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海克斯康

塑造智慧变革

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2018.hexagonchina.com.cn

HxMap common workflow platform for airborne sensors
航空传感器的通用数据处理平台HxMap

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The story so far……
发展历史

Leica RCD30

Z/I DMC I & II

Leica ADS

Leica ALS

Leica Mission Pro

Novatel Inertial Explorer

Leica IPAS CO+

Leica FramePro

Z/I PPS (+ GeoCue)

Leica CloudPro

Leica XPro
Image Processing, Georeferencing, Rectification, DSM
影像处理，影像配准，校正，DSM

Any photogrammetric workstation

ImageStation,

Imagine Photogrammetry

…

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Concept of Leica HxMap
Leica HxMap理念


RCD30


RCD30 Oblique


City Mapper


DMC IIe & III


SPL


ADS


Leica Mission Pro


Novatel Inertial Explorer

Leica HxMap

- ✓ RawQC 原始质检
- ✓ Data Ingest Processing 数据下载处理
- ✓ APM/ AT 自动匹配/空三
- ✓ DSM Generation DSM生成
- ✓ Image Output 影像输出
- ✓ Lidar Output 点云输出
- ✓ Building models & Textures 建筑模型&纹理
- ✓ Rectification 几何校正
- * Mosaic 影像镶嵌

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HxMap Setup
HxMap设置

Leica HxMap

Standard workflow modules

■ = Standard □ = Optional N/A = Not applicable

Sensor Type	RealCity CityMapper RCD30 Oblique	RealWorld RCD30 DMC III	RealTerrain SPL100
Enabler Enabler, Workflow Manager, Projection Engine	■	■	■
Provider Ingest, Raw QC	■	■	■
Core Image APM, AT, InfoCloud, Ortho, Mosaic	■	■	■
Core LiDAR AutoCalibration, Color Encoding, Registration, Point Cloud, Data Metrics	■	□	■
3D Modeller Basic City Modeller, Texture Mapper, 3D Editor	■	□	□
3D Modeller Advanced Building Finder, 3D Mesh	□	□	□
SDK Developer's Kit	□	□	□

Leica HxMap

- Is the core application behind the sales packages RealCity, RealWorld and RealTerrain
- Leica HxMaps heart is the Workflow Manager, a GUI
  - which allows to access and present data of the supported sensor types and guides the user through the post-processing workflow from QuickQC, Ingest, Radiometry setup, Georeferencing to final product generation
- 是解决方案RealCity，RealWorld和RealTerrain的核心应用程序
- Leica HxMap核心是工作流管理, 图形用户管理界面
  - 允许可支持的传感器数据的加载和展示，并指导从快速质检，下载，辐射校正参数设置，影像配准到最终产品输出的一体化后处理流程。

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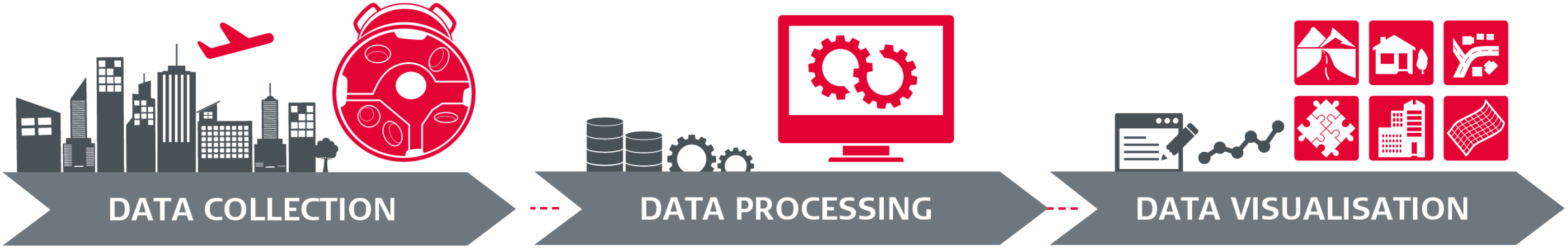
Leica RealCity – RealWorld - RealTerrain



RealCity

Solution for 3D Smart Cities

智慧城市解决方案

- RCD30 Oblique
- CityMapper
- DMC3

RealWorld

Wide area ortho mapping

大面积正射制图

- DMC3
- ADS100/120 （not fully supportd yet in HxMap）（ 目前HxMap不能完全支持)

- Used by HxIP!

RealTerrain

LiDAR for wide area coverage

大面积区域激光点云获取

- SPL100&TerrainMapper
- ALS80（not fully supported yet in HxMap，目前HxMap不能完全支持)

- Used by HxEP!

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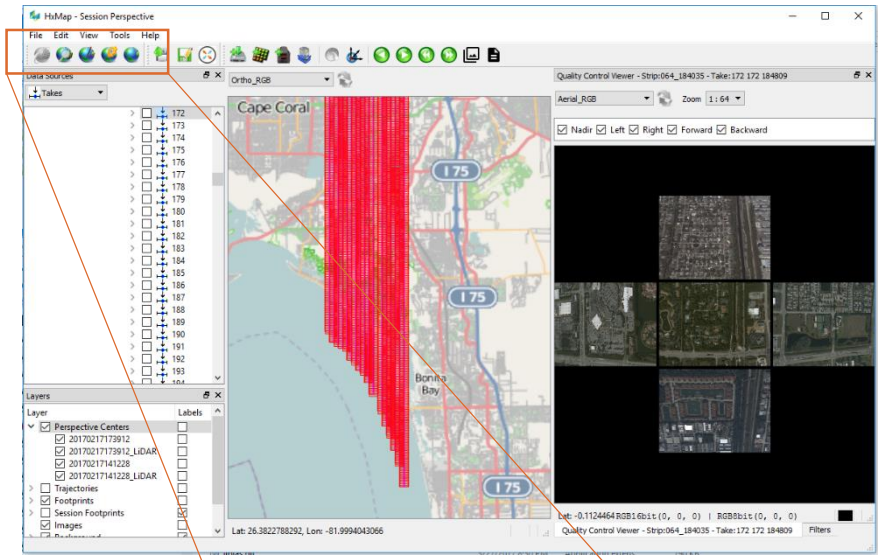
HxMap Keywords and Structure
HxMap关键字和软件结构



Session perspective 工程视角	Read & Evaluate Raw data；Launch Ingest 加载&评估原始数据，执行数据下载预处理
QC perspective 质检视角	QC of image and LiDAR data after Ingest Ortho rectified display on the fly Setup radiometric properties for L0 product 预处理后影像和点云数据质检 正射纠正影像联机预览；为L0级影像产品设置辐射校正参数
AT perspective 空三视角	Run Automatic Point Matching(APM) Manual point measurement Perform a bundle block adjustment and analyze adjustment results 自动点匹配；人工点量测；运行光束法平差并分析平差结果
Product Generation perspective 产品生成视角	Define product template with the type, radiometry and output formats；Generate 2D and 3D products 根据产品类型、辐射值和输出类型定义产品模板；输出2D/3D产品
Demo perspective 演示视角	3D visualization of end products generated in HxMap like point cloud and orthos HxMap输出终端产品（例如：点云和正射影像）的三维展示

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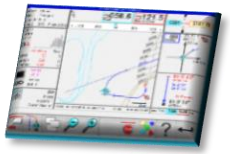
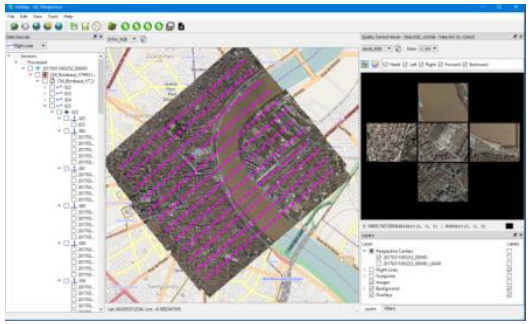
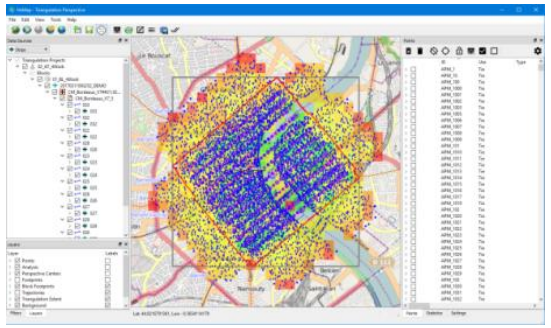
From Raw to output - our flowline
从原始数据到产品输出-我们的处理流程图

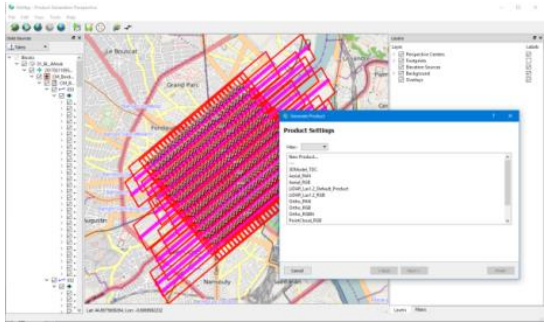
Leica Mission Pro



Leica FlightPro







Lidar data
激光数据

Image data
影像数据

GNSS/ IMU data
POS数据

Novatel Inertial Explorer

Initial QC 初始质检

Ingest
Raw data processing
Georeferencing
预处理
原始数据下载
几何定向

QC & Review
1:1 Quality check of captured data
Setup image radiometry

质检 & 查看
对数据进行1:1质检
生成影像调色模板

Aerial Triangulation
Run APM
Ground Control Measurement
Bundle Block Adjustment
空中三角测量
运行APM
地面控制测量
光束法区域网平差

Product generation
Aerial Images
Ortho Images
InfoCloud (DSM)
Lidar Point Cloud
Building Models & Textures
产品输出
航空/正射影像
信息点云(DSM)/激光点云
建筑物模型&纹理

Lidar Calibration
点云检校

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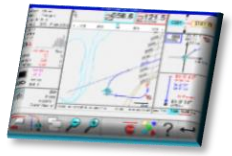
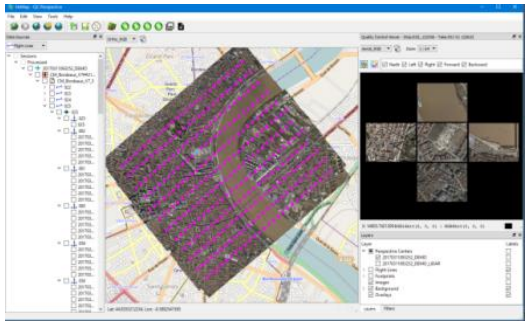
Common Workflow for supported Sensors
可支持传感器的通用数据处理流程

Leica Mission Pro



Leica FlightPro



Lidar data
激光数据

Image data
影像数据

GNSS/ IMU data
POS数据

Novatel Inertial Explorer

Initial QC初始质检

Ingest
Raw data processing
Georeferencing

预处理
原始数据下载
几何定向

- Easy Session setup in HxMap due to direct read from (copy of) Mass Memories for any supported sensor
- Initial overview regarding project layout
- QuickQC based on thumbnails
- Ingest kick-off in local or distributed processing environment
  - Project setup
  - Georeferencing
  - Raw data processing

- 由于可直接从大容量存储器中读取数据，HxMap方便为可支持的传感器数据创建工程
- 关于工程布局的原始概览
- 基于缩略图进行快速质检
- 预处理在本地或者分布式集群处理环境
  - 工程创建
  - 几何定向
  - 原始数据处理

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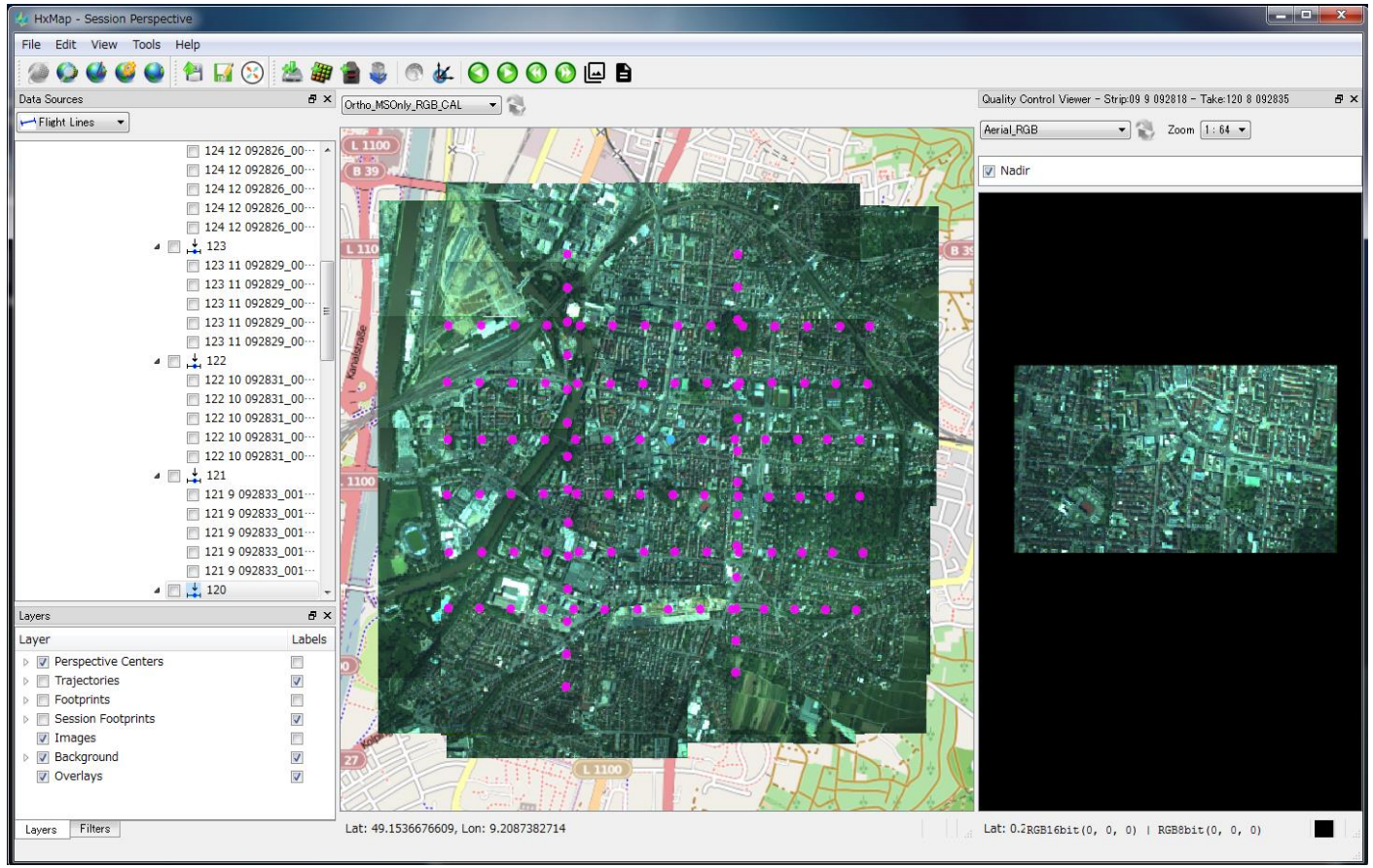
Perform Raw QC
执行原始质检

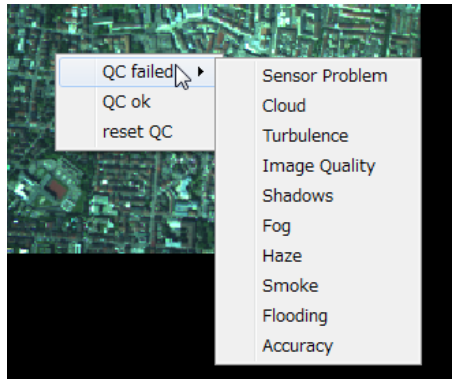
- **Check image quality prior the ingest step based on thumbnail images.**

基于缩略图在下载预处理之前检查影像质量



Quality Control Viewer:
质量控制浏览器

- Load images into viewer
  在浏览器窗口加载影像
- evaluate images and label them in case of failed QC
  评估影像质量，如果质检失败对原因标注



- QC status can be saved into QC report
  质检的情况可以存储为质检报告

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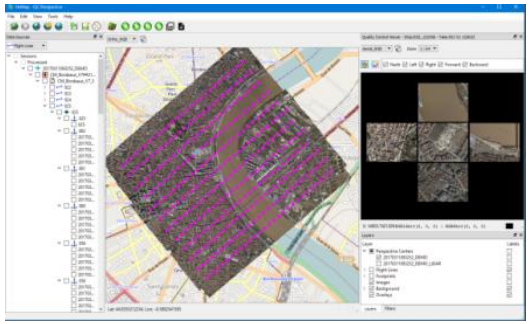
Common Workflow for supported Sensors
可支持传感器的通用数据处理流程



Initial QC
初始质检

Ingest
Raw data processing
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预处理
原始数据下载
几何定向

QC & Review
1:1 Quality check of captured data
Setup image radiometry

质检 & 查看
对数据进行1:1质检
生成影像调色模板

- **After Ingest**
  - Georeferenced Session
  - Intermediate imagery
  - Correction file set representing Dark Pixel/ Gradient correction plus radiometric normalization of ingested session
  - And/ or LidAR point cloud data
- **To Do**
  - Review image and/or LiDAR data
  - Define radiometric profiles to be used during product generation
  - Execute Lidar calibration tools, if required
  - Define blocks for further processing

- **下载预处理后**
  - 几何定向工程
  - 中间影像
  - 下载过工程的黑像素或参考辐射标准化灰度改正校正文件设置
  - 激光点云数据
- **下一步**
  - 再次检查影像和激光数据
  - 定义产品生成时要使用的辐射文件
  - 如果需要，运行点云检校工具
  - 为下一步处理定义测区

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Perform 1:1 QC after Ingest
预处理后进行1:1质量检查

Map View:
地图视角

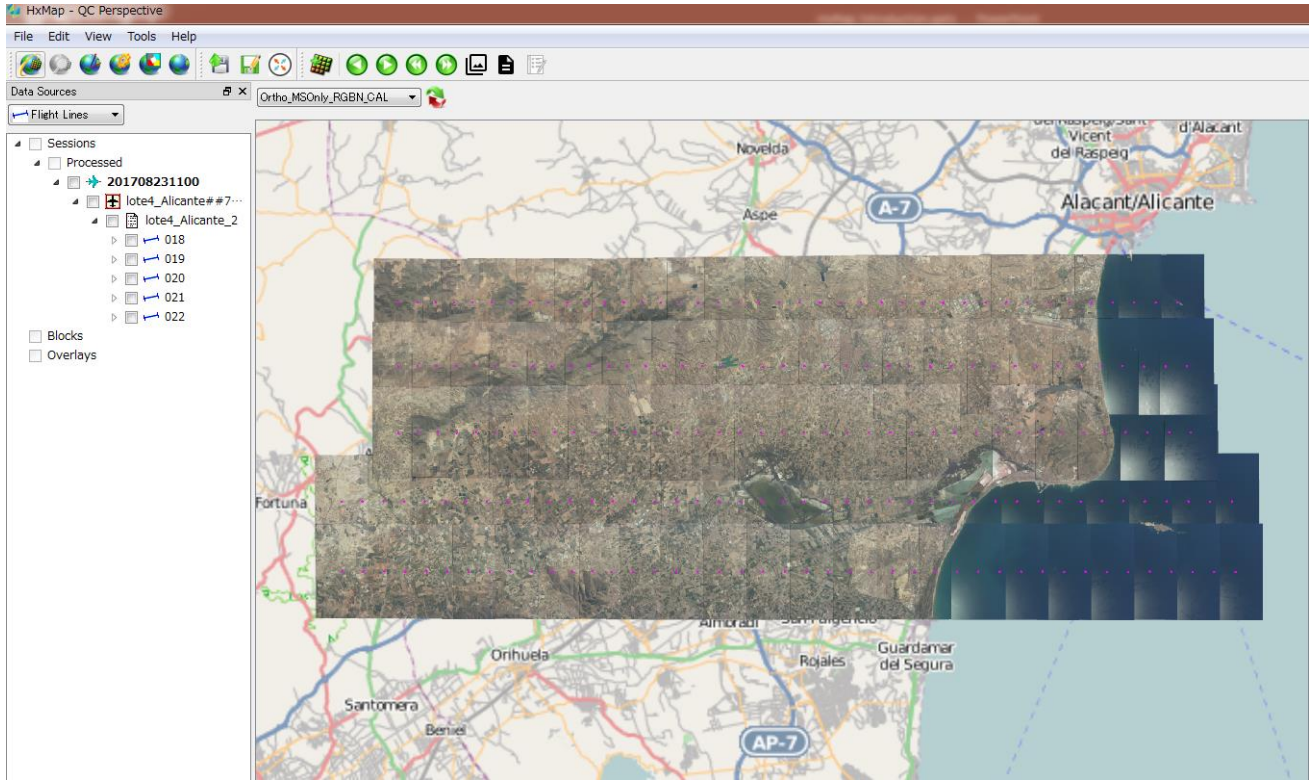
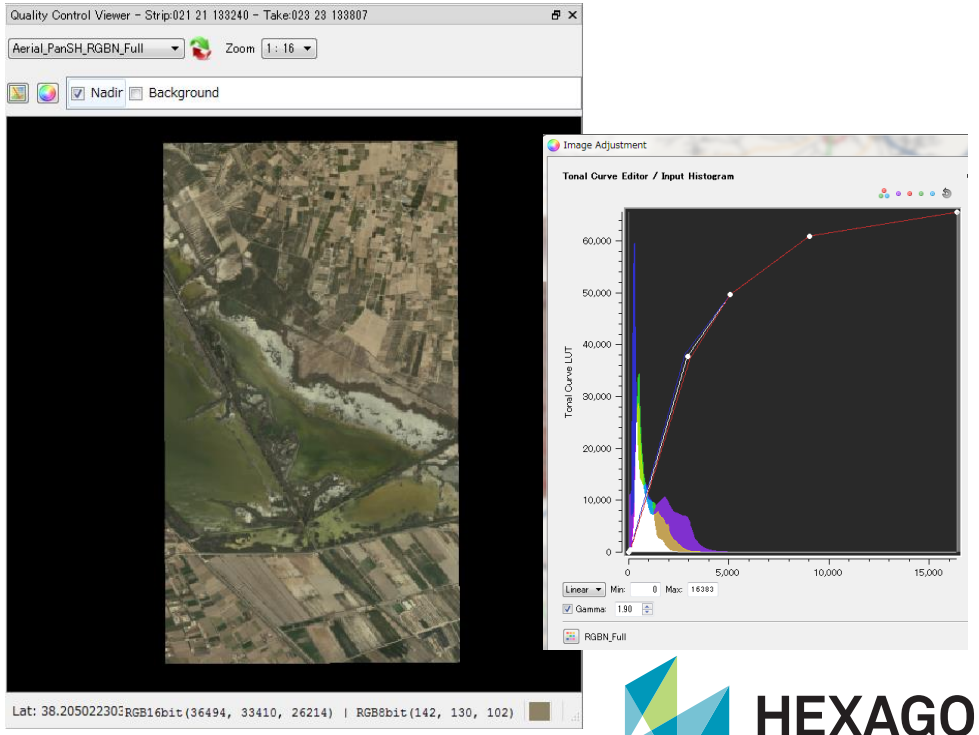


Image QC Viewer影像质检浏览器

- visualise single images and adjust the final radiometry
- Ortho and Image Space Mode

- 在浏览器加载单张影像并调整最终的辐射参数值
- 正射和影像的空间模式



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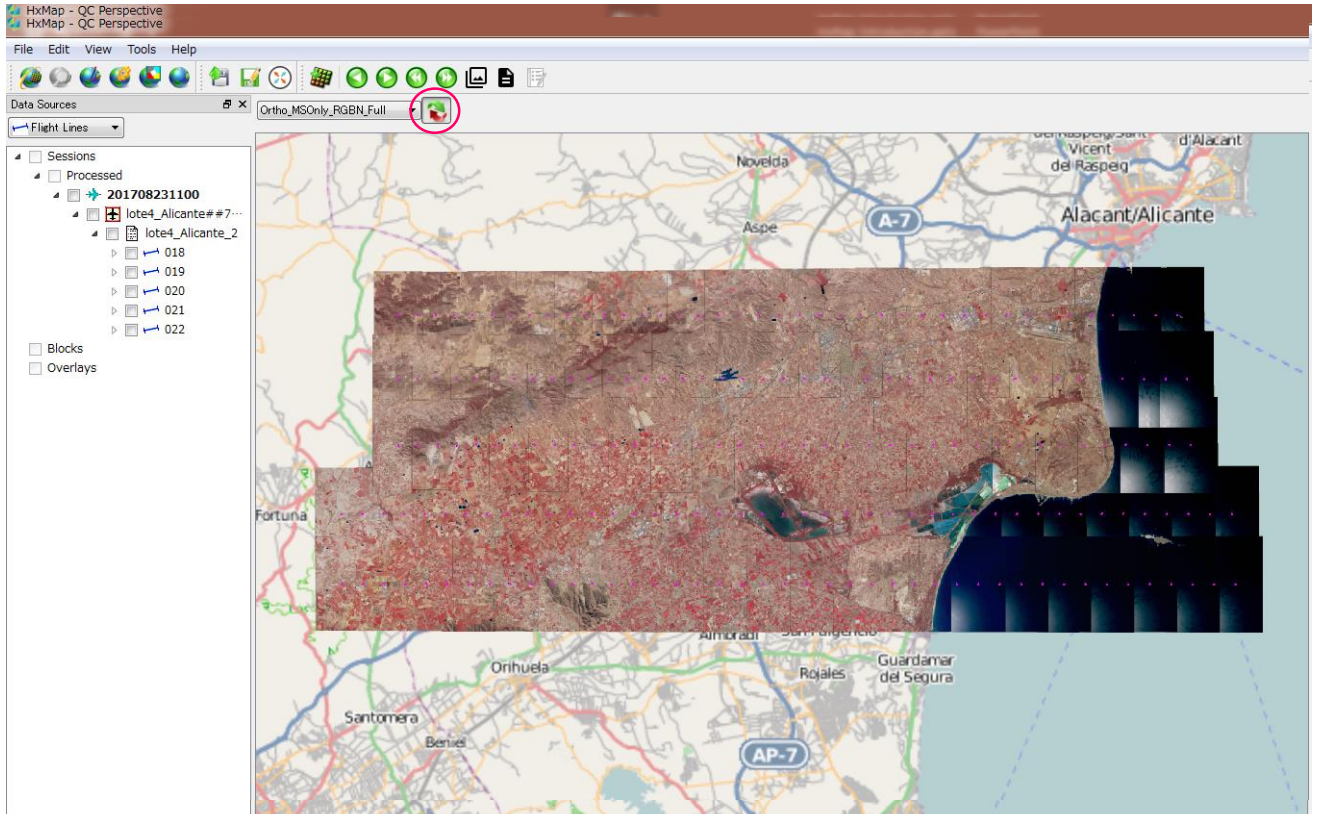
Perform 1:1 QC after Ingest
预处理后进行1:1质量检查

Map View:
地图视角



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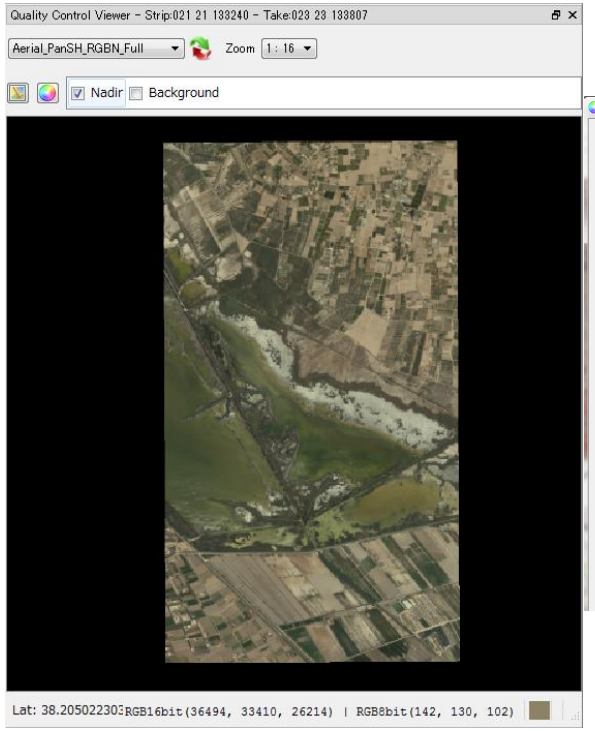

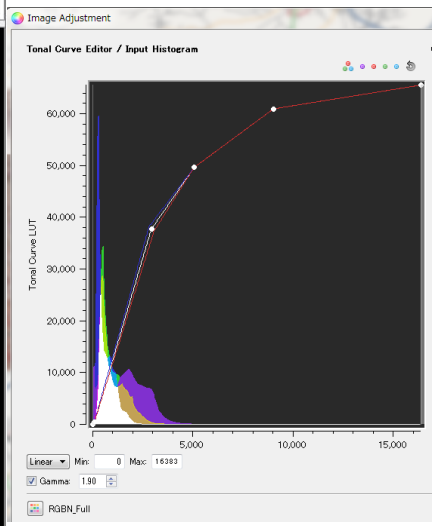

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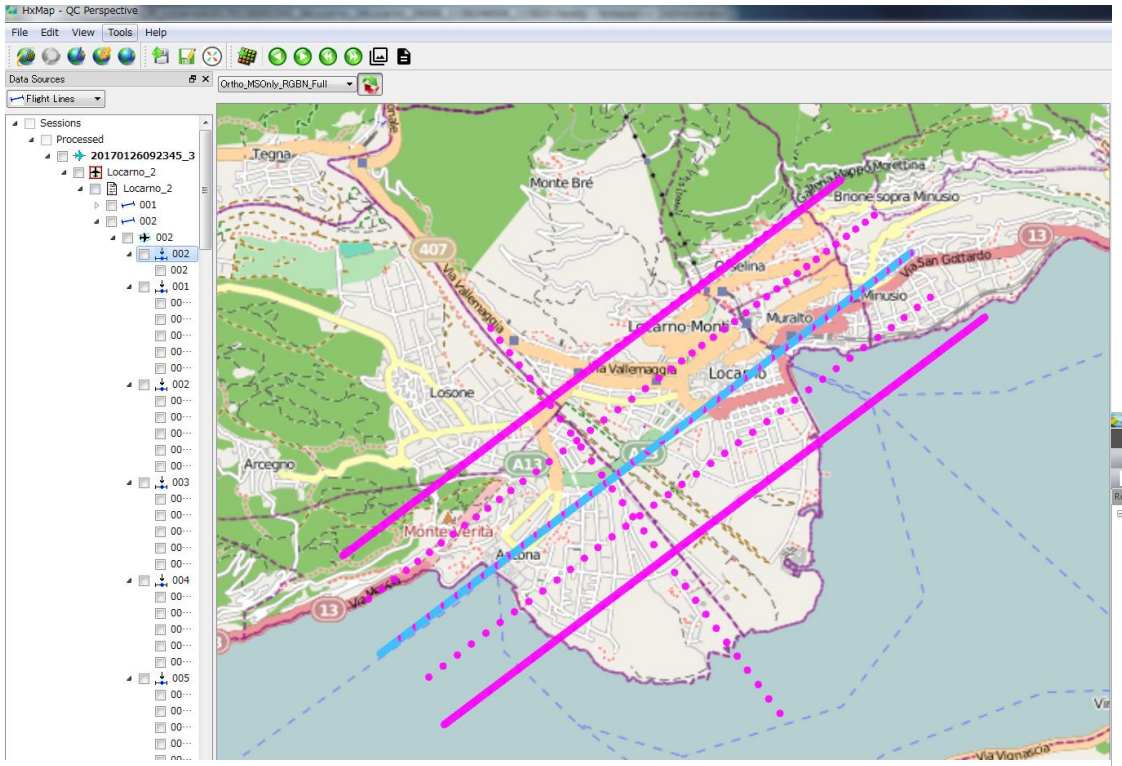
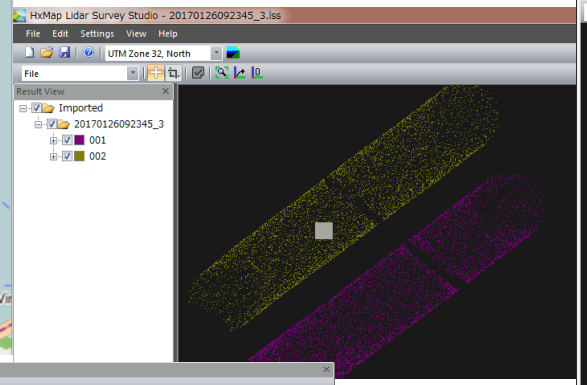
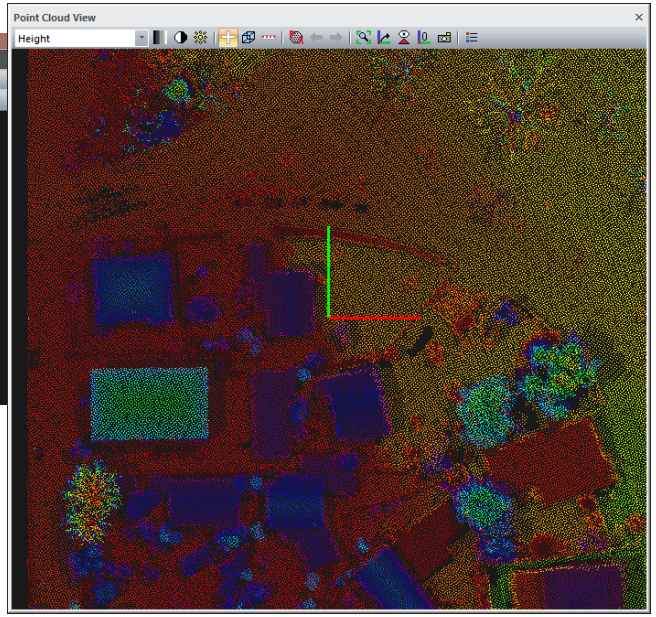
Perform 1:1 QC after Ingest
预处理后进行1:1质量检查







LiDAR QC Viewer 激光质检窗口

- visualise single or multiple LiDAR take point clouds with different colorization modes
- Check out cross sections
- 以不同的色彩模式展示单个或者多个激光点云
- 检查交叉区域的点云

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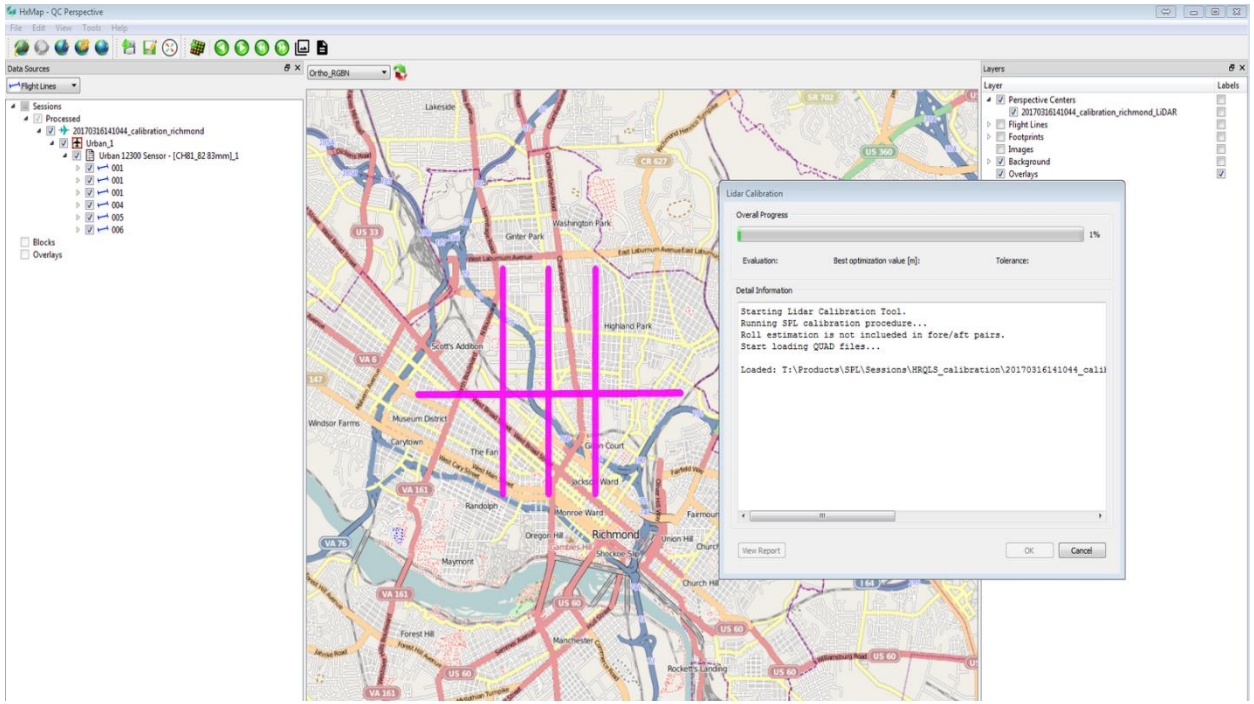
LiDAR automatic calibration
激光自动检校



- Select a small AOI for Calibration
- Analyze calibration results/reports
- Reuse that calibration to ingest the whole sessions
- Run automated QC tools to Analyze calibration results and confirm

- 选择小块感兴趣区域进行检校
- 分析检校结果/报告
- 重新利用检校文件下载处理整个工程
- 运行自动质检工具来分析检校结果并确认

Calibration report - 20170520

Calibration parameters

Parameter	Value
Roll [deg]	-0.0346936
Pitch [deg]	-0.0160438
Heading [deg]	1.6034
Wedge angle [deg]	25.18
Wedge angle bias [deg]	0.00275048
Coefficients_FM	-2.04285e-05 -5.49219e-05 -7.72225e-06 3.34015e-05 -2.45236e-06 1.14638e-05 -4.80188e-06 -2.35129e-05 -8.82803e-06 1.00524e-05

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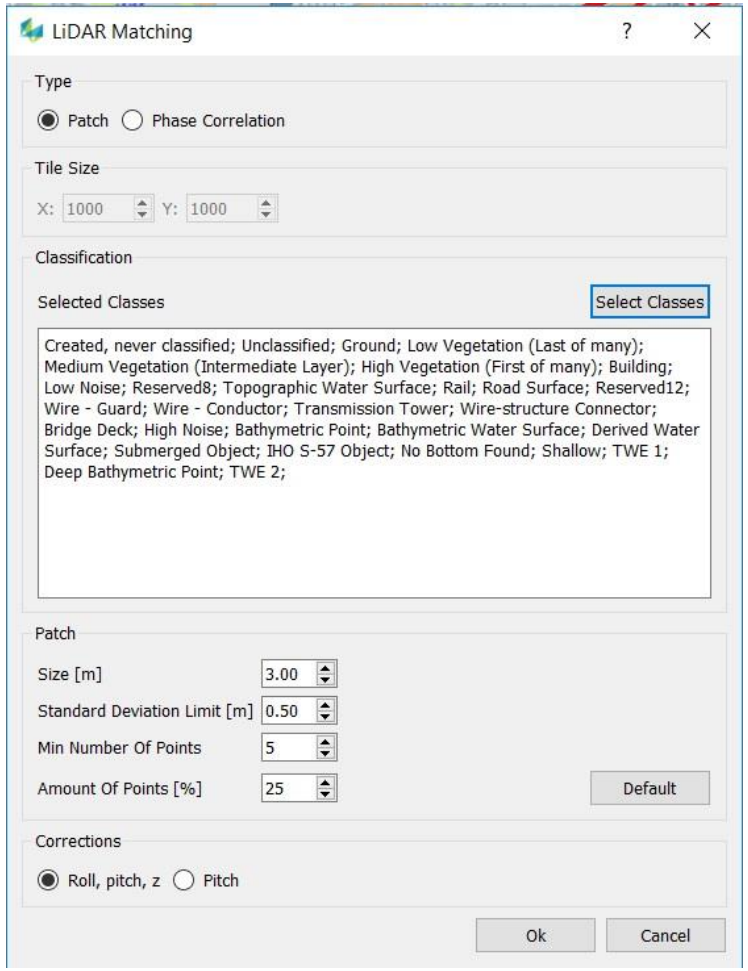
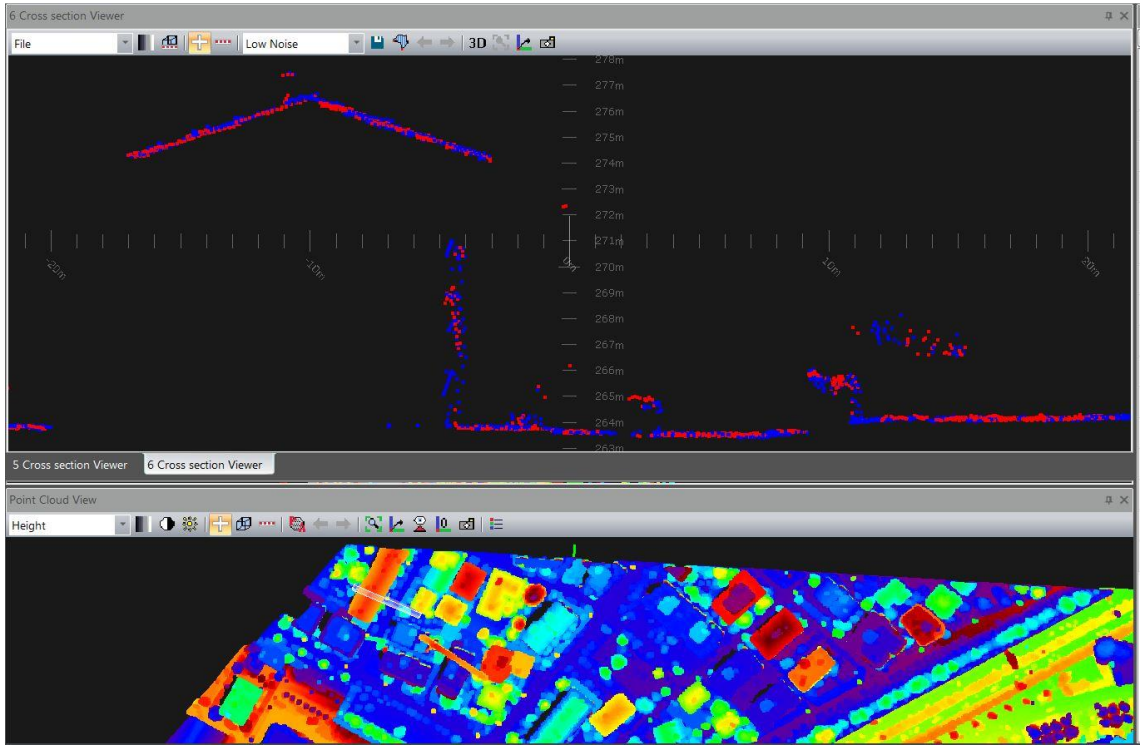
LiDAR automatic line to line registration
激光点云航线与航线之间匹配



- Registration Results
  匹配结果



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Automated LiDAR QC reports
激光点云自动质检报告

- Access LiDAR QC tools after LiDAR calibration or registration
- Analyze forward vs. backward scan, flightline to flightline or against a set of ground control points
- Review HTML report

- 点云检校或者匹配后使用激光质检工具
- 分析前向和后向之间，航线与航线之间，与一系列控制点之间的误差
- 回顾查看 HTML报告

Vertical Accuracy Flightline Comparison-20170606_100734

007 vs 006

367938 valid patches with size of 3 m found. Only patches with standard deviation < 0.1 m and minimum of 5 points are included.

Color	Limits [m]	Number of patches	Proportion of total number of patches [%]
	<=0.03	85058	23.12
	0.03-0.05	112283	30.52
	0.05-0.1	162855	44.26
	>0.1	7742	2.10

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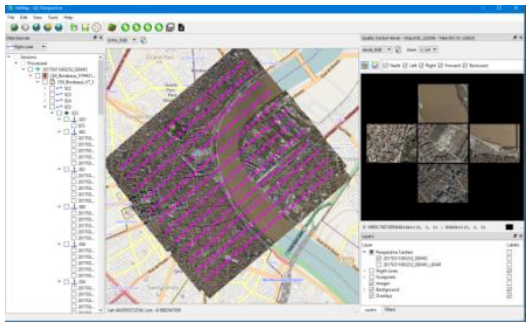
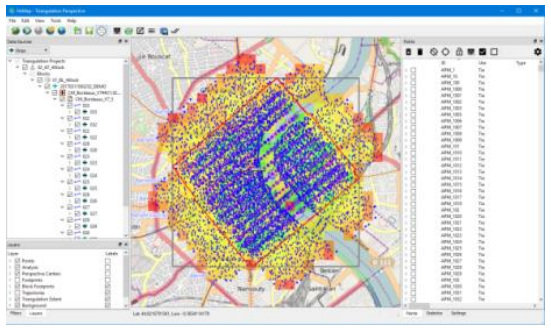
Common Workflow for supported Sensors
可支持传感器的通用数据处理流程





QC & Review
1:1 Quality check of captured data
Setup image radiometry

质检 & 查看
对数据进行1:1质检
生成影像调色模板

Aerial Triangulation
Run APM
Ground Control Measurement
Bundle Block Adjustment

空中三角测量
运行APM
地面控制测量
光束法区域网平差

- **Based on one or multiple blocks**
  - Move directly to product generation
  - Or continue with Aerotriangulation
- **Aerotriangulation on Image data**
  - Run APM
  - Integrated means for manual point measurement
  - Bundle Block Adjustment (Based on CAP-A Engine)
  - Graphical/ tabellaric analysis

- **基于一个或者多个测区**
  - 直接进入到产品生成模块
  - 或者进行空三操作
- **影像数据空三**
  - 运行自动点匹配
  - 人工点量测的集成方法
  - 光束法区域网平差 (基于CAP-A 引擎)
  - 图形误差分析

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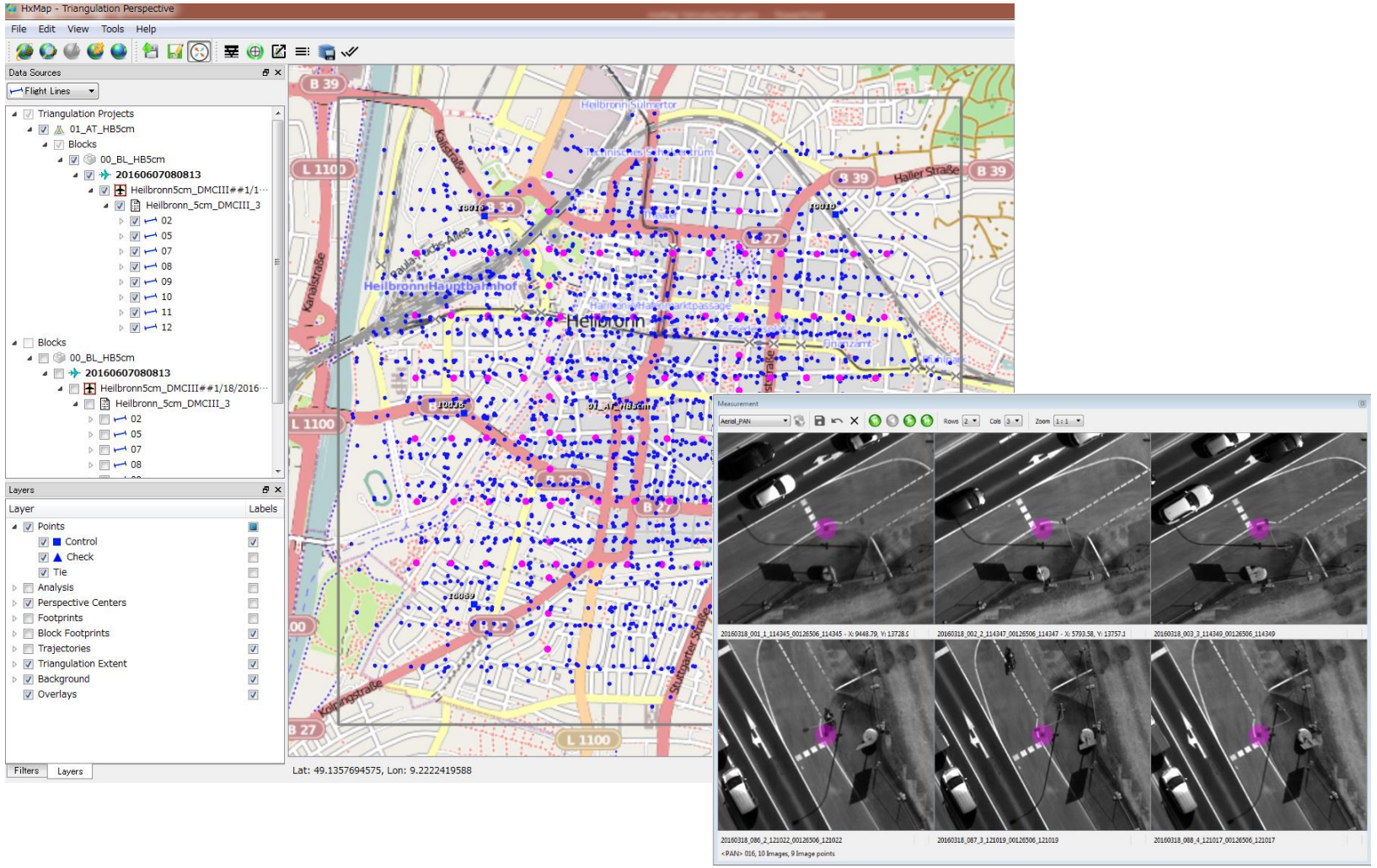
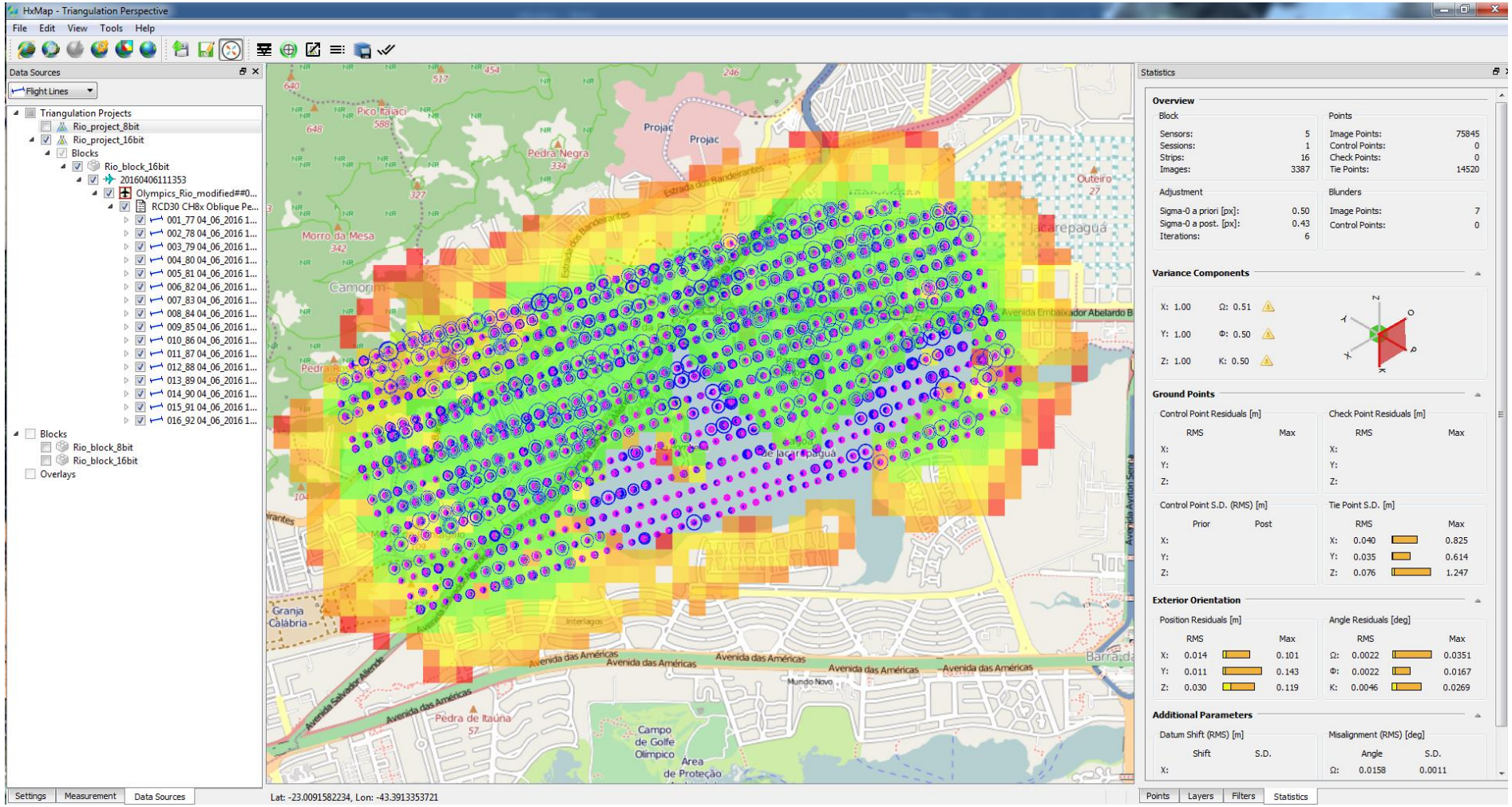
Complete Triangulation module
完成空三模块

- APM available for oblique and nadir imagery
- Manual point measurement
- Bundle block adjustment engine incl. parametrization option for
  - Misalignment
  - Datum shift
  - Camera calibration parameter

- 可对侧视和下视影像进行APM
- 人工点量测
- 光束法平差引擎，包括对以下选项参数化
  - 视准抽误差
  - 基准偏移
  - 相机检校参数



Triangulation Analysis
空三结果分析



- General statistics and detailed report
- Cell based analysis
- Graphical representation of residuals

- 综合的统计数据和详细的报告
- 基于单元的分析
- 残差值图形表示

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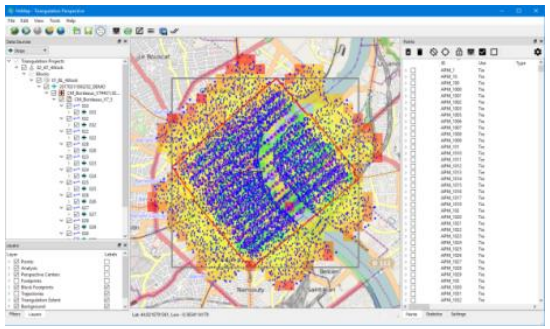
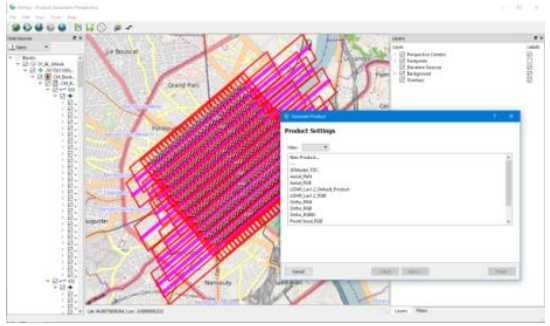
Common Workflow for supported Sensors
可支持传感器的通用数据处理流程





Aerial Triangulation
Run APM
Ground Control
Measurement
Bundle Block Adjustment

空中三角测量
运行APM
地面控制测量
光束法区域网平差

Product generation
Aerial Images
Ortho Images
InfoCloud (DSM)
LiDAR point clouds
Building models / textures

产品输出
航空/正射影像
信息点云(DSM)/激光点云
建筑物模型&纹理

- **Based on one or multiple blocks**
  - Switch to Product Generation perspective
  - Kick-off product generation
- **RealWorld Products**
  - Aerial Images；InfoCloud (DSM)；Ortho Images
- **RealTerrain Product**
  - Georeferenced LiDAR pointclouds
  - Colorized point clouds
- **RealCity Products**
  - Building models and textures；Mesh

- **基于一个或者多个测区**
  - 转换到产品生成视角
  - 开始输出产品
- **RealWorld解决方案产品**
  - 航空影像；信息点云（DSM）；正射影像
- **RealTerrain解决方案产品**
  - 几何校正过的激光点云；着色激光点云
- **RealCity解决方案产品**
  - 建筑物模型和纹理；格网模型

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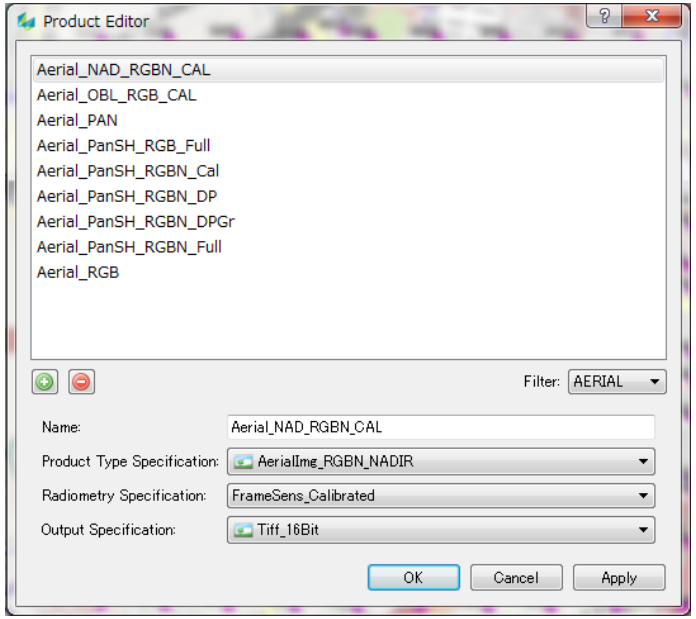
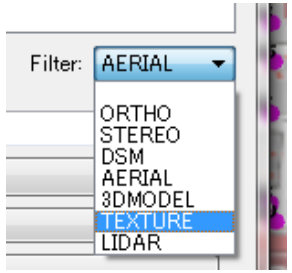
Product generation
产品输出

- Based on templates composed out of product type, radiometry and output specifications
- Runs locally and on cluster with optimized job dependencies

- 基于由产品类型，辐射值和输出类型定义的产品模板输出产品
- 根据工作任务，可优化选择在本地或者集群环境处理数据





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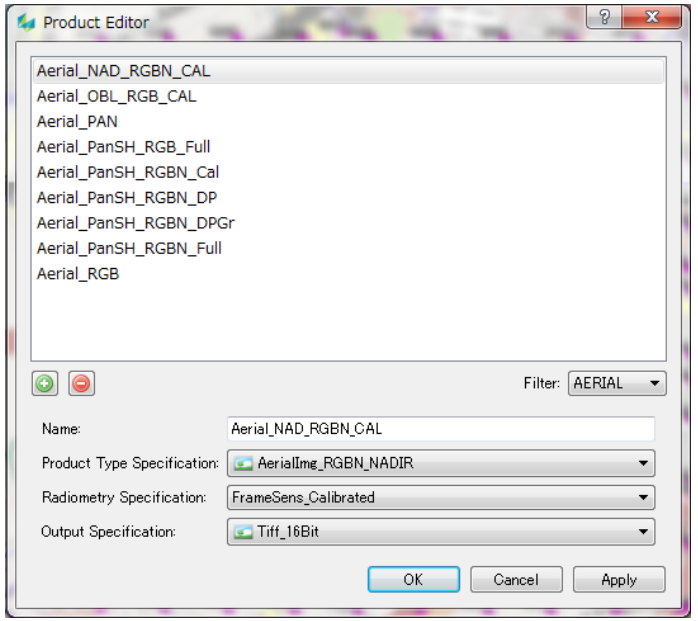

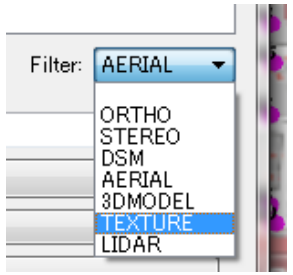

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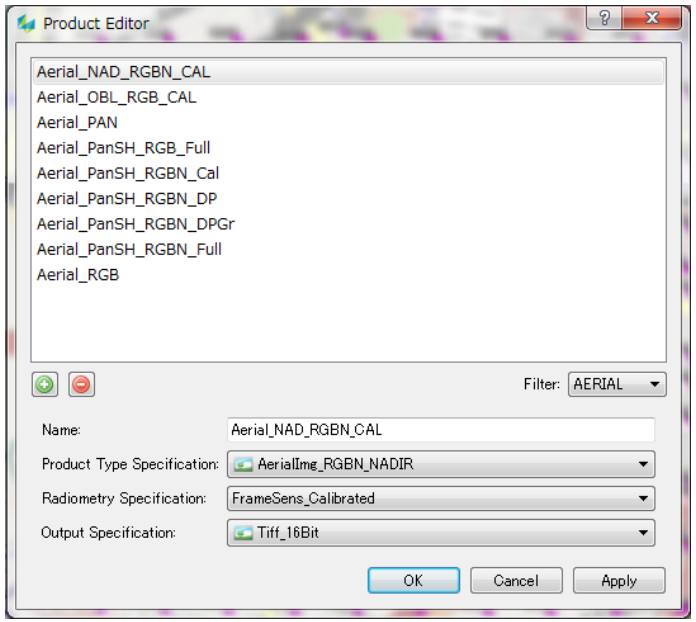

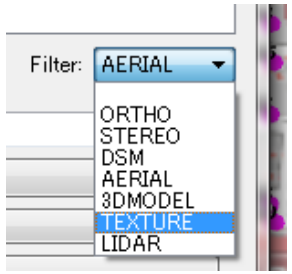

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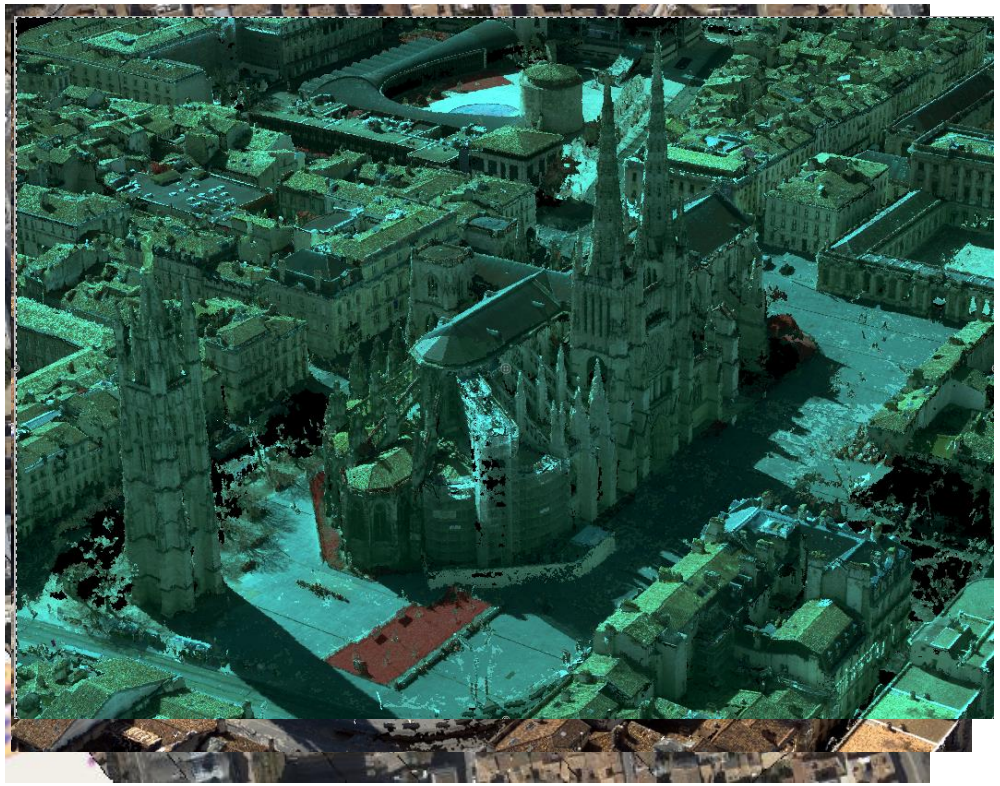

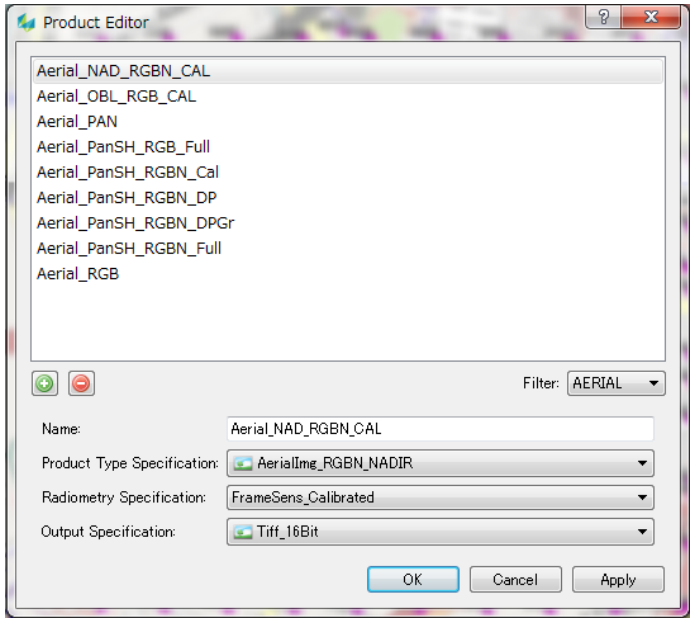

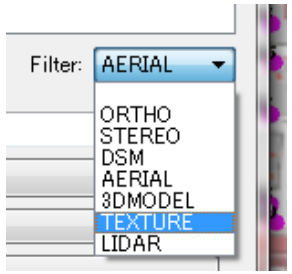

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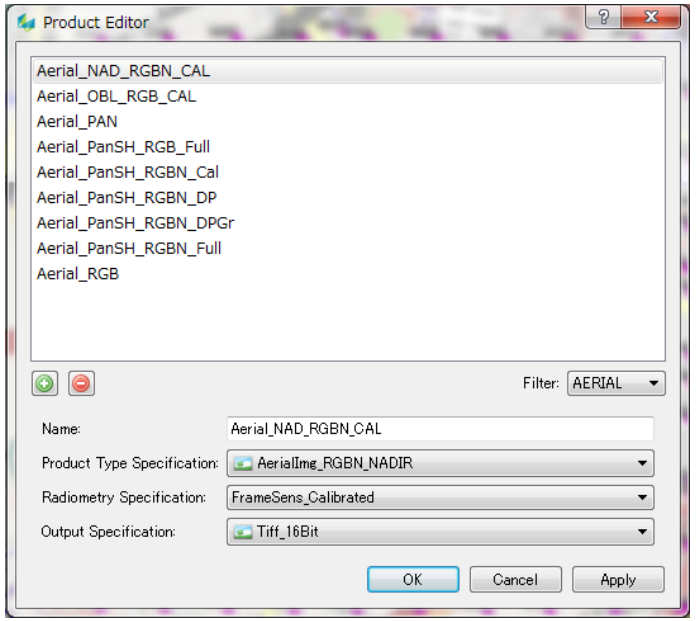

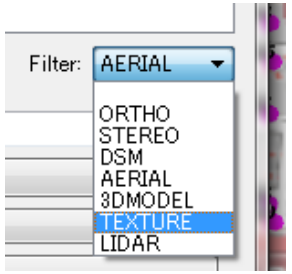

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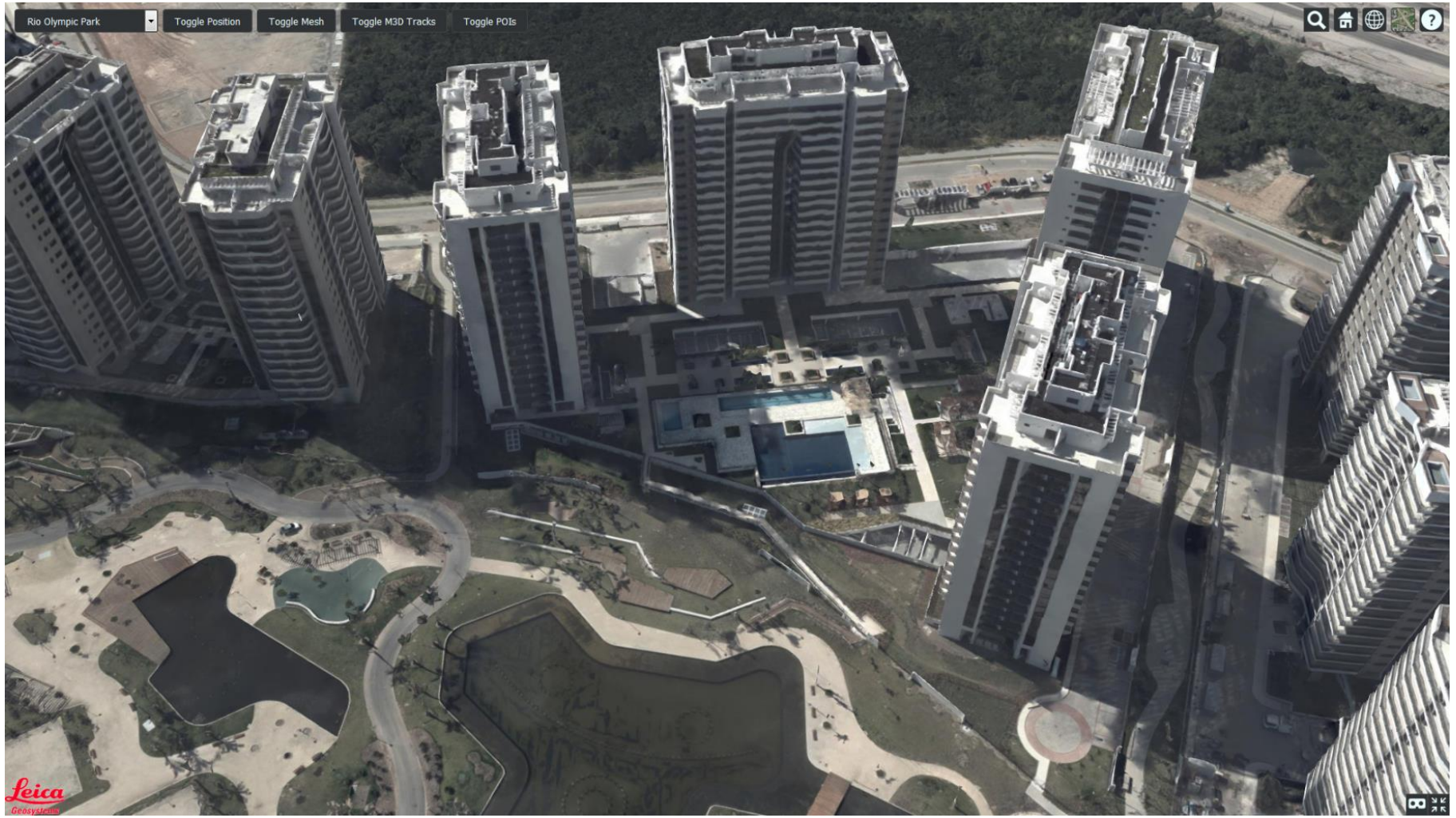
3D – Mesh
三维模型-格网模型



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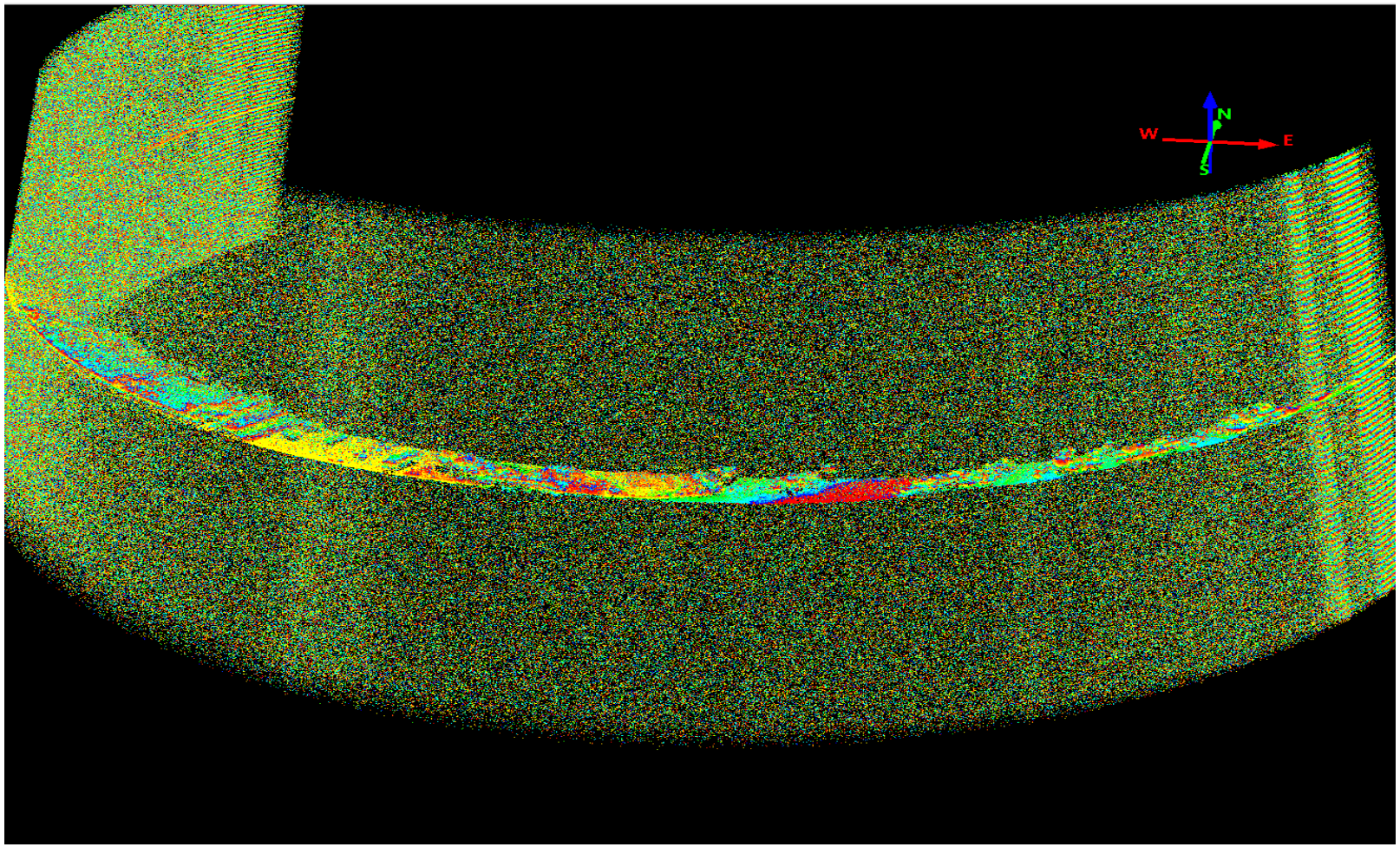
SPL100 Raw Data
SPL100原始数据



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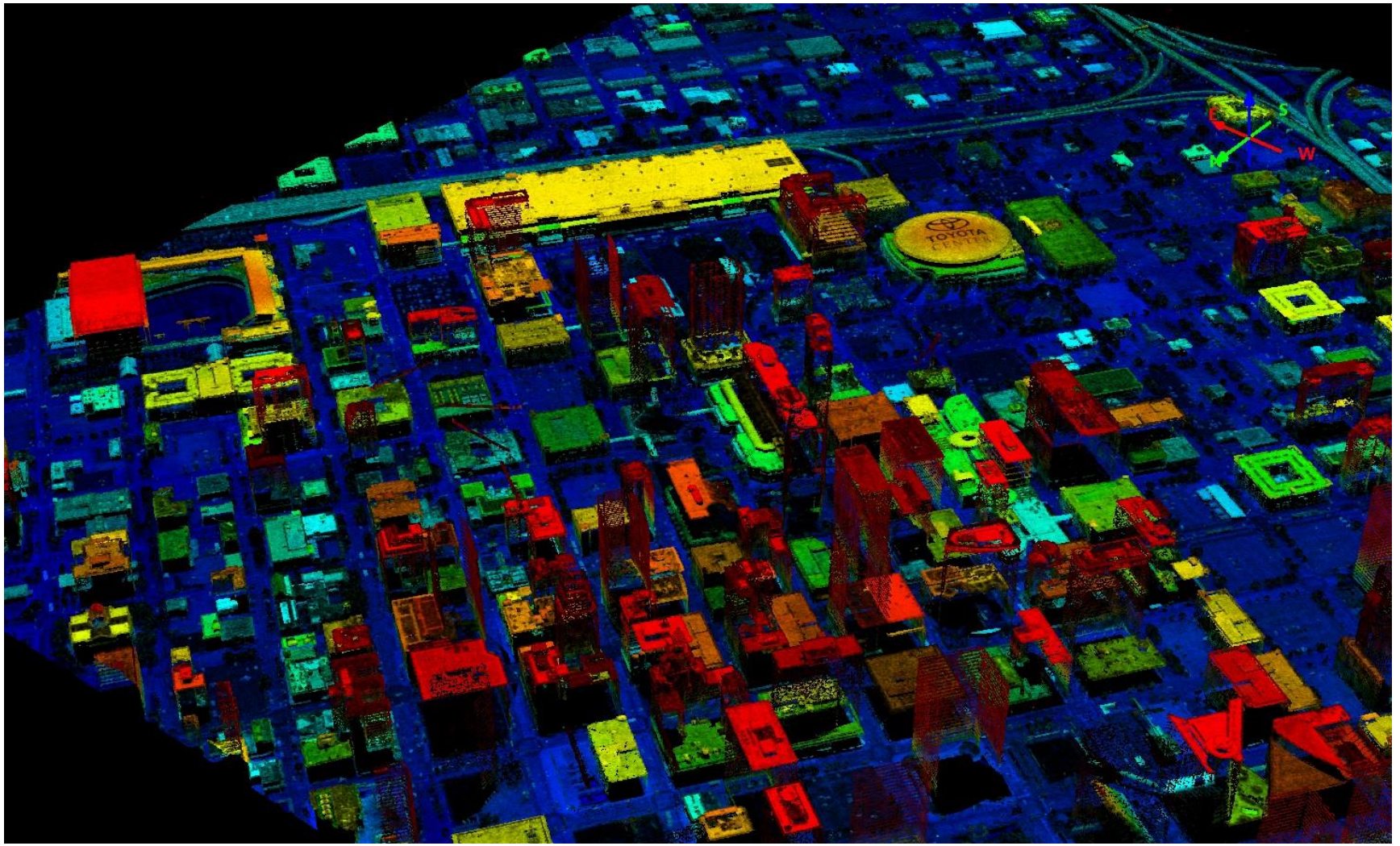
SPL Point Cloud
SPL点云



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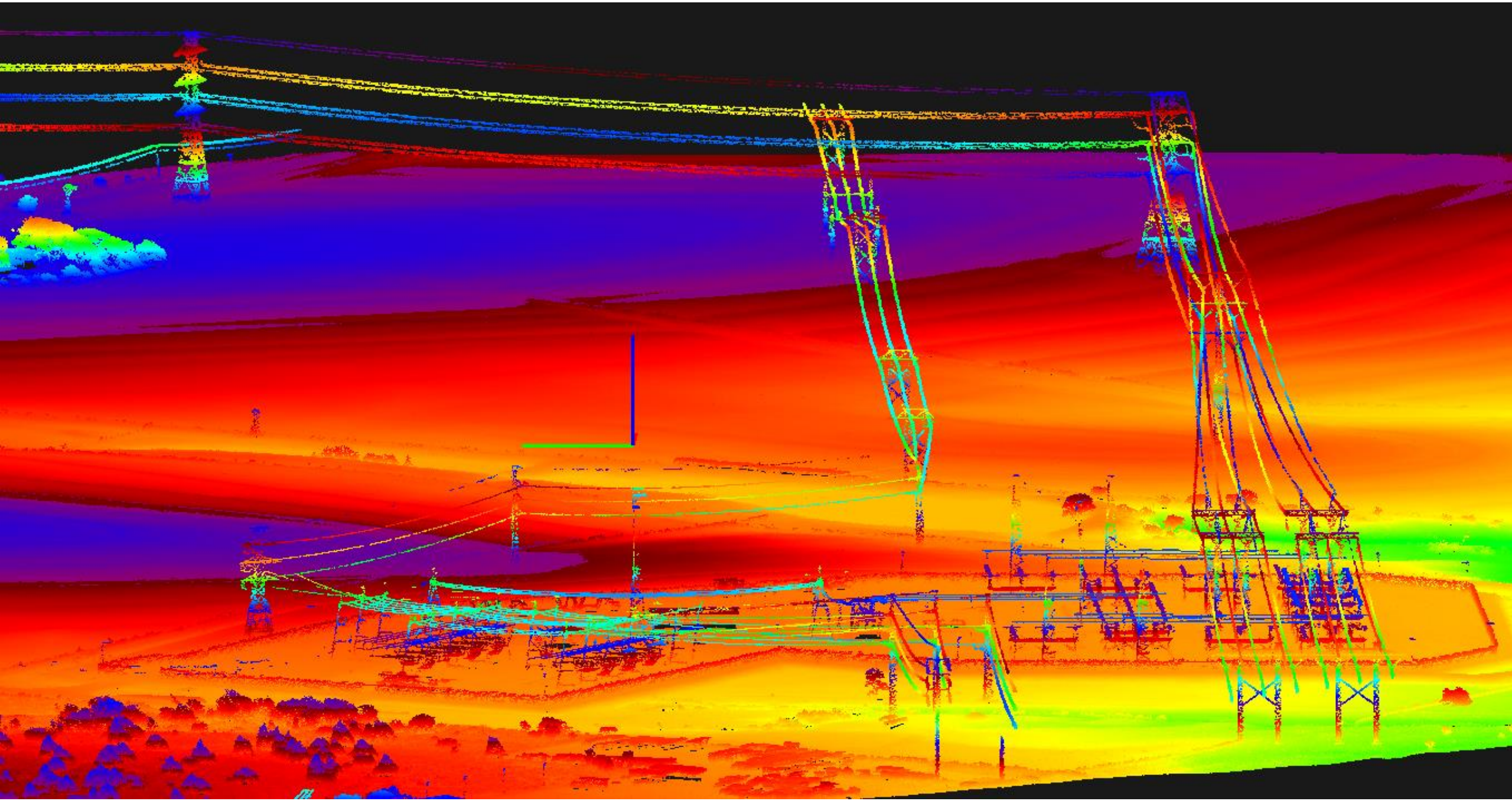

HxMap Infrastructure
HxMap运行环境

- HxMap has been designed with **3 levels of compute optimizations** to fully utilize each core, each compute-node, and across compute-nodes:

1. HxMap Perform simultaneous instructions on multiple data
   - This allows certain operations, such as per-pixel operations, to run many times faster by processing several pixels at once

- 为了充分利用每个内核，每个单机和计算机节点，HxMap设计从3个计算层级进行优化

1. HxMap可同时对多个数据执行处理命令
   - 允许例如：逐像素处理，可以同时处理多个像素从而使处理效率提升很多倍
   - 采用威斯康辛大学的开源项目HTCondor，HTCondor已经被证实可支持增加到10000台节点机

HxMap Infrastructure
HxMap运行环境

2. HxMap is highly multi-threaded and where possible will consume all cores available in a system
3. To achieve higher throughput HxMap employs distributed processing:
   - This allows multiple “jobs” to be run, in parallel, across multiple compute-nodes
   - uses an open-source project by the University of Wisconsin called HTCondor
   - HTCondor has been proven to scale to 10,000’s of thousands of nodes

2. HxMap运行需要多线程，在数据处理过程中可能会占用系统的所有内核
3. 为了获取较高的生产效率，HxMap采用分布式处理数据
   - 支持多个任务同时在多个节点机上计算运行
   - 采用威斯康辛大学的开源项目HTCondor
   - HTCondor已经被证实可支持增加到10000台节点机

Why is Leica HxMap a good value proposition?
为什么Leica HxMap是一个很好价值的主题

- Common workflow platform from QC to 2D and 3D Product Generation for all Leica airborne sensors, designed for high volume throughput
  - Reduces training needs
  - Increased flexibility and scalability (from a laptop to large HPC Cluster)
  - Focus on production, efficiency and throughput
  - Merges 2D and 3D workflows
  - Rapid and responsive development focused on innovation
  - Open interface to other workflows (SDK)
  - Attractive upgrade path for existing customers

- 对于所有的Leica航空传感器，可提供从质量检查到二维和三维产品输出，并且为高容量吞吐量而设计。
  - 减小培训需求
  - 增加灵活性和可和可扩展性（从一台笔记本扩展到大的集群环境）
  - 关注生产量，效率和数据吞吐量
  - 将二维和三维的工作流程进行合并
  - 创新为核心的快速和响应发展
  - 可打开其他工作流的界面 (SDK)
  - 对于已有的客户，有具备吸引力的升级方法

谢 谢

如果您对此篇PPT感兴趣，请扫描二维码

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