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Construction of a new cloud physics experimental chamber (CPEC) in Korea

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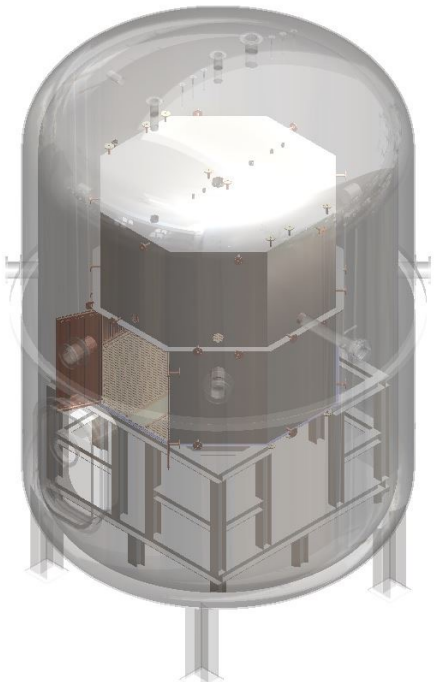
Introduction

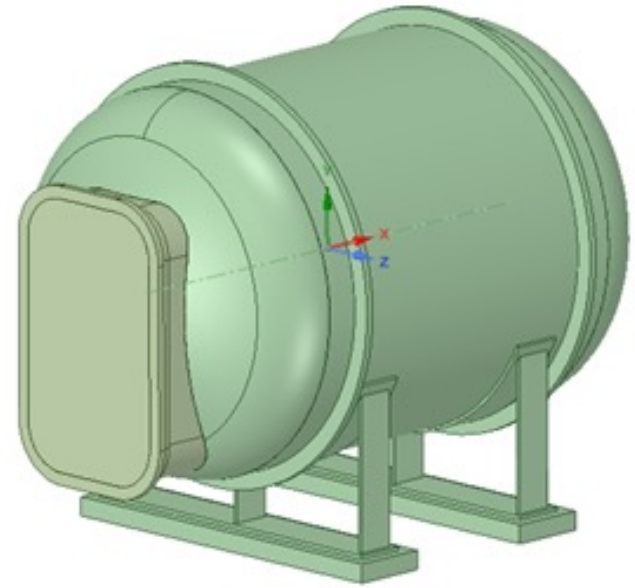
- To better understand the aerosol-cloud-precipitation processes, studies using cloud chambers have been carried out at several institutions.
- A new Cloud Physics Experimental Chamber (CPEC) is being built by the National Institute of Meteorological Sciences (NIMS) of Korea.
- Since spatial scales of cloud processes are varied, no single cloud chamber is suitable for investigation of all scientific questions of the aerosol-cloud-precipitation processes.
- CPEC is being built for the following purposes:
  - To lead an advanced experimental studies on the various cloud processes that occur in atmospheric clouds.
  - To be a ground test-bed for real weather modification experiments using aircrafts.

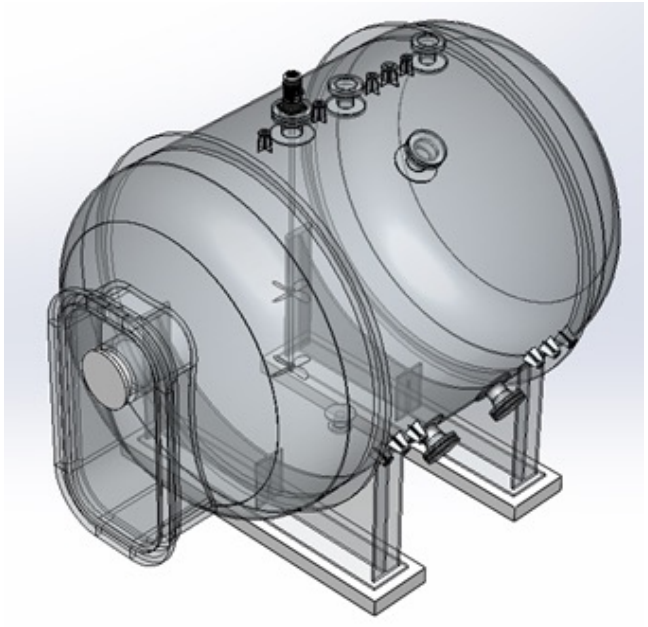
CPEC-cloud chamber



- Outer chamber: 5 m x 5 m, cylinder with rounded top/bottom
- Inner chamber: 3 m x 3 m, octagonal prism (~21 m^3)

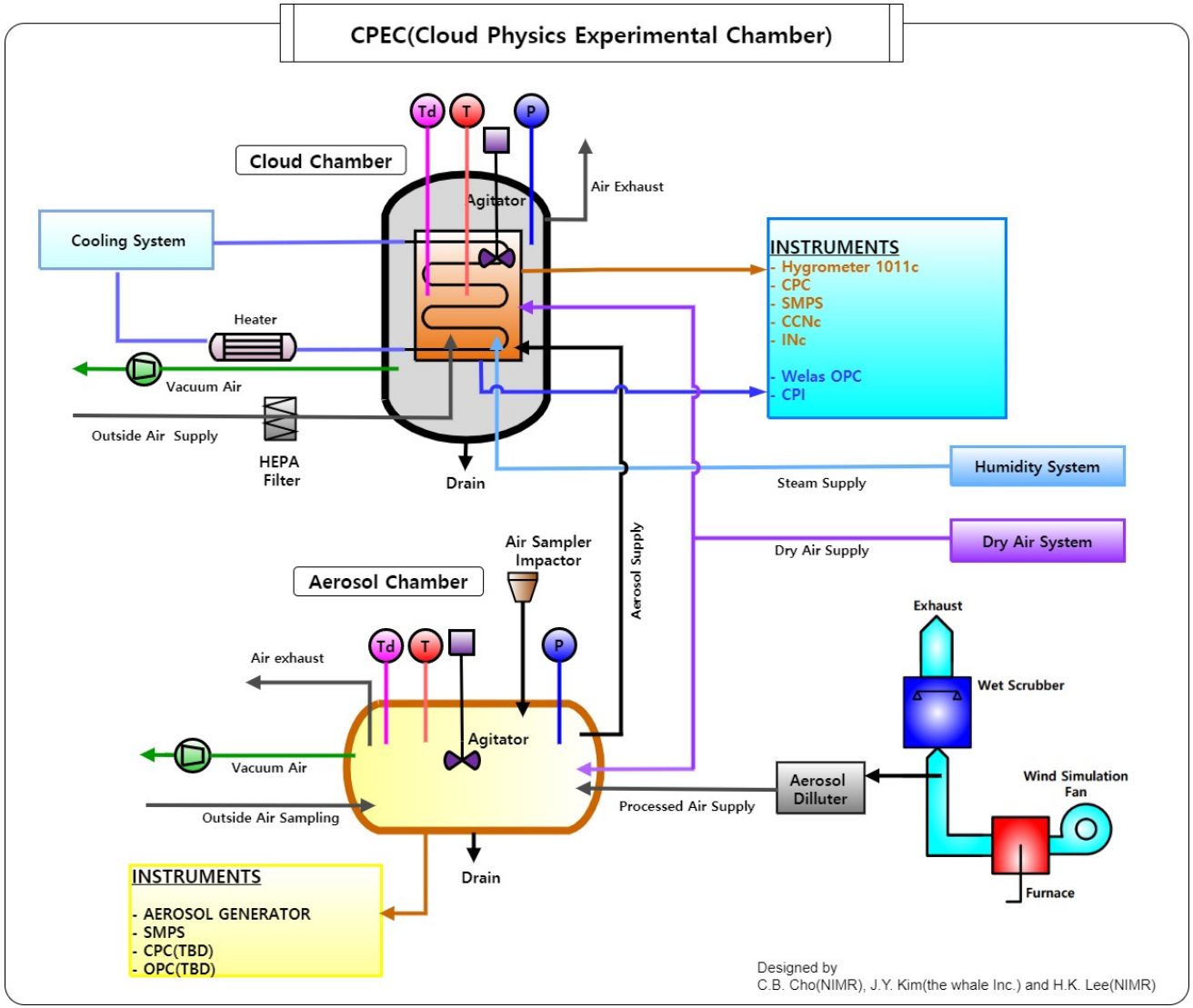
CPEC-aerosol chamber





- Chamber size: 3 m x 3 m (cylindrical part only)

CPEC-diagram



Comparison with other cloud chambers

Name	Volume (m^3)	Type	Location	Status
CPEC (cloud chamber)	**21**	**Expansion with dynamic walls**	**Korea (NIMS)**	**2021 (expected)**
AIDAc	84.5	Expansion	Germany (KIT)	1996-present
AIDAd	3.8	Expansion with dynamic walls	Germany (KIT)	2020-present
BACIC	70	Expansion	China (BWMO)	2017-present
Big Climate Chamber	3,200	Expansion	Russia (Inst. Experimental Meteorology)	1963-present
CESAM	4.2	Reaction chamber	France (LISA, CNRS)	2009-present
CLOUD	26.1	Reaction chamber/over-pressure expansion to atmos	Switzerland (CERN)	2006-present
LACIS-T	0.32 (2 m high)	Mixing wind tunnel	Germany (TROPOS)	2018-present
MICC	18 (10 m high)	Fall chamber/expansion	United Kingdom (Manchester Univ.)	2009-present
MRI	1.4	Expansion with dynamic walls	Japan (Meteorological Research Inst.)	2005-present
π chamber	3.14	Convection/Expansion with dynamic walls	United States (Michigan Tech. Univ.)	2015-present

(Shaw et al., 2020)

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- CPEC (cloud chamber) is designed as an adiabatic expansion type cloud chamber and has the ability to adjust wall temperatures dynamically to minimize moisture/heat flux from the warmer, ice-coated chamber wall.
- CPEC (cloud chamber) has a large volume compared to other expansion with dynamic walls type cloud chambers.

(Shaw et al., 2020)

CPEC-specification

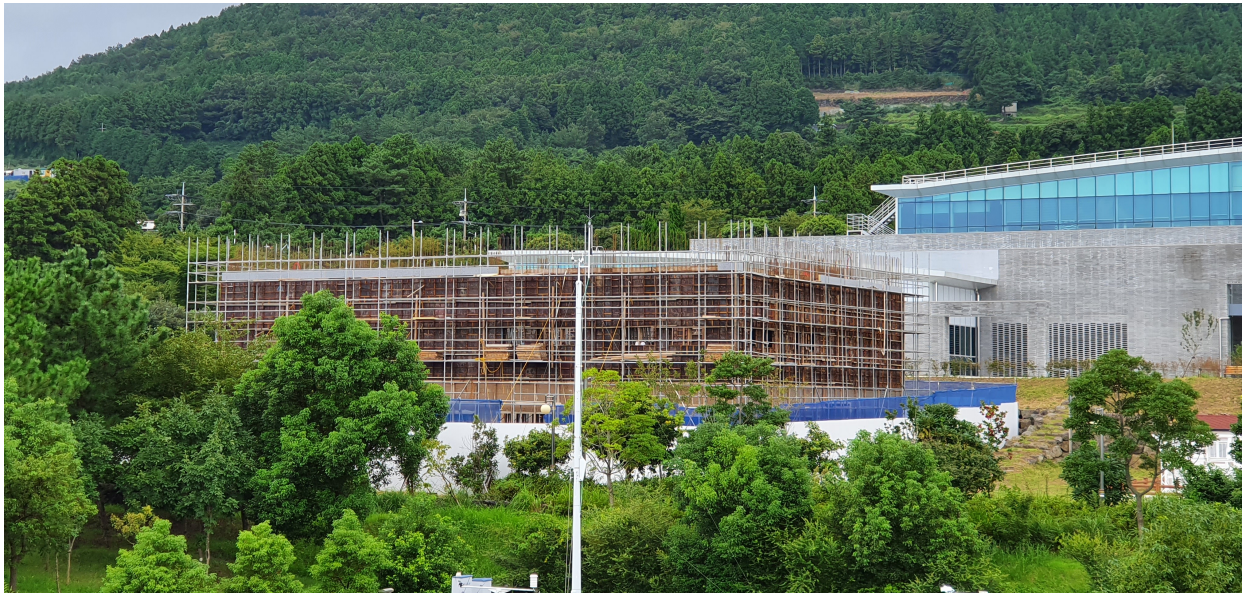
Cloud chamber		
Size	Outer chamber	5 m x 5 m
	Inner chamber	3 m x 3 m
Shape	Outer chamber	Cylinder
	Inner chamber	Octagonal prism
Volume	Inner chamber	21 m^3
Material	Outer chamber	Stainless steel
	Inner chamber	Copper (Cu) / Stainless steel
Temperature range	Range	60 to -70℃
	Static stability margin	≤±0.3℃
	Dynamic stability margin	≤±0.5℃
Pressure range	Range	1,013 to 30 hPa
	Margin of error	≤± 0.3 hPa
Heating/cooling time		≤ 45 min (-70 to 60℃)
		≤ 45 min (60 to -70℃)

Aerosol chamber		
Size		3 m x 3 m
Material		Stainless steel
Pressure range	Range	1,013 to 30 hPa
	Margin of error	≤± 0.3 hPa

CPEC-instruments

Instrument	Function	Year
Hygrometer (Buck research)	Measurement of water vapor	2021
CPC (TSI)	Measurement of aerosol number concentration	2021
Aerosol generator (Palas)	Generation of aerosols	2021
Welas OPC (Palas)	Measurement of particle size distribution 0.2–10 µm / 0.3–17 µm/ 0.6–40 µm / 2–100 µm	2021
SMPS (TSI)	Measurement of submicron aerosol size distribution	2022
CCN-200 (DMT)	Measurement of cloud condensation nuclei number concentration	2022
IN counter (TBD)	Measurement of ice nucleating particle	2022
CPI (SPEC)	Measurement of the size and shape of particles	2022

CPEC-construction



CPEC-construction

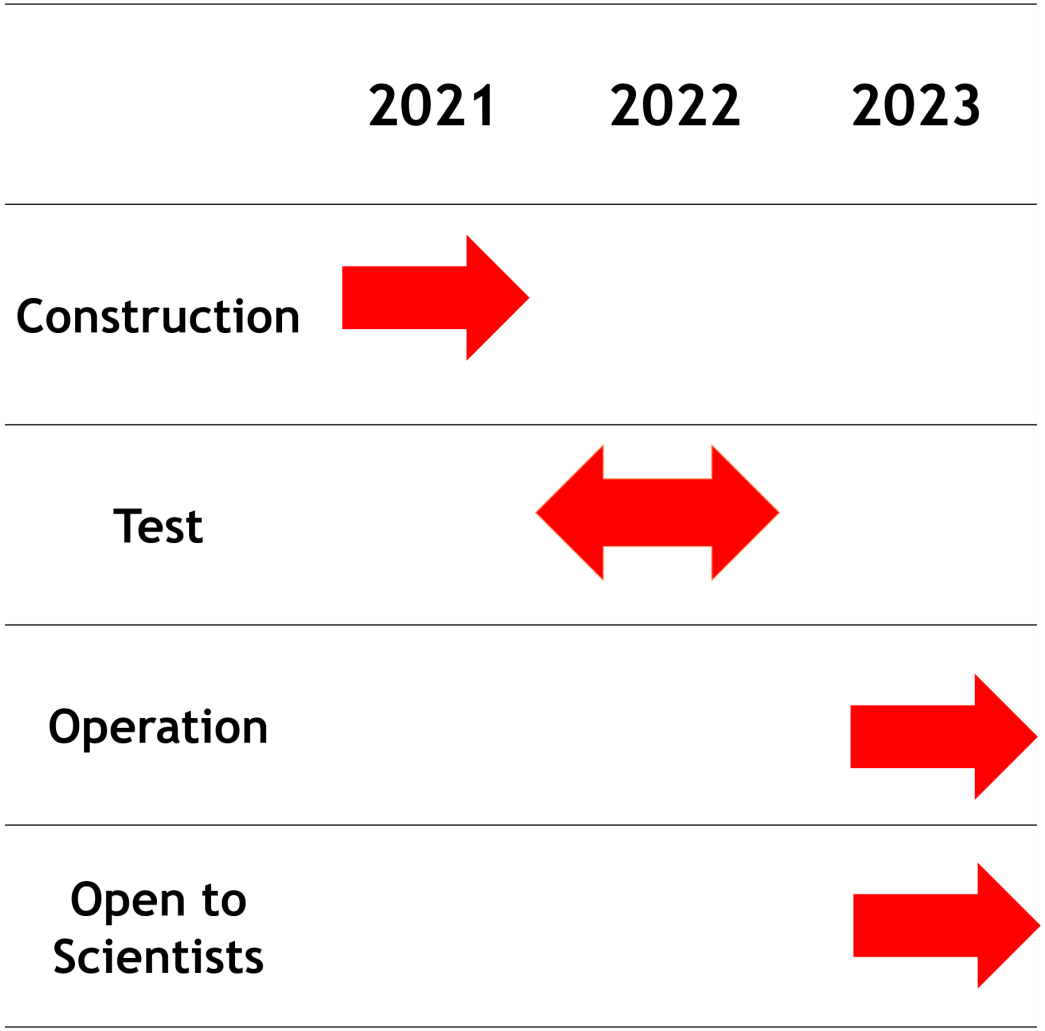
Aerosol chamber

Cloud chamber

What to study?

- CCN and INP capability of atmospheric particles
- Evaluation of currently available seeding material
- Development of new seeding material and test
- Effects on cloud microphysical properties of anthropogenic air pollutants
- Aerosol-cloud-precipitation interactions
- Instrument intercomparison and calibration
- Collaborative studies with other cloud chamber groups

Schedule



Contact Dr. Cha (jwcha@korea.kr)

if you would like to participate in CPEC experiments!

Thank You !