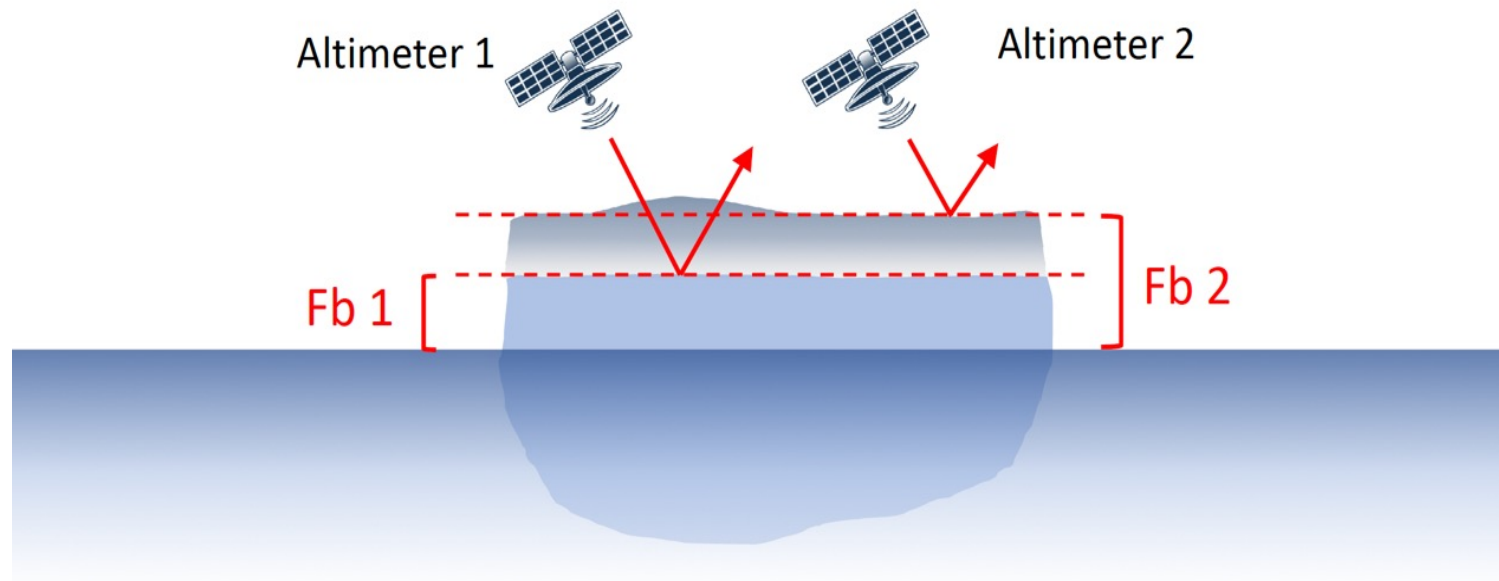
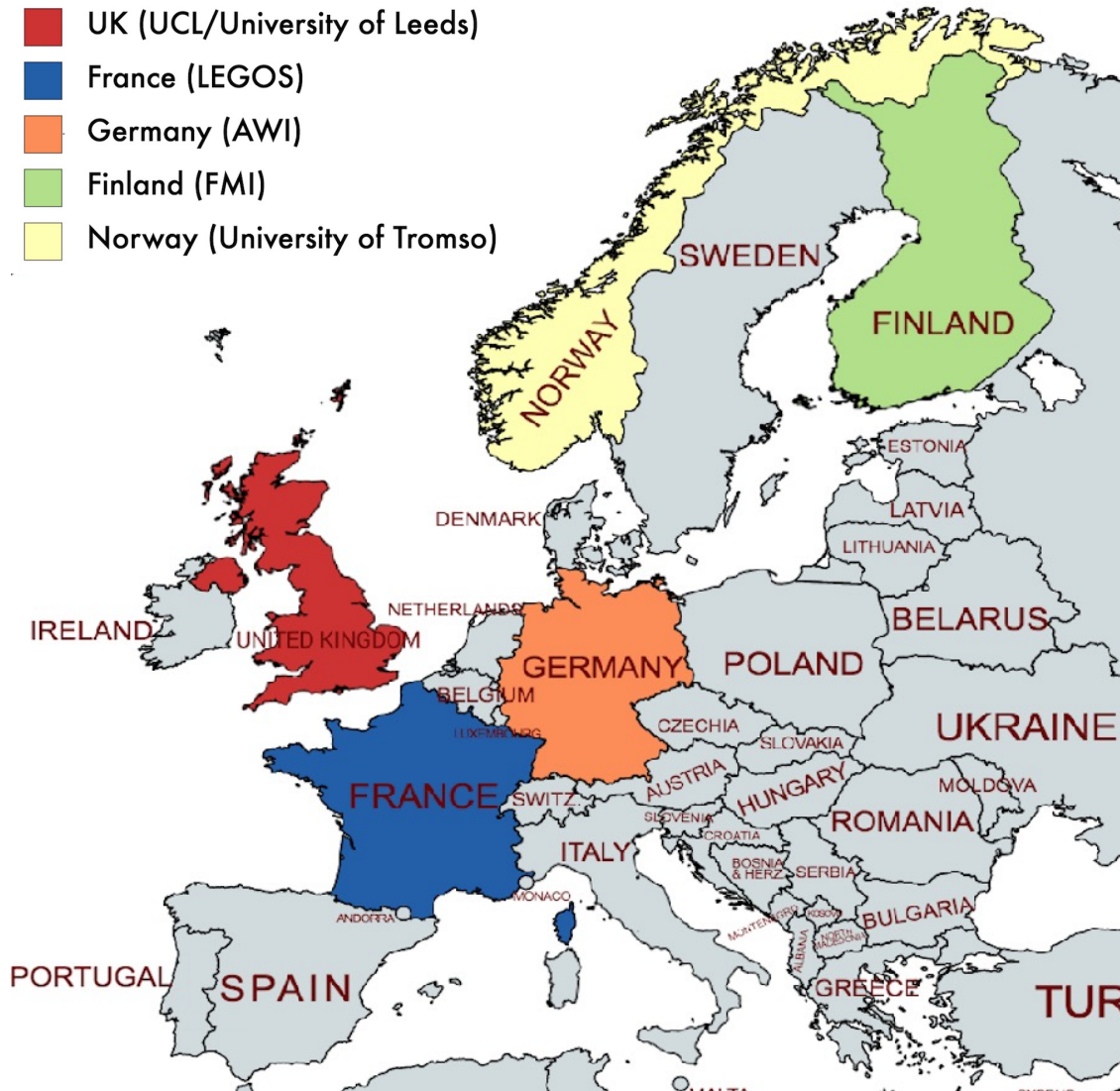


Multi-Frequency Satellite Approaches for Snow on Sea Ice: first results from the POLAR+ Snow on Sea Ice ESA project



EXPRO+ Snow on Sea Ice



Core partners:

- UCL (ES + MSSL)
- AWI
- FMI
- University of Leeds
- University of Tromsø
- LEGOS

Additional partners:

- University of Reading
- University of Helsinki
- Tsinghua University
- NASA Goddard

M. Tsamados
Science Lead +
Project manager
R. Willatt + others

S. Fleury
F. Garnier

J. Landy
C. De Rijke-Thomas

E. Rinne
Heidi Sallila



FMI



UNIVERSITY OF LEEDS



S. Baker
Support project manager
A. Muir

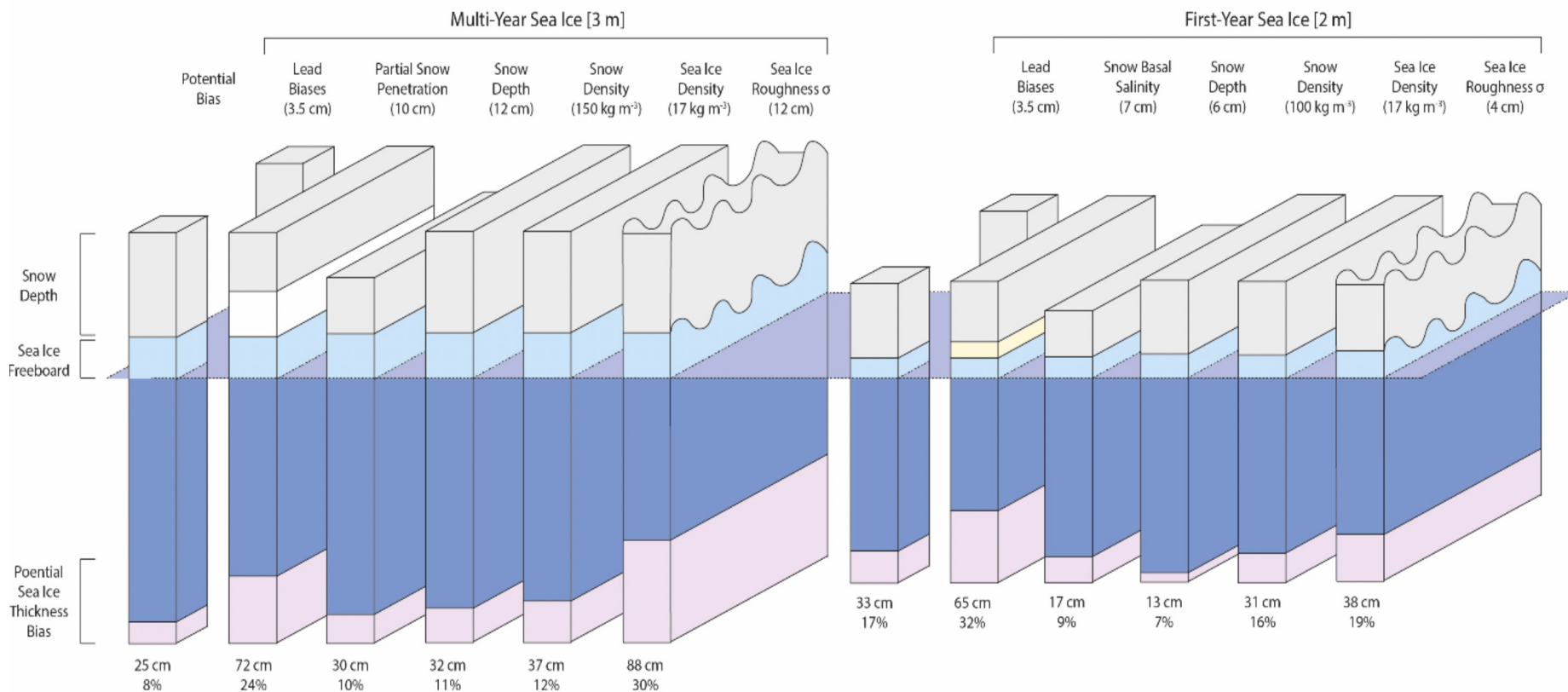
C. Haas
S. Hendricks

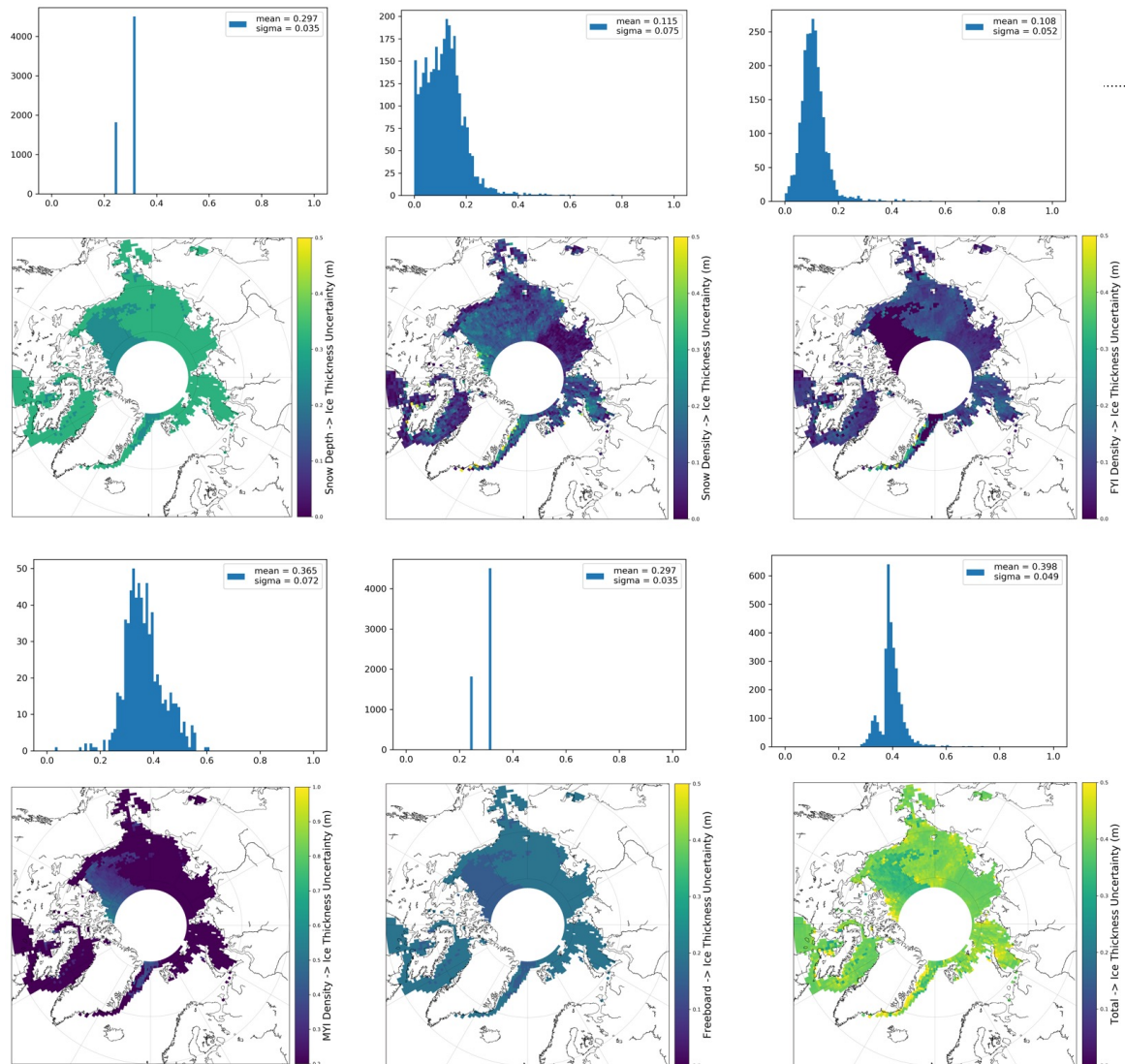
Jérôme Bouffard
Antoine Laforge
Renée
Fredensborg

A. Shepherd
I. Lawrence

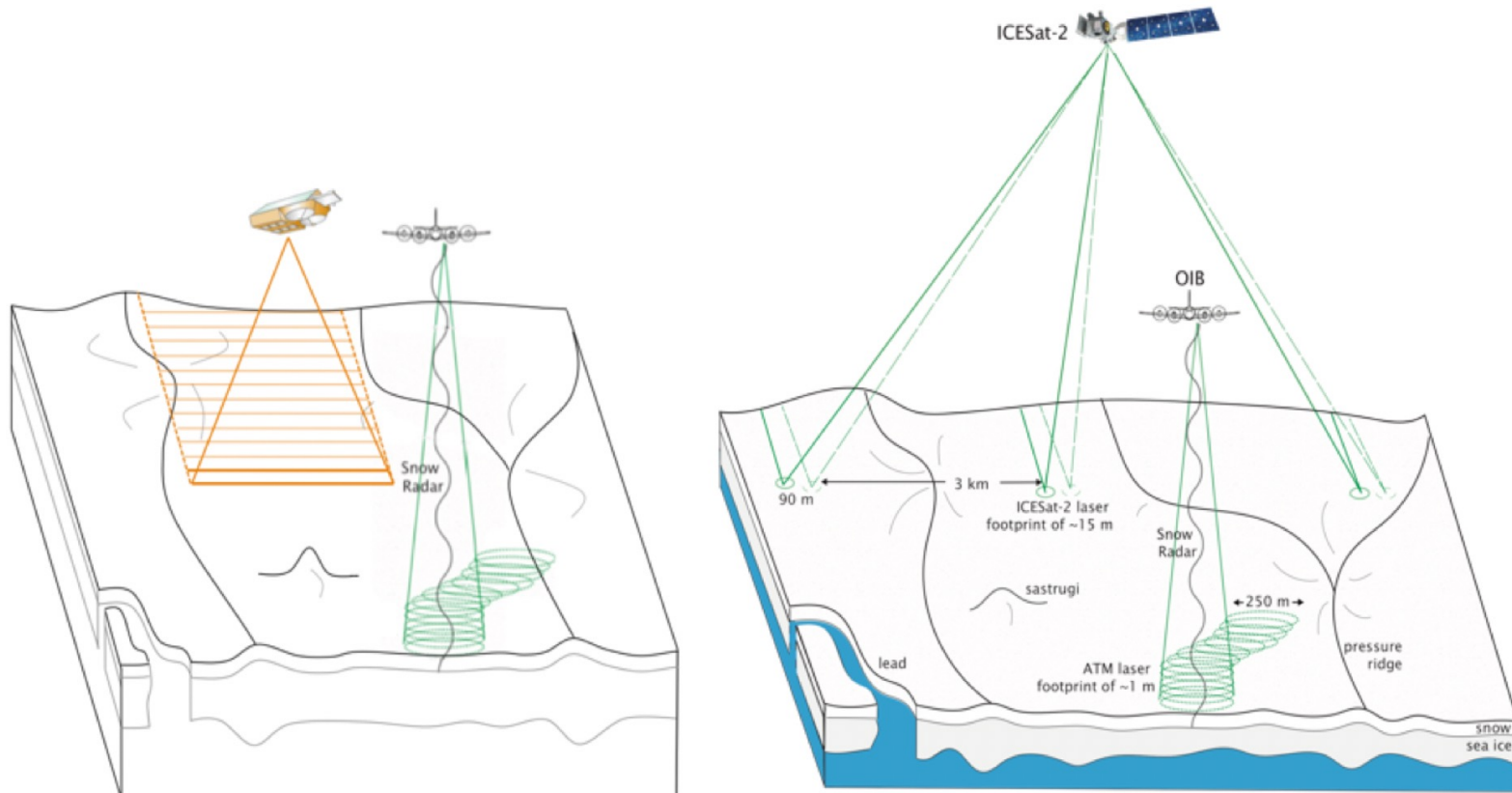
Collaborating Partners. NASA Goddard: N. Kurtz, A. Petty, R. Tilling Tsinghua University: S. Xu Reading: D. Feltham, D. Schroeder Helsinki: P. Uotila

Snow dominant in sea ice thickness uncertainty budget

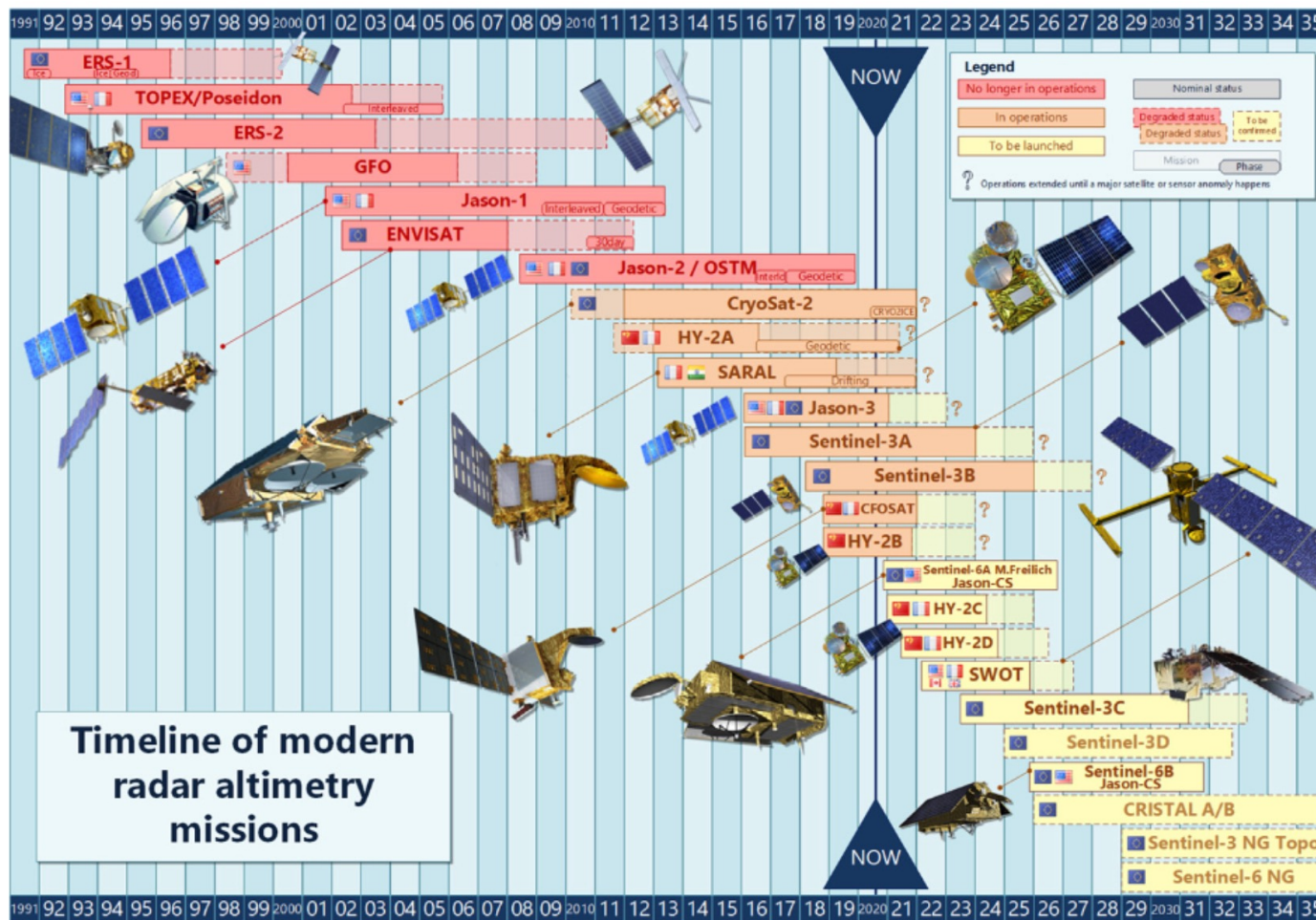




Taking advantage of the golden era of polar altimetry...

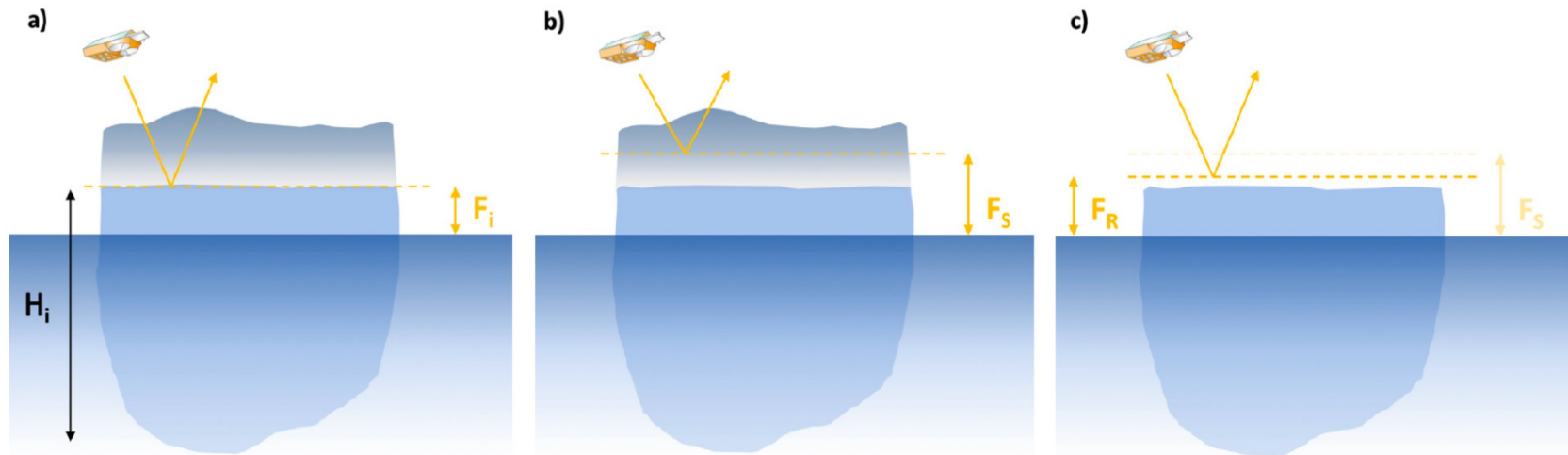


...and paving the way to future multi-frequency missions



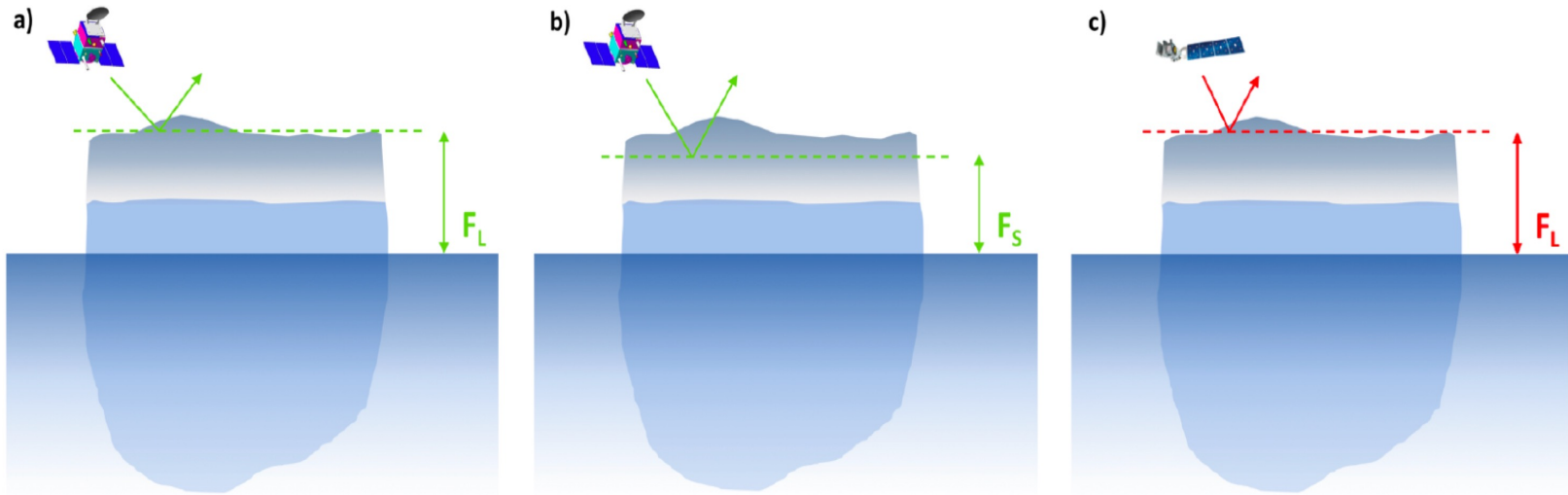
Ku-band radar from CryoSat-2 (+Sentinel-3 A&B)

$$F_R^{CS2} = F_I + \left(1 - \alpha^{CS2} \frac{c}{c_s}\right) H_S$$



Ka-band from AltiKa + Laser from ICESat-2

$$F_R^{AK} = F_I + \left(1 - \alpha^{AK} \frac{c}{c_s}\right) H_S$$



Multi-frequency snow thickness

Ku-band frequency (CryoSat-2):

$$F_R^{CS2} = F_I + \left(1 - \alpha^{CS2} \frac{c}{c_s}\right) H_S$$

Ka-band frequency (AltiKa):

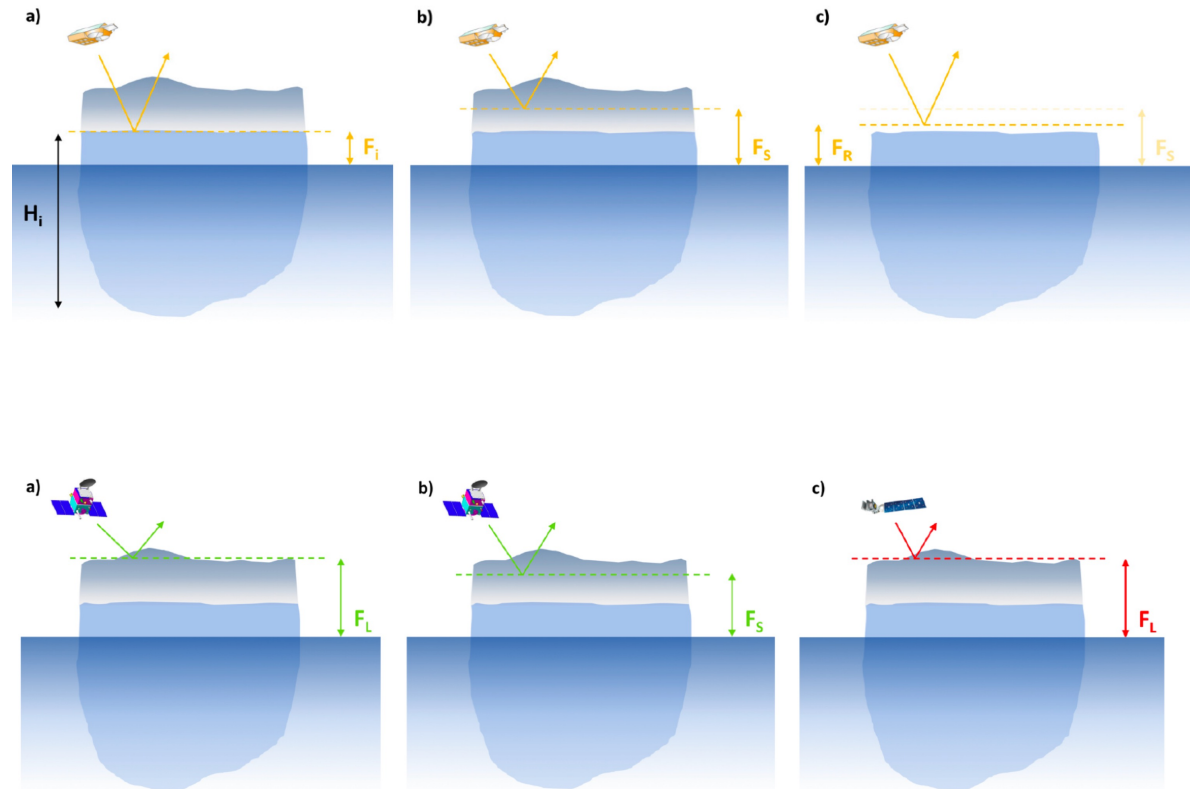
$$F_R^{AK} = F_I + \left(1 - \alpha^{AK} \frac{c}{c_s}\right) H_S$$

Laser altimeter (ICESat-2):

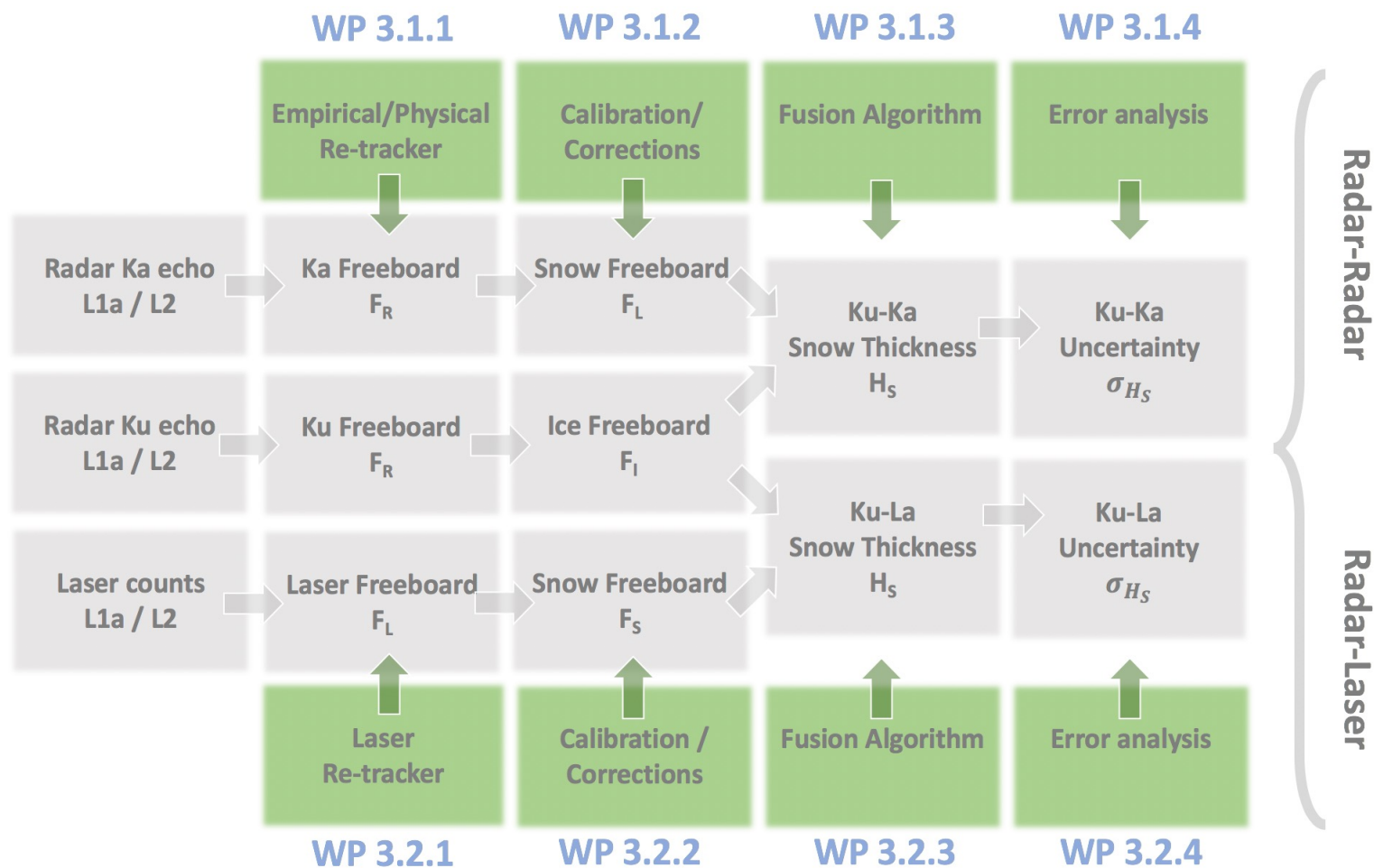
$$F_L^{IS2} = F_I + H_S$$

Bias corrected snow thickness:

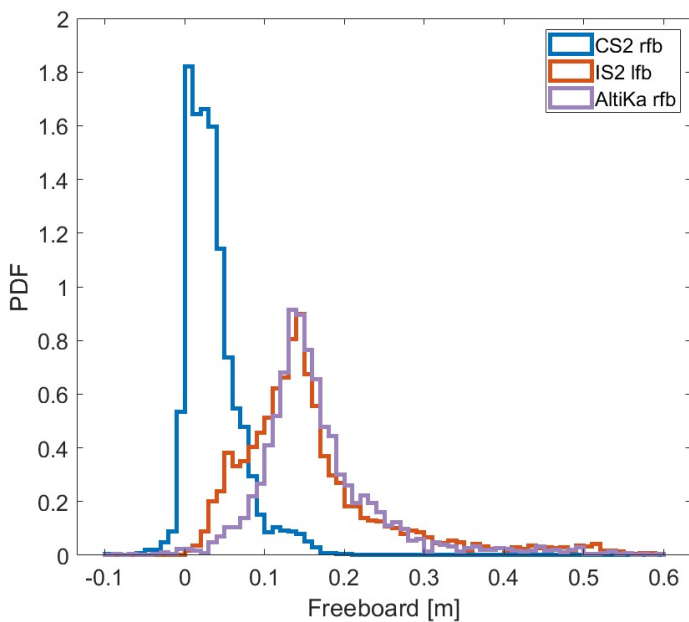
$$H_S = \frac{F_R^{AK} - F_R^{CS2}}{\alpha^{CS2} - \alpha^{AK}}$$



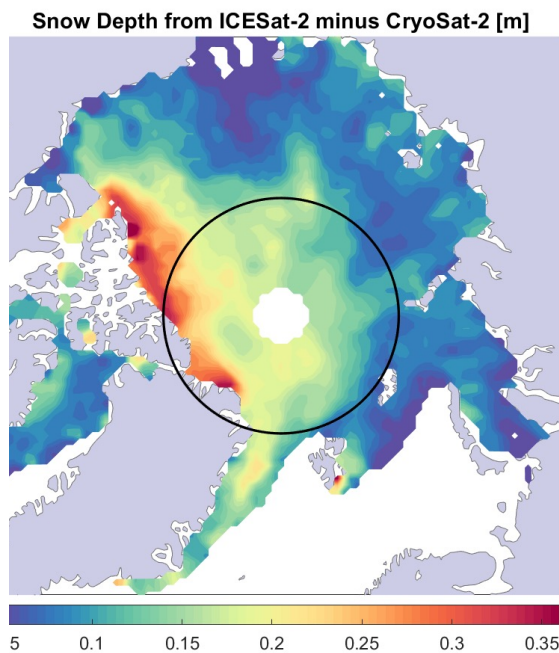
Radar-Radar (KuKa) and Radar-Laser (KuLa) approaches



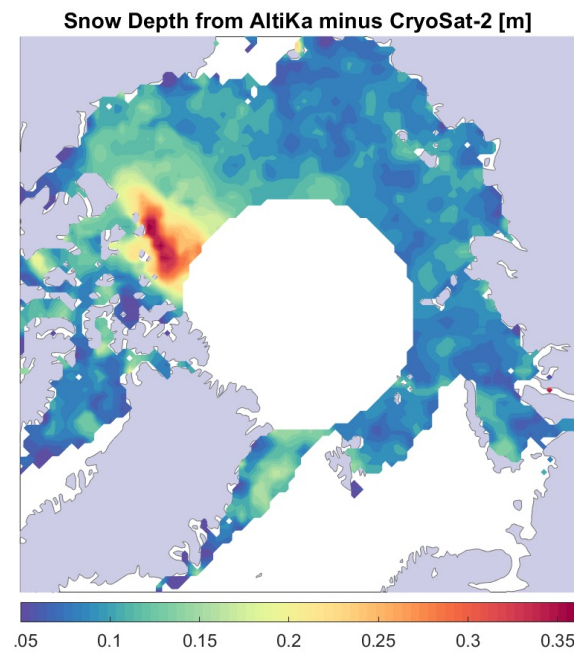
First KuKa and KuLa results are very promising



Credit: Jack Landy

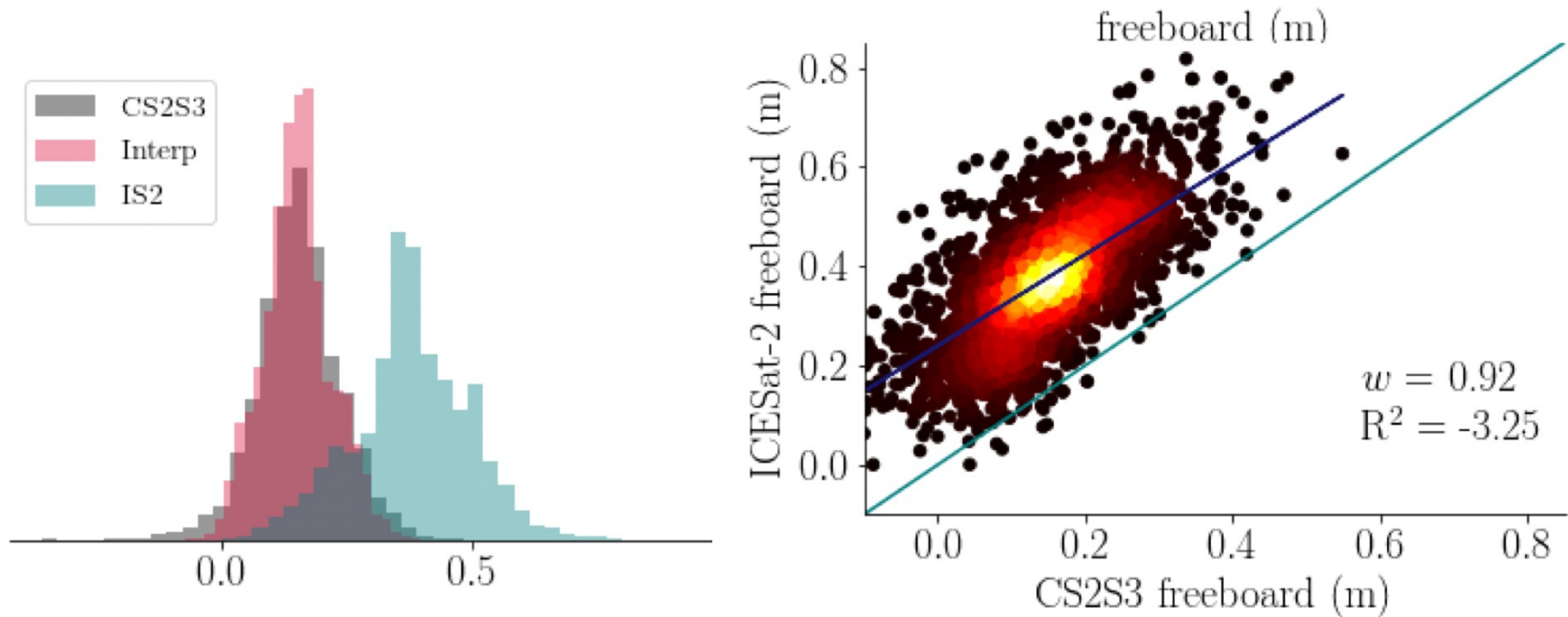


Ku-La



Ku-Ka

Comparison against merged CS2+S3 products



EGU21-11462 | vPICO presentations | [CR2.5](#) ★

[A Bayesian approach towards daily pan-Arctic sea ice freeboard estimates from combined CryoSat-2 and Sentinel-3 satellite observations](#) ▶

William Gregory, Isobel Lawrence, and Michel Tsimados

Fri, 30 Apr, 13:36–13:38

Related #vEGU21 presentations

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Florent Garnier, Sara Fleury, Michel Tsamados, Antoine Laforge, Marion Bocquet, and Frédérique Rémy

Thu, 29 Apr, 11:24–11:26

EGU21-11462 | vPICO presentations | [CR2.5](#) ★

[A Bayesian approach towards daily pan-Arctic sea ice freeboard estimates from combined CryoSat-2 and Sentinel-3 satellite observations](#) ▶

William Gregory, Isobel Lawrence, and Michel Tsamados

Fri, 30 Apr, 13:36–13:38

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Rosemary Willatt, Julianne Stroeve, Vishnu Nandan, Rasmus Tonboe, Stefan Hendricks, Robert Ricker, James Mead, Thomas Newman, Polona Itkin, Glen Liston, Robbie Mallett, Lu Zhou, Martin Schneebeli, Daniela Krampe, Michel Tsamados, Oguz Demir, Marc Oggier, Ella Buehner Gattis, and Jeremy Wilkinson

Fri, 30 Apr, 16:01–16:03

EGU21-15636 | vPICO presentations | [CR5.1/CL4.21/HS2.1.8](#) ★

[A comparison between coincident laser and Ku radar versus S- to C-band 'snow radar' data for airborne retrievals of snow depth on sea ice](#) ▶

Claude de Rijke-Thomas, Jack Landy, Joshua King, and Michel Tsamados

Wed, 28 Apr, 13:56–13:58