Surveillance, Modelling and Visualization Stream

Title: New Developments in NOAA's GNOME Suite for Oil Spill Modelling.

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Extended Abstract:

The GNOME (General NOAA Operational Modelling Environment) Suite is a set of software tools developed to support the response to oil and chemical spills in the marine environment. NOAA (The US National Oceanic and Atmospheric Administration) has the responsibility to provide scientific support, including fate and trajectory analysis, for spills in US marine waters. The GNOME Suite was developed to support this mission, and is made freely available to the global response community for use in response, training, drills, planning, research and education.

Always under active development to support both NOAA and the response community's needs, recent work has been focused on the development of web-based systems to allow use without needing to install custom software.

At the center of the Suite is the GNOME fate and transport model, but it also includes the ADIOS Oil Database, a publicly available database of oil properties, the Trajectory Analysis Planner (TAP), a tool for stochastic analysis of oil transport, and some smaller utilities. The entire suite is available for free, and the source code is fully Open Source.

In the last decade, the GNOME suite has seen a great deal of development. Recently added features include a brand new web interface to the ADIOS oil database, updated visualizations in WebGNOME, better handling of ice, integration with the TAMOC blowout plume model, and easier access to a variety of data sources, including meteorologic and oceanographic models. The modeling suite can be accessed via modern web interfaces, or extended or automated via a Python scripting environment.

The GNOME Model: The General NOAA Operational Modeling Environment (GNOME) model is an integrated oil spill fate and transport model. At its core is a flexible framework for Lagrangian element (particle tracking) models. The individual elements can be customized with specific behavior in order to simulate different substances in the environment. Out of the box, the elements can be used for passive floating drifters (such as marine debris),

passive neutrally buoyant drifters (to simulate soluble chemicals), and a complex pseudo-component model to simulate oil weathering processes.

For transport, the elements can be moved by the ocean currents and winds, as well as having a built in random walk diffusion. Code is included to use all of the commonly used file and grid formats from coastal, ocean, and meteorological models. Oil weathering processes that can be simulated include evaporation, dispersion, dissolution, bio-degradation, emulsion formation, and oil-sediment aggregation.

The system is written in a combination of the Python and C++ languages, and can be scripted, extended, and customized in Python.

WebGNOME is a web-browser based application that provides an easy to use graphical interface for setting up and running the GNOME model. NOAA runs a publicly available server for drills, training, etc. for modest scale simulations. The source code for the entire WebGNOME system is available to other institutions to run their own internal servers if the NOAA server does not meet their needs.

https://gnome.orr.noaa.gov

GOODS:
The GNOME Online Oceanographic Data Server (GOODS) is a system for obtaining data and model results that can be used to drive the GNOME system. It provides access to oceanographic models, as well as maps, wind data, and meteorological models. Development is currently underway to create a closer link between the WebGNOME and GOODS systems.

https://gnome.orr.noaa.gov/goods

ADIOS Oil Database:
The Automated Data Inquiry for Oil Spills (ADIOS) Oil Database is a collection of publicly available data about petroleum products that can be used to support spill response. The web site hosted by NOAA provides a searchable and easy to use interface to a large collection of publicly available data. The data can be downloaded for use with GNOME or other oil spill weathering models. The source code for software used to manage the data and provide the web interface, as well as the data itself, are all publicly available.

https://adios.orr.noaa.gov

TAP:
The Trajectory Analysis Planner (TAP) is a system for the analysis and presentation of stochastic results from oil spill modeling simulations. It provides a interactive interface that lets users explore the likely spatial and quantitative distribution of oil impacts resulting from potential spills in a region. NOAA hosts a web-based server with model results for a dozen regions in the US, as well as a couple of international locations.

https://tap.orr.noaa.gov

CAFE:
The Chemical Aquatic Fate and Effects (CAFE) database is a software program you can use to estimate the fate and effects of thousands of chemicals, oils, and dispersants. CAFE serves as a tool to help responders in their assessment of environmental impacts from chemical or oil spills in an aquatic environment. CAFE is available with a Web-based interface that guides the user through an analysis of particular chemicals.

https://cafe.orr.noaa.gov/

NUCOS:
The NOAA Unit Converter for Oil Spills (NUCOS) is a simple desktop tool that converts basic units of velocity, mass, length, etc., but more specifically, converts units that are unique to oil spill response. NUCOS includes some of the lesser known units used in managing oil and chemical spills. For example, it converts the units for oil volume, viscosity, and density, and surface concentration.

https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/response-tools/nucos-unit-converter-spill-responders.html

Source Code:
The source code for all these tools is in the public domain, and available on gitHub, in the NOAA Emergency Response Division's organization:

https://github.com/NOAA-ORR-ERD