Impacts of the sea surface temperature of the inner bay on the local climate using a regional atmospheric model

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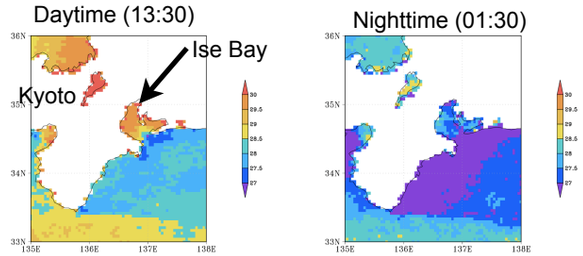
1. Introduction

Large diurnal variation of SST in the inner bay (Ise bay)



"MODIS SST data were obtained from the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at the NASA Jet Propulsion Laboratory, Pasadena, CA. http://podaac.jpl.nasa.gov."

RCM (Regional Climate Model):
Usually, there are no options to simulate the SST diurnal variation.

A coupled Ocean Mixing Layer (OML) simulation (Kawai and Kawamura, 2006)
Maximum airtemp in a inland area is 1 K higher than normal (Constant SST)

Sea breeze becomes weaker?

It cannot be ignored SST diurnal variation effects.

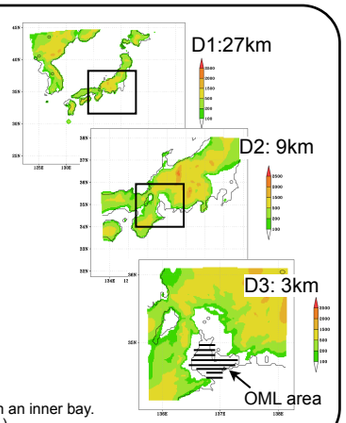
2. Method

WRF Ver. 3.2 with OML-KSI79 (Kondo et al. 1979)

Ise Bay area : OML-KSI79
The others area : NCEP SST daily update (1deg)

Simulation term : 1st to 31 in August 2010

Simulation Types
CTL : NCEP SST daily update only
OML-KSI79 : OML model run



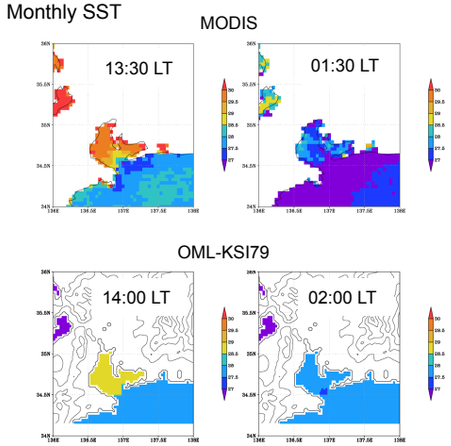
OML-KSI79 (Kondo et al. 1979)

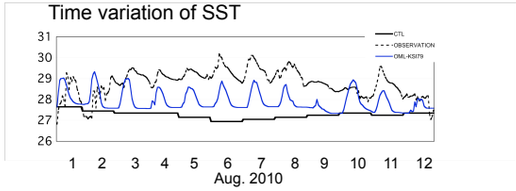
- One-dimension and multi layer model (20 Layer)
- Monin-Obukhov similarity theory
- Chlorinity vertical profile is constant
  (22 PSU at the surface , 35PSU at the bottom)
  (Chlorinity is very difficult to setup, in particular in an inner bay. The inflow from the rivers should be considered.)

3. Result

Diurnal variation of SST

Monthly SST





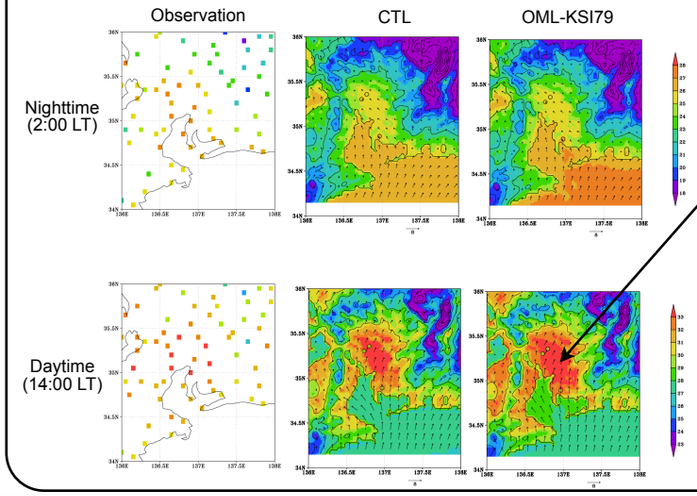
Observation: 1m depth from surface at Wanoku point
CTL: NCEP SST (Daily updatea, 1deg)
OML-KSI79 : 0~0.25m water temperature (SST)

Diurnal variation : OK?

However, the SST is underestimate (about 1K)

The initial value setting is wrong?
It needs the river inflow process?
(Detailed Chlorinity process is needed?)

Effects on air temperature in inland area

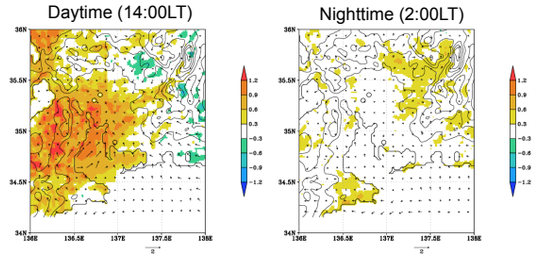


about 1K higher than CTL around the coastal area,

and well simulate the observed air temperature. (but still underestimate)

4. Discussion

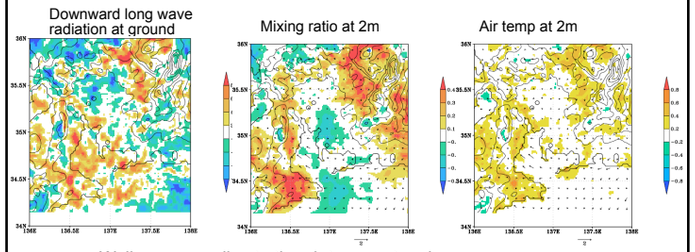
Difference in the air temperature between CTL and OML-KSI79
[OML-KSI79] - [CTL]



Sea breeze effect?

The effect seems too large.
(1 K increase temperature area extends to 50 ~ 100km inland area from the coast.)

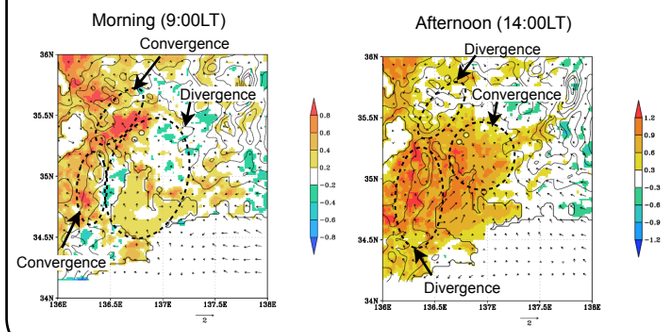
Difference between CTL and OML-KSI79 at 5:00LT (before sunrise)
[OML-KSI79] - [CTL]



Well corresponding to the air temperature increase areas

Effect of water vapor?

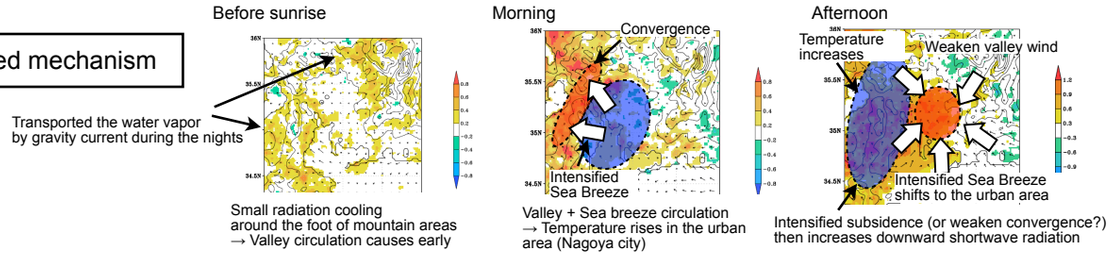
Difference in the air temperature between CTL and OML-KSI79
[OML-KSI79] - [CTL]



5. Conclusion

- Diurnal SST variation process is important to evaluate the inland air temperature.
- Necessary to improve the OML
  (River inflow process?)

Assumed mechanism



Small radiation cooling around the foot of mountain areas → Valley circulation causes early

Valley + Sea breeze circulation → Temperature rises in the urban area (Nagoya city)

Intensified subsidence (or weaken convergence?) then increases downward shortwave radiation