

# *40<sup>th</sup> Anniversary*

Performance of AERMOD modelling of  
hydrogen sulfide (H<sub>2</sub>S) concentration from  
geothermal power plants in Ulubelu, Indonesia,  
and Hellisheiði-Nesjavellir, Iceland

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# Introduction

- Energy policy and H<sub>2</sub>S air quality policy
  - Geothermal power in Indonesia (7,242 MW by 2025) and Iceland (energy consumption at 2.8% by 2020)
  - H<sub>2</sub>S air quality policy (i.e., the standards of odor, occupational health, and public health)
  - Taking rightful decisions in the setting up and reviewing regulation policy and mitigation action (i.e., underestimation or overestimation)
- Hydrogen Sulfide (H<sub>2</sub>S)
  - Colorless, heavier density than air, rotten egg smell (i.e. low concentration), loss of smell (i.e. high concentration)
  - Eyes, skin, and respiratory irritations
- AERMOD Viewtm Version 9.4 ,2017
  - Examined H<sub>2</sub>S concentration by seasons
  - Model performance for the time scales at 1-hr, 8-hr, 24-hr, annual average



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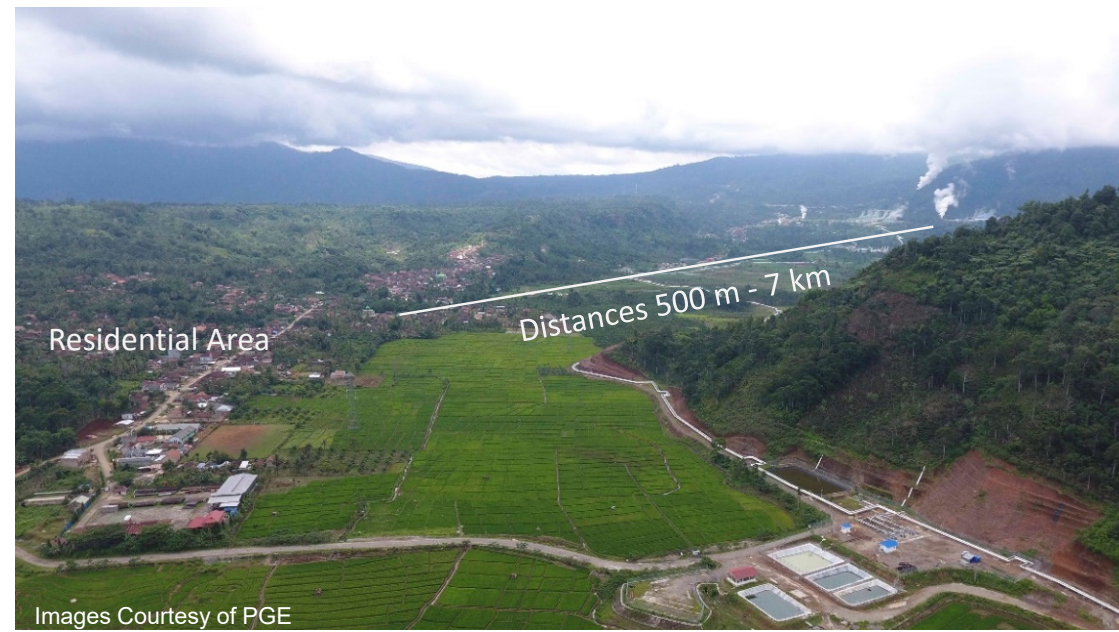
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# Project Location (Indonesia)





# Project Location (Iceland)



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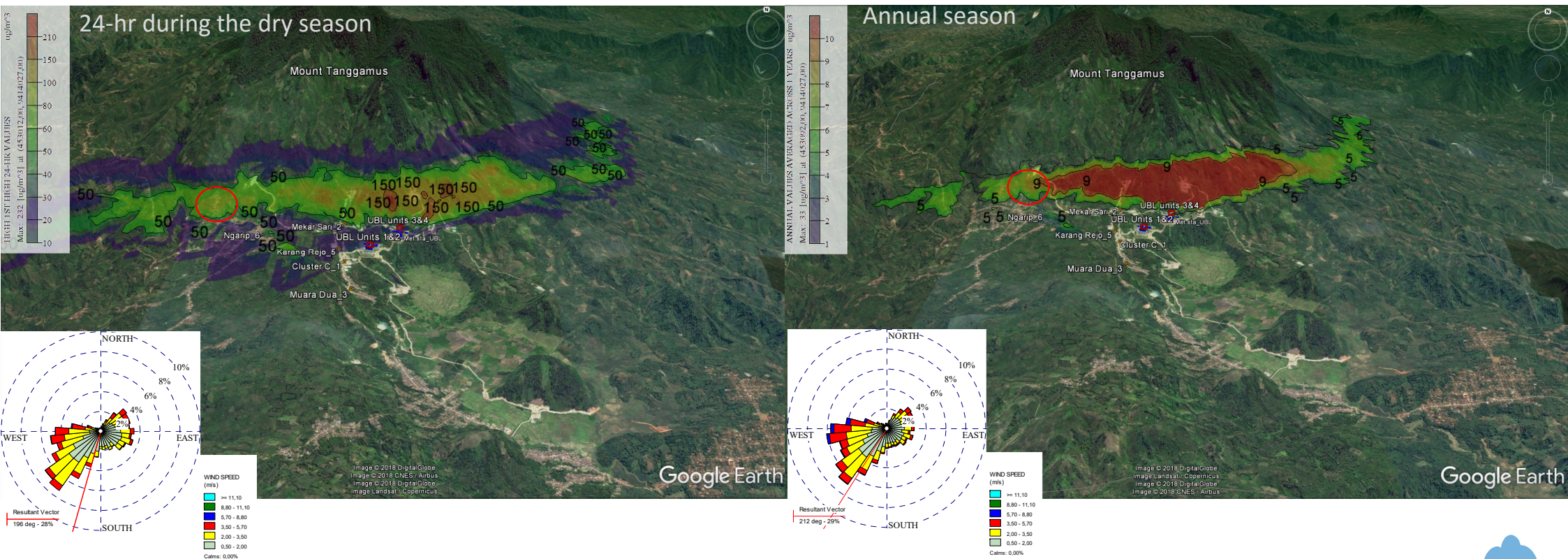
# Input data simulations and model performance

| Ulubelu Power Plant (UBL case)  | Hellisheiði and Nesjavellir PP (HEL-NES case)  |
|---|--|
| <b>Simulation of H<sub>2</sub>S concentration</b>   |  |
| Met data; UBL met data (UBL)*   | Reykjavik (REYK), and Hellisheiði met stations (HELS)*   |
| Input; rural, elevated terrain option   | Urban, flat terrain option   |
| H <sub>2</sub> S flowrate; Units 1 and 2 (21.05 g/s) and Unit 3 and 4 (16.57 and 21.35 g/s),  | Hellisheiði (540 g/s) and Nesjavellir (358 g/s)  |
| Receptors in Ulubelu village, dry season, time scales of 1-hr, 8-hr, 24-hr, and annual average against H <sub>2</sub> S legislations  | Receptors in Reykjavik greater area and Hveragedi, winter season, time scales of 24-hr and annual average  |
| <b>Model performance</b>  |  |
| <ul style="list-style-type: none"> <li>-Observation points; Mekarsari, Ngarip and Karang rejo villages, PP units 3&amp;4 (sources &lt; 3 km)</li> <li>-Sampling 28-31 August 2017</li> <li>-Met data; UBL</li> <li>-SD, RMSE, correlation (Taylor diagram)</li> </ul> | <ul style="list-style-type: none"> <li>- Grensasvegur (GRE), Hvaleyrarholt (HEH), and Norðlingaholt (NLH) H<sub>2</sub>S stations, data obtained; 1<sup>st</sup> March 2017 and 9<sup>th</sup> November 2015 and 2012-2016</li> <li>-Metdata; Straumvik (STRM), Reykjavik, and Hellisheiði met stations** (The distance of the sources &lt; 4 km – 30 km)</li> </ul> |
| no background H <sub>2</sub> S concentrations, *site-specific meteorological data   |  |





# Simulation of H<sub>2</sub>S concentration from the Ulubelu power plants

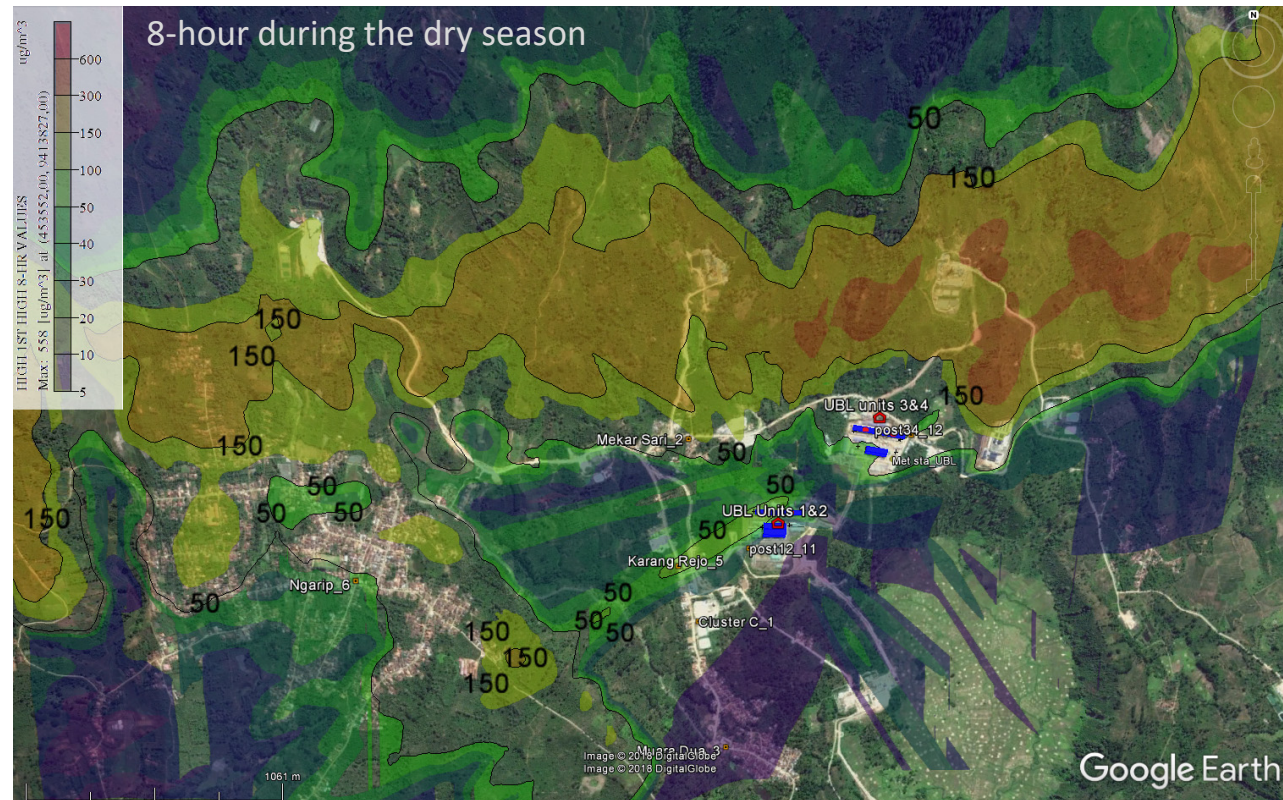
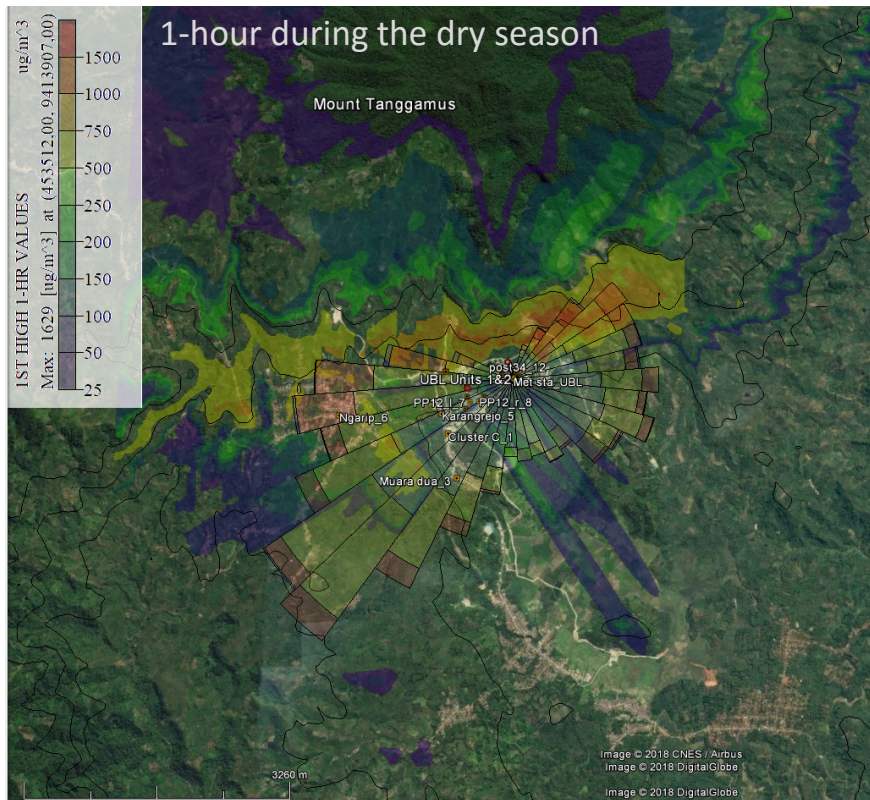


- H<sub>2</sub>S concentrations > The Icelandic public health limit (50 µg/m<sup>3</sup> for 24-hour and 5 µg/m<sup>3</sup> for annual period)
- H<sub>2</sub>S concentrations < The WHO air quality guideline (150 µg/m<sup>3</sup> for 24-hour)

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# Simulation of H<sub>2</sub>S concentration from the Ulubelu power plants



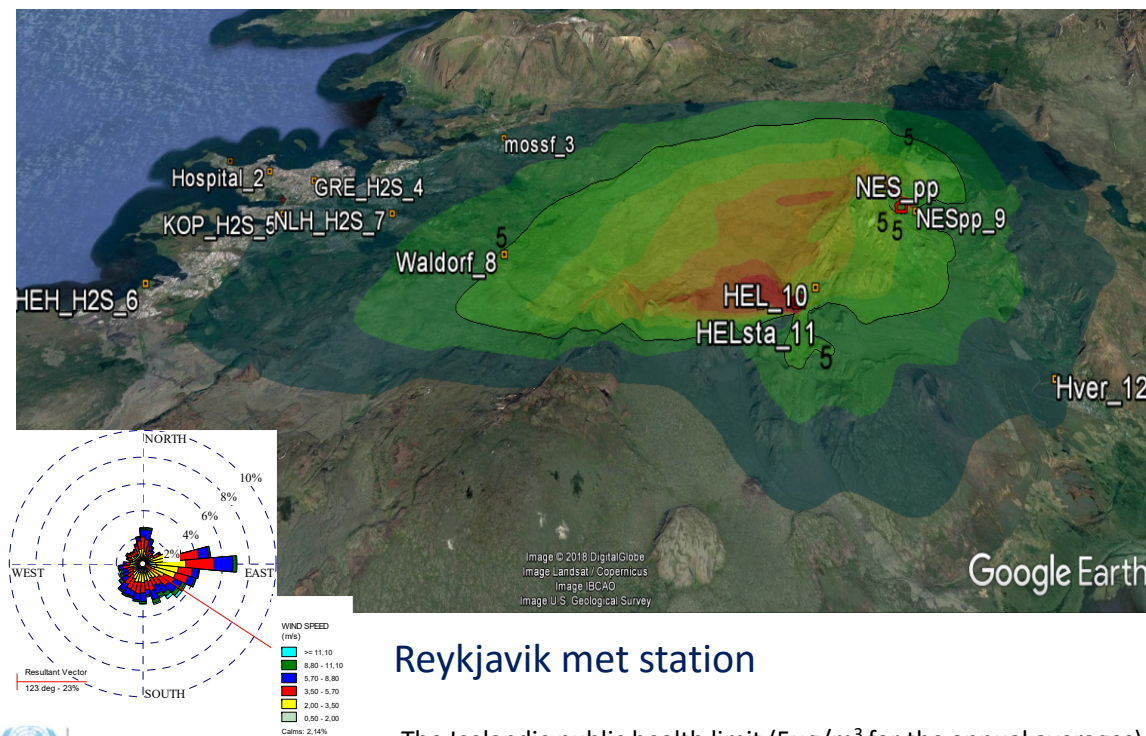
\*The predicted H<sub>2</sub>S concentration < the Indonesian occupational health limit (1,400 µg/m<sup>3</sup> for 8-hour averages)



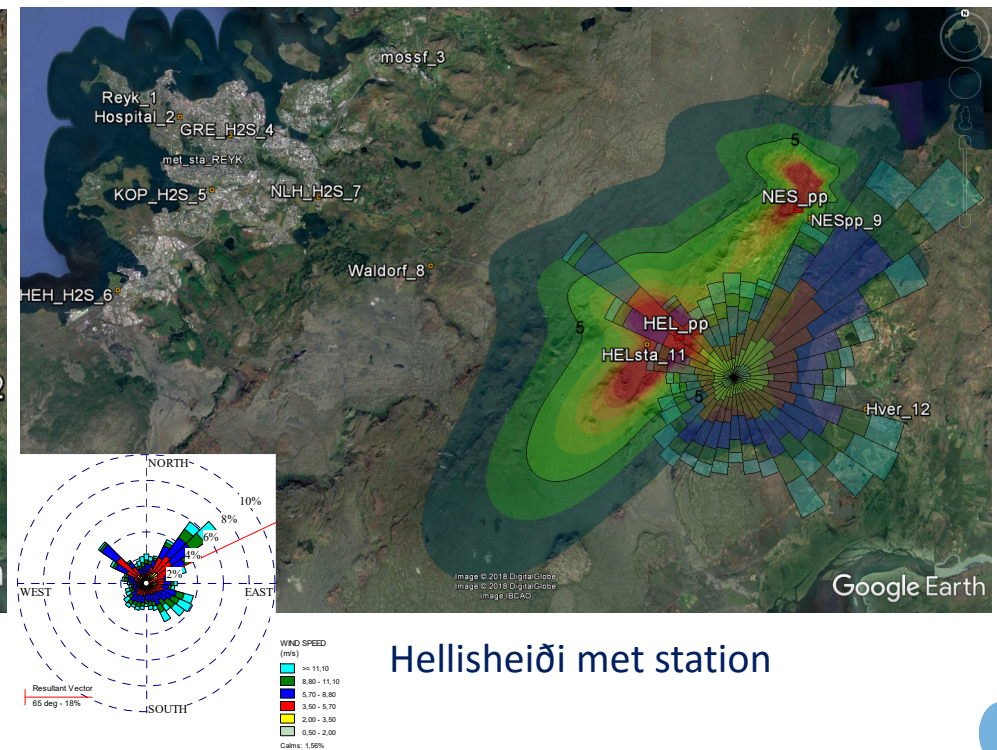


# Simulation of H<sub>2</sub>S concentration from the Hellisheiði and Nesjavellir power plants

Annual averages period

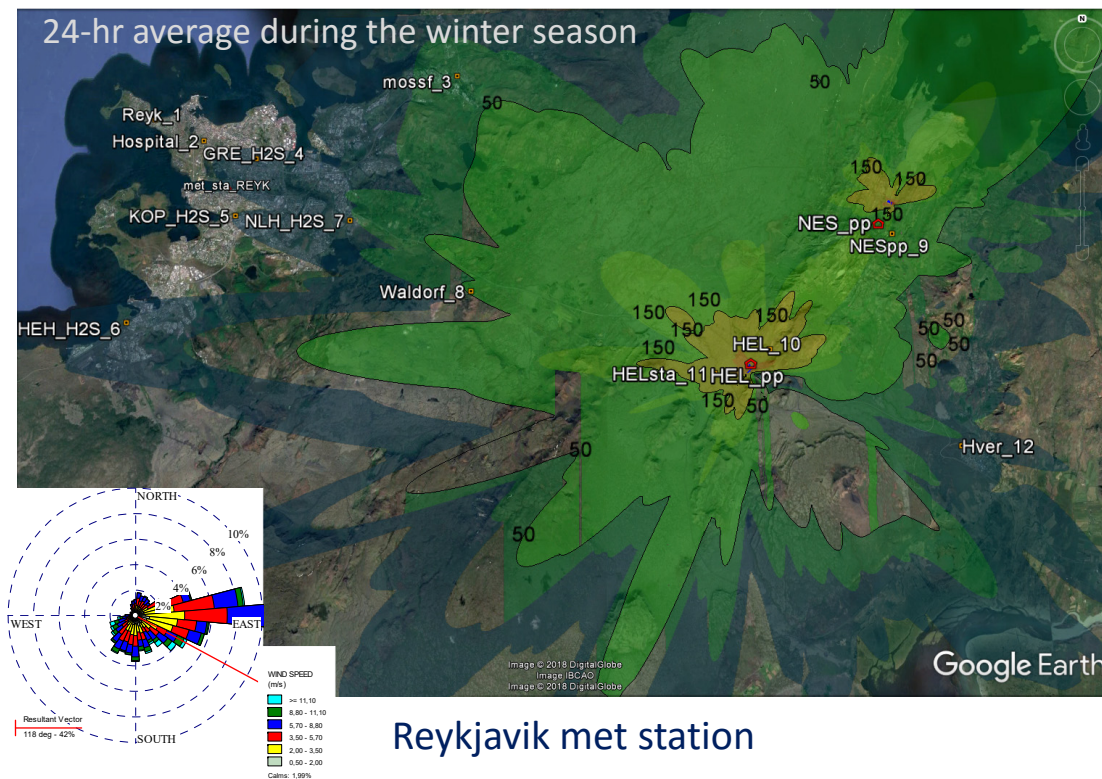


- The Icelandic public health limit ( $5\mu\text{g}/\text{m}^3$  for the annual averages)

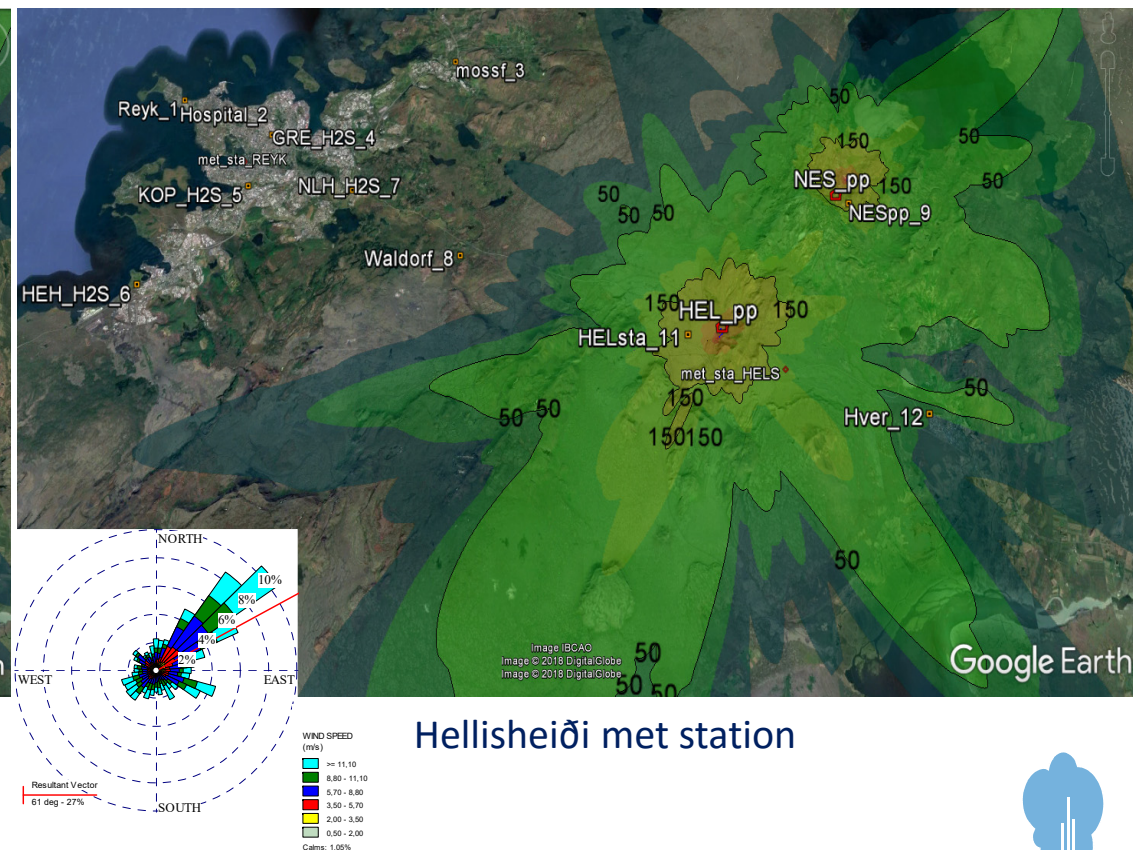




# Simulation of H<sub>2</sub>S concentration from the Hellisheiði and Nesjavellir power plants



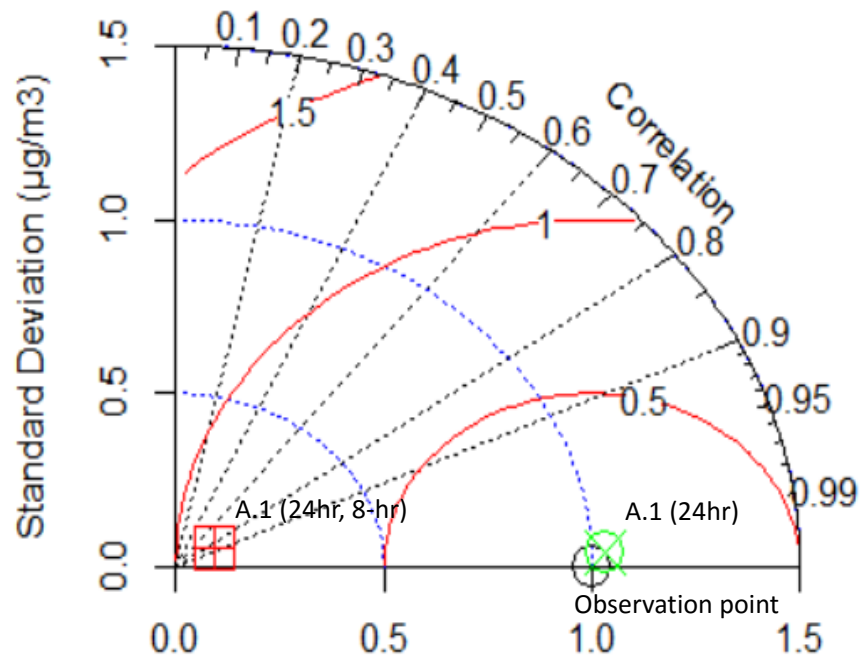
Reykjavik met station



Hellisheiði met station

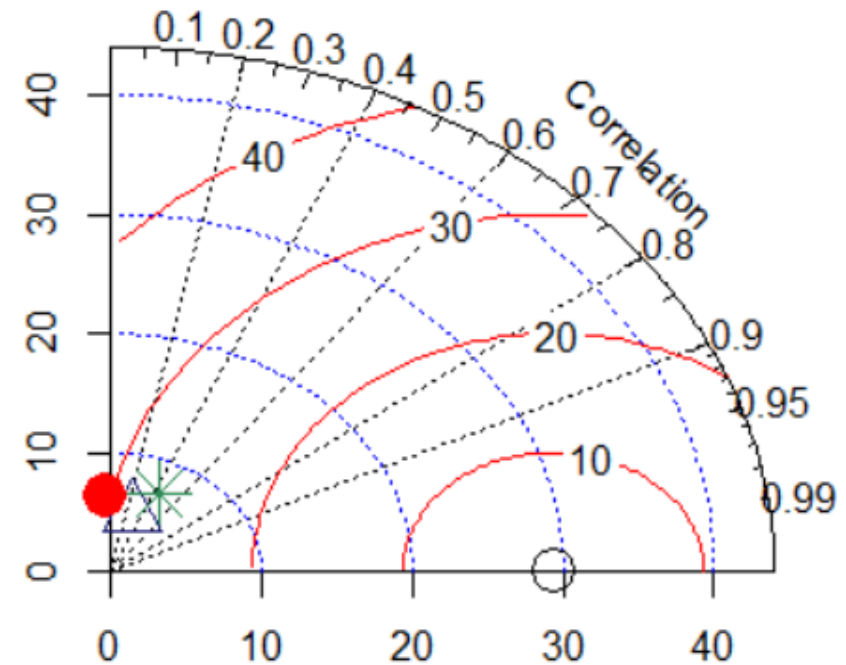
# Model performance

A. UBL case



Red square plus for the results model at 8 hr and 24-hr averages  
 Green circle cross for results model at 24 hr averages

B.1 HEL-NES case for 1-hr averages



HEL (red circled)  
 REYK (triangle)  
 STRM (green star)



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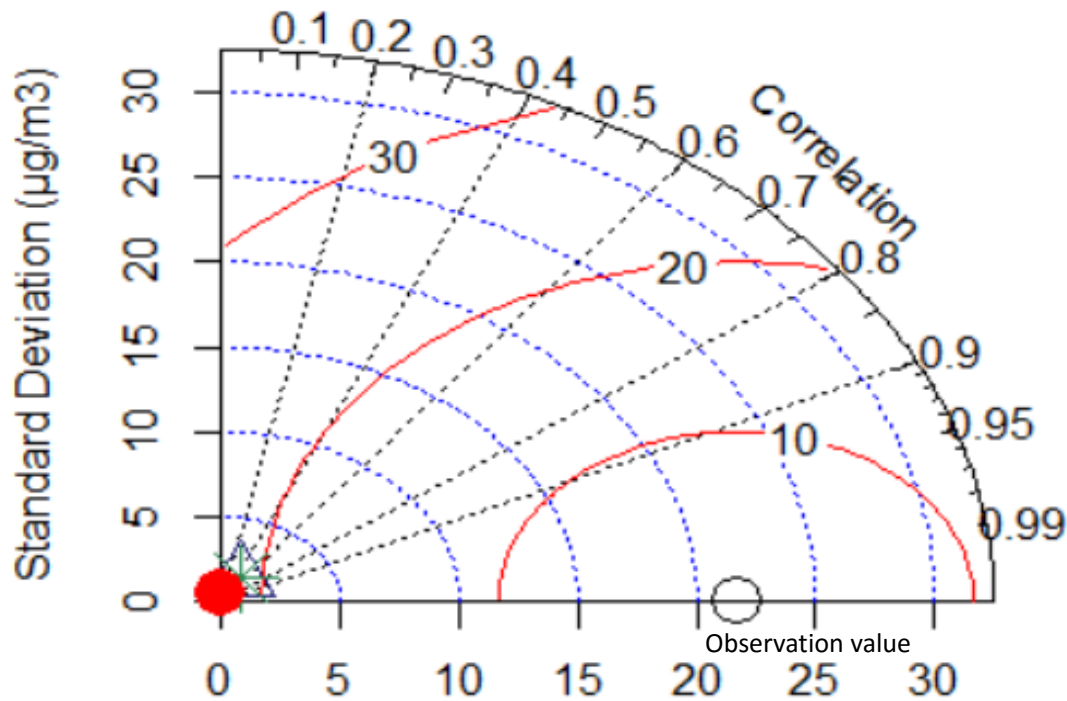
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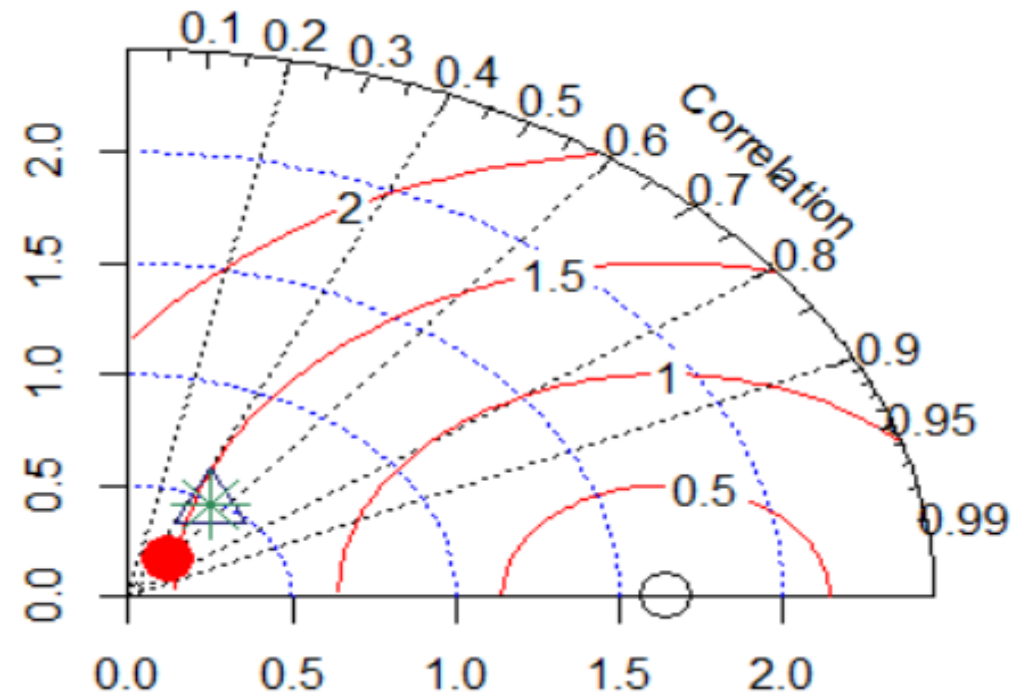


# Model performance

B.2 HEL-NES case (24-hr averages)



B.3 HEL-NES case (annual)



HELS (red circle)  
REYK (triangle)  
STRM (green star)

# Conclusions

- The models performed better for a long-term period than a short-term period (except UBL case model A.1 24-hr)
  - the distance of the receptors and emission sources (i.e. UBL < 3 km, HEL-HES; 30 km)
  - weather conditions (i.e., wind direction of REYK and HELS met stations )
- Evaluating the level of H<sub>2</sub>S concentration based on seasons
  - HEL-NES; the concentration is expected to be higher during the winter season
  - UBL case; the dry season
- Mitigations
  - H<sub>2</sub>S air pollution regulation and methods to predict H<sub>2</sub>S pollutant
  - integrating the policy of EIA (prior project started) with H<sub>2</sub>S air pollution guidelines (operation stage)
  - combines the multi-disciplinary approach



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“The only way forward, if we are going to improve the quality of the environment, is to get everybody involved “ R. Rogers

Thank you



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