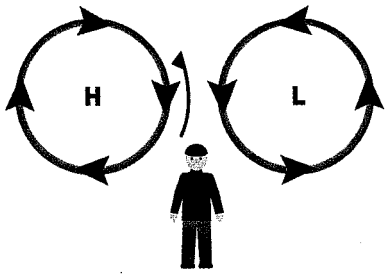
PRACTICAL SEAMANSHIP

Frank Singleton was a Met Office chief forecaster and director of operations. He now cruises a Hallberg-Rassy 34

How land features can affect the breeze

Do you think you know everything about land effects? Frank Singleton invites you to think again



GRAPHIC: MAXINE HEATH

Buys Ballot's Law

In 1857, Christophorus Henricus Diedericus Buys Ballot, a Dutch meteorologist, noted that, in the northern hemisphere, if you stand with your back to the wind, the centre of a low pressure will be on your left, and the centre of a high pressure on your right. This helped mariners to avoid the most dangerous quadrant of low pressure systems: the lower right.

To many sailors the most obvious coastal effect is when the land warms up, creating an onshore sea breeze in the afternoon on sunny days. But it's not as simple as that, and there's much more to understand. In an extract from his new *Reeds Weather Handbook*, Frank Singleton reveals how towns, headlands, cliffs, valleys and straits affect the wind, to help you understand what to expect in any location.

First, let's take a closer look at the sea breeze.

What affects the sea breeze?

The Coriolis effect, which is caused by the spin of the earth and described in Buys Ballot's law, has a significant impact on the sea breeze. In the absence of other effects, the 'classical' sea breeze will set in directly onshore but will then veer. When well established, and with no interference from significant headlands or bays, it will blow harder and almost along the coast.

Topography can often shape the sea breeze so that it becomes unexpectedly strong or blows in directions that may seem strange. The sea breeze cannot blow over cliffs or steep sloping ground but will be deflected around them, often with an increase in strength.

A good example is the strengthening of the wind around Berry Head on the south coast of England. Here, the main driver of the sea breeze is the strong heating of the towns of Torquay and Paignton. Anyone who sails regularly between Dartmouth and Torbay will be aware of the strength of the south-southwest head wind during the afternoon. It can be a hard beat back to Dartmouth on a sea breeze day.

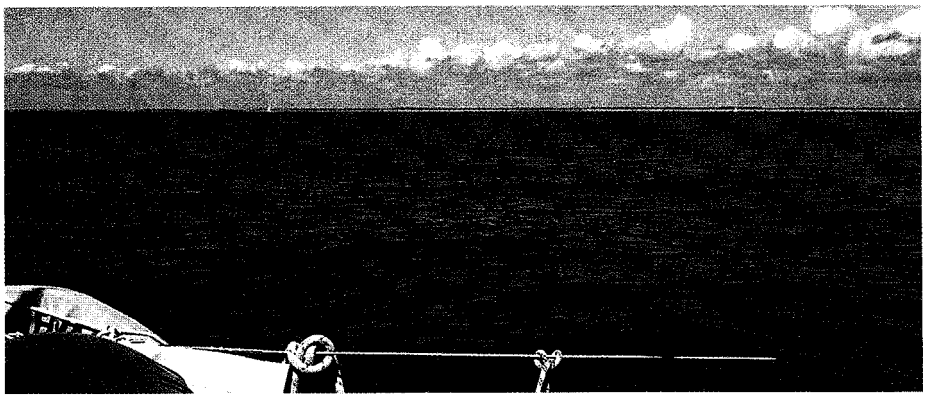
The Torbay sea breeze is complicated by the high ground to the north of the bay. The heating of the two towns can be so strong it can 'pull' the air from the north into the bay. The sight of two yachts running under spinnaker towards each other is well known here. As they approach each other, the wind will become variable and then each will start beating in opposite directions. The same effect can occur outside Plymouth Sound with Rame Head in one direction, and Yealm Head and the Great Mewstone in the other.

For rather different reasons, the Isle of Wight is another example of directly opposing winds in the same locality because of the sea breeze being shaped by topography. The strong heating of Southampton and nearby conurbations draws the sea breeze around both ends of the Isle of Wight and into both arms of the Solent.

The Solent provides a good example of what local heating can do to the wind. The sea breeze effect can be strong enough to reverse a north-east Force 3 morning wind in the western Solent into a south-westerly Force 4 by early afternoon. Heating of the Isle of Wight might be expected to create easterly winds along its northern side. However, the mainland heating is much stronger and the island heating effect may just lead to a more variable, lighter wind on its northern side.

There are other examples of sea breeze effects interacting with each other. During the morning, a fairly weak sea breeze can set into the St Helier Bay on the south of the island of Jersey. Later in the day, the heating over mainland France becomes dominant; the St Helier sea breeze weakens and gets reversed as the St Malo area sea breeze takes over.

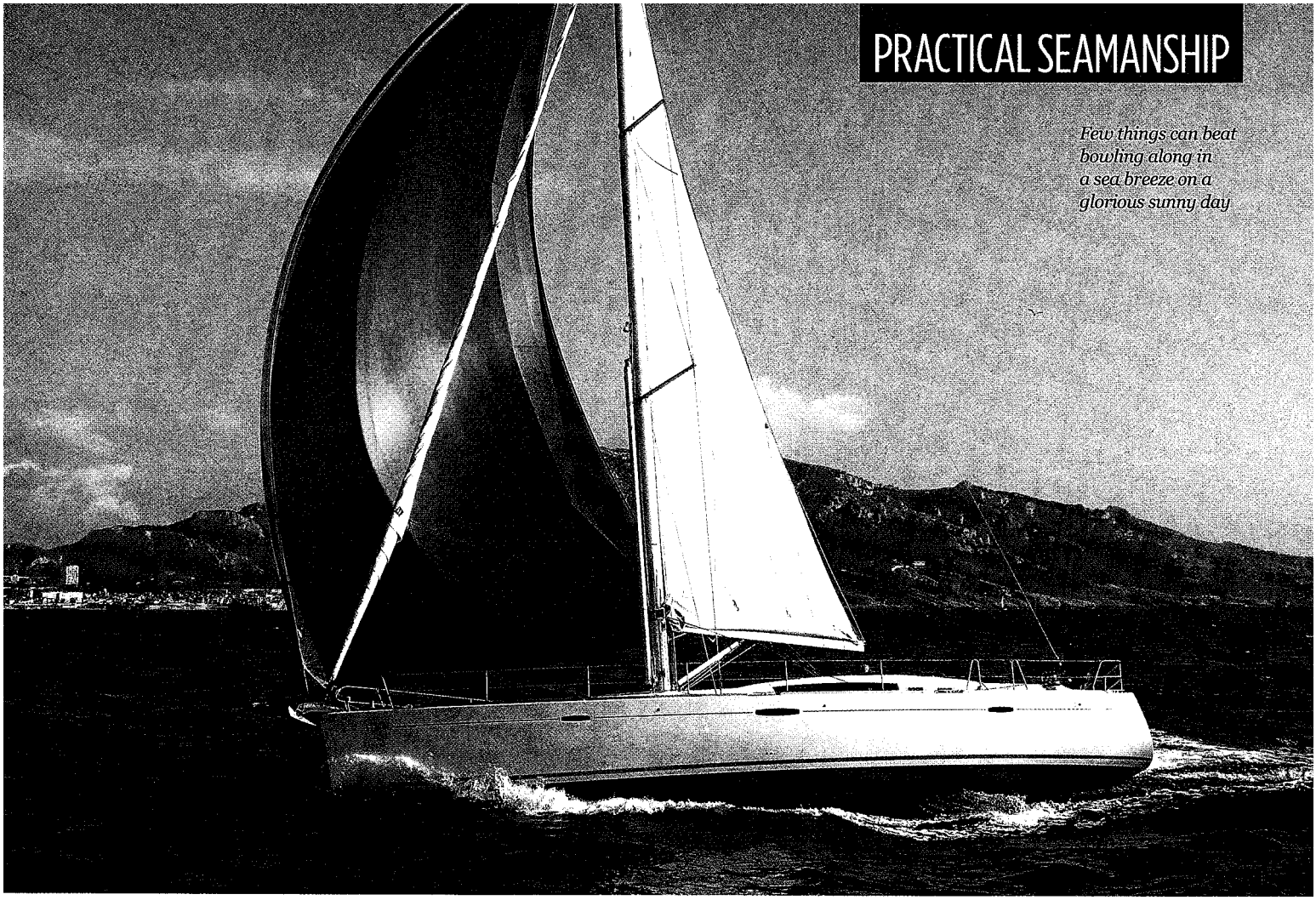
For similar reasons, the sea breeze along the south coast of Spain can be surprisingly weak. Although the gently sloping ground backed by



How sea breezes are formed

A 'typical' sea breeze day starts with a clear sky overnight, a slack pressure gradient and little or no wind. After sunrise, the land will warm up quicker than the sea. That causes the air near the ground to warm up and expand, leading to a movement of air out to sea at about 100–200m above sea level. That decreases the pressure over the land and increases the pressure over the sea. That pressure difference causes the air to flow from high to low pressure at sea level to compensate for the outflow higher up. That inflow is the sea breeze.

The descent of warm dry air over the sea causes warming and makes clouds dissipate. When cool moist air from the sea reaches land, the air rises and forms cloud, known as a sea breeze front. This is a fairly typical example of the front 'moving' inland, leaving no cloud over the sea.



Few things can beat bowling along in a sea breeze on a glorious sunny day

PHOTO: GRAHAM SNOOK/YM

hills facing the sun look ideal for a sea breeze, the effect of North Africa can dominate. Thus a promising day's sea breeze sail can turn into a disappointing motor-sail.

Land breezes

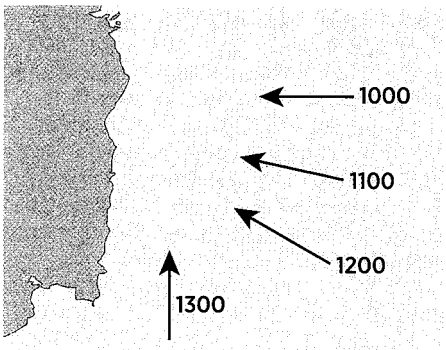
Cooling over land at night leads to higher pressure than over the sea and therefore a flow from land to sea. However, the effect is usually less well-marked and land breezes are generally lighter than sea breezes. The effect can be enhanced by the air being channelled by river valleys and even more so by the steep sides of the Scottish lochs and Norwegian fjords. These katabatic winds, as they are called, can be strong, up to gale force, in such areas and particularly around Greek islands, the Adriatic and the Aegean.

How strong? How far out to sea? How far inland?

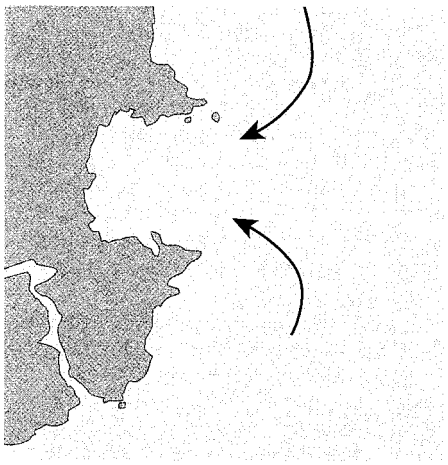
The answers to these questions depend on where you are, how hot the land can be by day and how cool at night. Here are a few pointers.

- A well-developed sea breeze can reach Force 4 or 5 around the UK but stronger when forced around headlands.
- In warmer areas, winds up to Force 7 or more can easily be achieved due to headland effects.
- A typical English south coast sea breeze can extend some 12 miles out to sea.
- The English south coast sea breeze can reach Salisbury, 30 miles inland, by evening.

In extreme cases, the sea breeze effect can be felt halfway across the English Channel; 30 miles out to the south of the Isle of Wight and about 40 miles south of Lyme Bay. In hotter regions of the world, sea breeze effects may reach up to 100 miles out to sea. ➔

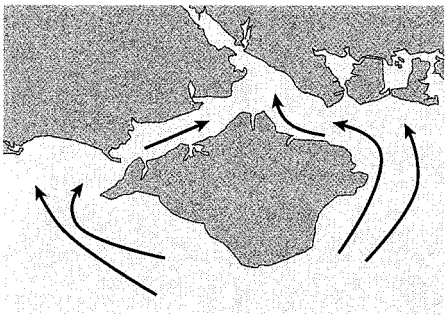


The Coriolis Effect means that a sea breeze will veer as it sets in, until it blows almost parallel to the coast

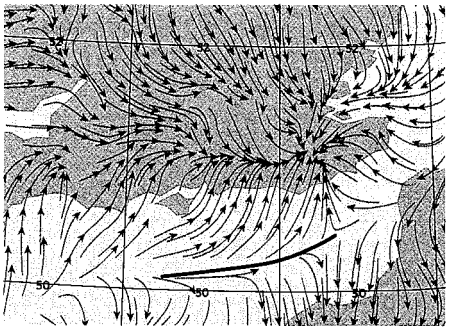


As Torquay and Paignton heat up on sunny days, the breeze is sucked into Torbay, strengthening around the headlands, Hope's Nose to the north and Berry Head to the south

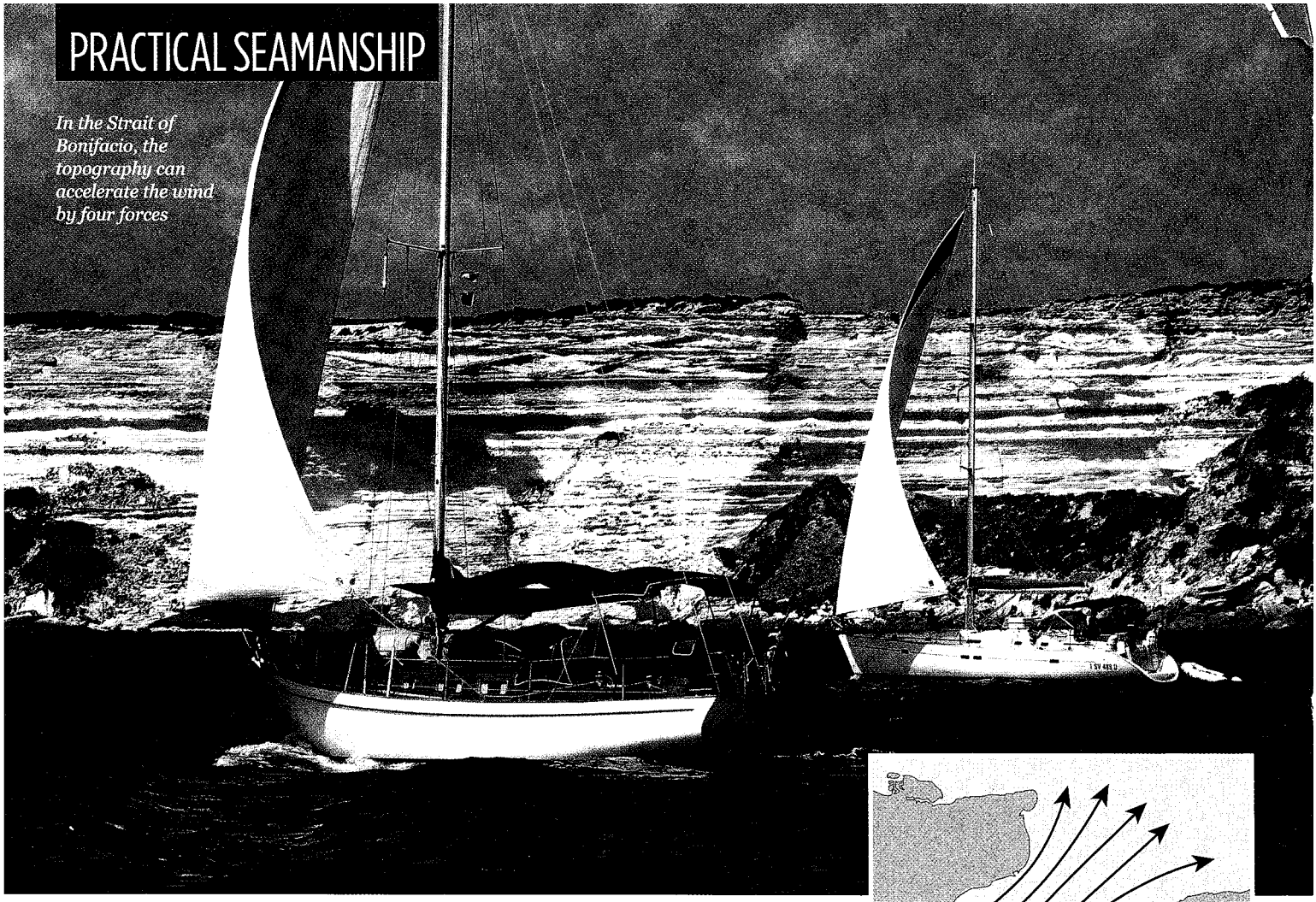
'The sight of two yachts running under spinnaker towards each other is well known in Torbay'



The heating of the mainland draws the breeze around the island, up both arms of the Solent

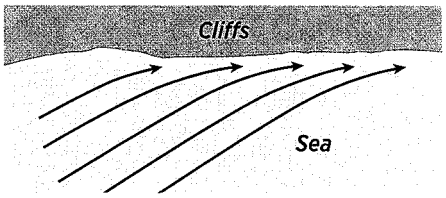


In this detailed analysis of sea breezes on a very hot day (reproduced courtesy of the UK Met Office), the solid black line shows where the sea breezes divide

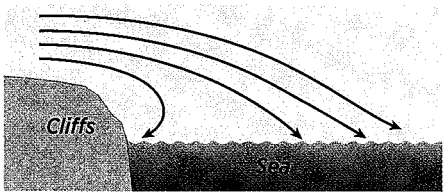


In the Strait of Bonifacio, the topography can accelerate the wind by four forces

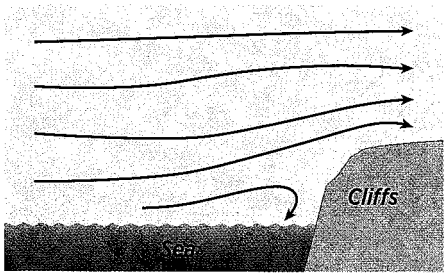
Cliffs, straits and headlands



Cliffs will deflect sea breezes along the coast, heading your course as you close the land



An offshore wind over a cliff can 'splashdown' causing strong gusts at a distance offshore of up to ten times the height of the cliff



Where onshore wind is deflected by a cliff, a reversing eddy can appear close inshore

In addition to the heating or cooling of the land, there are the 'mechanical' effects of headlands, cliffs, straits and shorelines in general, all causing changes in both wind speed and direction.

Wind blowing towards a line of cliff will be forced to change direction and move parallel to it. There is likely to be an increase in the speed as well as directional changes. The effect of being headed as a yacht approaches the coast is well known, and this is one reason.

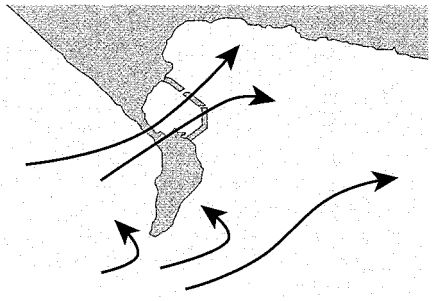
An offshore wind coming over a cliff may give eddy effects. The 'splashdown' of the wind can be an area of stronger winds; look for a more disturbed sea as far out as ten times the height of the cliffs. A wind directly onshore to a cliff may cause an eddy. Local sailors have been known to anchor close to the Babbacombe cliffs, just north of Torquay, using this eddying effect.

Wind blowing through a strait will be squeezed and thus increased in strength. Once through the strait, the wind will fan out. Through the Dover Strait, winds can be about one force stronger than up-or downwind. Through the Gibraltar Strait, the effect is more marked, while through the Strait of Bonifacio between Corsica and Sardinia, the effect can be an increase of four forces. A similar effect occurs in the North Channel between Northern Ireland and the Western Isles of Scotland.

Around Portland Bill. winds will form eddies, and squeeze between the Bill and the mainland. Changes in direction as the wind fans out over Weymouth Bay are well known – and used to win races by dinghy sailors with local knowledge. What happens on specific days will depend on the direction and strength of the wind approaching the Bill. As always, local knowledge and careful observation will pay handsome dividends.

PHOTO: ALAMY

Straits 'squeeze' the wind through a smaller gap, building its strength at the constriction



So many factors influence the breeze in places like Weymouth that local knowledge is key

Summary

Remember heating leads to lower pressure, and cooling leads to higher pressure. Think about Buys Ballot and it should start to make sense. Watch what happens; learn by experience. Try to distinguish between the effects of heating or cooling, mechanical effects of topography on the wind, and other effects such as gusts near showers and larger effects such as near fronts. It will not be easy but you will learn. That is the story of weather – and sailing. ▲