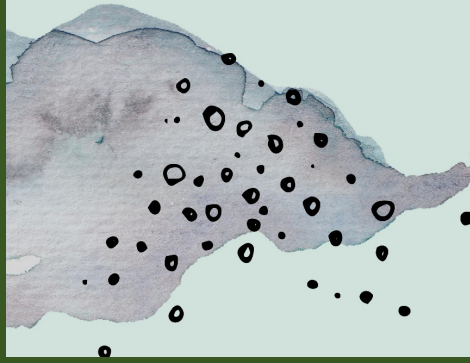




UTANGULIZI WA UFUATILIAJI WA UCHAFUZI WA HEWA

A Primer on Air Quality Monitoring



by: Dr Sarath Guttikunda
04-2023



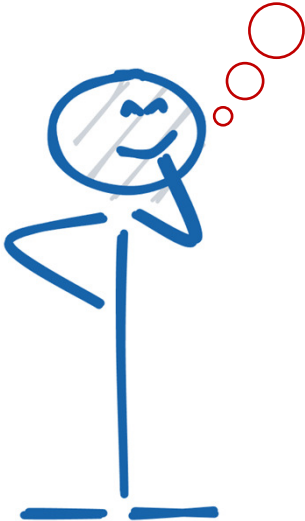


UrbanEmissions (UEinfo) ilianzishwa mwaka wa 2007 kwa lengo la kuwa ghala la habari, utafiti na uchambuzi juu ya uchafuzi wa hewa.

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Tuma maswali na maoni yako kwa simair@urbanemissions.info.

Google translated from English.



Katika jiji, tunaweza
kupunguza uchafuzi
wa hewa kwa kuongeza
idadi ya vituo vya
ufuatiliaji?



Ufuatiliaji ni chombo cha
uchunguzi cha kutathmini
viwango vya uchafuzi wa hewa.
Tendo la ufuatiliaji halipunguzi
uchafuzi wa hewa.

Ufuatiliaji hutoa hatua ya
kuanzia ya kuelewa uchafuzi wa
hewa (kwa muda na muda) na
mwelekeo wa kushughulikia
tatizo.



GOOD



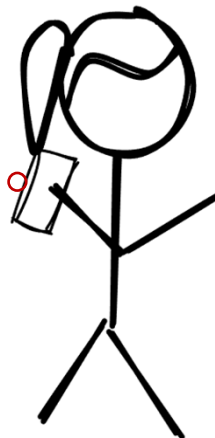
OKAY



BAD



Kwa nini tunadhani
kuwa ufuatiliaji wa
uchafuzi wa mazingira
utasababisha ubora
bora wa hewa?



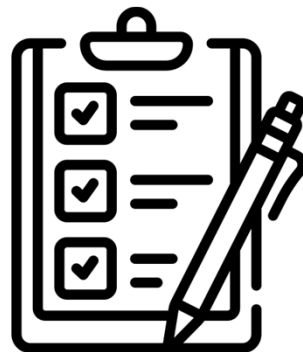
Shughuli za ufuatiliaji mara nyingi
hutajwa kama sehemu muhimu
(kama si kipimo muhimu zaidi) cha
mkakati wa kudhibiti uchafuzi wa
watunga sera na vyombo vya habari.

“The mobile air quality
monitoring unit will be
capable of real-time
sampling, analysis and
control of air pollution
from sources..”

Hindustan Times (2016)

Taarifa hii kwa vyombo vya
habari inaweza kutafsiriwa
kama wakati timu ya ufuatiliaji
inazunguka jiji, vifaa
vinapunguza uchafuzi wa hewa.

Kwa hivyo, kusababisha
kutokuelewana.



Kituo cha ufuatiliaji
wa hewa hufanya
kazi vipi?



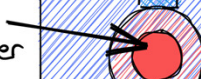
air inlet



Hapa kuna
muundamano rahisi
wa vifaa vya
ufuatiliaji

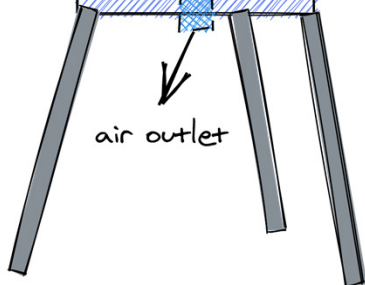


sensor or a
sampling filter



display board
for data

air outlet



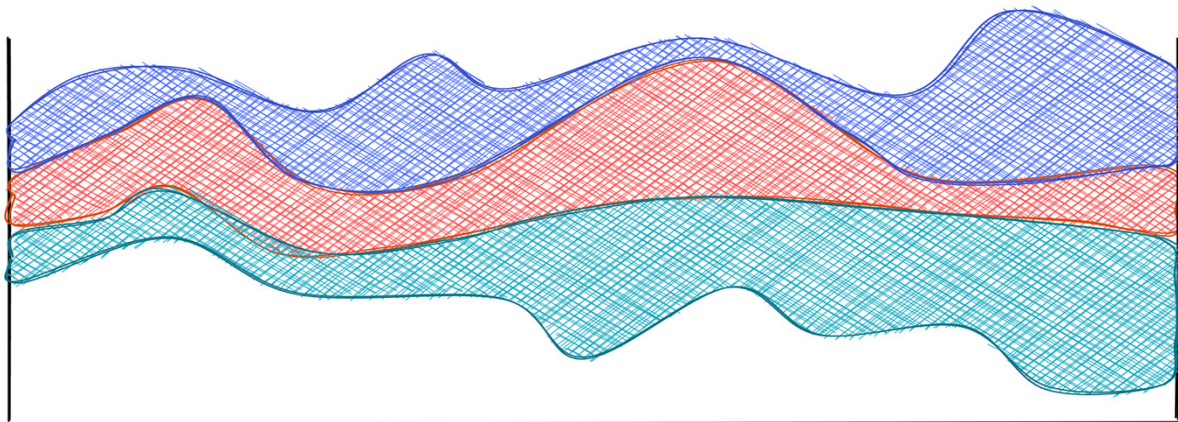
Ni ipi njia bora ya
kufafanua ufuatiliaji
wa uchafuzi wa
hewa?



Ufuatiliaji ni zoezi la
kupima viwango vya
uchafuzi wa hewa katika
eneo au chanzo.



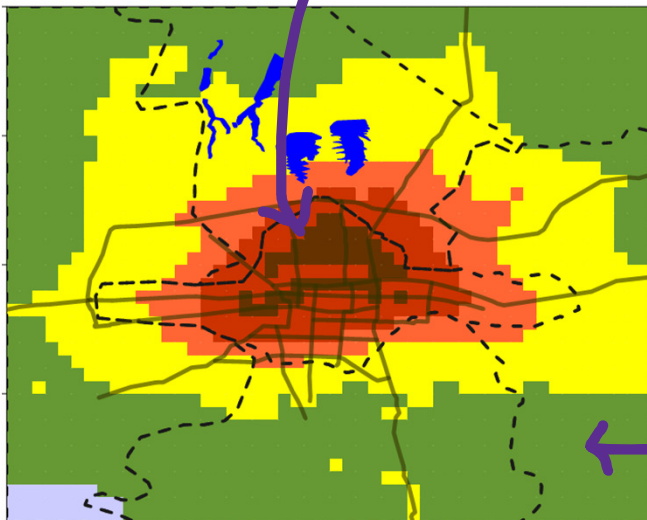
Data kwa muda mrefu inaruhusu sisi
tease nje ya mifumo ya diurnal na
msimu ambayo inasaidia kuunda na
kukagua mpango wa kudhibiti uchafuzi
wa mazingira.



Mifumo hii ni pamoja na tofauti za
anga katika uchafuzi wa mazingira,
kama vile ni maeneo gani ya jiji
yamechafuliwa zaidi au hupata
ubora bora wa hewa.



eneo lenye uchafu zaidi



safi nje kidogo





Kwa kutumia mwelekeo huu wa data, tunaweza kuhitimisha ikiwa jitihada zetu za kuboresha ubora wa hewa zitafanikiwa.

Ikiwa ndio, kwa kiwango gani.

Ikiwa sivyo, basi tunahitaji kujaribu chaguzi zingine au kuwa mkali zaidi katika juhudi zetu za sasa.



Kwa hivyo, wakati uchafuzi wa hewa Ufuatiliaji wenyewe haufanyi kupunguza uchafuzi wa hewa, Inatupa vidokezo juu ya...



.. Kiasi gani cha uchafuzi wa mazingira?



.. Uchafuzi wa mazingira uko wapi?

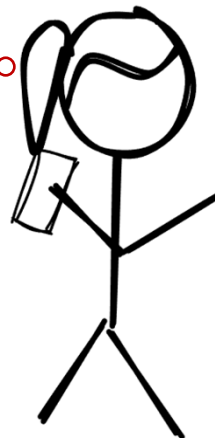


.. na uchafuzi wa mazingira lini?



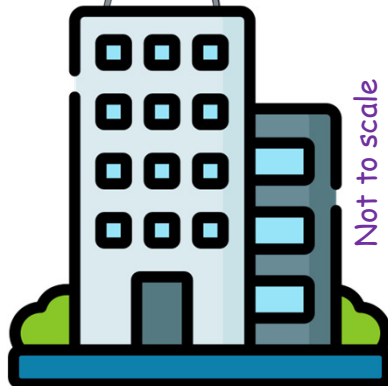
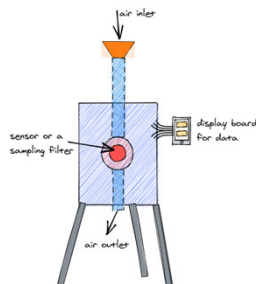


Ni aina gani
tofauti za
ufuatiliaji?



Hapa ni baadhi ya mifano

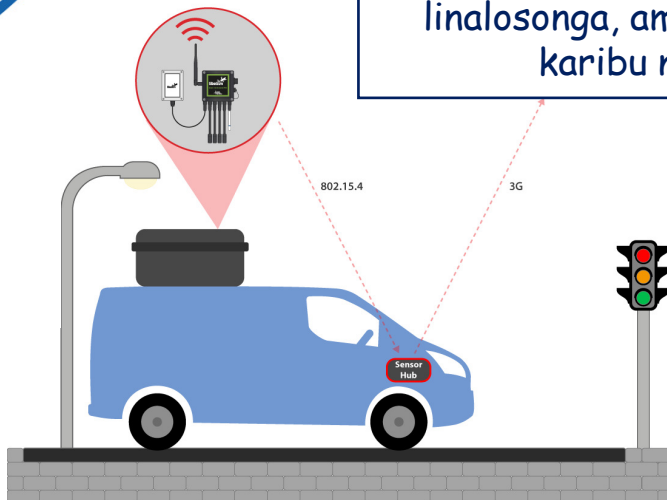
Mazoezi ya kawaida ni
"ufuatiliaji tuli (static monitoring)"
ambapo data inakusanywa tu kutoka
eneo moja kwa muda mrefu.



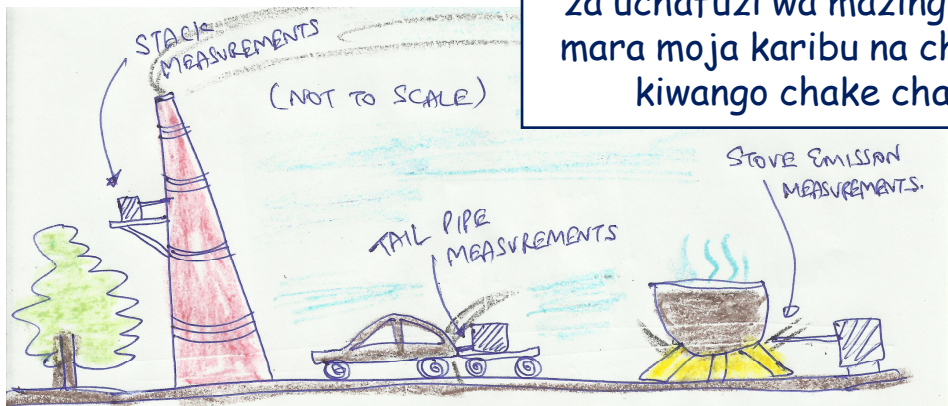
Not to scale



Kisha tuna "Ufuatiliaji wa Simu (mobile monitoring)", ambapo data inakusanywa katika gari linalosonga, ama barabarani au karibu na kizuizi.



Na tunayo "Ufuatiliaji wa Uzalishaji (emission monitoring)" ambapo takwimu za uchafuzi wa mazingira hukusanywa mara moja karibu na chanzo ili kupima kiwango chake cha uzalishaji.

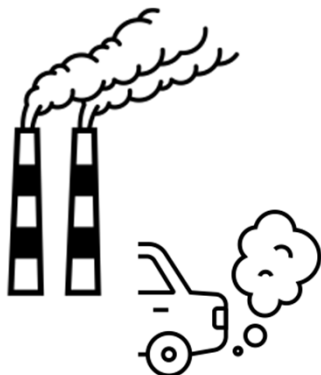




Kuna tofauti gani
kati ya uzalishaji na
ubora wa hewa?



Hili ni swali muhimu sana



Uzalishaji ni kiasi cha uchafu
unaotolewa moja kwa moja
kwenye chanzo (kama vile moshi
wa gari, chimney ya viwanda, au
rundo la taka zinazowaka wazi).

Typical unit: kg/day or kg/kg-fuel

ubora wa hewa au ukolezi ni
kiasi cha uchafu uliopo katika
kiasi cha kitengo cha hewa
iliyoko ambayo tunapumua.

Typical unit: $\mu\text{g}/\text{m}^3$ or ppm

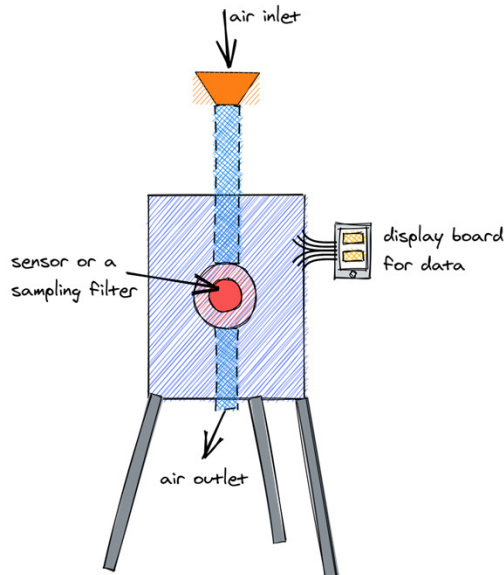


Ni mazoea gani ya
kawaida ya ufuatiliaji
wa ambient?



Kuna njia mbili tofauti za
kufanya kazi.

Wote ni muhimu na muhimu
kwa kuelewa mienendo ya
uchafuzi wa hewa.



kwa mkono
(Manual)

&

Endelevu
(Continuous)

How the process of manual ambient monitoring works

I have to conduct maintenance regularly to get reliable data

This process can take 1-2 days from sample collection to data release

kwa mkono
(Manual)

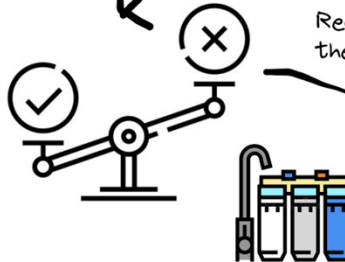
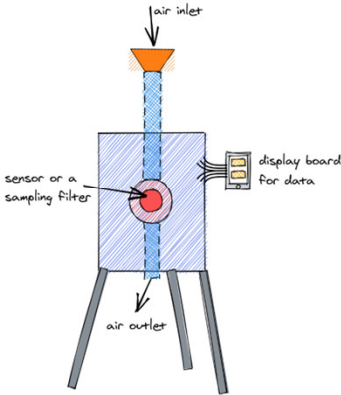
Data release

Take the filters to the lab for gravimetric and chemical analysis

Record the results

and archive them.

Sampuli hukusanywa kila siku au mara moja katika siku 2-3. Pointi moja tu ya data kwa kila kipindi cha ukusanyaji.

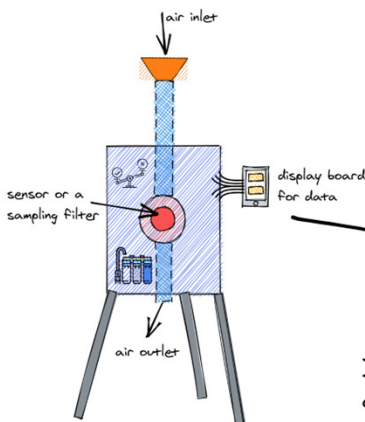


How the process of continuous ambient monitoring works

I have to conduct maintenance regularly to get reliable data and the unit also has internal QA/QC checks

This process only takes 15 minutes from sample collection to data release

Endelevu (Continuous)



Data records are archived immediately



After QA/QC checks immediately available for release

Data inapatikana kwa azimio bora la muda wa dakika 1 hadi saa 1.



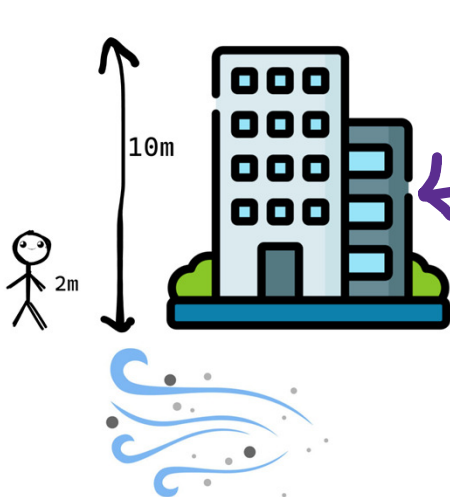
Je, ni urefu gani
unaofaa kwa
ufuatiliaji wa
uchafuzi wa hewa?



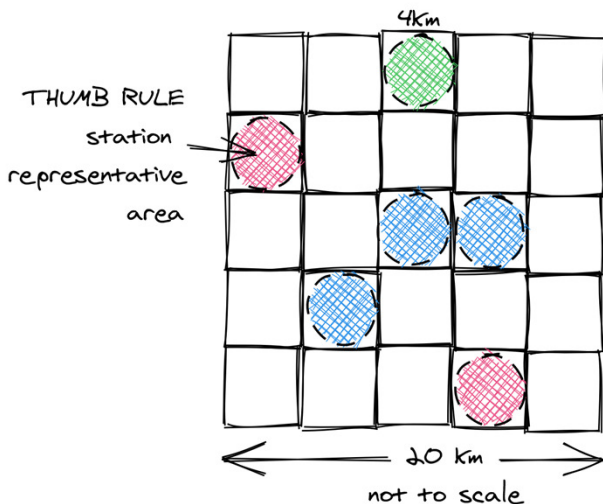
Hewa yote iliyo chini ya ~10m
inachukuliwa kuwa sawa na
inawakilisha vyanzo vyote vya
karibu vya uchafuzi wa masafa
marefu.



Urefu huu unatarajiwa kuwakilisha
vyanzo vyote vinavyochangia eneo
hilo na sio kupendelea chanzo
chochote mahususi (kwa mfano,
karibu na barabara, utokaji wa
magari utaleta upendeleo).



Jinsi ya kuchagua maeneo
ya ufuatiliaji?



ideal
requirement
is 25 stations
- one every grid

EXAMPLE

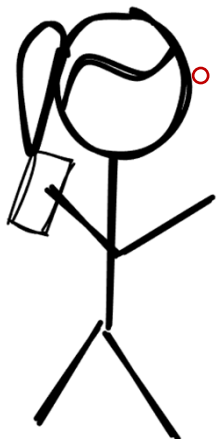
- populated/commercial
- industrial
- background



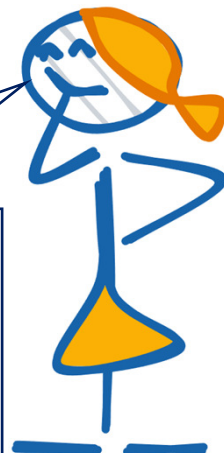
Maeneo ya ufuatiliaji ni
muhimu na yanaweza
kusababisha upendeleo
ikiwa haijachaguliwa kwa
uwakilishi.



Ili kupunguza upendeleo,
itifaki inapendekeza maeneo
mengi yanayowakilisha maeneo
yote, aina za matumizi ya
ardhi, na shughuli katika jiji.



Kuna idadi yoyote ya chini ya wachunguzi wa kusakinishwa?



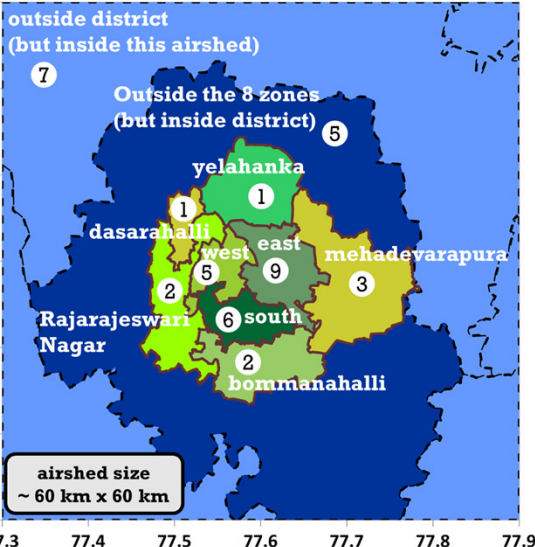
Ndiyo, kuna baadhi ya sheria. Kwa mfano, India ilifafanua yafuatayo katika suala la jumla ya watu (TP) kwa ufuatiliaji wa PM.

For TP under 100,000 -- 4 units
For TP under 1 million - 4 + 0.6 per 100,000
For TP under 5 million - 7.5 + 0.25 per 100,000
For TP above 5 million - 12 + 0.16 per 100,000

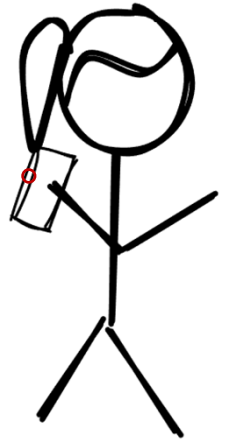
Table source: CPCB, India

Kwa mfano: Jiji la Bengaluru linahitaji wachunguzi 41 kulingana na idadi ya watu na habari za shughuli za kibiashara na maeneo.

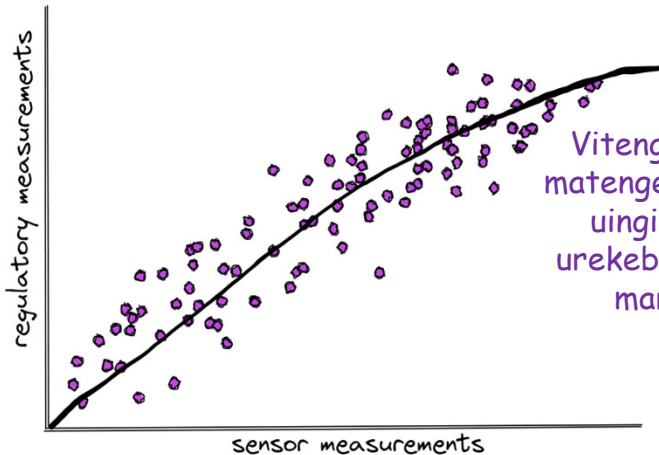
Hatimaye, uwezo wa kifedha, wafanyikazi, na uendeshaji wa jiji huamua ni wachunguzi wangapi wamewekwa.



Jinsi ya kuunganisha
matumizi ya sensorer
za gharama nafuu?



Vihisi hivi vinaweza kuunda ramani ya
uchafuzi wa mazingira ya haraka na
nafuu na kuongeza upanuzi wa mtandao
wa ufuatiliaji wa udhibiti.

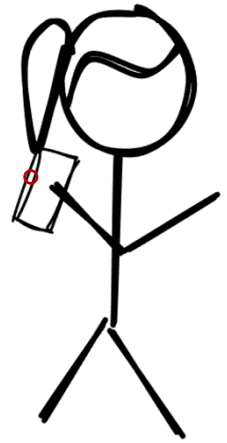


Vitengo vyote vinahitaji
matengenezo ya kawaida au
uingizwaji, pamoja na
urekebishaji wa mara kwa
mara wa matokeo.

Ikiwa haijasahihishwa ipasavyo au haitumiki
ipasavyo, usomaji wa vitambuzi utakuwa na
upendeleo na hautakubaliwa na maafisa
kama uchunguzi wa mwakilishi.



Uchunguzi wa satelaiti
unawezaje
msaada kwa ajili ya
kufuatilia ardhi?

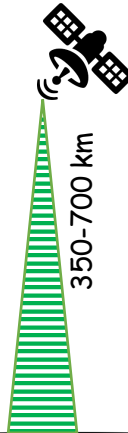


Data ya setilaiti ni safu -
inawakilisha kila kitu
kutoka kwa lenzi ya
setilaiti hadi ardhini.

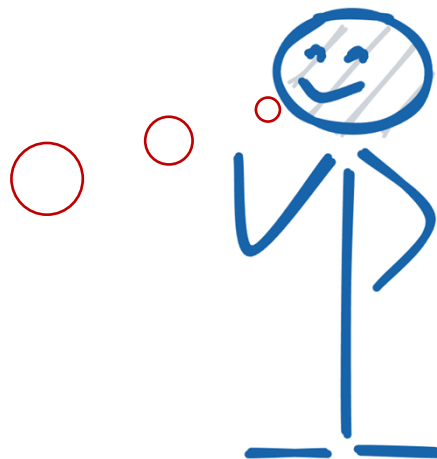
Kubadilisha thamani hii
kwa mkusanyiko wa uso
ni utaratibu wa hatua
nyingi unaohusisha
matumizi ya mfano wa
usafiri wa kemikali.

Miundo hii inategemea
makadirio ya utoaji na
data ya eneo la hali ya
hewa.

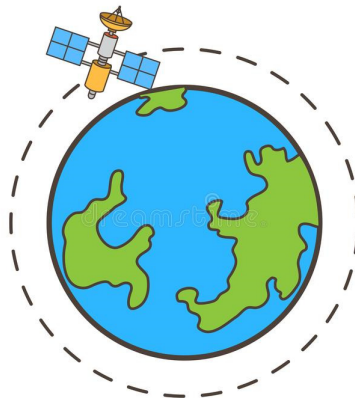
Kwa hiyo, kwa makadirio
sahihi kutoka kwa
ufuatiliaji wa satelaiti,
data kutoka kwa vituo
vya ufuatiliaji wa ardhi
na vyanzo vya uzalishaji
wa ndani ni pembejeo
muhimu.



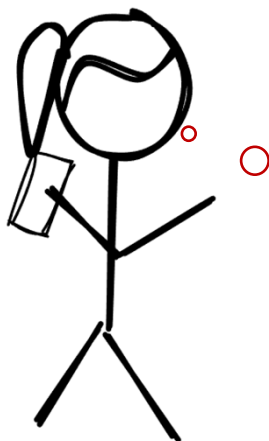
Satelaiti za
Geostationary
zinahitajika kujenga
mifano ya ndani na
kusaidia juhudi za
ufuatiliaji wa karibu.



Satellite ya geostationary,
hukusanya data kwenye
eneo moja, wakati wote.



Polar au orbital satellite,
hukusanya data duniani
kote kutoa snapshots.



Ni baadhi ya matumizi
gani ya vipimo vya ubora
wa hewa?



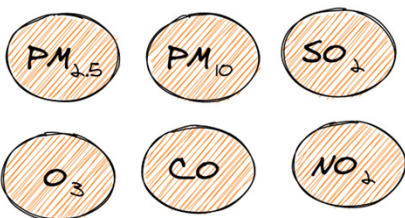
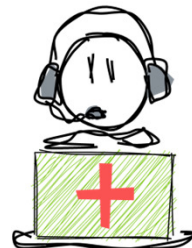
Msemo unasema,
"Hatuwezi kusimamia kile ambacho hatuwezi
kupima."

Kwa hivyo, kupata data ya kuaminika ni
muhimu sana kwa (a) usimamizi wa ubora wa
hewa (b) kuandaa mipango ya utekelezaji (c)
kusaidia uhamasishaji wa umma na (d)
kufuatilia maendeleo (au ukosefu wake).

Hapa kuna baadhi ya matumizi muhimu ya data
ya ubora wa hewa.



Kwanza, matumizi yake katika kuhesabu index ya ubora wa hewa (AQI). Msimbo huu unachanganya (a) sayansi yote ya utungaji uchafuzi (b) viwango vya afya (c) viwango vya upimaji na itifaki, ili kuwasilisha faharasa kama maonyo rahisi ya rangi.

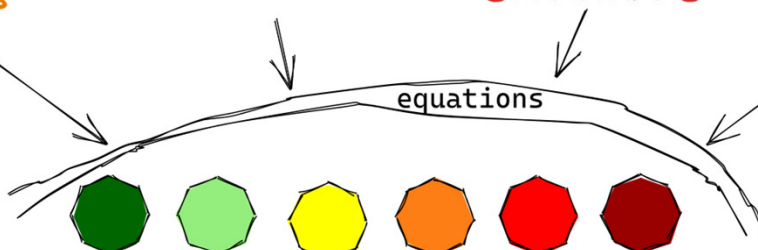


pollutants

units

standards

health-severity



simple color coded index

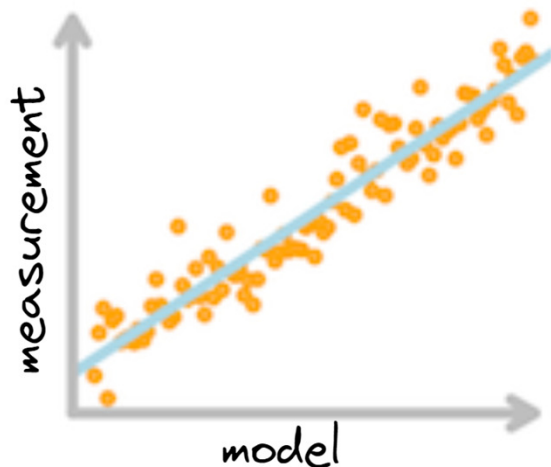
use

1



Vituo vingi vinamaanisha data zaidi na hiyo inamaanisha ufahamu bora wa mwelekeo wa anga na wa muda katika uchafuzi wa mazingira. Hii inaweza kusaidia juhudi za uundaji mfano zinazotaribu kuelewa mienendo ya uchafuzi wa mazingira.

Data hutumiwa kuthibitisha miundo na kuongeza viwango vya uaminifu.

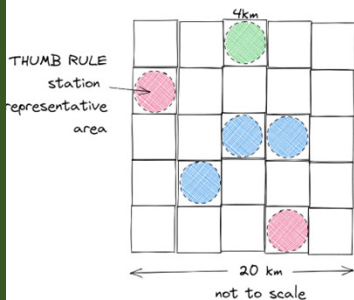


use
2



use
3

Vichujio vilivyokusanywa katika vituo vya mwongozo vinaweza kutumika kwa tathmini ya msingi ya uchambuzi wa kemikali ya michango ya chanzo.

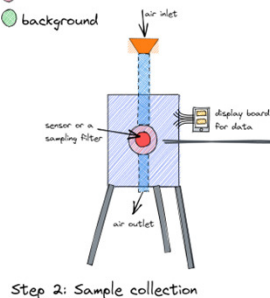


Step 1: Location selection

ideal
requirement
is 25 stations
- one every grid

EXAMPLE

- populated/commercial
- industrial
- background



Step 2: Sample collection

Step 3:
Chemical Analysis
in Laboratory

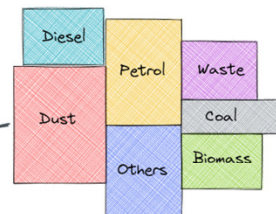


Chemical profile of the ambient sample
as ions, metals, and carbon species

Results:
Modeled source contributions



Step 5:
Receptor
Model



Step 4: Collect chemical profiles
of all known sources

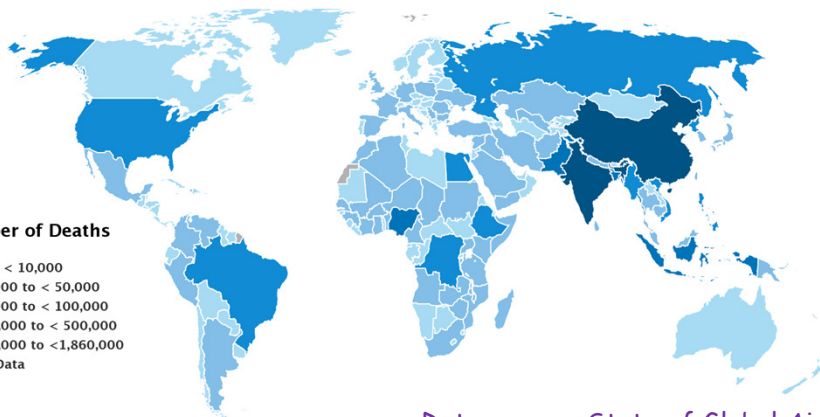
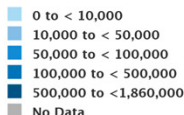


Matumizi muhimu zaidi ya data ya ufuatiliaji wa hewa ni kuanzisha uhusiano na madhara ya afya

- * cases of ischemic heart disease (heart attacks)
- * cerebrovascular disease (strokes)
- * chronic obstructive pulmonary diseases
- * lower respiratory infections
- * cancers (in trachea, lungs, and bronchitis)
- * obesity
- * diabetes and
- * Alzheimer's disease.



Number of Deaths



Data source: State of Global Air

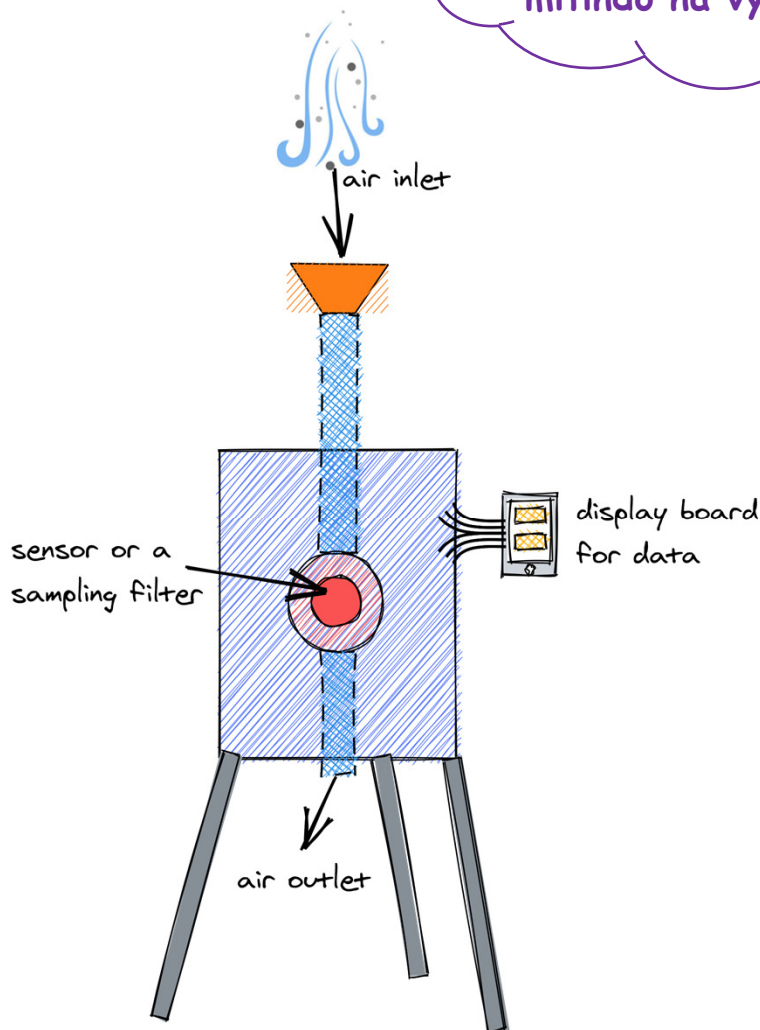
use

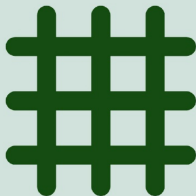
4

Lazima tuongeze
idadi ya vituo vya
ufuatiliaji.



Kwa mifano ya
hisabati, tunaweza
kujenga uelewa
mwingi kuhusu
mitindo na vyanzo.





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