

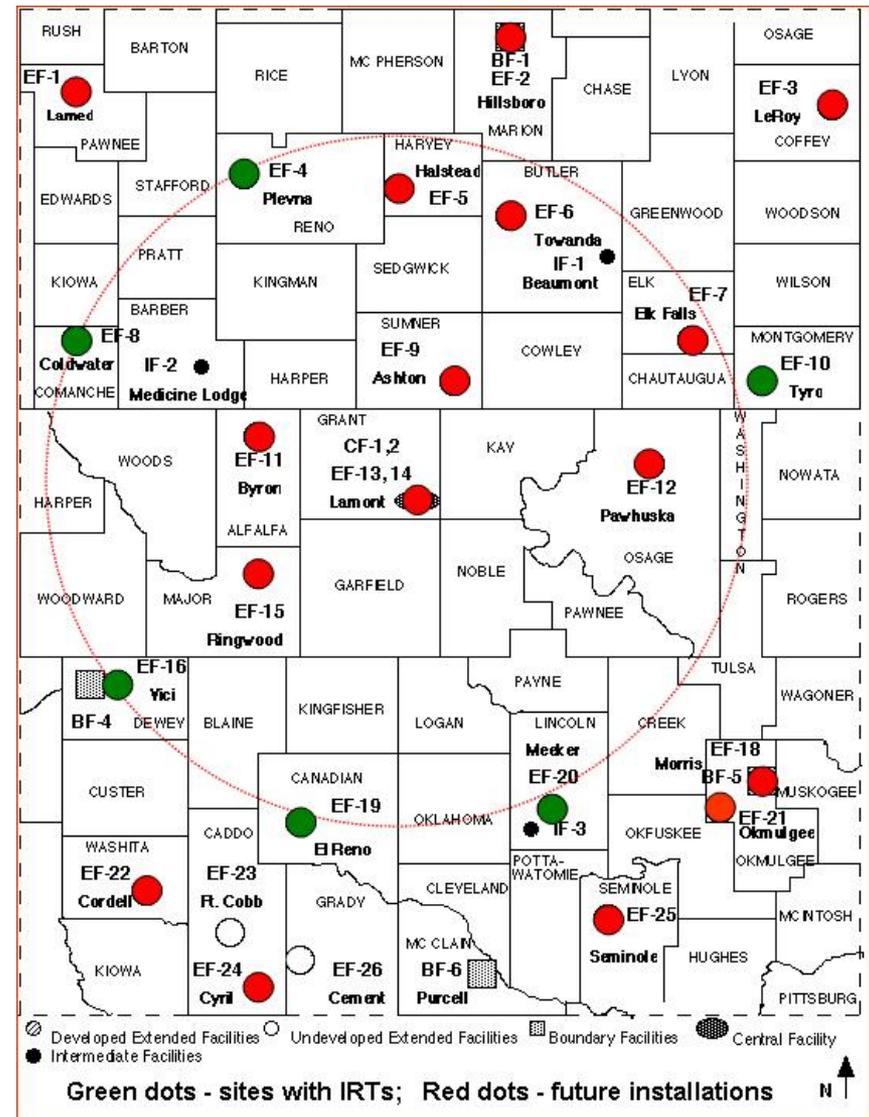
Status of Infrared Thermometer Network, Total Sky Imager Upgrades, and Infrared Sky Imager Options

Victor Morris, PNNL

ARM Radiative Processes Working Group Meeting
November 18, 2008

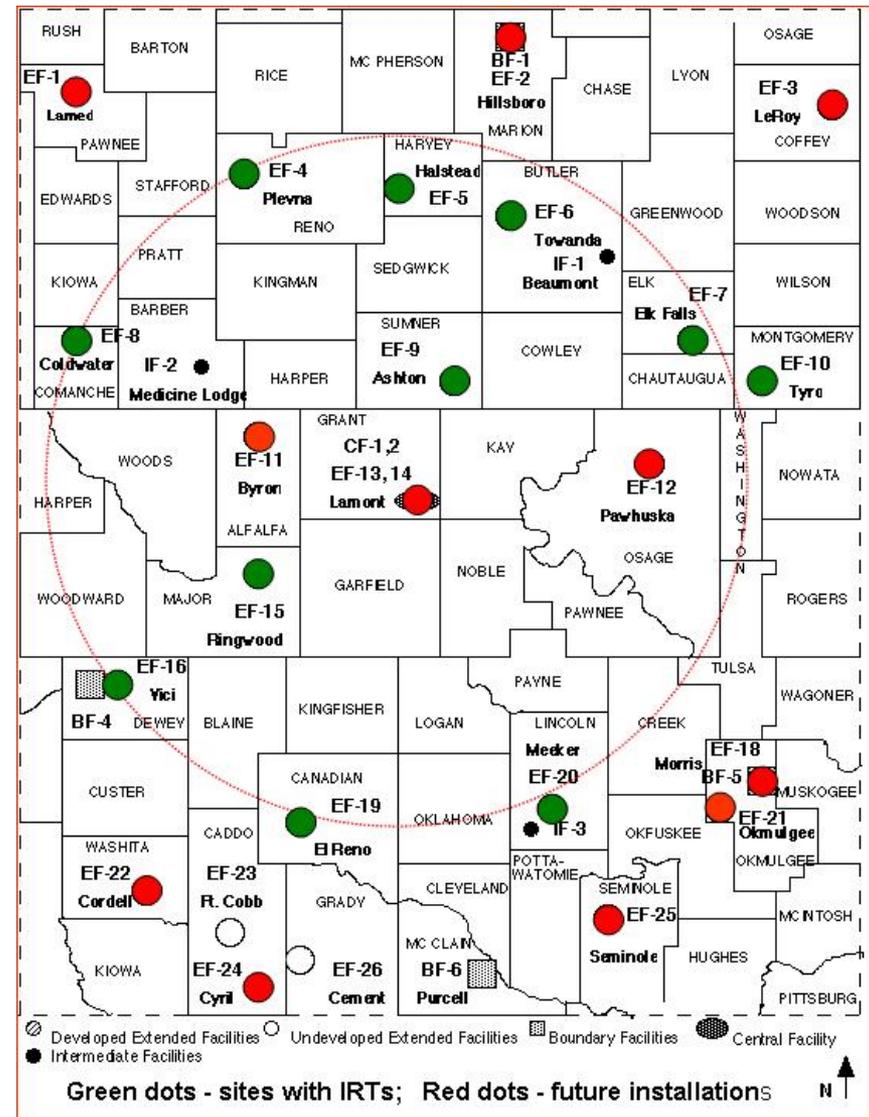
Infrared Thermometer (IRT) Network at Southern Great Plains (SGP)

- ▶ Twenty-one IRTs deployed across SGP domain (ECO-345)
 - Installed at eleven Extended Facilities (EF) from August to December 2005



Infrared Thermometer (IRT) Network at Southern Great Plains (SGP)

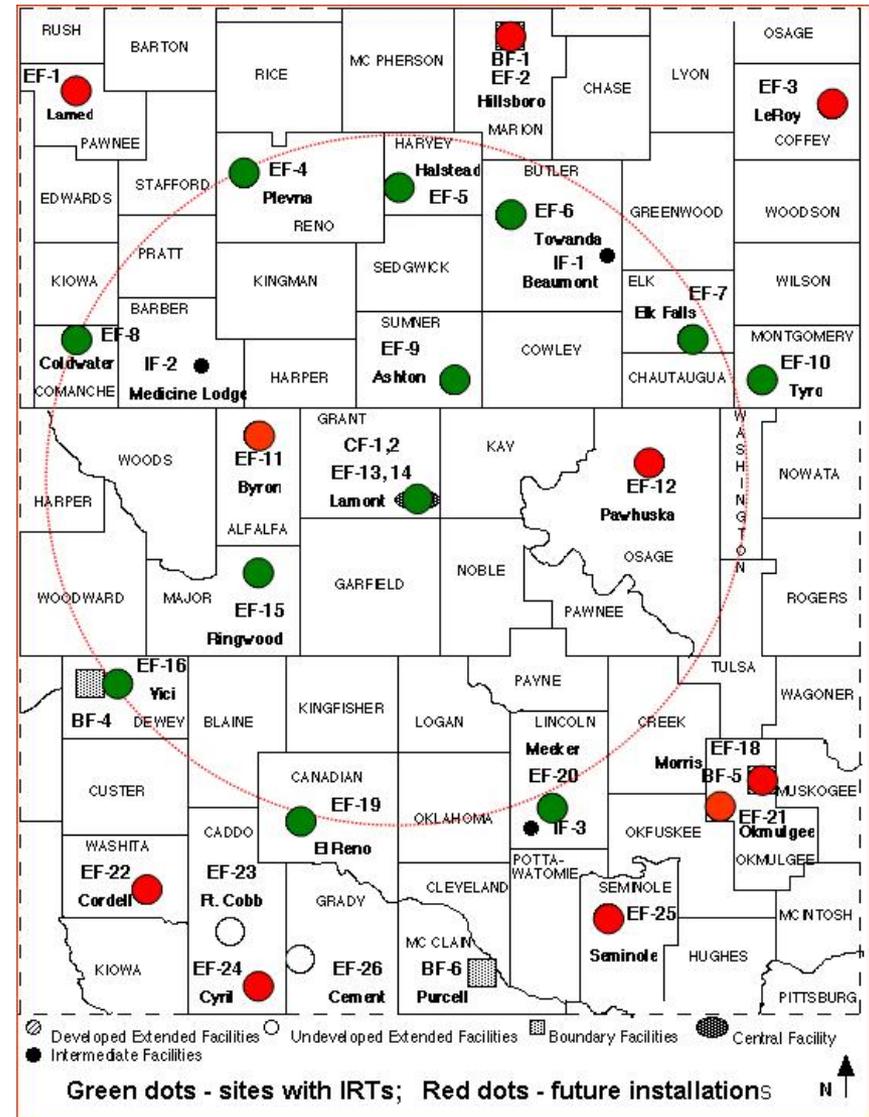
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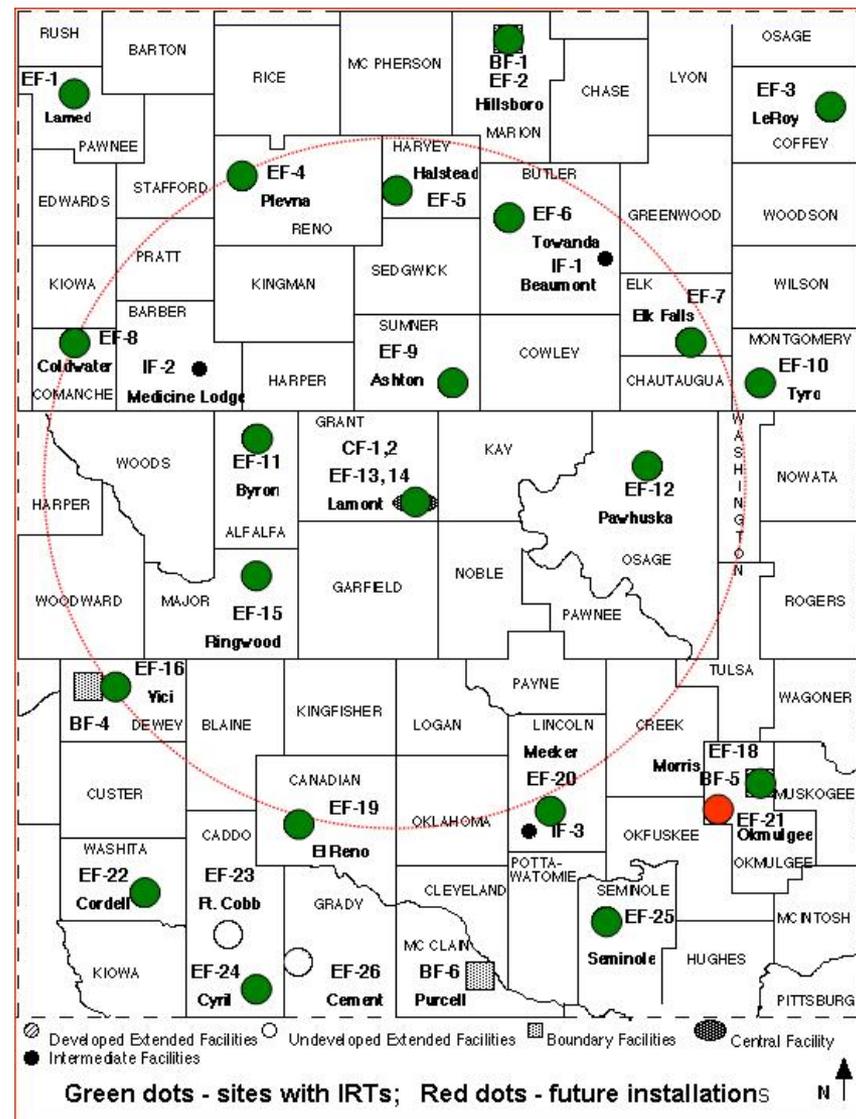
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Infrared Thermometer (IRT) Network at Southern Great Plains (SGP)

► Twenty-one IRTs deployed across SGP domain (ECO-345)

- Installed at eleven Extended Facilities (EF) from August to December 2005
- Replaced existing IRT at Central Facility in January 2006
- Instrumented nine additional EFs from August to October 2008



IRT Network at SGP

- ▶ IRTs with extended measurement range (-100C)
- ▶ Ventilated enclosure developed to prevent contamination of gold mirror
- ▶ Serial output sampled at 5 Hz by EF computers
- ▶ Sky temperature measurements compensated for mirror reflectance
- ▶ Datastreams available
 - irt – 1-min average
 - irt200ms – 5-Hz sample



IRT Network Future Plans

- ▶ Update serial program to automatically load configuration parameters (emissivity, time response, digital output, etc.)
- ▶ Deploy IRT at remaining EF
- ▶ Develop Cloud Temperature Value-Added-Product

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Total Sky Imager (TSI) Plans for Continued Operation

- ▶ Upgrade mirror control boards
- ▶ Upgrade image retrieval and processing software
- ▶ Upgrade camera



Total Sky Imager (TSI)

► Motivation for upgrades

- YES TSI-880s converted to ARM TSIs by BNL in 2005
- Control boards having problems
- Cameras are old and discontinued
- YES software doesn't support other cameras

Total Sky Imager (TSI)

- ▶ Upgrade mirror control interface boards (ECO-625)
 - Real-time-clock EEPROM producing problems
 - corrupted values of latitude, longitude, and internal temperature
 - improper positioning of shadowband
 - continuous cycling of heater and cooling fan
 - Power supply for external devices (e.g. serial device server and camera) is susceptible to overheating
 - Revised board has been developed and prototype built by BNL
 - will be tested with TSI at SGP this week by Remote Measurement & Research Co. (Mike Reynolds)

Total Sky Imager (TSI)

- ▶ Upgrade image retrieval and processing software (ECO-644)
 - Compatibility with current-model cameras
 - TSIs use discontinued and unserviceable cameras
 - Allow adjustment for differences in sky image size
 - User interface for setting the "horizon area", "sun circle", and "zenith circle" areas for image processing
 - Ability to generate site-dependent baseline clear-sky color image mapping for setting retrieval limits for image processing
 - Software being developed by NOAA (Ells Dutton) and tested by PNNL (Chuck Long)

Total Sky Imager (TSI)

- ▶ Upgrade camera (ECO-674)
 - Current, supported model
 - Improved low-light capability
 - Design and testing a new camera arm and environmental housing

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Infrared Sky Imager (IRSI) Intercomparison Study

- ▶ IRSI Intercomparison Study conducted at SGP Guest Instrument Facility from August 28 to October 5, 2007
- ▶ Compared measurements of cloud fraction from four different types of commercially-available IRSIs



IRSI Intercomparison Study

► Instruments

- Blue Sky Imaging All Sky Thermal Infrared Camera (ASTIC)
- Solmirus All Sky Infrared Visible Analyzer (ASIVA)
- Heitronics Nubiscope
- Atmos Cloud Infrared Radiometer (CIR-4)



IRSI Intercomparison Study

- ▶ Purpose of field campaign
 - Produce nighttime cloud fraction product at multiple fields-of-view
 - Capture hemispheric infrared images of the sky during both the day and night
 - Select instrument to be deployed at all sites

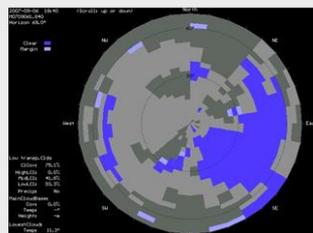
IRSI Intercomparison Study

Sky Image Comparison

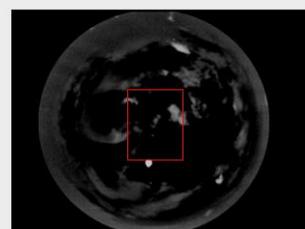
TSI



Nubiscope



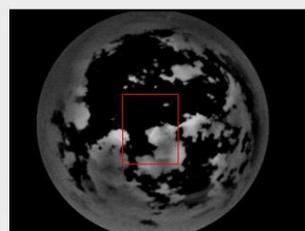
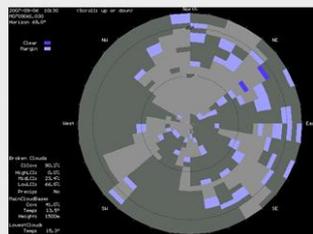
ASTIC



ASIVA



Daytime, 9/6/2007 13:41 CDT

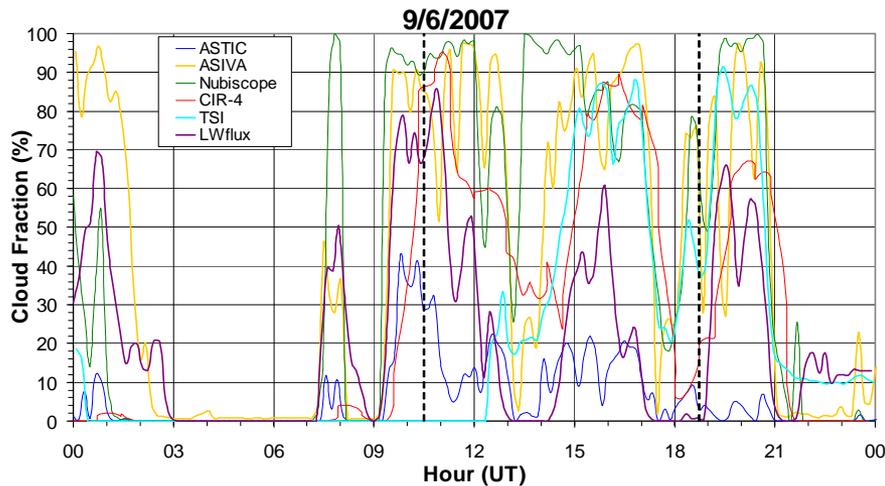


Nighttime, 9/6/2007 05:32 CDT

IRSI Intercomparison Study

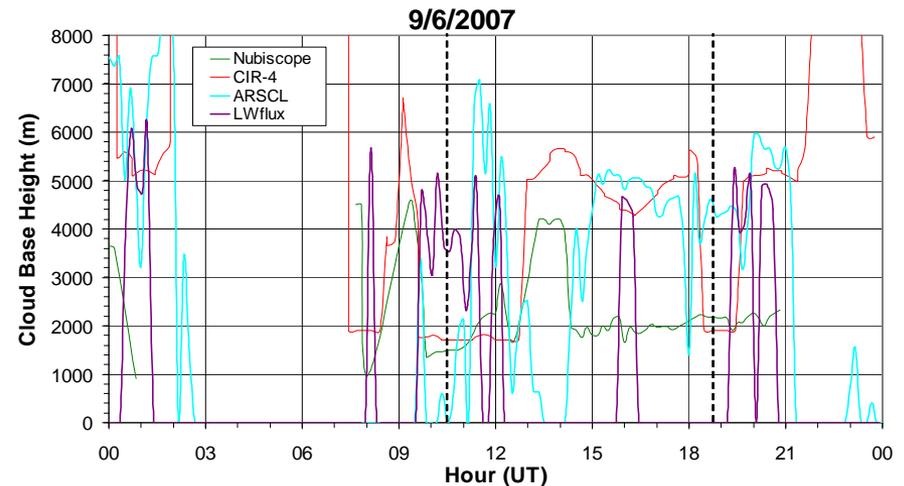
► No clear winner!

Cloud Fraction



Time series of 10-minute average cloud fraction in % at SGP on 9/6/2007 from IRSIs, TSI, and LWflux.

Cloud Height



Time series of 10-minute average cloud-base height in meters at SGP on 9/6/2007 from IRSIs, ARSCL, and LWflux.

IRSI Intercomparison Study

► Results

- Daytime images from ASTIC and ASIVA compare well with the TSI
- Cloud fraction data underestimate TSI values
- Nubiscope provides best comparison but has poor time-resolution
- Cloud height data from all IRSIs provide poor estimates compared to ARSCL
- Additional instrument comparisons are required for selection process

IRSI Future Plans

- ▶ Conduct second field campaign beginning March 2009
 - Improved Solmirus ASIVA
 - 100° field-of-view
 - real-time processing
 - water vapor and ozone determination
 - New version of Montana State University's (Joe Shaw) Infrared Cloud Imager
 - 110° field-of-view
 - internal thermally stabilized system
 - cloud optical depth determination

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