WGCM 24
report from the French groups:
IPSL and CNRM-CERFACS

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Many ongoing model developments:

- model tuning using emulators: atmosphere-only, ocean, coupled model (as a multi-timescaled problem)
- online bias correction
- model physics informed by LES
- planned transition to new atmospheric dynamical core
- more ESM: N cycle, couplings between C, N and aerosol cycles, water isotopes, river temperatures, coupling to ice sheets

\[ \frac{\partial X}{\partial t} = F(X) + G \]

where $G$ is the empirical bias correction

\[ G = -\frac{1}{\tau} (X - X_R)^{AC}. \]
Towards predicting river temperatures in IPSL-CM

Predicting river temperatures is beneficial for:
- coupling to the ocean model in fully coupled simulations
- the ORCHIDEE model when used offline
- future climate services

Average river temperature (in K) in 1980 over all hydrological transfer units in gridbox

Station: Ingolstadt, Upstream area=20001.0 [km^2]
Our vision of exascale computing is geared towards large ensembles of 20-50 km resol simulations:

- Use of LES up to ~0.1 km to develop parametrisations
- AI / ML to transfer information across scales
- Focus on model tuning & uncertainty characterisation
- 20-50 km resolution for the global Earth’s system model
- Simulations >> 100 yrs for uncertainties & slow components
- Consistent limited area modelling (*Funding limited and scattered*)

- Porting on GPU only starting and starting slowly
New developments in CNRM-CM’s components

- **Atmosphere (ARPEGE)**:
  - new developments in ARPEGE (version 7 in 2022)
  - investigations about the overestimated intensity of tropical cyclones in CNRM-CM6-HR (50 km resolution)

- **Land-surface (SURFEX)**:
  - vertical dynamics of soil carbon
  - biomass burning

- **Ocean**:
  - EDMF (convection) in NEMO 3.6

- **Machine Learning**:
  - numerical stability of parameterizations based on ML (toy models – Lorenz)
  - Successful emulation of GCM>RCM downscaling (ARPEGE 150 km>ALADIN 10 km)
Appetite for CMIP7

- Finish harvesting CMIP6
- Learn the lessons from CMIP6 before preparing CMIP7 (no need to prepare now)
- Wish for a more ‘frugal’ CMIP7 (simplified design)