# Arc5km2018: Arctic Ocean Inverse Tide Model, on 5 km grid, developed in 2018

The Arctic Ocean Tidal Inverse Model developed in 2018 (Arc5km2018) is a barotropic tide model on a 5 km polar stereographic grid. It is an update to the original Arctic Ocean Tidal Inverse Model (AOTIM5) model developed in 2004, described by Padman and Erofeeva (2004) (https://doi.org/10.1029/2003GL019003). The bathymetry grid is based on the original International Bathymetric Chart of the Arctic Ocean (IBCAO) bathymetry (Jakobsson et al., 2000; https://doi.org/10.1029/00EO00059). Arc5km2018 was developed with the OSU Tidal Inversion Software (OTIS) package (https://www.tpxo.net/otis) using the scheme described by Egbert and Erofeeva (2002) (https://doi.org/10.1175/1520-0426(2002)019<0183:EIMOBO>2.0.CO;2), and consists of grids of sea surface height and depth-integrated currents ("volume transports") for each of 12 tidal constituents; 5 semidiurnal (M2, S2, K2, N2, 2N2), 4 diurnal (K1, O1, P1, Q1), and 3 non-linear ($M_4$, $MS_4$, $MN_4$). The first step in building Arc5km2018 was development of a dynamics-based model, a so-called "prior" model, that was forced at open ocean boundaries by the TOPEX/Poseidon global barotropic tidal solution version 9.1 (TPXO9.1), and by local astronomical forcing ("potential tides") for linear constituents. Interior forcing for non-linear constituents was derived using the scheme described by Andersen et al. (2006) and Egbert et al. (2010). Arc5km2018 assimilated coastal and benthic tide gauges, and TOPEX/Poseidon/Jason and European Space Agency (ESA) satellite radar altimetry, to improve the five largest-amplitude constituents, M2, S2, N2, K1 and O1.

We recommend that users compare results from Arc5km 2018 and AOTIM5, which is also available at the Arctic Data Center (https://arcticdata.io/catalog/view/doi:10.18739/A2S17SS80), before deciding which to use for a specific application.

**NOTE: Also check the ESR Polar Tide Model webpage for more recent Arctic barotropic tide models.**

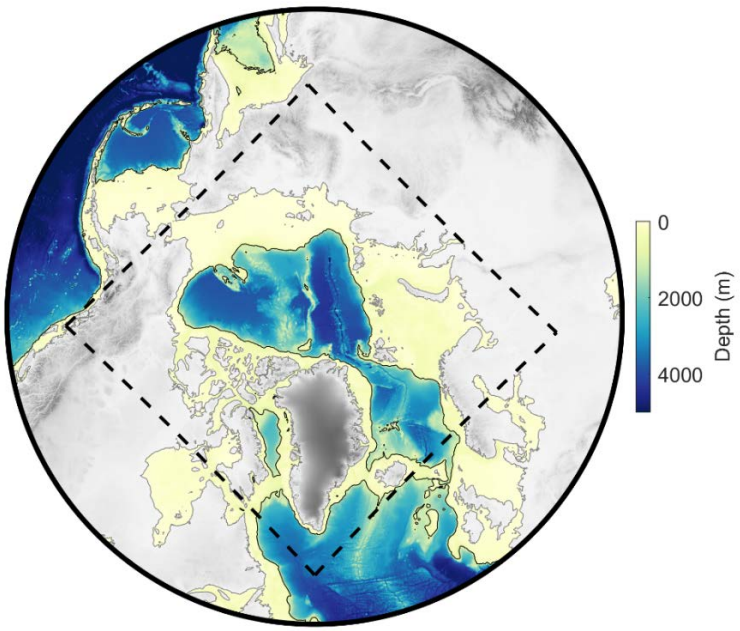


**Figure 1:** Domain for Arc5km2018 tide model (dashed black line); grid is idealized polar stereographic with uniform spacing of 5 km. Color scale shows depth (in meters).

# Arc5km2018: Model Summary

**Build Date:** 2018

**Model type:** Inverse (data assimilation) and Forward (dynamics-based), depending on constituent; barotropic (depth-integrated)

**Grid:** 5-km uniform idealized polar stereographic

**Constituents:** $M_2$, $S_2$, $N_2$, $K_2$, $2N_2$, $K_1$, $O_1$, $P_1$, $Q_1$, $M_4$, $MS_4$, and $MN_4$

**Units:** *z* (surface height; meters); *u,v* (currents; cm/s); *U,V* (transports; $m^2/s$)

**Coordinates:** Currents and transports are in East (*u,U*) and North (*v,V*) components

**Files**

| | |
|---|---|
| Model_Arc5km2018 | Model control file, used by TMD and OTPS to identify grid files |
| h_Arc5km2018 | Complex amplitude coefficients for sea surface height |
| UV_Arc5km2018 | Complex amplitude coefficients for depth-averaged volume transports |
| grid_ Arc5km2018 | Grid of bathymetry |
| xy_ll_Arc5km2018 | File for converting between polar stereo native grid and lat, lon |
| Arc5km2018_README.pdf | (This file) Readme file for the Arc5km2018 model |
| Arc5km2018_FileFormat.pdf | Document describing format of files included in this model package |

Contact Susan Howard (showard@esr.org) or Laurie Padman (padman@esr.org) for advice about the use of these models.

**Known Issues**

- This model provides ocean tide only; i.e., sea surface height change relative to the seabed. Some applications will require adjustment for seabed deformation ("ocean tide loading"). Users require a separate ocean load tide model for this calculation.
- Bathymetry in some areas is poorly constrained by data. For currents, we recommend that the user calculates depth-integrated volume transport, then divides by the latest depth data to get depth-averaged currents.
- The grid is an idealized polar stereographic form based on a spherical earth. To convert from (x,y) to (lat,lon), users must use scripts provided by the OTPS (Fortran) and TMD (Matlab) access toolboxes. Do not use standard conversion scripts that represent the earth as an oblate spheroid.

**File Formats**

The files are written as Fortran binary sequential files, formatted to match the Oregon State Tidal Inversion Software (OTIS) format. These can be easily accessed using ESR's Matlab "Tide Model Driver" (TMD) toolbox (found at https://github.com/EarthAndSpaceResearch) and OSU's FORTRAN "OSU Tidal Prediction Software " (OTPS) code (https://www.tpxo.net/otps).

For full details of our file format, please refer to Arc5km2018_FileFormat.pdf included in the model download.

**Related Links**

| | |
|---|---|
| ESR Polar Tide Models: | https://www.esr.org/research/polar-tide-models/ |
| TMD Matlab Toolbox: | https://github.com/EarthAndSpaceResearch |
| OSU Tidal Prediction Software (OTPS): | https://www.tpxo.net/otps |

**References**

Andersen, O. B., G. D. Egbert, S. Y. Erofeeva, et al. (2006). Mapping nonlinear shallow-water tides: a look at the past and future, Ocean Dynamics, 56, 416-429, https://doi.org/10.1007/s10236-006-0060-7.

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Padman, L., and S. Erofeeva (2004), A barotropic inverse tidal model for the Arctic Ocean, *Geophysical Research Letters,* 31(2), L02303, doi:10.1029/2003GL019003.

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