BOI 2011

Copenhagen, Denmark
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Day 1
Spoiler
vikings
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Treasures and Vikings

O(NM(N+M)) solution

With a bread first search (BFS), it is calculated how many rounds the Viking ship uses to get to any sea field. From every field you get to in the BFS you'll go horizontally and vertically (from this field) and note that the Viking can see these fields at the time they get to the first field. Since there are NM fields, and there are at most N+M fields that are horizontal or vertical to a given field the running time is O(NM(N+M))

Then make a BFS again, this time starting from the Y-position, so that you'll find all fields you can go to before the Viking can see them. Then just check if you can reach the treasure. This takes O(NM) times since there are NM fields, so the total running time is O(NM(N+M)).
Pseudo code for the Viking BFS:

```
Read input: water[i][j] ⇔ water at field (i,j)
Viking[i][j]: Num rounds before Viking can see (i,j). At first ∞
//BFS for Viking
Insert pos=V-position,distance=0 into bfsQueue
while bfsQueue is not empty:
    retrieve pos, distance from queue and remove afterwards
    updateVikingVertical(pos,distance)
    updateVikingHorizontal(pos,distance)
    add unvisited neighbours with distance=distance+1 to queue

procedure updateVikingVertical(pos=(i,j),distance):
    for k = i downto 1:
        if not water[i][j]: break
        Viking[i][j] = min(Viking[i][j],distance)
    for k = i to n:
        if not water[i][j]: break
        Viking[i][j] = min(Viking[i][j],distance)
```

O(NM) solution

The solution is based on the same idea. Initially: Find all "horizontal sea pieces", i.e. every sequence of horizontally aligned sea fields which have island fields (or the end of the map) to the left and to the right. When you do the BFS then every time you go horizontally to note that the Viking can see the fields, just store that the Viking can see this piece. Do the same vertically and you only check each field twice giving a running time of O(NM).

Task and spoiler made by Mathias Bæk Tejs Knudsen.