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Summary of Priority Project POMPA

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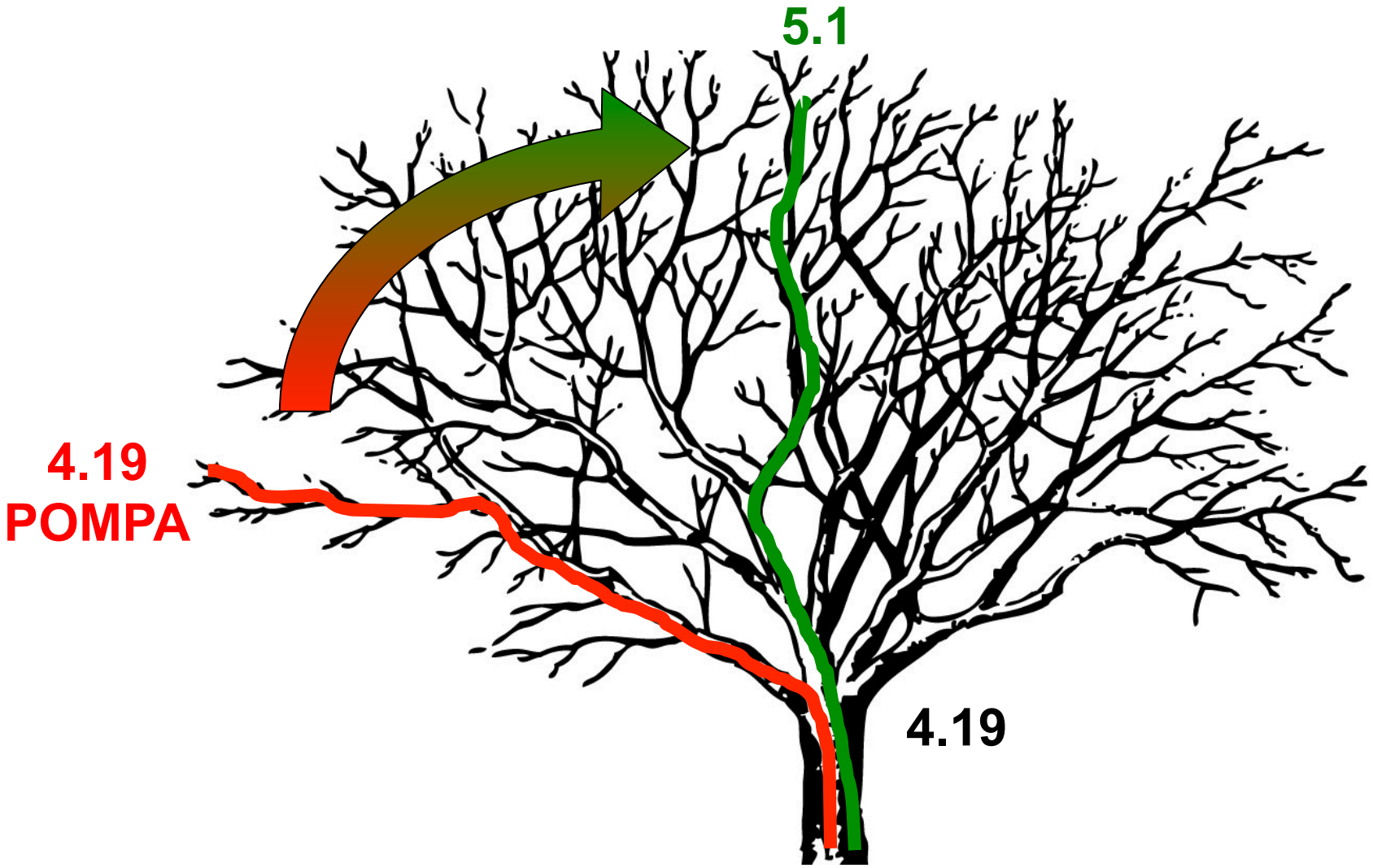
Summary of POMPA



Merge POMPA developments back to trunk until December 2014

Status (1/3)

Summary: Main tasks are done or on-track. Most delays are due to missing human resources, and not technical difficulties.

Task 1 Performance analysis and documentation [done]

Task 2 Redesign memory layout and data structures

- Prototype for blocking of physics implemented and accepted
- 09.2012: Blocking and unified physics library [partly in 5.1]

Task 3 Improve current parallelization [done, delivered to SCA]

- Loop level hybrid model version prototype pending for official version

Task 4 Parallel I/O [done, v4.25]

Status (2/3)

Task 5 Redesign implementation of dynamical core

- 12.2013: Modification of stencil library and C++ dynamical core according to review
- 03.2013: Port of full RK dynamical core using stencil library (including new FW-solver)
- 07.2014: Extension of stencil library with new features (indirect addressing, ij-caching, …)
- 07.2014: Key developers are full stencil library users
- 09.2014: Workshop for all interested COSMO users in the COSMO and CLM community (after the COSMO GM)
- 09.2014: Full validation of new dycore with respect to Fortran implementation

Deliverable (12.2014): Rewritten dycore for integration into 5.X

Status (3/3)

Task 6 Explore GPU acceleration

- 04.2014: Full unified physics package available with OpenACC directives
- 06.2014: GPU backend of stencil library ready for latest hardware
- 08.2014: Consolidated version of assimilation available with OpenACC directives (without LHN)
- 09.2014: Consolidated version of COSMO code with GPU acceleration ready for pre-operational use

Task 7 Implementation documentation

- 09.2011: Draft of implementation documentation (for COSMO) [task removed from project plan]

Task 8 Single / double precision

- 09.2013: Model version with switchable single/double precision [v5.1] (no single precision assimilation) [new task in project plan]

Hybrid parallelization / Blocking

- Hybrid OpenMP / MPI parallelisation
  - We have a loop-level prototype (getting older)
  - Performance improvements were not great
  - Slight strong scalability improvements
  - **How to go on?**

- Blocking / new data structures in Fortran dynamical core
  - Cray optimizations
  - Blocked version available on C++ side
  - **What are the plans on DWD side?**

GPU Acceleration

- Version based on COSMO 5.0 being developed
- Focus on functionality required for COSMO-1
- Regular COSMO-1 runs in GPU based machine (Cray XK7 @ CSCS) planned starting from end of September
- Validation period (parallel CPU runs) and continuous refinements (functionality & performance) for ~3 months
- **For details about integration into 5.X see following talk and discussions**

GPU Acceleration for COSMO-1

Parts	Status	Delivery / Required work	Remark
Physics	On-going	18/09/2014	Only turbulence and radiation still on-going.
Fortran-C++ interface	On-going	05/09/2014	First version working. Modifications on-going.
Dynamical core	On-going	18/09/2014	Working. Including new FW solver. Some features for C-1 still missing.
Assimilation	Ready to merge	1 day. On-demand	Tested with Cray, problem with PGI No LHN
Communication	Ready		Use GCL for GPU
Structure code (e.g. initialization, lmorg.f90, …)	On-going	18/09/2014	Mostly in lmorg.f90 + some utility functions
Diagnostics	Not started	2 days (for minimal set)	Minimal set sufficient for standard verification (also for CALMO)
Output	Not started	30/09/2014	Port already available, only need to be merged into 5.0
Single precision	On hold		Doesn't work for assimilation

Physical parametrizations

Scheme	C-1	Status	Delivery	Code origin
microphysics - hydci_pp (ice scheme) - hydci_pp_gr (graupel) - other schemes	 x 	 done done not considered		 ICON ICON
sub grid scale oro. (SSO)		only in 4.19		COSMO 4.19
radiation	x	on-going	18/09/2014	COSMO 5.1
turbulence	x	done	5/09/2014	ICON dev (2013)
soil model - terra_multlay - terra	 x 	 done not considered		 ICON dev (2013)
convection - conv_tiedtke - conv_shallow	 x	 only in 4.19 done		
seaice		not considered		
flake	x	not started		

Goal for GM14

- Coordinate on Tuesday afternoon
- Consolidated and agreed upon for 5.2 on GPU

Single precision

- Will be in official version 5.1

- **But…**
  - Some parts don’t work or haven’t been tested
  - Developer behavior has to change
  - Developers currently don’t run single precision

- Consequences
  - Advertise CNL
  - Regular testing of single precision version (testsuite!)
  - Extend COSMO Standards
  - **What else?**

Documentation

- **Existing**
  - Stencil library workshop material
  - Stencil library (implementation)
  - GCL documentation
  - Communication framework
  - Serialization framework
  - C++ style-guide
  - Single precision CNL
  - Block structure API + users guide
  - OpenACC (implementation)
- **Missing**
  - C++ Dycore (implementation)
  - Stencil library (users guide)
  - Parallel NetCDF I/O (users guide)
  - **What else?**

Knowhow Transfer

- Stencil workshop (investment 0.5 FTE, return 0.4 FTE + 0.07 FTE)
- OpenACC tutorial
- Documentation + Presentations + Publications + Newsletters
- **What else? Your suggestions?**

Administrative history

- Project milestone

  (03.2013) Preliminary ok by STC to continue work on all tasks to deliver a GPU-capable version of COSMO model based on dynamical core rewrite

SMC recommended to STC to go ahead
STC decided on preliminary go ahead

- Project milestone

  (03.2013) Final ok by STC to continue work on all tasks to deliver a GPU-capable version of COSMO model based on dynamical core rewrite

SMC should give a recommendation to STC

STC decided positive (September 4, 2013 in Sibiu)

Project Extension (1/2)

- **POMPA project scheduled to end 12.2014 (according to project plan v4.4)**
- **Main deliverable**
  (12.2014): Version of code 5.X which contains POMPA developments delivered to SCA.
- **Issues**
  - Integration into 5.X will require further work with code responsibles, SCA, and working group chairs
  - Further GPU porting work required/requested (physical parametrizations, LHN)
  - Work to keep C++ version of dycore synchronized
  - Support, training and documentation
  - Assimilation does not work in single precision
  - Open tasks (hybrid OpenMP/MPI, new halo-update, …)
  - Ongoing related activities (e.g. PASC GridTools project)

Project Extension (2/2)

- **Proposal: Extension until 09.2015**
- Project extension supported by WGC6 and SPM
- Revised project plan delivered (v5.0) to SMC and STC
- SMC recommends to STC to accept revised project plan and project extension (STC 20.08.2014)
- STC will make decision here in Eretria (today or tomorrow)