

Slimline decadal prediction proposal

Version 1

Requested model runs:

- 1.1 10 year integrations with initial dates of 1st November 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995 and 2000 and 2005;
Ensemble size of 3, optionally to be increased to O(10)
Ocean initial conditions should be in some way representative of the observed anomalies for the start date.

Model run time: 300 years (optionally, an additional 700 years)

- 1.2 Extend integrations with initial dates 1st November 1960, 1980 and 2005 to 30 yrs.
Each start date to use a 3 member ensemble, optionally to be increased to O(10)
Ocean initial conditions represent the observed anomalies

Model run time: 180 years (optionally, an additional 420 years)

Further details on these runs:

- Calendar start date can be 1st September, 1st November or 1st January, according to the convenience of the modeling group. Dates should allow complete years/decades to be analysed, eg start 1st Sep 1960, 1st Nov 1960 or 1st Jan 1961.
- Actual integration length should be long enough to produce 10 or 30 complete calendar years. We expect any extra ‘initial’ months to be discarded in the analysis.
- Choice of initial conditions is up to each group, subject to the principle that they should represent the observed anomalies for the start date. Possible initialization strategies are discussed below.
- All forcings should be included as observed values for past dates, with prescribed concentrations of well-mixed GHGs. The details should be the same as used in the CMIP5 historical (20th C) runs, with the same flexibility on the treatment of ozone and aerosol and the same specified observational datasets.
- For future dates, the RCP4.5 scenario should be used if possible. Specification of reactive species and aerosols will follow those used in CMIP5. A single scenario for anthropogenic aerosol will be used [specify].
- Any deviations from the standard specifications should be properly documented.
- **Volcanic aerosol** has a specific treatment: observed values should be used for past dates, as per CMIP5, but values to be used after 2005 should be specified based on the assumption of no further volcanic eruptions. The model runs are thus configured to predict what will happen to climate if no major eruptions take place, which is a possible outcome for a thirty year period. Sensitivity of predicted climate to hypothetical volcanic eruptions will be explored separately.

The runs needed here are only to augment whatever ensemble is generated for CMIP5. At the moment, CMIP5 calls for a single mandatory 150 year historical run, with a recommendation that this be extended to 5 ensemble members. Here we request that the historical runs are extended to O(10) ensemble members, for the period 1960 onwards. Although the most robust method of ensemble generation might be to run the full ensemble from pre-industrial climate, other cheaper approaches might also be considered. Given the emphasis on decadal/multi-decadal timescales, starting the full ensemble 10-30 years before 1960 would enable substantial spread to develop. [The possibility of using a pre-existing small ensemble to construct initial conditions for a larger one using linear combination of the ensemble members could also be considered - is non-linearity in the ocean equation of state a significant issue?]. Assuming CMIP5 has a 5 member ensemble, an additional 5 members for 1930-2005 would require 375 years of model integration.

CMIP5 only calls for a single ensemble member for each future scenario run. The ensemble size of the RCP4.5 scenario would be extended to 3-10 members, for the years up to 2035.

2. Optional studies to be done by the community, self-organized, only some models.
(Does this mean no official data collection?)

2.1. Intercomparison of initialization strategies

Repeat of runs (1.1) and possibly (1.2) using an alternate initialization strategy or alternate initial data.

Model run time: As a minimum, duplicating runs of (1.1)

2.2 Non-GHG forcing sensitivity runs

Repeat of the 1.1 2005 forecast with a high and/or low anthropogenic aerosol scenario

Repeat of the 1.1 2005 forecast with an imposed "Pinatubo" eruption in 2010

Ozone sensitivity run??

Ensemble size 3, optionally O(10)

Model run time: 90 years each (optionally an additional 210 years each)

The forecasts in 1.1 assume a particular evolution of anthropogenic aerosol, and a lack of major volcanic eruptions. These experiments aim to quantify the impact of such variation. In the case of volcanic aerosol, the proposal is to specify a "repeat" of the Pinatubo eruption, to take place in 2010.

Details need to be defined - will we also analyze uncertainty in short-lived species (inc ozone); how do we handle ozone perturbations in the volcanic eruption; should we coordinate with the chemistry modelers here?

Summary of runs

| Section | Experiment | minimum # years | 10 member # years |
|---------------|---------------------------|-----------------|-------------------|
| 1.1 | 10 year runs | 300 | 1000 |
| 1.2 | 30 year runs | 180 | 600 |
| 1.3 | ARGO era 1 year interval | 150+ | 500+ |
| 1.4 | Additional CMIP5 members | 0-210 | 585-945 |
| 1.4a | Non-volcanic C20 | ? 390 | ? 1300 |
| 2.1 | Initialization strategies | 0 | Varies |
| 2.2 | Aerosol sensitivity | 0 | 420 |
| Totals | 1.1 and 1.2 (minimum) | 480 | 1600 |
| | 1.1 - 1.4 | 630-840 | 2685-3045 |
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Additional notes

- The ENSEMBLES project is running decadal prediction experiments with start dates 1960, 1965, ... 2005, but with volcanic aerosol from eruptions after the start of the forecast excluded, and using GHG concentrations from an older scenario (A1B?). Despite these differences, the ENSEMBLES runs may form a useful contribution to the 1.1 runs described above.
- A discussion of options for initializing the oceans is needed. Analyses of past ocean states/anomalies are available. Methods to transfer such analyses into an ocean model's initial condition exist. Many groups will use anomalies, if a suitable coupled climate is available, but initializing the full state is also allowed.
- Given the observed behaviour of Arctic ice in the last few years, initialization and forecast of sea-ice is an issue which groups will need to address.
- The output of the model integrations needs to be defined. We start with the assumption that the output will be the same as that requested for the main CMIP5 runs.
- Data handling needs to be defined. It is hoped, but needs to be confirmed, that data from section 1 (at least) of this proposal can be archived as part of the general AR5 archive, to allow access by the wider scientific community. [Public access?]