# Transversal: Addressing future evolutions of software infrastructure

Enable the common codes to function with mixed HPC architectures (CPUs, GPUs, others …) and make code flexible by separating as much as possible software and hardware-dependent aspects. Proposed methods : invest in Atlas/DSL for LAM

Urgent topics (2020) : enable members to gather the necessary know how

- Decide on the approach (Atlas, DSL ?) to introduce flexibility in the 1D components, namely physical parameterizations and surface models
- Train people and start implementing Atlas, DSL ?
- Train people to Atlas, to MultIO

Second phase

- significant consortium contribution to defining a limited area version of a numerical environmental prediction “domain specific language”

Longer term

- implementation of Atlas
- development of alternative discretization schemes to LAM configurations

# Dynamics

Main goals :

1. Continue with improvements of the present dynamical core towards the hectometric scale
    - Work on ensuring model stability for steep slopes
    - Work on Vertical Finite Elements
    - Work on semi-Lagrangien

2. Invest in a long-term (~10 yr) evolution of an Atlas based dynamical core
    - Develop a LAM solution based on a finite-volume approach following the FVM developments of ECMWF
    - Finalize a gridpoint dynamics solver as a scientific testbed, as a backup solution and as an alternative to the spectral dynamics

# Physics parametrizations

Main goals :

1. Resolution increase to hm-scales:
    - Study validity of parametrizations at these scales (useful also for convergence)

2. Accelerate the work on radiation/clouds/aerosols interactions

3. Continue efforts to remove systematic model errors in multi-disciplinary task teams (also relevant for EPS, DA).

4. Engage in stronger collaboration with EPS teams to develop an EPS oriented physics

5. Explore usefulness of machine learning activities and possibly extend.

6. Convergence between CSCs:
    - Increase interoperability at level of exchanging parametrizations.
    - Make an inventory of scientific blocking points for convergence.
    - Define roadmap for interoperability by 2023.

7. Technical refactoring of the code:
    - Improve parametrization calls.
    - Code restructuring needed for 3D physics. 2+1D turbulence approach seems good first step.
    - Make an inventory of technical blocking points for convergence.

# Surface (model and DA)

Main goals

1. For Surface Model:

   - switch to SURFEX by all members, where some explore more advanced options (emphasis soil, snow, urban)

   - streamline the code for phasing and coupling with other parts of the NWP system

2. For Physiography:

   - continue to update physiographic databases as model resolution is increasing
   - assess the forecast impact of the new databases and perform the required tuning of surface modules

3. For Surface Data Assimilation:

   - assimilate satellite data and crowdsourced data,
   - work on the interoperability and modernization of the code for the spatialization and the adaptation to the OOPS framework
   - progressively move to a coupled surface-atmosphere data assimilation system,

# Ensemble forecasting

Main goal: A seamless, well-calibrated high-resolution ensemble prediction system from nowcasting to 2-3 days ahead

Create direct collaboration between EPS, PH, SU, DA staff!

1.Way forward for perturbations:

- Towards more physically based perturbations in a balanced manner
- Aim towards the same uncertainty estimate for EPS and DA.
- Aim to reduce spin-up through balanced physics and initial condition perturbations

2. Explore performance for extreme weather, NWC range, sub-km resolutions.

3. Calibration approach which pays special attention to extreme weather, enhances EPS for any grid, accounts for weather-type dependencies, and uses the latest statistical/machine learning methods.

4. Develop user-oriented approaches of common interest that facilitate the use of ensemble outputs, e.g. synthesis combination of ensemble members, time-junction of ensembles

5. Collaboration and working environment aspects enhanced through the work on the system.

# Data Assimilation

Main goals *(in italic, what falls in DA AL)*:

1. Efficient, accurate, maintainable algorithms
   - Implement OOPS: opportunity for convergence and permits component testing
   - Develop a DA algorithmic solution based on the ensemble variational approach
   - Designing DA tests
   - Optimize DA for nowcasting
   - *DA CSC's definition and testing*

2. Observations
   - Assess possibility for common obs preprocessing tool like SAPP
   - Liaison with Eumetnet and Eumetsat
   - *Continuous effort on high-resolution observations. Novelty is massive number of data from various sources (satellite, radar, aircraft, crowd-sourced data, ...) and their QC exploring machine-learning*

# Meteorological Quality Assurance

Aims:

1. Iterative consultation process (~1yr?) to collect requirements and assess what needs to be done to make HARP more attractive as common tool.

    Consider in this consultation methods/metrics, observations (which and why), maintainability (as cycle-independent as possible) and distribution. Statement on HARP as open source.

2. Development of common methods/metrics: focus on methods for spatial-temporal verification and high impact weather. This implies use of high resolution data and requires efficiency to handle large data amounts.

3. Verification of physical processes to aid model development, including the necessary observations and their quality

4. Consider synergy with DA team on observation format and quality control

5. Enhanced user-developer interaction: both R2O (didactic) and O2R (model weaknesses, cases).

# System

1. Develop a more distributed, efficient and continuous process for the integration and validation of new developments for the T-codes. Ensure that this process abides to evolving ECMWF and MF integration constraints.

    - Source code repository: shared, easily accessible; testing tool with some level of portability; wiki/ticketing facility

2. Collect information from Members to map their current scripting systems, their functionalities and their dependencies on IT elements that may constitute barriers to convergence on the scripting system

3. Assess Vortex potential as a basis for a future common system (MF will deliver the needed training)