A sensitivity analysis of dual-excitation, single-emission roGFP imaging

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Abstract

Abstract lorem ipsum

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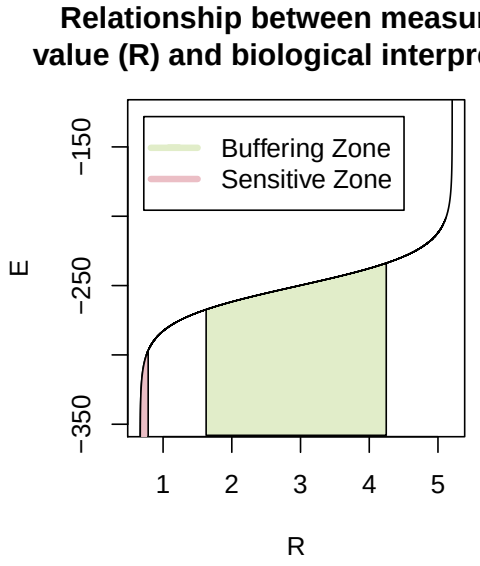
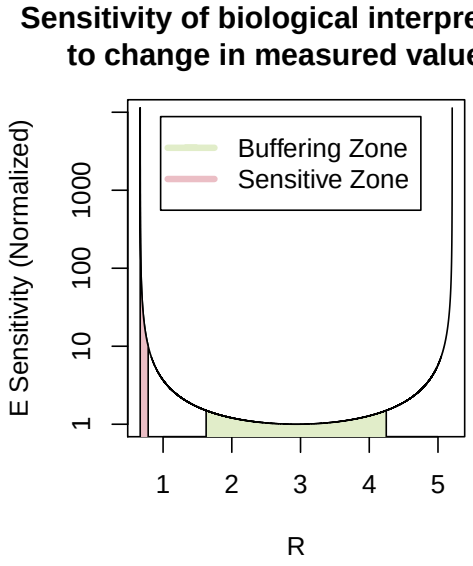
0.0.1 The biological interpretation (E) of redox imaging displays regions of differing sensitivity to changes in the directly-measured values (R).





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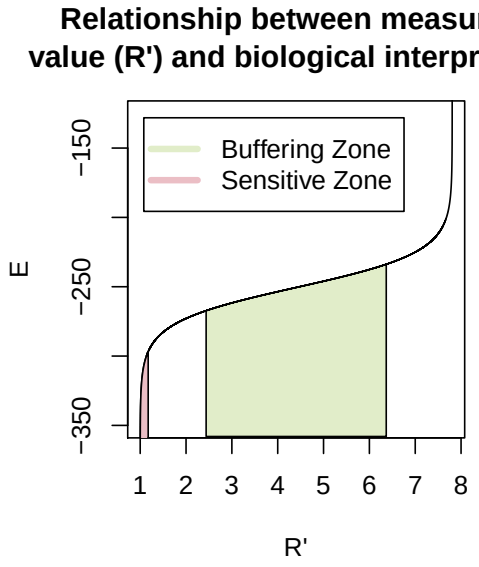
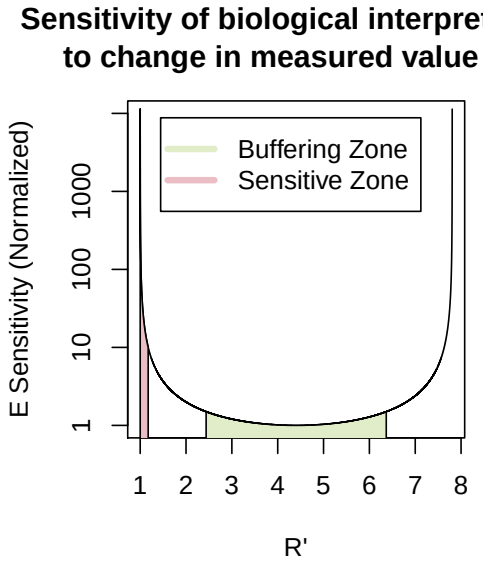




Note that the electrical potential E is related to R via E° , R_{min}, R_{max}, and δ:

$$E = E^\circ - \frac{-RT}{2F} ln(\frac{1 - \frac{R-R_{min}}{(R-R_{min})-\delta(R_{max}-R)}}{\frac{R-Rmin}{(R-R_{min})-\delta(R_{max}-R)}}) = E^\circ - \frac{-RT}{2F} ln(\frac{\delta * (R_{max} - R)}{R - R_{min}})$$

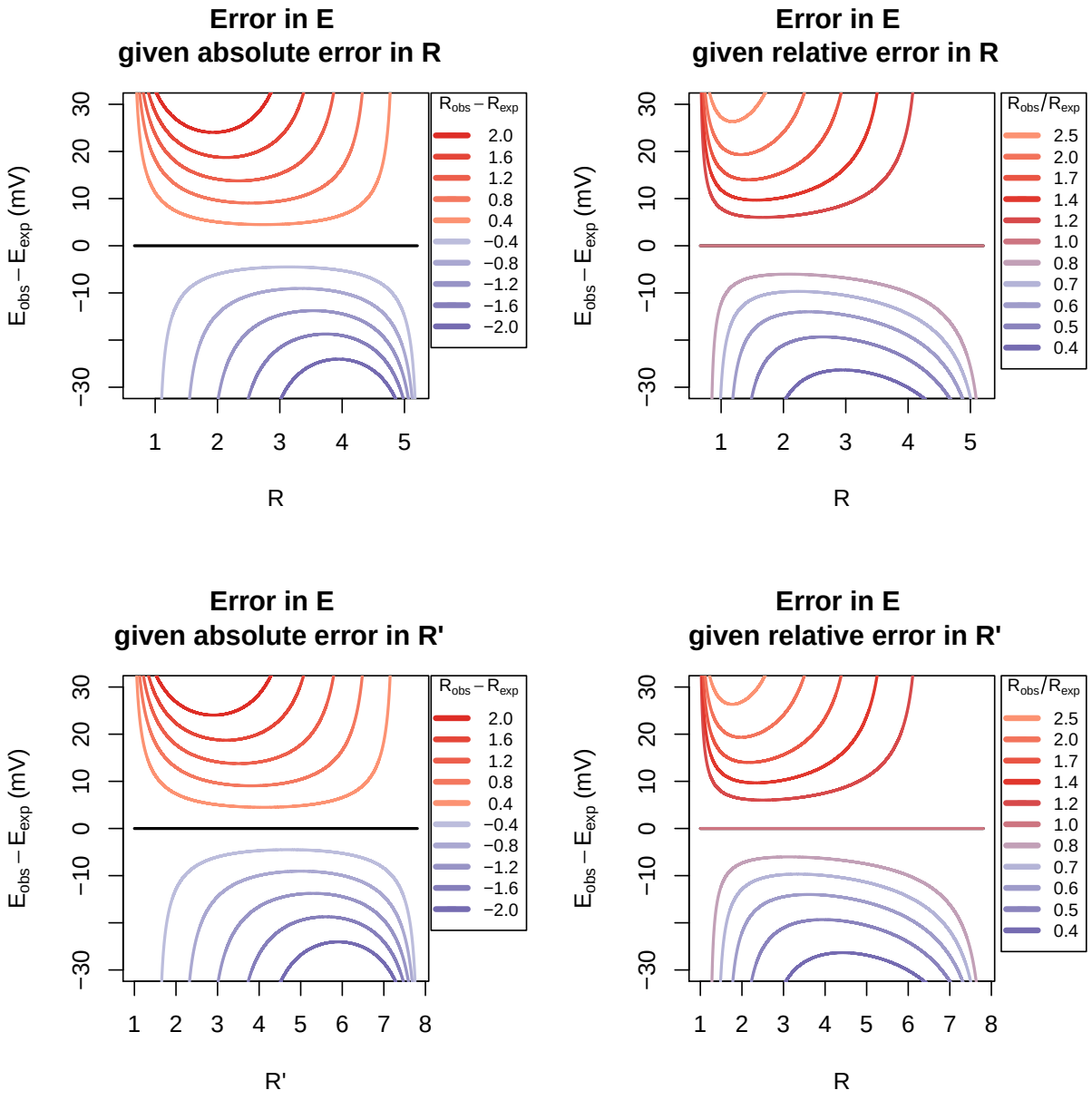
.

But the derivative of the electrical potential E with respect to R is only dependent on the R_{min} and R_{max}:

$$\frac{\partial E}{\partial R} = \frac{-RT}{2F} * \frac{R_{max} - R_{min}}{(R - R_{min})(R - R_{max})}$$

In other words, the relative dynamic range in each channel (δ_λ) has no effect on the sensitivity of the biological interpretation to a change in measured value. The error will be minimized when the measured value R is exactly in the middle of the maximum possible value R_{max} and the minimum possible value R_{min}. As the measured value approaches either of the extremes, the error asymptotically approaches infinity.

0.0.2 Translating from general sensitivity (in the previous section) to the particular errors in biological interpretation, given a relative or absolute error in the directly-measured value.



Following from the math in the previous section, changing the δ_λ of the sensor will have no effect on these graphs. Changing the overall dynamic range will scale the graphs, but the general shape of the plot will stay constant.