Chiltepin: A Federated Workflow System for Earth Science

Christopher W. Harrop
Isidora Jankov

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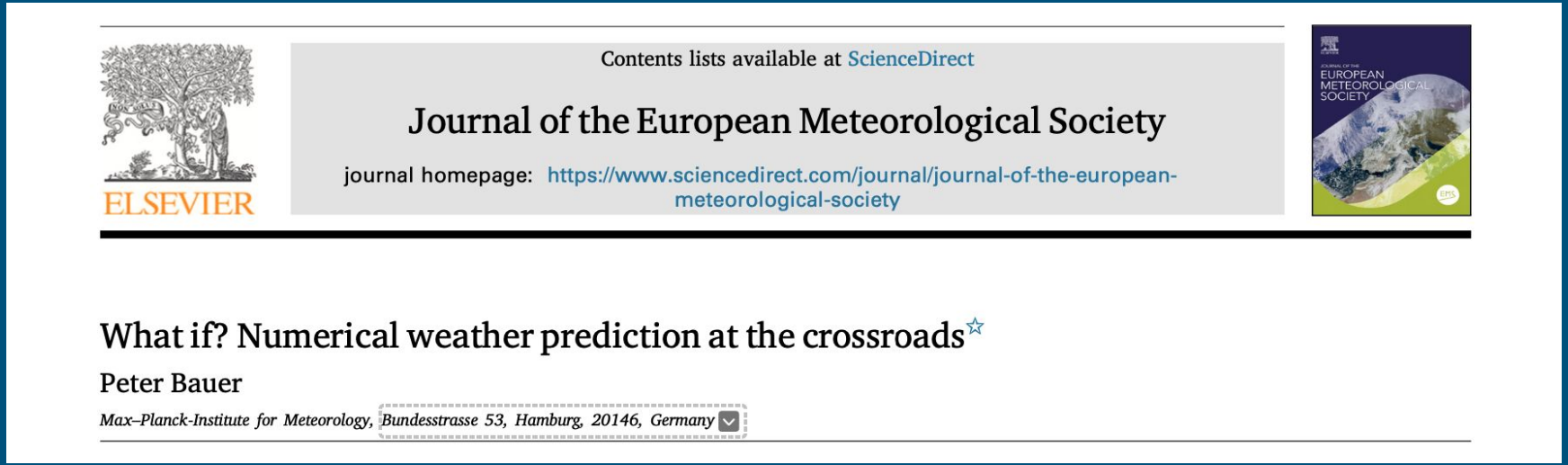
An Evolving HPC→NWP Landscape



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What if? Numerical weather prediction at the crossroads☆

Peter Bauer

Max–Planck-Institute for Meteorology, Bundesstrasse 53, Hamburg, 20146, Germany

Peter Bauer. 2024. What if? Numerical weather prediction at the crossroads. *Journal of the European Meteorological Society* 1 (2024), 100002. https://doi.org/10.1016/j.jemets.2024.100002

Some Existing NWP Workflow Products

- Rocoto (NOAA / GSL)
- ecFlow (ECMWF)
- Cylc (NIWA)
- CIME (NCAR)
- EWOK (JEDI)
- Autosubmit (Barcelona Supercomputing Center)
- uwTools (NOAA / GSL, EPIC)

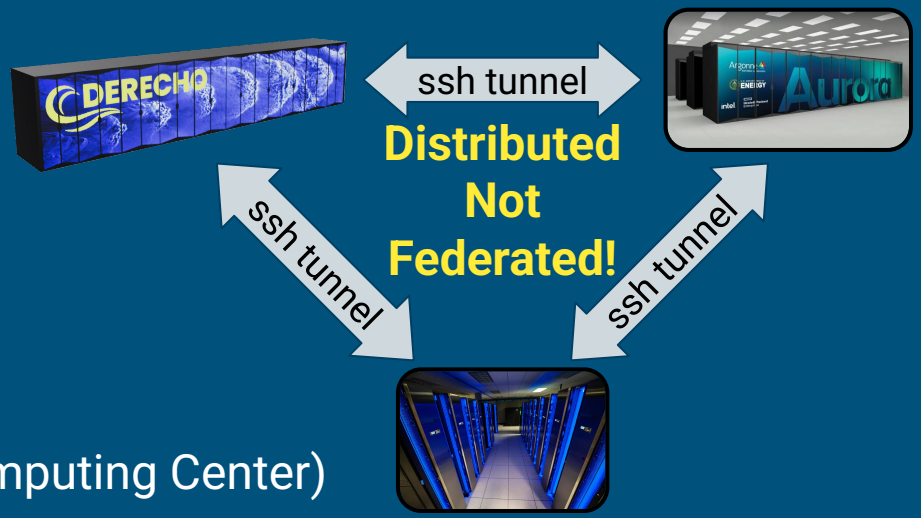

Image credits:
https://ncar.ucar.edu/sites/default/files/inline-images/derecho-ncar-render_0.png
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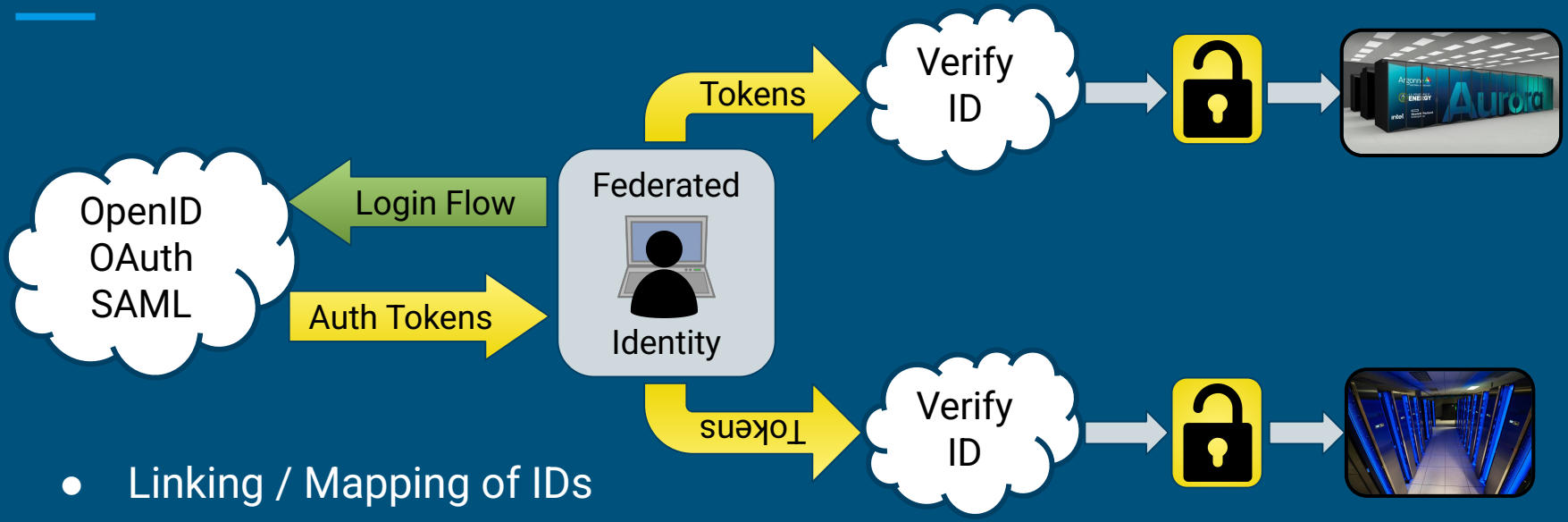
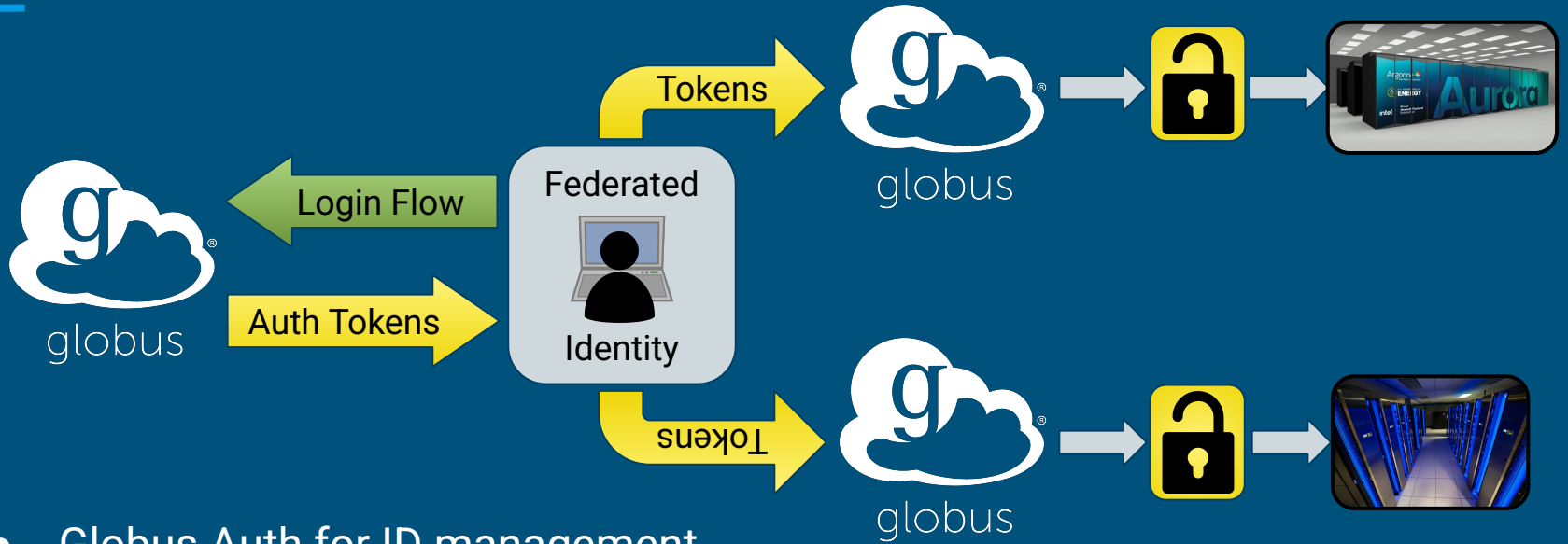
https://www.noaa.gov/media/image_download/309f7ef2-5bf4-4b91-8c00-fcf40dfaea29

What is a Federated Workflow?



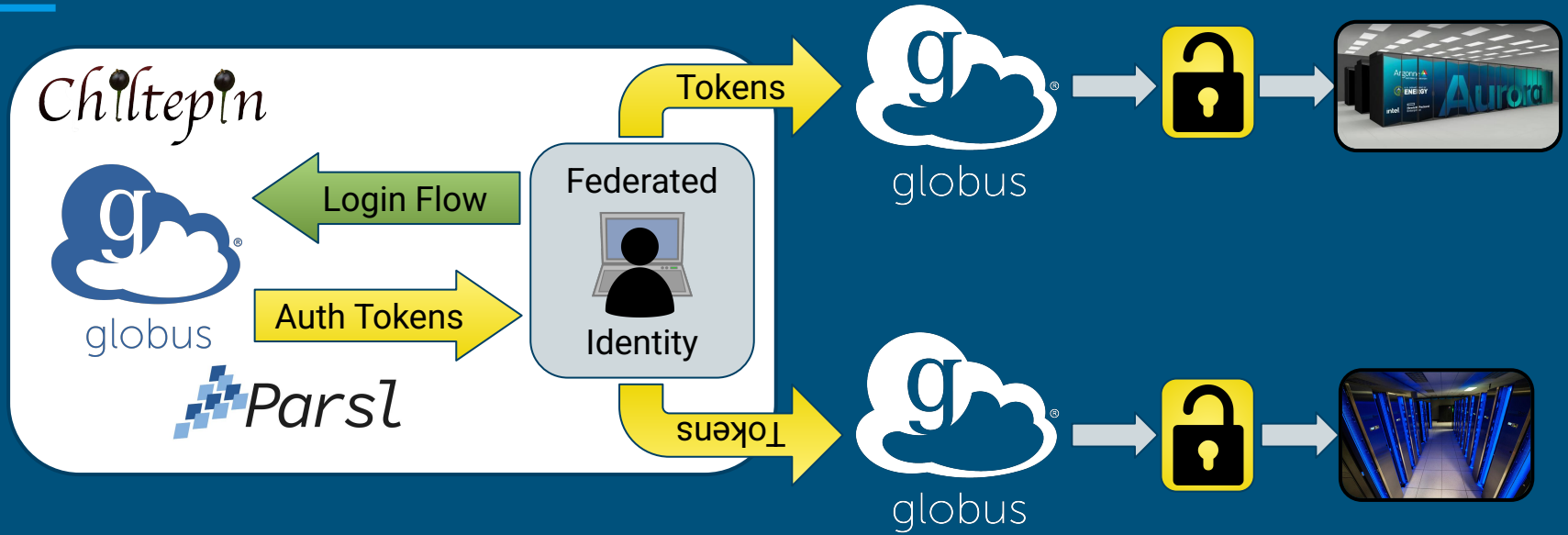
- Linking / Mapping of IDs
- Access control & limited scopes
- Reusable credentials until expiration
- Secure access across autonomous resources

Chiltepin Leverages Existing Solutions



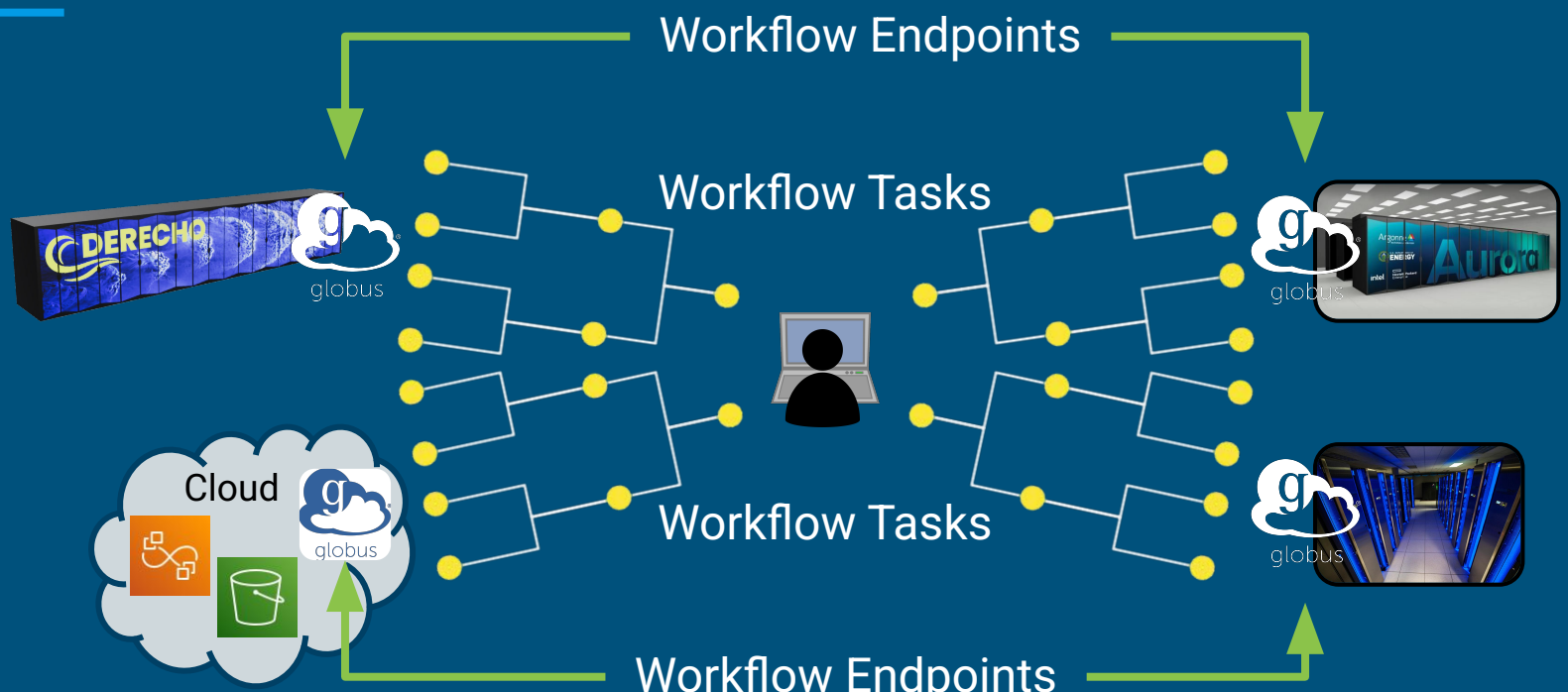
- Globus Auth for ID management
- Globus Compute FaaS for execution at workflow endpoints
- Globus Transfer for data movement

Chiltepin Leverages Existing Solutions



- Parsl for workflow automation
- Parsl's GlobusComputeExecutor for remote execution
- Globus SDK for login & transfers

Chiltepin Vision



Chiltepin Compute Endpoint Lifecycle Mgmt

```
$ chiltepin endpoint configure myendpoint

$ chiltepin endpoint list
myendpoint None Initialized

$ chiltepin endpoint start myendpoint

$ chiltepin endpoint list
myendpoint 46060b64-8383-4577-a74e-a45f928592dc Running
```

Chiltepin Tasks Are Python Functions / Futures

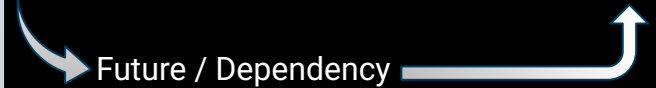
```
class MPAS:

    @bash_task
    def mpas_init(self, …):
        …

    @python_task
    def mpas_forecast(self, ….):
        …
```

```
import chiltepin.configure
import chiltepin.endpoint as endpoint

def main(...):
    endpoint.login()
    resources = chiltepin.configure.load(“config.yaml”)
    with chiltepin.init(resources):
        mpas = MPAS()
        init = mpas.mpas_init(..., executor=”aurora”)
        fcst = mpas.mpas_forecast(..., init, executor=”derecho”)
```



Chiltepin Configuration

```
resources:
  hercules:
    environment:
      - "module load ..."
      - "export MY_VARIABLE=my_value”
    endpoint id: "1234abcd-5678-90123-ab45-abcdef67891234”
    provider: "slurm"
    mpi_launcher: "srun"
    cores per node: 80
    nodes per block: 3
    partition: "hercules"
    account: "foobar"
```

```
endpoint.login()
resources = chiltepin.configure.load(“config.yaml”)
with chiltepin.init(resources):
   mpas = MPAS()
   init = mpas.mpas_init(..., executor=”hercules”)
   fcst = mpas.mpas_forecast(..., init, executor=”derecho”)
```

Challenges & Future Work

- Workflows as Python programs is a new paradigm (for us)
- Need to develop good monitoring tools
- Need to take better advantage of built-in failure recovery
- Develop interoperability with legacy Rocoto workflows
- Continue development to build a sustainable workflow future!
- Publication in preparation

Questions / Discussion