WGClimate

The Joint CEOS/CGMS
Working Group on Climate

Status of ECV Inventory and Gap Analysis

Alexandra Nunes[1], Jörg Schulz[2] & EUMETSAT Support Team[1,2]

[1] Hamtec Consulting Ltd. c/o EUMETSAT, [2] EUMETSAT

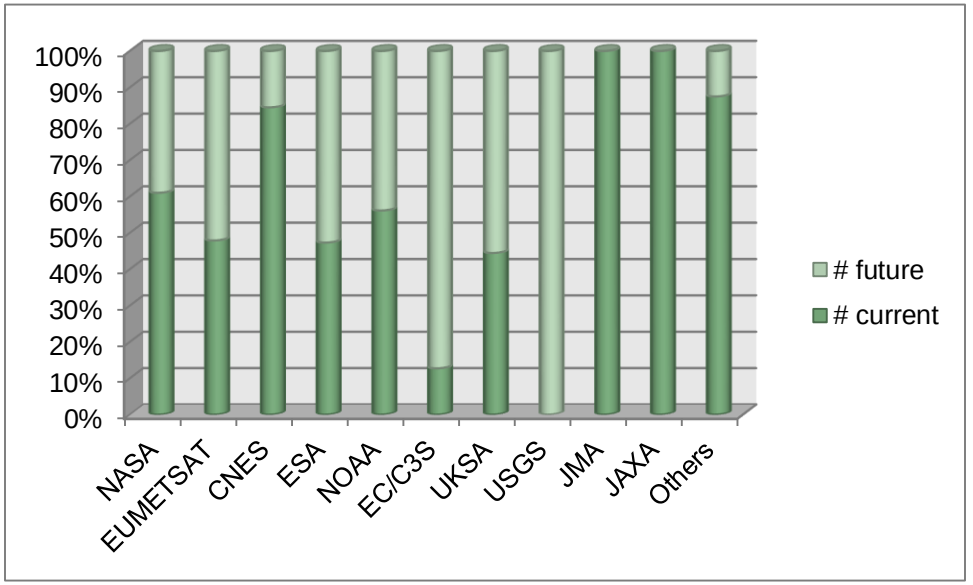
11th Meeting of the Joint CEOS/CGMS Working Group on Climate, 04-06 September 2019, Anchorage (USA)

Evolution: a steep learning curve…

- Cycle #1 (- 2014)
- Cycle #2 (2016-2018)
- 'Cycle' #3 (2018 -)

… with good results!

- 913 records (496 *existing* + 417 *planned*) contributed by ~ one hundred *Responders* from 10 agencies



Domain	Total	Current	Future
All	913	496	417
Atmosphere	658	376	282
Land	135	56	79
Ocean	120	64	56

Evolution: … to be followed by a flatter stretch (03.19)

- Cycle #1 (- 2014)
- Cycle #2 (2016 - 2018)
- *'Cycle #3'* (2018 -)

- Continuous data collection (update*), with cut-off dates for reference versions of the annual ECV Inventory, Gap Analysis, and Coordinated Action Plan
  - Conversion of *planned* into *existing*
  - Update of information for v2.0
  - Deletion of obsolete / redundant content
  - Registration of new content
- Lessons learnt from data collection, verification process, and gap analysis:
  - Minor changes to the questionnaire and terminology
  - Different approach for registration of ICDR-like datasets
  - Relaxation of commitment constraints for *planned* CDRs

Evolution: … and NOT (to be) followed by a flatter stretch

- Cycle #1 (- 2014)
- Cycle #2 (2016 - 2018)
- *'Cycle #3'* (2018 -)

- Update of Verification tools
  - Highlight changed database fields
  - Test all URLs, highlight non-working ones
- Update and adaptation of GA Stage 1 tools:
  - Accommodate new fields
  - Update tools to combine manual and automatic assessments
  - Keep useful assessment from 2017
  - Highlight changed fields needing to be re-assessed
- Adapt and update reporting tools
  - Accommodate changed and unchanged records and ICDRs
  - Map #2 into #3 (e.g. new ECVs / ECV Products / changes in naming)
  - Deal with delays in verification: develop several views (submitted / verified / assessed)
  - New requests…

Status: a pre-final* snapshot in numbers

* pre-completion of verification process

- 1396 entries
  - 420 new
  - 976 inherited (913 published + 63 non finished/verified from Cycle #2)
- 1300 entries "available" [1217 "submitted"]
  - 821 *existing* + 479 *planned*
  - 894 Atmosphere + 234 Land + 147 Ocean (+25)
- ~ two hundred Responders, Co-editors, Observers
  - 64 + 6 new registered Responders
  - New input on e.g. Above-Ground Biomass, Sea-surface Salinity, Lightning (previous "gaps"), Permafrost ("new" ECV)
  - New / Stronger contributors: KMA (new), JAXA and JMA (stronger)
  - New programs: ESA CCI+, C3S-funded Projects – *planned* CDRs
- … and still growing! verification often results in creation of new entries

Status: a pre-final* snapshot in numbers

1396 records	976* inherited (#2)	33 removed			
		943 available	**649 existing** 294 planned	817 existing + 481 planned	1300 records
	420 new (#3)	355 available	**168 existing** 187 planned		
		63 removed			

894 Atmosphere	688 (#2)	**486 existing** 202 planned	592 existing + 302 planned	803 existing + 472 planned	1275 records
	206 (#3)	**106 existing** 100 planned			
234 Land	139 (#2)	**84 existing** 55 planned	119 existing + 115 planned		
	96 (#3)	**35 existing** 60 planned			
147 Ocean	111 (#2)	**75 existing** 37 planned	92 existing + 55 planned		
	35 (#3)	**17 existing** 18 planned			
25 ?					

Status: a provisional (pre-verification) snapshot in numbers

Atmosphere	Aerosol properties	Aerosol optical depth
		Aerosol-extinction coefficient profile
		Single-scattering albedo
		Aerosol-layer height
	Cloud properties	Cloud optical depth
		Cloud-top pressure
		Cloud effective particle radius (liquid and ice)
		Cloud water path (liquid and ice)
		Cloud-top temperature
		Cloud amount
	Water vapour	Total column water vapour
		Upper tropospheric humidity
		Tropospheric and lower-stratospheric profiles of water vapour
	Earth radiation budget	Top-of-atmosphere ERB long-wave
		Top-of-atmosphere ERB short-wave (reflected)
		Solar spectral irradiance
		Total solar irradiance
	Ozone	Total column ozone
		Troposphere ozone profile
		Ozone profile in upper troposphere and lower stratosphere
		Ozone profile in upper stratosphere and mesosphere
	Precursors supporting the Ozone and Aerosol ECVs	CO tropospheric column
		SO2, HCHO tropospheric columns
		CO tropospheric profile
		NO2 tropospheric column
	Carbon Dioxide, Methane and other greenhouse gases	Tropospheric CH4 column
		Tropospheric CO2 column
		Tropospheric CO2 profile
		Tropospheric CH4 profile
		Stratospheric CH4 profile
	Surface wind speed and direction	Surface wind speed and direction
	Wind speed and direction (upper-air)	Upper-air wind retrievals
	Precipitation	Estimates of liquid and solid precipitation
	Surface radiation budget	Surface ERB short-wave
		Surface ERB long-wave
	Temperature (upper-air)	Tropospheric temperature profile
		Temperature of deep atmospheric layers
		Stratospheric temperature profile
	Lightning	Lightning

- Atmosphere

Temperature (upper-air)	Tropospheric temperature profile
	Temperature of deep atmospheric layers
	Stratospheric temperature profile
Lightning	Lightning

Status: a provisional (pre-verification) snapshot in numbers

Ocean	Sea level	Global mean sea level
		Regional sea level
	Sea state	Wave height
	Sea-surface temperature	Sea-surface temperature
	Sea ice	Sea-ice thickness
		Sea-ice extent/edge
		Sea-ice concentration
		Sea-ice drift
	Ocean-surface heat flux	Latent heat flux
		Radiative heat flux
		Sensible heat flux
	Sea-surface salinity	Sea-surface salinity
	Ocean colour	Chlorophyll-a concentration
		Water leaving radiance
	Surface stress	Surface stress
	Surface currents	Surface geostrophic currents

- Ocean

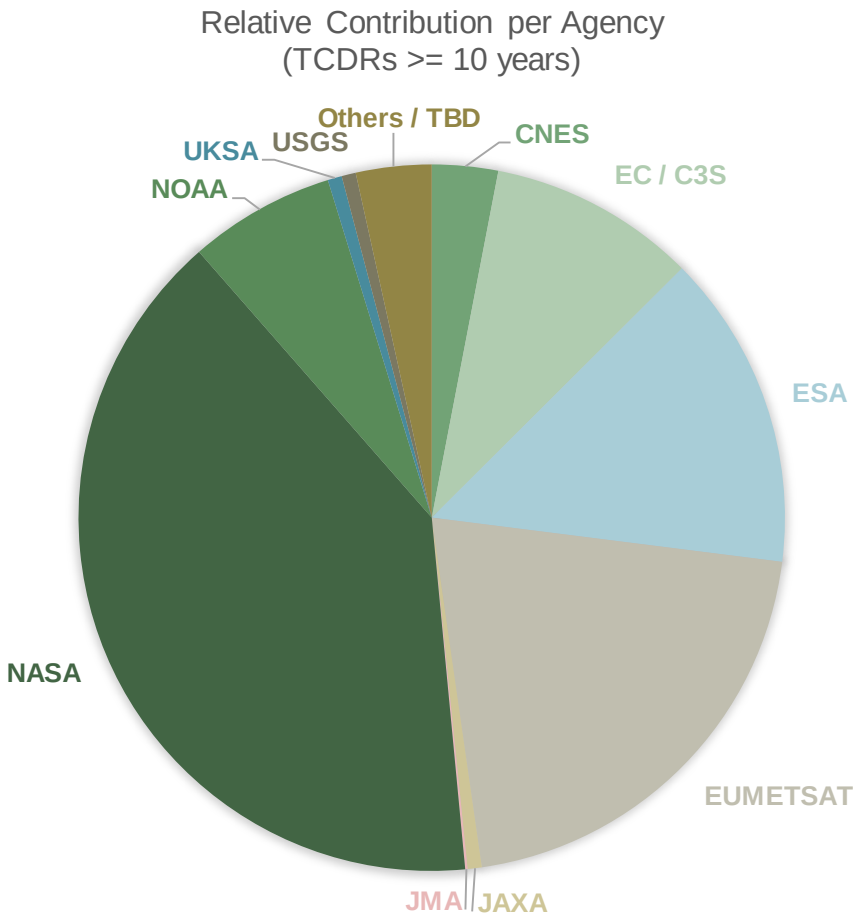
Status: a provisional (pre-verification) snapshot in numbers

Land	Anthropogenic greenhouse-gas fluxes	Estimated fluxes by inversions of observed atmospheric composition - continental
		Estimated fluxes by inversions of observed atmospheric composition - national
		High-resolution CO_2 column concentrations to monitor point sources
	Ice sheets and ice shelves	Ice mass change
		Ice velocity
		Surface elevation change
		Grounding line location and thickness
	FAPAR	Maps of FAPAR for modelling
		Maps of FAPAR for adaptation
		FAPAR (GCOS-154)
	Leaf area index	Maps of LAI for modelling
		Maps of LAI for adaptation
		LAI (GCOS-154)
	Albedo	Black-sky Albedo (GCOS-154)
		Maps of DHR albedo for modelling
		Maps of DHR albedo for adaptation
		White-sky Albedo (GCOS-154)
		Maps of BHR albedo for modelling
		Maps of BHR albedo for adaptation
	Fire	Burnt areas
		Fire radiative power
		Active fire maps
	Soil moisture	Surface soil moisture
		Freeze/thaw
		Root-zone soil moisture
		Surface inundation
		Vegetation optical depth
	Land cover	Maps of land cover
		Maps of high-resolution land cover
	Land-surface temperature	Maps of land-surface temperature
	Glaciers	Glacier elevation change
		Glacier area
		Glacier mass change
	Lakes	Lake colour (Lake water-leaving reflectance)
		Lake-ice cover
		Water extent
		Lake surface-water temperature
		Lake water level
		Lake-ice thickness
	Permafrost	Permafrost temperature
		Depth of active layer
	Snow	Area covered by snow
		Snow water equivalent
	Groundwater	Groundwater volume change
	Above-ground biomass	Maps of AGB

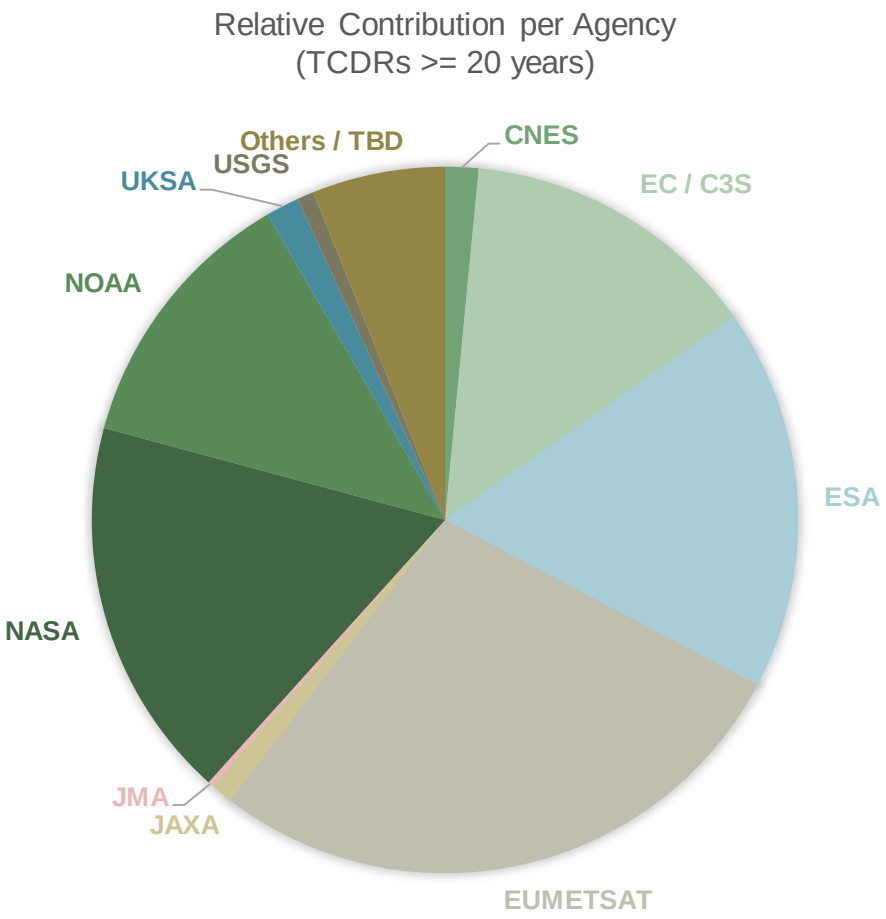
Land

Anthropogenic greenhouse-gas fluxes
Estimated fluxes by inversions of observed atmospheric composition - continental
Estimated fluxes by inversions of observed atmospheric composition - national
FAPAR
FAPAR (GCOS-154)
Leaf area index
Maps of LAI for modelling
Maps of LAI for adaptation
LAI (GCOS-154)
Albedo
Soil moisture
Surface soil moisture
Freeze/thaw
Root-zone soil moisture
Surface inundation
Vegetation optical depth
Glaciers
Glacier elevation change
Glacier area
Glacier mass change
Lakes
Lake colour (Lake water-leaving reflectance)
Lake-ice cover
Water extent
Lake surface-water temperature
Lake water level
Lake-ice thickness

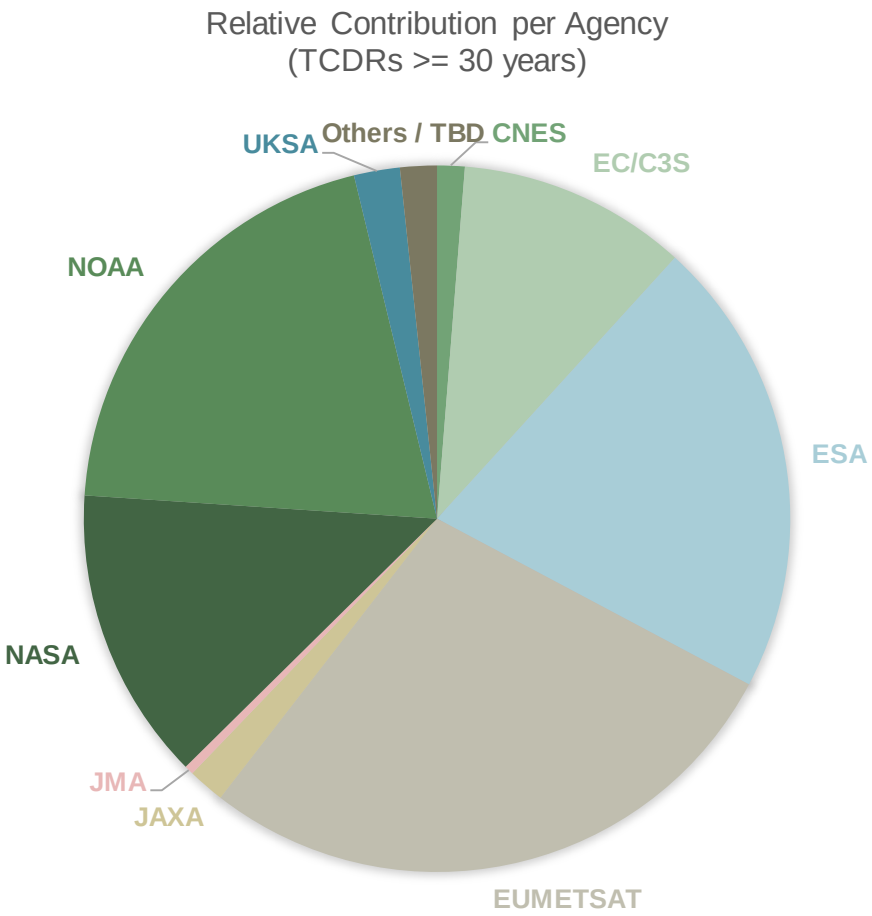
Status: relative contribution per agency (TCDR >= 10 yr)



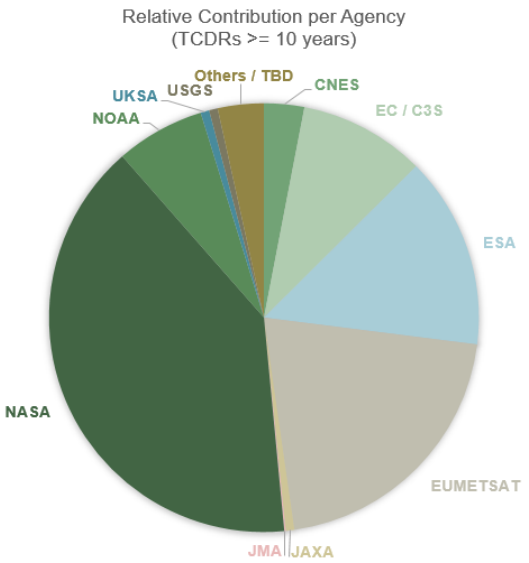
Status: relative contribution per agency (TCDR >= 20 yr)

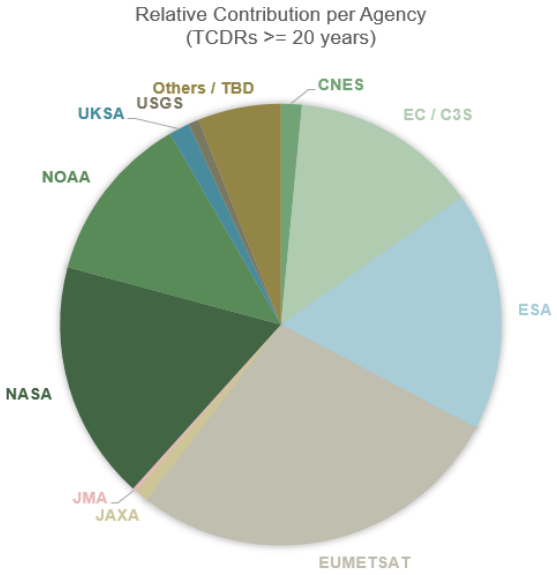


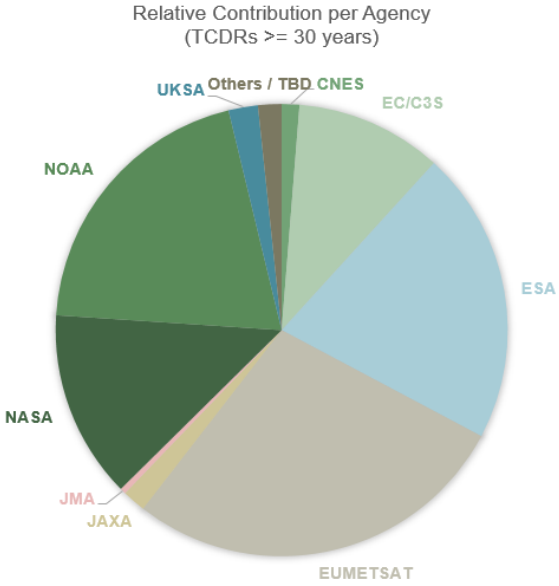
Status: relative contribution per agency (TCDR >= 30 yr)



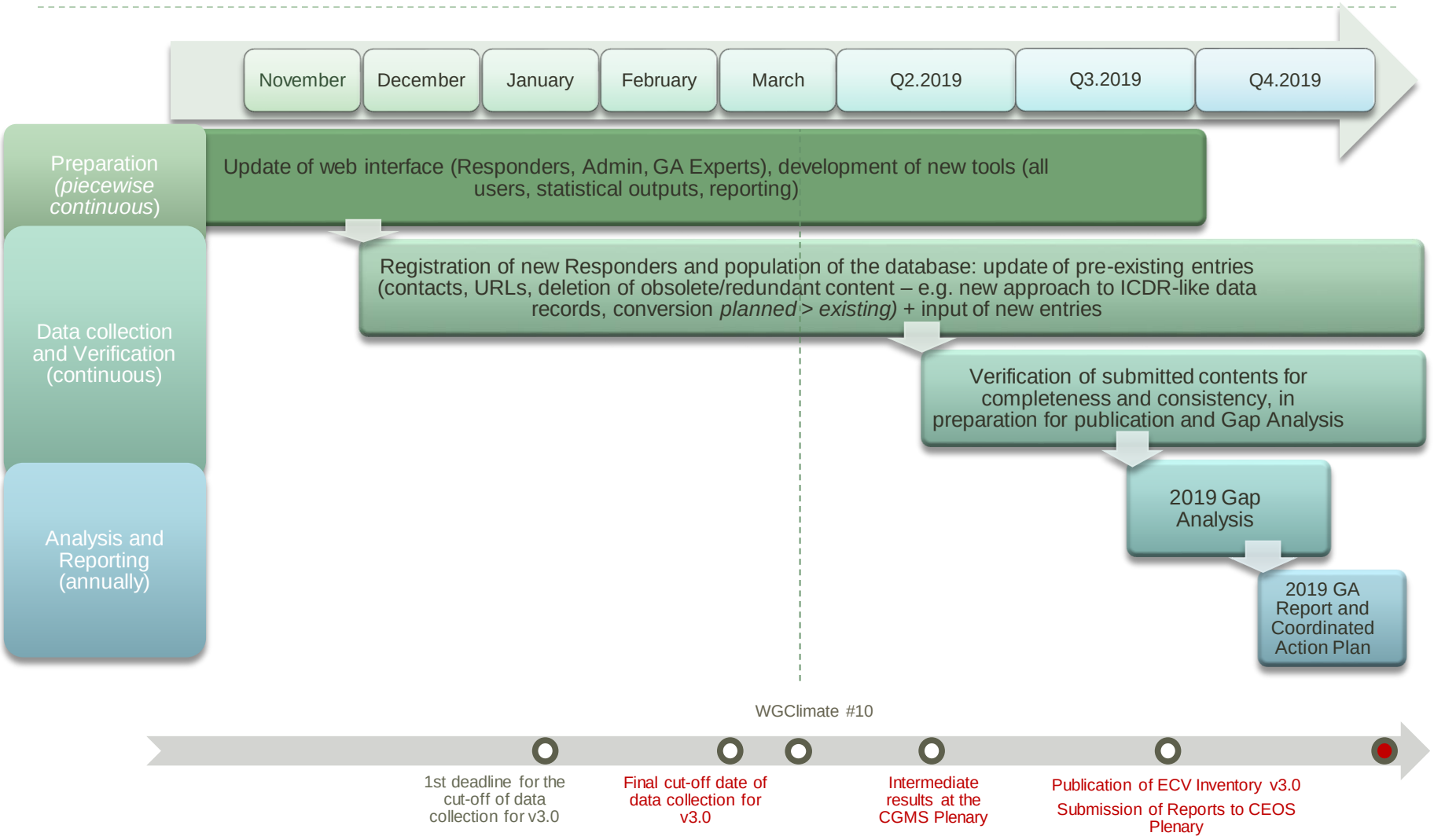
Status: relative contribution per agency (overview)



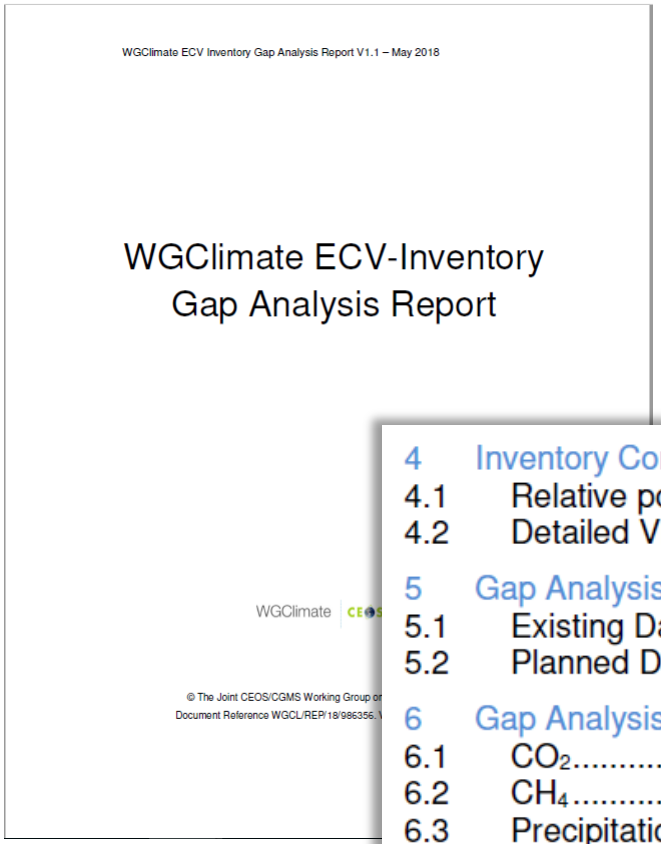




Status: updated timeline for 2019

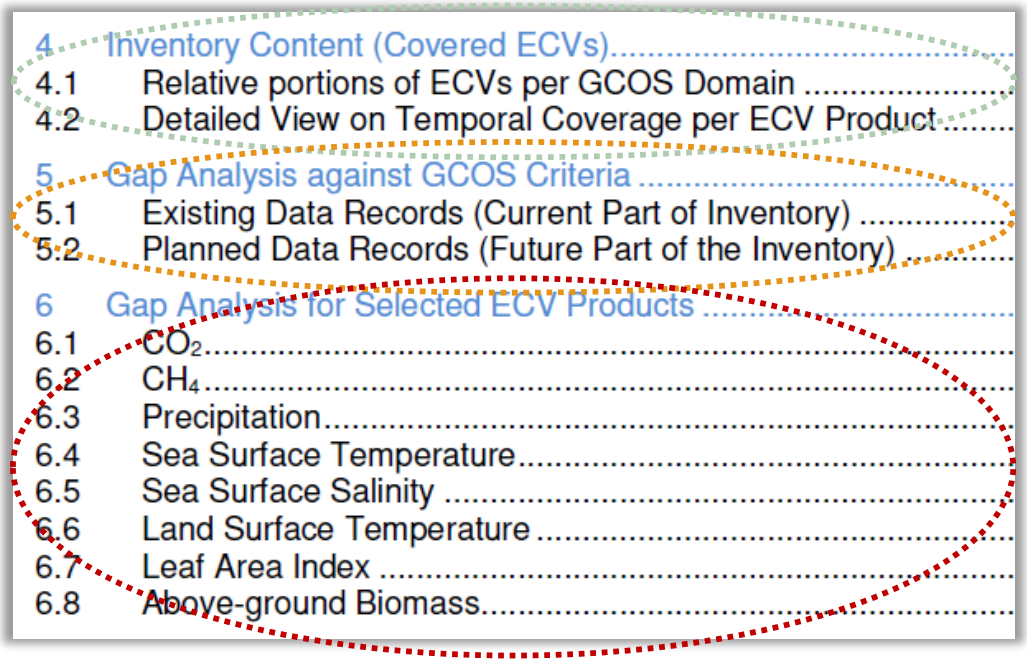


GA Process and timeline: Approach (1)



- Similar to 2018 GA exercise
- New set of ECVs
- Work on the "delta"
- Add comparative analysis

Process and timeline: Approach (2)

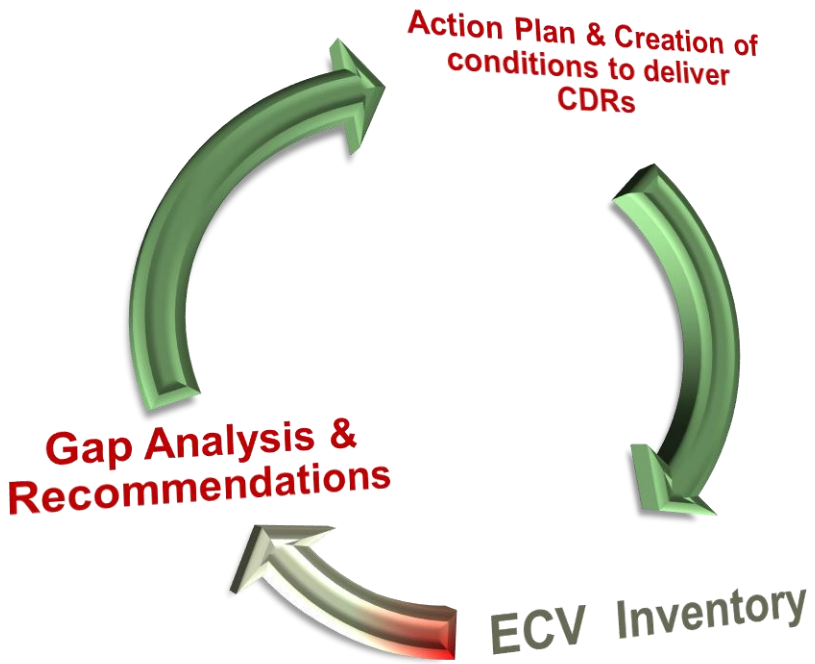


- Automatic assessment
- Statistical analysis tools and graphical display
- Individual CDRs
- Assessment tools on the web interface (GA teams of experts) > "delta"
- Statistical analysis tools and graphical display

- Detailed analysis per ECV / ECV Product
  - Missed known CDRs > GA Teams, VCs
  - Overview of analysis against GCOS criteria > resulting from previous phase
  - Missed opportunities (OSCAR, MIM) > EUMETSAT + GA Teams
  - Missing measurements for future > EUMETSAT + GA Teams

Process and timeline: cycle and constraints

- Upstream constraints
  - Data collection timeline
  - Verification process
  - Update of web interface tools
- Now: agreement on scope, approach and definition of teams
- Downstream constraints
  - Writing and reviewing of GA Report & Coordinated Action Plan
  - CGMS and CEOS Plenaries



Main targets: comparison #2/#3

- Overall analysis contents of the ECV Inventory: population (distribution per domain, existing / planned), absolute gaps, agencies' contributions
- General scenario with respect to assessment against GCOS criteria
- Revisit set of ECVs / ECV Products targeted by the previous gap analysis (CO2, CH4, Precipitation, Land Surface Temperature, Leaf Area Index, Above-Ground Biomass, Sea Surface Temperature, Sea Surface Salinity) and assess evolution, cross-referencing with the Recommendations and Actions

Process and timeline: cycle and constraints

	A	B	J
1	ECV Inventory Gap Analysis		
2			
3			
4	Stage 1 - Assessment against GCOS criteria		
5			
6	Domain / Expert	Organisation	Comments
7			
8	Atmosphere		
9	Wenying Su	NASA (LARC)	Started with ERB
10	Stefan Bojinski	EUMETSAT	Small contribution (WV); back on the 2nd of September
11	Rainer Hollmann	DWD (CM SAF)	Started with Clouds; back on the 12th of August
13	Simon Pinnock	ESA (ECSAT)	Start with Aerosols in early August
14			
15			
16	Ocean		
17	Ewa Kwiatkowska	EUMETSAT	OC only; start TBD > 26th of August
18	Jörg Schulz	EUMETSAT	Start TBD > 13th of August
19	Anne O'Carrol	EUMETSAT	SST only; start on the 12th of August
20	Paolo Cipollini	ESA (ECSAT)	SL, SS, SSS, ??; Start TBD > 12th of August
21			
22	Land		
23	Stephen Plummer	ESA	Start TBD > 13th of August
24	Isabel Trigo	IPMA (Portuguese Met Service)	LAI, FAPAR, LST, LC?; started in early August
25	Simon Pinnock	ESA (ECSAT)	Start TBD > 8th of August (if needed)
26			
27			

GA Stage 1: Atmosphere

ECV	NOT TO BE RE-ASSESSED (144)	TO BE PART/ RE-ASSESSED (523)	TO BE FULLY ASSESSED (186)	TOTAL (853)
Aerosol	24	24	20	68
GHG	16	36	17	69
Clouds	24	163	27	214
Earth Radiation Budget	7	75	7	89
Surf Radiation Budget	5	46	12	63
Ozone	26	19	39	84
Upper-Air Temperature	3	42	28	73
Precursors …	3	20	4	27
Surf Wind Speed / Dir	11	12	4	27
Upper-Air Wind Speed / Dir	1	1	0	2
Water Vapour	19	76	18	113
Precipitation	5	9	10	24

- 853 submitted
- 635 verified
- 433 assessed

GA Stage 1: Ocean

ECV	NOT TO BE RE-ASSESSED (49)	TO BE PART/ RE-ASSESSED (63)	TO BE FULLY ASSESSED (32)	TOTAL (144)
Ocean colour	0	16	1	17
Ocean Surf. Heat Flux	2	5	0	7
Sea Ice	18	10	23	51
Sea Level	14	4	2	20
Sea State	12	0	0	12
Sea Surf Salinity	0	0	2	2
Sea Surf Temperature	2	28	4	34
Sea Surf Stress	1	0	0	1

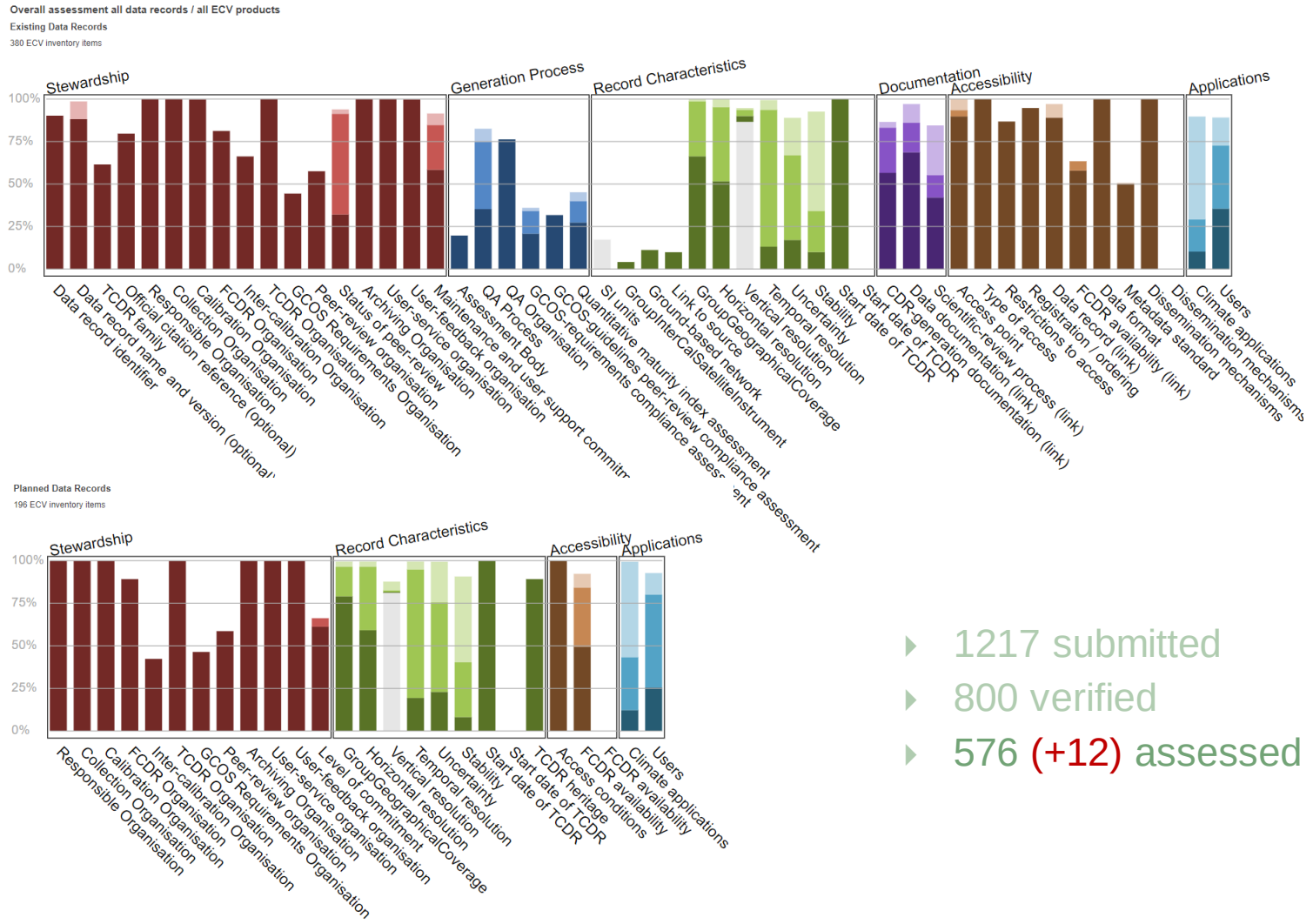
- 144 submitted
- 77 verified
- 67 assessed

GA Stage 1: Land

ECV	NOT TO BE RE-ASSESSED (57)	TO BE PART/ RE-ASSESSED (76)	TO BE FULLY ASSESSED (80)	TOTAL (213)
Above Ground Biomass	0	0	1	1
Albedo	9	15	9	33
FAPAR	0	5	5	10
Fire	2	10	8	20
Glaciers	2	0	0	2
Groundwater	1	1	4	6
Ice Sheets / Shelves	5	3	24	32
Lakes	0	3	4	7
Land Cover	1	3	6	10
LST	9	26	3	38
LAI	0	5	5	10
Permafrost	0	0	2	2
Snow	1	4	6	11
Soil Moisture	27	1	3	31

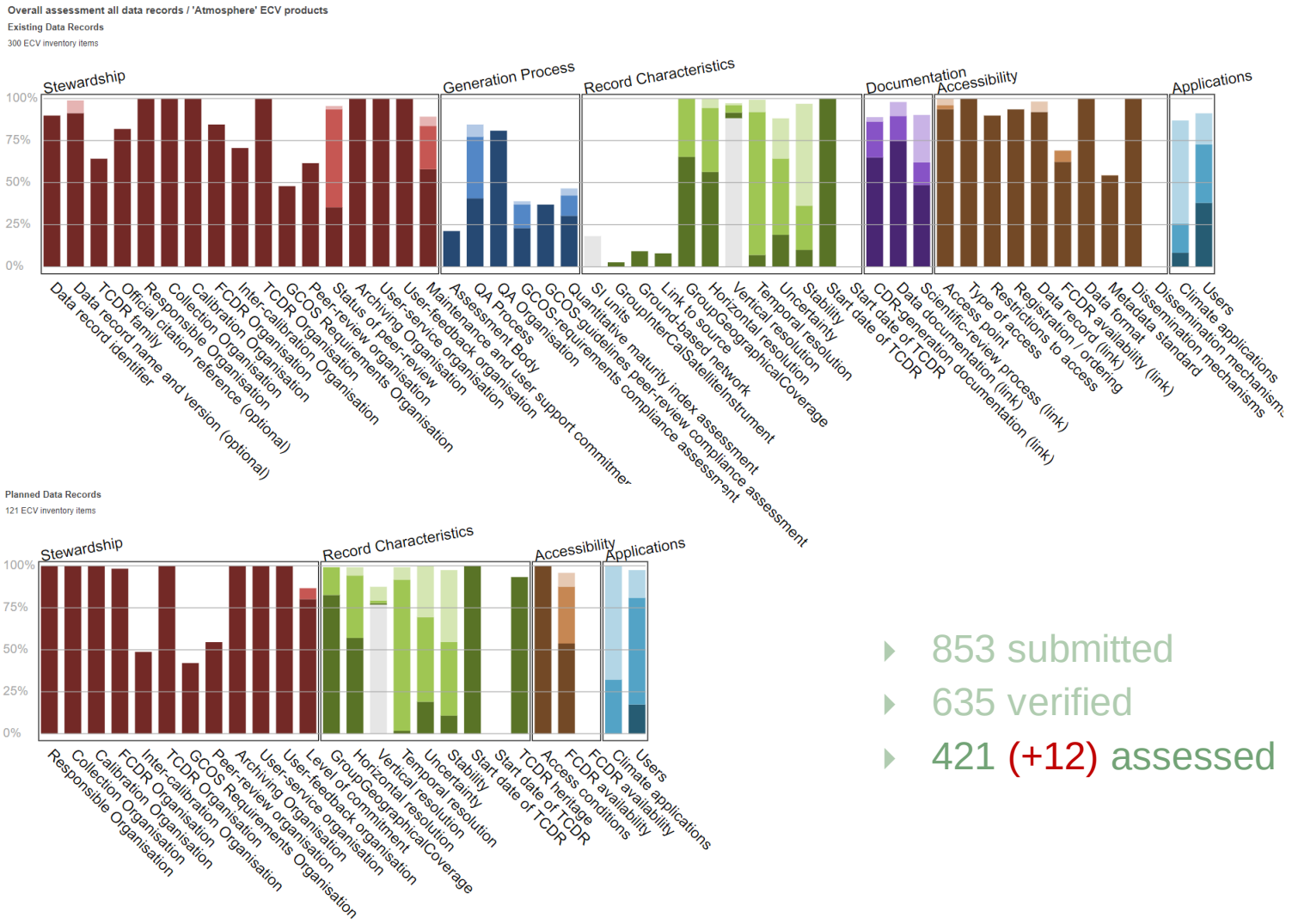
- 213 submitted
- 88 verified
- 88 assessed

GA Stage 1: All domains



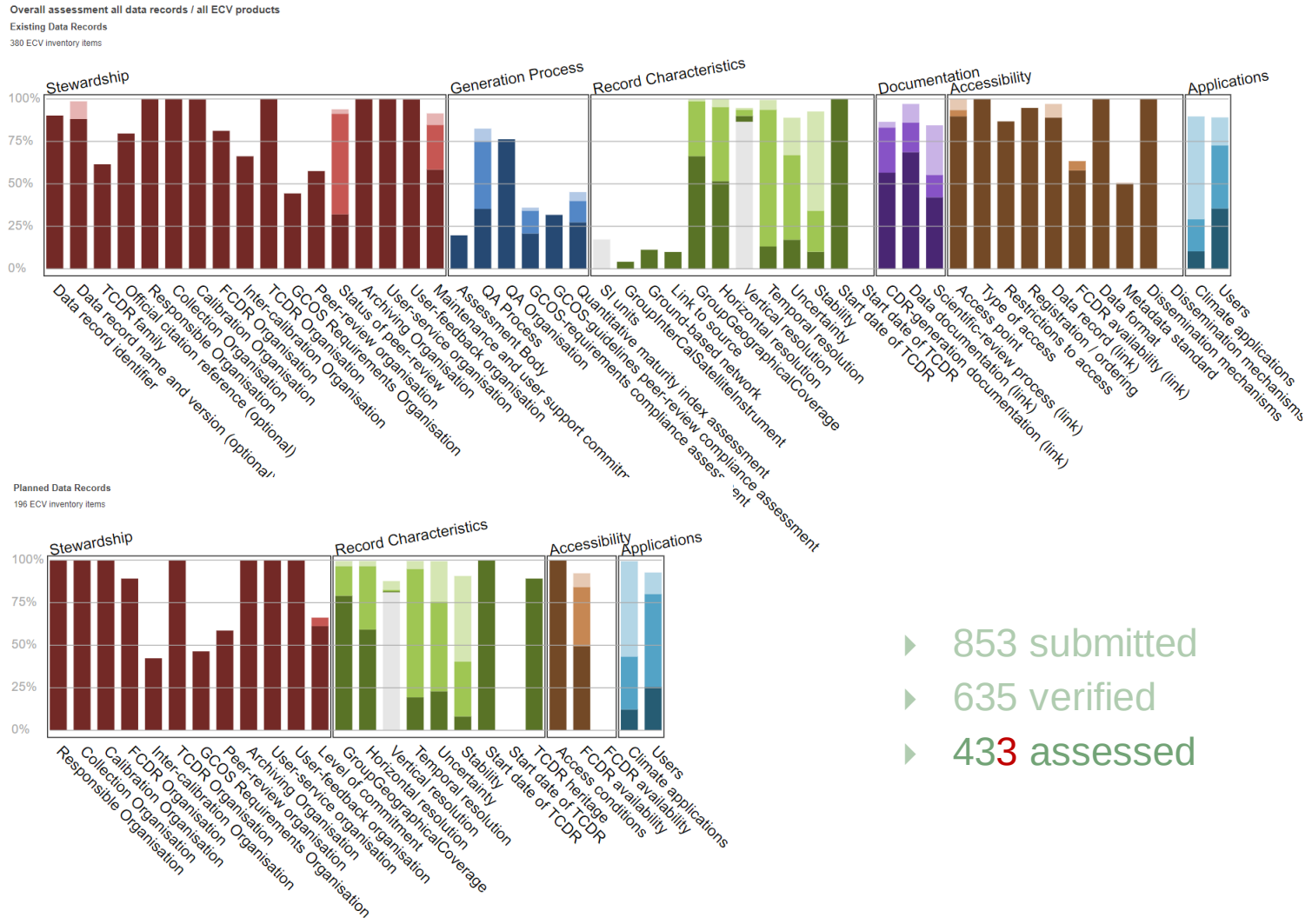
- 1217 submitted
- 800 verified
- 576 (+12) assessed

GA Stage 1: Atmosphere



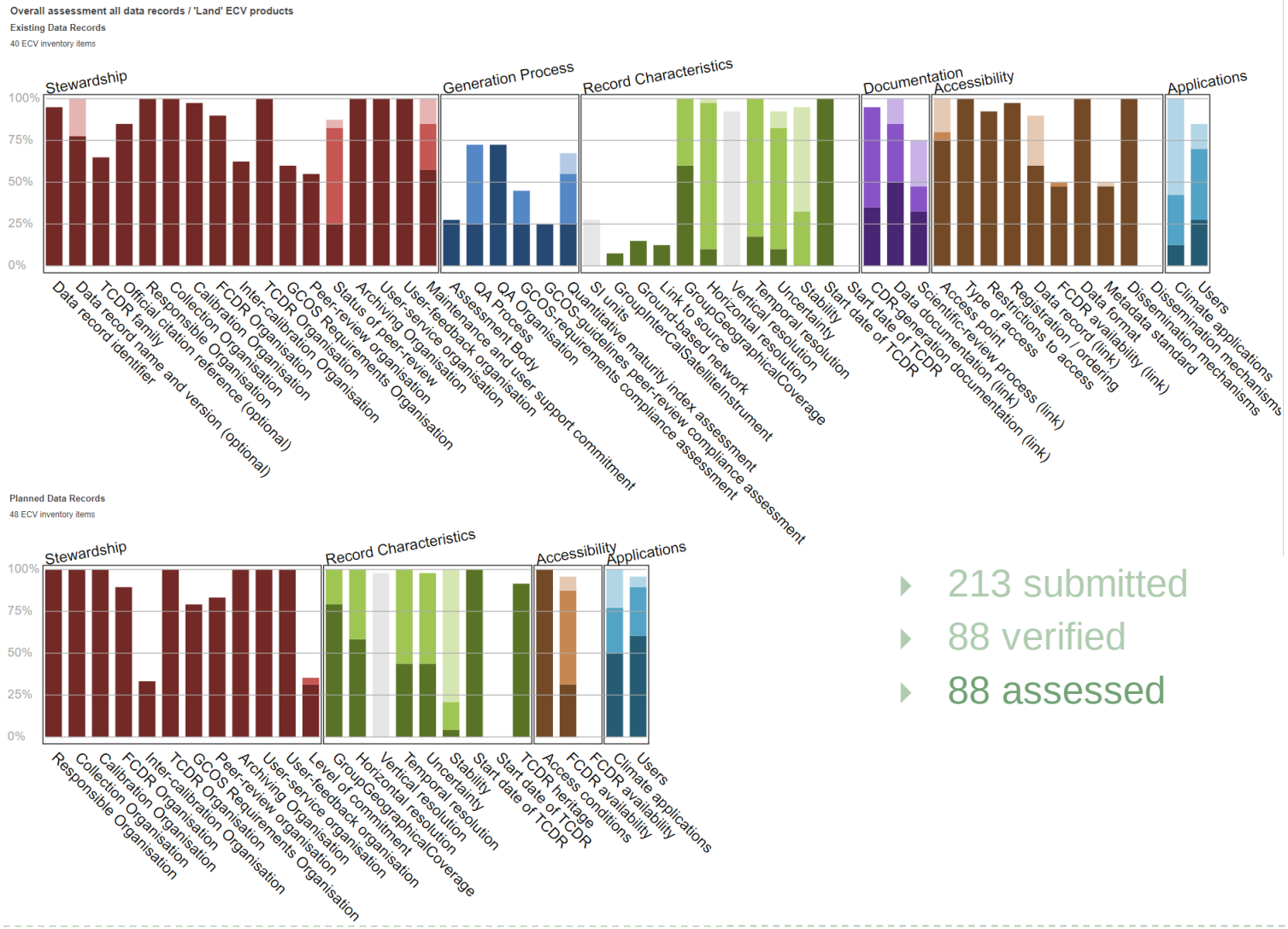
- 853 submitted
- 635 verified
- 421 (+12) assessed

GA Stage 1: Ocean



- 853 submitted
- 635 verified
- 433 assessed

GA Stage 1: Land



- 213 submitted
- 88 verified
- 88 assessed

GA Stage 2: pre-selection from WGClimate #10

- Atmosphere
  - Aerosols > Simon Pinnock, Wenying Su
  - Lightning > Wenying Su
  - Surface Winds > Wenying Su
  - Upper-air winds > Jörg Schulz
  - Water Vapour UT/LS > Jörg Schulz
- Land
  - Fire > Jeff Privette
  - Land Cover > Jeff Privette
  - Soil Moisture > Jeff Privette
  - FAPAR > Jörg Schulz
  - Glaciers > Simon Pinnock
- Ocean
  - Sea Level > Simon Pinnock
  - Sea State > Simon Pinnock
  - Ocean-surface heat flux > Jörg Schulz

GA Stage 2: status for Atmosphere

Stage 2 - Deatiled Gap Analysis

Domain / ECV	Coordination	Experts	Organisation	Status
Atmosphere				
Aerosols	(Simon and Wenying)	Thomas Popp Robert Levy	DLR / ESA-CCI / EC-FIDUCEO NASA	In progress, with feedback Ongoing?
Lightning	(Wenying)	?		Lightning CDRs being now contributed
Surface Winds	(Wenying)	CEOS OSVW-VC? No response…	?	CGMS Action…
Upper-Air Winds	(Joerg)	Marie Doutriaux-Boucher	EUMETSAT	Start TBD > 13th of September
Water Vapour	(Joerg / Simon)	Marc Schroeder Michaela Hegglin	DWD / ESA-CCI Univ. Reading / ESA-CCI	Contribution received Contribution received

GA Stage 2: status for Land

Stage 2 - Deatiled Gap Analysis

Domain / ECV	Coordination	Experts	Organisation	Status
Land				
Fire	(Jeff)	Emilio Chuvieco	Univ. Alcalá / ESA-CCI	Contribution received
		Wilfrid Schroeder	NOAA	In progress, with feedback
		Ivan Csiszar	NOAA	In progress, with feedback
Land Cover	(Jeff)	Xiwu Zhan (Jerry)	NOAA	?
		Kevin P. Gallo	NOAA	In progress, with feedback
Soil Moisture	(Jeff, Simon)	Xiwu Zhan (Jerry)	NOAA	TBD
		ESA CCI Team	EODC, TU Wien	Took off independently, providing input based on ECV Inventory #2; update TBD
FAPAR	(Joerg)	To be dropped for 2019?		
Glaciers	(Simon)	Dropped for 2019		Unavailability (negative feedback) from experts

GA Stage 2: status for Ocean

Stage 2 - Deatiled Gap Analysis

Domain / ECV	Coordination	Experts	Organisation	Status
Ocean				
Sea Level	(Simon)	Jérôme Benveniste	ESA-ESRIN / ESA-CCI	Contribution received
		Anny Cazenave	LEGOS / ESA-CCI	Contribution received
		ESA CCI Sea Level PM	CLS / ESA-CCI	Contribution received
Sea State	(Simon)	Guillaume Dodet	IFREMER / ESA-CCI	In progress, with feedback
		Fabrice Ardhuin	IFREMER / ESA-CCI	Ongoing?
Ocean-Surface Heat Flux	(Joerg)	Joerg Schulz	EUMETSAT	To be started soon

Main targets: ECVs for detailed analysis (2)

Domain	ECV	ECV Product	# records
Atmosphere (78 + 99)	Aerosol properties (73)	Aerosol optical depth	58
		Aerosol-extinction coefficient profile	5
		Single-scattering albedo	3
		Aerosol-layer height	7
	Carbon Dioxide, Methane and other greenhouse gases (75)	Tropospheric CH4 column	20
		Tropospheric CO2 column	31
		Tropospheric CO2 profile	2
		Tropospheric CH4 profile	21
		Stratospheric CH4 profile	1
	Wind speed and direction (upper-air) (5)	Upper-air wind retrievals	5
	Precipitation (24)	Estimates of liquid and solid precipitation	24
	Lightning (0)	Lightning	0

Main targets: ECVs for detailed analysis (3)

Domain	ECV	ECV Product	# records
Land (75 + 61)	FAPAR (10)	Maps of FAPAR for modelling	7
		Maps of FAPAR for adaptation	0
		FAPAR (GCOS-154)	3
	Leaf area index (10)	Maps of LAI for modelling	7
		Maps of LAI for adaptation	0
		LAI (GCOS-154)	3
	Fire (20)	Burnt areas	16
		Fire radiative power	3
		Active fire maps	1
	Soil moisture (31)	Surface soil moisture	30
		Freeze/thaw	1
		Root-zone soil moisture	0
		Surface inundation	0
		Vegetation optical depth	0
	Land-surface temperature (50)	Maps of land-surface temperature	50
	Glaciers (2)	Glacier elevation change	1
		Glacier mass change	0
		Glacier area	1
	Permafrost (2)	Permafrost temperature	1
		Depth of active layer	1
	Above-ground biomass (1)	Maps of AGB	1
	Land cover (10)	Maps of high-resolution land cover	1
		Maps of land cover	9

Main targets: ECVs for detailed analysis (4)

Domain	ECV	ECV Product	# records
Ocean (39 + 38)	Sea level (20)	Global mean sea level	5
		Regional sea level	15
	Sea state (13)	Wave height	13
	Ocean-surface heat flux (6)	Latent heat flux	4
		Radiative heat flux	0
		Sensible heat flux	2
	Sea-surface salinity (4)	Sea-surface salinity	4
	Sea surface temperature (34)	Sea surface temperature	34