Research on Coastal Disasters

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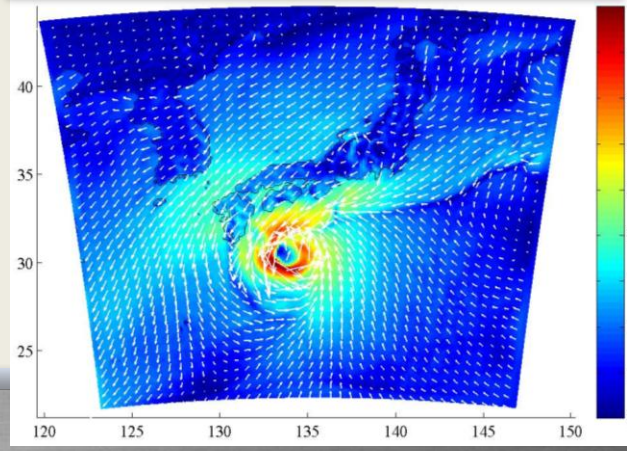
Basic Resarch

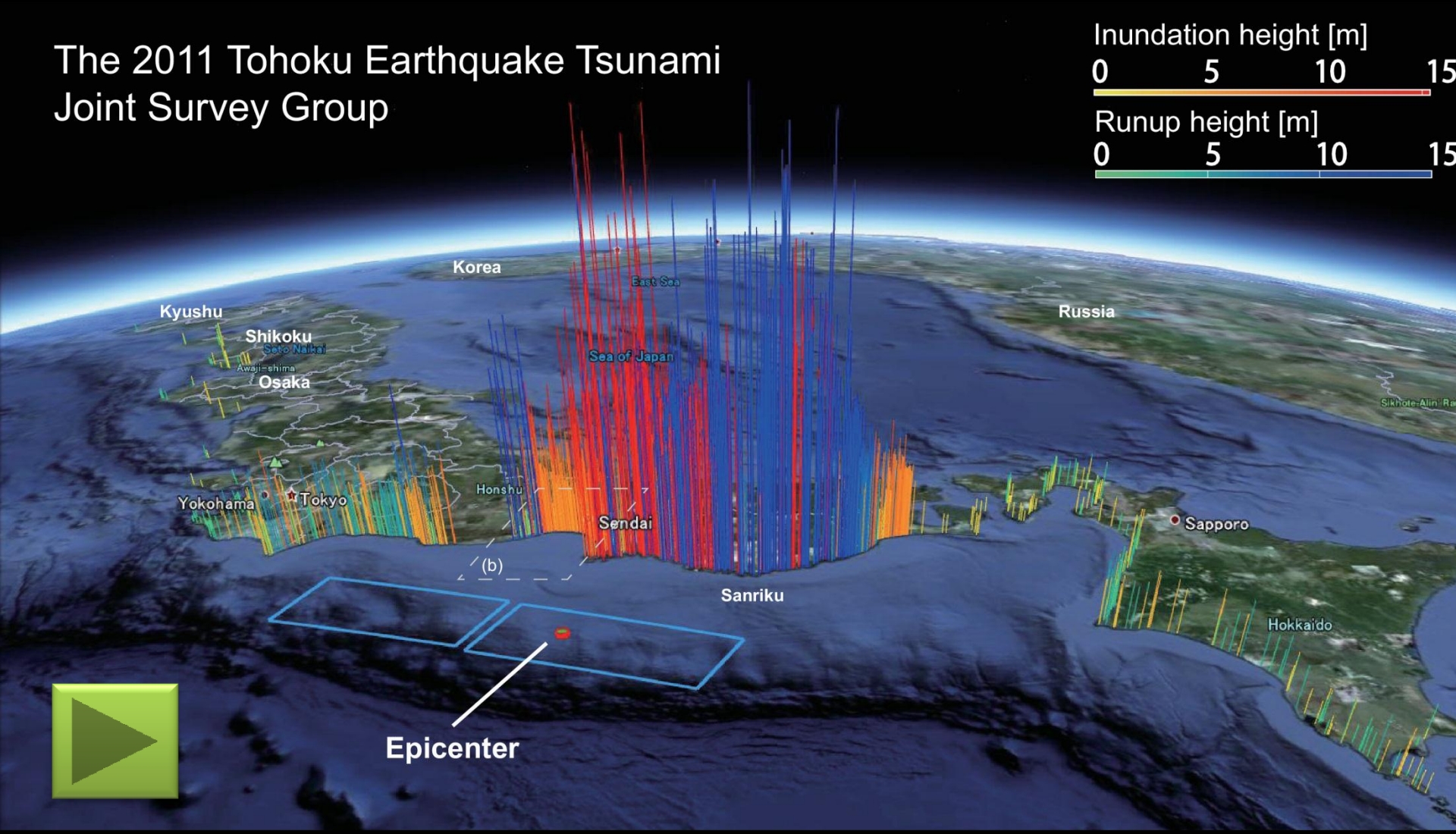
- Wave modeling
  - Nonlinear wave interactions, wave dissi
  - Freak/rogue wave prediction
- Storm surge modeling
  - ocean(2D)-wave-tide model
  - ocean(3D)-wave-atomsphere model
- Tsunami modeling
  - Propagation, inundation
  - Real time prediction
- Climate Impact on Coastal Area



Cooperation with UK

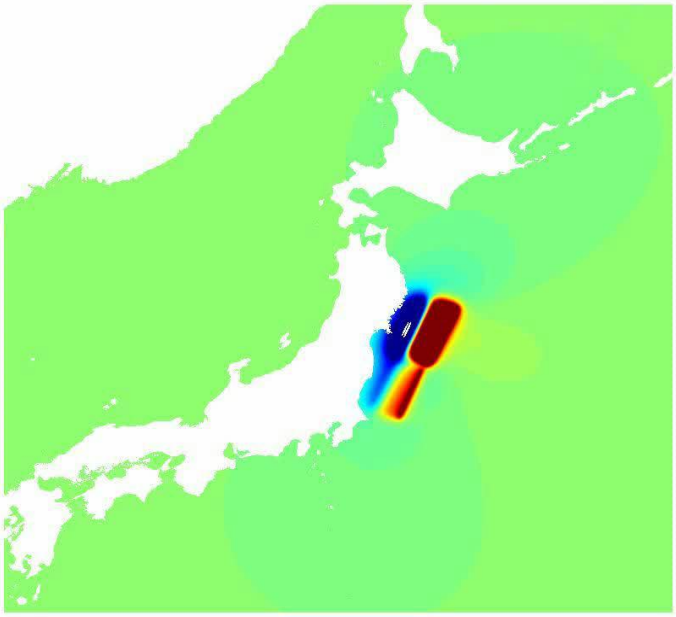
- Engineering and Physical Sciences Research Council (EPSRC) Global Partnerships (2012)
  - For renewal energy
  - U Edinburgh, Kyoto U, Hokkaido U, National Taiwan U
- AON (2012?-)
  - For tsunami risk assessment in the Pacific region
- ECWMF
  - Extreme wave modeling

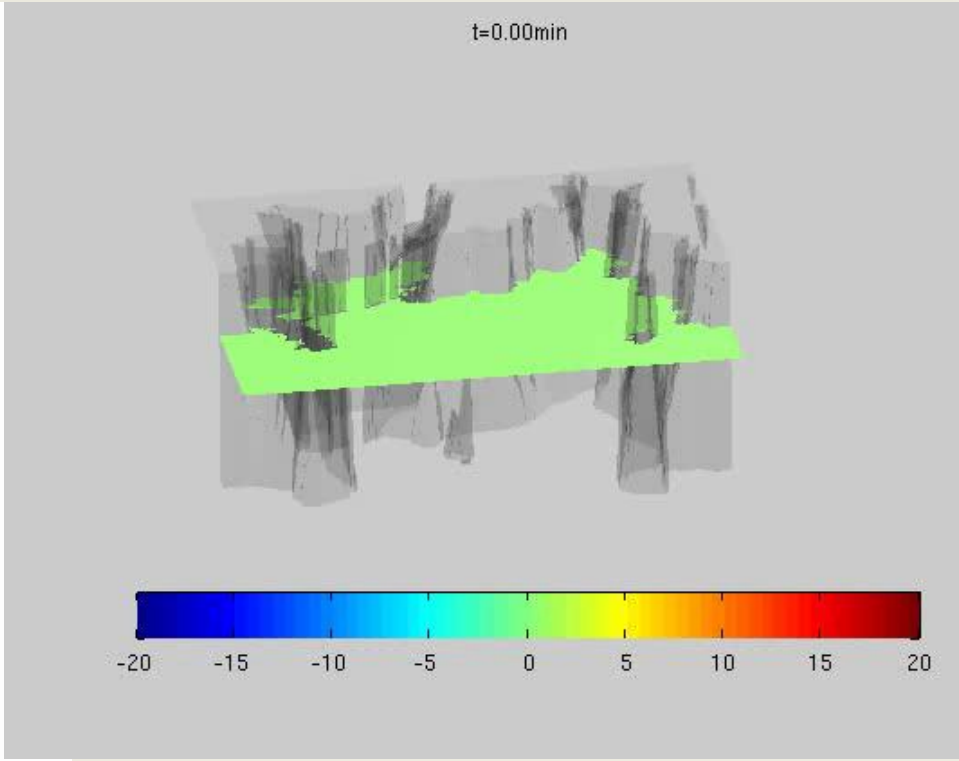
TSUNAMIS



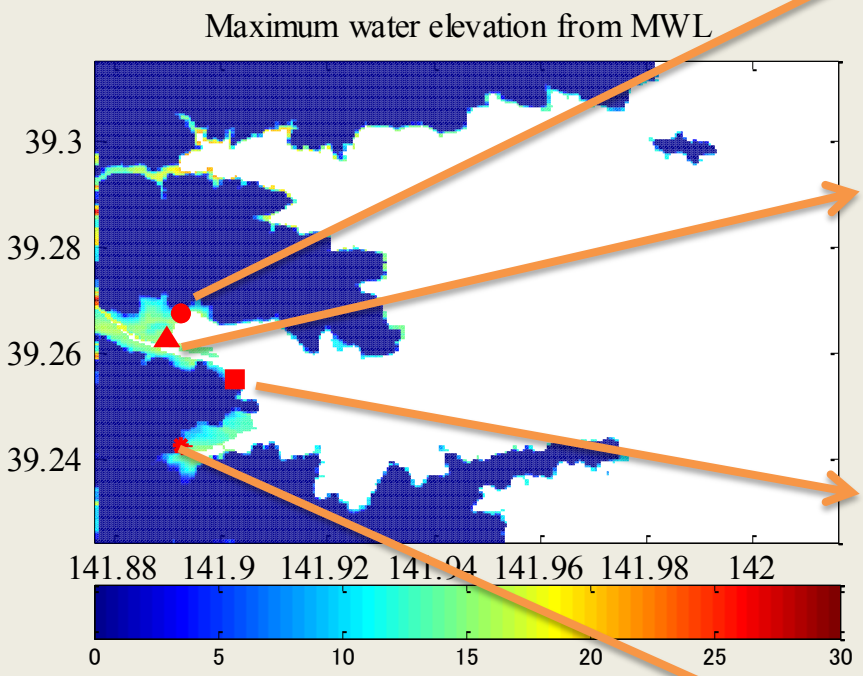
Mori, N et al. (2011) Geophysical Research Letters, 38, L00G14.
Mori, N., T. Takahashi and The 2011 Tohoku Earthquake Tsunami Joint Survey Group (2012) Nationwide Survey of the 2011 Tohoku Earthquake Tsunami, Coastal Engineering Journal
Mori, N. et al (2012) Earthquake Spectra

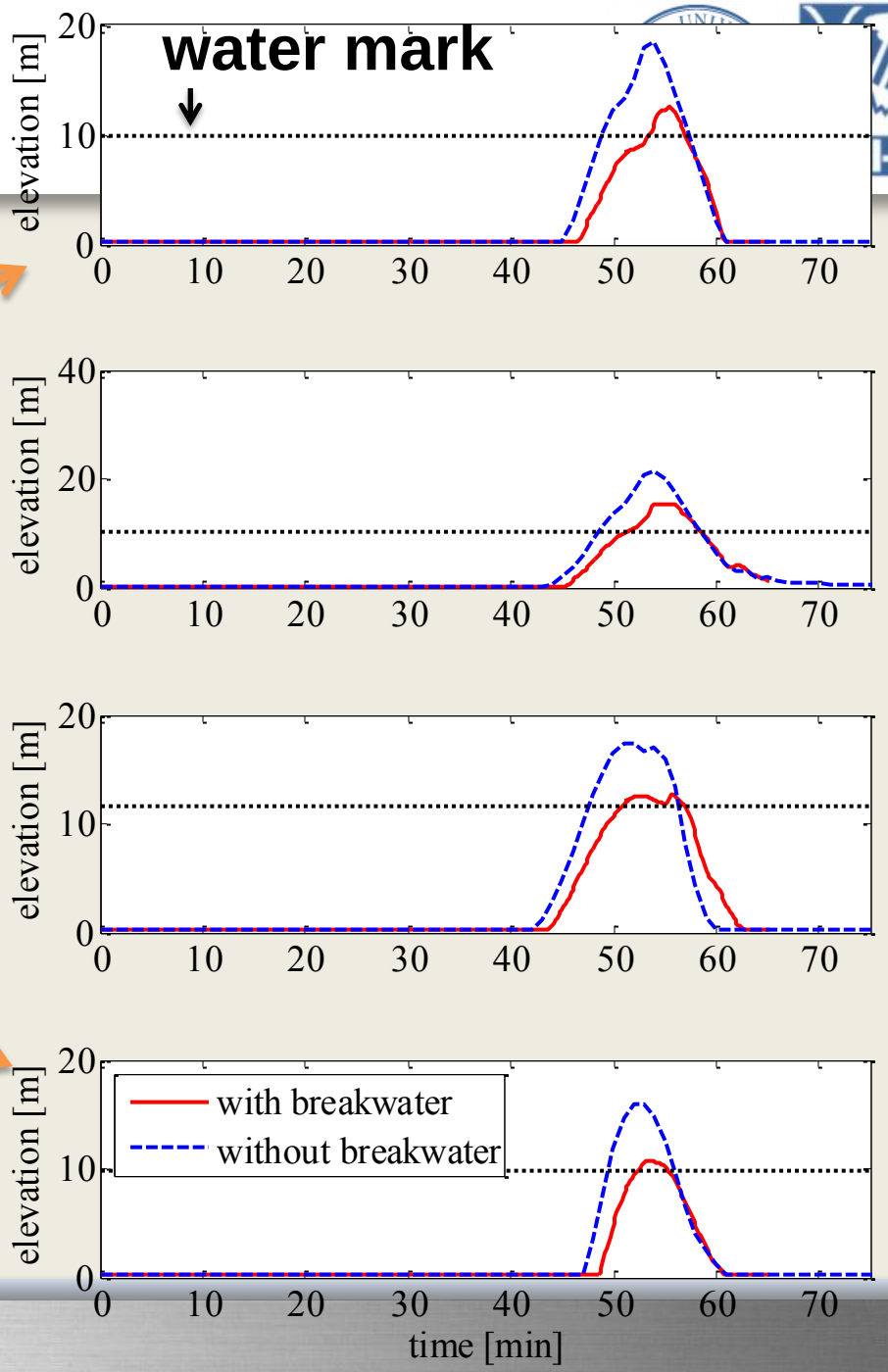
Tsunami Hindcast





Validation



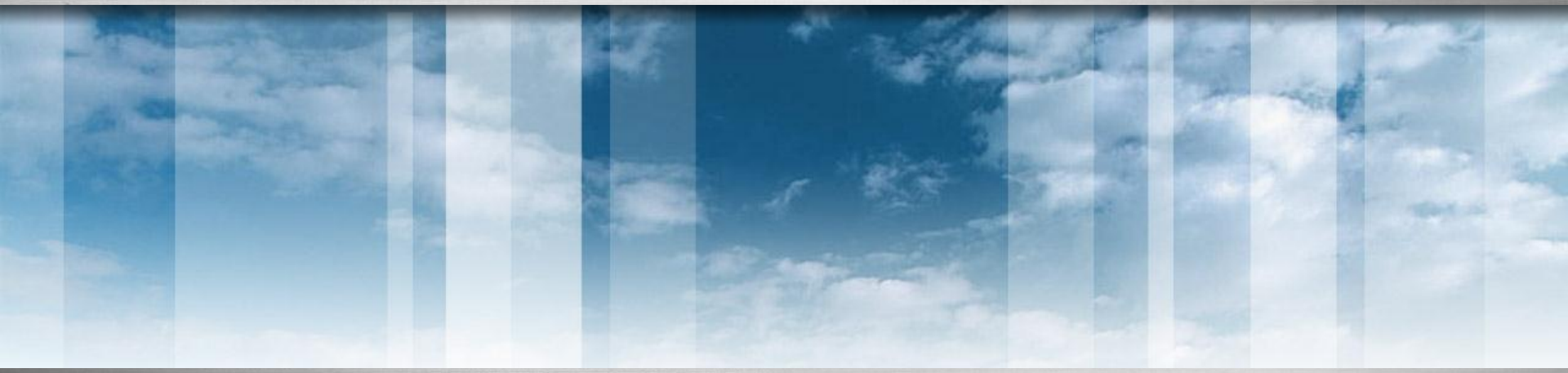


with barrier

without barrier

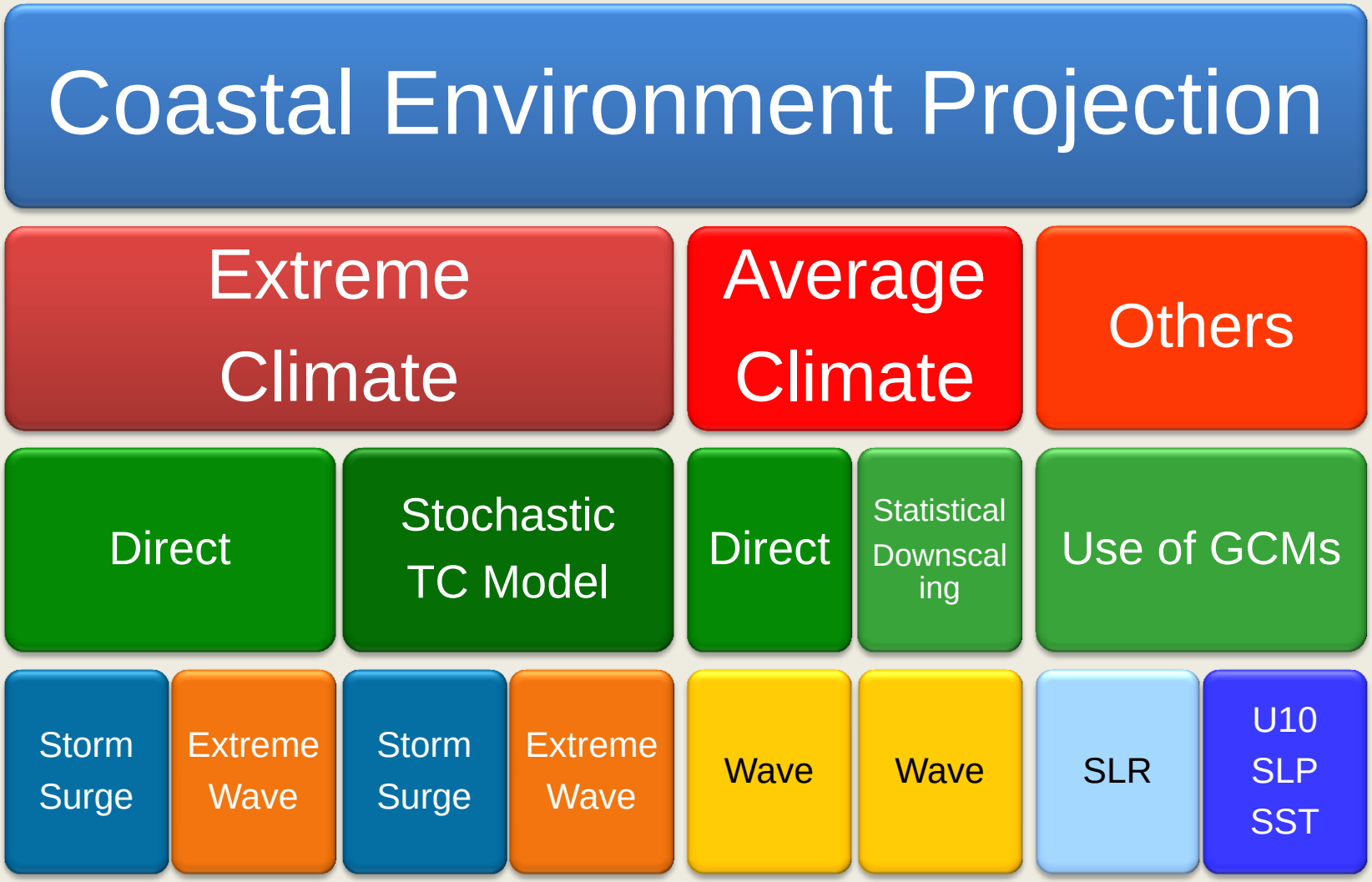
observation

Projection of Future Coastal Climate Change



CABOT-DPRI Workshop May 18, 2012

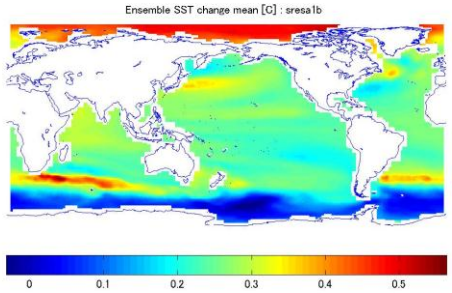
Project of Coastal Climate Change in Kyoto University

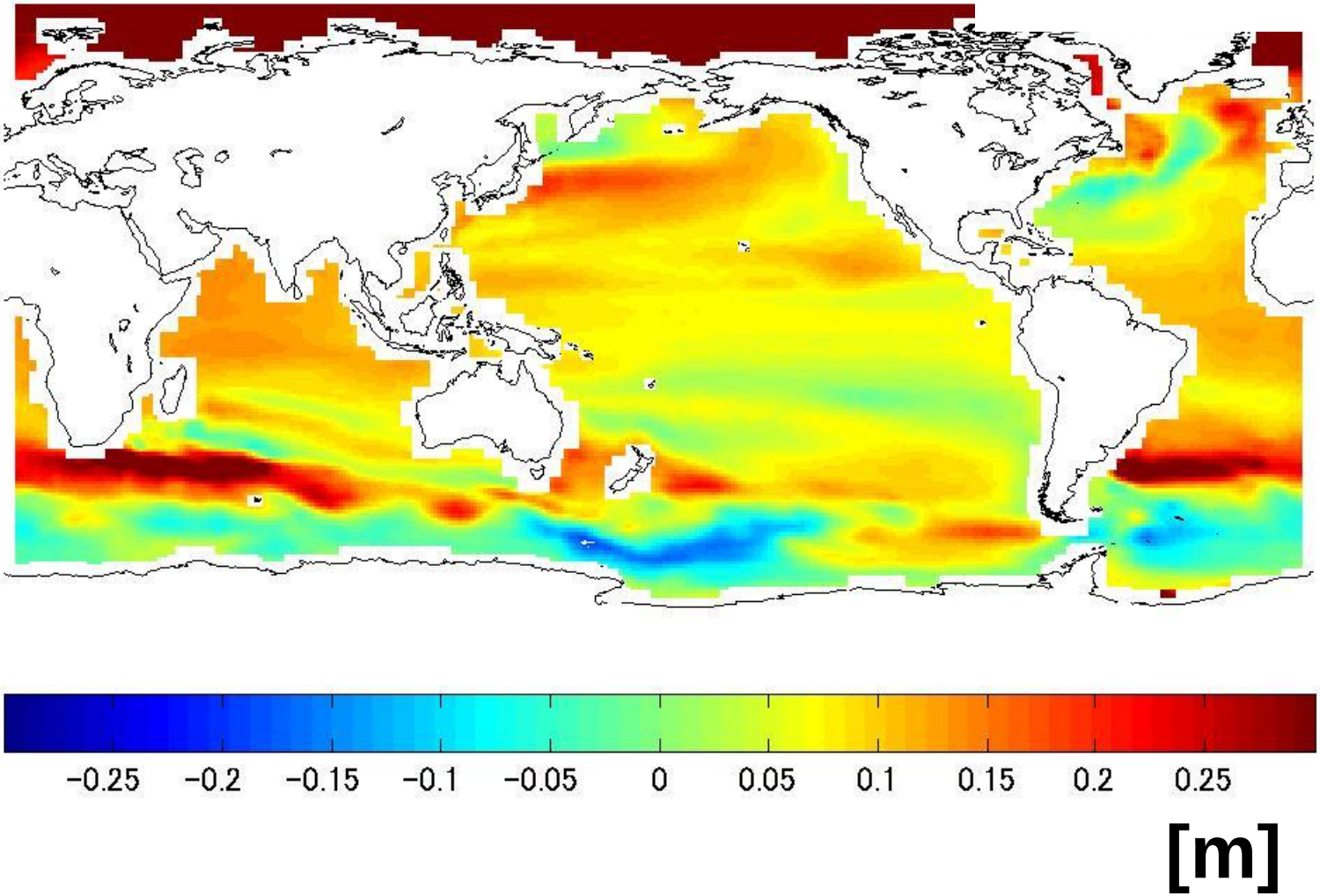


CMIP3 Model Ensemble

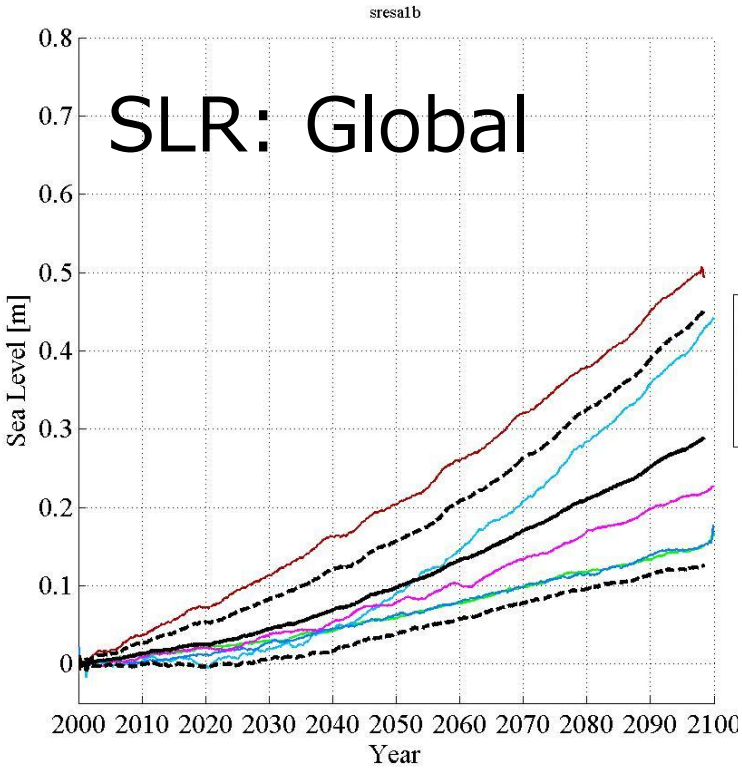
SEA LEVEL RISE (SLR)

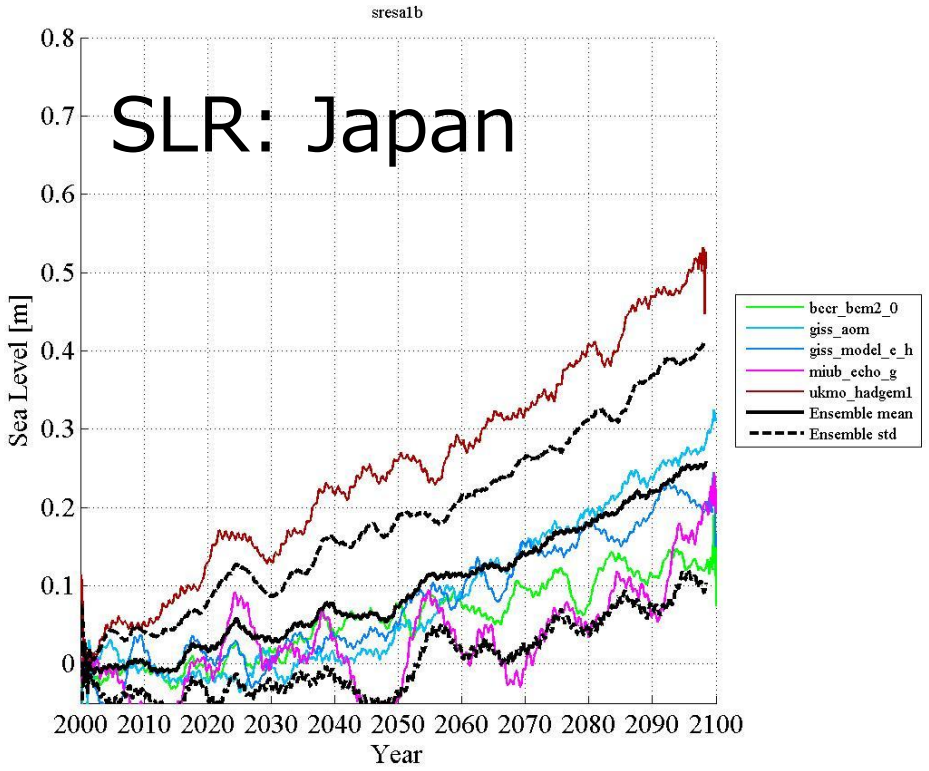
CMIP3 ensemble <SLR>
SRES A1B





CMIP3 Ensemble : SLR SRES A1B





20km resolution GCM+Wave Model

Mori et al. (2010) Hydrological Research Letters

Mori et al. (2012), Shimura et al. (2012) Submitted to J Climate and AR-5

PROJECTION OF COASTAL DISASTER

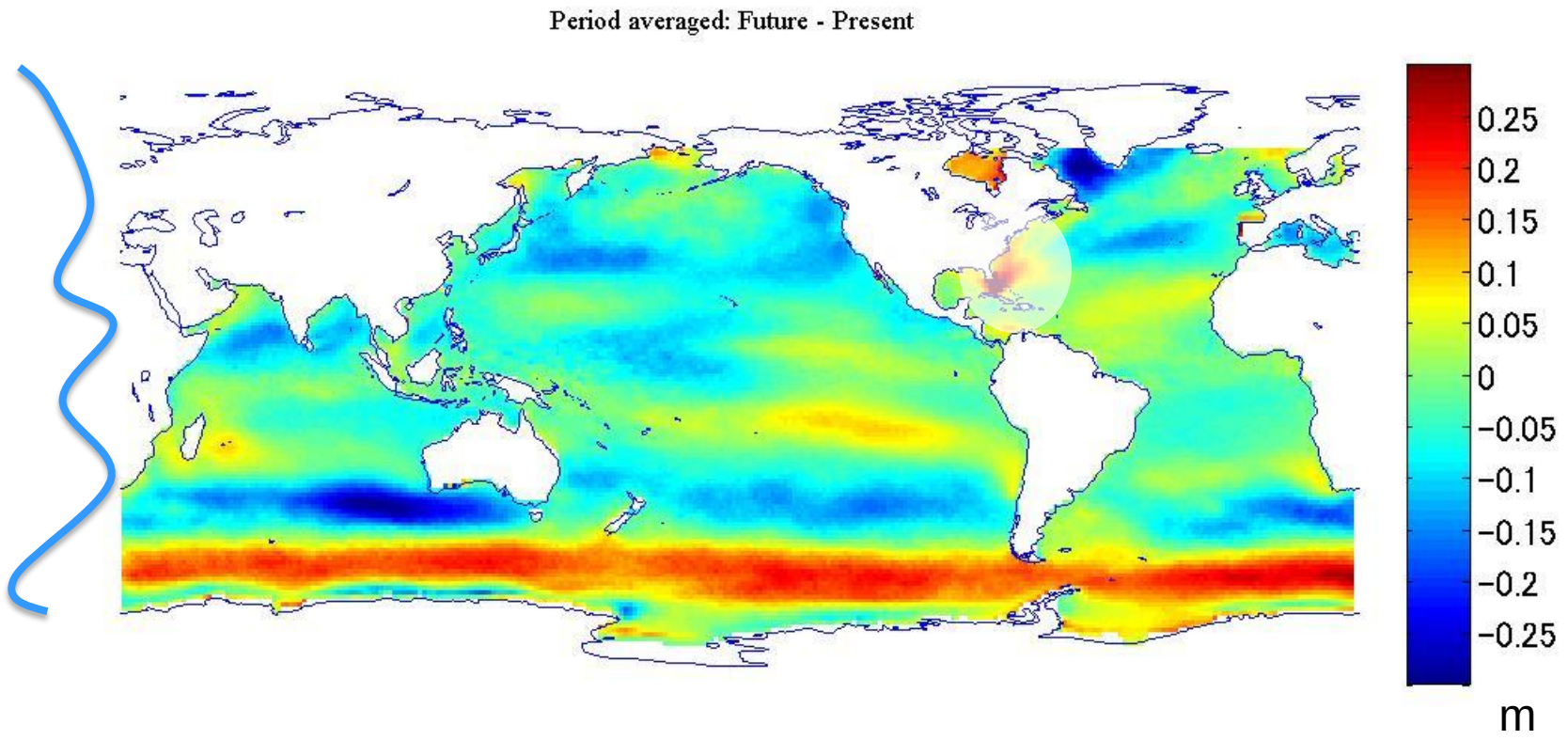
Supported by Kakushin Program

MRI AGCM-3.1S+SWAN

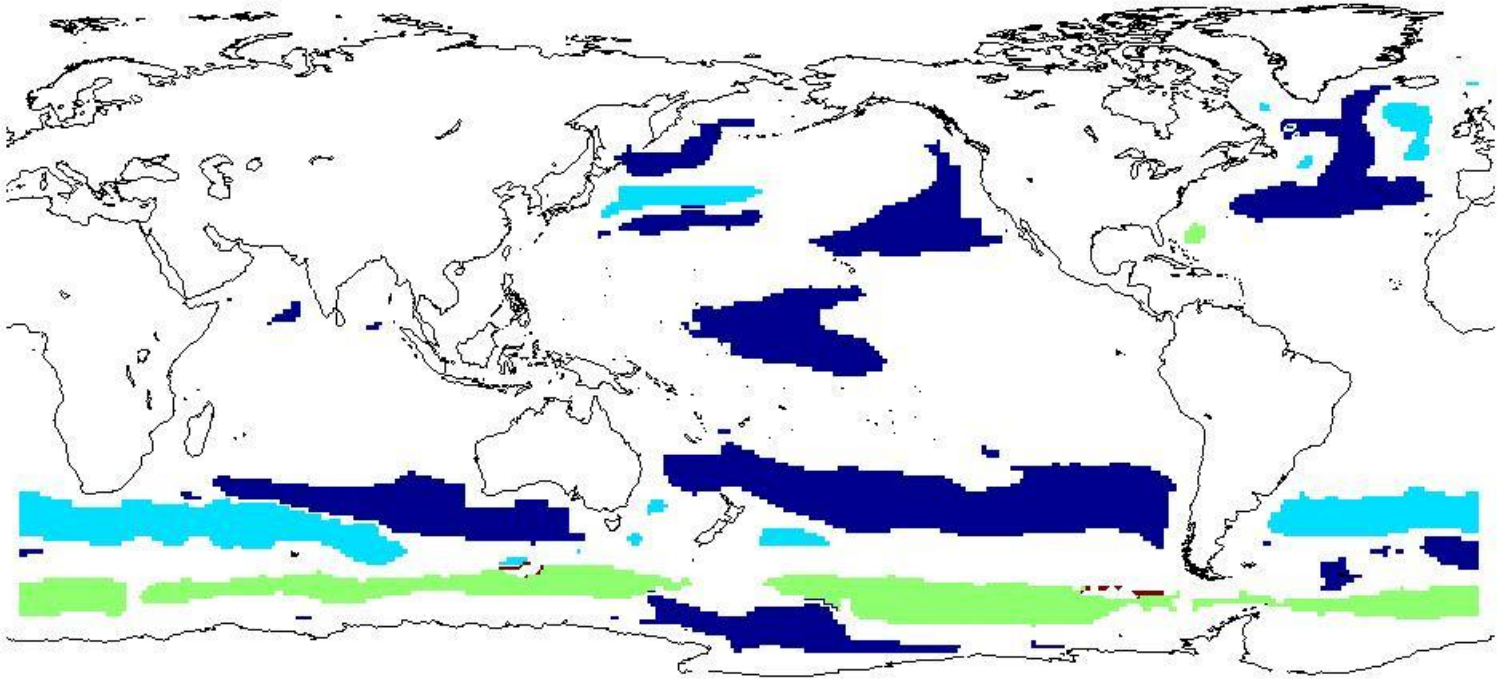
- GCM
  - MRI-AGCM-3.1S
  - Scenario: A1B
  - SST: CMIP3
  - Grid size：20km
  - Time step：6 min
- Spectral wave model
  - Delft SWAN version 40.51AB
  - Sin: Janssen
  - Snl: DIA
  - Sdis: Komen

	Start	End	Length
Present	1979/01	2003/12	25yrs
Near Future	2015/01	2031/12	25yrs
Future	2075/01	2099/12	25yrs

Averaged *Hs*: Future-Present



World Coastal Assessment due to SLR and Wave Climate Change



SLR dominant SLR>15cm

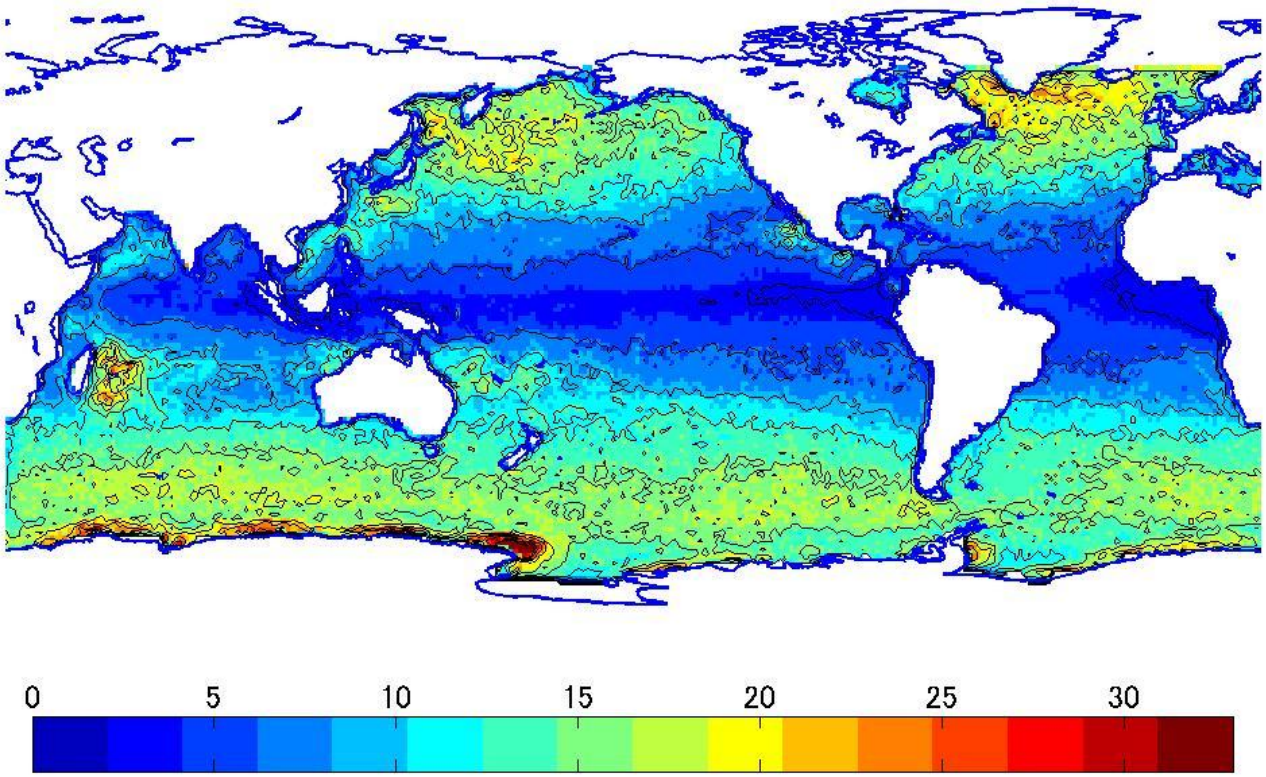
H_s dominant H_s>15cm

SLR+H_s negative SLR+H_s<0

(Threshold: SLR and H_s=15cm)

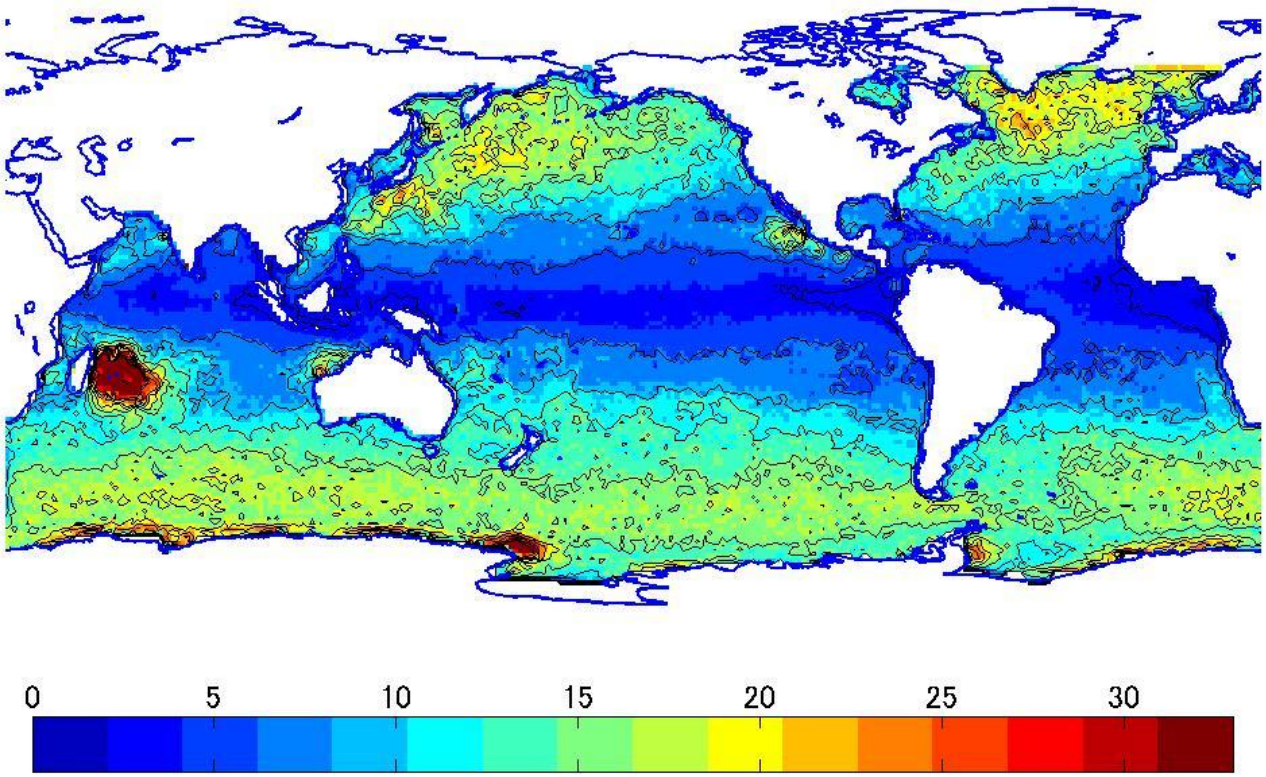
Extreme Wave Height Change

50 yrs Return Period: Present Climate

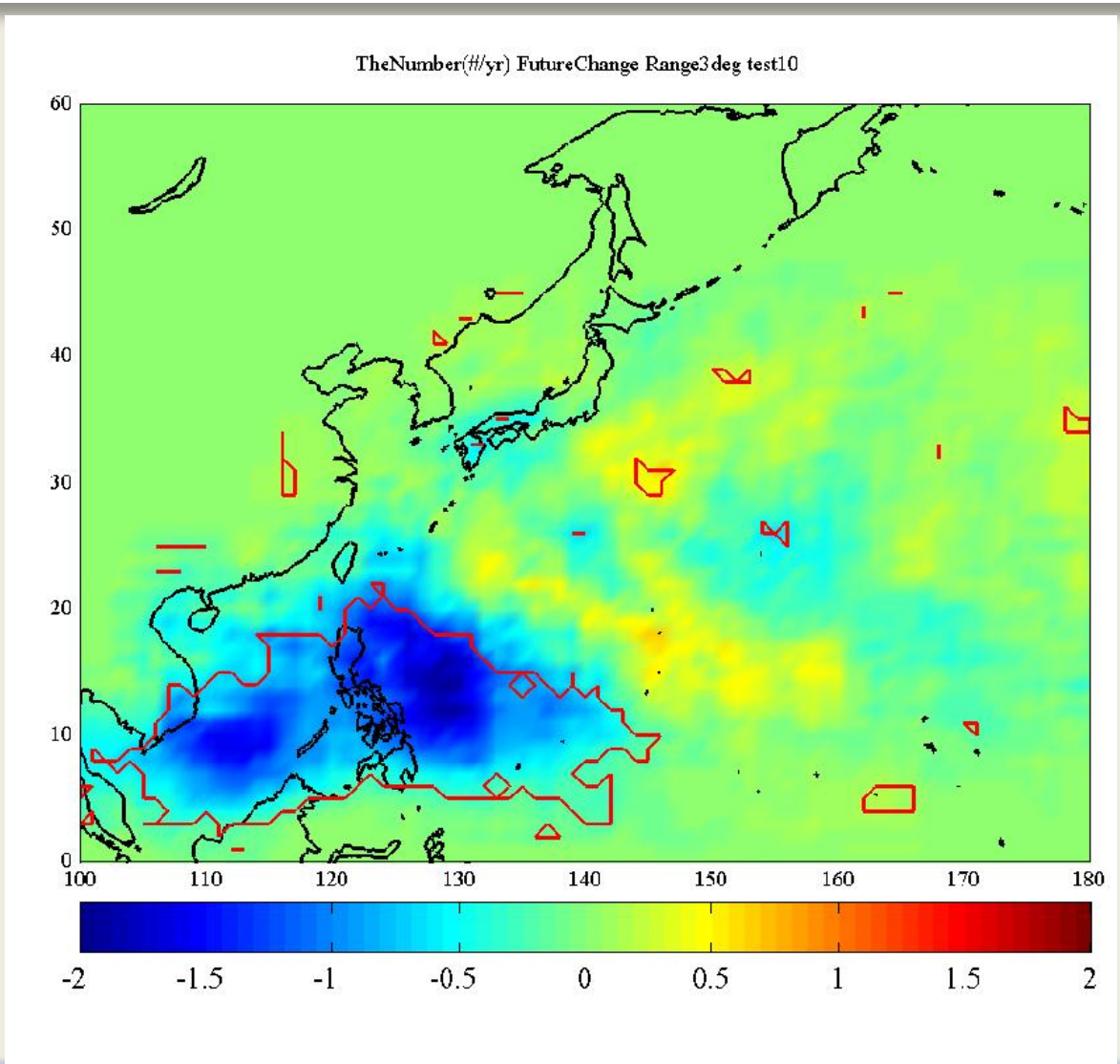


Extreme Wave Height Change

50 yrs Return Period: Future Climate

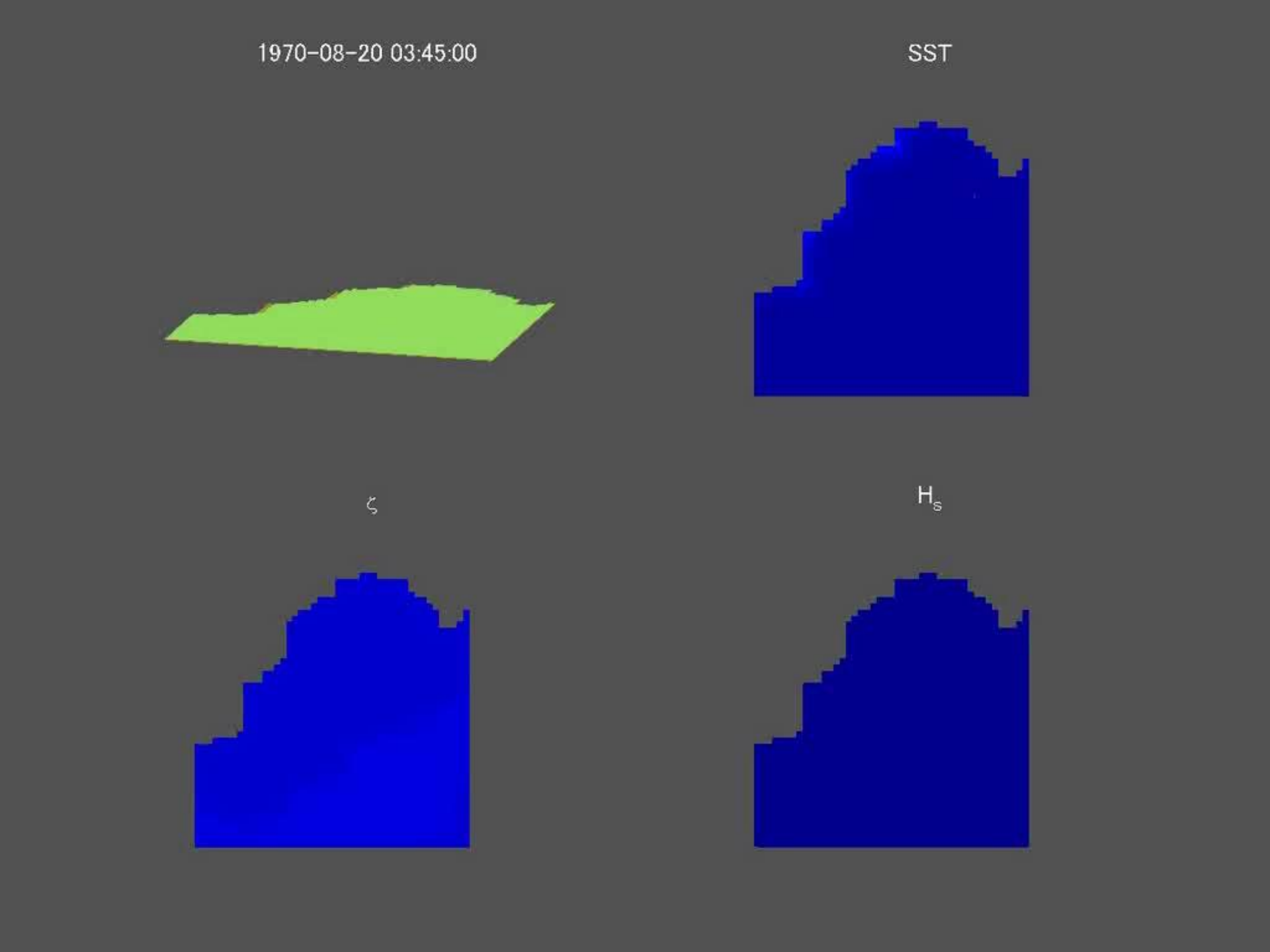


Future Change of TC # MRI-AGCM-3.1S



Yasuda et al. (2012) Hydrological Research Letters

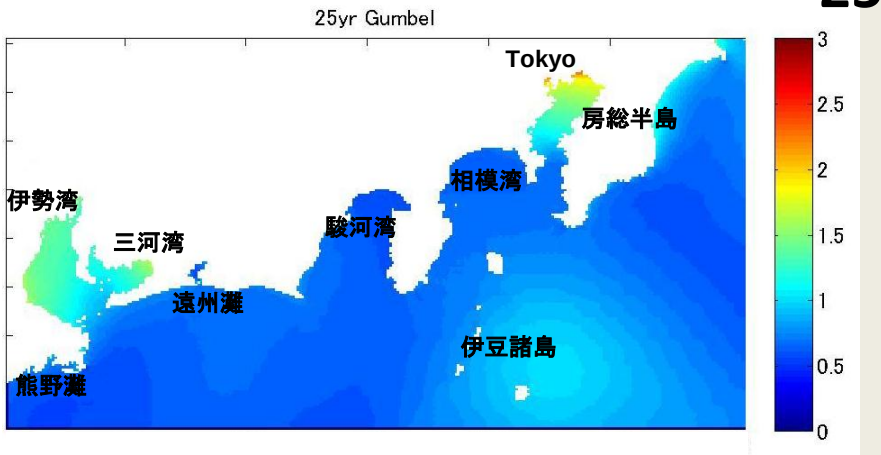
STORM SURGE


1970-08-20 03:45:00
SST
ζ
H_s

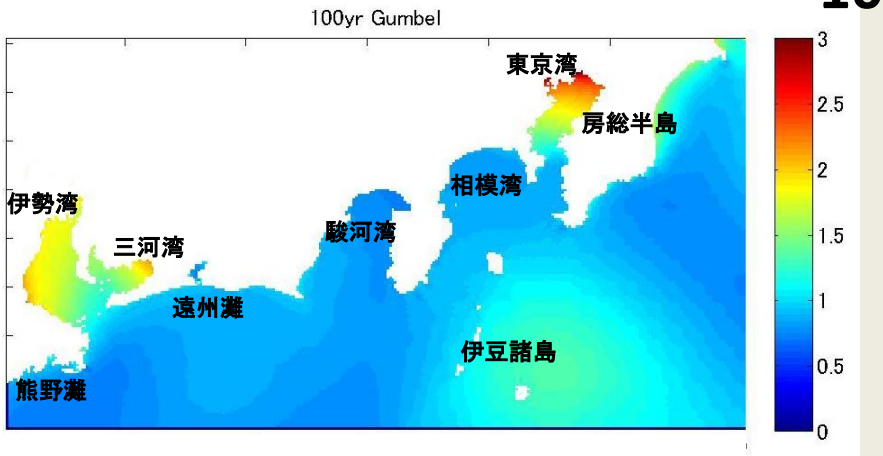
Domain D4: Middle Japan

Present

25yrs



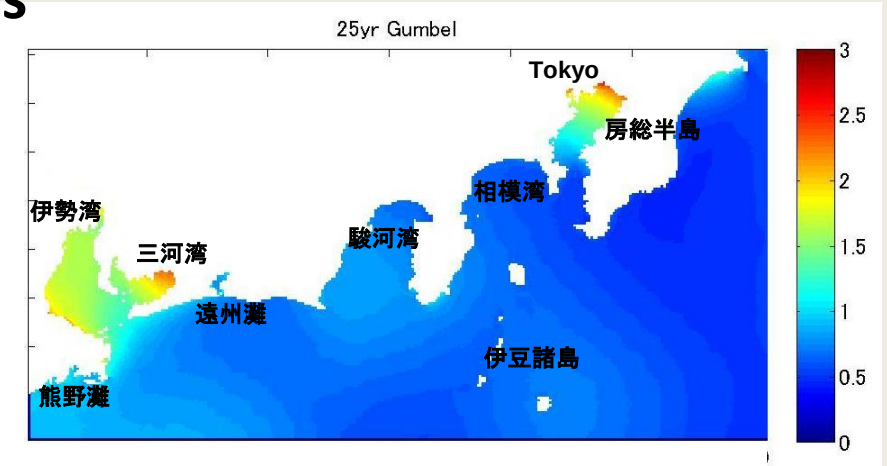
100yrs



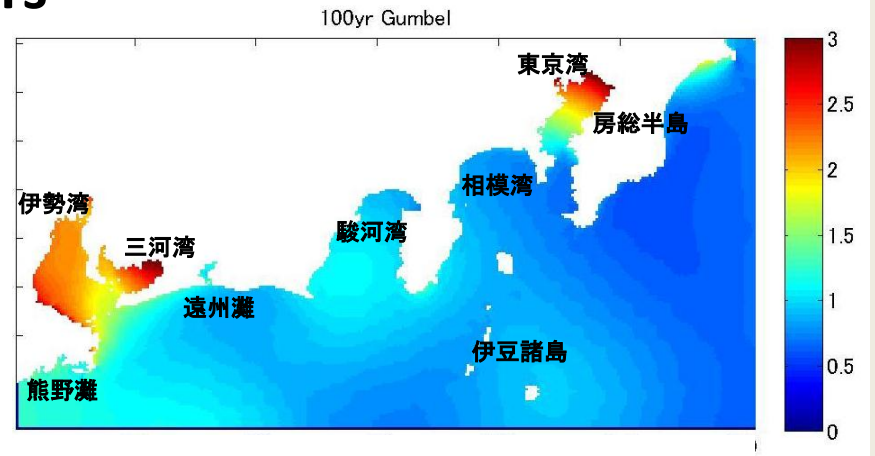
東京湾で最も大きく，100年確率で2.3～3.0m．
次いで，伊勢湾西部および三河湾で大きく，
それぞれ1.8～2.1m，1.5～2.1m．

Future

25yrs

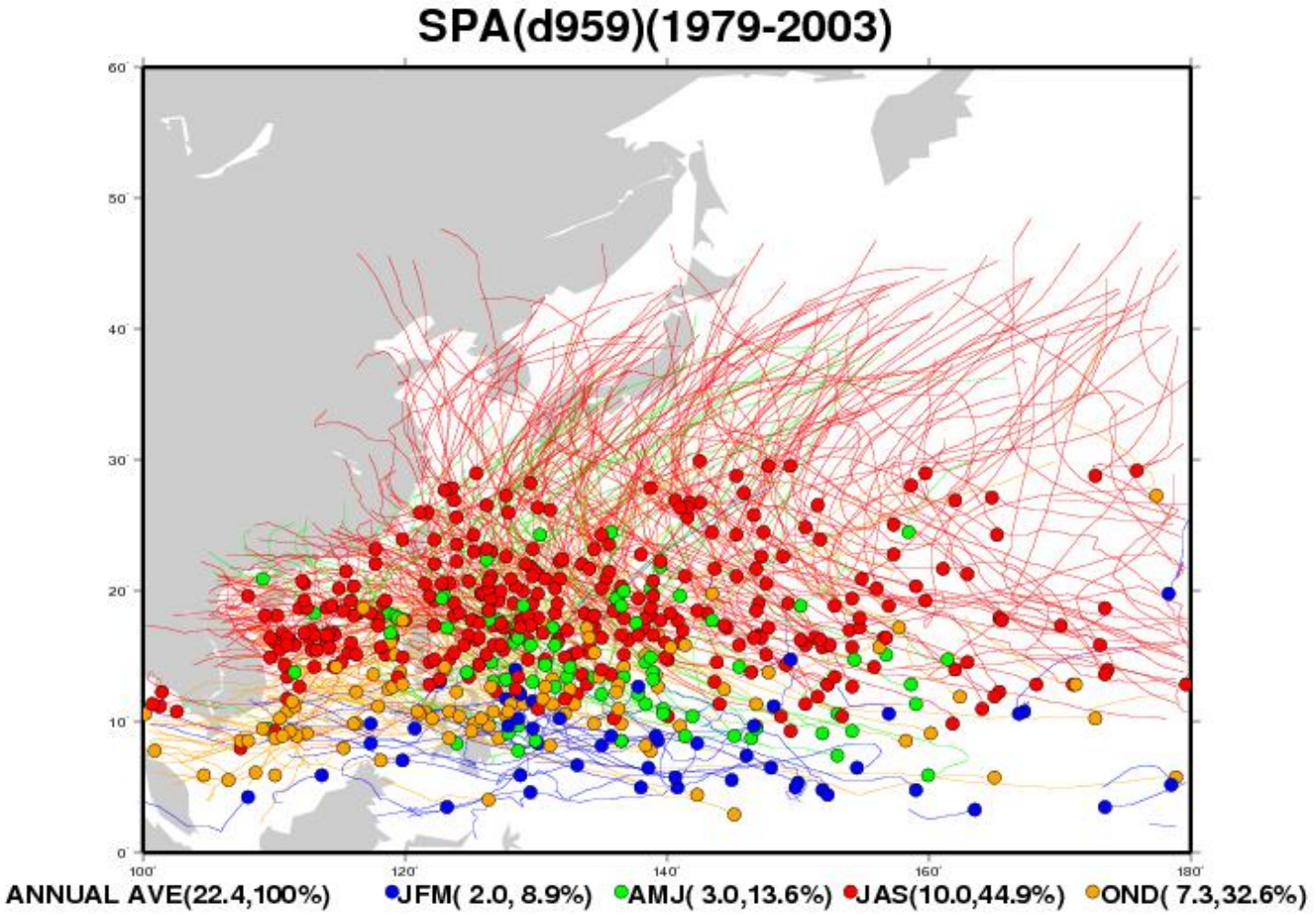


100yrs



東京湾では2.3～3.4mに増大したのに対し，
伊勢湾では2.2～2.6m，三河湾では2.5～
3.2mと際だって増大した．

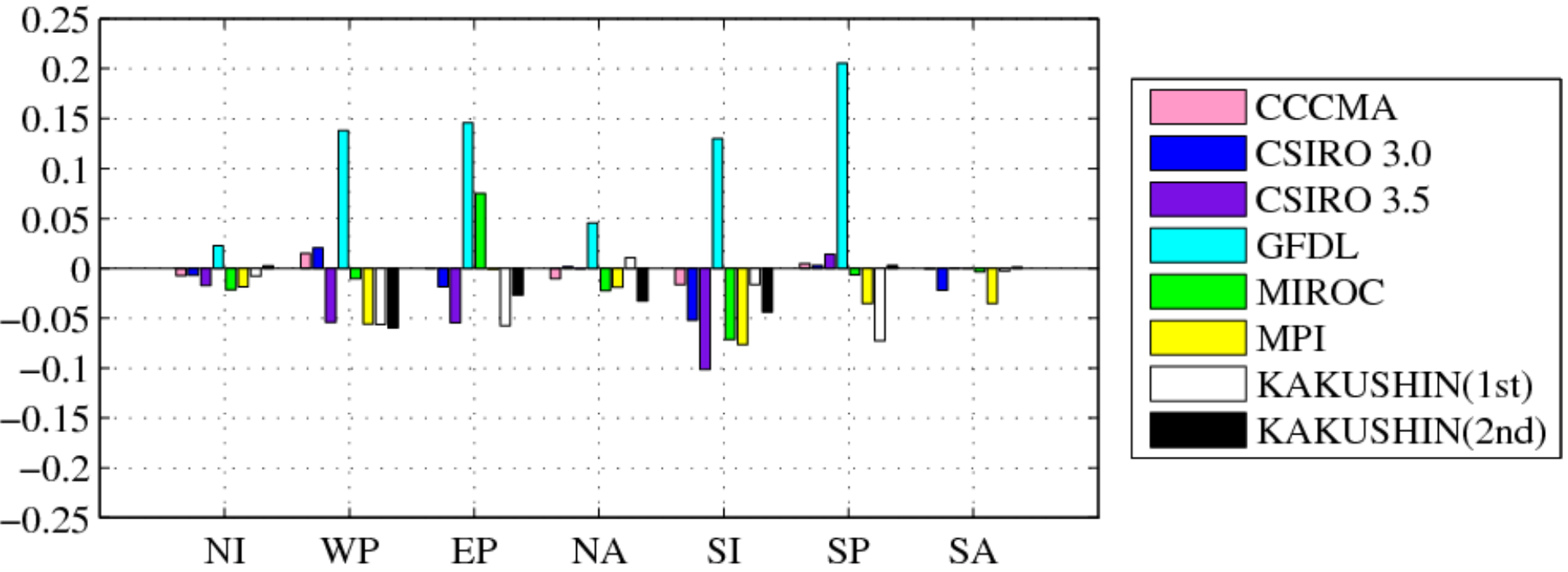
Sensitivity to TC Paths



Mori, N. (2012) Projection of Future Tropical Cyclone Characteristics based on Statistical Model, In Cyclones Formation, Triggers and Control, Nova Science Publishers, Inc., in press.

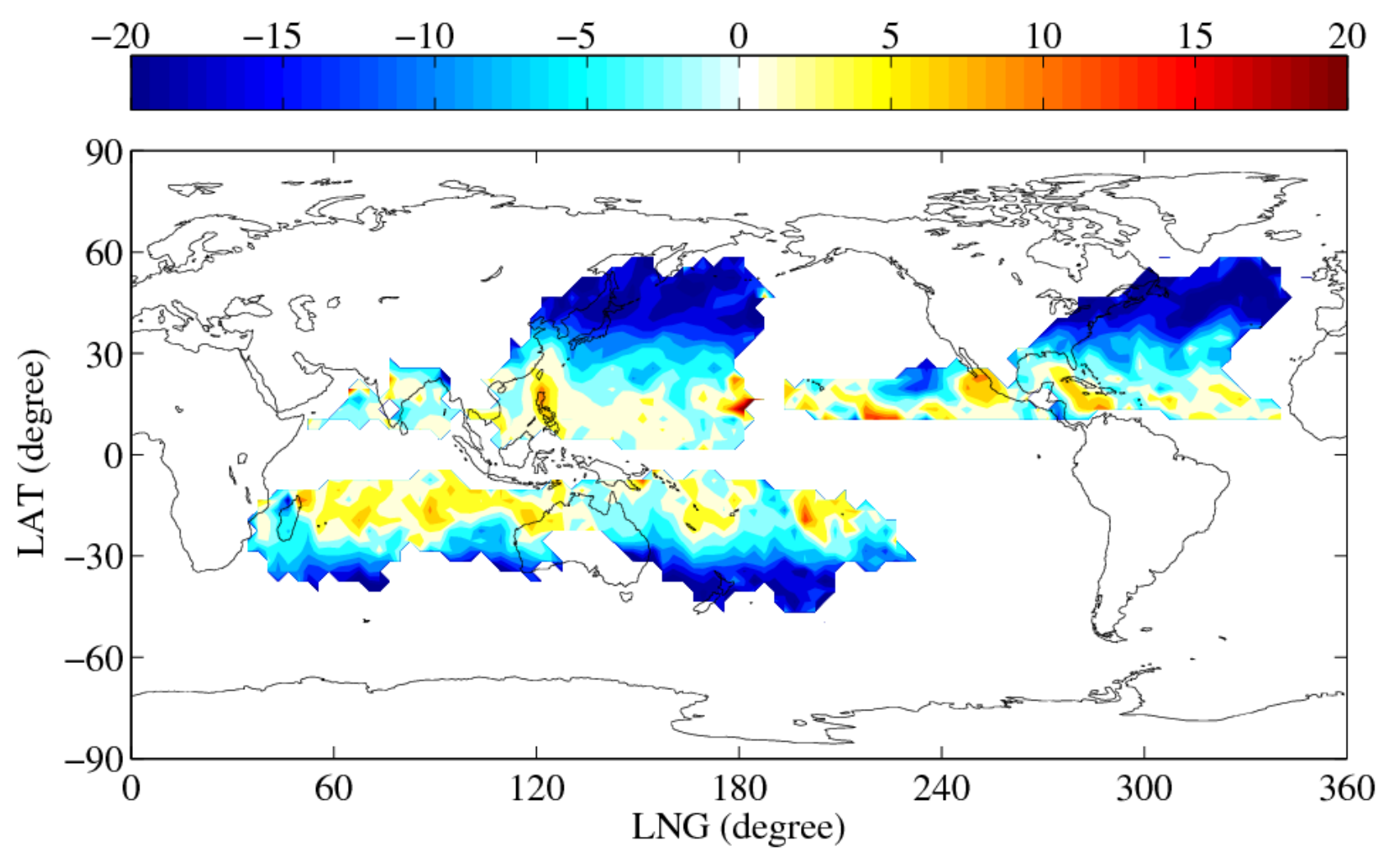
PROJECTION OF FUTURE CHANGE OF TC FOR ENGINEERING APPLICATIONS

Future change of Cyclogenesis #/yr

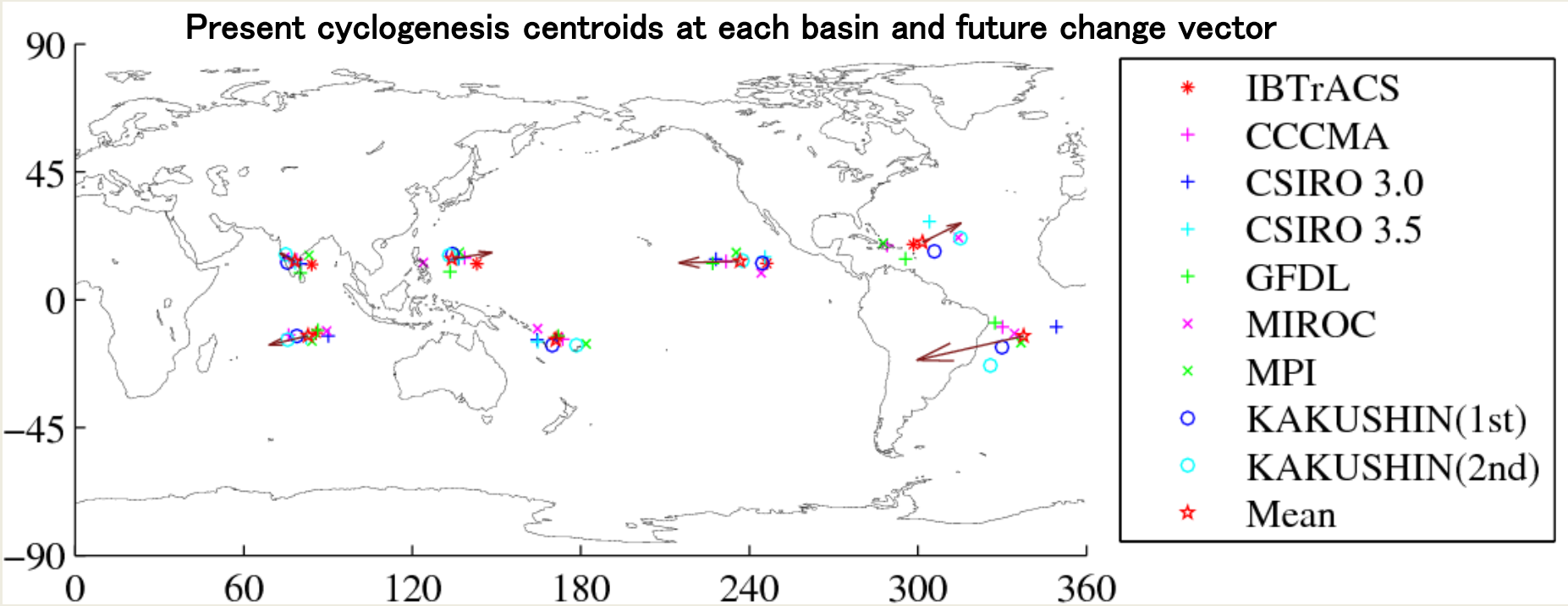


Number of TC will be decreased at the most of ocean

Future Change Central Pressure of TC [hPa]



Multi Model Ensemble Cyclogenesis Location Shift



* In this figure, future change vectors are 5 times larger than actual change.

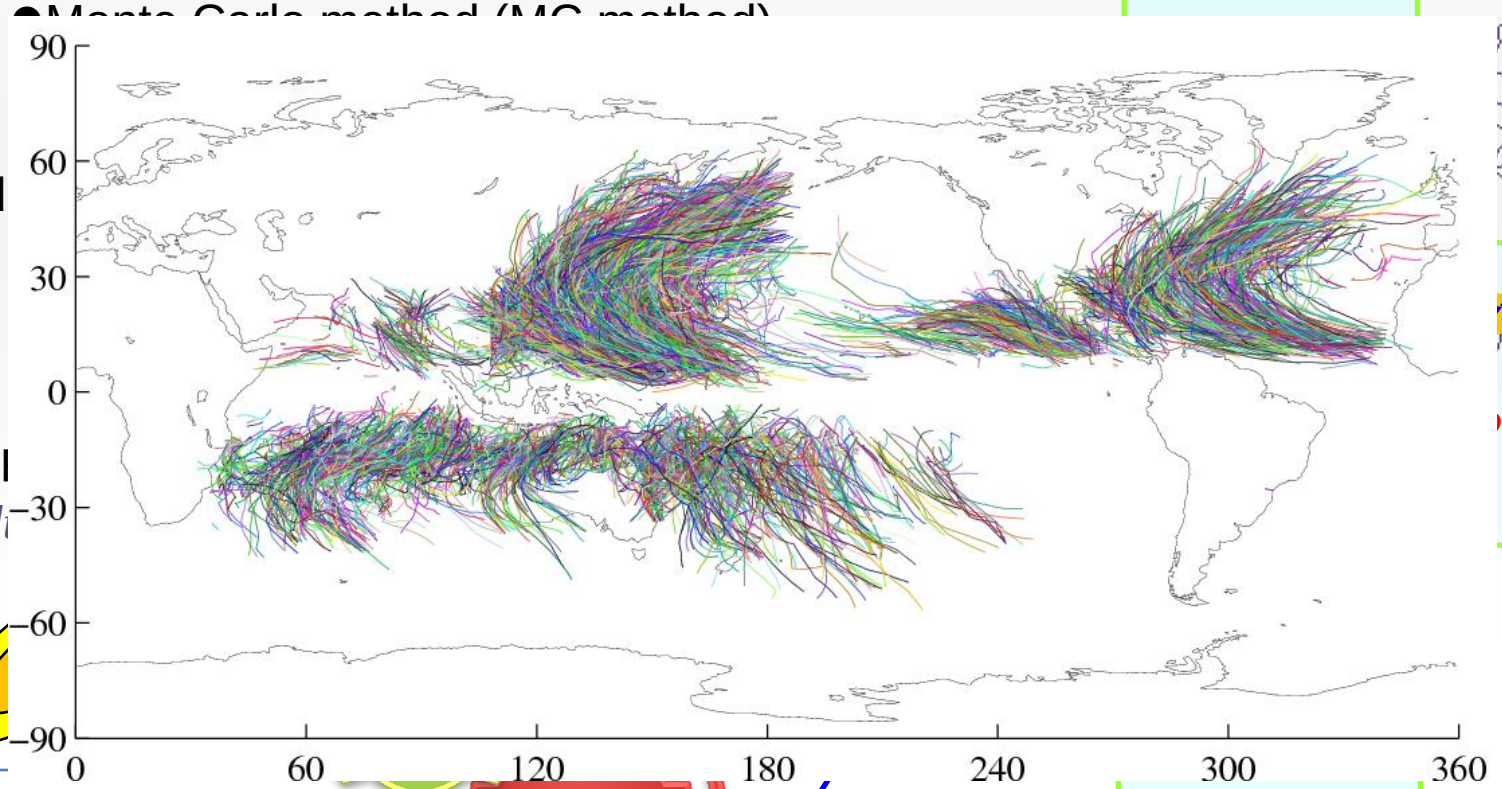
Future TC centroids will be moved toward center of ocean basins.

Stochastic Typhoon Model

STM

●Monte Carlo method (MC method)

Mod



2D−PDI

df/dt

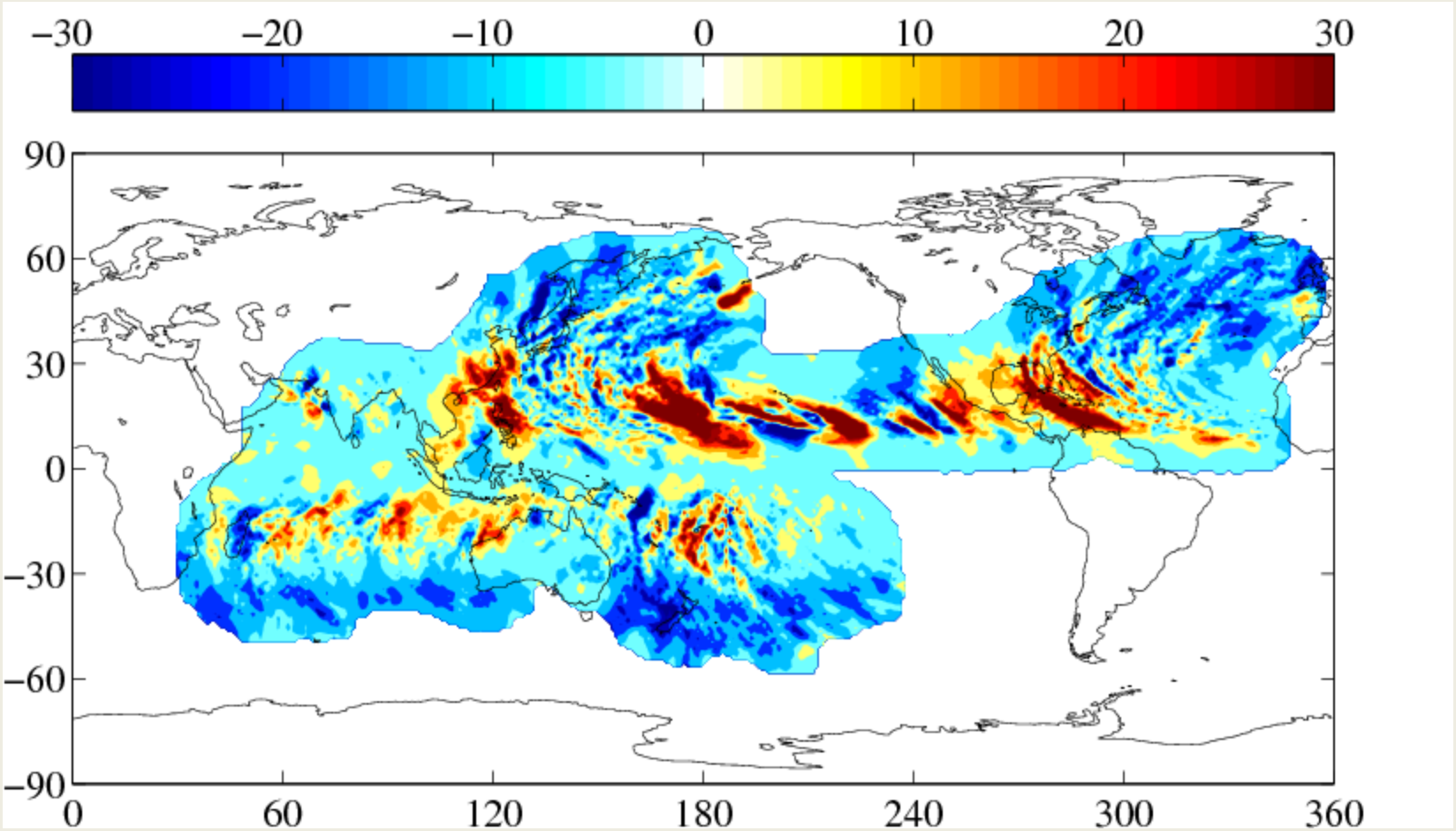
T=6hr

$df/dt = S(f_{in})$

rate *df/dt*

We use relationship between previous time step value and its change rate at each location based on principal component analysis (PCA). The first order Markov process is considered

Future Change of TC's min Pressure at the end of 21st Century (1/100yrs)



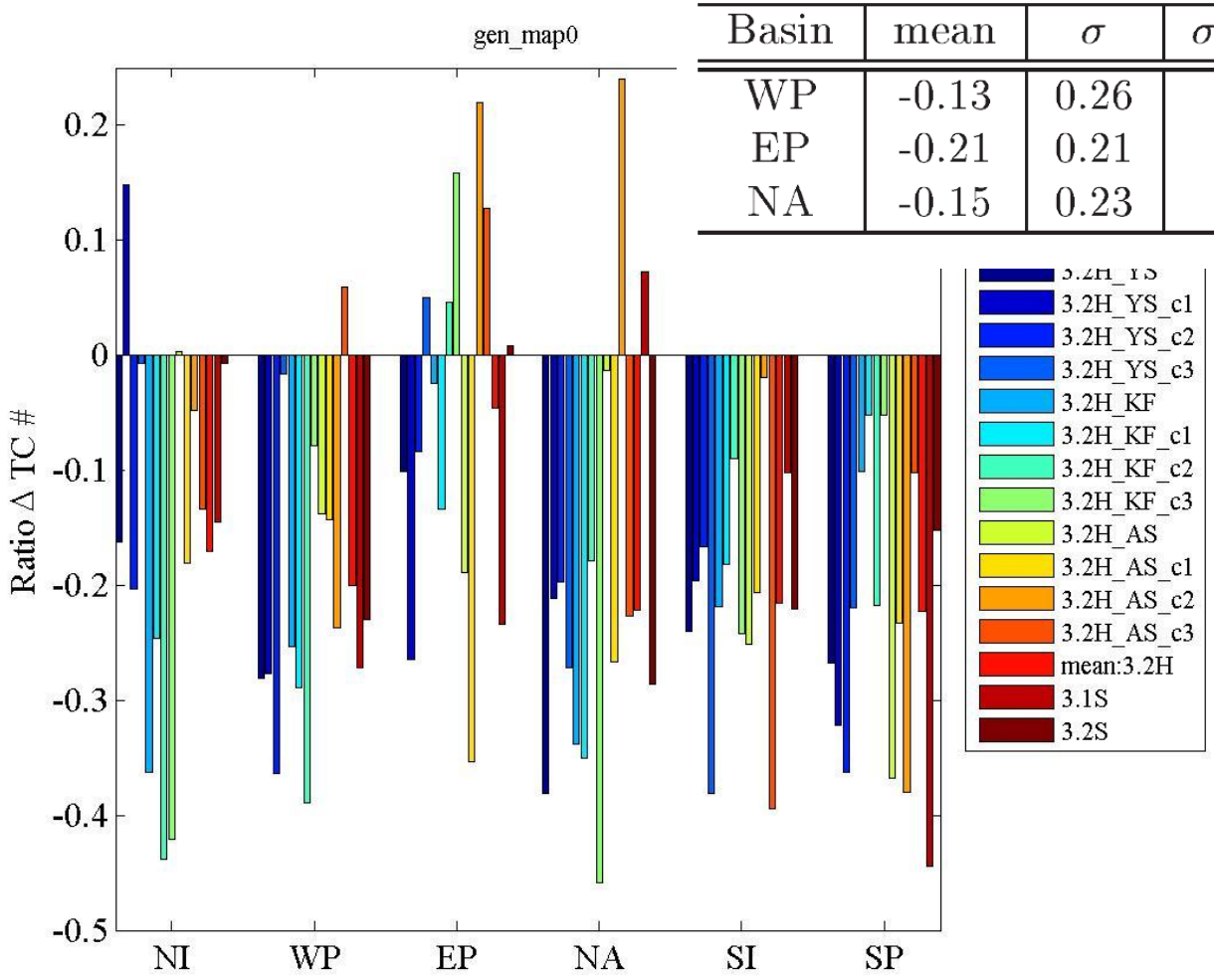
Extreme wave, Storm Surge

UNCERTAINTY OF TC PROJECTION

Use of Ensemble GCM simulations (SST, Physics and Initial conditions)

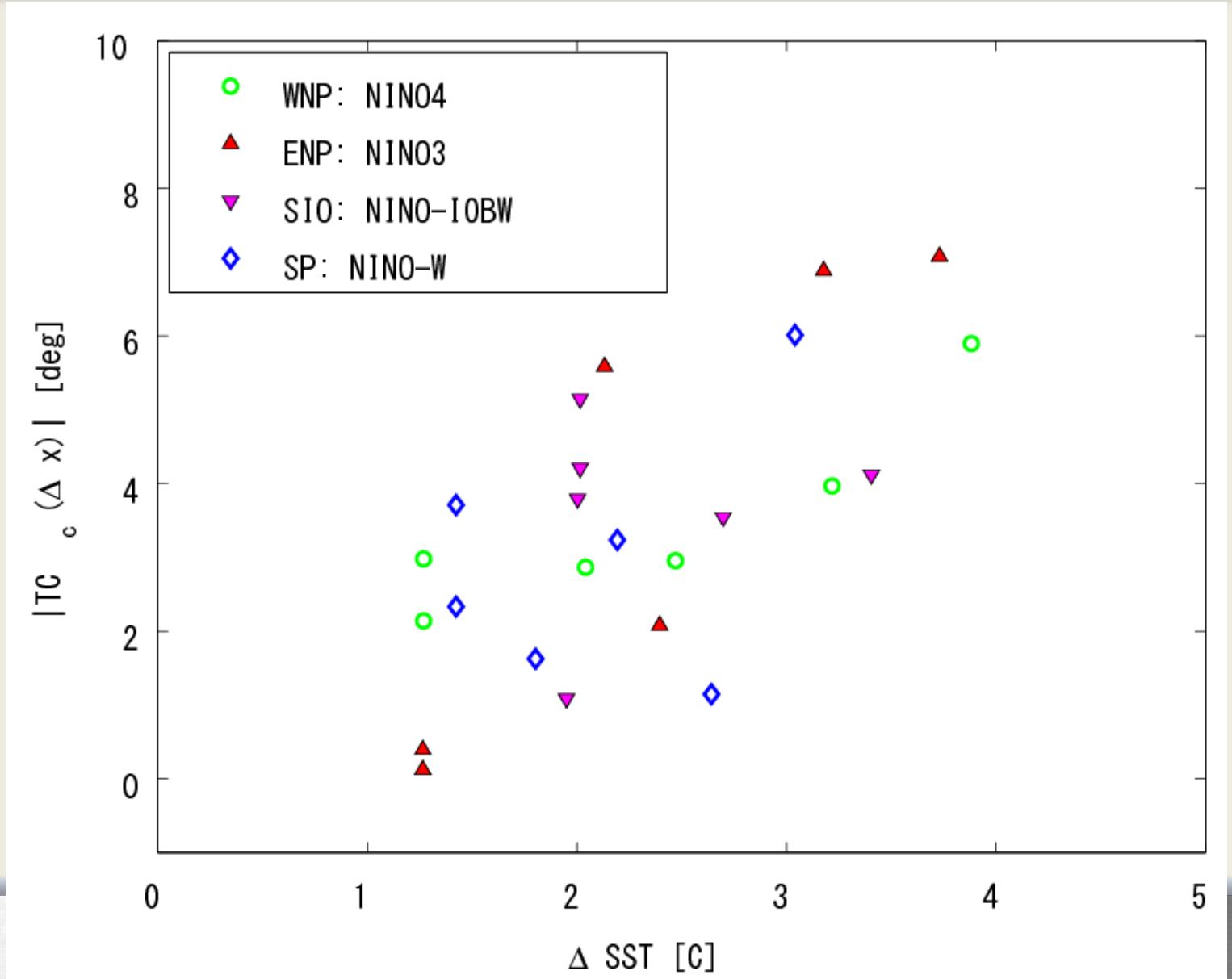
MRI-AGCM-3.1H and MRI-AGCM-3.2H (24 ensemble runs)

Future Change of TC



Basin	mean	σ	σ(SST)	σ(init)	σ(Phys)
WP	-0.13	0.26	0.29	0.08	0.09
EP	-0.21	0.21	0.16	0.07	0.14
NA	-0.15	0.23	0.23	0.20	0.23

TC Shift and El-Nino



THE END

References

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Mori et al. (2012) ASCE special issue
Shimura et al. in preparation

Storm Surge

Yasuda et al. (2010) Hydrological Research Letters,

Tropical cyclone

Mori, N. (2012) Cyclones Formation, Triggers and Control, Nova Science Publishers

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