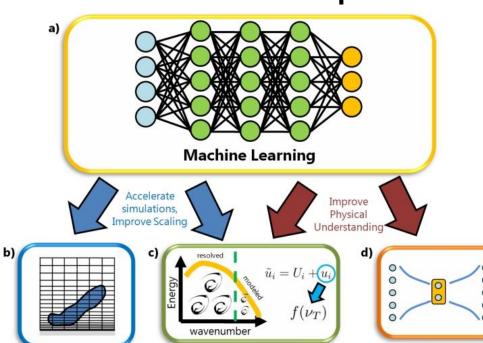
HPC - AI: Coupling Porting and Optimization

(Luca Marradi, luca.marradi@eviden.com)

Where could AI help in numerical simulation?



(Vinuesa et al. [1])

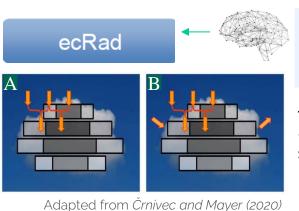
- **Modelling** sub-grid effect
- **Speed-up** solver time computing
- Surrogate model
- **Explainability**

Coupling RAPS20 - AI:

1 - Benefits of AI in HPC

- Tackle sub-grid modelling by datadriven approach
- Extends framework capability: automatic differentiation (Kochkov et al
- Exploit hybrid architecture (GPU-CPU)

2 - General Context

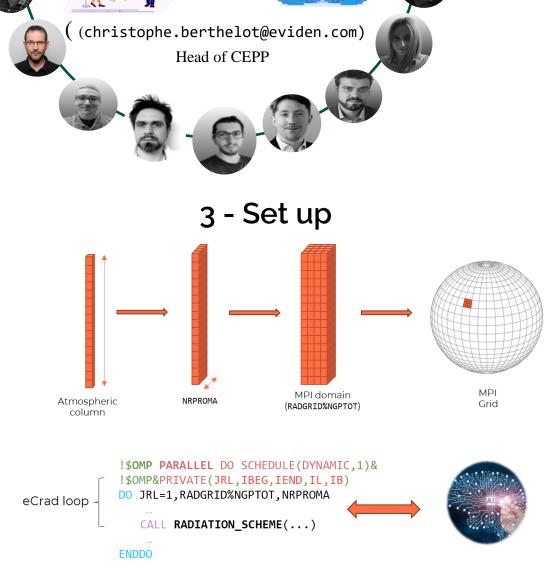


ECMWF

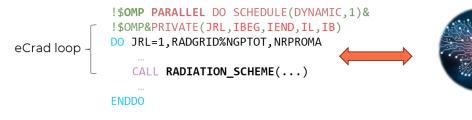
- Improve ecRad's accuracy
- · Wall time closer to Tripleclouds baseline

Tripleclouds (solver A) Represent cloud structure **SPARTACUS** (solver B)

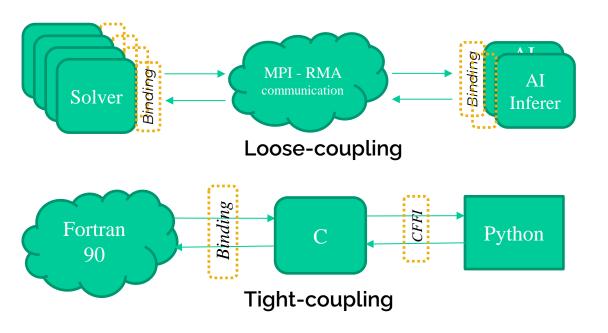
- Tripleclouds + the 3D cloud radiative effects
- ~ 3 times slower than Tripleclouds
- · Too expensive to run in IFS operational configuration



CEPP team



4 - Coupling Designs



Wall time Weak coupling RAPS20 RAPS20 - TCO399 w/ 128 CPUs 1500.00 1250.00 ■ Tripleclouds + IA-WC-128INE-CPU 750.00 500.00

Wall-time TCO399 - Spartan

Tight-coupling

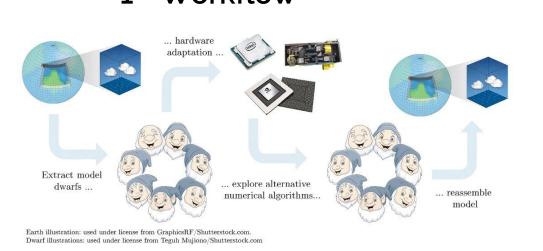
5 - Results

Accuracy

- Validated by ECMWF
- Still room for **improving** it with more complex model

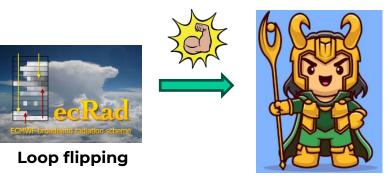
Heterogenous Computing:

1 - Workflow



2 - Optimization

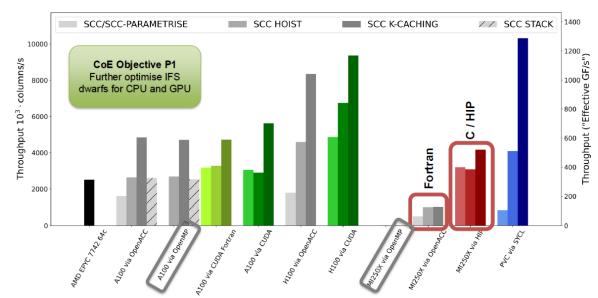
Loose-coupling



Loki: src to src translation

3 - Porting: from openACC to openMP

CLOUDSC cross-platform performance study^[4]



What next:

Coupling Atmosphere $\phi^{atm} = (\theta, u, v, P)_{z=10m}$ Surface $\mathcal{F} = (\tau_x, \tau_y, Q_{lat}, Q_{sen})_{z=0}$ module $\phi^{oce} = (T, u, v)_{z=0}$ Ocean Resolution:

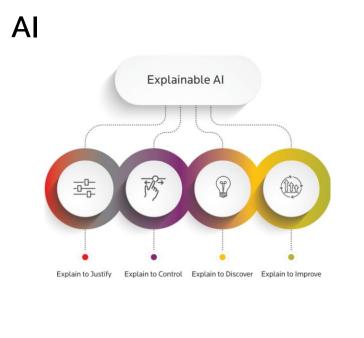
Loose coupling

- Scalability test (CPU GPU)
- Speed-up simulations

Porting Compiler Open**MP** Test fairly emerging hardware



- Inference: apply a pretrained model on Arome data
- Finetuning on Arome data
- Evaluation of sterched vs limited area model (lam) strategy





an atos business

Referencs