1 **Quantifying Future Climate Change**

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3 **Supplementary Information**

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5 **Glossary**

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7 **Climate Model:** A mathematical description of the climate system that may be used to make

8 simulations of past or historical and future climate variables such as the mean state, variability

9 and trends. The behaviour of the output of the model is controlled by internal model parameters

10 and external forcing, for example, from greenhouse gases. Mathematically we write

11 $c = M(p,R)$, where M is the model, c is a climate variable that the model simulations (vector or

12 scalar), p is a vector of model internal parameters that control the behaviour of the model and R

13 is the radiative forcing.

14

15 **Complex Climate Model:** A 3-dimensional climate model that solves the time-dependent

16 equations of fluid motion in the atmosphere and the ocean in which sub-grid-scale and other

17 processes are represented by parameterisation schemes. Experiments and outputs from

18 complex climate models are coordinated by the Coupled Model Intercomparison Project (CMIP)

19 and form the 'multi-model ensemble' or MME[4]. Complex Climate Models may simulate physical

20 climate processes and feedbacks but increasingly they include representations of chemical and

21 biological processes, in which case they may be termed Earth Systems Models.

22

23 **Simplified Climate Model:** Usually a 1-dimensional climate model written in terms of global

24 mean quantities. Often derived from global energy balance considerations and therefore often

25 called an **Energy Balance Model (EBM)**.

26

27 **Metric:** A measure of how well a climate model reproduces some observed or reconstructed

28 climate, climate variability, climate process or climate trend. A root mean squared error

29 formulation is often adopted. The concept of a metric is, at present, rather ill-defined in the

30 climate modeling literature hence it is recommended that this is an area for future work.

31

32 **Multi Model Ensemble (MME):** A collection of the output of a coordinated set of climate model

33 simulations produced by different climate modeling groups around the world. A typical example

34 is the Coupled Model Intercomparison Project (CMIP). Each model in the ensemble is usually

35 considered by the modeling group to be their 'best shot' at simulating the climate system i.e. to

36 have the best combination of resolved and parameterized processes as limited by practical

37 considerations of run time. Although some modeling groups now submit more than one version

38 of their model.

39

40   **Observational Constraint:** The use of observations to define a range or distribution of model

41   parameters. The observational constraint is derived from a metric that compares the model

42   simulation of past or historical climate with that observed.

43

44   **Parameter:** A physical 'constant' that is input to and controls the behaviour of a climate model.

45   In simple climate models, parameters may capture many physical processes e.g. the diffusion

46   of heat through the global ocean. In complex climate models, parameters tend to relate more to

47   specific physical processes e.g. the rate of entrainment of dry air into a cloud. While in principle,

48   parameters may have measureable physical counterparts, in many cases they control

49   approximations to the full complexity of that process.

50

51   **Perturbed Physics Ensemble or Perturbed Parameter Ensemble (PPE):** An ensemble in

52   which a single model structure is used and parameters that control the unresolved

53   parameterized processes are varied according to some strategy. More commonly a PPE is used

54   to describe a perturbed ensemble of complex model experiments.