

Overview-1: Climate Change

Projected Changes in the Physical Environment Relevant to Western Alaska Salmon

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In preparation for the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, an international group of modeling centers carried out sets of global climate simulations. A total of 23 different coupled atmosphere-ocean general circulation models were employed under common emission scenarios. The objective of this paper is to describe a protocol for using these simulations towards the projection of environmental factors known or suspected to be important to salmon stocks of western Alaska. Our method relies on critical evaluation of the models' 20th century hindcasts. The first step has been to determine the degree to which each available model was able to replicate the spatial pattern, temporal scale and magnitude of variance associated with the leading mode of variability in North Pacific SST, i.e., the Pacific Decadal Oscillation (PDO). The subset of 12 models successful at replicating the PDO were then examined further using a technique known as Bayesian Model Averaging (BMA). This technique provides weighted ensemble means and estimates of uncertainties in the models' predictions for individual parameters in specific regions. For example, Kuskokwim river chum salmon have been found to be sensitive to springtime air temperatures in western Alaska and winds in the vicinity of Unimak Pass (Shotwell et al. 2005); application of BMA indicates that the trends in these two parameters are likely to be deleterious to this particular stock. Other physical parameters that have been analyzed for the Bering Sea include maximum ice extent in spring and SST in summer. In general, our examination of the output from the global climate models indicates it is feasible to begin making projections for regional applications, as long as the physical environmental controls for a specific population or region are known. We consider our technique to be a reasonable way to achieve an early indication of the likely changes in selected fish populations. It should be considered as complementary to direct simulations, in which climate scenarios are used to force regional ocean numerical models, which in turn are linked to biological models, i.e., dynamical downscaling.