Nordic Reference Laboratory meeting on air quality modelling
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UNIVERSITY OF ICELAND

Modeling natural and anthropogenic sources

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ENVIRONMENT AND NATURAL RESOURCES

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Eruptions

- **Eyjafjallajökull 2010**
  - 6000 Gg of PM_{10}
- **Grímsvötn 2011**
  - Approximate estimate
  - 47000 Gg PM_{10} and
  - 13000 Gg of $PM_{2.5}$
- **Bárðabunga 2014-2015**
  - SO_2 emission total 11 ± 5 Mt
    - Six months eruption Aug 2014 - Feb 2015
  - CO_2 emission 5.6 ± 3.6 Mt

Gislason et al. (2015)

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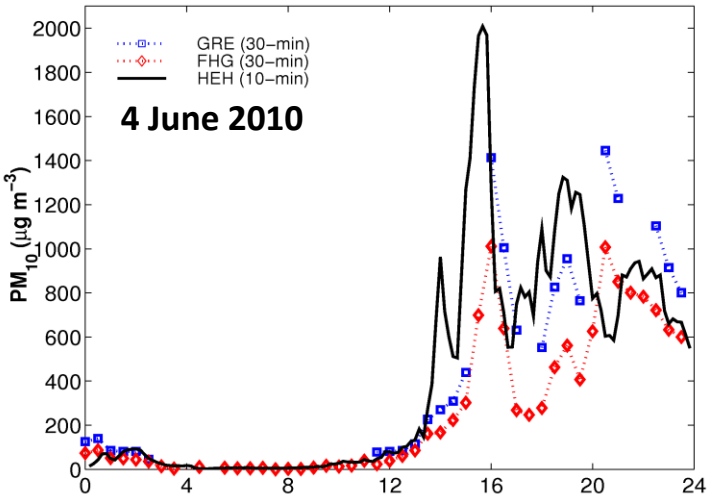
Reykjavik – after eruption

2010 Eyjafjallajökull

- Very poor air quality for those effected by the eruption plume during the eruption
  - Not very surprising
- Shortly after there was very poor air quality due to re-suspension
  - A little more noteworthy



Throstur Thorsteinsson, T. Jóhannsson, A. Stohl, and N. I. Kristiansen. 2012. **High levels of particulate matter in Iceland due to direct ash emissions by the Eyjafjallajökull eruption and resuspension of deposited ash.** *J. Geophys. Res.*, **117**, B00C05, doi:10.1029/2011JB008756.

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Dust storms

Tom Mockford, Joanna E. Bullard and Throstur Thorsteinsson. 2018. **The dynamic effects of sediment availability on the relationship between wind speed and dust concentration**. *Earth Surface Processes and Landforms*, doi: 10.1002/esp.4407.

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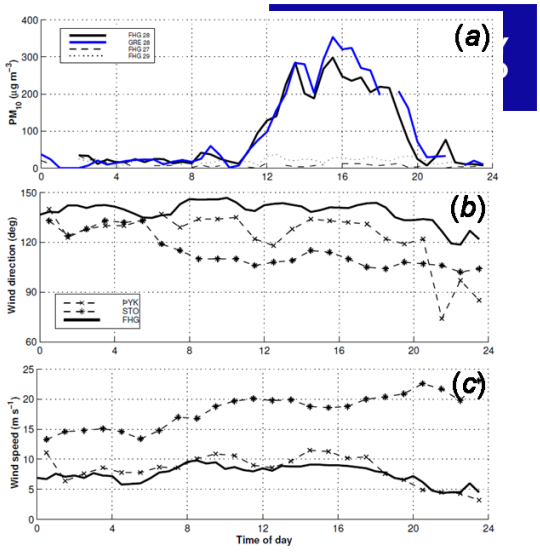
Dust storms: PM10 in Rvk



Throstur Thorsteinsson, Guðrún Gísladóttir, Joanna Bullard and Grant McTainsh. 2011. **Dust storm contributions to airborne particulate matter in Reykjavík, Iceland.** *Atmospheric Environment*, **45**: 5924 - 5933

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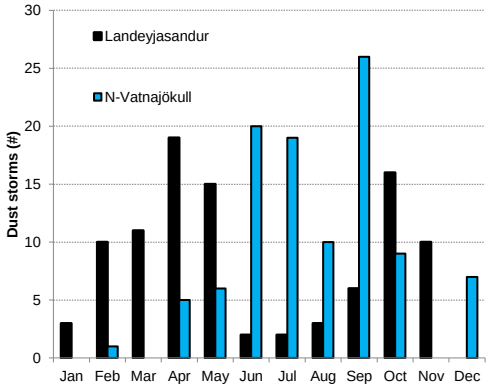
Dust Storm Seasonality

- Spring and fall
- Melting in spring
- Less water in fall
- Lowest wind speed during summer



(2002 – 2011)

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Summary

- Dust (and ash) storms spoil the air quality quite frequently.
  - **On average 22% of the times when over the health limit.**
- Know more and more about the negative health effects of PM …
  - But impact of different sources less well constrained
- Better knowledge of source areas and distribution improves models.

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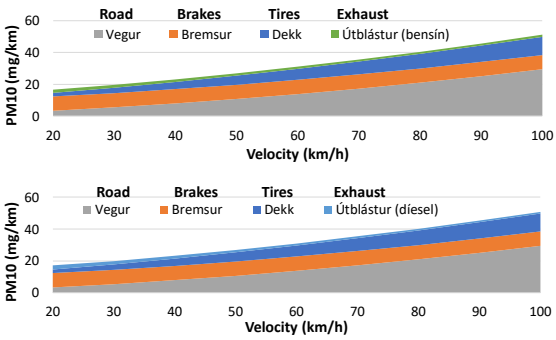
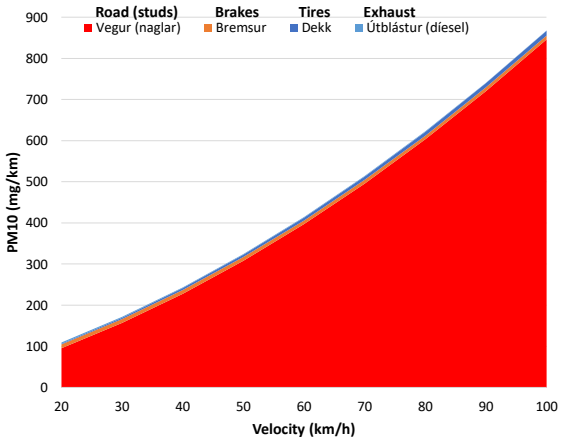
Traffic

- **PM - Studded tires dominate**





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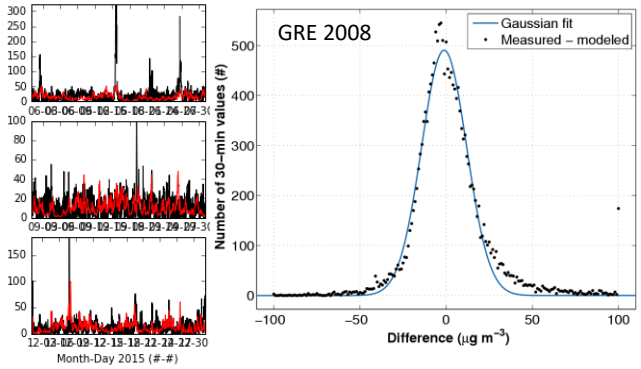
Simple location-based model …

- Includes traffic (volume proxy NOx)
- Resuspension locally
- Does not include natural sources (dust storms, eruptions)
- Not a strict budget accounting
- Does alright, but better option available NORTRIP

- **Example:**
  - **Few months at a traffic station called GRE in 2015**



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NORTRIP

NOn-exhaust Road Traffic Induced Particle emission modelling

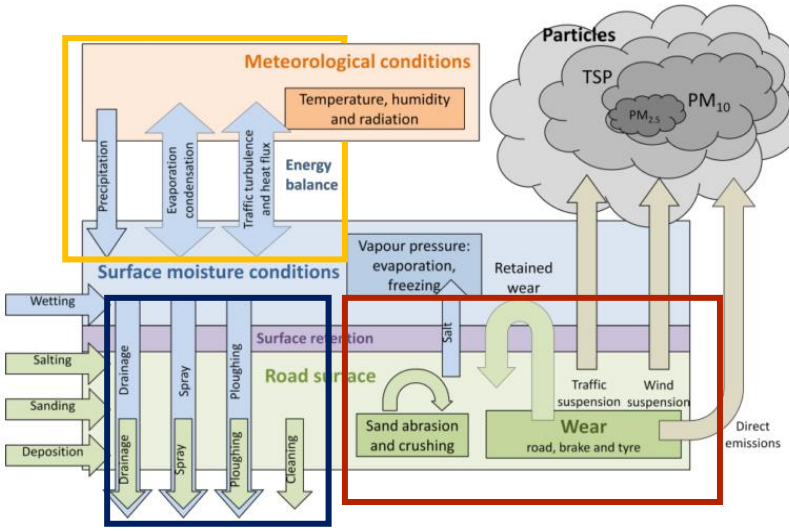
Process Based Emissions Model

Road Dust

- Sources
  - Wear (road, brakes, tires)
  - Abrasion/crushing
- Sinks
  - Drainage, spray, ploughing, cleaning

Road Moisture

- Energy Balance
  - Evaporation/condensation
  - Sources and sinks



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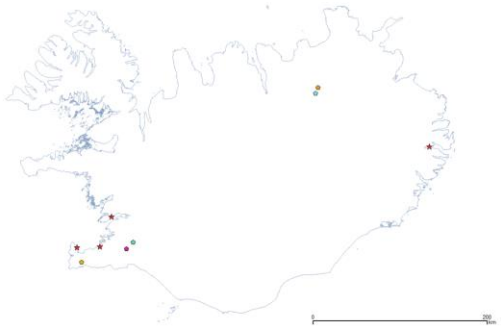
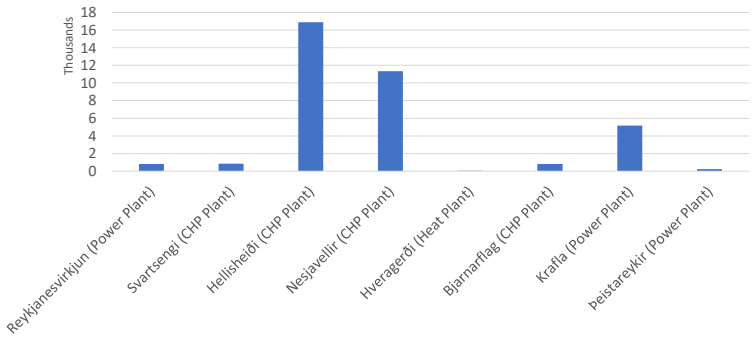
Point sources

- Location of aluminum smelters (stars) and geothermal power plants (pentagons).
- Example H2S:



H_2S from geothermal power plants 2012



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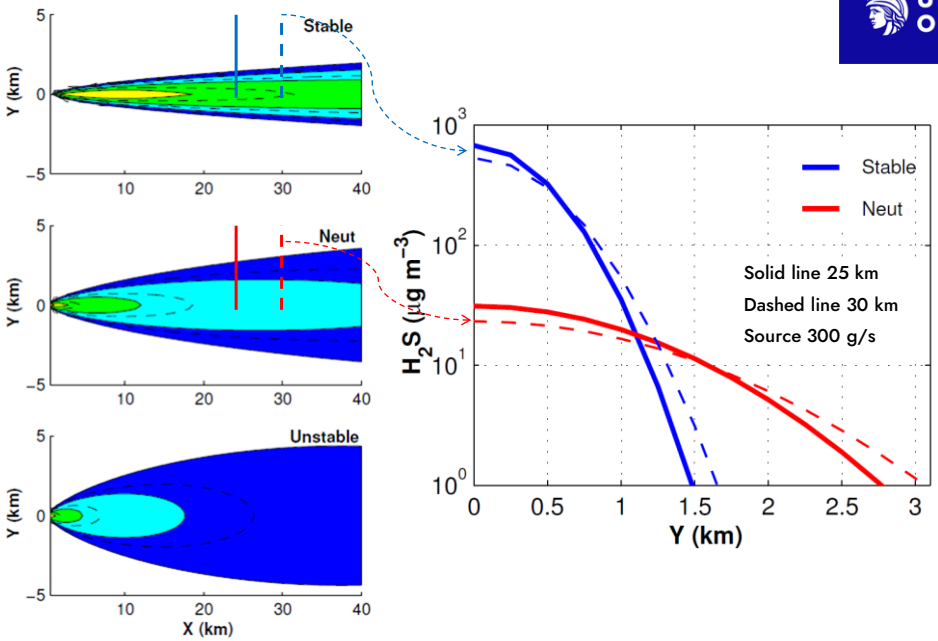
Gaussian plume



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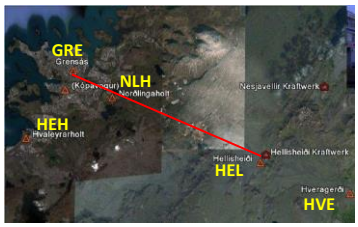
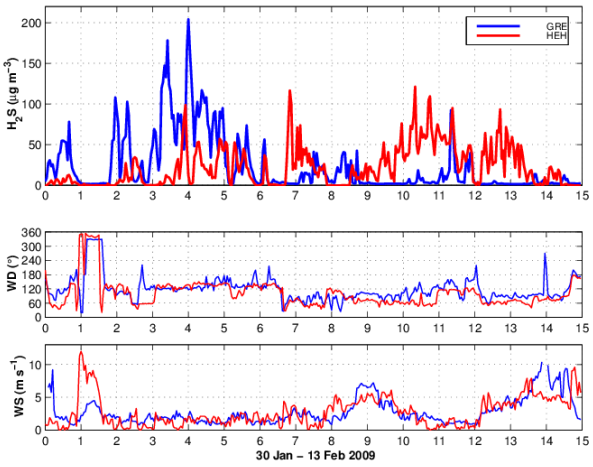
Narrow plume

- High correlation between GRE and NLH (Pearson 0.7)
  - Are in line with Hellisheiði
- Very low correlation between GRE og HEH (0.13), or HEL, HVE





Finnbjornsdottir et al. "Association between Daily Hydrogen Sulfide Exposure and Incidence of Emergency Hospital Visits: A Population-Based Study." *PLoS ONE*, vol. 11, no. 5, 2016, doi:10.1371/journal.pone.0154946.

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NordicWelfAir

Part of the project was to collect information about pollution sources, especially from traffic and industry

Calculate pollution using UBM

1 km x 1 km grid

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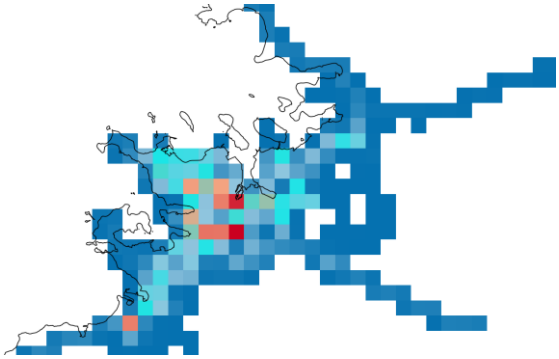
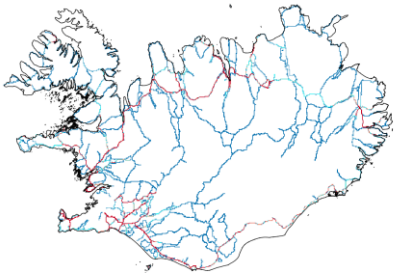
City traffic

- Traffic volume in the Reykjavik area (VSÓ 2012 data).
- 1 km x 1 km grid
- Estimate total emissions, distribute using traffic volume



Raster for highways in Iceland, omitting Reykjavik area (Vegagerðin 2015 data)



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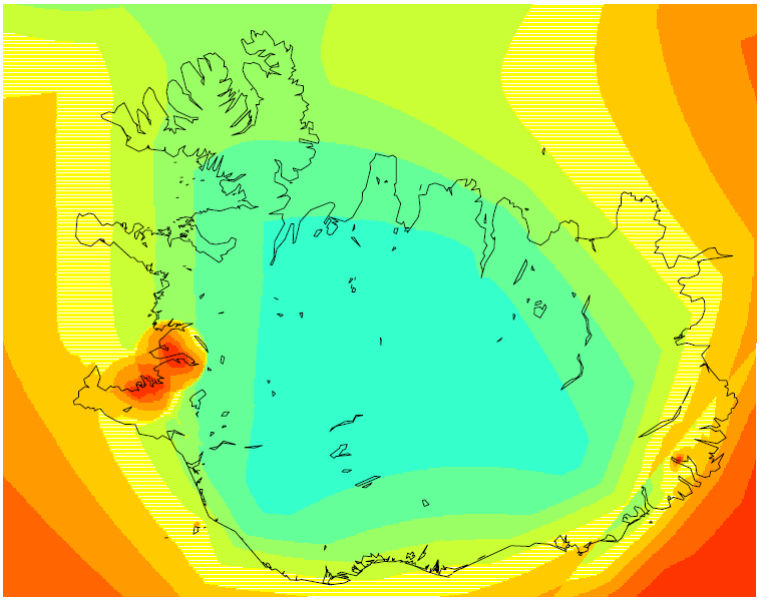

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