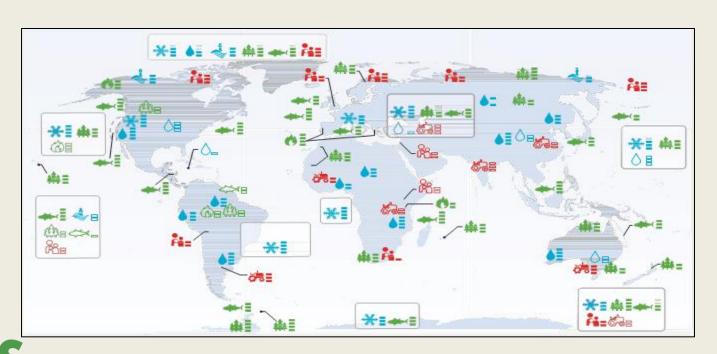
Assessing Observation Needs in Data Quality, Data Access, and Stewardship for Preparedness and Adaptation

John Bates

Chair Joint CEOS-CGMS Working Group on Climate





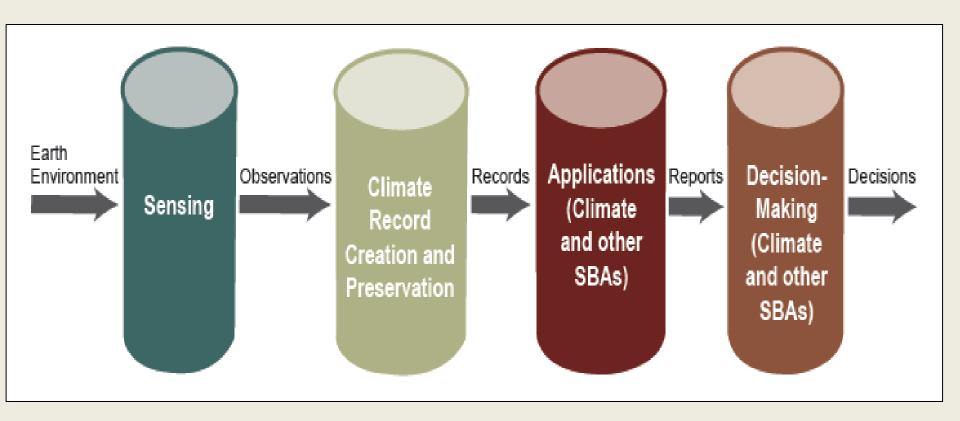
CEOS-CGMS Working Group on Climate

- 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





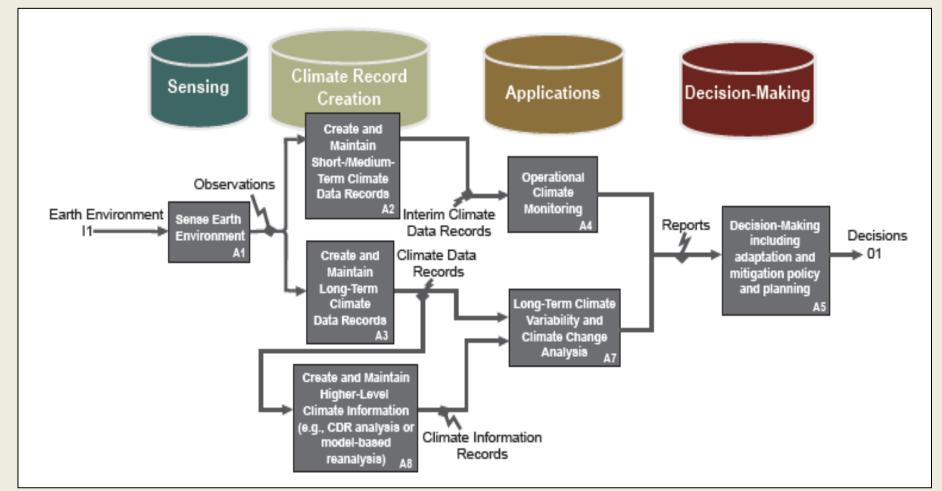
Climate Monitoring Logical Architecture 4 Pillars







Climate Monitoring Logical Architecture – Data Flow

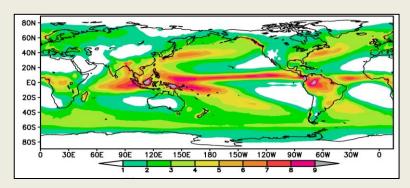


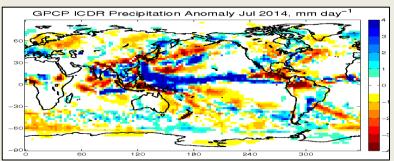


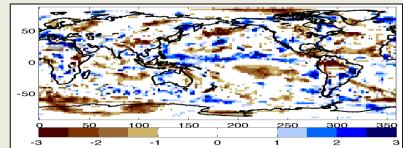


Climate Record Creation, Applications, and Decision Making Examples

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











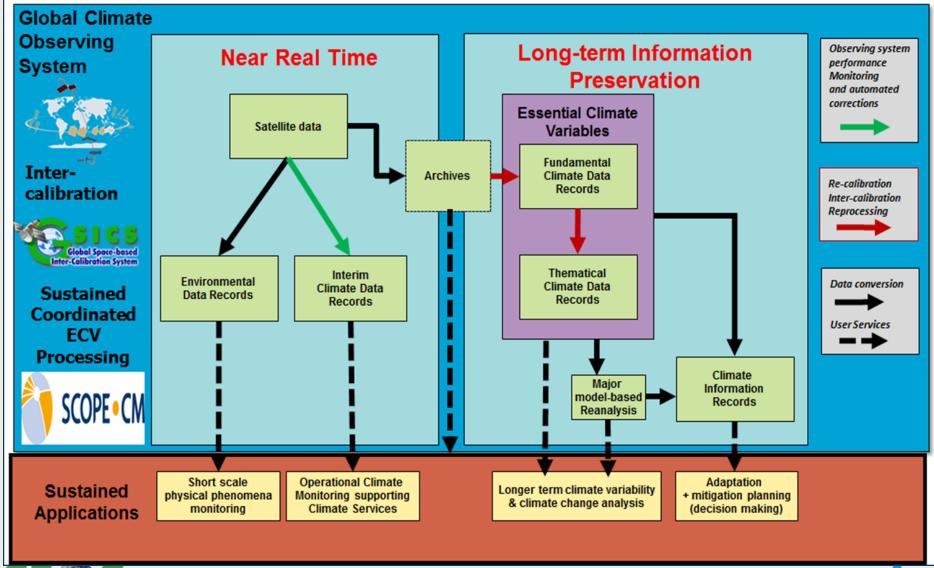
Flow of Essential Climate Variable

Requirements to Products

		Carbon Cycle	Water Cycle	USERS
	ECV Precipit ation	Priority 2	Priority 1	
	ECV CO2	Priority 1	Priority 3	
ent	Observations Climate Record Creation a Preservation	(Climate Making and other Climate and other	Decisions	Consolidated
	W	GClir	mate	Requirements



Climate Monitoring Architecture – Latency/Application View







Consider Requirements for Essential Climate Service Variables (ECSVs)

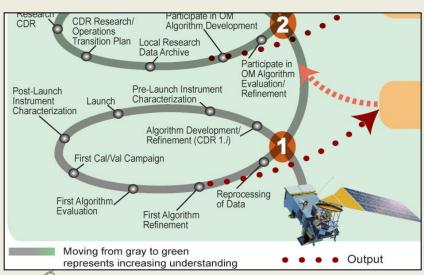
- ECSVs share some heritage with ECVs, however, we expect ECSVs to
 - Have shorter time and higher space resolutions
 - Have a latency requirement
 - Have a sustained and routine delivery requirement
 - Be connected to a decision-maker for additional tailoring
- Tools being developed for ECV maturity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

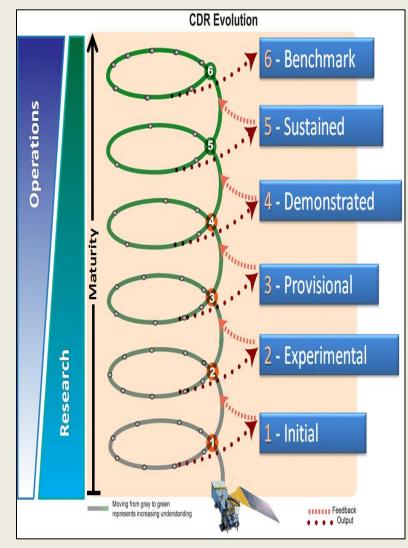




Best Practices => Maturity

- 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









Maturing Takes Time

The maturity model needs to be applied regularly to assess progress

MATURITY	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARATERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE
1						
2						
3						
4						
5						
6						

ESA SST CCI AVHRR L2P long-term product version 1.0 CORE-CLIMAX System Maturity Matrix									
Maturity	SOFTWARE READENESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FILIDRACK, LPDATE	UNAGE			
(:1/)	Conceptual development	See	Lasted wiestfit description of the exchanging available from PE	Non	Resident and dility from TS	Need			
1	Research grade code	Remeth grale	Comprehensive extensity decorption of the methodology, report on hazard validation, and hazard product over pade available time PE, pages on methodology in smatted for piece cerear.	Bandard socretainty connectator is identified in defined. Socied violation desc, basind information in societainty syndide.	Data or stable form PT, the back strongly scientific exchange, amplier updates by PT	Research: Benefits for applications identified DSS Printful benefits identified			
3	Research code with partially applied standards; code contains basder and comments, and a READOLE file. Pit affirms pertailedly, committed reproducebility and no security problems.	Translatis defined or obsertion, sufficient to use and understand the data and estimat decreasey contains	Score 2 - paper on methodology published, comprehenses validation opera establish Scor. PI and a paper on validation in submitted, comprehenses user gade is available from PI, Limited description of operations compre available from PI.	lums 2 + standard assentiators aggled, validation remedied to field product data coverage, congretamore information on scorringry available, starbado for naturated continuing defined.	Due and decomments publishly installed from Pf, foodback through scientifi michangs, ampalie updates by Pf	Research Sensifix for applications demonstrated. DSS: Use occurring and benefits ensemble			
4.	Score 3 - draft software intellation time manual available; led party offices portability and numerical reproducibility, passes data provides socially arriew	Score 3 = standards systematically applied; meets international standards for the data set, enhanced discovery metadars, limited lecotion level metadata	Some 3 + comprehensive scientific decorption smilable from data provider, report on inter companion smilable from PC, paper on validation published, user guide available from that provider, comprehensive description of operations concept available from PC	(arm/comparison against corresponding CDRs (other methods, models, etc); coarritative estimates of sacestatety provided	Data record and documentation available from this pervolve and under data provider's venions central; Data provider establishes feedback rescheenen, regular updates by 21	Score 3 = Research: Crizions on product yange o occurring DSS societal and economical benefits discussed			
5	Score 4 + operational code following standards, actions to achieve full compliance are defend, address entallation (see marcal complete, Jef purty installs the code operationally	Score 4+ fully compliant with standards, complies discovery metadata; complies location level metadata	Score 4 - comprehensive scientific description manufaced by data providin, report on data summaniar module costs, once pades on equity opiosition updates on product and residence, description on practical amplementation is available from data provider.	Score 4 = SC recentility partly established, data previde participated in one star-calineal data assessment, comprehensive visibilities of the quantitative successary estimates, automated quality reconstraing failty implemented (all production levels).	Soom 4 + sours code archived by Dara Provider, Seedinals, mechanism and informational data quality assessment are considered in periodic data record updates by Data Provider	Score 4+ Research: product become reference foresteen populatives DIS: Societal and concentrates therefor an demonstrated			

TCDR FSA-CCLSST (~5 years)

TCDR CM-SAF Clouds (~12 years)

CLARA-A1 Cloud Properties						maturity level as of 19 12 2013			
CORE-CLIMAX System Maturity Matrix									
Maturity	SOFTWARE READENESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE			
1	Conceptual development	Nota	Limited scientific description of the methodology available from PC	None	Restricted availability from Pl	None			
:	Research grade code	Research grade	Comprehensive scientific description of the methodology, open on leaked valutation, and leaked product user pade available from PI, paper on methodology in sunnited for peer cervier.	Standard uncertainty connectature is identified or defined, limited validation dose, limited information on uncertainty available.	Data avalable force Pf, fredback through scientific escharge, impular opdates by PI	Research Benefits for applications identified DSS: Potential benefits identified			
3	Research code with partially applied standards; code contains header and comments, and a READOUT file, PS affirms portholity, exmerical reproducibility and no security positions.	Standards defined or identified, sufficient to use and understand the data and entant discovery metadata	Scre 2 - paper on methodology published, comprehensive validation import available from PT and a paper on validation is substatted, comprehensive user gode is available from PT, larshed description of operations compr available from PT.	Score 2 * standard anomediature applied, validation emedied to full product data creasings, comprehensive information on uncertainty available, methods for automated societising defined.	Data and documentation publically available from Pf, feedback through scientific michange, empiler updates by Pf	Research Benefits for applications demonstrated DSS: Use occuring and benefits exampling			
	Scree 3 - draft software kondinion/user manual available; 3rd party affirms portability and numerical reproducibility; passes data providen security swiner	Score 3 = standards systematically applied; meets international madurals for the data set; enhanced discovery metadate; limited location level metadata	Score 3 + comprehensive scientific description available from data previder, report on latter comparison available from PP, paper on validation published, over guide available from data previder, comprehensive description of operations compet available from PT	Some 3 + procedures to establish St. traceability are defined; (atmicrosspation against corresponding CDEs (other methods, models, mt); quantizative estimates of accetantly provided within the product classification gives or less uncertain data points, automated mentioning partially explorament	Data record and documentarian available from data provider and under data provider's venion control, Data provider establishes findhack reschammer, regular updates by 21	Score 3 + Research: Cristions on product usage in occurring DSS: societal and economical benefits discussed			
5	Score 4 + operational code fedowing standards, actions to achieve full compliance are defined, software invitalistics/user manual complete, 3ed party installs the code operationally	Score 4+ fally compliant with standards; complete discovery metadats, complete location level metadats	Score 4 = comprehensive scientific description maintained by data provider, report on data summent moults exists, user gade is repularly updated with updates on product and validation; description on practical implementation is available from data provider	Score 4 - 52 traceshility partly established, data pervider participated as non size estimate data associatant; comprehensive visidations of the quantizative uncertainty estimates, automated quality monitorials digity implemented (still production liveta).	Store 4 = source code archived by Data Provider, fleeflands mechanism and international dean quality assessment are considered in periodic data recent updates by Data Provider	Score 4+ Rassach: product becomes reference for certain applications DSS: Societal and economic benefits are descounted.			
•	Some 5 + fully complaint with standards, Turnkey System	Score 5 = regularly updated	Score 5 + jeurnal papers on product updates are and more compenheasive validation and validation of quantizative successionly estimates are published; operations concept regularly updated	Some 5 = 51 transhility established, data provider participated in multiple inter-cational data assessment and acceptorating the datas into the product development cycle, respond and apatial error ovariance quantified. Automated occationing in place with results field back to other accessible information, e.g. meta data or documentation.	Stores 5 + source code evaluable to the pubble and capability for centimeous data provisions established (CDE)	Score 5 + Research: Product and its applications becomes references in multiple research field DSS: Influence on decision and policy making demonstrated			

*Courtesy CORE-CLIMAX J. Schulz





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

Baseline Surface Radiation Network (BSRN)

	not applicable		ne Surface Radiation No E-CLIMAX System Maturity M			maturity level as of 00 10/2014	
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 PL	None	Resourced availability from PI	None :	
2	Research grade code	Research grade	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available time PI; paper on methodology is sumitted for poer-arview	Standard socretainty assessfators is absented or defined, lamed validation does, instead information on socretainty available.	Data residute Som Ff. Seeblack through controls exchange, inequire updates by Ff.	Research Besefits for applications sherrified DSS Potential besefits identified	
3	Research code with partially applied standards, code continues beader and comments, and a PEADOAS file, PI affirms portability, numerical reproducibility and no security problems	Standards defined or identified, sufficient to use and understand the data and extend discovery metalities	Score 2 – paper on methodology published; comprehensive validation expect available from P1 and a paper on validation is substituted, comprehensive user guide is available from P1, Limited description of operations compt available from P1	Score 2 * standard nonneschture applied; validation estended to full product data coverage, esteppishessive information on uncertainty available, methods for automated mornicoling defined.	Data and documentation publically available from PL feedback through scientific enchange, trepulse apdates by Pl	Research: Beautits for applications demonstrated. DSS: Use occuring and beautits enemging	
4	Score 3 = draft sedware installation user manual available, 3rd party affenss portability and exmerical reproducibility; passes data providers security project	Score 3 - standards systematically applied; mosts interactional standards for the data set; enhanced discovery metadata, histoid location level metadata	Som 3 + comprehensive scientific description available from data previder, seport or inter comparison available from PL paper or validation published, user guide available from data previder, comprehensive description of operations concept available from PT	Some 3 = procedures to entablish III traceability are defined; (inter/companion against corresponding CDPs (other methods, medie, etc), quantitative estimates of incircularity provided white the product chearchesing more of less uncertains data points, automated monitoring partially implemented.	Data record and documentation available from data provider and indee data provided is variety control. Data provider emblashin frontiack exchanges, regular up-dates by FI	Scene 3 + Research: Cristines on product usage in occurring DSS: societal and essential beautits discussed	
5	Score 4 + operational code following standards, actions to achieve full compilates are defined, software installation user manual complete, 3rd party installs the code operationally	Score 4+ fidly compliant with standards; complete discussy metalata; complete location level metalata	Score 4 - comprehensiva scientific description maintained by data provider, report on data susessment mostle smins, user guide is regularly updated with updates on product and validation; description on practical suplementation is available fires data provider.	Some 4 + SI transibility partly established, data provider participated in one into-national data assessment; comprehensive validation of the quantitative uncertainty estimates, unformated quality inscribing fieldy implemented (sill production levels)	Score 4 + source code archined by Data Provider, feedback mechanism and international data quality assessment are creasidered in periodic data record updates by Data Provider	Soon 4+ Research: product becomes reference for certain applications DSS: Societal and reconnective benefits are described.	
•	Score 5 + Sally compliant with standards, Tunkey System	Store 5 + regularly updated	Scen 5 + journal papers on product updates are and more comprehensive validation and validation of quantitates outstance strength or published, operations concept regularly updated	Score 5 + 33 transmittiny established, data percoder participated in multiple inter-anisonal data assessment and incorporating feedback into the product development cycle interposit and produce quantified, Automated fractionaries in place with resolution of contractions in place with resolution feed back to other accessible information, e.g. meta data or documentation	Score 5 + source code smallable to the public and capability for continuous data previsions established (ICDR)	Score 5 + Research Product and its applications becomes references in multiple research field DSS Influence on documental policy making demonstrated	

NKDZ Precipitation time series

	NKDZ Precipitation time series (daily station data) CORE-CLIMAX System Maturity Matrix								
Maturity	SOFTWARE READINESS	METADATA	USER DOCUMENTATION	UNCERTAINTY CHARACTERISATION	PUBLIC ACCESS, FEEDBACK, UPDATE	USAGE			
1	Coscoptusi der elepasent	None	Limited scientific description of the methodology available from PI	None	Resoured availability from PI	None			
1	Research grade code	Research grade	Comprehensive scientific description of the methodology, report on limited validation, and limited product user guide available from PL; paper on methodology is smalled for pen-review	Standard successary access durine is absentified or defined, limited validation does, irased information on accessority available	Data avalable Som FF, freelinck through near-tile exchange, integrals: up dates by FF	Emeanth Benefits for applications of the control of			
3	Research code with partially applied standards, code contains header and comments, and a README file. PI affirms portability, numerical seproducibility and no security problems	Standards defined or identified, sufficient to use and understand the data and council factoring metadata	Score 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	Since 2 + standard monerclature applied, validation emended to full product data coverage, comprehensive automation on succertainty available, methods for automated monitoring defined.	Data and documentation publically available from PL feedback through scientific enchange, a regular apdates by Pl	Research: Beautits for applic demonstrated. DSS: Use occuring and beautits			
4	Score 3 – draft selfware installation tuer manual available, led party affirms porathility and examerical reproducibility; passes data providers security review	Score 3 + standards systematically applied; meets interminenal standards for the data set; enhanced discovery metadata; limited location level metadata	Score 3 – comprehensive scientific description available from data provider, report on inter comparison available from PI, paper on validation published; toer guide available from data provider, comprehensive description of operations occupy! available from PI	Some 3 – pracedures to establish III transhility are defined; inter/companion agrical corresponding CDPs (other methods, models, etc.; quantitative estimates of discretizing percedur within the product characterising naive or less sceniniss data points, accounted monitoring partially implemented.	Data record and documentation available from data provider and under data provider's version control. Data provider establishes findback nechanism, regular updates by Pl	Scans 3 + Research: Citations on produc occurring DSS: societal and economical discussed			
3	Scen 4 + operational code following standards, actions to actions full completes are defined, obvious installation/user manual complete, 3rd party installs the code operationally	Some 4+ fully compliant with standards; complete discovery netadata; complete location level metadata.	Som 4 + comprehenies scientific description maintained by data provider, import on data assessment results exists, user gathe in explainty updated with updates on product and validation, description on practical implementation is available from data provider	Socre 4 – SI transibility partly established, data provider participated in one intro-unifood data assessment; comprehensive validation of the quantitative assessment entirely uniformative, automated quality mentioning fully implemented (all production levels)	Score 4 + source code archimed by Data Provider, freefluck exchaning and international data quality assessment are creasidered in periodic data record updates by Data Previder	Score 4+ Research: product becomes ref- certain applications DSS: Societal and scoreons be documentated			
	Score 5 + fully compliant with standards, Turnlay System	Score 5 + regularly updated	Score 5 * journal papers on product updates are and more comprehensive validation and validation of quantitative uncertainty estimates are published, operations concept regularly updated	Score 5 + Si traceshiliny established, data provider participated in multiple inter-autimal data susessment and incorporating feedbacks into the product development cycle, temporal and apartial error coverance quantified. Automated monitoring in place with results field back to other accessible information, e.g. must data or documentation.	Score 5 + source code available to the politic and capability for continuous data pre-mines established (ICDR)	Scort 5 + Research Product and its app becomes references in multiple field DSS Influence as decision an multiple descentisted			

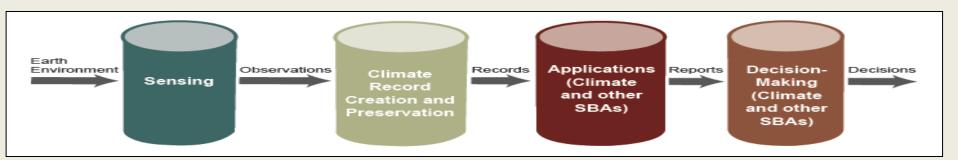
Providers of Maturity Assessments for In-Situ CDRs initially indicated that the Software Readiness and User Documentation categories are not applicable to their data.



*Courtesy CORE-CLIMAX J. Schulz



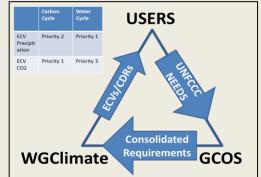
Proposed Roadmap for ECSV Requirements, Maturity Assessment, and Tiers of Service to Decision Support



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?



