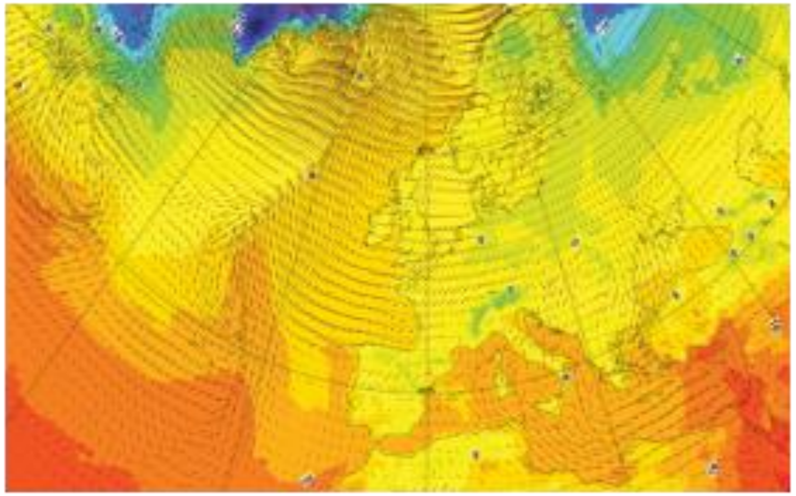
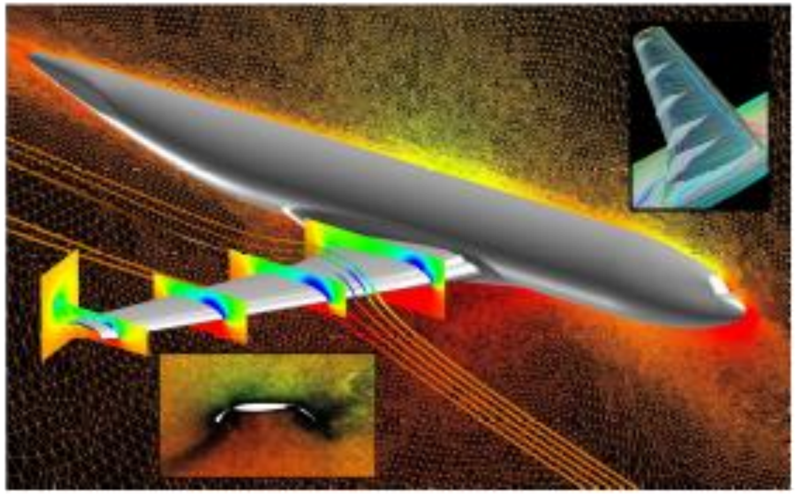
European Computing Solves Societal Challenges


PRACE's goal is to help solve these challenges. The days when scientists did not have to care about the hardware are over, and so are the days when compute centers did not have to worry about the scientific application!

Message:
Computing drives Science – and Science Computing

Remarkable Repeated Success Stories

- Recurring core part of Nobel Prizes in Physics & Chemistry
- Saving billions with better weather forecasting
- Improving human health with genomics, personalized medicine
- 3-4% better fuel efficiency of aircraft & wind turbines every year
- Disrupting communication, transportation and manufactoring
- Design of future materials from scratch based on desired properties
- Batteries & supercapacitors
- Artificial intelligence, machine learning, sensors, open data

Scientific computing keeps delivering impact, but European impact is limited by resources.

The Scientific Case for Computing in Europe showcases the achievements we predict will come true within the next 5-10 years with a factor 50-100x more computing power in Europe

Key Infrastructure Requirements

Urgent need for more compute cycles - but also high demands for memory bandwidth & I/O

Scientific Applications are not only ready to use Exascale, but have specific high-impact research goals that can only be realized with access to next-generation resources

However: Exascale will require new approaches to scaling by using ensembles, deep learning, and statistical models. High-end computing will dominate, but tomorrow's solutions will be different than yesterday's

Exascale systems will need to be able to handle tens of thousands of active jobs and large I/O requests

Software & algorithms take longer to change than hardware - first-generation systems must be based on present concrete needs, rather than hopes about being able to co-design

Linux rules the modern computing world: All systems will need to support a full Linux stack of development tools

Centers & their staff need to engage directly in software development together with scientific communities

Requests/Recommendations from the PRACE SSC

To be competitive with the rest of the world, *Europe* needs a *European* infrastructure & community for computing, support and research – with the agenda focused on solving the most challenging problems

Future infrastructures need to have involvement of leading academic and industrial researchers in direct government, not merely providing advice - because they are the ones that vouch for the requested funding

Future Infrastructures and operations will need to be much more diverse to support HPC, Data Science and different types of accelerators - but we also need to avoid fragmentation. Suggested to focus on **TWO** architectures.

Requests/Recommendations from the PRACE SSC

Investments in hardware must be paired with similar investments (reserve 10%) in algorithms, software, and workforce education, or the applications will not be able to use next-generation computers

Centers-of-Excellence appear to work very well for some communities, but compared to the US we frequently put too much emphasis on short-term deliverables in Europe. Help them focus on the real long-term goals!

Integrate infrastructure staff better in key user communities, both to get them involved in software development and aid communities that do not have any Center-of-Excellence

If this does not happen, Europe will fall behind US & Asia, and the most creative students, researchers & entrepreneurs will go elsewhere

Reflections from building the Scientific Case

Know the audience and write for them

- Known knowns: find explainable examples of discovery/progress enabled by scientific computing. Concise but for breadth of applications
- Known unknowns: build on progress to articulate scientific or societal challenges that will be addressed given future defined resources
- Unknown unknowns: leave room for the unexpected!

New Contexts for a New Scientific Case ...

- The current state of the world .... geopolitics, climate, ...
- Increasing focus on European competitiveness – Draghi & Heitor reports ... new *Commissioner for Startups, Research & Innovation* etc
- Increasing concern about and focus on export controls, dual use and knowledge security

- Education, training and skills
- Recruit and retain talent
- Viable career paths; reward and recognition