Ettore Pedretti

Scottish Association for Marine Science (SAMS)

From Imaging Stars to Measuring Waves in Sea Ice: An Interferometrist Tale

Photo credits: P. B Young

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Collaborators

J. Wilkinson, British Antarctic Survey

J. D. Monnier, University of Michigan

S. Rodwell, Scottish Association for Marine Science

N. Toberg, University of Cambridge

B. G. Hagan, Scottish Association for Marine Science

A. James, Scottish Association for Marine Science

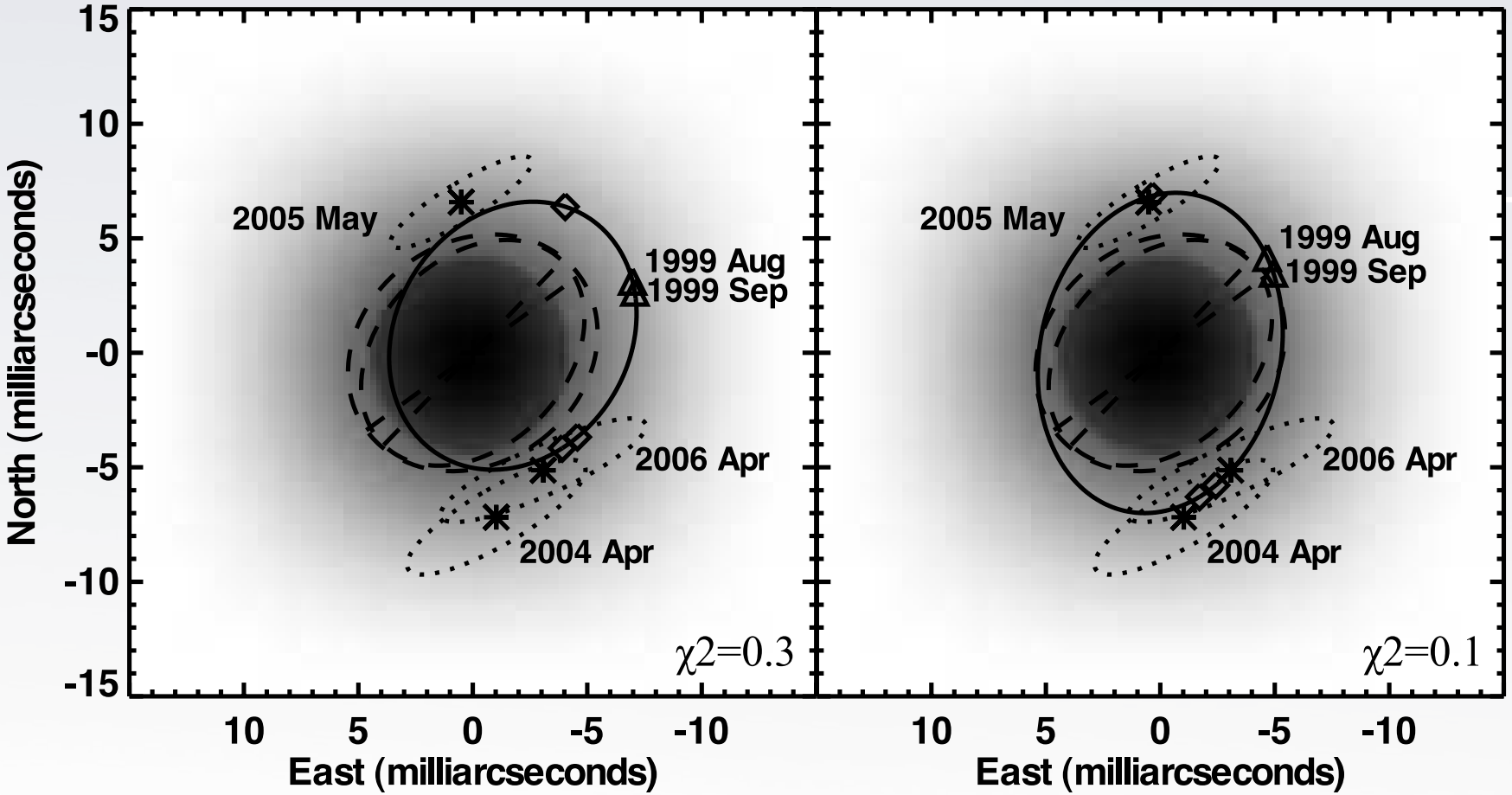
P. B. Wang , Scottish Association for Marine Science

N. D. Thureau, University of St Andrews

W. A. Traub , Jet Propulsion Laboratory

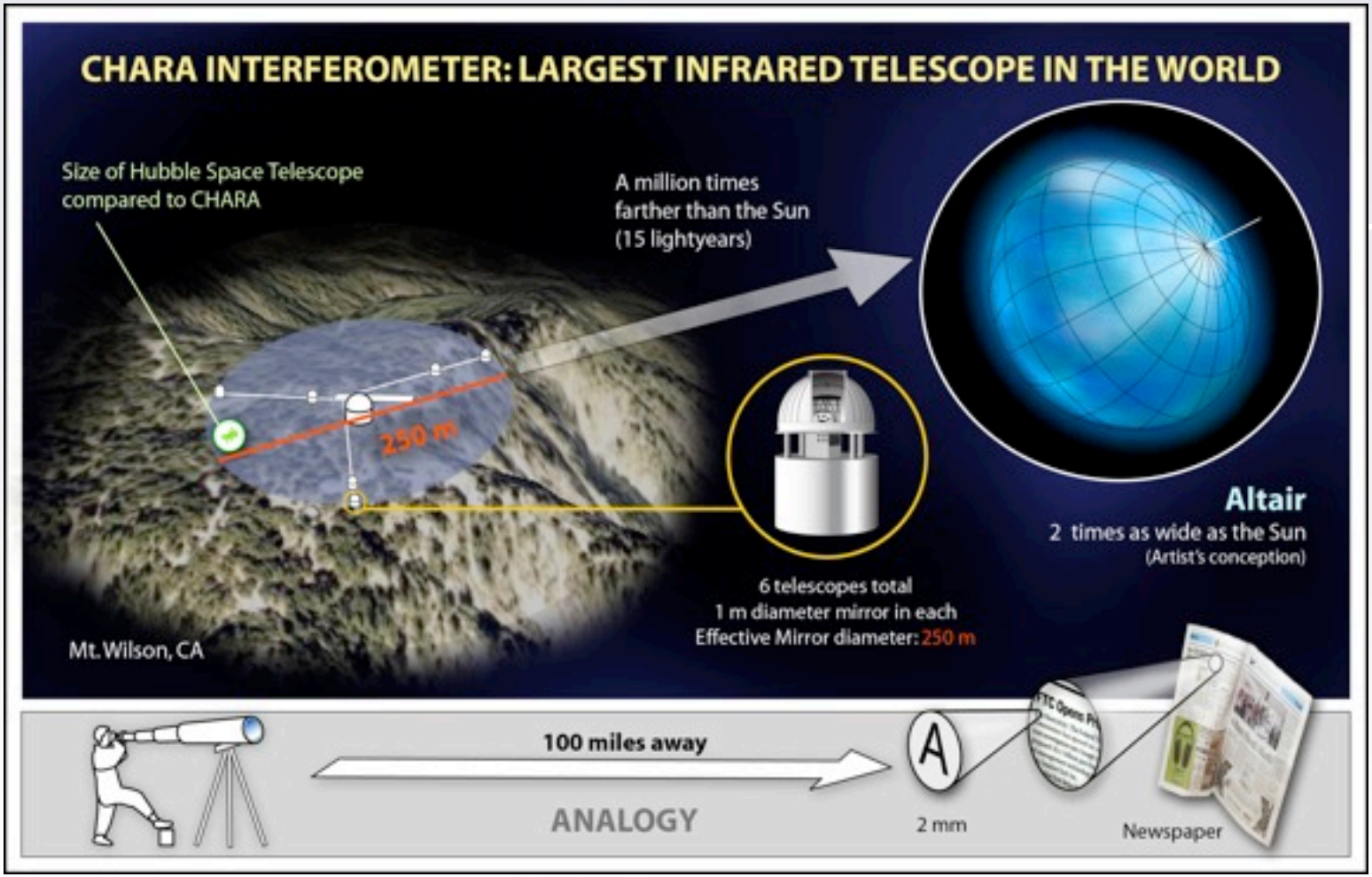
The IOTA Interferometer

Model-dependent imaging of CH Cyg



Pedretti et al, 2009 MNRAS

Imaging capabilities for the CHARA array



Monnier et al., Science (2007)

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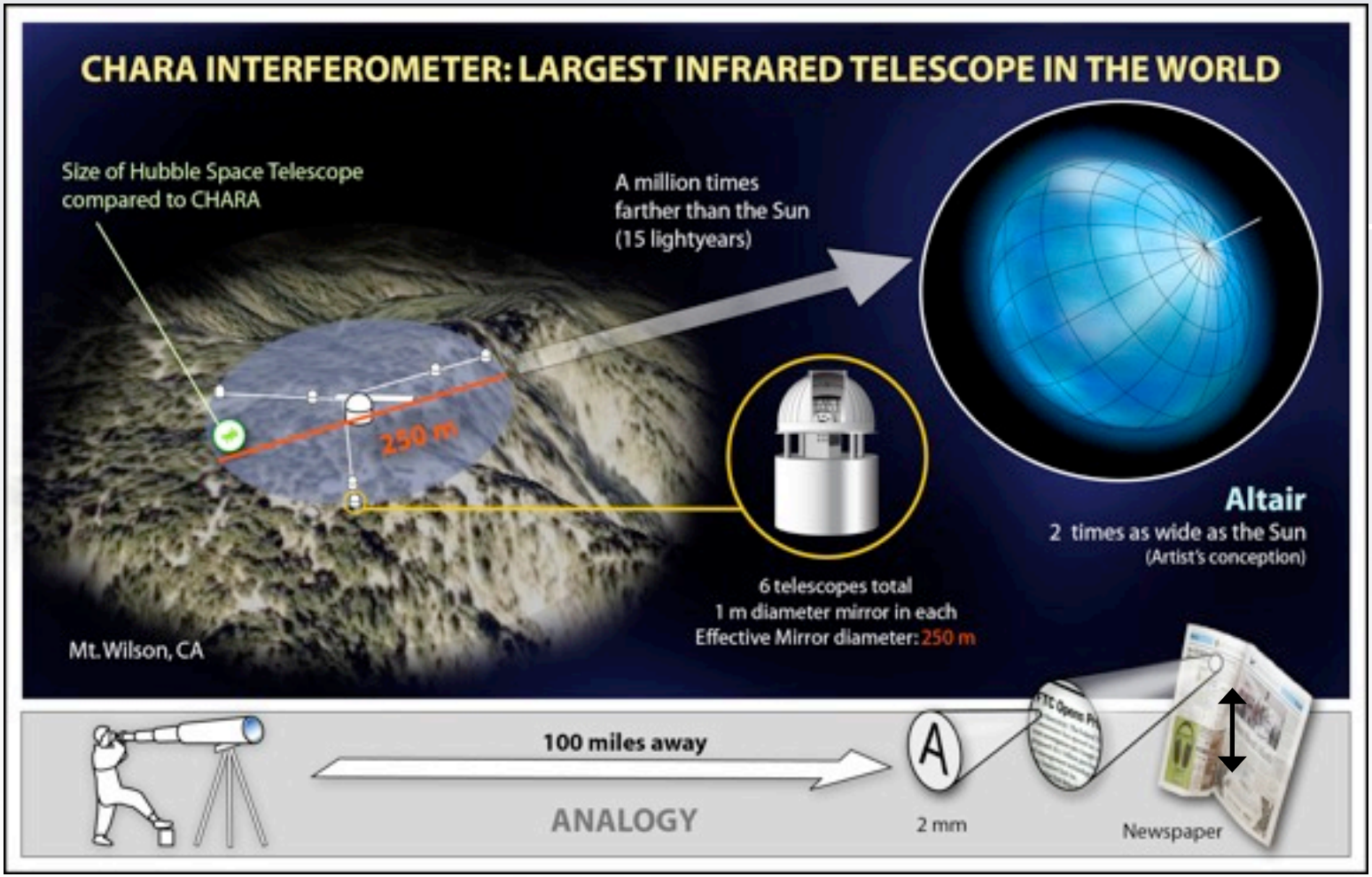


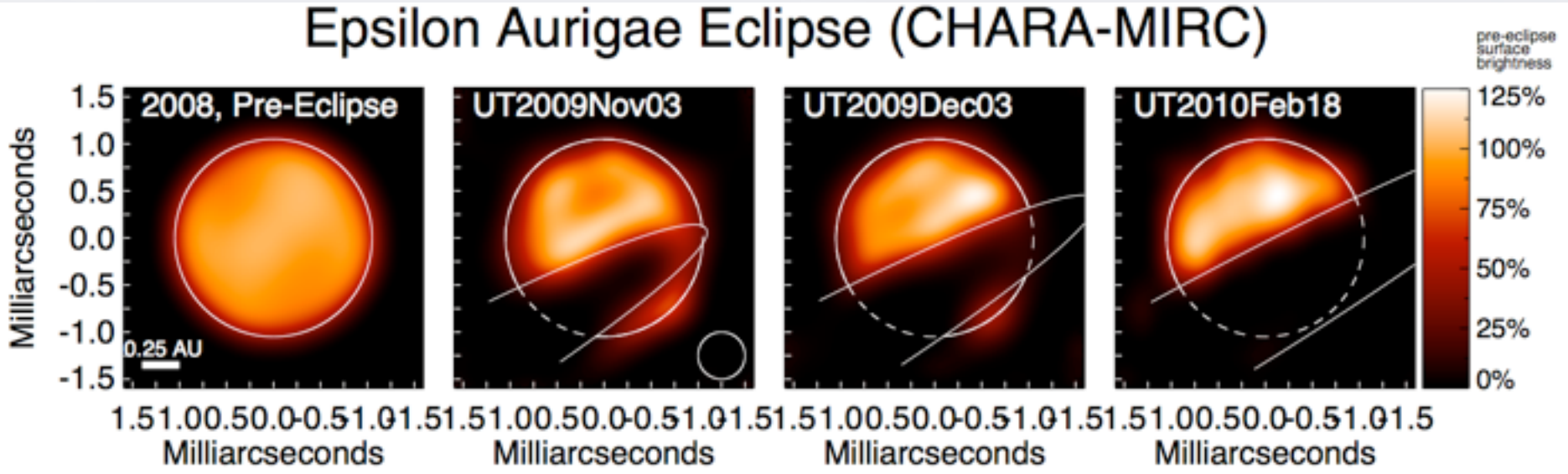
Monnier et al., Science (2007)

CHARA array: longest operational baseline

Observatory	Wavelength λ (μm)	Baseline (m)	Angular resolution (milli–arcseconds)
Hubble Space Telescope	0.5	2.4	43.0
Keck Telescope	1.65	10.0	34.0
CHARA Array	0.5	330.0	0.3
Very Long Baseline Array	10^4	8.6×10^6	0.24

Pedretti et al. 2009 NewAR

Model-independent imaging of Epsilon Aurigae

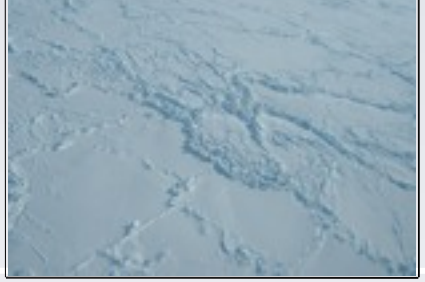


Kloppenborg et al. , Nature 2010

Stars and ice

Background in arctic sea ice change

Continuous cover



Marginal Ice Zone

Ridge

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Background in arctic sea ice change

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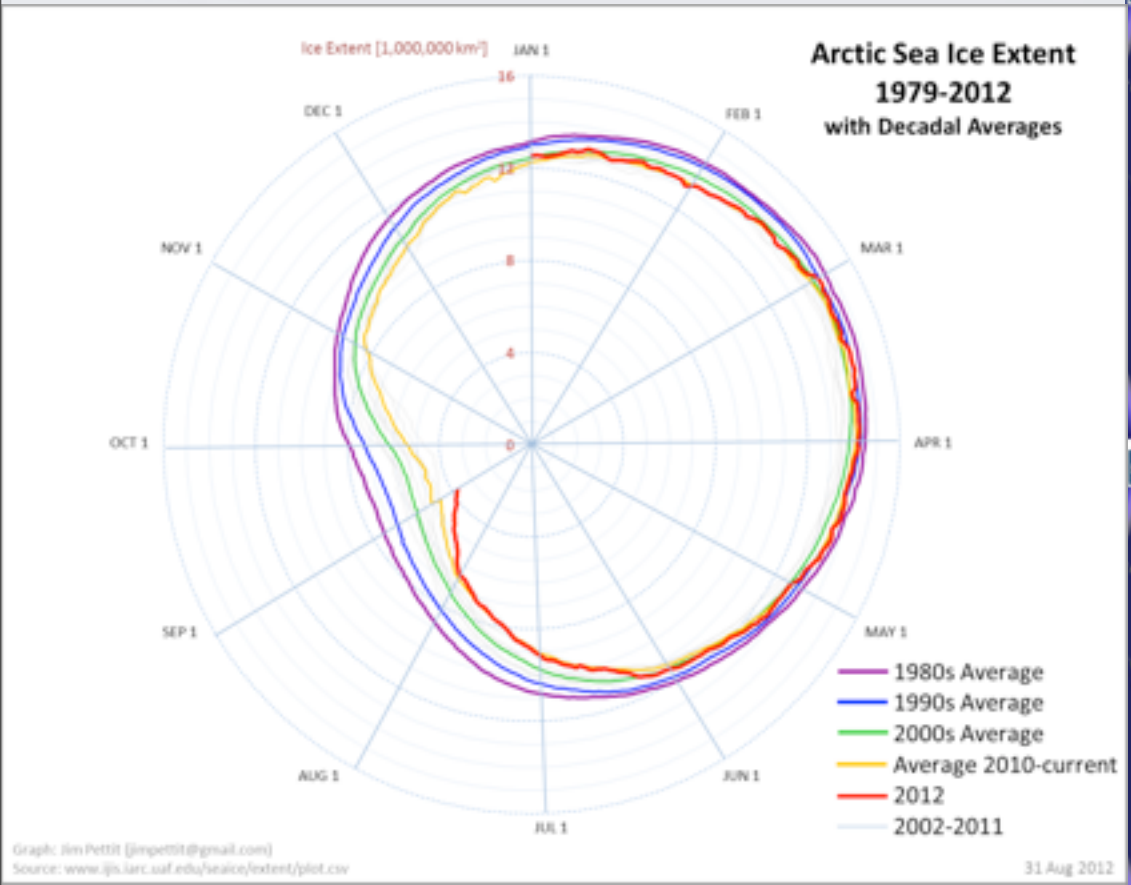
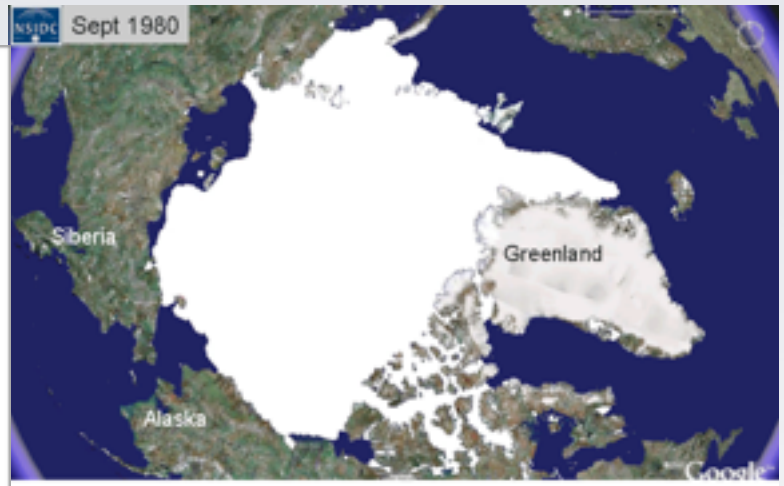
- Changes in ice extent.

Changes in ice extent





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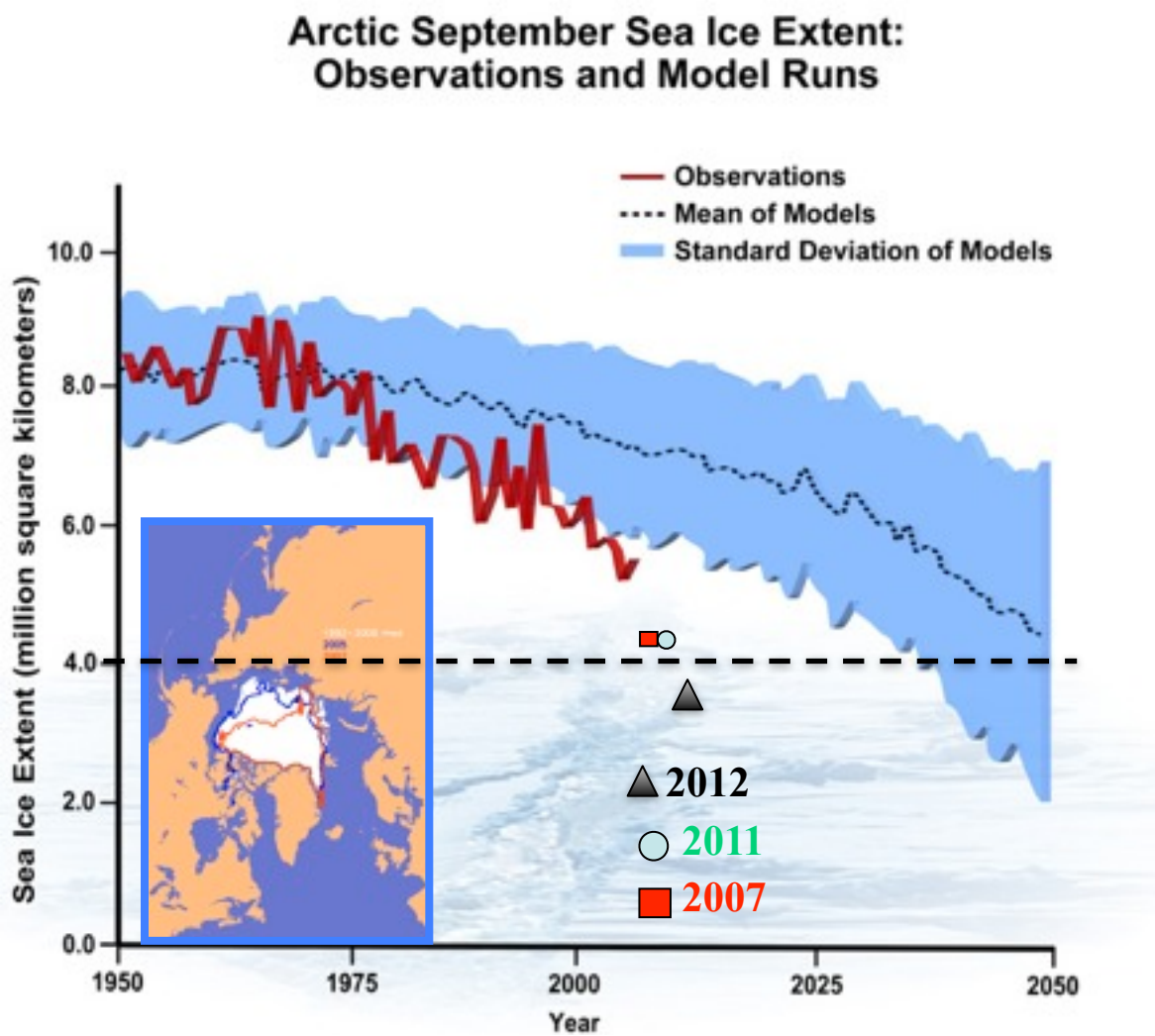
Comparisons of the model estimates and observations



Adapted from Stroeve, et al., *Geophys. Res. Lett.*, *34*, L09501, doi:10.1029/2007GL029703.

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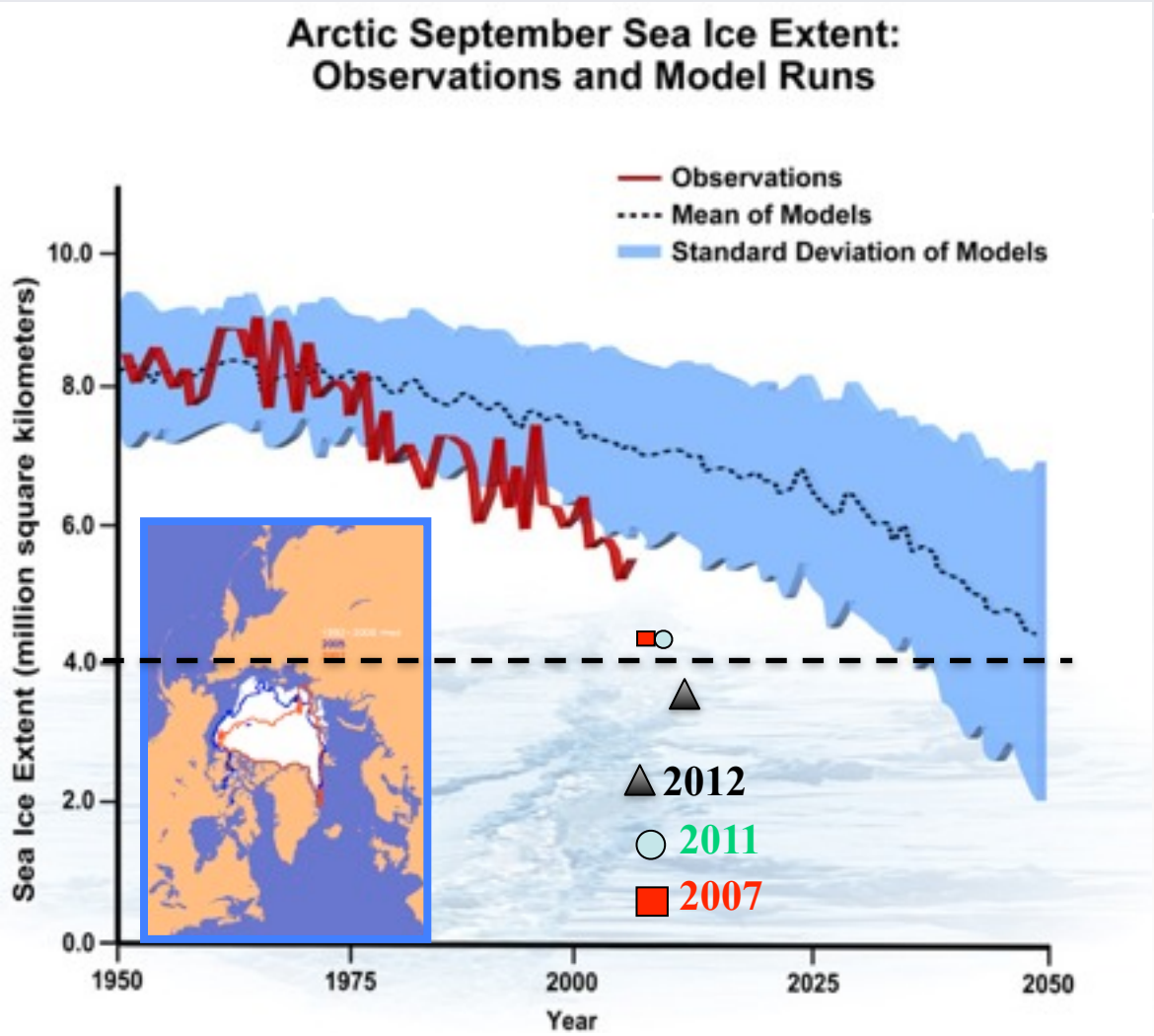

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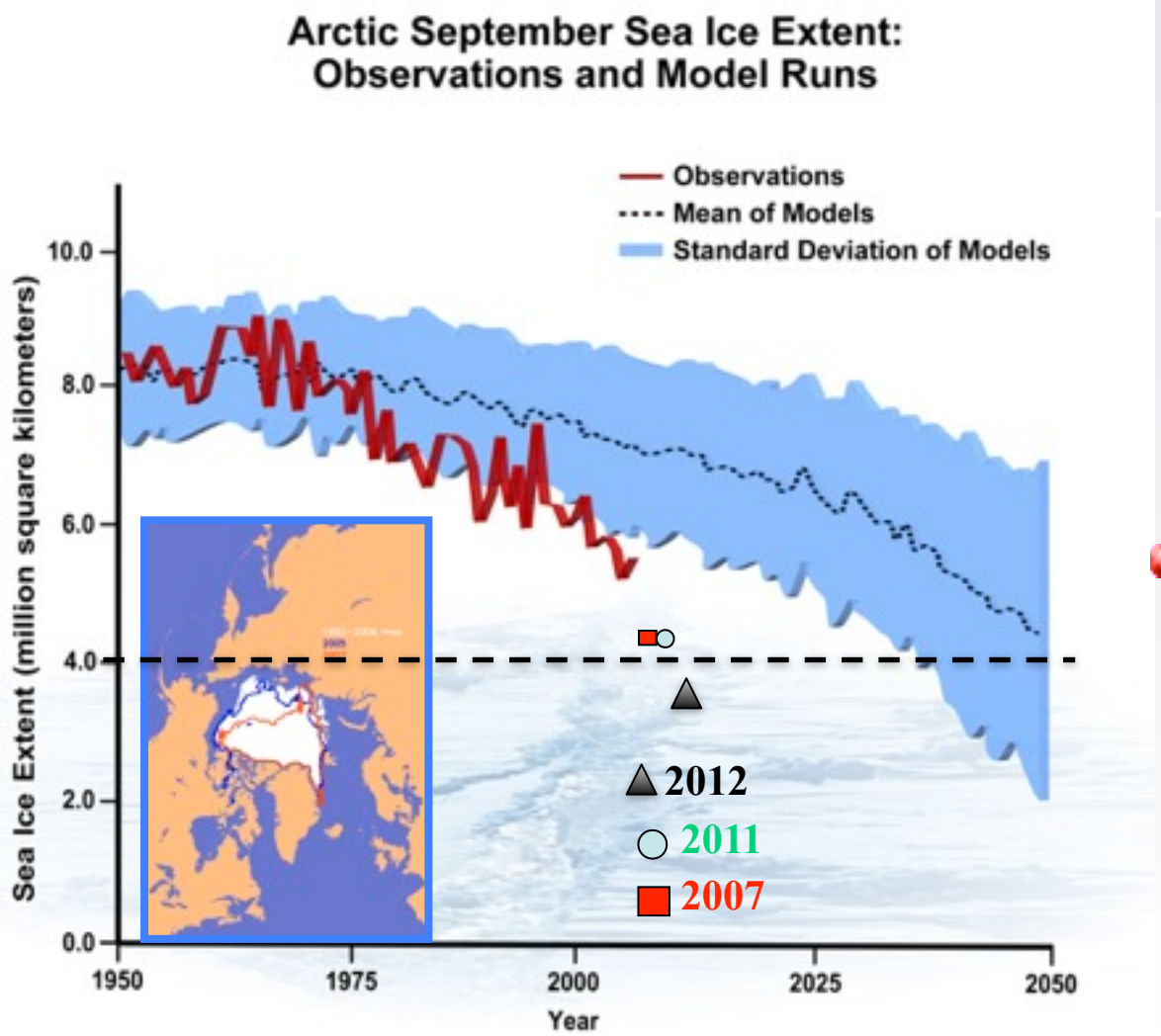

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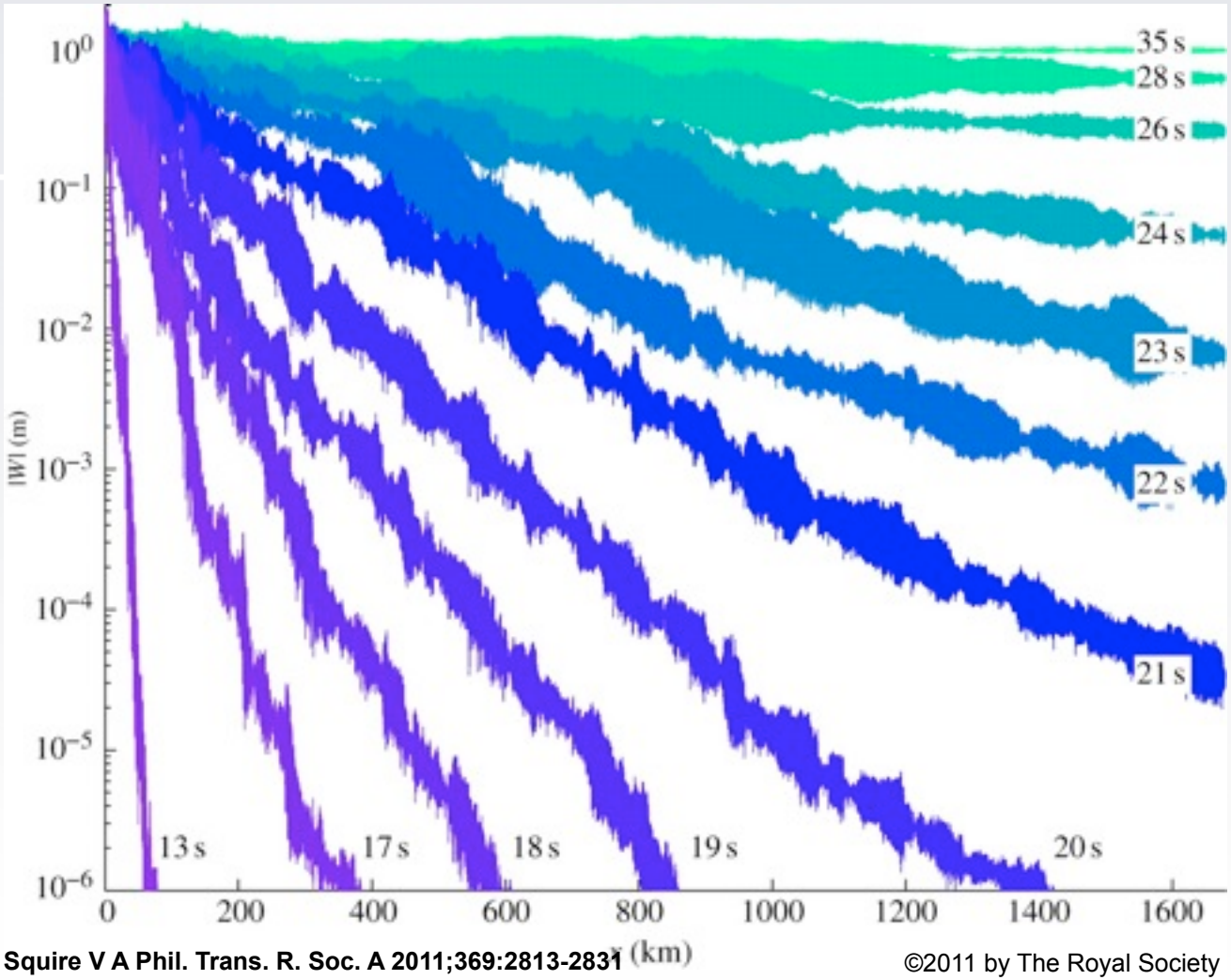
- Models show declining Arctic ice cover over the observational record, none show trends comparable to observations.
- Models underestimate the loss of sea ice. This suggests that forcing and/or feedbacks are not being represented correctly.

How the amplitude of ocean waves with period ranging from 13 to 35 s is affected by 1670 km of sea-ice terrain.



Squire V A Phil. Trans. R. Soc. A 2011;369:2813-2831

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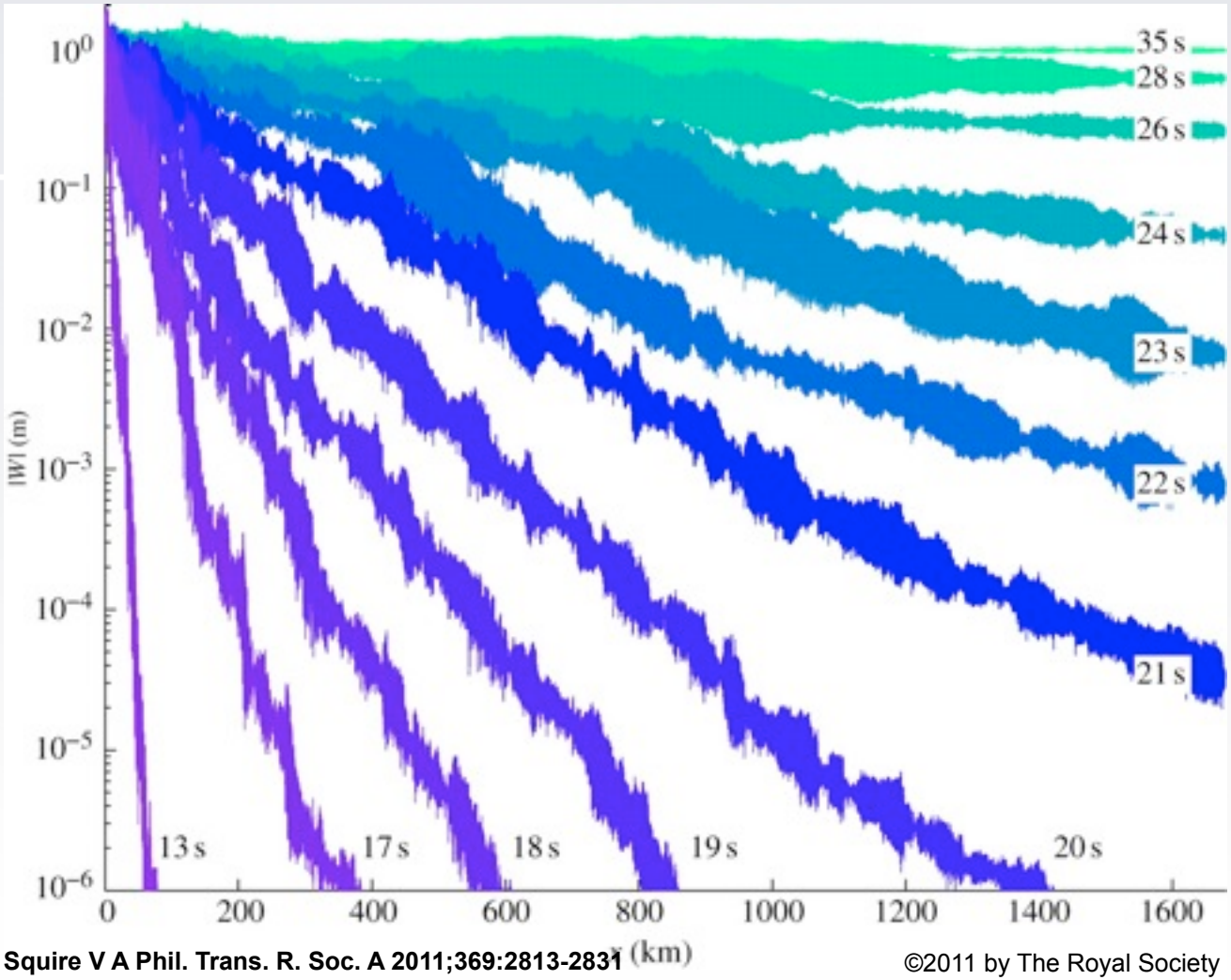
- Shorter-period swells require smaller amplitudes to break the ice.



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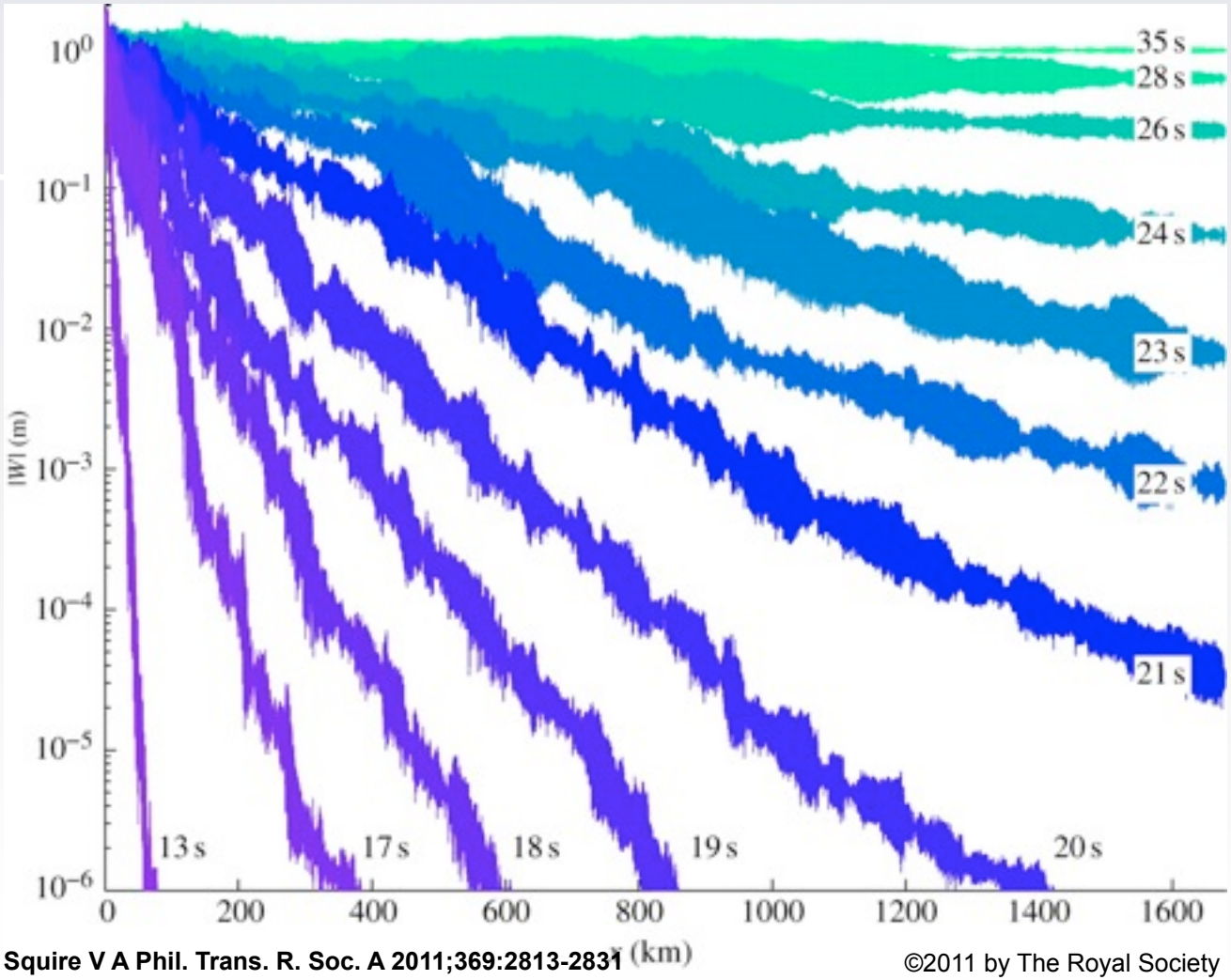
How the amplitude of ocean waves with period ranging from 13 to 35 s is affected by 1670 km of sea-ice terrain.

- Shorter-period swells require smaller amplitudes to break the ice.
- Longer-period swells reach deeper into the pack ice and require larger amplitudes to break the ice.



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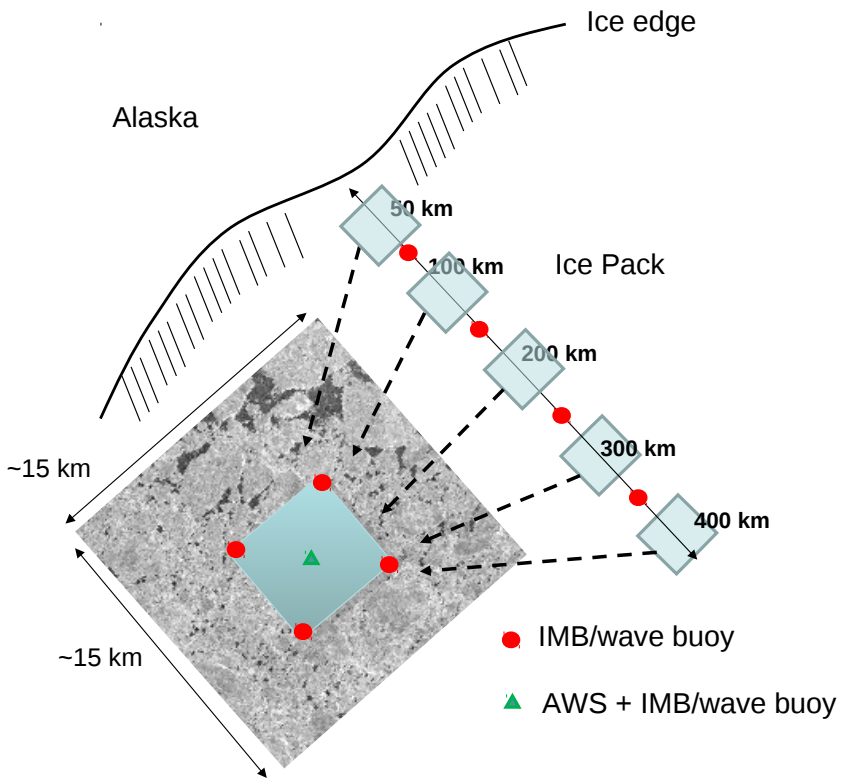
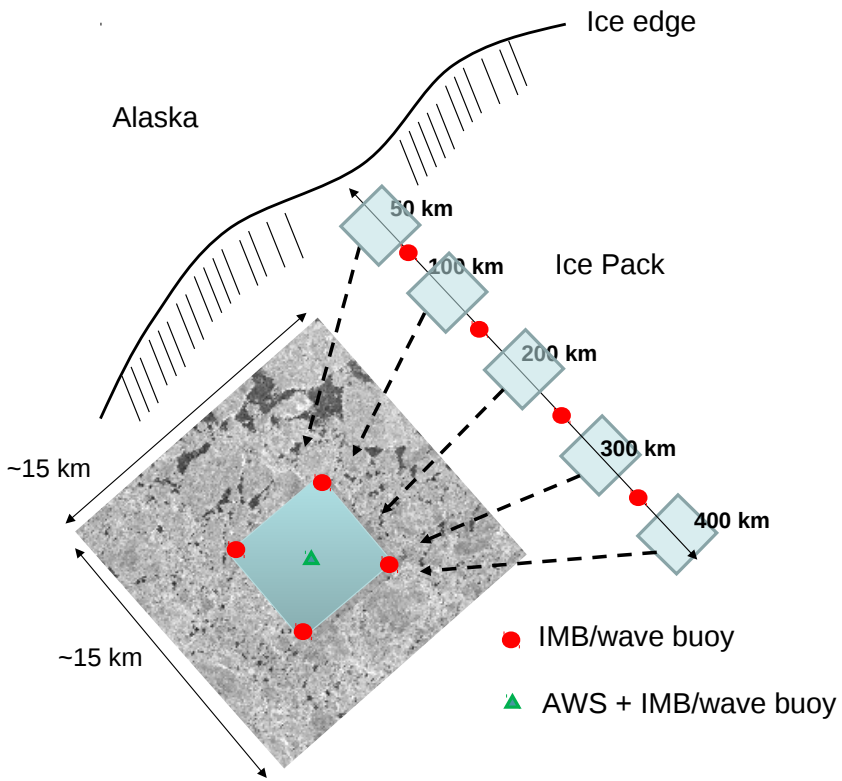
Ice, Ocean and Atmosphere Interactions in the Arctic Marginal Ice Zone



Ice, Ocean and Atmosphere Interactions in the Arctic Marginal Ice Zone

- Project funded by a Office of Naval Research (ONR) grant.



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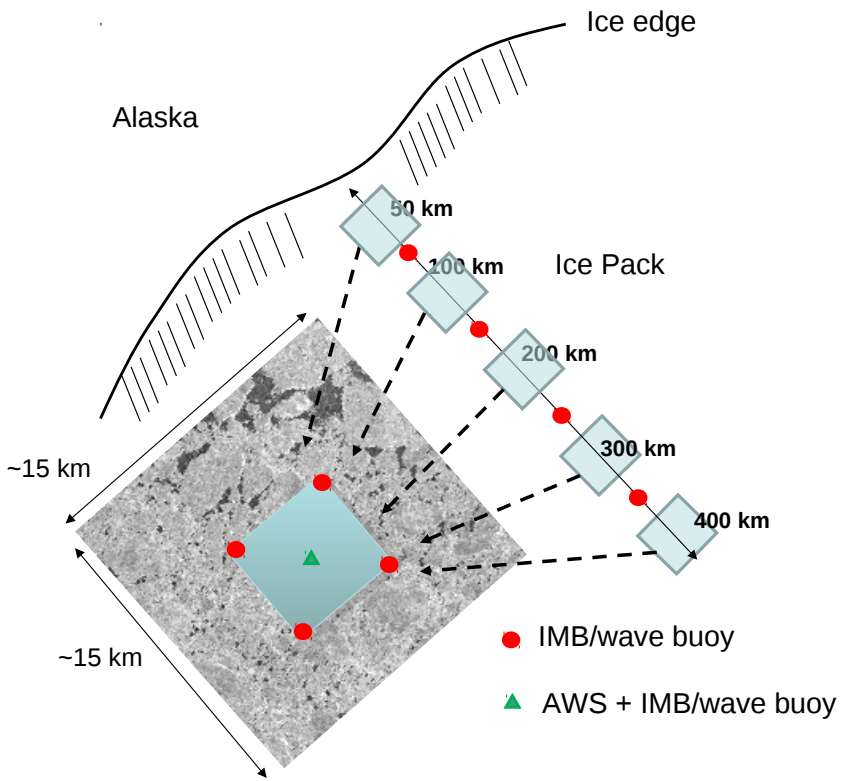

- Project funded by a Office of Naval Research (ONR) grant.
- 25 to 29 wave buoys / ice-mass balance (IMB) buoys to be deployed + 5 automatic weather stations (AWS).

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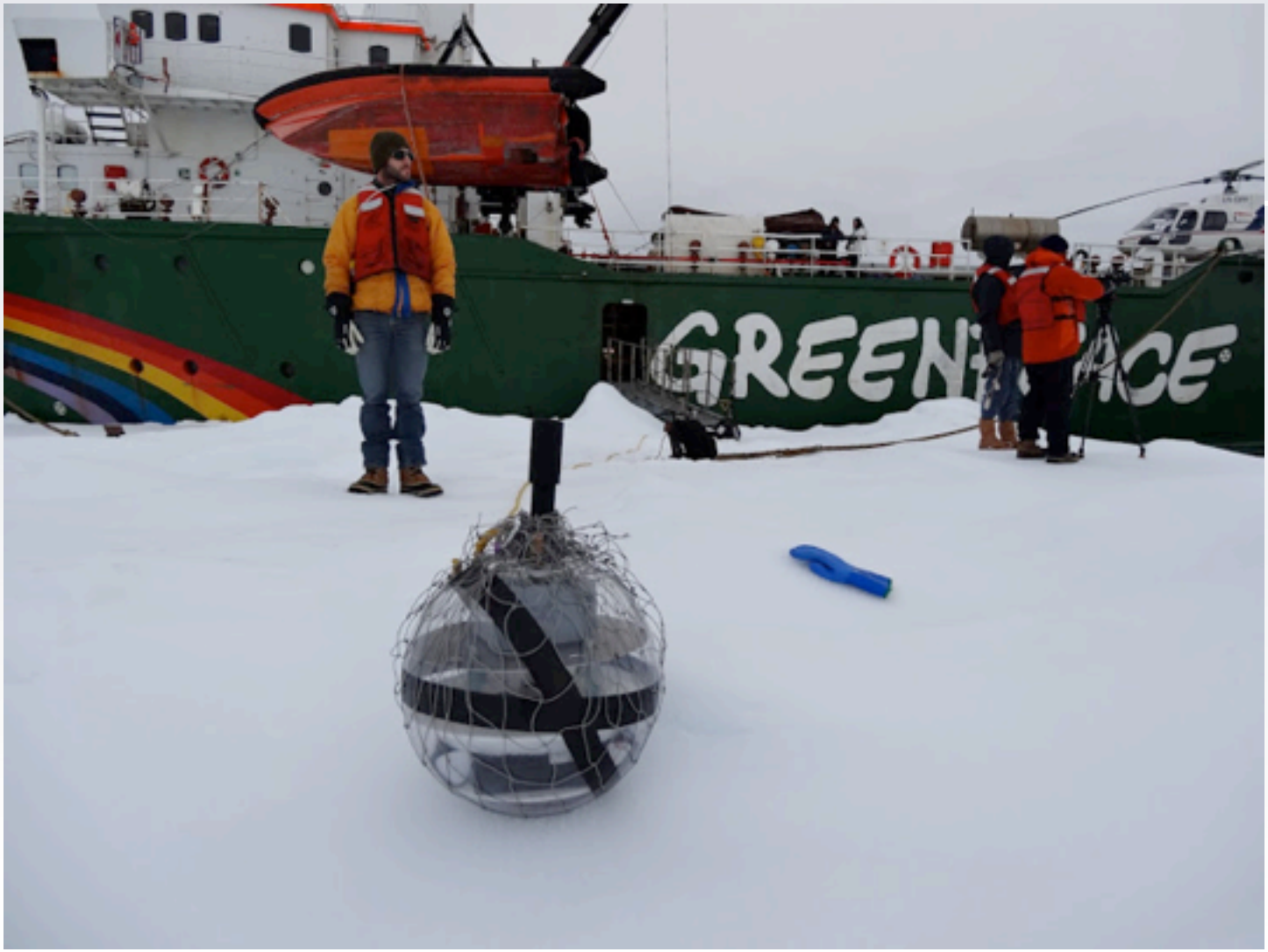
The experiment



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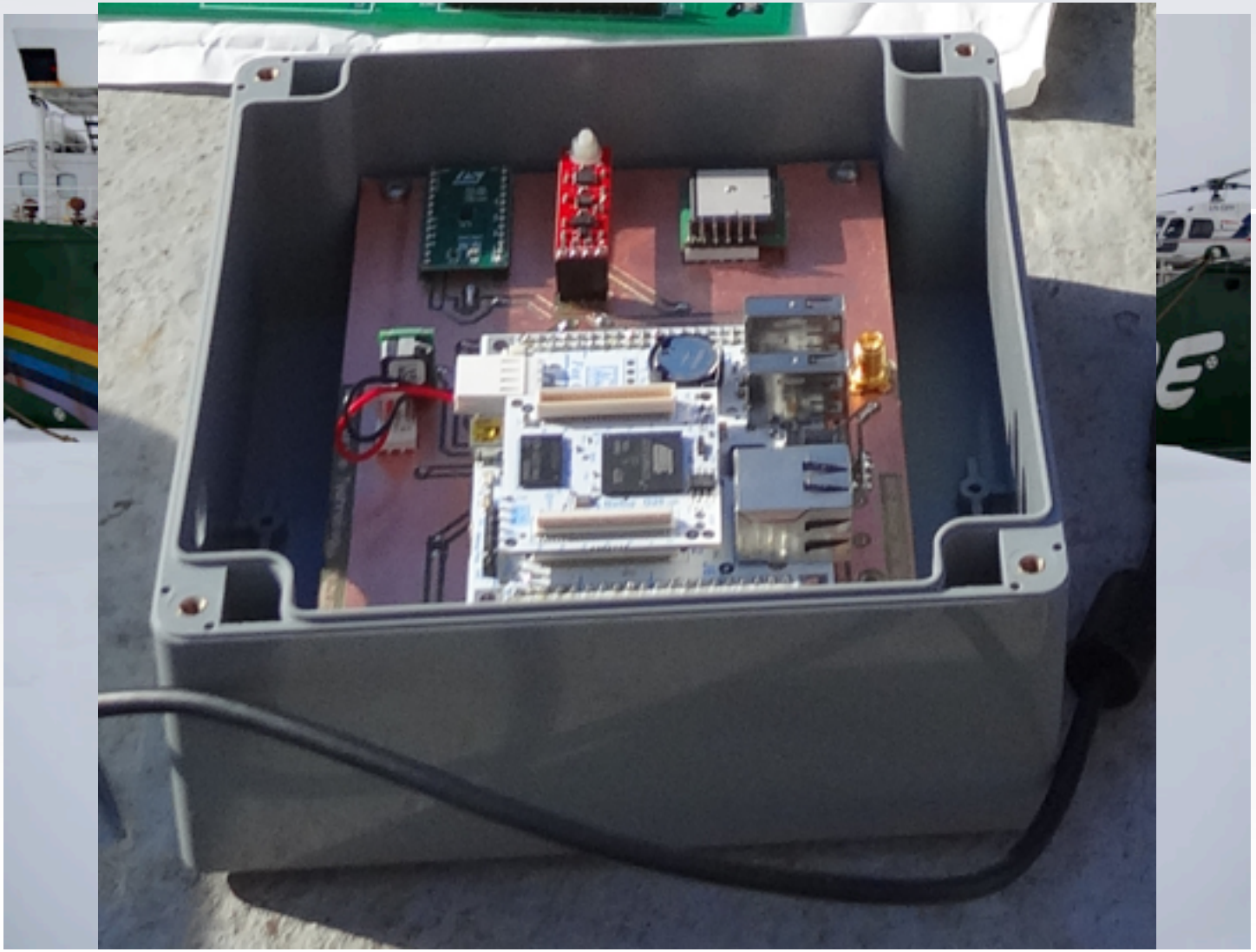
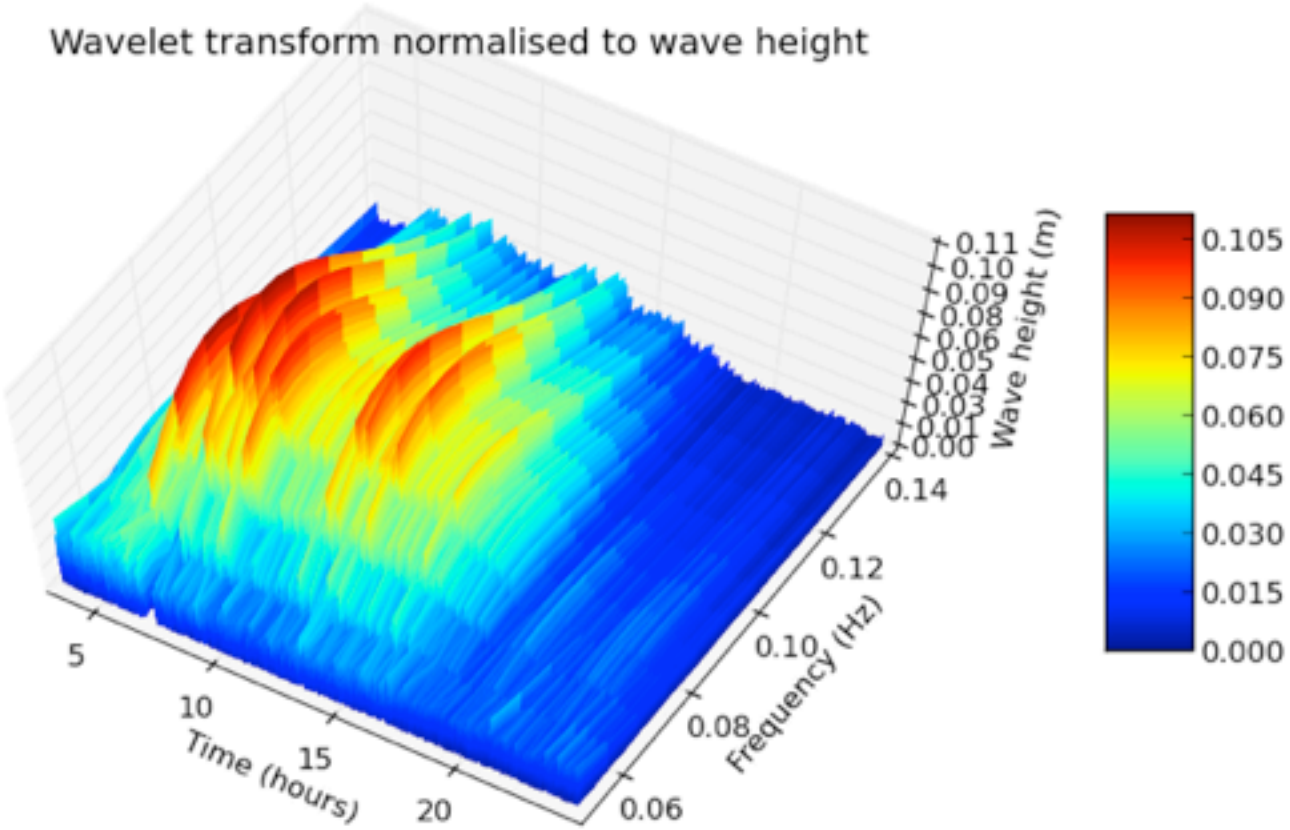
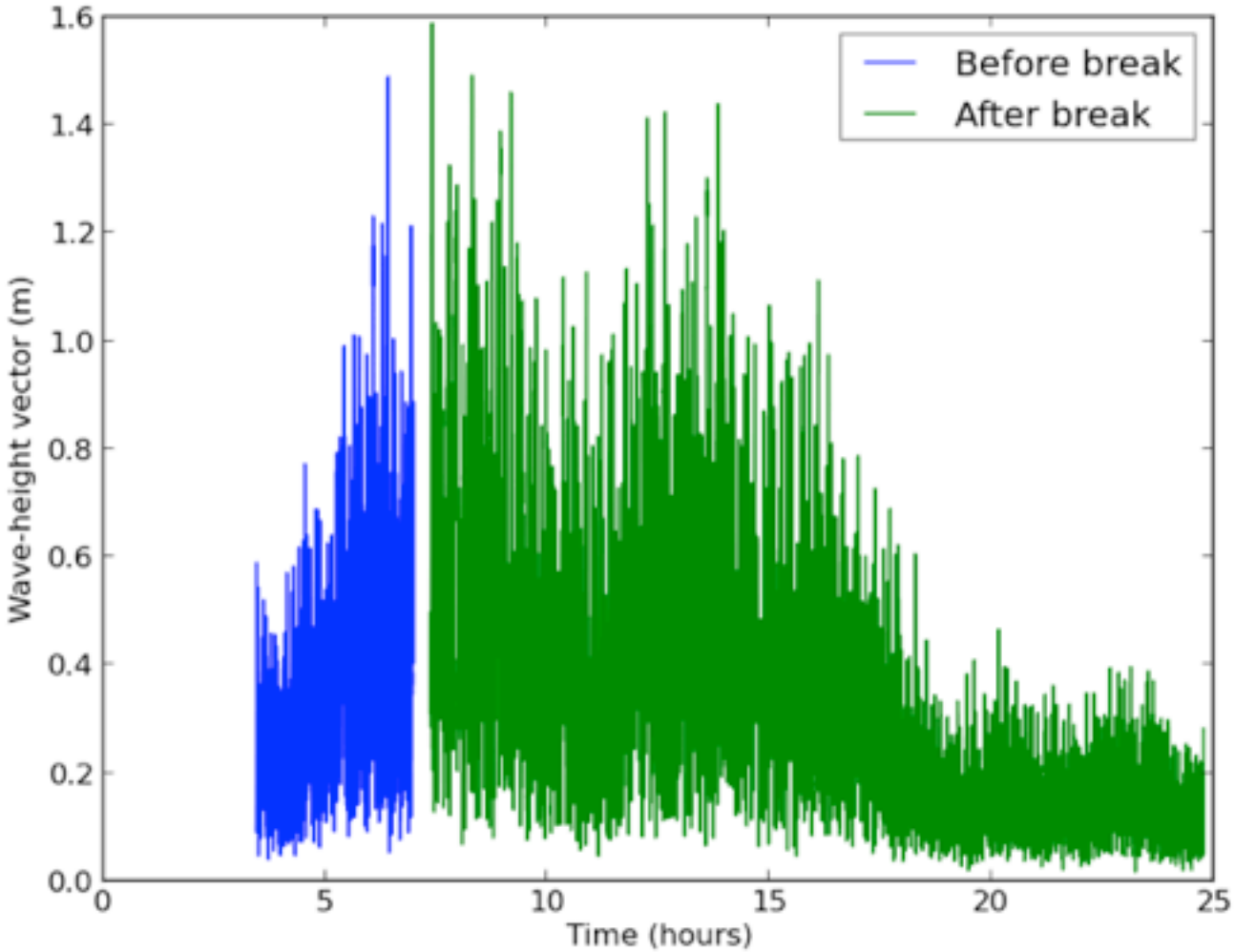


Wavelet analysis of the sea-ice waves



Wave height from wavelets



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Conclusions

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- Changing scientific discipline is possible and can be “refreshing”.
- Potential of bringing new techniques to a different field and conversely back to your own field.
- Changing field abruptly can be traumatic for your career. No track record, plenty to learn, difficult to get grants. The risk is becoming a “support” scientist.

Sea ice on Europa?

Credits:NASA/JPL

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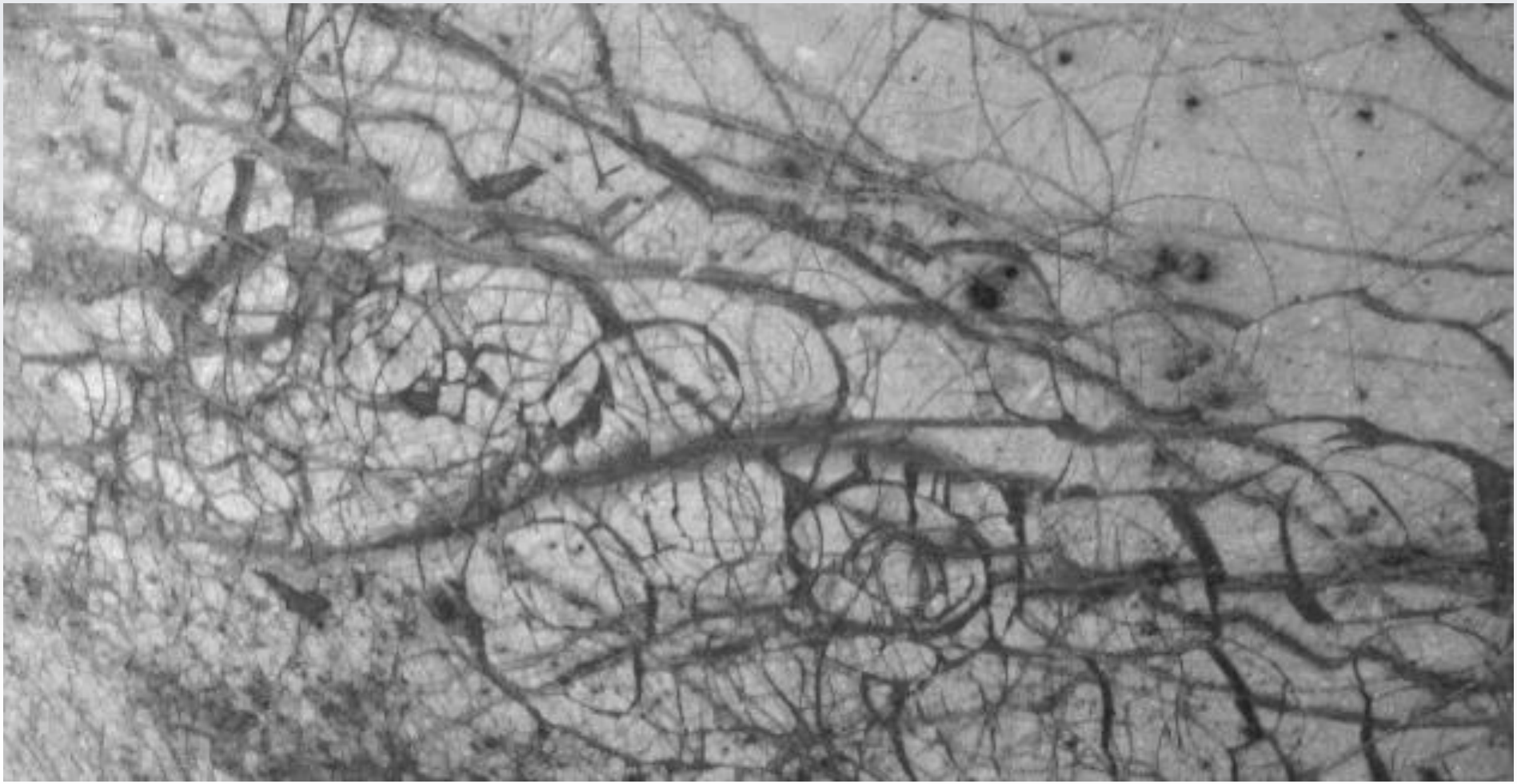

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