

Precious Cargo: Properly Insulating Protein Crystal for Shipping to LCLS

Viet Tran¹, Matt Hayes², Raymond G. Sierra²

¹Howard University, 2400 Sixth St NW, Washington, DC 20059

²Linac Coherent Light Source, SLAC National Accelerator Laboratory, 2575 Sand Hill Road, Menlo Park, CA 94025, USA.

Introduction

With the possession of hard X-ray free electron laser, LCLS can apply it for screening protein crystal. However, protein crystal is very temperature sensitive. Therefore, maintaining the appropriate temperature of the sample during its trip from the research facilities to LCLS is difficult. This project aims to come up with a solution for the shipping problem through testing a variety of packing method and to propose a guideline for future use.

Keyword: protein crystal, temperature sensitive, shipping time, guideline

Background

Objective:

Find a packaging method that can satisfy:

- Maintaining <10°C temperature for 5-7 days
- Using accessible material
- Suitable for shipping small sample such as crystallized protein

Material:

- Insulated Styrofoam Boxes
- Metalized Box Liners
- Insulated Bubble Mailers
- Cold Packs (24 oz) (kept at -10°C freezer)
- Ice Packs (32oz)
- Dry ice
- Temperature Data Loggers



Ice Pack



Cold Pack



Insulated Mailer



Regular Box Liner



Deluxe Box Liner

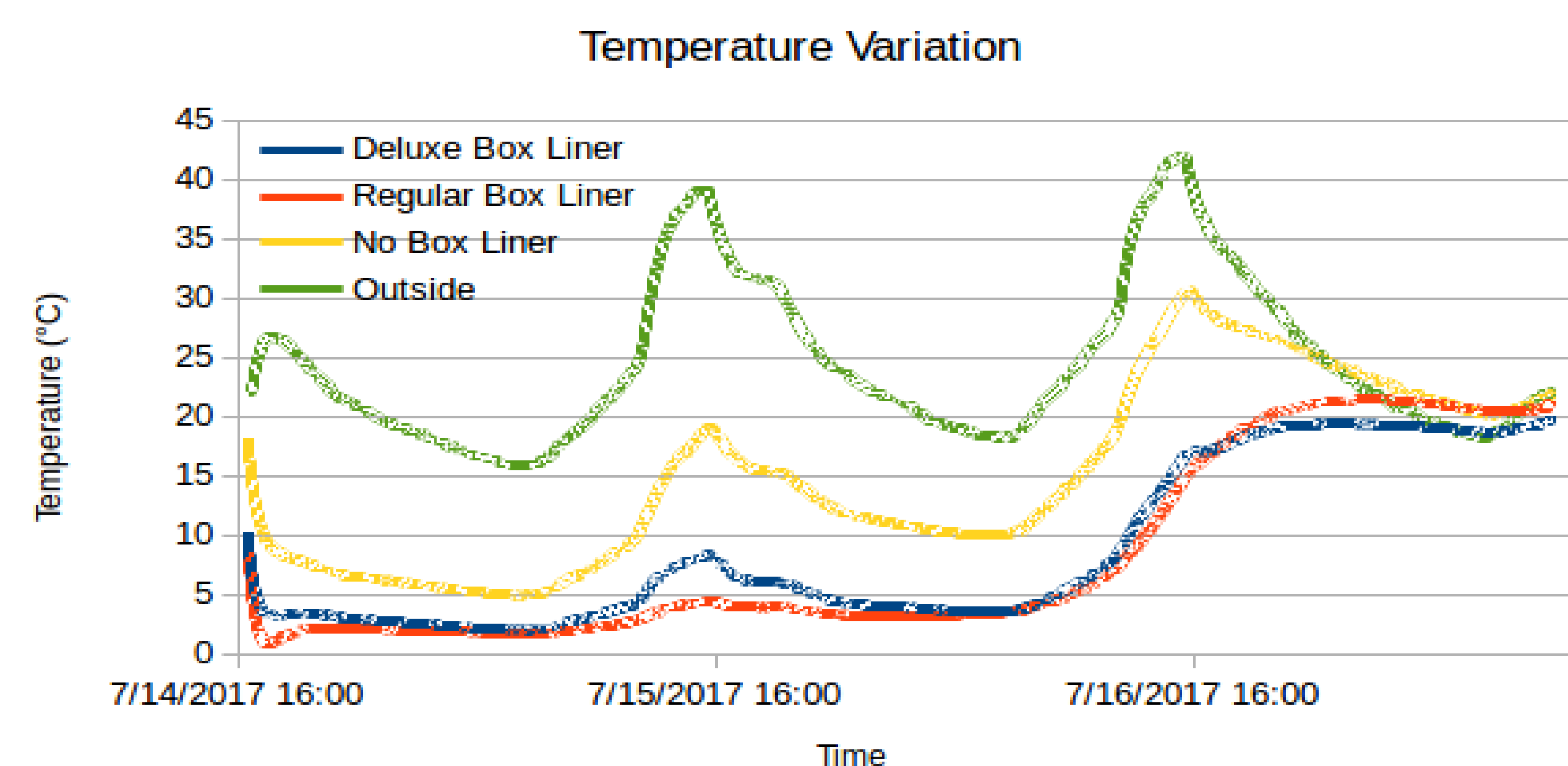
Research

Method:

Different packaging combinations are tested and monitored using temperature data loggers.

Results:

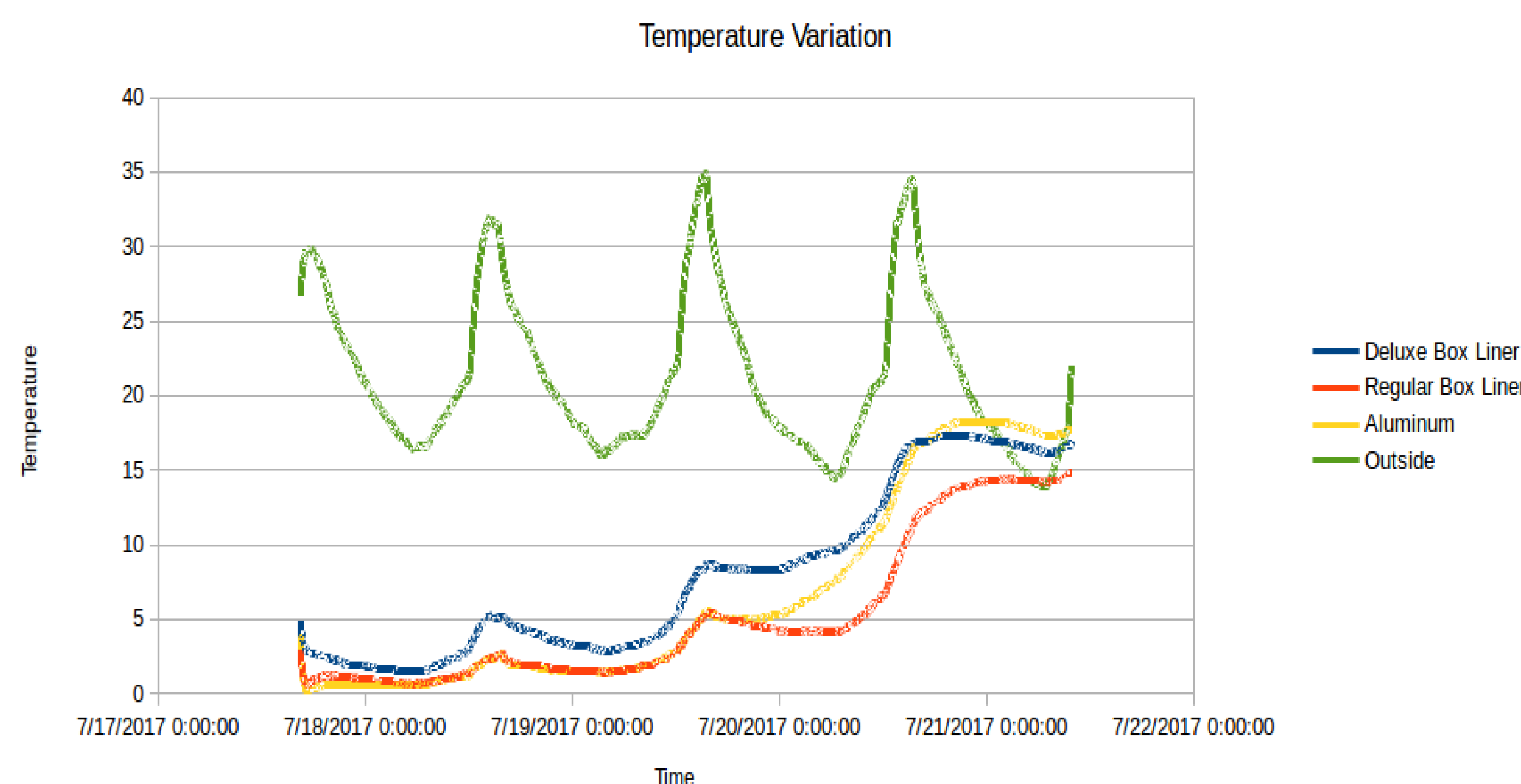
Trial #1: One Ice Pack inside 1 Insulated Bubble Mailer:



Trial #1 shows that:

- There were no significant difference between using Regular Box Liner and Deluxe Box Liner
- Box without box liner reached 10°C approximately 1 day before boxes using box liner.

Trial #2: Two Cold Packs inside 1 Insulated Bubble Mailer



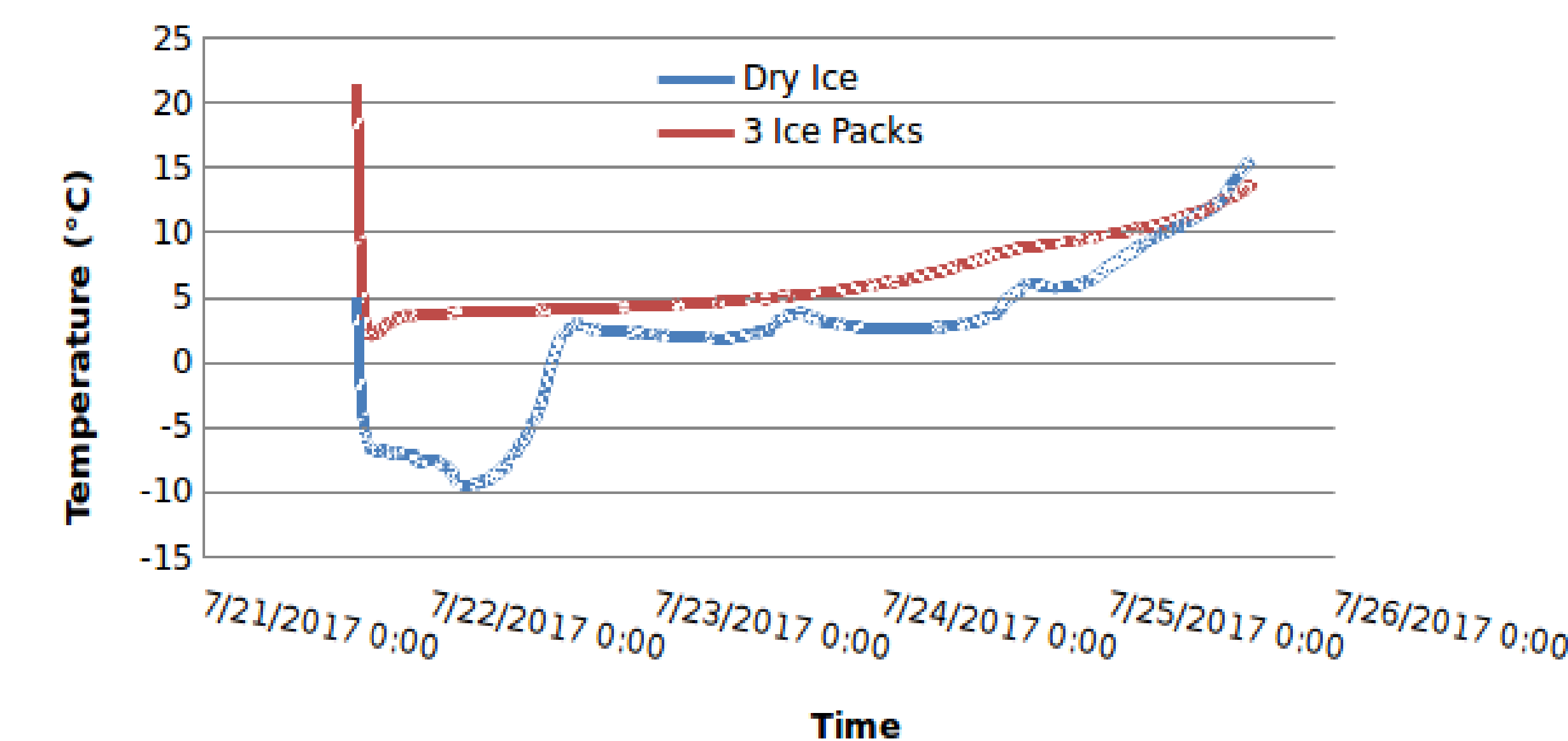
Trial #2 shows that:

- Compared to boxes from trial #1, all 3 boxes remained under 10°C 1 day longer due to the increasing in quantity of cold packs being added.
- Box using aluminum foil (more accessible) as box liner show no significant difference in performance compared to box using prepared box liner.

Trial #3 and Trial #4:

- Two Cold Packs inside 1 Insulated Bubble Mailer with Dry Ice outside
- 3 Ice Packs inside Aluminum foil

Temperature Variation



Trial #3 and #4 shows that:

- Dry ice increased the amount of time the box remain under 10°C up to around 16 hours. Nevertheless, dry ice evaporated at much faster rate than expected.
- Despite the increased time, using dry ice also created more temperature variation, which can be a disadvantage compared to trial #4

Conclusions

Among all the trials, trial #3 remains under 10°C for the longest amount of time. However, trial #4 does not show a significant different in the required amount of time and a better stability. Moreover, there are two case studies from Tempack and Thermosafe which guarantee keeping the sample in 2-8°C for more than 72 hours that can serve as alterations.

Further research can focus on other elements affect the temperature of the shipping package such as solar radiation, increasing volume and surface area, and different materials.

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