Continental river discharge for additional dataset of JRA55-do to drive a global ocean circulation model

*Tatsuo Suzuki[1], Dai Yamazaki[1], Hiroyuki Tsujino[2], Yoshiki Komuro[1], Hideyuki Nakano[2], Shogo Urakawa[2]

1. Japan Agency for Marine-Earth Science and Technology, 2. Meteorological Research Institute, Japan

A dataset of historical daily river discharge into oceans has been created using Global river routing model CaMa-Flood (Yamazaki et al., 2011) forced by runoff data from the land surface component of JRA-55 (Kobayashi et al. 2015). The major continental rivers are well resolved with 0.25-degree horizontal resolution. The total runoff on each drainage basin have some distinctive bias. Therefore, the input runoff data is modified by 5-year low pass filtered multiplicative factors to fit the long time mean and decadal variations of the major continental rivers and total river discharge into the individual basins to the reference dataset of Dai et al. (2009). The model is calculated from 1958 to 2016. The yearly and seasonal variations of major rivers are reasonably represented. This data production is planned to be update following the JRA-55.

Keywords: River discharge, Ocean modeling, JRA55

JRA-55 に基づく海洋ー海氷モデル駆動用データセット（JRA55-do）． Part II: 本データセットによって駆動した全球海洋ー海氷モデルの結果の検証

JRA-55 based surface data set for driving ocean-sea ice models (JRA55-do). Part II: Assessment on the results of global ocean-sea ice models forced by the data set

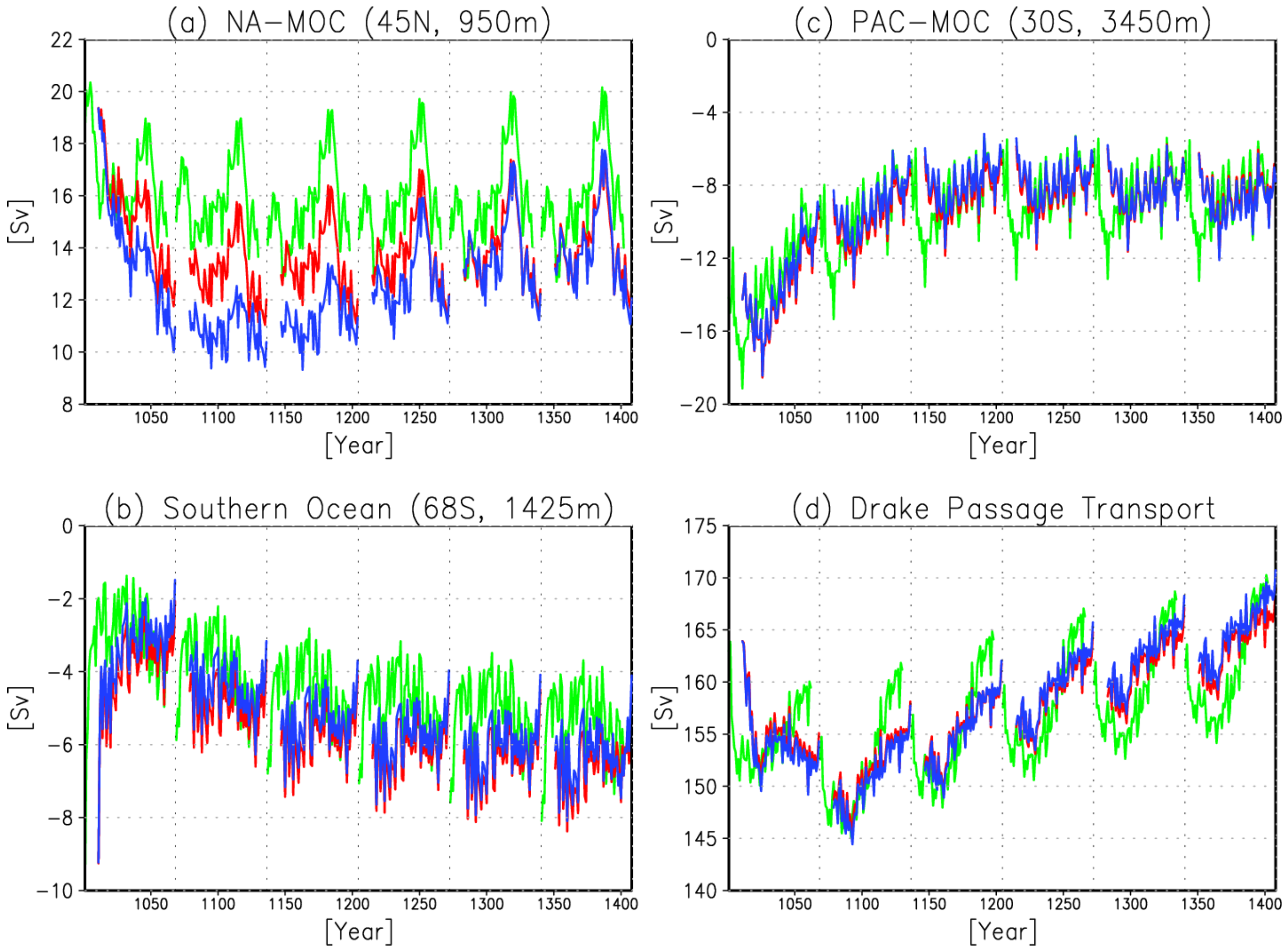
*辻野 博之[1]、浦川 昇吾[1]、中野 英之[1]、Small Justin[2]、Yeager Stephen[2]、Kim Who[2]、Danabasoglu Gokhan[2]、Large William[2]、Josey Simon[3]、鈴木 立郎[4]、小室 芳樹[4]、山崎 大[4]、Griffies Stephen[5]、富田 裕之[6]、Valdivieso Maria[7]、Marsland Simon[8,9,10,11]、Dias Fabio[11,10,9,8]
*Hiroyuki Tsujino[1], Shogo L. Urakawa[1], Hideyuki Nakano[1], R. Justin Small[2], Stephen G. Yeager[2], Who M. Kim[2], Gokhan Danabasoglu[2], William G. Large[2], Simon A. Josey[3], Tatsuo Suzuki[4], Yoshiki Komuro[4], Dai Yamazaki[4], Stephen M. Griffies[5], Hiroyuki Tomita[6], Maria Valdivieso[7], Simon J. Marsland[8,9,10,11], Fabio Boeira Dias[11,10,9,8]

1. 気象庁気象研究所、2. NCAR, USA、3. NOC, UK、4. 国立研究開発法人海洋研究開発機構、5. GFDL, USA、6. 名古屋大学、7. Reading Univ., UK、8. CSIRO Oceans and Atmosphere, Australia、9. Centre of Excellence for Climate System Science, Australia、10. Antarctic Climate and Ecosystems Cooperative Research Centre, University of Tasmania、11. Institute for Marine and Antarctic Studies, University of Tasmania
1. Japan Meteorological Agency / Meteorological Research Institute, 2. NCAR, USA, 3. NOC, UK, 4. JAMSTEC, Japan, 5. GFDL, USA, 6. Nagoya Univ., Japan, 7. Reading Univ., UK, 8. CSIRO Oceans and Atmosphere, Australia, 9. Centre of Excellence for Climate System Science, Australia, 10. Antarctic Climate and Ecosystems Cooperative Research Centre, University of Tasmania, 11. Institute for Marine and Antarctic Studies, University of Tasmania

The surface data set for driving ocean-sea ice models based on JRA-55 (JRA55-do) presented in the companion paper (Part I) was used to force global ocean-ice models. The result was compared with the one forced by the CORE-II data set used in the current CORE / OMIP framework. The experiments followed the CORE / OMIP protocol: Integration starts from the state of rest with climatological temperature and salinity and lasts for about 300 years by repeatedly using the 58-year (1958-2015) forcing data set for five times. Sea surface salinity is weakly restored to climatology. Water volume and salt content in the ocean - sea ice system are kept fixed by adjusting surface fluxes every time step.
The two simulations by a JMA/MRI’s global ocean model, differing only in the surface forcing, largely showed similar features in the last (5th) forcing cycle in terms of mean state, biases, and interannual variability. However, there were two non-trivial differences in relation to the meridional overturning circulation (MOC). First, in the JRA55-do forced run, the Atlantic MOC (A-MOC) declined in the early stage, touching the minimum of about 11 Sverdrups (Sv) in the 2nd cycle. However, it gradually recovered to reach about 16 Sv in the last (5th) cycle. The mean A-MOC strength in the last cycle (16 Sv) was weaker than that of the CORE-II forced run by about 2 Sv, which would warrant a dedicated investigation in the future. The second noticeable difference was the formation of open water Polynyas in the Weddell Sea in the last cycle of the JRA55-do forced run. To understand these differences in the simulation results, we performed sensitivity experiments with the runoff from Greenland and Antarctica of JRA55-do being replaced by that of CORE-II. This is because the run-off from Greenland of JRA55-do has been increased by an order of magnitude relative to CORE-II and the run-off from Antarctica in JRA55-do has spatial distribution as opposed to the uniform distribution in CORE-II. In the sensitivity run, the initial decline of the A-MOC diminished (the minimum is about 14 Sv in the 2nd cycle), but the A-MOC in the last cycle was

almost identical with the original run. This may imply that, in the presence of weak surface salinity restoring, an anomalous fresh water forcing from Greenland will certainly have impacts on the strength of A-MOC in a short term, but that the A-MOC is resilient in a longer term. The formation of open water Polynyas in the Weddell Sea did not occur with the CORE-II run-off around Antarctica. The less (more) run-off east (west) of the Antarctic Peninsula than CORE-II may have caused this difference in the model behaviors. This would warrant some improvements in the representation of cryosphere-ocean interactions in models.

In the poster, results from other ocean modeling groups will be included to investigate whether the above results depend on a particular model or not.



Tuning a North Pacific OGCM with regard to the Kuroshio Current System.

*中野 英之[1]、辻野 博之[1]、坂本 圭[1]、浦川 昇吾[1]、山中 吾郎[1]
*Hideyuki Nakano[1], Hiroyuki Tsujino[1], Kei Sakamoto[1], Shogo Urakawa[1], Goro Yamanaka[1]

1. 気象研究所
1. Meteorological Research Institute

Meteorological Research Institute/Japan has been developing the next generation of monitoring and forecasting system of the north western Pacific Ocean. One of the main targets is the Kuroshio Current System, which is composed of the Kuroshio, Kuroshio Extension (KE) and its recirculation gyres. Due to the enormous effects of the Kuroshio Current System on the various aspects of the North Pacific, its better representation is essential for the overall performance of the system. Here, we consider the performance of a North Pacific model in that system. The North Pacific model with a resolution of about 1/10 degree is nested in a global ocean model with a resolution of 1 x 1/2. This model is also used for nesting a Japan Model, which simulates ocean near Japan with about 2 km resolution. In hindcast experiments under JRA55-do forcing, the North Pacific model can represent a realistic KE separation. Nevertheless, it had following shortcomings until tunings were conducted. (1) The eastward extension of the KE was limited near Japan and the eddy kinetic energy around the KE and the recirculation gyres is too weak compared to the AVISO. (2) The path of the Kuroshio south of Japan south was too unstable, sometimes causing an unrealistic high frequency of large meander of the Kuroshio. After trial and error, we have found that following parameters can be used to mitigate the above problems. (A) Dependency of the ocean surface current to calculate the surface wind stress. (B) Boundary viscosity south of Japan. The former parameter (A) appears in the following bulk formulation in calculating wind stress. Tau = rho C|U - u|(U $-\alpha$ u), where rho is the density of air sea level, C is the drag coefficient, U is the wind velocity and u is the ocean surface velocity. We introduce "α", which describes the relative contribution of ocean surface velocity to the bulk formulation. Intuitively, this coefficient seems one, but in reality, it is not so simple because the momentum and energy transfer between the wind and ocean is caused not only by simple drag of the ocean current, but also through the excitation, spread, and break of ocean surface waves. We consider the parameter can take a value between 0 –1, and use this for a kind of turning parameter of the OGCM rather than going deeply into the detail mechanism. We have found that the KE is quite sensitive to the small change of this parameter. For the North Pacific model, the parameter is set to 0.05. Changing this value to 0.10 leads to significant reduction of eddy kinetic energy around the KE. We do not claim that this value is universal and physically correct. But we consider that this parameter can be a useful tuning parameter for the Kuroshio Extension. The latter parameter (B) is applied by using a large harmonic viscosity in the region near the southern coast of Japan. This works to stabilize the Kuroshio south of Japan, which tends to behave too vigorously. Too large value results in the failure of separation and reduction of eddy kinetic energy downstream along the KE. We set this as 2.5m^2/s. This parameter may represent unknown missing mechanism that stabilizes the Kuroshio path in reality. The former parameter, α, also can be used for this purpose. But to stabilize the path of the Kuroshio, the value of α should be increased and will not be suitable for the KE. The combined use of these two parameters enable us to tune the Kuroshio and KE separately.

キーワード：海洋モデル、黒潮、黒潮続流、チューニング
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