Regional Transport Analysis for Carbon Cycle Inversions Using the RUC-LPDM System

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We have extracted sets of hourly meteorological analyses generated by the Rapid Update Cycle (RUC) assimilation system on the 13-km grid over North America for the period from March 2005 to May 2006. Using selected RUC fields we drive the CSU Lagrangian Particle Dispersion Model (LPDM) backward in time in order to derive influence functions for specified sampling stations. The transport influence function quantifies the sensitivity of each observation at NOAA sampling towers to unit surface fluxes of CO_2 or other trace gases at all points upstream in the RUC domain. For each data point, i.e., tower location and sampling time (1 hour), a separate influence function is derived which depends on spatial coordinates of source areas as well as release time of fluxes from the surface. Therefore, the RUC-LPDM system is generating a huge amount of data, which would be impractical to store and disseminate at full resolution for a year. We have designed the storage and dissemination system to store Lagrangian particle positions rather than integrated influence functions. The system will therefore need to integrate influence functions "on the fly," at the time that the product is disseminated.

Unfortunately, the RUC archive contains numerous gaps lasting from 1 hour to several days. The data coverage is presented in Figure 2 under assumption that (1) data range must be at least 10 days long, (2) cannot contain missing gaps longer than 2 hours, (3) number of missing files in data range must be less than 2%, (4) missing gaps must have space between them longer than 4 hours. As a one of potential ways to deal with data gaps in the RUC archive, we have developed an interface between the RUC and CSU RAMS (Regional Atmospheric Modeling System). RAMS can be run on any subdomain smaller than the RUC domain with a similar or higher resolution and then, use to drive LPDM. This approach provides us with additional research capabilities as well.

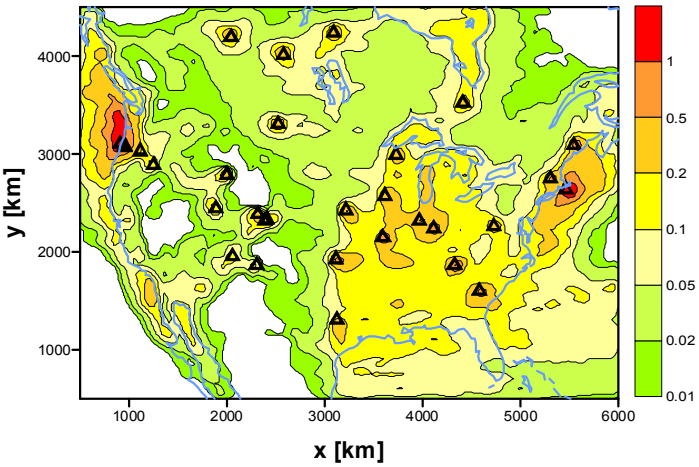

Figure 1. Example of influence functions for 38 day sampling period (159-197 Julian days in 2005) for 31 towers. Influence function are integrated with a constant $1\ \mu mol/m^2 s$ CO_2 flux and presented in ppm.

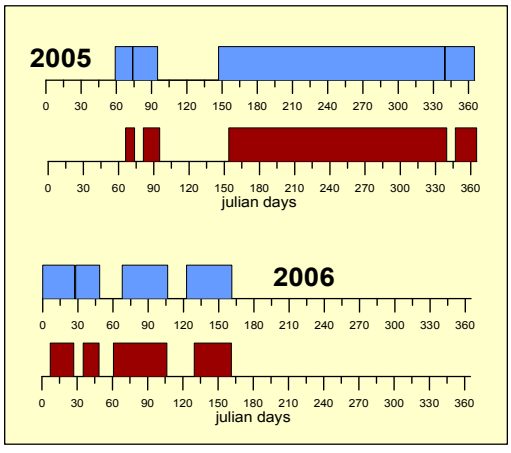

Figure 2. Coverage of RUC data (blue) from March, 2005 to May, 2006 and coverage of influence function analysis (sampling time – magenta) after filling gaps up to 2 hours and assuming that travel time in the US domain is not longer than 1 week.