C2SM Center for Climate Systems Modeling

ETH Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich

Porting the COSMO v5 Fortran code to GPU

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COSMO goes GPU: Overview

- Different approaches:
  - Dynamical core: complete re-write (C++)
  - Physics/assimilation/etc.: extend Fortran code (OpenACC)

- Reference: OPCODE (GPU prototype based on COSMO v4.X)
  - Started over with COSMO v5.0

- My areas of work:
  - radiation
  - assimilation
  - output
  - single precision

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OpenACC

- Directives: special comments, ignored on CPU
- Original code largely unaltered
- Separate CPU and GPU memory
- Relatively new technique

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```
DO k=1,ke
  DO j=1,je
    DO i=1,ie
      p(i,j,k) = p0(k)+pp(i,j,k)
    ENDDO
  ENDDO
ENDDO
PRINT*, MINVAL(p(:,:,ke))
```

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PRINT*, MINVAL(p(:,:,ke))
```

```
!$acc data present (p,p0,pp)
…
!$acc parallel
DO k=1,ke
  !$acc loop gang
  DO j=1,je
    !$acc loop vector
    DO i=1,ie
      p(i,j,k) = p0(k)+pp(i,j,k)
    ENDDO
  ENDDO
ENDDO
!$acc end parallel
…
!$acc update host (p(:,:,ke))
PRINT*, MINVAL(p(:,:,ke))
…
!$acc end data
```

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ENDDO
PRINT*, MINVAL(p(:,:
```

start data region

start parallel region

parallelization detail

parallelization detail

end parallel region

update CPU array

end data region

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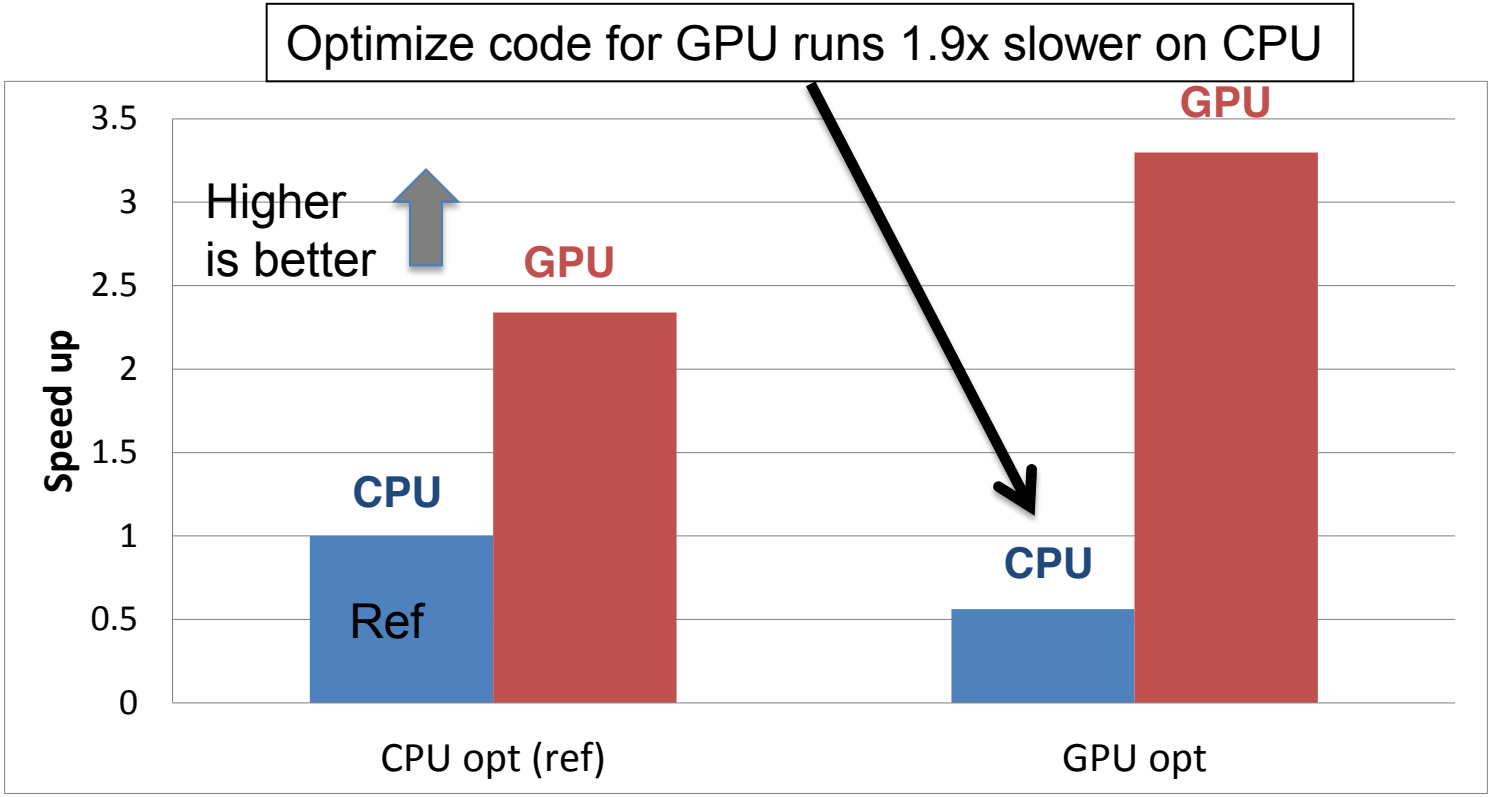
Radiation performance



- Key kernel of radiation: Speed-up with respect to reference code on CPU
- Radiation is the strongest example, on average in the physics, code optimized for GPU is 1.3x times slower when run on CPU

[Xavier Lapillonne]

Thanks for your attention