NOAA's Climate Data Record (CDR) Program

Leveraging 3 Decades of Satellite Investments To Provide Trusted Climate Information

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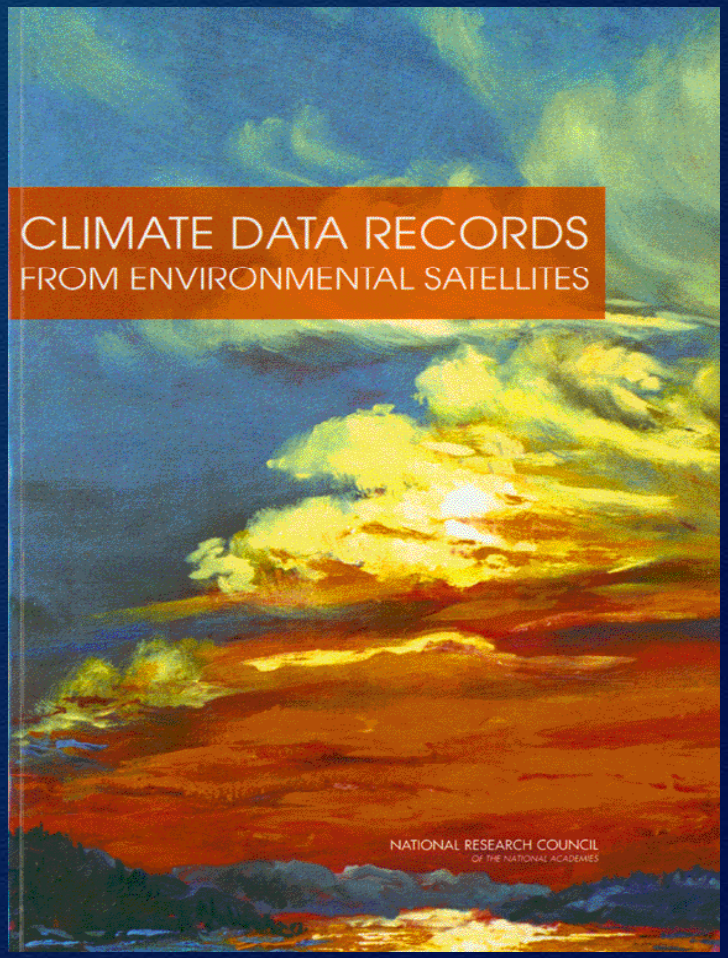
What is a Climate Data Record

- **A Climate Data Record (CDR) is a time series of sufficient length, consistency, and continuity to determine climate variability and change**
  - **FCDR**: Calibrated signals for a family of sensors together with the ancillary data used to calibrate them. (e.g. brightness temperatures, TOA radiances)
  - **TCDR**: Geophysical variables derived from FCDRs; May be generated by blending satellite observations, in-situ data, and model output (e.g., Aerosol Optical Depth, SST)
- **A Climate Information Record (CIR) is derived from CDRs and related data and provides specific information about an environmental phenomena of importance to science and society (e.g., Hurricane tracks, Arctic Sea Ice Extent, Incidence of disease)**



How is GPM Important to NOAA's CDRP

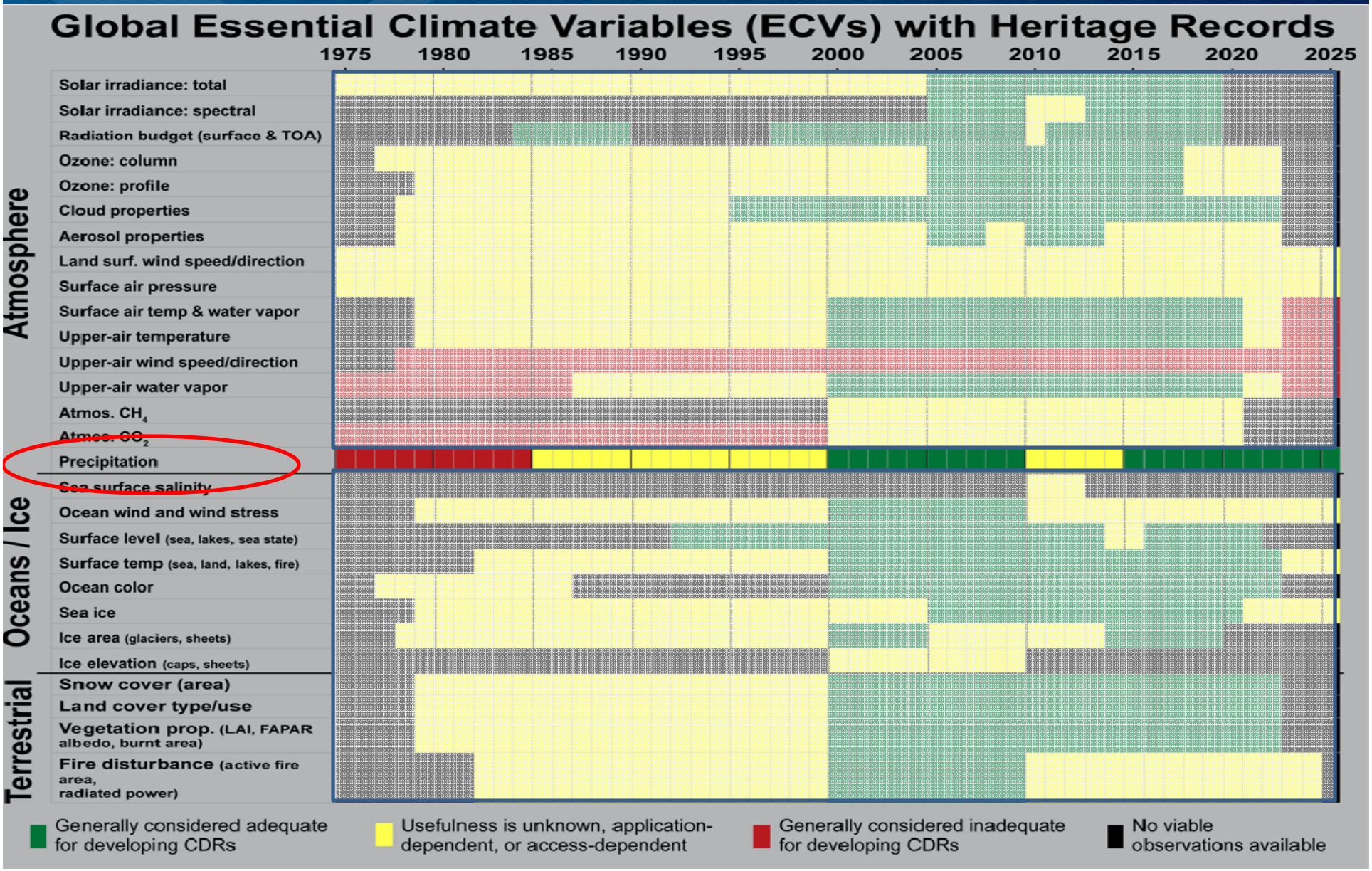
1) Precipitation information and trending as climate parameters are critical to CDR Program users and stakeholders.

2) As a research mission, the initial obvious use of GPM is to help validate precipitation data from NOAA operational missions that is being used to form CDRs.

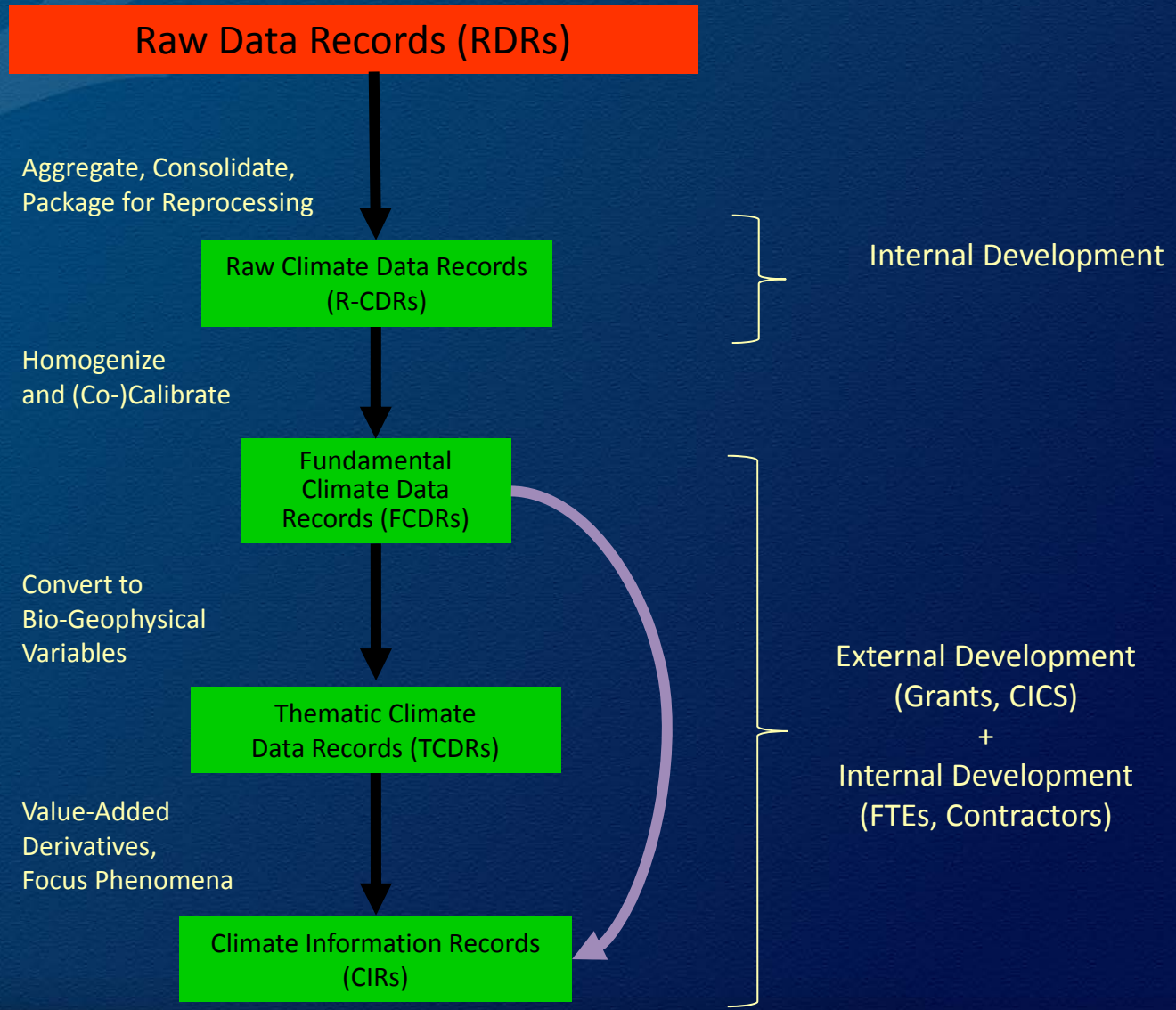
3) GPM can serve as a gap-filler if needed

4) Once GPM technologies are proven and demonstrated to be as good or better than status quo NOAA operational precipitation retrievals, NOAA should strongly consider an R2O.

Merging NASA/NOAA/USGS Data Will Provide Information at Climate Time Scales and Quality



Acquiring the Algorithms In the Production Chain



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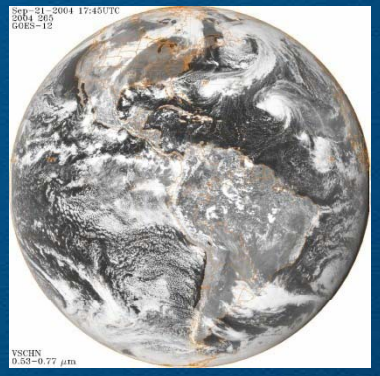
Revealing Climate Information Within Archived Data

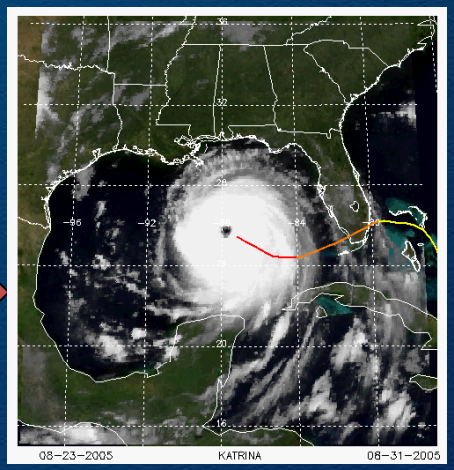
Raw Satellite Data



29 Geostationary Satellites
+ 8 Polar Satellites

Different designs, spectral bands, formats, navigation, resolutions, algorithms (Knapp et al., 2007)

30 Year Fundamental CDRs

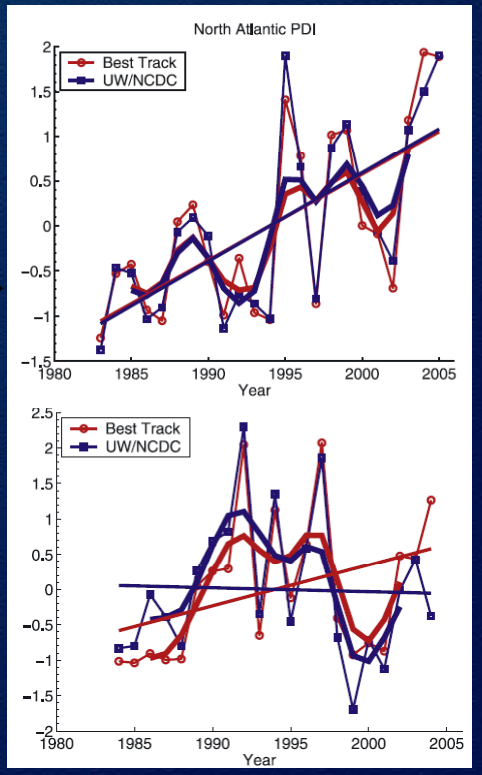


HURSAT-B1

- Geo-located
- Calibrated
- netCDF
- 8km, 3-hourly

(Knapp et al., 2007)

Global and Basin Objective Hurricane Intensity Trends



New intensity estimates (e.g., Kossin et al. 2007)

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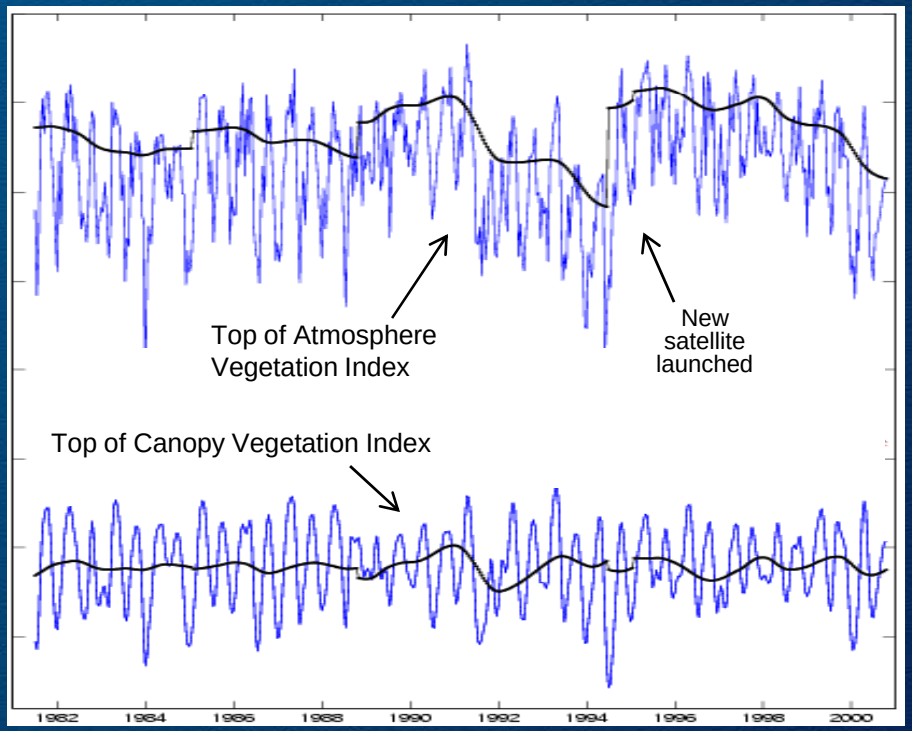
CDR Development Requires Application of Best Methods Across Different/Dirty Data Epochs

Uncorrected Data Time Series Contain Both Environmental Information and Satellite-induced Artifacts



← Operational weather and hazard products are produced rapidly to potentially save life and property

← Climate Data Records (CDRs) provide long term product consistency through rigorous reprocessing with advanced algorithms, ancillary data and evolved instrument understanding.

Image courtesy C. Tucker

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Product Development/Discipline Teams

Thematic CDR Teams	Atmospheric Profiles	Clouds & Aerosols	Precipitation	Ozone/Trace Gases	Oceans	Land	Cryosphere	Solar Irradiance	Radiation Budget
Discipline Lead	Menzel	Heidinger	Ferraro	Flynn	Evans	Vermote	Key	Pilewski	Zhao
NCDC Tech. Lead	Shi	Knapp	Nelson	Shi	Banzon	Guillevic	Zhang	Zhao	Zhao
NCDC IT Lead	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Hankins
	Menzel (Shi)	Heidinger (Knapp)	Boyles (Nelson)	Flynn (Shi)	Evans (Banzon)	Vermote (Guillevic)	Key (Zhang)	Pilewski (Zhao)	Rossow (Zhao)
	Ferraro (Kim)	Minnis (Knapp)	Ferraro (Kim)	Long (Shi)	Minnet (Zhang)	Rossow (Zhao)	Robinson (Guillevic)	Lean (Zhao)	Kato (Zhao)
	Ho (Shi)	Sarooshian (Kim)		Rosenlof (Shi)	Reynolds (Banzon)		Meier (Zhang)	Pap (Zhao)	Lee (Shi)
	Luo (Knapp/Young)				Casey (Banzon)				Lazlo (Zhao)
	Zou (Shi)				Clayson (Zhang)				Li (Zhao)
	Mears (Nelson)								Heidinger (Zhao)

Fundmental CDR Teams	Imagers (SW/IR)	Imagers (u-wave)	Sounders (TIR)	Sounders (u-wave)	Sounders (Trace Gas)	Solar Radiometers	ERB Instruments	GPS-RO
Team Leader	Evans	Kummerow	Cao	Ferraro	Flynn	Pilewski	Kato	Ho
NCDC Tech. Lead	Knapp	Semenegus	Shi	Kim	Shi	Zhao	Zhao	Shi
NCDC IT Lead	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Evans (Banzon)	Kummerow (Semenegus)	Cao (Shi)	Ferraro (Kim)	Flynn (Shi)	Pilewski (Zhao)	Kato (Zhao)	Ho (Shi)
	Mittaz (Knapp)	Wentz (Semenegus)	Menzel (Shi)	Luo (Nelson)		Rice (Zhao)	Rossow (Zhao)	
	Vermote (Guillevic)		Lee (Shi)	Zou (Shi)		Lean (Zhao)		
	Minnis (Knapp)							
	Heidinger (Knapp)							

Maturity Matrix Identifies Milestones and Research-to-Operations Transition Points

Maturity	Sensor Use	Algorithm stability	Metadata & QA	Documentation	Validation	Public Release	Science & Applications
1	Research Mission with limited period of record	Significant changes likely	Incomplete	Draft Operational Algorithm Description (OAD)	Minimal	Limited data availability to develop familiarity	Little or none
2	Research Mission with limited period of record	Some changes expected	Research grade (extensive)	OAD Version 1+	Uncertainty estimated for select locations/times	Data available but of unknown accuracy; caveats required for use.	Limited or ongoing
3	Research Mission with sufficient period of record	Minimal changes expected	Research grade (extensive); Meets international standards	Peer-reviewed OAD and product descriptions	Uncertainty estimated over widely distribute times/location by multiple investigators; Differences understood.	Data available but of unknown accuracy; caveats required for use.	Provisionally used in applications and assessments demonstrating positive value.
4	Operational Mission with sufficient period of record	Minimal changes expected	Stable, Allows provenance tracking and reproducibility; Meets international standards	Public Operational Algorithm Description (OAD); Peer-reviewed product descriptions	Uncertainty estimated over widely distribute times/location by multiple investigators; Differences understood.	Data archived and available but of unknown accuracy; caveats required for use.	Operationally used in applications and assessments demonstrating positive value.
5	All relevant research and operational missions; unified and coherent record demonstrated across different sensors	Stable and reproducible	Stable, Allows provenance tracking and reproducibility; Meets international standards	Public OAD and Validation Plan; Peer-reviewed product and validation articles	Consistent uncertainties estimated over most environmental conditions by multiple investigators	Multi-mission record is archived and publicly available with associated uncertainty estimate	Used in published applications and assessments by different investigators
6	All relevant research and operational missions; unified and coherent record over complete series; record is considered scientifically irrefutable following extensive scrutiny	Stable and reproducible; homogeneous and published error budget	Stable, Allows provenance tracking and reproducibility; Meets international standards	Product, algorithm, validation, processing and metadata described in peer-reviewed literature	Observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation	Multi-mission record is publicly available from Long-Term archive	Used in multiple published applications and assessments by different investigators

								Avg
ERSST	5	4	2	2	4	3	6	**3.7**
HIRS	5	3	3	2	2	2	3	**2.9**
PATMOS-X	5	3	3	1	3	3	5	**3.3**
GridSat	5	3	2	2	3	3	3	**3.0**

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5	All relevant research and operational missions; unified and coherent record demonstrated across different sensors	Stable and reproducible	Stable, Allows provenance tracking and reproducibility; Meets international standards	Public OAD and Validation Plan; Peer-reviewed product and validation articles	Consistent uncertainties estimated over most environmental conditions by multiple investigators	Multi-mission record is archived and publicly available with associated uncertainty estimate	Used in published applications and assessments by different investigators
6	All relevant research and operational missions; unified and coherent record over complete series; record is considered scientifically irrefutable following extensive scrutiny	Stable and reproducible; homogeneous and published error budget	Stable, Allows provenance tracking and reproducibility; Meets international standards	Product, algorithm, validation, processing and metadata described in peer-reviewed literature	Observation strategy designed to reveal systematic errors through independent cross-checks, open inspection, and continuous interrogation	Multi-mission record is publicly available from Long-Term archive	Used in multiple published applications and assessments by different investigators
Comments for Maturity rating **Avg rating = 2.9**	POR 1978 to present multiple HIRS instruments on NOAA series intercalibrated using SNO technique commonly used by many	Internal code documentation in progress code is almost packaged and deployable	NetCDF formated output Draft User's Manual	Draft OAD written Internal wiki page Paper published	Results consistent with	archive submission submitted infrequent updates, but will run monthly once coverted to ops	The data were used in JGR publication by Sohn and Park (2010).

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Take-away Points

1. View CDRP as a service to get to the 6 on the Maturity Matrix. (Precipitation)

2. CDRP should be a forethought in the GPM development.

3. CDRP is available to work with GPM from the start to develop climate observations.