

Terms of Reference

ESSAS Working Group 1: Regional Climate Prediction (WGRCP)

Ecosystem Studies of Sub-Arctic Seas (ESSAS)

28 February 2007

Introduction

A major goal of ESSAS is to predict the potential impacts of climate variability on the sustainable use of the sub-arctic seas. ESSAS has elected to employ a comparative approach, investigating in each of the sub-arctic seas which energy pathways appear particularly vulnerable to decadal and longer-term climate change. The ecosystem response to climate can be non-linear with thresholds, have complex interactions between species, and different species impacts from similar climate fluctuations. Reducing uncertainty about the future states of ESSAS ecosystems depends on knowledge of the response of the ecosystem to changes in climate and a quantitative ability to project future climate states. The first task represents understanding and modeling the complex linkages between climate variables and species distributions and is a primary focus of the other two ESSAS Working Groups (ESSAS Working Group 2: Biophysical Coupling Mechanisms and ESSAS Working Group 3: Modeling Ecosystem Responses).

A Goal of the **Working Group on Regional Climate Prediction (WGRCP)** is to provide quantitative estimates of the magnitude and uncertainty of future climate change for the ESSAS regions, and the frequency distribution of natural variability, such as the well known ecosystem reorganization of the North Pacific in the mid-1970s and historical interdecadal variability in the marginal seas of the North Atlantic. Climate elements known to be crucial to ESSAS ecosystems include sea ice cover, ocean temperature, circulation, and stratification.

A major resource for the development of future climate scenarios is the recently available results from 22 state-of-the art coupled atmosphere-ocean climate models which are part of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4). A preliminary investigation has shown that a subset of these models represents the physical forcing in several ESSAS ecosystems reasonably well based on comparison with *in situ* data for the late 20th century. There are several factors that lead to the perceived credibility of future climate scenarios from climate models, including the differences between models, validation exercises for different physical variables, and matching the spatial scales that are important to ecosystem biology.

Tasks

1. Evaluate the credibility of the 22 IPCC models as applied to each of the different ESSAS regions based on comparison of 20th century hindcasts with data, and model to model consistency and physical reliability in their forecasts. Produce a report which provides recommendations on which models perform well for each region.
2. Working within the larger ESSAS framework, establish which seasons, regions and variables are most important to potential ecosystem shifts and provide report on future scenarios and confidence estimates of these conditions for different future time horizons. Assess the contributions from intrinsic climate variability and external anthropogenic forcing.
3. Recommend IPCC models and procedures for downscaling of the model output for use in regional ocean/ecosystem models.
4. Be a community resource on retrospective and future climate change issues.

Implementation

1. The Working Group on Prediction shall exist for a period of three years, ending six months after the 2009 annual meeting of ESSAS.
2. Six to eight members will be chosen from the fields of climate science and numerical modeling. Input from experts on ecosystem processes will be sought through collaboration with ESSAS WG 2 and 3.
3. The development of the proposed products includes conducting workshops held at the annual ESSAS meetings and will require inter-sessional work. The purpose of the workshops is to vet and reach consensus on information made available prior to the workshops from the published IPCC Reports and from direct model evaluations provided by members.

Expected Results

To ensure the perceived credibility of future regional climate scenarios, we will develop a white paper after the ESSAS Workshop in 2007 that examines the differences between IPCC models, identifies the spatial scales and variables that are of relevance to ecosystem-effects of climate change, and delineates further validation exercises for different physical variables that have been performed.

After the ESSAS Workshop in 2008, we plan to have a set of climate predictions for the major ESSAS ecosystems, based on the IPCC climate models. These regional climate scenarios will have sufficient credibility that they

can be used by other ESSAS Working Groups as the basis for their ecosystem modeling efforts.

Membership

A list of the initial members of ESSAS WG 1 is as follows:

James Overland,	acting Chair, USA
Lennart Bengtsson	Germany
Paul Budgell	Norway
Vladimir Kattsov	Russia
Ken Drinkwater	Norway
Mike Foreman	Canada
Hisashi Nakamura	Japan
John Walsh	USA