

Exercise Observation Nudging

Hendrik Reich, DWD

Daniel Leuenberger, MeteoSwiss

Michael Würsch, LMU München

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Ex 1: First Simulation

- Set the default options for the simulation with
`opt = getoptions()`
- Type
`opt.which='1'` to switch to the LETKF
`opt.obsloc = 1:2:40;` to observe every 2nd grid point
`opt.plot_free = 0;` to switch off free forecast plot
- Run the simulation with `run95(500, opt, 10, 10, 0.25, 1);`
 - We start with a localization radius of 1
- Describe the behaviour of the RMS and spread

Ex 2: Observation density

- Start a second simulation with a reduced observation density with
`opt.obsloc=1:5:40;`
`run95(500,opt,10,10,0.25,1);`
- How did the RMS error change?
- Change the distribution of the observations (continent and sea) with
`opt.obsloc=1:20;`
`run95(500,opt,10,10,0.25,1);`
- How does the RMS change? What other effects can be seen?

Ex 3: Model dimension

- Change the model dimension

```
opt.modelsize=20 (or 50, 100)
```

- Don't forget to adapt the location of the observations

```
opt.obsloc=1:2:20;
```

- `run95(500, opt, 10, 10, 0.25, 1);`

- How does this effect the RMS? What else can you observe?

Ex 4: Observation Error

- Switch back to the reference simulation with
`opt.modelsize=40;`
`opt.obsloc=1:2:40;`
- Start a simulation with doubled observation error:
`opt.obserr=2;`
`run95(500,opt,10,10,0.25,1);`
- How has the RMS error changed?
- Start simulations with observation error 4,8 and 16
- Do the same experiments with model errors of 1,2,4 ,8 and discuss the results. Don't forget to put the observation error back to 1.

Ex 5: Ensemble size and covariance inflation

- Switch back to the reference simulation and try out different ensemble sizes

```
run95(500, opt, 10, 20, 0.25, 1);
```

- How does the error change?

- Try different values for the covariance inflation.

```
run95(500, opt, 10, 20, 0.25, 1.5);
```

- Which value is the best one for an ensemble size of 10? Are different values needed for different ensemble sizes?

Ex 6: Localization radius

- Again switch back to the reference simulation and try different localization radii.

```
run95 (500, opt, 10, 10, 1, 1) ;
```

The localization radius is defined by $2 * a_letkf$ where a_letkf is also used for the weighting of the observations where the weight decreases with distance. After a distance of a_letkf the weight has dropped to $1/e$.

If $a_letkf=0.25$ there is only 1 observation used.

If $a_letkf=0.5$, the localization radius is 1 and there are 3 observations used but the weights of 2 of them is very small.

If $a_letkf=1$, 5 observations are used.

- How does this effect the RMS? What else can you observe?

Ex 7: “Tuning”

- How low can the overall RMS be if you tune with covariance inflation and localization radius? Keep the other parameters fixed at the following values:
 - Ensemble size: 10
 - `opt.obsloc=1:2:40`
 - `opt.modelerr=0`
 - `opt.obserr=1`
 - `n_cycle=500`