

27<sup>th</sup> INFORUM World Conference  
Sochi, 2-6 September 2019

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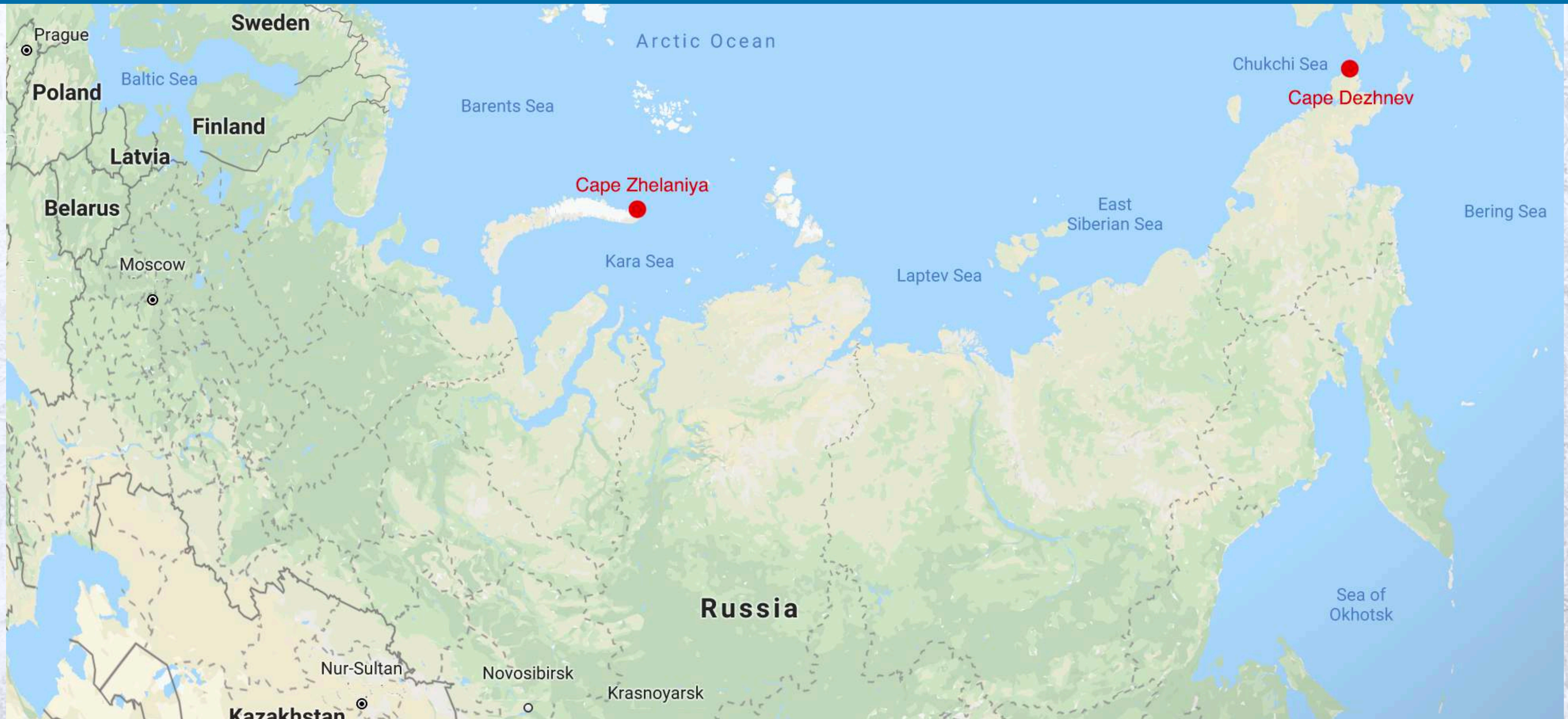
# Assessing the Prospects for the Formation of the Arctic Transport Corridor

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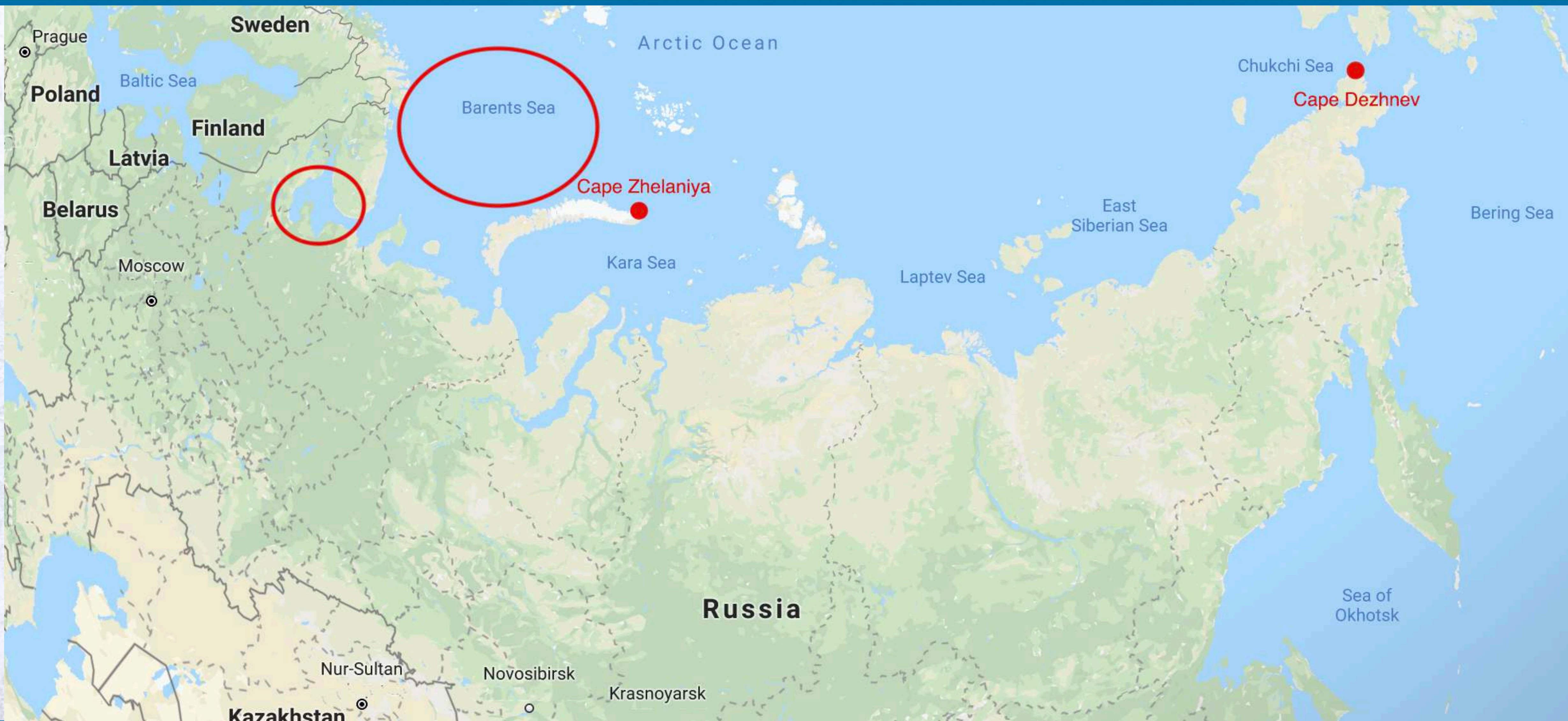
Institute of Economics and Industrial Engineering of SB RAS  
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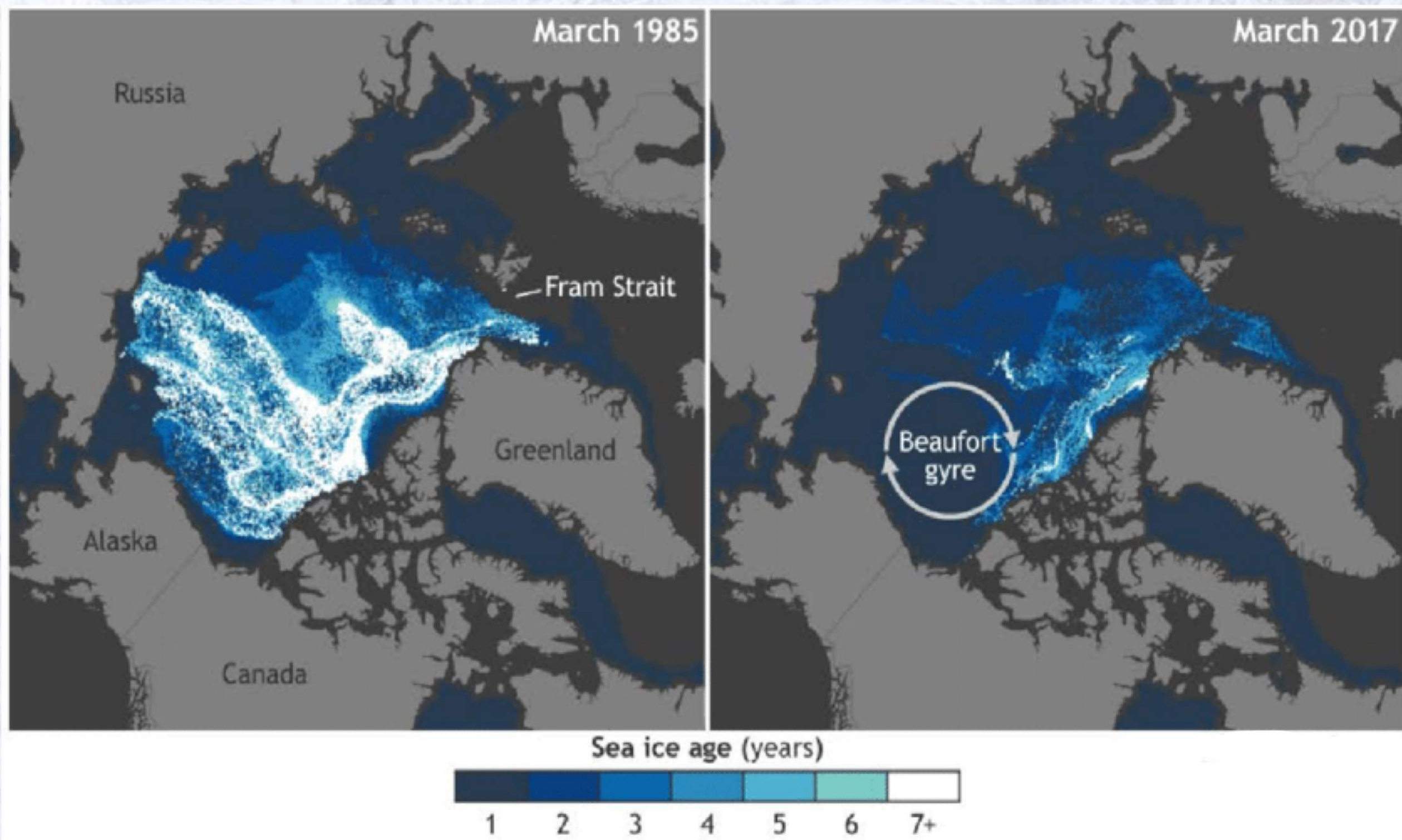
- Motivation behind this study
- The optimization multiregional input-output model
- Scenarios of development of the Arctic Transport Corridor
  - “Basic”
  - “Transit”
  - “Export”
- Review of results
- Ideas and future directions
- References

# the Northern Sea Route (NSR) vs the Arctic Transport Corridor (ATC)



# the Northern Sea Route (NSR) vs the Arctic Transport Corridor (ATC)





Extensive loss of multi-year sea ice in the Arctic Ocean (March 2017 vs March 1985)

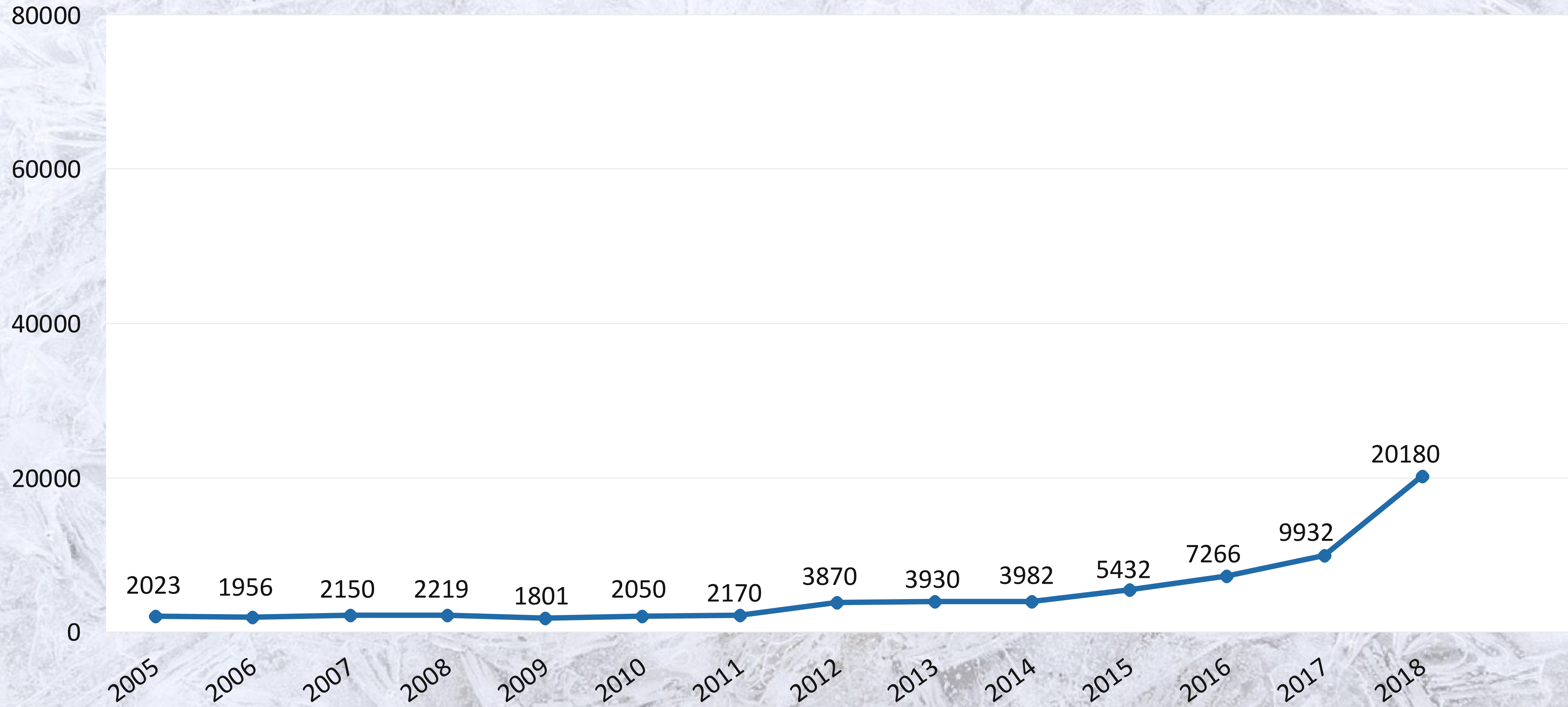
Reducing the thickness and area of ice in the Arctic:

- Humpert M., Raspotnik A. 2012. The future of Arctic shipping along the Transpolar Sea Route
- Wang M., Overland J. 2012. A sea ice free summer Arctic within 30 years: an update CMIP5 models
- Byers M. 2009. Conflict of cooperation: what future for the Arctic?

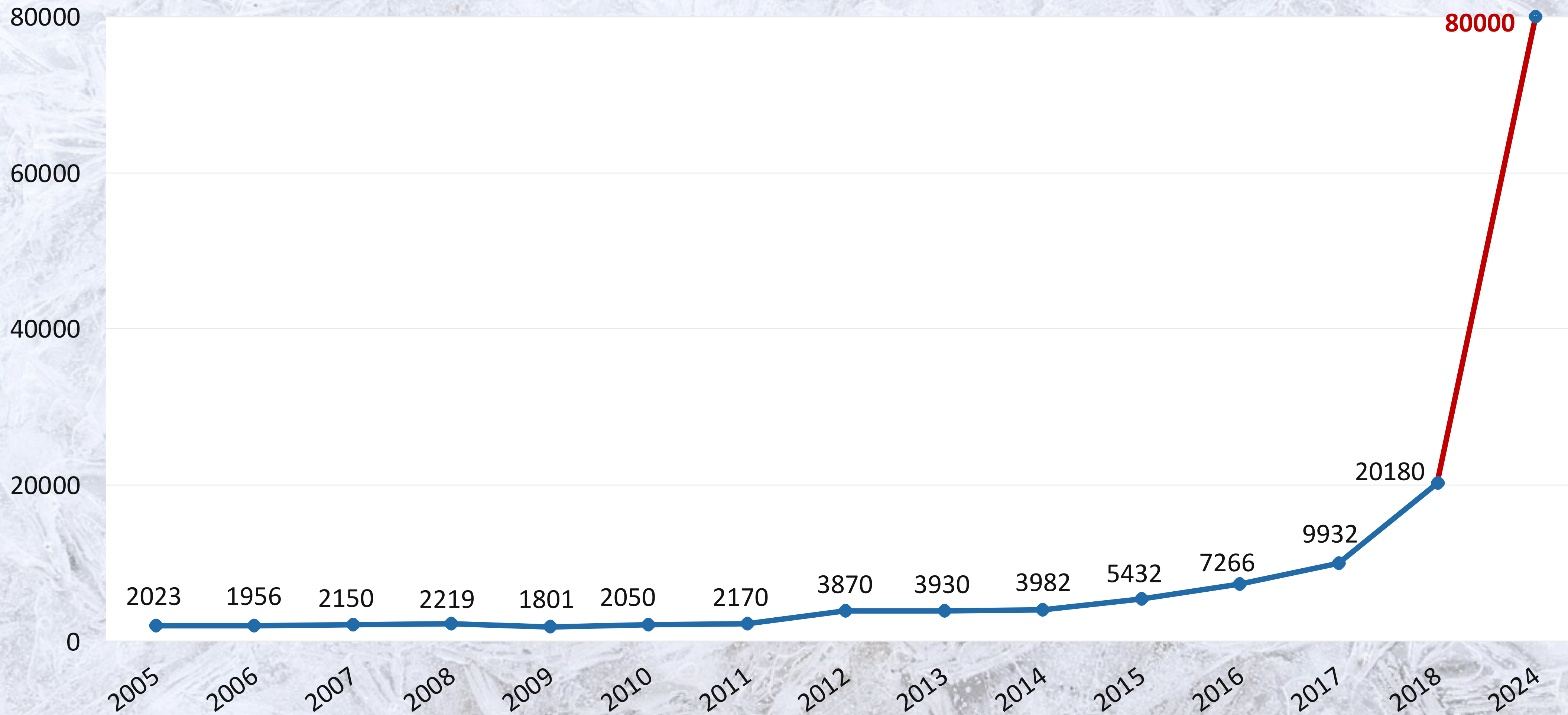
Potential development of commercial shipping in the Arctic:

- Theocharis D. et al. 2018. Arctic shipping: A systematic literature review of comparative studies
- Lasserre F. et al. 2016. Polar seaways? Maritime transport in the Arctic: An analysis of shipowners' intentions II

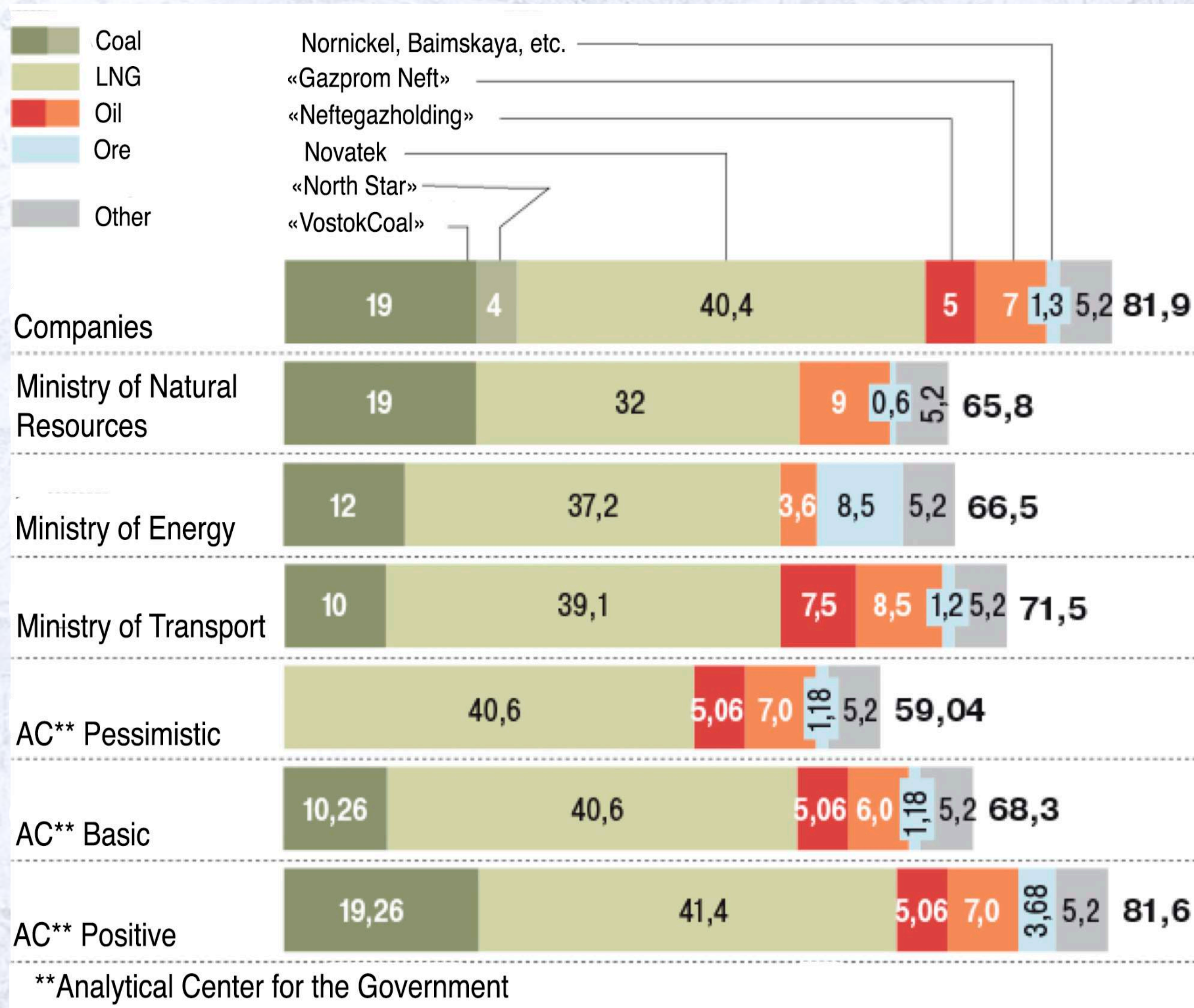
# Dynamic of NSR cargo shipment (thousand tons)



# the Presidential Decree "On National Goals and Strategic Tasks of the Development of the Russian Federation for the Period until 2024"



# Various forecasts of cargo flow along the NSR



Type of cargo	Volume
Gas	Yamal LNG: 19
	Arctic LNG: 22
Oil	Novoportovskoe field: 7,1
	Paiyahskoe field: 5
	Vankorskoe field: 5
Metal and other	Nornickel: 1,5
	Provision and supply: 1
Coal	Transit: 1
	Lemberovskoe field: 19
	Syradasajskoe field: 4
Railway freight for export	Northern Latitudinal Railway: 8

Total  
**92,6**  
mln t



## Algorithm for assessing indirect effects:

1. Selection and analysis of the investment projects
2. Collection of data for using the optimization multiregional input-output model (output, project period, etc.)
3. Calculation of the variant (basic scenario) of the national economic forecast without the implementation of the investment projects
4. Calculations of the variant (different scenario) of the national economic forecast taking into account conditions and consequences of the implementation of the investment projects
5. Comparison of the results of the forecast variants and determination of indirect effects (difference in the values of the objective function)

Objective function:  $Z \rightarrow \max$

Balances of production and distribution of productions:

$$(E - A)x_r - y_r - \alpha_r z_r - \sum_{s \neq r} (c_r^{rs} x_{rs} - c_r^{sr} x_{sr}) - (c_r v_r - c_r w_r) \geq B_r$$

Balances of capital investments:

$$-k_r x_r + y_r \geq K_r$$

Labor balances:

$$l_r x_r \leq L_r$$

Foreign trade balances:

$$\sum_r P_r (V_r - W_r) \geq S$$

Constraints on regional production, export and import:

$$N_r \leq x_r \leq D_r, \quad V_r \geq E_r, \quad W_r \leq J_r$$

Variables	$X_1$	$X_2$	$X_3$	& ...	$X_{12}$	$X_{23}$	Z		$B_r$
Parameters multiplied by variables	Region 1 E-A <sub>1</sub> ...				$-C_{i1}^{12}$		$-\alpha_1$	=	B <sub>1</sub> ...
		Region 2 E-A <sub>2</sub> ...			$-C_{i2}^{12}$	...	$-\alpha_2$	=	B <sub>2</sub> ...
			Region 3 E-A <sub>3</sub> ... -k <sub>3</sub> -l <sub>3</sub>	...		...	$-\alpha_3$	= >= >=	B <sub>3</sub> K <sub>3</sub> -L <sub>3</sub>

- 53 Sectors (the nomenclature of industries is based on the All-Russian Classifier of Types of Economic Activities)
  - Including various types of transport services (sea, river, car, avia, railway, pipeline, etc.)
- 34 interregional adjacent ties (links)
  - Including maritime communication between the Far East Federal District, Krasnoyarsk Territory and the North-West Federal District
- 8 federal districts are presented
  - with the division of Siberia into regions
- The base year is 2010. Time scope 2010-2035
  - We calibrated the model for 2015
- All indicators of the model are calculated in 2010 basic prices

BASIC	TRANSIT	EXPORT
<ul style="list-style-type: none"> <li>• Inertial development of the country</li> <li>• Intensification of cargo traffic in the ATC does not occur</li> <li>• The likelihood of such a scenario being implemented is almost zero</li> <li>• it is only needed as a comparison with other scenarios</li> </ul>	<ul style="list-style-type: none"> <li>• Increasing in international container traffic by 5 million tons in the ATC</li> <li>• Commissioning of new nuclear icebreakers ("Siberia", "Ural" and "Leader"; total investment - 269 bln rub)</li> <li>• Icebreaker assistance of transit vessels (the amount is estimated by calculating the fees, according to the "Rules of navigation in the waters of the Northern Sea Route" - 6.52 bln rub annually )</li> </ul>	<ul style="list-style-type: none"> <li>• Transit scenario +</li> <li>• Implementation of a number of investment (resource and infrastructure) projects; the total investment exceeds 2.6 trln rub</li> <li>• Increasing resources extraction in the Arctic by 84 mln tons</li> <li>• Increasing export of resources</li> <li>• Growth of cargo turnover in the ATC</li> </ul>

PROJECT	RECOURSE	INVESTMENT, BLN RUB	EXTRACTION VOLUME, MLN T
Kekura field	gold	23,8	0,000000309
Peschanka field	copper, molybdenum, gold	240	0,68
Beringovskij field	coal	45,6	12
Tirekhtyah field	tin	4,5	0,0055
Tomtor field	rare-earth metals	17,024	0,15
Talnahskoe field	copper-nickel ore	134	2,4
Malolemberovskoe field	coal	7,6	30
Pajyahskoe field	oil	614,08	18
Popigai field	diamond	10	0,0000002
Pavlovskoe field	zinc, lead	40	0,327
Arctic LNG	natural gas	775,2	19,8
Yamal LNG	natural gas	33	1
<b>Total</b>		<b>1944,8</b>	<b>84,36</b>

SEA PORT	PROJECT	INVESTMENT, BLN RUB
Beringovskij	Coal terminal	22,9
Tiksi	Modernization	3,2
Pevek	Modernization	0,77
Dudinka	Oil terminal	11,49
Dikson	Coal terminal	37,16
Bezmyannaya guba (Port Complex)	Intended for Pajyahskoe field	6,271
Murmansk	Deep water port	139,3
Sabetta	Terminal Yamal LNG	105,6
	Terminal for Arctic LNG	258
Indiga	Deep water ice-free port	125,6
<b>Total</b>		<b>710,291</b>

	TRANSIT - BASIC	EXPORT - TRANSIT
Indirect effects: final consumption, bln rub.	-7 (-0,02%)	+4116 (+8,31%)
Gross output, bln rub.	+1 (< 0,01%)	+7088 (+6,11%)
Multiplier of the investments in terms of gross output growth, times	0,003	2,675



1. The export-raw model of the economy of the country and Arctic regions is being strengthened
  - share of mineral resources in export increased by 3.98%
2. Structural shifts in the gross output of Russia
  - Increasing the share of oil, gas, non-ferrous metal productions, electric-power industry
  - Reducing the share of industries producing consumer goods
3. Connection between intensively developing Arctic regions and the south of Russia does not increase
4. Increase in interregional differentiation in terms of final consumption and the volume of investment in fixed assets

5. Growth of raw material extraction in some cases is accompanied by a decrease in the growth of production sectors and an increase in import in the same industries

E.g. Average annual growth rates of gross output in the Far East district by industries, %

	Transit scenario	Export scenario
Manufacture of machinery and equipment	-1,02	0,1
Electric-power industry	4,3	2,3
Extraction of non-ferrous metal	-2,2	18,8
Coal extraction	-0,4	15,1
Sea transport service	12,1	62,2
Manufacture of food products and tobacco	5,11	-3,3
Import of food products and tobacco	5,9	39,8

1. Evaluation of the commercial efficiency of the investment projects (using project level model)
  - change of conditions for the implementation of projects
  - change of scenarios
2. Evaluation of the commercial efficiency of the investment projects (using prices from input-output model)
  - Multiregional model?
  - Or another?

**Thank you for your attention**

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2. Humpert M., Raspotnik A. The future of Arctic shipping along the Transpolar Sea Route. Arctic Yearbook. 2012. P. 281-307.
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4. Byers M. Conflict of cooperation: what future for the Arctic?. Swords and Ploughshares. 2009. Vol 17. P. 17-21.
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6. Theocharis D., et al. Arctic shipping: A systematic literature review of comparative studies. Journal of Transport Geography. 2018. Vol. 69. P. 112-128.
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