

Single-precision strategy at ECMWF

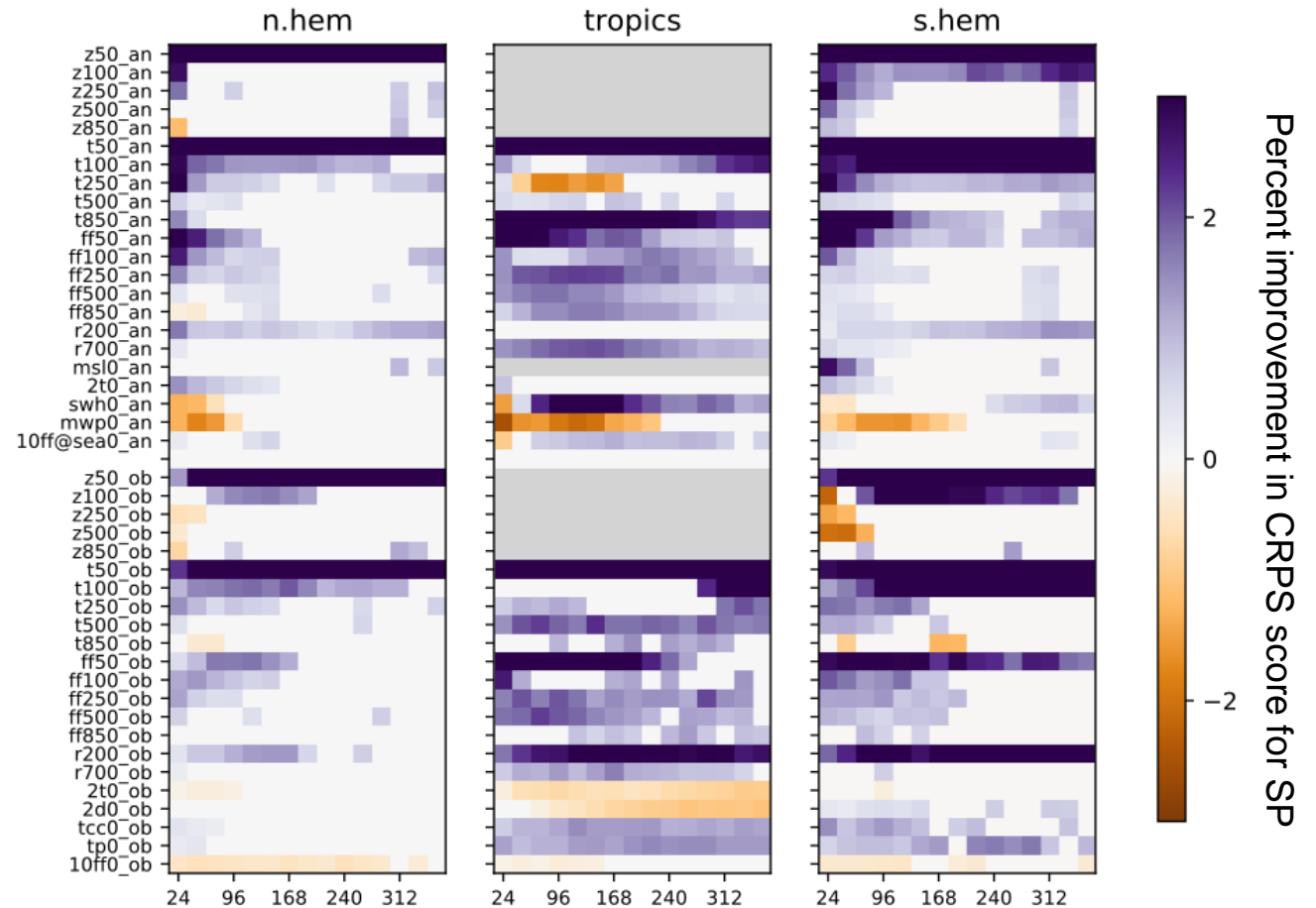
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Single-precision in the atmosphere

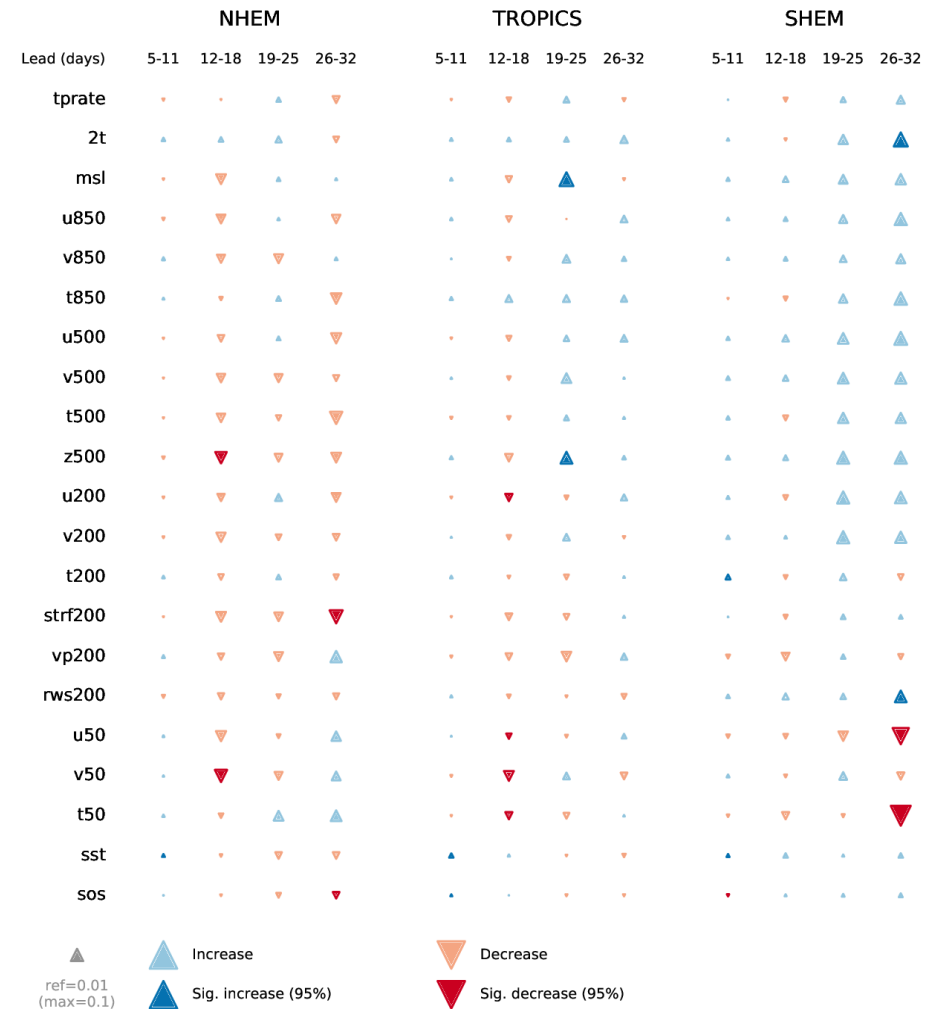
- The story:
 - 2014: Initial SP experimentation with OpenIFS
 - 2015/16: SP changes backported to IFS at ECMWF
 - 2016: SP option made available in IFS cycle 41r2 --- **experimental SP and operational DP model using same source code**
 - 2017/18/19: SP model undergoes extensive testing
 - 2021: SP implemented operationally in IFS cycle 47r2
- SP allows higher resolution atmosphere for **no extra cost** – 137 levels vs. 91 levels



Single-precision in the ocean

- The story:

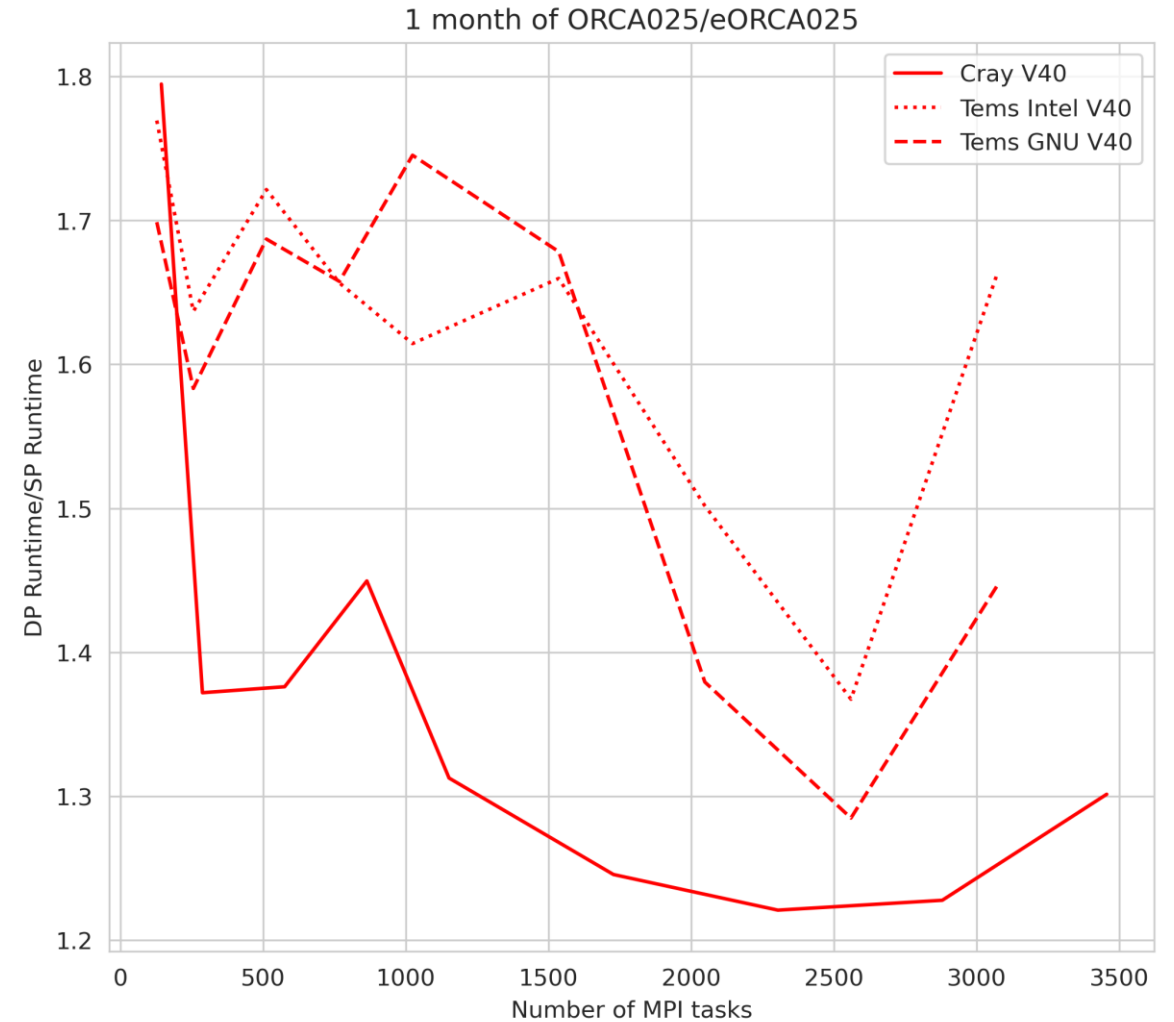
- 2019: Initial import of SP NEMO v4.0 from BSC
- 2020: Integration into ECMWF experiment system, debugging through forced-ocean runs (especially SP SI3), development of SP coupled system
- 2021: fully SP (atmos. + ocean + waves) coupled verification
 - First results suggest SP performs well but isn't yet neutral w.r.t. DP
- Tentative plan: 2023: SP NEMO put into operations -> depends on neutral performance w.r.t. DP



Example from coupled verification SP vs. DP (CRPSS) TCo199/eORCA1 (blue = SP better than DP)

Single-precision NEMO scalability

- Tems = small scale test of next ECMWF supercomputer
- Cray = current system
- Note: XIOS not used here
- SP/DP speed-up varies, but up to **1.75x** possible



Thoughts on single-precision maintenance

- The SP maintenance problem is **not** significant
- Let's compare my latest SP src against our original DP src (NEMO V4.0.4) (**all rough estimates**):
 - Excluding IOM (only 2 files different, mostly duplicated SP I/O routines)
 - Excluding LBC (12 files different, mostly duplicated SP MPI comm. templates):
 - **Gives 892 line changes in total**, comprising:
 - 654 changes including “wp” somewhere -> e.g. 1.0 -> 1.0_wp
 - **Mostly trivial, bit-reproducible and recommended coding practices in any case**
 - 238 remaining changes mostly bug fixes
 - **Many of these also benefit DP**
- My recommendation: first identify trivial, bit-reproducible changes (~75% of the total) that allow SP (wp etc.) and merge these into the NEMO trunk
- Then decide later if you want to officially support SP -> if not, no problem! Keeping our SP version up to date is much easier once the wp changes have been pulled