Mixed-Precision and Component Concurrency in Atmospheric Radiative Transfer

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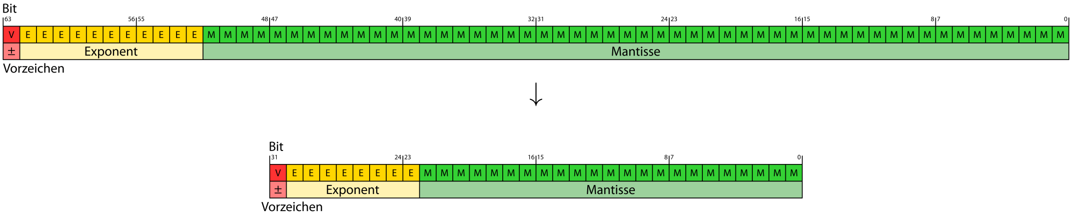
Reduced Precision in Climate Models

Single Precision in Weather Forecasting Models: An Evaluation with the IFS (Váňa, Düben et al. - 2016)

Modifications of the IFS climate model led to a performance gain of about 40%



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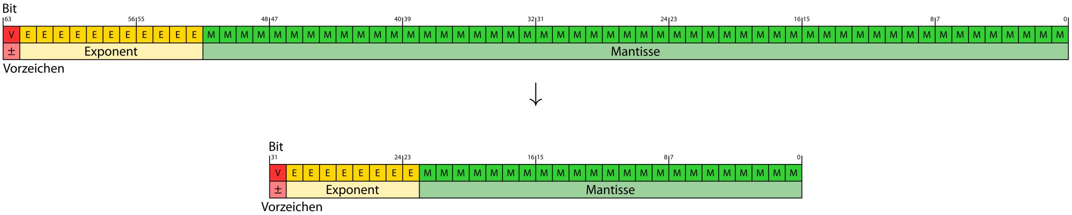
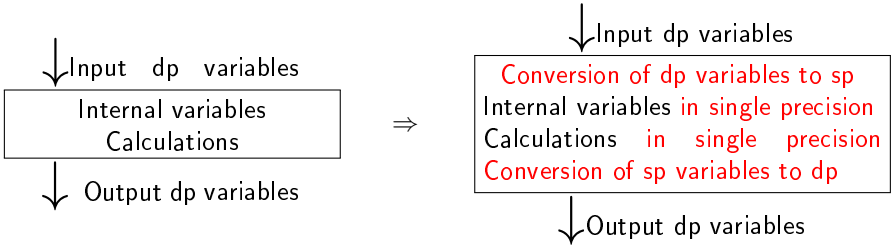


Will it work for the ECHAM atmosphere model?
Will this modification produce reliable climate data?

Image credits: Wikicommons

Precision Change Implementation

Our strategy: Changing precision inside the routines



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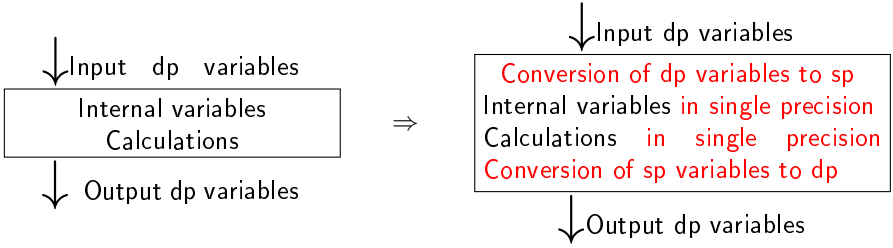


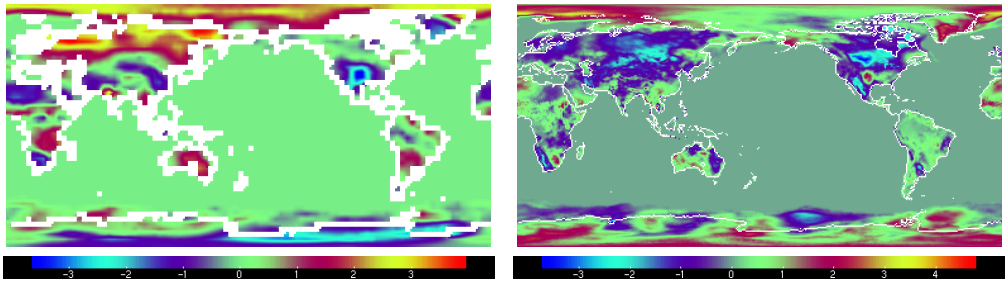
Routines are faster but conversions take time

- 47.90 mo_lrtm_gas_optics.gas_optics_lw
  - 22.43 mo_lrtm_gas_opticsgas_optics_lw.taumol01_
  - 22.29 mo_lrtm_gas_opticsgas_optics_lw.taumol02_
  - 100.40 mo_lrtm_gas_opticsgas_optics_lw.taumol03_

- 682.03 mo_lrtm_gas_optics.gas_optics_lw_
  - 20.36 mo_lrtm_gas_opticsgas_optics_lw.taumol01_
  - 19.93 mo_lrtm_gas_opticsgas_optics_lw.taumol02_
  - 73.94 mo_lrtm_gas_opticsgas_optics_lw.taumol03_

Solution: Working on bigger code blocks

Differences of yearly temperature means are sufficiently bounded



Temp. difference for model with a routine in dp and sp (left) consecutive model versions (right)