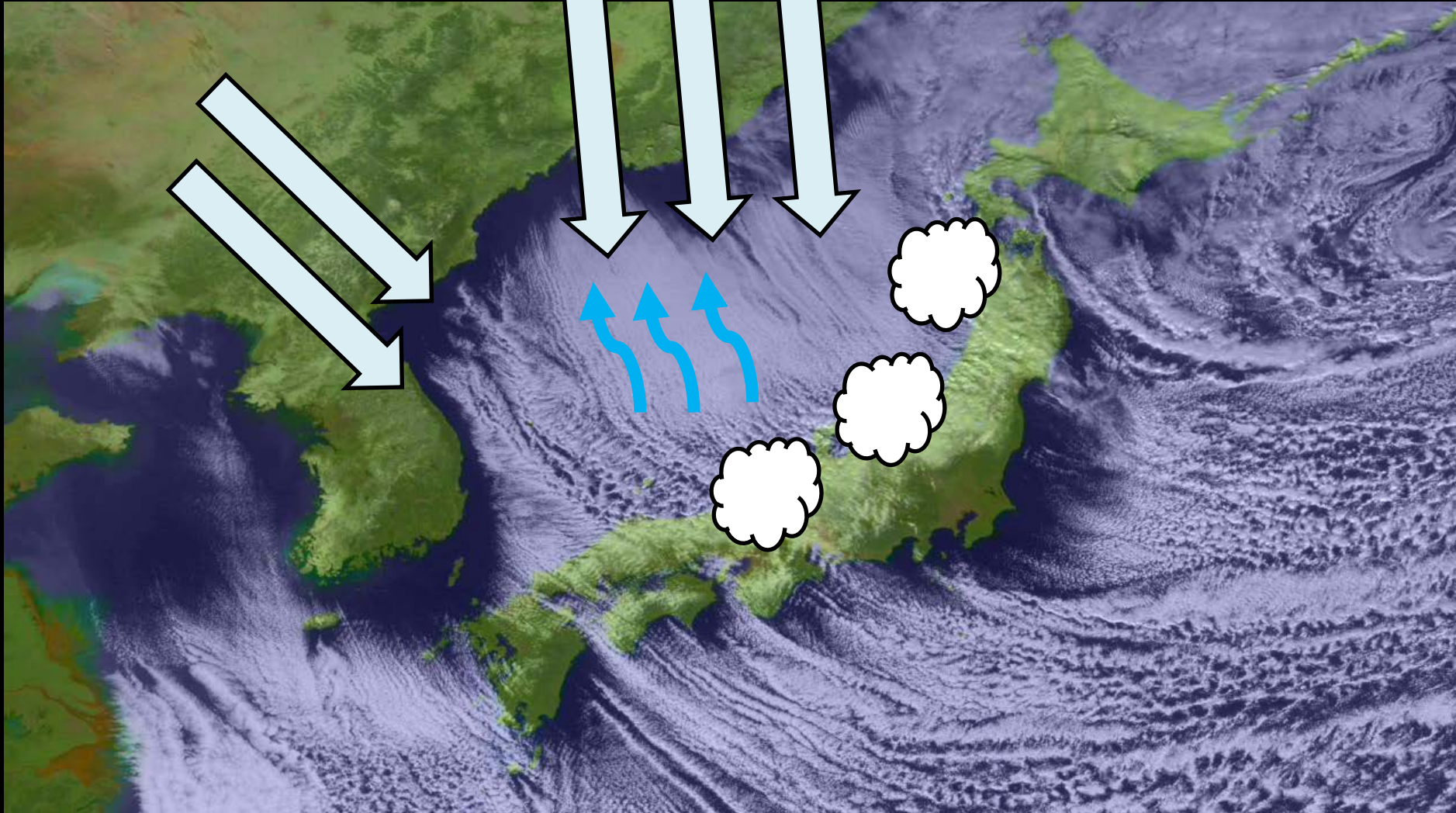


Characteristics of Rainfall and Snowfall on the Japan Sea Coastal Region during the Winter Monsoon Season

Members

Kazu. Yasunaga (Univ. of Toyama),
Noriyuki Nishi (Fukuoka Univ.)

Winter monsoon over the sea of Jpn



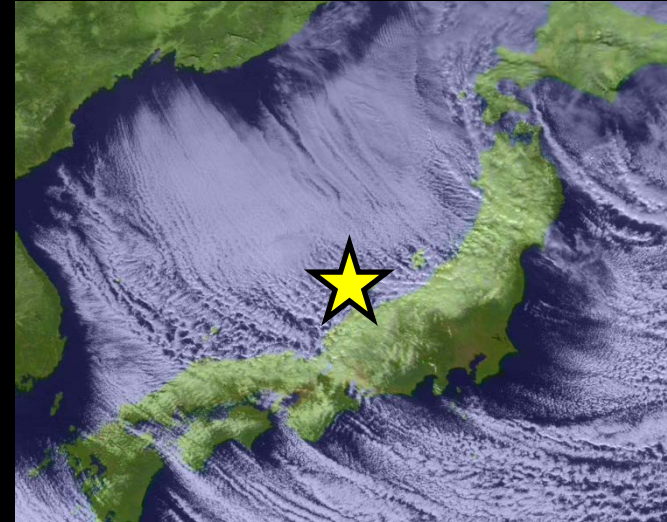
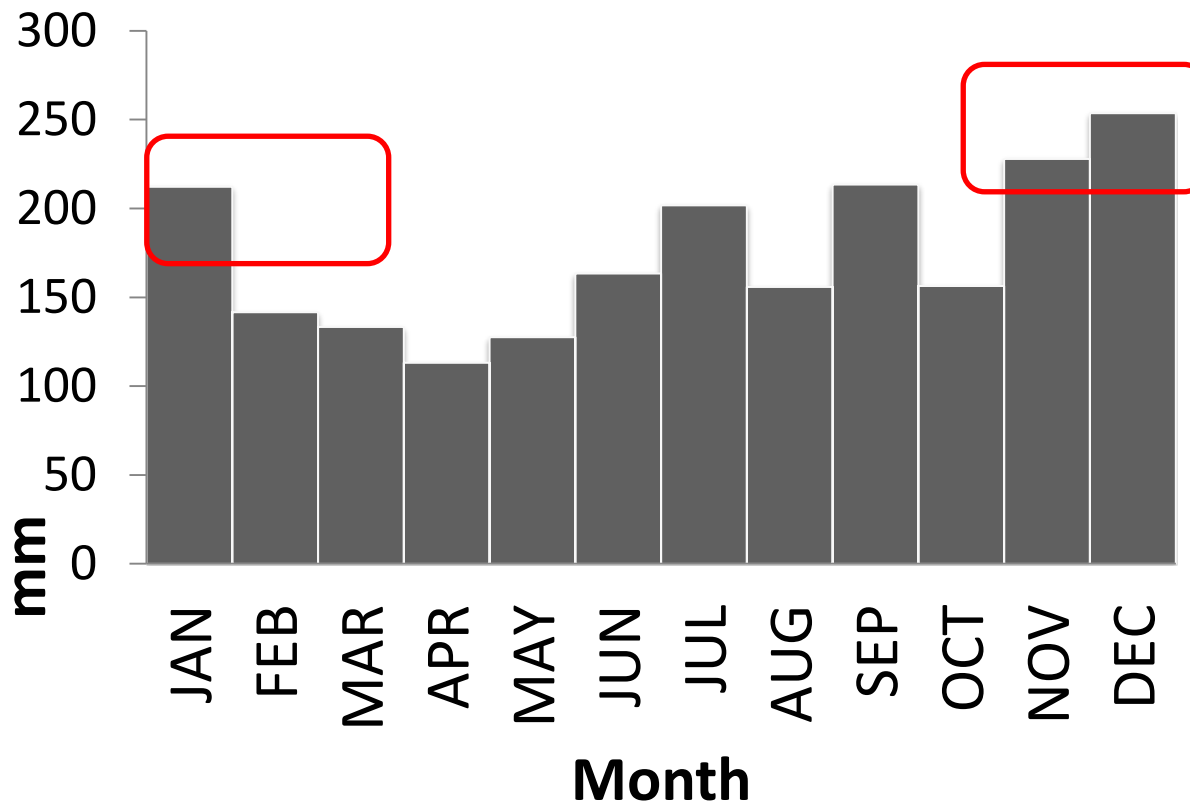
The winter monsoon (NW wind) brings about heavy snowfalls over the Japan Sea coastal areas.

Background

The most water resources during winter monsoon season.

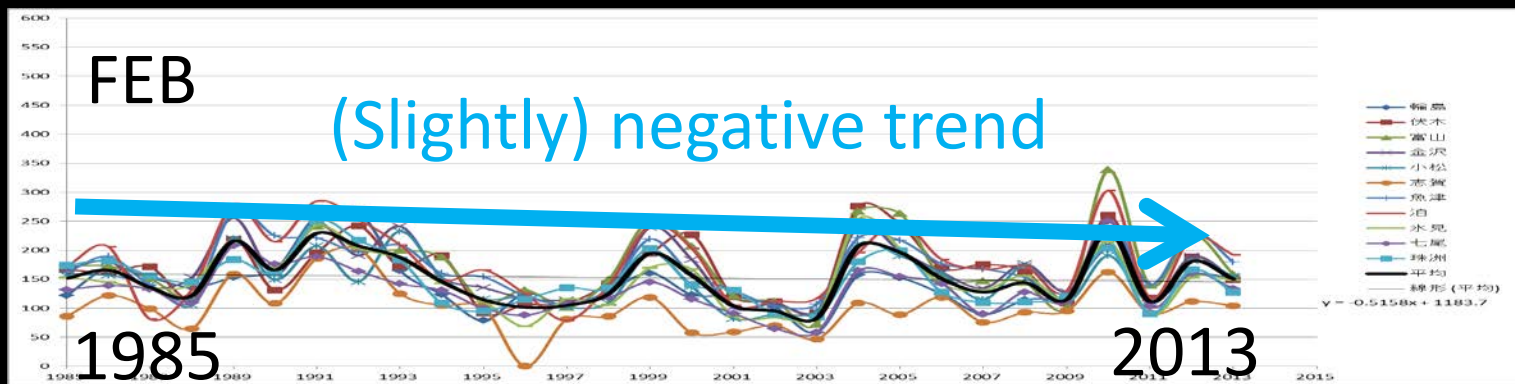
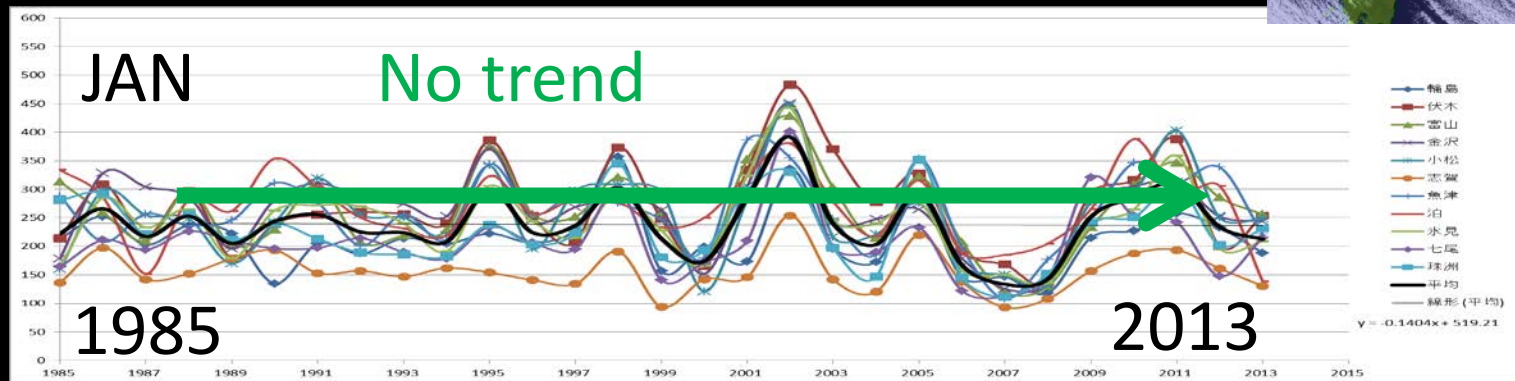
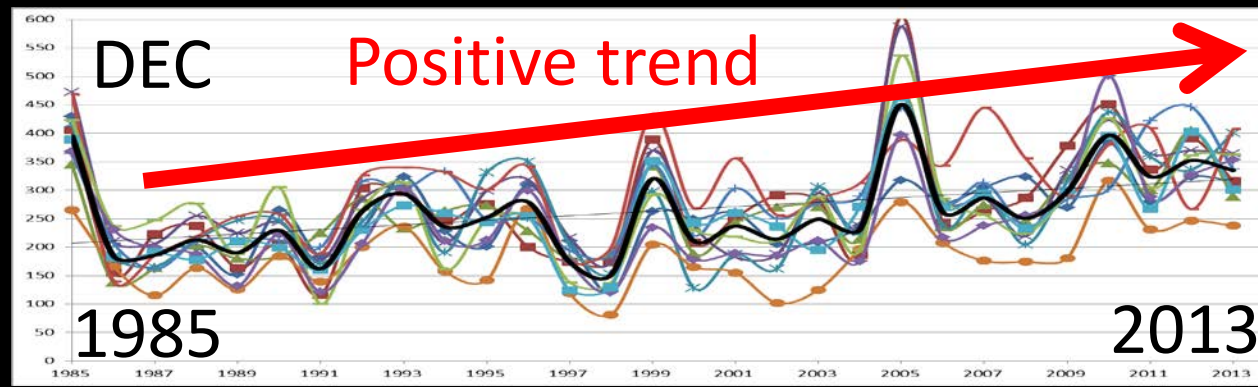
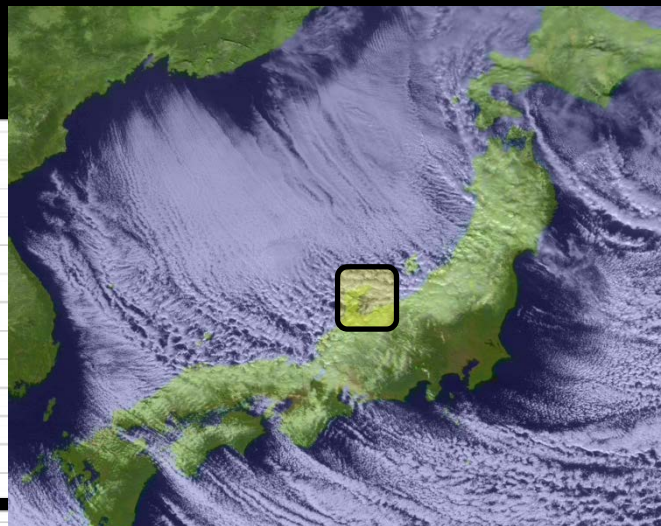
People along the Jpn. sea coast suffer from heavy snowfall disaster

Precipitation Amounts at Wajima



Recent trend of Pr amounts at Toyama

Precipitation observed with rain gauges



Motivation

Increasing trend

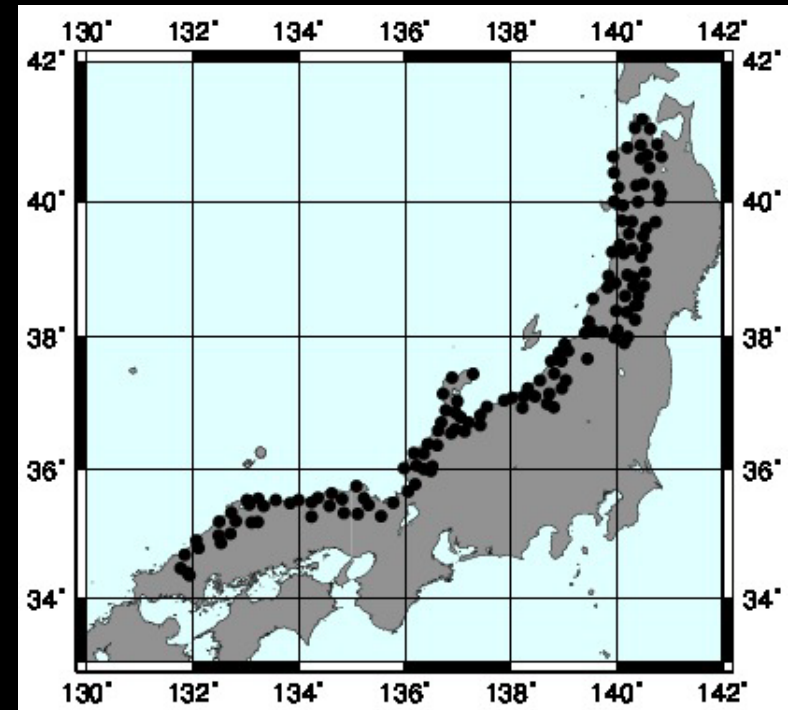
-> Wider area? Or Limited area?

-> real ? or artificial ?

-> Why ?

- Dataset
AMeDAS (Automated Meteorological Data Acquisition System)
- Analysis Area
Coastal areas of Sea of Jpn
- Periods
From 1990 - 2013

Analyzed AMeDAS points

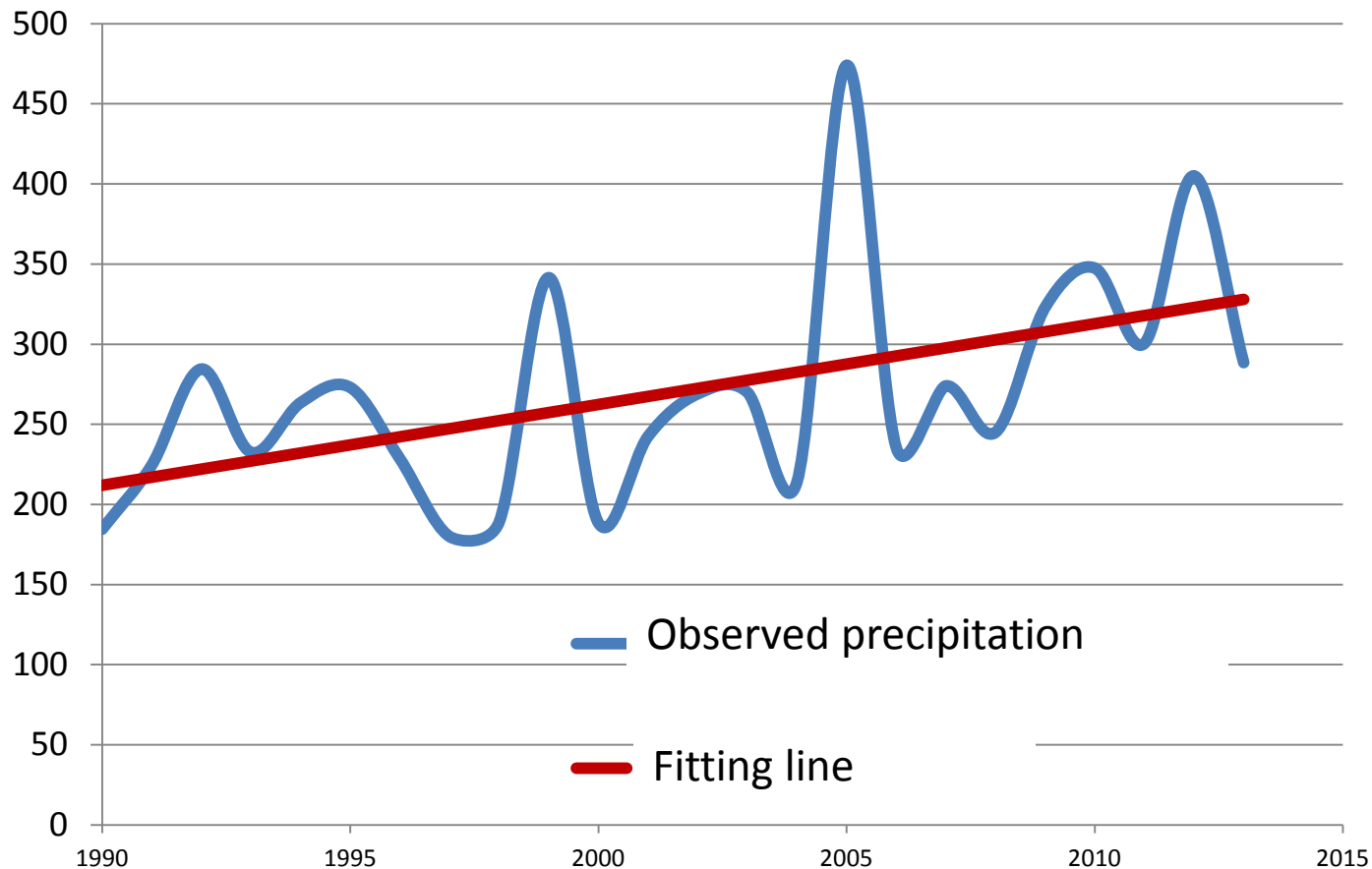


Methodology

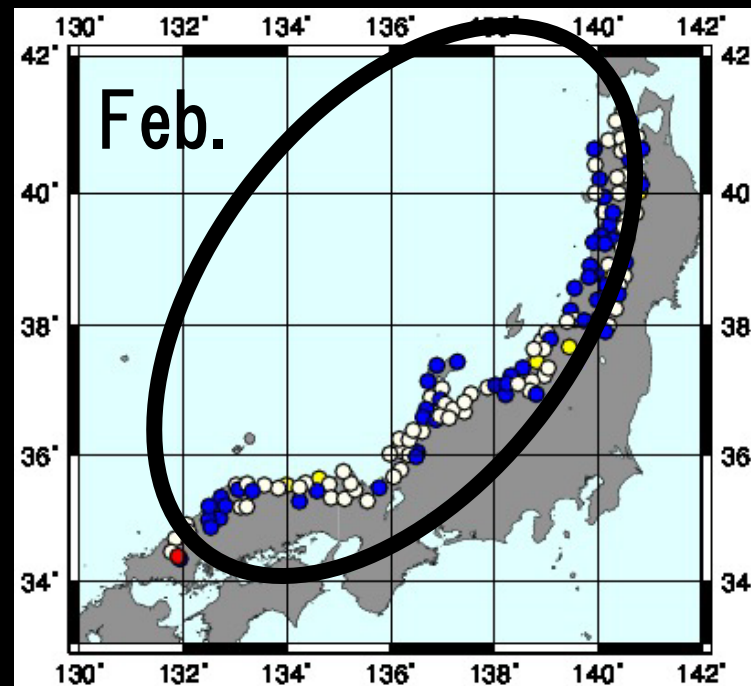
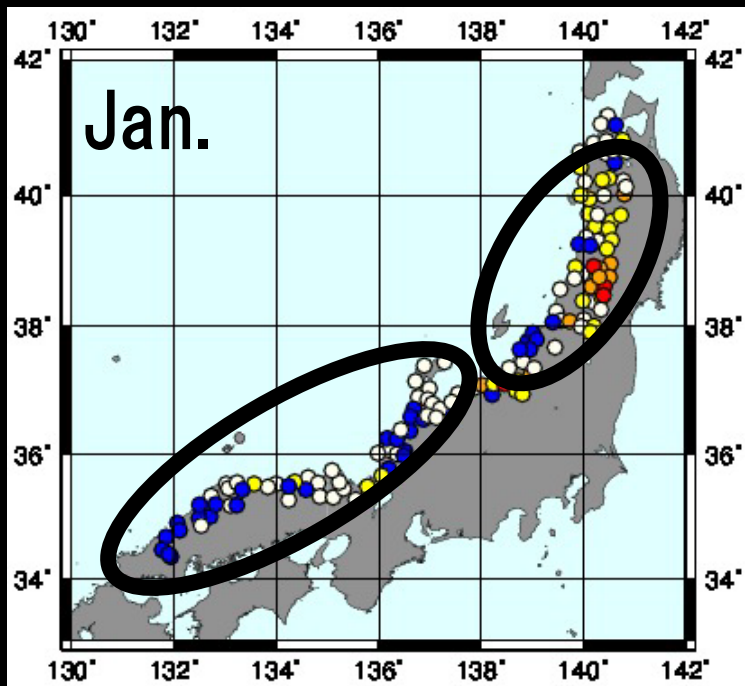
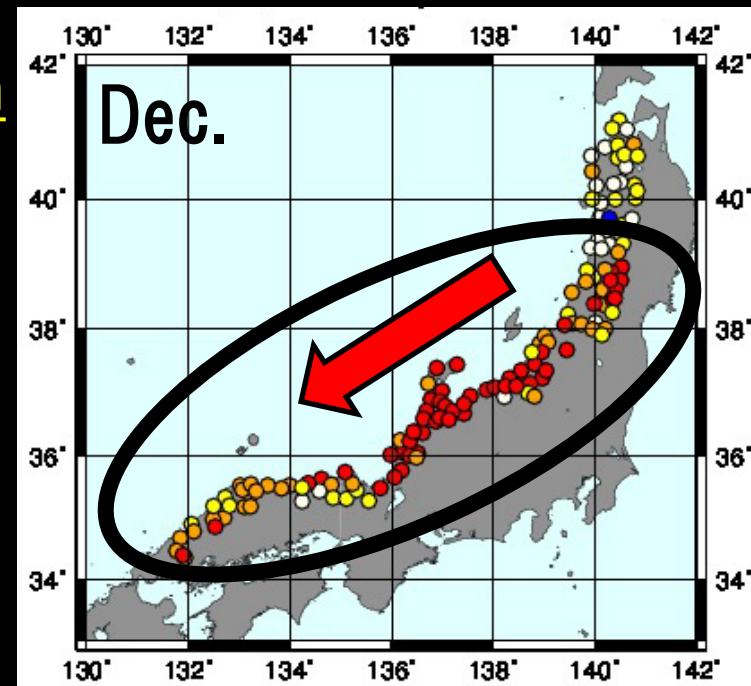
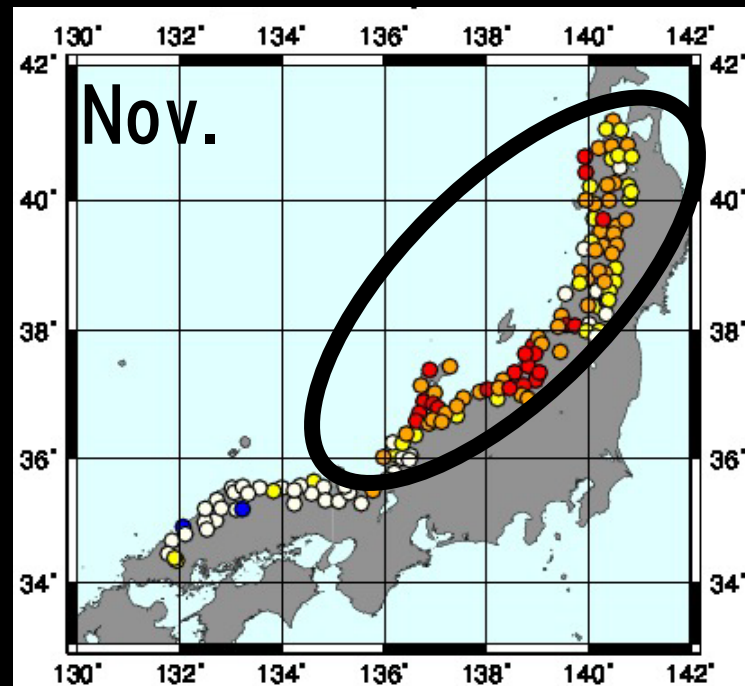
Linear regression analysis.

Regression coefficient > 0 ? Or

Regression coefficient < 0 ?



Precipitation



Relationships between catch ratio and wind speed

Real ? or Artificial ?

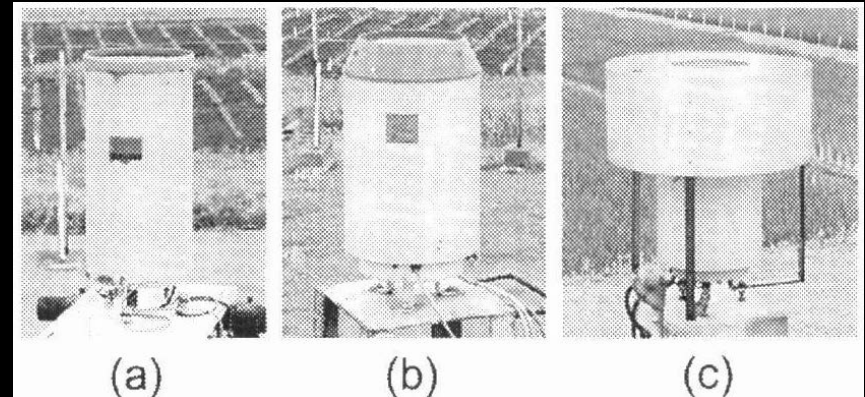
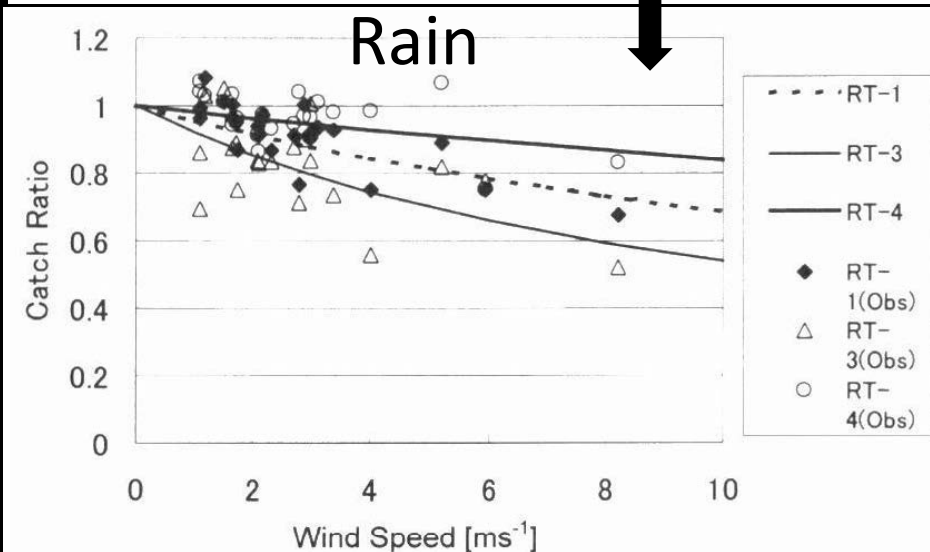
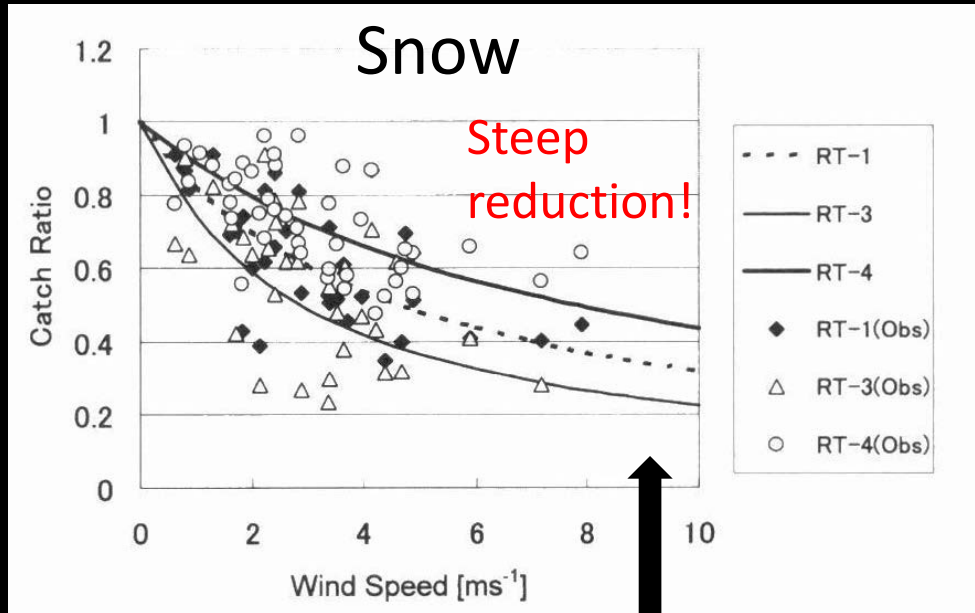
If snowfall turns to rainfall, more precipitation will be observed due to the more efficient catch ratios.

Independent Variables

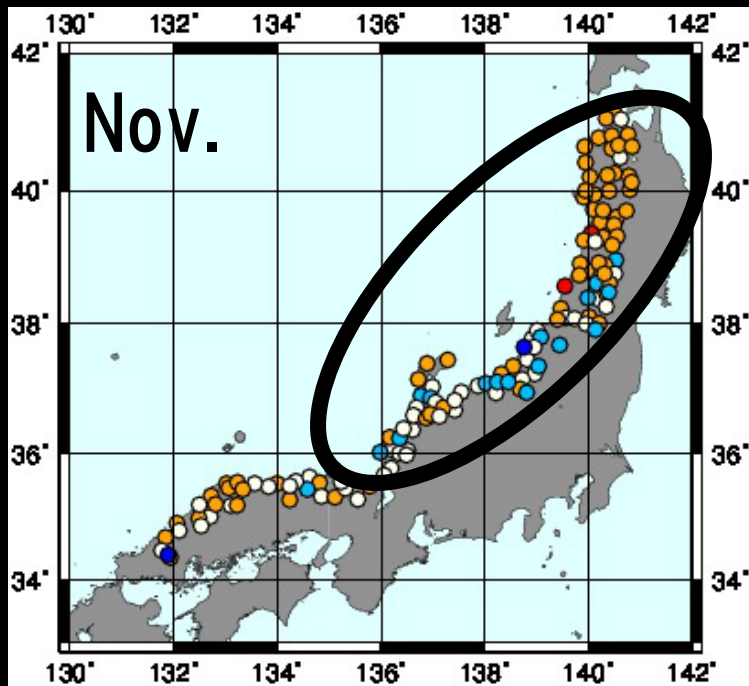
-> Temperature

-> Actual sunshine duration

-> Days with lightning detection



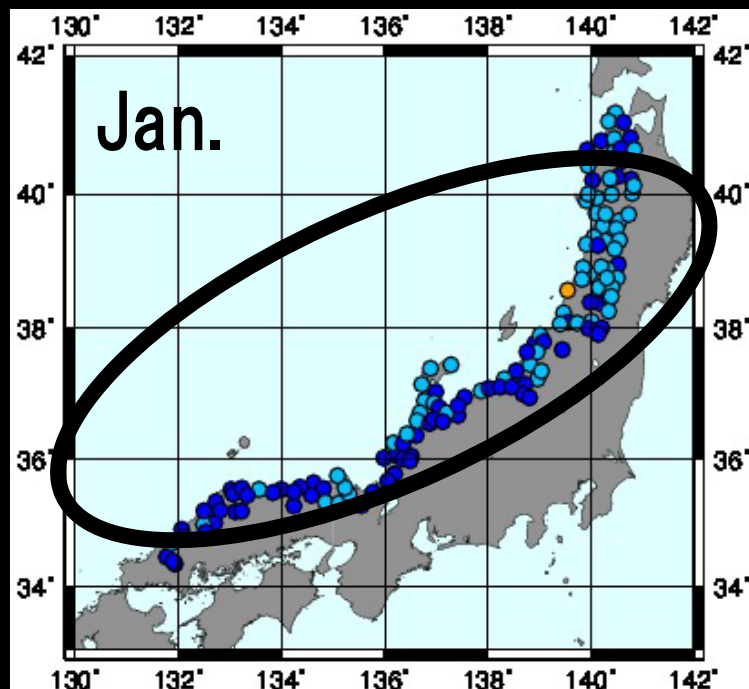
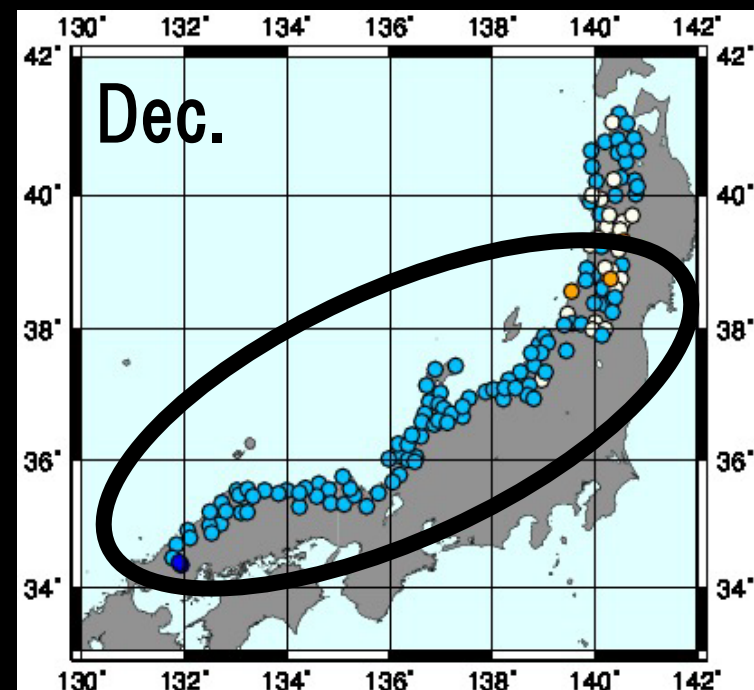
Yokoyama et al. (2003)
J. of Japanese Soc. of Snow and Ice



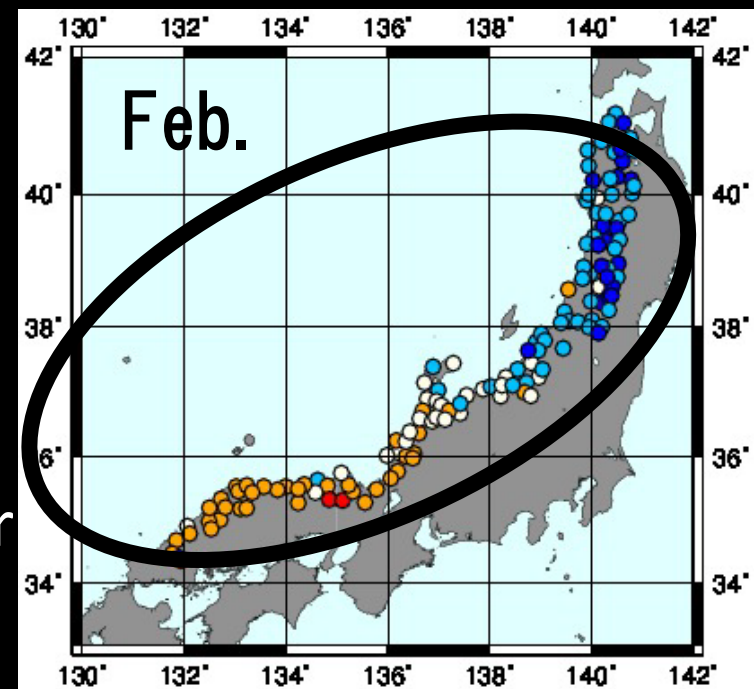
Temp.

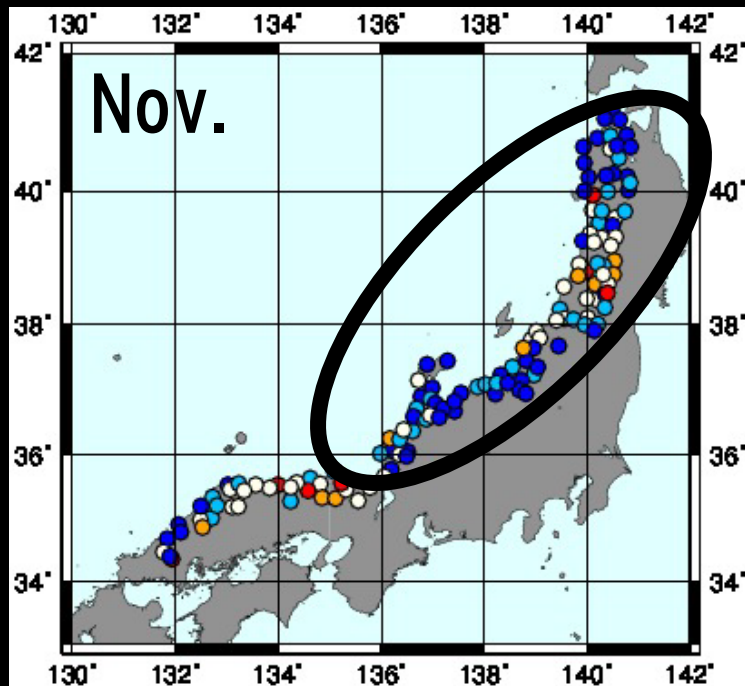


Negative
Trend!!

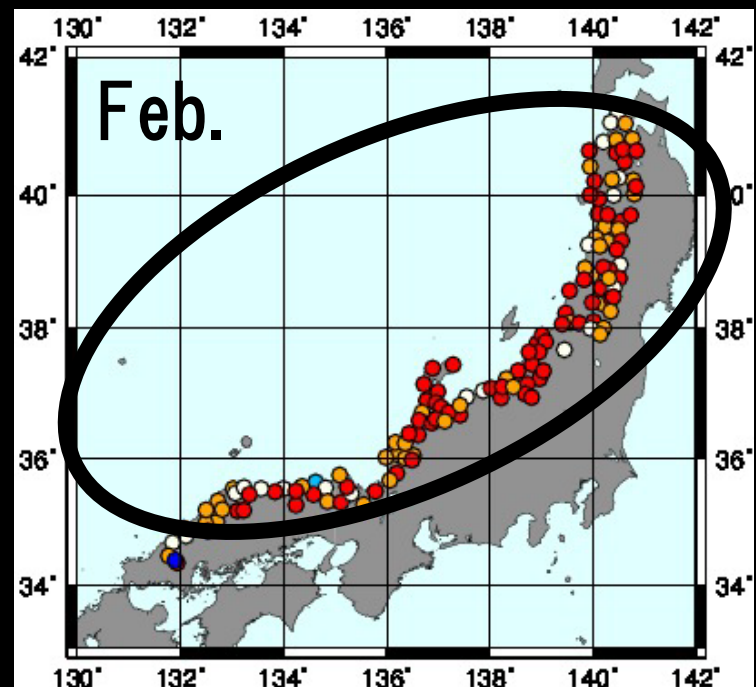
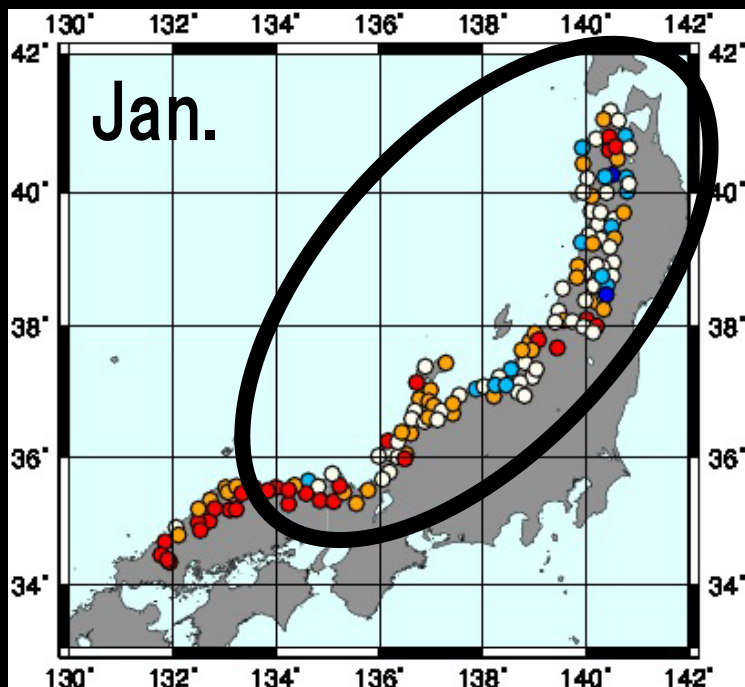
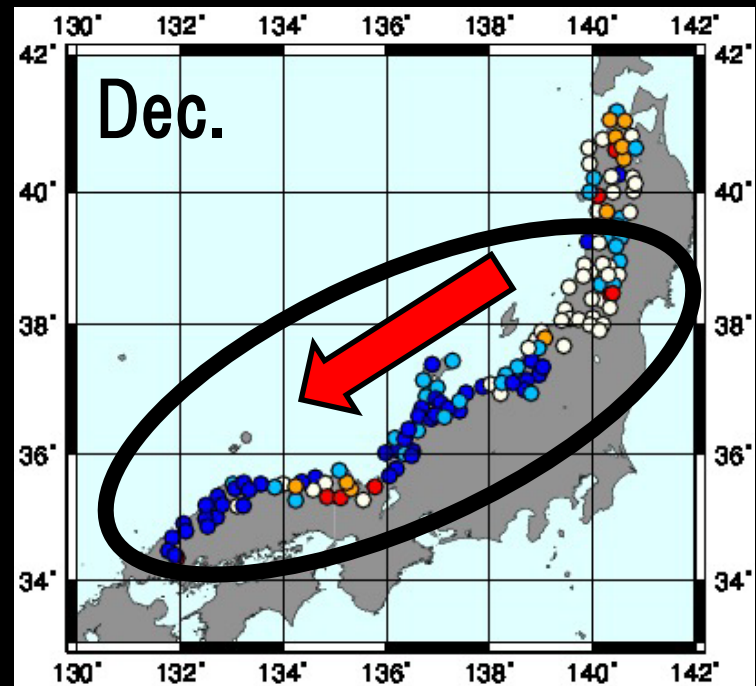
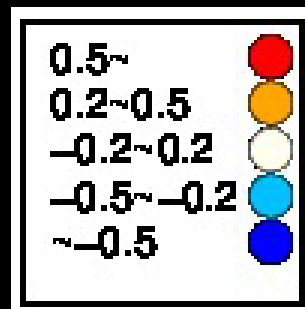


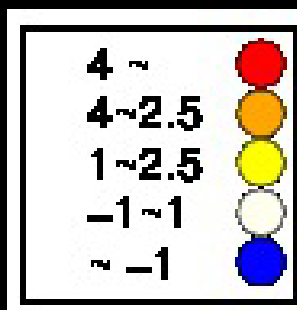
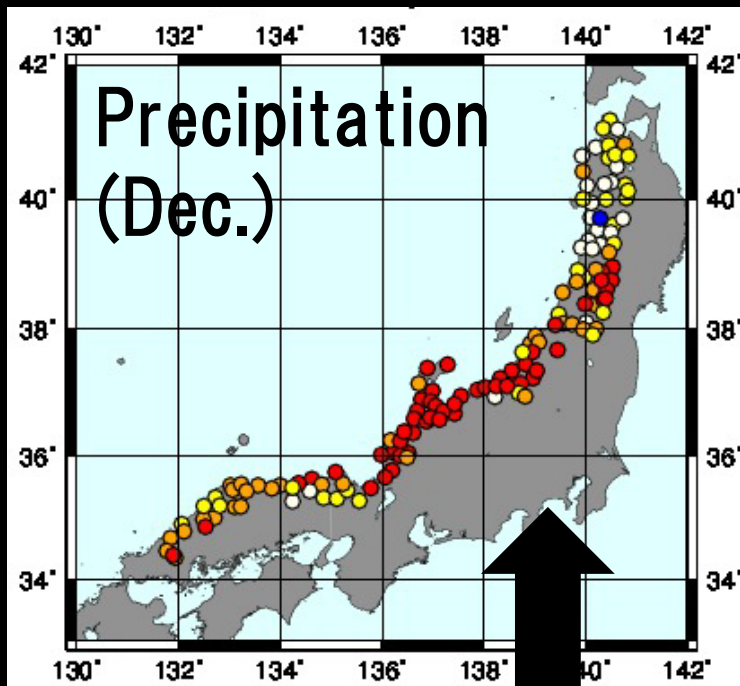
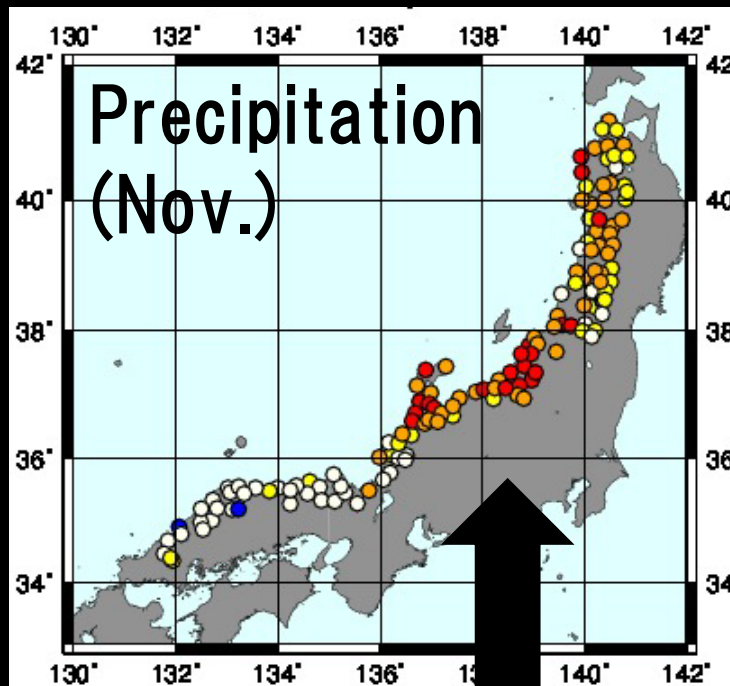
~~Higher
Temp.
More
Rainfall
w/o
changes of
total water
amounts~~



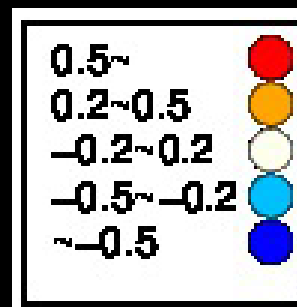
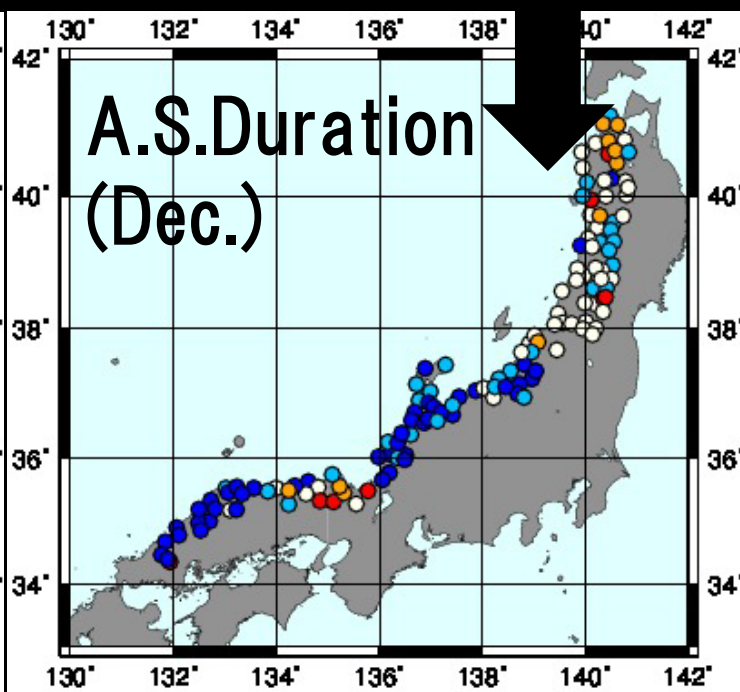
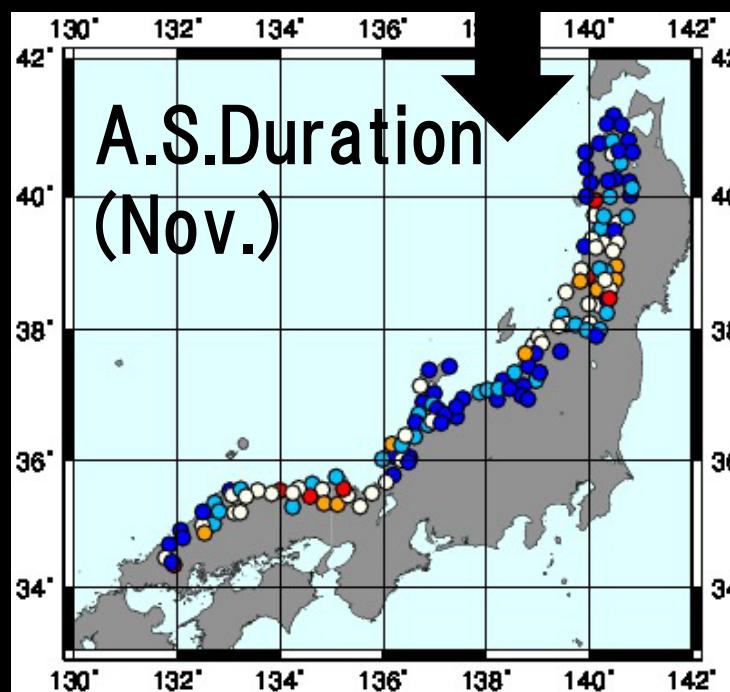


Actual Sunshine Duration

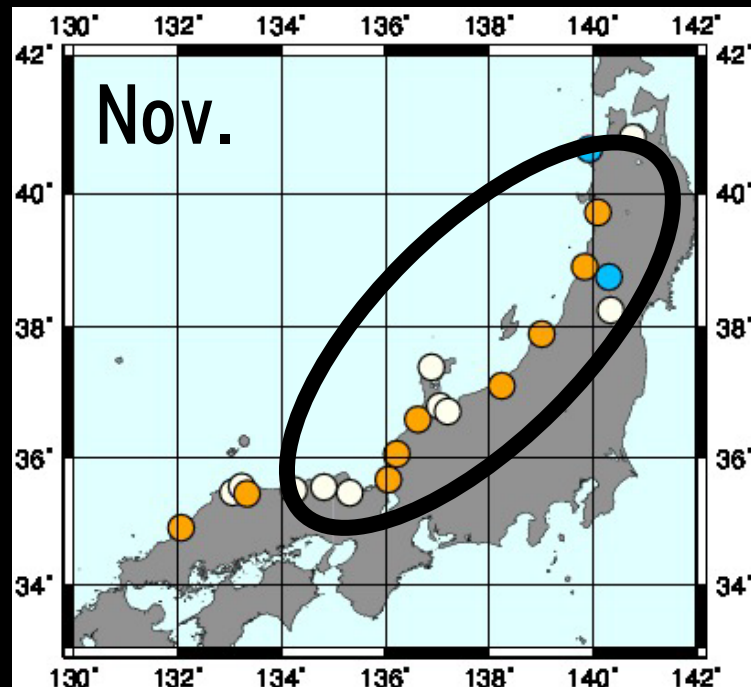




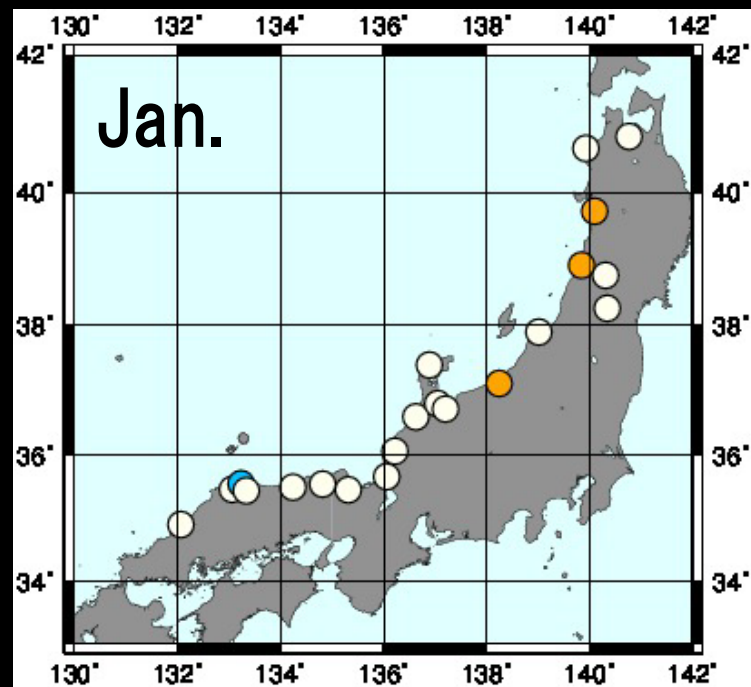
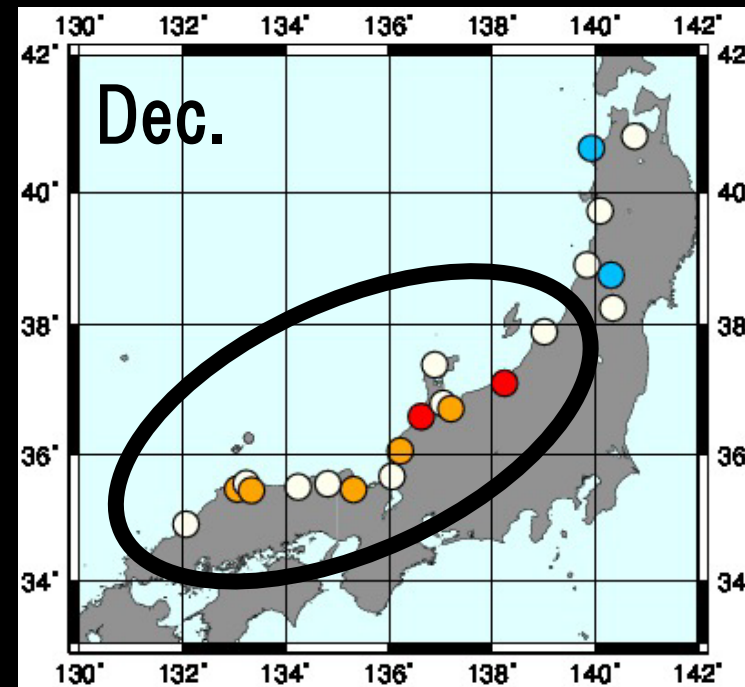
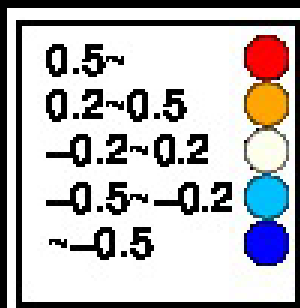
Consistent
More
Rainfall.



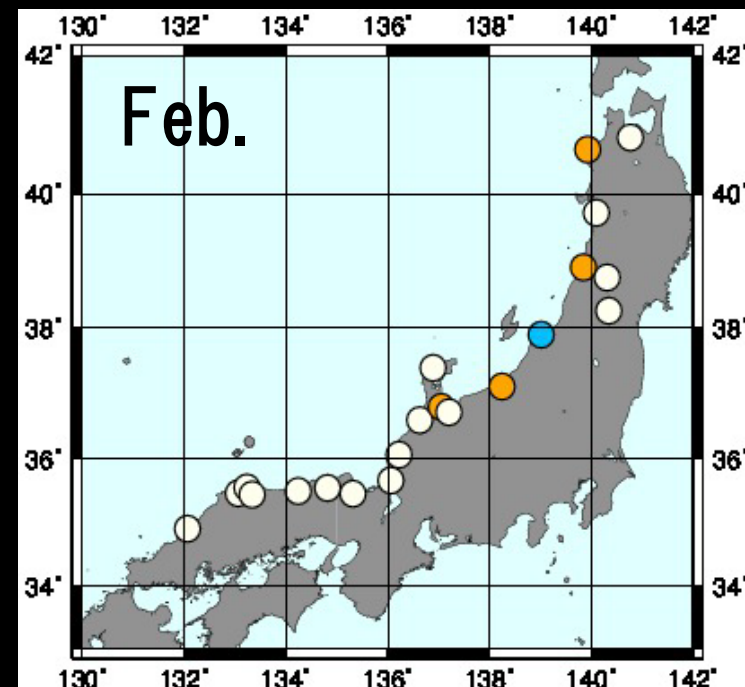
Less
Actual
sunlight



Days with
lightning
detection



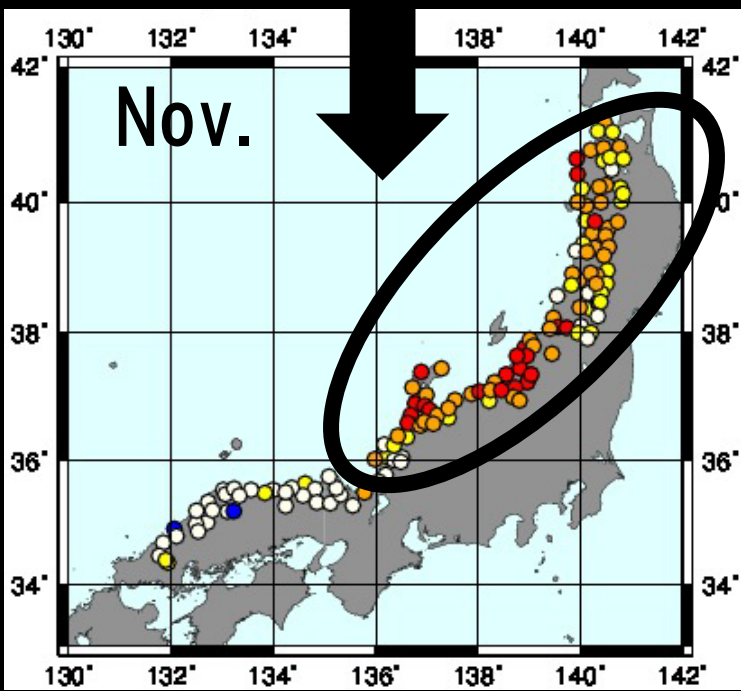
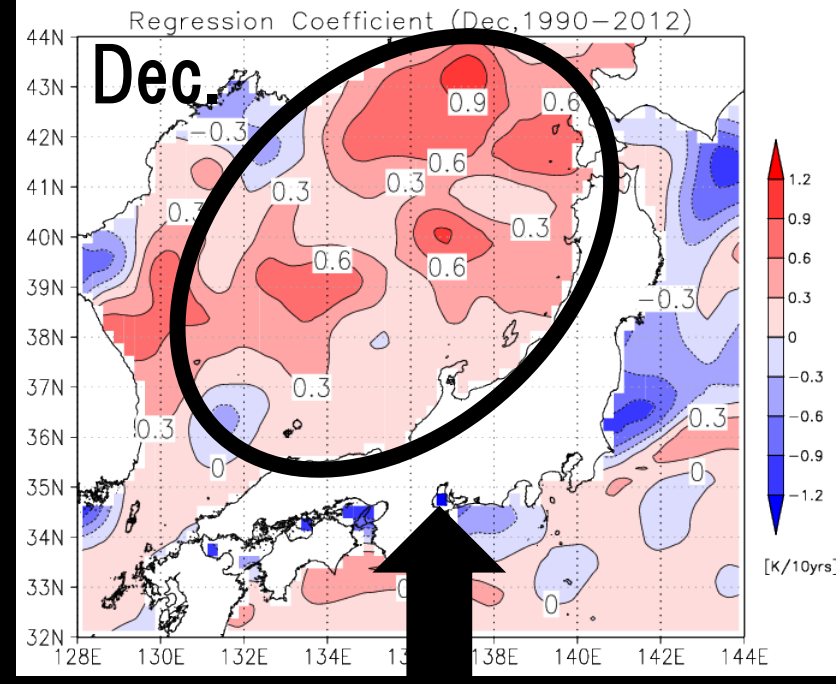
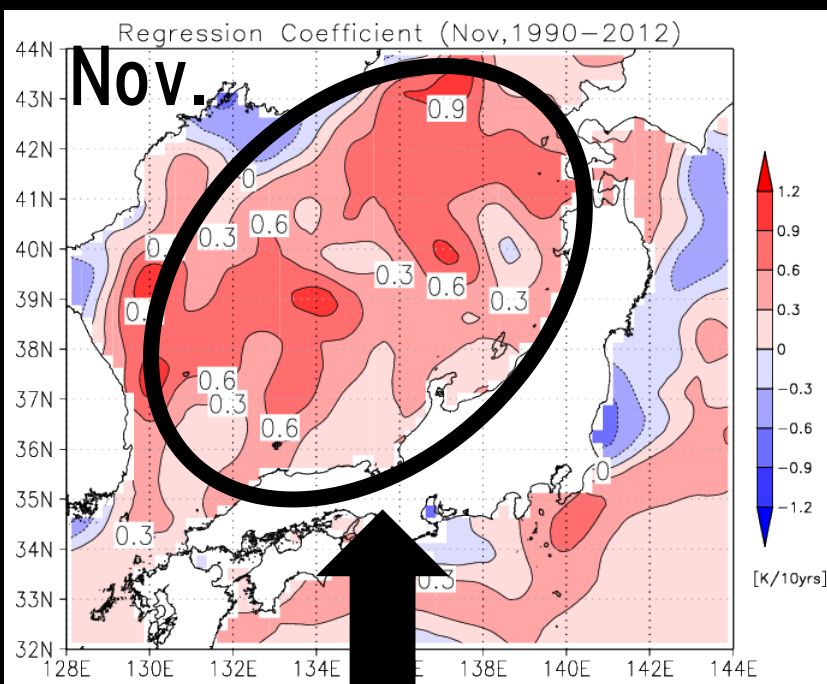
Consistent
More
Rainfall.
More
active
convection



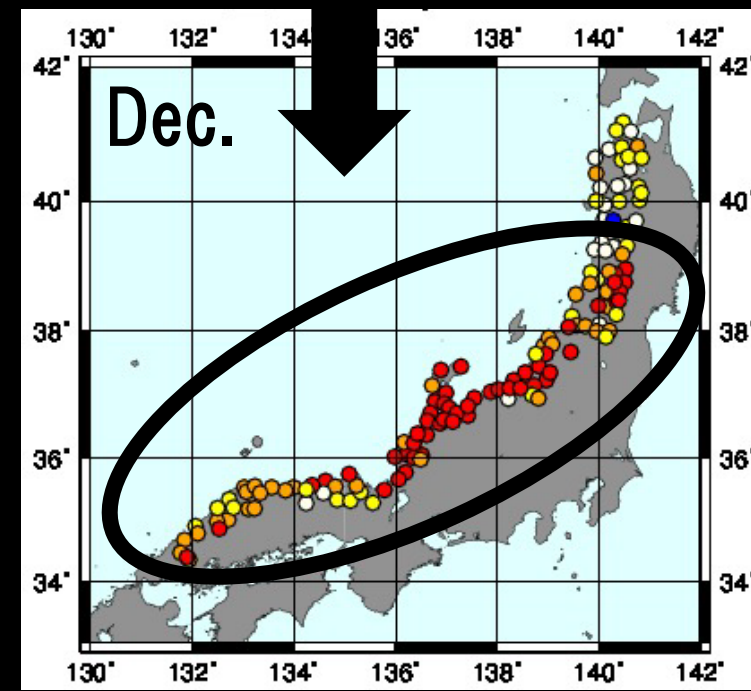
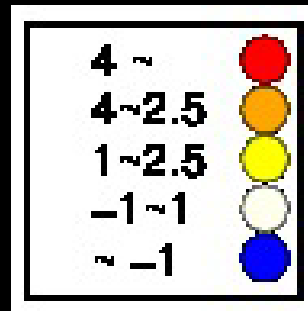
Discussions

- Positive trend of precipitation during Dec. (and Nov.) is real.
- Reason ?
- Hypotheses
 - (1) Sea Surface Temperature?
 - (2) Cloud-Characteristics?
 - (3) Other mechanisms ?

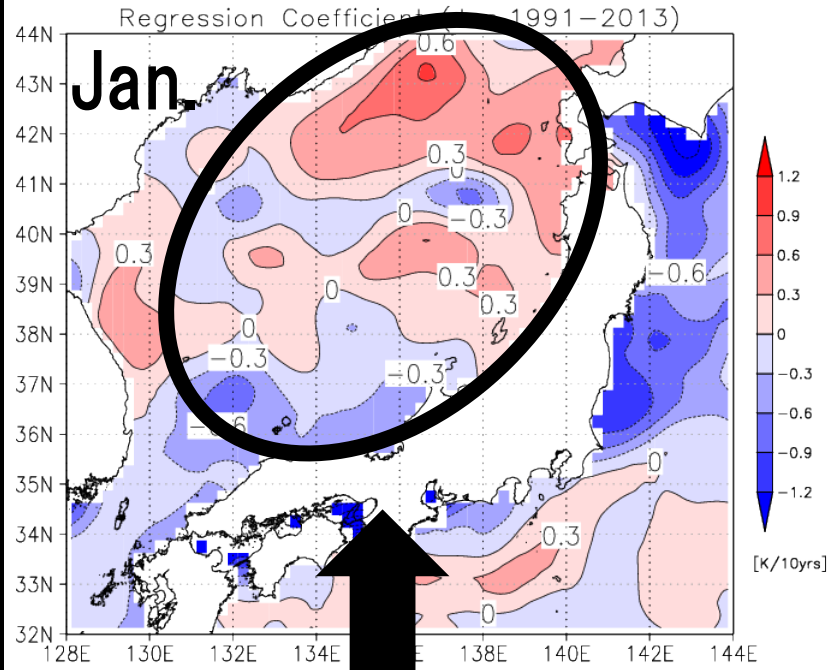
SST



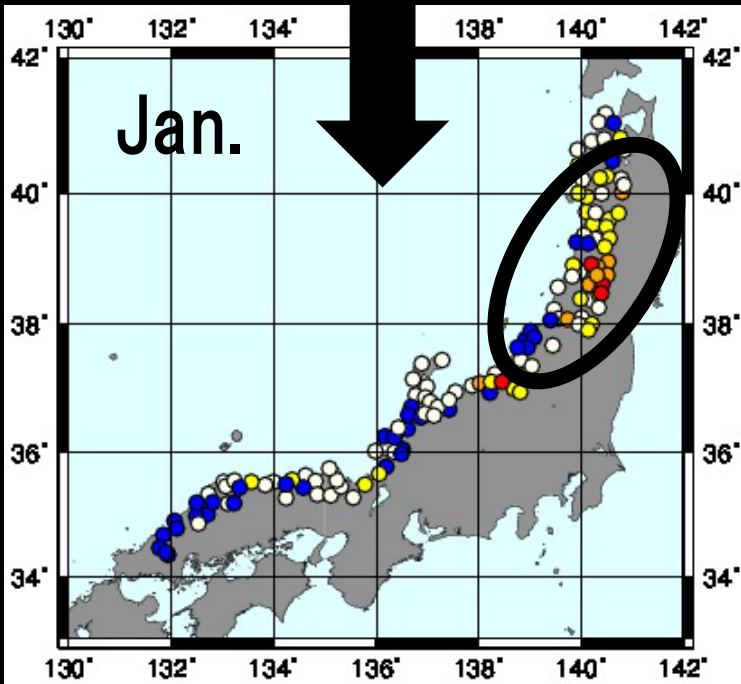
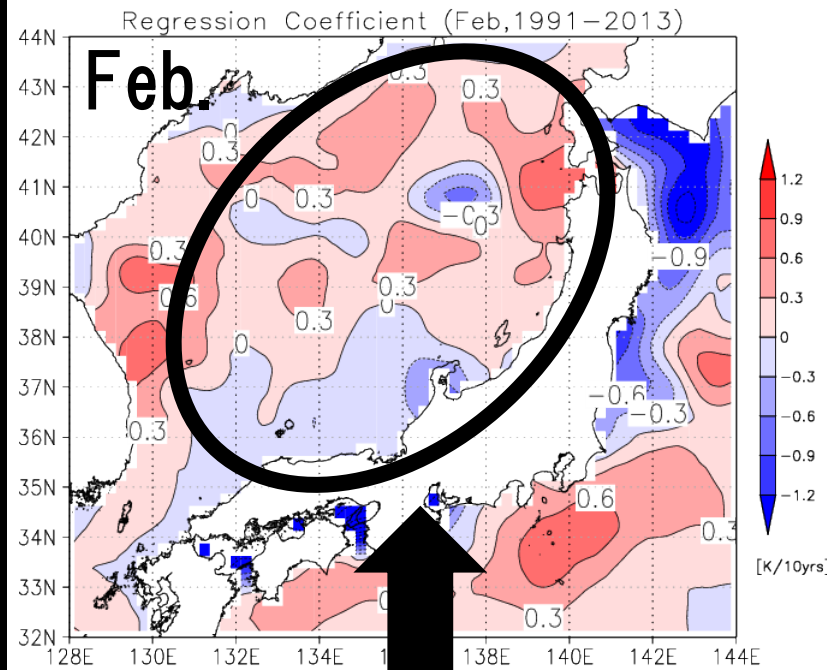
Precipitation



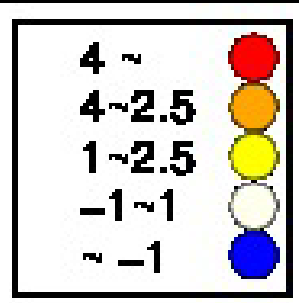
Southward shift is not seen in SST.



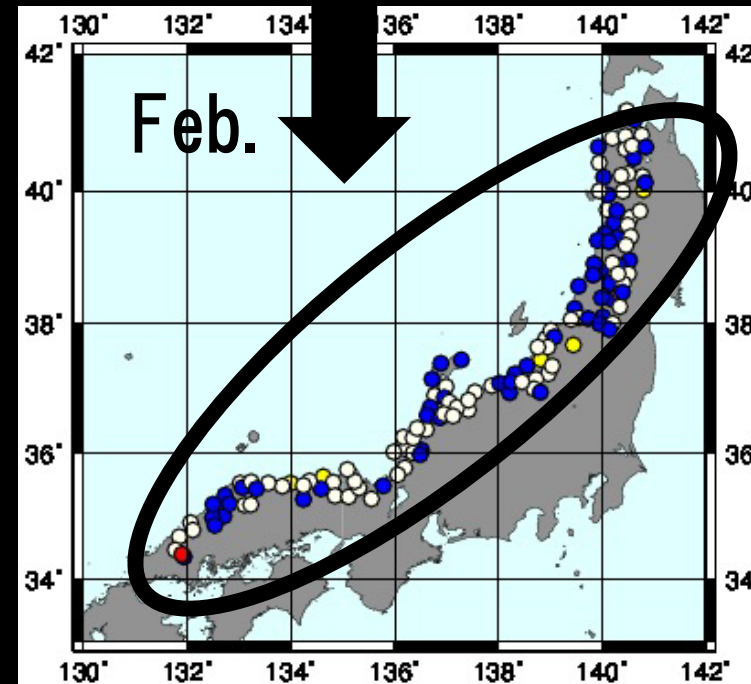
SST



Precipitation



SST trend > 0
However
Pr trend < 0



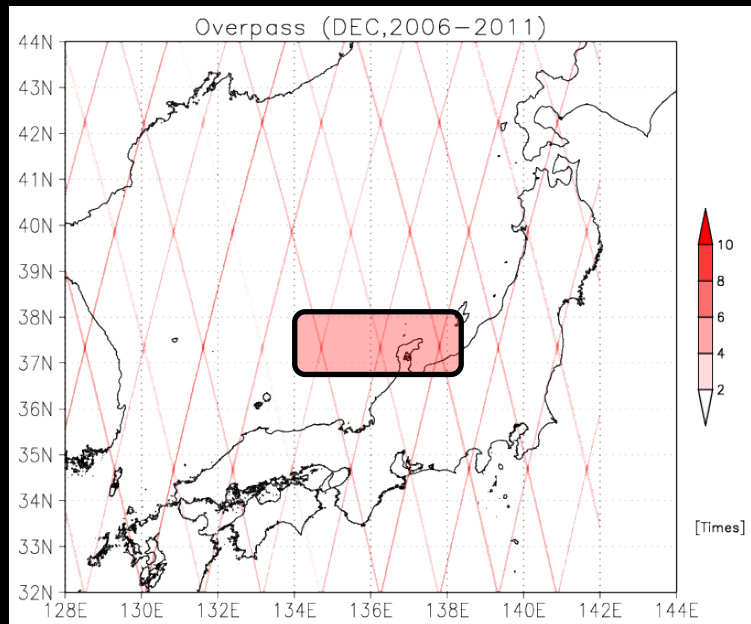
Discussions

- Positive trend of precipitation during Dec. (and Nov.) is real.
 - Reason ?
 - Hypotheses
- Partly consistent,
However, pr trend cannot be
completely explained.

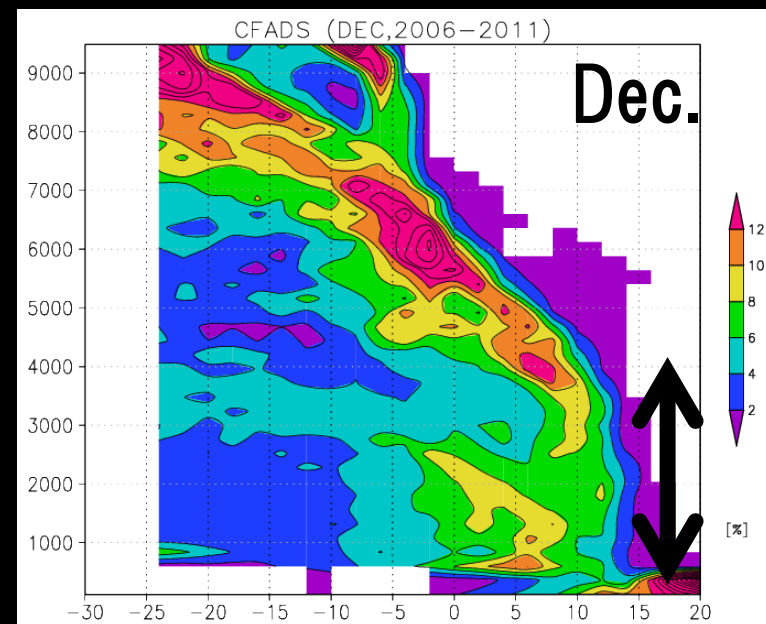
(1) Sea Surface Temperature?

(2) Cloud-Characteristics?

(3) Other mechanisms ?



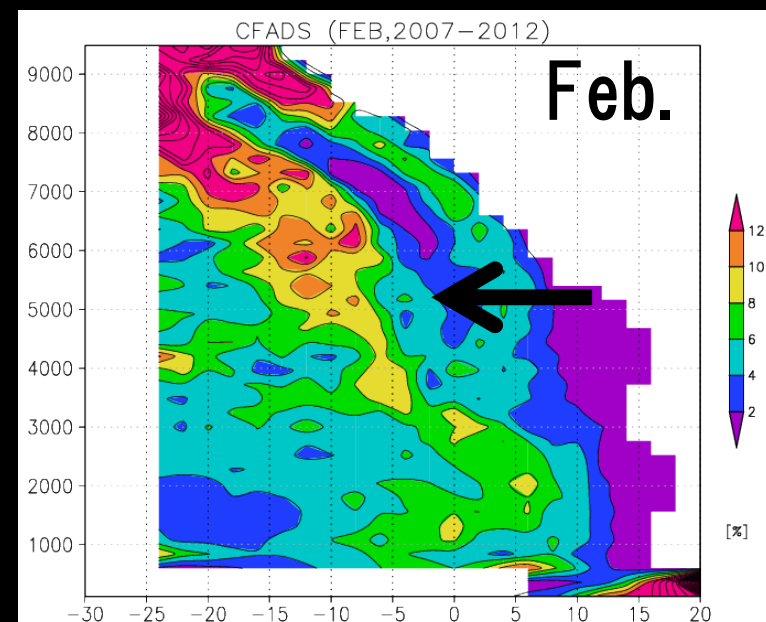
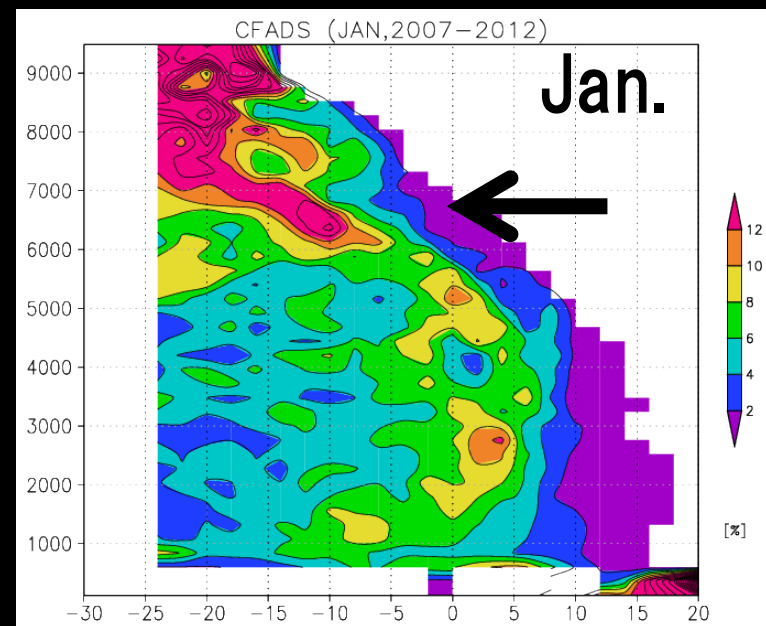
CFAD
(Cloud-sat)



Small samples



- Noisy!
- Difficult to draw robust results

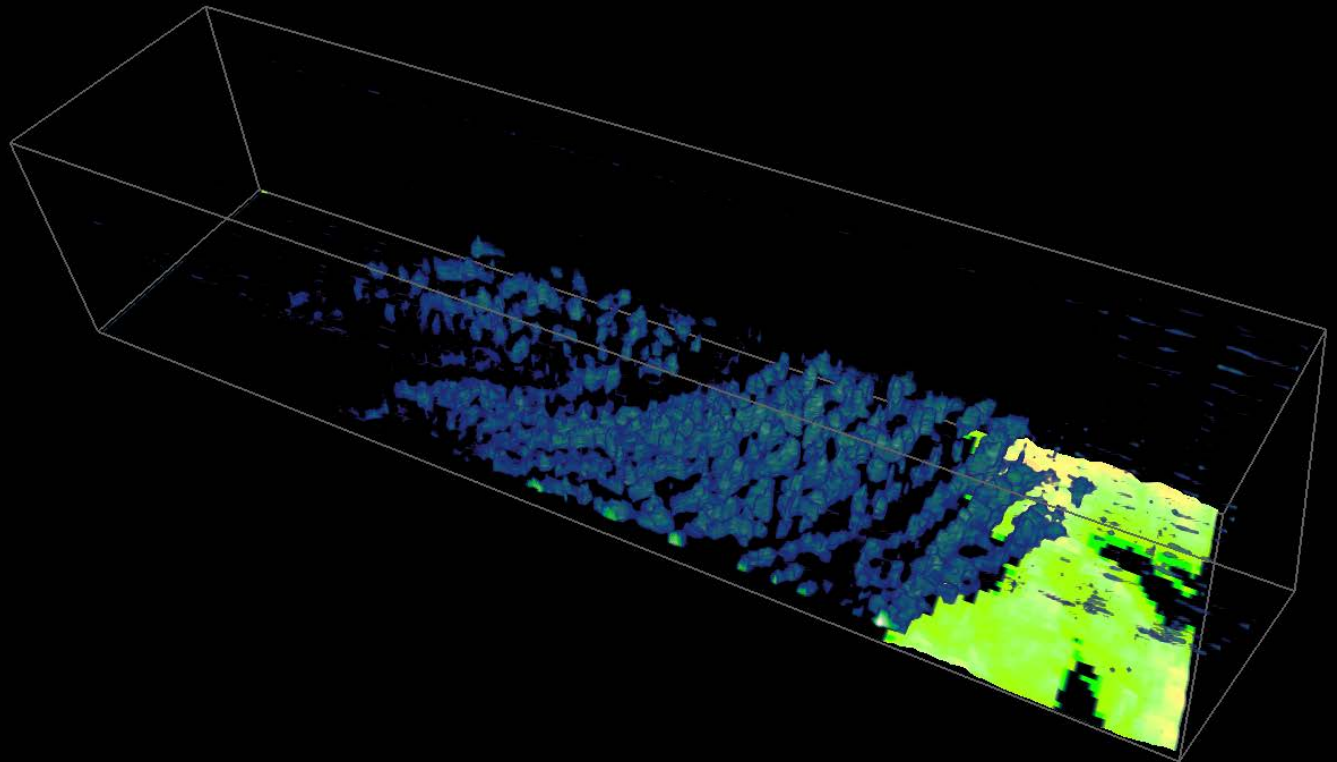


Future works

- Some good samples for snow clouds over the Jpn sea region by DPR.

Large seasonal SST variations →

- Response of clouds to SST warming.
- Indication for the positive Pr trend.



by courtesy of Hamada-san and Takayabu-san.