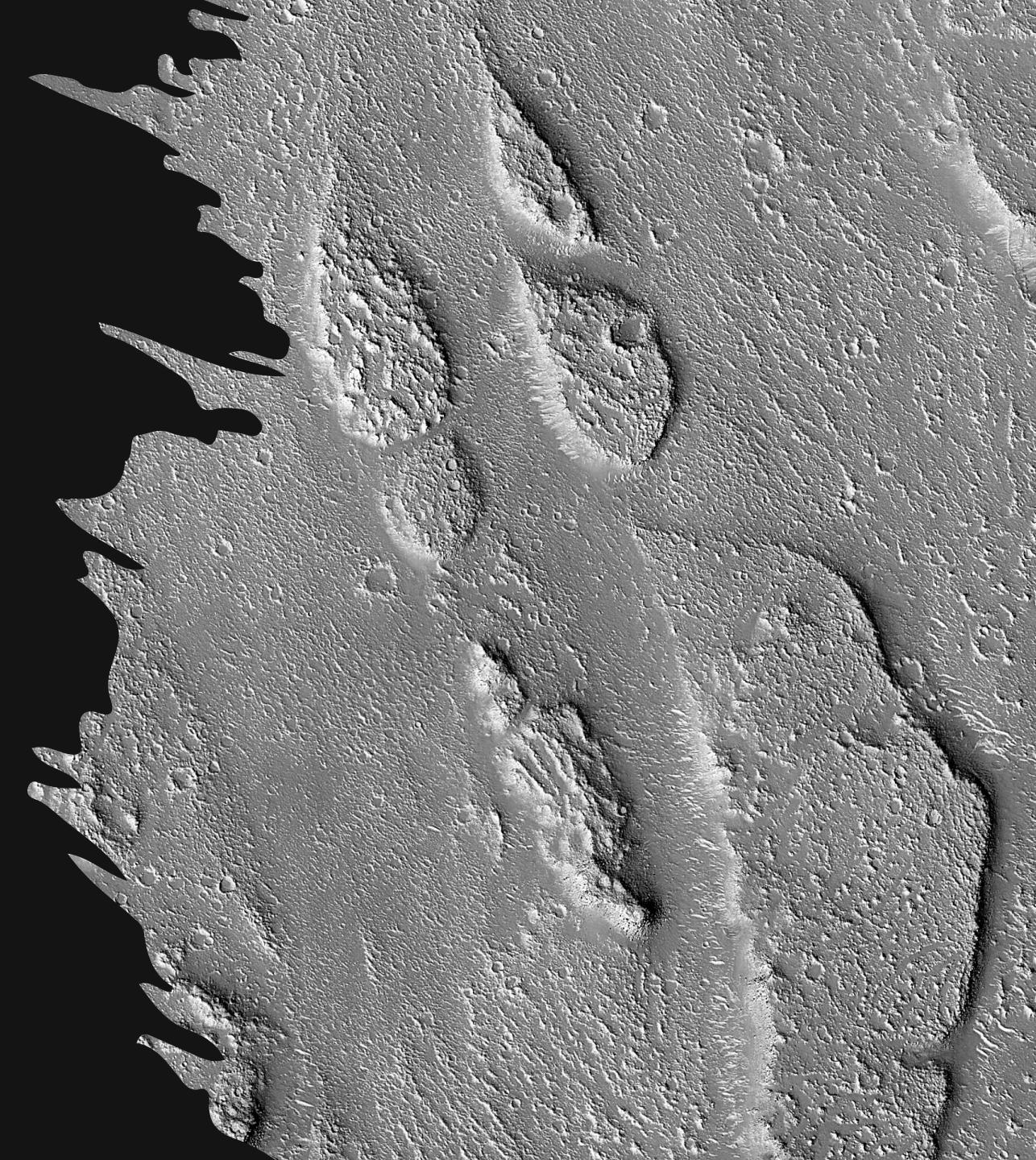


PREENCHIMENTO DE LACUNAS (GAP- FILLING) EM DTMS HIRISE USANDO INFERNÉCIA MONOCULAR COM VISION TRANSFORMERS (ViT)

BRUNO R. HOLANDA



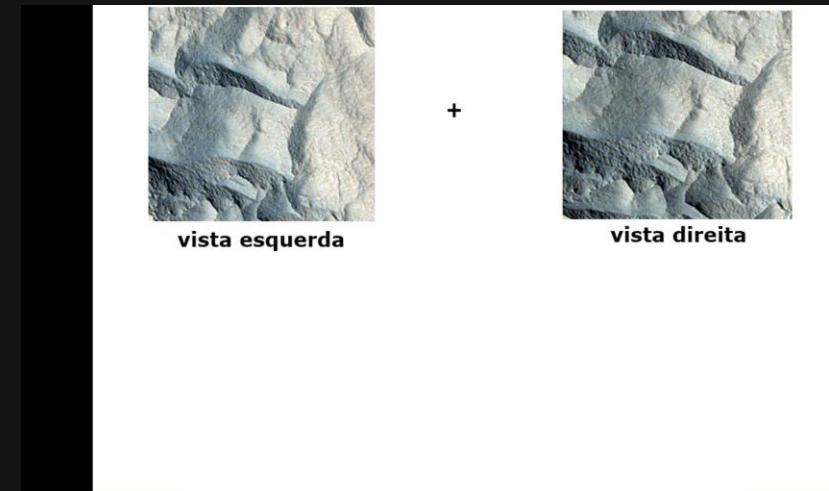
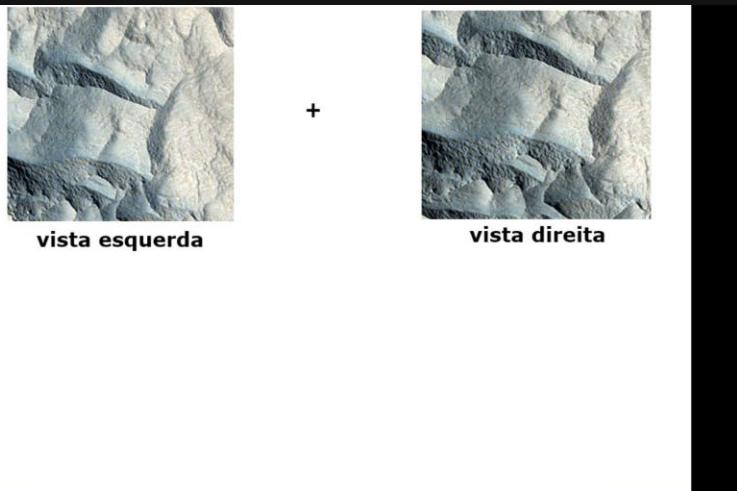
Contexto: Dados HiRISE

- HiRISE (Mars Reconnaissance Orbiter): Resolução de 1 metro/pixel.
- A base para o planejamento de rovers (Perseverance, Curiosity).



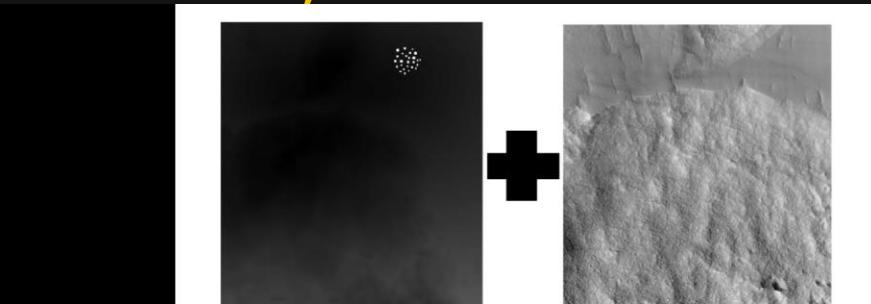
Problema: O "Apagão" dos Dados

- Falhas na Fotogrametria Estéreo.
- Causas: Texturas homogêneas (dunas) e Sombras profundas.
- Consequência: Lacunas "NoData" críticas para a navegação.

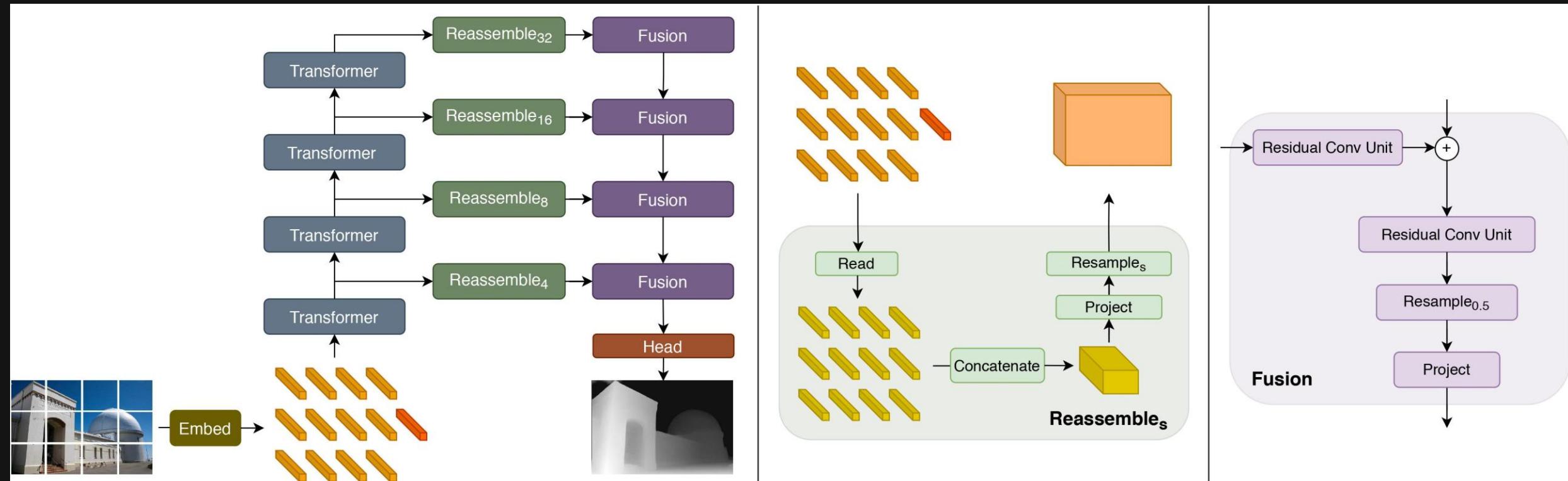


Solução: Inferência Monocular (IA)

- Inferência Monocular de Profundidade (MDE).
- Usar a textura e o sombreamento (*Shape-from-Shading*) para recuperar a forma.
- Se nós conseguimos ver a duna na foto, a IA também consegue.

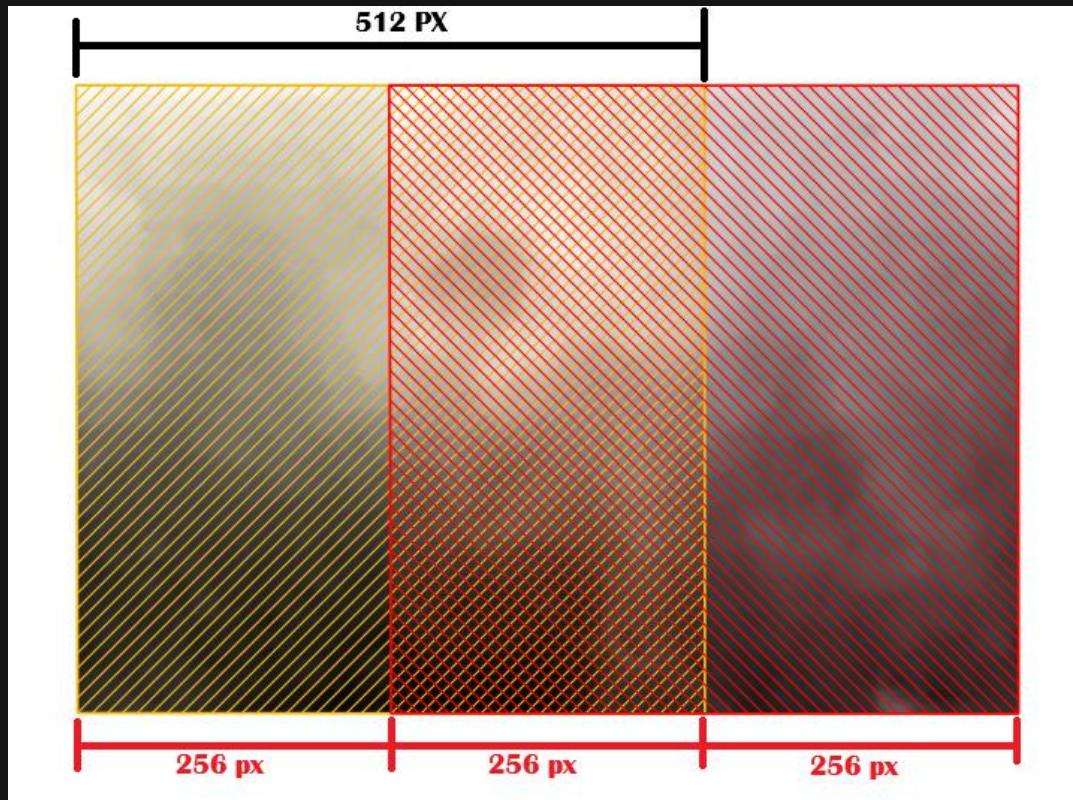


Dense Prediction Transformer (ViT-DPT)

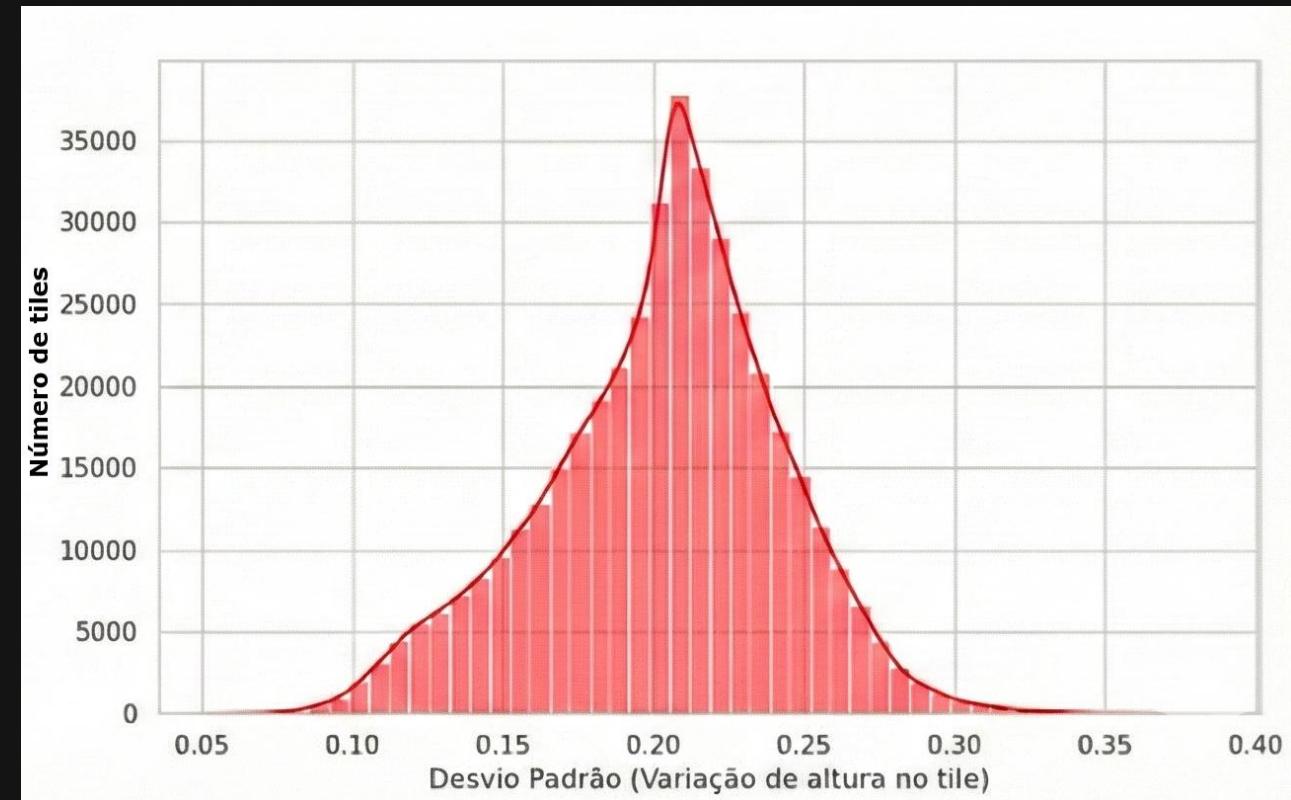


Dataset

Tiling/Stride



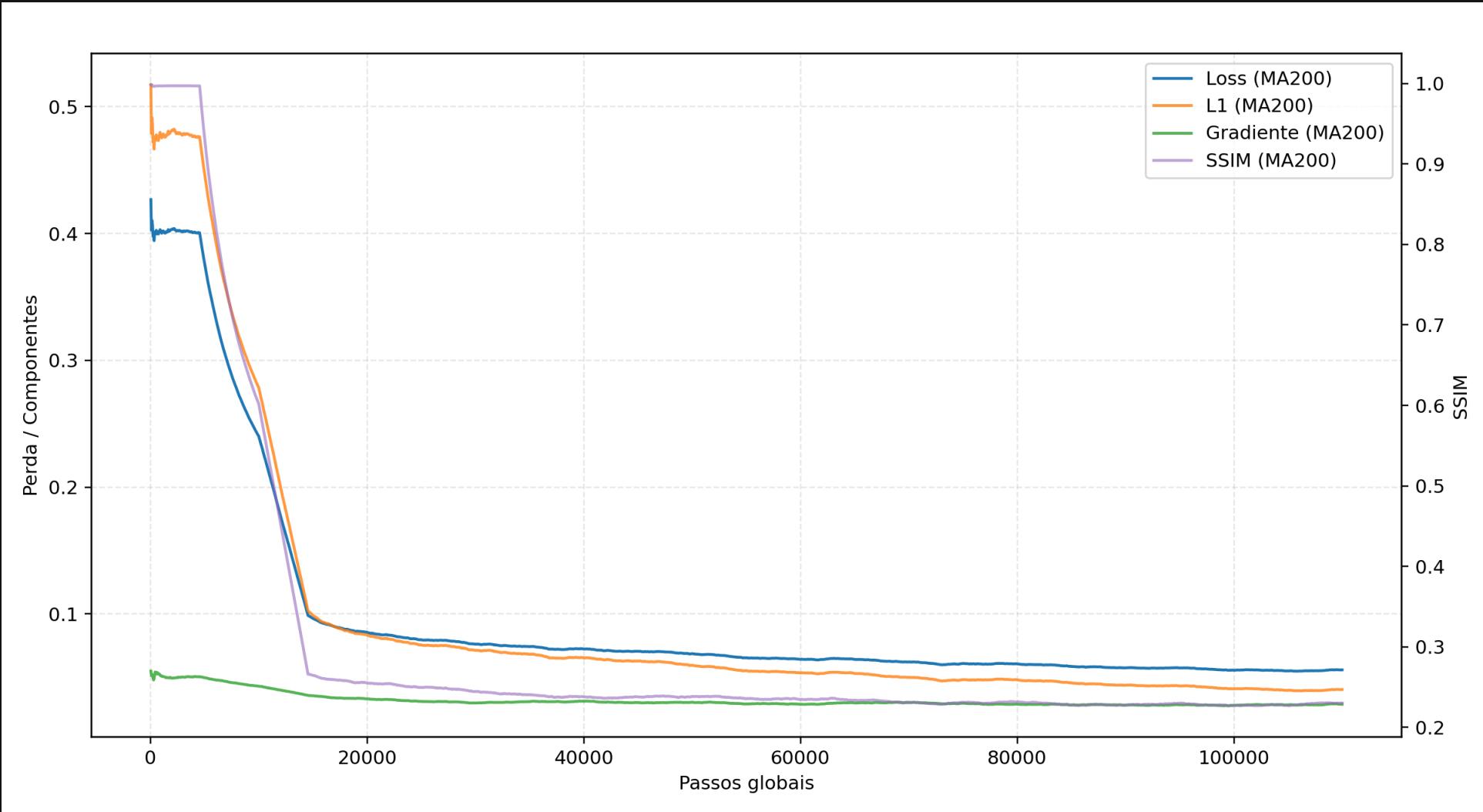
Histograma de Rugosidade



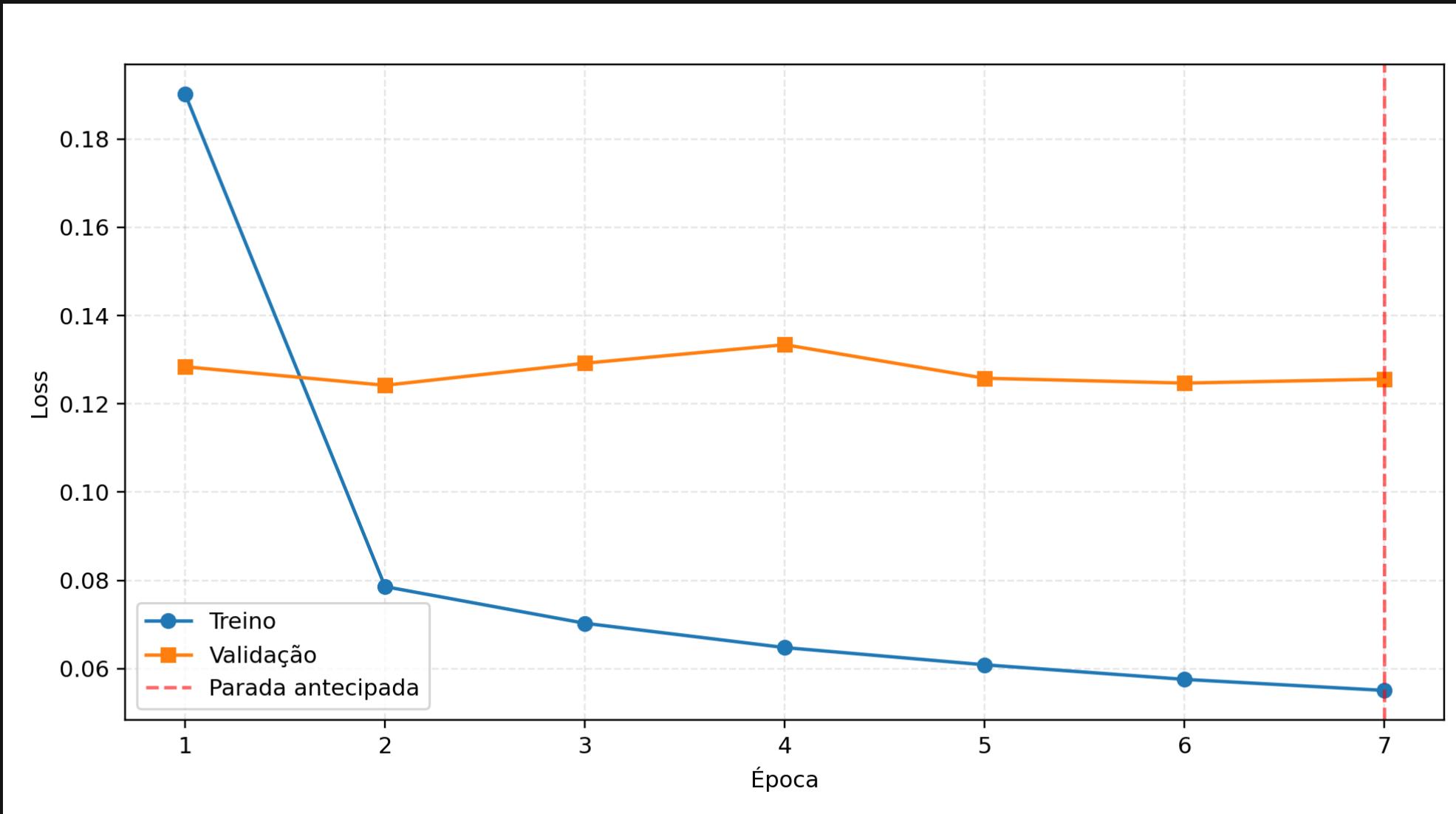
Função de perda

$$L_{total} = 0.6 \cdot \mathcal{L}_{L1} + 0.3 \cdot \mathcal{L}_{grad} + 0.1 \cdot \mathcal{L}_{SSIM}$$

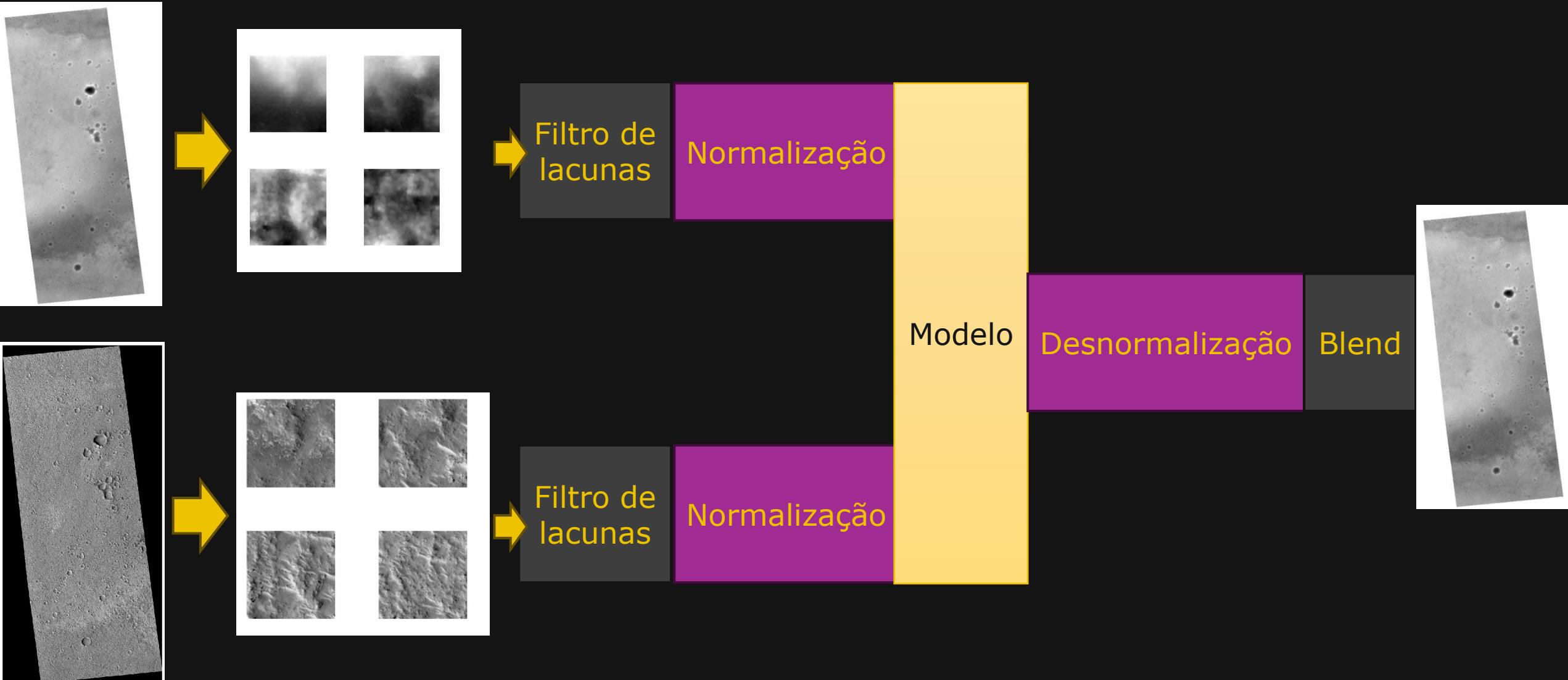
Treinamento



Treinamento

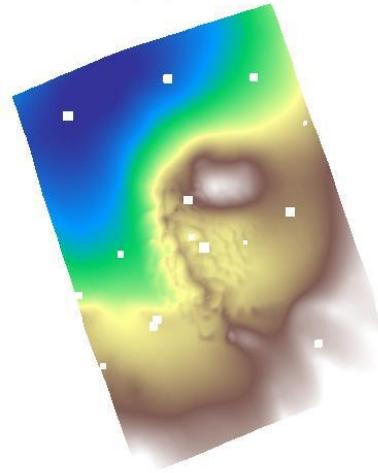


Pipeline de inferência

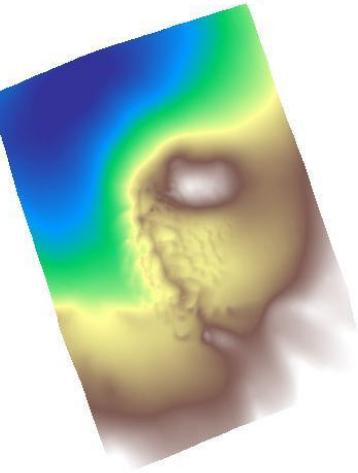


Resultados

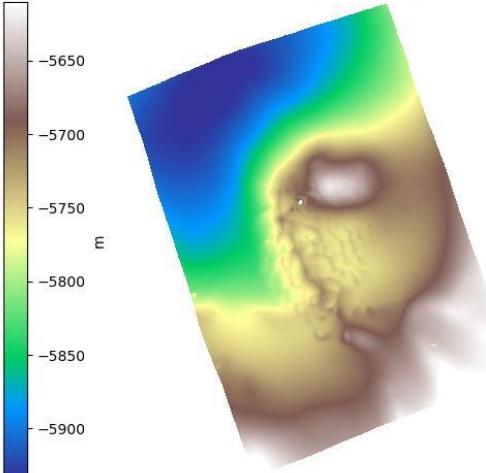
DTM com lacunas



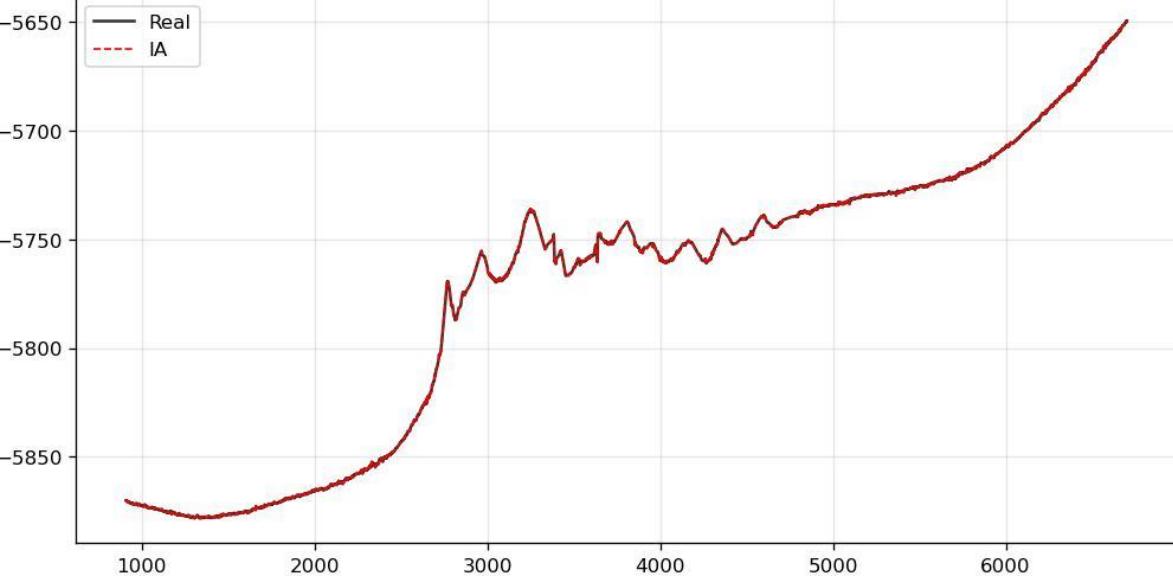
DTM original



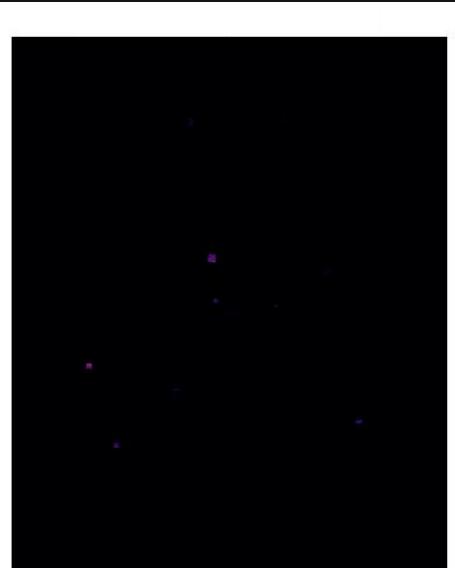
DTM Preditto



Perfil topográfico



RMSE



Métricas de Desempenho e Custo

Classe de Terreno	RMSE (m)	SSIM	Latência (s)
Dunas (Dunes)	14.67	0.9996	1.79
Planícies (Plains)	3.33	0.9998	2.52
Escarpas (Scarps)	15.21	0.9998	1.79
Média Global	11.07	0.9997	2.03

Custo total US\$ 1.940,49
70% para treinamento

Componente	Especificação	Função no Pipeline
GPU Cluster	4× NVIDIA A10G (24GB VRAM)	Treinamento Distribuído
GPU Inference	1× NVIDIA T4 (16GB VRAM)	Validação e Inferência
CPU	AMD EPYC (48 vCPUs)	Pré-processamento e DataLoader
RAM	192 GB DDR4	Cache de Datasets em Memória
Armazenamento	2 TB NVMe SSD	I/O de Alta Performance

Conclusão e Próximos Passos

