Minutes - First Meeting of the SCAR Action Group on Prediction of Changes in the Physical and Biological Environments of the Antarctic

Location – British Antarctic Survey, Cambridge, UK
Dates – 5-6 November 2008.

Wednesday 5 November 2008

Attending: Co-chairs: John Turner (JT; BAS) and Julian Gutt (JG; AWI)
Tom Bracegirdle (TB; BAS), Pete Convey (PC; BAS), Zhaomin Wang (ZW; BAS)
Colin Summerhayes (CS; SCAR).

Unable to attend: Martin Riddle, Yvon le Maho, Guido di Prisco

Morning session.

Initial discussion.

The Terms of Reference were revised to be:

- Assess our current ability to predict how the physical and biological environments of the Antarctic will evolve over the next century;

- Identify the extent to which the physical and biological approaches to prediction can be integrated

- Determine the parameters needed from climate models to predict changes in the biosphere;

- Consider the issues involved in downscaling from the resolution of climate models to those required for prediction of biological systems;

- Investigate the means of improving prediction of selected physical parameters and their impacts on aspects of marine and terrestrial biota;

- Identify areas where future research is needed.

NOTE – these could be refined further as there is quite a lot of overlap

Presentations.

John Turner.
An introduction to physical climate models was given. This was followed by a discussion of the current work on including biological processes in these models. Such work is being conducted at the Met Office and some plots of results of the TRIFFID dynamic vegetation model were shown.

Tom Bracegirdle.
Projections of how the atmosphere and sea ice might change over the 21st century were shown. The plots were created from data from climate model experiments that were run for the Intergovernmental Panel on Climate Change (IPCC) Assessment Report Four (AR4). The projections shown were from one of the future emissions scenarios, SRESA1B, which is about the middle of the spread of different scenarios in terms of temperature change.
Seasonal average projections were shown for temperature, sea ice, near-surface winds and net precipitation.

PC suggested other quantities that would be useful to terrestrial biologists. For instance, daily data for a range of variables, positive degree days and the frequency of individual precipitation events.

The importance of understanding climate variability in the absence of external forcing was raised. CS suggested the addition of a short section in ACCE on the variability of the climate system.

An issue with the interpretation of sea ice concentration plots was raised – *TB will make sure this is clarified in ACCE.*

Discussion to conclude morning session.

PC pointed out that we know little about the link between macroclimate and the microclimate experienced by plants. For instance, the large-scale (shade) temperature can differ significantly to the temperature in direct sunlight.
PC also raised the question of whether freshwater runoff becomes an issue as warming continues into the future.

JG initiated a discussion of the Action Group's emphasis on one-way information transfer from physical models to biological systems. There may be ways the biologists can feed back into the physical models and improve their coupling to the biosphere. This would involve significant research efforts beyond the scope and resources of the Action Group. However, topics and strategies could be suggested for future projects.

Afternoon session

Zhaomin Wang.
Projections of temperature, salinity and circulation in the ocean for the 21st century were shown. The data used were taken from the SRESA1B runs of the AR4 models.
Annual average sea-surface temperature (temperature of upper layer in model): This showed general warming with slight cooling in some sea-ice regions. Further plots of the projections for summer and winter would be a useful addition to ACCE.
Annual average zonal average ocean temperature cross sections: Again, widespread warming, concentrated in the upper layers. As above, summer and winter figures would be a useful addition.
Annual average surface salinity: General freshening attributed to increases of freshwater flux into ocean by precipitation. Some regions of increasing salinity in sea ice zone.
Annual average zonal average salinity cross sections: These show slight increases of salinity at most depths. Near the surface decreases are projected at high latitudes and increases at ~10-30° in latitude.
Circulation: A comprehensive overview of the Southern Hemisphere ocean circulation was shown (*use Rintoul's plot in ACCE).* ZW emphasised that there is a lack of knowledge of the sub-polar gyres. Projections of 21st century changes simulated by the AR4 models were shown for the Antarctic Circumpolar Current (ACC) and the sub-polar gyres. There is no consensus among the models for the ACC changes; some models show an increase and some show a decrease. Many factors can influence the strength of the ACC. There is more consensus over the future changes of two of the sub-polar gyres, the Ross Sea and Weddell Sea gyres. In particular all models show a strengthening of the Weddell Sea gyre, with most models showing an increase of gyre strength. Changes of the Australia-Antarctic Sub-polar gyre are more variable with a large uncertainty.

Pete Convey.
This was a discussion focussed on the interface between ecosystem records and meteorology. The background to this talk is that there are few long-term monitoring (LTM) surveys of the biosphere. PC showed data from a record of plant species in the Argentine Islands, which was limited and temporal coverage to time slices in the 1960/70s, early 1990s and early 2000s. This is unusual as in most cases surveys of a particular place are only conducted once.

PC and others have compared the plant (and animal?) population record of the Argentine Islands with the Faraday/Vernadsky temperature observation record. Between 1960/70s and early 1990s there was a population increase that coincided with an observed increase of temperature. The survey in the early 2000s has shown no significant population increase since early 1990s. This has coincided with no significant change of temperature over the same period. The main message is that populations may respond to temperature changes on a short (less than 10 year) time scale.
One possible approach to making a more comprehensive temporal comparison between ecosystem data and meteorological data might be the assessment of peat deposits, which are being studies at many locations along the western Peninsula. A peat mound with live moss at the southern vegetation limit has recently been studied and it seems that it was established long before recent warming. Estimates are that this and other peat accumulations across the western Peninsula provide a record going back 350-1400 years.

Julian Gutt.

The population dynamics of the ocean floor and the issue of matching the spatial scales of climate data with ecosystems data were discussed, with a particular reference to bio-regionalisation.

In most regions the effects of climate change have not been observed in benthos. Exceptions are local regions at the Peninsula, in particular disintegrating ice shelves. JG demonstrated results from an idealised model, which simulates population dynamics of benthos in iceberg-scouring regions.

As well as studies on a local scale JG showed results from a bio-regionalisation study of the ocean around Antarctica. Bio-regionalisation is where regions of the ocean are divided up spatially by a clustering analysis of multiple physical and chemical parameters. This approach more clearly matches the spatial scale of data output from climate models (~1°x1°). The bio-regionalisation approach and possible opportunities for cross-linkages with the climate community were discussed in more detail with SG on the morning of Thu 6/11 (see below).

A key point of the discussion was that there is a hierarchy of ecosystem models. This ranges from comprehensive models of the behaviour of single species to basic large-scale characterisations such as bio-regionalisation. Since climate models have a low spatial resolution, there may be more opportunities for collaboration between physical climate modellers and biologists who work on basic large-scale ecosystem models than those working on small-scale detailed ecosystem models.

Thu 6/11/2008
Co-chairs: John Turner (JT; BAS) and Julian Gutt (JG; AWI).
Tom Bracegirdle (TB; BAS), Pete Convey (PC; BAS), Susanna Grant (SG; BAS) and Zhaomin Wang (ZW; BAS).

Morning session.

SG in attendance to discuss possible overlap between climate modelling and the Antarctic-wide view of the bio-regionalisation work. SG agreed that there was scope for an overlap which could extend to predictive work.

A key rationale for work on bio-regions was to produce a map as a base for the next steps in designing protected areas. The different bio-regions in bio-regionalisation are defined using a clustering analysis of physical data (bathymetry, nitrate concentrations, ice concentration, chlorophyll and others). Divide into 40 different groups.

There is scope for ongoing revision of the bio-regions if/when updated physical data become available. For instance Phil O'Brien is doing work on identifying geomorphic units – maps of 20 different categories: troughs, slopes and other geomorphic features. This is currently not being done due to lack of personnel on project.

PC asked whether there is any concept of bringing climate prediction into the bio-regionalisation approach. SG felt that there definitely is. Seasonal or inter-annual variability of bio-regions hasn't even been captured yet, so there is lots to be done in addition to taking prediction into account. JG raised the possibility of a workshop to formulate how bio-regionalisation might be developed to incorporate predictions. It was emphasised that the main interest of the Action Group is prediction and not protection.

SG mentioned a joint workshop between CAMLR and Antarctic Treaty CEP (committee for environmental protection) in April. Not necessarily looking at detail of hard research, but looking at ways in which the two groups could co-operate. *Consult with CS on possible attendance*.

Alternative contact to SG is Andrew Constable who is at the Australian Antarctic Division.

Other interest
SG. Two other things that might be of interest.

1) Paper on sea floor temperature (SFT) with Andy Clark and Huw Griffiths. Generated a map of SFT around whole continent. Not clear where SFT came from. At least need to refer to it in ACCE.
2) Paper by Phil Tratham on effects of climate change on CAMLR fisheries. This made recommendations on what more could be done.

Agreed actions.

- Papers.
    1) One or two on perspectives of climate science in marine and terrestrial biology. A simplified review. Interested parties in group will write a paper. Year 1 – terrestrial, Year 2 possibly marine.
    2) Encourage research in direction of natural variability.
    3) Zhaomin work on future temperature and salinity in the ocean as nothing is written yet.
    4) Antarctic Science paper which summarises ACCE. 3-6 months timescale.
    5) Material for ACCE.

- Recommendations.
    1) Get involved with CCAMLR/CEP workshop in April.
    2) Workshop to combine understanding of bio-regionalisation and physical climate modelling (2-yr timescale). Produce a defined output.
    3) Long-term observations on biological side. This would make for a stronger link between climate and biology. There is a need to address lack of spatial and temporal ecological data.
    4) More studies required on physiological limits and ecological demands of ecological key species.

- Action Group website.
    1) A group web site has been established at http://www.antarctica.ac.uk/met/SCAR_ssg_ps/Prediction/index.html. Currently empty, the site will include:
    2) Summary one-page statement on current knowledge.
    3) Reference list of key papers.
    4) Needs for climate model output.
    5) Key mean fields for SCAR.

- Promote links with others in the community.

Tom Bracegirdle - secretary.