



# 6<sup>th</sup> Symposium on the Impacts of an Ice-Diminished Arctic on Naval and Maritime Operations

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**Chief of Naval Research**  
*14 July 2015*

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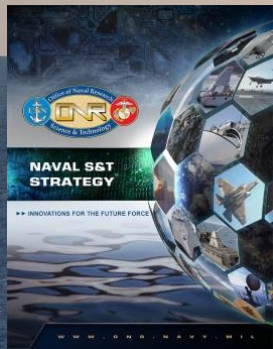


# The Office of Naval Research

## The S&T Provider for the Navy and Marine Corps



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- 23 Locations
- \$2.1B / year
- >1,000 Partners



*Discover*



*Develop*



*Deliver*



*Technological  
Advantage*

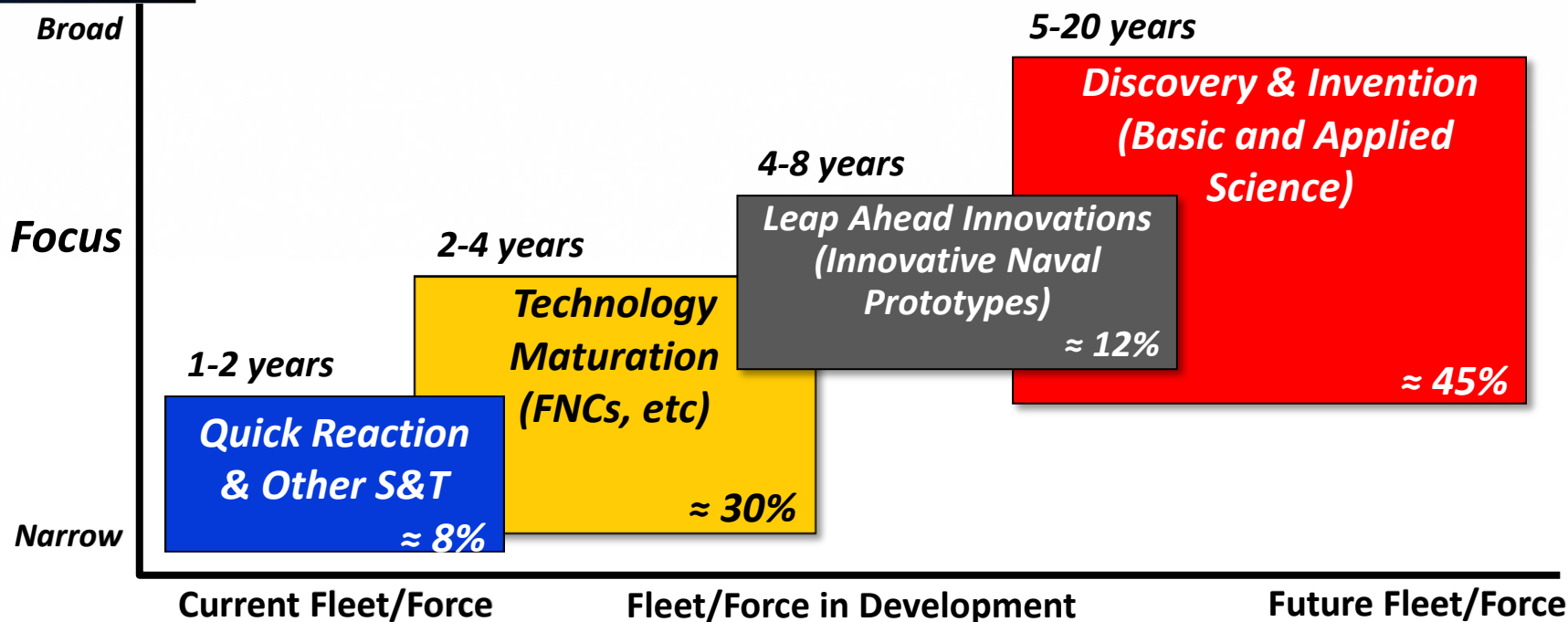




# Naval S&T Investment Strategy



- *Assure Access to Maritime Battlespace*
- *Autonomy & Unmanned Systems*
- *Electromagnetic Maneuver Warfare*
- *Expeditionary & Irregular Warfare*
- *Information Dominance/Cyber*
- *Platform Design & Survivability*
- *Power & Energy*
- *Strike & Integrated Defense*
- *Warfighter Performance*

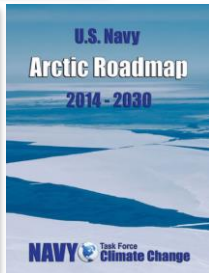
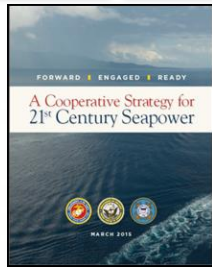
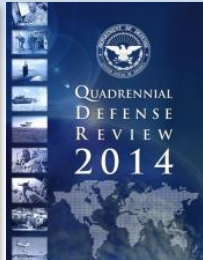


**Portfolio is balanced across near, mid, and long term S&T investments**





# Navy Arctic Guidance



**U.S. Navy  
Arctic Roadmap  
2014-2030**  
released Feb 2014

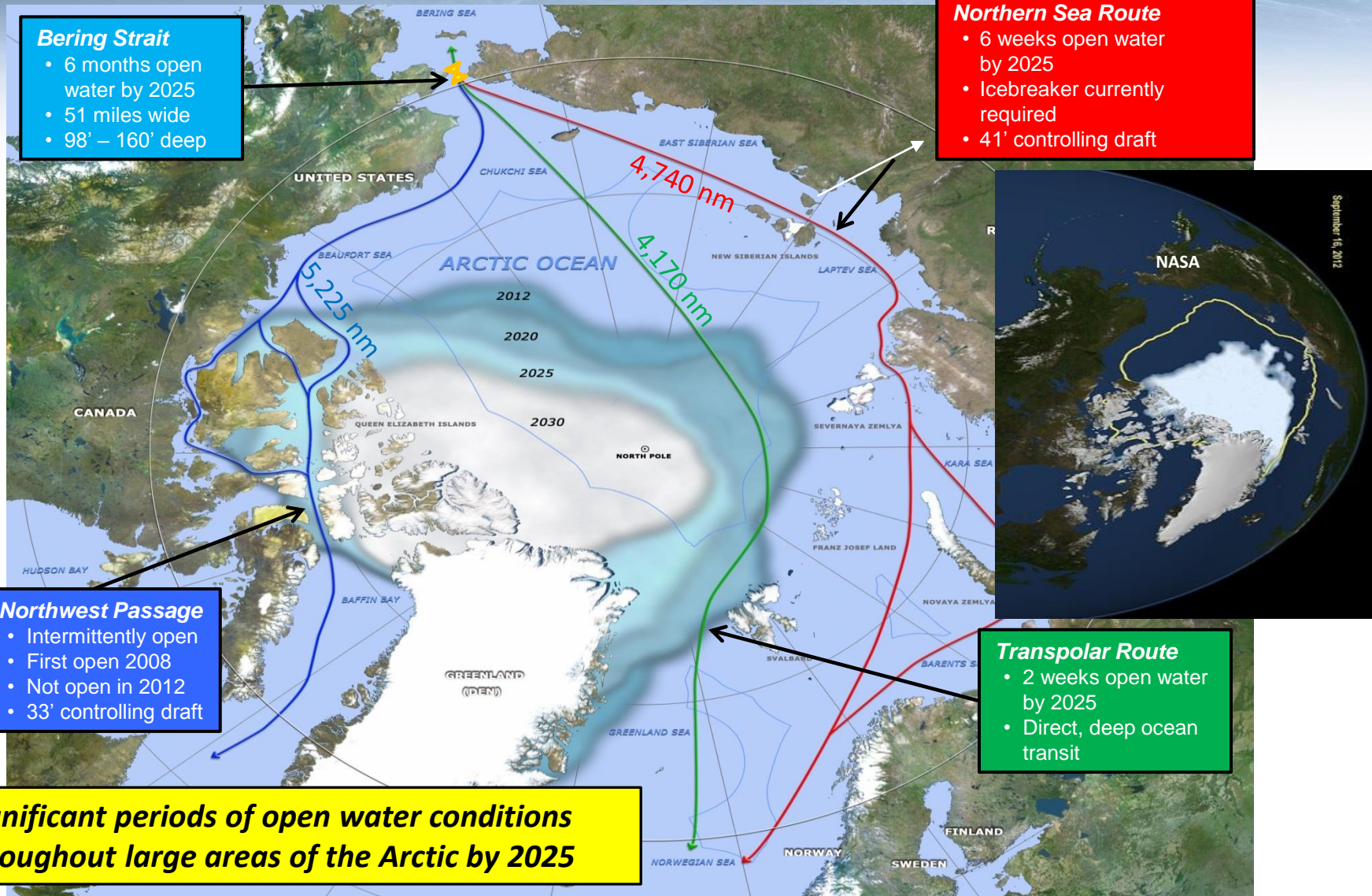
## Navy Strategic Objectives for the Arctic

- Ensure U.S. Arctic sovereignty and provide homeland defense
- Provide ready naval forces to respond to crises and contingencies
- Preserve freedom of the seas
- Promote partnerships within the U.S. and with international allies

## Navy Implementation Plan includes:

- Strategy, Policy, Missions, and Plans
- Operate Safely and Proficiently
  - Science and Technology
  - Environmental Observation and Prediction
  - Platforms, Weapons, Equipment and Sensors
- Build Trust and Confidence
- Execution

# Navy forecast of sea ice through 2030





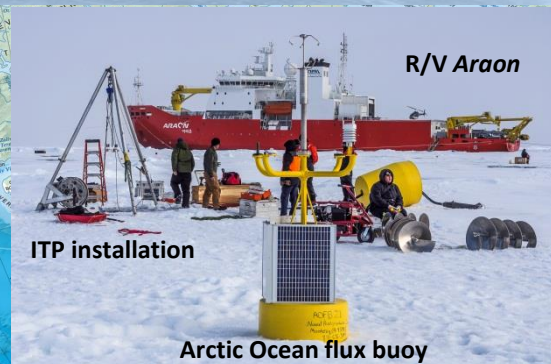
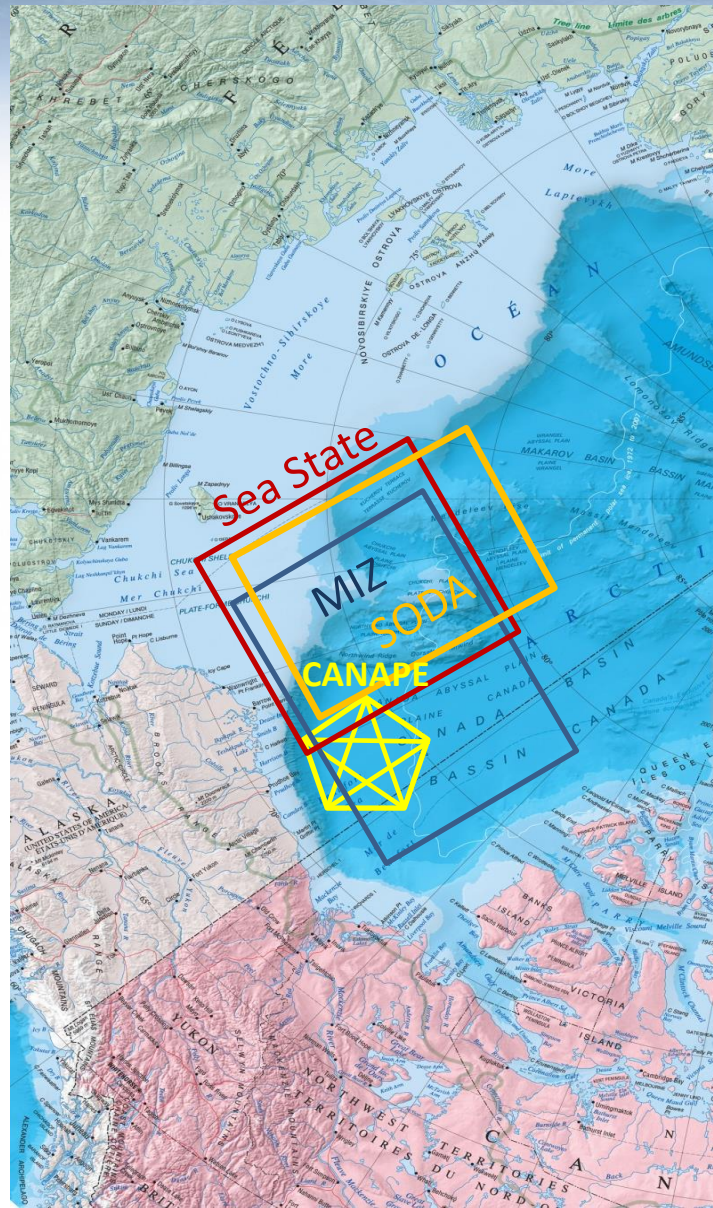


# ONR Initiatives in the Arctic (2012-2020)

- ❖ Arctic & Global Prediction Program
- ❖ Ocean Acoustics Program

- Marginal Ice Zone (MIZ) DRI  
2012-2016 (2014 Experiment)
- Canada Basin Acoustic Propagation Experiment (CANAPE)  
2015-2017
- Sea State & Boundary Layer Physics DRI  
2013-2017 (2015 Experiment)
- Stratified Ocean Dynamics in the Arctic (SODA)  
2016 -2020 (2018 Experiment)

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# Naval S&T Investments in Arctic Surface Platform Operations

## Ship Stability Risk from Ice Accretion

- Early warning system that quantifies the impact of topside icing on ship stability and provides an adjusted operational envelope

## Sea Ice - Hull Interactions

- Improved ice-ship interaction modeling techniques to aid in ice class ship design

## Ice-Phobic Coatings for Ships

- Robust and affordable anti-icing surfaces that also reduce ice adhesion to substrates

## Ice-Capable Propulsors

- Computational methods/tools for the design of ice-capable propellers/propulsors





# Naval Support to Arctic Science

“Today’s force is powered by naval research, and current investments will ensure the next generation of Sailors and Marines are equally dominant when called upon.” – *Naval S&T Strategy*

