



ASEAN NPSR

Conclusion of Last Benchmark Problem of ASEAN NPSR

Mr. Wasin VECHGAMA
TINT
wasin@tint.or.th

Mr. Kampanart SILVA
ENTEC
kampanart.sil@entec.or.th

Mr. TANG Jia Hao
SNRSI
snrtajh@nus.edu.sg

Outline

- **Motivation to conduct the benchmark problem**
 - Mr. Wasin VECHGAMA, TINT
- **Outputs of the benchmark problem**
 - Mr. Kampanart SILVA, ENTEC
- **How to proceed the benchmark problem**
 - Mr. TANG Jia Hao, SNRSI

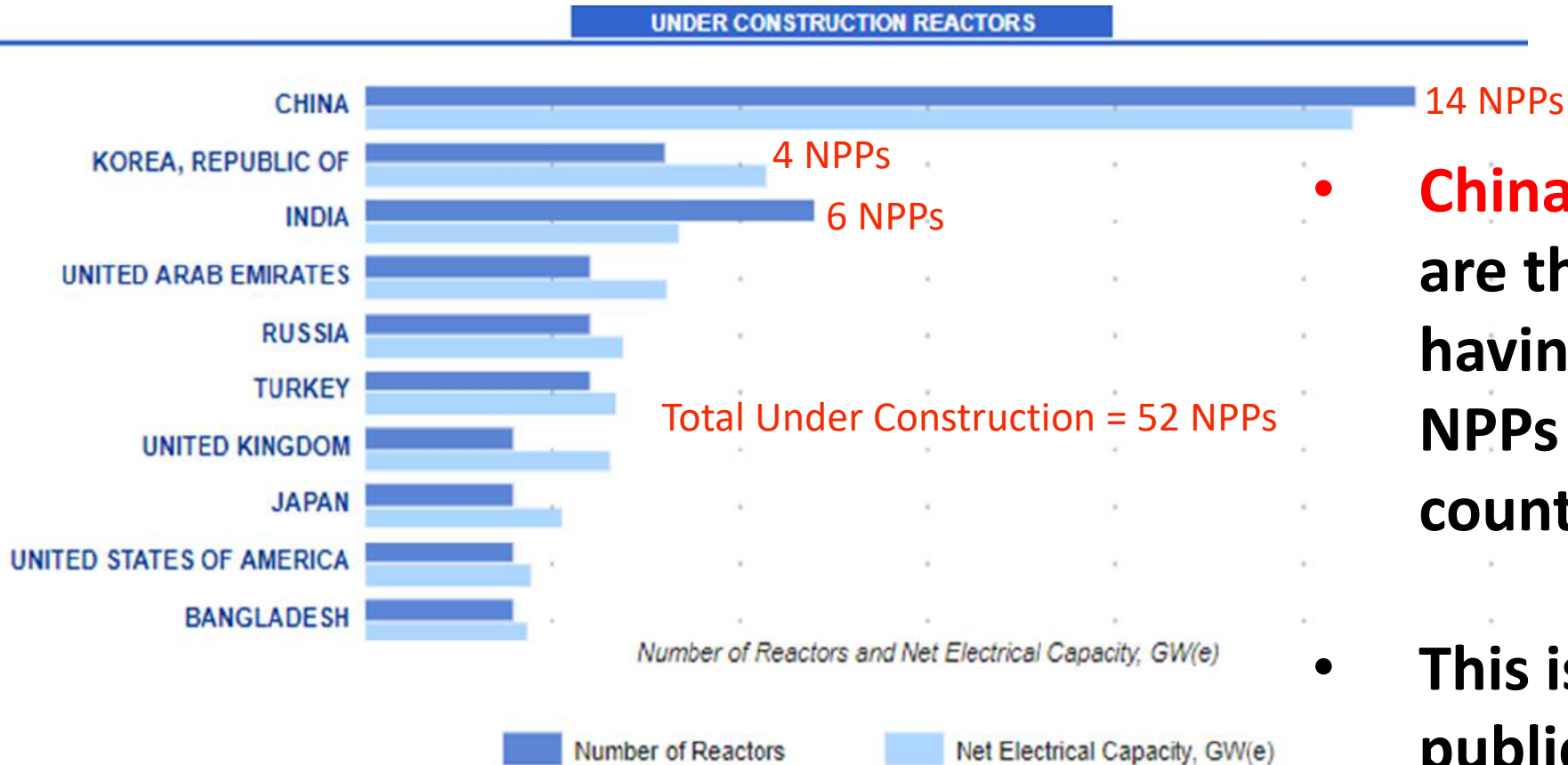


Motivation to conduct the benchmark problem

- Most ASEAN countries stuck at the NPP planning phase or abandoned the NPP projects due to the concerns of public acceptance, safety issues, or economic reasons.
- However, countries around the region, e.g., **China, India, South Korea, Taiwan,** and Japan continue to increase NPPs to meet their domestic energy demand.



Motivation to conduct the benchmark problem



- **China, India, South Korea** are the top three countries having under construction NPPs near by ASEAN countries.
- This issue always leads to public anxiety is the risk of a nuclear accident.

<https://pris.iaea.org/PRIS/WorldStatistics/UnderConstructionReactorsByCountry.aspx>

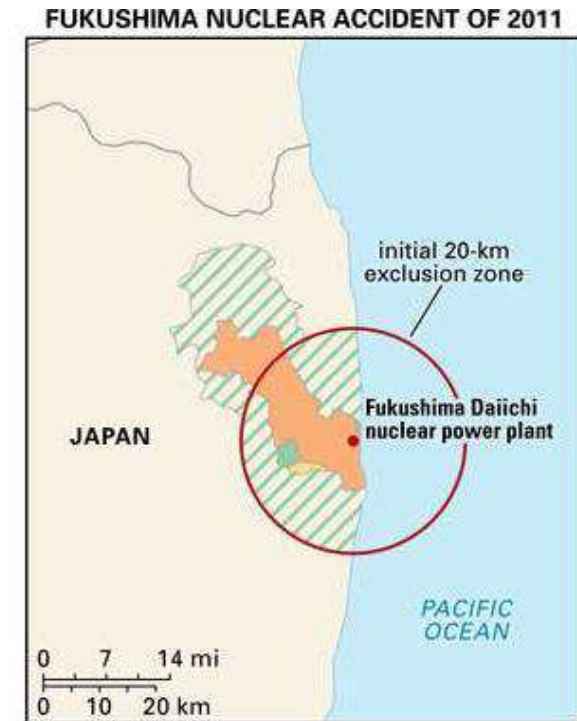


Motivation to conduct the benchmark problem

- The NPP accidents such as the Chernobyl NPP and the Fukushima Daiichi NPP led to the **atmospheric dispersion of radionuclides to many parts of the world.**
- ASEAN, **not having NPP**, should express great concern on the study of transboundary atmospheric dispersion of the release from NPPs.



<https://www.britannica.com/technology/nuclear-reactor/Fukushima>



Motivation to conduct the benchmark problem

- Most previous studies of transboundary atmospheric dispersion were conducted in the temperate climate zone that is **different weather with ASEAN.**
- ASEAN region, that is in the tropical climate zone, needs to have a good practices to **perform own transboundary atmospheric dispersion study.**



<https://www.quora.com/What-is-the-difference-between-tropical-region-and-temperate-region>



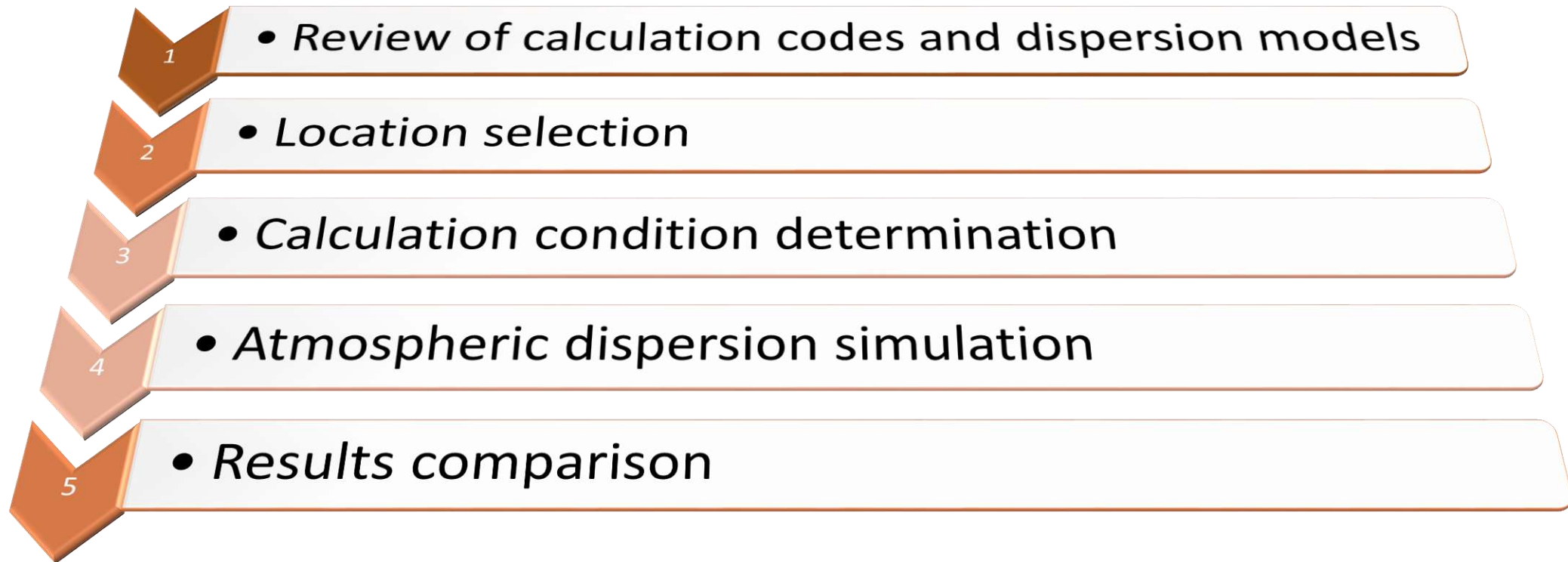
Objective of the benchmark problem

- **The aim is to summarize the efforts of the ASEAN NPSR** in comparing the release results of transboundary atmospheric dispersion from a hypothetical accident.
- **Inter-comparison** of atmospheric dispersion calculations were performed by different calculation codes employing **Lagrangian particle and Gaussian puff models with the same weather conditions.**



Flow of Benchmark Problem Assessment

The flow of the benchmark problem assessment of transboundary atmospheric dispersion calculations under the framework of ASEAN NPSR is divided into **five parts**.



Review of calculation codes and dispersion models

Lagrangian particle model	Gaussian puff model
<ul style="list-style-type: none">• Flexpart• LASAT module of JRodos• NAME3 module of PACE	<ul style="list-style-type: none">• ARGOS• RIMPUFF module of JRodos

Review of calculation codes and dispersion models

- **Lagrangian** particle models are more **suitable for long-range dispersion** than Gaussian puff.
- **Lagrangian** particle models **require anywhere from several hours up to several days** on an average personal computer (PC) depending on the sizes of domains.
- **Gaussian puff** models can perform a long-range dispersion calculation **covering one-day timeframe in seconds or minutes**.



Location selection

- **Criteria were set for the selection:**
 - **Short distance to Southeast Asian region**
 - **Influence from the regional wind patterns or monsoons**



<https://www.power-technology.com/projects/fangchenggang-nuclear-power-plant-guangxi/>



http://nnsa.mee.gov.cn/english/npps/list/201805/t20180517_440483.html



<https://www.google.com/maps/place/%E9%8B%B2%E5%9F%8E%E6%B8%AF%E6%AD%B8%E7%94%B5%E7%AB%99/@13.916274,113.1113606,3z/data=!4m5!3m4!1s0x36b334276b58d9af:0x2f3fa60e0bbab5418m2!3d21.65215314d108.491047?hl=en>

Calculation condition determination

Release characteristics	Weather data specification
<ul style="list-style-type: none"><input type="checkbox"/> Location: 21°40'15"N, 108°33'30"E<input type="checkbox"/> Release amount in long-term consequences<ul style="list-style-type: none">• I-131: 1×10^{16} Bq• Cs-137: 6×10^{13} Bq<input type="checkbox"/> Release starting time<ul style="list-style-type: none">• Dry scenario: from January 18, 2018, 07:00 (UTC)• Wet scenario: from November 24, 2018, 16:00 (UTC)<input type="checkbox"/> Release period: 24 hours<input type="checkbox"/> Release height: 10 meters<input type="checkbox"/> Heat content: 500 kW	<ul style="list-style-type: none"><input type="checkbox"/> Coverage: 6.5-32.0°N, 95.5-122.5°E<input type="checkbox"/> Resolution: 0.5° x 0.5°<input type="checkbox"/> Nesting scheme: Not specified

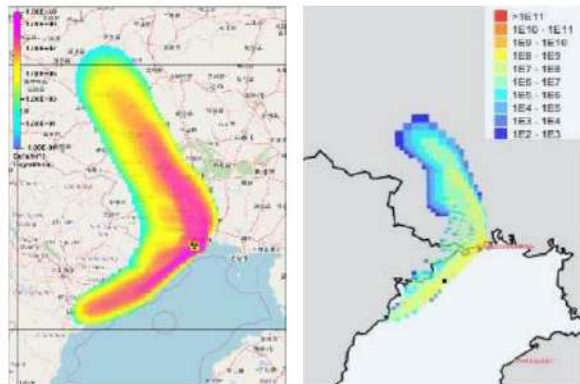
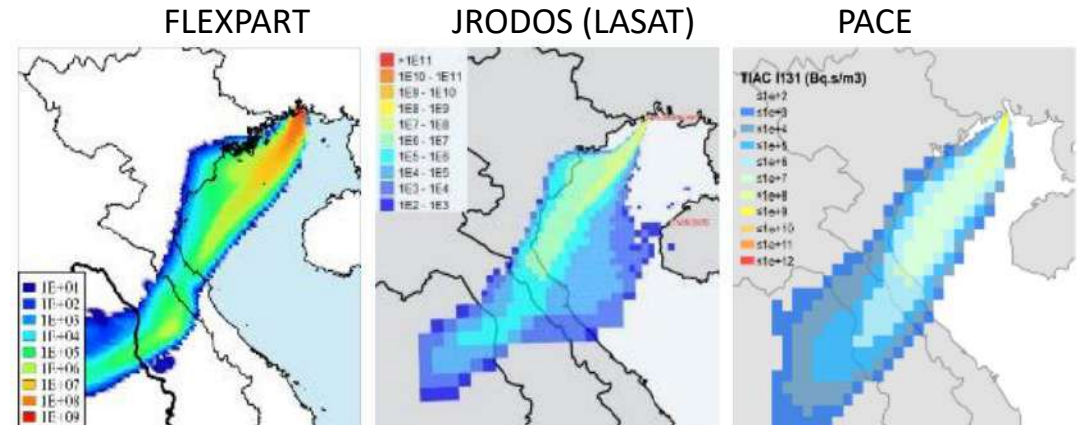
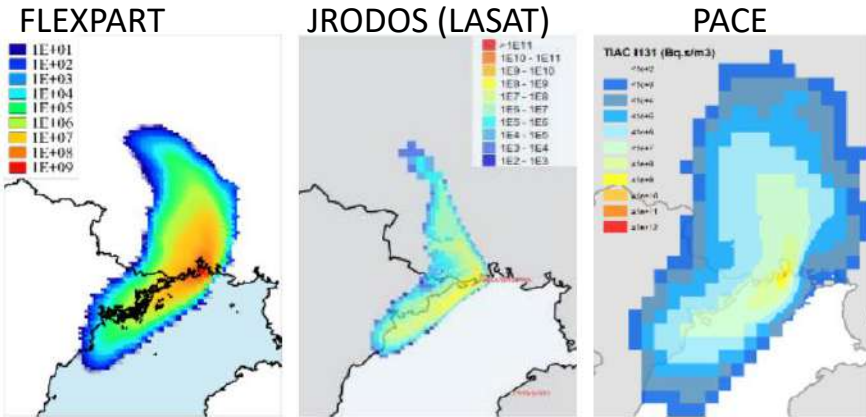
Simulations and comparisons

Results to be compared

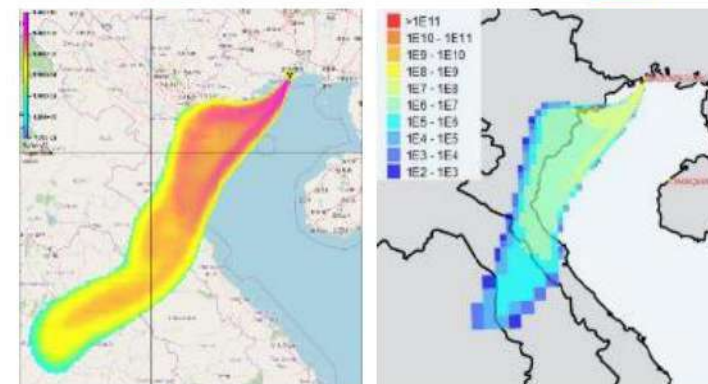
- Distribution maps of the following values at **1 day** from the release starting time
 - **(Time-integrated)** air concentration (Bq/m³)
 - **(Time-integrated)** ground concentration (Bq/m²)
 - Time-integrated exposure dose in terms of TEDE (μSv)
- **1-day** TEDE exposure extent (*defined as the furthest distance to which the specified TEDE is extended to*) for 1 μSv
- **Maximum** air concentration (Bq/m³), ground concentration (Bq/m²), exposure dose in terms of TEDE (μSv) at **1 day** from the release starting time at **10 / 100 km**



Simulations and comparisons

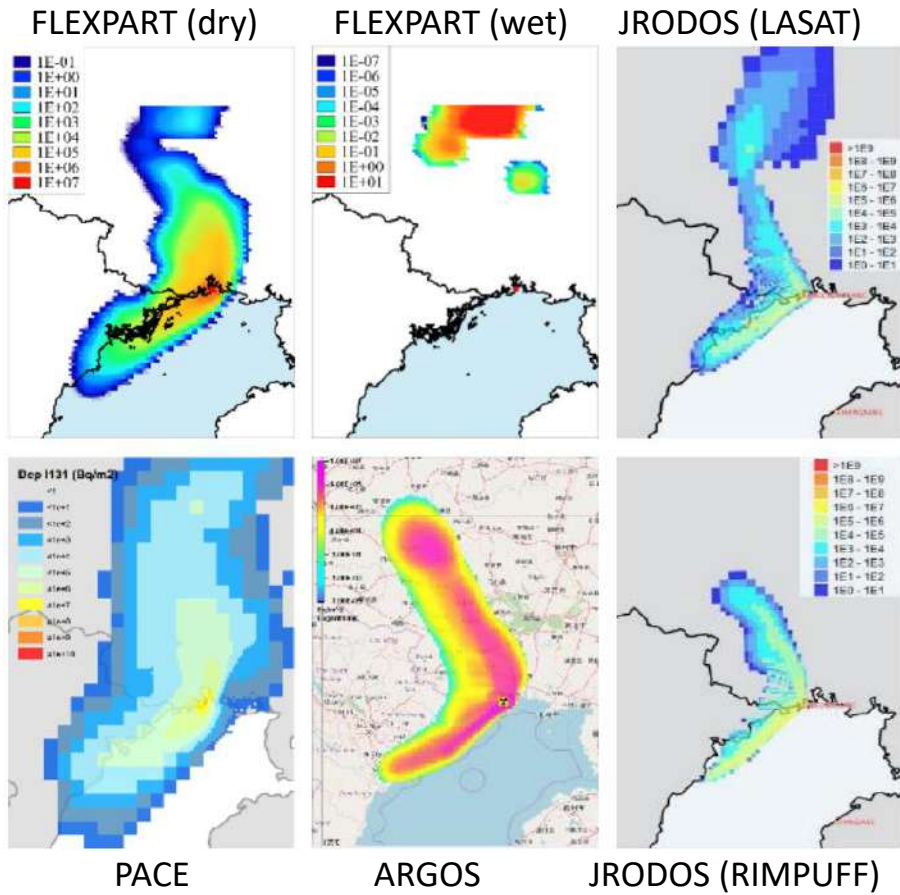


Integrated air concentration of I-131 (1 day) for January 18th scenario.

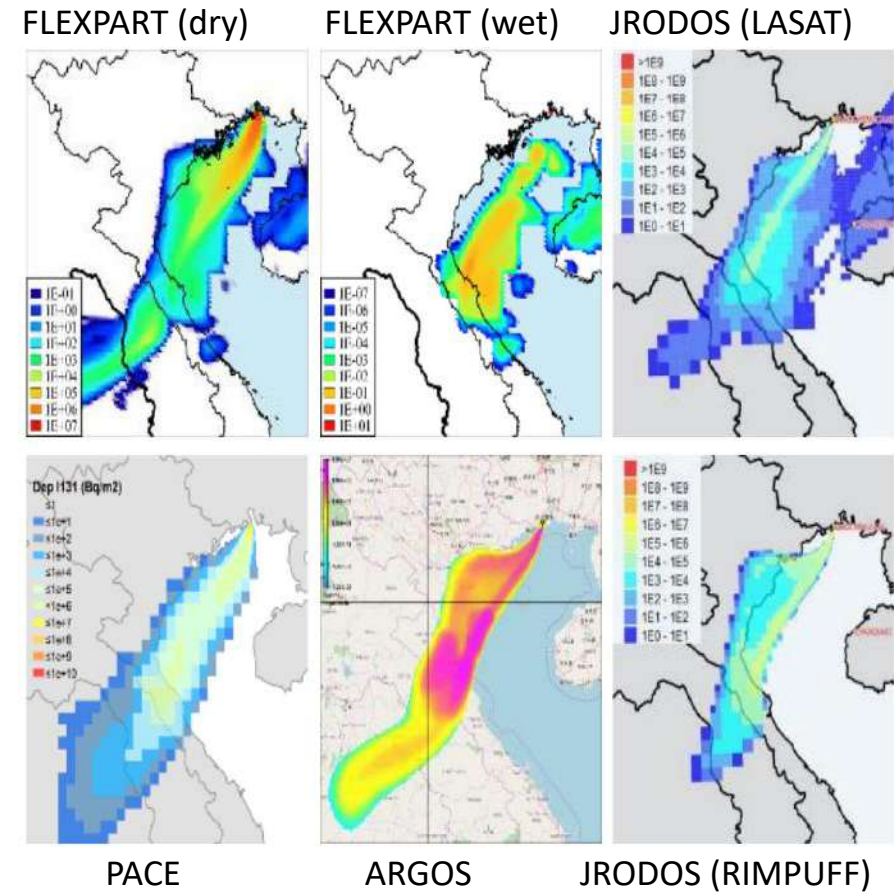


Integrated air concentration of I-131 (1 day) for November 24th scenario.

Simulations and comparisons



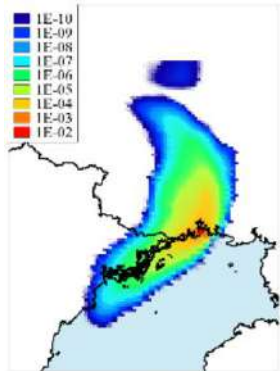
Integrated ground concentration of I-131 (1 day) for January 18th scenario.



Integrated ground concentration of I-131 (1 day) for November 24th scenario.

Simulations and comparisons

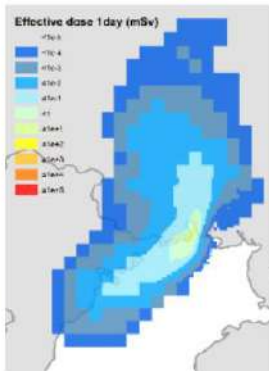
FLEXPART



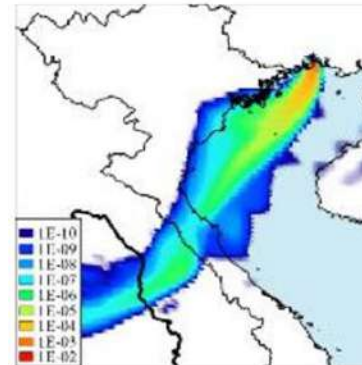
JRODOS (LASAT)



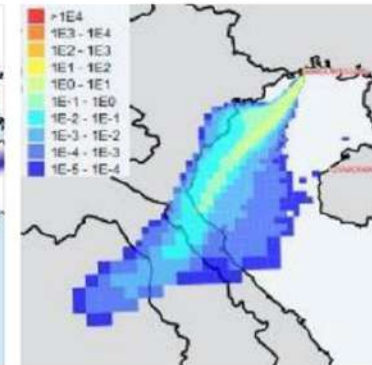
PACE



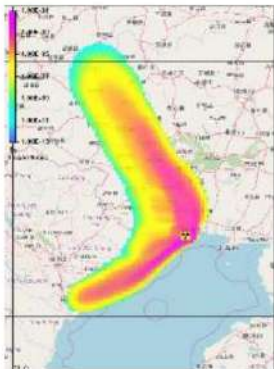
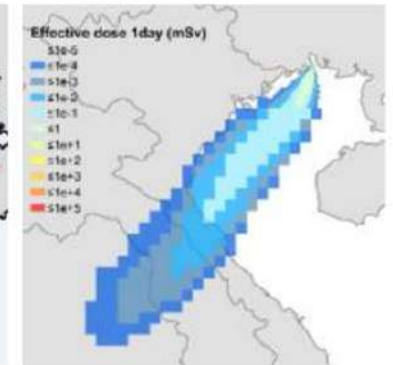
FLEXPART



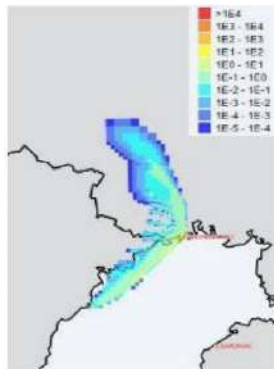
JRODOS (LASAT)



PACE

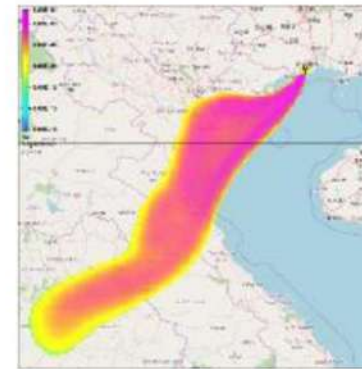


ARGOS

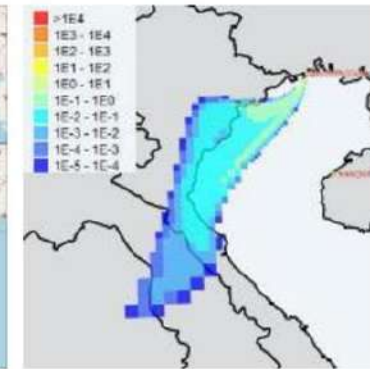


JRODOS (RIMPUFF)

1-day TEDE for January 18th scenario.



ARGOS



JRODOS (RIMPUFF)

1-day TEDE for November 24th scenario.

Observation

Distribution maps

- Similar shape
- Differences due to:
 - Different met data resolution
 - Different dispersion model
 - Different scale/cut-off values
 - Different mesh size(s)

Maximum air/ground concentration

- Less than one order difference between ARGOS and JRODOS
- Employ same dispersion model (RIMPUFF)



Observation

Maximum TEDE

- Big difference for dry deposition
- Small difference for wet deposition

Exposure extent

- Hundreds of km from source (with standard station blackout scenario for PWR)

Lead time

- Typically, less than one day

Other causes of differences

- Surface roughness vs deposition velocity
- Dry deposition vs wet deposition
- Not accounting for terrain



Outputs of the benchmark problem

Progress in Nuclear Energy 135 (2021) 103718

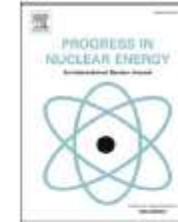


ELSEVIER

Contents lists available at ScienceDirect

Progress in Nuclear Energy

journal homepage: <http://www.elsevier.com/locate/pnucene>



Inter-comparison of transboundary atmospheric dispersion calculations: A summary of outputs from the ASEAN NPSR benchmark exercise

Kampanart Silva^{a,*}, Piyawan Krisanungkura^b, Narakhan Khunsrimek^c, Wasin Vechgama^d, Tang Jia Hao^e, Vitesh Krishnan^e, Pham Kim Long^f, Tom Charnock^g, Somboon Rassame^d, Tay Bee Kiat^h, Chung Keng Yeow^e, Hoang Sy Than^f, Nguyen Hao Quang^f, Pham Duy Hien^f

^a Renewable Energy and Energy Efficiency Research Team, National Energy Technology Center, National Science and Technology Development Center 114 Thailand Science Park, Phahonyothin Road, Khlong Nueng, Khlong Luang, Pathum Thani, 12120, Thailand

^b Office of Atoms for Peace, 16 Vibhavadi-Rangsit Road, Lat Yao, Chatuchak, Bangkok, 10900, Thailand

^c Department of Nuclear Engineering, Chulalongkorn University, 254 Phayathai Road, Patumwan, Bangkok, 10330, Thailand

^d Nuclear Research and Development Division, Thailand Institute of Nuclear Technology (Public Organisation) 16 Vibhavadi-Rangsit Road, Lat Yao, Chatuchak, Bangkok, 10900, Thailand

^e Singapore Nuclear Research and Safety Initiative, 1 CREATE Way #04-01 CREATE Tower, 138602, Singapore

^f Vietnam Atomic Energy Institute, 59 Ly Thuong Kiet Street, Hoan Kiem District, Hanoi, Viet Nam

^g Centre for Radiation, Chemical and Environmental Hazards, Public Health England, Chilton, Didcot, OX11 0RQ, United Kingdom

^h DSO National Laboratories, 12 Science Park Dr, 118225, Singapore



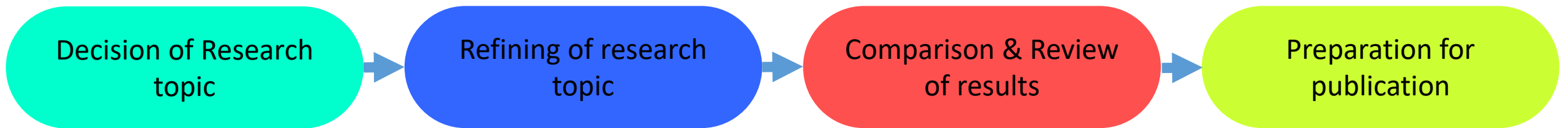
1st collaborative project
Atmospheric dispersion
assessment through
benchmark problem
(2017-2020)



ASEAN NPSR

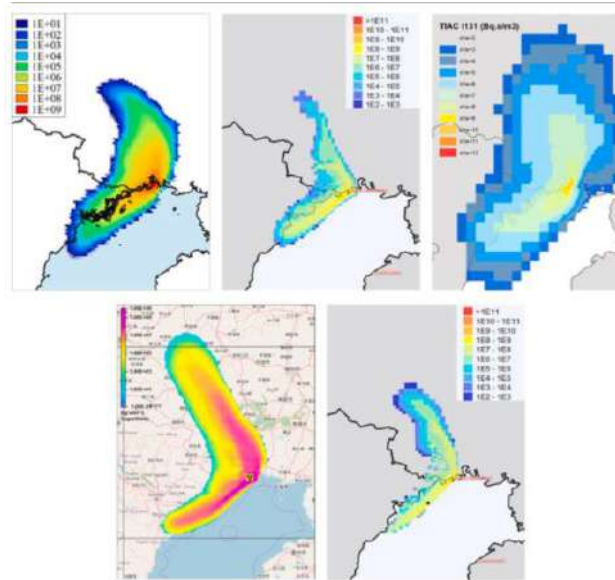
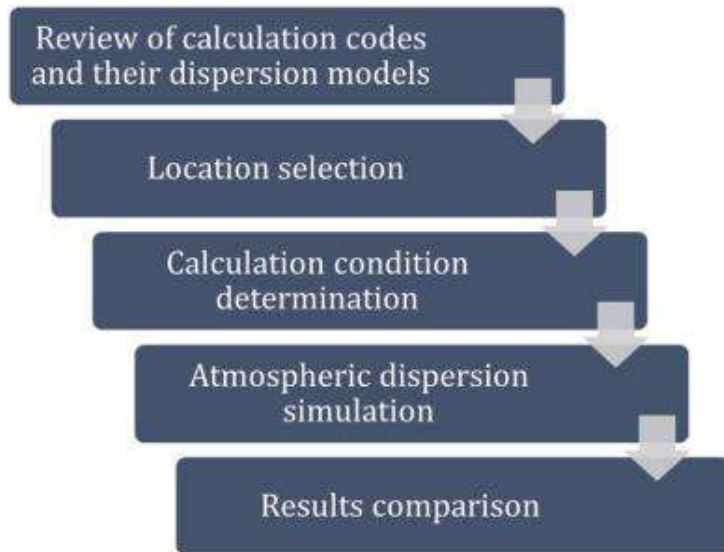
Cooperation for Benchmark Problem

- Completed over 4 years with inputs from many parties.
- During annual meeting, the research direction is determined
- Subsequent meeting with preliminary results and refining of research topic
- Comparison of results and reviewing of results
- Preparation for publication with results



Online meetings

- Online meetings
- Discussion and update of work progress every three months
- Troubleshooting of any problems encountered



Opportunities and Experience

- Work across organizations from different countries(OAP, TINT, VINATOM, SNRSI)
- Gain exposure to international, regional networks through ASEAN NPSR
- Planned Field work to Fangchenggang (cancelled due to Covid-19)





ASEAN NPSR

Q&A

