An Update on NOAA Operational Precipitation Products and NOAA's Contributions to the PMM Science Team

Bob Kuligowski[1], pinch-hitting for

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Includes contributions by other PI's on the PMM Science Team, other NOAA researchers and those at ESSIC/CICS at the University of Maryland

NOAA Needs, Activities and Status on GPM

- R2O and O2R
- Historical perspective…
- Accomplishments with GPM data and products

NASA-NOAA Relationship

- **Monitoring**
- **Mitigation**
- **Trends**

O2R

-Mission Goals	-Innovation
-Applications	-Algorithms
-Testbeds	-Validation
-Dissemination	-Archive

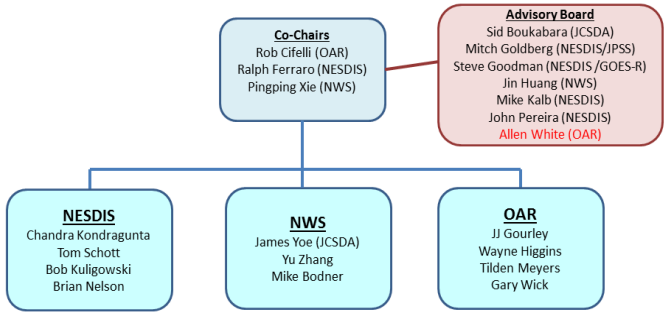
R2O

- **Nowcasting**
- **Warnings**
- **NWP**
- **Analysis**

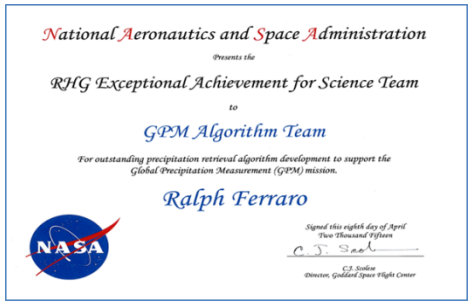
Partnership with NASA – Historical Perspective and Accomplishments

- **Our driver - 2007 NOAA funded NRC Study**
  - **"Lessons learned" from TRMM**
  - **Better NOAA organization for GPM**
    - **NOAA SGPMS (NESDIS, NWS, OAR)**
  - **Urged to consider R2O**
    - **Ground segment (PPS), follow on capability**

NOAA's Steering Group on Precipitation Measurement from Space



- **Partnerships with NASA on PMM Science Team**
  - **NOAA direct and in-kind funding to it's PI's**
  - **NOAA contributions to two TRMM/GPM products**
  - **NOAA contributions to NASA GV Program**


National Aeronautics and Space Administration
Presents the
RHG Exceptional Achievement for Science Team
to
GPM Algorithm Team
For outstanding precipitation retrieval algorithm development to support the Global Precipitation Measurement (GPM) mission.
Ralph Ferraro
Signed this eighth day of April Two Thousand Fifteen
C.J. Scolese
Director, Goddard Space Flight Center

- **Three NOAA User Workshops on GPM**
  - **Gather stakeholder interest**
  - **Leverage ongoing activities with GOES-R & JPSS**
  - **Developed GPM L1RD and CONOPS**

Current GPM Use/Plans at NOAA

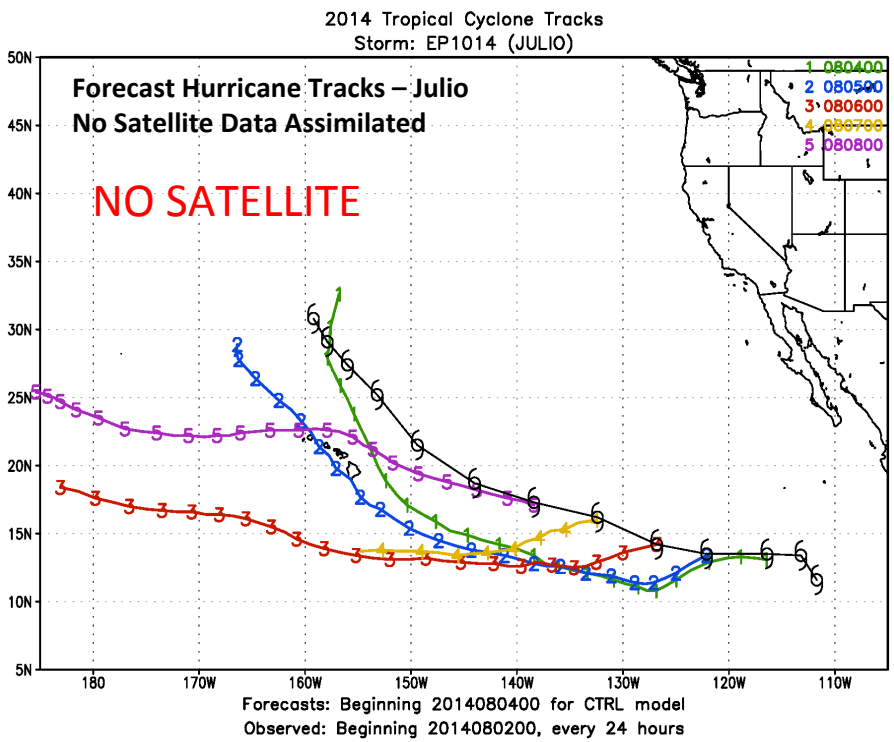
- **NWS requests to NESDIS**
  - **Need for GMI (and constellation) L1 and L2 products**
    - **NCEP/EMC, NHC, CPC; NWSFO**
    - **McIDAS, AWIPS-2, BUFR**
      - **NASA/SPoRT already providing demonstration GPM products to NWS!**
  - **OSPO/STAR working to fulfill the NWS requests**
- **Other NESDIS operational product systems will be utilizing GPM**
  - **MiRS, bTPW/bRR, eTRaP, etc.**
- **GMI data tested at JCSDA**
  - **Appears to be ready for incorporation into next GSI major update (late 2015/early 2016)**
- **NWS/NCEP CMORPH products**
- **GMI (should be) considered as potential gap mitigator at NOAA**
  - **Can *partially* replace ATMS non-sounding products such as precipitation rate, water vapor, cloud water.**

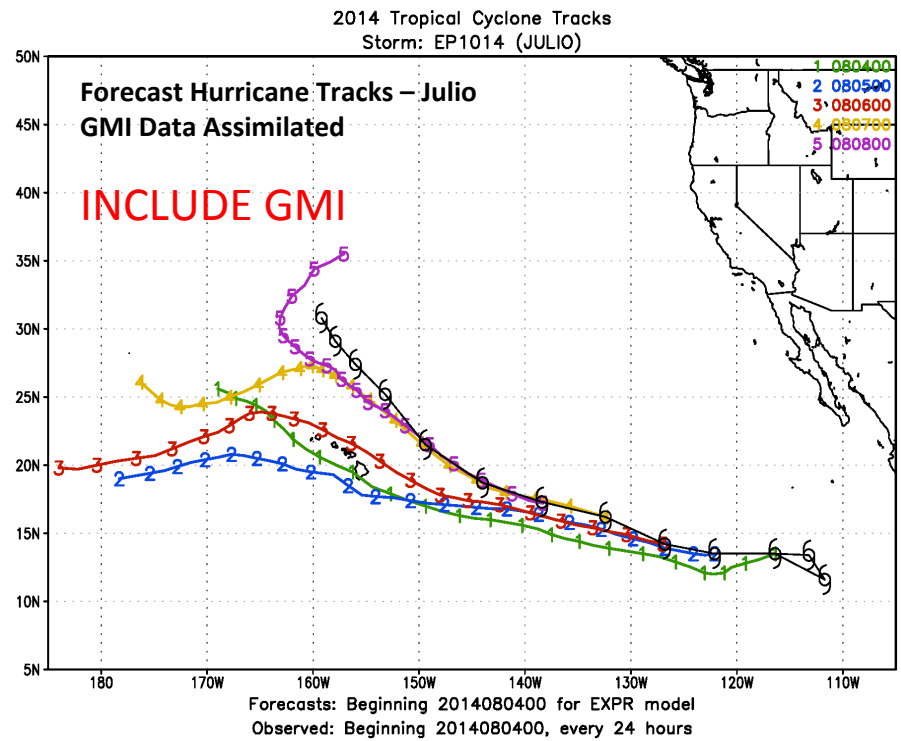
JCSDA GPM Data Assimilation

Results are preliminary, filtering, bias correction, QC, etc. not finalized.

GMI Data Assimilation – Preliminary Assessment of Impacts:

- The assimilation of clear-sky GMI data has an impact on GFS forecasts.
- Preliminary results indicate a mixed signal, but more assessment with larger sample sizes is needed to more precisely qualify overall impact.





Courtesy of Erin Jones & Sid Boukabara, JCSDA

Some near term emerging topics…

1. Take advantage of GPM PPS to optimize precipitation (and NOAA Unique Products) processing at NESDIS and advance the NESDIS GEARS concept
   - GEARS = Ground Enterprise Architecture System
   - Consolidates NOAA JPSS and GOES ground segments into a common framework
     - Include common "systems", algorithms, products…
   - GPM PPS is a STRONG GEARS PROTOTYPE…..

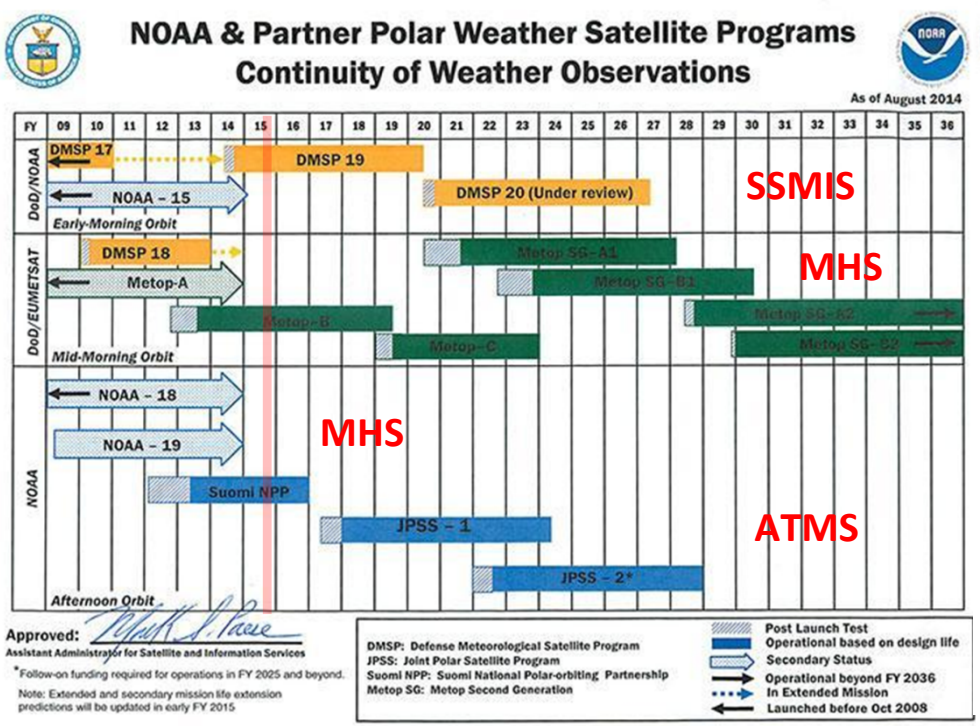
2. Move towards a unified "One NOAA" Precipitation Enterprise System
   - SGPMS developed a (draft) "Precipitation Roadmap" (NESDIS, OAR, NWS)
   - Gain NESDIS, OAR, NWS support to plan and hold a NESDIS-hosted workshop in FY16 to flesh out Roadmap and begin an implementation plan
     - Need AA support from all three line offices

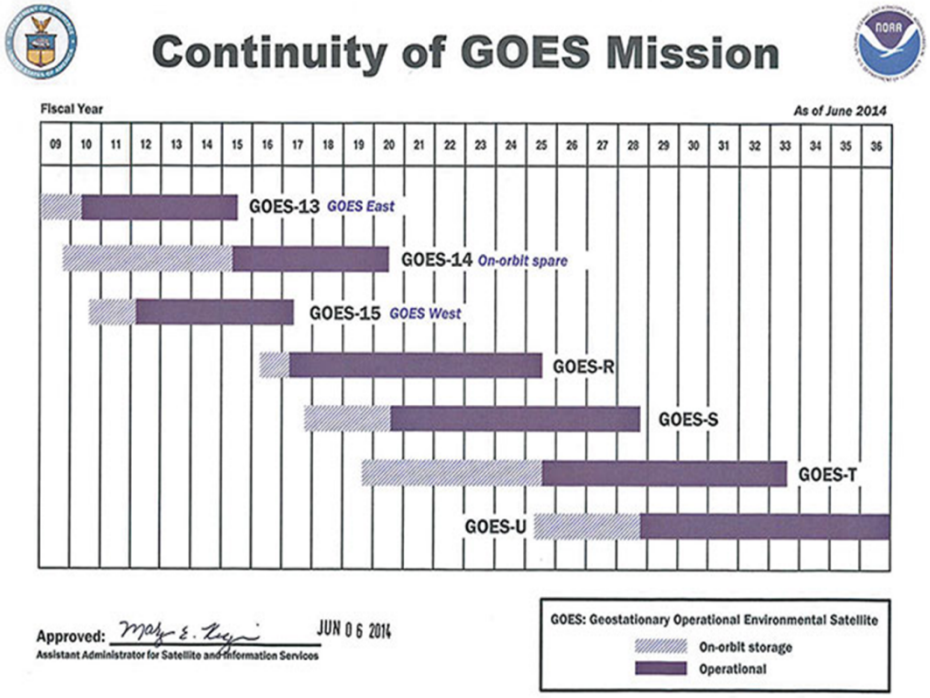
3. A variety of budget initiatives are being developed for R2O and utilization of non-NOAA observations assets

Update on NOAA Satellites, Partner Satellites and Precipitation Products

- POES/JPSS & GOES – satellites and products
- International Partners – GCOM-W1 AMSR-2, M-T SAPHIR

LEO and GEO Satellites





Operational MW Rain Rates, TPW, Cloud Liquid Water, Snow Cover

Sensors (Satellites)	Δx	Processing System	Formats
AMSU-A/MHS (N18/19, MetOP-A/B)	16 km	MSPPS→MiRS	HDF-EOS, McIDAS AREA (both); netCDF4 (MiRS only)
ATMS (S-NPP)	16 km	MiRS	HDF-EOS,netCDF4, McIDAS AREA
SSMIS (DMSP F17/18)	16 km	MiRS	HDF-EOS,netCDF4, McIDAS AREA
SAPHIR (M-T)	16 km	MiRS	*HDF-EOS,netCDF4, McIDAS AREA*
AMSR2 (GCOM-W)	≥ 5 km	GPDS GPROF, MiRS	netCDF4, McIDAS AREA (both); BUFR, GRIB (GPDS only), HDF-EOS (MiRS only)
GMI (GPM)	≥ 5 km	GPDS GPROF, MiRS	netCDF4, BUFR, GRIB, McIDAS AREA

MSPPS – Microwave Surface and Precipitation Products System; **MiRS** – Microwave Integration Retrieval System; **GPDS** - GCOM-W Processing and Distribution System; **GPROF** – Goddard Profiling Algorithm.

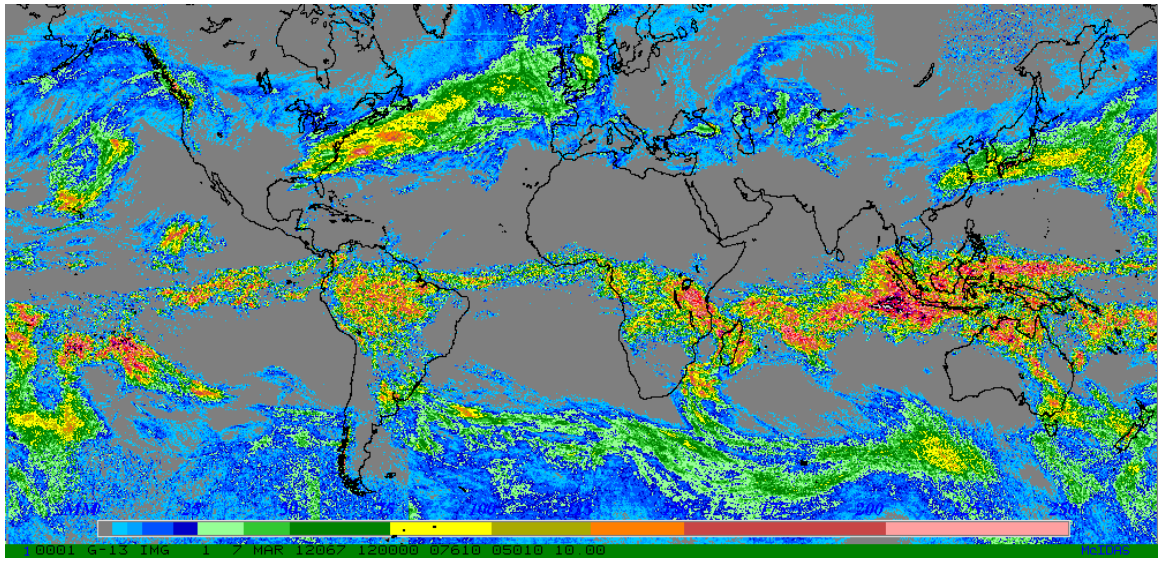
Operational MW Snowfall Rate

Sensors (Satellites)	Δx	Processing System	Formats
AMSU-A/MHS (N18/19, MetOP-A/B)	16 km	MSPPS→*MiRS*	HDF-EOS, McIDAS AREA (both); *netCDF4 (MiRS only)*
ATMS (S-NPP)	16 km	*MiRS*	*HDF-EOS,netCDF4, McIDAS AREA*
SSMIS (DMSP F17/18)	16 km	*MiRS*	*HDF-EOS,netCDF4, McIDAS AREA*
SAPHIR (M-T)	16 km	*MiRS*	*HDF-EOS,netCDF4, McIDAS AREA*
AMSR2 (GCOM-W)	≥ 5 km	*MiRS*	*HDF-EOS,netCDF4, McIDAS AREA*
GMI (GPM)	≥ 5 km	*MiRS*	*HDF-EOS,netCDF4, McIDAS AREA*

MSPPS – Microwave Surface and Precipitation Products System; **MiRS** – Microwave Integration Retrieval System

Operational Short-Fuse IR Rainfall

Satellites	Δx	Processing System	Formats
GOES-E ;GOES-W; MTSAT; Meteosat-7 & -10; (*IR Imager);* *Himiwari-8*	5 km, 15 min	Global Hydro-Estimator *(SCaMPR)*	netCDF4, McIDAS AREA, GRIB1/GRIB2



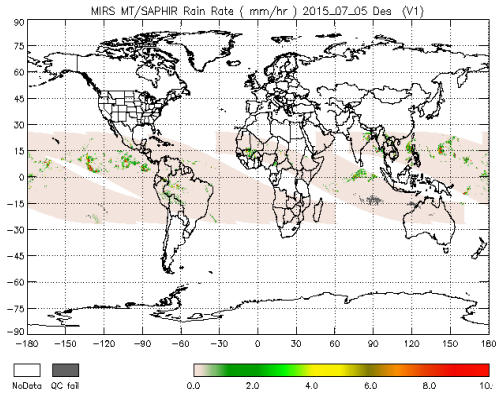
SCaMPR - Self-Calibrating Multivariate Precipitation Retrieval

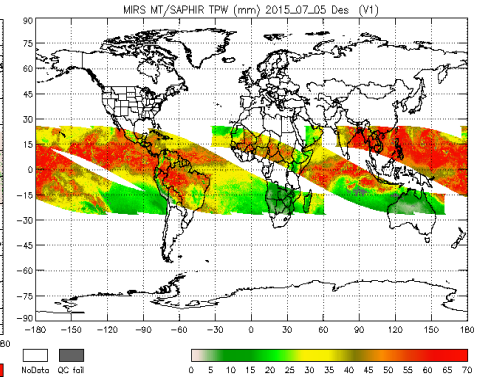
M-T and AMSR-2 Updates at NOAA

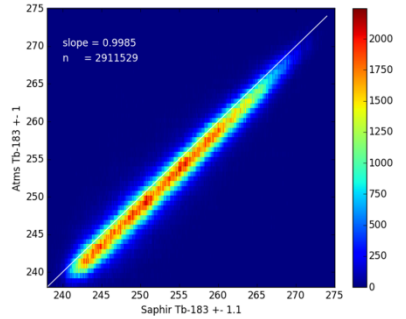
Ralph Ferraro, NOAA/NESDIS/STAR

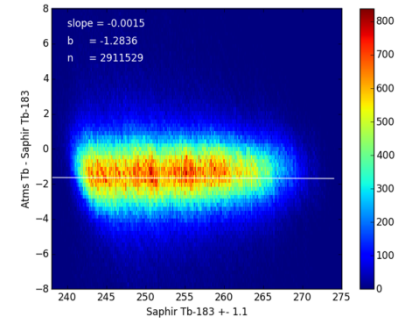
- **M-T:**
  - Receiving L1 SAPHIR data via EUMETSAT
  - Real time TPW and RR products via NOAA MiRS system
    - Limited capability due to MADRAS loss but still a useful gap filler, esp. with end of TRMM mission
  - BUFR data feeds being established for NWP use
  - SAPHIR and ATMS cross-calibration useful for JPSS program

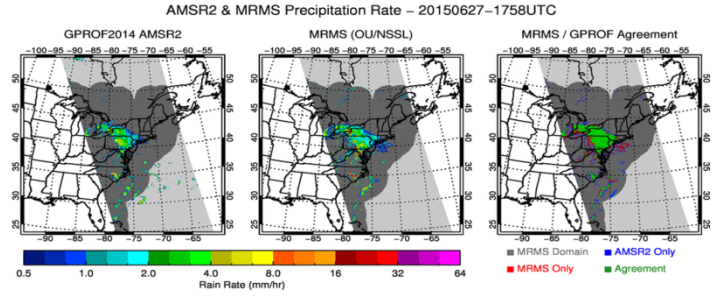
- **GCOM AMSR-2:**
  - NOAA receiving n.r.t. AMSR-2 L1 data via MOU with JAXA
  - L2 products are available via NOAA servers
    - The rain product is GPROF2010V2 (Meyers et al. 2015)
    - Other products based on heritage NOAA/Windsat algorithms
  - Ongoing comparisons with other products like GPM GPROF2014 and MiRS ATMS rain rates
  - Future work includes regional algorithms to serve NWS Alaska and Pacific regions and exploiting direct broadcast capabilities

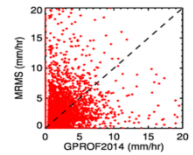


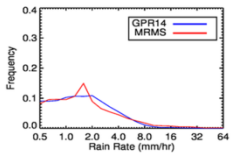


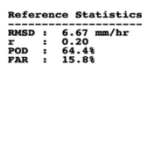












Science Team and Related Activities

- CMORPH/IMERG
- Completion/New Science Team Projects

CMORPH / IMERG

NOAA Contributions to the Day-1 Version IMERG

- **Primary members of the NOAA CMORPH team (R.Joyce and P.Xie) have been active members of the PMM L3 development team**

- **Have been working closely with G. Huffman and other team members**

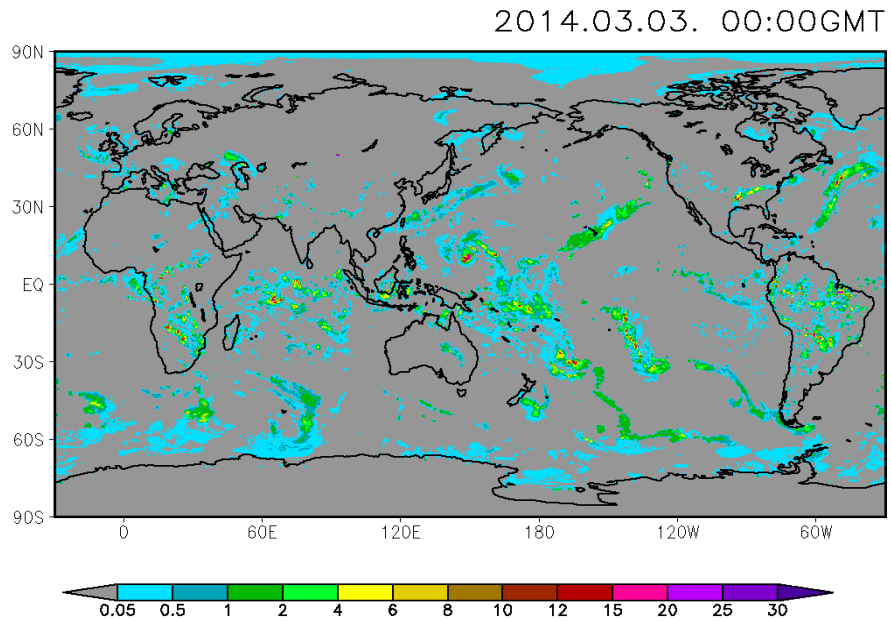
- **Made significant contributions to the development of Day-1 IMERG**
  - **Migrated the Kalman filter version of the CMORPH morphing algorithm on code level to NASA/GSFC to be used as a core part of the IMERG**
  - ***Produce full-resolution global geo-IR data and push it to GSFC on a real-time basis to be used to derive IR-based precipitation estimates and cloud motion vectors.***

CMORPH / IMERG

New CMORPH Developments and Potential Collaborations with IMERG

- **Recent CMORPH Developments**
  - **2nd generation CMORPH, pole-to-pole, rainfall and snowfall**
  - **GOES-R enhanced regional CMORPH: refined resolution, reduced latency**
  - **Gauge-radar-satellite-model all-source fusion: further improved quality with regionally available additional information**

- **Collaborations with IMERG**
  - **CMORPH and IMERG have many in common**
  - **We are open to future collaborations in the algorithm / products development**
    - **Bias correction**
    - **IR based precipitation estimates over high latitudes**
    - **motion vectors**
    - **Use of model based information**
    - **…..**



New NOAA Projects for PMM

Nine subtasks submitted as a single, no-cost to NASA, proposal

- **Contributions to the GPM GV Activities and Process Studies**
  - Characterization of Orographic Precipitation During IPHEX and HMT-SEPS (R. Cifelli)
  - Development of a ground radar-based snow database for satellite algorithms (J.J. Gourley)

- **Contributions to the Improvements of GPM Level 1, 2 and 3 Products**
  - Algorithm Enhancement for GPM Constellation Radiometers to Support NOAA/NWS Regions (R. Ferraro)
  - Enhancement of NOAA Operational Snowfall Rate (SFR) Product for GPM Constellation Satellites (H. Meng)
  - Development of 2nd generation pole-to-pole CMORPH (P. Xie and B. Joyce)
  - Enhancing regional CMORPH with gauge, radar and model data (P. Xie)

- **Improving NOAA Operations and Climate Data Records with GPM Data**
  - A Rainfall Nowcaster Based on Multisensor Data (R. Kuligowski)
  - Development and Transition of Precipitation Climate Data Records (B. Nelson)
  - Changes in the hydrological cycle in the extratropics using GPM data (P. Groisman)