DRAKKAR : Enhancing synergies between satellite, in-situ, and numerical oceanography

DRAKKAR Modelling Program

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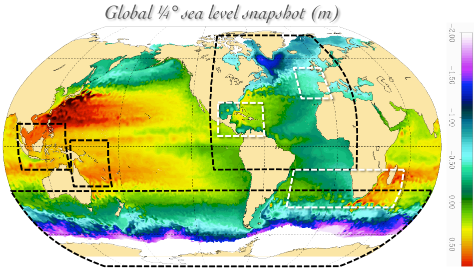
DRAKKAR's general objective within the OST/ST is to further develop synergies between ocean observations, theories, and models. This poster summarizes along 4 axes some results obtained these last years (with collaborations within the OST/ST community) and presents our objectives for the next years.

The **DRAKKAR ocean modelling consortium** is led by scientists from France, Germany, and the UK, with several collaborations in the operational and research oceanographic communities. This group continuously develops, upgrades, and integrates a hierarchy of global and regional ocean/sea-ice models over the period 1960-present, making continuous use of available observed datasets (forcing, validation, OSSEs).

Global ¼° sea level snapshot (m)



- NEMO ocean/sea-ice/$^{14}C/CFC_{11}$ z-level code
- Global 2°, Global 1°, Global ½°, Global ¼°
- Stand-alone configurations
- Nested configurations

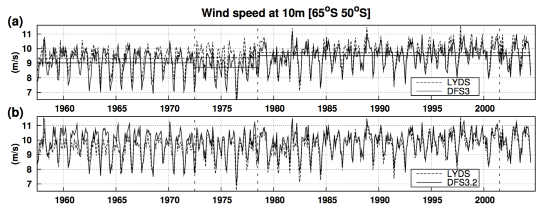
- Period of interest : 1958-present
- Both global and regional studies
- Water masses, dynamics, scale interactions, …
- Strong links with ocean observations & theories
- 100+ users collaborating on scientific studies

Improve the surface forcing for global ocean models: blending satellite observations (SST, air-sea fluxes, scatterometer data) with reanalyses.

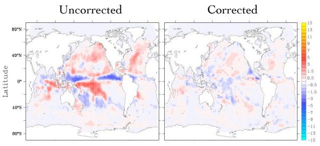
Part of our OST/ST project aims at improving and continuously extending bulk formulae-based atmospheric forcing functions, and thus, simulations. Building consistent surface forcing fields for long global ocean hindcasts requires assessments of atmospheric datasets, consistent blending between them, and a posteriori assessments. The figure below illustrates the first issue on Southern wind speeds: the NCEP reanalysis exhibits discontinuities between periods of different observing systems.

Building the *DFS3 hybrid forcing* that drives the DRAKKAR models has required a careful calibration of various observed/ reanalyzed products, and series of coarse-resolution integrations.

see poster by BRODEAU ET AL : AN ERA40-BASED ATMOSPHERIC FORCING FOR SIMULATIONS AND REANALYSES OF THE GLOBAL OCEAN CIRCULATION BETWEEN 1958 TO PRESENT.TOPIC: 4. KEY SCIENTIFIC & TECHNOLOGICAL ADVANCES (GODAE)



Perspective: Use data assimilation + satellite/in-situ observations to improve the forcing of climate-oriented runs (collab J. Verron's OST/ST project)



ERROR ON PRECIPITATION FIELDS

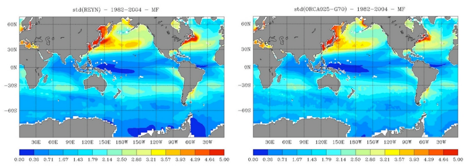
The SEEK filter can be used to correct the model state and/or the surface forcing. This figure demonstrates the feasibility of the latter in a 2°-resolution twin experiment based on DRAKKAR setups : the SEEK can strongly reduce errors on poorly-known air-sea flux components (here, precipitations) and model-data misfits. This technique will be applied to increasingly realistic cases.

see poster by SKANDRANI ET AL : IMPROVING THE SST AND SSS FORECASTS BY A KALMAN FILTER AUGMENTED CONTROL VECTOR TECHNIQUE: A GLOBAL TEST CASE STUDY USING MERCATOR REANALYSIS DATA (GODAE)

Extend the multivariate, quantitative, systematic assessment of DRAKKAR simulations with respect to, and after time/space collocation with :

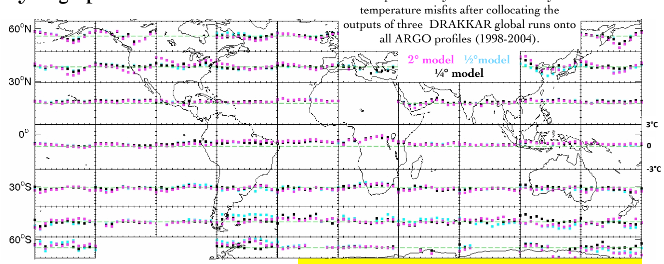
1. satellite observations

Standart deviation over 1993-2004 of Reynolds' satellite-derived SSTs band-pass filtered between 5 and 18 months (left), and their counterpart simulated by the ¼° DRAKKAR model (without assimilation) after space-time collocation. The seasonal cycle of SST appears very realistic in most areas, despite discrepancies around Antarctica. Diagnostics are underway on other SST timesacles, and about to be published concerning sea-level anomalies (Penduff, 2006, 2007)



2. hydrographic observations

Example: Monthly median of mixed-layer temperature misfits after collocating the outputs of three DRAKKAR global runs onto all ARGO profiles (1998-2004).



see poster by JUZA ET AL : ASSESSMENT OF DRAKKAR GLOBAL SIMULATIONS AGAINST HYDROGRAPHY OVER 1958-2007: METHODS, METRICS AND MODEL SKILLS (GODAE)

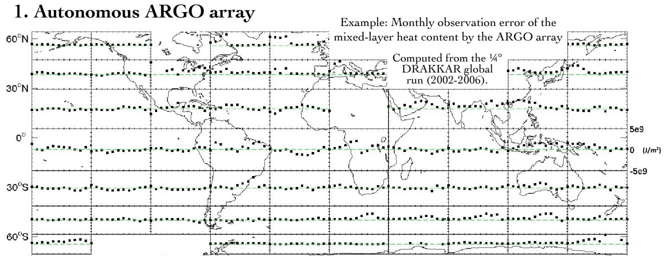
3. perspectives

Develop mehotds to extend simulation assessments to more datasets (e.g. SST, currentmeter, gravimetric, ARGO displacements).

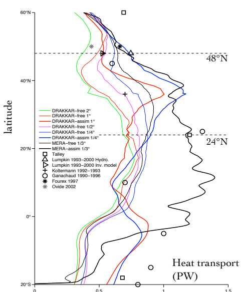
Study the observability of climate indices from observations, reanalyses, and simulations

1. Autonomous ARGO array

Example: Monthly observation error of the mixed-layer heat content by the ARGO array



2. Observed / simulated / reanalyzed Atlantic mean heat transport



The oceanic North Atlantic heat transport is a crucial climate index, whose evolutions are generally studied from either observations, simulations, or reanalyses. This example illustrates the impact of resolution (*DRAKKAR-free runs*) and of data assimilation (*assim*) on its mean value throughout the basin, along with observational estimates. Understanding the complex variability of this climate index would certainly benefit from *the combined investigation of models, reanalyses and direct observations* (e.g. the RAPID array at 24°N). This is one of DRAKKAR objectives.

see poster by JUZA ET AL : REGIONAL ACCURACY OF GLOBAL ARGO-BASED MONTHLY MIXED LAYER PROPERTY ESTIMATES: DEPTH, HEAT AND SALT CONTENTS (GODAE)

see poster by LECOINTRE ET AL : NORTH ATLANTIC VARIABILITY FROM OCEAN SIMULATIONS WITH AND WITHOUT IN-SITU/SATELLITE DATA ASSIMILATION (OST/ST)

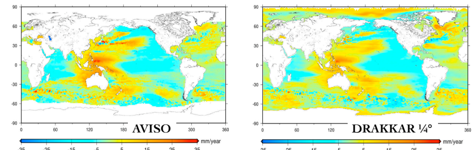
see poster by FERRY ET AL : GLORYS - GLOBAL OCEAN REANALYSES AND SIMULATIONS PROJECT: HOW LESSONS LEARNT FROM GODAE ARE USED FOR GLOBAL OCEAN REANALYSES (GODAE)

Distribute DRAKKAR simulations to the OST/ST community and beyond, to further develop model/observations/theories complementarities, promote collaborations with OST/ST contributors. This includes e.g. full model outputs, post-processed fields, model equivalents of satellite maps (SSH, SST, SSS, etc) or in-situ T/S profiles collocated in time & space.

Example 1 :

DRAKKAR + LEGOS + Mercator

Regional patterns of 1993-2004 sea-level trends from altimeter data and the global ¼° DRAKKAR simulation (without assimilation). The simulation allowed **Lombard et al (2008)** to gain insight into the origins of the observed signal, and requirements for simulating its structure.



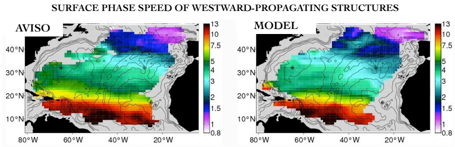
also see talk by A. CAZENAVE (Monday 2PM) : SEA LEVEL AND CLIMATE CHANGE (OST/ST)

Example 2 :

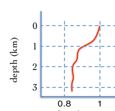
DRAKKAR + NOCS + Univ.Reading

The combined study of CLIPPER simulations and altimeter data allowed **Lecointre et al (2008)** to
- Assess the realism of westward propagation in such models
- Detect a robust tendancy of simulated structures to propagate slower at increasing depths.

SURFACE PHASE SPEED OF WESTWARD-PROPAGATING STRUCTURES



This latter result comes from an altimeter-assessed, numerical simulation.
It raises questions about hypotheses done in theoretical studies about Rossby waves (RW).



Subsurface-to-surface ratio of model phase speeds

DRAKKAR + obs. + theories are now being considered together in OST/ST RW-oriented research.

see poster by TAILLEUX ET AL : OBSERVATION, THEORY, AND MODELLING OF WESTWARD PROPAGATION IN THE OCEANS (OST/ST)

References

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- **DRAKKAR Group, 2007**: Eddy-permitting ocean circulation hindcasts of past decades. **Clivar Exchanges**, No 42 (vol 12 No 3), 8–10.
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