Using Jk in AROME 3DVAR
Some Initial Tests

Per Dahlgren

Definitions

Host model: provides lateral boundaries

Blending: Mix information from host model into the initial condition

Jk: Assimilate host model information together with observations

Jk in HARMONIE

Extra term in cost-function

$$J(\boldsymbol{x}) = J_b + J_o + \underbrace{(\boldsymbol{x} - \boldsymbol{x}_{ls})^T \boldsymbol{V}^{-1} (\boldsymbol{x} - \boldsymbol{x}_{ls})}_{J_k}$$

$$\boldsymbol{x} = Model\ state = \begin{pmatrix} \varsigma \\ \eta \\ T \\ q \\ \ln p_s \end{pmatrix}$$

Vorticity
Divergence
Temperature
Specific humidity
Surface pressure

$\boldsymbol{x}_{ls} = Host\ model$

$\boldsymbol{V} = \text{Matrix}\ with\ errors\ of\ \boldsymbol{x}_{ls}\ (Diagonal)$

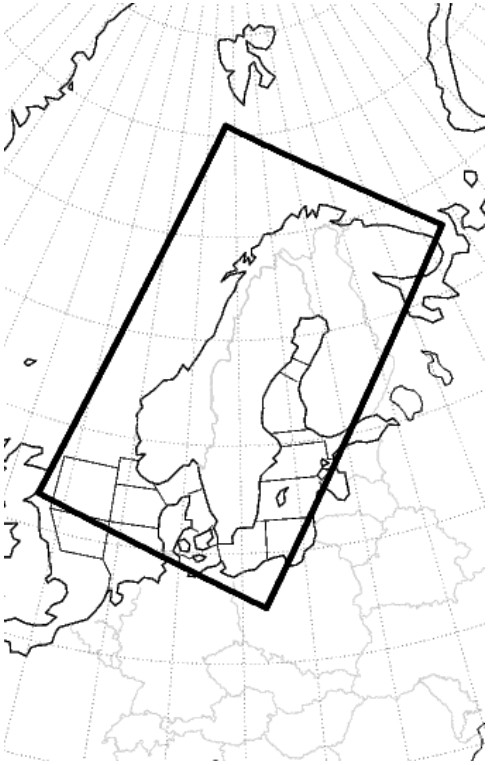
Guidard and Fischer QJRMS 2008

The MetCoOp project

Prepare operational joint NWP production between SMHI (Sweden) and met.no (Norway)

- AROME 2.5km
- Host model: ECMWF
- Task: evaluate and select appropriate blending method
- Hires1 – Domain for very first tests, mainly technical

NLON=540
NLAT=900
65 levels



Error Covariances

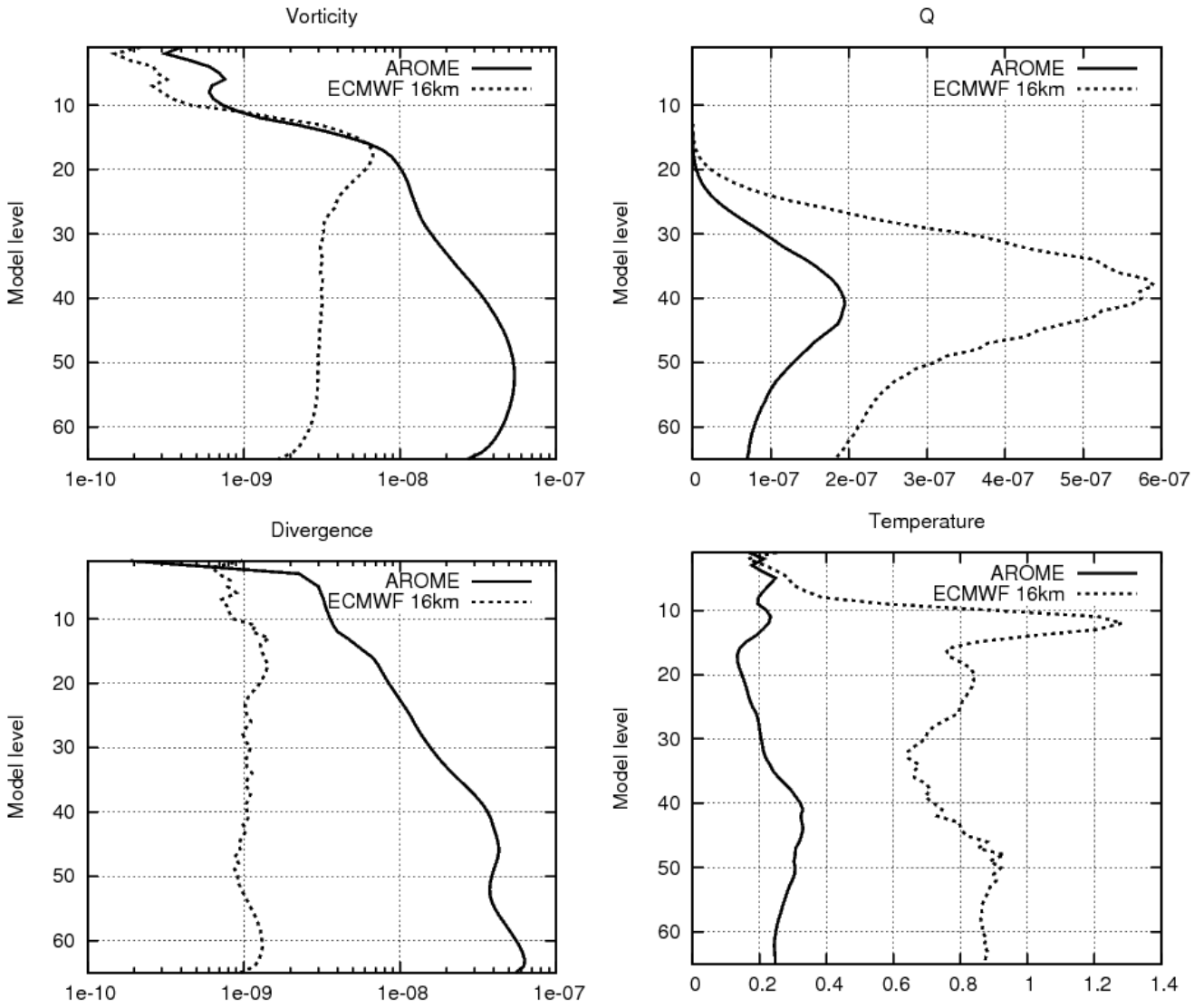
- Calculate ECMWF error covariances on Hires1 domain
- Differences between +48 and +24h forecasts valid at the same time, NMC-method

1. Interpolate global ECMWF, 16km, to Hires1-domain. Maintain 16km resolution
2. Calculate differences between fields using MASTERODB and LFEMARSD=.TRUE.
3. Calculate covariances using FESTAT Univariate only, LSTABAL=.FALSE.

- Sample January, April, July, October

Error Covariances

Total variances
Jb-full
Jk-dotted

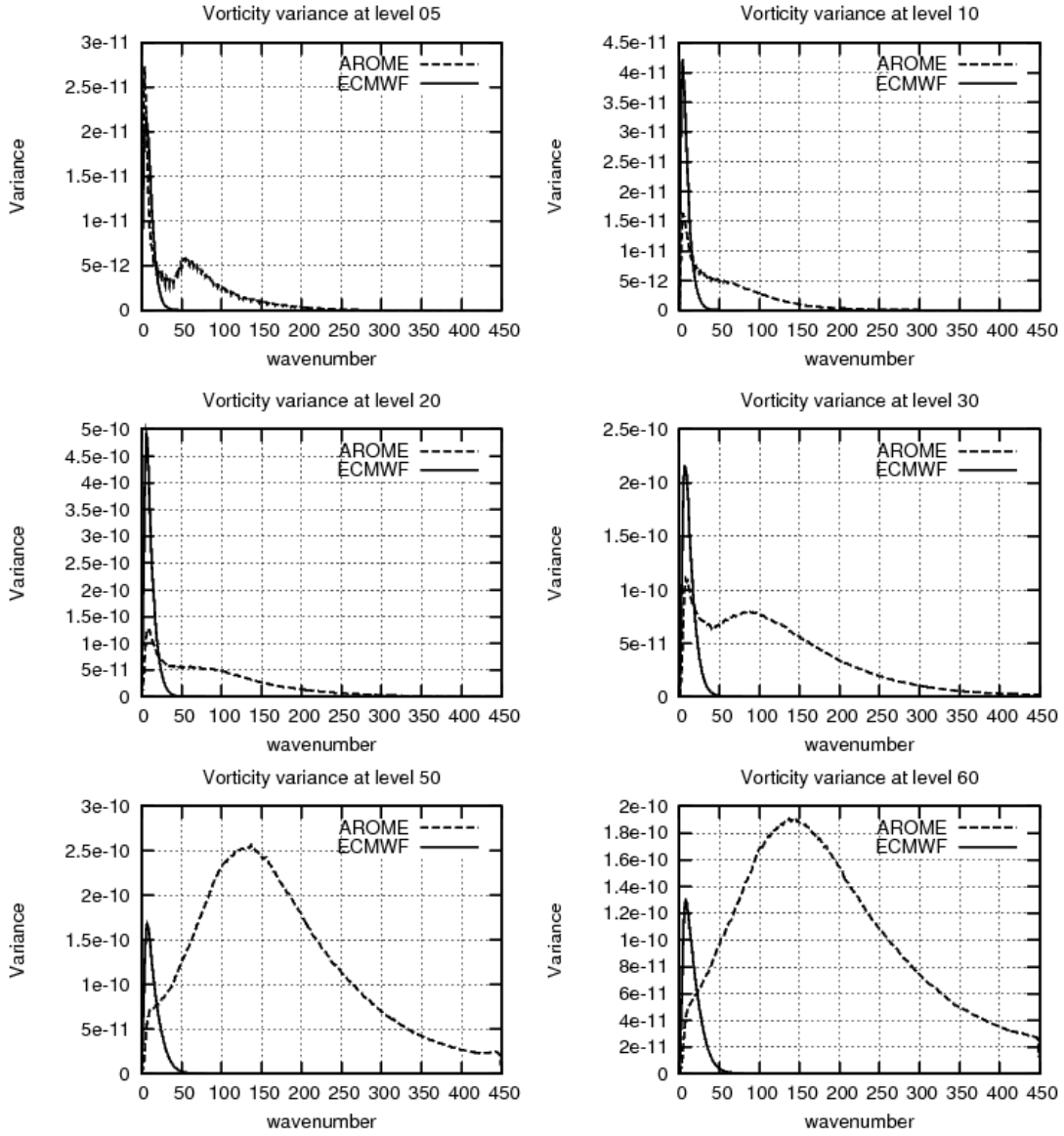


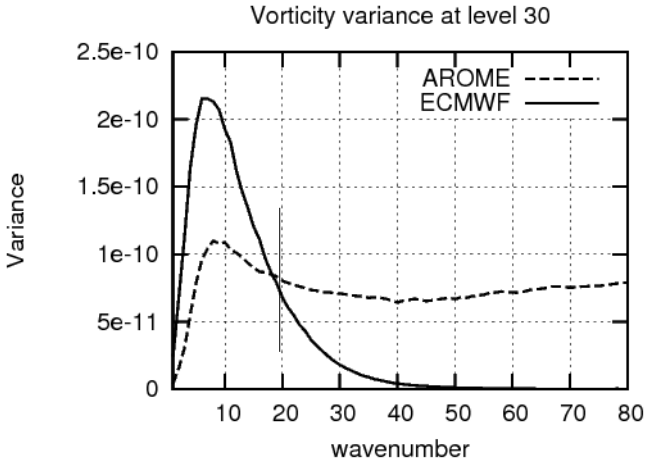
Maybe a misleading plot:
Different spectrums

* Jk 16km: K*=79
* Jb 2.5km: K*=449

Variance spectrum, Vorticity

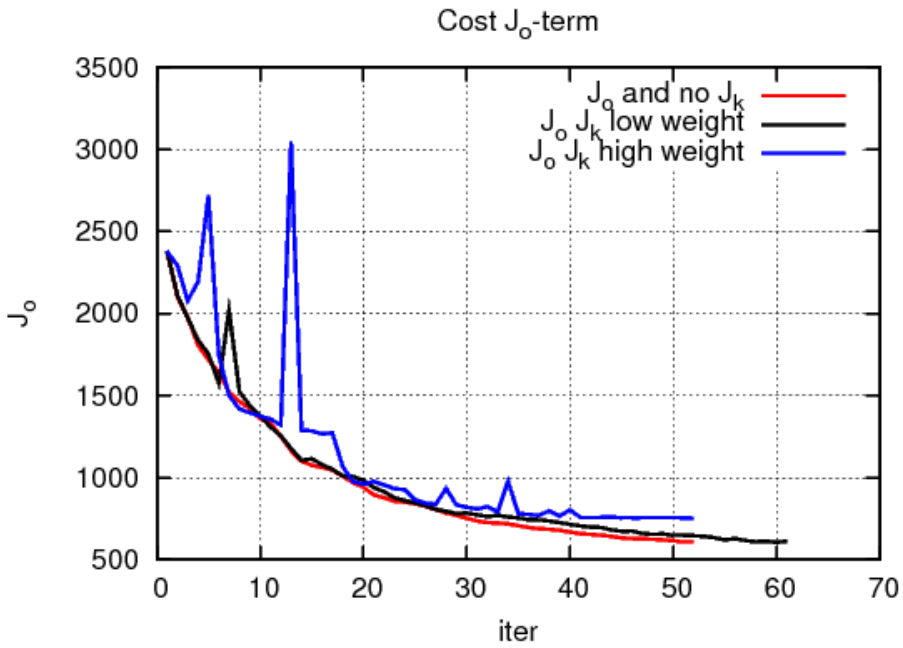
Used as weigths in V-matrix

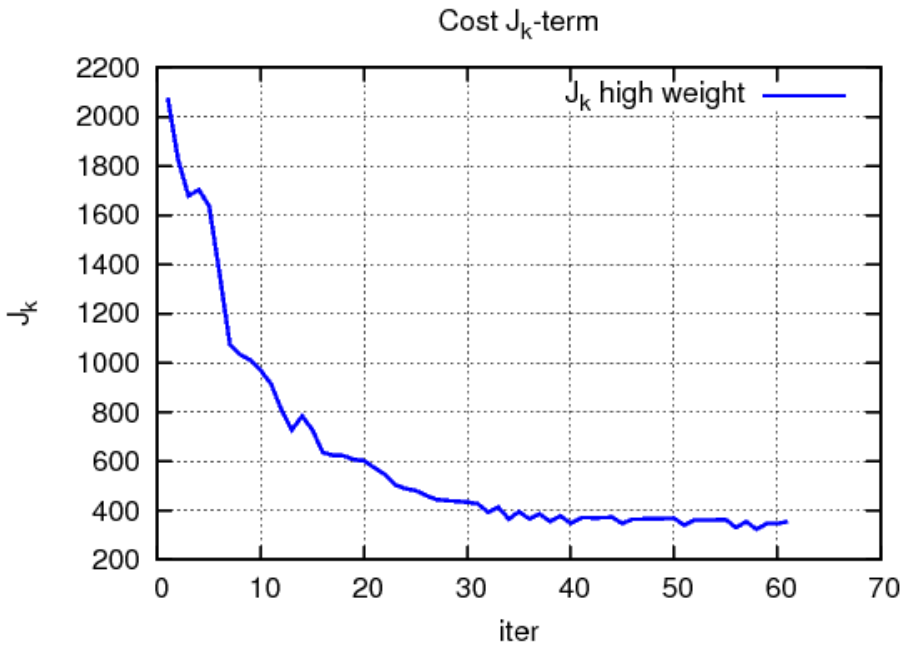




Truncate Jk information at K=20

Minimization and Observation Fit





Observation fit for 3 cases

Specific humidity NOT used in Jk

J=Jb+Jo

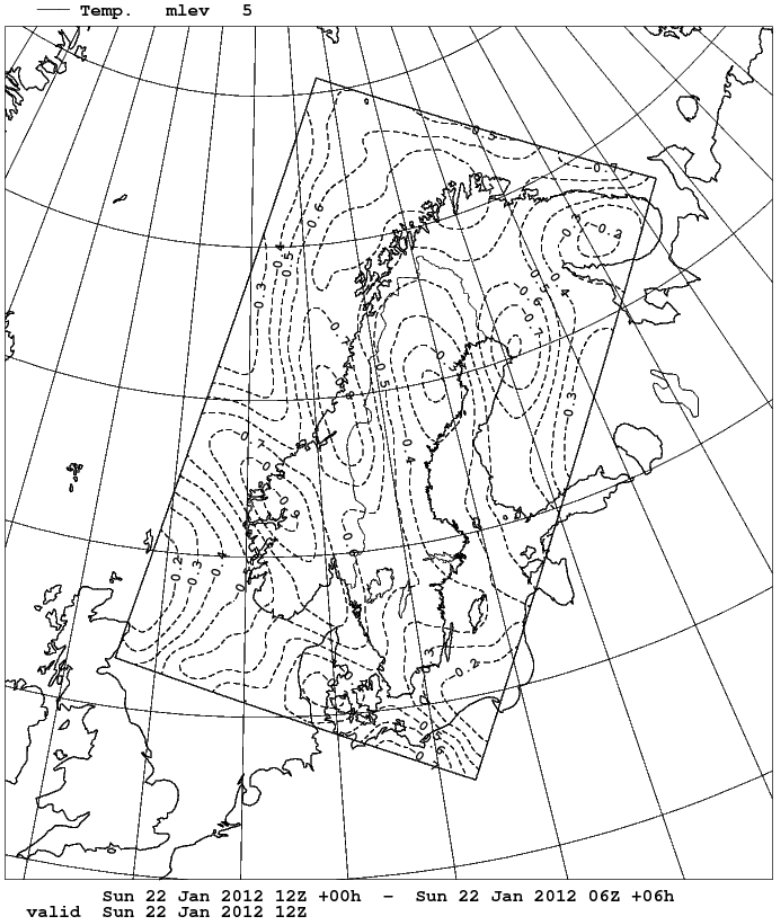
J=Jb+Jo+Jk (Jk with low impact)

J=Jb+Jo+Jk (Jk with high impact)

Balance: Adjust model state to the host model and observations

Case: SYNOP only And Jk Increments

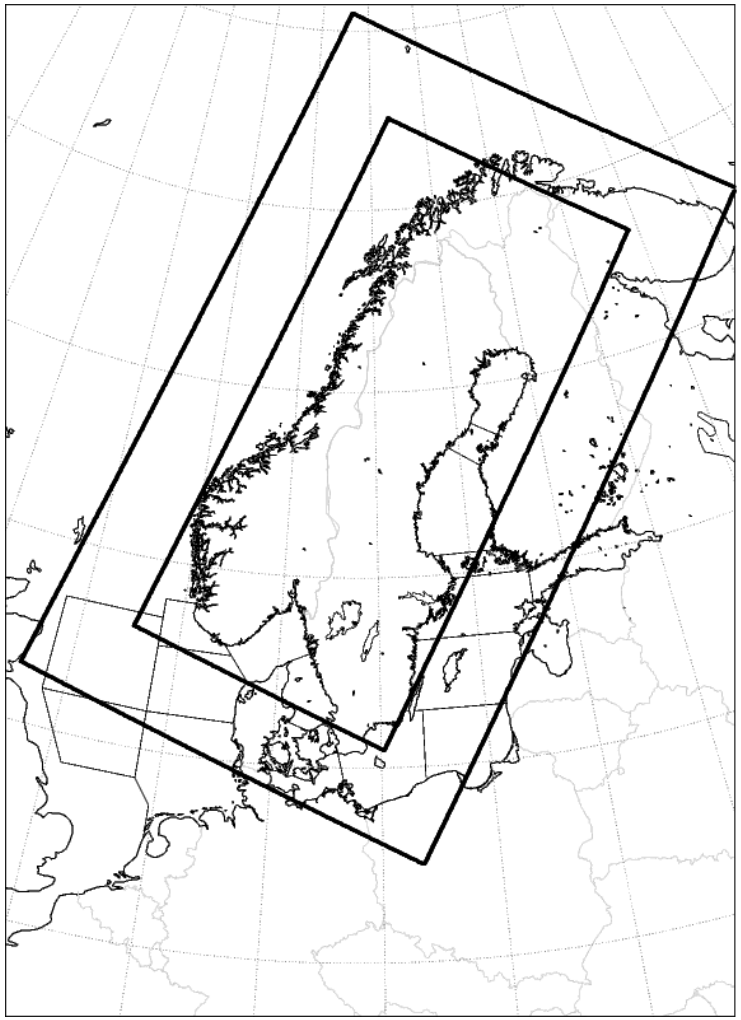
Temperature increments
(AN-FG)

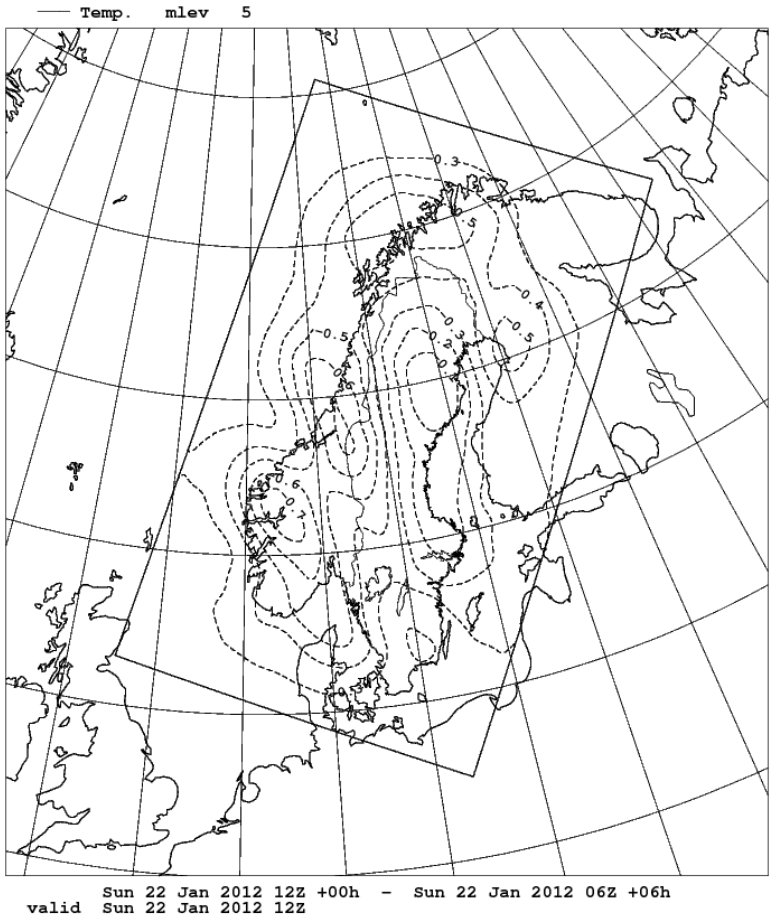


Wrap-around effects

Test: Zero Jk-information near boundaries

Temperature increments
(AN-FG)





The End