Referee comments on “Perspectives on future sea ice and navigability in the Arctic” (Chen & all – 2021) by Bjørn Åge Hjøllo, NAVTOR AS

General comments

In this study the Author give a valuable contribution to understand how global warming can influence artic navigability and open up for commercial shipping lines between Asia and Europe, based on the knowledge from the latest climate studies. Some of the discussions would benefit of a wider perspective of “navigability”, e.g. by also including possible changes in met-ocean conditions in artic sea areas. However, I would recommend publishing the manuscript, as a contribution in understanding future trends in the artic shipping.

- The language, especially in the abstract, is basic and would benefit by a native person reading through.
- NEP; also commonly named North East Sea Route or Northern Sea route, especially in the shipping industry.

Specific comments

- 64 “Climate models are effective and reliable for producing present and future spatial and temporal distributions”. This is a statement that should be discussed; what about uncertainties?
- 77 “Shared socioeconomic pathways (SSPs) 2–4.5”; to reach a wider audience, a section explaining the SSPs would be beneficial, e.g.:

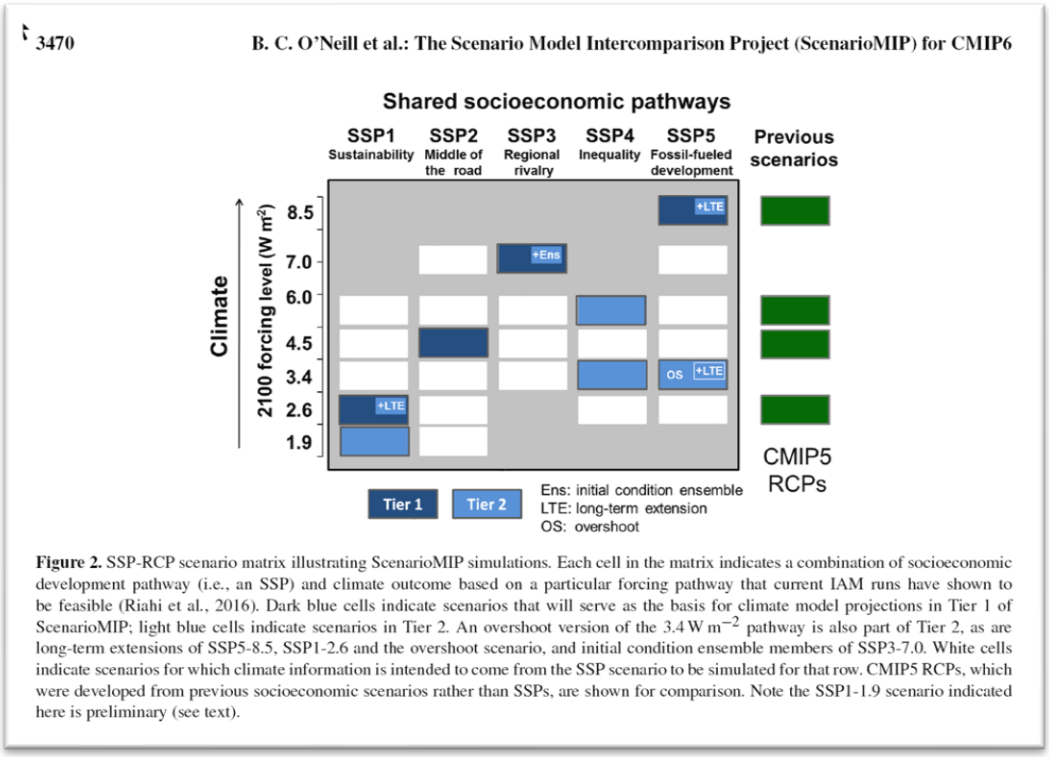

Figure 2. SSP-RCP scenario matrix illustrating ScenarioMIP simulations. Each cell in the matrix indicates a combination of socioeconomic development pathway (i.e., an SSP) and climate outcome based on a particular forcing pathway that current IAM runs have shown to be feasible (Riahi et al., 2016). Dark blue cells indicate scenarios that will serve as the basis for climate model projections in Tier 1 of ScenarioMIP; light blue cells indicate scenarios in Tier 2. An overshoot version of the 3.4 W m^{-2} pathway is also part of Tier 2, as are long-term extensions of SSP5-8.5, SSP1-2.6 and the overshoot scenario, and initial condition ensemble members of SSP3-7.0. White cells indicate scenarios for which climate information is intended to come from the SSP scenario to be simulated for that row. CMIP5 RCPs, which were developed from previous socioeconomic scenarios rather than SSPs, are shown for comparison. Note the SSP1-1.9 scenario indicated here is preliminary (see text).

- 114 “The spatial resolutions of the monthly sea ice concentration and thickness data were normalized to 1°×1° by bilinear interpolation». Why using 1°×1° resolution? A discussion related to benefit with a lower resolution would be fine, especially related to navigability ion coastal areas and straits? Could a Regional downscaling of the climate models give increased knowledge closer to the coastal areas/straits?
- 236 “By mid-century, both the NEP and NWP will open for OW ships under SSP5-8.5 in September” This might be true if only ice-conditions are taken into concern, however other limitations/concerns should also be discussed, e.g.:
    - Foreseen changes in extreme Met-Ocean conditions influencing navigability, e.g.

        - Very cold air outbreaks over open water forming explosive local polar lows
        - Icing on vessels
        - More fog and/or precipitation
        - Increase in extreme waves due to increased fetch caused by ice-free artic waters
    - Required infrastructure to allow for a large increase in Norther Sea Route?
        - The need for supporting infrastructure in very remote areas may be a limitation (fuel, towing, general services, etc)?
        - SAR?
        - The foreseen increase in green Shipping due to IMO recommendations; could requirement for Green fuel be a limitation?

Technical comments (listing of purely technical corrections at the very end ("technical corrections": typing errors, etc.).

- 218 Figure 4; mixed up units in the upper and lower figures ([m] / [%])