Nested Data Assimilation with KENDA for COSMO-MUC

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Airport Forecasts

Forecast strategy of COSMO-DE

- forecasts for Germany
- leadtime up to 21 hours
- started every 6 hours

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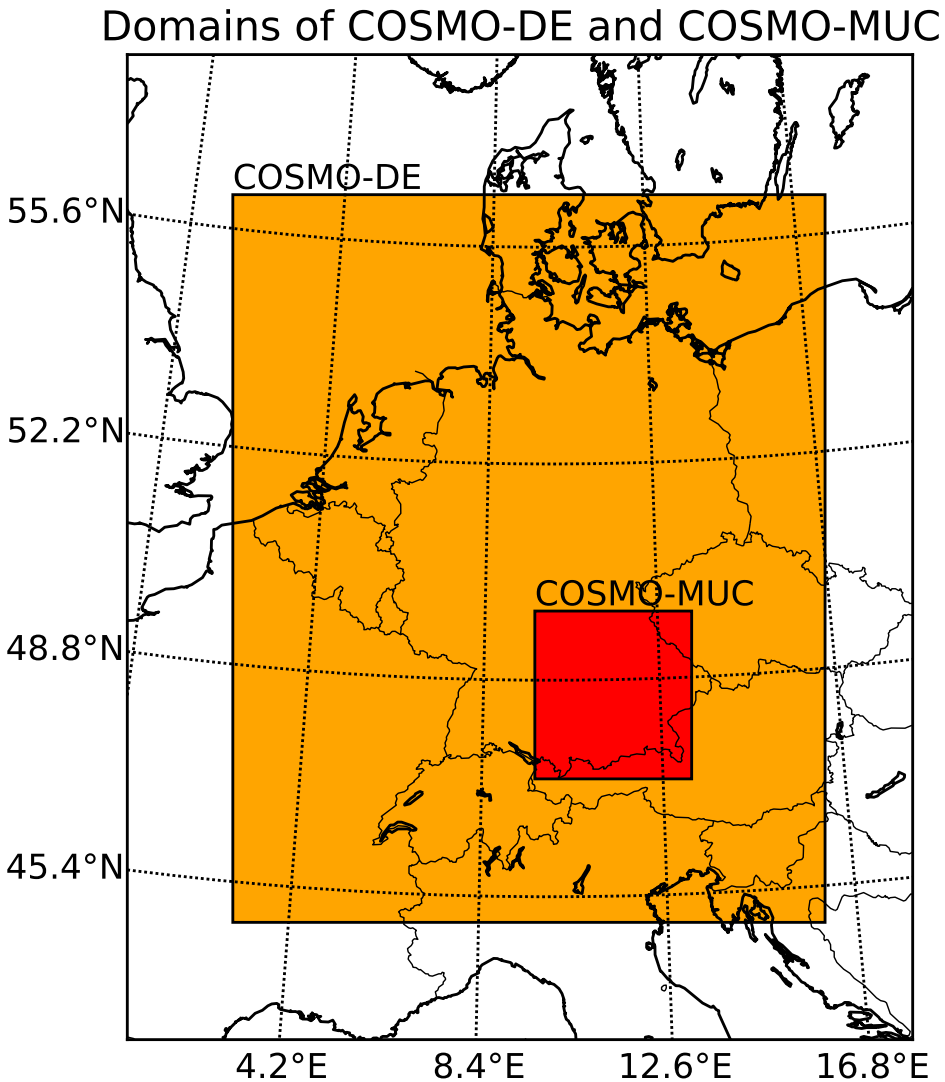
Forecast strategy of COSMO-MUC

- forecasts for Munich airport MUC
- leadtime up to 4 hours
- started every hour

COSMO-DE and COSMO-MUC



COSMO-DE and COSMO-MUC

COSMO-MUC Setup by Ingo Sölch, DLR Oberpfaffenhofen

	COSMO-DE	COSMO-MUC
Levels	50	50
Δx	2.8 km	1.4 km
Δt	25 s	12.5 s
BCs	ICON	COSMO-DE

Resolution dependence of forecast skill

Preliminary Experiments: DE vs. MUC

- Kilometre-Scale Ensemble Data Assimilation *(KENDA, Schraff et al. 2016)*
  - 40 Ensemble Members
  - assimilation of conventional data with Mode-S *(Lange & Janjić 2015)*
  - radar *(EMVORADO, Zeng et al. 2016)* only monitored
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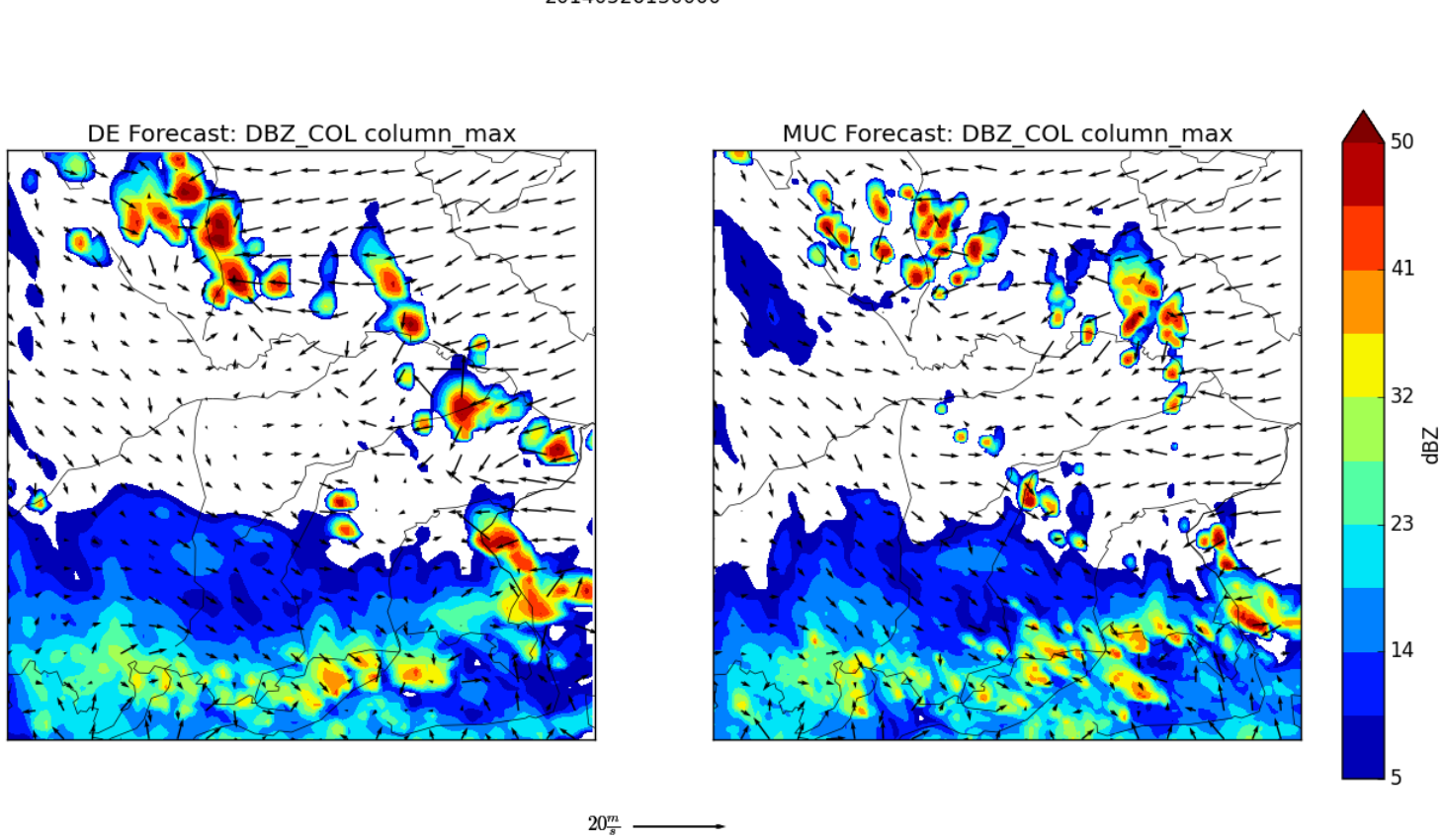
Main Result

No benefit of higher resolution model and data assimilation

Resolution-dependence of model convection

Left: COSMO-DE @ 2.8 km — Right: COSMO-MUC @ 1.4 km



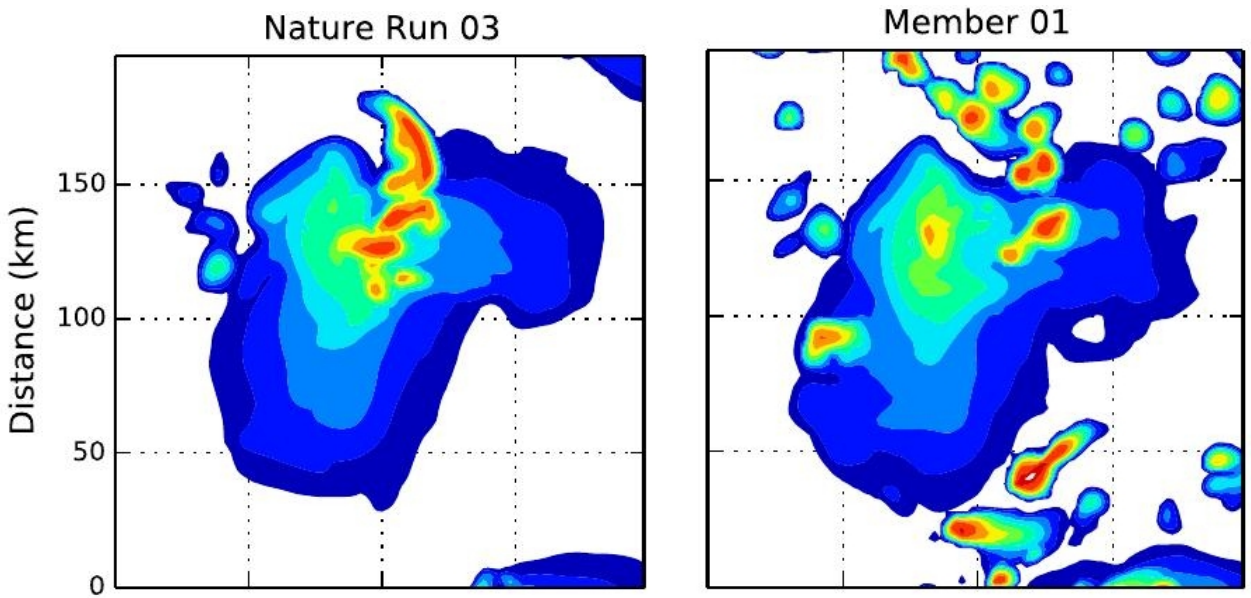
(radar observations not assimilated in this picture)

LHN vs. Radar Assimilation

operational: **Latent Heat Nudging (LHN)**	*planned:* **Radar Assimilation (KENDA)**
radar-derived precipitation rates	direct observations
physical inversion of observations	radar forward operator (EMVORADO)
enforces/damps model convection	analysis combines best members
deterministic	probabilistic

Spurious Convection in Radar-DA

Data Assimilation of Radar Observations can cause imbalances and spurious convection *(Lange 2014)*



See also: Poster of Matthias Schindler, HErZ-DA, LMU Munich

Research Questions

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1. How does deterministic Nudging + LHN perform against KENDA with radar data assimilation?
   - QPF skill?
   - Nonhydrostatic imbalances?
   - Spurious convection?

2. Does 1.4 km yield better QPF results than 2.8 km?

3. Is radial wind assimilation beneficial for QPF and balance?

Experiments

COSMO-DE

- only as driving model, no verification
- only rain/hydrometeor-assimilation
  - Nudging: LHN
  - KENDA: radar reflectivity *(Bick et al. 2016)*

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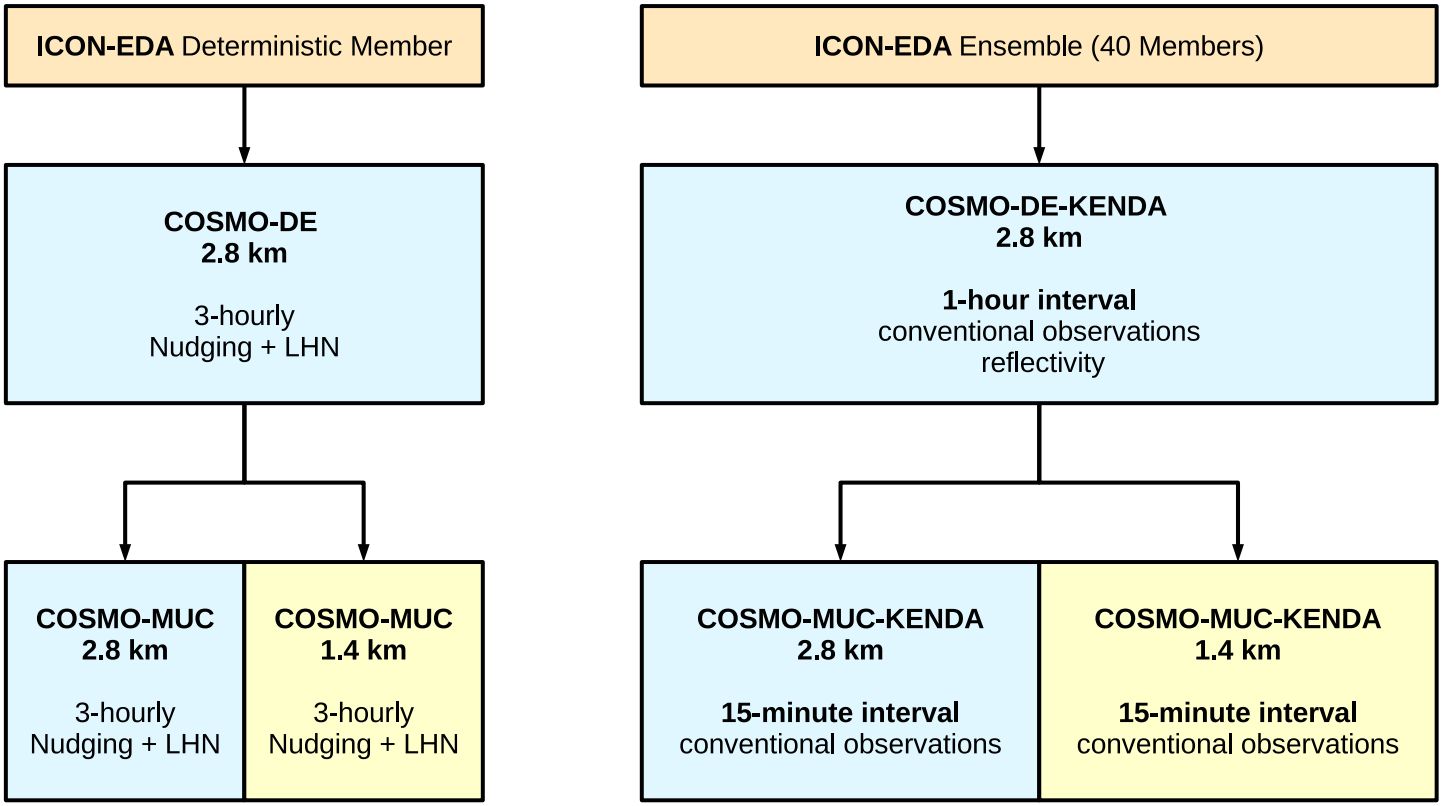
COSMO-MUC

- verification of analyses and 3-hour forecasts
- comparison of skill @ 2.8 km and @ 1.4 km resolution
- radar forward operator EMVORADO used for QPF-verification
- Superobservation resolution: 10 km

COSMO-MUC Experiment Chart



2.8 km	1.4 km

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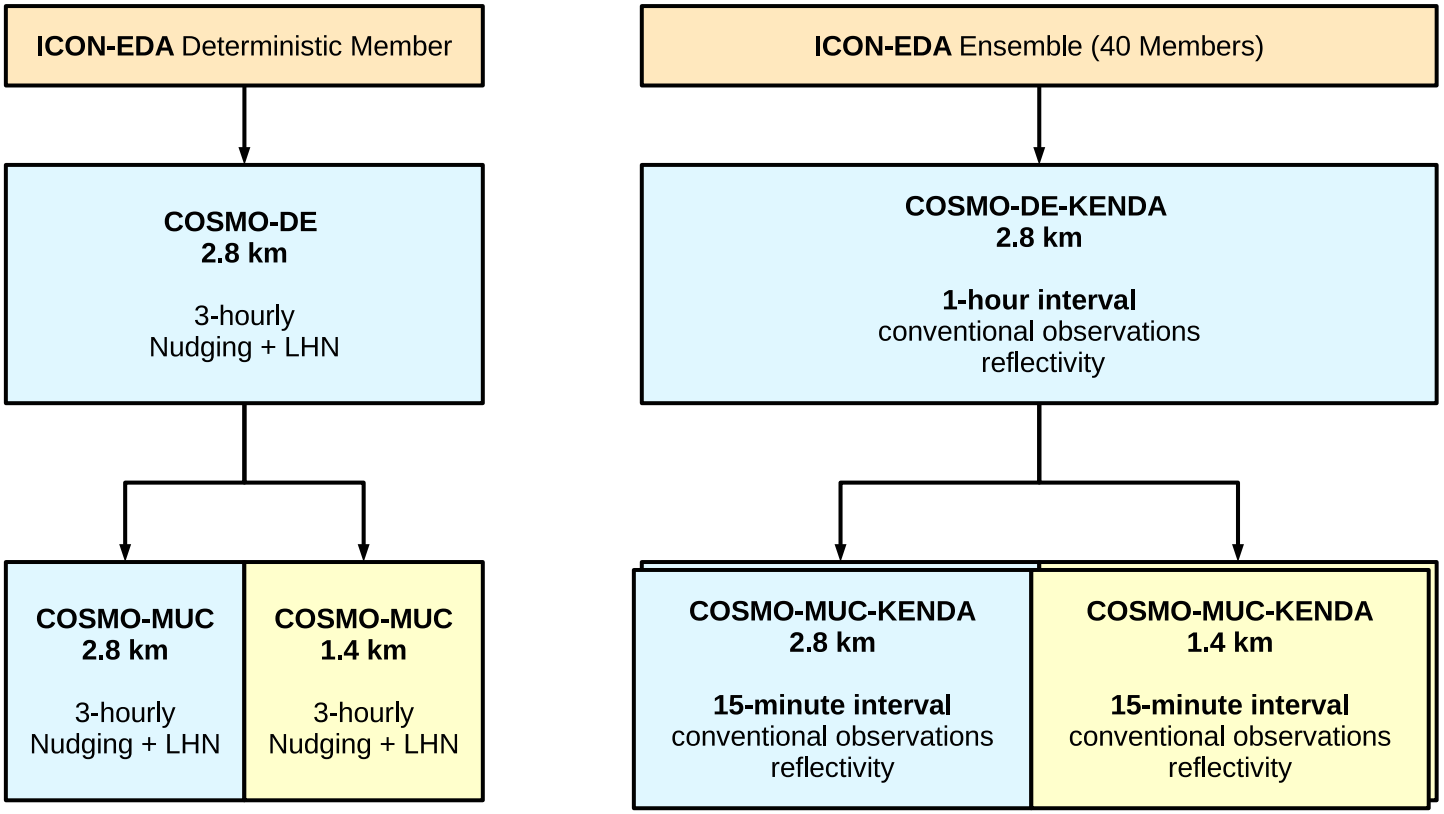

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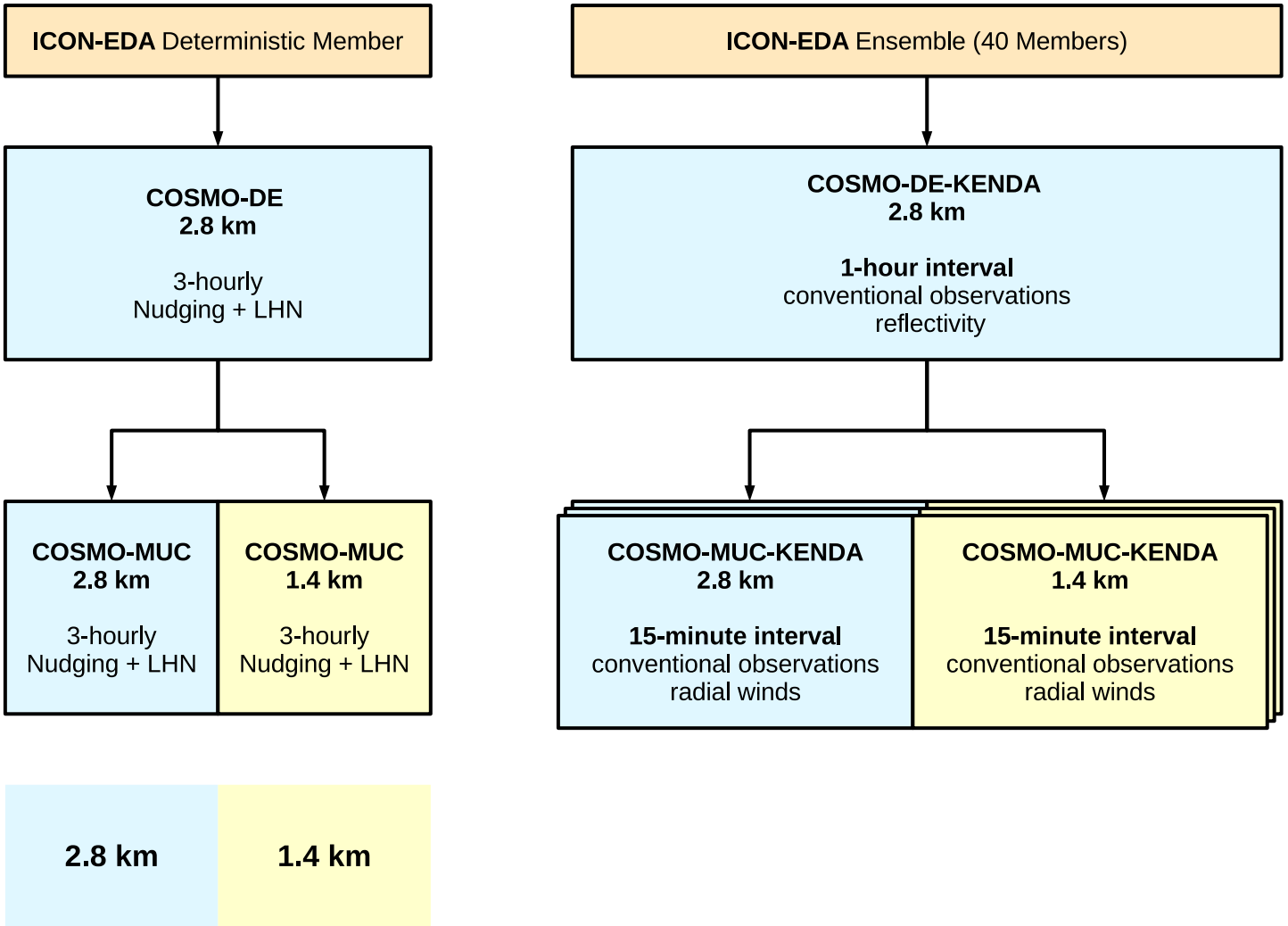

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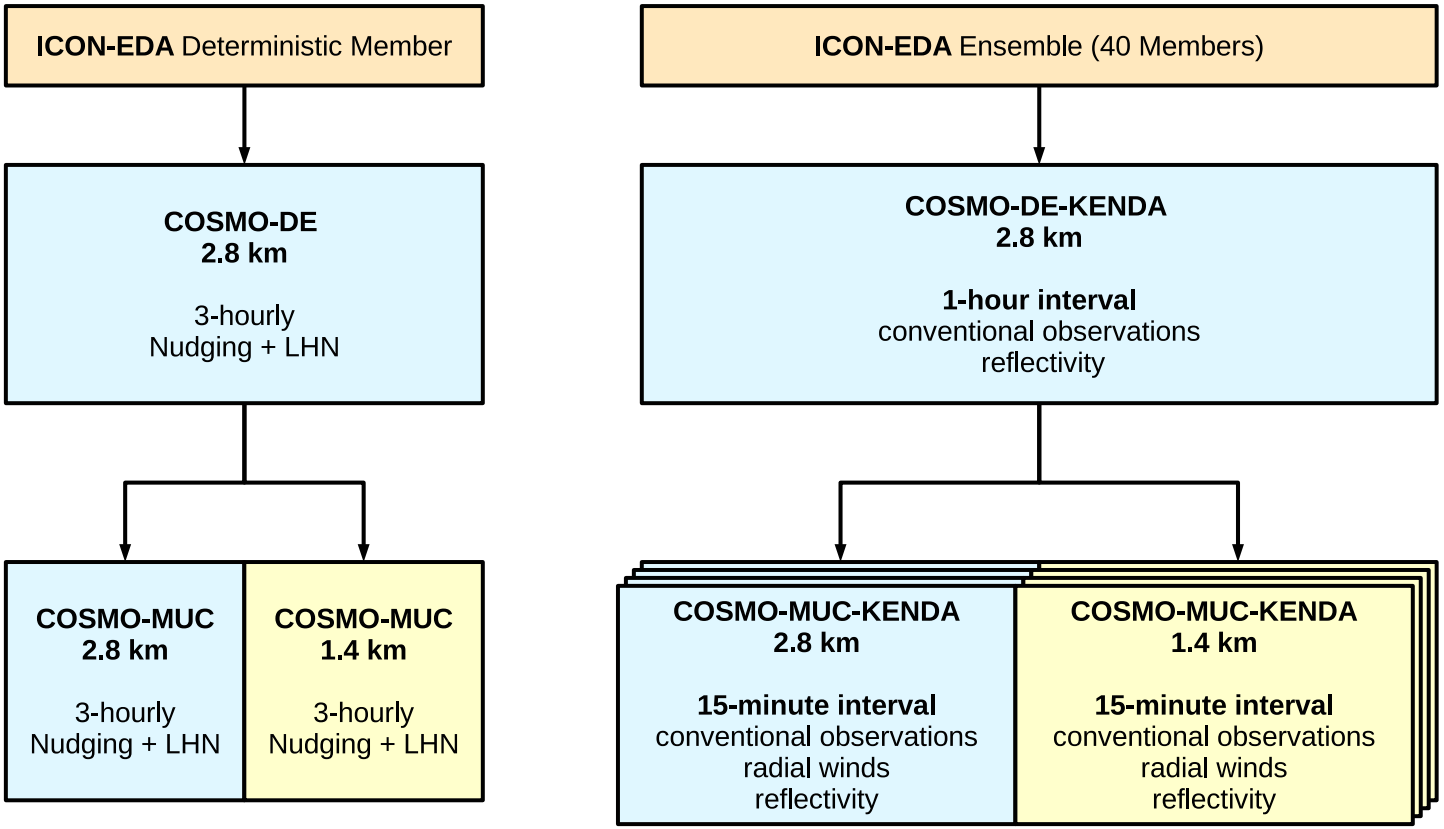

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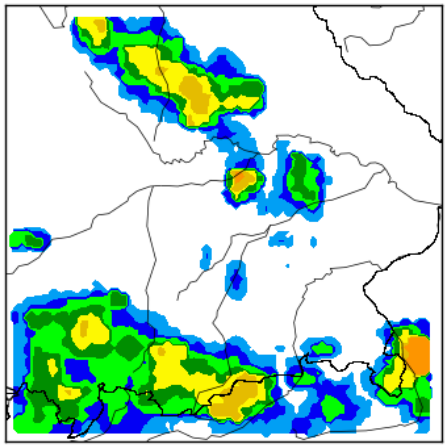
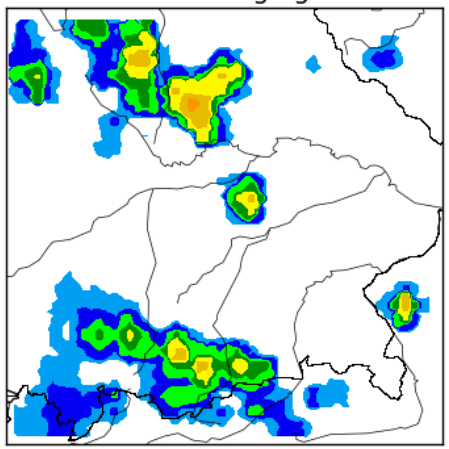
Convection 3 hour forecasts (example)

Radar Colmax : 2014-05-26 12:00:00 + 5 minutes

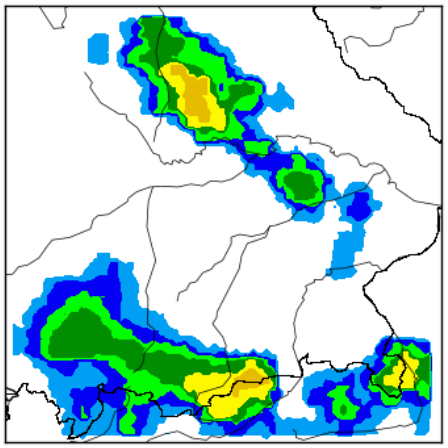
MUC14 Obs



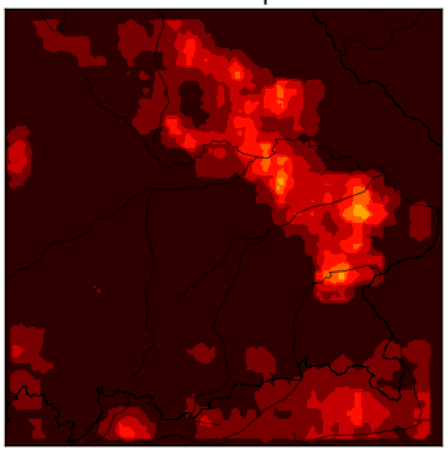
MUC14 Nudging FC



MUC14 MUC14 Ens Refl
Ensemble Mean



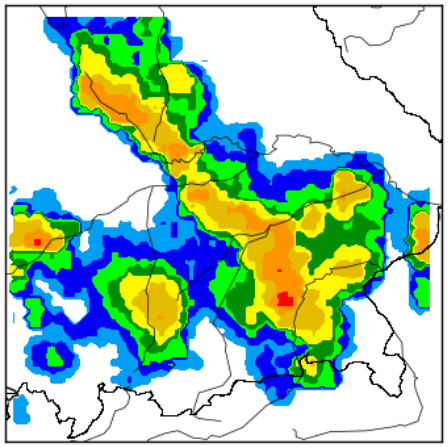
MUC14 MUC14 Ens Refl
Ensemble Spread



Convection 3 hour forecasts (example)

Radar Colmax : 2014-05-26 12:00:00 + 175 minutes

MUC14 Obs



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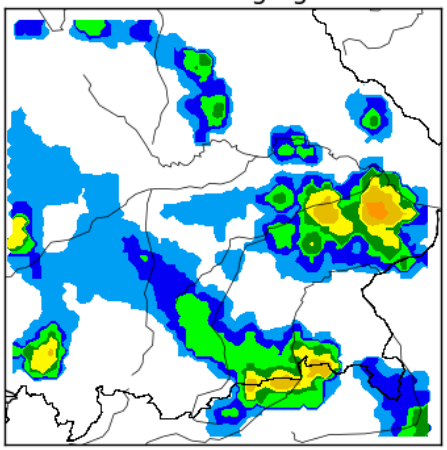

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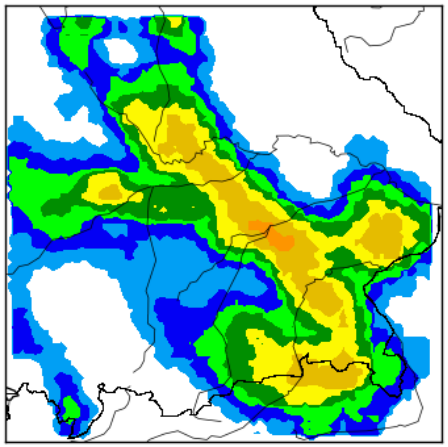

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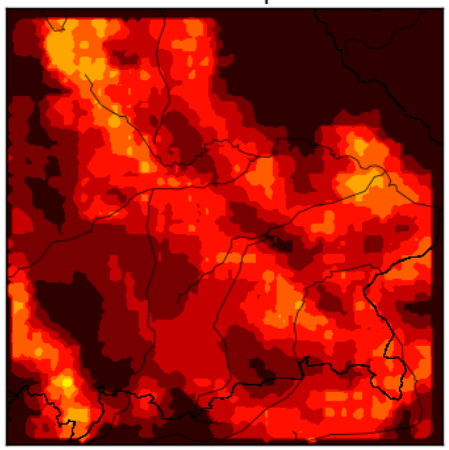
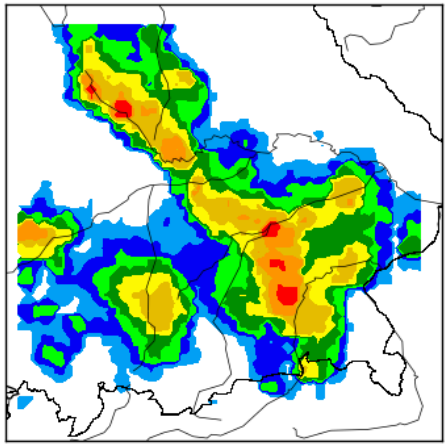
Ensemble Spread



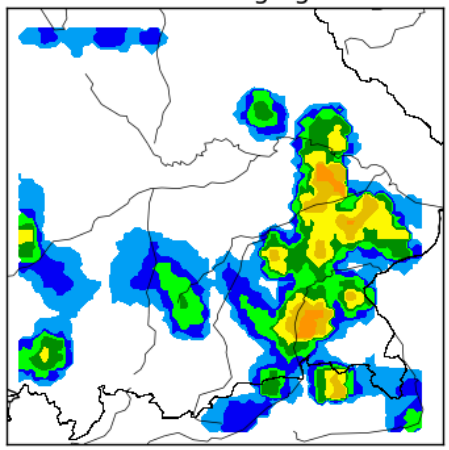
Convection 3 hour forecasts (example)

Radar Colmax : 2014-05-26 12:00:00 + 175 minutes

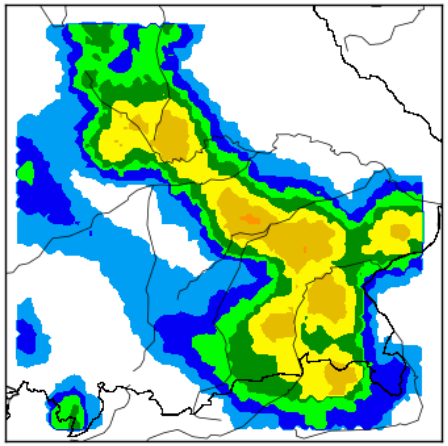
MUC28 Obs



MUC28 Nudging FC



MUC28 MUC28 Ens Refl
Ensemble Mean



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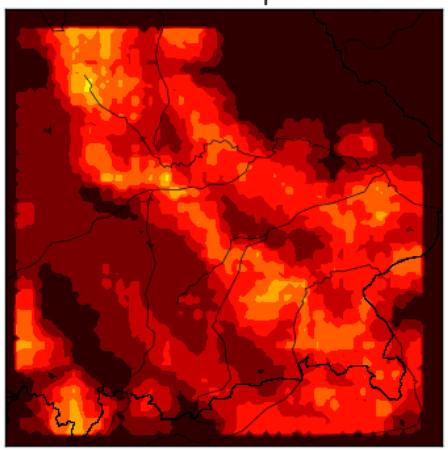
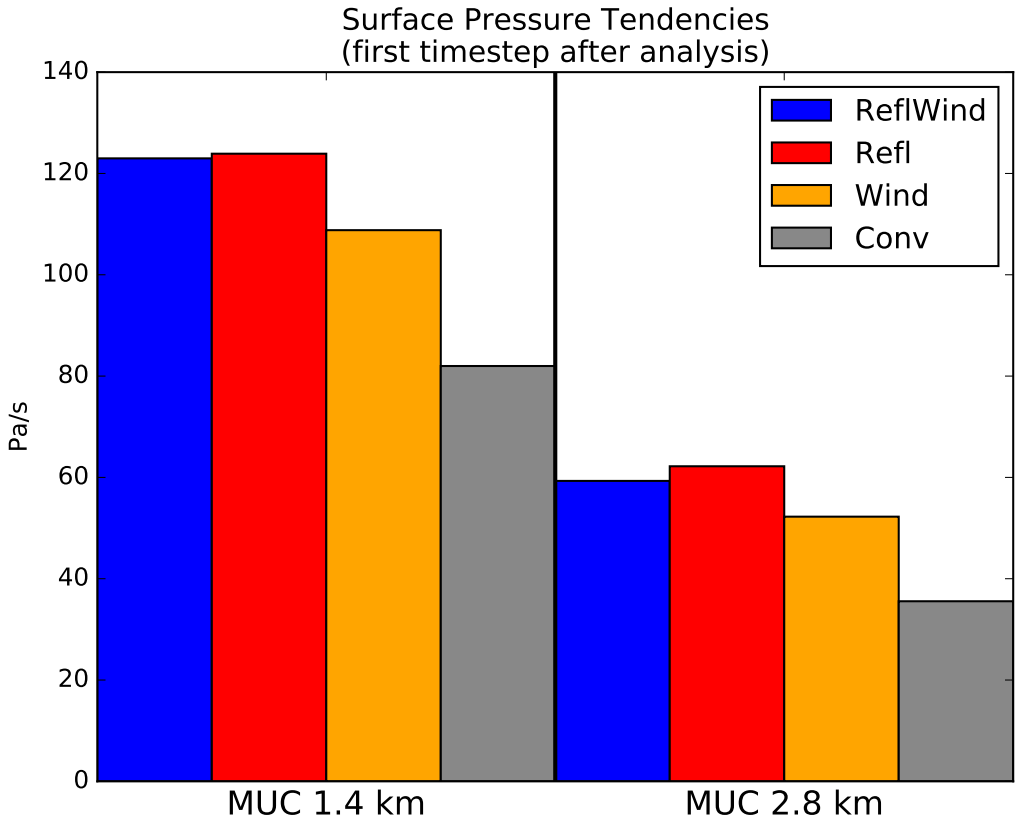


Surface Pressure Tendencies

KENDA-MUC, 26.5.2014



Outlook, Plans

Verifications: Comparison of Nudging to Ensemble DA

1. local forecast verification at MUC airport (LLWAS VVP)
2. QPF-skill (DAS, SAL, FSS)
3. imbalances
   - surface pressure tendencies
   - spurious convection measures

References 1

COSMO-KENDA

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References 2

KENDA idealized Radar

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