Sea Level Rise
Climate Sensitivity
Ocean-Atmosphere Variability

An Evolving Landscape

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(and Ben Kirtman)

FLOODING DAYS Projection Tool [prototype]

Developed by: UNIVERSITY OF HAWAII SEA LEVEL CENTER

Location

St. Petersburg, FL

Flooding Threshold

33 cm above MHHW

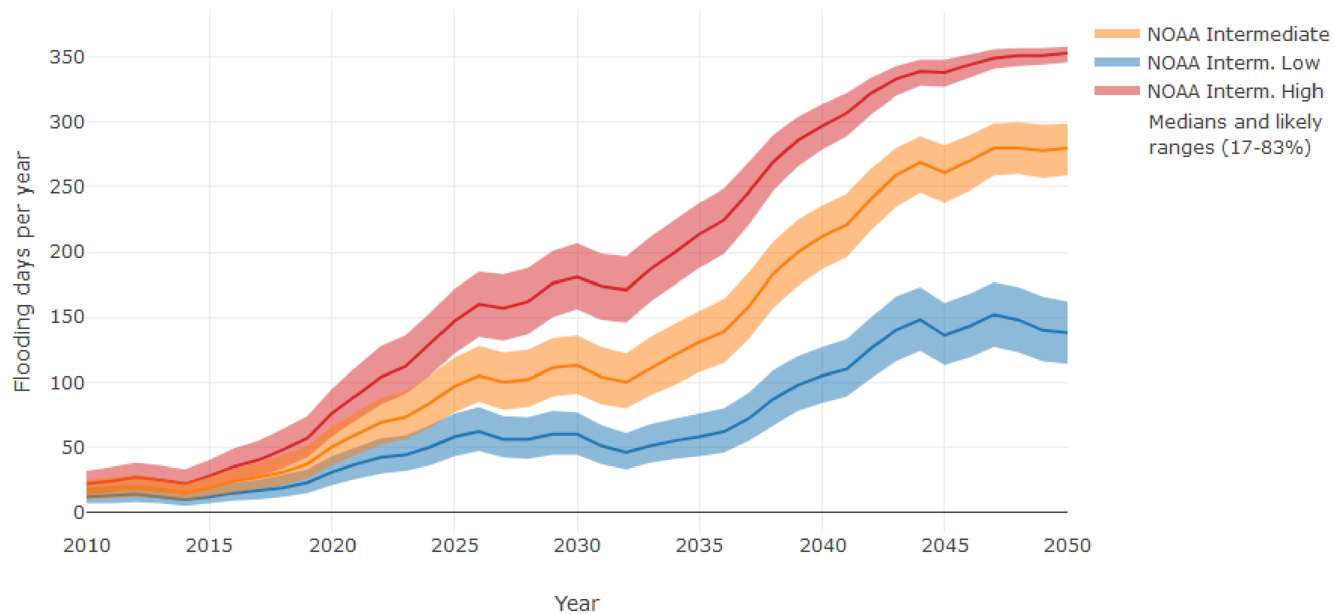
20 30 40 50 60 70 80 90 100

Annual projections | Decadal projections | Analysis

Flooding days during the 21st century

The following figure shows the number of days per year that sea level in **St. Petersburg, FL** will exceed **33 cm** above MHHW.

Based on local mean sea level projection: NOAA Sea Level Rise Scenarios



Take homes for today:

SLR is the key for long-term changes
and that projection depends on mitigation.

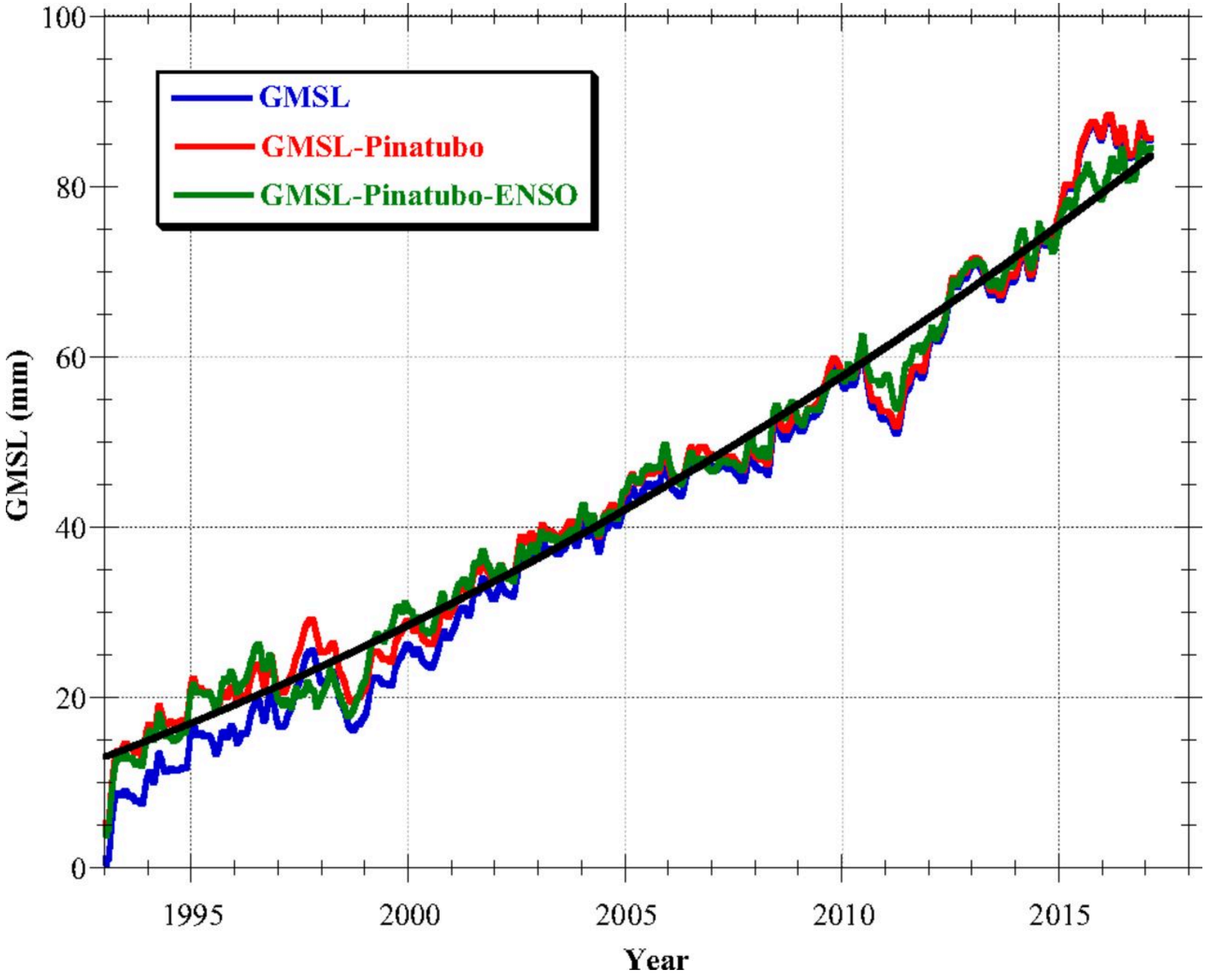
Tidal signals dominate on scales of years
and are more difficult than I expected!

Ocean-Atmosphere variability is important
on all time scales and is also difficult.

There is a lot of research to be done!

The sea level rise rate is accelerating

Nerem et al. using satellite altimetry



Zhu et al. using sea level reconstructions

Table 2.3: Regression models for GMSL

Model 1	$y = a + bt$
Model 2	$y = a + bt + ct^2$
Model 3	$y = a + bt + c\cos\left(\frac{2\pi t}{T}\right) + d\sin\left(\frac{2\pi t}{T}\right)$
Model 4	$y = \begin{cases} a + bt; & t \leq T1 \\ a + bt + c(t - T1); & T1 < t < T2 \\ a + bt + c(t - T1) + d(t - T2); & t \geq T2 \end{cases}$
Model 5	$y = \begin{cases} a + bt; & t \leq T1 \\ a + bt + c(t - T1); & T1 < t < T2 \\ a + bt + c(t - T1) + d(t - T2); & T2 < t < T3 \\ a + bt + c(t - T1) + d(t - T2) + e(t - T3); & t \geq T3 \end{cases}$
Model 6	$y = y_0 + a\exp(bt)$

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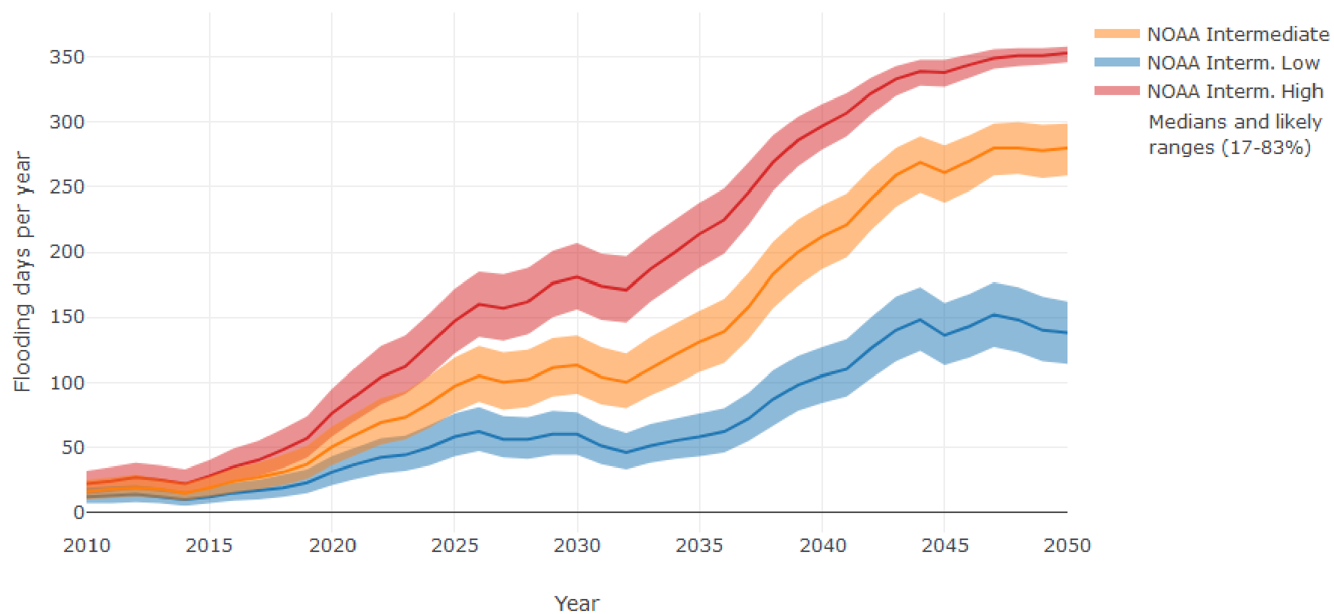

The tide modulations are easy, right?

Not really …

The scatter is ocean-atmosphere signals.

This is also (I think) not so easy …

Variability vs. Forcing

The two are linked, but …

Nerem and Fasullo
El Nino is forced

Mann et al.
PDO and AMO are noise

What?

Just one example of a research question.

Is El Nino part of the variability
or a change in the mean state?

Or both?

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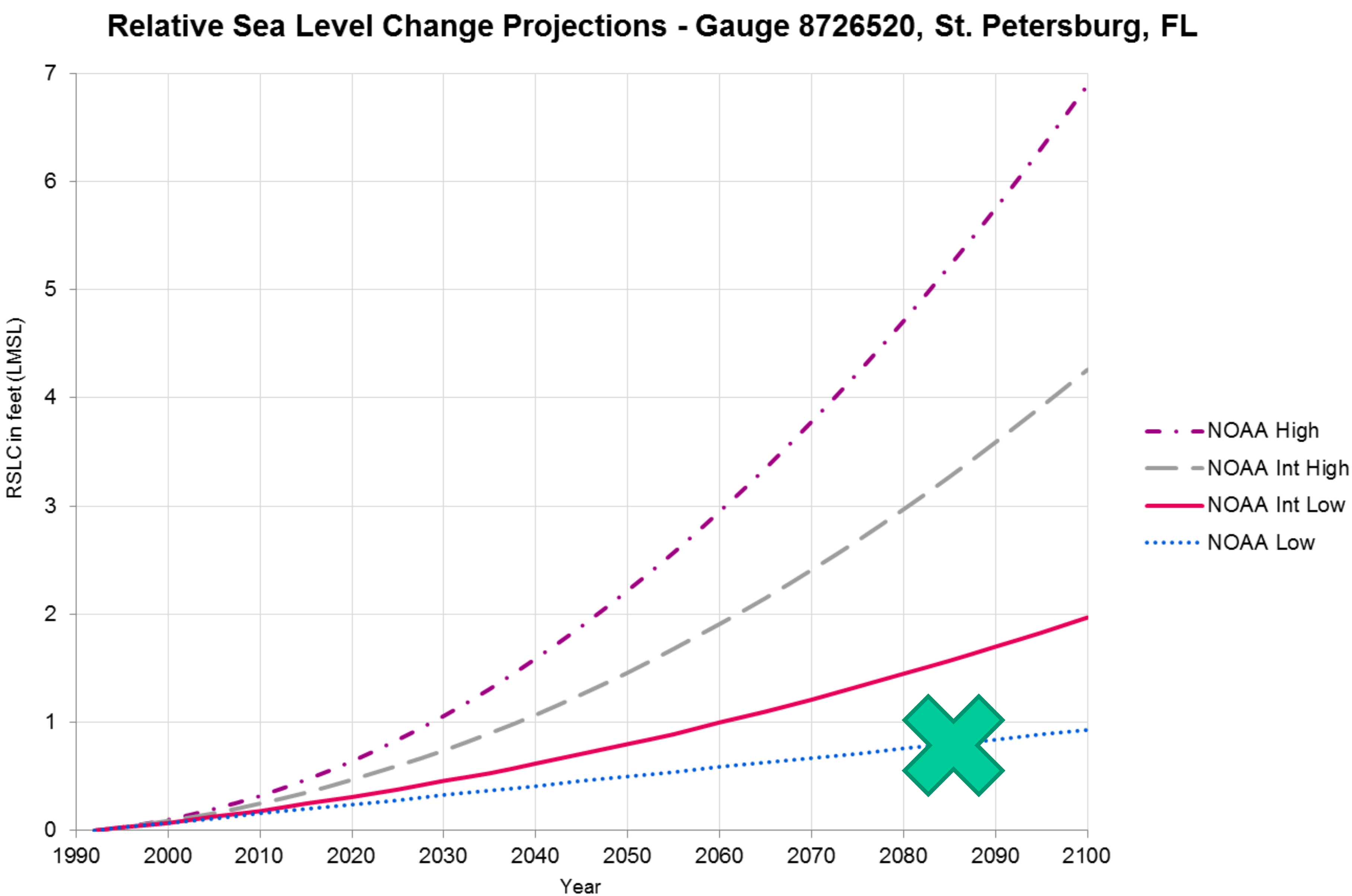
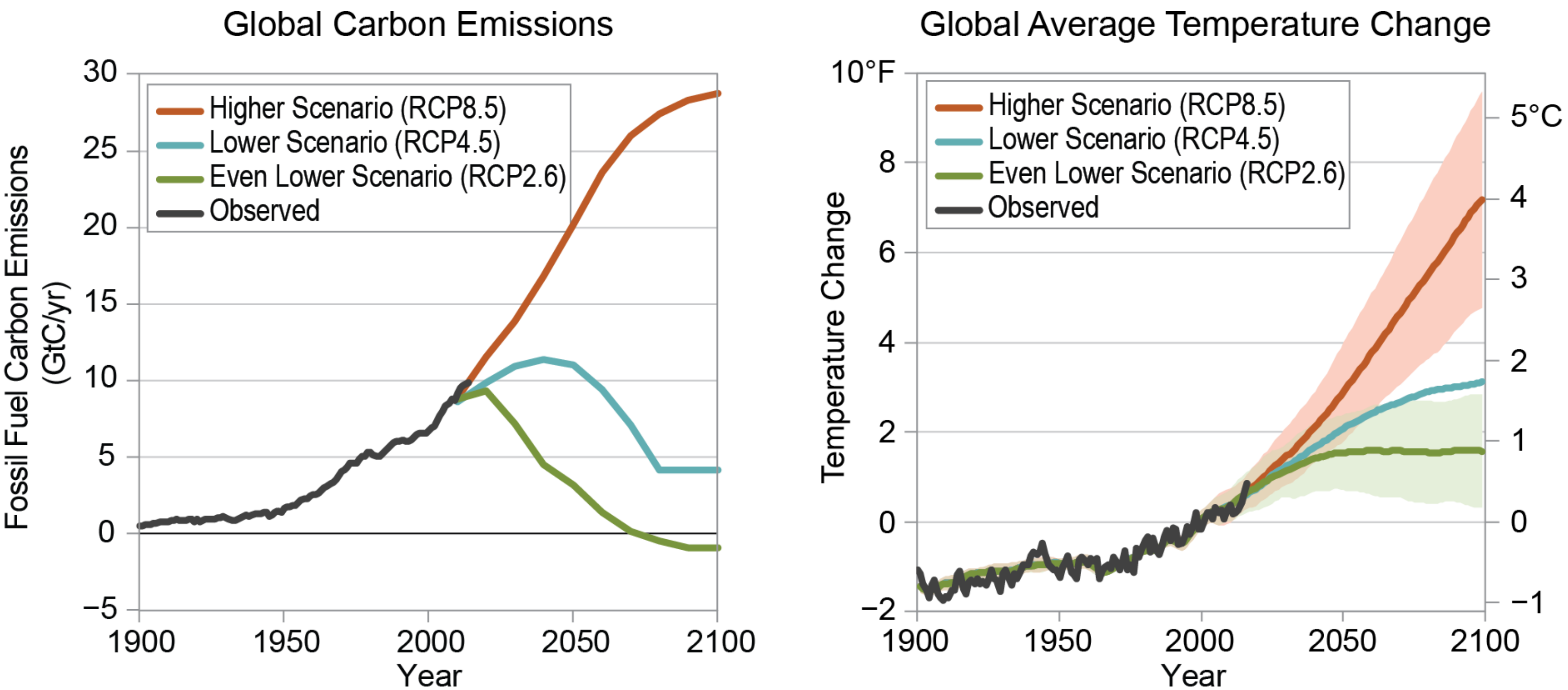
All of these are research topics!


Relative Sea Level Change Projections - Gauge 8726520, St. Petersburg, FL
RSLC in feet (LMSL)
Year
0
1
2
3
4
5
6
7
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
NOAA High
NOAA Int High
NOAA Int Low
NOAA Low

We are NOT communicating the link between emissions and climate change well enough …



Given an emission scenario,
the physics is reliable.

It has been for some time, actually …

Future emissions are the
only real unknown.

But what is the effect of the tidal
and ocean-atmosphere variations?

Present approaches

Statistics vs. Models
Persistence vs. Physics

Both have problems

This is still a research problem