Global Precipitation Measurement (GPM)

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GV: A Global Effort

Measure Locally, Impact Globally!
Physical Process Validation: Field Campaigns

2010: LPVEx

2011: MC3E

2012: GCPEX

2012-: Wallops PRF

2013: IFlooDS

2014: IPHEEx

2015-2016: OLYMPEX
Iowa Flood Studies (IFloodS)

- IFloodS was conducted May 1 – June 15, 2013
- Collaboration between NASA, University of Iowa, Colorado State University and other institutions
- First GPM field campaign with a hydrological focus
- NASA’s POLarimetric (NPOL) and Dual-frequency, Dual-polarization, Doppler (D3R) radars were collocated near Traer, IA
- Univ. of Iowa also deployed five XPOL radars
- Several multi-disdrometer/gauge/MRR sites established along a NPOL/D3R radial (Parsivel, 2DVD)
- Two dense clusters of rain gauges with soil moisture and temperature probes were deployed in two separate watersheds
**NASA IFloodS Instrumentation**

**Radars:**
- Rain mapping, 4-D precipitation structure, DSD, rain intensity
- NPOL S-band transportable, scanning dual-pol radar
- D3R radar: Dual-frequency (KA-KU), dual-polarimetric, Doppler radar.
- Metek Micro Rain Radars (K-band), vertically pointing

**Disdrometer & Gauge Sites**
- Six 2D Video Disdrometers
- 14 Parsivel-2 Disdrometer with MetOne 12” TB Rain Gauge
- 20+5 dual-gauge Met One TB rain gauges with soil moisture and temperature probes
NASA dual-POLarimetric Radar (NPOL)

- NPOL is NASA’s flagship radar
- S-band, transportable dual-polarization radar
- 2700-2900 MHz
- Typically run in STAR mode
- 850 kW peak power
- 0.8 and 2.0 μs pulse width
- 8.5m parabolic dish
- PPI, RHI, Full volume, PPI sector, birdbath capable

GPM Ground Validation
NPOL Data Products

Observed

- $Z_H$
- $Z_{DR}$
- $K_{DP}$
- $\langle HV \rangle$

Retrieved

- $D_0$
- $N_W$
- HID
- Rain Rate

- $D_0$ and $N_W$ retrieved from 3rd order polynomial using 2DVD data from MC3E.
- HID from Dolan et al. (CSU)
- Rain Rate and $K_{DP}$ from Chandra (DROPS)
Dual-frequency Dual-pol Doppler Radar (D3R)

- Mobile Dual-frequency (Ka/Ku), Dual-polarization, Doppler Radar (D3R)
- D3R/NPOL collocated for the entire campaign
- Data analysis being performed by CSU (Chandra et al).
- D3R also collocated with NPOL during IPHEx and currently at Wallops.
Collocated NPOL & D3R Observations

NPOL

D3R - May 8, 2013

Ku

ZDR

Ka

dBZ

ρHV

V_R

W

φDP

ρ
IPHEX consisted of two primary activities

1. Rain gauge network of 60 stations; Disdrometer network (20 APU + 2DVD + Joss); Oct 2013-14.

2. IOP from May–July of 2014 (post GPM launch); NPOL and D3R radars, four additional MRRs, and the NOAA NOXP radar

- NASA ER-2 and UND Citation aircraft used to conduct high altitude and “in the column” measurements.
- ER-2 equipped with multi-frequency-radiometers (AMPR and CoSMIR), the dual-frequency Ka-Ku band, HIWRAP Ka-Ku band, CRS W-band, and EXRAD X-band radars.

GPM!
NPOL located near Rutherfordton, NC. Collocated with D3R.

Principal goal was to provide 4D mapping of precipitation structure using NPOL and D3R radars, as well as four MRRs, and NOAA’s NOXP.

Provided coordinated observations for A/C operations and GPM overpasses.

Developed scanning sequences based on the presence (near/far) of precipitation, and A/C and satellite status, using a combination of sector PPIs and high-resolution RHIs.

Low-level 360° PPI “rain” scans every 3.5 – 4.0 minutes.
Golden Case during IPHEx: May 23, 2014

50,000 foot+ echo top. Hail core to 39,000 feet. Golf ball to tennis ball-sized hail

ER-2 view from 65,000 feet

Deep columns of large ice cause microwave scattering at high & low frequencies

NPOL Radar:
Vertical slice of precipitation ice physics

GPM Overpass @ 2316 UTC
http://gpm-gv.gsfc.nasa.gov/Tier1

Picture courtesy of D. S. Broce (AFRC)
The Olympic Peninsula is in the NW corner of Washington state

Consists of coast, lowlands, rain forests & high terrain

Receives > 2500 mm/yr precipitation on coast, and > 4000 mm/yr in interior

In wintertime, frequent mid-latitude cyclones impact the peninsula with variable melting levels, stratiform and convective rain.

National Park covers all of the high terrain where precipitation falls as snow.

Info and graphics thanks to Lynn McMurdie et al. (UW)
Wallops Precipitation Research Facility (PRF)

- GPM has established Wallops Flight Facility and surrounding areas as part of the Wallops Precipitation Research Facility (PRF).

- Goal is to deploy and operate all GPM GV instruments when not deployed for GPM field campaigns.

- NPOL/D3R serve as the cornerstone of this effort, along with a network of disdrometers (2DVD, Parsivel, Joss, PIP), rain gauges, profilers.

- Other instruments include:
  - Lightning Mapping Array (LMA) for 3-d lightning location.
  - ACHIEVE W-band radar
  - Micro-pulse Lidar (MPL)
  - SPANDAR and TOGA radars
Pocomoke Area Gauge Network

- Dual-tipping bucket rain gauges
- Provide rain intensity and accumulation
- Capable of soil moisture measurements
- Data telemetered to NASA servers every 15 minutes
- Used for satellite validation and variability studies
Thank you!
BACKUP SLIDES
High-Density Pocomoke Gauge Network

- Center of grid an optimal 30 km from NPOL
- Educational and public outreach

Pocomoke Area Gauge Network

- Pocomoke Middle School
- Pocomoke High School
- Near Sysco
- Discovery Center
- American Legion
- Hayward’s Lott
- Lowes
- Pocomoke Fairgrounds
High-quality gauge network

NASA is deploying dual-instrument, autonomous gauge platforms. These gauges will report their “tip” information every 15 minutes and the data are posted to a NASA web server (http://wallops-prf.gsfc.nasa.gov).