ISMIP7
Ice Sheet Model Intercomparison Project

www.ismip.org

ESM-ISM Simulations for ISMIP7

https://drive.google.com/drive/u/1/folders/1yKX68YqDf8O6x9gfyW7ZNosgiMisWWFu

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ISMIP7
Ice Sheet Model Intercomparison Project

ISMIP7 informs decision making by projecting sea level rise from the melting Greenland and Antarctic Ice Sheets

ISMIP7 Mission

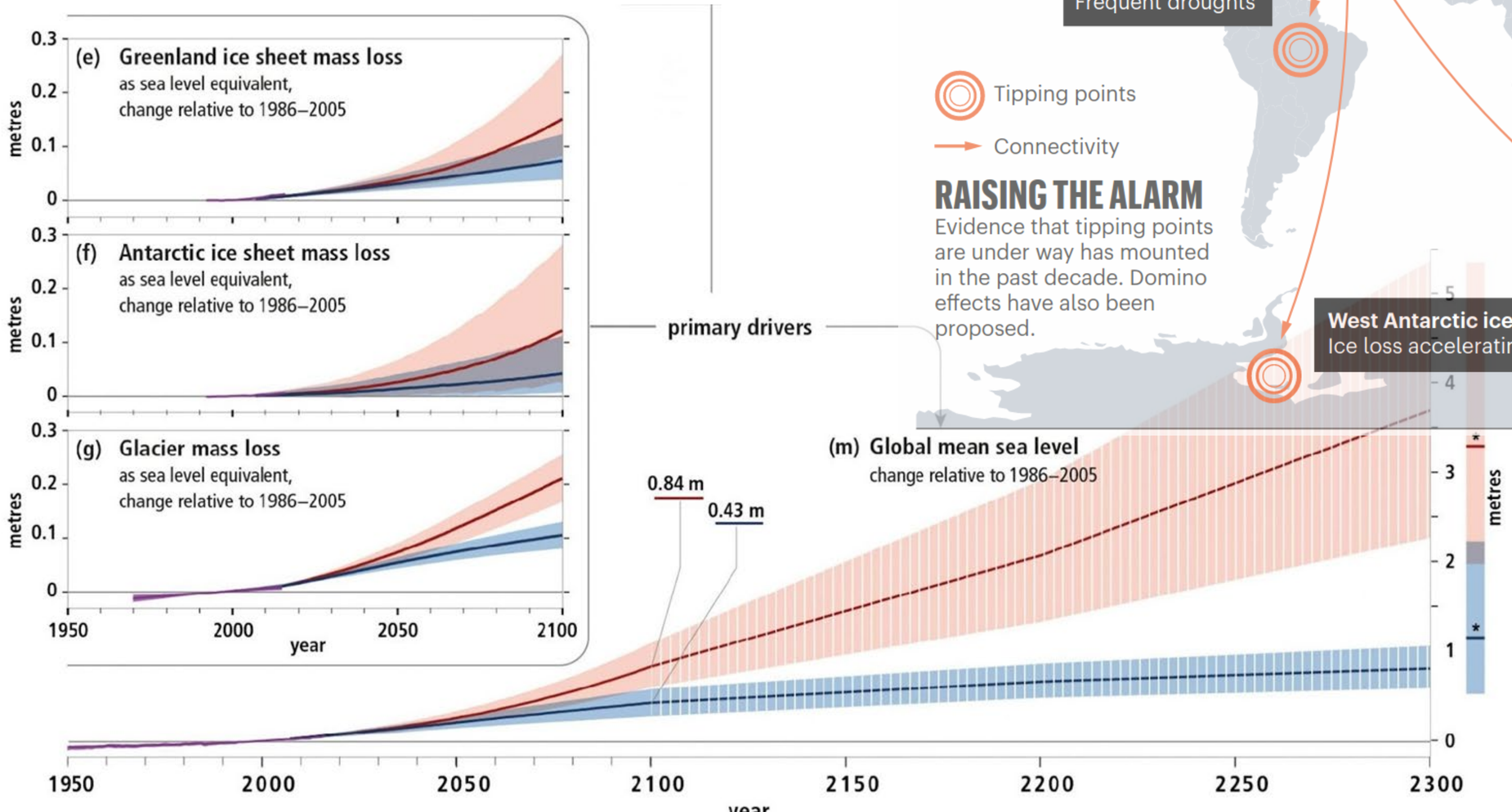
The mission of ISMIP7 is to establish consensus estimates of the sea level rise contribution from ice sheet change over the coming decades and centuries, given different trajectories for Earth's climate.

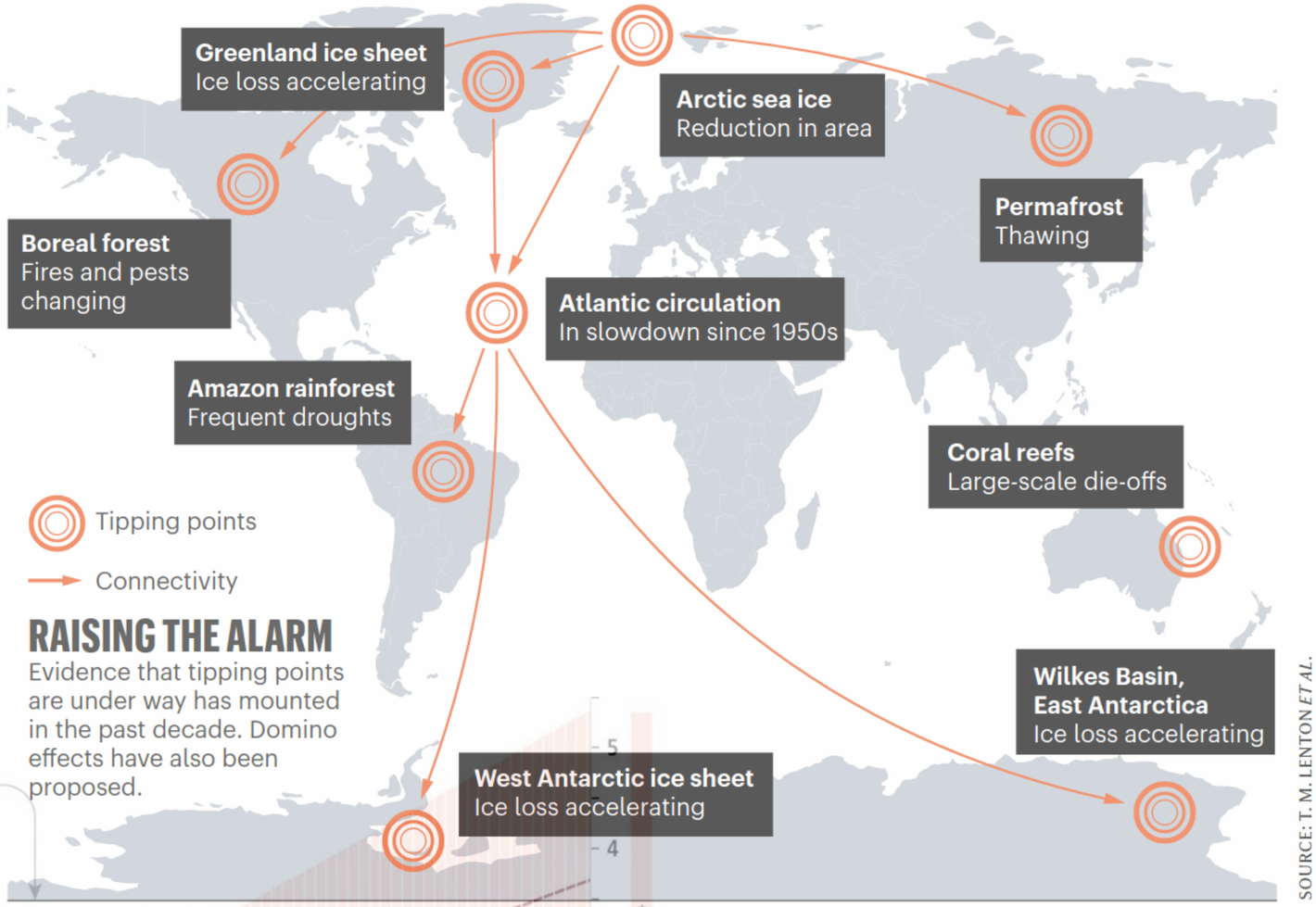
ISMIP7 Core activity

ISMIP7's core activity is the design and delivery of projections of the sea level contribution of the ice sheets using Coupled Model Intercomparison Project (CMIP) forcing. These projections are based on large-scale community intercomparisons among standalone ice sheets models and coupled Earth system models. ISMIP7 activities are designed for completion in time to inform the Seventh Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR7). ISMIP7 additionally provides information to practitioner communities working on the impacts of and adaptation to sea level rise.

Why model icesheets in an ESM?

SROCC SPM 2019





ESM-ISM experiments in ISMIP

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- Nowicki et al. (2016): "a suite of experiments designed to assess the **impacts of dynamic ice sheets on climate** and to better understand **feedbacks between ice sheets and climate**."

- Investigate **when, where, and how** ice sheet coupling becomes important for future projections of ice sheet mass loss and climate.

- Evaluation against *observed behavior* is a secondary aim. Unlike the ISMIP standalone ice-sheet model simulations, these runs are *not* intended as actionable sea-level projections.

Many CMIP ESMs do not include dynamic ice sheet components yet, although a number of groups are very actively working on developments in this area…

ESM-ISM Focus group

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- “… representatives of any ESM groups with a model complex enough that they could contribute to CMIP6 or 7 and with an interest in coupling ice sheets”

- Group aims of

1. community building and promoting modelling of ice sheets in ESMs

1. developing the ESM-ISM protocol for ISMIP7

- Mailing list ~50 interested people

- irregular discussion meetings of the whole group on specified topics

- more frequent meetings of small, self-volunteered groups that talks about knotty issues in the protocol

- mostly: UKESM, E3SM, CESM, NorESM, EC-Earth, AWI-ESM, MPI-ESM

ESM-ISM experiments in ISMIP7

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All experiments are ***paired*** to quantify the effects of ice sheet–climate feedbacks.

- **-withism:** The ice sheet model runs interactively with the ESM.
- **-withoutism**: The ice sheet geometry does not evolve. The simulation is otherwise configured as closely as possible to the -withism experiment.
  - In general, this will differ from standard CMIP7 DECK and Scenario experiments with the same ESM. For instance, the surface topography in -w*ithoutism* might match the spun-up ice sheet topography in -w*ithism*.

ISMIP7 ESM-ISM Protocol

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Tier 1 (entry card; required of all participants)

1950ctrl, with/withoutism

1pctCO2, with/withoutism

Tier 2

Historical, with/withoutism

High scenario, with/withoutism

Why not 1850?

- A 1950 baseline is easier for groups that use historical data to constrain their initialization.
- A 1950 start date makes historical runs shorter and cheaper.

Tier 3 (listed from highest to lowest priority)

Overshoot scenario, with/withoutism

Low scenario, with/withoutism

Mid scenario, with/withoutism

1950ctrl, withism_onlyGrIS | withism_onlyAIS
1pctCO2, withism_onlyGrIS | withism_onlyAIS

- Proof-of-concept runs, protocol paper starting Jan2025
- Aim to have useful, multi-model results by early 2027

Scenarios in CMIP7

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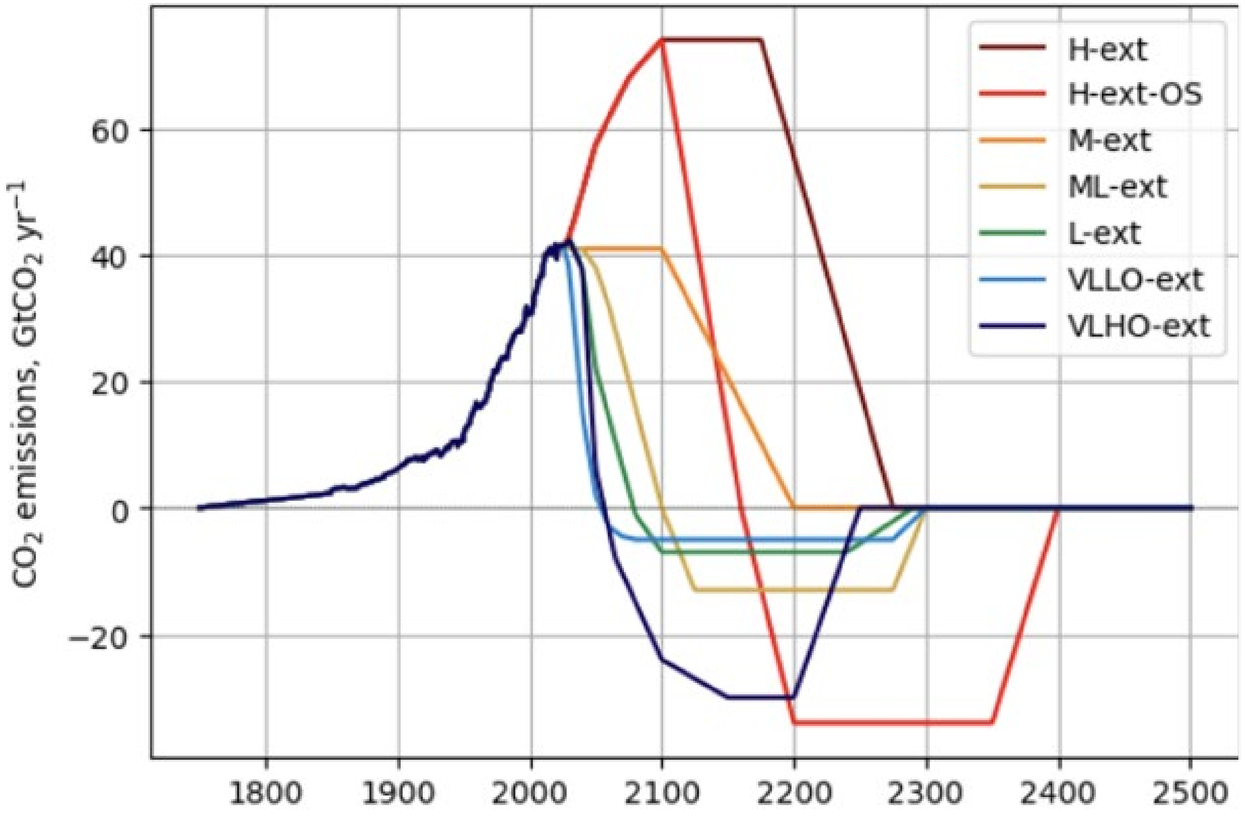
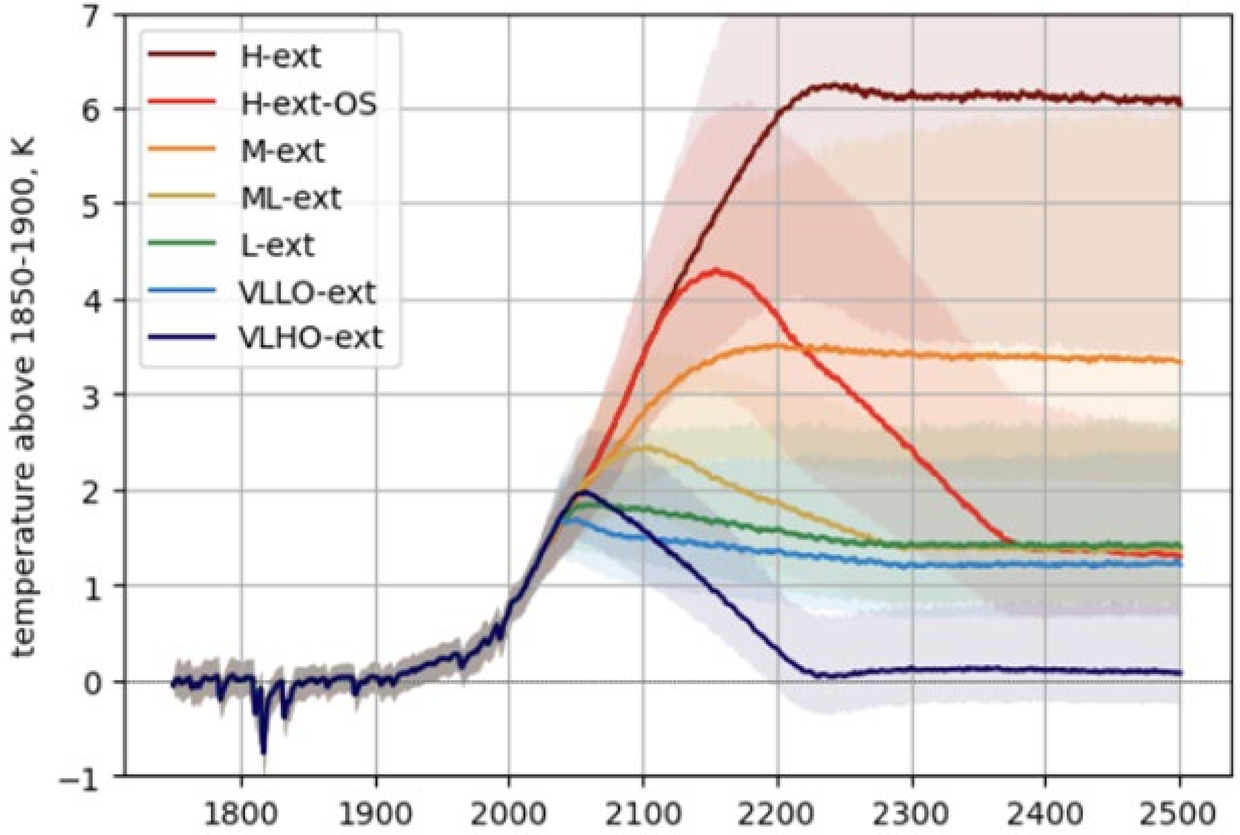




CMIP may prioritise 2 or 3 in FastTrack: VLLO and M (or H) + extensions

H extensions may still be revised?

ISMIP7 ESM-ISM protocol

TIER 1										
Name	start year	required length	preferred length	preferred n members	n*length(require	n*length(preferre	GrIS on/off	AIS on/off	required end year	prefered end year
1950ctrl-withism	1950	200	550	1	200	550	on if you can	on if you can	2150	2500
1950ctrl-withoutism	1950	200	550	1	200	550	off	off	2150	2500
1pctCO2-withism	1950	200	350	1	200	350	on if you can	on if you can	2150	2300
1pctCO2-withoutism	1950	200	350	1	200	350	off	off	2150	2300
		800	**1800**		**800**	**1800**				
TIER 2										
historical-withism	1950	75	75	4	300	300	on if you can	on if you can	2025	2025
historical-withoutism	1950	75	75	4	300	300	off	off	2025	2025
highscenario-withism	2025	125	275	1	125	275	on if you can	on if you can	2150	2300
highscenario-withoutism	2025	125	275	1	125	275	off	off	2150	2300
		400	**700**		**850**	**1150**				
TIER 3										
overshootscenario-withism	2025	125	275	1	125	275	on if you can	on if you can	2150	2300
overshootscenario-withoutisr	2025	125	275	1	125	275	off	off	2150	2300
lowscenario-withism	2025	125	275	1	125	275	on if you can	on if you can	2150	2300
lowscenario-withoutism	2025	125	275	1	125	275	off	off	2150	2300
midscenario-withism	2025	125	275	1	125	275	on if you can	on if you can	2150	2300
midscenario-withoutism	2025	125	275	1	125	275	off	off	2150	2300
1950ctrl-withismonlyGrIS	1950	200	350	1	200	350	on	off	2150	2300
1950ctrl-withismonlyAIS	1950	200	350	1	200	350	off	on	2150	2300
1pctCO2-withismonlyGrIS	1950	200	350	1	200	350	on	off	2150	2300
1pctCO2-withismonlyAIS	1950	200	350	1	200	350	off	on	2150	2300
		1550	**3050**		**1550**	**3050**				
Total Sum Simulated Years		1 member, require	1 member, preferred		n members, requ	n members, preferred				
		2750	**5550**		**3200**	**6000**				

ISMIP7 ESM-ISM -withoutism

- “ice sheet interactivity” can vary conceptually and structurally across different ESM-ISMs.

- ISMIP7 defines the ***ideal* goal** of a *-withoutism* configuration as

  a) having unchanging ice sheet geometries and surface types

  b) preventing **all** freshwater fluxes derived from the ice sheets from responding to changes in climate.

- keeping all of these fluxes non-responsive may not be possible in all ESMs; if a group’s submission clearly documents how they have configured *-withoutism* their simulation results will be accepted.

- Fluxes specified in *-withoutism* do not need to be in balance with the fixed ice sheet geometry or climate

- *-withoutism* configurations should be as close to as possible to the *-withism* model with some processes kept fixed, rather than simply being the default CMIP7 configuration

ISMIP7 ESM-ISM demonstration runs

Basic requirement to show that what we propose is in principle possible

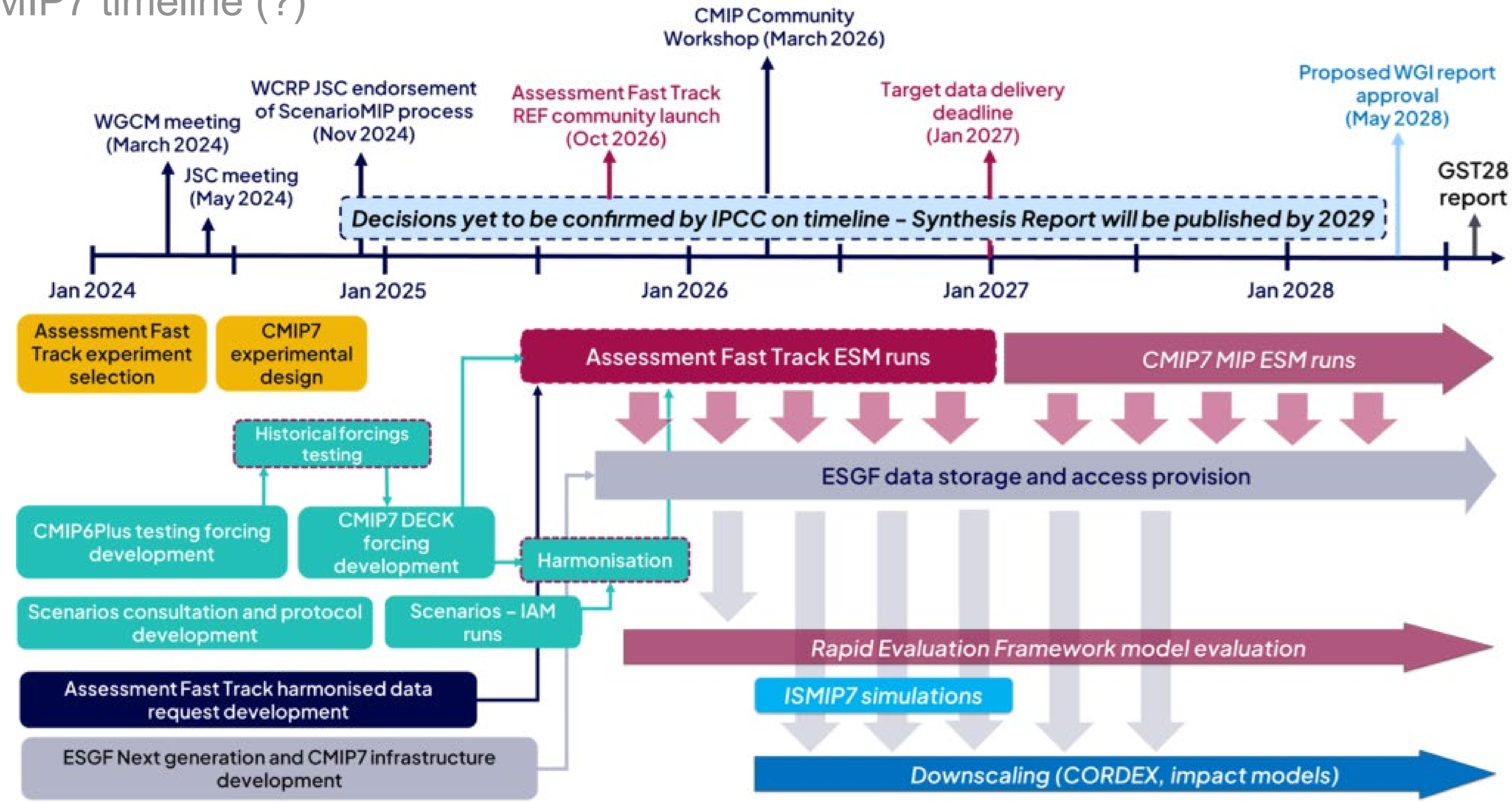
We feel we have some extra things to prove:

- ice sheet coupling has some measurable, non-trivial impact
- ice sheet coupling does not ruin/dominate global climate simulation
- the physics we can model is, by some metric, "plausible"
- we can initialise and run such that signal >> drift
- more than one (or two) models are capable of doing this
- there is a diversity of viable modelling approaches

Protocol description paper: 1950 baseline and 1pctCO2 simulations with 5 models, *-withism* and *-withoutism.* Both ice sheets

UKESM, NorESM, AWI-ESM, MPI-ESM, IPSL-CM

CMIP7 timeline (?)



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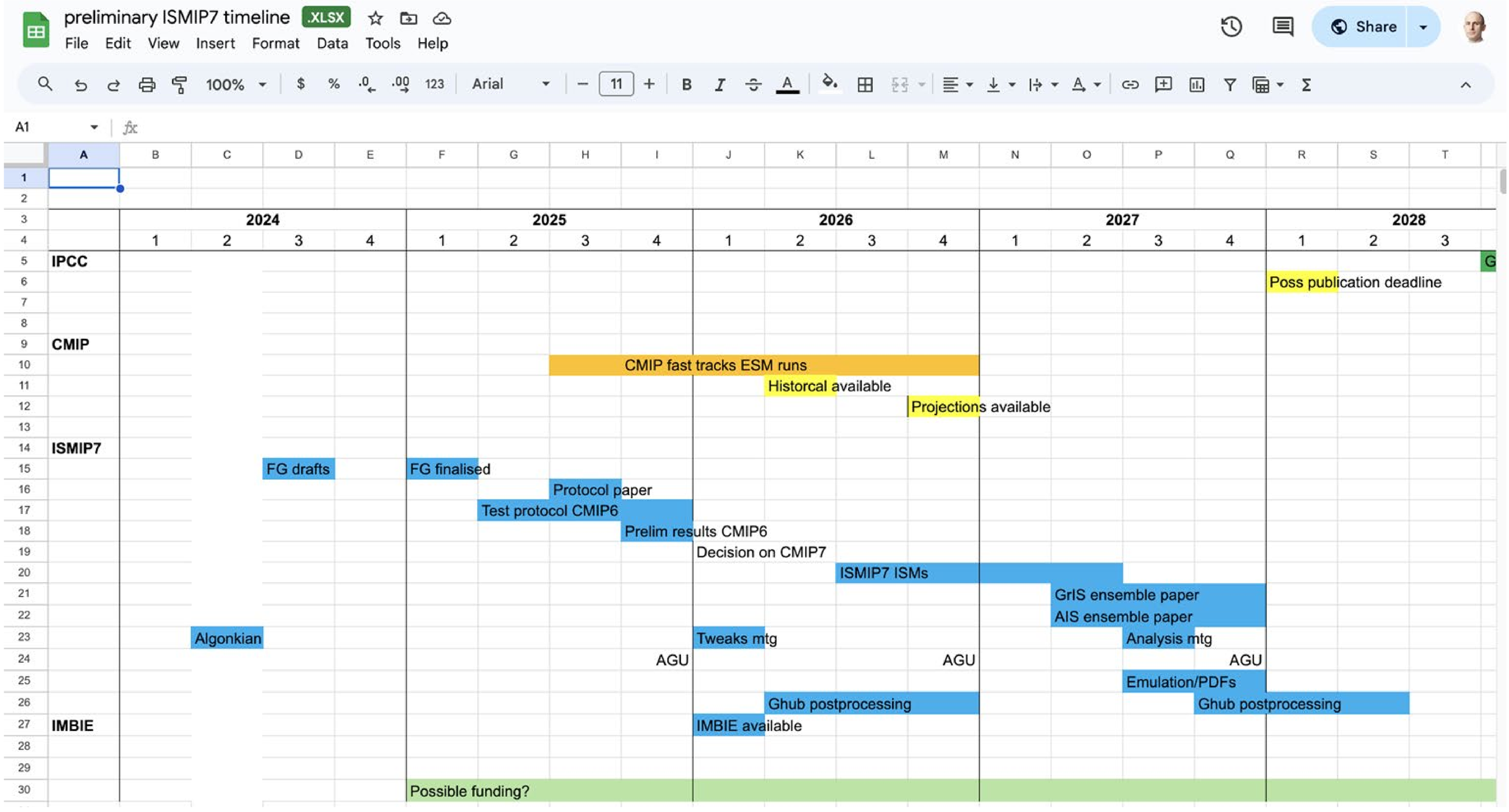
preliminary ISMIP7 timeline
.XLSX
File Edit View Insert Format Data Tools Help
Share
A1
2024
2025
2026
2027
2028
1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3
IPCC
Poss publication deadline
CMIP
CMIP fast tracks ESM runs
Historcal available
Projections available
ISMIP7
FG drafts
FG finalised
Protocol paper
Test protocol CMIP6
Prelim results CMIP6
Decision on CMIP7
ISMIP7 ISMs
GrIS ensemble paper
AIS ensemble paper
Algonkian
Tweaks mtg
Analysis mtg
AGU
AGU
AGU
Emulation/PDFs
Ghub postprocessing
Ghub postprocessing
IMBIE
IMBIE available
Possible funding?