

UK high resolution ocean/climate activities

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development teams

UK high resolution ocean/climate activities (1)

- Summary of state of the art simulations
 - Use only NEMO ¼ across timescales
 - ocean forecasting, seasonal prediction and climate
 - UK-ESM1 (CMIP6) will have low resolution version
 - Latest simulations (first major set since CMIP5, many components very different)
 - 150-200 year present day simulations using GC2
 - 130km and 60km atm coupled to NEMO025 and CICE
 - Other 'DECK' runs such as:
 - Pre-industrial, historic, 1%, 4xCO₂, RCP8.5
 - Next configuration of ORCA025 including:
 - Non-linear free surface, embedded sea-ice, extended grid (for later inclusion of Antarctic ice shelves), Lagrangian icebergs
 - 30+ year forced ORCA 1/12 simulation (run by NOC-S, being analysed by them, MO, Oxford)
 - No simple improvement in biases but largest differences in transport divergence in mid-high latitudes e.g. Boundary currents, where Rossby radius better resolved
 - (later this year) coupled 17km atm-ORCA1/12

UK high resolution ocean/climate activities (2)

- Scientific questions being applied to simulations
 - Sensitivity of simulations to resolution
 - Hierarchy of atmosphere from 130km to 25km coupled to ORCA025
 - Analysis of forced ocean integrations at 1, $\frac{1}{4}$ and $\frac{1}{12}$
 - Southern Ocean biases and causes (Pat Hyder and WG)
 - Analysis of flux biases, primarily atmospheric – lack of cloud, aerosol, wind – error worse in $\frac{1}{4}^\circ$ model vs 1° (viscosity)
 - Some hope for 30-50% improvement with yearly upgrade
 - Longer term – new ocean mixing such as OSMOSIS
 - Coupled fluxes, ocean \rightarrow atmos, mid-lat forcing and turbulent fluxes e.g. Kinter et al
 - Seasonal forecasting – North Atlantic Oscillation has increased predictability
 - Dense overflows and northward heat transport
 - What questions are most useful, how to best configure coupled ORCA1/12 simulations for short simulations
 - Case studies, idealised forcing, initialisation?
 - mesoscale coupling, boundary currents and associated coupling, eddy transports

UK high resolution ocean/climate activities (3)

- Main challenges in progress in high res modelling
 - Ocean spinup
 - What techniques to make this shorter, less expensive?
 - Southern Ocean warm bias
 - atmosphere fluxes – improve clouds, aerosols, winds
 - Ocean – improved near-surface mixing
 - How to test improvements when models are so expensive
 - Data
 - I/O,
 - data sizes,
 - how much information should we keep, full field, regridded, how do we know what to throw away

UK high resolution ocean/climate activities (4)

List of questions to discuss during meeting

- How to choose most informative configurations of forced ocean in such a way that they inform AMIP/coupled simulations
- Respective resolutions of atmosphere and ocean
 - Simply the highest in both?
- This in light of planned coordinated experiments:
 - HIRESMIP for CMIP6 (Haarsma, KNMI) as part of PRIMAVERA
 - 1950-2050, aerosol concentrations
 - Core - coupled ~20km atm, $\frac{1}{4}^\circ$ ocean – 7 models
 - Frontiers – coupled below 20km atm, $1/10$ - $1/12^\circ$ ocean - 5 groups
 - US-CLIVAR successor to Hurricane WG – use tropical cyclone forcing with eddy-resolving ocean model to look at interactions – discussing in San Diego at hurricane conference