



THE UNIVERSITY OF
MELBOURNE



The ARC Centre of Excellence
for Climate Extremes

Urban Scale Inverse Framework Using Carbon Monoxide Total Column Retrievals from TROPOMI for Tehran: Preliminary Results

Nasimeh Shahrokhi

Prof. Peter Rayner

Steven Thomas

Dr. Jeremy Silver

Dr. Robyn Schofield



19th ANNUAL
CMAS
Conference

October 2020 | Virtual



Introduction



- **Improving Regional Inventories, Using Satellite Concentration Measurements and Inverse Modeling**
 - ✓ Can satellite data be applied in an urban inverse modeling framework?

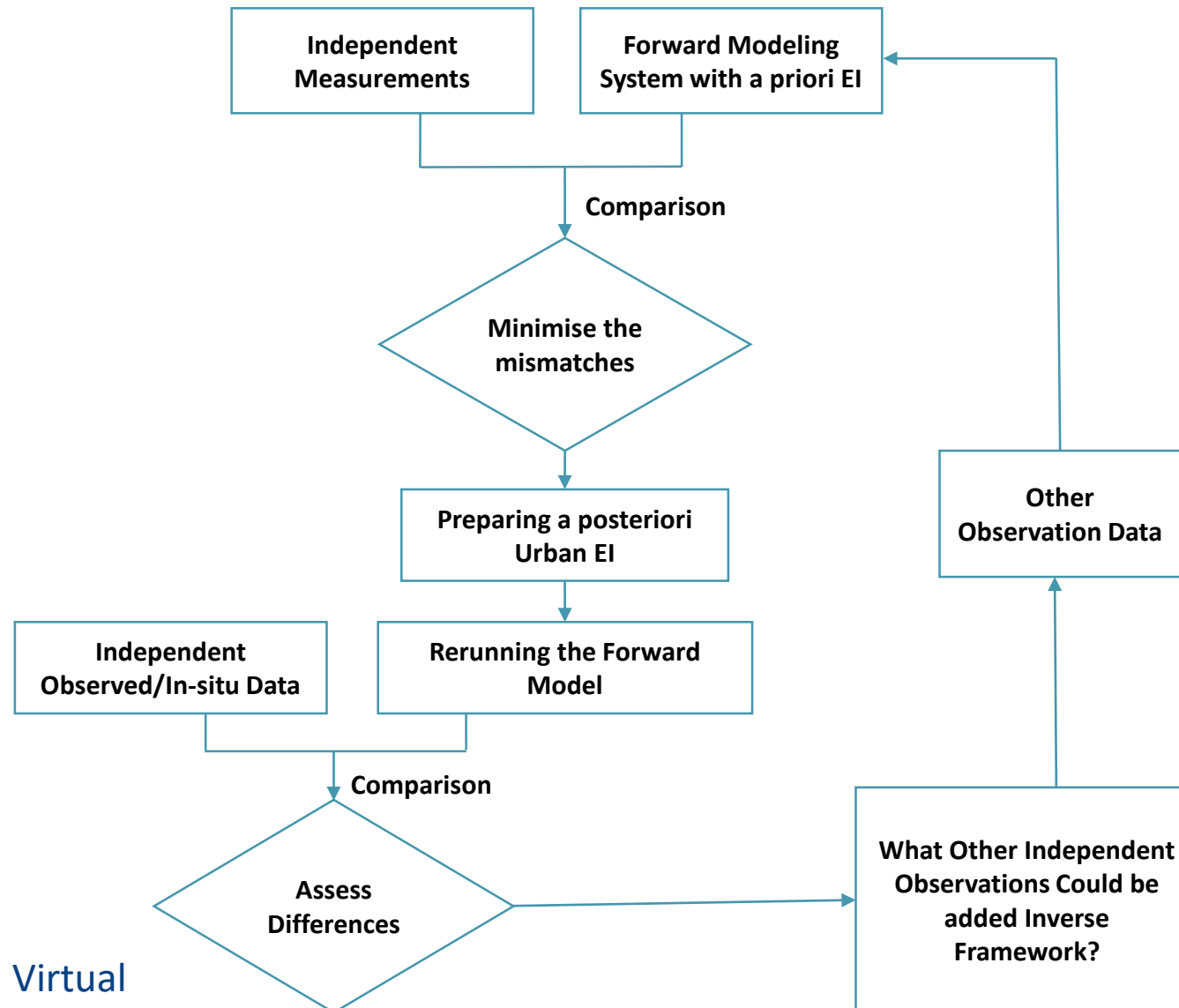


Introduction

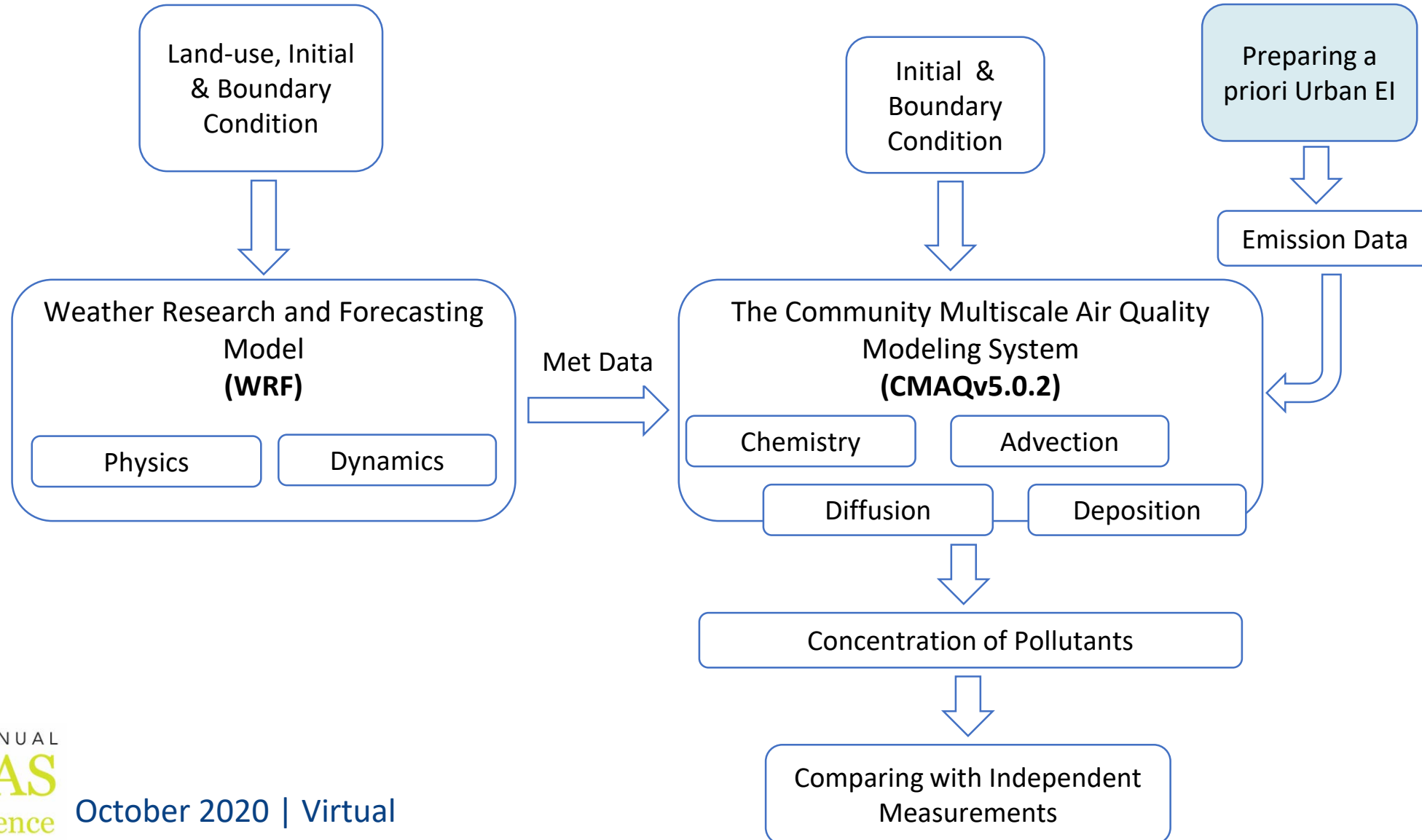


- **Tehran**
- **Carbon Monoxide**
 - ✓ How well does the model output and current urban EIs represent the observed data in Tehran?
 - ✓ How much information is in satellite data to constrain urban emissions?

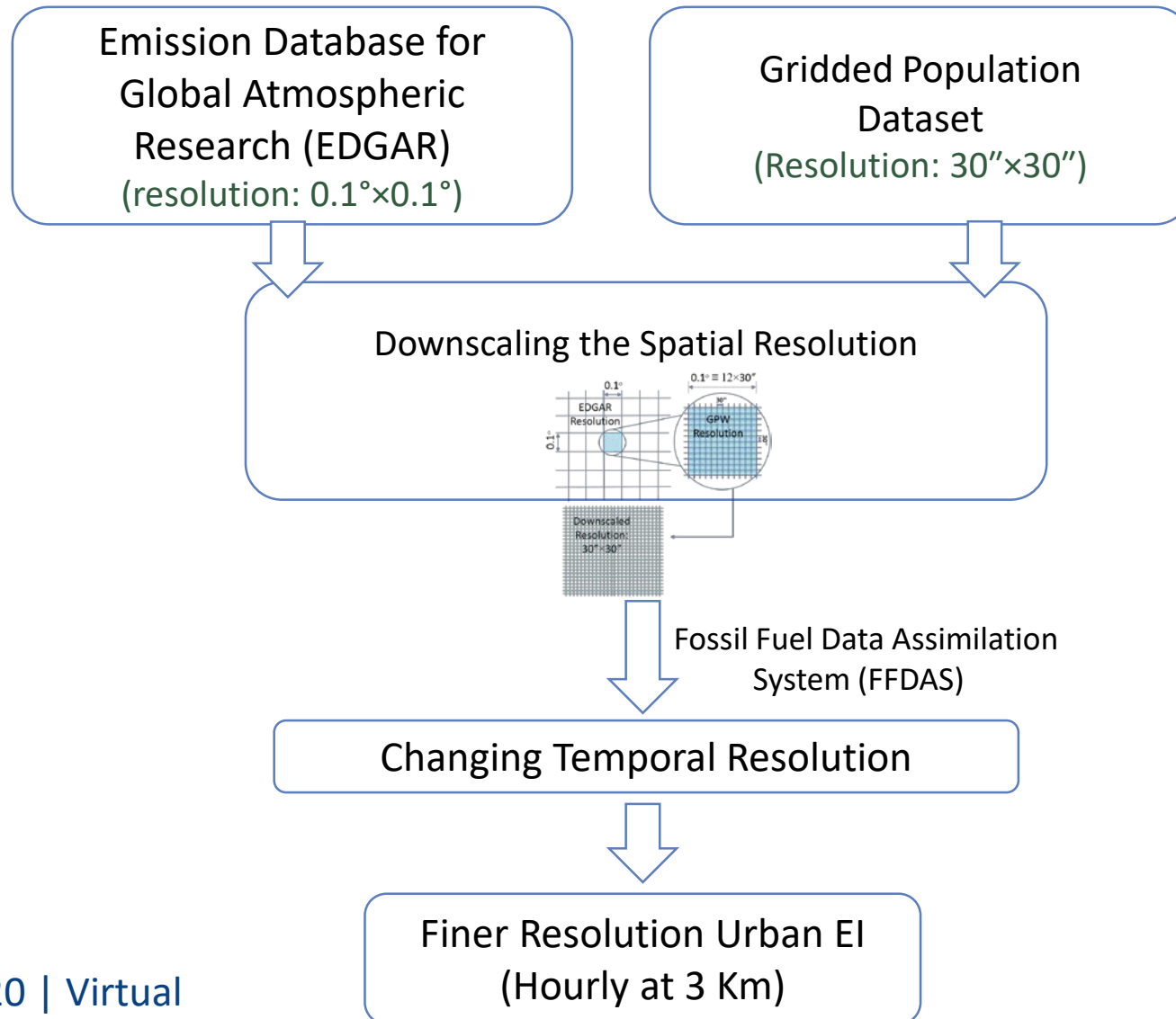
Methodology – Inverse Framework



Methodology – Forward System



Methodology – a priori Urban EI





Methodology

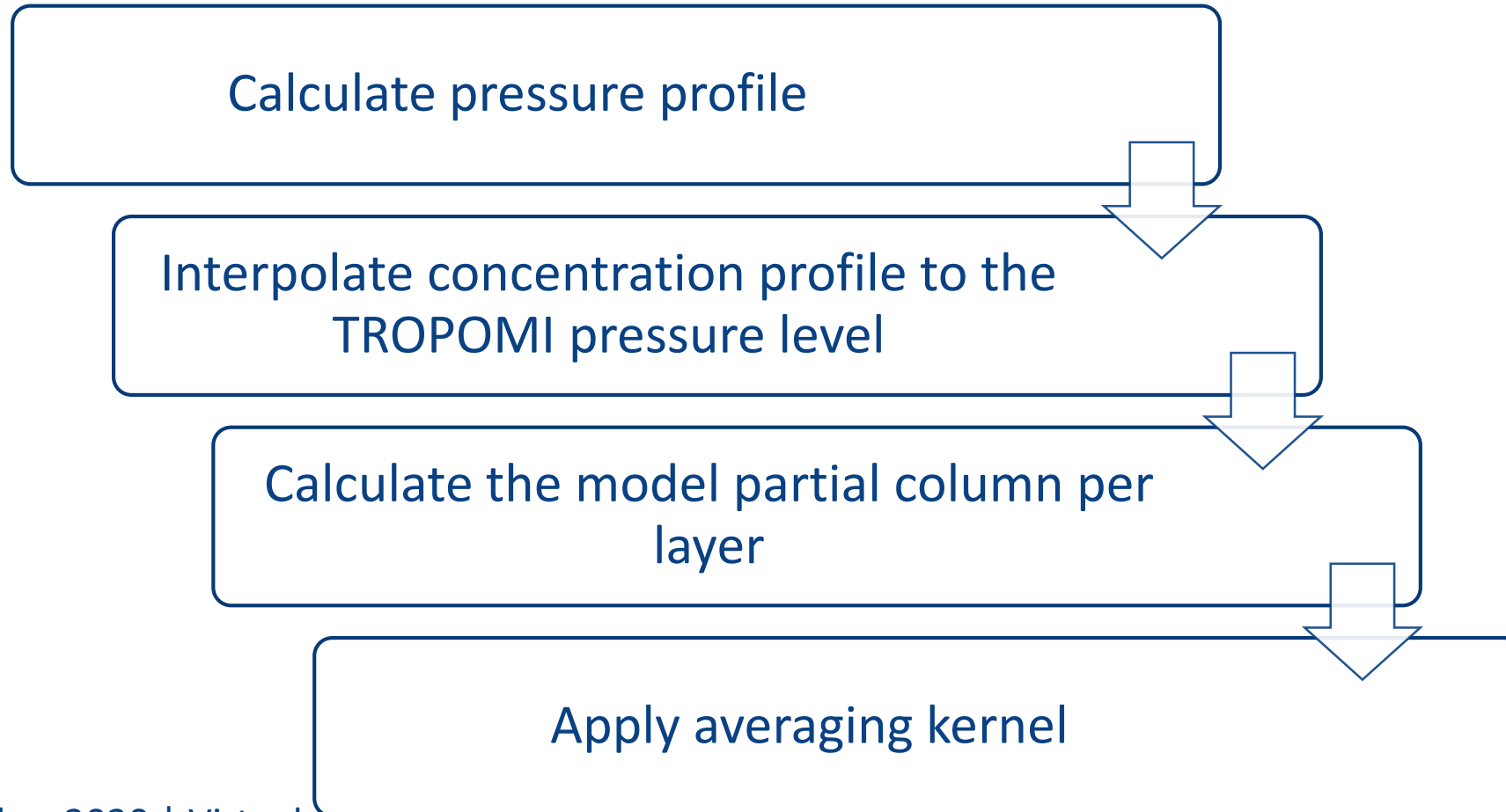


- Satellite Data
 - Carbon monoxide total column retrievals from TROPospheric Monitoring Instrument (TROPOMI)
 - **SRON** Netherlands Institute for Space Research
 - German Aerospace Center-Institute for Environmental Research/University of **Bremen**
- Surface Data
 - Measured data by the Air Quality Control Company (AQCC) in Tehran

Methodology- Satellite Data



Preparing TROPOMI column retrievals to be comparable with CMAQ outputs



Results – CO Comparison – Aug 2018

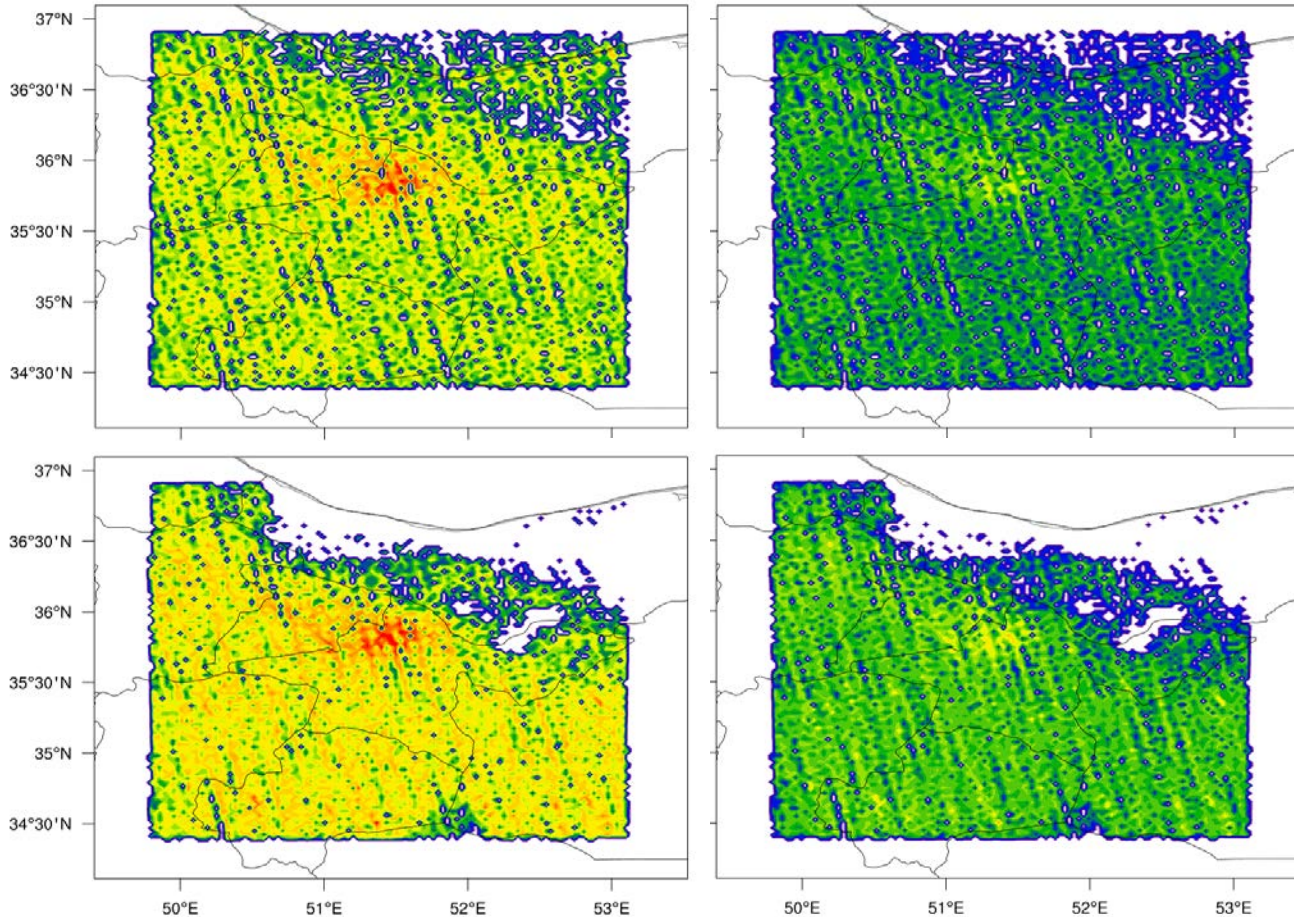


SRON Dataset

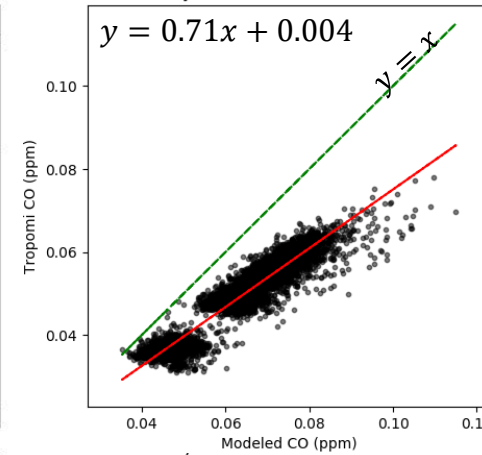
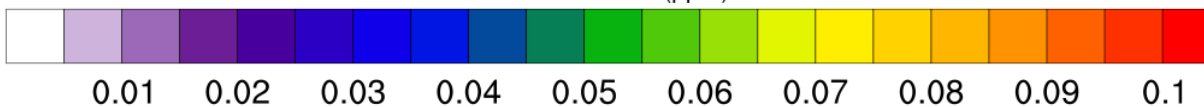
Bremen Dataset

TROPOMI

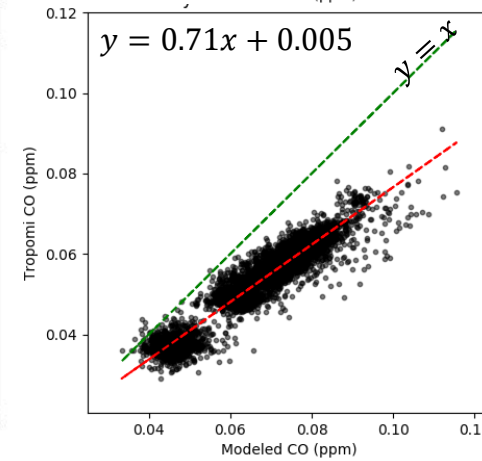
CMAQ



Concentration (ppm)



Pearson Corr. = 95%
 Bias = 14 ppb
 CMAQ Average = 49 ppb
 TROPOMI Average = 63 ppb



Pearson Corr. = 95%
 Bias = 15 ppb
 CMAQ Average = 53 ppb
 TROPOMI Average = 68 ppb

Results – CO Comparison – Nov 2018

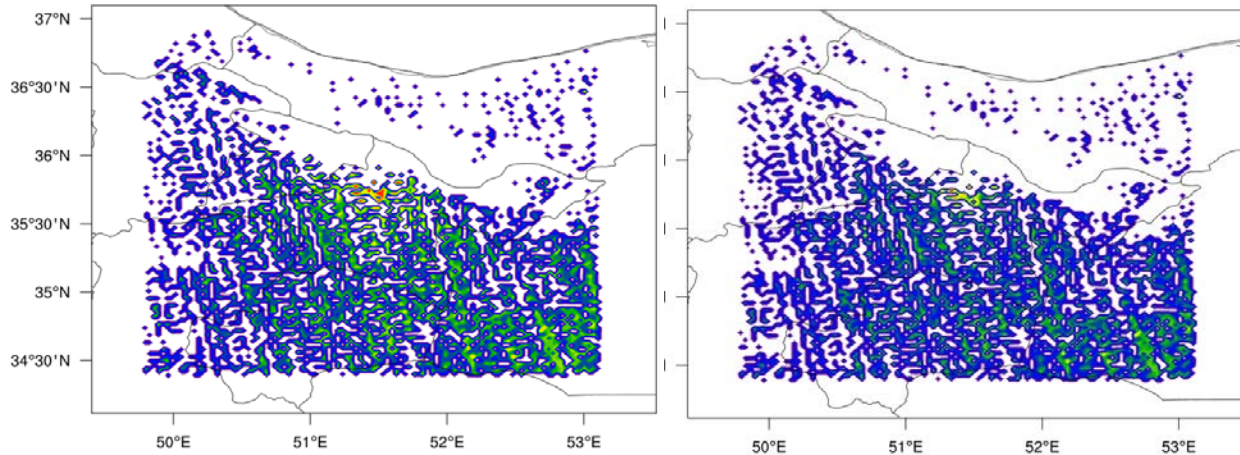
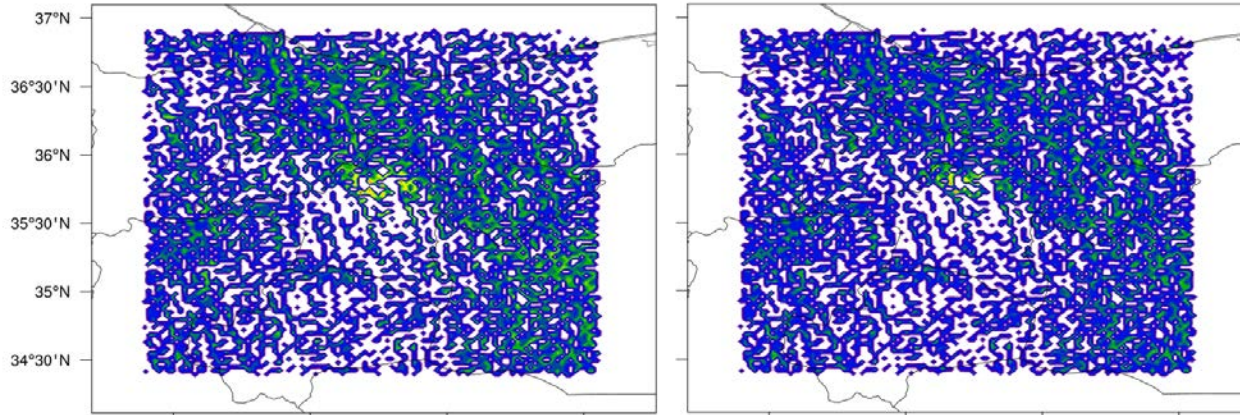


SRON Dataset

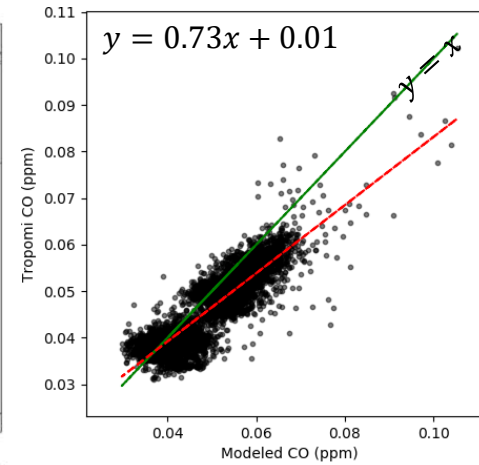
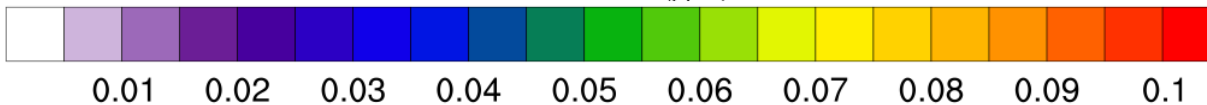
Bremen Dataset

TROPOMI

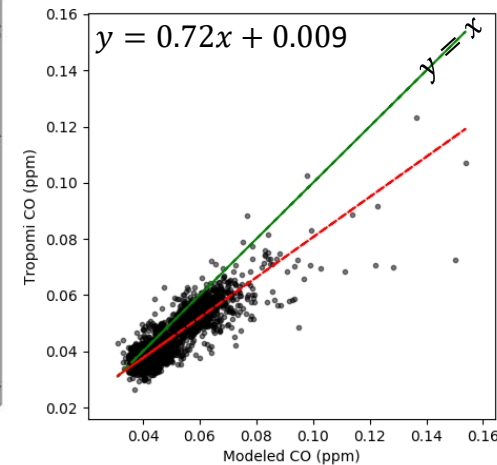
CMAQ



Concentration (ppm)

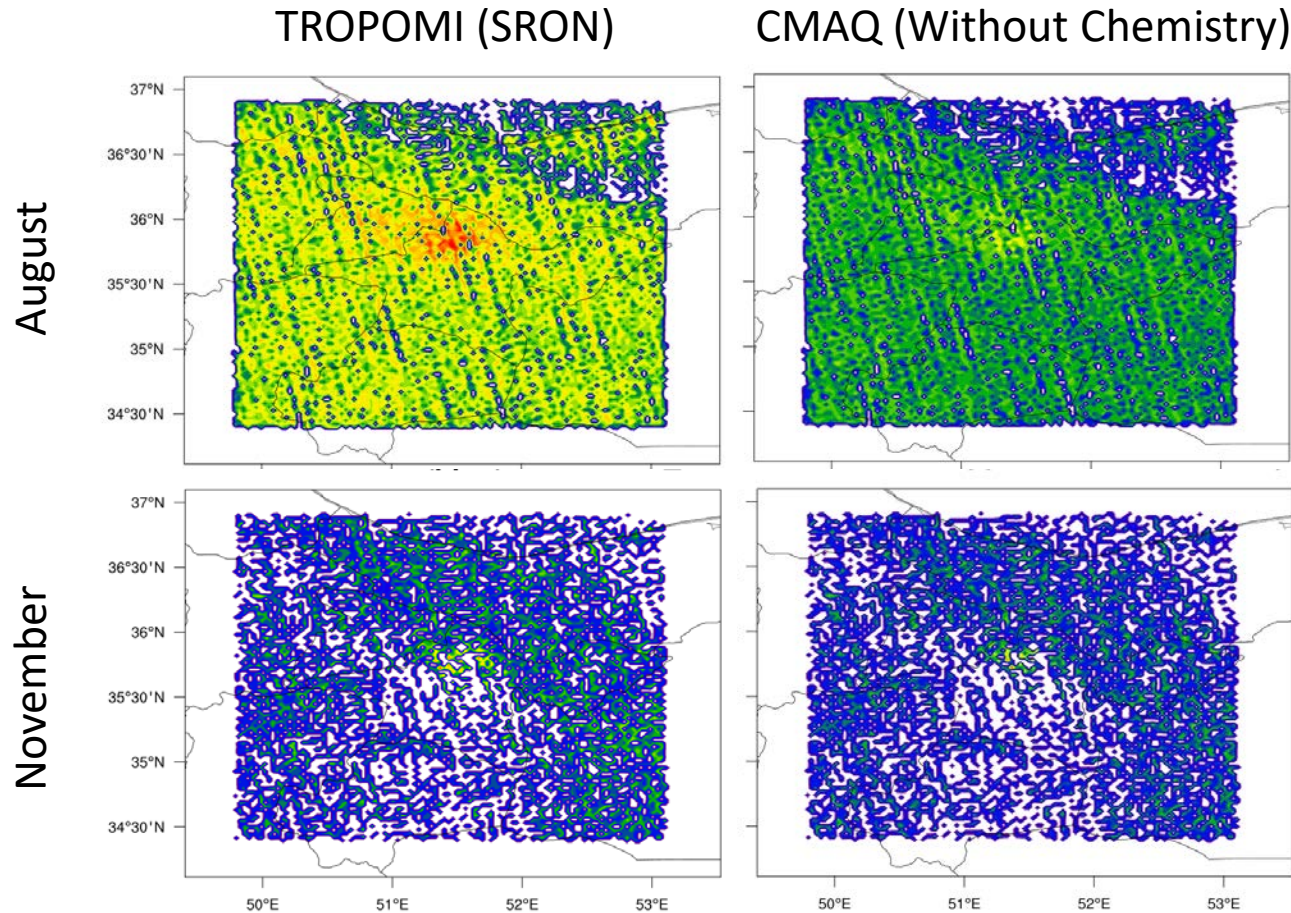


Pearson Corr. = 88%
Bias = 3 ppb
CMAQ Average = 45 ppb
TROPOMI Average = 48 ppb



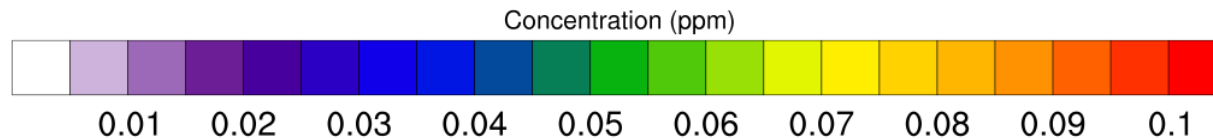
Pearson Corr. = 88%
Bias = 5 ppb
CMAQ Average = 44 ppb
TROPOMI Average = 49 ppb

Results – No Chemistry Version

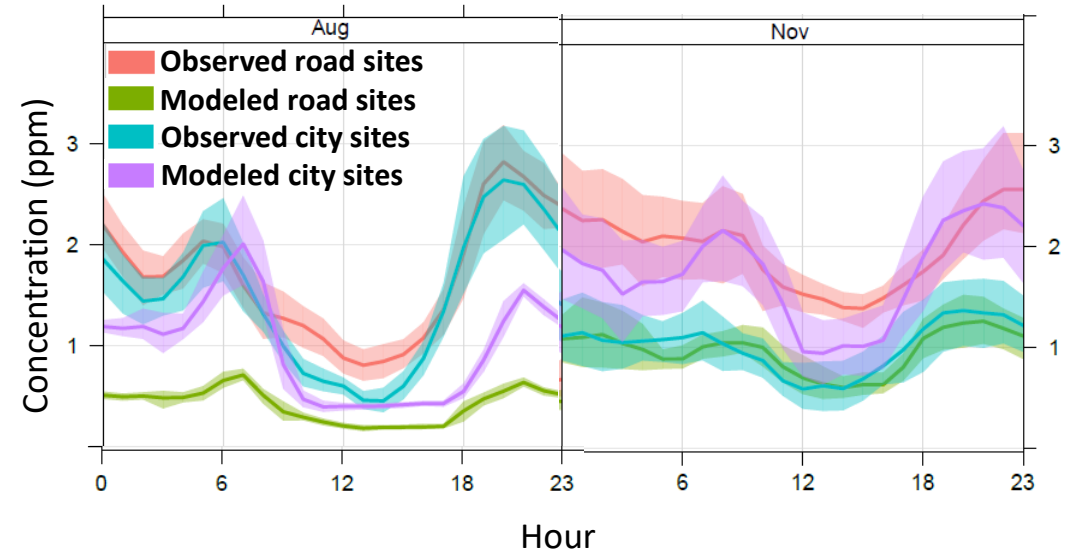
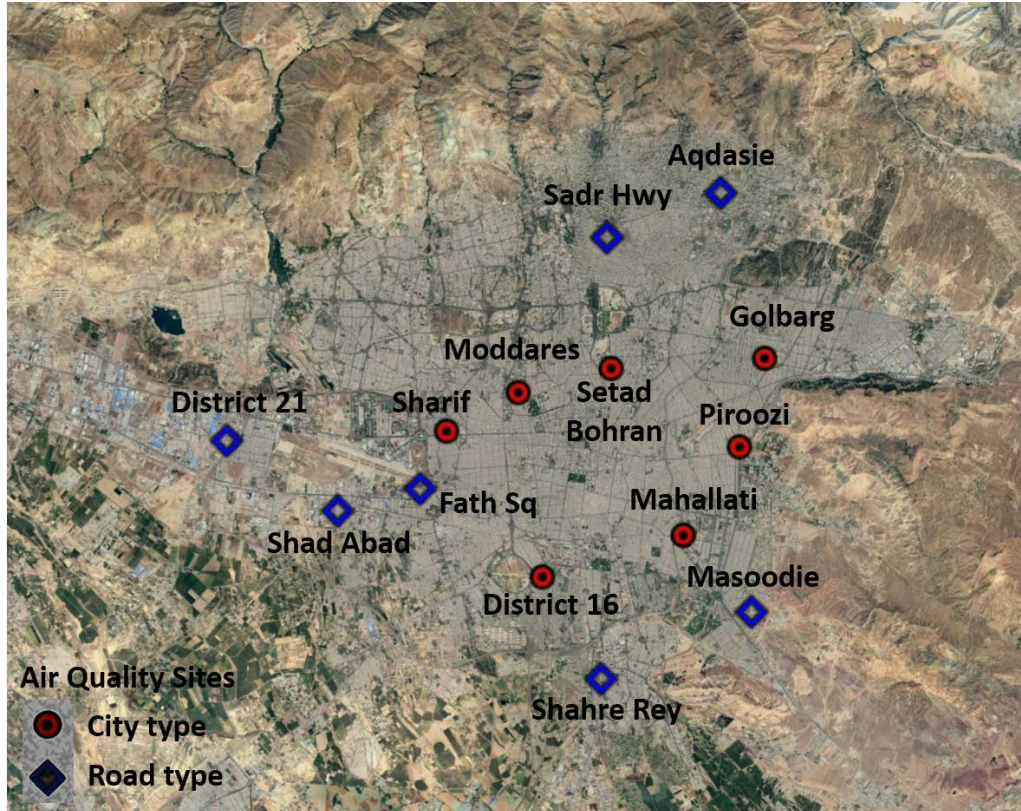


Pearson Corr. = 95%
 Bias = 14 ppb
 CMAQ Average = 49 ppb
 TROPOMI Average = 63 ppb

Pearson Corr. = 88%
 Bias = 2 ppb
 CMAQ Average = 43 ppb
 TROPOMI Average = 46 ppb



Results – Surface Data



Months	City sites		Road Sites	
	R	Bias (ppm)	R	Bias (ppm)
Aug -18	0.62	0.59	0.65	1.4
Nov -18	0.84	-0.83	0.81	1.15

Conclusion



- The modeled CO was compared with observations.
- The model underestimates the surface and satellite data.
- The TROPOMI retrievals from the SRON Institution and the Bremen University are almost similar, but with the larger number of the SRON soundings in our domain.
- Next steps for improving the EIs:
 - ✓ Establish an urban scale inverse framework using 4D-Var data assimilation.
 - ✓ Run the inverse model for CO in Tehran using SRON dataset.
 - ✓ Apply independent measurements to assess the inverse model capability in improving CO-EIs.
 - ✓ Modify the framework for other species and urban areas.



THE UNIVERSITY OF
MELBOURNE



19th ANNUAL
CMAS
Conference

October 2020 | Virtual

