Part 2: Flux inversion

Questions

- What are the strengths/limitations of the inversion approach?

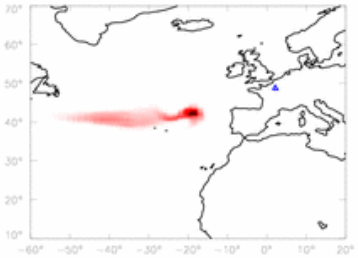
Three approaches to estimate fluxes

- Inventory (bottom-up)
  - e.g. forest inventory, GHG emission, land-use change…
- Processed-based modeling (bottom-up)
  - e.g. terrestrial biosphere models that include physical, biophysical, and biochemical processes (forward modeling)
- Inverse modeling (top-down)

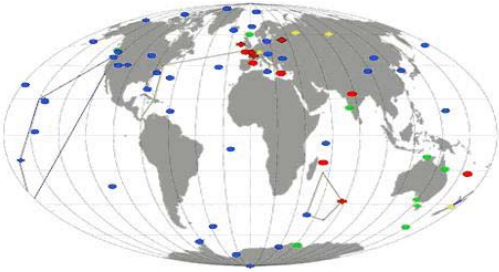
General scheme of flux inversion

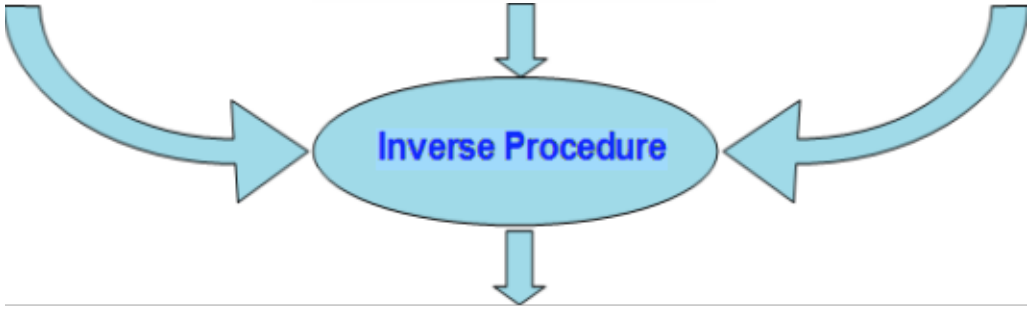
PRIORI FLUXES

TRANSPORT MODEL

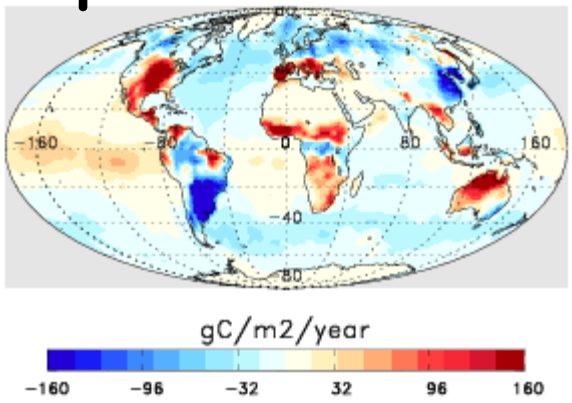


OBSERVATIONS





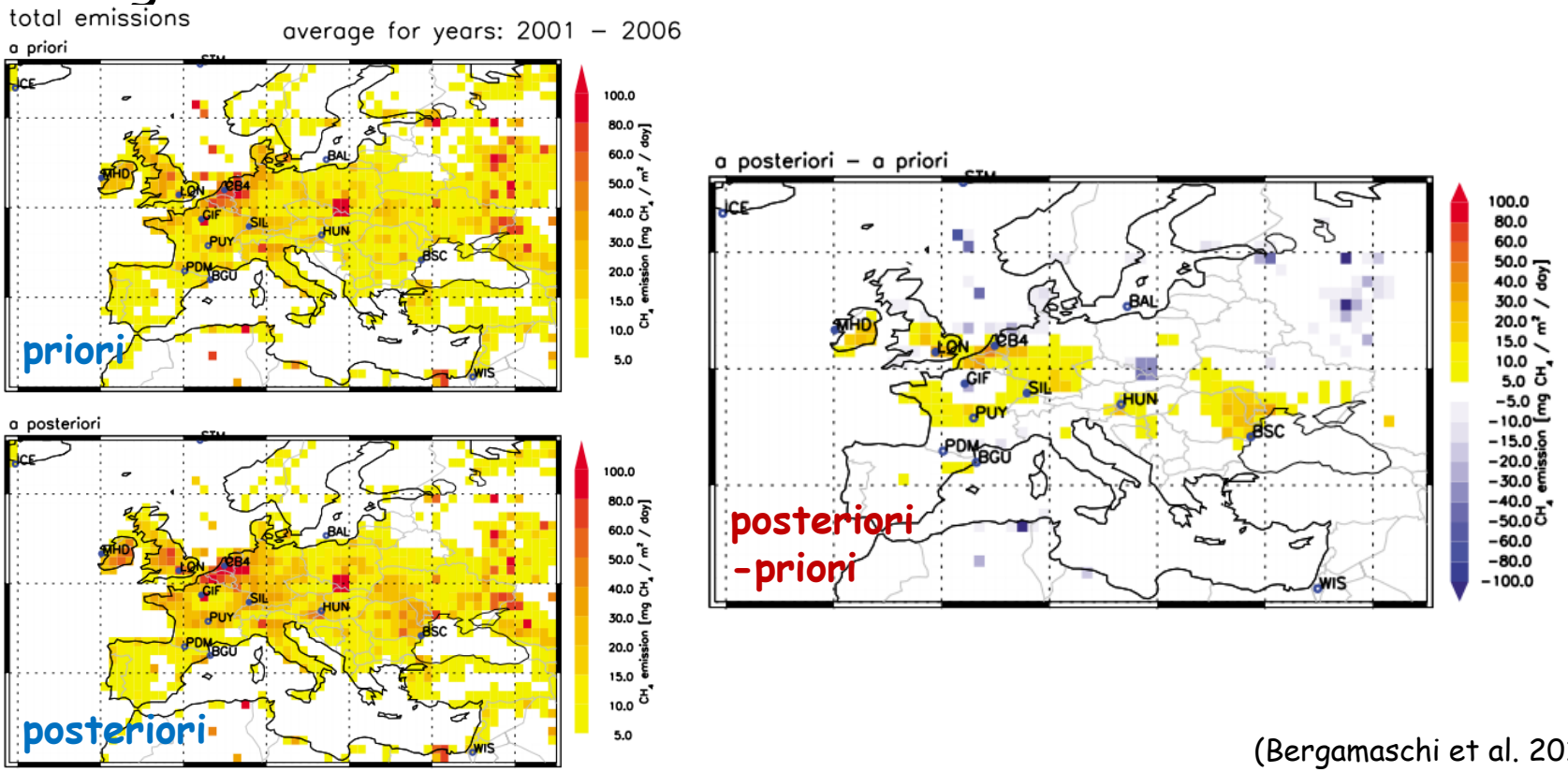
Optimized fluxes



From CarboScope (http://www.carboscope.eu)

Strengths

- It provides top-down flux estimates that can independently verify bottom-up estimates.
  - e.g. estimates of CH4 emissions in EU



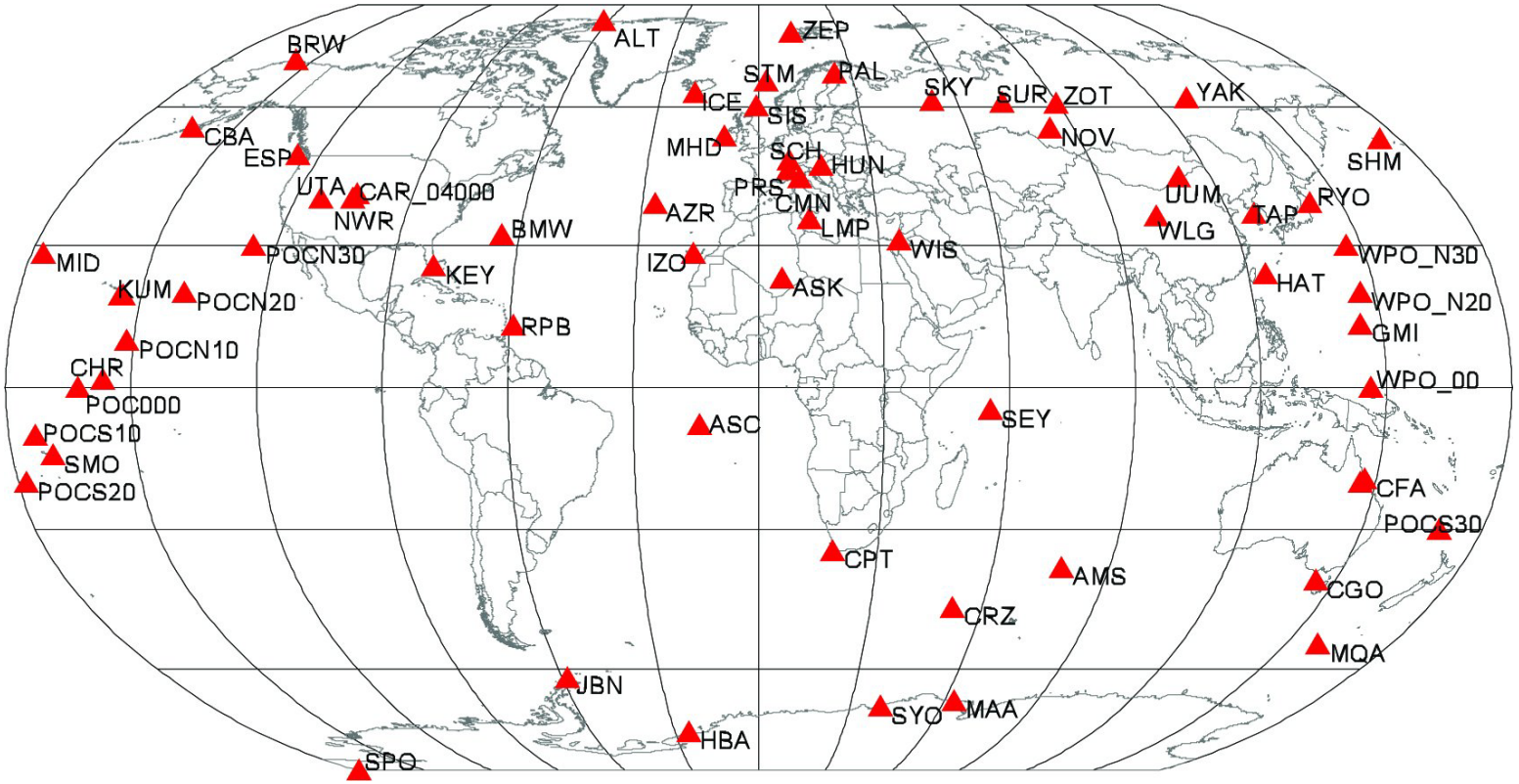
(Bergamaschi et al. 2010)

Strengths

- Relatively simple, with less inputs compared to process-based models
- It has the potential to accurately estimate fluxes at relatively high spatial and temporal resolutions if we
  - expand the atmospheric monitoring network
  - improve transport models and mathematical methods

Limitations

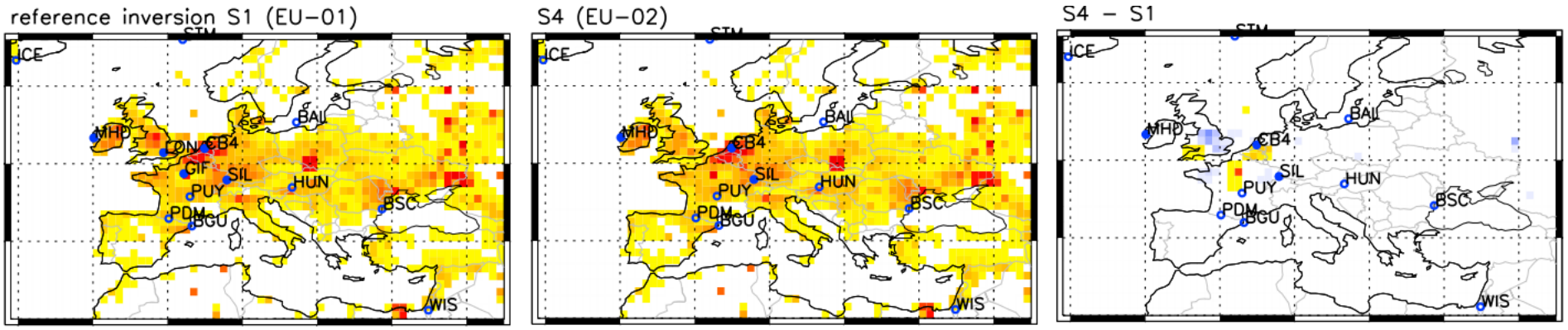
- Currently the atmospheric monitoring network is inadequate to effectively constrain fluxes in some regions (e.g. the Tropics)



From CarboScope (http://www.carboscope.eu)

Limitations

- Inverse methods are sensitive to errors in the setup and transport model, in the data, and in the selection of the sites.
  - Use of different sets of stations may affect the spatial pattern of estimated fluxes

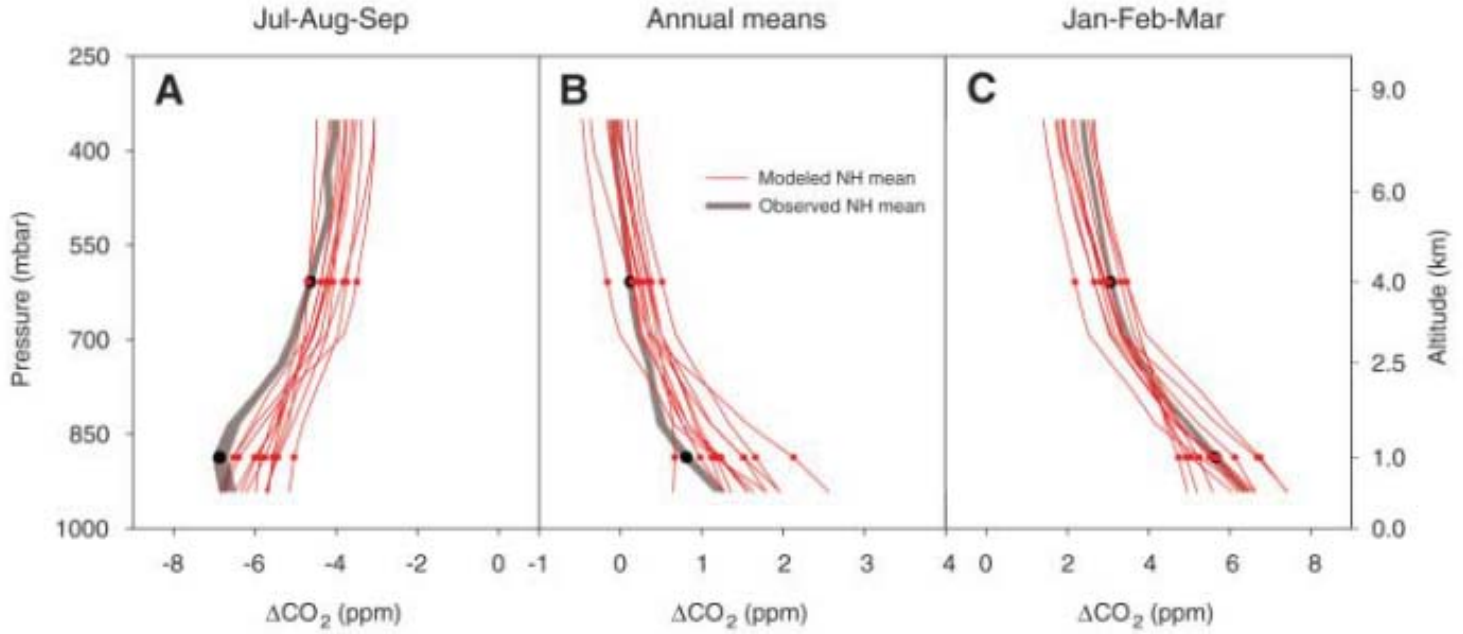


Monitoring stations very close to emission sources could introduce some systematic error.

(Bergamaschi et al. 2010)

Limitations

- Inverse methods are sensitive to errors in the setup and transport model, in the data, and in the selection of the sites.
  - Biases in atmospheric mixing will translate into biases in estimated fluxes



The substantial differences in vertical gradients reflect the biases in atmospheric vertical mixing.

(Stephens et al. 2007)

Limitations

- Inverse methods are sensitive to errors in the setup and transport model, in the data, and in the selection of the sites.
  - inversion setup: a priori standard deviation, spatial correlation scales…
  - resolution of the transport model
- Unclear about the underlying processes driving the spatial and temporal patterns of fluxes

Thank you