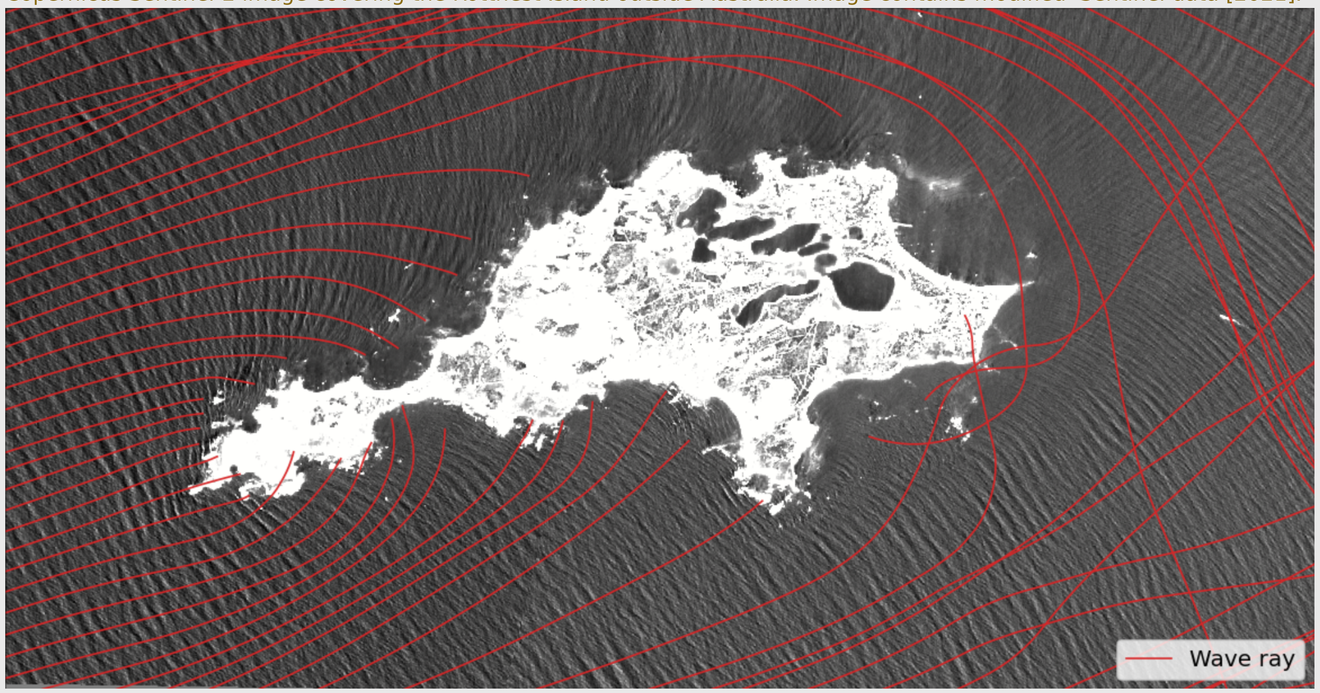
OCEAN WAVE TRACING: A NUMERICAL WAVE RAY SOLVER IN PYTHON

Trygve Halsne[1,2], Kai Håkon Christensen[1,3], Gaute Hope[1] and Øyvind Breivik[1,2]

[1]Norwegian Meteorological Institute, [2]University of Bergen, [3]University of Oslo

No open—source solver of the wave ray equations exists!?

Wave rays computed from a GEBCO 300m horizontal resolution bathymetry field. Rays are overlaied a 10m pixel resolution Copernicus Sentinel-2 image covering the Rottnest Island outside Australia. Image contains modified Sentinel data [2021].



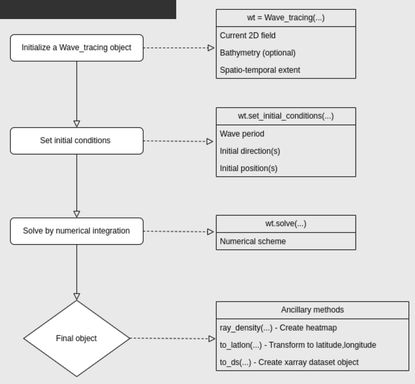
KEY FEATURES

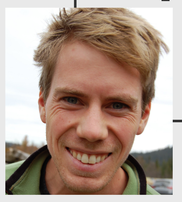
- Supports **variable currents and arbitrary depths**
  - **under the WKBJ approximation**
- **Aimed at supporting relevant workflows**
- **Compatible with ocean model field variables**
- **Supports the CF-convention and FAIR principles**
- **Available on GitHub** (see QR code)

EQUATIONS & WORKFLOW

- **Discretized using finite difference schemes**
  - **includes RK4 and FE**
- **Semi-lagrangian approach**
- **Initial conditions:**
  - **wave period**
  - **wave direction**
  - **position**

$$\frac{d\mathbf{x}}{dt} = c_\mathrm{g} + \mathbf{U},$$
$$\frac{d\mathbf{k}}{dt} = -\nabla_\mathrm{h}\sigma - \mathbf{k}\cdot\nabla_\mathrm{h}\mathbf{U},$$
$$\frac{d\omega}{dt} = 0.$$

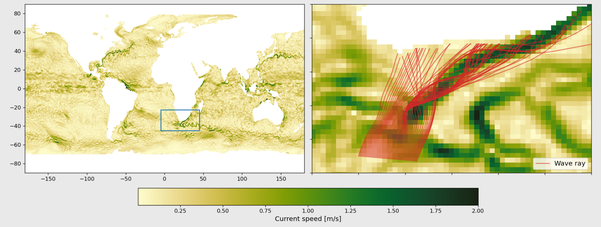




X: @trygvehalsne Mail: trygve.halsne@met.no

SOME REMARKS

- **Verified against analytical solutions**
- **Tested for numerical convergence**
- **Published in Geoscientific Model Development**



Results by using currents from the GlobCurrent project.