

## Education

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<b>The University of Chicago</b> PhD Geophysical Sciences, Advisor: Douglas R. MacAyeal Dissertation: <i>Surface melting on ice shelves and icebergs</i>	Chicago, IL, USA 2001–2005
<b>Moscow Engineering Physics Institute (State University)</b> Candidate of Sciences (PhD equivalent), Physics and Mathematics, Advisor: Oleg V. Nagornov Dissertation: <i>Numerical modeling of heat and mass transfer under an ice shelf and on its base</i>	Moscow, Russia 1996–1999
<b>Moscow Engineering Physics Institute (State University)</b> M.S. Physics (awarded with distinction), Advisor: Boris M. Tulinov Dissertation: <i>Numerical simulations of radioactive waste burial in permafrost</i>	Moscow, Russia 1989–1995

## Employment and professional activity

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<b>Princeton University</b> The Program in Atmospheric and Oceanic Sciences Research Glaciologist	Princeton, NJ, USA 2014–present
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Conducting research in the field of glaciology. Developing theories and numerical models to understand dynamics and stability of marine ice sheets, ice-sheet/ice-shelf/icebergs interactions with the oceans and atmosphere. Applying advanced mathematical methods, including inverse techniques to glaciological problems. Serving as Principal Investigator, developing, implementing and coordinating multi-institutional, multi-disciplinary research projects. Supervising and mentoring postdoctoral fellows and students. Leading a collaborative effort with researchers from the Cooperative Institute for Modeling the Earth System (Princeton University) and scientists from the Geophysical Fluid Dynamics Laboratory (GFDL) in developing the next-generation of the GFDL global ocean-cryosphere model OM5 and the global climate model CM5 that include dynamically coupled ice-sheet model, MOM6-IS. Facilitating development of a framework to represent icebergs in global ocean circulation models and its implementation in the GFDL ocean model MOM6.

<b>Princeton University</b> The Program in Atmospheric and Oceanic Sciences Associate Research Scholar	Princeton, NJ, USA 2009–2014
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Designed and led a Climate Processing Team on representing icebergs in the climate models. Developed novel inverse method techniques and remote sensing data analysis applied to glaciological applications. Supervised postdoctoral fellows and graduate and undergraduate students. Facilitated model developments to allow for sub-ice-shelf circulation in the GFDL ocean model MOM6. Conducted research on the ice/ocean interactions. Developed novel theories for understanding the impacts of supraglacial lakes on collapse of the ice shelves.

<b>Portland State University</b> Geology Department Research Assistant Professor	Portland, OR, USA 2008–2009
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Developed a research program and designed and conducted an NSF funded project. Developed theoretical and numerical models to understand mutual interactions between the basal traction, subglacial lakes and ice-stream flow.

**NASA Goddard Space Flight Center**

Greenbelt, MD, USA

Hydrospheric and Biospheric Sciences Laboratory

2006–2008

NASA Postdoctoral Fellow, mentor: Robert A. Bindschadler

Applied inverse methods to infer basal conditions under Bindschadler Ice Stream from surface observations. Developed numerical models to investigate the effects of dynamic subglacial lakes on the ice-stream flow.

**Moscow Engineering Physics Institute (State University)**

Moscow, Russia

High energy-density physics Department

2000–2001

Docent

Developed and taught courses *Mechanics of fluids and gases* (introduction and advanced), *Introduction to solid state physics*. Supervised a master student Nadezhda Boiko, MS, 2001 (thesis: *Thermal regimes in the vicinity of buried radioactive waste containers*).

**Moscow Engineering Physics Institute (State University)**

Moscow, Russia

The High energy-density physics Department

1999–2000

Lecturer

Developed and taught a course *Introduction to solid state physics*. Supervised a master student.

## Research grants

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• NASA NNH22ZDA001N-ESI, co-PI	03/01/2023–03/01/2026
“Greenland-scape: Uncovering topography and geology beneath the Greenland Ice Sheet	\$52,420
• NOAA NA13OAR4310097 Lead PI	01/09/2013–31/08/2017
“Climate Process Team: Representing Calving and Iceberg Dynamics in Global Climate Models”	\$1,295,000
• NSF PLR-1246151, co-PI	01/06/2014–01/06/2017
“Collaborative Research: Dynamic Response of the Ross Ice Shelf to Wave-Induced Vibrations”	\$42,000
• NSF ANT-0838811, Lead PI	15/07/2009–30/06/2013
“Collaborative Research: Model investigation of ice stream/subglacial lake system”	\$375,543
• NSF CMG-09344534, co-PI	15/09/2009–31/08/2013
“Enabling ice sheet sensitivity & stability analysis with a large-scale higher-order ice sheet model’s adjoint to support sea level change assessment”	\$68,968

## Teaching

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• <b>Guest Lecturer</b> at Princeton University	2013–2015, 2018
Courses: Introduction to Ocean Physics for Climate, Introduction to Physical Oceanography	
Special topics: the role of the cryosphere; ice-sheet dynamics; ice/ocean interactions	
• <b>Summer school lecturer/instructor</b>	8-19/06/2010
Advanced Climate Dynamics Courses	Lyngen, Norway
Lectures: <i>Ice-shelf dynamics; Special Processes at the Ice Front; Inverse Modeling</i>	

- **Summer school lecturer/instructor** 6-15/08/2009  
Ice Sheet Modeling Summer School Portland, OR, USA  
Lectures: *Ice-stream dynamics; Ice-shelf processes; Inverse Modeling*
- **Teaching assistant** at the University of Chicago 2001–2005  
Courses: Earth’s ice age, Global Climate Change, Introduction to climate dynamics
- **Docent, Lecturer** at Moscow Engineering Physics Institute (State University) 1999–2001  
Courses: Mechanics of fluids and gases (introduction and advanced), Introduction to solid state physics

## Advisees

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### Postdoctoral Fellows

Linda Pan	2024–present
Alexander Huth	2020–2022
Currently GFDL, Physical scientist	
Elisa Mantelli	2019–2021
Currently Ludwig-Maximilians-Universität Munich, Assistant Professor	
Anders Damsgaard	2017–2018
Currently Aarhus University, Assistant Professor	
Michael Wolovick	2016–2018
Currently Alfred Wegener Institute, postdoctoral fellow	
Alon Stern	2015 –2018
Currently Slide Financial Ltd, founder	
Marianne Haseloff	2015–2017
Currently University of Wisconsin-Madison, Assistant Professor	
Yonggang Liu	2012–2014
Currently Peking University, Associate Professor	
Daniel N. Goldberg	2009–2011
Currently the University of Edinburgh, Reader	

### Graduate students

Nail Coffey, PhD Thesis, Stanford University,	2022–present
Kaylie Cohanin, MS Thesis, Princeton University,	2020–2022
Justin Hiester, MS Thesis, Portland State University,	2010–2013
Nadezhda Boiko, MS Thesis, Moscow Engineering Physics Institute (State University),	1999–2001

### Undergraduate students

Kasturi Shah, Senior Thesis, Princeton University	2014–2017
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### Summer Interns

Eliana Gonzalez, Cooperative Institute for Modeling the Earth System	2024
Haemah Akhtar, Cooperative Institute for Modeling the Earth System	2023
Jules de la Cruz, Cooperative Institute for Modeling the Earth System	2022
Siobhan Light, NOAA Hollings Scholar	2022
Nuzhat Khan, Cooperative Institute for Modeling the Earth System	2021

## External Thesis Examiner

Martin Forbes, Doctor of Philosophy, Otago University  
Thesis “Numerical simulation of rifts in the Ross Ice Shelf, Antarctica”

March 2023

## Field experience

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McMurdo Ice Shelf	Antarctica October–November, 2004
Icebergs of the Ross Sea	Antarctica October–December 2005
Ross Ice Shelf	Antarctica October–December 2006

## Awards

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Fellow of Kavli Frontiers of Science	2015
NSF Medal for Service in Antarctica	2008
NASA Postdoctoral Fellowship	2006–2008

## Professional activities

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Editor of <i>Journal Geophysical Research: Earth Surface</i>	2019–present
Selecting Committee Member of the Climate & Global Change Postdoctoral Fellowship Program	2016–2020
Co-chair of the U.S. CLIVAR Greenland Ice Sheet/Ocean Interactions Working Group	2015–2018
Reviewer of core activities: the World Climate Research Programme	2024
Grant proposals reviewer and panelist: NSF, NASA, NOAA, DOE, Schmidt Futures, European Science Foundation, UK Natural Environment Research Council, Dutch Research Council, Royal Society of New Zealand, Australian Research Council	

## Publications

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1. **Sergienko O.** Treatment of the ice-shelf backpressure and buttressing in two horizontal dimensions. *Journal of Glaciology* **71**, e7. doi:10.1017/jog.2024.83 (2025).
2. MacGregor, J. A., Colgan, W. T., Paxman, G. J. G., Tinto, K. J., Csathó, B., Darbyshire, F. A., Fahnestock, M. A., Kokfelt, T. F., MacKie, E. J., Morlighem, M. & **Sergienko, O. V.** Geologic Provinces Beneath the Greenland Ice Sheet Constrained by Geophysical Data Synthesis. *Geophysical Research Letters* **51**. doi:10.1029/2023GL107357 (2024).
3. **Sergienko O.** & Wingham, D. Diverse behaviors of marine ice sheets in response to temporal variability of the atmospheric and basal conditions. *Journal of Glaciology* **70**, e52. doi:10.1017/jog.2024.43 (2024).
4. Huth<sup>†</sup>, A., Duddu, R., Smith, B. & **Sergienko O.** Simulating the processes controlling ice-shelf rift paths using damage mechanics. *Journal of Glaciology*, 1–14. doi:10.1017/jog.2023.71 (2023).
5. **Sergienko, O.** & Haseloff, M. ‘Stable’ and ‘unstable’ are not useful descriptions of marine ice sheets in the Earth’s climate system. *Journal of Glaciology* **69**, 1483–1499. doi:10.1017/jog.2023.40 (2023).
6. Coffey<sup>†</sup>, N. B., MacAyeal, D. R., Copland, L., Mueller, D. R., **Sergienko, O. V.**, Banwell, A. F. & Lai, C.-Y. Enigmatic surface rolls of the Ellesmere Ice Shelf. *Journal of Glaciology*, 1–12. doi:10.1017/jog.2022.3 (2022).
7. Harrison, M., Adcroft, A., Hallberg, R. & **Sergienko O.** Improved Surface Mass Balance Closure in Ocean Hindcast Simulations. *Journal of Advances in Modeling Earth Systems* **14**, e2021MS002888. doi:10.1029/2021MS002888 (2022).
8. Haseloff, M. & **Sergienko, O. V.** Effects of calving and submarine melting on steady states and stability of buttressed marine ice sheets. *Journal of Glaciology*, 1–18. doi:10.1017/jog.2022.29 (2022).
9. Huth<sup>†</sup>, A., Adcroft, A. & **Sergienko, O.** Parameterizing Tabular-Iceberg Decay in an Ocean Model. *Journal of Advances in Modeling Earth Systems* **14**, e2021MS002869. doi:10.1029/2021MS002869 (2022).
10. Huth<sup>†</sup>, A., Adcroft, A., **Sergienko O.** & Khan<sup>†</sup>, N. Ocean currents break up a tabular iceberg. *Science Advances* **8**, 1–5. doi:10.1126/sciadv.abq6974 (2022).
11. **Sergienko, O. V.** Marine outlet glacier dynamics, steady states and steady-state stability. *Journal of Glaciology* **68**, 946–960. doi:10.1017/jog.2022.13 (2022).
12. **Sergienko, O. V.** No general stability conditions for marine ice-sheet grounding lines in the presence of feedbacks. *Nature Communications* **13**, 2265. doi:10.1038/s41467-022-29892-3 (2022).
13. **Sergienko, O. V.** & Wingham, D. J. Bed topography and marine ice-sheet stability. *Journal of Glaciology* **68**, 124–138. doi:10.1017/jog.2021.79 (2022).
14. Damsgaard<sup>†</sup>, A., **Sergienko, O.** & Adcroft, A. The Effects of Ice Floe-Floe Interactions on Pressure Ridging in Sea Ice. *Journal of Advances in Modeling Earth Systems* **13**, e2020MS002336. doi:10.1029/2020MS002336 (2021).
15. MacAyeal, D. R., **Sergienko, O. V.**, Banwell, A. F., Macdonald, G. J., Willis, I. C. & Stevens, L. A. Treatment of ice-shelf evolution combining flow and flexure. *Journal of Glaciology*, 1–18. doi:10.1017/jog.2021.39 (2021).
16. **Sergienko O. V.** & Wingham, D. J. Grounding line stability in a regime of low driving and basal stresses. *Journal of Glaciology* **65**, 833–849. doi:10.1017/jog.2019.53 (2019).
17. Stern<sup>†</sup>, A. A., Adcroft, A. & **Sergienko, O.** Modeling Ice Shelf Cavities and Tabular Icebergs Using Lagrangian Elements. *Journal of Geophysical Research: Oceans* **124**, 3378–3392. doi:10.1029/2018JC014876. eprint: <https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2018JC014876> (2019).

18. Bronselaer, B., Winton, M., Griffies, S. M., Hurlin, W. J., Rodgers, K. B., **Sergienko, O. V.**, Stouffer, R. J. & Russell, J. L. Change in future climate due to Antarctic meltwater. *Nature* **564**, 53–58. doi:10.1038/s41586-018-0712-z (2018).
19. Damsgaard<sup>†</sup>, A., Adcroft, A. & **Sergienko, O.** Application of Discrete Element Methods to Approximate Sea Ice Dynamics. *Journal of Advances in Modeling Earth Systems* **10**, 2228–2244. doi:10.1029/2018MS001299. eprint: <https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2018MS001299> (2018).
20. Fyke, J., **Sergienko O.**, Löfveström, M., Price, S. & Lenaerts, J. T. M. An Overview of Interactions and Feedbacks Between Ice Sheets and the Earth System. *Reviews of Geophysics* **56**, 361–408. doi:10.1029/2018RG000600 (2018).
21. Haseloff<sup>†</sup>, M. & **O. V. Sergienko.** The effect of buttressing on grounding line dynamics. *Journal of Glaciology* **64**, 417–431. doi:10.1017/jog.2018.30 (2018).
22. Liu<sup>†</sup>, Y., Hallberg, R., **Sergienko, O.**, Samuels, B. L., Harrison, M. & Oppenheimer, M. Climate response to the meltwater runoff from Greenland ice sheet: evolving sensitivity to discharging locations. *Climate Dynamics* **51**, 1733–1751. doi:10.1007/s00382-017-3980-7 (2018).
23. **Sergienko, O. V.** Behavior of flexural gravity waves on ice shelves: Application to the Ross Ice Shelf. *Journal of Geophysical Research: Oceans* **122**, 6147–6164. doi:10.1002/2017JC012947 (2017).
24. Stern<sup>†</sup>, A. A., Adcroft, A., **Sergienko, O.** & Marques, G. Modeling tabular icebergs submerged in the ocean. *Journal of Advances in Modeling Earth Systems* **9**, 1948–1972. doi:10.1002/2017MS001002 (2017).
25. Hiester<sup>†</sup>, J., **Sergienko, O. V.** & Hulbe, C. L. Topographically mediated ice stream subglacial drainage networks. *Journal of Geophysical Research: Earth Surface* **121**. 2015JF003660, 497–510. doi:10.1002/2015JF003660 (2016).
26. Stern<sup>†</sup>, A. A., Adcroft, A. & **Sergienko, O.** The effects of Antarctic iceberg calving-size distribution in a global climate model. *Journal of Geophysical Research: Oceans* **121**, 5773–5788. doi:10.1002/2016JC011835 (2016).
27. MacAyeal, D. R., **Sergienko, O. V.** & Banwell, A. F. A model of viscoelastic ice-shelf flexure. *Journal of Glaciology* **61**, 635–645. doi:10.3189/2015JoG14J169 (2015).
28. **Sergienko, O. V.** Order in Antarctic ice streams. *Nature Geoscience* **8**, 822–822. doi:10.1038/ngeo2536 (2015).
29. Goldberg<sup>†</sup>, D. N., Schoof, C. & **Sergienko, O. V.** Stick-slip motion of an Antarctic Ice Stream: The effects of viscoelasticity. *Journal of Geophysical Research: Earth Surface* **119**, 1564–1580. doi:10.1002/2014JF003132 (2014).
30. **Sergienko O. V.** A vertically integrated treatment of ice stream and ice shelf thermodynamics. *Journal of Geophysical Research* **119**, 745–757. doi:10.1002/2013JF002908 (2014).
31. **Sergienko O. V.**, Creyts, T. T. & Hindmarsh, R. C. A. Similarity of organized patterns in driving and basal stresses of Antarctic and Greenland ice sheets beneath extensive areas of basal sliding. *Geophysical Research Letters* **41**, 3925–3932. doi:10.1002/2014GL059976. eprint: <https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1002/2014GL059976> (2014).
32. Banwell, A. F., MacAyeal, D. R. & **Sergienko, O. V.** Breakup of the Larsen B Ice Shelf triggered by chain reaction drainage of supraglacial lakes. *Geophysical Research Letters* **40**. 2013GL057694, 5872–5876. doi:10.1002/2013GL057694 (2013).
33. MacAyeal, D. R. & **O. V. Sergienko.** The flexural dynamics of melting ice shelves. *Annals of Glaciology* **54**, 1–10. doi:10.3189/2013AoG63A256 (2013).
34. **Sergienko O. V.** Basal channels on ice shelves. *Journal of Geophysical Research* **118**, 1342–1355. doi:10.1002/jgrf.20105 (2013).

35. **Sergienko O. V.** Glaciological twins: basally controlled subglacial and supraglacial lakes. *Journal of Glaciology* **59**. doi:10.3189/2013JoG12J040 (2013).
36. **Sergienko O. V.** Normal modes of a coupled ice-shelf/sub-ice-shelf cavity system. *Journal of Glaciology* **59**, 76–80. doi:10.3189/2013JoG12J096 (2013).
37. **Sergienko O. V.**, Goldberg<sup>†</sup>, D. N. & Little<sup>†</sup>, C. M. Alternative ice-shelf equilibriums determined by ocean environment. *Journal of Geophysical Research* **118**, 970–981. doi:10.1002/jgrf.20054 (2013).
38. **Sergienko O. V.** & Hindmarsh, R. C. A. Regular Patterns in Frictional Resistance of Ice-Stream Beds Seen by Surface Data Inversion. *Science* **342**, 1086–1089. doi:10.1126/science.1243903 (2013).
39. Straneo, F., Heimbach, P., **Sergienko, O.**, Hamilton, G., Catania, G., Griffies, S., Hallberg, R., Jenkins, A., Joughin, I., Motyka, R., Pfeffer, W. T., Price, S., Rignot, E., Scambos, T., Truffer, M. & Vieli, A. Challenges to Understanding the Dynamic Response of Greenland’s Marine Terminating Glaciers to Oceanic and Atmospheric Forcing. *Bulletin of the American Meteorological Society* **94**, 5773–5788. doi:10.1175/BAMS-D-12-00100.1 (2013).
40. Goldberg<sup>†</sup>, D. N., Little<sup>†</sup>, C. M., **O. V. Sergienko**, Gnanadesikan, A., Hallberg, R. & Oppenheimer, M. Investigation of land ice-ocean interaction with a fully coupled ice-ocean model, Part 1: Model description and behavior. *Journal of Geophysical Research* **117**. doi:10.1029/2011JF002246 (2012).
41. Goldberg<sup>†</sup>, D. N., Little<sup>†</sup>, C. M., **O. V. Sergienko**, Gnanadesikan, A., Hallberg, R. & Oppenheimer, M. Investigation of land ice-ocean interaction with a fully coupled ice-ocean model, Part 2: Sensitivity to external forcings. *Journal of Geophysical Research* **117**. doi:10.1029/2011JF002247 (2012).
42. **Sergienko O. V.** The effects of transverse bed topography variations in ice-flow models. *Journal of Geophysical Research* **117**. doi:10.1029/2011JF002203 (2012).
43. Goldberg<sup>†</sup>, D. N. & **O. V. Sergienko**. Data assimilation using a hybrid ice flow model. *The Cryosphere* **5**, 315–327. doi:10.5194/tc-5-315-2011 (2011).
44. MacAyeal, D. R., Abbot, D. S. & **Sergienko, O. V.** Iceberg-capsize tsunamigenesis. *Annals of Glaciology* **52**, 51–56. doi:10.3189/172756411797252103 (2011).
45. **Sergienko O. V.** & Hulbe, C. L. “Sticky spots” and subglacial lakes under ice streams of the Siple Coast, Antarctica. *Annals of Glaciology* **52**, 18–22. doi:10.3189/172756411797252176 (2011).
46. Bromirski, P., **O. V. Sergienko** & MacAyeal, D. R. Transoceanic infragravity waves impacting Antarctic ice-shelves. *Geophysical Research Letters*. doi:10.1029/2009GL041488 (2010).
47. **Sergienko O. V.** Elastic response of floating glacier ice to impact of long-period ocean waves. *Journal of Geophysical Research* **115**. doi:10.1029/2010JF001721 (2010).
48. **Sergienko O.**, MacAyeal, D. & Bindschadler, R. Stick—slip behavior of ice streams: modeling investigations. *Annals of Glaciology* **50**, 87–94. doi:10.3189/172756409789624274 (2009).
49. **Sergienko O. V.**, Bindschadler, R. A., Vornberger, P. L. & MacAyeal, D. R. Ice stream basal conditions from block-wise surface data inversion and simple regression models of ice stream flow: Application to Bindschadler Ice Stream. *Journal of Geophysical Research* **113**. doi:10.1029/2008JF001004 (2008).
50. **Sergienko, O. V.**, MacAyeal, D. R. & Thom, J. E. Reconstruction of snow/firn thermal diffusivities from observed temperature variation: application to iceberg C16, Ross Sea, Antarctica, 2004–07. *Annals of Glaciology* **49**, 91–95. doi:10.3189/172756408787814906 (2008).
51. **Sergienko O. V.**, MacAyeal, D. R. & Bindschadler, R. A. Causes of sudden, short-term changes in ice-stream surface elevation. *Geophysical Research Letters* **34**. doi:10.1029/2007GL031775 (2007).
52. Brunt, K. M., **O. Sergienko** & MacAyeal, D. R. Observations of unusual fast-ice conditions in the southwest Ross Sea, Antarctica: preliminary analysis of iceberg and storminess effects. *Annals of Glaciology* **44**, 183–187. doi:10.3189/172756406781811754 (2006).

53. MacAyeal, D. R., Okal, E. A., Aster, R. C., Bassis, J. N., Brunt, K. M., Cathles, L. M., Drucker, R., Fricker, H. A., Kim, Y. J., Martin, S., Okal, M. H., **O. V. Sergienko**, Spoinser, M. P. & Thom., J. E. Transoceanic wave propagation links iceberg calving margins of Antarctica with storms in tropics and Northern Hemisphere. *Geophysical Research Letters* **33**. doi:10.1029/2006GL027235 (2006).
54. Scambos, T., **Sergienko, O.**, Sargent, A., MacAyeal, D. & Fastook, J. ICESat profiles of tabular iceberg margins and iceberg breakup at low latitudes. *Geophysical Research Letters* **32**. doi:10.1029/2005GL023802 (2005).
55. **Sergienko O.** & MacAyeal, D. R. Surface melting on Larsen Ice Shelf, Antarctica. *Annals of Glaciology* **40**, 215–218. doi:10.3189/172756405781813474 (2005).
56. Nagornov, O. V. & **Sergienko, O. V.** The response of the ice-shelf base to the ocean temperature change. *Mathematical Modeling* **14**. (in Russian), 43–50 (2002).
57. Nagornov, O. V. & **Sergienko, O. V.** The effect of ocean temperature variations on the position of the lower boundary of an ice shelf. *Izvestiya Atmospheric and Oceaninc Physics* **37**, 671–676 (2001).
58. Nagornov, O. V. & **Sergienko, O. V.** The influence of the ocean temperature change on response of an ice shelf base. *News of Russian Academy of Sciences. Atmospheric and Oceanic Physics* **37**, 723–729 (2001).
59. Nagornov, O. V. & **Sergienko, O. V.** Special features of the processes of heat and mass transfer under a shelf glacier. *Journal of Engineering Physics and Thermophysics* **72**, 524–533. doi:10.1007/BF02699220 (1999).
60. Nagornov, O. V. & **Sergienko, O. V.** Temperature field of an ice shelf in the vicinity of a hot water-drilled well. *Journal of Engineering Physics and Thermophysics* **71**, 154–160. doi:10.1007/BF02682510 (1998).
61. Nagornov, O. & **O. V. Sergienko**. in *Development and Application of Computer Techniques to Environmental Studies* (eds Pepper, D., Brebbia, C. & Zannetti, P.) 281–295 (Wessex Inst Tech, Univ Nevada, 1998). ISBN: 1-85312-606-3.

<sup>†</sup>Advisees