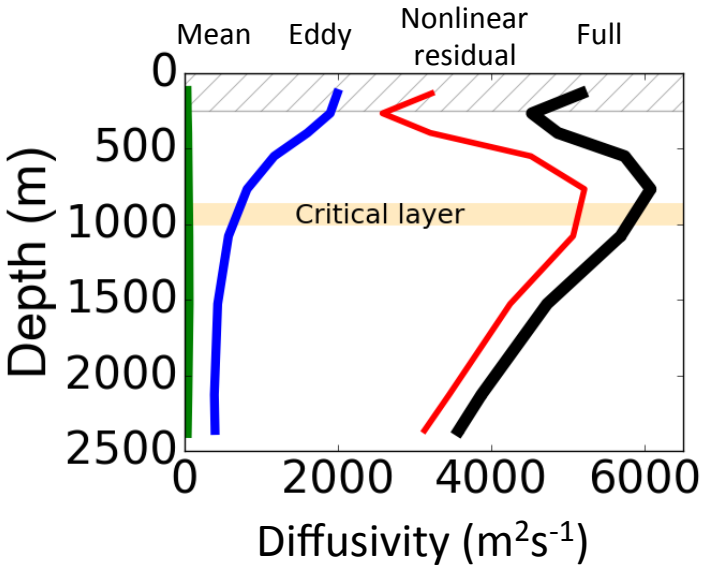
Understanding current and eddy contributions to ocean mixing

Objective

Large eddies and mean ocean currents interact to transport carbon and tracers from the atmosphere into the deep ocean. This mixing is measured via a full diffusivity that we decompose into its key mixing contributions by the eddy, mean, and eddy-mean residual flow.



Research

- Diagnosed mixing suggests slope front over shelf break inhibits on-shelf mixing within ice sheet melting process
- Mixing is largely produced by interactions of mean and eddy flow
- Eddy and mean contributions are small compared with nonlinear residual

Impact

- Diffusivity decomposition provides path for improved understanding of ocean mixing
- Importance of residual contribution of eddy-mean interactions indicates high resolution is key to resolving mixing
- Existing mixing models require new and improved parameterization strategies

Reference: Wolfram, P.J. and Ringler, T.D., 2017. Quantifying residual, eddy, and mean flow effects on mixing in an idealized circumpolar current. Journal of Physical Oceanography, 47(8).

Intercomparison of Dynamic Ocean Sulfur Cycle Models

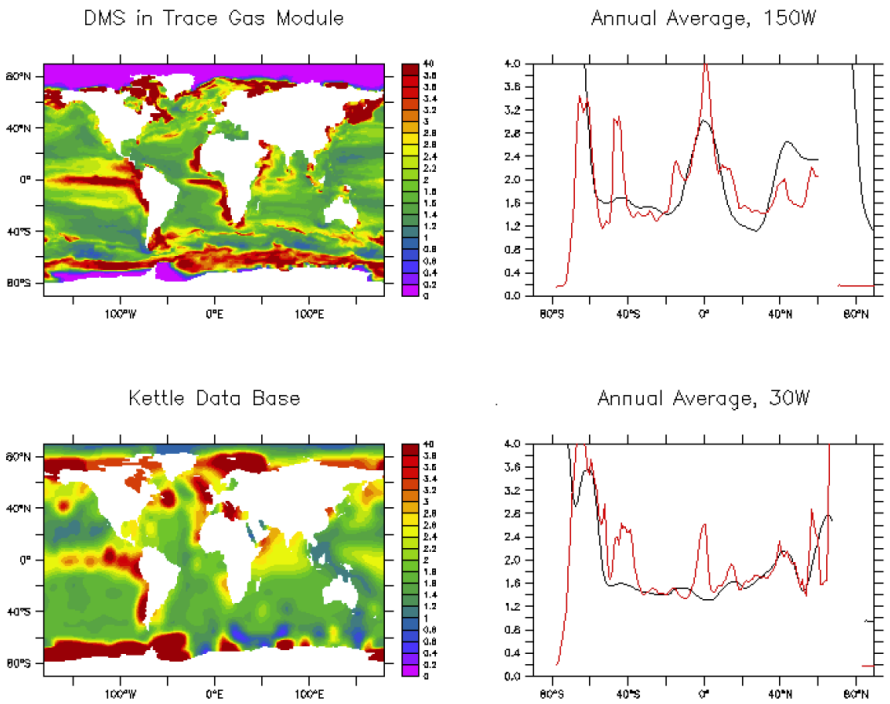
Objective

Surface ocean dimethyl sulfide (DMS) transfers to the troposphere, supplying sulfate to the aerosol and CCN. Stratus clouds are brightened globally (CLAW hypothesis). But models of the seawater distribution are new and difficult to validate.

Approach

- Developed a dynamic global marine S cycle code in the Los Alamos Parallel Ocean Program (POP)
- Driven by NCAR N, Si, C ecodynamics
- Participation in the first-ever international intercomparison for DMS models (CODiM)
- Los Alamos approach proved superior in capturing details of collective measurements

LANL model (top left and black) versus climatology (bottom left and red), nM units



Impact

Simulations of CLAW using this code are now being conducted in DOE-NSF CESM. We hope to demonstrate large forcing errors due to uncertainties in the ocean ecology controlling DMS fluxes

LeClainche, Y., with Elliott, S. among 17 others, 2010. A first appraisal of prognostic ocean DMS models and prospects for their use in climate simulation. *Global Biogeochemical Cycles,* 2009GB003721.

Exploring the potential for Arctic Systems Modeling (ASM)

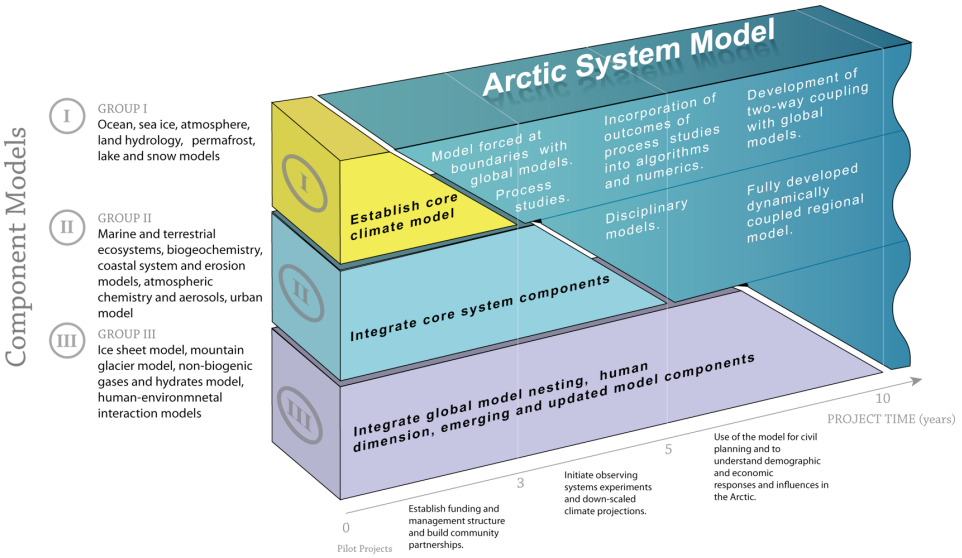
Objective

The Arctic is now undergoing rapid regional evolution driven by global warming. We define here a need for highly interactive, multidisciplinary models for the simulation of total boreal environmental change.

Approach

- Existing model frames are mainly physically based –e.g. meteorological
- Major needs are for coupling between media, via biogeochemistry and biology simulators plus incorporation of the human dimension
- Examples of the interchange with human activity include fisheries, hydrology, cultural and mineral rights

Schematic of major concepts



Impact

International level collaboration recommended as a means to complete and apply such codes. See also a full length report from the same authors and the International Arctic Research Center, describing detailed ASM

Roberts, A., Cherry, J., Doscher, R., Elliott, S. and Sushama, L. 2010. Exploring the potential for Arctic Systems Modeling. *Bulletin of the American Meteorological Society,* in press

Title

Objective

Research

Impact

Reference: