POLCOMS Metadata for the ARCoES project

Keywords: POLCOMS, WAM, residual circulation, waves, Liverpool Bay, UK shelf

POLCOMS is the Proudman Oceanographic Laboratory Coastal Ocean Modelling System. It comprises a baroclinic three-dimensional model with the ability to run in regions which include both the deep ocean and the continental shelf, together with linked sediment, turbulence, wave and ecosystem models. The model is based on a regular grid with terrain following vertical coordinates. It requires model nesting to achieve high resolution coastal simulations. At the highest resolution (180 m) wetting and drying of intertidal banks and beaches can be incorporated.

The EPSRC funded ARCoES project (research grant EPSRC EP/I035390/1) has made use of several coupled models at the National Oceanography Centre:

- POLCOMS, formulated on a B-grid following Cartesian coordinates in the horizontal solves the Boussinesq, hydrostatic equation of motion separated into depth varying and depth independent parts to allow time splitting between barotropic and baroclinic components. The water depth (or free surface elevation), horizontal velocity components, temperature and salinity fields are calculated at each node of the computational mesh.

- WAM, a 3rd generation spectral WAve Model that has been modified for shallow water application. WAM simulates wave propagation across the domain providing wave height, period and direction integrated at each node of the computational mesh. It is coupled to POLCOMS to enable wave-circulation interaction in both model simulations.

- GOTM, the General Ocean Turbulence Model is coupled to POLCOMS to enable greater choice of parameter settings and turbulence schemes within the simulation. This allows for more sophisticated turbulence modelling, such as accounting for turbulent mixing with TKE injection at the surface to represent wave white-capping.

POLCOMS was originally developed by the Proudman Oceanography Laboratory, now the National Oceanography Centre. The software is no longer under development and is available on-line. To obtain access please email dataproducts@noc.ac.uk and join the user group polcoms-users@mailman.nerc-liv.ac.uk, which is used to communicate information about POLCOMS. To be kept up to date please register at: http://livintweb.nerc-liv.ac.uk:1801/polcoms-gnu

Application of POLCOMS within ARCoES

POLCOMS has been used by the National Oceanography Centre within the ARCoES project at two key scales for a typical year (2008).

At the regional scale the model has been applied to Liverpool Bay at 180 m horizontal resolution to determine the processes that influence residual circulation within a hypertidal region of freshwater influence. The modelled velocities have been analysed (Fig. 1) to determine residual circulation within the bay for tide only (*LB_tide.mat*) and typical annual baroclinic conditions (*LB_fullCirculation.mat*).

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At the national scale the model is used at 1.8 km horizontal resolution to assess the residual wave-current, baroclinic (*HRCS_fullCirculation.mat*) and tidal circulation around the UK coastline (Fig. 2). Mapping the pathways identifies potential sources and sinks for sediment transport to inform coastal managers of the sediment trajectories between coastal management cells. The model can also be used to identify regions where 2D modelling is adequate and 3D modelling is required to determine the appropriate modelling complexity to use in further modelling studies.

The model results and accompanying matlab scripts below can be downloaded from the Channel Coast Observatory http://www.channelcoast.org/iCOASST/POLCOMS/. Parameters that are available in the *.mat files are the u- and v- components of the annual residual velocity.

- *HRCS_fullCirculation.mat*
- *LB_fullCirculation.mat*
- *LB_tide.mat*
- *plot_residuals_HRCS.m*
- *Plot_residuals_LBmodel_comparison.m*

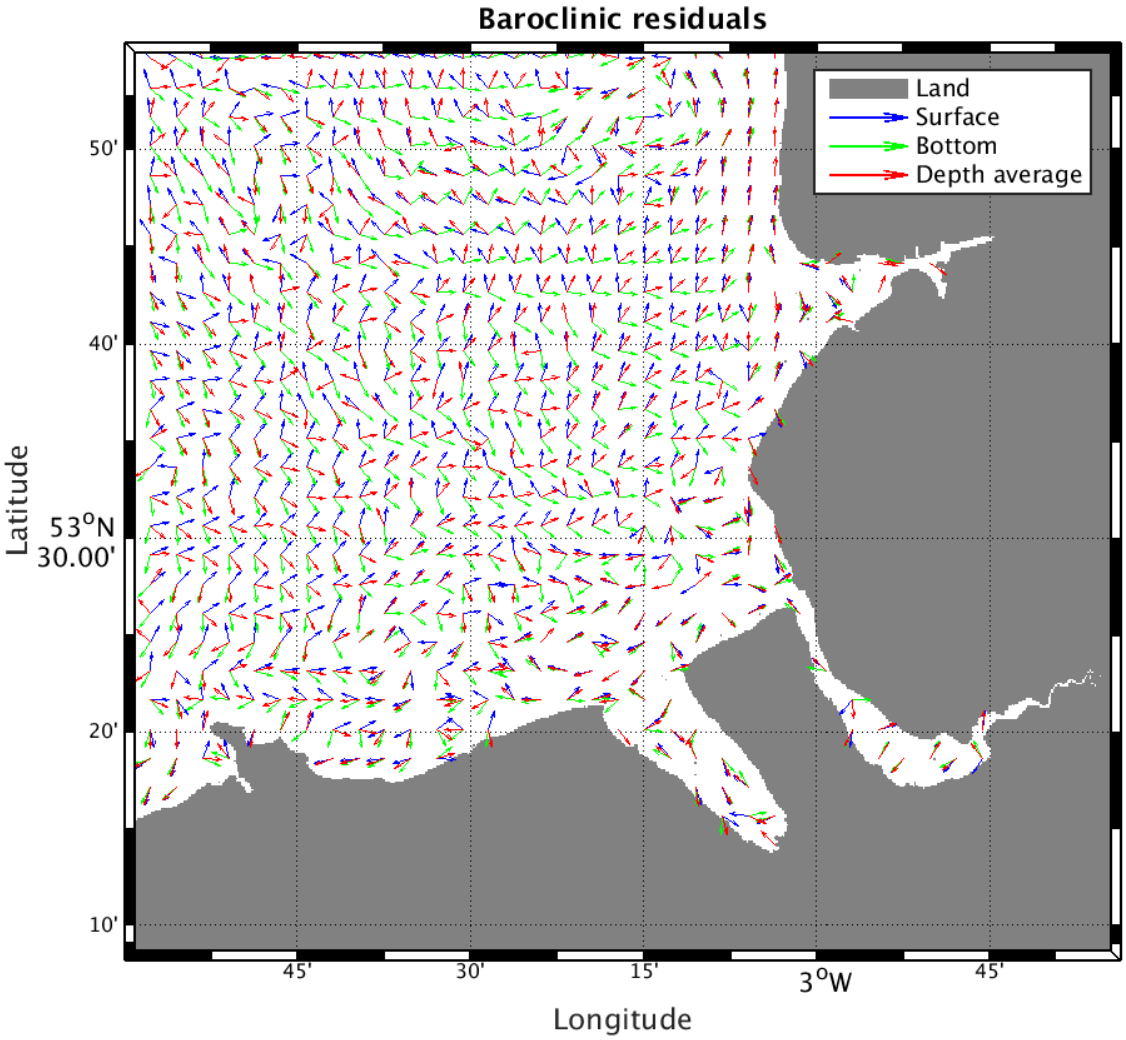

Figure 1: Residual circulations simulated for the year 2008 within Liverpool Bay.

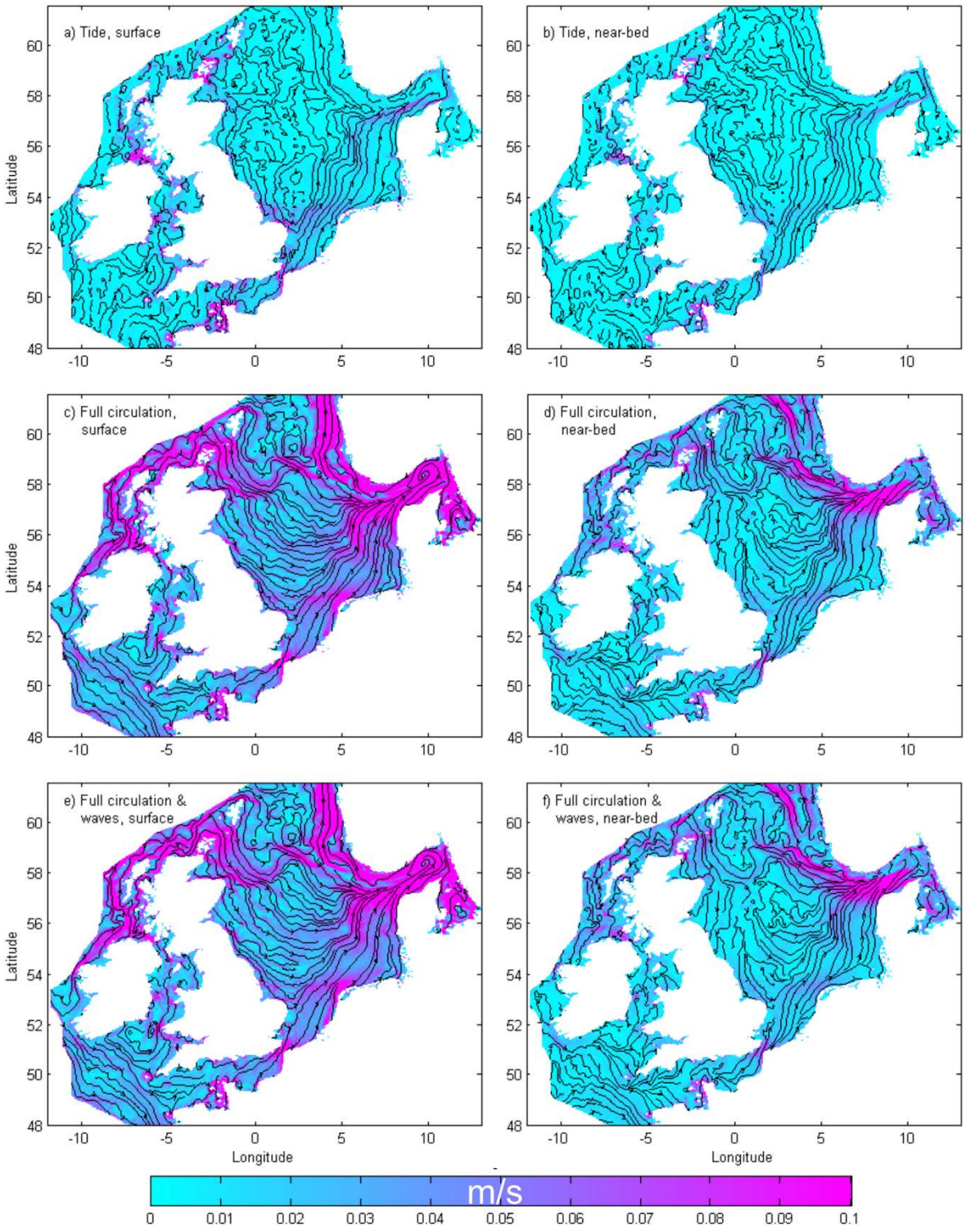

Figure 2: Residual circulations simulated for the year 2008.

Model publications within ARCoES:

1. Brown, J.M., Norman, D.L., Amoudry, L.O., Souza, A.J., (2016) Impact of operational model nesting approaches and inherent errors for coastal simulations, Ocean Modelling, 107, 48-63

2. Brown, J., Amoudry, L. O., Souza, A. J (2015) Residual circulation modelling at the national UK scale to identify possible sediment pathways to inform decadal geomorphic evolution models. Coastal Sediments 2015 (Proceedings of). ISBN: 978-981-4689-96-0

3. Brown, J.M. Amoudry, L.O., Souza, A.J., and Rees, J. (2015) Fate and pathways of dredged estuarine sediment spoil in response to variable sediment size and baroclinic coastal circulation. Journal of Environmental Management. DOI: org/10.1016/j.jenvman.2014.10.017

4. Brown, J., Bolanos, R., and Souza, A. (2014) Process contribution to the time-varying residual circulation in tidally dominated estuarine environments. Estuaries and Coasts. DOI: 10.1007/s12237-013-9745-6

5. Brown, J.M., Amoudry L.O., Mercier, F. M., Souza, A.J (2013) Intercomparison of the Charnock and CORE bulk wind stress formulations for coastal ocean modelling. Ocean Science Discussions. DOI:10.5194/osd-10-519-2013

6. Brown, J.M., Bolaños, R., Wolf, J. (2013) The depth-varying response of coastal circulation and water levels to 2D radiation stress when applied in a coupled wave-tide-surge modelling system during an extreme storm. Coastal Engineering. DOI: 10.1016/j.coastaleng.2013.08.009