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Europe 2023

GreenCourier: Towards Sustainable Serverless Computing

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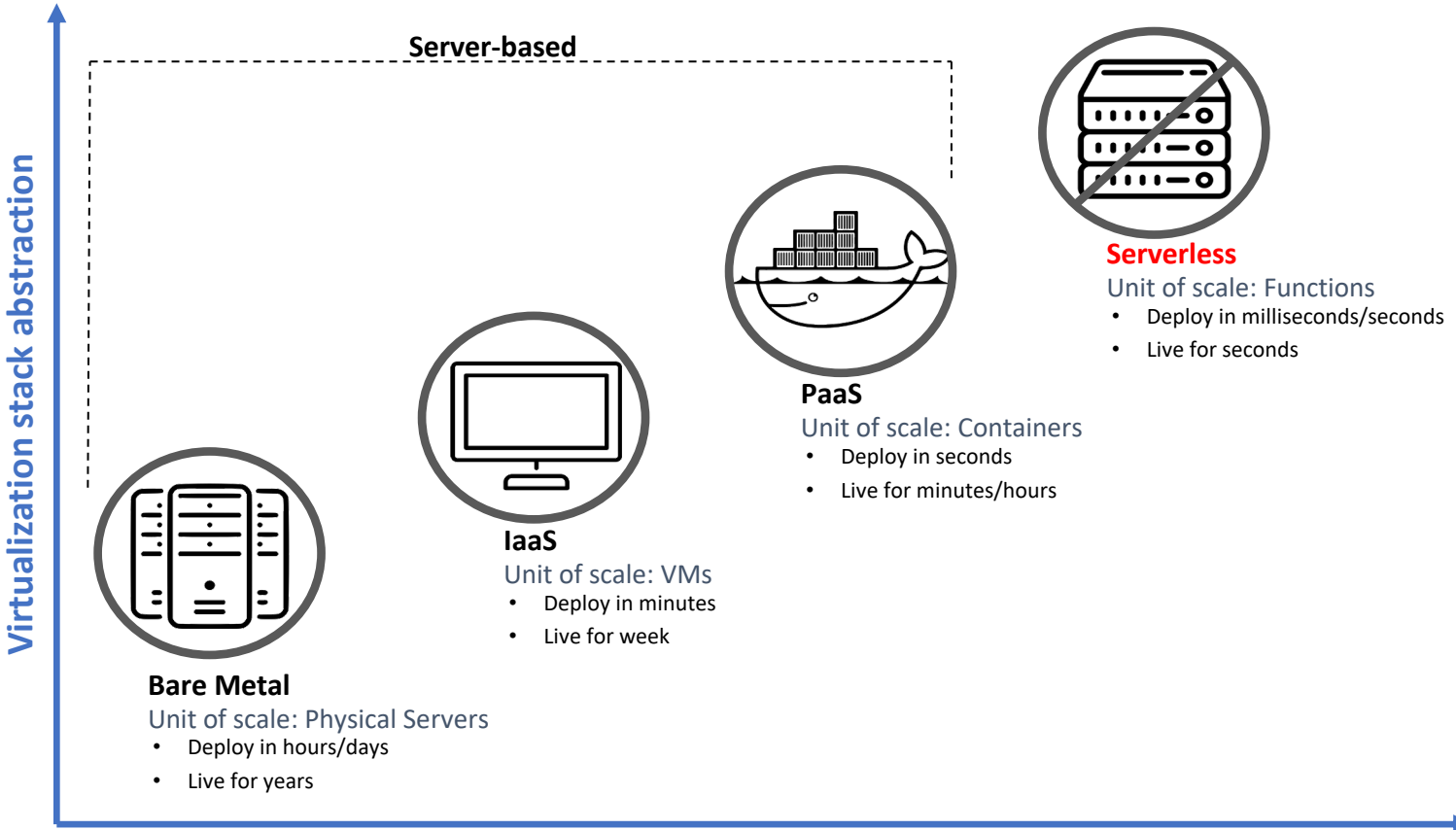
Serverless Computing



Function-as-a-Service Platforms

AWS Lambda

Azure Functions

1.1 Billion Function Invocations each day [ATC'19, SOSP'21]

Google Cloud Functions

IBM Cloud Functions

Challenges in Sustainable Serverless Computing

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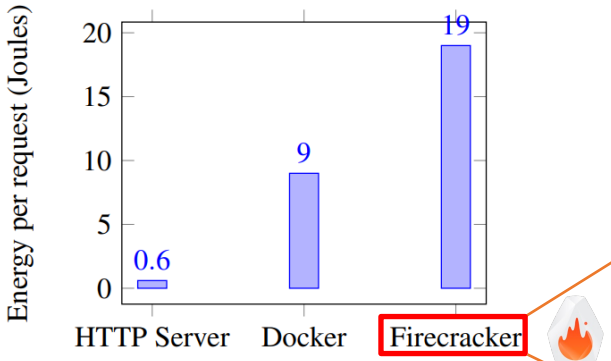
① FaaS virtualization overheads can increase the energy consumption by more than 15x compared to conventional HTTP servers. [HotCarbon'22]

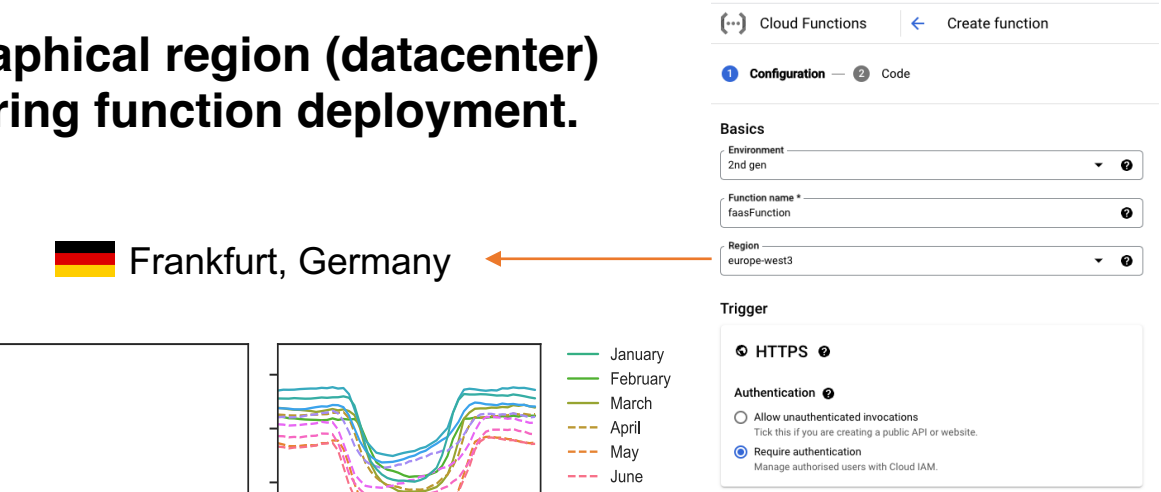


AWS Lambda

AWS Fargate

Challenges in Sustainable Serverless Computing

② **Pre-selection of the geographical region (datacenter) for function execution during function deployment.**



Average daily carbon intensity of Germany, Great Britain, France, and California in 2020. [Middleware'21]

GreenCourier

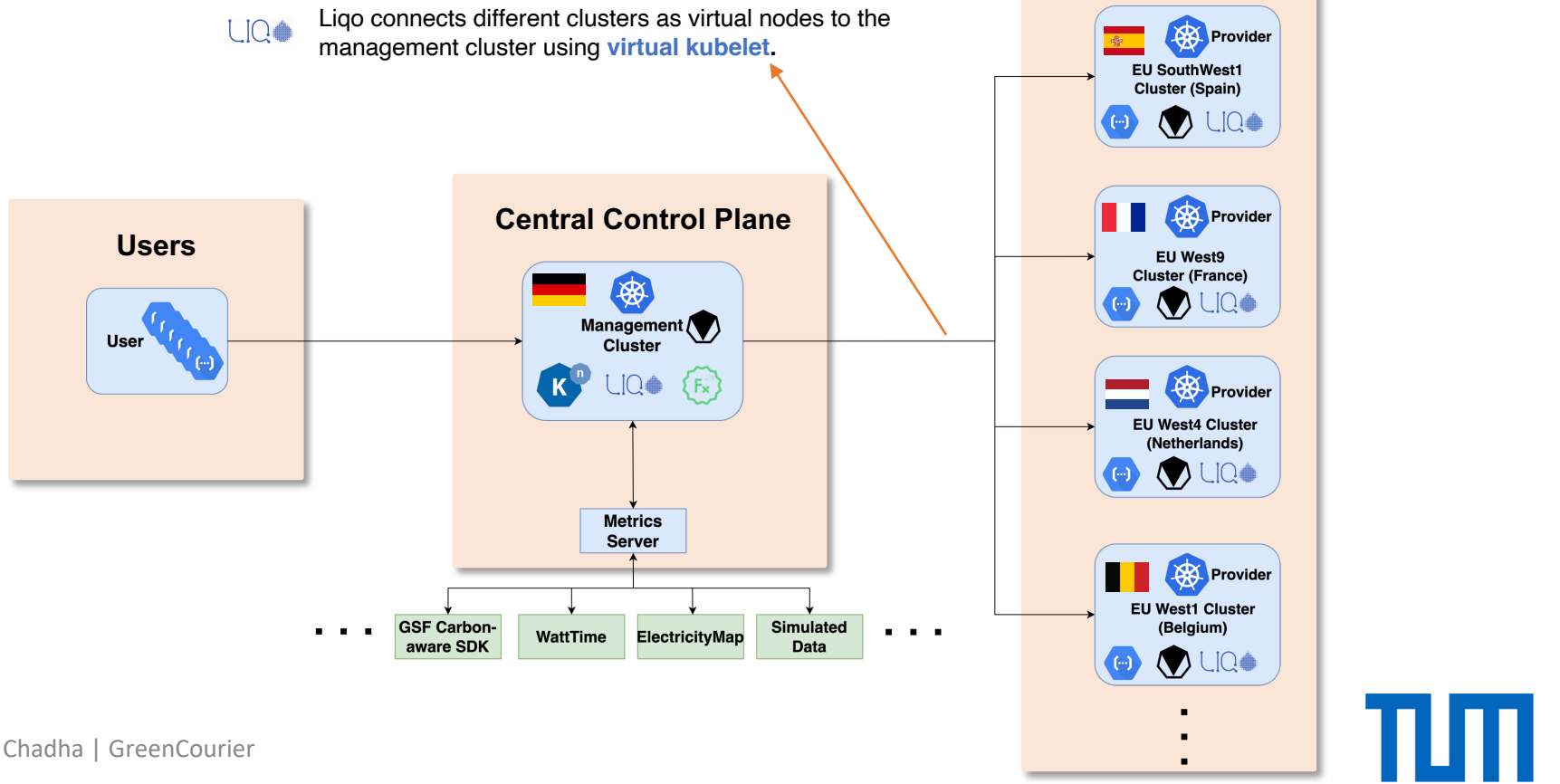
GreenCourier optimises the delivery of serverless functions across geo-spatial multi-cluster environment in the cloud for carbon efficiency.

Defacto platform for container orchestration
(offered by Microsoft, Amazon, Google, …)

GreenCourier builds on Kubernetes and Knative.

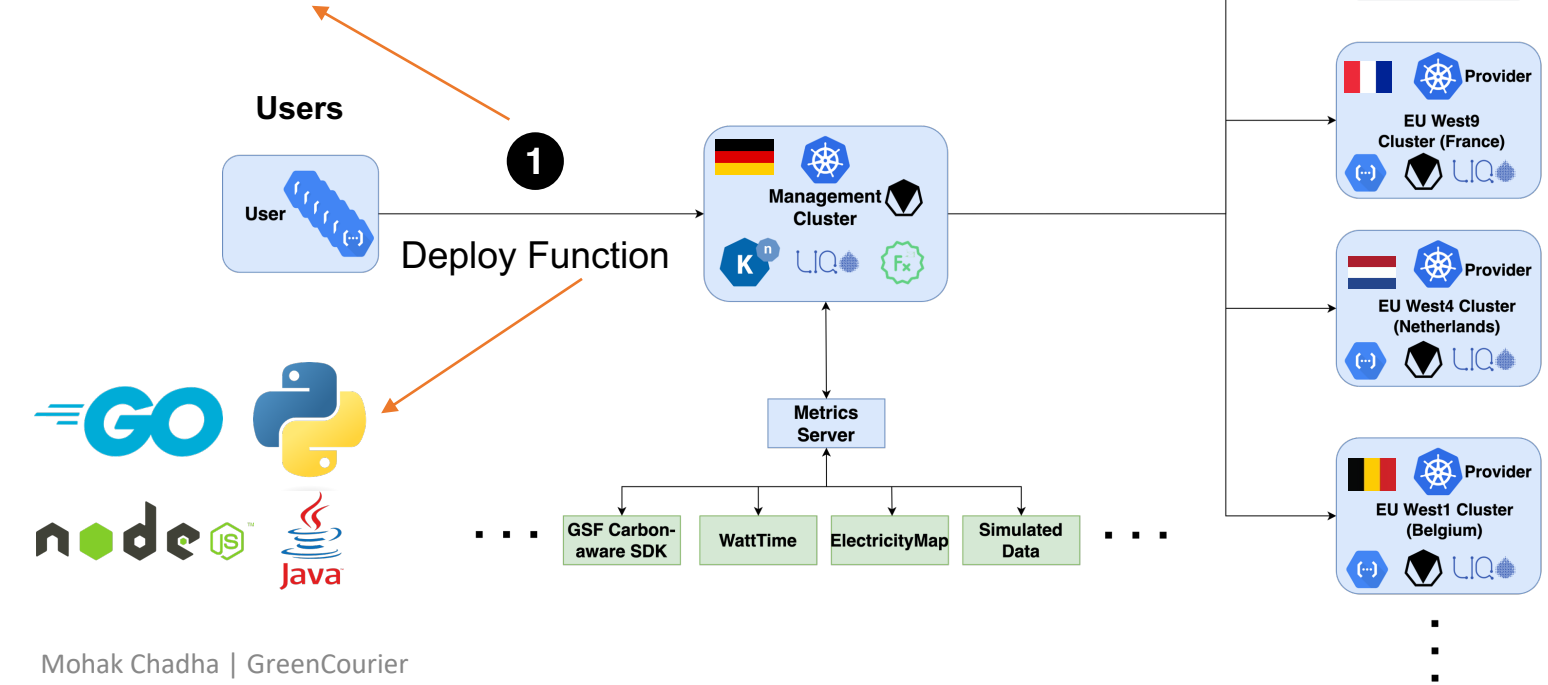
Enterprise-level platform to build serverless applications
(used by Google, IBM, …)

GreenCourier

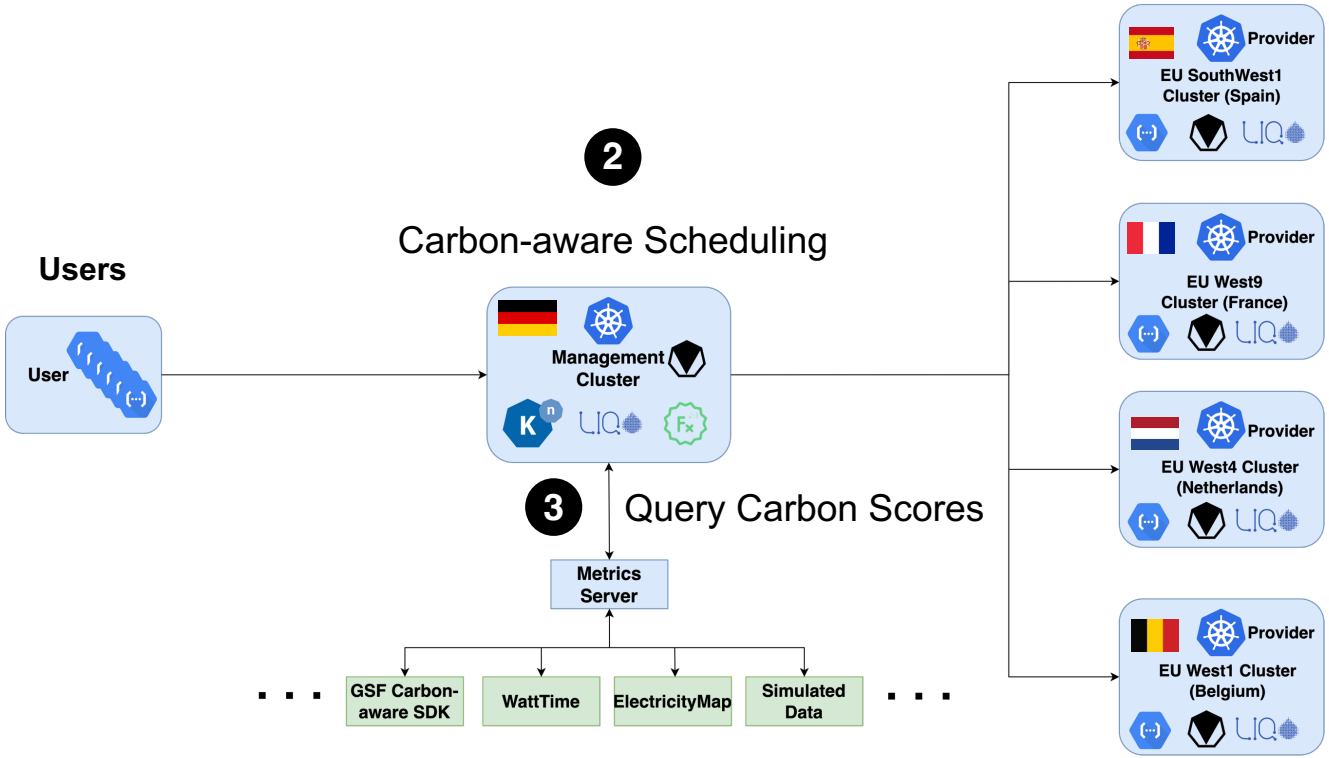


Using GreenCourier

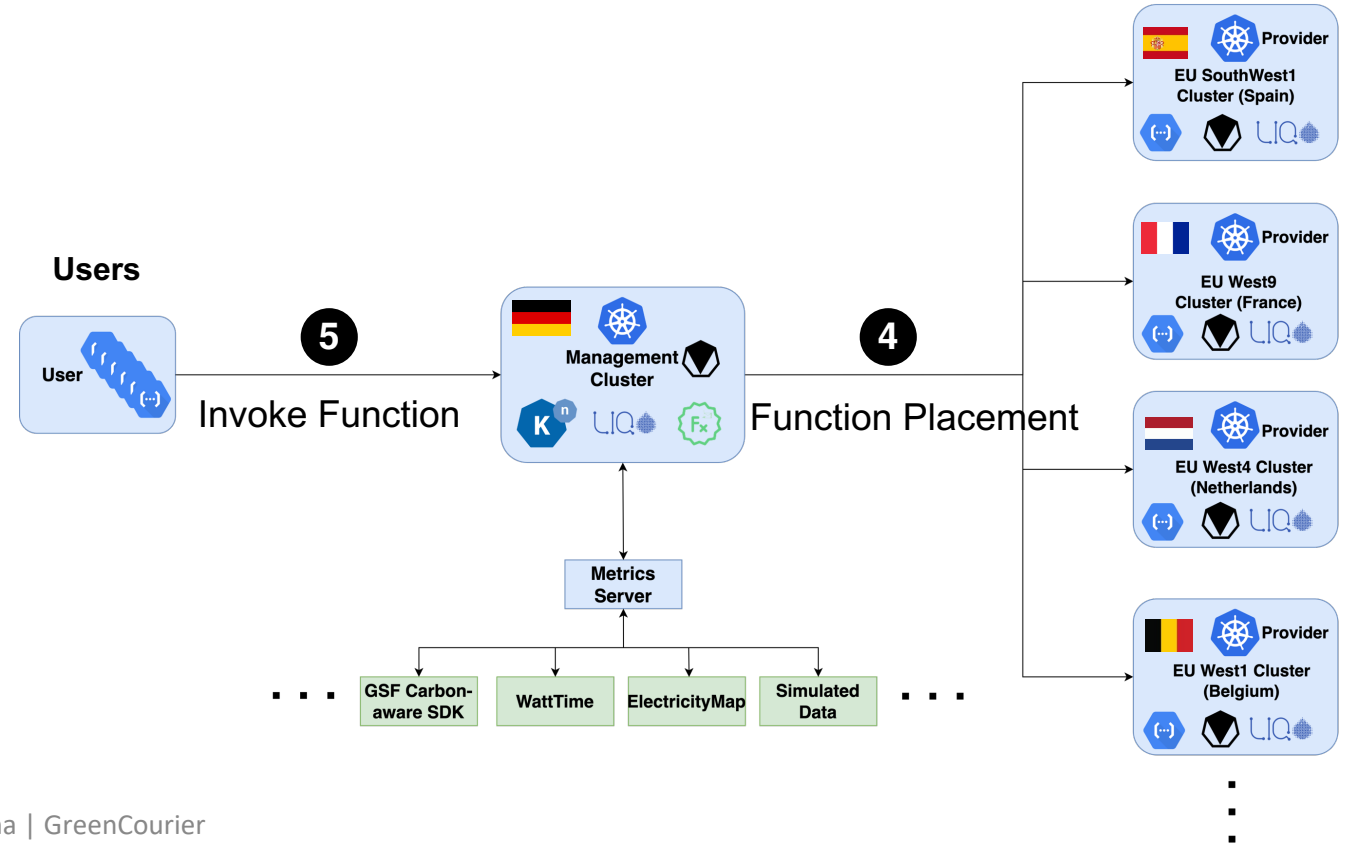
schedulerName: kube-carbon-scheduler



Using GreenCourier

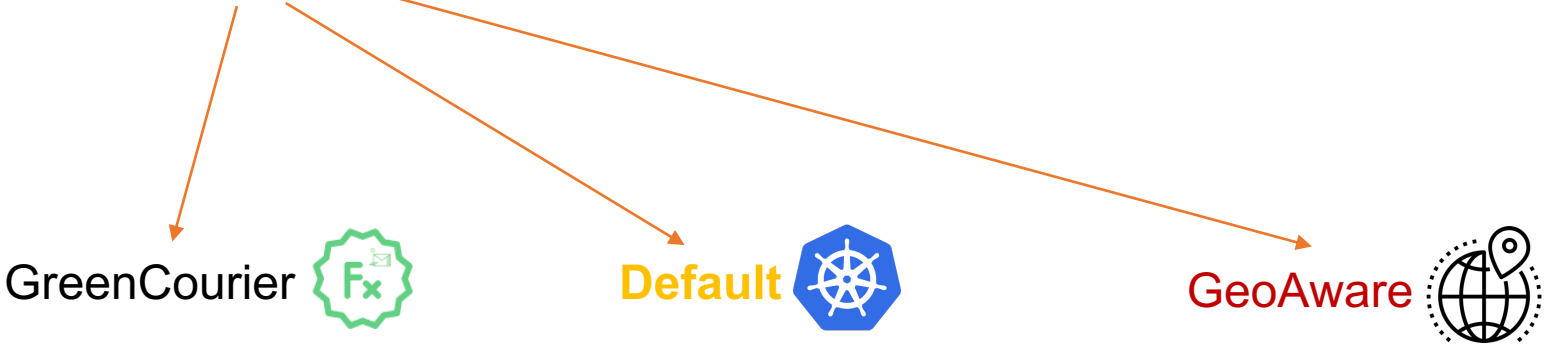


Using GreenCourier



Experimental Evaluation

- All experiments on Google Kubernetes Engine.
- Eight standardized serverless functions [CLOUD'19].
- Function request pattern using production function traces.
- Comparison with



Quantifying Carbon Emissions

- Software Carbon Intensity (SCI) Specification

Green Software Foundation

$$SCI = ((E * I) + M)/R$$

Energy consumption of software.

Marginal emissions factor.

Embodied emissions.

Functional unit.

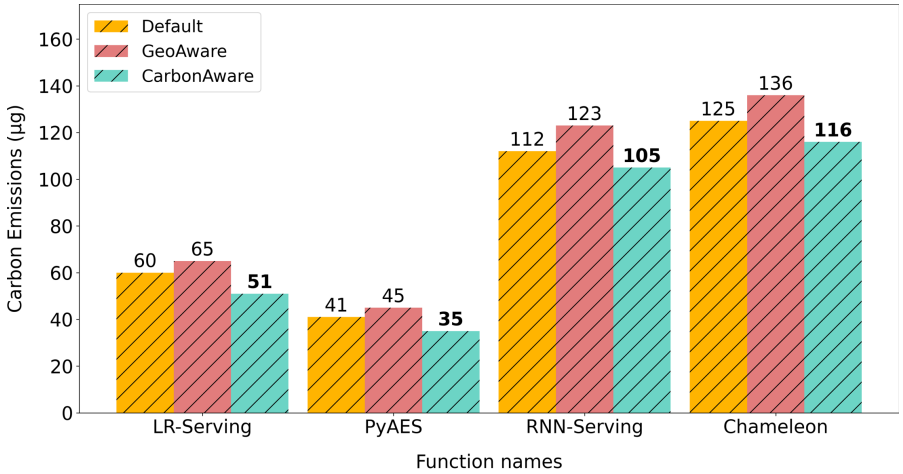
More Info:

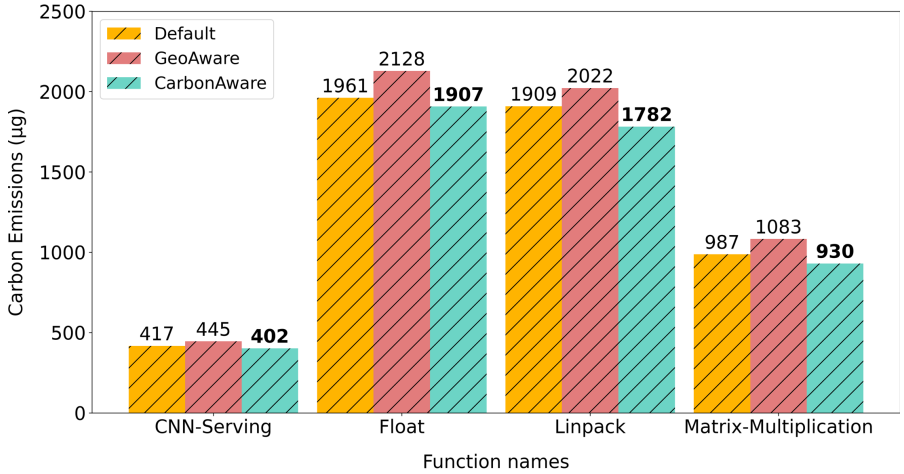
Comparing Carbon Emissions

8.7% vs Default

17.8% vs GeoAware

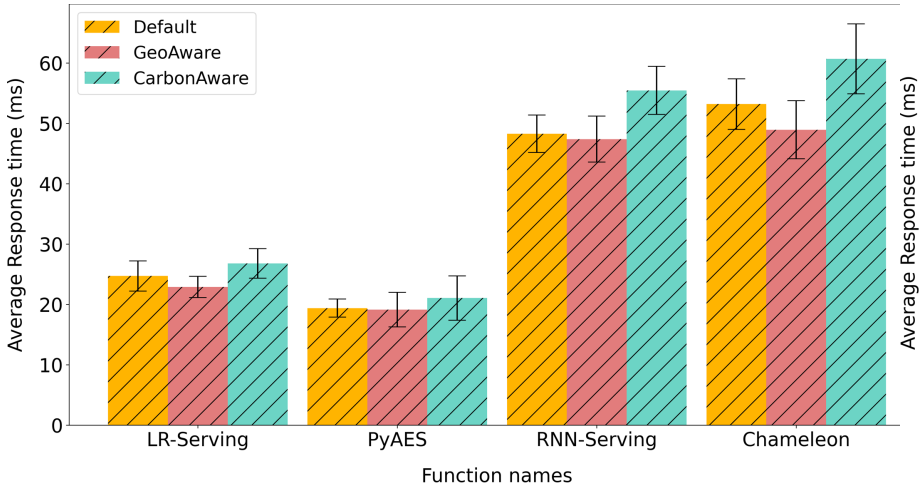
per function invocation



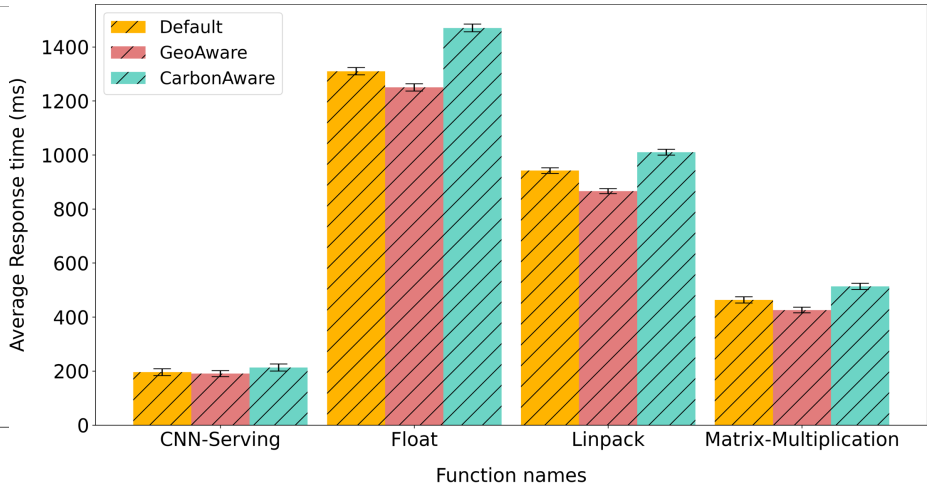


Comparing Response Times

10.26% vs Default



16.24% vs GeoAware



Thank You

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