

Possible next steps in community-based model evaluation

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with inputs from many colleagues

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Context

Peer-reviewed publication: primary mechanism for documenting CMIP research.

But, pressing reasons to more efficiently define, produce, summarize, and make relevant model evaluation results available, e.g.:

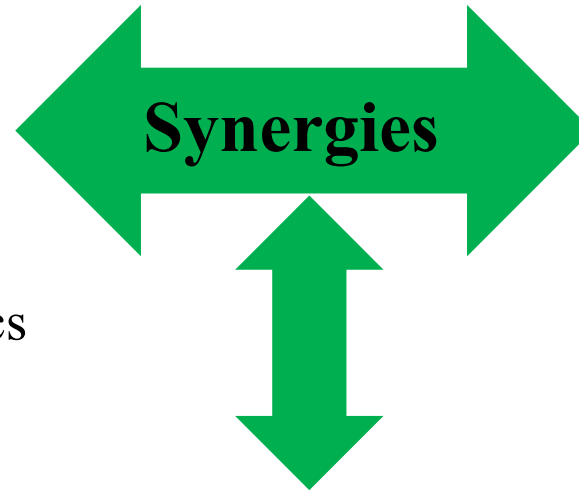
- Inform national assessments, the IPCC process, stakeholders, and public
- Advance science more efficiently (provide high level summaries; less re-inventing)
- More directly contribute to model development (via useful quick feedback)

Community-based model evaluation capabilities are becoming a reality, thanks to the design target provided by the CMIP conventions and standards

A few examples

Integrating capabilities

- ESMValTool (CVDP, *others*)
- CMEC (PMP, ILAMB, TECA)
- NOAA MAPP process diagnostics



Expert teams

- CLIVAR ENSO group
- WGNE MJO task force
- CFMIP diagnostics

There are also many scientifically focused independent tools under development

The WGNE/WGCM Metrics and Diagnostics Panel

Beth Ebert, Veronika Eyring, Pierre Friedlingstein, Peter Gleckler (chair), Simon Marsland, Robert Pincus, Karl Taylor, Keith Williams

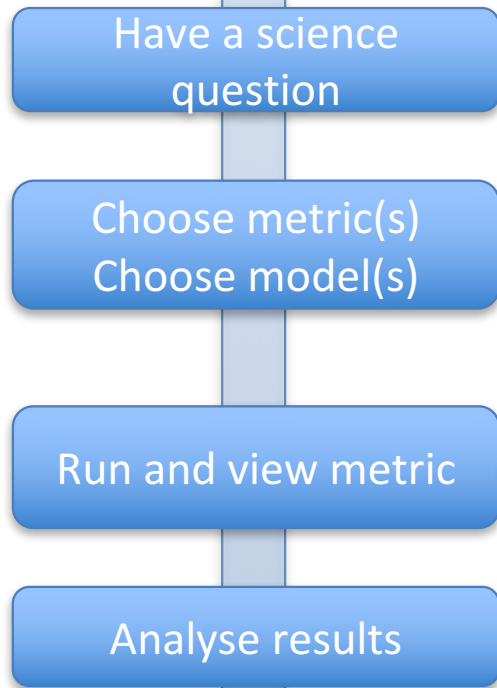
- Has helped draw attention to metrics and stimulate research
- The panel has been relatively inactive the last few years and in light of the the WCRP Strategic and Implementation plans it is a good time to rethink

Anticipating future needs and expectations in CMIPx

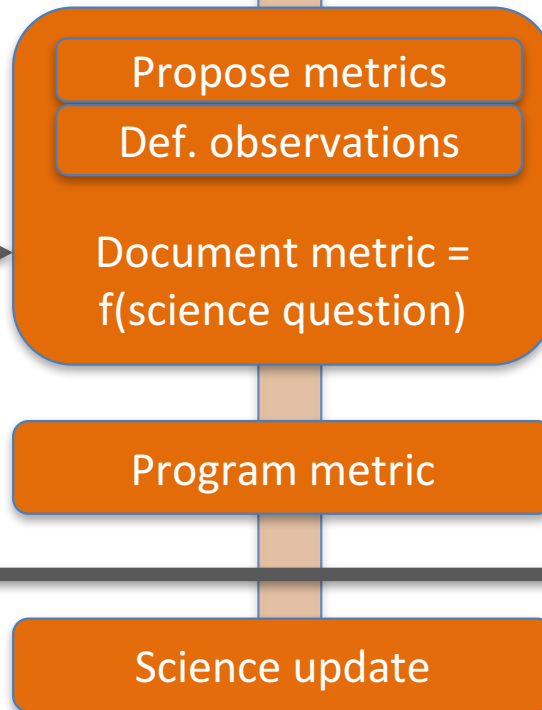
- Individual research still fundamental to CMIP related science
- Building on that, routine and systematic evaluation will only become increasingly important
- Increasing involvement by expert teams would help ensure advancing science is progressively incorporated into community evaluation capabilities
- Nurturing a set of standards for how these tools can be linked (yet remain independent) will be more complicated than establishing data standards but it is essential

Model evaluation workflow

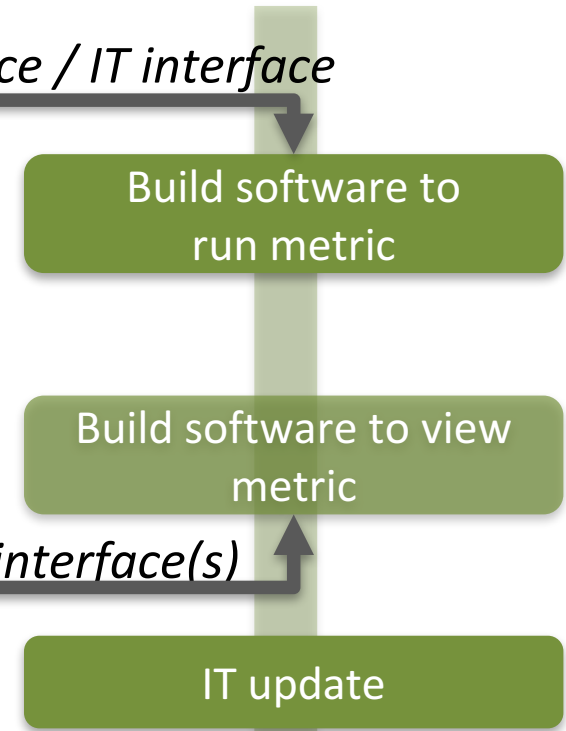
Climate information users



Climate experts



Software and data engineers



Science question interface

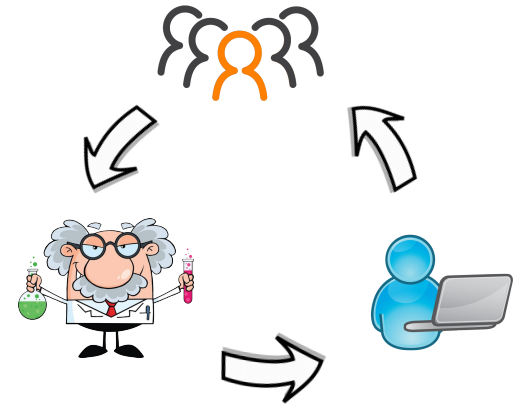
Science / IT interface

User interface(s)

Articulate different actors, different expertise and expectations

Separation of concerns + co-construction

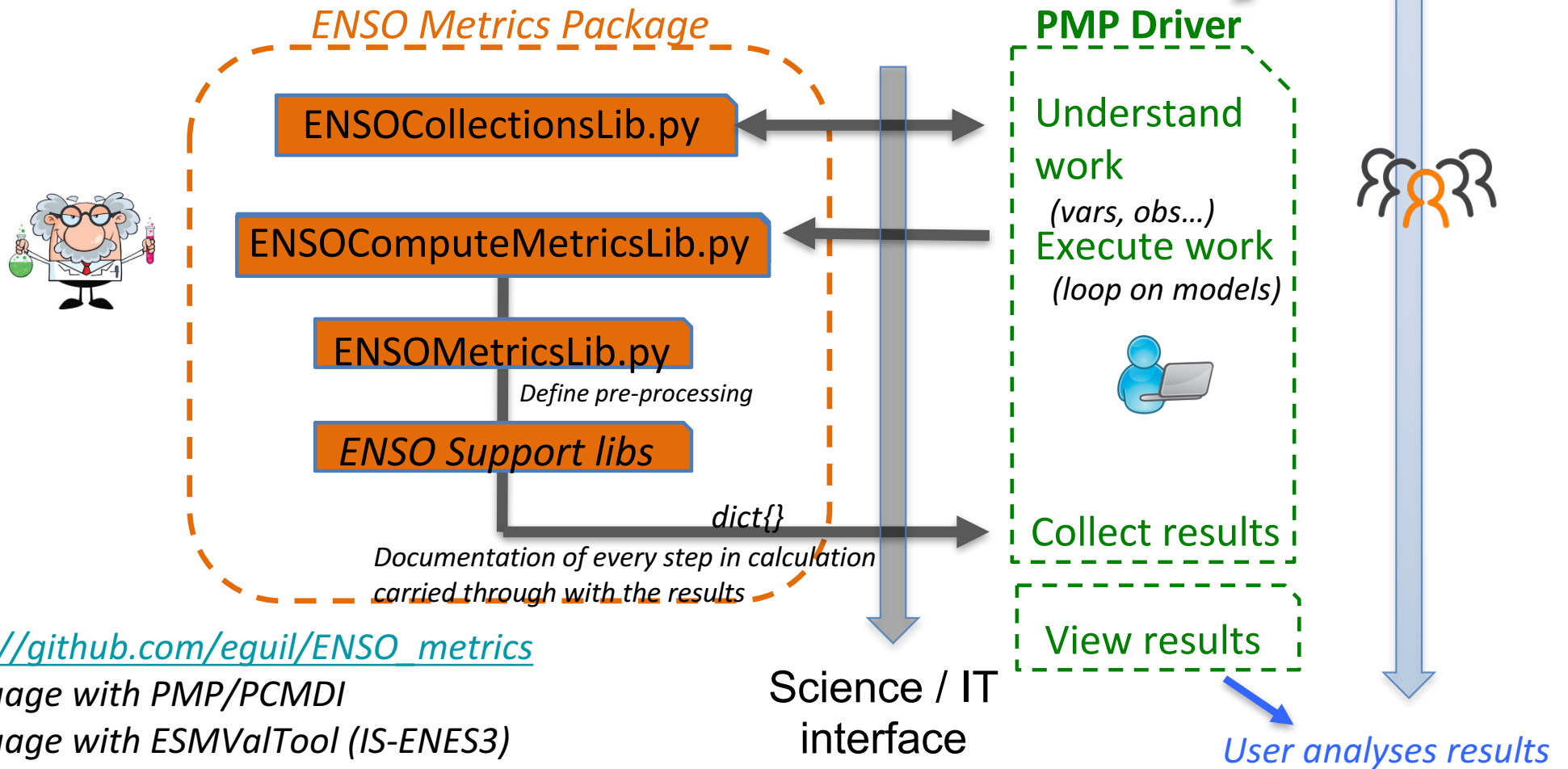
- Climate information users need state-of-the-art :
 - **Science** of model evaluation
 - **Software** tools for model evaluation
- Different experts -> different workflow
- Otherwise one of them becomes obsolete
 - High risk of mis-use
 - Loss of trust, wasted resources
- Articulation/modularity via clear interfaces
- e.g. lessons learned for CMIP, ESGF, ES-DOC,...



Pilot ENSO package to test ideas



Engage with an IT infrastructure (driver), here PMP



https://github.com/equil/ENSO_metrics

- 1) Engage with PMP/PCMDI
- 2) Engage with ESMValTool (IS-ENES3)

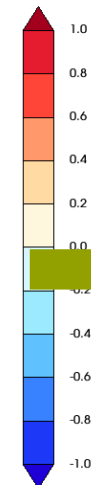
First results – ENSO performance in CMIP5 historical

Address these specific questions:

- ENSO performance in historical simulations
- ENSO teleconnections in historical simulations
- ENSO processes

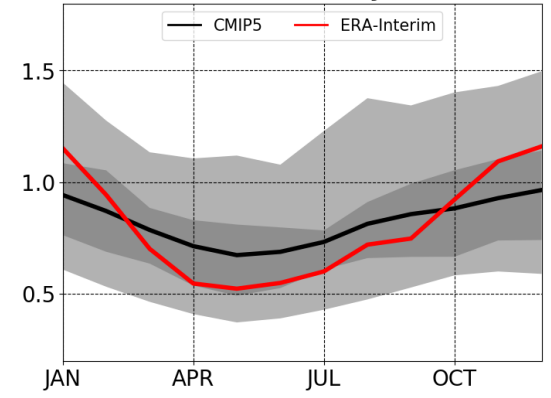
Shading : relative performance wrt MME
Values : actual metric value

Metric	ACCESS1-0	ACCESS1-3	BCC-CSM1-1	BCC-CSM1-1-M	CCSM4	CMESM1-BGC	CMESM1-CAM5	CESM1-FASTCHEM	CESM1-WACCM	CMCC-CESM	CMCC-CM	CMCC-CMS	CNRM-CM5	CNRM-CM5-2	CSIRO-Mk3-6-0	CanESM2	GFDL-CM3	GFDL-ESM2G	GFDL-ESM2M	GISS-E2-H	GISS-E2-H-CC	GISS-E2-R	GISS-E2-R-CC	GISS-E2-1-G	* GISS-E2-1-G	HadGEM2-AO	HadGEM2-CC	HadGEM2-ES	INMCM4	IPSL-CM5A-LR	IPSL-CM5A-MR	IPSL-CM5B-LR	* IPSL-CM6A-LR	MIROC4h	MIROC5	MIROC-ESM	MIROC-ESM-CHEM	MPI-ESM-LR	MPI-ESM-MR	MPI-ESM-P	NorESM1-M	NorESM1-ME	(Mean)	(Median)	
NinoSstDur (months)	1.35	1.93	1.13	1.30	1.81	1.86	1.89	2.14	1.68	2.09	1.88	1.58	1.66	1.42	1.25	1.89	1.57	1.81	2.18	1.23	1.20	1.18	0.95	1.31	1.76	1.69	1.44	1.86	1.79	1.66	1.86	2.45	1.46	2.72	2.42	1.95	1.88	1.44	1.71	2.35	1.67	1.72	1.71		
NinoSstDiv (%)	2.24	2.03	2.50	2.33	1.52	0.87	1.02	0.65	1.09	0.67	0.89	0.58	0.23	1.67	1.59	0.29	1.36	1.67	1.11	2.27	2.33	0.38	0.31	2.32	2.22	2.35	0.83	1.32	1.05	1.25	0.62	0.71	1.14	0.57	1.32	1.41	1.61	1.96	2.31	2.26	1.09	1.36	1.32		
NinaSstDur (months)	0.43	0.65	0.36	0.57	0.46	0.88	0.74	0.75	0.57	0.80	0.84	0.65	0.72	0.41	0.47	0.67	0.51	0.58	0.83	0.58	0.49	0.72	0.44	0.62	0.58	0.59	0.44	0.96	0.82	0.53	0.55	0.88	0.76	1.02	0.80	0.68	0.67	0.51	0.73	0.89	0.64	0.65	0.65		
NinaSstDiv (%)	2.50	1.88	1.97	2.36	1.70	1.92	1.80	1.33	1.73	2.00	1.06	0.54	0.60	1.72	1.85	0.00	1.45	1.67	1.36	1.39	2.35	0.45	0.21	2.32	2.50	2.50	1.35	1.25	1.47	0.77	1.25	1.25	0.42	1.13	0.88	2.29	1.72	2.39	2.07	2.18	1.25	1.53	1.67		
EnsoSstSkew (C)	0.09	0.49	0.06	0.86	0.39	1.35	0.85	1.28	0.33	0.66	1.45	0.80	0.55	0.47	0.46	0.92	0.41	0.46	1.25	0.69	1.67	0.21	1.19	1.40	0.92	0.72	0.54	0.19	0.83	0.31	0.85	0.53	0.35	2.27	0.88	0.18	0.13	0.27	0.50	0.47	0.30	0.26	0.39		
EnsoSeasonality (C)	0.90	0.55	0.95	0.80	0.72	0.74	0.67	0.83	0.82	0.80	0.56	0.60	0.64	1.14	1.11	0.44	0.63	0.80	0.54	0.73	0.79	0.89	0.88	0.70	0.69	1.06	1.06	1.62	0.94	1.40	0.52	0.55	0.58	0.63	0.95	0.66	0.53	0.54	0.52	0.84	0.84	0.50	0.62	0.71	0.67
EnsoDiversity (%)	1.12	0.92	0.79	1.01	1.12	2.20	1.76	2.05	1.59	2.97	1.19	0.93	2.64	1.03	1.16	0.00	1.06	1.00	1.23	0.61	1.01	1.18	0.67	1.00	1.12	1.06	1.06	1.62	0.94	1.40	0.52	2.00	1.75	0.17	1.99	0.67	1.63	1.07	1.22	0.90	0.96	1.15	1.24	1.12	
EnsoAmpl (C)	0.76	0.79	0.87	1.52	1.16	1.28	1.10	1.11	1.29	1.83	0.80	1.10	1.09	1.03	1.03	0.95	1.13	0.89	1.81	0.62	0.83	0.67	0.65	0.85	0.93	0.90	0.79	0.87	0.94	0.80	0.80	0.52	0.59	0.85	1.44	0.95	0.81	0.98	1.02	1.12	1.45	1.25	1.01	0.95	

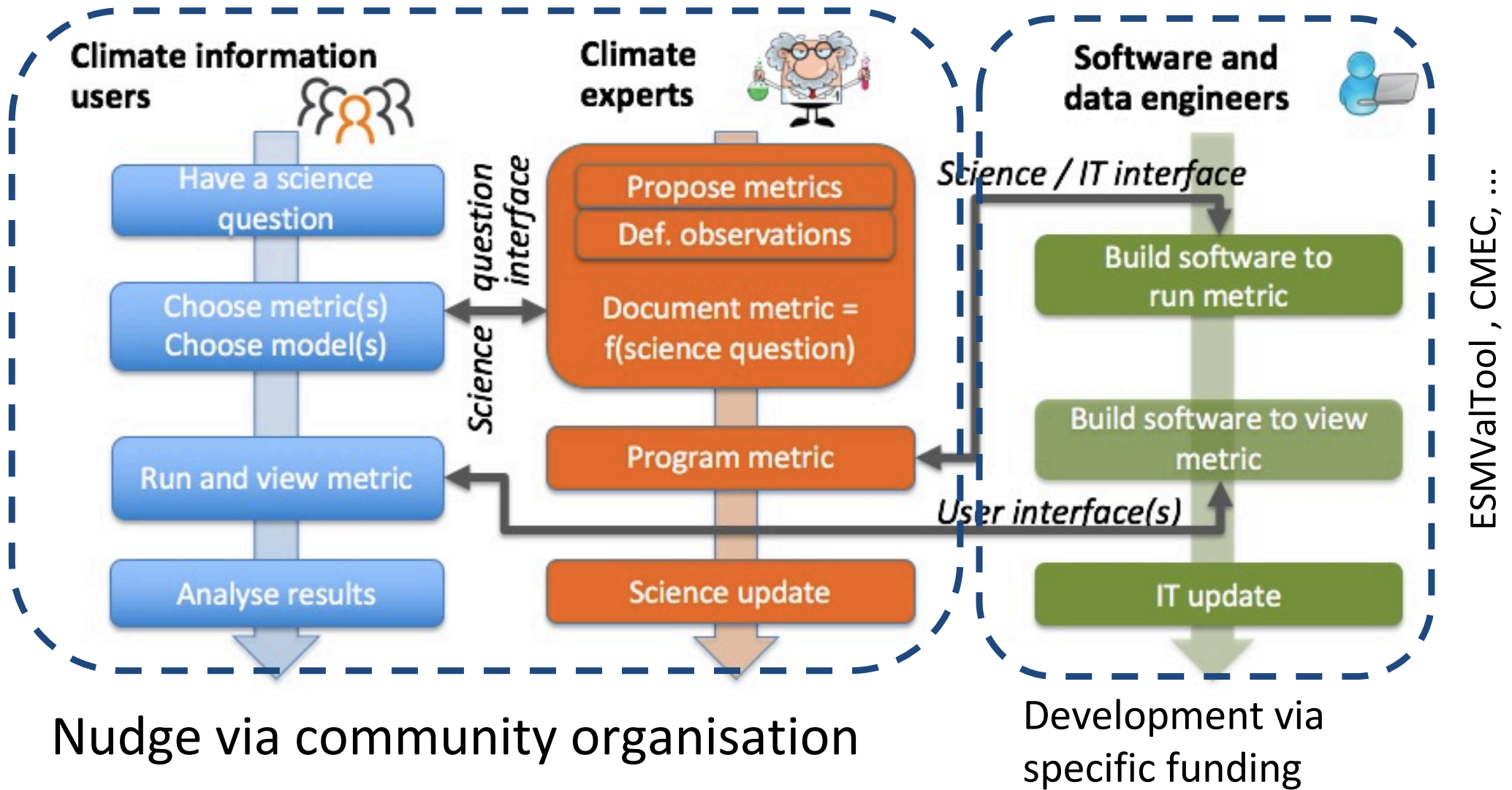


“Dive down” diagnostics

a) ENSO seasonality



How can we move forward ?



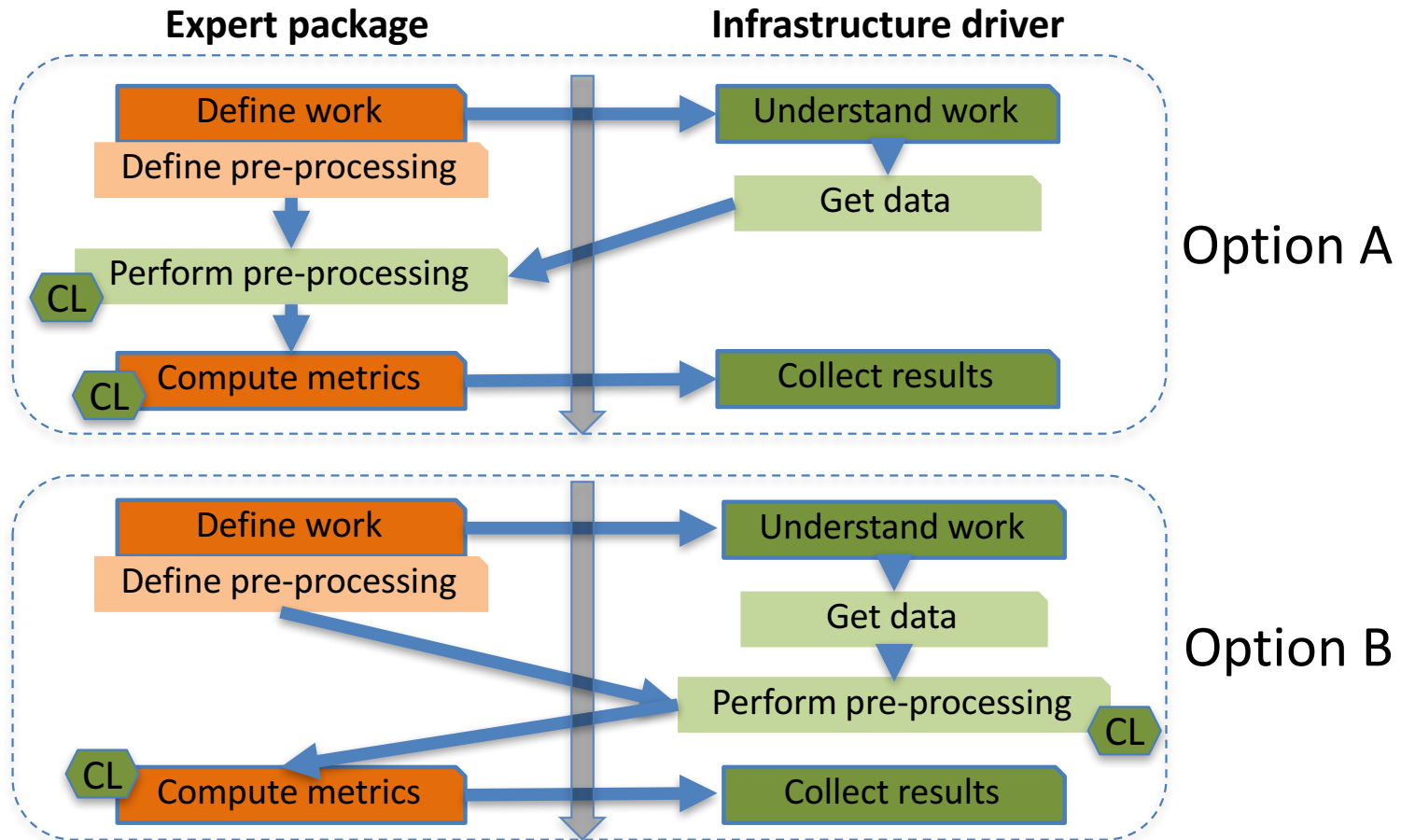
Possible work plan for a potential “WCRP model evaluation panel or work group”

- 2019: WCRP and existing panels help refine scope and vision and identify members
- First year (2019-2020): analysis of existing model evaluation efforts and identify opportunities/gaps
- Year 2: select and advance a few pilot areas (beyond ENSO)
- Year 3: unveil consensus model evaluation framework and process for these first areas
- Year 4: review activity via WCRP process (tdb)

Summary and discussion

- Community–based model evaluation involves 3 pillars that need to be articulated
- Viable process proposed (pilot study) that requires further community discussion (e.g. include NWP/SF ?)
- Because of our community organisation and funding, resilience requires modularity and diversity of software tools
- Model evaluation standards and framework may help many groups develop diagnostics towards interoperability
- Next steps

Example of interfaces choices



Enable different compute libraries <CL> kernels (e.g. CDAT, IRIS, ...)?