

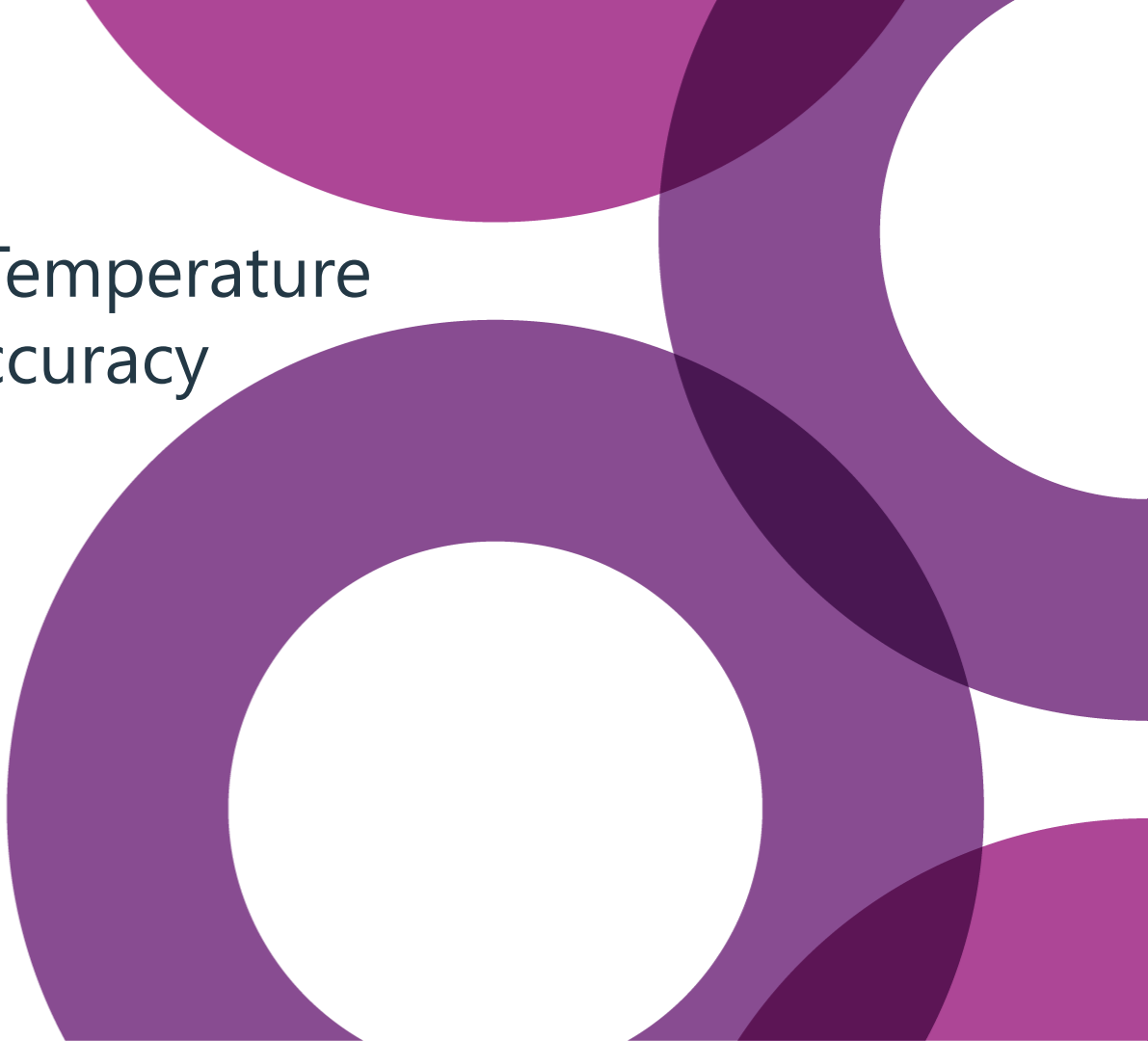


# Improving Subsea Temperature Sensors Reading Accuracy

A Review of Previous Projects  
Findings Using CFD at Wood

**Christophe Meynet**  
**Senior CFD Consultant**  
**Aberdeen**

[woodplc.com](http://woodplc.com)



# Wood Services

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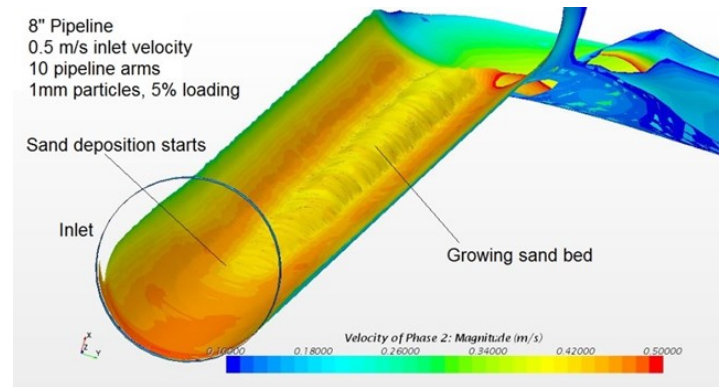
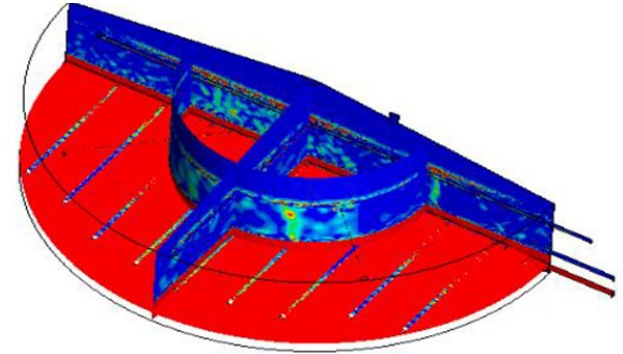
- Wide array of engineering services
- Automation & Control
  - Intelligent operations
    - Software
      - Virtual metering
      - Thermodynamics package
    - Consulting
      - Flow Assurance
      - Computational Fluid Dynamics (CFD)

wood.



# Wood CFD Services

- Separation
- Chemical reactions
- Diffusion, Mixing
- Thermal studies
- FIV/VIV
- Erosion/Deposition
- Topsides Gas Dispersion
- Non-Newtonian Fluid Modelling
- ...



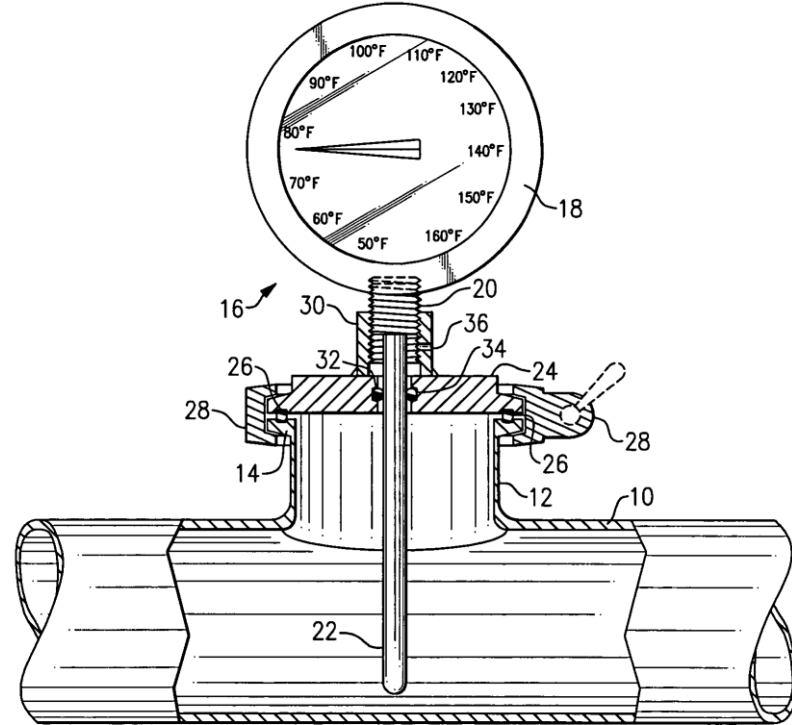
# Agenda

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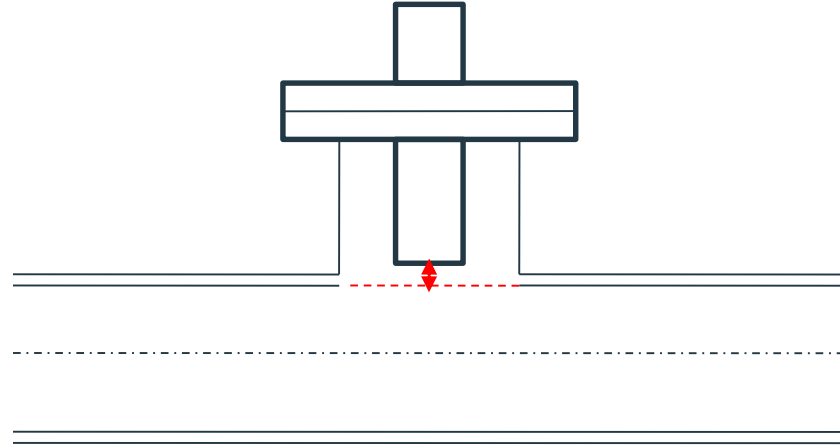
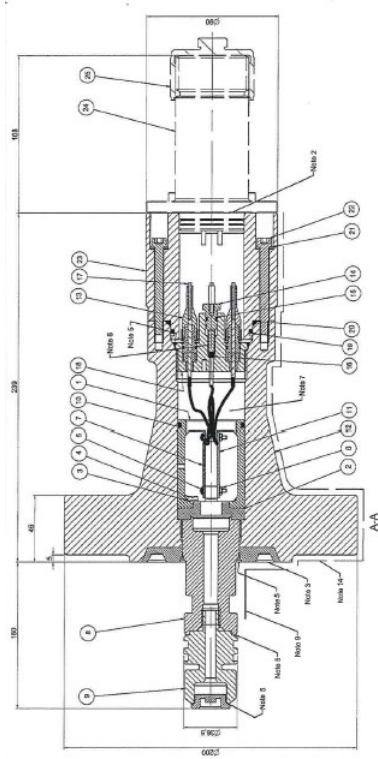
- Main types of temperature sensors
- Case studies
- Possible corrections
- Conclusions



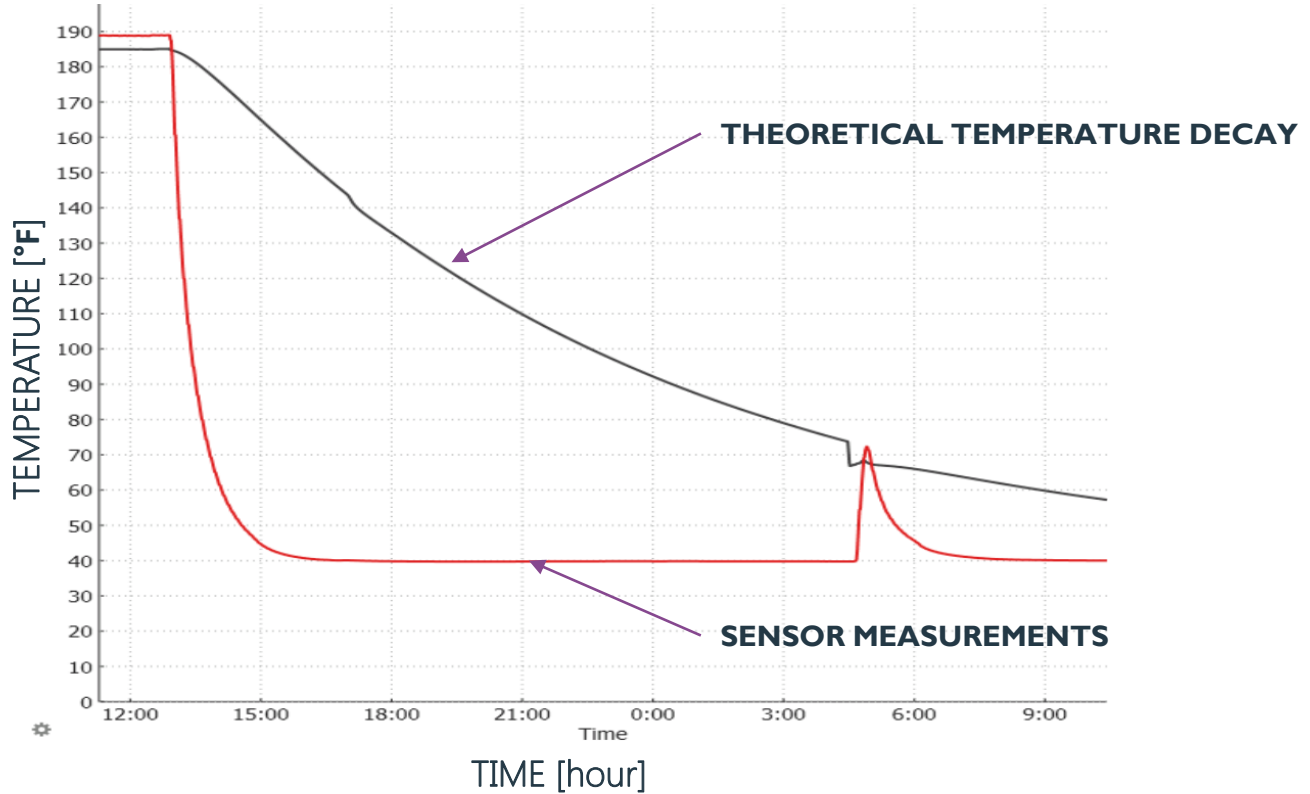
# Thermowells



# Temperature Sensors

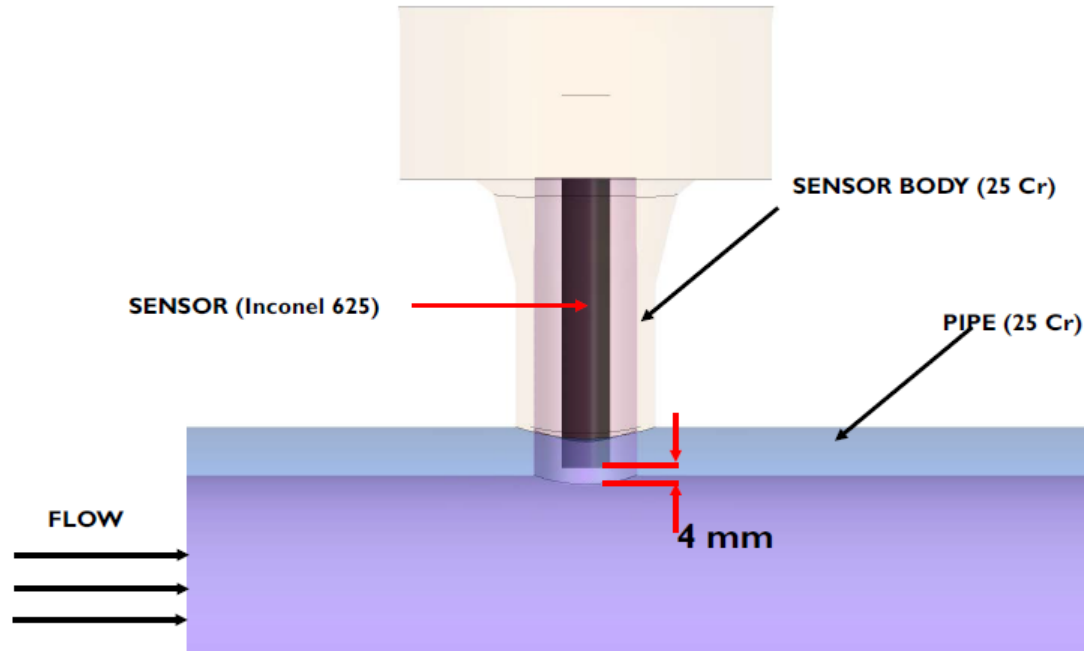


# Case Study 1



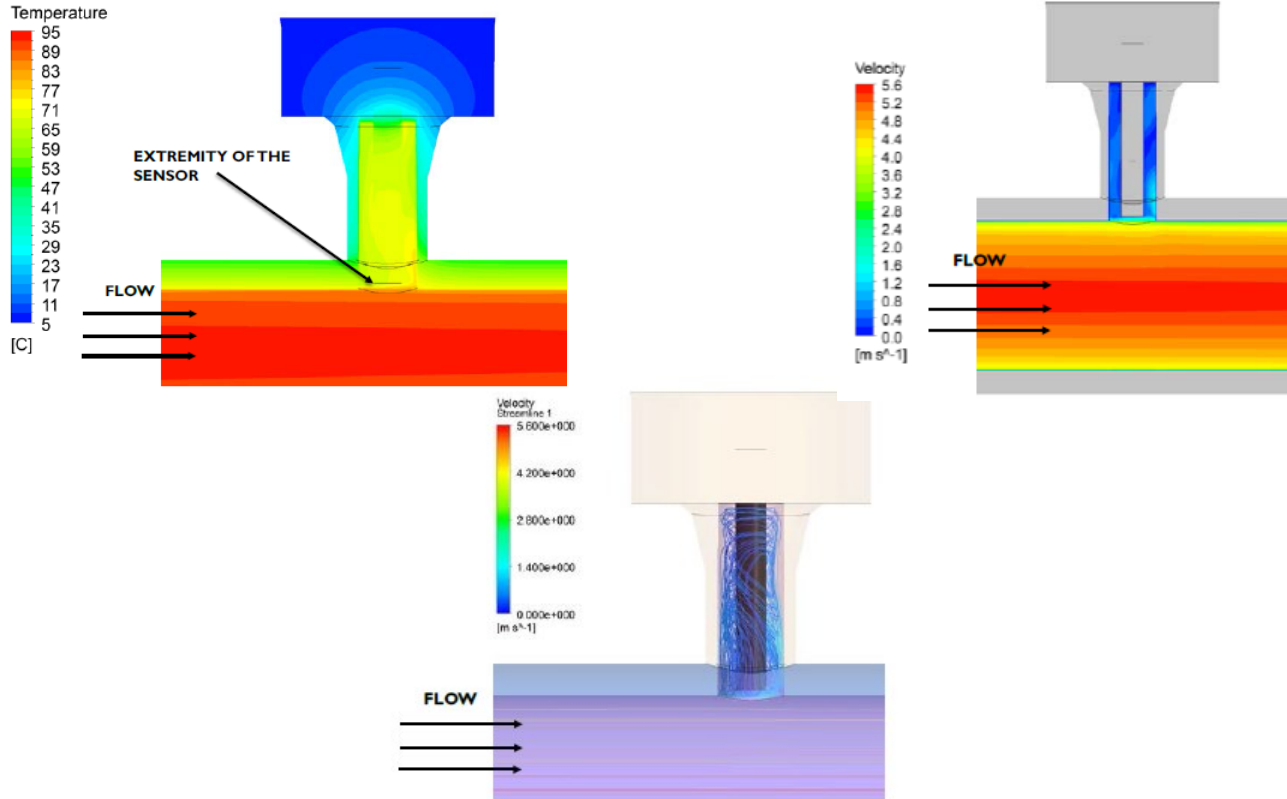
# Detailed Analysis

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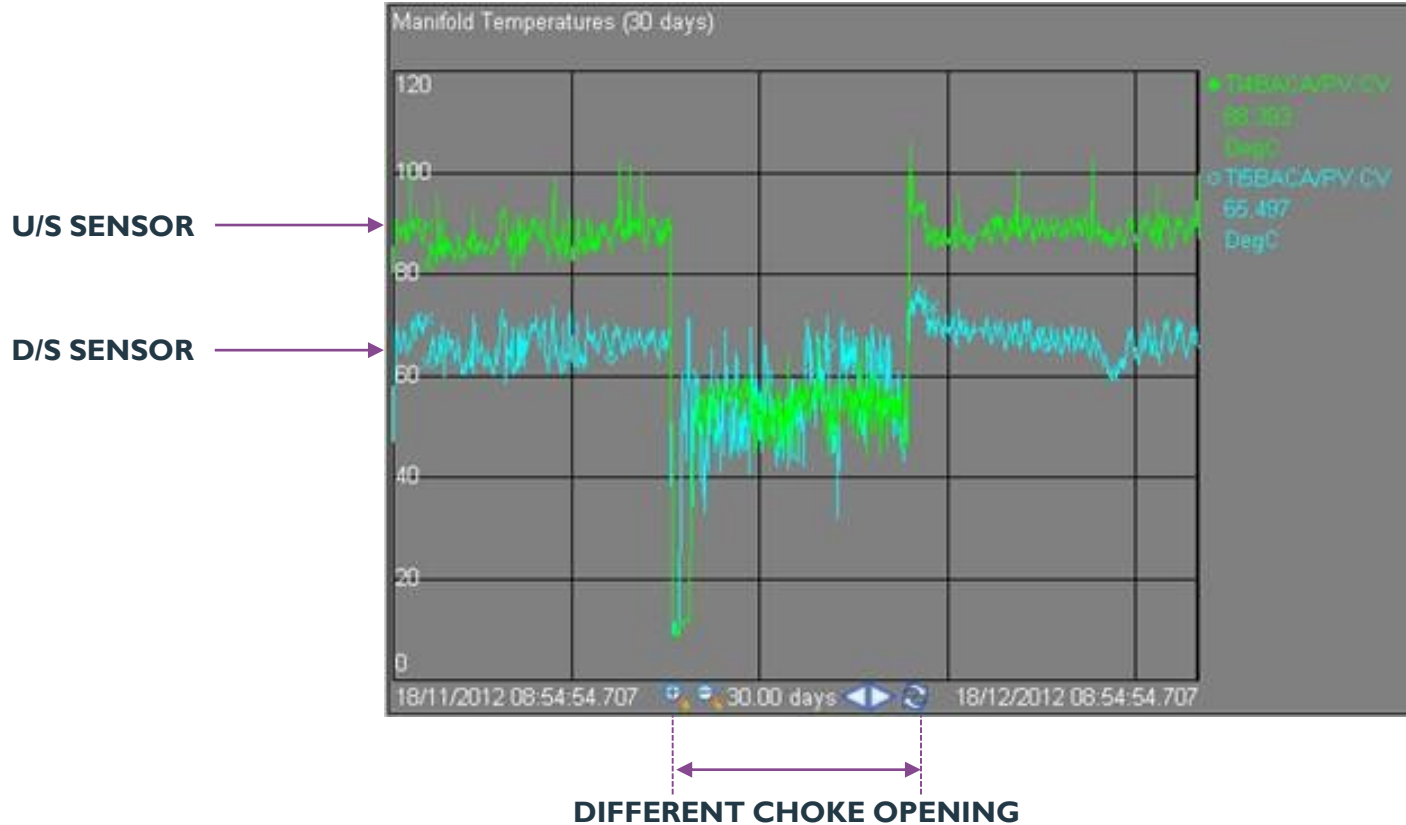




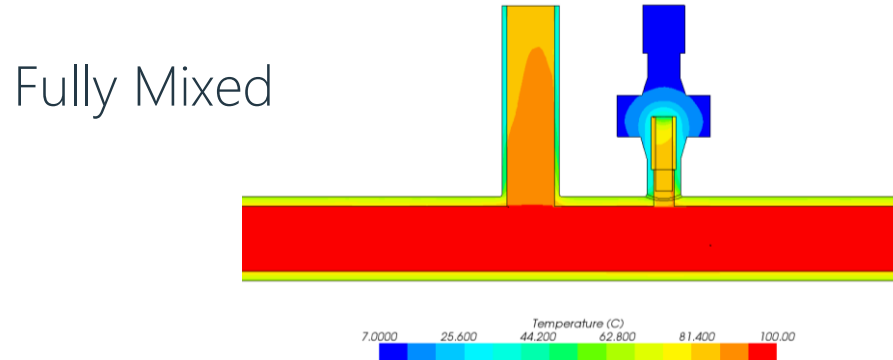
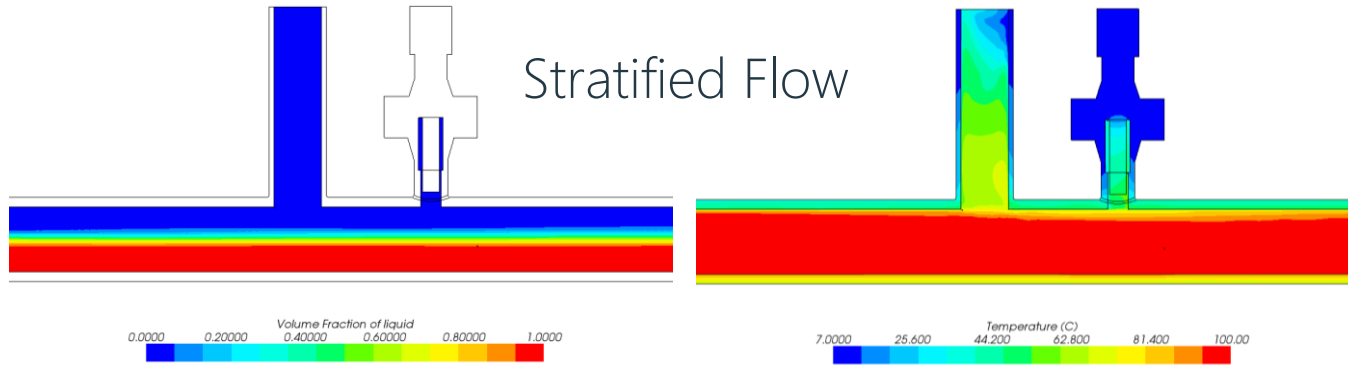
# Detailed Analysis



# Case Study 2



# Detailed Analysis



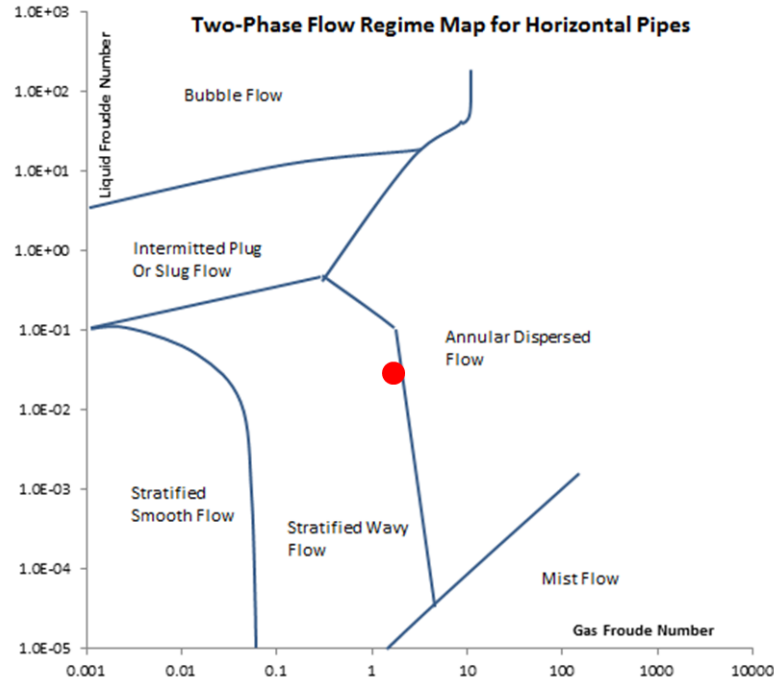
# Temperature Corrections

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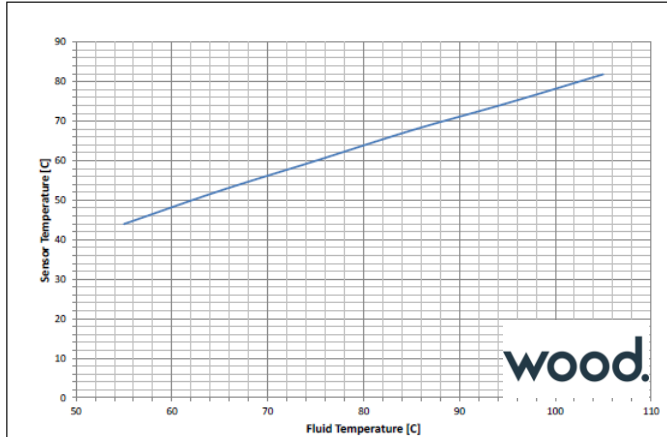
- Different factors should be taken into account to offer reading corrections:
  - Presence of elements U/S likely to form flow disturbances
  - Level of insulation
  - Fluid temperature
  - Ambient temperature
  - Flow regime



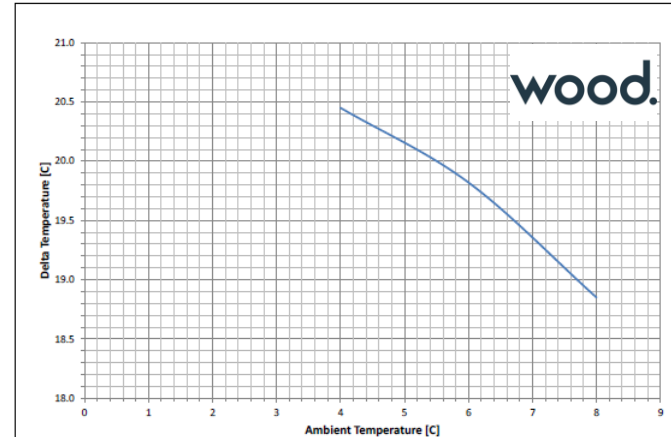
# Flow Regime Correction



# Ambient and Fluid Temperature Correction



Sensor Temperature vs. Fluid Temperature – Ambient 4°C



Temperature Difference – Ambient Temperature Sensitivity



# Conclusions

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- Positioning of the temperature sensor with respect to the internal pipe wall has a significant impact on the fluid temperature seen by the sensor
- The flow regime prediction is also a key parameter on the temperature sensor response
- Fluid temperature, ambient temperature and level of insulation of the sensor can also affect the readings in unusual ways
- The comparisons between model and field data require a more detailed analysis when large discrepancies are observed



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