



Cross-correlated inference of Carbon species emissions: A fire case study and first IFS results

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In the current IFS EDA system trade-offs have to be made between the two approaches!

Results from previous works with a pure EnKF on CO and Black Carbon and Organic Carbon

- Pseudo random perturbations for Emissions, using Evensen 2003 equations.
- EAKF (DART), 30 members, 1 degree resolution CAM-Chem
- Perturbation code can be used to set different length scales and correlate/de-correlate emissions variables and types: the user can build his own background covariance matrix making "good" apriori assumptions





Using independent emissions perturbations on sectoral emissions the EnKF inversions (here after 1month) show separate patterns of emissions changes.



RMS(control – inversion) of all sectors CO inversion (left) only fire CO inversion (right), using MOPITT CO August 2015 and Surface to 200hPa average



Ensemble cross-covariances have been used to infer surface fluxes from the 2015 WA fires using MOPITT CO and MODIS AOD. This example shows the capability of using different type of observation and fire related species to infer cross-correlated emission fields. Using MOPITT observations to infer OC and BC fire emission fields show similar results as using MODIS AOD observations.



First results with the EDA IFS system on CO emissions

00z 600hPa



Vertical sensitivity of CO atmospheric changes to emissions computed for 21-25 May 2017: 40 members equivalent





Pseudo random perturbations used in the IFS system for the physics (SPPT, Palmer 2009) or the GHG emissions (Massart 2016) are equivalent to Evensen 2003 (see above). Calculation of emission perturbation for reactive gases and aerosols is now possible.

We show results of the background error covariance matrix representation of the sensitivity of a given pressure level CO concentration to the CO surface fluxes using an EDA of 10 perturbed members (SPPT and fluxes).

Open questions:

- How many members the EDA require to provide robust emission estimates, global and sectoral?
- Is 12 hour assimilation window reasonable? Do we need to reduce to 6 hours to account correctly for the diurnal cycle?
- Using B climatological enough (fires?), can we afford 30+ members EDA? Can we use ensembles for previous days (24,48,72 hours)?

