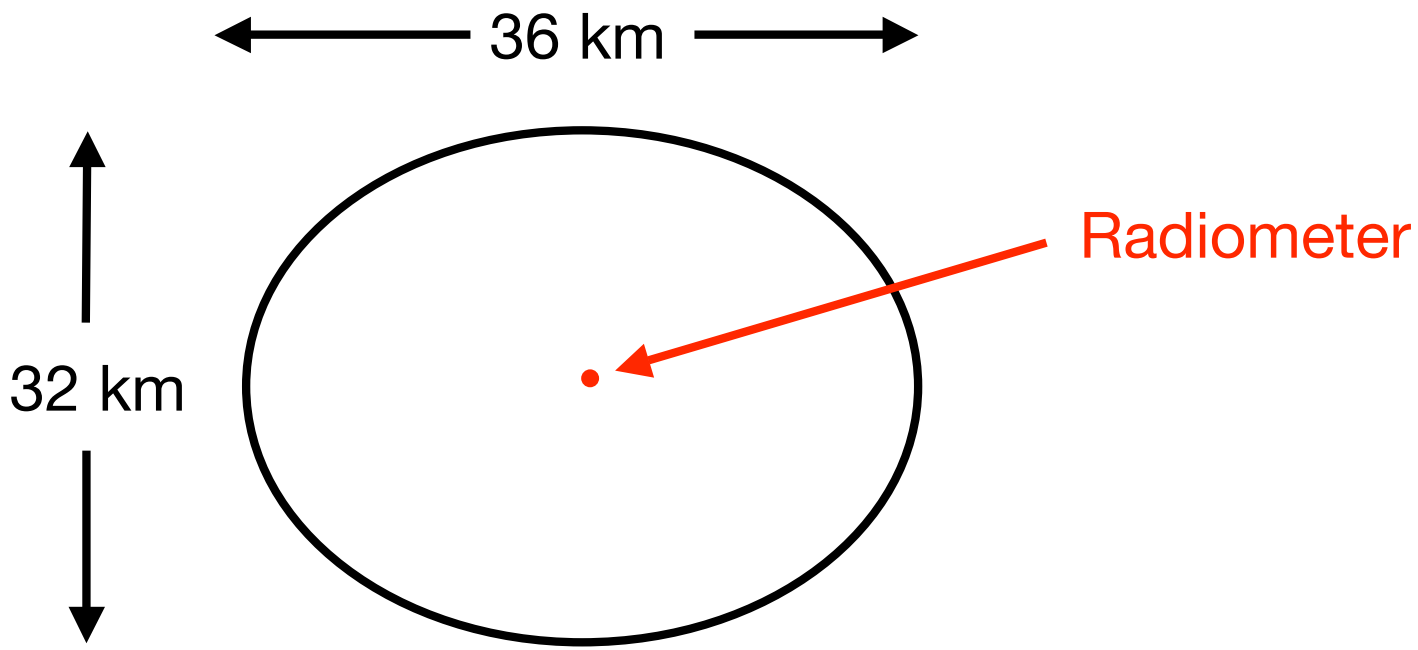
1) Measurement spot size at surface

Measurement spot size



CERES Single Scanner Footprint

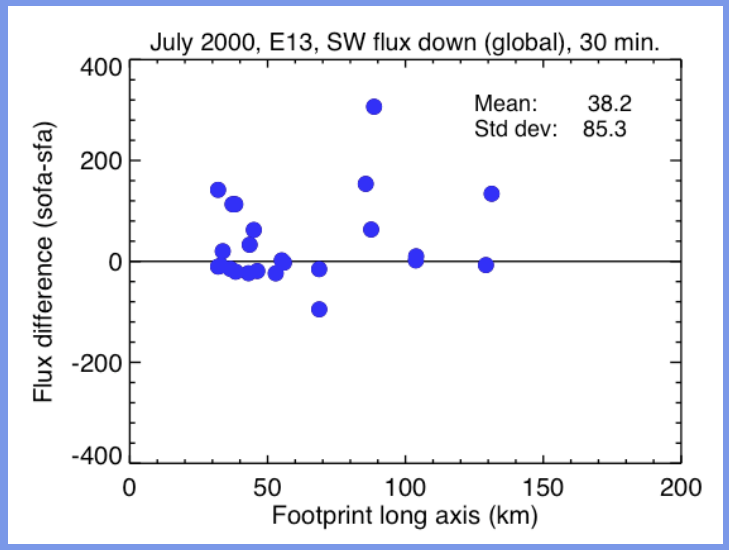
Measurement spot size

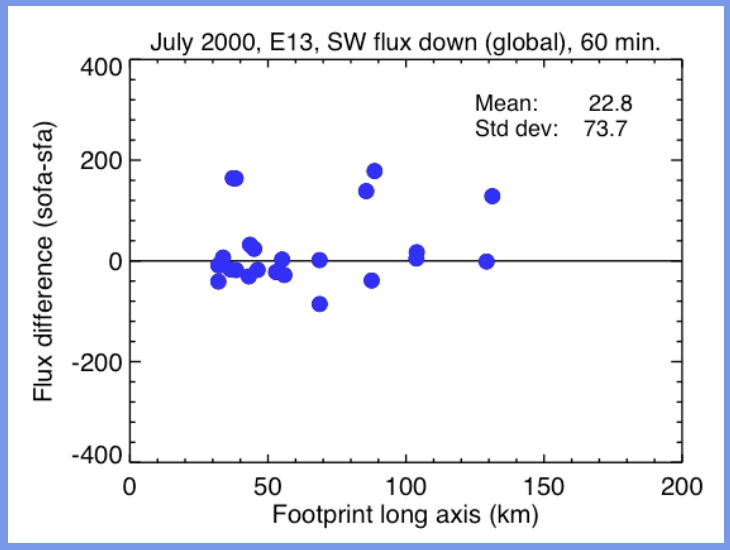


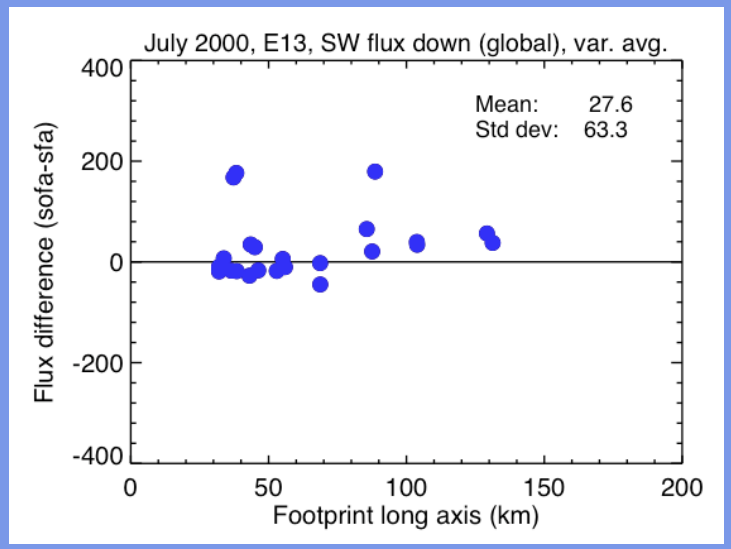
CERES Single Scanner Footprint

Average over time

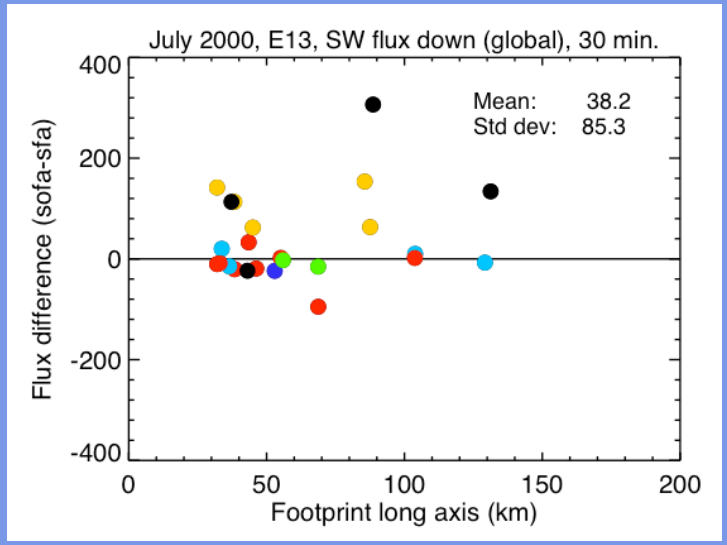
Effect of averaging time

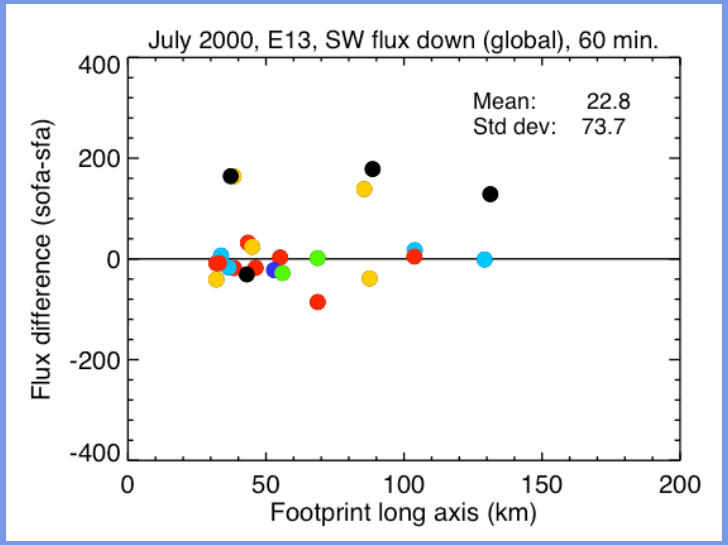


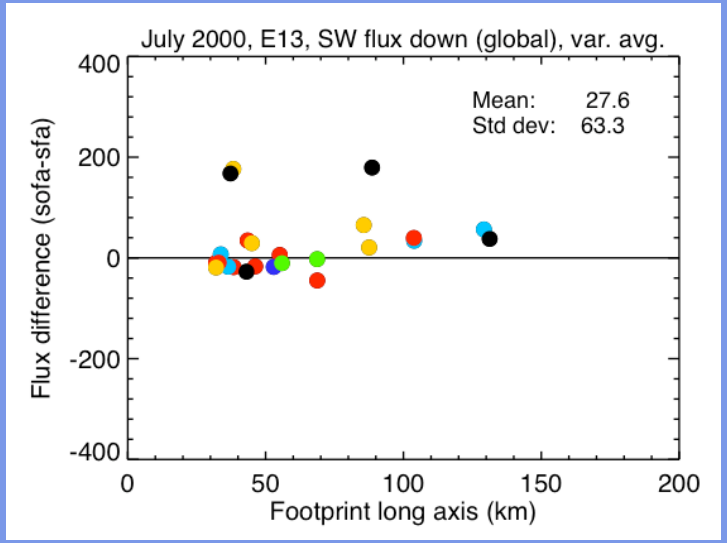


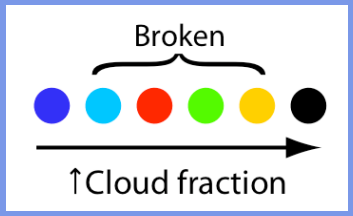


Cloud type and averaging time





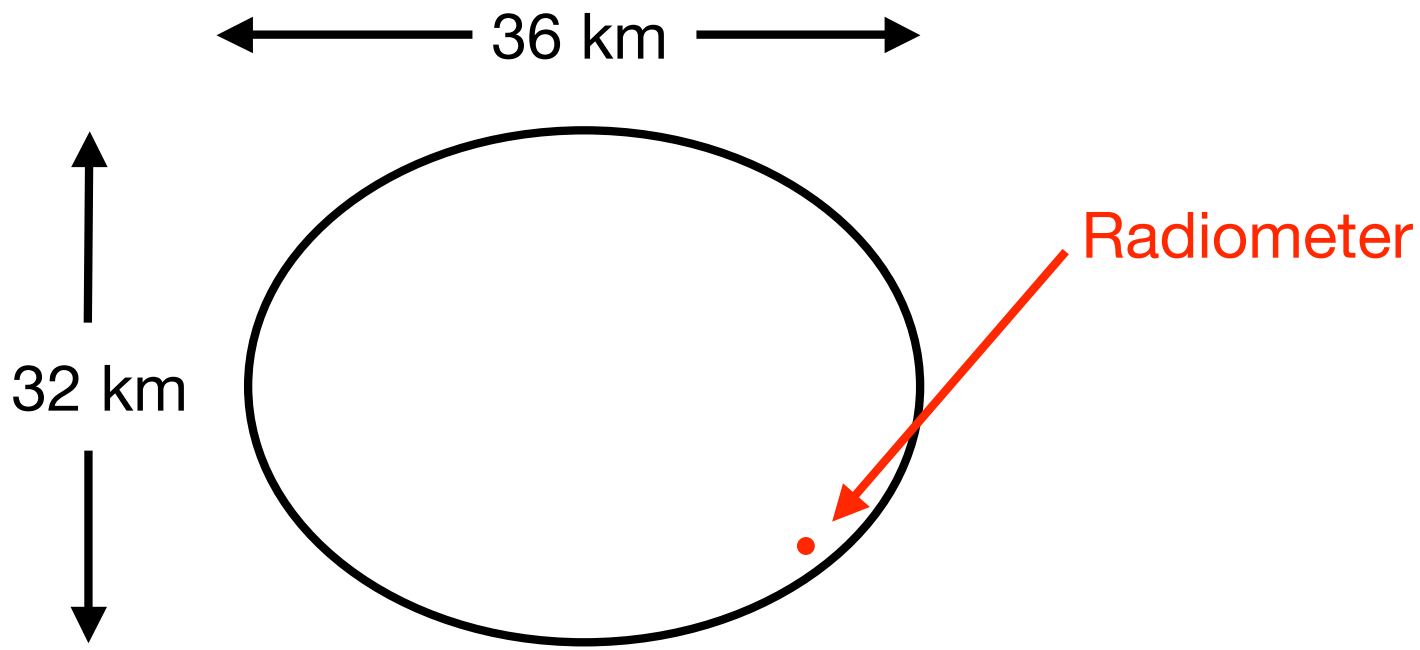




Spatial mismatch

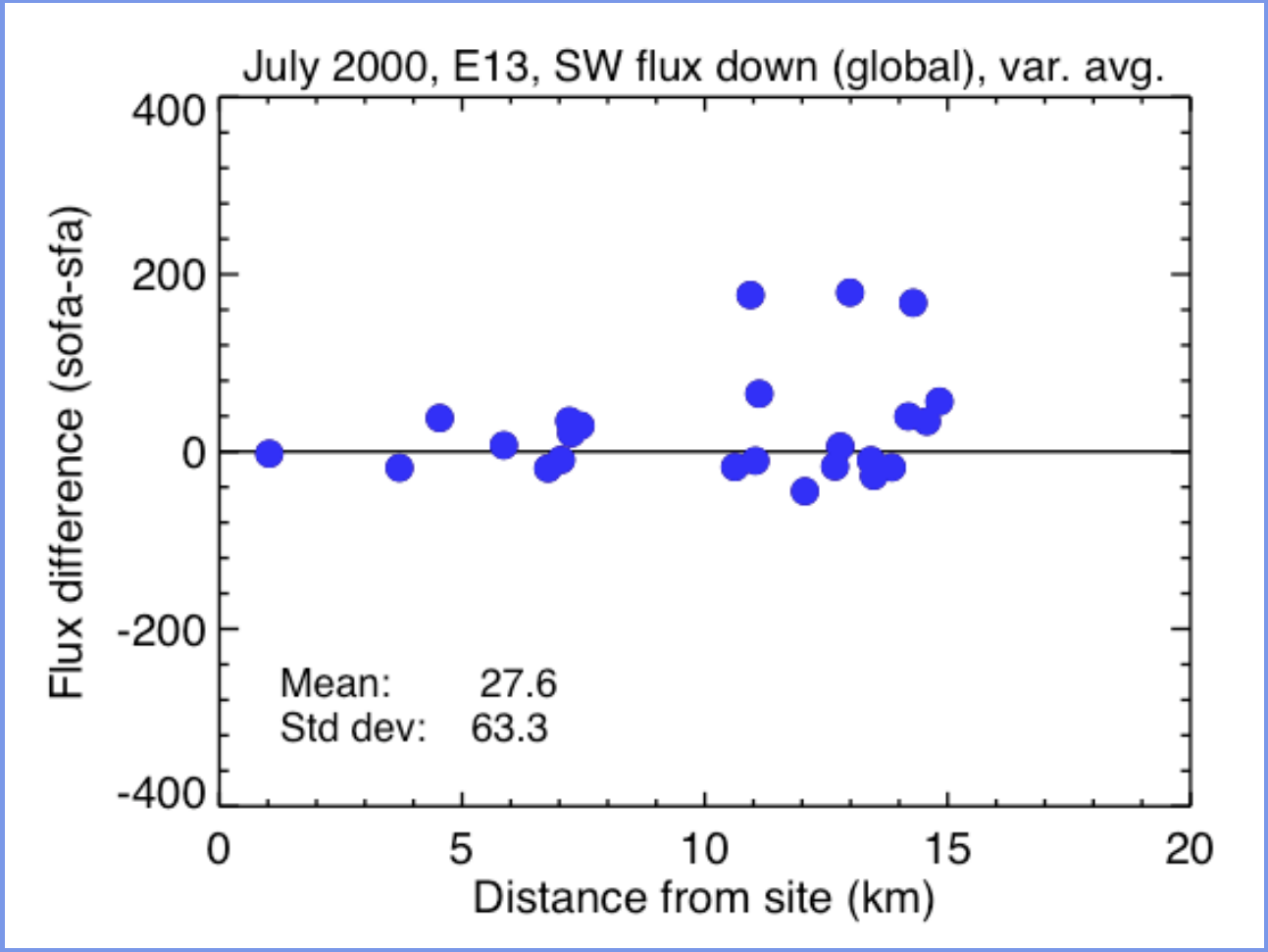
1) Measurement spot size
2) Measurement location at surface

Measurement location error



CERES Single Scanner Footprint

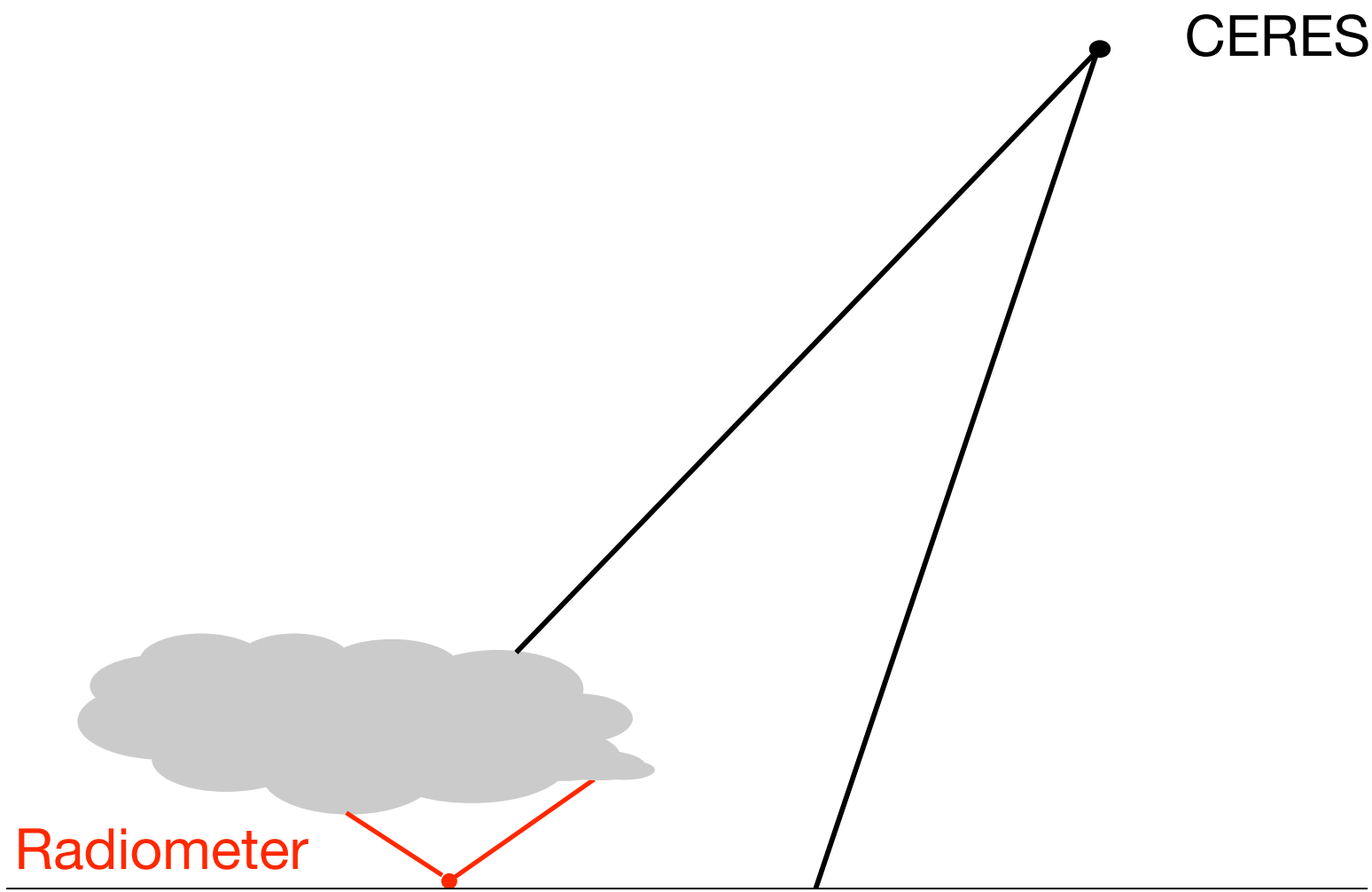
Effect of location differences



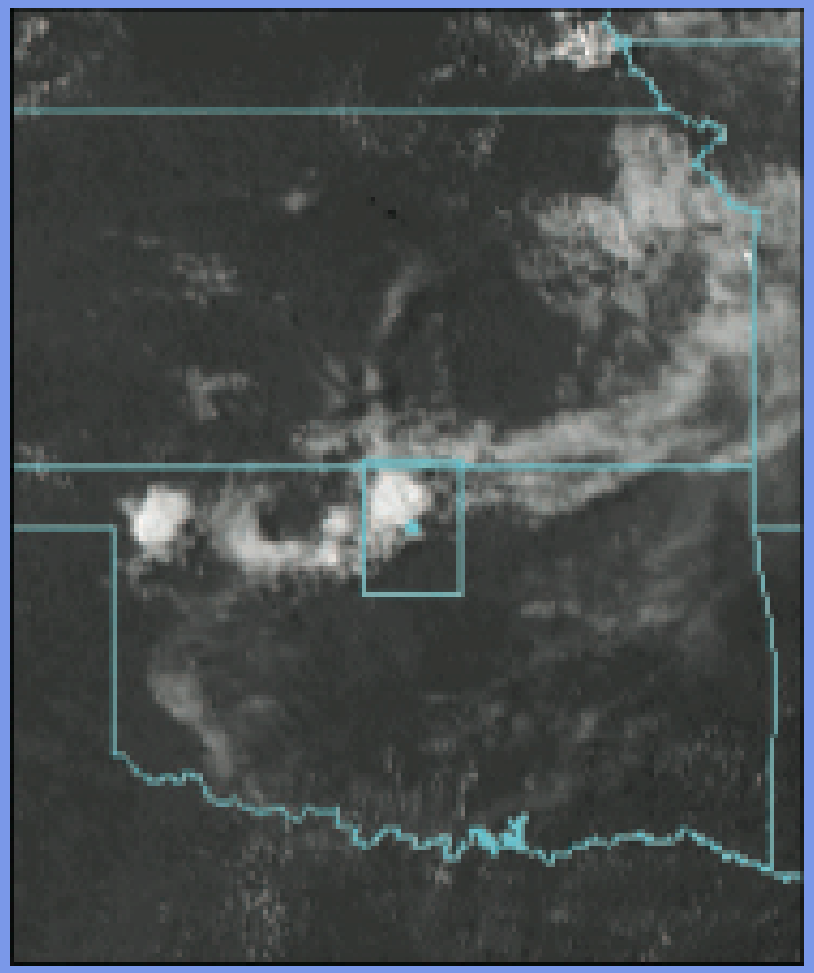
Spatial mismatch

1) Measurement spot size
2) Measurement location at surface
3) Field of view

Field of view differences



Field of view mismatch



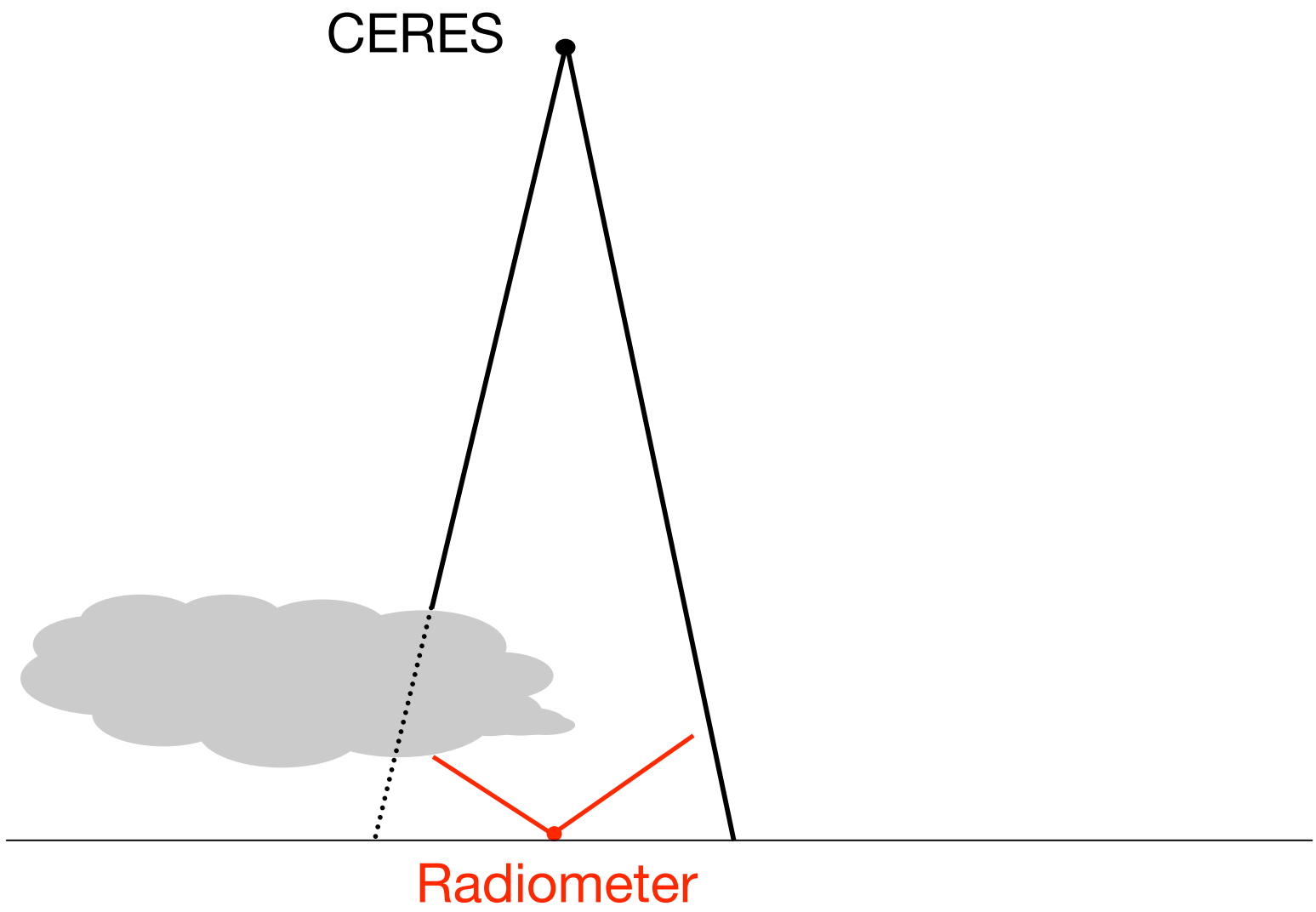
11 July 2000, 21 UTC

TISA: 599 Wm^{-2}
ARM CF: 44 Wm^{-2}
(60 min avg)

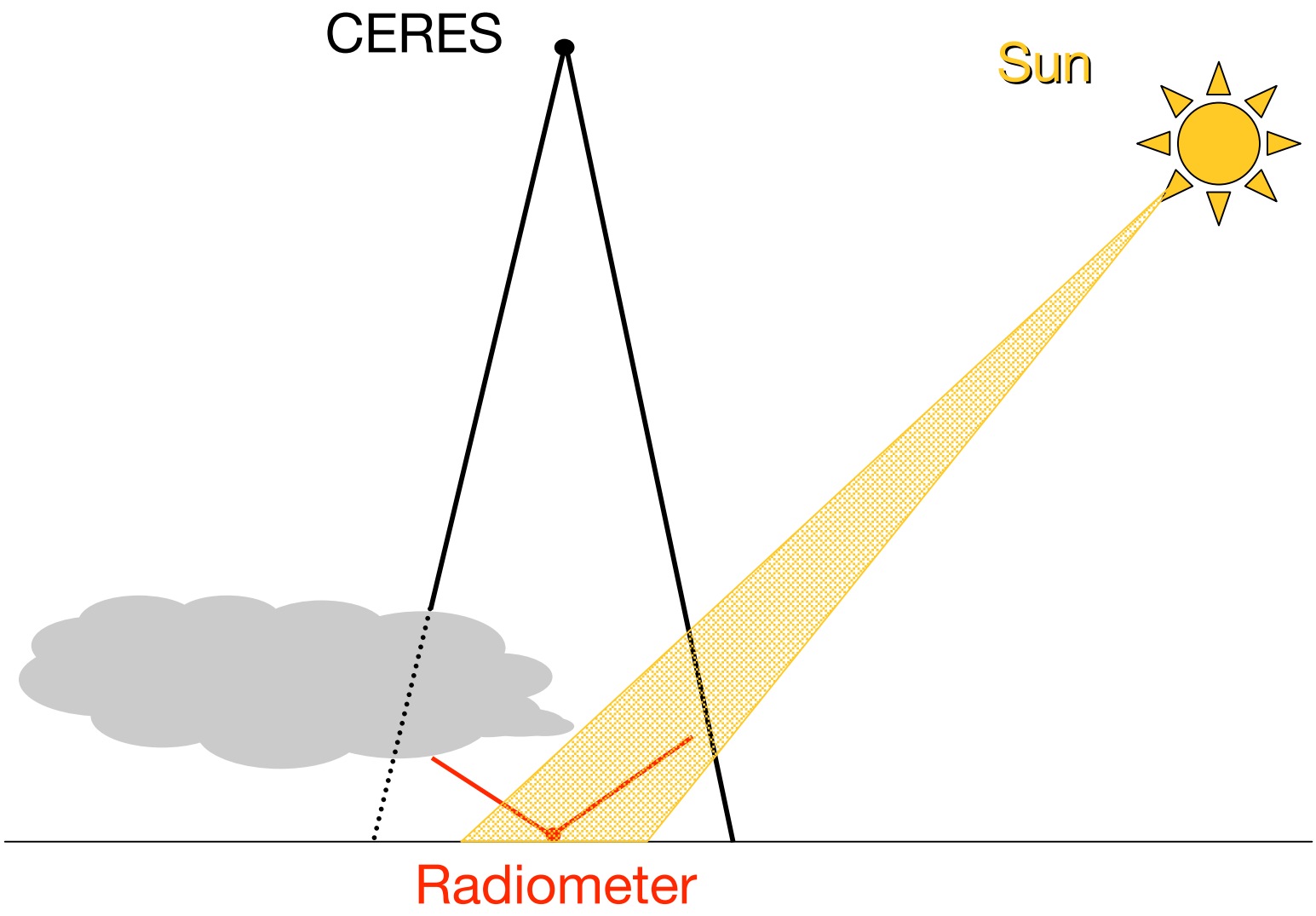
Spatial mismatch

1) Measurement spot size
2) Measurement location at surface
3) Field of view
4) Sensor position relative to sun

Sensor position vs. sun

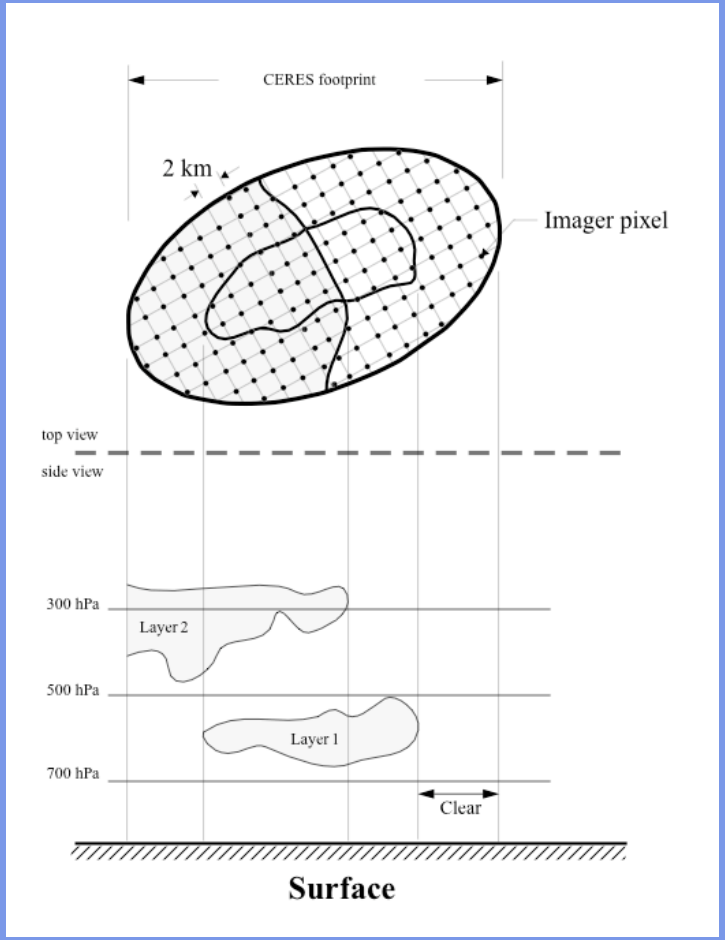


Sensor position vs. sun



Analysis approach

1) Reconstruct cloud scene from pixel-level imager data (MODIS).
2) Use geometry and simple radiative transfer computations to determine fluxes at surface, radiance at satellite.
3) Compare results for a variety of geometries and scene types.



Summary

Comparisons between CERES fluxes and surface data are complicated by spatial mismatch between the measurements.

Evaluation of CERES products is essential to their use.

A variety of techniques are being used to address the mismatch problems and provide error estimates for the CERES data.

Radiometric Surface Data

Advantages:

- ♣ Direct measurements
- ♣ Calibrated
- ♣ Frequent (10s-1m)
- ♣ Available for long time periods
- ♣ Available at many locations (ARM, BSRN)

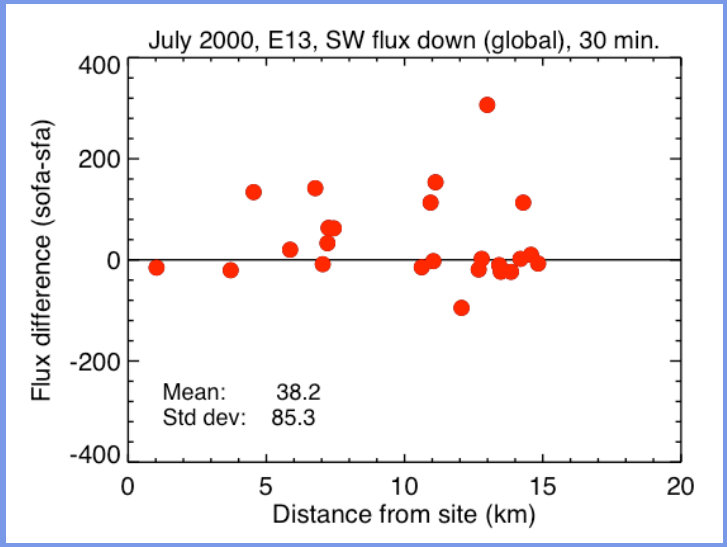
Disadvantages:

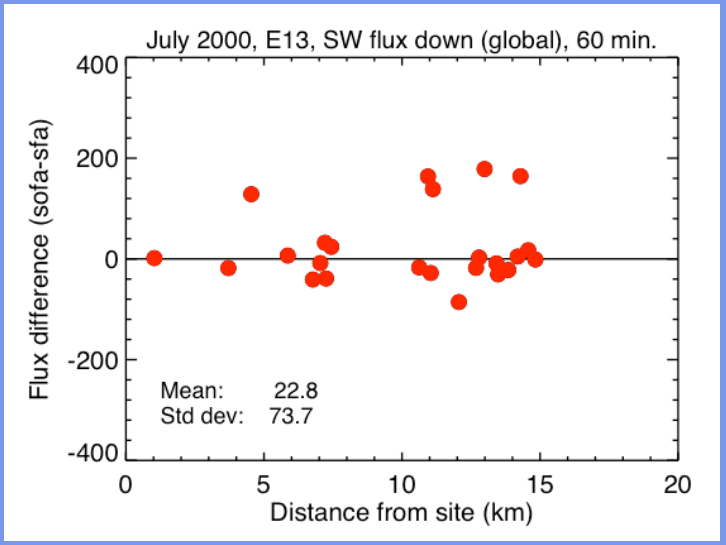
- ♣ Calibration depends on location
- ♣ Limited field of view

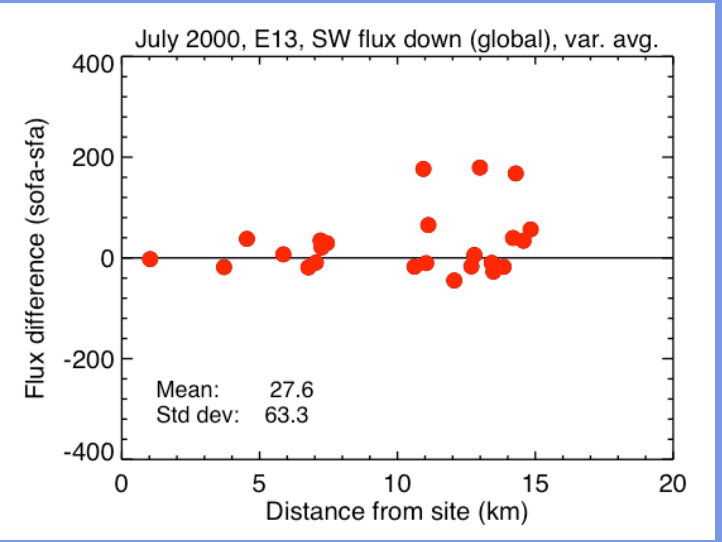
Spatial Mismatch

1) Measurement spot size
2) Measurement location at surface
3) Instrument view angle (meas. path?)
4) Sensor position relative to sun

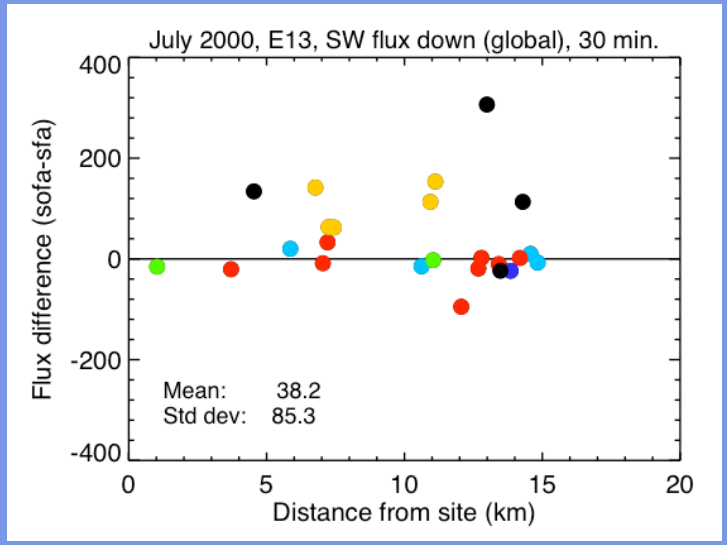
Effect of location differences

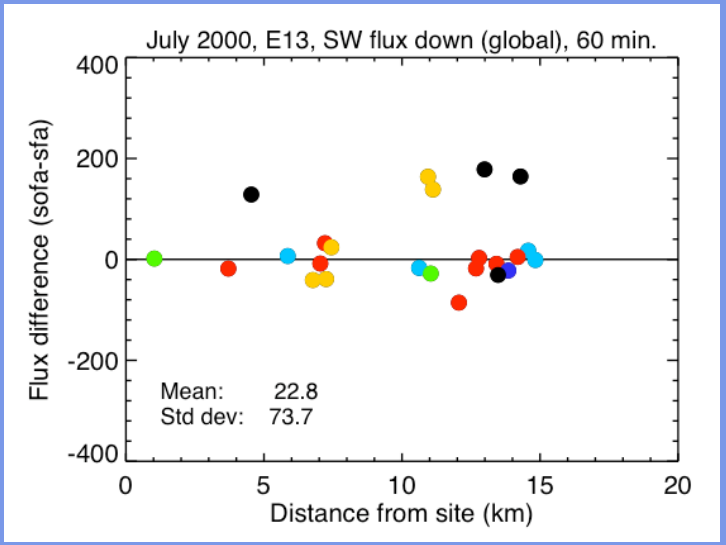


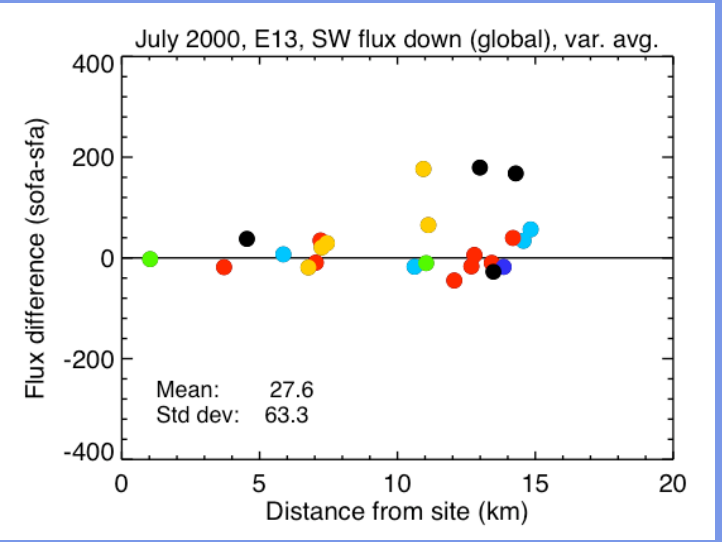




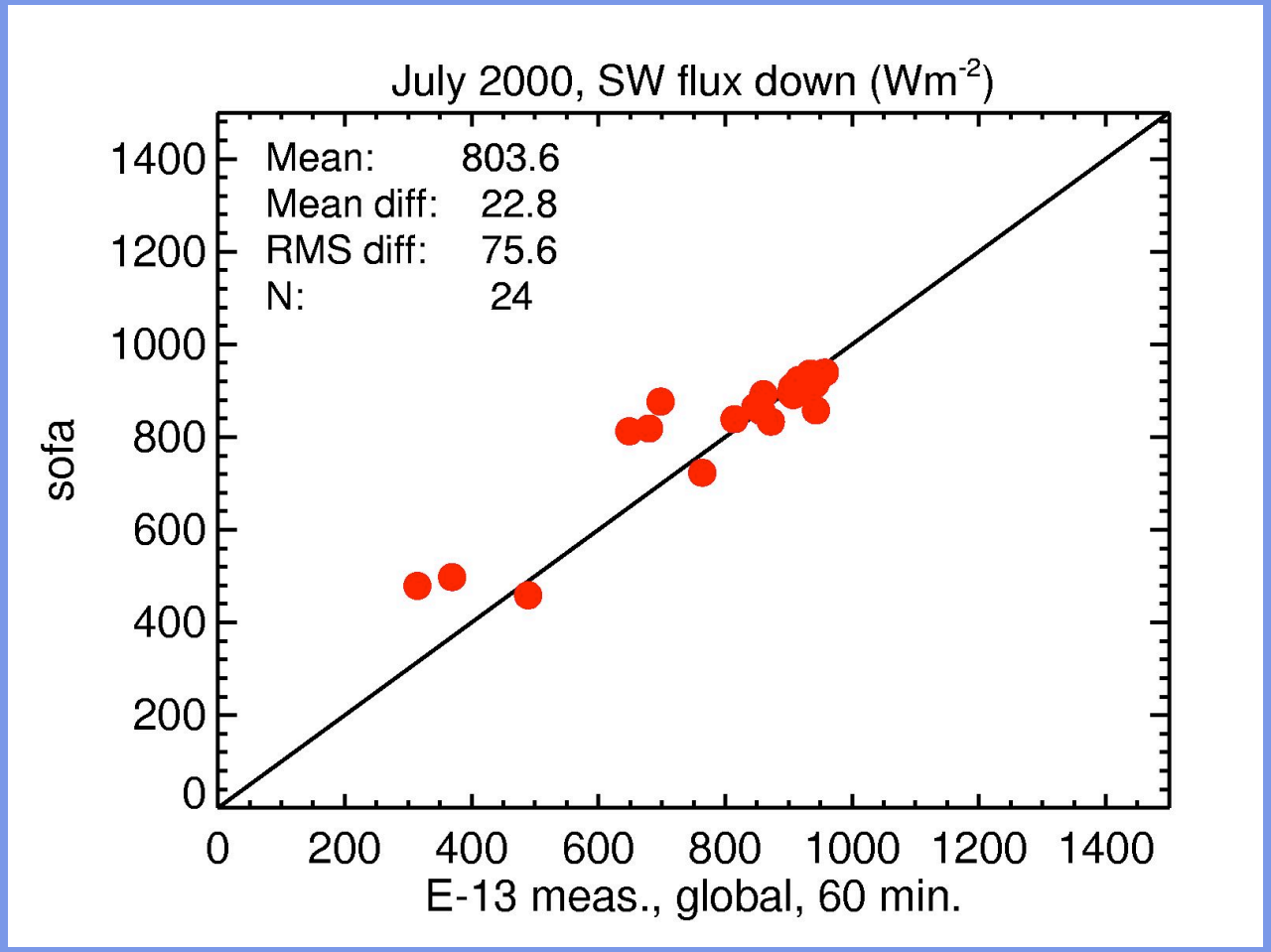
Effect of location differences







Example Comparison

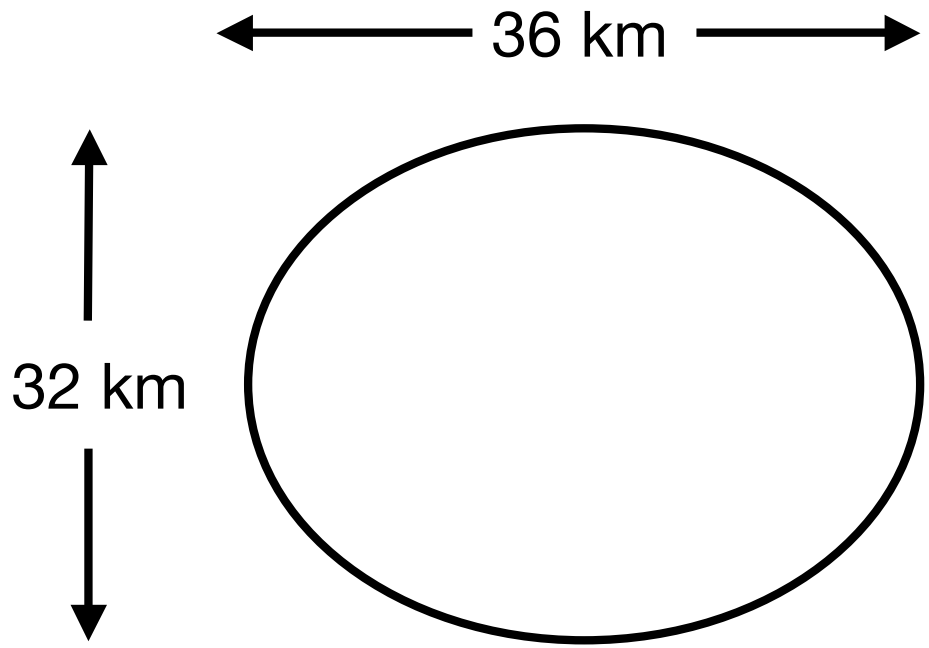


Sensor position vs. sun

Analysis approach:

1) Obtain pixel-level imager data (MODIS).
2) Use geometry and simple radiative transfer computations to determine fluxes at surface, radiance at satellite.
3) Compare results for a variety of geometries and scene types.

Measurement spot size



CERES Single Scanner Footprint

Analysis approach

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Analysis approach