Mesoscale numerical weather forecasts with COSMO in support of T-PARC 2008
University of Karlsruhe and Forschungszentrum Karlsruhe (KIT) / DWD

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Summary:
In support of summer T-PARC 2008 mesoscale weather forecasts were computed at the Steinbuch Centre for Computing (SCC), Karlsruhe Institute of Technology (KIT)[1], and in collaboration with the Deutscher Wetterdienst (DWD, German National Weather Service) using the COSMO model.
The forecast operation started on **1 Aug 2008** and lasted **until 20 Oct 2008**. The model was run on 2 domains, which were chosen every day according to the actual weather conditions. Within those domains a one-way nesting with 0.0625° resolution on the coarser and 0.025° resolution on the finer grid was performed. The model was initialised at 00UTC and 12UTC using the global forecasts from the GME (DWD) and IFS (ECMWF) models.
The forecasts were computed for forecast hours **0-72h** after initial time. **Hourly model output** is available. More than 700 model runs were performed in total. **All model products are stored in the T-PARC data archive.** The **raw model data** in GRIB1 format **will be archived at SCC for 5 years** (expiration date December 2013).
Selected model products for the first domain are available through the T-PARC field catalogue. Alternately all model products are available through a web-based navigator tool at
http://imk-tyne.physik.uni-karlsruhe.de/~christian/PhD/tparc/t-parc.html.

Model domains:
Two domains were specified and labelled "flex1" and "invest"

1.) **`flex1`**: Domain defined daily around our region of primary interest (Tropical cyclone, ET-System midlatitude jet, TC Outflow).
2.) **`invest`**: Domain defined daily around our region of secondary interest (2nd TC, cyclogenesis, decaying TC)

The domains were specified in the Western Pacific region within a box covering **LON 100°E to 150°W and LAT 15°S to 60°N**. **51 Levels** were used in the vertical accounting for a higher troposphere in the tropics.

Typically the horizontal extent of a domain was **20°LON x 20°LAT at 0.0625° (7km)**. Optionally a one way nesting was performed in that domain on a grid covering typically **15°LON x 15°LAT at 0.025° (2.8km)**.
The 7km runs use a Tiedtke-scheme for parametrising moist convection. The 2.8km explicitly resolve moist convection (no parametrisation). The domains were adapted/enlarged according to actual conditions.

Driving global models:
The initial and boundary conditions were obtained from the operational global forecasts of the **GME** (DWD) **and** the **IFS** (ECMWF) models. Forecast base times were **00 UTC and 12 UTC**.
The 7km GME and IFS and the 2.8km IFS based runs were directly nested in the global forecast. The 2.8km GME based run was nested in the 7km COSMO-GME run.

time shifted runs:
Optionally additional runs were started with IFS forecasts +48h or +72h as initial time. These are labelled `manual48` or `manual72` as domain name. Furthermore, an additional GME run was performed labelled `manual`.

Model run naming convention:
Depending on the date, base time, coarse grid model, domain, and horizontal resolution the model runs were labelled: `<yyyymmdd>_<bt><gm><domain>_<res>`

where `yyyymmdd` stands for 4 digit year, 2 digit month and 2 digit day,
`bt` stands for the base time either *`00`* or *`12`*
`gm` stands for the driving global model either *`IFS`* or *`GME`*

1 The Karlsruhe Institute of Technology represents the merger of the Universität Karlsruhe with the Forschungszentrum Karlsruhe.

`domain` stands for the domain either *`flex1,invest,manual, manual48 or manual72`*
`res` stands for the horizontal resolution, either *`0.0625`* or *`0.025`*

Data access:
A table summarising all available runs, actual forecast hours and the systems which were modelled is available from the authors.
A choice of model plot products for domain "flex1" are available through the T-PARC field catalogue (http://catalog.eol.ucar.edu/tparc_2008/index.html). All model plot products are available at http://imk-tyne.physik.uni-karlsruhe.de/~christian/PhD/tparc/t-parc.html. The plot naming convention follows the EOL guidance for the field catalogue described at http://catalog.eol.ucar.edu/tparc_2008/other/users_guide.html#name and should be self-explanatory. Instructions on how to use the plotting tool at the imk-tyne webpage is in the Appendix. If necessary, raw data can be provided by the authors. Please contact us in this case indicating the desired run using the identifier `temp<no>/<yyyymmdd>_<bt><gm><domain>_<res>.tar.gz`.

Model products (plots):
The plot naming convention follows the EOL guidance for the field catalogue:

`model.name2.yyyymmddhhmm.HHH_name3.png`

`name2` – is `COSMO_<gm><domain>_<reskm>`
`gm` stands for the driving global model either *`IFS`* or *`GME`*
`domain` stands for the domain either *`flex1,invest,manual, manual48 or manual72`*
`reskm` stands for the horizontal resolution either *7_0_km* or *2_8_km.*
`yyyymmddhhmm` – the forecast basedate and time
`HHH` - the forecast hour of the product.
`name3` - the product name (see table 1)

Table 1: model products

2mT-10m-wind	2m temperature (shaded, with a 2K contour interval), 10m wind barb
cloudhigh	high-level cloud cover (p<400hPa) in steps of 10% and pressure at mean sea level (contours with a 4hPa contour interval)
cloudlow	low-level cloud cover (p>800hPa) in steps of 10% and pressure at mean sea level (contours with a 4hPa contour interval)
cloudmid	mid-level cloud cover (400hPa<p<800hPa) in steps of 10% and pressure at mean sea level (contours with a 4hPa contour interval)
cloudtotal	total cloud cover in steps of 10% and pressure at mean sea level, (contours with a 4hPa contour interval)
omega700hPa	vertical velocity in Pa s^{-1} (shaded) at 700 hPa
precip3hourly	precipitation in the last 3 forecast hours in kg m^{-2}
preciphourly	precipitation in the last forecast hour in kg m^{-2}
preciptot	accumulated precipitation in kg m^{-2} and pressure at mean sea level (contours with a 4hPa contour interval)
PVat315K	Potential Vorticity in PVU and wind barb on theta=315K (this plot is available 3 hourly)
Qheatlatent-sfc	latent heat flux at the surface in W m^{-2}
Qheatsens-sfc	sensible heat flux at the surface in W m^{-2}
Qlwrad-sfc	net long wave radiation at the surface in W m^{-2}
Qswrad-sfc	net short wave radiation at the surface in W m^{-2}
qv_wind_1000hPa	specific humidity in g kg^{-1} (shaded with a 1 g kg^{-1} contour interval) and wind barb at 1000 hPa
qv_wind_700hPa	specific humidity in g kg^{-1} (shaded with a 1 g kg^{-1} contour interval) and wind barb at 700 hPa
SST-pmsl-1000-500FI	surface temperature (shaded with a 2 K contour interval), pressure at mean sea level (black contours with a 4hPa contour interval), and thickness 1000-500hPa (grey dashed contours with a 4 gpdm contour interval)
temperature_<p>hPa	temperature in K at p=150 [200,250,300,400,500,600,700,850,950] hPa (shaded with different intervals)

totalwater	vertical integrated water column (humidity, cloud water and cloud ice) in kg m^{-2}
wind_10m_maxvelocity	maximum wind speed at 10m (shaded with a 5 knots interval) and streamlines at 10m
wind200hPa-relvort700hPa-pmsl	relative vorticity at 700 hPa (shaded with a $2 \cdot 10^{-5}$ s^{-1} contour interval), pressure at mean sea level (grey contours with a 2 hPa contour interval) and wind barbs at 200hPa
windfield_10m_pmsl	wind speed at 10m (shaded with a 2 m s^{-1} contour interval), wind vectors at 10m, and pressure mean sea level (2 hPa contour interval)
windfield_10m	wind speed at 10m (shaded with a 5kn contour interval) and wind vectors at 10m
windfield_<p>hPa	wind speed at p=150 [200,250,300,400,500,600,700,850,950] hPa (shaded with a 5kn contour interval) and wind vectors at p
wind-relvort-FI-1000hPa	relative vorticity at 1000 hPa (shaded with a $2 \cdot 10^{-5}$ s^{-1} contour interval), pressure at mean sea level (grey contours with a 2 hPa contour interval) and wind vectors at 1000hPa
wind-relvort-FI-200hPa	relative vorticity at 200 hPa (shaded with a $2 \cdot 10^{-5}$ s^{-1} contour interval), geopotential at 200 hPa(grey contours with a 2 gpdm contour interval) and wind vectors at 200hPa
wind-relvort-FI-500hPa	relative vorticity at 500 hPa (shaded with a $2 \cdot 10^{-5}$ s^{-1} contour interval), geopotential at 500 hPa(grey contours with a 2 gpdm contour interval) and wind vectors at 500hPa
wind-relvort-FI-850hPa	relative vorticity at 850 hPa (shaded with a $2 \cdot 10^{-5}$ s^{-1} contour interval), geopotential at 850 hPa(grey contours with a 2 gpdm contour interval) and wind vectors at 850hPa
wind-temp-FI-850hPa	temperature at 850 hPa (shaded with a 2 K contour interval), geopotential at 850 hPa(grey contours with a 2 gpdm contour interval) and wind barbs at 850hPa

Raw data:
For archiving purposes each of the possible runs was numbered (<no>) (see appendix table 3). The raw data is archived at `temp<no>/<yyyymmdd>_<bt><gm><domain>_<res>.tar.gz .`
The raw data can be retrieved until December 2013 for scientific purposes. Please contact us defining the run according to the naming convention. (Either *date* plus *temp<no>* or the full name `temp<no>/<yyyymmdd>_<bt><gm><domain>_<res>.tar.gz` .) Raw data format is GRIB1.

pressure level data: (1000hPa to 25hPa with a 25hPa interval)

FI	(profile) geopotential [(m**2)/(s**2)]
OMEGA	(profile) vertical velocity [Pa/s]
QC	(profile) specific cloud water content, grid scale [kg/kg]
QI	(profile) specific cloud ice content, grid scale [kg/kg]
QV	(profile) specific humidity [kg/kg]
T	(profile) temperature [K]
TKE	(profile) turbulent kinetic energy [(m/s)**2]
U	(profile) u-component (zonal) of wind [m/s]
V	(profile) v-component (meridional) of wind [m/s]

model level data: (one level data except cloud coverage)

CLC	hybrid layer cloud cover, grid scale + convective [1]
ALBRAD	surface albedo [%]
ALHFLS	surface latent heat flux [W/(m**2)]
ASHFLS	surface sensible heat flux [W/(m**2)]
ASOBS	surface net short-wave radiation (surface) [W/(m**2)]
ASOBT	top of atmos net short-wave radiation (top of atmosphere) [W/(m**2)]
ATHBS	surface net long-wave radiation (surface) [W/(m**2)]
ATHBT	top of atmos net long-wave radiation (top of atmosphere) [W/(m**2)]
CLCH	surface high cloud cover [%]
CLCL	surface low cloud cover [%]
CLCM	surface medium cloud cover [%]
CLCT	surface total cloud cover [%]
HBASCON	cloud base cloud base, convective clouds (above msl) [m]
HTOPCON	cloud top cloud top, convective clouds (above msl) [m]
PMSL	mean-sea level pressure reduced to MSL [Pa]
PS	surface pressure [Pa]

QVS	surface specific humidity [kg/kg]
T2m	2 m above ground temperature [K]
TD2m	2 m above ground dew-point temperature [K]
TMAX2m	2 m above ground maximum temperature [K]
TMIN2m	2 m above ground minimum temperature [K]
TOTPREC	surface total precipitation [kg/(m**2)]
TWATER	surface vert. integral of humidity, cloud water (and ice) [kg/(m**2)]
TS	0 cm underground soil temperature [K]
U10m	10 m above ground u-component (zonal) of wind [m/s]
V10m	10 m above ground v-component (meridional) of wind [m/s]
VMAX10M	10 m above ground maximum wind velocity [m/s]

Schedule:

The model was run at the Steinbuch Centre for Computing (SCC Karlsruhe http://www.rz.uni-karlsruhe.de/ssck/3429.php). The following table shows the approximate schedule of the forecast operation.

Table 2: Schedule of COSMO-T-PARC Forecasts

UTC	res	0 1 2	3	4 5	6	7 8	9 10 11	12 13 14	15	16 17	18	19 20	21 22 23	0+1D 1+1D 2+1D
data available				00GME			00IFS			12GME			12IFS	
fcst start/stop	7			00GMEflex1						12GMEflex1				
	7			00GMEinvest						12GMEinvest				
	2.8				00GMEflex1						12GMEflex1			
	2.8				00GMEinvest						12GMEflex1			
fcst start/stop	2.8	12IFSflex1 D-1					00IFSflex1						12IFSflex1	
	2.8	12IFSinvest D-1					00IFSinvest						12IFSinvest	
	yellow: computing time red: model output (plots) latest available													

Appendix:

Table 3: Numbers identifying individual runs in archive:

name	base time (UTC)	driving model	domain	resolution
temp1	00	GME	flex1	0.0625
temp2	00	GME	invest	0.0625
temp3	00	IFS	flex1	0.0625
temp4	00	IFS	invest	0.0625
temp5	00	COSMO-GME	flex1	0.025
temp6	00	COSMO-GME	invest	0.025
temp7	00	IFS	flex1	0.025
temp8	00	IFS	invest	0.025
temp9	12	GME	flex1	0.0625
temp10	12	GME	invest	0.0625
temp11	12	IFS	flex1	0.0625
temp12	12	IFS	invest	0.0625
temp13	12	COSMO-GME	flex1	0.025
temp14	12	COSMO-GME	invest	0.025
temp15	12	IFS	flex1	0.025
temp16	12	IFS	invest	0.025
temp17	12	IFS	manual48	0.0625
temp19	00	IFS	manual48	0.0625
temp21	12	IFS	manual48	0.025
temp23	00	IFS	manual48	0.025
temp25	12	IFS	manual72	0.0625
temp27	00	IFS	manual72	0.0625
temp29	12	IFS	manual72	0.025
temp31	00	IFS	manual72	0.025
temp20	00	GME	manual	0.0625
temp18	12	GME	manual	0.0625

Model plot products:

Model output plots are available at
http://imk-tyne.physik.uni-karlsruhe.de/~christian/PhD/tparc/t-parc.html
using a plotting tool:

Instructions for T-PARC plotting tool

The plotting tool is useful to browse quickly through the COSMO model output.
All times are in UTC.
As domains are variable it may happen that the colorbar disappears. However you can refer to a prior run. The color range for a specific plot is fixed.

0. Simply click on OK and you will see a plot from today's 00GMEflex1_0.0625 forecast, if available. For more information continue reading.

1. Select a date by entering DD MM YYYY in the appropriate textfields.
   Alternatively click on <-today and the actual date will be selected.

2. Select a specific forecast by choosing the basetime, global model, and domain:

   basetimes are 00 and 12 corresponding to 00UTC and 12UTC

   initial and boundary conditions are obtained from operational global forecast models:
     GME: global model of Deutscher Wetterdienst DWD (German Weather Service)
     IFS: global model of the ECMWF

   the domains are labelled "flex1" and "invest" and usually cover an area of
   20°x20° lon/lat at 0.0625° (~7km) horizontal resolution, and
   15°x15° lon/lat at 0.025° (~2.8km) horizontal resolution
     flex1: flexible moving domain defined around a possible tropical cyclone
     invest: unless there is a second TC, the domain will be defined at a region of possible cyclogenesis. If possible it covers the so called invest areas, otherwise it is centred around Guam (144.5°E,13.5°N)

3. Select the horizontal resolution:
     0.025°: around 2.8km horizontal resolution; no parametrisation used for moist convection
     0.0625°: around 7km horizontal resolution; moist convection is parametrised with Tiedtke-scheme

4. Select a plot from the pull down menu

5. Click on OK and you get the plot for fcst hour 0, or alternatively choose another forecast hour first

6. You can browse through the plots by clicking on -3h -1h +1h +3h