Environmental Prediction Science Lab.
- Our Direction in FY2024 -

with many thanks to Muto-san and Kurosawa-kun for arrangements

Shunji Kotsuki

Center for Environmental Remote Sensing, Chiba University

Lab. Kick Off Meeting (April 2, 2024)

CHIBA UNIVERSITY

Environmental Prediction Science Laboratory

Our History

Date	# Profs & Postdocs	# Ph.D.	# MS	# BS	# Staffs	# Papers (in Eng.)	# Papers (in Jpn.)	Direction
2020 /04	1			4	2	1	1	Foundation (土台固め)
2021 /04	1		3	4	4	1		Standardization (幹・文化の形成)
2022 /04	4		7	3	4	5	3	Start Integration (融合の開始)
2023 /04	7		7	2	4	5	5	Deepening (深める)
2024 /04	12	1	6	2	7	?	?	**Reproducible Success (再現可能な成功)**

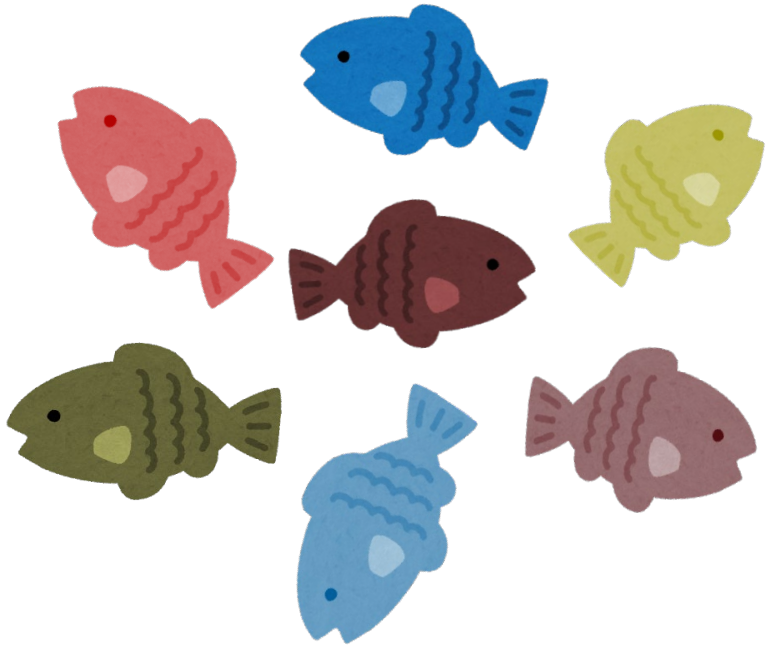
28 members in total

Only # of papers issued from our internal research activity

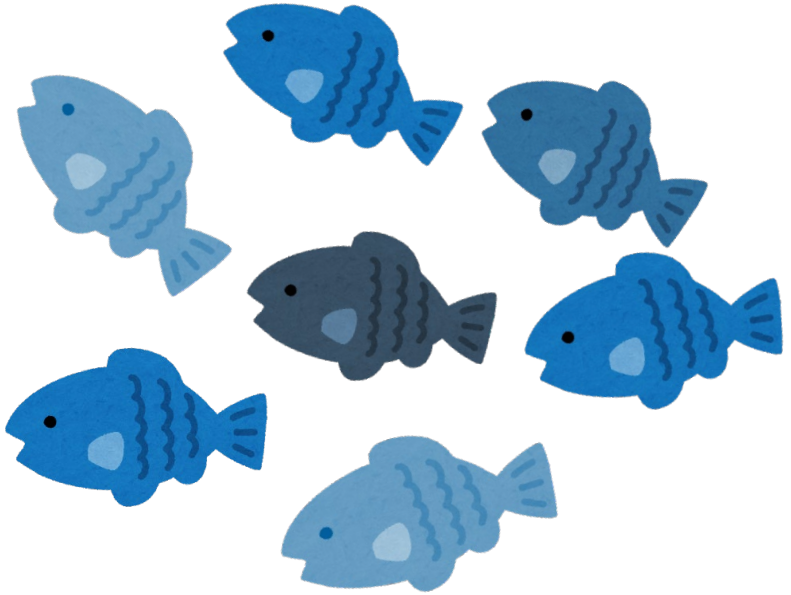
Why Mission & Vision?

We have grown to be a big group. It seems to be nice.
However, being a big group does not mean a productive and visionary group.
To maximize our outcomes and growth, let me share our mission and vision with you again.

a group w/o mission



a team w/ mission and vision



If you want to go fast, go alone. If you want to go far, go together. (from African proverb)

Today's talk for FY2024

- **to share what I am thinking about (考えていること)**
  - how I would like to lead this lab (研究室をどうしていきたいか)
  - What I would like to prioritize (何を大事にしたいのか)
  - how I see the current lab. (研究室をどう見ているのか)

- **to share what I would like you to be (成長して欲しいこと)**
  - to acquire critical thinking (クリティカルシンキングの獲得)
  - to improve leadership (リーダーシップの試行)

- **Our directions and actions**
  - What we keep doing and start trying

to share what I am thinking about (考えていること)

Environmental Prediction Science Laboratory

Our Desire and Mission (研究室をどうしていきたいのか)

When I launched our lab in 2020, I dreamed of growing this lab. to be a world-leading group.
Based on the dream, I defined our mission.

Let me remind you the most important “Our Mission (理念)” and “Our Value (価値観)”.
The point is I would like to commit to your internal growth in addition to research outcomes.

Our Mission: What roles do we play?
理念: 我々は何者か？何のために存在するか？

- Science: to create environmental predictions sciences
- Education: to encourage active members who will lead society
- Society: to realize real implementations for disaster preventions

- 科学: 我々だから可能な地球環境予測技術を創造する。
- 教育: 日本・世界で活躍する能動的な人材を育成する。
- 社会: 具体的な防災社会実装を通して社会に貢献する。

Remaining mission statement can be found at https://kotsuki-lab.com/research/mission-statement/.

Our Desire and Value (研究室をどうしていきたいのか)

When I launched our lab in 2020, I dreamed of growing this lab. to be a world-leading group.
Based on the dream, I defined our mission.

Let me remind you the most important “Our Mission (理念)” and “Our Value (価値観)”.
The point is I would like to commit to your internal growth in addition to research outcomes.

Our Value: What we always prioritize
価値観: 我々は何を尊重するか？

- Strengthening our competence while challenging in new areas.
- Achieving outcomes that cannot be accomplished alone.
- Providing chances with allowance of failure for young members.

- 我々のコンピタンスの強化と、新しい分野への挑戦を両立する。
- 一人では成し遂げられない研究成果を挙げる。
- 若いメンバーに失敗しても良いからチャンス・環境を提供する。

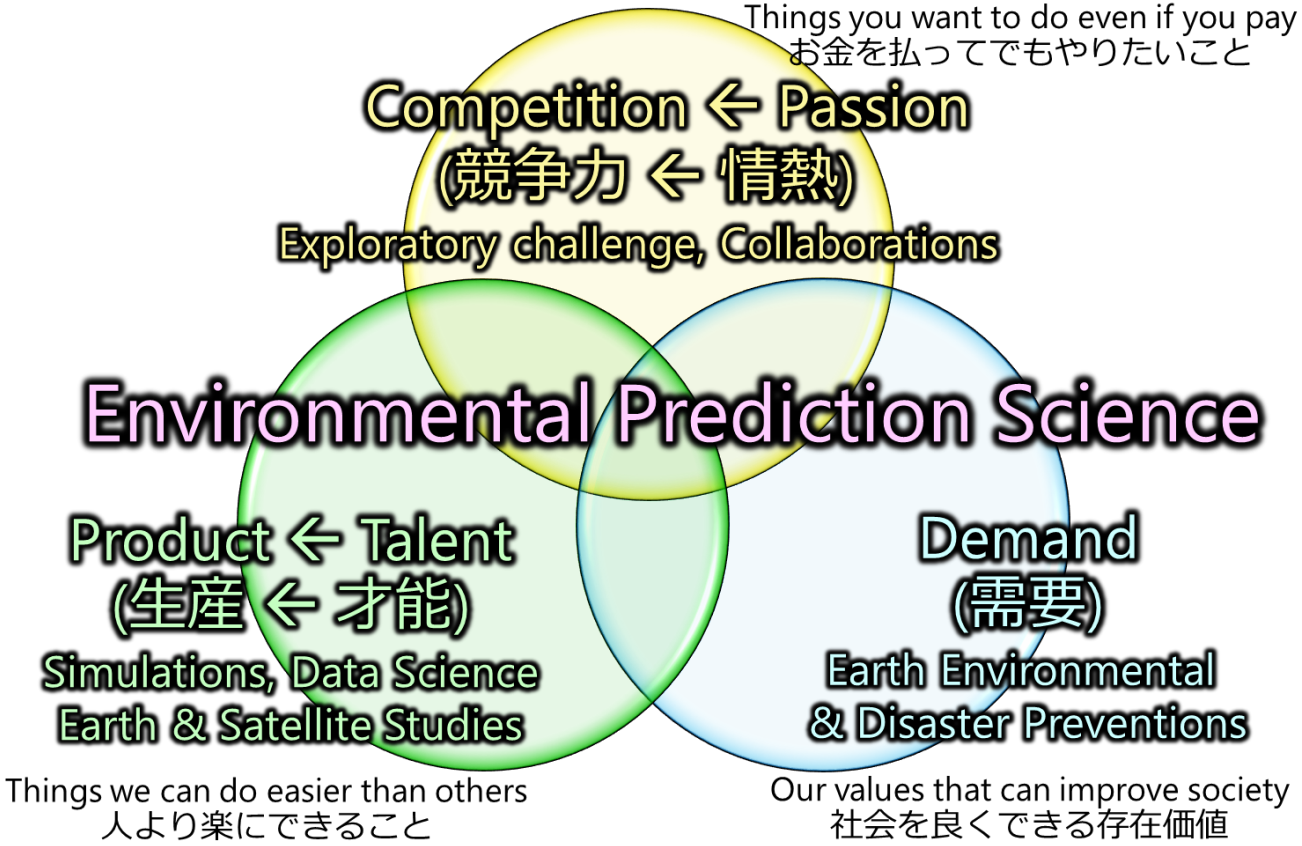
Remaining mission statement can be found at https://kotsuki-lab.com/research/mission-statement/.

Our Desire and Mission (研究室をどうしていきたいのか)

However, I noticed that we are a lab not in research institutes like RIKEN, but in a university.

To maximize the potential of fresh students' power, I steered toward a lanchester strategy, which is doing "Environmental Prediction Science (EPS)" bridging Earth and Data Sciences.

EPS to keep exploring product market fit (PMF)



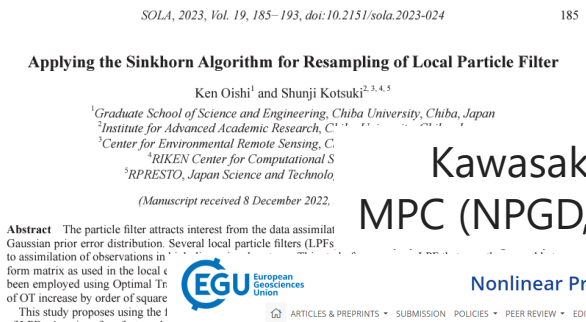
Our Positive Status: (研究室をどう見ているか)

Environmental Prediction Science Laboratory

Definitely, what we are doing is beyond my expectations four years ago.
I believe we can say we are a Japan-leading research group at least (not yet for the world).
I am very happy to work with you, and am proud of our group.

Publications by Students ☺

Oishi-kun's Sinkhorn LPF (SOLA 2023)



SOLA, 2023, Vol. 19, 185–193, doi:10.2151/sola.2023-024 185

Applying the Sinkhorn Algorithm for Resampling of Local Particle Filter

Ken Oishi[1] and Shunji Kotsuki[2, 3, 4, 5]

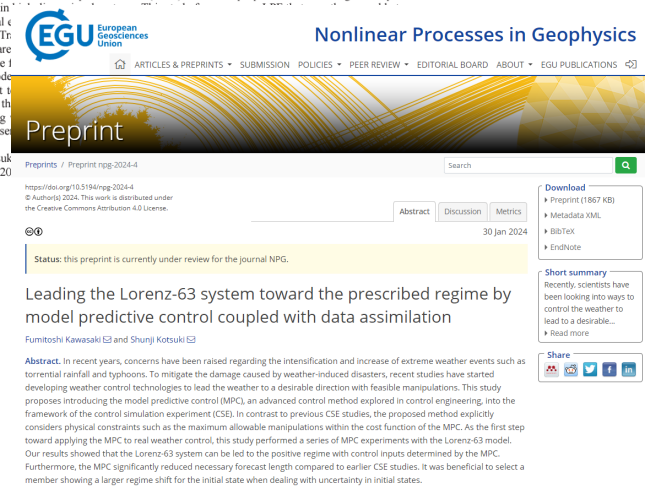
[1]*Graduate School of Science and Engineering, Chiba University, Chiba, Japan*
[2]*Institute for Advanced Academic Research, C*
[3]*Center for Environmental Remote Sensing, C*
[4]*RIKEN Center for Computational S*
[5]*RPRESTO, Japan Science and Technolo*

(Manuscript received 8 December 2022,

Abstract The particle filter attracts interest from the data assimilat
Gaussian prior error distribution. Several local particle filters (LPFs
to assimilation of observations in
form matrix as used in the local
been employed using Optimal Tr
of OT increase by order of square
This study proposes using the
of LPFs. A series of perfect mode
es accurate analyses equivalent
total computational time more th
The Sinkhorn-based resampling
error distribution with many ense

Citation: Oishi, K. and S. Kotsuk
19, 185–193, doi:10.2151/sola.20

Kawasaki-kun's
MPC (NPGD, in review)



EGU European Geosciences Union — Nonlinear Processes in Geophysics

ARTICLES & PREPRINTS · SUBMISSION · POLICIES · PEER REVIEW · EDITORIAL BOARD · ABOUT · EGU PUBLICATIONS

Preprint

Preprints / Preprint npg-2024-4

https://doi.org/10.5194/npg-2024-4
© Author(s) 2024. This work is distributed under the Creative Commons Attribution 4.0 License.

Abstract · Discussion · Metrics

30 Jan 2024

Download
Preprint (1867 KB)
Metadata XML
BibTeX
EndNote

Status: this preprint is currently under review for the journal NPG.

Leading the Lorenz-63 system toward the prescribed regime by model predictive control coupled with data assimilation

Fumitoshi Kawasaki and Shunji Kotsuki

Abstract. In recent years, concerns have been raised regarding the intensification and increase of extreme weather events such as torrential rainfall and typhoons. To mitigate the damage caused by weather-induced disasters, recent studies have started developing weather control technologies to lead the weather to a desirable direction with feasible manipulations. This study proposes introducing the model predictive control (MPC), an advanced control method explored in control engineering, into the framework of the control simulation experiment (CSE). In contrast to previous CSE studies, the proposed method explicitly considers physical constraints such as the maximum allowable manipulations within the cost function of the MPC. As the first step toward applying the MPC to real weather control, this study performed a series of MPC experiments with the Lorenz-63 model. Our results showed that the Lorenz-63 system can be led to the positive regime with control inputs determined by the MPC. Furthermore, the MPC significantly reduced necessary forecast length compared to earlier CSE studies. It was beneficial to select a member showing a larger regime shift for the initial state when dealing with uncertainty in initial states.

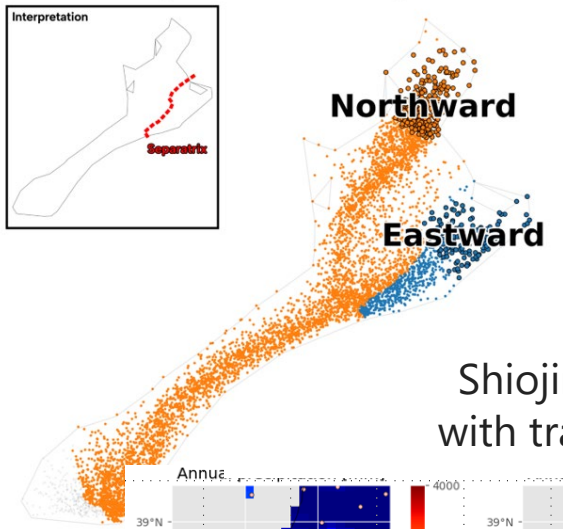
Short summary
Recently, scientists have been looking into ways to control the weather to lead to a desirable...
Read more

Share

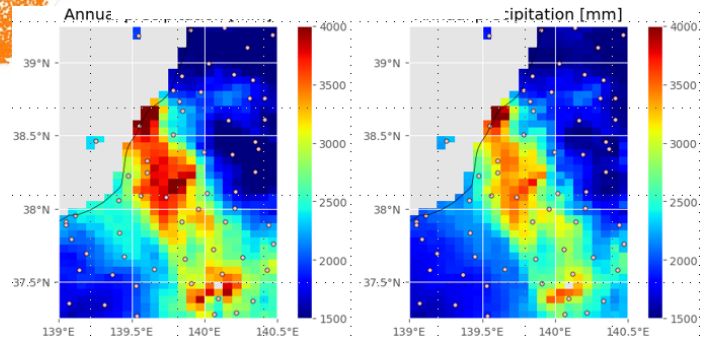
Even keep publishing in domestic journal is unusual!

Spreading collaborations ☺

Pascal's Landscape with mathematicians



Shiojiri-kun's SSP
with train company



Reliable staffs ☺

Administrative works

Budget managements

Documentations & Reports

Server managements

Project managements

Students' advisory

Outreach

Let's thank the administrative staff here.

Our Negative Status: (研究室をどう見ているか)

Environmental Prediction Science Laboratory

However, we also have challenges that we need to overcome to fulfill our missions, which are (1) encourage active members, and (2) achieving outcomes though collaborations

Unreproducible Research Success ☹
(研究成功の再現性を高める)

i.e., publications

can be solved technically by enriching

wikis

templates

materials

Independent Research Activity ☹
(なかなか融合が進まない)

With following slides,
I would like to work on your internal mindsets.

Three things
I want to tell for young members.

(1) To See “What is Research”
(2) To Improve Critical Thinking
(3) To Try Leadership

Environmental Prediction Science Laboratory

What is research? (研究って何なのか？)

Behind the “actual” research activity, there are many preparations and works.
If you want to grow up, it is good to think about which skill you need to acquire.

what the PI’s work is

what the whole research is

survey for research

what you may think research is

- Basic knowledge (math, physics)
- Review and Have Clear SQ
- Design Experiment
- Coding and Experiments
- Analysis and Discussion
- Writing and Publication

research administrative works

- Funding Acquisition
- Resource Management
- Project Administration
- Meeting
- Supervision

administrative works

- Roles in University
- Roles in Research Comm.
- Lectures
- HR
- Trouble Shooting

Required Skill

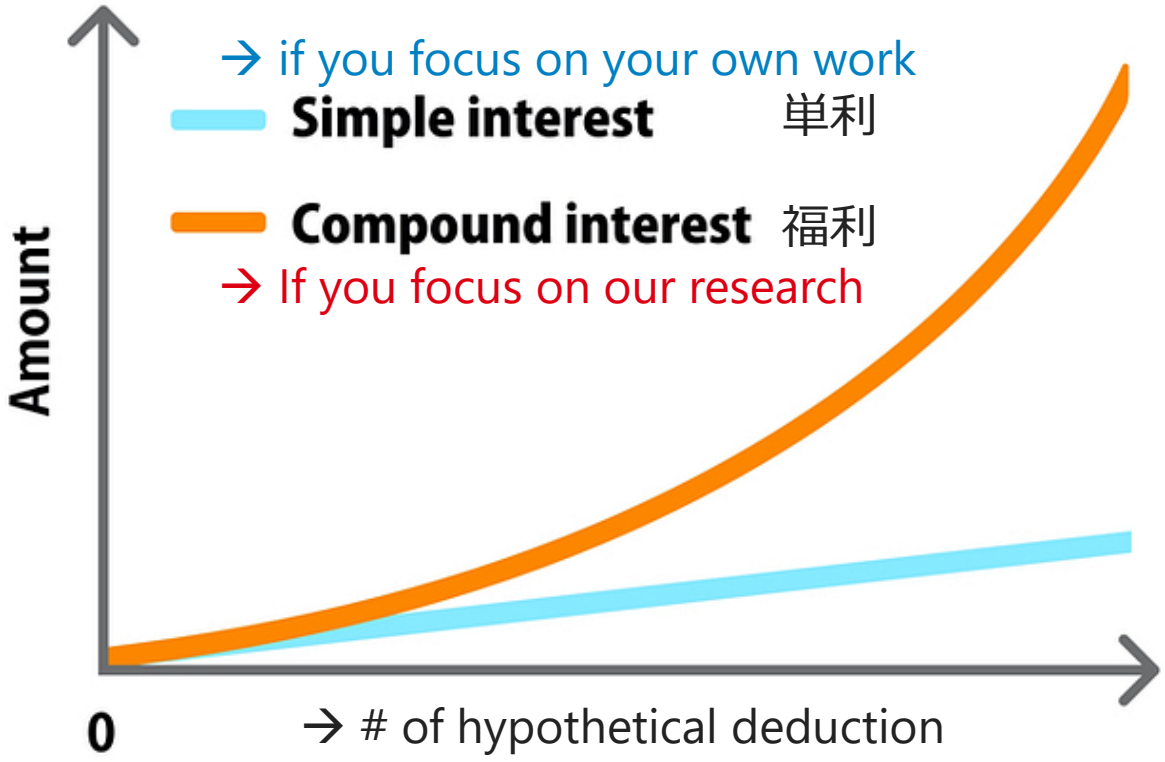
- Technical Issues
- Critical Thinking
- Leadership
- Responsibility

more technical ⟷ more internal

Hypothetical Deduction: the way to improve critical thinking

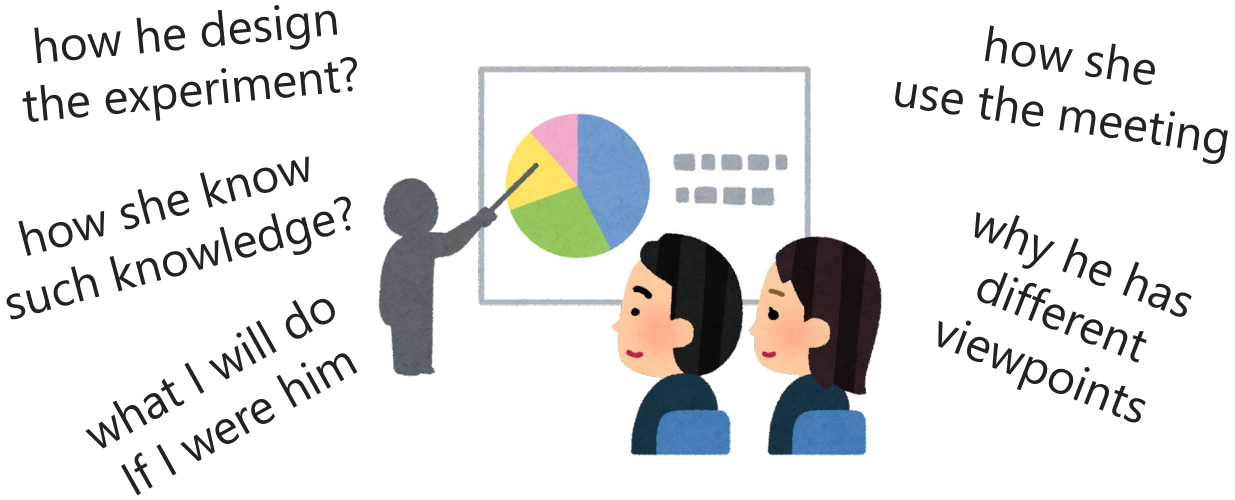
Among various technical research skills, the critical thinking is key to be productive research.
We can improve the skill through lab's activity.

If you keep increasing your skill 1%,
you can grow up exponentially.
The point is this is *f* of # of hypothetical deductions.



https://investmentu.com/simple-interest-vs-compound-interest/

Directly speaking, I want to change your mindsets
toward lab's meetings.
There are many lessons beyond results of research:

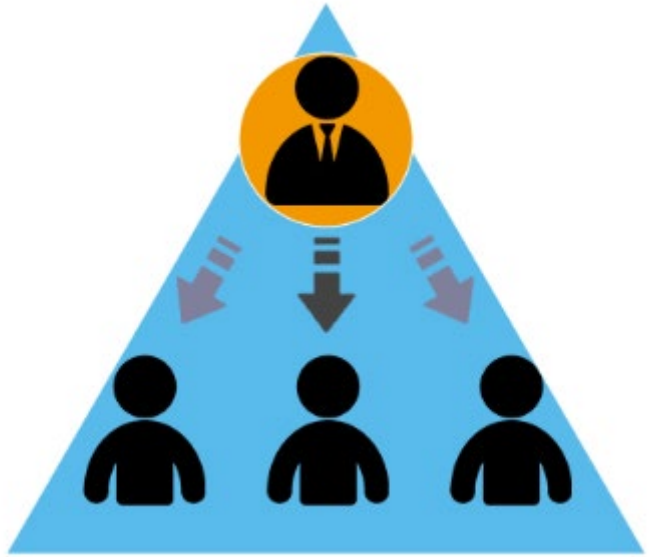


I must say there must be a limit that you can learn alone.
I think I and Okazaki-san have reached to our positions
because we learned a lot from surrounding members.

Laboratory: a good place to improve your leadership

The leadership is always required in the pyramid structure.
You can start trying in lab.

what you may think
the leadership is

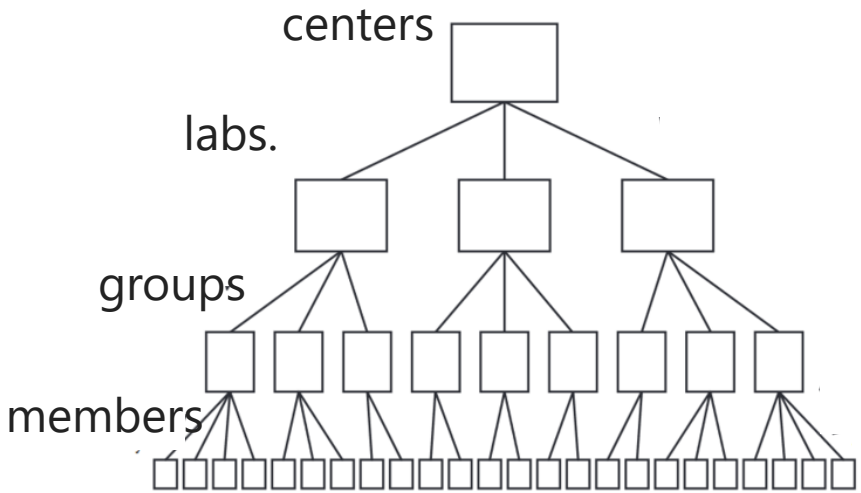


to order surrounding members

what I think
the leadership is

to take responsibility and
put yourself at the center of
surrounding members

the leadership is always required
in the pyramid structure



You do not need to be successful
You just need to understand
how difficult to lead other members is.

https://motifyhr.jp/blog/training/servant-leadership/

https://diamond.jp/articles/-/319853

Our Directions and Actions
- reproducible Research Success

Environmental Prediction Science Laboratory

Trickle down toward reproducible research success

https://www.linkedin.com/pulse/indicator-trickle-down-effect-must-working-through-applying-keyser

Our Directions and Actions

	Keep doing	Start Trying
Research	・Group Meeting ・Entire meeting	・Seminar (start in Autumn) **・to enrich research materials (wiki, templates, tasks)** **・to enrich research discussion**
Educational	・group meeting with advisors ・to write Japanese paper first	・to connect to publications in international journals
Administrative	・so far so good, in general	**・to realize wiki first** ・to initiate pyramid structures (e.g. for MS) ・to be more resilient

Summary

Today's talk

- **to share what I am thinking about (考えていること)**
  - how I would like to lead this lab (研究室をどうしていきたいか)
  - What I would like to prioritize (何を大事にしたいのか)
  - how I see the current lab. (研究室をどう見ているのか)
- **to share what I would like you to be (成長して欲しいこと)**
  - to acquire critical thinking (クリティカルシンキングの獲得)
  - to improve leadership (リーダーシップの試行)
- **Our directions and actions**
  - What we keep doing and start trying