14TH INTERNATIONAL WORKSHOP ON
WAVE HINDCASTING AND FORECASTING
Key West, 8-13 Nov 2015

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“waving in the rain”

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the point we started from -

Question:

what happens to wind wave generation when it rains?

contrarily to common belief,

we claim(ed) that

rain makes waves grow higher

rain

high frequencies decreased or cancelled

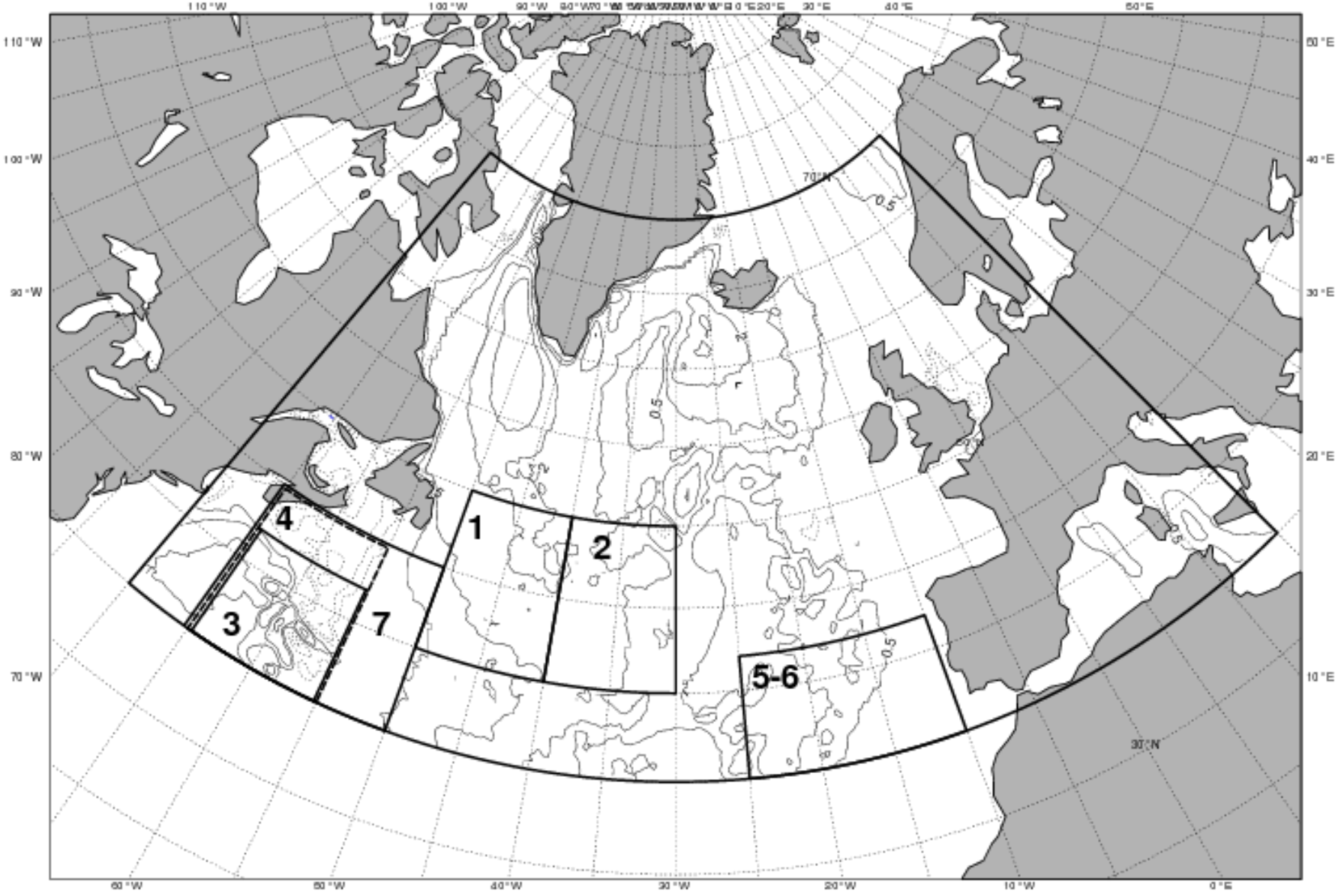
lower friction, hence less wind-to-waves momentum flow

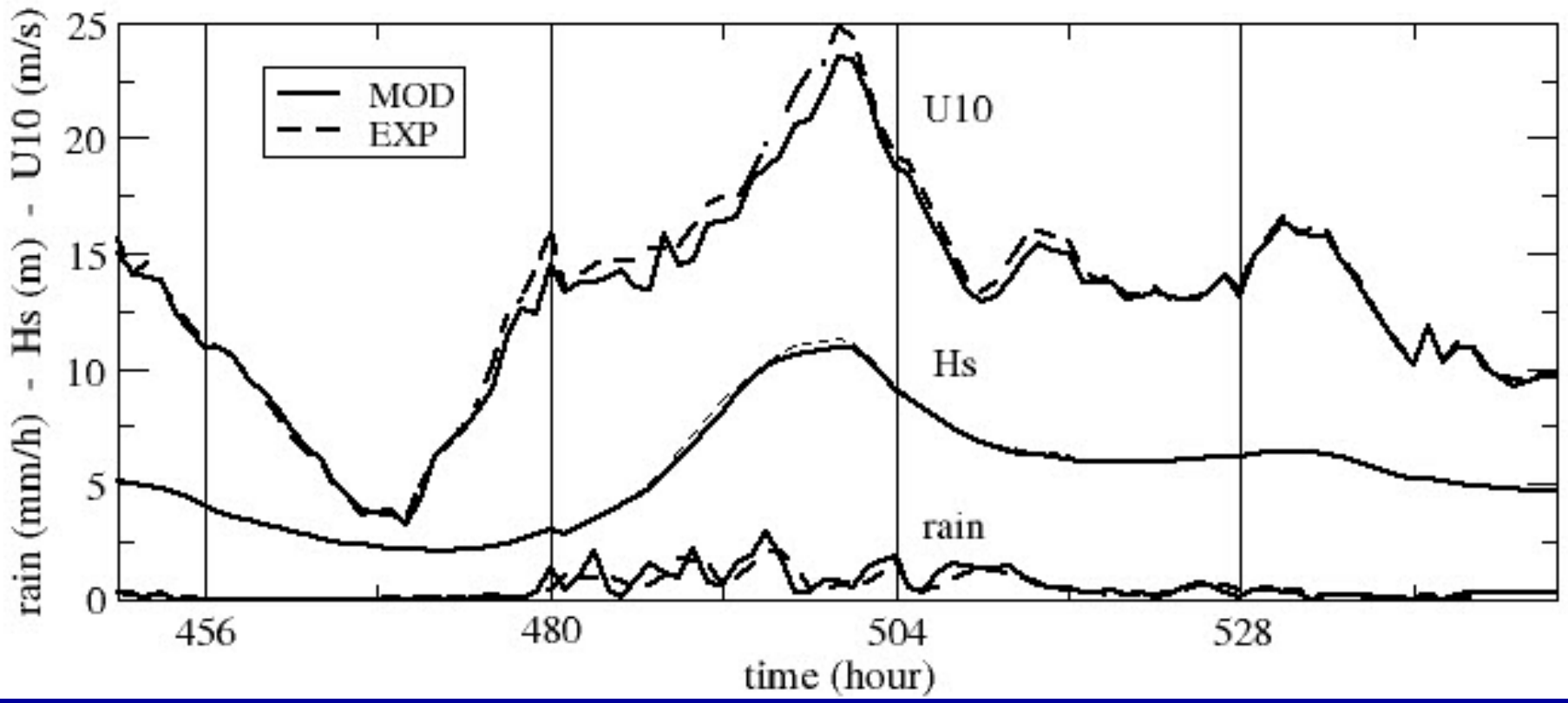
higher wind speed

Miles' or Janssen's process - more input to waves

larger wave heights

NORTH ATLANTIC - WAM WAVE HEIGHT AT 2009.12.10 09 UT
(Exp74 - Exp73): CONT=positive, DOT=negative, dH=0.1m




rain (mm/h) - Hs (m) - U10 (m/s)
25
20
15
10
5
0
MOD
EXP
U10
Hs
rain
456
480
504
528
time (hour)

now to serious business

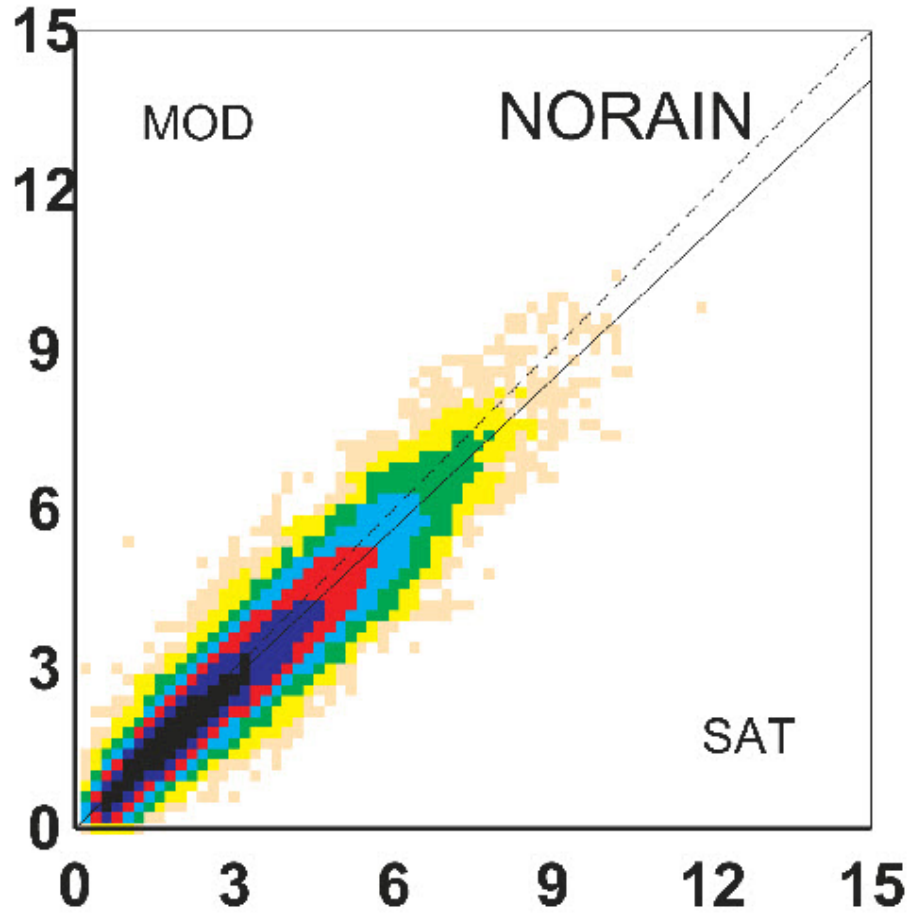
comparison of the operational results
in rainy and non-rainy areas

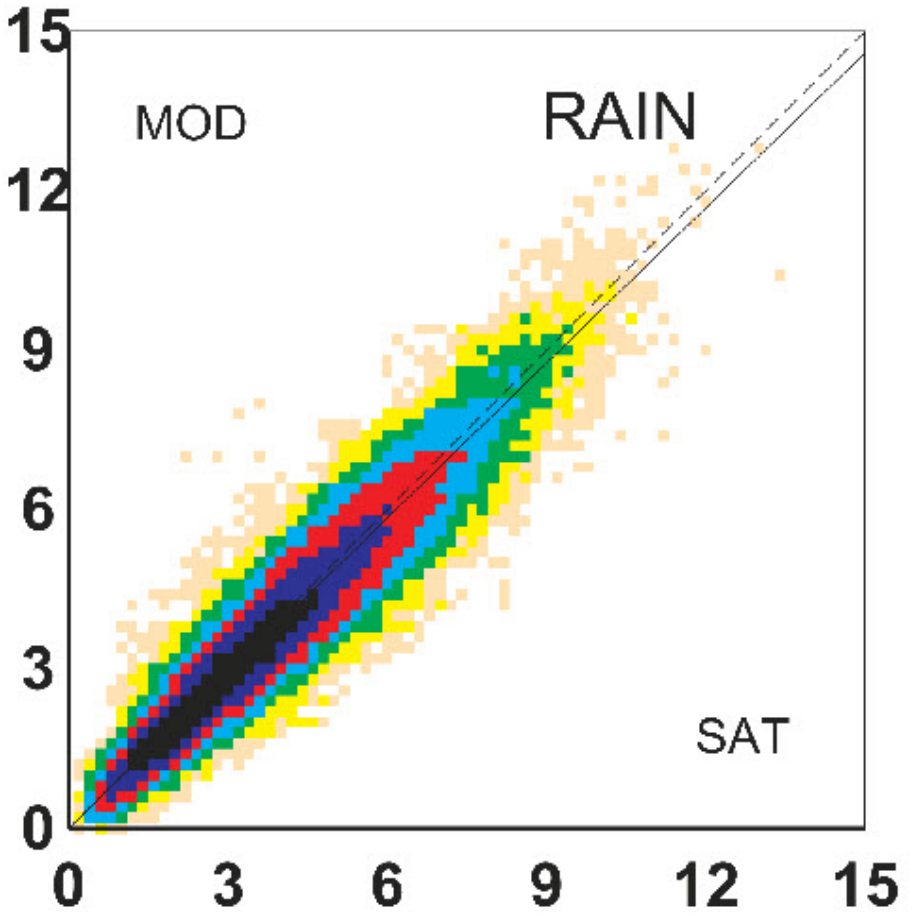
if we are right
we should find a difference

which difference?

if in rainy conditions waves grow higher,
model results (rain effects ignored)
should show an underestimate,
i.e. lower results compared to dry conditions

Hs operational results versus altimeter data



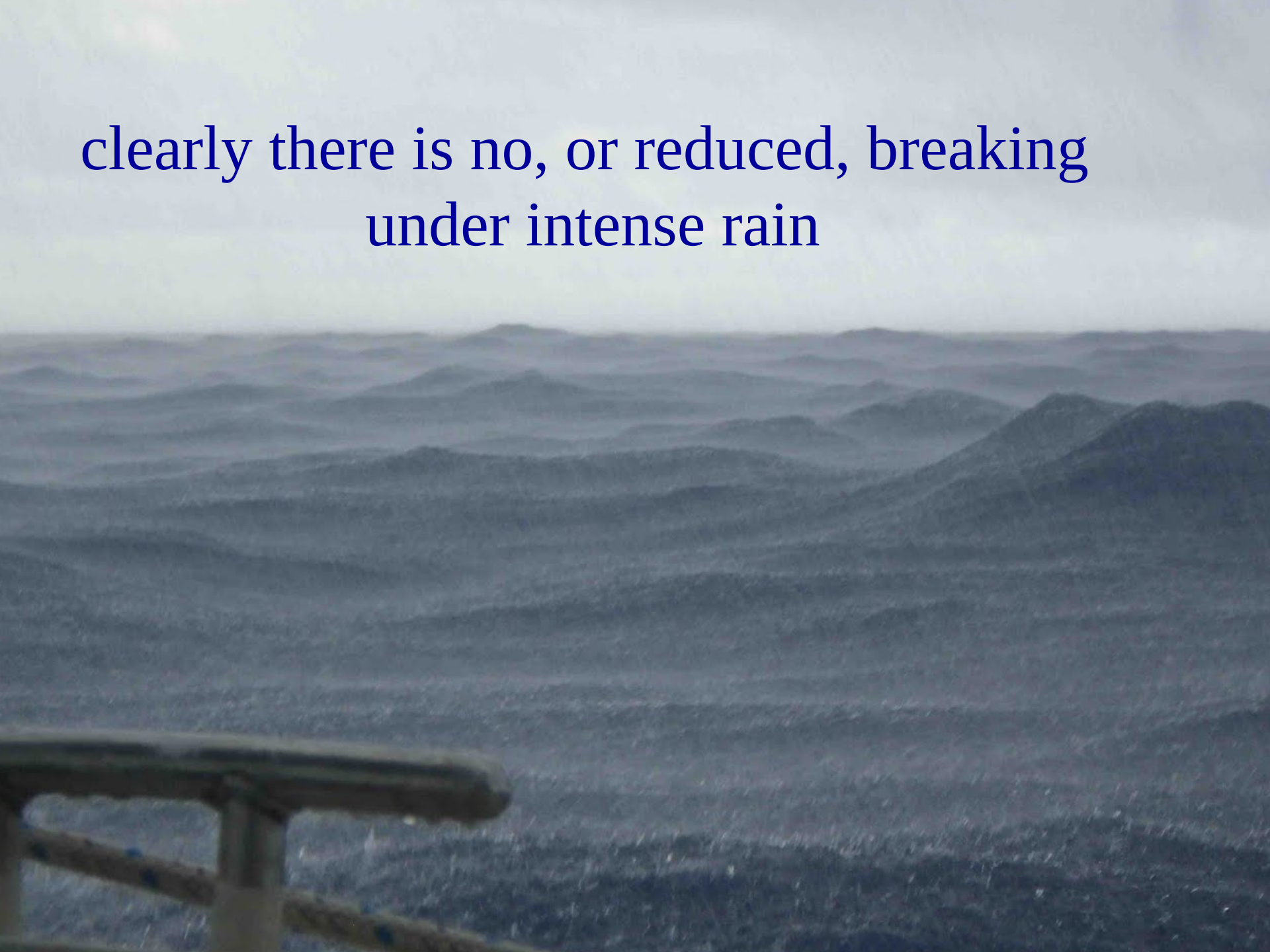


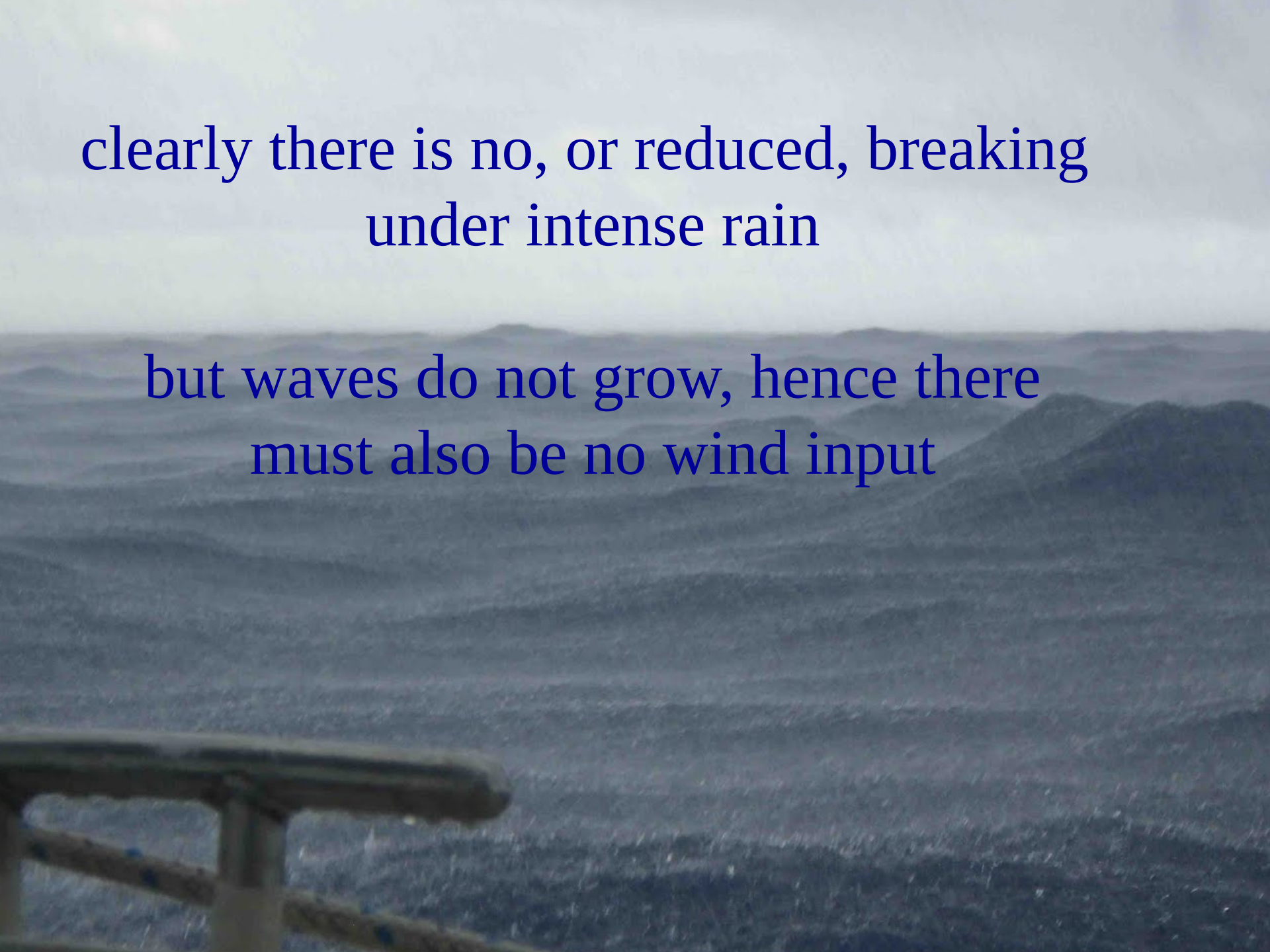
here we ran into trouble -

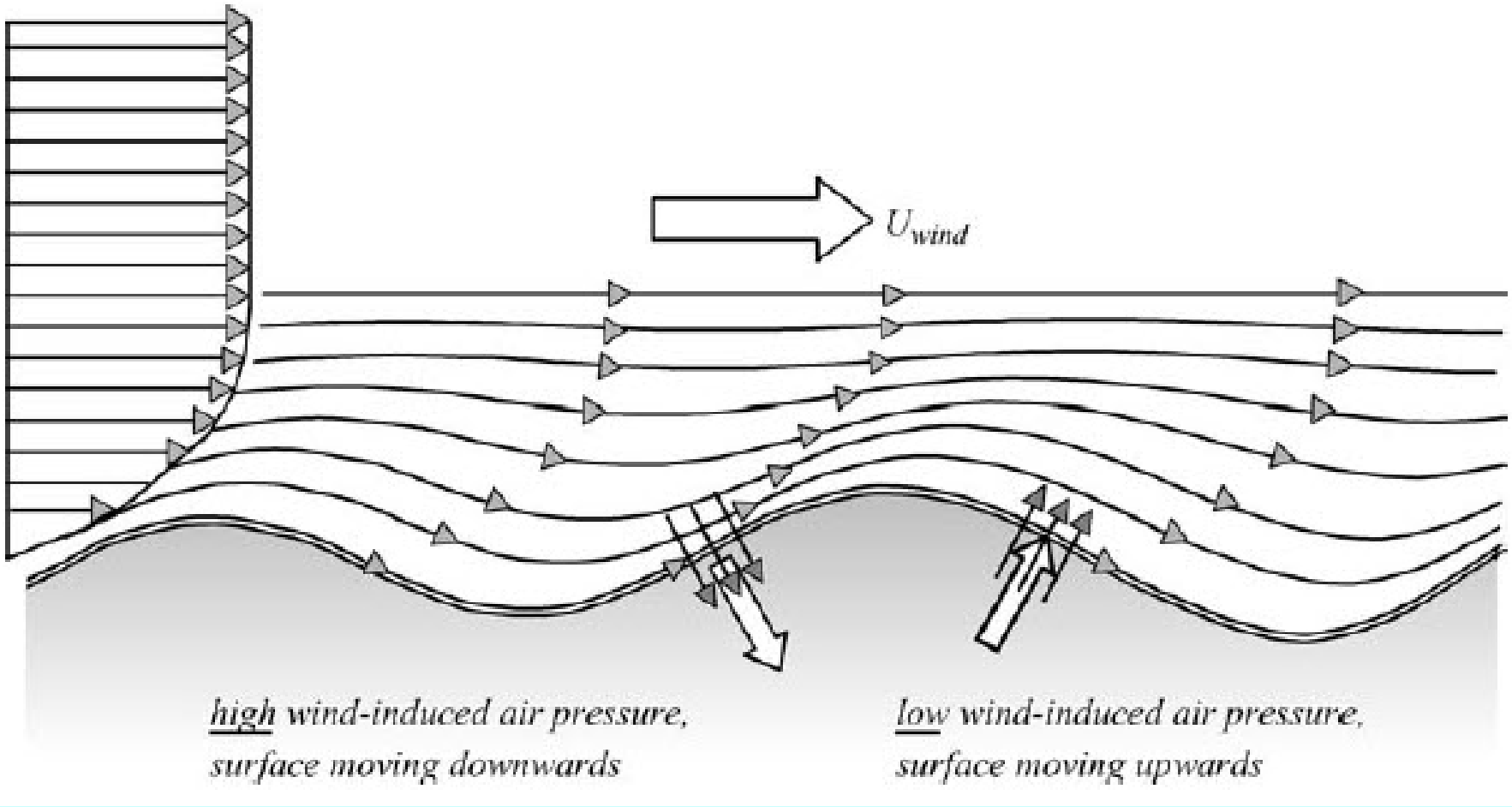
the results were the other way around -

wave heights are lower under the rain

(but wind speeds do appear faster)


clearly there is no, or reduced, breaking
under intense rain


clearly there is no, or reduced, breaking under intense rain
but waves do not grow, hence there must also be no wind input


U_{wind}
high wind-induced air pressure,
surface moving downwards
low wind-induced air pressure,
surface moving upwards

the wind slope at the sea (wave) surface
depends on the drag at the surface
(we are talking about wind stress)

the higher the drag at the surface,
the more rapidly the wind will grow there with height

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the relevant height for Miles' process is the so called
"critical height" – the lower this height,
the stronger the wind input, hence wave generation

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the first effect is to cancel the wavelets at the surface

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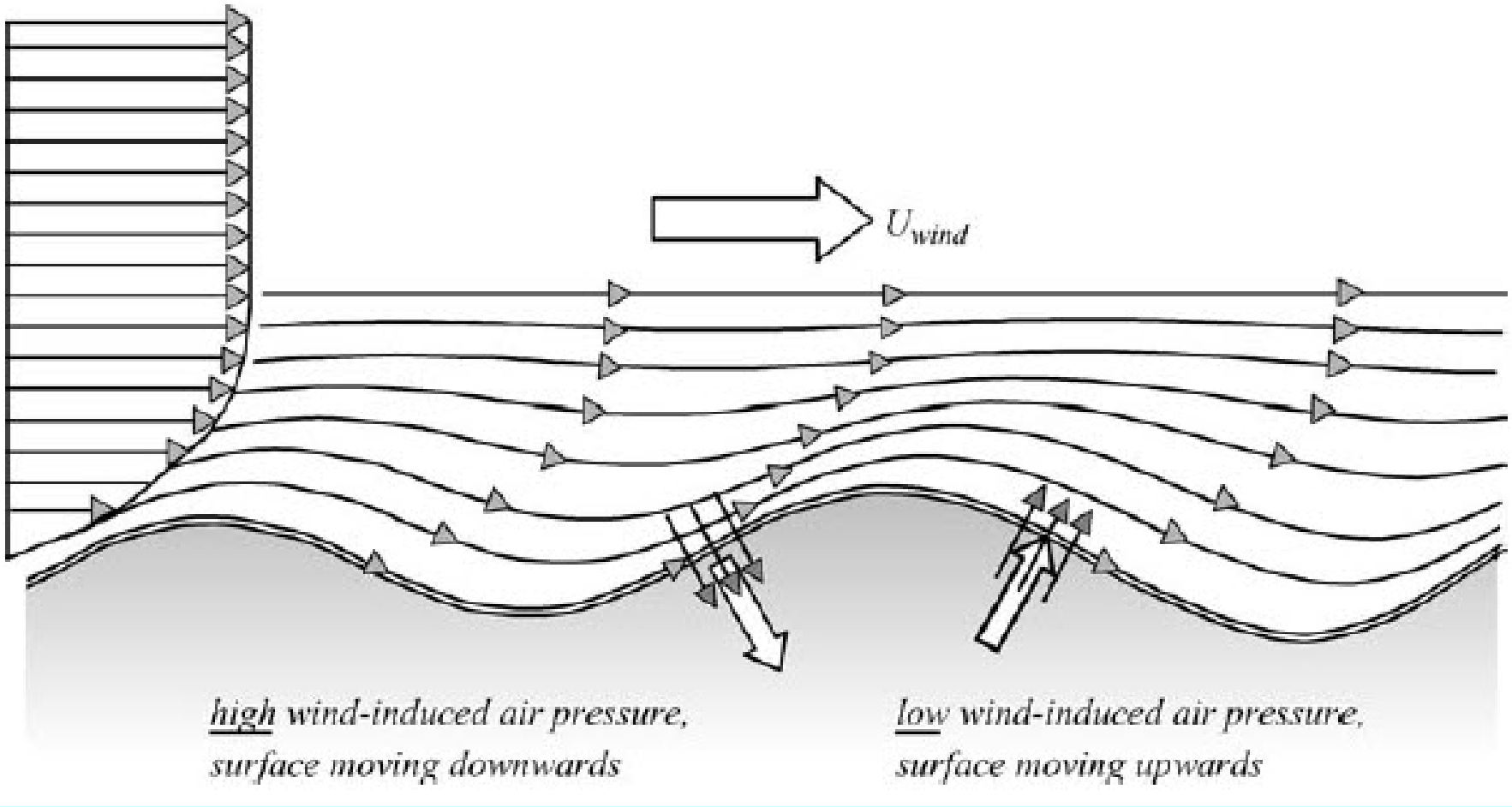
this makes the wind speed increase at the surface
more slowly with height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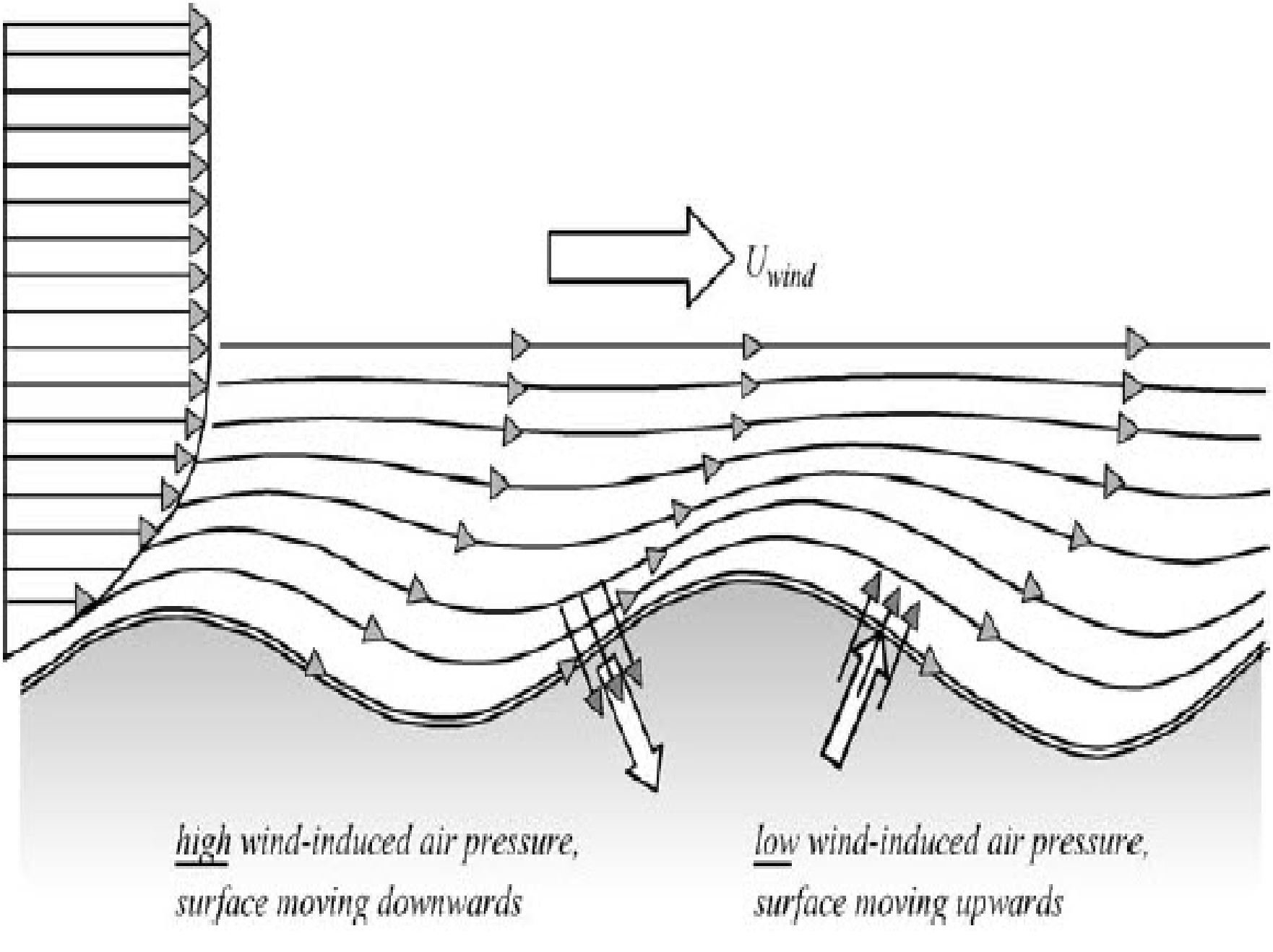
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this makes the wind speed increase at the surface more slowly with height

this increases the height of the “critical layer”, hence **Miles’ input drops drastically**

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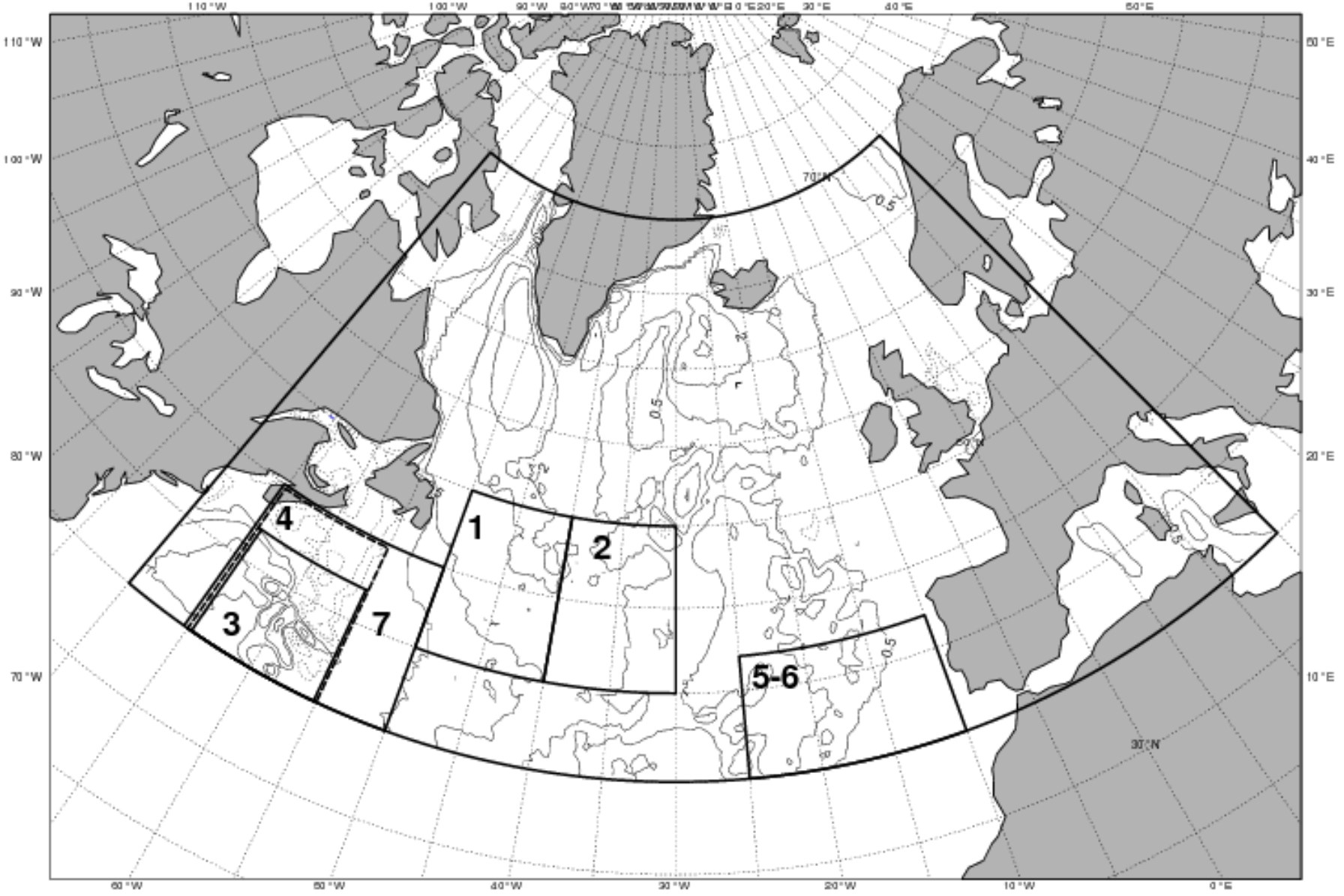
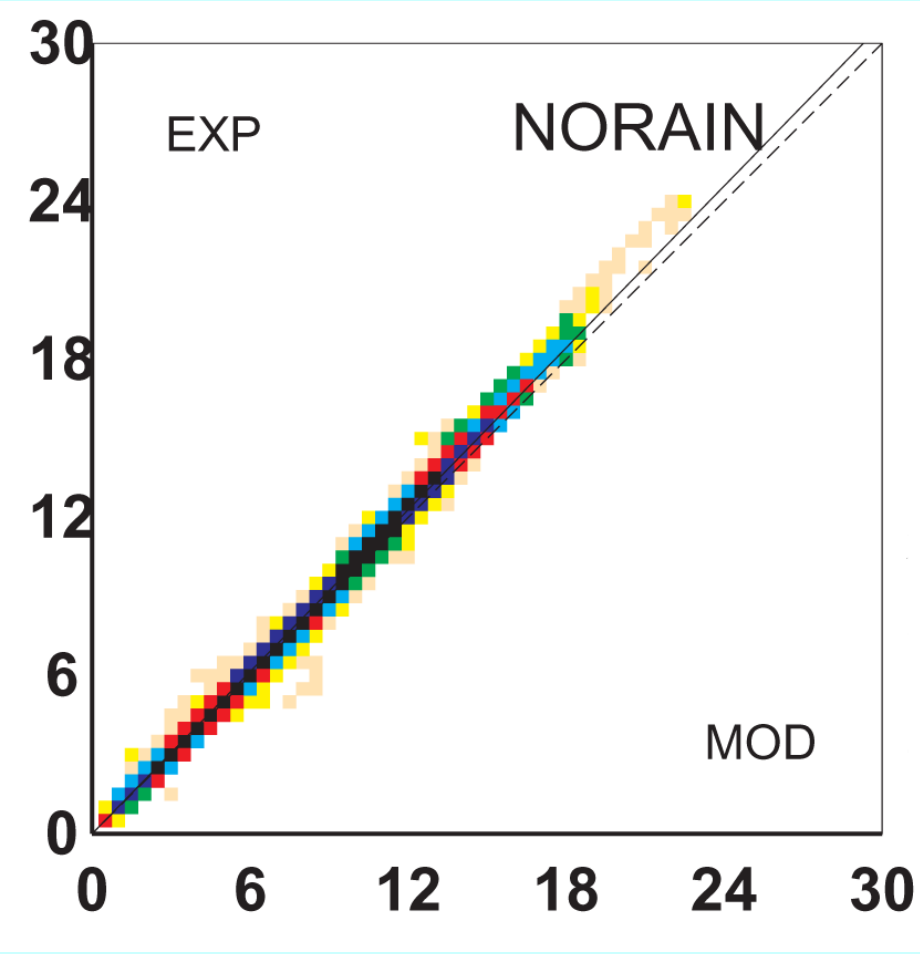
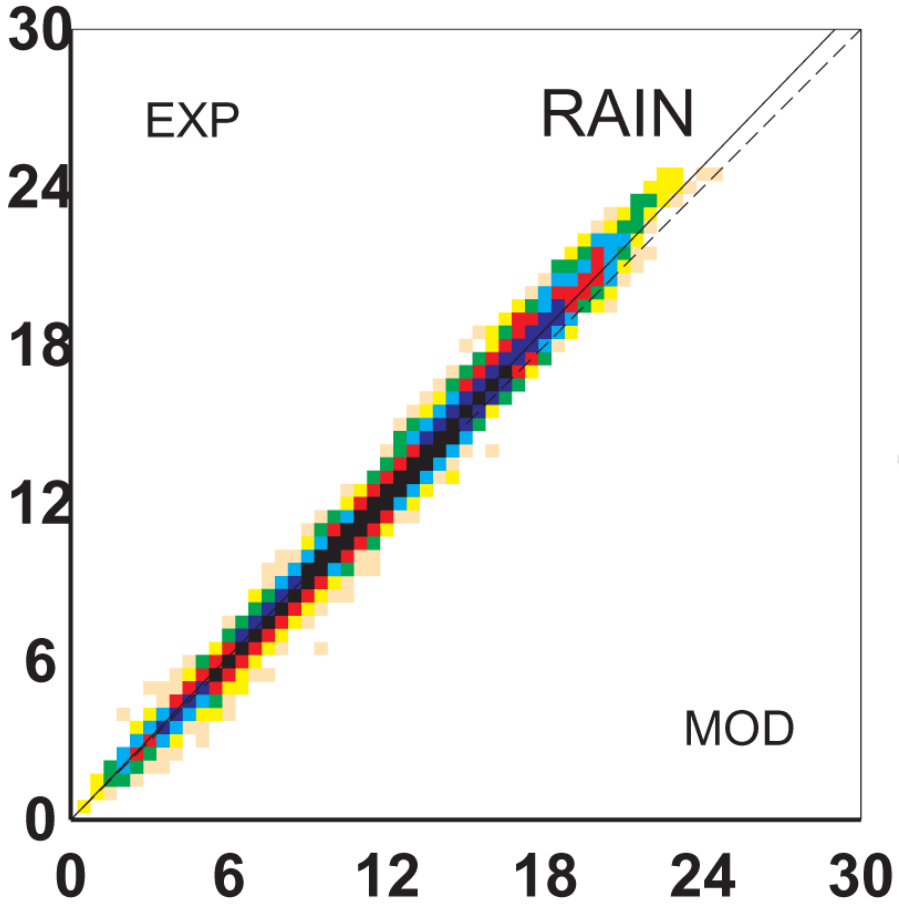


wind speed - exp versus regular model





sig. wave height - exp versus altimeter data