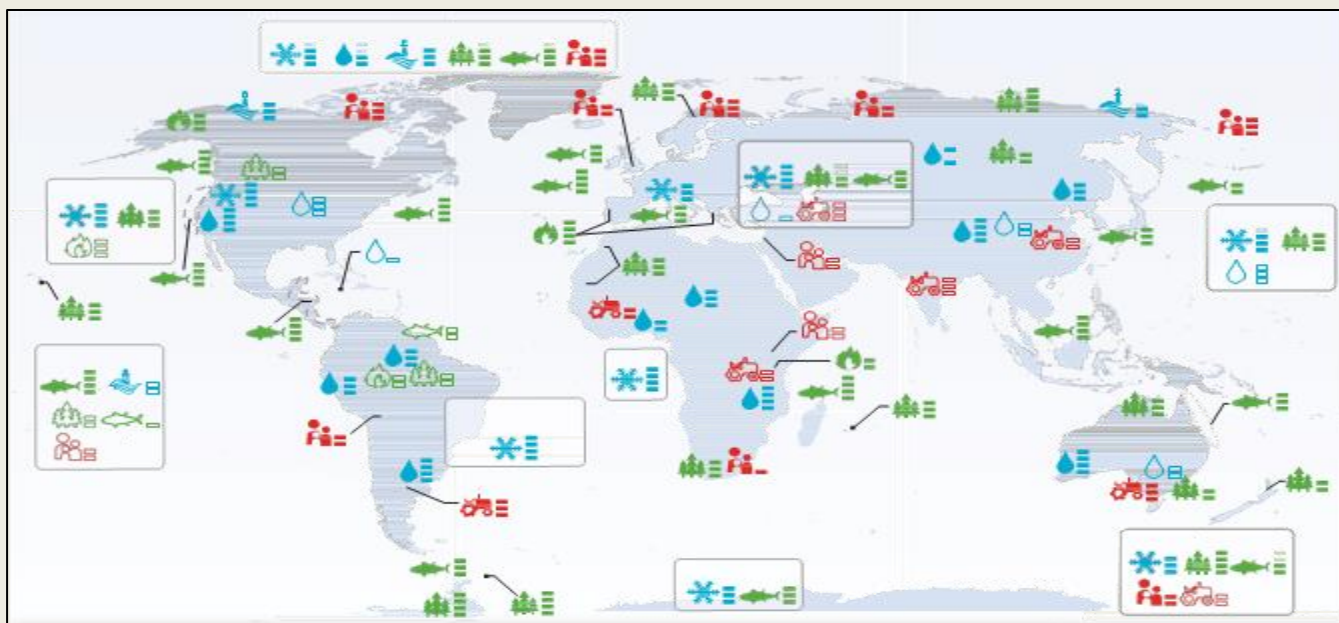


# Assessing Observation Needs in Data Quality, Data Access, and Stewardship for Preparedness and Adaptation

John Bates

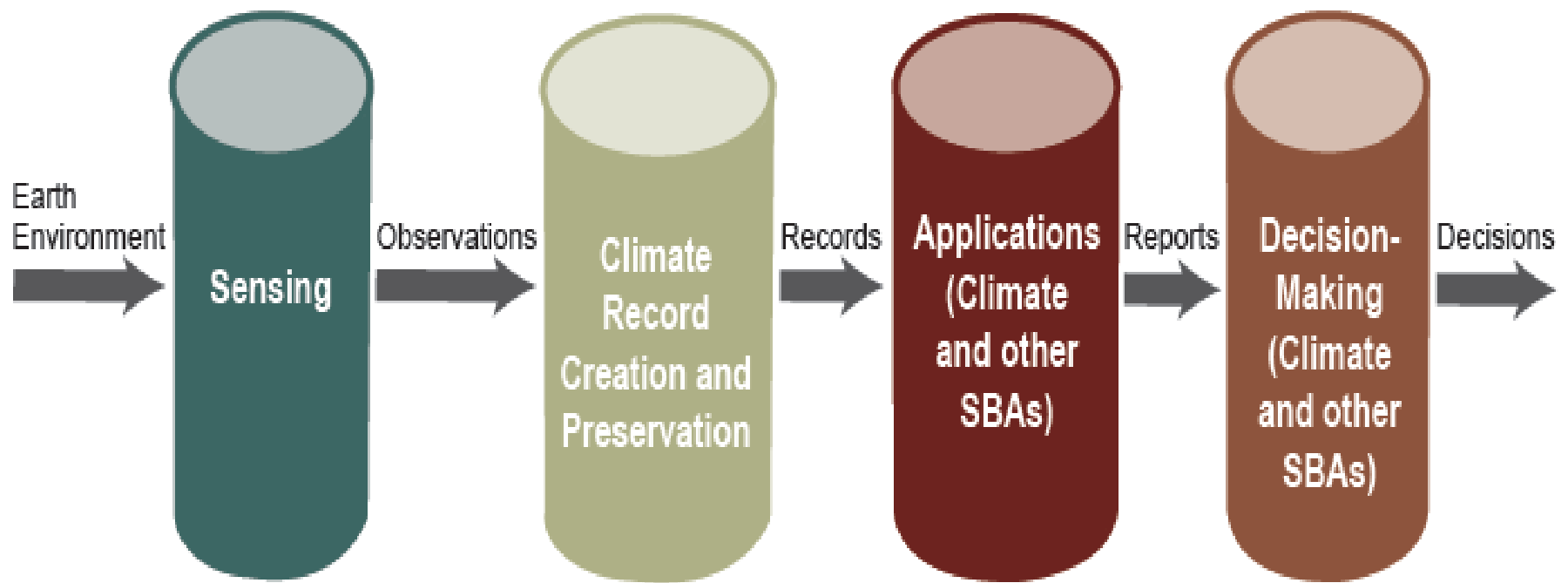
Chair Joint CEOS-CGMS Working Group on Climate



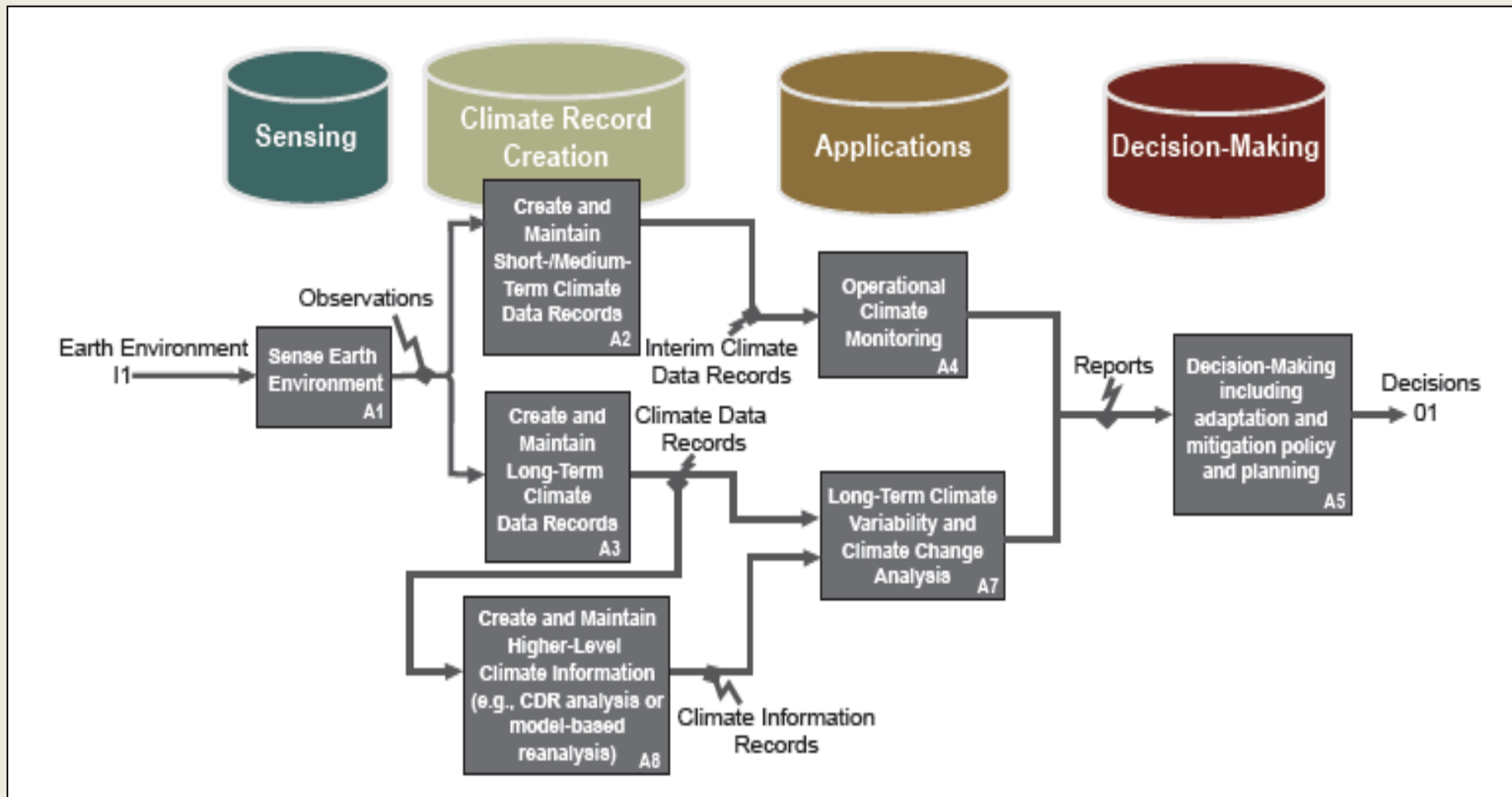
# CEOS-CGMS Working Group on Climate

- The Committee on Earth Observation Satellites (CEOS) created the Working Group on Climate (WGClimate) in 2010 to serve as a focal point for Space Agency climate coordination and was joined by the Coordination Group for Meteorological Satellites (CGMS) in 2013.
- The goals of the WGClimate include:
  - Providing a comprehensive and accessible view as to what Climate Data Records are currently available
  - Making best use of currently available data by delivering additional Climate Data Records (e.g. by identifying and targeting cross-calibration or re-processing gaps/shortfalls)
  - Optimizing the planning of future satellite missions and constellations to expand existing and planned Climate Data Records, in terms of both coverage and record length

# Climate Monitoring Logical Architecture 4 Pillars

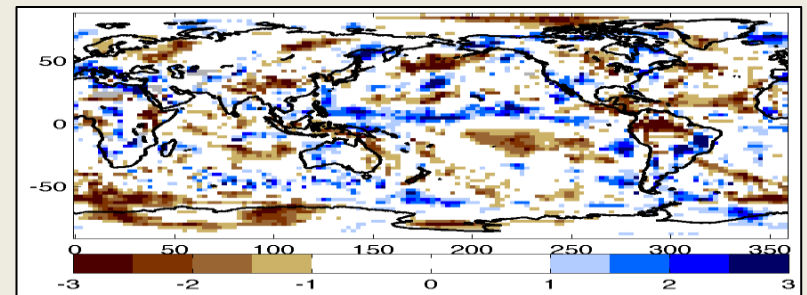
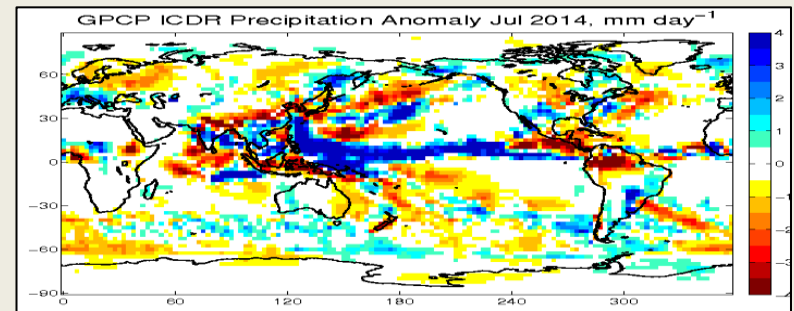
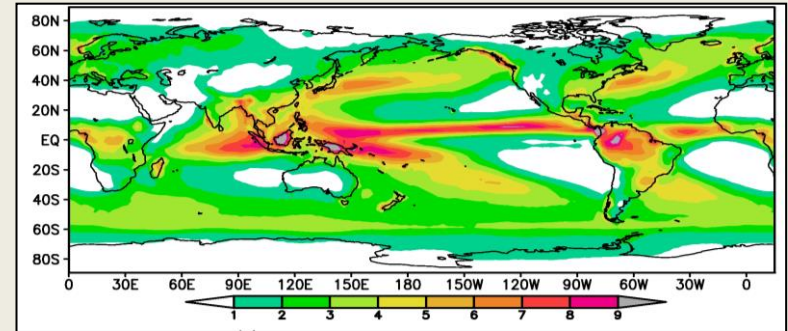


# Climate Monitoring Logical Architecture – Data Flow



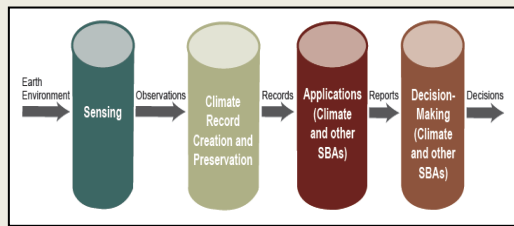
# Climate Record Creation, Applications, and Decision Making Examples

- EVC/CDR Mean - Precipitation 1979-2013
- Interim CDR - Precipitation anomaly for July 2014
- Climate Information Record - Standardized Precipitation Index for July 2014



# Flow of Essential Climate Variable Requirements to Products

	Carbon Cycle	Water Cycle
ECV Precipitation	Priority 2	Priority 1
ECV CO2	Priority 1	Priority 3



**WGClimate**

**USERS**

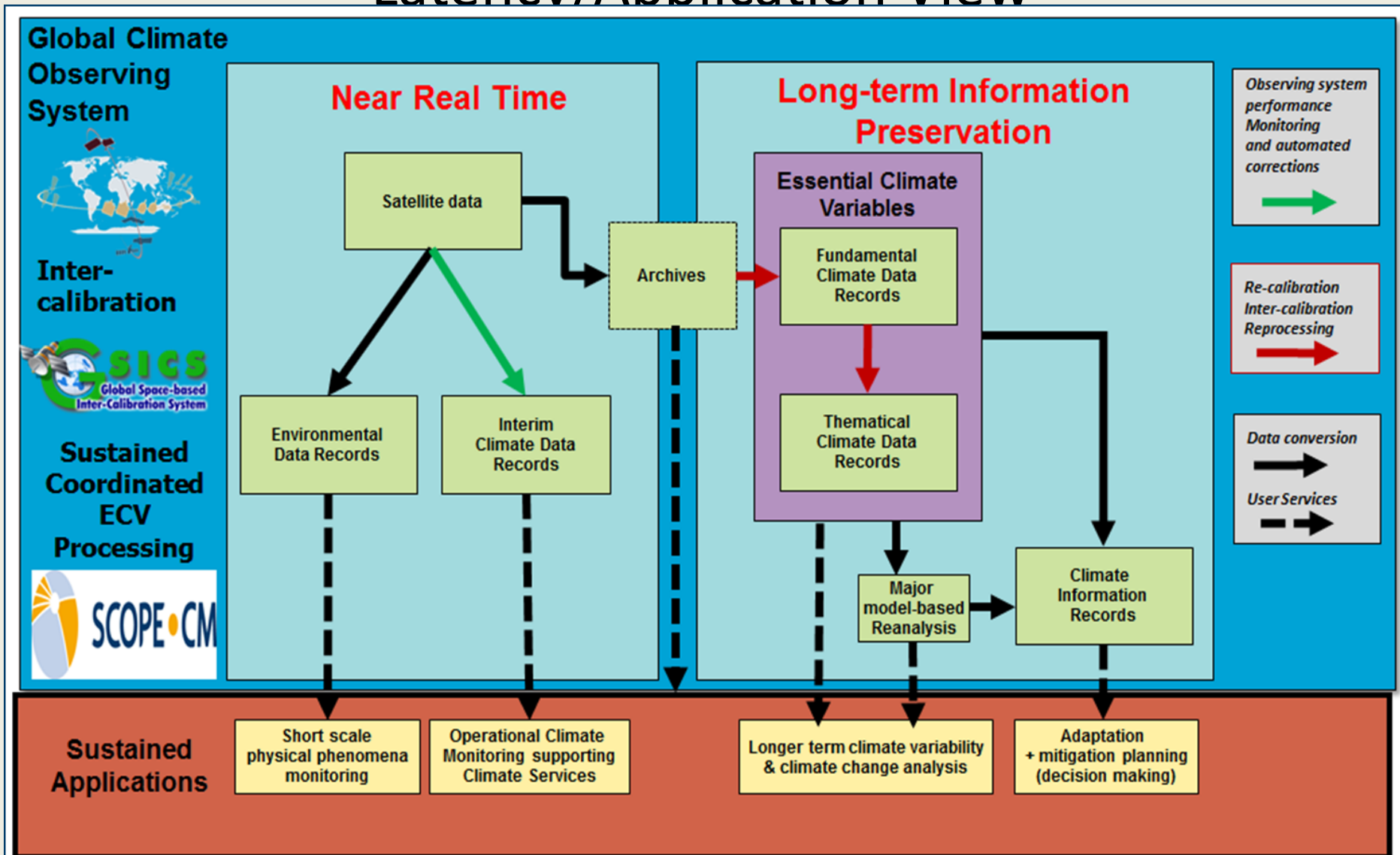
**GCOS**

ECVs/CDRs

UNFCCC  
NEEDS

Consolidated  
Requirements

# Climate Monitoring Architecture – Latency/Application View





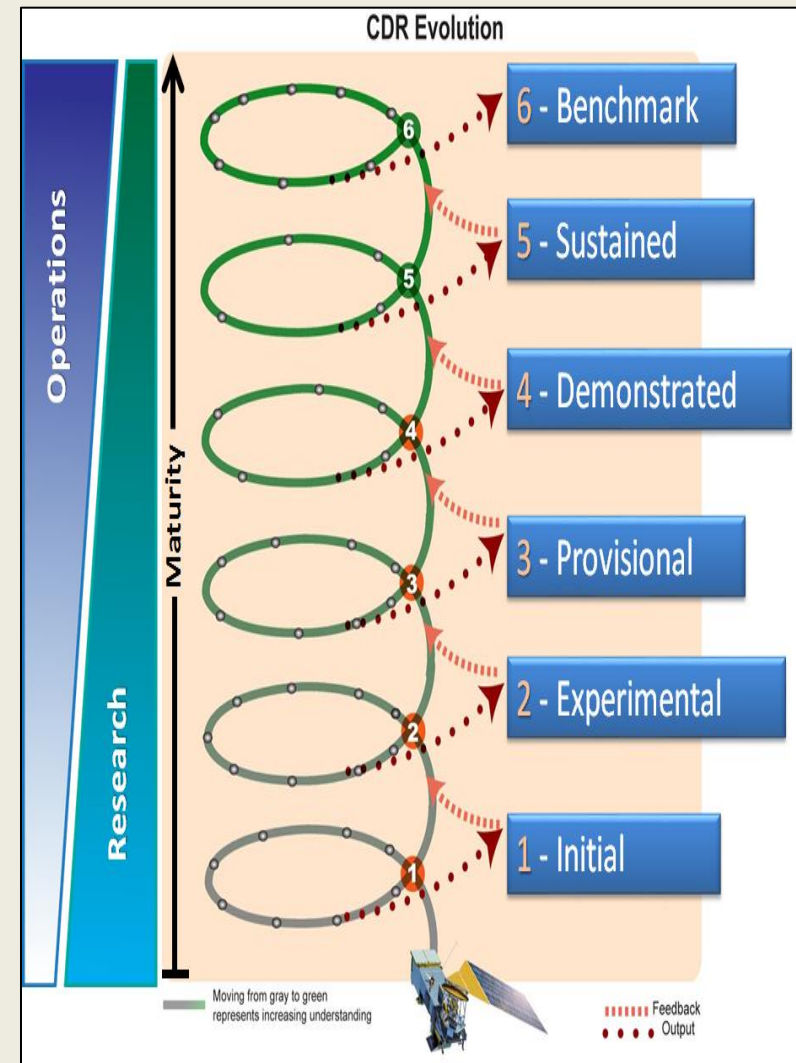
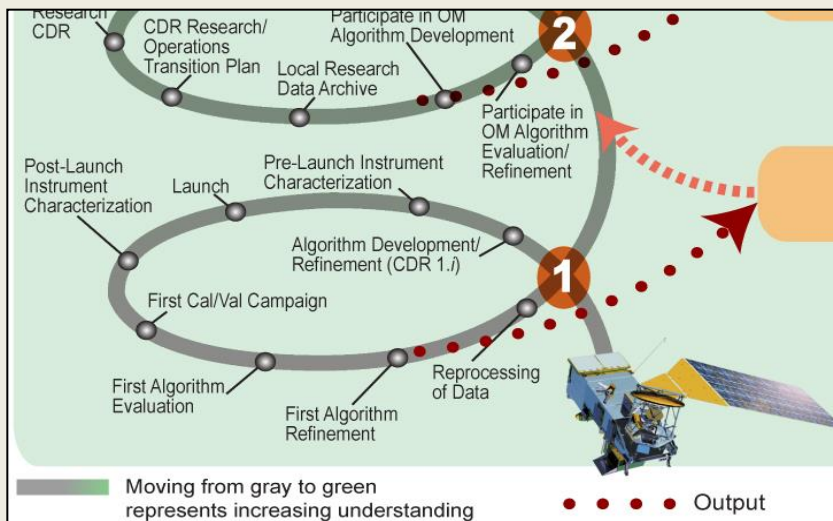
# Consider Requirements for Essential Climate Service Variables (ECSVs)

- ECSVs share some heritage with ECVs, however, we expect ECSVs to
  - Have shorter time and higher space resolutions
  - Have a latency requirement
  - Have a sustained and routine delivery requirement
  - Be connected to a decision-maker for additional tailoring
- Tools being developed for ECV maturity assessment and tiers of stewardship and access can then be identified to form an end-to-end value chain using the climate monitoring architecture



# Best Practices => Maturity

- Climate scientists have established an iterative process for best practices
- The maturity model captures these to facilitate inter use and establish common expectations and nomenclature



The maturity model needs to be applied regularly to assess progress

ESEA SST CCI AVHRR L2P long-term product version 1.0						Issued on 27 of 2023	
CORE CLIMAS User System Maturity Matrix							
Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERIZATION	PUBLIC ACCESS, FEEDBACK, TRUST	USAGE	
1	Conceptual development	None	Limited scientific description of the technology available from IT	None	Relevant evaluation from IT	None	
2	Research goals only	Research goals	Comprehensive scientific description of the technology, open to broad evaluation and limited public user availability from IT	Relevant scientific description is available to broad evaluation from broad evaluation on uncertainty available	Data available from IT, feedback through scientific exchange, regular updates by IT	Research benefits for applications identified, DMS Product/needs identified	
3	Research goals with partially applied research, such as climate trends and forecasts, and AVHRR-CCI for the effects probability, cannot responsibility and its security	Research outline is identified, sufficient to be used in addition to the data and some basic metadata	Users > 3 papers on methodology published, comprehensive evaluation report available from IT and > 3 papers in literature is submitted, comprehensive user guide available from IT, Limited description of quantitative system available from IT	Users > 3 studies in scientific journals, relevant assessment > 3 relevant data coverage, comprehensive evaluation of uncertainty provided, some relevant assessment available	Data available from IT, feedback through scientific exchange, regular updates by IT	Research benefits for applications identified, DMS Product/needs identified	
4	Users > 3 short scientific publications or conference papers, open availability and interest, reproducibility, good data governance and data security	Users > 3 scientific systematically applied, some assessment available for the data and relevant data coverage, broad, limited basic metadata	Users > 3 comprehensive scientific description available from data provider, open to broad evaluation from IT, paper in literature published, user guide available from IT, Comprehensive description of quantitative system available from IT	Users > 3 publications in scientific journals available, data provider's open access, comprehensive CCI (data, methods, metadata), quantitative uncertainty of uncertainty provided via the product documentation or via separate data products, assessed uncertainty provided by product documentation	Data used and documentation available from data provider and from the product's website, data provider available via the product's website, regular updates by IT	Users > 3 Research: Clinics or product usage in research Users > 3 scientific and non-scientific benefits derived	
5	Users > 3 repeated data following standards, access to archive & CCI compliance on demand, external evaluation on demand, complete user manual complete, but partly available (on the opportunity)	Users > 3 fully compliant with standards, complete user manual, complete basic metadata	Users > 3 comprehensive scientific description submitted by data provider, open to the assessment community, comprehensive evaluation of uncertainty in product and evaluation, description in general implementation is available from data provider	Users > 3 > 3 accessibility published, data provider participated in one or more national data assessment, comprehensive evaluation of the quantitative uncertainty, assessed quality measuring high implementation of product benefits	Users > 3 users code achieved by Data Provider, feedback mechanism and external data quality assessment are considered a priority, data record updates by Data Provider	Users > 3 Research: product benefits reference the scientific applications Users > 3 local and economic benefits are derived	
6	Users > 3 fully compliant with standards, complete user manual, complete basic metadata	Users > 3 regularly updated	Users > 3 > 3 journal papers or product updates that cover comprehensive evaluation and evaluation of quantitative uncertainty measures are published, comprehensive system regularly updated	Users > 3 > 3 scientifically established, data provider participated in multiple data assessment and benchmarking activities, data provider participated in scientific and applied research projects, improved and spread more scientific information, Automated assessment is given with methods defined in the overall information system data data in documentation	Users > 3 users code available to the public and usability for the contents data previously established (CCRD)	Users > 3 Research: Product used in applications Users > 3 reference in scientific research Users > 3 reference in external policy making (assessment)	

[illegible]

**CEOS**  
Committee on Earth Observation Satellites

# GCOS/IPCC/UNFCCC Enhancing Observations Workshop

# Is the Core-Climax maturity concept generally applicable? Yes (In-situ, Satellite, and Reanalysis CDRs)

## Baseline Surface Radiation Network (BSRN)

Baseline Surface Radiation Network						security level as of 11.10.2014
CORE CLIMAX System Maturity Matrix						
not applicable						
Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
1	Conceptual development	None	Limited scientific description of the methodology available from PI	None	Restricted availability from PI	None
2	Research path code	Research path	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available from PI, paper on methodology is submitted for peer review	Limited uncertainty characterisation is identified or defined, limited validation data, limited information on secondary available	Data available from PI, feedback through scientific exchange, simple updates by PI	Research benefits for applications identified DSI: Potential benefits identified
3	Research code with partially applied standards, code contains header and comments, and a README file. The PI affirms portability, material reproducibility and no security problems	Standards defined or identified, sufficient to use and understand the data and extent discovery metadata	Scale 2+ paper on methodology published, comprehensive validation report available from PI and a paper on validation is submitted, comprehensive user guide is available from PI, Limited description of operations concept available from PI	Scale 2+ standard uncertainty applied, validation extended to full product data coverage, comprehensive information on secondary available, methods for assessed uncertainty defined	Data and documentation publicly available from PI, feedback through scientific exchange, simple updates by PI	Research benefits for applications demonstrated DSI: Use warning and benefits emerging
4	Scale 3+ draft software available for external use, but party affirms portability and material reproducibility, proven data provides security errors	Scale 3+ standards systematically applied, meets international standards for the data set, enhanced discovery metadata, limited location level metadata	Scale 3+ comprehensive scientific description available from data provider, report on data assessment available from PI, paper on validation published, user guide available from data provider, comprehensive description of operations concept available from PI	Scale 3+ procedures to establish SI traceability are defined, data coverage and documentation available from data provider and under data provider's version control, Data provider establishes feedback mechanism, regular updates by PI	Data received and disseminated available from data provider and under data provider's version control, Data provider establishes feedback mechanism, regular updates by PI	Scale 3+ Research: Customer on product usage in increasing DSI: Several and occasional benefits demonstrated
5	Scale 4+ operational code following standards, actions to achieve full compliance are defined, software installation user manual complete, full party installs the code operationally	Scale 4+ fully compliant with standards, complete discovery metadata, complete location level metadata	Scale 4+ comprehensive scientific description examined by data provider, report on data assessment results exists, user guide is regularly updated with updates on product and validation, description on practical implementation is available from data provider	Scale 4+ SI traceability partly established, data provider participated in one site-national data assessment; comprehensive validation of the quantitative uncertainty estimates, assessed quality monitoring fully implemented (all production levels)	Scale 4+ source code endorsed by Data Provider, feedback mechanism and international data quality assessment are considered to provide data record updates by Data Provider	Scale 4+ Research: Product becomes reference for certain applications DSI: Several and occasional benefits are demonstrated
6	Scale 5+ fully compliant with standards, Turnkey System	Scale 5+ regularly updated	Scale 5+ journal papers on product updates are published and more comprehensive validation and validation of quantitative uncertainty estimates are published, operations concept regularly updated	Scale 5+ SI traceability established, data provider participated in multiple site-national data assessment and incorporating feedback into the product development cycle, temporal and spatial error covariance quantified, Assessed uncertainty in place with results fed back to other accessible information, e.g. meta data or documentation	Scale 5+ source code available to the public and capability for continuous data processing established (ICDR)	Scale 5+ Research: Product used in applications because references in multiple research field DSI: Software on decision and policy making demonstrated

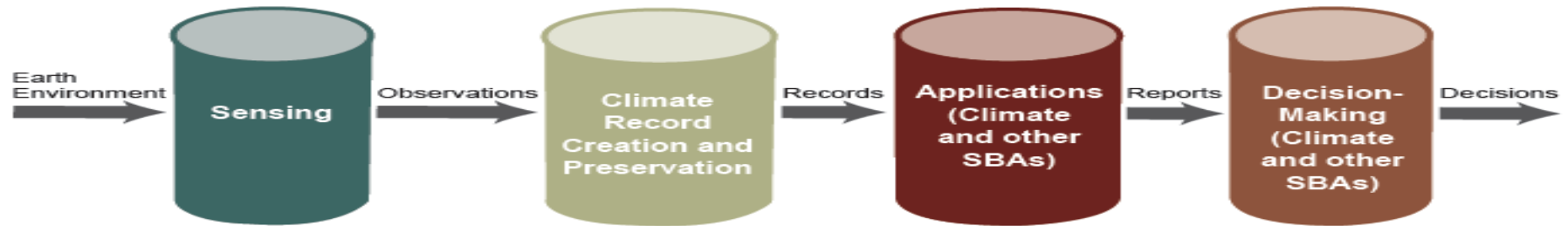
NKDZ Precipitation time series (daily station data)						security level 1 of 10 (2014, 2015, 2016, 2017)
CORE CLIMAX System Maturity Matrix						
Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
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2	Research path code	Research path	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available from PI, paper on methodology is submitted for peer review	Standard uncertainty characterisation is identified or defined, limited validation data, limited information on secondary available	Data available from PI, feedback through scientific exchange, simple updates by PI	Research benefits for applications identified DSI: Potential benefits identified
3	Research code with partially applied standards, code contains header and comments, and a README file. PI affirms portability, material reproducibility and no security problems	Standards defined or identified, sufficient to use and understand the data and extent discovery metadata	Scale 2+ paper on methodology published, comprehensive validation report available from PI and a paper on validation is submitted, comprehensive user guide is available from PI, Limited description of operations concept available from PI	Scale 2+ standard uncertainty applied, validation extended to full product data coverage, comprehensive information on secondary available, methods for assessed uncertainty defined	Data and documentation publicly available from PI, feedback through scientific exchange, simple updates by PI	Research benefits for applications demonstrated DSI: Use warning and benefits emerging
4	Scale 3+ draft software available for external use, but party affirms portability and material reproducibility, proven data provides security errors	Scale 3+ standards systematically applied, meets international standards for the data set, enhanced discovery metadata, limited location level metadata	Scale 3+ comprehensive scientific description available from data provider, report on data assessment available from PI, paper on validation published, user guide available from data provider, comprehensive description of operations concept available from PI	Scale 3+ procedures to establish SI traceability are defined, data coverage and documentation available from data provider and under data provider's version control, Data provider establishes feedback mechanism, regular updates by PI	Data record and documentation available from data provider and under data provider's version control, Data provider establishes feedback mechanism, regular updates by PI	Research: Customer on product usage in increasing DSI: Several and occasional benefits demonstrated
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6	Scale 5+ fully compliant with standards, Turnkey System	Scale 5+ regularly updated	Scale 5+ journal papers on product updates are and more comprehensive validation and validation of quantitative uncertainty estimates are published, operations concept regularly updated	Scale 5+ SI traceability established, data provider participated in multiple site-national data assessment and incorporating feedback into the product development cycle, temporal and spatial error covariance quantified, Assessed uncertainty in place with results fed back to other accessible information, e.g. meta data or documentation	Scale 5+ source code available to the public and capability for continuous data processing established (ICDR)	Research: Product used in applications because references in multiple research field DSI: Software on decision and policy making demonstrated

Providers of Maturity Assessments for In-Situ CDRs initially indicated that the Software Readiness and User Documentation categories are not applicable to their data.

\*Courtesy CORE-CLIMAX J. Schulz

# Proposed Roadmap for ECSV

## Requirements, Maturity Assessment, and Tiers of Service to Decision Support

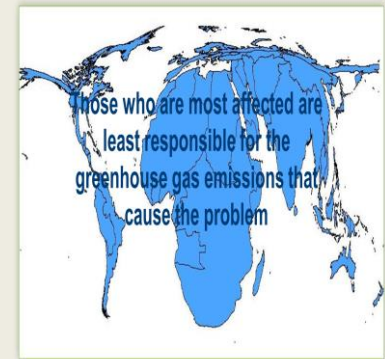
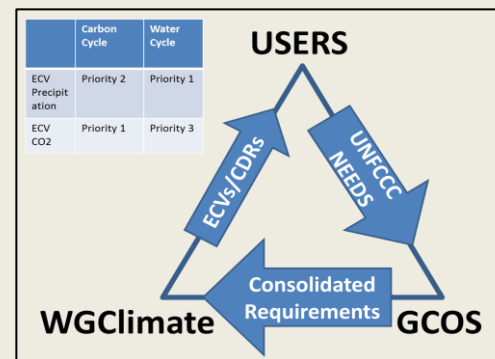


Observing System ECSV Needs Assessed

WGClimate Assesses ECSV Maturity

GCOS Captures ECSV Requirements

Establish Interface with Regional Providers





# Challenge and Question

- Challenge - GCOS has established the concept of Essential Climate Variables (ECVs) to provide a consolidated and vetted set of requirements for agencies making observations. The consolidated set of requirements has been a key in organizing Space Agency observing capabilities. The current set emphasize requirements to detect anthropogenic climate change on large space and long time scales. The move to support Climate Services requires a shift in this approach to identify the requirements to support applications and decision making for a subset of the ECVs, which I am calling Essential Climate Service Variables (ECSVs).
- Question - How can GCOS/IPCC/UNFCCC work with application and decision making experts to rapidly identify climate service requirements, including quality and access/timeliness, for a few ECSVs of highest priority?