

IHALOME

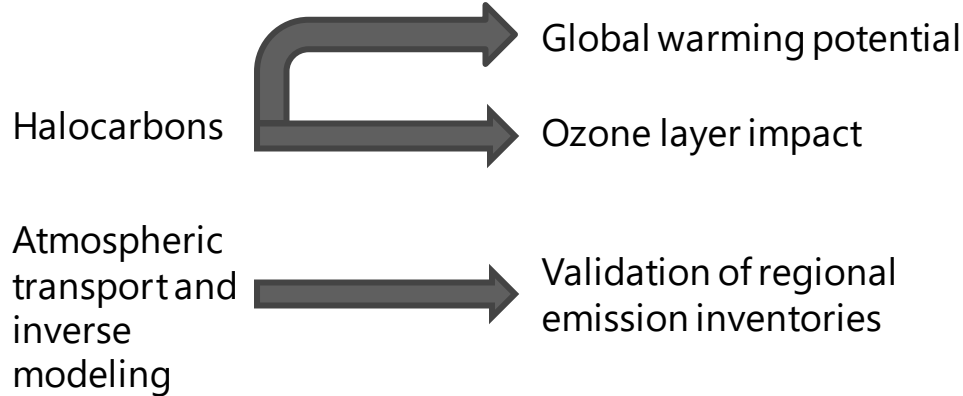
Innovation in Halocarbon Measurements and Emission
Validation

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Supervisor Empa: Stephan Henne

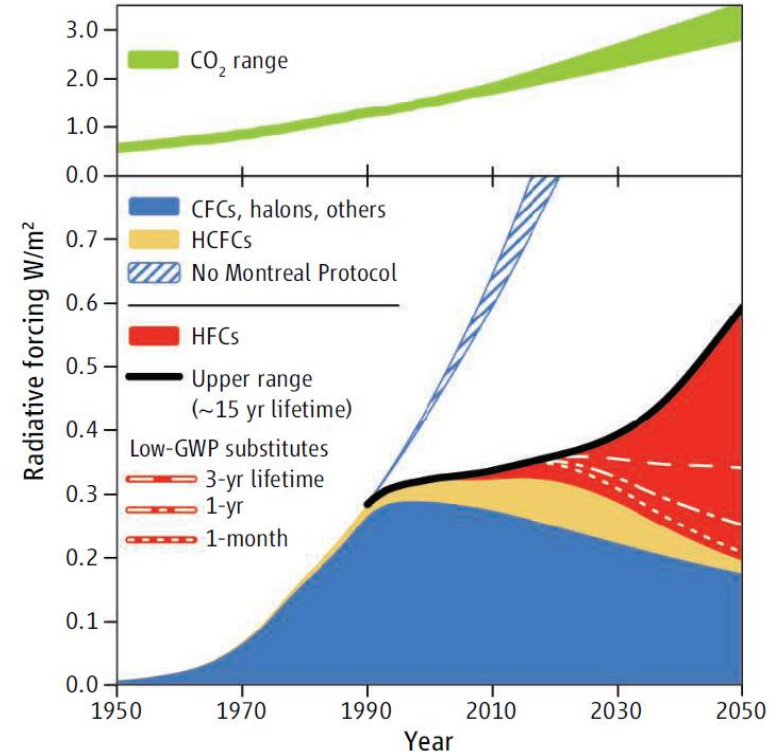
Supervisor ETH: Tom Peter

Motivation



Challenges

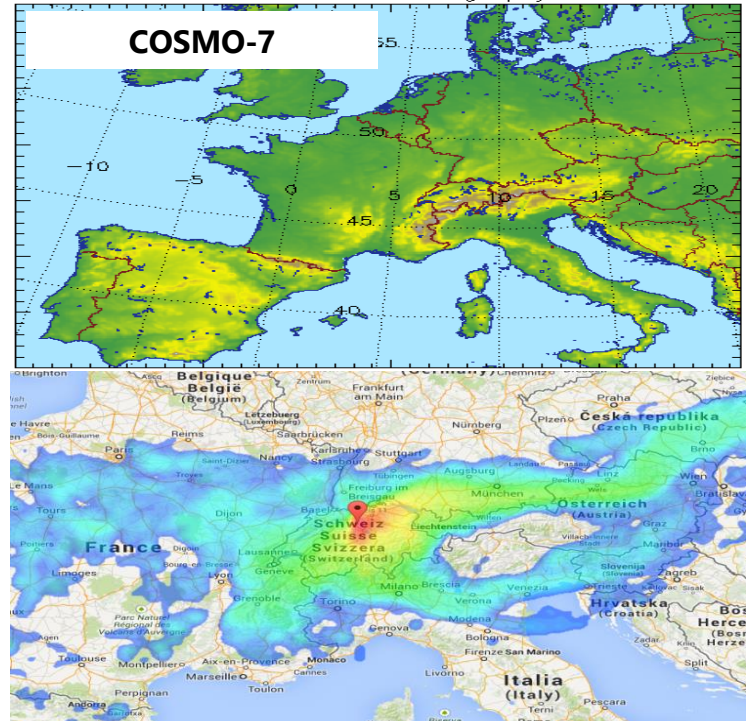
- Errors introduced in transport models
- Oversimplification of the inversion framework
- Sparse data coverage
- Resolution systematic errors
- Limitations in measurements



Time series of the radiative forcing (RF) of each different generation of halocarbons as well as a future forecast for their RF and comparison with the RF corresponding to CO₂.
Source: Velders et al. (2012)

FLEXPART-COSMO Transport Simulations

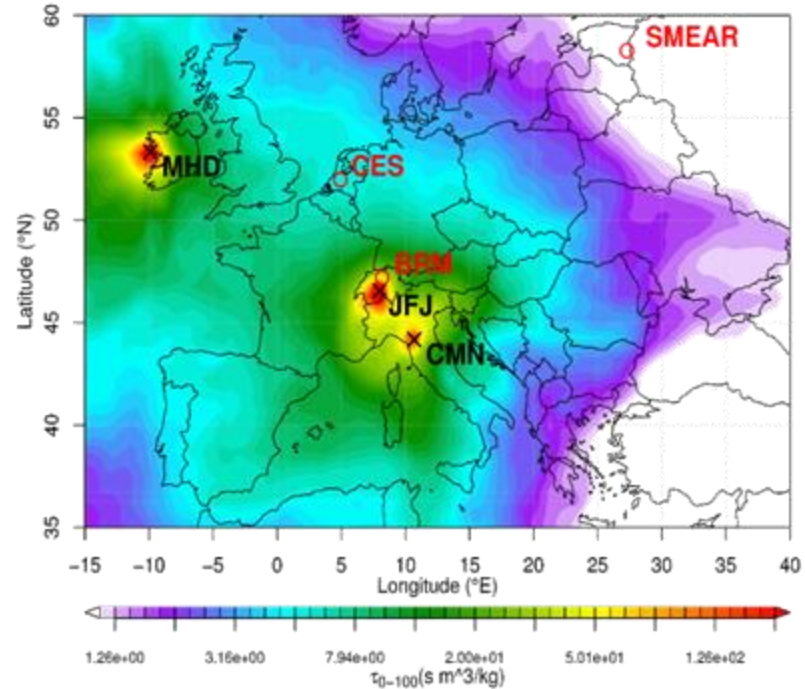
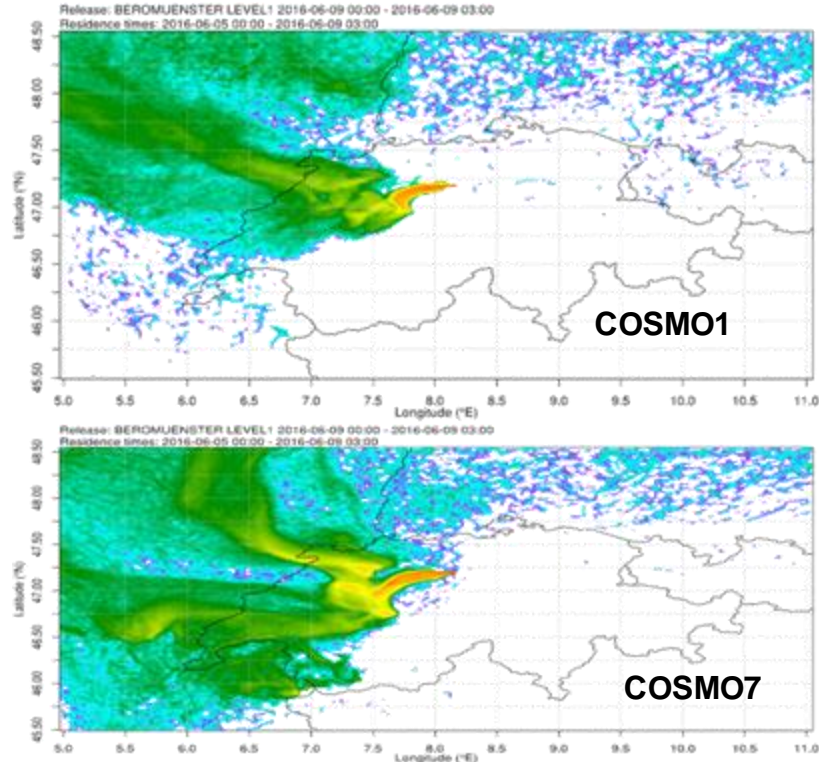
- FLEXPART-COSMO (V8C2.0)
- Input: COSMO-7 (analysis)
 - Validation: wind speeds, mixing layer heights
- Backward simulations for individual sites
- Set-up
 - 3-hourly release of 50'000 particles per site
 - 4 day backward or until out off domain
 - Different release heights above ground to account for uncertainty due to smoothed model topography



source sensitivities 1 site, 1 time

Challenges

- Improvement of our regional estimates of halocarbon emissions via higher resolution simulations
- Campaigns to extend our measurement network



Contour plot of annual mean source sensitivity of existing AGAGE sites (marked with black crosses) and location of additional measurement stations to be used in IHALOME (marked with red circles).

Total footprints from FLEXPART-COSMO model with 1km spatial resolution (upper figure) and 7km spatial resolution (bottom figure). The 1km model presents high values of dispersion in comparison with the 7km model.

Challenges

- Source attribution of new halogenated halocarbons
- Uncertainties associated with inversion scheme
- Uncertainties associated with transport
 - Ensemble method quantification of uncertainties
 - Artificial dispersion term describing uncertainty values
- Application of the improved model to the data of the campaigns

$$\mathcal{J} = \frac{1}{2}(\mathbf{x} - \mathbf{x}_b)^T \mathbf{B}^{-1}(\mathbf{x} - \mathbf{x}_b) + \frac{1}{2}(\mathbf{M}\mathbf{x} - \mathbf{x}_o)^T \mathbf{R}^{-1}(\mathbf{M}\mathbf{x} - \mathbf{x}_o)$$