

The Strategic Role of Essential Variables in Geodesy

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Motivation: Raising awareness of Geodesy

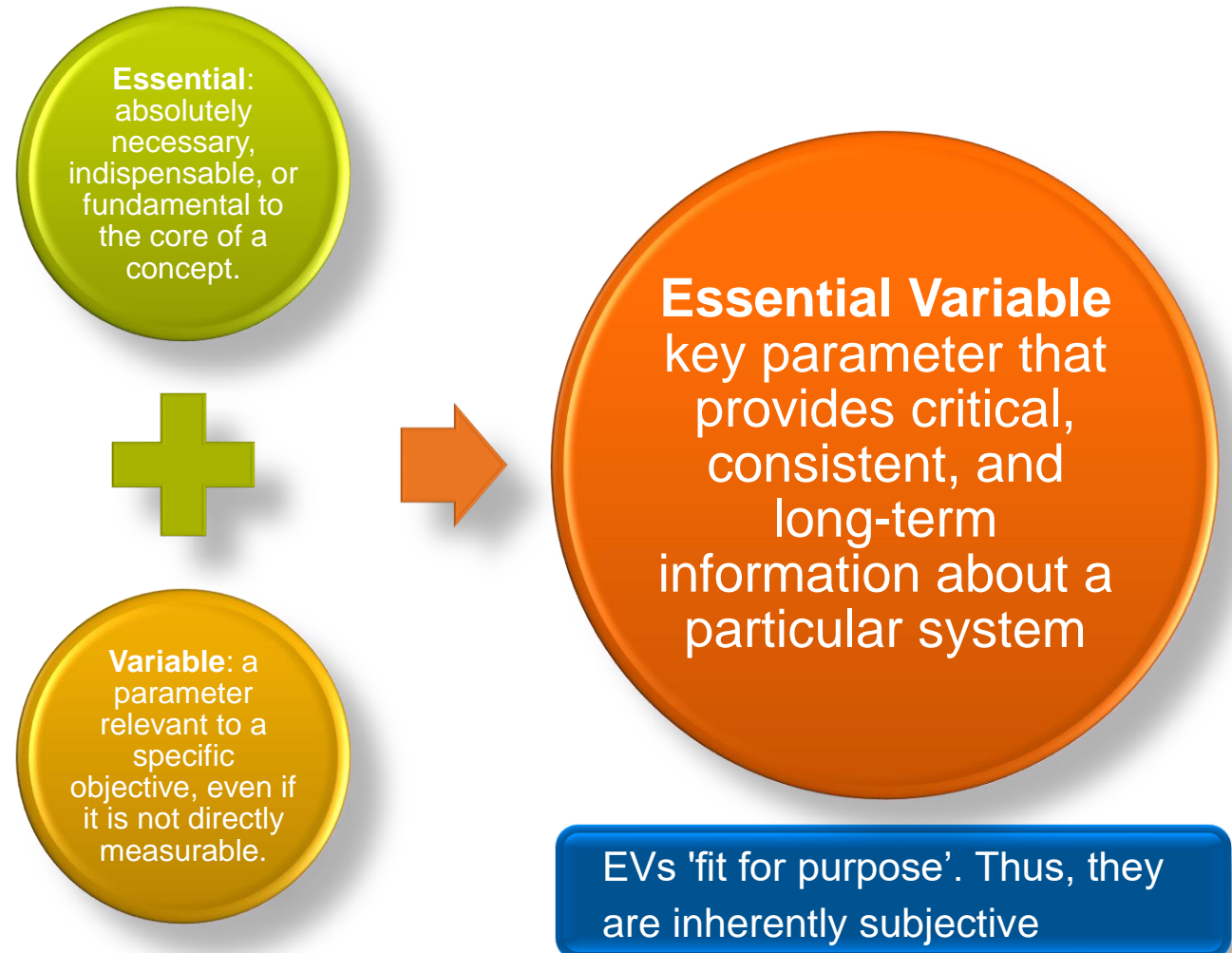


- Uneven global coverage, ageing infrastructure, **insufficient funding**
- Geodetic products on a **best-effort basis** (no guaranteed long-term operations)
- **Declining workforce and limited new talent**
- **Challenging transition from research to operational services**
- **Difficulty in translating technical geodetic information into actionable insights for decision-makers and the public**
- **Low visibility in policy, international initiatives, and other scientific domains**



Essential Variables (EVs): A powerful tool to raise awareness globally and across disciplines

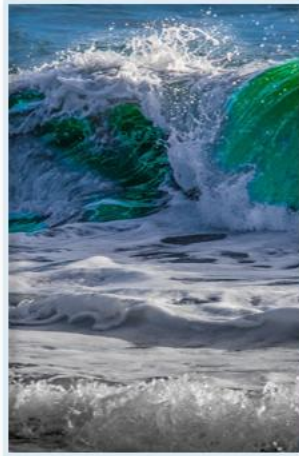
- Encourage scientists and observing systems to place **more emphasis** on these variables.
- Stimulate the **commitment of national and international organisations** and funding agencies to support the provision of these variables.
- Enable **cross-disciplinary data assimilation and interpretation**.
- Facilitate **interoperability** between science and evidence-based policy.



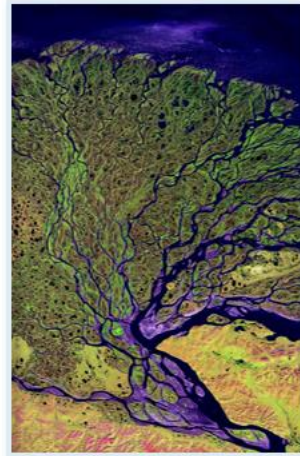
Essential Variables for monitoring Earth and Socio-Economic Systems



ECV–Climate



EOV–Ocean



EWV–Water



EBV–Biodiversity



EGdV–Geodiversity

GEO ESSENTIAL

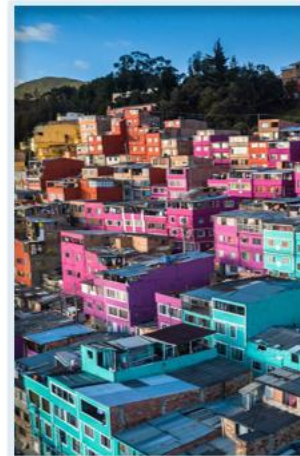
Essential Variables workflows
for resource efficiency and
environmental management



EAV–Agricultural



ETIV–Transport
and Infrastructure



EUV–Urban



EREV–Renewable
Energy



EMV–Mineral



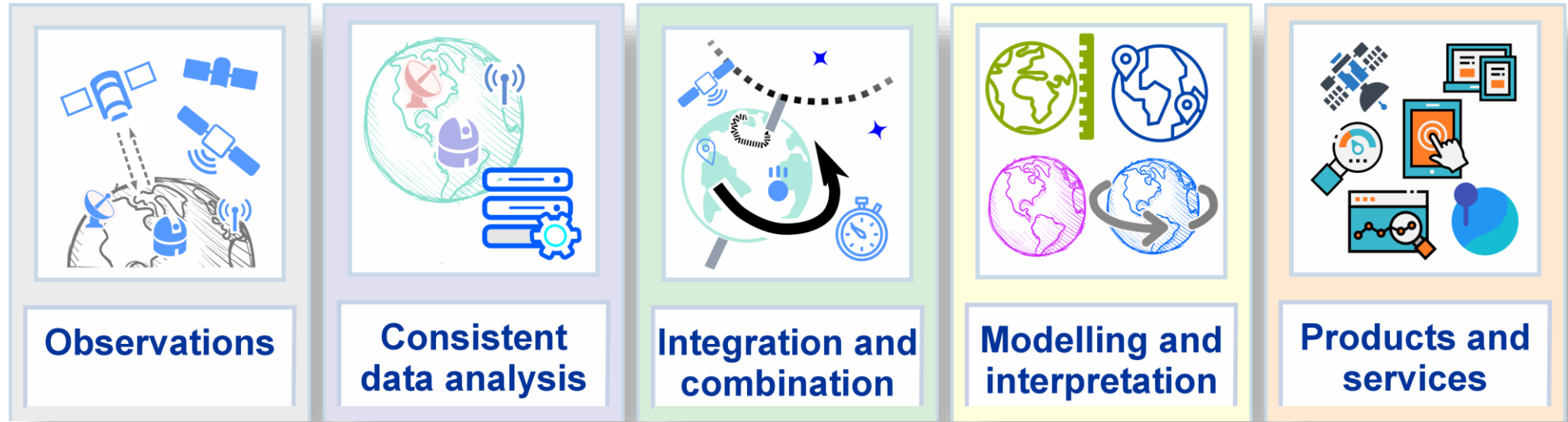
EHV–Health



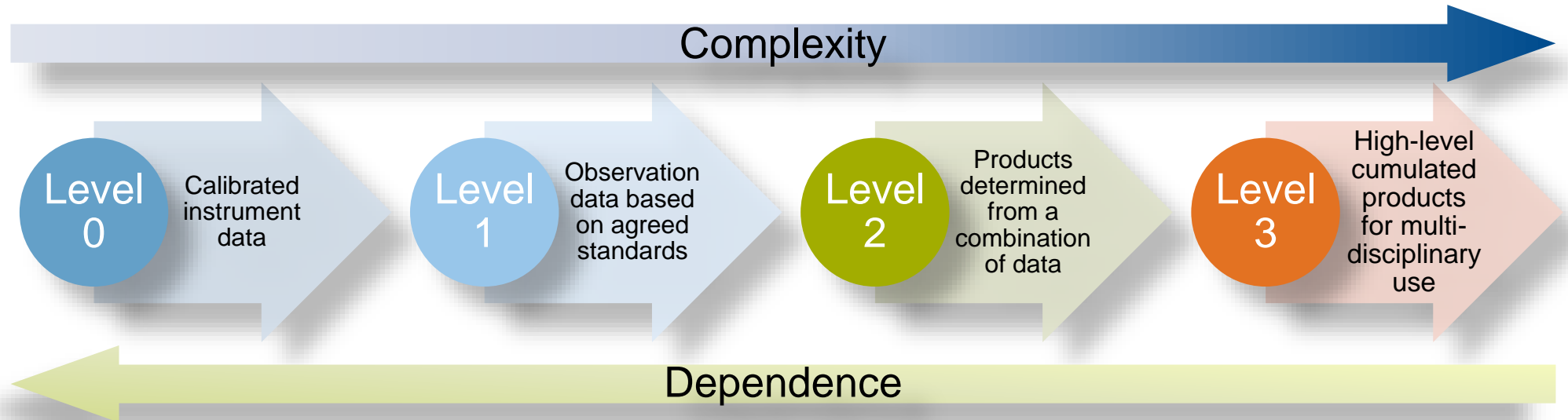
ESV–Social

Essential Variables in the workflows of geodesy

From geodetic observations to Earth system modelling



Essential Geodetic Variables Levels



Example: Workflow for the ITRF



Infrastructure



Observations



Standards

VLBI contribution

SLR contribution

GNSS contribution

DORIS contribution



Station position time series

Some (by-)products related to the Earth System



TEC



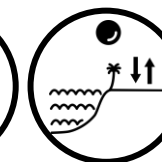
ZPD



Plate kinematics



Deformation models



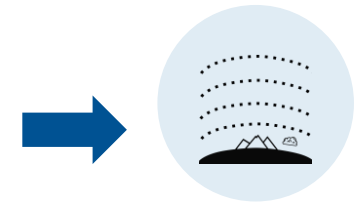
Vertical land motion



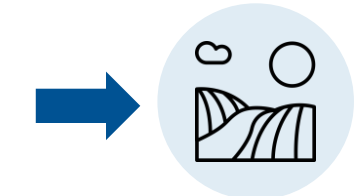
ITRF



EOPs



Atmosphere



Land geometry

Geodetic Products vs Essential Geodetic Variables



		Geodetic Products		CPO: Celestial Pole Offset		LOD: Length of Day		PM: Polar Motion		UT1: Universal Time		
												Essential Geodetic Variables (EGVs)
Earth Orientation Parameters		■	■	■	■	■	■	■	■	■	■	
L3 EGVs	Global Earth Gravity Field											
	Regional Reference Frames											
	Regional Gravity Field Model											
	Land Geometry		■	■	■							
	Sea Surface											
	Sea Level			■								
	Sea Ice											
	Ice Sheets											
	Glaciers											
	Inland Water Level											
	Terrestrial Water Storage											
	Atmosphere											
	L2 EGVs	Satellite Orbits										
Station Positions and Variations												
Sea Water Level Records												
Land and Marine Gravity Data		■										

■ Primary geodetic products directly related to the EGV

Geodetic Products vs Essential Geodetic Variables



		Essential Geodetic Variables (EGVs)		Geodetic Products		
		Earth Orientation Parameters	Global Reference Frames	GRF: Gravity Reference Frame	HRF: Height Reference Frame	
L3 EGVs	Global Earth Gravity Field					
	Regional Reference Frames					
	Regional Gravity Field Model					
	Land Geometry					
	Sea Surface					
	Sea Level					
	Sea Ice					
	Ice Sheets					
	Glaciers					
	Inland Water Level					
	Terrestrial Water Storage					
	Atmosphere					
	L2 EGVs	Satellite Orbits				
		Station Positions and Variations				
Sea Water Level Records						
Land and Marine Gravity Data						
		AGM: Absolute Gravity Measurements	CRF: Celestial Reference Frame	DOT: Dynamic Ocean Topography	DTM: Digital Terrain Model	
				EOT: Empirical Ocean Tide Model	ESD: Earth Surface Deformation	
				ESO: Earth Observation Satellite Orbits	GFO: Gravity Field Quantities	
				GFV: Glacier Flow Velocities	GGM: Global Gravity Field Model	
				GIM: Global Ionosphere Maps	GIT: Glacier Ice Thickness	
				GRF: Gravity Reference Frame	GSS: GNSS Satellite Clocks	
				HRF: Height Reference Frame	IST: Ice Sheet Thickness	
				IWW: Integrated Water Vapor	LGM: Land Gravity Measurements	
				LOD: Length of Day	MDT: Mean Dynamic Topography	
				MGC: Mean Geostrophic Currents	MGM: Marine Gravity Measurements	
				MRWL: Mean Regional Water Level	MSL: Mean Sea Level	
				MSS: Mean Sea Surface	PKM: Plate Kinematic Model	
				PM: Polar Motion	RGFQ: Regional Gravity Field Quantities	
				RGM: Regional Geoid Model	RGRF: Regional Gravity Reference Frame	
				RHRF: Regional Height Reference Frame	RMSL: Relative Mean Sea Level	
				RSLC: Relative Sea Level Change	RTRF: Regional Terrestrial Reference Frame	
				RWLC: Regional Water Level Change	SES: Sea State	
				SIE: Sea Ice Extension	SIV: Sea Ice Volume	
				SLA: Sea Level Anomaly	SLC: Sea Level Change	
				SLWR: Sea Level Water Records	SPTS: Station Position Time Series	
				TDM: Thermosphere Density Model	TGFM: Topographic Gravity Field Model	
				TRF: Terrestrial Reference Frame	UT1: Universal Time	
				VDP: Vertical Datum Parameter		

■ Primary geodetic products directly related to the EGV

Proposed Essential Geodetic Variables



54 geodetic products

EGVs

Level 3: 14

Level 2: 4

Level 1: ongoing

Level 0: ongoing

Domain

Global: 6

Land: 5

Ocean: 4

Land/Ocean: 3

Subdomain

Geometric: 7

Physical: 6

Geometric/Physical: 5

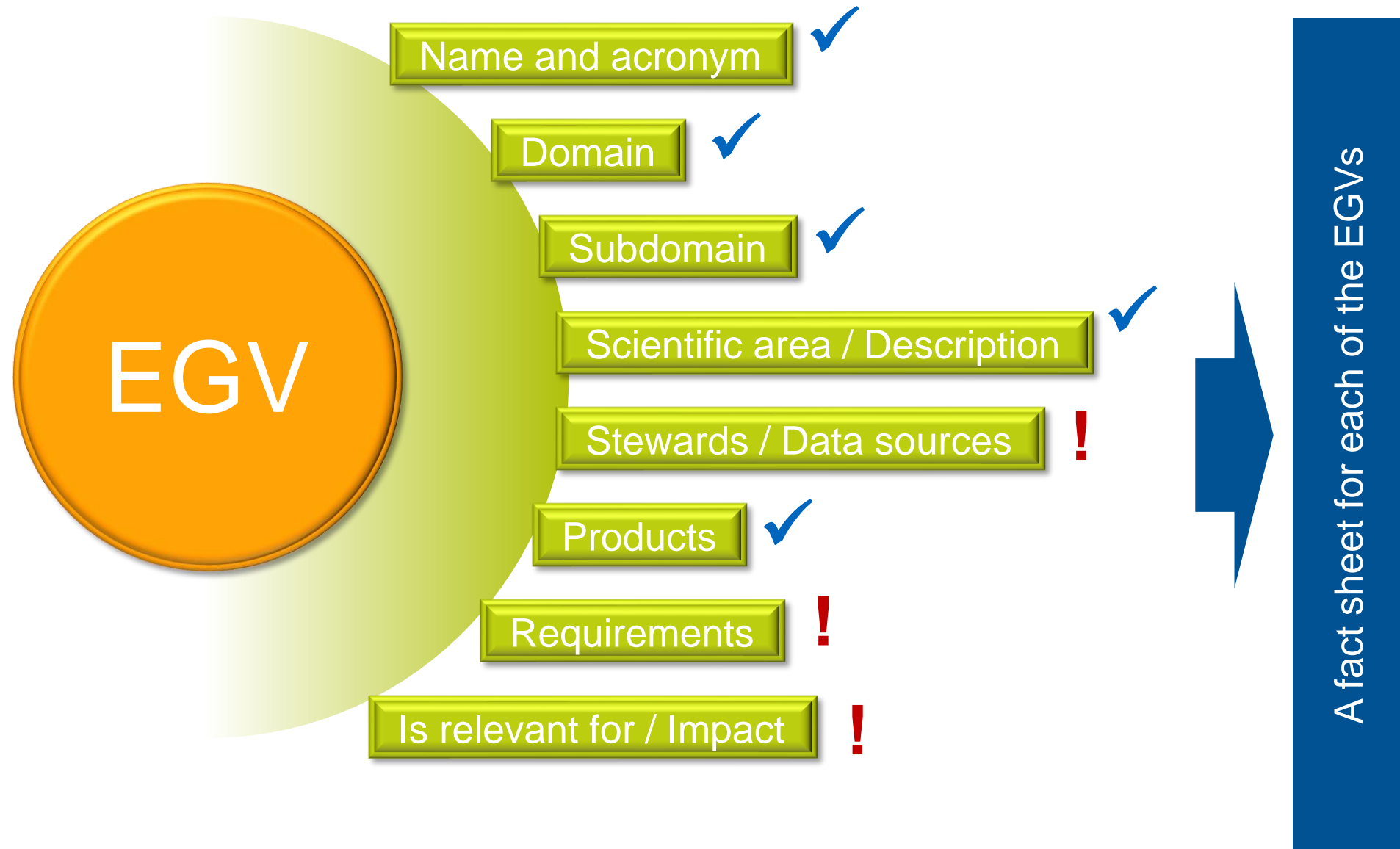
EGVs and GCOS/GOOS

8 EGVs linked to ECVs

3 EGVs linked to EOVS

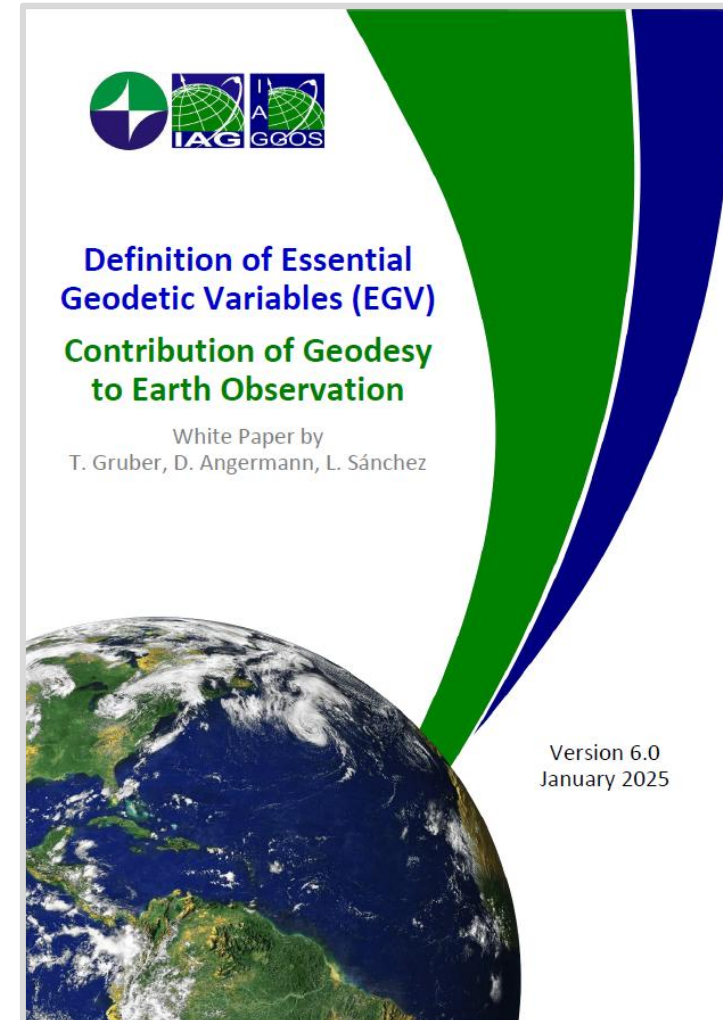
		Subdomain									
		Geometric			Physical		Geometric/Physical				
Domain	Global	Earth Orientation Parameters	Satellite Orbits	Station Positions and Variations	Global Earth Gravity Field	Atmosphere	Global Reference Frames				
	Land	Land Geometry			Terrestrial Water Storage		Ice Sheets	Glaciers	Inland Water Level		
	Ocean	Sea Surface	Sea Ice	Sea Water Level Records	Sea Level						
	Land/Ocean					Regional Gravity Field Model	Land and Marine Gravity Data		Regional Reference Frames		

Characterisation of Essential Geodetic Variables



Status and the way forward

- EGVs are a central component of
 - the GGOS Strategic Plan
 - the UN-GGCE 1st Joint Development Plan for Global Geodesy
- EGV concept already reviewed by
 - GGOS Science Panel
 - GGOS Governing Board
 - IAG Executive Committee (revision underway)
 - UN-GGCE (revision underway)
- EGVs Level 0 and Level 1 in progress
- Next step
 - Requirements
- Then a broader public review
 - Consensus



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