



Effects of different cooling techniques during processing and temperature fluctuations during air and sea freight on storage life of cod loins

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Short title:

**Is it an realistic option to export
fresh cod loins from Iceland with
sea freight?**

A child in a red hoodie is playing on a beach, with a mountain range in the background. The child is in the foreground on the right, and the mountains are in the background on the left. The text is overlaid on the image.

This presentation

Export of fresh fish from Iceland

New cooling techniques

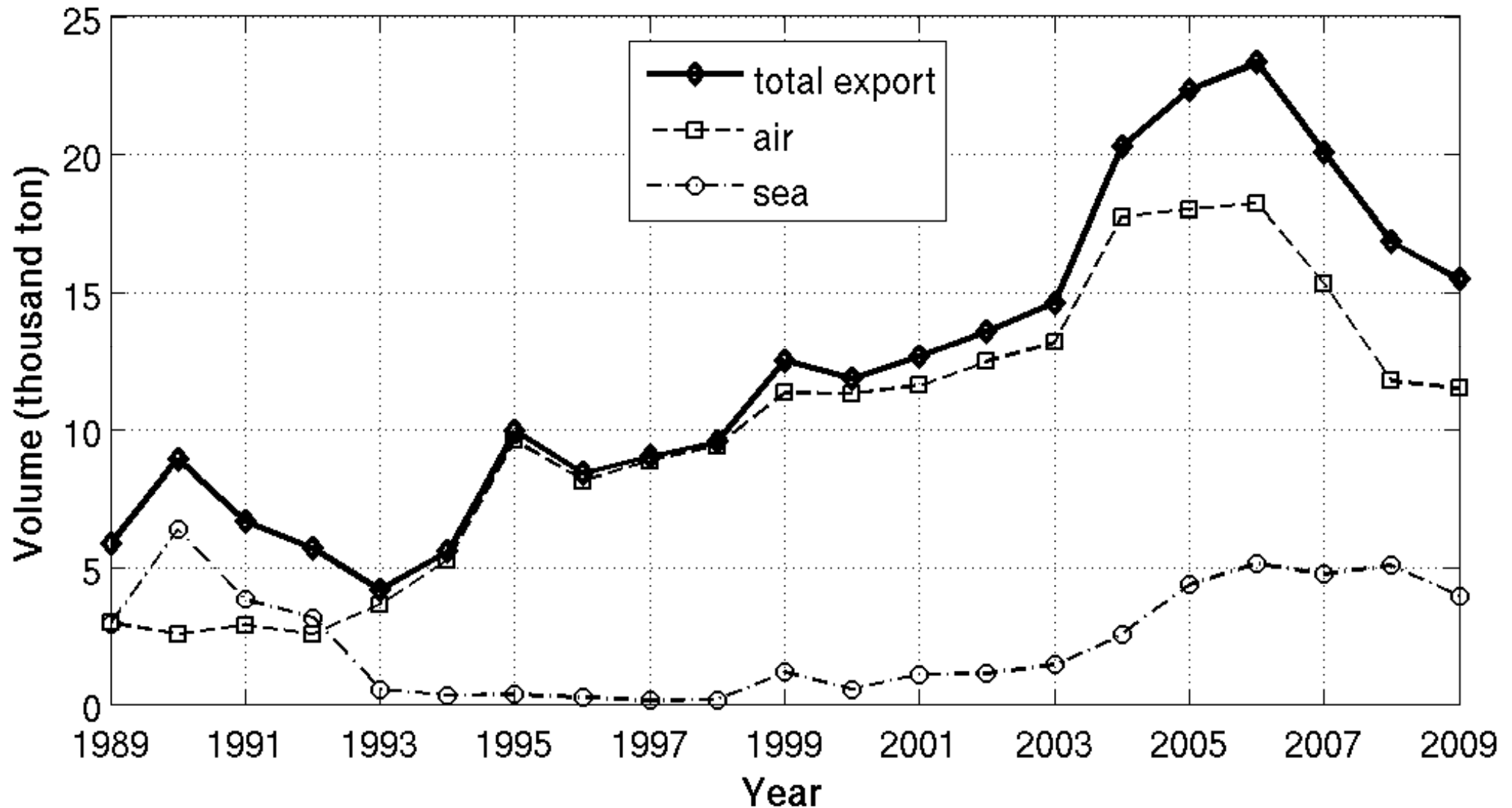
Temperature monitoring of cod loins exported to Germany

Case studies:

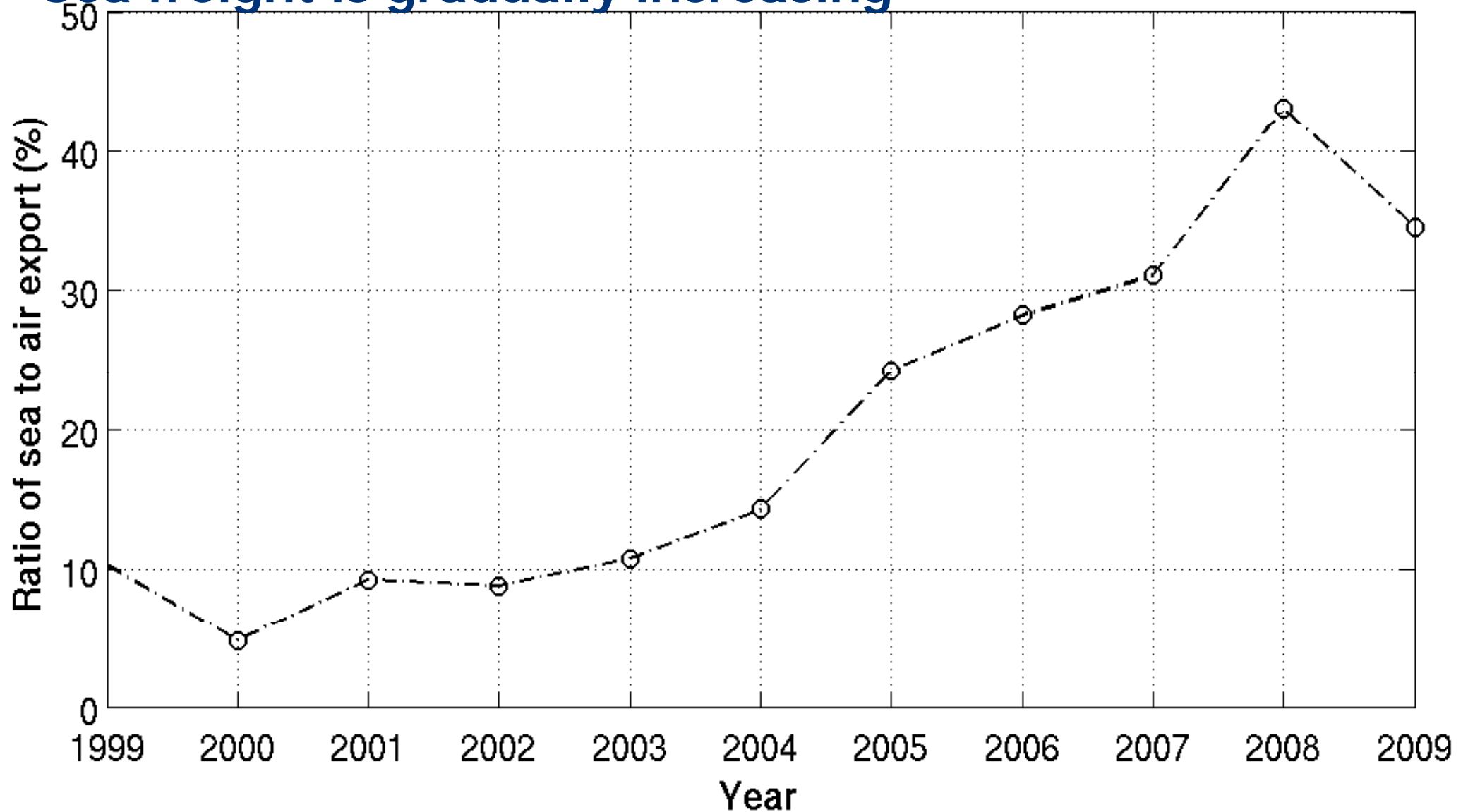
Different cooling techniques and temperature fluctuations

Simulated air and sea transport using optimal pre cooling techniques

Export of fresh fish fillets from Iceland



Sea freight is gradually increasing



Fresh fish fillet export



Transport time from Icelandic processors to retailers in Europe:

Sea: 5-7 days (cost = 1,0)

Air: 1-2 days (cost = 2,5)

3-6 days longer by sea depending on week day and location of processing

Cooling prior to deskinning and trimming:

- *No cooling*
- *Cooling (Liquid brine or slurry ice cooling)*
- *Liquid brine cooling followed by **CBC cooling***

New improved cooling technique: Combined Blast and Contact cooling (CBC)

- *Superchills the skin side*
- *Efficient for pre-chilling before packaging and to prolong shelf life*

Combined Blast and Contact cooling - CBC



Conveyor belt to the CBC tunnel



Equipment easily controlled to obtain desirable superchilled temperature of fillets to avoid freezing/crystal damages

Combined Blast and Contact cooling - CBC



The “cold load” trapped in the fillets contributes to long superchilled condition packed in EPS boxes

=> slower quality degradation at earlier stages

Inside....and out of
the CBC tunnel

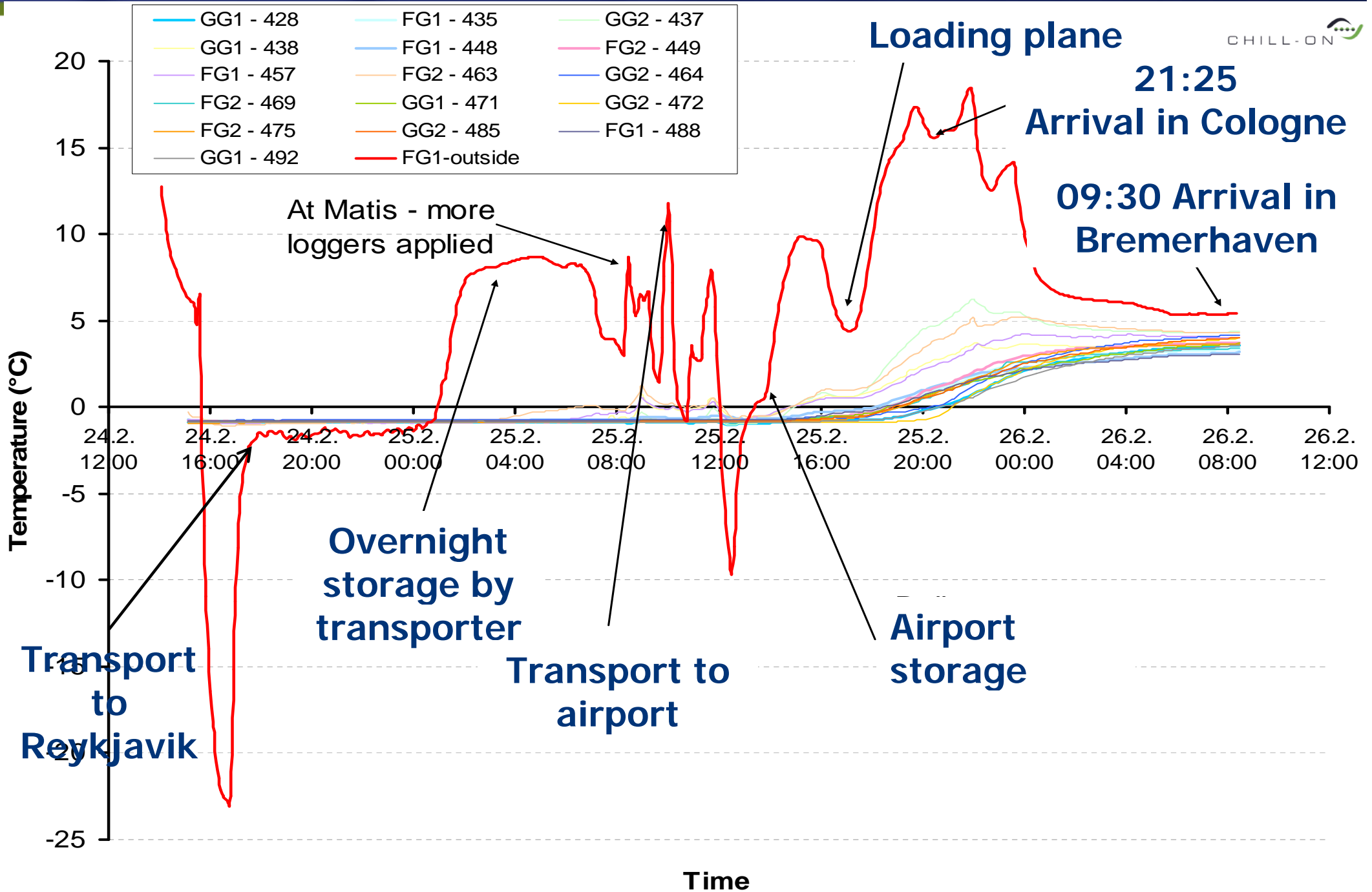
Maintaining a low and steady temperature through the cold chain is vital for the shelf life of valuable fresh cod loins

A comparison of **air** and **sea** transport:
CBC cooled cod loins (February) exported to Bremerhaven , Germany packed in EPS boxes

*Loggers to monitor the temperature during transport:
ambient and product temperature*



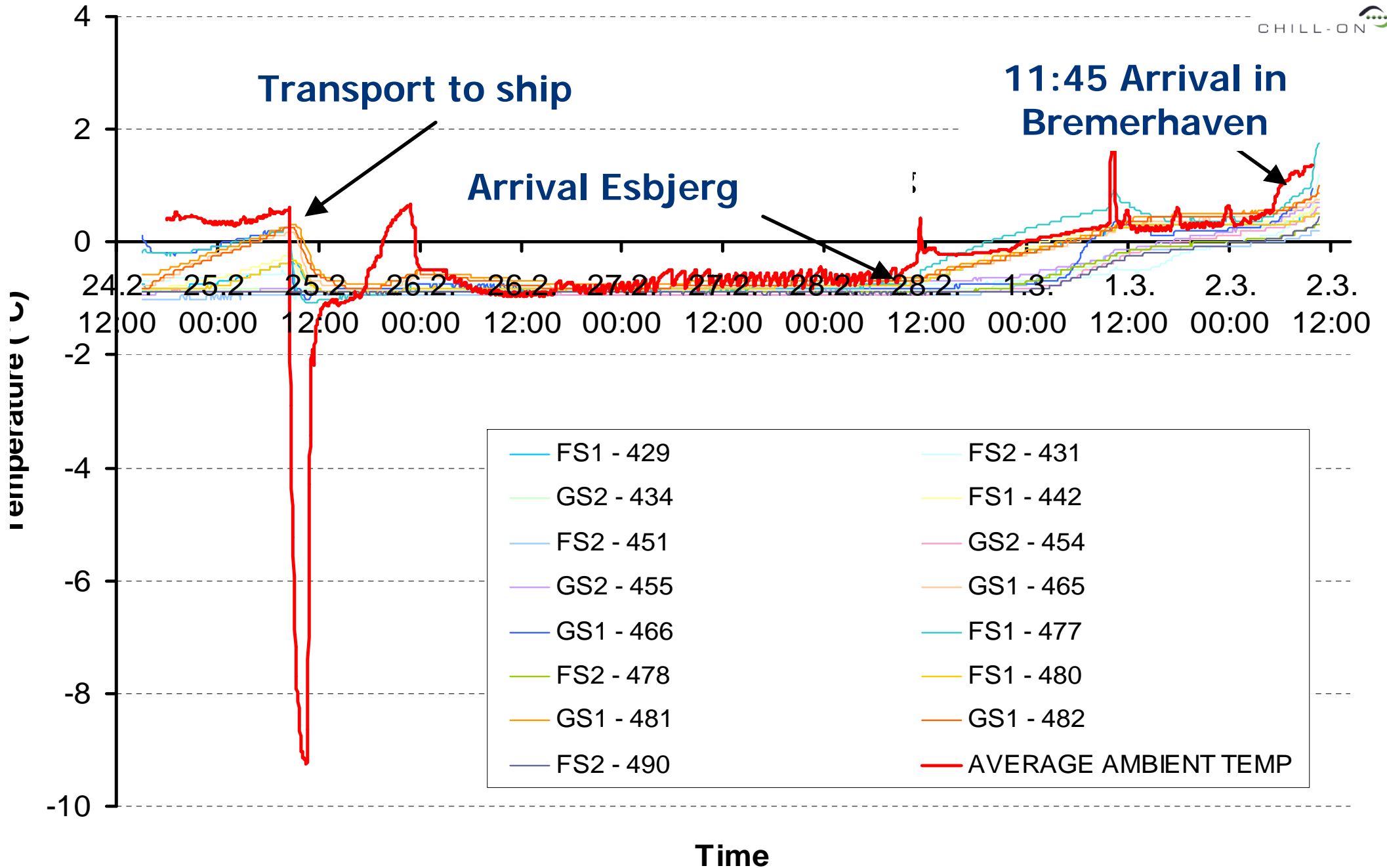
Temperature during **air** freight transport



Temperature during sea freight transport



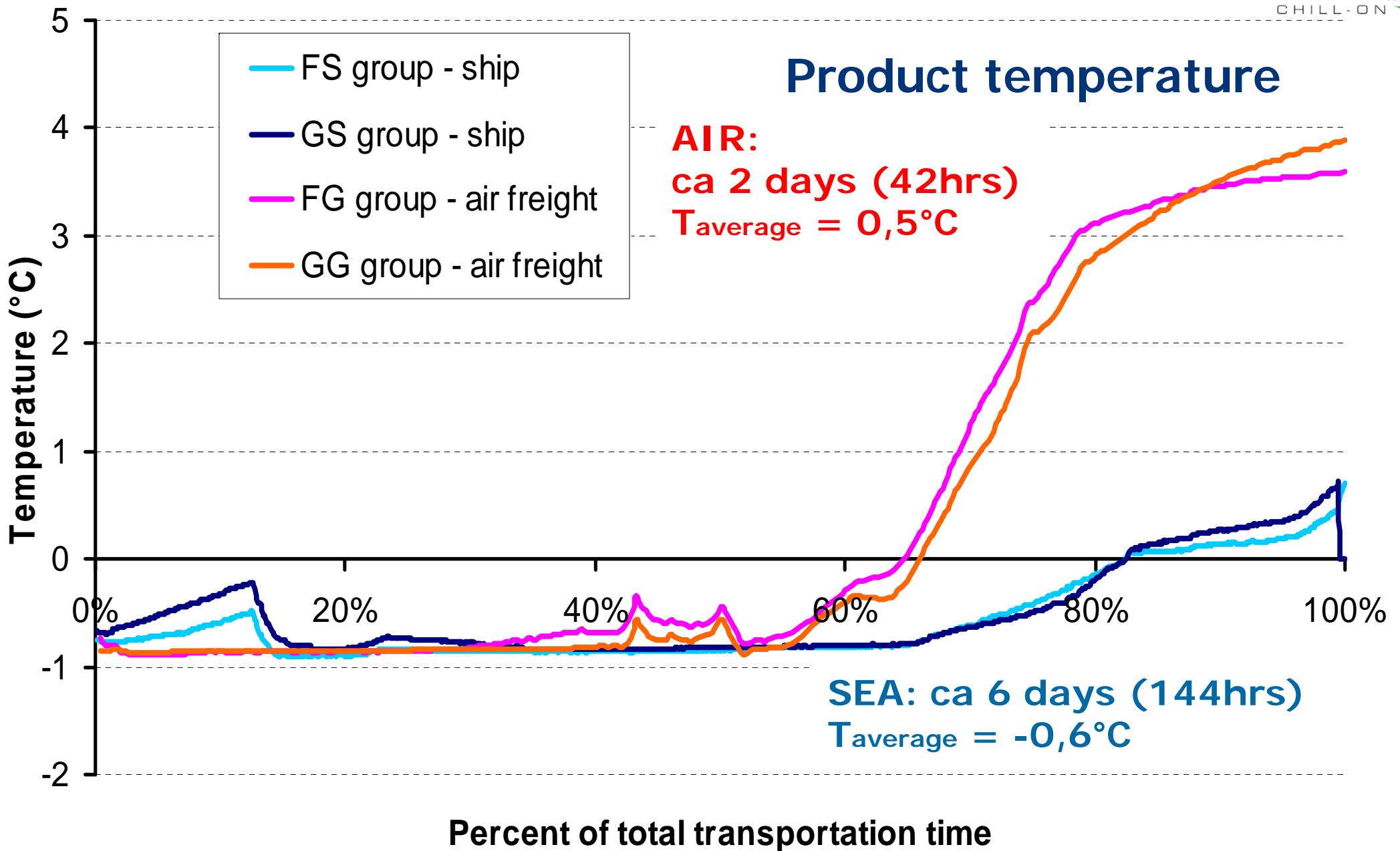
CHILL-ON



Comparison of air and sea transport



CHILL-ON



Comparison of air and sea transport



The “distance” to market differed by 4 days

The average product temperature differed by 1,1°C

Remaining shelf life after delivery?

Study 1 (February 2009)

Cooling before processing

Liquid cooling

Liquid cooling followed by CBC cooling

Real Temperature Simulation at Matis

Sea freight: -1 °C constant

Air freight: stored at fluctuating temperatures

Raw material

- *Fresh loins from Atlantic cod (*Gadus morhua*)*
- *Gutted and bled, kept for two days until processing*
- *Measured for up to 13 days*

Measures of freshness and deterioration

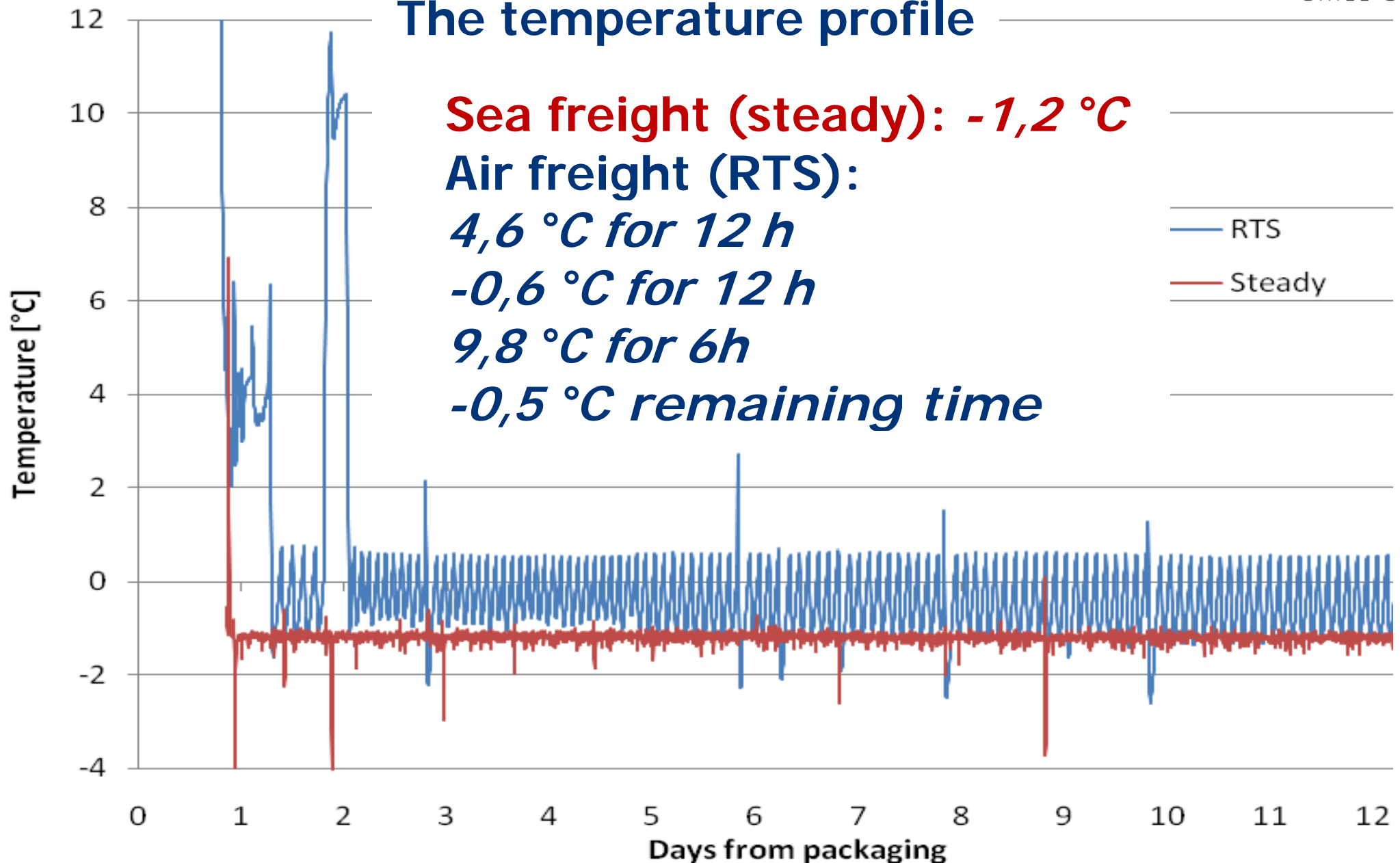
- *Sensory evaluation (Torry, QDA)*
- *Microbial (TVC, H₂S prod, *Pseudomonas spp*, *P. Phoshoreum*)*
- *Chemical (TVB-N, TMA, pH)*

Effects of different cooling techniques



CHILL-ON

The temperature profile



Effects of different cooling techniques

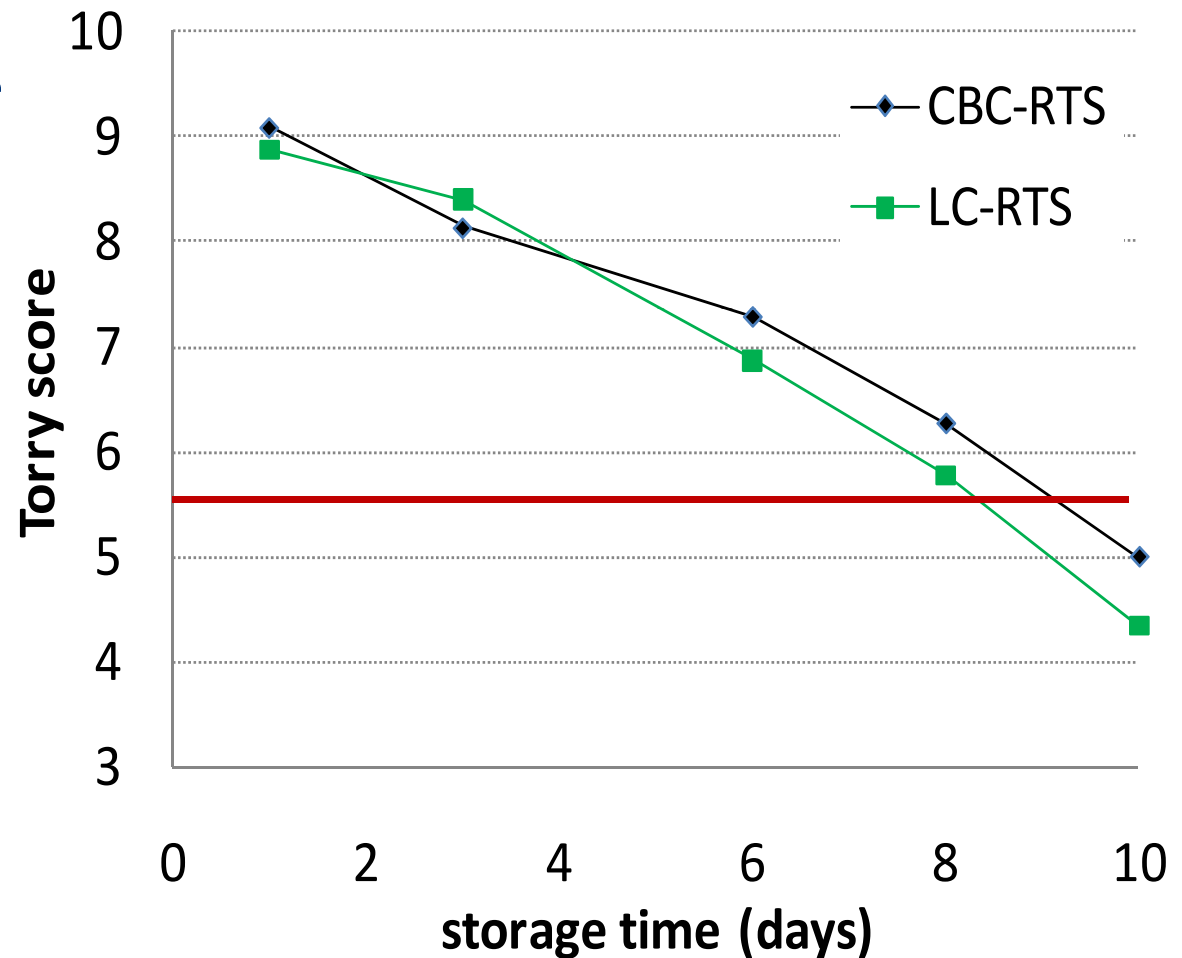
What is the gain of CBC cooling during fluctuating temperatures?

Average product temperature

Liquid cooling = $0,4 \pm 0,6$ °C
CBC cooling = $-0,1 \pm 0,3$ °C

Shelf life

Liquid cooling = 8-9 days
CBC cooling = 9-10 days

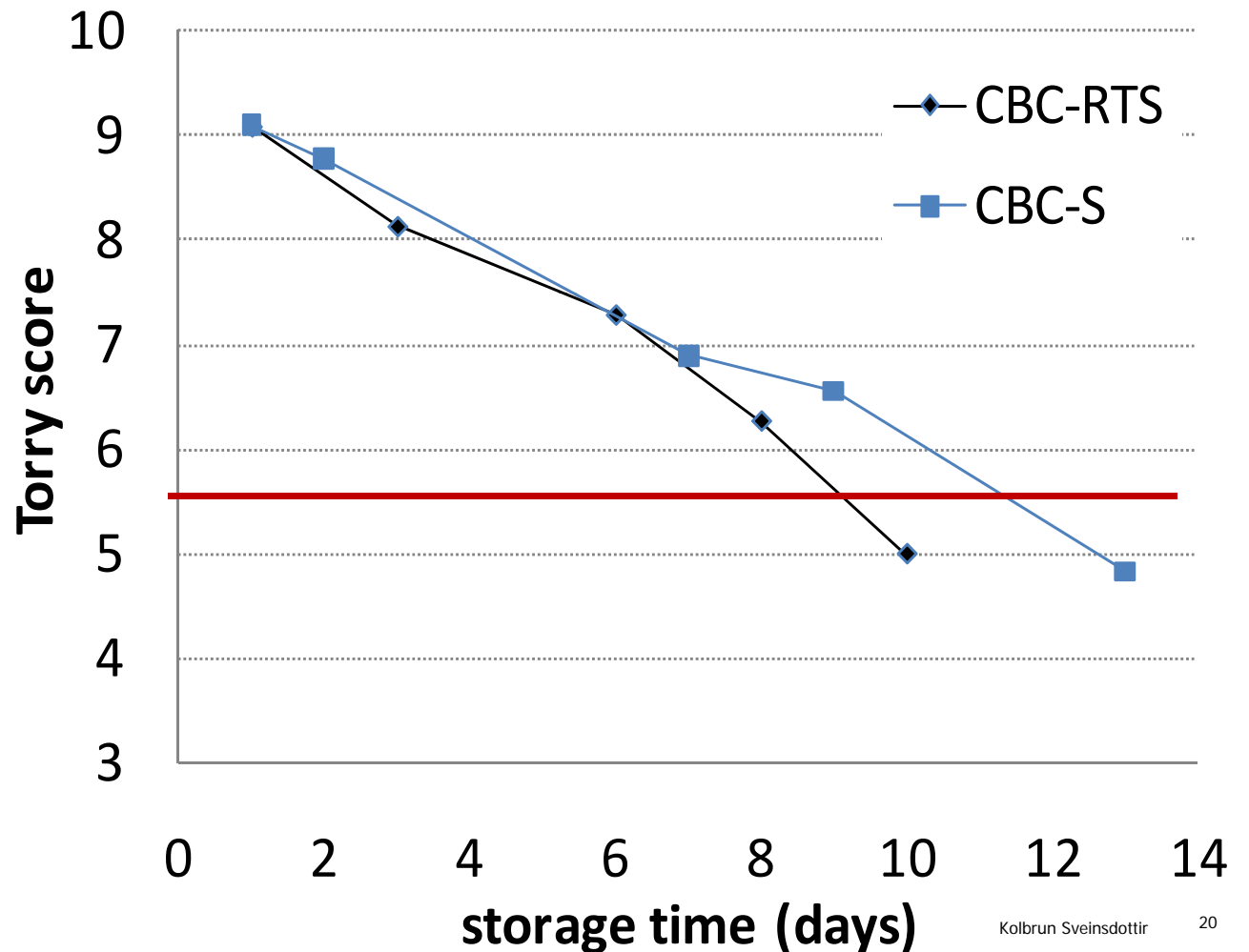


Effects of different cooling techniques

What is the difference in shelf life with sea (steady) and air (RTS) transport?

Shelf life of CBC cod loins

Steady = 12-13 days
RTS = 9-10 days



Effects of different cooling techniques

CBC adds to shelf life

Sea freight (steady low temperature) resulted in extended shelf life by 3 days

Study in March 2010

Real Temperature Simulation during air and sea freight

Raw material

- *Fresh loins from Atlantic cod (*Gadus morhua*)*
- *Gutted and bled, kept one day until processing*
- *CBC cooled*
- *Measured for up to 13 days*

Measures of freshness and deterioration

- *Sensory evaluation (Torry, QDA)*
- *Microbial (TVC, H₂S prod, *Pseudomonas* spp, *P. Phoshoreum*)*
- *Chemical (TVB-N, TMA, pH)*

Steady temperature (sea freight simulation)

-1°C constant

Surface = -1,1 ± 1,5°C

Product = -1,1 ± 0,1°C

Dynamic temperature (air freight simulation)

9°C for 9 h (overnight storage)

0-4°C for 3h

13°C for 4 h (in plane)

2°C remaining time (retailer)

Surface = 2,1 ± 3,4°C

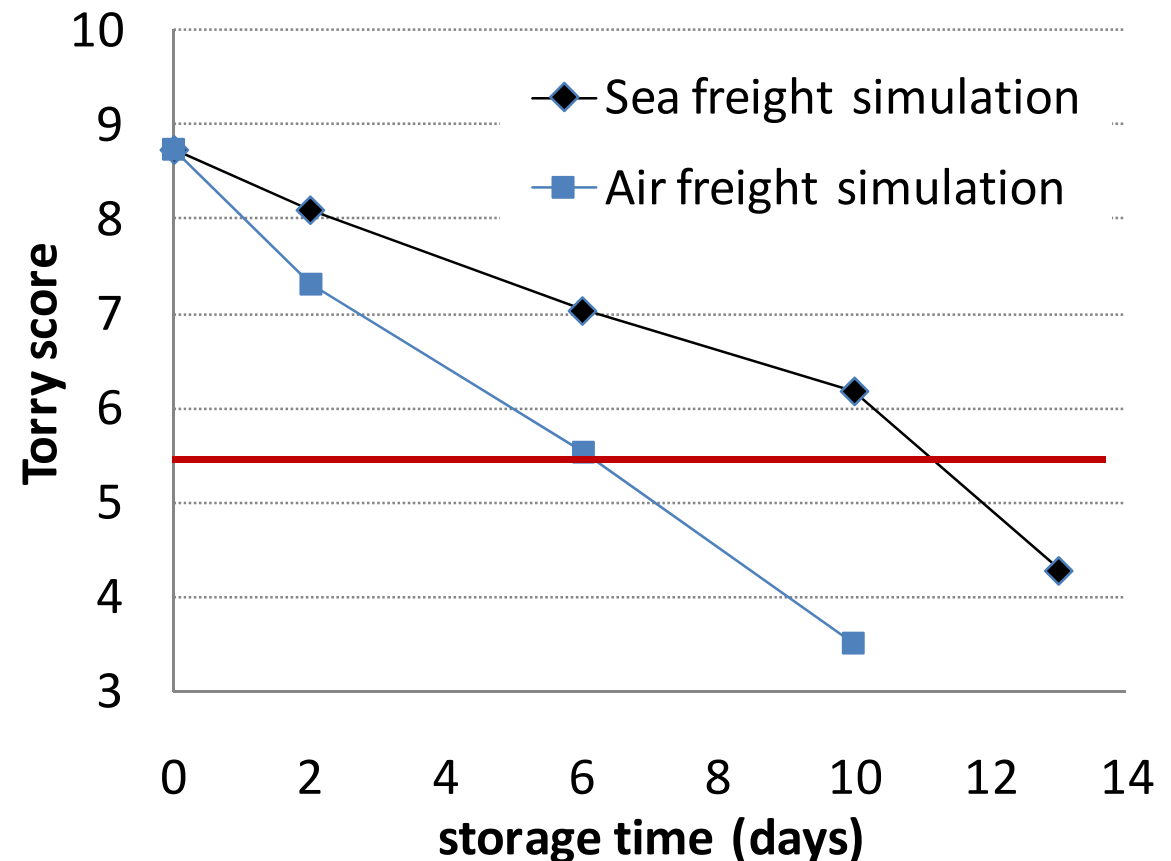
Product = 1,6 ± 0,8°C

Shelf life of cod loins

Sea freight simulation = 11-12 days

Air freight simulation = 6-7 days

Analysis	"Sea"	"Air"
Shelf life <i>days</i> (sensory)	11-12	6-7
TVC <i>cfu/g</i>	6,9	6,9
TVB-N <i>mgN/100g</i>	35	30
TMA <i>mgN/100g</i>	20	10



Conclusion



The export of cod loins to Europe?

The remaining shelf life at location is similar whether the loins are exported by sea or air freight

The longer time taken to export the loins with sea freight compared to air freight is compensated by the low and steady temperature during the transport

Thank you

Acknowledgements

The EU-funded Integrated Research Project CHILL-ON (contract FP6-016333-2), Chill-add-on and Thermal modelling of chilling and transportation of fish funded by the AVS research fund under the Ministry of Fisheries, the Technology Development Fund at the Icelandic Centre for Research

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