Land Surface Temperature product validation using climate observation networks

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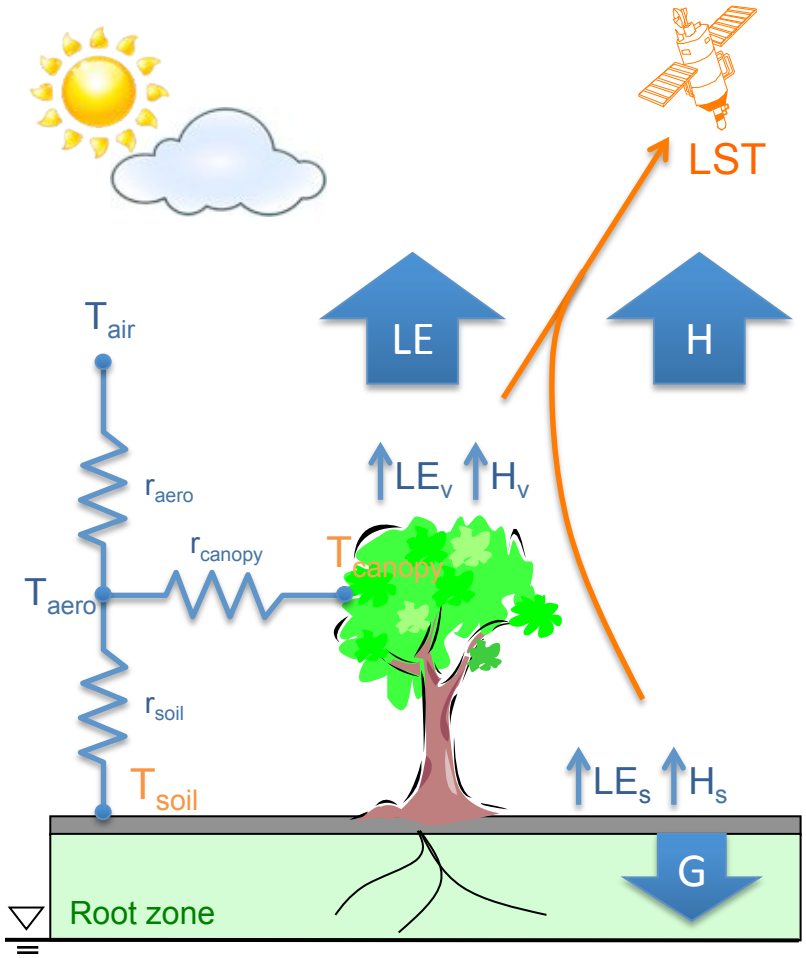
Context

JPSS program	Joint Polar Satellite System
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP satellite	NPOESS Preparatory Project
VIIRS instrument	Visible/Infrared Imaging Radiometer Suite
Land EDR	Environmental Data Record
LST EDR	Land Surface Temperature EDR
NPP launch	October 25, 2011

LST Remote sensing & Modeling



$$\frac{dLST}{dt} = C_T(R_n - LE - H - G)$$

Goal

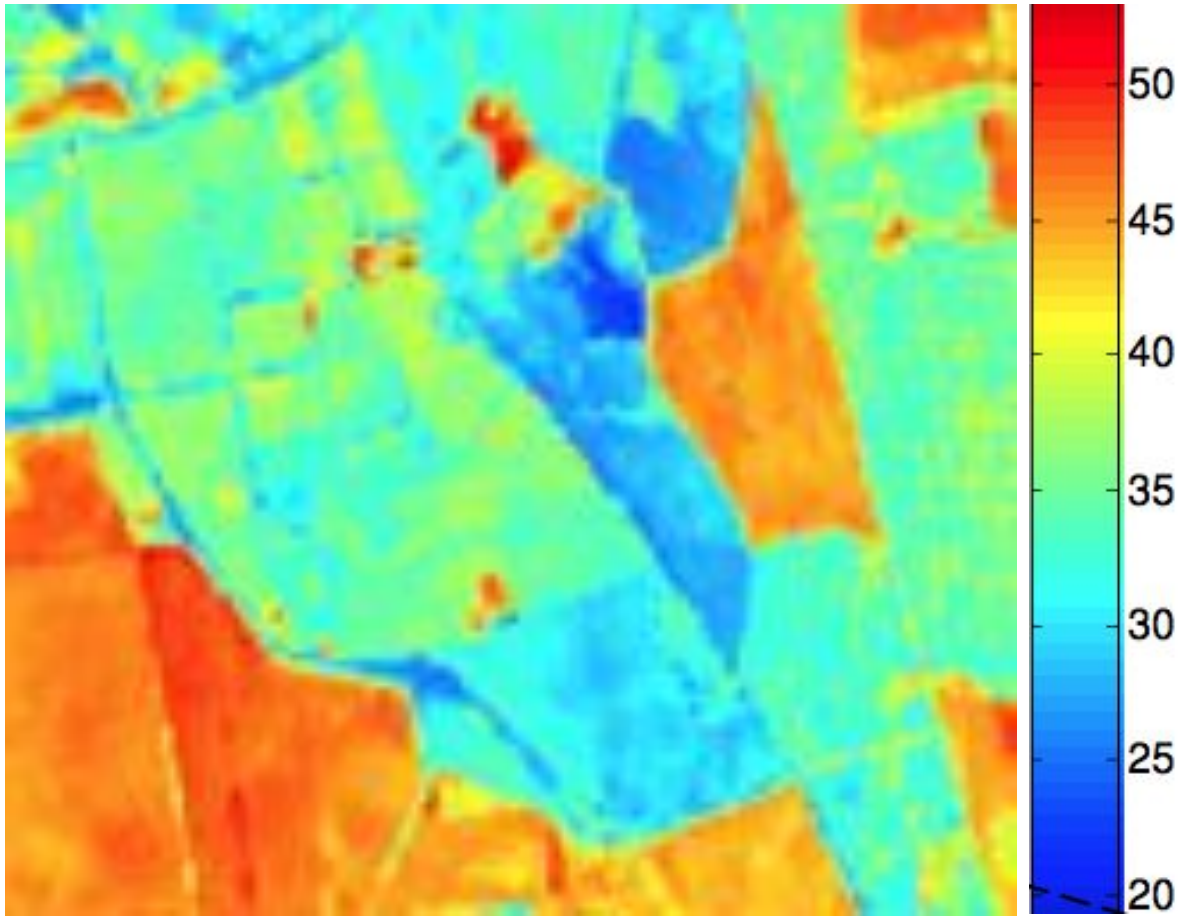
- Evaluate the LST algorithm over a full range of conditions:
  - Develop an up-scaling approach that allows to account for heterogeneous surfaces
  - Assess limitations and uncertainties
- Use NOAA's observations networks (USCRN) to assess long term product stability at low cost;
- Near real time validation over 30 sites.

Applications

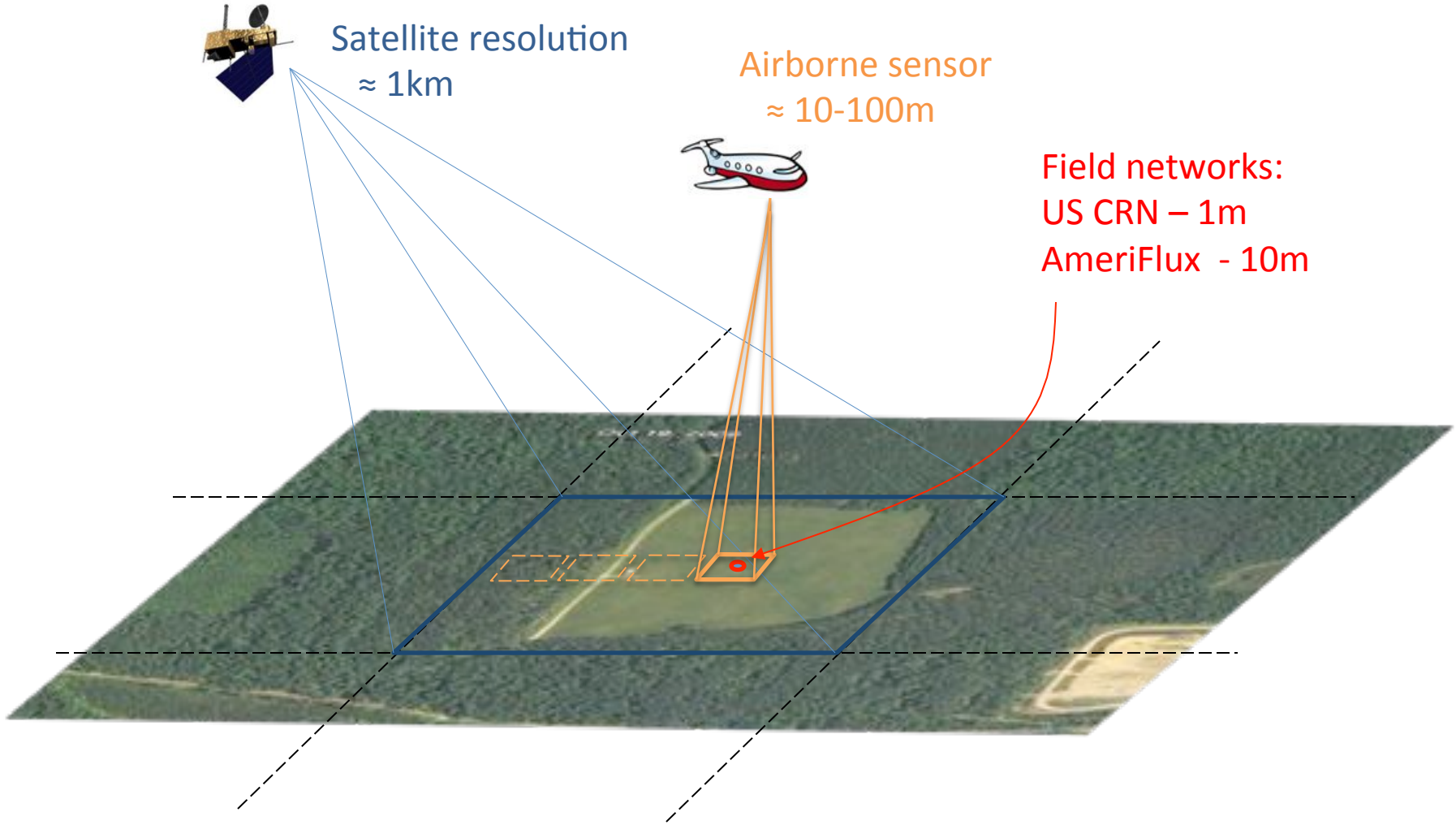
- Priority (short term): Test and improve the algorithm
- High quality data for weather and climate applications (data assimilation)
- Downscaling technics for water resources management and scenarios

LST Spatial variability

Surface hydrology indicator



Challenge: scaling problem



How to use ground observations to evaluate satellite product?

ASTER-derived LST Spatial variability

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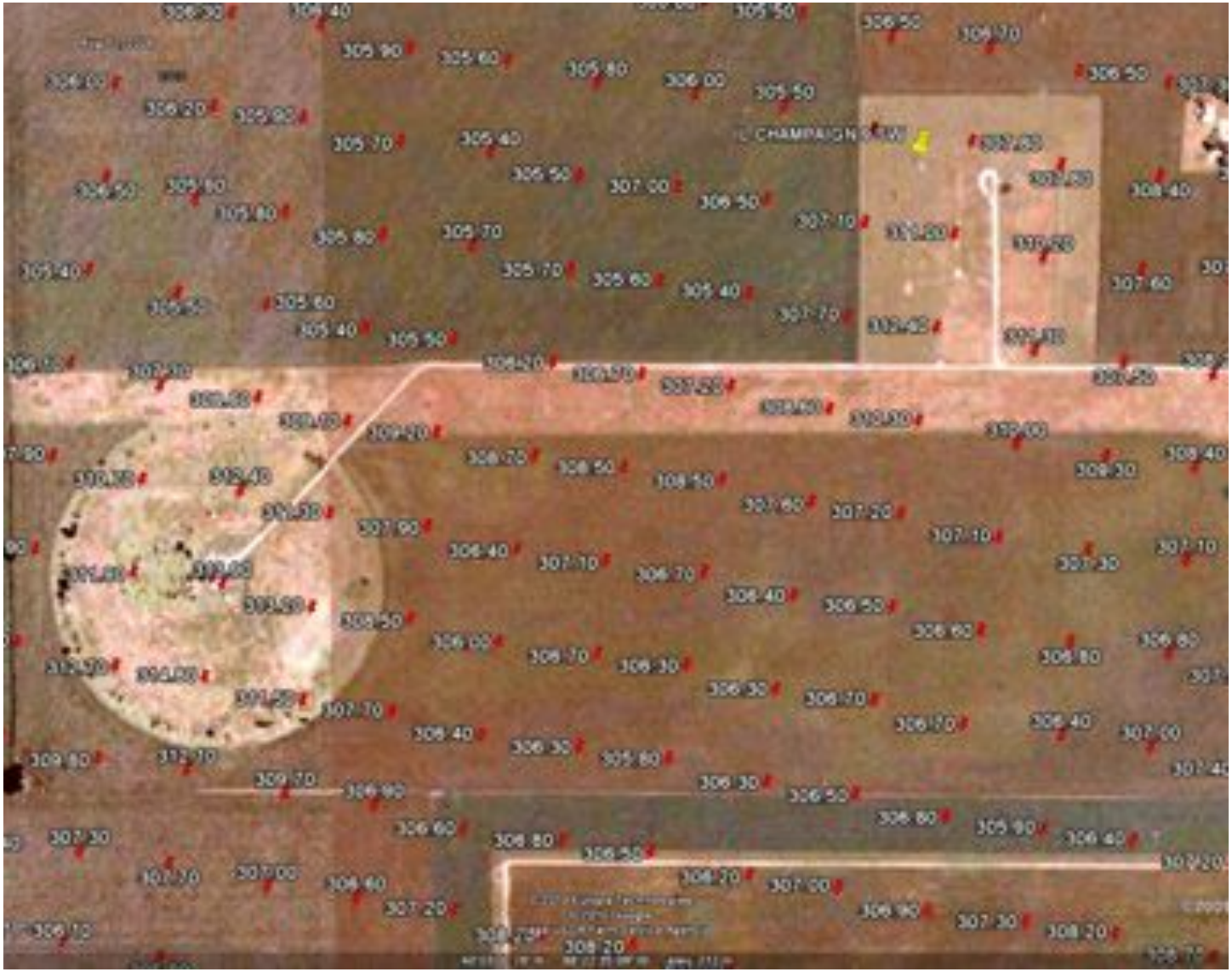
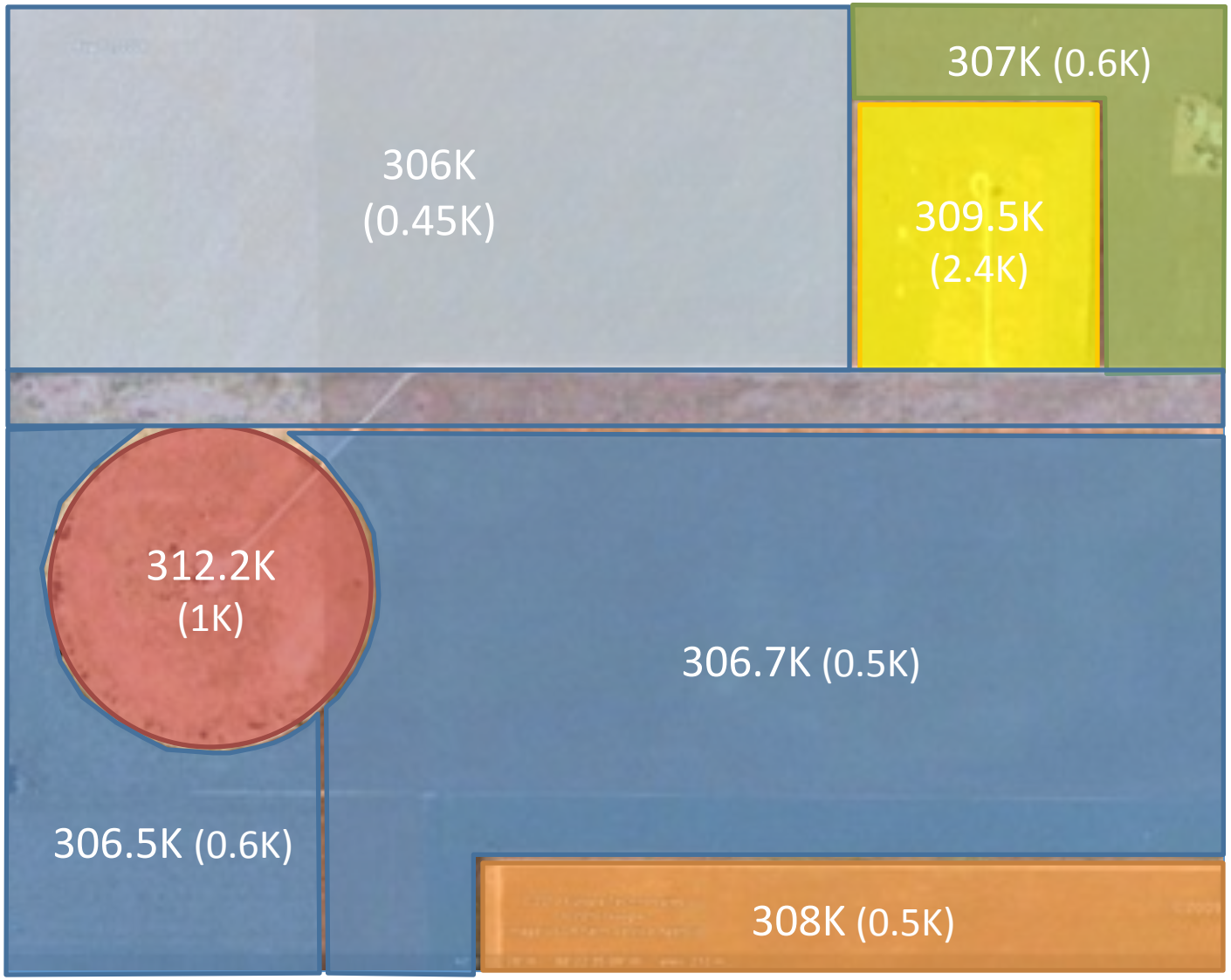
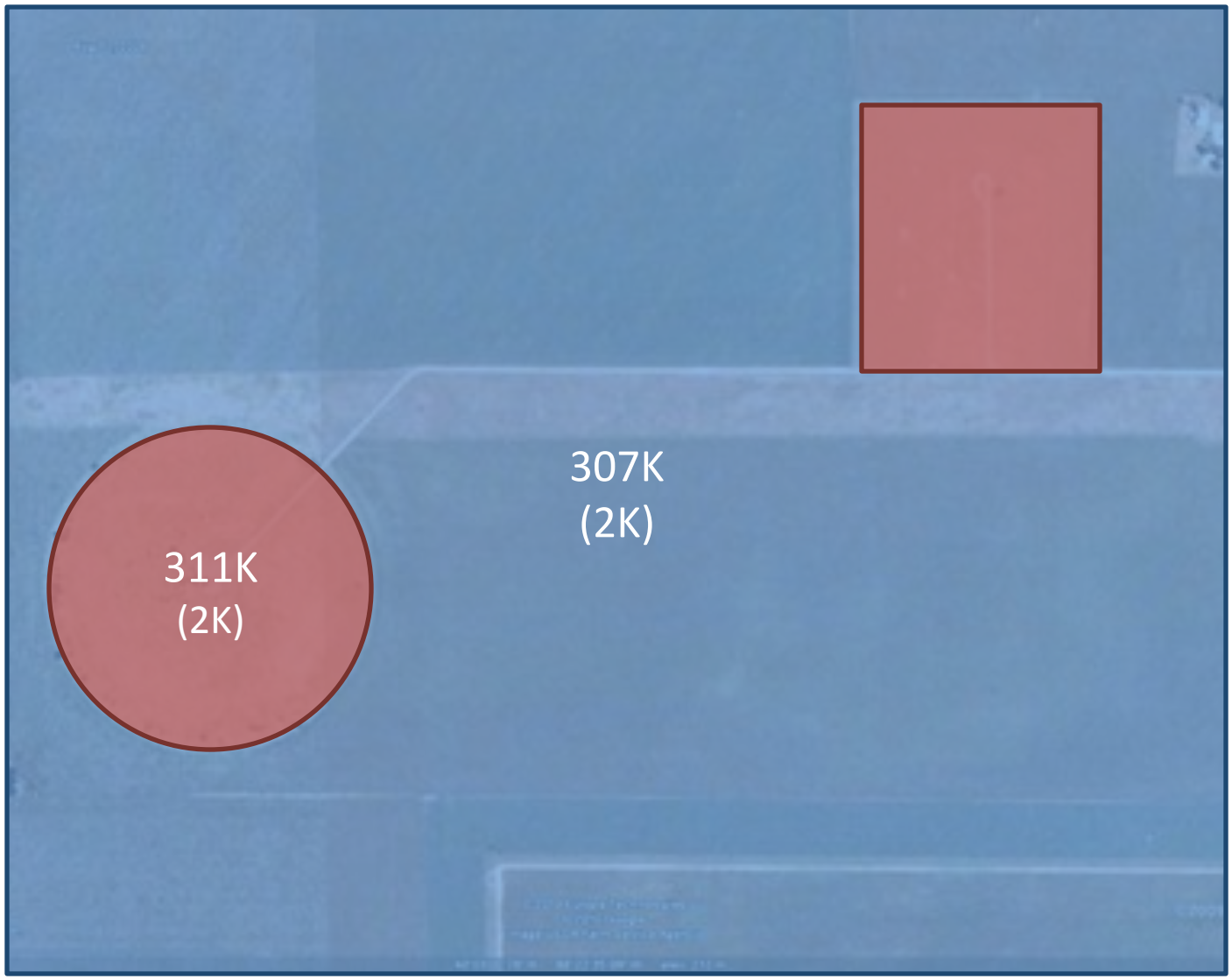


LST Spatial variability

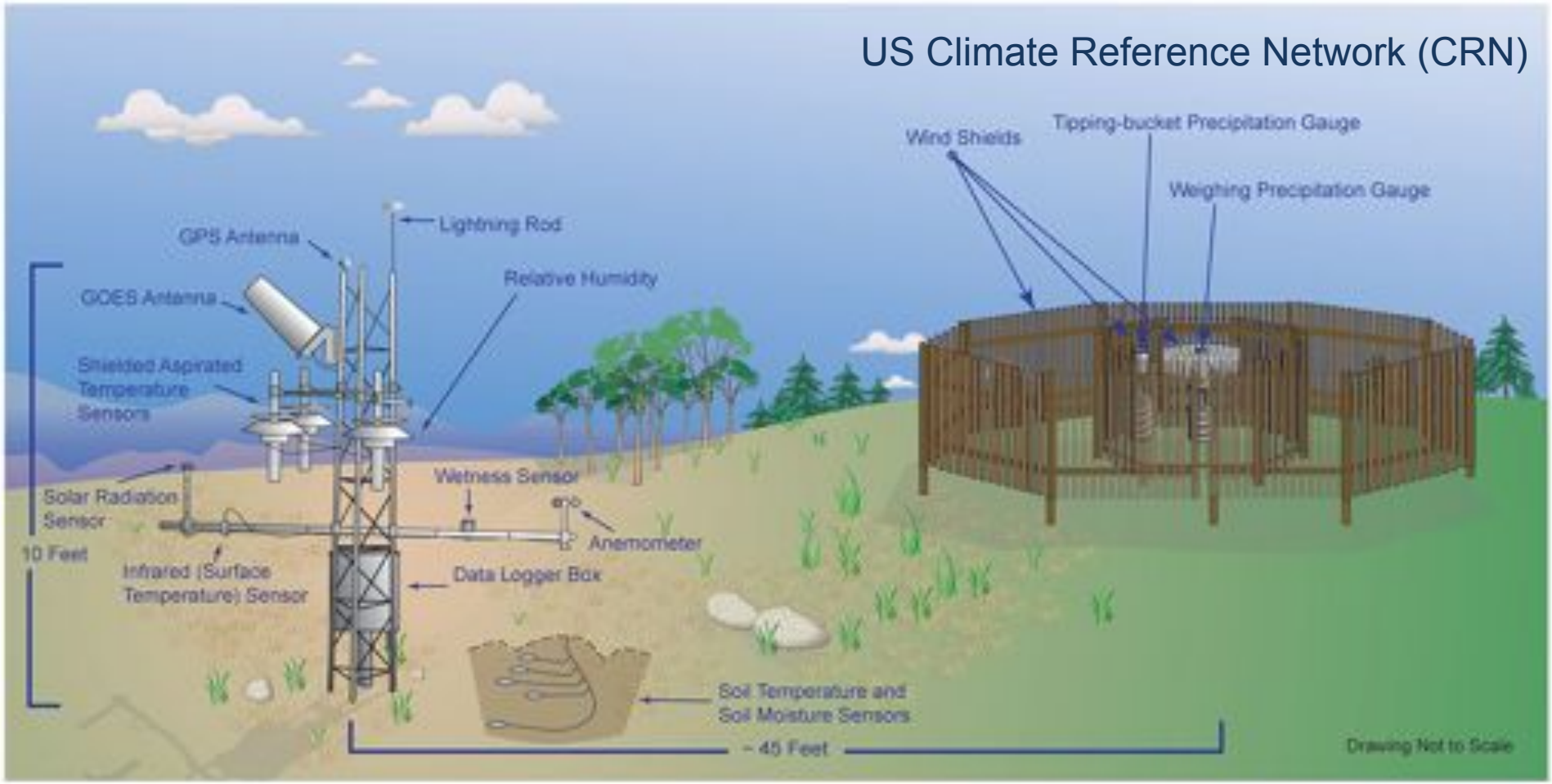


LST Spatial patterns



Field experiment

"Ground truth"



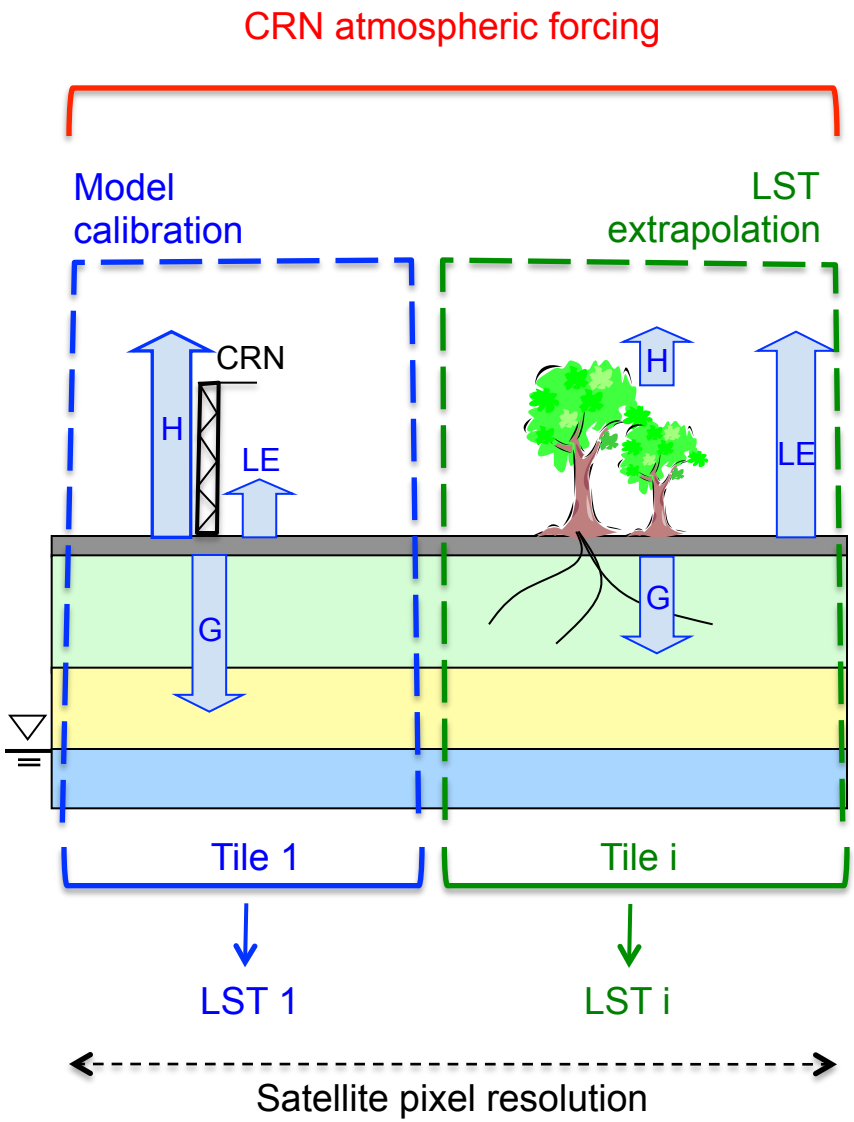
Field experiment – Crossville, TN

US Climate Reference Network (CRN)

Field experiment – Chestnut Ridge, TN

Ameriflux Network – Flux tower (60m)

Scaling model – Schematic view

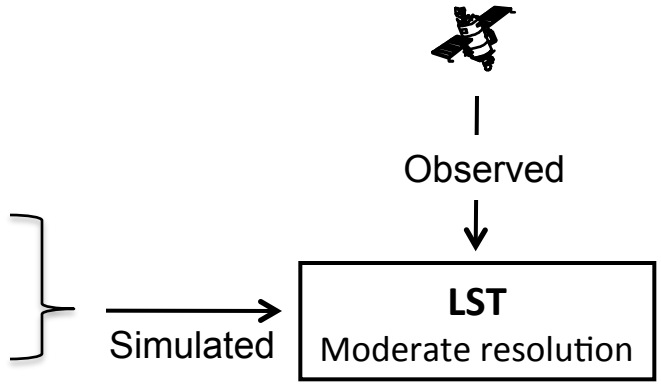


1. Model calibration

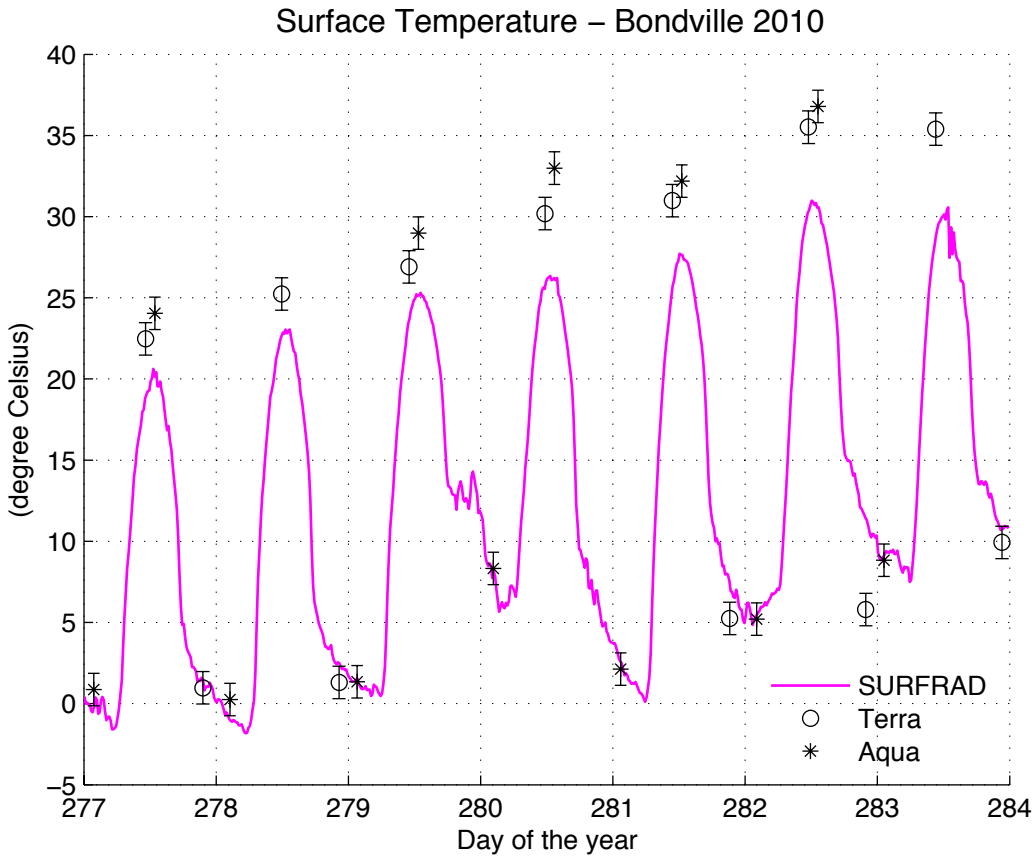
LST values from Ground measurements are used to adjust the model

2. LST extrapolation

The model is used to extrapolate the LST values and simulate a satellite pixel

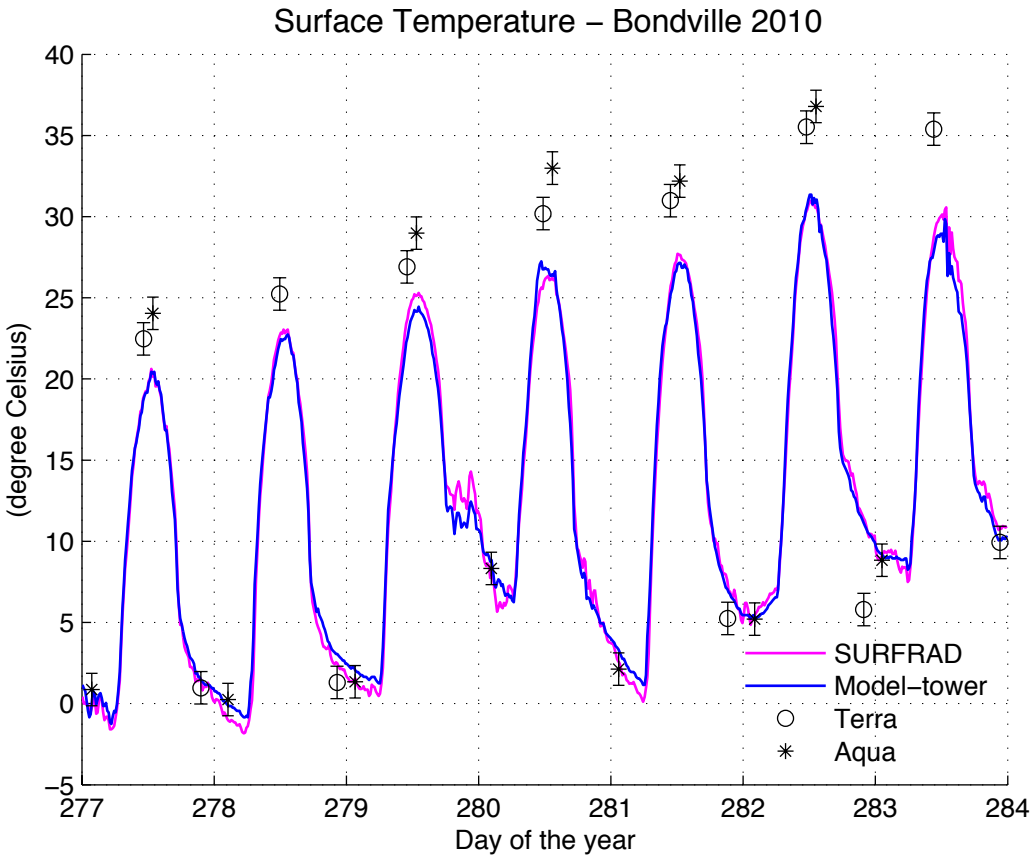


Scaling methodology



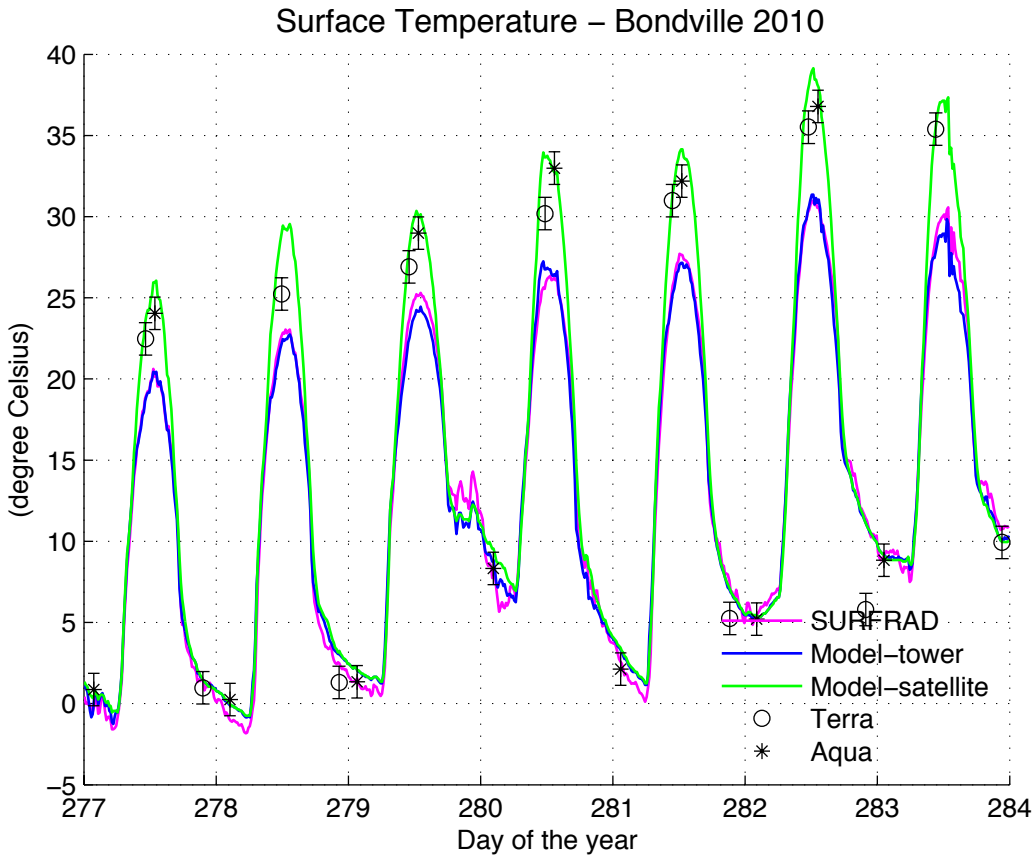
1) Reference = Ground-based measurements

Scaling methodology



2) Land Surface Model adjustment

Scaling methodology



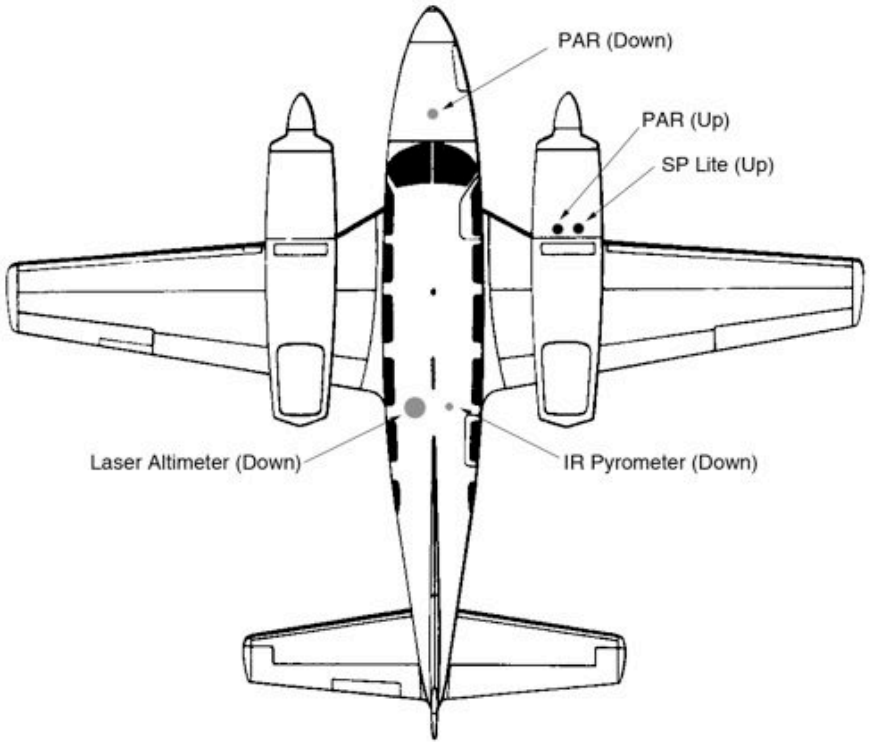
3) Extrapolate the LST using HR information

UTSI Flight Support

UTSI Piper Navajo airborne science research aircraft

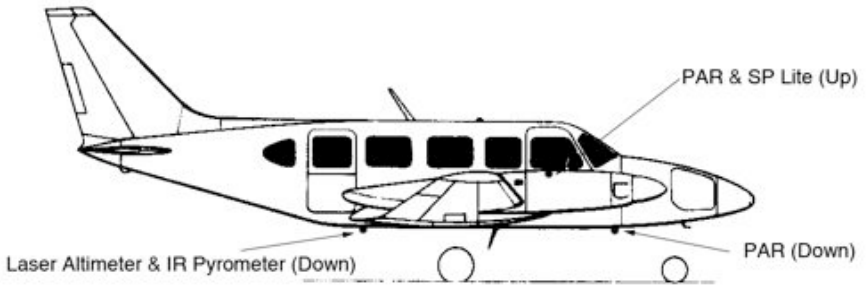
- Collaboration between UTSI, NOAA and CICS
- 13 flights completed in 2010 (34.1 flight hours)

Instrument setup



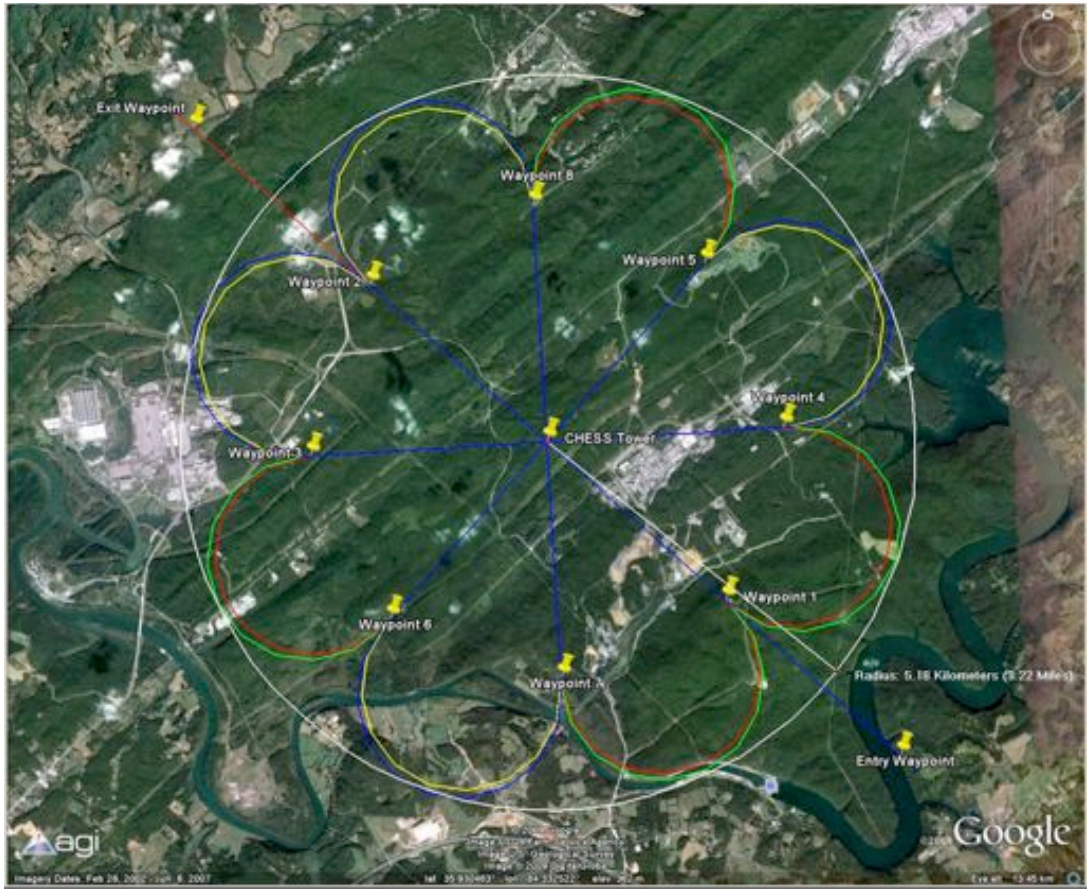
Altitude (ft)	Altitude (m)	Resolution (m)
500	150	8
1000	300	16
1500	450	24
2000	600	32
3000	910	48

IFOV=3˚

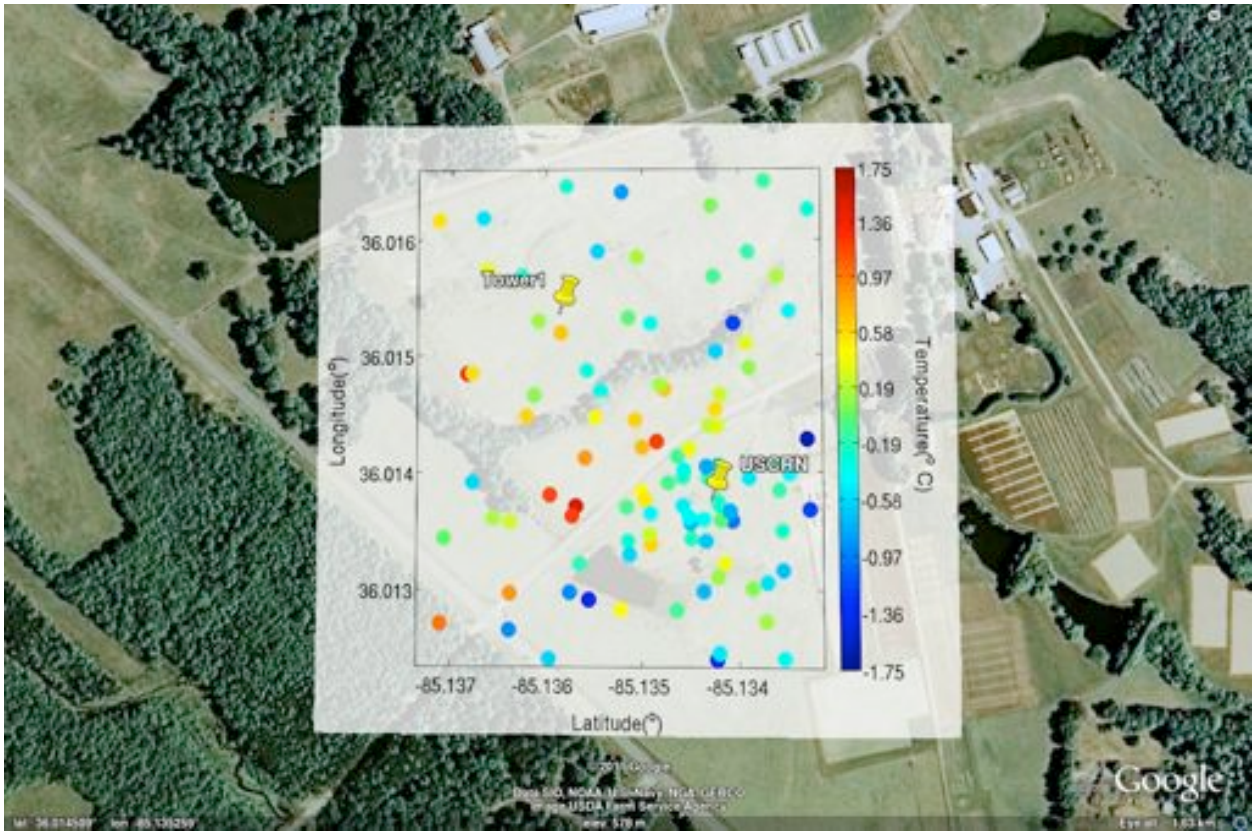


LST sensors and systems were installed in October 2009

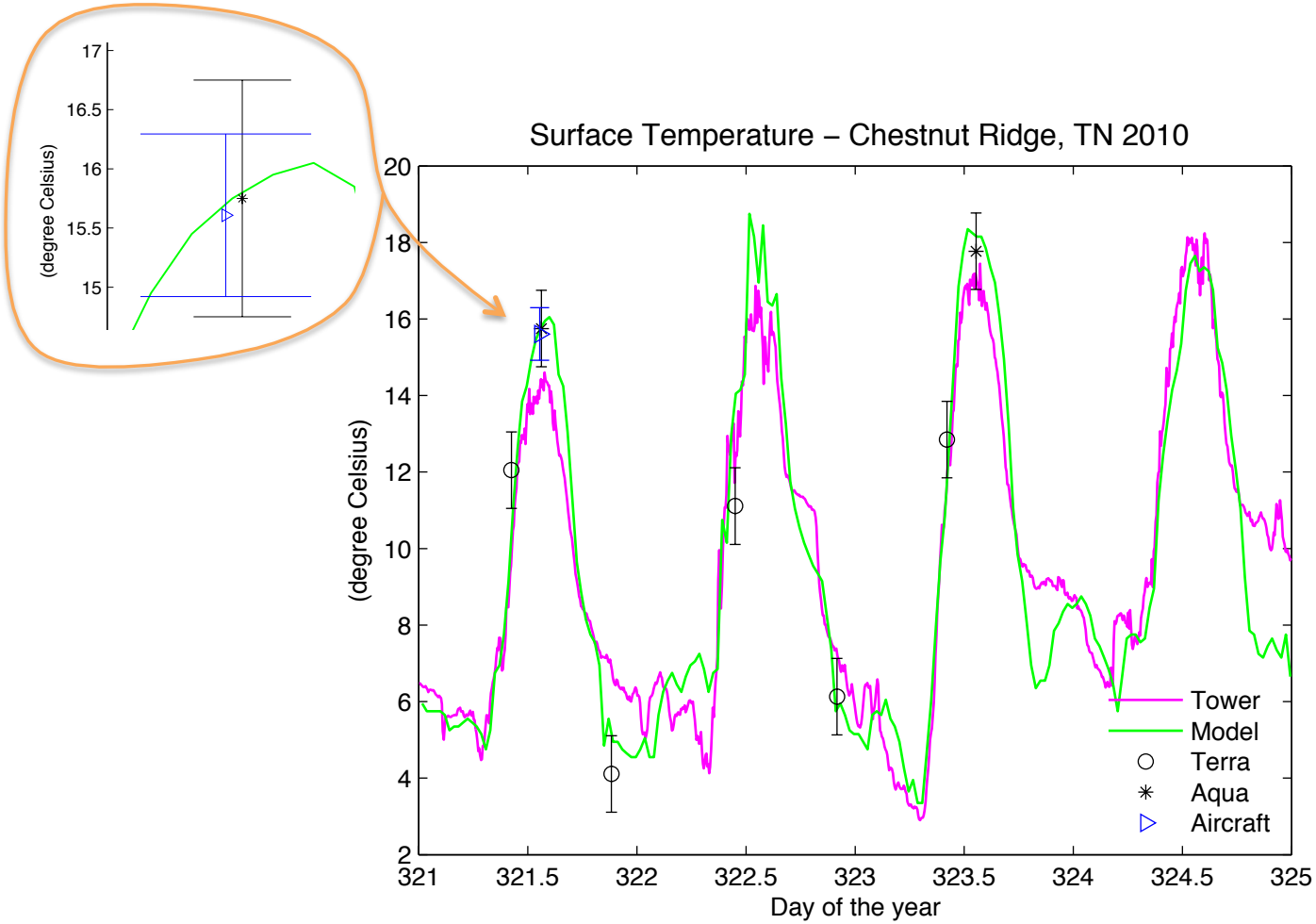
Flight pattern



LST Spatial variability



LST measured and simulated



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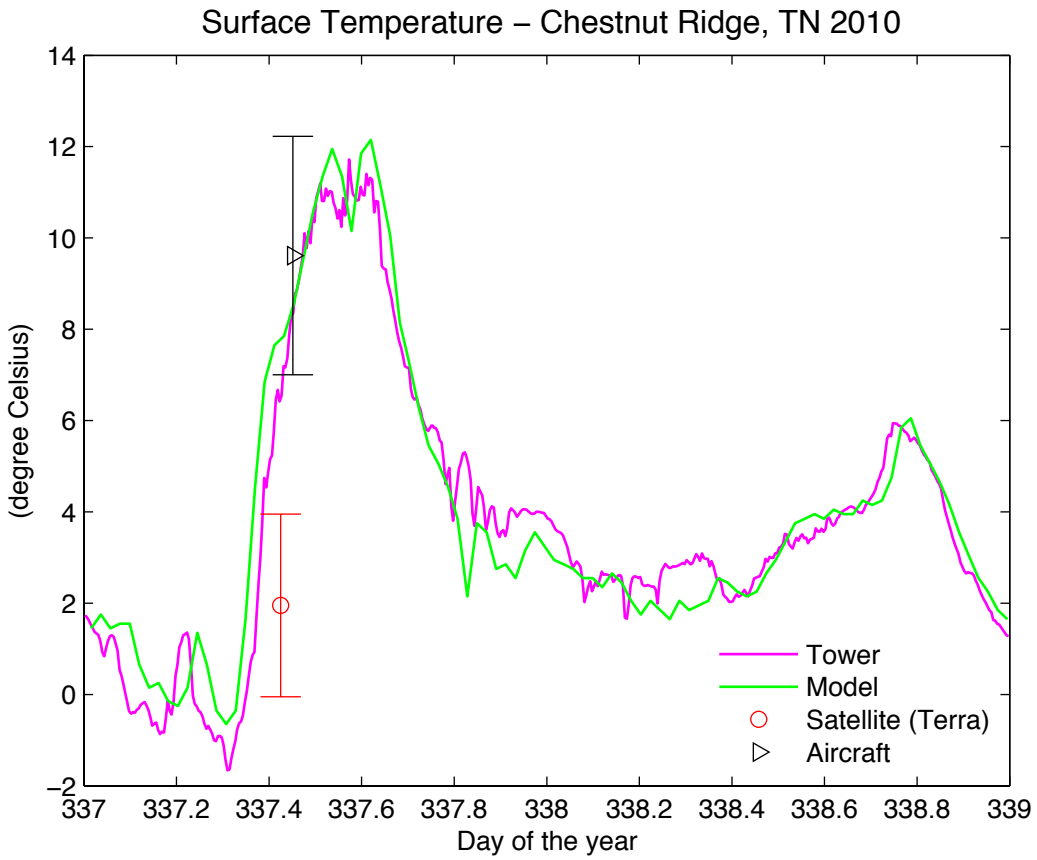
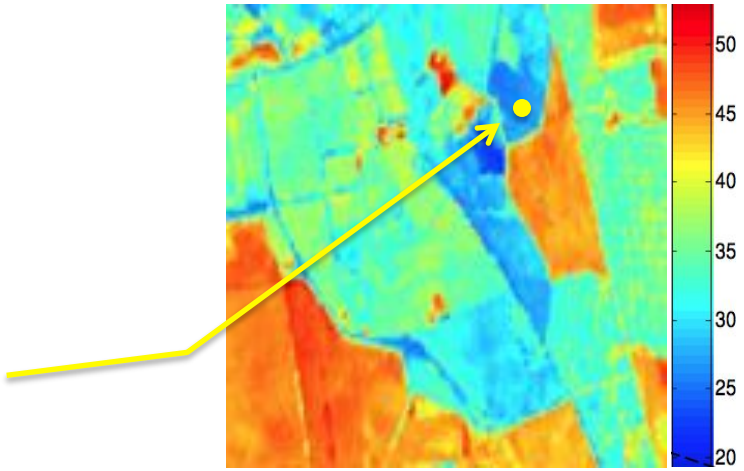
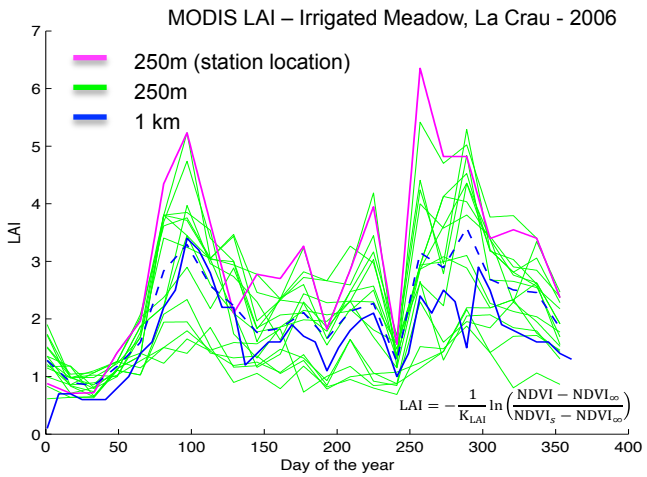
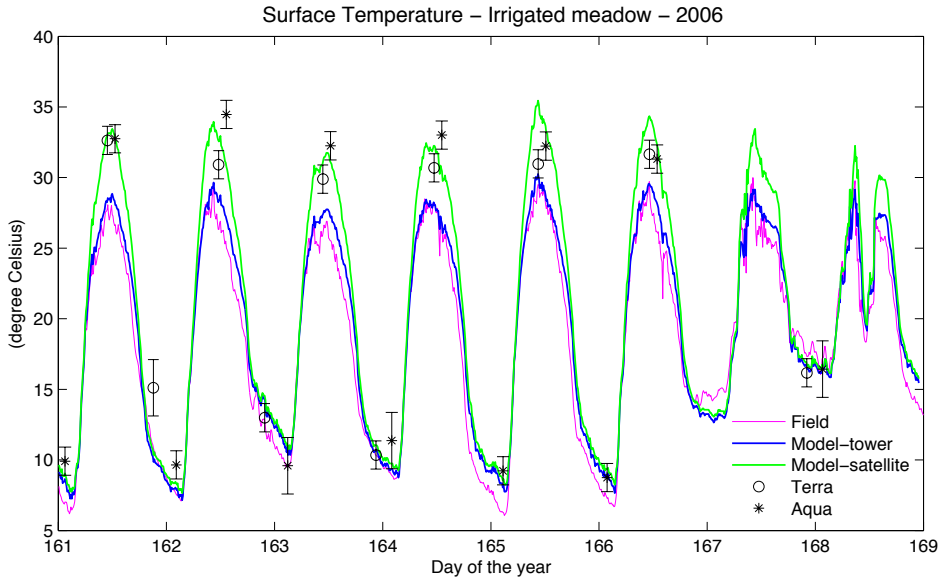


Application to ground stations worldwide

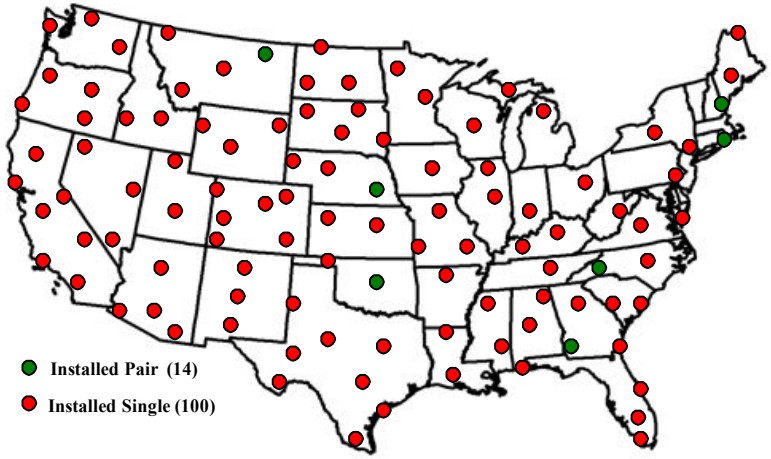






Next steps

- Scaling methodology allows to routinely evaluate satellite LST products using NOAA's observations network (i.e., US CRN)
- Improve LST retrieval algorithm



- JPSS cal/val rehearsal: July & August 2011
- Reinforce the use of LST in climate studies (data assimilation, drought monitoring)

Main collaboration

- NOAA STAR – Bob Yu
- NCDC's CRN Team – Mike Palecki and Egg Davis
- NOAA's ATDD – Tilden Meyers
- NOAA's ESRL – John Augustine
- NASA's JPL – Simon Hook & Glynn Hulley
- Karlsruhe University – Frank Goetsche
- French connection – Benoit Coudert, Jerome Demarty, Catherine Ottle, Dominique Courault and Albert Olioso