Towards CALMO-MED
A Proposed Experimental Design

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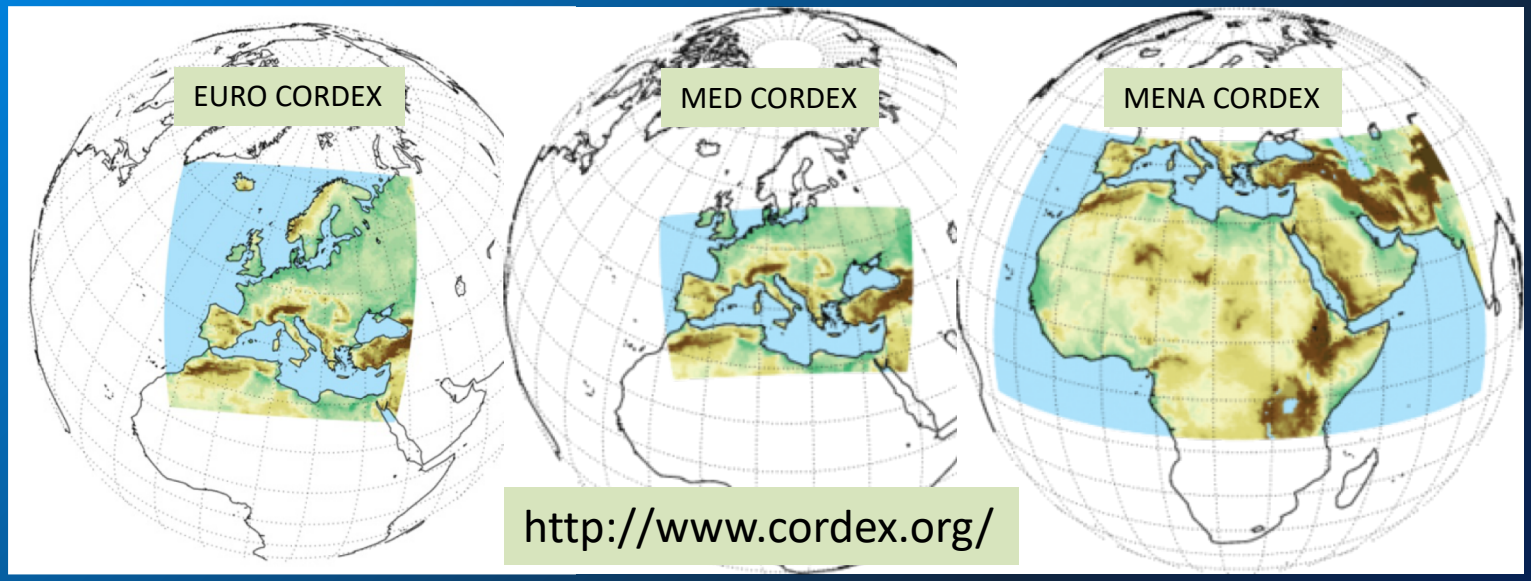
Motivation

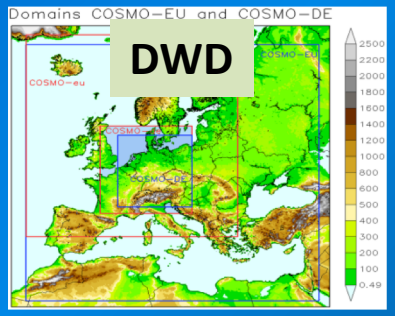
The Mediterranean domain stands, *in perpetuum*, as a formidable challenge for research as well as operational applications in meteorology and climatology.

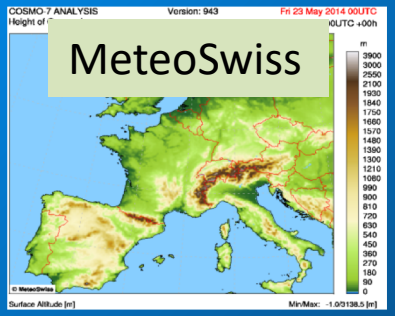
Arguably, this challenge lies in the *evenly distributed* land and sea areas accompanied by exceptional orographic and marine complexities as well as the crucial role of the Mediterranean in *all* tropical, subtropical and mid-latitude regions regarding Europe, Affrica and the Middle-East.

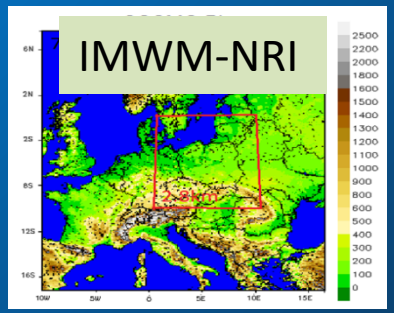


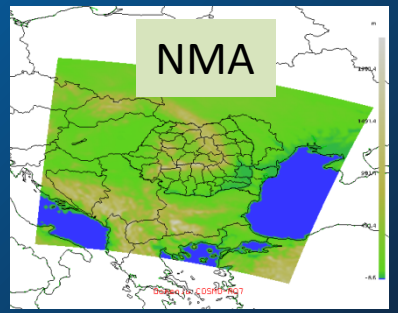
Motivation (cont.)

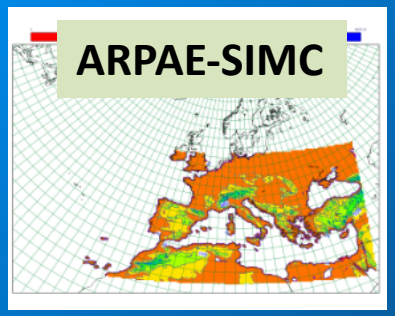
All COSMO Members include the Mediterranean, or part of it, in their operational model runs!!

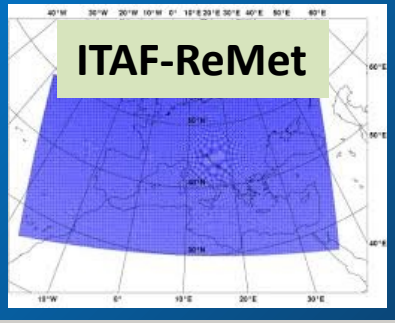


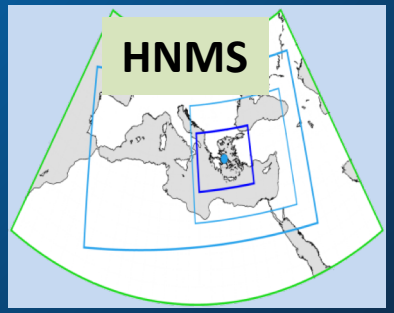


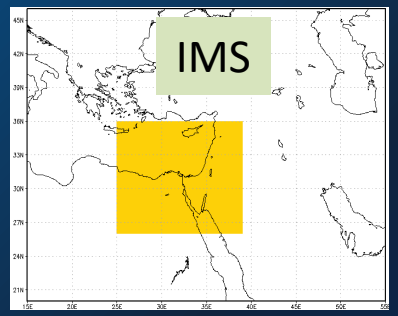


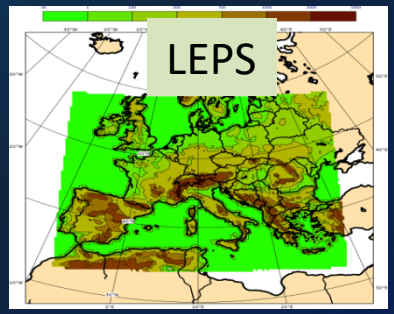








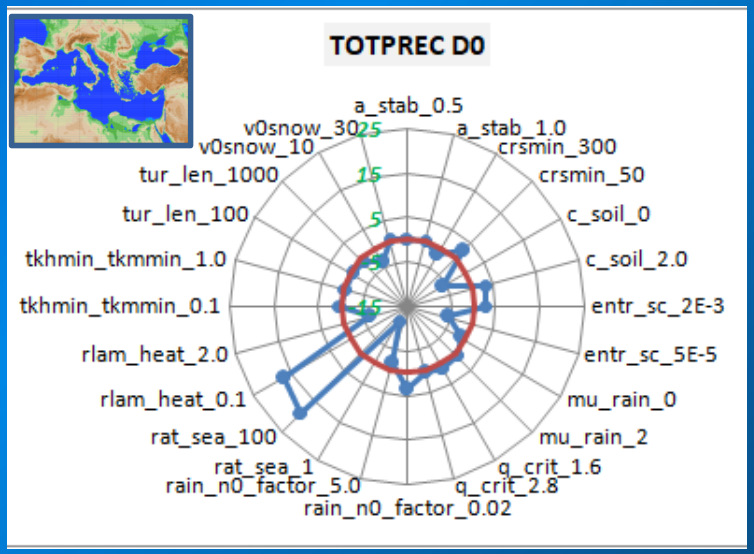




Motivation (cont.)

In sequence to CALMO philosophy , Metiterranean demonstrates strong *sensitivity* for several COSMO parameters.

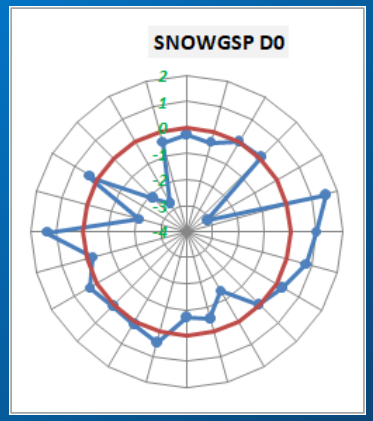
http://www.cosmo-model.org/content/consortium/generalMeetings/general2017/parallel/COSMO-GM2017_parallel_Euripides.pdf

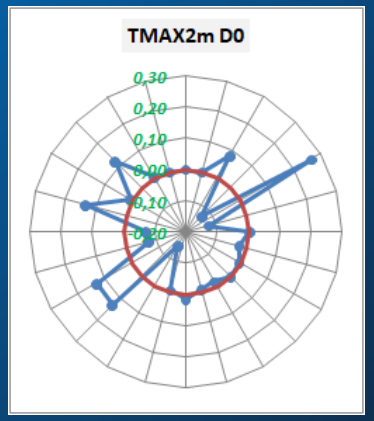


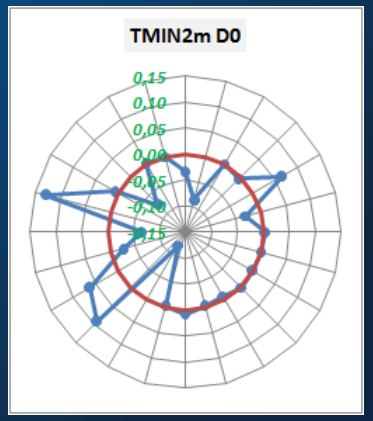
$$S_{<P>}(\%) = \frac{< P >_{TEST} - < P >_{DEFAULT}}{< P >_{DEFAULT}} \bullet 100$$

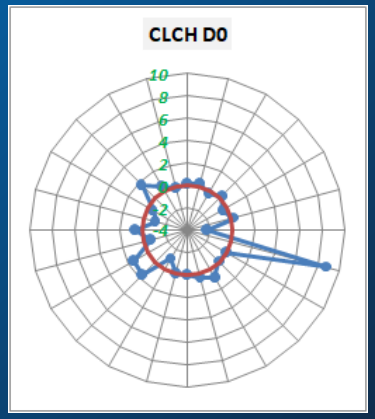
$< P >$ stands for $< SNOWGSP >$ *or* $< TOTPREC >$ *or* $< CLCL >$ *or* $< CLCM >$ *or* $< CLCH >$ *or* $< CLCT >$

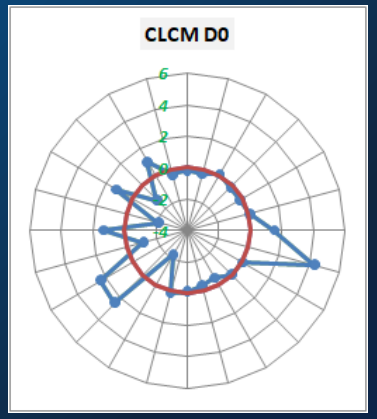
$$S_{\begin{bmatrix} TMIN2m \\ TMAX2m \end{bmatrix}} = \begin{bmatrix} < TMIN2m > \\ < TMAX2m > \end{bmatrix}_{TEST} - \begin{bmatrix} < TMIN2m > \\ < TMAX2m > \end{bmatrix}_{DEFAULT}$$

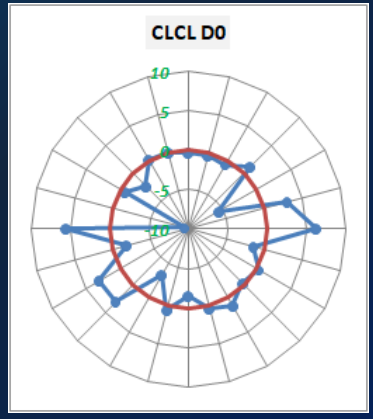












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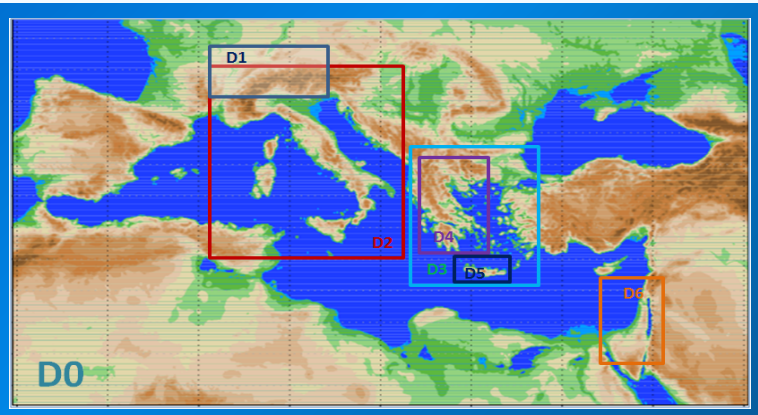

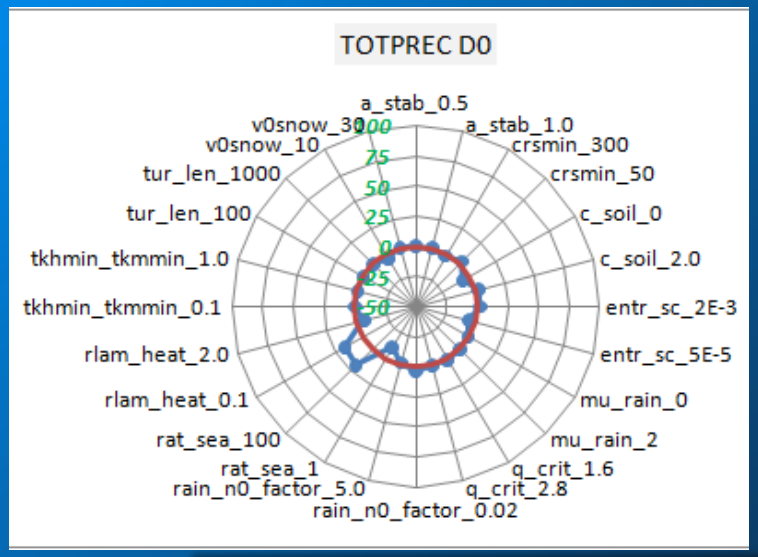

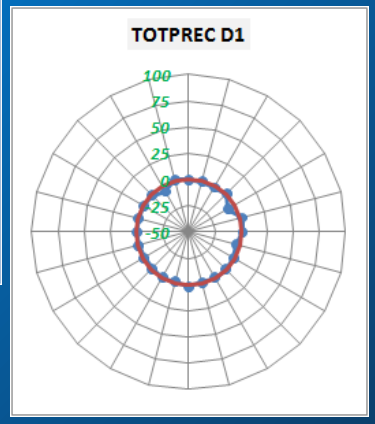

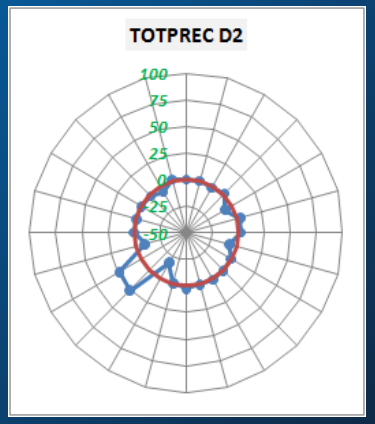

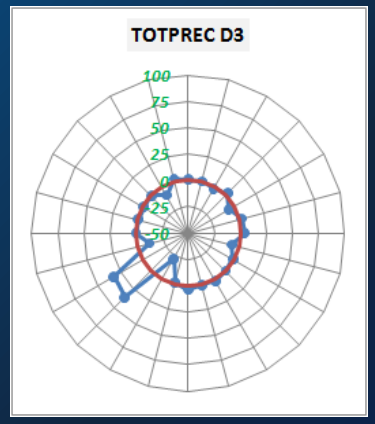

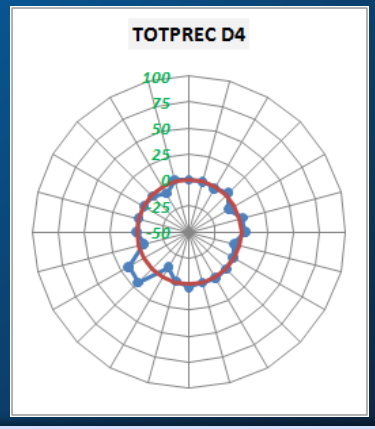

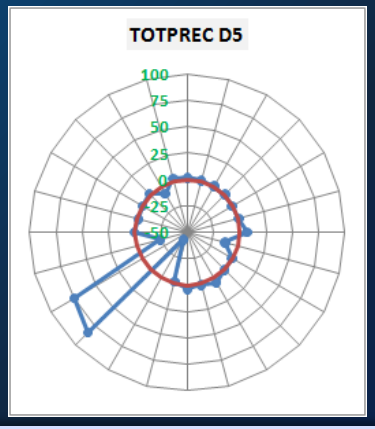

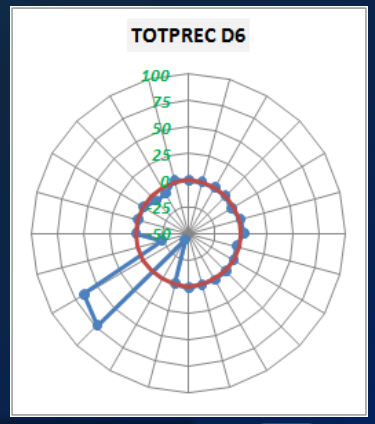

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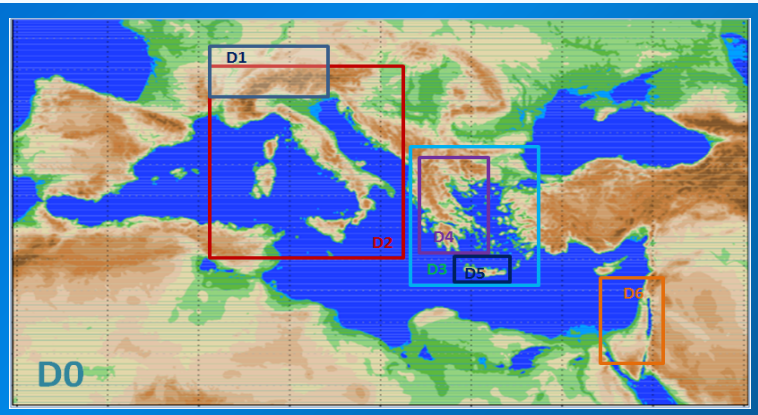
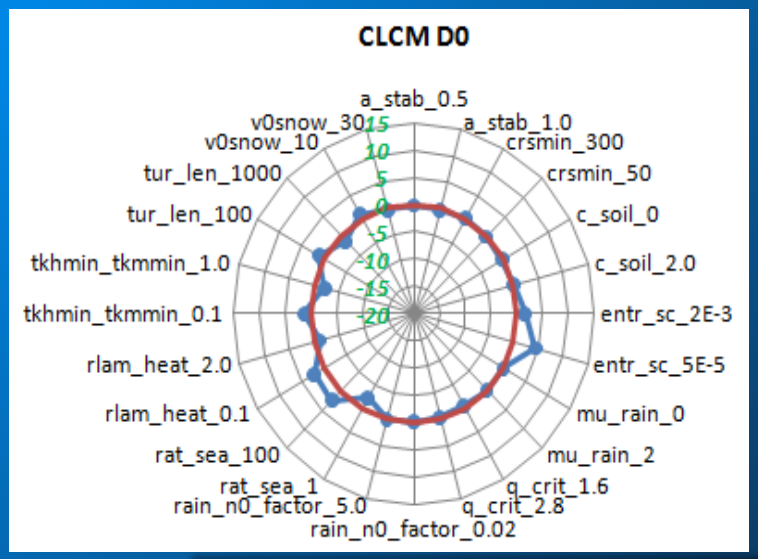
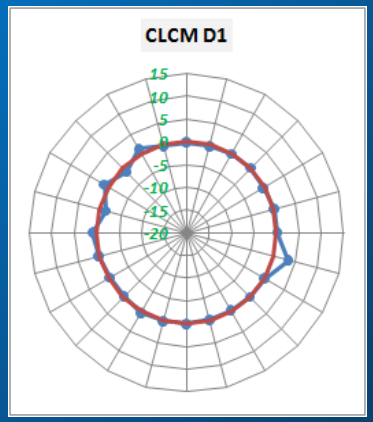
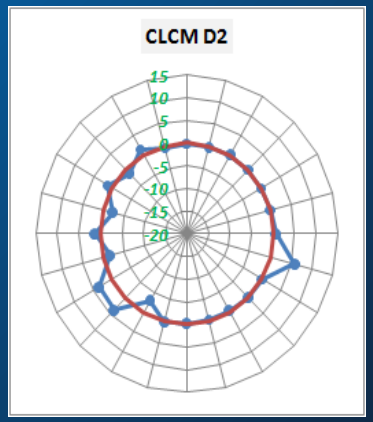
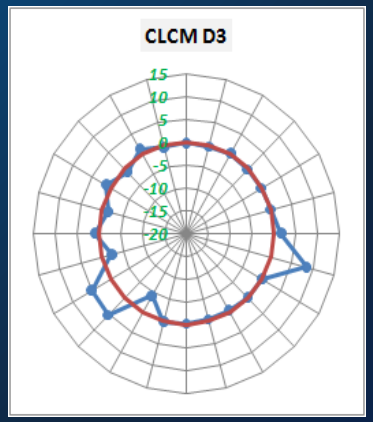
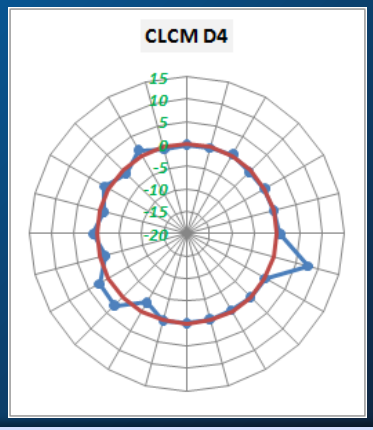


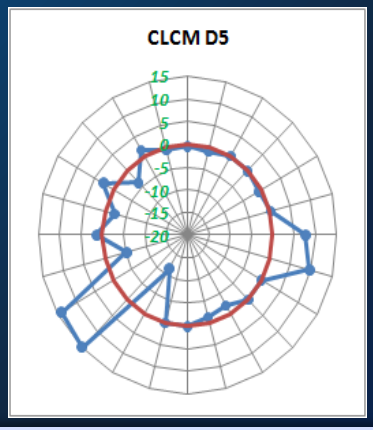


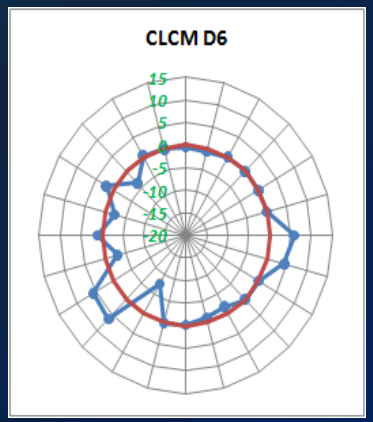


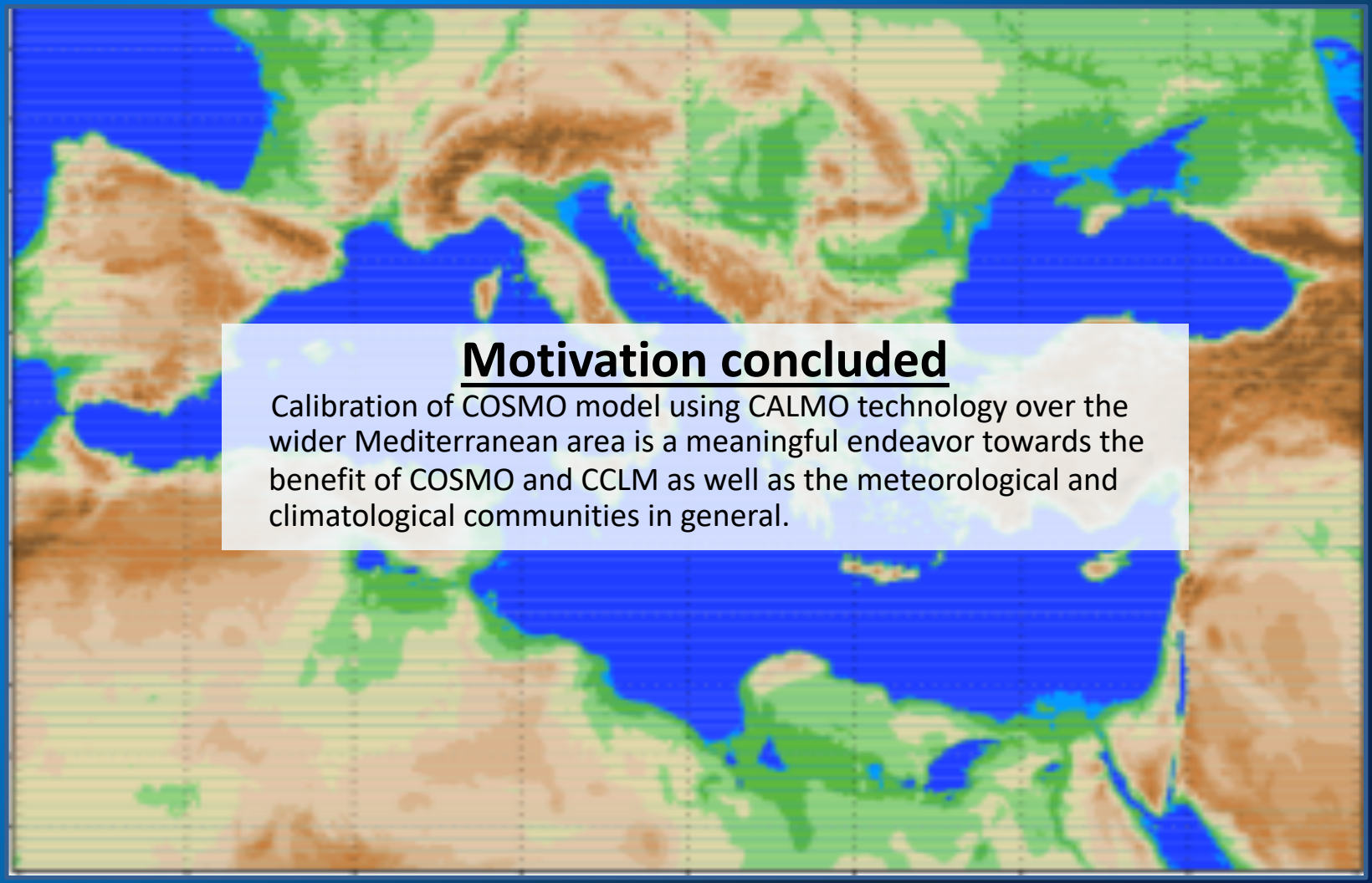












Motivation concluded

Calibration of COSMO model using CALMO technology over the wider Mediterranean area is a meaningful endeavor towards the benefit of COSMO and CCLM as well as the meteorological and climatological communities in general.

Experimental Design Scenario

- Computational Resources
- Computer System of Model runs
- Model version and set up
  - Parameter choice
  - Domain choice
- Output storage and data thining
- Observations
- Calibration
- Verification
- Communication (Visibility, Reports, Papers)
- Human resources

Computational Resources

Model runs:

Provision of billing units by HNMS at ECMWF Supercomputing System to run the model (not yet decided by HNMS mainly regarding the amount of b.u.).

Provision of billing units by ECMWF under a special project proposal.

…

Calibration:

Run the Metamodel at the University of Cotbus or at IMS.

- Computer System of Model runs

  Cray XC40 (ECMWF).

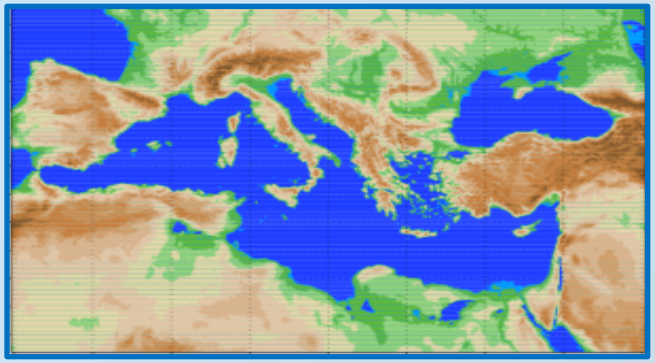
  ….

Model version and set up (one corner point)

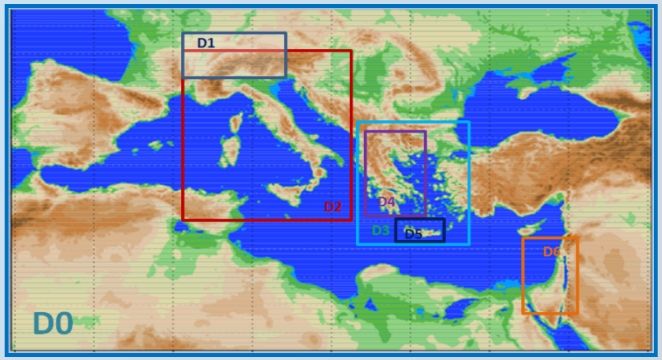
- Latest available COSMO version (ICON).
- Horizontal grid size: 0.0625^0 (A compromise between COSMO and CLM).
- 649x393 grid points (wider mediterranean area), 60 levels.
- Integration time-step: 40 secs.
- Integration period: 36 hs runs (last 24hs, 1 year) .
- Boundary conditions : 6hr IFS Analysis (~0.1^0)
  3hr IFS Forecast ((~0.1^0)
  1hr ERA5 Analysis (~0.25^0).
- Computational Cost: ~ $50 \cdot 10^6$ b.u. on Cray X C40 of ECMWF (pending decision by HNMS).

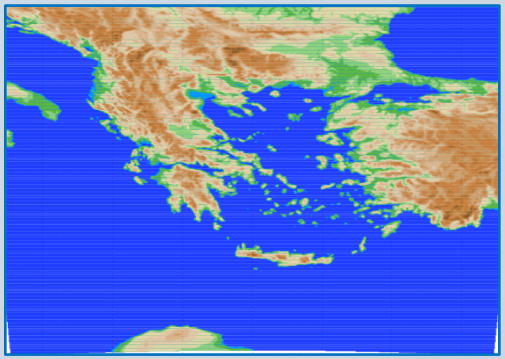
- Model version and set up
  - Parameter choice
    - Creation of a broad list of candidate parameters using, mainly heuristic, considerations in coordination with model experts, model users, project participants (parameter #: any) .
    - Create a first short list via a first round of *sensitivity* runs (parameter #: ~10)
    - Create a final list via second round of extensive sensitivity runs (parameter #: ~5)

- Model version and set up
  - Domain choice
    - Option 1: The wider Mediterranean area (0.0625^0 horizontal grid).



    - Option 2: Smaller domain/s (0.025^0 horizontal grid).





- Output storage and data thinning
  - Storage: ECFS
  - Data thinning:
    - Surface fields: T2m_max, T2m_min, Td, U10m V10m, TOTPREC, SNOWGSP, CLCL, CLCM, CLCH …
    - Upper air: QV, RELHUM, T, U, V

- Observations
  - Available meteorological stations (All or Central and Eastern Mediterranean)
  - Radiosonds
  - Regrid results and compare with ERA5

- Calibration (Metamodel Application)
  - Brandenburg_University_of_Technology_Cottbus-Senftenberg (BTU)
  - Israel Meteorological Service (IMS)
  - …

- Verification
  - Optimum parameter set for 1 year runs

- Communication (Visibility, Reports, Papers)
  - CALMO has introduced, successfully, COSMO model in the challenging modern area of model optimization in sequence to CCLM and its conclusion and possible extension should be considered a rewarding endeavor both for operational and research purposes.