



COSMO Science Plan – a review

COSMO General Meeting, 9 September 2014
Eretria

First edition of the COSMO Science Plan

The currently valid Science Plan (2010-2014) defines the goal of COSMO consortium as follows:

- „to develop a model-system for the short to very short range with a convective-scale resolution to be used for operational forecasting of mesoscale weather, especially high impact weather”
- adds the novel (2010!) strategic element: an ensemble prediction system for the convective scale
- that defines the base for current successful strategy of COSMO, which was also widely accepted and adapted elsewhere

Current developments

The work on new, updated Science Plan started at the beginning of 2013, with following milestones:

- May 2013: definition of the main goal and elements of strategy to achieve the goal, definition of the SP layout
- September 2013: definition of strategy outlines within all scientific areas
- March/April 2014: the complete draft text of the SP
- May/June 2014: results of external reviews, available
- end of July 2014: revised draft of the SP and of answers to the reviewers comments
- August 2014: STC comments to the revised document

New edition of the Science Plan (2015-2020): general information

The new SP document:

- main editors/authors: WGCs with contributions of many COSMO colleagues (thank you!), SPM
- the general layout (based on the first edition): introductory/summary chapters 1 to 4, scientific chapters 5 to 10; additional scientific chapter on cross-cutting issues
- additional analysis of available/required resources within scientific chapters for planning purposes
- volume: 143 pages (!) (the first edition: 80)

New edition of the Science Plan (2015-2020): content summary

The ‘steady’ definition of the COSMO goal :

- „the further development of an operational *and research* mesoscale model-system for the short to very short range and with very high convective-scale resolution, aimed especially at high-impact weather forecast and with ensemble prediction methodology at its core”

Also, the Plan:

- includes development of deterministic mode for work on model quality improvement (e.g. reduction of biases)
- defines targeted horizontal resolutions: 1 to 0.5 km for deterministic mode and 2 to 1 km for the ensemble one
- involves harmonization with ICON

New edition of the Science Plan (2015-2020): content summary

The strategic elements to achieve the goal are defined:

- an ensemble prediction system for the convective scale (quantifying the uncertainty, probabilistic forecasting)
- an ensemble-based data assimilation system for the convective scale (IC for ensemble and deterministic forecast; use of dense observations, fast updating)
- conservative robust dynamical core (high accuracy and stability; assessing ICON)
- atmospheric and surface physics for convective scale ('grey zone' targeted scale-adaptive atmospheric parameterisations; TERRA development for $O(1\text{km})$ horizontal scales)

New edition of the Science Plan (2015-2020): content summary

The strategic elements to achieve the goal (continuation):

- extension of the environmental prediction capabilities of the model (for modelling and assimilation capabilities)
- a verification and validation tool for the convective scale (validation at small scales, diagnosing and improving the model)
- use of massively parallel computer platforms and emerging new (heterogeneous) architectures (to adapt the model, provide for appropriate coding paradigm)
- intensified collaboration within and beyond COSMO, especially with academia.

External reviews of the Science Plan:

Comments from 8 reviewers were received (7, previously):

- François Bouttier (FB), Barbara Früh, Marion Mittermaier, Jean-François Mahfouf, Jeanette Onvlee (JO), Jacob Weismann Poulsen, Bernhard Vogel (BV), Nils Wedi (NW): thank you very much!
- most of scientific/organizational aspects of the SP were reviewed and challenged
- the overall COSMO goal was not questioned: „The plan clearly describes the COSMO goals and the planned activities to achieve those goals. In that sense, the document answers to its purpose quite successfully” (JO)
- with this, many tough questions were asked and a lot of helpful suggestions was offered (thanks!)

External reviews of the Science Plan: layout and consistency

There were important (and valid) comments on formal/ editorial aspects of the document:

- the text is generally too long
- some of the chapters go beyond the unified structure
- the information on FTEs resources is inconsistent between the chapters, so difficult to use for scientific planning (on the other hand this information implicitly defines the *actual* priorities of the consortium (BV))

External reviews of the Science Plan: content

- There were many important ‘high-level’ comments calling for careful consideration of the strategic elements of the Plan
- Here are a few examples:

A comment on ensemble prediction system:

In the resolution range which you are moving into, the processes get affected by grey zone effects to an as yet unknown amount (but probably not negligible). So your process descriptions will be deficient to that extent, hence biased (which is very bad for any ensemble). Also, the sensitivity of the predictability to the accuracy of the initial conditions becomes very very high at small scales.
(JO)

External reviews of the Science Plan: content

A comment on linking data assimilation and EPS strategy:

The link between KENDA and EPS is a strategic one. It is possible to generate IC perturbations without an ENKF (....). LETKF contains strong hypotheses that may be convenient for assimilation, but may be harder to justify for EPS, the relationship between DA and EPS performance is important to check. (FB)

External reviews of the Science Plan: content

A comment on data assimilation:

- You need to invest (...) a HELL OF A LOT OF effort in how to handle the high-resolution observations that you use: quality control, bias correction, thinning decisions all have huge effect on optimizing the impact of the data. This aspect is definitely underestimated in the COSMO plans... (JO)

External reviews of the Science Plan: content

A comment on COSMO/ICON harmonization and dynamical core strategy:

While the strategic wish is expressed to harmonise and unify COSMO and ICON, no detailed work plans or resources are allocated for the harmonisation process, the software engineering design, work flow design, and how the several disjoint dynamical core developments and ongoing efforts (e.g. discontinuous Galerkin, fast-waves solver, EULAG conservative dynamical core, ICON finite volume, different choices for conservative transport) may be combined. (NW)

External reviews of the Science Plan: content

Followed by:

Indeed, the role of COSMO ought to be (re-)defined as a modelling framework rather than the COSMO and ICON models in their own right as appears throughout the text. I firmly believe that developing and maintaining different choices during the 2015-2020 period is the right thing to do ... (NW)

Conclusion (?)

This presentation will not be conclusive :

- you will see/hear during the GM presentations and discussions how the reviewers' comments were already addressed
- but also you as COSMO scientists are still very much encouraged to take part in these discussions and further efforts to make the COSMO Science Plan better

There is a message from the Steering Committee which allows for a prolongation of the Science Plan preparation (by March 2015) to possibly deeply consider the reviewers' comments seen as „a chance to rething some of our thoughts we have gotten used to” (MCH comment)

Thank you to all Science Plan authors,
editors and reviewers for very hard and
valuable work and good luck in the
conclusive phase of the work!

Thank you for the attention
and fruitful General Meeting!