국내 에너지부문 메탄 발생 현황과 감축 필요성

Current Status of Methane Emission from the Energy Sector in S.Korea and the Need for Reduction

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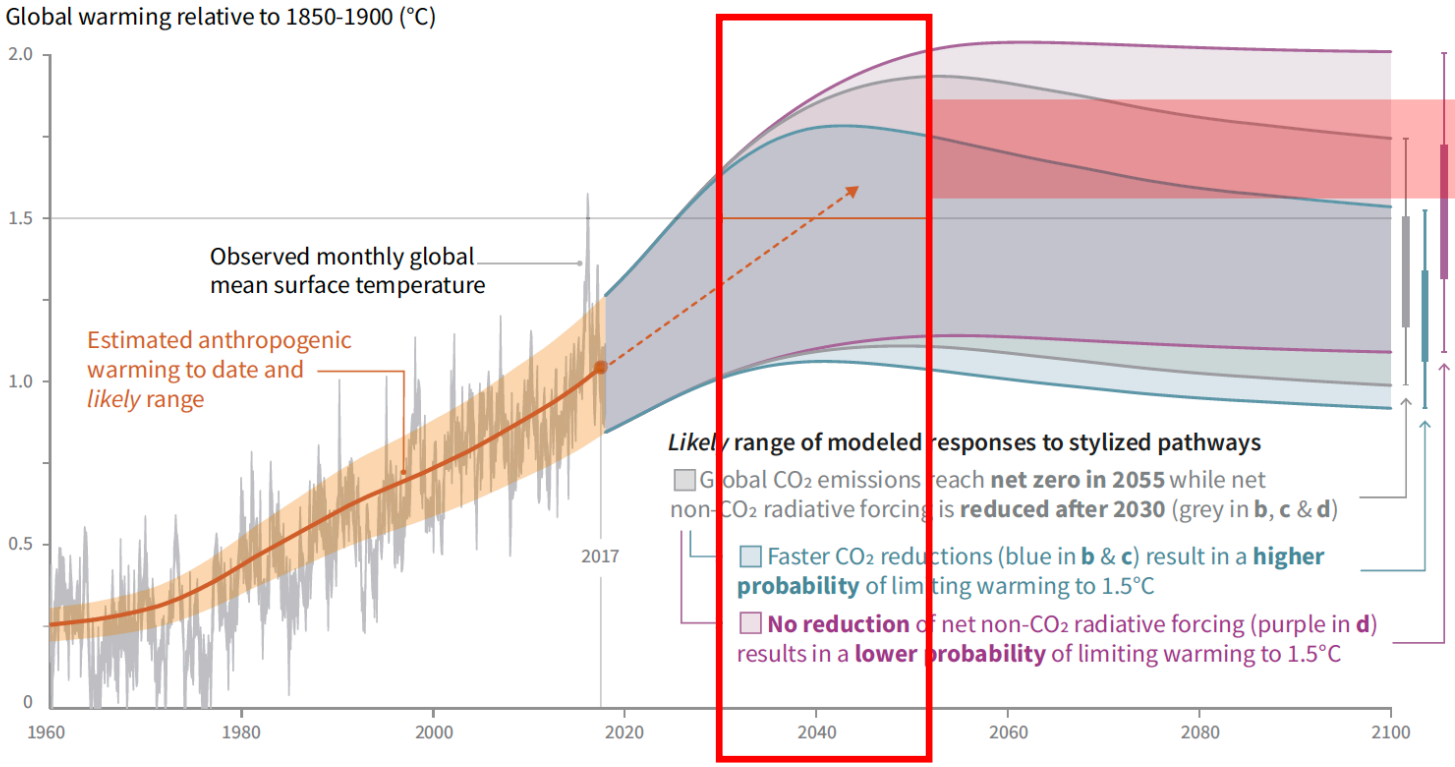
1.5 degree C Target !

Cumulative emissions of CO_2 and future non-CO_2 radiative forcing determine the probability of limiting warming to 1.5°C

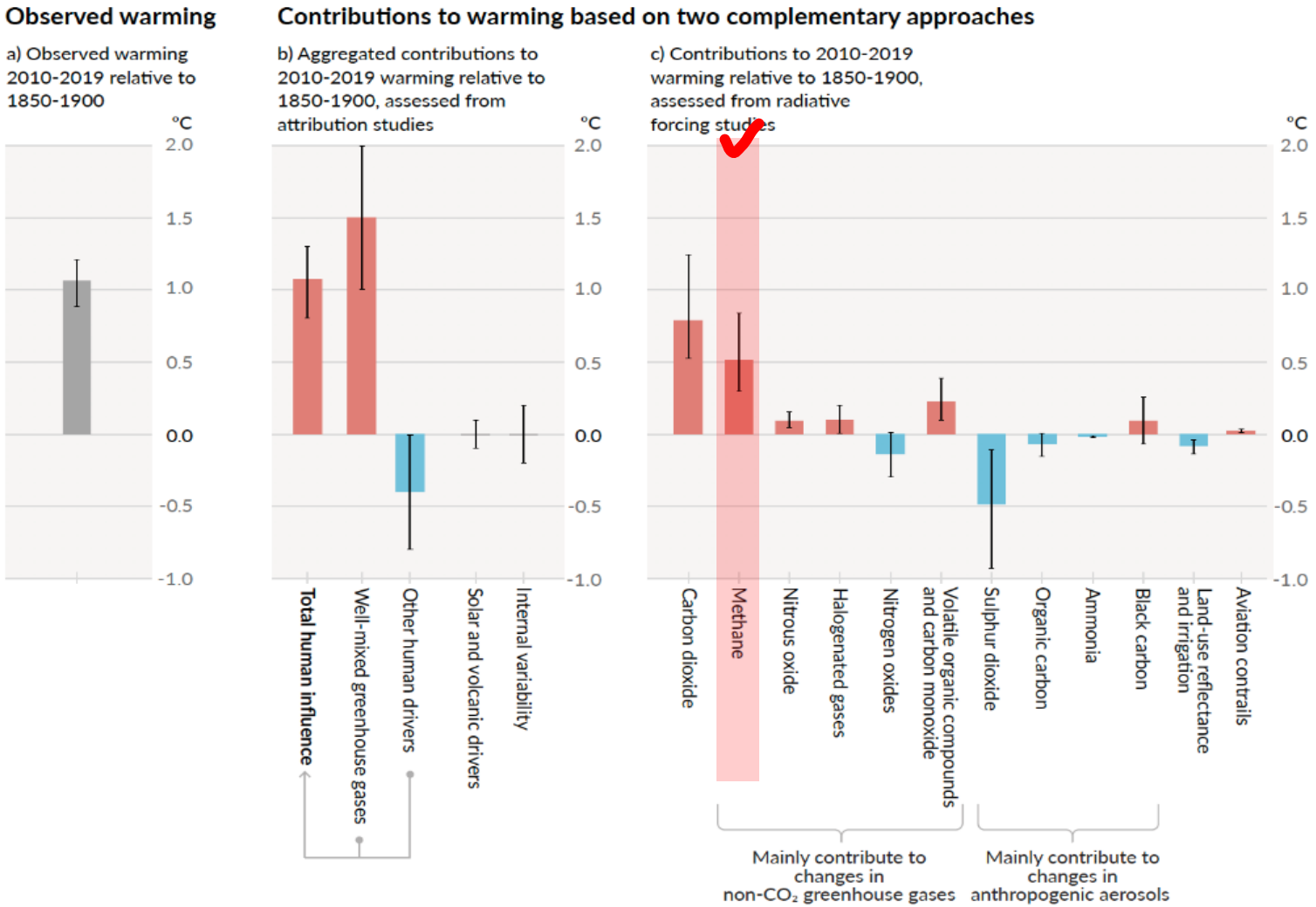
a) Observed global temperature change and modeled responses to stylized anthropogenic emission and forcing pathways



Time to reach the point 1.5 degree C increase !

(Source: IPCC 1.5 special report, 2018)

Contributions to global warming

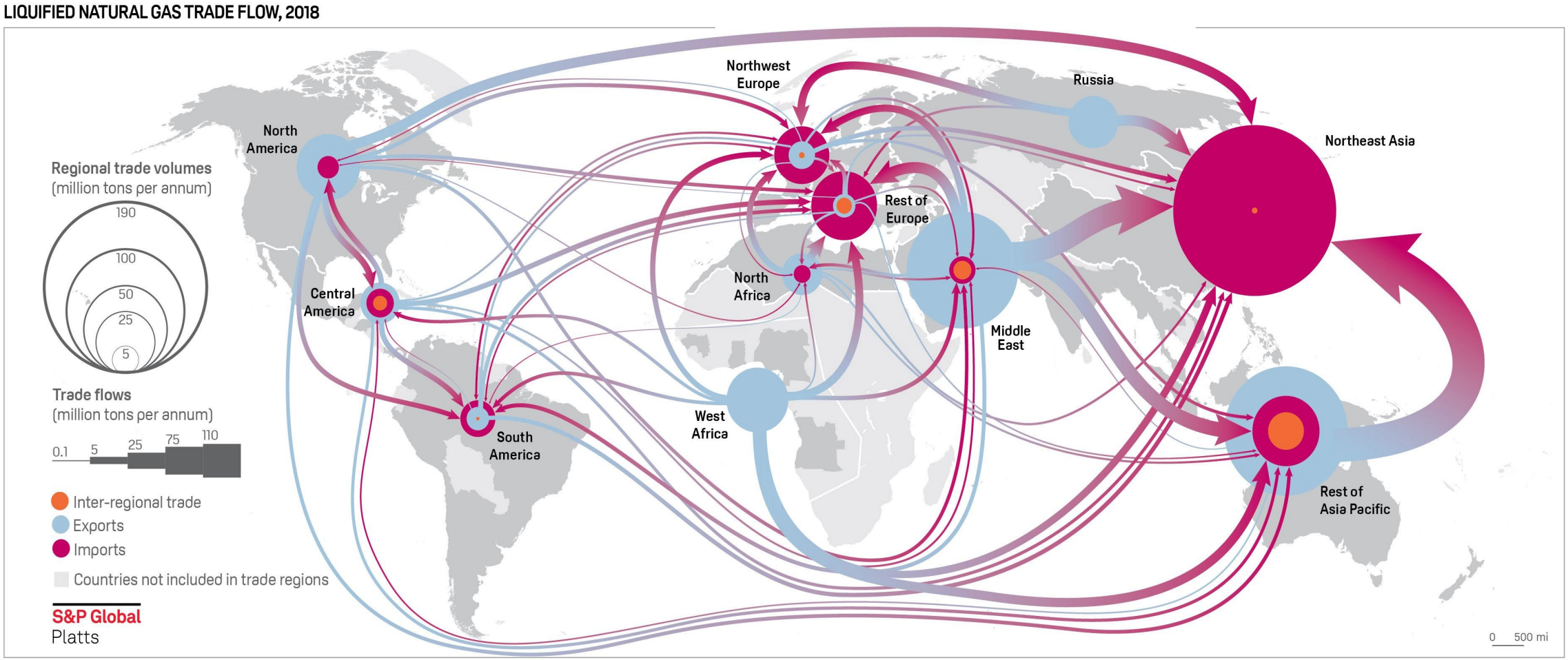


80

times more potent at warming than CO_2
(Over a 20-year period)

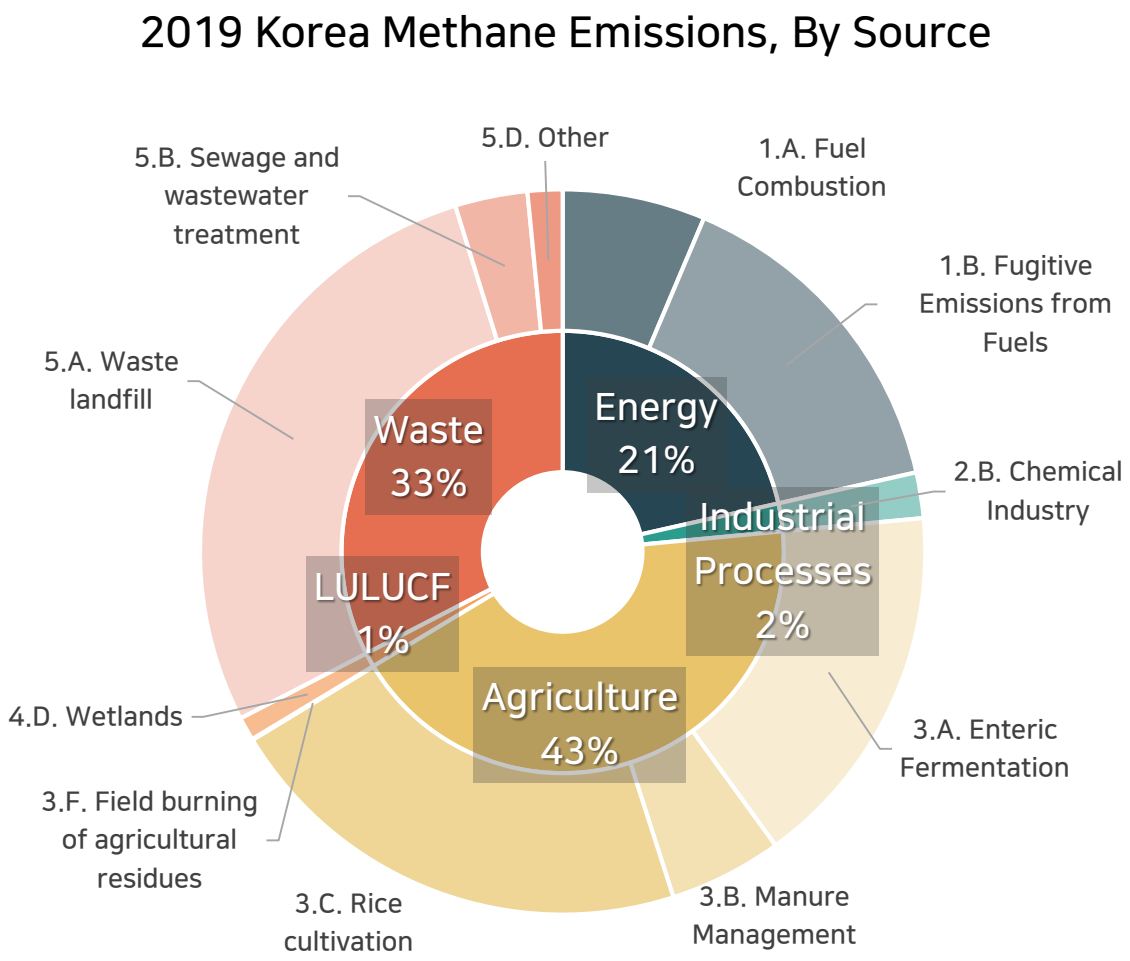
(Source: IPCC AR6, 2021)

Northeast Asia, the world's largest importer



(Source: S&P Global Platts, 2020)

Methane, Where's come from?



1. Agriculture (43%)
2. Waste (33%)
3. Energy (21%)
4. Industrial processes (2%)
5. LULUCF (1%)

Total 27,511 $GgCO_2eq.$

(Source: Korean National Inventory Report, 2019)

Fugitive Emission

Unintentional escape into the air during mining, production, process, storage, and transportation of fossil fuels and raw materials

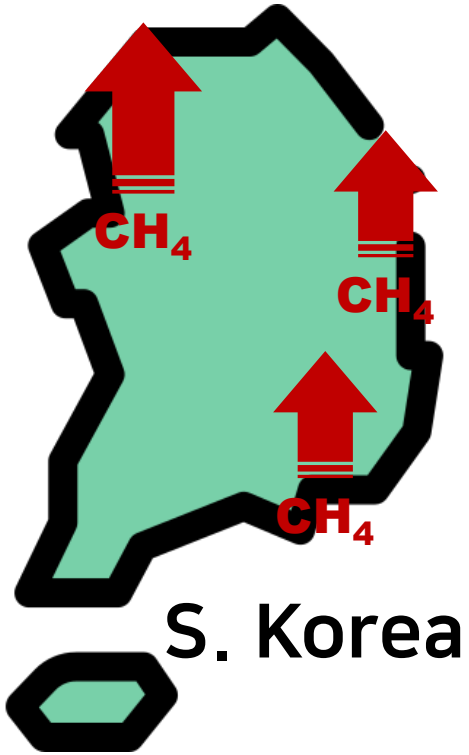
- In the case of Korea, fugitive emissions accounted for **16.1%** of the total methane emissions, showing the **third-highest value** (2018)

Fugitive Methane Emission in S. Korea

Fugitive Methane Emission

(Source: GIR, 2019)

4197.52 $GgCO_2eq$
= 199,880 tons CH_4



Producible Electricity by Fugitive Methane Emission

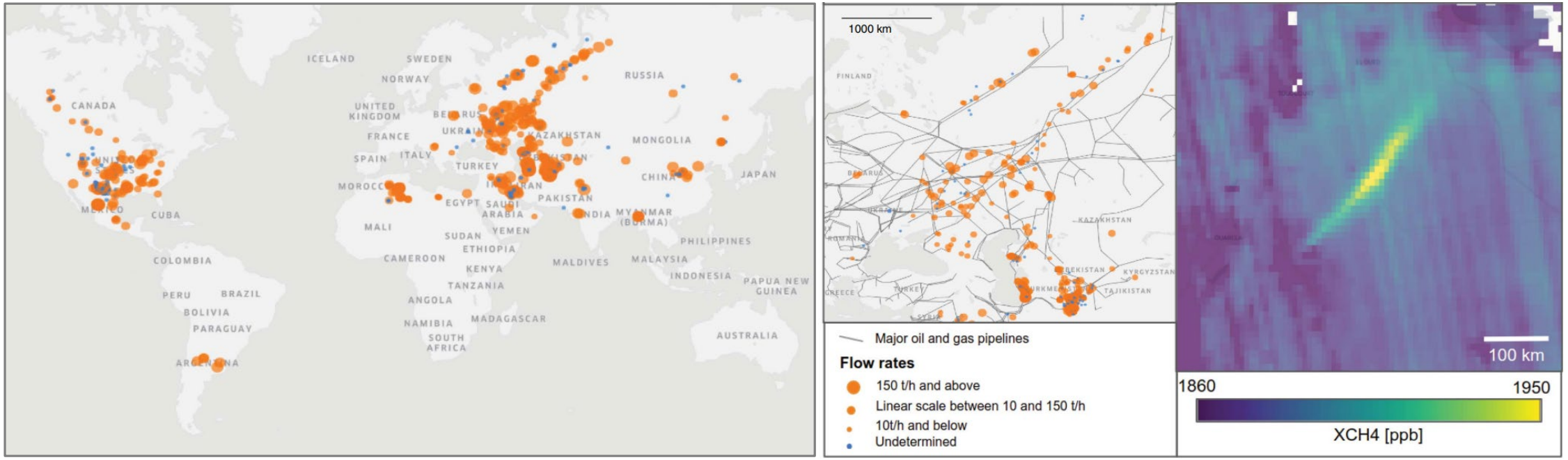
1,507,593 MWh

Produced residential electricity in Seoul
14,656,127 MWh

(Source: Korean Statistical Yearbook, 2021)

Fugitive emission 1,507,593 MWh
~ 1.23 months
for residential in Seoul !

Global assessment of oil and gas methane ultra-emitters from satellites

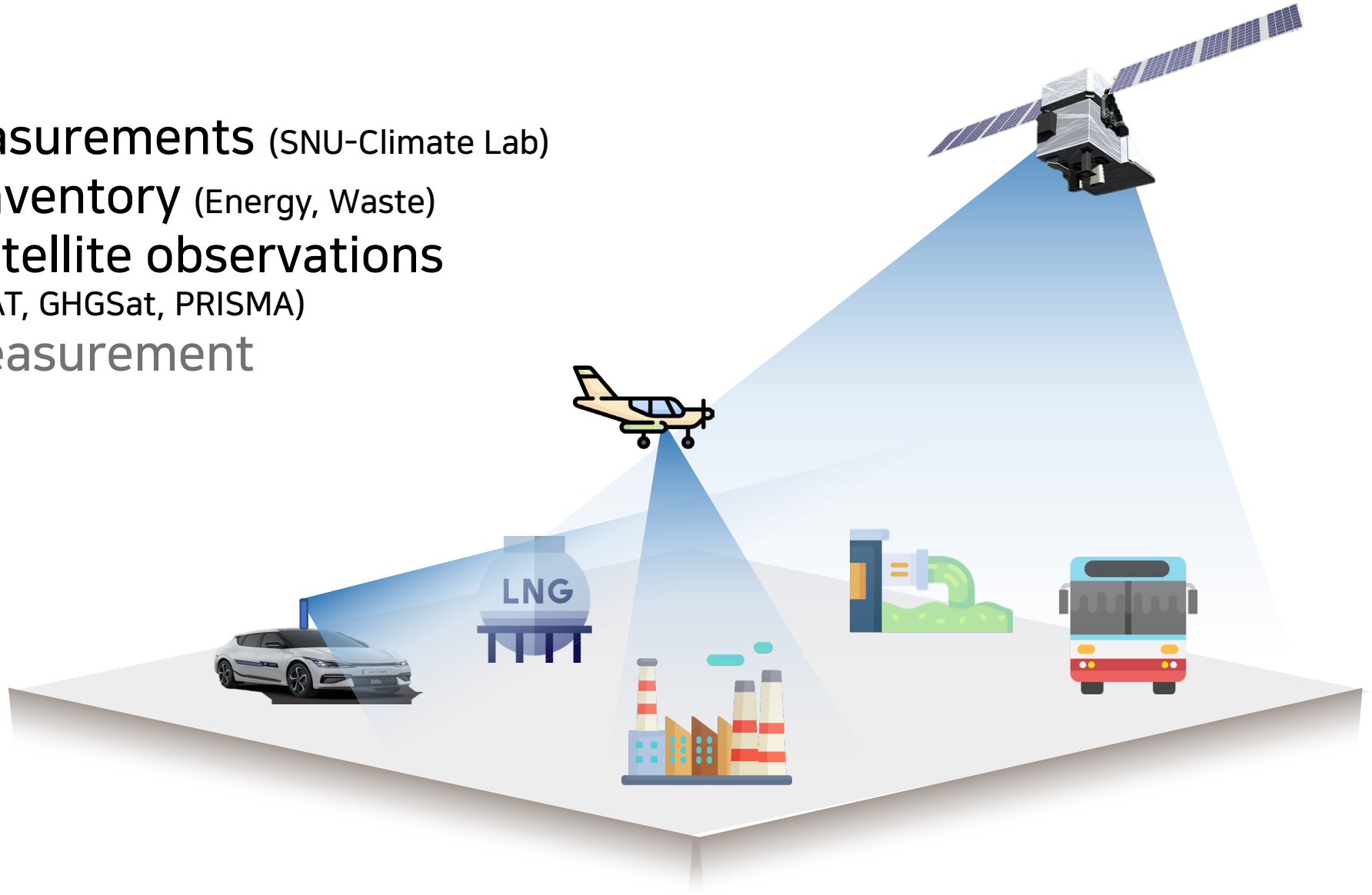


(Source: Lauvaux et al., 2022)

Through the advancement in satellite observation of other countries, <u>it is possible to detect high-concentration emission sources, including those in Korea</u>

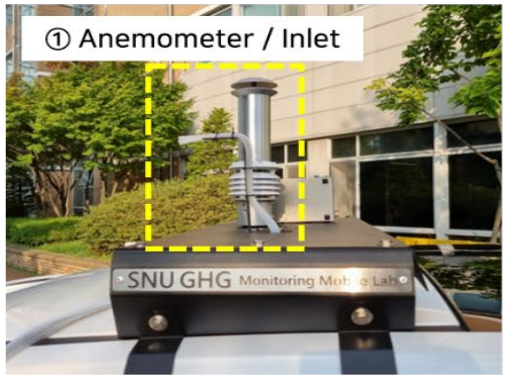
Methane Research in S. Korea

1. Moblie Measurements (SNU-Climate Lab)
2. Methane Inventory (Energy, Waste)
3. Mulitple Satellite observations
   (TROPOMI, GOSAT, GHGSat, PRISMA)
4. Aircraft Measurement

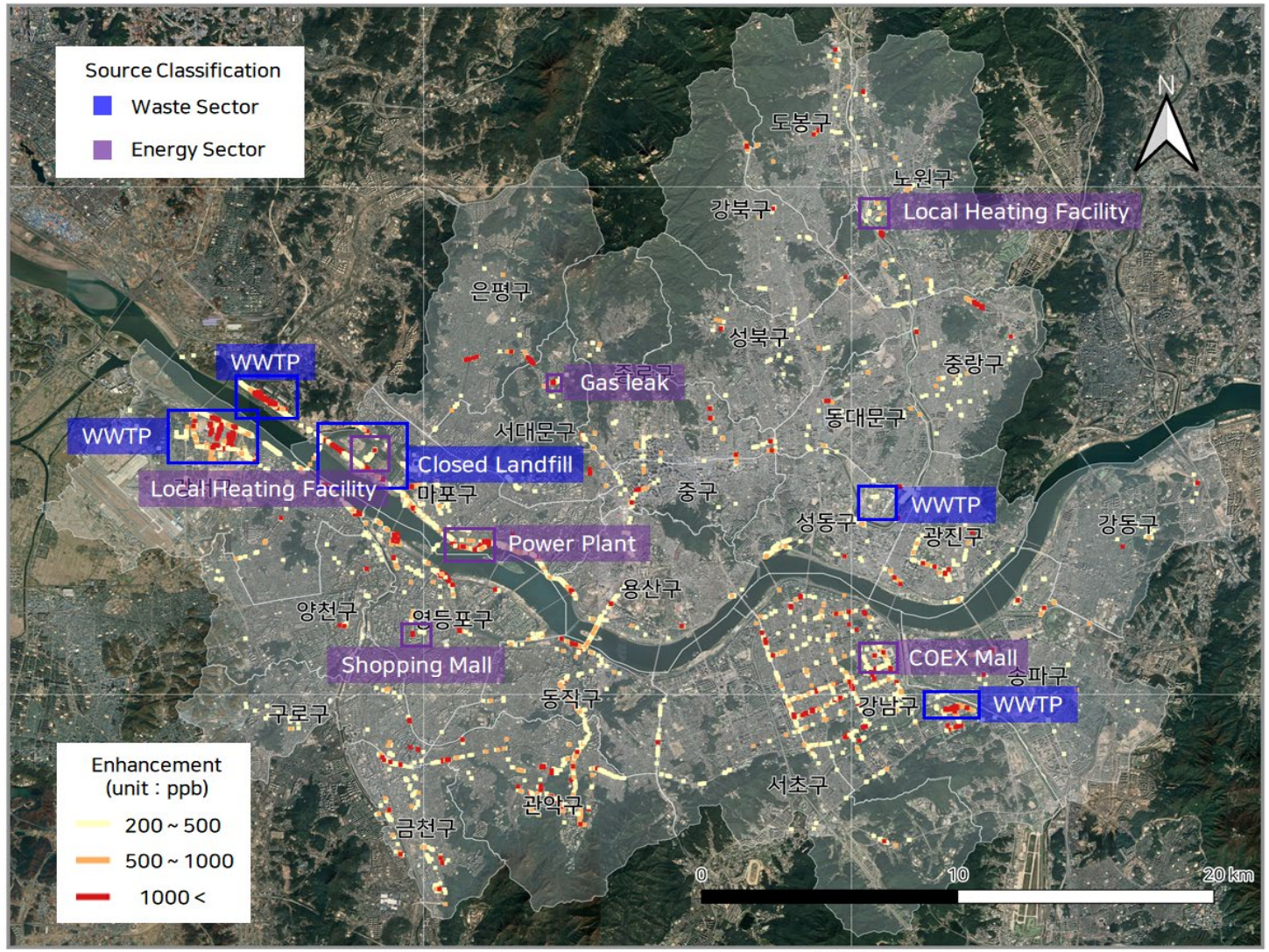


Mobile Measurements

(SNU-Climate Lab)



Methane source in Seoul



Fugitive methane signals

1,707 points in mobile measurements of 4,206 km (i.e., CH_4 enhancements of more than 10% above background levels)

Waste Sector - Biogenic Methane

Waste water treatment center, Landfill, Sludge treatment, etc.

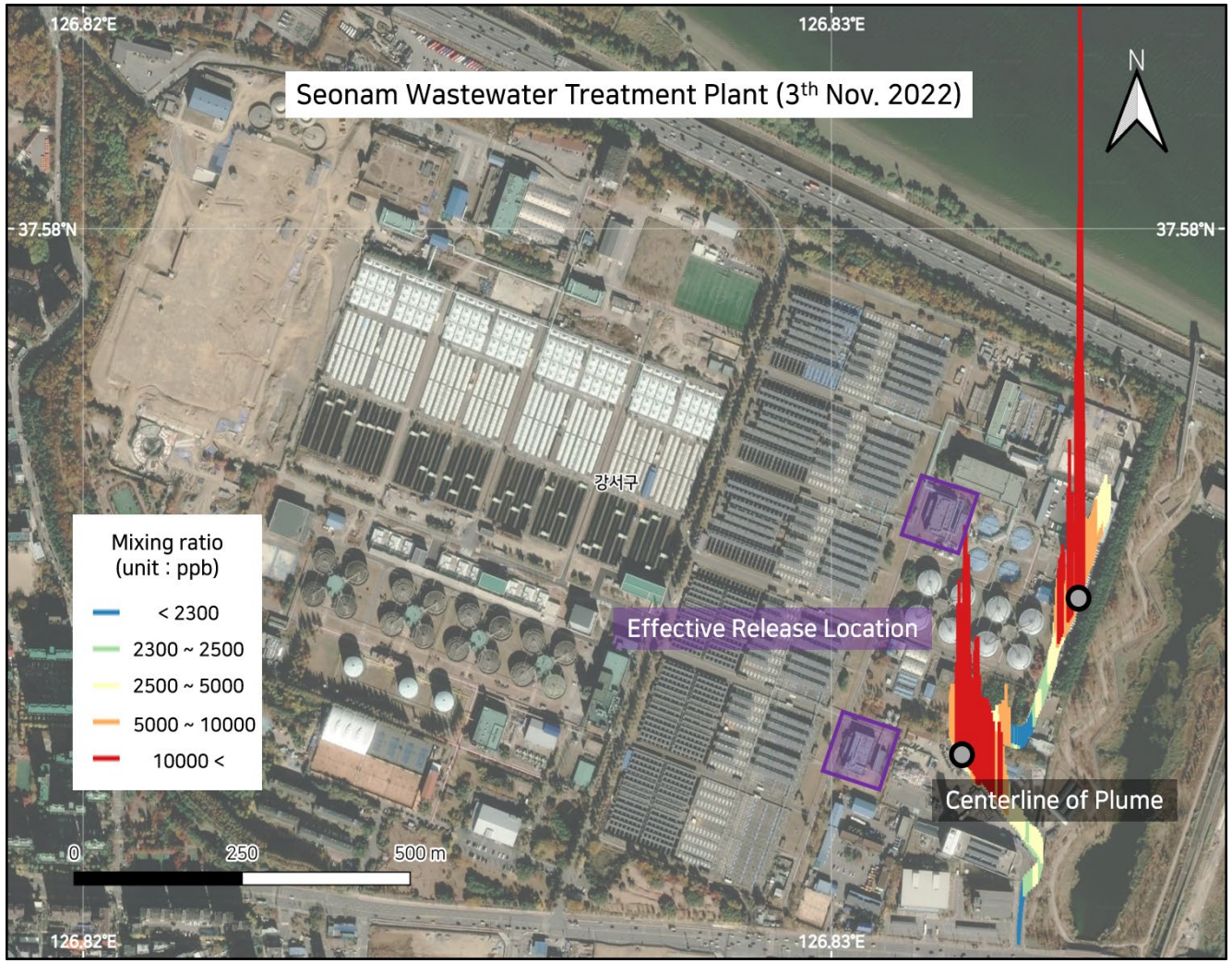
- Emitted from the decomposition process of organic matters under anaerobic conditions
- Escape from sewer pipe network (manhole, etc.)

Energy Sector - Fossil Fuel Origin

Power plant, Heating corporation, Natural gas bus, etc.

- Incomplete combustion and fugitive emissions from the use of LNG and CNG

Methane emission from wastewater treatment plant



Inventory for Seoul (2019)

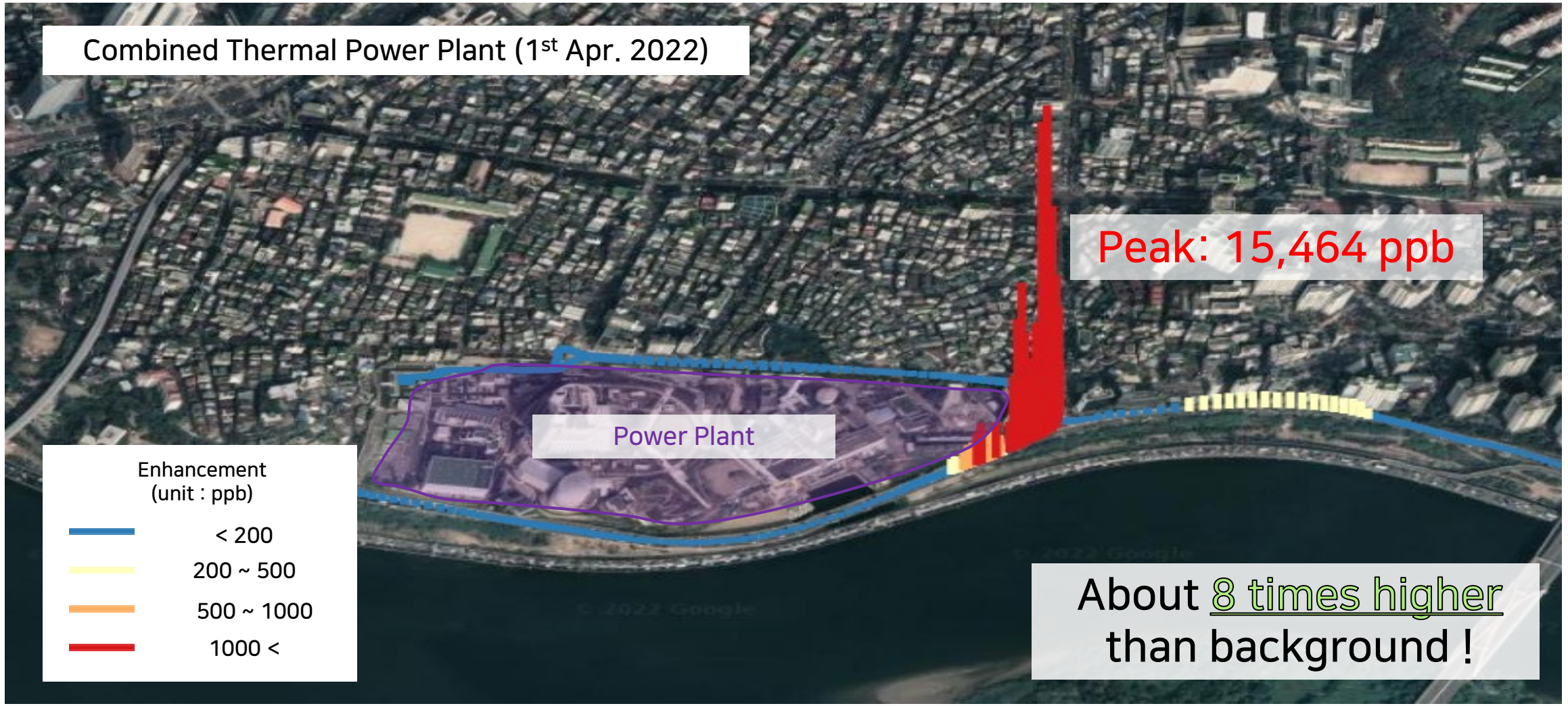
Methane emission of waste sector (Wastewater) is 72.17 $GgCO_2eq$

Estimate of Annual Emission

49.95 ± 5.92 $GgCO_2eq$

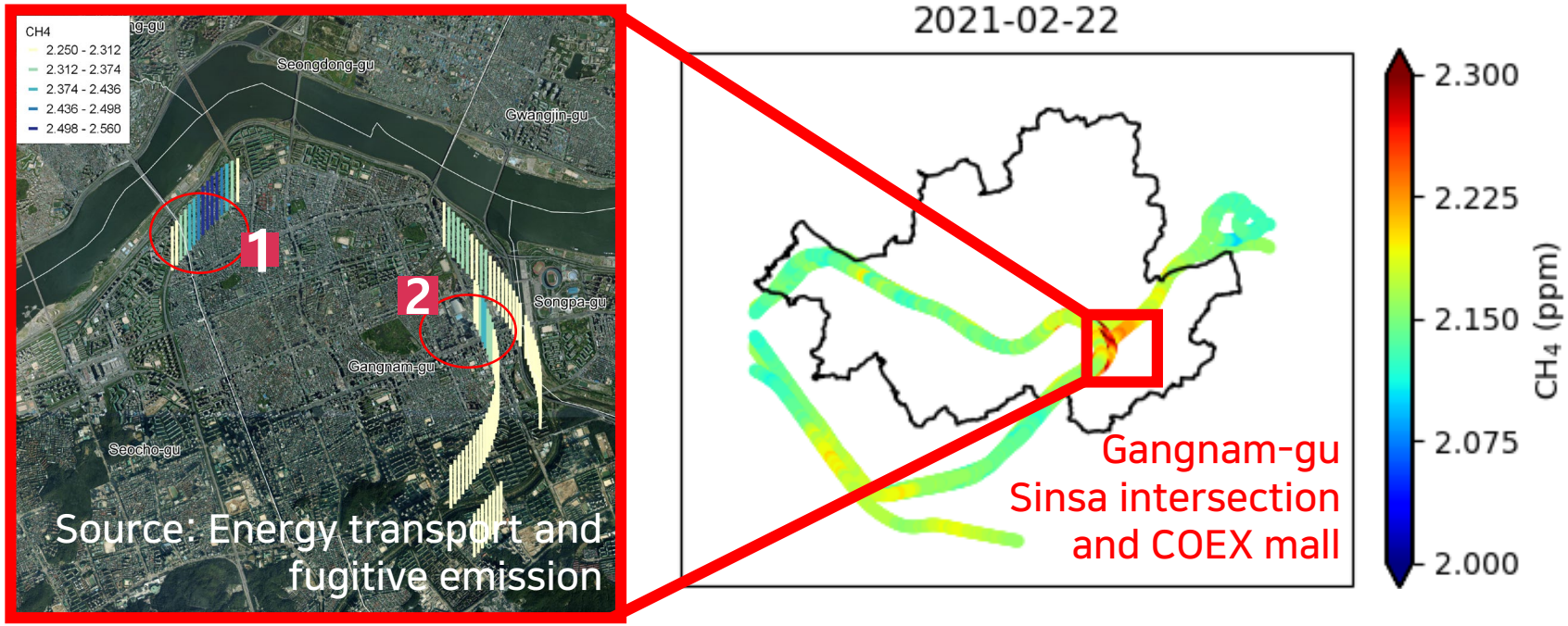
is about **70%** of total methane emissions of waste sector for in the 2019 inventory

Methane emission from power plant



Aircraft measurement

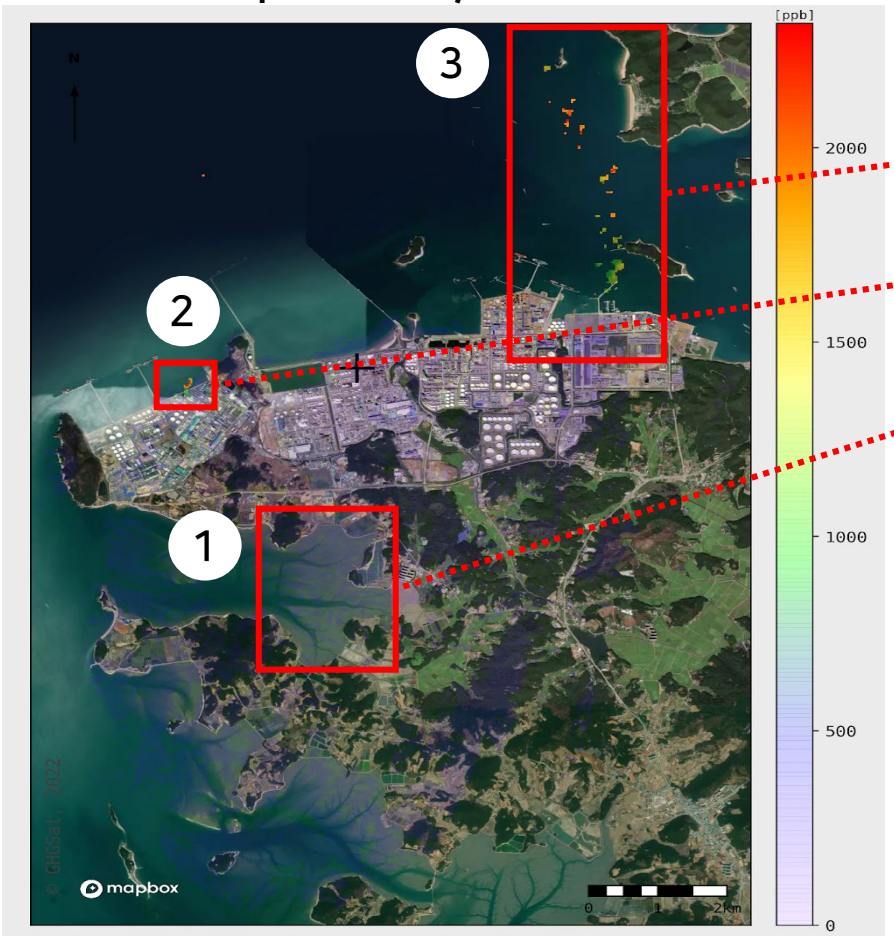
SNU – NIER Aircraft observation campaign (2021-02-19 ~ 2021-02-22)



Source: Finding the missing link in methane emissions inventories using aircraft and mobile observations. (Chang et al., 2021)
Unexpected urban methane hotspots captured from aircraft observations. (Park et al., 2022)

Daesan – the largest petrochemical complexes in S. Korea

Satellite Measurement
provided by GHGSat



Observation Time
16 May, 2022 (Local) 11:08:36

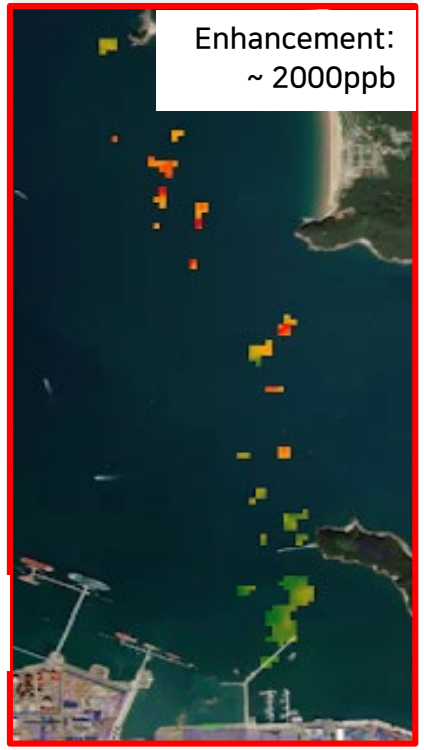
(1) Wetland (Mud flat)

Enhancement: ~500 ppb

(2) Chemical Plants

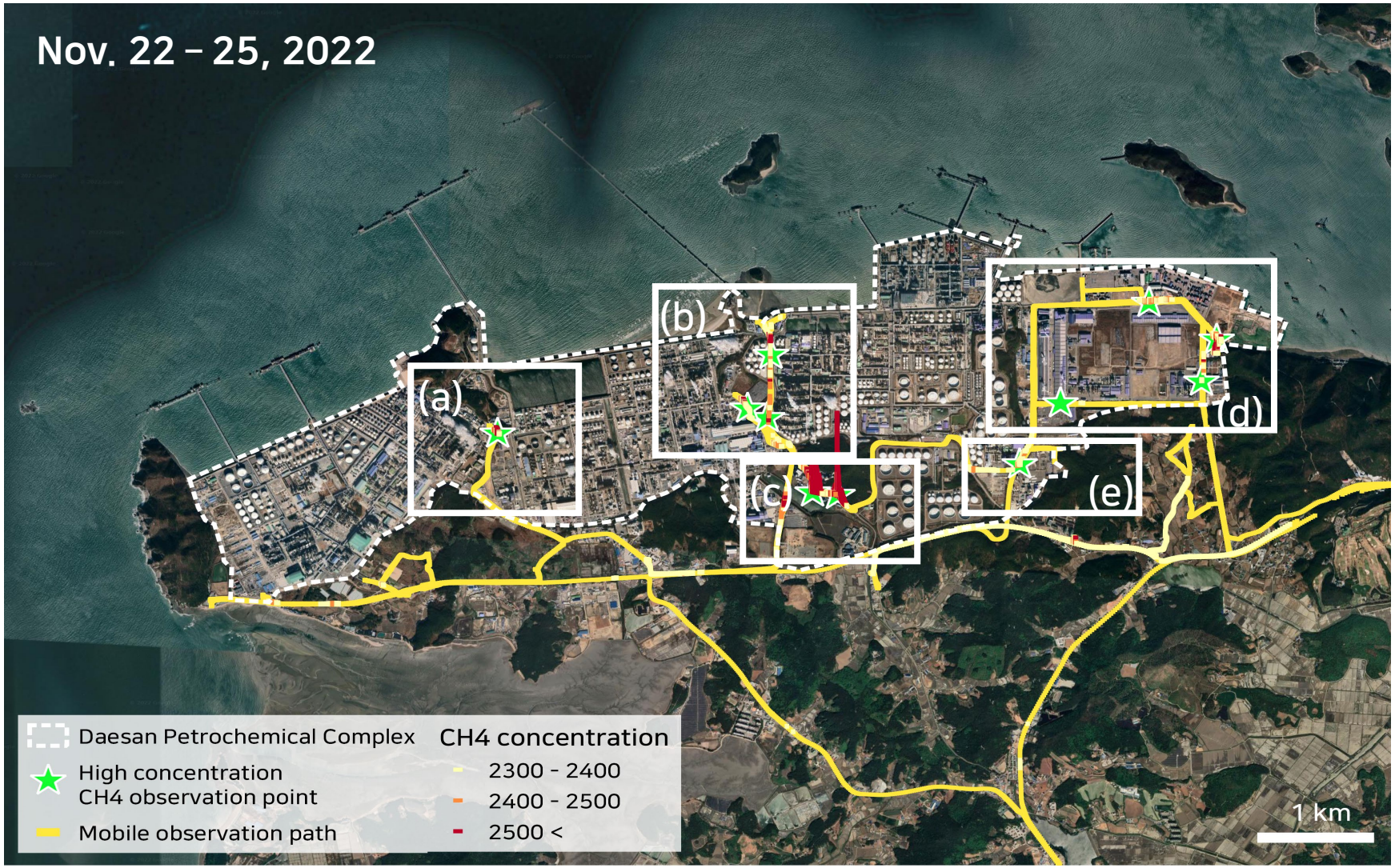
Enhancement: ~2300ppb

(3) Ocean



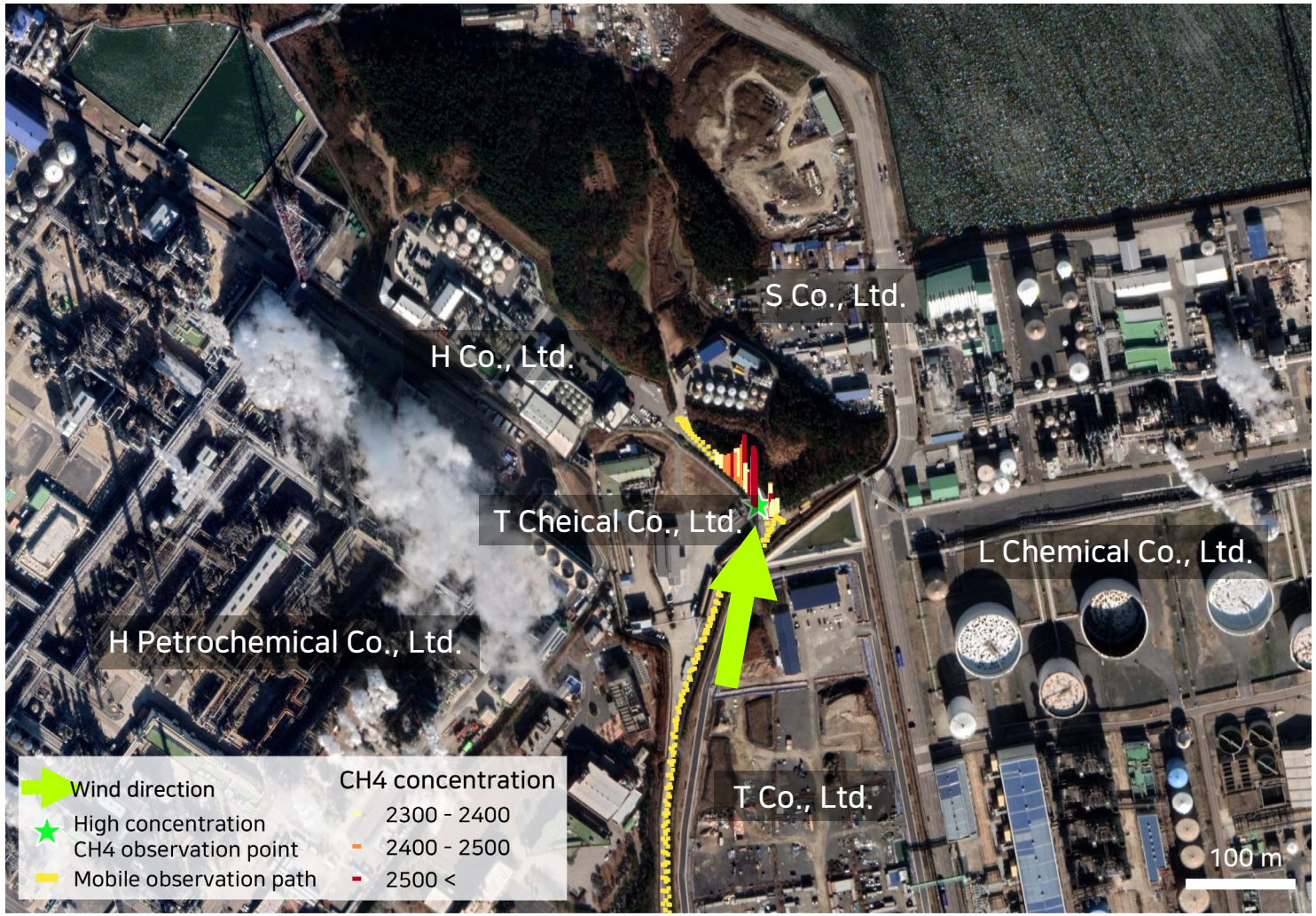
(Background: Approx. 1950ppb)

Daesan – the largest petrochemical complexes in S. Korea



(a) T Chemical Co., Ltd.
(b) H Company
(c) S Chemical Co., Ltd.
(d) K Factory
(e) K Industries Inc.

Daesan – (a) T Chemical Co., Ltd



- Observation date: 2022-11-25
- Peak of CH_4: 2,820 ppb
- CH_4 background (10%): 2,118 ppb
- C_2H_6/CH_4: 34%
- Wind direction: SSW
- Wind speed: 2.0~3.5 m/s

Daesan – (a) T Chemical Co., Ltd

Potential emission source

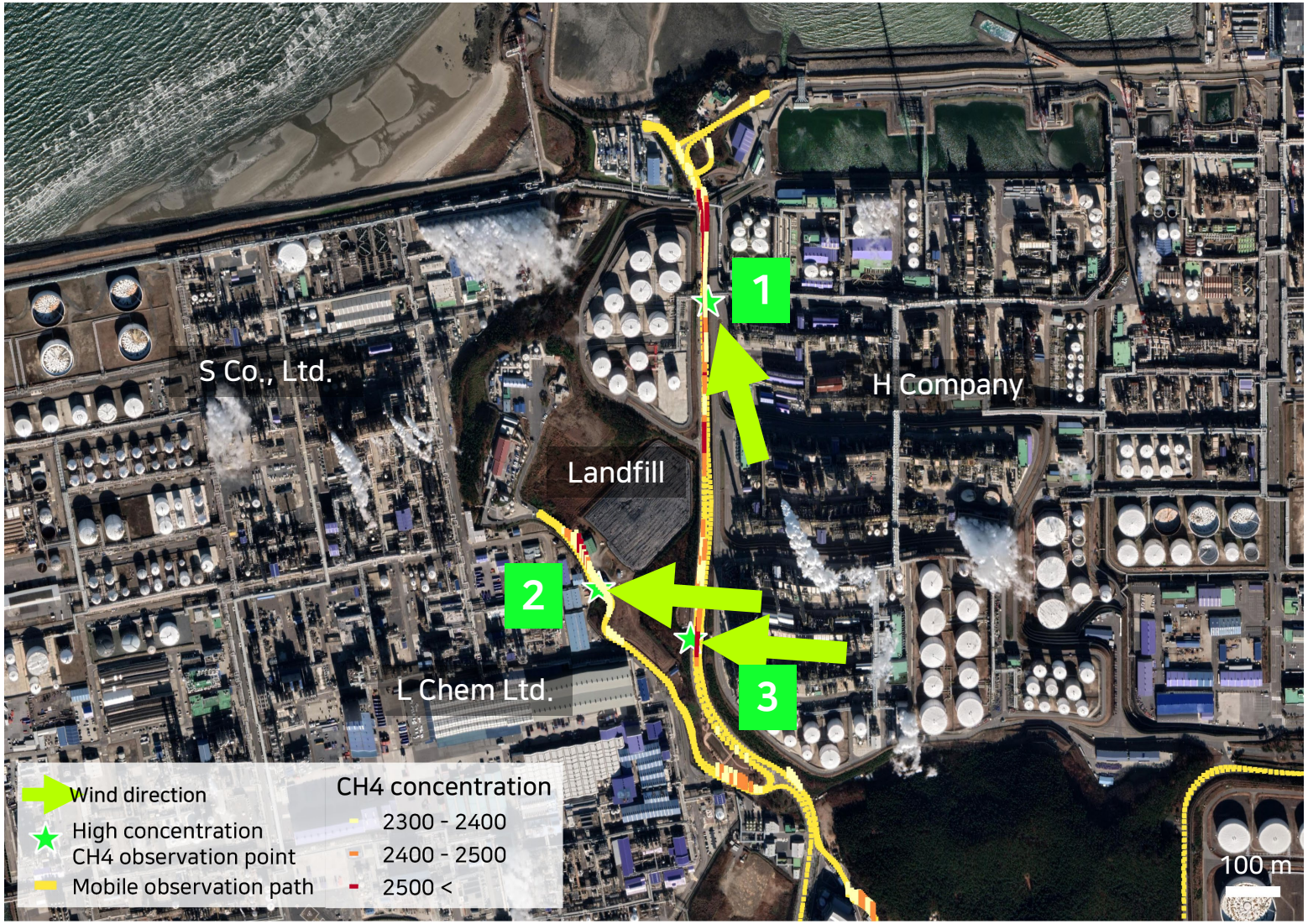
- Natural gas pipeline
- PSA-CO2 Plant

T Chemical Co., Ltd.

- make Liquid carbon dioxide
- PSA (Pressure swing adsorption) - CO_2 Plant

One of the primary applications of PSA is in the removal of carbon dioxide (CO_2) as the final step in the large-scale commercial synthesis of hydrogen (H_2) for use in oil refineries and in the production of ammonia (NH_3). gas to be sold as natural gas.

Daesan – (b) H Company



1

- Observation date: 2022-11-25
- Peak of CH_4: 2,772 ppb
- CH_4 Background (10%): 2,118 ppb
- C_2H_6/CH_4: 14%
- Wind direction: SSE
- Wind speed: 1.5~3.0 m/s

2

- Observation date: 2022-11-22
- Peak of CH_4: 2,608 ppb
- CH_4 background (10%): 2,174 ppb
- C_2H_6/CH_4: -0.06%
- Wind direction: E
- Wind speed: 0.5~1.0 m/s

3

- Observation date: 2022-11-22
- Peak of CH_4: 2,642 ppb
- CH_4 background (10%): 2,174 ppb
- C_2H_6/CH_4: 17%
- Wind direction: E
- Wind speed: 0.5~1.0 m/s

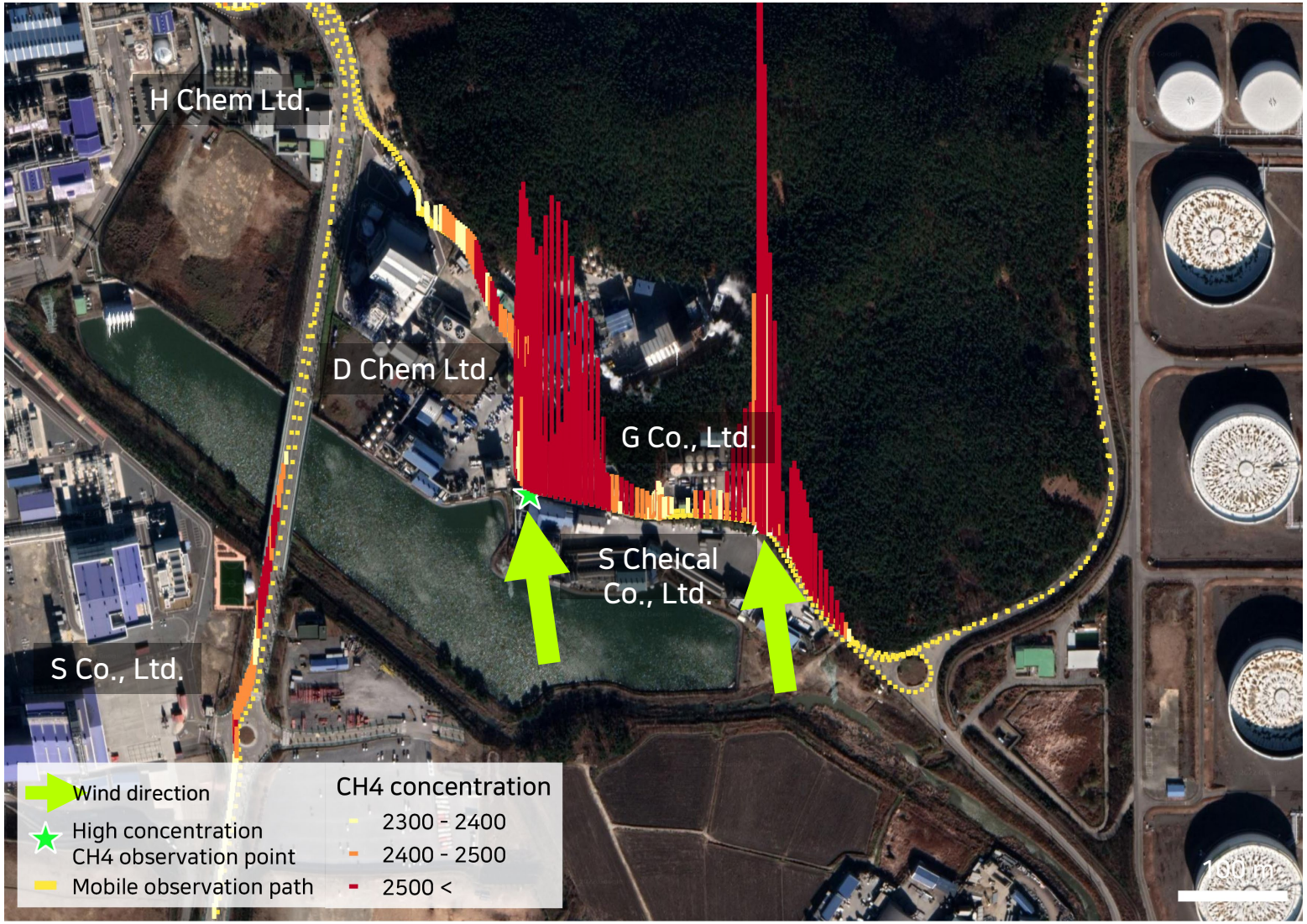
Daesan – (b) H Company

Potential emission source

Natural gas pipeline, RFCC (Residue Fluidized Catalytic Cracking), MX(Mixed Xylene) production unit

It features Oil Refining Facilities with a daily capacity of 561,000 barrels and Heavy Oil Cracking Facilities (Upgrading Facilities) which is also known as 'Ground Oilfields' in the 3.3M square meters of land.

Daesan – (c) S Chemical Co., Ltd.



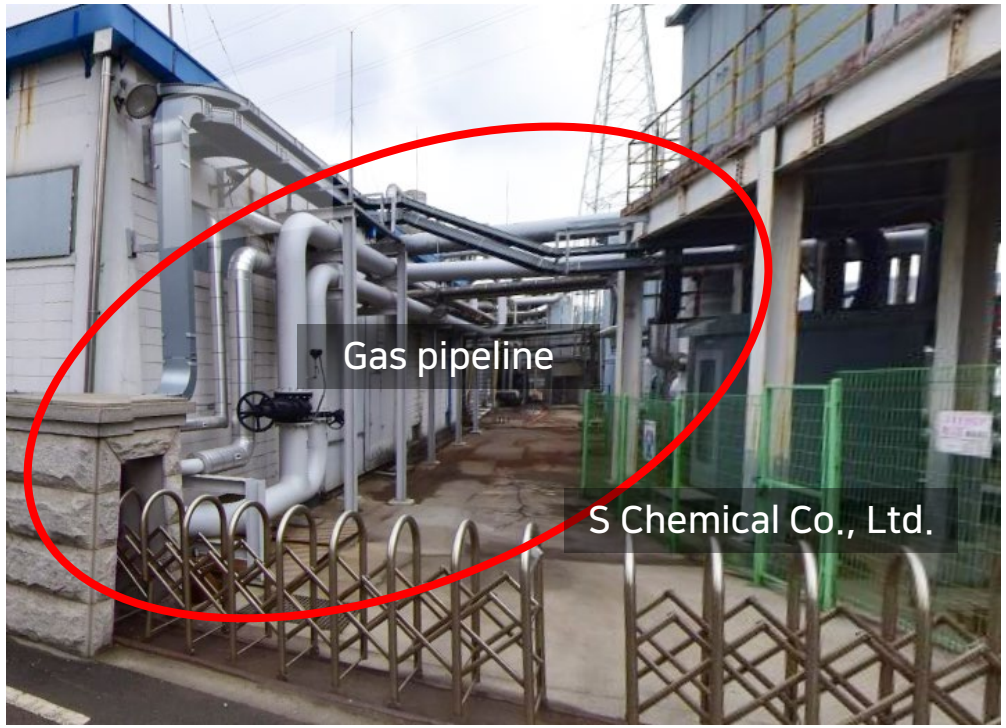
1

- Observation date: 2022-11-25
- Peak of CH_4: 6,432 ppb
- CH_4 Background (10%): 2,118 ppb
- C_2H_6/CH_4: 1%
- Wind direction: SSE
- Wind speed: 2.0~5.0 m/s

2

- Observation date: 2022-11-25
- Peak of CH_4: 13,056 ppb
- CH_4 background (10%): 2,118 ppb
- C_2H_6/CH_4: 1%
- Wind direction: SSE
- Wind speed: 2.0~5.0 m/s

Daesan – (c) S Chemical Co., Ltd.



Potential emission source

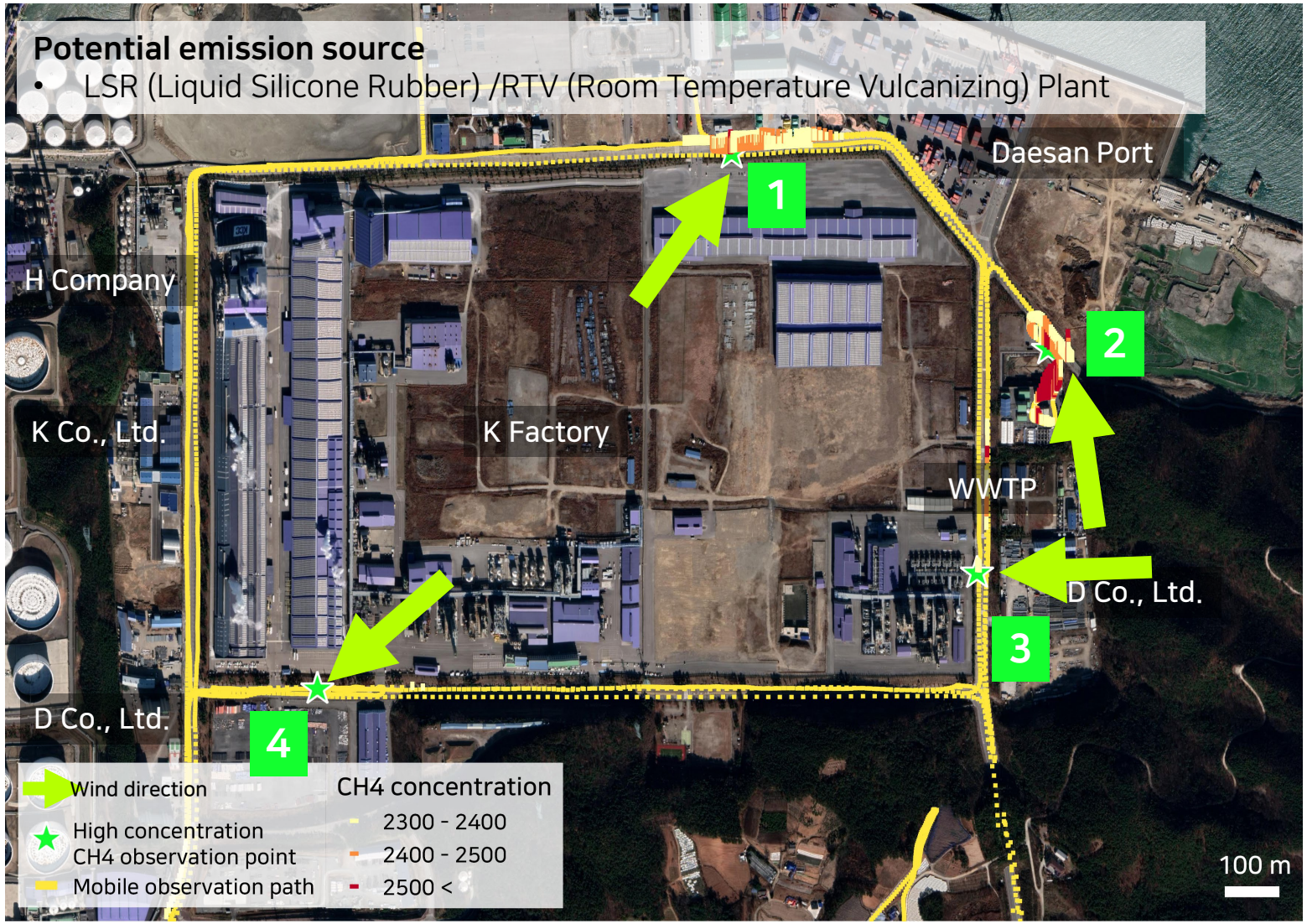
- Unknown biogenic methane source
- PSA-CO_2 Plant

S Chemical Co., Ltd.

- make Liquid carbon dioxide
- PSA(Pressure swing adsorption)-CO2 Plant

One of the primary applications of PSA is in the removal of carbon dioxide (CO_2) as the final step in the large-scale commercial synthesis of hydrogen (H_2) for use in oil refineries and in the production of ammonia (NH_3). gas to be sold as natural gas.

Daesan – (d) K Factory



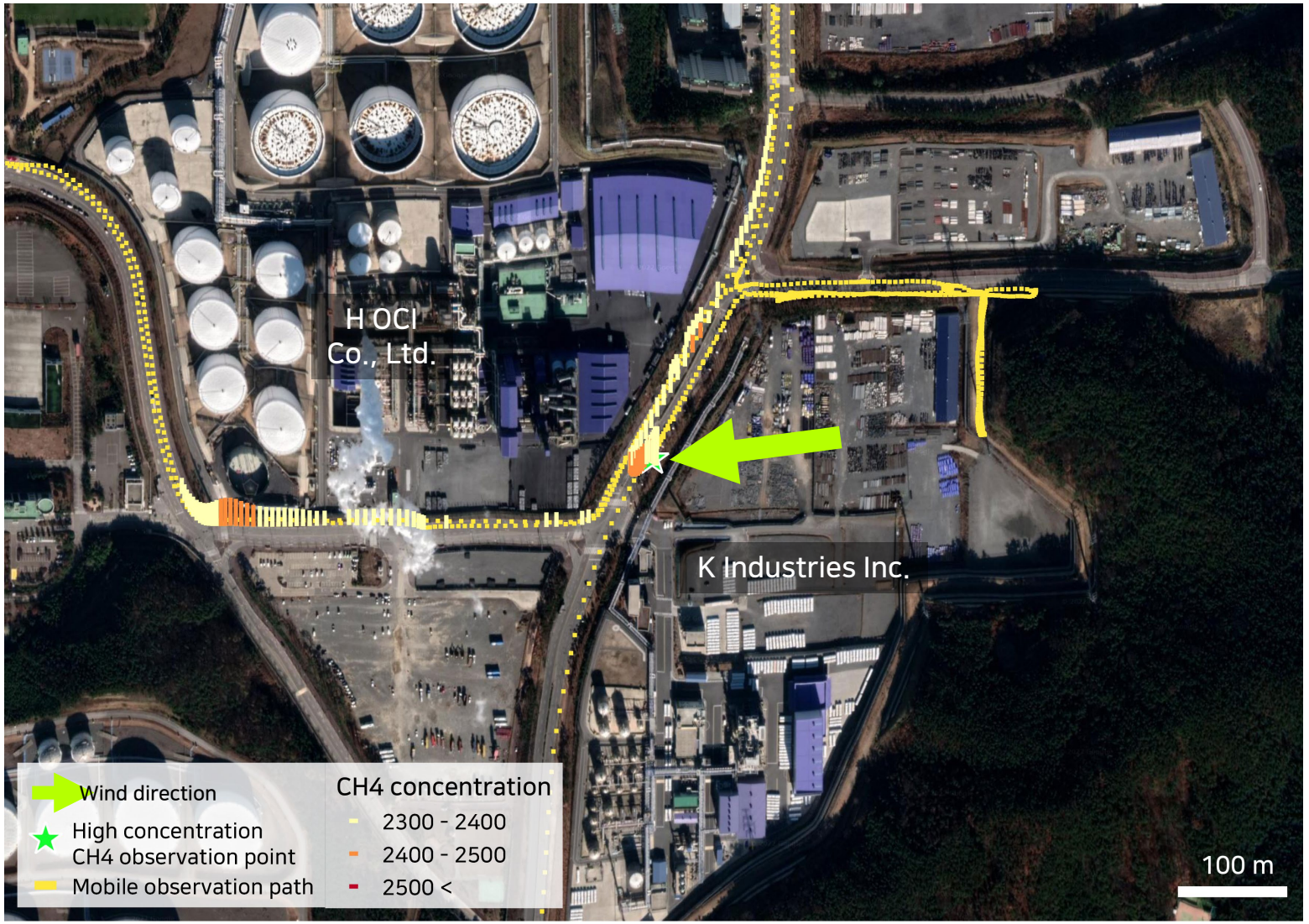
1
- Observation date: 2022-11-25
- Peak of CH_4: 2,636 ppb
- CH_4 Background (10%): 2,118 ppb
- C_2H_6/CH_4: 74%
- Wind direction: SW
- Wind speed: 2.0~5.0 m/s

2
- Observation date: 2022-11-25
- Peak of CH_4: 2,996 ppb
- CH_4 Background (10%): 2,118 ppb
- C_2H_6/CH_4: 1%
- Wind direction: SW
- Wind speed: 2.0~5.0 m/s

3
- Observation date: 2022-11-22
- Peak of CH_4: 2,715 ppb
- CH_4 Background (10%): 2,174 ppb
- C_2H_6/CH_4: 2%
- Wind direction: E
- Wind speed: 0.5~2.0 m/s

4
- Observation date: 2022-11-22
- Peak of CH_4: 2,339 ppb
- CH_4 Background (10%): 2,174 ppb
- C_2H_6/CH_4: 3,494%
- Wind direction: NE
- Wind speed: 0.5~2.0 m/s

Daesan – (e) K Industries Inc.



- Observation date: 2022-11-22
- Peak of CH_4: 2,469 ppb
- CH_4 background (10%): 2,174 ppb
- C_2H_6/CH_4: 81%
- Wind direction: E
- Wind speed: 0.5~2.0 m/s

Potential emission source

- Gas pipeline

K Industries Inc.

- Hydrogenated DCPD (Dicyclopentadiene) resin
- make Hot-melt adhesives, hot-melt adhesives for hygiene products, film modifications, other adhesives

Conclusion

- The greenhouse gases (GHGs) information we currently have is very limited and very far from reality.
- Multiple observation systems (satellite, ground-based observations) and modeling study can identify methane sources and quantify methane emissions.
- These systems can provide detailed emission information and comprehensive inventory information for each country, and can immediately verify the current situation and reduction of GHGs.
- There is no more hiding and no longer afford to procrastinate and hesitate. We need to prepare and respond proactively from now on.

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Thank you for listening

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