



Planned PLT/PLPT GOES-R Field Campaigns & Report on the GOES-R April Planning Workshop

Frank Padula & Steve Goodman

In coordination with the GOES-R CWG & AWG Teams

Joint MTG LI Mission Advisory Group & GOES-R GLM Science Team Workshop

May 28, 2015

Outline

Overview

Campaign
Objectives

Baseline Plan

Summary Items

GOES-R Field Campaign Overview

The purpose of the GOES-R field campaign is to support post-launch validation of L1b & L2+ products:

- **Advanced Baseline Imager (ABI) & Geostationary Lighting Mapper (GLM):**
 - Planning ~6 week field campaign (~100 flight hours) with the high-altitude NASA ER-2 platform coordinated with ground based and near surface observations over several Earth targets
 - An official flight request has been submitted to the NASA ER-2 Program
 - Tentative plan resulting from the GOES-R Field Campaign Workshop:
 - Split Phase 1 & 2 into potentially 2 campaigns
 - » Phase 1 (2 weeks)
 - October – November 2016
 - ER-2 Based in Palmdale, CA (U.S. West Coast)
 - » TBD - Phase 2 (4 weeks)
 - April – May 2017
 - ER-2 Based on the East Coast or Central U.S.



GOES-R Field Campaign Overview

The purpose of the GOES-R field campaign is to support post-launch validation of L1b & L2+ products:

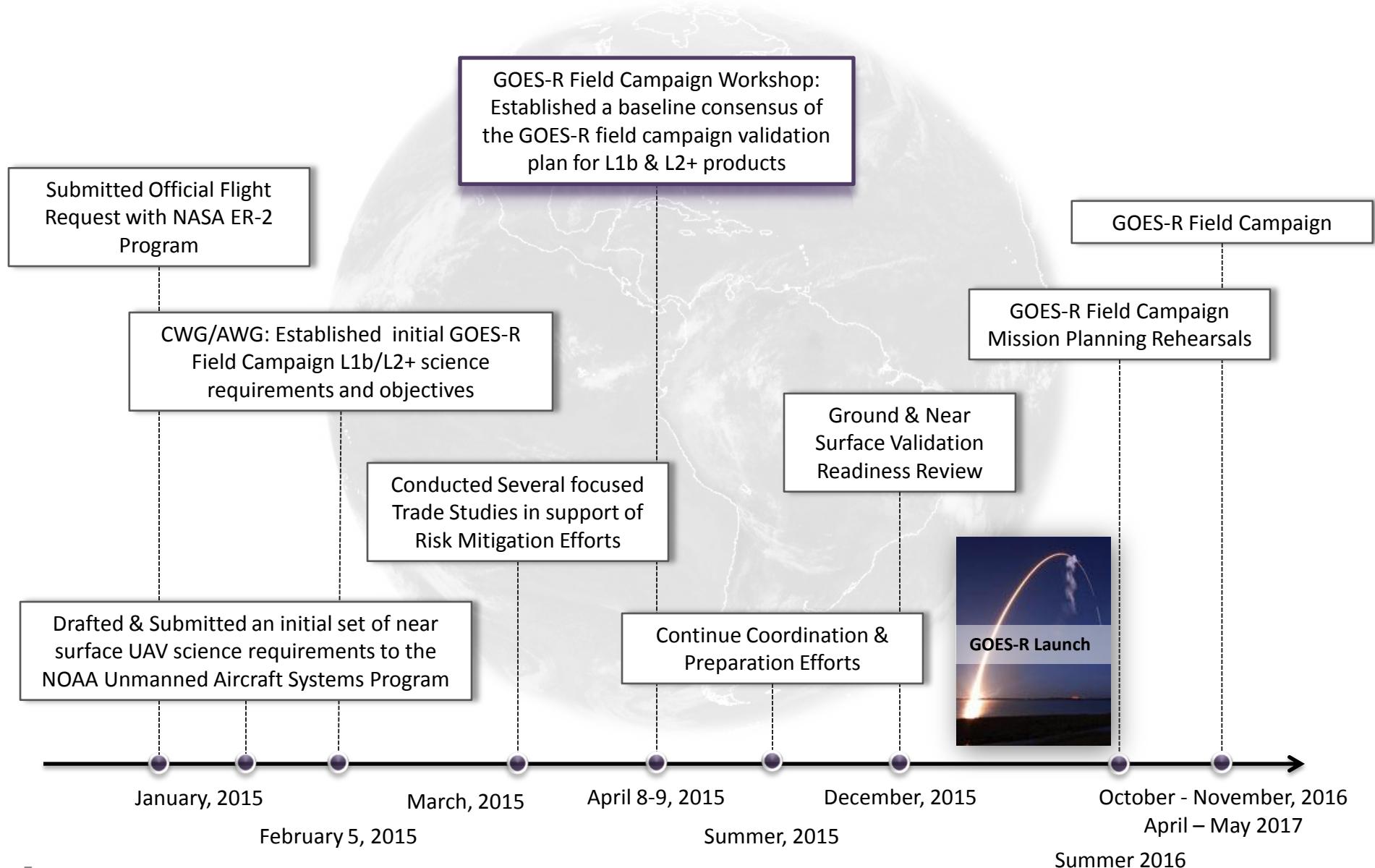
- **Advanced Baseline Imager (ABI) & Geostationary Lighting Mapper (GLM):**

- Planning ~6 week field campaign (~100 flight hours) with the high-altitude NASA ER-2 platform coordinated with ground based and near surface observations over several Earth targets

Investigating a revised strategy:

- Combine Phase 1 & 2: April – May 2017
 - » Phase 1 (2 weeks)
 - ER-2 Based in Palmdale, CA on the West Coast U.S.
 - » Phase 2 (4 weeks)
 - ER-2 Based on the East Coast or Central U.S.
- Reduces costs & may provide greater value (currently evaluating potential risks)
 - Better aligns the campaign with severe weather opportunities
- Underflights to be collected, when possible, with low Earth orbit environmental satellites which may include S-NPP, Terra/Aqua, METOP, Landsat, ISS & GPM
- We invite international participation in the field campaign
- We plan to have an open data access policy

GOES-R Field Campaign Planning Timeline



GOES-R Field Campaign Workshop

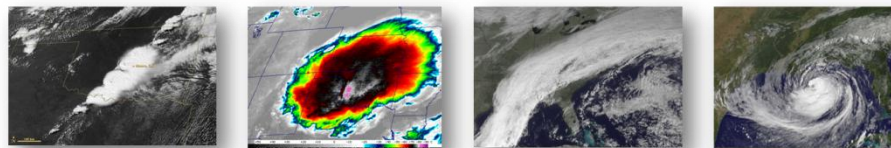
Milestone:

Established a baseline consensus of the GOES-R field campaign validation plan for L1b & L2+ products

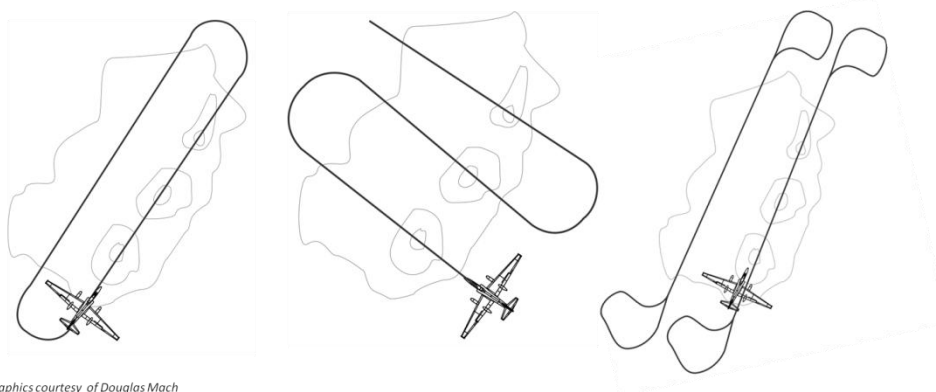
- Included participants from NOAA, NASA, and Universities
- All of the presentations are available at:
 - <http://www.goes-r.gov/users/2015-Campaign-Workshop.html>
- ~14 actions were submitted
 - All are closed or actively being worked to closure
- Developing a campaign validation matrix
- Enhancing our data management planning and developing a GOES-R field campaign portal
- Strengthening our collaboration efforts to ensure mission success
- Preparing to conduct mission planning rehearsals

GLM Validation Collection Strategies:

Collect Main Storms OR Stratiform Regions



Examples of Flight Patterns to Optimize Collection:



Graphics courtesy of Douglas Mach



NOAA Science Participation in All Phases of GOES-R Calibration Life-Cycle

- » GOES-R Calibration Working Group (CWG) has provided excellent support in the pre-launch calibration data analysis to verify the pre-launch instrument performance on behalf of NOAA over the past several years:
 - CWG has established an in-depth knowledge of the GOES-R instruments through extensive pre-launch support
 - Established a strong communication line between the CWG and Algorithm Working Group (AWG) as a result of GOES-R pre-launch activities
- » Understanding both CWG & AWG pre-launch performance concerns & waivers and post-launch validation limitations and challenges fosters a value added opportunity to develop comprehensive field campaign activities



GOES-R ABI & GLM

Key Validation Metrics



ABI Performance Metrics:

- Reflective Solar Bands (RSB)
 - 5 % radiometric uncertainty
- Thermal Emissive Bands (TEB)
 - 1 K radiometric uncertainty
- SI traceability established pre-launch



GLM Performance Metrics:

- 70 % flash detection efficiency
- 5 % false alarm rate

ABI Field Campaign Approach:

Primary Objective: provide high-altitude validation of ABI L1b spectral radiance observations to validate SI traceability

Secondary objective: provide surface and atmospheric geo-physical measurements to support L1b & L2+ product validation

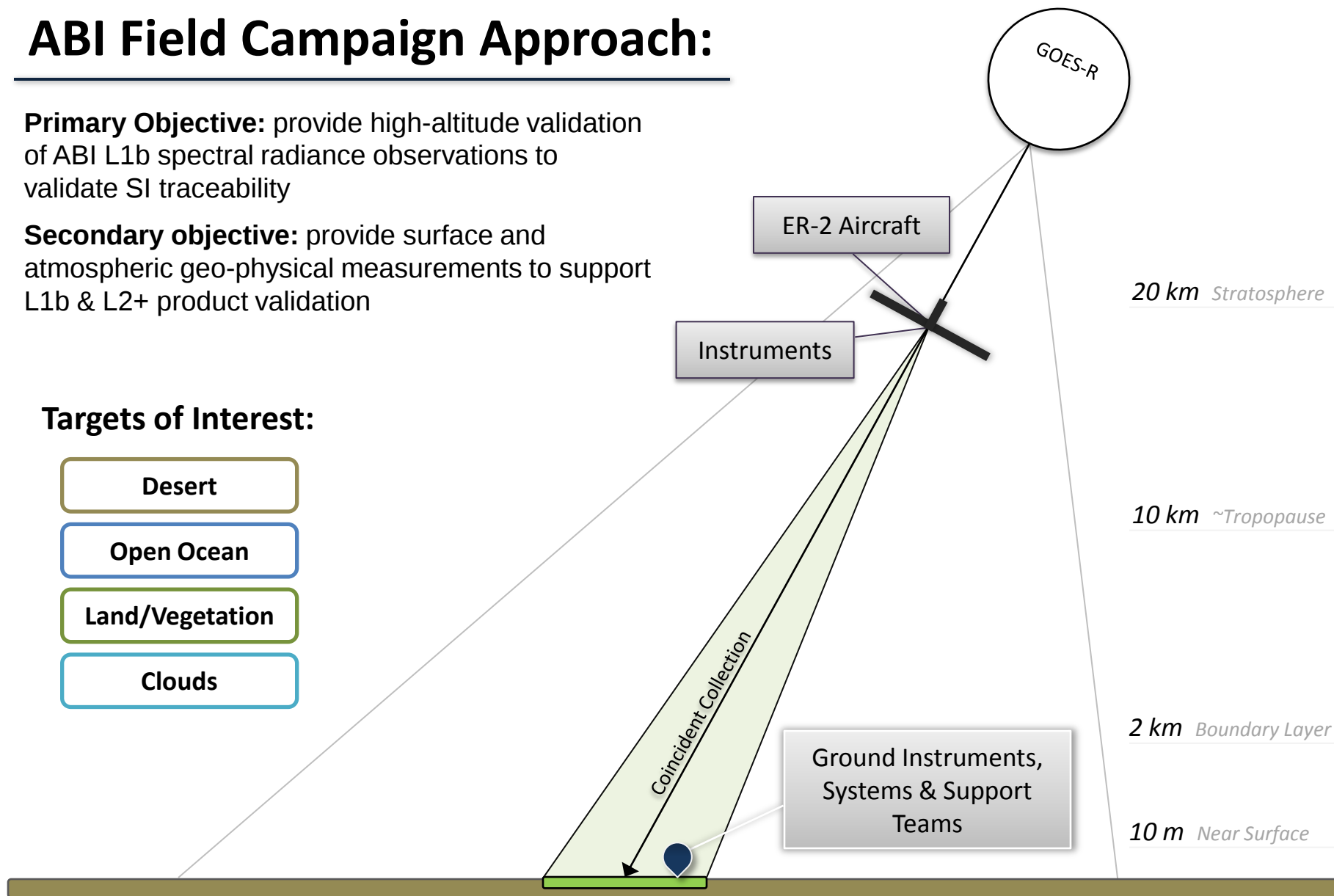
Targets of Interest:

Desert

Open Ocean

Land/Vegetation

Clouds



ABI L1b & L2+ Validation Priorities

Set of Priorities:

- Collect coincident & collocated high altitude airborne Hyper-Spectral Imagery (HSI), for all 16 ABI bands, with the same look angle as ABI over “uniform” Earth targets:

Required Collection Set (no ground based obs.):

- Desert & Water

Minimum Collection Set (with ground based & near surface obs.):

- Desert
- Open Ocean (≥ 100 km off-shore)
- Vegetation – over the Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) Cloud And Radiation Testbed (CART) site
- Other sites as available (i.e. SURFRAD sites, Chesapeake Bay, Great Lakes)

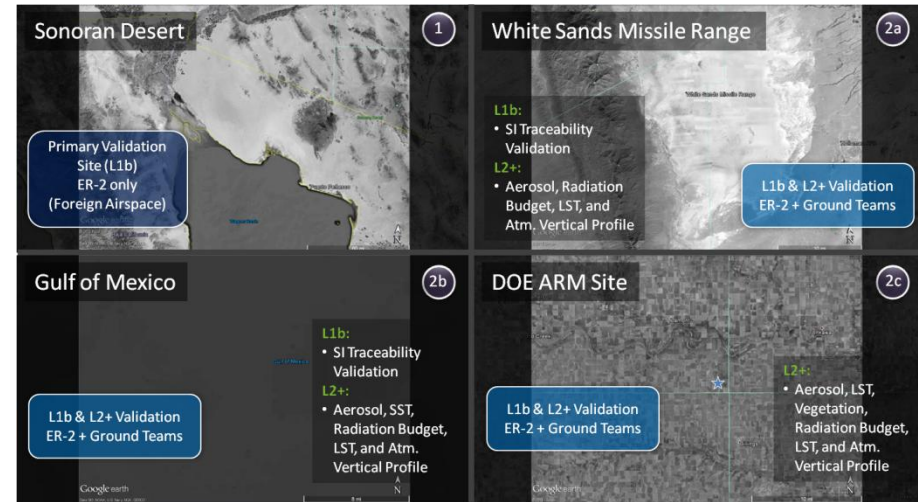
- Collect coincident & collocated high altitude airborne Lidar & Doppler Radar observations for validation of cloud and microphysical products:

Minimum Collection Set for Clouds:

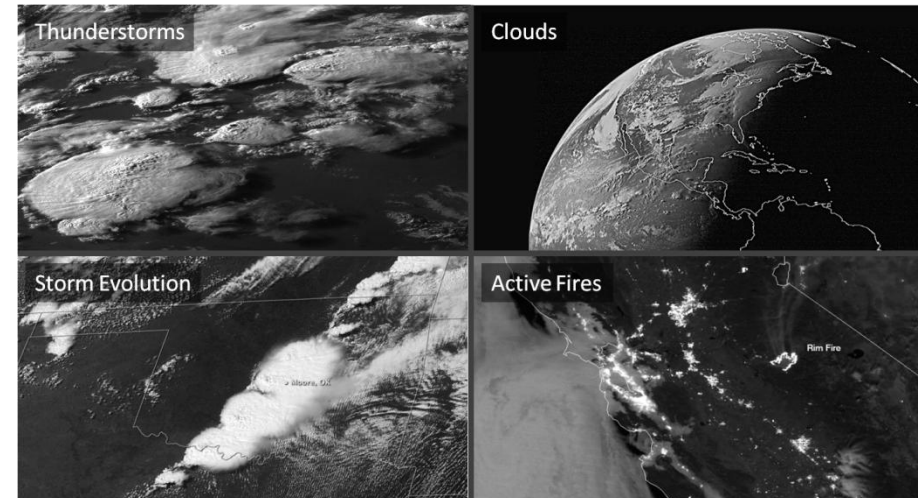
- Mixed phase, Multi-layer, Clouds in low light conditions (i.e. terminator)

- Collect coastline data when possible for INR validation
- Collect pre-storm environment and convective events
- Collect U.S. East coast (or subset) 50 km on-shore & 50 km off-shore following frontal passage
- Collect clouds over snow (if available)
- Collect active fires (need <100 m spatial resolution coincident with VIIRS)

ABI Collection Priorities



ABI Collections of Opportunity



GLM Field Campaign Approach:

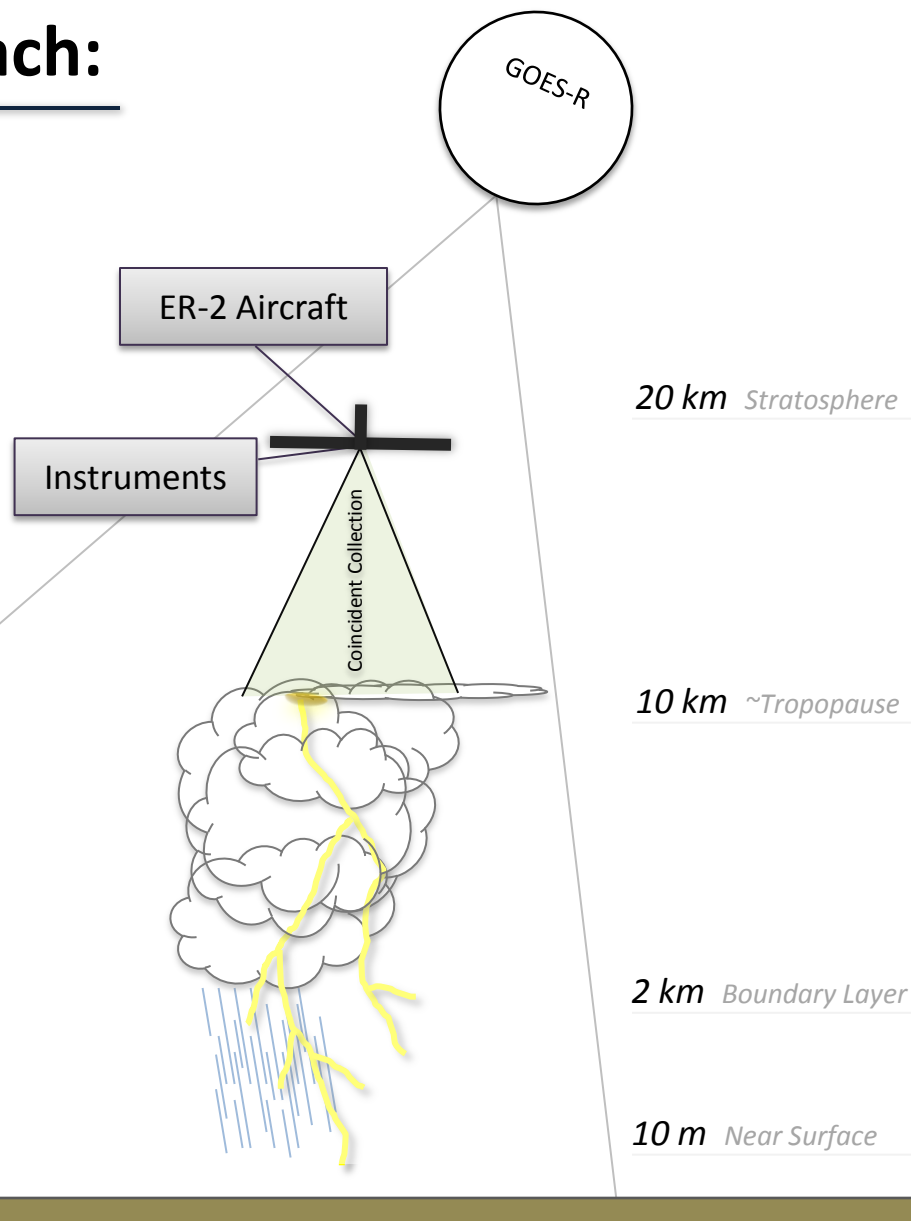
Primary Objective: provide validation of GLM flash detection efficiency day through night over land at well characterized total lightning super sites: Northern AL, Lubbock TX, Norman OK, KSC FL, and Wallops/DC area

Secondary Objective: provide validation of GLM flash detection efficiency day through night at other land locations and over ocean

Tertiary Objective: provide validation of GLM flash location & time stamp accuracy, and GLM image navigation and registration (INR) accuracy

Targets of Interest:

Storms



GLM Validation Priorities

- 1) Validation of GLM flash detection efficiency: collect coincident and collocated high altitude data over thunderstorms with the Fly's Eye GLM Simulator (FEGS*):
 - Minimum Collection Set: Over-flights of thunderstorms over total lightning super sites. Emphasis on large scale convection such as Mesoscale Convective Systems (MCSs) from pre-storm through entire evolution (include all times of day & other storm types)
 - Secondary Collection Set: Over-flights of thunderstorms at other locations (day / dawn or dusk/ night; high / low latitudes; land / ocean; various storm types / regimes)
- 2) Validation of GLM flash location & time-stamp accuracy, and INR
- 3) Validation of optical energy calibration for the GLM product (lightning, which consists of events, groups, and flashes)

* Also known in some circles as AGS (Airborne GLM Simulator)

Achievement Metrics

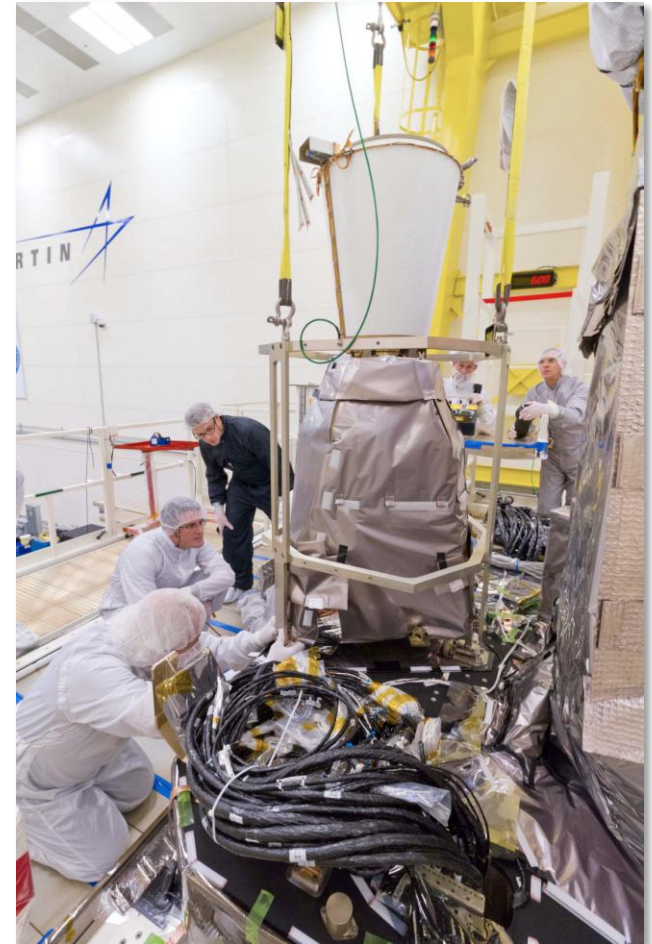
Field campaign success improved by complying with the following:

- ☐ Sample size on the order of 1000 flashes must be observed for any region and period of interest in order to characterize detection efficiency, and geo-location & time-stamp accuracy.
- ☐ Generally full storm life-cycle is desired, so do not interrupt life cycle when possible.
- ☐ More success is achieved by partially sampling multiple storm types (regime /region/time of day) rather than only fully sampling one or two types.

Value of the GOES-R Field Campaign

GLM:

- » Provides independent persistent and flexible validation capability for:
 - Flash detection efficiency
 - Geo-location & time-stamp accuracy characterization
 - Optical energy calibration
- » Ability to collect full storm life-cycle
- » Greater flexibility to collect over multiple storm types at different times of day and geospatial regions
- » No current satellite observations for cross validation as TRMM ended its data collection on April 8, 2015
- » The ISS Lightning Imager Sensor (LIS) instrument may be available for comparison (planned launch early 2016), but Airborne GLM Simulator guarantees an optical to optical cross comparison



GOES-R Field Campaign - Aircraft Candidate Instruments

Candidate Instruments	
AVIRISng	Next-Generation Airborne Visible/Infrared Imaging Spectrometer
S-HIS	Scanning High-resolution Interferometer Sounder
FEGS	Fly's Eye GLM Simulator
LIP	Lightning Instrument Package
CPL	Cloud Physics Lidar
CRS	94-GHz (W-band) Cloud Radar System (CRS)

GOES-R Field Campaign Candidate Instruments

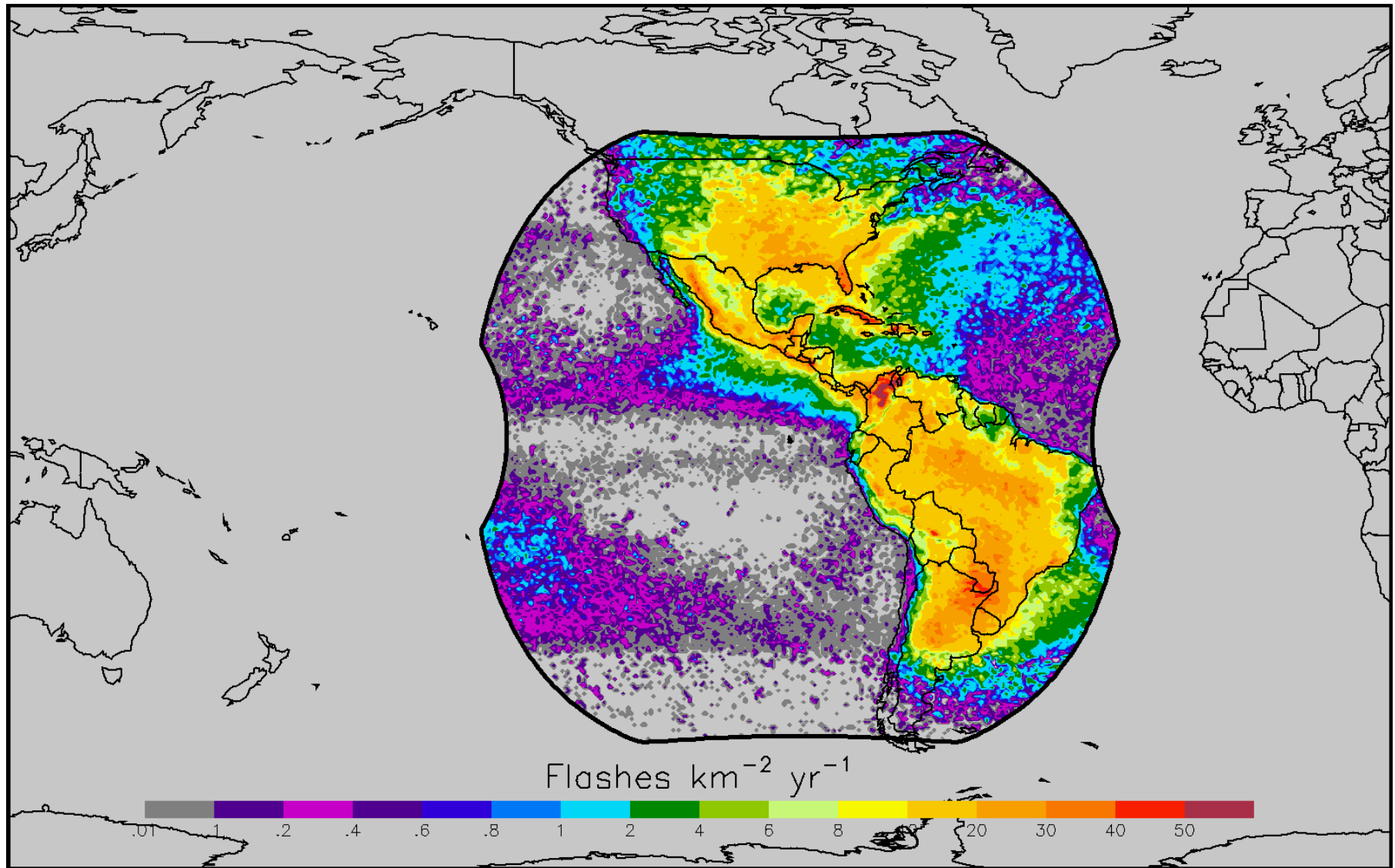
Instrument	Type	Spectral Range	Spectral Res.	GSD	FOV	Swath Width
AVIRISng	HSI	380 – 2510 nm	5 nm	0.3 m to 20 m	34 deg	~11 km
S-HIS	HSI	3.3 - 18 μ m	0.5cm ⁻¹	2 km	40 deg	40 km
FEGS	Passive EO	near-infrared (777.4 nm)	10 nm			~10 km
LIP	Passive Electrical					
CPL	Lidar	1064, 532, & 355 nm		30x200 m		
CRS	Doppler Radar	94 GHz (W-band; 3 mm wavelength)		na		

ABI & GLM combined campaign provides an opportunity for data collection with broad suite of instruments

Minimum Set of Instruments

Add-on Capability

GLM Field-Of-View centered @ 89.5 W: PLT & PLPT



ABI & GLM Validation

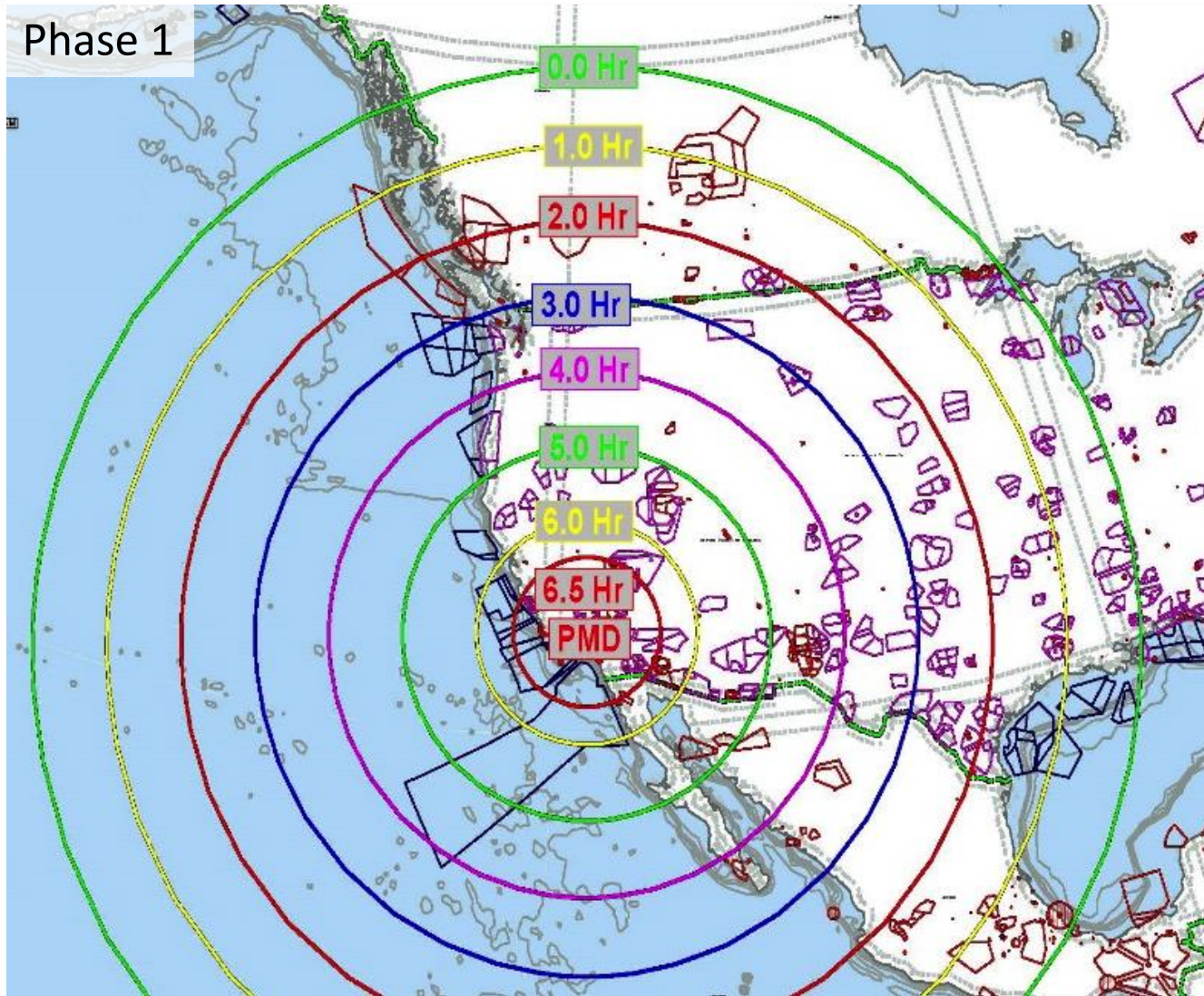


Circles are intended as visual guides for discussion purposes only

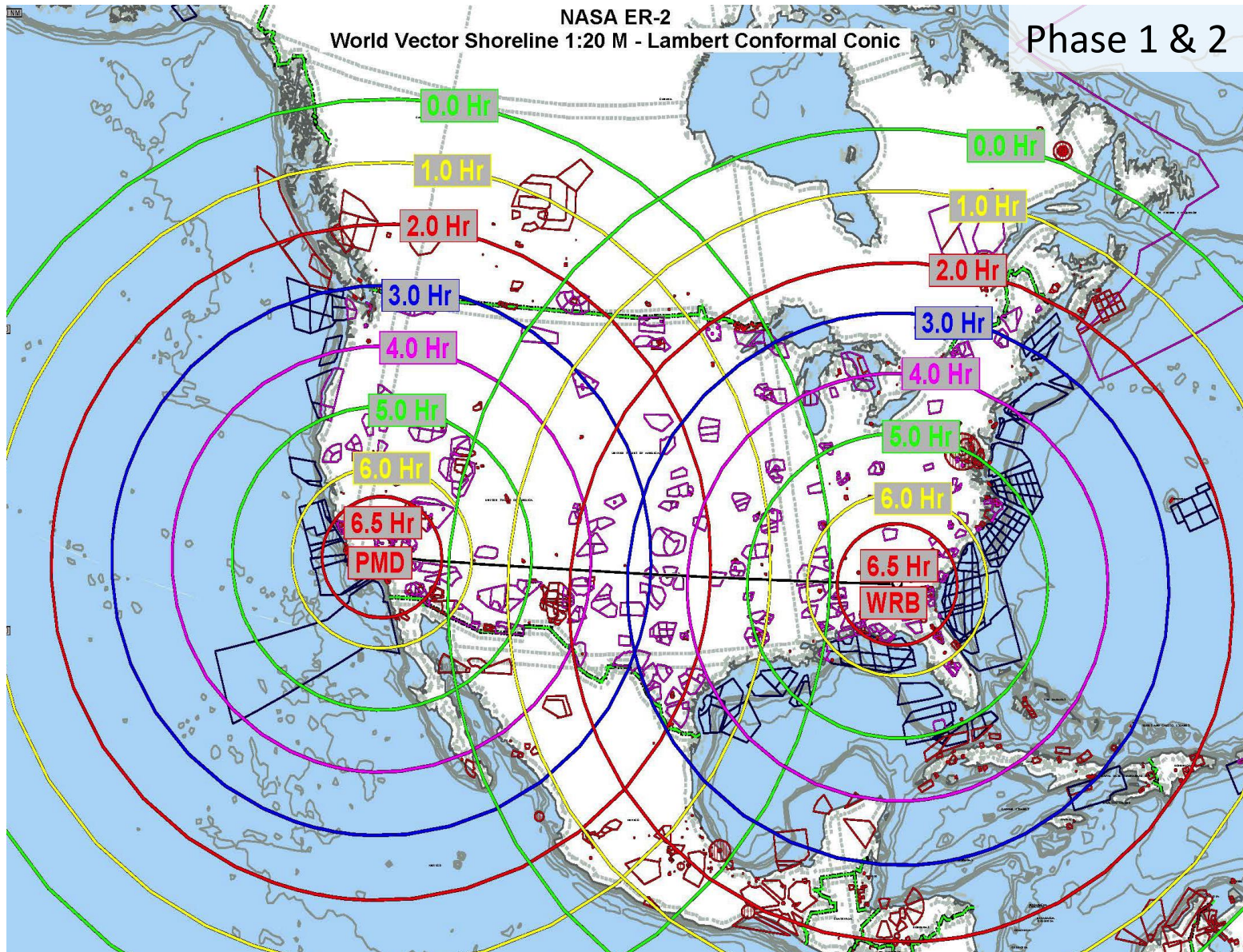
ER-2 Loiter Time (based on 8 hr mission)

» Operations depart from & return to Palmdale, CA (PMD)

Phase 1



ER-2 Loiter Time (based on 8 hr mission)



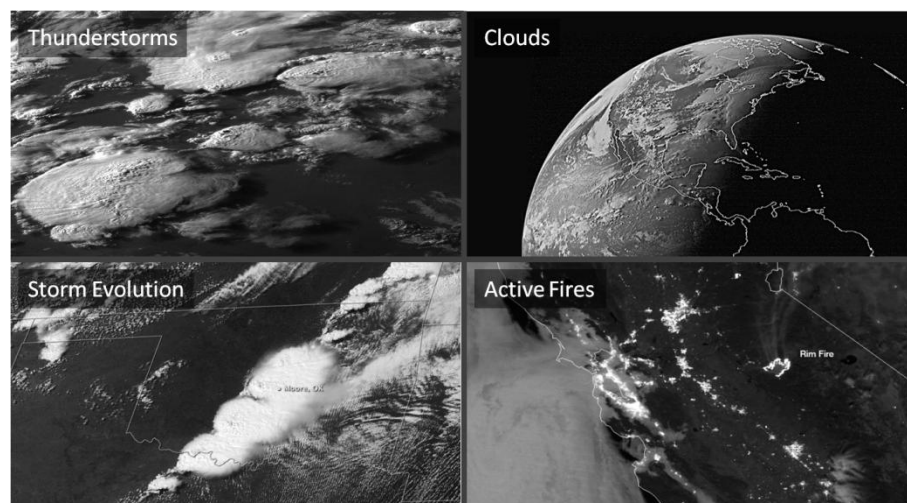
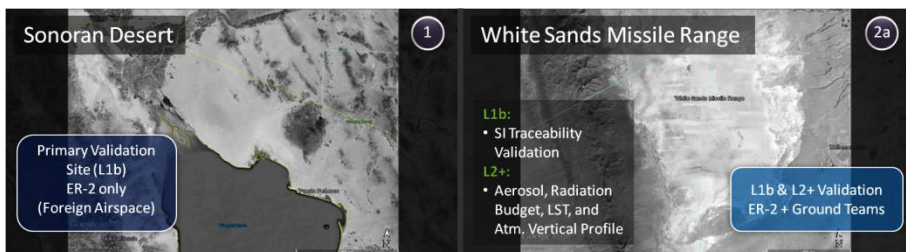
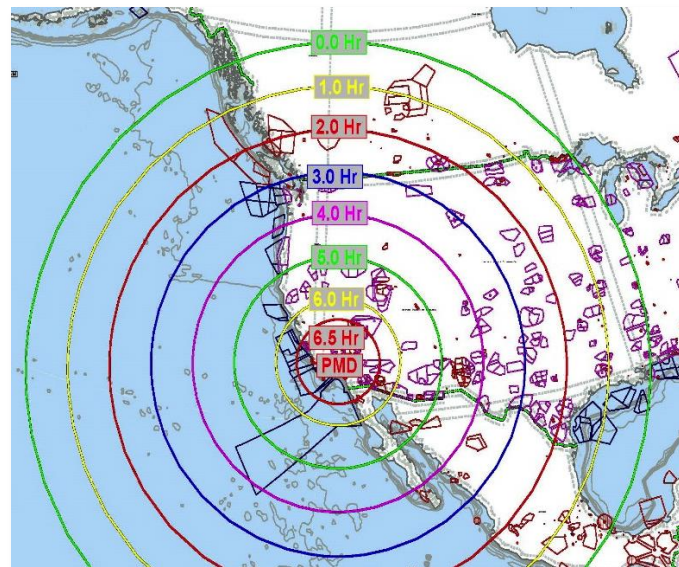
Phase 1 Summary: GOES-R Field Campaign

Duration: ~2 weeks

Flight hours: ~20-30 hrs

Summary:

- Focus is to achieve ABI primary validation objective (L1b)
- Opportunity for ABI Intensive ground campaign at WSMR
- Opportunity for GLM validation targets:
 - GLM LMAs within range:
 - Socorro, NM
 - Ft. Collins, CO
 - Lubbock, TX
 - Norman, OK
- Collections of opportunity for ABI & GLM



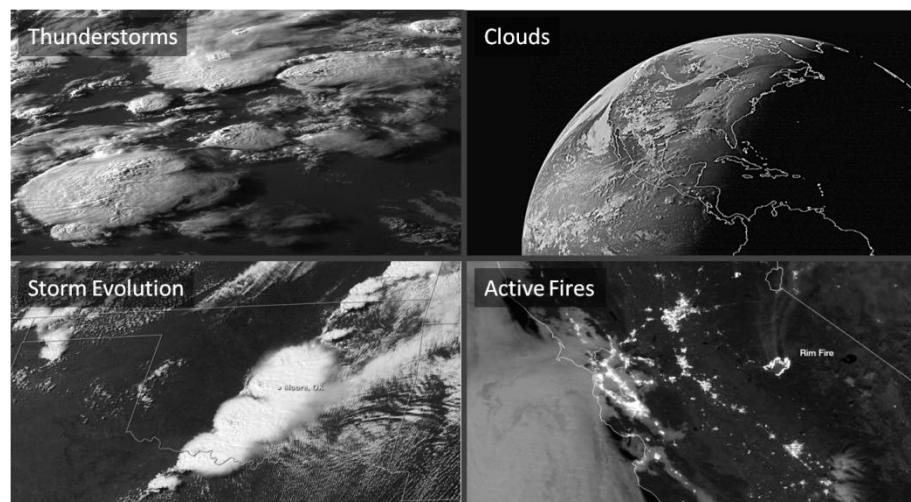
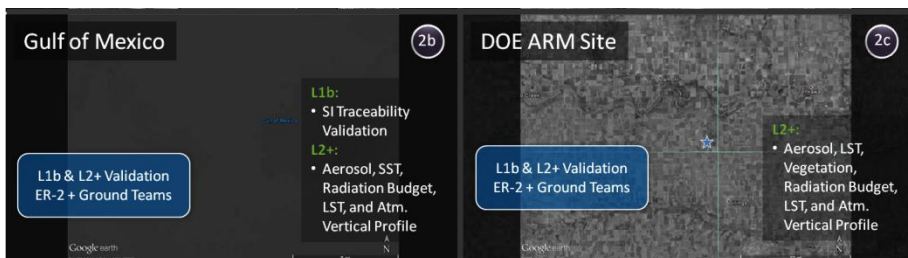
Phase 2 Summary: GOES-R Field Campaign

Duration: ~4 weeks

Flight hours: ~70-80 hrs

Summary:

- Focus GLM validation objectives and ABI secondary objectives
- GLM LMAs within range (dependent upon location of GOES-R):
 - Huntsville, AL
 - Washington, DC
 - Kennedy Space Center, FL
 - Houston, TX
 - Wallops Island, VA
 - Atlanta, GA
 - Toronto, Canada
 - Lubbock, TX
 - Norman, OK
- Opportunity for ABI Intensive ground campaigns in the Gulf of Mexico & at the DOE ARM site
- Collections of opportunity for ABI & GLM





Questions?

GOES-R Field Campaign Workshop

Day 1

Programmatic Overview

8:30 am 20 min Welcome & Overview – Steve Goodman (NOAA/NESDIS/GPO)
8:50 am 30 min Overview of Plan – Frank Padula (NASA/GSFC/GPO)
9:20 am 10 min PLT Coordination & Field Campaign Preparations – Jeff Kronenwetter (NASA/GSFC/Flight)
9:30 am 15 min ER-2 – Brian Hobbs (NASA/AFRC)
9:45 am 15 min Discussion Q&A

10:00 am 30 min break

ER-2 Instrument Candidates

10:30 am 10 min GLM Airborne Simulator, LIP, & High Speed Camera – Richard Blakeslee (NASA/MSFC)
10:40 am 10 min S-HIS – Dave Tobin/Joe Taylor (UW/SSEC)
10:50 am 10 min AVIRIS – Rob Green (NASA/JPL)
11:00 am 10 min CPL – Matthew McGill (NASA/GSFC)
11:10 am 10 min CRS – Gerry Heymsfield (NASA/GSFC)
11:20 pm 55 min Discussion Q&A

12:15 pm 1 hr lunch

Ground Support

1:15 pm 15 min CWG Participation Plans – Fred Wu /Changyong Cao (NOAA/NESDIS/STAR)
1:30 pm 15 min AWG Participation Plans – J. Daniels (NOAA/NESDIS/STAR)
1:45 pm 15 min NOAA UAS Capabilities & GOES-R Support – Robbie Hood (NOAA/OAR/UASP)
2:00 pm 15 min UW/CIMSS Measurement Capabilities – Brad Pierce (NOAA/NESDIS/STAR)/Wayne Feltz (UW/CIMSS)
2:15 pm 60 min Discussion Q&A

3:15 pm 15 min break

Ground Support Cont.

3:30 pm 15 min SURFRAD Capabilities & Status Update – Kathy Lantz (UC/CIRES)
3:45 pm 15 min NOAA Ocean Measurement Capabilities – *tentative* [Michael Ondrusek/Veronica Lance (NOAA/NESDIS/STAR)]
4:00 pm 30 min Discussion Q&A
4:30 pm 60 min Poster Session
5:30 pm Day 1 Meeting Adjourned

Day 2

Field Campaign Experience

8:30 am 10 min Day 1 Re-Cap – Steve Goodman (NOAA/NESDIS/GPO)
8:40 am 10 min Suomi NPP Field Campaign Experience – Allen Larar (NASA/LRC)
8:50 am 10 min GPM Field Campaign Experience – Walt Petersen (NASA/GSFC)
9:00 am 10 min EOS Field Campaign Experience – Steve Platnick (NASA/GSFC)
9:10 am 30 min Discussion Q&A

9:40 am 20 min break

Focused Discussions

10:00 am 40 min Discussion: Deployment (personnel, instrument integration planning, & operations)
10:40 am 40 min Discussion: Ground Measurement Coordination
11:20 am 40 min Discussion: Analysis
12:00 am 30 min Summary Discussion & Next Steps
12:30 pm Meeting Adjourned

When: April 8th - 9th, 2015

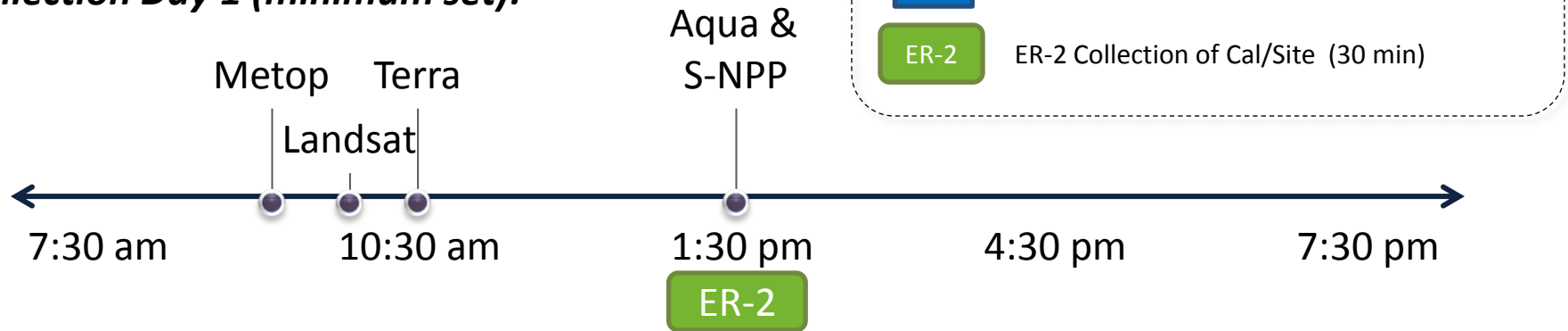
(Day 1: 8:30 am to 5:30 pm, Day 2: 8:30 am to 12:30 pm)

Where: ESSIC-4th floor Conference Room, Univ. of Maryland (M-Square)

Purpose: Achieve a baseline consensus of the initial GOES-R Field Campaign plan: refine validation planning efforts, identify required resources (i.e. budget and support teams), establish and refine coordination efforts, refine time-frames and identify and develop risk mitigation plans.

Intensive Ground Campaign Timelines:

Collection Day 1 (minimum set):



Collection Day 2:

