Tasmania internal tide experiment: Preliminary modeling

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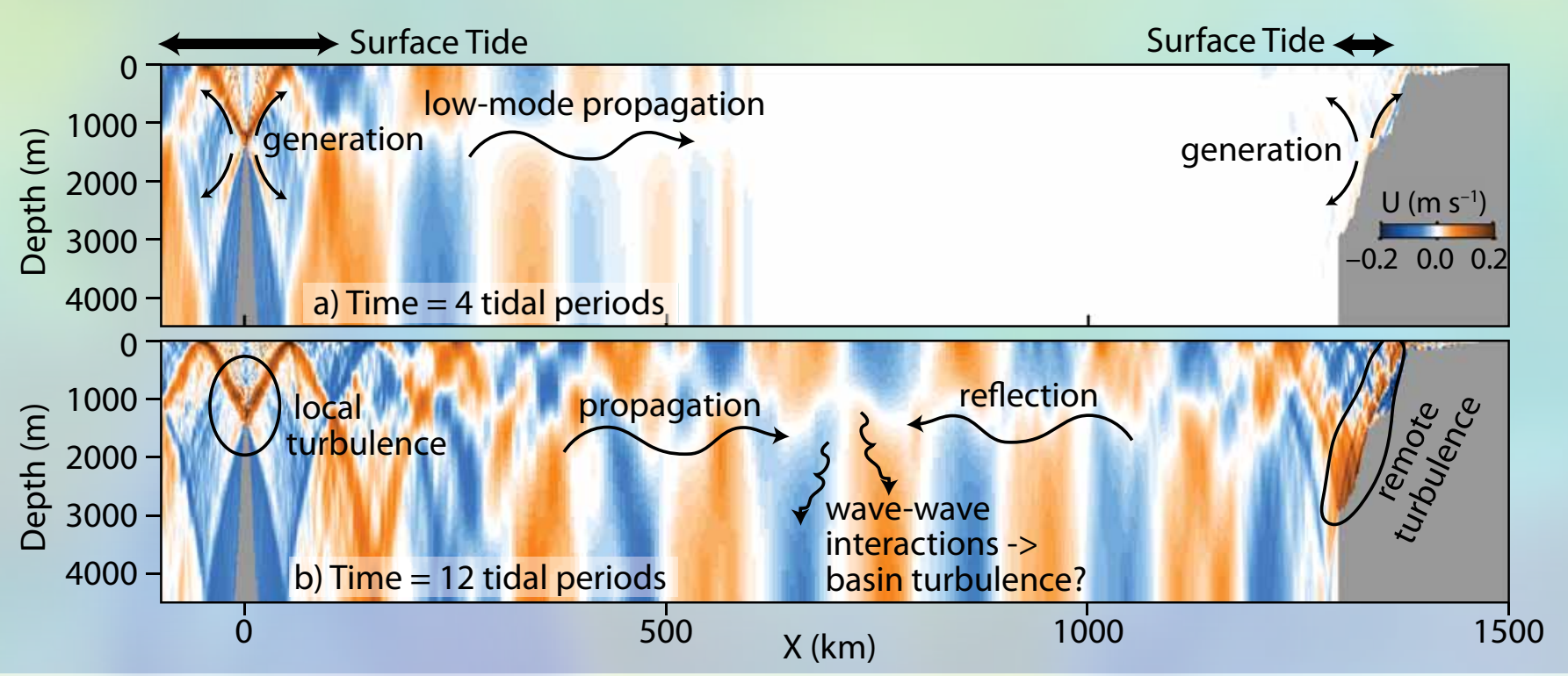
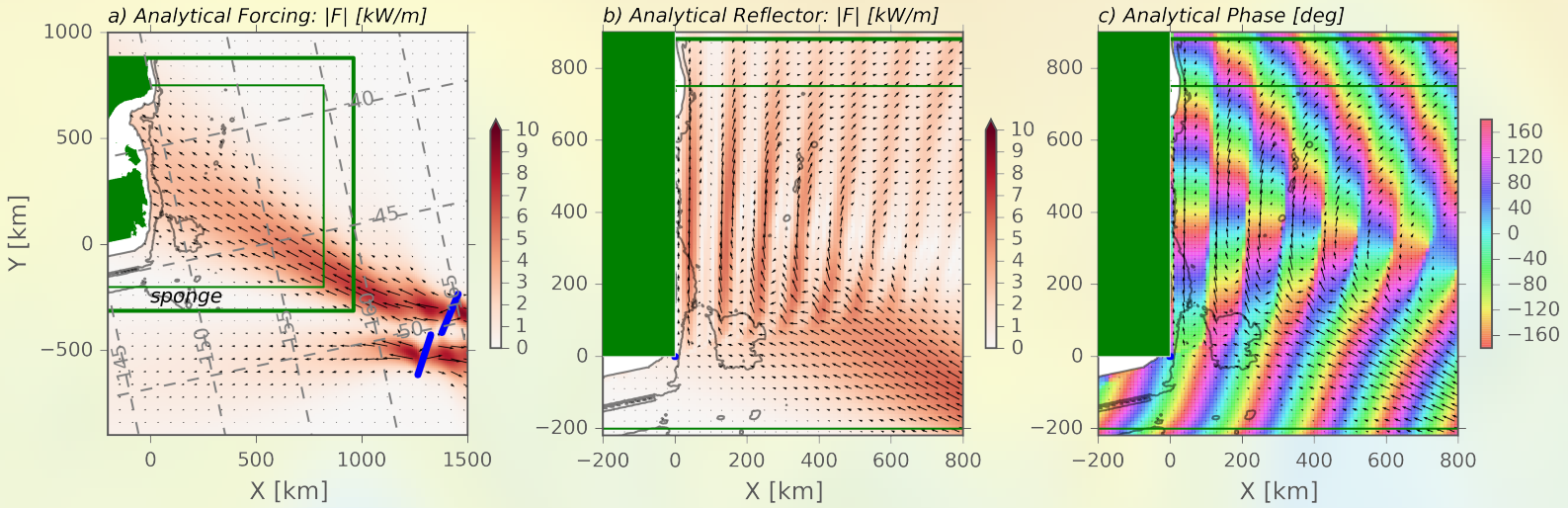


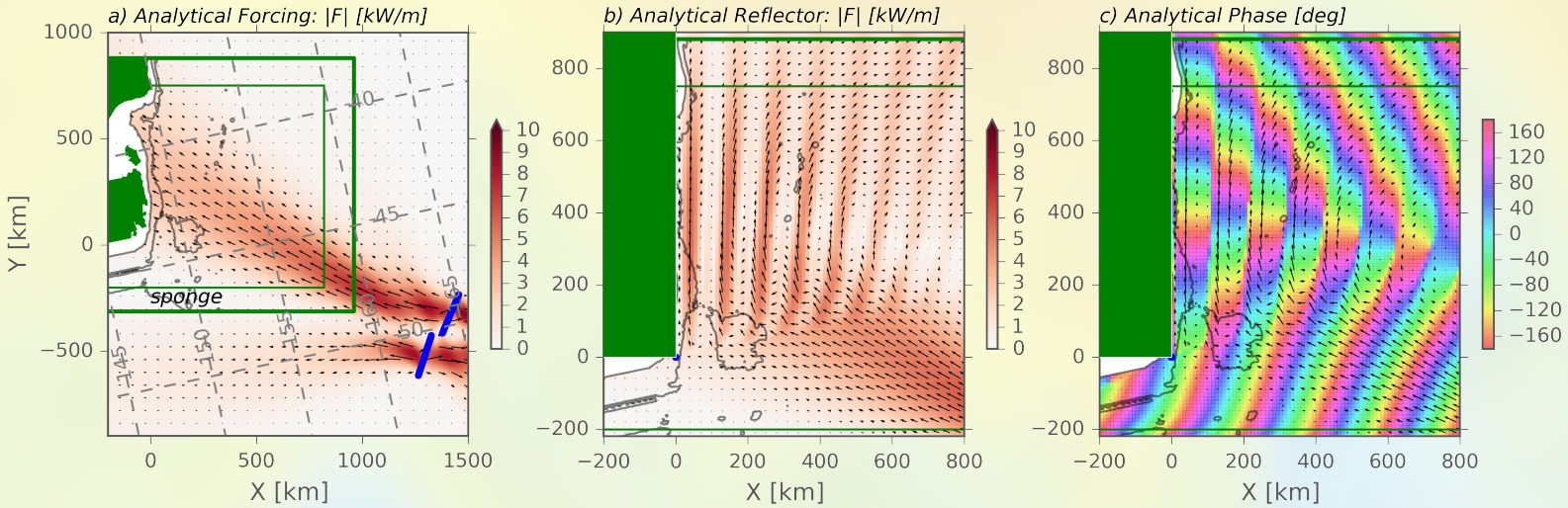
Rob Pinkel, Matthew Alford, Jennifer MacKinnon, Jonathan Nash, Harper Simmons, Dmitry Brazhnikov, Sam Kelly, Amy Waterhouse, Nicole Jones

Setup



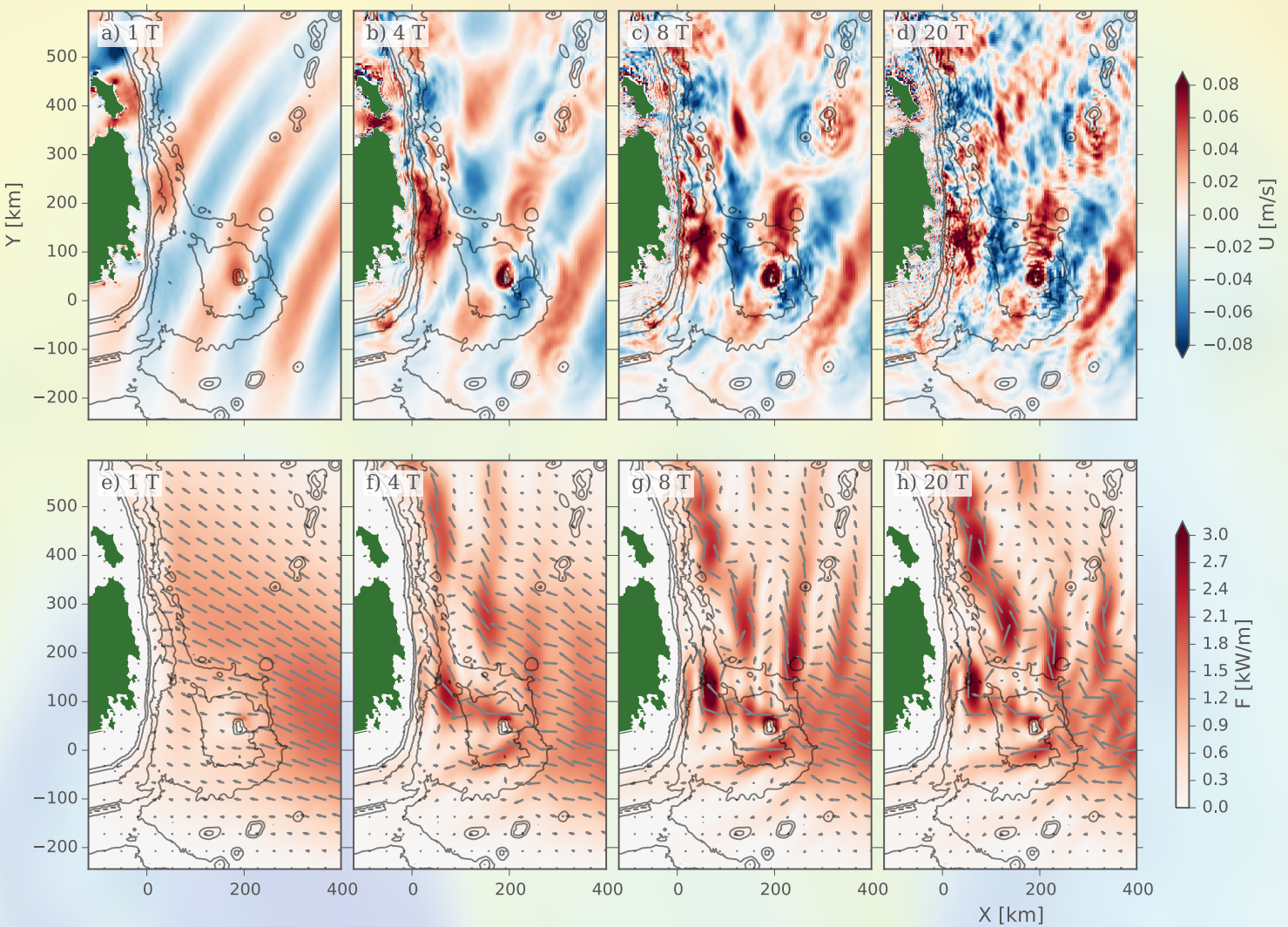
- MITgcm (hydrostatic, Klymak and Legg 2010 dissipation)
- Analytical M_2, mode-1, forcing meant to represent Macquarie Ridge
- Coarse: central region 5 km x 5 km, telescope around this.
- Fine: central region 100 m x 200 m, telescope around this.
- sponge forcing and absorbers

Setup

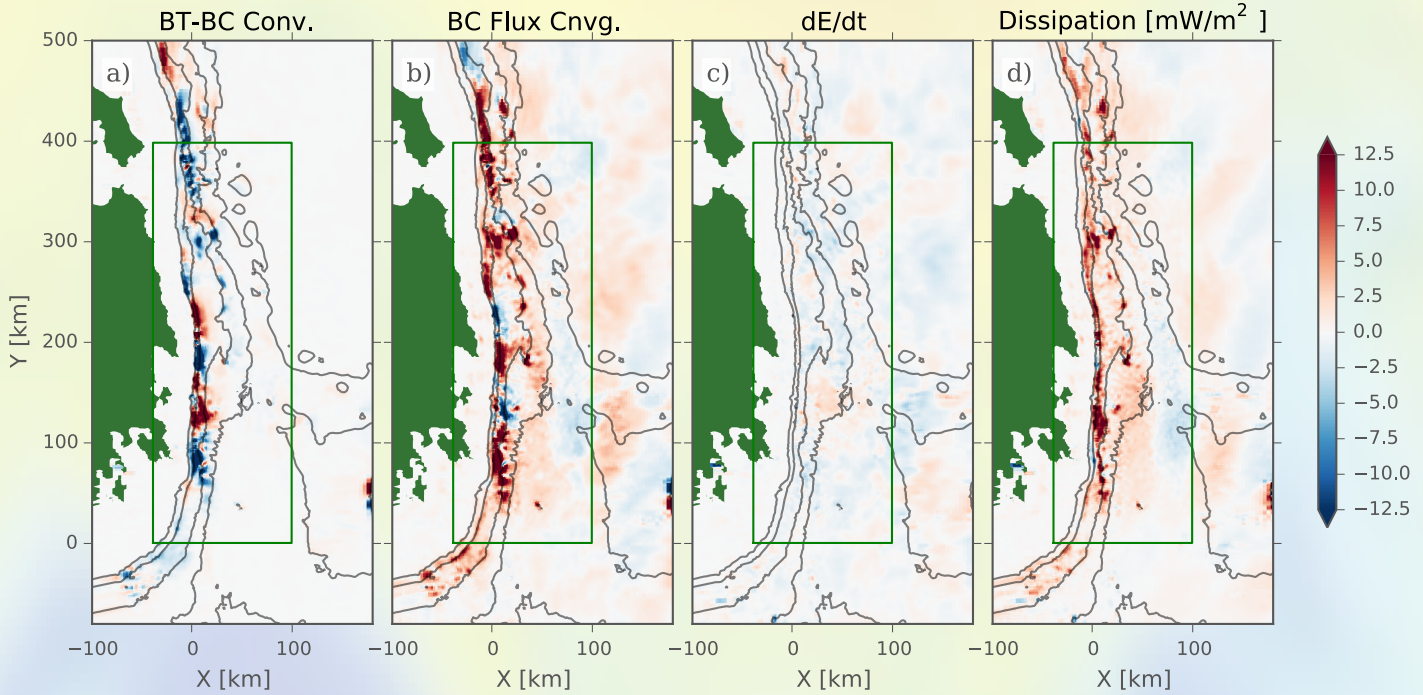


- Standing wave cross-slope ($k_x = cos(30)k_r$)
  - beam at about 30 degrees to wall.
  - 180 degree phase reversal at 50 km, 150 km, 250 km etc.
- Propagating wave along-slope ($k_y = sin(30)k_r$)
- Slight curvature due to the spherical spreading of the incoming wave.

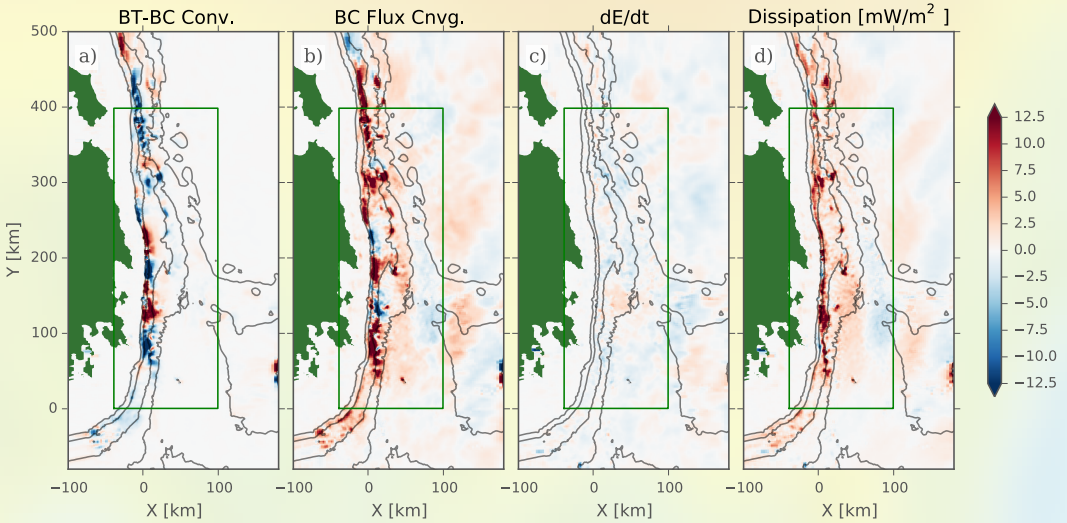
Response

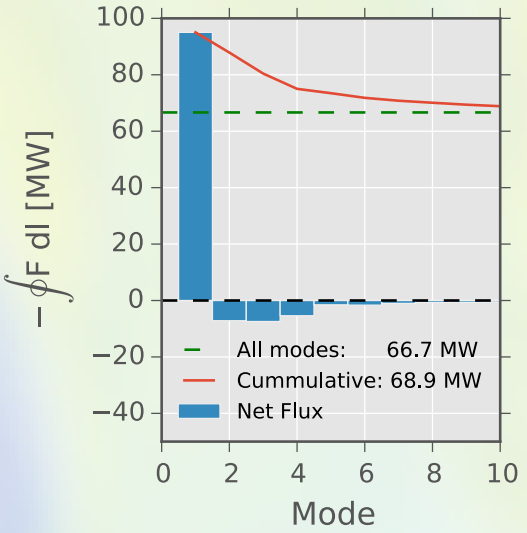


Response

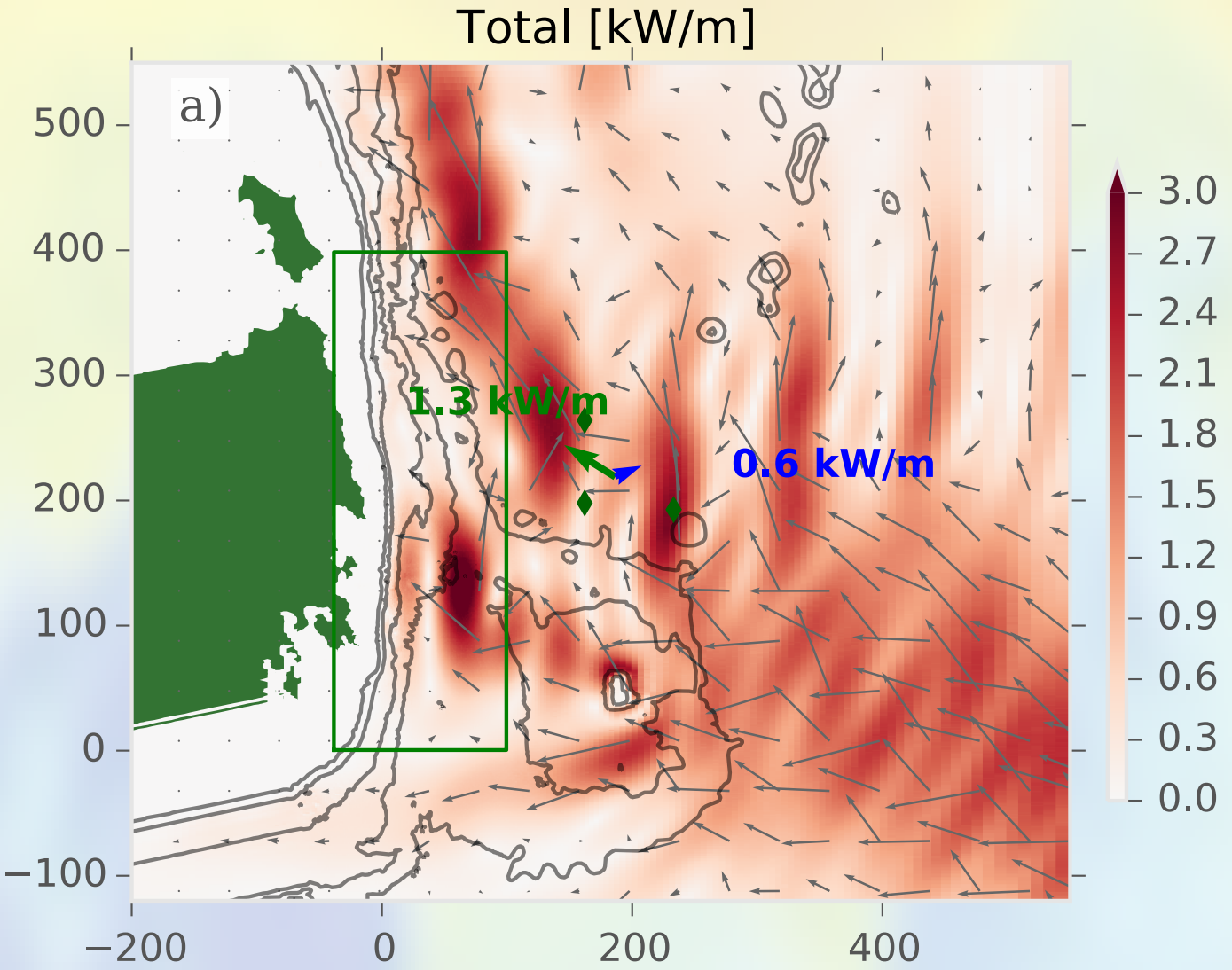

BT-BC Conv.
BC Flux Cnvg.
dE/dt
Dissipation [mW/m^2]
a)
b)
c)
d)
Y [km]
X [km]
500
400
300
200
100
0
−100
0
100
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
−12.5

Net Energy Budget

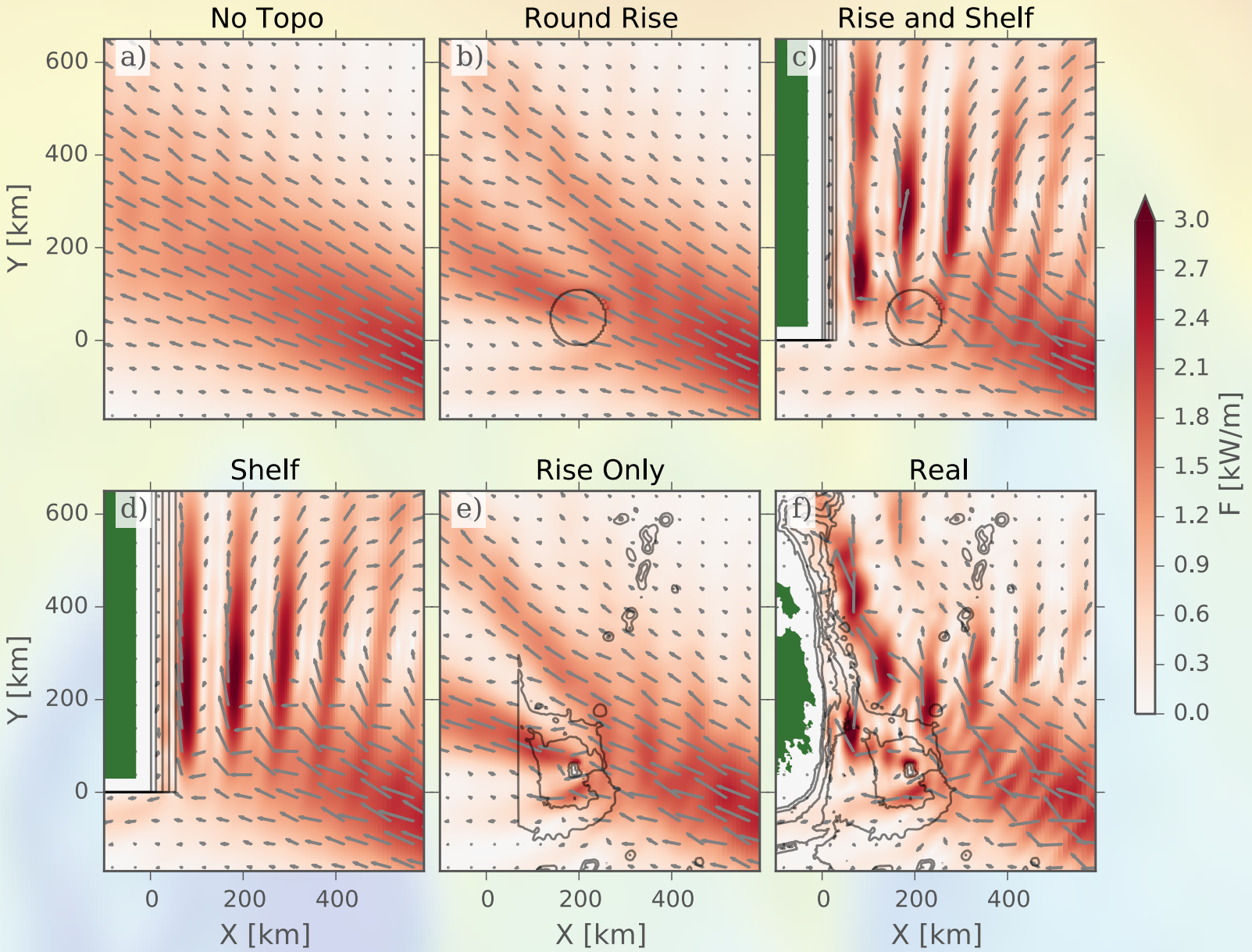




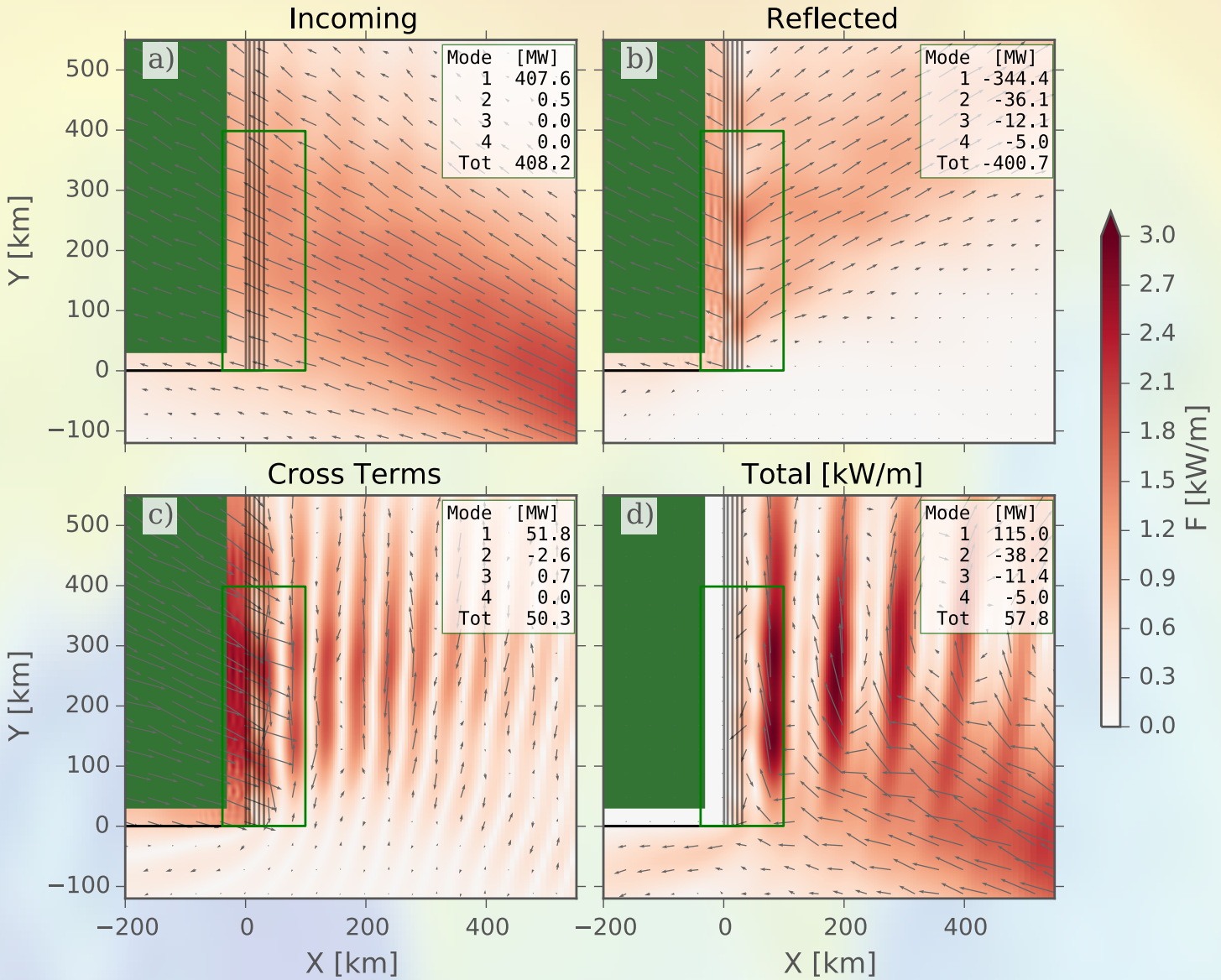
Two-waves: mooring



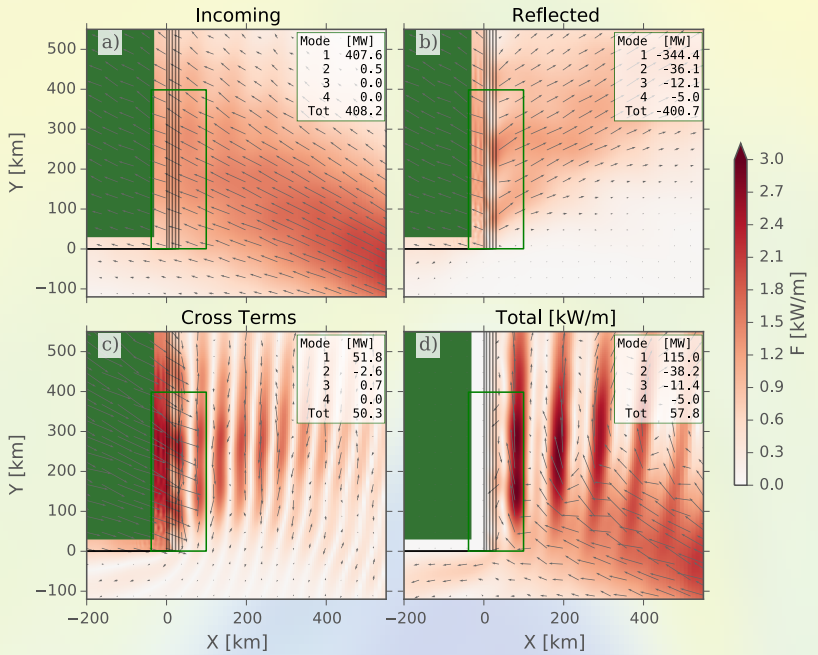
Incoming versus outgoing: Simplified Geometries



Incoming versus outgoing: Simple Shelf



Incoming versus outgoing

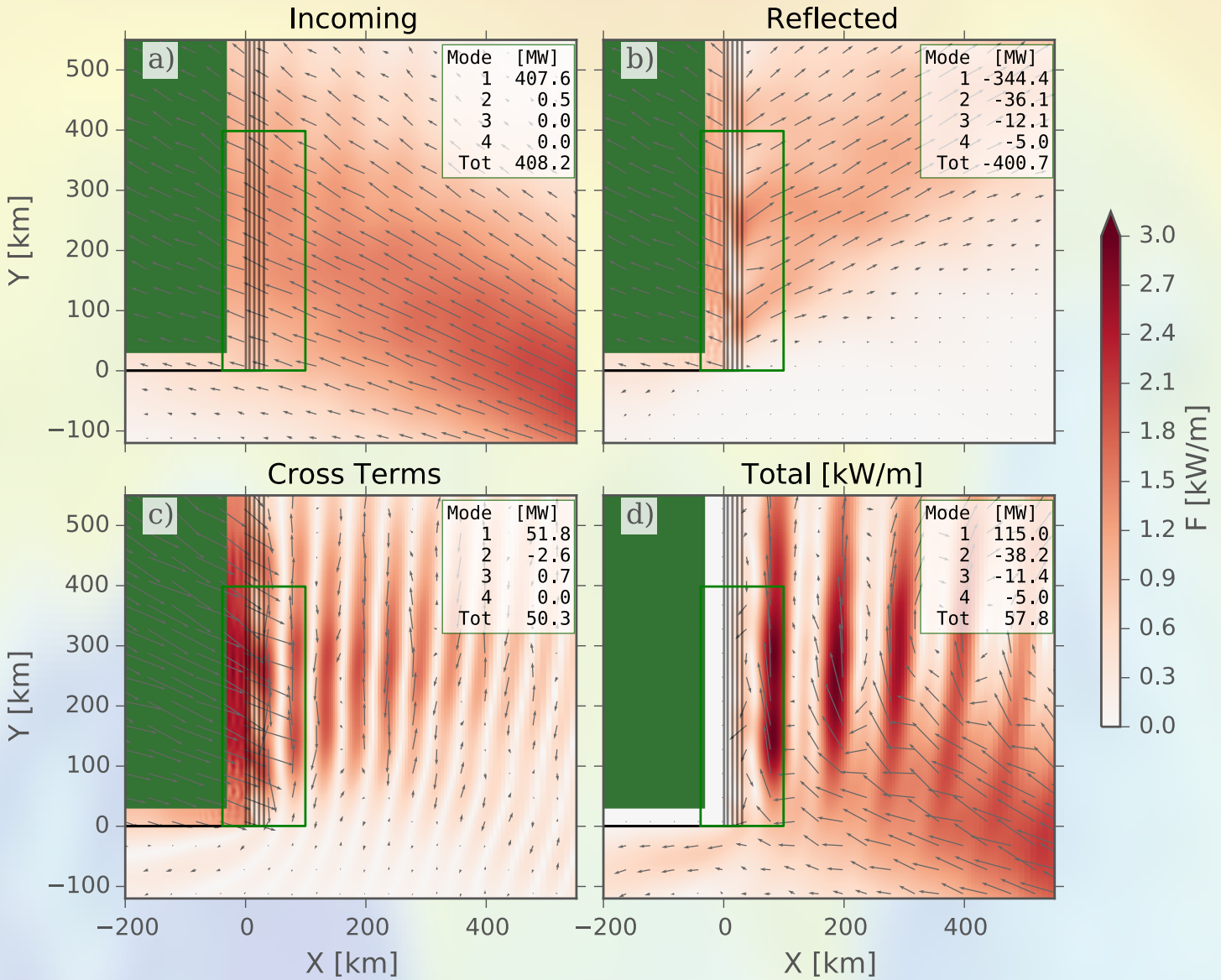


$$
\begin{aligned}
u_1^t(x,y) &= u_1^i + u_1^r \\
v_1^t(x,y) &= v_1^i + v_1^r \\
p_1^t(x,y) &= p_1^i + p_1^r
\end{aligned}
$$

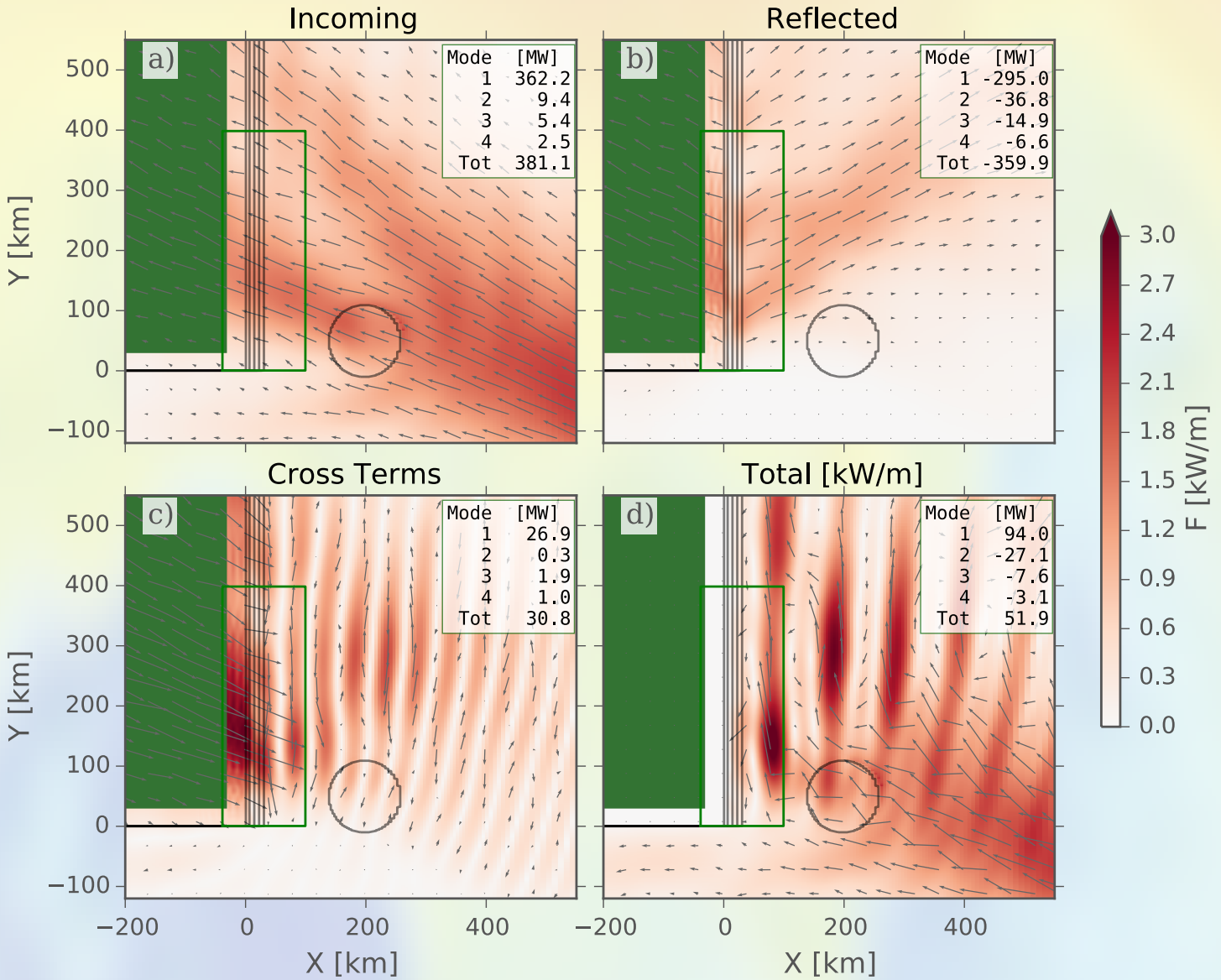
$$
P_{u1}^t = \overbrace{u_1^i p_1^i}^{Incoming} + \overbrace{u_1^r p_1^r}^{Reflected} + \overbrace{u_1^i p_1^r + u_1^r p_1^i}^{Cross\ \ Terms}
$$

$$
P_{v1}^t = \overbrace{v_1^i p_1^i}^{Incoming} + \overbrace{v_1^r p_1^r}^{Reflected} + \overbrace{v_1^i p_1^r + v_1^r p_1^i}^{Cross\ \ Terms}
$$

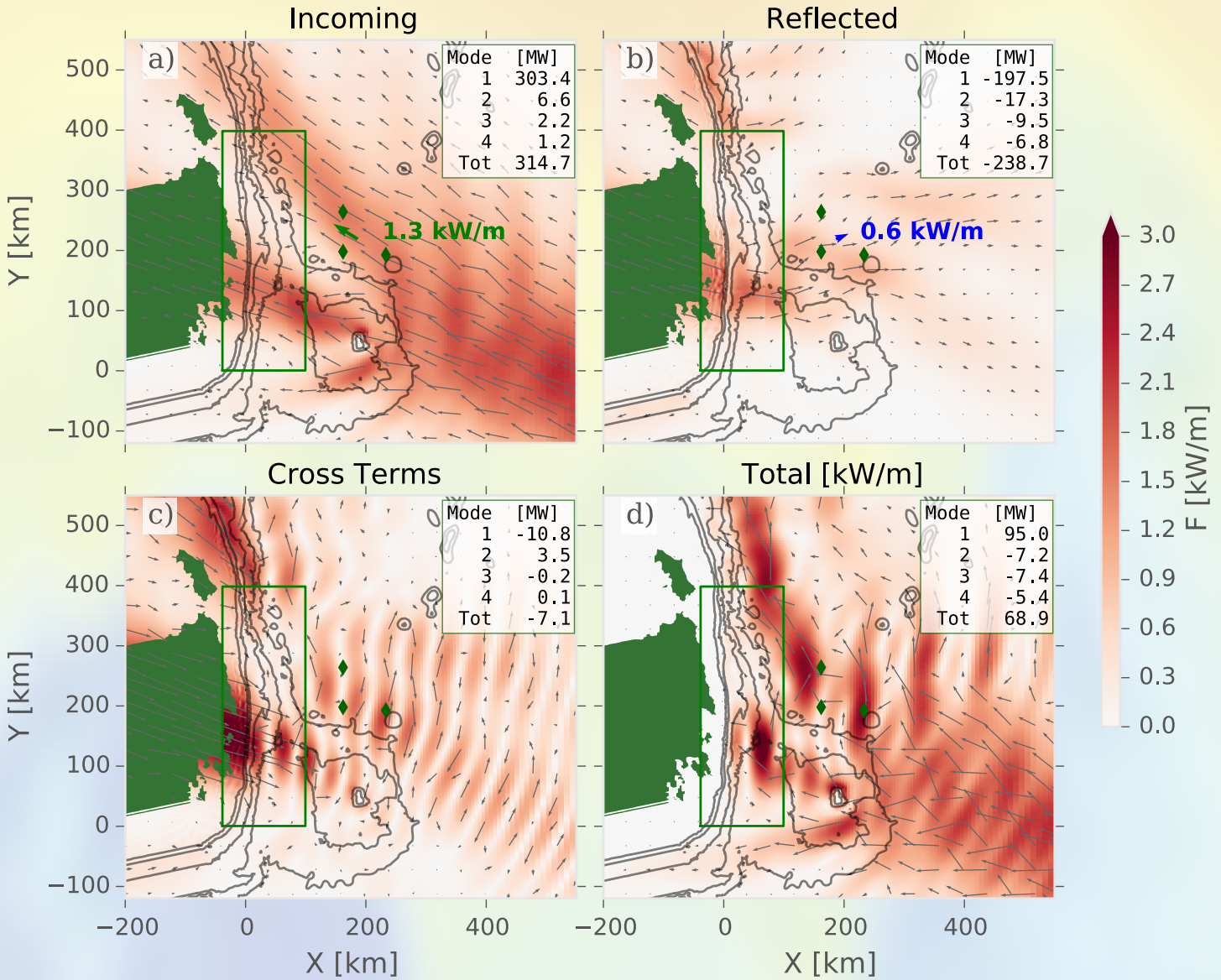
Incoming versus outgoing: Simple shelf



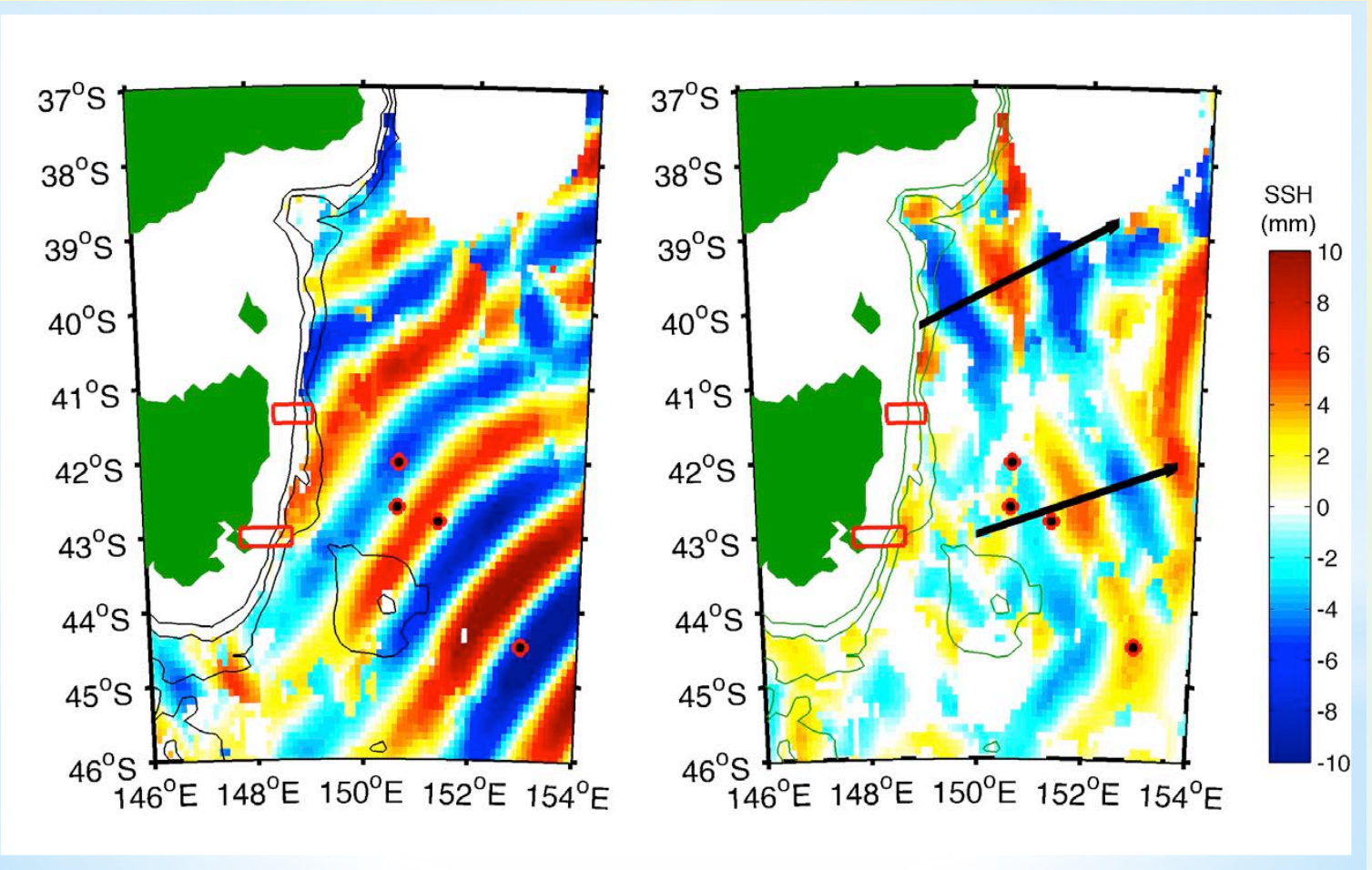
Incoming versus outgoing: Simple Rise and shelf



Incoming versus outgoing: Realistic

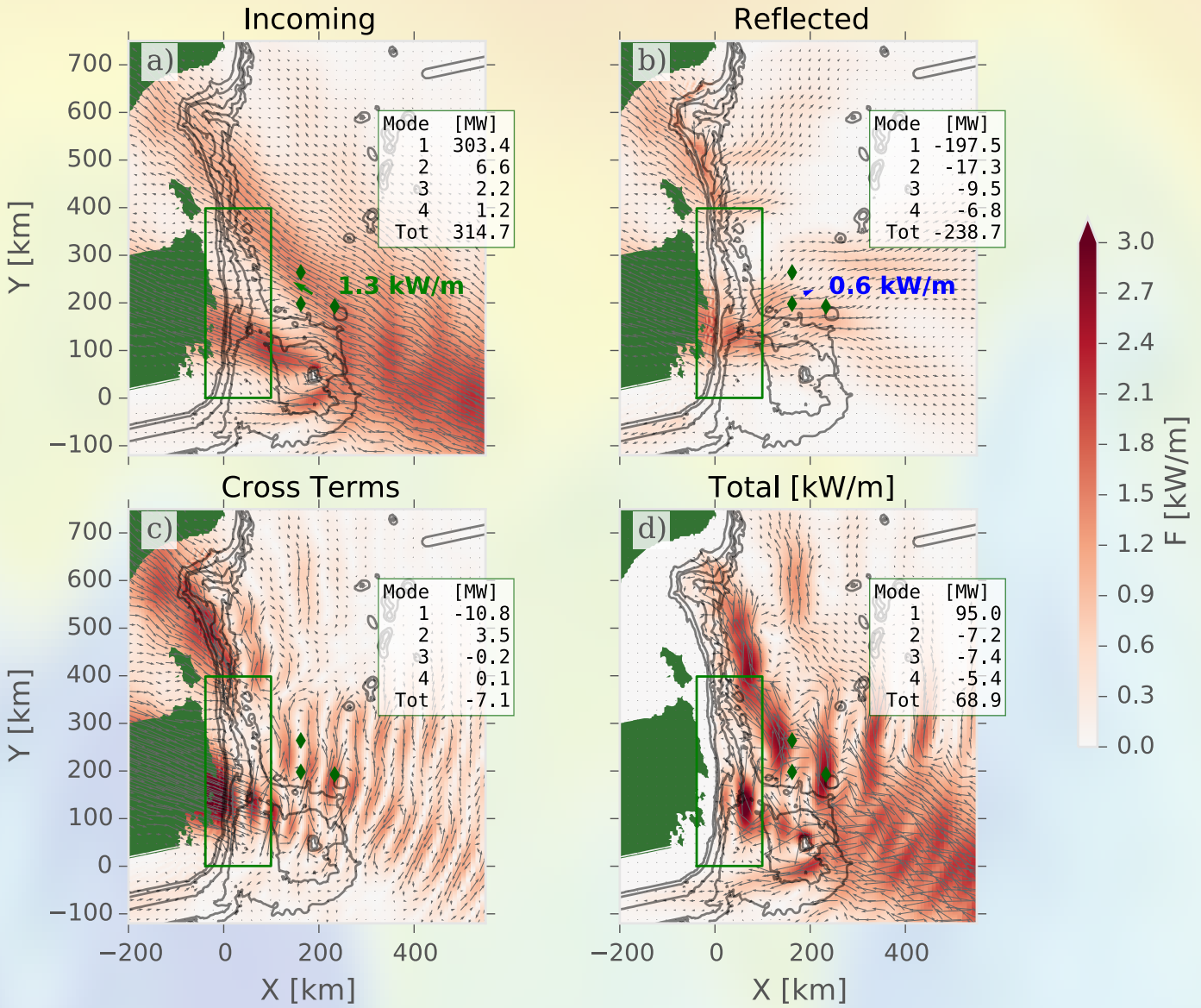


Incoming versus outgoing: Realistic

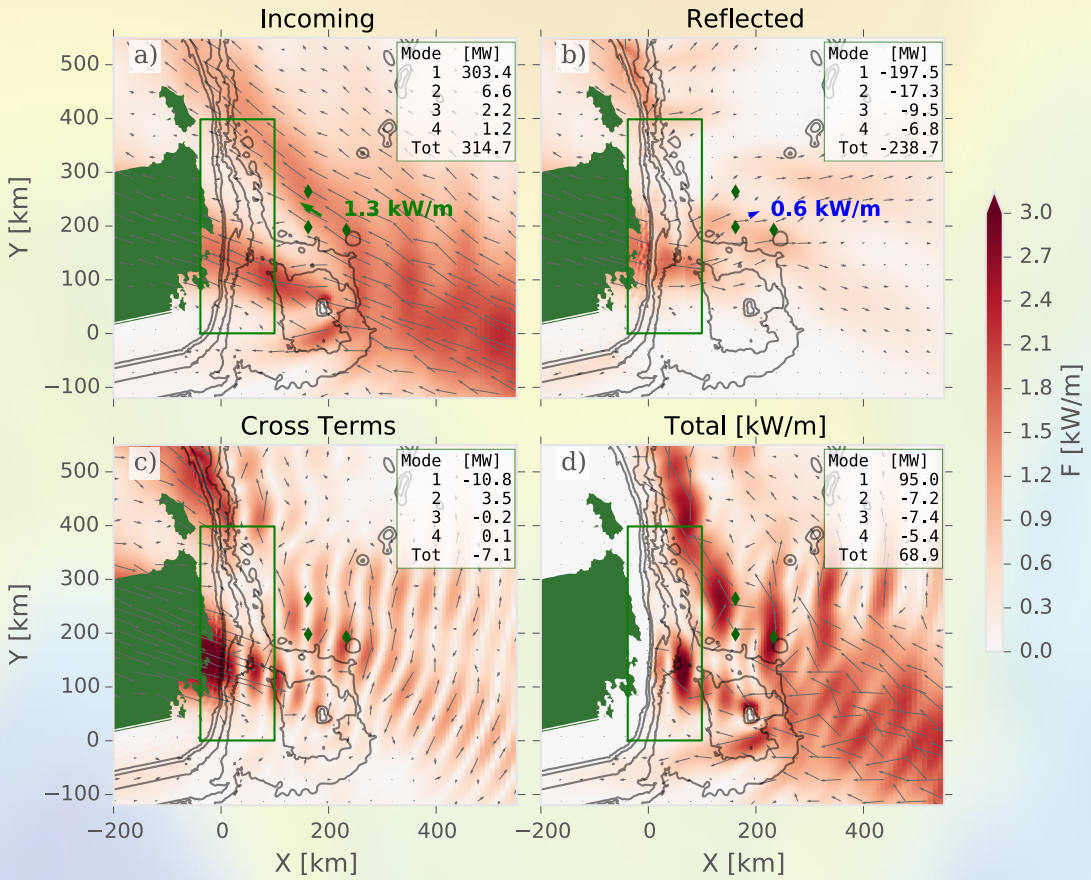


- Z. Zhao Altimeter measurements..

Incoming versus outgoing: Realistic



Incoming versus outgoing: Realistic



- Mooring: $(1.3 - 0.6)/1.3 \;\; [\mathrm{kW\,m^{-1}}] = 53\%$
- Mode 1 in Box: $(315 - 240)/315 \;\; [\mathrm{MW}] = 23\%$
- Total in Box: $69/315 \;\; [\mathrm{MW}] = 22\%$