PennState

GEOG 596A su20

FINAL PROPOSAL:

Evaluation of fog-based dust control measures in an open-pit mine operation through AERMOD dispersion modelling

Fernando Galindo Garcia

October 16, 2020. Coahuila, Mexico.

BACKGROUND

Air pollution is the discharge of any harmful pollutants into the atmosphere that potentially affect human health and other living beings and cause damage to the environment. These pollutants are known to be responsible for several diseases, such as lung cancer, heart disease, and respiratory disease (Sihag et al., 2019).

Total Suspended Particles (TSP)

15 µm

Inhalable particulate (IP)

2.5 µm

Fine particulate (FP)

< 100 µm

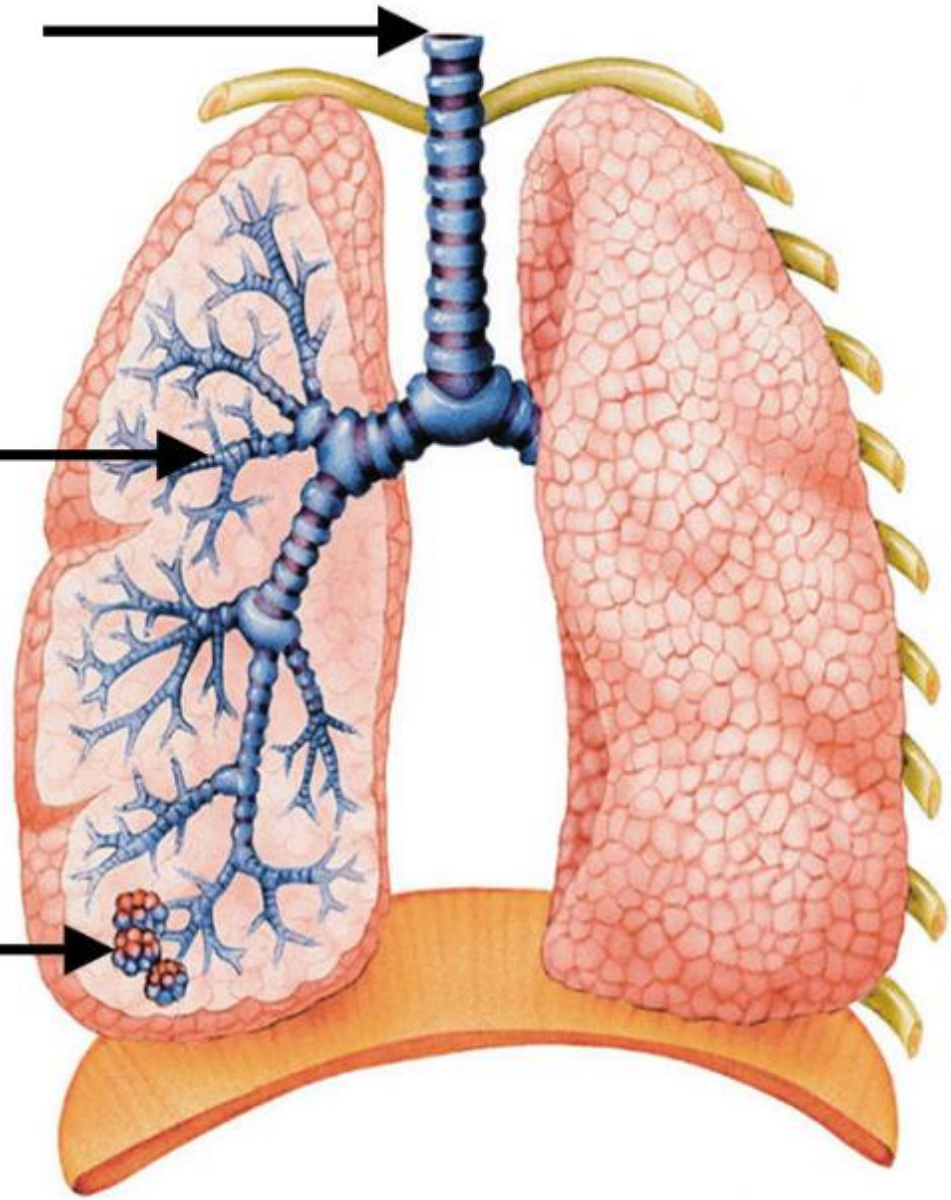
'Inhalable' fraction.
Can enter the throat:
Irritation

< 10 µm

'Thoracic' fraction.
Past the bronchus:
Acute disease

< 4 µm

'Respirable' fraction.
Can reach the alveoli:
Chronic disease



(Credit: Horwell, Claire. Public domain.)

BACKGROUND

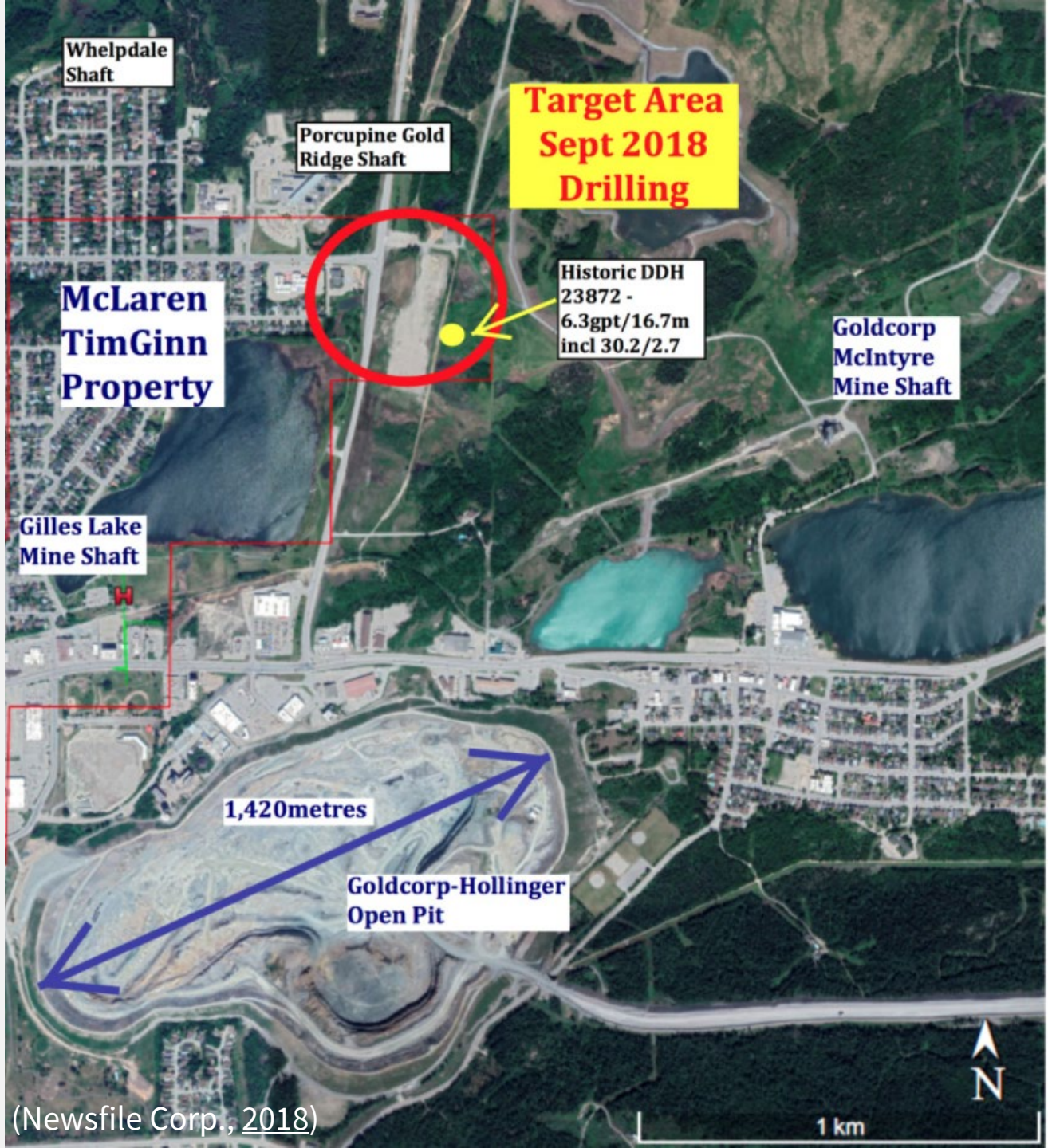
The air pollution is one of the most hazardous environmental issues associated with the **Open Pit mining** because of its:

Environmental

Health

Economic

Political impacts



(Newsfile Corp., 2018)

BACKGROUND

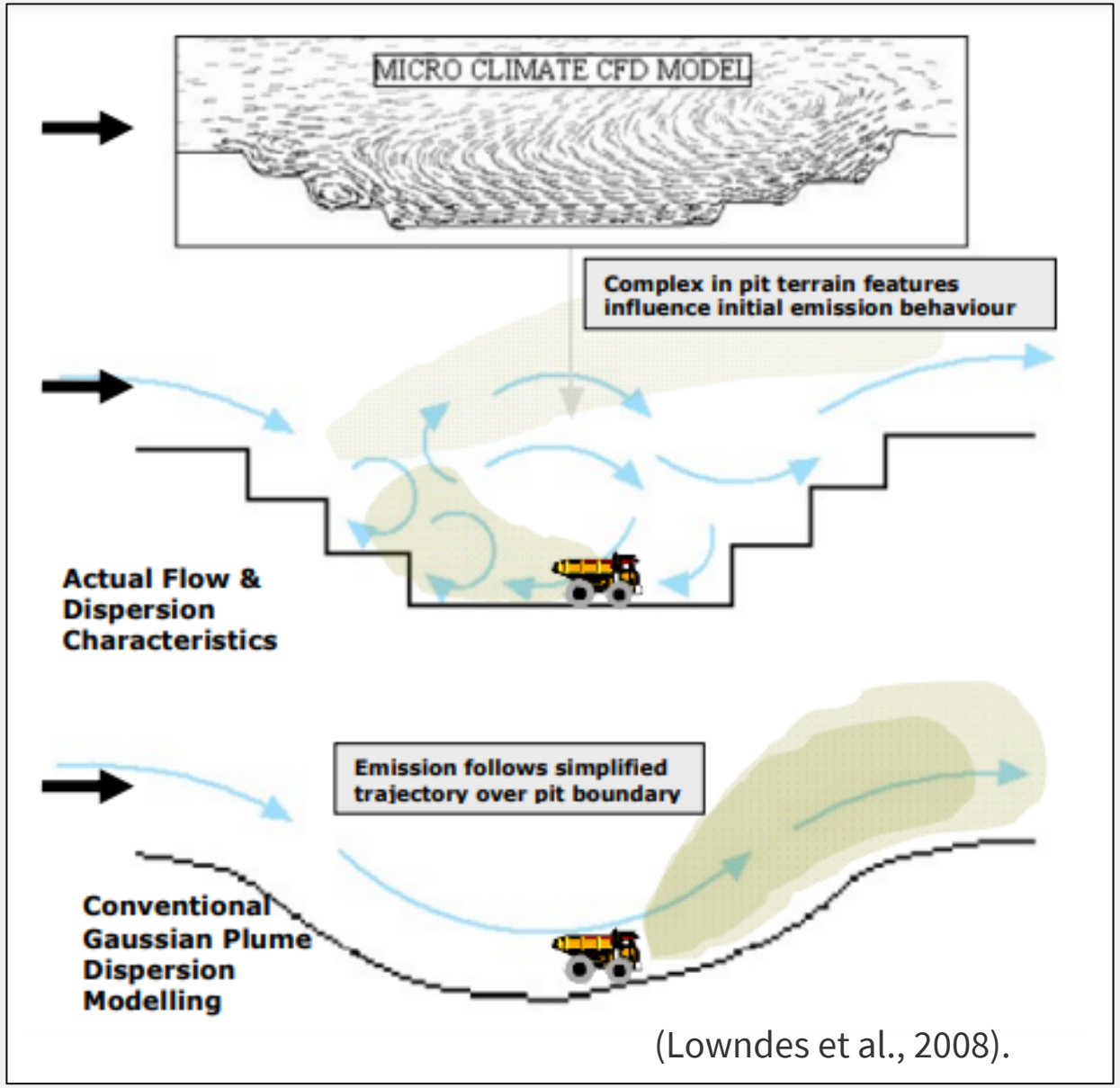
Particulate matter (PM) is released by the mining operations during the open-pit operation:

- Blasting
- Unpaved road haulage
- Loading and stockpiling

DISPERSION MODELS

How to measure?

How to predict?



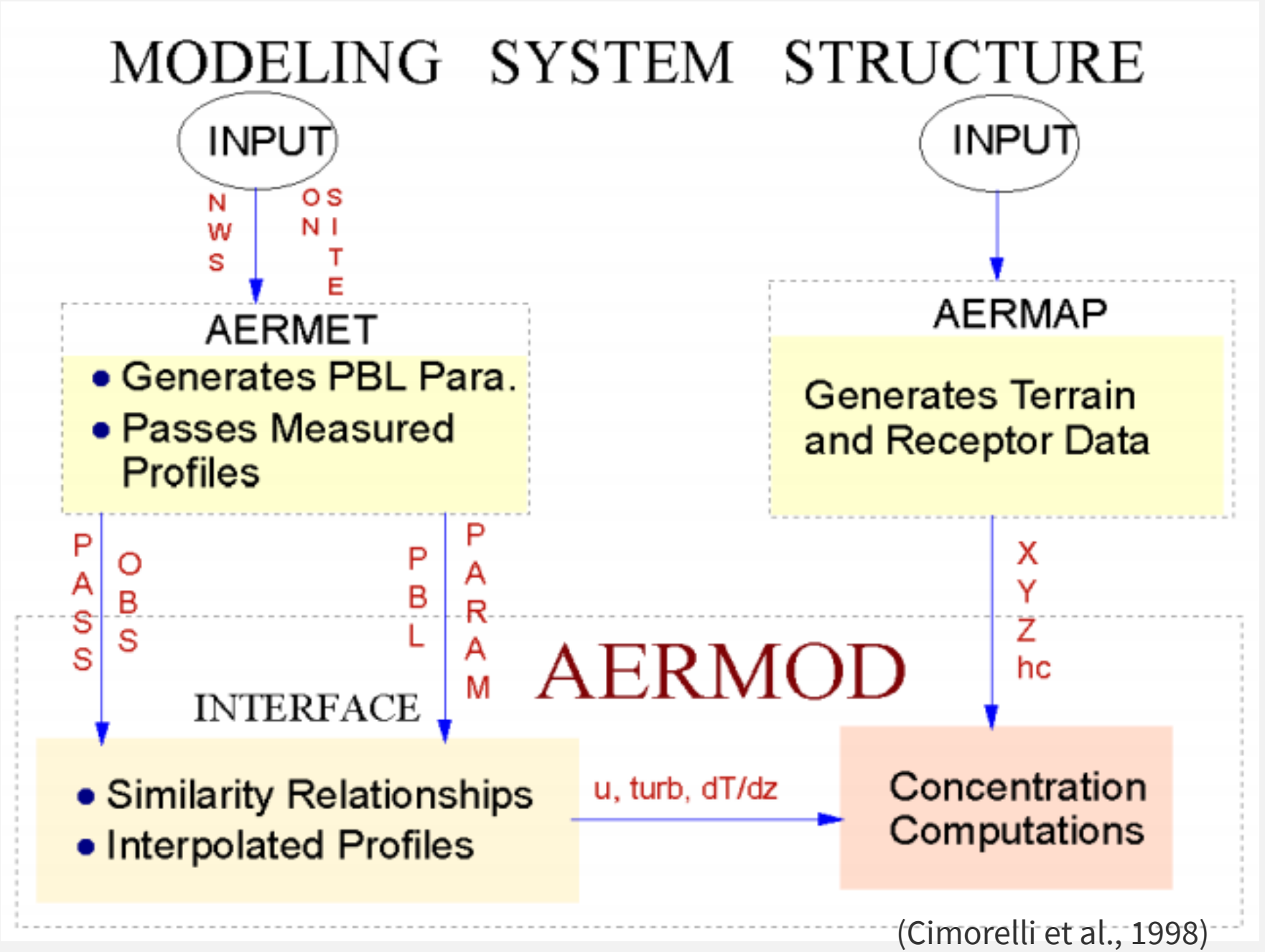
(Lowndes et al., 2008).

MODEL SELECTION

Principal factors:

- Terrain complexity
- Dimensions
- Particle sources
- Meteorological conditions

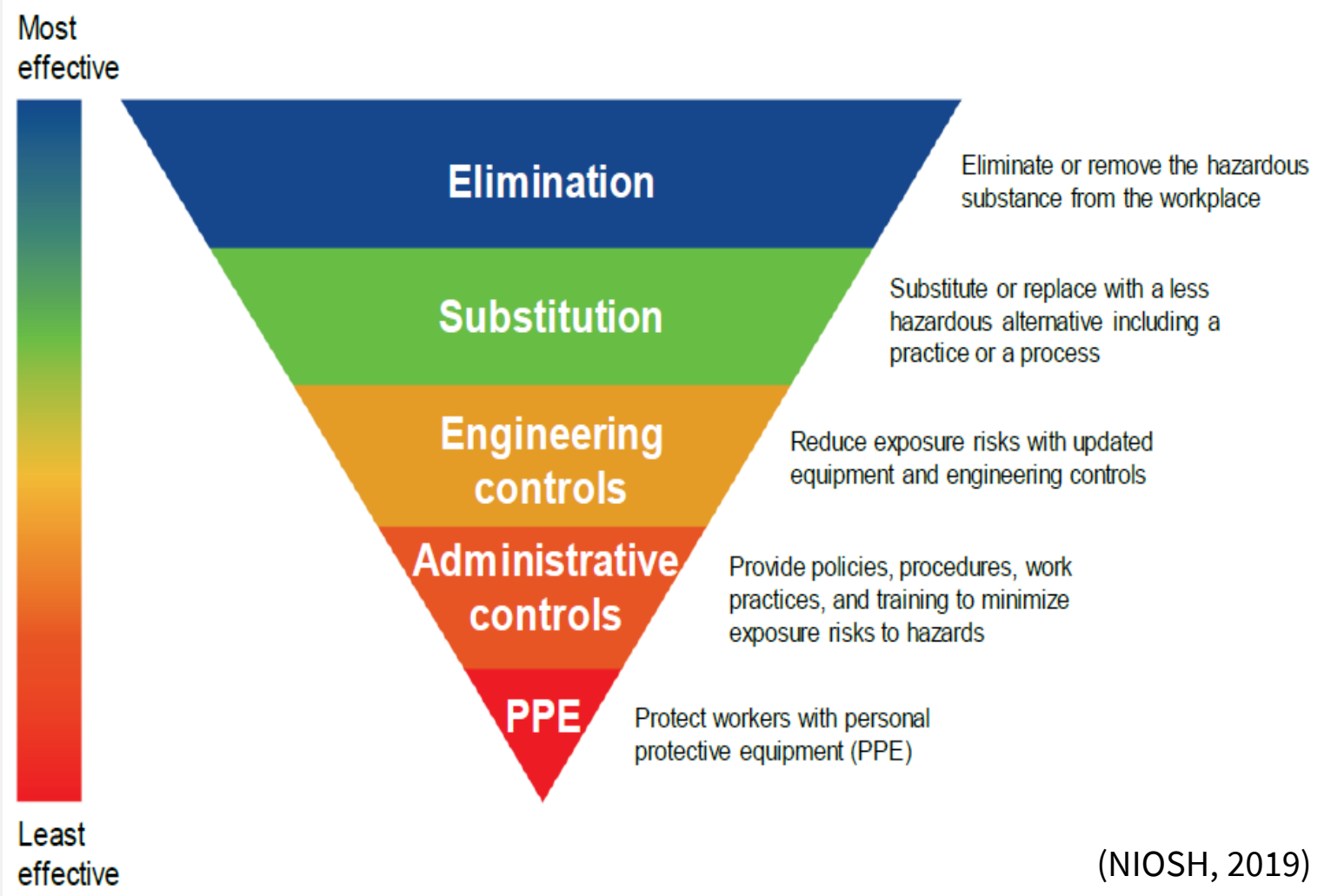
AERMOD
dispersion model



(Cimorelli et al., 1998)

BACKGROUND

Mining industry face a complex problem regarding dust control methods, which are estimated to reduce only 25% to 50% of the respirable-sized dust (Kissell, 2003).



(NIOSH, 2019)

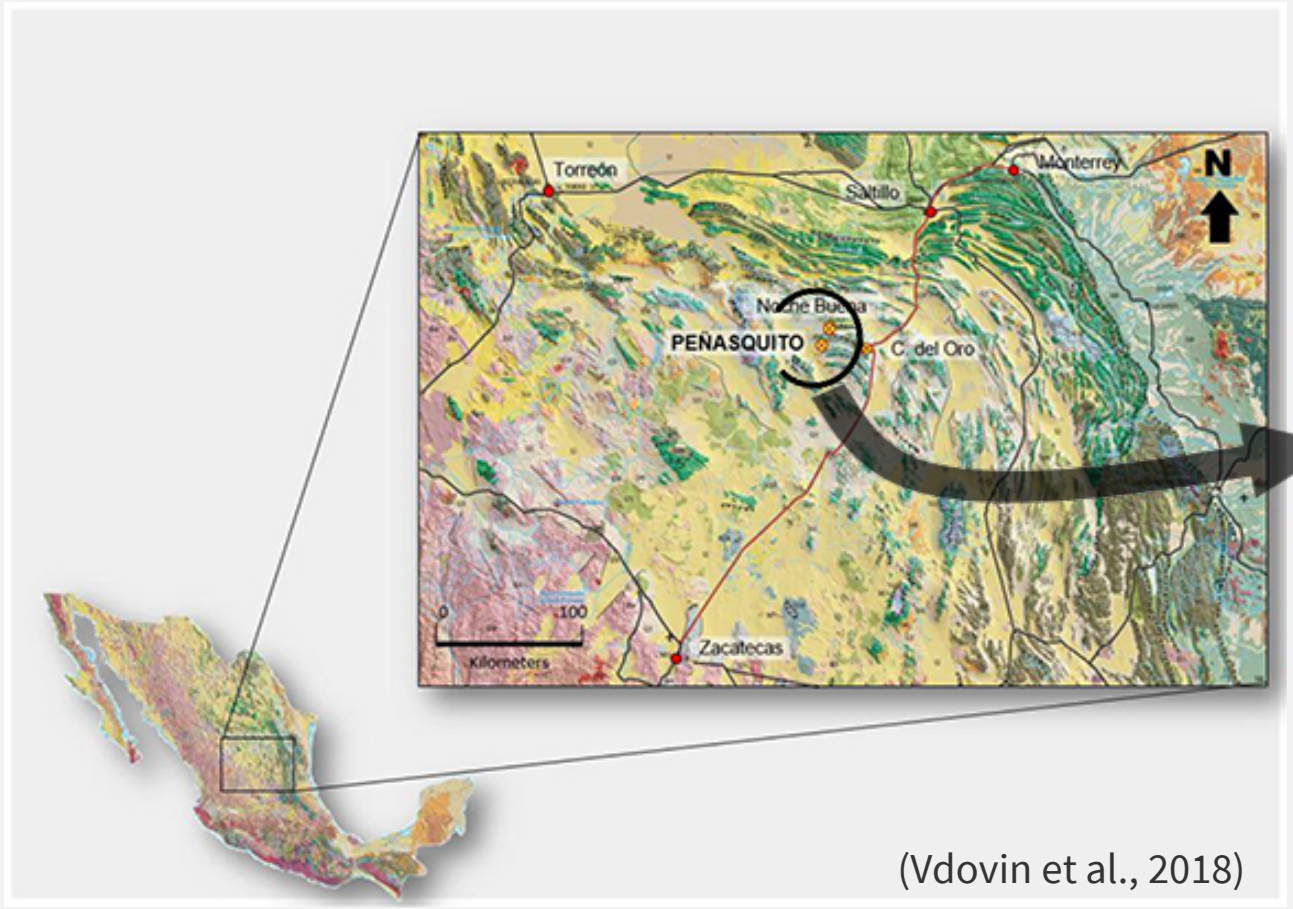
GOALS AND OBJECTIVES

Model parameters for dust control measures based on fog cannons in an open pit operation. This objective is composed by these specific aims:

- Update the emission inventory of PM2.5 and PM10 fractions for an open pit mining operation
- Applying the EPA regulatory model (AERMOD) for predicting the PM emissions during stable meteorological conditions
- Evaluate the impact of the fog cannon parameters over the PM emissions
- Predicting and validating the fog cannon influence over the PM emissions

METHODOLOGY

Study area: 1.236 billion tones of waste rock - LOM

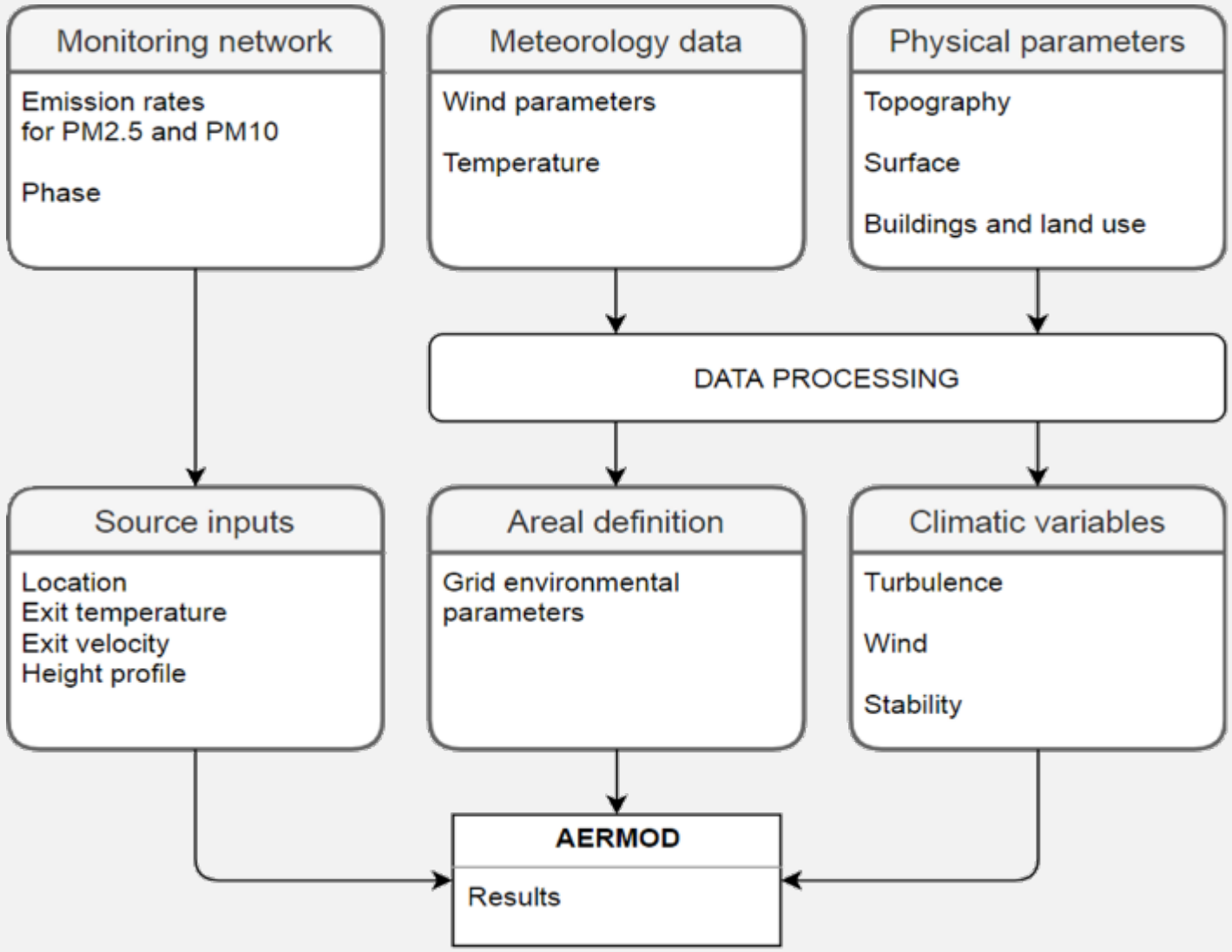


(Vdovin et al., 2018)

METHODOLOGY

Dispersion modelling

AERMOD view software 9.9.0 ®



METHODOLOGY

Monitoring → emission inventory

BAM-1020 Continuous Particulate monitor ®

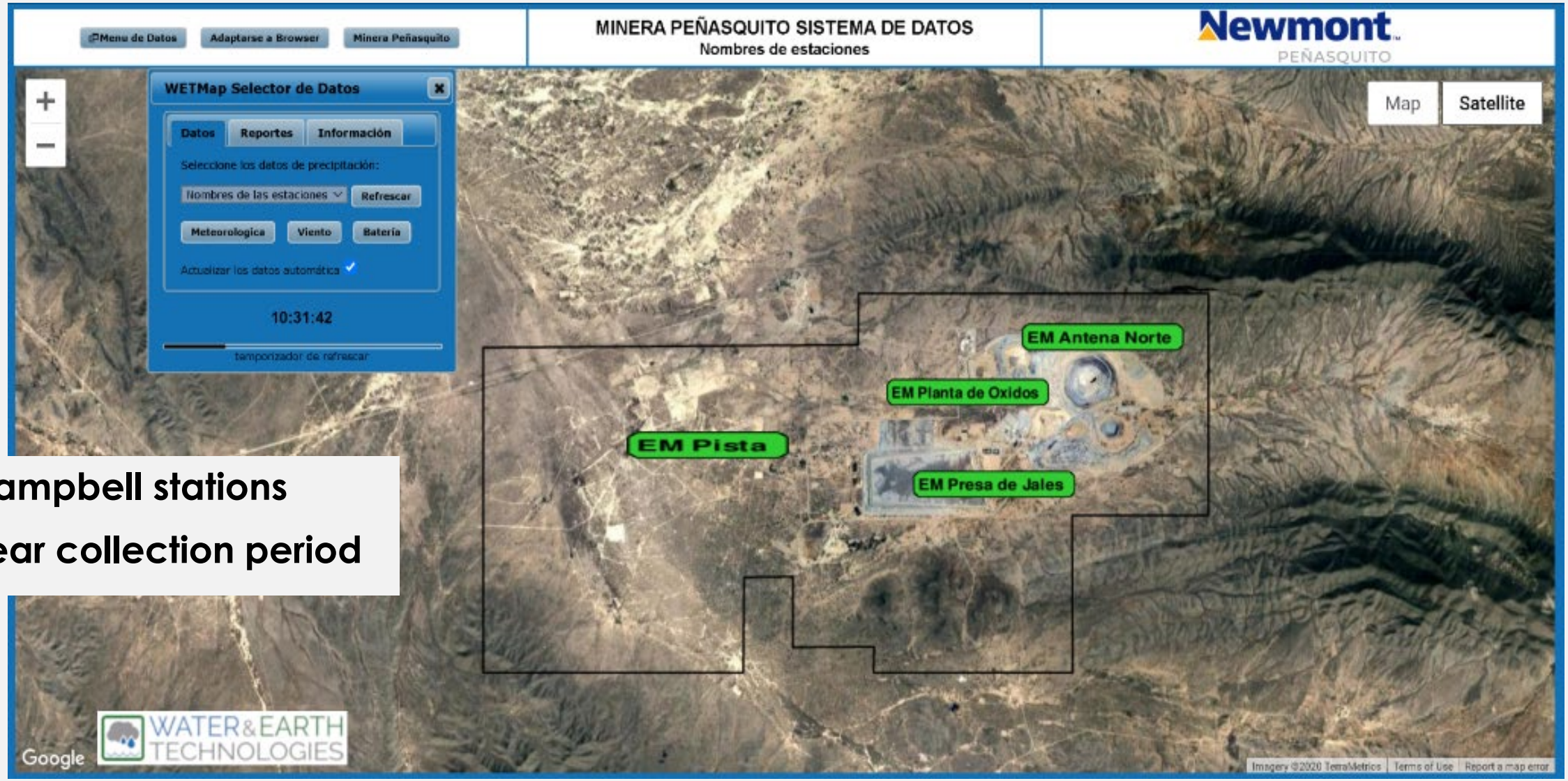
- Internal control
- Fixed location
- Lower accuracy
- Automated workflow
- Real-time data

Tisch Volumetric Flow Controlled Sampler ®

- Required by Official Mexican Standards
- Mobile
- Higher accuracy
- Manual data collection
- Lab test required
- Costly

METHODOLOGY

Meteorology data



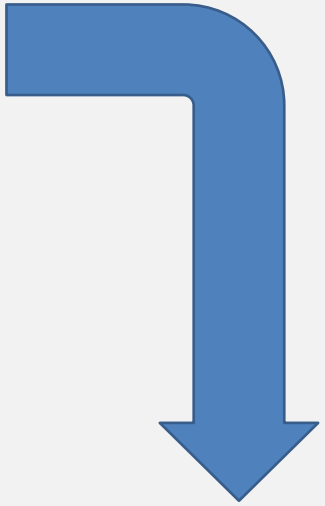
4 Campbell stations

5 year collection period

METHODOLOGY

Physical parameters

- Pit's Lidar network
- Infrastructure and buildings database registered by a drone fleet
- Annual lidar general survey

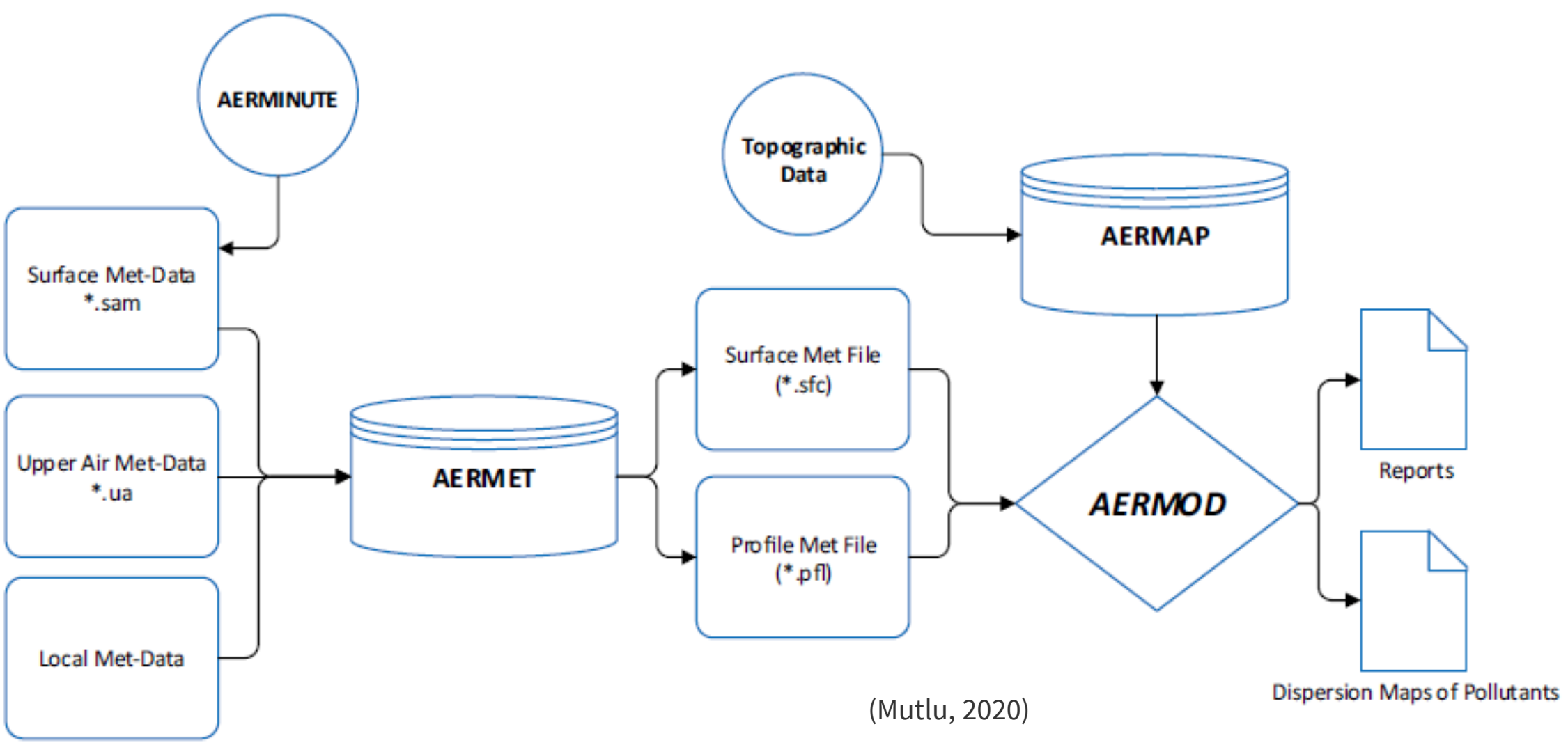


Digital elevation model (30cm accuracy and 5cm pixel resolution)

Land use parameters (1:2500 and1:5,000)

METHODOLOGY

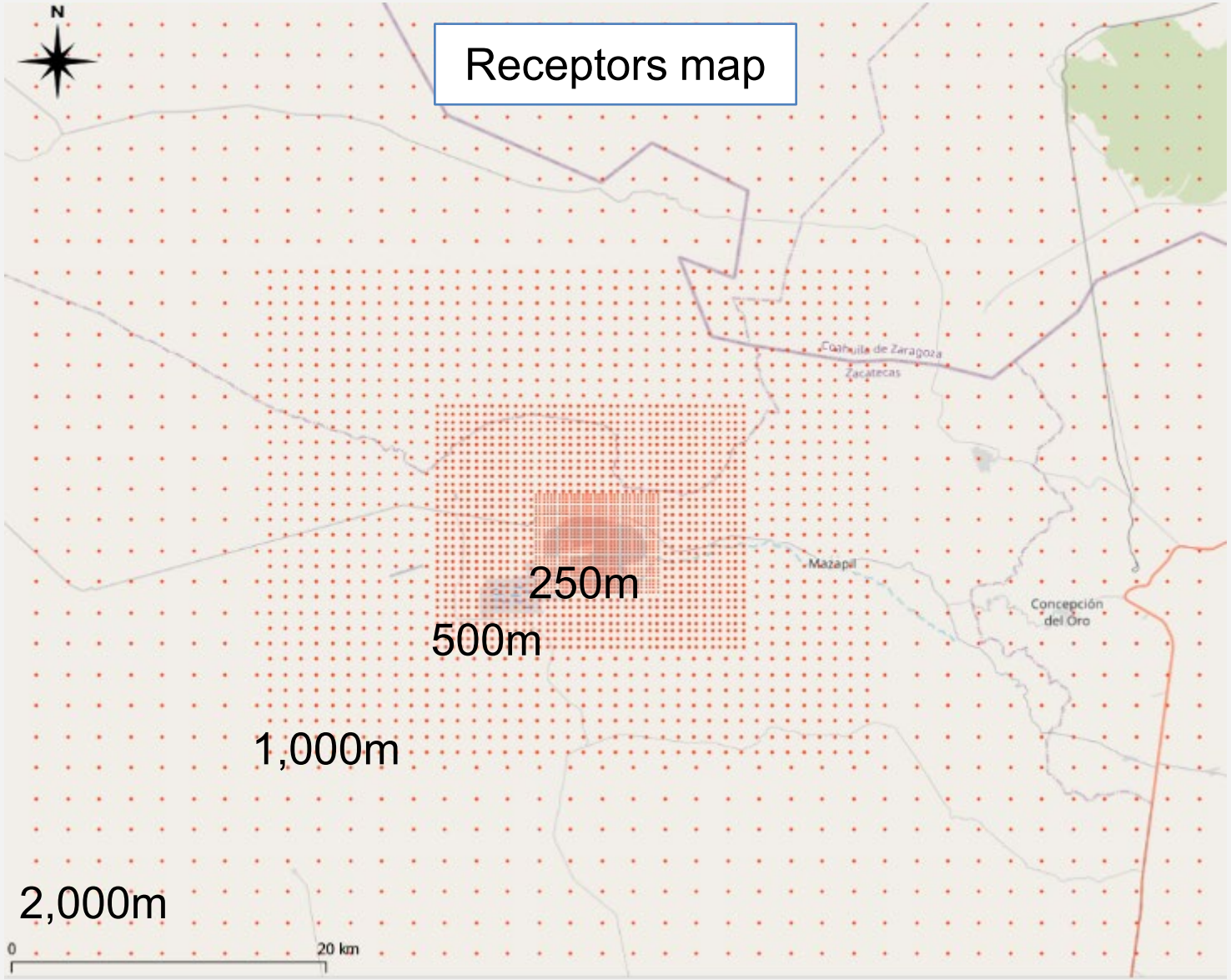
Analysis



(Mutlu, 2020)

METHODOLOGY

Analysis – plume visualization



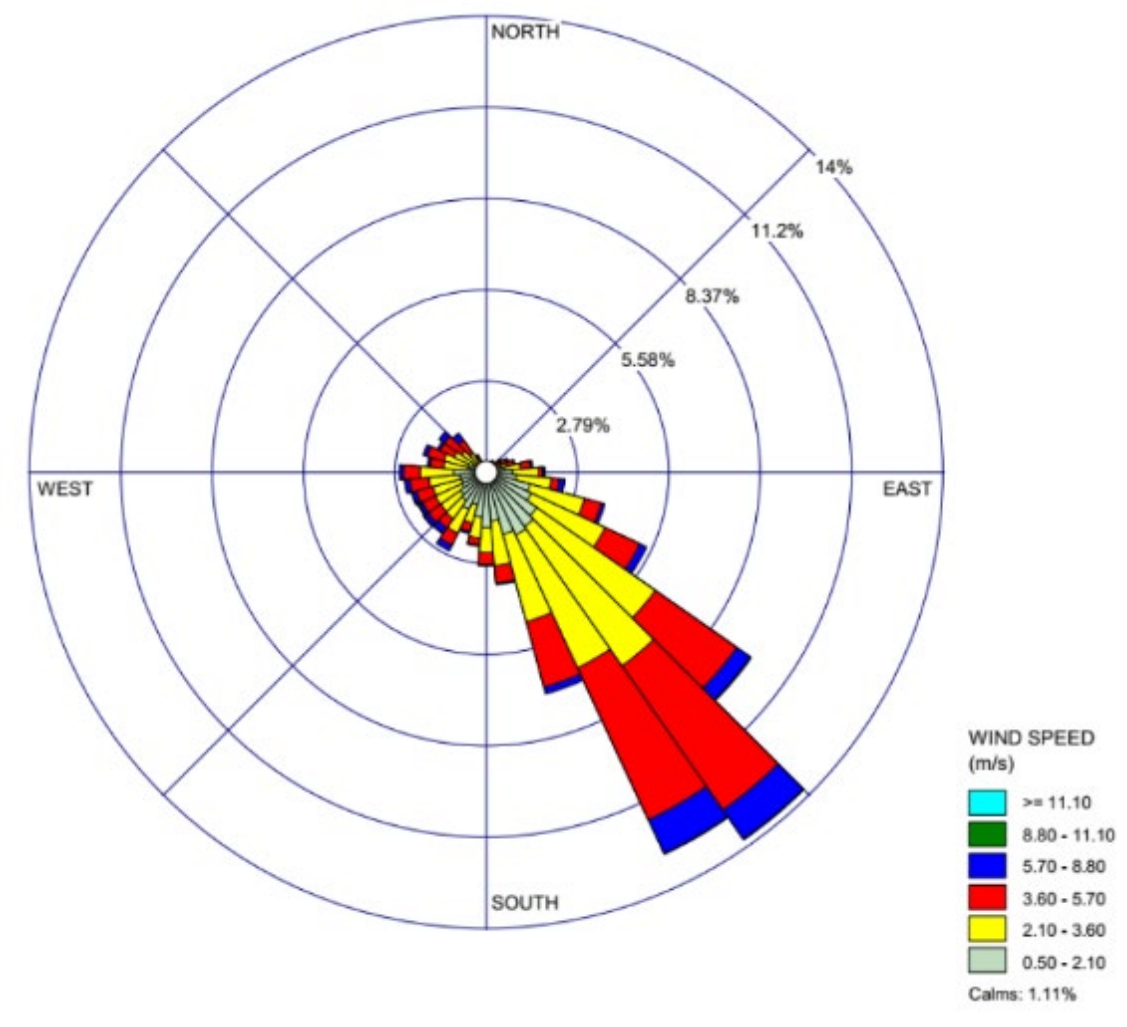
METHODOLOGY

Dust control

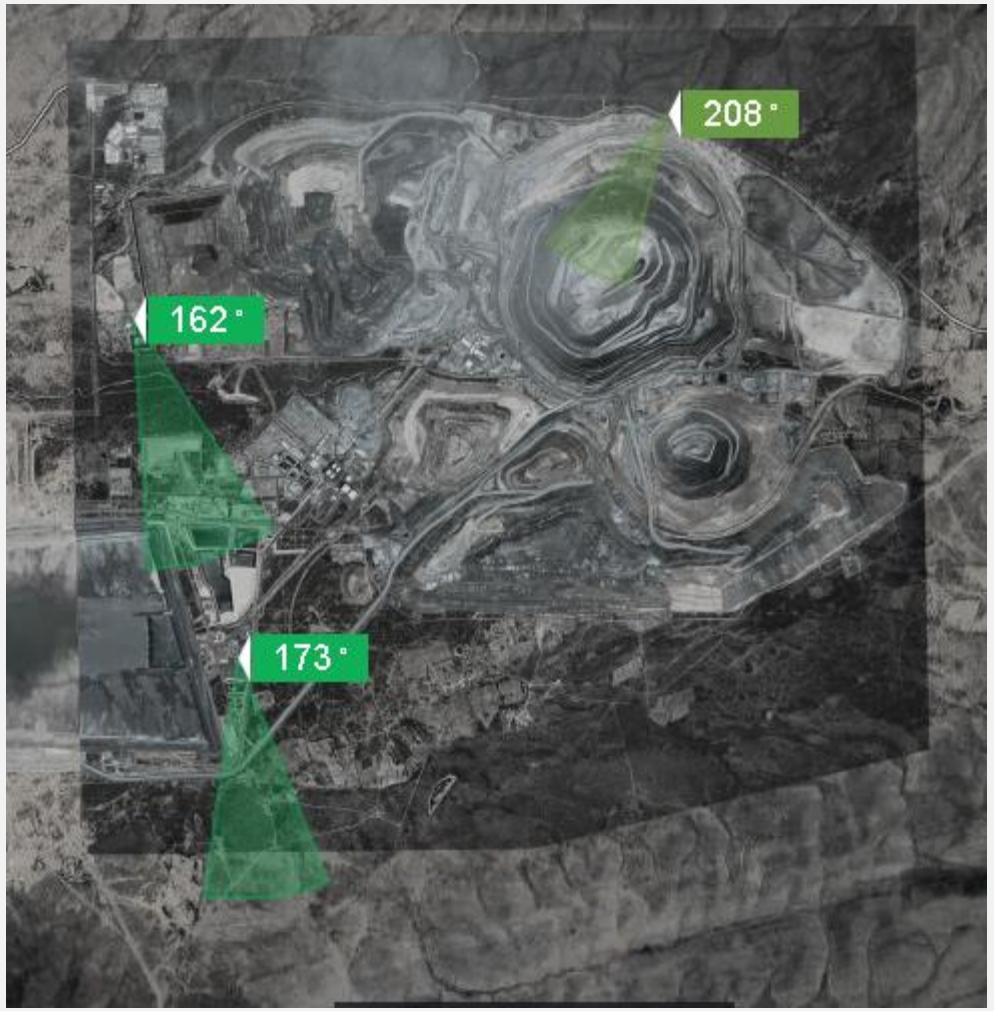
(Photo by: Minserco)

ANTICIPATED RESULTS

Wind characterization, 2019



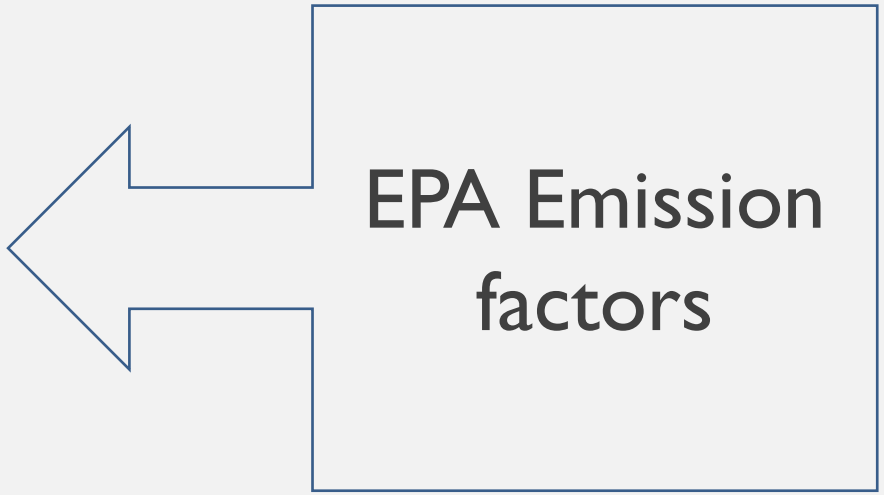
Summary, 2019



ANTICIPATED RESULTS

Emission inventory 2019

#	Type	Source
18	Point	Fixed sources: chimneys, dust collectors, gas scrubbers, filters, among others.
44	Surface	Stockpiles, pits and machinery movements.
19	Linear volumetric	Material hauling.
69	Volumetric	Loading, transferring operations, milling and screening.



ANTICIPATED RESULTS

Modelled values

Indicator

PM10 24 hours

PM10 annual

PM2.5 24 hours

PM2.5 annual

Maximum concentration

Total contribution (tpy)

PM10-PM2.5

Source

Area

Point

Volume

Linear Volume

ANTICIPATED RESULTS

The preliminary results show that there is a trend parting from the emission sources to the northwest of the operation, and those values are within the allowed limits.

However, the highest populated community in the north of Zacatecas state, is the campsite of the mine, because of this, further controls should be applied for protecting the immediate area. These results are useful for designing and planning the location of water cannons around the major dust contributors.