C2SM Center for Climate Systems Modeling

CONSORTIUM FOR SMALL SCALE MODELING COSMO

MeteoSwiss

ETH zürich

Status of the COSMO-POMPA PP

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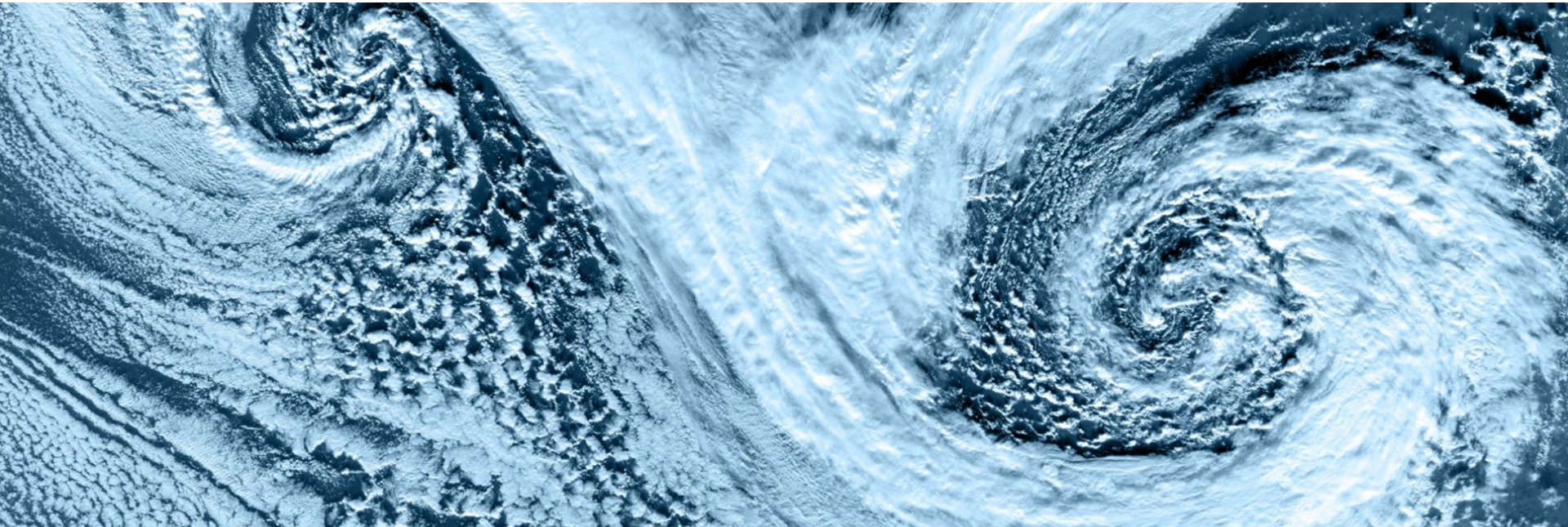

Timings
POMPA Branch

Performance Production Setup

COSMO-E Testcase

1x COSMO-E member
2 hour forecast
Version: 15th May 2017

Baseline

CPU Performance

Double Precision

	COSMO Fortran		COSMO C++ Dycore
Dynamics/Relaxation	280s	1.32x	207s
Physics	80s		80s
Other	14s		12s
Total	**374s**	**1.23x**	**309s**

Compute: **8**x Intel Xeon E5-2690 **Sockets** (96x Haswell Cores)
I/O: **4**x Intel Xeon E5-2690 **Cores** (4x Haswell Cores)

1.8x
COSMO C++ Dycore: CPU → GPU

GPU Performance

	Double Precision		Single Precision
Dynamics/Relaxation	98s	1.6x	63s
Physics	38s	1.4x	27s
Other	34s		21s
Total	**169s**	**1.5x**	**110s**

Compute: **8**x Intel Xeon E5-2690 **Cores** (8x Haswell Cores)
4x NVIDIA Tesla K80 **Cards** (8x Kepler Sockets)
I/O: **2**x Intel Xeon E5-2690 **Cores** (2x Haswell Cores)

Total Speedup **3.4x**
CPU Double Precision (Fortran) ⟶ GPU Single Precision (OpenACC Fortran & C++ Dycore)

Status of the Merge of the POMPA features

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C++ Dynamical Core

- Integrated: Works in GPU/CPU mode
- Tested daily together with COSMO technical testsuite
- Changes are tested through pull requests
- Full developer documentation distributed to SCA

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Physics (OpenACC)

- **Ported schemes**
  - Soil (terra), Radiation (not lradav), Shallow convection, sso
- **Ongoing**
  - Turbulence, Microphysics
- **Not Started yet**
  - Tiedke convection, Flake
- **Not considered in POMPA**
  - Sea-ice, Bechtold convection

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Other components

- Communication: GCL library is needed for efficient GPU/GPU communication
  - No progress yet (planned after COSMO GM)
- Assimilation
  - Nudging : ongoing
  - Latent Heat Nudging : not started
- Output and “glue code” (lmorg, organize_physics...) : not started

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Single Precision

- Only tested and operational (MCH and COSMO-LEPS) in the POMPA version

  Dynamics and Physics
- Possibly needs to be re-evaluated for the current official version of COSMO
- Data assimilation in single precision
  - Several tests with promoting internal variables to double
  - No success ⇒ may not be possible without significant change in the code

Documentation

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Documentation

- **Build Documentation**
  - Covers STELLA, C++ Dycore and COSMO
  - No extra build scripts needed
  - Available in cosmo/ACC/README.md
- **C++ Dynamical Core Documentation**
  - Oriented towards developers
  - Available in dycore/doc/Dycore
- **C++ Dycore Wrapper Documentation**
  - For C++ Dycore Maintainer
  - Available in dycore/doc/Wrapper
- **C++ Dycore Maintenance Guide**
  - For C++ Dycore Maintainer
  - Available in dycore/doc/DycoreMaintenanceGuide

Available here: https://wiki.c2sm.ethz.ch/COSMO/CXXDynamicalCore

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C++ Dycore Training Course

- Held in Langen, Germany as part of the COSMO/CLM/ART - Training Course
- March 27 - April 04, 2017
- 16 Participants (21 registered)
- Topics:
  - General setup of the code, testing
  - Configuration and compilation
  - Hands-on session on the DWD Cray
  - GPUs/Accelerators how and why
  - STELLA introduction
  - Extracting an intermediate computation

Material available here: https://wiki.c2sm.ethz.ch/COSMO/CXXDynamicalCore

Working Mode

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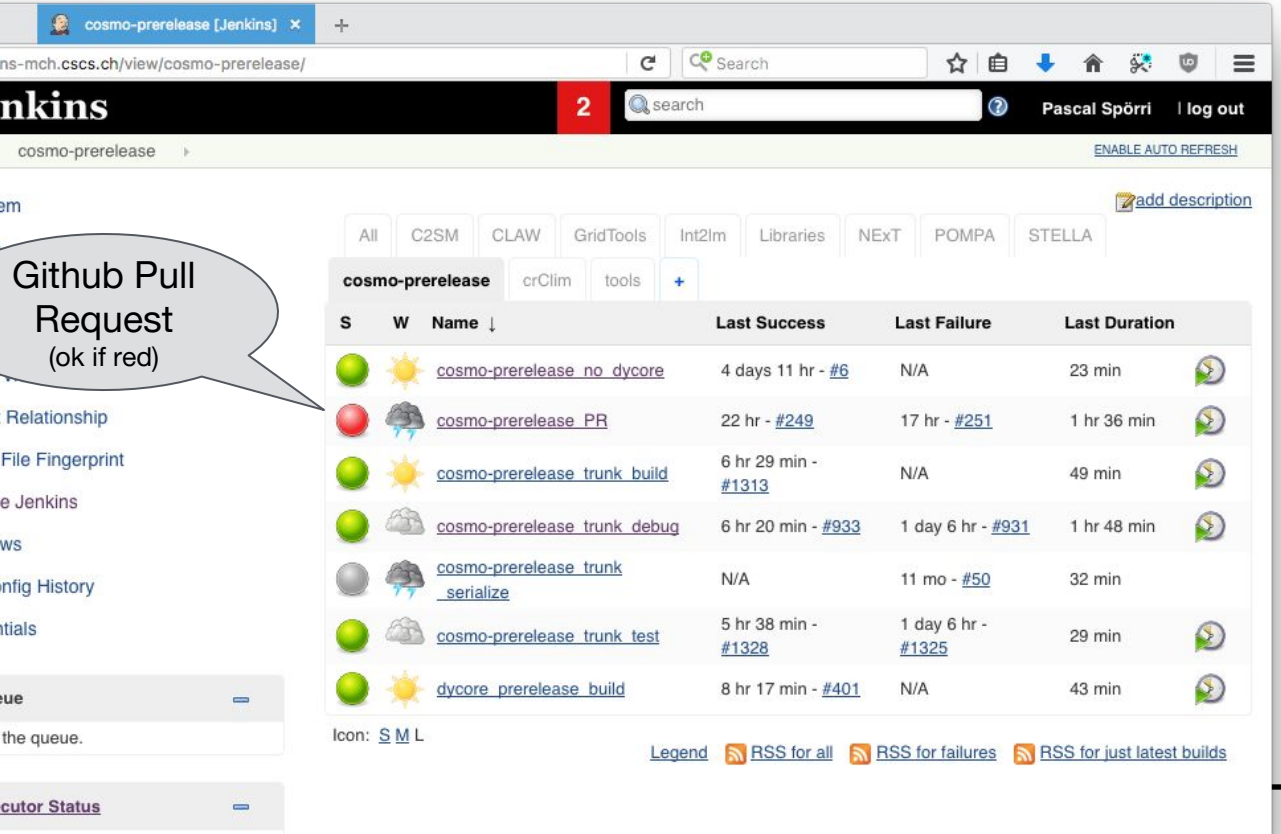
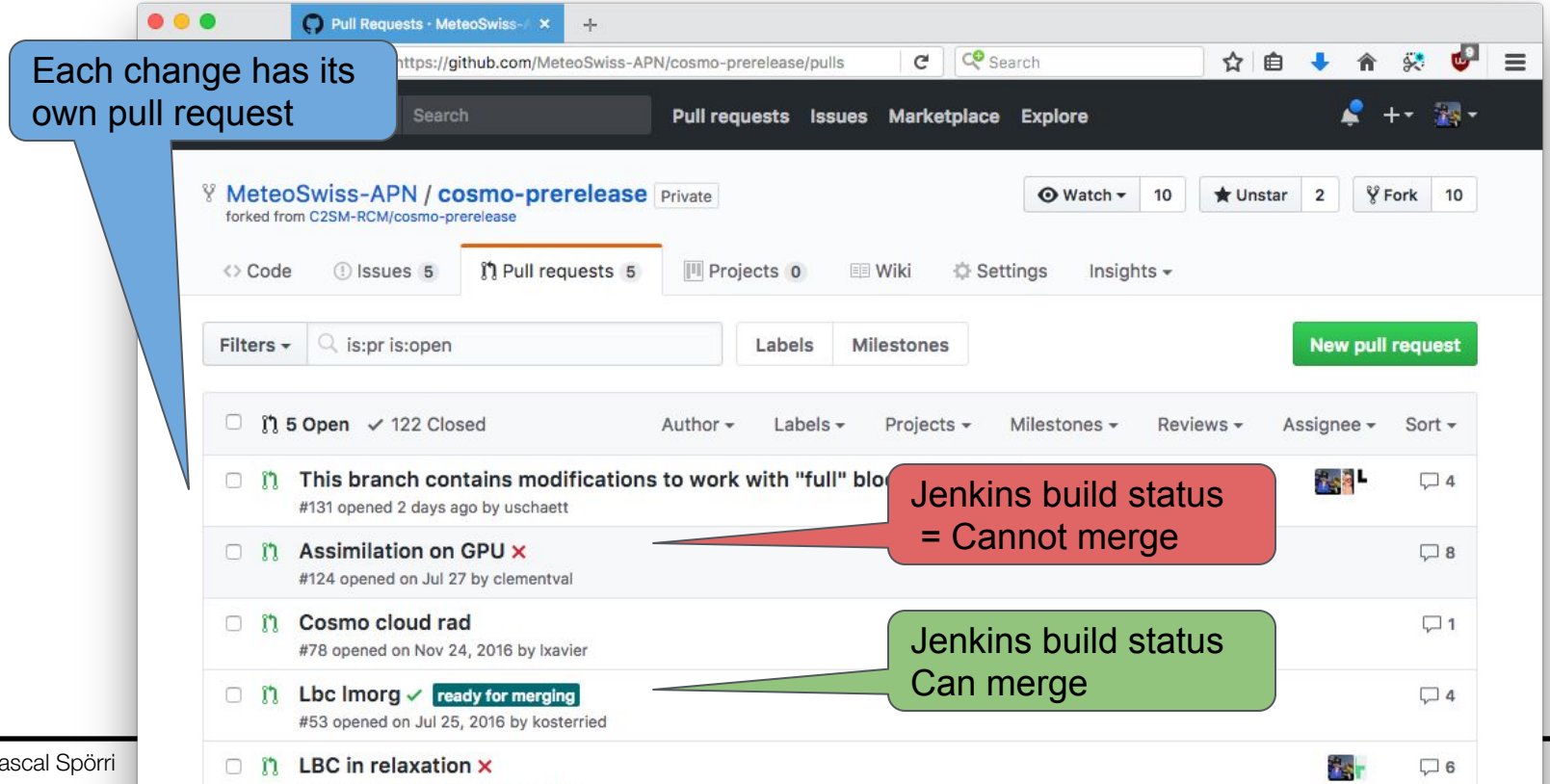
Daily Testing

Configuration Matrix		cpu	gpu
kesch	float	●	●
	double	●	●
kesch-pgi	float	●	●
	double	●	●



- Daily builds
  - CPU and GPU
  - Single and Double Precision
  - Debug and Release
  - C++ Dycore
  - PGI and Cray
- Testing
  - CPU and GPU
  - MeteoSwiss testlist
  - DWD testlist
  - C++ Dycore

Github Integration



Lessons Learned

- Github integration very important
  - Allows us to see the latest changes and regularly test them
  - Scalable for more collaborators

Thank you!

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Kesch System Update

Production
CUDA 7
GCC 4.9, MVAPICH 2.1, CCE 8.4.4, RHEL 6

• Timeloop	**111.6233**
• Dynamics	64.8235
• Physics	26.6754
• Init	1.6635
• Output	4.7423

Updated System
CUDA 8
GCC 5.4, MVAPICH 2.2, CCE 8.6.0, RHEL 7

• Timeloop	**95.4242**
• Dynamics	55.0604
• Physics	21.8393
• Init	1.8626
• Output	4.4630