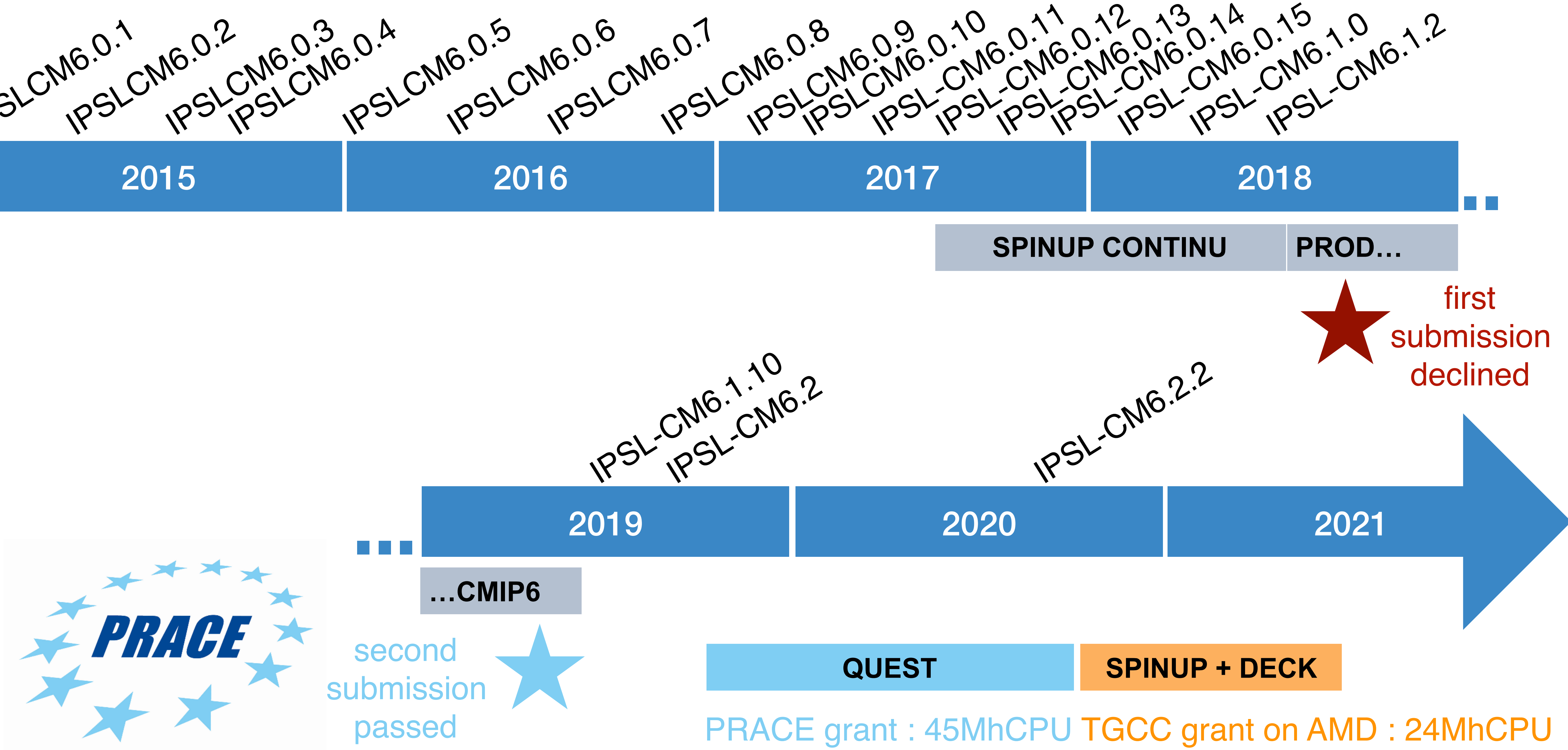
QUEST : Quantifying Uncertainties and Enhancing the Speed of climate model Tuning

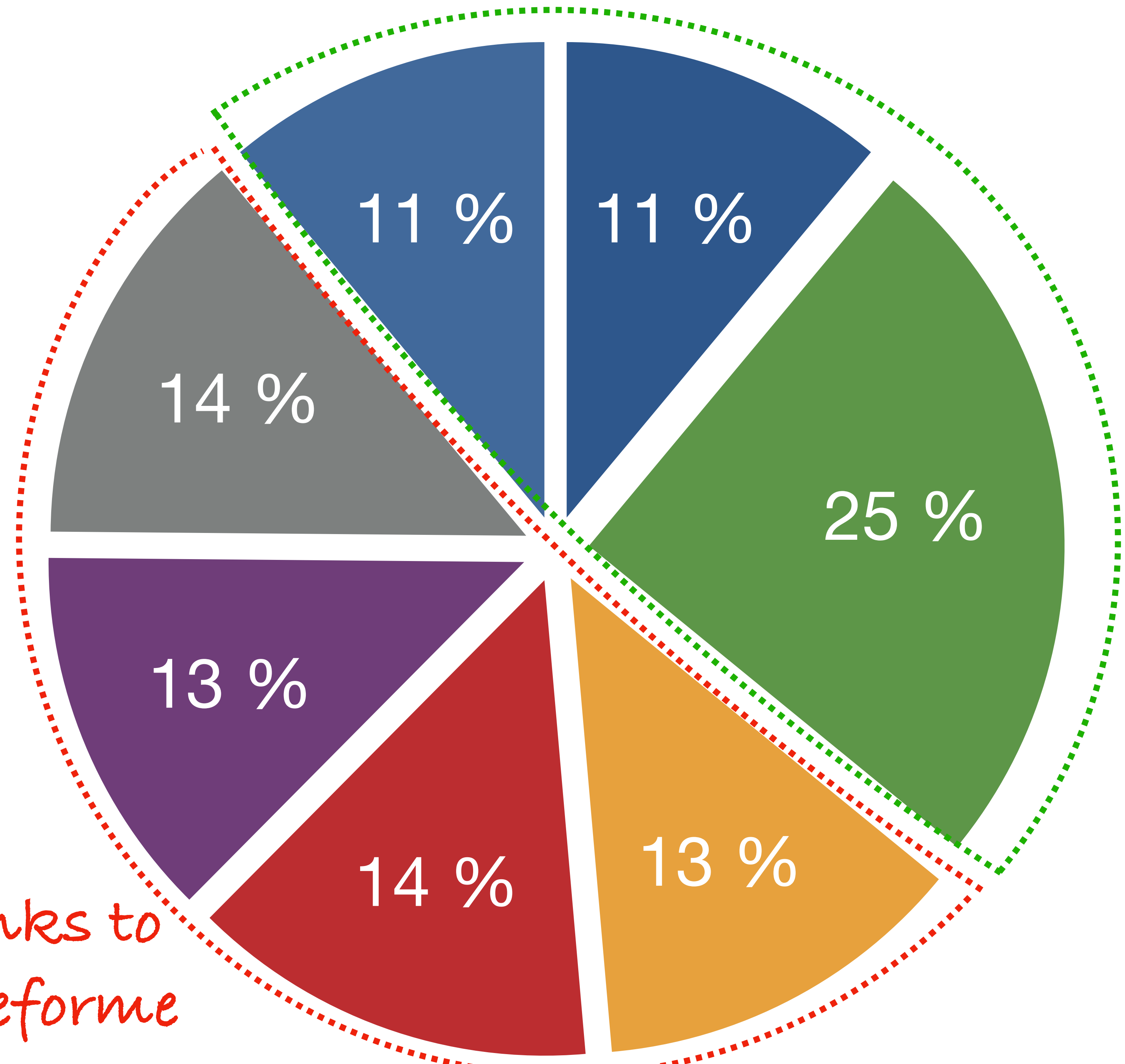
PIs : Juliette Mignot, Frédéric Hourdin and Julie Deshayes



QUEST : structure of project description

- 2.1 Scientific justification
- 2.2 Description of workpackages
- 2.3 Validation
- 2.4 Software and attributes
- 2.5 Data Management Plan
- 2.6 Performance of code
- 3. Project management, communication plan…

within my expertise as a "chercheur"



many thanks to groupe plateforme

Within IPSL-CM6A-LR, we have identified 3 types of uncertainty in climate model simulations :

QUEST

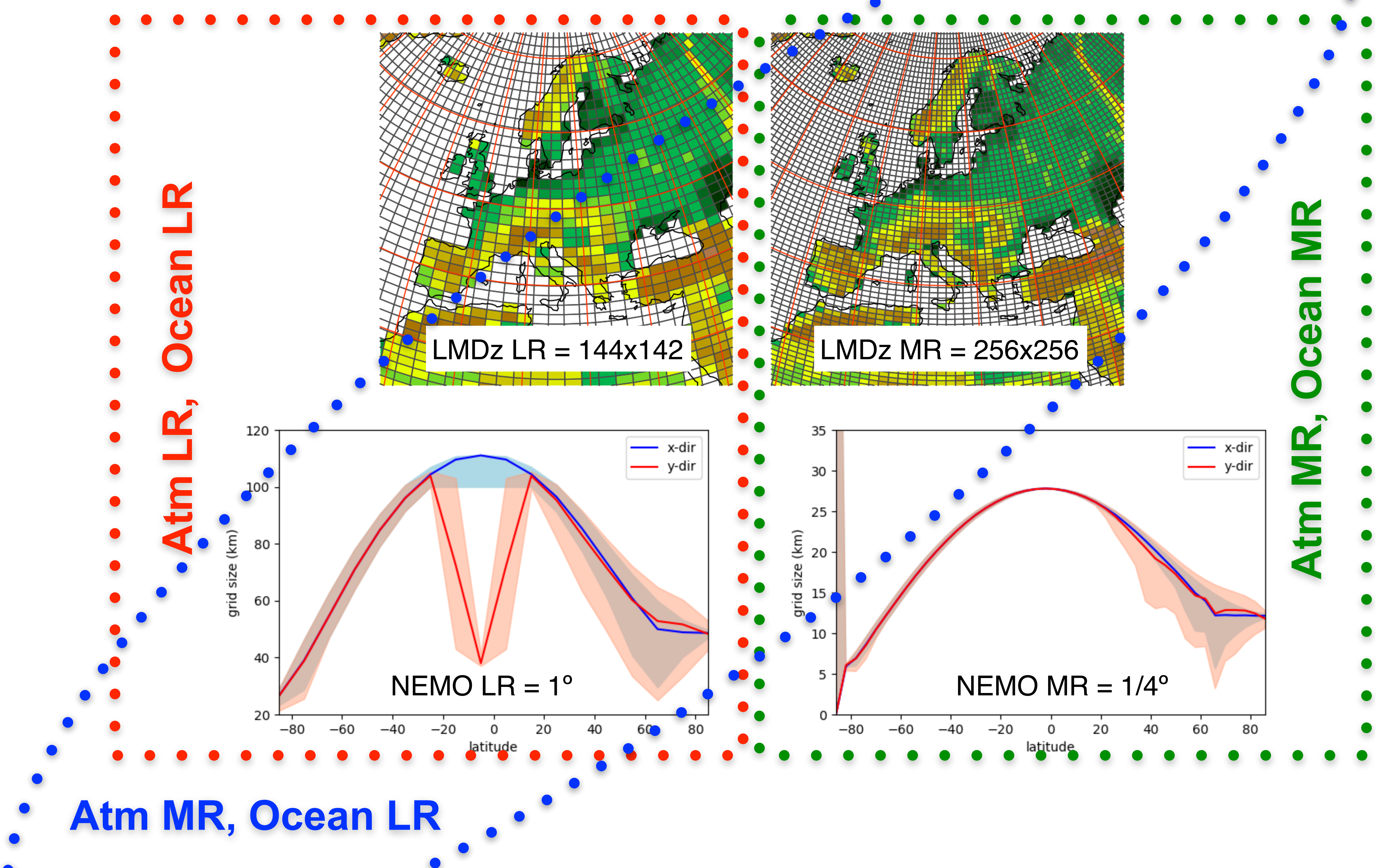
the **structural uncertainty**, related to each component : grid resolution, physics, numerical choices…

the **parametric uncertainty**, related to sub-grid-scale processes within each component and processes of interaction between components (hence non-scale aware parameters to be tuned) ;

the **intrinsic uncertainty** due to the chaotic nature of climate.

32 members in CMIP6 historical ensemble
5-11 members per ScenarioMIP
10 members per DAMIP
10 members per GMMIP
4 members per RFMIP

QUEST explored **structural uncertainty** in IPSL-CM6A-LR through new configurations with increased resolution in ocean and/or atmosphere components :



WP1. Physical tuning of ocean / sea-ice parameters of Atm LR,Ocean LR

blue ocean parameters (inter-comparing with UK GC3.1), Sea ice parameters (amax, LIM3 mono-category …)…

+ Impact of GrIS melting on oceanic circulation

+ Impact of persistent atmospheric conditions (NAO) on decadal variability

WP2. Automatic turning of atmospheric parameters

waves of automatic tuning, LMDz only then new tuning of LMDz, in coupled mode with **Atm MR,Ocean LR**

+ five new {pi,+4CO2} couples of **Atm LR,Ocean LR** simulations with new tuning to explore different ECS

WP3. Exploring Atm MR,Ocean MR

+ testing sensitivity to meso-scale parameterization (GM)

WP4. Production of CMIP6 DECK

with new tuning of **Atm LR,Ocean LR** (hopefully reduced ECS)

with **Atm MR,Ocean LR** , same physics and tuning as LR

with **Atm MR,Ocean LR** , new tuning

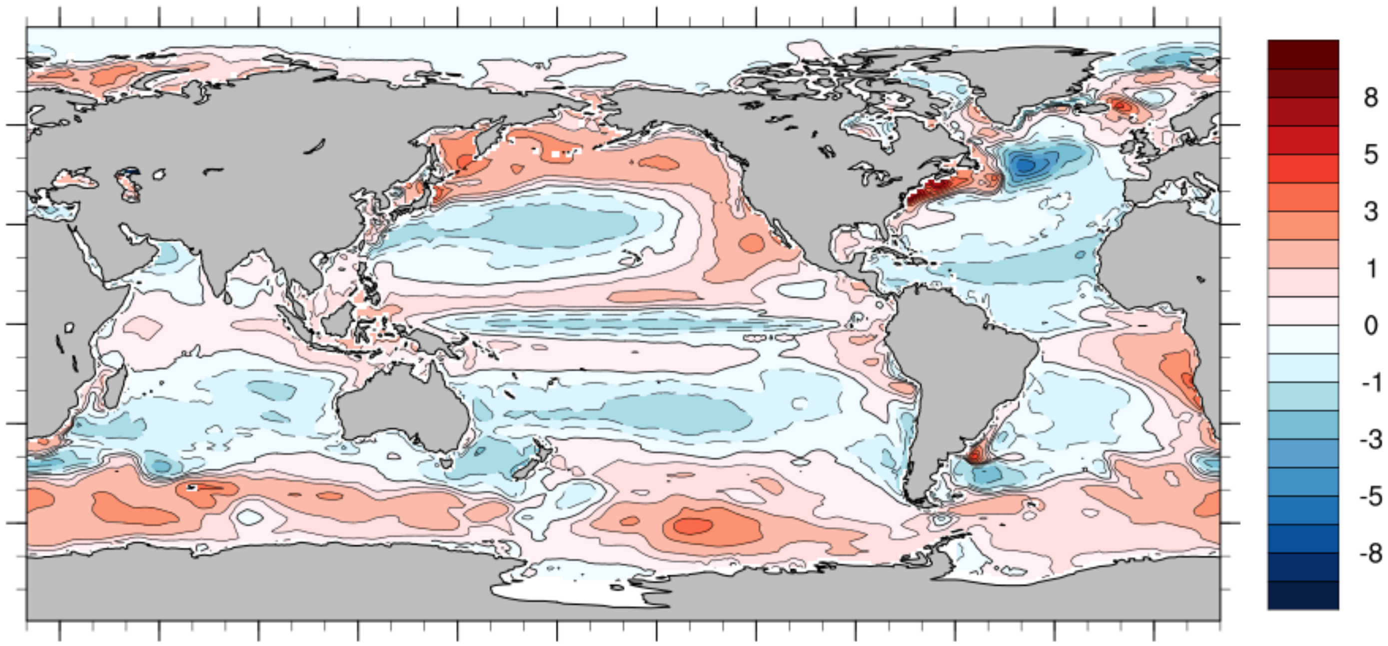
with **Atm MR,Ocean MR** , with GM parameterization

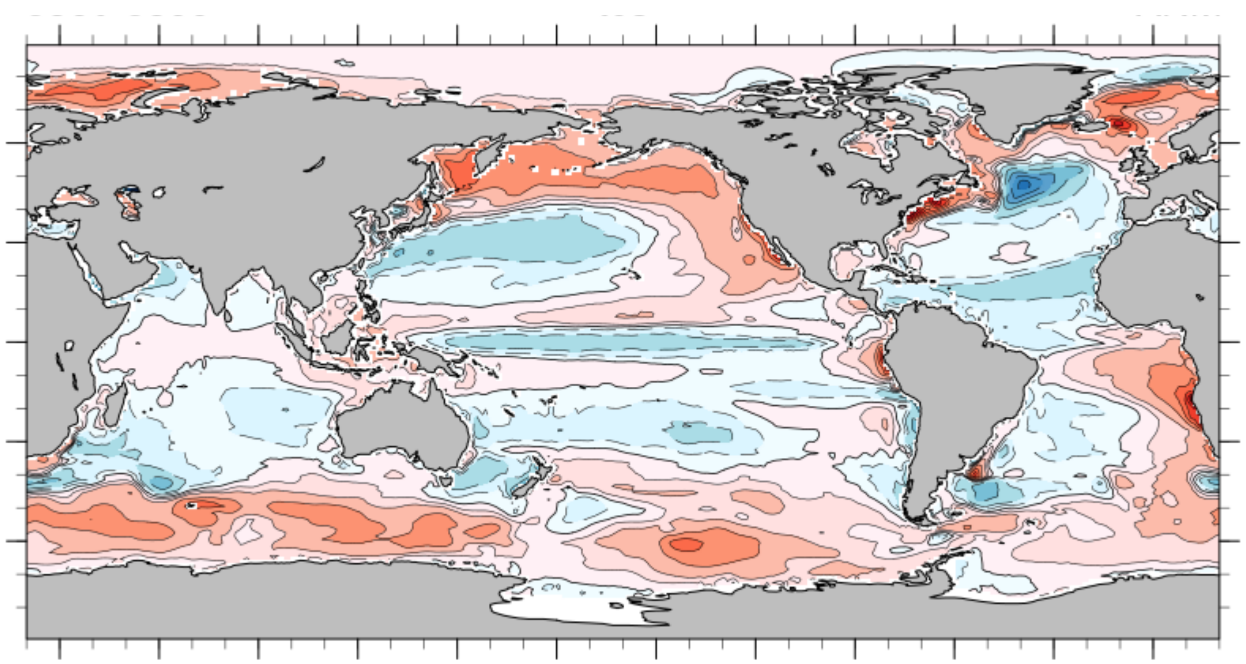
	on SKL (for development, no workflow)		on AMD (for production, with workflow)	
Atm LR, Ocean LR	960 cores	18,000 hCPU / 10 yr	2109 cores	20,000 hCPU / 10 yr
Atm MR, Ocean LR	1 800 cores	32,000 hCPU / 10 yr	2392 cores	41,000 hCPU / 10 yr
Atm MR, Ocean MR	4 720 cores	100,300 hCPU / 10 yr	(ongoing)	(ongoing)

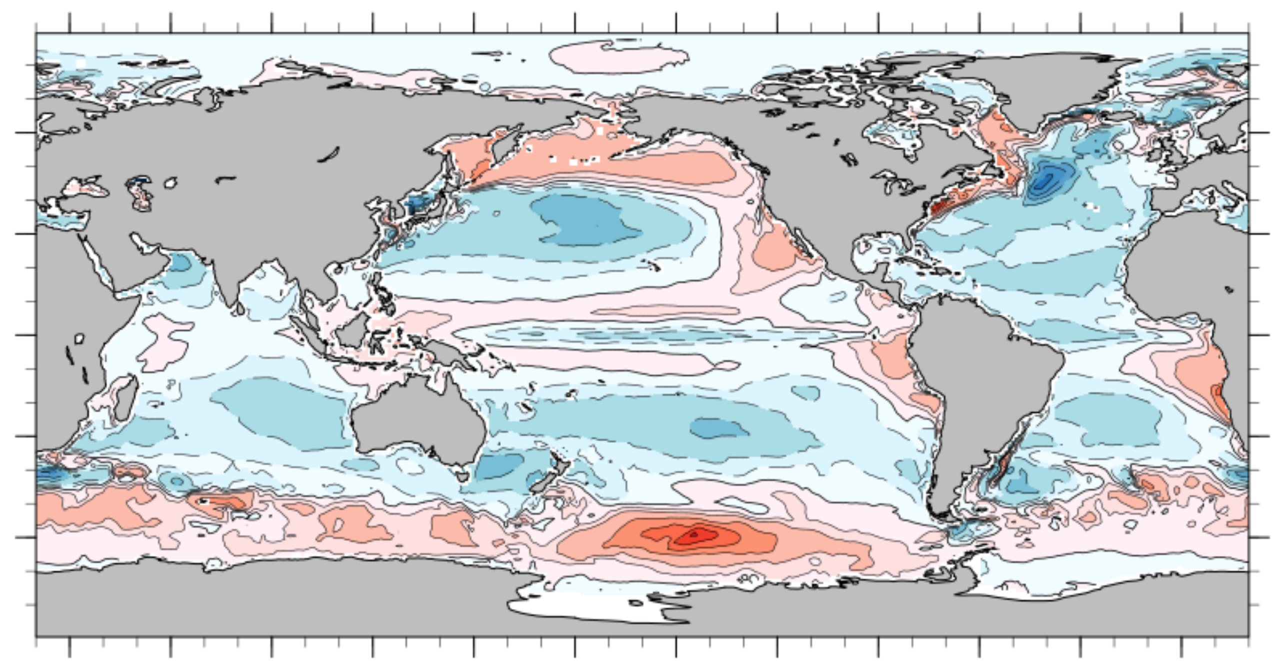
SST anomalies from WOA13

in **Atm LR,Ocean LR** , **Atm MR,Ocean LR** and **Atm MR,Ocean MR**

can you guess which model produced which figure ?







answer : will be given at QUEST meeting mid-january !

QUEST : Lessons learnt (1/2)

when running a new configuration, there are multiple variables to check, in mean state and anomalies, at all timescales (seasonal to centennial), which is extremely time consuming

➡ coordinate all possible diagnostics (intermonitoring, C-ESM-EP, atlas LMDz…) to save time in preliminary evaluation

transitioning from pdControl (ie today) to piControl (ie 1850's) conditions is not straightforward

➡ systematically verify simulations in piControl conditions, running couples of {pd,pi} in parallel for example

model development involves both technical and scientific actions, which must be coordinated

➡ associate engineers and scientists in frequent (1 / week) short meetings (<1h) with live reports

QUEST : Lessons learnt (2/2)

developing new configurations to quantify uncertainties, employing automatic tuning for the atmospheric component and speeding up tuning

➡ yes we can !

Thanks to Laurent, Nicolas, Eliott, Christian, Ionela, Arnaud, Jerome, Brady

+ all groupe plateforme

https://forge.ipsl.jussieu.fr/igcmg/wiki/IPSLCM6/QUEST