Developing a Thermal Monitoring and Management System Towards an Energy-Efficient Research Data Center

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DOST-ASTI
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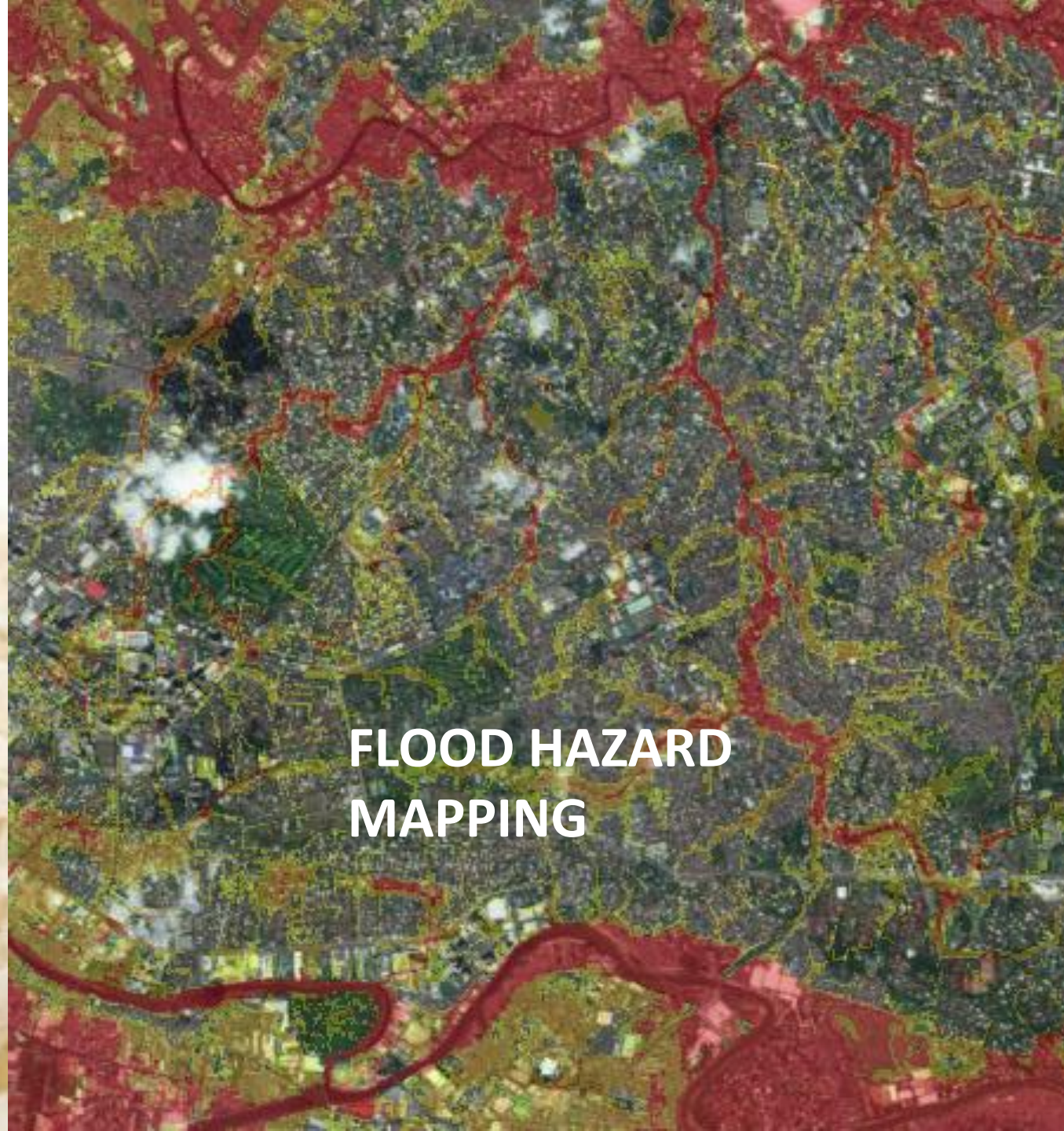
3,000 RICE GENOME SEQUENCING



DOST-ASTI

Research Data Center (RDC)

Or also known as the **Computing and Archiving Research Environment (COARE) Facility**


www.datacenterdynamics.com/content-tracks/power-cooling/overheating-brings-down-microsoft-data-center/74543.fulla
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Overheating brings down Microsoft data center
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Overheating at a Microsoft data center operating some of its cloud services, including Outlook, led to services being lost for close to 16 hours from the afternoon of March 12 to morning of March 13, US time.

Uneven cooling in data centers

Heat recirculation → Uneven cooling → **Degrades server performance**

Overworked cooling units

Requires more power to sustain cooling

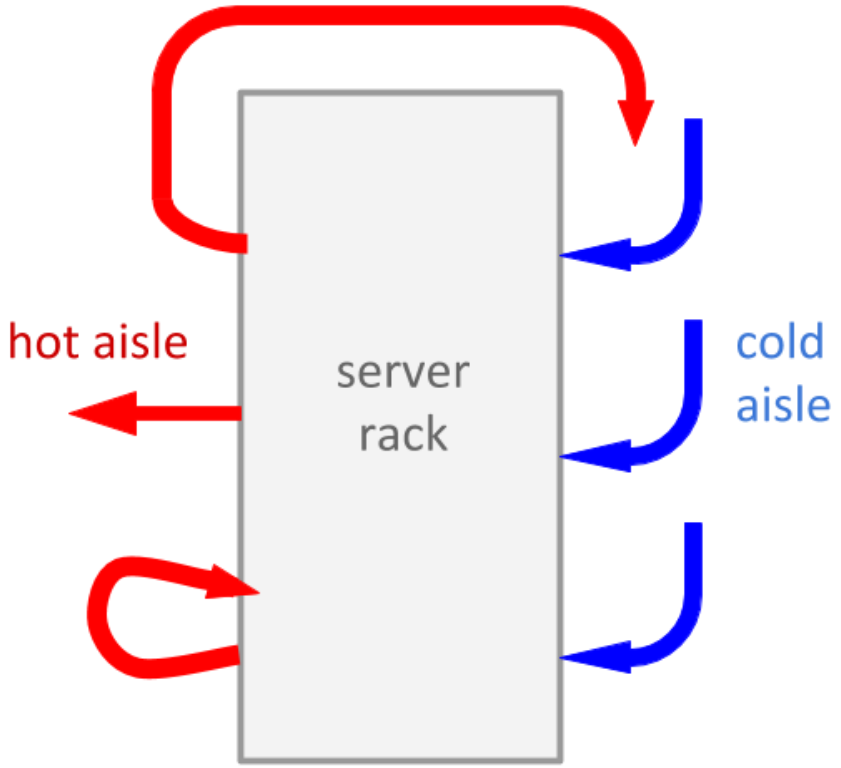
Not energy cost-saving to operate a data center

Cooling units contribute 40% of data center electrical cost [1]

Susceptible to failure when performance limit is reached

Can lead to downtime

Appropriate thermal management is essential



Heat recirculation in a hot and cold aisle system.

[1] Rubio, J.C. and Ramos, M.C., "Data Center Heat Distribution Modeling Using Onboard Sensors" *Proc. IEEE Region 10 Conference*, 2018.

Thermal Mapping

To visualize heat distribution and to identify causes of uneven cooling

To establish a system for developing appropriate strategies to maintain desired cooling and reduce electrical energy cost

CFD model for airflow prediction + environmental sensor infrastructure

Version 1 includes:
_2D thermal mapping
_Thermal camera c/o DOST-ASTI's EPDC

Ongoing version 2:
_3D visualization
_Real-time fetching of sensor readings

http://epdc.dost.gov.ph/

[1] Rubio, J.C. and Ramos, M.C., “Data Center Heat Distribution Modeling Using Onboard Sensors” *Proc. IEEE Region 10 Conference*, 2018.

Evaluating Thermal Management Strategies

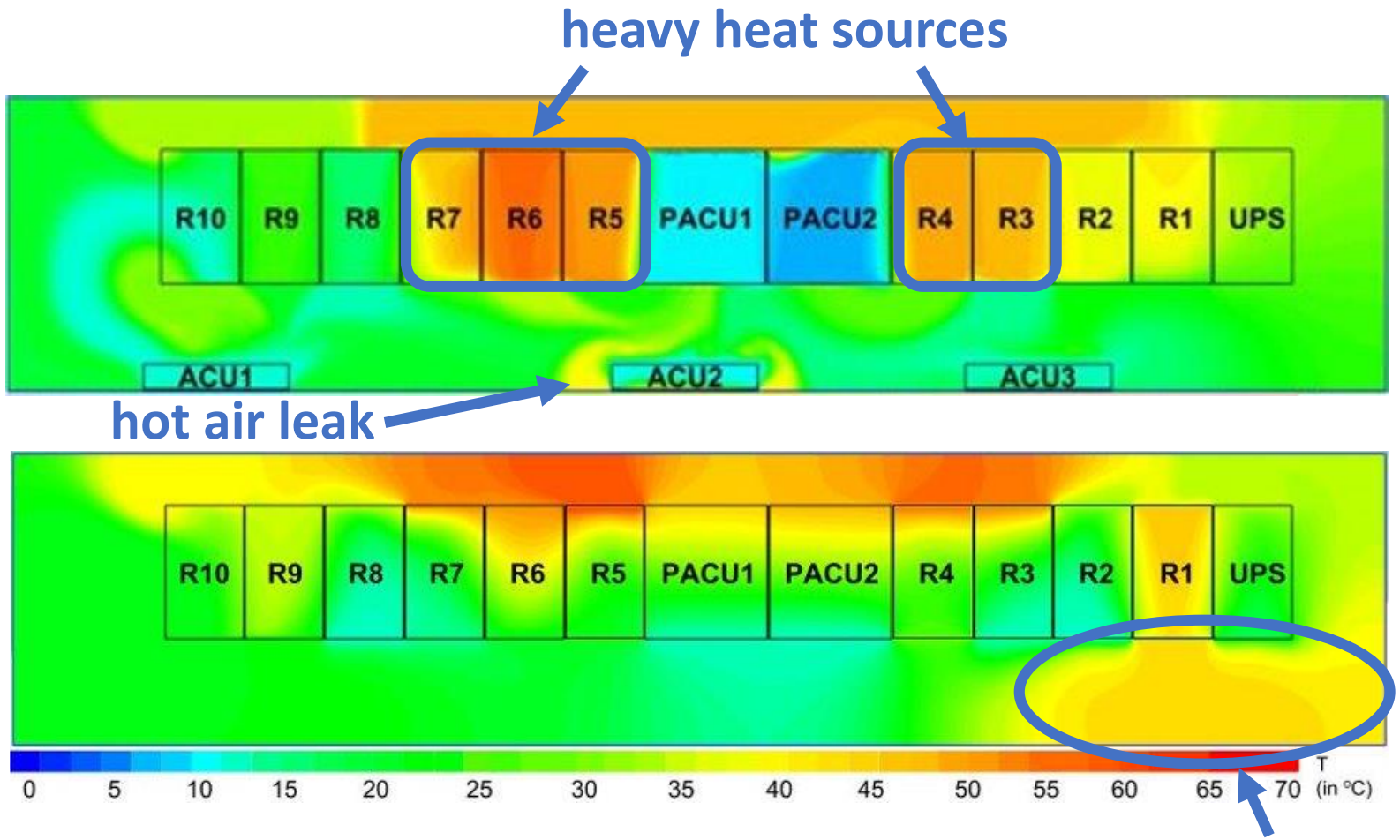
Some strategies	Power Usage Effectiveness (PUE) monitoring
Aisle containment	To determine the impact of implemented thermal management strategies
Backup cooling units	
Server relocation	Non-invasive measuring of power
Increasing the temperature in the data center	

Thermal Maps Analysis

Visualization by layers

Identifying heavy heat contributors

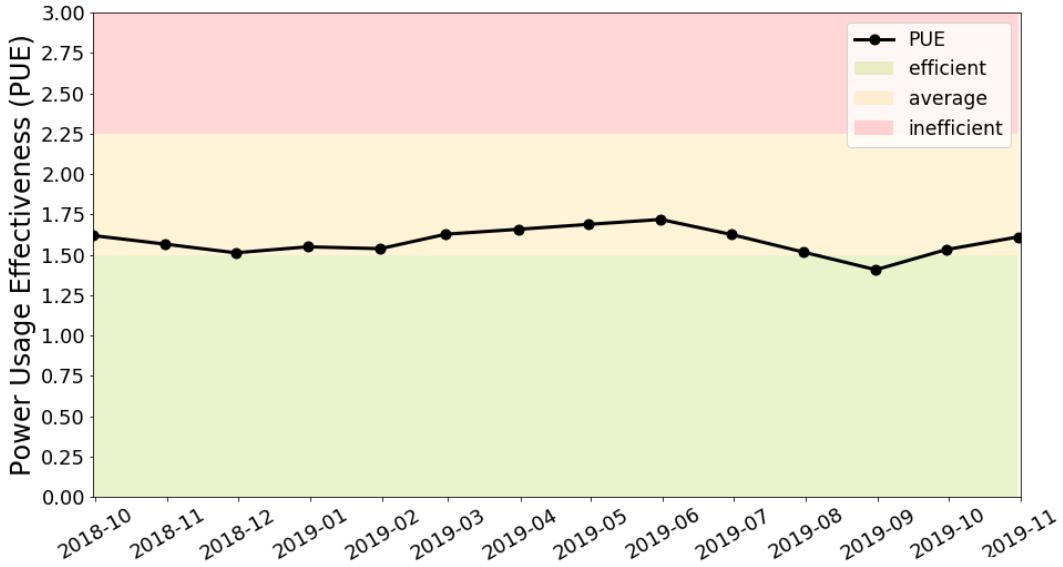
Heat recirculation



DOST-ASTI's RDC thermal map for the top and mid layers.

[1] Rubio, J.C. and Ramos, M.C., "Data Center Heat Distribution Modeling Using Onboard Sensors" *Proc. IEEE Region 10 Conference*, 2018.

PUE Analysis

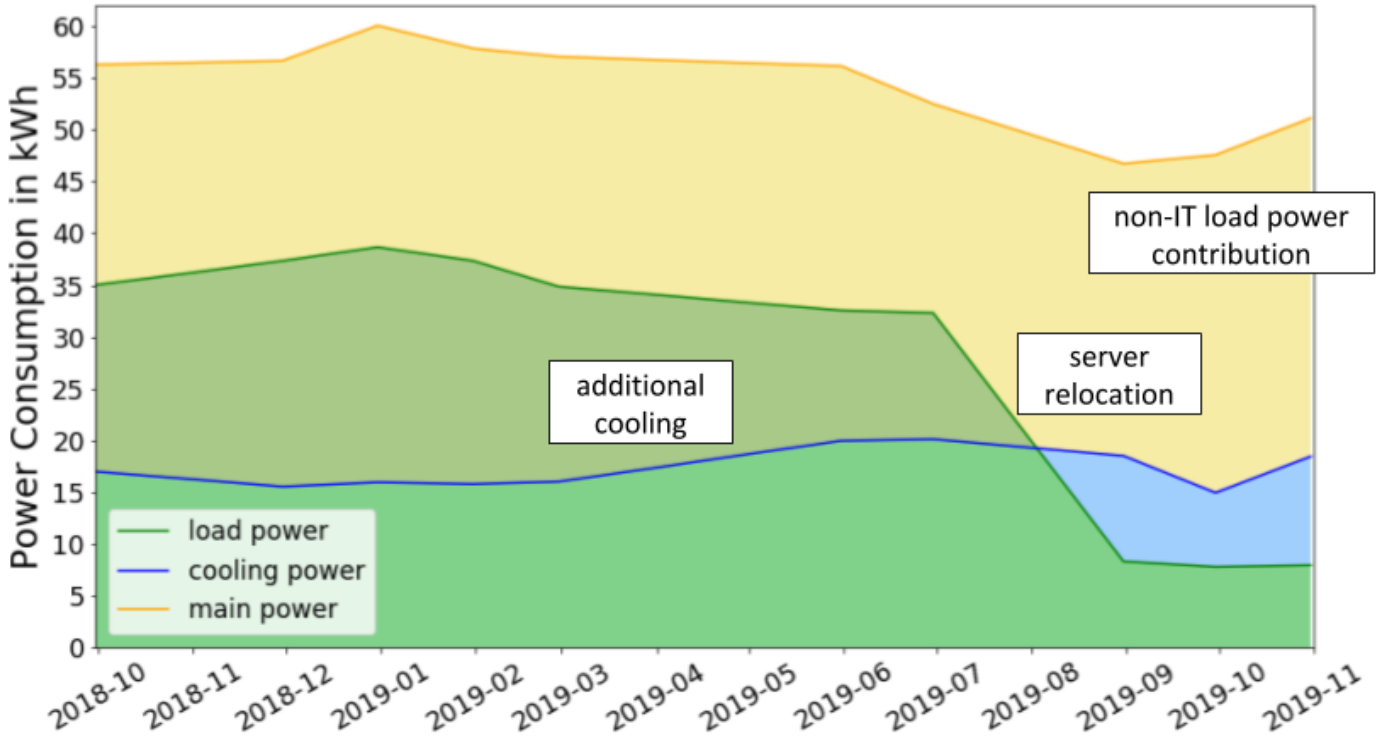


PUE monthly trend.

Energy efficient to average

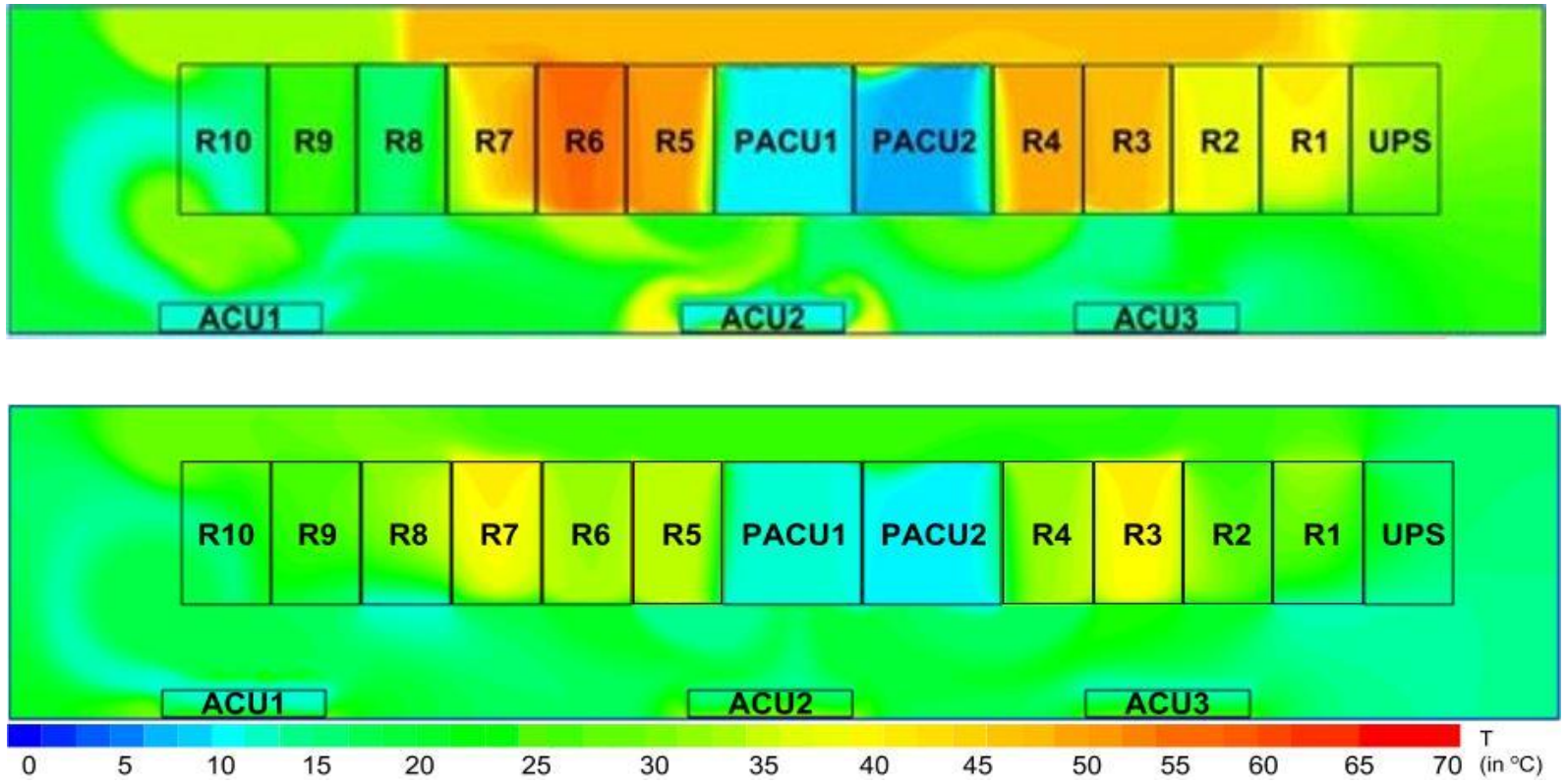
After server relocation, reduced kWh monthly consumption by **5,429 kWh**

Implementing aisle containment (new)



DOST-ASTI's RDC monthly power consumption trend.

After 6 months of implementing thermal management



Before

After

Towards an Energy-Efficient Data Center

Uneven cooling in data centers affects server and cooling supply performances

Thermal monitoring via thermal maps

Heat distribution models and sensor measurements

Employing thermal monitoring and management thus

Can be applied to similar small research data center facilities

- ✓ Easier monitoring
- ✓ Capacity planning
- ✓ Cooling balance
- ✓ Prevent downtime
- ✓ Save energy costs