



Consortium for Small-Scale Modelling

Marco Arpagaus

Consortia presentations
33rd EWGLAM and 18th SRNWP meeting
10 October 2011, Tallinn

Outline

- **COSMO Organisation: News**
- COSMO Model: Changes since last meeting
- COSMO Operational Applications
- **COSMO Activities**
- **First results of pre-operational COSMO-DE-EPS**

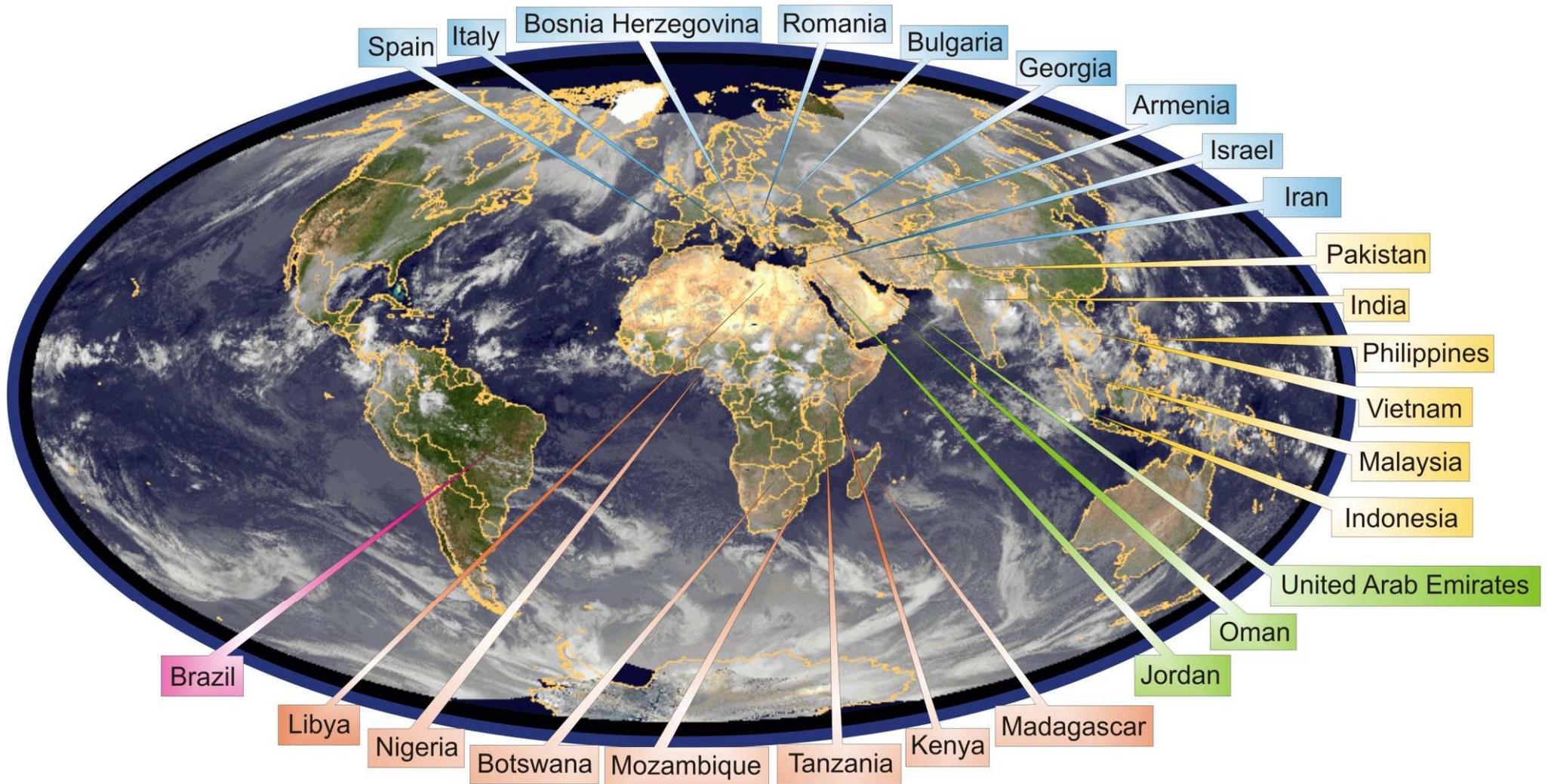
COSMO Organisation: News (1/2)

- **Philippe Steiner** is new chairman of the COSMO Steering Committee as of 1.1.2012.
- **Michał Ziemiański** is the new COSMO Scientific Project Manager as of 1.1.2012.
- **Flora Gofa** is the new COSMO WG 5 (Verification) Coordinator as of 1.1.2012.
- **Strengthening of role of Working Group Coordinators (0.5 FTEs) and Scientific Project Manager (0.75 FTEs)**
→ source code management, see below

COSMO Organisation: News (2/2)

- **Four COSMO licences sold** so far (United Arab Emirates, Brazil, Oman, Servei Meteorològic de Catalunya).
→ Licence fees earned are spent for workshops / short-term missions / conferences / travelling.
- **Free COSMO licence for low- and lower-middle-income economies** (up to \$3'975 GNI per capita) to allow migration from HRM to COSMO.

Current operational HRM users



COSMO Model: Changes since last meeting (1/2)

- Version 4.15
 - Correction of dry bias of Vaisalla RS92 radiosonde.
 - Option for 3rd order implicit vertical advection.
 - ...
- Version 4.17
 - Improvements for running idealized test cases.
 - ...
- Version 4.18
 - COSMO-ART interface for Runge-Kutta dynamical core.
 - Added (full) Strang-splitting for moisture advection.
 - ...

COSMO Model:

Changes since last meeting (2/2)

- Version 4.19
 - Changed horizontal advection to properly handle flow situations with confluent horizontal flows in neighbouring grid boxes. This avoids spurious and potentially detrimental heat sources, which eventually lead to grid point storms.
 - ...
- Version 4.20
 - Changed number of small time steps in the last Runge-Kutta step to get a more stable integration.
 - Interface to the OASIS coupler introduced.
 - ...

COSMO Operational Applications

→ www.cosmo-model.org/content/tasks/operational/default.htm

→ posters!

Deterministic:

- DWD: EU (7) and DE (2.8)
- MeteoSwiss: 7 (6.6) and 2 (2.2)
- USAM: ME (7) and IT (2.8)
- ARPA-SIMC: I7 (7) and I2 (2.8)
- HNMS: GR (7 and 2.8)
- IMGW: PL (7 and 2.8)
- NMA: RO (7 and 2.8)
- Roshydromet: (7 and 2.2)

COSMO Operational Applications

→ www.cosmo-model.org/content/tasks/operational/default.htm

→ **posters!**

Ensembles:

- DWD: *DE-EPS (2.8) pre-operational*
- COSMO ('shared service'): **LEPS (7)**

COSMO Activities: Source Code Management

Motivation:

Maintain the high quality of the source code with

- growing amount of software (COSMO, fieldextra, VERSUS, ...)
- growing community contributing to the development of the software (COSMO-ART, COSMO-CLM, licensees, ...)

Transparent source code management

- Technical requirements to ensure portability, documentation, support, and long-term maintenance
- COSMO Standards for Source Code Development

COSMO Activities: The COSMO Triumvirate

- Science Plan
 - Priority Projects, Priority Tasks, Work Package Lists
 - COSMO Standards for Source Code Development
- clear scientific strategy
- clear rules and procedures
- common COSMO aims and goals, and common COSMO responsibility

COSMO Activities

ET on data assimilation

- **Km-Scale Ensemble-Based Data Assimilation (KENDA)**

PL: Christoph Schraff ([christoph.schraff \[at\] dwd.de](mailto:christoph.schraff@dwd.de))

→ talk by Christoph Schraff

COSMO Activities

ET on dynamics

- **Conservative dynamical core (CDC)**
PL: Michael Baldauf ([michael.baldauf \[at\] dwd.de](mailto:michael.baldauf@dwd.de))

→ talk by Michael Baldauf

COSMO Activities

ET on physics

- **Towards Unified Turbulence-Shallow Convection Scheme (UTCS)**

PL: Dmitrii Mironov (dmitrii.mironov [at] dwd.de)

→ talk by Federico Grazzini on upper air physics developments within COSMO

COSMO Activities

ET on surface

- **Consolidation of Lower Boundary Conditions (COLOBOC)**

PL: Jean-Marie Bettems ([jean-marie.bettems \[at\] meteoswiss.ch](mailto:jean-marie.bettems@meteoswiss.ch))

→ talk (final report) presented by Christoph Schraff

COSMO Activities

ET on verification

- **Verification System Unified Survey (VERSUS 2)**
PL: Adriano Raspanti (a.raspanti [at] meteoam.it)

→ no talk this year

→ a few slides will be presented by Clive Wilson

COSMO Activities

ET on predictability and EPS

- **COSMO-DE-EPS**

PL: Susanne Theis (susanne.theis [at] dwd.de)

→ pre-operational since 9 Dec 2010
for first results see below

- **Consolidation of COSMO Ensemble (CONSENS)**

PL: Chiara Marsigli (cmarsigli [at] arpa.emr.it)

→ talk (final report) by Chiara Marsigli

COSMO Activities

ET on link with application

→ talk by Detlev Majewski on COSMO-ART

- ***New:* Consolidation of Operations and Research results for the Sochi Olympic Games (CORSO)**

PL: Gdaly Rivin (gdaly.rivin [at] mecom.ru) and Inna Rozinkina (inna [at] mecom.ru)

→ Russian poster

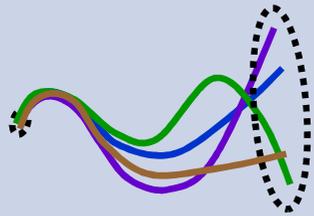
COSMO Activities

ET on system aspects

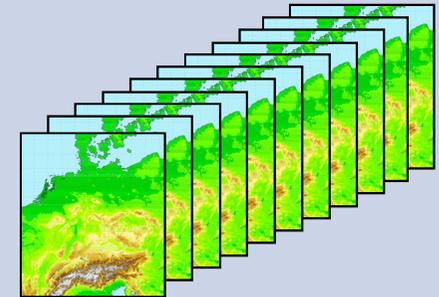
- **Performance on Massively Parallel Architectures (POMPA)**

PL: Oliver Fuhrer (oliver.fuhrer [at] meteoswiss.ch)

→ talk by Ulrich Schättler



COSMO-DE-EPS



Susanne Theis

Christoph Gebhardt, Zied Ben Bouallègue, Michael Buchhold



Setup of COSMO-DE-EPS

COSMO-DE-EPS status

→ **pre-operational phase has started:**

Dec 9th, 2010

→ **pre-operational setup:**

→ 20 members

→ grid size: 2.8 km

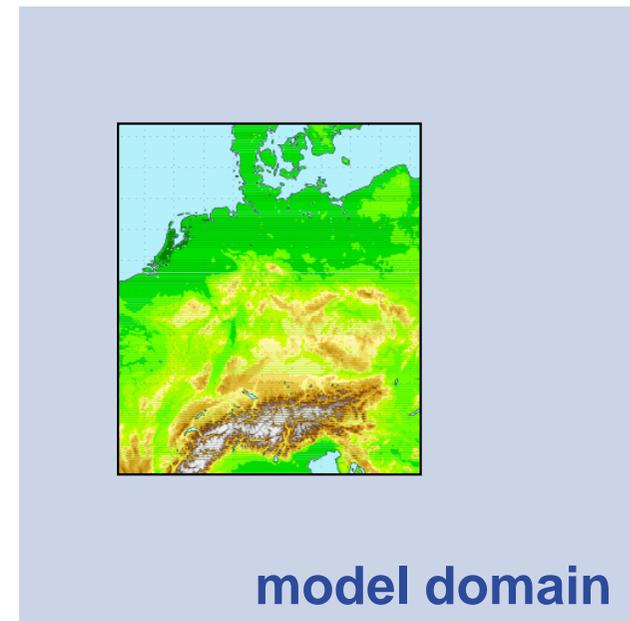
convection-permitting

→ lead time: 0-21 hours,

8 starts per day (00, 03, 06,... UTC)

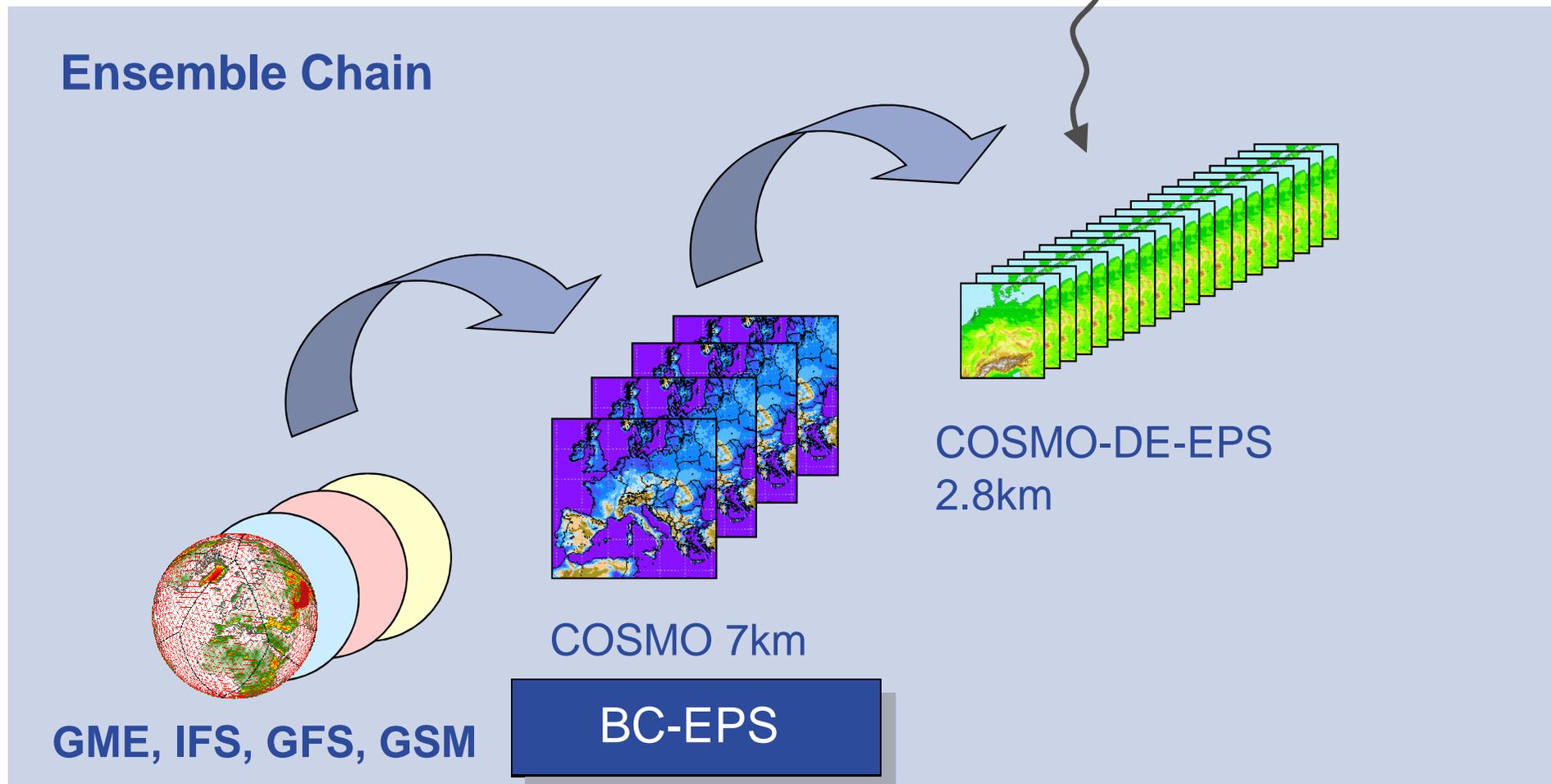
→ variations in

physics, initial conditions, lateral boundaries

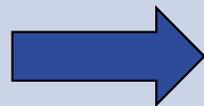


Generation of Ensemble Members

- plus variations of
- initial conditions
- model physics



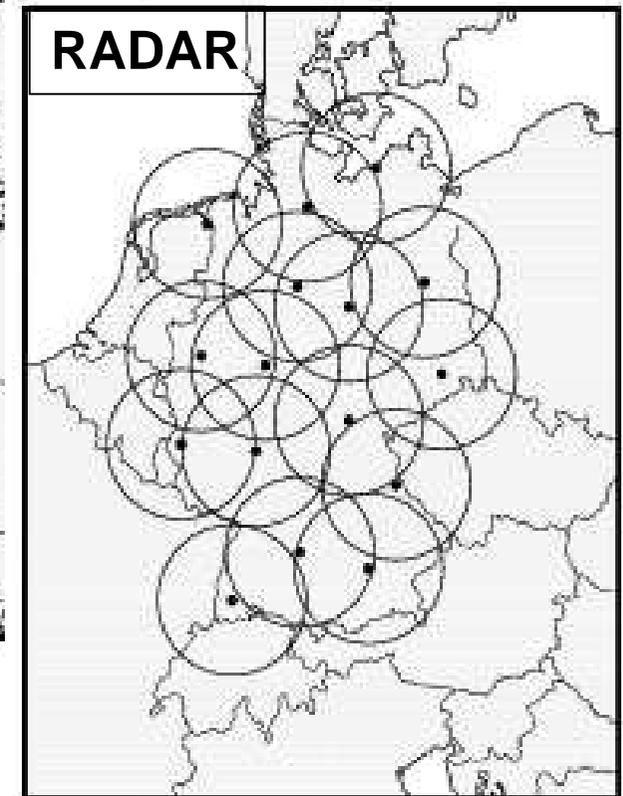
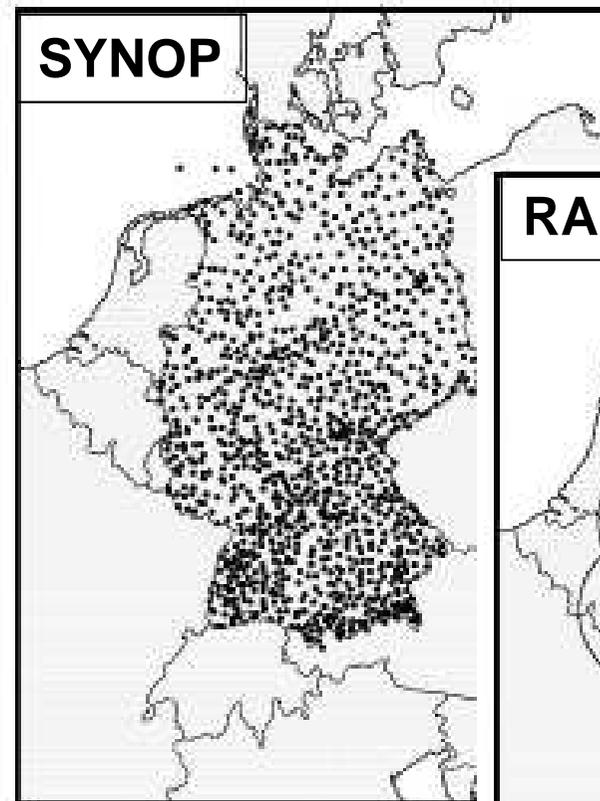
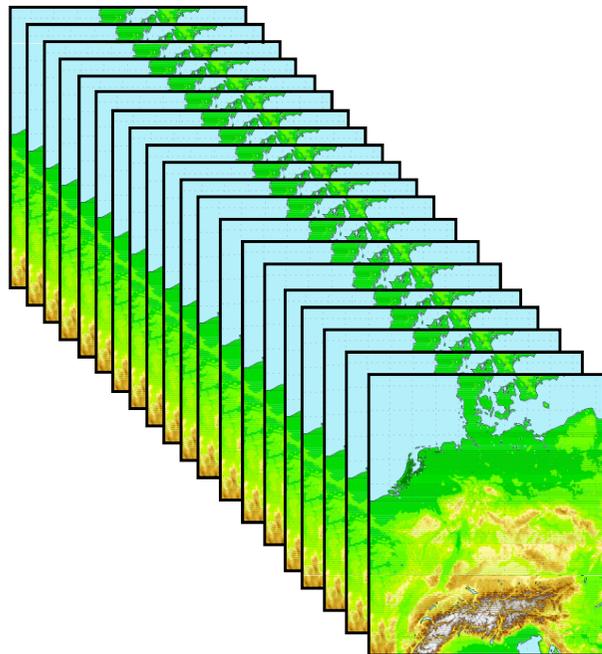
First Results of Pre-operational Phase



- verification

- forecasters' feedback

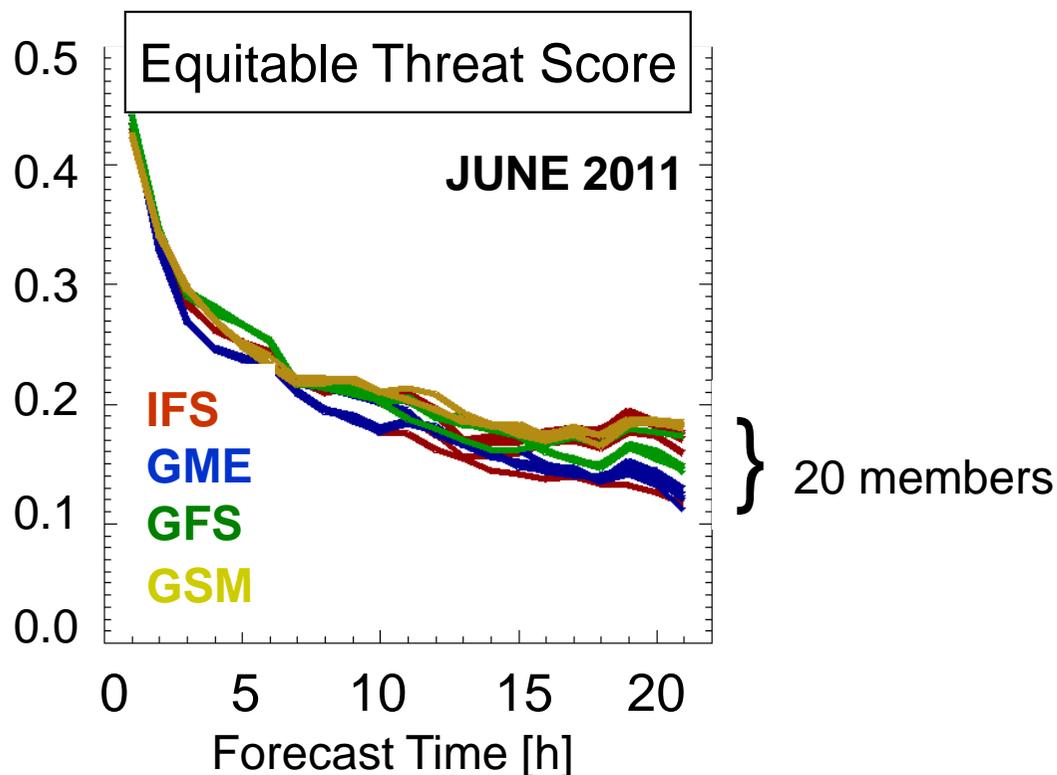
Verification Method



- Ensemble Members
- Probabilities of Precipitation



DETERMINISTIC SCORES for Individual Members



Do the ensemble members
have different long-term statistics?

(multi-model / multi-configuration)

Are there many cases with
the same „best member“
or „wettest member“?

- look at **Equitable Threat Score**

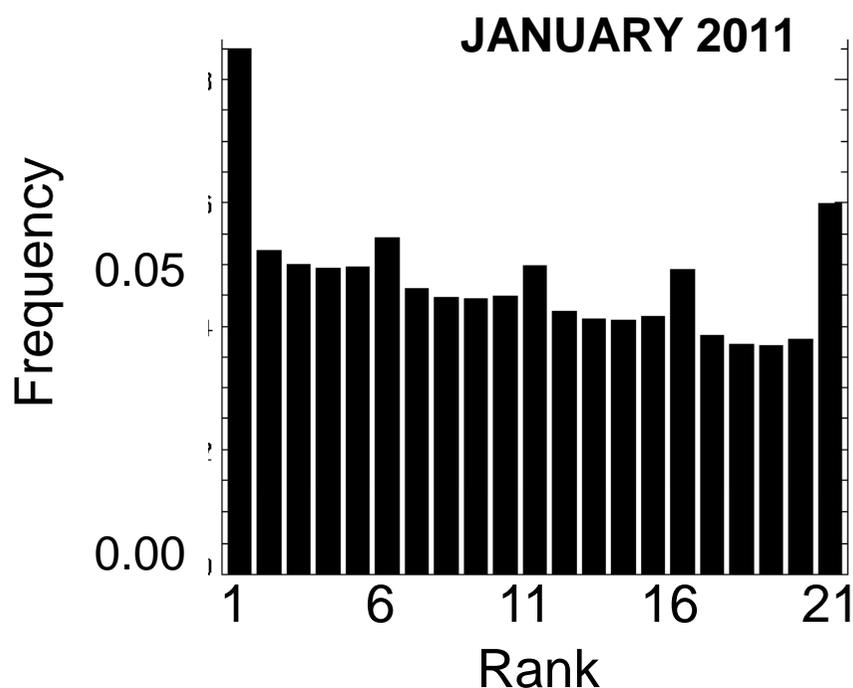
- look at **Frequency Bias Index**
(results similar, not shown)

Only small differences in long-term statistics

→ Members may be treated as equally probable



RANK HISTOGRAM

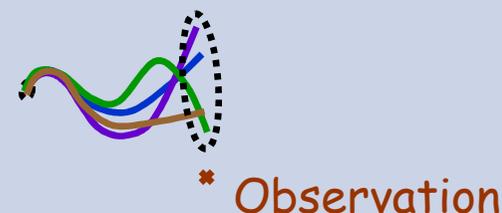


observation...

- ...treated as „Ensemble Member“
- ...ranked according to prec amount at each grid point and forecast hour

How frequent is each rank?

If ensemble underdispersive
→ U-shaped rank histogram

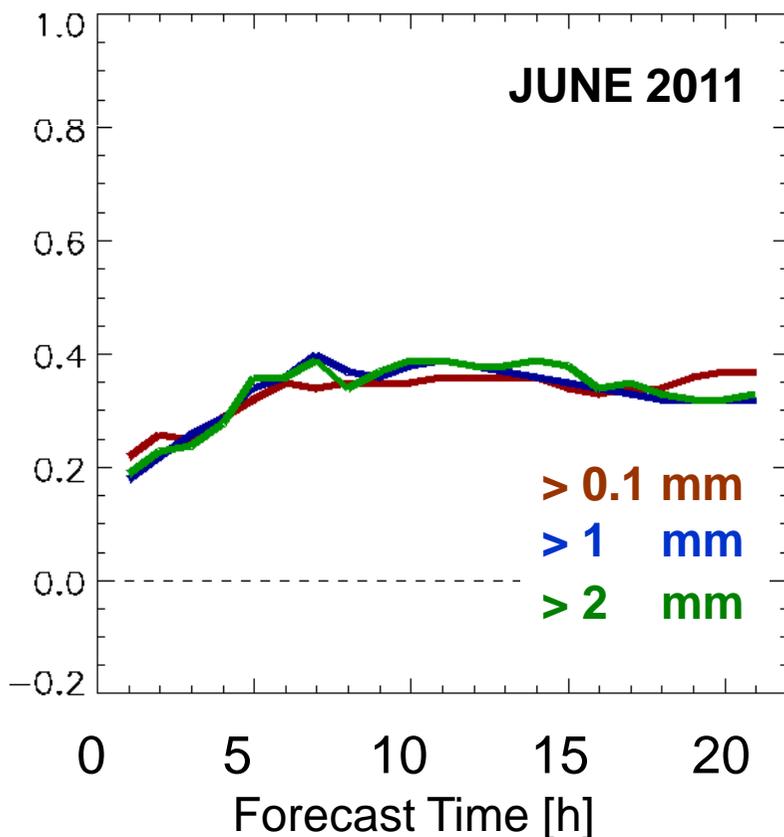


a) Underdispersiveness relatively small

b) Four groups → Many cases with large influence by global models



BRIER SKILL SCORE



How good are the probabilities derived from the ensemble?

compared to the deterministic COSMO-DE (always forecasting 0% or 100%)

Look at **Brier Skill Score** (no skill: zero)

- for different precipitation thresholds (colors) (probabilities of exceeding a certain threshold)
- for different forecast lead times (x-axis)

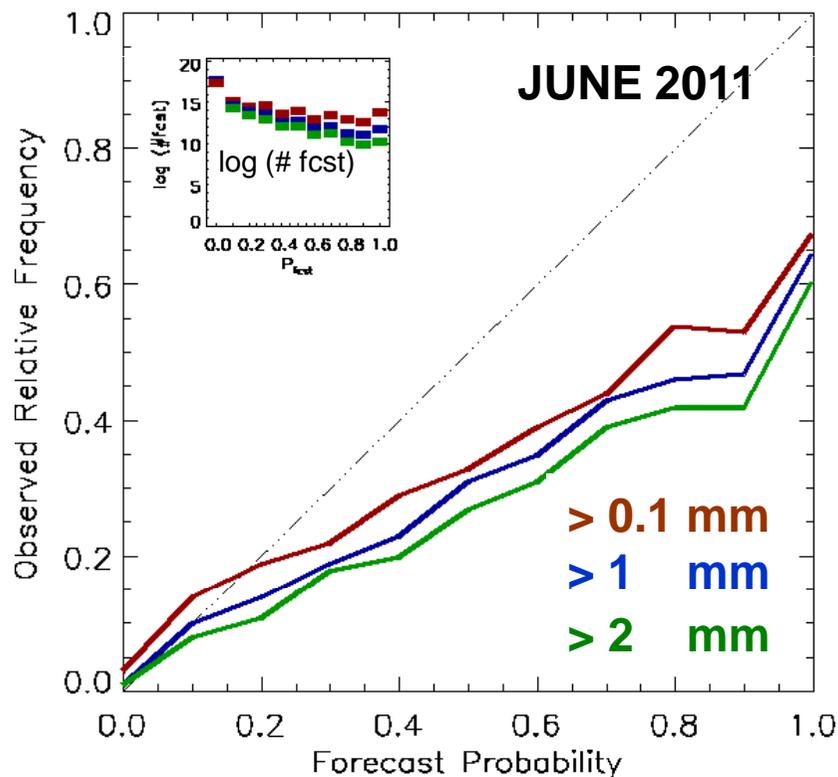
Always positive! → Ensemble provides additional value to COSMO-DE

Additional value grows with lead time (less deterministic predictability)





RELIABILITY DIAGRAM



Are the probabilities already well calibrated?

(without extra calibration)

If we isolate all cases with a forecast probability of -say- 75-85%

...

did the event occur in 80% of these cases?

diagonal line: optimal

- for different prec thresholds (colors)
(probs of exceeding a threshold)

Reliability diagram shows some bias and underdispersiveness

Lines are not flat → additional calibration has good potential



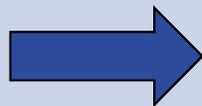
Other Variables

- T_2M and VMAX have been verified
- ensemble spread is far too small
- nevertheless, ensemble provides additional value to COSMO-DE

**COSMO-DE ensemble prediction system
has been developed with focus on precipitation**

First Results of Pre-operational Phase

- verification



- forecasters' feedback

Forecasters' Feedback

→ available products:

see figure

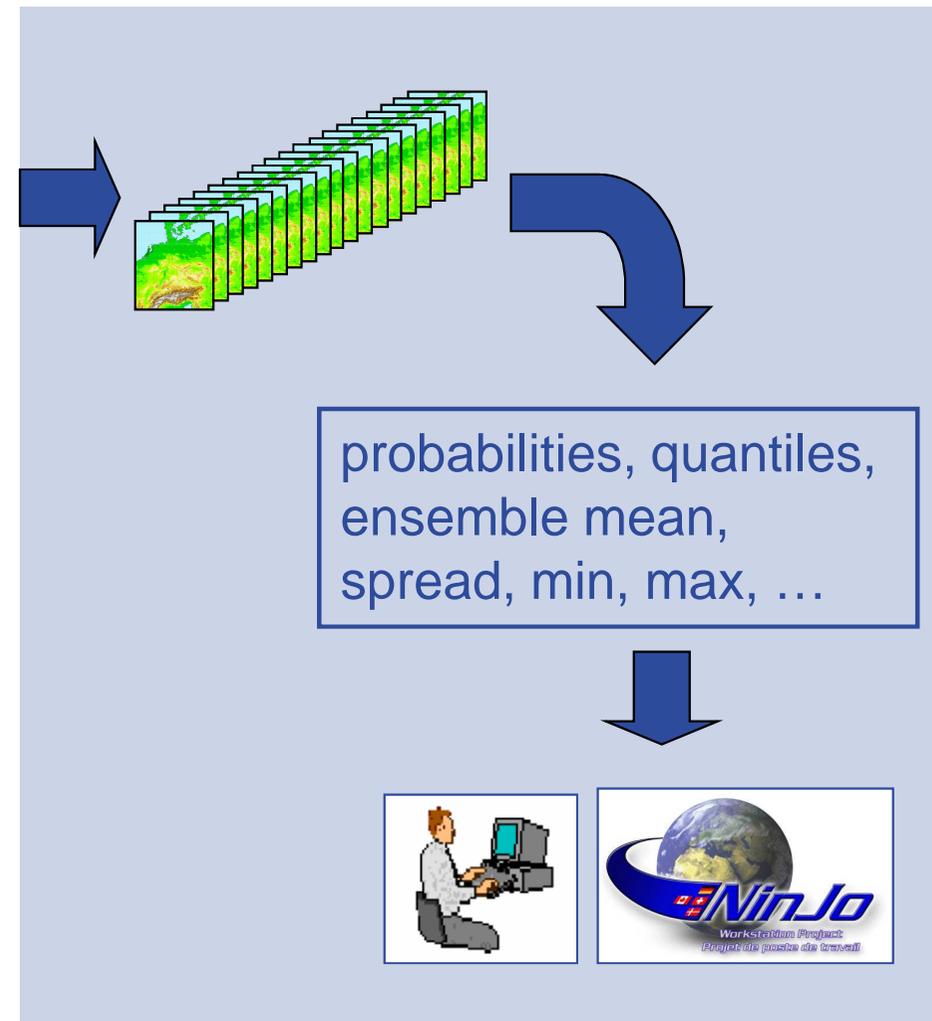
precipitation, snow, wind gusts, T_{2m}

*probability thresholds: **warning criteria***

→ all products on grid-scale (2.8km)

→ in addition: precipitation probabilities for larger areas (10x10 grid boxes)

„probability that the precipitation event will occur anywhere within the region“



Forecasters' Feedback



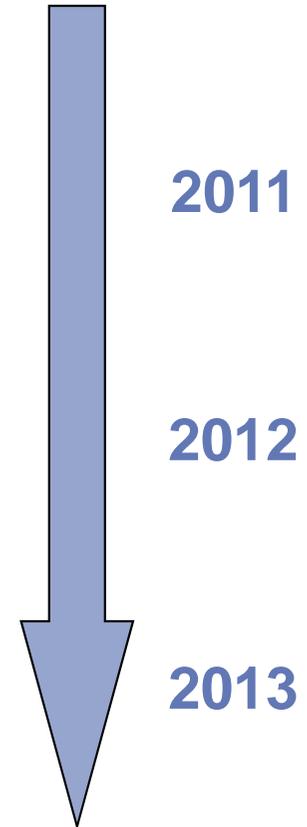
- what they **prefer to use**:
 - 90%-quantile of precipitation
 - precipitation probabilities for an area (10x10 grid points)
- what they **appreciate**:
 - early signals for heavy precipitation
 - indication that deterministic run may be wrong
- what they **criticize**:
 - jumpiness between subsequent runs
 - lack of spread in T_2M and VMAX
- what they are **learning**:
 - dealing with low probabilities (10% probability for extreme weather
→ issue a warning?)



COSMO-DE-EPS plans

COSMO-DE-EPS plans (2011-2014)

- under consideration:
including past production cycles in product generation
- **upgrade to 40 members, redesign**
- **reach operational status** —————
- statistical postprocessing
- initial conditions by LETKF
- lateral boundary conditions by ICON EPS





Thank you.