

# CliffCast Model Input Tensor Architecture

## Transect Data (Spatio-Temporal Geometry)

(B, T, N, 12) where T≈10 epochs, N=128 points

- distance\_m: From cliff toe
- intensity: LiDAR return
- elevation\_m: Height MSL
- red, green, blue: Color
- slope\_deg: Local slope
- classification: Point type
- curvature: Profile curvature
- return\_number: Echo #
- roughness: Surface texture
- num\_returns: Total echoes

## Metadata (Broadcasted to all points)

(B, T, 12)

- cliff\_height\_m: Total height
- transect\_length\_m: Length
- mean\_slope\_deg: Avg slope
- latitude: Lat coord
- max\_slope\_deg: Max slope
- longitude: Lon coord
- toe\_elevation\_m: Base elev
- transect\_id: MOP ID
- top\_elevation\_m: Top elev
- mean\_intensity: Avg LiDAR
- orientation\_deg: Azimuth
- dominant\_class: Main type

Temporal Alignment:  
• Transect T: Multi-epoch  
• Wave T\_w: 90d @ 6hr  
• Atmos T\_a: 90d @ daily

## Wave Data (Nearshore Forcing)

(B, T\_w, n\_features) where T\_w=360, n\_features∈{4,6}

- Basic (n=4):
- hs: Wave height (m)
  - tp: Peak period (s)
  - dp: Direction (°N)
  - power: Flux (kW/m)
- Derived (n=6):
- shore\_normal: Impact
  - runoff\_2pct: Runup (m)
  - Config:
  - 90d lookback
  - 6hr sampling
  - T\_w = 360 steps

## Atmospheric Data (Climate Forcing)

(B, T\_a, 24) where T\_a=90 days

- Precip:
- precip\_mm
  - cumulative
  - intensity
  - api\_7d, 30d
  - max\_1d, 3d
- Temp:
- temp\_mean
  - temp\_min
  - temp\_max
  - freeze\_thaw
  - wet\_days\_7d
  - dry\_days\_7d
- Derived:
- wet\_dry\_cycles
  - vpd
  - gdd
  - eto
  - (24 total)

Data Sources:  
• Transects: LiDAR (2017-2025, annual)  
• Waves: CDIP MOP (100m, hourly)  
• Atmospheric: PRISM (daily, 4km)

B = Batch size (typically 32)  
All inputs aligned by transect ID and scan date