WISCONSIN ICECUBE PARTICLE ASTROPHYSICS CENTER

IceCube Upgrade Travel Estimate Analysis from Historical Data

2022-007.1

Approval

Title	Name	Signature	Date
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Revision History

Version	Date	Author	Summary of changes
1.0	2022-02-14	V. O'Dell	1st Version

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1. Purpose of this Document

This document analyzes historical data for travel costs for the IceCube Upgrade Project. It is referenced in the *IceCube Upgrade Key Assumptions Document* as a reference to justify average travel costs.

2. Method

The analysis is done over all travel costs incurred by the Wisconsin Particle Astrophysics Center (WIPAC) from July, 2018 – January 2022. The data were examined in three main categories:, Domestic Travel, International Travel, and Deployment Travel and Associated costs. The following sections describe the data and results of each of these areas.

2.1 Domestic Travel

Domestic travel covers travel within the continental United States for collaboration meetings, reviews, and collaborative work. Figure 1 shows the costs per (7 day) domestic trip as a function of the length of the trip for WIPAC travel. Travel costs show a broad range of values; the nominal cost per domestic trip is taken at $1800 / trip (flat blue line). This is at the high end of the travel costs, however given the large fluctuations in costs, we elected to be conservative with the base costs and aggressive with the uncertainty assigned to it (LOE).

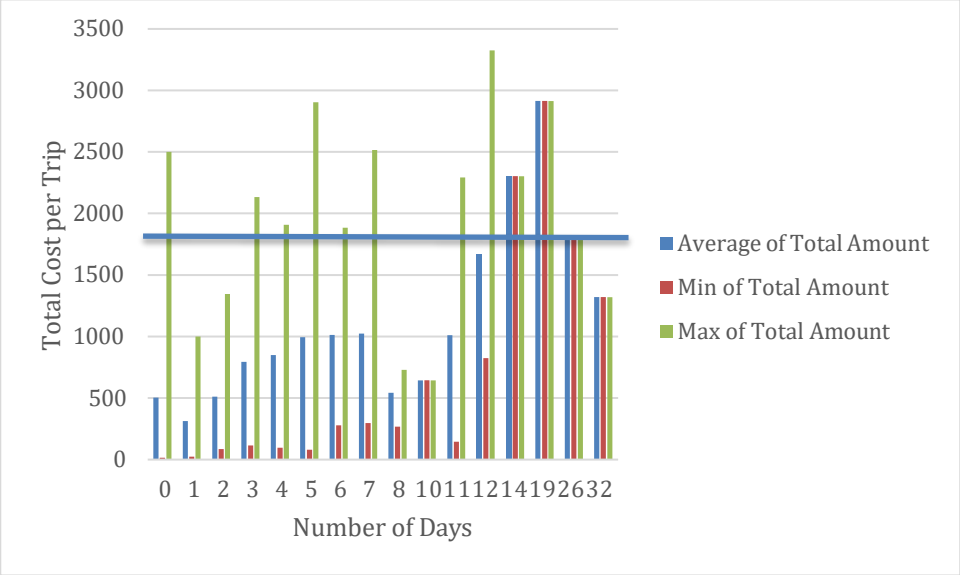

Figure 1 Average, minimum, and maximum costs of domestic trips as a function of the length of the trip. The data comes from WIPAC travel since July 1, 2018. The flat blue line is at the nominal domestic travel cost of $1800.

2.2 International Travel

International travel covers travel outside the continental United States for collaboration meetings, reviews, and collaborative work. Figure 1 shows the costs per domestic trip as a function of the length of the trip for WIPAC travel. Again, the travel costs show a broad range of values; the nominal cost per (7 day) international trip is taken at $3200 / trip (flat blue line). Again, this is at the high end of the travel costs, however given the large fluctuations in costs, we elected to be conservative with the base costs and aggressive with the uncertainty assigned to it (LOE).

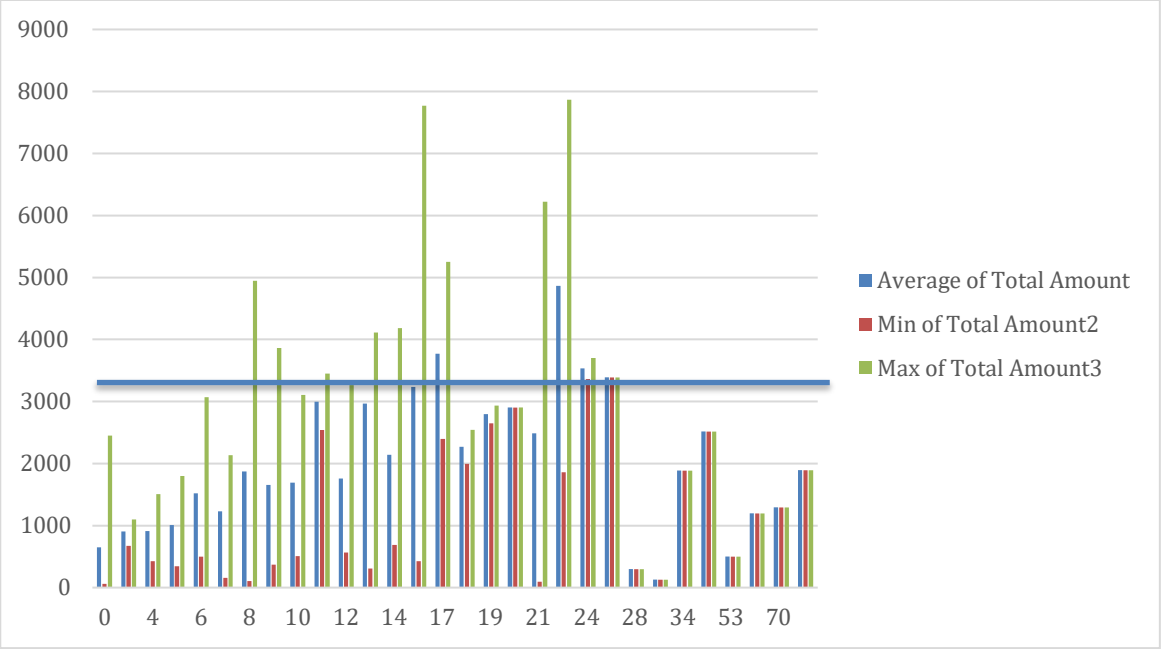

Figure 2 Average, minimum, and maximum costs of internatoinal trips as a function of the length of the trip. The data comes from WIPAC travel since July 1, 2018. The flat blue line is at the nominal international travel cost of $3200.

2.3 Deployment Travel and Associated Costs

For deployment to the South Pole, airfare is covered by the Antarctic Contractor, however the project pays for the hotel and perdiem stay in New Zealand while waiting for a flight to McMurdo, as well as “PQ” (Physical Qualifying) testing and “ECW” (Extreme Cold Weather) gear.

2.3.1 Deployment Travel

Deployment travel covered in the Upgrade project cost covers the cost of housing in New Zealand (Christchurch) when going to and returning from the South Pole. Here the data are a little spotty – the number of days, for example, is not really germane (the length of deployment is not the driving cost; rather the length of stay necessary in New Zealand). The time required to remain in New Zealand before deployment has been changing due to COVID necessitated quarantining before deployment. The most recent data point (in December 2021) for deployment + redeployment had a cost of $1785.

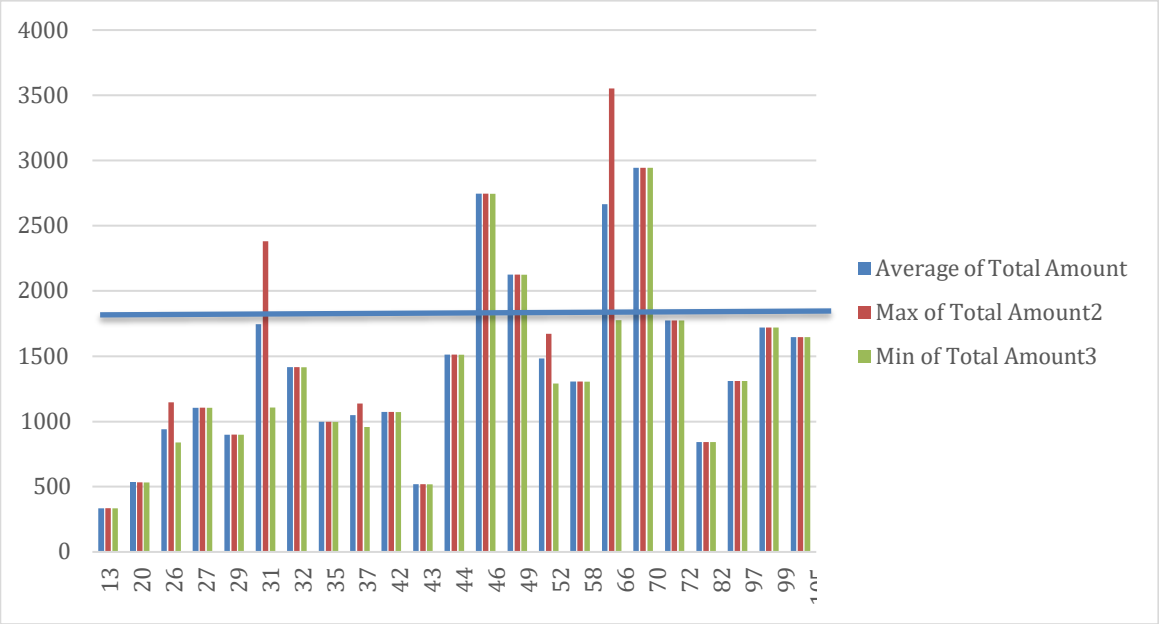

Figure 3 Average, minimum, and maximum costs of deployment trips as a function of the length of the trip. The data comes from WIPAC travel since July 1, 2018. The flat blue line is at the nominal deployment travel cost of $1800.

2.3.2 PQ and ECW costs

The cost of PQ and ECW is taken as $950, with $700 for the PQ testing and $250 for the ECW.

3. Summary Results

Table **1** summarizes the estimates used for the IceCube Upgrade Project.

Type of Trip	Cost
Domestic	$1,800
International	$3,200
Deployment: Travel	$1800
Deployment: PQ+ECW	$950

Table 1 Summary of travel cost estimates used for the IceCube Upgrade Project.

IceCube Upgrade Travel Analysis_2022-007

Final Audit Report 2022-04-13

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