CLIMATE:

from Greek *klima*, inclination

the composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine,cloudiness, and winds, throughout the year, averaged over a series of years.

Brianna Cato
Jil Sanchez
Yuan Zhang

Overview

The main determinant of our planet's climate is its distance from the sun. As the Earth orbits around the sun, the axial tilt of its rotation changes, creating the seasons. From December to March the Northern Hemisphere is tilted away from the sun, causing winter in the Northern and summer in the Southern Hemisphere. This tilt inverts every six months: when the North is tilted towards the sun during northern summer, it is winter in the South.

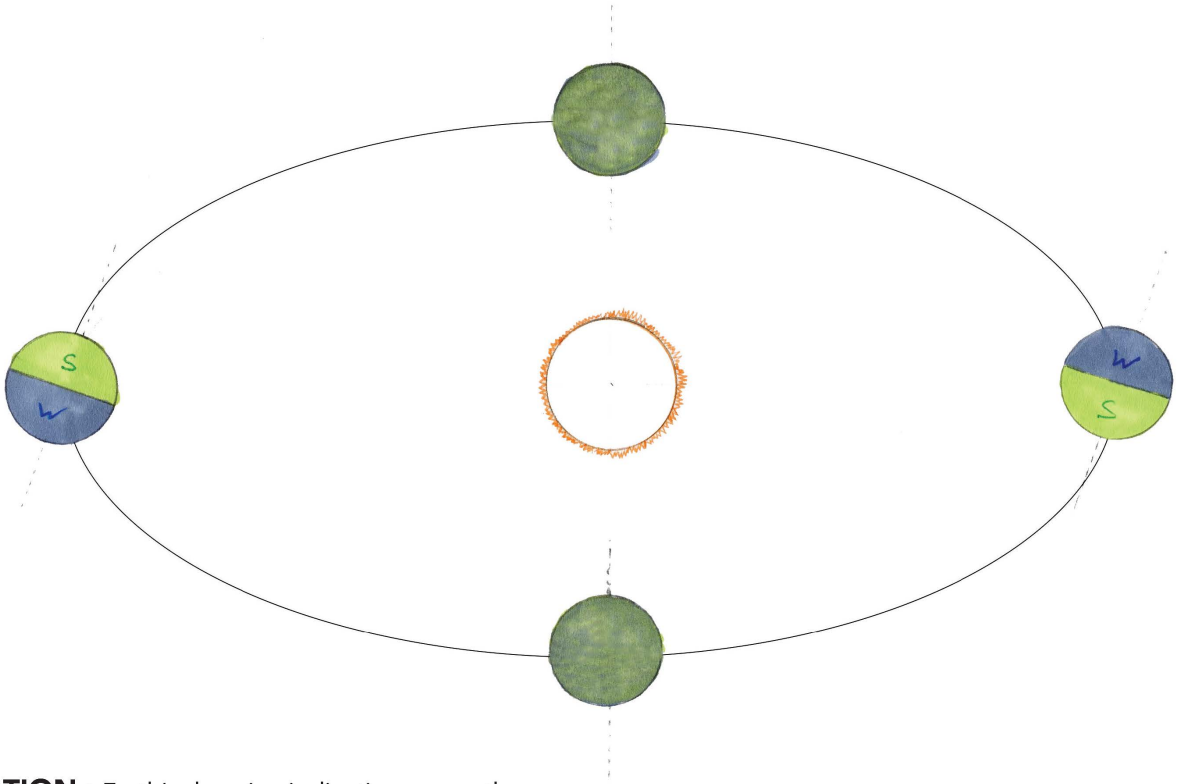
Since the Earth is round, latitude and longitude of a given place will affect its climate. As one moves from the equator towards the poles, the climate continues to become colder. Climates on Earth range from equatorial (hot and humid), subtropical (warm and seasonal), and temperate (cooler and seasonal) to polar (cold and dry).

LATITUDE : The angular distance north or south from the equator of a point on the earth's surface, measured on the meridian of the point.

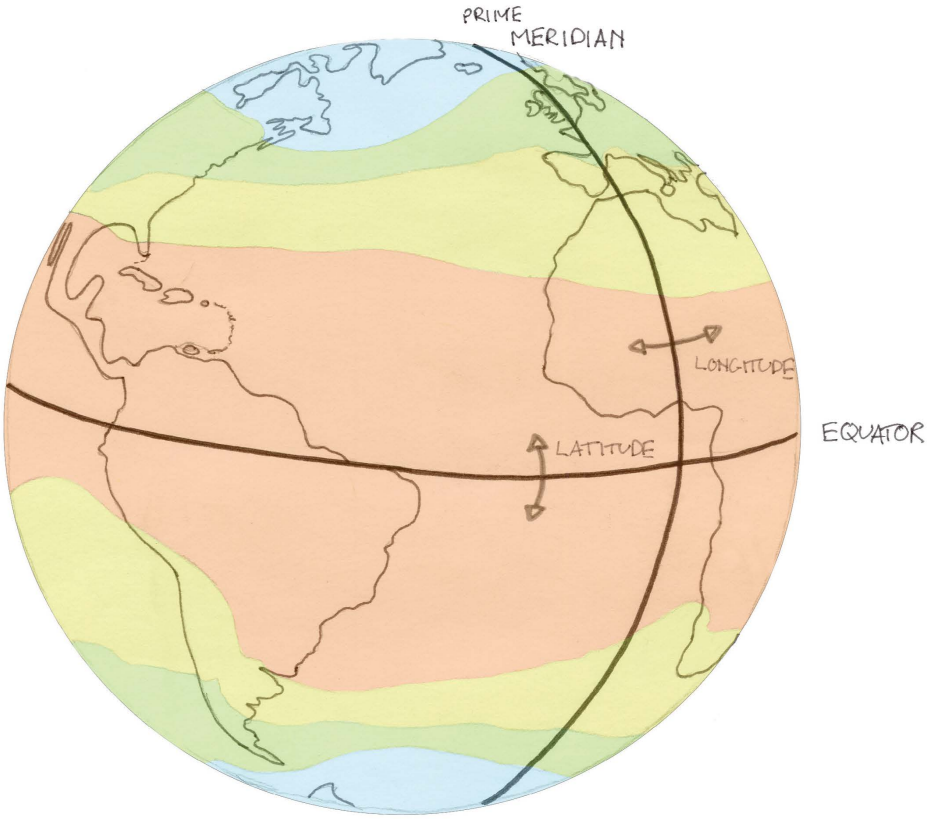
LONGITUDE: The angular distance east or west on the earth's surface, measured by the angle contained between the meridian of a particular place and some prime meridian, as that of Greenwich, England, and expressed either in degrees or by some corresponding difference in time.

Additionally, climate is governed by a planet's proportion of land to ocean, atmospheric composition, ocean currents, and vegetation. These last two factors together with altitude and distance from the ocean also play a role in determing a specific area's climate.

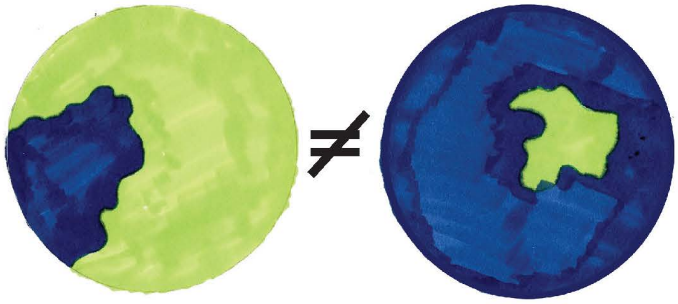
Global Climate



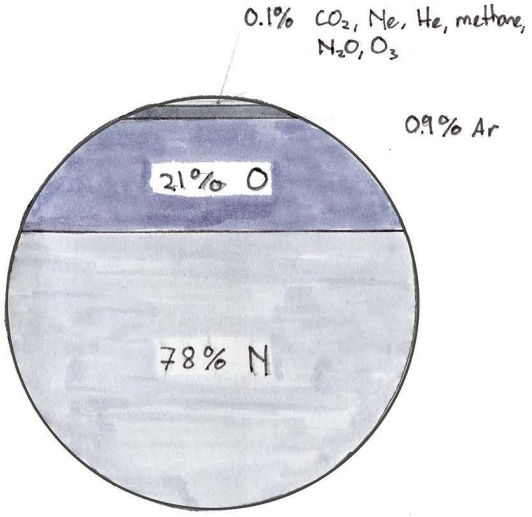
INCLINATION : Earth's changing inclination causes the seasons



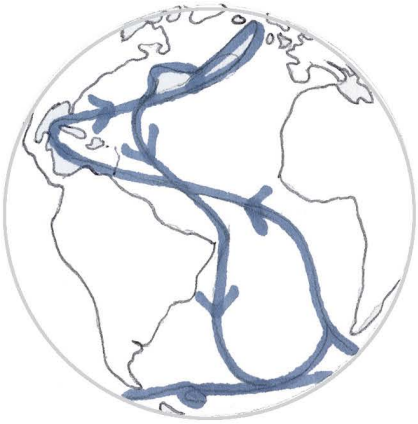
LATITUDE AND LONGITUDE: create climate zones



PROPORTION OF LAND TO OCEAN:
affects amount of reflected solar radiation

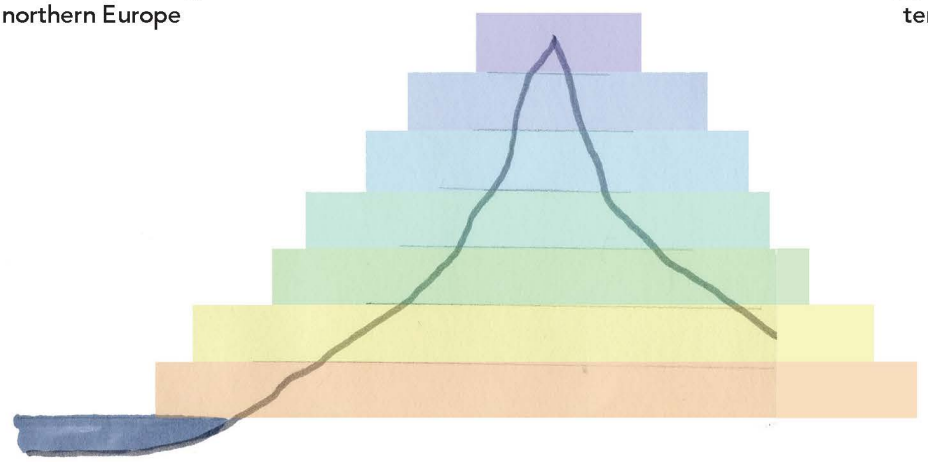


COMPOSITION OF ATMOSPHERE:
amount of green house gasses affects temperature



OCEAN CURRENTS:
movement of warm and cool streams affect climates on different continents. eg: the Gulf Stream warming northern Europe

VEGETATION:
converts carbon dioxide to oxygen, playing a role in regulating temperature; evapotranspiration affects air humidity

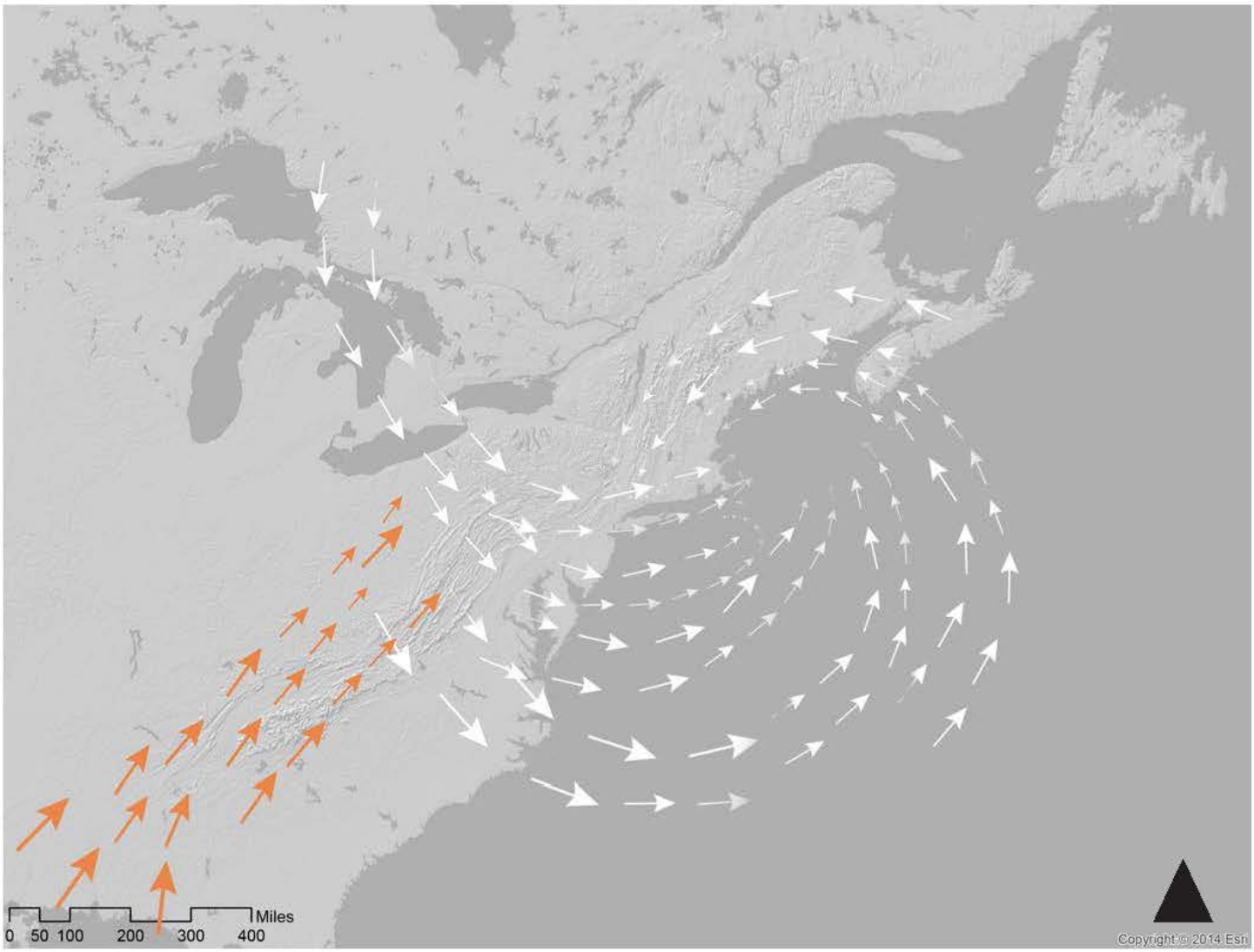


ELEVATION: temperature decreases between 5 and 10 °C every kilometer of altitude

New England Climate

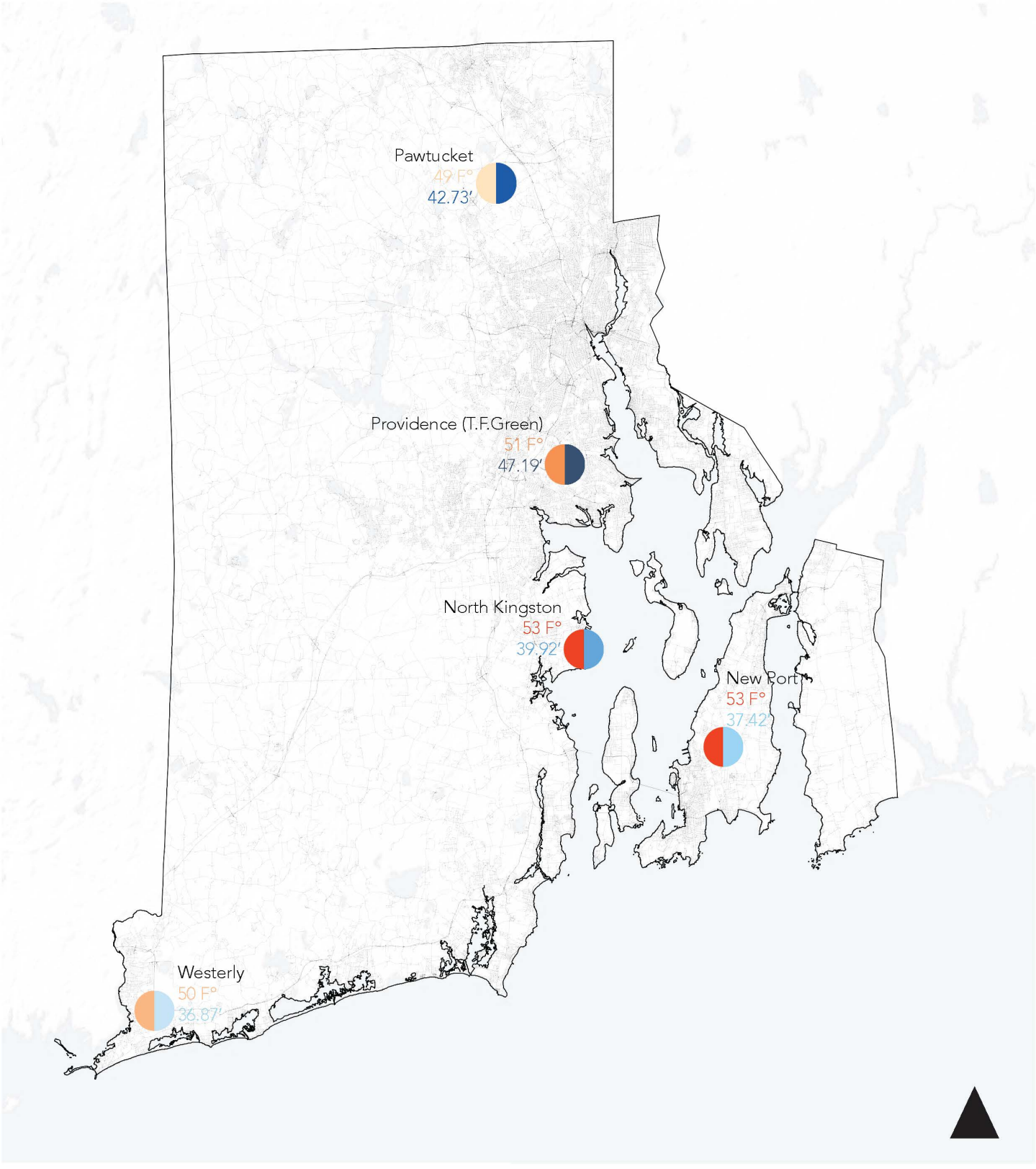
New England has multiple climates which differ according to location, altitude, and distance from the coast. Northern and Western New England is characterized by highlands and mountains, with climates between humid-continental and alpine. Here, winters are long and cold with short warm summers and precipitations spread throughout the year. Low lying coastal areas tend to be hotter than inland areas in the summer, and generally receive less snow in winter. However, these places are more exposed to strong coastal winter winds than the hilly hinterlands.

A common type of storm affecting the area during the winter months is the nor'easter, when winds blow from the north-east and rotate along the coast. In summer, the dominant winds come from the south-west.

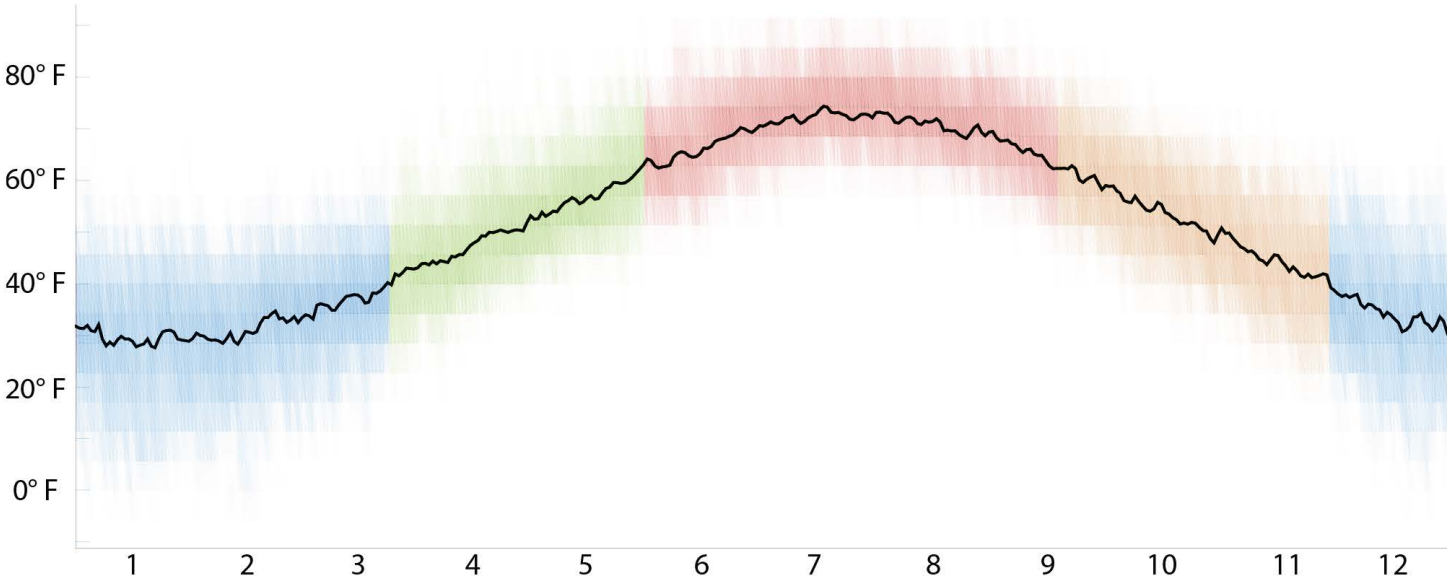


NOREASTERS (white) AND SOUTHWESTERS (orange)

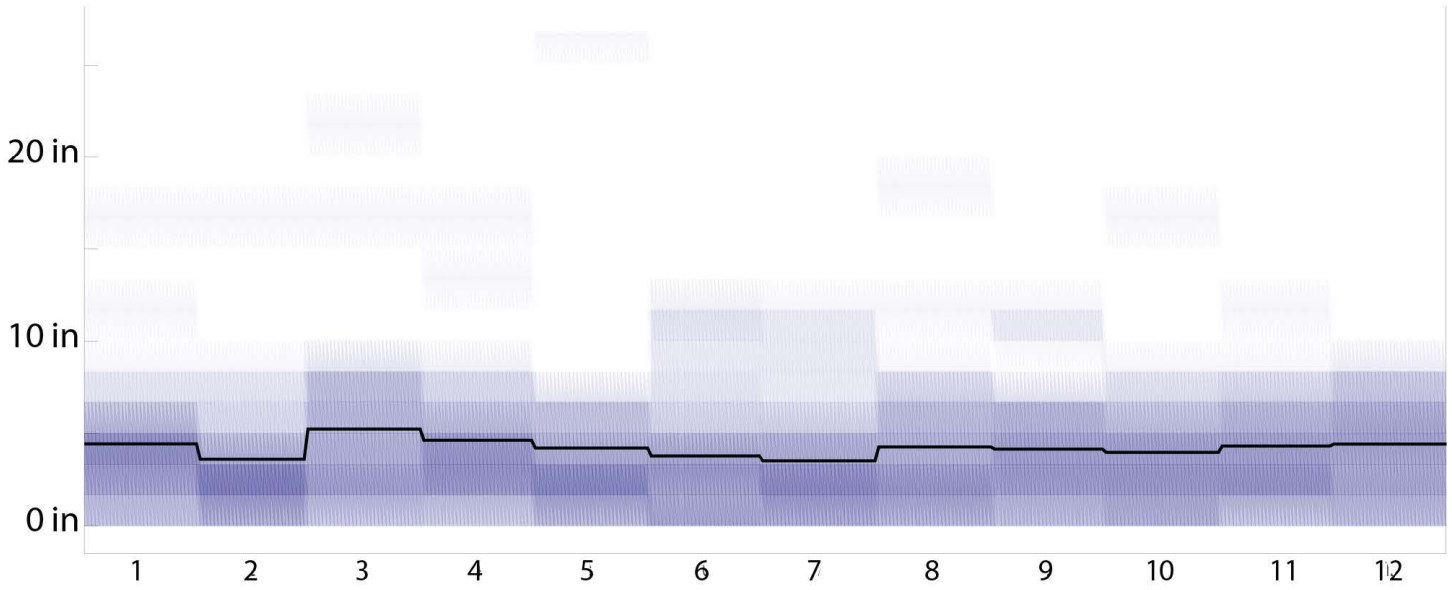
Rhode Island and Narragansett Bay Climate



ANNUAL AVERAGE TEMPERATURE AND TOTAL PRECIPITATION IN 2014

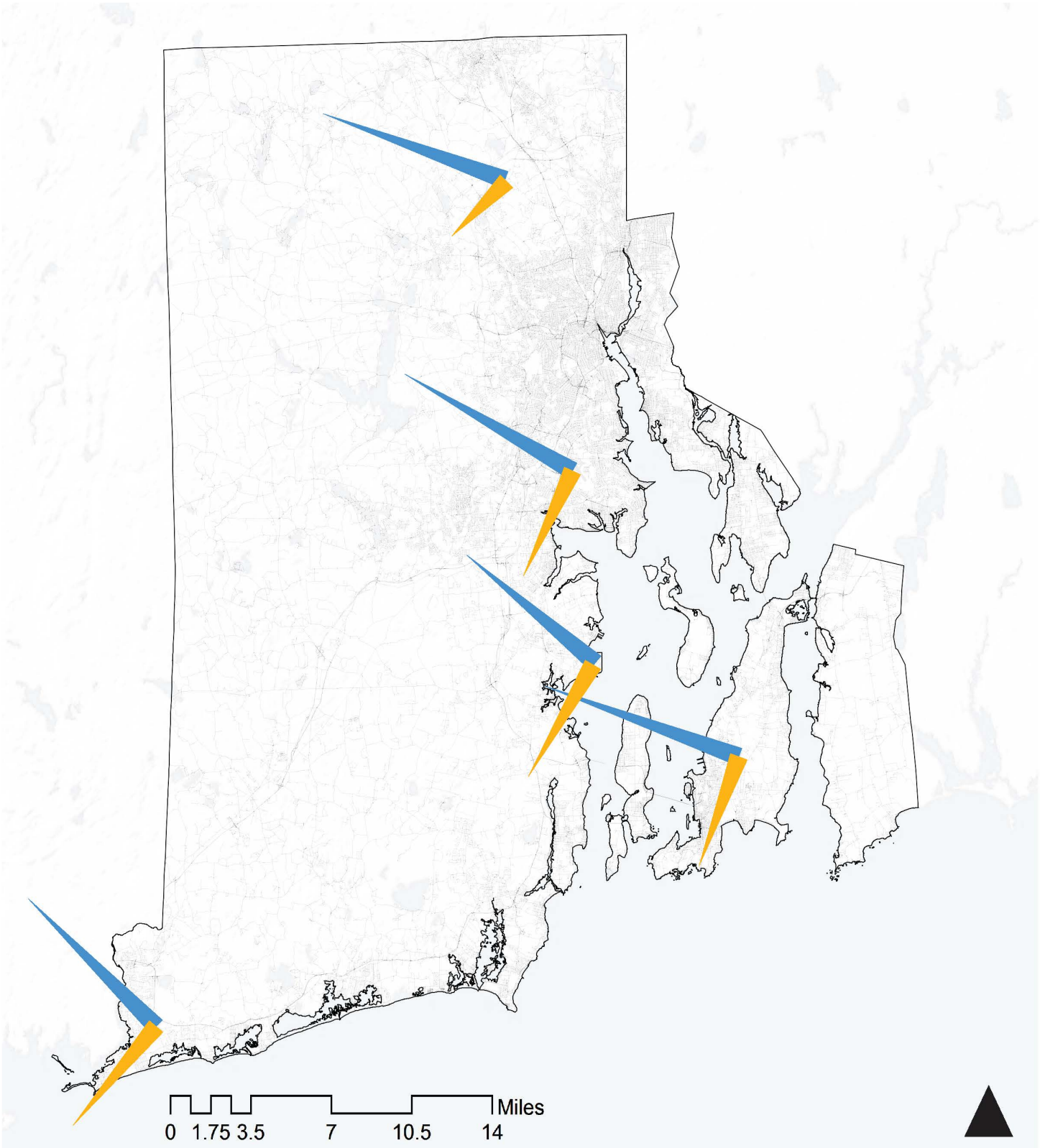


TEMPERATURE OF RHODE ISLAND 1942-2015

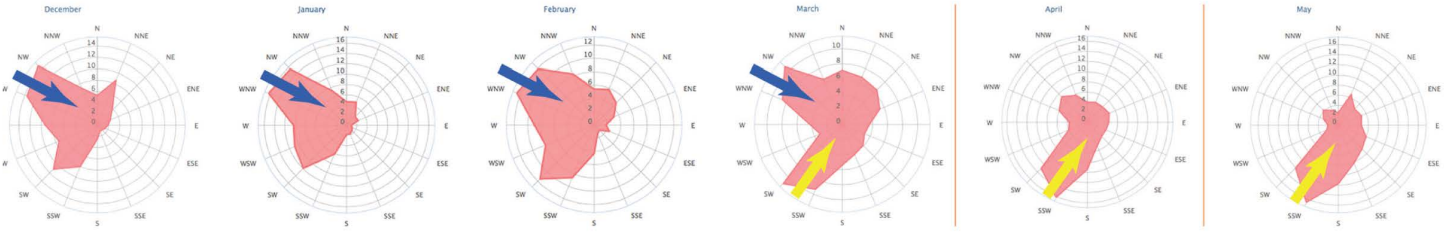


PRECIPITATIONS IN RHODE ISLAND 1973-2015

Rhode Island has four distinct seasons, with warm summers and cold winters. Precipitations are spread year round as for the rest of New England, ranging from rain in the spring, summer, and fall to snow and sleet in the winter.



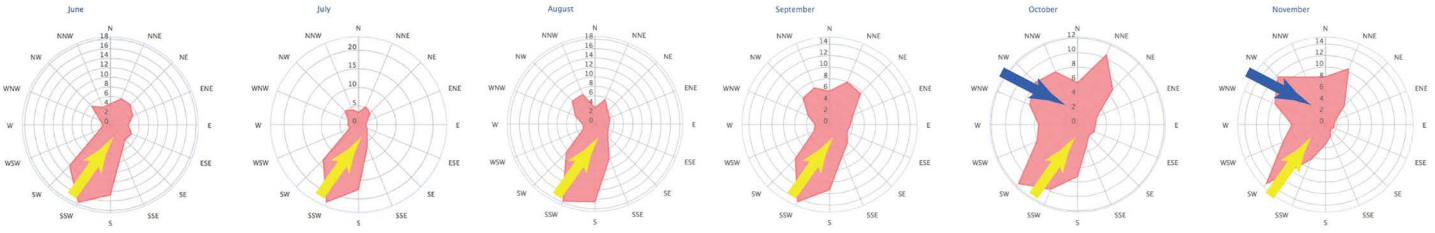
AVERAGE WIND DIRECTION AND RELATIVE SPEED IN FEBRUARY (BLUE) AND JULY (ORANGE)



NARRAGANSETT BAY WIND TUNNEL EFFECT

Not all parts of the New England coast are affected equally by coastal winds, since they are not equally exposed. Long Island acts as a barrier to the Connecticut coast, while Martha's Vineyard and Cape Cod protect southern Massachusett's coast. Narragansett Bay, on the other hand, is left fully exposed to winds blowing from the Altantic. The Bay acts as a wind tunnel, funnelling winds northward to Providence.

PREVAILING WINDS IN RHODE ISLAND

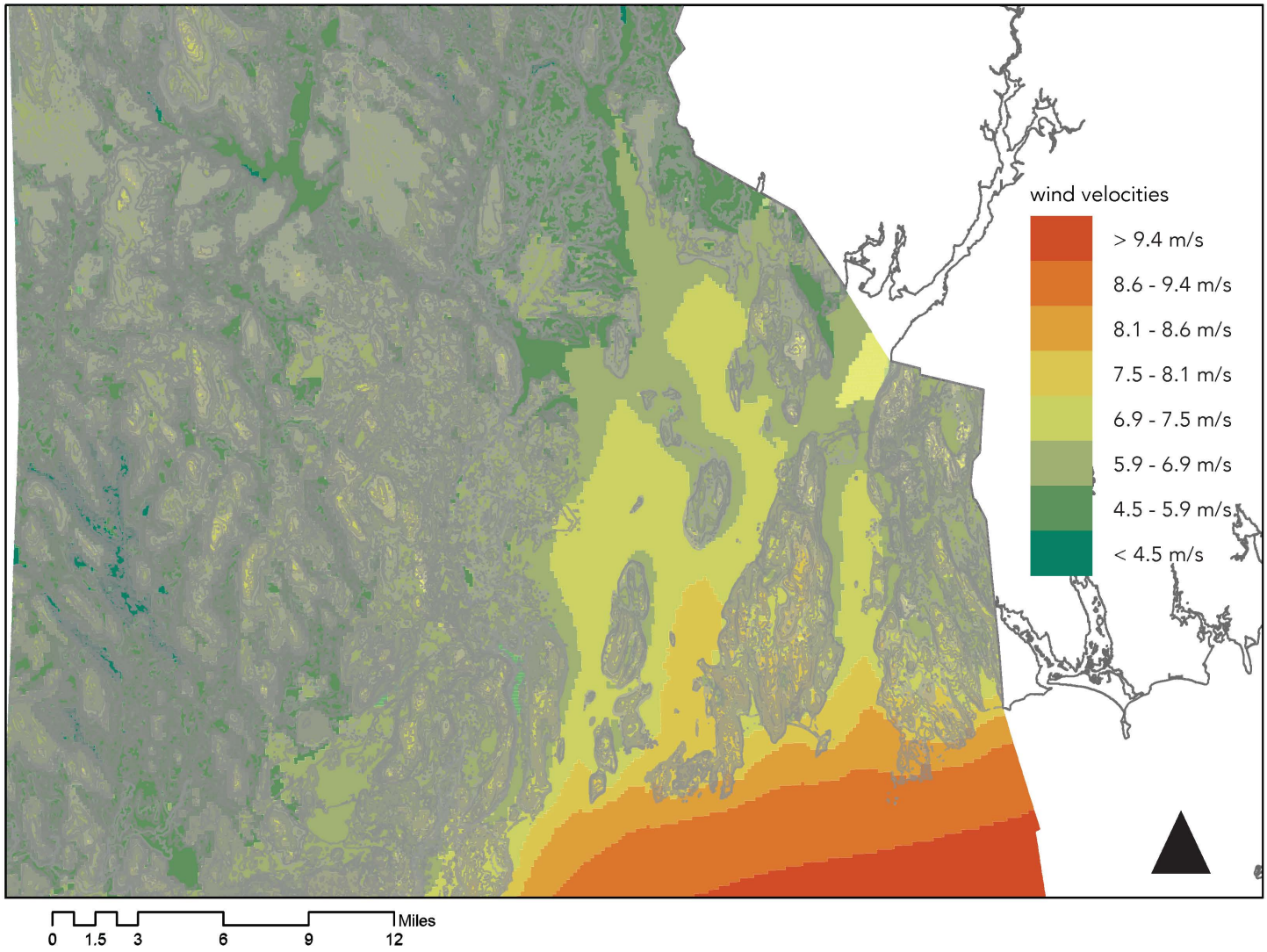


Microclimates

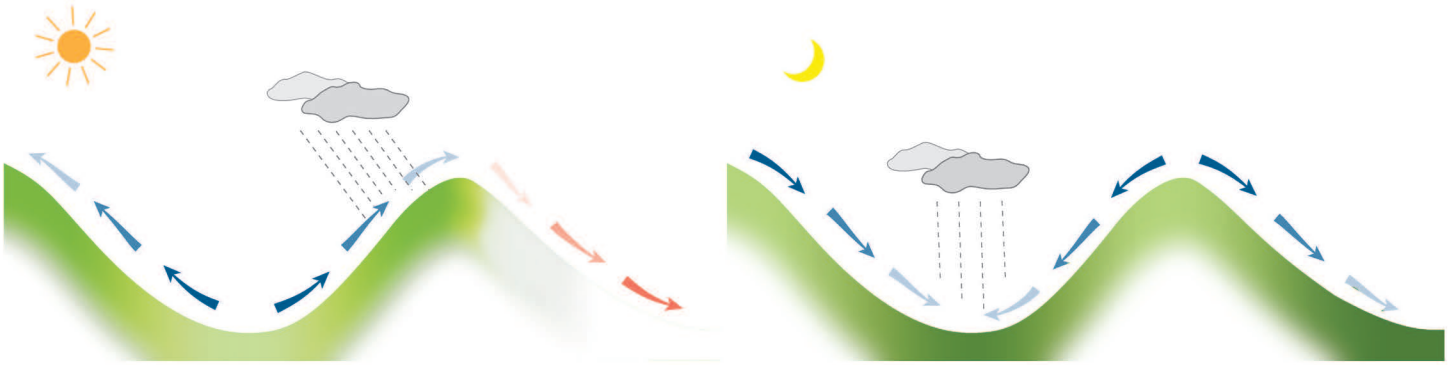
MICROCLIMATE : the climate of a small area, as of confined spaces such as caves orhouses (cryptoclimate) of plant communities, wooded areas, etc.(phytoclimate) or of urban communities, which may be different from that in the general region.

Microclimates occur in many places at many scales around Narragansett Bay, ranging from an island's leeward wind shadow to the conditions under a single rock. They are nested and combined, cumulatively yielding the Bay's general climate.

Humans also have a hand in shaping microclimates. For example, areas with a greater amont of impervious surfaces will reflect a higher proportion of solar radiation, creating the urban heat island effect. Additionally, individual buildings can cause microclimates.

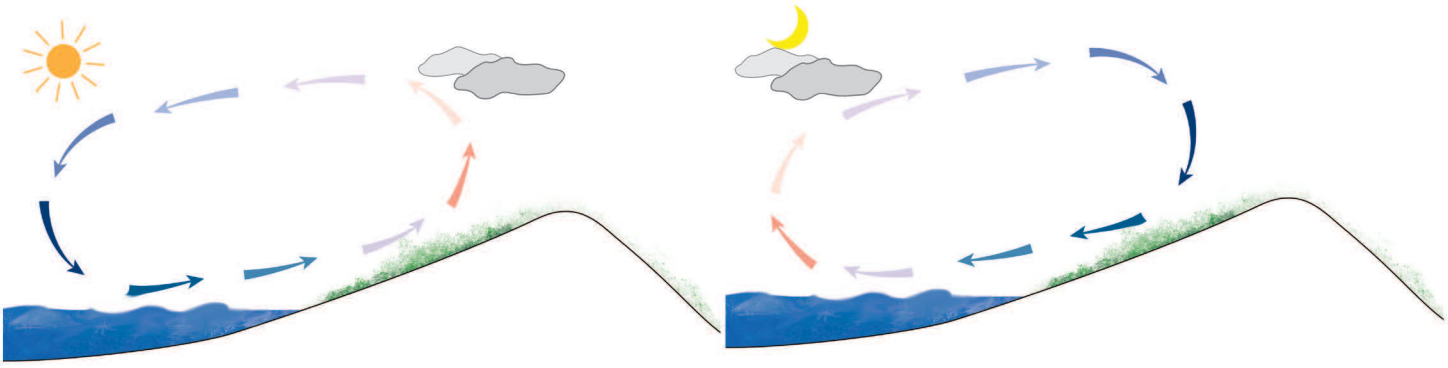


NARRAGANSETT BAY WIND SHADOWS



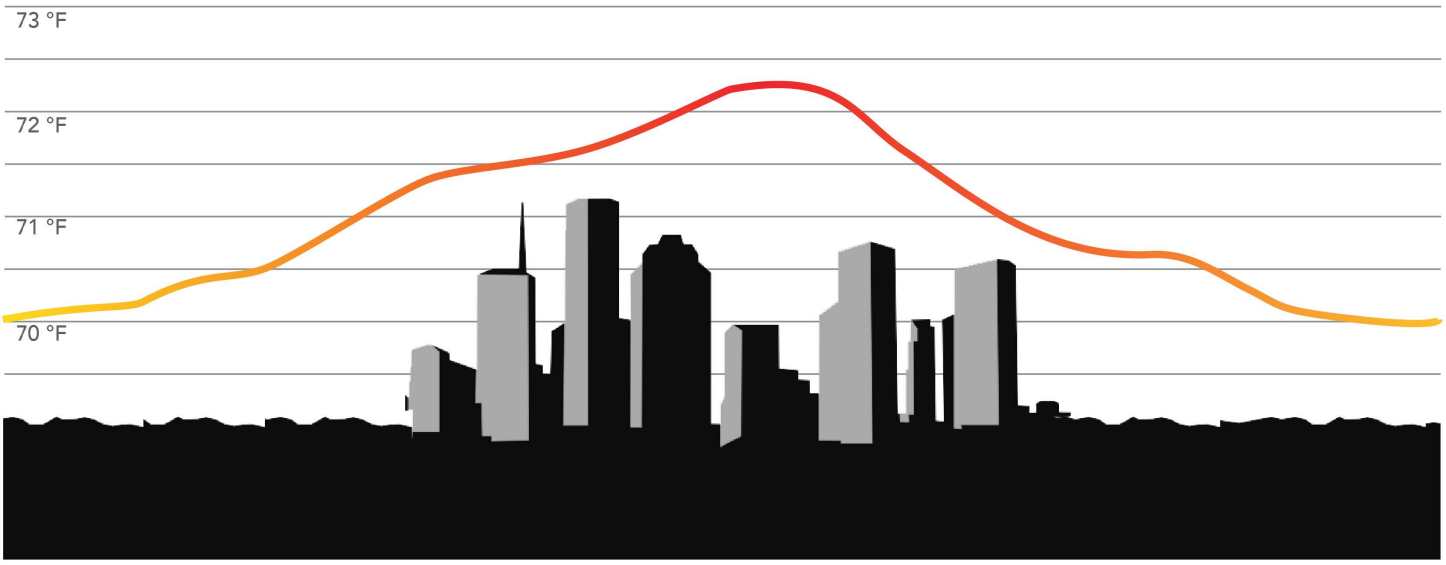
TOPOGRAPHY

In the daytime, wind blows from valley to the hill, because the hill receives more sunlight and is warmer than the valley. In another word, the air in the valley is cooler and has higher pressure than that on the hill. In the night time, the wind blows from the hill to the valley due to a similar reason. Sometimes the cold air moving to warmer area will create clouds and rainfall.

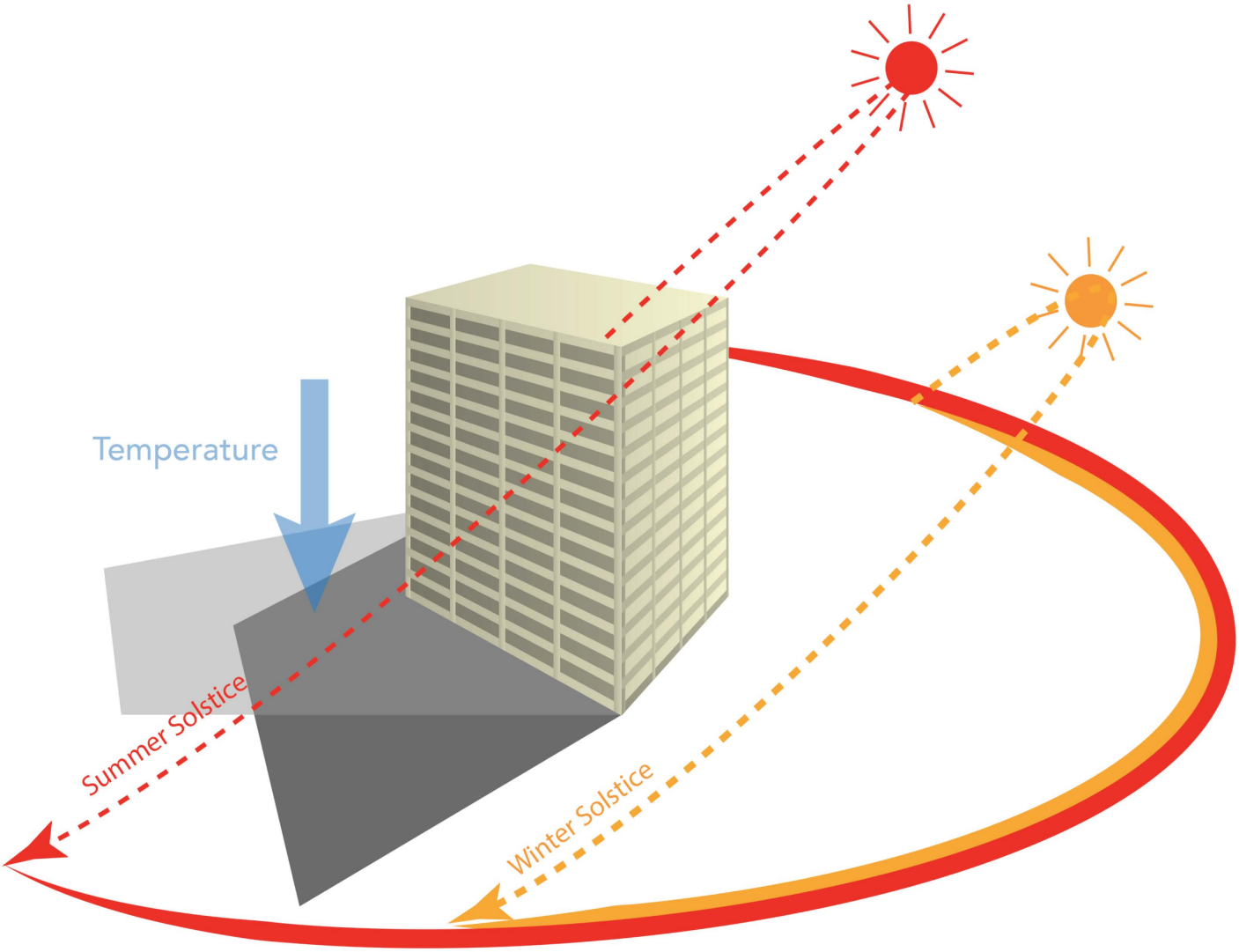


OCEAN

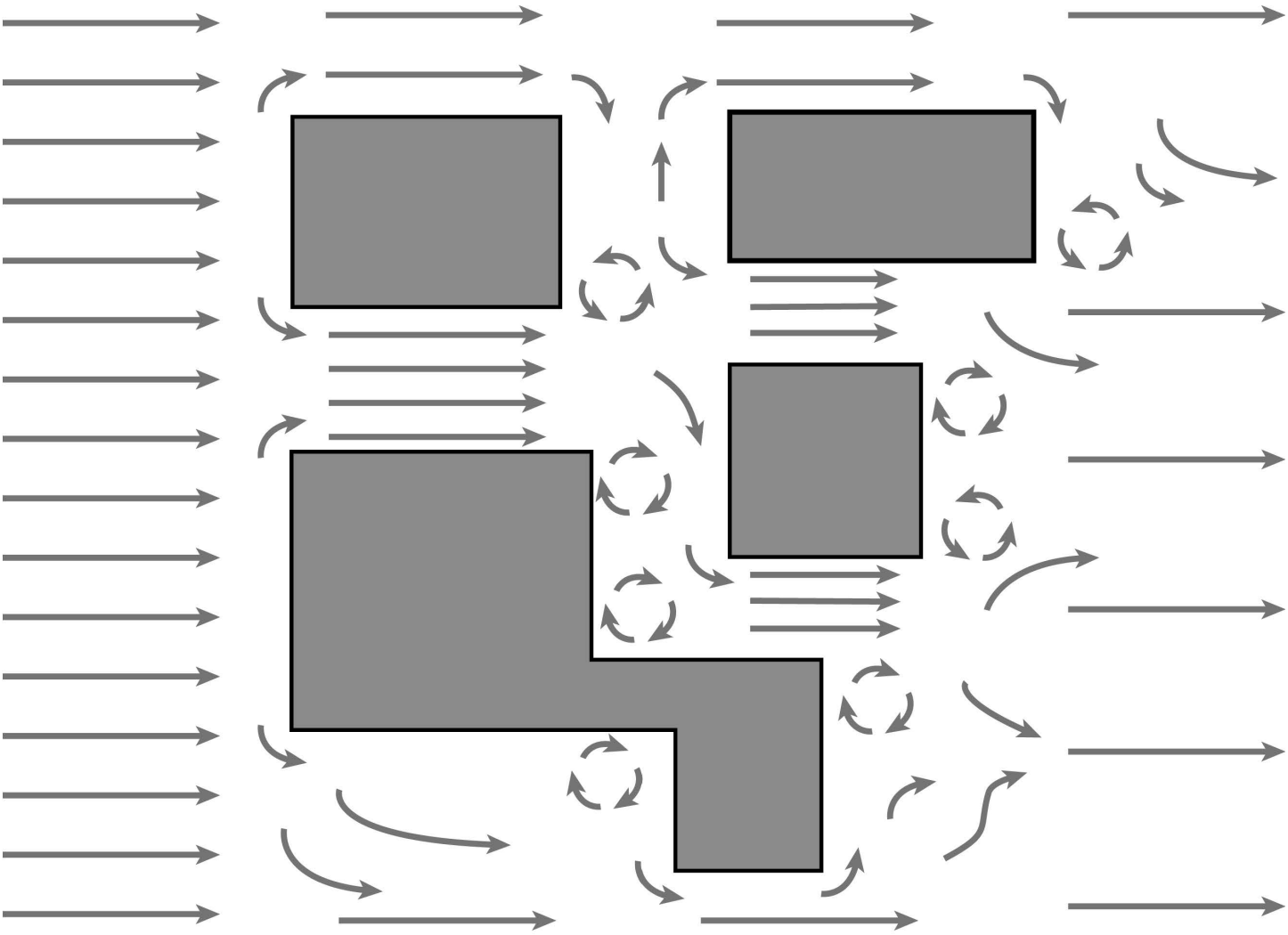
In the daytime, wind blows from the ocean to the land, because the land is better at absorbing heat and thus warmer than the ocean. In the night time, the wind blows from the land to the ocean due to that the land is also worse at keeping the heat from going and thus cooler.



URBAN HEAT ISLAND



BUILDING SHADE



VORTICES AND WIND TUNNELS

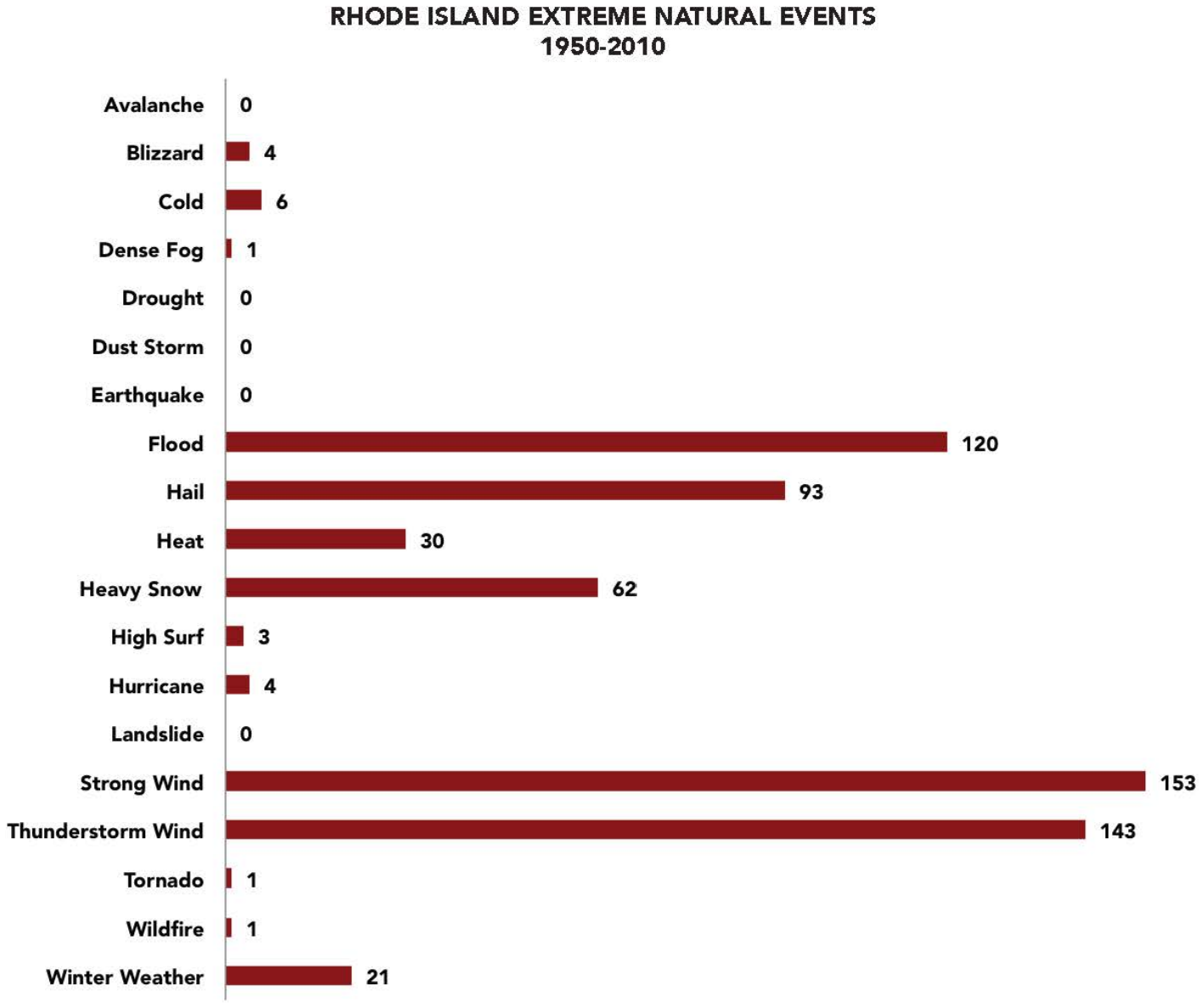
Due to impervious surfaces, reflective building materials, and heavy traffi, urban areas are usually warmer than suburban and rural areas.

At different time of a year, the sun angle is different and the size of the shade cast by a building is different too. Note that it is always cooler in the shade.

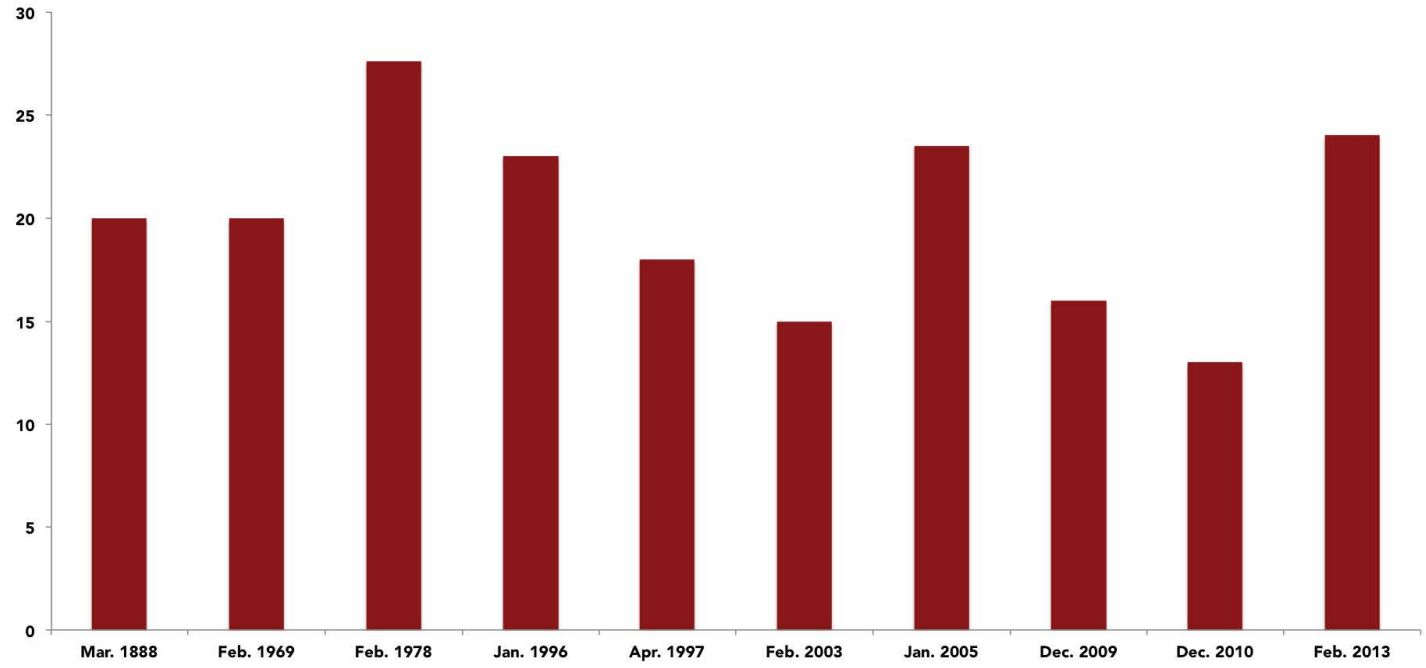
Wind tunnels and vortices are very common phenomena in urban areas. When the wind speed is too high it could cause danger to pedestrians and cars moving through dense building areas.

Extreme Weather

Compared to other states, Rhode Island has a rather calm existence. Its most frequently occurring extreme natural events tend to be weather-related rather than geological disasters. Most of these occur during winter, when strong winds sweeping through Narragansett Bay from the north-east combine with low temperatures, leading to heavy ice and snow accumulation.



EXTREME WINTER STORMS SNOW ACCUMULATION (INCHES)



HIGH SNOWS: though usually inconvenient, snow banks sometimes offer opportunities for play

Hurricane Timeline

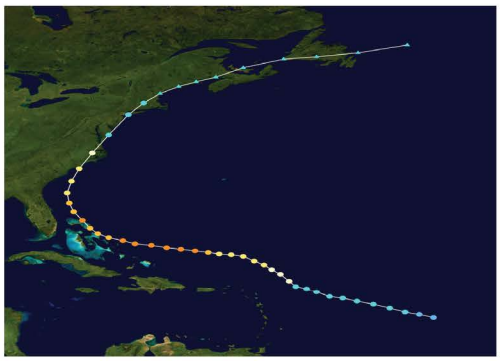
1804 - Snow Hurricane

1806 - Great Coastal Hurricane

1815 - The Great September Gale

1938 - New England Hurricane

The New England Hurricane caused unprecedented damage in Providence, flooding the city's downtown and causing $120 million of damage.



1999 - Hurricane Floyd

2012 - Hurricane Sandy

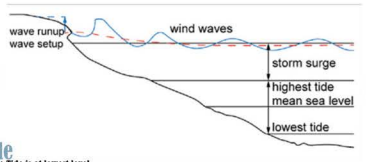
1954 - Hurricane Carol

2011 - Hurricane Irene

After Hurricane Carol struck Providence costing $41 million in damage, the city decided to build the Fox Point Hurricane Barrier to protect the Providence River's banks from strom surges.

2010 - Hurricane Earl

STORM SURGES: storms can cause more damage when they hit at high tide



Low Tide

When the Tide is at lowest level

Mean Sea Level Rise

Standard Elevation of the levels tide

Battering Waves can erode beaches and damage existing infrastructure

The surge can begin before the storm hits which causes a major effect on evacuation routes.

Storm Surge- Highest Tide

When the tide is at the highest level

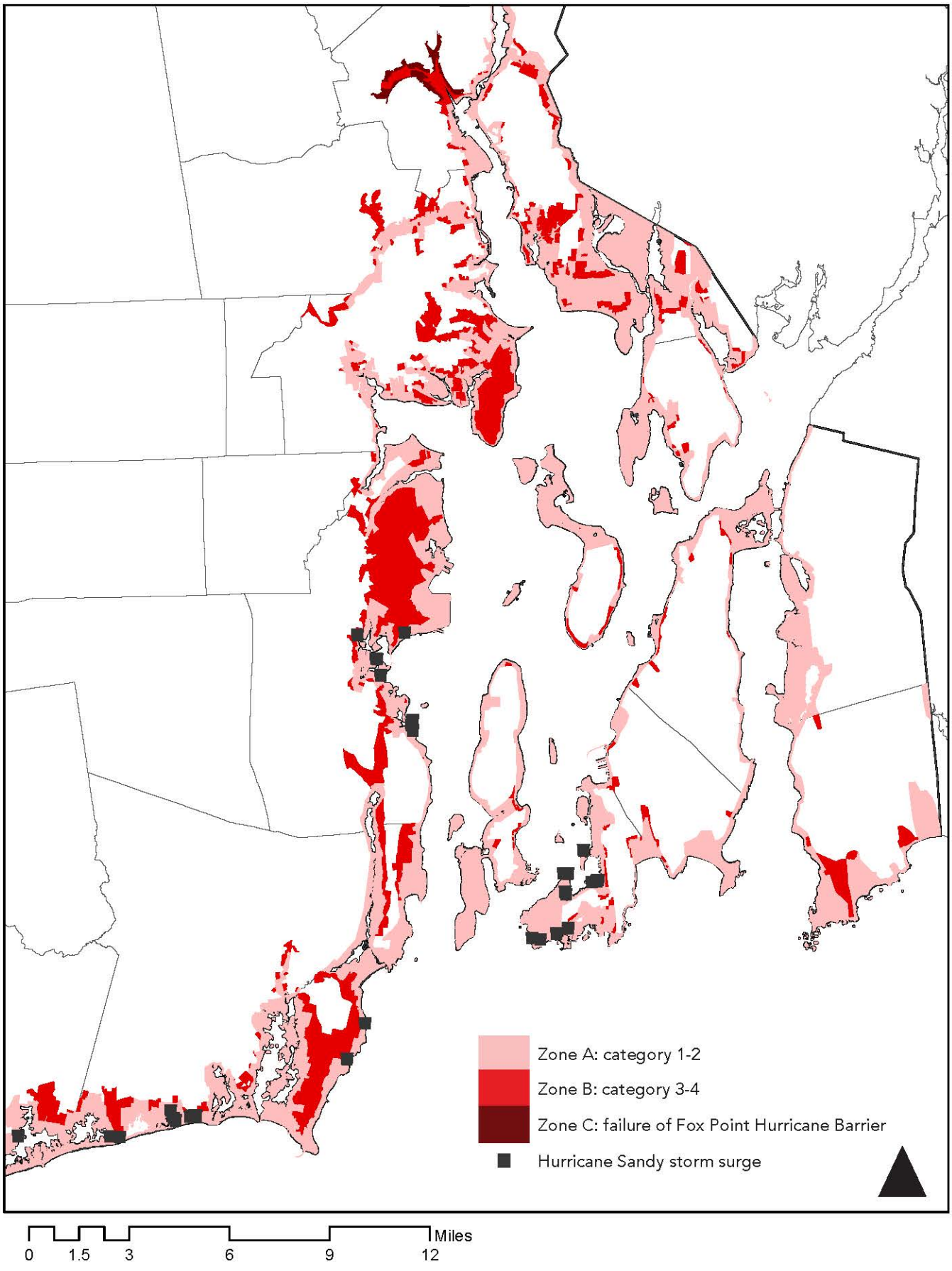
Low Pressure Pulls Water Higher

Winds pile up water and push it towards shore

Waves push the water inland faster than it can drain off

Floating Debris can also have impact on infrasture inland

Shallow coastline slope produces a greater surge than deeper slope



NARRAGANSETT BAY HURRICANE EVACUATION MAP

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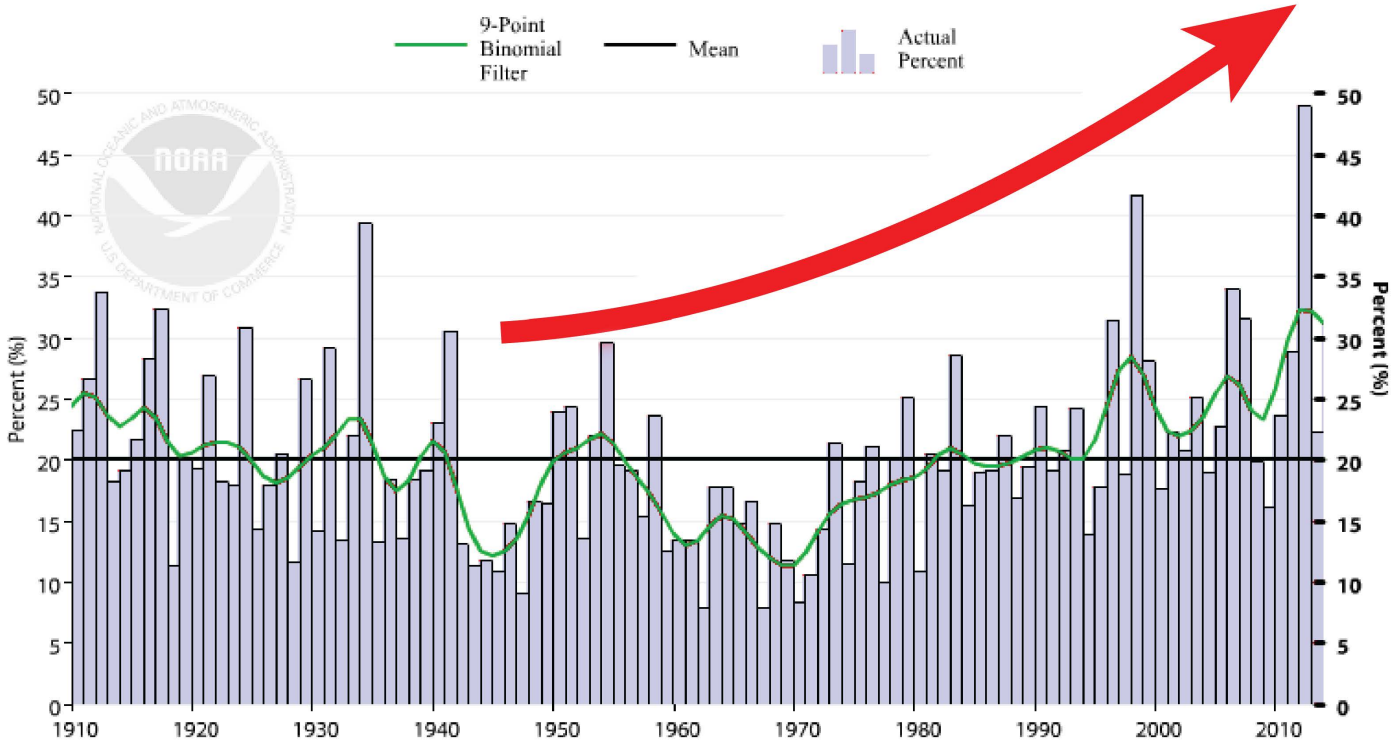
Climate Change

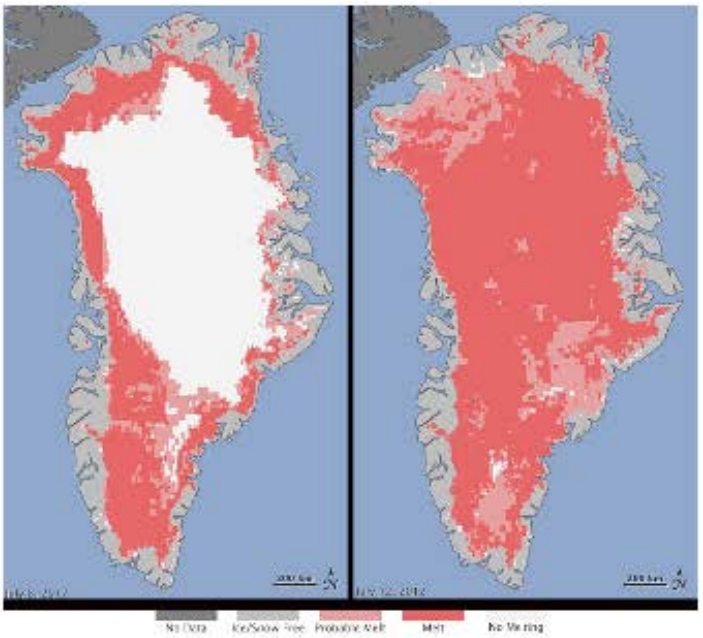
It is common knowledge that the Earth's climate is warming. This has strong effects on various meteorological phenomena, which affect humans, animals, and plants on many scales.

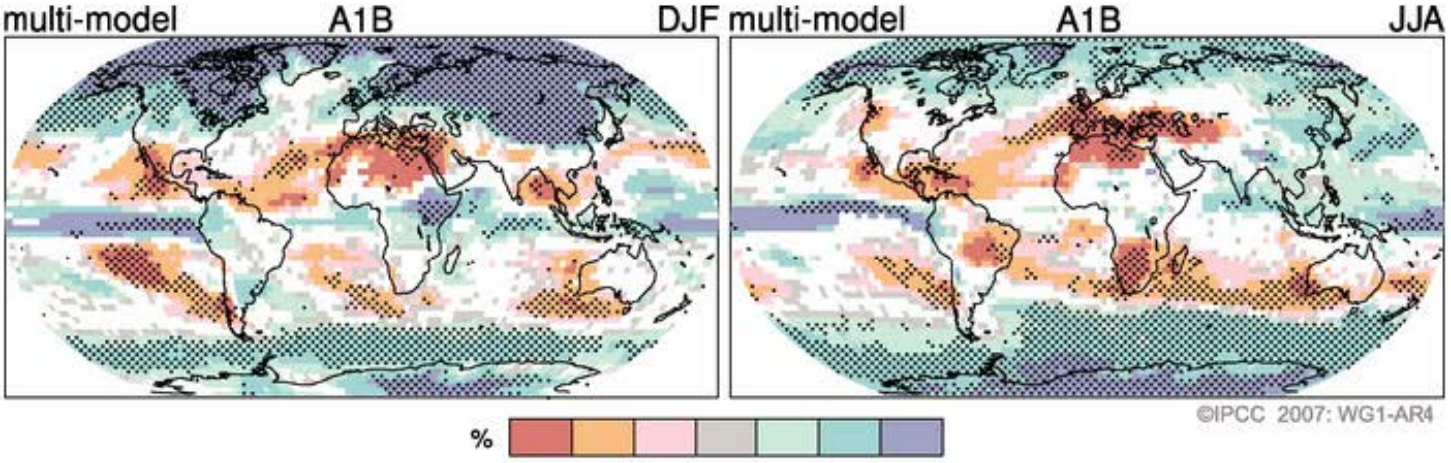
The recent increase in extreme weather events hints at the fact that the future's climate will feature more dramatic storms and hurricanes. However, this does not mean that the planet will become more humid: many areas will be faced with increasingly severe drought, perhaps leading to famine. Generally, regions near the equator are projected to become drier, while regions approaching the poles are expected to receive more precipitation than in the past.

Rising temperatures and ever stronger heatwaves are causing the polar ice sheets to melt, leading to sea level rise, which has major ramifications for all coastal areas.

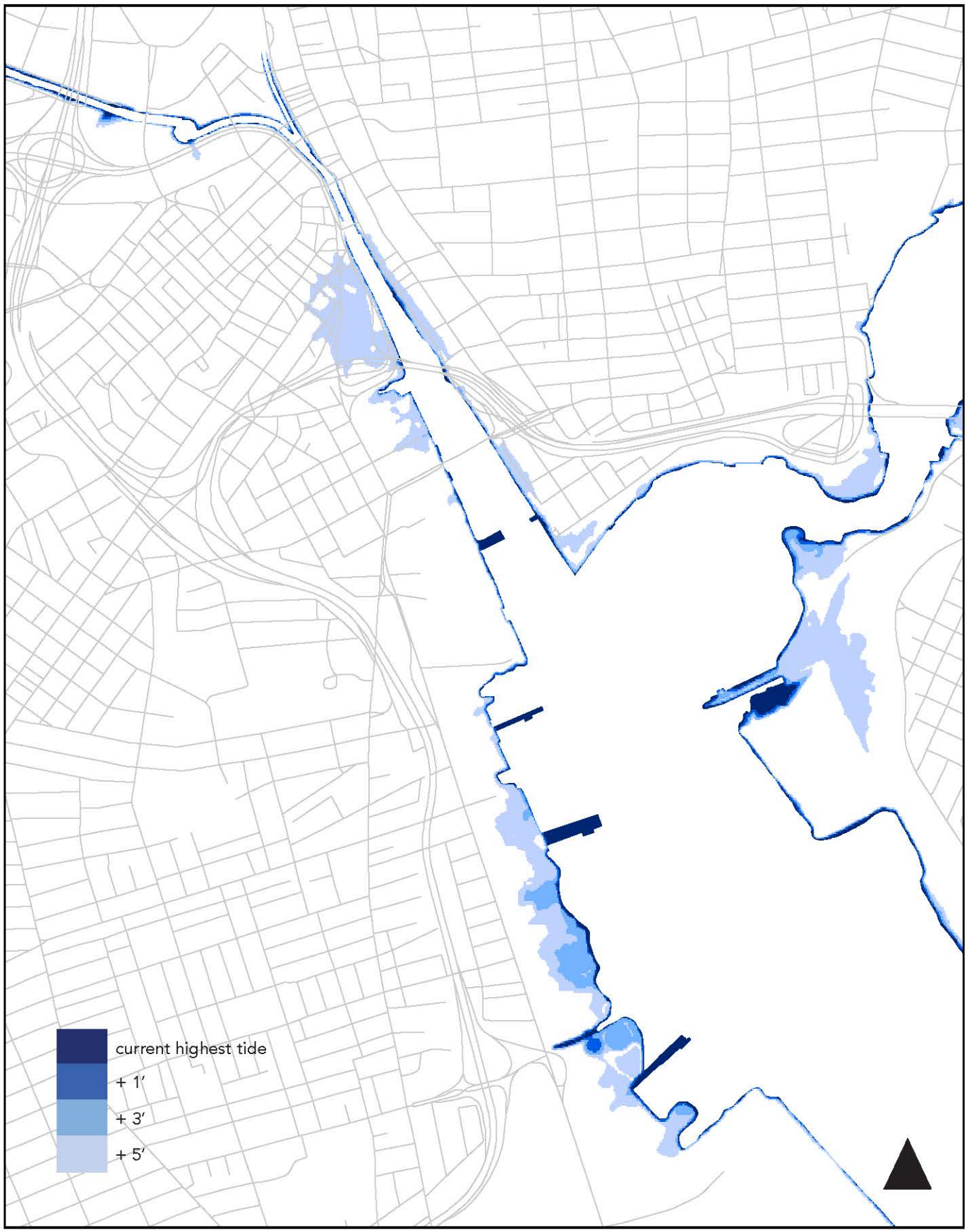


EXTREME WEATHER EVENTS INDEX FOR THE CONTINENTAL UNITED STATES





CLIMATE CHANGE PROJECTIONS



SEA LEVEL RISE IN PROVIDENCE

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